Alcatel-Lucent WCDMA
UMTS BTS Description

3FL12810ABAAWBZZA
Edition 2

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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Course Objectives

Welcome to **UMTS BTS Description**

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

- describe the functional and physical architectures of the UMTS BTS products.
- describe the function of each module as well as the interaction between the modules.
- identify the data paths (internal and external) and the modules involved in the BTS.
- list the different BTSs with their hardware equipment.
- list the optional equipment and describe the OAM.

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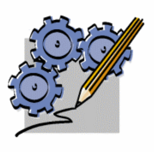
About this Student Guide

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 functional and physical architectures of the UMTS BTS products.			
2 To be able describe the function of each module as well as the interaction between the modules.			
3 To be able to identify the data paths (internal and external) and the modules involved in the BTS.			
4 To be able to list the different BTSs with their hardware equipment.			
5 To be able to list the optional equipment and describe the OAM.			

Thank you for your answers to this questionnaire

Self-Assessment of Objectives [cont.]

Other comments

1 The BTS within the UMTS Network

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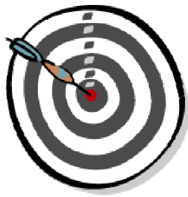
Let's start with a presentation of the situation of the BTS in the UMTS network.

Objectives

Objectives:
To be able to:
- understand the basic UTRAN architecture.
- locate the BTS within the UMTS network.
- explain the main functions of the BTS.



Content:
1.1 UTRAN Architecture
1.2 BTS Functions

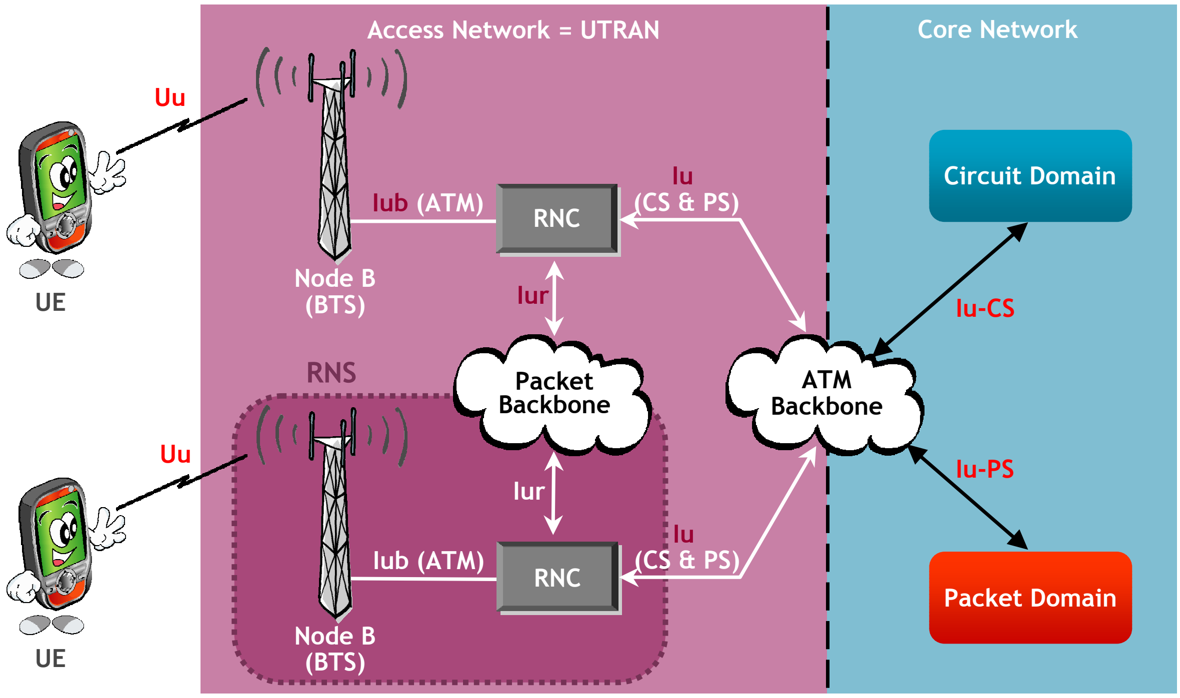
In this section, we are going to see a recap of the UTRAN architecture.
Then we will enumerate the functions performed by the BTS within the UTRAN.

1 The BTS within the UMTS Network

1.1 UTRAN Architecture

Do you remember what the UTRAN is made up of?

Situation

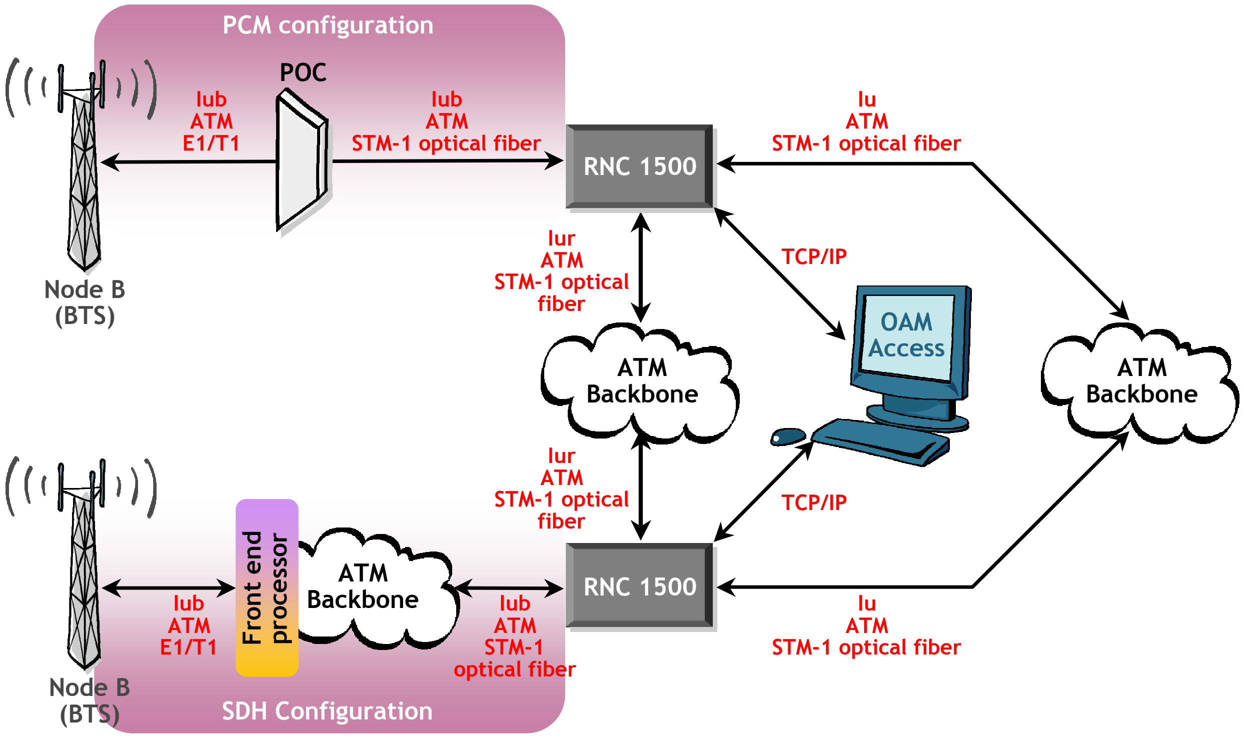


The UTRAN consists of a set of Radio Network Subsystems (RNSs) connected to the Core Network through the Iu interface.

An RNS consists of a Radio Network Controller (RNC) and one or more Nodes B.

To enhance interoperability of equipment from different vendors, UTRAN interfaces are fully standardized. First, the Uu interface is used between the node B and the UE. It is dependent on the technology used on the radio (it can be W-CDMA for example). Then the Iub interface is used between the RNC and the Node B. Next the Iu interface is used between the Core Network and the Access Network. This interface is split into the Iu-CS interface for the circuit domain and the Iu-PS interface for the packet domain. And finally, the Iur interface is used between the RNCs. This latter interface has been defined to support specific functions such as handover, without having the Core Network involved.

Alcatel-Lucent UTRAN Architecture



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In the Alcatel-Lucent UTRAN architecture, two different types of RNC 1500 configurations can be implemented to the physical links used by the operator.

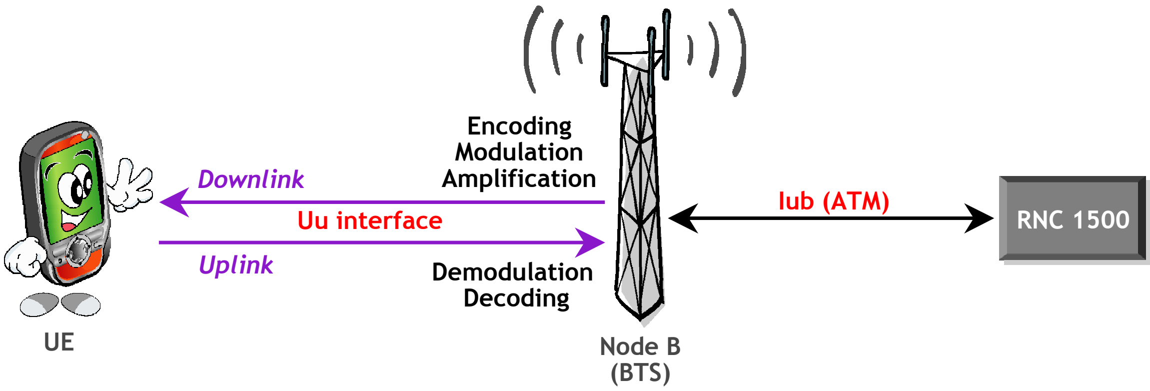
The first type of RNC 1500 is the **RNC Optical (with SDH/SONET technology).** The RNC Optical allows the operator to directly connect the RNC to the Nodes B through the Iub interface based on an STM-1/OC-3 optical link up to the ATM backbone. In this case, the electrical link for E1/T1 frames covers the second part of the Iub interface, from the ATM backbone down to the Nodes B.

The second type of RNC 1500 is the **RNC PCM**. This type of RNC allows the operator to connect the RNC to the Nodes B through the PCM Point of Concentration (POC). This solution offers E1 connectivity along the Iub interface. However, this solution requires an additional equipment which is the POC. This equipment is an ATM switch provided by Alcatel. The POC performs the conversion of E1 into STM -1.

What Is the Role of the BTS in the UTRAN?

Main Functions of the BTS

- Call processing
- Radio access
- Performance monitoring
- Network interface
- Random access detection



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The Alcatel-Lucent UMTS BTS is the 3GPP-compliant UMTS Node B developed by Alcatel-Lucent. The generic term BTS designates the Alcatel-Lucent UMTS Base Transceiver Station.

What is the role of the BTS in the UTRAN?

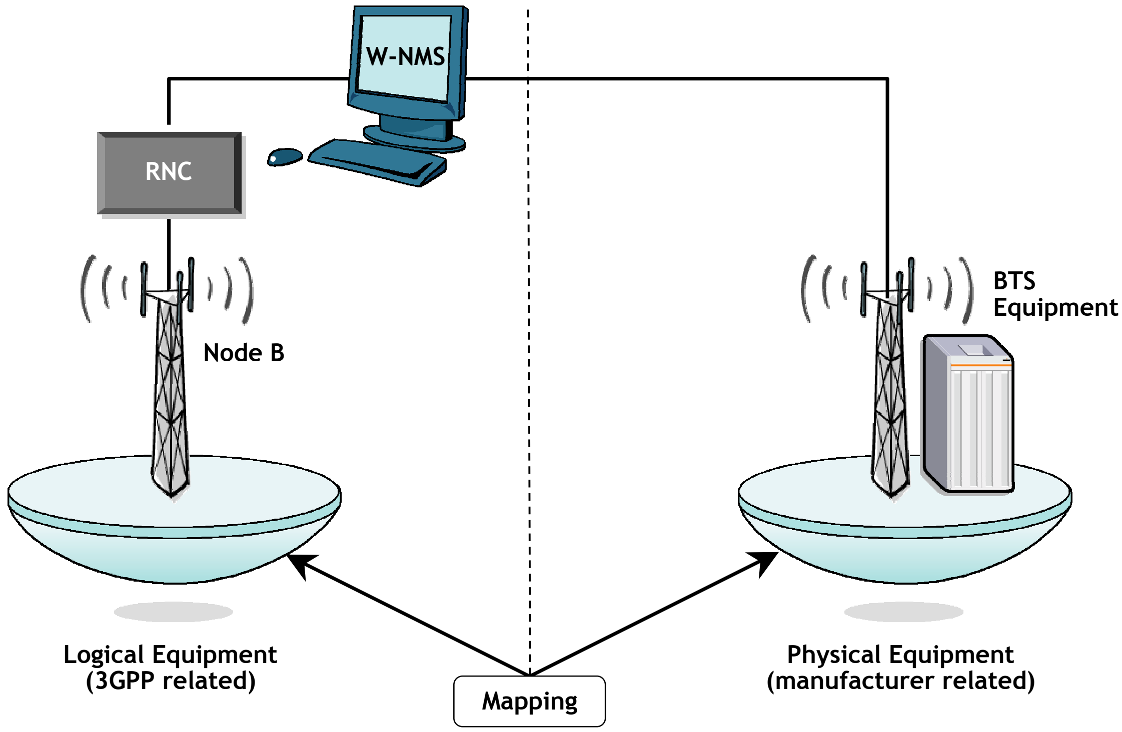
First of all, the BTS is responsible for radio transmission and reception in one or more cells from the User Equipment.

The BTS is connected to the RNC through the Iub interface.

As stated, the primary responsibility of the BTS is to transmit and receive radio signals from a user equipment over the Uu radio interface. To perform this function completely, the signals are encoded, modulated, amplified on one way then demodulated and decoded on the other way.

The BTS is also in charge of performing and reporting radio measurements to the RNC. Then the BTS detects random accesses from the UE. Finally, the BTS handles the Uu and Iub interfaces.

Object Model Definitions



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The standardization of the Iub interface has incited Alcatel-Lucent to define an object model based on a logical part and a physical part in order to cope with the multi-vendor configurations.

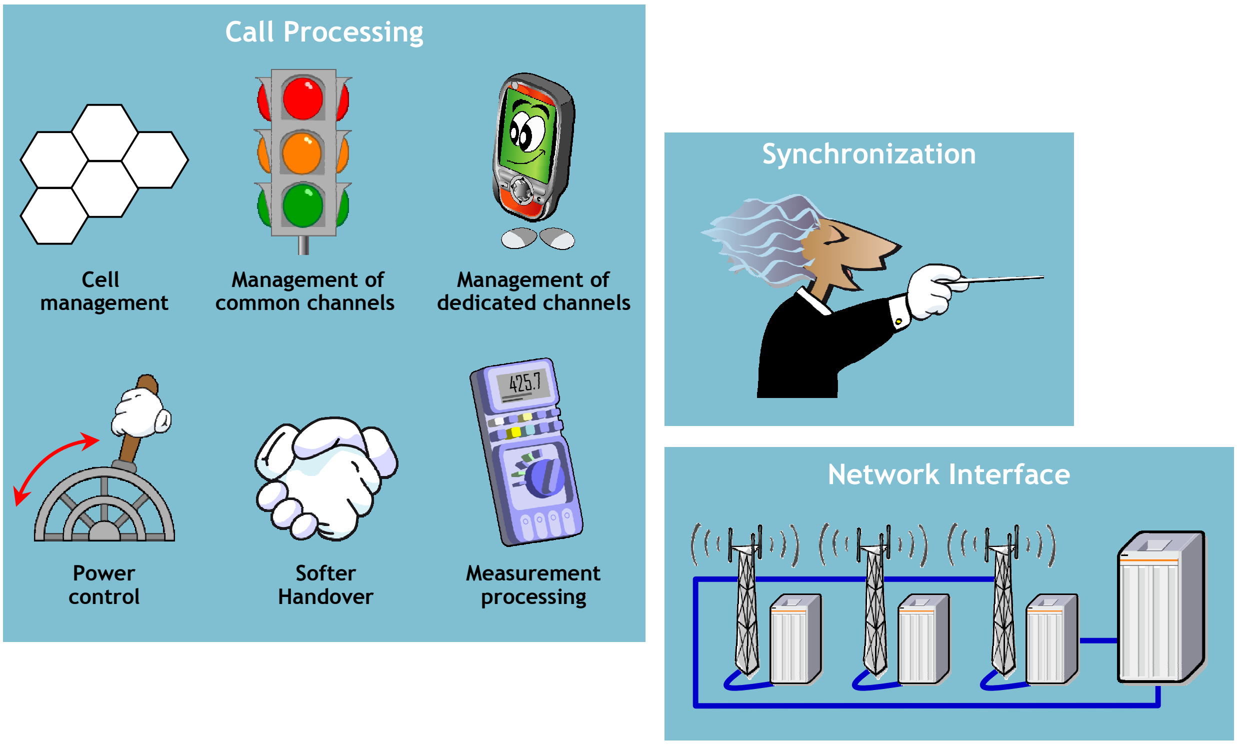
The object model applied to the BTS, defines two distinct parts. First the Node B is the logical part of the equipment. The Node B is generic and must be compliant with 3GPP recommendations. Second, the BTS equipment is the physical part of the equipment. The BTS is specific and depends on the technical options chosen by the manufacturer.

1 The BTS within the UMTS Network

1.2 BTS Functions

Now, let's move on to the functions performed by the BTS.

Basic Functions



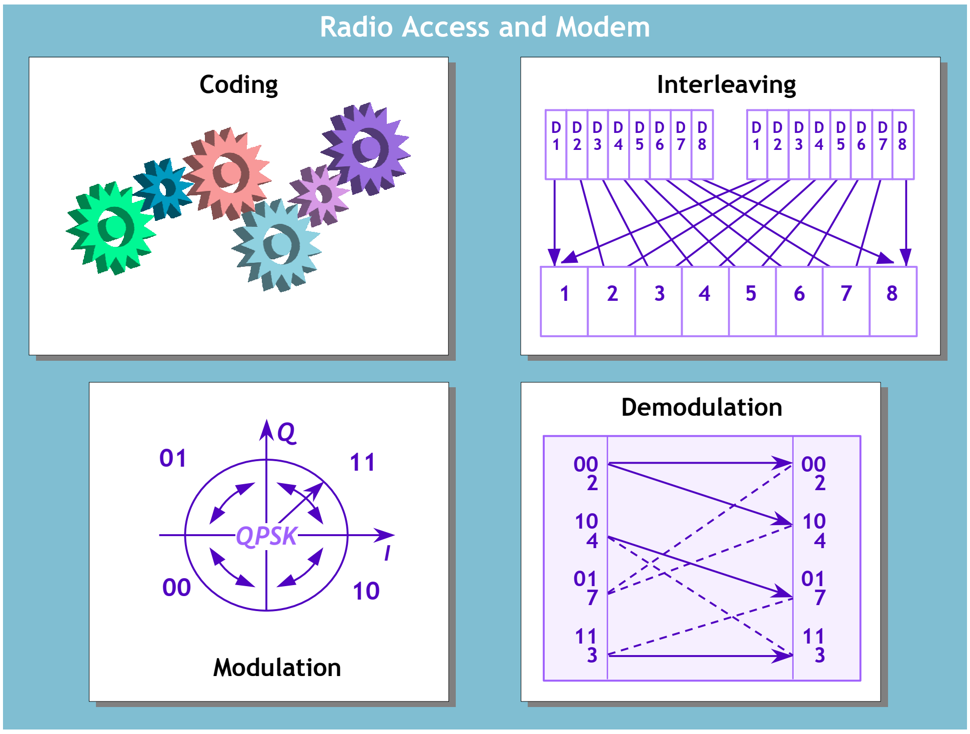
The BTS supports three basic functions. The first function is call processing which includes channel setup and management for both common and dedicated channels, cell management, power control, softer handover and measurement (for example, QoS estimation). This function is in charge of Radio Resource Management (RRM) inside the BTS.

Then the BTS supports the network interface function. Indeed, the BTS is the equipment interface between the RNC and the UE.

Here is illustrated a drop & Insert configuration where several nodes B are linked by the same E1 link.

Finally, the third basic function performed by the BTS is synchronization in order to retrieve a highly stable radio frequency from the network interface. The synchronization comes from the Iub interface.

Radio Access Functions



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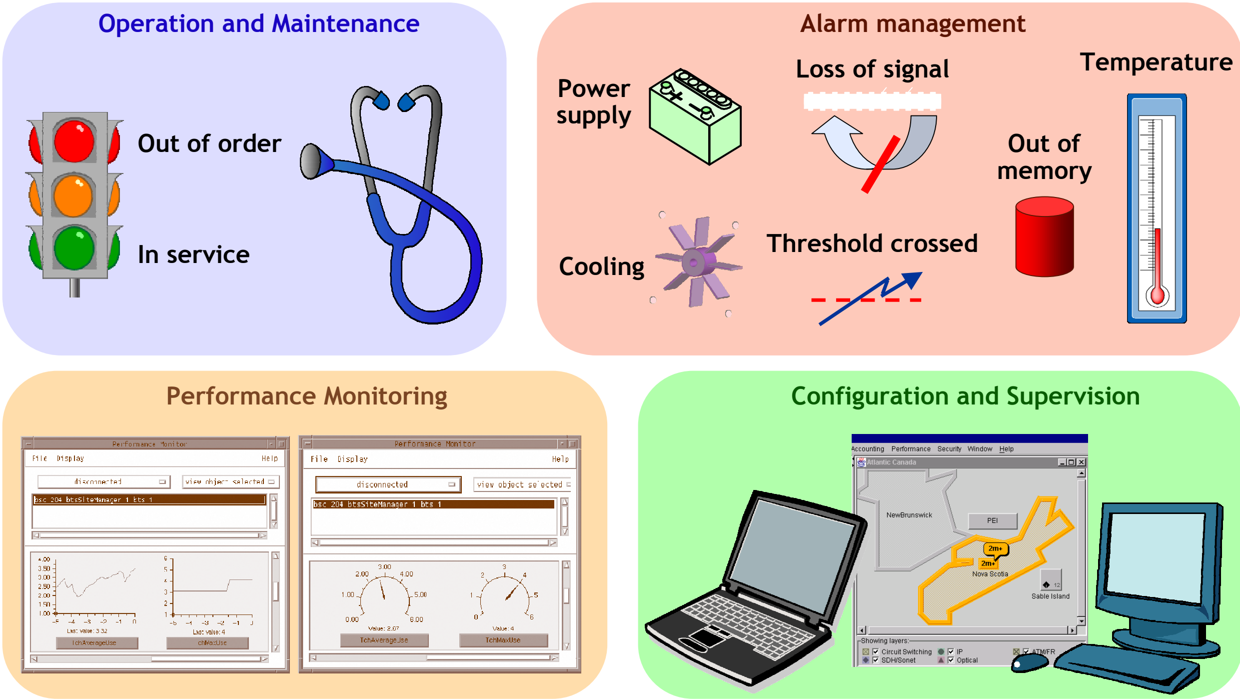
The BTS carries out the radio access and modem function which includes modulation in QPSK and demodulation in BPSK, up and down frequency conversion, as well as amplification.

Radio channel coding and decoding introduces redundancy into the source data flow, increasing its rate by adding information calculated from the source data. This allows the detection or correction of signal errors introduced by the transmission medium.

The channel coding algorithm used and the amount of redundancy introduced may be different for the different types of logical channels and the different types of data.

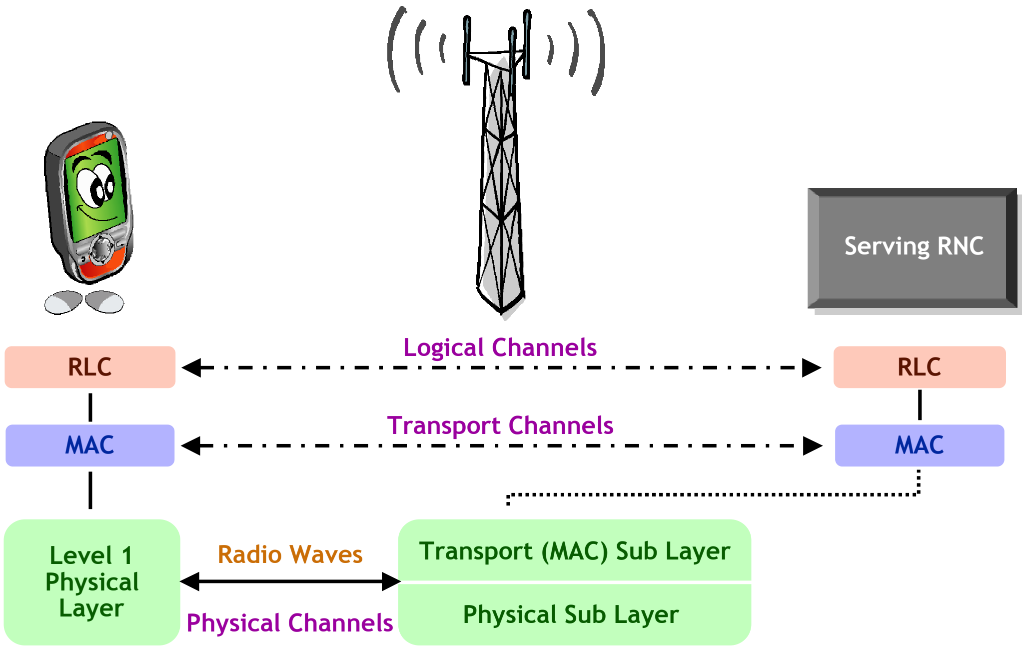
OAM Functions



As regards the OAM functions, the BTS supports the general Operation and Maintenance functionality thanks to which the state of each card is available. The BTS also performs Alarm management. Indeed, event reports are sent by all pieces of equipment to the OAM platform in order to constantly inform the system of the state of the whole network. Two types of event reports must be carefully handled by the OAM system. On the one hand, hardware anomalies automatically generate alarms which are forwarded up to the OAM system. On the other hand, the State changes usually generate notifications which are stored in the notification log file for investigation purposes, later on.

Another OAM function of the BTS is the configuration and supervision function. The BTS is in charge of configuring and supervising the modules which ensure inventory information, reporting and plug & play management. To end, thanks to the Performance monitoring, the BTS performs measurements on radio channels (current and surrounding cells) and translates these measurements into radio channel quality estimates.

Call Processing: Radio Traffic Protocol Layers



As seen previously, call processing is one of the BTS basic functions. Indeed, the BTS not only provides the means of communication between a UE and a network via Transport Channels but also the physical channels. These channels are necessary to synchronize the downlink and also to perform cell selection/reselection and handover preparation.

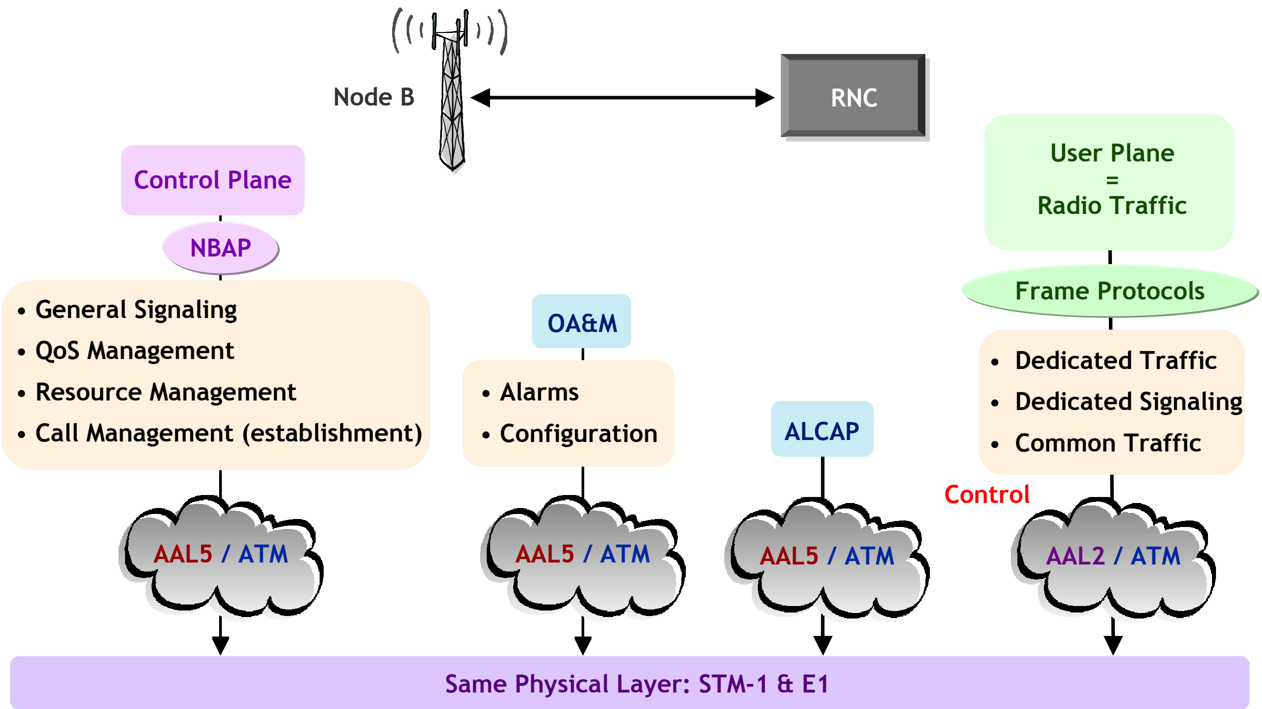
In addition, the BTS forwards measurement information to the RNC for radio resource management (for example, handover, power control).

If you look at the diagram, you can see that layer 1 is used to transmit information under the form of electrical signals corresponding to bits, between the network and the user equipment. This information can be either voice, circuit or packet data and includes network signaling.

The BTS offers data transport services to higher layers. The access to these services is made through the use of transport channels via the MAC sublayer. These services are provided by radio links which are established by signaling procedures. One radio link is made up of one or several transport channels and one physical channel.

The logical channels are decoded into the RNC.

Network Interface: Iub Traffic



In the UTRAN, Node B Signaling, User Data and Node B OAM are carried to the RNC over the Iub ATM interface.

The AAL5 format is used for the Control Plane and the Management Plane. Indeed, you can find NBAP c for Node B Application Part common or NBAP d for Node B Application Part dedicated. Then you find the Node B OAM. And finally, there is the ALCAP protocol which supervises the Transport Network Control Plane.

The AAL2 format is used for the User Plane. This format is used to transmit User Traffic (voice and data) over the radio interface or to receive the traffic from the radio interface. The AAL2 format is also used for Non-NBAP signaling (for example, Radio Resource Control, Mobility Management, Session management, Call Control, GPRS Mobility Management). Non-NBAP signaling is a Non-Access Stratum signaling also seen as User data from the transport network between the UE and the Core Network.

2 BTS Functional Description

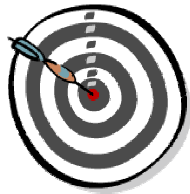
Now, let's look in detail at the BTS functional description.

Objectives

Objectives:

To be able to:

- identify the functional units of the BTS products.
- describe the main features.
- quote the functions associated to each module.
- locate the boards performing the functions.
- find the data flow between the different modules.



Content:

2.1 Overview of the BTS Software Architecture
2.2 Digital Shelf
2.3 RF Block
2.4 Configurations

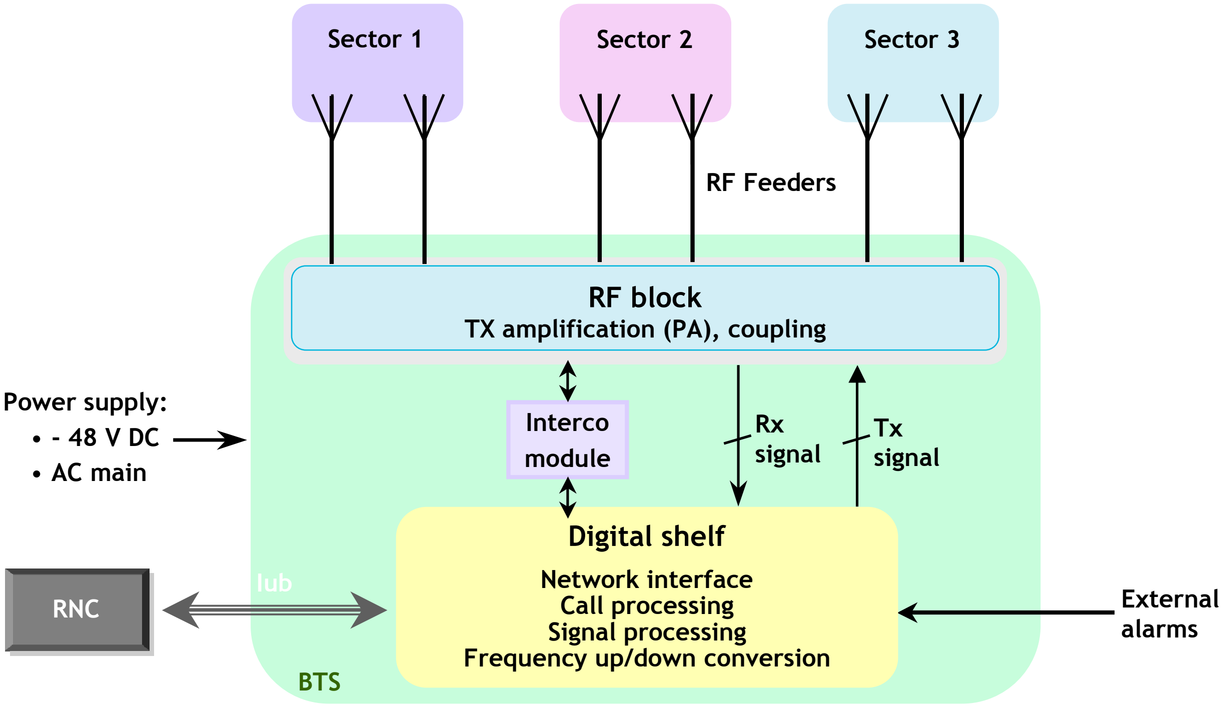
In this section, we are going to give a general description of the BTS software architecture.
Then, we will describe the characteristics of its 2 main components, the digital shelf and the RF block.
Finally, we will review the possible configurations of the BTS.

2 BTS Functional Description

2.1 Overview of the BTS Software Architecture

First, let's discover the general software architecture of the BTS.

Alcatel-Lucent UMTS BTS High-Level Block Diagram



The Alcatel-Lucent UMTS BTS is built around two main blocks: the Digital shelf and the Radio Frequency (RF) block.

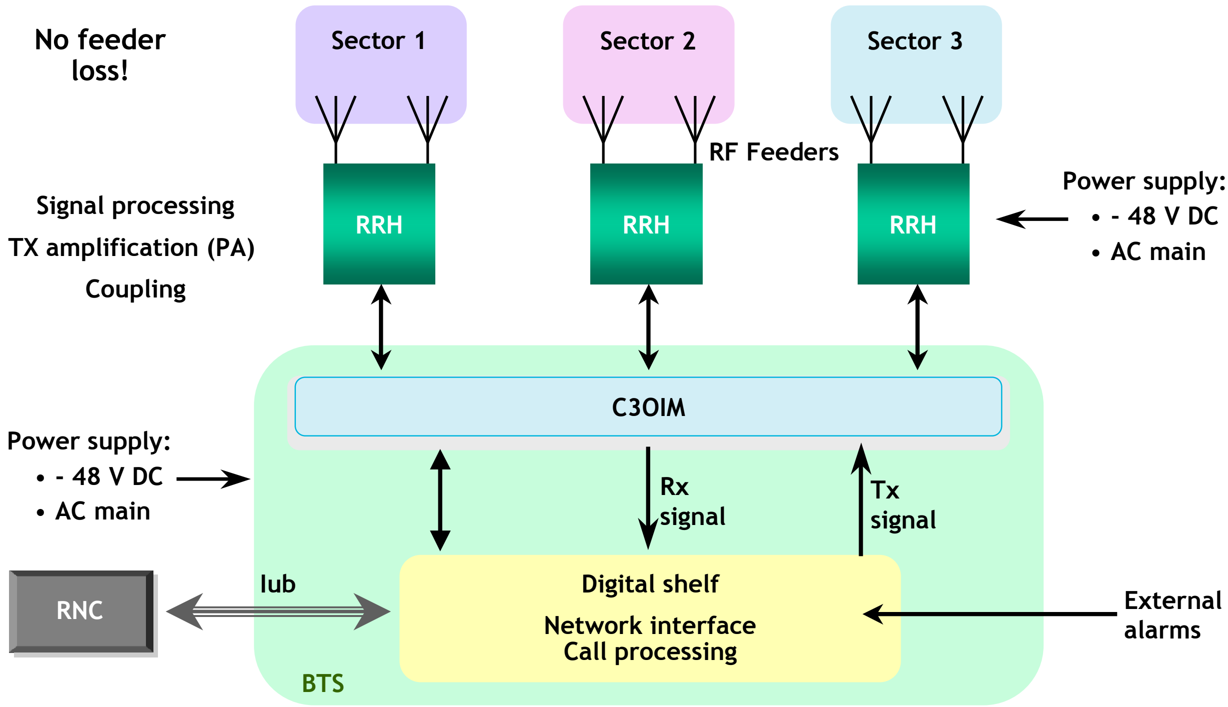
The main functions of the Digital shelf are network interface, call processing, signal processing and up and down frequency conversion.

The main functions of the RF block are transmission amplification with the Power Amplifier (PA) and coupling with the duplexer.

The Interco module is a standby module that carries digital signals between the two blocks.

You can notice that there are 2 antennas per sector.

