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9300 NodeB
UA07 Description
TMO18252 D0 SG DEN I1.0

STUDENT GUIDE

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Course Outline

Module 1: Description of the BTS Modules

Module 2: Description of the BTS Types

Appendix: Abbreviations Alcatel-Lucent UMTS BTS

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Course Objectives

Welcome to the course Hardware Description of the Alcatel-Lucent 9300 Macro NodeB in Release UA07.

Upon completion of this course, you should be able to:

- Identify the different module types.
- List the main features and characteristics of the modules.
- Identify the optional equipment.
- Describe the Alcatel-Lucent BTS portfolio.
- Identify the different types of BTS within the UTRAN portfolio.
- List the main features and characteristics of each BTS type.
- Understand the Remote Radio Head functionality.
- Explain the benefit of the distributed NodeB solutions.
- List the Alcatel-Lucent Remote Radio Head products.

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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.

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Where you can get further information

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- 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 :	9300 NodeB UA07 Hardware Description
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	Identify the different module types			
2	List the main features and characteristics of the modules			
3	Identify the optional equipment			
4	Describe the Alcatel-Lucent BTS portfolio			
5	Identify the different types of BTS within the UTRAN portfolio			
6	List the main features and characteristics of each BTS type			
7	Understand the Remote Radio Head functionality			
8	Explain the benefit of the distributed Node B solutions			
9	List the Alcatel-Lucent Remote Radio Head products			

Self-assessment of Objectives [cont.]

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

Other comments

Thank you for your answers to this questionnaire

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Section 1
Macro NodeB UA07 Description

Module 1
Description of the BTS Modules
TMO18252 D0 SG DEN I1.0

9300 Node B
Macro NodeB UA07 Description
TMO18252 D0 SG DEN I1.0

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Document History			
Edition	Date	Author	Remarks
1.0	2008-12-12	Kieslich, Roland	First edition in Release UA06
1.9 Draft	2010-05-12	Kieslich, Roland	Update to Release UA07: xCEM/xCEM-U support 64QAM Optical Interface Modules

Module objectives

Upon completion of this module, you should be able to:

- Identify the different module types
- List the main features and characteristics of the modules
- Identify the optional equipment

Description of the BTS Modules:

In this section, we are going first to identify the types of modules used in the BTS within the UTRAN portfolio. A module is a piece of hardware supporting several functions of the BTS.

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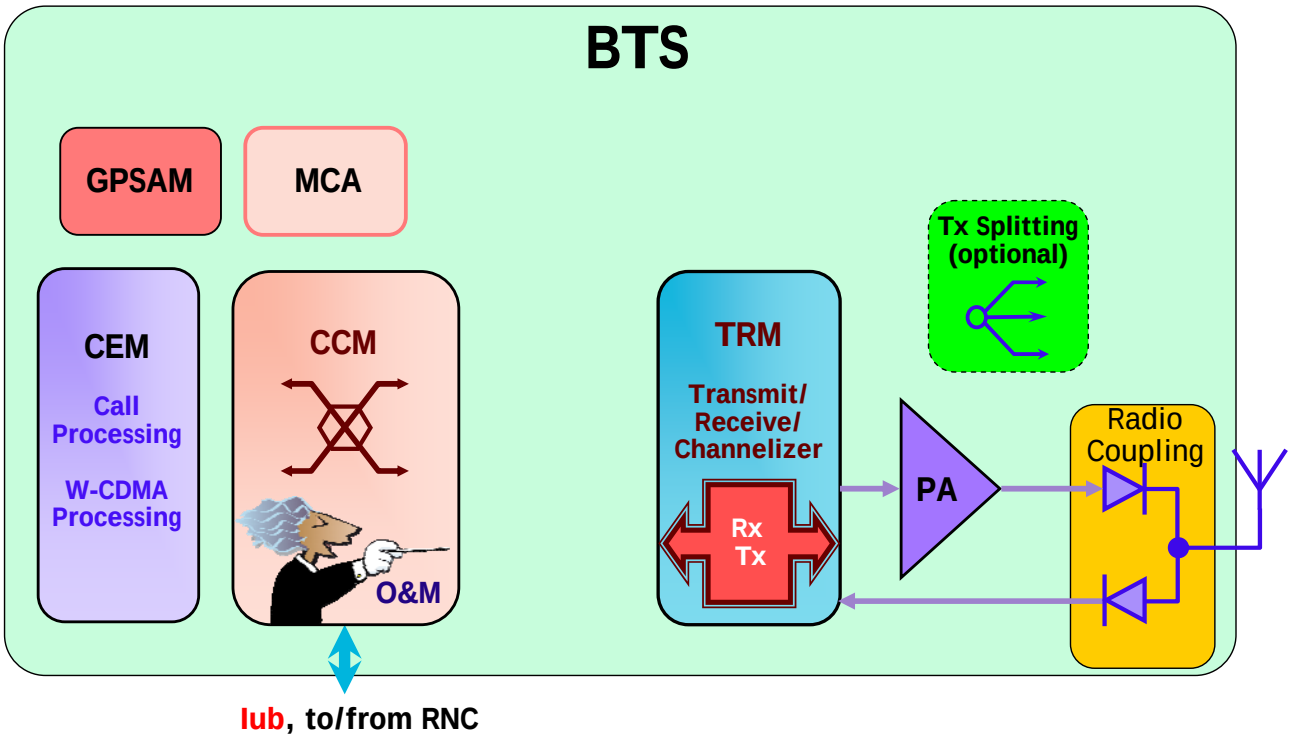
1 Functional architecture of the BTS

