EVOLIUM
ALCATEL BSS Description / B10

3FL10473ADAAWBZZA
Edition 02

TRAINING MANUAL

Safety Warning

Both lethal and dangerous voltages are present within the equipment. Do not wear conductive jewelry while working on the equipment. Always observe all safety precautions and do not work on the equipment alone.

Caution

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Table of Contents

Table of Contents [cont.]

Course Objectives

Welcome to **ALCATEL BSS Description**

After the successful completion of this course, you should be able to describe:

- the Base Station Subsystem
- the Alcatel 9120 and 9130 BSC
- the Alcatel G2 TC and 9125 Compact Transcoder
- the Alcatel 9100 BTS and 9110-E µBTS
- the Alcatel 9135 and 9130 MFS
- the BSS transmission interfaces
- the local and network operation and maintenance functions

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About this Student Guide

Conventions used in this guide

Note
Provides you with additional information about the topic being discussed. Although this information is not required knowledge, you might find it useful or interesting.

Technical Reference
(1) 24.348.98 - Points you to the exact section of Alcatel-Lucent Technical Practices where you can find more information on the topic being discussed.

Warning
Alerts you to instances where non-compliance could result in equipment damage or personal injury.

Where you can get further information

If you want further information you can refer to the following:

- Technical Practices for the specific product
- Technical support page on the Alcatel website: http://www.alcatel-lucent.com

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Self-Assessment of Objectives

Contract number :

Course title :		
Client (Company, Center) :		
Language :	Dates from :	to :
Number of trainees :	Location :	
Surname, First name :		

Did you meet the following objectives ?
Tick the corresponding box
Please, return this sheet to the trainer at the end of the training

Instructional objectives	Yes (or globally yes)	No (or globally no)	Comments
1 To be able to describe the Base Station Subsystem			
2 To be able to describe the Alcatel 9120 BSC and 9130 BSC			
3 To be able to describe the Alcatel G2 TC and 9125 Compact Transcoder			
4 To be able to describe the Alcatel 9100 BTS family and the 9110/9110-E µBTS			
5 To be able to describe the Alcatel 9135 MFS and 9130 MFS			
6 To be able to describe the BSS transmission interfaces			
7 To be able to describe the local and network operation and maintenance functions			

Self-Assessment of Objectives [cont.]

Instructional objectives	Yes (or Globally yes)	No (or globally no)	Comments

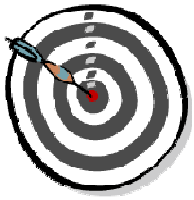
Other comments

Thank you for your answers to this questionnaire

1 Evolium Base Station Subsystem Introduction

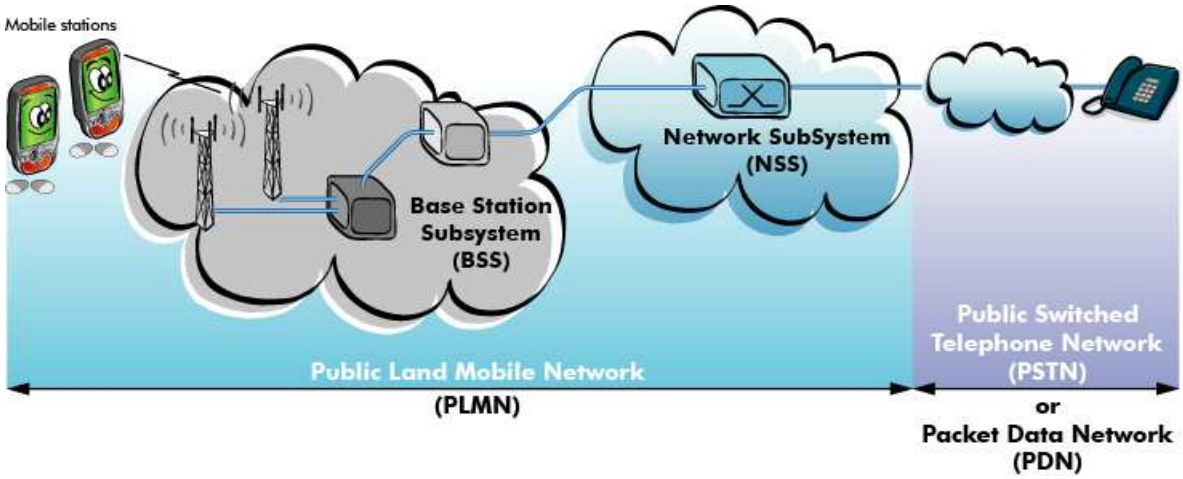
3FL10473ADAAWBZZA Edition 02

Section Presentation



- Objective: To describe the Evolium™ BSS network
- Program:
  - Situation and Functions
  - Architecture
  - Telecom Features
  - Operation and Maintenance Features
  - Cell Environments
  - Exercises

- Mobile telecommunication overview



The very first aim of a communication system is to transport user information (speech or data).

Objective : to introduce the **Cellular Network** structure:

- BSS, NSS, PLMN, PSTN

Remark: All the elements will be introduced later, part by part.

The main role of the BSS is to provide and support both bi-directional **signalling** and **traffic channels** between Mobile Stations and the Network and Switching System which is in charge to manage communications within the Public Land Mobile Network (PLMN) (Mobile to Mobile calls) and

- - the Public Switched Telephone Network (Mobile /Fixed telephone calls in circuit switching mode)
- - Packet Data Network in packet switching mode

The BSS provides radio coverage for GSM subscribers in a defined area.

- BSS functions (1): CALL SETUP
  - The BSS provides radio coverage (signalling and traffic channels) between Mobiles and the NSS.
  - MOBILITY MANAGEMENT
    - Location updating
  - SUPPLEMENTARY SERVICES
    - Short Message Service
  - USER TRAFFIC
    - Speech
    - Data

Call set up is required to establish communication between an MS and the NSS. The NSS is responsible for establishing the connection with the correspondent. Different types of calls require different teleservices. These teleservices are defined in the GSM specifications. The type of teleservice and bearer service to be used is negotiated before the normal assignment procedure.

Mobility Management : These calls, e.g. location update, are used by the system to gather MS information. The exchanges are protocol messages only; therefore, only a signaling channel is used.

Supplementary Services : These calls, e.g. SMS and SS calls, pass small amounts of information. Therefore, only a signaling channel is used.

User Traffic : These calls, e.g. speech or data calls to a correspondent, can pass large amounts of information. Therefore they require greater bandwidth than a signaling channel. These calls use traffic channels.

The channels used for calls are the SDCCH for signaling and the TCH for user traffic. These channels are associated with FACCH/SACCH. An SDCCH is always assigned for call set up, even if a TCH is later required for the call.

The role of the BSS in call set up is to assign the correct channel for the call, and to provide and manage a communication path between the MS and the MSC.

The phases involved in call set up:

- Radio and Link Establishment;
- Authentication and Ciphering;
- Normal assignment.

- BSS functions (2): CALL HANDLING
  - IN CALL MODIFICATION
    - Speech or data / Fax
  - HANDOVER
    - Type: Inter cell external / Inter cell internal / Intra cell
    - Cause: Better cell / Bad quality / Bad received level / Interference / Mobile Velocity / Traffic / Congestion /Preferred band
  - CIPHERING
    - no / A5-1 / A5-2
  - OVERLOAD CONTROL
    - BSC / BTS

An obvious requirement for the effective management of calls in the BSS is to provide the following:

- Maximum perceived signal quality with minimum perceived interference.
- Call continuity regardless of changes in propagation conditions or change of location of the MS.

Given that spectrum is limited, this must be accomplished with maximum resource reuse. Another important factor for the customer (and the operator as well) is power efficiency to reduce overall power consumption and prolong the autonomy of the MS under battery operation.

The supervision of calls in progress is provided by the Call Handling function. Call Handling, with associated features, implements needed changes in the required teleservice to maintain call quality and continuity. Call Handling functions and features include:

- In-Call Modification
- Frequency Hopping
- Discontinuous Transmission
- Radio Power Control
- Handover (the objective is to reduce HO timing)
- Overload Control
- Call re-establishment by the MS.

- UMTS to GSM Handover
- GSM to UMTS Cell -reselection

- BSS Functions (3): CALL RELEASE
  - CALL RELEASE in normal service
    - Calls terminated by call management
    - Calls terminated following a channel change
  - SPECIAL CASE
    - Call release following a reset
    - BSC, BTS or MS initiated release

The Call Release procedures ensure that resources allocated to a call are free for reuse when they are no longer required by the current call.

Call Release procedures are required when:

- A call is finished and either the called or calling party hang up
- An MS is turned off
- A call is handed over and the resources for the original call are released
- A call is modified and the resources for the original channel are released
- There is an operator intervention, such as a channel being blocked
- There is a failure
- There is a radio link failure
- The system detects a LAPDm failure.

If a call is terminated normally, the Call Release procedures are triggered automatically. If the call is terminated abnormally, the system has to detect that the resources are no longer required and release them.

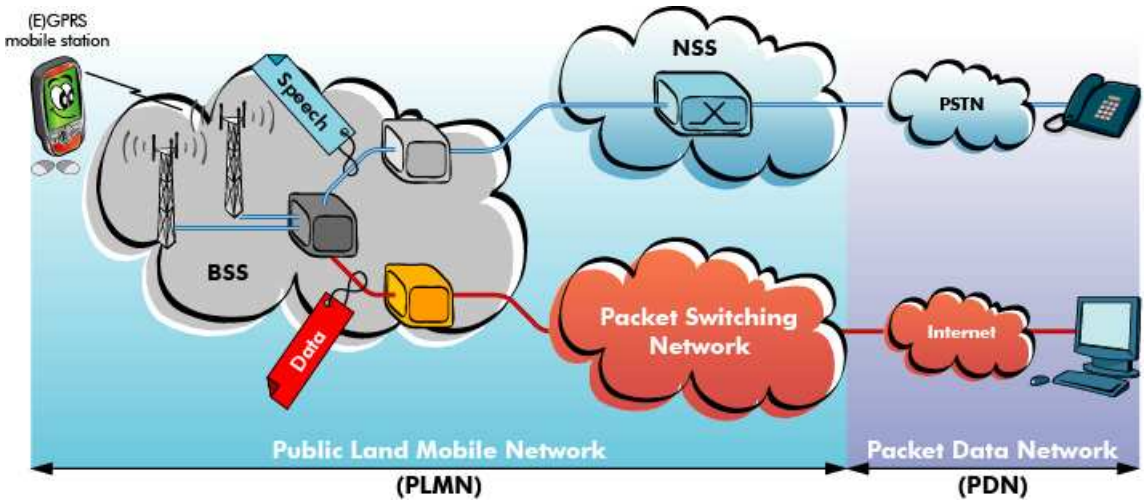
- BSS Functions (4): Operation and Maintenance
  - There are three categories of O&M functions:
    - CONFIGURATION Management
    - FAULT/ ALARM Management
    - PERFORMANCE Management

To ensure that the BSS functions correctly, O&M actions are implemented at all levels within the BSS. The O&M functions in the BSS are grouped into three categories:

- Configuration Management
- Fault/Alarm Management
- Performance Management

Each BSS subsystem has its own O&M function. To facilitate Fault Management, the BSS subsystems use an architecture based on the concept of functional blocks called Managed Objects (MOs).

- Evolution to (E)GPRS



The success of GSM has taken place in parallel with the explosion of interest in the Internet and related data services. Presently, data transmission over the air interface is limited to 9.6 kbps, too slow for use of graphics-intensive services.

GPRS

- The solution chosen by ETSI for the double challenge of increased demand for data service and pressure on radio resources is called General Packet Radio Service (GPRS). (without network modification)
- The GPRS network is called the GSS (GPRS Sub-System) or the GPRS “Core Network”.
- GPRS is an **IP network,** and therefore contains routers = machines handling the packet switching function.
- GPRS is a solution to wait for UMTS without network modification
- GPRS : maximum rate is **170 Kbps**.

EGPRS

- EGPRS (Enhanced GPRS) is based on TDMA and offers a maximum theoretical speed of **473 kbps**, using a new modulation 8-PSK, eight-phase shift keying.
- EGPRS compatible MTs are required. The BSS remains the same, except for new EGPRS/GSM compatible TRXs to be added to each cell where EGPRS has to be activated.

UMTS

- UMTS (Universal Mobile Transmission System) requires a RAN based on W-CDMA, it is then called a Radio Network Subsystem (RNS) and is part of the UTRAN (UMTS Terrestrial Radio Access Network)

- Evolution to (E)GPRS
  - (Enhanced) General Packet Radio Service is the solution chosen by 3GPP to answer the demand for increased data transmission rates.
  - Two parallel systems in the PLMN:
    - Circuit-switched transmission for speech
    - Packet-switched transmission for data

(E)GPRS is a standard, like GSM, managed by 3GPP (3rd Generation Partnership Project), the former ETSI (European Telecom Standard Institute)

So (E)GPRS is at the point of convergence between two very popular technologies: mobile telephony (GSM) and the Internet (IP).

Shared = the radio resources are shared by "statistical multiplexing". As in GSM, no subscriber has their own permanent radio resource.

High or low bit rates = more than one radio time slot per MS or conversely: more than one MS on the same radio time slot (one TDMA frame occupies 4.615 ms and is divided into 8 TS or channels).

Maximum instantaneous bit rate provided = **170 Kbps GPRS** and **473 Kbps EGPRS**, through the allocation of 8 TSs to one subscriber (always on the same carrier frequency). The stated maximum bit rates are different, because different ways of encoding the data, or "**coding schemes**", are used, on which depends the bit rate over a TS.

- According to the radio channel quality different Coding Schemes are used.
- The system selects automatically the best coding scheme.

GPRS Coding Schemes:

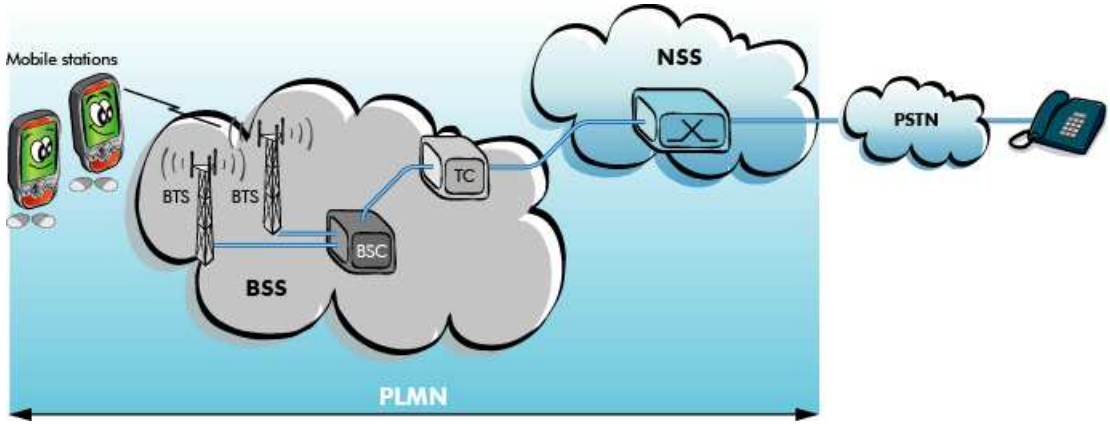
Scheme	Modulation	Maximum rate [kbps] per radio TS basis
CS-4	GMSK	21.4
CS-3	GMSK	15.6
CS-2	GMSK	13.4
CS-1	GMSK	9.05

- 8-PSK is more sensitive than GMSK to noise and interference.
- For the same C/I ratio, the BER (Bit Error Rate) will be higher for 8-PSK than GMSK.

EGPRS Modulation and Coding Schemes:

Scheme	Modulation	Maximum rate [kbps] per radio TS basis
MCS-9	8PSK	59.2
MCS-8	8PSK	54.4
MCS-7	8PSK	44.8
MCS-6	8PSK	29.6
MCS-5	8PSK	22.4
MCS-4	GMSK	17.6
MCS-3	GMSK	14.8
MCS-2	GMSK	11.2
MCS-1	GMSK	8.8

- BSS components in the PLMN (Circuit Switching)
  - BTS: Base Transceiver Station
  - BSC: Base Station Controller
  - TC: Transcoder

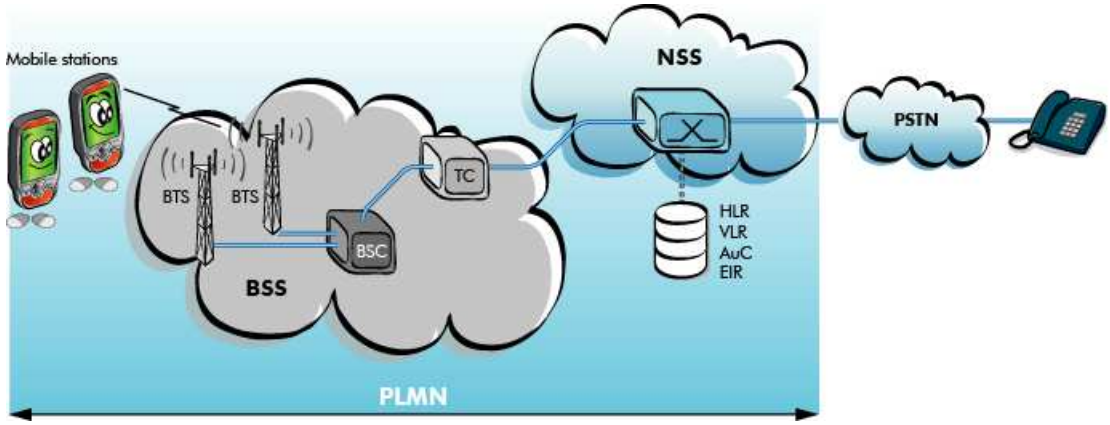


A BSS comprises:

- At least one Base Transceiver Station (BTS) which provides the radio links between the Mobile Stations and the BSC.
- A Base Station Controller (BSC) which controls several BTSs.
- A Transcoder (TC) located between the BSC and the NSS.

The BSS can include additional transmission equipment to perform multiplexing and monitoring functions.

- NSS components in the PLMN (Circuit Switching)
  - MSC: Mobile Switching Center
  - HLR: Home Location Register
  - VLR: Visitor Location Register
  - AuC: Authentication Center
  - EIR: Equipment Identity Register



MSC: Mobile Switching Center

- It is a switching exchange whose main functions are:
  - Call Handling
  - Specific GSM functions such as:
  - Mobility Management: Communication with the Location Databases (VLR and HLR)
  - Handover execution when involved
  - Gateway Function for Terminating Call (TC)

HLR: Home Location Register

- It is a reference database where the following information is stored:
  - identities of the subscriber (international identity, directory number)
  - subscribed services
  - rough location of the Mobile Station (identification of the VLR where the MS is now registered)

VLR: Visitor Location Register

- The VLR is associated with one or more MSC. It is a local database with the following information:
  - Copy of the HLR data for visiting subscribers
  - More precise location of the Mobile Station (an area of the network called “Location Area” which is a group of cells
  - Call re-direction data

AuC: Authentication Center

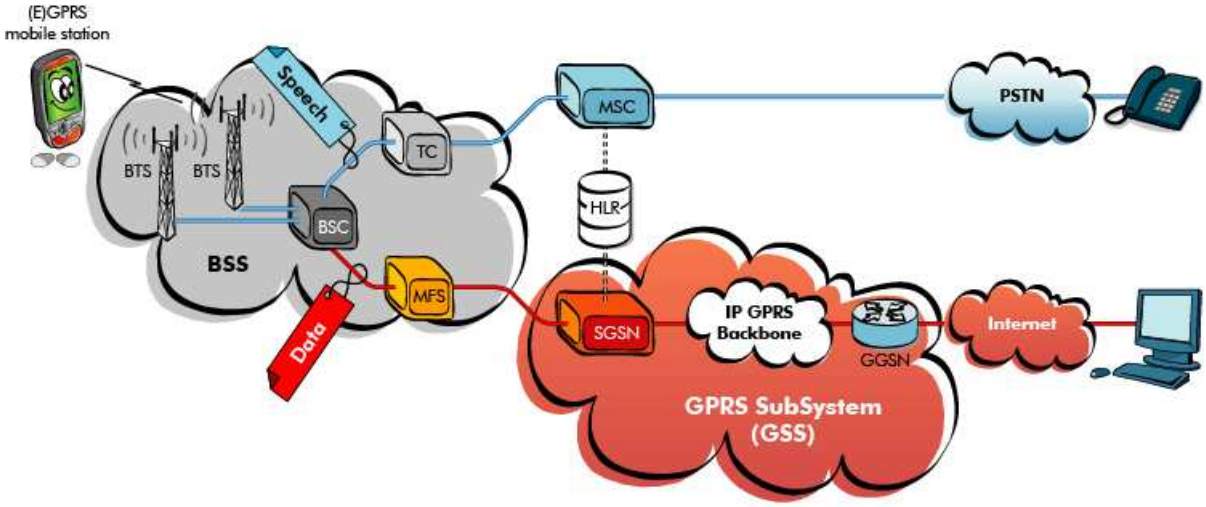
- The AuC is the Security Database of GSM which generates the parameters used during the Authentication and Ciphering procedures

EIR: Equipment Identity Register

- The EIR is a database where the identities of the Mobile Equipment are stored and classified in black, grey and white list.

Architecture

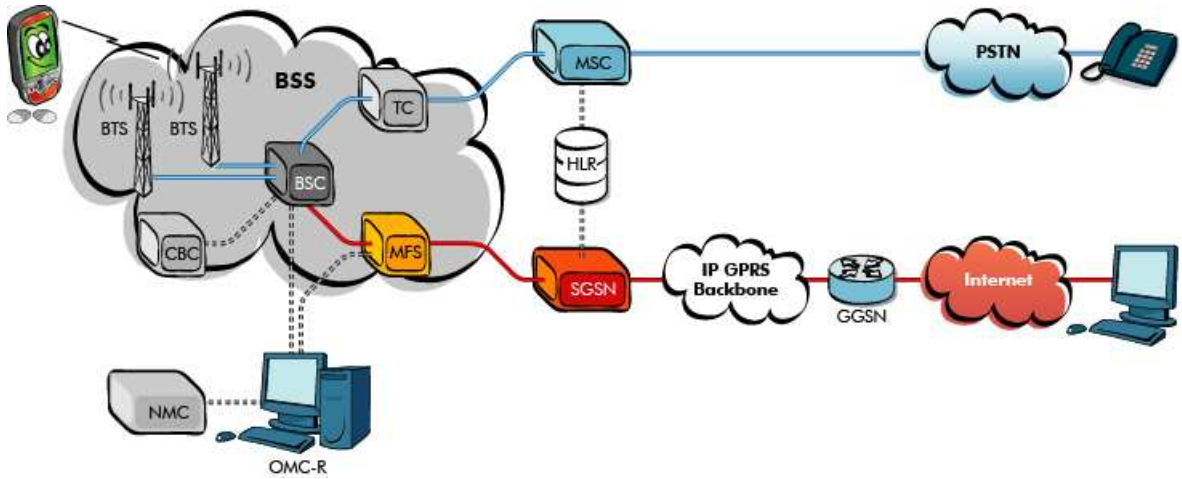
- BSS components for (E)GPRS solution
  - MFS: Multi-BSS Fast packet Server
  - SGSN: Serving GPRS Support Node
  - GGSN: Gateway GPRS Support Node



With (E)GPRS data traffic, the BSS also includes a Multi-BSS Fast packet Server (MFS) to manage data packets

Remark: GSS uses the same HLR for the packet network

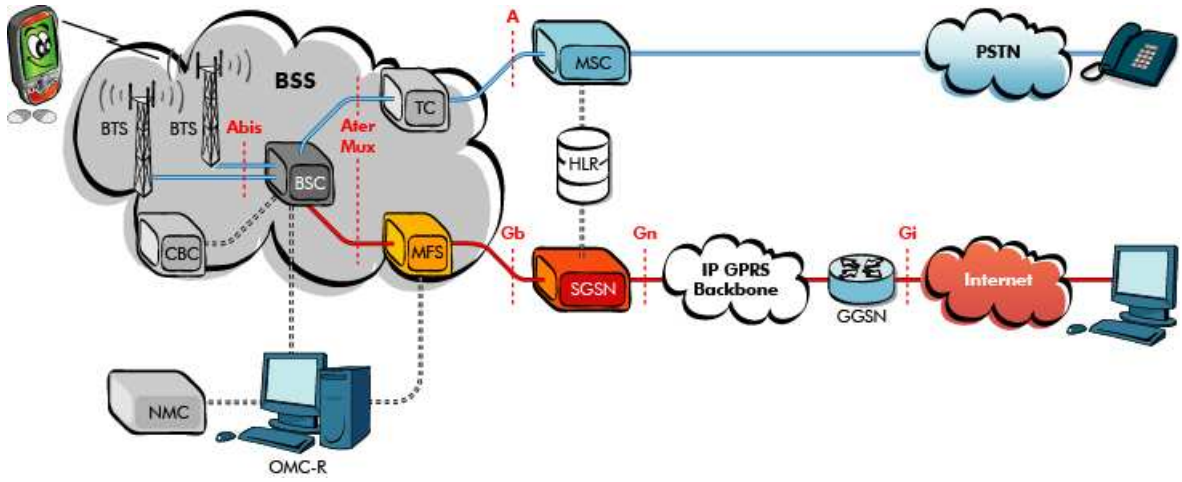
- External components
  - OMC-R: Operations & Maintenance Center - Radio
  - NMC: Network Management Center
  - CBC: Cell Broadcast Center



The OMC-R supervises one or more BSSs. It performs the following functions:

- Manages the BSS software version
- Acts as the central repository for configurations
- Manages fault and performance measurement reports
- Handles supervision of alarms and events.

- Interfaces in the BSS
  - Abis
  - Ater Mux / A
  - Gb



The BSS interfaces are:

- The A-ter mux interface is used to connect:
  - BSC to TC and/or MFS
  - MFS to TC.
- The “A” interface is used to connect TC to MSC.
- The A-ter interface is an internal interface to BSC and TC.
- The A-bis interface is used to connect BTSs to BSC.
- The Gb interface is used to connect MFS to SGSN (directly or through TC and MSC)-(Note: interface MSC-SGSN is called Gs).

All these interfaces are carried over standard 2Mbps PCM links of 32 TS, 64Kbps each.

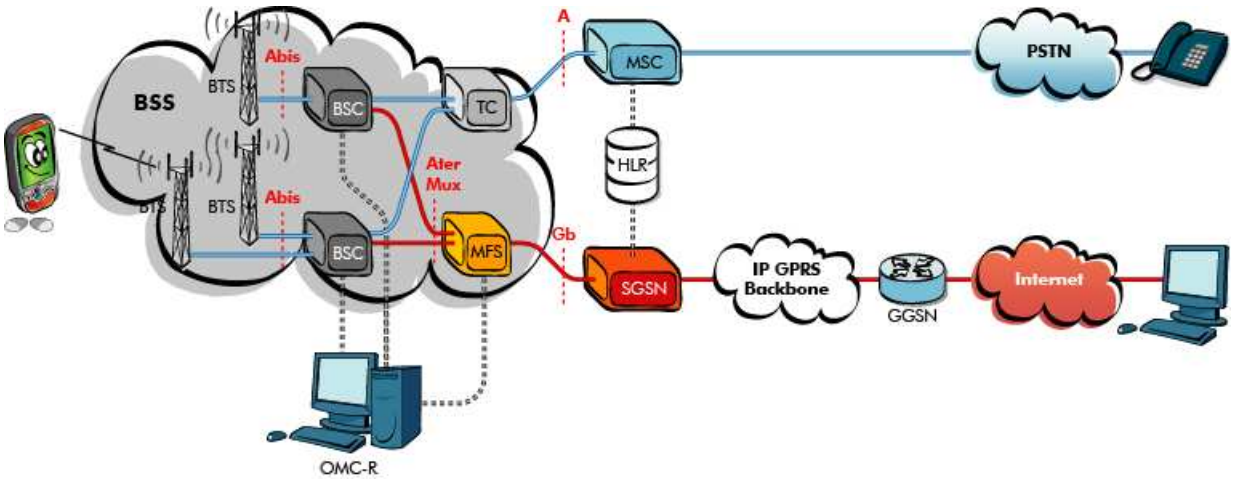
As an option, the A-ter mux and A interfaces in the TC can be carried over an optical STM1 interface (1 STM-1 can carry up to 63 E1 interfaces), which can be then routed over the SDH network, offering improved transmission efficiency.

Also as an option, the Gb interface can be carried over IP, offering easier routing and lower costs.

Other interfaces in this diagram:

- Interface Gi between GGSN and Internet
- Interface Gn between SGSN and GGSN

- GPRS communication: with several BSCs



Example with several BSC:

- 1 BSS= 1BSC

Summary :

- **No hardware changes** to existing Evolium™ BSS equipment
- All GPRS specific hardware at MSC site
- Reuse of the physical Ater trunks towards MSC
- Interoperability in a multi-vendor environment, SGSN can be connected to non-Alcatel BSS or NSS

Telecom Features

- Features defined in the GSM recommendations
  - Cellular Environment
  - Frequency Hopping
    - Radio Frequency hopping
    - Base Band Frequency hopping
  - Radio Power Control uplink and downlink (BTS / MS)
  - Discontinuous Transmission (DTX)
  - Discontinuous Reception (DRX) (MS)
  - Call Re-establishment by MS
  - Enhance Full Rate (EFR)
  - Adaptive MultiRate codec (AMR)
  - Tandem Free Operation (TFO)
  - Multiband operation
  - Multiple CCCH

Cellular environment: define different types of cell configurations to meet the requirements of geography and the strategies of the Network Operator.

RPC uplink and downlink: ensure the dynamic balance between the quality of the radio link in both directions (i.e., uplink and downlink), against interference with other cells. It also contributes to power conservation.RPC is achieved through BTS Radio Power Control and MS Radio Power Control.

Discontinuous Transmission/Voice Activity Detection:decrease the average interference level generated by the network in both the uplink and downlink directions. This feature, in association with FH, significantly improves spectrum efficiency without jeopardizing the quality of the telephony service.

Discontinuous Reception:conserve battery power by allowing the Mobile Station to switch off its receiver and data processing in the idle mode. This occurs except for the short time when the Mobile Station expects a message from the BTS. The Mobile Station only listens to that part of the paging channel corresponding to its paging group.

Call re-establishment by the MS: re-establish a connection in progress after a lower layer failure.

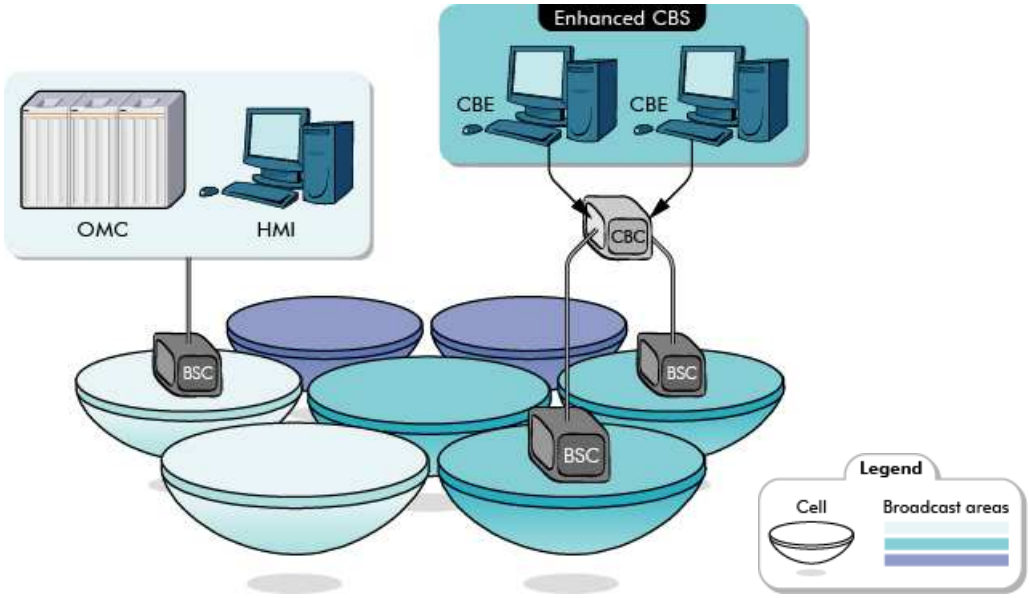
Enhanced Full-Rate: allow the use of codecs with an improved speech encoding algorithm, which provides enhanced speech quality on full-rate channels

Adaptive MultiRate codec (AMR): Adaptive Multi-Rate is a new codec defined by ETSI. This technology relies on a set of pre-defined "codec modes" (AMR-FR and AMR-HR), each one providing optimum performance under specific radio conditions.

Tandem Free Operation (TFO): TFO provides a better voice quality by avoiding unnecessary successive coding and decoding operations in the case of mobile to mobile calls. TFO is therefore a feature of great importance, as the percentage of mobile to mobile calls increases with the number of subscribers.

Multiple CCCH: to increase the signaling bandwidth on the Air interface, 3GPP defines up to 4 time slots to carry the CCCH information (TS0, TS2, TS4 and TS6). The Alcatel-Lucent solution supports multiple CCCH on TS0 and TS2 in G2 BSCs and MX BSCs.

- SMS CB environment (Short Message Service Cell Broadcast)



There are two types of Short Message Service (SMS):

- Point-to-point SMS allows a short message to be sent to, or received from, an MS.
- SMS-CB allows messages to be broadcast to the MSs (i.e., one way).

SMS-CB can be used for a number of reasons, e.g. to transmit emergency information, road traffic information, etc. An SMS-CB message can be transmitted to all the cells connected to the BSC, or to selected cells only, as required.

The SMS-CB is managed and operated from a separate CBC. The CBC is connected to the BSC and the data needed to connect the BSC to the CBC is sent from the OMC-R.

The operator at the CBC inputs the cell broadcast message identifying the broadcast text and the selected cell identities. Only one broadcast message per cell, or cells, is allowed. Any subsequent message simply replaces the message being broadcast.

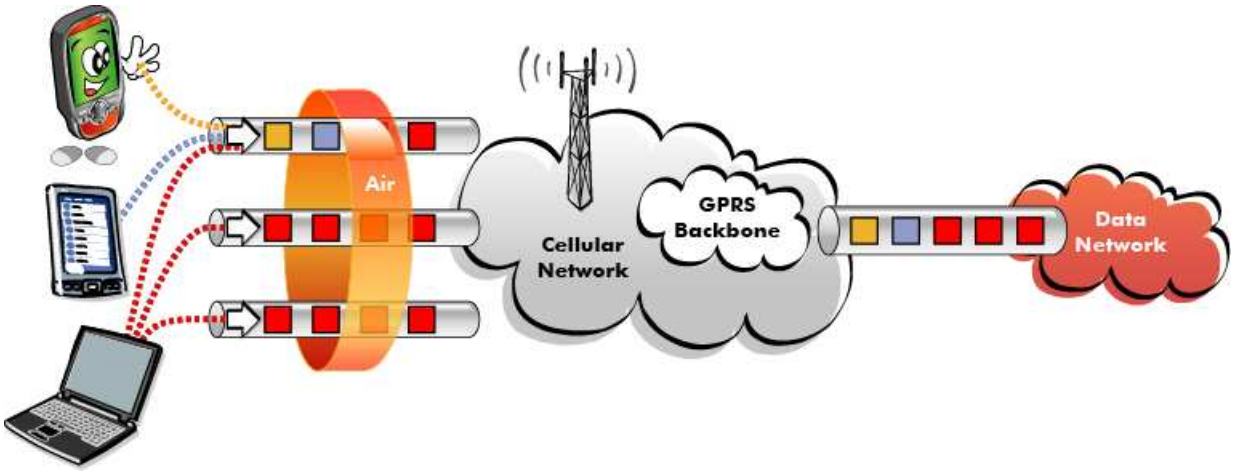
The message is sent from CBC to the BSCs handling the selected cells. The BSCs then send the message to the individual BTSs of the selected cells.

On receipt of the transmission request message from the BSC the BTS broadcasts the message to the MSs in the cell over the Cell Broadcast Channel of the Air Interface.

In addition to the feature “SMS CB managed from CBC”, compatible with the phase 2+ GSM recommendation:

- greater throughput with a second CBCH channel (extended CBCH),
- better responsiveness when urgent data is to be broadcast due to the use of high priority messages,
- better service availability through the “restart with recovery indication” feature.
- Support of multi-page messages (SMS-CB : 1 page = 82 bytes)

- Usage of Radio Resources with (E)GPRS



Capacity on demand thanks to:

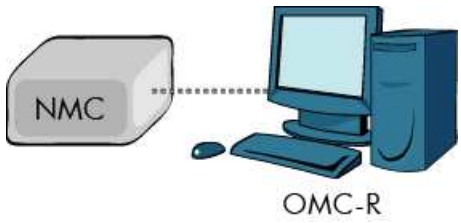
- Dynamic allocation of the GPRS radio timeslots
- Independent allocation of uplink and downlink timeslots

Up to 8 timeslots can be allocated to a mobile

To avoid transmission errors, channel coding schemes are defined to adapt bit rates to the environment

Operation & Maintenance Features

- BSS features (1)
  - Multiple Human Machine Interface (HMI)
  - Night time Concentration
  - Secured X25 connection
  - Usage State on Demand
  - BSC Alerter
  - Q3 MultiManager



Multiple Human-Machine Interface: This feature permits one OMC-R operator to perform actions normally done by several OMC-Rs, typically during off-duty hours. (X25 network) (Remote Display)

Night Time Concentration: allows an operator to perform alarm management operations for a complete network, where the network consists of more than one OMC-R.

Secured X.25 Connection From BSC to OMC-R: The Secured X.25 Connection feature provides redundant links in the event of a link failure on either the OMC-R or BSC side. When a link failure occurs, the initiator system involved must process the change over. Two physical links, one for Common Management Information Service Elements (CMISE), and one for File Transfer Access and Management (FTAM).

Usage State on Demand: The Usage State on Demand feature allows an OMC-R operator to have a snapshot of the current resource usage at a BSC.