BTS and RRH Functional Block Diagram



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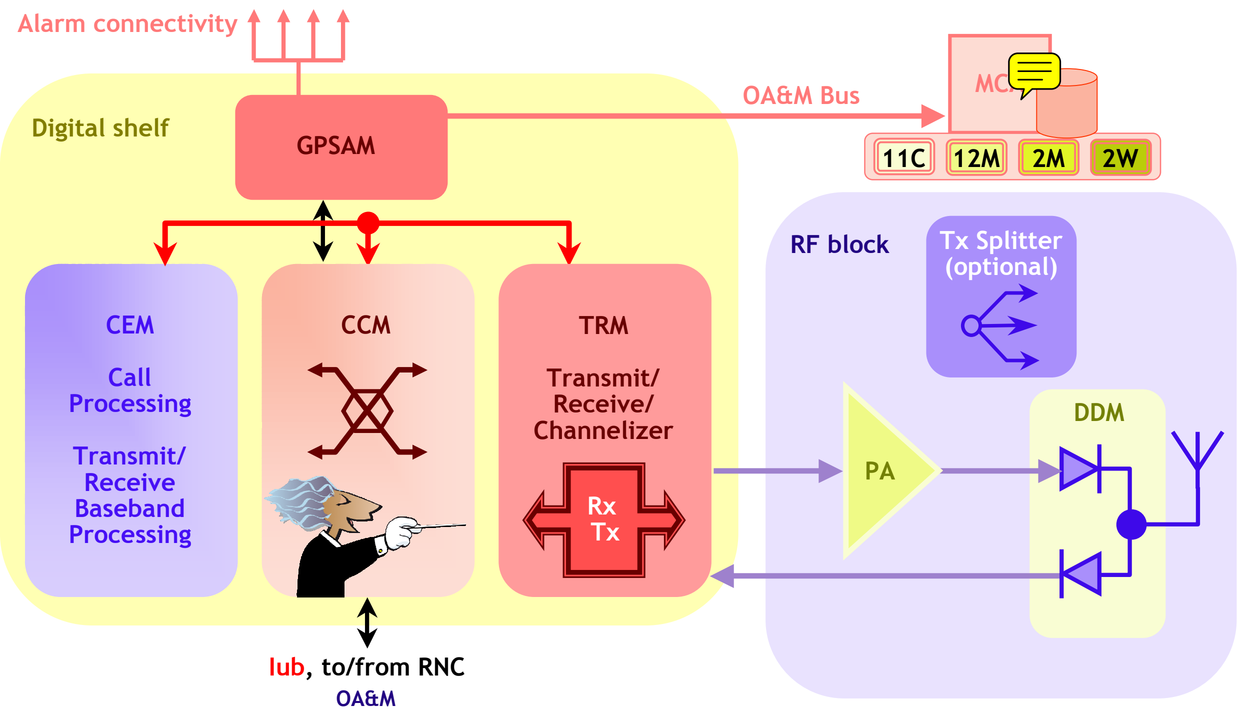
Here is presented the Remote Radio Head (RRH) configuration that is designed for macro-cellular applications. RRH is basically a solution where the transceiver, the Multi Carrier Power Amplifier (MCPA) and the filter functions are located remotely from the BTS.

In this particular configuration, the main functions of the BTS Digital shelf are network interface and call processing.

The Remote Radio Head solution for UMTS is composed of two modules. The Optical Interface Module (C3OIM) is located inside the UMTS BTS cabinet, in the Digital shelf. The Remote Radio Head is located on the remote site.

The main functions of the RRH are signal processing, up and down frequency conversion, transmission amplification with the Power Amplifier (PA) and coupling with the duplexer.

BTS General Architecture



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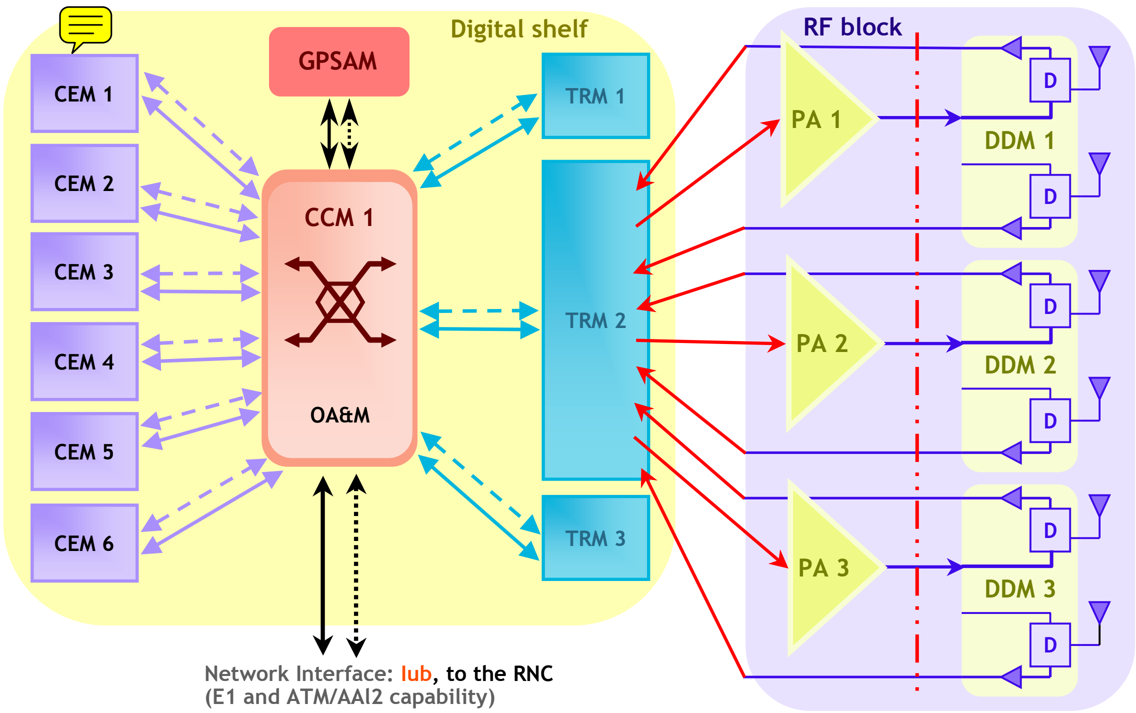
All the modules included in the cabinet (except the MCA card), can be gathered into two separate units. The first unit is the Digital shelf with CEM, CCM, TRM and GPSAM boards. The second unit is the Radio Frequency block with DDM and MCPA boards.

In the digital shelf, Channel Element Modules (CEM or iCEM) perform call processing and the transmit and receive baseband signal processing functions. The OAM management and part of call processing and internal/external data flow switching or combining are carried out by the Core Control Modules (CCM/iCCM). The receive / transmit channelizer function and the support of RF Block connectivity interface goes to the Transmit/Receive Modules (TRM/iTRM/xTRM). Finally, the external / internal alarm connectivity and the external synchronization reference interface are achieved by the GPS and Alarm Modules (GPSAM/cGPSAM).

In the RF block, the Transmit Radio Frequency signal amplification is performed by the Power Amplifier (PA). The RF input signal separation is achieved by the Tx splitters in OTSR configuration only. The isolation of Transmit / Receive frequency bands as well as the filtering is done by the Dual Duplexer Modules (DDMs).

Apart from these two modules, the Manufacturing Commissioning and Alarm module (MCA) is in charge of storing all commissioning information and collecting manufacturer alarms.

BTS Detailed Architecture



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Here is illustrated one of the possible configurations of the BTS.

The Digital shelf includes four types of modules: one CCM or two iCCMs, up to 6 CEMs or up to 2 iCEMs, up to 3 TRMs or xTRMs and one GPSAM.

The RF block contains the Radio Frequency modules with 1 to 6 Multi Carrier Power Amplifiers (MCPAs), 3 or 6 DDMs and 1 or 2 Tx splitters, in OTSR configuration only.

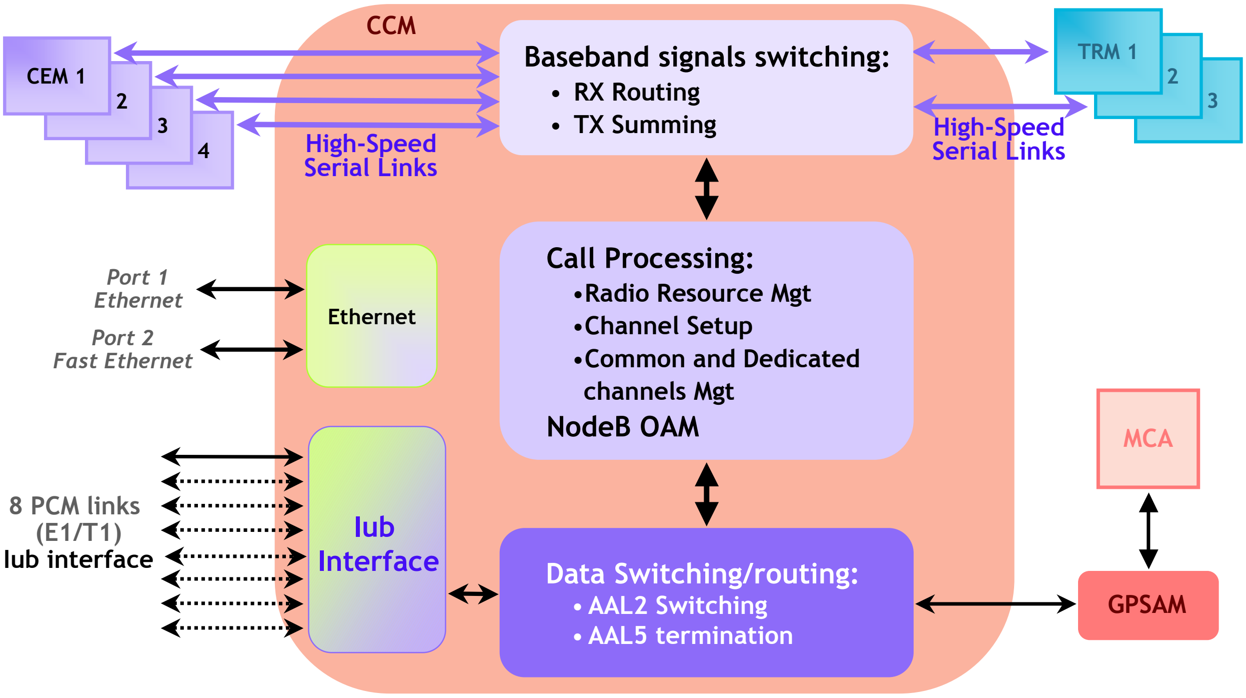
The Radio Frequency ports are connected to the two antenna connectors of the three DDMs.

2 BTS Functional Description

2.2 Digital Shelf

Let's now focus on the digital shelf and on the different modules this shelf houses.

CCM/iCCM: Functional Architecture



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The Core Control Module (CCM/iCCM) is considered as the "brain" of the BTS. The CCM board is an ATM switch that provides control and data routing functions for the BTS.

The CCM provides the Iub interface. This interface, which is connected to the RNC, consists of 8 physical links called PCM E1 and PCM T1, respectively at rates of 12.288 Mbps and 16.384 Mbps.

Another function of the CCM is call processing in charge of radio resource management inside the BTS. The call processing function is also responsible for channel setup and management for both common and dedicated channels, cell management, power control, handover and measurement processing.

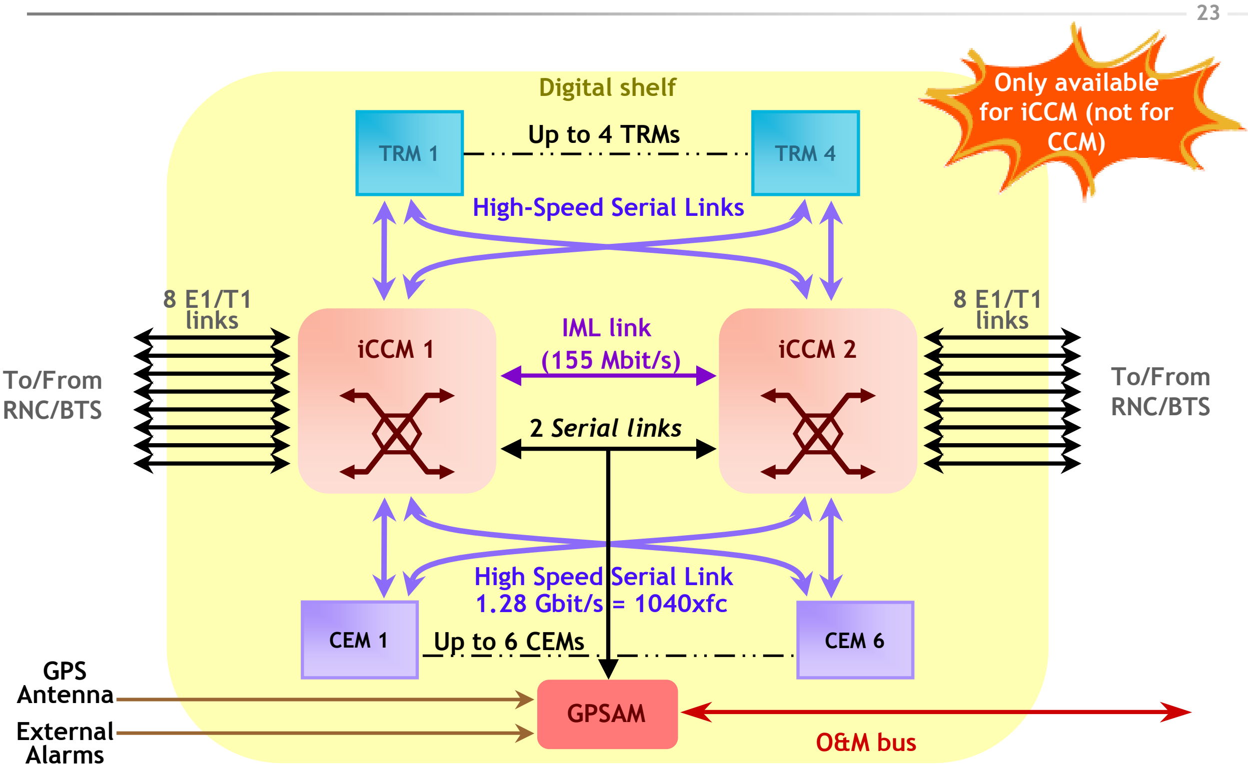
Then the CCM performs data switching and routing depending on the data flow. The ATM protocols AAL2 and AAL5, are used on the physical link between the BTS and the RNC.

Inside the CCM, baseband signals are routed (in reception) or summed (in transmission) between the CEMs and the TRMs.

Moreover, the OAM management function of the BTS includes the local maintenance through the Ethernet connection with the TIL.

Finally, the CCM supplies the BTS with frequency and timing reference. This function is in charge of retrieving a highly stable radio frequency from either the network interface.

iCCM: Redundancy



In this configuration, iCCM boards are used. With such a configuration, there is a redundancy unlike with a 1-CCM board configuration.

Each iCCM is connected to every CEM/TRM via bidirectional High-Speed Serial communication Links (HSSLs). This way, one CEM/TRM can dialog with either iCCM.

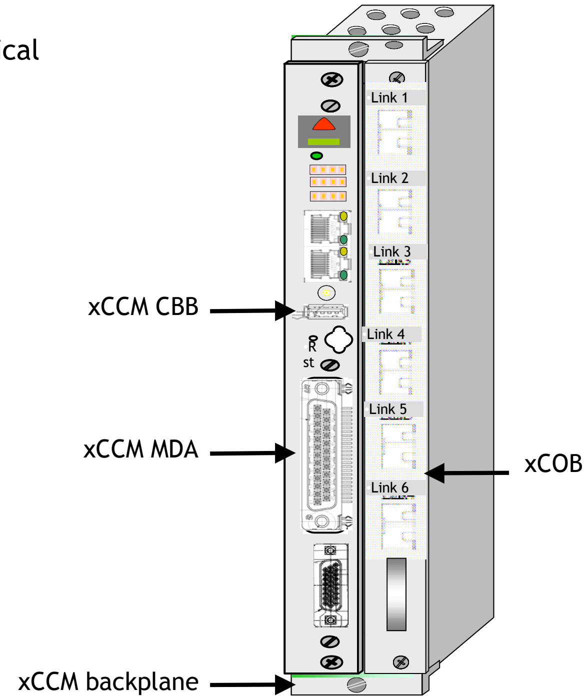
HSSLs are duplicated to enable redundancy in the case of link or module failure.

The Inter Module Link (IML) is used to exchange information between active and standby iCCMs. The activation of the standby iCCM can occur if the active iCCM fails or following an external user request.

xCCM Technical Description

xCCM is split into four functional/physical boards:

- Control & Base Band board.
- Media Dependent Adaptor (MDA).
- xCCM backplane.
- xCCM Optical Board (not available at xCCM introduction).



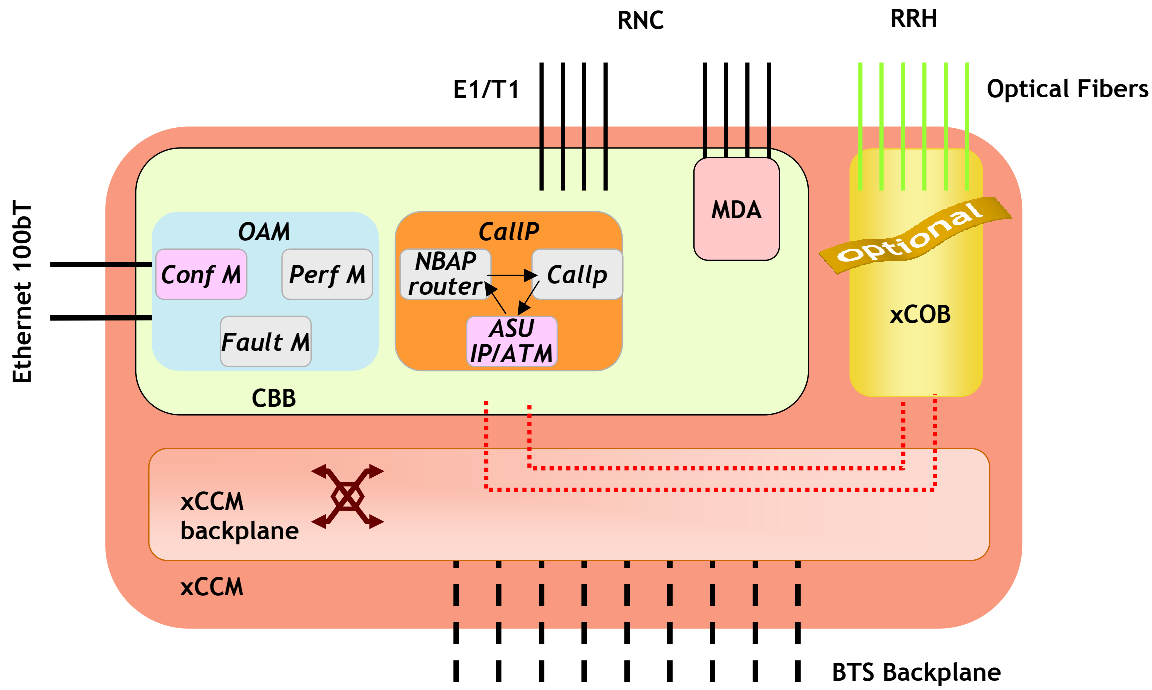
A new HW board, the xCCM board, is designed to replace the iCCM in the BTS. This xCCM board will provide the required switching capacity as well as the required capability set in terms of IP support.

As the xCCM is intended to replace the iCCM H/W platform, it is essential that this board also supports ATM legacy protocols. Indeed, it is not foreseen that ATM will disappear in the short or mid term from UMTS deployments.

At introduction, the xCCM module will provide the same functionality as the iCCM module in the same release (even though implementation will differ). Subsequently to its introduction, the xCCM will evolve to introduce a new functionality.

xCCM supports all backhaul configuration, i.e. Fractional PCM and Drop&Insert, Multi PCM, IMA group, IMA group + Multi PCM and 2 IMA groups.

xCCM Description



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xCCM is split into four functional physical boards: the CBB, the xCOB, the MDA and the xCCM backplane.

The **Control & Baseband Board (CBB)** provides built-in interfaces via 2x100 Base-T ports (Site LAN & debug) and 4 Els.

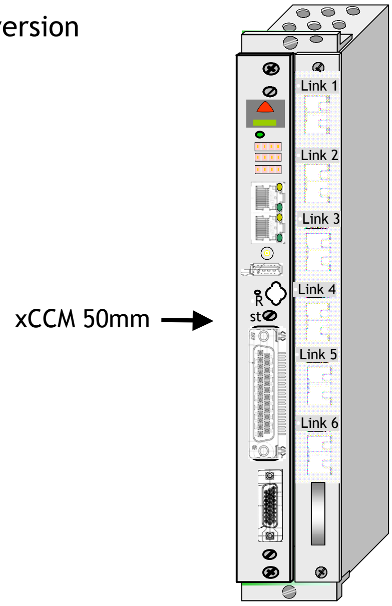
The **xCCM Optical Board (xCOB)** is optional and allows RRH connection. This module supports RRH via CPRI links which are accessible on the xCCM front panel.

Then the **Media Dependent Adaptor (MDA)** is a dedicated board for transport function. MDA will exist in many flavors, depending on the required connectivity. At xCCM introduction, MDA will provide E1 (4 E1s).

Finally, the **xCCM backplane** provides connectivity between xCCM CBB and xCOB, and between xCCM CBB and the iBTS backplane.

xCOB Description

- 6 SFPs providing electrical to/from optical conversion for CPRI links using multimode or single mode.
- I2C bus connected to xCCM.
- Connections to xCCM.
- Dallas connected to GPSAM.



The xCCM Optical Board (xCOB) is the Optical Interface Module for xCCM to support CPRI RRHs.

This feature defines the required BTS HW and SW in order to support RRH from xCCM through an optical fiber connection over CPRI.

The HW is based on the xCCM Optical Board (xCOB). In downlink, this module supports the conversion of electrical signals coming from the xCCM into optical signals, to send them towards RRH. In uplink, the xCOB supports the conversion of optical signals coming from the RRH into electrical signals and sends them to the xCCM. One xCOB drives up to 6 optical fibers.

The xCOB requires the xCCM (not supported on the iCCM) and is inserted inside the 50-mm mini backplane of the xCCM.

This feature enables a BTS equipped with xCCM to support CPRI RRHs: a BTS equipped with xCCM supports up to 6 RRHs in star configuration.

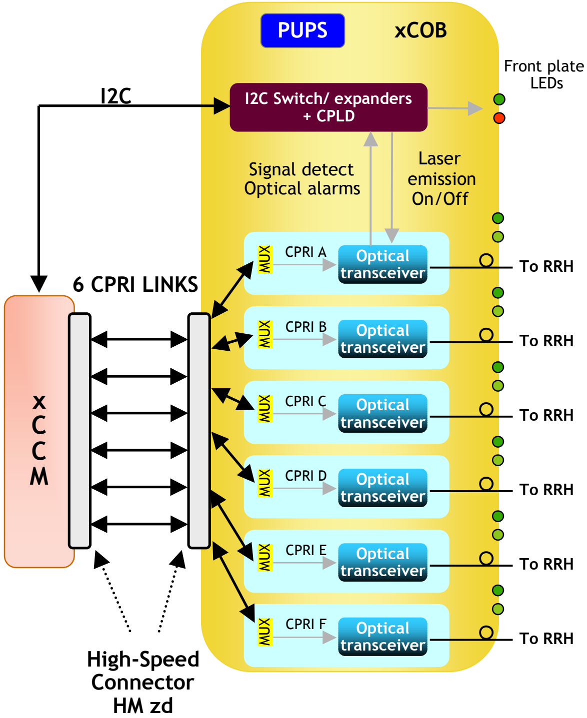
The xCOB is hosted in the xCCM module belonging to the BTS cabinet. It is a transparent electrical/optical gateway between the BTS and RRH providing 6 optical fiber interfaces.

For each fiber, the xCOB board receives two CPRI links from the active xCCM board. In downlink, the xCOB selects the CPRI links from the active board and sends its data stream to the optical transceiver. In uplink, the xCOB sends the received bit streams to the active xCCM board.

xCOB allows simplex or duplex mode. For duplex mode, an additional High-Speed connector must be equipped.

xCOB Description [cont.]

- 25-mm board which can be plugged in the 50-mm shelf.
- Support 6 links for CPRI protocol.
- Each link can be activated/shut down individually.
- Optical connectors are hosted in an SFP cage.
- SFP TX whatever the optical standard use.
- Managed through I2C (xCCM) link to access internal registers, control duplex and optical transceivers.
- Alarm management through I2C.



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xCOB is designed ready for Simplex Mode and Duplex Mode.

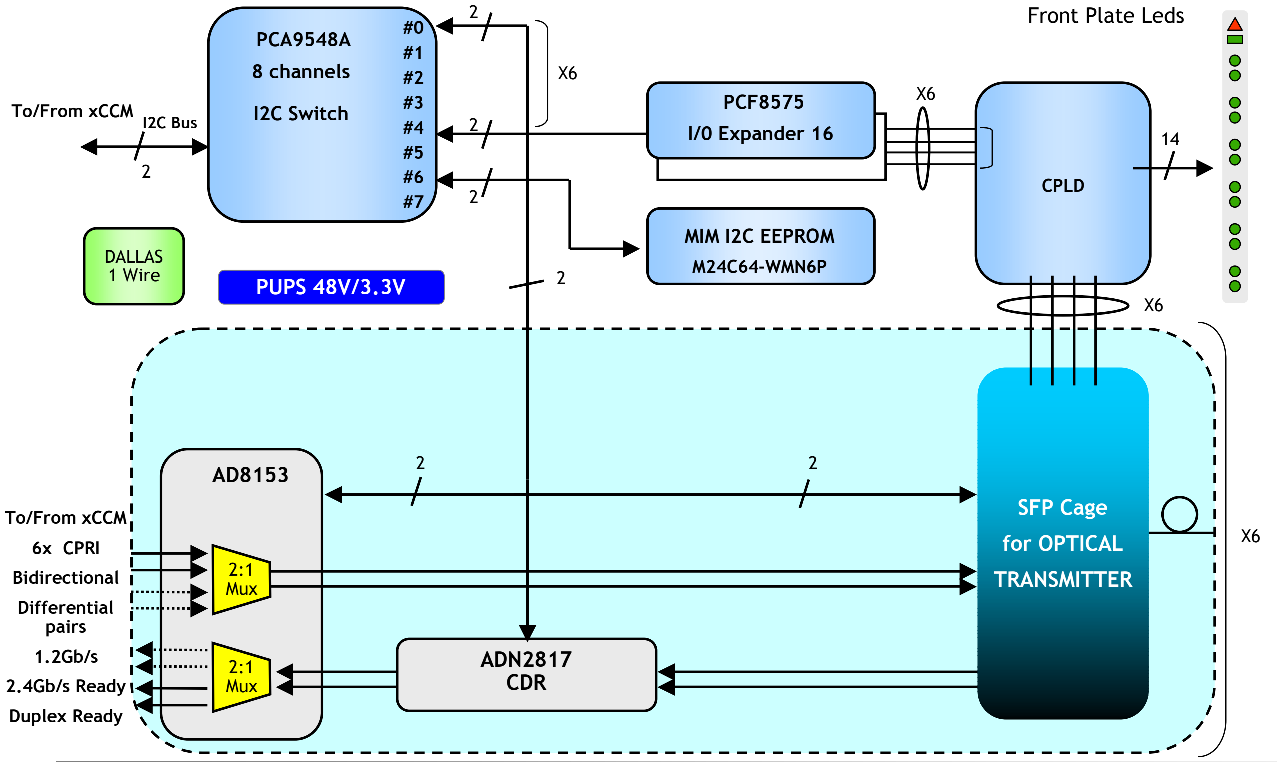
Simplex Mode

For each fiber, the xCOB board receives one CPRI link from the xCCM board. In downlink, the xCOB board sends its data stream to the optical transceiver. In uplink, the xCOB sends the received bit streams to the xCCM.

Duplex Mode

For each fiber, the xCOB board receives two CPRI links from the active and the passive xCCM boards. In downlink, the xCOB selects the CPRI link from the active board and sends its data stream to the optical transceiver. In uplink, the xCOB sends the received bit streams to the active xCCM board.

xCOB Block Diagram



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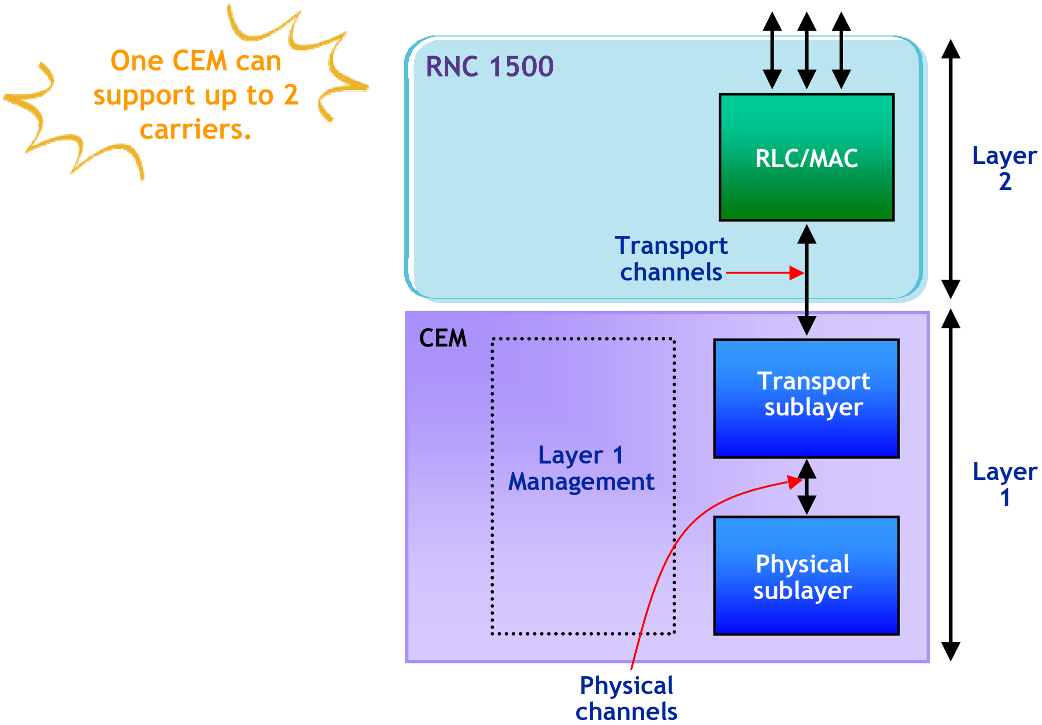
xCOB must handle the optical transmission of 6 CPRI links in 6 single bidirectional optical fiber interfaces toward RRH. The CPRI block provides the link to the xCCM board in simplex or duplex mode.

The power unit provides -48V input from the backplane with fuse, protection diodes, hot swap controller and PUPs to digital devices. The power unit also provides power monitoring, reverse polarity protection and DC inrush current limit.

Optical transceivers are in charge of reporting alarms of RX LOS, TX fault and SFP presence and of controlling TX disable.

The I2C bus (or Dallas TBC) parts report the xCCM inventory, the optical transceiver presence detection and the alarms for the optical transceivers. The I2C bus parts also manage the xCCM LED, the active CPRI selection and CPRI loopback. Finally, their last function is to disable the optical transmission, dallas output value latching TBC.

CEM/iCEM: Channel Management



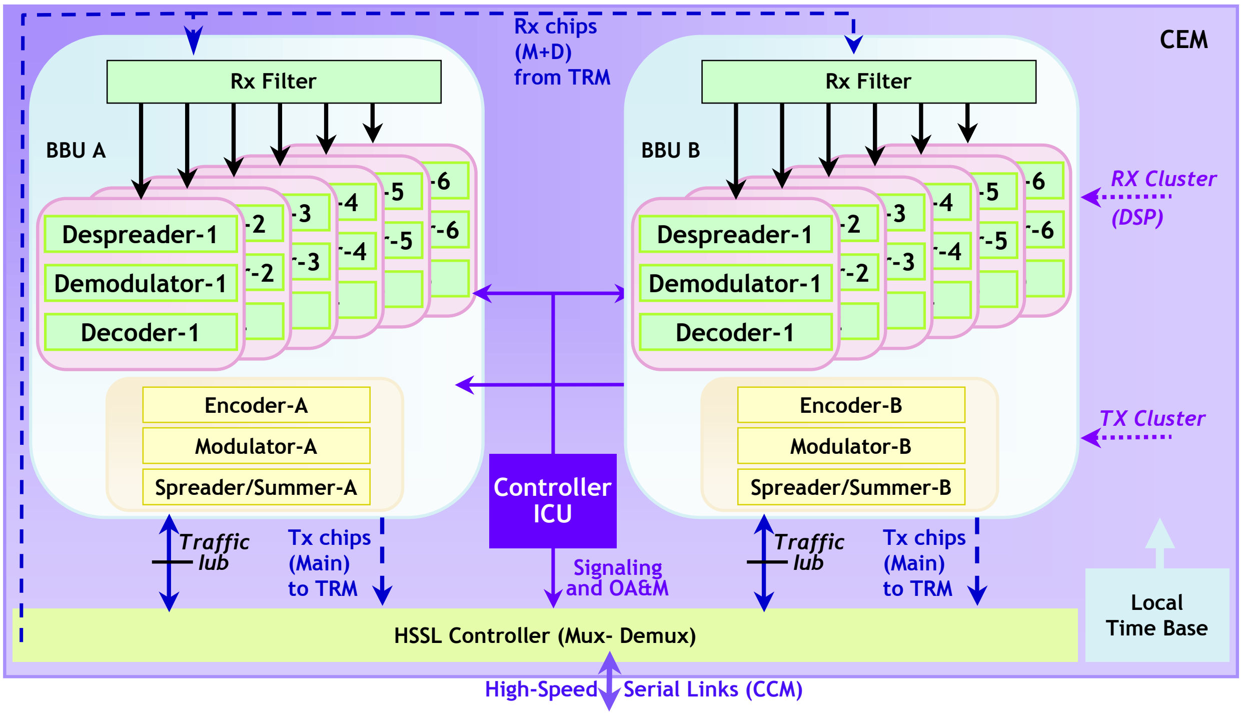
The Channel Element Module (CEM/iCEM), located in the BTS, deals with 2 parts of the protocol layers.

The first part is the baseband Layer 1. In uplink, the functionalities are among other things searching, despreading, channel decoding and RACH processing. In downlink, the functionalities are channel coding, spreading, summing and so on.

The second part of the protocol layers is a subset of Layer 2 MAC. This subset provides RACH messages with acknowledgements and the scheduling of all transmissions on FACH. Moreover, this subset of layer 2 MAC processes BCH information such as interference in the cell. This BCH information is updated very frequently (every 10 to 100 ms). Finally, it handles the signaling for distribution of paging between cells controlled by the BTS.

Note that **1 CEM can support up to 2 carriers.**

CEM/iCEM: Functional Architecture

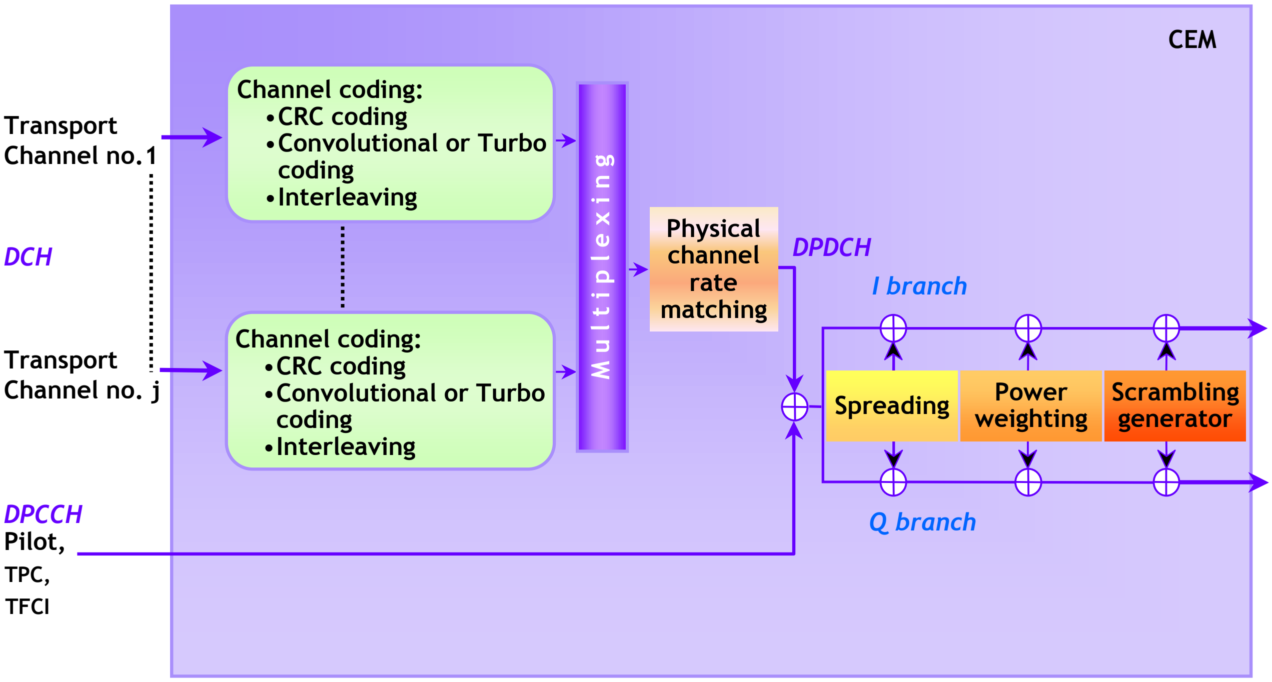


A CEM board is composed of 3 functional blocks: the Interface & Control Unit (ICU), the Base Band Unit 1 (BBU1) and the Base Band Unit 2 (BBU2) for more processing power.

The ICU block performs several main functions of the CEM. Indeed, the ICU block carries out the physical data interface functions for the entire CEM, the call processing functions (NBAP), the OAM functions of the CEM and the Baseband signal processing of some common channels.

The BBU block performs all transmit and receive baseband signal processing functions, in other words the layer 1 functions of the UMTS radio network.

CEM/iCEM: Tx Signal Processing



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How is the transmission signal processed in the CEM?

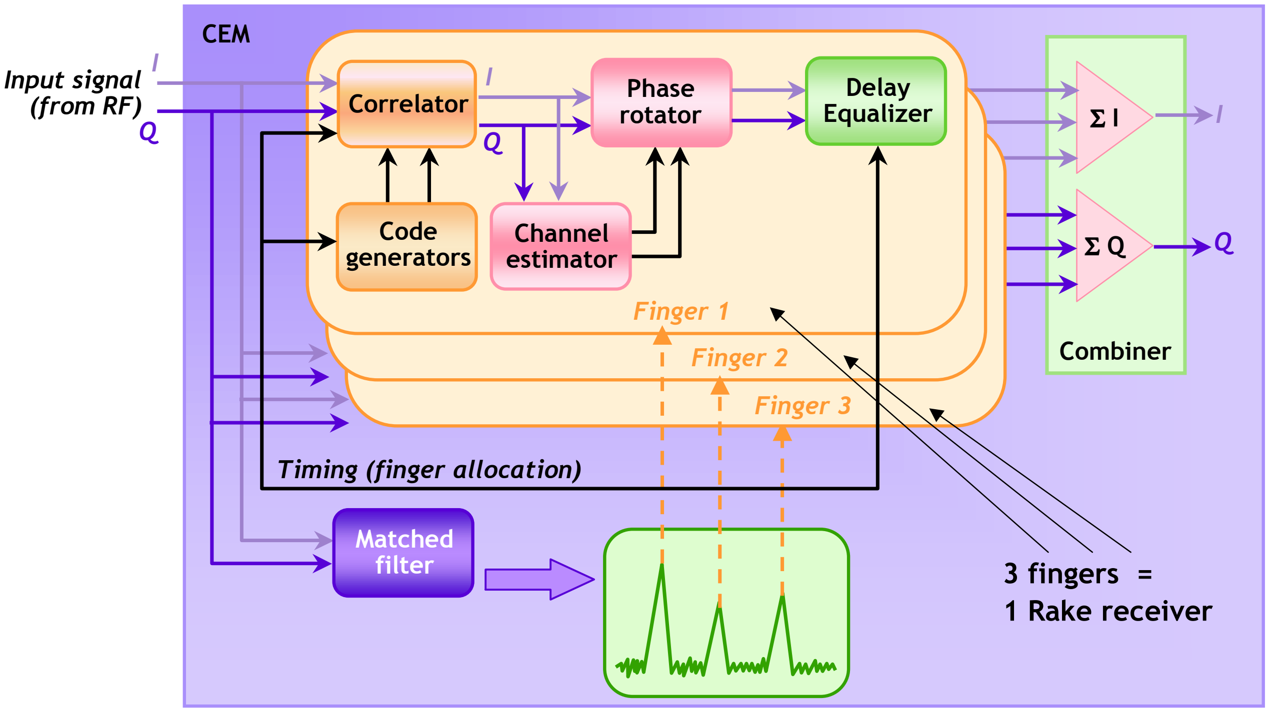
On the dedicated transport channels (DPDCH), data and control signals are part of the same information packet and are converted and then mapped onto an I and a Q branch.