1.1 Functional blocks in the BTS



The following functional blocks exist in the BTS:

CCM: The Core Control function can be regarded as the “brain” of the NodeB. It does the Operation and Maintenance and controls all the other functions.
It communicates to the RNC via the network interface, furthermore it generates the clock and synchronizes it.

CEM: The Channel Element function transforms the traffic data into signals for Wide-band Code Division Multiple Access (**W-CDMA)** and does a part of the call processing.

TRM: The Transmit Receive function adapts the Wide-band Code Division Multiple Access signals to the radio interface by shifting the frequency spectrum.
The Channel Element function and the Transmit Receive function are not directly connected, they exchange signals via a switch in the Core Control function.

PA: The Radio Transmission Power Amplification lifts the power level of the radio carrier to cover the area of the cells.

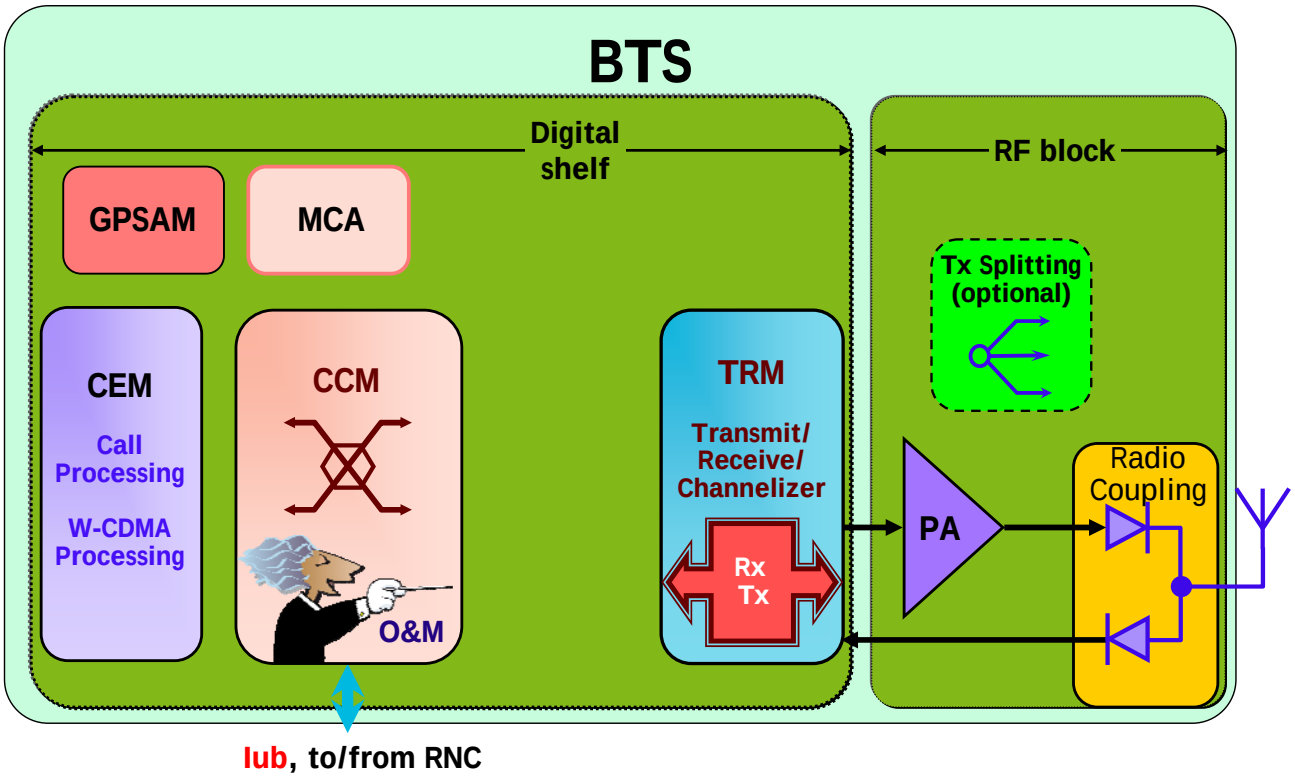
Radio Coupling: The radio coupling picks up the amplified radio carriers and distributes them to the antennas in each sector for the downlink direction.
In uplink direction it amplifies the received signals and distributes them to several Transmit Receive functions to support a main and a diversity path for each data transfer.

