Global System for Mobile Communications (GSM)

Nortel GSM BSS Fundamentals — Operating Principles

411-9001-007

Document status: Standard
Document version: 16.04
Document date: 16 October 2006

Originated in France

Contents

Figures

Tables

New in this release

The following sections detail what's new in the *Nortel GSM BSS Fundamentals Operating Principles* guide for release V16.0. See the following sections for information about feature changes:

Features

- PM1270 - TDMA based counters (15405) (v16.01)
  - This feature provides TDMA based counters that give a more precise view of the quality of the network. TDMA based counters provide the following metrics at the TDMA level:
    - TCH drop ratio normalized either per Erlang or per TCH successfully seized
    - TCH seizure failure ratio normalized per TCH seizure attempt
    - Handover failure rate
    - Layer one average performance avg Rxlev, Path balance, RxQual, FER, …
  - Modified Section 1.12.2.3 "Permanent observation report availability" (page 139).
- OMC-R OAM SW Delivery on DVD (26674) (v16.01)
  - This feature replaces the current SW delivery done on tapes by a delivery on DVD. The Workstation must have a DVD reader. It reduces the number of media required in the software delivery and reduces the installation time.
  - Modified Section 1.10 "Software management" (page 91).
- OMC-R Time Synchronization from an external NTP source (27018) (v16.01)
  - This feature allows the time synchronization of the local OMC-R server clock at the OS level thanks to the Network Time Protocol

(NTP). NTP uses its own time reference (similar to being based on GMT). The customer must provide the NTP server.

— Modified Section 1.18.3.4 "Time server" (page 254).

- Capacity increase for SF V890 (27817) (v16.01)

  — This feature introduces a UHC (Ultra High Capacity) for a SF V890 configuration to be able to manage 40 BSCs and 4800 cells.

  — Modified Section 1.4 "OMC-R features and functions" (page 29).

- Call Drop analysis – interface evolution V16.0 (29043) (v16.01)

  — This feature introduces some evolutions in the existing Call Drop analysis features.

  — Modified Section 1.12.9 "Call drop analysis" (page 171).

- Distributions on Radio Measurements – interface evolution V16.0 (29042) (v16.01)

  — This feature introduces some evolutions in the existing Distributions on Radio Measurements feature.

  — Modified Section 1.12.8 "Obtaining distributions on radio measurements" (page 168)

- WPS for PCUSN configuration (29818) (v16.01)

  — This feature introduces WPS (Wireless Provisioning Server) as a replacement for the configuration functions previously offered by the PCUengCONF tool).

  — Updated Section 1.6.13 "PCUSN configuration" (page 72).

- BSC 3000 support of BTS SW background downloading (25316) (v16.01)(v16.02)

  — This feature allows new software to be downloaded to a BTS while this BTS carries GSM/GPRS traffic (on a live network).

  — Inserted Section 1.10.3.6 "BTS software background downloading" (page 116).

- Channel release policy on BTS after Abis failure (22810) (v16.01) (v16.02)

  — This feature improves BTS behavior on Abis link failure (including BSC failure) by stopping BTS broadcast of BCCH and SACCH.

  — Inserted Section 2.6.6 "Channel Release on BTS after Abis failure" (page 321)in Section 2.6 "GSM for Railways (GSM-R)" (page 315).

- BSC 3000 support for Lb interface (multi DPC) to Nortel SMLC through Nortel and other vendors' MSC (20365)(v16.01)
  - — This feature introduces the support of the Lb interface on the BSC 3000.
  - — Re-organized Section 2.3 "Location services" (page 291) and inserted Section 2.3.4 "BSS-based solution" (page 294).
- U-TDOA support on the BSS (BSC 3000 Lb only) (24917) (v16.01)
  - — This feature provides support for the LCS messaging required for LCS U-TDOA (Uplink-Time Difference of Arrival) on the BSC 3000.
  - — Re-organized Section 2.3 "Location services" (page 291) , inserted Section 2.3.5 "Location methods" (page 300), and modified Section 2.3.5.4 "U-TDOA method" (page 302).
- GPRS/EDGE cell reselection improvement NACC for R4 MS (22859) (v16.01)
  - — This feature enables the network to assist the MS during cell reselection, thereby, reducing the service interruption at cell change.
  - — Updated Section 3.5.2 "Configuration parameters" (page 367)
  - — Inserted Section 3.5.5 "Network assisted cell change for release 4 MS" (page 372).
- EDGE: Minimum number of joker TS on Agprs set by the operator (26954) (v16.01)
  - — This feature enables the operator to define a minimum number of jokers that cannot be pre-empted by the Dynamic Agprs feature.
  - — Updated Section 2.4.9 "Dynamic Agprs & EDGE: Joker handling algorithm" (page 309)
- BSC defense procedures for centralized downloading (29213) (v16.01)
  - — This feature brings improved BSC defense for centralized downloading.
  - — Updated Section 1.10.6 "Centralized downloading of BTS by BSC" (page 121)
- PM1398 Switch interference matrix (16411) (v16.01) (v16.02)
  - — This feature enables Interference Matrix data to be collected. An Interference Matrix is used in frequency planning.
  - — Updated Section 1.12 "Performance management" (page 132)by inserting Section 1.12.10 "Generating an Interference Matrix" (page 174).

- — Updated Section 1.20 "Introduction to OMC-R data server (SDO)" (page 263)

- FACCH repetition (30296) (v16.02)
  - — This feature enables the BTS to re-transmit the FACCH (Fast Associated Control CHannel) frames in the downlink without waiting for the acknowledgement from the mobile. This helps to secure the handover procedure in poor radio conditions (with AMR FR).
  - — Inserted Section 1.9.4 "FACCH repetition" (page 91)

- Tx Power Offset for Signalling Channels (30293) (v16.02)
  - — This features enables the BTS to use a power offset to transmit signalling bursts to increase the robustness of the signalling channels (FACCH and SACCH) in the downlink. This can help avoid call drops in situations where the radio conditions are deteriorating.
  - — Updated Section 3.7.2 "Configuration parameters" (page 400)
  - — Inserted Section 3.7.4.3 "Tx Power Offset for Signalling Channels" (page 414)

- BTS 18000 MPRM differentiation at the OMC-R (30713) (v16.02)
  - — This features enables the OMC-R to distinguish MPRMs from RMs.
  - — Updated Table 8 "Correspondence between DRX hardware and EFT name" (page 126)

- Radio measurement distribution post-processing product introduction (30494)(v16.02)
  - — This feature provides a tool to process the data collected by the Radio Measurement Distribution (RMD) feature.
  - — Inserted Section 1.12.8.6 "Post-processing of data collected" (page 169)

- Call drop analsis post-processing (28796)(v16.02)
  - — This feature provides a tool to process the data collected by the Call Drop Analysis (CDA) feature.
  - — Inserted Section 1.12.9.6 "Post-processing of data collected" (page 172)

- Interference matrix port-processing product introduction (30769)(v16.02)
  - — This feature provides a tool to process the data collected by the Interference matrix (IM) feature.

- — Inserted Section 1.12.10.6 "Post-processing of data collected" (page 175)

- SDO data compression (30308) (v16.02)
  - — This feature provides a tool that automatically compresses SDO data files.
  - — Updated Section 1.20 "Introduction to OMC-R data server (SDO)" (page 263)

- BSC support for Lb interface to SMLC through A-link (33160) (v16.04)
  - — This feature allows the A interface and the MSC to be used as an STP to convey SS7 traffic between the BSC and the SMLC. This feature is an enhancement of the feature 20365 (referenced above).
  - — Updated the description of the BSS-based solution (location services) in

Other changes

See the following sections for information about changes that are not feature-related:

- Removed information on BSC 12000 due to EOL (End Of Life).
- Replaced all occurrences of BSC 2G with BSC 12000HC.
- Updated the directory name for configuration files in Section 1.12.3.6 "Consulting Performance Monitor observation reports" (page 152)
- Updated the directory name for manufacturer's files in Section 1.12.4.6 "Consulting temporary observation reports" (page 156)

Introduction

This Operations and Maintenance Center - Radio (OMC-R) operating NTP contains principles on general operating mechanisms and radio configuration.

Prerequisites

Users must be familiar with radio and networking principles.

< 000 > : Nortel GSM BSS Documentation Roadmap

They must also be familiar with the following NTPs:

< 001 > : Nortel GSM BSS Overview

< 006 > : Nortel GSM OMC-R Fundamentals

< 032 > : Nortel GSM OMC-R Routine Maintenance and Troubleshooting

< 034 > : Nortel GSM BSS Configuration — Operating Procedures

< 124 > : Nortel GSM BSS Parameter Reference

< 125 > : Nortel GSM BSS Performance Management — Observation Counters Dictionary

< 128 > : Nortel GSM OMC-R Commands Reference — Objects and Fault menus

< 129 > : Nortel GSM OMC-R Commands Reference — Configuration, Performance, and Maintenance menus

< 130 > : Nortel GSM OMC-R Commands Reference — Security, Administration, SMS-CB, and Help menus

< 133 > : Nortel GSM BSS Performance Management — Observation Counters Fundamentals

< 211 > : Nortel GSM PCUSN Performance Management — Observation Counters Dictionary

Navigation

Chapter 1 "General operating mechanisms" (page 21) describes the major operating principles under the following headings:

- Description of the position of the OMC-R in the mobile network (see Section 1.1 "Overview of network operations" (page 21)).
- Review of BSC 12000HC functions (see Section 1.2 "BSC 12000HC functional characteristics" (page 25)).
- Review of BSC 3000 functions (see Section 1.3 "BSC 3000 functional characteristics" (page 26)).
- Review of OMC-R functions (see Section 1.4 "OMC-R features and functions" (page 29)).
- Basic definitions (see Section 1.5 "Basic definitions" (page 30)).
- Configuration Management which is based on the operating object model (see Section 1.6 "Configuration management" (page 35)).
- OMN Access Management which enables BSS/OMC-R link connection and monitoring (see Section 1.7 "OMN access management" (page 75)).
- AMR management which manages the half and full rate (see Section 1.9 "AMR Overview" (page 89)).
- Software Management which manages BSS software applications (see Section 1.10 "Software management" (page 91)).
- SMS-CB Management which provides unacknowledged, short message broadcast facilities in radio cells (see Section 1.11 "SMS-CB management" (page 127)).
- Performance Management which is based on observation counter collection (see Section 1.12 "Performance management" (page 132)).
- Fault Management which is based on the feedback of notifications to the OMC-R (see Section 1.13 " Fault management" (page 177)).
- Preventive Maintenance management which is based on configurable plug-in tests on BSS sub-systems (see Section 1.14 "Preventive maintenance management" (page 202))
- State Management which provides a graphic aid for monitoring the network (see Section 1.15 "Network graphic management" (page 204)).
- Security Management which controls user access to OMC-R services and monitors their work sessions (see Section 1.16 "Security management" (page 231)).

- Command File Management which provides network configuration or reconfiguration facilities (see Section 1.17 "Command file management" (page 243)).
- User Facilities which allows users to consult the system logs, manage the system reference time, schedule jobs, and provides access to inter-user messaging and on-line help (see Section 1.18 "User facilities" (page 250)).
- Synchronization which allows users to synchronize a BTS from another BTS or using GPS (see Section 1.19 "Synchronization" (page 260)).
- OMC-R Data Server: It is used to export OMC-R data to external applications (see Section 1.20 "Introduction to OMC-R data server (SDO)" (page 263)).
- Network level presence identification which consists in finding a way to differentiate in a system view eDRX from DRX and ePA and HePA from PA (see Section 1.21 "Network level presence identification of eDRX, ePA and HePA" (page 264)).

Chapter 2 "GSM evolutions" (page 269) describes optional GSM extensions:

- GPRS (General Packet Radio Service)
- GSM-R (ASCI features)
- BSC 3000 and TCU 3000
- Location Services

Chapter 3 "Radio configuration principles" (page 323) introduces BSS radio configuration principles. It describes the relations between radio operating parameters and the effects on the BSS.

Chapter 1
General operating mechanisms

1.1 Overview of network operations

1.1.1 The OMC-R

The OMC-R is the Operations and Maintenance Center for the BSS Radio subsystem.

A Base Station Subsystem (BSS) includes a Base Station Controller (BSC) connected:

- to TransCoding Units (TCUs) for access to the MSC
- to Packet Control Unit Support Node (PCUSN) for access to the SGSN (Serving GPRS Support Node)

In addition, the BSC manages a group of Base Transceiver Stations (BTSs).

The BSS and OMC-R are organized in a hierarchical tree structure:

- A BSC can manage several BTSs, but a BTS is connected to only one BSC.
- A BSC can be connected to several TCUs, but a TCU is connected to only one BSC.
- An OMC-R can manage several BSCs, but a BSC is connected to only one OMC-R.

The BSCs and the OMC-R in the Public Land Mobile Network (PLMN) are connected via the operations and maintenance network interface (OMN).

Position of the OMC-R in the mobile network shows the position of the OMC-R in the mobile network.

1.1.2 Major operating principles

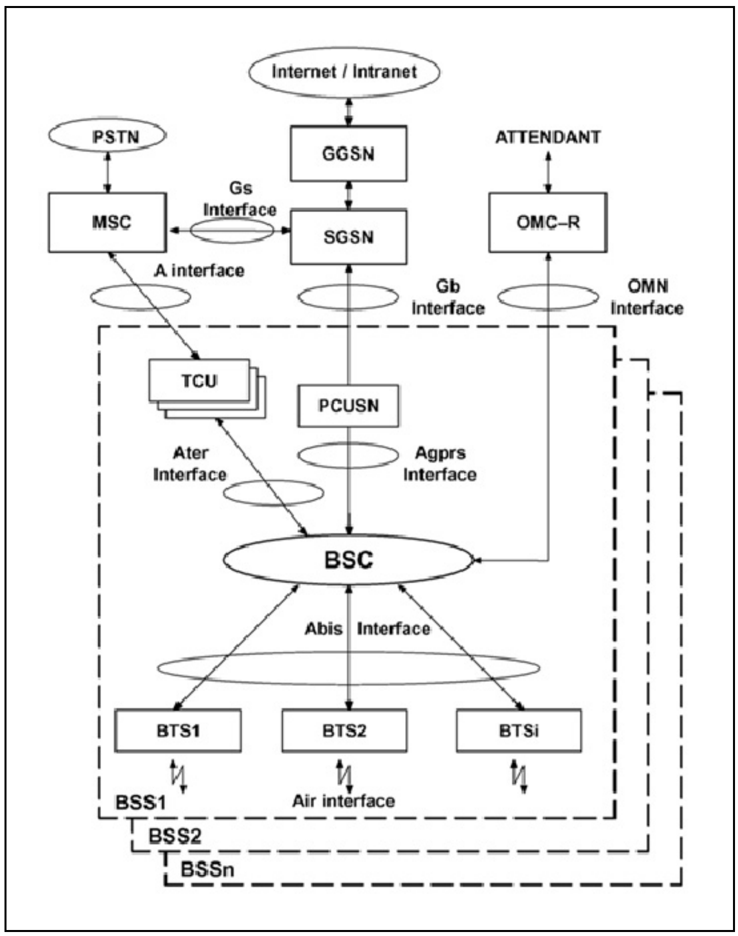
The OMC-R provides the following services to operate a digital mobile network:

- hardware and software resource management

- control of BSS operating conditions
- control of BSS/OMC-R links:
  - — X.25 transport layers (BSSs and OMC-R communicate across an X.25 type network for BSC 12000HC)
  - — Ethernet link (BSSs and OMC-R communicate by Ethernet link for BSC 3000)

The Configuration Management function, including OMN Access and Software Management subfunctions, performs this task.

Figure 1
Position of the OMC-R in the mobile network



- graphic screens that provide users with a synthetic view of the network element states. The State Management function performs this task.
- short message service that allows users to broadcast unacknowledged, short messages in network cells. The SMS-CB function performs this task.

- network observations that provide users with the information required to monitor operations in order to optimize performances. The Performance Management function performs this task.
- network maintenance repairs, malfunctions, and system failures. The OMC-R saves all the information it receives and analyzes it in real time or stores it for a later time. It sends alarm event messages to users to facilitate equipment reconfiguration and the analysis of test results. The Fault Management function performs this task.
- network preventive maintenance. The OMC-R enables the user to manage growing networks and to anticipate equipment failures, outages, and quality of service deterioration. It allows the user to configure, schedule and activate preventive maintenance tests on BSS sub-systems and to view the associated results. The Preventive Maintenance modules (one module for each test) perform this task. They can be installed as plug-ins without any OMC-R restart.
- network protection which consists of controlling system users' access rights. Only a limited number of users can access all OMC-R operations. The Security Management function performs this task.
- network operations services that optimize user working conditions. The Command File Manager and User Facilities provide these services.
- To facilitate the commissioning of new BSS versions when hardware and software are upgraded, the OMC-R provides an effective File Transfer Service with the BSSs that allow users to manage configuration files from the OMC-R. The Software Management function uses this service to manage software and the Performance Management function to collect certain types of observation data.

The OMC-R operations require the administration of its own resources:

- The administration task consists of organizing its hardware and software entities (and their use) to archive and restore the managed system data and specific OMC-R application data required to monitor its own hardware and software operations. The OMC Administration function performs this task.

The OMC-R Data Server, or SDO, is used to export OMC-R data to external applications.

The Man-Machine Interface (MMI), developed for network management, provides a user-friendly communication interface. The MMI is described in NTPs <128> to < 130 >.

This NTP reviews the BSC and OMC-R digital mobile network management functions and details the major operating principles, apart from the OMC Administration function which is described in the NTP < 006 >.

OMC-R centralized installation and upgrade service feature This feature was introduced in V15.0 and is used for OMC-R installations and upgrades. It is based on Sun Microsystems™ JumpStart ™, LiveUpgrade and Flash Archive features, which facilitate the installation and upgrade of Sun Microsystems™ Solaris™ machines by automating JumpStart™, performing Operating System Upgrades On-Line (LiveUpgrade) and speeding-up the installation and upgrade phase (Flash Archive). Coupled with a GUI sequencer, this feature offers a full "Hands Free" efficient and automatic installation and upgrade package for the entire OMC-R system. Additional information for this feature is available in NTP < 006 >.

OMC-R Solaris jumpstart automated installation feature This feature was introduced in V15.0 and is an automatic installation process available in the Sun Microsystems™ Solaris™ operating environment. It allows system administrators to categorize machines on their network and automatically install systems based on the category to which a system belongs. The Solaris™ JumpStart™ Automated Installation feature provides the system administrator with the following advantages:

- simplifies installations
- speed - Faster than CD-ROM installation
- allows unattended installation
- replication - same systems across the enterprise

All Solaris™ base installations require some basic configuration. With JumpStart™, Sun has enabled the system administrator to avoid repetitive tasks associated with bringing a Sun system online.

OMC-R system patch automation feature This feature was introduced in V15.0 and is used to manage OMC-R system patches automatically. It was added to the install_data tool, which is normally used to install and/or apply patches and plug-ins in installed OMC-R configurations. The OMC-R system patch automation feature performs the following functions:

- installs and applies system patches automatically
- performs fallback functions from system patches
- displays the system patch level

The install_data tool performs these functions from an application script which is delivered with the patch by the Nortel team responsible for system patches. The system patch automation feature will be introduced progressively as system patches are delivered with an application script.

The install_data tool will place system patches delivered without an application script on the OMC-R active server. Additional information for this feature is available in NTP < 006 >.

1.2 BSC 12000HC functional characteristics

The Base Station Controller provides the following:

- Base Transceiver Station (BTS) management which:
  - configures physical paths to control radio transceivers (TRX/DRXs)
  - initializes TRX/DRXs and configures channels
  - concentrates LAPD signalling with the BTSs
  - monitors BTS operations
  - reconfigures the BTSs when required
  - updates system parameters
- TransCoding Unit (TCU 2G) management which:
  - initializes and configures the TCBs
  - concentrates LAPD signalling with the TCU 2Gs
  - monitors TCU 2G operations
- Radio resource management which:
  - controls radio access
  - allocates radio channel
  - monitors radio channel operations
- Call processing which:
  - seizes terrestrial and radio circuits
  - switches channels from BTSs to MSC, and vice versa
  - packets channels from BTSs to SGSN, and vice versa
- Call sustaining procedure execution which
  - processes measurements taken by mobiles and base stations with preprocessing at BTS level
  - controls uplink and downlink power
  - performs handovers without loss: such as intra-bss, inter-bss and intra-bts handovers on TCHs and SDCCHs (traffic and signalling channels)

- Message transport from MSC or SGSN to mobiles, and vice versa
- Message transport from SMLC to mobiles, and vice versa
- Operations and maintenance which
  — links with an operations and maintenance center (OMC-R)
  — executes the operating procedures required by the OMC-R, saves the procedure data, and distributes to BSS equipment, when necessary
  — saves BSS configurations and software with distribution to the required entities
- Defense which
  — detects failures and malfunctions
  — performs local defense by isolating defective equipment to avoid fault propagation
  — reconfigures equipment onto redundant equipment. This function also includes BSC 12000HC chain switchover and restart procedures.

1.3 BSC 3000 functional characteristics

The BSC 3000 provides the following

- Radio resource management which:
  — processes radio access
  — allocates radio channels (traffic and signalling)
  — monitors radio channel operating states
- Call processing which:
  — sets up and releases terrestrial and radio links
  — transfers messages between the mobile stations and:
    – the MSC via TCU 2G or TCU 3000 and the BTS
    – the SGSN via PCUSN and the BTS
  — commutes the switch channels between BTSs and MSC via TCU 3000
  — commutes the packet channels between BTSs and SGSN via PCUSN
- Call sustaining procedures which:
  — process measurements from mobile stations and the BTSs

- launches:
  - the power control procedures
  - the handover procedures

- BTS management which:
  - sets physical channels, to control transceivers (TRX)
  - initializes the TRX and sets the channels
  - supervises BTS operating states
  - provides BTS reconfiguration, if needed
  - updates system parameters

- TCU management
- BSC 3000 defense which:
  - detects and corrects failures and operating anomalies
  - provides local defense by isolating faulty units, to avoid problem spreading
  - provides equipment unit reconfiguration using redundant units. These functions include the module switching and restart mechanisms for the BSC 3000.

The BSC 3000 houses the following main systems:

- a cooling system
- an alarm system
- a power system
- a control node
- an interface node
- a PCM switching system

For more information about these systems refer to NTP < 126 >.

The BSC 3000 software architecture is based on a network model of processors called a "core system", which can be tailored to fit into different hardware structures. The core system is divided into logical process units. A set of modules which house boards and processors provide each logical unit with the processing power they need.

The main types of processing unit are split up as follows:

- for the control node:

- the OMU modules enable the following basic BSC 3000 operating functions:
  - MMS module management
  - BSC 3000 initialization sequences (loading the programs and data into the different processors)
  - monitoring correct processor operations
  - OMC-R access and related function management
  - interface node
- the TMU modules enable:
  - centralized call processing functions
  - communication with the BTS (traffic management, radio environment monitoring, message broadcasting, traffic overload control, etc.)
  - communication with the MSC (SS7 signalling channels)
  - communication with the SGSN
  - TCU 2G and TCU 3000 management
- the ATM_SW (also named CC-1) modules enable:
  - conversion of the ATM 25 to the SONET interfaces (ATM 155)
  - conversion of the LAPD and SS7 channels on each TMU module via the VP-VC on AAL1

• for the interface node:
- the ATM-RM modules enable:
  - conversion of the AAL1 to S-link interfaces
  - conversion of the AAL5 to Spectrum messaging interfaces
- the CEM modules enable:
  - management of the ATM-RM, 8K-RM and LSA-RC
  - management of the mixing order for the 64K and the 8K switching parts
- the 8K-RM modules enable:
  - running of the mixing order to the 8K switching part
- the LSA-RC enable:
  - management of the PCM/defect monitoring

– conversion of the PCM to S-link interfaces

1.4 OMC-R features and functions

The OMC-R enables BSS subsystem operations and maintenance operations in digital GSM and dualband mobile networks. It performs the functions required by the network operator for management.

The OMC-R manages resources, initializes the system, configures BSS entities, controls the start and end of operations. The OMC-R manages the entire radio chain or the OMUs.

The OMC-R monitors the network from the *Air* interface to the A interface. It stores BSC observation data and allows users to analyze the measurements in real time or at a later time.

The OMC-R monitors the GPRS network and reports observations and alarms. The OMC-R enables dynamic queries.

The OMC-R provides system maintenance facilities by reporting malfunctions and failures, saving the information on disk, and enabling equipment reconfiguratio n.

The OMC-R controls system access rights that vary according to the user.

The OMC-R monitors its own operations. In a standard configuration including two servers operating in duplex mode, the OMC Administration function automatically switches the active server onto the backup server and manages redundant resources.

A graphic user interface enables user dialogues for network management purposes. The user can enter commands, view traffic conditions and eventual malfunctions.

The OMC-R also provides services for backing up data to cartridges such as fault files, observation reports, trace data and operating data files.

OMC-R provides two types of server configurations:

- Single server configuration
- Dual server configuration

The standard system configurations of the OMC-R are the following:

- Single server configuration

  . The supported or nominal single-server configurations are made up of either

  — one SFV890 (V890+) server with internal disks or

  — one SFV880 server and two external T3 disk arrays or

  — one E4XXX server and two external T3 disk arrays

- Dual server configuration

  . The supported dual-server configuration is made of

  — Two E4500 servers and two external T3 disk arrays

The two servers are linked by a serial link used for mutual surveillance purpose. They are also connected on 100baseT Full Duplex Ethernet LAN.

The OMC-R stations are ULTRA 45 (nominal) or SUNBLADE 1500 (nominal) or SUNBLADE 150 (Supported) or ULTRA 5 (Supported).

The new nominal workstation is the ULTRA 45 (1600 MHz).

For more information on these configurations, refer to NTP < 006 >.

Throughout this document, the names of directories beginning with "/OMC" or "/MD" should be read as "/OMC_SRV" or "/MD_SRV" for the active server and "/OMC_BKP" or "/MD_BKP" for the backup server.

1.5 Basic definitions

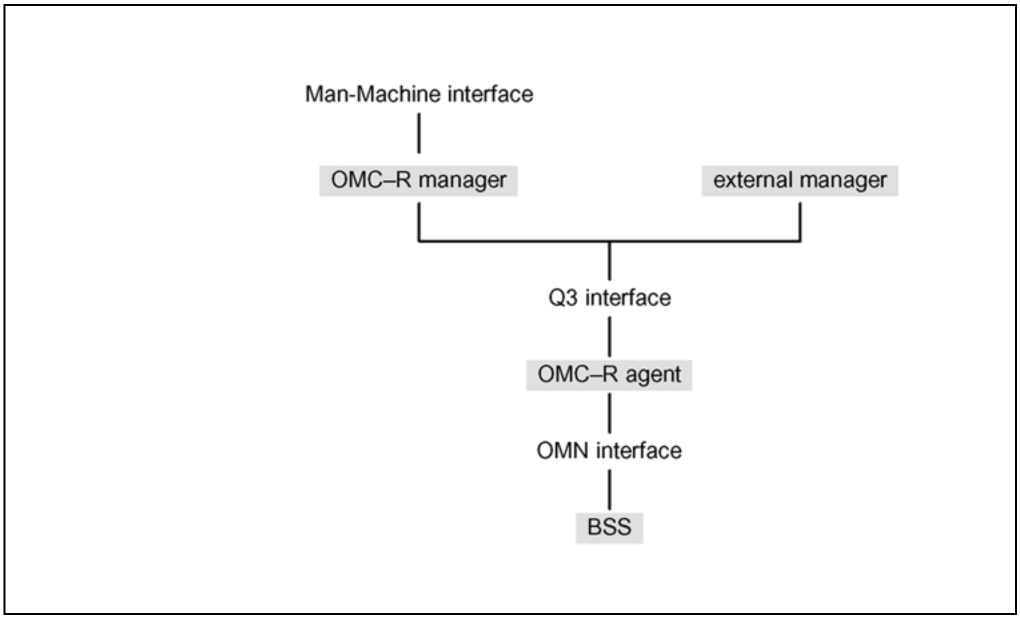
1.5.1 OMC-R functional architecture

The OMC-R is a BSS subsystem manager that performs mediation functions and provides a Q3 interface:

- The OMC-R manager enables exchanges with users through the Man-Machine interface, and with the OMC-R agent through the Q3 interface.
- The OMC-R agent enables exchanges with the BSSs through the OMN interface and provides mediation functions between managed objects on the Q3 interface and managed objects on the OMN interface.

The notifications are forwarded from the md to the local manager using a pseudo Q3 interface. Whereas the notifications sent to the external managers are correlated, those sent to the local manager are un-correlated. Thus the flood of notifications is faster for the local manager, whichever is the response delay of the external managers.

Figure 2
OMC-R design



1.5.2 Objects

BSS and OMC-R interchanges are based on an object model definition. All the transactions between BSSs and OMC-R and between OMC-R agent and manager use a specific application data description.

The managed objects check the managed object defined by ISO (ISO/IEC 7498-4 OSI - Basic reference model - Management framework):

"A managed object is defined in terms of its parameters, the operations it can perform, the notifications it can issue, and its relationship with other objects".

The OMC-R manager recognizes the BSS subsystem by the objects that describe it on the Q3 interface (as the user sees the objects on the Man-Machine interface). The OMC-R agent recognizes the BSS subsystem by the objects that describe it on the Q3 and OMN interfaces.

BSS subsystems and OMC-R agent are described by objects managed on the Q3 interface. Each object describes a function or an equipment.

1.5.3 Databases

Objects are managed in two databases which are illustrated in Figure 3 "Operations database and application database" (page 33).

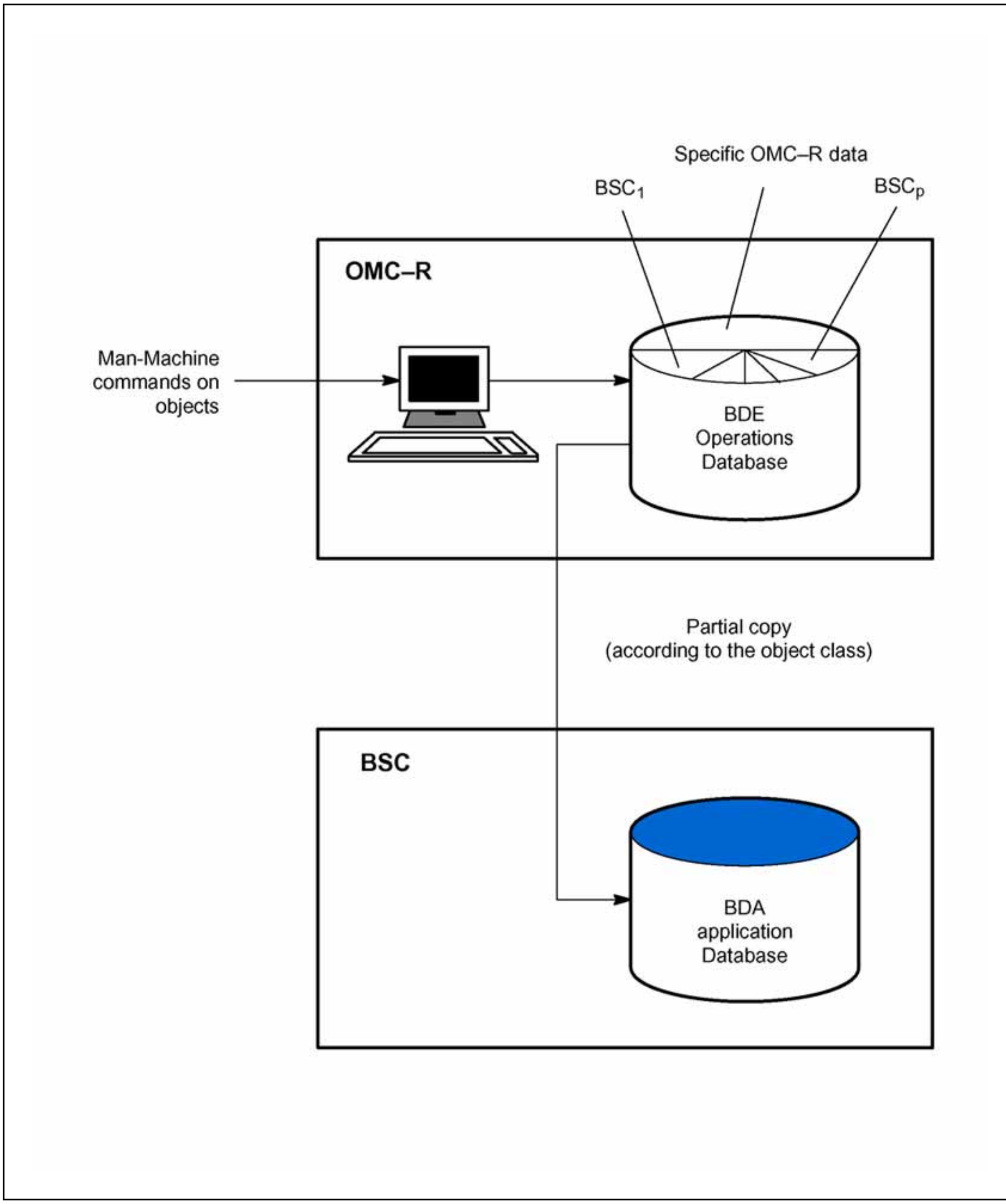
- The OMC-R operations database (BDE) is the main database. It is managed by the OMC-R and built as the objects are created. It is stored on the OMC-R agent disks.

The BDE is automatically updated after each operation and contains all the BSS objects, and certain specific OMC-R objects that are not known to the BSC.

- The BSC application database (BDA) is stored on the BSC disk. It is built from the BDE. The BSC database building operation is controlled by users.

To allow the system to function correctly, the two databases must be consistent. Users can check their consistency by using an auditing command. The system warns the user if the two bases are inconsistent, by sending a specific message in response to the command.

Figure 3
Operations database and application database



1.5.4 Object classes and instances

An object, as defined above in terms of parameters, operation notifications, and relationships is a generic object. The same information structure describes same-kind individual objects that can be configured and behave differently.

For example, the same information structure is used to describe all the bts objects modelling the radio cells under OMC-R management control. The description differentiates a non-operational cell C1 configured with two TRX/DRXs at a given time from an operational cell C2 configured with four TRX/DRXs at the same time.

To avoid any ambiguity between the generic object and the individual object, a difference is made between the object class and the object instance. In the example above, C1 and C2 are both instances of the bts object class.

1.5.5 Parameters

All the objects in a same class are described in the same way by a set of parameters. The values of these parameters vary according to the object.

There are three kinds of parameters:

- **Permanent parameters,** which are defined by the users

  They are recorded in the BDE and BDA databases. Most of them are mandatory and are defined with the object that uses them. Some of them are optional and their value depends on the radio subsystem configuration. They are designated by the abbreviation DP (Permanent Data) in this NTP.

- **Dynamic parameters,** which are not controlled by the users

  They are not controlled by users. They are not recorded in the databases. The BSC manages dynamic parameters that are updated by BSC applications and can be consulted on request. They are designated by the abbreviation DD (Dynamic Data) in this NTP.

- **Internal parameters,** which are managed from the OMC-R

  They are recorded in the BDE database and cannot be modified by users. They supply additional information on the object configuration at a given time and can be consulted on request. They are designated by the abbreviation DI (Internal Data) in this NTP.

For more information on parameters:

- In alphabetical order, refer to NTP <124>.
- Grouped according to the objects, refer to NTP <128>.

1.5.6 Operations

Operations on objects are commands that the user sends to the OMC-R on the Man-Machine interface. They allow users to communicate with the OMC-R and update the databases when necessary.

The OMC-R checks the command semantics before forwarding the commands to the BSC to ensure that it only receives commands that are likely to be correctly executed.

The same set of operations apply to all the objects in a given class. The main types of operation are as follows:

- Create an object.
- Delete an object.
- Lock or unlock an object.
- Set an object’s permanent parameters.
- Display an object’s permanent and internal parameters.
- Display an object’s permanent, internal, and dynamic parameters.
- Audit a BDA to check consistency.
- Perform an action on an object.

1.5.7 Unsolicited messages

Unsolicited messages sent by the managed objects are translated into notifications that provide users with information on network operating conditions.

The same types of message apply to all the objects in a given class. These messages are grouped as follows:

- software anomaly
- hardware fault
- warning
- state change
- parameter value change
- restart
- BIST result
- purge
- observation
- trace
- build BDA request

1.6 Configuration management

1.6.1 Object classes

The system configuration is based on object class definitions. Figure 4 "Object main tree structure" (page 37) to Figure 7 "Network subtree objects" (page 39) show the tree structure of the configuration objects managed on the OMC-R:

- main tree structure

- omc subtree
- md subtree
- network subtree
- bsc subtree

The present paragraph only details the objects that model the radio subsystem, which are managed by the OMC-R Configuration Management function, that is, the bscMdInterface object of the md subtree and the objects of the bsc subtree.

1.6.1.1 OMN access management

The md object describes the OMC-R agent that mediates Q3 objects and OMN objects, and handles exchanges with the BSSs on the OMN interface. The md object is unique to the OMC-R and is created automatically by the system.

The bscMdInterface objects describe the BSS/OMC-R links. They depend on the md object.

OMN Access Management is a Configuration Management subfunction. It controls BSS/OMC-R links and:

- X25 transport layers for BSC 12000HC
- Ethernet links for BSC 3000

1.6.1.2 Radio subsystem configuration

Each object that describes a radio subsystem item depends directly or indirectly on the bsc object that models the BSC and is identified by a specific number.

Equipment The bsc objects describe the architecture and the hardware of the BSCs managed on the OMC-R. They allow users to manage BSC application databases (BDA), processing chains for the BSC 12000HC, processing OMU modules for the BSC 3000 and date/time.

The pcmCircuit objects describe external BSC (Abis, Agprs and Ater interfaces) and TCU (A interface) PCM links.

The lapdLink objects describe the Level 3 links used by the BSCs for LAPD signalling.

Figure 4
Object main tree structure

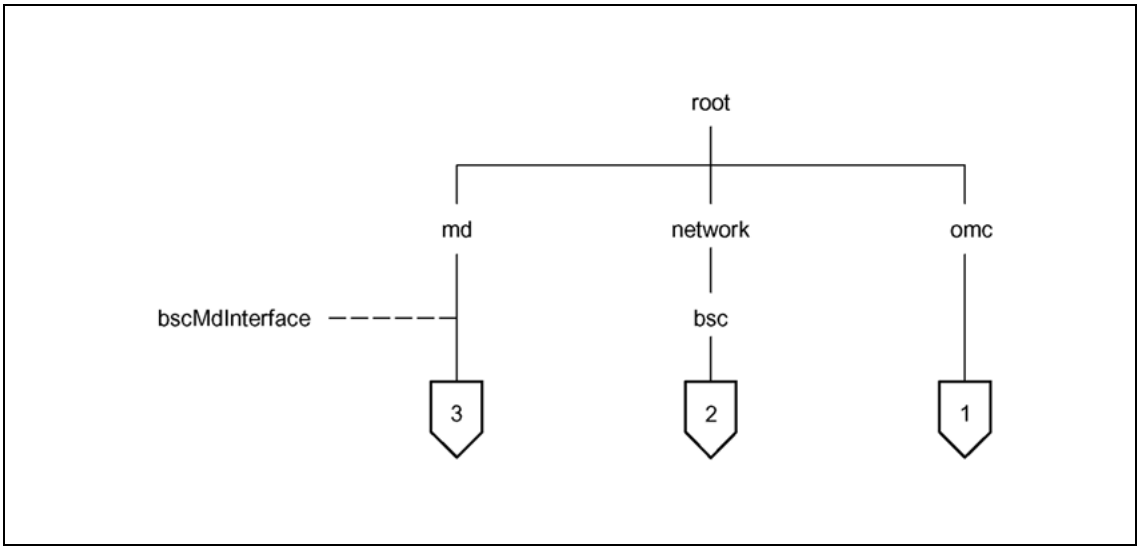


Figure 5
OMC subtree objects

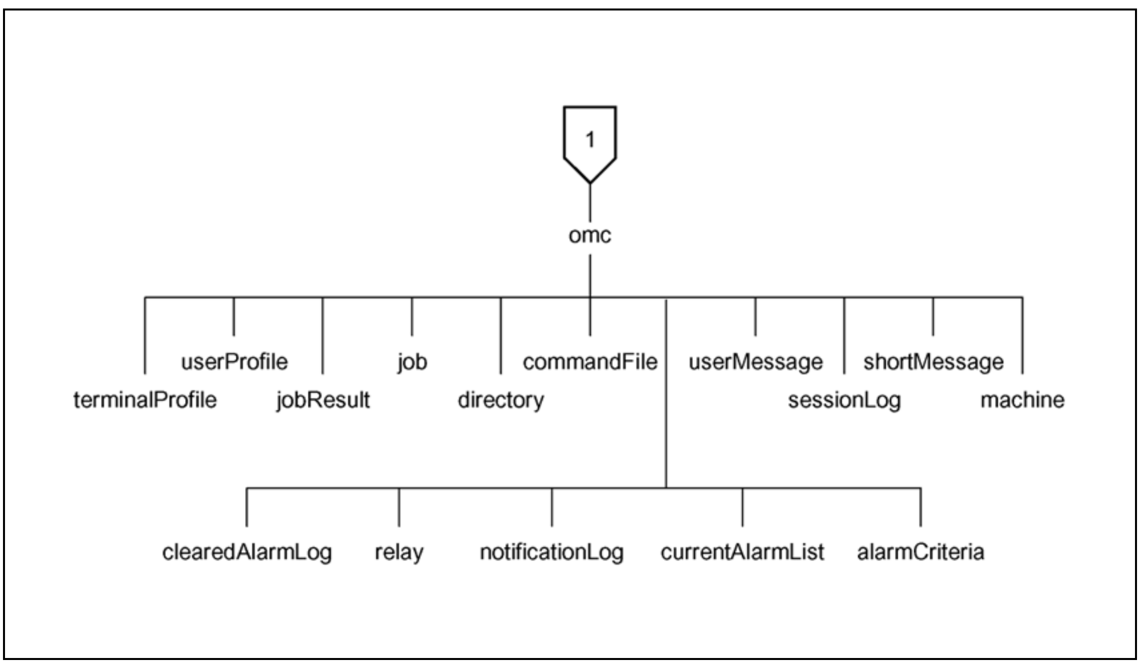


Figure 6
MD subtree objects

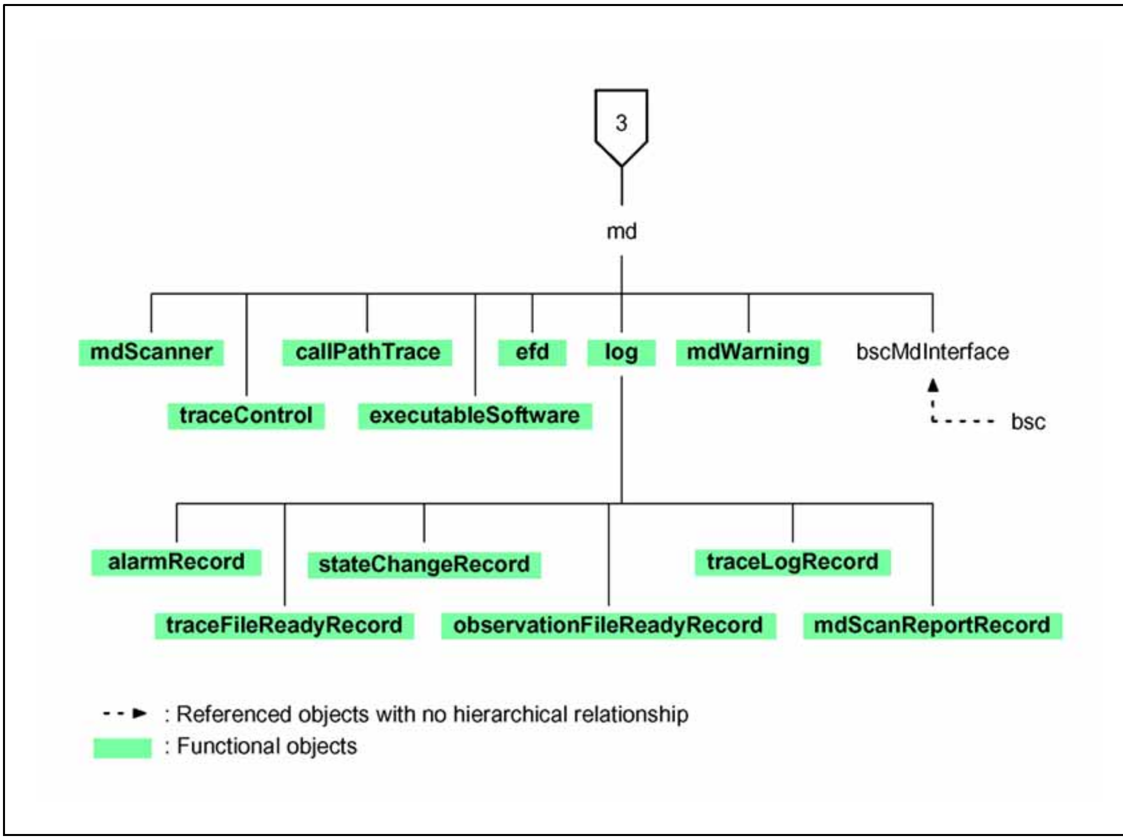


Figure 7
Network subtree objects

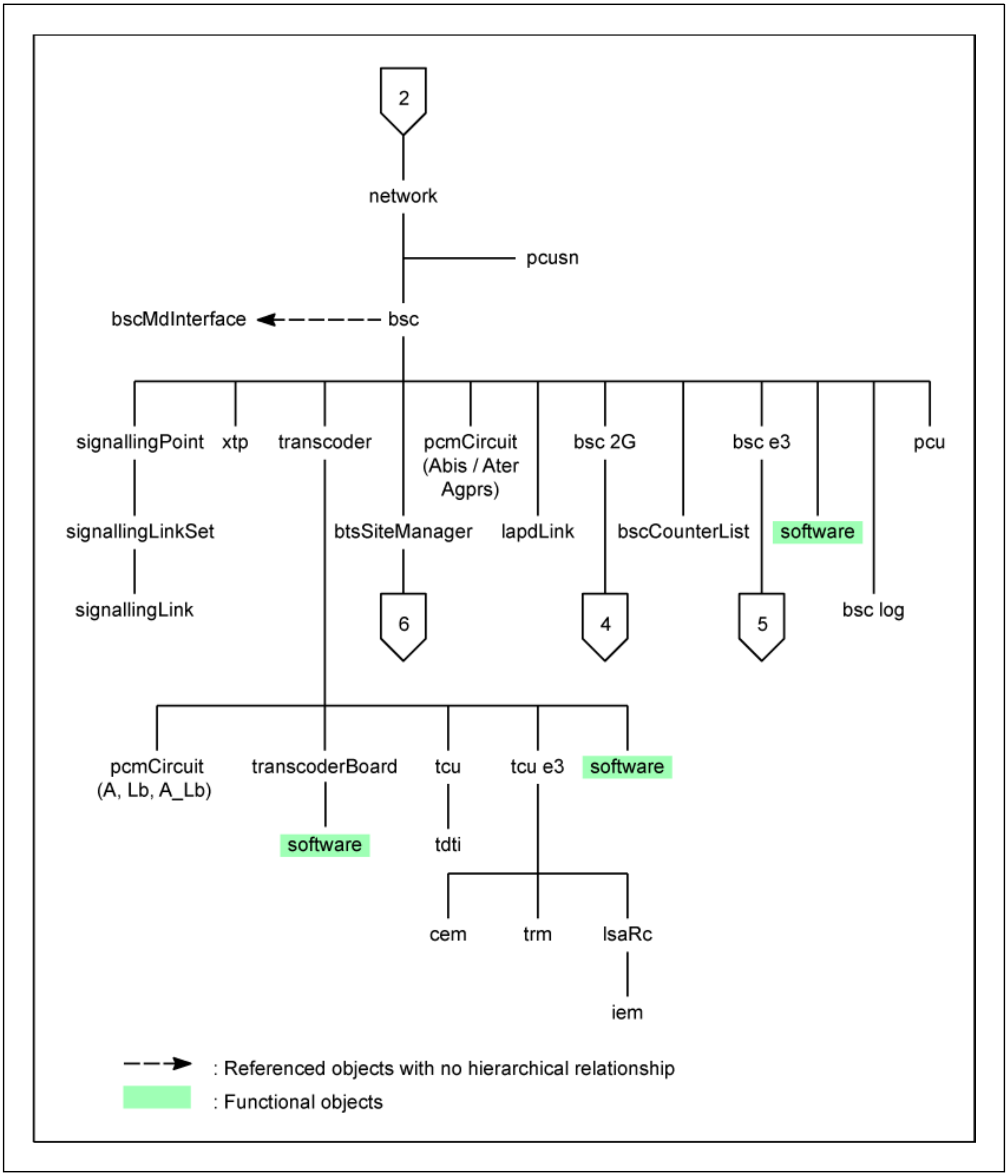


Figure 8
BSC 12000HC subtree objects

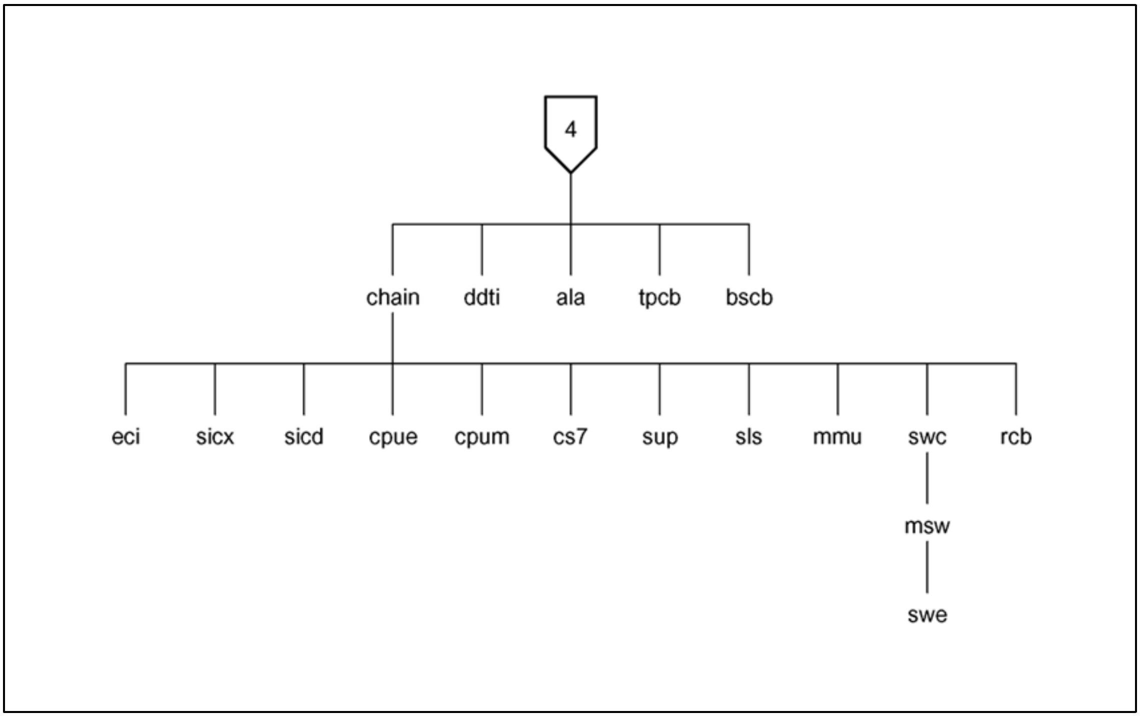


Figure 9
BSC 3000 subtree objects

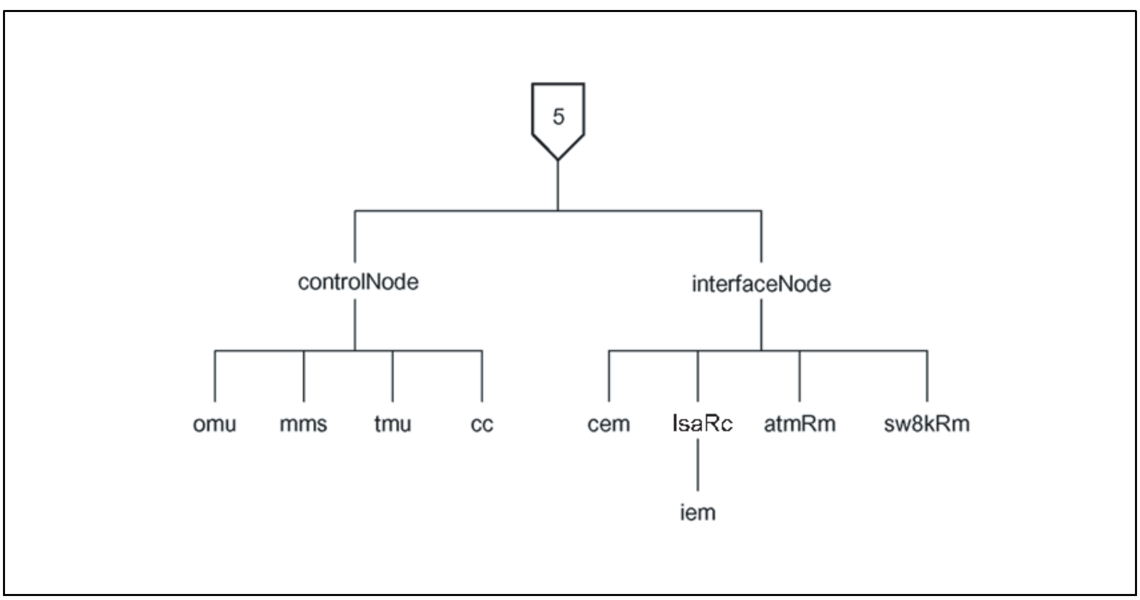
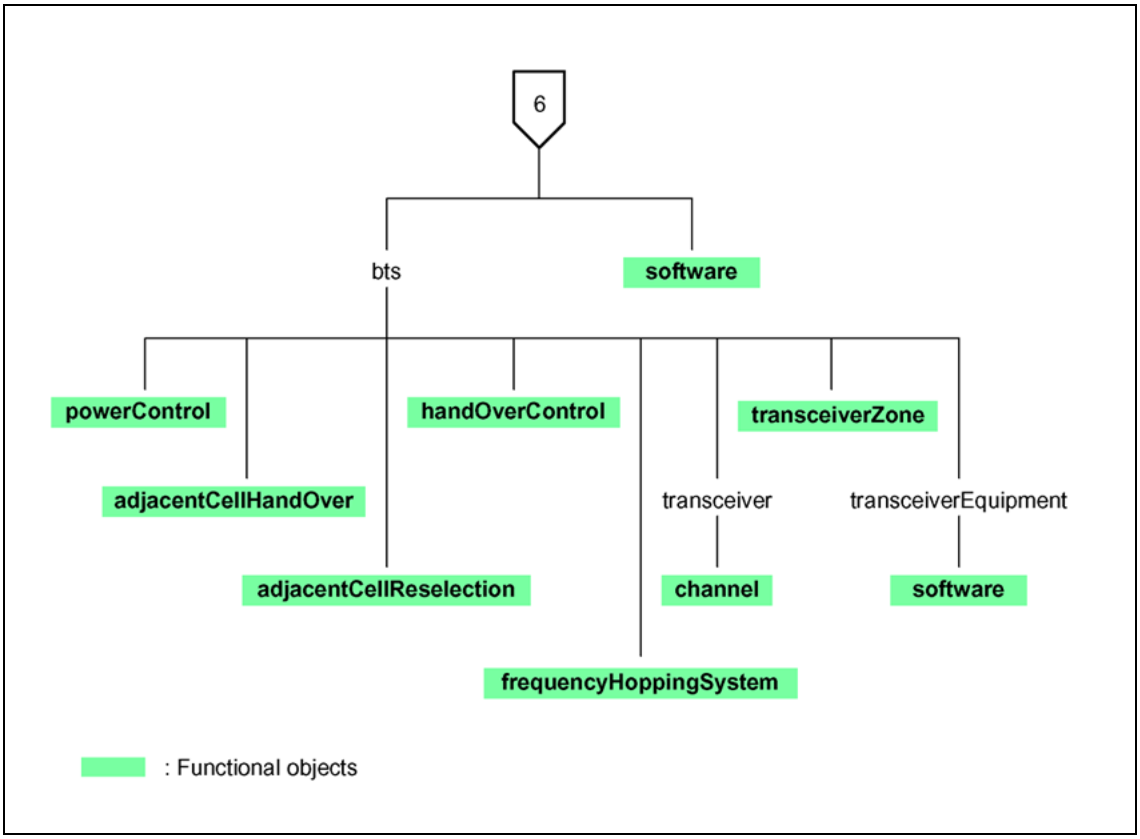


Figure 10
btsSiteManager subtree objects



A interface The signallingPoint and signallingLinkSet objects describe the A interface on BSC and MSC ends, respectively.

The transcoder objects describe the remote transcoding units (TCUs), connected to the BSC but installed on the MSC site.

The transcoder board object describes the TCU 2G transcoding board (TCBs).

The tcu object describes the tdti board.

The tcu e3 object describes the following objects:

- cem

  This object describes the resources required to support the Interface Node application.

- trm

  This object describes managing the vocoding of speech channels.

- lsaRc/iem

  This object describes the electrical interface for the PCM link.

The signallingLink objects describe the SS7 signalling links handled by the TCUs and used to convey signalling on the A interface.

The xtp objects describe the terrestrial traffic circuits handled by the TCUs, used to convey traffic and data on the A interface.

Radio and Abis resources The btsSiteManager objects describe radio sites (BTSs). BTS management on the Abis interface includes PCM links (level 1), LAPD protocol (level 2), and traffic and O&M signalling (level 3).

The bts objects describe the serving cells of radio sites.

The transceiverEquipment objects describe the transceiver units (TRX/DRXs) that manage TDMA frames in radio sites.

The transceiver objects describe TDMA frames (time-division multiplexing of radio channels) that enable radio transmissions.

The channel objects describe physical radio channels (TSs) in TDMA frames.

1.6.1.3 Software management

The software-bsc objects allow users to download and start up BSC software.

The software-btsSiteManager objects are used to download and start up BCF software.

The software-transceiverEquipment objects are used to download and start up TRX software.

The software transcoder board objects are used to download and start up TCB software.

The software bsc e3 and tcu e3 objects are downloaded to the BSC 3000 disk. BSC 3000 is used to start up the TCU 3000 software.

Software Management is a Configuration Management subfunction that does not depend on the radio subsystem configuration. Refer to Section 1.10 "Software management" (page 91) for more details.

1.6.1.4 SMS-CB management

The short message objects allow users to create short messages and to manage unacknowledged message broadcasts in network radio cells.

SMS-CB management is a Configuration Management subfunction that does not depend on the radio subsystem configuration. Refer to Paragraph Section 1.11 "SMS-CB management" (page 127) for more details.

1.6.2 Managed entities

Object management entities are divided into the following subsets:

- managed object
- functional object
- Man Machine Interface (MMI) object

1.6.2.1 Managed object subset

A MANAGED OBJECT describes a graphic object, shown on the Man-Machine interface, that models a network element. A managed object can be directly accessed by users.

1.6.2.2 Functional object subset

A FUNCTIONAL OBJECT describes an object, which can be shown or not shown on the Man-Machine interface (called a hidden object in case when it is not visible on the Man-Machine interface), that models a given functionality.

A functional object relates to one managed object:

- The *adjacentCellHandOver* object associated with the bts object describes the neighbor cells of serving cells for handover management purposes. It has numerous instances.
- The *adjacentCellReselection* object associated with the bts object describes the BCCH frequencies used for reselection management purposes. It has numerous instances.
- The *frequencyHoppingSystem* object associated with the bts object (and related to the channel object) describes radio time slot frequency hopping management parameters. It has numerous instances.
- The *handOverControl* object associated with the bts object describes handover management parameters in serving cells. It has only one instance and must be created for each created bts object.
- The *powerControl* object associated with the bts object describes power control management parameters in serving cells. It has only one instance and must be created for each created bts object.
- The *transceiverZone* object associated with the bts object (and related to the transceiver object) describes TDMA frame allotment zones in concentric serving cells. It has two instances and must be created for each created bts object of this type.

- The *software* object associated with bsc, btsSiteManager, transceiverEquipment, transcoderBoard and tcu e3 objects, describes the BSC, radio site BCF, TRX/DRX, TCB and TCU 3000 software versions, respectively. It has only one instance and must be created for each created object in these classes.

Functional objects are managed by users as follows:

- A functional object is created after the managed object to which it refers. It can not be created unless required by the system configuration.
- A functional object instance is defined by the managed object instance to which it refers and a specific identifier.

1.6.2.3 MMI object subset

An MMI OBJECT is a non-Q3 object shown on the Man-Machine interface. MMI objects are managed by the OMC-R manager, they are not known by the OMC-R agent and are not stored in its operations BDE database.

Two types of MMI OBJECT subsets are defined:

- The **summary objects** (See Figure 4 "Object main tree structure" (page 37) to Figure 7 "Network subtree objects" (page 39)) represent sets of objects at higher level. They also summarize the real time information on alarms available below on the corresponding objects.
- The **omc object** allows the user to manage the active alarm criteria configuration, monitor OMC-R manager and connected workstation performance, and initiate specific actions on the OMC-R manager.

1.6.3 State parameters

The managed objects have three ISO states:

- administrativeState
- operationalState
- availabilityStatus

1.6.3.1 AdministrativeState

The administrative state is a permanent parameter [DP] with the following values:

- unlocked
- locked
- shuttingDown (soft release of bts, transceiverEquipment and xtp objects only)

The OMC-R forces the administrativeState to "locked" when an object is created, except for the bscMdInterface objects that are created in unlocked state. It can then be updated for users.

The administrativeState of certain objects is not significant:

- The bts, pcmCircuit, btsSiteManager, signallingLink, transceiverEquipment, transcoder, transcoderBoard, and xtp objects have an administrativeState. Other objects cannot be brought to service until these objects are unlocked.
- The channel, lapdLink, signallingLinkSet, signallingPoint, and transceiver objects have no administrativeState of their own (they are only significant to the OMC-R). The BSC manages their operationalState, which depends on the administrativeState of higher level objects.
- A functional object can have an administrativeState.

A managed object with no administrativeState of its own is automatically put into service on the network.

The OMC-R manages the administrativeState of the bsc object as follows:

- The transition from unlocked to locked state has no impact on the BSC's own operations.
- The transition from locked to unlocked state causes the automatic suicide of both BSC processing chains if Class 1 parameters have been modified (BSC 12000HC only, see below).

1.6.3.2 OperationalState

The operationalState of an object is a dynamic parameter [DD] that cannot be modified by users. It can be displayed on the user's request:

- enabled
- disabled

The operationalState of an object may be changed by internal system operating conditions, or when the administrativeState of the object or another network object changes.

1.6.3.3 AvailabilityStatus

The availabilityStatus of an object is a dynamic parameter [DD] that cannot be modified by the user.

It can be displayed on the user’s request:

{}	not significant
dependency	out of reach
failed	faulty

The availabilityStatus of an object is specific to that object. It provides additional information in association with other state parameters.

1.6.4 Managed object relationships

1.6.4.1 Parent/child dependency

An object A depends on an object B if A is out of reach when B is locked, and if when object B is unlocked, object A remains disabled until object B is enabled.

The parent/child dependencies are as follows:

Object B > > > > >	***Object A***
pcmCircuit (BCF) ..	btsSiteManager
pcmCircuit	transceiverEquipment
pcmCircuit	signallingLink, xtp
btsSiteManager	bts
bts	transceiverEquipment
bts	transceiver
transceiver	channel

One should note that, if the PCM used by a radio site BCF or TRX/DRX is disabled, and if the used TSs (time slots) can be reconfigured onto a redundant PCM, the site or TRX/DRX remains operational. In this case the btsSiteManager and transceiverEquipment objects do not depend on the pcmCircuit object involved.

1.6.4.2 Functional dependency

An object A is functionally dependent on an object B if object B operations influence object A operations.

For example:

- A transceiver or transceiverEquipment object cannot operate if the parent bts object is locked.
- A bts object cannot be unlocked if a minimum number of transceiver objects dependent on it are not created.

- A transceiver object cannot operate if the associated transceiverEquipment object is not operational.

The logical order to put objects into service is:

bts >>> transceiverEquipment >>> transceiver

A cell cannot operate if a minimum number of the TDMA frames depending on it are not configured correctly (priority allocation) or if the TDMA frame conveying the BCCH is no longer operational.

1.6.4.3 Order of creating objects

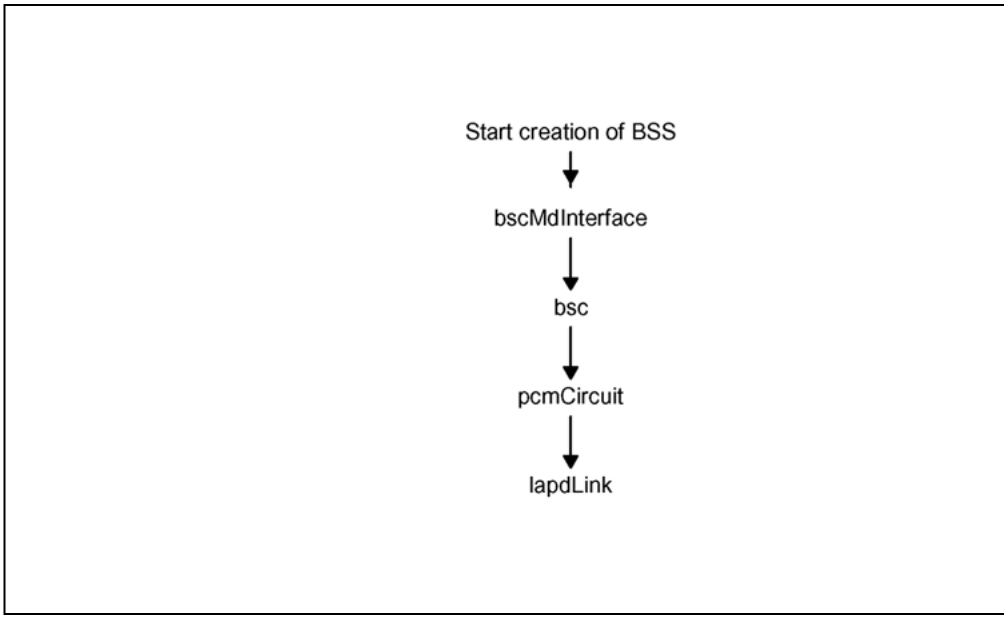
The order in which managed objects are created is determined by their relationships:

- A bsc object is the parent of a btsSiteManager object.
- A btsSiteManager object is the parent of a bts object.
- A bts object is the parent of a transceiverEquipment object.
- A bts object is the parent of a transceiver object.
- A transceiver object is the parent of a channel object.
- A bsc object is the parent of a pcu object.

Generally speaking, if an object B references an object A, object A must be created before object B.

The following figure shows the order in which the objects modeling the equipment are created.

Figure 11
Equipment configuration



The following figure shows the order in which the objects modeling the Agprs interface are created. In release 15.0, the capacity of the Agprs PCMs is doubled from a maximum number of 12 to 24 for BSC 3000 only.

All pcmCircuit objects depending on an object on the Agprs interface must be created before the pcu objects that use them.

All lapdLink objects depending on an object on the Agprs interface must be created before the pcu objects that use them.

The pcusn object is optional. It allows to group several pcu objects.

For more information on the SGSN, see Paragraph Section 2.1.3 "Implementation" (page 270).

Gb interface The Gb interface connects the BSS and the SGSN, allowing the exchange of signalling information and user data. The Gb interface allows many users to be multiplexed over the same physical resource. Resources are given to a user upon activity (when data is sent or received) and are reallocated immediately thereafter. This is in contrast to the A interface where a single user has the sole use of a dedicated physical resource throughout the lifetime of a call irrespective of activity.

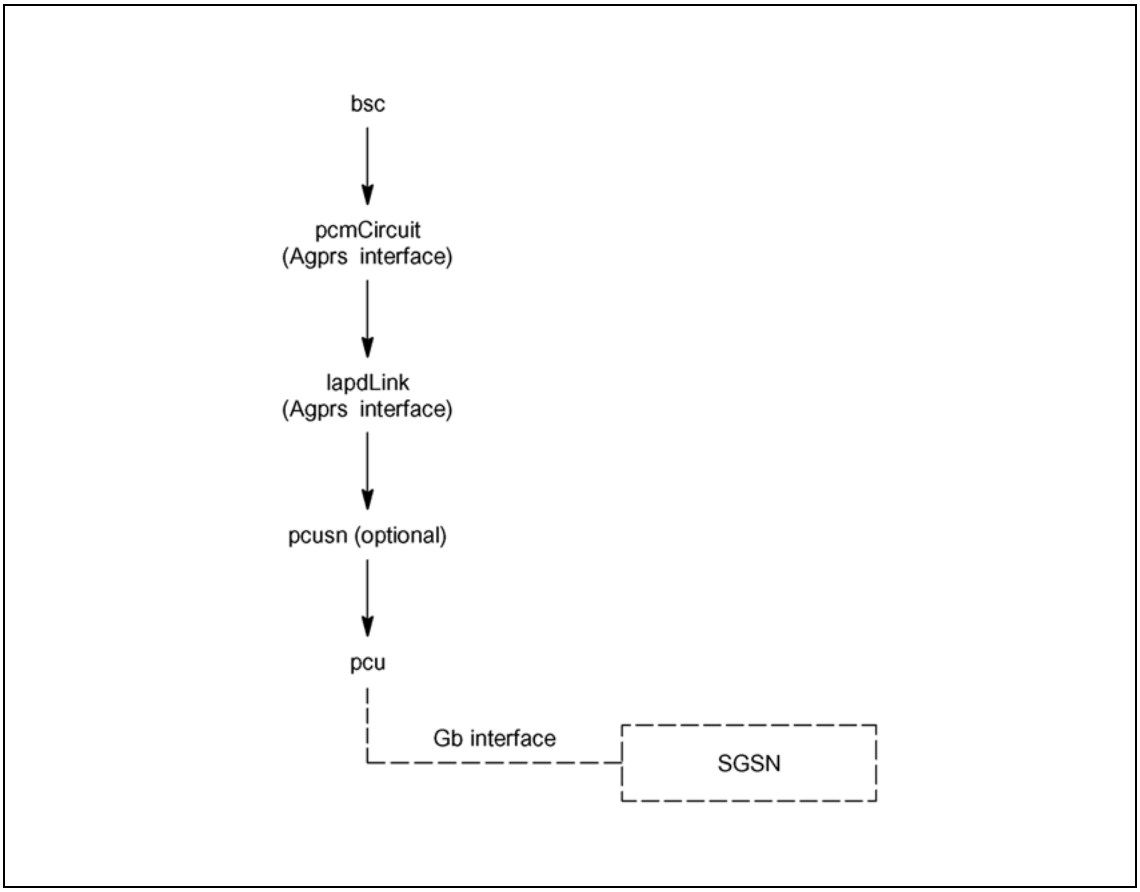
GPRS signalling and user data are sent in the same transmission plane. No dedicated physical resources are required to be allocated for signalling purposes.

Access rates per user may vary without restriction from zero data to the maximum possible line rate (for example, 1984 kbit/s for the available bitrate of an E1 trunk).

The Gb interface link layer is based on Frame Relay. Frame Relay virtual circuits are established between the SGSN and the BSS. Data from many users are multiplexed on these virtual circuits. The virtual circuits may be multi-hop and traverse a network of Frame Relay switching nodes. Frame Relay is used for signalling and data transmission.

Gs interface The Gs interface connects the SGSN and the MSC/VLR. Since the SGSN and the MSC/VLR communicate using different protocols, the messages are routed through the SS7/IP Gateway (SIG) for conversion.

Figure 12
Agprs interface configuration

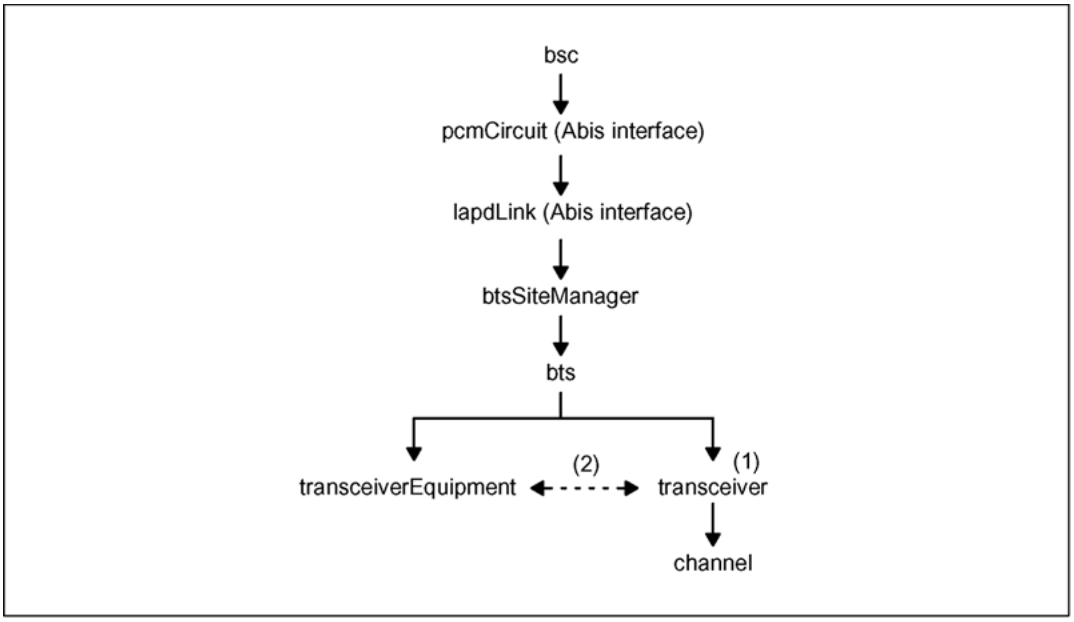


The following figure shows the order in which objects modeling radio resources are created.

- All pcmCircuit objects depending on a bsc object on the Abis interface must be created before the btsSiteManager objects that use them.

- All lapdLink objects depending on a bsc object must be created before the btsSiteManager and transceiverEquipment objects that use them.

Figure 13
Radio resource configuration (Abis interface)



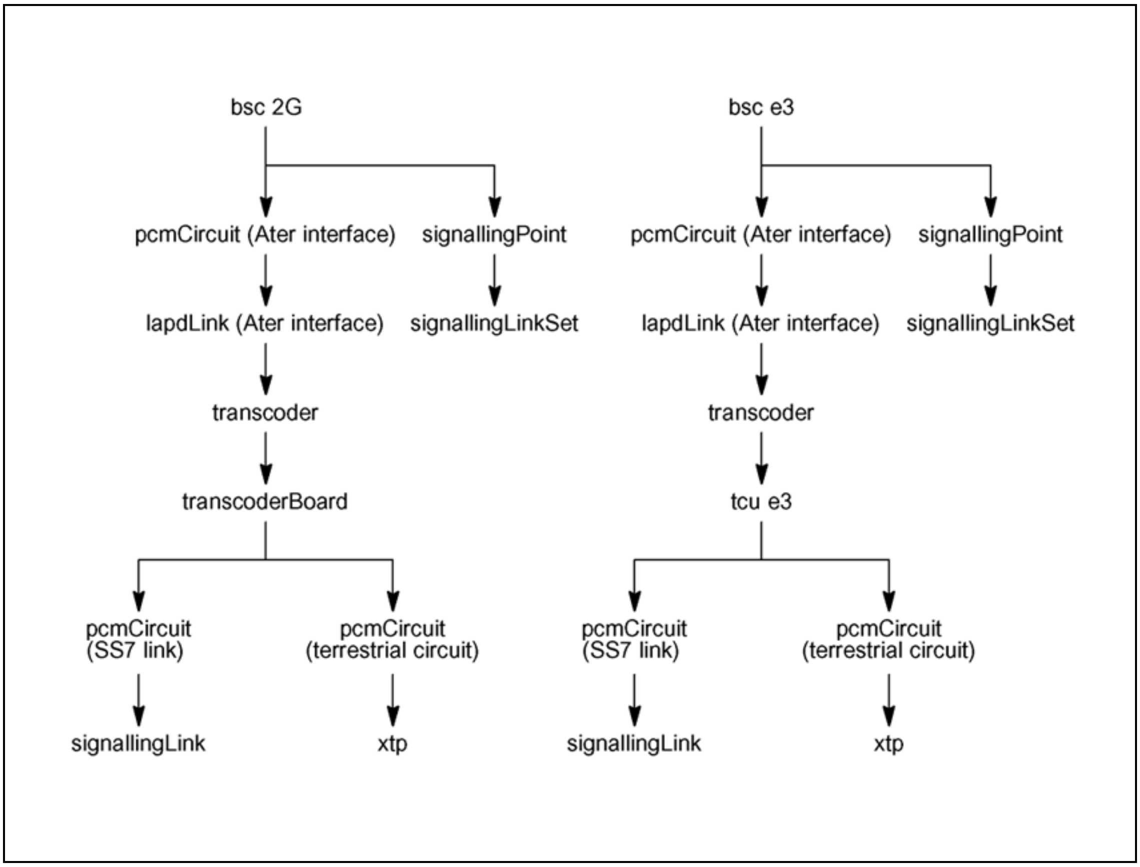
(1) The transceiver objects do not depend on transceiverEquipment objects when they are created.

(2) The dynamically creates TDMA–TRX/DRX associations.

The following figure shows the order in which the objects modeling the A interface are created.

- All pcmCircuit objects depending on a bsc object on the Ater interface must be created before the transcoder objects that use them.
- All lapdLink objects depending on a bsc object must be created before the transcoder objects that use them.
- All pcmCircuit objects depending on a transcoder object on the A interface must be created before the signallingLink (SS7 links) and xtp (terrestrial traffic circuits) objects that use them.
- All transcoderBoard objects describing the transcoding boards in a TCU must be created before the pcmCircuit objects depending on the transcoder object on the A interface.
- All tcu e3 objects describing the transcoding in a TCU 3000 must be created before the pcmCircuit objects depending on the transcoder object on the A interface.

Figure 14
Ater and A interface configuration for BSC/TCU 2G and BSC/TCU 3000



1.6.4.4 Order of deleting objects

Objects are deleted in the reverse order of creation. A referenced object cannot be deleted.

1.6.4.5 BDA building

The application database (BDA) must be built when the BSC is initialized.

The relationships between create object and build database commands are as follows:

- The database is created from the objects depending on the object created in the BDE.
- Requests to create objects depending on a object are refused if the application database has been built and the BSS/OMC-R link is not set up or down.

The application database must be rebuilt if the following occur:

- The BSC detects an inconsistent BDA when it restarts.

- BDA prototype configuration files are modified when the software version is changed.
- The architecture or type of the object changes (class 0 parameters).

  Only OMC-R class 0 is available for BDA.
- The result of the audit command indicates BDA inconsistencies.
- The system returns a software anomaly notification or an error message in response to a user command.

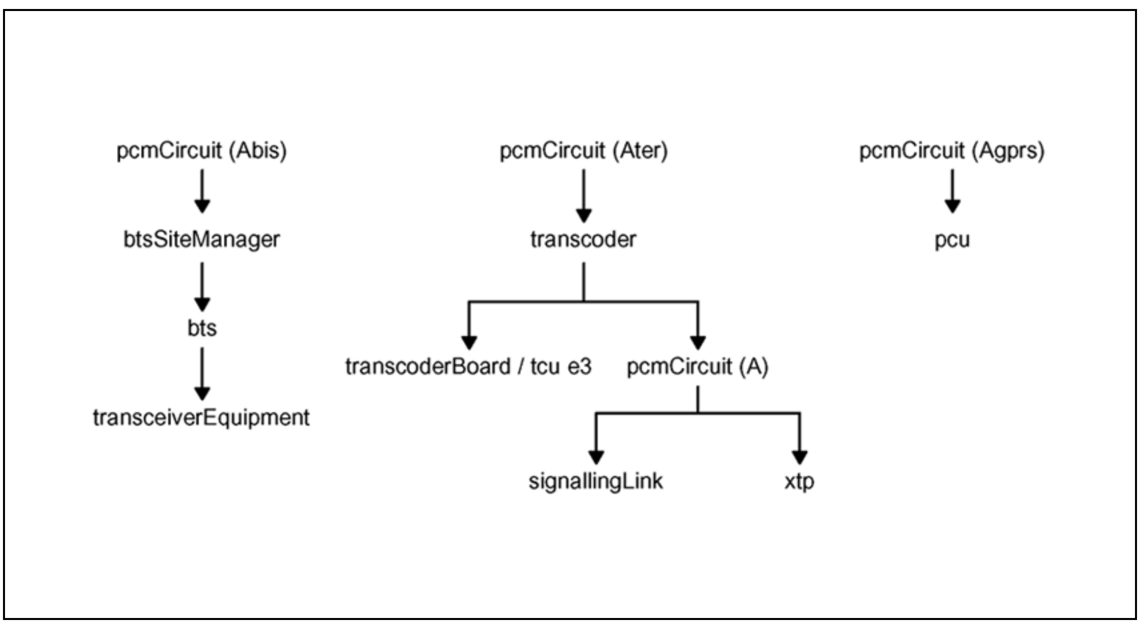
In all cases, the database must be reset before rebuilding.

The database must also be rebuilt after an *On line reset BDA* command is used to reconfigure the network without influencing BSC operations.

1.6.4.6 Object enabling sequence

The following figure shows the logical sequence in which objects are put into service, which changes their operationalState to "enabled".

Figure 15
Object enabling sequence



The objects are taken out of service in the reverse order. Their operationalSta te changes to "disabled".

There are no administrativeState management restrictions, however, operationalState management at BSC level depends on administrativeState management.

For example:

- To make a site operational, the PCM link between the BSC and the site BCF must be in service. The BSC selects one of the operational PCM links on the site. Consequently, at least one PCM must be in service on the site.
- To make a TRX/DRX operational, the PCM link used for transferring TRX/DRX data must be in service. The BSC selects one of the PCM links allocated to the site. Consequently, at least one of the PCMs must be in service and free to be allocated to the TRX/DRX.

1.6.4.7 Order of creating BDE objects

Table 1 "Order of creating objects in the BDE" (page 53) shows an example of the order in which objects are created in the OMC-R operations database (BDE).

The abbreviations in the **Type** column mean the following:

O	Managed object
F	Mandatory functional object
FF	Optional functional object

Table 1
Order of creating objects in the BDE

Order	BDE/OMC-R object	Type	Command
1	bscMdInterface	O	Create
2	bsc	O	Create
3	software-bsc	F	Create
4	bscCounterList (*)	F	Create
5	signallingLinkPoint	O	Create
6	signallingLinkSet	O	Create
7	bsc 2G	O	Build BDA
8	bsc e3	O	Build BDA
9	pcmCircuit (Abis & Ater & Agprs)	O	Create
10	lapdLink	O	Create
11	pcu (**)	FF	Create

(*) There are four mandatory *bscCounterList* objects (one for each type of V13 observations, ODIAG, OFS, OGS, and ORT).

(**) pcu and pcusn objects need to be created in case of BSS supporting GPRS/EDGE feature. They can be created after the whole BSS has been created, but they cannot be created before the first eight objects.

Order	BDE/OMC-R object	Type	Command
12	pcusn (**)	FF	Create
13	transcoder	O	Create
14	tcu	O	Create
15	tcu e3	O	Create
16	transcoderBoard	O	Create
17	software-transcoderBoard	F	Create
18	software-tcu e3	F	Create
19	pcmCircuit (A)	O	Create
20	signallingLink	O	Create
21	xtp	O	Create
22	btsSiteManager	O	Create
23	software-btsSiteManager	F	Create
24	bts	O	Create
25	powerControl	F	Create
26	handOverControl	F	Create
27	frequencyHoppingSystem	FF	Create
28	adjacentCellHandOver	F	Create
29	adjacentCellReselection	F	Create
30	transceiverZone for concentric cells	F	Create
31	transceiverEquipment	O	Create
32	software-transceiverEquipment	F	Create
33	transceiver	O	Create
34	channel	O	Create

(*) There are four mandatory *bscCounterList* objects (one for each type of V13 observations, ODIAG, OFS, OGS, and ORT).

(**) pcu and pcusn objects need to be created in case of BSS supporting GPRS/EDGE feature. They can be created after the whole BSS has been created, but they cannot be created before the first eight objects.

1.6.5 Permanent parameter classes

The permanent parameters [DP] of objects are recorded in the operations database (BDE) of the OMC-R and in the application database (BDA) of the BSC modeled by the related bsc object.

Users must validate parameter changes. The OMC-R performs the appropriate checks before implementing the changes and informs the user of any errors.

The system is not always reconfigured immediately after the parameters are set. The impact of the changes on other objects or BSC operating conditions is determined. For this reason, permanent parameters are organized in classes. The classes are as follows:

- Class 0 parameters
- Class 1 parameters
- Class 2 parameters
- Class 3 parameters

1.6.5.1 Class 0 parameters

The class 0 parameters are as follows:

- The OMC-R manages class 0 parameter changes (no transaction is sent to the BSC). Class 0 parameters can only be set before the BSC application database (BDA) is built (bdaState = "not built").
- The system is effectively reconfigured after the BSC database is built in response to a *Build BDA* command.
- Class 0 is the most restrictive class.

1.6.5.2 Class 1 parameters for BSC 12000HC only

The class 1 parameters are as follows:

- The class 1 parameters of an object created on the OMC-R can only be set when the related bsc object is locked.
- In this mode, the modeled BSC remains operational, but the system only accepts commands that modify the class 1 parameters of the bsc or dependent objects, and the following commands:
  — *On line* and *Off line reset BDA* commands on the bsc object
  — *Kill chain* and *Suicide chain* commands on the bsc 12000HC object
  — *Kill cn/in* and *Suicide cn/in* commands on the bsc e3 object
  — change software version commands (see Section 1.10 "Software management" (page 91))
- The system is effectively reconfigured after the bsc object is unlocked. Both BSC 12000HC processing chains are reset when class 1 parameters are effectively modified.

1.6.5.3 Class 2 parameters

The class 2 parameters are as follows:

- The class 2 parameters of an object created on the OMC-R can only be set when the object is locked and the parent bsc object is unlocked.

- If the object in question does not have an *ad ministrativeState*, the object on the next higher level must be locked.
- The system is effectively reconfigured when the object is unlocked.

1.6.5.4 Class 3 parameters

The class 3 parameters are as follows:

- The class 3 parameters of an object created on the OMC-R can only be modified when the parent bsc object is unlocked.
- The system is immediately reconfigured. There is no impact on system operations.

1.6.6 Parameter validity controls

The system controls the validity of permanent parameters [DP] before implementing the changes.

The parameters listed in the following table match system definitions. They are part of the OMC-R static configuration and are designated by the abbreviation DS (Static Data) in this NTP.

1.6.6.1 BSC/TCU 2G parameter validity controls

Their maximum values are shown in square brackets

Table 2
Static data maximum configuration with BSC/TCU 2G.

Static data	Definition
maxAdjCHOARMPerBts	number of neighbor cells associated with a serving cell for handover and reselection management [32]
maxBscPerNetwork	number of BSC 12000HC managed by an OMC-R; this depends of the type of server (see NTP < 006 >)
maxBtsPerBtsSM	number of cells allocated to a radio site [6]
maxBtsPerNetwork	number of cells managed by an OMC-R V14; this depends of the type of server (see NTP < 006 >)
maxLapdChPerBtsSM	number of LAPD channels allocated to a radio site [6]
maxPcmCPerBtsSM	number of PCMs used by a radio site [6]
maxPcmCTPerTranscd	number of PCMs used by a TCU 2G on the A interface [4]
maxSigLPerSigLS	number of SS7 links connected to a BSC 12000HC [6, 4 or 2 depending on type]

Static data	Definition
maxTeiPerLapdCh	number of TEI addresses allocated to an LAPD channel [15 for SICD 8V boards]
maxTranscdBPerTranscd	number of TCBs equipping a TCU 2G [10 in a GSM 900 or 1800 network ; 8 in a GSM 1900 network]
maxTranscdPerBsc	number of TCU 2G connected to a BSC 12000HC [12, 7 or 3 in a GSM 900 or 1800 network, depending on architecture; 14, 9 or 3 in a GSM 1900 network, depending on architecture]

1.6.6.2 BSC/TCU 3000 parameter validity controls

Their maximum values are shown in square brackets.

Table 3
Static data maximum configuration with BSC/TCU 3000

Static data	Definition
maxAdjCHOARMPerBts	number of neighbor cells associated with a serving cell for handover and reselection management [32]
maxBscPerNetwork	number of BSCs managed by an OMC-R; this depends of the type of server (see NTP < 006 >)
maxBtsPerBtsSM	number of cells allocated to a radio site [6]
maxBtsPerNetwork	number of cells managed by an OMC-R V14; this depends of the type of server (see NTP < 006 >)
maxLapdChPerBtsSM	number of LAPD channels allocated to a radio site [6]
maxPcmCPerBtsSM	number of PCMs used by a radio site [6]
NB_SYS_PCMA_TCU 3000	number of PCMs used by a TCU 3000 on the A interface [67 for PCM E1 end 89 for PCM T1]
SYS_NB_MAX_SIGNALLINGLINK	Maximum number of Signalling links SS7 [16]
NB_SYS_TEI_LAPD	number of TEI on a LAPD channel [10]
NB_SYS_TRM_TCU	number of TRM equipping a TCU 3000 [12]
NB_SYS_TCU BSC 3000	Maximum number of TCU 3000 per BSC 3000 [2]

1.6.7 Hardware configuration

1.6.7.1 BSC 12000HC hardware configuration

The OMC-R manages five types of BSC 12000HC. BSC 12000HC hardware configuration is shown in Table 4 "BSC 12000HC configurations managed on the OMC-R" (page 58)

One should note the following:

- Depending on their architecture, two BSCs of the same type can manage a different number of PCM links.
- The BSC 12000HC is equipped with SICD8V boards that manage eight ports each.
- A control is performed at the OMC-R level to check that the maximum number of TRXs connected to a SICD8V board does not exceed 64.

Table 4
BSC 12000HC configurations managed on the OMC-R

Equipment	BSC 12000HC				
	T1	T2	T3	T4	T5
CCS7	1	2	2	2	3
SICD8V	1	2	3	4	5
RCB	1	2	3	4	5
DDTI	24	24	24	24	24
external PCMs	48	48	48	48	48

Table 5 "BSC 12000HC architecture controls" (page 58) list BSC 12000HC hardware configuration and architecture controls and gives the maximum values allowed.

Table 5
BSC 12000HC architecture controls

Controls	BSC 12000HC				
	T1	T2	T3	T4	T5
radio sites per BSC 12000HC	28	60	92	124	147
LAPD ports per BSC 12000HC	8	16	24	32	40
radio sites per LAPD port	4	4	4	4	4
radio cells per BSC 12000HC	120	120	160	160	160
TDMA frames per BSC 12000HC	100	100	320	320	320
TRX/DRXs per BSC 12000HC	200	200	320	320	320
external PCMs per BSC 12000HC	48	48	48	48	48
Ater PCMs per BSC 12000HC T1 E1	12 14	12 14	12 14	12 14	12 14
A interface PCMs per TCU 2G	4	4	4	4	4

Controls	BSC 12000HC				
	T1	T2	T3	T4	T5
signaling links per BSC 12000HC	2	4	4	4	6
XTPs per BSC 12000HC T1 PCMs E1 PCMs	1440 1288	1440 1288	1440 1288	1440 1288	1440 1288

1.6.7.2 BSC 3000 hardware configuration

The OMC-R manages the BSC 3000. The main processing parts of the BSC 3000 are the Control Node and the Interface Node.