"Physical channel rate matching" means that bits on a transport channel are repeated or punctured in order to have a uniform bit rate presented to the physical channel.

The spreading function applied to all physical channels consists of three operations. A channelization code is applied to transform each data symbol into a number of chips. Each spread channel is weighted by a weight factor. And a scrambling code is applied to spread the signal, for BTS identification and to decrease RF interference.

All DL physical channels are then combined in the CCM using complex addition by using the DPCCH channels. You can find on this type of channel, control information as for example the Pilot information. This information gives the bits equivalent to the training sequence in GSM. This is used to estimate the channel. Another control information is Transmit Power Control (TPC) which corresponds to the bits used to increase or decrease the output power. A last example of control information is the Transport Format Combination Indicator (TFCI), that is the bits used to indicate the method by which the transport channels have been multiplexed.

CEM/iCEM: Rx Signal Processing



Now, let's see how the reception signal is processed in the CEM.

Demodulation includes two stages: the first stage is chip demodulation and the second one is symbol demodulation.

Chip demodulation is performed by the Rake receiver that is used to estimate which chip was transmitted using information received from several paths. Indeed, the BTS receives several copies of the signal with different delays.

This diagram shows a Rake receiver with 3 fingers. First, digital input samples are received from the RF from the CCM in the form of I and Q branches. Then, code generators and a correlator perform the despreading and the integration of user data symbols.

Here begins the second stage of demodulation which is **symbol demodulation**. The channel estimator uses the pilot symbols to estimate the channel state which will then be removed by the phase rotator from the received symbols. Delay compensation is required to account for the difference in arrival times of the symbols at each finger.

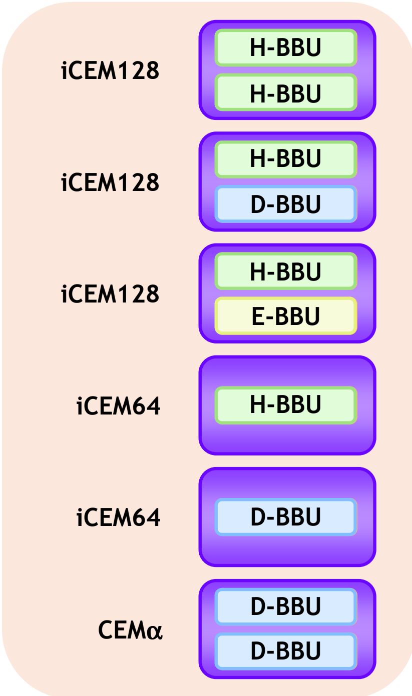
The Rake combiner then sums the channel-compensated symbols, thereby providing multipath diversity against fading.

CEM, iCEM and the Base Band Unit (Reminder)

Limitations

- iCEM (64/128) is HxDPA hardware ready but needs a specific software.
- One BBU cannot support both standard (R99/R4) and HSxPA (R6) services.

iCEM Capacity without Common Channels					
	12.2/12.2 Speech	PS 32/32	PS 64/64	PS 64/128	PS 64/384
iCEM64	64	32	16	16	8
iCEM128	128	64	32	32	16



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According to their capacity, the iCEM boards are composed of one or two BBUs. iCEM64 contains one BBU whereas iCEM128 contains two BBUs.

With the introduction of HSDPA, we make the difference between two types of BBUs: D-BBUs and H-BBUs.

A **D-BBU** is a Base Band Unit dedicated to DCH. The D-BBU is in charge of the "R99/R4" channel processing. So, channel processing only applies to the DCHs including SRB and TRB and to the common control channels like pCPICH, p/sCCPCH, PICH, AICH and pRACH. The D-BBU also processes the DCHs associated to HSDPA users. The D-BBU has a capacity of 64 Channel Elements (CEs). The D-BBU is able to process the traffic of any sector of the BTS (and up to two carriers).

The second type of BBU is the **H-BBU**. An H-BBU is a Base Band Unit dedicated to HSDPA. The H-BBU is in charge of the new channels introduced by HSDPA, namely HS-PDSCH, HS-SCCH and HS-DPCCH. The H-BBU has four limitations. Indeed, the maximum number of cells is limited to 3 HSDPA cells. Then there can be only a maximum of 20 simultaneous HSDPA users in release UA 4.2 and 48 in release UA 5.0. Moreover, the maximum throughput allowed is 10.2Mbps of user traffic (HS-PDSCH) at RLC. The last limitation concerns the number of OVSF codes which is limited to 15 in each cell.

The H-BBU can be either shared between HSDPA cells (up to 3 cells per H-BBU) or dedicated to one cell. When the H-BBU is shared, its processing is shared among the active cells. An active cell is a cell where at least one HSDPA user received data. If all users of one cell have an HS-DPCCH but do not receive data, the cell is not considered as "active".

E-BBU is another type of BBU. An E-BBU is a BBU supporting E-DCH. E-BBU can be supported by iCEM64 and iCEM128.

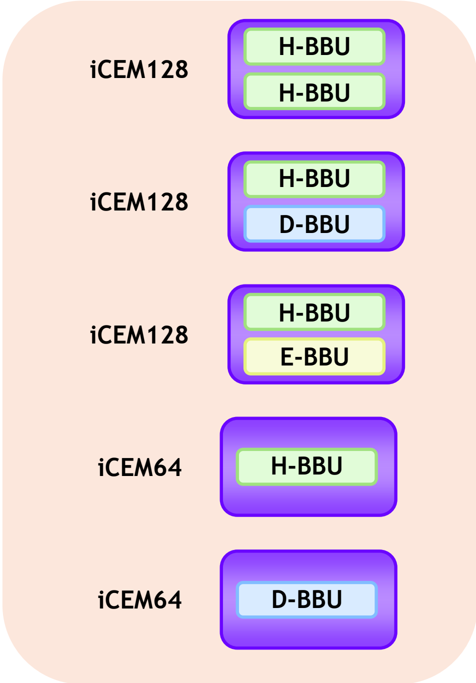
HSDPA Scalable Configuration

H-BBU Limitations

- 3 cells
- Simultaneous users: 48 (UA 5.0)
- User traffic: 10.2Mbps
- OSVF codes:
  - 15 SF 16 (HS-PDSCH)
  - 4 SF 128 (HS-SCCH)

E-BBU Limitations

1 E-BBU per BTS



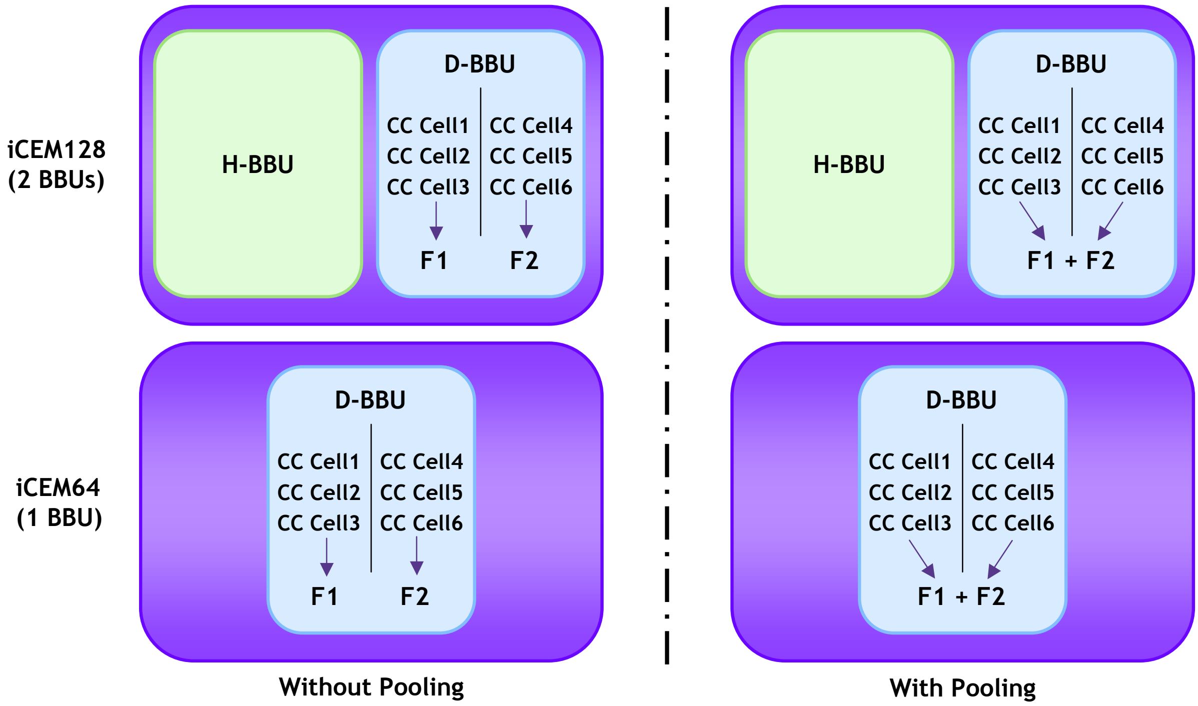
The HSDPA support on UMTS BTS requires the second generation of CEMs, i.e. iCEM64 or iCEM128. CEM Alpha is not HSDPA hardware ready.

Nevertheless, HSDPA support on UMTS BTS is possible assuming that CEM Alpha modules are already installed.

So, CEM Alpha and iCEM modules can coexist within the Digital shelf while providing HSDPA service with UMTS BTS.

Base Band processing is performed by BBUs of CEM and iCEM. One restriction of current BBUs is that one BBU cannot process both Dedicated and HSDPA services.

D-BBU Resource Pooling between Frequencies



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Inside a D-BBU, the available capacity is pooled between two frequencies. This feature called **D-BBU frequency pooling** allows to optimize the use of BBU capacity, for configurations with strictly more than one frequency.

D-BBU frequency pooling is applicable to all R99 RABs whatever the way D-BBUs are distributed on the CEM board. This feature is not applicable to HSDPA (with H-BBUs) or HSUPA (with E-BBUs).

If you look at the diagrams, you can see that without pooling, frequency F1 is allocated to cells 1,2,3 and F2 to cells 4,5,6. But with pooling, frequencies F1 and F2 are shared between all the cells.

2.2 Digital Shelf

xCEM Functional View

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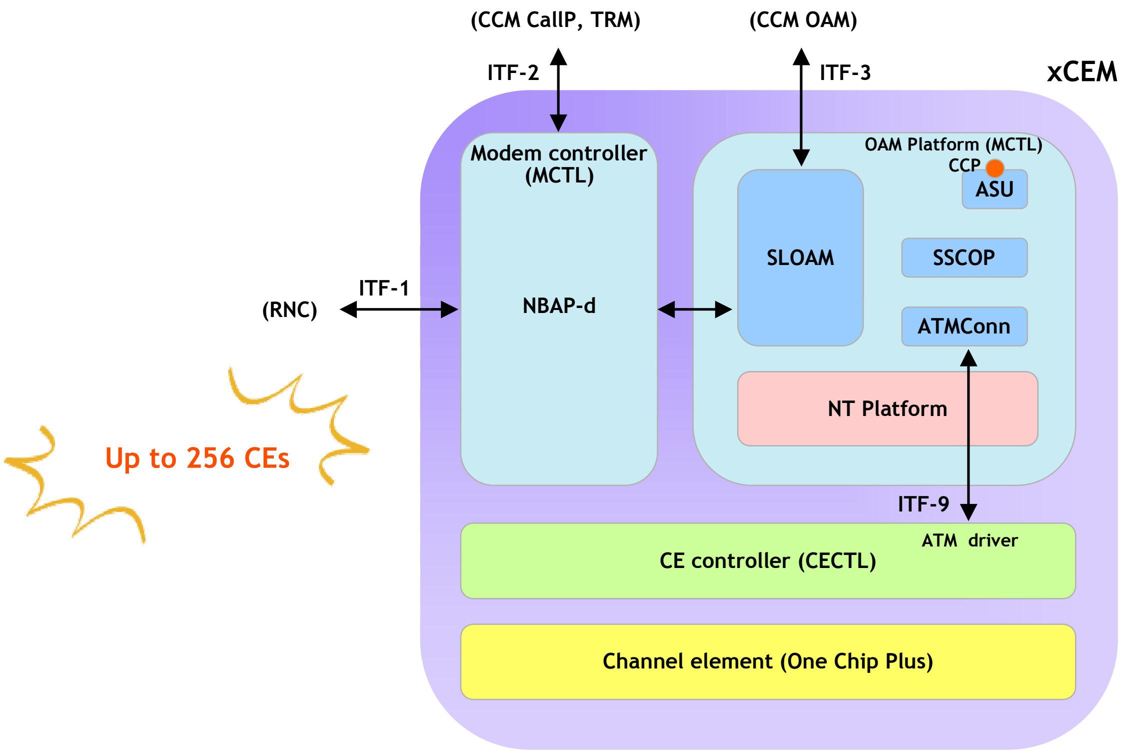

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xCEM provides higher performance and capacity compared to current module generation, in particular for high-speed data services.

The CEM capacity is expressed in different ways, depending whether we consider Dedicated Channels (DCHs), HSDPA traffic or HSUPA Traffic. The xCEM supports 256 Channel Elements (CEs) or the quantity of simultaneous user channels.

This module can be integrated, from introduction, in several Node-B cabinets, namely BTS 12010 & 12020, dBTS 6100, BTS 6010 & 6020 and Mono BTS.

xCEM must fully interoperate with the previous versions of CEM modules which are CEM alpha & iCEM (64 & 128).

xCEM must be compatible with all supported variants of CCM, that is CCM alpha, iCCM and xCCM.

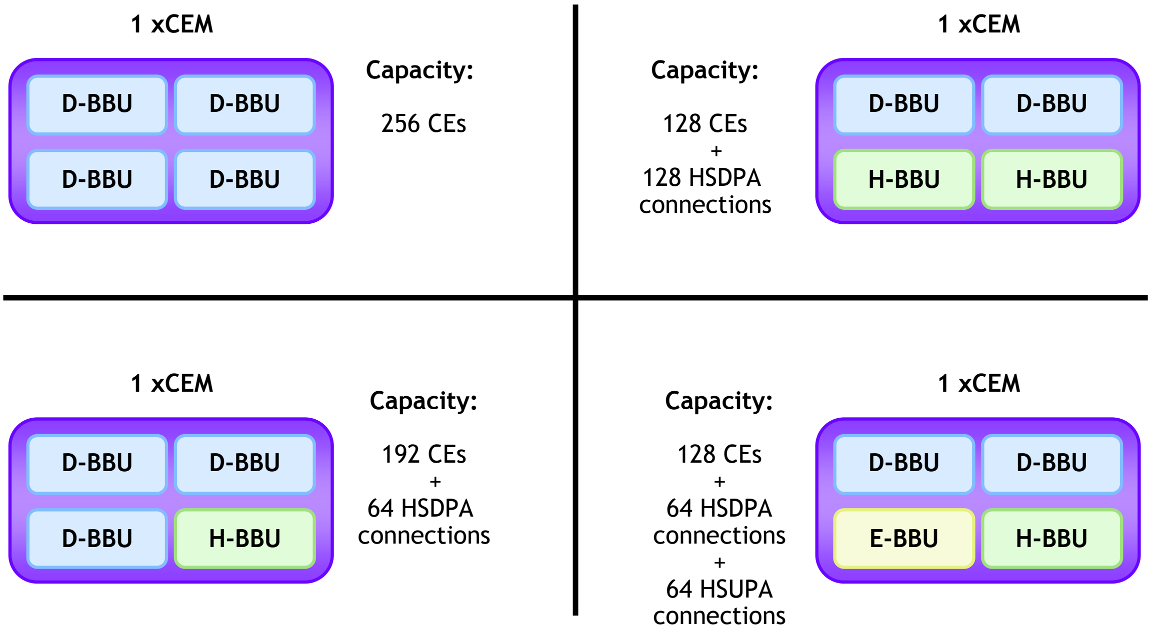
xCEM must also be compatible with all supported variants of TRM which are TRM alpha, iTRM, xTRM, RRH and Repeaters.

The xCEM top-level software architecture consists of three main components. The first component is the platform OAM which is inherited from the former NT SLOAM / Platform software. The second component is the Modem Controller in charge of implementing the 3GPP NBAP-d functionality. The CE Controller is the third component which function is to implement the layers L1 and L2 of the UTRAN.

SLOAM software uses ITF-4 in order to provide the NBAP-d Call Processing software with all necessary configuration parameters. ITF-4 is also used for fault reporting.

ITF-9 provides SLOAM with the means to set up and release internal needed AAL5 PVCs (for inter-board SMSG connections) as well as the external AAL5 PVC supporting the SSCOP connection associated to the CCP. This external SSCOP connection is set up, maintained and torn down by the ASU layer. ITF-9 also provides SLOAM with the means to configure internal AAL2 PVCs used to transport the data streams (i.e. the different frames protocols instances) internally (i.e. between the CCM board and the xCEM modules).

xCEM BBU Model



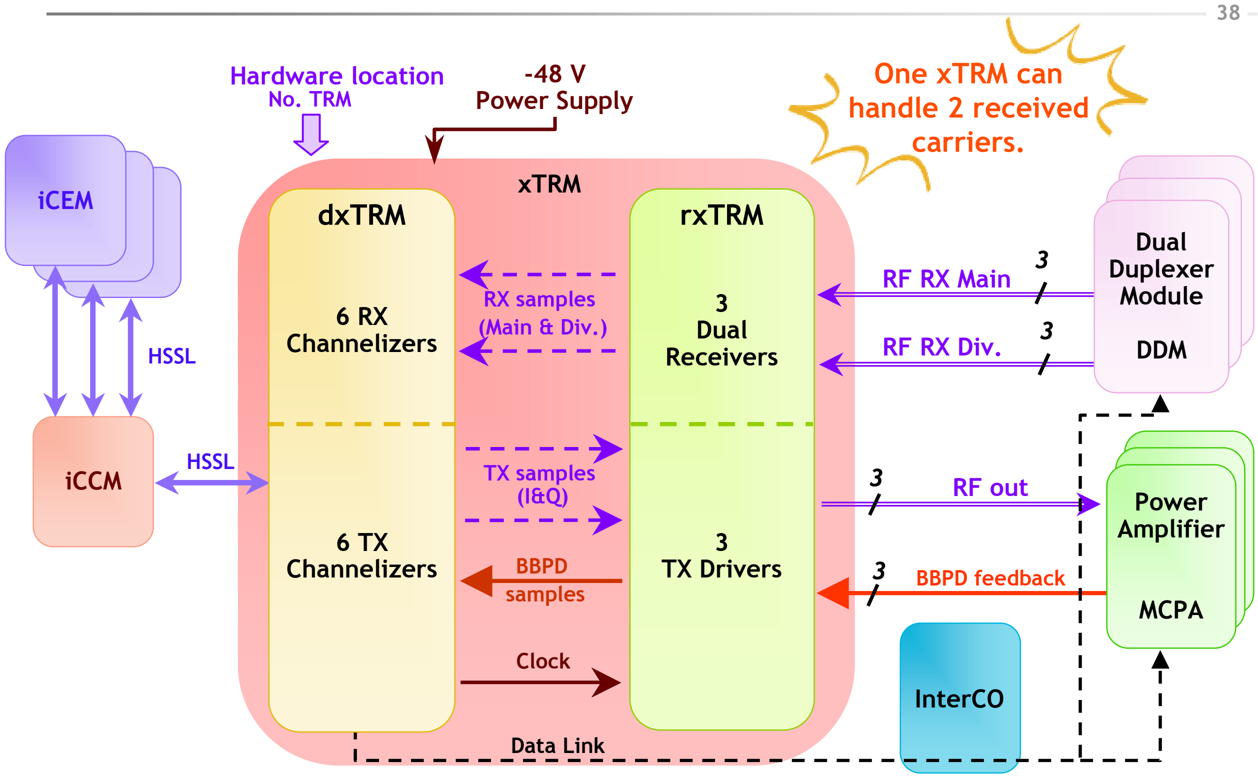
In UA05.1, the xCEM is modeled as four Base-Band Units (BBUs) which can be configured at OMC-B to handle R99 channels (D-BBU), HSDPA channels (H-BBU) or E-DCH channels (E-BBU).

Each D-BBU (respectively H-BBU or E-BBU) will support up to 64 DCHs (respectively HSDPA or E-DCH) users.

As per requirement, the xCEM will also support up to **6 cells** on D-BBU, H-hBBU and E-BBU to allow **2 carriers x 3 sectors** Node-B configuration equipped with a single xCEM.

A capacity licensing scheme is required for introduction and includes at least the ability to limit the number of channel elements (parameter per BTS applied to xCEM installed in this BTS) – 16 CE steps, the ability to limit the number of HSDPA and HSUPA users – 16 users steps, and the ability to limit the HSDPA and HSUPA throughput per board –0%, 25 %, 50 %, 75 %, 100 %.

TRM/iTRM/xTRM



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The X Transceiver Module or xTRM is the third generation of the Alcatel-Lucent TRM. The xTRM is an enhancement of the iTRM module designed to work with the new MCPA-60.

The xTRM can be used in all Alcatel-Lucent UMTS BTSs, except the BTS 1020.

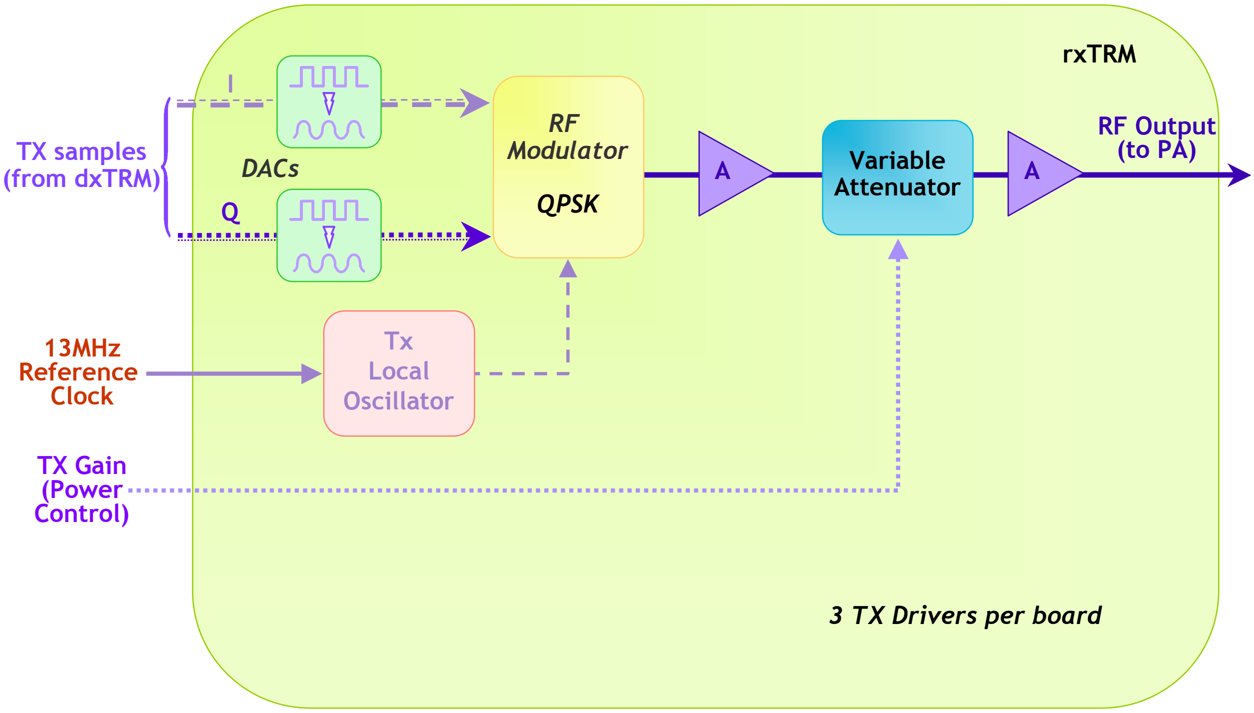
By default, the functions of iTRM are applicable to xTRM.

Compared to the iTRM, the xTRM can receive two UMTS frequency carriers, instead of one. Another difference is the integration into the xTRM of the Base Band Pre-Distorsion (BBPD) linearization technique. Finally, the xTRM can be configured in uplink with one carrier only which is called xTRM-1R configuration, or with two carriers. In this case, we call it an xTRM-2R configuration.

The xTRM contains the transmit and receive circuitry for six transmit chains and six receive chains. The xTRM module performs Digital-to-Analog (DAC) and Analog-to-Digital (ADC) Conversion as well as up and down frequency conversion. The low frequency is used for internal processing within the BTS whereas the high frequency is used for external transmission by the antenna. The xTRM also carries out amplification and variable attenuation (power control) and assures clock recovery and synchronization.

The xTRM consists of two boards. First, the digital TRM board (dxTRM) performs signal processing (in transmission and reception) by means of channelizers. Second, the radio TRM board (rxTRM) consists of three transmit chains and three dual receive chains. We are going to describe this latter board in the next two slides.

TRM/iTRM/xTRM: the Transmit Part of the Radio Board



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The rxTRM board consists of three Tx drivers and three dual receivers.

This diagram illustrates only the transmission part of rxTRM/RTRM board with 3 Tx Drivers.

In the transmit part, the rxTRM board performs the Digital-to-Analog Conversion (DAC), the Radio Frequency modulation (QPSK) and the variable amplification called Gain Control.

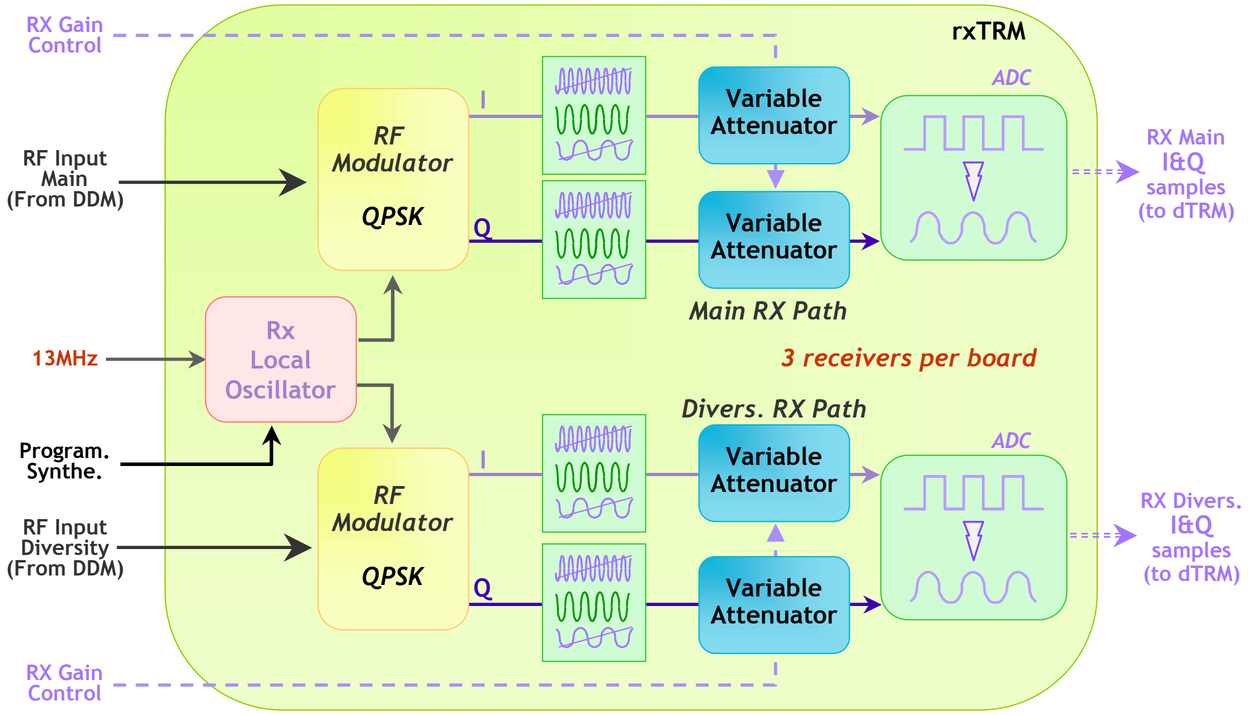
The transmitted carrier is modulated by several WCDMA signals with a chip rate of 3.84MHz.

The two branches (I and Q) of the complex-valued chip sequence generated by the spreading process (coming from CEMs) are QPSK-modulated signals.

A Gain Control Loop takes into account the variations of the driver and the Power Amplifier, to obtain the nominal output power at the antenna, by means of a variable attenuator.

The power control function adjusts each RF signal level to optimize the total interference level noise between the BTS and the UE.

TRM/iTRM/xTRM: the Receive Part of the Radio Board



In the receive part, the rxTRM board handles up to three pairs of received signals (UMTS carriers). The rxTRM performs demodulation (QPSK), baseband filtering, gain control and Analog-to-Digital Conversion (ADC).

Each of the three receivers is composed of two identical chains (main and diversity).

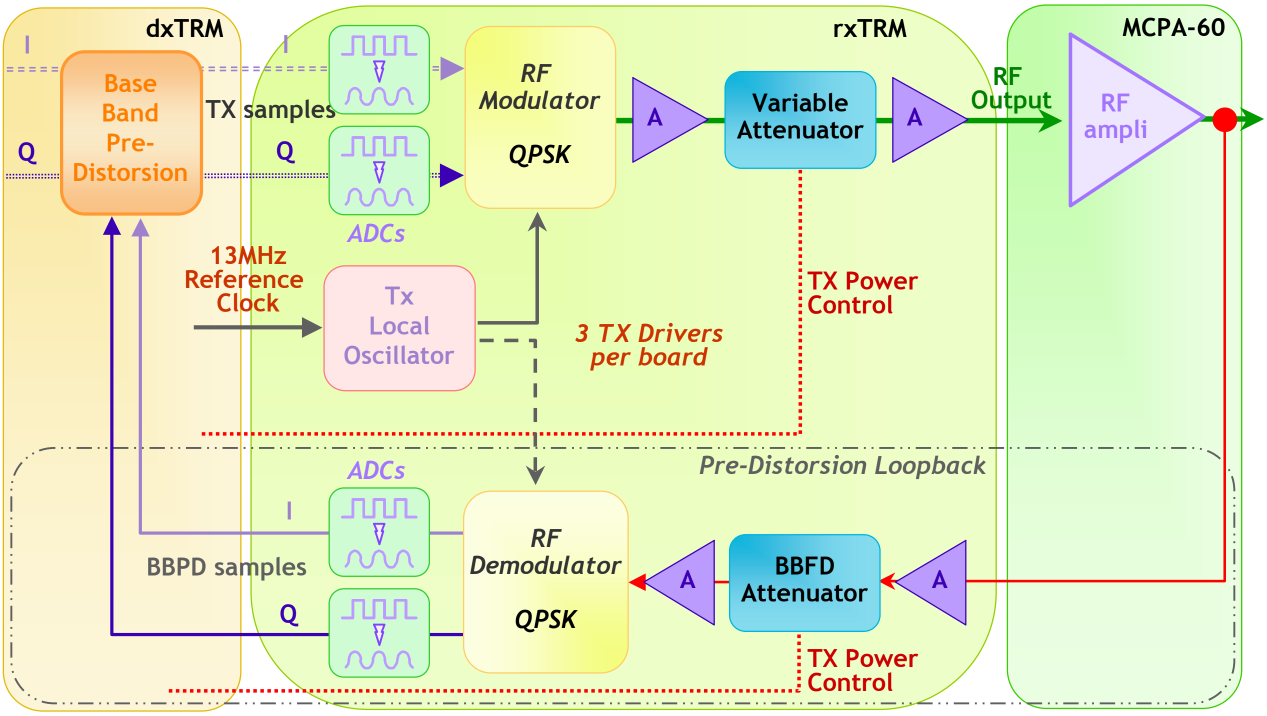
The Main and Diversity Radio Frequency signals come from the receive part of the coupling system, that is the DDM which provides filtering.

The demodulator is a quadrature demodulator (QPSK).

The gain control range provided by the variable attenuator is defined to allow correct operation of the ADC, whatever the input level signal.

Then the baseband I & Q signals are sampled in the ADC which provides I&Q multiplexed data. This data is then sent to the Rx channelizer of the digital part of TRMs.

xTRM: the Tx Pre-Distorsion Loopback



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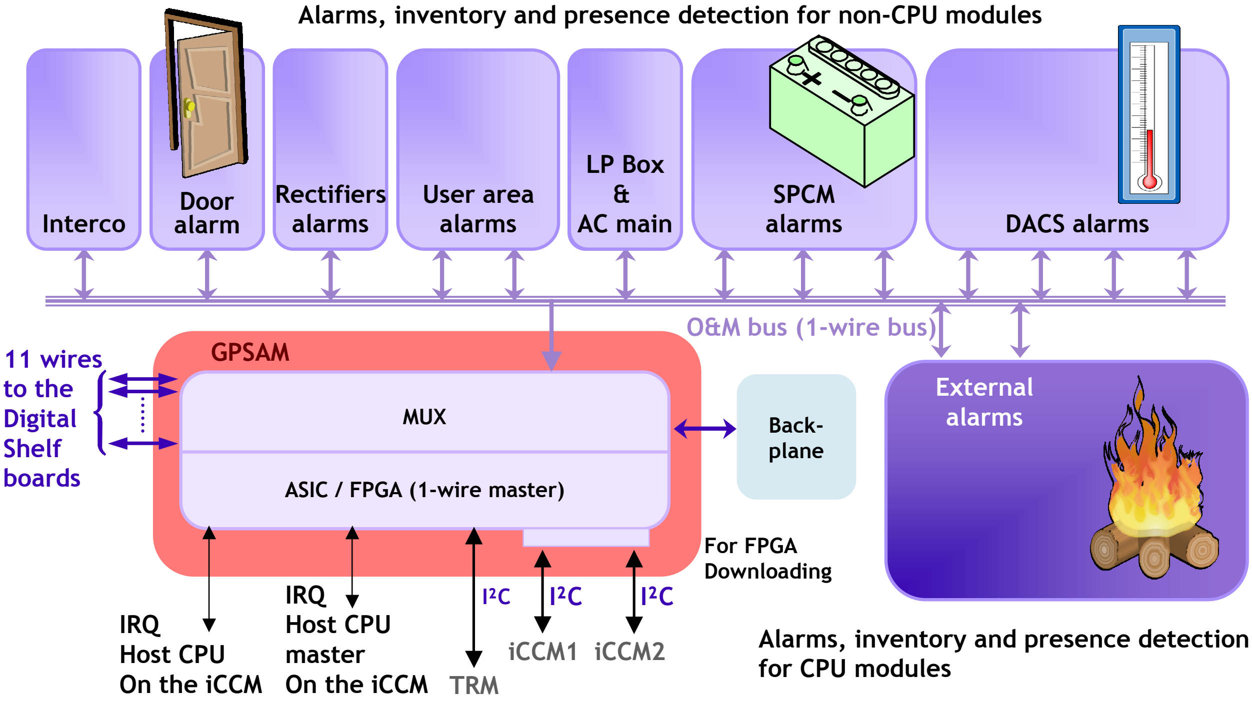
The Base Band Pre-Distorsion (BBPD) feature reduces the complexity of the PA but needs the use of the new PA to be provided, that is the Multi Carrier Power Amplifier (MCPA).

The rxTRM radio board includes 3 Tx drivers with their own Local Oscillators. Hence the need for a common Local Oscillator.

In the dxTRM, the BBPD algorithm detects the RF power received on each feedback input per sector and computes the distorsion introduced by the analogic section (rxTRM). This algorithm also applies a pre-distorsion mechanism and ensures that the overall gain of the loop remains equal to 1, by increasing or decreasing the gain block at the output of the BBPD.

GPSAM: Alarms, Inventory and Presence



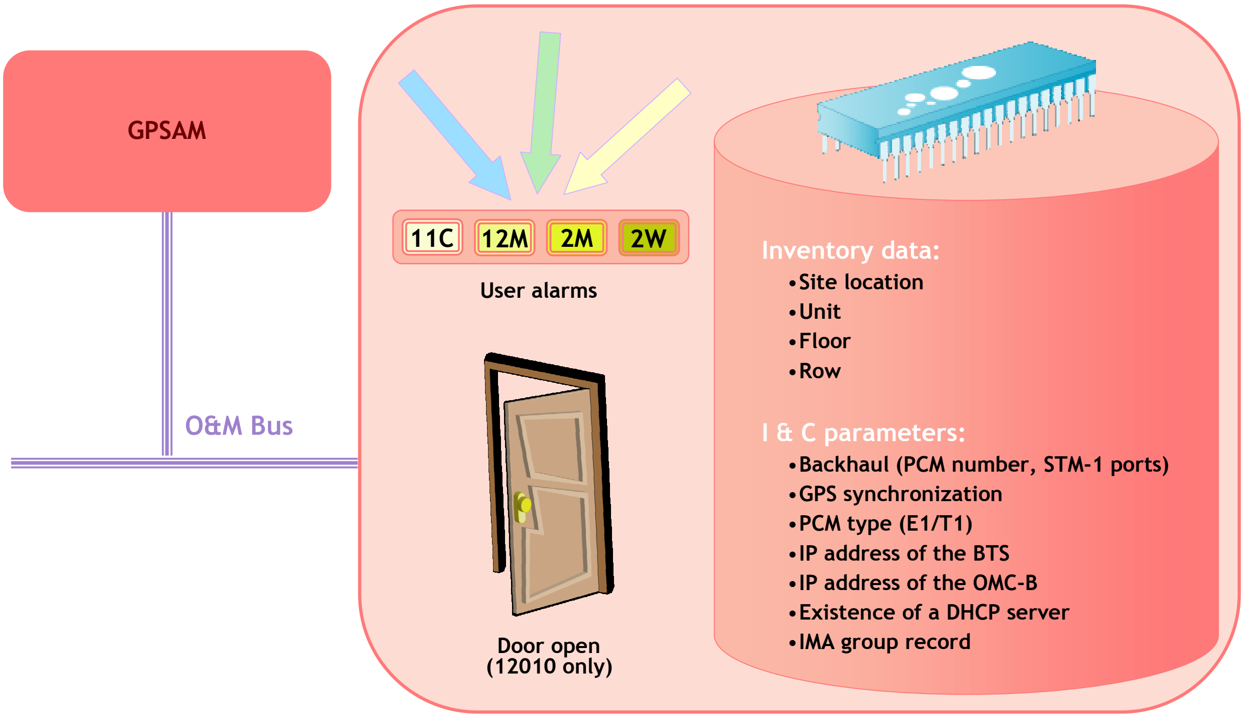
The GPS and Alarm Management module (GPSAM/cGPSAM) provides two functions. The first function is the collection of information about the state of the BTS, in other words alarms, inventory and commissioning information. The second function of this module is to supply timing information. This latter function is optional.