In some configurations a optional **Tx-Splitting** distributes the amplified radio carriers to the radio coupling.

MCA: The Manufacturing, Commissioning and Alarm function stores installation and commissioning parameters, inventory data and reports the internal alarms.

GPSAM: External alarms enter the NodeB via the Global Positioning System and Alarm function**.** Another optional function of the GPSAM is the interface to an external clock reference, for example a Global Positioning System satellite receiver. Keep in mind that in standard mode the clock is not synchronized to this external reference but to the network interface.

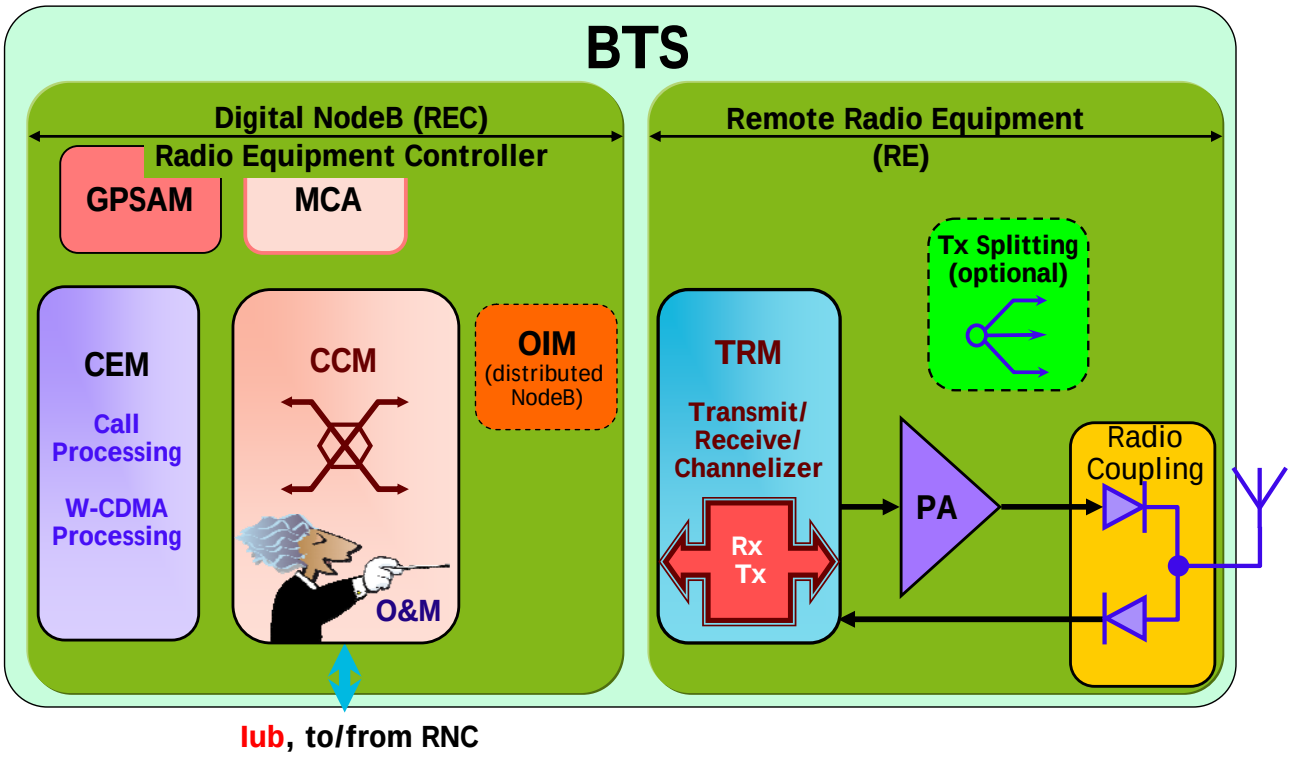
1.2 Split into digital shelf and RF block



In the case of a **conventional NodeB** we split into two main groups:
On the right side the functions power amplification, splitting and radio coupling set up the so called "radio frequency block" (**RF**).

A second set of functions is done by the so called "Digital shelf" on the left side. It executes the Core Control function, the Transmit Receive function, the Channel Element function and the functions MCA and GPSAM.

1.3 Functional blocks in the distributed BTS



Remember that there exist two main architectures of Alcatel-Lucent NodeBs. One is the conventional NodeB with all the modules in one rack, the other one is the distributed NodeB, where a centralized digital part is separated from the remote radio part. Such a remote radio part contains Transmit Receive functions, Power Amplification and Radio Coupling.