Control Node The Control Node houses the following modules:

- **OMU:** Operation and Maintenance Unit
- **TMU:** Traffic Management Unit
- **MMS:** Mass Memory Storage
- **ATM_SW:** ATM SWitch, also named CC-1 (CAM Controller 1)
- **SIM:** Shelf Interface Module

The maximum configuration for the Control Node is the following:

- 2 OMU modules
- 12 (+2) TMU modules
- 4 MMS modules
- 2 ATM_SW modules
- 2 SIM modules

Interface Node The Interface Node houses the following modules:

- **CEM:** Common Equipment Modules
- **8K-RM:** 8K subrate matrix Resource Module
- **LSA-RC:** Low Speed Access Resource Complex module
- **ATM-RM:** Asynchronous Transfer Mode Resource Management
- **SIM:** Shelf Interface Module

The maximum Configuration for the Interface Node is the following: 6 LSA-RC modules

- 2 ATM-RM modules
- 2 8K-RM modules
- 2 CEM modules

- 2 SIM modules

For more information about the BSC 3000 architecture refer to the NTP < 126 >.

1.6.8 BSC 3000 load balancing - estimatedSiteLoad parameter

The "BSC 3000 load balancing - estimatedSiteLoad parameter" feature (24520), introduced in V15.1, enables the operator to specify the estimated Erlang load of a cell group using the estimatedSiteLoad parameter and provides an improved load distribution function.

1.6.8.1 Erlang load of a cell group

An Erlang is a unit of measure of telecommunications traffic load/intensity. Capacity can also be expressed in Erlangs (since capacity is the capability to handle a given traffic load). Since handling traffic involves consuming resources, there is also a relationship between traffic load (in Erlangs) and resource consumption. For example, a high Erlang value results in a greater consumption of CPU and memory resources than a low Erlang value.

Pre-V15.1, the Erlang load of a cell group was calculated from a MIB table "Erlang_Per_N_TRX_Cell". This table can be modified using the BSC Data Configuration procedure (see the description of this procedure in NTP <034>).

With the feature 24520, the operator can also specify the Erlang load of a cell group using the estimatedSiteLoad parameter which is then used instead of the value in the MIB table. If the estimatedSiteLoad is not specified or is set to 0, the value in the MIB table is still used.

1.6.8.2 Load distribution

The BSC 3000 Load Balancing function distributes the load among the TMUs (Traffic Management Units) that are available.

If the traffic load is modified, the Load Balancing function adjusts this distribution. Examples of events that modify the traffic load include: cell reconfiguration, addition of TRX, addition of a cell/site/cell group, addition of TCU, change of TCU/PCU configuration, etc.

The Load Balancing function also adjusts the load distribution if the offered capacity is modified. Examples of events that modify the offered capacity include: addition of a TMU, failure/recovery of a TMU, and removal of a TMU.

Each time the Load Balancing function adjusts the load distribution, it sends a notification (ANO_LB_RESULT) to the OMC-R.

1.6.8.3 Anomaly detected during load distribution

The BSC 3000 Load Balancing function compares the number of TMUs available with the number of TMUs required to reach the capacity configured by the OMC (in terms of sites, cells, TRXs, TCUs, PCUs, etc.).

If the Load Balancing function concludes that there are not enough TMUs available, it notifies the OMC (alarm ANO_LOADBALANCING) and indicates the number of extra TMUs needed (to reach the required capacity).

The parameters estimatedSiteLoad, associatedTMUPosition, cpueNumber, and cpueOccurence are associated with this feature. See also the descriptions of these parameters in NTP <124>.

1.6.9 Number radio site configuration

1.6.9.1 BSC 12000HC number radio site

The number of radio sites controlled by a BSC 12000HC is calculated as follows:

- When a BSC 12000HC does not concentrate BTS LAPD signaling, the maximum number of sites managed by the BSC 12000HC is less than the number of available SICD ports: one port is reserved for the remote transcoders and each site uses one SICD port.
- When a BSC 12000HC concentrates BTS LAPD signaling, it is equipped with twelve BSCBs. Since each BSCB concentrates the signaling of twelve radio sites on three LAPD links (four sites per link) and each LAPD link uses one SICD port, the following apply:
  - — Twelve BSCBs handle 12x12 = 144 sites.
  - — Twelve BSCBs use 3x12 = 36 SICD ports.

  Since the BSC 12000HC is equipped with forty SICD ports among which one is reserved for TCU signaling, three more can be allotted to three individual sites, which gives a total of 144 + 3 = 147 radio sites.

  If one of the BSCBs is used for redundancy (default configuration), the concentration is performed by eleven BSCBs (that is 132 sites) which use thirty-three SICD ports. Six SICD ports can then be allotted to six individual sites (40 - 33 - 1), which gives a total of 132 + 6 = 138 radio sites.

  For BSC 12000HC types 1, 2, 3, and 4, the number of sites controlled by the BSC 12000HC is limited by the number of SICD ports available; one port is reserved for remote transcoders and any other SICD port can be used for four concentrated sites signaling.

The following table lists the BTS controls and gives the maximum allowed values.

Table 6
BTS controls for BSC 12000HC

Controls	BTS
number of cells per BTS	6
number of TRX/DRXs per cell	16
number of TDMA frames per cell	16
number of TEIs per LAPD terminal	15
number of DRXs on one LAPD*	8
number of LAPD per cell**	1
* : Only S8000 BTSs are concerned by this control.	
** : Only S8000 BTSs equipped with BCF are concerned by this control.	

In a BTS, the following apply:

- The number of TRX/DRXs covered by a radio site is limited to 24, regardless of the BTS version.
- The number of TRX/DRXs covered by a radio cell at least equals the number of TDMA frames allotted to the cell; one TRX/DRX is associated with one TDMA frame. More TRX/DRXs can be added to provide resource redundancy.

Although there are no hardware or software restrictions, limits may be enforced, depending on the traffic load handled by the BSC 12000HC.

The system systematically controls object semantics.

For example:

- Any object directly or indirectly referenced in a command must exist.

  Therefore, if a channel object references a *frequencyHoppingSystem* object, the *frequencyHoppingSystem* object must be created for the bts object controlling the transceiver object for which the channel object is defined.
- Class 1 parameters can only be set when the parent bsc object is locked.
- Class 2 parameters can only be set when the referenced managed object is locked and the parent bsc object is unlocked.
- Class 3 parameters can only be set when the parent bsc object is unlocked.

- A lapdlink object can only be deleted when the parent bsc object is unlocked. A transceiver or channel object can only be deleted when the parent bts object is locked.
- A referenced object cannot be deleted.

The OMC-R also performs functional controls on objects, such as the validity of object declarations in relation to system requirements or other objects. For more information refer to the NTP < 124 >.

1.6.9.2 BSC 3000 number radio site

The number of radio sites controlled by BSC 3000 depends on the number of DS0 LAPD which it can support, for example, the number of modules TMUs (each TMU module supports 62 LAPD channels).

The following table lists the BTS controls and gives the maximum allowed values.

Table 7
BTS controls for BSC 3000

Controls	BTS
number of cells per BTS	6
number of TRX/DRXs per cell	16
number of TDMA frames per cell	16
number of TEIs per LAPD terminal	15
number of DRXs on one LAPD*	8
number of LAPD per cell**	1
* : Only S8000 BTSs are concerned by this control.	
** : Only S8000 BTSs equipped with BCF are concerned by this control.	

In a BTS, the following apply:

- The number of TRX/DRXs covered by a radio site is limited to 24, regardless of the BTS version.
- The number of TRX/DRXs covered by a radio cell at least equals the number of TDMA frames allotted to the cell; one TRX/DRX is associated with one TDMA frame. More TRX/DRXs can be added to provide resource redundancy.

Although there are no hardware or software restrictions, limits may be enforced, depending on the traffic load handled by the BSC 3000.

The system systematically controls object semantics.

For example:

- Any object directly or indirectly referenced in a command must exist.

  Therefore, if a *channel* object references a *frequen cyHoppingSystem* object, the *frequencyHoppingSystem* object must be created for the bts object controlling the transceiver object for which the channel object is defined.
- Class 1 parameters can only be set when the parent bsc object is locked.
- Class 2 parameters can only be set when the referenced managed object is locked and the parent bsc object is unlocked.
- Class 3 parameters can only be set when the parent bsc object is unlocked.
- A lapdlink object can only be deleted when the parent bsc object is unlocked. A transceiver or channel object can only be deleted when the parent bts object is locked.
- A referenced object cannot be deleted.

The OMC-R also performs functional controls on objects, such as the validity of object declarations in relation to system requirements or other objects. For more information refer to the NTP < 124 >.

1.6.10 Basic operations

The system imposes the following conditions on user commands involving radio subsystem operating objects:

- The BSC described by the bsc object on which the object depends is defined in the user's profile BSS zone of interest.
- The command is defined in the user's profile command domain.

A command is a "command+object" combination. Therefore, the *Create bsc* command may be allowed, but the *Create mdScanner* command forbidden.

Basic operations cover four domains: Configuration, Display, Audit, and Actions.

Domain	Basic operations
Configuration	Create Delete Set Set class 1 parameters (managed object) Set administrativeState
Display	Display (DPs and DIs) Display all (managed object DPs, DIs, and DDs) List (created object instances)

Domain	Basic operations
Audit	Audit BDA (bsc object)
Actions	Actions are not one category; they are detailed at the end of the paragraph.

1.6.10.1 Configuration

Create

- Functional objects:
  - A functional object is specific to a managed object.
  - If it is mandatory with one instance, the number of created instances must equal the number of created managed objects.
  - If it is mandatory with numerous instances, the number of instances depends on specific parameter values (see NTP < 124 >).
- Managed objects:
  - Mandatory permanent parameters must be defined, except the *administrativeState* (if any) that is set by the OMC-R.
  - The object is created in locked *administrativeState*, except the bscMdInterface object that is created in unlocked state.
  - The number of objects created in a class depends on the configuration and/or architecture of the bsc parent object, or specific parameter values. For more information, refer to NTP < 124 >.

Delete Users must confirm delete commands before the system performs them.

- Functional objects:
  - A functional object can only be deleted in certain conditions that are determined by its class. For more information refer to NTP < 124 >.
- Managed objects:
  - A managed object can only be deleted in certain conditions that are determined by its class. For more information refer to NTP < 124 > .
  - All the functional objects related to a managed object must be deleted before the managed object is deleted.
  - All the alarms caused by the object are cleared. For more information refer to Section 1.13 " Fault management" (page 177).

Set Set commands apply to all created objects and allow to modify their permanent parameters.

- Class 0, 2, and 3 parameters:
  - These parameters can only be changed in certain conditions that are determined by their class (see above).
  - System reconfiguration conditions are determined by the class of the parameter that is changed (see above).
- Class 1 parameters (BSC 12000HC only):
  - These parameters can only be set when the parent bsc object is locked.
  - The system is effectively reconfigured when the bsc object is unlocked. Both BSC processing chains are automatically reset at that time.
- AdministrativeState parameter:
  - This command only applies to bsc, bscMdInterface, bts, btsSiteManager, pcmCircuit,signallingLink, transceiverEquipment, transcoder, transcoderBoard, and xtp objects.
  - If the object is unlocked, all the functional objects related to it are created.
  - If the object is unlocked, all the alarms caused by the object are cleared. For more information refer to Section 1.13 " Fault management" (page 177).

1.6.10.2 Display

Display

- This command applies to all created objects.
- It displays the permanent and internal object parameters, including their *administrativeState* (if any).
- The BDE is queried.

Display all

- This command applies to all created managed objects with defined dynamic parameters.
- It displays the permanent, internal, and dynamic object parameters, including their operationalState and *availabilityStatus* (if any).
- The BDE is queried and the BSC provides the dynamic data.

List

- This scope & filter type command applies to all managed and functional created objects.
- It displays the list of created objects in a given class: list of BSCs created on the OMC-R, list of BSC sites, list of radio site cells, etc.
- Various filtering criteria can be selected.

1.6.10.3 Audit BDA

- This command applies to bsc objects.
- It compares the permanent parameter values of all the objects that depend on a bsc object (including created functional objects) recorded in the BSC application database (BDA) with the values recorded in the OMC-R agent operations database (BDE).
- The audit also detects the objects dependent on the bsc object that exist in the BDA but not in the BDE, and vice-versa.
- All commands for the BSC are refused during the audit, except for *Display*.
- If the two databases are inconsistent, the command response contains the list of the first ten objects with the parameters on which BDE-BDA differences are detected, and indicates if there are more, in which case, the audit stops.

1.6.10.4 Actions

Actions allow users to perform specific operations on objects. Only specific, radio subsystem configuration actions are described below.

The actions available only for the BSC are as follows:

- bsc objects: *Build BDA 1/ Off line reset BDA / On line reset BDA*.

  Build BDA regenerates the BSC application database (BDA) and automatically resets the active BSC processing chain (BSC access is inhibited during the build operation).

  On line reset BDA is used to configure the network with the BSC working in duplex mode from the memory copy of its BDA stored at the time the command was issued. The network is reconfigured. A *Build BDA* command in automatic mode is used to implement the new data, whereas in case of the use of *Build BDA* in commanded mode, the new data are implemented when the *Activate New Version* command has been executed.

  Off line reset BDA resets the BSC application database (copies the prototype database into the current application database area) and automatically resets the active BSC processing chain. This command can be executed whichever is the BSC working mode, duplex or simplex.

- bsc objects: *Synchronize bsc clock*

  This command broadcasts the OMC-R agent reference date and time to a BSC. It can be launched on several BSCs at a time.

- bscMdInterface objects: *Display circular file state / Close circular file / Open circular file / Clear circular file*

  These commands respectively display the state, close, open, and clear a circular file which contains spontaneous messages from a BSC.

- bts object: *Force HandOvers*

  This command redirects the traffic handled by a serving cell towards its neighbor cells. It can be launched on several cells at a time. It can be used before shutting down a serving cell in order to speed up the soft release process.

- btsSiteManager objects: *Display hardware configuration*

  Display hardware configuration displays the configuration of ardware and is mainly used for system maintenance. It can be launched on several radio sites at a time. The BTS or BTSs that receive the message return the information to the OMC-R.

- btsSiteManager objects: *Display data configuration*

  Display data configuration optionally displays report information related to Edge capability of the BTS and TRX configuration data.

- btsSiteManager objects: *Display hardware information*

  Display hardware information displays detailed information on hardware of a BTS described by a btsSiteManager object (site, cell and TRX related equipment type, number, status...)

- btsSiteManager objects: *Display data information*

  Display data information displays detailed information on configuration data of a BTS described by a btsSiteManager object (SITE data configuration display or SITE EDGE data display).

- btsSiteManager objects: *Use btsSiteManager battery*

  Use btsSiteManager battery forces 1a BTS to use its battery if it is such equipped. The battery must operate correctly.

- channel objects: *Set channel state*

  Set channel state is used to block or unblock a logical channel supported by a radio time slot.

- channel objects: *Display channel state*

  Display channel state displays the states of all the logical channels supported by a radio time slot. It can be launched on several time slots at a time. It is also used to check the results of a block command on a channel object.

- signallingLink objects: *Set inhibit*

  This command is used to inhibit or enable an SS7 signaling link on the A interface.

  Inhibiting an SS7 link stops all the traffic on the link, but the link remains in service (terrestrial traffic circuits remain preempted).

- transceiver objects: *Display channel state*

  This command displays the states of all the logical channels supported by all the radio time slots of a TDMA frame. It can be launched on several TDMA frames at a time.

- transceiverEquipment objects: *Display hardware configuration*

  This command displays the configuration of a TRX/DRX hardware and is mainly used for system maintenance. It can be launched on several TRX/DRXs at a time. The BTS or BTSs that receive the message return the information to the OMC-R.

Actions available only for BSC 12000HC Each action available only for the BSC 12000HC are as follows:

- bsc objects: *Display chain information*

  Display chain information displays the state of BSC 12000HC processing chain boards (chain A or B). It can be launched on several BSC 12000HC at a time. The BSC 12000HC that receive the message return the information to the OMC-R.

- bsc objects: *Kill chain*

  Kill chain resets one (active or standby) or both BSC 12000HC chains. The user must confirm the command. It has the following effect:

  — active chain: The chain is reset and declared as standby; the other chain is activated (switchover). Operations restart automatically but the system is not reconfigured. Class 1 DP parameters are not updated in applications, since the newly active chain is not reset.

  — standby chain: The chain is reset when it can be reached. This command has no impact on operations (BSS operations are not interrupted).

  — active and standby chains: Both chains are reset. The first processing chain that is operational again is declared active. Operations restart automatically and the system is reconfigured. Class 1 DP parameters are updated in the applications, since the newly active chain has been reset.

- bsc objects: *Suicide chain*

  Suicide chain resets a BSC 12000HC processing chain (A or B). The user must confirm the command. It has the following effect:

  — If the chain is active when the BSC 12000HC receives the command, the chain is reset and is declared standby. The other chain is activated (switchover). Operations restart automatically.

  — If the chain is standby when the BSC 12000HC receives the command, it is reset when it can be reached.

1.6.11 Secure operation in reparenting

1.6.11.1 Overview

This feature provides a new Graphical User Interface (GUI) for the Network Reconfiguration Procedure (NRP) tool. In the previous versions, each NRP procedure was described on paper. This tool eliminates the need for paper procedures.

This feature applies to version 15.0 of the BSS system. The NRP integrations in this tool are:

- BSC reparenting
- BTS reparenting
- PCU reparenting

These procedures help the user to operate and reconfigure a BSS without referring to paper procedures. This tool has the following enhancements:

- Reparenting procedures are performed using only mouse clicks, without a UNIX window. The tool executes all the steps in one procedure.
- Typing errors are minimized because the paper procedure is no longer required.
- The tool can handle error cases and fallback in real time. In previous versions, errors were displayed in the log file.
- The tool provides a simple way to configure the network with a window look and feel.

1.6.11.2 Architecture

The tool is based on the client/server architecture. A tool server is installed on each OMC-R server. The tool server uses a socket connection with a specific port number. The tool also uses Sybase client/server connections. The tool client connects to each server to obtain information such as configuration files, etc. or to execute a script on the server. Using this architecture, the tool client can be installed on any UNIX station, even if it is not an OMC-R station. The server/client tools enable communications between the local machine and available OMC-Rs. The tool can handle up to 4 active OMC-Rs, but it does not support a remote workstation.

1.6.11.3 Security

The server is in a listen mode at each OMC-R level via the default communications port. This port is only authorized to handle communications between the client and server with encrypted keys. For that reason, a security tool is implemented on each machine hosting a client and/or server tools.

The security tool interacts with following tools:

- Reparenting tool: gives it encrypted keys for the administration users and remote server tools. This is done only for authorized administration users after their login using the security tool.
- Server tool: gives it its encrypted key and/or the result of the password contained in the encrypted key for validity. All communications with the server tools are dependent on the validity of the encrypted keys sent by the client tools.

All operations performed by the reparenting tool via client/server tools are indexed with encrypted keys. These keys are limited in time. Each command sent to server tool through client tool has a unique key and can not be reused.

The security tool has the following four main roles:

Administrator login security The operator must be logged-in with administrator user privileges to execute the reparenting tool procedures. The reparenting tool connects to the security tool during the login process and the security tool displays a login window where the operator enters the administrator name and password. The security tool checks the validity of user and password and returns an administrator-encrypted key, if the check is ok. An error message is returned, if the security check fails.

Server key security To communicate with server tools, the reparenting tool must have a valid server-encrypted key per server tool. This server-encrypted key is obtained via the security tool from the remote server.

Command send security To communicate with server tools, the commands sent by the client tools must be followed by a valid and unique server-encrypted key (one per command at a given time). The server tool executes this command, if the server-encrypted key is valid. If not, it returns an error code status to the client tool.

Managing security information The security tool is used to:

- Create users and their passwords on the local and remote machine
- Change user name or password on the local and remote machine
- Add users on the local and remote machine
- Delete users from the local and remote machine

1.6.12 Improved build online performance

The build on line improvements, introduced in V15.1, reduce the amount of time required for a BSC start-up. This start-up is required after the MIB is built.

Currently, the build on line is done in two phases:

- Phase 1: A MIB build that is done without interruption of services.
- Phase 2: A complete restart of the BSC that involves an interruption of services.

The improvements reduce the duration of the interruption of services due to the BSC restart. These improvements have no impact on the OMC-R.

The improvements include:

- restarting OMU applications (instead of resetting the OMU) to load new data from the new MIB
- restarting some components earlier in the BSC restart cycle
- reducing the number of messages exchanged during PCM configuration

1.6.13 PCUSN configuration

General Packet Radio Service (GPRS) on the BSS. The PCUSN is a separate node within the BSS which is based on a Nortel Networks Multiservice Switch, Figure 16 "PCUSN in the BSS subsystem" (page 74). It has a dedicated Operation, Administration and Maintenance (OAM) server running on a Sun Blade 150 or a Sun Blade 1500 workstation. The PCU-OAM server is connected to the OMC-R through the OMC-R LAN.

The dedicated PCU-OAM server will not be needed when the OMC-R server is upgraded to a Sun Fire™ V880 because the PCU-OAM server functions will be transferred to it.

From V15.1, the Sun Fire™ V890 server is used as the successor of the Sun Fire™ V880, and the Sun Blade 1500 workstation is used as the successor of the Sun Blade 150 workstation.

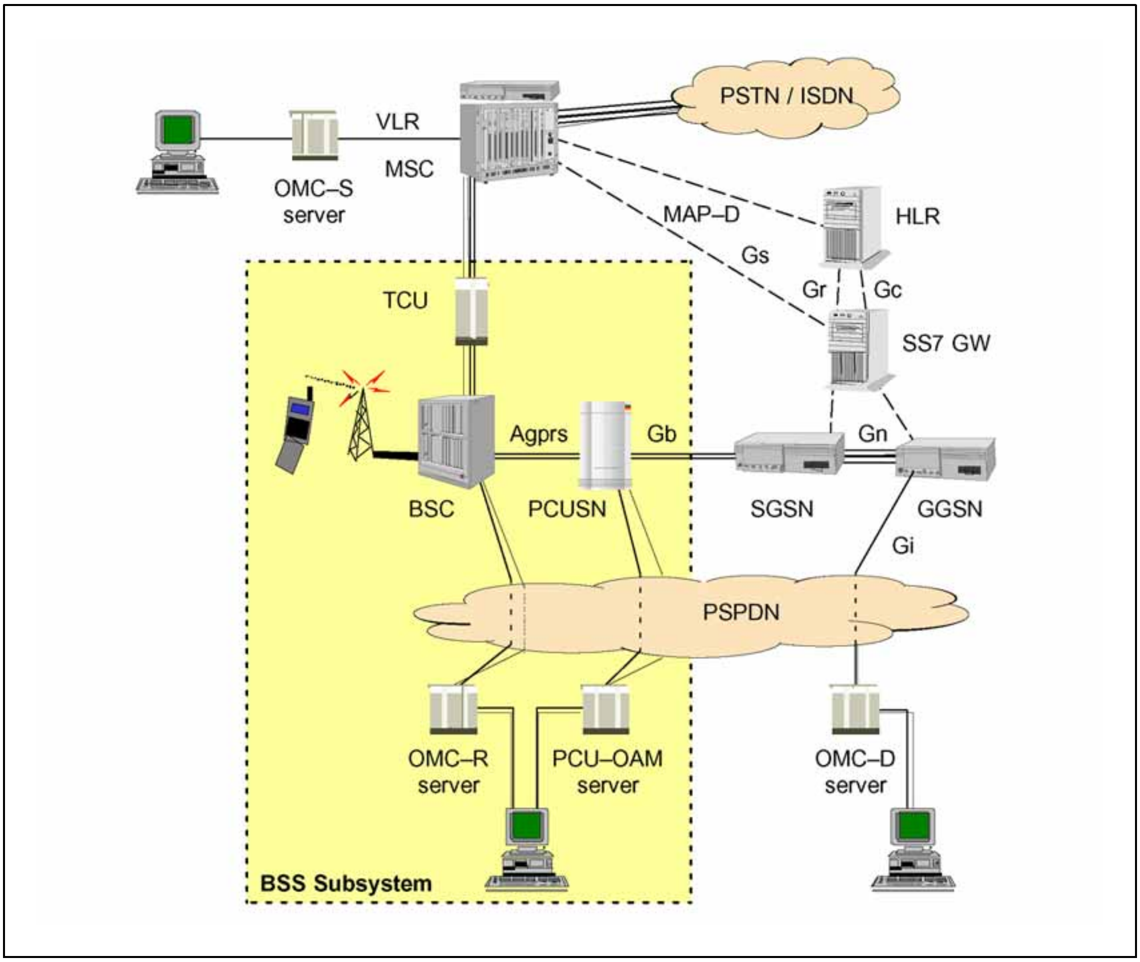
The PCUSN is managed through specific software integrated in the server. The following two software packages are utilized on the PCU-OAM server:

- MDM (Multiservice Data Management) for the configuration and the fault management functions
- MDP (Management Data Provider) for the performance management functions

The following day-to-day PCUSN operations are also integrated in the OMC-R for easy access:

- The GPRS access fault management is fully integrated within the GSM access faultmanagement. The fault and alarmmessages are forwarded in real time to the OMC-R database to be displayed on a Man--Machine Interface (MMI) workstation.
- Configuration management is accomplished with MDM hosted in the OMC-R server. It allows the operator to configure the PCUSN using an emulation window on each workstation.
- Other specific MDM applications are available on each MMI workstation to complete the integration of the functions for the GPRS PCUSN into the OMC-R server.

Figure 16
PCUSN in the BSS subsystem



The feature "WPS Introduction for PCUSN Configuration" (29818), introduced in V16.0, replaces the configuration part of the PCU/CIQ and the PCUSN Provisioning plug-in chain.

The main features are:

- Off-line PCUSN provisioning
- On-line PCUSN creation by doing the provisioning preparation off-line
- HW configuration using a wizard and equipment model library

For off-line configuration, the module runs on the CT2000 PC station. It allows the user to create and modify the PCUSN configuration. This module is called "WPS for PUCSN" and it replaces the "PCU_EngConf" tool and the "PCU/CIQ" tool.

For on-line configuration, the module runs on the OMC-R workstation connected to the PCU-OAM. This module is included on the current plug-in “PCUSN provisioning”. It replaces the DRF to CAS converter.

The PCUSN Provisioning process contains 3 main steps:

1. Creation/Modification of the PCUSN configuration off-line
2. Generation of commands (CAS files) for PCUSN creation or modification
3. Applying modifications on the PCUSN

Step 1 is managed by WPS. Steps 2 and 3 are managed by the PCUSN provisioning plug-in

The reverse process contains 2 main steps:

1. Retrieve the current PCUSN configuration
2. Load the configuration on the off-line tool

Step 1 is managed by the PCUSN provisioning plug-in evolution. Step 2 is managed by WPS.

1.7 OMN access management

1.7.1 OMN access management for BSC 12000HC

1.7.1.1 Overview

The Operations and Maintenance Network (OMN) is a packet switched data network used for communications between the OMC-R and the BSS in the Public Land Mobile Network (PLMN). The OMN is a layered communication network complying with the first four layers of the OSI reference model.

The OMC-R communicates with the BSC 12000HC across the OMN network via the first four layers of the OSI reference model:

- Level 1 (physical layer) supports synchronous serial links (V35interface).
- Level 2 (LAP-B data layer) and Level 3 (packet switching network layer) comply with CCITT X.25 recommendations.
- Level 4 (transport layer) complies with CCITT X.214 and X.224 standards.

The OMC-R has two OMN network access points. Both access points are used to handle communications with the BSC 12000HC on a load-sharing mode. If one access is inhibited, the other handles the other’s load until the other access is restored.

The following associations with a BSS can be opened on the OMN interface:

- INIT association (initialization)
- FAULT association (fault message transfer)

- MARK association (marking message transfer)
- PERF association (observation message transfer)
- TRACE association (trace message transfer)
- TRANSAC association (TGEs)
- UPDATE association (on-line build operation)

The INIT and FAULT associations are opened when the BSS/OMC-R link is established. The INIT association is opened first.

The MARK, PERF, TRACE, and TRANSAC associations are opened when the BSC 12000HC application database (BDA) is being built.

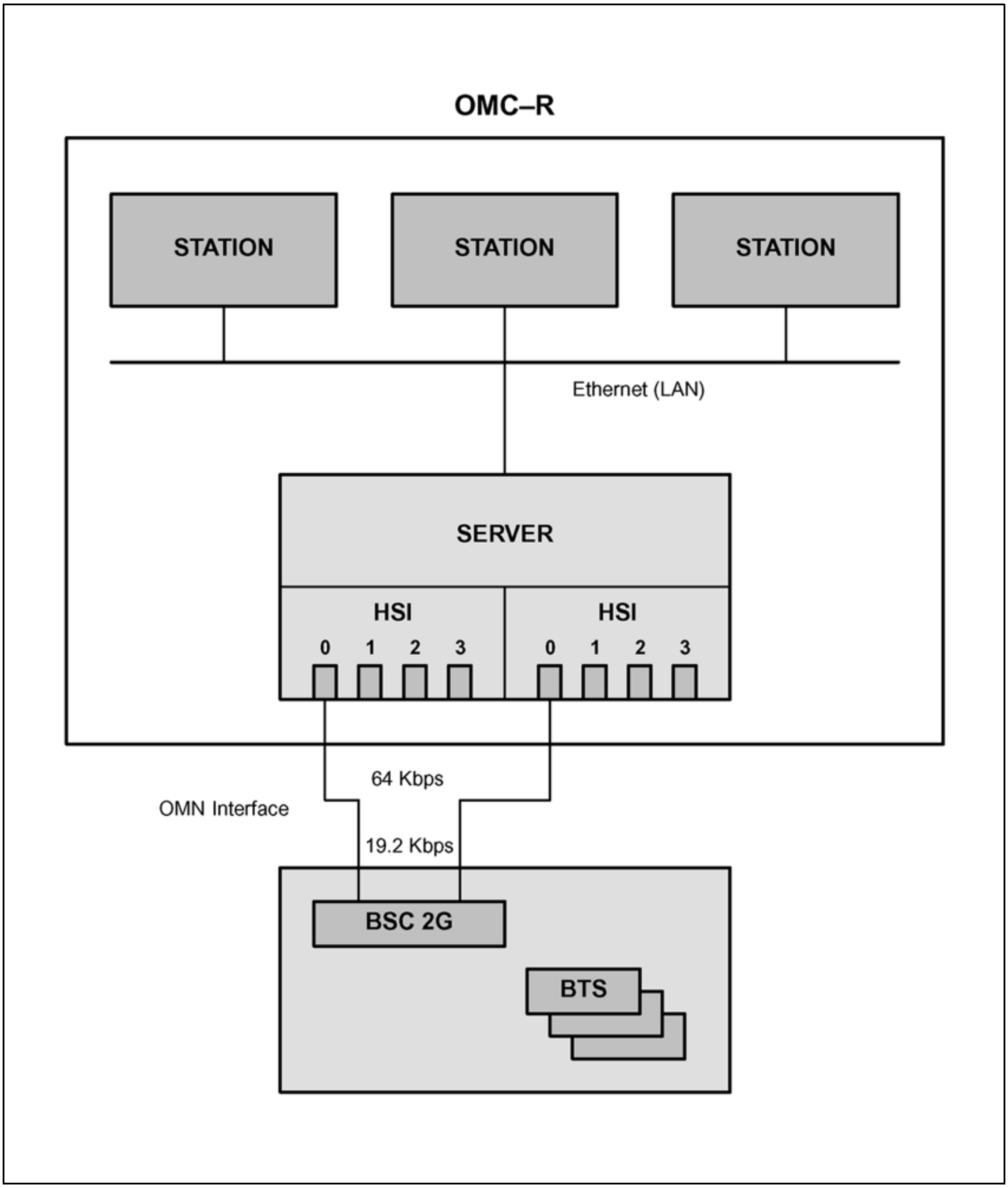
1.7.1.2 OMN access equipment

OMC-R equipment The standard OMC-R configuration includes one or two server(s) working and three local workstations.

Figure 1-16 (OMC-R communication equipment) shows the High Speed Interface (HSI) board equipping the servers that provides the OMC-R with OMN access points. Each board controls two 64 kbit/s X.25 links.

For more details on the OMC-R equipment, refer to NTP < 006 >.

Figure 17
OMC-R communication equipment for BSC 12000HC



1.7.1.3 BSS equipment

The BSC 12000HC provides the BSS with OMN access points. The BSC two access points are defined by X.25 addresses. One is the preferred address, the other is used as a backup address. Each port controls one 19.2 kbit/s X.25 link.

These ports are reserved for BSS/OMC-R links.

1.7.1.4 Terminals

In addition to local workstations, the system contains the following:

- remote workstations, identical to the local workstations, and connected to the OMC-R through routers across the X.25 network
- X terminals, selected by the operator, and connected across a local area network through local or remote workstations
- remote access terminals, connected to the OMC-R by telephone link and modem via a terminal server. The remote access terminals (RACEs) are PCs running under Windows.

1.7.1.5 Link management

Port selection principles Each BSS has one link with the OMC-R.

A BSS/OMC-R link uses an X.25 virtual circuit and has two transport connections, one for transaction protocol messages (TGE, RGE, and event reports), the other for file transfers (FTAM).

The network operator selects the access port for OMC-R communications when the link is created. The OMN Access Management function can automatically select the port to use on the basis of equal loads.

To select the correct access port, the X.25 network must not set up the call transfer; therefore, this service should not be subscribed in the network subscriptions.

Identifying a link Each BSS/OMC-R link in the OMC-R operations database (BDE) is described by a bscMdInterface object. Specific commands on this object allow users to manage the BSC circular files that contain spontaneous messages transmitted by the BSC.

Creating a link The OMC-R always initiates BSS/OMC-R link setup. The OMC-R is the calling party (outgoing connections) and the BSS are the called parties (incoming connections).

Since OMC-R and BSC each have two OMN access points, the access used to set up a link are selected as follows:

- The preferred BSC 12000HC X.25 address is used. If the connection fails, the backup address is used.
- The access port is selected by the user or the OMN Access Management function (see above).

Link states A BSS/OMC-R link is managed as an equipment. The bscMdInterface object that describes the link is characterized by three ISO states: administrativeState, operationalState, and availabilityStatus.

Setting up a link The OMC-R agent attempts to set up a BSS/OMC-R link when the bsc object is created and if the provided bscMdInterface object describing the link is unlocked. Users may request link setup if the link has been taken out of service (bscMdInterface object locked).

The operation consists of setting up a first transport connection from the list of parameters selected in descending order of preference.

If link setup procedure fails, attempts to reconnect the link are made at intervals defined in static configuration data.

OMC-R port selection by the user

1st choice	destination = preferred BSC 12000HC access
2nd choice	destination = backup BSC 12000HC access

Automatic OMC-R port selection

1st choice	destination = preferred BSC 12000HC access OMC-R port = least loaded port
2nd choice	destination = backup BSC 12000HC access OMC-R port = least loaded port
3rd choice	destination = preferred BSC 12000HC access OMC-R port = most loaded port
4th choice	destination = backup BSC 12000HC access OMC-R port = most loaded port

Releasing a link A BSS/OMC-R link is released by locking the bscInterface object that describes the link to disconnect the link between the OMC-R and the BSC 12000HC. The link remains created but the BSC 12000HC is out of reach and cannot communicate with the OMC-R.

Deleting a link User requests to delete a BSS/OMC-R link must be confirmed and are accepted if the bsc object has been deleted. It is then impossible to communicate with the BSS.

Fault handling Since the OMC-R always initiates BSS/OMC-R link setup, any disconnect indication for which the user is not responsible is considered abnormal.

The OMN Access Management function sends a hardware fault message to the Fault Management function that generates a notification for OMC-R users.

Periodic attempts are made to set up the link. When the OMC-R starts up, the value of the interval between two attempts is set with a minimum value defined in static configuration data. It is reset when the connect attempt is successful. It is multiplied by two after each unsuccessful attempt until it reaches a maximum value defined in static configuration data. When the maximum value is reached, the attempts are stopped and the link is declared defective.

1.7.1.6 Access management

Access port configuration The system command to start up the X.25 layers assigns a logical number (0, 1, 2, or 3) to each physical X.25 access port and selects the number of bits/s used: 64 kbits/s on ports 0 and 1 (OMN access) and 9.6 kbits/s on other ports (reserved).

X.25 port configuration parameters are derived from network subscription data.

Transport layer configuration The values of transport layer operating parameters are stored in OMC-R system files. They must be compatible with the connected BSS transport layer definitions.

1.7.1.7 Management mechanisms

Link configuration at start-up BSS/OMC-R links are configured from the information recorded in the OMC-R operations database (BDE).

1.7.1.8 Restoring links when servers switch over

The server switchover mechanism is used when the OMC-R has two servers operating in duplex mode (standard configuration). It does not apply in single-server configurations with redundancy.

The standby server is declared active when the system switches over.

Since the operations database managed by the standby server is an exact copy of the other server database, the link restoration mechanism uses the information in the ex-standby server database to automatically restore BSS/OMC-R links.

The normal start-up procedure is used.

Reconfiguring links at shutdown When the OMC-R shuts down, the OMN Access Management function automatically releases all the BSS/OMC-R links without changing their *administrativeState*.

When the OMC-R starts up again, the link configuration is restored as it was before shutdown.

Choosing the OMC-R channel The network operator can select to use an A interface PCM time slot to handle the BSS/OMC-R link.

This choice is made when the BSC 12000HC is commissioned. In that case, a DPN100 equipment or a BayStack ASN is used to set the X.25 connection between the BSC 12000HC and the OMC-R.

1.7.2 BSC 3000 OMN access management

1.7.2.1 Overview

The Operations and Maintenance Network (OMN) is a packet switched data network used for communications between the OMC-R and the BSS in the Public Land Mobile Network (PLMN). The OMN is a layered communication network complying with the layers of the OSI reference model.

The BSC 3000 cabinet and the OMC-R communicate through an OSI protocol stack which covers the following needs:

- physical connection capability

  LAN/RFC1006 (TCP/IP): two Ethernet links at up to ***100 Mbps***.

- association management capability

  The associations manager is interfaced upon the Transport layer API.

- the FTAM (File transfer Access Management)

  The FTAM contains the following characteristics:

  — only the responder capability is needed

  — restart and recovery capabilities are used

  — content list types needed: NBS9, FTAM-1 and FTAM-3

The OSI protocol stack is compliant with the following recommendations:

- General

  — ISO 7498/ITU-T X.200

  Basic Reference model of Open Systems Interconnection

  — ITU-T Q.811

  Lower layer Protocol Profiles for the Q3 Interface

  — ITU-T Q.812

  Upper Layer Protocol Profiles for the Q3 Interface

- Application Layer

— ISO 8571

File Transfer, Access and Management Protocol

— ISO 8649/ITU-T X.217

Association Control Service Element Service

— ISO 8649/ITU-T X.227

Association Control Service Element Protocol

- Presentation Layer

— ISO 8822/ITU-T X.216

Connection-Oriented Presentation Definition

— ISO 8823/ITU-T X.226

Connection-Oriented Presentation Protocol

— ISO 8825/ITU-T X.209

ASN 1, Basic Service Element Protocol

- Session Layer

— ISO 8326/ITU-T X.215

Connection Oriented Session Service Definition

— ISO 8327/ITU-T X.225

Connection Oriented Session Protocol

- Transport Layer

— ISO 8072/ITU-T X.214

Connection Oriented Transport Service

— ISO 8073/ITU-T X.224

Connection Oriented Transport Protocol Class 4,2,0

— RFC 1006

OSI Transport Services on top of TCP

- Network Layer

— ISO 8208/ITU-T X.25

Packet Level Protocol for DTE

— ISO 8348/ITU-T X.213

Network Service Definition

- Datalink & Physical Layer

  Essentially an Ethernet link:

  LAN/RFC1006 (TCP/IP): two Ethernet links at up to ***100 Mbps***.

The OMC-R has two OMN network access points. Both access points are used to handle communications with the BSC 3000 on a load-sharing mode. If one access is inhibited, the other handles the other's load until the other access is restored.

The following associations with a BSS can be opened on the OMN interface:

- INIT association (initialization)
- FAULT association (fault message transfer)
- MARK association (marking message transfer)
- PERF association (observation message transfer)
- TRACE association (trace message transfer)
- TRANSAC association (TGEs)
- UPDATE association (on-line build operation)

The INIT and FAULT associations are opened when the BSS/OMC-R link is established. The INIT association is opened first.

The MARK, PERF, TRACE, and TRANSAC associations are opened when the BSC 3000 application database (BDA) is being built.

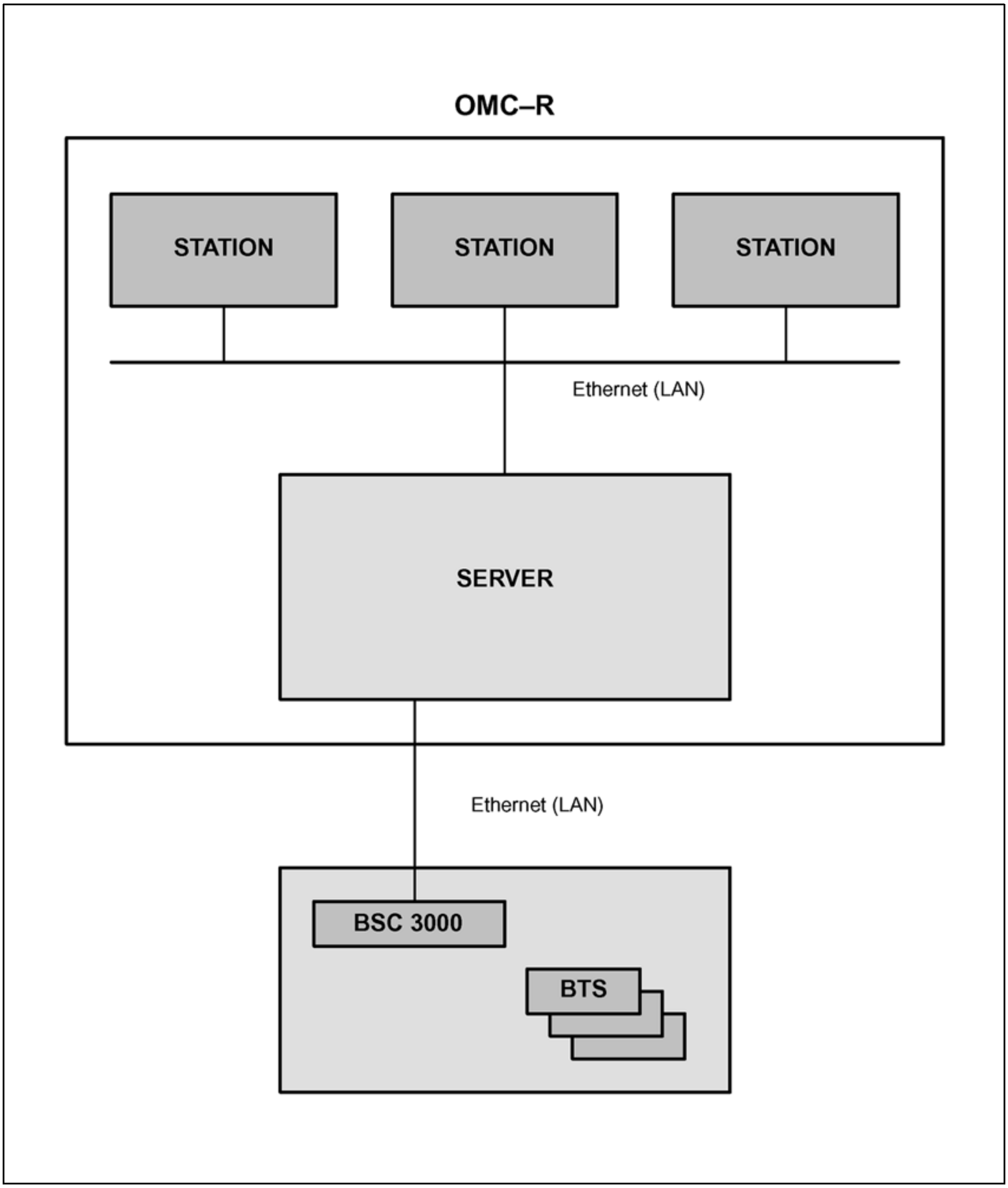
1.7.2.2 OMN access equipment

The standard OMC-R configuration includes one or two working server(s) and three local workstations.

Figure 18 "OMC-R communication equipment for BSC 3000" (page 84) shows the OMC-R equipment connected to an Ethernet Local Area Network (LAN) and the OMN connection between the OMC-R server and a Base Station Controller (BSC 3000). The OMN LAN connection between the OMC-R server and the BSC 3000 uses two Ethernet links, which have a combined capacity up to 100 Mbps.

For more details on the OMC-R equipment, refer to NTP < 006 >

Figure 18
OMC-R communication equipment for BSC 3000



1.7.2.3 BSS equipment

The BSC 3000 provides the BSS with OMN access points. The two access points of the BSC 3000 are defined by Ethernet addresses. One is the preferred address, the other is used as a backup address.

1.7.2.4 Terminals

In addition to local workstations, the system contains the following:

- remote workstations, identical to the local workstations, and connected to the OMC-R.
- X terminals, selected by the operator, and connected across a local area network through local or remote workstations
- remote access terminals, connected to the OMC-R by telephone link and modem via a terminal server. The remote access terminals (RACEs) are PCs running under Windows.

1.7.2.5 Link management

Port selection principles Each BSS has one link with the OMC-R.

A BSS/OMC-R link uses an Ethernet Network.

The network operator selects the access port for OMC-R communications when the link is created. The OMN Access Management function can automatically select the port to use on the basis of equal loads.

Identifying a link Each BSS/OMC-R link in the OMC-R operations database (BDE) is described by a bscMdInterface object. Specific commands on this object allow users to manage the BSC 3000 circular files that contain spontaneous messages transmitted by the BSC 3000.

Creating a link The OMC-R always initiates BSS/OMC-R link setup. The OMC-R is the calling party (outgoing connections) and the BSS are the called parties (incoming connections).

Since OMC-R and BSC 3000 each have two OMN access points, the access used to set up a link are selected as follows:

- The preferred BSC 3000 Ethernet address is used. If the connection fails, the backup address is used.
- The access port is selected by the user or the OMN Access Management function (see above).

Link states A BSS/OMC-R link is managed as an equipment. The bscMdInterface object that describes the link is characterized by three ISO states: administrativeState, operationalState, and availabilityStatus.

Setting up a link The OMC-R agent attempts to set up a BSS/OMC-R link when the bsc e3 object is created and if the provided bscMdInterface object describing the link is unlocked. Users may request link setup if the link has been taken out of service (bscMdInterface object locked).

The operation consists of setting up a first transport connection from the list of parameters selected in descending order of preference.

If link setup procedure fails, attempts to reconnect the link are made at intervals defined in static configuration data.

OMC-R port selection by the user

1st choice	destination = preferred BSC 3000 access
2nd choice	destination = backup BSC 3000 access

Automatic OMC-R port selection

1st choice	destination = preferred BSC 3000 access OMC-R port = least loaded port
2nd choice	destination = backup BSC 3000 access OMC-R port = least loaded port
3rd choice	destination = preferred BSC 3000 access OMC-R port = most loaded port
4th choice	destination = backup BSC 3000 access OMC-R port = most loaded port

Releasing a link A BSS/OMC-R link is released by locking the bscInterface object that describes the link to disconnect the link between the OMC-R and the BSC 3000. The link remains created but the BSC 3000 is out of reach and cannot communicate with the OMC-R.

Deleting a link User requests to delete a BSS/OMC-R link must be confirmed and are accepted if the bsc object has been deleted. It is then impossible to communicate with the BSS.

Fault handling Since the OMC-R always initiates BSS/OMC-R link setup, any disconnect indication for which the user is not responsible is considered abnormal.

The OMN Access Management function sends a hardware fault message to the Fault Management function that generates a notification for OMC-R users.

Periodic attempts are made to set up the link. When the OMC-R starts up, the value of the interval between two attempts is set with a minimum value defined in static configuration data. It is reset when the connect attempt is successful. It is multiplied by two after each unsuccessful attempt until it reaches a maximum value defined in static configuration data. When the maximum value is reached, the attempts are stopped and the link is declared defective.

1.7.2.6 Transport layer configuration

The values of transport layer operating parameters are stored in OMC-R system files. They must be compatible with the connected BSS transport layer definitions.

1.7.2.7 Management mechanisms

Link configuration at start-up BSS/OMC-R links are configured from the information recorded in the OMC-R operations database (BDE).

1.7.2.8 Restoring links when servers switch over

The server switchover mechanism is used when the OMC-R has two servers operating in duplex mode (standard configuration). It does not apply in single-server configurations with redundancy.

The standby server is declared active when the system switches over.

Since the operations database managed by the standby server is an exact copy of the other server database, the link restoration mechanism uses the information in the ex-standby server database to automatically restore BSS/OMC-R links.

The normal start-up procedure is used.

Reconfiguring links at shutdown When the OMC-R shuts down, the OMN Access Management function automatically releases all the BSS/OMC-R links without changing their *administrativeState*.

When the OMC-R starts up again, the link configuration is restored as it was before shutdown.

Choosing the OMC-R Channel There are two Ethernet ports which may be ‘called’ by the OMC-R, each with a different IP address. Both are accessible for local maintenance with a local TML, but only the active one will ′answer′ to the OMC-R ′call′.

The operator can choose to switch ports according to the active OMU.

If the active Ethernet link fails, the OMC-R tries to connect to the second IP address. Because the second IP address corresponds to the passive OMU, no connection will be established.

1.8 OMC-R network configuration

Network configuration includes the OMC-R server and station and every device that is used to connect the OMC-R components either through a LAN or a WAN.

An OMC-R server has two types of network connection:

- TCP/IP over Ethernet
- X25 over serial link

1.8.1 TCP/IP over Ethernet

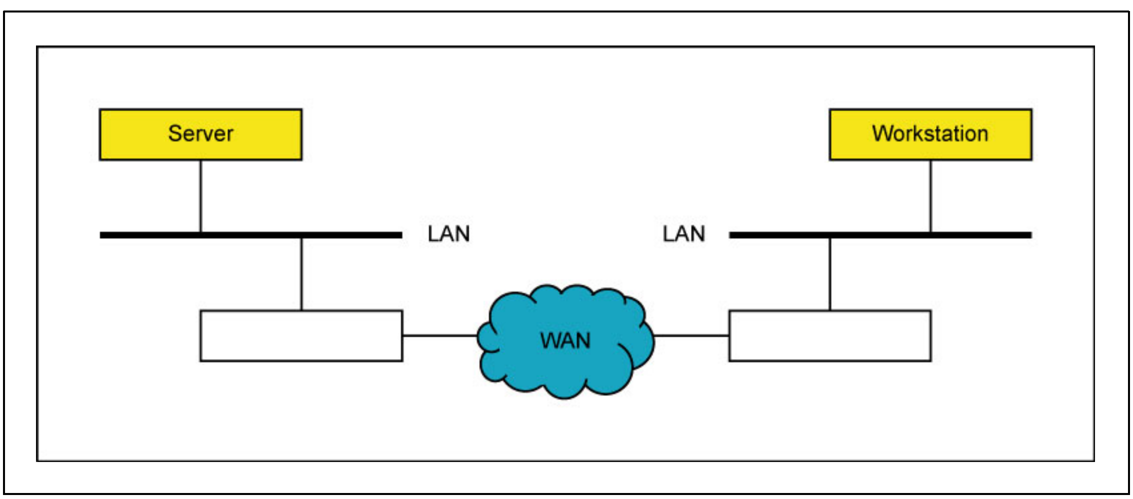
TCP/IP over Ethernet can be used to connect the OMC-R server to:

- Clients: Workstations, SDO, PCUOAM
- Q3 External Manager
- Network elements: BSC 3000, PCUSN

The recommended Ethernet bandwidth is 1000baseT/100baseT Full Duplex per machine. The Sun Fire V890 can support a Gigabit LAN.

A LAN with one or more IP subnets is usually used. However, when equipment is located far from the OMC-R server, a WAN is required between the two LANs (as shown in Figure 19 "OMC-R WAN" (page 88)).

Figure 19
OMC-R WAN



1.8.2 X25 over a serial link

This connection is used to connect the OMC-R server to:

- Q3 External Manager
- Network element: BSC 12000HC

with a bandwidth up to 2048 kbps.

1.9 AMR Overview

The feature AMR [SV713 - *AMR full rate (FR); SV885 AMR Half rate (HR)]* was introduced in V14. AMR (Adaptive Multi-Rate) enables the BSS to introduce sophisticated traffic management features which deal with call quality management and capacity improvements.

AMR introduction induces creations or modifications of following algorithms in the BSS:

- AMR management: AMR vocoders, dedicated VAD (Voice Active Detection)/DTX, link adaptation mechanisms, RATSCCH (Robust ARM Traffic Synchronized Control Channel) channel and TRAU (Transcoding and Rate Adaptor Unit) frames.
- To guarantee good voice quality, the choice between a half rate and a full rate channel are usually determined by a threshold based on radio criteria. AMR half rate channels are now allocated only during heavy traffic periods. By selecting more aggressive radio thresholds, you can get more radio capacity for the same number of TRX.
- L1m (Layer one Management) mechanisms: adaptation of current mechanisms (power control and handover to the intrinsic quality of AMR channel.
- TMG (Traffic ManaGement) mechanisms: allocation and management of AMR channels and especially half rate channel.

Up to V14, L1m algorithms are common for all types of dedicated channels, but due to performances of AMR channels:

- an FR AMR channel, especially with low codec mode, is more resistant than the normal FR channel,
- an HR AMR channel is more sensitive to interference than the normal FR channel.
- some new mechanisms dedicated for AMR channels have been designed.

These mechanisms are mainly based on "requested codec mode" in uplink and downlink paths, which is the best representation of the quality in this case. For this reason, RxQual criterion is not used in L1m algorithm, dealing with AMR channel.

In V14, only the L1m V2 introduced in V12 is available for DCU4 and DRX, In V14, only the L1m V1 is available for DCU2. But, to allow a smooth AMR introduction, this new AMR L1m can be deactivated, thanks a dedicated parameter.

For more information, refer to NTP <126>.

1.9.1 BSS capacity

1.9.1.1 Abis PCM

AMR half Rate allows twice the number of calls that could be carried on a Abis PCM.

1.9.1.2 BSC 3000 capacity

The introduction of AMR on BSC 3000 introduces:

- the handover between half rate and full rate TCH, in order to adapt the radio link to radio conditions
- more complex algorithm

1.9.1.3 TCU 3000 capacity

AMR introduce more complexity on TCU 3000, but no capacity reduction compared with EFR (enhancement full rate) or FR (Full rate) calls is expected.

For more information refer to NTP <126>.

1.9.2 Effect of satellite links on AMR services link adaptation mechanism

The Satellite link on BSS Abis (E1) feature (26834), introduced in V15.1, allows the implementation of satellite links instead of terrestrial links on the Abis interface. Feature 26834 is an optional feature.

For AMR services, a link adaptation mechanism is used to switch from one codec to another one. The efficiency of this mechanism depends on its reactivity (around 160 milliseconds for the downlink path). The use of satellite links increases this delay (by around 550 milliseconds). The link adaptation tables must be tuned accordingly.

1.9.3 AMR based on traffic

In order to guarantee good voice quality, the choice between a half rate and a full rate channel are usually determined by a threshold based on radio criteria. AMR half rate channels are now allocated only during heavy traffic periods.

Thanks to this strategy, you can select more aggressive radio thresholds and then get more radio capacity for the same number of TRX.

1.9.4 FACCH repetition

With the feature 30296 (FACCH repetition), introduced in V16.0, the BTS can re-transmit the FACCH (Fast Associated Control CHannel) frames in the downlink without waiting for the acknowledgement from the mobile. The FACCH is a dedicated signaling channel (in the Um interface).

The BTS uses this repeated downlink FACCH functionality when FR low rate codecs are used and when the first transmission fails.

The purpose of the feature is to secure the handover procedure in poor radio conditions (with AMR FR). The implementation is consistent with the 3GPP approved contribution GP-050905.

Enhanced mobiles have the possibility to combine both repeated frames. Legacy mobiles can also benefit since the decoding probability is improved and this results in a faster handover. The expected benefit for mobiles using soft combining is about 4 dB gain and about 2 dB gain for legacy mobiles.

The feature applies to the BTS 18000, the e-cell, and the BTS S8000 and S12000 equipped with e-DRX or DRX-ND3. The feature does not apply to other BTS hardware.

The parameter enableRepeatedFacchFr (bts object) is used to enable/disable the feature. For a description, see NTP < 124 >.

Repeated FACCH frames are not considered by the Call Drop Analysis feature.

REJects (for each repeated I-frame, the mobile may receive an I-frame with an unexpected sequence number and so send a REJect frame to the BTS) are captured in the LAPDm history.

The feature leads to better call retaining in badly covered areas or highly interfered areas. Acceptable voice quality is maintained due to the robust AMR/FR codec. Since voice quality may be degraded slightly during the handover procedures (because of repeated frame stealing), the preventive retransmission scheme should be triggered only in bad radio conditions.

1.10 Software management

1.10.1 Definitions

BSS entity For the radio subsystem entity driven by software = BSC 12000HC; BCF (BTS switching and control unit), TRX/DRX (radio BTS transceivers), and TCB (TCU transcoding boards).

For the radio subsystem entity driven by software = BSC 3000, BCF (BTS switching and control unit), TRX/DRX (radio BTS transceivers), and TCU 3000.

BSS object Object of class bsc (BSC 12000HC or BSC e3), btsSiteManager (radio site), transceiverEquipment (TRX/DRX), transcoderBoard (TCB) or tcu e3 used in the OMC-R operations database.

Software type Specific BSS entity software.

EFT Set of transferable files containing a given type of software that does not depend on the equipment hardware. EFT files are an indivisible entity.

From V12 onwards, EFT files can be delivered compressed. A specific header is present at the beginning of a compressed EFT file. In the absence of this header, the file is considered non compressed.

Both compressed or non compressed files can be downloaded from the same EFT to a BSC 12000HC. The decompression of a file is started only when the file has been entirely transferred.

Since in parallel a compressed file can be downloaded while another is being uncompressed, file transfer on X.25 and downloading durations are reduced.

delivery In the case of the BSC/TCU 3000, **delivery** is defined as being a collection of EFTs, each one of them containing a unit of file with the extension **".LIV". Delivery** is a physical object.

executableSoftware The **executableSoftware** is the name of the delivery.

Both compressed or non compressed files can be downloaded from the same executableSoftware to a BSC 3000. The decompression of a file is started only when the file has been entirely transferred.

Since in parallel a compressed file can be downloaded while another is being uncompressed, file transfer on Ethernet and downloading durations are reduced.

DLU (Data Load Unit) BTS variable configuration file associated with a BCF-type EFT that allows to configure the software according to the equipment hardware.

STF (File Transfer Service) File transfer service used to copy EFTs onto the OMC-R server disks and download EFTs onto a BSC disk.

1.10.2 BSC 12000HC software management

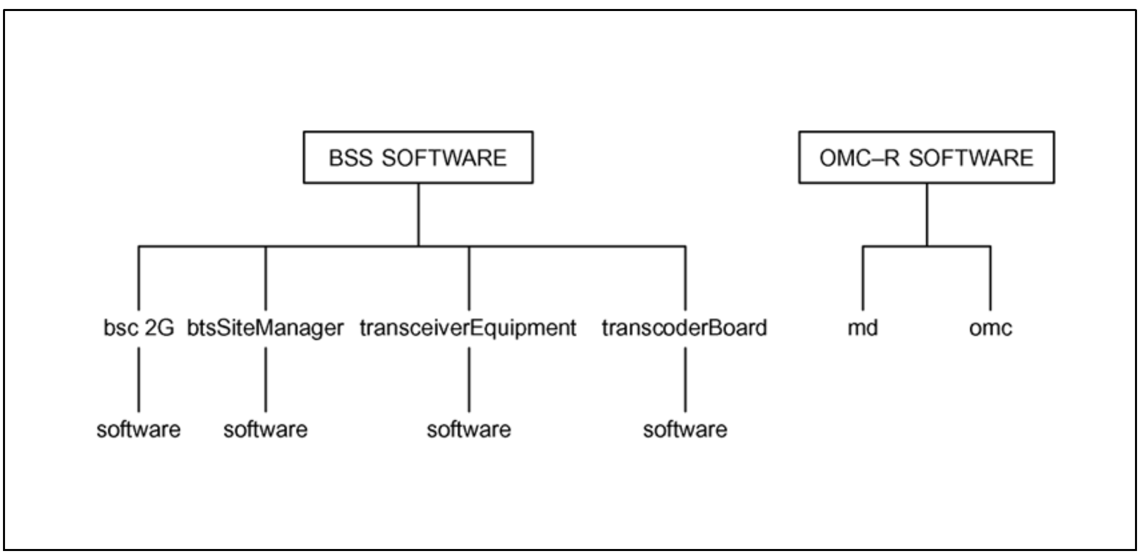
1.10.2.1 Principles

The BSC 12000HC software management function is used to manage BSS software applications and consult OMC-R software applications. It is controlled by the OMC-R Configuration Management function and distributed on two levels:

- OMC-R functions are available to users via the omc and md objects that describe the OMC-R manager and agent on the Man-Machine interface to create and manage EFTs on disks, and consult OMC-R manager and agent software application markers.
- OMC-R manages the BSC 12000HC functions, which are available for the users via software objects. These functions are used to download the EFTs containing new BSS software versions on the BDA (BSC 12000HC disk), start up the software in the BSS entities concerned and consult BSS software application markers.

The following figure describes user software management on the Man-Machine interface.

Figure 20
Software management (specific BSC/TCU 2G) on the man-machine interface



1.10.2.2 Software object

All the managed objects that describe the BSS entities driven by software (BSS objects) reference a software object that the Configuration Management function manages in the OMC-R operations database in response to user commands.

Each object is identified by the BSS object instance that references it and is characterized by the following parameters:

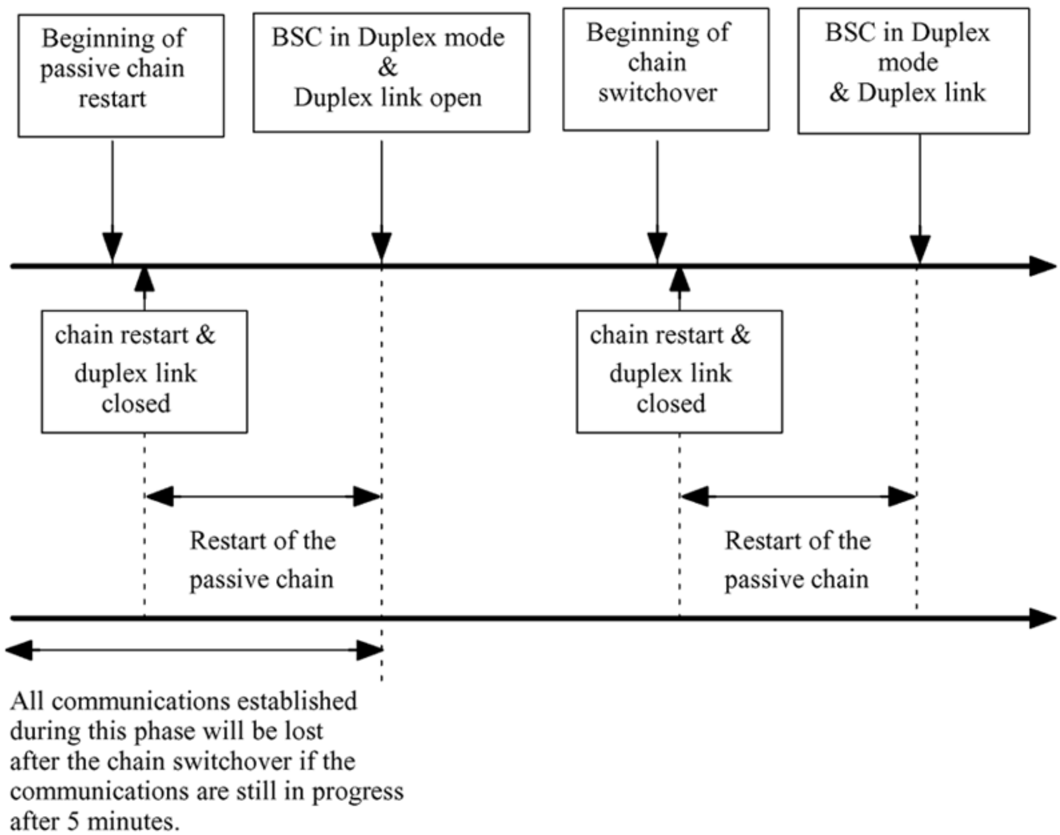
- **sWVersionRunning** defines the software version currently running on the BSS entity described by the BSS object.
- **sWVersionNew** defines the newly loaded software version on the BSC 12000HC disk that is not yet running or the software version that was previously running.
- **sWVersionFallback** defines the software version that was running on the BSS entity before the current version.
- **sWVersionBackUp** defines the software version backup. It is identical to **sWVersionRunning** by definition.

The software object that describes a BSS object must be created and the EFT that contains the current software version must be downloaded onto the BSC 12000HC disk before the BSS object is unlocked:

The following apply:

- The **sWVersionRunning** parameter defines the software version loaded on the BSS entity described when the object was created.
- The other parameters are not defined if no matching software version is loaded on the BSC 12000HC disk.

For a type 4 upgrade:



A communication is "mirrored" on both chains only if the BSC is in duplex mode.The mirroring of the communication context is always done at the onset of call establishment on both chains. If the BSC is not in duplex mode at the time of call establishment, the communication context is not mirrored on the passive chain and in case of a BSC switchover the communication is lost. As a timer is present before the switchover, only communications established before the duplex state and lastingmore than 5 minutes will be lost.

1.10.2.3 OMC-R software management

Identifying the software deliveries A DVD formatted delivery tape is identified by a delivery name and contains the following two records:

- The first record contains two empty files: the name of one of the files is set from the name of the EFT recorded on the DVD and is suffixed ".EFT", the name of the other file is set from the name of the delivery and is suffixed ".LIV".
- The second record contains the EFT itself, that is a directory named after the EFT, with the consisting files, and the associated DLU files.

A delivery name does not depend on the version of the software and DLUs stored on the DVD.

Identifying the EFTs An EFT containing BSS software has a standard name that defines the associated software type and version, and is used to create a specific directory on the OMC-R manager and agent disks. The name of an EFT is formatted as follows:

- BSC 12000HC software: Format = "BSxabvcdefgh"

Field	Meaning	Value
BSx	Name	x = [1 .. .4]
ab	Version number	[09 ... 32]
v	Reserved	
cd	Sub-version number	[01 ... 99]
ef	Edition number	[01 ... 99]
gh	Patch version	[01 ... 99]

- BTS/TRX/TCU software: Format = "XXXabcdef"

Field	Meaning	Value		
	Type of software	BTS	TRX	TCU
XXX	Name	**BCF** (S4000 and S2000E) **BC1** **BC2** (S8000 BCF) **SBC** (S2000 H/L) **CBC** (S8000 CBCF) **IBC** (S12000) **PIC** (PicoNode) **RM** (BTS 18000) **ICM** (BTS 18000)	**TRX** (S4000 and S2000E) **TR1** (S4000 and S2000E) **DRX** (S8000 BCF and CBCF) **CDR** (S2000 H/L and S8000 BCF and S8000 CBCF) **EDG** (S8000 CBCF)	**TCB** **TC1** (TCB1) **TC2** (TCB2)
ab	Version number	[0 ... 32]	[0 ... 32]	[0 ... 32]
c	Sub-version number	[A ... H]	[A ... H]	[A ... H]
d	Edition number	[1 ... 8]	[1 ... 8]	[1 ... 8]
ef	Patch version	[01 .. 32]	[01 .. 32]	[01 .. 64]

Identifying the DLUs The name of a DLU configuration file is coded as "Fabcyyyz", where:

- *abc* is the software version number (ab = [08 to 32], c = [A to H]).
- *yyy* is the hardware configuration index (0 to 9, A to V) of the DLU file for the equipment.
- *z* is the revision factor (0 to 9, A to V).

The DLU name is used to create a special subdirectory under the associated EFT directory on the OMC-R manager and agent disks.

BSS software management by the OMC-R manager User commands are available when using the OMC object:

- **`Read Gigatape`**

  Copy a set of transferable files containing a BSS software version and the associated DLUs supplied on DVD to the OMC-R manager disks..

  The DVD must be installed in the drive of the active OMC-R manager server.

  The delivery and EFT names supplied on the tape are displayed in session logs when the copy is complete. The EFT name defines the OMC-R manager disk directory where the EFT is stored.

- **`Download EFT to md`**

  Copy an EFT containing a BSS software version and the associated DLUs from OMC-R manager disks onto OMC-R agent disks.

  The EFT to download is identified by name. The OMC-R agent disk directory used to store the EFT must be created (see next Paragraph).

- **`Download and validate EFT from Gigatape to md`**

  Copy a set of transferable files containing a BSS software version and the associated DLUs supplied on DVD to the OMC-R manager and agent disks, and validate the EFT and DLU downloading to disk.

  This command enables to gather in one command the two previous listed commands and the two creating commands described in the following subparagraph.

- **`Delete EFT`**

  Delete an EFT containing a BSS software version and the associated DLUs from the OMC-R manager disks.

  The EFT is identified by name. The disk directory and all the files it contains are deleted.

- **`List EFT`**

  Display the list of EFTs and associated DLUs created on the OMC-R manager disks. The OMC-R manager file manager supplies theinformation.

BSS software management by the OMC-R agent This function performs tasks that may cause the OMC-R operations database (BDE) to be updated.

User commands are available using the md object as follows:

- **`Create EFT dir`**

  Create a directory on the OMC-R agent disks to store an EFT containing a BSS software version and the associated DLUs.

  The directory is identified by the name of the EFT due to be downloaded next (see previous Paragraph):

  — BSC 12000HC software: The EFT creation is not already validated (see next).

  — BCF software: If the EFT creation is already validated, the command can be used to associate more DLU files to the EFT.

  — TRX/DRX and TCB software: The EFT creation is not already validated (see next).

- **`Create EFT`**

  Validate an EFT and associated DLU downloading to the OMC-R agent disks (see previous Paragraph) to declare the BSS software version to the OMC-R agent Software Management function.

  If the command follows a **`Create EFT dir`** command used to associate more DLU files to the EFT, downloading the EFT to a BSC 12000HC disk is forbidden until the command is complete.

  The directories corresponding to an EFT delivery that is not validated are automatically cleared and deleted when they are more than three days old.

- **`Delete EFT`**

  Delete an EFT and the associated DLUs from the OMC-R agent disks. The disk directory and all the files it contains are deleted.

  The command is refused if the software version is referenced by a software object created in the BDE.

- **`List EFT`**

  Display the list of EFTs and associated DLUs created on the OMC-R agent disks. The OMC-R agent file manager supplies the information.

- **`List (object instances referencing an EFT)`**

Display the list of software objects that reference a named EFT. The BDE supplies the information.

This command is a multiple-type command (scope & filter) and cannot be accessed using a software object. It can be used before deleting an EFT to check whether the EFT is referenced.

EFT loading sequence BSS software loading commands must be entered in the following order to allow the OMC-R Software Management function to organize software versions correctly:

- **`Read GigaTape`** (omc object)
- **`Create EFT dir`** (md object)
- **`Download EFT to md`** (omc object)
- **`Create EFT`** (md object)

After the system validates the last command, the EFT is effectively accepted by the OMC-R agent Software Management function and can be downloaded to the BSC 12000HC disk.

Use the **`Download and validate EFT from Gigatape to md`** command instead of the four separate commands listed above.

Consulting BSS and OMC-R software markers This function identifies the software applications currently running on BSS entities and on OMC-R manager and agent servers.

The marker files are stored in BSC 12000HC and OMC-R server disk directories. A software application marker contains the following information:

- type (BSS entity or server) and name of the associated entity
- name and number of the application version (a version number is encoded in Vab_cd Enn format)
- a variable comments area, depending on the application type (usually the date when the application was generated)

Consulting BSS software markers The **`Display markers`** command on any created software object provides the following information:

- software versions running on a BSC 12000HC, radio site BCF, radio transceiver (TRX/DRX), or remote transcoding unit (TCB)
- PROM software versions in the same entities
- BSC 12000HC prototype application database (BDA) configuration files

The command run invokes a reference file updated by the BSC 12000HC that contains the list of BSS markers. The BSC 12000HC then sends the information to the OMC-R.

A reference file updating request is sent to the BSC 12000HC and the resulting information is provided to users.

Consulting OMC-R software markers The **`Display markers`** command on the md object identifies the OMC-R agent active and passive server software applications.

The **`Display server markers`** and **`Display workstation markers`** commands on the omc object respectively identify the OMC-R manager active and passive server software applications, and the software applications of a given workstation.

The file manager provides information on the application software that is running in the servers and workstations.

1.10.2.4 BSC 12000HC disk configuration

The BSC 12000HC disk is divided into partitions defined in static configuration data. Some partitions are dedicated to BSS software management. The simplified outline of the disk configuration that follows is only intended to help users to understand the disk management structure.

The hard disk of the BSC 12000HC houses:

- the BSC 12000HC software, which is split up as follows:
  - The active partitions :MB_CODE: and :MB_PROTO: contain the current BSC software version (actually running):
    - The :MB_CODE: partition contains the application code.
    - The :MB_PROTO: partition contains the prototype application database (BDA) configuration files.
  - The delivery partitions :LIV_COD: and :LIV_PRO: contain the software version to be delivered if any (*either* a new version of BSC 12000HC software downloaded to the BSC 12000HC disk *or* the previously running version):
    - The :LIV_COD: partition contains the application code.
    - The :LIV_PRO: partition contains the prototype application database (BDA) configuration files.
- the BCF and TRX/DRX software, which is stored as follows:

  The :BTS: partition contains GSM site entity software versions (BCF and TRX/DRX) downloaded to the BSC 12000HC disk.

- the TCB software, which is stored as follows:

  The :TCB: partition contains remote TCU 2G transcoding board (TCB) software versions downloaded to the BSC 12000HC disk.

1.10.2.5 Downloading management

This function allows users to download new BSS software versions to the BSC 12000HC disks from the EFT created and validated on the OMC-R agent disks.

User command The `Download` command is available for all created software objects.

Downloading consists of copying a BSS software version from the OMC-R agent disks to the BSC 12000HC disk related to the selected BSS object.

The user enters the EFT name.

EFT and associated DLU files are stored in dedicated directory(ies). The directory and subdirectories are identified from the information supplied by the EFT.

Requirements The main requirements for the BSC 12000HC are:

- No change software version command is executing on the selected BSC 12000HC.
- No create or download new DLU file command is being processed for the concerned EFT.
- Up to five download commands that involve different BSC 12000HCs can be executed at the same time by system users. After that, the OMC-R refuses the commands.

The STF service provided by the OMC-R agent and the MTF service on the BSC 12000HC manages the download command routine.
A download command can be launched on several BSC 12000HCs at a time.

BSC 12000HC software downloading All the files in the delivery partition :LIV_COD: are deleted except for the FCP_VCHG.TXT file.

Only the EFT files that are different in the current version (stored in :MB_xxx: partitions) are transferred to the corresponding :LIV_xxx: partitions. The BSC 12000HC file transfer service copies the files that are identical in the current version from the active partition to the delivery partition.

BTS and TCB software downloading by the BSC 12000HC All the files in the dedicated :BTS: or :TCB: partition on the BSC 12000HC disk that are not associated with a software version referenced in the BDE are deleted (files not referenced by a software object).

Only the EFT files not stored in the dedicated BSC 12000HC disk partition are transferred. The list of files is obtained by comparing them with existing files.

The maximum number of site background downloading processes that can be performed simultaneously by a BSC 12000HC is eight.

Consequences

- BSC 12000HC software:
  - If the **sWVersionNew** or **sWVersionFallback** parameter was defined before downloading, the reference to the associated software version is deleted.
  - The **sWVersionNew** parameter is defined with the newly loaded software version.
  - The **sWVersionRunning** is not changed.
  - The **sWVersionFallback** is not defined.
- BCF, TRX/DRX, and TCB software:
  - If the **sWVersionNew** parameter was defined before downloading, the reference to the associated software version is deleted.
  - The **sWVersionNew** parameter is defined with the newly loaded software version.
  - The **sWVersionRunning** and **sWVersionFallback** parameters are not changed.

DRX automatic downloading See Section 1.10.7 "Automatic downloading of DRX software" (page 125).

1.10.2.6 BTS software background downloading

CAUTION
Customer specific
Indicates that specific equipment and specific software (such as specific software in the BSC) dedicated to a specific application is used and that therefore the feature is not available for all standard GSM users.

This function allows the downloading of BTS software while BTSs are still working and, in doing so, reduces the out of service time during software upgrades. It requires BTSs support of the centralized downloading protocol.

The update process of BTS software consists of two separate phases:

- The first one, the longest, is the software downloading. The BTS is still working and is not yet upgraded.
- The second one is the activation of the new software. During this phase, the service is interrupted for a short time.

User commands OMC-R commands are provided to manage the upgrade process:

- The "BTS background download" command launches the software downloading, which can be immediately followed by an activation.
- The "BTS background activate" command activates the new software.
- The "BTS background abort" command interrupts the software downloading.
- The "BTS background download status" provides information on software downloading.

1.10.2.7 Version management

This function allows users to manage BSS software versions. The OMC-R operations database (BDE) is updated.

User commands The user commands for changing software versions are available for all created software objects:

- The **`Activate new version`** command starts up a new software version in a BSS entity.
- The **`Return to previous version`** command reactivates an old software version in a BSS entity.

Requirements

- General conditions:
  - No BSC 12000HC downloading command is executing on the selected BSC 12000HC.
  - The bsc object is unlocked.
  - **`Activate new version:`** A new software version is installed on the BSC 12000HC disk for the BSS object involved (the **sWVersionNew** parameter of the associated software object is defined).

  — **`Return to previous version:`** An old software version is installed on the BSC 12000HC disk for the BSS object involved (the **sWVersionFallback** parameter of the associated software object is defined).

- BSC 12000HC software:
  — The BSC 12000HC has two processing chains operating in duplex mode.
  — **`Return to previous version`**: No new BSC software version has been downloaded to the BSC disk since the current version was activated (see previous Paragraph).

- BCF and TRX/DRX software:
  — The concerned btsSiteManager or transceiverEquipment object is locked.

- TCB software:
  — The concerned transcoderBoard object is locked.
  — To optimize TCB software downloading time in remote transcoding units, the system limits the number of operational TCB software versions to two at any given time.

  This limit must be respected. Before changing a software version of this type, the procedure for checking and possibly upgrading software must be performed (see NTP < 034 >).

After validating the command, the BSC 12000HC loads the software version in the BSS entity. The software type determines when the version is put in service.

Starting up BSC 12000HC software System and user actions depend on the impact of the new software version on operating conditions.

Type 3 version change The configuration of the BSC 12000HC prototype application database in the new version is incompatible with the running version. The system does the following:

- resets both BSC 12000HC processing chains at the same time
- deletes the BDA
- restarts the BSC 12000HC

The BSC 12000HC sends a build application database request to the OMC-R. Upon receipt of the notification, the user performs a **`Activate New Version`** command on the bsc object to make it operational.

Any observations that were running on the BSC 12000HC before the **Activate New Version** command was issued are suspended until the BDA is rebuilt, then restart automatically.

Type 4 version change Only the application code is different in the new and running versions. The system does the following:

- resets the BSC 12000HC processing chains one after the other
- restarts the BSC 12000HC

The BSC 12000HC sends a restart message to the OMC-R. The user receives a notification at the end of the command run. The BSC 12000HC remains operational throughout the operation, except during the restart phase.

Type 5 version change The configuration of the BSC 12000HC prototype application database in the new version is incompatible with the running version.

The BSC 12000HC sends a build application database request to the OMC-R. Upon receipt of the notification, the user performs a **Build BDA** command followed by a **Activate New Version** command. Then the BSC 12000HC is again operational.

For a Type 5 version change the period during which the BSC 12000HC is not operational is reduced compared to a Type 3 version change. From V11, BSC BDA is being built in a dedicated partition of the BSC 12000HC disks, so that two BDAs coexist on the BSC 12000HC disks. The period during which the BSC 12000HC is not operational takes place during the **BDA New Version Activation**. Moreover the user is asked at the end of this phase whether he accepts the software change ("Validate software change") or refuses it ("Cancel software change") through the **End of probative phase** command.

Any observations that were running on the BSC 12000HC before the **Activate New Version** command was issued are suspended until the end of the *Probative Phase*.

Starting up BCF, TRX/DRX, and TCB software The new software version starts up automatically when the concerned BSS object is unlocked by the user.

Consequences The impact on software object parameters is the same, regardless of the new software type.

- *Activate new version*

— If the **sWVersionFallback** parameter was defined before the command, the reference to the associated software version is deleted.

— The **sWVersionRunning** parameter is defined with the new software version.

— The **sWVersionFallback** is defined with the previously running software version.

— The **sWVersionNew** parameter is not defined. The reference to the associated software version is deleted.

- *Return to previous version*

  — If the **sWVersionNew** was defined before the command, the reference to the associated software version is deleted.

  — The **sWVersionRunning** parameter is defined with the restored software version.

  — The **sWVersionNew** parameter is defined with the previously running version.

  — The **sWVersionFallback** parameter is not defined. The reference to the associated software version is deleted.

1.10.3 BSC 3000 software management

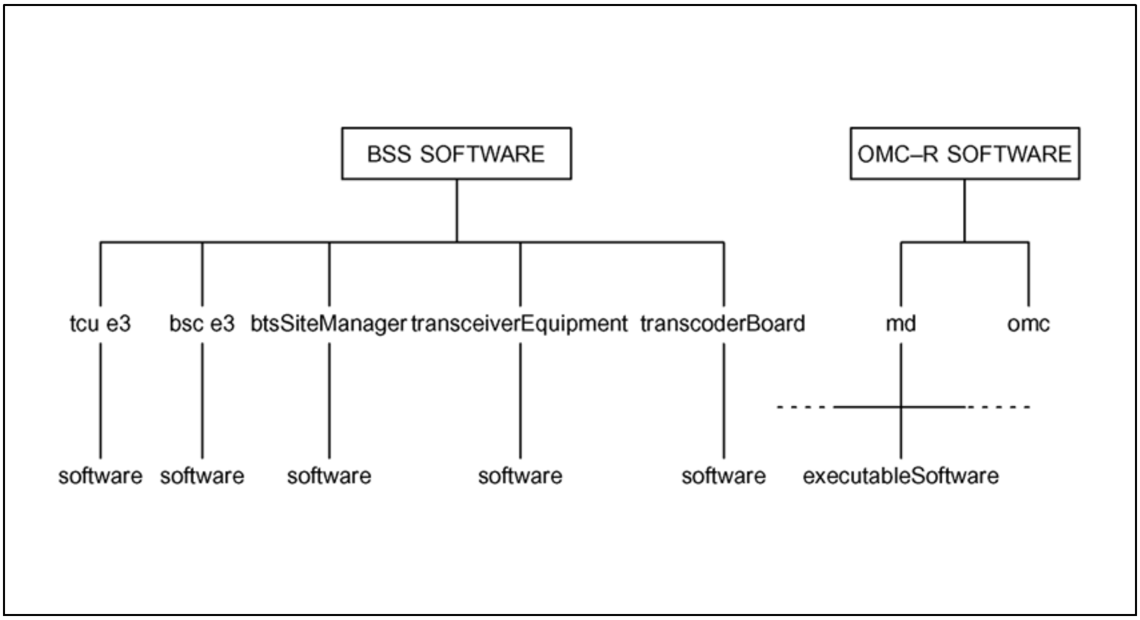
1.10.3.1 Principles

The BSC 3000 software management function is used by the user to manage BSS software applications and consult OMC-R software applications. It is controlled by the OMC-R Configuration Management function and distributed on two levels:

- OMC-R functions are available to users via the omc and md objects that describe the OMC-R manager and agent on the Man-Machine interface to create and manage **delivery** on the disks, and consult OMC-R manager and agent software application markers.
- OMC-R manages the BSC 3000 functions, which are available for the user through software objects. These functions are used to download the **delivery** containing new BSS software versions on the BDA (BSC 3000 disk), start up the software in the BSS entities concerned and consult BSS software application markers.

The following figure describes user software management on the Man-Machine interface.

Figure 21
Software management (specific BSC/TCU 3000) on the man-machine interface



1.10.3.2 Software object

All the managed objects that describe the BSS entities driven by software (BSS objects) reference a software object that the Configuration Management function manages in the OMC-R operations database in response to user commands.

Each object is identified by the BSS object instance that references it and is characterized by the following parameters:

- **sWVersionRunning** defines the software version currently running on the BSS entity described by the BSS object.
- **sWVersionNew** defines the newly loaded software version on the BSC 3000 disk that is not yet running or the software version that was previously running.
- **sWVersionFallback** defines the software version that was running on the BSS entity before the current version.
- **sWVersionBackUp** defines the software version backup. It is identical to **sWVersionRunning** by definition.

The software object that describes a BSS object must be created and the executableSoftware that contains the current software version must be downloaded onto the BSC 3000 disk before the BSS object is unlocked:

The following apply:

- The **sWVersionRunning** parameter defines the software version loaded on the BSS entity described when the object was created.

- The other parameters are not defined if no matching software version is loaded on the BSC 3000 disk.

1.10.3.3 OMC-R software management

Identifying the delivery An executableSoftware containing BSS software has a standard name that defines the associated software type and version, and is used to create a specific directory on the OMC-R manager and agent disks. The name of an **executable software** is formatted as follows:

- BSC 3000 software: Format = "BSxabvcdefgh"

Field	Meaning	Value
BSx	Name	x = [1 .. .4]
ab	Version number	[09 ... 32]
v	Reserved	
cd	Sub-version number	[01 ... 99]
ef	Edition number	[01 ... 99]
gh	Patch version	[01 ... 99]

- BTS/TRX/TCU 3000 software : Format = "XXXabcdef"

Field	Meaning	Value		
	Type of software	BTS	TRX	TCU 3000
XXX	Name	**BCF** (S4000 and S2000E) **BC1** **BC2** (S8000 BCF) **SBC** (S2000 H/L) **CBC** (S8000 CBCF) **IBC** (S12000) **PIC** (PicoNode) **RM** (BTS 18000) **ICM** (BTS 18000)	**TRX** (S4000 and S2000E) **TR1** (S4000 and S2000E) **DRX** (S8000 BCF and CBCF) **CDR** (S2000 H/L and S8000 BCF and S8000 CBCF) **EDG** (S8000 CBCF)	**TRM** (TRM1) (TRM2)
ab	Version number	[0 ... 32]	[0 ... 32]	[0 ... 32]
c	Sub-version number	[A ... H]	[A ... H]	[A ... H]
d	Edition number	[1 ... 8]	[1 ... 8]	[1 ... 8]
ef	Patch version	[01 .. 32]	[01 .. 32]	[01 .. 64]

- BSC3000 software: Format = "B3Gabcdefghv"

Field	Meaning	Value
B3G	Name	
ab	Version	[09 ... 32]
cd	Sub-version	[01 ... 99
efgh	Internal stream	
v	Reserved	

- TCU3000 software: Format = "TC3abcdefgh"

Field	Meaning	Value
TC3	Name	
ab	Version	[09 ... 32]
cdefgh	Reference of the delivery inside the version	

Identifying the DLUs The name of a DLU configuration file is coded as "Fabcyyyz", where:

- *abc* is the software version number (ab = [08 to 32], c = [A to H]).
- *yyy* is the hardware configuration index (0 to 9, A to V) of the DLU file for the equipment.
- *z* is the revision factor (0 to 9, A to V).

The DLU name is used to create a special subdirectory under the associated executableSoftware directory on the OMC-R manager and agent disks.

BSS software management by the OMC-R manager User commands are available using the omc object:

- **`Read Gigatape`**

  Copy a set of transferable files containing a BSS software version and the associated DLUs supplied on DVD to the OMC-R manager disks.

  The tape must be installed in the drive of the active OMC-R manager server.

  The executableSoftware name defines the OMC-R manager disk directory where the executableSoftware is stored.

- **`Download executableSoftware to md`**

  Copy an executableSoftware containing a BSS software version and the associated DLUs from OMC-R manager disks onto OMC-R agent disks.

The executableSoftware to download is identified by name. The OMC-R agent disk directory used to store the executableSoftware must be created (see next Paragraph).

- **`Download and validate executableSoftware from Gigatape to md`**

  Copy a set of transferable files containing a BSS software version and the associated DLUs supplied on DVD to the OMC-R manager and agent disks, and validate the executableSoftware and DLU downloading to disk.

  This command enables to gather in one command the two previous listed commands and the two creating commands described in the following subparagraph.

- **`Delete executableSoftware`**

  Delete an executableSoftware containing a BSS software version and the associated DLUs from the OMC-R manager disks.

  The executableSoftware is identified by name. The disk directory and all the files it contains are deleted.

- **`List executableSoftware`**

  Display the list of delivery and associated DLUs created on the OMC-R manager disks. The OMC-R file manager supplies the information.

BSS software management by the OMC-R agent This function performs tasks that may cause the OMC-R operations database (BDE) to be updated.

User commands are available using the md object as follows:

- **`Create executableSoftware dir`**

  Create a directory on the OMC-R agent disks to store an executableSoftware containing a BSS software version and the associated DLUs.

  The directory is identified by the name of the executableSoftware due to be downloaded next (see previous Paragraph):

  — BSC 3000 software: The executableSoftware creation is not already validated (see next).

  — BCF software: If the executableSoftware creation is already validated, the command can be used to associate more DLU files to the executableSoftware.

  — TRX/DRX and TCU 3000 software: The executableSoftware creation is not already validated (see next).

- `Create executableSoftware`

  Validate an executableSoftware and associated DLU downloading to the OMC-R agent disks (see previous Paragraph) to declare the BSS software version to the OMC-R agent Software Management function.

  If the command follows a `Create executableSoftware dir` command used to associate more DLU files to the executableSoftware, downloading the executableSoftware to a BSC 3000 disk is forbidden until the command is complete.

  The directories corresponding to an executableSoftware delivery that is not validated are automatically cleared and deleted when they are more than three days old.

- `Delete executable software`

  Delete an executableSoftware and the associated DLUs from the OMC-R agent disks. The disk directory and all the files it contains are deleted.

  The command is refused if the software version is referenced by a software object created in the BDE.

- `List executableSoftware`

  Display the list of delivery and associated DLUs created on the OMC-R agent disks. The OMC-R agent file manager supplies the information.

- `"List (object instances referencing an executable-Software)`

  Display the list of software objects that reference a named executableSoftware. The BDE supplies the information.

  This command is a multiple-type command (scope & filter) and cannot be accessed through a software object. It can be used before deleting an executableSoftware to check whether the executableSoftware is referenced.

executableSoftware loading sequence BSS software loading commands must be entered in the following order to allow the OMC-R Software Management function to organize software versions correctly:

- *Create executableSoftware dir* (md object)
- *Download executableSoftware to md* (omc object)
- *Create executableSoftware* (md object)

After the system validates the last command, the executableSoftware is effectively accepted by the OMC-R agent Software Management function and can be downloaded to the BSC 3000 disk.

Consulting BSS and OMC-R software markers This function identifies the software applications currently running on BSS entities and on OMC-R manager and agent servers.

The marker files are stored in BSC 3000 and OMC-R server disk directories. A software application marker contains the following information:

- type (BSS entity or server) and name of the associated entity
- name and number of the application version (a version number is encoded in Vab_cd Enn format)
- a variable comments area, depending on the application type (usually the date when the application was generated)

Consulting BSS software markers The **`Display markers`** command on any created software object provides the following information:

- software versions running on a BSC 3000, radio site BCF, radio transceiver (TRX/DRX), or TCU 3000.
- PROM software versions in the same entities
- BSC 3000 prototype application database (BDA) configuration files

The command run invokes a reference file updated by the BSC 3000 that contains the list of BSS markers. The BSC 3000 then sends the information to the OMC-R.

A reference file updating request is sent to the BSC 3000 and the resulting information is provided to users.