The GPSAM only collects the alarms and the inventory information of some of the BTS modules. The inventory information allows the OAM access to know the state of the BTS and its hardware composition.

Alarms, remote inventory information and commissioning information are collected through an O&M bus of Dallas type. They are then stored by the GPSAM.

This O&M bus is connected to the internal modules of the BTS as the GPSAM, the cooling unit, the rectifiers and the MCA.

MCA: Manufacturing, Commissioning and Alarm



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The MCA module incorporates three 4k-memory modules for storing cell site manufacturing and commissioning information.

Therefore, information such as the BTS IP address, the OMC-B IP address or the serial number of the BTS are stored in this module.

At each start, the I&C information is downloaded from the MCA module to the CCM, via the O&M bus and the GPSAM.

In addition, the MCA module connects a maximum of 5 internal alarms. The alarm information can be collected by the GPSAM.

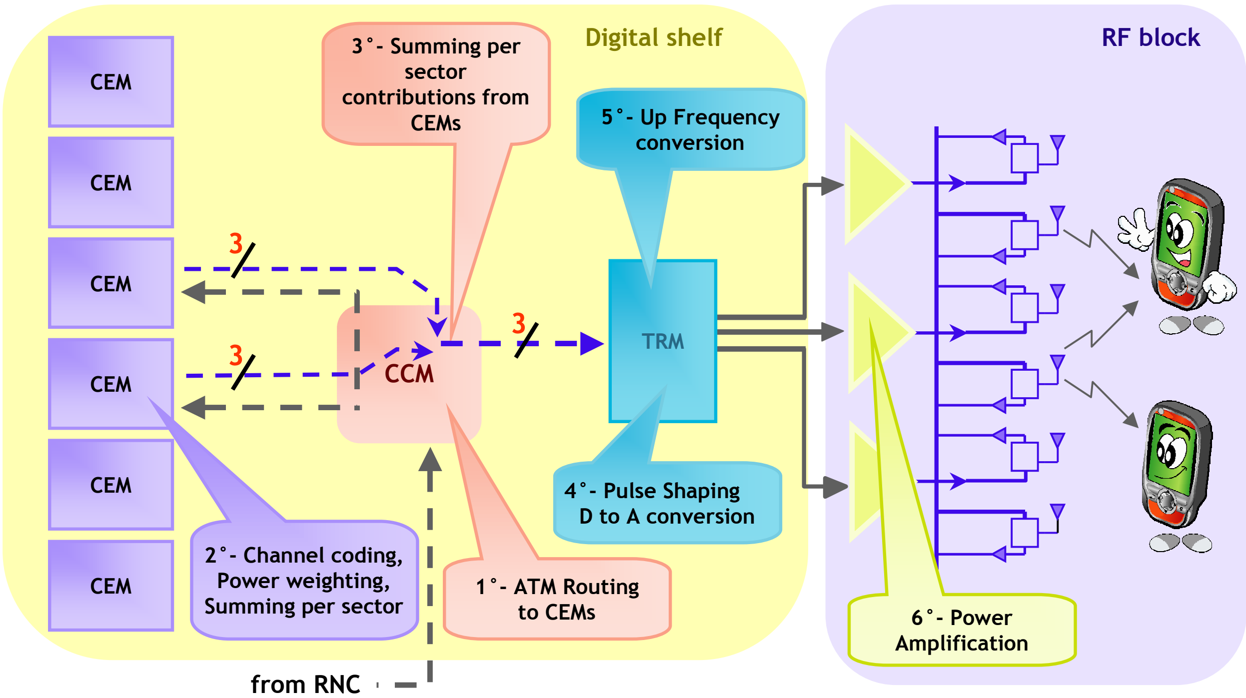
Redundancy Mechanisms

	Module	Redundancy Policy
Digital shelf	CCM	No redundancy
	iCCM	1+1 Active/Standby
	GPSAM	No redundancy
	CEM/iCEM	Load balancing
	TRM/iTRM	1+1 or Soft failure mode

To minimize the impact of hardware module failure, several redundancy strategies are implemented in the BTS: the active/standby mechanism based on full 1+1 redundancy, the load balancing mechanism and no redundancy.

A failure impact depends on the module and on the configuration. A failure can generate a site loss, a capacity loss or even a coverage loss.

Transmit Data Flow



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To complete the description of the digital shelf, let's remind the functions of each module, by considering first the transmit path.

Three main modules of the Digital Shelf are involved in the baseband transmit path: the CEM, the CCM and the TRM.

The CEM is used as the channel coder and modulates the symbols and chips.

The CEM can modulate a maximum of 70 channels (data for up to 32 channels with a maximum Spreading Factor (SF) of 256).

Each of these signals can be fed to one of six antenna outputs, assuming that Tx diversity is provisioned.

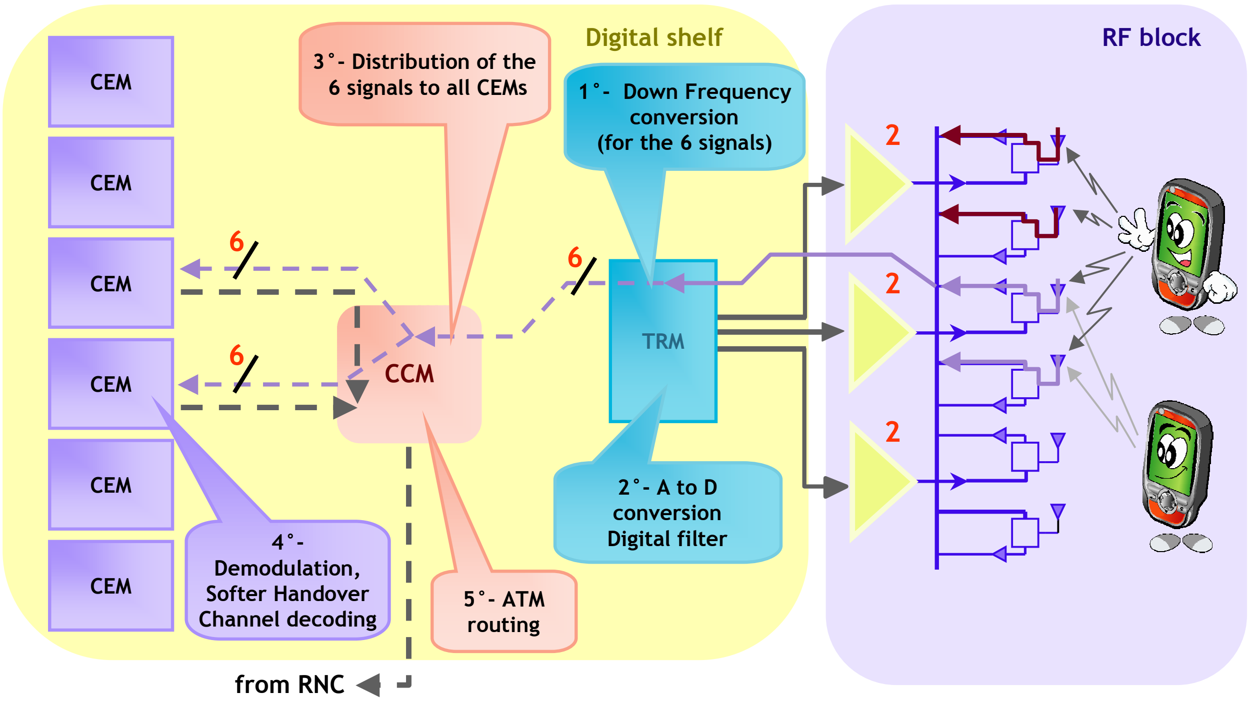
The signals from the CEMs are then transmitted to the CCM.

The radio TRM board consists of three transmit chains and three dual receive chains.

In the transmit path, the radio TRM board performs Digital-to-Analog conversion, modulation, up frequency conversion and amplification.

Then the TRM transmits the signal to the MCPA.

Receive Data Flow



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Now, let's consider the receive path.

Here again, three main modules of the Digital Shelf are involved in the baseband receive path: the TRM, the CCM and the CEM.

Both the transmit path and the receive path include three modules in transmission of the data: TRM, CCM and CEM.

The TRM transforms the analog data into digital data and translates the frequency into a lower value.

The I and Q outputs of the TRM are used as a means to obtain modulation. These inputs are also used in the transmit path.

The CCM is only used to switch the user traffic towards the appropriate CEM. A signal to up to six CEMs can be switched. The signal is then routed out of the Digital shelf using the CCM again.

The CEM is used as the channel decoder and demodulates the symbols and chips.

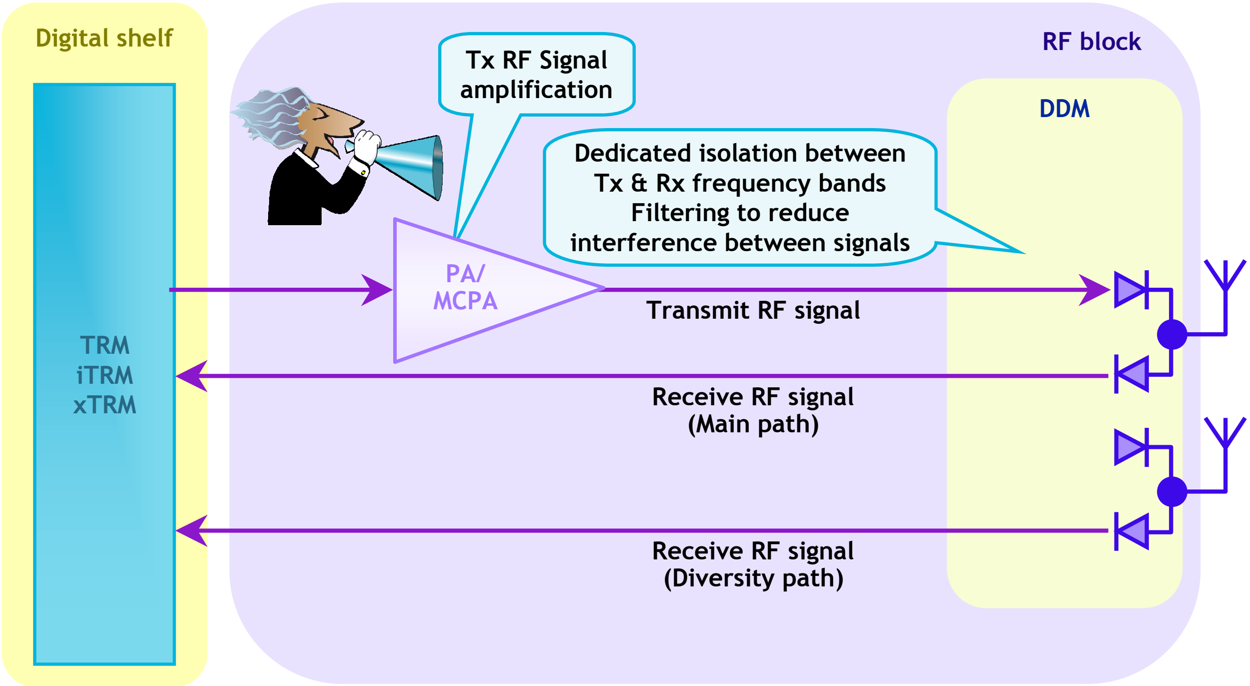
Then, the signal is sent to CCM to go on the Iub.

2 BTS Functional Description

2.3 RF Block

Now, let's describe the functional modules that make up the RF block.

General Description



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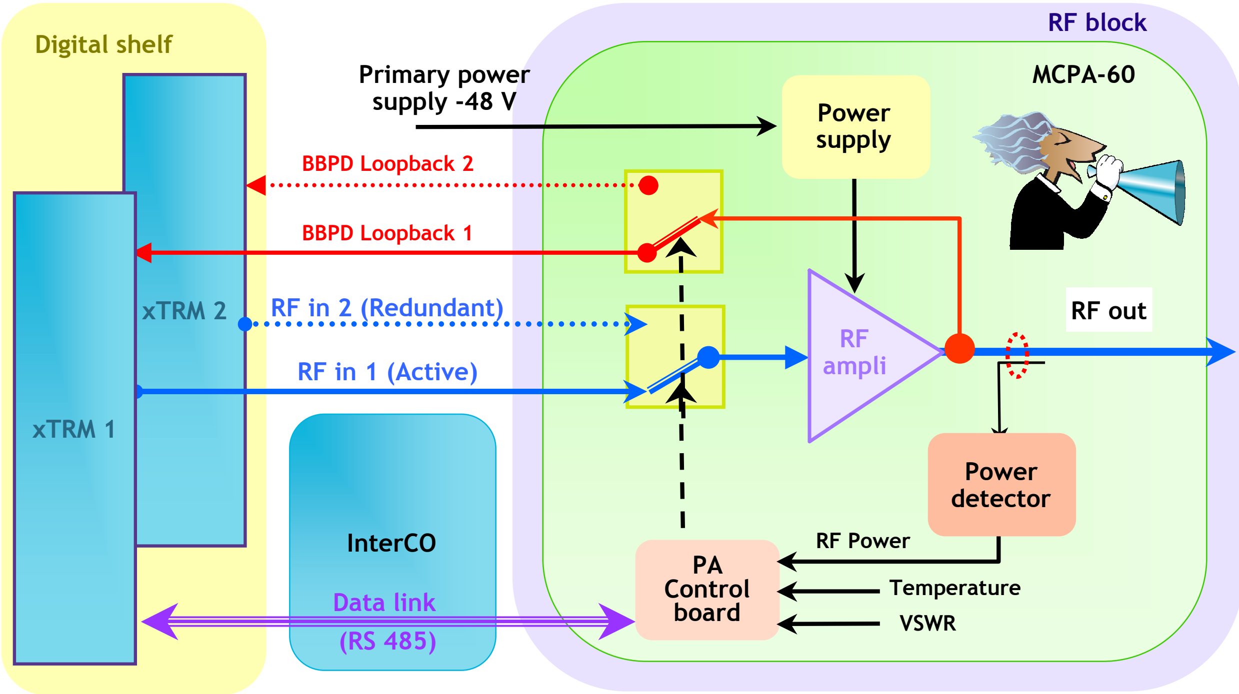
The RF block consists of 2 separate devices in charge of three specific functions. Indeed, the Power Amplifier (PA) or Multi Carrier Power Amplifier (MCPA), boosts the Radio Frequency signal delivered by the TRM. One PA is required per sector. Then, the Dual Duplexer Module (DDM) consists of a double duplexer Low Noise Amplifier (LNA) chain, one for the main path and the other for the diversity path.

MCPA/MCPA-60 Functional Description

MCPA 1900 / MCPA 2 / MCPA 60W



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The xTRM can control up to six MCPAs through the data bus ICO. The dxTRM can independently enable each of these six MCPAs. Each MCPA can be connected to two xTRMs for redundancy purposes.

Alcatel-Lucent provides three types of Power Amplifiers (PAs) for Tx amplification. The MCPA 1900 operates within a bandwidth ranging from 1930-1990MHz (for UMTS 1900). The MCPA-2 2100 module operates within a bandwidth ranging from 1210-2170MHz (for UMTS 2100). The MCPA-60, the new MCPA module, operates within a bandwidth ranging from 2110-2170MHz (for UMTS 2100) and supports up to two carriers per sector in reception.

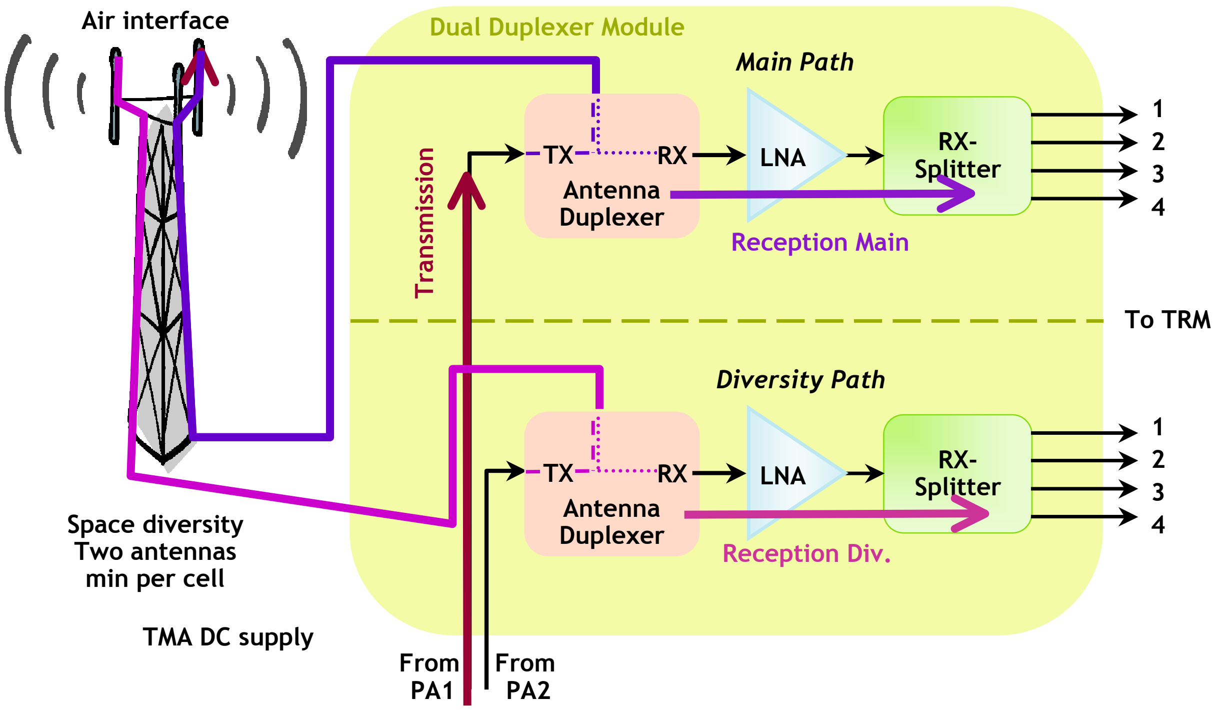
Alcatel-Lucent recommends not to mix together two MCPA types, because no mechanism of defense is implemented to protect the electrical network.

It is not possible as well to mix in the same BTS cabinet MCPA-60 and MCPA/MCPA-2, or else MCPA-60 and TRM/iTRM.

The new MCPA-60 is a module which includes a 60W PA with a PA Controller (PAC). The MCPA-60 is only supported with an xTRM. The MCPA-60 is only compatible with BTS 6010, BTS 6020, BTS 12020, BTS 12020 - 2, BTS 12010, BTS 12010 – 600 and BTS 12010 – 2.

According to the BTS configuration, the MCPA-60 is either connected to one xTRM (in STSR1 and STSR2 configurations) or two xTRMs (in STSR3 configuration).

Dual Duplexer Module (DDM)



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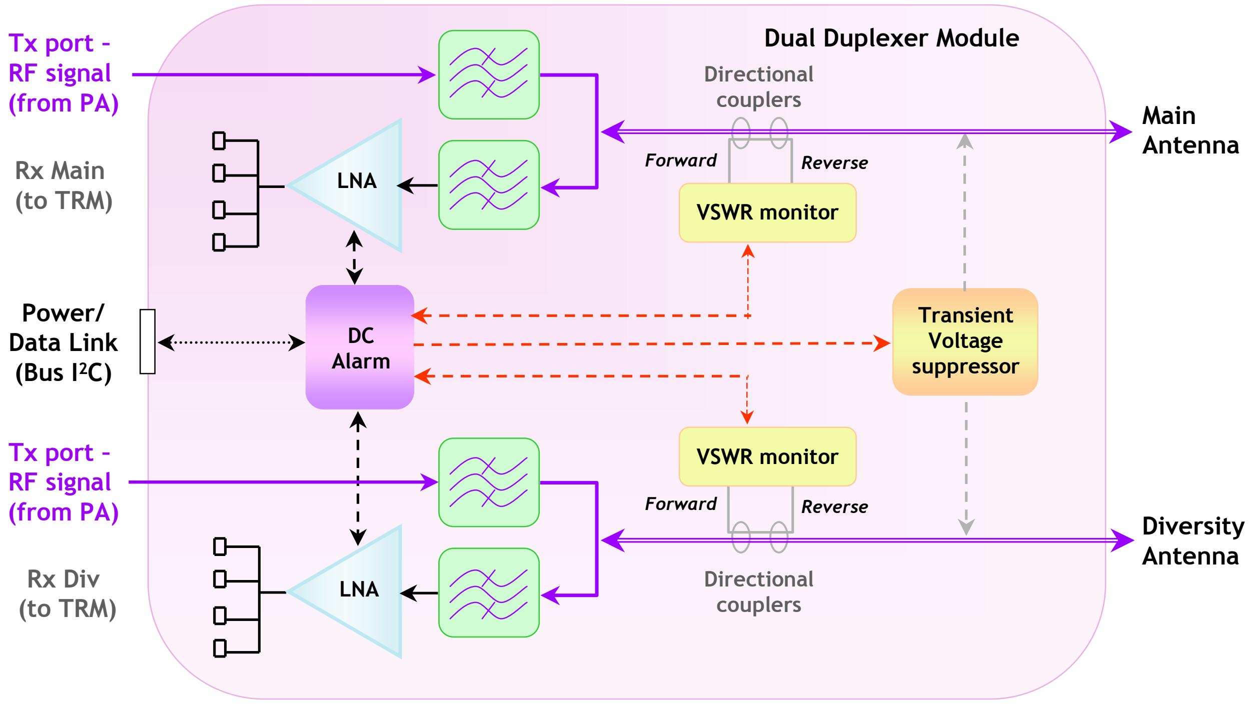
The Dual Duplexer Module or DDM, houses two full duplexer/LNA assemblies: one for the main path and the other for the diversity path. These 2 chains are used for Rx diversity. There is no Tx diversity. So there is just one way for the transmission.

The main functions of the DDM are to provide one single antenna port used for both Tx and Rx paths, to provide dedicated isolation between Tx and Rx frequency bands and Tx and Rx out-of-band filtering. The DDM also performs low noise amplification in Rx frequency bands and signal splitting into four local outputs, and has VSWR alarm monitoring capability. Next the DDM carries out TMA DC supply and TMA alarm monitoring. Finally, the DDM suppresses any transient voltage coming from the antenna port after external lightning protection.

DDM Detailed Description



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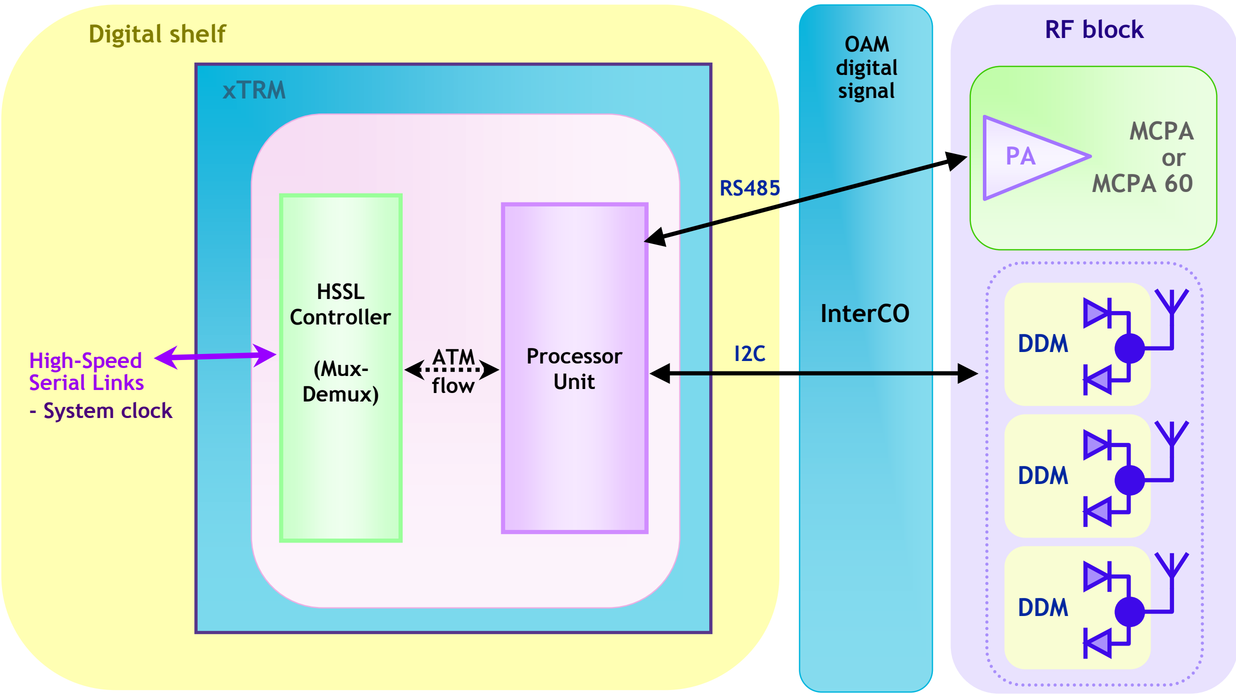
We have just seen that the DDM Module, houses two full duplexer/LNA assemblies: one for the main path and the other for the diversity path.

The LNA provides low noise amplification at the system front end, thereby reducing the overall effects of noise. After the LNA, the received band signals are split into four local outputs prior to distribution to the TRMs via coaxial cables.

A VSWR monitor circuit is provided to monitor forward and reflected power at the antenna port. This VSWR then supervises the connection between the BTS and the antenna. Matching is deduced and compared with three fixed values. Finally, the VSWR monitor provides four logical signals.

The DDM includes two DC/DC converters dedicated to the main and diversity branches. The main DDM and the main TMA are supplied by one DC/DC converter while the other is dedicated to DDM diversity and TMA diversity. This is a good example to demonstrate the advantage of redundancy.

xTRM: PA and DDM Management



The InterCOnnection module (or InterCO) is a standby module that carries digital signals.

All the xTRMs are connected to the InterCO module and can manage MCPA and DDM.

As regards MCPA Management, the xTRM controls up to three MCPAs (even if the xTRM is able to "see" the six MCPAs). To do this, the xTRM uses the dedicated RS485 bus. This bus reads the output power, enables/disables the MCPA, reads temperature sensors, queries the alarm status and reads the inventory information.

The dxTRM can also independently enable each of these six MCPAs.

Each MCPA can be connected to two xTRMs for redundancy purposes.

The xTRM can also reset the MPCA.

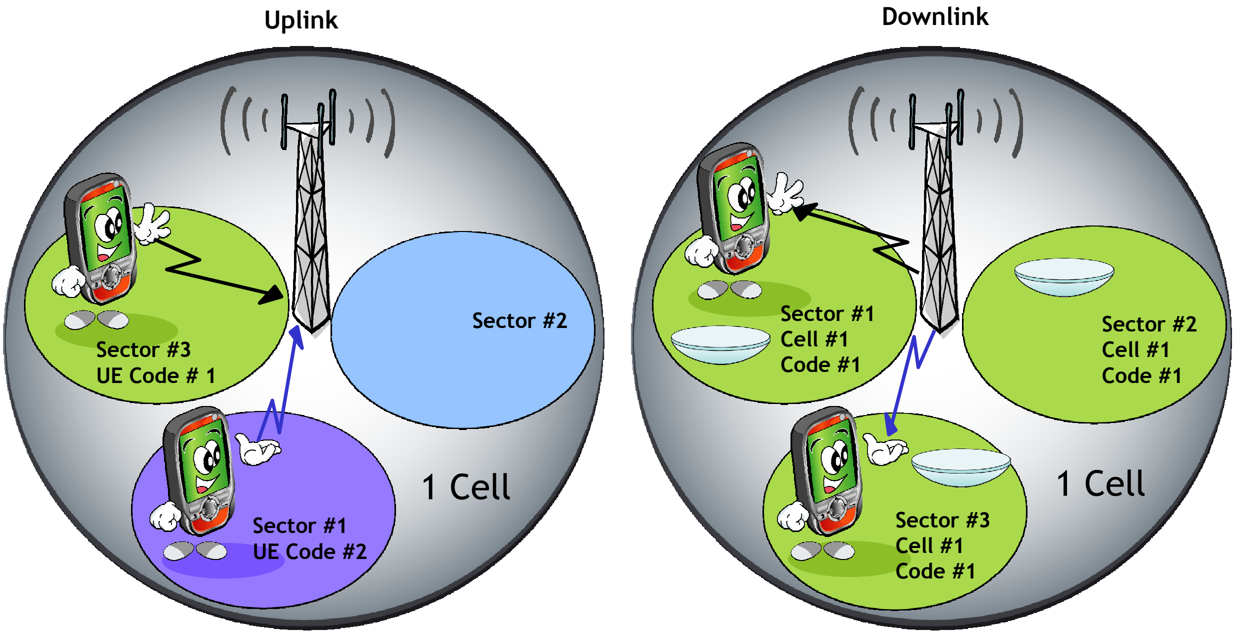
As regards DDM Management, the xTRM controls DDMs through the I2C bus. Three DDM detect signals are available on the DDM connector. Moreover the xTRM reads the alarm register and configures DDM.

2 BTS Functional Description

2.4 Configurations

Now, let's have a look at the configurations of the BTS.

Omni Transmit Sectorized Receive (OTSR)



- 3 sectors, 1 cell
- 1 scrambling code per UE

- 3 sectors
- 1 BTS scrambling code ⇨ 1 cell

Omni-directional Transmit Sectorized Receive (OTSR) is a basic configuration for UMTS BTS. In this configuration, transmission signals are sent out in all direction whereas received signals arrive on a sectorized basis.

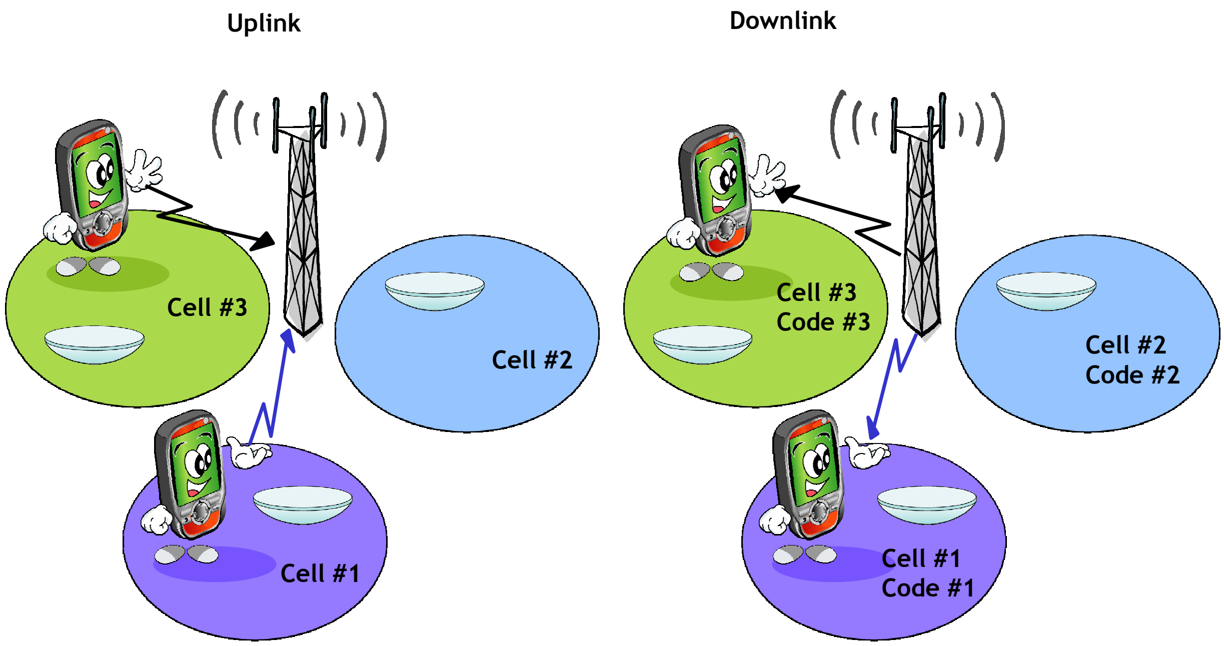
OTSR is a minimum BTS configuration in terms of cost and capacity since one Power Amplifier is only used. This configuration is typically used for early deployment to cover low traffic area.

Since the BTS cannot use soft handover messages to determine the location of the UE, searching and combining are systematically performed on the three received signals.

In reception, the signals received in each sector are transferred to the modem independently.

Reception is then equivalent to that of a three-sector BTS in permanent three-way softer handover. This arrangement is equivalent to omni-directional transmission. Therefore, the BTS is declared at the RNC as a single cell.

Sectorial Transmit Sectorized Receive (STSR)



- 3 sectors, 3 cells,
- 1 scrambling code per UE

- 3 sectors, 3 cells,
- 3 BTS scrambling codes (1 per cell)

Sectorial Transmit Sectorized Receive (STSR) is the typical BTS configuration for a multi-sector configuration.

STSR configuration provides high capacity and low cost per user. The power allocation in STSR is independent across different sectors, unlike OTSR, where power is shared.

This allows a higher downlink capacity. In addition, the upgrade from an OTSR configuration is readily achieved.

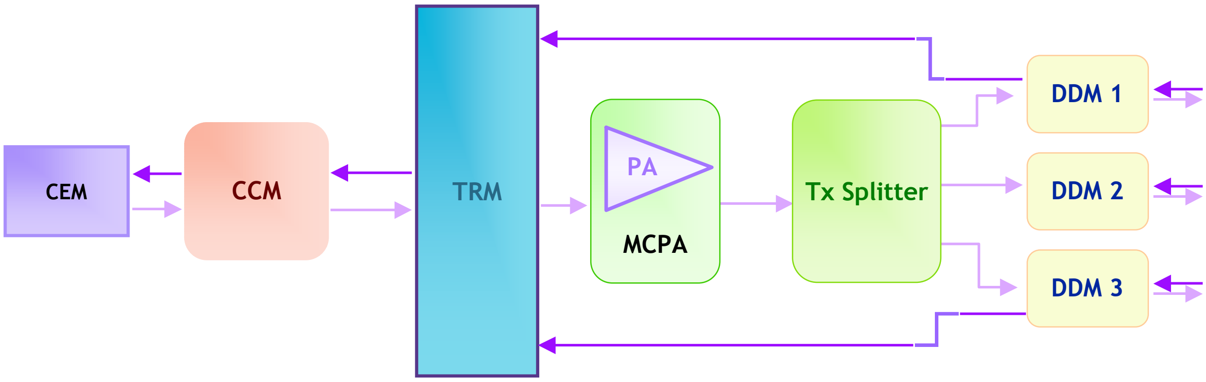
Alcatel-Lucent Implementation: OTSR

Characteristics of OTSR

- Omni directional Tx
- Sectorial Rx
- 1 carrier

Limitations of OTSR

Not supported in UTRAN 04 for 1900MHz



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For a three-sector system, the OTSR configuration uses a single MCPA and a Tx splitter to transmit the Tx signal in the three directions.

Signals received are transferred to the TRM independently.

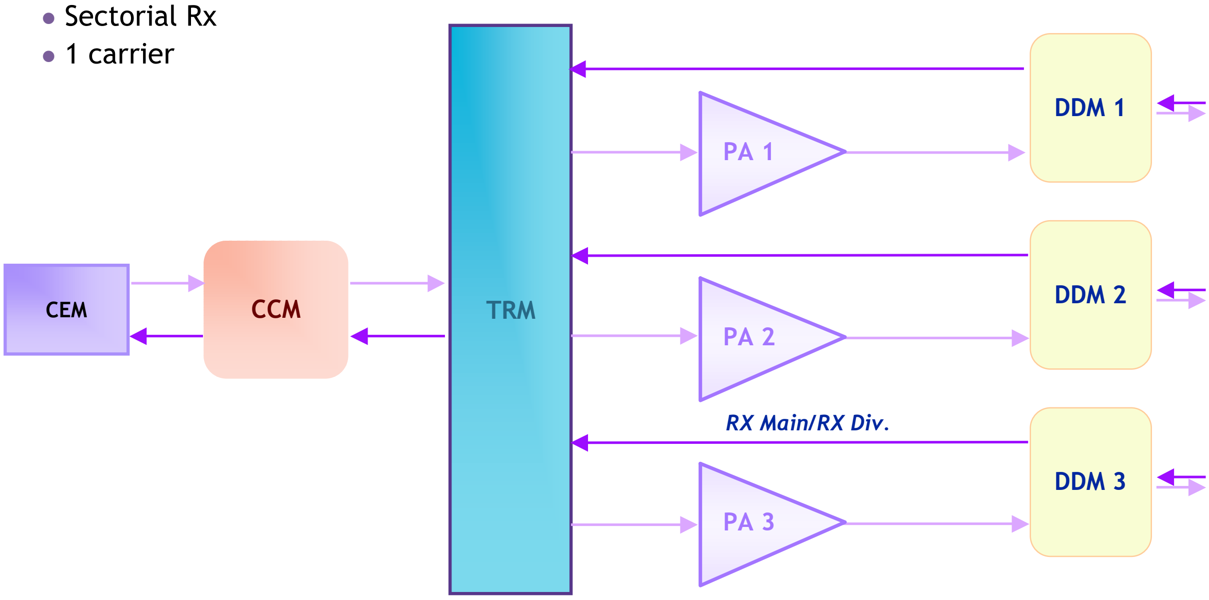
The antenna and the RF feeder configuration in OTSR are identical to the standard STSR devices.

This is why upgrading from OTSR to STSR is achieved by simply adding modules and does not require any change in the cabling outside the cabinet.

Alcatel-Lucent Implementation: STSR

Characteristics of STSR1

- Sectorial Tx
- Sectorial Rx
- 1 carrier



Here is an example of a 3-sector base station with STSR1, 5MHz over 3 sectors and the Tower Mounted Amplifier (TMA) option.

Since it requires a full RF configuration, three DDMs and three MCPAs are required. The installation cost given, only one frequency carrier is higher than for OTSR.