BSC Alerter: The BSC Alerter is a telecom supervision function which generates an alarm event when the system suspects abnormal behaviour of a resource.(ex: TCH - Average occupancy time too long)

- BSS features (2)
  - Online/Offline Hardware Extension/Reduction
  - Provisioning Radio Configuration
  - Performance Management
    - Indicator/counter Display via MPM (METRICA Performance Management)
  - OMC-R - MFS support

Online / Offline Hardware Extension / Reduction (general O&M): lets an operator perform hardware configuration operations without having to generate and download a new software package. Online extension / reduction is only available with G2 BSCs.

Provisioning Radio Configuration: lets an operator prepare changes on the radio configuration in advance, check them, then activate all the changes as a whole, when he chooses.

Performance Management: METRICA Performance Management (MPM) is based on the NPA/NPO functions and characteristics.

Network element provisioning: Being able to differentiate equipment that are not yet in commercial use from equipment under maintenance is of high importance for the network monitoring:

- The feature introduces the status "commercial use" that can be associated to the BTS. This status is changeable on-line from the OMC-R HMI.
- For the BTS marked as "not in commercial use", potential alarms are raised with only a "warning" severity and the performance measurement results are not taken into account. And these BTS can be also filtered from the supervision view.

Cell Environments

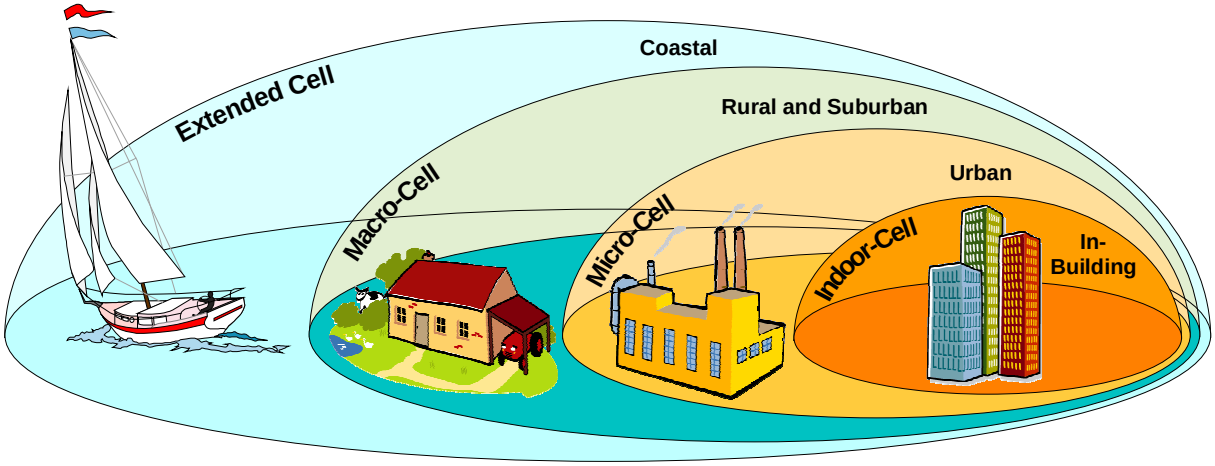
- Alcatel BSS supports the following frequency bands:

Frequency band	ARFCN	Max. ARFCN span	Uplink Frequency band	Downlink Frequency band
GSM 850	128,...,251	124	824 MHz to 849 MHz	869 MHz to 894 MHz
P-GSM	1,..,124	124	890 MHz to 915 MHz	935 MHz to 960 MHz
E-GSM	1,...,124 and 975,...,1023,0	174	880 MHz to 915 MHz	925 MHz to 960 MHz
DCS 1800	512,...,885	374	1 710 MHz to 1 785 MHz	1 805 MHz to 1 880 MHz
DCS 1900	512,...,810	299	1 850 MHz to 1 910 MHz	1 930 MHz to 1 990 MHz

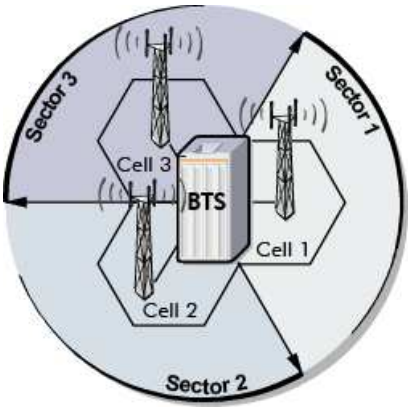
- Multiband configurations are also supported. Exemple: 900 and 1800 Mhz TRXs in the same cell.

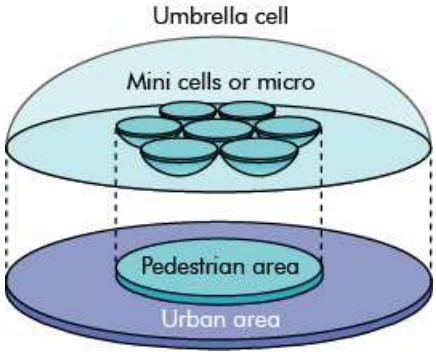
Cell Environments

- Alcatel BSS provides coverage suited to the needs of:
  - Coastal areas
  - Rural areas
  - Urban areas
  - Dense urban areas

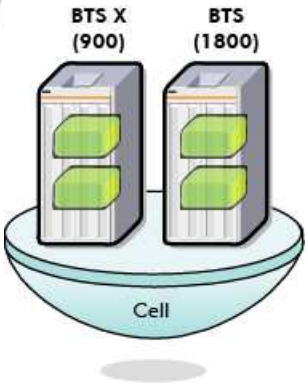


- Sectored site configuration and cells types:





- Cell split over 2 BTSs:



A sectored BTS site uses a single physical BTS equipped with up to six antennae illuminating six sectors, each covering a separate single macrocell. Figure shows a three-sector arrangement.

When very high capacity cells are required, one BTS may not have enough resources to support them. In this cases one cell can be split over two BTSs (the frequencies of one cell are provided by modules from two different BTSs). Because all the carriers of a cell must have the same timing, the two BTSs must be clock synchronized.

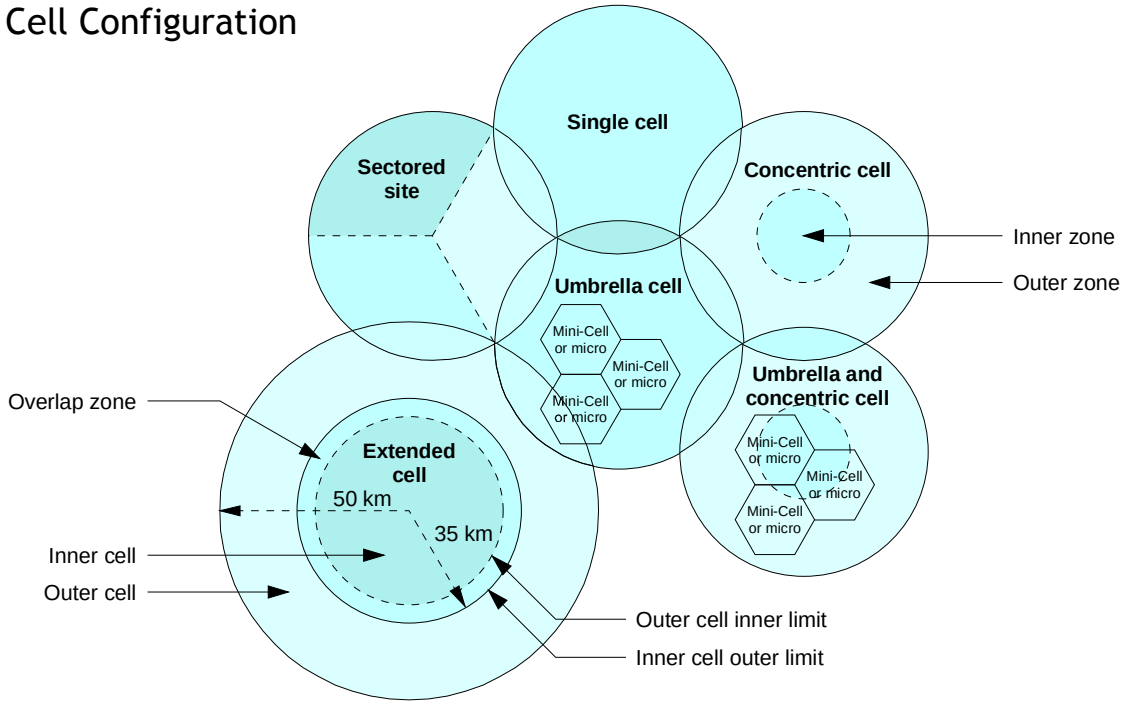
The same principle can be used to create multiband cells or to extend the capacity of an existing site using an additional BTS.

Mini cells are used for dense urban areas where traffic hot-spots are covered by very small macrocells (500 m to 1 km radius) and continuous coverage is provided by an overlaid macrocell (5 to 10 km radius). The lower layer mini cells handle pedestrian traffic while the umbrella cell handles the faster moving mobiles. As only macrocells are used there is no street corner effect.

Microcells have a small coverage area (less than 300 m radius). These cells are usually situated indoors or along streets in built-up areas. Microcells have an umbrella cell (1 to 2 km radius) to minimize the risk of losing calls by providing maximum coverage.

Cell Environments

Cell Configuration



EVOLIUM
ALCATEL BSS Description

Alcatel·Lucent

In the rural and coastal environment coverage is principally a function of cell planning. Standard cell layouts, providing coverage of up to 35 km, include:

- Single cells
- Concentric cells.

The goal of concentric cells is to increase the frequency economy of the network. This is done by reducing the interference levels of some BTS carriers. These carrier frequencies can be re-used for smaller distances.

The inner zone serves a high concentration of MS calls in a small area, with a reduced maximum power output limit. The outer zone performs call handling for a greater radius with a normal maximum power output limit. A non-concentric cell has all the frequencies serving all of the 35km radius area. This causes interference problems due to the large number of frequencies being used.

The BCCH, CCCH and SDCCH in concentric cells are put on the outer zone frequencies. TCH assignment during call connection can be allocated to either the outer or inner zones. It depends on the location of the MS at that time.

The outer zone maximum power limit is the same as normal zones. The inner zone is controlled by two maximum power limit values. One maximum power limit value for the MS and one maximum power limit value for the BTS.

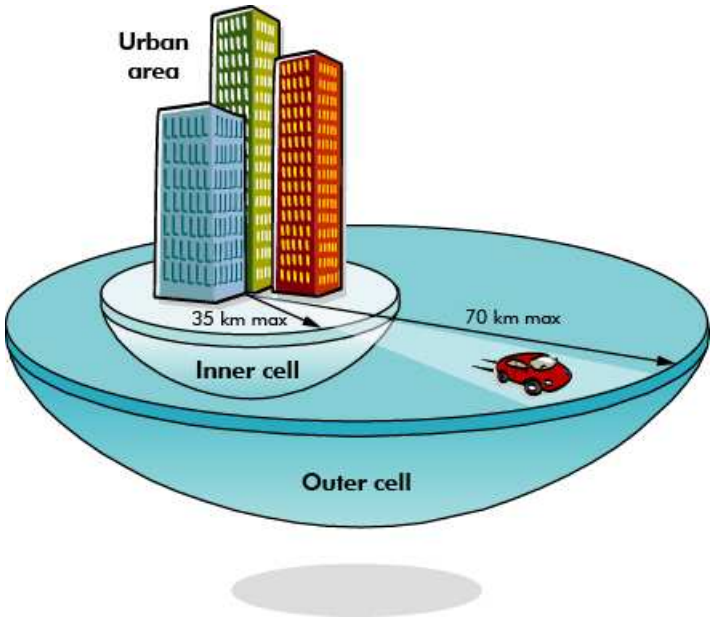
Extended cells, which have two co-located antennas, provide options covering traffic density and ranges up to 70 km.

In the urban environment the coverage is determined by the location of the BTS antennae. Two types of cells are normally used:

- Macrocells - where the antenna is located above the roof tops and propagation occurs in all directions. These cells can be sectored by using specific antenna patterns.
- Microcells - where the antenna is located below roof top level, on building facades or street lights. Propagation occurs mainly as line of sight along the street, with strong attenuation at street corners.

These two cell types can be used in a hierarchical cell environment where continuous coverage is provided by the macrocell (umbrella cell) and locations of increased traffic density are covered by dedicated microcells.

- Example of extended cell topology



An extended cell is made up of two cells, an inner and an outer, see Figure . The inner cell handles calls up to a distance of 35 km (the same as a normal cell), while the outer cell handles traffic from 33 km up to a maximum range of 70 km.

The reception (uplink) of the outer cell is delayed to correspond to a 33 km shift in range. Radio continuity between the two cells is ensured by the overlap zone.

The beacon frequency of the inner cell is bared so the MS's access is always made on the outer cell beacon frequency.

The beacon frequency receiver of the inner cell is tuned to the outer cell beacon frequency (both receivers will use the same frequency).

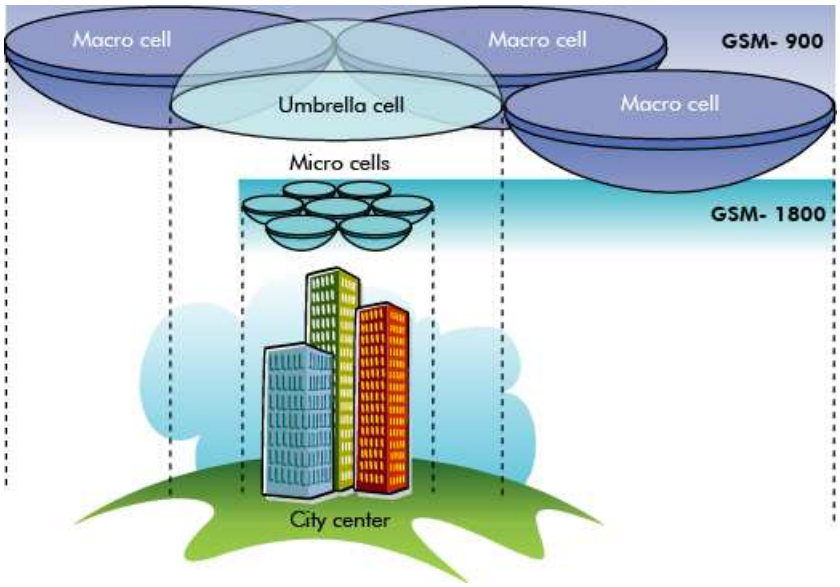
According to the distance between the MS and the BTS and due to the time shift between the inner and outer frequencies, the access burst sent by the mobile station will be properly received by the inner beacon receiver (when the MS in in the inner cell), outer beacon receiver (when the MS is in the outer cell) or both (when the MS is in the overlap zone). After that, the radio resources will be allocated in the proper cell.

In both inner and outer cell up to 4 carriers can be configured.

Frequency hopping is not supported in the extended cell.

Cell Environments

- Example of multiband hierarchical network

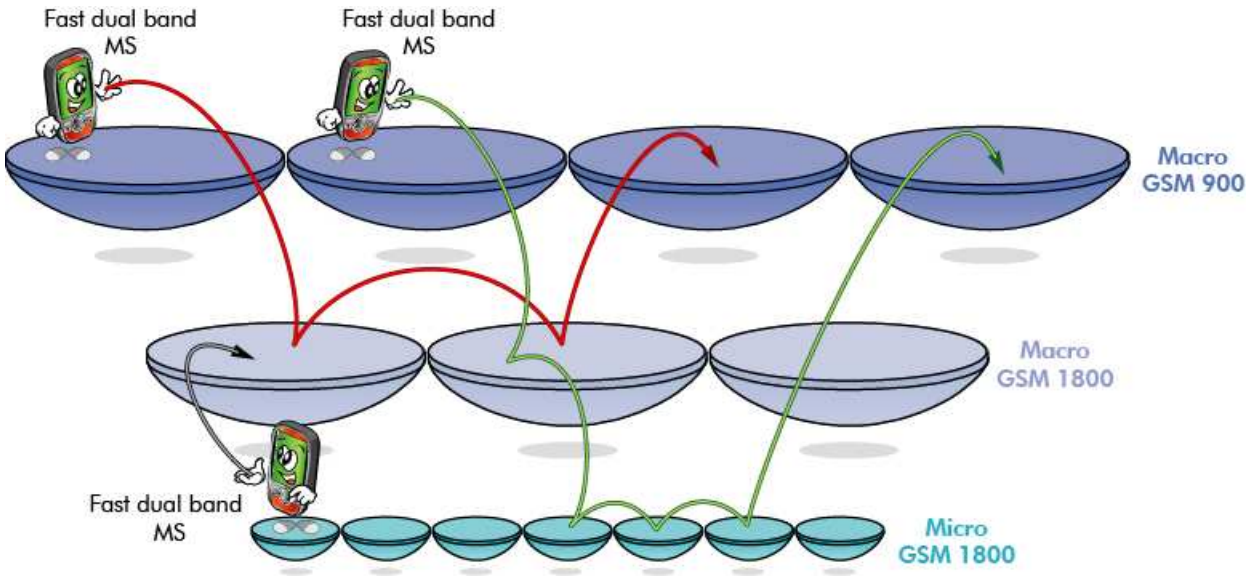


In much denser traffic areas, depending on the required traffic capacity, a hierarchical network is used, where continuous coverage is provided by an umbrella cell (macrocell), and traffic hot-spots are covered with dedicated lower layer cells of limited range. Fast moving mobiles are kept in the upper layer cell to avoid a high rate of handovers.

For medium density areas small macrocells (called mini cells) are overlaid with one umbrella macrocell

For higher traffic densities microcells are installed in all the streets where very dense traffic occurs. Umbrella macrocells provide continuous coverage for level and quality handovers, and saturated overlaid cells.

- Example of Handover



EVOLIUM
ALCATEL BSS Description

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Handover occurs more frequently in a microcell environment due to the small radius sizes. Microcell handovers occur:

- To handle stationary MSs (especially MSs used indoors).
- When an MS moves in a street covered by microcells.
- To avoid loosing calls. Whenever there is a risk of loosing a call, a handover is triggered to the umbrella cell.

Fast moving mobiles are handled by the umbrella cell. A mobile handled by a microcell is sent to the umbrella cell if the delay between handovers becomes too small. Conversely a mobile is sent to a microcell if it receives a high level of signal for a sufficient time.

Call quality/control is achieved by providing four thresholds for microcell handover and one handover threshold for macrocell handover.

Microcell to microcell handover occurs due to the proximity of the two cells. When the power budget is better in another cell, the MS is handed over to the cell which will serve the call more efficiently. This normally occurs in microcells serving in the same street.

Answer the Questions

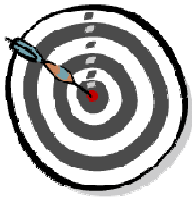
- Give 3 different causes for Handover?
- What does the MFS abbreviation mean?
- Does the GPRS use packet or circuit switching?
- What is the interface between BSC and MFS?
- What different types of cell exist in a network?
- For Alcatel GPRS solution, what types of equipment do you need?

Self-Assessment on the Objectives

- Please be reminded to fill in the form *Self-Assessment on the Objectives* for this module
- The form can be found in the first part of this course documentation

2. Base Station Controller Description

Section Presentation



- Objective: To present the two types of Evolium™ Base Station Controller BSC 9120 and BSC 9130
- Program:
  - BSC Types
  - Situation and Features
  - Functions
  - BSC 9120 Hardware Configuration
  - BSC 9120 Configurations
  - Introduction of new technologies
  - Emulation concepts
  - BSC 9130 Hardware and Functional Description
  - BSC 9130 Configurations
  - Exercises

- For the operation, administration and maintenance of the network it is necessary to locate and identify the functional units of the various BSC configurations.
- When responding to a call for bids, it is necessary to know the main functions, the various configurations and the performance levels of the BSC.

BSC Types

- There are 2 versions of BSC and MFS
  - The previous version BSC, called : BSC 9120
  - The new version BSC, called : BSC 9130
- These two BSC hardware versions are using the same application software running on different hardware.

BSC 9120

BSC 9130

Alcatel has developed a new equipment platform intended in particular to support evolutions of the existing G2 BSC and MFS products.

Alcatel strongly believes in the future of GSM and is ready to invest further in this technology. The approach for the new BSC is based on the sharing of the same applicative software for both the existing and the evolved products. This allows smooth introduction in the mobile networks, and offers cost savings thanks to leading-edge equipment technology used in a hardware platform that will be shared by a range of network elements (e.g. BSC, MFS…).

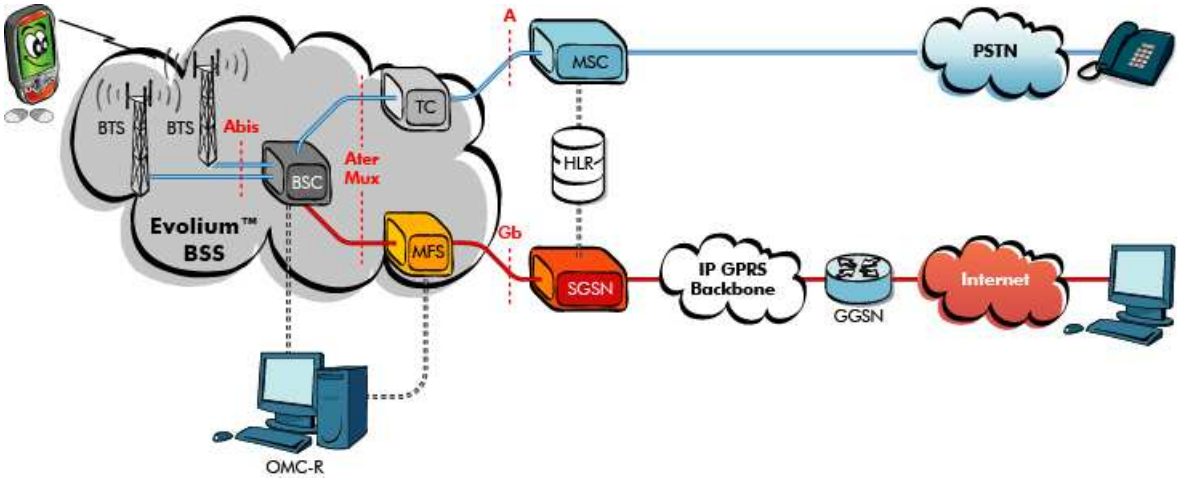
This new platform will be based on a state of the Art technology, Advanced Telecom Computing Architecture, ATCA. However, in parallel, the previous generation (A9120 BSC and A9135 MFS) will continue to support new BSS releases and functionalities.

Fast changing market situations with the appearance of new innovative subscriber services and applications as well as the introduction of multi-standard mobile terminals will cause the need for a high degree of flexibility and scalability within the network infrastructure. Especially the expected higher usage of mobile data services will need the fast adaptation of network resources.

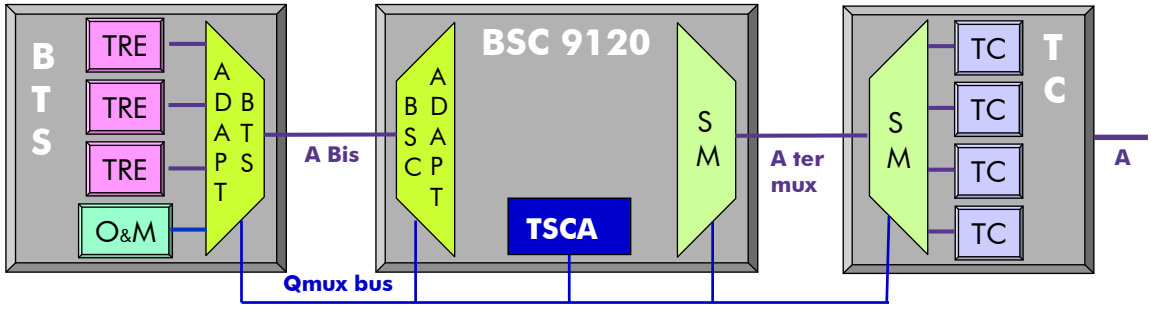
Specific network infrastructure for specific radio access technologies will limit the success in the reduction of operational costs and equipment expenditures, one of Alcatel's main targets. For example separate backbones with different equipment technology will cause higher operational costs in terms of transmission lines, operational staff, floor space, spare parts, and so on.

Situation and Features

- The Base Station Controller: 



- Transmission functions in the 9120 BSC:
  - BSC ADAPT
    - minimizes the number of PCM links on the Abis interface
  - TC SM ADAPT is used between BSC and TC
    - minimizes the number of PCM links on Ater interface



- TSC: Transmission Sub-system Controller
  Manages all transmission equipments through the Qmux bus, transmits commands, routing tables and collects transmission alarms

BSC ADAPT or BIUA (Base Interface Unit Abis Transmission function on A bis

SM (submultiplexer) can be ASMB / ASMC / or can be included in MT120 for the Alcatel 9125 TC .

The TSC has a Q1 (Qmux) interface to the transmission equipment. A system of double polling occurs on the Qmux interface:

- The first poll checks if there was a change in states
- The second poll occurs only if the state has changed, in order to obtain more information about the changes.

- BSC Telecommunications functions (1)
  - Radio Frequency channel management
  - Traffic channel resource management
  - Radio channel management
  - Connection of “A“ channels to Radio channels
  - Message Distribution
  - Radio Measurement

Radio Frequency channel management: GSM requires a number of different types of radio channels. The BSC performs management functions for the following types of channel: BCCH, CCCH, SDCCH, FACCH, SACCH.

Traffic channel resource management: It mainly establishes and releases radio resources in response to requests from the MSC and the MSs.

Radio channel management: The BSSMAP function performs related radio channel management functions such as paging, assignment, handover,...

Connection of “A“ channels to Radio channels: The BSC manages the radio channel resources, and the MSC manages the A channels. This allows the BSC to connect any radio channel to any A channel using Abis (terrestrial) channel.

Message Distribution: The Base Station Subsystem Application Part (BSSAP) function handles messages between the MSC and the MSs either transparently by DTAP function, or non-transparently by BSSMAP function.

Radio Measurement: The BTS performs a series of radio measurements. The BSC processes the measurements to allow it to control the power levels of both the BTSs and the MSs. As a result of processing these measurements, the BSC can initiate the handover of a MS.

- BSC Telecommunications functions (2)
  - Central Trace
  - Overload Control
  - SMS - Cell Broadcast
  - In Call Modification
  - Multiband MSs

Central Trace: An operator at the MSC can request the tracing of a MS along the PLMN, based on its IMSI; the radio data associated to this trace can be displayed in the OMC-R.

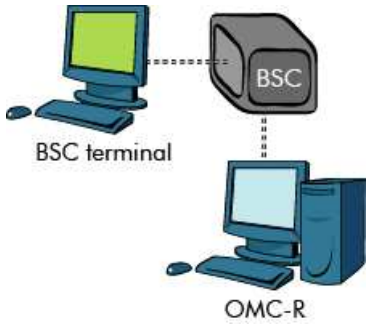
Overload Control: When the BSC detects an overload (e.g. a BSC processor overload), it takes steps to reduce the overload. For example, by decreasing the number of BTS measurement result messages handled.

Short Message Service: There are two types of SMS, Point-to-point SMS (sent or received from a specific MS), SMS-CB (which allows messages to be broadcast to all the MSs of a cell, road information...)

In Call Modification: During the active phase of a call, ICM can be performed to: Change the service of the call (speech to data), reduce the transmission speed of a transparent data call, change the Discontinuous Transmission (DTX) downlink mode.

Multiband operation: permit a sectorized BTS Alcatel 9100 to operate in the GSM 900 band in some sectors and GSM 1800 band in others

- Data Base
  - BSS (BSC + BTS + Transmission) Software and data storage
  - File downloading from BSC Terminal or OMC-R Terminal
- Network Element (NE) Supervision
  - Collection of data (alarm, performance) from NE
- Fault Management
  - Fault Detection
  - Fault Localisation
  - Defence (ex: disable Last N7 is not possible)
  - Radio Resource Reconfiguration

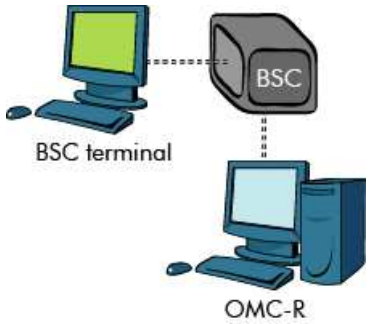


The BSS generates alarms to signal a change in the behaviour of a particular function within the system, such as a potential problem or a confirmed failure in the system.

Network element provisioning : Being able to differentiate equipment that are not yet in commercial use from equipment under maintenance is of high importance for the network monitoring.

- The feature introduces the status "commercial use" that can be associated to the BTS. This status is changeable on-line from the OMC-R HMI.
- For the BTS marked as "not in commercial use", potential alarms are raised with only a "warning" severity and the performance measurement results are not taken into account. And these BTS can be also filtered from the supervision view.

- Configuration Management
  - Hardware (Configuration):
    - Displayed from BSC Terminal
    - Modified from OMC-R Terminal
  - Software/Database (Configuration):
    - Stored in BSC
    - Modified from OMC-R Terminal
  - Logical Parameters:
    - Stored in BSC
    - Modified from OMC-R Terminal



Configuration Management, simply, is the process of putting in place the essential hardware and software components of the network, and determining their operating capabilities.

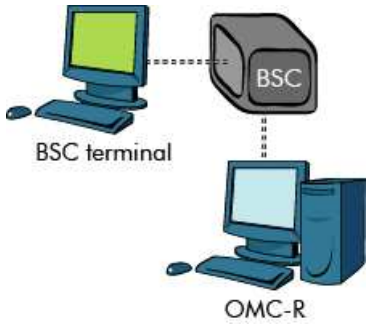
Hardware Configuration: Hardware Configuration enables the operator to control the placement in service of BSS hardware, the manner in which deployed hardware elements will act and interact within the BSS, and to modify the parameters that control these elements. It also permits the operator to view the current hardware configuration status of the network

Logical Configuration: There are two types of Logical Configuration:

- Radio Logical Configuration allows the operator to change the parameters that control the Air Interface. This includes channel definitions, manipulating and reconfiguring the CUs or TREs and the definition of Frequency Hopping Systems (FHS).
- Cell Logical Configuration displays and modifies BSS logical parameters and threshold values which influence a cell's operational behaviour. These are divided into several classes which simplify searches. It also allows the operator to see additional information about cells which is used during cell creation, modification and deletion

Software Configuration: Software Configuration enables new versions of the BSS software to be installed in the BSS. This feature also allows the operator to display current software versions of the BSS.

- Performance Management
  - Observation and Measurement management and transfer to OMC-R
  - Alerter
- Transmission module maintenance
  - The BSC manages the transmissions



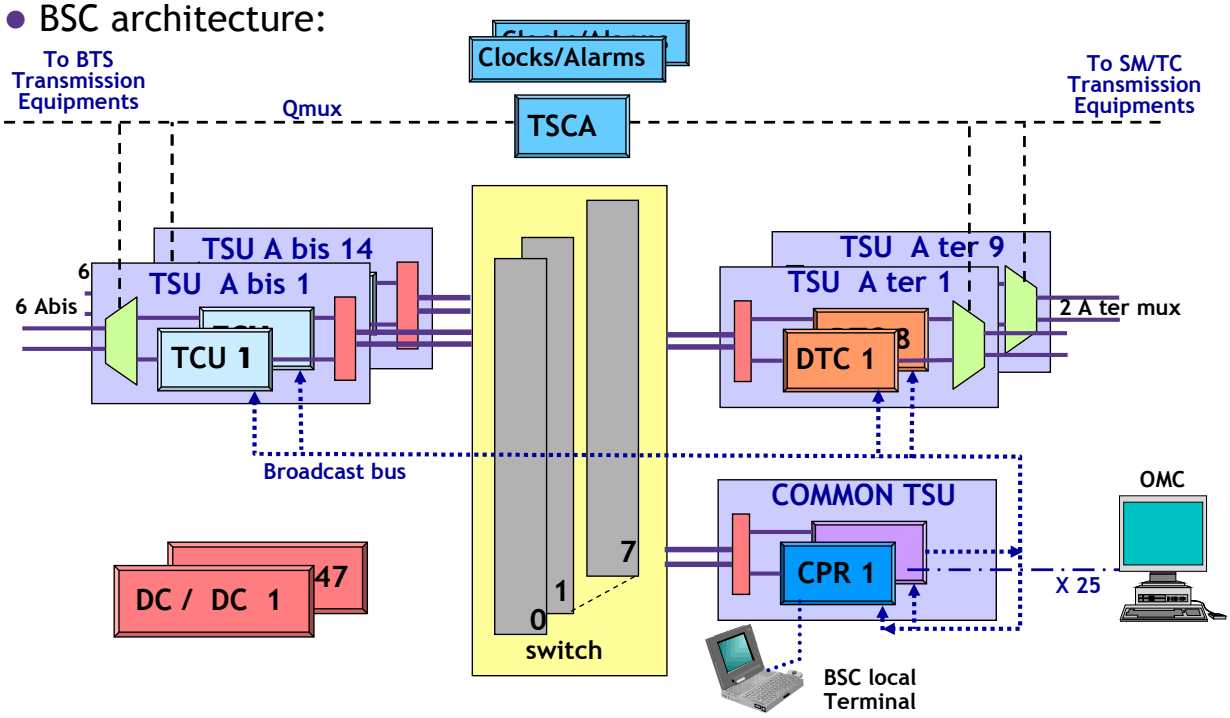
Transmission network elements link the BTS, BSC, MFS, and MSC, and provide support for the internal interfaces of the BSS.

The transmission components within the BSS consist of:

- Base Station Interface Equipment (BIE)
- Submultiplexer (SM)
- Transcoder (TC)
- Transmission Sub-system Controller (TSC).

Bsc 9120 Hardware Configuration

- BSC architecture:



TSU: Terminal Sub Unit

TCU: TRX Control Unit

The G2 BSC consists in one switch and 3 main sub-units (TSU):

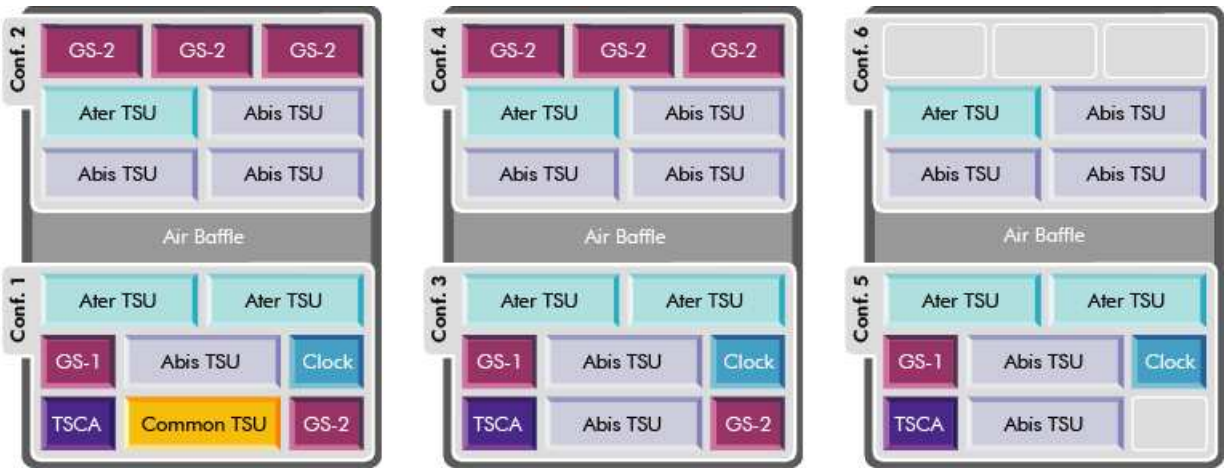
- Abis TSU which determines the connectivity with BTS
- Ater TSU which sets the capacity the BSC can handle
- Common TSU

Bsc 9120 Hardware Configuration

- Evolium™ BSC consists of three building blocks
  - A-bis TSU to connect BTS and TRX (or TRE)
    - Capacity of 32 FR TRX per TSU
  - A-ter TSU to provide the connection to the Transcoder
    - Capacity of 240 channels per TSU
  - Common Functions TSU to provide the O&M and system functions for the BSC
    - All modules in hot-standby
    - Two spare slots for future extensions
- Each BSC configuration consists of one Common Functions TSU and several A-bis and A-ter TSU

BSC 9120 Configurations

- Cabinet Layout, maximum Configuration (conf. 6):
  - Smaller configurations consist of less racks or half filled racks



BSC 9120 Configurations

- 6 Configurations : up to 448 TRX/264 cells
  - Maximum capacity can be achieved in a phased approach
  - Transcoder is configured according to traffic requirements
    - One TC cabinet per BSC cabinet or less if low traffic

Conf.	capacity in erlang	nb of FR TRX	Nb of BTS	Nb. of cells	Nb. of A interface trunks	Max. nb of #7 links (256 SCCP)	Nb. of A-bis interface trunks (chain/loop)	Number of cabinets	Nb. of A-bis/ A-ter TSU
1	160	32	23	32	16	4	6/3	1	1/2
2	620	128	95	120	24	6	24/12	1	4/3
3	1050	192	142	180	40	10	36/18	2	6/5
4	1300	288	214	240	48	12	54/27	2	9/6
5	1700	352	255	264	64	16	66/33	3	11/8
6	1900	448	255	264	72	16	84/42	3	14/9

- * See comments

This table gives maximum values per item, but not all maximum values can apply at the same time. For actual dimensioning of a BSC, Alcatel can only commit on values related to the customer traffic model.

Due to dimensioning rules, the maximum number of TRX cannot be reached at any time. A specific study must be done on a case by case basis in order to compute the real maximum value according to the BTS configurations connected to the BSC.

Remark :

- In conf 6 there are 9 Ater Mux TSU with 2 ASMB per TSU so 18 Ater Mux maximum for one BSC conf 6.

Introduction of new technologies

The BSC 9130 is based on MX platform which is in particular developed and based on

Advanced Telecom Computing Architecture (ATCA) standards.

Objective is to rationalize architecture, mechanics, types of boards, software for network element in Evolium applications.