OIM: In the case of **distributed NodeBs** the Optical Interface function connects the remote radio part to the Core Control function via an optical link. This interface fulfills the standard Common Public Radio Interface or **CPRI.**

2 Core Controller Modules (CCM)

The first type of modules to be explained is the Core Control Module. It does the following sub functions:

First it does the network interface Iub to the RNC, then it routes the traffic signals between the Channel Element Modules and the Transmit Receive Modules.

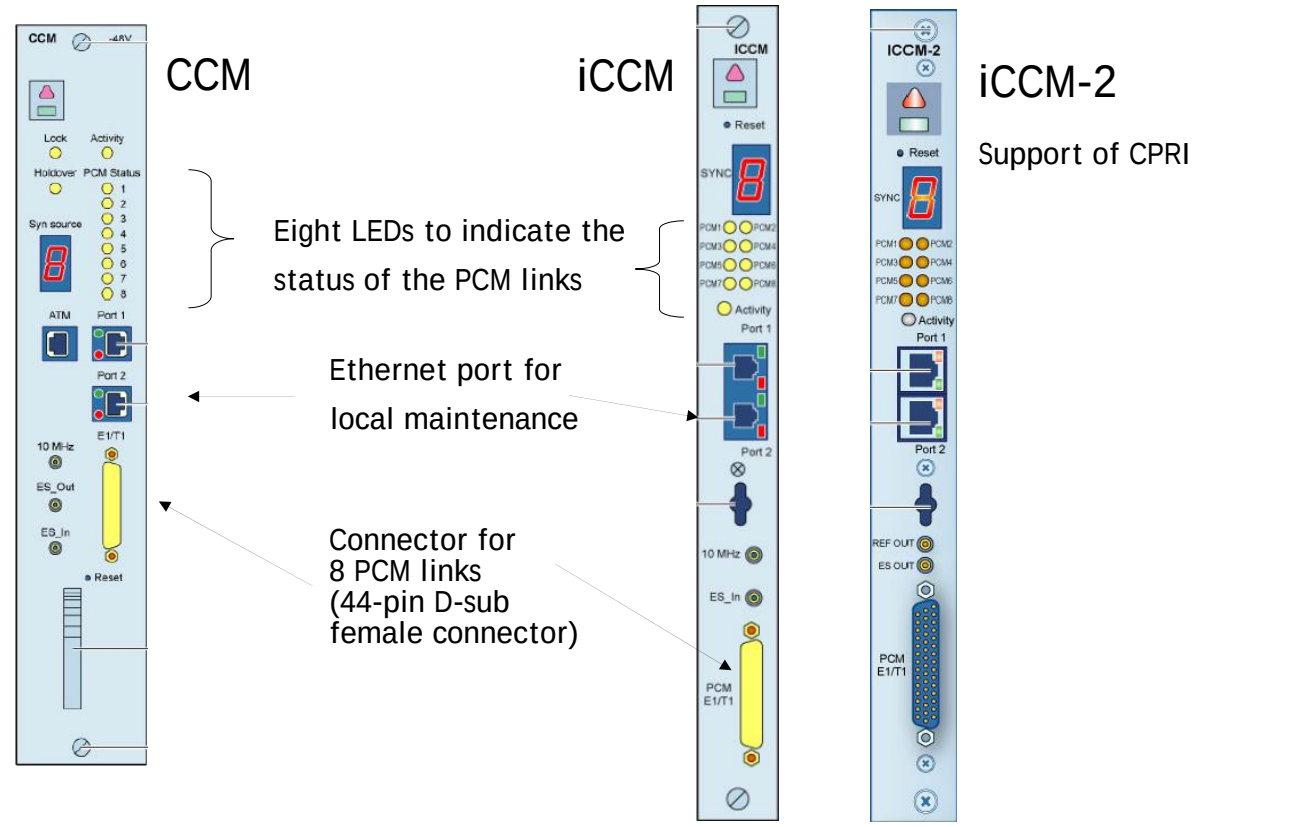
Besides this traffic handling it administrates the BTS, its radio cells and the radio channels in these cells.

Finally it generates the master clock of the BTS and synchronizes it to a selected reference signal.

The following six variants exist:

CCM - classical Core Controller Module
iCCM - integrated Core Controller Module
iCCM-2 - integrated Core Controller Module second generation
iCCM-U - integrated Core Controller Module-U
xCCM - eXtended Core Controller Module
xCCM-U - eXtended Core Controller Module-U
eCCM-U - Core Controller Module