Consulting OMC-R software markers The **`Display markers`** command on the md object identifies the OMC-R agent active and passive server software applications.

The **`Display server markers`** and **`Display workstation markers`** commands on the omc object respectively identify the OMC-R manager active and passive server software applications, and the software applications of a given workstation.

The file manager provides information on the application software that is running in the servers and workstations.

delivery downloading to the BSC 3000 The BSC 3000 delivery must be downloaded in /OMU/delivery/B3G/new. In fact, this directory contains six subdirectories which are AIX, AIN, BIN, BCN, BDA, APT; and the subdirectories which correspond to the delivery are transferred to that delivery.

The TCU 3000 delivery must be downloaded in **/OMU/delivery/TC3/new**.

The BTS delivery must be downloaded in **/OMU/delivery/BTS**.

1.10.3.4 BSC 3000 disk configuration

The BSC 3000 houses two types of SCSI hard disks:

- the private disks
- the shared disks

Private disks Two private or local disks are used in a BSC 3000. Each of them is associated with one OMU module:

The partitions in each private disk are split up as follows:

- The root partition "/" contains the root directory, and AIX root file.
- The "/usr", "/var", "/tmp", "home" partitions contain the AIX running software. The sizes are derived from the AIX software needs.
- The "/tmp" file system partition is used also during upgrade to store the copy of the package.
- The "/OMU_STORAGE" directory contains the applicative files stored on the OMU local and shared disk. The **`rw_ data`** directory is a "read/write" directory, used for important, long life applicative data. The log directory is used for short life data, which is temporarily stored on the disk before being either sent to the OMC or erased by newer data. In case of disk space shortage on the log directory, **`the rw_data`** directory is not affected because they are on different partitions.
- The LOCAL_LOG "/OMU_STORAGE/log/local" partition contains the dump of the AIX board, because the OMU may not have access to the shared disk when restarting.
- The LOCAL_LOG "/OMU_STORAGE/rw_data/local" partition does not contain anything.
- The LOCAL_LOG "/OMU_STORAGE/TREEn/local/usr" partition contains OAM platform and BaseOS application and tools.

Shared disks Two shared disks are used in a BSC 3000. Each of them is managed in a mirroring way for both OMU modules:

The partitions in each shared disk is split up as follows:

- Partition /OMU_STORAGE/rw_data/share, this partition contains files that are of long duration, compulsory, and whose size does not depend on the traffic or network configuration.

- Partition /OMU_STORAGE/SHARE, this partition contains the SW (switch) needed by the BSS, which includes all the former partitions (transited into directory only).

1.10.3.5 Downloading management

This function is used to download new BSS software versions to the BSC 3000 disks from the executableSoftware created and validated on the OMC-R agent disks.

User command The `Download` command is available for all created software objects.

Downloading consists of copying a BSS software version from the OMC-R agent disks to the BSC 3000 disk related to the selected BSS object.

The user enters the executableSoftware name.

executableSoftware and associated DLU files are stored in dedicated directory(ies). The directory and subdirectories are identified from the information supplied by the executableSoftware.

Requirements The main requirements for the BSC 3000 are:

- No change software version command is executing on the selected BSC 3000.
- No create or download new DLU file command is being processed for the concerned executableSoftware.
- Up to five download commands that involve BSC 3000 can be executed at the same time by system users. After that, the OMC-R refuses the commands.

The STF service provided by the OMC-R agent and the MTF service on the BSC 3000 manages the download command routine.
Two download commands can be launched on BSC 3000 at the same time.

BSC 3000 software downloading The BSS software (BSC 3000, TCU 3000 and BTS) is downloaded by the BSC 3000 from the OMC-R. For each version and edition, the complete BSS software is delivered on a CD-ROM.

It is sufficient for all upgrades from any authorized version (typically N-2 and N-1 versions).

It is compressed and divided into several files in order to download only the modified files between two versions and to reduce as much as possible the duration of downloading.

The BSC 3000 stores two versions of the BSS software and the new version can be downloaded in the background without impacting BSC 3000 service.

Both the BSS software and the BSC 3000 OS can be downloaded in the background task, or installed locally from the TML through the Ethernet link.

There is no PROM memory on the BSC 3000 & TCU 3000 hardware module, with the exception of the ATM_SW module (ATM switch).

All firmware is in flash EPROM and can be modified and downloaded remotely by the system.

The complete BSS software (BSC 3000, TCU 3000 and BTS) is downloaded from the OMC-R to the BSC 3000 through FTAM.

The OMC-R and BSC 3000 are connected through Ethernet and IP protocols. The throughput is up to 10/100 Mbit/s (Ethernet standard) if the OMC is locally connected to the BSC 3000.

When the BSC 3000 is remote, a minimum throughput of 128 kbps is necessary for the efficiency of OMC-R / BSC 3000 communication.

BTS and TCU 3000 software downloading by the BSC 3000

BTS software downloading The BSC 3000 can download ten BTS/TRXs simultaneously per TMU module. With ten "active" TMU modules, 100 BTSs can be downloaded simultaneously.

TCU 3000 software downloading TCU 3000 software is downloaded by the BSC 3000. It is compressed and divided into several files, in order to download only the modified files between two versions and to reduce the downloading duration as much as possible.

The BSC 3000 stores two versions of TCU 3000 software.

The new version can be downloaded as a background task, without impacting TCU 3000 service.

The TCU 3000 software can also be installed locally from the TML.

A set of LAPD connections is used for TCU 3000 management in normal operation. These connections pre-empt (or wait for) time-slots used for communications. Two LAPD channels are managed per LSA module.

Download of a set of files (size of about 20 Mbytes per TCU 3000) lasts:

- with four LAPDs: about 20 minutes (requires a minimum of 2 LSAs)
- with eight LAPDs: about 10 minutes (requires a minimum of 3 LSAs)

Consequences

- BSC 3000 software:
  - If the **sWVersionNew** or **sWVersionFallback** parameter was defined before downloading, the reference to the associated software version is deleted.
  - The **sWVersionNew** parameter is defined with the newly loaded software version.
  - The **sWVersionRunning** is not changed.
  - The **sWVersionFallback** is not defined.
- BCF, TRX/DRX, and TCU 3000 software:
  - If the **sWVersionNew** parameter was defined before downloading, the reference to the associated software version is deleted.
  - The **sWVersionNew** parameter is defined with the newly loaded software version.
  - The **sWVersionRunning** and sWVersionFallback parameters are not changed.

DRX automatic downloading See Section 1.10.7 "Automatic downloading of DRX software" (page 125).

1.10.3.6 BTS software background downloading

Two phase upgrade process

With the feature “BSC3000 support of BTS SW background downloading (25316)”, introduced in V16.0, the upgrade process is done in two distinct phases: download and activation.

Without BTS background downloading, the time required to perform a start, a download, and a restart is much longer.

Download phase

BTS background downloading allows the software of the BTS to be downloaded while the BTS is still running. The download phase can last several hours but it does not impact the service. This phase can be done outside of the maintenance window.

Activation phase

The activation phase is similar to the pre-V16.0 activate procedure. However, it is much shorter since it no longer includes the time needed by the download (which is done in a separate phase). This phase should be done in the maintenance window.

User commands

OMC-R commands are provided to manage the upgrade process:

- The "BTS background download" command launches the software downloading, which can be immediately followed by an activation.
- The "BTS background activate" command activates the new software.
- The "BTS background abort" command interrupts the software downloading.
- The "BTS background download status" provides information on software downloading.

1.10.3.7 Version management

This function allows users to manage BSS software versions. The OMC-R operations database (BDE) is updated.

User commands The user commands for changing software versions are available for all created software objects:

- The `Activate new version` command starts up a new software version in a BSS entity.
- The `Return to previous version` command reactivates an old software version in a BSS entity.

Requirements

- General conditions:
  - — No BSC 3000 downloading command is executing on the selected BSC 3000.
  - — The bsc e3 object is unlocked.
  - — `Activate new version:` A new software version is installed on the BSC 3000 disk for the BSS object involved (the **sWVersionNew** parameter of the associated software object is defined).
  - — `Return to previous version:` An old software version is installed on the BSC 3000 disk for the BSS object involved (the **sWVersionFallback** parameter of the associated software object is defined).
- BSC 3000 software:
  - — The BSC 3000 has two processing OMUs operating in duplex mode.
  - — `Return to previous version:` No new BSC 3000 software version has been downloaded to the BSC 3000 disk since the current version was activated (see previous Paragraph).
- BCF and TRX/DRX software:

  - The concerned btsSiteManager or transceiverEquipment object is locked.

- TCU 3000 software:
  - To optimize TCU 3000 software downloading time in remote transcoding units, the system limits the number of operational TCU 3000 software versions to two at any given time.

    This limit must be respected. Before changing a software version of this type, the procedure for checking and possibly upgrading software must be performed (see NTP < 034 >).

After validating the command, the BSC 3000 loads the software version in the BSS entity. The software type determines when the version is put in service.

Starting up BSC 3000 software

BSC 3000 or TCU 3000 Cold Startup (BDA not built) The overall startup sequence describes how the BSC 3000 goes from its initial power-up state, with no software running, to a fully operational state where the applications are running and providing GSM service.

This type of startup is called dead office recovery and first needs the entire Control Node startup sequence to be performed.

The operator builds the network at OMC-R level and creates the BSC 3000 logical object. He has to create the LSA-RC modules as well (with their hardware positions).

As soon as the OMC-R/BSC 3000 link is established, the BSC 3000 sends a notification indicating that an BDA build is requested.

Upon receipt of this notification, the OMC-R triggers the BDA build phase:

- The BDA is built on the active OMU.
- The "Build BDA N+1" upgrade feature is provided on the BSC 3000, as in a BSC 12000HC.
- This phase ends with the creation of the BDA logical objects followed by the reception of a report build message.

Board startup: general behavior A module is said to be operational when all of its boards are operational.

For each board, the startup sequence consists of three ordered steps:

- boot sequence
- platform initialization
- application initialization

Application initialization covers both the creation and initialization of the GSM BSC 3000 applications, this phase is managed in accordance with the BSC 3000 configuration and available resources.

Some boards are able to start autonomously, booting from non-volatile storage, whereas others must wait as they require the services of another board when operational.

The Control Node is operational once application initialization has completed successfully and the BSC 3000 is operational when the Control and Interface Nodes are operational.

BSC 3000 or TCU 3000 hot startup (BDA built) Since the BDA is already built, we only have to check the hardware configuration consistency.

We must check that modules have not been introduced or removed when the BSC 3000 or the TCU 3000 was previously switched off.

The BSC 3000 and TCU 3000 will have the same behavior as for a cold startup. The consistency between the new and the previous hardware configuration is checked out at the OMC-R level.

Three things can happen:

- A module has been extracted: the corresponding object is deleted on the MMI and in the BDA, and an alarm on the parent object indicates the suppression.
- A module has been plugged into a previously-free slot: the corresponding object is automatically created on the MMI and in the BDA, and an alarm on the parent object indicates the creation.
- A module has been replaced by another one:
  - — The object corresponding to the replaced module is deleted on the MMI and in the BDA.
  - — The object corresponding to the newly inserted module is created on the MMI and in the BDA.
  - — Alarms on the parent object indicate the suppression and the creation.

Consequences The impact on software object parameters is the same, regardless of the new software type.

- `Activate new version`
  - — If the **sWVersionFallback** parameter was defined before the command, the reference to the associated software version is deleted.

— The **sWVersionRunning** parameter is defined with the new software version.

— The **sWVersionFallback** is defined with the previously running software version.

— The **sWVersionNew** parameter is not defined. The reference to the associated software version is deleted.

- **`Return to previous version`**

— If the **sWVersionNew** was defined before the command, the reference to the associated software version is deleted.

— The **sWVersionRunning** parameter is defined with the restored software version.

— The **sWVersionNew** parameter is defined with the previously running version.

— The **sWVersionFallback** parameter is not defined. The reference to the associated software version is deleted.

1.10.4 Consulting BSS software versions

This function identifies the software versions available for the different types of BSS entities. The OMC-R supplies the information recorded in its operations database.

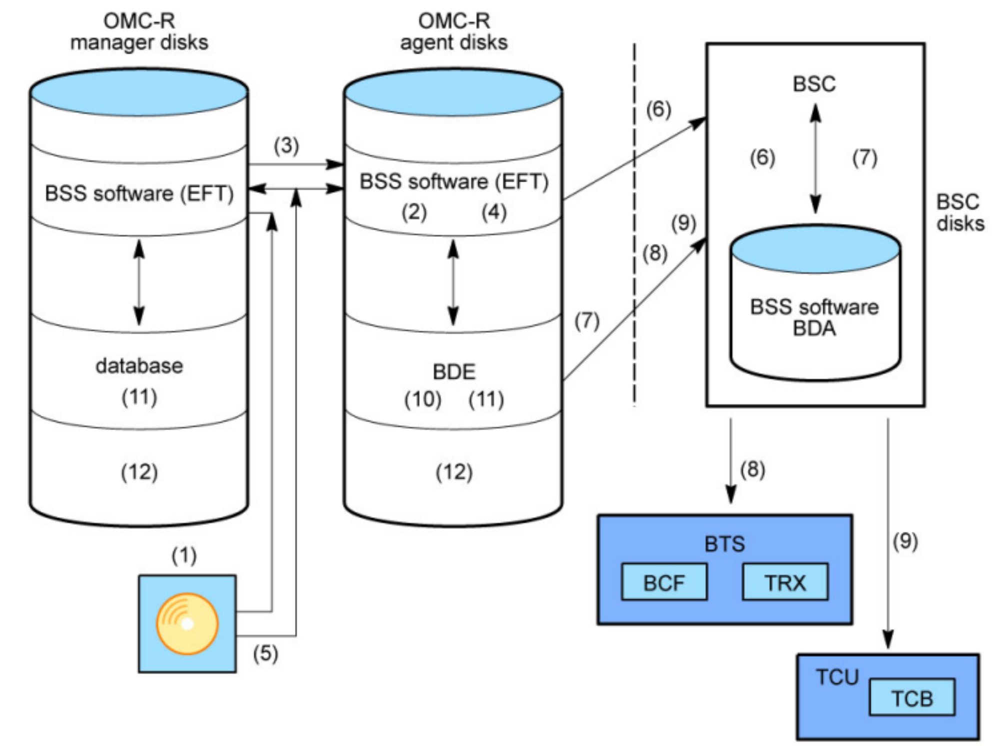
The **`Display`** command on any created software object displays the object parameters and the software versions it references.

1.10.5 BSC/OMC-R exchanges

The following figure illustrates the BSC/OMC-R exchanges related to user software management commands.

The exchange with an OMC-R by a BSC 3000 or a BSC 12000HC is identical. However, the EFT for the BSC 12000HC corresponds to the "executableSoftware" for the BSC 3000.

Figure 22
BSC 12000HC/OMC-R exchanges



(2) *Create EFTdir* (md object)
(3) *Download EFT to md* (omc object)
(4) *Create EFT* (md object)
(5) *Download and validate EFT from Gigatape to md* (omc object)
(6) *Download* (software objects)
(7, 8, 9) *Activate new version / Return to previous version* (software objects)
bsc (7), btsSiteManager (8), transceiverEquipment (8), transcoderBoard (9)
(10) *Display / Display markers* (software objects)
(11) *Delete EFT / List EFT* (omc object, md object)

1.10.6 Centralized downloading of BTS by BSC

With the "DRX software downloading improvement (centralized)" feature (14967), introduced in V15.1, the upgrade of the BTS software can be managed by the BSC.

This features provides a new download mechanism known as the centralized download protocol. The previous mechanism is referred to as the non-centralized download protocol.

1.10.6.1 Centralized download protocol

With the centralized download protocol, the management of the software download is centralized in the Base Common Functions (BCF) of the BTS. The BSC gives the BCF a description of the software version(s) to be downloaded. The BCF requests an Abis download of the necessary files. This avoids sending the same file several times on the Abis link. The BCF also manages software duplication within the BTS. Since upgrades are done in parallel, the overall time required is reduced. The BSC periodically sends a message to monitor progress and to detect changes in the downloading status of the equipment.

Each DRX downloads its software directly from the BTS instead of from the associated BSC. Consequently, the DRX software is transferred just once from the BSC to the BTS (instead of being transferred for each DRX).

1.10.6.2 Non-centralized download protocol

To ensure compatibility with the existing non-centralized download protocol, and to permit the upgrade/downgrade of software versions that support the centralized download protocol, the BTS informs the BSC of the download protocols that it supports. The BTS can indicate that it supports one of the following:

- only the non-centralized protocol
- only the centralized protocol
- both protocols

If this field is not present in the message sent by the BTS, by default, the BSC selects the non-centralized download protocol. Existing BTSs remain compatible with the non-centralized download protocol.

The non-COAM BTS (S4000) supports only the non-centralized download protocol.

For operational reasons, some BTSs (as e-cell and BTS 18000) support only the new centralized download protocol.

For a BTS that supports both protocols, if the non-centralized download protocol is selected by the BSC, the software download behavior is the same as in V14.2, V14.3, and V15.0.

1.10.6.3 Improved BSC defense for centralized downloading

The “BSC defense procedures for centralized downloading” feature (29213), introduced in V16.0, offers improved BSC defense procedures in the case of centralized downloading.

The BSC and BTS exchange messages using the CSM (Centralized Software Management) protocol. These messages are internal and are not described here. However, since the message name may appear in the Cause/Source associated with a Fault Number (for example, 1052 and 1073), their names are listed below.

Names of CSM messages

The names CSM messages used are the following:

- CSM load container
- CSM load container ack/nack
- CSM software update init
- CSM software update control
- CSM software update report
- CSM software update abort
- CSM software update abort report
- CSM downloading start
- CSM downloading start ack/nack
- CSM downloading end
- CSM downloading end ack/nack
- CSM load init
- CSM load init ack/nack
- CSM load data
- CSM load data ack/nack
- CSM load end
- CSM load end ack/nack
- CSM flash activation (only used in offline mode)
- Extended CSM flash activation (only used in background mode)
- CSM flash activation report

Stages of an Abis download

The download of a file on the Abis takes place in three stages:

- CSM Load init procedure
- CSM Load data procedure
- CSM Load end procedure

CSM Load init procedure

This sequence permits the BSC and the BTS equipment to initiate the download of a file and establish the characteristics of the data transfer.

The BSC proposes the parameters of the download taking account of its own capacity.

The equipment confirms the parameters of the download, taking account of its own capacity and that of the BSC. The equipment can modify some parameters without exceeding the maximum or minimum limits proposed by the BSC.

CSM Load data procedure

The download takes place as follows:

1. The BSC sends a CSM load data message within the limit of the sending buffer size (a download parameter).
2. The equipment (BCF or TRX) acknowledges by sending a CSM load data ack message taking account of the limit of the acknowledgement buffer size (a download parameter).

The CSM load data messages are numbered.

In case of loss of a message, the equipment sends a CSM load data nack containing the number of the incomplete window. The BSC then resumes emission of CSM load data messages at the beginning of the window containing the unreceived block.

In case of non-receipt of a CSM load data ack, the BSC resumes the emission of CSM load data messages at the beginning of the unacknowledged window.

This mechanism of resuming is activated several times before aborting the download (so as to be able to resume the download of a file in progress after a loss of PCM).

CSM Load end procedure

The BSC sends a CSM downloading end message and the equipment replies with a CSM downloading end ack message.

BSC defense mechanisms

The following enhanced BSC defense mechanisms are implemented in V16.0. These mechanisms are used on:

- receipt of BTS error report
- non-response of BTS to a CSM message sent by BSC

When there is a no response from the BTS, a notification 1059 (with the cause “no response from BTS”) is sent to operator. In the case of offline downloading, this notification includes the CSM message sent by the BSC.

The BSC uses internal counters to count the number of attempts at downloading and the number of attempts at sending of a message. The BSC takes account of these counters in deciding the defense action it takes.

The BSC defense actions are:

- Retry the download
- Stop the download

Retry the download (also known as “retry_dwld”)

1. Emit a Fault number 1073 with the cause related to the problem detected.
2. Send a CSM software update abort message (if the report is OK, NOK, or if there is no response, the following actions will be the same).
3. Send a RESET message (only for offline downloading, not for background downloading).
4. Wait for a TBOOT.
5. Retry the session (by sending a new CSM software update init message).

Stop the download (also known as “stop_dwld”):

1. Send a CSM software update abort message (if the report is OK, NOK, or if there is no response, the following actions will be the same),
2. Send a RESET message (only for offline downloading, not for background downloading),
3. Emit a Fault number 1052 with the cause related to the problem detected.

1.10.7 Automatic downloading of DRX software

Each of type of DRX hardware: DRX, eDRX, ND3, etc. has its own software load (EFT, catalog file) and a hardware reference. If one type of DRX is replaced by another type, the operator must download the appropriate software for the new type.

1.10.7.1 Downloading procedure

The "S8000 DRX-EDGE DRX automatic downloading on BSC 3000" feature (27633), introduced in V15.1, automatically finds the EFT on the OMC-R and downloads it.

However, this automatic download works only after a DRX of the new type has already been manually downloaded. So the first time a DRX of a new type is used, the operator must still perform a manual DRX software download for it.

The downloading procedure is fully automatic only if 1 (and only 1) EFT is found. If more than 1 EFT is found, the operator has to choose which one to download (that is, an operator action is needed).

DRX automatic downloading is available under the following conditions:

- OMC-R from V15.1 and BSC from V14.3
- AUTODRX_Mode parameter in omc_services.cfg file is set to enable

1.10.7.2 EFT names for DRX hardware

The DRX software is delivered as an EFT. This EFT includes a set of downloadable files and one catalog file. This catalog file contains the file names to be downloaded onto a DRX. It is used by the BSC before downloading DRX software. The catalog file is also used by the OMC-R to check if all downloaded files exist on DVD.

The EFT name is of the form: TTTxxayzz

where

`TTT` is a trigram specific to the DRX hardware
`xxayzz` is the software reference

For DRX versions earlier than V15, the correspondence between the EFT name trigram and the hardware references is hard-coded in the OMC-R. These are shown in the Table 8 "Correspondence between DRX hardware and EFT name" (page 126).

Table 8
Correspondence between DRX hardware and EFT name

DRX Hardware Type	EFT Trigram Name	Hardware Reference
COAM DRX	CDR	0x04
DCU4	TR1	0x08
ND DRX	CDR	0x11
eDRX	EDG	0x12
ND3 DRX	DRX	0x14
BTS 18000 RM	ERM	0x19
BTS 18000 HPRM	ERM	0x1F
BTS 18000 MPRM	ERM	0x23

The catalog file contains an internal table that contains hardware masks and hardware references. The hardware masks list the features available for each DRX hardware type supported by the catalog file. The hardware references identify the types of BTS hardware supported by the catalog file. Column 3 of Table 8 "Correspondence between DRX hardware and EFT name" (page 126) lists these hardware references for the case of DRX hardware.

Any values of hardware references other than those shown in the table are not treated by the DRX automatic downloading feature.

For DRX versions later than V15, the OMC-R manages a dynamic table that gives the correspondence between the EFT name trigram and the hardware references.

Each time a V15 EFT is downloaded on the OMC-R, the OMC-R:

- analyses the EFT
- opens the catalog file to read the hardware references
- updates its correspondence table with the EFT trigram/hardware references

1.10.8 Improved upgrade performance

The upgrade improvements, introduced in V15.1, reduce the amount of time required for an upgrade. These improvements apply to upgrading from V15.1.

The improvements include:

- upgrading components in parallel instead serially where possible (CN and IN)
- verifying that the component status is compatible with upgrade before starting the upgrade (CC1 reset)
- improving the flash upgrade protocol (OMU)

1.11 SMS-CB management

1.11.1 Overview

The OMC-R Short Message Service - Cell Broadcast (SMS-CB) function allows users to broadcast short messages to a preselected list of BSCs and BTSs.

This service allows users to manage short messages on the OMC-R and send the orders to the BSSs to broadcast the messages to mobiles. It has two functions:

- short message management
- message broadcast management

1.11.2 Principles

Short messages are defined on the OMC-R. They are managed locally by the OMC-R manager and recorded as **short message** objects in its database.

Each short message is identified by a specific name allocated by the user. The name is unique on the OMC-R.

The messages are broadcast on a Cell Broadcast control CHannel (CBCH):

- A short message broadcast in unacknowledged mode is characterized by an identifier specified by the user and a unique serial number allocated by the OMC-R at the start of the broadcast. It allows the mobiles to identify the message and ignore a previously received message.
- A short message broadcast can be started in any number of cells, possibly belonging to different BSSs, at the same time.
- Five short messages at a time can be broadcast in a cell, whatever the BSS version is.

System users can access all the short messages, regardless of their owner.

Each BSC that controls the cells where a message is being broadcast sends the selected message to the BTSs covering the cells at regular intervals according to the repetition rate defined by the user.

The messages broadcast in a BSS are stored in a duplex partition on the BSC disk. In case of BSC restart or switchover, short message broadcasts are not interrupted.

Short message broadcasts in a BSS are automatically interrupted if the BSC application database is reset by a user command. The broadcast must be restarted when the database is rebuilt.

Short message broadcasts in a radio cell are aborted if the broadcast conditions in the cell are not satisfied (CBCH deleted).

1.11.3 Message management

The Message Management subfunction of the SMS-CB service allows users to do the following:

- create, modify, and delete short messages
- display created short message characteristics
- list the short messages created on the OMC-R

1.11.3.1 Short message characteristics

A short message is identified by a name defined by the user who creates it and is unique on the OMC-R. This information is not forwarded to the BSCs.

The message parameters are as follows:

- message language (English, French, Spanish, etc.)
- message text
- message identifier
- optional comments

The short message characteristics (including its name) can be changed during an ongoing broadcast. The new data are only implemented when the short message broadcast restarts.

A short message cannot be deleted during an ongoing broadcast.

1.11.3.2 Editing short messages

Users can change the name of a short message created on the OMC-R with the **`Rename`** command.

The **`Display`** command displays short message characteristics.

The multiple-type **`List`** command or the Line mode **`List short messages`** command allows users to display the list of short messages created on the OMC-R (only the message names and comments, if any, are supplied).

1.11.3.3 Managing the SMS-CB alphabet

The Man-Machine interface allows the user to use any SMS-CB alphabet character, as defined in the GSM 03.41 standard, version 4.4.0, in order to write a short message text.

The following apply:

- ASCII characters that can be directly entered from the keyboard are seized either by pressing the corresponding key or by typing the ‘ character followed by the character hexadecimal value.
- Characters that cannot be directly entered from the keyboard are seized in one of the following ways:
  - — type the ’character followed by the character hexadecimal value
  - — for some of them, use the compose key followed by a special sequence of keys

The Man-Machine interface checks that all characters seized by the user are part of the SMS-CB alphabet.

In the dialogue window, the short message text definition field includes a dialogue zone where the text is displayed as it is seized (ASCII display when the seizure is direct or the **compose** key is used, or hexadecimal display when the hexadecimal value is entered), and a zone where the hexadecimal values of all entered characters are displayed.

On-line help provides the correspondence between all SMS-CB alphabet characters and their hexadecimal codes.

Starting from V14.2, customers can access the binary data format in addition to the existing ASCII format.

The characters of the 7-bits coded SMS-CB alphabet and the special sequences of keys used with the **compose** key are detailed in the NTP <130> (Chapter describing the SMS-CB management commands).

1.11.4 Broadcast management

The Broadcast Management subfunction of the SMS-CB service allows users to do the following:

- start and stop short message broadcast
- display information on a short message broadcast

1.11.4.1 Requirements

The bts and bsc objects concerned by an unacknowledged, short message broadcast must be created on the OMC-R.

No more than five short messages at a time can be broadcast in a cell.

The messages are broadcast to mobiles on a specific radio channel, the CBCH. This channel must be defined for any cell concerned by a broadcast command or the OMC-R refuses the request for that cell.

Unacknowledged short messages can only be broadcast in a BSS when the BSC application database (BDA) is built or the OMC-R refuses the request.

1.11.4.2 Starting a broadcast

The **`Start broadcast`** command on a short message object starts a given short message broadcast in a number of cells that may belong to different BSSs.

The user specifies the following:

- name of the short message to broadcast
- periodicity (repetition rate). The authorized values are as follows: 2 s, 30 s (default), 1 mn, 2 mn, 4 mn, 8 mn, 16 mn, and 32 mn

- cells concerned (list of bts objects). Each cell is identified by a (bsc, btsSiteManager, bts) combination or by a list of BSCs that identifies the cell on the OMC-R.

The OMC-R manager searches for an available serial number in the range of values [16 to 16368] to allocate to the broadcast:

- The search starts in ascending order from the last allocated serial number, plus 16.
- If the maximum number is reached, the search continues from the minimum value [16].
- The first available serial number is allocated to the broadcast and recorded.
- If no serial number is available, the broadcast request is refused and the user is informed.

If the broadcast command is validated, the system response to the user command contains the serial number allocated to the broadcast.

If the short message broadcast in a cell is refused, the user is informed of the cause. This does not prevent the broadcast in the other cells in the list.

Choosing a broadcasting repetition rate of 2 seconds forbids other messages to be broadcast in the concerned cell at the same time; this is due to the maximum capacity of the Air interface which is limited to one message every two seconds. Since the OMC-R does not check that constraint, the user is not warned.

1.11.4.3 Broadcast scheduling in the BSS

When several messages are scheduled for broadcasting at the same time, the BSC has to choose which message should be broadcast first.

In case of broadcasting conflict, the following rules apply:

- If two messages are scheduled for broadcasting in the same slot, the BSC will favor the message with the longer repetition rate.
- If two messages with the same repetition rate are scheduled for broadcasting in the same slot, the BSC will favor the message that has not been broadcast the most recently (this allows to alternate between the two messages).

1.11.4.4 Stopping a broadcast

A broadcast can be stopped in two ways.

- **`Stop broadcast`** command on a bts object

This command stops short message broadcasting in the specified cell. Once the command is validated, the system response to the command contains the list of the short messages that were being broadcast in the cell.

- `Stop broadcast` command on a short message object

  This command stops the specified short message broadcast in all the cells where it is broadcast. Once the command is validated, the system response to the command contains the list of the cells where the broadcast has been stopped.

1.11.4.5 Displaying broadcast characteristics

Users can choose between the following commands:

- `Display broadcast characteristics` on a bts object displays the characteristics of ongoing short message broadcasts in a specified cell. For each ongoing message broadcast in the cell, the OMC-R supplies the following information:
  - short message name and characteristics
  - broadcast periodicity (repetition rate)
  - serial number allocated to the broadcast

- `Display broadcast characteristics` on a short message object displays the characteristics of a specified short message broadcast in network cells. The short message is identified by name. The OMC-R supplies the following information:
  - short message characteristics
  - for each cell broadcasting the short message:
    - (bsc, btsSiteManager, bts) combination identifying the cell
    - broadcast periodicity (repetition rate)
    - serial number allocated to the broadcast

1.12 Performance management

1.12.1 Overview

1.12.1.1 Principles

The OMC-R Performance Management function analyzes the information on operating conditions supplied by the OMC-R manager and connected workstations on one hand and by the OMC-R agent and the BSSs it controls on the other hand, to provide users with network monitoring and archiving facilities.

The raw measurements obtained from the OMC-R agent and BSS observations (for GSM and GPRS services) allow users to monitor network and management system performances and intervene on operating conditions.

The Performance Management function does the following:

- manages the observations:
  - — for the OMC-R agent and BSSs, starts (create mdScanner objects), stops (delete these objects or automatic abort by the system), and controls (display and set created objects)
  - — collects raw measurements (raw counters) from the OMC-R manager and connected workstations on one hand (permanent observation) and from the BSSs and the OMC-R agent on the other hand (permanent and temporary observations)
  - — calculates performance indicators (synthetic counters) in real time from raw counters (manager, md, BSS permanent, real time and pcuSN).

    The operator can create synthetic counters for the observations supporting this function (i.e. permanent observation: OFS, OGS, ORT, ODIAG and OPCUSN).
  - — detects BSS and OMC-R agent permanent observation raw counter threshold crossing at OMC-R agent level
  - — detects BSS, MD-R, PCUSN and Manager synthetic counter threshold crossing at OMC-R manager level
- manages Call tracing and Call path tracing functions:
  - — starts (create traceControl and callPathTrace objects), stops (delete or lock these objects), and controls (display and set created objects)
  - — collects trace messages from the BSS tracing functions
- stores observation records in specific files on the OMC-R agent and manager disks
- stores trace records in specific files on the OMC-R agent disks
- makes available, on request, permanent and temporary observation reports (raw, custom, daily, and busiest day of the month)
- archives information at OMC-R manager level on removable magnetic cartridges that allow users to study the information at a later time to improve the quality of service and optimize cost effectiveness
- collects radio distribution files from the BSC and makes them available on SDO in XML format

- collects call drop files from the BSC and makes them available on SDO in XML format
- collects interference matrix files from the BSC and makes them available on SDO in XML format

1.12.1.2 Managed objects

Managed objects at OMC-R agent level The objects managed at OMC-R agent level fall into the following categories:

- The mdScanner objects created by users stop and start the OMC-R agent permanent observation and the BSS permanent and temporary observations.
- The traceControl and callPathTrace objects created by users stop and start the BSS Call tracing (traceControl objects) and Call path tracing (callPathTrace objects) functions.
- The associated log objects created by the OMC-R agent define associated message storage conditions on the OMC-R agent disks: a current observation log is partnered with each created mdScanner object (not including the instrument panel), a current trace log is partnered with each created traceControl or callPathTrace object, a restored message log is created when observation or trace files are restored to OMC-R agent disks.
- The efd objects of "obs" and "trace" types allow users to filter the observation or trace message feedback to the OMC-R manager.
- The mdWarning objects describe the conditions in which alarms related to "observation counter threshold crossing" and "excessive software application error rate" notifications are issued by the OMC-R agent.
- The mdScanReportRecord objects store the temporary observation data record in an observation log.
- The observationFileReadyRecord objects store the filename of permanent observation data record in an observation log.
- The traceLogRecord objects describes the call tracing data record format in a trace log for the priority traces collected by the Call tracing function.
- The traceFileReadyRecord objects describe the names of the files where the records of non--priority traces collected by the Call tracing and Call path tracing functions are stored.

All these objects are functional objects that depend on the md object. They can be accessed through the related managed object (such as bsc, bts, md, etc.). They have numerous instances.

Managed objects at OMC-R manager level The MMI omc object allows users to consult OMC-R manager and connected workstation observation reports.

1.12.1.3 Mechanisms of observation.

The mechanism of observation can be subdivided as follows:

- ***Permanent observation : specific mechanisms***
  - — Real time observation (ORT)
  - — The general statistic permanent observation (OGS)

  This observation must allow the realization of daily statistics.
  - — The fast statistic observation (OFS)

  This observation must allow the realization of hourly statistics.
  - — Diagnostic permanent observation (ODIAG)

  This observation must allow the observation and the control of network or the investigation on the bad function. The diagnostic of observation is activated on cells selected or preselected during a time defines.
- ***Temporary observation (specific to the BSC 12000HC)***

  The temporary observations types available depend on BSS release.
  - — Abis Interface temporary observation
  - — Interference temporary observation,
  - — SS7 link temporary observation

BSS permanent observation The BSS permanent observation is started on user request and covers a large number of BSS counters that are periodically sent to the OMC-R agent for forwarding to the OMC-R manager.

The data are stored. They are displayed and backed up on user request.

Permanent md observation The permanent md observation is started on user request and involves all the OMC-R agent counters that are periodically read by the OMC-R agent and forwarded to the OMC-R manager.

The data are stored. They are displayed and backed up on user request.

Permanent manager observation The permanent manager observation is automatically started when the OMC-R is started up and is not managed by users. It involves all the OMC-R manager and connected workstation counters that are periodically read and collected by the OMC-R manager.

The data are stored. They are displayed and backed up on user request.

Real time observation The BSC real time observation is a subset of the BSS permanent observation. Its content is informative and is periodically forwarded to the OMC-R agent.

The last received message can be displayed in real time.

Temporary observations (specific for the BSC 12000HC) A temporary observation is started on user request and involves a large number of counters that supply indications on the operating conditions of BSS entities (physical or logical) that are not regularly monitored.

BSS counters are periodically sent to the OMC-R agent for forwarding to the OMC-R manager.

The data are used for in--depth analysis of permanent observations and are stored. They are displayed and backed up on user request.

1.12.1.4 Observation time parameters

Observation time parameters are as follows:

- periodicity of BSS counter collection

  The mdGranularityPeriod parameters of the mdScanner objects describing the BSS permanent, performance monitor, and temporary observations define the period at which the OMC-R agent collects the BSS counters.

  These periodicities are set by the user with different values according to the observed BSC and observation type. The BSS permanent and performance monitor observation parameters can be modified.

- periodicity of OMC-R agent counter collection

  The mdGranularityPeriod parameter of the mdScanner object describing the permanent md observation defines the period at which the OMC-R agent reads its own counters.

  The default value of this parameter is 5 minutes but can be modified.

- periodicity of OMC-R manager counter collection

  The period at which the OMC-R manager reads its own counters and those of the connected workstations is defined in the static configuration and cannot be modified.

- temporary observation run times

  The stopTime parameter of mdScanner objects describing temporary observations defines the corresponding observation run time.

Run times are set by the user with different values according to the observation. They cannot be modified and are limited to 24 hours.

1.12.1.5 Observation counters

There are two types of observation counters:

- Raw counters contain the raw measurements from the BSS (GSM and GPRS services) or OMC-R agent and are divided into cumulative counters, load counters, and value counters (BSS).
- Synthetic counters contain the data calculated from raw counter data or other synthetic counter data. The calculation formulas are defined in configuration files.

  These counters allow users to perform an in--depth analysis of network operating conditions. They are unique to permanent manager, permanent md, BSS permanent, pcuSN and Performance Monitor observations.

Some totals can be calculated in time (custom totals, daily totals) and in space (for example, totals calculated on all cells of a BSS).

1.12.1.6 Identifying the observation counters

The OMC-R identifies each observation counter by a Q3 name and title that identify the counter in a defined class/type:

- class = raw, synthetic
- type = BSS permanent (OFS and OGS), Real Time (ORT), temporary (including ODIAG), permanent md, permanent manager and PCUSN

A raw counter contains the raw data measured by the BSS entity, whereas a synthetic counter contains the processed results calculated by the OMC-R from raw measurements or synthetic calculations.

NTPs < 125 > and < 133 > detail the observation counters and their functions.

1.12.2 Permanent observations

1.12.2.1 Permanent observation management

- BSS permanent observation

  A BSS permanent observation must be activated when the BSS is started up for the first time by creating an mdScanner object. The observation is stopped by deleting the mdScanner object but this is not recommended.

  The `Display` command on the object allows users to see whether the observation is running, check the counter collection period (mdGranularityPeriod parameter), and obtain other characteristics. The collection period can be changed while the observation is running.

A BSS permanent observation processes raw counters collected by the BSS and synthetic counters computed by the OMC-R agent.

- Permanent md observation

  The OMC-R agent permanent observation starts automatically when the system is initialized and cannot be stopped. When the mdScanner object that describes the observation is created, the OMC-R agent immediately starts collecting and forwarding its own counters to the OMC-R manager.

  The **`Display`** command on the object allows users to check the counter collection period (mdGranularityPeriod parameter), and obtain other characteristics. The collection period can be changed when the corresponding mdScanner object is created.

  The permanent md observation processes raw counters collected on the OMC-R agent active server and synthetic counters computed by the OMC-R manager.

- Permanent manager observation

  The OMC-R manager permanent observation starts automatically when the system is initialized and cannot be stopped. When a new workstation is connected, its own counters are automatically collected.

  The permanent manager observation processes raw counters collected on the active OMC-R manager and connected workstation servers, and synthetic counters computed by the OMC-R manager.

1.12.2.2 Permanent observation periods

The mdGranularityPeriod periods are used to manage this observation.

Their characteristics are the following:

- A BSS permanent observation collection period may vary independently of the permanent observation collection periods of other BSSs controlled by the OMC-R agent. Each period is synchronized on the BSC reference time stamp.

Depending on NNS permanent observation type, the authorized values are the following:

Type	Period (T1)
ORT	1, 2, 3, 4, 5 minutes
OFS	15, 30, 60 minutes
OGS	1440 minutes (24 hours)
ODIAG	15 minutes (*)
TEMPORARY OBS (BSC 12000HC)	5, 10, 15, 30 minutes
(*) for the BSC 3000, the ODIAG T1 value is depending on the objects and the number of objects observed. Typically, the value is limited to 15 minutes if the cells are observed 4 days (limit). Typically, if there are no cell top observe, the value can be down to 5, 10 minutes (same value as SS7 or LAPD observation for BSC 12000HC).	

- The recommended and default OMC-R agent permanent observation collection time is 5 minutes.

  The authorized values are 5, 10, and 15 minutes.

  The collection time is re-initialized to 5 minutes when the associated mdScanner object is deleted.
- The OMC-R manager permanent observation collection time is defined in the static configuration and cannot be modified.

1.12.2.3 Permanent observation report availability

Six levels of observation reports are available on request, according to the observation period:

- bts level

  One observation report per cell is available on user request. The report contains the raw cell counters read by BSC applications and the associated synthetic counters.

  A report containing the total number of raw and synthetic counters read in all cells of a BSS can also be requested.
- adjacentCellHandOver level

  One observation report per neighbor cell is available on user request. The report contains the raw neighbor cell counters read by BSC applications.

  A report containing the total number of raw counters read in all neighbor cells of a BSS can also be requested.
- transceiverZone level

One observation report per zone is available on user request. The report contains the raw counters read by BSC applications related to the allocation of resources and intra-bts handovers in a concentric cell.

- bsc level

  One observation report per BSC is available on user request. The report contains the raw and synthetic counters computed from the BSS cell, PCM and radio site raw counters.

- md level

  One single md observation report is available on user request, that contains the raw counters read on the active OMC-R agent server.

- manager level

  One single omc observation report is available on user request, that contains the raw counters read on the active OMC-R manager and connected workstation servers.

- transcoderUnit level

  One observation report per TCU is available on user request. The report contains the raw TCU counters read by BSC applications and the associated synthetic counters. A report containing the total number of raw and synthetic counters read in all TCUs of a BSS can also be requested.

- TDMA level

  The feature “PM1270 - TDMA based counters (15405)”, introduced in V16.0, provides TDMA based counters (for BSC 3000 only). These are in addition to having counters at the TDMA class (TransceiverZone) or cell level. The purpose of these TDMA-based counters is to give the operator a more precise view of the quality of the network.

The counters are produced on a multiple of <mdGranularityPeriod> minutes after the exact hour. The following apply:

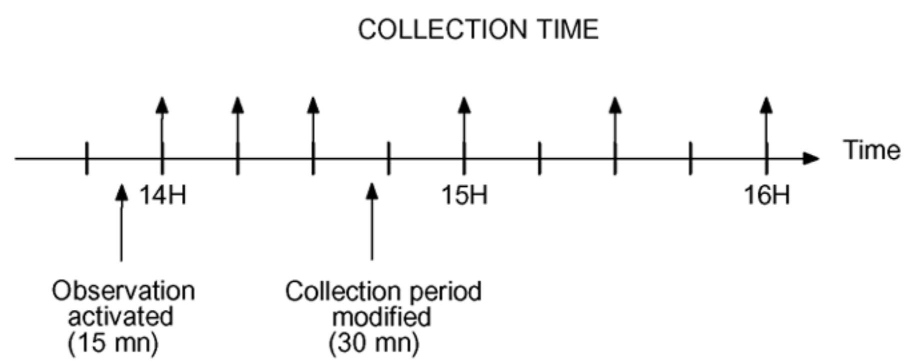
- If an observation run is started at 13H 50 mn with a 15 minutes collection period, the counters are produced at 14H, 14H 15 mn, 14H 30 mn, etc.
- If an observation run is started at 14H 10 mn with a 30 minutes collection period, the counters are produced at 14H 30, 15H, 15H 30 mn, etc.

If the user changes the collection period, counting is not interrupted, but the time of the next reading is automatically reset to a multiple of <mdGranularityPeriod> minutes after the exact hour.

The **mdObservationDuration** value is for each observation record the exact duration of the measurement;

The change may result in collecting the counters after an intermediate period different from the new defined period. The following - illustrated on the figure below - apply:

- If, for example, a 30 minutes period is changed to 5 minutes at 14H 37, counters will be next collected at 14H 40, then at 14H 45, 14H 50, 14H 55, and so on.
- Therefore, there will have two collections at 14H and 14H 30 with a 30 minutes gap, one collection at 14H 40 with a 10 minutes gap, and the following collections with a 5 minutes gap as required.



To complete network monitoring information, additional observation reports are available. They allow activity statistics to be evaluated at short (custom reports), medium (daily reports), and long (busiest day of the month reports) terms.

- custom observation reports (user-defined period)

  A custom observation report is available on user request. It contains the totals or mean values (depending on the type of counter) of the measurements collected, on a given date and over a period of time ranging from zero to six hours, on all the permanent bsc, md, or manager observation counters.

  The time band defines the number of observation message included in totals and mean value calculations (addition of collection periods).

  The OMC-R manager supplies custom observation reports for the present day and the three previous days.

- daily observation reports (day period)

  A daily observation report is available when the first of the next day's messages is received (it is not available for the current day). It contains the totals or mean values (depending on the type of counter) of the measurements of all previous day's permanent bsc, md, or manager observation counters.

The totals and mean value calculations start at 0h on D-day and are updated in real time as each new observation message is received the same day.

The OMC-R manager can at most supply daily observation reports for the last three days. The availability of the daily observation reports depends on purge configuration at manager level.

- busiest day of the month observation reports

  An observation report on the busiest day of the month is the daily observation report generated on the day of the month during which the total values measured on a reference counter over a given reference period were the highest. The reference period can be in the range of 00 to 24 hours (it may be as follows: 08:00 - 19:00). The reference time and counter are statically configured (raw BSS counter, or active OMC-R agent or manager UNIX server counter).

  The OMC-R manager supplies the busiest day of the month observation report for the current and previous months. The busiest day of the current month observation report is available as soon as the second day of the month is started and is updated each day until the first day of the following month.

1.12.2.4 Custom report and daily report counter processing

An elementary report is the report that uses data collected when the defined mdGranularityPeriod elapses.

A custom or daily report is established from a number (N) of elementary reports calculated by adding the periods of each elementary report it contains. For example, a custom report covering a period of two hours can contain three elementary reports of 30 minutes each and two elementary reports of 15 minutes each.

The method used to calculate a custom or daily report depends on the type of counter involved (cumulative, value, or load).

Elementary report counters Let *i* be the elementary report number:

- cumulative counter T_i:
  - Tcv_i = total of T_i
- value counter V_i:
  - Vcv_i = total of V_i
  - Vne_i = number of samples in V_i
  - Vav_i = average of V_i = Vcv_i / Vne_i

- load counter C_i:
  - Ccv_i = total of C_i
  - Cne_i = number of samples in C_i
  - Cav_i = average of $C_i = Ccv_i / Cne_i$

Custom or daily report counters Let n be the number of elementary reports in the custom or daily report:

- total cumulative counter value:
  - $Tcv = Tcv_1 + Tcv_2 + ... + Tcv_n$
- mean value counter value:
  - $Vav = (Vcv_1 + Vcv_2 + ... + Vcv_n) / (Vne_1 + Vne_2 + ... + Vne_n)$
- mean load counter value:
  - $Cav = (Cav_1 + Cav_2 + ... + Cav_n) / n$

1.12.2.5 Storing permanent observation records

Storage and transfer Two modes of sending observation results to the OMC-R are used depending on the observation type. These are described below :

- The first mode is direct access to the OMC-R for the messages related to the temporary (only for the BSC 12000HC) and the real time observation.
  - Temporary observations are stored at the end of each period of observation in a circular file able to contain 24 hours of observation at most.
  - Real time observations are stored at the end of each period of observation in a circular file able to contain only one message.
- The second mode uses the standard protocol of File Transfer (FTAM). This mode is necessary for counter messages related to general statistic observation, fast statistic observation and diagnostic observation. One file per observation type, named with its collecting date, is opened for each counter message. This file is also mirrored. After concatenation of the segments and the storage of the complete message on the disk, an event report is sent to the OMC-R file, signalling the existing file. The OMC-R has to read and then to delete this file according to the FTAM protocol.

BSC 12000HC observation record store Each time the defined mdGranularityPeriod expires, the observation counters are collected and an observation record is generated. It is stored in a file of the :GPO: partition on BSC 12000HC disks with relevant information, such as serial number, measurement time, an collection period. The BSC 12000HC informs the OMC-R agent that a new observation file is ready for transfer.

In normal operating conditions, the observation file is immediately transferred and automatically purged from the :GPO: partition.

For some reason, particularly in case of BSS/OMC-R link outage or when a BSC 12000HC audit is in progress, it may not be possible to transfer the file. Then it is stored in the :GPO: partition with all subsequent observation files until the link is restored or the audit ends (see the following figure).

If the :GPO: partition of the BSC 12000HC is saturated, then BSC 12000HC removes the whole partition.

When the BSS/OMC-R link is restored or the audit ends, the files are transferred in chronological order and purged from the :GPO: partition.

If the BSC 12000HC switches over to the standby chain, the file transfer (when the BSS/OMC-R link is operational) or storage (when the link is down) continues since the BSC 12000HC processing chains are mirrored.

If the BSC 12000HC application database is rebuilt, some records may be lost since the BSC automatically deletes any record collected but not transferred once its database is rebuilt.

The :GPO: partition can store all the observation files generated in a 24-hour period. In case of overflow, then the BSC 12000HC deletes all the files that are over 24 hours old.

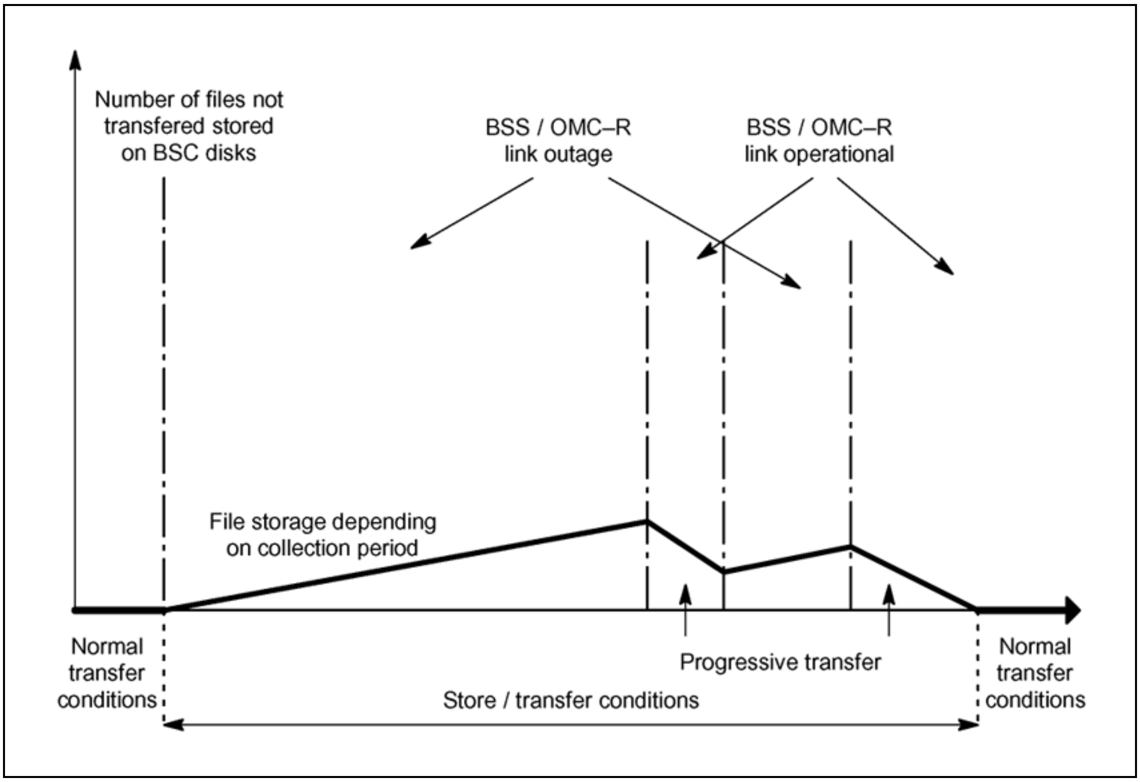
All the observation records received more than three days after they were collected are purged the following night. The OMC-R automatic purge function only recognizes the date included in the OMC-R file name.

BSC 3000 observation record store General statistic observation, fast statistic observation and diagnostic observations are stored at the end of each period of observation in the corresponding file on a disk partition of the BSC 3000. The name of the partition in Unix is "/OMU/share /log/". This partition is sized in order to be able to contain at least 72 hours of observation. After 72 hours, the messages will be discarded each hour,

- a warning will be sent to the OMC-R as well as the name of associated file.
- if no place is available, a hardware anomaly, as well as the name of the partition, will be sent to the OMC-R.

The format of the name of the file is /OMU/share/log/**`directory/name_file`** where the *directory* depends on the type of observation.

Figure 23
Observation file store and transfer process



OMC-R observation record store All the observation records collected by the OMC-R agent are stored on the OMC-R agent disks with relevant information, such as the time counters were read and received, and the collection period. By default, the records are stored for no more than 4 days (D, D-1, D-2, D-3) on E45XX and up to 8 days (D, D-1, D-2, D-3, D-4, D-5, D-6, D-7) on SFV880 and SFV890.

The maximum configurable duration for MD storage is 20 days including today for all hardware configurations.

All the observation records forwarded to the OMC-R manager by the OMC-R agent or directly collected by itself are stored on the OMC-R manager disks with the same information. The default and maximum storage duration on local manager is the same as on MD-R (see above).

The observation records are stored in special files in dedicated directories. Daily reports and busiest day of the month reports are stored in the same way.

The directories and observation file naming rules are described in Section 1.12.6 "OMC-R message store" (page 163).

1.12.2.6 Consulting permanent observation reports

Users can only display and print permanent observation reports during work sessions. Reports are not automatically displayed and printed but must be requested.

The reports are available immediately after the defined collection time expires.

A manufacturer's file stored in the "/OMC/config/locale/en" directory on the OMC-R manager disks describes the display presentation format.

Other than the actual observation data, the reports contain the following information:

- report level (adjacentCellHandOver, bts, bsc, md, manager, transceiverZone, tdma)
- identifier of the observed object (for all BSS reports), OMC-R agent (md report), OMC-R manager and connected workstations (manager report)
- date and time of counter collection by the BSC (permanent bsc observation reports), the OMC-R agent (permanent md observation report), or the OMC-R manager (permanent manager observation report)
- date and time the OMC-R agent received the messages (permanent bsc and md observations) or the OMC-R manager collected the messages (permanent manager observation)
- effective observation run time

Users may also consult the current and the last three days' custom reports, the last three daily reports, and the busiest day of the month reports for the current and previous months.

- On the BSC 3000, the collection of the information is duplex (mirror disk and duplex OMU), but the entities where we collect the observations may be themselves duplex (swact of activity of any entity of the BSC). Typically, it is possible that collection of observations on specific objet is temporarily unavailable, lost or not representative because of a swact of activity inside the system.

1.12.2.7 Archiving permanent observation messages

The permanent observation messages stored before the current day can be backed up and restored on--line.

The right to archive permanent observation messages is set in configuration data the user can modify when the mdScanner object describing the observation is created.

Observation message archiving parameters are statically configured (see NTP < 006 >). All the reports generated on a given date are archived (raw reports, daily reports, busiest day of the month reports).

1.12.2.8 Permanent observation synthetic counters

There are two types of permanent observation synthetic counters: "manufacturer" and "operator".

The "manufacturer" synthetic counters are defined by Nortel and cannot be modified by the user. They are delivered with the OMC-R. They are stored in files whose names are: *_nmc_formulas.dat (where * is bss, omc, or pcu).

The "operator" synthetic counters are defined by the user and can be modified using the Synthetic Counters Editor tool (and reloaded on user request). They are stored in files whose names are: *_operator_formulas.cfg (where * is bss, omc, or pcu).

The following operations are allowed:

- add, subtract, multiply, divide
- total of all counter occurrences
- minimum of all counter occurrences
- maximum of all counter occurrences
- mean value of all counter occurrences

BSS permanent observation The manufacturer file is in the directory "/OMC/data/perf" directory (on the OMC-R manager disks) and its name is "bss_nmc_formulas.dat".

The operator file is in the directory "/OMC/data/custo_config/config" directory and its name is "bss_operator_formulas.cfg".

Synthetic counters are uniquely identified in the OMC-R. They are displayed using the appropriate formatting file with observation reports.

When consulting a permanent bsc observation report, the user can choose whether to include synthetic counters in the report.

OMC-R agent and manager permanent observations The manufacturer file is in the directory "/OMC/data/perf" directory (on the OMC-R manager disks) and its name is "omc_nmc_formulas.dat".

The operator file is in the directory "/OMC/data/custo_config/c onfig" directory and its name is "omc_operator_formulas.cfg".

Permanent md and manager observation synthetic counters are uniquely identified in the OMC-R and are part of these permanent observations.

PCUSN permanent observation It is possible to have synthetic counters for the PCUSN.

The manufacturer file is in the directory "/OMC/data/perf" directory (on the OMC-R manager disks) and its name is "pcu_nmc_formulas.dat".

The operator file is in the directory "/OMC/data/custo_config/config" directory and its name is "pcu_operator_formulas.cfg".

1.12.2.9 Counter threshold crossing

BSS permanent observation (GSM and GPRS services)

Raw counters (BSS only) When the OMC-R agent Performance Management function receives a BSS permanent observation message, it analyzes the counters contained in the message.

If *for the first time* one of the counters crosses the limits defined by the operator (values above or below the high and low thresholds defined with the associated mdWarning object), the OMC-R agent sends a message to the Fault Management function that may issue a notification or generate an alarm. Refer to Section 1.13 " Fault management" (page 177).

The mdWarning functionality is available only for OFS observations (not for all BSS permanent observations).

Figure 24 "Threshold crossing detection" (page 149) shows the threshold crossing message generation mechanisms.

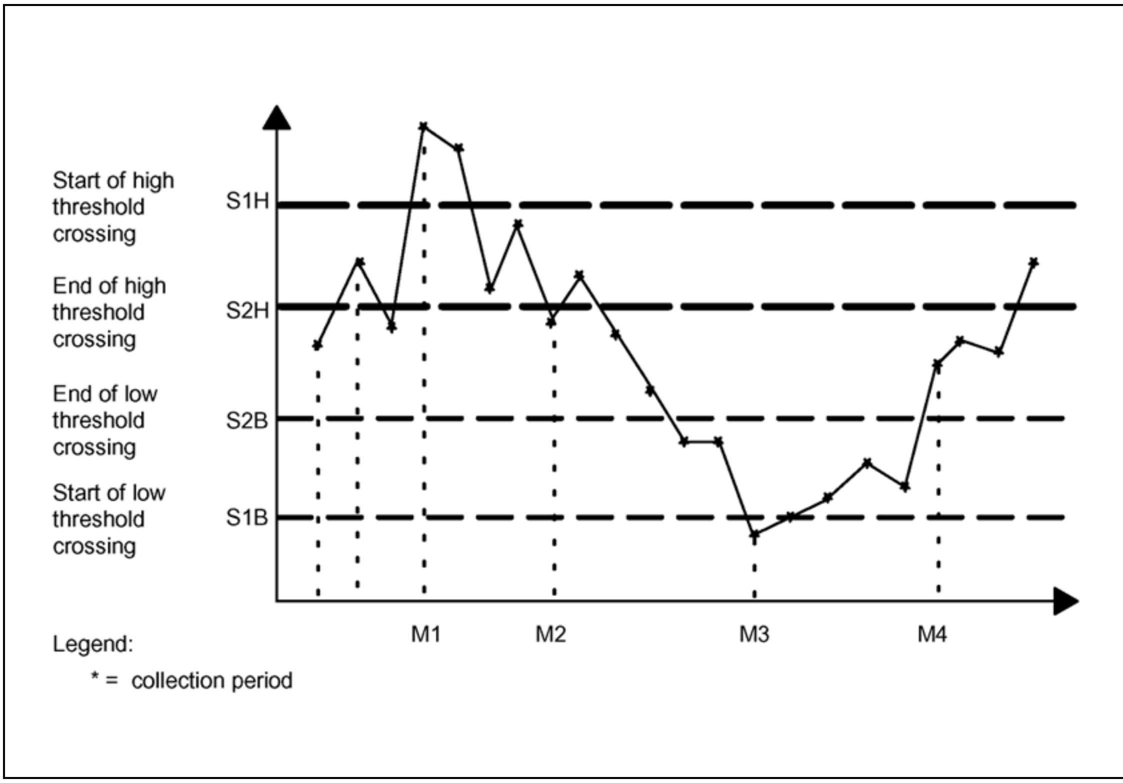
For a cumulative counter, the accounting time used for the test is set to one minute in static configuration data. The threshold values correspond to the defined accounting time and are independent of the counter collection period.

Four types of messages are generated:

- M1 on start of high threshold crossing (S1H)
- M2 on end of high threshold crossing (S2H)
- M3 on start of low threshold crossing (S1B)
- M4 on end of low threshold crossing (S2B)

The mdWarning objects created by the users define the threshold values and the conditions in which the alarms handled by the mdWarning objects are generated.

Figure 24
Threshold crossing detection



Two independent mdWarning objects can be associated with every BSS permanent observation counter occurrence:

- One defines the high threshold crossing processing conditions, the other defines the low threshold crossing processing conditions.
- Changing the administrativeState of the mdWarning objects allows users to activate or deactivate the generation of the alarms that they handle.
- In a BSS, one counter occurrence can be managed independently of other occurrences of the same counter.

Synthetic counters (GSM and GPRS services) When the user requests a permanent observation report to be output and the synthetic counters to be included in the report, the OMC-R Manager Performance Management function calculates and checks thresholds for the defined synthetic counters.

If one of the counters crosses the limits defined by configuration, the OMC-R agent sends a message to the Fault Management function that may issue a notification and generate an alarm.

Threshold values and alarm processing conditions are defined in the configuration file.

One should note that, unlike raw counters, the following apply:

The high and low thresholds associated to the definition of a synthetic counter are used for all the occurrences of this counter. For instance if the "TOTO" counter of bts class has two thresholds H and L, these two thresholds apply to the "TOTO" counter in all the bts objects (bts1, bts2, ...).

1.12.3 Performance Monitor observation

1.12.3.1 Performance Monitor observation management

The performance monitor (ORT, and OFS) observation must be started when the BSS starts up for the first time by creating an mdScanner object. The observation can be stopped by deleting the mdScanner object but this is not recommended.

The **`Display`** command on the object indicates whether the observation is running, and allows users to check the counter collection period (mdGranularityPeriod parameter) and other characteristics. The collection period can be changed while the observation is running.

The Performance Monitor observation uses the raw counters collected by the BSS and the synthetic counters processed by the OMC-R. When the *Performance Monitor* window is opened, the report the user accesses is an historical report on the selected counters over the period configured in the "*Display only last ... hours (<2)*" field of the **Performance Monitor** window.

1.12.3.2 Performance Monitor observation periods

The mdGranularityPeriod periods are used to manage this observation:

- The value of the period at which performance monitor data are collected in a BSS may vary independently of the collection periods of other BSSs controlled by the same OMC-R.

  The authorized values for ORT are 1, 2, 3, 4, and 5 minutes, and for OFS (available in the **Performance Monitor** window from V12), 15, 30, and 60 minutes.

1.12.3.3 Performance Monitor observation report availability

The following reports are available on user request:

- bsc
- btsSiteManager
- bts
- pcmCircuit

- adjacentCellHandover
- transceiverZone
- tdma
- omu
- tmu
- cc
- cem
- pcmPort
- signallingLink
- channel

The report is refreshed when new observation messages are received.

1.12.3.4 Storing Performance Monitor observation messages

BSC observation message store Each time the defined mdGranularityPeriod expires, the observation counters are collected and an observation message is generated. It is stored in a file of the :GPO: partition on BSC 12000HC disks with relevant information, such as serial number, measurement time, and collection period. The BSC 12000HC informs the OMC-R agent when a new observation message is ready for transfer.

In normal operating conditions, the observation message is immediately transferred and automatically purged from the :GPO: partition.

For some reason, particularly in case of BSS/OMC-R link outage or when a BSC 12000HC audit is in progress, it may not be possible to transfer the messages. Then they are stored in the :GPO: partition with all subsequent observation messages until the link is restored or the audit ends.

If the :GPO: partition of the BSC 12000HC is saturated, then BSC 12000HC removes the whole partition.

When the BSS/OMC-R link is restored or the audit ends, the messages are transferred in chronological order and purged from the :GPO: partition.

If the :GPO: partition of the BSC 12000HC is saturated, it is deleted.

If the BSC 12000HC switches over to the standby chain, the message transfer (when the BSS/OMC-R link is operational) or storage (when the link is down) continues since the BSC 12000HC processing chains are mirrored.

If the BSC 12000HC application database is rebuilt, some messages may be lost since the BSC automatically deletes any message collected but not transferred once its database is rebuilt.

The :GPO: partition can store all the observation messages generated in a 24-hour period. In case of overflow, then the BSC 12000HC deletes all the messages that are over 24 hours old.

All the observation messages received more than three days after they were collected are purged the following night. The OMC-R automatic purge function only recognizes the date included in the OMC-R file name.

OMC-R observation message store See the section "OMC-R observation record store" in Section 1.12.2.5 "Storing permanent observation records" (page 143).

1.12.3.5 Updating Performance Monitor observation reports

The OMC-R Manager only keeps in memory the last record received.

When a user requests a report in Performance Monitor, all the information is immediately displayed. The data are automatically updated after each collection.

1.12.3.6 Consulting Performance Monitor observation reports

Users can display and print performance monitor observation reports during a work session or from an off-line terminal. Reports are not automatically displayed and printed but must be requested.

"Performance monitor" windows are partnered with an output class (refer to Section 1.16 "Security management" (page 231) in this chapter). The reports that can be consulted are available immediately after the defined collection time.

The configuration files defining the presentation of text ORT report are stored in /OMC/config/locale/en/<xxVyy>, where <xxVyy> can be 2GV12, 2GV15, 3GV14, 3GV15 and 3GV16.

Other than the actual observation data, the reports contain the following information:

- report level (bts, bsc)
- observed cell (bts report) or BSC (bsc report) reference number
- date and time of counter collection by the BSC
- date and time of message reception by the OMC-R agent
- effective observation period

1.12.3.7 Archiving Performance Monitor observation messages

Performance Monitor observation messages are only intended for real time displays. They are not stored, on the OMC-R disks and cannot be archived.

1.12.3.8 Performance Monitor observation synthetic counters

There are two types of Performance Monitor observation synthetic counters: "manufacturer" and "operator".

The "manufacturer" synthetic counters are defined by Nortel and cannot be modified by the user. They are delivered with the OMC-R. They are stored in the "/OMC/data/perf/bss_nmc_formulas.dat" file.

The "operator" synthetic counters are defined by the user and can be modified using the Synthetic Counters Editor tool (and reloaded on user request). They are stored in the "/OMC/data/custo_config/config/bss_operator_formulas.cfg" file.

The following operations are allowed:

- add, subtract, multiply, divide
- total of all counter occurrences
- minimum of all counter occurrences
- maximum of all counter occurrences
- mean value of all counter occurrences

Performance Monitor observation synthetic counters are uniquely identified in the OMC-R and are part of the BSS Performance Monitor observation. They are displayed using the appropriate formatting file with BSS Performance Monitor observation reports.

When consulting a Performance Monitor observation report, the user can choose whether to include synthetic counters in the report.

1.12.4 Temporary observation for BSC 12000HC only

1.12.4.1 Temporary observation management

BSS permanent and Performance Monitor observations should not be interrupted and are an essential part of network performance monitoring.

Users can start temporary observation measurements (by creating an mdScanner object) to obtain additional information on the performance of a particular BSS entity in case of operating problems. To stop temporary observation measurements, the user deletes the mdScanner object when the problem is solved or when sufficient information has been supplied.

The **`Display`** command on the mdScanner object indicates whether the observation is running and allows the user to check the counter collection period (mdGranularityPeriod parameter), and the observation run time (stopTime parameter). The observation collection period and duration cannot be modified while the observation is running.

A temporary observation is stopped by the OMC-R agent when the stopTime timer expires or when the user deletes the mdScanner object. If the observation is still running when the user closes the work session, the observation continues until the defined run time expires.

Notes:

- The user must specify a **stopTime** for a temporary observation by applying the following rule:

  startTime + mdGranularityPeriod < stopTime <startTime + 24 h

  Thus, at least one observation record is collected.

- Concerning the last record, since the collections take place at instants multiple of **mdGranularityPeriod** (ex: H:00, H:30, for **mdGranularityPeriod** = 30 min), if the observation expiration occurs at H:03, the last collected record will be the one of H:00.

Restrictions regarding temporary observation management are the following:

- Two temporary observations of the same type cannot be run at the same time in a BSS.
- Temporary observations in a BSS cannot be stopped before the stopTime timer expires if the BSS/OMC-R link is down or if a BSC database audit is in--progress.
- The number of temporary observations that can be run simultaneously on all the BSSs controlled by the OMC-R agent is limited.

BSS temporary observation measurements only produce raw counters.

1.12.4.2 Temporary observation periods and run times

The mdGranularityPeriod periods and stopTime run times are used to manage this observation:

- The value of the period at which temporary observation data are collected in a BSS may vary independently of the temporary observation collection periods of other BSSs controlled by the OMC-R agent.

  The authorized values, for all temporary observation types (except for ODIAG) are 5, 10, 15, 30 and 60 minutes.

  For ODIAG the only authorized value is 15 minutes.

- A temporary observation run time must be greater or equal to the defined collection period and is limited to 1440 minutes (24 hours).

1.12.4.3 Temporary observation report generation

The following types of BSS observations can be run:

- Interference temporary observation
- Abis Interface temporary observation
- SS7 link temporary observation
- ODIAG

Additional custom observation reports are available to evaluate activity statistics at short terms:

- A custom report per temporary observation is available on user request. It contains the totals or mean values (depending on the type of counter) of the measurements collected on a given date and over a period of time ranging from zero to six hours, on all the temporary observation counters.
- The time band defines the number of observation message included in totals and mean value calculations (addition of collection periods).
- The OMC-R manager supplies custom observation reports for the present day and the three previous days.

1.12.4.4 Storing temporary observation messages

BSC observation message store Each time the defined mdGranularityPeriod expires, the observation counters are collected and temporary observation records are generated. They are stored in a circular file created in the :TO: partition on the BSC disks with relevant information, such as serial number, time of reading, and collection period. The BSC informs the OMC-R agent when a new observation record is ready for transfer.

In normal working conditions, the observation records are immediately transferred to the OMC-R agent and the circular file is progressively purged.

For some reason, particularly in case of BSS/OMC-R link outage or if a BSC audit is in progress, it may not be possible to transfer the observation records to the OMC-R agent. The data are stored in the circular file until the link is restored or the audit ends.

As soon as the link is restored or the audit ends, the records are sent to the OMC-R agent one by one, starting with the oldest record. The frequency of transfer is set at 20 seconds in static configuration data.

The same process shown on Figure 23 "Observation file store and transfer process" (page 145) is used for storing and transferring temporary observation records.

The circular file can store all the records generated in a 24-hours period.

If the BSC switches over to the standby chain, the message transfer (when the BSS/OMC-R link is operational) or storage (when the link is down) continues since the BSC processing chains are mirrored.

If the BSC application database is rebuilt, some records may be lost since the BSC automatically deletes any record collected but not transferred once its database is rebuilt.

All observation records received more than three days after they were collected are purged the following night. The OMC-R automatic purge function only recognizes the date included in the OMC-R file name.

1.12.4.5 Statutory time change

When the statutory time changes (from Summer to Winter time, and vice--ver sa), temporary observation run times are decreased or increased accordingly.

1.12.4.6 Consulting temporary observation reports

Users can only display and print temporary observation reports during work sessions. Reports are not automatically displayed and printed but must be requested.

A user can request a report while the observation is running or after it stopped. The reports are available after each defined collection time.

A manufacturer's file stored in /OMC/config/locale/en/<xxVyy> (where <xxVyy> can be 2GV12, 2GV15, 3GV14, 3GV15 and 3GV16) on the OMC-R manager disks describes the display presentation format.

Other than the actual observation data, the reports contain the following information:

- report type: handOver, interference, etc.
- reference numbers of the observed objects on the OMC-R
- date and time of counter collection by the BSC
- date and time of message reception by the OMC-R agent
- effective observation period

1.12.4.7 Archiving temporary observation messages

The temporary observation messages stored before the current day can be backed up and restored on-line.

The right to archive temporary observation reports is defined in configuration data the user can update when the mdScanner object describing the temporary observation is created.

Observation message archiving is defined in static configuration data (see NTP < 006 >) for a given date. It concerns all the raw reports generated on the given date.

1.12.5 Trace management

1.12.5.1 Principles

Call tracing function The Call tracing function is unique in a BSS and allows, on MSC request, to record information related to one or more calls controlled by the BSC.

Trace data storage is activated at BSC level on receipt of the BSSMAP MSC TRACE INVOKE message (MSC Phase II) or the BSSMAP TRACE INVOKE message (MSC Phase I) issued by the MSC. Trace characteristics (type of transfer according to the trace priority, type of trace = basic, handover, radio) are transmitted to the BSC through this message.

Tracing a call ends when the call is no more controlled by the BSC, that is when the call ends or when an outgoing handover is performed.

The BSS Call tracing function is activated by creating a traceControl object. It is deactivated when the object is locked or deleted.

The **`Display`** command on that objet allows the user to know if the function is active (unlocked object) and check its characteristics. They can be modified when the traceControl object is locked.

Call path tracing function The Call path tracing function (follow-up of calls using common resources) is unique in a BSS and is controlled by the BSC. It allows to record information related to calls using selected resources in the BSS, such as set of cells, set of TRX/DRXs, set of terrestrial circuits.

During a path tracing follow-up, all calls that enter the observation area are automatically traced by the BSC (in the limits set for each type of trace). For example, if only one terrestrial circuit is observed and a call is established on that circuit when the Call path tracing function is activated, then the call is automatically traced.

Tracing a call ends when the call stops using the traced resources or when the path tracing follow-up stops.

The BSS Call path tracing function is activated by creating a callPathTrace object. It is deactivated when the object is locked or deleted.

The **Display** command on that objet allows the user to know if the function is active (unlocked object) and check its characteristics. They can be modified when the callPathTrace object is locked.

1.12.5.2 Management parameters

Call tracing function A BSS Call tracing function is identified in the OMC-R by a traceControl object which defines the number of the associated BSC and partial record generation conditions such as the following:

- at the expiration of a given period of time
- on occurrence of a given event (the only type of event managed by the BSC is "handover")
- on each occurrence of a given number of "handover" events
- on BSC request only, if the manual of data associated with a traced call crosses a given threshold set by static configuration (8 Kbytes for a priority trace, 20 Kbytes for a non--priority trace), or if the manual of data associated with all traced calls crosses a given threshold set by static configuration (100 Kbytes)

The type of information to collect (basic, handover, radio) is given to the BSC in the trace message issued by the MSC:

Data	basic	handover	radio
Invocation message	x	x	x
BTS Id	x	x	x
TRX Id	x	x	x
TRAU Id			
Radio channel information	x	x	x
Request type	x	x	x
End indication	x	x	x
MS power			x
BS power			x
Timing advance			x
MS classmark 1	x	x	x
MS classmark 2	x	x	x
MS classmark 3	x	x	x
BSIC	x	x	x
CIC	x	x	x
Handover result	x	x	x
Handover cause	x	x	x

Data	basic	handover	radio
Handover duration			
Target Cell List		x	x
Synchronization information	x	x	x
SCCP connection event			
BSSMAP message			x
DTAP message			x
RR message			x
A--bis messages			x
Timed A--bis messages			
Measurements			x
Timed Measurements			
Power control			x
Timed Power control			
Record extensions			

Additional manufacturer data are recorded in trace messages. They describe the equipment used by the traced call at a given time :

Data for BSC 12000HC	basic	handover	radio
pcm-ts A interface	x	x	x
TCU 2G Id	x	x	x
TDTI A interface	x	x	x
TCB Id	x	x	x
TDTI A-ter	x	x	x
pcm-ts-circuit A-ter interface	x	x	x
DDTI A-ter	x	x	x
BIFP	x	x	x
SICD	x	x	x
TEI-Abis	x	x	x
DDTI A-bis	x	x	x

Data for BSC 12000HC	basic	handover	radio
pcm-ts-circuit A-bis interface	x	x	x
bts-pcm	x	x	x

Data for BSC 3000	basic	handover	radio
pcm-ts A interface	x	x	x
TCU e3 Id	x	x	x
LSA-TCU A interface	x	x	x
tcu e3 Id	x	x	x
LSA-TCU A-ter	x	x	x
pcm-ts-circuit A- ter interface	x	x	x
LSA-BSC A-ter	x	x	x
TMU	x	x	x
TEI-Abis	x	x	x
LSA-BSC A-bis	x	x	x
pcm-ts-circuit A-bis interface	x	x	x
bts-pcm	x	x	x

Call path tracing function A BSS Call path tracing function is identified in the OMC-R by a callPathTrace object that defines the associated BSC, the resources used (bts, transceiverEquipment, xtp), the end-of-session criteria such as the following:

- at the expiration of a given period of time
- when a given number of radio measurements is recorded (for radio-type data only)
- when the callPathTrace object is locked

and the type of data to collect (basic, handover, radio).

Partial records are only generated on BSC request in that case (see the previous Paragraph).

1.12.5.3 Collecting trace data

For each new traced call, the BSC starts recording the associated data and generates a trace record.

Data are recorded according to their type. The following apply:

- Call tracing function: The type is provided in the message issued by the MSC and is specific to each traced call.

- Call path tracing function: The type is set by the user (parameter of the associated callPathTrace object) and is common to all traced calls.

Either the BSC generates partial records, or it saves all data until the end of the call and then generates complete records.

1.12.5.4 Storing trace records

BSC trace record store

- Call tracing data

  Priority call trace records are temporarily stored in a circular file on the BSC disks. In normal operating conditions, the records are forwarded to the OMC-R agent as spontaneous messages as soon as they are available and the file is automatically purged. They are stored on the OMC-R in files with the names "/MD/trace_function/os_ftam/<date>/<bsc>/naPTCL_<traceReportNbr>.<log", where:

  — <date> - date of trace reception in YYYYMMDD format

  — <bsc> - bsc Id

  — <traceRepor tNbr> - an auto incremented number of received trace message (initialized with UNIX time of the first received message)

  — <logId> - associated log instance

  For the BSC 12000HC, non-priority call trace records are stored as files in the :CALLTR: partition on the BSC disks. For the BSC 3000, non-priority call trace records are stored as files in the /OMU/share/log/OBR_CT/ directory. The names of the files for both the BSC 12000HC and 3000 are formatted as "ydddmmmsrrrrnn", where:

  — y = year [0 to 9]

  — ddd = day of the year [001 to 365]

  — mmm = minute of the day in hexadecimal [000 to 59F]

  — s = time stamp of 4 seconds of the minute in hexadecimal [0 to E]

  — rrrr = trace reference [0 to 255]

  — nn = trace sequence number [0 to 99]

  On the OMC-R, the same previous files are named as "/MD/trace_function/os_ftam/<date>/<bsc>/aTCL_<bsc>_<chhmm><mmms.<logId>", where:

  — <date> - date in YYYYMMDD format

  — <bsc> - bsc Id

  — <chhmm> - deltaUTC with preceding "P" or "M"

— <logId> - associated log instance

Once a record is stored, a spontaneous message is sent to the OMC-R agent, indicating that a new data file is available. Data are transferred using FTAM, and under the OMC-R agent control.

- Call path tracing data

  Non-priority traces are the only type that is possible for the callPathTrace. Non-priority traces are always archived. On the BSC 12000HC, non-priority callPathTrace file names are stored in the :CALLPATH: partition on the BSC disks in a file whose capacity is set by the user (parameter of the associated callPathTrace object).

  When the file is full, a spontaneous message is sent to the OMC-R agent, indicating that a new data file is available. Data are transferred using FTAM, and under the OMC-R agent control.

  A new file is then open and this file stores the new records of the ongoing traces.

  On the BSC 3000, non--priority callPathTrace records are stored as files in the OMU/share/log/OBR_CPT/ directory. The names of the files for both the BSC 12000HC and 3000 are formatted as "ydddmmms", where:

  — y - year [0 to 9]

  — ddd - day of the year [001 to 365]

  — mmm - minute of the day in hexadecimal [000 to 59F]

  — s - time stamp of 4 seconds of the minute in hexadecimal [0 to E]

- Special cases

  When the BSC operations switch over to the standby chain, ongoing call tracing is stopped (all data are lost, unless they have been recorded in partial records). New calls are automatically traced when the standby chain becomes active.

  When the BSC application database is rebuilt, some messages may be lost since the BSC automatically purges all collected messages that have not been transferred once the database is rebuilt.

OMC-R trace record store Each trace record collected by the OMC-R agent is stored on disk. The records are stored for no more than four days (D, D-1, D-2, D-3) by default. This period can be statically modified.

The maximum configurable duration for MD storage is 10 days including today for all hardware configurations.

Directories and trace file naming rules are described in the Section 1.12.6 "OMC-R message store" (page 163).

1.12.5.5 Archiving trace data

Trace data stored before the current day can be backed up and restored on--line.

Trace data archiving is defined in static configuration data (see NTP < 006 >) for a given date. It concerns all the records generated on the given date.

1.12.6 OMC-R message store

1.12.6.1 OMC-R agent message store

Specific objects model observation and trace message storing by the OMC-R agent:

- The observationFileReadyRecord objects define the recording format of permanent observation data in observation logs.
- The mdScanReportRecord objects define the recording format of temporary observation data in observation logs.
- The traceFileReadyRecord objects define the recording format of non--priority trace messages in trace logs.
- The traceLogRecord objects define the recording format of priority trace messages in trace logs.

Directories The raw messages contained in elementary permanent and temporary observation reports are stored in dedicated OMC-R agent disk directories

/MD/obs/os_ftam/yyyymmdd/nnn

where "yyyymmdd" is the date on which the OMC-R agent collected the messages and "nnn" is the reference number of the observed entity (BSC or OMC-R agent). For example, if bsc = 5, nnn is read "005".

The raw messages contained in trace reports are stored in dedicated OMC-R agent disk directories

/MD/trace_function/os_ftam/yyyymmdd/nnn

where "yyyymmdd" and "nnn" have the same meaning as above.

A new directory is created when the first observation or trace record of the day is delivered. It stores all records delivered on that same day.

Raw messages are stored on OMC-R manager disks. See Section 1.12.6.2 "OMC-R manager message store" (page 165).

File naming rules

Observation record files (/MD/obs/os_ftam) The format of an observation file name containing an elementary report is:

(n)aTTTnnn_SYYYYHHMN.logId

Title	Meaning
a na	the file can be archived the file cannot be archived
TTT	observation type (see below)
nnn	reference number of observed entity (if bsc = 5, nnn is read "005")
S	sign of md object *deltaUtc* parameter = "P" (positive) or "M" (negative)
YYYY	absolute value of md object *deltaUtc* parameter
HHMN	hour and minute of message collection
logId	identifier of the associated log object

The observation types are coded as follows:

TTT	Observation
021	fast statistic observation (OFS)
022	general statistic observation (OGS)
023	diagnostic observation (ODIAG)
050	"interference" temporary observation
051	"signallingLink" temporary observation
056	"Abis interface bts" temporary observation
100	permanent md observation

The deltaUtc attribute of the md object defines the difference between the current OMC-R agent reference time and the GMT time. The difference is positive if the OMC-R agent is located to the west of Greenwich.

Trace files (/MD/trace_function/os_ftam) The name of a call tracing file is formatted as follows:

aTCL_nnn_SYYYYmmmsrrrrxx.logId

The name of a call path tracing file is formatted as follows:

aCPT_nnn_SYYYYmmmsrrrrxx.logId

Title	Meaning
a	the file can be archived
TCL CPT	call tracing file call path tracing file
nnn	reference number of the BSC (if bsc = 5, nnn is read "005")
S	sign of md object *deltaUtc* attribute = "P" (positive) or "M" (negative)
YYYY	absolute value of md object *deltaUtc* attribute
HHMN	hour and minute of message collection
rrrr	trace reference number
xx	trace sequence number
logId	identifier of the associated log object

Active server switchover Observation and trace files are mirror--managed on the disks of the two OMC-R agent servers.

If the OMC-R agent operations switch over to the standby server, only messages that are being processed at that time may be lost.

1.12.6.2 OMC-R manager message store

BSS and OMC-R agent observation messages BSS and OMC-R agent observation messages are stored in the following directories on the OMC-R manager disks:

/OMC/obs/raw/yyyymmdd/nnn
/OMC/obs/sum/nnn (daily permanent observation and busiest day of the month reports generated by the OMC-R manager)

The names of the observation files match those of the files stored on the OMC-R agent disks. Only the suffix differs and identifies the associated mdScanner object.

Totaling files naming rules (/OMC/obs/sum) The format of an observation file name containing a daily report is as follows:

aDAY_TTTnnn_YYYYMMDD

The format of an observation file name containing a busiest day of the month reports is as follows:

aBDM_TTTnnn_YYYYMMDD

Title	Meaning
a	the file can be archived (by definition)
DAY BDM	daily report busiest day of the month report
TTT	type of observation: 010 = permanent bsc observation 100 = permanent md observation 021 = fast statistic observation (OFS) 022 = general statistic observation (OGS)
nnn	reference number of observed entity (if bsc = 5, nnn is read "005")
YYYYMMDD	date of observation report creation

A totaling file containing a daily report is created when the first observation message of the day is delivered, it is updated in real time. It cannot be consulted until the following day.

A totaling file containing a busiest day of the month report is created on the first day of the new month. The search for the busiest day is performed progressively as each daily report is established.

Index files naming rules The description of information concerning each raw permanent or temporary observation message is stored in an index file with the following format:

TTT.scannerId

Title	Meaning
TTT	type of observation (see above)
scannerId	identifier of mdScanner object describing the observation

There is one index file per day and per created mdScanner object. An observation running through N days has N index files.

OMC-R manager observation messages OMC-R manager observation messages are stored in equivalent directories on the OMC-R manager disks, under the names

aTTTnnn_SYYYYHHMN.0

The TTT value is "101". The suffix "0" identifies the messages of this observation.

Trace data Trace data are stored as tables in a dedicated database of the OMC-R manager.

1.12.7 Performance management reporting

1.12.7.1 NIMS PrOptima™

The V15.0 BSS release introduces a performance analyzer: NIMS PrOptima. It replaces the CT7100 tools for BSS and NSS. Fully integrated into the BSS release, the NIMS PrOptima is backward compliant with V14.3 and V14.2 releases.

NIMS PrOptima processes with performance data recorded by the BSS network equipments and collected by the OMC-R in SDO files. Performance data are then analyzed to provide feedback for corrective actions or to make recommendations for future improvements.

Standalone implementation PrOptima for GSM Access in a standalone implementation provides a performance management solution on a single platform. It includes data warehousing for all counters, monitoring and online query, historical performance reporting, optimizing on thresholds and observations for:

- Network performance and troubleshooting
- Network maintenance and operations
- Capacity planning
- Radio frequency evaluation
- Management reporting
- Network optimization

Client - server architecture PrOptima for GSM Access is built on a client - server architecture. The PrOptima server runs on a SUN Solaris machine and the client runs on a Windows Professional PC. The server - SDO communication and the client - server communication take place through an Ethernet LAN or through high speed TCP/IP WAN links. The PrOptima server and the PrOptima client must be isolated from the OMC-R LAN by a filtering bridge.

Data analysis PrOptima provides the following BSS analysis:

- Performance reporting:
  - — Executive indicators, which allow the user to evaluate global performance and trends of the network from graphs and tables
  - — Advanced reports, which provides more details at cell level or BSC level

- Quality of service monitoring. It provides Top N QoS module (which filters the worst cases to be processed in priority), Network Element trending, Group of Cells trending, information on dual band networks, and handover analysis
- Capacity monitoring, which analyzes the dimensioning and the load of radio resources and BSC processors

Report builder The Report Builder function allows the user to customize reports. It is achieved by selecting predefined counters or Network Elements, and building up a report from related data.

BSS data import BSS data are collected by the PrOptima server through one or several SDO. Data that can be collected are:

- Observation data
- BSS network configuration data

1.12.8 Obtaining distributions on radio measurements

1.12.8.1 Principles

You can get distribution on radio measurements at the TRX level. When working at the cell level, all TRX from this cell are sending information.

The Radio Measurement Distribution (RMD) feature provides the following information:

- power control steps,
- RxLev and RxQual,
- FER uplink,
- Timing advance,
- SNR,
- RxLev rescaled to Pmax.

1.12.8.2 Benefits

These measurements provide information about voice quality and radio conditions which help you:

- increase the network capacity,
- optimize the "coverage vs. capacity" tradeoff.

1.12.8.3 Activation

The following class 3 OMC-R parameters on bts object trigger the feature:

- distributionActivation: enabled/disabled
- distributionTime: starting time in hour, minutes

- distributionDuration: observation duration by increments of 15 minutes.

For details on parameters, see NTP <124>.

1.12.8.4 File naming conventions

For the file naming conventions on the SDO, see NTP < 130 >.

1.12.8.5 Interoperability with other features

Call path/call path trace The features Call path/Call path trace and Radio Distribution Measurements both use a lot of memory space in the BSC and the SDO. To avoid congestion on the BSC and the SDO, it is recommended not to activate both features at the same time (to avoid congestion on the BSC and the SDO).

Switch Interference Matrix (16411) The Switch Interference Matrix stores a lot of data on the BSC disk. Due to disk space limitation on the BSC, it is forbidden to activate simultaneously both the Switch Interference Matrix and the Radio Distribution Measurements features.

When activating the Radio Distribution Measurements on a cell, the OMC-R/W-NMS checks the flag interferenceMatrixRunning. If the cell is still running the Interference Matrix measurements, then the distributionActivation parameter cannot be set to enabled (that is, the Radio Distribution Measurements feature cannot be activated).

1.12.8.6 Post-processing of data collected

The feature 30494 (Radio Measurement Distribution post-processing product introduction), introduced in V16.0, provides a tool to process the data collected by the Radio Measurement Distribution (RMD) feature. This tool is available on the OMC-R but not on the WNMS.

The purpose of this tool is to provide a way to monitor the radio interface by analysing distributions at a specific timeframe and TRX, Cell level, or Tdma class level.

Using the tool With the tool, the user can select/transfer the RMD data from the server (SDO) where it is stored to the PC on which the tool is installed, and then process the data.

For performance reasons, it is recommended not to run the RMD (Radio measurement distribution), CDA (Call drop analysis), and IM (Interference matrix) post-processing tools at the same time.

For more details of the post-processing tool, see NTP < 006 >.

There are three phases:

- transferring data

- selecting data
- post-processing the data

Transferring data The data can be transferred in one of the following ways:

- Manually

  A file explorer window helps the user to select the files or folder to be retrieved. The user can select one or more SDO servers and/or retrieve one or more days data from these SDOs.

- Semi-automatically

  Using a profile name, the user can launch the data retrieval by pressing a button. From the profile, the tool knows the SDO server to connect to and all RMD data not present on the user's PC is retrieved.

- Automatically

  A job scheduler helps the user to set the time, date, and the periodicity of the data retrieval. This operation can be set only if the PC on which the tool is installed is connected (that is, it is not in offline mode). The job scheduler definition is associated with a profile.

Selecting data Examples of data selection are:

- Select data from one or more SDOs, one or more days, one or more BSCIds, one or more Cells.
- Select data based on: Cells, Group of cells, TRX, Group of TRX, TDMA class.
- Select data for a period (one or more days selected with start and end date).
- Select data for a time of the day (whole day or a specific time period).