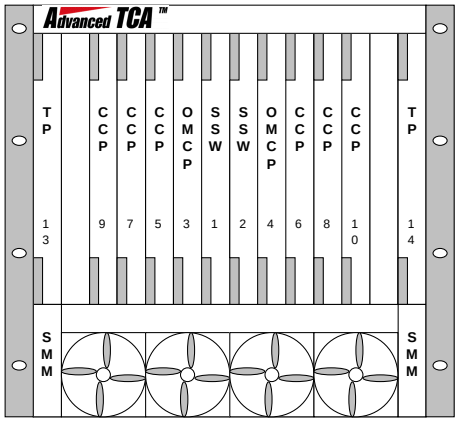
This concept means Telecom configurations not only relevant to Product management strategy but also physical ATCA shelf capacity in terms of boards quantity used in an ATCA shelf for a Telecom capacity.

All Telecom configurations at BSC or MFS level need also External E1 links. MX platform is also based on :

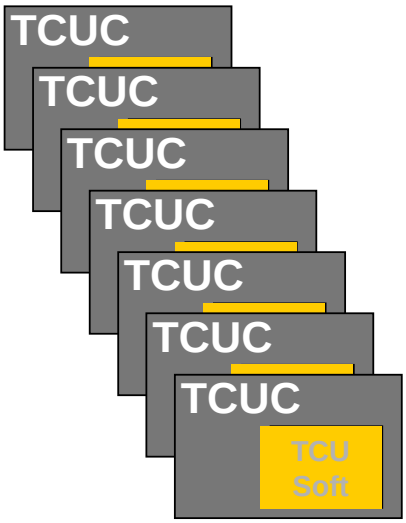
E1 Termination shelf, called LIU

The ATCA standard is providing standard functions through Ethernet Gigabyte switches

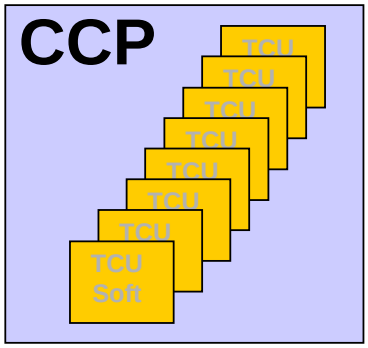
- 19” Chassis, 13U high
- 14 slots, Dual Star back plane
- Pulled air for up to 200W per slot
- Front access:
  - 4 x Blowers
  - 2 x Switch slot
  - 12 x Node slot
  - 1 x Air Filter
- Rear access:
  - 4 x PEMs (power supply)
  - 2 x Shelf Managers
  - 2 x I/O Alarm card
  - 2 x 8 x 1GbE Uplink ports (located on 2 x RTM)
  - 12 Rear Filler Plates for MX configurations



Emulation concepts 1

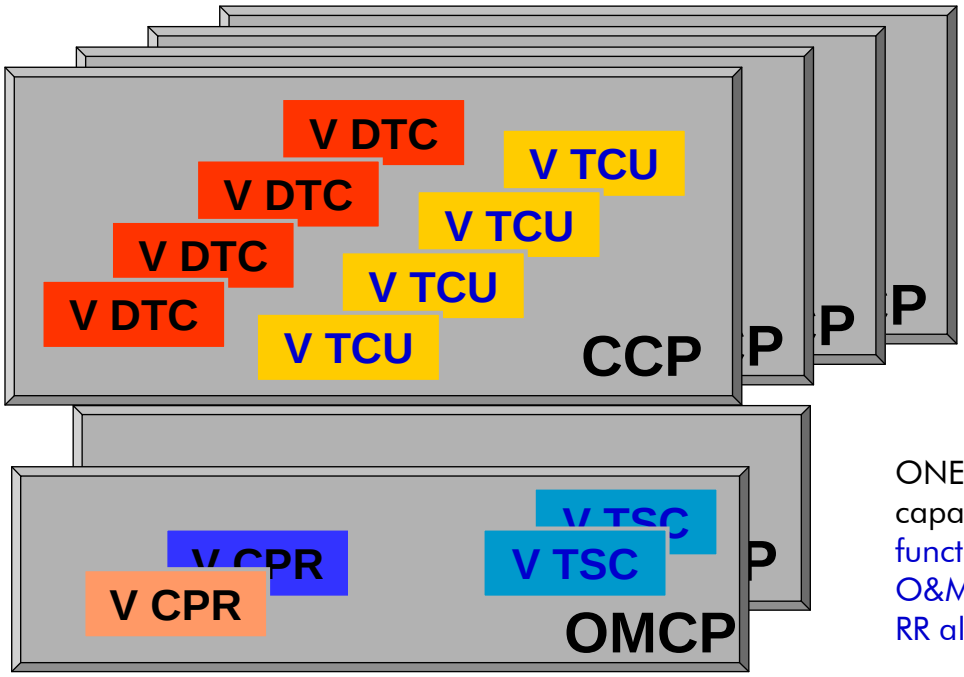


n°TCU Boards using old processors run n software instances



A CCP Boards, using a more powerful processor, runs n software instances emulating n TCUC pieces of hardware

Emulation concepts



ONE CCP has a capacity for
200 TRX
50 TCU and
64 DTC

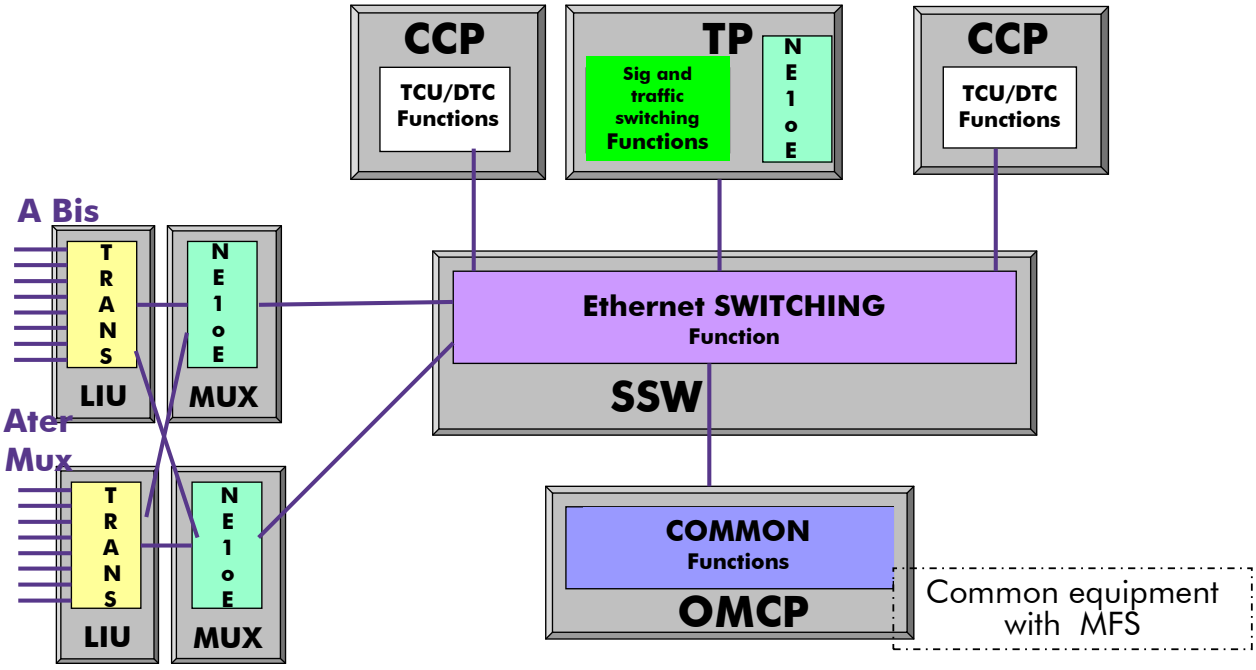
ONE OMCP has the capacity for CPR functions TSCA for O&M and TCHRM for RR allocation

EVOLIUM
ALCATEL BSS Description

Alcatel·Lucent

Due to hardware reasons, the BC CPR function is no longer required and, therefore, is not emulated.

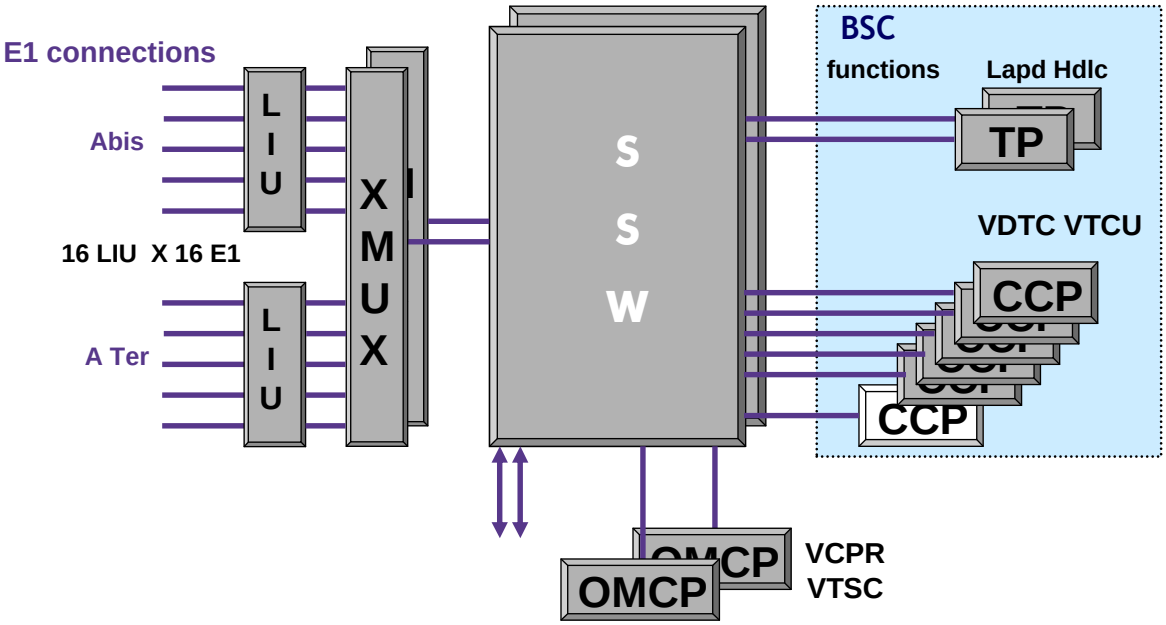
BSC 9130 Description and configuration



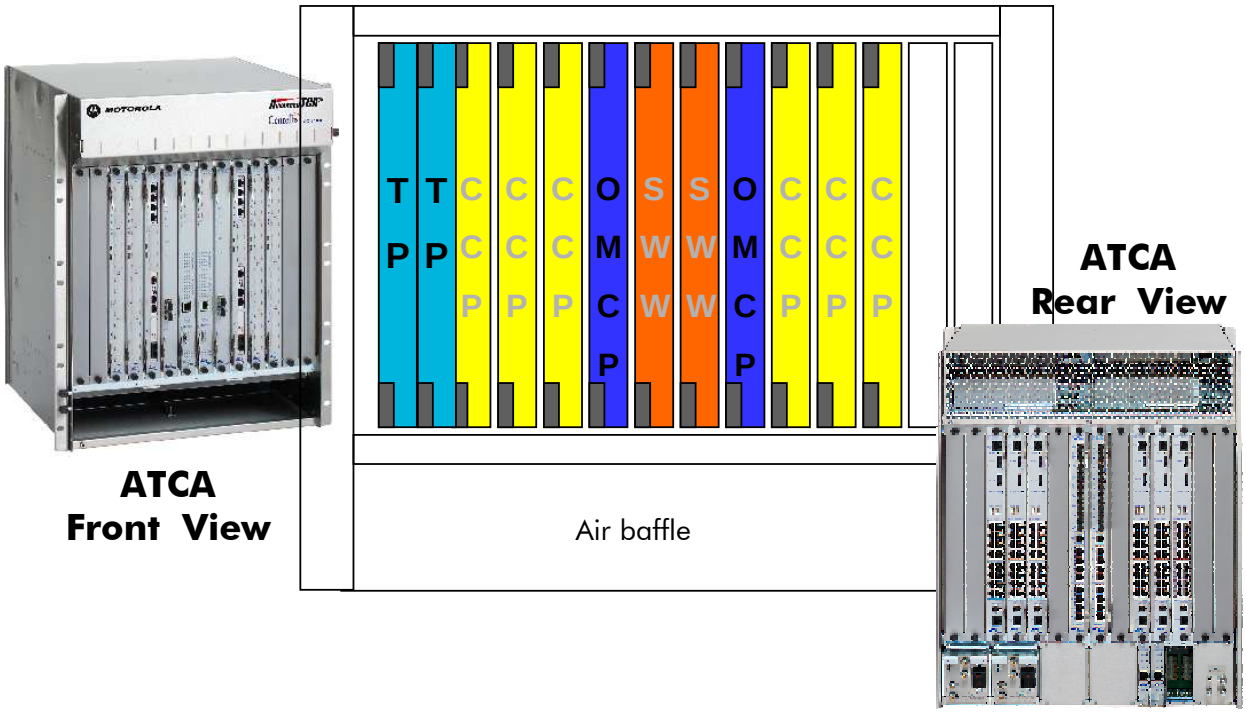
EVOLIUM
ALCATEL BSS Description

Alcatel·Lucent

- The LIU (Line Interface Unit) boards terminate the E1(Abis and Atermux) links.
- The MUXs (Multiplexers) encapsulate the E1 traffic coming from all the LIU boards into Ethernet frames using the NE1oE protocol (N° E1 over Ethernet).
- The NE1oE frames are sent trough the SSW (Ethernet Switch) to the TP board (Transmission Processing)
- The TP board extracts the E1 frames from the NE1oE frames and switches the telecom traffic. On the other hand, the signaling timeslots are extracted and the data is processed (only the low layer protocols like HDLC, MTP2, MTP3,etc)
- For further processing of the signaling messages, the TP board sends them to the CCP (Call Control Processing) trough the Ethernet switch. For this signaling messages, the CCP processes the high layer protocols like RLS/OML and SCCP/BSSAP (TCU/DTC functions).
- The OMCP (O&M Control Processing) provides common functions (O&M), transmission control (TSC functions), and TCH allocation functions.



- LIU SHELF
  - Up to 256 E1 links termination
    - 16 x LIU boards
  - NE1oE (2 x MUX Boards)
    - Packing/unpacking of E1 frames over Ethernet
    - 2 x GbE (1000 Base T) connections with ATCA shelf
  - Redundant DC power supply
    - 2 x Power Entry Module (PEM)
- TP board
  - NE1oE (Demultiplexing/Multiplexing of up to 252 E1 from/to GbE)
  - E1 framers
  - TDM switching
  - HDLC and SS7 handling
  - Q1 handling
  - (ML-)PPP handling and IP routing
  - Control Processing
  - Gigabit Ethernet (GbE) switching
- **CCP OMCP Board** (CCP running application software , OMCP running common functions and O&M OMCP)
  - Pentium M, 1.8 GHz
  - 2 GB SDRAM
  - 60 GB hard disk drive IDE (OMCP variant only)
  - Redundant ATCA Base Interface
  - 2 x USB 2.0 ports at face plate
- **SSW Board** (switch)
  - GbE Base Interface Switch
  - SNMP Agent for switch management
  - Front Ethernet and Serial ports (Debug)

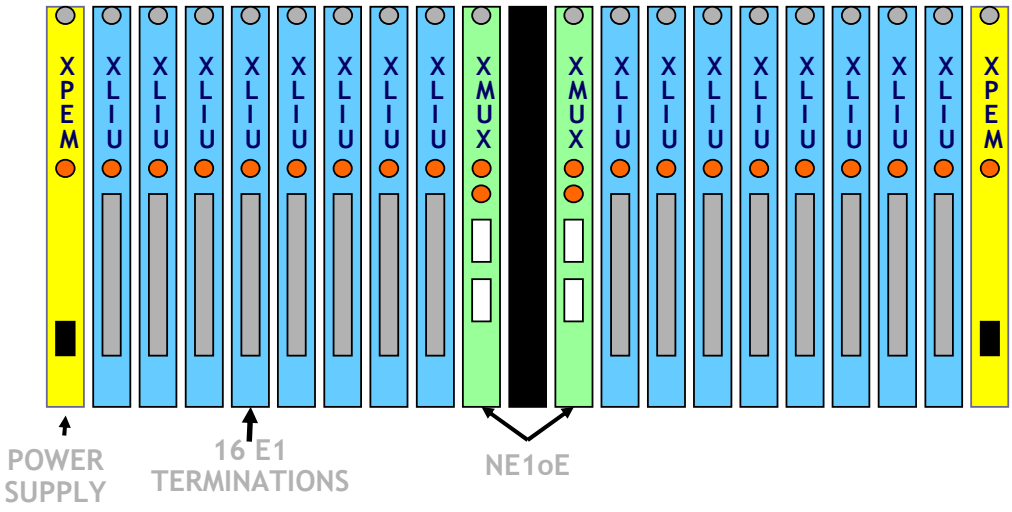


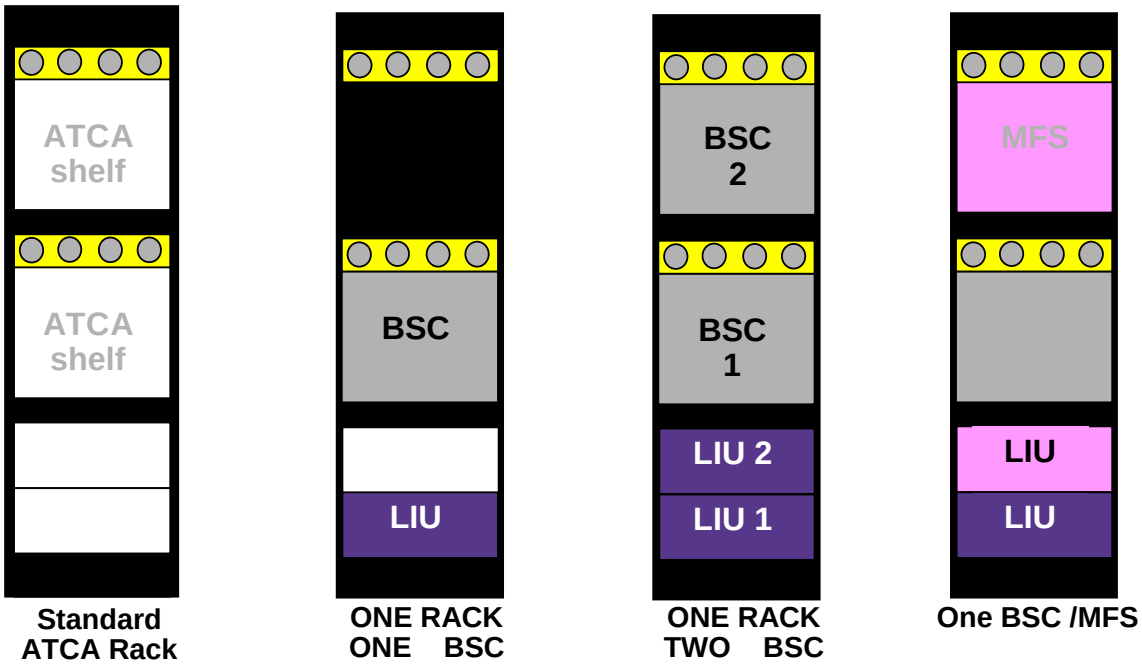
System Defense and reliability

- EVOLIUM™ A9130 BSC & MFS Evolution are built to sustain high traffic load, large number of users and wide coverage. Architecture has been specifically designed to be able to provide very high reliability, as well as marginal unavailability ratios and global availability of 99.999%.
- Therefore BSC and MFS high capacity are not endangered by partial failures and maintenance costs can be reduced without operational impacts. A set of defence mechanisms is possible within BSC and MFS architecture

Shelf	Element	Redundancy
BSC	Board redundancy	
	SSW	Duplication
	OMCP	Duplication
	CCP	N+1
	TP	Duplication

BSC 9130 Hardware and Functional Description





EVOLIUM™ A9130 BSC Evolution has been designed according to the principles of high capacity, scalability and large connectivity.

- **Two main types of configuration are available for the BSC Evolution**:
  - **standalone configuration**: BSC Evolution with **one telecom subrack** equipped with minimum 2 and maximum 6 CCP boards (one CCP board is used for redundancy).
  - **rack sharing configuration**: 2 BSCs Evolution with one telecom subrack equipped for each BSCs and two LIU shelves houses in one rack. Each telecom subrack is equipped with minimum 2 and maximum 6 CCP boards (one CCP board is used for redundancy). The BSC can also share the rack with a 9130 MFS
  - Its modular design and its excellent scalability allows then to optimize the initial investment in the network by simple addition of additional CCP boards, in order to match traffic requirements as soon as the subscribers base grows.

- The TRX capacity of the BSC is 200TRX/CCP so up to 1000 TRXs are supported in this software release

Answer the Questions

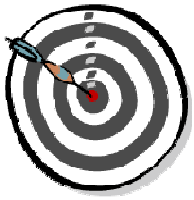
- How many types of TSU exist in the BSC?
- What is a TSC?
- Where do you put the Sub-Multiplexing equipment and what is its name?
- What is the maximum number of racks for one BSC?
- What is the maximum cell capacity for a BSC conf. 4?

Self-Assessment on the Objectives

- Please be reminded to fill in the form *Self-Assessment on the Objectives* for this module
- The form can be found in the first part of this course documentation

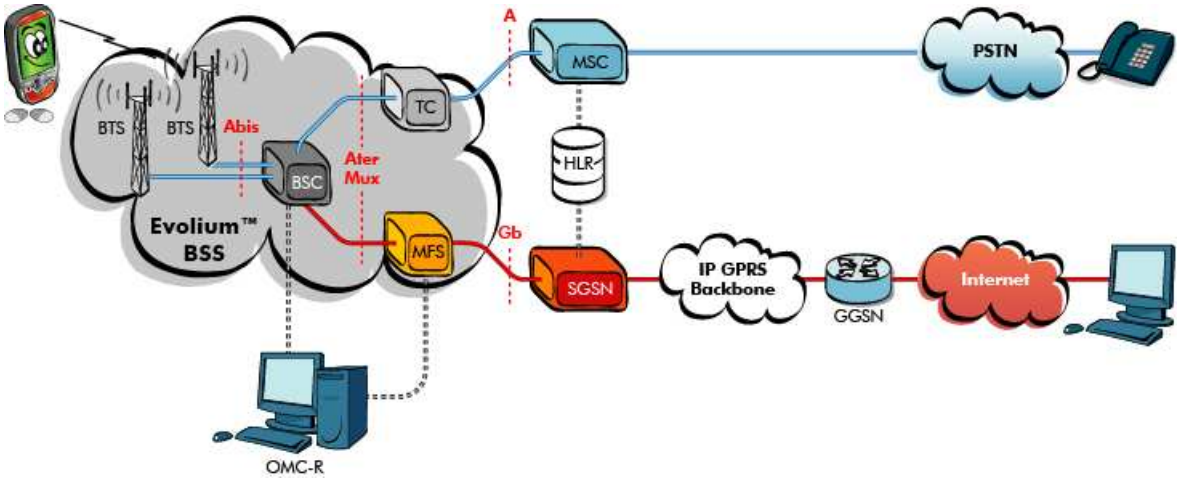
3. Transcoder Description

Section Presentation



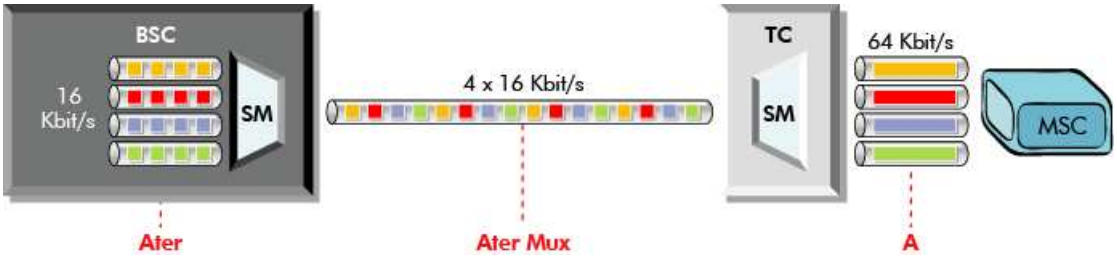
- Objective: To present the two types of Transcoder:
  - G2 TC
  - Evolium™ Alcatel 9125 Compact Transcoder
- Program:
  - Situation and Features
  - Functions
  - Hardware Configuration
  - Exercises

- Two generations of Transcoders: G2 TC and Alcatel 9125 TC



- The Transcoder provides:
  - Speech compression / expansion (16Kbps <--> 64Kbps)
  - Data Rate adaptation
  - O&M control of the transmission function

- The TC is usually located next to the MSC
- The Sub-Multiplexer (SM) optimizes the link between BSC and TC



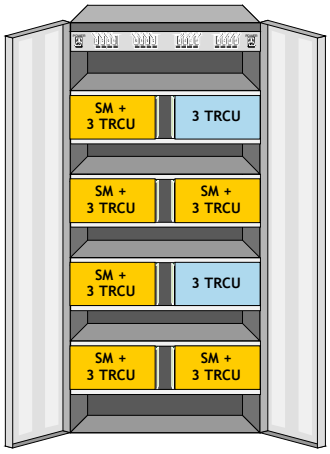
The TC performs **two main basic functions**:

- Provides conversion between the 16 kbps signals exchanged with the BSC, and the 64 kbps received from and sent to the MSC
- Reduces the number of terrestrial channels needed between the BSC and the TC.

The TSCA in the BSC performs supervisory, control and management functions for the TC. The TSCA is connected to the TC via the Qmux busses.

SM can be ASMC board or can be included in MT120 for the Alcatel 9125 Transcoder.

- G2 TC:
- Multiple Codec
  - Supports Full Rate, Enhanced Full Rate and Half Rate on a per call basis
  - Prepared for TFO and AMR
- Scalable capacity: 6 A-ter mux
  - Up to 24 A interface trunks with 4:1 submultiplexing
    - 120 TCH per A-ter mux interface trunk
- Equipment Practice
  - Based on the same practice as the Evolium™ BSC



1 G2 TC = 1 BSC

1 G2 TC = 6 Ater Mux (6 ASMC)

AMR (Adaptive Multi Rate) is a new technology defined by ETSI which relies on two extensive sets of "codec modes". One has been defined for FR and one for HR. When used in combined FR and HR mode, AMR brings a new answer to the trade-off between capacity and quality:

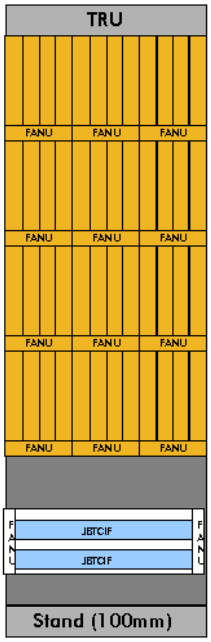
- Speech quality is improved, both in full-rate and half-rate,
- Offered capacity is increased due to the provision of half-rate channels allowing to densify the network with low impact on speech quality.

TFO : The Tandem Free Operation feature is a way to avoid tandeming of transcoders in speech mobile-to-mobile calls.

- Alcatel 9125 TC: New generation
- Main Characteristics
  - High capacity, multi-BSC, high compactness (48 MT120= 48 A-ter mux= 192 A interface)
  - Compatibility with Evolium™ TC G2
  - O&M improvements (central software downloading)
- New Technical concept based on
  - A new board MT120 corresponds to 13 boards: (1 ASMC + 4 ATBX + 8 DT16)
  - MT120 includes all transmission and processing functions and all interfaces required to support 120 channels

New transport capabilities integrated (B10 option)

- A new board TCIF can support 4 STM-1 connections for a and Atrermux interfaces



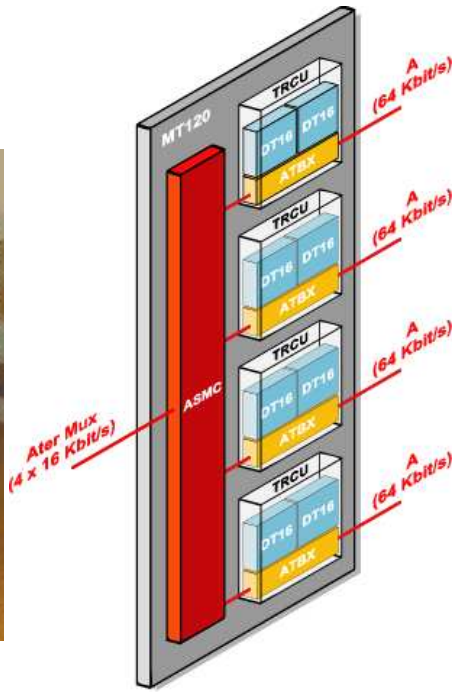
1 Alcatel 9125 Transcoder = several BSCs (depending on the number of the MT120 and the number of the BSC configuration)

- MT120 Compatible with current G2 TC equipment practice and interfaces, fully mixable with current G2 TC modules
- MT120 includes all transmission and processing functions and all interfaces required to support 120 channels

1 Alcatel 9125 Transcoder = 48 MT120 boards = 48 A-ter Mux

- 2 MT120 minimum for one BSC conf2
- 24 BSC maximum for 1 Alcatel 9125 (48/2)

- TC G2 and Alcatel 9125 TC comparison:
  - One MT120 board (Alcatel 9125) replaces 13 boards (TC G2)
  - The newer MT120-WB board supports W-AMR codec for improved voice quality

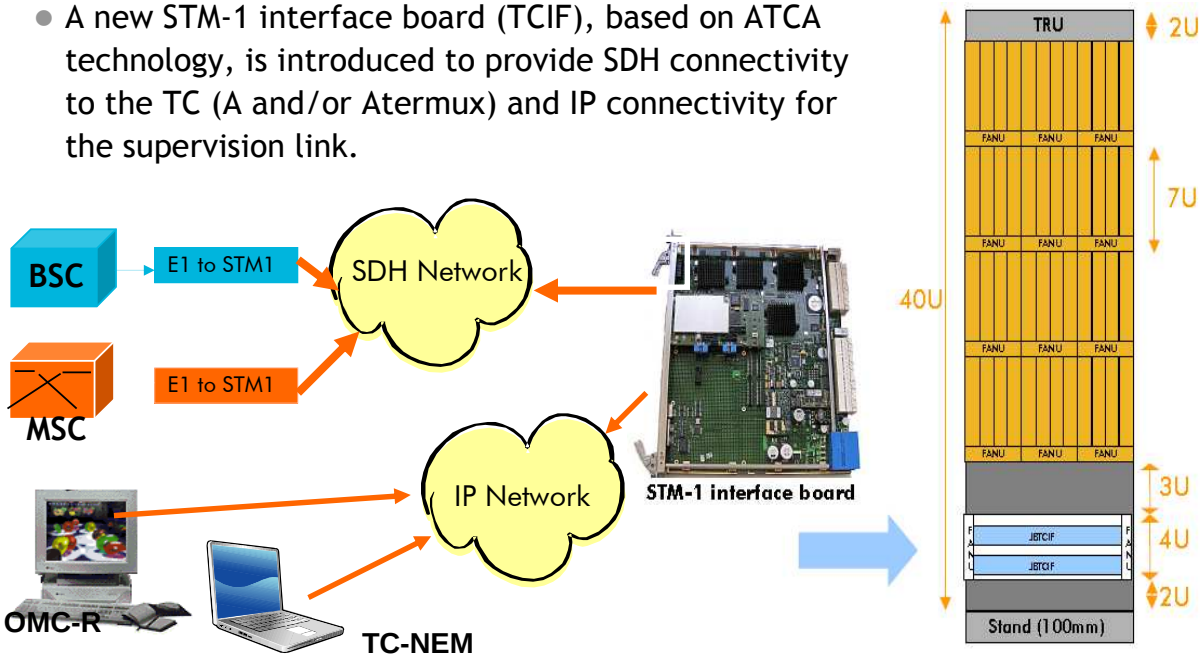


Wideband speech coding extends speech bandwidth between 50 Hz up to 7000 Hz. The extension from 3400 to 7000 Hz provides high intelligibility. The extension down to 50 Hz adds the feeling of transparent communication and supports speaker recognition. The result is a significant improvement in the speech quality compared to narrow band speech.

In Alcatel-Lucent implementation, Wideband AMR uses 6.60 Kbps, 8,85 Kbps and 12,65 Kbps.

In order to take benefit from the high voice quality offered by this codec, TFO should be used.

- Transmission capabilities
  - A new STM-1 interface board (TCIF), based on ATCA technology, is introduced to provide SDH connectivity to the TC (A and/or Atermux) and IP connectivity for the supervision link.

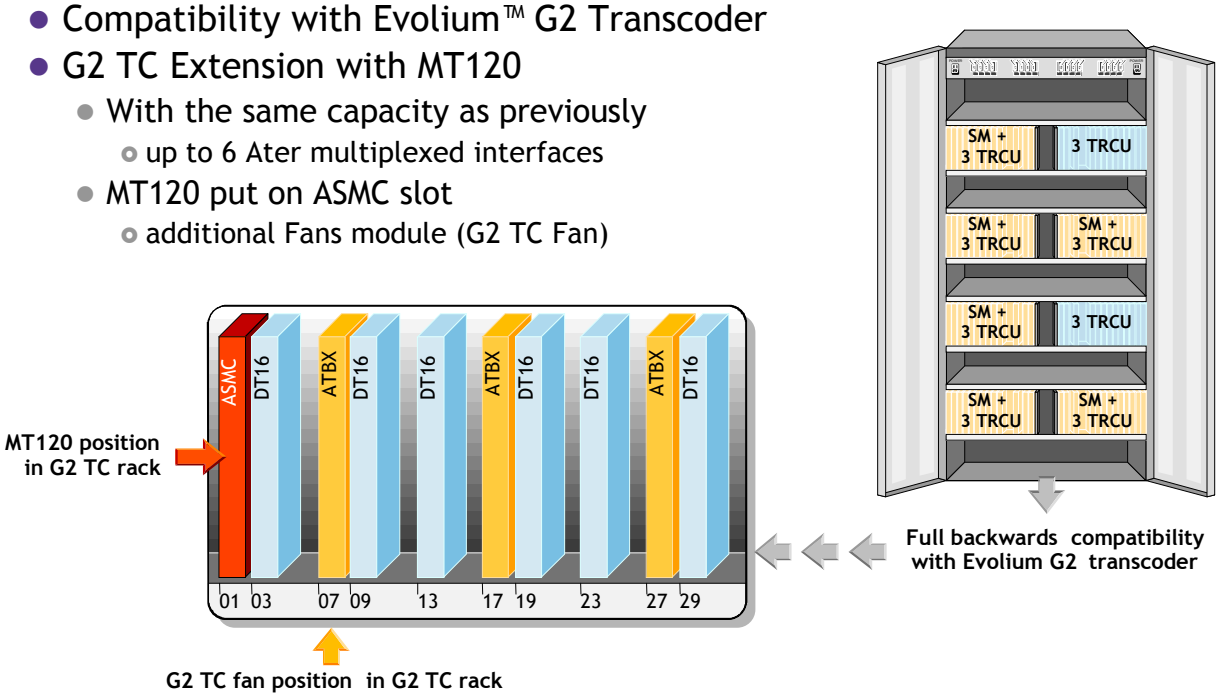


The E1 links of the TC are transported transparently trough the SDH network. Each TC can be pure E1, pure STM-1, or mixed E1 & STM-1.

Integrated STM-1 interface on the TC is intended to:
- reduce cost on interface equipment to SDH network: removal of E1 to STM-1 boards to connect the TC to the SDH network;
- reduce the cabling effort: only 4 STM-1 interfaces are needed to replace the 192 E1 links for A interface and 48 E1 links for Ater interface;
- reduce the space needed for cables and distribution frames: the 8 STM1 fibers use much less cable ways and distribution frames than the 240 PCM links;

Hardware Configuration

- Compatibility with Evolium™ G2 Transcoder
- G2 TC Extension with MT120
  - With the same capacity as previously
    - up to 6 Ater multiplexed interfaces
  - MT120 put on ASMC slot
    - additional Fans module (G2 TC Fan)



Answer the Questions

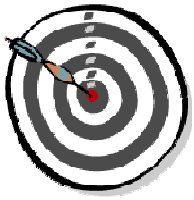
- What is the TC rate adaptation? (between BSC and MSC)
- For the Alcatel 9125 TC, how many boards does one MT120 replace ?
- What are the Sub-Multiplexers used for ?
- What is the interface between TC and MSC ?