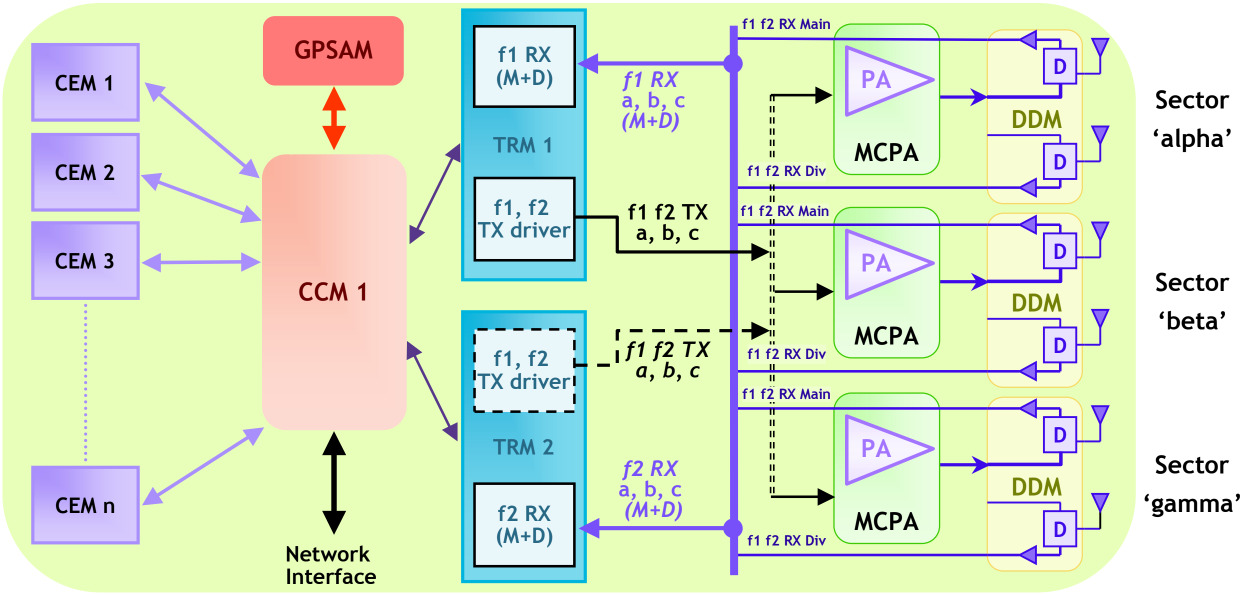
The power allocation in STSR is independent across sectors, as opposed to OTSR. This enables a higher downlink capacity.

The antenna and the RF feeder configuration is identical to OTSR and STSR, not requiring changes in the cabling outside the cabinet.
Consequently, upgrade from an OTSR configuration is readily achieved.

Multi-Carrier Configuration: TRM

Main Characteristic of STSR-2 (2 carriers) with one TRM Board

1 TRM is mandatory for each received carrier.



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The BTS is hardware ready to support more than one carrier. This is what we call the multi-carrier mode.

In UTRAN 5.0, multi-carrier configurations are limited to two carriers per sector. In this case, we talk about the STSR2 configuration.

STSR 1+1 is also a configuration with 2 carriers per sector. In this case, there are 2 MCPAs per sector.

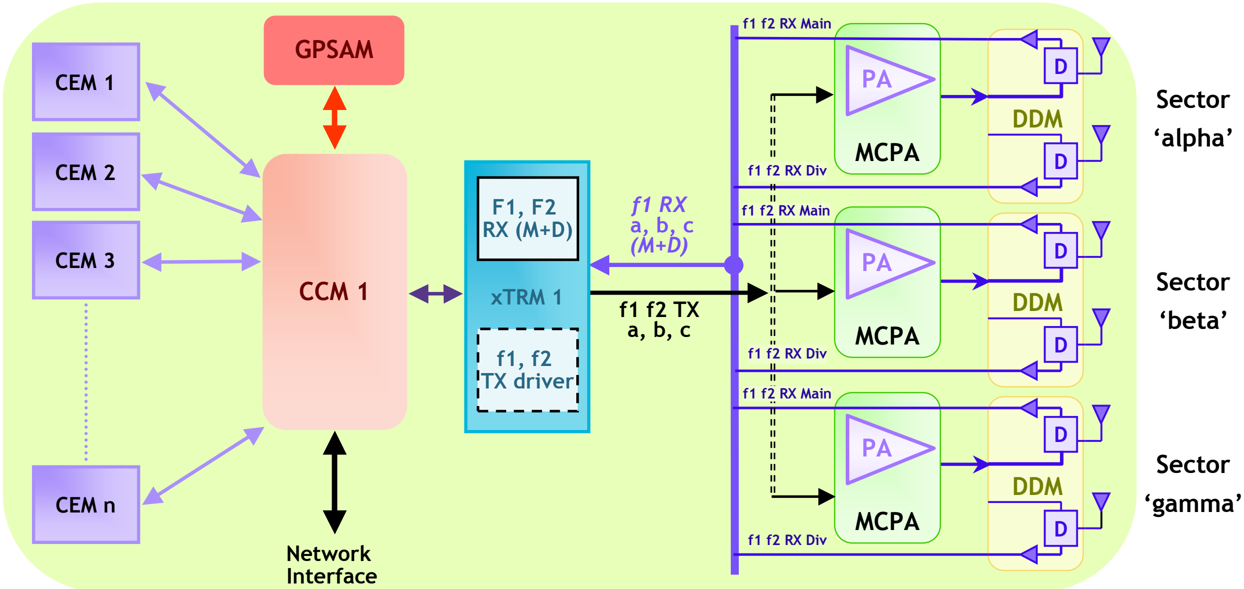
Still in UTRAN 5.0, one TRM/iTRM is mandatory for each RECEIVED carrier. Thus 2 TRMs are needed for STSR2. Then one CEM/iCEM can support up to two carriers. Finally, one or two MCPAs and one DDM are necessary for each sector.

If you examine the diagram, you can notice that this is the STSR2 configuration with one TRM board which is represented. This configuration supports two contiguous carriers in a 10-MHz bandwidth each. TRM1 processes f1 and f2 in transmission for all 3 sectors, and f1 in reception for 3 sectors with diversity. TRM2 processes f2 in reception for 3 sectors with diversity. In case of TRM1 failure, just one frequency (f1 or f2) is re-allocated on TRM2.

Multi-Carrier Configuration: xTRM

Main Characteristic of STSR2 with one TRM Board

1 xTRM can support 2 carriers.

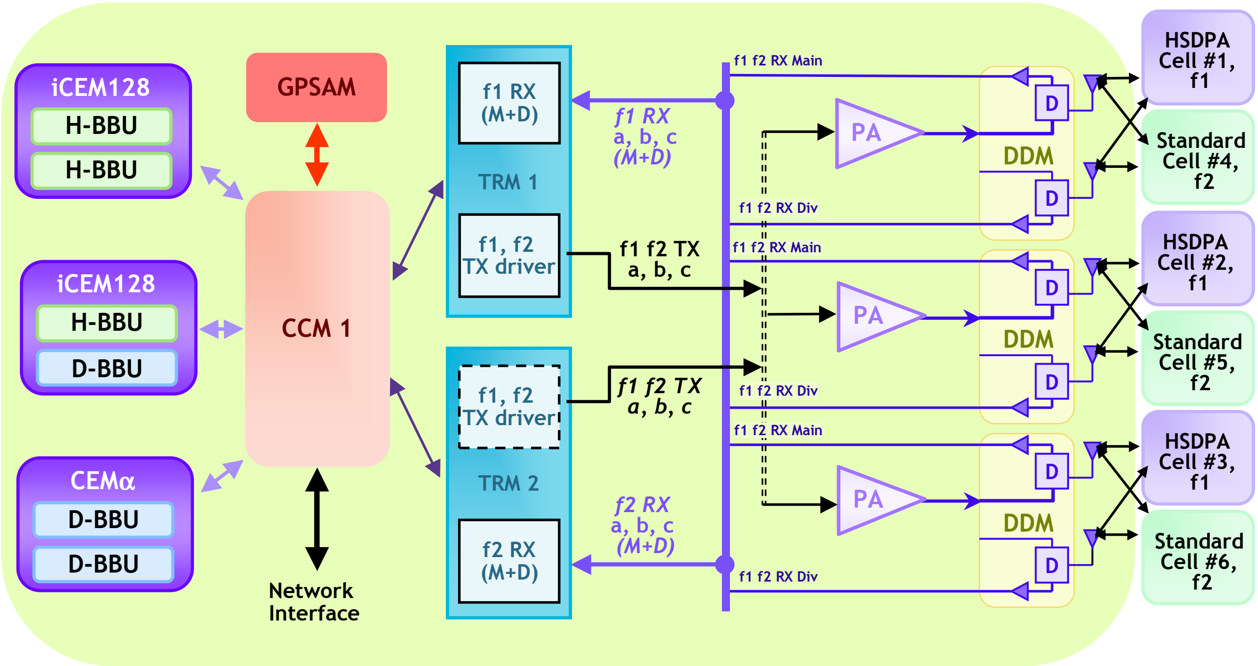


Here is illustrated the STSR2 configuration with one xTRM board.

The configuration is the same as for a configuration with TRM boards with the exception that the xTRM can manage up to 2 carriers in Reception and Transmission.

It is possible as well to add a second xTRM for redundancy purposes.

Example of the HSDPA Configuration Solution



The introduction of HSDPA is simpler by dedicating a new additional carrier for HSDPA and leaving current carrier for standard (R99) services with its related existing engineering dimensioning.

Hardware Requirements

	Module	Modules capacity	O1	OTSR1	OTBR1	STSR1	STSR1R	STSR2
Digital shelf	CCM	One for all config.	1	1	1	1	1	1
	CEM	One handles 3 sectors/carriers	1	1	1	1	1	1 functional (2 for capacity)
	TRM	Rx: handles up to 6 signals Tx: 3 outputs/ 2 carriers	1	1	1	1	2	2
	xTRM		1	1	1	1	1	1
RF block	DDM	One for each sector	1	3	2	3	3	3
	Tx splitter	Three-way splitter	no	1	1	no	no	no
	MCPA	One handles up to 3 carriers	1	1	1	3	3	3

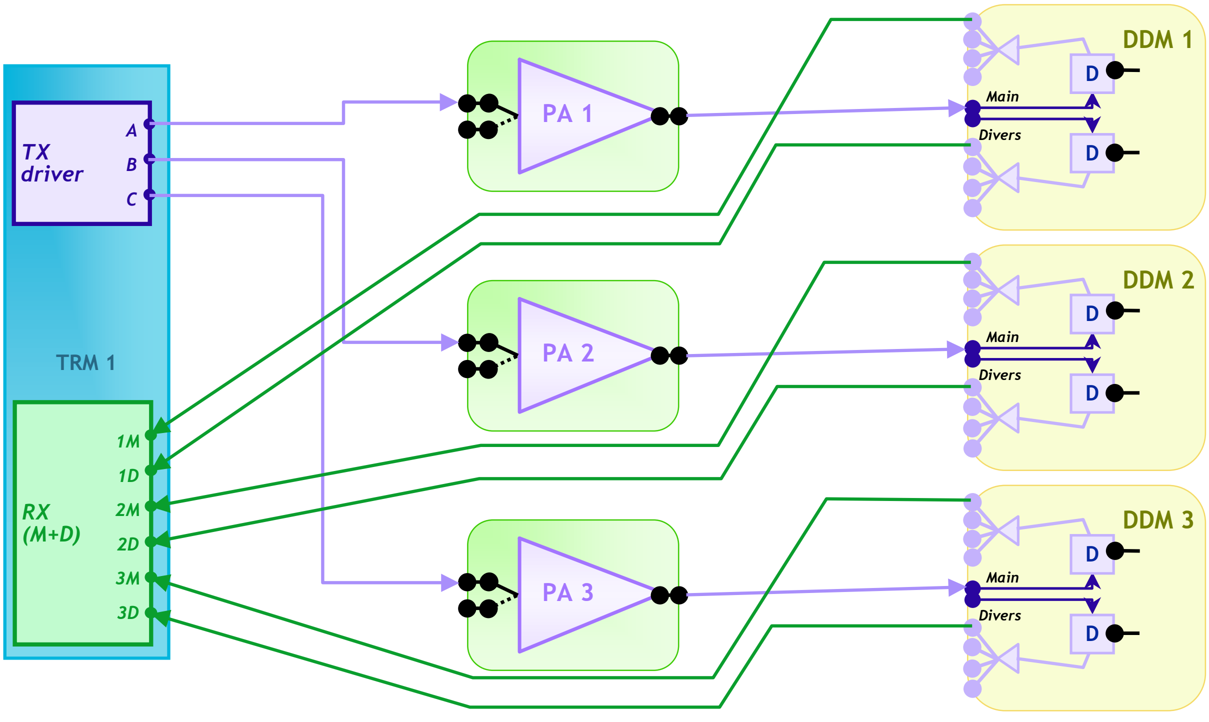
This table gives you the hardware requirements according to the BTS configuration.

The BTS architecture is able to support 2, 4, 6 or 12 antennas, both OTSR and STSR modes of operation, one to 2 carrier frequencies and TRM redundancy.

In UTRAN 5.0, only two carriers are supported. However, Tx diversity is not supported yet.

The BTS can be equipped with 2 antennas, for single sector or omni-directional configuration, 4 directional antennas for bi-sector configuration, 6 antennas for tri-sector configuration and 12 antennas for hexa-sector configuration.

STSR1: 3 Sectors and 1 Carrier



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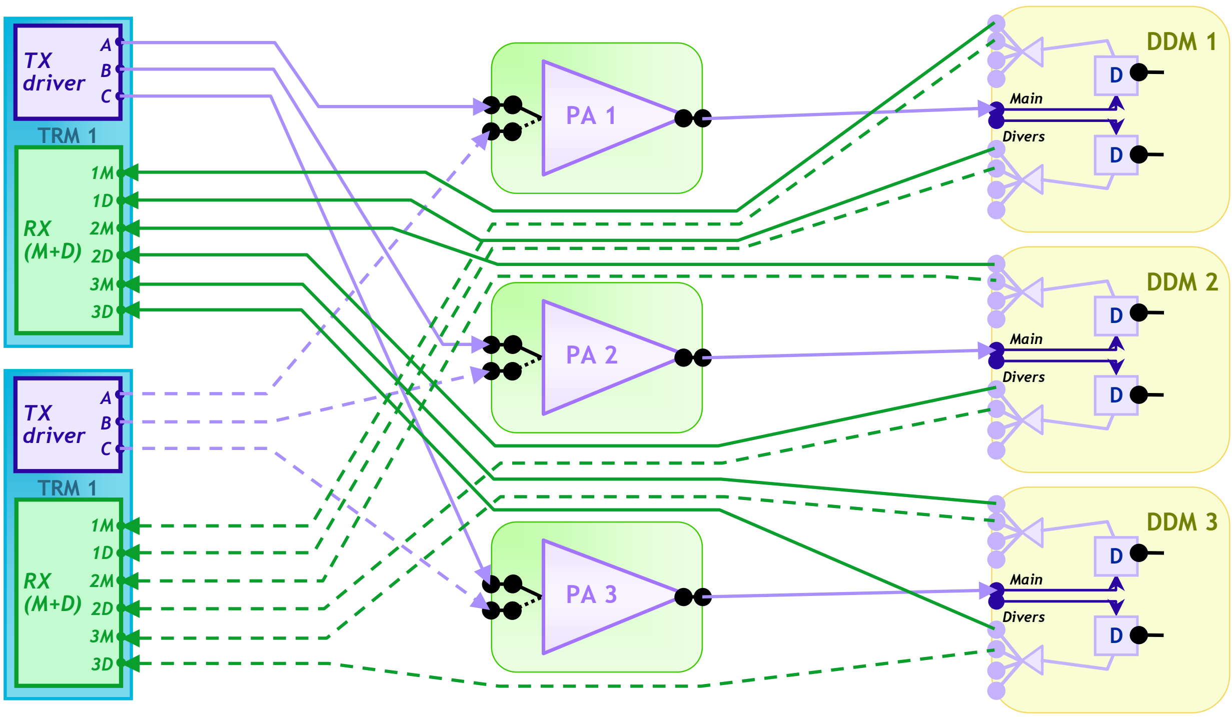
Let's examine the RF links between TRM/iTRM and MCPA/DDM for the STSR1 configuration, without TRM redundancy.

STSR1R: with Redundancy



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Let's examine the same configuration, this time with TRM redundancy.

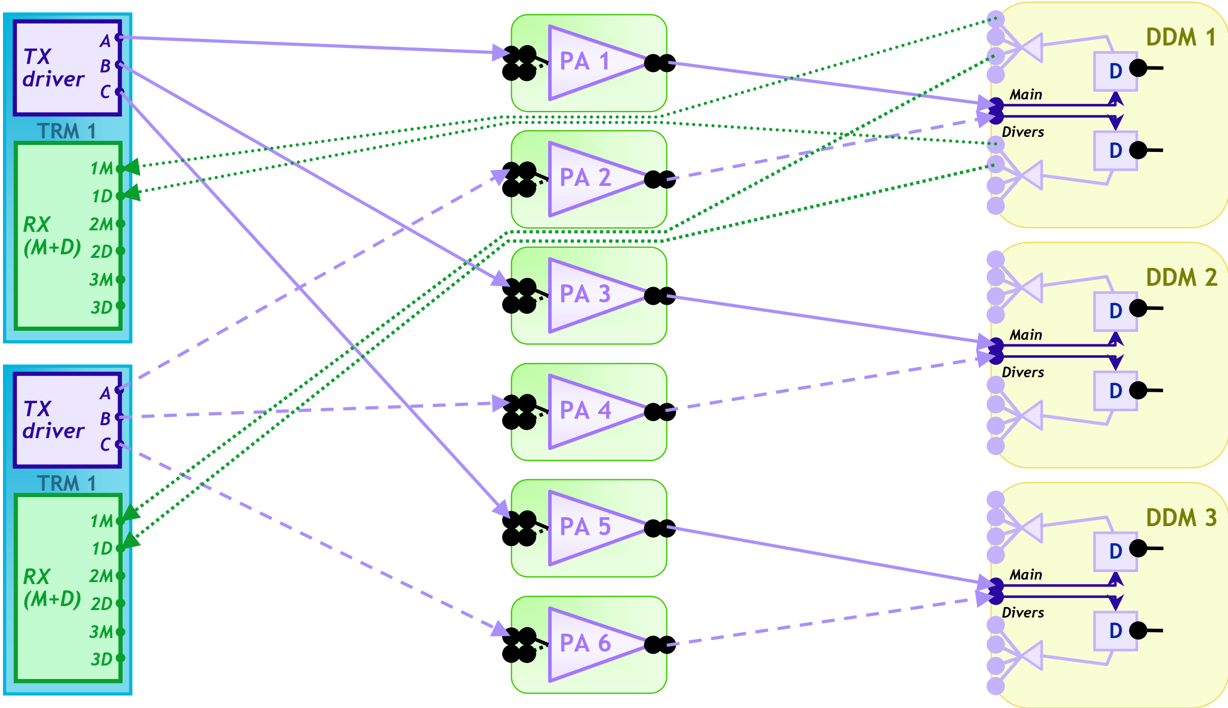
To improve robustness in case of TRM failure, an additional TRM can be added to support STSR1R configuration.

With that arrangement, the failure of a TRM has no impact on BTS capacity.

Note that the STSR1R configuration is equivalent to the STSR2 configuration.

The upgrade from STSR1 to STSR2 does not require to disconnect any existing RF cable. Indeed, the additional TRM needed for STSR2 is used in reception and for Tx redundancy.

STSR 1+1: 3 Sectors and 2 Carriers



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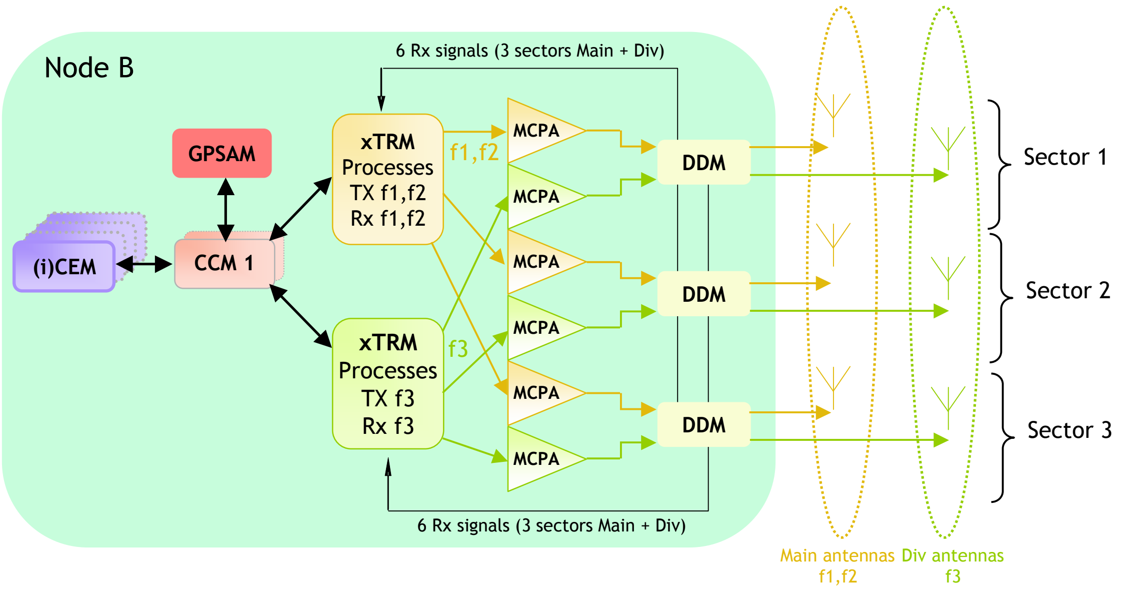
To end, let's see how RF links are connected between TRM/iTRM and MCPA/DDM for the STSR 1+1 configuration.

With STSR 1+1, each frequency has its own separate power amplification path.

STSR2+1 Overview

Characteristics of STSR2+1

- Up to 3 sectors x 3 carriers (local sectors only, not supported on RRH).
- 2 MCPAs per sector / 2 xTRMs per Node B.



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The STSR2+1 is a 3-carrier configuration. In an STSR2+1, (f1, f2) or (f2, f3) must be adjacent. It is an enhancement of STSR1+1 where 2 MCPAs are used per sector (one of them transmits 2 carriers and the other transmits 1 carrier).

What are the main specificities of STSR2+1 in UA05.1? Firstly, xTRM is mandatory and must be configured in 2-carrier mode. Indeed, the STSR2+1 configuration is not compatible with TRM and iTRM. Next, STSR2+1 is supported only in Macro Indoor (Indoor 2) and Macro Outdoor (Outdoor 2). Then, STSR2+1 is not supported with BTSs having more than 3 local sectors or BTSs with RRH sectors. Finally, a CEM board manages a maximum of 2 carriers. This has impacts on dimensioning and a static allocation between CEM and carriers is performed.

STSR Configurations

	STSR2	STSR1+1	STSR2+1
Number of PAs per BTS	3	6	6
Number of PAs per sector	1	2	2
Number of transmitting paths per sector	1 (Main path only)	2 (Main & Div paths)	2 (Main & Div paths)
Max number of sectors	6 local sectors or 3 local sectors + 3 RRHs	3 local sectors or 3 local sectors + 3 RRHs	3 local sectors only
Max downlink power	Max PA power shared between the 2 cells	Max PA power available for each cell	2 carriers shared on an MCPA, 3rd carrier on a dedicated PA
Δfreq: |F1-F2|	4.6MHz ≤ Δfreq ≤ 5MHz	4.6MHz ≤ Δfreq (*)	Notation: F1 & F2 grouped, F3 alone 4.6MHz ≤ |F1-F2| ≤ 5MHz 4.6MHz ≤ |F1-F3| (*) 4.6MHz ≤ |F2-F3| (*)

(*) upper limit is linked to the frequency bandwidth

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Here are presented the main differences between STSR configurations. As said in the previous slide, STSR2+1 is an enhancement of STSR1+1.

STSR Configurations [cont.]

	STSR2	STSR1+1	STSR2+1
Cabinet compatibility	Macro Indoor & Outdoor (all versions) RRH Compact Indoor BTS 6010 Street BTS 6020	Macro Indoor & Outdoor (all versions)	Macro Indoor & Outdoor (Indoor 2 & Outdoor 2)
Other HW constraints			xTRM mandatory Specific CEM dimensioning rules
Frequency band compatibility	Band I (2100MHz) Band II (1900MHz) Band V (850MHz) All carriers must belong to the same frequency band (no multi-band configurations)	Band I (2100MHz) Band II (1900MHz) Band V (850MHz) Band VIII (900MHz) All carriers must belong to the same frequency band (no multi-band configurations)	Band I (2100MHz) All carriers must belong to the same frequency band (no multi-band configurations)

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STSR2+1 is not available in band VIII (900) because the PA supports only one single carrier signal.

STSR2+1 power configuration can be seen as STSR2 (for f1+f2) and STSR1 (for f3).

STSR2+1 has no dependency regarding the CCM & GPSAM modules.

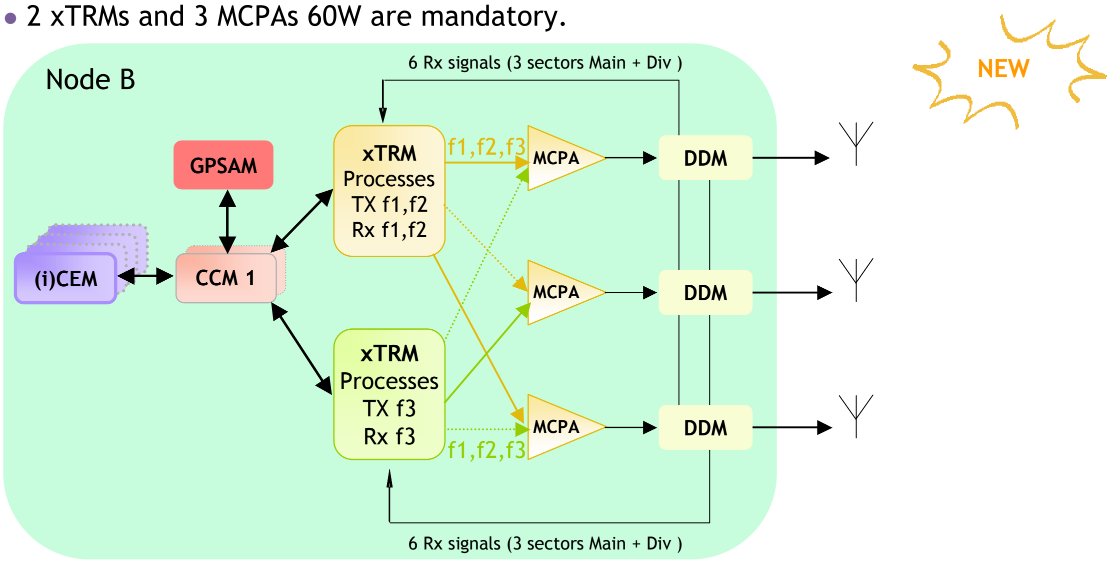
MCPA 30/45W and MCPA 60W are supported. Restricted mixity between MCPA 30/45 & MCPA 60W (MCPA 1, 3, 5 must be similar, idem for MCPA 2, 4, 6).

HSDPA is supported over 2 carriers. E-DCH is supported over 1 carrier, except for UTRAN sharing case. E-DCH support over 2 carriers is planned with xCEM. For UTRAN sharing case, the 2 adjacent carriers (f1 & f2) must belong to the same operator. E-DCH is supported with iCEM over 2 carriers from 2 different operators (f1 or f2 and f3).

STSR3 Overview

Characteristics of STSR3

- In UA05.1, cabinets supporting STSR3 are Macro Indoor/Outdoor.
- 2 xTRMs and 3 MCPAs 60W are mandatory.



xTRM managing 2 MCPAs, 3 Tx carriers (f1,f2,f3) and 2 adjacent Rx carriers (f1,f2)

xTRM managing 1 MCPA, 3 Tx carriers (f1,f2,f3) and 1 Rx carriers (f3)

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The STSR3 BTS has a capacity of 3 carriers in 3 sectors with a traffic capacity depending on CEM resources equipped in the BTS.

The STSR3 BTS has a capacity of 60W per sector.

F1, f2 and f3 share this 60W TX capacity: 20W per carrier if equal power is configured per carrier.

Customers can get a 3-carrier configuration to face up a UMTS traffic increase, with high capacity per carrier: cost ownership (day-to-day operation, fault management, upgrade, preventive/curative maintenance, etc.), capacity and dimensioning (Connectivity, storage capacity, etc.).

The end user will see more available capacity on this BTS with an easier access and throughput (Quality Of Service: call drop, availability, etc.).

3 BTS Portfolio and Cabinet Specifications

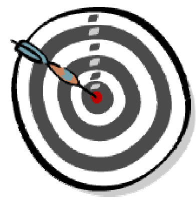
Let's discover the BTS portfolio.

Objectives

Objectives:

To be able to:

- identify the different types of BTS within the UTRAN portfolio.
- list the main features and characteristics of each BTS type, including dimensions, weights, consumption, etc.
- identify the different hardware units of a BTS.
- understand the RRH functionality.



Content:

3.1 UMTS BTS Portfolio
3.2 BTS 12000 Family
3.3 BTS 6000 Family
3.4 dBTS 6100
3.5 rBTS 6100
3.6 BTS 1020
3.7 dBTS 2U
3.8 dBTS 4U
3.9 RRH 20W
3.10 RRH 40W

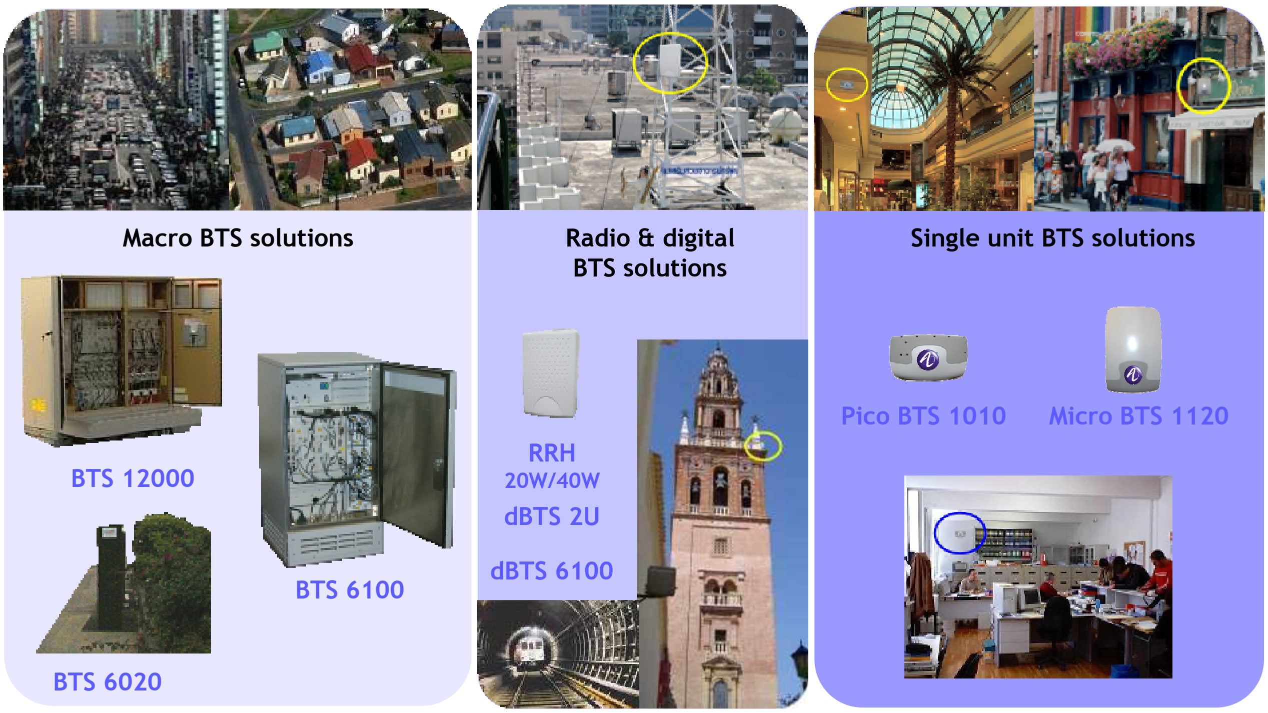
In this section, we are going to identify the types of BTS within the UTRAN portfolio.
Then, we will enumerate the main features and characteristics of each BTS family.
Finally, we will explain the Remote Radio Head functionality.

3 BTS Portfolio and Cabinet Specifications

3.1 UMTS BTS Portfolio

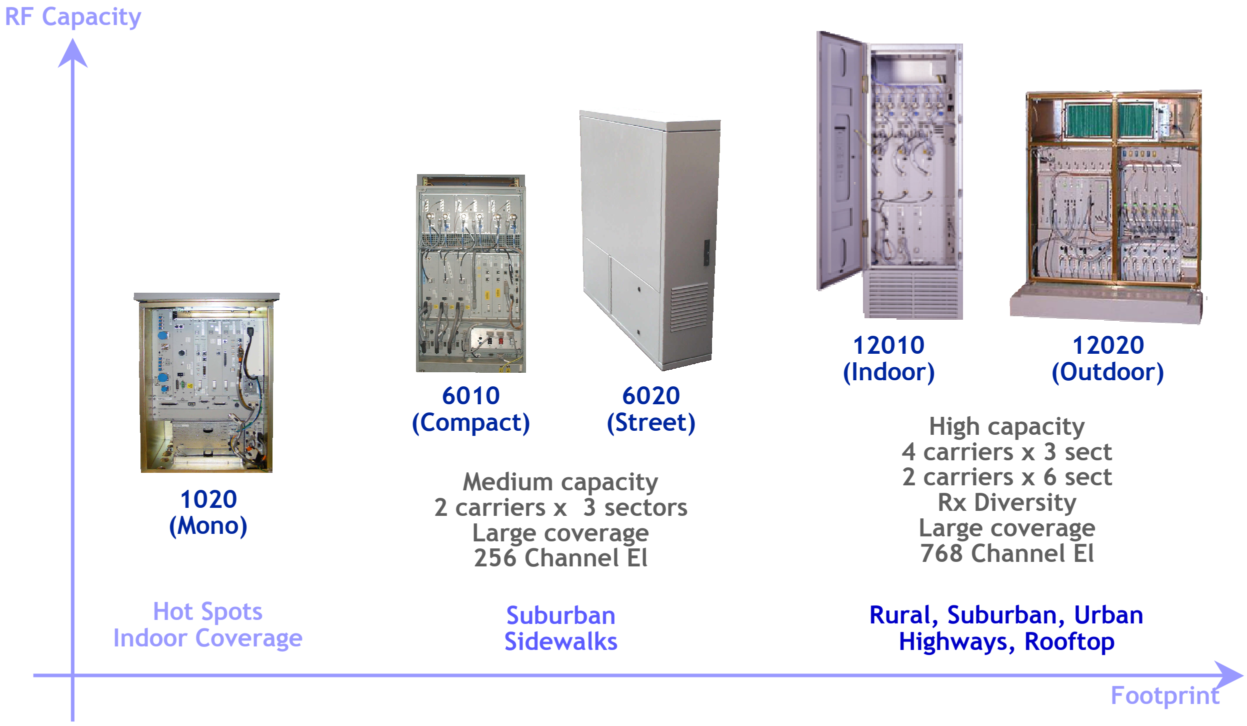
First, let me show you the different types of equipment within the BTS portfolio.

Alcatel-Lucent BTS Solutions



Alcatel-Lucent offers 3 types of BTS solutions. First the **Macro BTS solutions** comprise **BTS 12000, 6020** and **6100.** Then **dBTS 2U, dBTS 6100 with RRH 20W/40W** are part of the **Radio & digital BTS solutions.** Finally, in the **single unit BTS solutions**, we find the **pico BTS 1010** and the **micro BTS 1120.**

Characteristics of Macro BTS Solutions



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As we have just seen, **BTS 12000, 6020 and 6100** are part of the **Macro BTS solutions.**

The UMTS BTS is modular in design for easy network growth and flexibility, to manage diverse traffic demands. The BTS has several key differentiators. One of these differentiators is the multi-carrier capacity. The BTS can support one to three UMTS carriers per sector. Another differentiator is the output power of up to 2x45W per sector (for a configuration with 6 power amplifiers). Flexibility also ranks among the key differentiators as it defines the possible growth from low capacity to high capacity in one cabinet. Finally, the last key differentiator is the automatic software upgrade with minimum service downtime.

What differentiates each type of BTS within the Macro BTS solutions?

The BTS 1020 (Mono) is designed for omni cell site and indoor coverage.

The BTS 6020 (Street) is designed to be as small as possible, and to have minimum visual impact.

The BTS 6010 (Compact) is designed for the US market (1900MHz only), in a standard rack.

The BTS 12020 (Outdoor) and 12010 (Indoor) has high capacity characteristics. Indeed, they are used for Rural, Suburban, Urban, Highways and Rooftop coverage, optimized to provide a wide capacity BTS in a very small footprint.

Extended UMTS BTS Portfolio

BTS 1120

- 2 carriers x 1 sector
- Microcellular coverage (medium range)
- 128 CEs per carrier
- Low power (5W per carrier)
- 2100MHz

Capacity hot spots
Coverage cold spots

BTS 1010

- 1 carrier x 1 sector
- Picocellular coverage (local area)
- 80 CEs
- Very low power (250mW)
- 2100MHz

Indoor coverage
Indoor capacity

RRH 20W/40W

- 2 carriers x 1 sector
- Macrocellular coverage
- Cost-effective deployment (CAPEX/OPEX savings)
- Medium power (20W)
- 2100 - 900MHz
- In UA05.1 RRH 40W

Rooftop.
Used with Macro BTS, digital BTS

dBTS 2U

- 2 carriers x 3 sectors (linked to 3 RRH)
- Macrocellular coverage
- Cost-effective standalone deployment or in 19" user spaces (CAPEX/OPEX savings)
- 384 CEs
- In UA05.1 dBTS 4U

Macro in GSM sites
Use with RRH

dBTS 6100

- 2 carriers x 3 sectors (linked to 3 RRH)
- Macrocellular coverage
- Very flexible configurations
- Up to 640 CEs (future 1280)
- In UA05.1 compact BTS = dBTS + rBTS

Macro in urban/rural
Use with RRH

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The extension of the BTS portfolio provides a large range of solutions for any situation.

For Hot spot coverage (high capacity for small coverage), you can use the micro Node and its main features which are 128 Channel Elements with a 5W power.

For indoor coverage, its very low power allows to place the pico BTS close to where people are in building, office location.

To use the maximum power at the antenna connector when high feeder losses are expected (tower), you can replace the standard BTS solution by the combination of a Remote Radio Head (RRH) and a digital Node B. We will detail this configuration in the coming slides.