Post-processing data Examples of post-processing for RMD data are:

- Filter the different distributions to take account only of certain measurements.
- Print all or part of distributions.
- Export all or a selected distribution in csv (comma-separated values) format.
- Export all or a selected distribution in HTML format.
- Display all or part of a distribution.
- Display distribution at TRX level, Tdmaclass level or Cell level.
- Compare different distributions for different dates.

- Compare different distributions for different Cell/TRXs.

1.12.9 Call drop analysis

1.12.9.1 Principles

With this feature, you can obtain information about call drops. This information can help analyse the call drop scenarios and fine-tune the network.

The data available includes:

- RSL layer 3 history:

  It gives a maximum of 63 last treated Abis RSL and BTS internal messages at the BTS at TDMA level. This allows you to determine in which phase of the communication the call drop occurred. For each message, it gives the message type and the BTS state when the message was treated.

- LAPDm history:

  It gives a maximum of 16 LAPDm frames exchanged between the MS and the BTS (uplink and downlink) on SAPI 0 of the main channel. For each message, it gives the channel and the N3 message type if any.

- Connection context:

  It gives last average measurements available in L1M for the communication, and last received (enhanced) measurement report. This allows you to check the radio characteristics of the communication.

The role of the BTS in the Call Drop Analysis feature is to provide the relevant information for the analysis to be done at the OMC-R.

When the call drop is detected by the BTS, the BTS systematically sends the data it owns to the BSC to help in analysing the call drop.

When the Call Drop is detected by the BSC, the BSC requests information through a RF_CHAN_REL message. The request can be for one or more items of information.

This feature is guaranteed only with a BSC 3000.

GSM-R dropped calls are not analyzed.

1.12.9.2 Interoperability with other features

Call path/call path trace The features Call path/Call path trace and Call Drop analysis both use a lot of memory space on the BSC and the SDO. Both features can be activated at the same time, but in that case, it is recommended that the operator activates only a few cells at a time on the same BSC (to avoid congestion on the BSC and the SDO).

Switch Interference Matrix (16411) The Switch Interference Matrix stores a lot of data on the BSC disk. Due to disk space limitation on the BSC, it is forbidden to activate the Switch Interference Matrix and the Call Drop analysis features simultaneously.

When activating the Call Drop Analysis on a cell, the OMC-R/W-NMS checks the flag interferenceMatrixRunning. If the cell is still running the Interference Matrix measurements, then the callDropActivation parameter cannot be set to enabled (that is, the Call Drop Analysis feature cannot be activated).

1.12.9.3 Benefits

The feature provides the operator with a means to analyze call drops and thus to optimize the RF network.

On cells where the call drop ratio is too high, the operator can activate the feature and analyze the call drops. This enables time and cost efficient RF network optimization according to the call drops causes.

1.12.9.4 Activation

The class 3 OMC-R parameter callDropActivation (on the bts object) is used to enable or disable the feature. If enabled, the operator can select:

- drops on TCH communications
- drops on SDCCH communications
- drops on both TCH and SDCCH communications

1.12.9.5 File naming conventions

For the file naming conventions on the SDO, see NTP < 130 >.

1.12.9.6 Post-processing of data collected

The feature 28796 (Call drop analysis post-processing), introduced in V16.0, provides a tool to process the data collected by the call drop analysis (CDA) feature. This tool is available on the OMC-R but not on the WNMS.

The purpose of tool is to help extract and process information to:

- Characterize the conditions when the call drop occurred.
- Sort the different types of call drops.
- Create user customized reports and graphs to identify call drop causes.
- Provide statistics for each kind of call drop or group of call drops respecting the same criteria (filter choice) for a selected NE (cell, group of cells).

Using the tool With the tool, the user can select/transfer the CDA data from the server (SDO) where it is stored to the PC on which the tool is installed, and then process the data.

For performance reasons, it is recommended not to run the RMD (Radio measurement distribution), CDA (Call drop analysis), and IM (Interference matrix) post-processing tools at the same time.

For more details of the post-processing tool, see NTP < 006 >.

There are three phases:

- transferring data
- selecting data
- post-processing the data

Transferring data The data can be transferred in one of the following ways:

- Manually

  A file explorer window helps the user to select the files or folder to be retrieved. The user can select one or more SDO servers and/or retrieve one or more days data from these SDOs.

- Semi-automatically

  Using a profile name, the user can launch the data retrieval by pressing a button. From the profile, the tool knows the SDO server to connect to and all CDA data not present on the user's PC is retrieved.

- Automatically

  A job scheduler helps the user to set the time, date, and the periodicity of the data retrieval. This operation can be set only if the PC on which the tool is installed is connected (that is, it is not in offline mode). The job scheduler definition is associated with a profile.

Selecting data Examples of data selection are:

- Select data from one or more SDOs.
- Select data based on: BSCIC, Cell Id, LAC.
- Select data for a period (one or more days selected with start and end date).
- Select data for a time of the day (whole day or a specific time period).

Post-processing data Examples of post-processing for CDA data are:

- Filter the data with user-defined filters.
- Display the total number of signalling and traffic drops per cell.
- Export CDA data in csv (comma-separated values) format.
- Export CDA data in HTML format.

- Display statistical reports (general drops, radio drops, intercell HO drops, intracell HO drops, system drops etc.).
- Compare graphs for the same cell at different dates.

1.12.10 Generating an Interference Matrix

1.12.10.1 Principles

This feature enables you to request the network to generate an interference matrix.

An interference matrix is a matrix of coefficients (Mij), where the value of each Mij represents the cell overlaps between cell *i* and cell *j*.

An interference matrix is used during frequency planning.

1.12.10.2 Benefits

An interference matrix that is calculated directly by the network itself, gives an improved view of the network and consequently the quality of the final frequency plan is improved.

An interference matrix, allows you to evaluate cell overlaps. It also allows you to detect which neighboring cells cause interference and optimize intercell relationships.

Interference can be reduced, and both the network quality and network capacity are increased.

1.12.10.3 Activation

To start the generation of an interference matrix, the operator uses the “Launch Interference Matrix Measurement” menu option (from the OMC-R or W-NMS graphical user interface).

At the launch stage, the operator defines the network cells to be included in the matrix.

At the BSC, the interferenceMatrixRunning parameter (bts object) indicates whether or not the Interference Matrix feature is running.

On the MMI, you can use a Get command to see if the Interference Matrix feature is running on a BTS (interferenceMatrixRunningOnBts = yes), or on a BSC (interferenceMatrixRunningOnBsc = yes, if there is at least one cell of the BSC with interferenceMatrixRunningOnBts = yes).

For details on parameters, see NTP <124>.

1.12.10.4 File naming conventions

For the file naming conventions on the SDO, see NTP < 130 >.

1.12.10.5 Interoperability with other features

The Switch Interference Matrix stores a lot of data on the BSC disk.

Due to disk space limitation on the BSC, it is forbidden to activate simultaneously the Switch Interference Matrix and the Call Drop analysis features, or the Switch Interference Matrix and the Radio Distribution Measurement features.

When activating the Call Drop Analysis on a cell, the OMC-R/W-NMS checks the flag interferenceMatrixRunning. If the cell is still running the Interference Matrix measurements, then the callDropActivation parameter cannot be set to enabled (that is, the Call Drop Analysis feature cannot be activated).

When activating the Radio Distribution Measurement feature on a cell, OMC-R/W-NMS checks the flag interferenceMatrixRunning. If the cell is still running the Interference Matrix measurement, then the distributionActivation parameter cannot be set to enabled (that is, the Radio Distribution Measurements feature cannot be activated).

1.12.10.6 Post-processing of data collected

The feature 30769 (Interference matrix port-processing product introduction), introduced in V16.0, provides a tool to process the data collected by the Interference matrix (IM) feature. This tool is available on the OMC-R but not on the WNMS.

The purpose of this feature is to provide:

- an interference matrix
- graphical information on CI
- output files compatible with an AFP (Automatic Frequency Plannning) tool
- neighbour analysis

Using the tool With the tool, the user can select/transfer the IM data from the server (SDO) where it is stored to the PC on which the tool is installed, and then process the data.

For performance reasons, it is recommended not to run the RMD (Radio measurement distribution), CDA (Call drop analysis), and IM (Interference matrix) post-processing tools at the same time.

For more details of the post-processing tool, see NTP < 006 >.

There are three phases:

- transferring data
- selecting data

- post-processing the data

Transferring data The data can be transferred in one of the following ways:

- Manually

  A file explorer window helps the user to select the files or folder to be retrieved. The user can select one or more SDO servers and/or retrieve one or more days data from these SDOs.

- Semi-automatically

  Using a profile name, the user can launch the data retrieval by pressing a button. From the profile, the tool knows the SDO server to connect to and all IM data not present on the user's PC is retrieved.

- Automatically

  A job scheduler helps the user to set the time, date, and the periodicity of the data retrieval. This operation can be set only if the PC on which the tool is installed is connected (that is, it is not in offline mode). The job scheduler definition is associated with a profile.

Selecting data Examples of data selection are:

- Select data from one or more SDOs, one or more ImSession Ids, one or more BSCIds, one or more Cells.
- Select data for a period (one or more days selected with start and end date).
- Select data for a time of the day (whole day or a specific time period).

Post-processing data Examples of post-processing for IM data are:

- Filter the data using BSIC, BCCH, CELLID, LAC.
- Select an interfered cell and one or more interfering cells.
- Export all or selected data in csv (comma-separated values) format.
- Display different interference matrices (complete IM, cochannel IM, adjacent channel IM).
- Perform neighbouring analysis.
- Perform polluting cell analysis.

1.13 Fault management

1.13.1 Definitions

1.13.1.1

Unsolicited message Message spontaneously issued by BSS or OMC applications such as software and hardware faults, state and parameter value changes, counter threshold crossing, excessive error rate, restart, warnings, and BIST results.

Q3 notification Notification sent to the OMC-R manager by the OMC-R agent, following an unsolicited message. The cross-reference between unsolicited messages and Q3 notifications is as follows:

- parameterValueChange (parameter value change)
- CommunicationAlarm (restart or warning)
- EnvironmentalAlarm (equipment environment alarm)
- EquipmentAlarm (hardware fault)
- ObjectCreation (object creation)
- ObjectDeletion (object deletion)
- ProcessingErrorAlarm (software or BIST result)
- QualityOfServiceAlarm (threshold crossing or error rate)
- StateChange (state change)

User notification Q3 notification translated into plain language by the OMC-R manager for user purposes

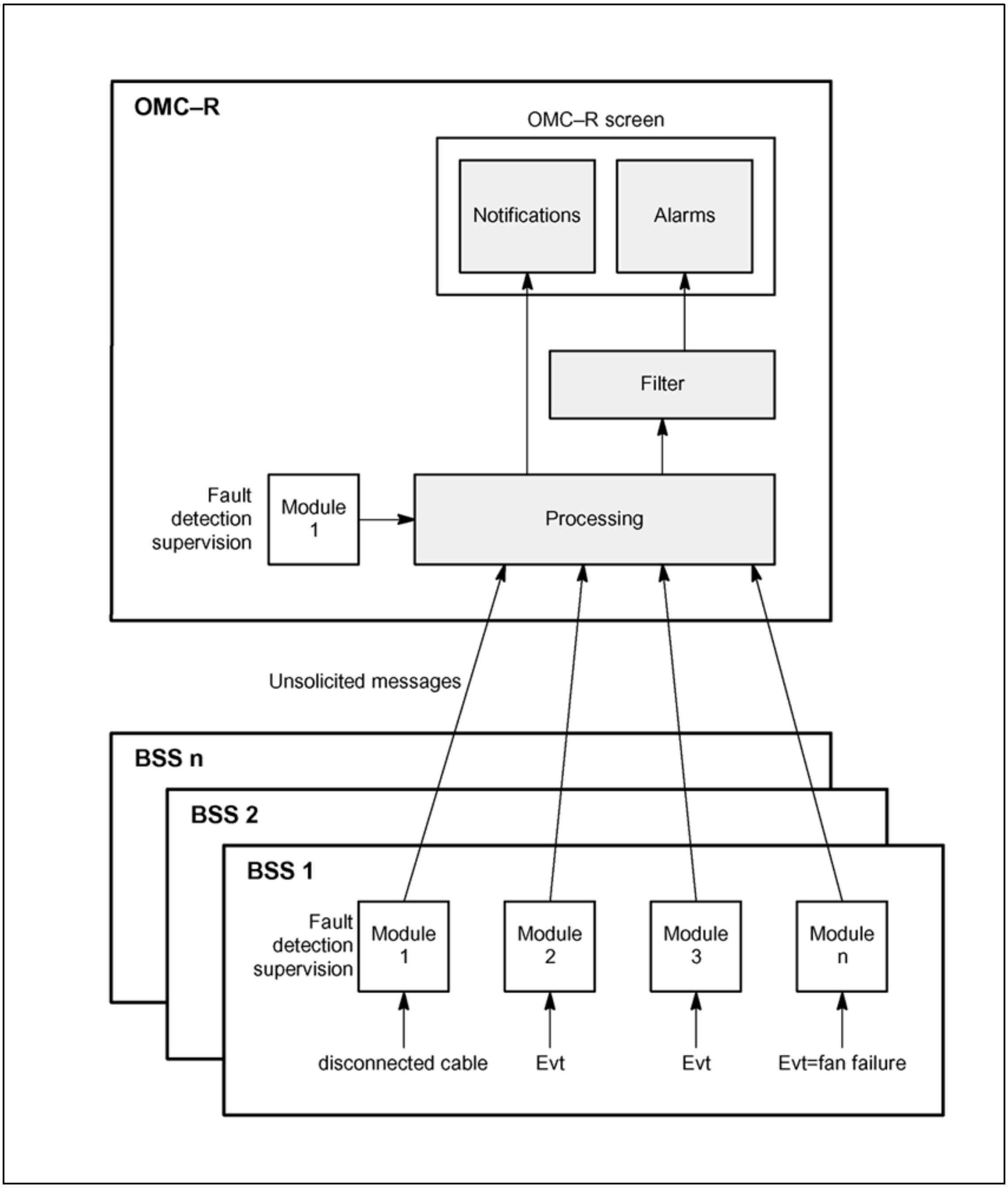
Alarm Message generated by the OMC-R manager to warn users that a notification has occurred that requires user action

1.13.2 Overview

Fault management is based on the retrieval and analysis of unsolicited messages sent by BSS or OMC applications.

An unsolicited message that gives rise to a notification is sent to the Fault Management function (see the following figure).

Figure 25
Information concentration for maintenance purposes



The resultant notifications and alarms warn users of network element malfunctions, or inform users of internal system operating changes. OMC-R maintenance tasks are based on notifications and alarms.

The OMC-R Fault Management function includes notification management and resultant alarm management.

- notification management:
  - unsolicited message reception
  - unsolicited message translation into notifications
  - notification storage in a database
  - notification log processing
- alarm management:
  - filtering notifications to avoid redundancy
  - alarm generation: A notification cannot trigger an alarm (the conditions in which alarms are triggered are defined in the configuration and can be modified by users).
  - alarm storage in a database: The list of ongoing alarms and the cleared alarms.
  - current alarm processing: display, acknowledge, cease, purge, and print
  - ceased alarm processing: display, purge, and print
  - alarm counter and relay management

1.13.2.1 Management objects

A log object managed by the OMC-R agent describes the way in which faults collected on the OMC-R agent disks are stored. The OMC-R agent creates restored log type objects whenever a fault file is restored to disk.

The mdWarning objects allow users to control the conditions in which BSS observation counter threshold crossing and excessive error rate events are handled.

Six efd objects managed by the OMC-R manager allow users to filter the types of alarms that are fed back:

- efdAlarm: CommunicationAlarm, EnvironmentalAlarm, EquipmentAlarm, ProcessingErrorAlarm, and QualityOfServiceAlarm notifications
- efdConfiguration: parameterValueChange, ObjetCreation, and ObjetDeletion notifications
- efdStateChange: StateChange notifications
- efdObs: CommunicationAlarm notifications (observationFile Ready and mdScanReport) related to observation message processing and managed by the Performance Management function

- efdTrace: CommunicationAlarm notifications (traceFileRead y and traceReport) related to trace message processing and managed by the Performance Management function
- efdSpecificNotif: beginning and end of specific action notifications sent by the OMC-R agent, such as end of BDA buiding, end of audit. These messages are displayed in the session logs.

The mdWarning, log, and efd objects are functional objects related to the md object. They have numerous instances.

1.13.3 Unsolicited message management

The Fault Management function manages the following:

- unsolicited messages sent by the BSC
- unsolicited messages sent by OMC applications

1.13.3.1 Unsolicited messages sent by the BSC

The unsolicited messages are stored in circular files on BSC disks. Each message contains the following:

- date and time the message was sent (BSS reference)
- message type
- identity of the logical entity (object) responsible for the message
- specific information (type and number of BTS equipment, type and number of BSC processor, etc.)

In case of BSS/OMC-R link outage, the files must be able to store all the messages sent in a 24-hours period.

When the link is restored, the messages contained in these files are forwarded to the OMC-R agent. Messages may be lost if the maximum circular file capacity is reached or if the disks are reset when the BSC is restarted.

The BSS unsolicited messages handled by the Fault Management function are as follows:

- software anomaly
- hardware fault
- warning
- state change
- parameter value change
- restart
- BIST result

- purge

Their functions are as follows:

- The *software anomaly* messages inform users of anomalies detected in software applications running on BSC processing chains. They are generated by bsc objects.
- The *hardware fault* messages inform users of equipment failures and malfunctions. They are generated by bsc, bsc e3, bts, btsSiteManager, pcmCircuit, tcu e3, transceiver, transceiverEquipment, transcoder, and transcoderBoard objects.
- The *warning* messages inform users of network operating changes, such as reference clock resetting, short-lived faults, inconsistencies detected on A, Abis, and Ater interfaces, etc. They are generated by bsc, bsc e3, bts, btsSiteManager, lapdLink, signallingLink, signallingLinkSet, signallingPoint, tcu e3, transceiverEquipment, transcoder, and transcoderBoard objects.
- The *state change* messages inform users of object operationalState changes that may be due to a change in internal system operating conditions or changes to the same or another object administrativeState. They are generated by bsc, bsc e3, bts, btsSiteManager, lapdLink, pcmCircuit, signallingLink, tcu e3, transceiver, transceiverEquipment, transcoder, transcoderBoard, and xtp objects.
- The *parameter value change* messages inform users of spontaneous changes to managed BSC object parameter values: dynamic re-allocation, state change, etc. They are generated by bsc objects.
- The *restart* messages inform users
  - **For BSC 12000HC**

    that the BSC 12000HC has been reconfigured because of an internal problem or in response to a BSC 12000HC chain suicide request. They are generated by bsc 2G objects:

    - restart after a TRAP or NMI (Non Maskable Interrupt) due to an MPU, OMU, SICD 8V, or CCS7 processor in the BSC
    - suicide request triggered by a board and generated by the ECI or the SICX board in the BSC 12000HC
    - suicide triggered by a BSC 12000HC application and generated by the OMU processor in the BSC 12000HC

    BSC 12000HC chain suicide may also be triggered by users.
  - **For BSC 3000**

that the BSC 3000 has been reconfigured for an internal problem. They are generated by bsc e3 objects:

- restart after a TRAP or NMI (Non Maskable Interrupt) due to an OMU, TMU, or ATM-SW processor in the BSC 3000.
- suicide triggered by a BSC 3000 application and generated by the OMU processor in the BSC 3000.

- The *BIST result* messages inform users of problems with Built-In Self Test runs. They are generated by bsc objects.
- The *purge* messages are issued by the BSC, usually after a restart or a chain switchover, and are used to improve end-of-fault management by "clearing" the notifications issued before the BSC restart or chain switchover. They are generated by bsc, bsc e3, btsSiteManager, tcu e3, transcoder and chain objects.

The BSS event report messages are sent to the OMC-R according to their priority level. The messages with the highest priority are sent first. Five priority levels have been defined as follows (priority level 1 is the highest priority):

Priority level	Types of messages
1	BSC faults, traffic with the MSC state change, and parameter value changes for A interface (signallingPoint and signallingLinkSet objects)
2	State changes for pcmCircuit (A and Abis/Ater), btsSiteManager, and transcoder objects
3	All other state changes and parameter value changes
4	Other hardware faults, major software anomalies, and warnings
5	Minor software anomalies

1.13.3.2 Unsolicited messages sent by the OMC applications

The Fault Management function handles all the unsolicited messages sent by the OMC-R agent application functions. They include the following:

- create, set, delete, lock, or unlock an object
- BSS/OMC-R link state change message (BSS/OMC-R links are described by bscMdInterface objects): break, abnormal disconnection.
- high or low permanent bsc or md observation counter threshold crossing messages (see Section 1.12 "Performance management" (page 132))

  The conditions in which these messages are sent is determined by the characteristics of the mdWarning objects defined by users (low and high raw observation counter thresholds).

- abnormally high error rate messages from the same BSS entity

  The conditions in which these messages are sent is determined by the characteristics of the mdWarning object defined by users (maximum error rate, accounting reference period).

- OMC-R malfunction messages.The OMC-R considers itself a network element and manages its own faults in the same way as the other entities (see NTP < 032 >).

  Disk, memory, database (BDE) rebuilding operation, etc., are responsible for software or hardware faults.

  The OMC-R defense function preprocesses these messages and may decide not to forward the information to the Fault Management function.

- purge messages

  These messages are issued by the OMC-R agent, under the following conditions:

  — defensive purge: When the number of correlated notifications for a given BSC reaches a threshold set by configuration, the OMC-R agent deletes the oldest notifications to avoid disk overflowing.

  — daily purge: Everyday, the OMC-R agent activates a process to purge the correlated notifications which are more than N days old, where N is set in static configuration data.

1.13.3.3 Notifications

The unsolicited messages are translated into notifications for user purposes.

All unsolicited messages resulting in an alarm notification are identified by a fault number which is specific to the message type: a given fault number is only contained in messages of a given type.

All notifications are given a specific serial number that allows users to identify them. The message also includes the date/time when the event message was sent and the date/time of delivery to the OMC-R manager.

The OMC-R decodes the object identifiers contained in the messages. The OMC-R operations database is read to obtain the information supplied by the Configuration Management function.

The BSC 12000HC and BSC 3000 architectures provide information on the BSC hardware configuration, such as the number of the equipment, the processor or the chain, that allows the defective board to be located.

More than one notification may be issued in response to an unsolicited message. Each notification contains the following information:

- Common information:

  — identification number of the notification on the OMC-R manager

- identification number of the notification on the OMC-R agent when the message is issued by a BSS or the OMC-R agent
- notification type
- identification number of the BSC when the message is issued by a BSS
- identification number of the OMC-R agent when the message is issued by the OMC-R agent
- reference number and name of the machine (server or workstation) when the message is issued by the OMC-R manager
- reference number of the task when the message is issued by the OMC-R manager
- class and instance of the concerned object
- date and time of unsolicited message transmission
- date and time of notification reception on the OMC-R manager

- Alarm notification:
  - specific problems. This parameter includes two fields:
    - fault number
    - associated cause(s)
  - probable cause = numerical value of the ISO probableCause field
  - perceived severity. It indicates how it is perceived that the capability of the managed object has been affected; "cleared" indicates the clearing of one or more previous faults.
  - model, type, and equipment number when the message is issued by a BSC or a BTS
  - location of the faulty equipment (cabinet, rack, etc.) when the message is issued by a BSS
  - additional information such as post-mortem information, identifier of the BSC 12000HC chain or the BSC 3000 OMU involved, identifier of the observation counter involved, or identifier of the mdWarning object involved
  - additional information such as the information for the operator (PLMNO) and for the manufacturer (MANU)
- State change notification:
  - source indicator

— state parameter values such as administrativeState, operationalState, availabilityStatus, standbyStatus, usageState, controlStatus, and upgradeStatus

- parameter value change notification:
  - — source indicator
  - — list of the parameters involved and their values when the message is issued by a BSS

1.13.3.4 Notification correlation mechanism

The notification correlation mechanism provides an alarm notification which contains a list of identifiers of the notifications that are considered to be correlated.

Two notifications are said to be correlated if they contain the same values of the following information items:

- class and instance of the related managed object
- type and number of the processor involved (when appropriate)
- type and number of the equipment involved (when appropriate)
- identifier of the chain involved (when appropriate)
- identifier of the related mdWarning (when appropriate)
- fault number
- MD cause when the event is from an OMC application

The alarm notifications issued by this process have a severity parameter set to "cleared".

1.13.3.5 Notification logs

System notification log The OMC-R automatically saves notifications in real time in a system notification log.

The system notification log contains all the notifications that are generated except the notifications that are hidden to the operator. The list of such rejected notifications is statically configurable in the file /OMC/base/config/fmMgr.cfg, parameter listCodanosReject (as well as for user notification log). It is kept up to date and to avoid saturation, the oldest messages are progressively deleted to make room for the more recent messages. The log storage capacity is set in the static configuration to hold seven days’ notifications.

Authorized users can consult the log in a dedicated log consultation window during work sessions. The notifications are filtered according to the zone of interest defined in the connected user’s profile.

The entire log or selected portions can be consulted. The following is a partial list of selection criteria:

- messages of a given type
- messages containing given fault numbers
- messages sent by a type of BSC processor, BTS equipment, or object (the user can also select a given processor, equipment, or particular type of object)
- messages sent or received in a given period of time
- notifications with given serial numbers

One or more criteria can be selected. Without criteria, all the notifications related to entities in the user's zone of interest are displayed. The displayed notifications can be printed.

User notification log A user notification log is made available to every user during a work session in a dedicated log consultation window.

This log only contains the notifications issued after the window was opened in response to the unsolicited messages sent by the entities defined in the zone of interest of the connected user.

Notifications can be selected with the same criteria as above. The displayed notifications can be printed.

A user notification log is deleted when the consultation window is closed.

User state change log Object state changes are notified to the user in a dedicated log, the user state change log.

This log contains all Q3 notifications of StateChange type resulting from object locking/unlocking user commands (administrativeState changes) or unsolicited state change messages (operationalState and availabilityStatus changes).

Each notification is translated into a specific message stored in the log that contains the following information:

- date and time of state change occurrence
- class of the concerned object
- object administrativeState, operationalState, availabilityStatus, usageState, controlStatus, upgradeStatus, and standbyStatus parameter values
- identity of the concerned object

A user state change log is made available to every user during a work session in a dedicated log consultation window.

The log only contains state change messages related to the entities defined in the zone of interest of the connected user. The window contents are refreshed in real time.

A user state change log is deleted when the session ends.

1.13.4 Alarm management

1.13.4.1 Alarm triggering mechanisms

A notification contains a certain amount of information. It is identified by a fault number specific to the associated unsolicited message type. It is also identified by hardware fault, state change, threshold crossing, etc.

If the Fault Management function recognizes start-of-fault information in a message, an alarm may be triggered. The alarm message is sent to pinpoint a specific problem and to warn users that action is required.

The following Q3 notifications may trigger an alarm:

- CommunicationAlarm (restart, warning)
- EnvironmentalAlarm (equipment environment alarm)
- EquipmentAlarm (hardware fault)
- ProcessingErrorAlarm (software anomaly, BIST result)
- QualityOfServiceAlarm (threshold crossing, error rate)
- StateChange (state change)

Start-of-alarm conditions are defined in the configuration and partially depend on the type of Q3 notification issued. An alarm is only triggered when the defined conditions are met.

1.13.4.2 Alarm clearing mechanisms

An alarm is cleared if the OMC-R receives an end-of-fault message meaning that the Fault Management function considers that the fault has been cleared and the defective element is now operating correctly.

Specific end-of-alarm conditions are defined in the configuration. They must be consistent with the start-of-alarm conditions.

If, for example, a start-of-alarm message is issued when an object state changes to disabled (for possible causes, refer to the **operationalState** entries in NTP < 124 >), an end-of-alarm message must be sent when the object state changes back to enabled.

In some conditions, the end of fault is not detected and no corresponding message is generated.

The event(s) that trigger(s) end-of-fault messages may not be delivered to the OMC-R. For example, to repair a defective equipment, the equipment is taken out of service and the object on the level above that describes the defective equipment may also be taken out of service. After repairs, the equipment and the object on the level above are both returned to service. However, some of the information may no longer be available and the end-of-fault message is not generated.

To overcome this problem, alarms can be ceased in two ways, automatically by the system or manually by the user.

- automatic alarm ceasing when the following occurs:
  - — end-of-fault message received. All alarms activated on the same criteria and concerning the same object or equipment are ceased.
  - — purge message received. All alarms resulting from correlated notifications that correspond to the criteria defined in the purge message are ceased.
  - — object deletion or unlocking. All alarms related to the object are ceased (the OMC-R assumes that the problem has been solved). The following also occur:
    - – All alarms related to transceiver and channel objects depending on an unlocked bts object are ceased.
    - – For alarms raised by synthetic counters which are automatically cleared after an unlock command, then in accordance with common behavior, the alarm will be immediately generated again if the fault is still present, that is, if the counter is still above (or below) the threshold at the moment of the purge.
  - — BSS observation counter threshold change. All alarms related to the counter occurrence are ceased if the new threshold value returns the counter to normal operating mode.
  - — All alarms are ceased by the purge mechanism if the corresponding end-of-fault message is not received or generated within 30 days.
- manual alarm ceasing by users:

  A user can cease alarms in one of the following ways:
  - — cease selected alarms
  - — cease selected object alarms
  - — cease whole subtree (md, bsc, etc.) alarms

1.13.4.3 Alarm state detecting mechanisms

The conditions in which alarms are triggered or ceased are defined in configuration data and depend on the type of the Q3 notification issued. Note that all alarms can be ceased by users or on system time-out. Only the conditions specific to each notification type are described below.

- EquipmentAlarm notification:
  - An alarm may be generated after a failure that triggers this type of message sending.
  - The alarm is ceased if one of the following occurs:
    - An end-of-alarm message is received (message generation is only guaranteed when the fault is detected by ALA boards in BSC).
    - The defective object is deleted or unlocked.
    - The defective object depends on an unlocked object: transceiver and channel objects.
- CommunicationAlarm notification:
  - An alarm may be generated if the system operating conditions are severely degraded.
  - This type of alarm is only ceased on time-out.
- StateChange notification:
  - An alarm may be generated if an object has changed into an alarm generating state.
  - The alarm is ceased on receipt of an end-of-alarm message indicating that the object has changed out of an alarm generating state.

  The list of alarm generating states varies according to the object. As a general rule, an alarm is generated if the object changes to "disabled/{dependency}" or "disabled/{failed}" state when its administrativeState is "unlocked". It is ceased when its operationalState is "enabled" or its administrativeState is "locked" (see **operationalState** entries in NTP < 124 >).
- ProcessingErrorAlarm notification:
  - An alarm may be generated when this message is received.
  - This type of alarm can only be ceased by users or on time-out.
- QualityOfServiceAlarm notification:
  - threshold crossing:

- An alarm may be generated when a BSS permanent observation counter crosses a high or low threshold.
- The alarm is ceased when the end-of-alarm message is received, indicating that the counter is operating normally.

The operator can set threshold values dynamically for each observation counter occurrence. If a counter alarm was reported and the newly read value is no longer above or below the defined threshold, an end-of-fault message is automatically generated.

The threshold crossing detection mechanism is described in the Section 1.12 "Performance management" (page 132).

— excessive error rate:

- An alarm may be generated if the OMC-R detects an error rate above the maximum reference threshold over a given reference period and from any BSS entity.
- An end-of-alarm message is generated when the rate drops below the minimum threshold for a given minimum accounting time.

The operator configures the thresholds and reference periods dynamically. They may vary between BSSs. The accounting time is set at one minute in the static configuration.

In order to give the operator some time to react when this type of notification is received, the alarm state is maintained over a 15-minutes period by the OMC-R agent. At the expiration, a new period is started and the following apply:

— If an end-of-fault message is received during this period, an end-of-fault notification is generated.

— If no new notification is received during this period, the state of the entity is controlled at the end of the period and the OMC-R agent takes the appropriate actions.

If the associated mdWarning object is locked, the system does not take any alarm change state into account.

1.13.4.4 Alarm generating mechanisms

If the alarm triggering conditions are met after checking, the OMC-R allows users to decide whether to generate the alarm and define the type of action (severity) required if the alarm is generated (the alarm is then called a current or ongoing alarm).

When a current alarm is generated, the OMC-R generates an alarm message. These messages are automatically saved in chronological order and real time in a dedicated log, the list of ongoing alarms.

When an alarm is ceased automatically or manually, the corresponding message is deleted from the list of ongoing alarms and stored in another dedicated log, the cleared alarm log.

1.13.5 Alarm criteria

The function of the alarm criteria is to determine whether the notifications that are issued should result in alarms.

The OMC-R provides users with alarm criteria configurations that allow to associate user alarms with BSS or OMC-R faults.

There are three alarm criteria configurations. Each configuration defines specific conditions in which notifications are handled. The following apply:

- The OMC-R Fault Management function uses one of the configurations to manage the notifications, it is called the active alarm handling configuration.
- MMI commands on the omc object allow users to display and set the active alarm handling configuration at any time.

1.13.5.1 Manufacturer and operator alarm criteria

There are two types of alarm criteria:

- Some alarm criteria are defined by the manufacturer and can only be locked or unlocked by the operator (they cannot be deleted or edited by the operator).
- Other alarm criteria can be modified by the operator. The value of the alarm criterion identifier determines whether it is a "manufacturer" or an "operator" alarm criterion. These values are given in the description of the alarm criteria identifier in Section 1.13.5.3 "Definition of alarm criteria" (page 192).

All alarm criteria are stored in the directory named /OMC/data/fm.

Alarm criteria files are not an interface for alarm criteria modifications. All actions with alarm criteria should be done through the MMI browser.

1.13.5.2 Operating configurations

Three alarm operating configurations are supplied, they are named daytime, nighttime and specific.

- "/OMC/data/fm/fmCritAlaDay.dat" - file in which the daytime configuration is stored.

- "/OMC/data/fm/fmCritAlaNight.dat" - file in which the nighttime configuration is stored.
- "/OMC/data/fm/fmCritAlaPart.dat" - file in which the specific configuration is stored.

The network operator defines the operating configurations in agreement with the manufacturer. They can be modified during work sessions.

The names given to the configurations are used to differentiate them. Users may activate any configuration at any time, but only one configuration can be activated at a time. Users may create a job that automatically switches to a given configuration at defined dates and times (see Section 1.18 "User facilities" (page 250)).

When the OMC-R starts up or after the active server switches over, the OMC-R activates the configuration corresponding to the time at which start-up or switchover occurred. It is the only occasion when the "time" in the configuration name is significant:

- The daytime configuration is activated if the operation is performed between 9 a.m. and 6 p.m. (this period of time can be statically reconfigured).
- The nighttime configuration is activated if the operation is performed between 6 p.m. and 9 a.m. (this period of time can be statically reconfigured).

By definition, an operator alarm criterion is simultaneously created in the three operating configurations with identical management parameters, except for the type of action that can differ from one configuration to the other.

These configurations give users some flexibility in managing the alarms. One configuration could, for example, be used during weekday working hours, the second at night when traffic conditions are different, and the third on statutory holidays or week ends when traffic conditions are different again.

1.13.5.3 Definition of alarm criteria

An alarm configuration is a table that defines the list of criteria for handling the faults according to their type and source.

Each criterion is identified by a unique number in the table and is described by a list of associated parameters as follows:

- alarm criteria identifier:
  - — Alarm criteria with identifiers < 100000 are pre-defined. They are also OMC-R configuration and cannot be deleted or changed by

the user. However, it is possible to lock or unlock these criteria (by changing the administrative state).

— Alarm criteria with identifiers >= 100000 can be added, edited and deleted by the user without any restriction. These are also known as "operator" alarm criteria.

ATTENTION
The total number of alarm criteria must not exceed 1000 in V16.0.

- associated parameters:
  - — type of configuration (manufacturer or operator) where the criterion is defined. Note that an operator criterion simultaneously exists in the three operating configurations.
  - — type of the notifications handled by the criterion. There are two possibilities as follows:
    - – all alarm notifications (CommunicationAlarm, EnvironmentalAlarm, EquipmentAlarm, ProcessingErrorAlarm, QualityOfServiceAlarm)
    - – all state change notifications (StateChange)
  - — scope of the criterion = subset of network objects to which the criterion applies. There are four possibilities as follows:
    - – one object instance
    - – all object instances of a given class
    - – all objects in a given subtree
    - – all objects
  - — type of the BSC 12000HC, BTS or BSC 3000 controlling the subset of network elements to which the criterion applies
  - — criterion state indicator for analysis purposes: An active criterion (unlocked state) is analyzed when the notification satisfies the criterion, an inactive criterion (locked state) is ignored.
  - — action to take when the notification satisfies the criterion (no alarm, immediate alarm, deferred alarm, alarm with no action)
  - — if no counter is associated with the criterion:
    - – start-of-alarm condition = logical expression that defines the type of notifications to which the criterion applies (for example: severity = MAJOR & fault number = 1067) and which activates an alarm when TRUE

  - end-of-alarm condition = logical expression that depends on the type of notifications to which the criterion applies and which allows to cease the alarm

- if a counter is associated with the criterion:
  - counter level consulting condition = logical expression
  - synthetic fault number to assign to the alarm [39500 to 39549]
  - alarm duration
  - accounting reference period
  - high threshold level triggering a start-of-alarm message
  - low threshold level triggering an end-of-alarm message

The configuration may therefore contain a criterion xxx partnered with a notification whose source is any object instance of the bts class with an immediate action alarm category, and a criterion zzz partnered with the same type of notification whose source is any object instance of another class with a deferred action alarm category.

In the same way, a criterion xxx partnered with a notification whose source is any object instance of the bts class may activate an immediate alarm in the daytime configuration, activate a deferred alarm in the nighttime configuration, and not activate any alarm in the specific configuration.

1.13.5.4 Notification processing

Alarm criteria are organized as two groups which are the following:

- the group of criteria that request to activate an alarm (action = immediate alarm, deferred alarm, no-action alarm)
- the group of criteria that do not request to activate an alarm (action = no alarm)

Within each group, alarm criteria are organized as coherent sub-groups called "families". By definition, a family is made of all criteria with the same scope and applying to the same type of notification.

When a notification is received, the OMC-R analyzes its type and source. Then, the analysis from the alarm criteria configuration that is active at that time is as follows:

- The search for the alarm criterion to apply to the received notification starts with the group of criteria that request to activate an alarm. If no criterion in that group is found, the search goes on with the group of criteria that do not request to activate an alarm.

Therefore if two criteria apply to the same fault number, with one that requests to activate an alarm and the other that does not request to activate an alarm, then the former is applied and the notifications with that fault number will always activate an alarm.

- Within a given family, criteria are analyzed in ascending order.

  Therefore if two criteria in a same family can apply to the received notification and request to activate an alarm, the one with the smallest identifier will be applied.

- The search goes on until the most specific criterion that can apply to the received notification is found.

  Therefore if two criteria in two different families can apply to the received notification, with one that applies to the instance of the object involved and the other to the class of the object involved, the former will be applied.

When the most suitable criterion is found, according to the rules defined above, the analysis stops and the OMC-R executes the action defined by that criterion.

Notes:

- Inactive criteria are not analyzed when a notification is received.
- The priority of alarm triggering criteria over non-alarm triggering criteria is a default configuration data. It can be reversed by reconfiguration.

1.13.5.5 Table of alarm configuration criteria

The detailed structure of the alarm criterion configuration table is described in NTP < 006 >.

1.13.6 Man-machine commands

1.13.6.1 Alarm management

The Current alarm list windows The MMI "Current alarm list" windows allow users to display and manage ongoing alarms.

A "Current alarm list" window is opened from an "OMC-R Browser" window by selecting one of the **Show** options of the **Fault** menu. Alarm messages are displayed by manually selecting network elements in the "OMC-R Browser" window.

In a "Current alarm list" window, ongoing alarms are displayed as a table. Each alarm is described on one line which contains the following information:

- identification number of the alarm
- identification of the object that is the source of the alarm
- date and time of alarm creation on the OMC-R

- type of the associated Q3 notification
- alarm severity and acknowledgment state

Selecting an alarm in the table leads to display the associated alarm message in the window, as it is stored in the OMC-R list of ongoing alarms.

Various buttons allow users to filter the alarms to display.

Only the alarm messages related to network elements belonging to the zone of interest defined in the connected user's or off-line terminal profile are displayed.

The window contents can be permanently refreshed on a new alarm occurrence from a selected network element, acknowledgement, automatic or manual ceasing of current alarms, or the display can be frozen. Two special buttons allow users to switch from a permanently refreshed state to a frozen state or vice versa.

The "Current alarm list" windows are partnered with an output class. Refer to the Section 1.16 "Security management" (page 231).

Alarm messages An alarm message contains the following information:

- a serial number that identifies the alarm in time. At a given time, a number is allocated to one alarm. This number is increased whenever a new alarm is received.
- the serial number assigned to the notification responsible for the alarm message
- date and time at which the notification was sent: BSS reference time for unsolicited messages sent by the BSS, OMC-R reference time for messages sent by the OMC applications
- date and time at which the notification was received (OMC-R agent reference time)
- type of the corresponding Q3 notification
- fault number that identifies the kind of fault and its cause (this code is the unsolicited message code if the BSS sent the message)
- alarm severity: critical (immediate action), major (deferred action), or minor (no action required)
- alarm title
- identity and location of the object and/or equipment responsible for the alarm (meaning the element that detected the problem and that is not necessarily the defective element)

- alarm acknowledgement state. An alarm is generated in unacknowledged state. It may subsequently be acknowledged by a user (see below).
- if the alarm is acknowledged, the identity of the acknowledger, either an OMC-R user (manual acknowledgement) or the OMC-R agent (automatic acknowledgement)
- if the alarm is ceased:
  — date and time at which the corresponding notification was sent
  — identity of the clearer, either a user (manual ceasing) or the OMC-R agent (automatic ceasing)

Alarm messages are stored in chronological order and real time in two dedicated OMC-R logs that users may consult: the list of ongoing alarms and the cleared alarm log.

- list of ongoing alarms

  The list of ongoing alarms contains all the current alarm messages.

  The list is kept up to date: new alarm occurrence, manual or automatic acknowledgement, manual or automatic ceasing.

  The list of ongoing alarms is never purged and is always available to users.
- cleared alarm log

  When an alarm is ceased, either manually or automatically, the corresponding message disappears from the list of ongoing alarms and is stored in the cleared alarm log.

  The OMC-R automatically and progressively purges ceased alarms from the log. To avoid saturation, the oldest alarm messages are deleted to make room for the most recent.

Acknowledging alarms An alarm is acknowledged when the user attends to it. This does not mean that the cause of the alarm has been cured, but that the user is aware of the problem.

Alarms can be acknowledged by MMI commands, either from an "OMC-R Browser" window (alarms related to a selected network element or subtree), or from an "Alarms monitor" window (selected alarms). The list of ongoing alarms is updated in the OMC-R, as well as all the concerned windows that are opened.

Only an authorized user can manually acknowledge alarms. The right to acknowledge alarms is determined by the output domain defined in the connected user's profile.

Ceasing alarms Alarms can be ceased by MMI commands, either from an "OMC-R Browser" window (alarms related to a selected network element or subtree), or from an "Current alarm list" window (selected alarms). The ceased alarm messages are deleted from the list of ongoing alarms and stored in the cleared alarm log. All the concerned windows that are opened are updated as well.

Only an authorized user can manually cease alarms. The right to cease alarms is determined by the output domain defined in the connected user's profile.

1.13.6.2 Log consultation

Users can display all or selected notifications stored in the system notification log, or all or selected alarm messages stored in the cleared alarm log, during a work session, and within the limits of the zone of interest of the connected user's profile.

These logs can be accessed by selecting the matching option of the *Fault* menu in an "OMC-R Browser" window. The information is displayed in a log consultation window that opens on the terminal screen.

The selection criteria applying to both logs are as follows:

- messages with a given fault number
- messages with given serial numbers
- messages from a type of BSC 12000HC processor, BSC 3000 processor, BTS equipment, or object (users can also choose a processor, equipment, or an object of a given type)
- messages related to the notifications sent or received at a given time or in a given interval of time

The following criterion can be applied to cleared alarms only:

- alarm messages ceased by a given user

1.13.6.3 Off-line alarm management

The graphic elements shown in an "OMC-R Browser" window on any management level are filtered according to the zone of interest defined in the profile of the terminal that is used and represent the set of network elements that users can monitor using that terminal outside a work session.

The following occurs in this context:

- Only the alarms resulting from the notifications sent by the entities defined in the zone of interest defined in the terminal's profile are displayed in an "Current alarm list" window.
- Acknowledge and cease alarm commands are rejected.

1.13.6.4 Alarm criteria management

Alarm criteria manager window The MMI "Alarm criteria manager" window allows users to display and manage alarm criteria.

This window is opened from any "OMC-R Browser" window by selecting the **Alarm criteria manager** option in the **Fault** menu with the mouse.

The "Alarm criteria manager" window is partnered with an output class. Refer to the Section 1.16 "Security management" (page 231).

Alarm criteria configuration management Alarm criteria defined in the three alarm criteria configurations are displayed as a table in the "Alarm criteria manager" window. Each line in the table identifies an alarm criterion and each column in the table displays one of the associated parameters.

Alarm criteria are displayed in ascending numerical order by default. The order of display can be re-arranged by moving columns one by one to the left or to the right. A configuration menu allows to filter the alarm criteria or associated parameters to display at a given time.

The following commands are used for managing the alarm criteria:

- `Create`

  This command allows to create a new alarm criterion in the three operating configurations at a time.
- `Set`

  This command allows to modify the parameters of an alarm criterion in the three operating configurations at a time.
- `Delete`

  This command allows to remove an alarm criterion from the three operating configurations at a time.
- `Clone`

  This command allows to create an alarm criterion.

A test command allows to simulate a given notification processing. It provides the list of the alarm criteria that would possibly be taken into account if the notification were really processed by the OMC-R Fault Management function.

ATTENTION
Alarm criteria with identifiers < 100000 cannot be deleted or changed by the user.

ATTENTION

Alarm criteria with identifiers >= 100000 can be added, edited and deleted by the user without any restriction. See also the description of the alarm criteria identifier in Section 1.13.5.3 "Definition of alarm criteria" (page 192) "Definition of alarm criteria".

Active configuration management Two commands on the omc object shown in the "OMC-R Browser" window on OMC level are used for managing the active alarm handling configuration.

- **`Display`**

  This command displays the name of the current OMC-R alarm handling configuration (day / night / specific / reference).

- **`Set`**

  This command sends instructions to the OMC-R Fault Management function to use the specified fault handling configuration (day / night / specific / reference).

  If the requested configuration cannot be loaded, the OMC-R switches to the reference configuration and warns the user.

  The groups and families of alarm criteria are defined at that time from the newly loaded configuration.

1.13.7 Alarm counters and relays

1.13.7.1 Alarm counters

The OMC-R manager controls alarm counters covering two management levels: system level and BSS level.

- At system level, three totaling counters tally the following:
  — the number of ongoing, critical, unacknowledged alarms on all BSSs and OMC-R agent
  — the number of ongoing, major, unacknowledged alarms on all BSSs and OMC-R agent
  — the number of ongoing, minor, unacknowledged alarms on all BSSs and OMC-R agent

- At BSS level, three totaling counters tally the following:
  — the number of ongoing, critical, unacknowledged alarms for the BSS
  — the number of ongoing, major, unacknowledged alarms for the BSS
  — the number of ongoing, minor, unacknowledged alarms for the BSS

The OMC-R manager updates all the counters whenever a new alarm occurs or disappears, or an old alarm is acknowledged.

Three BSS alarm counters are permanently displayed in the "Alarms banner" window on the terminal screen:

- When a user session is open on the terminal, the counters tally the number of unacknowledged ongoing critical, major, and minor alarms on the network entities defined in the BSS zone of interest in the connected user's profile.
- If no user session is open on the terminal, the alarm counters tally the number of unacknowledged ongoing critical, major, and minor alarms on the network entities defined in the BSS zone of interest in the off-line terminal profile.

1.13.7.2 Alarm relays

In order to transfer the state of the alarm counters to an alarm monitoring panel or a remote alarm monitoring site, each OMC-R server has a board managing 64 usable relays (with other possible values of 0, 24 and 32). This number can be statically reconfigured..

- Relays 1 and 2 indicate that system counters are not zero. Relay 1 is dedicated to unacknowledged ongoing immediate action system alarms, relay 2 is dedicated to unacknowledged ongoing deferred action system alarms.
- A relay in the range [4 to 31] indicates that a counter of unacknowledged ongoing immediate action alarms is not zero for one of the BSSs assigned to the relay.

BSS alarm relays are described by relay objects on the Man-Machine interface. Each relay is managed independently of the other relays, as follows:

- BSS-relay associations are dynamically managed by users.
- A BSS can be assigned to several relays at a time.

1.13.8 PCUSN interface

The following day-to-day PCUSN operations are also integrated in the OMC-R for an easy access. The GPRS access fault management is fully integrated within the GSM access fault management. The fault and alarm messages are forwarded in real time to the OMC-R database to be displayed on a Man-machine Interface (MMI) workstation. The fault management function treats system malfunctions and failures to supply the elements needed for maintenance actions. This function continuously monitors system operations. The OMC-R stores all of the event reports it receives from the PCU-OAM server. The incoming proprietary notification format from the PCUSN Network Management System (NMS) includes the following information:

- NMS notification type (mandatory)

- Date and time of the PCUSN event creation (mandatory)
- PCUSN identifier number (mandatory)
- CompId (mandatory for events on PCUSN objects only)
- Fault number (mandatory)
- Start/end flag (mandatory for fault reports only)
- Operational state (mandatory for state change notifications only)
- Other notification specific data (optional)

1.14 Preventive maintenance management

1.14.1 BSC 12000HC

Preventive maintenance management is based on software modules (plug-ins) containing preventive maintenance tests on BSS sub-systems. These tests can be configured, scheduled, and activated from the OMC-R. And their results can be displayed at the OMC-R. These software modules enable the user to schedule and perform preventive maintenance operations on BSS equipment from the OMC-R.

The Preventive Maintenance management function allows to:

- schedule preventive maintenance tests (according to the user’s zone of interest)
- execute, abort, suspend or continue tests on user demand (according to the user’s zone of interest)
- handle test execution conflicts (through the "Scheduler" window)
- monitor test execution
- display test results in logs and sometimes in reports (depending on the test)
- monitor test scheduling
- print and save reports

1.14.1.1 Definitions

Preventive maintenance test A preventive maintenance test is a software module that can be installed as a plug-in without any OMC-R restart. It contains a test concerning one specific BSS target equipment. Log files and result reports are produced at the end of tests, and they can be displayed, stored and retrieved from the Maintenance menu at the OMC-R.

The following preventive maintenance test is available: BSC 12000HC chain switchover (see NTP < 034 >). This test triggers a BSC 12000HC chain switchover, so as to check preventively that the chain switchover function is operational and that the passive chain is operational too.

Target equipment A target equipment is the network element to be tested, for example a BTS or a BSC 12000HC.

Activation object An activation object is related to a target equipment, and is directly interfaced with the OMC-R. If the target equipment is a BTS, or a list of BTSs, the associated activation object is the related BSC 12000HC. The target equipment and the activation object can be the same object, for example: a BSC 12000HC.

Preventive maintenance execution window A execution window is the time interval during which a scheduled test test can be activated, for example: from 22:15 to 05:30.

1.14.1.2 Configuring a test

A test must be configured before being executed or scheduled.

The parameters to be defined depend on the test itself:

- parameters to define specific test options (if any)
- parameters to define the selected target equipment, which can be:
  - — either one specific network element (for example one BSC 12000HC)
  - — or a list of target network elements (for example a list of BTSs). These target elements are grouped according to the related activation object (generally the BSC 12000HC.

Executing a test

Tests can be triggered in two different ways:

- activation on user demand
- scheduled activation

If a target equipment list contains several activation objects (for example several BSC 12000HC), at execution time each couple (test, activation object) will be executed separately:

- test abortion triggered on user demand can be done per activation object only
- a test can be executed for one given activation object, even if other activation objects are busy

Activation on user demand

Method Selecting the **Execute test** option in the **Maintenance** menu of the "OMC-R Browser" window enables the user to trigger one preventive maintenance test.

Requirements It is possible to execute only one test at a time per activation object.

Scheduled activation

Requirements It is possible to execute only one test at a time per activation object.

1.14.2 PCUSN

The preventive maintenance management functions for the Packet Control Unit Support Node (PCUSN) are performed by the Network Information Management System (NIMS) PrOptima™ Performance Management tool, which is designed by third-party Mycom International. NIMS-PrOptima user manual PRO-SUP-USM-NOR- 041-1.04-EN describes how to use the modules offered in the NIMS-PrOptima solution including the QOS Warnings module, which performs Quality of Service (QoS) functions for the PCUSN.

1.15 Network graphic management

1.15.1 Network display

1.15.1.1 OMC-R browser windows

The MMI "OMC-R browser" windows present network elements. Two view modes exist:

- the logical mode view is based on a logical approach to show Q3 objects.
- the physical mode view is based on a physical approach to show the equipment.

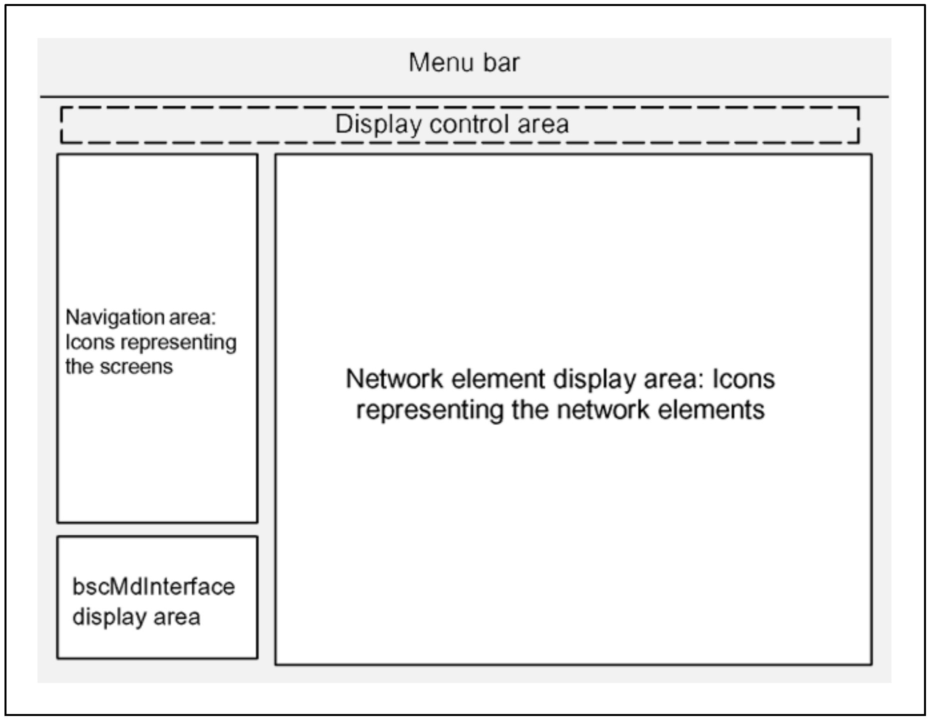
The main purposes of the "OMC-R browser" windows are:

- to allow network supervision by providing synoptic real time information about all network elements using the logical and physical modes.
- to perform various commands by accessing to all Q3 objects and related commands using the logical mode.

The OMC-R browser is made up of the 5 following areas:

- the menu bar which allows to access the services
- the network elements display area
- the navigation area which reflects the network part displayed in the network element display area
- the display control area which allows to display alarms and states. Display mode (physical versus logical) control is also included in this area.
- The bscMdInterface display area which contains the bscMdInterface (or matching summary) representation.

Figure 26
Layout of the OMC-R browser



1.15.1.2 Double screen display

> **CAUTION**
> **Customer specific**
> Indicates that specific equipment and specific software (such as specific software in the BSC) dedicated to a specific application is used and that therefore the feature is not available for all standard GSM users.

With this optional feature, it is possible to display the MMI windows on two screens. It is then easier to organize the windows and, for example, use one screen for fault management only.

1.15.1.3 Graphic objects

There are two types of graphic objects: the basic graphic objects and the summary graphic objects.

Basic graphic objects A basic graphic object defines an object managed by the Configuration Management function and unambiguously identified on the OMC-R.

Summary graphic objects A summary graphic object describes a set of objects at a higher level but also may summarize the real time information on alarms available below on the corresponding objects.

1.15.1.4 Graphic object display

Each graphic object is represented in an "OMC-R Browser" window by a rectangle displaying its type (or a logo matching the type) and its OMC-R reference number, and its name displayed.

Basic graphic objects The following table shows the correspondence between basic graphic objects and associated Q3 objects: the described managed Q3 object is first in the list, followed by the associated functional objects for configuration (in bold characters), performance, and fault.

basic graphic object	corresponding Q3 objects	Used on logical mode views	Used on physical mode views
omc		X	X
md	**md** mdScanner mdWarning eventForwardingDiscriminator log	X	X
bscMdInterface	**bscMdInterface** mdWarning	X	X

basic graphic object	corresponding Q3 objects	Used on logical mode views	Used on physical mode views
bsc	**bsc** **software (1)** mdWarning mdScanner traceControl callPathTrace	X	
bsc e3	**bsc e3**	X	X
signallingPoint	**signallingPoint** mdWarning	X	
signallingLinkSet	**signallingLinkSet** mdWarning	X	
pcmCircuit	**pcmCircuit** mdScanner mdWarning	X	
signallingLink	**signallingLink** mdScanner mdWarning	X	

basic graphic object	corresponding Q3 objects	Used on logical mode views	Used on physical mode views
xtp	**xtp** mdWarning	X	
lapdLink	**lapdLink** mdWarning	X	
tcu e3	**tcu e3**	X	X
transcoder	**transcoder** mdWarning	X	
transcoderBoard	**transcoderBoard** **software** (1) mdWarning	X	
btsSiteManager	**btsSiteManager** **software** (1) mdWarning	X	
bts	**bts** mdScanner mdWarning **handOverControl** (1) **powerControl** (1)	X	

basic graphic object	corresponding Q3 objects	Used on logical mode views	Used on physical mode views
	adjacentCellReselection (n) **frequencyHoppingSystem** (n)		
transceiverEquipment	**transceiverEquipment** **software** (1) mdWarning	X	
transceiver	**transceiver** mdWarning **channel** (n)	X	
transceiverZone	**transceiverZone** mdScanner mdWarning	X	
pcu	**pcu**	X	
pcusn	**pcusn**	X	X

Summary graphic objects The following table gives a comprehensive list of all summary graphic objects. It also lists, for each summary graphic object, the graphic objects being summarized.

Summary graphic	alarm information scope	Summary scope	graphic object	Used on	Used on physical

objects			type	log ical mode views	mode views
central office per default sub Network	alarms for pcmA ter- Summary + summary of pcm A + summary of tcu of the bsc belonging to the default subNet work	default subNet work	physical		X
central office	alarms for pcmA ter- Summary + summary of pcm A + summary of tcu of the bsc belonging to the subNetwork	same sub Network	physical		X
Abis interface per bsc	alarms for all Abis PCMs of one bsc	same bsc	link	X	
Abis interface per multiSite	alarms for all Abis PCMs belonging to the same multiple site	same mul tiple site	link	X	X
Abis per radio site	alarms for all Abis PCMs belonging to the same radio site	same radio site	link	X	X
Abis interface per radio sites group	alarms for all Abis PCMs belonging to the same radio site group	same radio site group	link	X	
adjcantCellHand Over per bts	alarms for all adjacent CellHandOvers of the bts	same bts	link	X	
A interface per bsc	alarms for all A PCMs of one **bsc** + corre sponding xtp(s) + sig nallingLinkSet	same bsc	link	X	

Summary graphic objects	alarm information scope	Summary scope	graphic object type	Used on log ical mode views	Used on physical mode views
A interface per default sub Network	alarms for all A PCMs of one bsc + corre sponding xtp + signal lingLinkSet of the bsc belonging to the default subNetwork	default subNet work	link		X
summary of pcm A	alarms for current object + corresp onding xtp(s) + signallingLink Set	same pcmA	link	X	
A interface per subNetwork	alarms for all A PCMs of one bsc + corre sponding xtp + signal lingLinkSet of the bsc belonging to the sub Network	same sub network	link		X
A interface per tcu	alarms for all A PCMs of one tcu + corre sponding xtp(s) + sig nallingLinkSet	same trans coder	link	X	
Ater interface per bsc	alarms for all Ater PCMs of one bsc	same bsc	link	X	X
Ater interface per default sub Network	alarms for all Ater PCMs of the bsc belonging to the default subNetwork	default subNet work	link		X
Ater interface per subNetwork	alarms for all Ater PCMsr of the bsc belonging to the sub Network	same sub Network	link		X
bscMdInterface per default subNetwork	alarms for all bscMdIn terface not linked to known subnetwork	default subNet work	link		X

Summary graphic objects	alarm information scope	Summary scope	graphic object type	Used on log ical mode views	Used on physical mode views
bscMdInterface per subNet work	alarms for all bscMdIn terface linked to one subnetwork	same sub Network	link		X
summary of bsc	alarms for current bsc + signallin gPoint + signal lingLinkSet + unreferenced pcm + unreferenced lapd	current bsc	physical simple modelled off-pag e connector	X	X
bss radio	alarms for summary of bsc + summary of radio site + summary of pcm Abis of one bsc	same bsc	flexible group		
bss radio per default subNet work	alarms for summary of bsc + summary of radio site + summary of pcm Abis of the bsc belonging to the subNetwork	default subNet work	off-page selector		X
bss radio per subNetwork	alarms for summary of bsc + summary of radio site + summary of pcm Abis of the bsc belong ing to the subNetwork	same sub Network	off-page selector		X
summary of btsSiteManager	alarms for current btsSiteManager + associated lapd	current btsSiteMa nager	expandable modelled	X	
summary of bts	transceiver zone per bts	current bts	expandable modelled	X	
defaultSubNetw ork	alarms for all bss com posing the default sub Network	default subNet work	flexible group		X

Summary graphic objects	alarm information scope	Summary scope	graphic object type	Used on log ical mode views	Used on physical mode views
multiple site	alarms for all the sum mary of radio site which belong to the multiple site	current multiple site	physical simple modelled off-pag e connector	X	X
radio sites group	alarms for the associ ated btsSiteManager and all its children + lapd associated to the matching trx	see note above	simple modelled container	X	
radio sites per bsc	alarms for all summary of radio site of one bsc	same bsc	container	X	
summary of radio site	alarms for all associ ated btsSiteManager and all their children + lapd associated to the matching trx	same btsSit eManager	simple modelled off-page connector	X	X
subNetwork	alarms for the centra lOffice + all bss partial summaries of a subnet work	current subNet work	flexible group		X
tcbs per tcu	alarms for all tcbs of the current tcu	same trans coder	container	X	
transcoders per bsc	alarms for all (tcu + tcb(s) + lapdAter) of the matching bsc	same bsc	simple modelled off-page selector	X	X
summary of tcu	alarms for current transcoders + transcod erBoards + lapdLink	current transcoder	simple modelled container physical off-page connector	X	X
summary of transceiverEquip ments per bts	alarms for current object + matching lapd	same trx	expandable modelled	X	

Summary graphic objects	alarm information scope	Summary scope	graphic object type	Used on log ical mode views	Used on physical mode views
transceiverZone per bts	alarms for all transceiv erZones of the bts	same bts	expandable modelled	X	
unreferenced lapd per bsc	alarms for all unrefer enced lapd of the bsc	same bsc	expandable modelled	X	
unreferenced pcm per bsc	alarms for all unrefer enced pcm of the bsc	same bsc	expandable mod elled	X	
summary of pcu	alarms for pcu + lap dLink (Agprs)	current pcu	physical simple modelled off-page connec tor	X	X
pcu per bsc	alarms for pcu of current bsc	current bsc	physical simple modelled	X	
Agprs interface per bsc	alarms for Agprs inter face linked to a bsc	same bsc	link	X	X
Agprs interface per default subNetwork	alarms for all Agprs interfaces of the bsc belonging to the sub Network	same sub Network	link	X	
Agprs interface per subNet work	alarms for all Agprs interfaces of the bsc belonging to the default subNetwork	same sub Network	link	X	

The "default subNetwork" class has been introduced to gather BSSs which do not belong to a particular subNetwork. This concept leads to creation of related classes such as "bscMdIntPerDefaultSubNet" which summarize the bscMdInterface of the whole default subNetwork.

The notion of radio site group has been introduced to gather sites. The set of radio sites gathered in a radio site group share the same pcmAbis links. This concept leads to the creation of the "radioSiteGroup" and related classes.

A summary object may belong to several graphic object types according to the type and level of view from which they are observed.

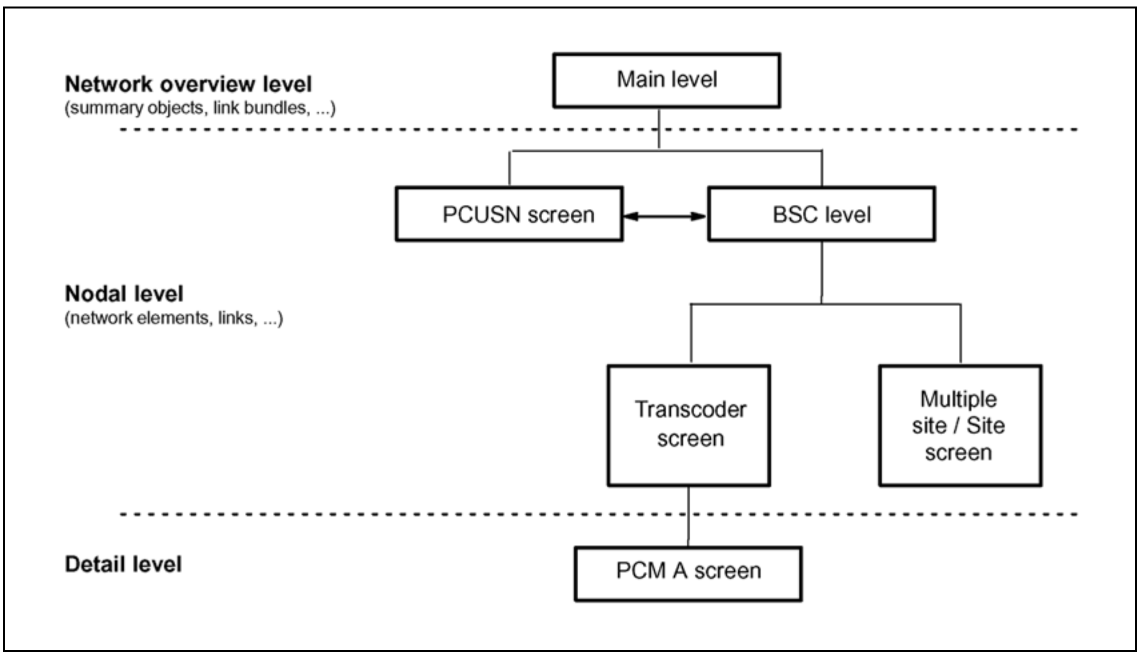
1.15.1.5 Management levels

Browsing is not a service in itself, but is a necessary function because of the different levels of display and the two display modes. Depending on the screen level and type, basic graphic objects directly associated to a Q3 object or summary objects may be displayed.

Displays level and screen types The display level hierarchy depends on the display mode: logical or physical.

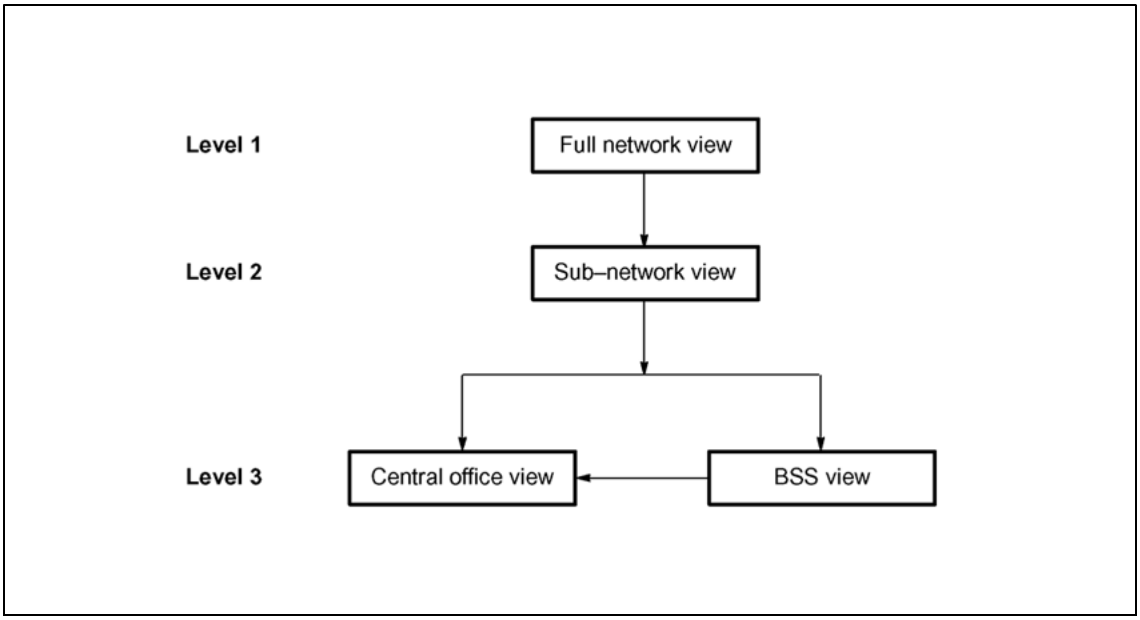
The logical view mode has four levels and six screens.

Figure 27
Logical mode screen hierarchy



The physical view mode has three levels and four screens.

Figure 28
Physical mode screen hierarchy



Navigation among screens

Vertical navigation The OMC-R browser window is split into two parts. The left part contains icons representing screens. The user can localize the currently displayed screen since the bottom icon represents the current screen and the others its predecessors. The network elements are displayed in the right part.

The user can navigate in the screen hierarchy in a vertical manner by double clicking on sensitive graphic objects. For instance, to go down from the ***mai n level*** to the ***bsc level***, one has to double-click on the bsc summary of the corresponding bsc. Conversely, one may go up from the ***bsc screen*** to the ***main level*** by performing a double click on the graphic object representing the logical main screen in the left part of the OMC-R browser. So, this principle can be used to vertically navigate among the different levels of display.

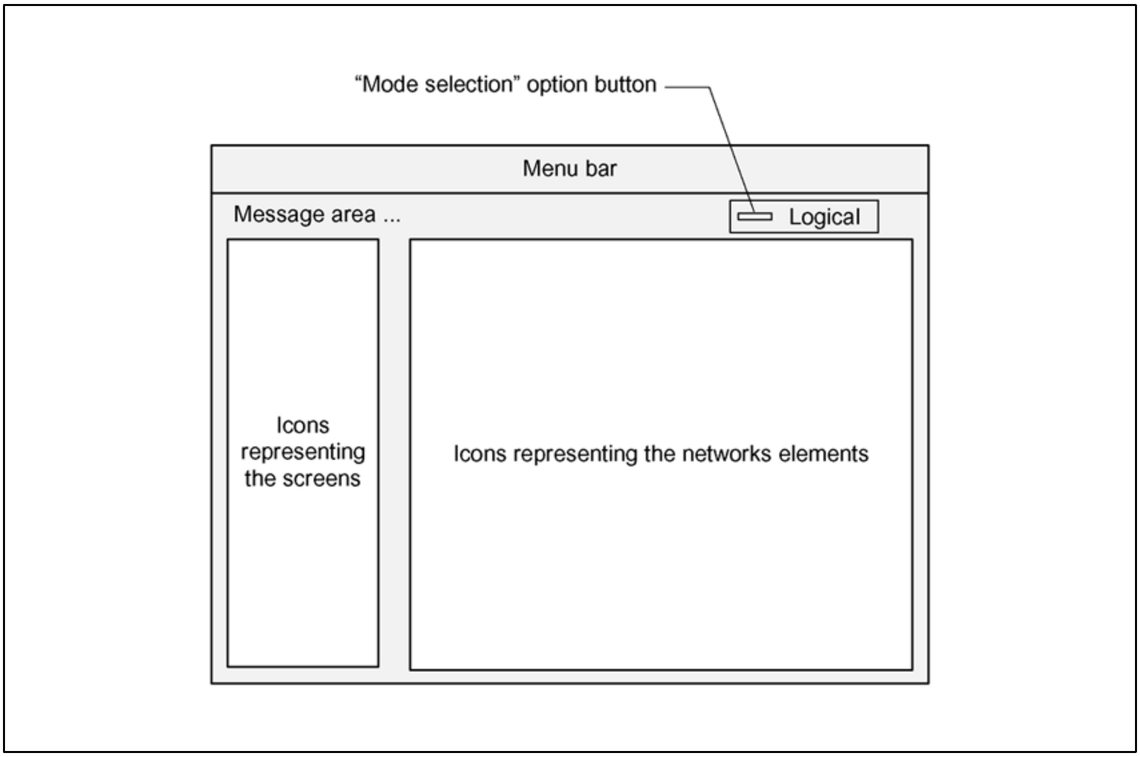
Horizontal navigation The way to navigate in an horizontal manner in the screen hierarchy tree is provided in order to request for a sibling screen. For instance, the user can request the screen corresponding to a particular ***BSS view*** from a ***BSS view*** belonging to the same subNetwork. A popup menu displayed when the user pushes the right button of the mouse on an icon representing a screen (left part of the OMC-R browser) allows the user to access to a sibling screen.

The following table gives the screens which can be requested using the horizontal navigation model from the graphic objects representing the screens.

Display mode	Screen icons	Accessible sibling screens
Logical	Main	**No sibling screen**
	BSC	All bsc screens
	pcuSN	All pcuSN screens
	site / multiple site	All Site / Multiple site screens belonging to the same bsc
	transcoder	All transcoder screens belonging to the same bsc
	pcm A	All pcm A screens belonging to same transcoder
	transcoder	All transcoder screens belonging to the same bss (bsc)
	radio site and multiple site	All radio site and multiple site screens belonging to the same bss (bsc)
Physical	Full network	**No sibling view**
	Sub network	All subNetwork view
	bss View	All bss view belonging to the same subNetwork
	central office	**No sibling view**

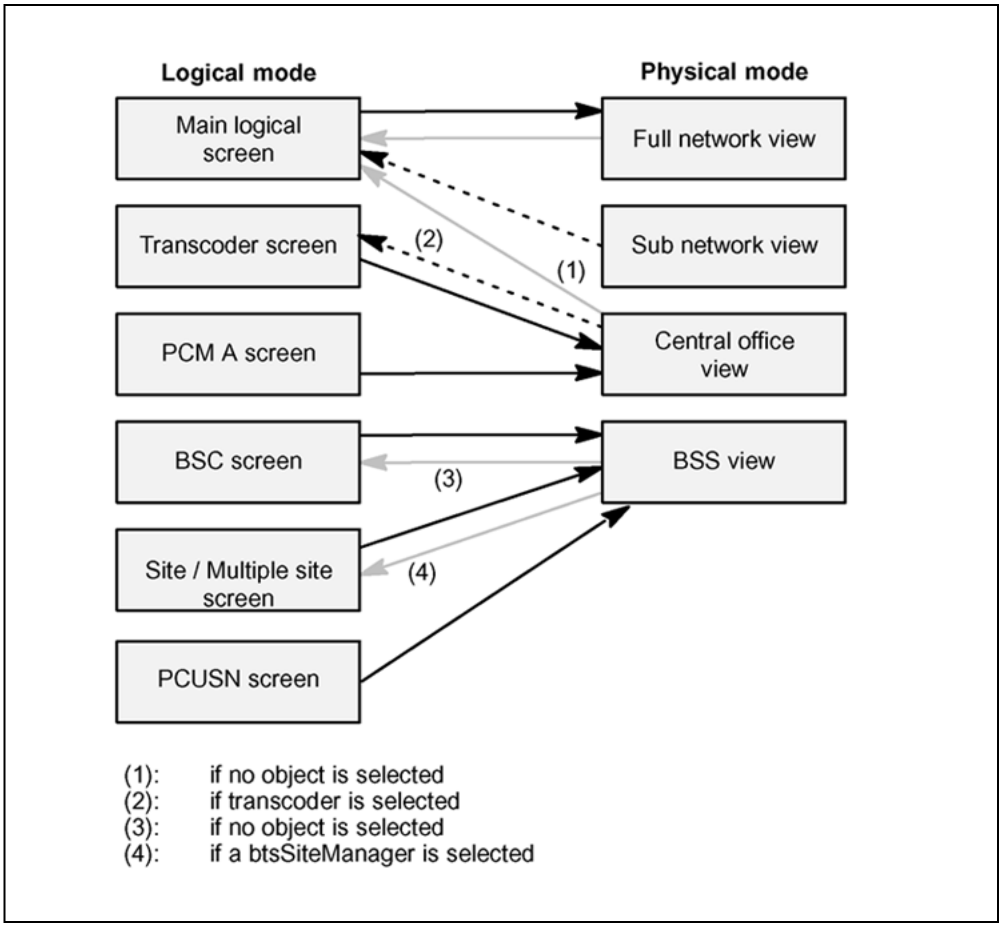
Logical Physical mode swapping The user may change the display mode (logical/physical) using a dedicated option button (See figure below).

Figure 29
Mode display selection on the OMC-R browser



When the user modifies the mode, the new selected screen level depends on the current screen. The figure below shows how is established the correspondence between the logical and the physical display levels.

Figure 30
Logical / Physical mode swapping scheme



1.15.1.6 Updating graphic elements

Graphic elements are displayed or removed in real time when the BDE database is updated.

Reminder: A new object created in the BDE is not displayed in an "OMC-R Browser" window unless it belongs to the zone of interest defined in the connected user's off-line terminal profile.

1.15.1.7 Information line

The information line shown at the top of each an "OMC-R Browser" window has the following purposes:

- display unsolicited help messages if the user makes a mistake
- identify a selected graphic element shown in the window without changing management levels. This is when the screen is difficult to read because of the small size of the window.

Moreover, it allows the user to identify the radio sites using a given PCM Abis link on request.

The information displayed on the line gives the name and/or reference number of the objects described by the selected graphic elements.

1.15.1.8 On-line help

Users can obtain on-line help at all times on all management levels.

- User help requests

  Select the **Color legend** option of **Help** menu in an "OMC-R Browser" window. A text appears in the help window that opens on the screen to remind users of the meaning of the different colors shown in the window.

- Unsolicited system help

  If the user makes a mistake, unsolicited system help messages appear on the information line.

1.15.1.9 Sizing the OMC-R browser windows

They can be enlarged to fill the entire screen or reduced to small size.

No information is lost when the windows are reduced, but they become more difficult to read. The graphic elements are reorganized to be as legible as possible and their size is tailored to match the size of the window.

1.15.1.10 OMC-R browser icon

When an "OMC-R browser" window is iconified, it is represented by the **OMC-R Browser** icon on the terminal screen.

The pictogram is symbolic and does not represent alarm states on the management level that was on display when the window was closed

1.15.2 State management

Objects appearing in this view are graphic objects, which conform to the Nortel Corporate Design Group (CDG) recommendation:

- The shape and the aspect of the object depends on the object type (link, managed Q3 object, summary ...).
- The state of the Q3 objects is displayed using specific symbols located on the left top.
- The alarms are displayed using colored alarm balloons and object background.
- The selection status is shown using a white border. The objects can be selected using the mouse.

States are not displayed on the physical view.

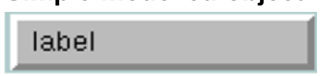
Depending on the size of the window and the number of graphic objects represented, scrollbars may be displayed to allow the user to see the objects one wants to supervise.

1.15.2.1 Shape and aspect of the graphic objects

Depending on the view display mode (logical/physical) and on the object kind, the shape and the aspect of the graphic objects may differ. Only the link and the connector objects have the same aspect on the logical and the physical view modes.

Logical view graphic objects The first kind of graphic object displayed on the logical view mode is the ***simple modelled object***. This kind of graphic object represents a single Q3 object. The following figure shows its layout.

Figure 31
Simple modelled object



The displayed label depends on the Q3 objects. Moreover, a bitmap is added on the left of the label for some main objects such as the bsc.

The second type of graphic object is the ***expandable modelled object***. This kind of object may be used (depending on the screen level) to summarize a main object and some directly associated objects (children for example). This object can be expanded or closed on clicking on the arrow displayed inside it.

Figure 32
Expandable modelled object

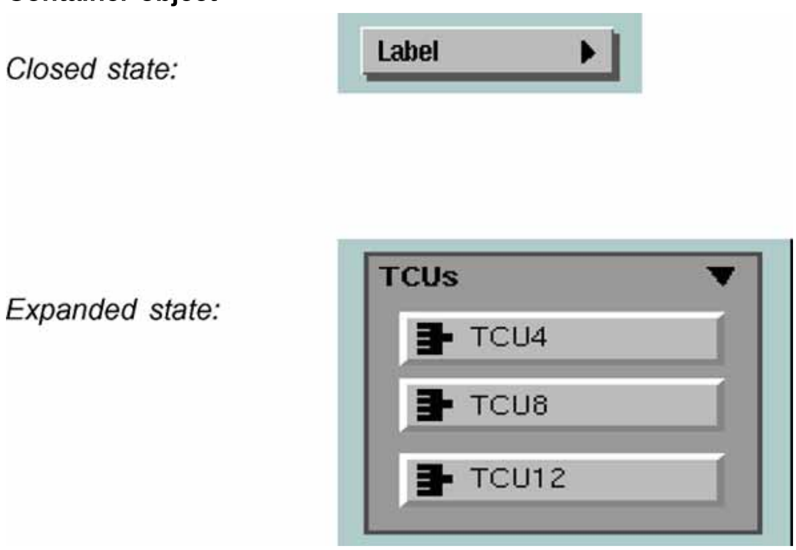
Closed state:

Expanded state:

As this kind of object represents a summary when it is closed and as the states are not displayed for the summary objects, the matching Q3 object state is displayed only when the object is expanded.

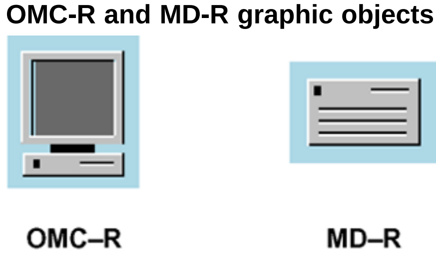
The third type of graphic object is the ***container object***. This kind is used to gather objects belonging to the same class. This graphic object can be expanded or closed on clicking on the arrow displayed inside it. When expanded, the summarized objects are shown inside it.

Figure 33
Container object



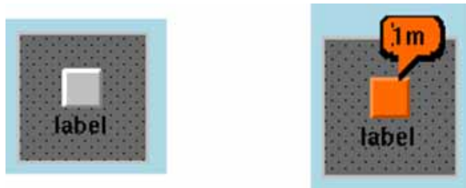
Physical view graphic objects On the physical view mode, the ***OMC-R*** and the **MD-R *objects*** are displayed using dedicated graphic objects. The following figure shows their layouts.

Figure 34
OMC-R and MD-R graphic objects



The ***sub-networks*** and the ***BSS areas*** are represented using ***flexible group graphic objects***. The following figure shows their layouts.

Figure 35
Flexible group graphic object



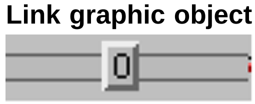
Finally, here is the last kind of graphic object displayed on the physical view. This kind of graphic object is used to represent the ***summary objects*** such as a bsc or a site for example a single Q3 object.

Figure 36
Physical view graphic object

The icon depends on the displayed object class: bsc, tcu (as represented above), site or multiple site. A label may be displayed below the graphic object depending on the needs.

Link graphic objects The graphic object associated to the managed objects such as the pcmCircuit representing the links is dedicated. Its appearance is given below.

Figure 37
Link graphic object

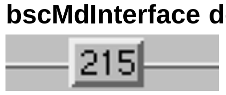


Managed links can be summarized in a link group. Its appearance is given below.

Figure 38
Link group graphic object

The bscMdInterface link is represented using a dedicated graphic object. Its appearance is given below.

Figure 39
bscMdInterface dedicated graphic object



The number is replaced by a star (as for the link group) for the bscMdInterface link groups.

Off-page connector and off-page selector graphic objects When a link object is terminated against a network element summary which is not in the current window, an off-page connector is used. Its appearance is given below.

Figure 40
Off-page connector graphic object

The displayed label depends on the managed object which is summarized.

A double click on a selector opens the matching view level when the connector represent a managed object summary.

When a link object is terminated against a summary which represent a set of objects (or summaries) belonging to the same class which are not completely described in the current window, an off-page selector is used to present them. Its appearance is given below.

Figure 41
Off-page selector graphic object

The displayed label depends on the managed object which is summarized.

1.15.2.2 State display

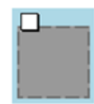
Each object has a status which depends on five elementary states:

- relevance: ***TRUE*** for Q3 objects, ***FALSE*** for other objects
- administrative state: ***LOCKED, SHUTTING DOWN*** or ***UNLOCKED***
- object state: ***KNOWN*** or ***UNKNOWN***
- operational state: ***DISABLED*** or ***ENABLED***
- availability status: ***EMPTY, FAILED*** or ***DEPENDENCY***

These states are exclusive and influence the visual aspect of the object on the logical view. Only a given set of states combinations is possible.

Here are the 8 possible object states and their corresponding visual aspect for any object.

Figure 42
State display

Relevance	administrative state	object state	operational state	availability status	object aspect
TRUE	LOCKED	—	—	—	
	SHUTTING DOWN	—	—	—	
	UNLOCKED	UNKNOWN	—	—	
		KNOWN	DISABLED	EMPTY	
				FAILED	
				DEPENDENCY	
			ENABLED	—	
FALSE	—	—	—	—	

Note: The cells that are not specified (i.e. with '—') indicate that the corresponding elementary state is not relevant.

The state displayed on the link differs as the shape of the object is different but the display principle and the used icons are exactly the same.

1.15.2.3 Alarm display

Alarms can appear on any object. The current alarm classifications, colors and letters (in function of the alarm severity) are:

- minor (Yellow, m)
- Major (Orange, M)

- Critical (Red, C)

The colors are configured off-line.

Figure 43
Graphic object with alarms

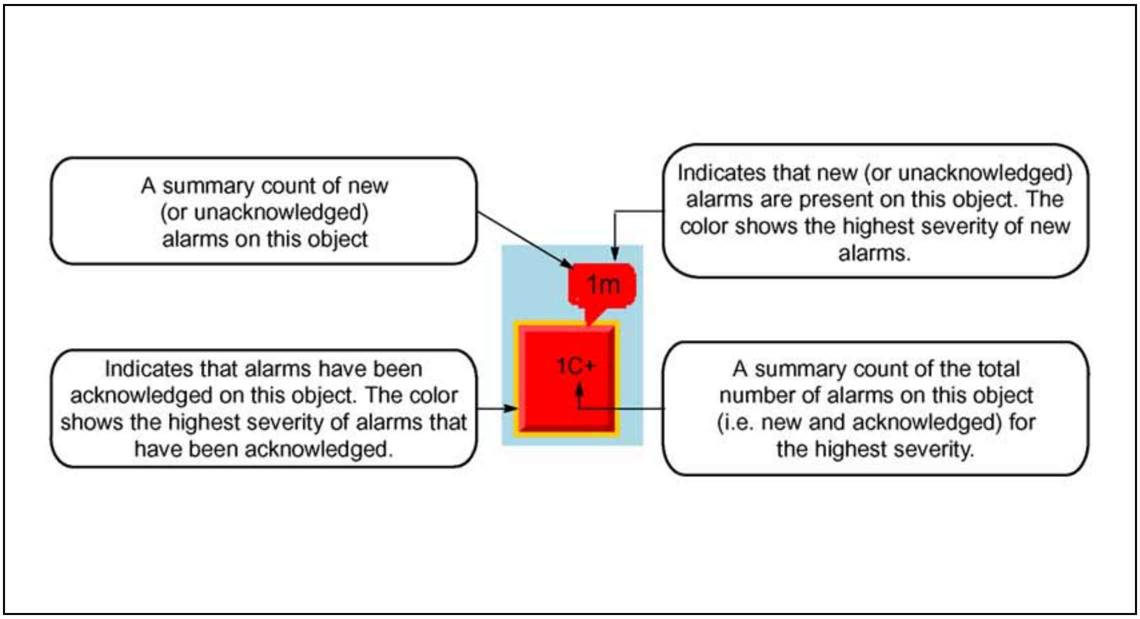
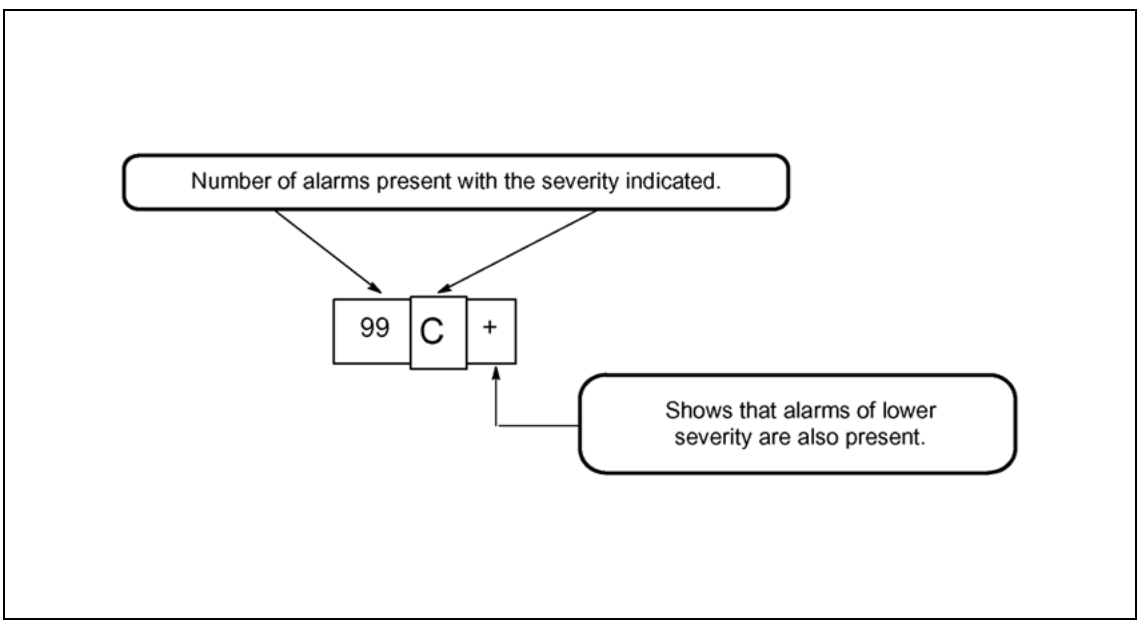
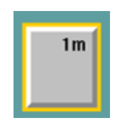
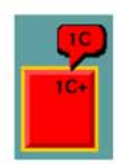
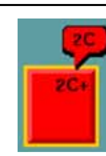


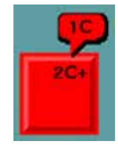
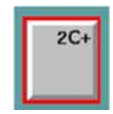
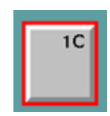
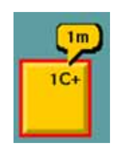
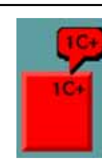
Figure 44
Graphic summary count symbolic

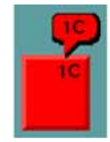
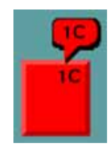
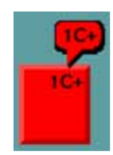
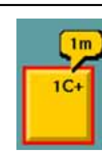
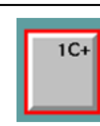


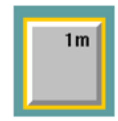
The following scenario illustrates how the graphic objects evolves according to the alarm evolution.