Self-Assessment on the Objectives

- Please be reminded to fill in the form *Self-Assessment on the Objectives* for this module
- The form can be found in the first part of this course documentation

4. Base Transceiver Station Description

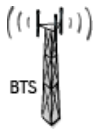
Section Presentation

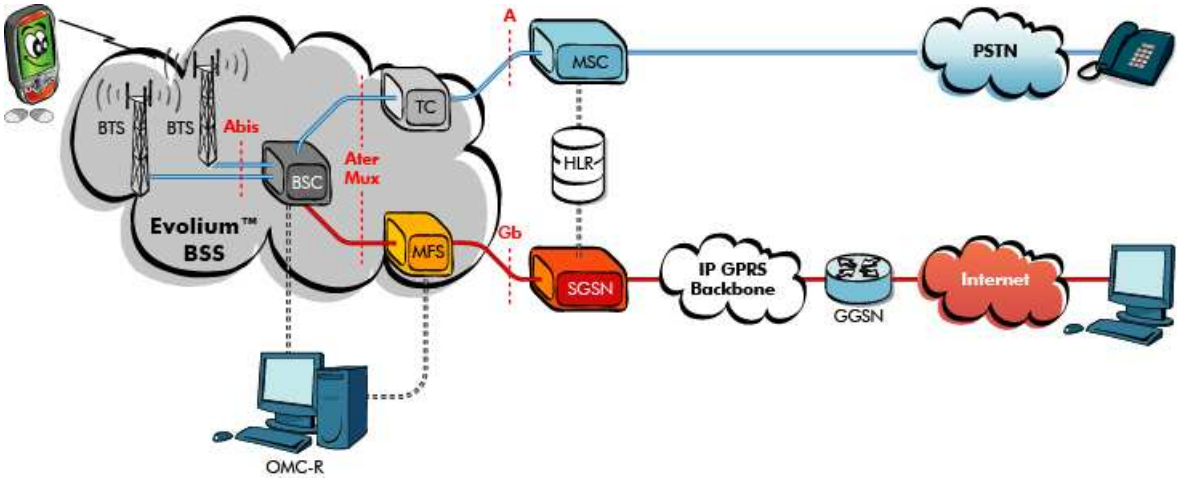


- Objective: To present the Alcatel Evolium™ 9100 BTS and the 9110–E Micro BTS

- Program:
  - Situation and Functions
  - Evolium A9100 BTS Features
  - Evolium A9100 BTS Architecture
  - Evolium A9100 MBS Hardware Configuration
  - Evolium A9110-E Features
  - Evolium A9110-E Architecture
  - Evolium A9110-E Hardware Configuration
  - Exercises

- The Base Transceiver Station:





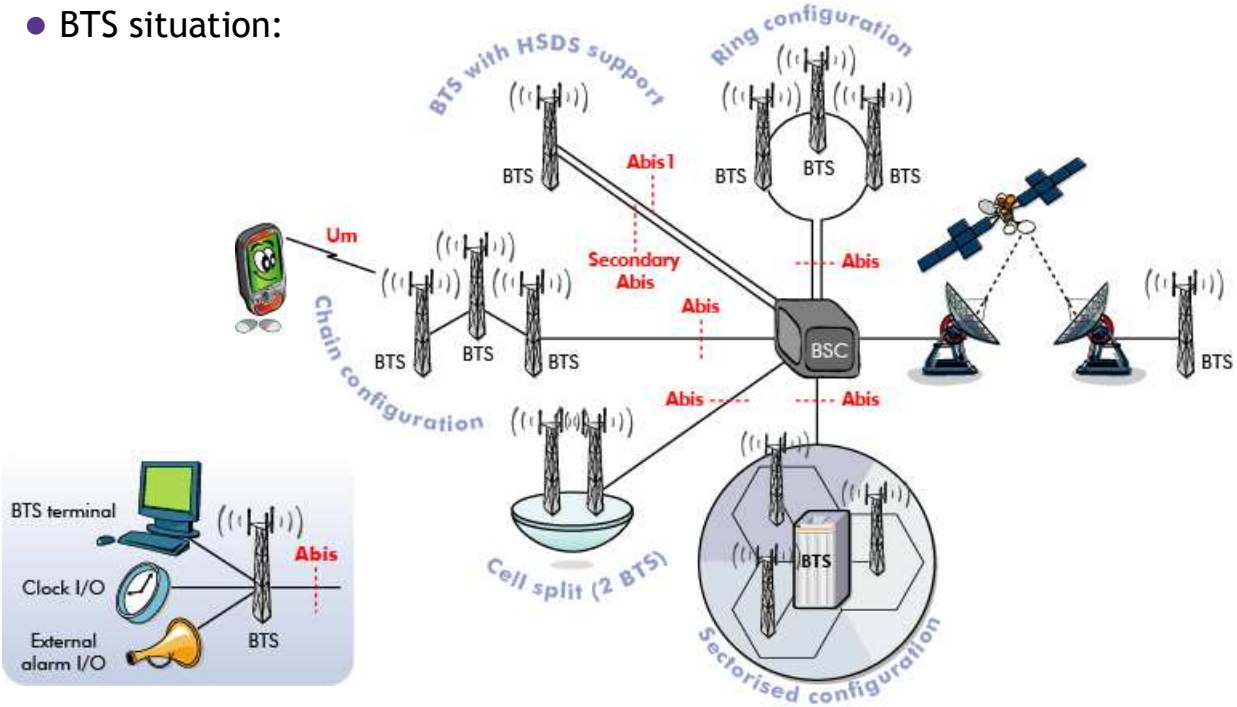
The area covered by a BSS is divided into cells and each cell is managed by a sector of a BTS.

Each BTS consists of radio transmission and reception devices including antennae and signal processing equipment for the Air Interface.

Situation and Functions

- The Base Transceiver Station:
  - Provides radio transmission, control and baseband functions for a cell
  - Supports the Air interface with the Mobiles

- BTS situation:



EVOLIUM
ALCATEL BSS Description

Alcatel·Lucent

Open Multi-drop topology "CHAIN": One PCM link connects up to 15 BTS (only 1 TRE for each BTS and using the 16 Kbit/s Statistic multiplexing) in serial order and the PCM is not looped back to BSC by the last BTS.

- In chain topology, the BSC is connected on an Abis link to a BTS. This one is connected on its second Abis port to a second BTS, the second BTS in its turn is connected to a third one, and so on.

Closed Multi-drop topology "RING": One PCM link connects up to 7 BTS in serial order and the PCM is looped back to BSC by the last BTS.

- In ring or loop topology, the last BTS of a chain is connected back to the BSC. This topology offers some security since traffic between any BTS and BSC is broadcast on the two paths, selection is based on dedicated Service bits / bytes.

Industrialisation of satellite features (On Evolium™ BSC/BTS only)

- Satellite : type of link (Terrestrial, Satellite) can be chosen from the OMC-R
- Abis side and A-interface side are exclusive
- For Abis links
  - No Close Multi-drop
  - transmission supervision via OML only
  - BTS must be configured as free run (OCXO synchronization, not PCM synchronized)
- Timer changes only for the satellite BTS

Cell split over 2 BTSs: The system is able to handle cells whose TRXs are located in two different BTSs.

- This feature brings important flexibility by allowing particularly:
  - To extend an existing site by only adding TRXs in a new BTS, not touching the arrangement of the existing BTS,
  - To combine existing cells into one, e.g. one 900 cell and one 1800 cell in order to get a multi-band cell,
  - To support 3x8 TRXs configurations in 2 racks (instead of 3).

BTSs with High Speed Data Service support: In certain conditions one BTS may need more than one PCM connection to the BSC.

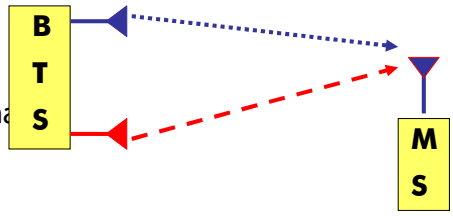
Situation and Functions

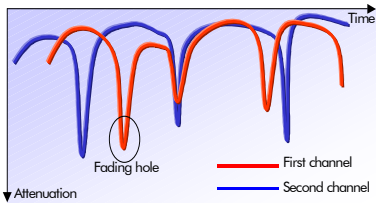
- The BTS performs the following functions (some of them are done under the control of the BSC):
  - Transmit and receive functions
  - Antenna diversity (2RX 4RX and 2TX)
  - Frequency hopping
  - Radio channel measurements
  - Radio frequency testing
  - Radio Measurement Statistics (RMS)
- The BTS includes the BIEs:
  - To Communicate with the BSC over the Abis Interface

The RMS feature provides statistics on the radio measurements performed by mobiles and BTSs on TCH channels.

These statistics are computed by the BTSs and made available at the OMC-R through the PM application. Thus RMS can provide an exhaustive set of QoS statistics on the whole network updated every day.

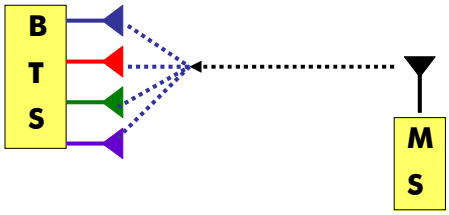
- **Transmit diversity**
- Basic Idea:
  - Transmit twice the same signal from two antenna
  - No combining losses (on air combining)





2 paths (blue and red) They show independent amplitude (fast) fading
Probability to fall in a hole is reduced
Fading holes of a channel are often compensated by the other channel

4 path reception diversity
Same signal is received by 4 antennas



Theoretically 3dB additional gain

The transmission diversity coverage gains

Dense Urban 6db	Sub Urban 4,6db	Rural	4db

The Receiption diversity 4ways

Dense Urban 10db	Sub Urban 8,6db	Rural	6,4db

Evolium A9100 BTS Features

- Characteristics of the Alcatel 9100 BTS:
  - Support GSM 900 (E-GSM), GSM 1800 (DCS), GSM 1900 and GSM 850
  - Indoor BTS and outdoor BTS variants are available
  - Multiband BTS, and multiband cell
  - EGPRS supported with TRA
  - Air combining BTS (Low Loss configuration)
  - AC indoor
  - Indoor Unit (IDU) of Microwave entity
  - Option: Range Extension Kit

Air combining BTS: the objectives is to have a Low Loss antennas configuration. But the numer of antennas is increased

Range Extension Kit: used to enhance the capabilities of the Alcatel 9100 BTS in term of coverage (limited to 900 MHz band) (Ampli)

The **TMA** (Tower Mounted Amplifier) is used for the reception

Indoor Unit (IDU) of Microwave entity is coupling to the ODU (Outdoor Unit)

- Example of TRE boards with their frequency band and power characteristics

NAME	BAND	POWER	GMSK		8PSK	
			W	dBm	W	dBm
TRAL	850	MP	45W	46,5	15W	41,8
TRAG	900	MP	45W	46,5	15W	41,8
TRAGE	900	MP	45W	46,5	30W	44,8
TAGH	900	HP	60W	47,7	25W	44,0
TAGHE	900	HP	60W	47,8	30W	41,8
TRAD	1800	MP	35W	45,4	12W	40,8
TRADE	1800	MP	35W	45,4	30W	44,8
TRAP	1900	MP	45W	46,5	25W	40,0
TRDH	1800	HP	60W	47,7		
TADH	1800	HP	60W	47,7	25W	44,0
TADHE	1800	HP	60W	46,8	30W	44,8
TGT09	900		45W	46,5	30W	44,8
TGT18	1800		35W	45,4	30W	44,8

Different Transceivers are used depending on the band : 900, 1800, 1900 (in America) and 850MHz (this new band has been introduced in the Release 1999 of the 3GPP Standard).

The list above is not exhaustive.

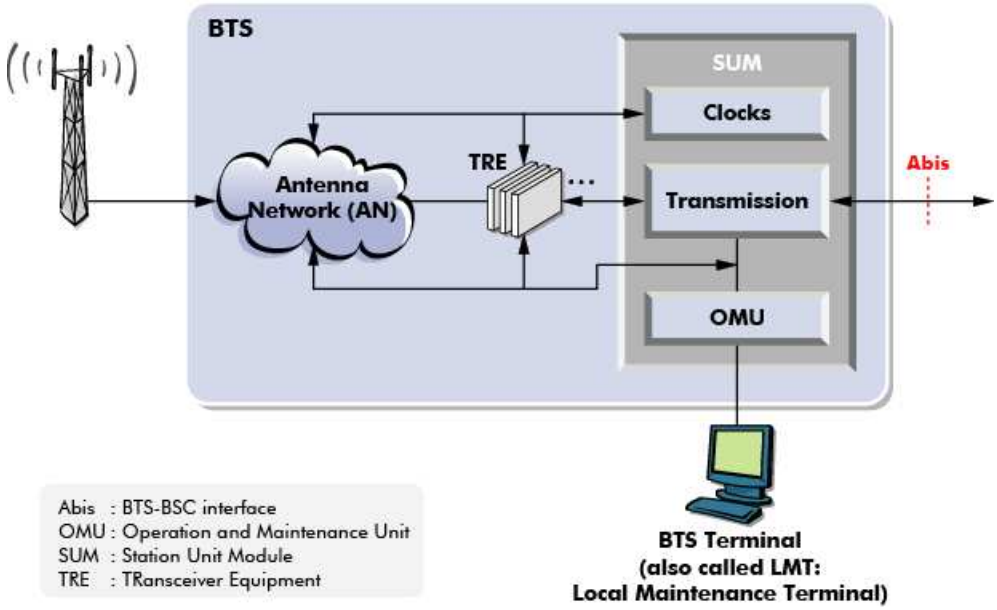
A new Tx Rx hardware module gives the possibility to have per Hardware module transmission receiption function. In this case the module is called **Twin TRX**

For example

In the MBI5 rack, the number of hardware module is 12 maximum, but if all are Twin TRX the maximum number of **Transmitter functions will be 24.**

The new Twin TRX (TGT) gives also the possibility to provide **TX diversity**

- Alcatel 9100 BTS functional organisation:



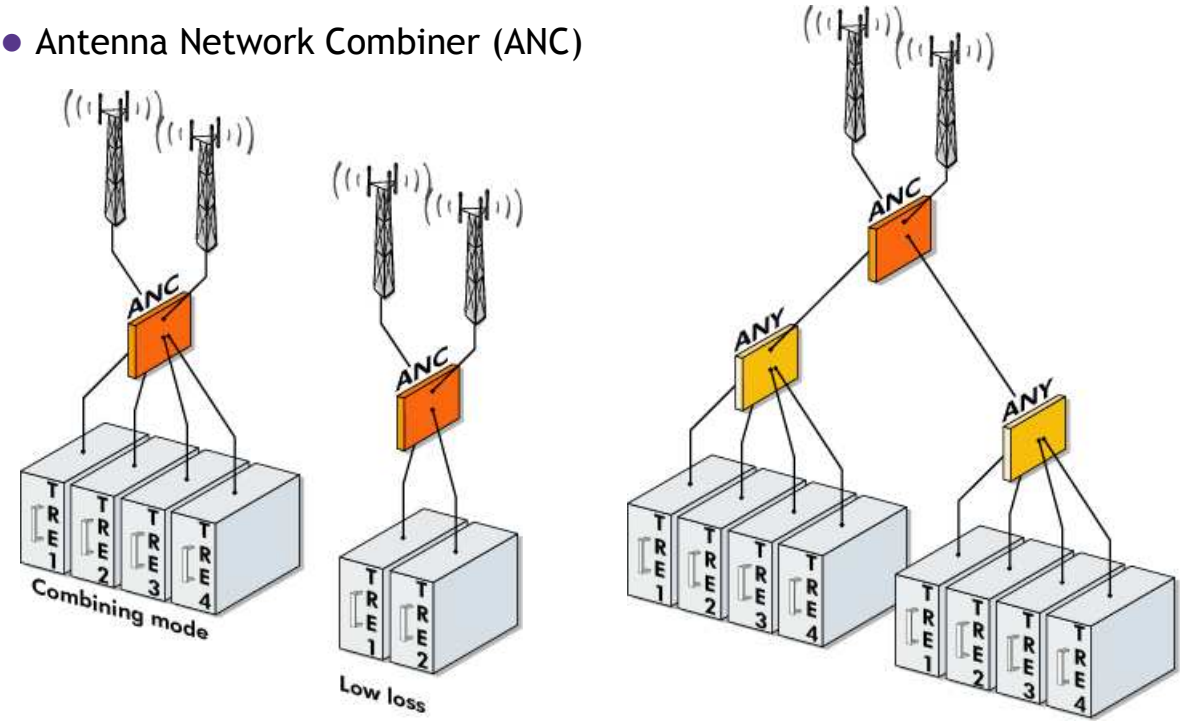
Alarms in the BTS are tracked by the OMU.

- TRANS = transmission Board (= Base Interface Equipment)
- SUM: Station Unit Module

The antenna network provides all necessary front-end filters, combiners, splitters and amplifiers to allow the connection of several transceivers to a set of antennas.These functions are performed by 2 independent modules :

- ANC For duplexing and wide band combining,
- ANY For wide band combining.

- Antenna Network Combiner (ANC)



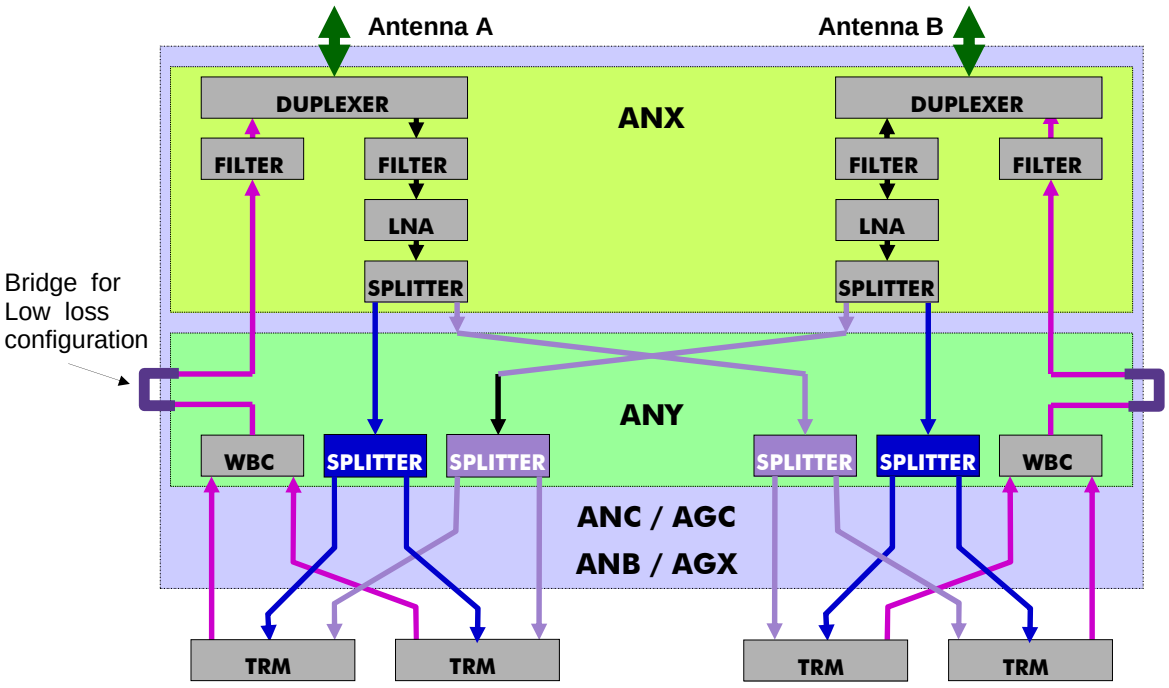
ANC performs the duplexing and the wide band combining.
AGC Antenna network Evolution with Combiner.

ANY can be by-passed for low loss configurations:

- A low loss configuration is possible with only 2 TRE

ANX Antenna network.

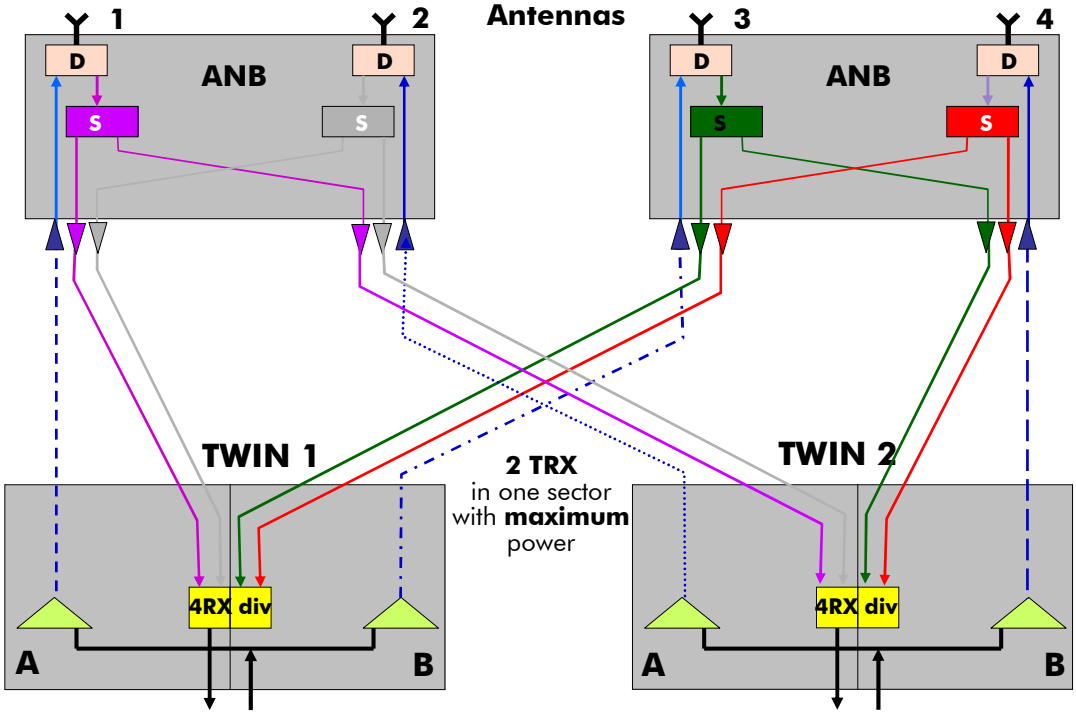
ANB Antenna network BI TRX.
AGX Antenna network Evolution BI TRX.



Bridge explaination

A combiner is mandatory if there is more than one TR per antenna and at that time about 3dbm are lost

If each TR transmit on its antenna a combiner is avoided and 3dBm are saved



Transmission reception configuration with transmission diversity

TRX 1A Transmission on 1 receiption on 1 2 3 4

TRX 1b Transmission on 2 receiption on 1 2 3 4

TRX 2A Transmission on 3 receiption on 1 2 3 4

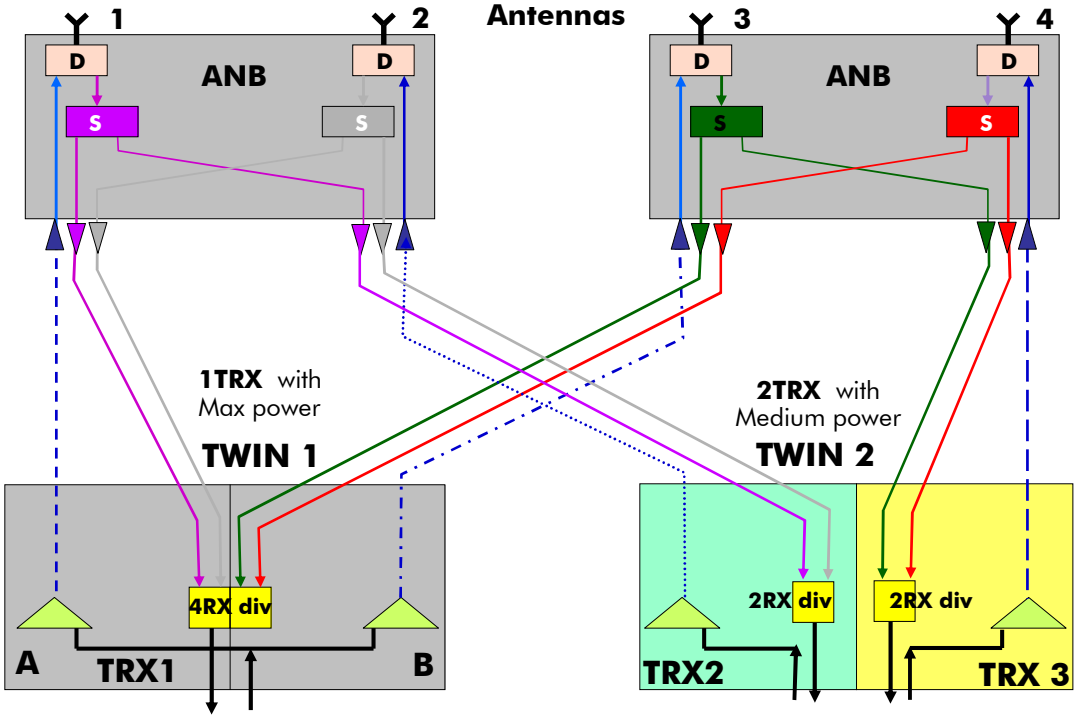
TRX 2B Transmission on 4 receiption on 1 2 3 4

Transmission :

Same signal is transmitted over 2 antennas with a given time difference

Reception :

With **4 Rx diversity**, **2 Antenna Networks** are required in each sector



Transmission reception configuration with transmission diversity

TRX 1A Transmission on 1 reception on 1 2 3 4

TRX 1b Transmission on 2 reception on 1 2 3 4

TRX 2 Transmission on 2 reception on 1 2

TRX 3 Transmission on 4 reception on 3 4

To change from twin TRX to Two TRX to have more capacity doesnot need recabling

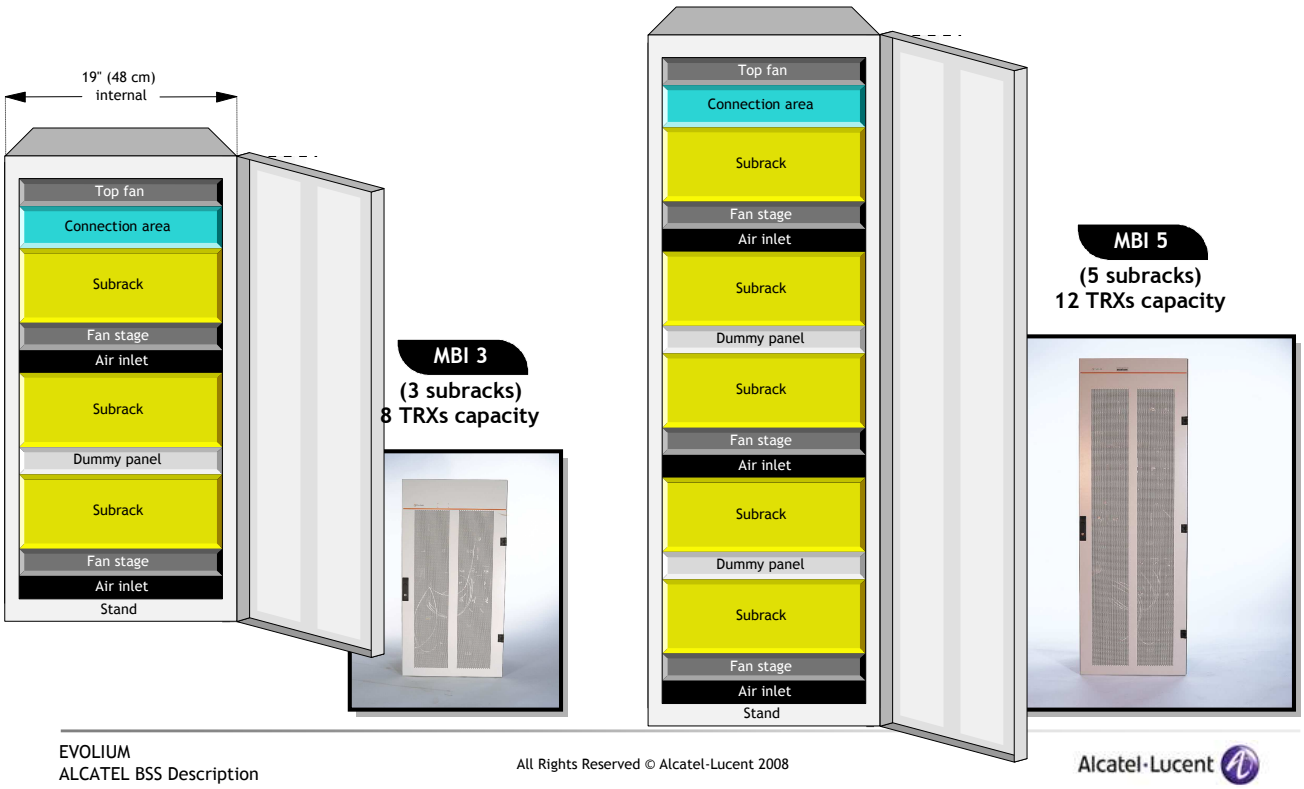
	Sectors	Min TRX per sector	Max TRX per sector				Notes	Frequency band
			Indoor		Outdoor			
			MBI3	MBI5	MBO1	MBO2		
Standard	1	1	8*	8	8*	8	* GSM 1900: 6	850/900/1800/1900
	2	1	4*	6	4*	6	* GSM 1900: 3	850/900/1800/1900
	3 (note 1)	1	2	4	2	4		850/900/1800/1900
Low-loss	1	3 (5 for MBO2)	4	12	4	12		850/900/1800/1900
	2	3		6		6		850/900/1800/1900
	3	3				4		850/900/1800/1900
High power	1	1	4	4	4			1800
	2	1	2	4	2	4		1800
	3	1	2	3	2	4		1800
Indoor AC	1	1	4	8				850/900/1800/1900
	2	1	2	6*			* if integrated battery: 4	850/900/1800/1900
	3 (note 2)	1	1	4*			* if integrated battery: 2 * if GSM 1900: 3	850/900/1800/1900

MBS for Multi Standard BTS. The interest is that in the same rack, UMTS and GSM/GPRS boards can be plugged in, sharing the same housing, power supply, external alarms etc

Note 1 : The configurations standard 3,2,2 and 3,3,2 are allowed in all cabinets MBI and MBO.

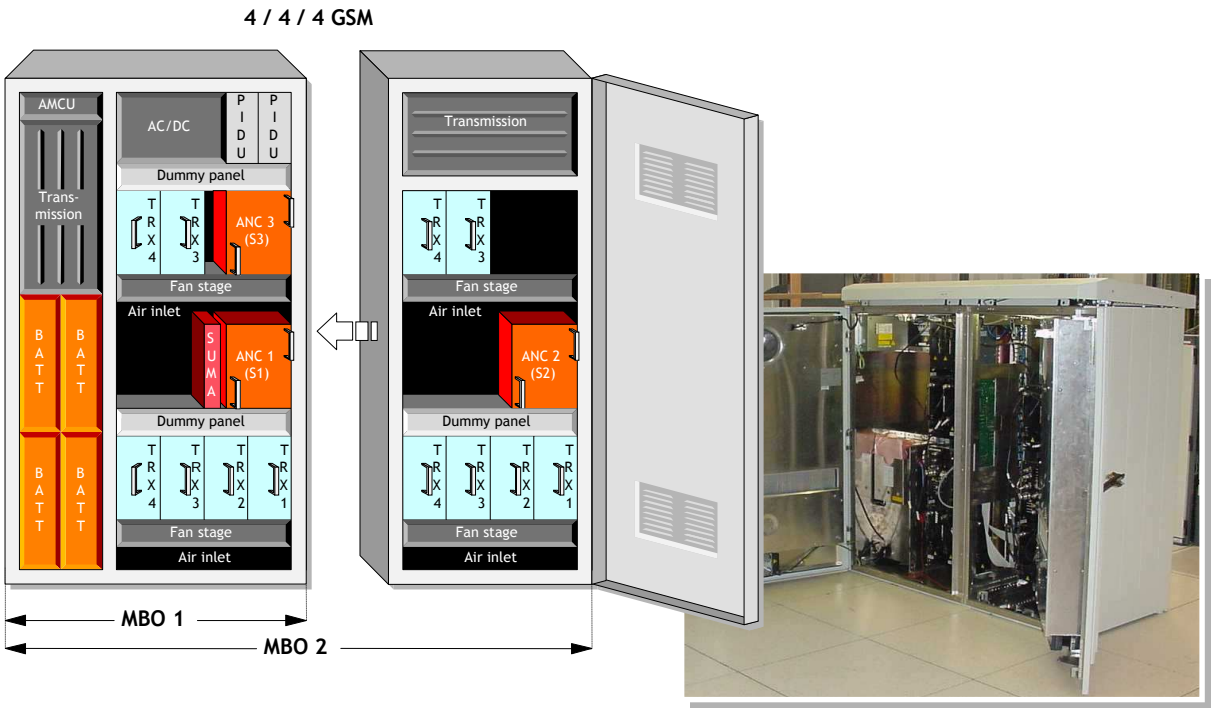
Note 2 : The configurations indoor AC 3,2,2 and 3,3,2 are allowed only in MBI5 cabinet.

Evolium A9100 MBS Hardware Configuration (MBI)



Multistandard base station indoor cabinet

- MBI configurations
  - MBI-3 (8 TRXs)
    - instead of Mini Cabinet
    - 1x8,2x4,3x2
  - MBI-5 (12 TRXs)
    - instead of Medi Cabinet
- New capabilities for MBI3
  - AC indoor with BU 5
    - 4 TRXs capacity
    - 1x4,2x2,3x1
  - 3x2 for MBI-3
    - was 3x1 for Mini Cabinet
- In the same rack UMTS and GSM/GPRS boards can be plugged in, sharing the same housing, power supply, external alarms etc.



Types of Cabinet and Configurations

- MBO1 - Multi Standard BTS Outdoor 1-door
  - up to 8 TRX GSM in 4 subracks
  - BBU; battery size 90Ah, further options 5HU (NTL, DDF, MW etc.)
- MBO2 - Multi Standard BTS Outdoor 2-doors
  - up to 12 TRX GSM in 7 subracks
    - Note : additional space available for other modules, equivalent to 4 TRXs which will be used for Multistandard configurations
  - additional further options 6HU (DDF, MW, TMA, REK etc.)

BBU : Battery Backup Unit

DDF : Digital Distribution Frame

MW : Microwave

NTL : Network Termination Line

REK : Range Extension Kit

TMA : Tower Mounted Amplifier

In the same rack UMTS and GSM/GPRS boards can be plugged in, sharing the same housing, power supply, external alarms etc.

- Micro Base Transceiver Station A9110-E
- Main radio features:
  - GSM 900, GSM 1800, GMS 1900, GSM 850
  - Single-antenna or low-loss version
  - Omni, sectored
  - Dualband configurations (with more than 1 BTS)
- EGPRS supported
- Micro-BTS A9110-E power specifications

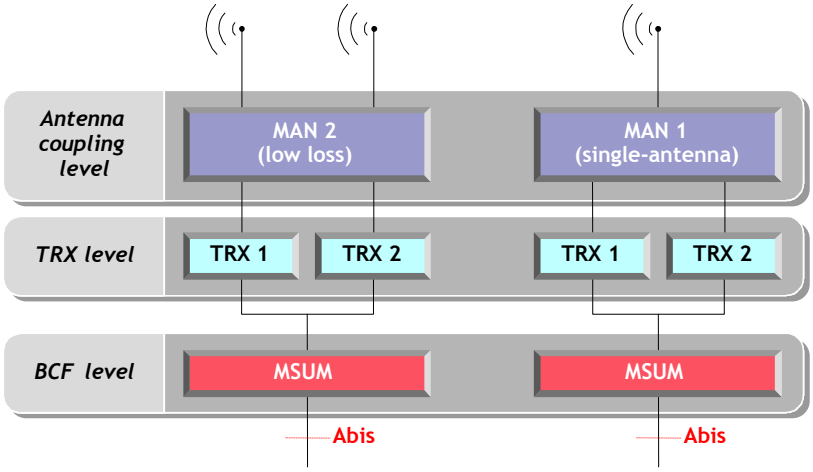
Variant		Output Power, GMSK	Output Power, 8-PSK
A9110-E 900 Mhz	Single antenna	3.2 W, 35.1 dBm	2.3 W, 33.6 dBm
	Low loss	7 W, 38.5 dBm	5 W, 37 dBm
A9110-E 1800 Mhz	Single antenna	3.2 W, 35.1 dBm	1.8 W, 32.6 dBm
	Low loss	7 W, 38.5 dBm	4 W, 36 dBm

Radio performance:

- GSM 900 and GSM 1800 variants (E-GSM in second step)
- Dualband configurations: Dualband cell (or sector)
- Two Tx power versions:
  - single-antenna: 35.1 dBm (integrated WBC)
  - low-loss: 38.5 dBm (no internal WBC)
- -107 dBm Rx sensitivity at antenna connector
- Integrated duplexer (standard)
- Radio frequency hopping (standard)
- Antenna diversity (standard for low-loss version)
- Integrated antennas (optional for low-loss version)

- **Mechanical/ environmental**
- same entity to be used as master or slave unit
- extension up to 12 TRX
- Wall/pole, indoor/outdoor mounting
- Complete cover (for aesthetics or protection)
- Integrated fan for hot environmental conditions
- VSWR detector
- Optional Site Support Cabinet:
  - battery backup unit (270 min. for 2 TRX, 180 for 4 TRX, 90 for 6 TRX)
  - Transmission (HDSL = High rate Digital Subscriber Line, NTL = Network Termination Line)

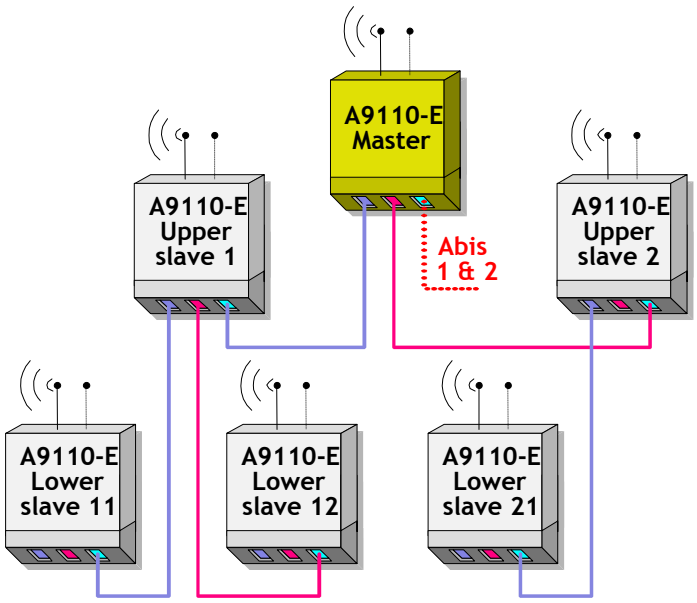
- Alcatel 9110-E Micro-BTS



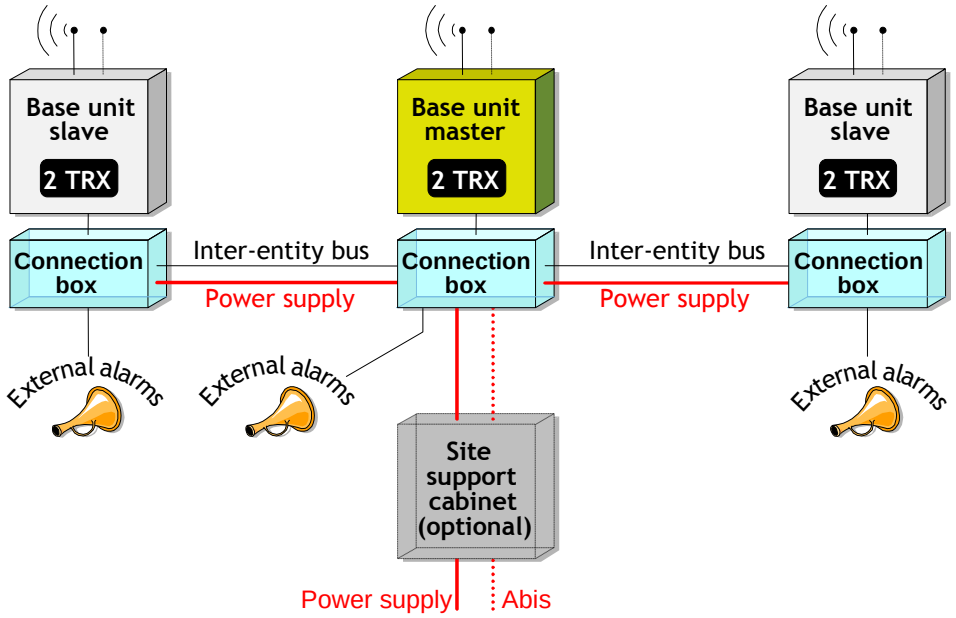
BCF : Base station Control Function
MAN : Micro-BTS Antenna Network
MSUM : Micro-BTS Station Unit Module
TRX : Transceiver

Evolium A9110-E Hardware Configuration

- The A9110-E Micro-BTS may be used in configurations from 2 up to 12 TRX, connecting one up to 6 Basic Units.