2.1 Variants CCM, iCCM and iCCM-2



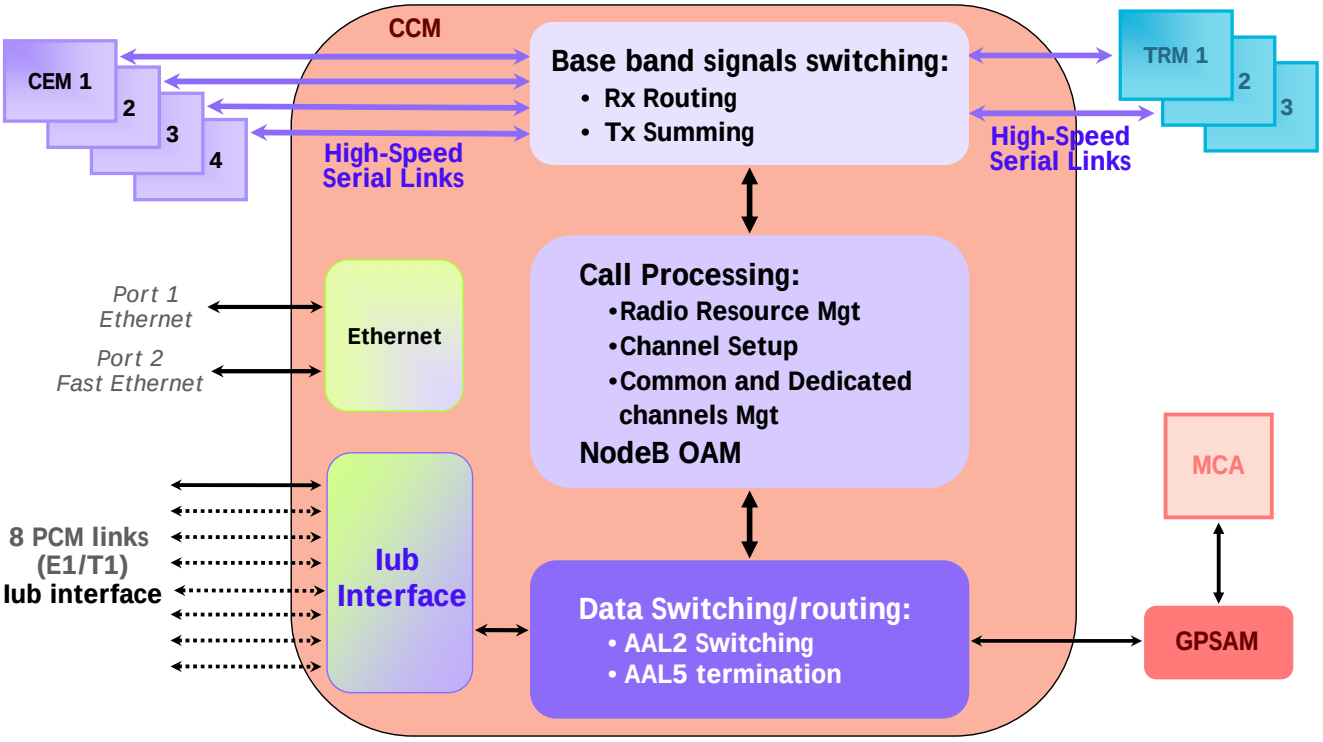
This slide shows the front plates of three variants of the Core Control Module.

The classical Core Control Module (**CCM)** is the first kind of this type of board. It supports up to eight PCM links. Local Operation and Maintenance can be done via an Ethernet port.

The integrated Core Controller Module (**iCCM**) is the second generation of Core Control Module used in all NodeB products. It is based on a single printed circuit board, whereas the classical Core Control Module is based on two printed circuit boards.

The integrated Core Controller Module - 2nd generation (**iCCM-2**) is an hardware evolution of the previous iCCM module. It provides the same interfaces and functions as the original iCCM, with provision for a new standard interface towards radio equipment, the Common Public Radio Interface (**CPRI**). The iCCM-2 module is inserted in the position of the current iCCM module without any change.

2.2 CCM/iCCM/iCCM-2: Common architecture



The Core Control functions are considered as the "brain" of the BTS. This slide shows the architecture of three CCM types:

- The classical CCM
- the integrated CCM and
- the integrated CCM second generation

These modules contain a switch for Asynchronous Transfer Mode **(ATM)** that provides control and data routing functions for the BTS.

Beside this the Core Control Module provides the network interface **Iub**. It is connected to the RNC and its standard version contains up to eight physical PCM links using either E1 or T1. It transports at rates of up to 12.288 Mbps (in the case of T1) or up to 16.384 Mbps (in the case of E1).

Another function of the Core Control Module is call processing with the 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.