Table 9
Alarm display evolution

alarm evolution	Total alarms numb er	Alarm balloon label and color	Object alarm label and color	Out line color	graphic object
no alarm	0	- / -	- / -	-	
new minor	1	1m / yellow	1m / yellow	-	
acknowledge minor	1	- / -	1m/-	yellow	
new critical	2	1C /red	1C+ / red	yellow	
new critical	3	2C / red	2C+ / red	yellow	

alarm evolution	Total alarms numb er	Alarm balloon label and color	Object alarm label and color	Out line color	graphic object
acknowledge critical	3	1C / red	2C+ / red	red	
acknowledge critical	3	- / -	2C+ / -	red	
cease minor	2	- / -	2C / -	red	
cease critical	1	- / -	1C / -	red	
new minor	2	1m / yellow	1C+ / yellow	red	
cease critical	1	1m / yellow	1m / yellow	-	
new critical	2	1C+ / red	1C+ / red	-	

alarm evolution	Total alarms numb er	Alarm balloon label and color	Object alarm label and color	Out line color	graphic object
cease minor	1	1C / red	1C / red	-	
cease critical	0	- / -	- / -	-	
new critical	1	1C / red	1C / red	-	
new minor	2	1C+ / red	1C+ / red	-	
acknowledge critical	2	1m / yellow	1C+ / yellow	red	
acknowledge minor	2	- / -	1C+ / -	red	

alarm evolution	Total alarms numb er	Alarm balloon label and color	Object alarm label and color	Out line color	graphic object
cease critical	1	- / -	1m / -	yellow	
cease minor	0	- / -	- / -	-	

The alarm display of the link objects differs as the shape of the object is different but the display principle is exactly the same

1.15.2.4 Selection status display and behavior

Each object also owns a selected status that can be combined with any of the object states (when available) and any of the alarm states.

When an object is selected, a white rectangle surrounds the graphic objects.

Figure 45
Selection display

The selection display differs on the link objects: the white rectangle surrounds the central part of the link.

Each graphic object can individually be selected by clicking the left mouse button with the shift key not pressed when the pointer is on the graphic object or on the central part of graphic object for the links. When the user clicks outside any graphic objects all the objects are deselected.

When the shift key is pressed when clicking, the multiple selection mode is enabled. So, each time the user clicks on an object (or on the central part for the links): the object is selected if it was previously unselected or unselected if it was previously selected.

Some configuration and functional Q3 objects such as the software or the adjacentCellHandOvers are not displayed into the browser. They are named "hidden objects". They are automatically selected when the matching "reference" Q3 object is selected. These "reference" objects are named "hiding" objects. For example, when the user selects a bsc, the matching bsc software is automatically selected when it exists. But, the selection of the hidden object is made as a snapshot and not refreshed in real time. That is to say the hidden objects remain in the selected object list until the hiding object is reselected even if they are deleted. The same kind of behavior exists on hidden object creation: it is not automatically selected when the matching hiding object is already selected. In this case the user have to reselect the hiding object to be able to access to the new hidden object.

When a Q3 "reference" object is selected, the user has access to all commands that are relevant to both the object itself (hiding object) and all associated configuration and functional objects (hidden objects).

For instance, if the graphic object representing a bts is selected, the user will have access to all commands relevant to:

- the bts object instance (main configuration object)
- the handOverControl object instance
- the powerControl object instance
- the adjacentCellReselection object instance(s)
- the frequencyHoppingSystem object instance(s)
- the mdScanner object instance(s)
- the mdWarning object instance(s)

1.16 Security management

1.16.1 Overview

Security management controls users' access to OMC-R services.

The OMC-R manager Security Management function does the following:

- monitors service access by controlling the information that users can access and controlling the terminals through which users communicate with the OMC-R

  It is based on the analysis of user and terminal profiles that define access rights to different services.

- monitors work sessions by controlling each step in the routine (login, session interactions, logout)

  It is based on the following:

  — analysis of users' profiles defining each user's working conditions

— recording user interactions with the system: command execution and system responses to the commands, system warning messages

It uses the system and user session logs as supports.

User and terminal profiles are stored in mirrored files on the OMC-Rmanager disks.

1.16.2 Service access management

1.16.2.1 Access rights

There are three categories of service access rights, as follows:

- command domain
- output domain
- zone of interest

Command domain The user's rights to execute commands are defined by a command domain that contains the list of command classes that a user is allowed to access. A command domain contains up to twenty-five command classes.

A command class is identified by a number in static configuration data that references a set of commands associated with a given object (a *Create* btsSiteManager object command may be allowed in a user's profile but a *Create* mdScanner object command not allowed). One command may belong to several classes.

The user's command domain defines the set of data that the user can access through MMI commands. Managing the alarms generated by the Fault Management function is, for instance, controlled by a command class.

The mobile network operator, in agreement with the manufacturer, defines command classes. The command classes are unique to an installation and are configured before the network is commissioned. They cannot be modified in user work sessions.

The MMI `List command classes` command allows authorized users to list all the MMI commands and command class(es).

Output domain The user or terminal rights to output data are defined in the output domain that contains the authorized output classes.

Output classes provide access to various MMI windows from the main MMI screen. Each window allows the user to manage (during work sessions) or monitor (from off-line terminals) a set of same-kind data. BSS instrument panel observation data are, for instance, in this category.

The mobile network operator, in agreement with the manufacturer, defines output classes in the static configuration. They cannot be modified. Output classes are described at the end of this chapter.

The command domain and output domain defined in the same user's profile must be consistent.

Zone of interest The zone of interest defines the user's field of action during a work session. It defines the portion of the network monitored by a terminal when the user has not opened a work session on the terminal.

The zone of interest is divided into the BSS zone and the OMC zone.

- BSS zone of interest

  The BSS zone of interest allocated to a user defines the BSSs for which the user is responsible (one BSS may be managed by different users) and allows the user to do the following:

  — filter the commands entered on the Man-Machine interface according to the objects involved

  — filter the data that can be managed according to the source

  A terminal BSS zone of interest defines the BSSs that users can monitor outside work sessions and allows users to filter the data that they can consult from the terminal according to the source.

- OMC zone of interest

  The OMC zone of interest allocated to a user or terminal defines access rights to the notifications and alarm messages generated in response to unsolicited messages by the OMC-R manager or agent.

1.16.2.2 User profiles

A user is registered as an OMC-R user by the definition of a specific profile. The network operator creates and determines user profiles.

A user's profile contains the following information:

- name and password
- password validity duration
- access rights (command domain, output domain, zone of interest)
- authorized inactivity time
- authorized access time
- session context saving mode

The operator controls the profiles of all the system users. They can only be modified and deleted by authorized users. The profiles can be modified inside or outside work sessions. The new parameters are used the next time the concerned user opens a work session.

When a user profile is deleted, the user is denied access to the network. The session is not aborted if the user is working when the profile is deleted, but future login requests are denied.

Name and password To access the network, a user must be known to the system. A user is identified by a specific name and password.

Name and password are a unique combination that identifies the user at login time. They are compared to the values defined in the user's profile and allow the OMC-R to control user access, as follows:

- The name is limited to thirty characters.

  The name of an OMC-R user cannot be modified
- The password must begin with a letter and be at least six-characters long, with one non-alphanumeric character among the first eight characters.

  A list of "forbidden" passwords is defined in static configuration data. Any password beginning with a string of characters that matches one of the passwords in the list is refused (the character case is significant).

  The password of an OMC-R user can be modified in a work session by the user (MMI **`Change password`** command) or by an authorized user (MMI Set a user profile command).

  When a user runs the **`Change password`** command, current and new passwords are not displayed on the terminal screen. The new password must be entered twice to be validated.

  A new password must be different from its N previous occurrences (N is defined in static configuration data) and is only used the next time the user logs into a work session.

Password validity duration For security reasons, users' passwords must be changed at regular intervals.

The password validity duration is limited and can be modified. Users receive a warning message just before the validity counter defined in their profile expires.

If a password is not updated at the required time, the user must change it on opening the next work session. The system displays the password entry window at the start of the session. If the user does not update the password, the system refuses access to commands on the Man-Machine interface.

Access rights There are three categories of user access rights to OMC-R services, which are the following:

- The command domain defines the commands that the user is allowed to execute in work sessions and the data that can be accessed through MMI commands.
- The output domain defines the sets of data that the user can manage from dedicated windows.
- The zone of interest defines the network entities where the user is allowed to intervene:
  - Configuration commands are only allowed on the objects describing entities in the zone of interest.
  - Notifications and alarm messages are only displayed if the corresponding unsolicited messages are generated by entities defined in the zone of interest.

  The results of multiple-type (scope & filter) commands are not filtered by the zone of interest.

Inactivity time-out During a work session, a counter defines the maximum period of user inactivity between two commands. After that time, the system automatically generates a logout request.

- The default inactivity time is five minutes. It can be set to another value at a later time and may be infinite.
- A warning message is displayed on the terminal just before this period elapses. The session is broken off with no further warning when the time runs out.
- The inactivity counter is reset to zero by moving the mouse in an MMI window displayed on the terminal screen, without the user actually entering a command.

The jobs executed by the Job scheduler are not counted in inactivity time-out.

Access time A table defines the time at which users are allowed to login each day and the time after which access is prohibited.

If the user is still working after the authorized access time, a warning message is periodically displayed on the terminal and a buzzer is triggered, but the system does not close the session.

Authorized users define and update the table. A user is not allowed to access the OMC-R outside the defined time band. The time band may include midnight (for example: 20H - 4H).

Session context saving mode This parameter indicates whether the Man-Machine interface configuration is saved automatically each time the concerned user logs out or only on request.

The automatic context saving allows to start a new work session with the MMI characteristics of the last work session: All windows opened or iconified on the terminal screen are represented in the same way and at the same place. Specific display options are saved too.

However, one should note that, in order to avoid confusion, the window information contents correspond to the state of the network at the time the new session is open.

If the session context is not saved, the standard MMI screen is displayed when a newwork session is started.

User profile management commands OMC-R user profiles are described as **user profile** objects on the Man-Machine interface.

The following object-oriented commands are managed locally by the OMC-R manager:

- **`Create / Set / Display / Delete`**

  These commands are used to manage system user profiles.

  Modified values are used at the start of the next work session.

- **`Change password`**

  This command allows users to change their password during a work session using the password entry window on the terminal screen.

  The new password must be used the next time the user logs in.

- **`Modify session context saving mode`**

  This command allows users to set their own MMI context on opening a work session (see the previous page).

  By default, the automatic saving mode is on when the user profile is created or modified by the network operator. Then, the concerned user can de-activate or re-activate it by this command.

- **`List command classes`**

  This command displays the list of MMI commands and class(es).

- **`List user profiles`** (Line mode command)

  This command displays the list of user names declared to the OMC-R. This list is displayed in the "Security Manager" window on the terminal screen.

- `List connected users`

  This command displays the list of users working in session when the OMC-R executes the command.

1.16.2.3 Terminal profiles

Data are displayed on the following terminals: local or remote workstations, X terminals.

During work sessions, the terminals support user communication with the OMC-R. Outside user work sessions, the data spontaneously output by the system are automatically displayed on the same off-line terminals.

Each OMC-R terminal is identified by a profile identifying the terminal access rights. The mobile network operator controls the profiles of all OMC-R terminals. They can be modified by authorized users.

Access rights Terminal access rights to OMC-R services are divided into the following categories:

- The output domain defines the sets of data that users can consult from dedicated windows on the terminal outside work sessions.
- The zone of interest filters data output according to the data source (BSS and/or OMC-R).

Therefore, only predefined data are displayed on a terminal.

When a terminal is used for a work session, the connected user's profile supersedes the terminal profile. The following apply:

- The sets of data that can be managed on a terminal during a work session depend on the output domain and zone of interest defined in the user's profile.
- The sets of data that can be monitored on a terminal outside a work session depend on the output domain and zone of interest defined in the profile of the terminal used.

Terminal profile management commands The OMC-R terminal profiles are described as **terminal profile** objects on the Man-Machine interface.

The following object-oriented commands are managed locally by the OMC-R manager:

- `Create / Set / Display / Delete`

  These commands are used to manage the profiles of the OMC-R terminals.

- `List terminal profiles` (Line mode command)

This command displays the list of terminal names declared to the OMC-R. This list is displayed in the "Security Manager" window opened on the terminal screen.

- `List machines`

  This command displays the list of servers and workstations declared to the OMC-R. Each machine is identified by the name and the type.

1.16.2.4 Initial configuration

When the system is commissioned, the OMC-R software has one user profile template which is the following:

• name	administrator
• password duration	two days
• command domain	class allowing access to all MMI commands
• output domain	all classes
• zone of interest	unrestricted
• inactivity time-out	unrestricted
• access time band	0H - 24H
• context saving mode	on user request

1.16.3 Work session management

1.16.3.1 Session logs

The information concerning user communication with the OMC-R is recorded in the system session log and the user session log.

- The system session log records all the commands entered by users during work sessions, the system responses to the commands, and the system warning messages. Users are identified by their user name and the name of the terminal where they are logged in.

  The system session log is stored in an OMC-R manager disk file. Its capacity is set in static configuration data to store the past three days' data.

  Authorized users can consult the system session log. The user responsible for network monitoring should examine the log at regular intervals.

  The system session log is accessed by selecting the **System session log** option of the **Administration** menu in an "OMC-R Browser" window. The contents are displayed in a dedicated log consultation window.

  A subset of data recorded in the log can be selected; for example, the sessions opened by a given user, all the sessions opened on a given terminal, or the information recorded over a given period of time.

- A user session log only records, in real time, the commands executed by the user, the system responses to the commands, and the system warning messages concerning the user.

  A user session log is accessed by selecting the **User session log** option of the **Administration** menu in an "OMC-R Browser" window. The contents are displayed in a dedicated log consultation window.

  A user session log is deleted at the end of the work session.

The size of a user session log is limited by a parameter defined in the static configuration data (the default value is 940000 bytes).

The information displayed in the log consultation window can be printed or saved in a temporary file on user request.

1.16.3.2 Work session monitoring

A work session is divided into three steps: login, the session itself, and logout.

Login A login request is not accepted unless the user’s profile contains matching information:

- The name entered by the user must match an existing profile.
- The password entered by the user must match the password in the user’s profile.

  If the password duration has elapsed, the user must change the password before continuing (access to all commands is denied).
- The date and time of the login request must be inside the access time band defined in the user’s profile.

If the information matches, the system access request is granted. If not, the user is not allowed to access the system and a message indicates the cause.

The commands entered by the user and the system responses are recorded in the system session log regardless of the outcome.

Several users identified by the same name and password can log in at the same time on different terminals.

If the MMI context is saved for the user who logs in, the information contents of the windows that are displayed correspond to the network state at the time the session opens.

OMC-R access confidentiality A special mechanism allows the OMC-R to block the access to the "Login" window for a period of T seconds after N unsuccessful attempts to enter the right name/password combination. T and N are defined in static configuration data (T = 180 seconds or 3 minutes).

Simultaneously, a notification is issued. It contains the name of the terminal used, the name of the host workstation for an X terminal, and the date and time of the event.

On T elapse, connections with the terminal are resumed.

If a second round of N unsuccessful connection attempts is made, access to the "Login" window is blocked for 2T seconds. If a third round is made, access to the window is blocked for 4T seconds, and so on until a maximum blocking time M is reached. M is defined in static configuration data (1000 seconds).

Session A work session is constantly monitored using the information defined in the user's profile.

- access rights:
  - — Commands entered by a user must be authorized by the command domain defined in the user's profile. If not, the system rejects them.
  - — User access to data depends on the output domain and zone of interest defined in the user profile.

  The command domain, output domain, and zone of interest are defined by the network operator. The OMC-R manager detects inconsistencies and warns the user.

  Some commands do not depend on the user's zone of interest and are accepted only if the command domain is authorized.
- inactivity time-out:

  The interval between two commands must not exceed the inactivity time defined in the user profile.

  The system automatically ends the session after that time (mouse movement in an MMI window resets the counter to zero).
- access time:

  Users may only open sessions within the access time band defined in their profile.

  If the user is still working when the access time runs out, the system issues a warning message on the terminal where the user is working and triggers a buzzer, but the session is not aborted.

The information entered by the user and the system responses are recorded in the session logs.

Commands that are refused for syntax reasons are not recorded in the system log. Spontaneously issued warnings are recorded.

Logout A logout command is required to end a work session.

- logout upon user request: The work session is closed after confirming the request.

> **ATTENTION**
> Before ending a work session, users should wait for the system response to the last command to check the result (responses may take some time).

- logout on system request when the inactivity time-out between two commands elapses (see above)
- unconditional logout requested by the system when the terminal or OMC-R needs to be restarted

The reason and the time of logout are always recorded in the system session log. If saving the session context is required in the profile of the user who logs out, the MMI context is saved, unless a communication problem with the OMC-R server leads to loose the data; the user is then warned.

1.16.4 Special cases

1.16.4.1 Command management

The following commands cannot be accessed from a remote access terminal (RACE):

- `Create, Set, Display, Delete` a user profile
- `Create, Set, Display, Delete` a terminal profile
- `List user profiles, List terminal profiles`
- `List machines`
- `Set administrativeState` for a job
- `Switch over, Restart` (md object)
- `Shut down, Shut server down, Shut workstation down` (omc object)

1.16.4.2 Zone of interest management

The zone of interest management mechanism is not activated for all commands.

- commands not concerned on input:
  — `Display-Several` when base = "network"

— **`Set-Several`** when base = "network"

— **`Delete-Several`** when base = "network"

— **`List-Several`** when base = "network"

- commands not concerned on output:
  - **`Display-Several`** when base = "network" or "md"
  - **`List-Several`** when base = "network" or "md"
  - Call tracing data consulting in a "Call trace display" window
  - Call path tracing data consulting in a "Call path trace display" window

1.16.5 Output classes

Class	Function
OMC-R browser	Manage network in sessions (user profiles) or monitor network outside work sessions (terminal profiles)
alarm window	Manage alarms in sessions (user profiles) or consult alarms outside work sessions (terminal profiles)
performance monitor	Edit instrument panel observation reports in sessions (user profiles) or outside work sessions (terminal profiles)
command file manager	Manage users' command files in sessions (user profiles)
security manager	Manage user and terminal profiles in session (user profiles)
SMS-CB manager	Manage and broadcast short messages in sessions (user profiles)
description window	Manage network configuration in sessions (user profiles)
job scheduler window	Manage users' jobs and job results in sessions (user profiles)
alarm log window	Edit the cleared alarm log in sessions (user profiles)
system session log window	Edit the system session log in sessions (user profiles)
call traces window	Edit call tracing or call path tracing data in sessions (user profiles)
Unix window	Access to UNIX in sessions (user profiles)
notification log window	Edit the system notification log in sessions (user profiles)
notification window	Edit the user notification log in sessions (user profiles)
relay manager	Manage BSS alarm relays in sessions (user profiles)
alarm criteria	Manage alarm criteria configurations in sessions (user profiles)

All output classes are authorized in a user profile.

Only the following output classes are authorized in a terminal profile:

- OMC-R browser
- alarm window

- performance monitor

1.17 Command file management

1.17.1 Overview

The OMC-R Command File Manager allows system users to create command files to facilitate network configuration, reconfiguration, and monitoring.

Instead of executing commands entered on a terminal, the user records the commands in a file in the chronological order of execution.

1.17.2 Operating principles

1.17.2.1 Creating a command file

A command file is created by activating the record mode and entering commands in Menu mode.

In active record mode, the commands are saved without being executed. Command syntax is checked as each command is entered.

A command file can invoke another command file. The default number of nested calls is set to five, but it can be statically reconfigured. All the commands authorized in the command domain defined in the user's profile are accepted. Commands to create and delete user or terminal profiles are not usually authorized.

When the user deactivates the record mode, the file is added to the list of command files managed on the OMC-R. It is identified by a file name. The newly created command file is saved in the OMC-R manager disk directory selected by the user at the start of the command recording procedure.

A command file can be modified or deleted only by the user who created the file. It can be copied, displayed, and run by an authorized user (when copied, that user has the same privileges as the owner of the file).

Notes:

- The **`Display / Set`** command cannot be used in record mode (its selection with the mouse has no effect). Use the **`Display`** (**`in session log`**) command instead.
- Only MMI commands can be recorded in a command file. Directives cannot be recorded.
- If a user closes a work session without deactivating the record mode, the command file that was being prepared is not created and all the previously recorded commands are lost.

1.17.2.2 Managing command files

Command File Manager commands and directives are as follows:

- `Display`

  This command displays the properties of a command file in a display window opened for that purpose, that is:

  — name of the command file owner

  — date of file creation on the OMC-R

  — date of last modification

  — list of users authorized to copy, visualize, execute and display the properties of the command file. The list is empty when the command file is created and can be updated using the Set command described below.

  — summary explaining the goal of the file

  — list of $XXX parameters included in the file (see "Setting command parameters" in the paragraph)

- `Copy`

  — `Copy file`

  This command copies a command file to the same directory, under the name "<command_filename>.cpy". The copy belongs to the user who made it.

  — `Copy`

  This directive, using the "drag & drop method" copies a command file to another directory, under the name "<command_filename>.cpy". The copy belongs to the user who made it.

- `Move`

  This directive moves a command file from one directory to another, using the "drag & drop" method. The file is copied to the new directory then deleted from the old directory.

- `Edit file`

  This directive displays the contents of a selected command file in the **Command file editor window** from where it can be updated and executed.

- `Run`

  This command starts a selected command file run without editing it beforehand.

This command can be used to create an associated job. The command file run is then delayed until the first execution date and time set by the user (see Section 1.18.4.3 "Job scheduler" (page 256)).

- `Abort`

  This directive stops a command file currently running. The file run command is identified by a dedicated serial number in session logs.

  If the command to abort is a simple MMI command, the command file run stops when that command is executed. If the command to abort is another command file run command, the command file run stops when the last command in that file has been executed.

- `Set`

  This command allows the owner of a command file to modify its properties (such as the list of authorized users).

- `Rename file`

  This command changes the name of a command file without changing directories.

- `Delete file`

  This command deletes a command file from a directory after confirmation.

  If the file is running (see end of chapter), the file is deleted after the last command in the file has been executed.

- `Display file`

  This directive displays the contents of a selected command file in the **Command file editor window** from where it can be executed but not updated.

1.17.2.3 Editing command files

All command files created on the OMC-R can be edited by their owner before being run. The commands recorded in the file are displayed in Line mode syntax and can be modified according to Line mode syntax rules.

Line mode syntax The general rules of Line mode syntax are as follows:

Action - class: object = (id = ident); param = value; param = value; ...

- Action .... command name (Create, Display, etc)
- class .... object class (bsc, bts, etc)
- object = () .... string of characters to insert unchanged
- id = ident .... object identification sequence

- param .... name of a command parameter
- value .... parameter definition

A command is identified at the OMC-R by an "Action + class" combination. Object classes and commands are listed in NTP < 124 > and at the end of NTPs to < 128 >.

The following separators are used:

- - (hyphen) separates the action from the command object.
- : (colon) separates the command from its parameters.
- = (equal) separates an identifier or parameter name from its value.
- ; (semicolon) separates command parameters.

Parentheses can be used. If there is a space in a character string, the string is written between quotes. For example:

Set - bsc: object = (bsc = "BSC 2"); bscName = BSC2

Object identification The elements that identify an object depending on a higher level object are separated by an ampersand "&". Example:

Create - btsSiteManager: object = (bsc = 1 & btsSiteManager = 1); ...

List parameters A list is a variable number of elements separated by a "commercial &". Example:

mobileAllocation = 1 & 2 & 3

Group parameters A group is a fixed number of indivisible elements separated by a tilde. Example:

thresholdInterference = -100 ~ -90 ~ -80 ~ -70

Filter parameters A filter is a variable number of elements matching mathematical criteria and linked through the following logical operators:

- = means "equal".
- > means "greater or equal".
- < means "less or equal".
- & defines a "logical and".
- | defines a "logical or".
- ! defines a "logical not".

Special commands

- The format of a command that does not apply to an object is as follows:

  Action: param = value; param = value; etc.

  For example: Sleep: duration = 12

- The format of a multiple command that may apply to several objects is as follows:

  Action - Several: object = (id = ident) ; scope = scopeValue; filter = filterValue; param = value; param = value; ...

  "Several" is a keyword, "object" defines the node of objects concerned by the command, "scope" defines the subset of objects depending on the node, "filter" defines the conditions in which the command applies, and "param" defines the command parameters.

  For example:

  — This command is used to unlock all bts object instances describing the radio cells of a BSS at the same time:

    Set - Several: object = (bsc = 1); scope = "whole sub-tree"; filter = (objectClass = bts & administrativeState = locked); administrativeState = unlocked;

  — This command is used to list all bts object instances describing the radio cells of a BSS created on the OMC-R:

    List - Several: object = (bsc = 1); scope = (level = 2); filter = (objectClass = bts);

  Logical operators that can be used to define the conditions in which the command applies are listed in the previous paragraph.

Setting command parameters Users can edit command files to update command parameters.

For example, a command file containing a "Display bsc" command is as follows:

Display - bsc: object = (bsc = 1)

If the command is run, the attributes of the BSC no. 1 are displayed.

Let’s modify the command and replace "1" with $BSCID. The command is now as follows:

Display - bsc: object = (bsc = $BSCID)

Before starting the file run, the OMC-R manager recognizes the $ character and prompts the user to enter the reference number of the BSC whose attributes are required.

With one command file, the user can then display the attributes of any bsc object created in the OMC-R.

For instance, a BSS configuration file could be created in this way that contains the identifiers or names of all the network elements.

> **ATTENTION**
> Any string of alphanumerical, uppercase characters recorded in a command file that begins with $ and ends with a space or a lowercase character is viewed as a variable when the command file is run.

Special-purpose commands The following commands are useful for command file purposes:

> **CAUTION**
> **BSC 12000HC specific**
> The sleep command was specifically designed for the BSC 12000HC. Attempting to use this command on the BSC 3000 can damage some of its files.

- `Sleep: duration = xxx` is used to stop the command file run for xxx seconds and delay execution of the commands that follow.
- `Echo: text = blah blah blah` is used to display the text "blah blah blah", which indicates the exact position of the command file run.

Lines of comments Lines of comments can be inserted. These lines always begin with a "#" character and are ignored when the command file is run.

Blank lines also can be inserted. These lines are ignored when the command file is run.

1.17.2.4 Running command files

The `Run` command is used to execute the commands contained in a command file in the order which they were recorded. The next command is run only after the system response to the previous command.

The commands and the system responses are saved in session logs in the same way as commands entered directly on the terminal.

The system assigns a line number to identify each command recorded in a command file.

Users can decide to start running a command file from a given line number. The commands recorded before the line number specified in the command are not executed.

Users can decide to stop or continue a command file run if an application error is detected during the run. If the system detects any other type of error, the command file run is stopped. The user is informed and the OMC-R supplies the incorrect command number.

The OMC-R can be configured so that, when an application returns an error in response to a command, the command is re-run. The period between two re-runs, the maximum number of re-runs, and the errors that can be handled that way are defined in static configuration data. This treatment has priority over the user’s choice to stop or continue the command file run when an application error occurs.

1.17.2.5 Saving command files

This directive is used to save the commands being edited in a new or previously created command file.

Saving commands in a previously created file (whether the file is the one being edited or another file) may generate a backup file version containing the previously recorded commands (static configuration option).

1.17.3 File Execution time Duration (FED)

1.17.3.1 Principles

The File Execution time Duration tool (FED) estimates the duration of a command file execution. This tool adds up durations of each command, using laboratory test results.

1.17.3.2 Command File Estimator plug-in

CAUTION
Customer specific
Indicates that specific equipment and specific software (such as specific software in the BSC) dedicated to a specific application is used and that therefore the feature is not available for all standard GSM users.

The Command File Estimator is an OMC-R plug-in which is an enhancement of the FED. As a plug-in, it is integrated into the standard OMC-R graphical user interface (GUI).

1.17.4 Command file directory management

1.17.4.1 Principles

All command files created by OMC-R users are saved in subdirectories of the "root" directory on the OMC-R manager disks.

Each user can create a dedicated subdirectory to save the command files created during the user's work sessions. Sub-subdirectories can also be created.

1.17.4.2 Managing the directories

The following MMI commands are available:

- **`Create directory`**

  Creates a new command file directory in the "root" tree.

- **`Rename directory`**

  Changes the name of a command file directory in the "root" tree.

- **`Delete directory`**

  Removes a command file directory from the "root" tree, after confirmation.

- **`List`**

  Displays the contents of a command file directory in the "root" tree. Subdirectories and command files created in the selected directory are identified by name.

1.18 User facilities

1.18.1 Overview

User Facilities concern general operating aspects. They are largely independent of other OMC-R functions and include the following:

- system log services
- system time management
- job scheduler management
- inter-user mail facility
- on-line help

The SMS-CB and Command file management services are also user facilities. These services are detailed in previous paragraphs.

1.18.2 System log services

1.18.2.1 System logs

The OMC-R manages the following system logs:

- system notification log
- cleared alarm log
- system session log

The system notification log stores all the notifications received or spontaneously issued by the OMC-R agent. This log is independent of user sessions and is kept up to date in real time by the Fault Management function.

The cleared alarm log stores the alarms automatically ceased by the system or manually ceased by users. This log is kept up to date in real time by the Fault Management function.

The system session log stores all the information on user interactions with the OMC-R during work sessions. It is kept up to date by the Security Management function and contains the following information:

- login and logout requests accepted or not by the system
- commands executed during the sessions (commands refused because of syntax errors are not stored in the log)
- system response to commands
- system warning messages

System logs are stored in OMC-R disk files:

- Their capacity is set in the static configuration to store the last three days' information.
- They are systematically purged to hold only the most recent information.

Only authorized users may consult the system logs.

1.18.2.2 System notification log

Connected users can consult the notifications generated in response to the unsolicited messages issued by the entities in the zone of interest defined in their profile.

Within these limits, authorized users can consult the entire log or selected portions of the log. The following criteria can be used to select notifications:

- notifications with given serial numbers
- notifications of a given type
- notifications containing a given fault number
- notifications involving a type of BSC model and equipment, BTS model and equipment, or object (the user may also select a named equipment or object)
- notifications generated at a given time or within a given period of time
- notifications generated in response to unsolicited messages issued within a given period of time

If no criterion is selected, all notifications in the connected user's zone of interest are displayed.

If optimization mechanism is activated, then the number of processed incoming notifications depends on CPU load.

1.18.2.3 Cleared alarm log

Connected users can consult the alarm messages related to the entities in the zone of interest defined in their profile.

Within these limits, authorized users can consult the entire log or selected portions of the log. The following criteria can be used to select alarm messages:

- alarm messages with given serial numbers
- alarm messages with a given severity
- alarm messages containing a given fault number
- alarm messages related to notifications of a given type
- alarm messages involving a type of BSC model and equipment, BTS model and equipment, or object (the user may also select a named equipment or object)
- alarm messages generated at a given time or within a given period of time
- alarm messages generated in response to unsolicited messages issued within a given period of time
- acknowledged or unacknowledged alarm messages
- alarm messages acknowledged by a given user
- alarm messages ceased by a given user
- alarm messages ceased for a given reason

If no criterion is selected, all notifications in the connected user's zone of interest are displayed.

If optimization mechanism is activated, then the number of processed incoming alarms depends on CPU load.

1.18.2.4 System session log

Authorized users can consult the entire log or selected portions of the log. The following criteria can be used to select the information:

- consultation of a user's work sessions
- consultation of all user sessions opened on a given terminal

- consultation of information recorded within a given period of time. This criteria can be combined with either of the previous criteria, but the two other criteria are mutually exclusive

If no criterion is selected, all the information stored in the log is displayed.

1.18.3 System time management

1.18.3.1 Purpose

Monitoring and resetting the reference date and time of the OMC-R agent is fundamental for all the network operating events in time, such as:

- time-stamping events (notifications and alarms)
- time-stamping observation reports
- job runs triggered by the OMC-R manager

1.18.3.2 System time setting

Setting the OMC-R agent reference date and time is fundamental since this information is broadcast to all the connected BSSs.

The user in charge must monitor the OMC-R agent reference date and time closely. These references are characterized as follows:

- The md object **externalTime** attribute defines the current OMC-R agent date and time.
- The md object **deltaUtc** attribute defines the difference between the current OMC-R agent time and the Greenwich reference.

When the current OMC-R agent date and time are updated, the new data are broadcast to all managed BSCs. When the GMT difference is updated, the new value is transmitted to the OMC-R manager.

Changing the reference OMC-R agent date and time does not affect the date and time data displayed in the "Session information" window, if open, which refer to the terminal internal clock.

When the statutory time changes (automatically reset on the OMC-R manager and agent), the new system references are broadcast to the managed BSCs no later than TCLOCK1 (periodicity with which the OMC-R agent controls the BSC time = one hour). Consult the note at the end of the paragraph and the BSC time control mechanism described in codano 31001 in NTP < 032 >.

1.18.3.3 Managing system time differences

The statutory time is automatically reset on the OMC-R manager and agent.

Since the new time is not transmitted to the BSCs immediately, a time difference can exist between the OMC-R agent and a BSC at that time, which is highlighted by the following warning message:

Event: MAJOR SOFTWARE FAULT
Fault number: 31001
BSC-OMC time difference greater than TCLOCK4

The user in charge has the following choices:

- Either wait for the next BSC time control by the OMC-R agent (every TCLOK1 = one hour), when the new references are automatically broadcast to all the managed BSCs,
- Or execute the Synchronize bsc clock command on each BSC created on the OMC-R to immediately broadcast the system reference date and time to the managed BSCs.

1.18.3.4 Time server

The feature “OMC-R Time Synchronization from an external NTP source (27018)”, introduced in V16.0, allows the time of several OMC-R hosts to be adjusted from a single source. This single source can be a reference atomic clock (through a local time server) or an external NTP (Network Time Protocol) server.

NTP is an Internet standard protocol used to synchronize the system clocks of networked workstations and servers to some time reference over TCP/IP networks. NTP uses UDP packets for data transfer.

The OMC-R server(s) can transmit the reference time they obtain to workstations, BSCs, and PCUSNs connected to them.

Local time server

A local time server can be held on an OMC-R workstation. For redundancy purposes, two distinct OMC-R workstations are required. A local time server gets the reference time from an atomic clock through a radio clock box. It is regularly polled for time by the OMC-R server(s) by means of the NTP protocol.

External NTP server

The reference time from an external NTP server can be obtained through a gateway to an external network. This external network can include up to 10 NTP servers. These servers are regularly polled for time by the OMC-R server(s) by means of the NTP protocol like the local ones.

1.18.4 Job scheduler

The OMC-R Job scheduler allows users to execute deferred MMI command runs by partnering management parameters to the command. The "command/management parameters" combination defines a job.

The Job scheduler is an efficient way to perform big jobs during off-peak system periods, or perform specific jobs at a given date or at regular intervals (setting the active alarm handling configuration, for example).

The Job scheduler is installed on the OMC-R servers. The scheduler, which is the list of jobs created by users, is stored in a mirrored disk file so that jobs are not lost when the active server switches over.

The scheduler contents are updated in real time according to user commands (create, set, or delete a job) or internal OMC-R job scheduler management (automatic job deletion by the system, or deletion of a user profile meaning that all the jobs created by the user are automatically deleted).

1.18.4.1 Jobs

There types of jobs are defined: the occasional jobs, the repeated jobs over a given period, and the repeated jobs with no time limit set.

- An occasional job is run once at a given date and time. These jobs are withdrawn from the scheduler after the run.
- A repeated job over a given period is run at regular intervals, starting on a given date and time. These jobs are withdrawn from the scheduler at the end of the given period.
- A repeated job with no time limit set is run at regular intervals, starting on a given date and time, until the user decides to withdraw it from the scheduler.

A job is identified by name and contains the following information:

- command line
- name of the machine where the job is run (server or workstation)
- date and time of first run
- for repeated jobs: job run period, job activation state (newly created jobs are active by definition, but they can be set inactive by the user at any other time), and date and time of next run (progressively calculated by the system for successive job occurrences during the defined run period)
- for repeated jobs over a given period of time: date and time of automatic purge (calculated by the system from the date and time of the last run defined by the user)

Not all the machines declared to the OMC-R are allowed to run jobs (X terminals and RACEs are usually excluded). The list of authorized machines is defined in static configuration data.

1.18.4.2 Command line

The command that references a job is defined in Line mode syntax. For example:

Display - bsc: object = (bsc = 2);

This command may reference a command file. For example:

Run - commandFile: object = (commandFile = "/root/brigitt e/test");

1.18.4.3 Job scheduler

The OMC-R Job Scheduler manages all the jobs created by users in real time.

Job management On a machine, several jobs may be simultaneously run. The maximum number N of jobs that can be simultaneously run is defined in static configuration data.

When this maximum number is reached for a machine, the OMC-R delays the start of a new job that is ready to run. The following apply:

- If the new job is occasional, it is run no more than one minute after one of the current jobs finishes running.
- If it is repeated, it is run at the date and time of the next scheduled occurrence and the job owner is warned.

If a machine shuts down for any reason and a job is scheduled before the machine restarts, the following apply:

- An occasional job is executed as soon as possible after the machine restarts.
- A repeated job is executed at the date and time of the next scheduled occurrence after the machine restarts.

When the system date and time are set (see "*System time management*"), these data are forwarded to the Job scheduler. If the statutory time changes, a job may be run twice during the same night when clocks are set back or not run at all when clocks are set forward.

A repeated job is only run if it is active when the next occurrence is due (**administrationState** attribute = "unlocked").

A message is sent to the users' mailbox when a job they created has been executed. Users are also warned if one of their jobs could not be run and gives the reason (inactive job, run delayed, etc.).

User commands Job scheduler operations are detailed below.

Users can manage the jobs they create without any restrictions. Authorized users may also manage the other users' jobs.

- *Create*

  A job is created by defining the command to run and the parameters required by the OMC-R to manage the run as follows:

  — job name (identifier)

  — command to execute

  — name of the machine where the job is run

  — date and time of first job run

  — for repeated jobs, period of execution, and date and time of the last run if any

  The job must not exist in the Job scheduler, the Line command syntax must be correct, and the machine must be authorized to run jobs.

  When the command references a command file, the system does not check whether the file exists at this point (it is checked on the first job occurrence).

  After the create command is validated, the job is recorded in the scheduler.

  By definition, a job newly created is active.

- *Display / Display any*

  These commands allow connected users to display the characteristics of a job they have created or any scheduled job.

  The job is identified by name with the following information:

  — name of the user who created the job

  — command line to execute

  — name of the machine where the job is run

  — date and time of first run

  — for repeated jobs, period of execution, activation state, and date and time of next occurrence

  — for repeated jobs over a limited period, date and time of last run

- *Set / Set any*

  These commands allow connected users to update a job they have created or any scheduled job.

  The job is identified by name. All the job parameters can be set with this command, apart from the activation state.

  The *Set* command is only validated if the date and time of the next run calculated by the system from the data defined in the command are before the end date and time, whether or not these data are set.

  The parameters of a running job cannot be updated.

- *Set administrativeState / Set any administrativeS tate*

  These commands allow connected users to modify the activation state of a job they have created or any scheduled job.

  The job is identified by name.

  The activation state of a running job cannot be updated.

  Reminder: An inactive job is not run when its next occurrences are due.

- *Delete / Delete any*

  These commands allow connected users to delete a job they have created or any scheduled job.

  The job is identified by name. If it is running, the run is not interrupted.

  These commands must be confirmed before the system validates them and can be used for all job types. They are useful for deleting repeated jobs when the date and time of last run have not been defined.

  The result of a job that is deleted from the scheduler is not erased (see below).

  Reminder: The system deletes occasional jobs from the scheduler after the run and deletes repeated jobs over a limited period from the scheduler on the calculated date and time.

- *Abort running job / Abort any running job*

  These commands only concern jobs that are running and allow connected users to abort a job they have created or any scheduled job.

  The job is identified by name. Repeated jobs that are aborted are run on the next scheduled occurrence.

- *List jobs* (Line mode command)

  This command displays the characteristics of all jobs created in the OMC-R.

  All jobs created on the OMC-R are displayed in the "Job Scheduler" window on the terminal screen.

- *List running jobs* (Line mode command)

  This command displays the characteristics of all the jobs that are currently running on a machine at the time of the command.

  If no job is running, the system displays an appropriate message.

  All jobs currently running are identified by a special logo in the "Job Scheduler" window on the terminal screen.

1.18.4.4 Job results

Principles One job result references each scheduled job and contains all the messages related to the successive job runs (executed commands and system responses). The system assigns a job result the name of the job it represents.

The OMC-R stores job results in mirrored disk files so that no information is lost when the active server switches over. The system regularly purges the files to avoid overfilling the disks.

If a second job is created with the same name as a previous job and the previous job result is still stored on disk, the result of the second job is recorded in the same file.

User commands The operations on job results are detailed below.

- *Display (any) job result contents*

  These commands display the result of a job created by the connected user or the results of any scheduled job.

- *Delete (any) job result*

  These commands delete the result of a job created by the connected user or the results of any scheduled job.

  The job is not deleted when the associated result is deleted.

1.18.5 Inter-user mail facility

The OMC-R Mail function manages inter-user messages.

Users registered with the OMC-R have a mailbox that is allocated when their profile is created and stores all the user’s mail.

Users can send mail to selected users (identified by name) or all system users at one time.

If a user is working in a session when a message is delivered, a message appears on the terminal and the mail can be read without closing the session. Any mail that is delivered when the user is not connected is announced the next time the user logs in.

The OMC-R Mail function allows all connected users to list, consult, print, and delete the messages in their mailbox, send new mail, or answer a previously received message.

Users are prompted to purge their mailboxes at regular intervals to avoid overfilling.

1.18.6 On-line help

Users can consult the OMC-R On-line Help facility during work sessions to obtain information on each menu, button, or operating parameter displayed on the terminal screen.

Any item in an MMI window is associated with a text that explains its function. After selecting the item and the appropriate option in the *Help* menu, the information on the selected item is displayed in a special window on the terminal screen.

On-line help is not available on remote access terminals (RACEs).

1.19 Synchronization

1.19.1 BTS Synchronization

Principles

BTS synchronization consists in synchronizing one BTS with another BTS instead of with a BSC (through the Abis link). The principle is to synchronize one or two BTSs, called slave BTSs, with the synchronization signal received from a third BTS, called master BTS, instead of from the Abis link

The BTS that synchronizes another BTS is called the master BTS. An S8000 Compact Base Common Functions (CBCF) module or an S12000 BTS can synchronize an S8000 CBCF module, an S12000, or a BTS 18000.

The master BTS receives the synchronization from the BSC using the Abis link (and generates its own GSM time as a regular BTS does) or from a GPS clock.

The BTS that is synchronized by the master BTS is called a slave BTS. The slave BTS receives the synchronization and GSM time from an external signal coming from the master BTS using a new specific cable. The GSM time that is received by the slave BTS is re--generated and sent to the TRX without delay, to ensure that the radio frames of the slave BTS are in phase with the radio frames of the master BTS.

The new specific cable is a “Y” cable that diverts the signal sent by the main cabinet of the master BTS to its two extension cabinets towards the two slave BTSs. The cable is connected to the Base Common Functions interconnection (BCFICO) board of the slave BTS S8000 or S12000 or to the Interface Module (IFM) board of the BTS 18000 slave.

The operator can detect whether the slave BTS is correctly synchronized with the master BTS by loking at the LEDs.

Benefits

BTS synchronization allows:

- large capacity site configuration by extension of S8000 and S12000 colocalized sites,
- 1*1 reuse pattern, using optimized frequency hopping system between synchronized sites.

Parameters

Two specific parameters are associated with this feature:

- btsSynchroMode which tells in which mode the BTS operates (normal, master or slave),
- masterBtsSmId which gives the identifier of the master BTS.

For details on these parameters, refer to NTP <124>.

Loss of synchronization

If a slave BTS loses its external synchronization (on the master), there is an alarm on the OMC-R stating that synchronization is no longer guaranteed. The slaveBTS synchronizes itself on the BSC (using the Abis link) to avoid service interruption.

Activation

The operator activates BTS synchronization at the OMC-R.

The BTS synchronization is sent to the BTS in the SET EXTERNAL CONTACT REQUEST message.

Full BTS synchronization

Full BTS synchronization consists in activating the master and slave modes by setting the btsSMSynchroMode parameter.

If the master BTS is synchronized using GPS, the GPS time is indirectly broadcast to the slave BTSs. The cable that broadcasts the master time to the slave BTSs introduces delays that are compensated at the slave

BTS level. To achieve this configuration, the possible values for the btsSMSynchroMode parameter for the master can be GpsBurstSync or masterGpsTimeSync. The values for the slaveBTSs are set to normal.

Full BTS synchronization can also be achieved by synchronizing 3 BTSs using GPS. To achieve this configuration, the btsSMSynchroMode parametermust be set to gpsTimeSync.

BTSs must be on the same BSC

The synchronizing and synchronized BTS must be on the same BSC.

For a description of BTS reparenting in case of BTS synchronization, see the description in NTP < 034 >.

1.19.2 Network synchronization

Principles

The network synchronization feature is a standalone feature.

The network synchronization consists in using the network as a common clock source for network synchronization.

The following synchronization modes are available:

- Burst synchronization
- Time synchronization

The burst synchronization consists in enslaving the network on a source clock and ensuring that all bursts are aligned in time.

The time synchronization consists in enslaving the network on a source clock and forcing the GSM time to be deduced from a unique source time.

A network is synchronized when its entities share a common time source.GSMtime synchronization is not mandatory but all clocks must follow the same pulse (burst synchronization). The pulse reference is taken from the GPS system.

1.19.2.1 Benefits

The main benefits are:

- the smaller number of frequencies needed
- the increased frequency load on hopping plans

Activation

The operator activates network synchronization by setting the appropriate value of the **btsSMSynchroMode** parameter. The operator also specifies which mode is used for network synchronization: burst or time.

The activation (the value of the **btsSMSynchroMode** parameter) is directly transferred from the OMC-R to the BTS in the SET EXTERNAL CONTACT REQUEST message.

1.20 Introduction to OMC-R data server (SDO)

The OMC-R Data Server, or SDO, is installed by the manufacturer when the system is commissioned.

The SDO Data Server application is a communication interface between the OMC-R and the peri-OMC applications. It does the following:

- processes data records and radio network configuration parameters in an ASCII readable format:
  - counters of the Fast Statistic Observation - OFS records
  - counters of the General Statistic Observation - OGS
  - counters of the PCUSN observation
  - counters of the PCU/BSC observation
  - call tracing records
  - call path tracing records
  - cellTiering records
  - fault and stateChange notification records
  - radio network configuration parameters
  - zones of interest (ZI) of the connected workstations
  - OMC-R session log
- transfers OMC-R data the following ways, depending on data types and SDO configuration parameters:
  - periodically (up to one day)
  - at start time (only for automatic transfer mode), to recover the current day data records produced at the OMC-R level since the last SDO has been stopped.
  - on event reception: each time a data record is received by the OMC-R
  - on demand: these transfers apply to data collection period defined as part of one or more days using the *beginSearchTime* and the *endSearchTime* input criteria.
- builds per-record reports for:
  - observation data

- builds per-period transfers for:
  - fault and stateChange notifications
- builds consolidated reports (daily or user-defined time interval) for:
  - observation data
  - call tracing data
  - call path tracing data
  - fault and stateChange notifications
- builds reports for:
  - radio network configuration
  - OMC-R system session log
  - zone of interest
- provides the following administration facilities:
  - start and stop
  - suspend and continue
  - delay management
  - survey and defense mechanisms
  - daily purge
  - defense purge
  - on-demand purge
  - data archival
  - log SDO activity
  - automatic data file compression algorithm
- transform and stores data on radio distribution measurements (see Distributions on radio measurements)
- transform and stores data on call drops (see Call drop analysis)
- transforms and stores interference matrix data (see Interference matrix)

For more details, see NTP <006> and NTP <130>.

1.21 Network level presence identification of eDRX, ePA and HePA

1.21.1 Overview

This feature (SV1374.1 & 020247 - *Network level identification of eDRX, ePA and HePA presence*) is a 14.3 features.

The feature consists in finding a way to differentiate in a system view eDRX from DRX and ePA and HePA from PA for maintenance purpose and Edge feature implementation preparation.

1.21.2 Operating principles

The differentiation can be done in adding three new equipments in the BTS POD of the products:

- EDRX type: 0xC0
- EPA type: 0xC1
- HEPA type: 0xC2

Existing equipment types are the following:

- DRX type: 0x90
- PA type: 0x68

Event reports on Abis interface will then be sent with the corresponding equipments in the event_code.

StatusRsp with Hardware Config will also be fulfilled in function of the present equipments, eDRX or DRX and ePA, HePA or PA.

BTS starts with default equipments DRX and PA and update them in function of the connection of the Edge equipments. Type of DRX and type of PA is detected by the BCF by the mean of the BoardInitRsp message from the DRX; the equipments by default will be DRX and PA.

When the BCF detects the presence of a eDRX or a ePA or a HePA, the copy of the DLU in RAM must be updated with eDRX or ePA or HePA. The equipment table in the DRX Slave Manager table must be also updated with eDRX or ePA or HePA. Event reports and Status with Hardware Config must be built with eDRX or ePA or HePA.

When eDRX has never been connected, it is seen by the BTS by default as a DRX (and not a eDRX). When ePA has never been connected, it is seen by the BTS by default as a PA (and not a ePA)

When HePA has never been connected, it is seen by the BTS by default as a PA -and not a HePA- (from a status report and event report point of view ; from a power management point of view, it is seen as a "unknown type" PA).

When starting, default equipment are DRX and PA, on Enable TRX message, an Event DRX_LINK is sent to the BSC on DRX equipment (even if a eDRX is present).

When eDRX is connected (after StatusRsp from DRX), end of fault event is sent to the BSC on DRX equipment (BoardInitRsp message has not been received yet) and on BoardInitRsp message.

eDRX and ePA or HePA equipments are used in the Status with HwConfig and in other Event Report messages that could appear.

1.21.3 Impacts

No modification on HW/SW compatibility (mapping of TDMA Edge on Edge eDRX and ePA or HePA will use another mechanism, type of DRX is not enough to decide if the TDMA could be mapped or not, ePA or HePA is also necessary to take the decision and BSC has no vision for the moment on equipments PA)

Existing alarms that can occur on the equipment DRX can now occur also on eDRX equipment. Existing alarms that can occur on the equipment PA can now occur also on ePA and HePA equipments.

CODANO 1060 and 1067 can now accept new causes wording corresponding to the eDRX, ePA and HePA fault causes.

New equipment at OMC-R allow to identify the type of equipment to replace in case of failure: DRX or eDRX, PA or ePA or HePA.

Replacement of a DRX by a eDRX procedure : A Lock/Unlock TRX must be made to ensure the coherence of the notifications sent to OMC-R. Replacement of a (H)(e)PA procedure : A Lock/Unlock or a reset TRX must be made to ensure the coherence of the control of the number of HePA and PA in the BTS.

Notes:

1. Feature SV1374 identifies eDRX, ePA and HePA at a network level.
2. A BSS configuration which contains an OMC-R with feature SV1374 and a BTS without feature SV1374 works.
3. A BSS configuration which contains an OMC-R without feature SV1374 and a BTS with feature SV1374 does not work because the OMC-R cannot display a Status with Hardware Configuration containing unknown equipment.

New equipment eDRX (0xC0), ePA (0xC1) and HePA (0xC2) have to be implemented in the OMC-R in terms of event reports decoding and display hardware decoding. The event report causes defined for the equipment DRX and PA can occur now also on eDRX, ePA and HePA equipment.

When failure on a (e)DRX or a (H)(e)PA, the operator will arrive on site with the right equipment to replace thanks to the differentiation mechanism.

BTS detects the presence of eDRX, ePA and HePA and modify the DLU copy in RAM to update the corresponding equipment types. Abis Events and StatusRsp with Hardware Config are then fulfilled with eDRX or DRX and ePA, HePA or PA equipment.

1.22 Disaster recovery

If a disaster occurs on an OMC-R, all of the supervision is lost on that OMC-R. The disaster plan describes how an OMC-R can be reconfigured to minimize the amount of time a loss of supervision lasts when an OMC-R fails.

The disaster plan is divided into the following three main parts:

- Configuration. Sites are configured to perform daily backup operations as part of the disaster recovery plan process.
- Recovery. A recovery of the backed-up OMC-R configuration occurs on a spare configuration to replace the failed OMC-R.
- Site restoration. The site which failed is restored to normal operations.

Additional procedural information for the disaster recovery plan in available in the NTP <006>.

Chapter 2
GSM evolutions

2.1 General Packet Radio Service (GPRS)

2.1.1 Introduction

The GPRS is a wireless packet data service which is an extension to the GSM network. It provides an efficient method to transfer data by optimizing the use of network resources together with providing the mobility. The GPRS radio resources allocator allows to provide multiple radio channels to one user in order to reach high data user rate. Furthermore, one radio channel can be shared by multiple users in order to optimize the radio resources.

Operators can offer Data Services based on GSM for applications such as:

- Corporate services, including e-mail, Fax, Internet & Intranet accesses, File transfer, Telecommuting services
- Fixed access, including e-mail, Fax, Internet access, File transfer
- Consumer oriented info based messaging, WAP, SIM toolkits, Java
- Telemetric type applications

The GPRS is available only for BSSs equipped with a BSC 12000HC or BSC 3000 and in cells whose transceiver architecture consists of either DCU4 or DRX, but are not mixed.

2.1.2 Principles

GPRS uses a packet-mode technique to transfer high-speed and low-speed data and signalling in an efficient manner. GPRS optimizes the use of the network and radio resources.

New GPRS radio channels are defined and the allocation of these channels is flexible.

The radio interface resources can be dynamically shared:

- by the active users (for GPRS TSs only)

- between speech and data services (GPRS TSs and speech TSs on the same TDMA, see Section 2.1.5 "GSM/GPRS/EGPRS TSs dynamic sharing" (page 271))

2.1.3 Implementation

2.1.3.1 New equipment

The GPRS network architecture is implemented on the existing wireless infrastructure with the addition of the following network identities:

- on the BSS side

  The Packet Control Unit Support Node (PCUSN) performs the functions linked to GPRS traffic management.

- on the Core Network (new packet handling subsystem) side:
  - The Serving GPRS Support Node (SGSN) performs security functions and access control
  - The Gateway GPRS Support Node (GGSN) provides interworking with external packet-switched networks.

The SGSN has the equivalent role as the MSC role in the NSS but for the data domain. Moreover the HLR is enhanced with GPRS subscriber information.

The main functions of the SGSN include:

- detecting new GPRS mobile stations in its service area
- sending and receiving data packets to and from the mobile stations
- recording the location of mobile stations inside its service area

One of the main roles of the SGSN is to perform data packet routing. Another key role of the SGSN is mobility management. In addition to these two key roles, the SGSN provides a number of other functionalities. These include ciphering and compression.

2.1.4 OA&M interfaces evolution

The implementation of GPRS introduces new parameters, redefines semantics for some existing parameters, and introduces new observation counters. The parameters are described in the NTP <128> and the counters are described in this section.

2.1.4.1 New observation counters

Two types of new counters are introduced by the GPRS feature. These new counters are described in the following sub-sections.

New BSS observation counters

- 1086/x (grpsRachRejectedSicd<x>)

- 1087/x (grpsImmAssRejectedSicd<x>)
- 1088/x (grpsPagingRejectedSicd<x>)
- 1812 (allocatedCircuitTs(TrZone)Cum/Ech/Max/Moy)
- 1813 (allocatedPacketTs(TrZone)Cum/Ech/Max/Moy)

Refer to these new entries in NTP < 125 >.

New PCUSN observation counters The PCUSN presence in the network introduces new PCUSN counters. The PCUSN observation consists in the two following groups:

- BSS observed counters
- PCUSN observed counters

The numbering of these new PCUSN counters is 150xx and 151xx.

Refer to these new entries in NTP < 125 >.

Synthetic counters Synthetic counters contain the data calculated from raw counter data or other synthetic counter data. The calculation formulas are defined in configuration files.

2.1.5 GSM/GPRS/EGPRS TSs dynamic sharing

This feature (TF1121 - *GSM/GPRS TSs Dynamic sharing*) enables dynamic sharing between GSM and GPRS of the TSs on the Air interface. The main benefit is the increase of the efficiency of this interface.

2.1.5.1 Principles

For GSM/GPRS networks, three types of radio TSs are defined. The types are as follows:

- fixed GPRS radio TSs

  These TSs are used in order to guarantee a minimal number of radio TSs allocated to GPRS in this option. The operator sets this number at the OMC-R level.
- fixed GSM radio TSs

  These TSs are only used for GSM mode.
- shared radio TSs between GSM and GPRS

  These TSs are by default used in GPRS mode, thus given to the PCUSN at the cell configuration and preempted by GSM in case of lack of fixed GSM radio TSs.

At the OMC-R the operator indicates the cell radio TSs which manage GPRS (*channelType* attribute of the channel object set to "*pDTCH*") and the corresponding TSs on the Abis interface connected through the BSC to the Agprs interface. Thus the same number of Agprs TSs as GPRS allocated radio TSs is reserved on the Agprs interface.

In case of lack of GSM radio TSs, the BSC starts a preemption procedure to allocate shared radio TSs for GSM. Moreover, when a shared radio TS temporarily allocated to GSM is released (end of GSM allocation due to end of call or handover), a reallocation procedure towards GPRS is started to increase the GPRS capacity.

The EDGE dynamic allocation features a single cell to share one or more packet data channels (PDCHs) on the air interface between Enhanced GPRS (EGPRS) and GPRS mobiles. With this feature, cells share on-air timeslots and backhaul resources by multiplexing GPRS and EGPRS mobiles. The multiplexing feature can be introduced on every kind of network (GPRS only, EGPRS only and EGPRS/GPRS) without any constraints. There are no degradations of the service when only GPRS is used. Sharing on-air timeslots and backhaul resources improves resource use and increases capacity. No parameters are required for multiplexing EGPRS/GPRS.

2.1.5.2 Configuration

The implementation on the OMC-R interface is the following:

- on channel object:

  The *channelType* parameter must be set as follows:

  — "tchFull" value for GSM only TSs

  — "pDTCH" value for GPRS only and shared TSs

- on bts object:

  — *radioAllocator* parameter enables to choose whether "voice+data circuit" or "voice + data circuit + packet data" is supported.

  In a GSM-R V.15 specific context, *radioAllocator* should be set to "voice + data circuit + packet data" to allow both GPRS calls and Advanced Speech Call Item (ASCI) calls in the same cell.

  — *minNbrGprsTs* parameter defines the minimum number of GPRS TSs in the cell.

  — *gprsPreemption parameter* allows (or not) PCUSN to send a PCUSN TDMA Nack Status message at the end of the preemption procedure.

— *gprsPreemptionProtection* parameter defines the protection timer used to reduce the load in case of NACK during the preemption procedure.

- on transceiver object:

  — *gprsPriority* parameter defines TDMA capacity to manage GPRS.

2.1.6 RLC polling improvement

The GPRS/EDGE Radio Link Control (RLC) polling improvement feature provides a way for the operator to modify the polling frequency used by the PCUSN at the end of Temporary Block Flow (TBF) periods (when the probability for uplink TBF setup is high). The polling frequency has an impact on the end-user’s perception of system reactivity for applications composed of many short transfers which alternate Uplink (UL) and Downlink (DL).

2.1.6.1 Principle

Before this feature was available, the polling frequency was fixed and set to 240 ms during the Keep Alive period, the DL pre-establishment period and the DL preventive retransmissions period. During these periods, the MS waits 240 ms for the next polling occurrence to request a UL TBF. This waiting period can be reduced by increasing the polling frequency. Parameter "rLCPolling" was added to the OMC-R for this purpose. Refer to NTP <124> for its description and values.

2.1.6.2 Polling limitation

Increasing the polling frequency for a given MS reduces the available bandwidth for other mobile stations partitioned on the same Time Slots (TS). In order to reduce TBF establishment time and have more bandwidth for the UL TBF when established, the number of blocks used for polling is intentionally limited to 50% of the overall TS bandwidth, if at least one TBF is established on this TS. If no UL TBF is allocated on a TS, the polling frequency is only limited by the available bandwidth and the number of mobile stations requesting polling.

2.1.6.3 Polling during keep alive

During the first 240 ms period of the Keep Alive period, the polling frequency is controlled by a timer set to 240 ms (or 120 ms or 60 ms depending on the rLCPolling parameter). After the first 240 ms period, polling is repeated every 240 ms up to the Keep Alive Timer expiration.

2.1.6.4 Polling during DL pre-establishment period

During the first 240 ms period of the DL pre-establishment period, the polling frequency is controlled by a timer set to 240 ms (or 120 ms or 60 ms depending on the rLCPolling parameter). After the first 240 ms period, polling is repeated every 240 ms up to the DL TBF pre-establishment timer expiration.

2.1.6.5 Polling during DL preventive retransmissions period

During preventive retransmission period, the polling frequency is controlled by a timer set to 240 ms (or 120 ms or 60 ms depending on the rLCPolling parameter). Note that the DL preventive retransmissions period is usually shorter than 240 ms (typically 140-180 ms); therefore if the timer is set to 240 ms, this may prevent any polling during the DL preventive retransmissions period.

2.1.7 TBF establishment improvements

This feature (TF1220 - *TBF establishment improvements*) enables to decrease the time for starting data transfer. More precisely, it enables to decrease the uplink and downlink TBF (Temporary Block Flow) establishment time, in order to increase the data throughput.

2.1.7.1 Principles

This aim is reached using different sub-features related to one or both TBF types (uplink and downlink):

Uplink TBF improvement

TF1220.4 fast uplink assignment: This sub-feature allows to start the uplink data transfer immediately. The PCUSN immediately allocates one TS when receiving an initial PACKET RESOURCE REQUEST message.

This sub-feature is always activated.

Downlink TBF improvement

TF1220.3 transfer non DRX mode: This sub-feature is used when a downlink data transfer occurs, just after the release of downlink TBF. More precisely, in case of downlink data packet reception at the PCUSN level during the non-DRX period, the PCUSN takes into account a timer (partly defined by the *drxTimerMax* parameter), and sends an IMMEDIATE ASSIGNMENT message to the MS in non-DRX mode.

This sub-feature allows to:

- reduce the TBF establishment time by half a CCCH period
- make the TBF establishment time independent of the CCCH configuration in some specific cases

The duration of the CCCH period is directly linked to CCCH parameters and especially the *noOfMultiFramesBetweenPaging* parameter.

TF1220.6 fast downlink assignment: When receiving an initial downlink data frame, the PCUSN starts data transfer as soon as possible (i.e. when receiving the IMMEDIATE ASSIGNMENT message by the MS + reaction time). This sub-feature is always activated.

TF1220.7 downlink pre-establishment: At the end of an uplink data transfer, when the last data block is received and acknowledged, the PCUSN immediately starts a downlink TBF and triggers a timer defined by the *upAckTime* parameter (before the reception of LLC frame coming from the SGSN), in order to resume faster, downlink data transfer, if needed.

This sub-feature induces an increase of bandwidth and TFI use.

Nevertheless, as the downlink TBF is established without Lapd and CCCH messages, this feature decreases:

- the BSC load the
- Lapd channel load
- the CCCH load

Uplink and downlink TBF improvement

TF1220.5 TBF keep alive algorithm: This sub-feature is used at the end of a downlink TBF, in order to resume data transfer faster in case of:

- uplink data request
- downlink data request

In case of downlink TBF, if the last data block is sent, the TBF is not released even if the MS has acknowledged all data, in order to resume faster, uplink or downlink data transfer, if needed.

At the end of a downlink TBF, this feature keeps the TBF alive during a period defined by a timer (*dwAckTime* parameter), instead of releasing immediately all associated resources, thus increases resource use (bandwidth and TFI).

However, since the MS has still an established TBF, there is no need of Lapd and CCCH messages to restart the data transfer. Thus this feature decreases:

- the BSC load
- the Lapd channel load
- the CCCH load and avoid in some cases a supplementary CCCH radio TS

2.1.7.2 Configuration

The implementation on the OMC-R interface is the following:

- on transceiver object:
  - — *dwAckTime* parameter (packetAckTime) enables to activate / deactivate the sub-feature TF1220.5 *keep alive algorithm*
  - — *upAckTime* parameter (packetAckTime) enables to activate / deactivate the sub-feature TF1220.7 *downlink pre-establishment*
- on bts object:
  - — *drxTimerMax* parameter enables to activate / deactivate the sub-feature TF1220.3 *transfer non-DRX mode*

Refer to these entries in NTP < 124 >.

Sub-features TF1220.4 *fast uplink assignment* and TF1220.6 *fast downlink assignment* are always activated.

2.1.8 GPRS TBF establishment improvement: one phase access

The GPRS "one phase access" feature allows the uplink Temporary Block Flow (TBF) to start faster, which decreases the uplink TBF establishment time in order to increase the data throughput from an end-user point of view.

The GPRS "one phase access" feature is implemented in the V15.0 release and is only applicable to GPRS. This feature is not available for DCU2 and DCU4 dual channel units.

2.1.8.1 Principles

This feature allocates resources requested by an uplink TBF at the reception of a "One phase" Channel Request message and starts the uplink data transfer as soon as possible.

2.1.8.2 GPRS one phase access feature activation parameter

This feature is activated at the OMC-R using the following parameter:

- onePhaseAccess:
  - — Object: bts
  - — Values: enable / disable
  - — Class: 2
  - — Default value: disable

If the one phase access feature is deactivated, the BTS manages all GPRS and EDGE Channel Requests as in previous version (if CCCH at BTS is activated).

The PCUSN uses the PDCH Assignment Parameters procedure, in order to inform the BTS of the activation or deactivation of the one phase access feature.

2.1.8.3 Cell configuration and modification parameter

The default number of downlink TS is managed in the pCU2GConfCell element (byte 11). The number of downlink TS can be changed at the OMC-R using the following parameter:

- onePhaseDnMsCapability
  - range: 1..255
  - default value: 1

  Values 1 to 8 are significant, but values 0 and 9 to 255 must be interpreted as the default value by the PCUSN.

2.1.8.4 GPRS one phase access feature PCUSN counters

The following PCUSN counters are associated with the GPRS "one phase access" feature:

- pcuChannelRequestOnePhase
- pcuUpTbfImmediateAssignmentOnePhase
- pcuContentionFailureOnePhase

Refer to NTP <125> for a description of these counters.

2.1.9 Extended uplink TBF

The "Extended Uplink TBF" feature (22915), introduced in V15.1, enables the uplink TBF (Temporary Block Flow) to be extended at the end of an uplink data transfer so that another uplink transfer can begin immediately afterwards.

This feature is defined in the 3GPP Release 4 (TS 44.060). It is mandatory for 3GPP Release 4 terminals and optional for the network.

This feature enables uplink resources to the MS to be retained during temporary inactive periods (when the MS has no RLC data blocks to send). During such periods, the network keeps allocating UL radio blocks to the MS so that it can send new RLC data blocks as soon as they become available. In this case, the MS is said to be operating in extended UL TBF mode. However, even in this mode, after a certain period of inactivity (during which the MS has sent no RLC data blocks), the uplink TBF is released by the PCUSN (at a point determined by the PCUSN).

Without the feature, all resources are released at the end of an uplink TBF. Consequently, there will be a set-up time for the next uplink transfer. In this case, the MS is said to be operating in non-extended UL TBF mode.

The parameters nwExtUtbf, extUtbfNoData, tNwExtUtbf, tUsfExt, nUsfExt, onlyExtUtbf, and fullD1Ka are associated with this feature. See also the descriptions of these parameters in NTP <124>.

2.1.10 Full Keep Alive

The "GPRS/EDGE Full Keep Alive" feature (28111), introduced in V15.1, enables pre-Release 4 terminals, operating in non-extended UL TBF mode, to increase their UL throughput by preserving DL TBF at UL TBF establishments.

The feature increases throughput by decreasing set-up times and "saving" UL blocks. This feature is a consequence to the feature Extended Uplink TBF (described in Section 2.1.9 "Extended uplink TBF" (page 277)).

Without the feature, during an UL TCP transfer, a short DL TBF is set up to carry the TCP acknowledgements. This increases the set-up time and "wastes" UL blocks when sending control blocks for these TBF. Such control blocks include Packet Control Acknowledgement messages responding to the receipt of the DL TBF establishment requests (for example, Packet Downlink Assignment messages), or Packet Downlink Ack/Nack messages responding to the receipt of the DL TBF release requests (last data blocks with FBI=1 and RRBP).

2.1.11 Disabling TBF Keep Alive during GMM procedure

The "Disabling TBF Keep Alive during GMM procedure" feature (23038), introduced in V15.1, enables the MS to disable DL Keep Alive during a GMM (GPRS Mobility Management) procedure.

GMM procedures between the MS and SGSN result in the establishment of short TBFs which are followed either by a "DL TBF pre-establishment" or a "DL Keep Alive" procedure. During these latter 2 procedures, if NMO1 is not activated, the MS is not reachable and cannot receive CS-paging. In the case of "DL TBF pre-establishment" procedure, this can be 0.5 seconds. In the case of a a "DL Keep Alive" procedure, this can be 2.5 seconds.

The tGmmKeepAlive parameter is used to disable/enable and configure the feature. See also the description of this parameter in NTP <124>.

2.1.12 GPRS sleepy cells Step 1: automatic detection and recovery

Up to V14 BSS version, some configuration problems or sub-system component failures may lead to what we call "GPRS sleepy cells". That is a cell on which GPRS is not operational but this state is not clearly stated to the operator.

The aim of this feature is to try an automatic recovery when the PCUSN detects a problem that may be solved by a cell GPRS reconfiguration.

This recovery is done respectively through a cell GPRS reconfiguration.

2.1.12.1 Principles

This feature modifies the BSS defense mechanism when the PCUSN detects a problem that may be solved by a cell GPRS reconfiguration.

The problem detected by the PCUSN can be:

- BTS is not responding to CELL_GPRS_OPEN
- SGSN is not responding to BSSGP protocol message and BSSGP parapet NOK
- Cell unsynchronized on Agprs interface
- Pdch Assign Param procedure failure
- Incomplete config received from BSC

This defense is based on a message to the operator and a reconfiguration of the faulty entity in order to recover as soon as possible the GPRS service.

2.1.12.2 Main defense mechanisms

GPRS service closing consists in disabling GPRS in MS using BCCH sys_info messages:

- System information 13 with empty content: the BTS stops broadcasting SI13 messages to the MS
- System information 3 and 4 (and 7 and 8 if necessary): deactivate GPRS broadcast indicator

A cell_GPRS_close message is also sent from the PCUSN to the BTS if necessary (cell_open previously sent). On receipt of this message, the BTS stops counters and the Abis GSL link is disabled.

2.1.13 Configure sending of SI13 and SI2Quater on Ext or Normal BCCH

This feature (27318) allows System Information 13 (SI13) and System Information 2 Quater (SI2Quater) messages to be configured for normal or extended BCCH. The feature is implemented in the V15.0.1 release and is only applicable for GPRS.

2.1.13.1 Principles

SI13 and SI2Quater broadcast information is sent to the BTS and MS in the System Information 3 (SI3) message, in the SI3 rest octet Information Element (IE).

This feature allows the operator to choose normal or extended BCCH to send the SI13 and SI2Quater messages. Two new parameters were added to the BSC DATA CONFIG table on label 64 "mobile specificity configuration" to allow the selection of normal or extended BCCH. See Section 2.1.13.2 "BSC data configuration parameters" (page 280) for a description of the configuration parameters.

Sending system information messages on extended BCCH will add traffic on PCH/AGCH.

2.1.13.2 BSC data configuration parameters

Bit 9: SI13_position:

- 0x00 (default value): SYSTEM INFORMATION TYPE 13 message is sent on BCCH Norm
- 0x01: SYSTEM INFORMATION TYPE 13 message is sent on BCCH Ext

Bit 10: SI2Quater_position:

- 0x00 (default value): SYSTEMINFORMATIONTYPE 2Quater message is sent on BCCH Norm
- 0x01: SYSTEMINFORMATIONTYPE 2Quatermessage is sent on BCCH Ext

SI13_position and SI2Quater_position IE in the SI3 rest octet will be set by the BSC according to the BSC data configuration value.

2.1.13.3 Feature benefits

The following concerns are resolved by the feature:

- MS device issues
  - — If the MS cannot read SI13 messages when sent on extended BCCH, prevents the MS from connecting to GPRS services.
  - — If MS cannot read SI2Quater messages when sent on normal BCCH, leads to MS reboot or CS calls set up failure.
- Both SI13 and SI2Quater
  - — If both SI13 and SI2Quater are sent on normal BCCH, the MS takes more time to read system information, causing increased reselection time.

— The number of reselection attempts may increase for some MS when both SI13 and SI2Quater are sent on normal BCCH.

2.1.14 PS paging duplication on BSC

The "PS Paging duplication on BSC" feature (26186), introduced in V15.1, reduces the Agprs load due to PS paging in the Downlink direction.

Without this feature, PS paging duplication is done on the PCUSN side.

With this feature, PS paging duplication is done by the BSC instead of on the PCUSN side. This reduces the number of paging commands sent on the Agprs GSL (GPRS Signaling Link) link towards the BTS. There is a consequent improvement in performance.

2.1.15 GRPS/EDGE Suspend and Resume

The "GPRS/EDGE Suspend and Resume" feature (25155), introduced in V15.1, enables a class B MS to resume its GPRS service after suspension without sending a new RA (Routing Area) Update request.

Every class B MS which is GPRS attached must suspend its GPRS service when it enters dedicated mode. Dedicated mode includes handling a circuit call, making an LA (Location Area) update, sending/receiving an SMS, etc. When it leaves dedicated mode, it resumes its GPRS service.

Without this feature, the GPRS service is resumed using an RA Update request to establish a TBF over the PS domain. Both TBF establishment and the RA Update procedure consume resources.

With the feature, the GPRS service is resumed using a GPRS Resume request. The MS does not need to perform an RA Update. This procedure saves resources in the PDTCH and the PCUSN CPU. As less PCUSN processing is required for signaling, the PCUSN capacity for handling data traffic is increased. This feature also reduces the duration of the MS unavailability period to receive an incoming CS call.

The parameters suspendResumeActivation, tSuspendAck, and tResumeAck are associated with this feature. See also the descriptions of these parameters in NTP <124>.

2.1.16 Implementing Network Mode of Operation 1 (NMO1)

The "Network Mode of Operation 1 (NM01) (TF 1134.2)" feature (17635), introduced in V15.1, enables a class B mobile currently performing a data transfer (GPRS service) to be paged for an incoming voice call (GSM) and suspend the data transfer to accept the voice communication.

A number of interfaces are used by this feature. These are shown in Figure 46 "Interfaces associated with the NMO1 feature" (page 282).

Class B mobile station

A class B mobile station is a one that can be attached to both GPRS and GSM services. However, it does not support simultaneous activation of both services.

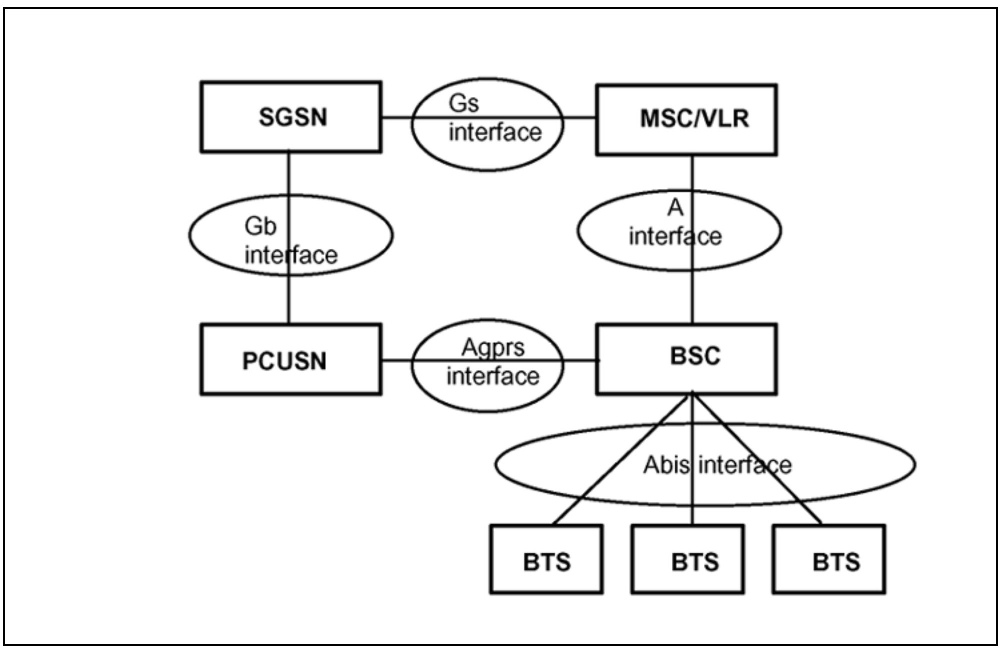
CS paging

CS paging is associated with GSM is used to inform the MS about an incoming GSM call (voice). CS paging is managed by the MSC. The BSC receives the CS paging message on the A interface. The BSC routes the CS paging message from an A LAPD port to an Abis LAPD port to reach the appropriate cells.

PS paging

PS paging is associated with GPRS is used to establish a GPRS data communication. PS paging is managed by the PCUSN. The BSC receives the PS paging message on the Agprs interface. The BSC routes the PS paging message from an Agprs LAPD port to an Abis LAPD port to reach the appropriate cells.

Figure 46
Interfaces associated with the NMO1 feature



Interfaces used for CS and PS paging

With the NMO1 feature, the CS and PS paging procedures are sent on the Gb and Agprs interfaces. Attach/Detach and LA update procedures for CS and PS are combined in a way that is transparent to the BSS.

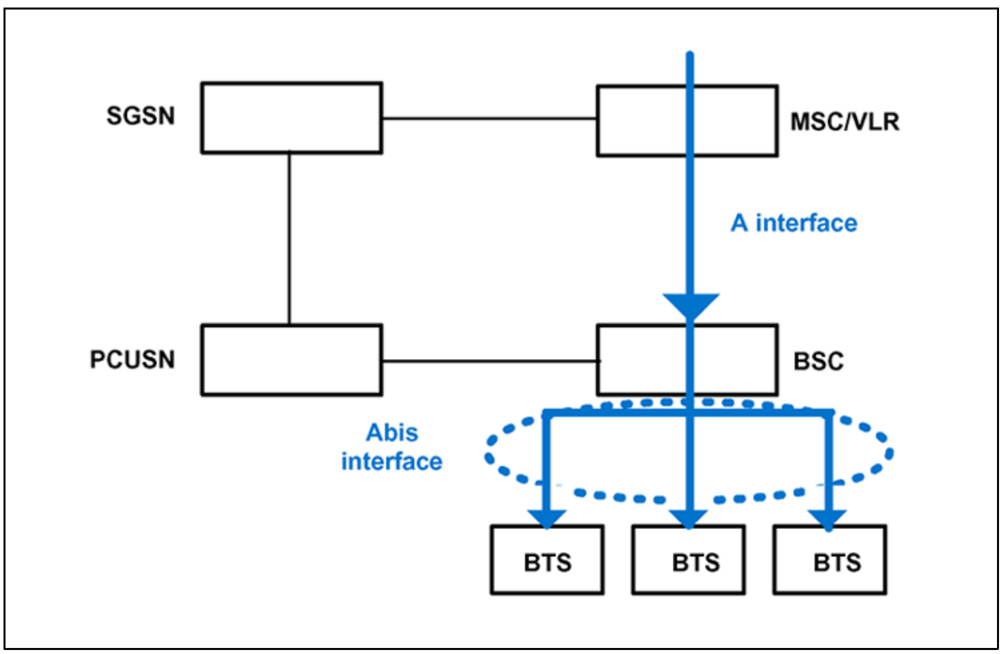
Three cases are described:

- Case 1: The MS is not attached to GPRS. This is shown in Figure 47 "MS not attached to GPRS - CS paging via A interface" (page 283).
- Case 2: The MS is attached to GPRS, but the MS is not in a GMM (GPRS Mobility Management) READY state. This is shown in Figure 48 "MS attached to GPRS - paging via Gs, Gb, and Agprs" (page 284).
- Case 3: The MS is attached to GPRS and the MS is in a GMM (GPRS Mobility Management) READY state. This is shown in Figure 49 "MS attached to GPRS - in GMM ready state" (page 285).

Case 1 - normal CS paging

In the case shown in Figure 47 "MS not attached to GPRS - CS paging via A interface" (page 283), the CS paging message is sent via the A and Abis interfaces. This is the normal CS paging procedure.

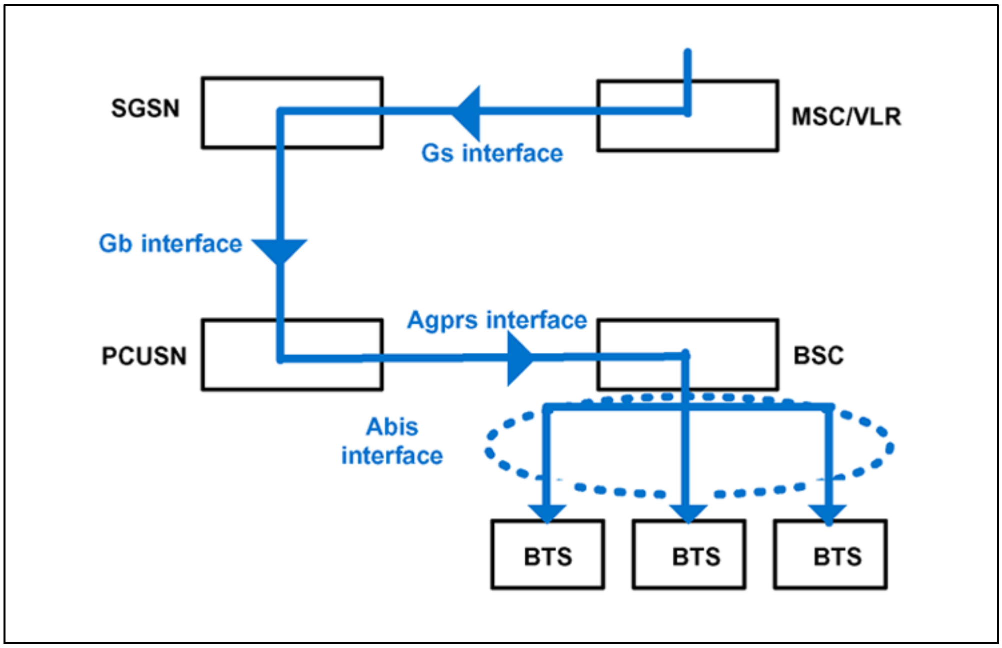
Figure 47
MS not attached to GPRS - CS paging through A interface



Case 2 - MS attached to GPRS - but not in GMM READY state

In the case shown in Figure 48 "MS attached to GPRS - paging via Gs, Gb, and Agprs" (page 284), the MS is attached to GPRS. The PS paging message is sent through the Gs, Gb, Agprs, and Abis interfaces. Since the MS is not in the GMM READY state, the BSC sends the message to several cells. Therefore, the BSC has to broadcast this CS paging message on the CCCH of all target cells.

Figure 48
MS attached to GPRS - paging through Gs, Gb, and Agprs



Case 3 - MS attached to GPRS and in GMM READY state

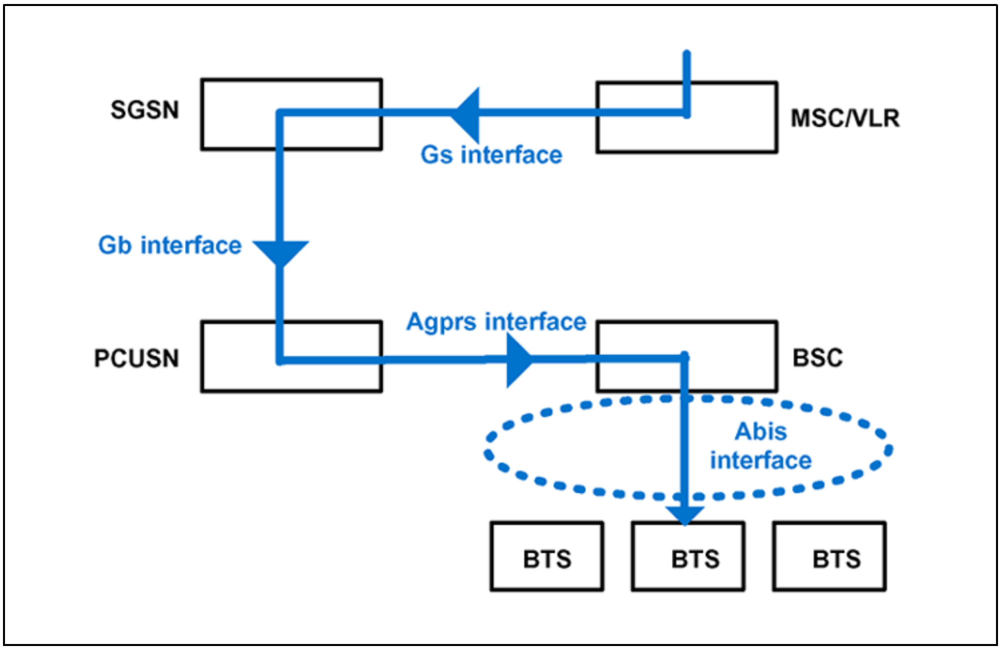
In the case shown in Figure 49 "MS attached to GPRS - in GMM ready state" (page 285), the MS is attached to GPRS. The paging message is sent through the Gs, Gb, Agprs, and Abis interfaces. Since the MS is in the GMM READY state, the SGSN knows its location.

This is an option in the Core network. Even in the READY state, the Core may page the MS as in the Case 2.

If a TBF is established, the PCUSN sends the paging message on the PACCH (Packet Associated Control Channel). If no TBF is established, the PCUSN sends the paging message on the CCCH (Common Control Channel) of the cell.

The BSC sends the message to the appropriate cell. The BSC does not broadcast this message on the CCCH for other cells.

Figure 49
MS attached to GPRS - in GMM ready state



Benefits of the NMO1 feature

The NMO1 feature brings the following benefits:

- an increased probability of success of a CS paging procedure for an MS of class B
- improved ability to reach subscribers (who can now be paged while they are using data services)
- better use of radio resources by combining the separate CS and PS procedures (Attach/Detach, LA update) into a one procedure on the PS channels.
- reducing the signaling load on the BSC which will have to handle fewer Attach/Detach and LA update procedures (this is partially offset by the fact that the BSC can now also receive CS paging through the SGSN/PCUSN).

Activating the NMO1 feature

The gprsNetworkModeOperation parameter is used to activate/deactivate the NMO1 feature. See also the description of this parameter in NTP <124>. The activation of the feature also requires that BSC Data Config be positioned to enable NMO1 in the BSC.

2.2 Base Station Controller 3000 and TransCoder Unit 3000 (BSC 3000 and TCU 3000)

2.2.1 OMN interfaces evolution

The implementation of the BSC/TCU 3000 in the GSM system introduces new objects and parameters seen from the OMC-R.

2.2.1.1 New objects

The new object classes for an OMC-R V14 are the following:

- atmRm
- cc
- cem
- controlNode
- g3BscEqpt
- executableSoftware
- bsc2GEqpt
- g3Transcoder
- iem
- interfaceNode
- lsaRc
- mms
- omu
- sw8kRm
- tmu
- trm
- bscLog

2.2.1.2 New parameters

The following functional objects are defined:

- atmRm object

  The atmRm object attributes are the following:

  — administrativeState

  — availabilityStatus

  — operationalState

  — upgradeStatus

  — standbyStatus

— positionInShelf

— shelfNumber

- cc object

  The cc object attributes are the following:

  — administrativeState

  — availabilityState

  — operationalState

  — upgradeStatus

  — positionInShelf

  — shelfNumber

- cem object

  The cem object attributes are the following:

  — administrativeState

  — availabilityStatus

  — operationalState

  — upgradeState

  — standbyStatus

  — positionInShelf

  — shelfNumber

- controlNode object

  The controlNode object attributes are the following:

  — availabilityStatus

  — interOmuEtherlinkOper

  — operationalState

  — rowPosition

- iem object

  The iem object attributes are the following:

  — administrativeState

  — availabilityStatus

  — CTU cable

  — lsaRc Reference

— numberOfEnabledHDLCPorts
— operationalState
— upgradeStatus
— standbyStatus
— positionInShelf
— shelfNumber
— lapdexists
— lsaPcmList

- interfaceNode object

  The interfaceNode object attributes are the following:

  — availabilityStatus
  — operationalState

- lsaRc object

  The lsaRc object attributes are the following:

  — administrationState
  — availabilityStatus
  — lapdexists
  — lsaPcmList
  — operationalState
  — positionInShelf
  — shelfNumber

- mms object

  The mms object attributes are the following:

  — administrativeState
  — availabilityStatus
  — operationalState
  — positionInShelf
  — shelfNumber
  — privateMmsOmuRef
  — mmsUsag e

- omu object

The omu object attributes are the following:

- administrativeState
- availabilityStatus
- portEthernetOperational
- portEthernetStatus
- X25Port0Operational
- X25Port1Operational
- port0X25Status
- port1X25Status
- operationalState
- upgradeStatus
- standbyStatus
- positionInShelf
- shelfNumber

• sw8kRm object

The sw8kRm object attributes are the following:

- administrativeState
- availabilityStatus
- operationalState
- upgradeStatus
- standbyStatus
- positionInShelf
- shelfNumber

• tmu object

The tmu object attributes are the following:

- administrativeState
- availabilityStatus
- numberOfEnabledHDLCPorts
- operationalState
- upgradeStatus
- positionInShelf

— shelfNumber

- trm object

  The trm object attributes are the following:

  — administrativeState

  — availabilityStatus

  — operationalState

  — upgradeStatus

  — standbyStatus

  — positionInShelf

  — shelfNumber

- bsc2GEqpt

  The bsc2GEqpt object attributes are the following:

  — bsc2GEqptId

  — tSCBNumber

  — tSCBUse

  — aLAIntState

- bsc3GEqpt

  The bsc3GEqpt object attributes are the following:

  — bsc3GEqptId

  — bscReset

- bscLog

  The bscLog object attributes are the following:

  — bscLogId

  — maxNbrConsMess

- executableSoftware-

  The executableSoftware object attributes are the following:

  — executableSoftwareId

  — executableSoftxareName

  — RelatedSoftwares

  — configRefList

— bscList

— softwareLabel

2.3 Location services

2.3.1 Introduction

The objective of this feature is to allow the GSM network to geographically position of Mobile Stations (MSs).

Nortel offers 3 solutions:

- NSS-based solution (supported in V16.0 for compatibility reasons)
- Tandem-hybrid solution (replaced by the BSS-based solution in V16.0)
- BSS-based solution (V16.0 solution)

The Tandem-hybrid solution is also known as the “Multi-SSN Lb” solution.

Each solution is described below.

2.3.2 NSS-based solution

The NSS-based solution enables the SMLC (Serving Mobile Location Center) to be connected to the MSC, in order to locate the mobile through the Ls and the A interface. This implementation is present on BSC 3000 and BSC 12000HC.

In this solution Nortel provides a combined Gateway Mobile Location Center and Serving Mobile Location Center (GMLC/SMLC) in a single platform, the Mobile Location Server. This server is connected to the MSC. The BSS acts as a relay between the mobiles on one side and the Mobile Location Server on the other side.