- The Site Support Cabinet is an optional unit which can be added on the Micro BTS site, independently of the TRX capacity (up to 12 TRXs).



The characteristics of the site support cabinet are:

- Battery backup
- Environmental :
  - temperature range from -33 to + 45 °C thanks to an advanced cooling system
  - Lightning protection
- Free space and 2000W power is available such as:
  - Two microwave baseband units or
  - Two network terminations for multidrop or
  - Two HDSL modems

The cabinet is supervised via the external alarms of the micro-BTS

Answer the Questions

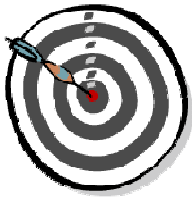
- For an Evolium A9100 BTS, which board allows to support EGPRS?
- For an Evolium A9100 BTS, which board includes the Base Interface Equipment ?
- For a micro BTS, is it possible to use a dualband configuration ?
- For a micro BTS, is it possible to have one sector with 12 TREs?

Self-Assessment on the Objectives

- Please be reminded to fill in the form *Self-Assessment on the Objectives* for this module
- The form can be found in the first part of this course documentation

5. MFS Description

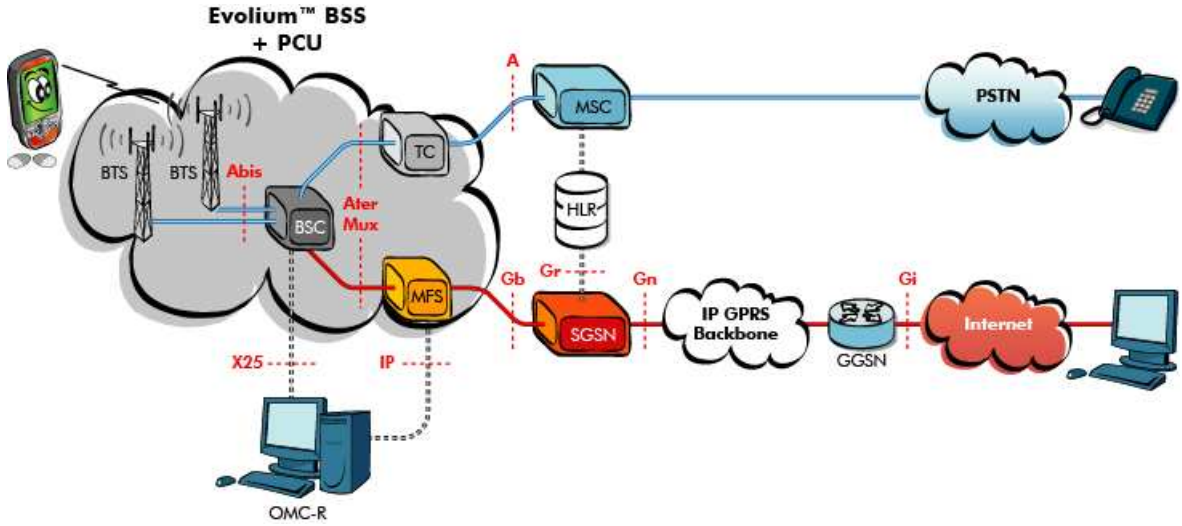
Section Presentation



- Objective: To present the two types of Multi-BSS Fast Packet Server : Alcatel 9135 MFS, Alcatel 9130 MFS.

- Program:
  - Situation and Features
  - Functions
  - Hardware Configuration
  - MFS 9135 Configurations
  - MFS 9130 Description
  - MFS 9130 ATCA shelf
  - MFS 9130 Configurations
  - Exercises

- The Multi-BSS Fast Packet Server:



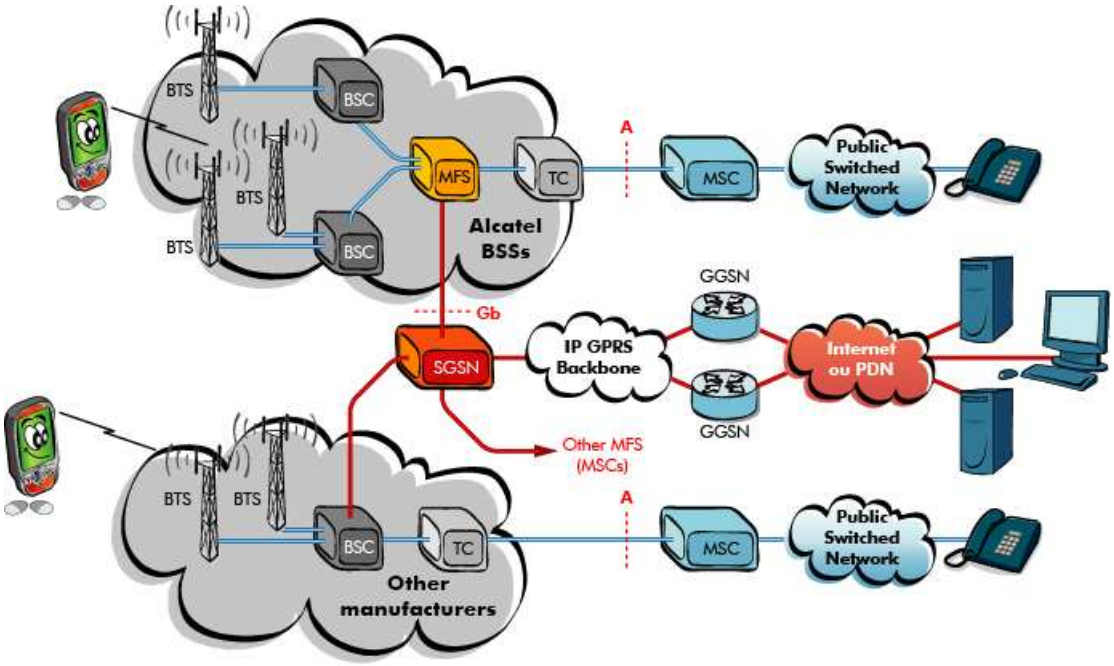
The MFS provides resource and equipment management facilities for the packet-switched system (GPRS) in the BSS.

It allocates resources and manages the data flow between the BTS and the GSS.

The MFS provides the PCU (Packet Control Unit) function:

- Resource allocation
- Segmentation
- Assembly
- Power control
- Timing advance
- Coding scheme adaptation control (with CCU function, implemented into BTS)
- Radio Block acknowledgement

- Interconnection with other manufacturers



The Alcatel approach for the implementation of (E)GPRS is to group the PCU and Gb termination functions of several BSS into one new Network Element called "Multi BSS Fast Packet Server" (A9135 MFS).

The MFS manages the interface with the SGSN in the NSS. The MFS supports multiple BSSs and can be connected to several SGSNs.

Several MFSs can be connected to the same OMC-R.

Reminder: 1 BSS = 1 BSC

- New System Element for (E)GPRS
  - MFS Multi BSS Fast packet Server
    - GPRS Packet Control Unit functions (GSM 03.60 standard)
    - Radio Resource Management for (E)GPRS for several BSSs
    - Management of the interface with the GPRS core network
  - SGSN Serving GPRS Support Node
    - Mobile packet routing
    - Security and access control
    - Interface to the Home Location Register (HLR)
    - VLR for (E)GPRS (MS location)
  - GGSN Gateway GPRS Support Node
    - part of the (E)GPRS core network
    - IP router, linked to one or several data networks
    - Interworking with external packet-switched networks

MFS O&M Functions

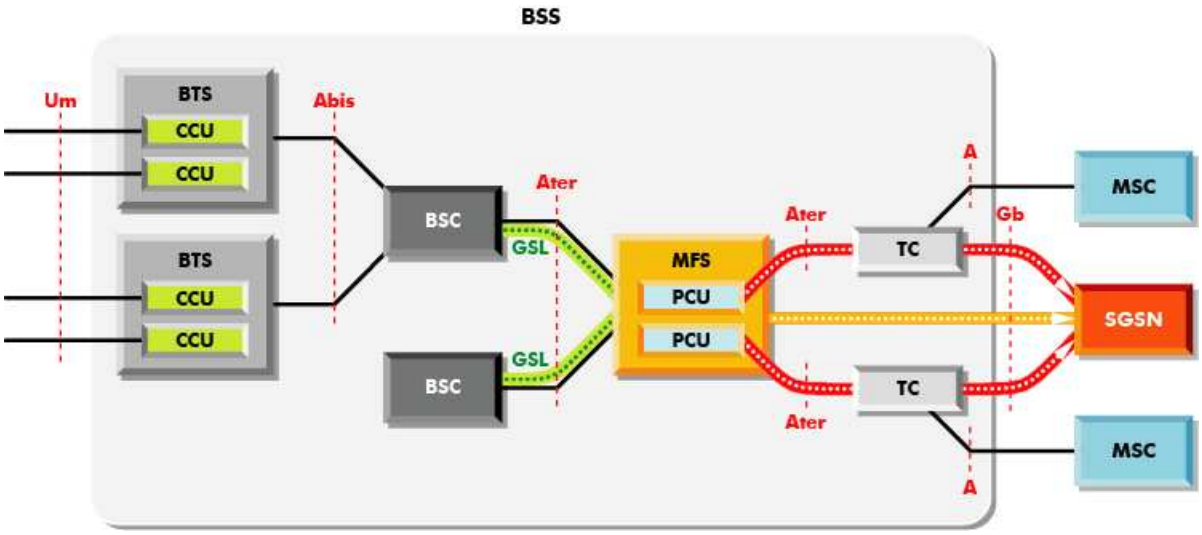
Even though the MFS is included in the BSS, the BSC does not act as a control point for collecting and processing O&M data for the MFS. The MFS does this itself and sends the necessary alarm and performance data directly up to the OMC-R.

The MFS is designed with built-in redundancy for the GPRS Processing Unit (GPU), the LSN Switches and also for the servers. One of the 15+1 GPUs in a Telecom subrack operates in redundant mode and replaces, when needed, a faulty GPU.

The MFS manages its equipment, including low level software management. It also manages the GPU telecom operations, and is responsible for telecom resource configuration and supervision. The MFS provides a terminal interface, the IMT, for local O&M.

- The MFS within the BSS: Alcatel's solution

CCU : Channel Codec Unit
GSL : GPRS Signaling Link
PCU : Packet Control Unit



Alcatel Solution: dedicated unit, **MFS**= « Multi-BSC Fast packet Server ». The PCU function is linked to the CCU function (BTS).

The **MFS** has 2 functions: **PCU function & Gb interface**

The MFS is transparent to Circuit Switching (CS): A-ter interface on both sides of MFS. (called: **Cross-Connection**)

Gb interface can be either directly provided by MFS (IP or Frame Relay can be used for transportation) or through TC (with traffic flow through TC on same PCM links already used for CS, only Frame Relay can be used for transportation).

The BSC is responsible of the allocation of radio resources (OMC-R tuning)

BTS (cells) connected to one MFS are always managed by the same SGSN but may be managed by several MSC (RCP).

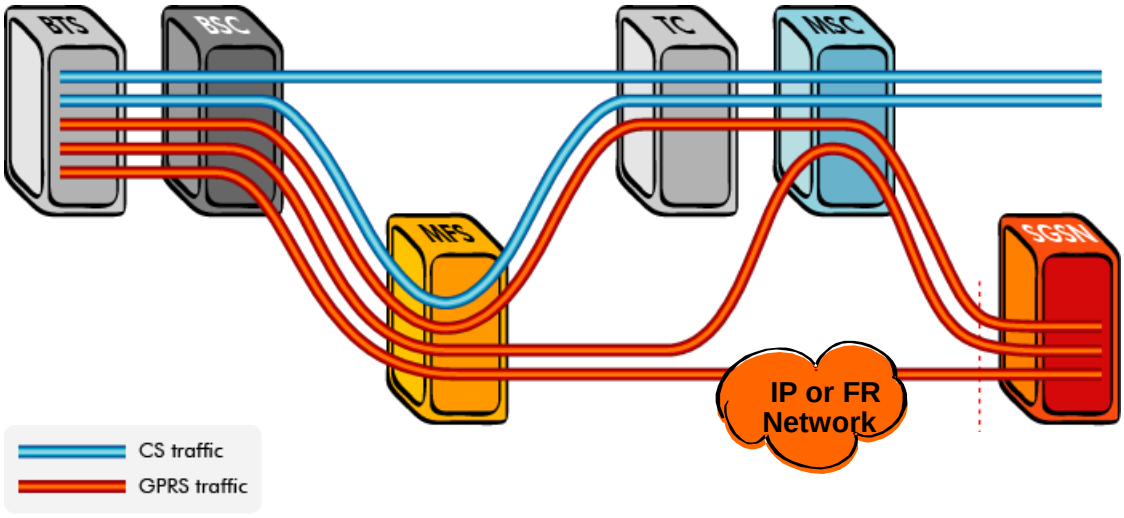
Reminder:

- Abis: (BTS-BSC) 16 Kbps channels
- Ater: (BSC-TC) 16 Kbps channels
- A: (TC-MSC) 64 Kbps channels

CCU function (BTS) manage the Coding Sheme:

- CS1: 9.06 Kbps / CS2: 13.4 Kbps / CS3: 15.6 Kbps / CS4: 21.4 Kbps (GMSK modulation)
- MCS1: 8.8 Kbps / MCS2: 11.2 Kbps / MCS3: 14.8 Kbps / MCS4: 17.6 Kbps (GMSK modulation)
- MCS5: 22.4 Kbps / MCS6: 29.6 Kbps / MCS7: 44.8 Kbps / MCS8: 54.4 Kbps / MCS9: 59.2 Kbps (8-PSK modulation)

- Position in the network / Interface routing



3 options for MFS interconnection with SGSN:

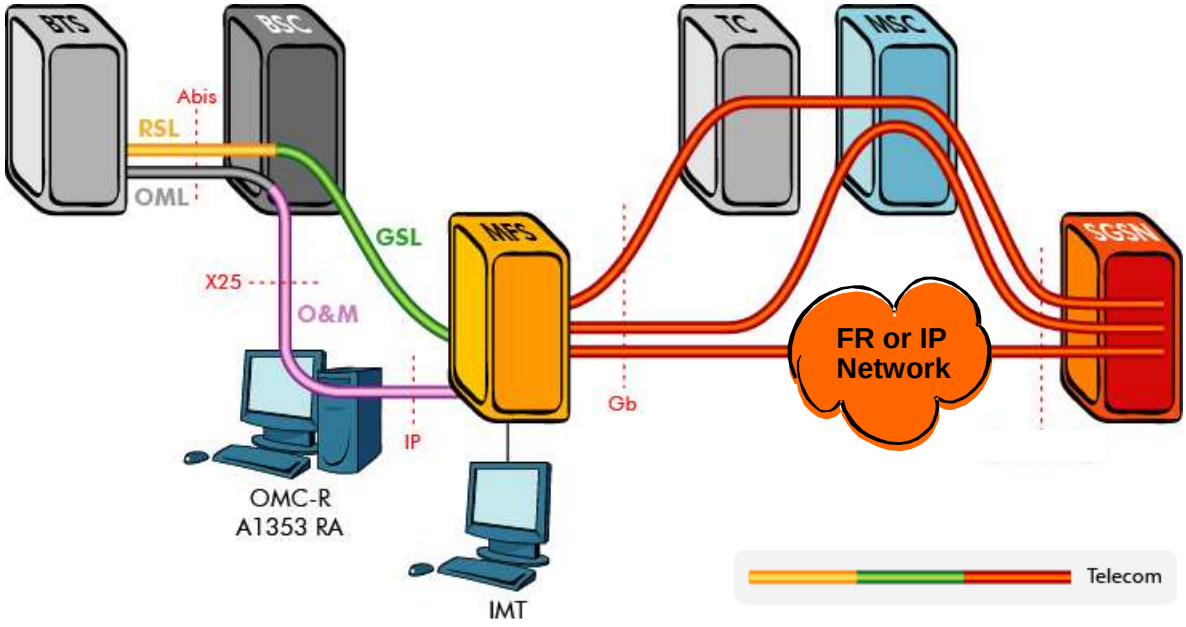
- 1) via TC/MSC (Frame Relay):
  - The PS traffic is processed inside the MFS in order to provide Gb timeslots sent to the TC.
  - The PS traffic is routed transparently through TC.
- 2) via MSC (Frame Relay)
  - the PCM link between MFS and MSC is dedicated to Gb interface
- 3) direct to SGSN (Frame Relay or IP)
  - In case of Gb over IP an Edge Router must be used for interconnecting the MFS with the IP netork.

In all 3 options, **CS traffic is routed transparently through MFS (Cross Connection)**

(the dotted line inside the TC indicates that information is processed: frames are reformatted. Inside MFS or BSC no processing is carried out)

In option 1 and 2, PCM links (on A-ter interface) already exist before GPRS introduction and can be shared by CS and GPRS traffic.

- Flow of Signaling

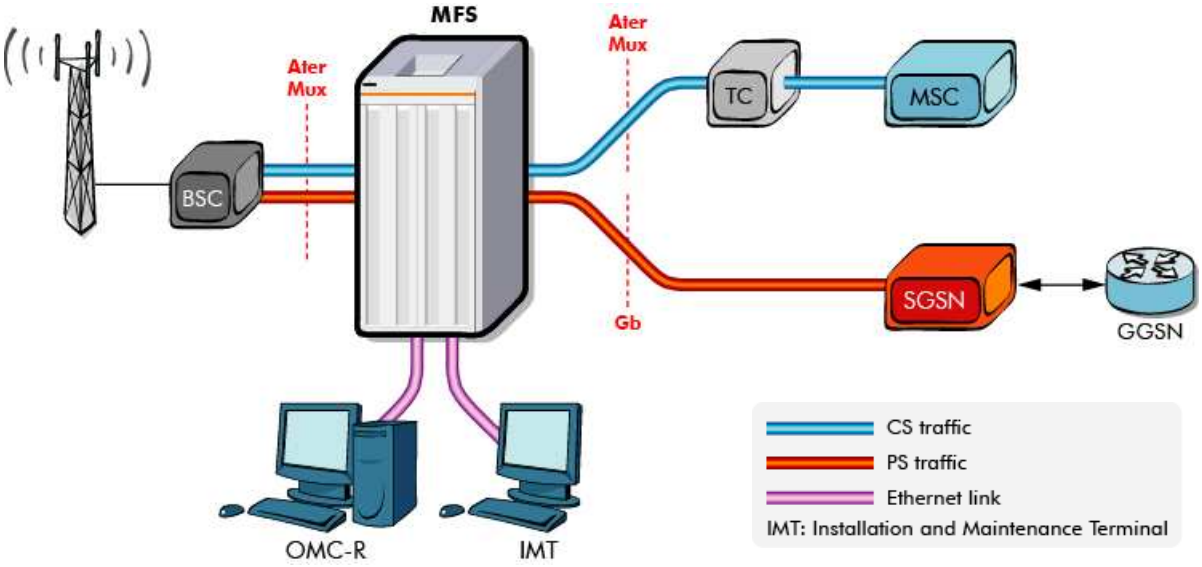


1 GSL LapD can be defined per A-ter mux (with a maximum of 2 GSL per BSC)

2 GSL links are recommended for redundancy reasons (one per PCM)

the radio signalling for GSM CS traffic is not represented

- Operation and Maintenance and interfaces
  - OMC-R
  - IMT



MFS to BSC: AterMux interface:

- 2Mbps PCM link of 32 TS at 64Kbps, shared between CS timeslots and PS timeslots
  - CS timeslots are made of :
    - N7 signalling link
    - CICs = « speech nibbles » at 16Kbps
    - O&M timeslots (X25, Qmux, Alarm octet,..)
  - PS timeslots contain :
    - GICs = « GPRS data nibbles » at 16Kbps
    - GSL (GPRS Signalling Link) = LAPD link at 64Kbps (2 per BSC for redundancy)

Within the MFS :

- PS timeslots are processed and transferred, usig the Gb interface, towards the SGSN.
- CS timeslots are cross-connected transparently towards the MFS - TC interface

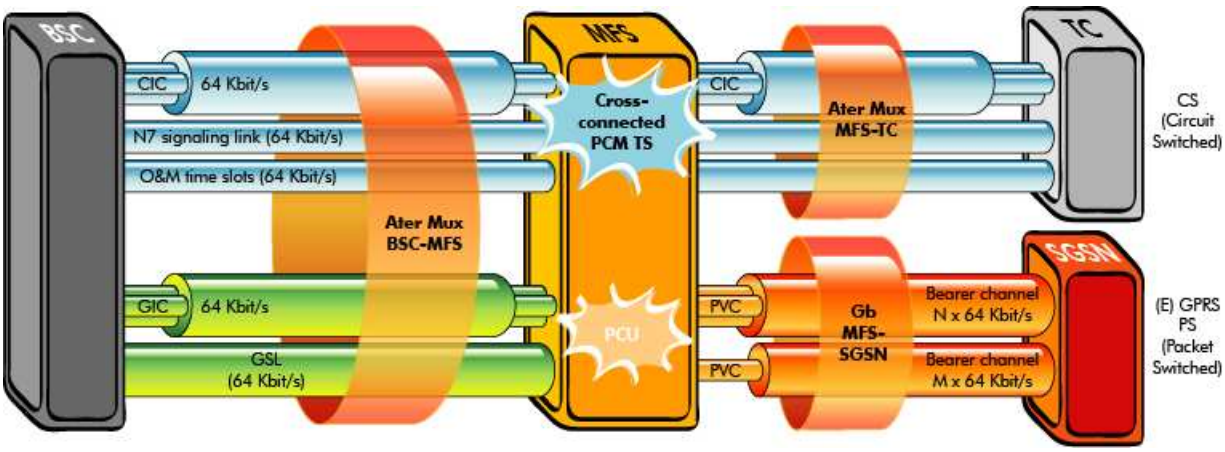
MFS to TC: AterMux interface

- 2Mbps PCM link of 32 TS at 64Kbps, which correspond to the CS timeslots cross-connected within the MFS, from (to) the BSC. (CIC of 16Kbps)

MFS to SGSN interface: Gb interface

- 2Mbps PCM link of 32 TS at 64Kbps, supporting the Frame Relay Link layer or IP over Ethernet connection.

- Ater-mux interface



The introduction of GPRS into the BSS basically requires the following three modifications:

- (1) the introduction of the **Packet Control Unit** (PCU): it controls the GPRS activities of one Alcatel BSS.
- (2) the software upgrade of the Channel Coding Unit (CCU) located in the BTS, for the support of the new GPRS channel coding schemes.
- (3) the introduction of the Gb interface termination function.

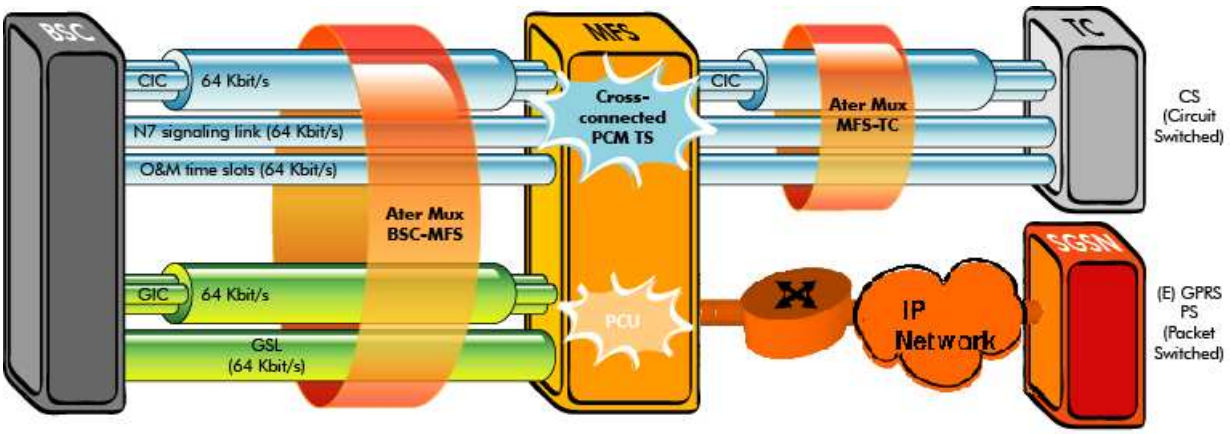
CIC: Circuit Identification Code

GIC: GPRS Identification Code

GSL: GPRS Signalling Link

PVC: Packet Virtual Circuit

- Gb over IP



GboIP is an alternative transport solution to the legacy Gb/Frame Relay/E1, allowing to take benefit from the IP transformation of the mobile networks. As part of it, GboIP allows to connect to the IP SGSN that have also implemented this protocol stack.

While in the legacy Gb/Frame relay/E1 architecture, the NS-VCs are built with Frame Relay Permanent Virtual Circuit, in the GboIP architectures, the NS-VCs are made of an association between a MFS IP Endpoint (UDP port / IP @) and a SGSN IP endpoint.

MFS types

- According to the evolutions of technologies
- There is 2 Families of MFS
  - The MFS legacy : MFS 9135
  - The new MFS reference: MFS 9130

- These two hardware versions of MFS are using the same Application software running on different hardwares .

MFS 9135

MFS MX 9130

MFS 9135 Hardware Configuration

- The 9135 MFS is composed of:
  - Up to 16 GPU boards (GPRS Processing Unit) per shelf (15 + 1).
    - One or more GPUs (up to 6) connected to one BSC.
  - The shelf is also composed of Alarm collection boards, DC/DC converters, synchronization (over Ater) and Ethernet connections.
  - Two Servers (*), which provide the configuration of the MFS and a remote connection (O&M).
  - Internal Hubs, used for Ethernet connections.
- It is not mandatory that the MFS is fully equipped with GPUs.

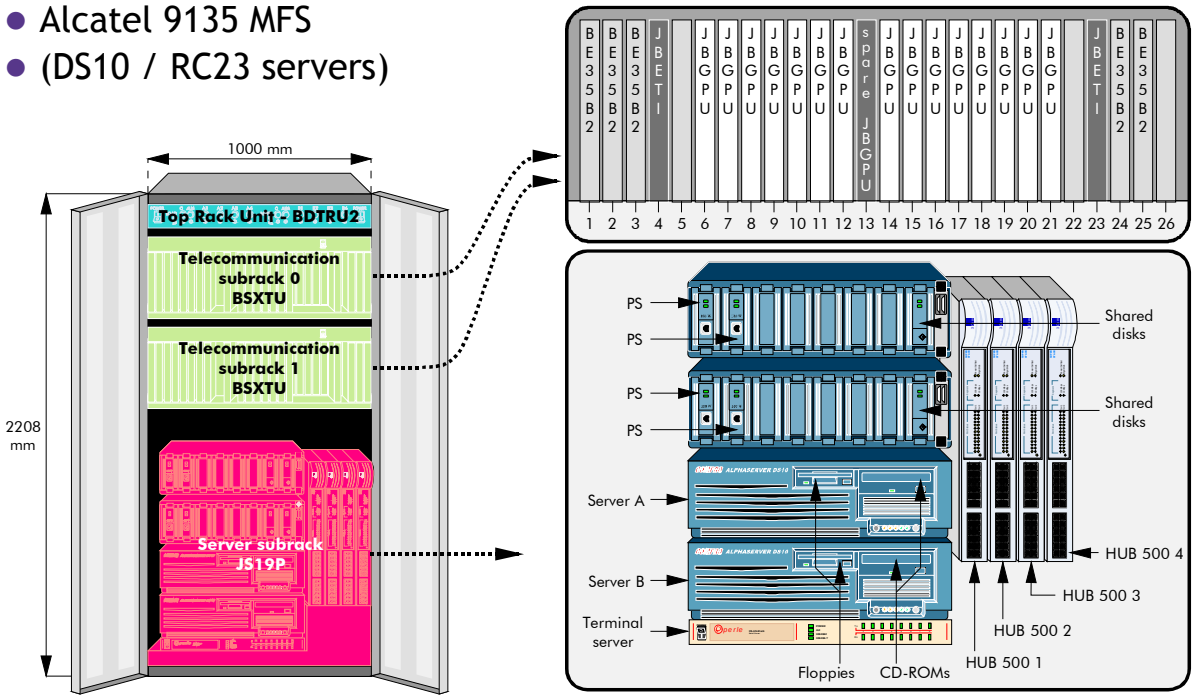
MFS Alarms : The MFS generates alarms to signal a change in the behaviour of a particular function within the system, such as a potential problem or a confirmed failure in the system. The Global Alarm Manager (GAM) manages the MFS alarms. It processes all hardware and telecom alarms and is responsible for:

- Collecting all fault information relating to GPUs, the active server, telecom and external alarms
- Recording alarms in a table
- Allowing the IMT and the OMC-R to access the alarms
- Generating end alarm messages when a fault is cleared (for example, when a GPU is replaced)
- Managing a communication session with the IMT.

(*) initially 2 Digital DEC alpha Servers AS800, replaced by 2 Compaq DS10

MFS 9135 Configurations

- Alcatel 9135 MFS
- (DS10 / RC23 servers)

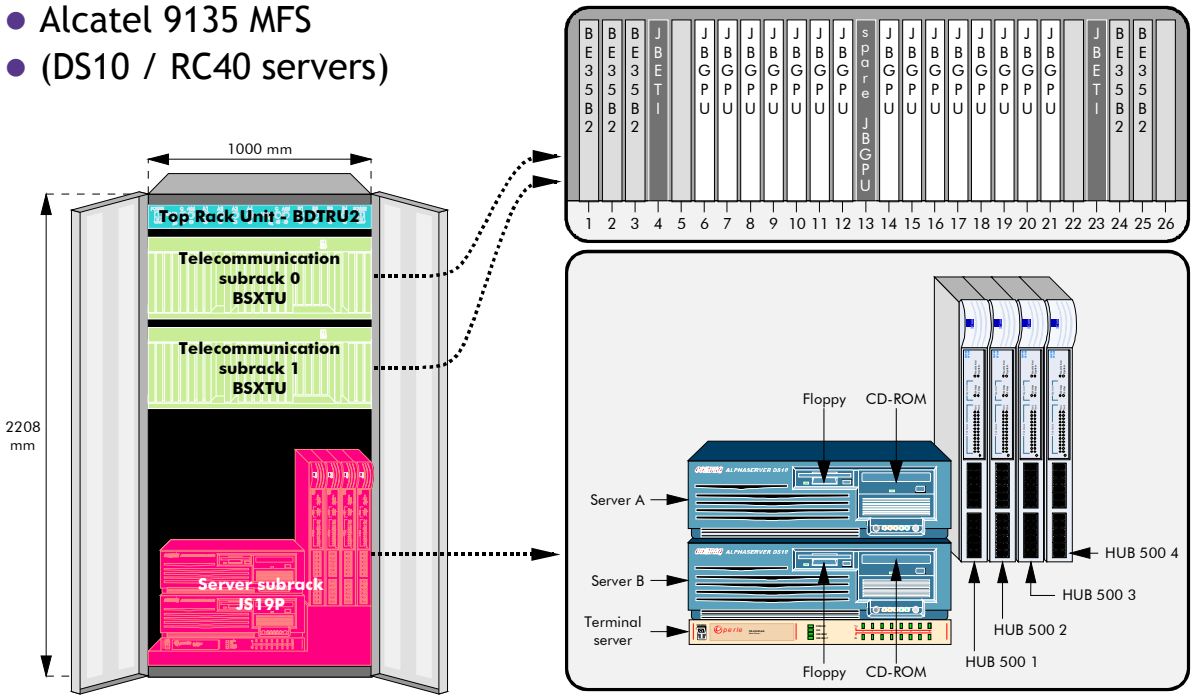


Notes:

- For obsolescence reasons HUB 500 can be replaced by ethernet switch (ethernet switch is allowed only in MFS DS10 /RC23 or RC40)

MFS 9135 Configurations

- Alcatel 9135 MFS
- (DS10 / RC40 servers)

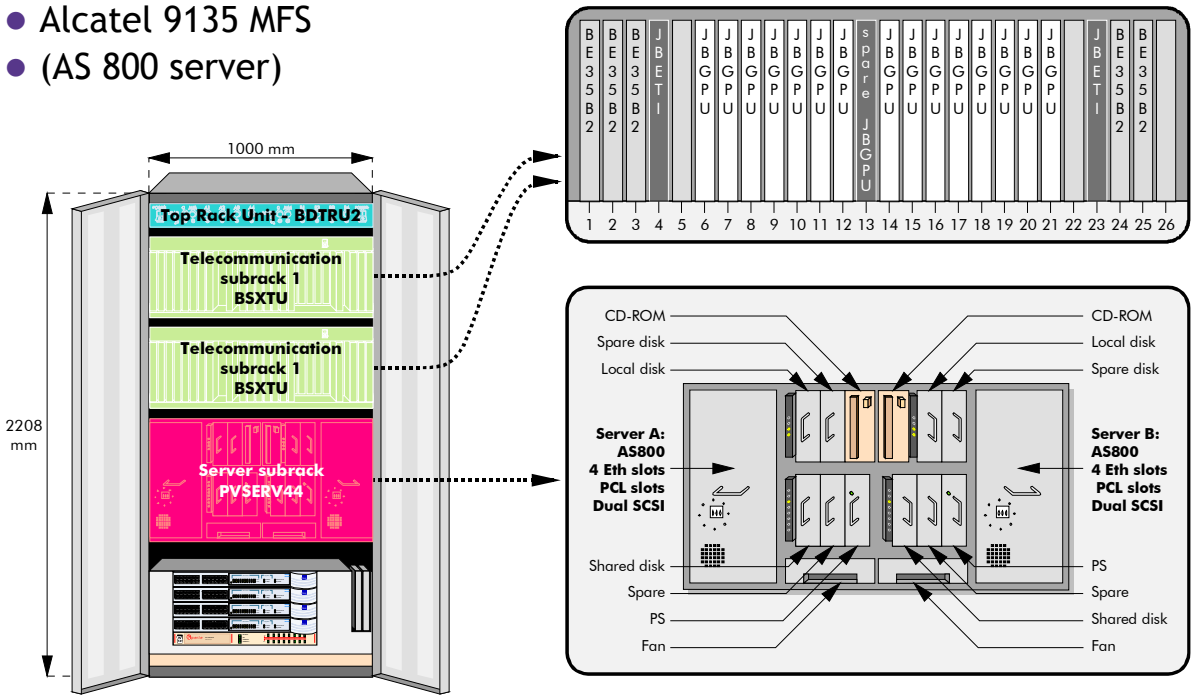


Notes:

- For obsolescence reasons HUB 500 can be replaced by ethernet switch (ethernet switch is allowed only in MFS DS10 /RC23 or RC40)
- The external shared disks from Storage Works are replaced by one disk in each server.

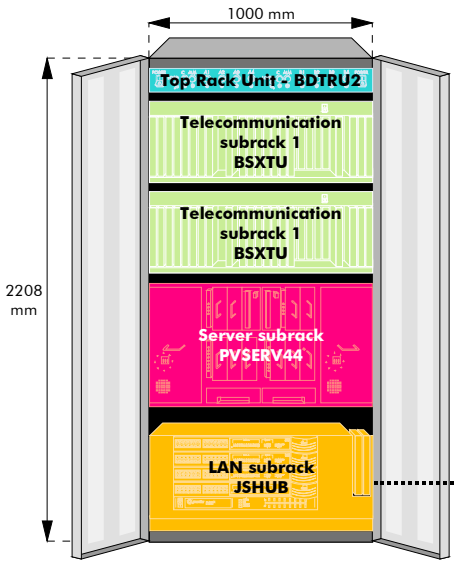
MFS 9135 Configurations

- Alcatel 9135 MFS
- (AS 800 server)



MFS 9135 Configurations

- Alcatel 9135 MFS
- (AS800 servers)

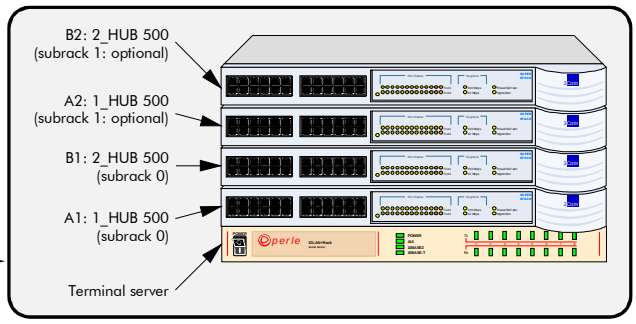


Mandatory : - Internal cabling done
- PCM of 1st subrack done
- Back panel of 2nd subrack

Optional : - PCM of 2nd subrack
- minimum kit

Up to **30 BSS** (1GPU/BSS)

Extension element : - GPU until the 12th
- from the 12th, add of minimal kit



There are 3 major subsystems:

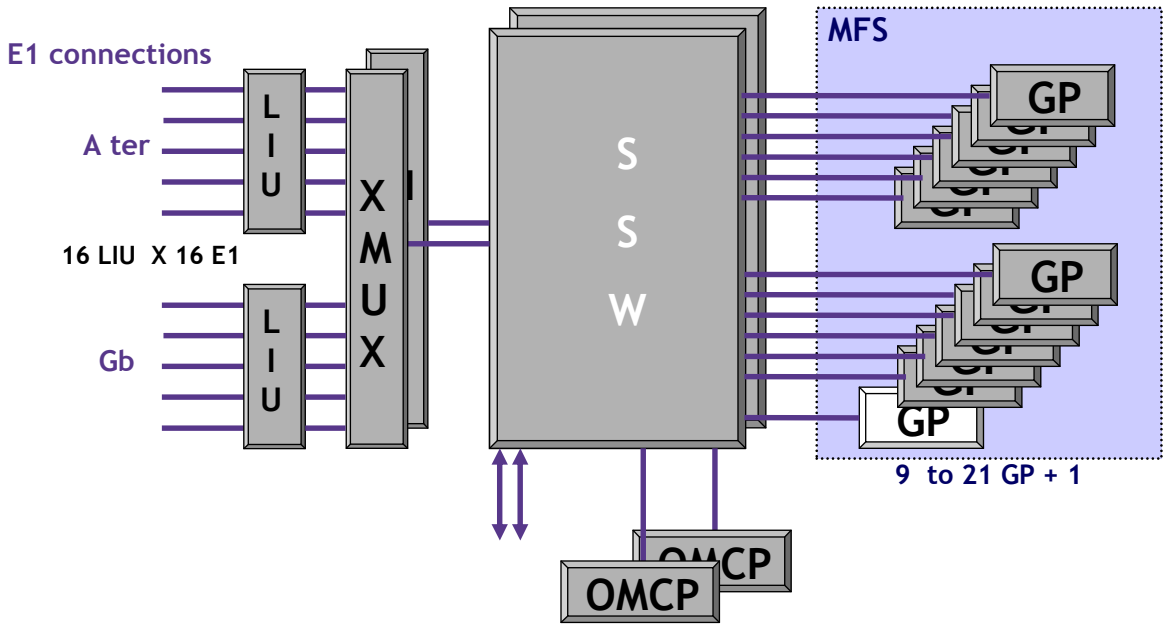
- Telecommunications Subracks
- Server
- Hub

1) The **telecommunication subrack** uses 1 GPRS Processing Unit (GPU) to implement the PCU function for 1 BSS.
   - The JBETI board provides alarm and status information for the server.
   - There is a pool of six 200W DC/DC converters. Each converter consists of one BE35B2 PBA. One of the 6 converters operates in redundant mode.