For the digital solution, 2 main cases are deployed. In the first case, a digital BTS is located in the equipment user space of a dBTS 2U, meaning that it takes the space of 2 units in a standard BTS user space such as GSM BTS. It allows to have a cost-effective deployment in existing sites. From UA05.1, the dBTS 4U might also be used to extend the capacity in terms of channel elements. In the second case, a digital BTS is located in a compact cabinet. The dBTS 6100 can also be used with the RRH. In UA05.1, note that the dBTS 6100 can also be associated with a remote part called the rBTS 6100, in order to create a macro BTS, that can be easily transported in any location thanks to the split of the macro BTS functions into 2 compact cabinets: dBTS + rBTS.

3 BTS Portfolio and Cabinet Specifications

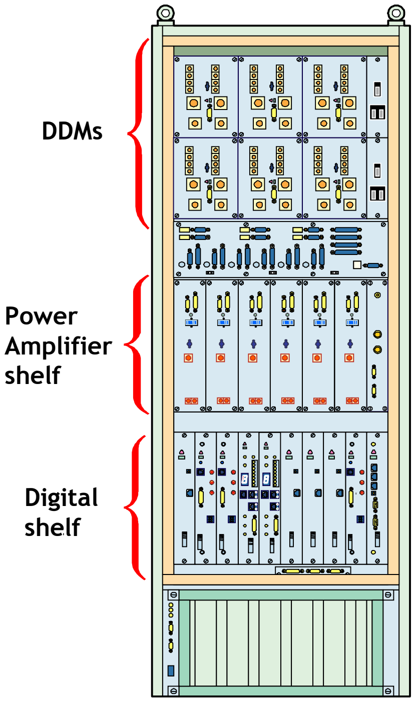
3.2 BTS 12000 Family

Let's begin with the BTS 12000 Family.

BTS 12010-2: Cabinet Description

Characteristics (Indoor-2)

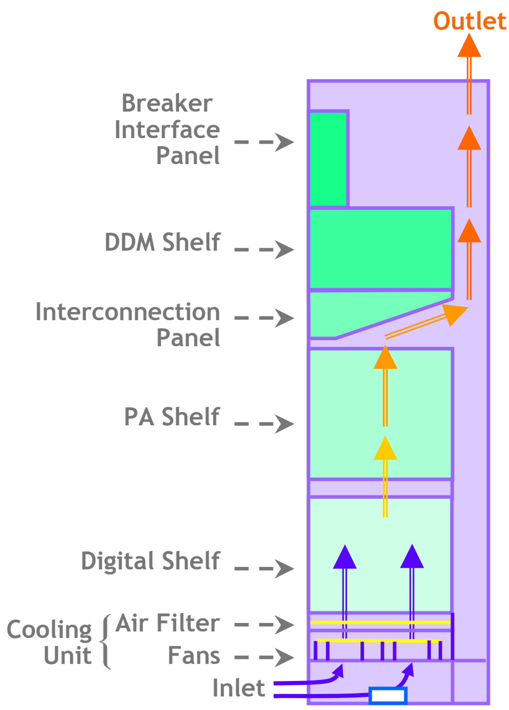
- Fully-integrated self-contained cell site: Up to 3 sectors and 3 carriers in a single cabinet
- Optimized ratio size versus capacity:
  - Cabinet size (HxWxD): 165 x 60 x 60cm
  - Volume: 594L
- DC Power: -48V DC (optional +24V DC)
- Operational Temperature Range:
  - Short term: -5°C to +45°C
  - Long term: +5°C to +45°C
- Weight:
  - Fully equipped: 305kg
  - Empty: 140kg
- Acoustic:
  - Normal speed: 51.2dB(A)
  - Maximum speed: 68.4dB(A)

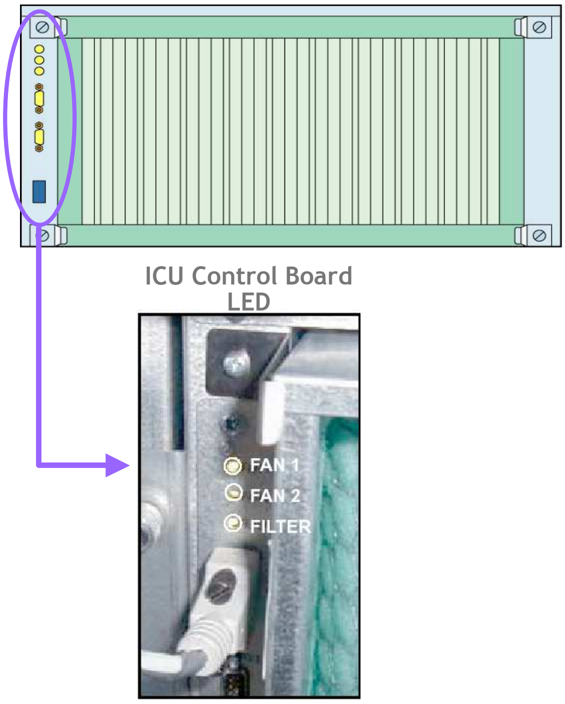


The BTS 12010-2 (Indoor 2) offers several advantages. Indeed, this BTS allows front access only and generates less acoustic noise. Sound power is less than 62dB up to 35°C. Its operating range is 5% to 95% RH, 1 to 29g/m^3 absolute. Its short-term range as well is 5% to 90% but must not exceed 0.024kg water/kg of dry air.

The BTS 12010-2 has some additional physical characteristics. First this BTS is equipped with standard E1/T1 connections with up to 8 E1/T1, with drop & insert capability. Then its operational range is -40.5 to -57V DC and up to -60V DC for abnormal conditions. Finally, the BTS supports connection for external battery for AC version.

BTS 12010-2: Cooling Unit





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The Indoor Cooling Unit (ICU) is installed at the bottom of the cabinet and is accessible through a front grate or protection panel.

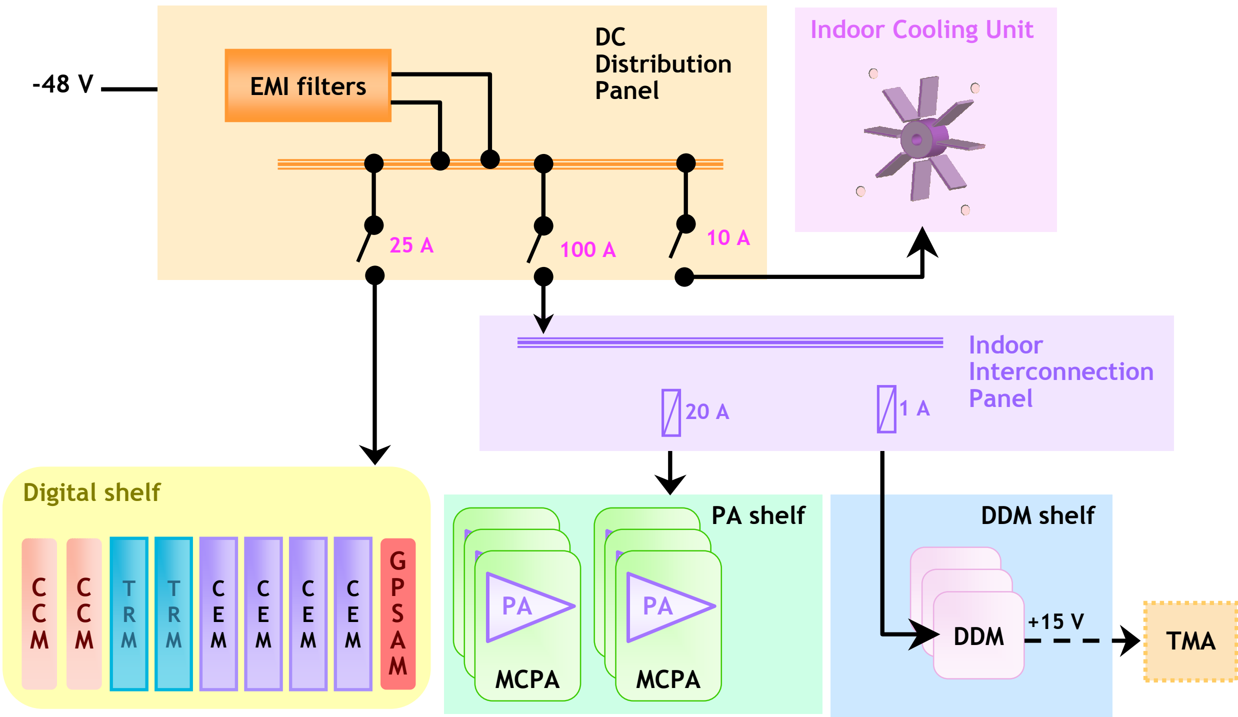
The ICU is composed of two variable speed fans, one Control board and some temperature control sensors.

The BTS 12010-2 is cooled by convection through a single open loop ventilation unit.

What is the cooling airflow path?

First, the air enters at the bottom front section of the cabinet. Then, the air is pulled through a filter by the ventilation unit. Next, the air is pushed through the installed digital and MCPA shelf. Finally, the air is released at the top rear section of the cabinet.

BTS 12010-2: Direct Current (DC) Distribution



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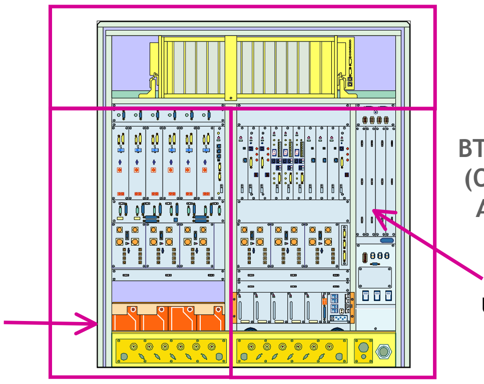
The BTS 12010-2 cabinet supplies a fixed -48V DC electrical distribution system, in order to power the installed electronic equipment.

This distribution system is designed with three separate DC output connections. The "INTERCO" DC output is used to supply electrical power to MPCAs and DDMs, via the Indoor Interconnection Panel. The "DIGITAL" DC output is used to supply electrical power to Digital shelf modules. And the "COOLING UNIT" DC output is used to supply electrical power to the Indoor Cooling Unit (ICU).

BTS 12020-2: Cabinet Description (AC/DC Power Supply)

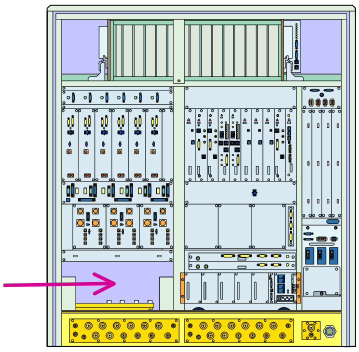
Characteristics

- Fully-integrated self-contained cell site:
  - Up to 3 sectors and 3 carriers in a single cabinet
  - Cooling system
- Optimized ratio size versus capacity:
  - Footprint: 1m²
  - Cabinet size (HxWxD): 150 x 135 x 75cm
  - Volume: 1500L
- DC Power: -40.5V > V > -57V
- AC Power:
  - Single/Split: 20A/phase
  - Three phases: 10A/phase (balanced)
  - Rectifiers, battery backup
- Operational Temperature Range: -40°C to +50°C
- Weight:
  - Fully equipped: 532kg
  - Empty: 180kg
- Acoustic: about 44dB(A) at 5 feet



BTS 12020-2
(Outdoor 2)
AC power

User space:
4U



BTS 12020-2
(Outdoor 2)
AC/DC power

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The BTS 12020-2 for AC power cabinet is divided into three parts. The upper compartment comprises the climatic unit. The left compartment includes the power amplifiers, the RF combiners and the battery. The right compartment includes the functional modules, the RF combiners, the User space, the rectifiers and the AC filtering.

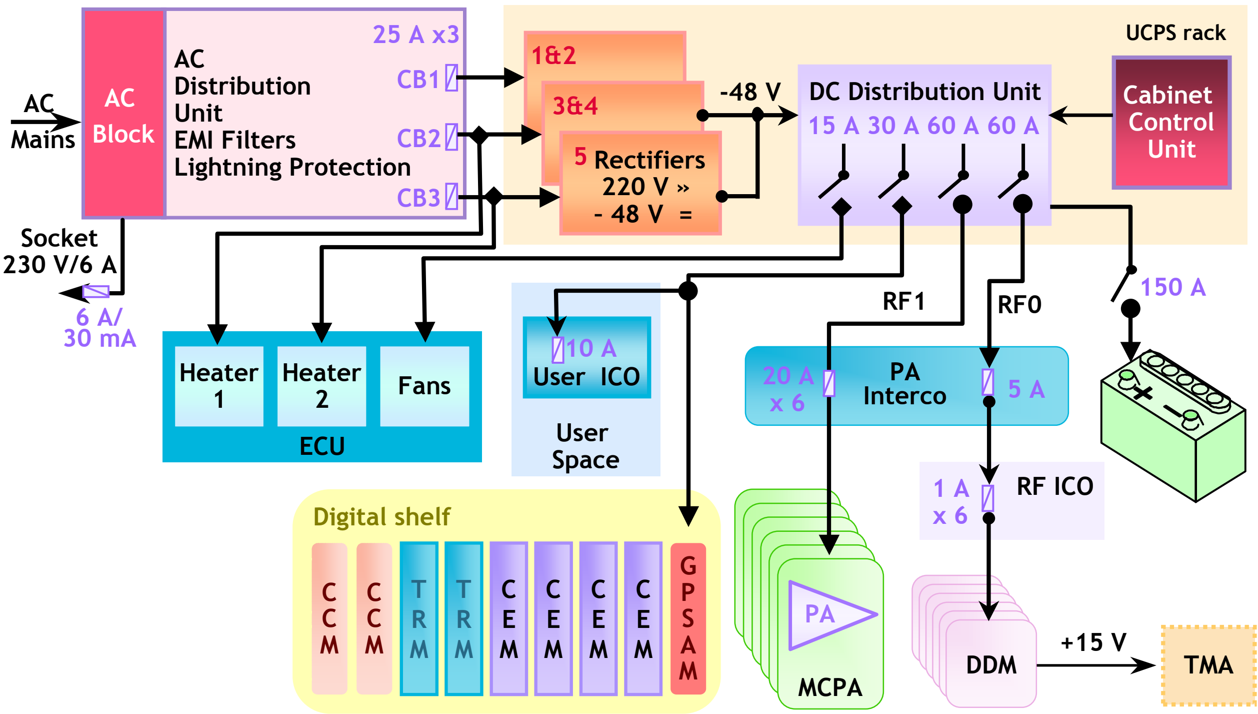
Some improvements have been brought to the BTS since the rectifiers and DC distribution of the energy system are now located in a rack. Moreover, the cooling system comprises two fans (one for each compartment) instead of one. Lastly, the user space has now four modules instead of three.

Compared to the AC only variant, the BTS 12020-2 AC/DC integrates several changes. Indeed, the internal batteries are removed. The battery space houses a DC Connection Block and the rectifiers are replaced by fillers.

The DC input voltage range is -40.5V up to –57V.

The AC main power is still required to power the heaters and the maintenance plug.

BTS 12020-2: Power Supply (AC Only)



The BTS 12020-2 supports Alternative Current power supply.

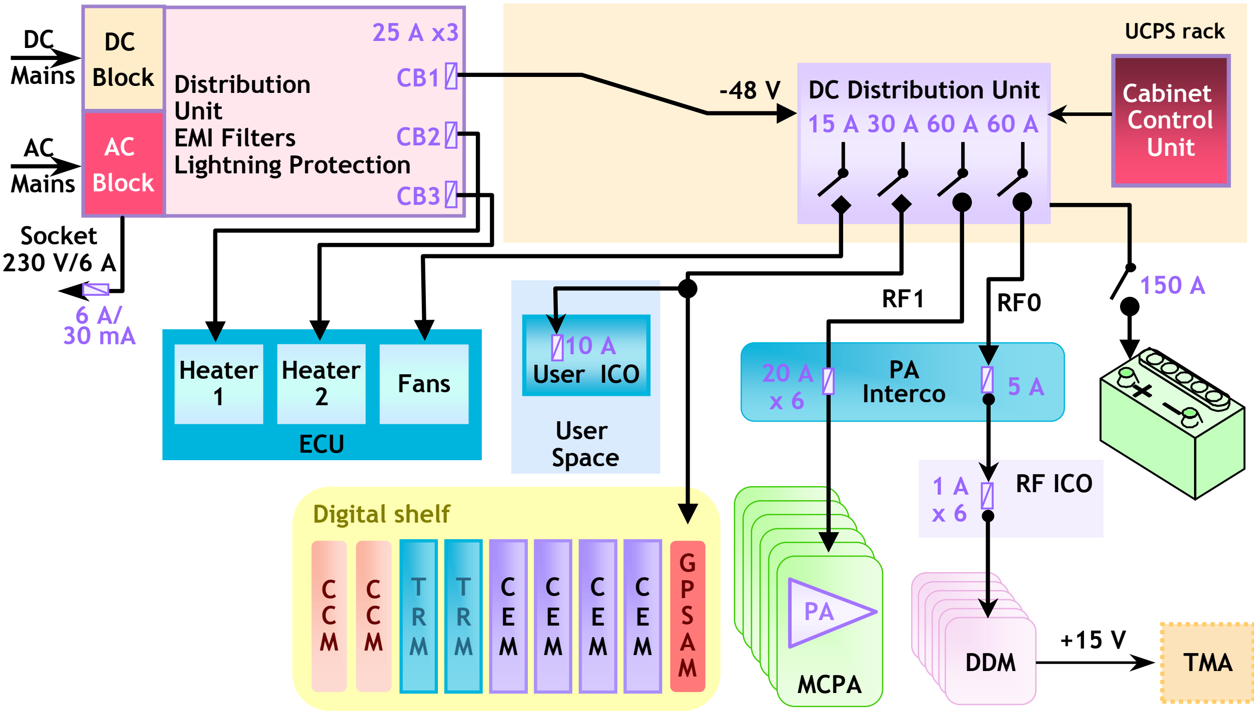
The two main power supply units are the AC Distribution Unit (ADU) and the Universal Common Power System (UCPS) rack.

The UCPS rack includes up to 5 Rectifiers (of 1400W maximum), one Cabinet Control Unit (CCU) and one DC Distribution Unit (DDU).

The DDU distributes the DC power towards the BTS modules.
For the battery, the DDU module is equipped with the DC wiring, connected on one breaker (of 150A).

The maximum DC power available for OEM equipment in the User Space does not exceed 300W.

BTS 12020-2: Power Supply (AC/DC)



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The BTS 12020-2 (AC/DC variant) supports DC power supply for functional modules.
The UCPS rack includes one Cabinet Control Unit (CCU) and one DC Distribution Unit (DDU).

The DDU distributes the DC power towards the BTS modules.
The maximum DC power available for OEM equipment in the User Space does not exceed 300W.
The two heaters are powered by the AC source.

3 BTS Portfolio and Cabinet Specifications

3.3 BTS 6000 Family

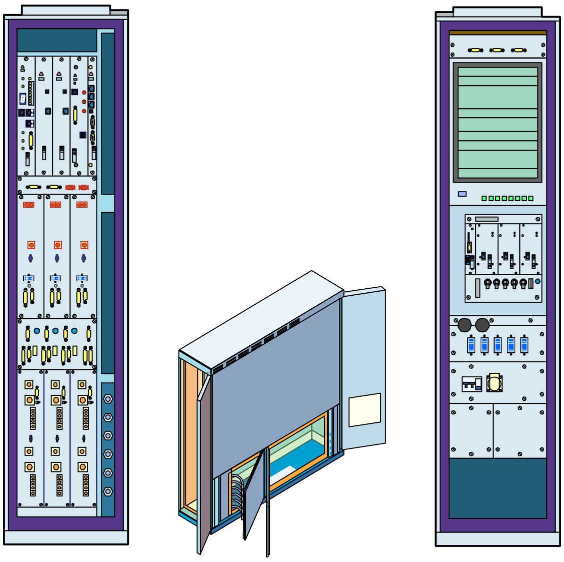
Let's go on with the BTS 6000 Family.

BTS 6020 (Street)

Characteristics

- Fully-Integrated self-contained cell site:
  - Up to 3 sectors and 2 carriers in a single cabinet
  - Rectifiers, cooling system
- Optimized size versus capacity ratio:
  - Footprint: 0.52m²
  - Cabinet size (HxWxD): 150 x 148 x 35cm
  - Volume: 761.25L
- AC Power:
  - Single/Split: 120/240V AC
  - Three phase: 120/208V AC or 240/416V AC
- Operational Temperature Range: -40°C to +45°C
- Weight:
  - Fully equipped: 321kg
  - Empty: 180kg
- Acoustic: 47dB(A) between –20°C and +40°C

2100MHz only



Left hand Side compartment

Front side

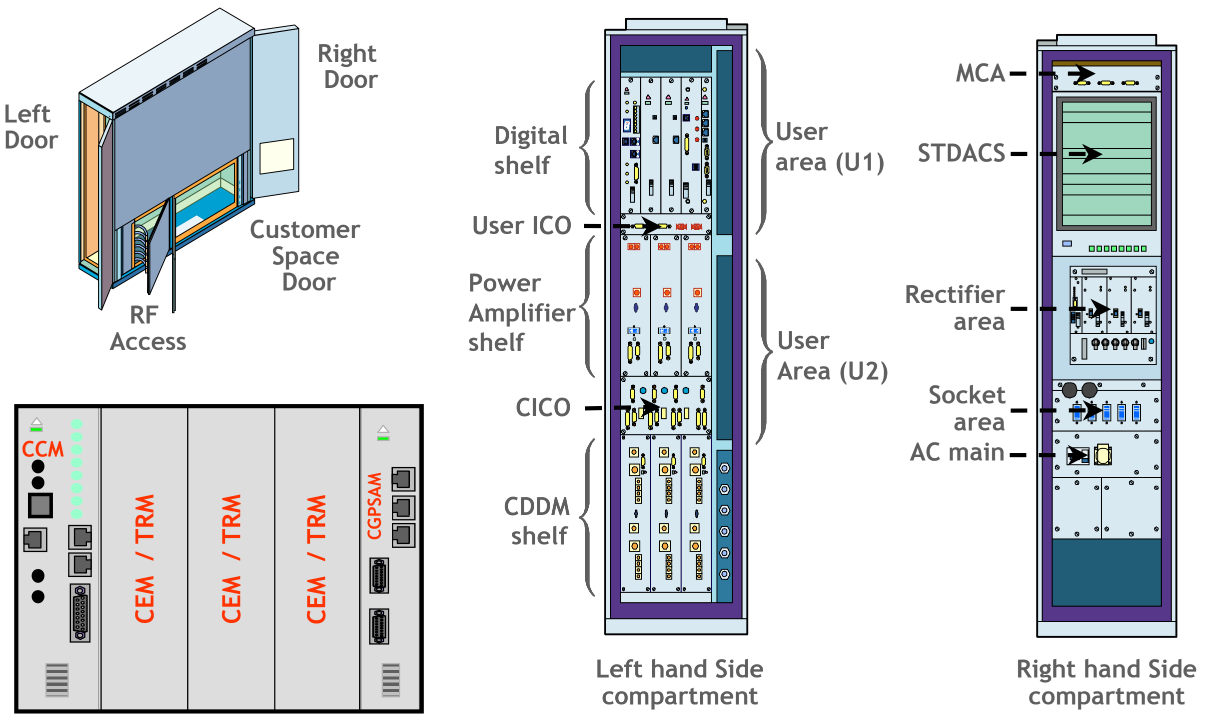
Right hand Side compartment

The BTS 6020 is an outdoor product optimized for street deployment with a minimum visual impact.

The BTS 6020 is characterized by the fact that all cables enter the cabinet from a cable bulkhead located on the front side of the cabinet. Moreover, this BTS has no extra site cabinet since user space and batteries are integrated.

The 6020 cabinet is divided into three parts. The left compartment comprises the functional modules, the user compartment, the power amplifiers and RF combiners area. The right compartment includes the cooling unit, the rectifiers, AC Main. Finally, the front side compartment includes the batteries and RF access.

BTS 6020: Cabinet Description



Alcatel·Lucent

The modules of the BTS 6020 are accessible by side doors.

The left compartment includes the Digital shelf, the User space and its interconnection panel User/ICO, the MCPA shelf, the interconnection module ICO, the Compact Dual Duplexer Module (CDDM) shelf and the PCM and alarms protection modules.

The right compartment includes the climatic unit STDACS, the rectifiers, the DC distribution module and the AC filtering box.

The Digital shelf of the BTS 6020 is smaller than that of the BTS 12020/12010 (Outdoor & Indoor) but uses the same four modules.

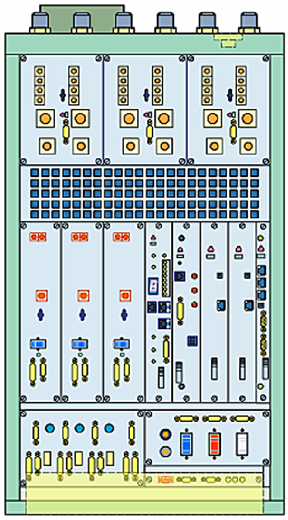
The backplane is a five-slot type. Consequently, the slot numbers have changed as compared to the 12020 and/or 12010 racks. Indeed, CCM/iCCM is located in slot number 1. Then, up to two CEM/iCEMs can be located in slots number 2, 3 and 4. Next, up to two TRM/iTRMs can be located in slots number 2, 3, and 4. Finally, cGPSAM, the compact GPSAM which is 25 mm wide, is located in slot number 5.

BTS 6010 (former-Compact)

Characteristics

- Fully-integrated self-contained cell site: up to 3 sectors and 2 carriers in a single standard rack (19 inch)
- Optimized size versus capacity ratio:
  - Footprint: 0.34m^2
  - Cabinet size (HxWxD): 90 x 48 x 65cm
  - Volume: 282L
- DC Power: -48V DC (–36 to –60) or +24V DC (option)
- Operational Temperature Range:
  - Long term: -5°C to +45°C
  - Short term: +5°C to +45°C
- Weight: < 63kg
- Acoustic:
  - Normal speed: 65dB(A)
  - Maximum speed: 70dB(A)

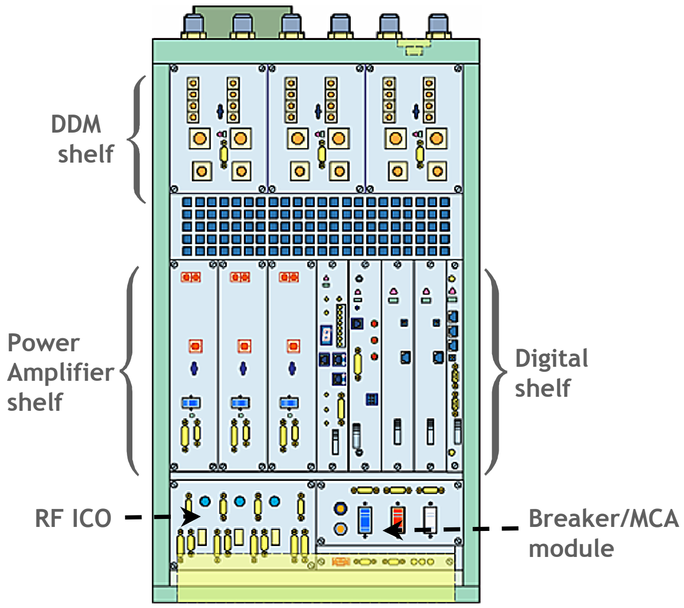
US Market only (1900MHz)

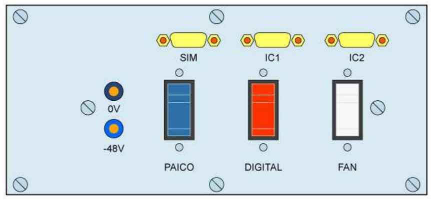


The BTS 6010 is ideal for suburban environments with up to 2 carriers for 3 sectors and provides high capacity from a very small footprint. This type of BTS is designed to support an initial lower capacity, high coverage situation, with the possibility of a smooth growth path through modular upgrades.

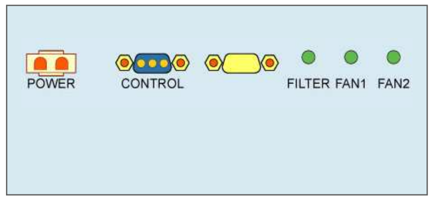
This BTS is housed in a single rack and can fit in standard racks or even on tabletops.

BTS 6010: Cabinet Description





Breaker/MCA module



Compact Indoor Cooling Unit (CICU)

Alcatel·Lucent

The BTS 6010 is divided into four parts. The first part includes up to three DDM-2 1900 modules. The second part includes up to three MCPAs 1900 modules, one iCCM module, up to two iTRM modules, up to two iCEM modules and one cGPSAM module. The third part includes the Radio Frequency InterCOnnection (RF ICO), the Breaker/MCA module and the DC test. Finally, the fourth part includes the Compact Indoor Cooling Unit (CICU) which houses the AC power, the control and three LEDs (FAN1, FAN2, and FAN3).

3 BTS Portfolio and Cabinet Specifications

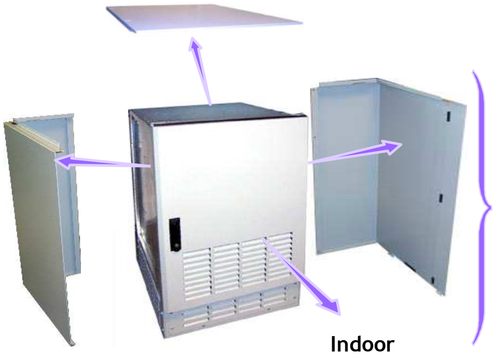
3.4 dBTS 6100

Let's move on to one of the new BTS: the dBTS 6100.

2 Versions

Characteristics

- Compact BTS:
  - High density indoor and outdoor BTS
  - Up to S222 in 1 cabinet / Up to S666 in 3 cabinets
  - Same modules as BTS 18000
    - Standard power Tri-TRX modules
    - 60W high power modules
- Enhanced features support: supports all enhanced features as BTS 18000
- Optimized size versus capacity ratio:
  - Footprint: $0.38m^2$
  - Cabinet size (HxWxD): 108 x 58 x 65cm
  - Volume: 408L
- BTS 6100 evolution:
  - Hardware ready to support HSDPA/HSUPA
  - Optical OC-3/STM-1, IP/Ethernet

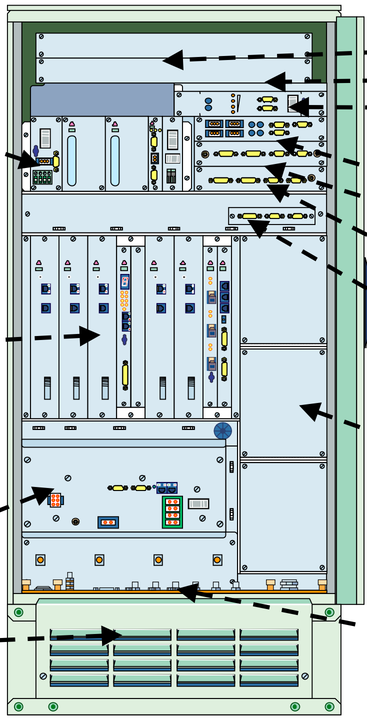


Alcatel·Lucent

The UMTS dBTS 6100 in association with the UMTS RRH, offers Macro BTS capabilities in a compact BTS packaging.

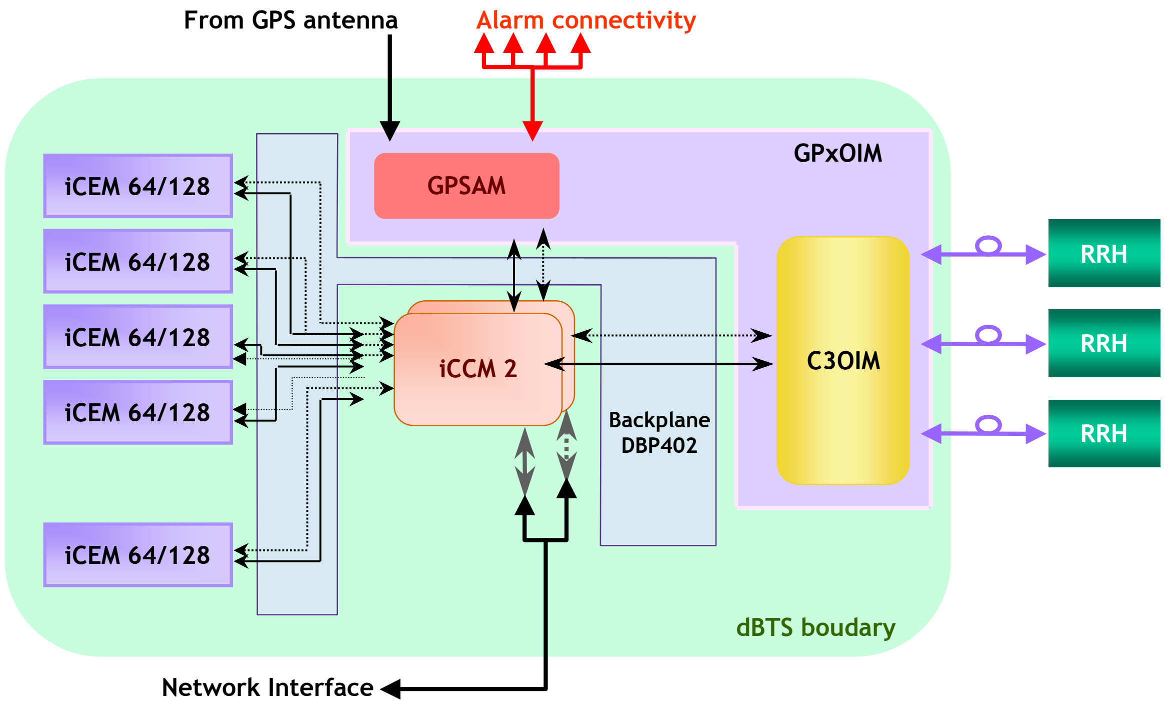
The same cabinet addresses indoor and outdoor applications, providing the operator with installation flexibility. Indoor and outdoor versions only differ in their protective shielding and climating environmental control. The outdoor version comprises heaters, unlike indoor version.

UMTS dBTS 6100 Layout



Compared to the other types of BTS, the UMTS dBTS 6100 is characterized by key construction features. Indeed, all sub-racks and mechanical supports are an integral part of the cabled cabinet design. Then a cooling unit (CECU), installed at the bottom of the cabinet, supplies cooling performance regardless of dBTS 6100 configuration. Next, this BTS is equipped with a specific DC distribution system called Universal Common Power System (UCPS). In the AC version, the ADU provides AC input termination and AC power feed to the AC heaters. In the DC version, the DCU provides DC input termination and DC power feed to the DC heaters. Finally, all external cables are interconnected using water-protected connectors on the cabinet bottom panel bulkheads.

Digital Shelf



Alcatel·Lucent

The Digital shelf of the UMTS dBTS consists of the backplane and four types of modules. First, the iCCM-2 manages OAM, part of call processing and internal/external data flow switching/combining. Then, iCEM2 manages the remaining part of the call processing and base band transmit/receive digital signal processing. Next, GPxOIM is composed of 2 slots, one containing nGPSAM and one C3OIM if 3 RRHs are connected, or C2OIM if only 2 RRMs are used. C2/3OIM is the connections to any Remote Radio Head. Finally, nGPSAM supports any external/internal alarm connections and external synchronization.

The hTRM is located into the RRH, and contains receive/transmit channelizer as well as radio signal ADC/DAC.

3 BTS Portfolio and Cabinet Specifications

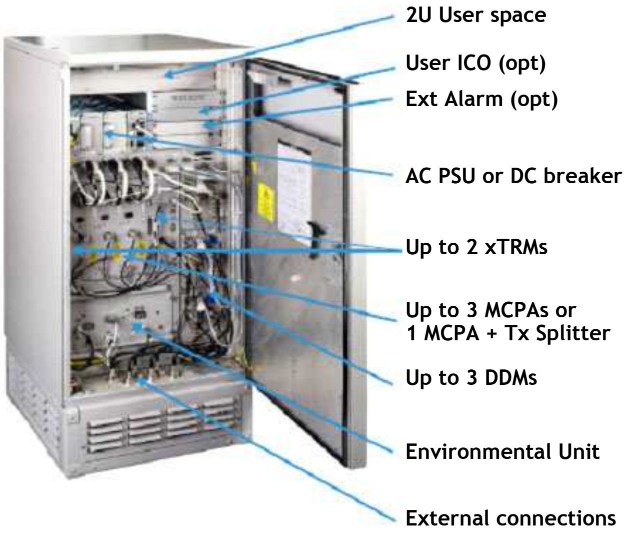
3.5 rBTS 6100

We have just described the dBTS 6100. As said previously, in UA05.1, the dBTS 6100 is associated with a remote part called rBTS 6100. In this section, we will look in detail at this radio part in charge of amplifying the signal received from the digital shelf and coupling it to the antenna.

A Compact BTS

Characteristics

- Up to 2 xTRM modules
- Up to 3 MCPAs
- Re-use of the same UMTS modules as Macro Node B
- Optimized ratio size versus capacity:
  - Footprint: 0.377m²
  - Cabinet size (HxWxD): 110 x 58 x 65.6cm
  - Volume: 410L
- Indoor DC and Outdoor AC
- Weight:
  - Fully equipped: 160kg
  - Empty: 75kg
- Value
  low footprint, volume, weight and power consumption



The Alcatel-Lucent Remote Radio solution improves flexibility for deploying mobile broadband base stations in space-constrained locations. It is particularly suited to macro-cellular application in dense areas, where site acquisition is difficult, and on sites where installation constraints prevent the use of legacy base stations.

Compared to legacy base station site deployment, the Remote Radio solution enables to reduce volume, weight, footprint, acoustic noise and power consumption, and also to reduce the cost of feeder paths from the base station to the antenna. Other benefits of the remote radio solution are an increased RF power per carrier at the antenna feeder and a reduced radio loss with the use of the remote RF block concept. This latter eliminates the distance between the radio amplifier and the antenna.

The rBTS 6100 is equipped with five main types of external interfaces, namely the radio interface, the optical interface, alarm/remote control interfaces (optional), the power supply interface (AC and DC input) and a user equipment.