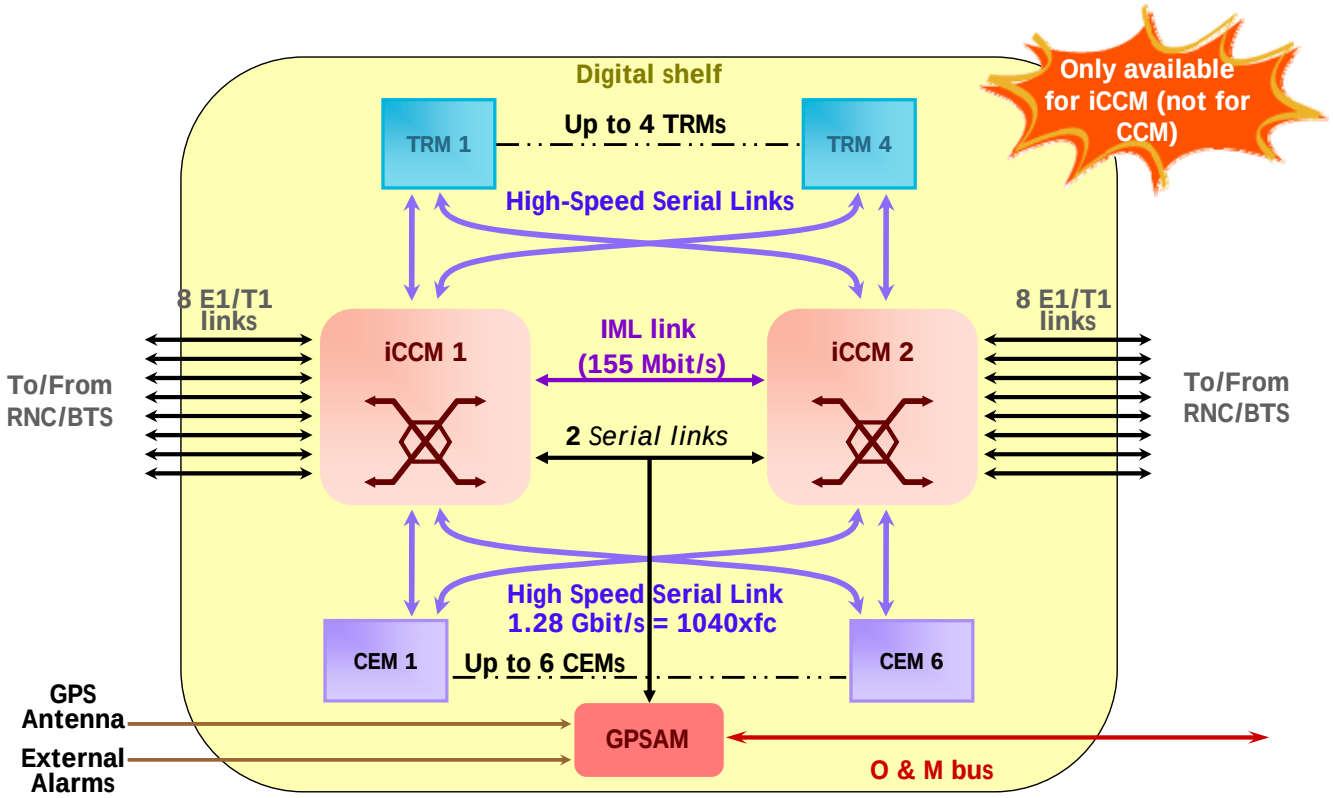
Then the Core Control Module performs data switching and routing depending on the data flow. The Asynchronous Transfer Mode Adaptation Layers AAL2 and AAL5 are used on the link between the BTS and the RNC.

Inside the Core Control Module the kind of processing of the base band signals depends on the direction of the flow. In reception direction they are routed from the Transmit Receive Modules to the Channel Element Modules, in transmission direction the signals are summed.

Moreover, the Operation and Maintenance (OaM) management function of the BTS includes the local maintenance through the Ethernet connection with the Terminal for Local Installation (**TIL**).

Finally, the Core Control Module 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 or synchronizing via a GPSAM to an external clock reference.

2.3 iCCM supports equipment protection



In this configuration,the variants integrated Core Controller Modules (**iCCM**) are used. This variant supports equipment protection. In a configuration with two cooperating modules the boards protect each other against a single equipment defect: If one module fails the other one takes over. The classical CCM does not support such a protection.

Each integrated Core Controller Module is connected to every Channel Element Module (**CEM**) and Transmitter Receiver Module (**TRM**) via bidirectional High-Speed Serial communication Links (**HSSLs**). In this way, one CEM or TRM can dialog with each iCCM.