2) The **Server subsystem** consists of 2 Alpha servers, one of which operates in redundant mode. Each server has its own local disk storage and also shares a common disk. Both servers are interconnected via the Ethernet hubs. The server is used for:
   - MFS initialisation (loading, configuration)
   - Supervision and defence
   - O&M interface

3) The **Hub subsystem** consists of duplicated 100 Mbps Ethernet networks, one of which operates in the redundant mode. The Ethernet networks interconnect the GPUs (in the telecommunication subsystem) with the servers. They provide the connection points for the OMC-R and IMT.
   If a second telecommunications subrack is fitted, 2 additional Ethernet hubs are required.

A terminal Server provides a remote control access for maintenance (RS232 / Ethernet connection)



The main dimensioning characteristics of the EVOLIUM™ A9130 MFS Evolution are given below:

- - MFS Evolution is made of **1 to 21 GP**.
- - GP handles the packet traffic of one BSS.
- - MFS Evolution can handle the packet traffic of 21 BSCs.
- - One BSS can be connected to one or several GP boards, according to its GPRS traffic.
- - All BSSs connected to a given MFS Evolution are managed by the OMC-R managing this MFS.
- - BSSs connected to a same MFS Evolution can be linked to one or several co-located MSCs;
- - MFS Evolution can be connected to one or several SGSN, but a GP board can be connected to only one SGSN.

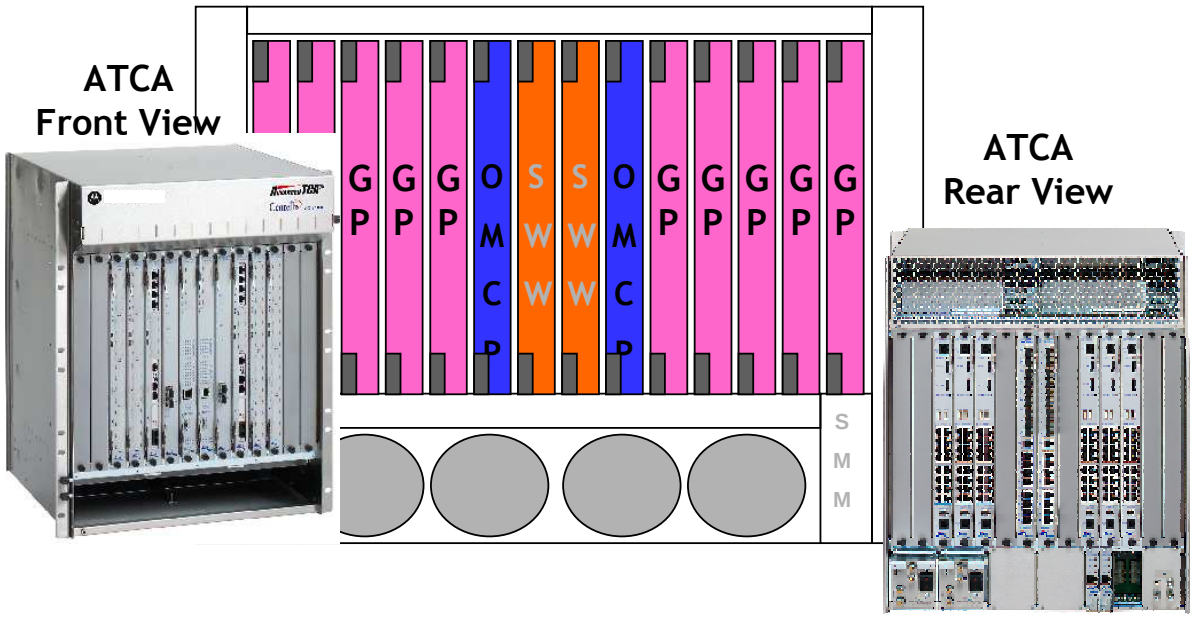
System Defense and reliability

Architecture has been specifically designed to be able to provide very high reliability, as well as marginal unavailability ratios and global availability of 99.999%.

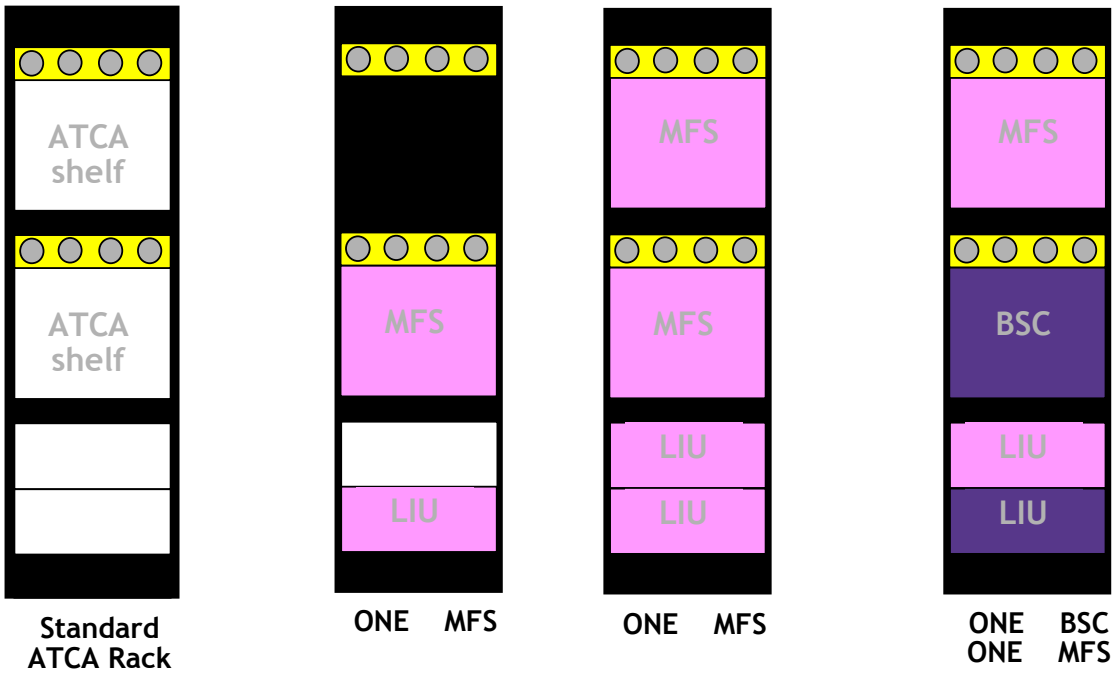
Therefore BSC and MFS high capacity are not endangered by partial failures, and maintenance costs can be reduced without operational impacts. A set of defence mechanisms is possible within MFS architecture .

MFS	Board redundancy	
	SSW	Duplication
	OMCP	Duplication
	GP	N+1

MFS 9130 ATCA shelf



MFS 9130 Configurations



- **The table below gives some key figures of the MFS configurations:**

Config	N° of equipped Subrack	Minimum GP boards	Maximum GP Boards	Scalability GP Boards	Maximum N° of BSS
Standard	1	2*	10	1	9
Large	2	2*	10+12**	1	21

*) One GP board to interface one BSC, and one GP protection board for redundancy for both telecom subracks.

- **) Second telecom subrack supports up to 12 GP boards as maximum capacity due to the fact that **no OMCP boards are necessary**.
- When more than 10 GP boards (in addition to the GP board for redundancy) have to be supported, then the second telecom subrack has to be added in order to accept hot plug of additional GP boards.
- This second telecom subrack extension is done on site, without power off and without telecom outages for the MFS Evolution boards and links already configured.

- **The table below gives some key figures of the MFS configurations in case of Rack sharing**

Config	N° of equipped Subrack	Minimum GP boards	Maximum GP Boards	Scalability GP Boards	Maximum N° of BSS
Standard	1	2	10	1	1

Answer the Questions

- How many BSSs can you connect to one MFS ?
- Does only packet switched traffic go through the MFS ?
- Which equipment implements the PCU functions?
- Do the Ater and Gb interfaces carry the same type of traffic?
- In the MFS, which board is associated with one BSC?

Self-Assessment on the Objectives

- Please be reminded to fill in the form *Self-Assessment on the Objectives* for this module
- The form can be found in the first part of this course documentation

6. BSS Interfaces Description

3FL10473ADAAWBZZA Edition 02

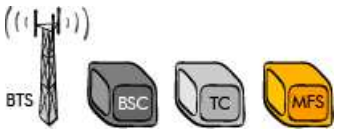
Section Presentation

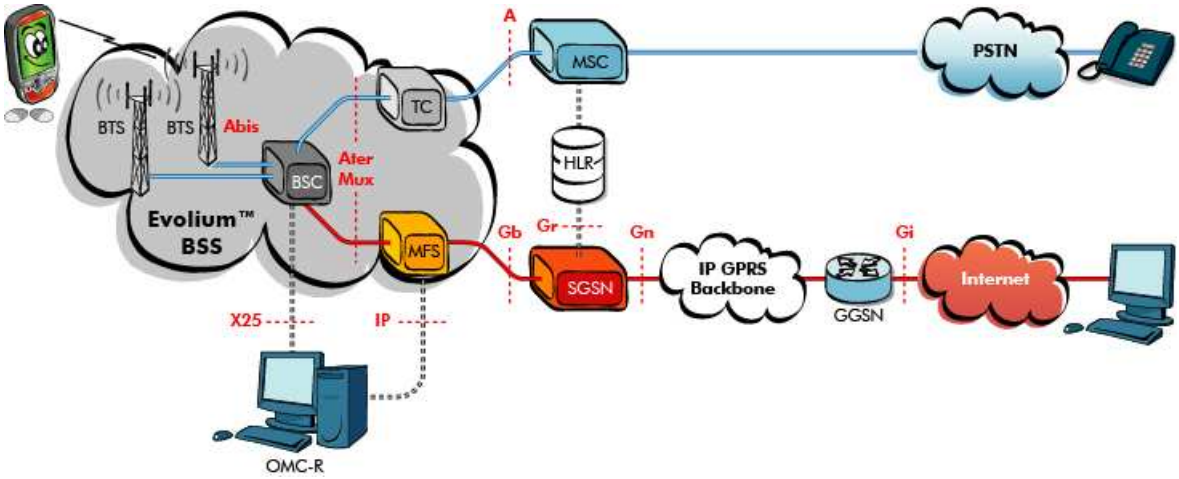
- Objective: To describe the BSS transmission interfaces.

- Program:
  - Situation
  - Interface Presentation
  - A, Ater, Ater Mux Interfaces
  - Abis Interface
  - Exercises

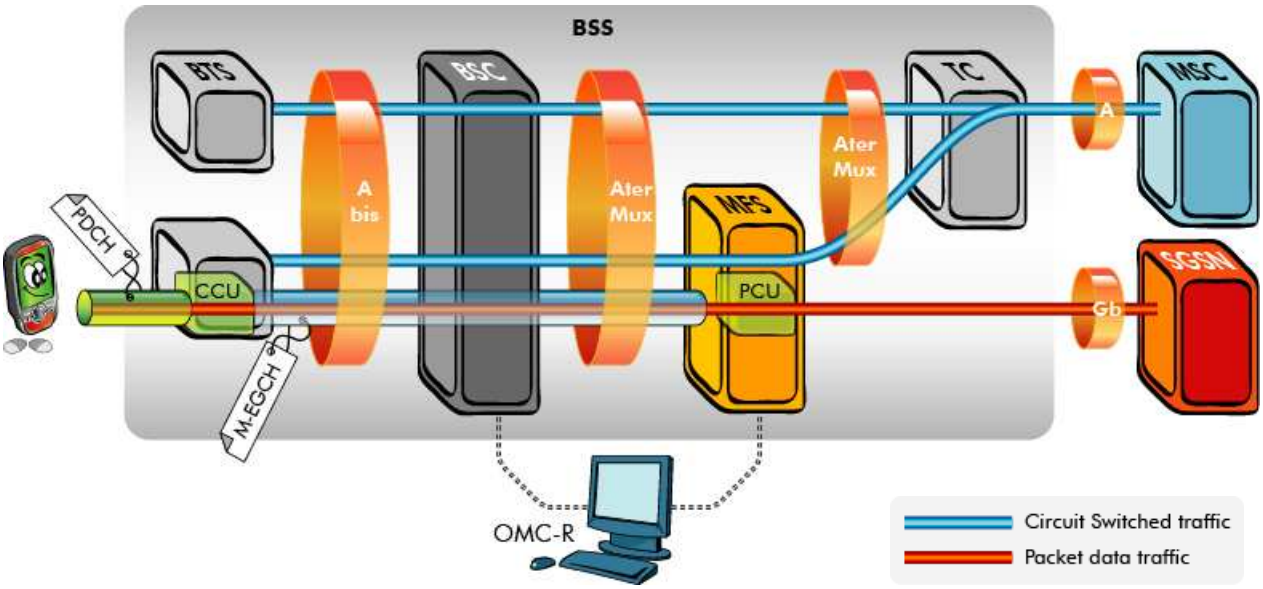
Situation

- The BSS Interfaces:





- BSS interfaces within (E)GPRS



MFS is shared by several BSCs, preferably colocated with the MSC

As long as traffic does not justify the usage of a full 2 Mbps links, data and voice are multiplexed on common A-ter links

The introduction of (E)GPRS into the BSS basically requires the following three modifications:

- 1- the introduction of the **Packet Control Unit** (PCU): it controls the GPRS activities of one Alcatel BSS.
- 2- the software upgrade of the Channel Coding Unit (CCU) located in the BTS, for the support of the new GPRS channel coding schemes.
- 3- the introduction of the Gb interface termination function.

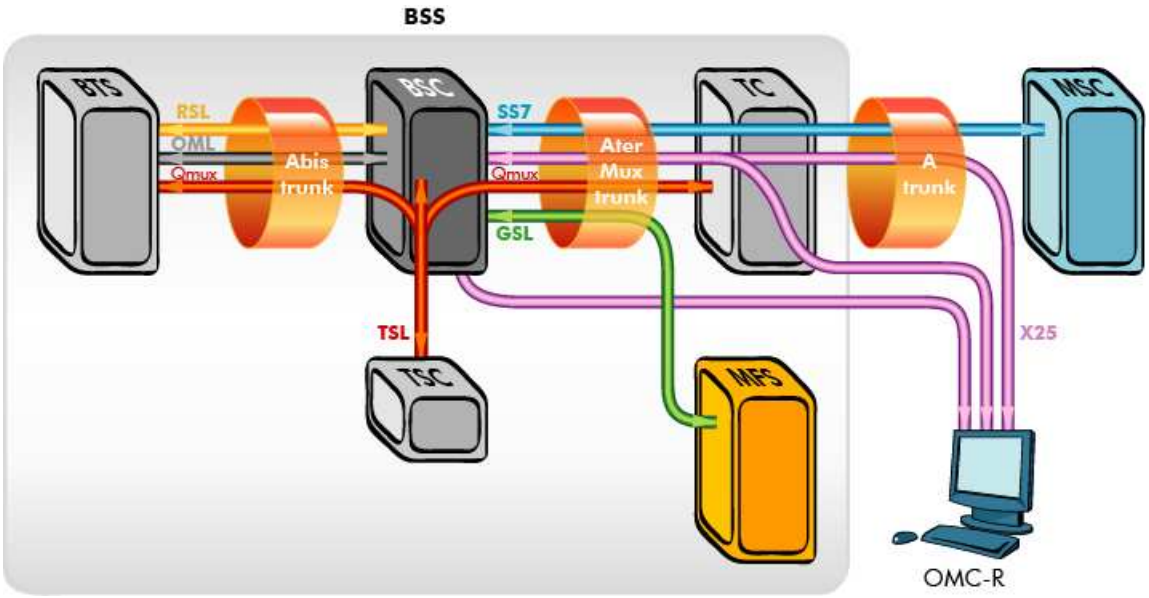
Within the Alcatel BSS, two communication planes are used:

- 1-Transmission plane: The PCU in the MFS communicates with the CCU in the BTS via GCH, transparently through the BSC.
- 2-Control plane: the following two signalling interfaces are used:
  - a) GPRS Signalling Link (GSL) between the MFS and BSC: this link is used for co-ordination between the BSC and PCU, mainly for GPRS capacity on demand and for GPRS paging, access request and access grant when the CCCH is used for GPRS.
  - b) The Radio Signalling Link (RSL) between the BTS and BSC mainly used for GPRS paging, access request and access grant when the CCCH is used for GPRS.

M-EGCH is a set of n associated 16kb/s channels (one main GCH and n-1 auxiliary GCHs).

n depends on the coding scheme used on the air interface for all the PDCHs of a TRX.

- Logical links within the BSS



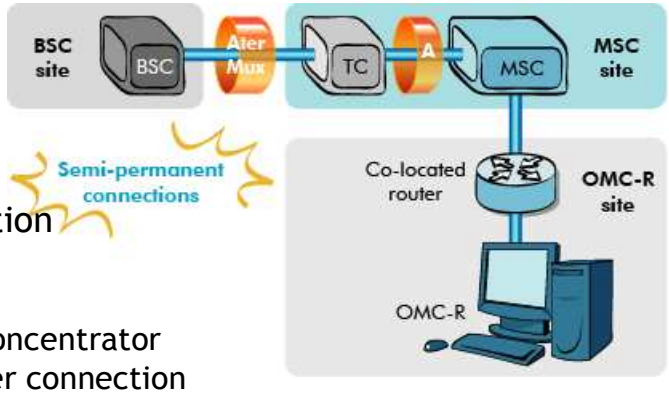
Signalling (RSL-OML)

- The signalling multiplexing allows the mixing of several flows of information onto the same physical connection. Typically, it allows to use only a 64 kbps pipe to carry Telecom and O&M information and -if necessary- Qmux related information. The Alcatel 9100 BTS supports both static and statistical signalling multiplexing.

Qmux link on Abis

- Allows the transfer of transmission related information between the TSC and the trasmission module in the BTS. It is used only for BTSs older than A9100 Evolium. A9100 and A9110 use OML link to carry this type of information.

Interface Presentation



- OMC-R / 9120 BSC connection
  - Via PSDN
  - Co-located site
  - Dedicated links with X25 concentrator
  - Via A-interface / transcoder connection
  - Via A-interface / MSC connection (EvoliumTM Universal Routing) (now recommended as the standard solution):
- OMC-R / 9130 BSC connection
  - Direct IP connection (trough an IP network)
  - Via A-interface using MLPPP protocol

OMC-R / BSC connection:

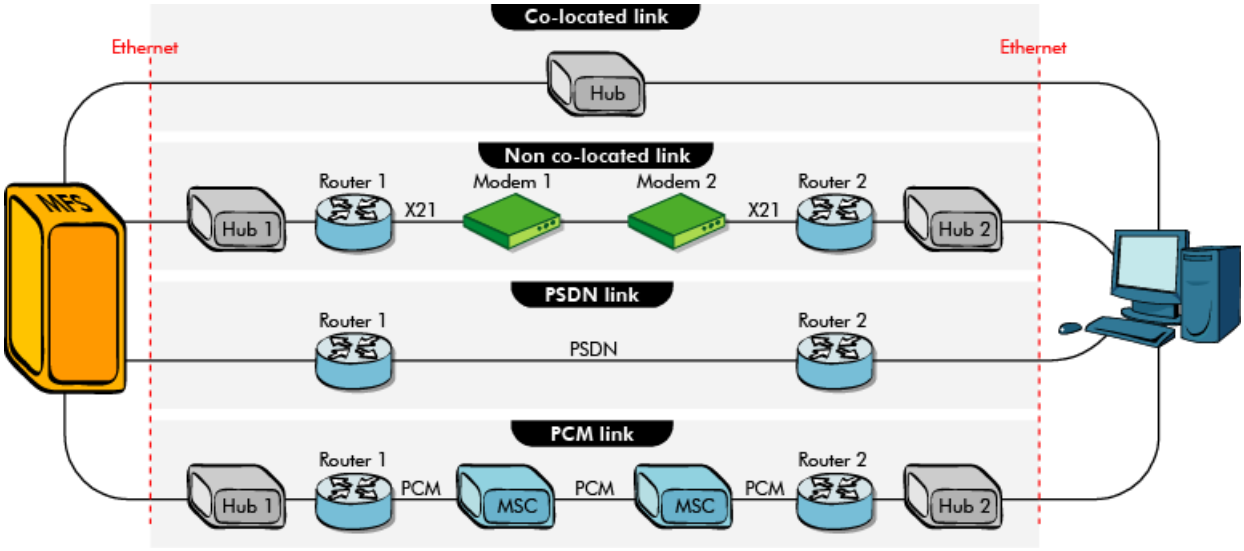
- 1) Via Public Switching Data Network (PSDN)
- 2) Co-located site
- 3) Dedicated links with X25 concentrator
- 4) Via A-interface / transcoder connection
- 5) Via A-interface / MSC connection (Evolium™ Universal routing)
  - This solution becomes more and more attractive for customers thanks to the availability on the market of “intelligent” multi-protocol routers. It is now recommended as the standard solution.

Note: 2 X25 links are used per BSC for each Host. When the connection to OMC-R is made through A-ter interface, 2 different A-ter Mux PCM links are used for redundancy.

EvoliumTM Universal routing:

- In order to reduce the operating costs, Alcatel has designed a flexible and innovative solution using the transmission capabilities of the PLMN itself.
- BSS O&M channels are reserved on each PCM trunk between the BSC and the MSC. All these channels are concentrated by the MSC cross-connect service into a single PCM link routing all BSC data to the OMC-R.
- This solution is made possible through the use of intelligent routers located at the OMC-R site and MSC sites, routers that also build an IP network interconnecting the OMC-R and the BSCs in a very efficient, flexible and fault resistant way. This flexible corporate network for TCP/IP and X.25 traffic supports any O&M services: SMS Cell Broadcast Centre, GPRS MFS Multiple Function Server, remote user sessions, and remote access to maintenance terminals…

- OMC-R / MFS connection



OMC-R / MFS connection:

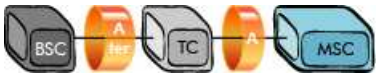
- The Alcatel 1353 RA OMC-R and the MFS communicate using the TCP/IP Protocol, unlike the BSC/Alcatel 1353 RA connection which uses an X25 interface. The OMC-R and the MFS can be collocated or remote. They can be connected using either an Ethernet LAN or PSDN Network.

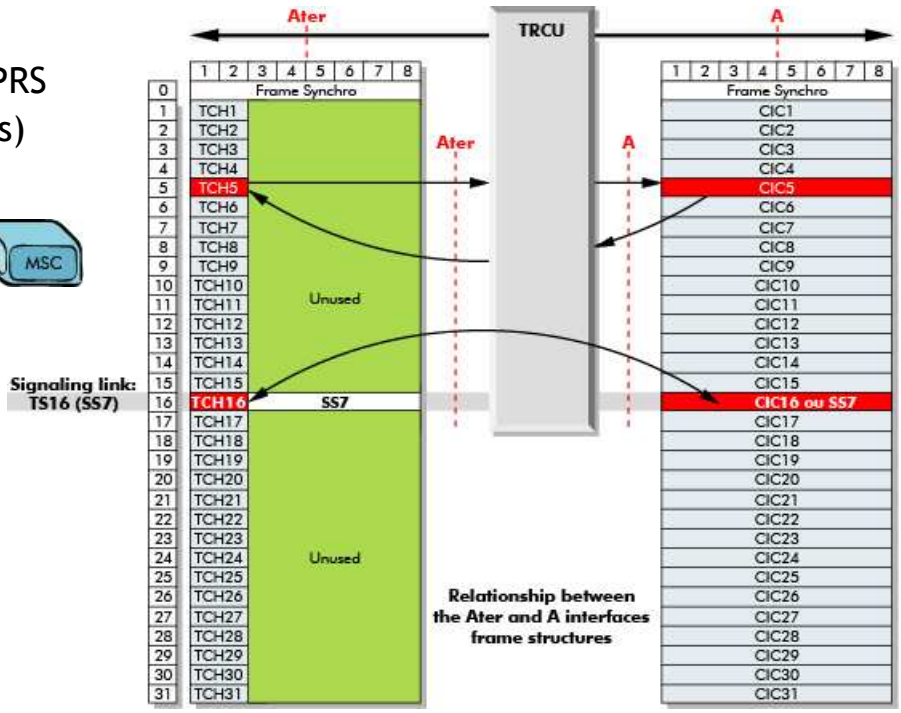
Connecting an OMC-R to the MFS can be achieved in the following ways:

- collocated link
- non-collocated link
- PSDN link
- PCM link
- 2 links are used per MFS

A, Ater, Ater Mux Interfaces

- Ater and A:
- TC without (E)GPRS
- (16Kbps->64Kbps)





A, Ater, Ater Mux Interfaces

- Ater Mux: BSC-MFS
- with (E)GPRS

(1) TCH14 for Trib 2/3/4

Ater Mux

	1	2	3	4	5	6	7	8
0	Frame Synchro							
1	TCH1 / 1		TCH1 / 2		TCH1 / 3		TCH1 / 4	
2	TCH2 / 1		TCH2 / 2		TCH2 / 3		TCH2 / 4	
3	TCH3 / 1		TCH3 / 2		TCH3 / 3		TCH3 / 4	
4	TCH4 / 1		TCH4 / 2		TCH4 / 3		TCH4 / 4	
5	TCH5 / 1		TCH5 / 2		TCH5 / 3		TCH5 / 4	
6	TCH6 / 1		TCH6 / 2		TCH6 / 3		TCH6 / 4	
7	TCH7 / 1		TCH7 / 2		TCH7 / 3		TCH7 / 4	
8	TCH8 / 1		TCH8 / 2		TCH8 / 3		TCH8 / 4	
9	TCH9 / 1		TCH9 / 2		TCH9 / 3		TCH9 / 4	
10	TCH10 / 1		TCH10 / 2		TCH10 / 3		TCH10 / 4	
11	TCH11 / 1		TCH11 / 2		TCH11 / 3		TCH11 / 4	
12	TCH12 / 1		TCH12 / 2		TCH12 / 3		TCH12 / 4	
13	TCH13 / 1		TCH13 / 2		TCH13 / 3		TCH13 / 4	
14	TCH14 / 1 or Qmux		TCH14 / 2		TCH14 / 3		TCH14 / 4	
15	A1 R1		A2 R2		A3 R3		A4 R4	
16	SS7 or U							
17	TCH17 / 1		TCH17 / 2		TCH17 / 3		TCH17 / 4	
18	TCH18 / 1		TCH18 / 2		TCH18 / 3		TCH18 / 4	
19	TCH19 / 1		TCH19 / 2		TCH19 / 3		TCH19 / 4	
20	TCH20 / 1		TCH20 / 2		TCH20 / 3		TCH20 / 4	
21	TCH21 / 1		TCH21 / 2		TCH21 / 3		TCH21 / 4	
22	TCH22 / 1		TCH22 / 2		TCH22 / 3		TCH22 / 4	
23	TCH23 / 1		TCH23 / 2		TCH23 / 3		TCH23 / 4	
24	GCH7 / 1		GCH7 / 2		GCH7 / 3		GCH7 / 4	
25	GCH6 / 1		GCH6 / 2		GCH6 / 3		GCH6 / 4	
26	GCH5 / 1		GCH5 / 2		GCH5 / 3		GCH5 / 4	
27	GCH4 / 1		GCH4 / 2		GCH4 / 3		GCH4 / 4	
28	GCH4 / 1		GCH4 / 2 or GSL		GCH4 / 3		GCH4 / 4	
29	GCH3 / 1		GCH3 / 2		GCH3 / 3		GCH3 / 4	
30	GCH2 / 1		GCH2 / 2		GCH2 / 3		GCH2 / 4	
31	GCH1 / 1		GCH1 / 2 or X25		GCH1 / 3		GCH1 / 4	

(E) GPRS traffic

Ater Trib 1/2/3/4

	1	2	3	4	5	6	7	8
	Frame Synchro							
TCH1	Unused							
TCH2								
TCH3								
TCH4								
TCH5								
TCH6								
TCH7								
TCH8								
TCH9								
TCH10								
TCH11								
TCH12								
TCH13								
TCH14 or unused (1)								
	SS7 or U / U / U / U							
TCH17	Unused							
TCH18								
TCH19								
TCH20								
TCH21								
TCH22								
TCH23								
GCH7								
GCH6								
GCH5								
GCH4	GCH4 or unused / GCH 4 or GSL / GCH 4 or U / GCH 4 or U							
GCH3	Unused							
GCH2								
GCH1	GCH1 or unused / GCH 1 or X25 / GCH 1 or U / GCH 1 or U							

In this configuration, 4 Tributaries are multiplexed in one PCM link on A-ter Mux interface. Circuit-Switched traffic is represented by “TCH” and Packet-Switched traffic (E)GPRS by “GCH”. In this configuration the GPRS granularity is 25 % which means 3/4 GSM & 1/4 (E)GPRS

One Time Slot usually contains four two-bit nibbles. Each nibble contains one channel (2 bits) from one of the 4 tributaries (numbered from 1 to 4).

Time Slot 16 can be used to carry a complete 64 kbps channel from the BSC to the TRCU (through the MFS).

Time Slot 28 can be used for carrying the signalling link between BSC and MFS (GSL)

Time Slot 31 can be used for carrying the X.25 connection to the OMC_R.

- Ater Mux: MFS-TC

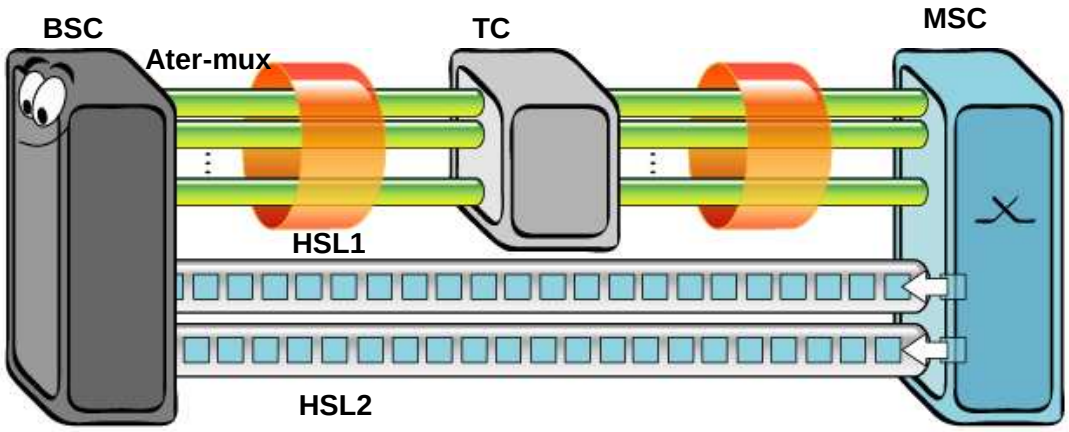
(1) TCH14 for Trib 2/3/4

	Ater Mux								Ater Trib 1/2/3/4								A Trib 1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
0	Frame Synchro								Frame Synchro								Frame Synchro							
1	TCH1 / 1		TCH1 / 2		TCH1 / 3		TCH1 / 4		TCH1								CIC1							
2	TCH2 / 1		TCH2 / 2		TCH2 / 3		TCH2 / 4		TCH2								CIC2							
3	TCH3 / 1		TCH3 / 2		TCH3 / 3		TCH3 / 4		TCH3								CIC3							
4	TCH4 / 1		TCH4 / 2		TCH4 / 3		TCH4 / 4		TCH4								CIC4							
5	TCH5 / 1		TCH5 / 2		TCH5 / 3		TCH5 / 4		TCH5								CIC5							
6	TCH6 / 1		TCH6 / 2		TCH6 / 3		TCH6 / 4		TCH6								CIC6							
7	TCH7 / 1		TCH7 / 2		TCH7 / 3		TCH7 / 4		TCH7								CIC7							
8	TCH8 / 1		TCH8 / 2		TCH8 / 3		TCH8 / 4		TCH8								CIC8							
9	TCH9 / 1		TCH9 / 2		TCH9 / 3		TCH9 / 4		TCH9								CIC9							
10	TCH10 / 1		TCH10 / 2		TCH10 / 3		TCH10 / 4		TCH10								CIC10							
11	TCH11 / 1		TCH11 / 2		TCH11 / 3		TCH11 / 4		TCH11								CIC11							
12	TCH12 / 1		TCH12 / 2		TCH12 / 3		TCH12 / 4		TCH12								CIC12							
13	TCH13 / 1		TCH13 / 2		TCH13 / 3		TCH13 / 4		TCH13								CIC13							
14	TCH14 / 1 or Qmux		TCH14 / 2		TCH14 / 3		TCH14 / 4		TCH14 or U (1)								CIC14 or U / CIC14 / CIC14 / CIC14							
15	A1	R1	A2	R2	A3	R3	A4	R4	Unused								Unused							
16	SS7 or U								SS7 or U / unused / unused / unused								SS7 or U / unused / unused / unused							
17	TCH17 / 1		TCH17 / 2		TCH17 / 3		TCH17 / 4		TCH17								CIC17							
18	TCH18 / 1		TCH18 / 2		TCH18 / 3		TCH18 / 4		TCH18								CIC18							
19	TCH19 / 1		TCH19 / 2		TCH19 / 3		TCH19 / 4		TCH19								CIC19							
20	TCH20 / 1		TCH20 / 2		TCH20 / 3		TCH20 / 4		TCH20								CIC20							
21	TCH21 / 1		TCH21 / 2		TCH21 / 3		TCH21 / 4		TCH21								CIC21							
22	TCH22 / 1		TCH22 / 2		TCH22 / 3		TCH22 / 4		TCH22								CIC22							
23	TCH23 / 1		TCH23 / 2		TCH23 / 3		TCH23 / 4		TCH23								CIC23							
24	Gb 8								Unused / Gb 8 / U / unused								Unused / Gb 8 / U / unused							
25	Gb 7								Unused / Gb 7 / U / unused								Unused / Gb 7 / U / unused							
26	Gb 6								Unused / Gb 6 / U / unused								Unused / Gb 6 / U / unused							
27	Gb 5								Unused / Gb 5 / U / unused								Unused / Gb 5 / U / unused							
28	Gb 4								Unused / Gb 4 / U / unused								Unused / Gb 4 / U / unused							
29	Gb 3								Unused / Gb 3 / U / unused								Unused / Gb 3 / U / unused							
30	Gb 2								Unused / Gb 2 / U / unused								Unused / Gb 2 / U / unused							
31	Gb 1 or X25								Unused / Gb 1 or X25 / U / unused								Unused / Gb 1 or X25 / U / unused							

(E) GPRS traffic

In this configuration the GPRS granularity is 25 % which means 3/4 GSM & 1/4 (E)GPRS

- HSL (High-Speed Signaling Link)
  - In order to achieve the maximum traffic capacity of the 9130 BSC, the bandwidth used for No. 7 signaling must be increased
  - The HSL mode allows to carry dedicated No. 7 signaling on a whole PCM link (TS 1 to 31).



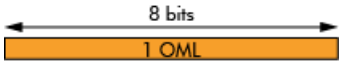
Low-Speed Signaling Link (LSL) mode allows up to 16 64-kbps signaling channels. With this mode, the committed capacity on the A interface is 2600 Erlangs.

Abis Interface

- The Abis interface is supported by a PCM link where the need in terms of ressources is:

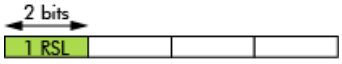
- 1 Operation and Maintenance Link (OML) per BTS to allow the BSC to control Base Transceiver Station
- 1 Radio Signaling Link (RSL) per TRX for signaling information between the BSC and the BTSs.
- 6, 7 or 8 Traffic Channels (TCHs) per TRX depending if it supports or not BCCH (beacon) or SDCCH (signaling on air).

- Submultiplexing OML and RSL:
- The OML can be mapped on a 64 Kbit/s Time Slot:

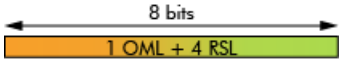


- There are four options Signaling Link Multiplexing rules:
  - No RSL multiplexing : the RSL is mapped on a 64 Kbit/s Time slot.