Cabinet Description

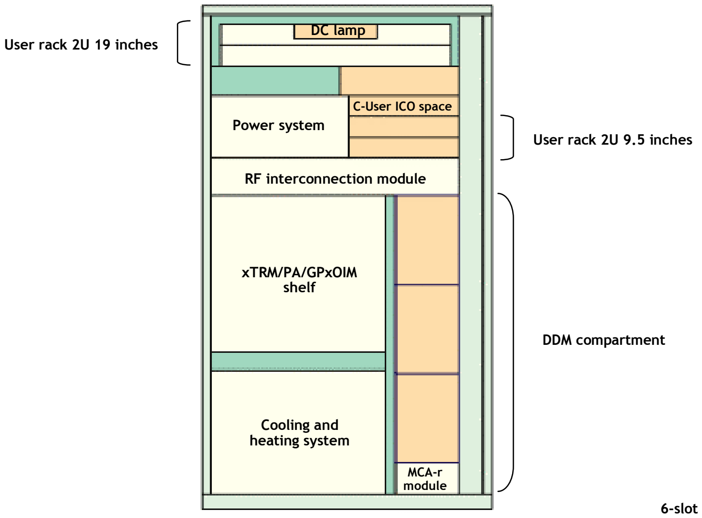
- Radio part of the Node B:
  - Up to 3 sectors x 2 carriers (UA05.0)
  - MCPA 60W (45W at BTS output)
  - 2100MHz only in UA05.0
  - Up to 2 xTRMs (only 1 in UA05.0)
- Modules:
  - Common: GPxOIM, MCPA 60W, DDM, xTRM
  - Specific: C2OIM-r
- Optical interface:
  - 1 per xTRM board
  - Single or Multi-mode
  - Max distance with digital: 500m
- 1 Outdoor variant in UA05.0:
  - DC input for modules + AC for heaters
  - New variants later pending market request
- Options:
  - DDM AISG
  - TMA: external alarms (not in UA05.0)

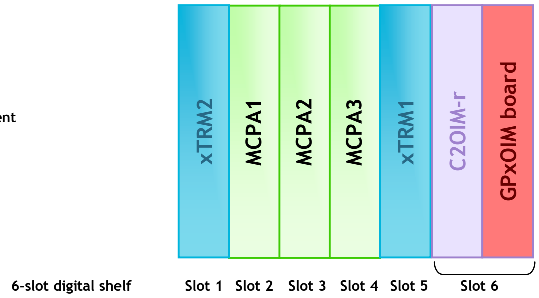
The rBTS 6100 is a radio device designed to be connected to a digital control device via optical fiber links. This digital control device can be either the dBTS 6100 or the dBTS 2U.

The rBTS 6100 operates in the 2100-MHz bandwith.

The rBTS 6100, combined with the dBTS 6100 or the dBTS 2U, offers Macro Node B capabilities in a compact Node B packaging. It constitutes an alternative Macro Node B solution.

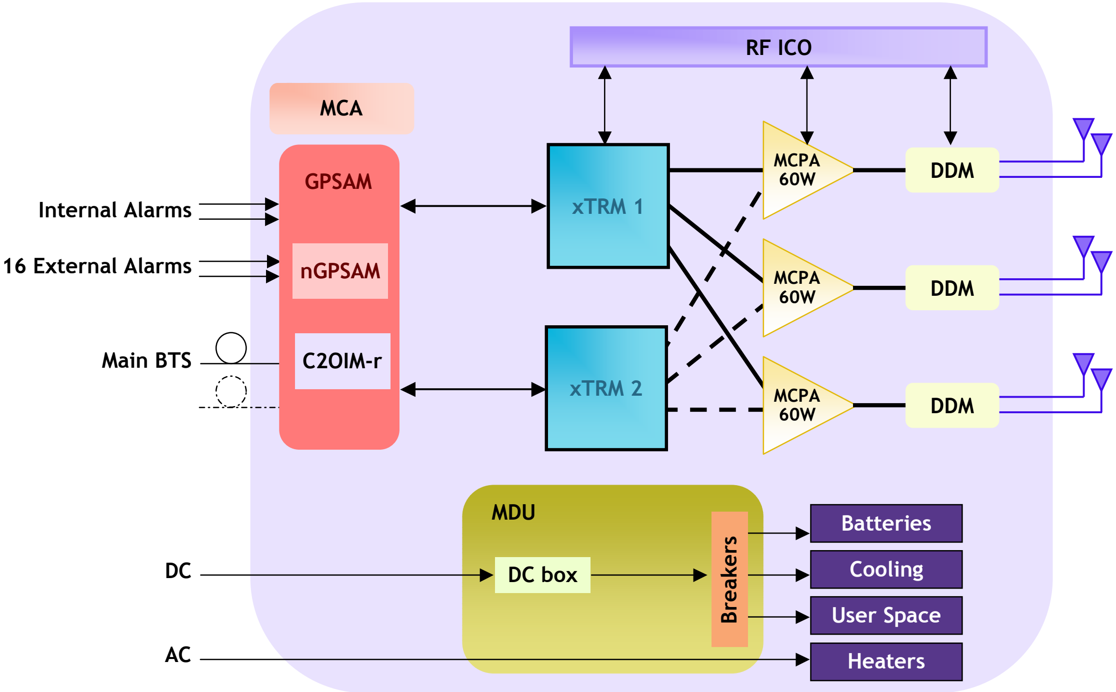
Compartment Layout in the rBTS Outdoor AC/DC Cabinet





The rBTS 6100 is built around the xTRM/PA/GPxOIM compartment, the DDM compartment, the RF interconnection module, the power system, the cooling system, the user compartment and the associated C-user ICO module and the bulkhead.

Radio Shelf Layout



The radio shelf of the UMTS rBTS consists of the backplane and four types of modules. First, the xTRMs convert digital signals into analog signals and analog signals into digital ones (in transmission/reception) and manage part of call processing. Then, signals are sent to / received from the MCPAs 60W which are used to amplify the signal with a pre-distorsion loop. Next, DDMs are responsible for coupling to the antenna in main and diversity paths. The GPxOIM is composed of 2 slots, one containing nGPSAM and one C2OIM-r. nGPSAM supports any external/internal alarm connections and external synchronization. C2OIM-r provides connections to the digital BTS through optical links.

MDU stands for Mixed Distribution Unit. The MDU is responsible for the power system operation of the radio Compact BTS. The MDU allows AC, DC or AC/DC connections. AC power connection is mainly used for heaters and DC power connection is used to distribute the power for user space, cooling and batteries, and so on.

3 BTS Portfolio and Cabinet Specifications

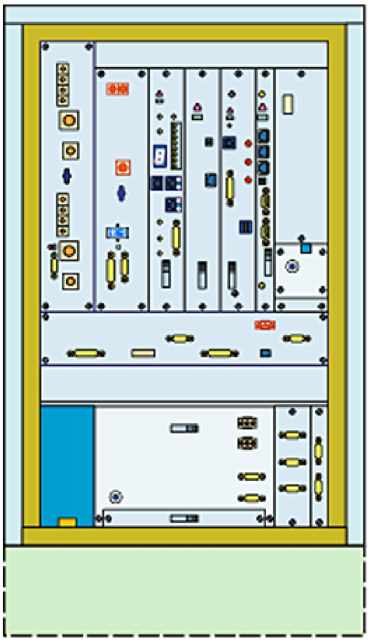
3.6 BTS 1020

Well, what about the BTS 1020?

BTS 1020 (Mono)

Characteristics

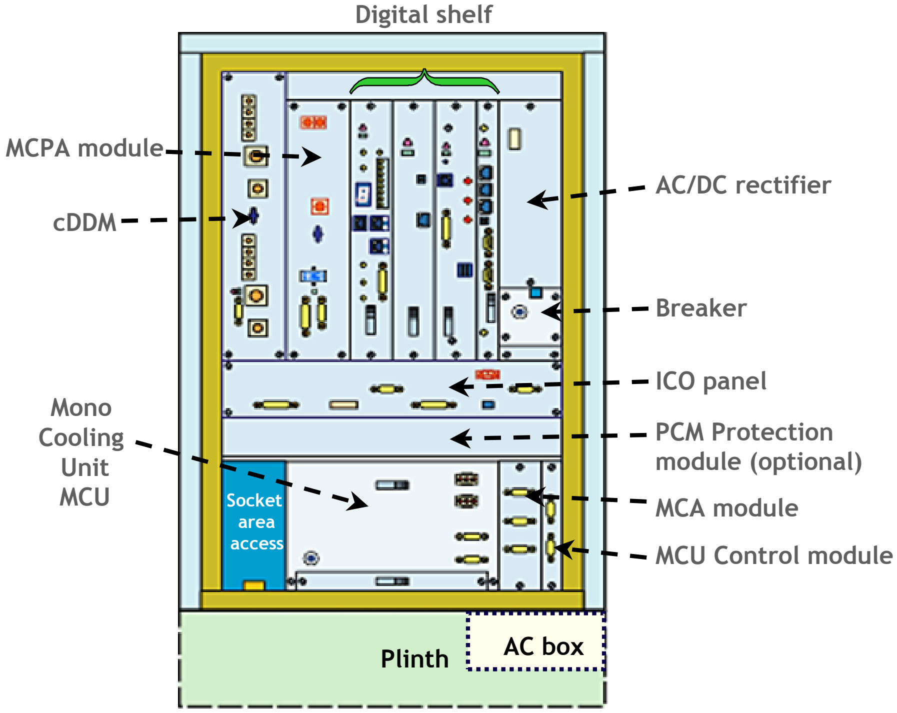
- Fully-integrated omni-cell (O1) site
- Pole, floor, and/or wall mountable
- Optimized size versus capacity ratio:
  - Footprint: 0.27m²
  - Cabinet size (HxWxD): 70 x 46 x 60cm
  - Volume: 193L
- AC/DC Power:
  - AC only (800W max)
  - DC (BTS) -48V DC (–36 to –60), AC (heater)
- Operational Temperature Range: -20°C to +45°C
- Weight: < 90kg
- Acoustic: < 52dB(A) (–20°C < T° < +45°C)

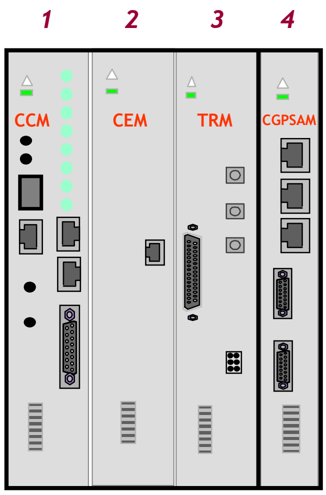


The BTS 1020 is useful to decrease the coverage hole, cover hot spot and/or isolated areas, in building coverage from an outdoor antenna.

The BTS 1020 is an outdoor, single-box solution with an easier site acquisition as it is pole, floor or wall mountable. The BTS has an omni configuration (with 1 sector per carrier) and is equipped with a 30-Watt PA. This BTS is made up of the same modules as the Street, Indoor and Outdoor BTSs. As a consequence, you can use the same spares, which requires less maintenance.

BTS 1020: Cabinet Description





Alcatel·Lucent

The BTS 1020 houses one Dual Duplexer Module (cDDM), one Multi Carrier Power Amplifier (MCPA) and the Digital shelf. The digital shelf houses one CCM/iCCM, one CEM/iCEM, one TRM/iTRM and one 25mm-wide cGPSAM. The BTS 1020 also includes the power system shelf composed of the AC/DC rectifier and the breaker.

TRM, CEM, CCM and cGPSAM share 4 slots numbered from 1 to 4 starting from the left. Slot 4 is half-sized compared to others. CCM is located in slot number 1. CEM is located in slot number 2. TRM is located in slot number 3. Finally, cGPSAM is located in slot number 4.

You can notice that for the BTS 1020, the full and unique configuration is 1 CEM + 1 TRM.

3 BTS Portfolio and Cabinet Specifications

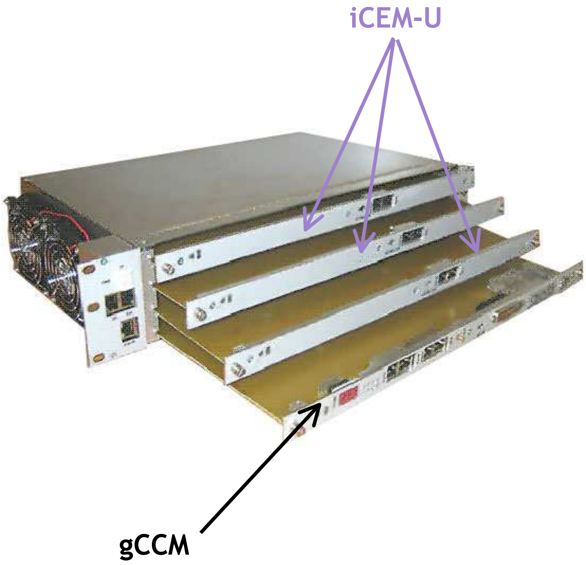
3.7 dBTS 2U

Now, let's define the characteristics of the dBTS 2U.

Description

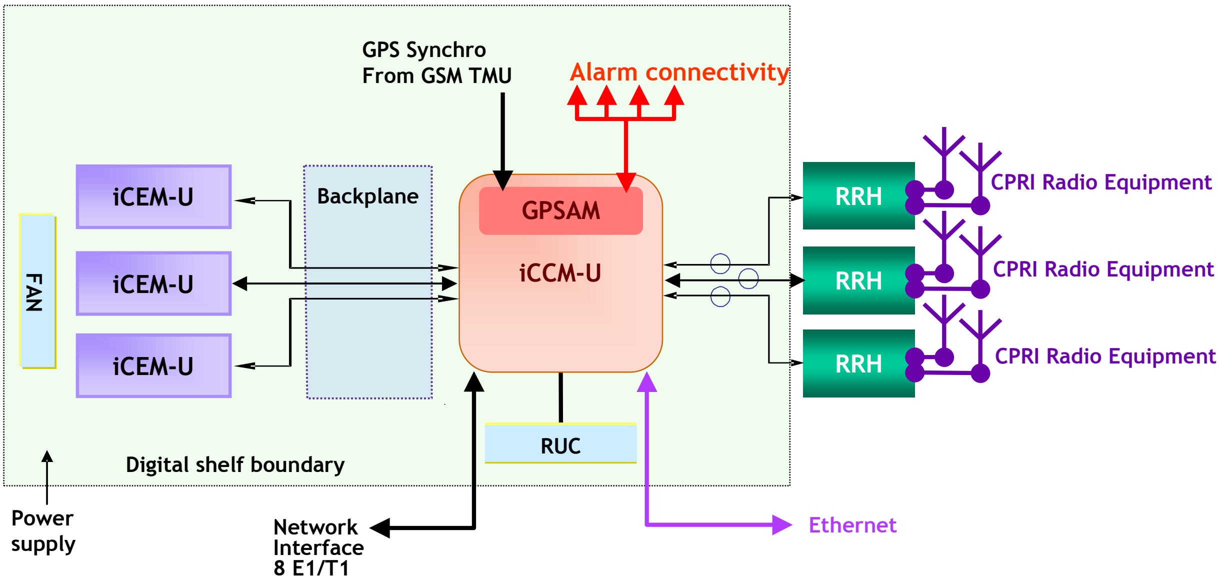
Characteritics

- Dimensions:
  - 2U height equivalent to 88 mm
  - Width according to 19 inches standard (i.e. 482.6mm)
  - Depth: 240mm
- Environmental conditions:
  - IP20
  - Operating temperature range: -5°C to +65°C
- Maximum power consumption: 190W when fully equipped (i.e. 3 iCEM128s)
- Connectivity: up to 8 E1/T1 on backhaul
- Up to 3 iCEM128s for a total of 384 CEs
- Up to 3 RRH CPRIs or HSSLs
- Airflow managed by fans, powered and controlled from the backplane



The dBTS 2U shelf is made up of four different types of modules. gCCM, first, is a single board for CCM, GPSAM and OIM functions in a 21mm-high module. gCCM is in charge of OAM management, part of call processing and internal/external data flow switching/combining, supporting external/internal alarm connectivity and external synchronization reference interface. Then iCEM128 is the same iCEM2-128 but re-routed on a new PCB size in a 21mm-high module. The iCEM128 is in charge of part of call processing, base band transmit/receive digital signal processing. Up to 3 of these modules can be inserted in the shelf. Next the Rack user Back Plane (RBP) is in charge of supporting all internal links between modules. Finally, the Rack User Commissioning (RUC) is in charge of supporting all commissioning non-volatile memories and fan alarms.

Functional Architecture



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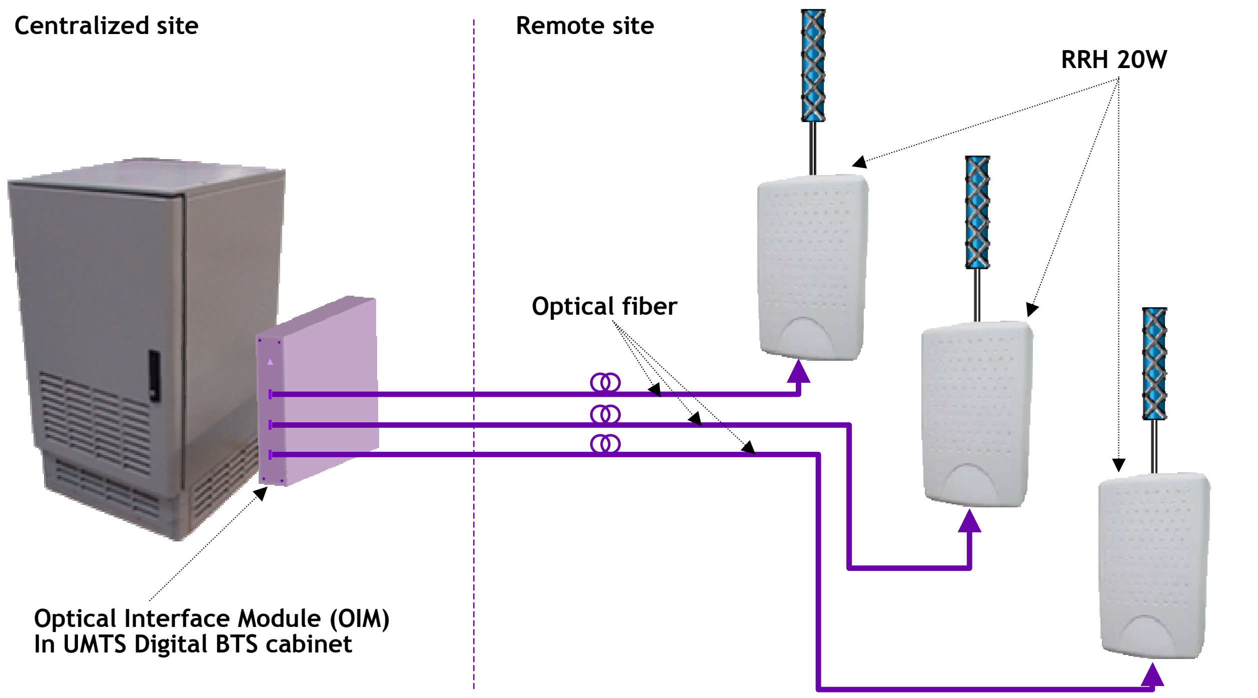
The dBTS 2U comprises two functional types of modules. First, the iCCM-U is in charge of OAM management, part of call processing and internal/external data flow switching/combining, supporting external/internal alarm connectivity and external synchronization reference interface. Second, the iCEM-U is in charge of part of call processing, base band transmit/receive digital signal processing. Up to 3 of these modules can be inserted in the shelf.

3 BTS Portfolio and Cabinet Specifications

3.9 RRH 20W

Let's follow the review of the BTS portfolio by the description of the RRH 20W.

Solution Overview



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The Remote Radio Head (RRH) is designed for macro-cellular applications.

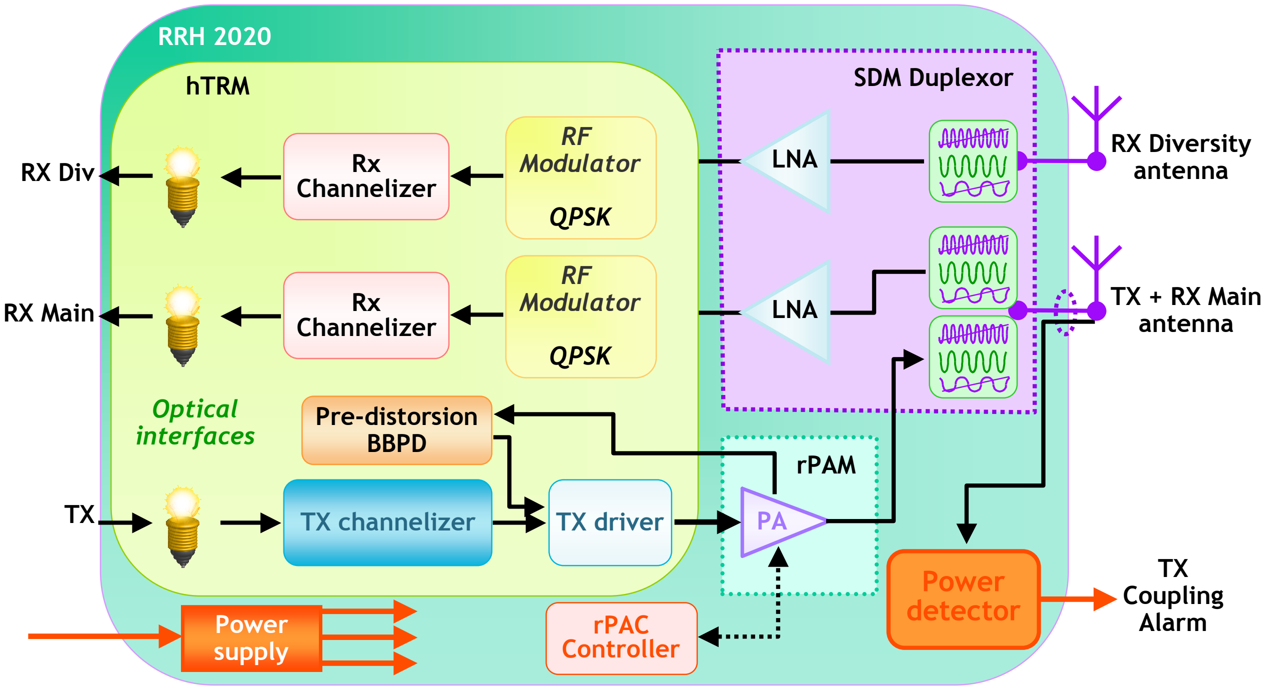
Use of RRH gets the most benefits when replacing a BTS in rooftop installation. In fact, the limited space available in some sites prevents installation of full BTS equipment, thus coverage holes may appear. These sites can however host an RRH installation.

As a result, the installation times and costs are highly reduced. Indeed, the coaxial feeder is replaced by optical fiber. So, the Radio Frequency losses practically disappear.

The Alcatel-Lucent Remote Radio Head solution for UMTS is composed of two modules: the Optical Interface Module (OIM) and the Remote Radio Head (RRH). The OIM is located within the UMTS BTS cabinet, in the digital shelf. The RRH is located on the remote site. RRH is basically a solution to locate the transceiver, MCPA and filter functions remotely from the BTS.

These two modules are linked thanks to optical fibers, carrying UMTS downlink and uplink (main and diversity) base band digital signals, and OAM information.

Functional Architecture



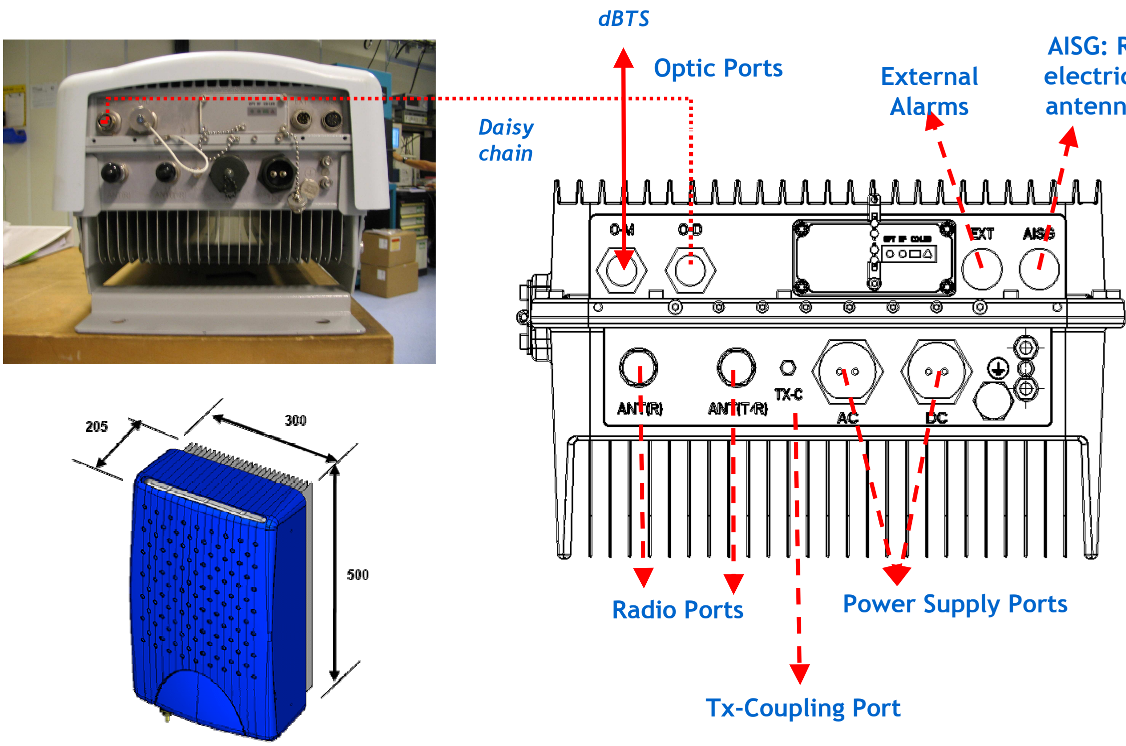
RRH is a single sector and two-carrier 2100MHz self-contained radio module, including one Power Amplifier (PA) and its controller, the hTRM module, the SDM duplexor and the power supply (AC or DC). The hTRM module is made up of two Rx chains (main and diversity), one Tx chain and the optical interfaces.

In downlink, the RRH receives the optical signal from the OIM. The signal is converted into an electrical digital base band signal, which is then converted from digital into analog and up converted into an RF signal. The RF signal is amplified through a power amplifier and sent to a duplexer. The RRH has the capability to measure the transmit RF power and to monitor VSWR alarms.

In uplink, two signals are received from the main and diversity antennas. Each signal is amplified by an LNA and down converted before being converted into digital signals. The signals are then multiplexed according to the required format and converted into optical signals that are sent to the OIM.

The RRH has two antenna ports: one port is connected to a duplexer, which provides the necessary isolation to connect the transmitter and one receiver on the same antenna. The second RRH port enables Rx diversity.

Physical Description



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All interface ports are placed on bottom.

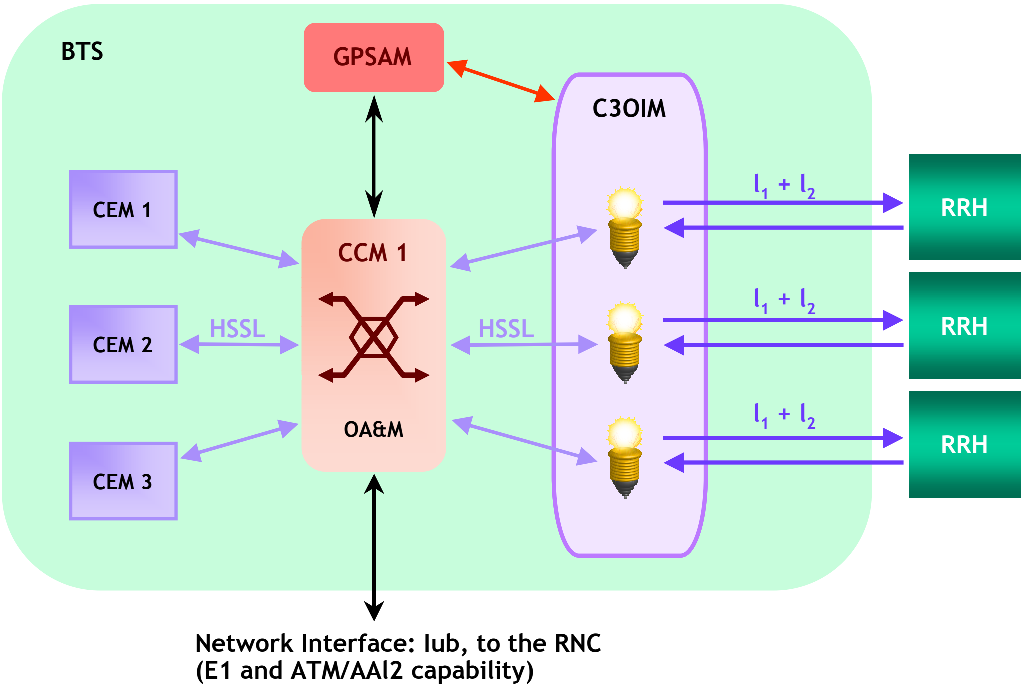
RRH 20W is provided with two optical connectors, one to interface with OIM, the other one for daisy-chain.

RRH is provided with 3 RF connectors that is 2 antenna ports (for N-type connectors) and 1 Tx test port (for 55dB SMA connector).

RRH is also equipped with one AISG RS485 connector, to support RET antenna using AISG protocol.

RRH is able to manage and report two external alarms to the OMC.

Optical Interface Module (OIM)



The Optical Interface Module (OIM) is a module hosted in the BTS that enables the interface between RRH and BTS through optical fibers. This module behaves as an electrical/optical converter.

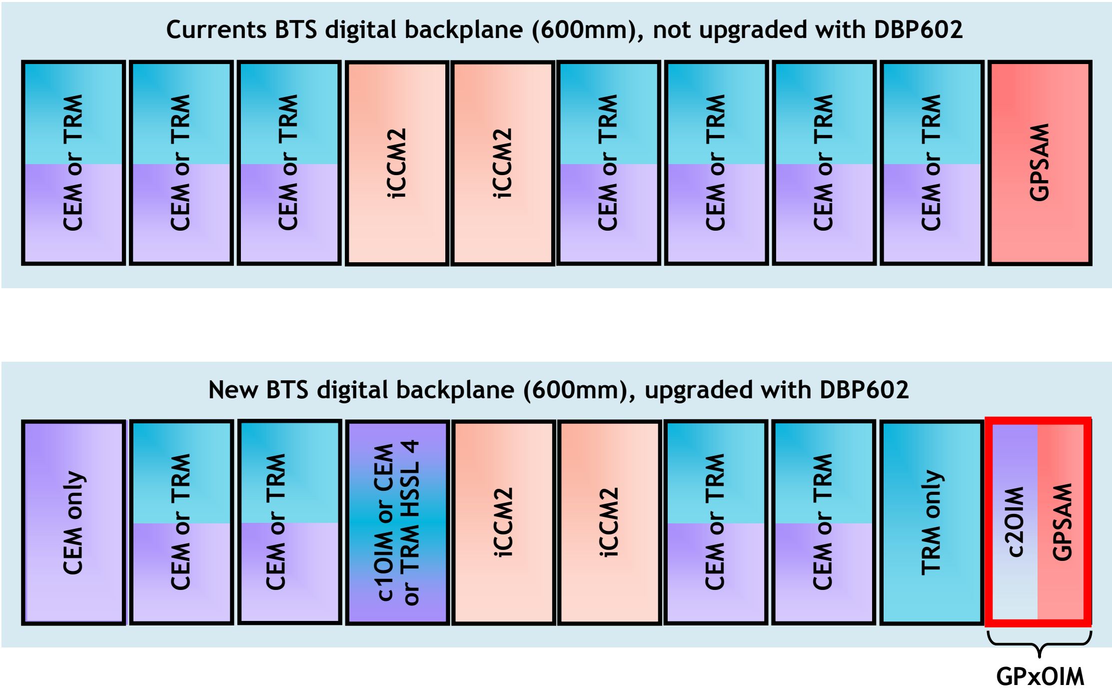
OIM converts digital signals coming from iCCM into optical signals in downlink and does the reverse operation in uplink.

In the BTS, there is one high-speed link for each digital board (CEM, TRM), called HSSL. In the same manner, there is a one-to-one relation between one high-speed link and one fiber link.

In downlink, for each fiber, the OIM board receives HSSL links from the active and standby iCCM2 boards. The OIM selects the HSSL link from the active board and sends its data stream to the optical transceiver. This one converts the signal into an optical one.

In uplink, for each fiber, the OIM optical transceiver (the optical receiver part) converts the optical signals into an electrical HSSL link. The OIM sends the received bit streams to both iCCM2 boards.

GPxOIM and New Backplane DBP602



Alcatel·Lucent

GPxOIM is a module supporting GPSAM functions and ready for CxOIM insertion. It is a 50-mm module on which a GPSAM board and CxOIM board are mounted.

GPxOIM is only supported by BTS 12000-2 and dBTS 6100 equipped with a new digital backplane DBP602.

This new digital backplane is proposed to optimize the number of CEMs for all types of BTS configurations, as without this DBP602, support of one RRH requires the replacement of one CEM by one C1OIM.

3 BTS Portfolio and Cabinet Specifications

3.10 RRH 40W

Let's complete the review of the BTS portfolio by the description of the RRH 40W.

RRH40-21 (2100MHz) and RRH40-19 (1900MHz) Description

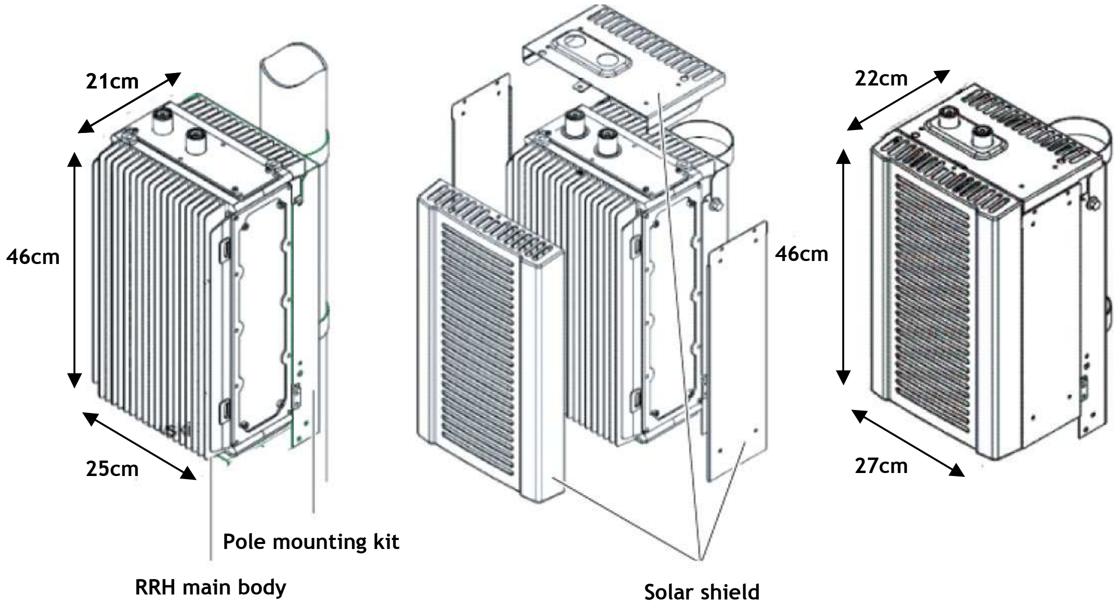
Characteristics

- **High power compact RRH:**
  - 40W – 230W consumption
  - 46 x 25 x 21cm (24L) – 19kg
  - 3 carriers – 10MHz LTE ready
- **Supported from any digital Node B:**
  - d2U
  - dCompact
- **Value:**
  - Enables UMTS easy roll-out
  - OPEX reduction

Alternative Macro Node B solution for UMTS roll-out
Light and zero footprint solution

The main benefits of the RRH 40W are an easier site acquisition and installation, due to small footprint and low weight, significantly reduced RF loss in uplink/downlink as optical fibers replace coaxial feeders and reduced power consumption, and an increased efficiency as the RRH 40W can be located closer to the antenna. Among those main benefits, we can also quote a reduced acoustic noise, due to natural convection cooling, longer battery backup time and reduced maintenance requirements.

RRH40-21 (2100MHz) and RRH40-19 (1900MHz) Hardware Description



The RRH 40W main body mechanics is built around the solar shied, the bottom protection, the mounting kit and the handle.

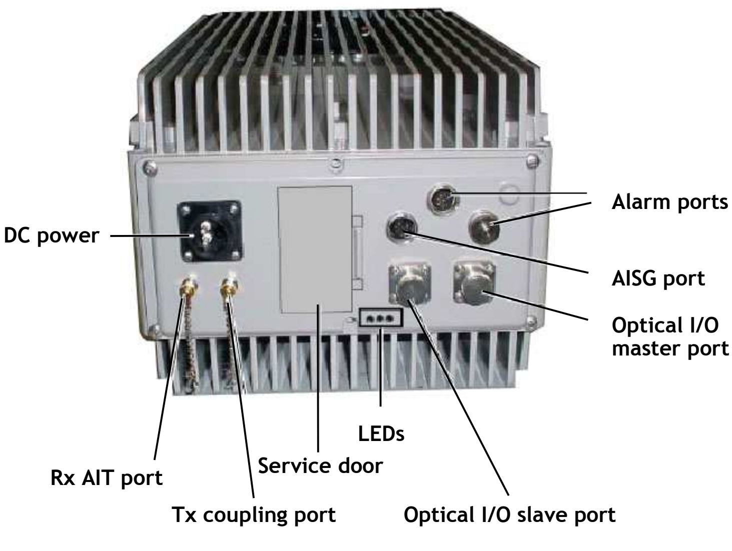
The **solar shield** protects the RRH 40W from solar radiation. It is factory-assembled to the RRH 40W main body.

The **bottom protection** (for RRH40-21) or cable junction box (for RRH40-08) prevents the connectors and connected cables from being exposed to damage when the RRH40-21 is handled or lifted. The bottom protection is factory-assembled to the RRH40-21 main body and should be removed after complete installation of the RRH40-21 on the mounting kit. The cable junction box protects the RRH40-08 external interfaces from climatic conditions.

The **mounting kit** is required to install the RRH 40W on a wall, a pole or a floor.

Finally the **handle** facilitates installation. It is factory-assembled to the RRH 40W main body and should be removed after installation.

RRH40 (2100MHz) and RRH40 (1900MHz) Hardware Description [cont.]



With the help of the above 2 pictures, we are going to locate the input and output ports of the RRH 40W . On the left picture, you can see for example that the RRH 40W is equipped with optical ports which have to be connected to the digital BTS through optical fibers.

The right picture shows that the RRH 40W is equipped with only 2 ouptut ports: the main and the diversity antenna ports.