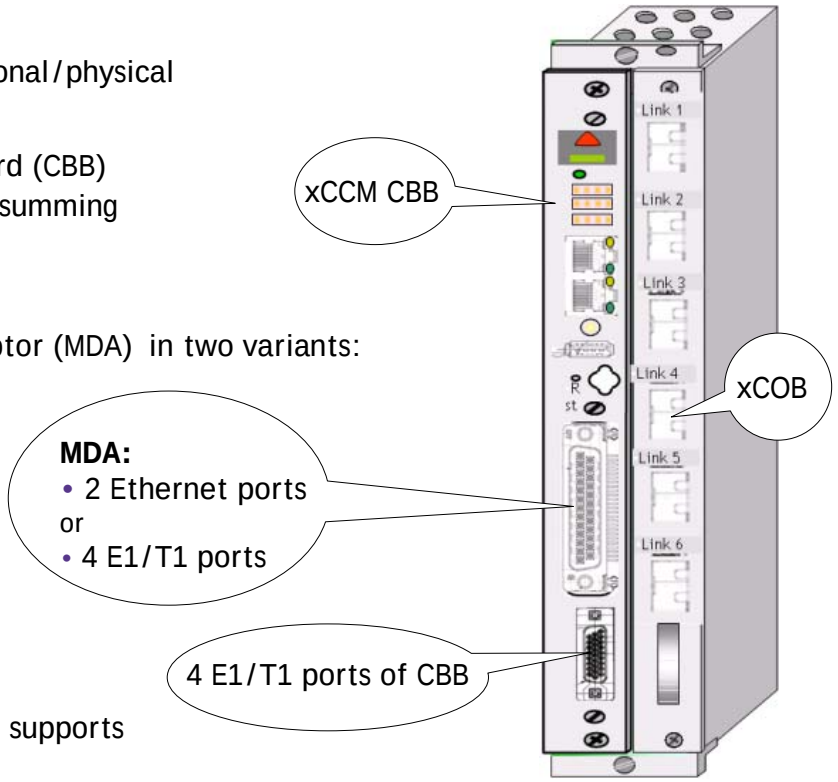
HSSLs are duplicated to enable redundancy in the case of link or module failure.

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

2.4 xCCM consists of four boards

xCCM is split into four functional/physical boards:

- Control and Base Band board (CBB)
  - base-band routing and summing
  - up to nine HSSL links
  - 4 E1/T1 ports
- The Media Dependent Adaptor (MDA) in two variants:
  - GE MDA
  - 4E1/T1 MDA
- xCCM backplane.
- xCCM Optical Board (xCOB) supports remote radio units via CPRI



The extended Core Controller Module **(xCCM)** is more advanced than the integrated Core Controller Module. This xCCM board will provide the required switching capacity as well as the required capability to support IP via Ethernet.

As the eXtended Core Controller Module is intended to replace the integrated Core Controller Module hardware platform, it is essential that this board also supports the legacy protocols of Asynchronous Transfer Mode.

The eXtended Core Controller Module is split into four functional physical boards: The CBB, the xCOB, the MDA and the xCCM backplane.

The Control and Baseband Board **(CBB)** provides built-in interfaces via 2x100 Base-T ports to support Operation and Maintenance and debugging. Beside this it carries a 26-pin High Density D-Sub connector to connect four PCM links of type E1 or T1 transporting the ATM/PCM component of the Iub.

The Media Dependent Adaptor **(MDA)** is a dedicated daughter board supporting the Iub, too. In release UA07.1 two types of MDA are supported:

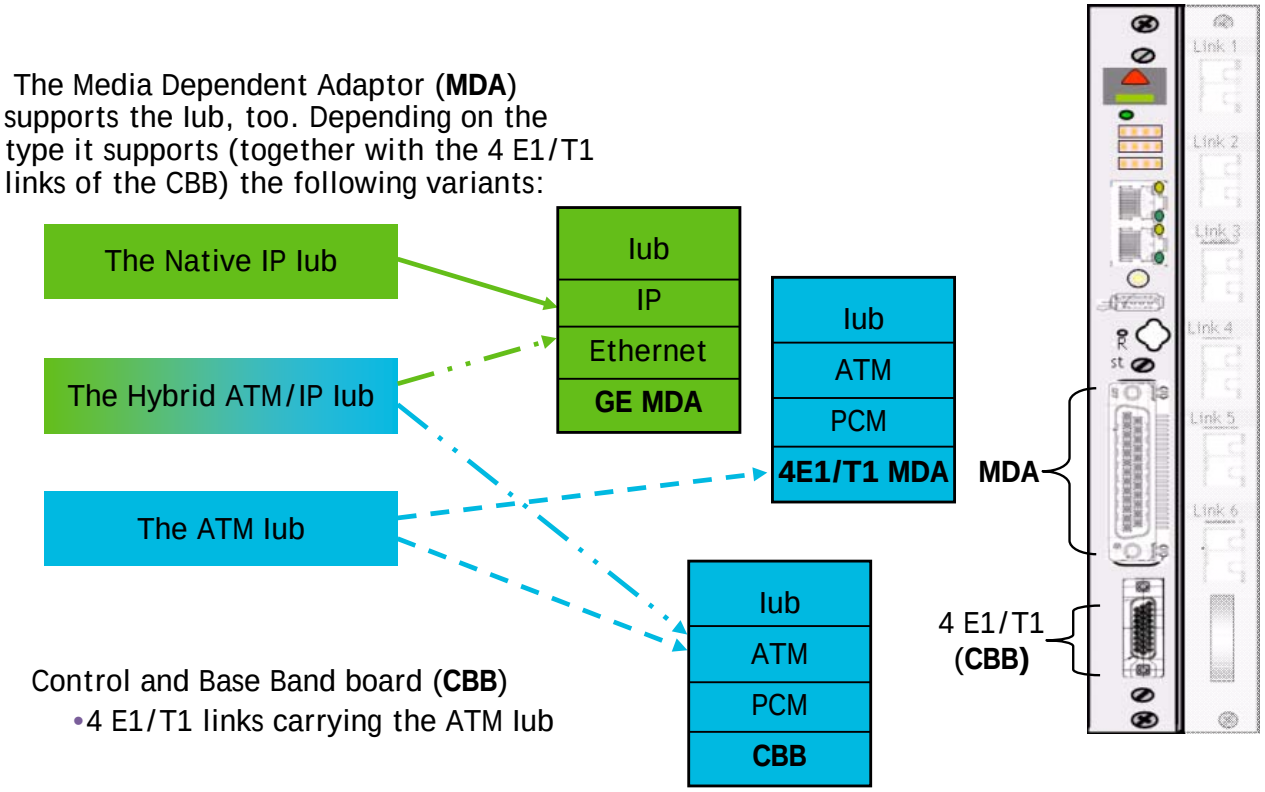
- The E1/T1 MDA is equipped with a 25-pin D-Sub connector and provides four electrical ports for PCM signals of type E1 or U1.
- The 1 Gigabit Ethernet MDA (GE MDA) supports 2 Gigabit Ethernet links.