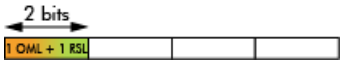
  - Static RSL multiplexing : 1 RSL is mapped on a nibble (a quarter of Time Slot) at 16 Kbit/s



  - Statistical RSL multiplexing at 64 Kb/s: 1 OML and up to 4 RSL share the same physical channel at 64 Kbit/s



  - Statistical RSL multiplexing at 16 Kb/s : 1 OML and 1 RSL share the same physical channel at 16 Kbit/s



The signalling submultiplexing offers improvement in terms of required PCM time slots on the A-bis interface. This leads to substantial savings in terms of A-bis interface trunks.

Hardware support :
Alcatel 9120 BSC (G2), Alcatel 9100 BTS, Alcatel 9110 BTS, Alcatel 9110-E BTS

Remarks:

For an Evolium BTS, transmission configuration must be done via OML. The Evolium BTS retrieves autonomously its OML location by scanning the 31 TSs of the PCM link.

The static RSL multiplexing is not compatible with Half Rate configurations (RSL capacity)

Abis Interface

- Example of channel structure on one Abis interface.

Frame structure example corresponding to:
Ring "Full Alcatel" with 3 BTS,
BTS n° 1 with 4 TREs and RSL 16 kbit/s
BTS n° 2 with 2 TREs and RSL 64 kbit/s
BTS n° 3 with 2 TREs and RSL/OML 16 kbit/s

1/4/0 means BTS 1; TRE 4; Radio Time Slot 0
RSL TRE 1/4 means the RSL for the TRE 4 of BTS 1

	Bits 0	1	2	3	4	5	6	7	
TS 0	PCM Frame Synchro								
TS 1	Qmux				S bits				
TS 2	Ring control								
TS 3									
TS 4									
TS 5									
TS 6									
TS 7									
TS 8									
TS 9									
TS 10									
TS 11	RSL 3/2		3/2/1		3/2/2		3/2/3		
TS 12	3/2/4		3/2/5		3/2/6		3/2/7		BTS N° 3
TS 13	OML+RSL 3/1		3/1/1		3/1/2		3/1/3		
TS 14	3/1/4		3/1/5		3/1/6		3/1/7		
TS 15	2/2/0		2/2/1		2/2/2		2/2/3		
TS 16	2/2/4		2/2/5		2/2/6		2/2/7		
TS 17	RSL BTS 2, TRE 2								
TS 18	2/1/0		2/1/1		2/1/2		2/1/3		BTS N° 2
TS 19	2/1/4		2/1/5		2/1/6		2/1/7		
TS 20	RSL BTS 2, TRE 1								
TS 21	OML BTS 2								
TS 22	1/4/0		1/4/1		1/4/2		1/4/3		
TS 23	1/4/4		1/4/5		1/4/6		1/4/7		
TS 24	1/3/0		1/3/1		1/3/2		1/3/3		
TS 25	1/3/4		1/3/5		1/3/6		1/3/7		
TS 26	1/2/0		1/2/1		1/2/2		1/2/3		BTS N° 1
TS 27	1/2/4		1/2/5		1/2/6		1/2/7		
TS 28	1/1/0		1/1/1		1/1/2		1/1/3		
TS 29	1/1/4		1/1/5		1/1/6		1/1/7		
TS 30	RSL TRE 1/1		RSL TRE 1/2		RSL TRE 1/3		RSL TRE 1/4		
TS 31	OML BTS 1								

EVOLIUM
ALCATEL BSS Description

Alcatel·Lucent

The use of 64 kbps and 16 kbps channels for traffic channels and signalling channels is specified in GSM specifications 08.52-08.58, however the detail of the multiplexing structure and the use of the interface for other purposes is undefined. A manufacturer may, therefore, define his own variant of the A-bis interface.

Different aspects (Equipment or 2.048 kbps link suppliers constraints, Installation & Maintenance Department objectives, Service /System outage ...) have to be taken into account for the definition of these Mapping rules.

Abis Interface

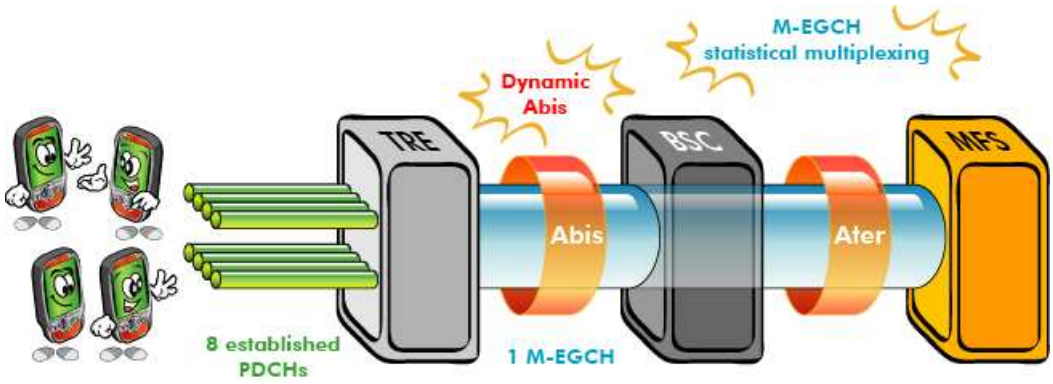
- In case of (E)GPRS traffic and according to the coding scheme used on the air interface, one single Abis nibble (16 kb/s) is not enough to carry all data traffic from one PDCH.
- Several nibbles can be necessary. For the highest data rate over one PDCH (MCS9), 5 Abis nibbles are necessary.

PDCH Usage	Abis resources
CS1-CS2 / MCS1-MCS2	No extra Abis timeslots
CS1-CS4 / MCS1-MCS5	2 extra Abis timeslots
CS1-CS4 / MCS1-MCS6	4 extra Abis timeslots
CS1-CS4 / MCS1-MCS8	6 extra Abis timeslots
CS1-CS4 / MCS1-MCS9	8 extra Abis timeslots

Abis Interface

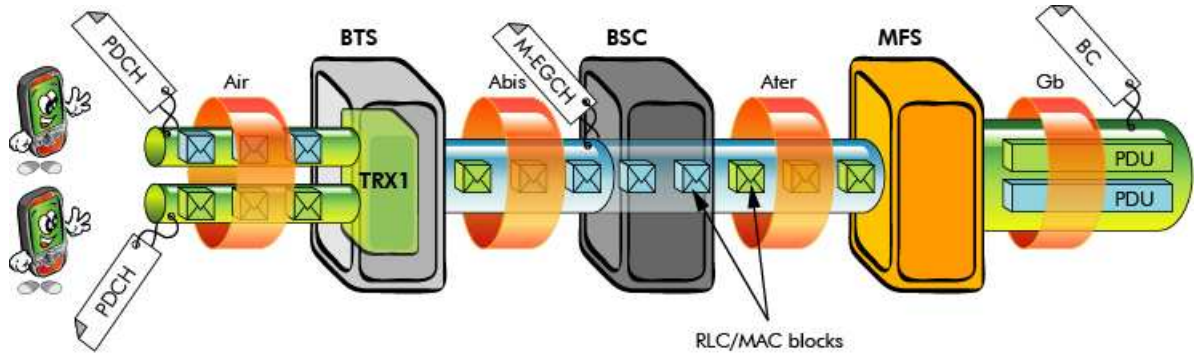
- In order to minimize the consumption of resources on abis link and to guarantee a good data throughput on air interface two features are implemented:

  Dynamic Abis allocation
  M-EGCH Statistical multiplexing



Abis Interface

- The **Multiplexed EGCH (M-EGCH)** multiplexes the RLC/MAC blocks of all the PDCHs of a TRX on a single transmission link. It has the following characteristics:
  - An M-EGCH is composed of **GCHs**.
  - **One** M-EGCH is assigned **per TRX**.
  - The M-EGCH size **varies with PS traffic**.



The size of an **M-EGCH** link is dynamically controled (by the MFS) to serve PS traffic variation on a TRX.
The **M-EGCH** size depends on:

- The number of **PDCH_EGPRS** established on the TRX.
- The number of **PDCH_GPRS** established on the TRX.
- The number of **MPDCH** established on the TRX

Abis Interface

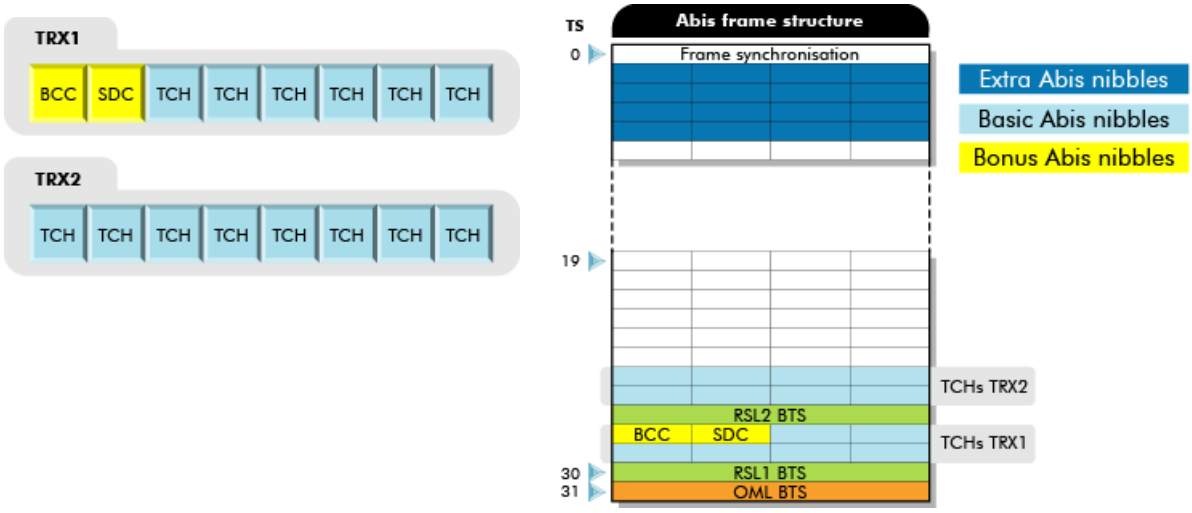
- The **dynamic abis allocation** consists of dynamically allocating Abis nibbles among the TREs used for PS traffic in a given BTS.

- There are 3 types of Abis nibbles:
  - **Bonus Abis nibbles** are nibbles on Abis link on which are defined BCCH and static SDCCHs, able to carry only PS traffic. => They are shareable at BTS level.
  - **Extra Abis nibbles** are nibbles on Abis link able to carry only PS traffic.

    => They are defined at BTS level and they are shared among all the TREs of the BTS.
  - **Basic Abis nibbles** are nibbles on Abis link able to carry CS and PS traffic.

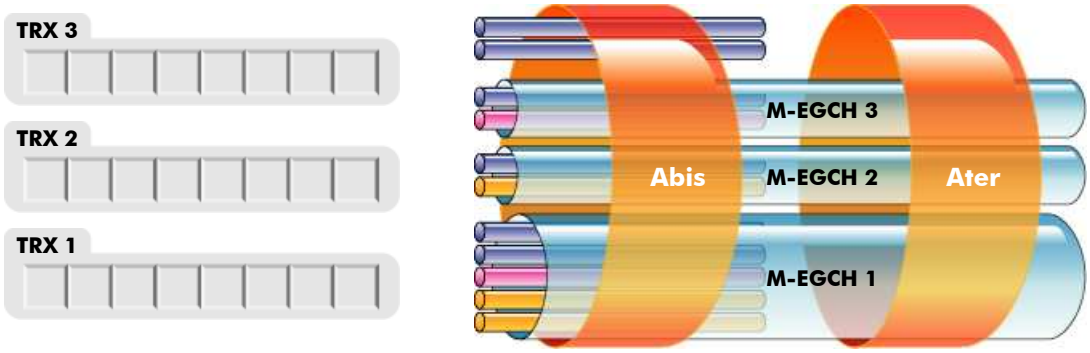
    => They are defined at sector level and they are shared among all the TREs of the sector.

- Example of Abis configuration for one BTS with 1 cell of 2 TRXs, with this logical configuration, and on which some extra Abis nibbles have been declared.



Abis Interface

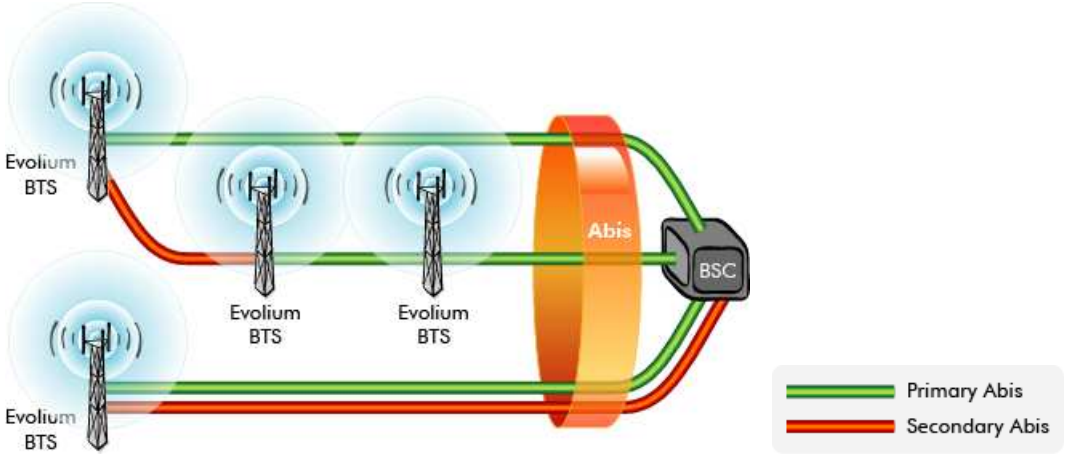
- The Abis resources can be seen as a pool of Abis nibbles shareable between all TREs of a given sector (basic Abis nibbles) or all the TREs of a given BTS (extra and bonus Abis nibbles).
- An M-EGCH organizes the transmission resources (pool of Abis nibbles and Ater nibbles) given to a TRX for its PS traffic.



What is the difference between Abis and M-EGCH allocation?

Abis Interface

- In some cases, one Abis link is not enough to carry all the traffic. A secondary Abis can be added to an Alcatel 9100 MBS with SUMA and to an Alcatel 9110-E BTS.
  - The primary Abis supports OML, RSL, Basic, bonus and Extra Abis nibbles.
  - The secondary Abis can support RSL, Basic, bonus and Extra Abis nibbles.



In some cases, due to the configuration of the BTS, or due to the number of BTS cascaded on one Abis, the declaration of Extra Abis nibbles is not possible on one Abis due to a lack of free ressources.

Answer the Questions

- What is the Gb interface ?
- Is it possible to have RSL and OML on the same Time Slot over Abis interface?
- In one Ater Mux, how many Ater links are multiplexed?
- Does the GPRS traffic (data) go through the Abis interface?

Self-Assessment on the Objectives

- Please be reminded to fill in the form *Self-Assessment on the Objectives* for this module
- The form can be found in the first part of this course documentation

7. Operation and maintenance principles

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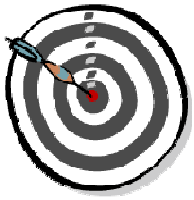
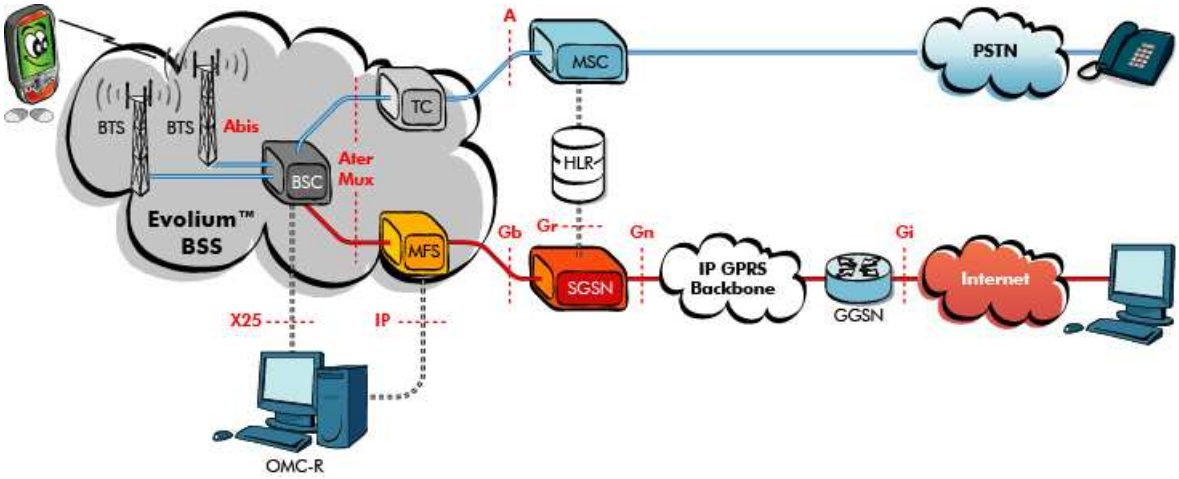
Section Presentation



- Objective: To identify the local and the network Operation and Maintenance functions.

- Program:
  - Operation and Maintenance Generalities
  - BSS O&M Terminal Functions
  - OMC-R Architecture
  - Exercises

- Operation and Maintenance Center-Radio:



EVOLIUM
ALCATEL BSS Description

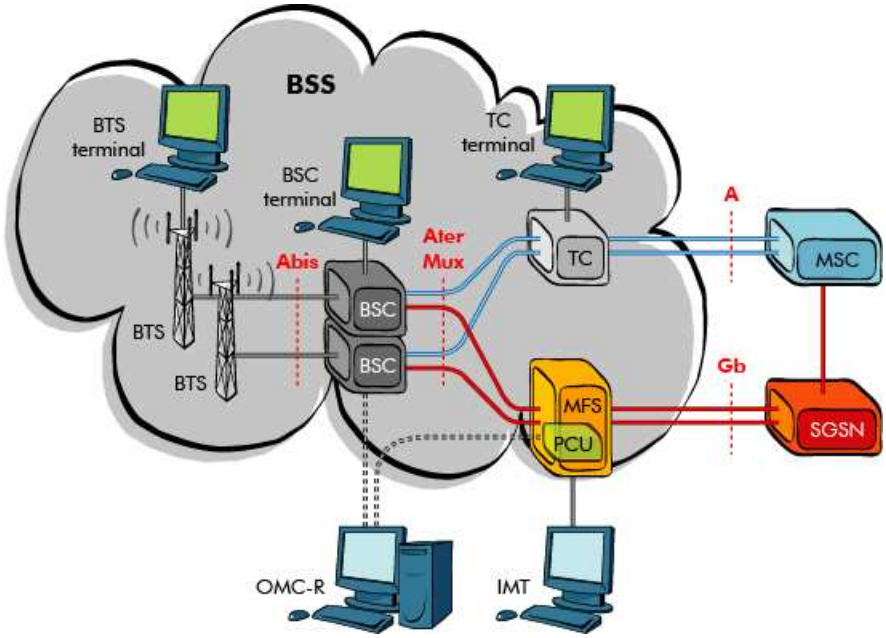
Alcatel·Lucent

To ensure that the BSS functions correctly, O&M actions are implemented at all levels within the BSS. The O&M functions in the BSS are grouped into three categories:

- Configuration Management
- Fault Management
- Performance Management

Each BSS subsystem has its own O&M function. To facilitate Fault Management, the BSS subsystems use an architecture based on the concept of functional blocks called Managed Objects (MOs).

- BSS maintenance overview:



There are several types of terminals:

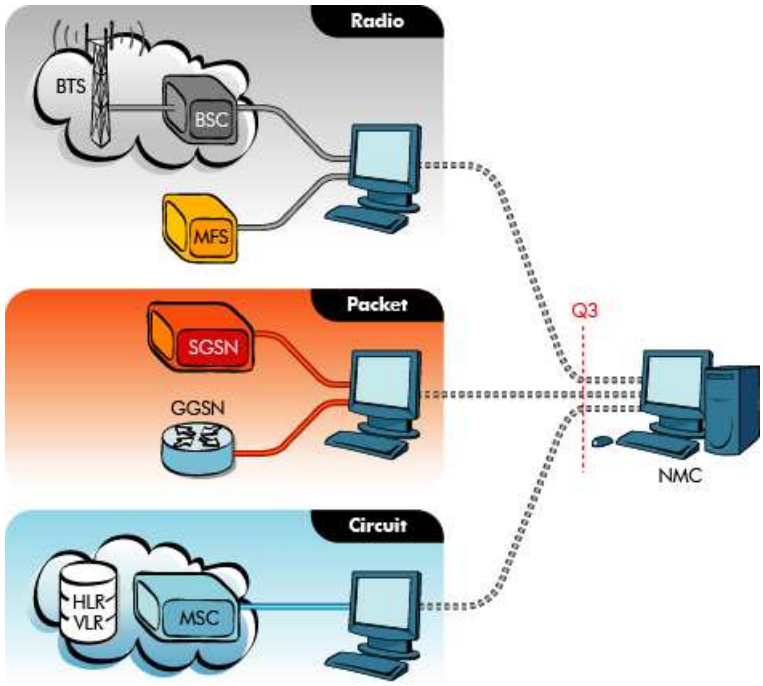
- BTS terminal
- BSC terminal
- TC terminal
- OMC-R terminal
- IMT: Installation and Maintenance Terminal (for MFS)

- **O&M Architecture**
  - The BSS subsystems perform O&M functions as follows:
    - The BTS monitors the condition of the hardware modules it manages, and reports any change in status to the BSC.
    - The BSC supervises its own hardware modules and reports changes in status to the OMC-R.
    - The BSC and TC provide together a set of transmission O&M functions to ensure a high level of fault tolerance and reliability. The function also provides efficient use of the terrestrial links between the equipments of the BSS.
    - The MFS, like the BSC, supervises its own hardware modules and reports changes in status to the OMC-R.

The OMC-R is an external component of the PLMN. Although it is technically not a BSS component, it functions directly with the BSC for O&M purposes.

The OMC-R O&M functions of the BSS mainly involve operation and control actions. The BSC O&M functions mainly involve the routing, control and filtering of O&M messages.

- A consistent approach



- SGSN System
  - One logical network element from operator's view
  - Based on an Alcatel's Common Server (commercial UNIX Platform)
  - OAM Interface handling Q3 and SNMP
  - Local and remote operation
- GGSN System
  - One logical network element
  - OAM Application of the GGSN provides an interface to the OMC-SGSN
- Alcatel 9135 MFS
  - Belongs to the BSS network elements
  - O&M integrated into the OMC-R
- OMC-G
  - Based on ALMAP 3.0
  - Full scalable platform (HP, UNIX)
  - Integrates SGSN Router-Management Application
- NMC
  - Standard Q3 interface to NMC

Operation and Maintenance Generalities

- The OMC-R supervises several BSSs:
  - Manages the BSSs software versions
  - Stores the BSSs configurations
  - Manages fault and performance measurement reports
  - Handles supervision of alarms and events

- O&M functions:
  - Configuration Management
  - Performance Management
  - Alarm Management

Configuration Management is the process of viewing and controlling network resources. CM allows you to:

- Configure the BSS hardware and software when it is first installed
- Change the network by adding, deleting, or moving network entities.
- Upgrade to new hardware or software.
- Change equipment and telecom parameters to improve system performance.

Fault Management

- Fault Management allows the operator to supervise and to repair the network when anomalies occur. It does this through a sequence of steps from detection to reporting and recovery. These are carried out by all the BSS subsystems, and are reported to the operator at the OMC-R or at another designated maintenance site.

Performance Management

- Performance Management allows the operator to monitor the efficiency of the system and the telecom services. It is controlled entirely from the OMC-R and provides measurements and statistics about various traffic events and resource usage in the BSS.

- Remote inventory from the OMC-R:
  - => Automatic acquisition process allowing to have an up to date view of the hardware and firmware of BTS and MFS equipment.
- Radio Measurement Statistics (RMS):
  - => Provides statistics on the radio measurements performed by mobiles and BTSs on TCH channels.
- Mobile Assisted Frequency Allocation (MAFA):
  - => Based on RMS, interesting for frequency plan improvement purpose
- Network Element provisioning on the OMC-R

Remote inventory: The remote and automatic process improves the reliability of the inventory data and suppresses the need of site visits. Thus, the feature provides:

- easier maintenance: whenever a board fails, all information needed to replace it is available in the OMC-R,
- Easier planning of retrofits or deployment of new features.

Radio Measurement Statistics (RMS):. These statistics are computed by the BTSs and made available at the OMC-R through the PM application. (“on demand” or a “permanent” job). Thus RMS can provide an exhaustive set of QoS statistics on the whole network updated every day.

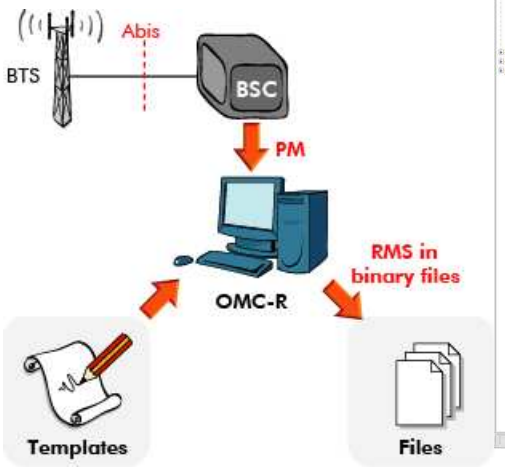
- Using these statistics, the operator will be able in particular to:
  - detect interfered frequencies as well as interfering cells,
  - detect and quantify cell unexpected propagation,
  - derive an experience matrix,
  - assess the coverage quality,
  - ensure the handover and Power Control correct parameter settings,
  - obtain additional information to diagnose call-drop origin,
  - evaluate the speech quality,
  - detect possible hardware or antenna problems,
- and from this he will take the following benefits:
  - QoS problems detection without drive-test or Abis measurements,
  - easier network planification and optimization,

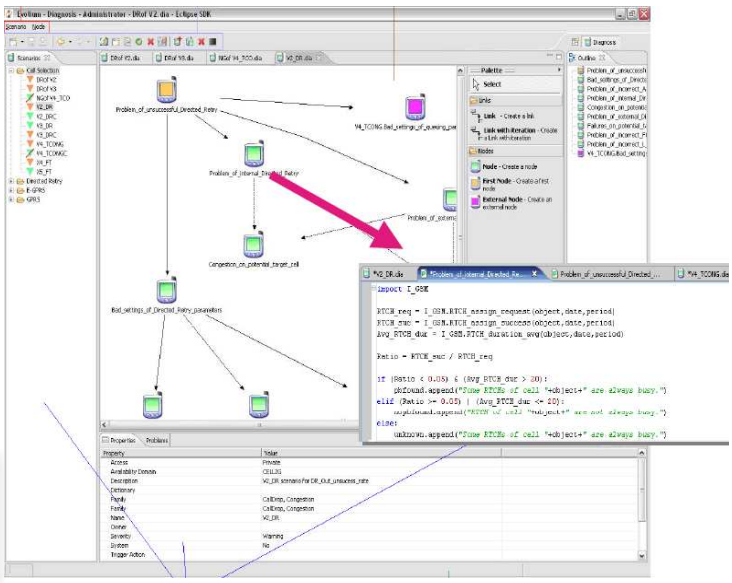
Mobile Assisted Frequency Allocation (MAFA): The feature enables the operator to declare at the OMC-R extra frequencies to be monitored by mobiles in dedicated mode. With these measurements, the BTSs compute statistics which are reported as part of the RMS results. Enabling to obtain measurements on any ARFCN, the MAFA feature is useful to:

- detect an interferer not declared as neighbour cell,
- search clean frequencies.

Network element provisioning on the OMC-R : For the BTS marked as "not in commercial use", potential alarms are raised with only a "warning" severity and the performance measurement results are not taken into account. They can be also filtered from the supervision view.

- NPO:





This feature allows the operator to monitor the Quality Of Service of his network in a centralized way. NPO integrates all data and services dealing with the management of the Quality of Service in one application:

- A data warehouse containing all data sources (counters, indicators, parameters, topology, alarms…) collected from the different OMC managing the network
- Consolidations processes manipulating the data warehouse content: consolidation per hour, day, week and month but also per topology level.
- An analysis desktop composed of a graphical user interface that allows browsing and benefiting from the optimization data of the data warehouse. It allows creating and displaying reports.
- External interfaces allowing an external system to extract QoS information from NPO

- Higher Capacity, Scalability & Robustness
  - Max. 6 000 cells, 30 000 TRXs
- Seamless Network Operations
  - HW on-line extension for TRX plug and play
  - Massive logical configuration update to manage parameters globally
  - Powerful fault management
  - BSS Software migration with minimum outage

On-line HW extension

- On the basis of three major extension principles
  - Auto-detection of BTS HW
  - Autonomous resource allocation by the BSC
  - On-line BSS extension/reduction from OMC-R
- Fast and automatic configuration
  - Configuration extension through plug and play
  - Minimised number of operator inputs (No more upload/download/audit)
- Secure hardware extension / reconfiguration operations
  - BSC is the master and the reference for configuration management
- Non correlated hardware and logical configuration management

Massive logical update

- Providing you the best efficiency for:
  - Massive tuning and optimisation of radio configuration
  - Frequency plan modification, LAC reorganisation, activation of radio features (dual-band, micro-cell, synthesized frequency hopping, …)
- Comfortable logical configuration management
  - Integration of LPM and Sidonie
  - No upload/download/audit needed
  - Preparation off-line and in parallel of several tuning sessions
- Secure logical configuration management

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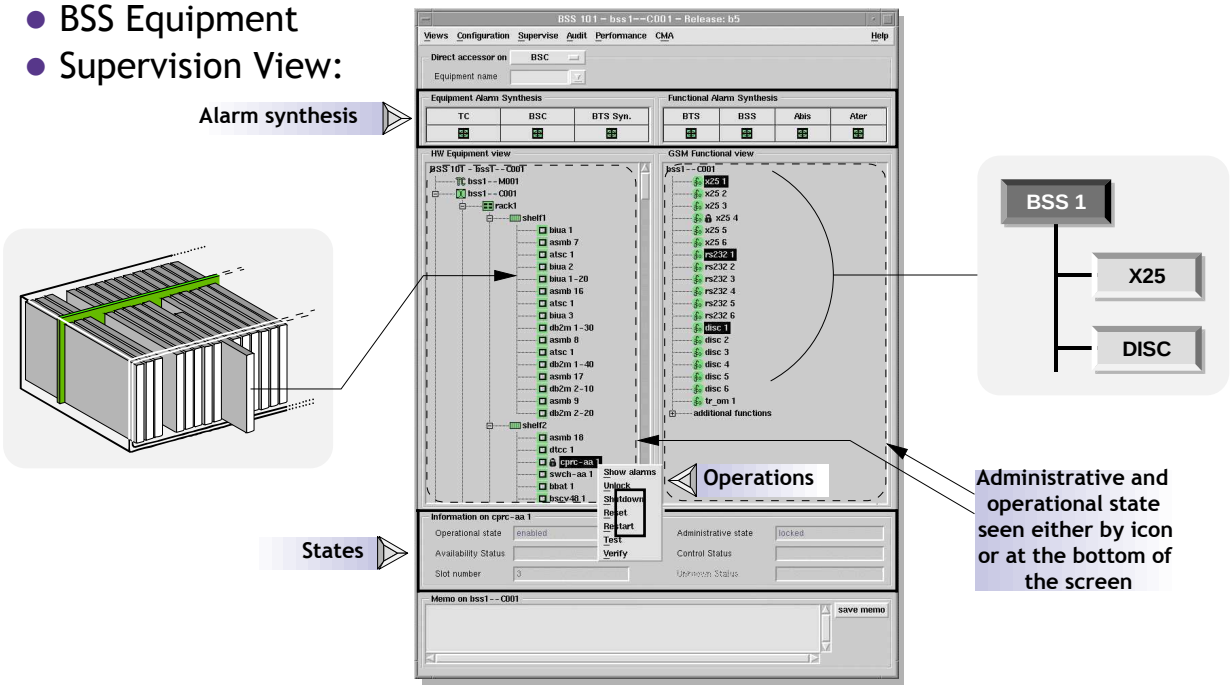
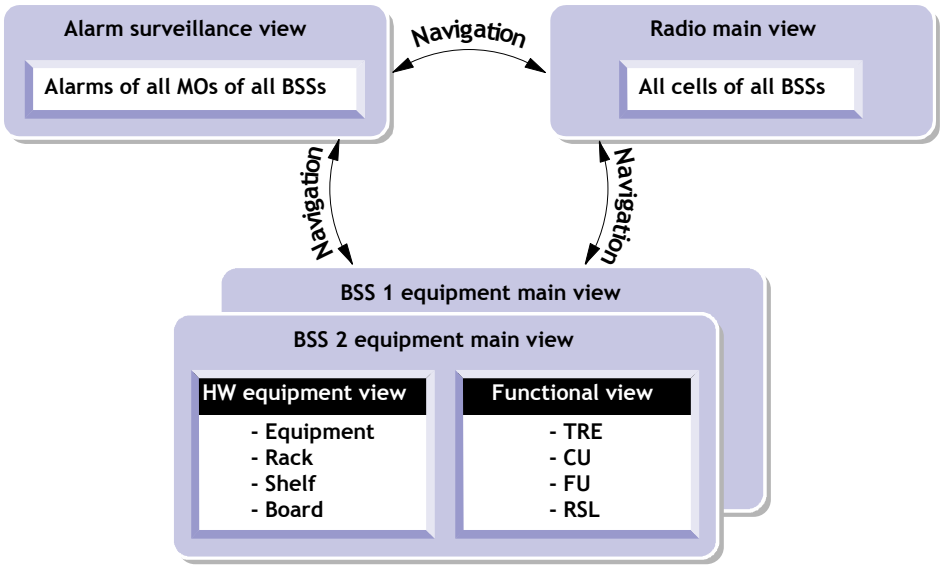
- BSS Equipment
- Supervision View:



BSS equipment supervision:

- The BSS equipment main view is used to manage hardware and software components of the BSS and the transmission elements:
  - on top of the screen, alarm synthesis for the “managed elements”
  - at the bottom, state of the selected object
  - on the left: HW equipment view : physical location of the boards: rack, shelf, slot + possible operations when clicking on the selected object
  - on the right: GSM functional view : associated function if needed

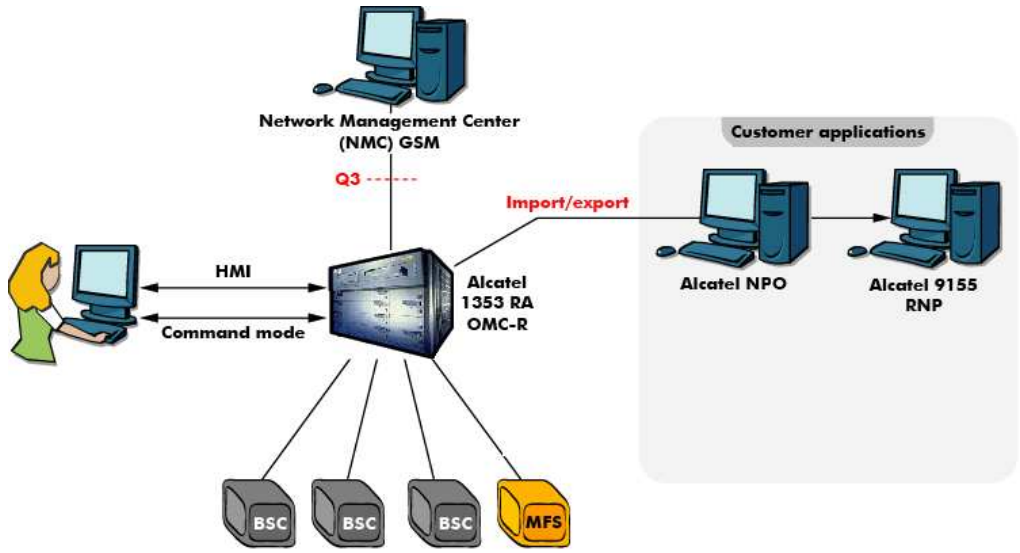
- Fault Management: Network Supervision



This diagram shows the general organization of the alarm management user interface: (examples are given in the next pages)

- The alarm surveillance view:
  - alarms of all managed objects of all BSSs (more or less detailed, different levels)
- The radio main view:
  - display of radio resources (cells ..), possibility of commands, alarm synthesis
- The BSS equipment view:
  - display of equipment and function states, possibility of commands, alarm synthesis

- External Interfaces



Definitions :

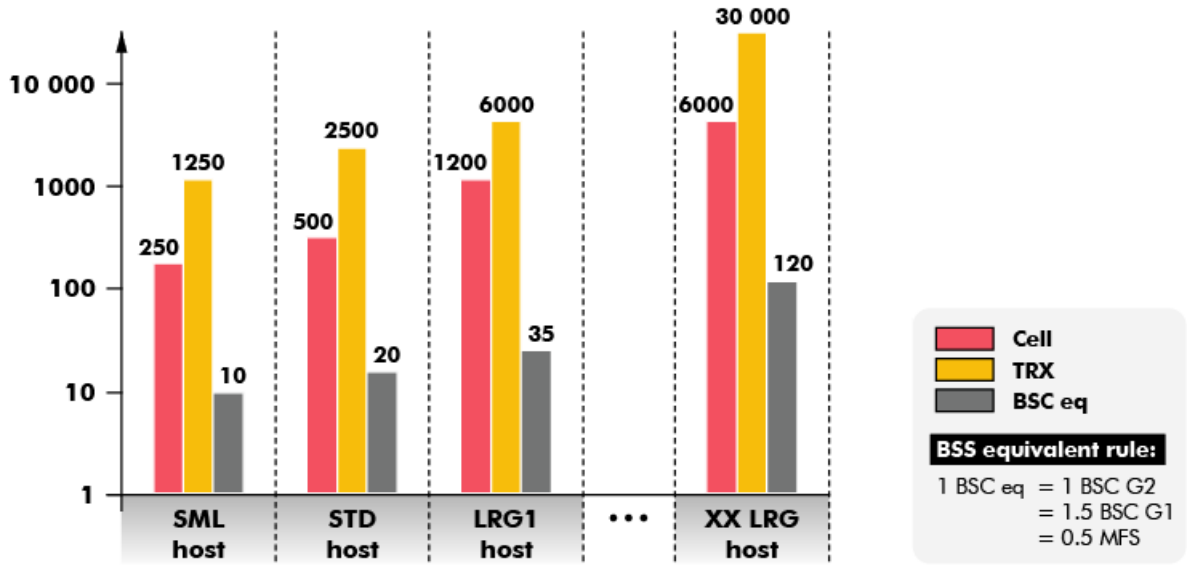
- **NPO**: Radio Network Optimizer
  - This feature allows the operator to monitor the Quality Of Service of his network in a centralized way. NPO integrates all data and services dealing with the management of the Quality of Service in one application
- **RNP**: Radio Network Planing

Radio Measurement Statistics (RMS):. These statistics are computed by the BTSs and made available at the OMC-R through the PM application. (“on demand” or a “permanent” job). Thus RMS can provide an exhaustive set of QoS statistics on the whole network updated every day. RMS statistics may be transferred to Alcatel NPA via the PM export interface and post-processed by Alcatel 9156 RNO.