RRH40-08 (850MHz) Description

Characteristics

- High power compact RRH
- 40W – 280W power consumption
- 50 x 40 x 17cm (34L) – 22kg
- 2 carriers
- Supported from any digital Node B:
  - d2U
  - dCompact
- Value:
  - Enabler for UMTS850 easy roll-out
  - OPEX reduction

Alternative Macro Node B solution for UMTS 850MHz roll-out
Zero footprint solution to upgrade 2G sites to UMTS 850MHz

Alcatel·Lucent

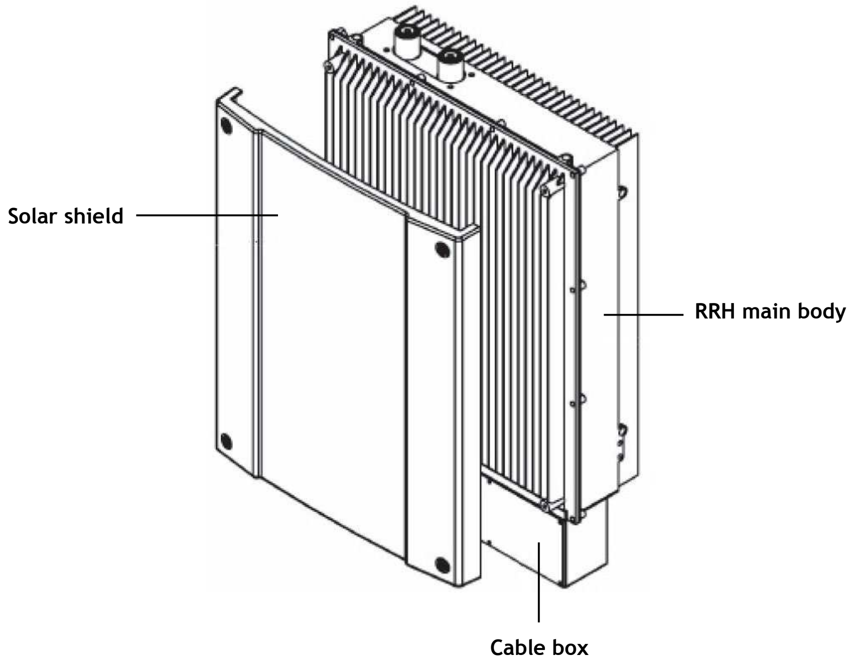
The RRH 40W solution is based on the remote RF block concept, and involves the centralized Node B site and the remote RRH site.

The RRH 40W solution provides operators with a suitable solution whatever the site constraints. It is particularly suitable for macro-cellular application in dense areas, where site acquisition is difficult, and on sites where installation constraints prevent the use of regular full size macro Node B (BTS 12010 (indoor) or BTS 12020 (outdoor)).

The RRH 40W solution is compliant with the Common Protocol Radio Interface (CPRI).

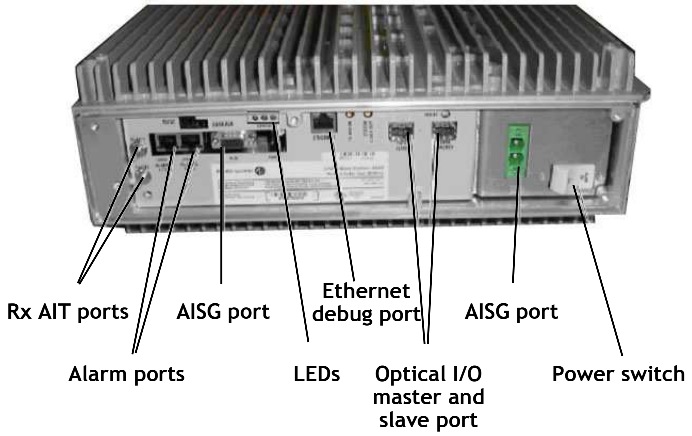
The RRH 40W modules deliver 40W nominal composite RF power at antenna port and support up to 3 contiguous frequency carriers: 40W x 1 frequency carrier, 20W x 2 frequency carriers and 13W x 3 frequency carriers (only with RRH40-21).

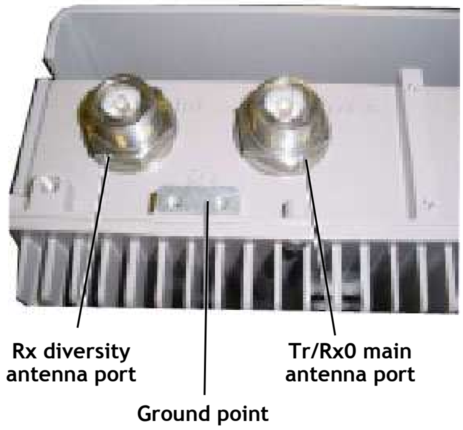
RRH40-08 (850MHz) Hardware Description



In the RRH 40W solution, the transceiver, power amplifier, and filter functions are located as close as possible to the antenna, on the remote RRH site, far away from a main Node B cabinet located on the centralized Node B site. The remote RF part (or Radio Frequency Module, for RRH40-08) interfaces with the digital shelf of the main Node B cabinet (or Base Band Unit, for RRH40-08) via an optical fiber link.

RRH40-08 (850MHz) Hardware Description [cont.]





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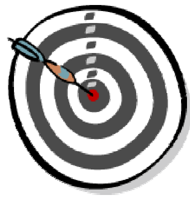
The RRH40-08 is equipped with the same input and output ports as the RRH40-21 and RRH40-19.

4 Optional Equipment & OAM

To end the training, let's take an interest in the optional equipment and OAM.

Objectives



Objectives:

To be able to:

- identify the optional equipment.
- identify maintenance tools that apply to the BTS.

Content:

4.1 Optional Equipment

4.2 OAM

In this last section, we are going to identify the optional equipment of the BTS.

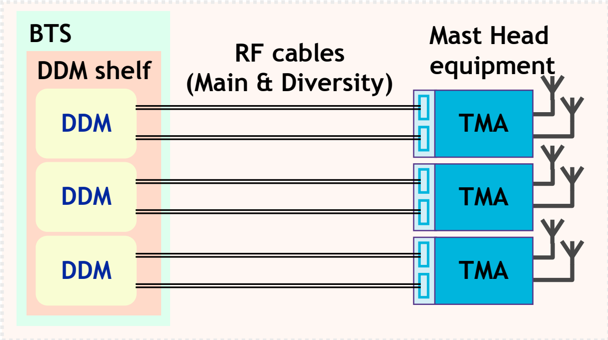
Then, we will briefly describe how the BTS OAM is organized.

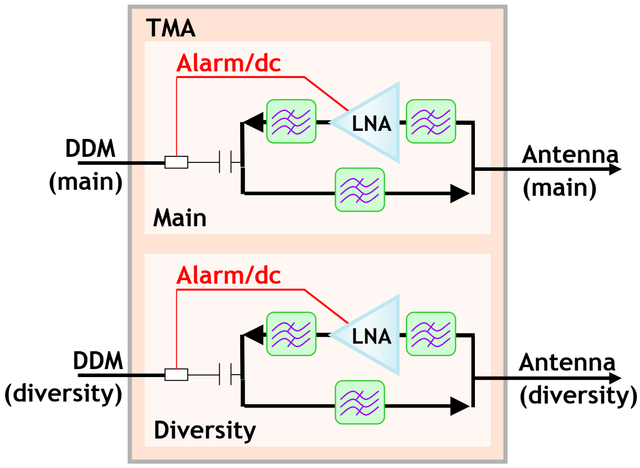
4 Optional Equipment & OAM

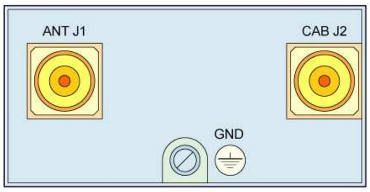
4.1 Optional Equipment

Let's first determine what the optional equiment of the BTS are.

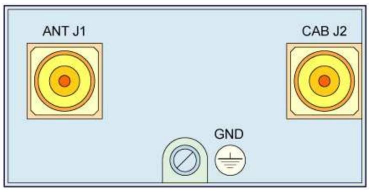
Tower Mounted Amplifier (TMA)







Double Light TMA 2100 module



Single TMA 1900 module

Alcatel·Lucent

The main purpose of the Tower Mounted Amplifier (TMA) is to decrease the overall noise of the system by amplifying the received signal.

The TMA is a Low Noise Amplifier (LNA) designed to be mounted as close as possible to the antenna system. The TMA compensates the feeder loss on the receiving path by amplifying the received signal at the top of the mast head equipment.

The TMA has a gain of 12dB.

The advantages of placing an amplifier on the tower are an increase in uplink budget (at BTS level), a better coverage in rural areas (at cell level) and an increased battery life (at UE level).

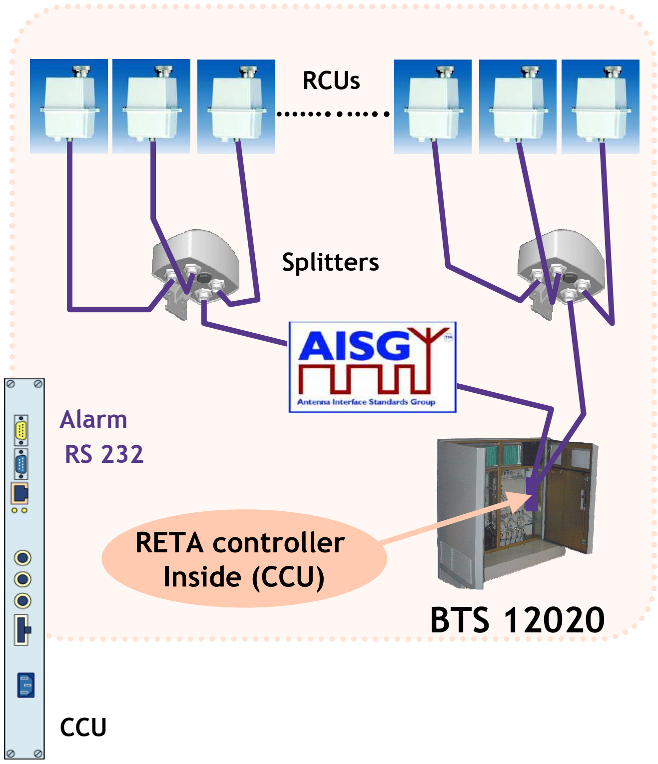
The LNAs are powered from the BTS at DDM level through the RF coaxial cable.

LNA monitoring is integrated in the BTS cabinet. Alarms are monitored by the DDMs and are reported to the Digital shelf.

Remote Electrical Tilt Automatic (RETA) – (1/2)

RETA: Integration of Kathrein CCU

- Save operational expenses
  - 60% of site antennas would be revisited during the optimization period at least once to change the tilt
  - 50% of the sites would be impacted during densification processes
- Integrated RETA controller
  - Included in UMTS BTS 12020 user space
  - IOT between Kathrein CCU and OEM antennas
  - Management is made through the UMTS BTS iCCM Ethernet port
- Optimized installation
  - Up to 100 meters control cable
  - Up to 9 antennas per CCU
  - Optional Smart bias Tee



Alcatel·Lucent

The Remote Electrical Tilt Automatic (RETA) feature allows the user to adjust remotely the tilt of any antenna sector from the OMC-B (over IP) through the BTS.

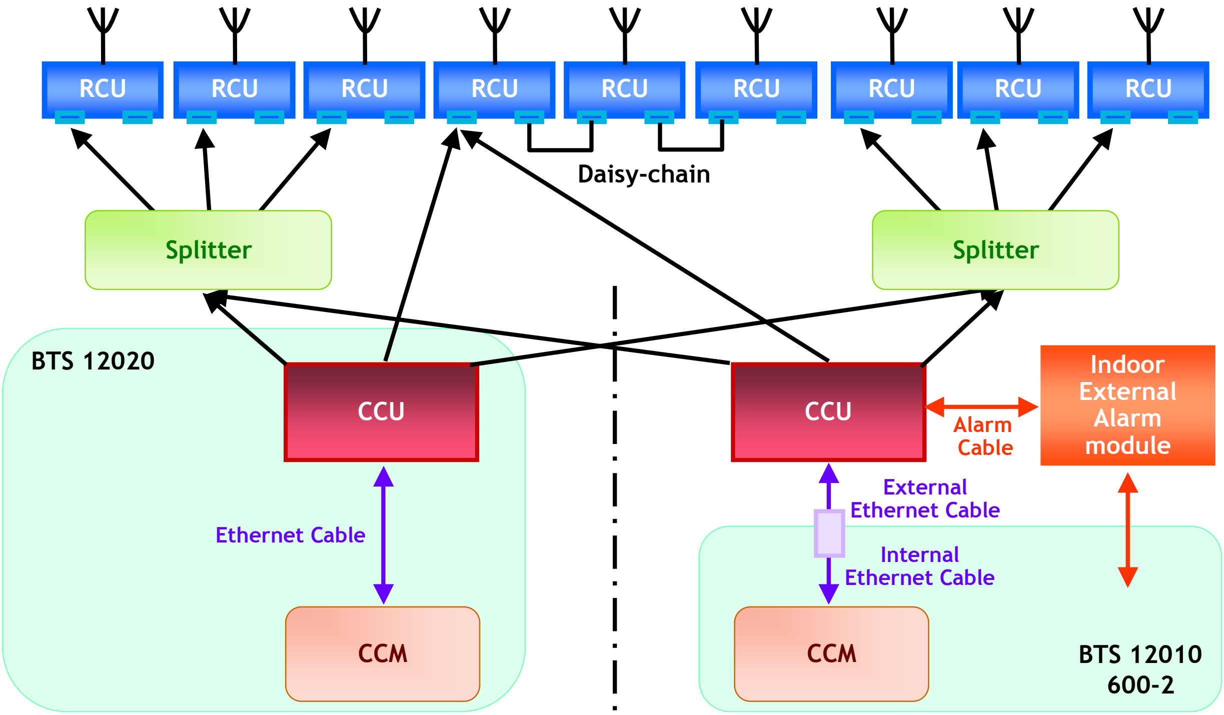
The RETA allows to improve coverage and capacity and to reduce interference.

All the antennas for one BTS are operated from one Central Control Unit (CCU).

For the BTS 12020-2, the CCU module is integrated in the User Space.

For the BTS 12010 - 600 - 2, the CCU module is located outside the cabinet.

Remote Electrical Tilt Automatic (RETA)- (2/2)



Alcatel·Lucent

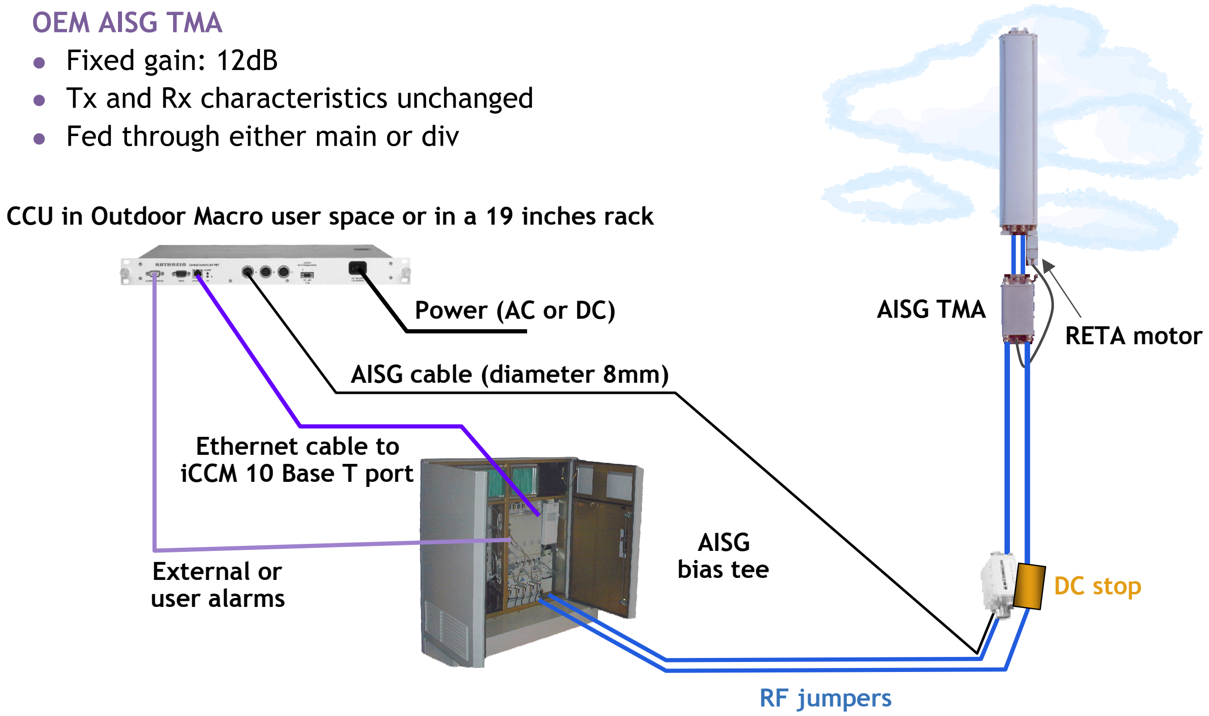
The RETA hardware system is composed of one Central Control Unit (CCU) module, none or up to three splitters according to the BTS configuration, one (or up to nine per site) Remote Control Unit (RCU) module and one cable per site for the DC power and data.

The CCU module is connected to the CCM module via the Ethernet 10BASE-T link on one side and the RCU module via control cables on the other side.

RETA Integration with AISG TMA with Current DDM

OEM AISG TMA

- Fixed gain: 12dB
- Tx and Rx characteristics unchanged
- Fed through either main or div



Alcatel·Lucent

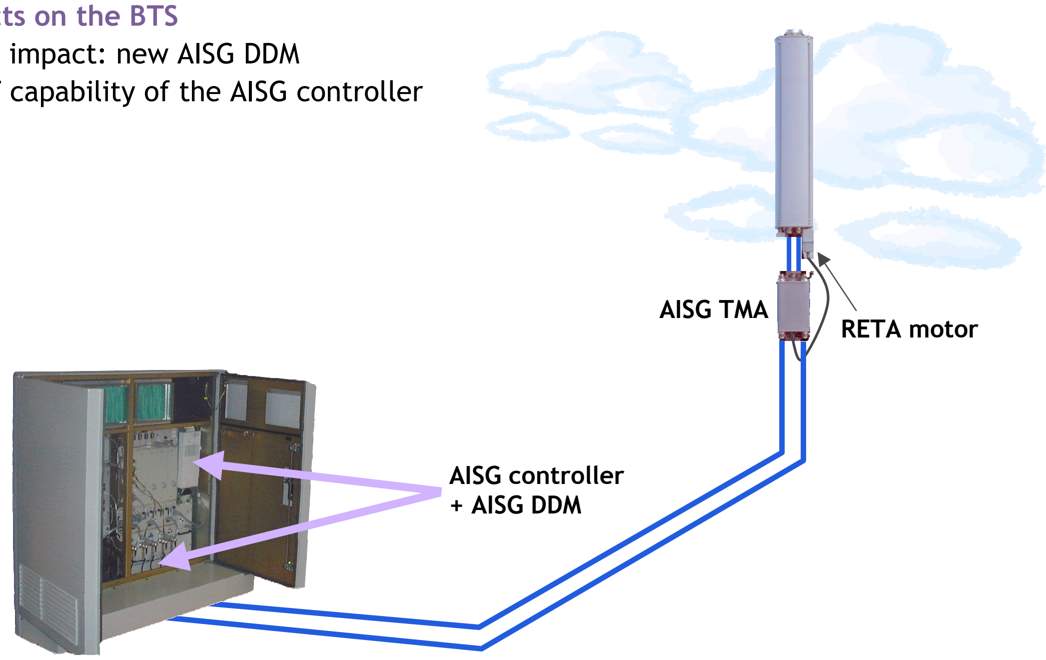
This diagram shows how RETA integration with AISG TMA with current DDM is achieved inside the outdoor macro BTS.

3 cables must be linked to the CCU board: first the AISG cable, then the Ethernet cable to the iCCM and finally the external or user alarms cable.

RETA Integration with AISG TMA and AISG DDM

Impacts on the BTS

- HW impact: new AISG DDM
- IOT capability of the AISG controller



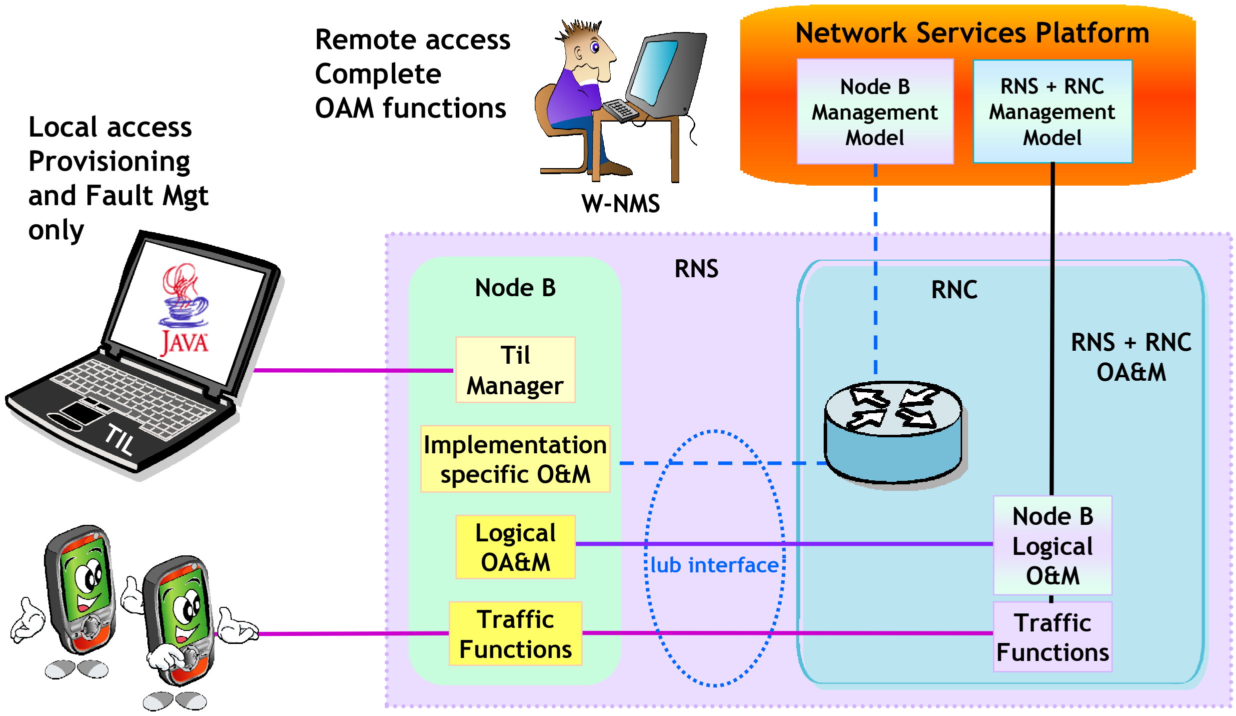
In this configuration, the AISG controller and DDM are integrated to the BTS contrary to the previous configuration. The AISG controller is installed at user slot level.

4 Optional Equipment & OAM

4.2 OAM

Let's terminate the BTS description by a brief overview of the OAM organization.

Overview



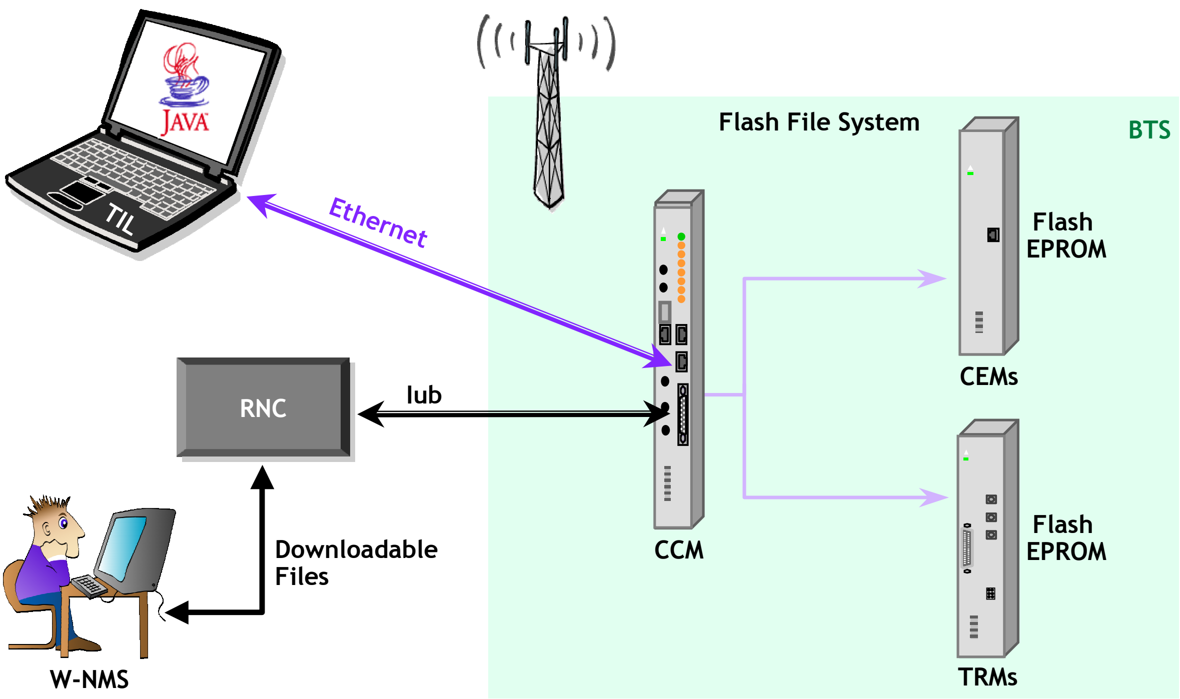
Alcatel·Lucent

The BTS OAM can be done using two methods. First, the user can access all the BTS OAM functions remotely from the OAM Access application, running on the W-NMS platform. Second, the user can access locally the Provisioning and Fault management functions only, from the TIL application.

The OAM of Node B is divided into two parts. The first part called "Implementation Specific O&M" is the O&M linked to the actual implementation of Node B. The second part called "Logical O&M" is the O&M which impacts on the traffic carrying resources in Node B controlled from the RNC.

The OAM connectivity is based on standard IP over Ethernet.

Software Organization



Alcatel·Lucent

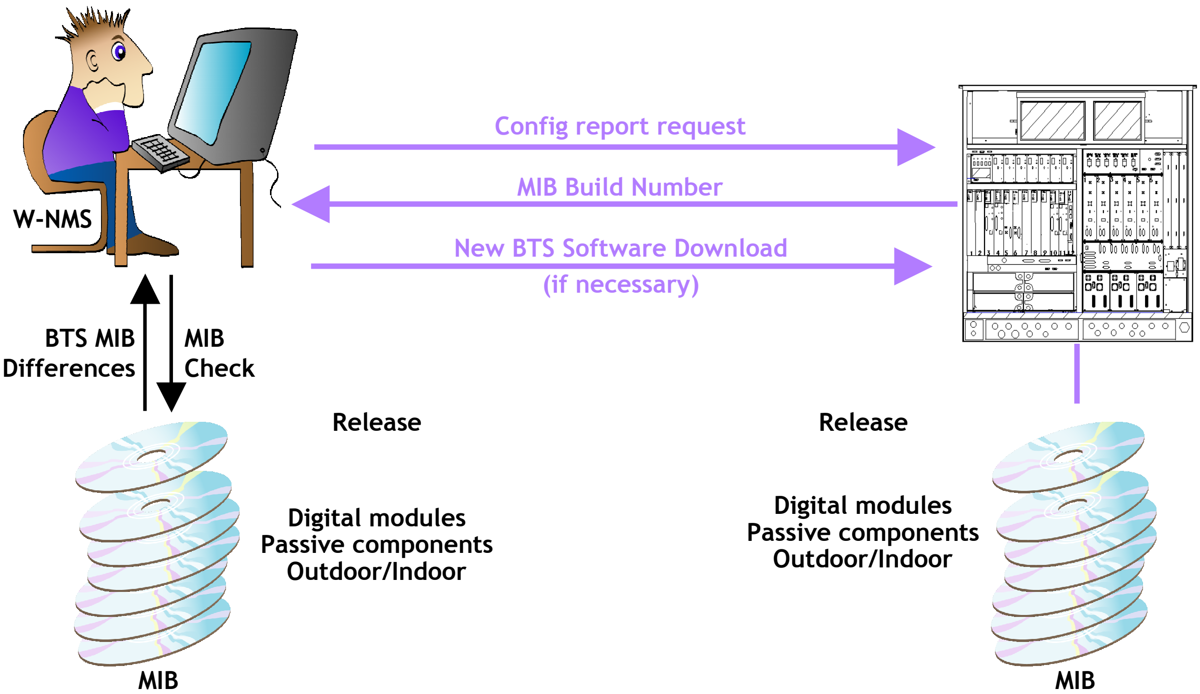
The BTS software is composed of a BTS platform able to support multiple radio system and a system dedicated software for UMTS system.

OMC-B takes in charge the download and the activation of software for each module and for each BTS it manages. These files are located on the OMC-B, and can be transferred through the RNC.

Files are downloaded first into the CCM, which does not have any mass storage, but only a flash memory of limited size.

Another possible option is to have files on a CD-ROM and download them from the TIL through Ethernet.

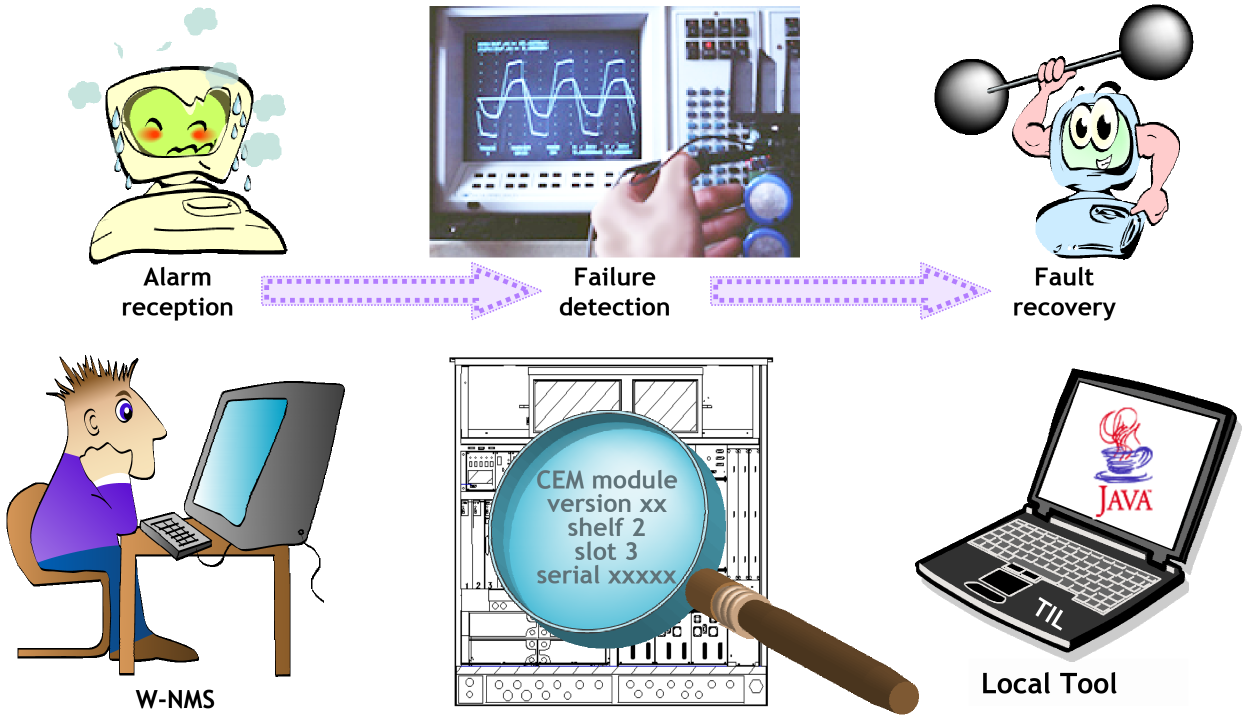
Software Customization



The Management Information Base or MIB is a database containing a set of data concerning the BTS. This database is used by the OMC-B to update the configuration. The MIB is located in both the OMC and the CCM. These two databases must be synchronized.

Therefore, after a first OMC/BTS connection, a config report request is sent by the OMC-B. The BTS reports its Mib identifier (called BuildNumber), and consistency checks are performed. The MIB contains information like Mib Build Number, List of modules, List of Passive Components, IMA/PCM configuration, or Active and Passive Software.

Maintenance Overview



The BTS design has been optimized to facilitate its maintenance. Indeed, all parts of equipment are accessible from the front of the cabinet. Then Remote software and hardware inventory can be carried out from the W-NMS. Next, remote localization of key components enables efficient preventive and corrective maintenance processes, by reducing intervention time. Finally, hot insertion of active modules is possible.

The Wireless-Network Management System (W-NMS) UMTS solution simplifies the increasingly complex task of network and service management. Indeed, W-NMS integrates a comprehensive set of tools and applications into a coherent management solution targeted for UMTS service providers.

5 Appendix

Before you take the final test, let's have a look at some useful information concerning the new re-branding/re-naming rules for all Alcatel-Lucent portfolio (for the former-Nortel products). We'll also give you some information about the use of all these products according to the frequency bands.

Re-Naming and Re-Branding

Alcatel-Lucent 9 3 X Y

- 9 — Wireless Business Group
- 3 — WCDMA
- X — Category equipment
- Y — Additional information

X

0 = RNC
1 = NodeB
2 = digital NodeB (2U, dCompact, etc.)
3 = radio NodeB
4 = RRH
5 = OAM
6 = BSR
7 = reserved
8 = reserved
9 = ex-Lucent NodeB, Street BTS

Y

If X = NodeB, radio NodeB, digital NodeB, RRH, BSR:
1= Macro
2 = Compact
3 = Micro
4 = Pico
5 = Femto
6 = 19 inch solution (2U, 4U)
7 to 9: reserved

Indoor/outdoor not captured in a digit; added -i or -o if needed/relevant

XX connected to YY when the digital is not integrated to the radio:
Use "+" (d2U + RRH40 or d2U + rCompact)

XX integrated in YY when the digital is integrated into the radio solution
Use "in" (2U in rCompact)

Note that this is mechanical integration, but still managed like a distributed solution at O&M; unlike the Multi-standard or the Compact NodeB

Alcatel-Lucent

Each Alcatel-Lucent product is named following the same rules. In the product name Alcatel-Lucent 93xy which is given as an example in this slide, 9 stands for Wirelesss Business Group, 3 stands for W-CDMA, x stands for the product (that is RNC/NodeB) and y stands for the type of the product such as macro/micro/pico.

Re-Naming and Re-Branding [cont.]

New Alcatel-Lucent Product Names	Quick Names
Alcatel-Lucent 9311 Macro NodeB Indoor	Macro Indoor
Alcatel-Lucent 9311 Macro NodeB Outdoor	Macro Outdoor
Alcatel-Lucent 9312 Compact NodeB Indoor	Compact Indoor
Alcatel-Lucent 9312 Compact NodeB Outdoor	Compact Outdoor
Alcatel-Lucent 9313 Micro NodeB	Micro
Alcatel-Lucent 9314 Pico NodeB	Pico
Alcatel-Lucent 9322 digital Compact NodeB Indoor	dCompact Indoor
Alcatel-Lucent 9322 digital Compact NodeB Outdoor	dCompact Outdoor
Alcatel-Lucent 9326 digital 2U NodeB	d2U
Alcatel-Lucent 9326 digital 4U NodeB	d4U
Alcatel-Lucent 9332 radio Compact NodeB Indoor	rCompact Indoor
Alcatel-Lucent 9332 radio Compact NodeB Outdoor	rCompact Outdoor
Alcatel-Lucent 9341 RRH 20w 2100MHz	RRH20-21
Alcatel-Lucent 9341 RRH 40w 2100MHz	RRH40-21
Alcatel-Lucent 9341 RRH 40w 850MHz	RRH40-08
Alcatel-Lucent 9341 RRH 40w 1900MHz	RRH40-19
Alcatel-Lucent 9341 RRH 40w 900MHz	RRH40-09
Alcatel-Lucent 9341 RRH 40w 2100MHz (band IV)	RRH 40-21 (IV)
Alcatel-Lucent 9365 BSR Femto	BSR Femto

Using the new re-branding and re-naming rules, a new list of products is defined. Each product is also given a quick name as you can see in the list on the right.

Re-Naming and Re-Branding [cont.]

Former Names	New Names (Quick Names)
UMTS BTS 12010, version 2 (Indoor 2)	9311 Macro NodeB Indoor (Macro Indoor)
UMTS BTS 12020, version 2 (Outdoor 2)	9311 Macro NodeB Outdoor (Macro Outdoor)
UMTS dBTS 6110 (dBTS 6100 Indoor)	9322 digital Compact NodeB Indoor (dCompact Indoor)
UMTS dBTS 6120 (dBTS 6100 Outdoor)	9322 digital Compact NodeB Outdoor (dCompact Outdoor)
UMTS rBTS 6120 (dBTS 6100 Outdoor)	9332 radio Compact NodeB Outdoor (rCompact Outdoor)
UMTS dNodeB 2U	9326 digital 2U NodeB (d2U)
UMTS BTS 1120 (Micro)	9313 Micro NodeB (Micro)
UMTS BTS 1010 (Pico)	9314 Pico NodeB (Pico)
UMTS BTS 12010 – 600 (Indoor 600)	N/A
UMTS BTS 12010 – 700 (Indoor 700)	N/A
UMTS BTS 12020, version 1 (Outdoor)	N/A
UMTS BTS 6020 (Street)	N/A
UMTS BTS 6010 (Compact Indoor)	N/A
UMTS BTS 1020 (Mono)	N/A

This table summarizes all former-Nortel names and the correspondance to the new Alcatel-Lucent names.

For example, the former BTS12010 is now named as Alcatel-Lucent 9311 Macro Node B Indoor. Its quick name is Macro Indoor.

BTS Models vs. Frequency Bands

	Band			
	850MHz	900MHz	1900MHz	2100MHz
Alcatel-Lucent 9311 Macro ID	X	X	X	X
Alcatel-Lucent 9311 Macro OD	X	X		X
Alcatel-Lucent 9312 Compact ID			X	
Alcatel-Lucent 9312 Compact OD				X
Alcatel-Lucent 9313 Micro Node B				X
Alcatel-Lucent 9314 Pico Node B				X
Alcatel-Lucent 9322 digital Compact Node B ID	dependent of the radio part			
Alcatel-Lucent 9322 digital Compact Node B OD	dependent of the radio part			
Alcatel-Lucent 9326 digital 2U Node B	dependent of the radio part			
Alcatel-Lucent 9326 digital 4U Node B	dependent of the radio part			
Alcatel-Lucent 9332 radio Compact Node B OD				X
Alcatel-Lucent 9341 RRH 20W				X
Alcatel-Lucent 9341 RRH 40W	X		X (end 2008)	X

Note that **Alcatel-Lucent 9341 RRH 40-08** can only be used with the former Lucent digital BTS or **Alcatel-Lucent 9326 digital 2U Node B.**

Version 2 is not yet available at UA05.1 start.

6 Test Yourself

This is the end of this e-learning training.
Thank you for your attention.
Now, you are invited to take the test about the BTS Description.

Test Yourself

You have reached the end of this module.

You are invited to self-assess your knowledge.

Therefore, answer the following 13 questions beginning on the next page!

Click here to launch the test.

End of Module

Alcatel·Lucent