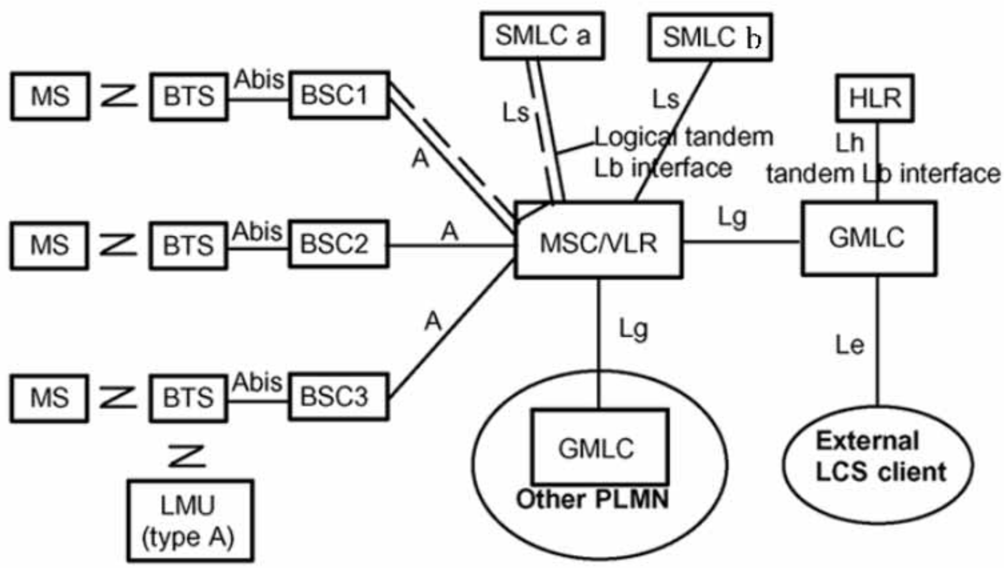
There are no specific overload protection mechanisms for LoCation Services (LCS) other than the general overload mechanisms. No specific new counters or configuration parameters are introduced.”

In these software releases, there are no specific overload protection mechanisms for LoCation Services (LCS) other than the general overload mechanisms. Also, no specific new counters or configuration parameters are introduced.

LCS is logically implemented on the GSM structure through the addition of two network nodes, the Gateway Mobile Location Center (GMLC) and the Serving Mobile Location Center (SMLC). Nortel has implemented both nodes on the same platform called Mobile Location Server.

A generic LCS logical architecture is shown in LCS logical architecture.

Figure 50
LCS logical architecture



2.3.3 Tandem-hybrid solution

Nortel Networks currently provides an NSS based SMLC architecture for E911 & LCS. Ericsson provides a BSS based SMLC architecture for E911 & LCS. This creates interoperability issues in the areas with Nortel BSCs homed to an Ericsson MSC.

In order to resolve these issues, a common Nortel Networks and Ericsson solution called "Multi SSN Lb or Tandem Hybrid" has been defined. This proprietary solution will be implemented only on a combination of a Nortel BSS, a Nortel SMLC and an Ericsson MSC.

This solution is BSS based and should allow Nortel to go one step further to the standard BSS based solution, that will be provided in a future version of BSS.

This BSS based solution requires specific development on:

- Nortel BSC
- Nortel SMLC
- Ericsson MSC

The aim of this section is to describe the new feature "*20364: BSC support for Lb interface (Multi SSN or Tandem Hybrid) to Nortel SMLC through Ericsson MSC*" solution and serve as a common reference to both Ericsson and Nortel for all future developments linked to this solution.

Depending on the SMS-C implementation on Nortel SMLC, Inter-Operability Testing (IOT) with the Ericsson MSC may be required. This will not be addressed in this document.

This solution only impacts low-level communication layers between the BSC, MSC and SMLC (up-to BSSAP/BSSAP-LE). Application layers above (BSSLAP) are not impacted by this solution. Only the initiation and the ending of the location procedure are modified.

From V15.1, the "Multi SSN Lb or Tandem Hybrid" feature is declared End of Life (EOL) on BSC 12000HC. With the swap from BSC 12000HC to BSC 3000, this feature is no longer needed or supported on BSC 12000HC. It is still supported on BSC 3000 in V15.1.

A interface evolution

The Hybrid solution is a Nortel and Ericsson common solution. It will allow the Nortel BSS to support the BSS based SMLC network architecture (Logical Lb interface support). The Lb logical interface is supported by the A and the Ls physical interfaces as well as a relay function implemented within Ericsson MSC.

New messages

The A interface supports some BSSMAP_LE messages, which were supported as BSSMAP in NSS based solution. The following three messages have been added:

- Perform_Location_Request
- Perform_Location_Response
- Perform_Location_Abort

O&M interface evolution

Moreover, the state of the new SSN won’t be sent to the OMC as there is no object SSN created at OMC level. Instead of a state change, there will be a notification (warning) sent by the BSC to the OMC in order to give at BSC level the state of the SSN LCS (OK or NOK)

New alarms & notifications

A new notification message identified as VAL_SYS_ANO_S7M_I_LCS is sent by S7M (BSC 12000HC) to the OMC. This notification provides the state of the SSN LCS and will be emitted on the object signalling link set which defines the A interface. Refer to < 128 > OMC-R User Manual - Volume 1 of 3: Object and Fault menus for a description of notification messages.

New counters

Counters 1104 and 1106 have some new screenings dedicated to SSN LCS. Refer to NTP < 125 > for a description of these counters.

2.3.4 BSS-based solution

2.3.4.1 Principles

The BSS-based solution enables the SMLC to exchange messages directly with the BSC through the Lb interface and thereby locate a mobile station. The BSC has to make the correlation between the communication managed with the MSC and the location procedure required by the SMLC. This solution is available only on BSC 3000.

From V16.0, the BSS-based solution replaces the Tandem-hybrid solution (which emulates the Lb interface) on BSC 3000 and it is more efficient as regards the message flow.

The BSS-based solution supports the following four methods of MS location:

- cell_id
- Timing-Advance (also known as TA/NMR)
- U-TDOA
- A-GPS

2.3.4.2 Routes used

The BSS-based solution relies on two distinct physical routes between the BSC and the MSC and the BSC and the SMLC. Each route supports one link set:

- one for the A interface with the SCCP connections for the communications (DPC=MSC).
- one for the Lb interface with the SCCP connections destined to the LCS procedure (DPC=SMLC).

Two pools of Signalling Links (SLK) are available on that route for the couple (DPC, SSN) MSC and the couple (DPC, SSN) SMLC.

Either distinct PCMAs or one common pool of PCMAs (outside the TCU) are used to convey the signalling links.

2.3.4.3 Architecture

A MSC may be connected to several SMLCs and manage several BSCs.

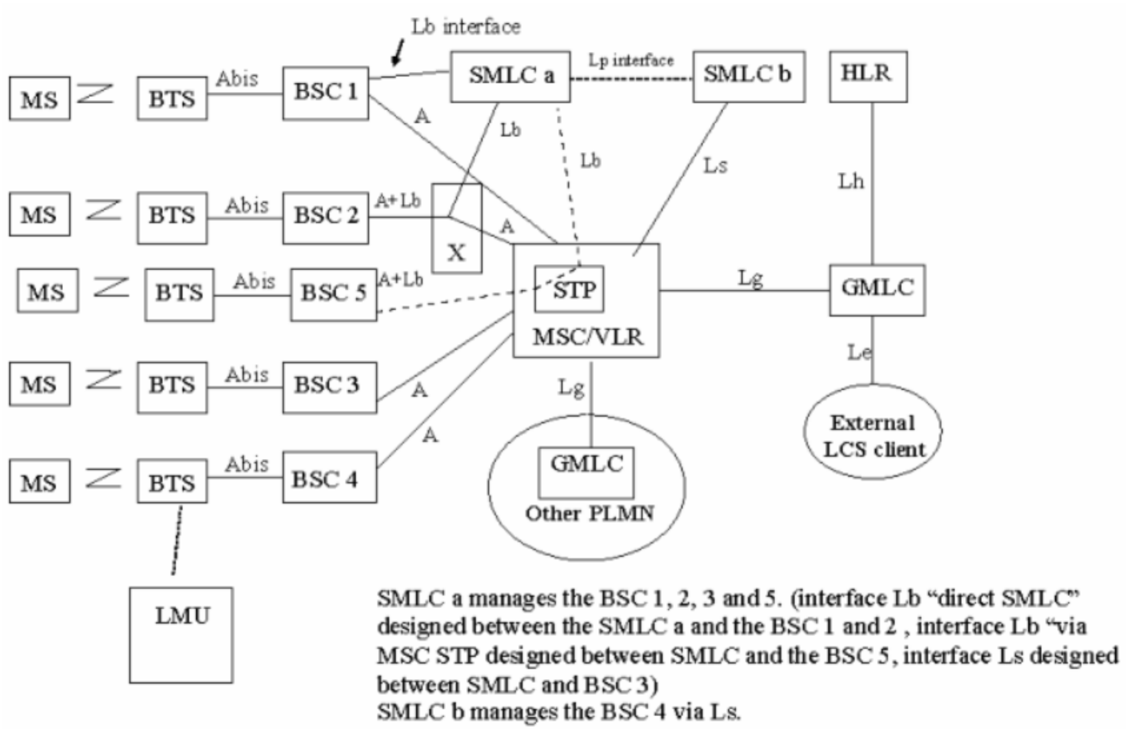
One SMLC can support some BSC 12000HCs (working in Tandem-hybrid configuration) and some BSC 3000s (working in BSS-based configuration).

A Nortel SMLC area may cover a part of an MSC area, a whole MSC area, or several MSC areas. The SMLC is able to support simultaneous connections on both the Ls and Lb interfaces.

One BSC is managed by one SMLC and one MSC.

The Lp interface supports the SMLC to SMLC signalling via SS7 STPs using SMLCPP messages as defined in GSM standards.

Figure 51
Standard LCS network architecture



Two architectures (configurations) are available for the BSS-based solution:

- Lb direct SMLC (not available in V16)
- Lb via MSC STP

Only one of these 2 configurations is supported at any time (both are not supported simultaneously).

The choice between the configurations is made using the BSC Data Configuration. The default value is considered by the BSC to be Lb direct SMLC. To choose the Lb via MSC STP configuration, label 143 for instance 1 (LCS) must be set to MSC DPC.

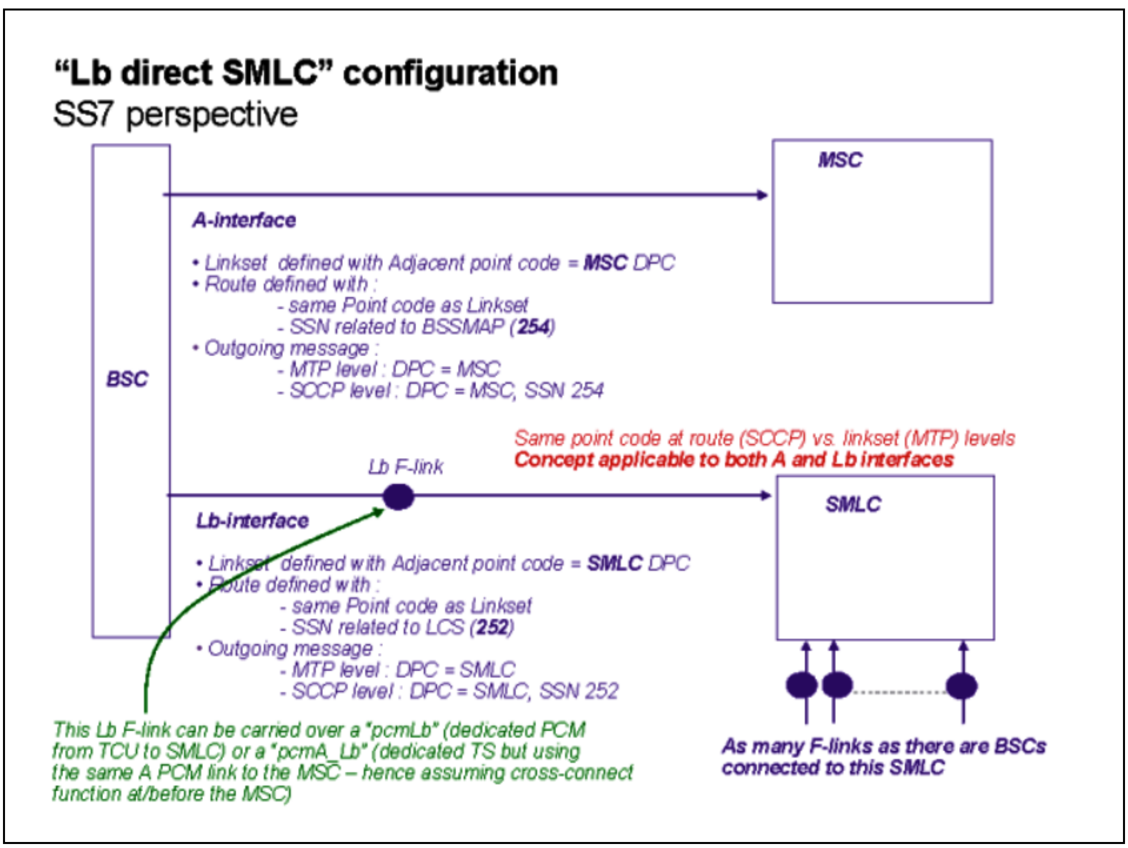
Lb direct SMLC configuration (not available in V16) This BSS-based network architecture relies on two distinct physical routes between the BSC and the MSC and the BSC and the SMLC.

Each route supports one F-link set:

- one for the A interface with the SCCP connections for the communications (DPC=MSC, SSN = BSSMAP)
- one for the Lb interface with the SCCP connections destined to LCS procedure (DPC=SMLC, SSN = Lb, adjacent DPC = SMLC)

Two pools of Signalling Links (SLK) are available for the pair (DPC, SSN) MSC and the pair (DPC, SSN) SMLC. Either distinct PCMAs or one common pool of PCMAs (outside the TCU) are used to convey the signalling links.

Figure 52
Lb direct SMLC configuration

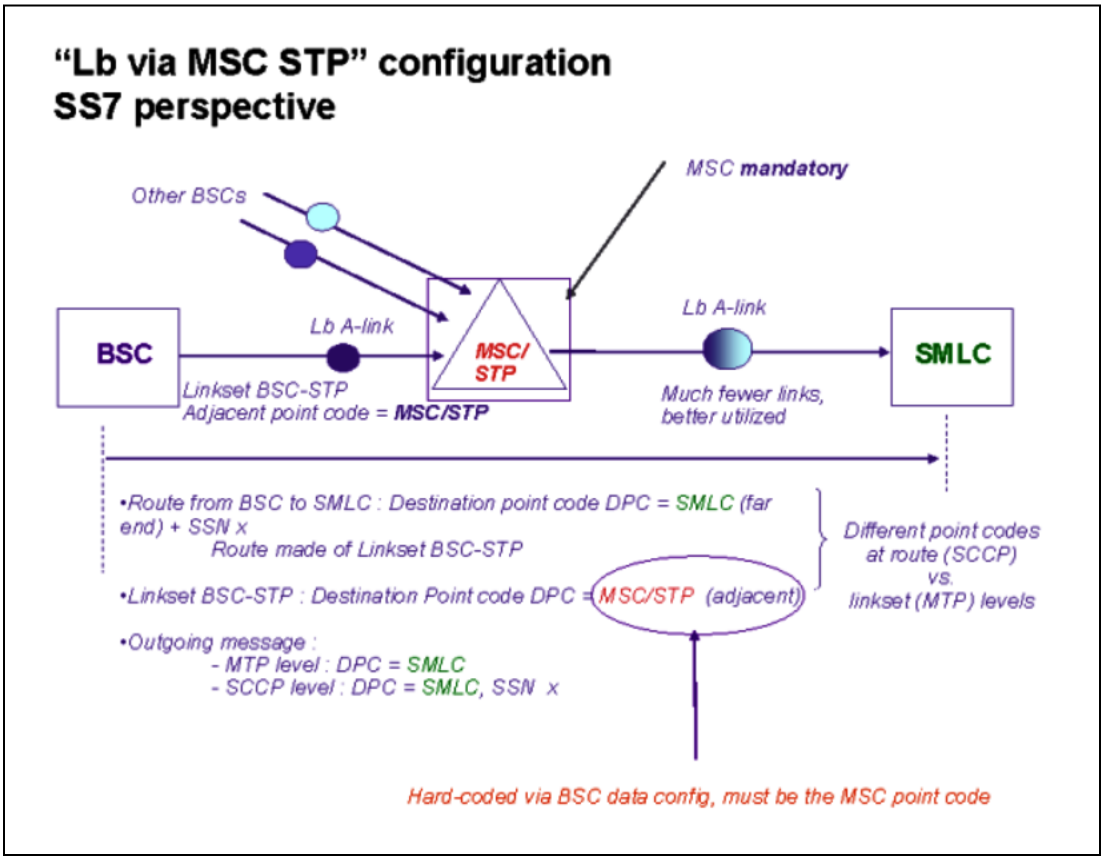


Lb via MSC STP configuration This architecture relies on the existing route to the MSC. In this configuration, the MSC is used as an adjacent STP with A-links linkset.

Only one pool of signalling links is available, common to A and Lb interfaces:

- A interface route is defined with (DPC=MSC, SSN = BSSMAP)
- Lb interface route is defined with (DPC=SMLC, SSN = Lb, adjacent DPC = MSC)

Figure 53
Lb via MSC STP configuration



2.3.4.4 Lb interface management

The Lb interface is used only for the LCS application and relies on SS7.

There are two SS7 interfaces: A and Lb. The BSC has to manage the dialog with multi distant point codes (SMLC and MSC). This requires having an SCCP and an MTP3 layer multi-SSN and multi-DPC. As there is one SSN dedicated on the A interface for BSSMAP messages, there is one SSN dedicated on the Lb interface for LCS messages. As there is one DPC for the MSC, there will be one DPC for the SMLC.

Each interface (A and Lb) relies on one distinct physical route from the BSC.

As the SMLC, the MSC and the BSC are part of the same SS7 network, the set of SCCP parameters should be identical for the Lb and A interfaces.

This physical route goes through either specific or common PCMs. Two pools of Signalling Links (SLK) supported by these PCM circuits are defined: one pool for the A interface, the other one for the Lb interface. If one SLK is lost for any reason (for example, loss of the PCM), the SCCP connections running on this SLK will be recovered on another SLK of the same pool.

The following possible values are added to the pcmType parameter:

- pcmA_Lb (4)
- pcmLb (5)

The existing pcmA-Lb (0) value is still used when the A and Lb interface are on the same PCMA out of the TCU (use of cross-connect equipment).

2.3.4.5 SCCP management

The MS location procedure (cell_id method, Timing-Advance method, U-TDOA and A-GPS method) requires a specific SCCP connection between the BSC and the SMLC per mobile.

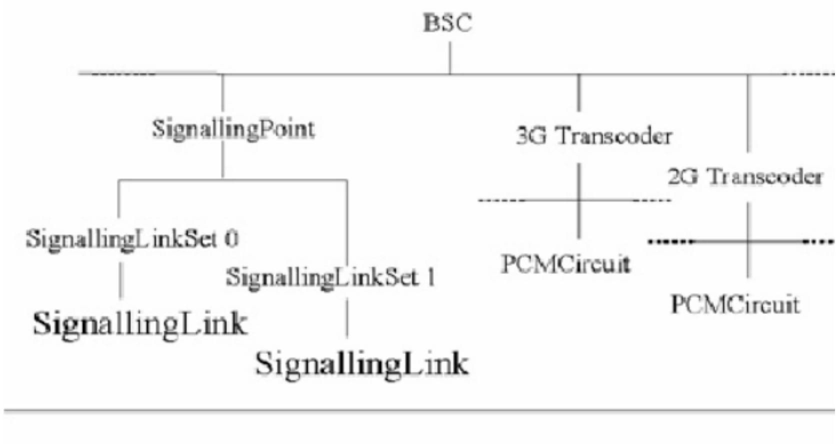
The following SCCP messages are supported on the Lb interface:

- CR (Connection Request)
- CC (Connection Confirm)
- CREF (Connection REFusal)
- DT1 (Data Type 1)
- IT (Inactivity Test)
- UDT (Unit Data)
- RLSD (SenD ReLease)
- RLC (ReLease Confirm)
- SSP (SubSystem Prohibited)
- SST (SubSystem Test)
- SSA (SubSystem Allowed)

2.3.4.6 Data model

The part of the data model of interest to feature 20365 is shown in the following Figure.

Figure 54
Signalling part of the data model



signallingLinkSet object

This object represents the interface from the DPC point of view (SMLC or MSC). This object has to be instantiated.

Instance [0] always corresponds to the A interface.

Instance [1] corresponds to Lb interface.

On the MMI, the name of the interface is displayed (to avoid confusion).

If the flag lcsType on the BSC object is set to nss-based, there is only one signallingLinkSet to be defined (this is, the pre-V16.0 configuration).

If the flag lcsType on the BSC object is set to bss-based, you have to define two signallingLinkSet.

signallingLink object

This object represents the signalling links for SCP connections to the SMLC or the MSC.

A signallingLink object instance depends on one of the signallingLinkSet instances.

Depending on the configuration, there are either one or two pools of signalling links:

- In the Lb direct SMLC configuration (not available in V16.0), there are two pools of signalling links:
  - — one attached to the signallingLinkSet for the A interface
  - — the other one attached to the signallingLinkSet for LCS
- In the Lb via MSC STP configuration, there is only one pool of signalling links, attached to SignallingLinkSet 0 (BSC/MSC route)

A signallingLink object instance is defined with:

- BSCid
- SignallinglinkPointid
- SignallingLinksetid
- SignallingLinkId

One signallingLink will support either some SCCP connections with the SMLC (OPC:BSC, DPC:SMLC, SSN:LCS), or some SCCP connections with the MSC (OPC:BSC, DPC:MSC, SSN=BSSMAP).

pcmCircuit object

The PCM dedicated to the A interface (in previous releases) may now be dedicated to A and Lb interface.

The pool of PCMs may be common.

2.3.5 Location methods

2.3.5.1 Cell_id method

This method applies only to the BSS-based solution and the BSC 3000.

When the communication is established (with a dedicated SCCP connection reference) and as the MSC detects the mobile that needs to be located, the MSC sends a BSSMAP Perform Location message to the serving BSC for the target MS.

On reception of this message, the BSC opens a new SCCP connection with the SMLC dedicated for the location of that mobile. This SCCP is defined with the DPC = SMLC and the SSN = LCS. The message BSSMAP_LE Perform location request is sent from the BSC to the SMLC encapsulated in the SCCP connection request.

The LCS procedure starts between the SMLC and the BSC. There is no specific message for the transfer of the cell_id. The SMLC already gets the cell_id of the MS in the message initiating the procedure.

The SMLC answers with a BSSMAP_LE perform location response (on the SCCP cnx just opened).

The BSC sends back the BSSMAP Perform Location response to the MSC on the SCCP_ref dedicated to the communication.

On reception of the message, the BSC closes the SCCP connection with the SMLC dedicated to LCS.

2.3.5.2 Timing-advance method

This method applies only to the BSS-based solution and the BSC 3000.

The timing advance method (also known as the TA/NMR method) has the same initiation and the same release as the cell_id method. This method requires the support of the two BSSMAP_LE connection oriented information messages on the Lb interface for the LCS procedure. These messages are routed on the SCCP connection dedicated to LCS.

The SMLC sends the BSSMAP_LE connection oriented information that includes the messages TA request to the BSC on the SCCP connection dedicated to LCS.

The BSC returns the current TA value and current serving cell for the target MS to the MSC in a TA response contained within a BSSMAP_LE connection oriented information message. TheTA response must not include the latest measurement results received from the target MS for the serving and neighboring cells. If the BSC does not get the TA, it will send a reset with a cause “failure for other radio related event”. The SMLC derives a location estimate for the target MS based on received serving Cell_id, TA value, and other measurement results.

2.3.5.3 A-GPS method

This method applies only to the BSS-based solution and the BSC 3000.

The A-GPS method requires the same initiation and release as the cell_id method.

The SMLC sends the BSSMAP_LE connection oriented information message to the serving BSC containing an embedded BSSLAP MS position command with an RRLP message. This is transferred to the BSC.

If the RLLP message is an Assistance Data message, the BSC transfers it to the BTS without any control or treatment. The BSC gives the embedded RRLP message to the target MS inside an RR application information message. Once the RR application message has been transferred, the BSC starts a positioning supervision timer. If the timer expires before the final response is received, the BSC returns a BSSMAP_LE connection oriented information message to the SMLC containing the BSSLAP abort with a cause of timeout BSC. This message of abort will be routed by the MSC to the SMLC.

If the BSC receives a response from the MS after the timer expires, the BSC discards the RRLP message just received. If the mobile is unable to perform the necessary measurements, or compute a location, a failure indication identifying the reason for failure is returned instead.

Otherwise, the BSC forwards the RRLP message to the SMLC inside a BSSLAP MS position response message contained in a BSSMAP_LE connection oriented information message to the SMLC. The BSC stops the supervision timer started earlier when the message is forwarded to the SMLC.

2.3.5.4 U-TDOA method

This method applies to the Tandem-hybrid, NSS-based, and BSS-based solutions, and to the BSC 3000

The SMLC sends the BSSMAP_LE connection oriented information that includes the message U-TDOA request to the BSC on the SCCP connection dedicated to LCS.

The BSC starts a “delta_timer” (value given in the U-TDOA request) and returns the channel description parameter for the target MS to the MSC in a U-TDOA response contained within a BSSMAP_LE connection oriented information message.

On reception of the BSSMAP_Perform_Location_Response, or on delta-timer expiry, the BSC closes the LCS related SCCP connection.

The U-TDOA location method uses transmit energy to locate an MS on an existing dedicated connection (SDCCH or TCH).

Channel assignment information is given by the BSC to the SMLC, then transmitted to a set of Location Measurement Units (LMUs). These LMUs start capturing and storing MS bursts. Each LMU determines a Time Of Arrival (TOA) value and sends it to the Positioning Determination Entity (PDE).

LMUs are wireless devices (type A).

The PDE uses the received TOA values to calculate a geographic position. Information transfer between the PDE and the LMUs is independent from the BSC.

During the localization procedure, all changes in channel assignment information is sent by the BSC to the SMLC. A timer called delta-timer is used to define the maximum time during which the BSC supervises the location request.

When a MS is close to a base station, the power control can be up to 36dB. Surrounding base stations may have difficulty listening to that MS. The number of bursts required for U-TDOA positioning may be considerably increased.

2.3.6 A-GPS Assistance data support

With the "GPS Assistance data support over LS interface" feature (25363), introduced in V15.1, more information can be sent to an A-GPS capable MS to help it complete its GPS location measurements.

This information is sent to the MS during the A-GPS (Assisted-Global Positioning System) location procedure. The A-GPS assistance data messages are part of the Radio Resource LCS Protocol (RRLP) used between the MS and the Serving Mobile Location Center (SMLC). The assistance data that the SMLC has decided to send or that the MS has requested, may be sent in one or more assistance data components. Neither RRLP segmentation nor the LAPDm priority management feature is used.

The feature uses three new RRLP messages:

- RRLP (Assistance data)
- RRLP (Protocol error)
- RRLP (Assistance data Ack)

These messages are described in the following recommendation:

- 3GPP TS 44.031 Release 6 "Location Services (LCS) Mobile Station (MS)/Serving Mobile Location Centre (SMLC)" Radio Resource LCS Protocol (RRLP)".

This feature is available only if the BSC is working with an SMLC that supports the A-GPS location procedure. It is supported by BSC 3000. It is not supported by BSC 12000HC.

2.4 EDGE

2.4.1 Introduction

Enhanced Data for GSM Evolution (EDGE) is an extension of the GSM/GPRS Access network. It largely inherits the administration, maintenance and supervision of the currently deployed BSS. The GPRS Coding Schemes are enhanced with seven EDGE coding schemes (MCS2, MCS3, and MCS5 through MCS9) using two radio modulations (GMSK and 8-PSK). These schemes increase the peak radio throughput of a carrier. (The EDGE throughput is three times greater than GPRS throughput). To benefit from the coding schemes, a BTS needs E-DRX and E-PA hardware. Extending the backhaul of a BTS allows it to benefit from the full range of schemes.

EDGE is part of the 1999 release of 3GPP specifications and is supported by the 1997 release of SGSN. The BSS complies with the 1999 3GPP specification on the radio interface.

Note that to benefit from EDGE features:

- BSC 3000 is required

- eDRX and ePA are necessary on the BTS

2.4.2 Data backhaul

When V12.4 introduced packet data services in the BSS, the radio throughput was limited to 13.4 kbps. From V15, new EDGE coding schemes are managed from MCS1 up to MCS9 (59.2 kbps). Seven EDGE coding schemes greatly improve the capacity of EDGE backhaul functions and support higher data rates. The Abis and Agprs interfaces based on 16kbps TS have been enhanced in order to manage this new throughput. EDGE also provides a backhaul mechanism to increase capacity by routing data indirectly, beyond its destination and back again to utilize more available routes, when doing so is more efficient, less expensive, necessary, or otherwise advantageous.

2.4.3 TDMA selection

In V15.0, the maximum number of TDMAs of a cell that could support EDGE channels was 1. In V15.1, all the TDMAs of a cell can support EDGE channels.

Due to the Feature 25494 "EDGE Multiple TDMA" feature (25494), introduced from V15.1, the selection principles have been modified (as described below).

2.4.3.1 Selection principles on PCUSN

Once an EDGE capable MS connects to the network, the PCUSN allocates it a TDMA.

As far as EDGE is concerned, any TDMA can be of 2 types:

- No EDGE
- Full EDGE

For more details on these types, refer to description of the edgeDataServiceTyp e parameter in NTP < 124 >.

To benefit from the higher EDGE throughput, an EDGE MS should be allocated on EDGE capable TDMAs if possible.

To benefit from the higher EDGE throughput, an EDGE MS should be allocated on EDGE capable TDMAs if possible. The edgeFavor parameter, introduced in V15.0 to favor EDGE TDMA against GPRS TDMA, is used to assign a higher offer to an EDGE TS for an EDGE MS. The parameter is set on a per TDMA basis and it reflects the relative throughput that can be obtained with EDGE on that TDMA.

The selection of a TDMA depends on the type of the TDMA and on the value of the edgeFavor parameter. It also depends on the GPRS and EDGE load in the TDMA. In V15.1, where multiple EDGE TDMA can be configured, the edgeFavor parameter can also be used to favor one EDGE TDMA compared to another EDGE TDMA.

Allocator principles The Allocator principles for TS selection are:

- In the case of an equal offer for 2 TDMAs, the PCUSN will select an EDGE capable TDMA for an EDGE capable MS.
- In the case of an equal offer for 2 TDMAs, the PCUSN will select first a GPRS-only TDMA for a GPRS capable MS.

2.4.3.2 Selection principles on BSC

From a BSC point of view (the PCUSN uses the reverse way), shared radio TSs are allocated using the following criteria:

- a TDMA priority linked to the requested service
- the TDMA number
- the TS number

This algorithm is not changed for GPRS-only TDMAs.

In order to avoid pre-emption of EDGE TSs, the EDGE TDMAs are assigned a "Super High" priority by the BSC. This means that they are assigned in priority to PCUSN. Note that a TDMA is declared as being EDGE using the edgeDataServiceType parameter.

Allocator principles The allocation order is:

- an EDGE TDMA (according to the GPRS priority)
- a GPRS TDMA (according to the GPRS priority)
- the TDMA number
- TS number

Pre-emption follows the reverse order.

2.4.3.3 Allocation in case of lack of resources

When an EDGE capable MS is allocated in GPRS mode because of lack of resources, a specific counter pcuEdgeDowngradedTbf is increased.

The MS is treated as a GPRS MS up to the end of the TBF (note that the specification does not allow a GPRS TBF to be modified to an EDGE TBF or vice-versa). It means that the MS is considered as a standard GPRS MS and all the counters related to GPRS are increased accordingly.

In case of Full Duplex establishment, the PCUSN always selects the same mode (GPRS or EDGE) rather than the already established TBF.

When a TBF is established in EDGE mode, the MS will be constrained by the PCUSN Allocator for an EDGE capable TDMA.

2.4.3.4 Multi-slot class

Once an EDGE capable MS has been allocated in EDGE mode, the PCUSN allocates a set of TSs according to the MS EDGE Multi-slot class. Note that the MS EDGE Multi-slot class can be different from the GPRS Multi-slot class.

2.4.4 Link adaptation

To improve end-user throughput and the efficiency of network radio resources, a link adaptation mechanism matches the selected modulation and radio coding scheme to an appropriate radio quality. Each mobile station (MS) link uses the link adaptation mechanism independently. Link adaptation operates in acknowledge mode for both uplink and downlink EDGE transmissions.

To adjust to different physical channel conditions, link adaptation increases data throughput for each MS by changing modulation and coding schemes for the transmission of RLC data blocks. If channel conditions are poor, link adaptation applies a robust coding with a lower rate (for better error correction). If channel conditions are good, link adaptation uses a less robust coding with a higher rate (for faster transmission). The switching points offer the maximum radio throughput to the mobile. An operator, however, can use a set of parameters to modify those switching points through the OMC-R.

For downlink transmissions, link adaptation relies on the feedback information about the link condition from the receiver (MS) to the transmitter (PCUSN). For uplink transmissions, link adaptation relies on BTS computations for every radio block in the band that the BTS receives and sends to the PCUSN. This feedback defines the link quality for the channel. The Link Quality Measurements (LQM) parameter describes the condition of the physical channel. The LQM is based on the Mean Bit Error Probability (MEAN_BEP) and the coefficient of variation of the Bit Error Probability (CV_BEP). The link adaptation mechanism uses the received LQM to select a modulation and coding scheme. It only applies to RLC traffic data blocks. RLC/MAC blocks carrying control messages use the CS-1 coding schemes.

2.4.5 Dynamic allocation

The EDGE dynamic allocation features a single cell to share one or more packet data channels (PDCHs) on the air interface between Enhanced GPRS (EGPRS) and GPRS mobiles. With this feature, cells share on-air timeslots and backhaul resources by multiplexing GPRS and EGPRS mobiles. Sharing on-air timeslots and backhaul resources improves resource use and increases capacity.

2.4.6 ARQ window management and compressed bitmap feature

The ARQ (Automatic Request For Retransmission) window management describes the mechanisms to use at the EGPRS RLC level to provide a highly reliable data path. This mainly covers the following aspects: window size management, retransmission of blocks which were received unsatisfactorily and polling strategy.

The compress bitmap is a new feature defined in EGPRS to encode the acknowledgement bitmap for the higher window sizes. This mainly covers the following aspects: compression strategy and extended polling management.

According to the mobile multislot capability (and the number of allocated timeslots), the EGPRS RLC window size can be set from 64 to 1024 (in GPRS the window size is fixed and limited to 64). Versus GPRS, this also has an impact on the polling strategy because for the higher window sizes, the stalling of the window is less critical. The feedback of the received RLC data block is provided through an acknowledgement bitmap, by a Packet Downlink Ack/Nack message in the downlink TBF and by a Packet Uplink Ack/Nack message in the uplink TBF. For the higher window sizes it may be not possible to provide the full bitmap in these messages, in that case the bitmap must be compressed. When the bitmap doesn’t fit in one acknowledgement message (after compression or not) it must be split in partial bitmaps. This has an impact on the polling strategy because more than one acknowledgement message may be needed to get (or provide) a full feedback on the blocks sent to (or received from) the mobile. In downlink, in order to get the acknowledgement bitmap from the mobile an extended polling mechanism has been defined. Through this mechanism the network must specify which part of the bitmap it wants to get from the mobile.

2.4.7 DL incremental redundancy

Incremental redundancy is applied by the MS in the downlink direction. When a retransmission is requested by the MS in the Packet-Downlink-Ack/Nack message, the PCUSN also applies a puncturing scheme diversity on the re-transmitted blocks.

The puncturing scheme is applied by the BTS and sent to the mobile. Data block decoding is performed at the MS. If the decoding fails, the bitmap associated with the standard Packet-Downlink-ACK/NACK message is updated. Quality reports carried by this message are used by the link adaptation and backhaul management procedures to determine which MCS will process the new blocks.

2.4.8 Configuration

BSS provides a tool to configure the EDGE extension and EDGE backhaul. This configuration tool, based on a UNIX program, runs interface command files on an OMC-R to configure EDGE parameters, the EDGE backhaul, or both for the BSS.

See the description of NRP for EDGE configuration in NTP < 034 >.

Automated EDGE configuration reduces the duration of the configuration and reduces errors. The following is a list of parameters which are used to configure the EDGE features:

- egprsServices
- edgeFavor
- sGSNRelease
- jokerPerMainTarget
- eDGEMixity
- bEPPeriod
- initialMCSDL
- dlMCS2UpperThreshold
- dlMCS3UpperThreshold
- dlMCS5UpperThreshold
- dlMCS6UpperThreshold
- dlMCS7UpperThreshold
- dlMCS8UpperThreshold
- dlGMSKMCS1UpperThreshold
- dlGMSKMCS2UpperThreshold
- dlGMSKMCS3UpperThreshold
- ulBepPeriod
- initialMCSUL
- ulMCS2UpperThreshold
- ulMCS3UpperThreshold
- ulMCS5UpperThreshold
- ulMCS6UpperThreshold
- ulMCS7UpperThreshold
- ulMCS8UpperThreshold
- ulGMSK_MCS1UpperThreshold

- ulGMSK_MCS2UpperThreshold
- ulGMSK_MCS3UpperThreshold

EDGE backhaul parameters:

- edgeDataServiceType
- numberOfJokerDS0

2.4.9 Dynamic Agprs & EDGE: Joker handling algorithm

In V14.2, the Dynamic Agprs feature was introduced to save PCM usage between BSC and PCUSN. The detailed algorithm is described in [PE/DAS/DD/0001 TF1262: Dynamic Agprs].

For EDGE, the Agprs is evolving with the introduction of the Joker principle. New mechanisms are introduced in order to optimize Agprs PCM usage taking into account Jokers introduction. The messaging and overall principle is described in [PE/DAS/DD/0008 19174: EDGE Abis and Agprs Backhaul].

For that purpose, a new TDMA parameter is introduced:"JokerPerMain-Target".

This parameter provides the target number of Jokers TS for each main TS. It is used on the BSC side during Agprs configuration and compression (see [PE/DAS/DD/0008 19174: EDGE Abis and Agprs Backhaul] for details). It is used on the PCUSN side during the Dynamic Agprs mechanism.

When the parameter is modified, no immediate action is taken by BSC or PCUSN. It will be used by BSC or PCUSN at the next Agprs circuit connection modification (Main or Joker).

2.4.9.1 Joker / Main Section

When 2 cells have been selected as the most loaded and less loaded cells, the PCUSN have to select whether a main channel or a joker channel needs to be moved from the less to the most loaded cell. The objective of the PCUSN algorithm is to have "JokerPerMainTarget" Jokers per Main channel in an EDGE TDMA.

2.4.9.2 Operator can reserve Joker bandwidth of the Agprs for a given TDMA

By using the minNbOfJokersPerConnectedMain parameter, the operator can define a minimum number of jokers that cannot be pre-empted by the Dynamic Agprs algorithm. In this way, it is possible to reserve Joker bandwidth on the Agprs for a given TDMA. If Dynamic Agprs is not activated, this parameter has no effect and should be left set to 0.

During the dynamic Agprs procedures, the PCU uses minNbOfJokersPer-ConnectedMain in the selection of the least loaded cell, and the least loaded TDMA in that cell. If the number of Jokers associated to a given TDMA on Agprs is equal or less than minNbOfJokersPerConnectedMain multiplied by the number of connected main TS, the dynamic Agprs algorithm does not remove a joker for that TDMA (another TDMA is selected, or a main is selected according to the Dynamic Agprs algorithm).

The parameter “minNbOfJokersPerConnectedMain” ranges from 0 to 4, in steps of 1/8, and is defined as 16kbps Jokers. It represents the minimum number of Jokers TS per main TS connected on the Agprs that shall not be removed by the Dynamic Agprs feature.

For example, if the parameter is set to 1, this means that the minimum number of jokers per main TS is 1 full 16kbps TS. If the cell has 4 PDCH connected when it is selected as the least loaded cell, no joker will be removed if there are 4 (or fewer) 16kbps Joker TS connected on that TDMA.

If the computation does not result in an integer number of 16kbps TS, the PCU always takes the upper value as the minimum.

In general, the efficiency of the Dynamic Agprs algorithm is reduced by reserving Joker bandwidth, but the throughput of EDGE MSs in the impacted cells is improved.

If the minNbOfJokersPerConnectedMain plus the minimum number of PDCH is close to the Agprs capacity, the Dynamic Agprs algorithm is inhibited.

2.4.10 Rules applicable to EDGE from V15.1

2.4.10.1 Mandatory hardware rule

As the maximum number of joker TSs per TDMA is directly linked to the type of site, the following rule is mandatory:

Rule: "Both chains of the site must have the same level of hardware"

If this rule is not respected, then:

- EDGE TDMA cannot be configured, or
- the maximum DS0 capability cannot be used and some EDGE TDMA will not be configured, or
- the duplex functionality will be restricted.

2.4.10.2 Maximum number of DS0 per TRX (from V15.1)

Each type of site (BCF, CBCF, CSWM,...) is able to connect a given number of DS0 to one TRX. If there is a lack of DS0 capability, the EDGE TDMA is degraded but it is still considered as EDGE with a number of DS0 limited to the site hardware capability. The following table gives the capability of each type of site:

Table 10
Maximum number of DS0 per TRX

Type of Site	Maximum number of DS0 (Joker and main) per TRX
BCF old GTW PROM	2
BCF new GTW PROM	6
CBCF CMCF phase I	6
CBCF CMCF phase II	8
e-cell	8
BTS 18000	10

For example, the BSC can configure one TDMA with 6 DS0 only if the site is one of the following:

- a BCF equipped with a new GTW PROM
- a CBCF equipped with CMCF phase I
- a CBCF equipped with CMCF phase II
- a CBCF equipped with 2 CMCFs phase I and phase II
- an e-cell
- a BTS 18000

2.5 Wireless Priority Service

2.5.1 Introduction

Disasters, terrorist attacks, and major accidents trigger tremendous telephone traffic in the landline and wireless networks. National Security and Emergency Preparedness (NS/EP) personnel at all levels of government compete with the public for congested landline and wireless resources. Wireless Priority Service (WPS) is an enhancement to basic wireless service which allows NS/EP calls to queue for priority service in order to complete the call. WPS provides the means for NS/EP wireless calls to get through the congestion. WPS also supports national and international emergency communications.

2.5.2 Queuing services

When a user invokes WPS and the cell has no available radio traffic channel, the BSS queues the request according to the WPS priority level, the call initiation time, and the queuing state for the cell. Priority levels for WPS request range from level 1 (the highest priority) to level 7 (the lowest priority). When the BSS receives a WPS assignment request message from an MSC, it determines whether a traffic channel is available and assigns the available channel to the WPS request.

Activation of WPS queuing management requires the following:

- The WPS request allows queuing (provides a bscQueuingOption flag)
- The BSC object allows queuing (enables the wPSManagement flag)

When a BSC object does not enable the wPSManagement flag, that object applies its own internal queuing priority levels for these WPS requests. When a BSC object enables the wPSManagement flag, it implements the WPS queuing management for WPS requests.

When possible, a BSS distributes WPS requests to separate queues based on the priority level of the WPS request and several properties and priorities of each queue. This queue management method is faster than processing requests only by priority level. The system processes WPS requests in the same queue from highest priority to lowest.

2.5.3 Public access bandwidth protection

The public access bandwidth protection feature helps to ensure that high levels of traffic congestion and support for WPS does not prevent public users from accessing the network.

To implement public access bandwidth protection, a BSC designates two different types of traffic channels. Although all of the channels support both WPS calls and public calls, most of the channels support public calls with a higher priority. A smaller number of channels gives higher priority to WPS calls. The system supports fewer WPS users than public users, and typically requires fewer resources for WPS.

As traffic channels become free, the BSC radio resource allocator applies an algorithm to allocate channels to WPS or public calls.

2.5.4 Directed retry without queuing activation feature

This feature improves the directed retry function and applies to system versions 14.3.1 and 15 with BSC 3000. When directed retry is enabled in the BSS with the directed retry without queuing activation feature, both WPS and public calls are processed whether queuing is activated or not. WPS users and public users now have directed retry processing independent of queuing activation, which provides a better chance to get a traffic channel.

2.5.5 Access class barring

Because WPS provides a priority service only to NS/EP leadership and key personnel, the number of users is small. WPS will typically avoid a significant impact on public use of CMRS radio capacity. During exceptional events, however, initial WPS requests could be so numerous that they fully block access to the system by public users. The Access Class Barring feature help prevent this problem.

To avoid conflicts between WPS and public support, a BSS can dynamically allocate resources based on user classes, barring some access based on the access class or classes of the associated MS. The SIM card in an MS defines one or more access classes for the MS.

Possible access classes for an MS include the following:

- Access classes 0 through 9 are normal classes
- Access class 10 indicates whether an MS with an access class of 0-9 has network access for emergency calls
- Access class 11 identifies Public Land Mobile Network (PLMN)
- Access class 12 identifies Security Services
- Access class 13 identifies Public Utilities (water, gas, electric)
- Access class 14 identifies Emergency Services
- Access class 15 identifies PLMN staff

An MS with one or more access classes of 11 through 15 cannot access the network for emergency calls if the BSS uses Access Call Barring to block both access class 10 *and* the relevant access class (from 11 to 15) of the MS.

The bscMSAccessClassBarringFunction controls the Access Call Barring feature on a BSC object and the btsMSAccessClassBarringFunction controls the Access Call Barring feature on a BTS object.

During times of traffic congestion, the BSC sends Access Call Barring information to the BTS. When the cell is no longer congested, the BSC sends system information and returns to the BTS to deactivate Access Call Barring.

A BSC checks for traffic congestion whenever it allocates a traffic channel. The following parameters define the level of congestion necessary to trigger Access Call Barring:

- numberOfTCHFreeBeforeCongestion (the number of free traffic channels in the cell)
- numberOfTCHQueuedBeforeCongestion (the number of requests for traffic channels in all channel queues)

The following parameters define the level of congestion necessary to end Access Call Barring:

- numberOfTCHFreeToEndCongestion (the number of free traffic channels in the cell)
- numberOfTCHQueuedToEndCongestion (the number of traffic channel requests in all channel queues)

When traffic in a cell becomes congested, the BSC sets a supervision timer. Every three minutes, the BSC checks the state of the congestion and adjusts Access Call Barring as follows:

- If traffic is still congested, the system bars two more access classes (provided that they are not all barred)
- If traffic is no longer congested, the system removes the bar from two of the barred access classes.

When traffic in a cell is no longer congested and the system is not barring any access classes, the BSC stops the three-minute supervision timer and discontinues Access Call Barring.

Another mechanism, a 60-second timer, works independently of the three-minute timer. Whereas the three-minute counter changes the number of access classes barred, the 60-second timer changes which access levels are barred. If Access Call Barring always blocked the same access classes (while always allowing access for other classes), it would block the same group of customers unfairly. By rotating the classes that it bars, Access Call Barring more evenly affects customers.

The accessClassCongestion parameter in a BTS lists all of the access classes which are eligible for Access Call Barring. As the 60-second timer changes the subset of the access levels barred at different times, it only selects access levels that the accessClassCongestion parameter lists. If an access class is not in this parameter’s list, Access Call Barring will not block it.

2.5.5.1 Performance management

In order to monitor the access class barring feature, new counters were created to provide following information:

- duration access class 11 has been barred
- duration access class 12 has been barred
- duration access class 13 has been barred
- duration access class 14 has been barred
- duration access class 15 has been barred

- a counter was created to monitor the number of barred access classes during cell congestion every 1 minute (incremented at each rotation of access classes). Only access classes between [0..9] are taken into account, since a dedicated counter exists for classes 11 to 15. A correlation with the number of barred access classes contained in the AccessClassCongestion parameter (removing access classes 11 to 15) gives the number of minutes a given access class (between 0 and 9) has been barred. Barred Access classes of the notAllowedAccessClasses parameter are excluded from the counter triggering.

2.6 GSM for Railways (GSM-R)

CAUTION
GSM-R specific
Indicates that specific equipment and specific software (such as specific software in the BSC) dedicated to Railway application is used and that therefore the feature is not available for all standard GSM users.

2.6.1 Introduction

Railway telecommunication networks use different systems for various types of applications and users. Most of these systems belong to a generation of radio systems based on analog technology and different frequency ranges with limited applications and performances.

GSM-R (GSM for Railways) is a pan-European radio system which covers the mobile telecommunication needs of the European railways. GSM-R uses standard GSM technology and additional features customized for railway operations. General Packet Radio Services (GPRS) is a major part of GSM-R for data transport.

Railway operations requirements are as follows:

- A dedicated network (infrastructure, dial plan...) with specific applications (shunting...) and operational efficiency
- Secured operations and a high reliability, especially in case of emergency
- Group communication facilities for working teams
- Interoperability with:
  - Existing railway communication infrastructures
  - International railway communication networks
  - Public communication networks

GSM-R is also designed to reduce operational costs.

2.6.2 Advanced Speech Call Items (ASCI)

Railway communication networks require specific applications to support safe and efficient operations. Advanced Speech Call Items (ASCI) are a set of features and functions dealing with railway operation aspects. ASCI comes on the top of the standard GSM architecture to support all the railway voice and data applications.

ASCI consists of the following services:

- eMLPP (enhanced Multi-Level Precedence and Pre-emption), which allows resource pre-emption for priority calls
- VBS (Voice Broadcast Service), which allows groups of users to receive common information
- VGCS (Voice Group Call Service),which allows groups of users to make calls among groups or within a group

2.6.2.1 Enhanced Multi-Level Precedence and Pre-emption (eMLPP)

By subscribing to eMLPP service, a user can explicitly or by default select a priority value when originating a call. This priority value is used within the network to provide precedence to network resources, during call setup, to high priority calls. Moreover, a high priority call can pre-empt other outgoing calls of lower priority in case of congestion.

eMLPP service can be provided for the following call types:

- Point to point calls:
  - — mobile to mobile calls
  - — mobile to land calls
  - — land to mobile calls
- VBS/VGCS calls

2.6.2.2 Voice Broadcast Service (VBS)

VBS is, for speech calls only, allows a user to broadcast a speech call to a pre-defined set of destination subscribers in a pre-defined geographical broadcast area.

The set of destination subscribers is identified by a Group Id. Mobile destination subscribers are only involved in the call while they are located within the broadcast area, unless they have been marked as dispatchers. Fixed-line destination subscribers and mobile subscribers marked as dispatchers may be located anywhere. The information about registered destination subscribers, dispatchers and broadcast areas is, for each Group Id, stored in the Group Call Register (GCR).

A VBS call can be established by either a service subscriber or by a dispatcher, while the call can be terminated by either the calling subscriber or any nominated dispatcher. Other service subscribers can not terminate a VBS call. They have listening capabilities only.

A standard full duplex channel is provided to the calling subscriber and dispatchers, while simplex down-link channels are allocated to all destination service subscribers, with one common down-link per cell of the broadcast area.

2.6.2.3 Voice Group Call Service (VGCS)

VGCS is for speech calls only and has standardized on the basis of VBS. VGCS allows speech conversations between a pre-defined set of destination subscribers in a pre-defined geographical Group Call Area.

The set of destination subscribers is identified by a Group Id. In general, mobile served subscribers will only be involved in the call while they are located within the Group Call Area. Fixed-line destination subscribers and fixed-line or mobile subscribers marked as dispatchers may be located within or outside the Group Call Area. The information about registered dispatchers, destination subscribers and Group Call Area is, for each Group Id, stored in the Group Call Register (GCR).

A VGCS call can be established by either a service subscriber or by a dispatcher. The call can be terminated by either the calling subscriber or any nominated dispatcher, using an operator determined DTMF tone sequence or by detecting silence on the voice channel. A standard full duplex channel is provided to dispatchers and to the calling subscriber during the call setup. Simplex down-link channels are initially allocated to all destination service subscribers, with one common down-link per cell of the VGCS Group Call Area.

Once the call has been setup, dispatchers (both mobile and fixed) keep the 2-way speech connection. Mobile call originators may release their uplink to allow other mobile users to talk. Once the up-link has been released, the calling subscriber and other mobile users may talk only after requesting the up-link. Only one up-link is available for each group, regardless of group area size. Dispatchers are allowed to talk anytime, and their voice is broadcasted to all members. When call originators and mobile destination subscribers who are not dispatchers move out of the group area their call is dropped. Their call is resumed when they move back into the group area.

2.6.2.4 ASCI feature interworking

WPS features (for a description, refer to Section 2.5 "Wireless Priority Service" (page 311)) are not impacted by ASCI calls (either VBS or VGCS).

If WPS features are activated, they have an impact on the way TCHs are allocated to incoming requests. This impact on TCH allocation has an impact of the way ASCI calls are established.

ASCI calls and WPS calls are mainly managed inside the BSS based on the priority of the call.

Pre-emption, which is used in GSM-R, is not authorized for WPS.

2.6.3 Activation of GSM-R features

In order to the activate GSM-R features, the Asci_Mode parameter has to be set to Enabled in the omc_services.cfg file at the OMC-R. Hence, the ASCI related parameters become available at the OMC-R.

2.6.4 Hardware constraints

ASCI features are only guaranteed on BSC 12000HC of type 12000 and on BSC 3000.

ASCI features are only guaranteed on a BTS with CBCF, New Design DRX, DRX ND3 and eDRX, independently of the frequency band.

DCU2, DCU4, DRX EGAL 1 and DRX EGAL 2 do not support ASCI features.

2.6.5 Features implemented

The following features were introduced in V15.1R release.

2.6.5.1 MS late entry

This feature allows an MS, which is moving to a cell where a railway emergency call is ongoing, to be periodically notified of this ongoing emergency call even if the MS is already involved in another call.

Two parameters, emergencyThreshold and timerGcchNotif, are provided to implement this feature. Refer to these entries in NTP <124> for more information.

2.6.5.2 Uplink reply and notification response

This mechanism applies to VBS and VGCS calls. It aims at optimizing the use of radio resources.

Upon request of the network, MSs which have listening capabilities of an ongoing group call, have to report their presence. If no report is received from a cell, the traffic channel of the group call is released in this cell. Only a notification that a group call is ongoing is broadcasted on the notification channel. If then an MS roams to such a cell and sends a request (notification response), a traffic channel is established for the group call.

Two parameters, uplinkReply and uplinkReplyTimer, are provided to implement this feature. Refer to these entries in NTP <124> for more information.

2.6.5.3 VGCS uplink release management

The VGCS signalling between BSS and NSS has been modified so that it is now compliant with the 3GPP specifications. The Nortel Networks BSS can then better interface with another vendor NSS.

2.6.5.4 ASCI/GPRS support in one cell

GPRS communications can be established in a cell where ASCI calls are ongoing. Similarly, ASCI calls can be established in a cell where GPRS communications are ongoing. There is no interaction between ASCI and GPRS calls (no notifications).

Note that the radioAllocator parameter must then be set to "voice + d ataCircuit + packetData". Refer to this entry in NTP <124> for more information.

2.6.5.5 OTDI Immediate Setup 2

This feature allows the setup message to carry Originator To Dispatcher Information (OTDI) in case of emergency. This information includes the Functional Number (FN) of the originator. A group call can then be immediately setup using Immediate Setup 2 procedure.

2.6.5.6 Mobility class sensitivity counters

A GSM-R network handles various types of application, which require different levels of Quality of Service (QoS). The radio design of the Train Control Applications is based on 8-watt MSs, which require a high level QoS. The radio design of the Shunting Applications is based on 2-watt MSs, which require lower QoS.

It is then important that observation counters distinguish between 8-watt MS events and 2-watt MS events. The msPowerClassToggle parameter is provided for that purpose. Moreover, dedicated counters trace 8-watt MS events regardless of msPowerClassToggle parameter value.

For more information on msPowerClassToggle, refer to NTP <124>. For more information on counters, refer to NTP <125>.

2.6.5.7 Secured loop on BSC 12000HC

CAUTION
Customer specific
Indicates that specific equipment and specific software (such as specific software in the BSC) dedicated to a specific application is used and that therefore the feature is not available for all standard GSM users.

An SLTI board, when used in the secured mode, is connected to two PCM links. This combination makes up a secured loop. In case of a transmission failure, signalling links are automatically switched to the redundant path and ongoing calls are kept up.

The securedLoopActivation parameter is provided to enable or disable this function. Refer to NTP <124> for more information.

2.6.5.8 Microcell capture timer at 500 seconds

This facility is designed to cater for cases where a train passes through a station without stopping. In this case, an ongoing call is captured by the railway station cells as the train enters the station and re-captured by the railway cells as the train leaves the station (resulting in another handover).

The facility is implemented by increasing the range of the parameter MicroCellCaptureTimer. For more details, see Section 3.6.6 "Microcells" (page 398) and in particular the Notes in Section 3.6.6.3 "A algorithm" (page 399). For more information on the parameter, refer to NTP <124>.

2.6.5.9 GSM-R functions on BSC 3000

With the Migration of GSM-R capabilities on BSC 3000 platform feature (13913), introduced in V15.1, all the GSM-R features implemented in previous GSM-R releases are available on the BSC 3000.

The exceptions are the secured loop feature (feature id 13738 in V15.1R, for a description, see Section 2.6.5.7 "Secured loop on BSC 12000HC" (page 320)) and the BTS software background downloading (feature id 13881 in V15.1R, for a description, see Section 1.10.2.6 "BTS software background downloading" (page 102)). Neither of these features have been implemented on BSC 3000.

ASCI features are designed at the application level. Consequently, there are few dependencies on the BSC type for these features. In terms of dimensioning, the maximum number of simultaneous calls controlling SCCP connections in the BSC is 100 (Max nb of ASCI setup).

2.6.6 Channel Release on BTS after Abis failure

If an MS is connected to a BTS and an Abis link or a BSC failure occurs, the data communications remains ongoing on the cell at the BTS side whereas the communications are released on the BSC/MSC side.

For voice calls, the user will detect that the speech path is lost and will take down the call. For data communication, the MS will remained parked on the cell until the application realizes that no data is going through and takes down the call.

Without this feature, 30 seconds after the Abis PCM failure (or BSC failure) detection, the BTS sets in the system information broadcast on BCCH to the MS that the cell is “barred”. However, this barring does not drop ongoing calls in this cell, and it does not prevent a handover to this cell. Voice and data communications remain ongoing on the cell and the MS because the BTS keeps broadcasting BCCH and SACCH, even though the communications are released on the BSC/MSC side. As long as the BTS continues to broadcast, another MS can select the cell.

With this feature, if an Abis PCM failure (or a BSC failure) is detected by the TRXs of the BTS, the transmission is turned off and this stops the broadcasting of BCCH and SACCH. When the TRXs of the BTS detect that the Abis PCM (or BSC) has come back, the power amplifiers are turned on again. Ongoing calls are dropped thanks to MS radio link time out algorythm, and no MS can select this cell for a handover or to camp on it.

Since turning the PA off will affect its MTBF, it is preferable to turn off the transmission instead of the PA so that its life is not affected.

Chapter 3
Radio configuration principles

3.1 Introduction

A Base Station Subsystem includes a Base Station Controller (BSC) that manages Base Transceiver Stations (BTSs) and is linked to TransCoding Units (TCUs) and a Packet Control Unit Support Node (PCUSN).

The Dictionary of objects (see Section 3.2 "Dictionary of objects" (page 324)) describes the physical and logical objects that make up a digital mobile network under OMC-R management control, and the objects that describe the OMC-R functions. Section 3.3 "Radio entity management principles" (page 339) introduces some principles to help users manage network entities.

The BSS main radio configuration principles are described under the following headings:

- radio measurement processing (see Section 3.4 "Radio measurement processing" (page 355))
- cell selection and reselection (see Section 3.5 "Radio cell selection and reselection" (page 367))
- handover management (see Section 3.6 "Handover management" (page 372))
- power control (see Section 3.7 "Power control" (page 399))
- call monitoring (see Section 3.8 "Call monitoring" (page 415))
- radio resource allocation (see Section 3.9 "Radio resource allocation" (page 418))
- frequency hopping management (see Section 3.10 "Frequency hopping management" (page 421))
- defense and reconfiguration (see Section 3.12 "Defense and reconfiguration" (page 424))

3.2 Dictionary of objects

3.2.1 The omc object

The **omc** object describes the OMC-R manager that controls the exchanges with the users on the Man-Machine interface and the OMC-R agent on the Q3 interface.

This non Q3, MMI object allows users to manage the active alarm criteria configuration and do the following:

- shut down the applications in a workstation, the active server, or all machines
- consult OMC-R manager server software application markers (each application is marked with a name and a version number)
- consult workstation software application markers (each application is marked with a name and a version number)
- manage the EFTs (or delivery) containing BSS software at manager level
- archive/restore operating data and files such as job results, system session log, and inter-user mail, and manage archiving cartridges
- consult OMC-R manager observation reports

The omc object is unique on the OMC-R. It is created by the system and cannot be deleted.

3.2.2 The md subtree

The md subtree includes the following objects:

- md
- bscMdInterface
- mdScanner
- traceControl
- executableSoftware
- callPathTrace
- mdWarning
- log
- record-type objects
- efd

3.2.2.1 The md object

The **md** object describes the OMC-R agent that provides mediation functions and manages the exchanges with the BSSs on the OMN interface.

The md object defines the OMC-R agent hardware configuration. It allows users to manage the system date and time parameters and do the following:

- switch over the operations to the backup server
- restart the active server
- consult the OMC-R agent software application markers
- manage the EFTs containing BSS software at agent level
- archive/restore operating data and files and manage archiving cartridges
- consult OMC-R agent observation reports

The md object is unique on the OMC-R. It is created by the system and cannot be deleted.

3.2.2.2 The bscMdInterface object

The **bscMdInterface** object class describes the BSS/OMC-R links, that is the transport connections used for BSS/OMC-R exchanges on the OMN interface (X.25 links on BSC 12000HC / Ethernet link on BSC 3000 and access ports on OMC-R).

- All the transport connections between a BSS and the OMC-R are carried by one, dedicated protocol support link. The link is enabled when the object is created.
- BSS access points are identified by two X.25 addresses; one is the preferred address and the other is the backup address. The OMC-R selects one of these addresses and enters the associated transport selector (preferred or backup).
- The OMC-R access point is identified by the logical number of the OMC-R agent port. It is selected by the OMC-R agent if not defined by the user.

The bscMdInterface objects allow users to manage BSC circular files in which unsolicited messages are stored. The possible actions are open, close, display state, and purge. The following types of circular files are defined:

- INIT .... initialization
- MAJOR FAULT .... major faults
- MINOR FAULT .... minor faults
- PERF .... permanent and temporary observation data
- INST PANEL ...... instrument panel observation data
- TRACE .... call tracing and call path tracing data
- MARK .... markers

- TRANSAC .... BSS/OMC-R transactions (TGE-RGE)
- UPDATE .... on-line build operation

Circular files are automatically created by the system and cannot be deleted. The following apply:

- INIT and FAULT files are created with the BSC.
- PERF, INST PANEL, TRACE, MARK, and TRANSAC files are created when the BSC application database is built.
- INIT, MARK, and TRANSAC files are not managed by users.

3.2.2.3 The mdScanner object

The **mdScanner** object class describes all the observations handled by the OMC-R agent Performance Management function, which are as follows:

- permanent general md observation
- permanent general bsc observation
- general statistic observation - *OGS*
- fast statistic observation - *OFS*
- real time observation - *ORT*
- diagnostic observation - *ODIAG*
- temporary Signalling Link observation
- temporary Abis Interface Bts observation
- temporary pcmCircuit observation
- temporary handover observation

3.2.2.4 The bscCounterList object

The **bscCounterList** object class describes the lists of counters a given V11+ BSC collects for an observation type.

The four **bscCounterList** objects (one for OGS, one for OFS, one for ORT, and one for ODIAG) must be defined at BSC creation but in a "no build" state. These object instances are necessary for the operation "Build BDA" of the BSC.

3.2.2.5 The traceControl object

The **traceControl** object class describes the BSS Call tracing function which is controlled by the MSC.

3.2.2.6 The executableSoftware object

The executableSoftware object describes a collection of files which are downloaded between the OMC-R and the BSC 3000. The role of the executableSoftware object is to send a software package to the BSC 3000.

3.2.2.7 The callPathTrace object

The **callPathTrace** object class describes the BSS Call path tracing function, meaning the follow-up of calls using one or more radio resources of a given type in the BSS (cells, TRX/DRXs, or terrestrial circuits).

All calls using the selected resources are monitored, provided the maximum number of observations authorized for each type of data collected (basic, handover, or radio) is not reached.

3.2.2.8 The mdWarning object

The **mdWarning** object class describes the conditions in which notifications related to "observation counter threshold crossing" and "excessive software application error rate" are processed by the OMC-R agent and the related alarms are triggered.

3.2.2.9 The log object

The **log** object class describes the logs used to store fault, observation, and trace messages on the OMC-R agent disks.

- The current alarm log is no.1.

  The records of the current alarm log are represented by **alarmRecord** and **stateChangeRecord** objects.

- A current observation log is associated with each created mdScanner object that describes a permanent or temporary observation (instrument panel observation data are not stored).

  The records of a current permanent observation log are represented by **observationFileReadyRecord** objects.

  The records of a current temporary observation log are represented by **mdScanReportRecord** objects.

- A current trace log is associated with each created traceControl or callPathTrace object that describes a BSS Call tracing or Call path tracing function.

  The records of a current trace log associated with a traceControl object are represented by **traceFileReadyRecord** and **tracelogRecord** objects.

  The records of a current trace log associated with a callPathTrace object are represented by **traceFileReadyRecord** objects.

- A restored log is created whenever fault, observation, or trace data are restored to the OMC-R agent disks.

The OMC-R agent creates and manages log objects. A current or restored log is automatically deleted when the storage time defined in static configuration data expires.

3.2.2.10 The record-type objects

The **alarmRecord** object class describes the logged information that results from alarm notifications.

The **stateChangeRecord** object class describes the logged information that results from state change notifications.

The **observationFileReadyRecord** object class describes the format of permanent observation data recorded in an observation log.

The **mdScanReportRecord** object class describes the format of temporary observation data recorded in an observation log.

The **traceLogRecord** object class describes the format of call tracing data recorded in a trace log for the priority traces collected by the Call tracing function.

The **traceFileReadyRecord** object class describes the names of the files where non priority traces collected by the Call tracing and Call path tracing functions are recorded.

The OMC-R agent creates and manages record-type objects.

3.2.2.11 The efd object

The **efd** object class describes the conditions in which observation and trace messages are fed back to the OMC-R manager.

If the **administrativeState** of an efd object is "unlocked", the OMC-R agent feeds back the messages handled by the object to the OMC-R manager. If not, the messages are not forwarded.

3.2.3 The network subtree

The network subtree includes the following objects:

- network
- bsc subtree objects

3.2.3.1 The network object

The **network** object gathers the overall BSSs defined in the OMC-R. It is the root of the bsc subtree described hereafter.

This object allows users to run multiple-type commands (scope & filter) on a set of BSSs, such as List, Set, Get, and Delete. These commands are accessed as options of the *Several* submenu of the *Objects* menu in an "OMC-R Browser" window.

The network object is unique on the OMC-R agent. It is created by the system and cannot be deleted.

3.2.4 The bsc subtree

The Base Station Controller (BSC) is the core of the BSS configuration. A BSC is solely identified on the OMC-R, and all the objects describing a BSS are defined in relation to the bsc object.

A BSC communicates with the MSC (via the TCUs) through the A interface, with the TCUs through the Ater interface, and with the BTSs through the Abis interface.

The bsc subtree includes the following objects:

- bsc
- pcu
- signallingPoint
- signallingLinkSet
- pcmCircuit
- lapdLink
- bscCounterList
- transcoder subtree objects
- btsSiteManager subtree objects

3.2.4.1 The bsc object

The **bsc** object class describes the BSCs and their hardware configuration (architecture and type).

Specific actions on the bsc objects allow to do the following:

- manage the BSC operations such as BSC processing chain reset that may trigger restart
- control the operations such as manage BSC application database BDA (build, on-line reset, or off-line reset), and check BDA and OMC-R agent operations database (BDE) consistency
- monitor BSC control unit and equipment operations
- synchronize the operations to provide equipment management by checking BSS date and time consistency with the system references, broadcasting the reference date and time to the BSCs

BSCs are driven by software.

3.2.4.2 The signallingPoint and signallingLinkSet objects

The **signallingPoint** object class describes the BSC-MSC links on BSC end.

The **signallingLinkSet** object class describes BSC-MSC links on MSC end.

There is one SS7 signalling link set per BSC. A (signallingPoint, signallingLinkSet) combination identifies the set on the OMC-R.

3.2.4.3 The signallingLink object

The **signallingLink** object class describes the SS7 signalling links used on the A interface for BSC-MSC call processing exchanges such as call establishment, release of resources, etc.

The SS7 links are carried out by the TCUs. Each link occupies one time slot at 64 kbps on an A interface PCM link and one time slot at 64 kbps on an Ater interface PCM link.

A special action on signallingLink objects allows users to inhibit the SS7 links.

3.2.4.4 The pcmCircuit object (Abis, Ater and Agprs interfaces)

The **pcmCircuit** object class describes the external BSC PCM links on the Abis (BSC-BTS connections), Ater (BSC-TCU connections) and Agprs (BSC-PCUSN connections) interfaces.

3.2.4.5 The xtp object

The **xtp** object class (eXchange Termination Point) describes the terrestrial traffic circuits used on the A interface for BSC-MSC voice call and data processing exchanges.

The terrestrial traffic circuits are carried out by the TCUs. Each circuit occupies one time slot at 64 kbps on an A interface PCM link and one time slot at 16 kbps on an Ater interface PCM link.

3.2.4.6 The lapdLink object

The **lapdLink** object class describes the Level 3 links that support LAPD signalling between the BSCs and the following radio entities:

- radio site BCF and TRX/DRXs on the Abis interface
- remote transcoders on the Ater interface

3.2.4.7 The bsc 2G object

The bsc 2G object describes the managed object class representing a second generation BSC hardware.

3.2.4.8 The bsc e3 object

The bsc e3 object describes the managed object class representing a third generation BSC equipment

3.2.4.9 The bscCounterList object

The **bscCounterList** object class describes the lists of counters a given V11+ BSC collects for an observation type.

The four **bscCounterList** objects (one for OGS, one for OFS, one for ORT, and one for ODIAG) must be defined at BSC creation but in a "no build" state. These object instances are necessary for the operation "Build BDA" of the BSC.

The maximum number of observation counters is the result of a formula. For its description, refer to the "Build BDA" action of bsc object in NTP <128>.

ORT counters cannot be dynamically configured.

3.2.5 The transcoder subtree

The remote transcoding units (TCUs) installed on the MSC site are used to minimize Abis and Ater interface PCM link needs.

The TCUs communicate with the BSC through the Ater interface and with the MSC through the A interface.

The transcoder subtree includes the following objects:

- transcoder
- pcmCircuit (A)
- transcoderBoard
- tcu
- tcu e3

3.2.5.1 The transcoder object

The **transcoder** object class describes the remote transcoding units that handle the information conveyed on PCM links between the BSC and the MSC.

A TCU controls one PCM link with the BSC and four links with the MSC. A TCU communicates with the BSC across an LAPD signalling link and is identified by a TEI address.

3.2.5.2 The pcmCircuit object (A interface)

The **pcmCircuit** object class describes the external TCU PCM links on the A interface (TCU-MSC connections).

3.2.5.3 The transcoderBoard object

The **transcoderBoard** object class describes the transcoder boards (TCBs) equipping the TCU 2G which handle the rate conversions between data conveyed on the Ater interface PCM links (BSC 12000HC-TCU 2G exchanges) and data conveyed on the A interface PCM links (TCU 2G-MSC exchanges).

TCBs are driven by software.

3.2.5.4 The tcu object

The tcu object describes the tdti board which handles the PCM links on the Ater interface (BSC-TCU2G exchanges) and on the A interface (TCU 2G-MSC exchanges).

3.2.5.5 The tcu e3 object

The tcu e3 object describes the equipment of TCU 3000 which handles the conversion rates between data conveyed on the Ater interface PCM links (BSC 3000-TCU 3000 exchanges) and data conveyed on the A interface PCM links (TCU 3000-MSC exchanges).

The tcu e3 objects are driven by tcu e3 software.

3.2.6 The btsSiteManager subtree

The Base Transceiver Stations (BTSs) handle radio transmissions.

A BTS communicates with the BSC through the Abis interface and with the mobiles through the Radio interface.

The Radio interface is characterized by geographic space divisions (cell coverage), time divisions (TDMA), and frequency divisions (mobile network frequency band).

The btsSiteManager subtree includes the following objects:

- btsSiteManager
- bts and functional associated objects
- transceiverEquipment
- transceiver
- channel

3.2.6.1 The btsSiteManager object

The **btsSiteManager** object class describes the radio equipment (BTSs) controlled by the BSC.

A radio site covers one or more cells. A BTS manages a synchronous set of cells.

Actions on btsSiteManager objects include querying the hardware configuration of a BTS, querying the data configuration of a radio site, querying information on battery (voltage value, malfunctions...), and forcing a BTS to use its battery.

Radio site BCFs are driven by software.

3.2.6.2 The bts object and the functional associated objects

The bts object The **bts** object class describes the serving radio cells.

A radio cell is a geographic area covered by synchronous radio equipment (same GSM reference time).

The different types of cells are normal, micro, and umbrella. The cells can be concentric and work in normal (35-km coverage) or extended (120-km coverage) mode.

Actions on bts objects include controlling short message broadcasts in unacknowledged mode and forcing handovers towards the neighbor cells.

The bts-related functional objects are as follows:

- adjacentCellHandOver
- adjacentCellReselection
- frequencyHoppingSystem
- handoverControl
- powerControl
- transceiverZone (concentric cells)

The adjacentCellHandOver object The **adjacentCellHandOver** object class describes the neighbor cells of the serving cells for handover management in a BSS.

At least one object must be associated with each bts object created on the OMC-R in order to authorize handovers in the network serving cells.

The number of created instances per serving cell is limited to 32.

The adjacentCellReselection object The **adjacentCellReselection** object class describes the cells used by the serving cells for reselection management in a BSS.

At least one object must be associated with each bts object created on the OMC-R in order to authorize reselections in the network serving cells.

The number of created instances per serving cell is limited to 32.

The frequencyHoppingSystem object The **frequencyHoppingSystem** object class describes the sets of frequency channels that can be allotted to the radio time slots (TSs) of the serving cell TDMA frames.

These objects are not created from a bts object unless frequency hopping is enabled in the cell. They are referenced by the channel objects that describe the radio time slots in the TDMA frames related to cells where frequency hopping is allowed.

The number of created instances per serving cell is limited to 64.

The handOverControl object The **handOverControl** object class defines the handover management parameters in serving cells.

A handOverControl object must be created for each bts object created on the OMC-R. This object is unique for a given bts object.

Handover management parameters include the following: enabling conditions, level and quality thresholds, average distance computing parameters, level, quality, interference, and corrective factors used for missing measurements.

The powerControl object The **powerControl** object class defines the power control management parameters in serving cells.

A powerControl object must be created for each bts object created on the OMC-R. This object is unique for a given bts object.

Power control management parameters include the following: enabling conditions, power control algorithm selection, maximum authorized power, signal reception level and quality, starting conditions, and mobile transmission power steps.

The transceiverZone object The **transceiverZone** object class describes the TDMA frame distribution in concentric cells.

Two transceiverZone objects must be created for each bts object describing a concentric cell on the OMC-R. One of the objects describes the outer or large zone, the other one describes the inner or small zone.

The transceiverZone objects are referenced by the transceiver objects that describe the TDMA frames used by concentric cells.

A transceiverZone object must also be created in mono-zone or non-concentric cells due to mediation reasons.

3.2.6.3 The transceiverEquipment object

The **transceiverEquipment** object class describes the radio transceivers (TRXs or DRXs) that handle TDMA frames in the BTSs.

A TRX is a logical entity that regroups the following physical entities: a radio transmitter (TX), a TDMA frame processor (FP), and a radio receiver (RX). Each RX is partnered with one FP to create a FPRX entity.

A DRX is a physical entity that handles the same three functions.

The TRX/DRXs communicate with the BSC across LAPD signalling links and are identified by a TEI address.

The TEI addresses of the TRX/DRXs must be allocated in logical ascending order (see NTP < 124 >).

A special action on transceiverEquipment objects allows users to query TRX/DRX hardware configuration.

TRX/DRXs are driven by software.

3.2.6.4 The transceiver object

The **transceiver** object class describes the TDMA radio transmission carrier frames (logical transmitters).

At any given time, a TDMA frame is partnered with one, and only one, TRX/DRX. The BSC dynamically decides the TDMA-TRX/DRX associations.

A transceiver object has no *administrativeState* of its own. Its *operationalState* depends on the *administrativeState* of the parent bts object.

3.2.6.5 The channel object

The **channel** object class describes the radio time slots of the TDMA transmission frames. Each TDMA frame carries eight physical channels.

If frequency hopping is not allowed in a cell, all the time slots (TSs) in the TDMA frames related to the cell use the same time frequency channel defined by the user.

If frequency hopping is allowed in the cell and a radio time slot, the TS uses a specific radio frequency channel at a given time selected from the **mobileAllocation** list defined by the *frequencyHoppingSystem* object referenced by the channel object (**fhsRef** attribute) and dependent on the bts object describing the covering cell.

A time slot in the same TDMA frame may not be allowed to frequency hop (it uses the frequency channel allocated by the user), or can obey frequency hopping laws.

The BCCH in a cell is automatically assigned the **bCCHFrequency** allocated to the cell by the user. If the frequency is changed by the user, the radio time slot is appropriately reconfigured.

3.2.7 The multiple site object

The Base Transceiver Stations (BTSs) controlled by a BSC may be chained (drop & insert connections) on a radio site and share the same Abis PCM resources.

The **multiple site** object class describes such BTS chains in the BSSs.

The btsSiteManager objects that describe the BTSs in a chain must be entered in the order of physical chaining, beginning with the BTS closest to the BSC.

The multiple site objects are non-Q3, MMI objects that are locally managed by the OMC-R manager. They are unknown to the OMC-R agent and are not stored in its operations database (BDE).

3.2.8 The software object

The **software** object class describes the software versions of the BSS entities driven by software, saved on BSC disks.

A software object must be created for every bsc, btsSiteManager, transceiverEquipment, and transcoderBoard object created on the OMC-R. This object is unique for a given managed object.

The software objects are locally managed in the OMC-R (no information is recorded in the BSC application databases).

Actions on the software object allow users to do the following:

- download BSS software in the BSC
- start up new BSS software versions
- consult BSS software application markers

3.2.9 The short message object

The **short message** object class describes the short messages created by users for unacknowledged broadcast to mobiles not engaged in calls.

Only a limited number of short messages can be broadcast in a radio cell at a time.

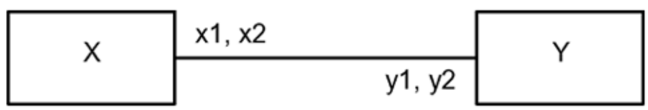
The short message objects are not available on the Q3 interface and are locally managed in the OMC-R (no information is recorded in the BSC application databases).

Actions on these objects and the bts objects allow users to manage broadcasting short messages in network radio cells.

3.2.10 Inter-object relationships

Figure 55 "Inter-object relationships" (page 338) shows the relationship between the configuration objects of a BSS managed on the OMC-R.

The following diagram shows inter-object relationships:



The diagram should be understood as follows:

- An X object instance occurs at least x1 times and no more than x2 times in the X-Y object relationship.
- A Y object instance occurs at least y1 times and no more than y2 times in the X-Y object relationship.

In the example below, a site manages from one to n cells, but a cell is controlled by one site.

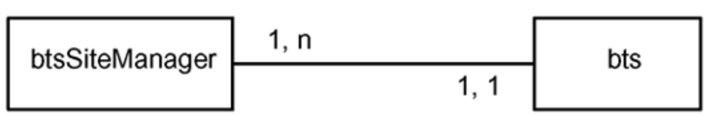
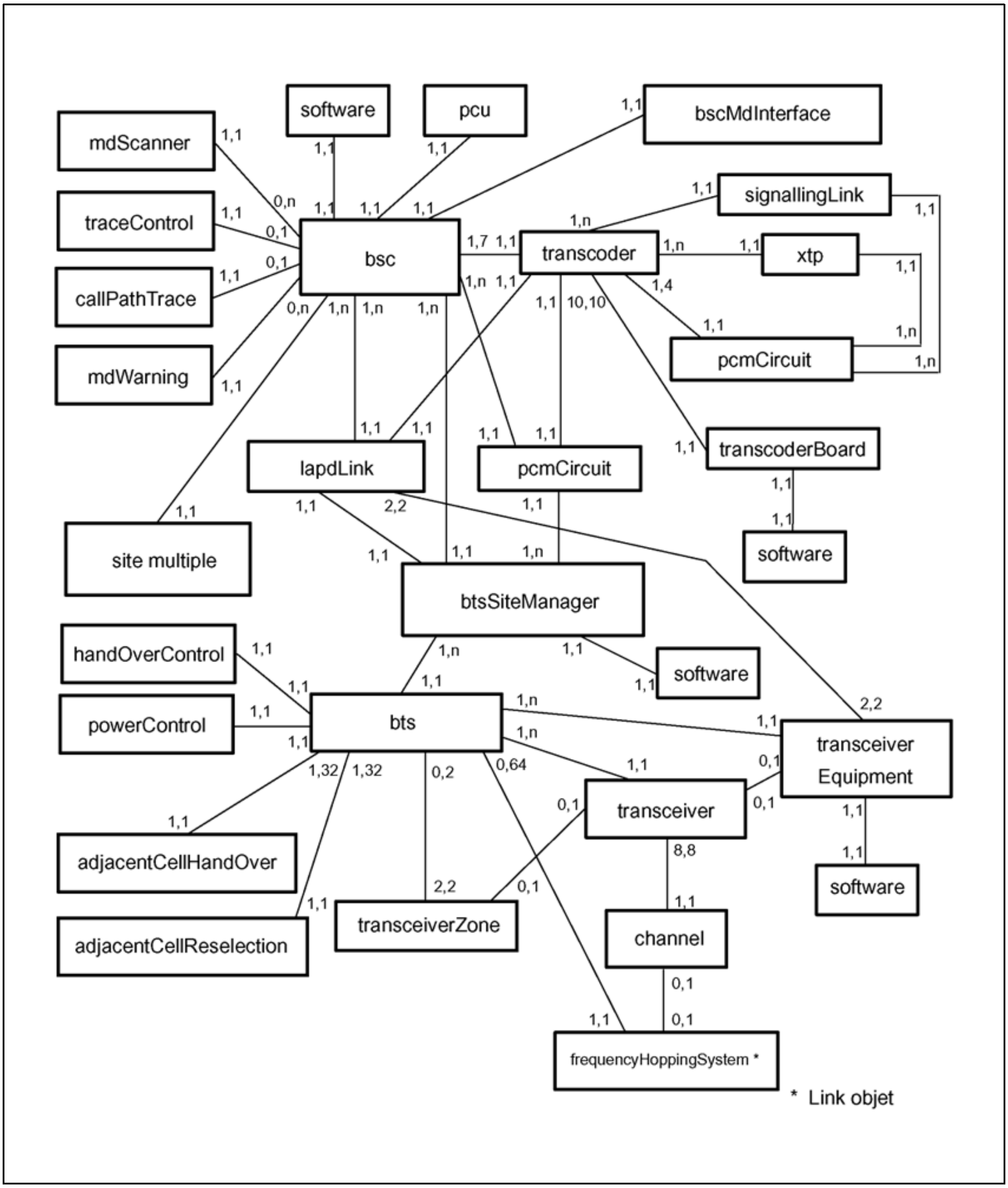


Figure 55
Inter-object relationships



3.3 Radio entity management principles

3.3.1 BSC management

3.3.1.1 BSC application database management

The following actions are performed on a BSC application database:

- audit to check the application database (BDA) and operations database (BDE) for consistency
- build when the BSC is initialized or rebuild in response to one of the actions described hereafter
- on-line reset to reconfigure the network without impact on BSC operations or ongoing calls
- off-line reset when the BSC restarts (after a Type 3 software version change, for example) or when an audit detects a major inconsistency with the OMC-R agent operations database (BDE)

The **bdaVersionNumber** attribute indicates the current BDA version number. "0" means that the BDA is not built.

The **bdaVersionBuild** attribute defines the number of the BDA version for rebuilding needs. It is reset with an off-line reset command.

3.3.1.2 BSC date and time management

The date and time information broadcast by the OMC-R agent situate in time the messages exchanged on the OMN interface (BSS/OMC-R links) and time stamp the spontaneous messages issued by the BSC.

The information is checked regularly. If the difference between the OMC-R agent reference date and time exceeds accepted limits, the OMC-R agent returns the correct data to the BSCs involved.

These data are also broadcast in the following cases:

- system references set by users (md object)
- BSS/OMC-R link setup (bscMdInterface object)
- link restoration after a break
- *Synchronize bsc clock* user command (bsc object)

The **bscDateTime** attribute indicates the current BSC reference date and time.

3.3.1.3 Only for BSC 12000HC: processing chain management

A BSC has two processing chains (A and B) that operate in duplex mode. At a given time, one chain is active and the other is on standby.

A processing chain is set of the following boards and functions organized around an INTEL MULTIBUS:

- MPU boards [master and slave]
- SICX boards [SIC X.25]
- SICD 8V boards [SIC LAPD]
- CCS7 boards [SIC SS7]
- ECI board
- ALA board
- switching boards
- PCM connectors and switching matrix
- OMN interface link

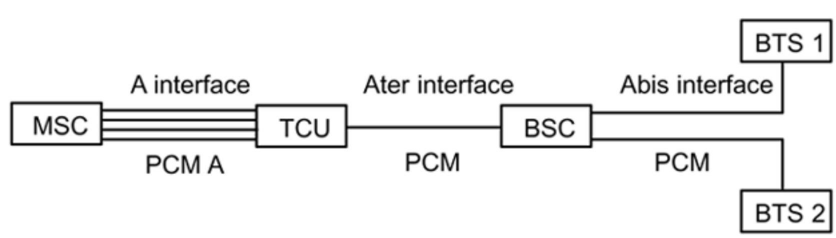
The actions on the BSC processing chains are as follows:

- display the state of the boards and functions on a given chain (A or B).
- resets one or both BSC processing chains in different ways. The impact on operations depends on the command used (see **bscChainId** and **chainId** entries in NTP < 124 >).

3.3.2 PCM link management

3.3.2.1 Principles

The following graph shows how PCM links are distributed in a mobile network.



A PCM link used by a BSC on the Abis interface cannot be used for TCU connection on the Ater interface, and vice versa.

By definition, a PCM link depending on a BSC is used on the Abis or Ater interface and a PCM link depending on a TCU is used on the A interface.

The pcmCircuit objects depending on a bsc object (PCM Abis or Ater) are created after the bsc object that uses them.

The pcmCircuit objects depending on a transcoder object (PCM A) are created after the transcoder object that uses them.

3.3.2.2 PCM link management on the Abis interface for the BSC 12000HC

The **bscSitePcmList** attribute of a btsSiteManager object identifies the Abis interface PCM links used by the radio site (maximum of six) in the list of PCMs allotted to the BSC that controls the site.

An Abis interface PCM link is identified on BSC side by a **pcmCircuitBsc** reference and on BTS side by a **pcmCircuitBtsSiteManager** reference.

The reference numbers identifying a PCM link are directly related to the number of the boards to which the link is physically connected on both sides of the interface: a DDTI board in the BSC to a DTI board in the BTS.

The following rule applies:

- The reference of a PCM link connected to DDTI no.i board in the BSC 12000HC is **pcmCircuitBsc** "2i" or "2i+1" (a DDTI board manages two PCM links). The board numbers and positions in the BSC 12000HC equipment cabinet are cross-referenced in the BSC 12000HC Reference Manual.
- The reference of the same PCM link connected to DTI no.j board in the BSC in the BTS is **pcmCircuitBtsSiteManager** "j" (a DTI board manages one PCM link). The board numbers and positions in BTS cabinets are cross-referenced in the BTS Reference Manuals.

3.3.2.3 PCM link management on the Abis interface for the BSC 3000

The **bscSitePcmList** attribute of a btsSiteManager object identifies the Abis interface PCM links used by the radio site in the list of PCMs allotted to the BSC 3000 that controls the site.

An Abis interface PCM link is identified on the BSC 3000 side by a **pcmCircuitBsc** reference and on BTS side by a **pcmCircuitBtsSiteManager** reference.

The reference numbers identifying a PCM link are directly related to the number of boards that are physically connected to the interface : the LSA-RC module. There can be up to 6 LSA-RCs in a BSC 3000 and these are identified by an id = [0...5] linked to their slot position in the cabinet. Each LSA-RC can host up to 21 E1 PCM or 28 T1 PCM links.

The following rule applies :

- The reference of a PCM link on BSC 3000 side is given by :

  PCM_Number = 21 * LSA_Number + Port_Number to an E1 type BSC 3000

PCM_Number = 28 * LSA_Number + Port_Number to a T1 type BSC 3000

The LSA-RC module numbers and positions in BTS in the interface node (in BSC 3000 equipment cabinet) are referred to in NTP <126>.

- The PCM0, PCM1, PCM2 and PCM4 of LSA-RC0 (corresponding to the ports 0 2 4 of port LSA-RC0) are reserved for the Ater interface but cannot be modified during the startup.
- The PCM1, PCM3 and PCM5 of LSA-RC0 (corresponding to the ports 1, 3, 5 of port LSA-RC0) are reserved for the Ater interface and they can be modified by any value of the list :
  - ports [1, 2, 5 to 20] equivalents PCM1, PCM3, PCM5 to PCM20 for PCM E1
  - ports [1, 3, 5 to 27] equivalents PCM1, PCM3, PCM5 to PCM27 for PCM T1

Thus the following rules should be considered :

- for the type of PCM E1 link :
  - It is possible to use PCM6 to PCM20 on LSA-RC0, like all the others PCM of other LSA-RC for the A or Ater link, with in more some conventions of distribution.
  - To distribute PCM E1 link on different LSA-RC for a BSC 3000 cabinet.
  - To distribute PCM E1 link on different LSA-RC of the MSC.
- for the type of PCM T1 link :
  - It is possible to use PCM3 to PCM21 on LSA-RC0, like all the others PCM of other LSA-RC for the A or Ater link, with in more some conventions of distribution.
  - To distribute PCM T1 link on different LSA-RC for a BSC 3000 cabinet.
  - To distribute PCM T1 link on different LSA-RC of the MSC.

Convention of classification of PCMs.

the classification of the PCM is established following rules :

- for the PCM E1 link :
  - dedicated to the Ater interface, start with PCM0 and allocate the PCM numbers in ascending order.
  - dedicated to interface A, start with PCM4 and allocate the PCM numbers in descending order.

- for the PCM T1 link :
  - — dedicated to the Ater interface, start with PCM0 and allocate the PCM numbers in ascending order.
  - — dedicated to interface A, start with PCM21 and allocate the PCM numbers in descending order.

3.3.2.4 Radio site usable PCM time slot management

The **radioSiteMask** attribute of a btsSiteManager object defines the PCM time slots (TSs) that a radio site is allowed to use and helps manage the "drop & insert" connections on the Abis interface. According to convention, the TSs are allocated in descending numerical order. The allocation usually begins with bit 31 if PCM E1 links are used and bit 24 if PCM T1 links are used.

The user assigns the site scheduled time slot (attribute **pcmTimeSlot-Numbe**r), that is the PCM time slot used by the site BCF OML link for initializing all BTS communication with the BSC. Although it belongs to the site, the scheduled time slot must be masked in the **radioSiteMask** to avoid being allocated by the BSC.

In a BTS chain, several sites share a same PCM link. Configuration restrictions are as follows:

- Different usable time slots must be allotted to each site (separate masks).
- All the scheduled time slots of the radio sites in the chain must be masked in the **radioSiteMask** of each site.

In the case of a BTS mono PCM (star, drop & insert) or BTS single loop, if the number of defined TS for the "radio site mask" is greater than the number of really used TS, the remaining bits (the most significant bits) are never used for traffic management purpose.

3.3.2.5 TEI address management

TEI address allocation In a BTS chain, the TEI addresses must be allocated in ascending order (TEI0, TEI1, TEI2, etc.), beginning with the BTS closest to the BSC.