Universal Terminal Concept

- User terminals connected to the OMC-R may be PC running Windows or low cost Unix terminals, on wich the ICA Citrix client software is installed.
- The ICA Citrix Metaframe software must be installed on the OMC-R server and/or HMI workstations.
- It allows the user to open several working sessions on different OMC-R the same time.

- Alcatel 1353 RA Dimensioning rules



6 OMC-R configurations are defined:

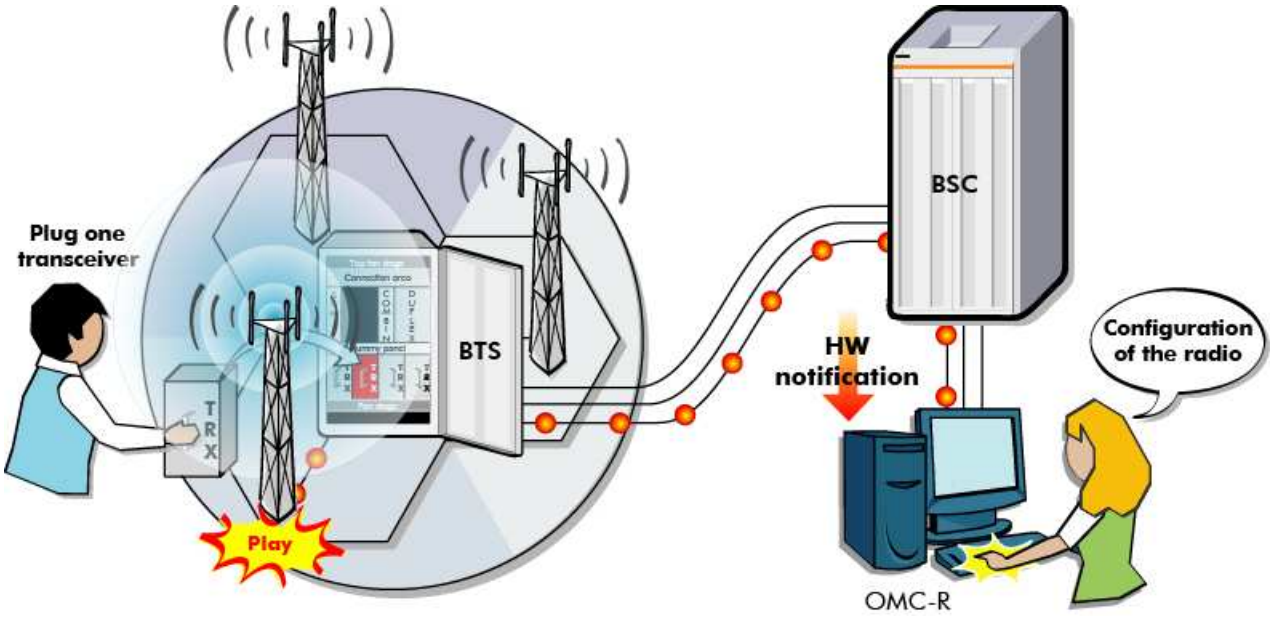
Small / Standard / Large1 / Large2 / X Large / XX Large

The OMC-R capacity depends on the OMC-R configurations which are based on SUN Entreprise, SUN Fire V880 and SUN Fire V490.

The maximum number of cells and TRXs will be reached if the OMC-R is based on Sun Fire V490 (UltraSPARC-4) servers.

- Example: XX-Large Configuration maximum 6000 Cells, 30000 TRXs.

- Alcatel 1353 RA on-line HW Extension



Auto-detection of BTS HW

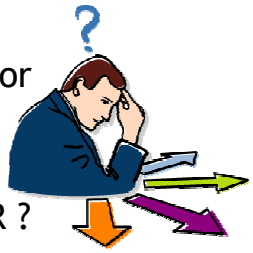
- BTS capabilities to poll its HW configuration are used
  - Plug-in of new boards can be detected by the BTS
- BTS informs BSC on new BTS HW components
- BSC synchronizes its database and the OMC-R
- Autonomous resource allocation by the BSC
- BSC performs automatically:
- Calculation of TRX / TCU mapping
- Calculation of A-bis TS allocation for OML, TRX and RSL based on Abis free mapping allocation rules
- Programming of transmission boards by BSC and BTS

No manual operator definitions/inputs needed

OML Autodetection:

- For Evolium™ BTS the transmission configuration must be done via OML
- The OML auto-detection allows the BTS to retrieve autonomously its OML location by scanning the 31 Time Slots and to connect its OML on the right TS.
- The feature “OML autodetection” targets :
  - Transmission configuration via OML on all Evolium™ BTS
  - No LMT configuration necessary during Move BTS
  - Secure recovery after OML breakdown
  - A simplification of the BTS installations (in the idea of Plug&Play BTS)
- HW coverage: all Evolium™ BTS: M4M, BTS G3.x, BTS G4

Answer the Questions



- Which Operation and Maintenance Center is needed for the MFS supervision ?
- Which are the most important functions of the OMC-R ?
- Can the BSS perform on-line hardware extension? What does this mean ?
- How many cells can be supervised by an OMC-R in the XX-Large Host configuration ?

Self-Assessment on the Objectives

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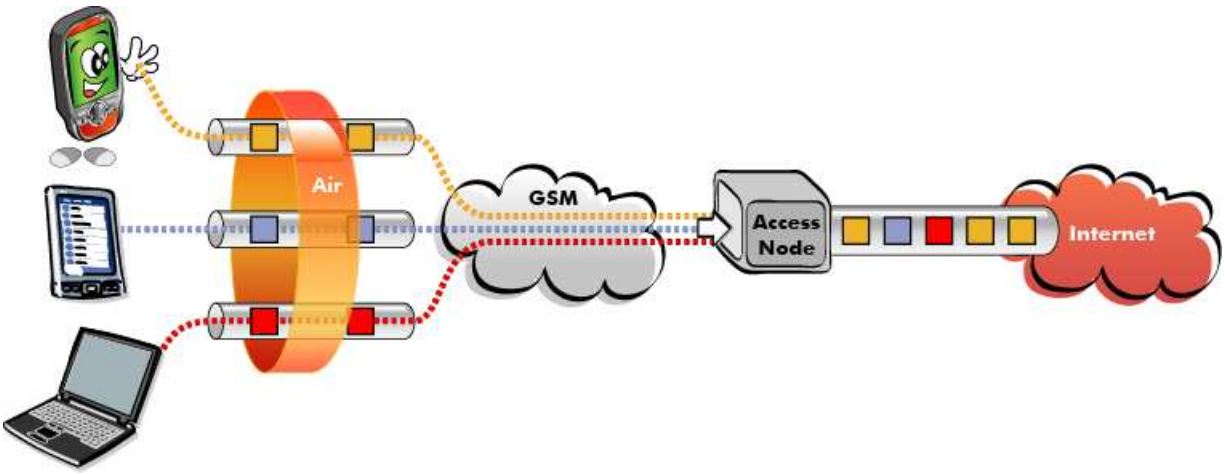
Annexes

Annex A: GPRS Definition

- Purpose of General Packet Radio Service:
  - The GPRS allows the service subscriber to send and receive data in an end to end packet transfer mode, without using network resources in circuit-switched mode
  - It allows a charging based on data volume (resources really used)
  - It also brings benefits to the network operator who may then use scarce radio resources more efficiently by sharing these resources
  - GPRS provides packet mode transfer of data for applications that exhibit one or more of the following characteristics:
    - Intermittent, non periodic (i.e. bursty) data transmission
    - frequent transmission of small volumes of data
    - infrequent transmission of larger volumes of data

- (Enhanced) General Packet Radio Service ((E)GPRS): principles



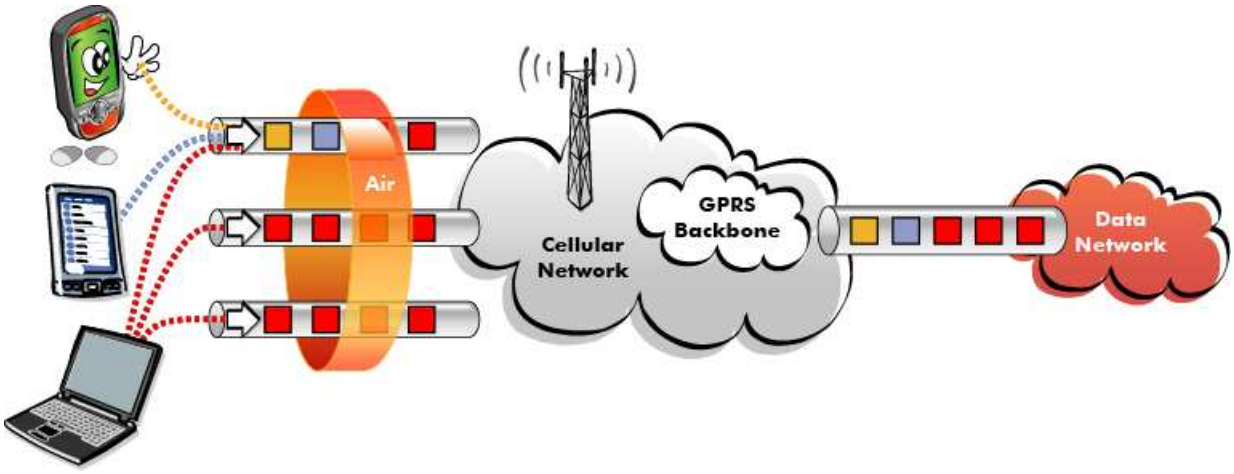
Drawback of the Circuit Switching Technique :

A circuit is established for a single terminal and this connection, including the reserved network resources, is held as long as the session is active.

- 1 radio channel = 1 TS on one TDMA frame) per user => fixed rate => waste of resource (in case of silence) and rate limitation (1TS per MS, except in the case of HSCSD)

Note: on the diagram, one cylinder on the air interface = 1 physical channel (1TS) on one carrier.

- (Enhanced) General Packet Radio Service ((E)GPRS): principles



Capacity on demand thanks to:

- Dynamic allocation of the GPRS radio timeslots
- Independent allocation of uplink and downlink timeslots

Up to 16 mobiles can share the same timeslot: 10 Downlink, 6 Uplink

Up to 8 timeslots can be allocated to one mobile

To avoid transmission errors, 4 channel Coding Schemes (CS, in GPRS) or 9 Modulation and Coding Schemes (MCS, in E-GPRS) are defined, to adapt bit rates to the environment

The Burst format is unchanged

Note: in the diagram, on the Air interface, one grey tube = 1 TS on one carrier (= 1 PDCH divided into 12 blocks that can be allocated to 8 different MS)

Optimal Use: the radio resource is only allocated during the data transfer thanks to set up / release of asymmetrical micro-connections (Temporary Block Flow, TBF) each time a datagram has to be transmitted on the air interface → the technique is adapted to variable bursty traffic (e.g. web pages downloading)

Dynamic Allocation: statistical multiplexing is the guarantee of efficient and fair radio resource sharing between users.

- Alcatel's Solution principles
  - Smooth and cost effective introduction of GPRS in the BSS by minimizing the hardware modification needed to the already installed network elements
  - Only software upgrade is needed on the installed BTS, BSC and OMC-R
  - GPRS functions are introduced in one network element called MFS (Multi-BSS Fast packet Server), one central entity which controls several BSS and supports the GPRS specific functions:
    - Packet Control Unit (PCU) function
    - Standard Gb Interface protocol stack
  - Maximum usage of the existing transmission resources

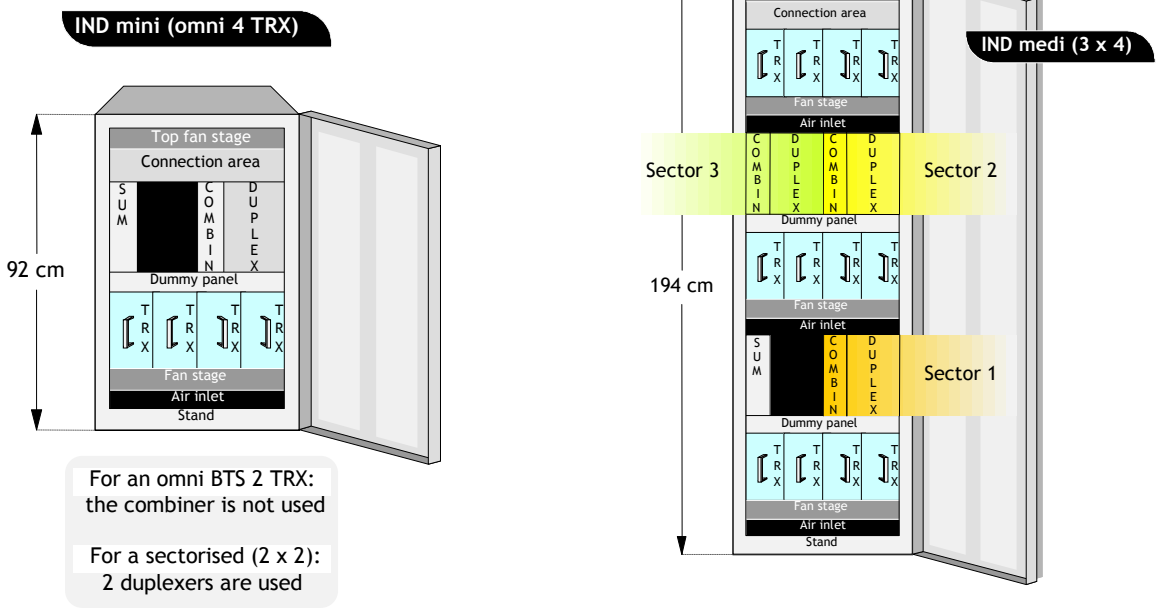
Maximum usage of the existing transmission resources:

- At both air and A-bis interface: implementation of the "capacity on demand" principle
- At the A-ter mux interface: the timeslots not used by the circuit switched traffic can be used by the packet switched traffic. Additional 2 Mbps links carrying packet traffic are only added when the traffic volume exceeds the unused bandwidth.
- The Alcatel MFS is able to cross-connect transparently the CS traffic between the BSC and the transcoder

Minimum cost of the additional equipment:

- PCU function for a complete BSC is implemented on a single GPU board
- Up to 30 GPUs can be housed in a single Alcatel MFS
- The management functions are implemented on a pair of control stations which are shared by all the GPUs

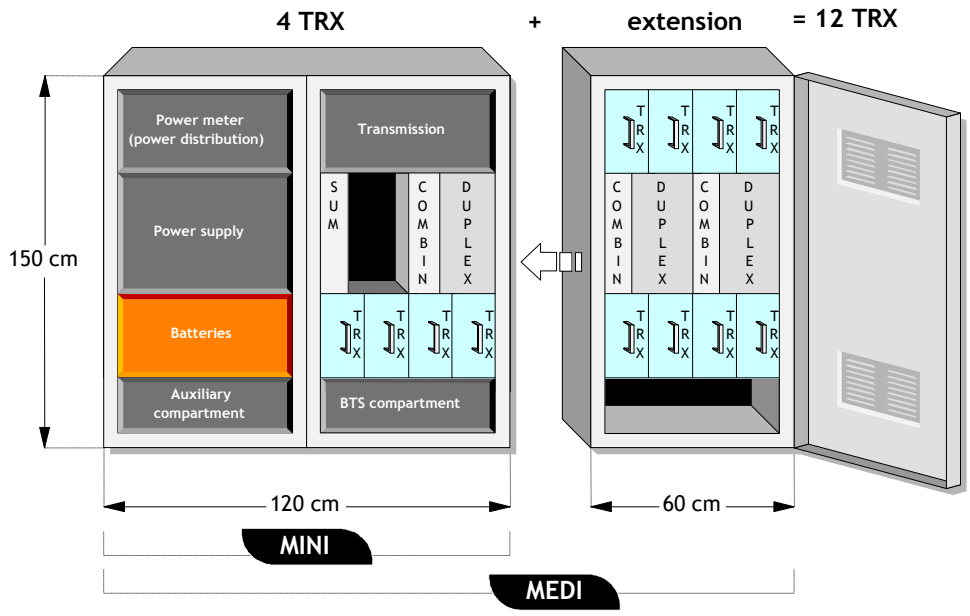
- Alcatel 9100 BTS Indoor



ANX= Duplexer, used for Duplexing, Filtering, Amplification and Splitting,

ANY= Combiner, used for Coupling (WBC) and Splitting.

- Alcatel 9100 BTS Outdoor



ANX= Duplexer, used for Duplexing, Filtering, Amplification and Splitting,

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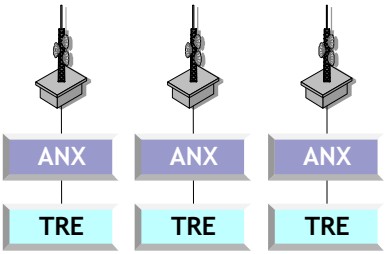
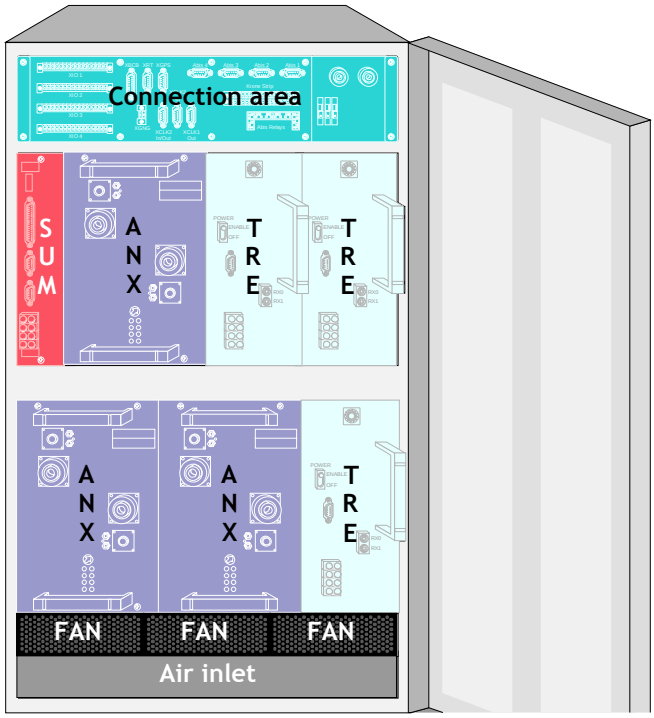
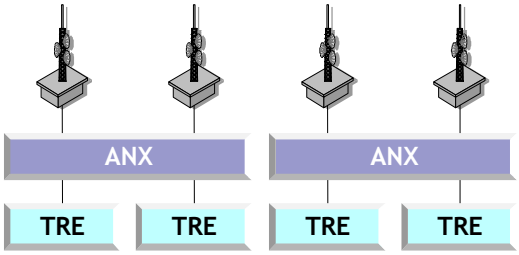
MEDI = MINI + Extension

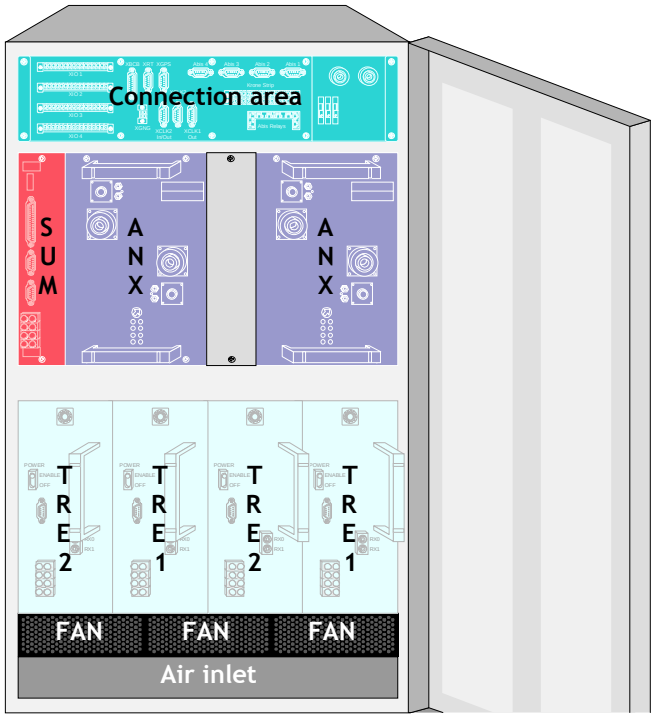
- Mini indoor 3x1 900 or 1800



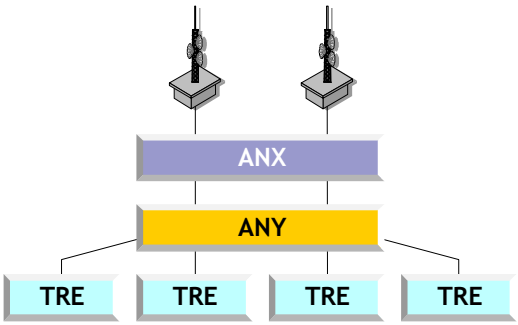


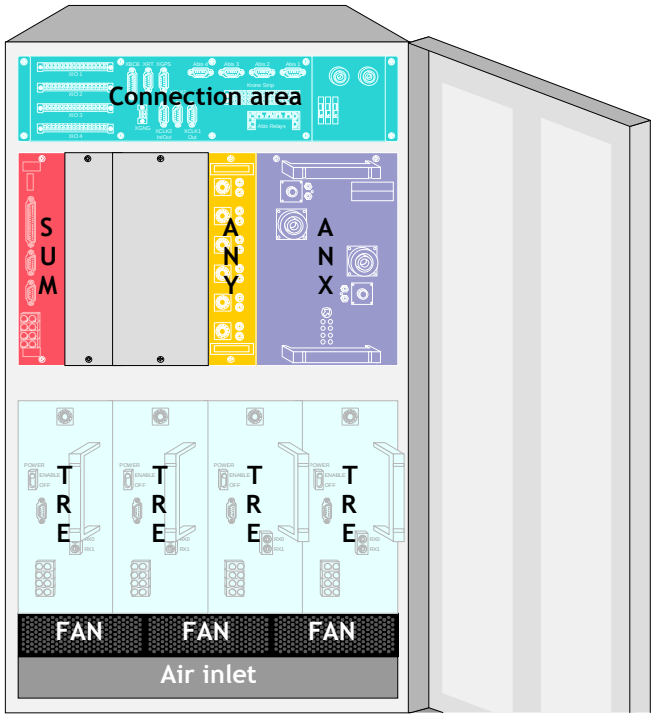
- Alcatel 9100 BTS Mini indoor 2x2 900 or 1800





- Mini indoor 1x4 900 or 1800





ANX= Duplexer, used for Duplexing, Filtering, Amplification and Splitting,

ANY= Combiner, used for Coupling (WBC) and Splitting.

- Alcatel 9100 BTS: Some monoband configurations

Range	Rack Family	Configuration
900/1800	IND mini	omni ...4 TRX
		sectored ...2x2 TRX
	IND medi	omni ...12 TRX
		sectored ...2x6 TRX
		sectored ...3x4 TRX
		sectored ...4x2 TRX
	OUT mini	omni ...4 TRX
		sectored ...2x2 TRX
		sectored 3x1 TRX
	OUT medi	omni ...12 TRX
		sectored ...2x6 TRX
		sectored ...3x4 TRX
		sectored ...4x2 TRX

Remark: in the tables, « … » means «up to »

Example:

- 2x6 TRX 900 **or** 1800

Remark:

- The Antenna Network for 900 or 1800 and ANX/ANY are specific
- 1 cell = 1 BCCH

- Alcatel 9100 BTS: Some multiband BTS configurations

Range	RackFamily	Configuration	900/1800
Multiband 900/1800	IND mini	...2x2	...2 / ...2
	IND medi	...2x6	...6 / ...6
		...3x4	...4 /...2x4
			...2x4 / ...4
		2x4 + 2x2 (4 sectors)	2x4 / 2x2
			2x2 / 2x4
		(6 sectors)	3x2 / 3x2
	OUT mini	...2x2	...2 / ...2
	OUT medi	...2x6	...6 / ...6
		...3x4	...4 /...2x4
			...2x4 / ...4
		2x4 + 2x2 (4 sectors)	2x4 / 2x2
			2x2 /2x4
		(6 sectors)	3x2/3x2

Multiband BTS configuration

Example:

- configuration 2x6 means 1 sector with 6 TRE= 900 and 1 sector with 6 TRE= 1800

Remark:

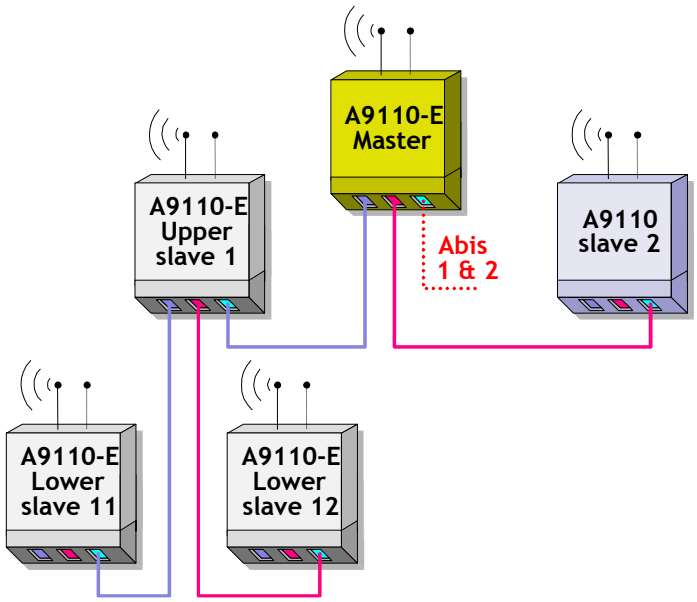
- The Antenna Network for 900 or 1800 and ANX/ANY are specific
- 1 cell = 1 BCCH

Annex B: Evolium BTS and Evolium BTS Evolution

- Evolium™ BTS Evolution
  - Station Unit Module: SUMA
  - Antenna Network Module: ANC (D = 1800, G = 900)
  - TRA module supporting 8-PSK modulation
  - AC/DC Power Supply for indoor and outdoor cabinets:
    - Power Module 1200W : PM12
    - Adapter Module: ADAM
  - AC Switch Unit: ACSU
  - Optional Indoor Unit (IDU) of microwave entity associated with Outdoor Unit (ODU) fixed on the mast
  - SUMA and ANC usable in previous Alcatel 9100 BTS versions

ANC is equivalent to ANX (duplexer) + ANY (wide band combiner).

- Mixed configurations are also accepted. Example of 10 TRX configuration:



Example of rules for the mixed configurations:

- Maximum 3 levels (master, upper and lower slave)
- The master must be A9110-E
- A9110 used as upper slave, terminates the IEB (Inter Entity Bus)
- A9110 can not be used as lower slave

FEATURES PRESENT IN MR1

- BSC Evolution capacity improvement
  - - 1000 TRX/500 Cells BSC capacity
  - - Support of N7 HSL
  - - Up to 4000Erlangs BSC capacity with TPv1
  - - Removal of HR impact on BSC connectivity
- Multiple CCCH
- Dual Transfer Mode (DTM)
- Improved delayed UL TBF Release
- Refined criteria for 2G to 3G handover
- DLS check tool
- Expressive icons
- Log viewer improvements
- Alarm management of external equipments
- Free search engine replacing Verity

ANC is equivalent to ANX (duplexer) + ANY (wide band combiner).

FEATURES ADDED IN MR2

- Support of CPICH Ec/No and CPICH RSCP for 2G to 3G cell re-selection
- Fast 3G re-selection at 2G CS call release
- MCCCH feature: to be locked at cell level
- Dual Tranfer Mode: optional feature to be locked at
- TRX level
- Higher OMC-R capacity at reduced Performance
- Security improvements for O&M systems
- O&M routing over Ethernet (with link redundancy) without RIP router for BSC Evolution
- Gb over IP

FEATURES ADDED IN MR2 Ed 2

- Reshuffling of TRX mapping between CCP boards
- Correction of NE1o1 FW to allow 12 E1 per GP with
- centralized clock

ANC is equivalent to ANX (duplexer) + ANY (wide band combiner).

FEATURES ADDED IN MR2 Ed 3

- MBS-Maintenance Terminal Software (same software for any MBS configuration)
- AMR; optional feature to be locked at TRX level
- Implementation of ALU new common look and feel on OMC-R (GUI and

FEATURES ADDED IN MR2 Ed 4

- STM-1 introduction in TC G2.5
- WB_AMR
- DTMF cancellation in TC (MT120)
- Extended Dynamic Allocation
- DTM multislot class 11
- GboIP: dynamic configuration of IP endpoints
- MFS with 16 GP per cabinet and 16 E1 per GP
- Several IMT session with admin access possible per MFS
- Improved CCP takeover
- Improvements TWIN module GSM1800 with GMSK 45W RF power

ANC is equivalent to ANX (duplexer) + ANY (wide band combiner).

A-GPS	Assisted GPS
AMR	Adaptive Multi Rate (TC)
AN	Antenna Network (BTS)
AS	Access Switch (BSC)
AS	Alarm Surveillance (O&M)
ASMB	A-ter Submultiplexer BSC
ASMC	A-ter Submultiplexer TC
BBU	Battery Backup Unit
BC	Broadcast
BCU	Broadcast Unit
BCLA	BSC Clock A
BCR	Broadcast Register
BCU	Broadcast Unit
BCCH	Broadcast Common Control Channel (GSM TS)
BCF	Base station Control Function (BTS)
BG	Border Gate (GPRS)
BIE	Base Station Interface Equipment
BIEC	Base Station Interface Equipment (BSC)
BIUA	Base Station Interface Unit A
BPA	Back Panel Assembly
BSC	Base Station Controller
BSS	Base Station (sub)System
BSSGP	Base Station System GPRS Protocol (GPRS)
BTS	Base Transceiver Station
CAE	Customer Application Engineering
CAL	Current Alarm List (O&M)
CBC	Cell Broadcast Center
CBCH	Cell Broadcast Channel (GSM TS)
CBE	Cell Broadcast Entity
CCCH	Common Control Channel (GSM TS)
CCU	Channel Coding Unit
CDMA	Code Division Multiple Access
CE	Control Element (BSC)
CEK	Control Element Kernel
CIC	Circuit Identification Code
COC	Signalling Channel COde
CLK	Clock
CLSI	Custom Large Scale Integrated circuit
CMA	Configuration Management Application

CMDA	Common Memory Disk A
CMFA	Common Memory Flash A
CPR	Common Processor
CRC	Cyclic Redundancy Check
CS	Circuit Switching (Telecom)
CS	Coding Scheme (GPRS): CS-1, CS-2, CS-3, CS-4
CU	Carrier Unit (BTS)
DCE	Data Circuit Terminating Equipment
DDF	Digital Distribution Frame
DL	DownLink
DLS	Data Load Segment
DMA	Direct Memory Access
DRFU	Dual Rate Frame Unit
DRX	Discontinuous Reception (GSM TS)
DSE	Digital Switching Element
DSN	Digital Switching Network
DTX	Discontinuous Transmission (GSM TS)
DTC	Digital Trunk Controller
DTE	Data Terminal Equipment
EDGE	Enhanced Data rates for GSM Evolution
EGPRS	Enhanced GPRS
EI	Extension interface
EML	Element Management Level
EPROM	Erasable Programmable Read Only Memory
FPE	Functional and Protective Earth
FR	Full Rate (GSM TS)
FR	Frame Relay (Telecom)
FRDN	Frame Relay Data Network (Telecom)
FU	Frame Unit (BTS)
FW	Firmware
GGSN	Gateway GPRS Support Node (GPRS)
GMM	GPRS Mobility Management (GPRS)
GPRS	General Packet Radio Service
GPU	GPRS Packet Unit
GS-1	Group Switch of stage 1 (BSC)
GS-2	Group Switch of stage 2 (BSC)
GSL	GPRS Signalling Link

GSM	Global System for Mobile Communications
GSM TS	GSM Technical Specification
HAL	Historical Alarm List (O&M)
HDSL	High rate Digital Subscriber Line
HDLC	High Level Datalink Control
HLR	Home Location Register
HMI	Human Machine Interface
HO	HandOver
HR	Half Rate
HSDS	High Speed Data Service
HW	Hardware
ICA	Independent Computing Architecture
IDR	Internal Directed Retry
ILCS	ISDN Link Controller
IMT	Installation and Maintenance Terminal (MFS)
IND	Indoor (BTS)
IP	Internet Protocol
ISDN	Integrated Services Data Network
IT	Intelligent Terminal
LA	Location Area (GSM TS)
LAC	Location Area Code (GSM TS)
LAN	Local Area Network
LED	Light Emitting Diode
LLC	Logical Link Control (GPRS)
LSN	Local Switching Network
MA	Mobile Allocation (GSM TS)
MAC	Medium Access Control (GPRS)
MAN	MicroBTS Antenna Network (BTS)
MCB	Multiplex Channel Block
MCS	Modulation and Coding Scheme for EGPRS
MFS	Multi-BSS Fast Packet Server (GPRS)
	MCS1 – MCS9
MLU	Massive Logical Update
MMI	Man Machine Interface
MMM	(3M) Maximum Multiband Mobile Control
MO	Managed Object (O&M)
MPM	Metrica Performance Management
MS	Mobile Station
MSC	Mobile Switching Center

MSUM	MicroBTS Station Unit Module (BTS)
MW	Microwave
NMI	Non Maskable Interrupt
NPA	Network Performance Analyser
NPO	Network Performance Optimizer
NSS	Network SubSystem
NTL	Network Termination Line
NW	Network
OBC	On Board Controller
OBCI	On Board Controller Interface
ODMC	On Demand Measurement Campaign (O&M)
O&M	Operation and Maintenance
OMC	Operation and Maintenance Center
OMC-R	Operation and Maintenance Center - Radio
OML	Operation and Maintenance Link
OMU	Operation and Maintenance Unit (BTS)
OS	Operating System
OUT	Outdoor (BTS)
PBA	Printed Board Assembly
PBCCH	Packet Broadcast Common Control CHannel (GPRS)
PC	Personal Computer
PCCCH	Packet Common Control Channel (GPRS)
PCH	Paging CHannel (GSM TS)
PCM	Pulse Coded Modulation
PCU	Packet Control Unit (GPRS)
PDCH	Packet Data CHannel
PDN	Packet Data Network (Telecom)
PLL	Phase Locked Loop
PMA	Prompt Maintenance Alarm (O&M)
PMC	Permanent Measurement Campaign (O&M)
PPCH	Packet Paging CHannel (GPRS)
PRACH	Packet Random Access CHannel (GPRS)
PRC	Provisioning Radio Configuration (O&M)
PSDN	Packet Switching Data Network (Telecom)

PSTN	Public Switching Telephone Network (Telecom)
PTP-CNLS	Point To Point CoNnectionLeSs data transfer (GPRS)
QoS	Quality of Service
RA	Radio Access
RACH	Random Access CHannel (GSM TS)
RAM	Random Access Memory
REK	Range Extension Kit
RLC	Radio Link Control (GPRS)
RLP	Radio Link Protocol (GSM TS)
RML	Radio Management Level
RNO	Radio Network Optimisation
RNP	Radio Network Planning
RSL	Radio Signalling Link
RTS	Radio Time Slot
RxLev	Received Level
RxQual	Received Quality
SACCH	Slow Associated Control Channel (GSM TS)
SAU	Subrack assembly unit (BSC)
SC	Supervised Configuration (O&M)
SCC	Serial Communication Controller
SCCP	Signalling Connection Control Part
SCSI	Small Computer Systems Interface
SDCCH	Standalone Dedicated Control Channel (GSM TS)
SGSN	Serving GPRS Support Node (GPRS)
SIEA	SCSI Interface Extension A
SM	Submultiplexer
SMLC	Serving Mobile Location Centre
SMS	Short Message Service
SMS-CB	Short Message Service - Cell Broadcast
SRAM	Static RAM
SRS	SubRate Switch
SS7	Signalling System ITU-T N°7 (ex CCITT)
SSD	Solid State Disk
SW	Software
SWEL	Switch Element
TBF	Temporary Block Flow (GPRS)

TC	Transcoder
TCC	Trunk Controller Chip
TCH	Traffic CHannel (GSM TS)
TCIL	TransCoder Internal Link
TCSM	TransCoder / SubMultiplexer equipment
TCU	TRX Control Unit (Type: TCUA, TCUC)
TDMA	Time Division Multiple Access
TFO	Tandem Free Operation (TC)
TLD	Top Level Design
TMA	Tower Mounted Amplifier
TMN	Telecommunication Management Network
TRAC	Trunk Access Circuit
TRAU	Transcoder and Rate Adapter Unit
TRCU	Transcoder Unit
TRE	Transceiver Equipment
TRS	Technical Requirement Specification
TRU	Top Rack Unit
TRX	Transceiver
TS	Time Slot
TS	Technical Specification (GSM TS)
TSS	Time Space Switch
TSCA	Transmission Sub-System Controller A (BSC)
TSU	Terminal Sub Unit (BSC)
TU	Terminal Unit (BSC)
UL	UpLink
UMTS	Universal Mobile Transmission System
VLR	Visitor Location Register
VSWR	Voltage Standing Wave Ratio (BTS)
WAN	Wide Area Network
WAP	Wireless Application Protocol
WBC	Wide Band Combiner

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