In a BTS loop configuration, the TEI addresses must be allocated in ascending order (TEI0, TEI1, TEI2, etc.), beginning with the BTS directly linked to the BSC that uses DTI board no.0 for the Abis link input.

Relation TEI scheduled time slot When a PCM switching matrix is used between the BSC and the BTS, the relation "scheduled time slot = **teiBtsSiteManager** + 1" needs not be true at BSC level; otherwise, it must be true.

The relation remains true at BTS level in all cases.

3.3.2.6 PCM link management on the Ater and A interfaces

A TCU is connected to a BSC by a PCM link identified in relation to the BSC (pcmCircuit object on Ater interface called Ater PCM).

A TCU is connected to the MSC by four PCM links identified in relation to the TCU (pcmCircuit objects on A interface called PCM A) and numbered 0 to 3.

Two TCUs cannot use the same PCM links.

For the BSC 3000 there can be several Ater links per TCU 3000 (up to 17 for MIC E1 of the TCU 3000 and 21 for the MIC T1 of the TCU 3000). The number of links on interface A is larger for TCU 3000 (up to 62 for the MIC E1 and 82 for the MIC T1).

3.3.2.7 PCM time slot configuration on the Ater and A interfaces

A 64 kbps time slot (TS) on an Ater PCM conveys four logical 16 kbps TSs. A 64 kbps time slot (TS) on a PCM A conveys one logical 64 kbps TS.

By definition, an SS7 signalling link occupies a 64 kbps TS on the Ater interface and a 64 kbps TS on the A interface.

By definition, a terrestrial traffic circuit occupies a 16 kbps TS on the Ater interface and a 64 kbps TS on the A interface.

For the TCU 2G Time slot mapping of the Ater PCM link assigned to a TCU on the four PCM links used by the TCU on the A interface is defined in the transcoding unit hardware configuration data (see the *transcoderMatrix* entry in NTP < 124 >).

Configuration requirements are as follows:

- TS 1 on the Ater PCM is assigned to LAPD signalling between the BSC and the TCU. It has no A interface equivalent.
- The X.25 connection between the BSC and the OMC-R (OMC channel), if any, occupies TS 2 on the Ater PCM and TS 2 on PCM A no.0.
- A first-created SS7 signalling link occupies TS 3 or 2 on the Ater PCM, depending on whether the OMC channel exists, regardless of the PCM and TS allotted by users on the A interface.
- A second-created SS7 signalling link occupies TS 4 or 3 on the Ater PCM, depending on whether the OMC channel exists, regardless of the PCM and TS allotted by users on the A interface.
- If PCM E1 links are used, TSs 28 to 31 on PCM A no.3 cannot be used since they have no Ater interface equivalent.

- If PCM T1 links are used, TSs 21 to 24 on PCM A no.3 cannot be used since they have no Ater interface equivalent.

Terrestrial traffic circuit preemption conditions are as follows:

Configuration	PCM A no.0	PCM Ater
OMC channel or one SS7 link	TSs 1 to 4 preempted	TS 2 reserved
OMC channel + one SS7 link or two SS7 links	TSs 1 to 8 preempted	TSs 2 to 3 reserved
OMC channel + two SS7 links or three SS7 links	TSs 1 to 12 preempted	TSs 2 to 4 reserved
OMC channel + three SS7 links or four SS7 links	TSs 1 to 16 preempted	TSs 2 to 5 reserved

Terrestrial traffic circuit preemption is effective if the SS7 signalling link(s) is(are) created and in service (signallingLink object(s) unlocked).

For the TCU 3000 Time slot mapping of the Ater PCM links is managed dynamically by the TCU 3000.

LAPD and SS7 channels are distributed in the PCM available on the Ater interface.

3.3.2.8 PCM fault management for BTSs in Drop and Insert configuration

Introduction This feature (*FM1189 - D&I PCM Fault Management*) improves PCM fault detection on the following BTSs:

- S8000 BTS with BCF
- S8000 BTS with CBCF
- S8002 BTS with CBCF
- S2000 H/L BTS
- e-cell

It allows the BTSs in Drop and Insert configuration (from the first BTS to the last but one) to supervise the odd PCM ports connected with a physical link, in order to detect the level 1 transmission network link failures.

Principles

- in V12.2 release, an alarm (with fault number 1067 and the cause "PCM" 6488065 on the PCM equipment) can raise only for the BTS PCM links described through the **bscSitePcmList** parameter (six PCM links at the maximum).

- from V12.4 release, an alarm (with fault number 1067 and the cause "PCM" 6488065 on the PCM equipment) can raise for additional BTS PCM links described in new parameters according to BTS configuration.

Figure 56
1st example of drop and insert configuration: chained BTSs and no redundant CPCMI board

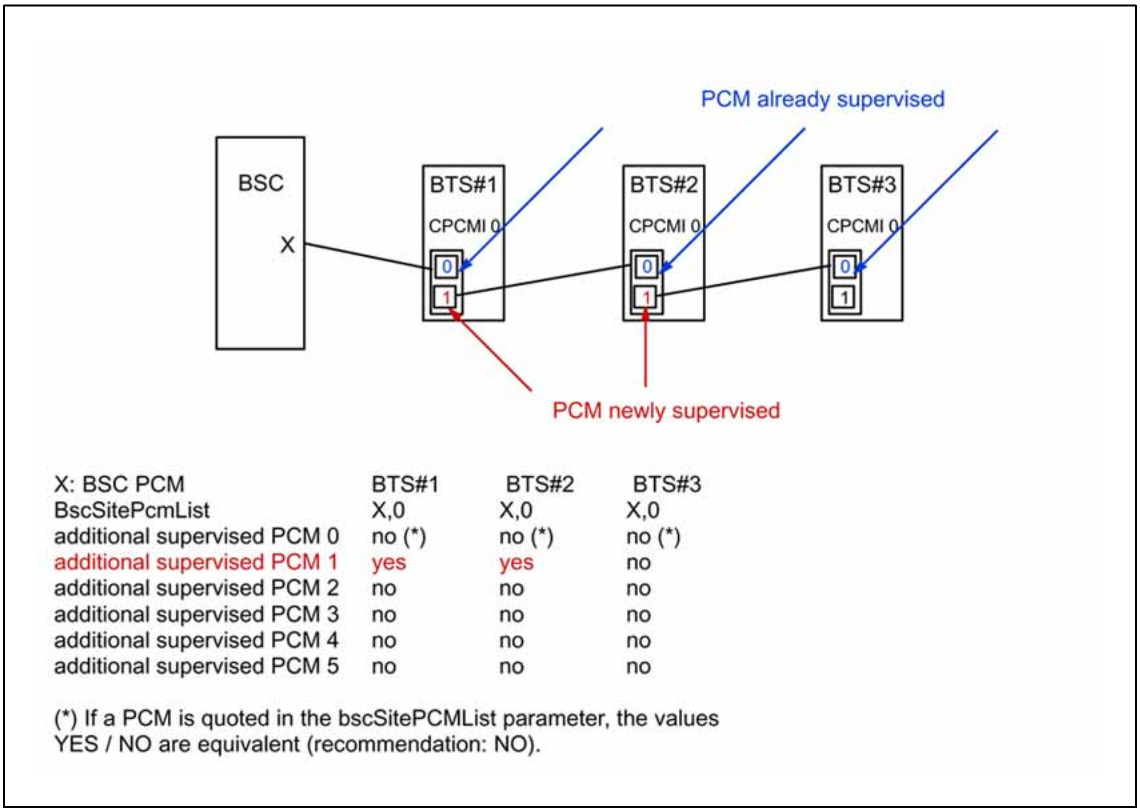
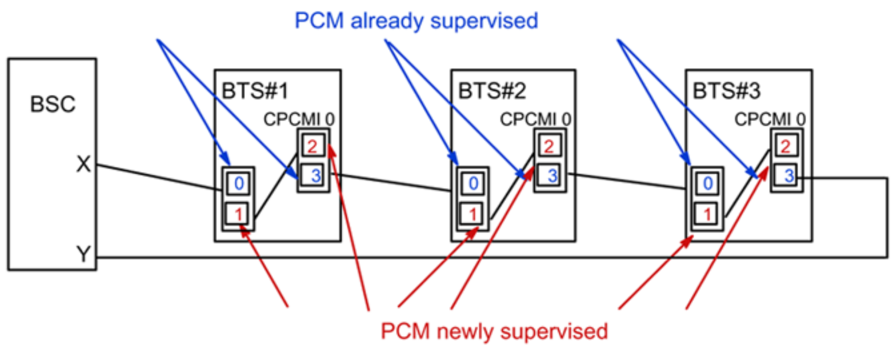


Figure 57
2nd example of drop and insert configuration: looped BTSs with redundant CPCMI boards



X & Y: BSC PCM	BTS#1	BTS#2	BTS#3
BscSitePcmList	X,0 Y,3	X,0 Y,3	X,0 Y,3
additional supervised PCM 0	no (*)	no (*)	no (*)
additional supervised PCM 1	yes	yes	yes
additional supervised PCM 2	yes	yes	yes
additional supervised PCM 3	no (*)	no (*)	no (*)
additional supervised PCM 4	no	no	no
additional supervised PCM 5	no	no	no

(*) If a PCM is quoted in the bscSitePCMList parameter, the values YES / NO are equivalent (recommendation: NO).

The supervision of a "Site PCM" isn't stopped even if it is not set in "PCM additional supervision" mask.

O&M interface evolution The implementation of this feature introduces six new parameters related to the btsSiteManager object:

- **additional supervised PCM 0 [YES / NO]**
- **additional supervised PCM 1 [YES / NO]**
- **additional supervised PCM 2 [YES / NO]**
- **additional supervised PCM 3 [YES / NO]**
- **additional supervised PCM 4 [YES / NO]**
- **additional supervised PCM 5 [YES / NO]**

They enable the user to mask (or not) and thus to supervise up to six PCM links independently from one another. YES indicates that the PCM link is supervised by the BTS, and NO indicates the opposite.

Refer to these new entries in NTP < 124 >.

3.3.2.9 Displaying PCM information and Agprs compression rate

The "Display PCM information & Agprs compression rate" feature (26560), introduced in V15.1, collects PCM information from the OMC-R databases and displays it in a GUI.

There are two modes of operation:

- Detailed PCM view
- Agprs resource distribution.

Detailed PCM view In this mode, you can see information about all PCM links on the Abis, Ater, and Agprs interfaces and about the objects connected to a given PCM link. The information is displayed in an hierarchical tree form.

Agprs resource distribution In this mode (which is also known as Agprs compression rate mode), the compression rate, the PCUSN Id, BSC Id, the number of PDTCHs per BSC, the and the number of Agprs TSs, are displayed. Such information can be used to make more efficient use of PCM resources (E1/T1).

The feature is implemented as a new NRP plug-in. The operator selects the mode using a parameter of the NRP plug-in. The mode cannot be changed while the NRP plug-in is running. If desired, the operator can de-activate the feature. For a description of this plug-in, refer to the document DS/BSS/APP/012277 (Plug-in for Display PCM Information and Agprs Compression Rate).

3.3.3 LAPD link management

3.3.3.1 Principles

The Link Access Protocol on D channel (LAPD) links handle signalling exchanges between the BSCs and the following entities: radio site BCF and TRX/DRX entities on the Abis interface, remote transcoders on the Ater interface and packet control unit support node on the Agprs interface. Figure 58 "LAPD link management in a BSS (with BSC 12000HC)" (page 352) shows how LAPD links are managed in a BSS.

The lapdLink objects are characterized by the following:

- a LAPD terminal in the BSC 12000HC (SICD 8V port number) defined by users.
- For the BSC 3000 there is no real terminal number: as for the BSC 12000HC, the operator will be able to set the LAPDTerminalNumber associated with each TEI (BTS and TRX). But now, the LAPDTerminalNumber is interpreted as the value LAPD port, and is no longer the number of the real LAPD port of the a SICD 8V.
- a Service Access Point Identifier (SAPI) defined by users

- an assigned interface (Abis or Ater) defined by users that tells which type of signalling is supported (BTS or TCU)
- a Terminal Endpoint Identifier (TEI) address allocated by the OMC-R agent according to the TEI address allocated by users to the BCF, TRX/DRX, or TCU entity using the LAPD link
- a (pcmCircuit, timeSlotNumber) combination allocated by the OMC-R agent that identifies the PCM TS used

In a BSS, an LAPD link is assigned to the Abis or Ater interface, never to both. An LAPD Abis link cannot use the same:

- BSC SICD 8V port as an LAPD Ater link
- BSC 3000 TMU does not have a TMU port. There is no such limitation for the BSC 3000. The Abis LAPD are managed by the cell group they are related to. Ater LAPD processes are distributed independently on the available TMUs.

Only for BSC 12000HC: LAPD concentration is always true on the Ater interface. It can be true on the Abis interface, provided the BSC is consequently configured and equipped with BSCBs (BTS signalling concentrating boards).

For the BSC 3000 there is no LAPD concentration because there is no port limitation due to the SICD 8V card. The LAPD data is routed internally and processed by the TMU.

At least one LAPD link must be defined for a radio site to support signalling with its BCF.

A lapdLink object has no *administrativeState* of its own. Its *operationalState* depends on the *administrativeState* of the parent bsc object.

3.3.3.2 Main and secondary LAPDs

Main LAPD The TS number carrying the main LAPD, called the RDV (*Rendez-vous*) TS, obeys the following BTS rule:

RDV TS number = TEI_bcf_number + 1.

The following tables indicate the link between the BTS RDV TS number (BTS matrix) and the BTS external PCM TS number.

E1 configuration

TEI	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RDV TS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ext TS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

T1 configuration

TEI	0	1	2		4	5	6		8	9	10		12	13	14	
RDV TS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ext TS	1	2	3		4	5	6		7	8	9		10	11	12	

Secondary LAPD When a site (btsSiteManager) has more than on cell (bts), one LAPD is associated with each cell:

- one main LAPD shared with the BCF site and one cell,
- one secondary LAPD for each other cell

These rules apply for all the cases except for the following configuration:

- up to Sxy (single LAPD for 2 cells) if $x+y \le 8$
- up to Sxyz (single LAPD for 3 cells) if $x+ y+ z \le 8$
- up to Sxyz-x’y’z’ (one LAPD for 3 cells) if $x+ y+ z \le 8$ and $x’+ y’+ z’ \le 8$
- up to Sxyz-x’y’z’ (one LAPD for 2 cells) if $x+ y \le 8$, $z+ x’ \le 8$, and $y’+ z’ \le 8$

Whenever possible, each LAPD should be connected to a different SICD 8V. Moreover, main and secondary LAPDs must be connected to different SICD 8V ports.

3.3.3.3 LAPD dimensioning on the Abis interface

For LAPD dimensioning on the Abis interface refer to the corresponding BTS Reference Manual.

- BTS S4000s:
  - — BTS S4000 Indoor - NTP < 003 >
  - — BTS S4000 Outdoor - NTP < 023 >
- BTS S2000/S2000E - NTP < 053 >
- BTS S8000/S8002 - NTP < 063 >
- BTS S2000 H/L - NTP < 035 >
- BTS S12000 - NTP < 142 >
- BTS 18000 - NTP < 160 >

Starting with the V14 release, considering the actual proportion of AMR mobiles in the network, the classical dimensioning of one LAPD for 8 TRXs can be sufficient.

3.3.3.4 LAPD channel management on the Abis interface

A radio site uses one LAPD link with OML **sapi** for operations and maintenance.

A TRX/DRX uses two LAPD links, one with OML **sapi** for operations and maintenance, the other with RSL **sapi** for carrying data.

The LAPD channel TEI addresses on the Abis interface are allocated by users when the btsSiteManager or transceiverEquipment objects that use them are created.

If several radio site LAPD channels use the same BSC SICD 8V port or ***TMU port***, they also use the same PCM time slot. The following apply:

- If one of the channels supports the radio site BCF link, the TS equals the radio site scheduled time slot (**pcmTimeSlotNumber** attribute of the concerned btsSiteManager object). The OMC-R agent supplies the BSC with the information.
- If all the channels are allocated to the radio site TRX/DRXs, the BSC selects the TS from the usable radio site time slots (**radioSiteMask** attribute).

The same LAPD channel can be allocated on the Abis interface to support the links with a radio site BCF and eight TRX/DRXs. This corresponds to nine lapdLink object instances with OML **sapi** and eight lapdLink object instances with RSL **sapi**.

3.3.3.5 Effect of satellite links on Abis interface

The Satellite link on BSS Abis (E1) feature (26834), introduced in V15.1, allows the implementation of satellite links instead of terrestrial links on the Abis interface.

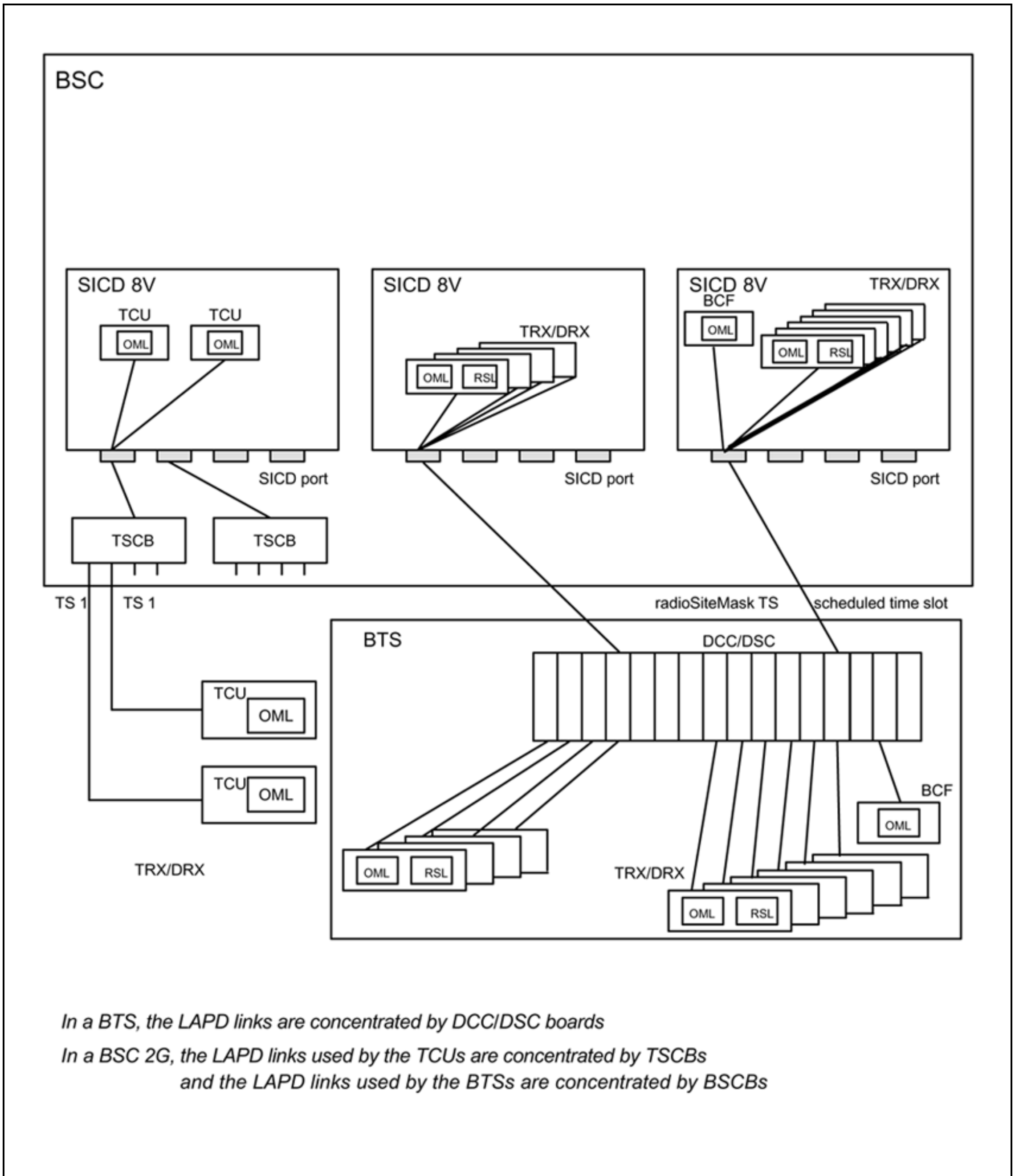
In some network areas, there is no terrestrial transmission infrastructure between the BSC and the BTS. The 26834 feature solves this problem by enabling a satellite link to be used instead. However, because of the extra time taken to go to/from the satellite, the propagation delay between BSC to BTS increases from a few milliseconds to more than 200 milliseconds. All Abis OAM procedures take longer. LAPD capacity is reduced (and LAPD parameters have to be tuned).

Feature 26834 is an optional feature.

3.3.3.6 LAPD channel management on the Ater interface

A remote transcoder uses one LAPD link with OML **sapi** for operations and maintenance.

Figure 58
LAPD link management in a BSS (with BSC 12000HC)



There is one LAPD link per defined TCU.

3.3.4 Concentric cells

3.3.4.1 Principles

A cell is defined as concentric if two pools of resources (TDMAs) are defined using RxLev and optionally Timing Advance as allocation criteria. One or two types of TRXs/DRXs can be used.

Thus a concentric cell describes a combination of two transmission zones, the outer (large) zone and the inner (small) zone.

The different types of concentric cells are the following:

- **dualzone**

  The two pools of TRXs/DRXs are configured to transmit at different powers. Thus transmission powers being different result in two different coverage areas.

  The *concentric cell* bts object attribute is set to "concentric". Refer to this entry in NTP < 124 >.

- **dualcoupling**

  The two pools of TRXs/DRXs are not combined with the same types of combiners. Thus coupling losses being different results in two different coverage areas.

  The *concentric cell* bts object attribute is set to "dualcoupling". Refer to this entry in NTP < 124 >.

  Only S8000 DRXs cells can be "dualcoupling".

- **dualband**

  One pool of GSM 900 TRXs/DRXs and one pool of GSM 1800 TRXs/DRXs are defined and share the same BCCH in the GSM 900 or GSM 1800 frequency band. Thus propagation losses being different results in two different coverage areas.

  The *concentric cell* bts object attribute is set to "dualband". Refer to this entry in NTP < 124 >.

  Only cells whose transceiver architecture is non mixed DCU4 or DRX can be "dualband".

3.3.4.2 Customer benefits

The customer benefits of the use of concentric cells are the following:

- **dualzone**

  For an equivalent coverage in terms of geographic area and number of used TDMA frames, it allows to minimize the number of useful frequencies.

  For the same band of useful frequencies it allows to increase the number of used TDMA frames, and therefore the number of network users.

- **dualcoupling**

  This configuration allows capacity increase (number of DRXs) while maintaining superior coverage without reducing cell coverage i.e. same EIRP (*Equivalent Isotropic Radiated Power*) for the BCCH frequency transmission.

- **dualband**

  Having GSM 900 and GSM 1800 TRXs/DRXs in the same cell provides a strong capacity. This capacity enhancement is efficient in terms of transmission costs and traffic management thanks to band prioritization mechanisms.

3.3.4.3 Radio resource configuration

The TDMA frames used by concentric cells are shared between the outer zone and the inner zone. The difference between the partnered TRX/DRXs in each zone is based on the maximum allowed transmission power

The hardware specifications of the TDMA frames may differ from one zone to another, but, in that case, the frames that belong to one zone cannot be reconfigured to be used in the other zone.

All common channels, such as the cell BCCH, are carried on TDMA frames that belong to the outer zone.

3.3.4.4 Radio resource management

In all the cases the BCCH frequency is carried on a TDMA frame that belongs to the outer zone.

From V12, the *Direct TCH allocation in the small zone feature* (TF889) enhances handover mechanisms. This enables to avoid a subsequent intra cell (from large to small zone) handover whilst allocating a TCH (call set up) or handing over directly into the inner zone of a concentric cell.

The direct handover towards the inner zone of a concentric cell is only allowed for intra-BSS handovers.

An intra-zone handover in a concentric cell is managed in the same way as an intra-bts handover in a non-concentric cell. It only calls on the radio resources in one zone, which means that the newly assigned radio resource always belongs to the same zone as the radio resource that is released.

3.3.4.5 Frequency management

The *Frequency reuse in both zones* feature (CM888) allows fractional reuse techniques which enable to define one set of frequencies (except the BCCH frequency) usable by all the DRXs in both zones of a concentric cell.

3.3.5 Software management

3.3.5.1 The software object

The software objects are associated with bsc, btsSiteManager, transceiverEquipment, and transcoderBoard objects.

Software object attributes are updated by download and change version actions. They identify the BSS entity software versions loaded on the BSC disk involved as follows:

- The **sWVersionBackUp** attribute identifies the backup software version. It is identical to **sWVersionRunning**.
- The **sWVersionFallback** attribute identifies the software version that was operational before the current version was activated and is reinstalled in response to a `Return to previous version` command
- The **sWVersionNew** attribute identifies the last software version downloaded to the BSC disk with a `Download` command or software version that was running but is no longer running after a `Return to previous version` command
- The **sWVersionRunning** attribute identifies the software version currently running in the BSS entity. This attribute is updated whenever the version is changed.

If one of these attributes is not defined (NULL value), it means that no software version is referenced by the attribute. If, for example, the **sWVersionNew** attribute value is "NULL", either no new version has been downloaded since the BSS entity was enabled or no fallback on the preceding version has been performed since the current version was activated.

The **sWVersionRunning** attribute of a software object is always defined.

3.3.5.2 BCF configuration file management

The **configRef** attribute of a btsSiteManager object identifies the DLU (Data Load Unit) variable configuration file which allows to configure the radio site BCF software with parameters such as coupling mode used, number of TX transmitters. This file is downloaded in the radio site BCF together with the software version.

3.4 Radio measurement processing

This paragraph describes processing of radio measurements performed by mobile stations or the BTS to manage handover requests, control transmission power, and monitor calls.

3.4.1 Principles

Calculations involve the measurements returned by mobile stations on the downlink and the BTS on the uplink.

The BTS processes the radio measurements and sends the results to the BSC.

The BTS draws up a list of eligible serving cells that qualify to handle the handover requests and sends the list to the BSC.

3.4.2 Configuration parameters

- averagingPeriod (handOverControl object)
- bsTxPowerMax (powerControl object)
- cellDeletionCount (bts object)
- distHreqt (handOverControl object)
- distWtsList (handOverControl object)
- missDistWt (handOverControl object)
- missRxLevWt (handOverControl object)
- missRxQualWt (handOverControl object)
- msTxPwrMax (bts object)
- msTxPwrMax2ndBand (bts object)
- msTxPowerMaxCell (adjacentCellHandOver object)
- new power control algorithm (bts object)
- powerBudgetInterCell (handOverControl object)
- powerControlIndicator (bts object)
- radChanSelIntThreshold (handOverControl object)
- runCallClear (bts object)
- runHandOver (bts object)
- runPwrControl (bts object)
- rxLevAccessMin (bts object)
- rxLevHreqave (handOverControl object)
- rxLevHreqaveBeg (handOverControl object)
- rxLevHreqt (handOverControl object)
- rxLevWtsList (handOverControl object)
- rxNCellHreqave (handOverControl object)

- rxLevNCellHreqaveBeg (handOverControl object)
- rxQualHreqave (handOverControl object)
- rxQualHreqt (handOverControl object)
- rxQualWtsList (handOverControl object)
- thresholdInterference (handOverControl object)

Radio measurement control and management parameters are defined at cell level. The decisions related to power control and handover requests may, therefore, vary from one BSS cell to another.

3.4.2.1 Control parameters

The **runXxx** parameters define the time between computing and decision making algorithm runs as a number of received "Measurement results" messages for each type of processing: handover (**runHandOver**), power control (**runPwrControl**), and call clearing (**runCallClear**).

The **cellDeletionCount** parameter defines the number of consecutive, missing neighbor cell measurements after which the neighbor cell is ignored and the previously stored measurements for that cell are deleted.

The measurements returned by mobile stations on the BCCH may, or may not, be counted in calculations (**powerControlIndicator**).

The **new power control algorithm** parameter specifies which power control algorithm is used by the BTS to control power in a given cell: step by step (standard algorithm) or one shot (advanced algorithm).

3.4.2.2 Management parameters

The **xxxHreqave** / **xxxHreqaveBeg** parameters define the number of raw measurements used to calculate mean values.

The **xxxHreqt** parameters define the number of mean values (or raw distance measurements) weighed by **xxxWtsList** factors used to calculate super-averages. The number of weights in each list equals the corresponding **xxxHreqt** parameter value and the sum of the weights equals 100.

The **missXxxWt** parameters define the weighting factors used to calculate the super-averages when measurements are missing.

The **averagingPeriod** parameter defines the number of samples used to calculate mean interference levels on idle channels. The **thresholdInterference** parameter is used to classify idle channels according to four interference levels.

3.4.3 Definitions

Parameters resulting from radio measurement processing that are used in the various processing algorithms detailed in the following paragraphs are listed below.

- MS_BS_DIST is the arithmetic mean MS-BTS distance calculated by the BTS which sets the timing advance used by the mobile station:
  - A distance below 35 km (normal mode) corresponds to a timing advance smaller than 63.
  - A distance over 35 km (extended mode) corresponds to a timing advance greater than 63.
- RXLEV_DL is the weighed mean signal strength level on the downlink for a serving cell, calculated by the BTS from mobile station measurements.
- RXLEV_UL is the weighed mean signal strength level on the uplink for a serving cell, calculated from the BTS self-measurements.
- RXLEV_NCELL(n) is the arithmetic mean signal strength level on the downlink for a neighbor cell n, calculated by the BTS from information collected by the mobile station.
- RXQUAL_DL is the weighed mean signal quality level on the downlink for a serving cell, calculated by the BTS from mobile station measurements.
- RXQUAL_UL is the weighed mean signal quality level on the uplink for a serving cell, calculated from the BTS self-measurements.
- PBGT(n) is the power budget criterion for a neighbor cell n when handovers with cause "power budget" are authorized in the associated serving cell.
- BSTxNewPower is the new BTS transmission power level in a cell, calculated by the BTS when the advanced power control algorithm is used.
- MSNewPower is the new transmission power level of a mobile station in a cell, calculated by the BTS when the advanced power control algorithm is used.
- MSPowerMax is a mobile station RFPC power that depends on its class.

3.4.4 Measurement processing

The decision making algorithm is described in Section 3.6 "Handover management" (page 372) to Section 3.8 "Call monitoring" (page 415).

3.4.4.1 Mean distance calculations

When **runCallClearing** or **runHandOver** "Measurement results" messages have been received, the L1M function in the BTS weighs **distHreqt** raw distance measurements with the weights defined in **distWtsList** and calculates distance super-averages as follows:

MS_BS_DIST = [Σ (measurement$_j$ $\times$ weight$_j$)] / 100, j = 1 to **distHreqt**

Each measurement is associated with one, and only one weight. The associations are established in sequence, in the order which the weights are listed. The last received measurement is always associated with the first weight in the list.

Any missing measurement is replaced by the last received raw measurement weighed by the **missDistWt** factor.

The BTS does not calculate mean distances. The raw measurements are used in the super-average calculation.

3.4.4.2 Mean signal strength calculations

Serving cells When **rxLevHreqave** / **rxLevHreqaveBeg** measurements have been received, the L1M function in the BTS calculates the mean signal strength level on the downlink and uplink from raw measurements, as follows:

downlink Mean = Σ (downlink measurement$_i$) / **rxLevHreqave (rxLevHreqaveBeg)**, i = 1 to **rxLevHreqave (rxLevHreqaveBeg)**
uplink Mean = Σ (uplink measurement $_i$) / **rxLevHreqave (rxLevHreqaveBeg)**, i = 1 to **rxLevHreqave (rxLevHreqaveBeg)**

When **runCallClearing, runHandOver**, or **runPwrControl** "Measurement results" messages have been received, the L1M function in the BTS weighs the calculated **rxLevHreqt** mean values with the weights defined in **rxLevWtsList** and calculates the signal strength super-averages as follows:

RXLEV_DL = [Σ (downlink Mean$_j$ $\times$ weight$_j$)] / 100, j = 1 to **rxLevHreqt**
RXLEV_UL = [Σ (uplink Mean$_j$ $\times$ weight$_j$)] / 100, j = 1 to **rxLevHreqt**

Each measurement is associated with one, and only one weight. The associations are established in sequence, in the order which the weights are listed. The last received measurement is always associated with the first weight in the list.

Any missing measurement is replaced by the last calculated mean value, or by the last received raw measurement if no mean value is available, weighed by the **missRxLevWt** factor.

Super-averaging is optimal when the time between two algorithm runs is a multiple of **rxLevHreqave** / **rxLevHreqaveBeg**

Serving microcells When **rxLevHreqave** / **rxLevHreqaveBeg** measurements have been received, the L1M function in the BTS also evaluates the difference between the last two calculated mean signal strength values on the downlink as follows:

E = downlink $Mean_j$ - downlink $Mean_{j-1}$

Neighbor cells When **rxNCellHreqave** / **rxLevNCellHreqaveBeg** measurements have been received, the L1M function in the BTS calculates the mean signal strength levels in neighbor cells on the downlink from raw measurements, as follows:

Mean(n) = $\sum$ ($measurement_i$(n)) / **rxNCellHreqave (rxLevNCellHreqaveBeg)**, i = 1 to **rxNCellHreqave (rxLevNCellHreqaveBeg)**

When **runHandOver** "Measurement results" messages have been received, the L1M function in the BTS calculates the neighbor cell signal strength super-averages, as follows:

RXLEV_NCELL(n) = $\sum$ ($Mean_j$(n)) / number of calculated mean(n)

The BTS does not calculate weighed super-average in neighbor cells.

When **runHandOver** "Measurement results" messages have been received, the L1M function in the BTS also evaluates the PBGT(n) parameters using the following formulas:

Classical case (monoband neighbor cell in the same band as the serving cell)

PBGT(n) = min(**msTxPwrMax**, MSPowerMax) - RXLEV_DL - (**bsTxPwrMax** - BSTxCurrentPower) - (min(**msTxPwrMaxCell**(n), MSPowerMax) - RXLEV_NCELL (n))

where:

- RXLEV_DL is the current, mean downlink signal strength level for the serving cell.
- RXLEV_NCELL(n) is the current, mean signal strength level in the neighbor cell.
- MSPowerMax is the mobile station RFPC power that depends on its class.

- BSTxCurrentPower is the current BTS transmission power in the neighbor cell, updated by the power control algorithm.

Handover towards band 1 of the selected neighbor dualband cell If the serving cell TDMA band is in band0

PBGT(n) = min(**msTxPwrMax**, MSPowerMax) - RXLEV_DL - (**bsTxPwrMax** - BSTxCurrentPower) - (min(**msTxPwrMaxCell**(n), MSPowerMax) - RXLEV_NCELL (n))

where:

- RXLEV_DL is the current, mean downlink signal strength level for the serving cell in band0.
- RXLEV_NCELL(n) is the current, mean signal strength level in the neighbor cell.
- MSPowerMax is the mobile station RFPC power that depends on its class.
- BSTxCurrentPower is the current BTS transmission power in the neighbor cell, updated by the power control algorithm.

If the serving cell TDMA band is in band1

PBGT(n) = min(**msTxPwrMax**, MSPowerMax) - (RXLEV_DL(band1) + biZonePower Offset) - (**bsTxPwrMax** - BSTxCurrentPower) - (min(**msTxPwrMaxCell**(n), MSPowerMax) - RXLEV_NCELL (n))

where:

- RXLEV_DL(band1) is the current, mean downlink signal strength level for the serving cell in band1.
- RXLEV_NCELL(n) is the current, mean signal strength level in the neighbor cell.
- MSPowerMax is the mobile station RFPC power that depends on its class.
- BSTxCurrentPower is the current BTS transmission power in the neighbor cell, updated by the power control algorithm.
- biZonePowerOffset is a corrective factor that applies to the dualband neighbor cell cases. It enables to take into account the difference of the propagation model between the two frequency bands of the network.

Direct allocation in the inner zone of the selected neighbor dualband cell If the serving cell TDMA is in the outerzone

PBGT(n) = min(**msTxPwrMax**, MSPowerMax) - RXLEV_DL -
(**bsTxPwrMax** - BSTxCurrentPower) -
(min(**msTxPwrMaxCell**(n), MSPowerMax) - RXLEV_NCELL (n))

where:

- RXLEV_DL is the current, mean downlink signal strength level for the serving cell in the outer zone.
- RXLEV_NCELL(n) is the current, mean signal strength level in the neighbor cell.
- MSPowerMax is the mobile station RFPC power that depends on its class.
- BSTxCurrentPower is the current BTS transmission power in the neighbor cell, updated by the power control algorithm.

If the serving cell TDMA band is in inner zone

PBGT(n) = min(**msTxPwrMax**, MSPowerMax) -
(RXLEV_DL + biZonePower Offset) -
(**bsTxPwrMax** - BSTxCurrentPower) -
(min(**msTxPwrMaxCell**(n), MSPowerMax) - RXLEV_NCELL (n))

where:

- RXLEV_DL is the current, mean downlink signal strength level for the serving cell in the inner zone.
- RXLEV_NCELL(n) is the current, mean signal strength level in the neighbor cell.
- MSPowerMax is the mobile station RFPC power that depends on its class.
- BSTxCurrentPower is the current BTS transmission power in the neighbor cell, updated by the power control algorithm.
- biZonePowerOffset is a corrective factor that applies to the dualband neighbor cell cases. It enables to take into account the difference of the propagation model between the two frequency bands of the network.

Neighbor microcells When **rxNCellHreqave** / **rxLevNCellHreqaveBeg** measurements have been received, the L1M function in the BTS also evaluates the difference between the last two calculated mean signal strength values on the downlink for the neighbor microcell with the best signal strength, as follows:

E(m) = downlink Meanj(m) - downlink Meanj-1(m)

Measurement equalizing for power control Mobile station and BTS transmission power levels in a cell may vary from one measurement sample to another if the power control algorithm is run and power levels are modified. These variations must, therefore, be taken into account to calculate the mean signal strength in the cell.

Signal strength measurements on the downlink and uplink are adjusted as follows:

- Each raw downlink measurement is equalized by a coefficient of (MSCurrentPower - MSOldPower) and each raw uplink measurement is equalized by a coefficient of (BSTxCurrentPower - BSTxOldPower).

  MSCurrentPower and BSTxCurrentPower are the current transmission power levels of the mobile station and the BTS in the cell.

  MSOldPower and BSTxOldPower are the transmission power levels previously used by the mobile station and the BTS in the cell.

  Therefore, the equalizing coefficient may be null, positive or negative.

- Each calculated mean downlink value is equalized by a coefficient of (MSCurrentPower - MSOldMeanPower) and each calculated mean uplink value is equalized by a coefficient of (BSTxCurrentPower - BSTxOldMeanPower).

  MSCurrentPower and BSTxCurrentPower are the current transmission power levels of the mobile station and BTS in the cell.

  MSOldMeanPower and BSTxOldMeanPower are the mean transmission power levels used by the mobile station and the BTS when the previous super-average was calculated.

  Therefore, the equalizing coefficient may be null, positive or negative.

List of eligible cells When the BTS detects that a handover is needed, it draws up a list of eligible serving cells that verify the formulae

RXLEV_DL > **rxLevMinCell** + Mx (+ **biZonePowerOffset**)

where Mx is calculated as follows:

Mx = max (0, **msTxPwrMax** - MSPowerMax)

biZonePowerOffset is a corrective factor that applies to the dualband neighbor cell cases. It enables to take into account the difference of the propagation model between the two frequency bands of the network.

3.4.4.3 Mean quality calculations

When rxQualHreqave measurements have been received, the L1M function in the BTS calculates the mean quality level on the downlink and uplink from raw measurements, as follows:

downlink Mean = $\sum$ (downlink measurement$_i$) / **rxQualHreqave**, i = 1 to **rxQualHreqave**

uplink Mean = $\sum$ (uplink measurement$_i$) / **rxQualHreqave**, i = 1 to **rxQualHreqave**

When **runCallClearing, runHandOver**, or **runPwrControl** "Measurement results" messages have been received, the L1M function in the BTS weighs the calculated **rxQualHreqt** mean values with the weights defined in **rxQualWtsList** and calculates quality super-averages as follows:

RXQUAL_DL = [$\sum$ (downlink Mean$_j$ × weight$_j$)] / 100, j = 1 to **rxQualHreqt**
RXQUAL_UL = [$\sum$ (uplink Mean$_j$ × weight$_j$)] / 100, j = 1 to **rxQualHreqt**

Each measurement is associated with one, and only one weight. The associations are established in sequence, in the order which the weights are listed. The last received measurement is always associated with the first weight in the list.

Any missing measurement is replaced by the last calculated mean value, or by the last received raw measurement, weighed by the **missRxQualWt** factor.

Super-averaging is optimal when the time between two algorithm runs is a multiple of **rxQualHreqave**.

3.4.4.4 Interference level calculations

The L1M function in the BTS permanently measures the signal strength on cell idle TCHs and SDCCHs.

When **averagingPeriod** "Measurement results" messages have been received, the BTS calculates mean interference levels on each idle channel, classifies the channels according to the threshold values defined by **thresholdInterference** and sends the information to the BSC.

Five interference levels, numbered from 0 to 4, are defined, which depend on the four thresholds set by the user, as follows (Level 0 is the lowest interference level):

Figure 59
Interference level calculations

- Level 0: RXLEV < threshold 1
- Level 1: threshold 1 ≤ RXLEV < threshold 2
- Level 2: threshold 2 ≤ RXLEV < threshold 3
- Level 3: threshold 3 ≤ RXLEV < threshold 4
- Level 4: threshold 4 ≤ RXLEV

The BSC uses the **radChanSelIntThreshold** parameter to classify the idle channels as follows:

- The first group contains the channels for which the interference level average calculated by the BTS is less than or equal to the defined threshold.
- The second group contains the channels for which the interference level average calculated by the BTS exceeds the defined threshold, and also contains recently released channels for which no measurements are yet available.

The following pools of resources are defined for each type of SDCCH and TCH:

- low interference radio channels with frequency hopping
- low interference radio channels without frequency hopping
- high interference radio channels with frequency hopping
- high interference radio channels without frequency hopping

The channels in each pool are allocated in cyclic order.

A dedicated channel is said to be idle when it has remained inactive between the last two "Measurement results" messages received by the BTS right before **averagingPeriod** time-out elapse.

3.4.5 New power control algorithms

The advanced power control algorithms in a cell (**new power control algorithm** = "**one shot**" (from V9) or "**enhanced one shot**" (V12)) allow to directly calculate new BTS and mobile station transmission power levels in a cell.

3.4.5.1 Downlink power calculation

When **runPwrControl** "Measurement results" messages have been received, the L1M function in the BTS calculates the new BTS transmission power level in the cell as follows:

BSTxNewPower = **bsTxPwrMax** - K x P
where P = (RXLEV_DL + **bsTxPwrMax** - BSTxCurrentPower - **lRxLevDLP**)

and checks the following:

If RXQUAL_DL > **lRxQualDLP**, then BSTxNewPower = **bsTxPwrMax**

BSTxNewPower is the new BTS transmission power level in the cell. K is a preset BTS parameter that depends on the RXQUAL_DL quality level calculated at this instant and whether the cell uses frequency hopping. BSTxCurrentPower is the current BTS transmission power level in the cell.

3.4.5.2 Uplink power calculation

When **runPwrControl** "Measurement results" messages have been received, the L1M function in the BTS calculates the new MS transmission power level in the cell as follows:

MSNewPower = **msTxPwrMaxCCH** - K x P
with P = (RXLEV_UL + **msTxPwrMaxCCH** - MSCurrentPower - **lRxLevULP**)

and checks the following:

If RXQUAL_UL > **lRxQualULP**, then MSNewPower = **msTxPwrMaxCCH**

MSNewPower is the new transmission power of a mobile station in the cell.

MSCurrentPower is the current transmission power level of the mobile station in the cell.

Case of one shot algorithm K is a preset BTS parameter that depends on the RXQUAL_DL quality level calculated at this instant and whether the cell uses frequency hopping.

Case of enhanced one shot algorithm K is no longer depending on the RX_QUAL_DL quality level but only on the frequency hopping activation. The recommended values for K are the following:

- if frequency hopping: 0.7
- if no frequency hopping:... 0.5

3.4.5.3 Notes

When used, the **uRxLevDLP, uRxLevULP, uRxQualDLP, uRxQualULP, powerIncrStepSize**, and **powerDecStepSize** parameters are ignored.

3.4.5.4 Comparison between the enhanced one shot and the one shot algorithm

The "enhanced one shot" algorithm brings an improvement of the one shot power control on SDCCH allocation (enhanced power control on SDCCH) and on TCH allocation (enhanced power control on TCH for first allocation or on TCH after an handover).

To reduce the "one shot" power control duration, the activation is done with the first **rxLevHrequaveBeg** measurements, i.e. before the Max(**rxLevHreqave*rxLevHreqt, rxQualHreqave*rxQualHreqt**) is reached.

With the following recommended values:

- **rxLevHreqave** = **rxQualHreqave** = 8
- **rxLevHreqaveBeg** = 2
- **rxLevHreqt** = **rxQualHreqt** = 1

the first power control decision for the "enhanced one shot" algorithm occurs after 2 measurements instead of 8, thus the time at Pmax is decreased by 6 measurements (i.e. 3 seconds).

3.5 Radio cell selection and reselection

This paragraph is an insight into the actions performed by non-communicating mobile stations to camp on a network cell and describes the different processes that are used.

3.5.1 Principles

A mobile uses a camp cell to send requests for GSM services to which it is entitled and to do the following:

- receive system information on BCCH
- receive paging messages for incoming calls
- send outgoing call requests

Since the mobile obviously moves around the network, it permanently searches for the best camp cell.

3.5.2 Configuration parameters

- cellBarQualify (bts object) (Phase II mobiles)
- cellBarred (bts object) (Phase I and Phase II mobiles)
- cellReselectHysteresis (bts object)
- cellReselectOffset (bts object)
- cellReselInd (bts object)

- emergencyCall (bts object)
- maxNumberRetransmission (bts object)
- msTxPwrMaxCCH (bts object)
- noOfMultiFramesBetweenPaging (bts object)
- notAllowedAccessClasses (bts object)
- penaltyTime (bts object)
- rxLevAccessMin (bts object)
- temporaryOffset (bts object)
- nACCActivation (bts object)
- packetSiStatus (bts object)

The permission for non-communicating mobiles to select or reselect cells is managed at cell level.

The reselection process may vary from one BSS cell to another.

3.5.2.1 Control parameters

The **cellBarred** parameter grants or denies direct mobile access to a cell.

The **cellBarQualify** parameter defines the priority of cell selection by the mobile.

The **cellReselInd** parameter allows or disallows the use of cell reselection criterion (C2) by the mobile.

The **emergencyCall** and **notAllowedAccessClasses** parameters define the cell services that the mobile is allowed to access.

3.5.2.2 Management parameters

The **rxLevAccessMin** and **msTxPwrMaxCCH** parameters define the MS minimum reception and maximum transmission levels required to access a cell.

The **maxNumberRetransmission** and **noOfMultiFramesBetweenPaging** parameters are used in the reselection decision making process.

The **cellReselectHysteresis** parameter is used in reselection algorithms.

The **cellReselectOffset, penaltyTime**, and **temporaryOffset** parameters are used in the reselection algorithm C2.

3.5.3 Selection management

3.5.3.1 Cell selection priority

Cells are selected according to their priority rating.

cellBarQualify	cellBarred	CELL SELECTION PRIORITY	STATUS FOR CELL RESELECTION
False	Not barred	Normal	Normal
False	Barred	Selection is forbidden	Reselection is forbidden
True	Not barred	Low	Normal (see note below)
True	Barred	Low	Normal (see note below)

A low priority cell is only selected if no normal priority cell satisfies the selection criterion.

This allows an operator to declare a cell always as a low priority one for a phase 2 MS, but keeps the opportunity for an operator to decide whether a phase 1 MS is permitted to camp on such a cell or not.

3.5.3.2 Selection algorithm

When a mobile is switched on, it tries to contact a PLMN. After establishing contact, it searches for network cells on which it can camp.

The selection criterion (C1) verifies the following statements:

- If direct cell access is barred (**cellBarred**), the status for cell selection is normal (**cellBarQualify**).
- The cell belongs to the contacted PLMN.
- The cell is in an authorized location area.
- C1 = A - max(0,B) is greater than 0.

  A and B are evaluated as follows:

  A = RXLEV_DL - **rxLevAccessMin**

  B = **msTxPwrMaxCCH** - P

  P = Maximum RF output power of the MS

  RXLEV_DL is the mean downlink power level received by the mobile.

The mobile station selects the highest priority cell with the best mean downlink signal strength level from the list of cells satisfying the selection criterion, then registers in the location area of that cell.

The selected cell is then the mobile station's camp cell.

3.5.3.3 Note

For mobiles that can work in various frequency bands (they are called multiband mobiles), the operator can favor the selection of a cell that belongs to a frequency band other than the standard GSM band by setting the **cellBarQualify** parameter of the cells in the GSM band to "true".

In that case, the only way to bar access to a cell in the GSM band is to modify both the **cellBarQualify** and the **cellBarred** parameters.

3.5.4 Reselection management

A mobile may have to reselect a camp cell for a number of reasons:

- The mobile periodically searches for a better camp cell in the same PLMN and draws up the list of the best qualified cells to receive its calls.
- Direct access to the camp cell changes to barred or its selection priority changes from low to normal.
- The paging channel monitoring process for the current camp cell detects abnormal downlink interference.

3.5.4.1 Reselection algorithm C1

The reselection algorithm C1 ensures that the mobile is camping on the cell offering the best communication capabilities without interference. It is used by Phase I and Phase II mobiles.

The reselection criterion (C1) verifies the following statements:

- If direct cell access is barred (**cellBarred**), the status for cell selection is normal (**cellBarQualify**).
- The cell belongs to the same PLMN as the current camp cell.
- The cell is in an authorized location area.
- C1 = A - max(0,B) is greater than 0. The meaning of A and B is the same as in the selection algorithm.

The mobile only qualifies the cells from those satisfying the reselection criterion where the value of C1 is greater than C1 in the current camp cell.

3.5.4.2 Reselection algorithm C2

The reselection algorithm C2 ensures that the mobile is camping on the cell offering the best communication capabilities on both the downlink and the uplink. It is only used by Phase II mobiles.

The reselection criterion (C2) verifies the following statements:

- If direct cell access is barred (**cellBarred**), the status for cell selection is normal (**cellBarQualify**).

- The use of the reselection criterion (C2) is allowed for the cell (**cellReselInd**).
- The cell belongs to the same PLMN as the current camp cell.
- The cell is in an authorized location area.
- C2 is greater than zero.

  If **penaltyTime** = 640, then C2 = (C1 - Cr); otherwise, C2 = (C1 + Cr)

  C1 = A - max(0,B), as before.

  Cr = **cellReselectOffset** - (**temporaryOffset** × H(**penaltyTime** - T))

  — T is a timer that is started when the mobile includes the cell in the list of best qualified cells to receive calls and is stopped when the cell is removed from the list.

  — H(**penaltyTime** - T) equals 0 if **penaltyTime** < T and equals 1 if **penaltyTime** ≥ T.

  Therefore, at a given time, Cr may be null, positive or negative.

The mobile only qualifies the cells from those satisfying the reselection criterion where the value of C2 is greater than the value of C1 in the current camp cell.

3.5.4.3 Decision making

Qualified cells are listed in the descending order of their reselection parameter value (C1 or C2).

The decision making algorithm is as follows:

- If the first cell in the list is in the same location area as the current camp cell, this cell is selected and becomes the new camp cell for the mobile.
- If the first cell in the list is in a different location area than the current camp cell, the following apply:

  — If its reselection parameter value is greater than the selection parameter value C1 of the current camp cell by at least **cellReslectHysteresis** dB, this cell is selected and becomes the new camp cell for the mobile.

  — If the previous criterion is not verified, the mobile searches in the list for a qualified cell in the same location area and selects that cell as its new camp cell.

- If no cell in the list qualifies, the mobile starts the reselection process again with new radio measurements.

The **cellReslectHysteresis** factor is used to prevent the mobile from switching back and forth from one location area to another.

3.5.4.4 Notes

- If a mobile cannot find a new camp cell or receives an "Illegal MS" response to a location update request from the camp cell, it tries to camp on a cell regardless of the contacted PLMN identifier but its service state is restricted to emergency calls.
- Mobiles can still access a cell where direct access is barred provided incoming handovers are allowed in that cell (**incomingHandOver** attribute).
- For mobiles that can work in various frequency bands (they are called multiband mobiles), the operator can favor the reselection of a cell that belongs to another frequency band by giving different values to the **cellReselectOffset** parameters in the cells of each frequency band.
- When a mobile starts communicating, the serving cell that will be used during the call is selected by the BSC according to the results of the radio measurement processing performed by the BTS.

3.5.5 Network assisted cell change for release 4 MS

Network Assisted Cell Change (NACC) for release 4 MS enables the network to assist the MS for cell reselection during on-going TBF.

By reducing the duration of cell reselection, NACC improves the end-user throughput when the MS is moving from one cell to another.

The feature can be activated on a per cell basis. The feature is limited to intra-BSC cell re-selection. It does not impact the core network.

The feature does not affect the behavior of pre-release 4 MSs. A pre-release 4 MS will not benefit from the NACC feature, and its reselection time will not be modified by NACC activation.

The NACC feature is divided into 2 sub-features:

1. The indication of the reselection and the first SI download in the initial cell (CCN).
2. The acquisition of the missing SI in the target cell (SI Status).

These sub-features are enabled/disabled by the bts parameters nACCActivation and packetSiStatus, respectively. The sub-features can be activated independently, but both contribute to the reduction of the cell reselection duration.

3.6 Handover management

3.6.1 Principles

3.6.1.1 Definition of a handover

A handover designs the process of call sustaining while the mobile station is moving from one serving cell to another one.

The main purpose of handovers is to avoid losing a call in progress.

Handover management is based on:

- the results of downlink measurements performed by mobile stations
- uplink measurements performed by the BTS
- the currently user defined values of super-average computing and decision making parameters in the OMC-R (see Section 3.6.2 "Configuration parameters" (page 377))

A handover is carried out in four steps:

1) **Triggering**: the BTS detects that a handover is needed (comparison with thresholds)

2) **Screening**: in the BTS, the L1M (layer one management software) determines what are the three best suitable target cells for the handover (from the preferred cells list), and sends them to the BSC in the HANDOVER INDICATION message.

3) **Selecting**: in the BSC, the TMG (traffic management software) determines the target cell according to the resource found.

4) **Executing**: Assignment of the new channel by the TMG, allocation and activation, then switching onto this channel.

Handovers involving concentric cells (see Section 3.6.4 "Concentric cells" (page 389)), neighbor cells (see Section 3.6.5 "Neighbor cells" (page 392)), and microcells (see Section 3.6.6 "Microcells" (page 398)) are described too.

In V14 release a new handover is introduced. This handover is a classic handover complement which is called Handover adaptation.

3.6.1.2 handover adaptation

This feature (TD1216: *automatic handover adaptation*) adapts handover parameters to the radio environment of each call, taking into account both mobile speed and frequency hopping.

The handover adaptation minimizes to call drop and bad quality transmission.

The handover adaptation provides a better network quality:

- In a rural environment by:
  - reducing the time to decide to perform a PBGT handover, thus avoiding some handovers on alarm criteria.

- In an urban environment by:
  - reducing the time to decide to perform a PBGT handover, and consequently the network interference level
  - reducing interference level due to better power control
  - reducing the time to decide to increase the power level of a mobile with interference.

The principle of this feature is to use these averages introduced by the frequency hopping and the MS speed, in order to decrease the number of measurements taken into account or handover margin.

Frequency hopping decision In order to have a sufficient averaging of the Rayleigh fading, the number of frequencies in the hopping law has to be greater than or equal to 8.

If the number of frequencies in the hopping law is less than 8, the mobiles are considered as non-hopping, and all defined processes for non hopping mobiles are applied.

This decision and all associated mechanisms are applied to the following channels:

- TCH Full Rate whatever the channel coding (data circuit, EFR, FR, AMR...)
- TCH Half Rate
- SDCCH.

Mobile Station (MS) speed evaluator decision The standard deviation of Rxlev during one period of measurement (104 bursts, thus 480ms) is less than 1.4 dB.

The standard deviation represents approximately:

- 20 km/h in GSM900
- 10km/h in GSM 1800/GSM1900

This standard is sufficient to have a good average of Rayleigh fading.

Half Rate and SDCCH channels For half rate channels, the number of burst during the period (one time slot) is sufficient to evaluate accurately the standard deviation criteria. Then, all treatments associated to this criteria are relevant for the kind of channel.

Uplink DTX In the case of Uplink DTX, which is activated during the period (one time slot), the number of bursts received in decreased, thus the accuracy of calculated standard deviation is also decreased. In this case the standard deviation is not evaluated and the last calculated standard deviation is taken.

Uplink power control In the case of Uplink power control, the BTS is not able to distinguish between a variation due to Rayleigh fading and one due to power control attenuation. Thus if the power control required a variation of more than 8 dB during the period, then the standard deviation is not evaluated and the last calculated standard deviation is taken.

3.6.1.3 The different types of handover

There are several causes of call loss, which implies different types of handovers to avoid them:

Table 11
Handover causes and types

Handover cause:	Handover type:
The mobile station leaves the radio coverage area of the serving cell.	**Rescue handover** An extreme form of rescue handover is the call re-establishment performed after an effective loss of communication with the serving cell.
It is useful to change the serving cell of a given mobile station preventively, even in the transmission quality is still adequate, in order to optimize the interference level.	**Preventive handover** This type of handover aims at avoiding rescue handovers. *Prerequisites*: a cell with correct transmission quality must be available.
A cell is very busy with a high traffic load.	**Confinement handover**

3.6.1.4 The different cases of handover

The different types of handover can also be defined with regard to cells. All in all there are five different cases in the handover execution procedure (see Figure 59 "Interference level calculations" (page 365)):

- intra-cell handover (see Section 3.6.3.1 "Intra-bts handovers" (page 384)): case 1
- inter-cell handover (see Section 3.6.3.2 "Inter-bts handovers" (page 386)). Inter-cell handover itself can be further divided into four cases:

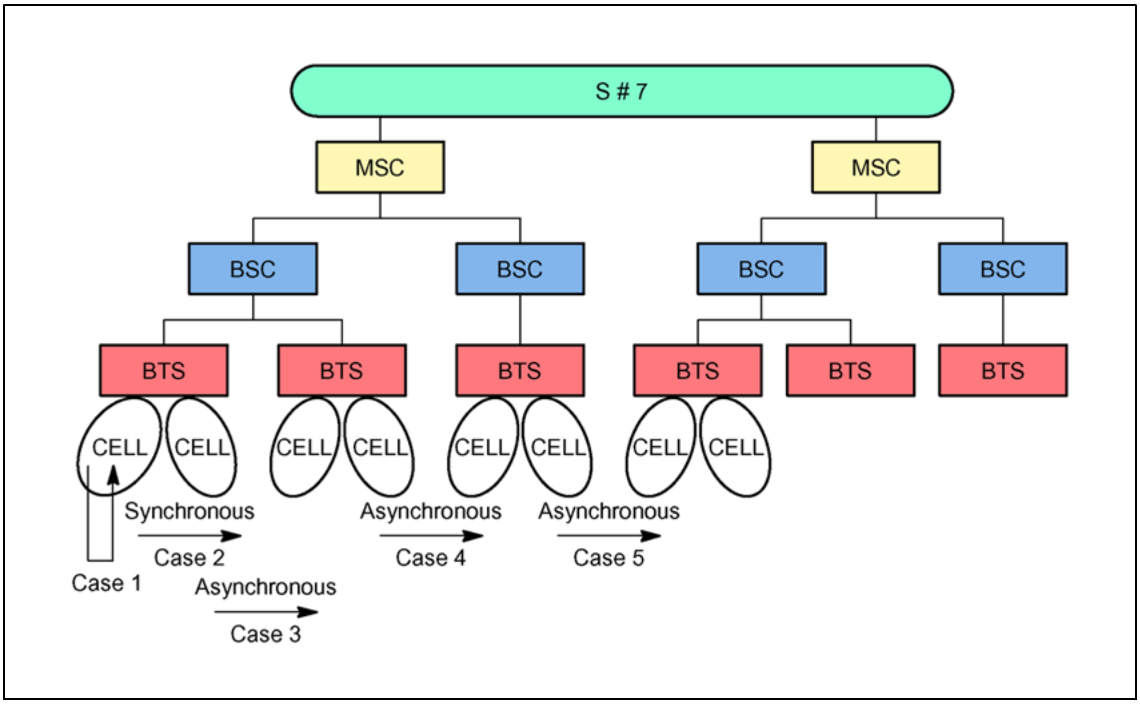
— inter-cell intra-BTS: case 2

— inter-cell intra-BSC: case 3

— inter-cell intra-MSC: case 4

— inter-cell inter-MSC: case 5

Figure 60
Handover cases



3.6.1.5 Handover priority

If a number of handover conditions are satisfied at the same time, the highest priority cause is used to determine a single request to execute. The descending order of priority is as follows:

- DIRECTED RETRY (see Section 3.6.2.2 "Management parameters" (page 379))
- CAPTURE
- RXQUAL: uplink signal quality then downlink signal quality
- RXLEV: uplink signal strength then downlink signal strength
- DISTANCE
- PBGT (power budget)
- TRAFFIC
- INTRACELL: uplink intra-bts handover then downlink intra-bts handover (see Section 3.6.3.1 "Intra-bts handovers" (page 384))

- INTERBAND handover for dualband cell, INTERZONE for concentric cell and dualcoupling cell
- FREQUENCY TIERING (see page 2-52)

In V14 feature, this functionality in not modified for mobiles, but for AMR mobiles, it becomes the following order:

- AMR quality: uplink then downlink
- DISTANCE
- PBGT (power budget)
- TRAFFIC
- INTER-MODE (HR -> FR)
- INTRACELL: uplink intra-bts handover then downlink intra-bts handover (see Section 3.6.3.1 "Intra-bts handovers" (page 384))
- INTERBAND handover for dualband cell, INTERZONE for concentric cell and dualcoupling cell
- FREQUENCY TIERING (see page 3-61)

3.6.2 Configuration parameters

- adjacent cell umbrella Ref (bts object)
- biZonePowerOffset (handOverControl object)
- bssMapTchoke (bsc object)
- bts time between HO configuration (bts object)
- btsReserved3 (bts object)
- concentAlgoExtMsRange (handOverControl object) (concentric cell)
- concentAlgoExtRxLev (handOverControl object) (concentric cell)
- concentAlgoIntMsRange (handOverControl object) (concentric cell)
- concentAlgoIntRxLev (handOverControl object) (concentric cell)
- directedRetry (adjacentCellHandOver object)
- directedRetryModeUsed (bts object)
- forced handover algo (adjacentCellHandOver object)
- HandOver from signalling channel (bts object)
- hoMargin (adjacentCellHandOver object)
- hoMarginBeg (bts)
- hoMarginDist (adjacentCellHandOver object)

- hoMarginRxLev (adjacentCellHandOver object)
- hoMarginRxQual (adjacentCellHandOver object)
- hoMarginTiering (handOverControl object)
- HOSecondBestCellConfiguration (bsc object)
- incomingHandOver (handOverControl object)
- interBscDirectedRetry (bsc object) interBscDirectedRetryFromCell (bts object)
- interferenceType (adjacentCellHandOver object)
- intraBscDirectedRetry (bsc object)
- intraBscDirectedRetryFromCell (bts object)
- intraCell (handOverControl object)
- intraCellSDCCH (handOverControl object)
- lRxLevDLH (handOverControl object)
- lRxLevULH (handOverControl object)
- lRxQualDLH (handOverControl object)
- lRxQualULH (handOverControl object)
- measurementProcAlgorithm (bts object)
- microCellCaptureTimer (adjacentCellHandOver object - A algorithm)
- microCellInstabilityTimer (bts object - B algorithm)
- microCellStability (adjacentCellHandOver object - A algorithm)
- microCellStability (bts object - B algorithm)
- msBtsDistanceInterCell (handOverControl object)
- msRangeMax (handOverControl object)
- msTxPwrMaxCell (adjacentCellHandOver object) numberOfPwciSamples (handOverControl object)
- plmnPermitted (bts object)
- powerBudgetInterCell (handOverControl object)
- pwciHreqave (handOverControl object)
- radChanSelIntThreshold (handOverControl object)
- runHandOver (bts object)
- rxLevDLPBGT (adjacentCellHandOver)
- rxLevDLIH (handOverControl object)

- rxLevMinCell (adjacentCellHandOver object)
- rxLevULIH (handOverControl object)
- rxQualDLIH (handOverControl object)
- rxQualULIH (handOverControl object)
- selfTuningObs (handOverControl object)
- thresholdInterference (handOverControl object)
- timeBetweenHOConfiguration (bsc object)

For more information on these parameters, refer to (NTP < 124 >).

3.6.2.1 Control parameters

Various types of handovers can be authorized or forbidden in a serving cell, such as:

- incoming handovers (**incomingHandOver**)
- intra-bts handovers on TCH (**intraCell**) or on SDCCH (**intraCellSDCCH**)
- inter-bts handovers for distance reasons (**msBtsDistanceInterCell**) or power budget reasons (**powerBudgetInterCell**)
- handovers in signalling mode (**HandOver from signalling channel**)

Super-averaging results verify whether or not the conditions for intra-bts handover or inter-bts handover to a neighbor cell are satisfied.

3.6.2.2 Management parameters

The following thresholds are defined independently on the downlink and the uplink:

- signal strength level thresholds (**lRxLevDLH** and **lRxLevULH**)
- quality level thresholds (**lRxQualDLH, lRxQualULH, rxQualDLIH**, and **rxQualULIH**)
- interference thresholds (**rxLevDLIH** and **rxLevULIH**)

The **HOSecondBestCellConfiguration** parameter allows the BSC to attempt immediate handover to another cell if the first attempt fails with MS going back to the old channel.

The V10+ **rxLevDLPBGT** parameter enables to prevent handovers (in issue such as street corner) for power budget reason. If the downlink signal strength in serving cell exceeds this threshold, handover is not allowed. This value is set such as serving cell received level (above this threshold) in the serving cell is good enough and a handover for power budget reason would not improve the situation.

Intra- and inter-bss handovers The **plmnPermitted** parameter defines the PLMNs where the mobile stations camped in a cell are permitted to perform measurements for handover purposes.

Directed retry handovers When the MSC executes an assign procedure, the BSC may be allowed to direct neighbor cell selection if the serving cell has no available TCH resources.

The **xxxDirectedRetry** parameters define the conditions in which directed retry handovers are legitimate. The directed retry algorithm is not started for a serving cell unless directed retry handovers are allowed both in the BSC and the cell.

The **directedRetryModeUsed** parameter defines whether directed retry handover processing is controlled by the BSC or the BTS. BSC processing is allowed only for serving microcells and, in that case, the BSC directly selects the neighbor umbrella cell chosen by the user (**adjacent cell umbrella Ref**).

The Queueing feature must be activated.

Forced handovers A forced handover is a user action aimed at forcing the BSC to redirect all ongoing calls in a serving cell to its neighbor cells.

The **forced handover algo** parameter defines access conditions to a neighbor cell for processing these handovers.

Frequency tiering

Definition The frequency tiering technique aims at allocating resources during a handover, by taking into account the criterion representing the potential interference that could be experienced by the call (Feature TF995 - *Automatic Cell Tiering*).

Thus it aims at decreasing the global interference level in a fractional reuse pattern network. (Fractional reuse is an optimized frequency hopping feature, in which TCH TRX/DRXs hop on a large set of frequencies. Each BTS is allocated a number of frequencies which is superior to the number of TRX/DRXs. Thus each TRX/DRX hops on a large set of frequencies, lowering the probability of collisions between inter-site timeslots).

The frequency tiering technique allocates the worst communications (in terms of downlink CIR (Carrier on Interference Ratio)) to the BCCH frequencies, taking advantage of their larger reuse pattern and consequently of their better resistance to interference.

The frequency tiering technique uses the BTS self-tuning functionality. This functionality enables the BTS to determine the most appropriate threshold values for the tiering handover algorithm, since they are dynamically adapted to O&M events and to radio environment modifications. The BTS self-tuning functionality uses the radio-electrical profile of the cell, established by gathering and processing radio link measurements at cell level. The cell profile enables to obtain PwCIDLH and uPwCIDLH tiering threshold values:

- The lPwCIDLH tiering threshold is the threshold to handover from the small (TCH) pattern to the large (BCCH) pattern.
- The uPwCIDLH tiering threshold is the threshold to handover from the large (BCCH) pattern to the small (TCH) pattern.

The relation is: uPwCIDLH = lPwCIDLH + hoMarginTiering

The **hoMarginTiering** parameter is the hysteresis between the uPwCIDLH and lPwCIDLH tiering thresholds, to avoid ping-pong handovers.

Prerequisites

- The whole network must have been upgraded to v12.4 system release.
- The frequency tiering technique is available on the following BSS sub-systems:
  - — S8000 BTS
  - — S2000 H/L BTS
  - — e-cell BTS
- BTSs must use the V2 release of the L1M software.

  The **measurementProcAlgorithm** parameter defines the L1M software version used by each BTS, and it must be set to "L1MV2".

Restrictions Frequency tiering handovers are not applicable to GPRS since GPRS channels are not TCH resources but pDTCH resources.

Activation of the frequency tiering feature Intracell handovers that are performed for signal quality/strength and those performed for tiering reasons are mutually exclusive. To activate the tiering handover decision function at the BTS level, the **intracell** parameter must be set to "cellTieringHandOver".

PwCI computation The tiering decision relies on a CIR estimate which uses signal strength measurements (Rx_LEV_DL and Rx_LEV_NCell(n)) performed by the mobile station on the BCCH of neighbor cells. This estimate gives a Potential Worst case value of the real CIR (PwCI), in the following cases:

- when all interferers transmit at maximum transmission power
- when the interference is either a co-channel interference or an interference between first adjacent cells. The **interferenceType**

parameter is defined for the adjacentCellHandOver object and it indicates the type of interference created by neighbor cell.

- when the network is fully loaded (all neighbor cells using the same TCH frequency set create co-channel interferences)

The practical range of values of PwCI is [-40dB ; +50dB], and its computation is valid for reuse patterns from 1x1 to 1x3 only.

The **selfTuningObs** parameter indicates whether or not the PwCI distribution is sent to the Abis interface periodically by the BTS, in a specific event report message, in order to limit the load on the BSC-OMC-R interface.

The PwCI distribution is sent when one of the following events occurs:

- reliable statistics have been obtained for the first time (at least numberOfPwciSamples PwCI values have been gathered)
- reliable statistics exist and at least (numberOfPwciSampl es /2) additional PwCI values have been gathered
- the BCCH/TCH resources ratio has changed (a TDMA has been lost or has been retrieved)

The **numberOfPwciSamples** parameter indicates the minimal number of PwCI samples gathered by the BTS, and required to compute a reliable tiering threshold.

The PwCI is averaged for tiering decisions. The averaging window size used for PwCI is defined by the **PwciHreqave** parameter.

Tiering handover decision by the BTS PwCI is constantly monitored by the BTS for each TCH channel. The tiering decision is taken by the BTS only when a reliable threshold has been obtained from the statistics gathered by the BTS.

- 1st case: the TDMA bearing the channel belongs to the small (TCH) pattern. Besides, it does not belong to the "small zone" of a multizone cell.
  - If PwCI < lPwCIDLH, then the traffic channel must be put on the large BCCH frequency reuse pattern (if possible).
  - So the BTS sends a HANDOVER INDICATION message, with "Frequency tiering" as a cause, to the BSC.
  - Then the counter C1138/16 hoRequiredTchTieringSmallToLargePattern is updated.

- 2nd case: the TDMA bearing the channel belongs to the large (BCCH) pattern. Besides, it belongs to the "large zone" of a multizone cell.

— If PwCI > uPwCIDLH, then the traffic channel must be put on the small TCH frequency reuse pattern (if possible).

— So the BTS sends a HANDOVER INDICATION message, with "Frequency tiering" as a cause, to the BSC.

— Then the counter C1138/15 hoRequiredTchTieringLargeToSmall-Pattern is updated.

The BTS repeats the HANDOVER INDICATION message, with "Frequency tiering" as a cause, as long as the tiering condition is fulfilled.

Resource allocation by the BSC When receiving a HANDOVER INDICATION message with "Frequency tiering" as a cause, the BSC:

- either allocates a channel belonging to a large pattern TDMA (BCCH or non hopping) if the current channel belongs to a TDMA within the small pattern. Then the counter C1802/1 hoSuccessTieringTchSmallToLargePattern is updated.
- or allocates a channel belonging to a small pattern TDMA (TCH and hopping) if the current channel belongs to a TDMA within the large pattern. Then the counter C1802/0 hoSuccessTieringTchLargeToSmallPattern is updated.

If no channel is available in the target pool, no queuing is applied. The handover indication is ignored and the relevant counter is updated:

- either C1801/0 hoFailureTieringTchNorrLargeToSmallPattern
- or C1801/1 hoFailureTieringTchNorrSmallToLargePattern

For more information on these counters, refer to NTP < 125 > .

The **nbLargeReuseDataChannels** parameter gives the mean number of radio timeslots in the large (BCCH) reuse pattern which is used for data communications (and which is consequently not available for tiering). It has been introduced to allow a correct interworking between data and frequency tiering. Data communications are known to be more sensitive to interferences, and as a consequence they are preferably put on the large (BCCH) reuse pattern.

3.6.3 Processing algorithms

Handovers are managed at cell level. Therefore, the algorithm used to compute super-averages and make handover decisions may vary from one BSS cell to another.

The same algorithm is used for both directions. Decision making depends on the defined threshold values for each direction.

3.6.3.1 Intra-bts handovers

An intra-bts handover takes place from one channel in the serving cell to another channel in the same cell.

An intra-bts handover in a serving cell is attempted when the quality of the signal is poor but the signal strength is correct. Radio link measurements performed on the serving cell indicate a decrease in quality due to interference, and the system assumes that the radio channel alone is responsible for the interference.

When **runHandOver** "Measurement results" messages have been received and intra-bts handovers are permitted in the serving cell (**intraCe ll** = enabled or **intraCellSDCCH** = enabled), the following controls are performed:

Control	Action
RXLEV_DL > **rxLevDLIH** and RXQUAL_DL > **lRxQualDLH**	downlink intra-bts handover request
RXLEV_UL > **rxLevULIH** and RXQUAL_UL > **lRxQualULH**	uplink intra-bts handover request

The algorithm selects the new radio channel according to:

- its allocation priority. The selection criteria are described in Paragraph Section 3.9 "Radio resource allocation" (page 418).
- its frequency hopping ability
- its interference level. For more information on interference level calculations, refer to Section 3.4.4.4 "Interference level calculations" (page 364).

The interference levels are defined thanks to the **thresholdInterference** parameter. Besides, the **radChanSelIntThreshold** parameter enables to define an interference threshold which is used to select idle radio channels with an acceptable interference level.

The selection of idle radio channels with an acceptable interference level is performed in the following way (Feature TF819 - *Intracell HO Improvement*):

- either idle radio channels are available in the low interference pool (see Figure 59 "Interference level calculations" (page 365)): in this case the intracell handover is executed

- or the low level interference pool is empty (because there are idle radio channel only in the high level interference pool, or because there are not any idle radio channels at all). In this case the intracell handover request is:
  - — either rejected, because queuing intracell handover requests is not allowed
  - — or queued, because queuing intracell handover requests is allowed. However, deactivating the intracell handover request queueing is highly recommended and sometimes mandatory (see Section 3.9.4 "Queuing management" (page 419)).

This selection criterion is not applied for intracell handover due to TDMA removal, and for interzone handover.

Starting with the V14 release, the intracell handover principle is an improved method of reducing interference for the mobile. This principle is applicable only to FR AMR mobiles, due to interactions with HR to FR handovers. In these situations, it is more efficient to allocate a FR radio TS to an HR AMR mobile, than to perform a handover from an HR TS to a FR TS.

The following parameter is introduced on handoverConrol object, in order to specify the target requested codec mode for FR AMR channel:

- AMRFRIntracellCodecModeThreshold

The intra-cell handover (that is say intra-bts handover) includes the feature "TF1217 - *protection against intra-cell handover (HO) ping-pong*".

Protection against intra-cell handover This feature provides two kinds of intra-cell handover in terms of capacity and quality:

- The capacity intra-cell handover

  The capacity intra-cell handover groups all intra-cell handovers which are triggered in order to increase the network capacity.

  It affects the following:

  - — inter-zone handover from the outer to the inner zone
  - — AMR handover from FR to HR TCH
  - — tiering from BCCH to TCH frequency patterns.

- The quality intra-cell handover

  The quality intra-cell handover groups all intra-cell handover, which are triggered if the quality of the call is not sufficient.

  It affects the following:

  - — inter-zone handover from the inner to the outer zone

— AMR handover from HR to FR TCH

— tiering from TCH to BCCH frequency pattern

— normal intra-cell handover

The "protection against intra-cell handover ping-pong" is to introduce two timers associated to the intra-cell handover type, which delay an other intra-cell handover after an intra-cell handover.

It affects the following parameters which are included in the handoverControl object:

- capacityTimeRejection

  this parameter defines the rejection time of the capacity intra-cell handover after an intra-cell handover.

- minTimeQualityIntraCellHO

  this parameter defines the defines the minimum time between one intracell HO and the next quality intracell HO

To avoid loads, filtering is done at the BTS level, thus at the L1m (Layer 1 management) for the dedicated channel, the BSC specifies the following causes:

- initial assignment
- capacity intra-cell handover
- quality intra-cell handover
- inter-cell handover

Due to the following handover priorities:

- RXQUAL (Received signal Quality)
- RXLEV (Received signal Level)
- PBGT (Power Budget)
- TRAFFIC
- INTRA-CELL
- AMR INTRA-CELL and INTER-ZONE

The BTS checks if a cause of lower priority is fulfilled. It sends the number of each kinds of filtered intra-cell handovers to the BSC.

3.6.3.2 Inter-bts handovers

An inter-cell handover takes place from a serving cell to an adjacent cell.

It normally occurs when radio link measurements performed on the current serving cell show:

- a low received signal strength, and/or
- a low received signal quality

and that a higher signal strength is available on an adjacent cell.

An inter-cell handover can also occur when an adjacent cell enables communications with a lower TX power level. This typically indicates that a mobile station is located on the border of a cell coverage area.

When **runHandOver** "Measurement results" messages have been received, the following controls are performed.

Control	Action
RXLEV_DL < **lRxLevDLH**	inter-bts handover request with cause "downlink signal strength"
RXLEV_UL < **lRxLevULH**	inter-bts handover request with cause "uplink signal strength"
RXQUAL_DL > **lRxQualDLH**	inter-bts handover request with cause "downlink signal quality"
RXQUAL_UL > **lRxQualULH**	inter-bts handover request with cause "uplink signal quality"
MS_BS_DIST > **msRangeMax**	inter-bts handover request with cause "distance"

The algorithm recognizes two different cases:

- When processing incoming handovers, the BSC selects the best serving cell from the list of eligible cells supplied by the BTS (see Section 3.4 "Radio measurement processing" (page 355)).
- When processing outgoing handovers, the BSC selects the best neighbor cell of the current serving cell from the list of eligible cells supplied by the BTS (see Section 3.6.6 "Microcells" (page 398)).

3.6.3.3 Handover request timing

The **bssMapTchoke** parameter defines a time-out that inhibits new inter-bts handover requests in the cells of the BSS when none of the eligible cells in the list supplied by the BTS has satisfied the selection criterion.

The **timeBetweenHOConfiguration** and **bts time between HO configuration** parameters are used to optimize handover request processing by inhibiting another handover attempt in the same cell for a minimum time:

- The **timeBetweenHOConfiguration** parameter defines the conditions in which this mechanism is used.
- The **bts time between HO configuration** parameter defines a time-out that inhibits new intra- or inter-bts handover attempts in the cell where a successful inter-bts handover has just been executed.

3.6.3.4 New handover attempt in case of failure and return to the old channel

If, during an inter-bts handover procedure, the handover fails with return to the old channel, the BSC may be allowed to try again in another cell from the list of eligible cells by the BTS.

The **HOSecondBestCellConfiguration** parameter defines the conditions in which this processing is allowed, as follows:

- If it equals 1, no new attempt is permitted.
- If it equals 2, a new attempt is permitted on the second best cell in the list of eligible cells.
- If it equals 3, a new attempt is permitted on the third best cell in the list of eligible cells if the handover attempt to the second best cell has failed again with return to the old channel.

3.6.3.5 Note on quality threshold definitions

To comply with GSM TS Recommendation 05.08, the quality **lRxQualDLH** and **lRxQualULH** thresholds are defined by a range of values [minBER to maxBER] in the OMC-R.

The BTS uses the following conversion table:

minBER (%)	maxBER (%)	RXQUAL
0	0.2	0
0.2	0.4	1
0.4	0.8	2
0.8	1.6	3
1.6	3.2	4
3.2	6.4	5
6.4	12.8	6
12.8	-	7

In all checks where "greater than" is used, the BTS selects the maxBER value.

In all checks where "smaller than" is used, the BTS selects the minBER value.

3.6.4 Concentric cells

3.6.4.1 Principles

A concentric cell describes a combination of two transmission zones, the outer (or large) zone and the inner (or small) zone.

The TDMA frames used by a concentric cell are shared between the outer zone and the inner zone. The difference between the TRX/DRXs in each zone is based on the maximum allowed transmission power.

Handover management principles in concentric cells are as follows:

- Since all the common channels, including the BCCH, are carried on TDMA frames that belong to the outer zone, an incoming handover to a concentric cell can:
  - either call on resources assigned to the outer zone
  - or call on resources assigned to the inner zone (*Direct TCH allocation in the small zone* - Feature TF889)
- An intra-zone handover in a concentric cell is managed in the same way as an intra-bts handover in a non-concentric cell. It only calls on the radio resources in one zone, which means that the newly assigned radio resource always belongs to the same zone as the radio resource that is released.
- An inter-zone handover in a concentric cell is managed as a special sort of intra-bts handover in which the BTS initiates the handover by sending a request to the BSC. It calls on the radio resources in both zones, which means that if the radio resource to release belongs to one zone, the newly assigned radio resource always belong to the other zone.

The major difference therefore concerns inter-zone handover management.

In V14, inter-zone handover are not modified due to AMR services introduction, except for quality handover from inner-zone to outer-zone.

For non ARM calls, if the inter-cell RxQual criterion is verified and no neighboring cell is eligible, then an inner to large zone handover is triggered.

For ARM call, if the inter-cell ARM quality criterion is verified and no cell neighboring cell is eligible, then a inner to large zone handover is triggered and the target channel is always a FR channel

3.6.4.2 Configuration parameters

The detection of inter-zone handover needs is based on the following parameter definitions (see Figure 61 "Inter-zone handover" (page 391)):

- The **concentAlgoExtXxx** parameters define the minimum MS distance and the maximum signal strength level received by the mobiles that permit an intra-bts handover from the outer to the inner zone.
- The **concentAlgoIntXxx** parameters define the maximum MS distance and the minimum signal strength level received by the mobiles that permit an intra-bts handover from the inner to the outer zone.

3.6.4.3 Processing algorithm

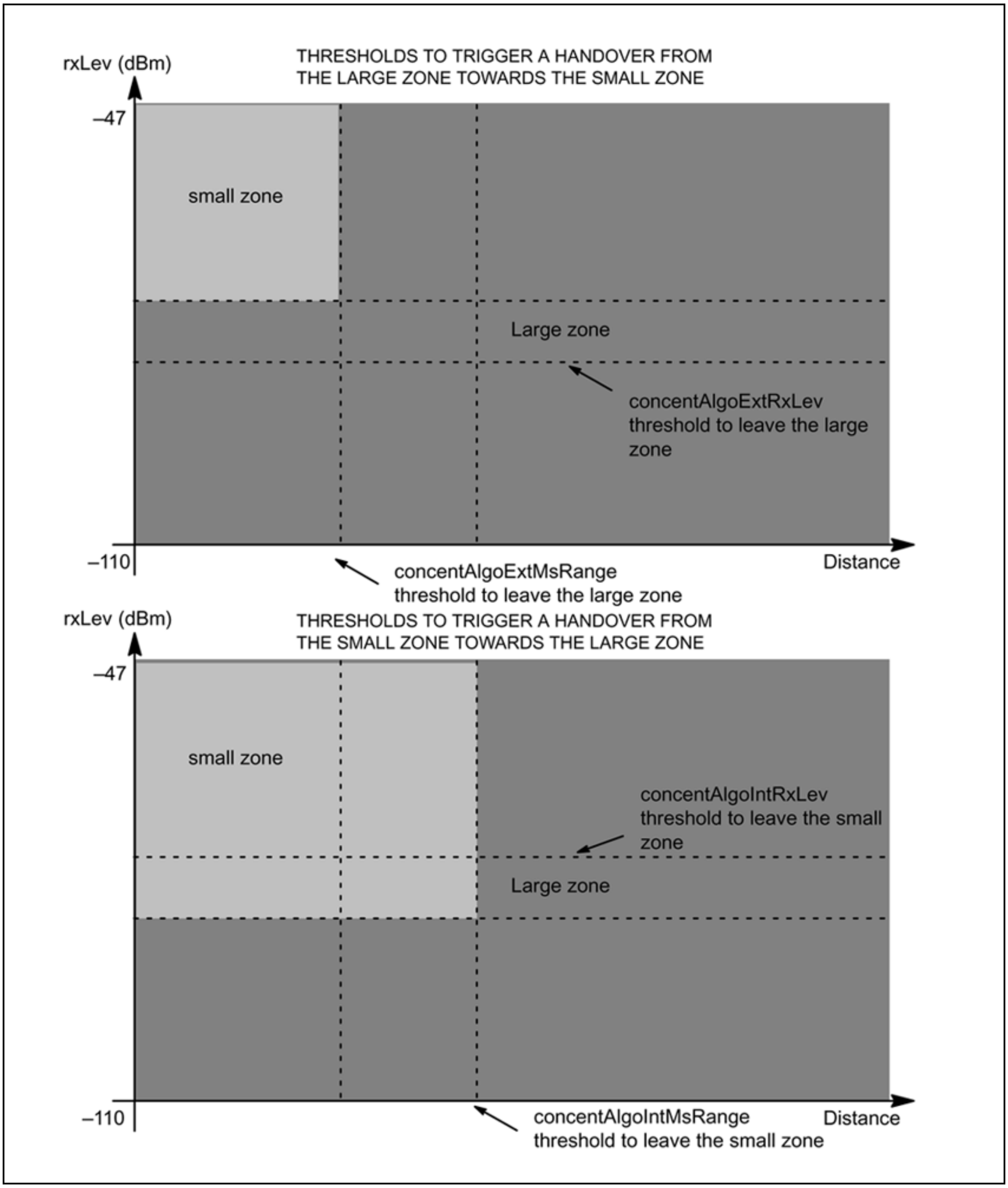
When **runHandOver** "Measurement results" messages have been received, and for each TDMA frame that belongs to the outer zone of the concentric cell, the following control is performed, in which BTSTxPower is the BTS transmitting power.

Control	Action
RXLEV_DL - (bsTxPwrMax - BTSTxPower) > **concentAlgoExtRxLev** and MS_BS_DIST < **concentAlgoExtMsRange**	intra-bts handover request from the outer to the inner zone

When **runHandOver** "Measurement results" messages have been received, and for each TDMA frame that belongs to the inner zone of the concentric cell, the following control is performed.

Control	Action
RXLEV_DL - (bsTxPwrMax - BTSTxPower) < **concentAlgoIntMsRange** or MS_BS_DIST > **concentAlgoIntMsRange**	intra-bts handover request from the inner to the outer zone
RXQUAL_DL > **lRxQualDLH** and no neighbor cell eligible	intra-bts handover request from the inner to the outer zone
RXQUAL_UL > **lRxQualULH** and no neighbor cell eligible	intra-bts handover request from the inner to the outer zone

Figure 61
Inter-zone handover



Notes:

- **Dualband cells**

  The standard concentric cell algorithm applies except for that the Timing Advance is not significant and therefore the timing advance criteria shall be disabled. Moreover the BSC knows MS dualband capability from MS Classmark 3 (CM3).

- **Dualcoupling cells**

  The standard concentric cell algorithm applies except for that the Timing Advance is not significant and therefore the timing advance criteria shall be disabled.

3.6.5 Neighbor cells

Outgoing inter-bts handover management is based on the definition of the neighbor cells to which the BSC can request handovers when serving cell release conditions (signal strength, signal quality, and distance) are satisfied.

The following cases are treated:

- outgoing inter-bts handover needs detected by the BTS
- directed retry handover requests sent by the BSC to the BTS
- forced handover requests sent by the BSC to the BTS

3.6.5.1 Configuration objects

The adjacentcellHandOver objects attached to a bts object define the neighbor cells of the serving cell where outgoing inter-bts handovers can be performed.

3.6.5.2 Processing algorithms

Outgoing inter-bts handovers detected by the BTS When the BTS detects the need for an outgoing inter-bts handover, it draws up a list of eligible neighbor cells that verify the formula

RXLEV_NCELL(n) > **rxLevMinCell**(n) + Mx

where Mx = max (0, **msTxPwrMaxCell**(n) - MSPowerMax)

Then, the BTS arranges the neighbor cells in the preferred order based on the cause of the handover:

PBGT(n) > **hoMargin**(n) **or**	
PBGT(n)>**hoMarginBeg**(n)	cause = power budget
PBGT(n) > **hoMarginDist**(n)	cause = distance
PBGT(n) > **hoMarginRxLev**(n)	cause = signal strength
PBGT(n) > **hoMarginRxQual**(n)	cause = quality

The BTS sends the information to the BSC when the list is complete.

Directed retry handovers requested by the BSC

BTS control When the BSC sends a directed retry handover request to the BTS, the BTS draws up the list of eligible neighbor cells that verify the formula

RXLEV_NCELL(n) > **directedRetry** + Mx

where Mx = max (0, **msTxPwrMaxCell**(n) - MSPowerMax)

The BTS sends the information to the BSC when the list is complete.

The BSC first selects the neighbor cell with the strongest transmission signal.

BSC control This mode is only authorized when the serving cell is a microcell.

The BSC selects the neighbor umbrella cell chosen by the user to handle directed retry handovers in the serving cell (**adjacent cell umbrella Ref**).

Forced handovers requested by the BSC When the BSC sends a forced handover request to the BTS, the BTS draws up the list of eligible neighbor cells that verify the formula

RXLEV_NCELL(n) > **forced handover algo** + Mx

where Mx = max (0, **msTxPwrMaxCell**(n) - MSPowerMax)

The BTS sends the information to the BSC when the list is complete.

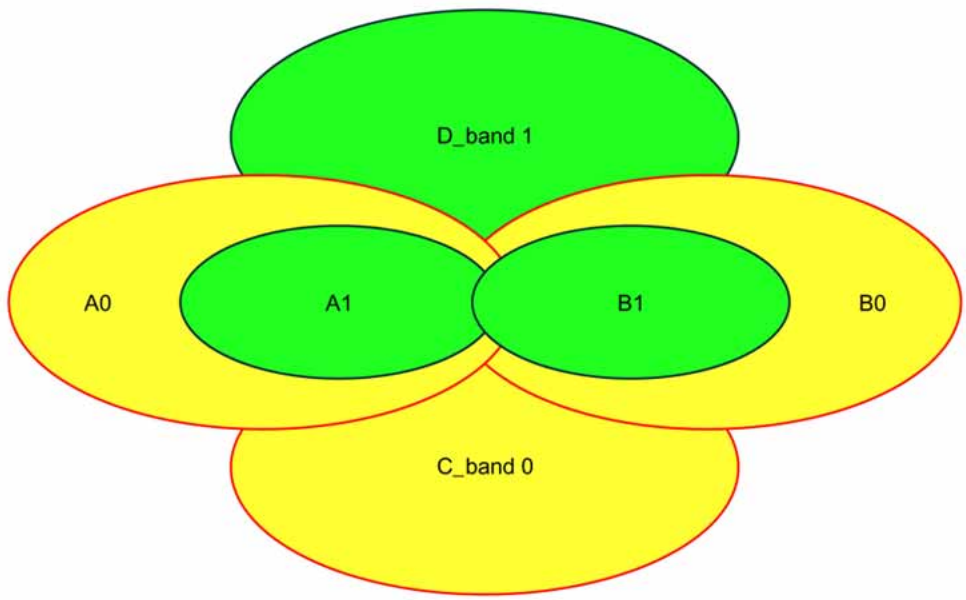
The BSC first selects the neighbor cell with the strongest transmission signal.

If the BTS sends an empty list to the BSC, no further forced handover is attempted.

Remark: This command can be combined with a soft cell release command to speed up the release process. Since, before triggering a soft release in a cell, the user is advised to bar direct access and incoming handovers to the cell, a preliminary forced handover command will speed up effective cell shutdown.

Dualband handovers detected by the BTS The following figure presents the different handover cases crossed while handling dualband cell handovers.

Figure 62
Dualband cell handover cases



A: biband cell with BCCH in band 0
B: biband cell with BCCH in band 0
C: normal cell with BCCH in band 0
D: normal cell with BCCH in band 1

Target zone/cell	A0	A1	B0	B1	C	D
Serving outer zone A band 0	Case 3	Case 1	Case 4	Case 6	Case 4	Case 5
Serving inner zone A band 1	Case 2	Case 3	Case 7	Case 8	Case 7	Case 7
Serving cell C band 0	Case 4	Case 6	Case 4	Case 6	Case 3	Case 5
Serving cell D band 1	Case 5	Case 6	Case 5	Case 6	Case 5	Case 3

Note: band 0 = GSM 900 ; band 1 = GSM 1800.

In the remainder of this paragraph the frequency bands are designed as follows:

- band0: GSM 900 frequency band
- band1: GSM 1800 frequency band

The new handover cases introduced by the dualband management are the following:

Case 1 & Case 2: interzone handover (band0 → band1 or band1 → band0)

When **runHandOver** "Measurement results" messages have been received, and for each TDMA frame that belongs to the outer zone of the concentric cell, the following control is performed, in which BTSTxPower is the BTS transmitting power.

Control	Action
RXLEV_DL - (bsTxPwrMax - BTSTxPower) > **concentAlgoExtRxLev** and MS dualband capability	intra-bts handover request from the outer to the inner zone

When **runHandOver** "Measurement results" messages have been received, and for each TDMA frame that belongs to the inner zone of the concentric cell, the following control is performed.

Control	Action
RXLEV_DL - (bsTxPwrMax - BTSTxPower) < **concentAlgoInRxLev** and MS dualband capability	intra-bts handover request from the inner to the outer zone

Case 3: intra cell handover (band0 → band0 or band1 → band1)

This case is a normal intra band intra cell handover.

Case 4: inter cell handover (band0 BCCH → band0 BCCH)

This case is a normal intra band inter BSS or intra BSS handover.

Case 5: inter cell handover (band0 BCCH → band1 BCCH or band1 BCCH → band0 BCCH)

This case is a normal inter band inter cell or inter BSS handover.

Case 6: inter cell handover (band0 BCCH → band1)

This case is only allowed for an intra BSS handover.

The L1M uses the standard inter cell handover algorithm. Furthermore the check is done on the level obtained in the inner DRX zone (band1) of the selected adjacent cell:

RXLEV_NCELL(n) > **rxLevMinCell**(n) + Mx + **biZonePowerOffset**(n)

where Mx = max (0, **msTxPwrMaxCell**(n) - MSPowerMax)

biZonePowerOffset is the corrective factor which takes into account the difference of the propagation model between the inner or outer zones of the adjacent dualband cell.

Case 7: inter cell handover (band1 → band0 BCCH)

This case is only allowed for an inter or intra BSS handover.

The L1M uses the standard inter cell handover algorithm. Furthermore the check is done on the level obtained in the outer DRX zone (band0) of the selected adjacent cell:

RXLEV_NCELL(n) > **rxLevMinCell**(n) + Mx - **biZonePowerOffset**(n)

where Mx = max (0, **msTxPwrMaxCell**(n) - MSPowerMax)

biZonePowerOffset is the corrective factor which takes into account the difference of the propagation model between the inner or outer zones of the adjacent dualband cell.

Then the normal formula used to rank the eligible adjacent cells according to their excessive power budget relative to the serving cell is used is checked:

PBGT(n) > **hoMargin**(n) **or**

PBGT(n)>**hoMarginBeg**(n)	if cause is "power budget"
PBGT(n) > **hoMarginDist**(n)	if cause is = distance"
PBGT(n) > **hoMarginRxLev**(n)	if cause is "signal strength"

Case 8: inter cell handover (band1 → band1)

This case is a combination of *Case 5* and *Case 6* but only applies to an intra BSS handover.

Thus the level of the signal of the target cell and the level of the signal of the serving cell have to be corrected to take into account the difference of the propagation model between band0 and band1.

3.6.5.3 Multiband mobiles and handovers on power budget

The power budget algorithm allows to select the cell that offers the minimum path loss to the mobile at a given time. It takes the mobile power class (actually the maximum MS power output) into account, both in the serving cell and in the neighbor cell.

In a frequency multiband network, serving cells and neighbor cells may belong to different frequency bands, as shown in the following table.

Mobile power class	Maximum power GSM 900 network	Maximum power GSM 1800 network
1	-	1 W
2	8 W	0.25 W
3	5 W	4 W
4	2 W	-
5	0.8 W	-

According to the **hoMarginxxx** parameter values, the operator has the following choices:

- either to maintain power budget calculation between the two frequency bands by using a fine parameter tuning, so as to avoid giving priority to the cells in the GSM 1800 band during handovers that involve multiband mobiles;
- or to forbid power budget calculation between the two frequency bands.

3.6.5.4 900-1900 and 850-1800 mobility support

With the feature 28349 "900-1900 and 850-1800 mobility support", introduced in V15.1.1, cell reselection and handover between 900 and 1900 cells, and between 850 and 1800 cells, is supported. In this context, "900" refers to the P-GSM frequency band. The E-GSM band is not in the scope of this feature. Both E1 and T1 connectivity are supported.

The Neighboring cells parameters are sent to the MS in system information messages:

- SI2/2bis/2ter (for reselection)
- SI5/5bis/5ter (for handover).

For each cell, the BCCH ARFCN defines the frequency band that the cell belongs to. To distinguish between 1800 and 1900 bands, the flag band_indicator is sent in system_information 1 and 6. Only an MS that is able to read the band_indicator flag will support this feature.

The operator can configure bi-band networks with cells either 900 or 1900, or networks with cells either 850 or 1800. The BSS can manage MS multi-band capability and power class.

The OMC-R and CT2000 will allow the new neighboring cells configurations shown in the following table:

Serving cell standard indicator	Neighboring cell standard indicator
900	900 or 1900
1900	900 or 1900
850	850 or 1800
1800	850 or 1800

Mono-BCCH dualband cells 900-1900 or 850-1800 are not supported in this feature.

The MS gives its multi-band capability in the classmark3 element.

Before handover, directed retry or resource assignment, the BSS checks that the MS supports the corresponding multi-band. Similarly, the BSS shall convert the MS power according to the frequency band of the host cell. Intercell handover counters on dualband MS are incremented (1208, 1209, 1783 to 1795) as usual for a dualband MS. The MS capability (classmark3) is available in Call Path Trace files.

3.6.6 Microcells

3.6.6.1 Principles

The microcell handover A algorithm is based on signal stability over a given proving period and a stability criterion that confirms that the microcell has been captured.

The A algorithm is used when the serving cell is a macro-cell (or normal cell) and the neighbor cell is a microcell.

Decision making depends on management parameter values. One should note that:

- Handover requests from a microcell to a neighbor umbrella cell are conditioned by signal strength, signal quality, and distance criteria.
- Handover requests from a serving umbrella cell to a neighbor microcell are conditioned by capture criteria.

3.6.6.2 Configuration parameters

The **microCellCaptureTimer** and **microCellStability** parameters are used to control the state of the neighbor microcell connection and to decide whether to attempt handover.

The network can be configured to use or not to use a specific microcell processing algorithm. When the network is configured to use a processing algorithm, it is used all over the network.

3.6.6.3 A algorithm

Each time **runHandOver** elapses and provided the **microCellCaptureTimer** timer is not running for any neighbor microcells of the serving cell, do the following:

- If one or more neighbor microcells satisfy the RXLEV_NCELL(n) > **rxLevMinCell**(n) criterion, select cell m with the greatest difference.
- Start the **microCellCaptureTimer** timer in neighbor cell m and set the following parameters:

  RXLEV_MIN(m) = RXLEV_NCELL(m)

  RXLEV_MAX(m) = RXLEV_NCELL(m)

During the time **microCellCaptureTimer**(m) is running, do the following:

- If RXLEV_NCELL(m) > **rxLevMinCell**(m), update the following parameters:

  RXLEV_MIN(m) = min(RXLEV_MIN(m), RXLEV_NCELL(m))

  RXLEV_MAX(m) = max(RXLEV_MAX(m), RXLEV_NCELL(m))

- If RXLEV_NCELL(m) ≤ **rxLevMinCel l**(m), stop the capture process and **microCellCaptureTimer**(m).

On **microCellCaptureTimer**(m) time-out elapse, do the following:

- If RXLEV_MAX(m) - RXLEV_MIN(m) < **microCellStability**(m), then request handover to cell m.
- If RXLEV_MAX(m) - RXLEV_MIN(m) ≥ **microCellStability**(m), then stop the capture process.

Notes:

- During the proving **microCellCaptureTimer** (m) period, handover requests to a macro-cell are allowed. In this case, the neighbor microcell capture process is stopped and the handover request is submitted.
- From V15.1R, specific values of **microCellCaptureTimer** are provided to widely increase its period.
- When the microcell capture process is stopped, the algorithm is rerun from the beginning.

3.7 Power control

3.7.1 Principles

Power control management is based on the results of downlink measurements performed by mobile stations, uplink measurements performed by the BTS, and the currently user defined values of super-average computing and decision making parameters in the OMC-R.

3.7.2 Configuration parameters

- bsPowerControl (powerControl object)
- bsTxPwrMax (powerControl object)
- facchPowerOffset (bts object) (Tx power offset, feature 30293)
- frPowerControlTargetModeDl (powerControl object) (Tx power offset, feature 30293)
- hrPowerControlTargetModeDl (powerControl object) (Tx power offset, feature 30293)
- lRxLevDLP (powerControl object)
- lRxLevULP (powerControl object)
- lRxQualDLP (powerControl object)
- lRxQualULP (powerControl object)
- msTxPwrMax (bts object)
- msTxPwrMaxCCH (bts object)
- new power control algorithm (bts object)
- powerIncrStepSize (powerControl object) (standard algorithm)
- powerRedStepSize (powerControl object) (standard algorithm)
- runPwrControl (bts object)
- sacchPowerOffset (bts object) (Tx power offset, feature 30293)
- sacchPowerOffsetSelection (bts object) (Tx power offset, feature 30293)
- transceiver equipment class (transceiverEquipment object)
- uplinkPowerControl (powerControl object)
- uRxLevDLP (powerControl object) (standard algorithm)
- uRxLevULP (powerControl object) (standard algorithm)
- uRxQualDLP (powerControl object) (standard algorithm)
- uRxQualULP (powerControl object) (standard algorithm)
- txPwrMaxReduction (transceiver object)
- zone Tx power max reduction (transceiverZone object - concentric cells)

3.7.2.1 Control parameters

Power control may be allowed or not allowed independently on the downlink (**bsPowerControl**) and the uplink (**uplinkPowerControl**).

The **new power control algorithm** parameter defines the algorithm used by the BTS to control power in a given cell ("step by step" is the standard algorithm, "one shot" is the advanced algorithm).

3.7.2.2 Management parameters

The **bsTxPwrMax** and **msTxPwrMaxCCH** parameters define the maximum BTS and mobile station transmission power in a cell. Users must make sure that the maximum transmission power they set for mobile stations is above their minimum effective transmission power

Low and high signal strength level thresholds are defined independently on the downlink (**lRxLevDLP**, **uRxLevDLP**) and the uplink (**lRxLevULP**, **uRxLevULP**). High signal strength level thresholds are only significant when the standard power control algorithm is used.

Low and high quality thresholds are defined independently on the downlink (**lRxQualDLP**, **uRxQualDLP**) and the uplink (**lRxQualULP**, **uRxQualULP**). High quality level thresholds are only significant when the standard power control algorithm is used.

The relative values of power increase (**powerIncrStepSize**) or drop (**powerRedStepSize**) are identical in both directions. They are only significant when the standard power control algorithm is used.

3.7.3 Processing algorithms

Power control is managed at cell level. Therefore, the algorithm used to compute super-averages and make handover decisions may vary from one BSS cell to another.

The same algorithm is used for both directions. Decision making depends on the defined threshold values for each direction.

3.7.3.1 Standard algorithm

The following inequalities must be respected:

lRxQualDLP ≥ uRxQualDLP
lRxQualULP ≥ uRxQualULP
lRxLevDLP + powerIncrStepSize ≥ uRxLevDLP
lRxLevULP + powerIncrStepSize ≥ uRxLevULP
uRxLevDLP - powerDecStepSize ≤ lRxLevDLP
uRxLevULP - powerDecStepSize ≤ lRxLevULP

Downlink direction When **runPwrControl** "Measurement results" messages have been received, the following controls are performed.

Control	Action
RXLEV_DL < **lRxLevDLP** or RXQUAL_DL > **lRxQualDLP**	The BTS transmission power in the cell increases by **powerIncrStepSize** dB, but cannot exceed **bsTxPwrMax**.
RXLEV_DL > **uRxLevDLP** and RXQUAL_DL > **uRxQualDLP**	The BTS transmission power in the cell drops by **powerRedStepSize** dB.

Uplink direction When **runPwrControl** "Measurement results" messages have been received, the following controls are performed.

Control	Action
RXLEV_UL < **lRxLevULP** or RXQUAL_UL > **lRxQualULP**	The MS transmission power in the cell increases by **powerIncrStepSize** dB, but cannot exceed **msTxPwrMax** or the RFPC power determined by the mobile class.
RXLEV_UL > **uRxLevULP** and RXQUAL_UL > **uRxQualULP**	The MS transmission power in the cell drops by **powerRedStepSize** dB.

3.7.3.2 Advanced algorithm

Only a V9+ BTS can use the advanced algorithm (see Section 3.4.5 "New power control algorithms" (page 365)).

Downlink direction When **runPwrControl** "Measurement results" messages have been received, the L1M function in the BTS calculates the new transmission power of the BTS in the cell (BSTxNewPower) and performs the following control.

Control	Action
RXQUAL_DL > **lRxQualDLP**	Set BSTxNewPower = **bsTxPwrMax**

Uplink direction When **runPwrControl** "Measurement results" messages have been received, the L1M function in the BTS calculates the new transmission power of the mobile stations in the cell (MSNewPower) and performs the following control.

Control	Action
RXQUAL_DL > **lRxQualDLP**	Set MSNewPower = min(**msTxPwrMax**, MSPowerMax)

3.7.3.3 Note on quality threshold definitions

To comply with GSM TS Recommendation 05.08, the quality **lRxQualDLP** and **lRxQualULP** thresholds are defined by a range of values [minBER to maxBER] in the OMC-R.

The BTS uses the following conversion table:

minBER (%)	maxBER (%)	RXQUAL
0	0.2	0
0.2	0.4	1
0.4	0.8	2
0.8	1.6	3
1.6	3.2	4
3.2	6.4	5
6.4	12.8	6
12.8	-	7

In all checks where "higher than" is used, the BTS selects the maxBER value.

In all checks where "smaller than" is used, the BTS selects the minBER value.

3.7.4 Maximum transmission power

3.7.4.1 Theoretical transmission power

The maximum transmission power of the TRX/DRXs defines the power used to transmit the cell BCCHs on TDMA carrier frames.

The maximum theoretical transmission power for a TRX/DRX depends on its class and can be set by the OMC-R. It is obtained with the formula:

bsTxPwrMax - txPwrMaxReduction

In a concentric cell, the maximum theoretical transmission power for a TRX/DRX partnered with a TDMA frame that belongs to the inner zone (which does not by definition transmit on BCCH) also depends on the maximum transmission authorized power in that zone. It is obtained with the formula:

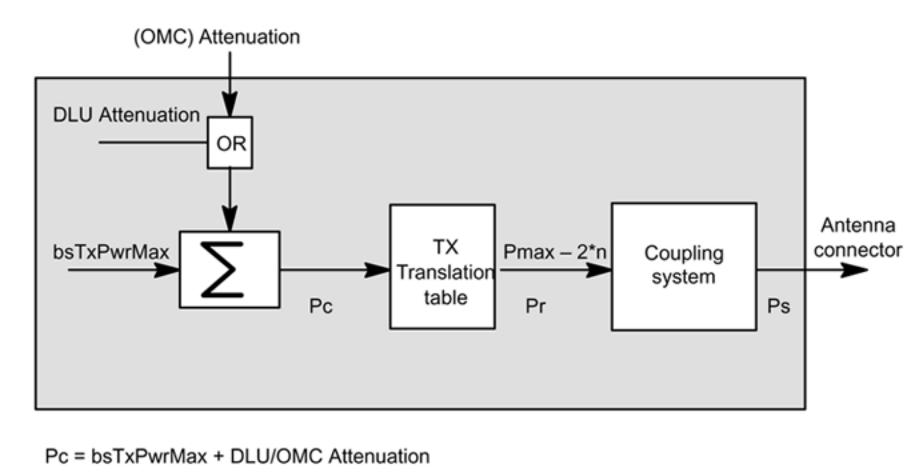
bsTxPwrMax - max(**zone Tx power max reduction, txPwrMaxReduction**)

and must always be less than the maximum transmission power of the TRX/DRXs partnered with TDMA frames that belong to the outer zone.

3.7.4.2 Effective transmission power

Position of the problem To reach the maximum theoretical transmission level on output from the BTS cabi net, the PA amplifier power and the coupling system loss must be counted in TX transmission power calculations.

The input parameter at the OMC is ***bsTxPwrMax*** **value** and the output value is (Pr) power before the coupling system. So, it is possible to calculate the output cabinet power (Ps) with the subtraction of the coupling loss to Pr.



The following extracts from NTP < 124 > remind the user how to set these parameter values.

Attenuation Class 2	**V9**

Range value : [0 to 14] dB

Note:

bsTxPwrMax Class 3

Range value : [2 to 51] dBm

ATTENTION

Some high **bsTxPowerMax** values are not compatible with the effective power output by the BTS. Refer to the Section 3.7 "Power control" (page 399).

Translation tables in the TX : Pr = f n (Pc, PA type) These tables are implemented in the TX software to control the PA.

DRX based BTSs

PA 30W S8000/S8002 PA 30W S2000H			**PA 5W S2000L**	
Pc	**Pr**		**Pc**	**Pr**
45 .. 51	Nack		38 .. 51	Nack
43 .. 44	Pmax		36 .. 37	Pmax
41 .. 42	Pmax - 2		34 .. 35	Pmax - 2
39 .. 40	Pmax - 4		32 .. 33	Pmax - 4
37 .. 38	Pmax - 6		30 .. 31	Pmax - 6
35 .. 36	Pmax - 8		28 .. 29	Pmax - 8
33 .. 34	Pmax - 10		26 .. 27	Pmax - 10
31 .. 32	Pmax - 12		24 .. 25	Pmax - 12
0 .. 30	Nack		0.. 23	Nack

TRX based BTSs

Other types (*)			PA 30W S4000 GSM 1800	
Pc	Pr		Pc	Pr
43 .. 51	Pmax		44 .. 51	Pmax
41 .. 42	Pmax - 2		42 .. 43	Pmax - 2
39 .. 40	Pmax - 4		40 .. 41	Pmax - 4
37 .. 38	Pmax - 6		38 .. 39	Pmax - 6
35 .. 36	Pmax - 8		36 .. 37	Pmax - 8
33 .. 34	Pmax - 10		34 .. 35	Pmax - 10
31 .. 32	Pmax - 12		32 .. 33	Pmax - 12
0 ..30	Nack		0 .. 31	Nack

(*) this item includes the following PAs for:

- S4000 Indoor/Outdoor except S4000 Indoor TX 30W GSM 1800
- S2000(E)
- S4000 Smart

e-cell The following table gives, for e-cell, the correspondence between bsTxPwrMax

and Pr according to the attenuation parameter value.

Table 12
e-cell bsTxPwrMax versus coupling system

Pc ↓	Pr ↓
33 to 51	Nack
31 to 32	PAmax
29 to 30	PAmax-2
27 to 28	PAmax-4
25 to 26	PAmax-6
23 to 24	PAmax-8
21 to 22	PAmax-10
19 to 20	PAmax-12
2 to 18	Nack

DLU attenuation DLU attenuation can have different values for the same BTS and coupling system because it may depend on the configuration.

The DLU Attenuation values are defined in the "System Release Definition" depending on the BTS type (configRef, number of TRX or DRX / Cell).

In the DLU attenuation tables, the following terms are used for the coupling system:

TxF =>Tx Filter
D => Duplexer
H2 => Two-way hybrid coupling
H4 => Four-way hybrid coupling
H4D => Four-way hybrid duplexer coupling

The values for all BTSs except the BTS 18000 are given in Table 13 "DLU attenuation versus coupling system" (page 407)

Table 13
DLU attenuation versus coupling system

BTS	PA Watt (dBm)			Coupling system	DLU Attenuation
	GSM 900	GSM 1800	GSM 1900		
S2000(E)	25 (44)	20 (43)	20 (43)	D	1
S2000H	30 (44.7)	30 (44.7)	30 (44.7)	D	0
S2000L	5 (37)	5 (37)	5 (37)	D	1
S4000 Indoor	25 (44) 25 (44) or 35 (45.4) 25 (44) 25 (44) 35 (45.4)	20 (43) 30 (44.7)	20 (43)	H2 H4 H2D Cavity / D Cavity	4 7 4 3 / 4 2 / 3
S4000 Outdoor	25 (44) 25 (44)	20 (43) 20 (43)	20 (43) 20 (43)	D H2D	1 / 2 4
S4000 Smart			20 (43)		0
S8000/S12000 Indoor / Outdoor	30 (44.7) 30 (44.7) 30 (44.7)	30 (44.7) 30 (44.7) 30 (44.7)	30 (44.7) 30 (44.7) 30 (44.7)	TxF / D H2D H4D	1 4 8
S8002	30 (44.7)			D	1
e-cell (without Edge)	30			D	0
e-cell (with Edge)	27			D	0

The equivalent information for the BTS 18000 is given in Table 14 "DLU attenuation versus coupling system for BTS 18000" (page 408)

Table 14
DLU attenuation versus coupling system for BTS 18000

BTS	PA Watt (dBm)			Coupling system	DLU Attenuation
	RM	MPRM	HPRM		
BTS 18000	30W (44.7)	40W (46)	60W (47.8)	D H2 H4	1 4 8

Example The following table shows - in a sample configuration (25 Watt TX power amplifier and S4000 Indoor BTS with H2 combiner and DLU Attenuation of 4 dB) where (OMC) **Attenuation** parameter has been set to NULL - that some bsTxPwrMax values are not compatible with the effective PA power (Pr).

Pt = bsTxPwrMax	Pc = bsTxPwrMax + DLU Attenuation	Pr = Pmax - 2*n (dB)	Ps = Pr - effective coupling loss
39 to 47	43 to 51	44	40.5
38	42	42	38.5
37	41	42	38.5
36	40	40	36.5
35	39	40	36.5
34	38	38	34.5
33	37	38	34.5
32	36	36	32.5
31	35	36	32.5
30	34	34	30.5
29	33	34	30.5
0 to 28	4 to 32	32	29.5

The table shows that from **bsTxPwrMax** value 39 to greater ones, the effective cabinet power Ps is limited on reaching the maximum PA threshold.

Pr = f n (bsTxPwrMax, DLU Attenuation) The hypothesis is the following: **Attenuation parameter is not set (NULL value)**.

In this case:

Pc = bsTxPWrMax + DLU Attenuation

Thanks to the translation tables given before, it is possible to give the tables giving **Pr** according to the **bsTxPwrMax** value entered at the OMC-R and the **DLU Attenuation**.

Table 15
Pr vs bsTxPwrMax (Part 1)

BTS =>	**S8000 / S8002**			**S2000H**	**S2000L**	**S4000 30W GSM1 800**		**e-cell**
Coupling system =>	Dp or TxF	H2D	H4D	Dp	Dp	1 cavity	2 cavities	D
DLU Attenuation or OMC Attenuation =>	1	4	8	0	1	3	4	0
bsTxPwrMax	Pr	Pr	Pr	Pr	Pr	Pr	Pr	Pr
51	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
50	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
49	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
48	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
47	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
46	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
45	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
44	Nack	Nack	Nack	Pmax	Nack	Nack	Nack	Nack
43	Pmax	Nack	Nack	Pmax	Nack	Nack	Nack	Nack
42	Pmax	Nack	Nack	Pmax-2	Nack	Pmax	Nack	Nack
41	Pmax-2	Nack	Nack	Pmax-2	Nack	Pmax	Pmax	Nack
40	Pmax-2	Pmax	Nack	Pmax-4	Nack	Pmax-2	Pmax	Nack
39	Pmax-4	Pmax	Nack	Pmax-4	Nack	Pmax-2	Pmax-2	Nack
38	Pmax-4	Pmax-2	Nack	Pmax-6	Nack	Pmax-4	Pmax-2	Nack
37	Pmax-6	Pmax-2	Nack	Pmax-6	Nack	Pmax-4	Pmax-4	Nack

BTS =>	S8000 / S8002			S200 0H	S200 0L	S4000 30W GSM1 800		e-cell
36	Pmax-6	Pma x-4	Pmax	Pma x-8	Pmax	Pmax -6	Pmax -4	Nack
35	Pmax-8	Pma x-4	Pmax	Pma x-8	Pmax	Pmax -6	Pmax -6	Nack
34	Pmax-8	Pma x-6	Pmax -2	Pmax -10	Pma x-2	Pmax -8	Pmax -6	Nack
33	Pmax-10	Pma x-6	Pmax -2	Pmax -10	Pma x-2	Pmax -8	Pmax -8	Nack
32	Pmax-10	Pma x-8	Pmax -4	Pmax -12	Pma x-4	Pmax -10	Pmax -8	PAm ax
31	Pmax-12	Pma x-8	Pmax -4	Pmax -12	Pma x-4	Pmax -10	Pmax -10	PAm ax
30	Pmax-12	Pmax -10	Pmax -6	Nack	Pma x-6	Pmax -12	Pmax -10	PAm ax-2
29	Nack	Pmax -10	Pmax -6	Nack	Pma x-6	Pmax -12	Pmax -12	PAm ax-2
28	Nack	Pmax -12	Pmax -8	Nack	Pma x-8	Nack	Pmax -12	PAm ax-4
27	Nack	Pmax -12	Pmax -8	Nack	Pma x-8	Nack	Nack	PAm ax-4
26	Nack	Nack	Pmax -10	Nack	Pmax -10	Nack	Nack	PAm ax-6
25	Nack	Nack	Pmax -10	Nack	Pmax -10	Nack	Nack	PAm ax-6
24	Nack	Nack	Pmax -12	Nack	Pmax -12	Nack	Nack	PAm ax-8
23	Nack	Nack	Pmax -12	Nack	Pmax -12	Nack	Nack	PAm ax-8
22	Nack	Nack	Nack	Nack	Nack	Nack	Nack	PAm ax-10
21	Nack	Nack	Nack	Nack	Nack	Nack	Nack	PAm ax-10
20	Nack	Nack	Nack	Nack	Nack	Nack	Nack	PAm ax-12
19	Nack	Nack	Nack	Nack	Nack	Nack	Nack	PAm ax-12

BTS =>	S8000 / S8002			S200 0H	S200 0L	S4000 30W GSM1 800		e-cell
2 -> 18	Nack	Nack	Nack	Nack	Nack	Nack	Nack	Nack
0 -> 2	Nack	Nack	Nack	Nack	Nack	Nack	Nack	

Table 16
Pr vs bsTxPwrMax (Part 2)

BTS =>	S4000 (except 30W GSM 1800) S2000 (E) / S4000 smart					
	S4000 smart	S2000E S4000-Outdoor	S4000-Indoor S4000-Outdoor	S4000-I ndoor	S4000-Outdoor S4000-Indoor (25W)	S4000-I ndoor
Coupling system =>	Smart	Dp Dp	Cavity Dp	Cavity	H2D H2/H2D/Dp	H4
DLU Attenuation or OMC Attenuation =>	0	1	2	3	4	7
bsTxPwrMax	Pr	Pr	Pr	Pr	Pr	Pr
51	Nack	Nack	Nack	Nack	Nack	Nack
50	Nack	Nack	Nack	Nack	Nack	Nack
49	Nack	Nack	Nack	Nack	Nack	Nack
48	Nack	Nack	Nack	Nack	Nack	Nack
47	Nack	Nack	Nack	Nack	Nack	Nack
46	Nack	Nack	Nack	Nack	Nack	Nack
45	Nack	Nack	Nack	Nack	Nack	Nack
44	Pmax	Nack	Nack	Nack	Nack	Nack
43	Pmax	Pmax	Nack	Nack	Nack	Nack
42	Pmax-2	Pmax	Pmax	Nack	Nack	Nack
41	Pmax-2	Pmax-2	Pmax	Pmax	Nack	Nack
40	Pmax-4	Pmax-2	Pmax-2	Pmax	Pmax	Nack
39	Pmax-4	Pmax-4	Pmax-2	Pmax-2	Pmax	Nack
38	Pmax-6	Pmax-4	Pmax-4	Pmax-2	Pmax-2	Nack
37	Pmax-6	Pmax-6	Pmax-4	Pmax-4	Pmax-2	Pmax
36	Pmax-8	Pmax-6	Pmax-6	Pmax-4	Pmax-4	Pmax
35	Pmax-8	Pmax-8	Pmax-6	Pmax-6	Pmax-4	Pmax-2
34	Pmax-10	Pmax-8	Pmax-8	Pmax-6	Pmax-6	Pmax-2

BTS =>	S4000 (except 30W GSM 1800) S2000 (E) / S4000 smart					
33	Pmax-10	Pmax-10	Pmax-8	Pmax-8	Pmax-6	Pmax-4
32	Pmax-12	Pmax-10	Pmax-10	Pmax-8	Pmax-8	Pmax-4
31	Pmax-12	Pmax-12	Pmax-10	Pmax-10	Pmax-8	Pmax-6
30	Nack	Pmax-12	Pmax-12	Pmax-10	Pmax-10	Pmax-6
29	Nack	Nack	Pmax-12	Pmax-12	Pmax-10	Pmax-8
28	Nack	Nack	Nack	Pmax-12	Pmax-12	Pmax-8
27	Nack	Nack	Nack	Nack	Pmax-12	Pmax-10
26	Nack	Nack	Nack	Nack	Nack	Pmax-10
25	Nack	Nack	Nack	Nack	Nack	Pmax-12
24	Nack	Nack	Nack	Nack	Nack	Pmax-12
23	Nack	Nack	Nack	Nack	Nack	Nack
22	Nack	Nack	Nack	Nack	Nack	Nack
21	Nack	Nack	Nack	Nack	Nack	Nack
20	Nack	Nack	Nack	Nack	Nack	Nack
19	Nack	Nack	Nack	Nack	Nack	Nack
2 -> 18	Nack	Nack	Nack	Nack	Nack	Nack
0 -> 2	Nack	Nack	Nack	Nack	Nack	Nack

Nack <=> Codano 1067: the Tx has not acknowledged the power consign request.

For the equivalent table of **bsTxPwrMax** values for the BTS 18000, see NTP < 161 >.

Cabinet output power (Ps) **Ps** = Pr - coupling loss

Ps (*) = Pr - maximum coupling loss

(*) By subtracting the maximum coupling loss value, one gets the minimum guaranteed power output value.

The following table giving coupling loss values (mean values) enables you to compute cabinet output power values.

Table 17
Coupling loss mean values

BTS Type	Coupling system	Coupling loss mean value (dB)
S2000(E)	D	1
S2000H	D	1
S2000L	D	1
S4000	D H2 H4 H2D Cavity coupler	4.9 3.5 7 4.5 4.9
S4000 Smart	Smart	0
S8000	D TxF H2D H4D	1 1 4.5 8
S8002	D	1
S12000	D TxF H2D H4D	1 1 4.5 8
e-cell	D	
BTS 18000	D TxF H2 H4	1 1 4.5 6.8

Example BTS S2000H Duplexer PA 30W GSM 1800 for V10 release

bsTxPwrMax = 33

Attenuation value is not set (NULL value)

DLU attenuation = **1** and maximum coupling loss = **1 dB**

Pr = f n (bsTxPwrMax, DLU attenuation) table gives:

Pr = Pmax -10

Ps = Pr - max coupling loss

Ps = (Pmax -10) - 1

Numerical application: **Ps** = (44.7 -10) -1 = **33.7 dB**

Management

Any change to a cell **bsTxPwrMax** attribute is sent to the BTS that then updates all the TRX/DRXs in that radio cell.

Any change to a TDMA frame **txPwrMaxReduction** attribute is sent to the BTS that then updates the partnered TRX/DRX.

Any change to the zone **Tx power max reduction** attribute in a zone of a concentric cell is sent to the BTS that then updates all the TRX/DRXs partnered with the TDMA frames that belong to that zone.

3.7.4.3 Tx Power Offset for Signalling Channels

With the feature 30293 (Tx Power Offset for Signalling Channels), introduced in V16.0, the BTS may use a power offset to transmit signalling bursts. In this case, the related signalling Tx power is above the current Tx power used for voice traffic (but it is still less than or equal to the nominal Tx power of the BTS).

The purpose of this feature is to increase the robustness of the signalling channels (FACCH and SACCH) in the downlink. The signalling channel is better protected to avoid call drops in situations where the radio conditions are deteriorating rapidly. The power offset is triggered only if the loss of the signalling message is likely to lead to a call drop.

The feature applies to the BTS 18000, the e-cell, and the BTS S8000 and S12000 equipped with e-DRX or DRX-ND3. The feature does not apply to other BTS hardware.

Since this feature improves the downlink robustness for signalling, it is possible to use a more protected AMR codec in the downlink than the one used in the uplink. Therefore, new parameters have been introduced to define the dedicated power control targets for the uplink and downlink AMR codec.

The benefit depends on the signalling robustness and it allows the operator to increase the fractional load and thus the spectrum efficiency. The voice quality is still acceptable thanks to the use of a robust AMR codec.

The following parameters are used to enable/disable and tune the feature in each cell:

- facchPowerOffset (bts object)
- sacchPowerOffset (bts object)
- sacchPowerOffsetSelection (bts object)
- hrPowerControlTargetModeDl (powerControl object)
- frPowerControlTargetModeDl (powerControl object

For a description of these parameters, see NTP < 124 >.

3.8 Call monitoring

3.8.1 Principles

Call monitoring is based on the following principles:

- control of the distance that separates the mobile stations from the BTS that handles their calls
- radio link monitoring

3.8.2 Mobile distance control

Mobile distance control is based on the results of uplink measurements performed by the BTS and currently user defined super-average computing and decision making parameters in the OMC-R.

3.8.2.1 Configuration parameters

- callClearing (bts object)
- msRangeMax (bts object)
- runCallClear (bts object)
- runHandOver (bts object)

The **msRangeMax** parameter defines the maximum distance between a mobile and the cell that conditions a handover attempt.

The **callClearing** parameter defines the maximum distance between a mobile and the cell that conditions call release.

The following inequality must be respected:

callClearing > msRangeMax

3.8.2.2 Processing algorithm

Mobile distance control is managed at cell level. Therefore, the algorithm used to compute super-averages and make handover or call release decisions may vary from one BSS cell to another.

When **runCallClear** "Measurement results" messages have been received, the L1M function in the BTS performs the following control.

Control	Action
MS_BS_DIST > **callClearing**	call clearing request

When **runHandOver** "Measurement results" messages have been received, the L1M function in the BTS performs the following control.

Control	Action
MS_BS_DIST > **msRangeMax**	inter-bts handover request with cause "distance"

The first control is performed systematically, regardless of the **msR angeMax** value, since a handover with cause "distance" may not be executed before the mobile goes out of call clearing range.

In case of clear request, the connection state of the radio link changes to CLEAR REQUIRED until the link is released.

The maximum **callClearing** distance is 35 km for a cell working in normal mode and 90 km for a cell working in extended mode.

3.8.3 Radio link monitoring

Radio link monitoring is based on SACCH message analysis. It is performed by the mobile stations on the downlink and the BTS on the uplink.

3.8.3.1 Configuration parameters

- callReestablishment (bts object)
- radioLinkTimeOut (bts object)
- rlf1 (bts object)
- rlf2 (bts object)
- rlf3 (bts object)
- t3109 (bts object)

The **radioLinkTimeOut** parameter defines the initial value assigned to the counter (S) in the downlink monitoring process, expressed as multiples of SACCH frames.

The **rlf1** parameter defines the initial value assigned to the counter (CT) in the uplink monitoring process. The **rlf2** and **rlf3** parameters define the relative values by which the (CT) counter is stepped up or down for each SACCH occurrence.

Remark: The OMC-R does not check whether the values assigned to the **radioLinkTimeOut** and **rlf1** parameters by users for a same cell are consistent.

3.8.3.2 Processing algorithms

Downlink direction The mobile station executes the monitoring process on SACCH blocks in dedicated mode.

Counter (S) is set to **radioLinkTimeOut**.

On each SACCH message occurrence, the mobile station does the following:

- If the message is decoded, then S = min(**radioL inkTimeOut**, S+2)
- If the message is not decoded, then S = max(0, S-1)

If the counter (S) drops to zero, the radio link is declared faulty. An attempt to restore the link is made if call reestablishments are allowed in the cell (**callReestablishment**).

Uplink direction The FP in the BTS executes the monitoring process on SACCH channels.

The rlf parameter clarification is shown as follows:

The FP runs the following algorithm to monitor the uplink SACCHs (MS-to-BTS direction).

The FrameProcessor sets the CT counter to 0 at channel activation.

On each correct SACCH:

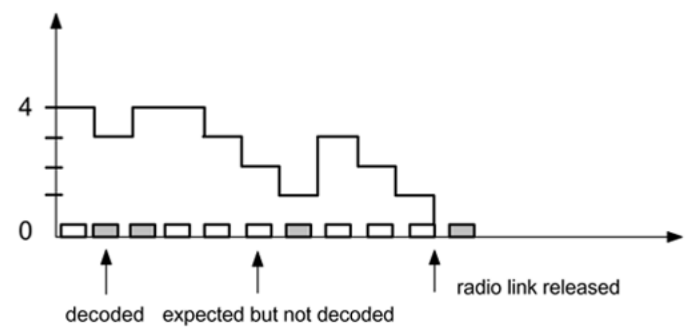
if (CT = 0) then CT=4*rlf1 + 4 else CT=min(4*rlf1 + 4,CT+rlf2)

On each incorrect SACCH:

CT = max(0,CT-rlf3)
When CT reaches 0, a CONNECTION FAILURE INDICATION message is sent to the BSC every T3115, until a Deactivate SACCH or RF CHANNEL RELEASE message is received.

Summary diagram

Summary diagram



3.9 Radio resource allocation

3.9.1 Principles

The BSC radio resource allocator is in charge of managing allocation requests and optimizing radio resource allocations in terms of time.

There are two sorts of TCH allocation requests, as follows:

- the priority requests that are never queued, such as immediate assignment, inter- and intra-bss handover requests, and inter-bts handover requests
- the non-priority requests that can be queued, such as paging and intra-bts handover requests, etc.

TCH allocation requests are processed according to the priority rating assigned to the request by the network operator. A number of TCHs in each cell are reserved for allocation requests with the maximum priority.

The radio resource allocator then assigns the best available resource according to the predefined idle channel classification established by the L1M function in the BTS.

The TCH reservation mechanism is independent of the queue management mechanism, even though they both use the same priority conversion table.

3.9.2 Configuration parameters

- allocPriorityTable (bts object)
- allocPriorityThreshold (bts object)
- allocPriorityTimers (bts object)
- allocWaitThreshold (bts object)
- allOtherCasesPriority (bts object)

- answerPagingPriority (bts object)
- assignRequestPriority (bts object)
- bscQueueingOption (signallingPoint object)
- callReestablishmentPriority (bts object)
- emergencyCallPriority (bts object)
- interCellHOExtPriority (bts object)
- interCellHOIntPriority (bts object)
- intraCellHOIntPriority (bts object)
- intraCellQueueing (bts object)
- otherServicesPriority (bts object)
- small to large zone HO priority (bts object - concentric cells)

The overall permission to queue allocation requests is defined at BSS level (**bscQueueingOption**).

The permission to queue allocation requests for intra-bts handovers is defined at cell level (**intraCellQueueing**) and may differ from one BSS cell to another. It is not significant unless queuing is permitted at BSS level.

The priorities of allocation request processing (**xxxPriority**) are defined at cell level and may vary from one BSS cell to another.

3.9.3 Priority management

The external priority of each type of request is converted into an internal priority (**xxxPriority**).

The MSC or OMC-R supplies the external priorities, and the user defines the internal priorities.

The possible priority values are the following:

- External MSC priorities are in the range [1 to 14)].
- External OMC-R priorities are in the range [0 to 17].
- Internal priorities are in the range [0 to 7].

3.9.4 Queuing management

Queuing consists in placing TCH allocation requests in waiting lists according to the priority of the request if no TCH resource is available. All the requests with the same priority are placed in the same queue.

The internal priority of each type of request is assigned to a given queue using the **allocPriorityTable**.

Each queue is assigned a maximum request waiting time (**allocPriority Timers**) and the maximum number of requests it can contain (**allocWaitThreshold**).

Remark: If the value of these two parameters is set to zero for a given priority, then allocation requests with that priority are never queued.

Concerning intracell handover requests, it is recommended not to allow queuing for this kind of request in monozone cells.
In dual-zone cells (concentric cells, dual-coupling cells, and dual-band cells), queuing must not be allowed at all for intracell handover requests.

3.9.5 Processing algorithm

The following table summarizes the allocation request processing algorithm.

TCH allocation request	Processing
Maximum priority and queuing allowed	If a TCH is available, allocation. If no TCH is available, queuing or request refused if the queue is full.
Maximum priority and queuing not allowed	If a TCH is available, allocation. If no TCH is available, request refused.
Non-maximum priority and queuing allowed	If the number of available TCHs exceeds **allocPriorityThreshold**, allocation. If it does not exceed **allocPriorityThreshold**, queuing or request refused if the queue is full.
Non-maximum priority and queuing not allowed	If the number of available TCHs exceeds **allocPriorityThreshold**, allocation. If it does not exceed **allocPriorityThreshold**, request refused.

3.9.6 Concentric cells

In a concentric cell, the radio resources are shared between the outer zone and the inner zone.

Any immediate assignment or incoming inter- or intra-bss handover request can:

- either call on radio resources assigned to the outer zone
- or call on radio resources assigned to the inner zone (Direct TCH allocation in the small zone - Feature TF889)

The priority of allocation request processing for intra-bts handovers in a concentric cell (**small to large zone HO priority**) is only significant in case of inter-zone handover from the inner to the outer zone.

No processing priority is assigned to allocation requests for intra-zone handovers. These handovers are initiated by the BTS.

3.9.7 Idle radio channel classification

Available radio resources in the BSS are regularly monitored. The measurements processed by the BTS are used to classify idle radio channels according to user-dependent interference levels. The BSC then processes the list of idle channels and arranges them in the order of allocation priority.

This information is sent to the radio resource allocator. When the allocation request is legitimate, it first assigns the idle channels with the lowest interference level.

In the case of an intracell handover, the target resource is limited to low interference level timeslots only. If no low interference level resources are available, the requested intracell handover is not executed (Feature TF819 - *Intra cell HO Improvement*).

Refer to Section 3.4 "Radio measurement processing" (page 355).

3.10 Frequency hopping management

This paragraph describes frequency hopping management principles and the processes used by the BSC to redefine frequencies if a frequency is lost as a result of a TRX/DRX failure.

3.10.1 Configuration parameters

- bscHopReconfUse (bsc object)
- btsHopReconfRestart (bts object)
- btsIsHopping (bsc object)
- btsThresholdHopReconf (bts object)
- cellAllocation (bts object)
- fhsRef (channel object)
- hoppingSequenceNumber (frequencyHoppingSystem object)
- maio (channel object)
- mobileAllocation (frequencyHoppingSystem object)
- siteGsmFctList (bts SiteManager object)
- zone frequency threshold (transceiverZone object)

The **mobileAllocation** and **hoppingSequenceNumber** parameters of the frequencyHoppingSystem objects related to the bts objects define the frequencies and hopping sequences used by radio time slots (channel objects) that support frequency hopping.

The **maio** and **fhsRef** parameters of the channel objects attached to the transceiver objects define the frequency hopping laws used by the radio time slots that support frequency hopping.

The **btsIsHopping** parameter defines the overall radio channel frequency hopping conditions in a cell.

The **bscHopReconfUse** parameter defines the frequency hopping redefinition conditions in the BSS for BTSs using cavity coupling.
The **btsHopReconfRestart** parameter defines the frequency hopping redefinition conditions in a BSS cell when a TX is restarted.

The **btsThresholdHopReconf** parameter defines the minimum number of working frequencies required in a cell for the cell to remain operational.

The **zone frequency threshold** parameter defines the minimum number of working frequencies in a zone of a concentric cell that allows hopping frequency reconfiguration in the zone.

The **siteGsmFctList** parameter defines the GSM functions supplied by the radio site BCF. When the "freqMgt" function is supplied, it authorizes use of the frequency redefinition process.

3.10.2 Frequency hopping management principles

Frequency hopping is not allowed on a radio channel unless it is also allowed in the cell covering the TDMA frame.

Frequency hopping on a radio channel carrying a cell BCCH is forbidden.

In one TDMA frame, frequency hopping may be allowed on some radio channels and disallowed on others.

Each radio channel supporting frequency hopping in a TDMA frame is characterized by the following parameters:

- a list of MA hopping frequencies (**mobileAllocation**)
- an HSN hopping sequence number (**hoppingSequenceNumber**)
- an index pointing the list of hopping frequencies (**maio**)

The **mobileAllocation** list contains a subset of frequencies defined for the parent cell (**cellAllocation**).

A radio channel can use the 1:3 re-use pattern or a unique 1:1 reuse pattern, which reduces cochannel interference more effectively. The 1:1 reuse pattern has the following restrictions:

- The same Hopping Sequence Number (HSN) and Mobile Allocation Index Offset (MAIO) are not reused on two different cells in the same site.
- Different HSNs are not used on cells in the same site.
- The minimum frequency spacing between channels is 400 kHz.
- The MAIOs are distributed equally in order to have the same space (for example, 600 kHz) between used frequencies.

3.10.3 Frequency redefinition process

The conditions in which the frequency redefinition process is implemented are described in the Section 3.12 "Defense and reconfiguration" (page 424).

If the **btsThresholdHopReconf** parameter defines the nominal number of frequencies in a cell, then the redefinition process is inhibited for that cell.

For a concentric cell, if the **zone frequency threshold** parameter defines a number of frequencies greater than the number of available frequencies in a zone, then the redefinition process is inhibited for that zone.

Dynamic hopping frequency reconfiguration is only possible in a BTS using cavity coupling.

The frequency redefinition process calls on all the TDMA frames defined for the parent cell (or for the partnered zone in a parent concentric cell).

The BSC is charged with the following:

- clear all the TDMA frames that are configured for the cell
- select the TDMA frame to remain unconfigured. If the TDMA frame partnered with the faulty TRX/DRX has priority over other TDMA frames in the cell, it is reconfigured to the prejudice of another one.
- define the new configuration parameters
- reconfigure all TDMA frame radio time slots with the new parameter values
- report the event to the OMC-R agent

The TDMA frame that is not reconfigured cannot be used until the process is run again.

3.10.4 Time slot reconfiguration

Let assume that the current cell is configured with the following:

- N TDMA frames
- N frequencies
- M TDMA frames with radio time slots allowed to hop on M frequencies (M is less than or equal to N)

Then, the radio time slots are reconfigured as follows:

- The same **hoppingSequenceNumber** is assigned to all radio time slots in the M TDMA frames. It equals the HSN defined for the first time slot allowed to hop in the TDMA frame with the highest priority.
- The same **maio** index is assigned to all radio time slots allowed to hop in a given TDMA frame and is allotted in the order of the M TDMA frame priority. It is less than M and differs from one TDMA frame to another.
- The same **mobileAllocation** list of frequencies is assigned to all radio time slots in the M TDMA frames.
- For all time slots no.0 allowed to hop in the M TDMA frames, if the BCCH frequency is included in the **mobileAllocation** list, it is withdrawn from the list and the **maio** index is decreased by 1.

3.11 Frequency plan change for large scale networks

As networks grow, the task of changing a frequency plan needs to be simplified and non-obtrusive into the network traffic.

This function will make maintenance easier and improve quality of service for the end-user.

Command file generation for a middle-size network lasts less than 3 hours. Its execution remains within 3 hours, leaving time to fallback if necessary.

3.12 Defense and reconfiguration

This paragraph describes the fail-safe actions taken by the BSC or BTS when an equipment problem is detected:

- Defense consists of protecting the BSS against the adverse effects of component failures by isolating the responsible entity.
- Reconfiguration consists of maintaining the quality of service by enabling redundant equipment.

The BSC (BTS) is required to inform the OMC-R (BSC) of any problems that may be encountered and the fail-safe actions performed to resolve them.

3.12.1 Configuration parameters

- bscHopReconfUse (bsc object)
- btsHopReconfRestart (bts object)
- btsThresholdHopReconf (bts object)
- minNbOfTDMA (bts object)
- redundantPcmPresence (btsSiteManager object)
- traffic PCM allocation priority (transceiver object)

The **bscHopReconfUse** parameter defines the conditions in which hopping frequencies may be reconfigured in the BTSs of a BSS using cavity coupling. The **btsHopReconfRestart** defines the conditions in which hopping frequencies may be reconfigured in a BSS cell when a TX is restarted.

The **btsThresholdHopReconf** and **minNbOfTDMA** parameters define the minimum number of working frequencies and TDMA frames required for the cell to remain operational.

The **redundantPcmPresence** parameter defines the presence of a redundant PCM on a radio site.

The **traffic PCM allocation priority** parameter defines the priority in which TDMA time slots on the covered site PCMs are allocated and is used if Abis PCMs are reconfigured.

3.12.2 Defense

3.12.2.1 Radio site

Isolating a radio site triggers the following actions:

- isolate the site radio cells
- lock the LAPD channels used by the site and its GSM equipment (BCF and TRX/DRXs)
- disconnect the PCM time slots used by the site
- report the event to the OMC-R agent that sends alarm notifications and state change messages for the btsSiteManager object describing the faulty radio site (**operationalState** = "disabled" and **availabilitySt atus** = "dependency") and all dependent objects (see below)

3.12.2.2 Radio cell

Isolating a radio cell triggers the following actions:

- isolate the TRX/DRX transceivers in the radio cell
- break the O&M dialogue with the cell GSM equipment (TRX/DRXs)

- report the event to the OMC-R agent that sends alarm notifications and state change messages for the bts object describing the faulty radio cell (**operationalState** = "disabled" and **availabilitySt atus** = "dependency") and all dependent objects (see below)

3.12.2.3 Radio transceiver

Isolating a radio transceiver triggers the following actions:

- clear the partnered TDMA frame configuration
- report the event to the OMC-R agent that sends alarm notifications and state change messages for the transceiverEquipment object describing the faulty TRX/DRX (**operationalState** = "disabled" and **availa bilityStatus** = "failed") and the partnered transceiver object (see below)

If the number of working frequencies drops below the **btsThresholdHo-pReconf** operating limit for the related cell, the cell is isolated at the same time, or else it remains operational.

3.12.2.4 TDMA frame

Clearing a TDMA frame configuration triggers the following actions:

- inform the BTS of TDMA unavailability and break off all ongoing calls on TCHs
- end the dialogue with the partnered TRX/DRX on the RSL link
- report the event to the OMC-R agent that sends alarm notifications and state change messages for the transceiver object describing the faulty TDMA frame (**operationalState** = "disabled" and **availabilitySt atus** = "dependency").

If the TDMA frame is one of the **minNbOfTDMA** priority frames that must be configured for the parent cell, the cell is isolated at the same time, or else it remains operational.

3.12.2.5 PCM link

Isolating a PCM link triggers the following actions:

- if LAPD channels use the link, force their resource state to "unavailable"
- if traffic channels use the link, break off all calls conveyed on these channels

3.12.3 Reconfiguration

3.12.3.1 TDMA frame

This procedure is used if the partnered TRX/DRX becomes faulty.

- If a redundant TRX/DRX exists for the radio cell, the following apply:
  — The TDMA frame is reconfigured if the TRX/DRX class is compatible.

- — The dialogue with the TRX/DRX on the RSL link is restored.
- — The TCHs in the TDMA frame are allotted to radio time slots on one of the PCM links used by the radio site.

- If no redundant TRX/DRX exists for the radio cell, the following apply:
  - — If the TDMA frame has priority over another TDMA frame allotted to the same cell, it is reconfigured on the TRX/DRX partnered with the low priority TDMA frame if the TRX/DRX class is compatible and the configuration of the low priority TDMA frame is cleared.
  - — If the TDMA frame has not priority over others and respects frequency hopping laws, and if the BTS uses cavity coupling, the frequency redefinition process is executed (see Section 3.10 "Frequency hopping management" (page 421)).
  - — If the TDMA frame has not priority over others and respects frequency hopping laws, and if the BTS does not use cavity coupling, the TDMA frame remains operational and does not need to be reconfigured.

3.12.3.2 Radio transceiver

To reconfigure a TRX/DRX, the Level 3 dialogue has to be reestablished.

The frequency redefinition process is executed on the partnered TDMA frame if it is allowed.

3.12.3.3 Radio site

If the site has to be reconfigured because of a PCM link failure, the following apply:

- If the LAPD link with the radio site BCF is affected, the BSC reestablishes the Level 2 dialogue on another PCM link (whether normal or redundant). This supposes that the same time slot is available on the new PCM link.
- If other LAPD links are affected and the GSM function "abisSig" is supplied by the radio site, the BSC sets the redundant PCM link in service and assigns the same PCM time slot as before to each LAPD link.
- If traffic channels are affected and the GSM function "abisTraf" is supplied by the radio site, the BSC sets the redundant PCM link in service and assigns the same PCM time slot as before to each traffic channel.

  Reconfiguration priority is given to the traffic channels conveyed by the highest priority TDMA frames.

3.13 Uplink mapping

3.13.1 Principles

Uplink mapping aims at producing uplink coverage maps and consequently interferences matrices based on field measurements (Feature TF876 *Uplink Mapping*).

BTSs measure the signal generated by a mobile tool on a given frequency, and thus obtain field measurements.

A mobile tool is composed of:

- a transmitter
- a test mobile station
- a Dead Reckoning - Global Positioning System (DR-GPS)

Measurements are sent by BTSs to the BSC and then collected by an external data server. This server merges the measurements with the data recorded by the mobile tool, so as to obtain coverage maps.

3.13.2 Prerequisites

- Uplink mapping is applicable to GSM1800 network using software system release V12.4 (Uplink mapping is therefore not applicable to dual-band networks such as GSM900/GSM1800).
- BTSs must be equipped with DCU4 boards only (no DCU2 bands at all).

3.13.3 Configuration parameters

- uplinkMappingChannelNumber (bts object)
- uplinkMappingFreq (bts object)
- uplinkMappingMeasurementMode (bts object)
- uplinkMappingProcessingMode (bts object)

3.13.3.1 Management parameters

The **uplinkMappingChannelNumber** parameter defines the monitored timeslot used during an uplink mapping campaign.

This information is provided to the BTSs by the user through the OMC-R, together with the frequency f0 which is defined by the **uplinkMappingFreq** parameter. The frequency f0 is used by the transmitter to send a continuous sinusoidal signal to all the cells of the network.

The **uplinkMappingMeasurementMode** parameter enables to set a BTS in measurement mode or in non measurement mode.

The **uplinkMappingProcessingMode** parameter enables to set a BSC in monitoring mode or in idle mode.

3.13.4 Measurement processing

3.13.4.1 Hardware installation

- Install the Ethernet kit on the BSC to connect the external data server to the BSC(s).
- Install an RARP (Reverse Address Resolution Protocol) server in the LAN (Local Area Network) to manage the mapping between BSC Ethernet addresses and IP addresses.

3.13.4.2 Configuration

- At the OMC-R, send the values of the frequency f_0 and the monitored TS to each cell of the network:
  - — Set the bts objects to "locked".
  - — Set the **uplinkMappingChannelNumber** and the **uplinkMappingFreq** parameters to their correct values.
  - — Set the **uplinkMappingMeasurementMode** parameter to "enabled".
  - — Set the bts objects to "unlocked".
- Then the network is in idle state: the measurements sent by the BTSs (if any) are still ignored by the BSC.

3.13.4.3 Activation

- At the OMC-R, set the f0 channel to "locked" through the "set channel state" action.
- At the OMC-R, set the BSC in monitoring state: set the **uplinkMappingProcessingMode** parameter to "enabled".
- Then the BSC starts to send measurements to the external data server.

3.13.4.4 Measurement period

- The mobile tool moves through the network.
- the transmitter broadcasts a predefined frequency f0 which is a continuous sinusoidal signal.
- the test mobile station listens to the BTSs. It is coupled to a DR-GPS to record the position of the transmitter and also information on the serving cell.
- The uplink f_0 received level is monitored by all the cells of the network, and level measurements are sent by the BTSs to the BSC and then by the BSC to an external data server.

- The data server collects all the data transmitted by the BSC and merges these data with the data recorded by the mobile tool, so as to obtain coverage maps.

3.13.4.5 Deactivation

- At the OMC-R, set the BSC in idle state: **uplinkMappingProcessing-Mode** parameter to "disabled".
- Then the BSC stop sending measurements to the external data server.
- At the OMC-R, set the f0 channel to "unlocked" through the "set channel state" action.

3.13.4.6 Unconfiguration

-
  — Set the bts objects to "locked".

  — Set the **uplinkMappingMeasurementMode** parameter to "disabled".

  — Set the bts objects to "unlocked".

- Then the network is in idle state: BTSs stop collecting and sending measurements. Their nominal configuration is reestablished.

3.14 Hardware constraints (from V14 release):

The handover adaptation is not available on DCU2, thus its activation on this equipment type has the following consequences:

- S4000/S2000E DCU2: this feature is not activated and all PBGT(n) and power control mechanisms related to the L1mV1 are applied
- S4000/S2000E DCU2/DCU4, this feature created some inconsistencies between TRXs. It is strongly recommended to deactivate the feature, with this kind of BTS.

Appendix A
BTS TEI NUMBERING RULES

The TEI numbering rules are given hereafter for each BTS equipment in all the configurations available in V13, V14, V15 and V16.

A.1 S2000 BTSs

A.2 S4000 BTSS

A.3 S2000 H/L BTSs

A.4 e-cell BTSs

A.4.1 Monoband configurations

BTS	Standard configura tion	TEI_{trx} cell 1	TEI_{trx} cell 2	TEI_{trx} cell 3
e-cell	1O2 2O4	32 32, 33, 34, 35		
e-cell dualba nd	O2O2	32, 33, 34, 35		

A.4.2 Dualband BCF configurations with monoband cells

Configuration	BTSId	
BCF	0	1
	F1	F2
1O2_2 D	32, 33	35, 34

A.5 S8002 BTSs

BTS	Standard configuration	TEI_{TRX} cell 1	TEI_{TRX} cell 2	TEI_{TRX} cell 3
S8002 Outdoor Dup	O2	32, 33		

A.6 S8000 Outdoor/Indoor BTSs

A.6.1 Monoband S8000 BTS configurations

A.6.1.1 Mono-cabinet

Configurations	TEI_{TRX} cell 1	TEI_{TRX} cell 2	TEI_{TRX} cell 3
1S111 D to 1S222 D	32, 33	35, 36	38,39
1O1 D to 1S44 D (+Tx Filter)	32 to 35	36 to 39	
1O1 H2D to 1O8 H2D	32 to 39		
1S11 H2D to 1S44 H2D	32 to 35	36 to 39	
1S113 H2D to 1S323 H2D	32 to 34	35, 36	38, 39, 37
1S133 H2D to 1S233 H2D	32, 33	35, 36, 34	38,39,37
1S411 H2D to 1S422 H2D	32 to 35	36, 37	38, 39
1S141 H2D to 1S242 H2D	32, 33	34 to 37	38, 39
1S114 H2D to 1S224 H2D	32, 33	34, 35	36 to 39
1O1 H4D to 1O8 H4D	32 to 39		
1O2 H2D_D to 1O6 H2D_D	32 to 37		
1O2 H4D_H2D to 1O8 H4D_H2D	32 to 39		

A.6.1.2 Bi-cabinet

Configurations	TEI_{TRX} cell 1	TEI_{TRX} cell 2	TEI_{TRX} cell 3
2S111 D to 2S444 D (+Tx)	32 to 35	36 to 39	40 to 43
2S111 H2D to 2S444 H2D	32 to 35	36 to 39	40 to 43
2S11 H2D to 2S88 H2D	32 to 39	40 to 47	
2S11 H4D to 2S88 H4D	32 to 39	40 to 47	
2S115 H2D to 2S448 H2D	32 to 35	36 to 39	40 to 47
2S111 H2D/H4D to 2S448 H2D/H4D	32 to 35	36 to 39	40 to 47
2S511 H2D to 2S844 H2D	32 to 39	40 to 43	44 to 47
2S111 H4D/H2D to 2S844 H4D/H2D	32 to 39	40 to 43	44 to 47
2S22 H2D_D to 2S66 H2D_D	32 to 37	40 to 45	
2S22 H4D_H2D to 2S88 H4D_H2D	32 to 39	40 to 47	

A.6.1.3 Tri-cabinet

Configurations	TEI_{TRX} cell 1	TEI_{TRX} cell 2	TEI_{TRX} cell 3
3S111 H2D to 3S888 H2D	32 to 39	40 to 47	48 to 55
3S111 H4D to 3S888 H4D	32 to 39	40 to 47	48 to 55
3S111 H2D_D to 3S666 H2D_D	32 to 37	40 to 45	48 to 53
3S222 H4D_H2D to 3S888 H4D_H2D	32 to 39	40 to 47	48 to 55

A.6.2 Dualband BCF S8000 BTS configurations with dualband cells

A.6.2.1 Mono-cabinet

Configurations	BTSId					
BCF	0		1		2	
	F1	F2	F1	F2	F1	F2
1O1_1 D to 1O2_2 D	32, 33	35, 36				
1O1_1 H2D to 1O4_4 H2D	32 to 35	36 to 39				
1O5_1 H2D to 1O6_2 H2D	32 to 37	38, 39				

Configurations	BTSId					
BCF	0		1		2	
	F1	F2	F1	F2	F1	F2
1O1_1 H4D/H2D to 1O6_2 H4D/H2D	32 to 37	38, 39				
1O5_3 H2D	32 to 36	37 to 39				
1O1_3 H4D/H2D to 1O5_3 H4D/H2D	32 to 36	37 to 39				

A.6.2.2 Bi-cabinet

Configurations	BTSId					
BCF	0		1		2	
	F1	F2	F1	F2	F1	F2
2S110_110 D 2S222_222D	32, 33	40, 41	35, 36	43, 44	38, 39	46, 47
2S11_11 H2D to 2S44_44 H2D	32 to 35	48 to 51	36 to 39	52 to 55		
2O1_1 H2D to 2O4_4 H2D	32 to 35	48 to 51				
2S11_11 H2D/D to 2S44_22 H2D/D	32 to 35	48, 49	36 to 39	52, 53		
2O1_1 H2D/D to 2O4_2 H2D/D	32 to 35	48, 49				
2S111_111 H2D to 2S332_332 H2D	32 to 34	40 to 42	35 to 37	43 to 45	38, 39	46, 47
2S5_1/5_1 H2D to 2S6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47		
2S1_1/1_1 H4D/H2D to 2S6_26_2 H4D/H2D	32 to 37	38,39	40 to 45	46, 47		
2S5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47		
2S1_3/1_3 H4D/H2D to 2S5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47		

A.6.2.3 Tri-cabinet

Configurations	BTSId					
BCF	0		1		2	
	F1	F2	F1	F2	F1	F2
3S111_111 H2D to 3S444_444H2D	32 to 35	44 to 47	36 to 39	48 to 51	40 to 43	52 to 55
3S11_111 H2D/D to 3S444_222H2D/D	32 to 35	44, 45	36 to 39	48, 49	40 to 43	52, 53
3S5_1/5_1/5_1 H2D to 3S6_2/6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S1_1/1_1/1_1 H4D to 3S6_2/6_2/6_2 H4D	32 to 37	38, 39	40 to 45	46 to 47	48 to 53	54, 55
3S5_3/5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55
3S1_3/1_3/1_3 H4D/H2D to 3S5_3/5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55

A.6.3 Dualband BCF S8000 BTS configurations with monoband cells

A.6.3.1 Mono-cabinet

Configurations	BTSId					
BCF	0	1	2	3	4	5
1O1_1 D to 1O2_2 D	32, 33	35, 36				
1O1_1 H2D to 1O4_4 H2D	32 to 35	36 to 39				
1O5_1 H2D to 1O6_2 H2D	32 to 37	38, 39				
1O1_1 H4D/H2D to 1O6_2 H4D/H2D	32 to 37	38, 39				
1O5_3 H2D	32 to 36	37 to 39				
1O5_3 H4D/H2D to 1O5_3 H4D/H2D	32 to 36	37 to 39				

A.6.3.2 Bi-cabinet

Configurations	BTSId					
BCF	**0**	**1**	**2**	**3**	**4**	**5**
2S110_110 D to 2S222_222D	32, 33	35, 36	38, 39	40, 41	43, 44	46, 47
2S11_11 H2D to 2S44_44H2D	32 to 35	36 to 39			48 to 51	52 to 55
2O1_1 H2D to 2O4_4 H2D	32 to 35				48 to 51	
2S11_11 H2D/D to 2S44_22 H2D/D	32 to 35	36 to 39			48, 49	52, 53
2O1_1 H2D/D to 2O4_2H2D/D	32 to 35				48, 49	
2S111_111 H2D to2S332_332 H2D	32 to 34	35 to 37	38, 39	40 to 42	43 to 45	46, 47
2S5_1/5_1 H2D to 2S6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47		
2S1_1/1_1 H4D/H2D to 2S6_2/6_2 H4D/H2D	32 to 37	38,39	40 to 45	46, 47		
2S5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47		
2S1_3/1_3 H4D/H2D to 2S5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47		

A.6.3.3 Tri-cabinet

Configurations	BTSId					
BCF	**0**	**1**	**2**	**3**	**4**	**5**
3S111_111 H2D to 3S444_444 H2D	32 to 35	40 to 43	36 to 39	44 to 47	48 to 51	52 to 55
3S111_111 H2D/D to 3S444_222 H2D/D	32 to 35	36 to 39	40 to 43	44, 45	48, 49	52, 53
3S5_1/5_1/5_1 H2D to 3S6_2/6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S1_1/1_1/1_1 H4D/H2D to 3S6_2/6_2/6_2 H4D/H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S5_3/5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55
3S1_3/1_3/1_3 H4D/H2D to 3S5_3/5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55

A.6.4 Dualband CBCF S8000 BTS configurations with dualband cells

A.6.4.1 Mono-cabinet

Configurations	BTSId					
CBCF	0		1		2	
	F1	F2	F1	F2	F1	F2
1O1_1 D to 1O2_2 D	32, 33	35, 36				
1O1_1 H2D to 1O4_4 H2D	32 to 35	36 to 39				
1O5_1 H2D to 1O6_2 H2D	32 to 37	38, 39				
1O1_1 H4D/H2D to 1O6_2 H4D/H2D	32 to 37	38, 39				
1O5_3 H2D	32 to 36	37 to 39				
1O1_3 H4D/H2D to 1O5_3 H4D/H2D	32 to 36	37 to 39				

A.6.4.2 Bi-cabinet

Configurations	BTSId					
CBCF	0		1		2	
	F1	F2	F1	F2	F1	F2
2S110_110 D to 2S222_222 D	32; 33	40, 41	35, 36	43, 44	38, 39	46, 47
2S11_11 H2D to 2S44_44 H2D	32 to 35	48 to 51	36 to 39	52 to 55		
2O1_1 H2D to 2O4_4 H2D	32 to 35	48 to 51				
2S11_11 H2D/D to 2S44_22 H2D/D	32 to 35	48, 49	36 to 39	52, 53		
2O1_1 H2D/D to2O4_2 H2D/D	32 to 35	48, 49				
2S111_111 H2D to 2S332_332 H2D	32 to 34	40 to 42	35 to 37	43 to 45	38, 39	46, 47
2S5_1/5_1 H2D to 2S6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47		
2S1_1/1_1 H4D/H2D to 2S6_2/6_2 H4D/H2D	32 to 37	38, 39	40 to 45	46, 47		

Configurations	BTSId					
CBCF	0		1		2	
	F1	F2	F1	F2	F1	F2
2S5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47		
2S1_3/1_3 H4D/H2D to 2S5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47		

A.6.4.3 Tri-cabinet

Configurations	BTSId					
CBCF	0		1		2	
	F1	F2	F1	F2	F1	F2
3S111_111 H2D to 3S444_444 H2D	32 to 35	44 to 47	36 to 39	48 to 51	40 to 43	52 to 55
3S111_111 H2D/D to 3S444_222 H2D/D	32 to 35	44, 45	36 to 39	48, 49	40 to 43	52, 53
3S5_1/5_1/5_1 H2D to 3S6_2/6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S1_1/1_1/1_1 H4D/H2D to 3S5_3/5_3/5_3 H4D/H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S5_3/5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55
3S1_3/1_3/1_3 H4D/H2D to 3S5_3/5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55

A.6.5 Dualband CBCF S8000 BTS configurations with monoband cells

A.6.5.1 Mono-cabinet

Configurations	BTSId					
CBCF	0	1	2	3	4	5
1O1_1 D to 1O2_2 D	32, 33	35, 36				
1O1_1 H2D to 1O4_4 H2D	32 to 35	36 to 39				
1O5_1 H2D to 1O6_2 H2D	32 to 37	38, 39				
1O1_1 H4D/H2D to 1O6_2 H4D/H2D	32 to 37	38, 39				

Configurations	BTSId					
CBCF	0	1	2	3	4	5
1O5_3 H2D	32 to 36	37 to 39				
1O1_3 H4D/H2D to 1O5_3 H4D/H2D	32 to 36	37 to 39				

A.6.5.2 Bi-cabinet

Configurations	BTSId					
CBCF	0	1	2	3	4	5
2S110_110 D to 2S222_222 D	32, 33	35, 36	38, 39	40, 41	43, 44	46, 47
2S11_11 H2D to 2S44_44 H2D	32 to 35	36 to 39			48 to 51	52 to 55
2O1_1 H2D to 2O4_4 H2D	32 to 35				48 to 51	
2S11_11 H2D/D to 2S44_22 H2D/D	32 to 35	36 to 39			48, 49	52, 53
2O1_1 H2D/D to 2O4_2 H2D/D	32 to 35				48, 49	
2S111_111 H2D to 2S332_332 H2D	32 to 34	35 to 37	38, 39	40 to 42	43 to 45	46, 47
2S5_1/5_1 H2D to 2S6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47		
2S1_1/1_1 H4D/H2D to 2S6_2/6_2 H4D/H2D	32 to 37	38,39	40 to 45	46, 47		
2S5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47		
2S1_3/1_3 H4D/H2D to 2S5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47		

A.6.5.3 Tri-cabinet

Configurations	BTSId					
CBCF	0	1	2	3	4	5
3S111_111 H2D to 3S444_444 H2D	32 to 35	40 to 43	36 to 39	44 to 47	48 to 51	52 to 55
3S111_111 H2D/D to 3S444_222 H2D/D	32 to 35	36 to 39	40 to 43	44, 45	48, 49	52, 53

Configurations	BTSId					
CBCF	0	1	2	3	4	5
3S5_1/5_1/5_1 H2D to 3S6_2/6_2/6_2 H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S1_1/1_1/1_1 H4D/H2D to 3S6_2/6_2/6_2 H4D/H2D	32 to 37	38, 39	40 to 45	46, 47	48 to 53	54, 55
3S5_3/5_3/5_3 H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55
3S1_3/1_3/1_3 H4D/H2D to 3S5_3/5_3/5_3 H4D/H2D	32 to 36	37 to 39	40 to 44	45 to 47	48 to 52	53 to 55

A.7 S12000 Outdoor/Indoor BTSs

A.7.1 Monoband S12000 BTS configurations

A.7.1.1 Mono-cabinet

Configurations	BTSId			ConfigRef CBCF Indoor/ Outdoor
	0	1	2	
1O0 D+TxF to 1O12 D+TxF (2)	32-17			U10/V10
1O0 to 1O12 H2D (1)	32-17			U90/V90
1O0 to 1O12 H4D	32-17			UA0/VA0
1S0 0 D+TxF to 1S6 6 D+TxF	32-37	38-17		U14/V14
1S0 0 H2D to 1S6 6 H2D (1)	32-37	38-17		U94/V94
1S0 0 to 1S6 6 H4D	32-37	38-17		UA4/VA4
1S000 D+TxF to 1S444 D+TxF	32-35	36-39	14-17	U11/V11
1S000 H2D to 1S444 H2D (1)	32-35	36-39	14-17	U90/V90

A.7.1.2 Bi-cabinet

Configurations	BTSId	ConfigRef CBCF Indoor/

				Outdoor
	0	1	2	
2S000/000 D+TxF to 2S444/444 D+TxF	32-35 40-43	39-39 44-47	14-17 18-21	U11/V11
2S000/000 H2D to 2S444/444 H2D (1)	32-35 40-43	39-39 44-47	14-17 18-21	U90/V90
2S0 0/0 0 H2D to 2S6 6/6 6 H2D (1)	32-37, 40-45	37-17, 46-21		U94/V94
2S0 0/0 0 to 2S6 6/6 6 H4D	32-37, 40-45	40-45, 46-21		UA4/VA4
2S0 0/0 0 D+TxF to 2S12 12/12 12 D+TxF (2)	32-17	40-21		U10/V10
2S0 0/0 0 H2D to 2S12 12/12 12 H2D (1)	32-17	40-21		U90/V90
2S0 0/0 0 H4D to 2S12 12/12 12 H4D	32-17	40-21		UA0/VA0

The configuration followed by the () are only available for monocabinet which are equipped with H2D or D (not with Tx Filter). There are available in 1Sxxx, 1 Sx_x_x, 1Sxx_x and 1Sx_xx.

(1) : Limited to 2O6_2/6_2 as long as is not possible to manage more than 16 TRX per sector.
(2) On BSC 3000 only for more than 8 TRXs per sector.

A.7.1.3 Tri-cabinet

Configurations	BTSId	ConfigRef CBCF Indoor/

				Outdoor
	0	1	2	
3S0-0-0 D+TxF to 3S12-12-12 D+TxF (2)	32-17	40-21	48-25	U10/V10
3S0-0-0 H2D to 3S12-12-12 H2D (2)	32-17	40-21	48-25	U90/V90
3S0-0-0 H4D to 3S12-12-12 H4D (2)	32-17	40-21	48-25	UA0/VA0

The configuration followed by the () are only available for monocabinet which are equipped with H2D or D (not with Tx Filter).

(2) On BSC 3000 only for more than 8 TRXs per sector.

A.7.2 Dual band S12000 BTS configurations with dualband cells

A.7.2.1 Mono-cabinet

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
CBCF	0		1		2		
	F1	F2	F1	F2	F1	F2	
1S000_000 D to 1S222_222 D	32; 33	38, 39*	34, 35	14, 15*	36, 37	16, 17*	U93/V93
1S00_00 D+TxF to 1S33_33 D+TxF	32 to 34	38 - 14*	35 - 37	15 - 17*			U15/V15
1S00_00 H2D+D to 1S33_33 H2D+D	32 - 34	38 - 14*	35 - 37	15 - 17*			U95/V95
1O0_0 H2D to 1O8_4 H2D	32 - 39	14 - 17*					U92/V92
1O0_0 H4D+H2D to	32 - 39	14 -					UA2/VA2

(*) means F2

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
CBCF	0		1		2		
	F1	F2	F1	F2	F1	F2	
1O8_4 H4D+H2D		17*					
(*) means F2							

A.7.2.2 Bi-cabinet

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
CBCF	0		1		2		
	F1	F2	F1	F2	F1	F2	
2S000_000 D to 2S222_222 D	32; 33 40, 41	38, 39 46, 47	34, 35 42, 43	14, 15* 18, 19*	36, 37 44, 45	16, 17* 20, 21*	U13/V13
2S000_000 D+TxF to 2S444_444 D+TxF	32 - 35	40 - 43*	36 - 39	44 - 47*	14 - 17	18 - 21*	U11/V11
2S000_000 H2D to 2S444_444 H2D	32 - 35	40 - 43*	36 - 39	44 - 47*	14 - 17	18 - 21*	U90/V90
2S00_00/00_00 D+TxF to 2S33_33/33_33 D+TxF	32 - 34 40 - 42	38 - 14 46 - 18	35 - 37 43 - 45	15 - 17* 19 - 21*			U15/V15
2S00_00/00_00 H2D to 2S33_33/33_33 H2D	32 - 34 40 - 42	38 - 14 46 - 18	35 - 37 43 - 45	15 - 17* 19 - 21*			U95/V95
2S4_0/4_0 H2D to 2S8_4/8_4 H2D	32 - 39	14 - 17*	40 - 47	18 - 21*			U92/V92

(*) means F2

(1) : Limited to 2O6_2/6_2 as long as is not possible to manage more than 16 TRX per sector.

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
CBCF	0		1		2		
	F1	F2	F1	F2	F1	F2	
2S4_0/4_0 H4D+H2D to 2S8_4/8_4 H4D+H2D	32 - 39	14 - 17*	40 - 47	18 - 21*			UA2/VA2
2O4_0/4_0 H2D to 2O8_4/8_4 H2D	32 - 39 40 - 47	14 - 17 18 - 21*					U92/V92
2O4_0/4_0 H4D+H2D to 2O8_4/8_4 H4D+H2D (1)	32 - 39 40 - 47	14 - 17 18 - 21*					UA2/VA2

(*) means F2

(1) : Limited to 2O6_2/6_2 as long as is not possible to manage more than 16 TRX per sector.

A.7.2.3 Tri-cabinet

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
CBCF	0		1		2		
	F1	F2	F1	F2	F1	F2	
3S4_0/4_0/4_0 H2D to 3S8_4/8_4/8_4 H2D (2)	32 - 39	14 17*	40 - 47	18 - 21*	48 - 55	22 - 25	U92/V92
3S4_0/4_0/4_0 H4D+H2D to 3S8_4/8_4/8_4 H4D+H2D (2)	32 - 39	14 17*	40 - 47	18 - 21*	48 - 55	22 - 25	UA2/VA2

(*) means F2

(2) On BSC 3000 only for more than 8 TRXs per sector.

A.7.3 Dualband CBCF S12000 BTS configurations with dualband sites

A.7.3.1 Mono-cabinet

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
	0	1	2	3	4	5	
1S000_000 D to 1S222_222 D	32; 33	34, 35	36, 37	38, 39*	14, 15*	16, 17*	U93/V93
1S00_00 D+TxF to 1S33_33 D+TxF	32 - 34	35 - 37		38 - 14*	15 - 17*		U15/V15
1S00_00 H2D+D to 1S33_33 H2D+D	32 - 34	35 - 37		38 - 14*	15 - 17*		U95/V95
1O0_0 H2D to 1O8_4 H2D	32 - 39			14 - 17*			U92/V92
1O0_0 H4D+H2D to 1O8_4 H4D+H2D	32 - 39			14 - 17*			UA2/VA2
(*) means F2							

A.7.3.2 Bi-cabinet

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
	0	1	2	3	4	5	
2S000_000 D to 2S222_222 D	32; 33 40, 41	34, 35 42, 43	36, 37 44, 45	38, 39* 46, 47*	14, 15* 18, 19*	16, 17* 20, 21*	U13/V13
2S000_000 D+TxF to 2S444_444 D+TxF	32 - 35	36 - 39	14 - 17	40 - 43*	44 - 47*	18 - 21*	U11/V11
2S000_000 H2D to 2S444_444 H2D	32 - 35	36 - 39	14 - 17	40 - 43*	44 - 47*	18 - 21*	U90/V90
2S00_00/00_00 D+TxF to 2S33_33/33_33 D+TxF	32 - 34 40 - 42	35 - 37 43 - 45		38 - 14* 46 - 18*	15 - 17* 19 - 21*		U15/V15
2S00_00/00_00 H2D to 2S33_33/33_33 H2D	32 - 34 40 - 42	35 - 37 43 - 45		38 - 14* 46 - 18*	15 - 17* 19 - 21*		U95/V95

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
	0	1	2	3	4	5	
2S4_0/4_0 H2D to 2S8_4/8_4 H2D	32 - 39	14 - 17		40 - 47*	18 - 21*		U92/V92
2S4_0/4_0 H4D+H2D to 2S8_4/8_4 H4D+H2D	32 - 39	14 - 17		40 - 47*	18 - 21*		UA2/VA2
2O4_0/4_0 H2D to 2O8_4/8_4 H2D (1)	32 - 39	14 - 17		40 - 47*	18 - 21*		U92/V92
2O4_0/4_0 H4D+H2D to 2O8_4/8_4 H4D+H2D (1)	32 - 39	14 - 17*		40 - 47*	18 - 21*		UA2/VA2

A.7.3.3 Tri-cabinet

Configurations	BTSId						ConfigRef CBCF Indoor/ Outdoor
	0	1	2	3	4	5	
3S4_0/4_0/4_0 H2D to 3S8_4/8_4/8_4 H2D (2)	32 - 39	40 - 47	48 - 55	14 - 17*	18 - 21*	22 - 25	U92/V92
3S4_0/4_0/4_0 H4D+H2D to 3S8_4/8_4/8_4 H4D+H2D (2)	32 - 39	40 - 47	48 - 55	14 - 17*	18 - 21*	22 - 25	UA2/VA2
(*) means F2 (1) : Limited to 2O6_2/6_2 as long as is not possible to manage more than 16 TRX per sector. (2) On BSC 3000 only for more than 8 TRXs per sector.							

A.8 BTS 18000

A.8.1 TEI Numbering

To be able to manage up to 54 TRXs (BTS 18000 green field in an S181818 configuration), the TEI must be coded on the Abis interface on 7 bits. This has an impact on the OMC-R, BSC 12000HC, and BSC 3000.

An RM always supports three consecutive TEI TRX numbers. If only one TRX is configured on an RM, the other two values are reserved and s cannot be used by another RM. The TEI supported by one RM must have values that are consecutive in the tables given below.

For example, for shelf 1 in Table 18 "TRX TEI Numbering" (page 447), TEIs 38, 39, and 14 are considered as being consecutive. In an RM, the first TEI (TEI 38 in this example) is always associated with the first transmit path, the second TEI (TEI 39) is always associated with the second transmit path, and the third TEI (TEI 14) is always associated with the third transmit path.

Some of the TEI of the RM can be configured as spares, in order to be used as a spare TRX in case of failure of one of the others. This defense mechanism still exists.

A.8.2 TEI Mapping

A.8.2.1 TEI numbering for TRXs

The TRX TEI numbering per shelf is given in Table 18 "TRX TEI Numbering" (page 447).

Table 18
TRX TEI Numbering

Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5	Shelf 6
32	15	40	19	48	23
33	16	41	20	49	24
34	17	42	21	50	25
35	62	43	68	51	74
36	63	44	69	52	75
37	64	45	70	53	76
38	65	46	71	54	77
39	66	47	72	55	78
14	67	18	73	22	79

A.8.2.2 TEI numbering for ABM

The ABM TEI numbering per shelf is given in Table 19 "ABM TEI Numbering" (page 447).

Table 19
ABM TEI Numbering

Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5	Shelf 6
80	81	82	83	84	85

A.8.2.3 Other TEIs

TEI 0 to 9 are site TEIs.

If SPMs are connected to the ICM through a LAPD link, TEIs 86 and 87 are used.

If IFMs are connected to the ICM through a LAPD link, TEIs 88 and 89 are used.

A.8.2.4 Spare TRXs

Spare TRXs can be defined exactly the same way they are on S8000/S12000 BTSs.

The spare TRXs are part of the BTS configuration. All radio and coupling modules necessary for the spare TRX are installed and connected. Each spare TRX is created on the OMC-R and is dedicated to a given cell. The spare TRX are available for TDMA defenses managed by the BSC through the TDMA reconfiguration function.

A.8.3 Location of shelves

A.8.3.1 Indoor BTS 18000

Shelves 1 and 2 are in the main cabinet (shelf 1 is upper and shelf 2 is lower); shelves 3 and 4 are in the first extension (shelf 3 is upper and shelf 4 is lower); shelves 5 and 6 are in the second extension (shelf 5 is upper and shelf 6 is lower).

A.8.3.2 Outdoor BTS 18000:

Shelves 1 and 2 are in the main cabinet (shelf 1 is left and shelf 2 is right); shelves 3 and 4 are in the first extension (shelf 3 is left and shelf 4 is right); shelves 5 and 6 are in the second extension (shelf 5 is left and shelf 6 is right).

Appendix B
GSM EQUIVALENCES

This appendix presents the equivalence between radio parameter names used on the OMC-R Man-Machine interface and the GSM series recommendation names.

GSM 12.20 and OMC-R names	GSM series 04.xx and 05.xx names
absoluteRFChannelNo	ARFCN
averagingPeriod + thresholdInterf erence	INTAVE
baseColourCode	BCC
bCCHFrequency	BA *or* BCCH ARFCN
bssMapT1	BSSMAP/T1b *and* BSSMAP/T1u
bssMapT12	BSSMAP/T12
bssMapT13	BSSMAP/T13
bssMapT19	BSSMAP/T19
bssMapT20	BSSMAP/T20
bssMapT4	BSSMAP/T4
bssMapT7	BSSMAP/T7 *or* T_HAND_RQD
bssMapT8	BSSMAP/T8
bssSccpConnEst	SCCP/T(conn est)
bssSccpInactRx	SCCP/T(iar)
bssSccpInactTx	SCCP/T(ias)
bssSccpRelease	SCCP/T(rel)
bssSccpSubSysTest	SCCP/T(state info)
bsTxPwrMax	BS_TXPWR_MAX
btsIsHopping	FH
callClearing	MS_RANGE_MAX_CLEAR
callReestablishment	CALL_REESTAB

GSM 12.20 and OMC-R names	GSM series 04.xx and 05.xx names
cellAllocation	CA
cellBarQualify	CELL_BAR_QUALIFY
cellBarred	CELL_BAR_ACCESS
cellDeletionCount	CELL_DELETE_COUNT
cellIdentity	CI
cellReselectHysteresis	CELL_RESELECT_HYSTERESIS
cellReselectOffset	CELL_RESELECT_OFFSET
channel	TN
cRC	CRC_USED
distHreqt	DIST_HREQT
distWtsList	DIST_WT
dtxMode	DTX_USED
emergencyCallRestricted	ACCESS_CONTROL_CLASS
hoMargin	HO_MARGIN(n)
hoMarginDist	HO_MARGIN_DIST(n)
hoMarginRxLev	HO_MARGIN_RXLEV(n)
hoMarginRxQual	HO_MARGIN_RXQUAL(n)
hoppingSequenceNumber	HSN
iMSIAttachDetach	ATT
intraCell	INTRACELL_USED
intraCellSDCCH	INTRACELL_USED_SDCCH
locationAreaCode	LAC
lRxLevDLH	L_RXLEV_DL_H
lRxLevDLP	L_RXLEV_DL_P
lRxLevULH	L_RXLEV_UL_H
lRxLevULP	L_RXLEV_UL_P
lRxQualDLH	L_RXQUAL_DL_H
lRxQualDLP	L_RXQUAL_DL_P
lRxQualULH	L_RXQUAL_UL_H
lRxQualULP	L_RXQUAL_UL_P
maio	MAIO
maxNumberRetransmission	MAX_RETRANS
missDistWt	MISS_DIST_WT
missRxLevWt	MISS_RXLEV_WT

GSM 12.20 and OMC-R names	GSM series 04.xx and 05.xx names
missRxQualWt	MISS_RXQUAL_WT
mobileAllocation	MA
mobileCountryCode	MCC
mobileNetworkCode	MNC
msBtsDistanceInterCell	MS_BS_DIST_USED
msRangeMax	MS_RANGE_MAX_HAND
msTxPwrMax	MS_TXPWR_MAX
msTxPwrMaxCCH	MS_TXPWR_MAX_CCH
msTxPwrMaxCell	MS_TXPWR_MAX(n)
networkColourCode	NCC
noOfBlocksForAccessGrant	BS_AG_BLKS_RES
noOfMultiframesBetweenPaging	BS_PA_MFRMS
notAllowedAccessClasses	ACCESS_CONTROL_CLASS
numberOfSlotsSpreadTrans	TX_INTEGER
plmnPermitted	PLMN_PERMITTED
pointCode (*signallingLinkSet object*)	DPC (Destination Point Code)
pointCode (*signallingPoint object*)	OPC (Origin Point Code)
powerBudgetInterCell	PBGT_USED
powerControl	BTS_PWR_USED
powerControlIndicator	BA_USED *or* PWRC
powerIncrStepSize	POW_INCR_STEP_SIZE
powerRedStepSize	POW_RED_STEP_SIZE
radioLinkTimeout	RADIO_LINK_TIMEOUT
runCallClear	RUN_CALL_CLEAR
runHandOver	RUN_HANDOVER
runPwrControl	RUN_POW_CONTROL
rxLevAccessMin	RXLEV_ACCESS_MIN
rxLevDLIH	RXLEV_DL_IH
rxLevHreqave	RXLEV_HREQAVE
rxLevHreqt	RXLEV_HREQT
rxLevMinCell	RXLEV_MIN(n)
rxLevULIH	RXLEV_UL_IH
rxLevWtsList	RXLEV_WT

GSM 12.20 and OMC-R names	GSM series 04.xx and 05.xx names
rxNCellHreqave	NCELL_HREQAVE
rxQualHreqave	RXQUAL_HREQAVE
rxQualHreqt	RXQUAL_HREQT
rxQualWtsList	RXQUAL_WT
slc	SLC
subChanId	SCN
synchronized	SI
t3103	T3103 *or* H_INTERVAL
thresholdInterference + averagingPeriod	INTAVE
timerperiodicUpdateMS	T3212
uRxLevDLP	U_RXLEV_DL_P
uRxLevULP	U_RXLEV_UL_P
uRxQualDLP	U_RXQUAL_DL_P
uRxQualULP	U_RXQUAL_UL_P

Global System for Mobile Communications (GSM)

Nortel GSM BSS Fundamentals — Operating Principles

Publication: 411-9001-007
Document status: Standard
Document version: 16.04
Document date: 16 October 2006

For more information, please contact:

For all countries, except USA:

Documentation Department
Parc d’activité de Magny-Chateaufort
CHATEAUFORT
78928 YVELINES CEDEX 9
FRANCE
Email : umts-gsm.ntp@nortelnetworks.com
Fax : (33) (1) 39-44-50-29

In the USA:

2221 Lakeside Boulevard
Richardson TX 75082
USA
Tel: 1-800-4 NORTEL
1-800-466-7838 or (972) 684-5935

Internet Address:

http://www.nortel.com

To provide feedback or report a problem in this document, go to www.nortel.com/documentfeedback

Originated in France

NORTEL