The xCCM is not functional without its MDA!

The xCCM Optical Board **(xCOB)** is optional and allows the connection towards Remote Radio Heads. It connects those remote radio units via standardized Common Public Radio Interface (CPRI) links which are accessible on the xCCM front panel.

Finally, the **xCCM** backplane connects between Control and Baseband Board CBB and the Optical Board **xCOB** and between Control and Baseband Board **CBB** and the BTS backplane.

2.5 xCCM supports the hybrid Iub and the native IP Iub



The Media Dependent Adaptor **(MDA)** is a dedicated daughter board for transport of the Iub. In the global release UA07.1 two types of MDA are supported:

- The E1/T1 MDA is equipped with a 25-pin D-Sub connector and provides four ports for PCM links of type E1 or T1 that transport ATM.
- The Gigabit MDA (**GE MDA**) provides two Gigabit Ethernet links. The Ethernet layer carries an IP layer.

The same MDA can be used in the xCCM and the xCCM-U!

The Control and Baseband Board **(CBB)** provides four ports for PCM links used to transport ATM.

The resulting transport for the Iub depends now on the installed type of MDA and on the usage of the PCM ports on the CBB. Three main cases exist:

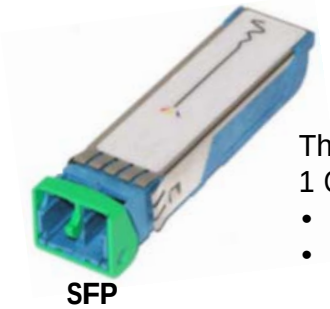
1st) If a GE MDA is installed and the four PCM links on the CBB are not used then this is called the **Native IP Iub** (or sometimes **Full IP Iub**). All information in the Iub - signaling, operation and maintenance control, clock synchronization, voice and HSPA - is completely transported via IP/Ethernet.

2nd) If a GE MDA is installed and the four PCM links on the CBB are used then only a part of the traffic – the HSDPA – uses the IP/Ethernet link. The rest of the Iub is transported on the PCM links terminated on the CBB. This is the **Hybrid ATM/IP Iub**.

3rd) If a E1/T1 MDA is installed then in total eight PCM links transport the Iub via ATM. This is the legacy **ATM Iub** using the existing ATM backbone that has been installed in the beginning of UTRAN.

2.6 One Gigabit Ethernet Media Dependent Adaptor (GE MDA)

One **RJ45** port supporting Ethernet using an electrical interface:
- 10BASE-T
- 100BASE-T
- 1000BASE-T



Supported features:
- Synchronous Ethernet
- BTS hubbing
- Flat IP
- IPsec
- LAG

The SFPs support Ethernet at 1 Gigabit using an optical interface:
- 1000BASE-X
- 100BASE-FX

The GE MDA fulfils the listed standards :
- Precision Time Protocol (**PTPv2**) due to IEEE 1588v2
- Synchronous Ethernet due to ITU-T G.8261 and 8262
- Flat IP due to the standard 3GPP specification TR 25.999
- Internet Protocol Security (**IPsec**) due to the standards RFC 2401 and RFC 4301
- Link Aggregation (**LAG**) IEEE 802.3ad
- Ethernet in the First Mile (**EFM**) IEEE 802.3ah
- Ethernet Maintenance IEEE 802.3ag
- **IPv6**
- Multilink Point-To-Point-Protocol (**MLPPP)** via E1, T1 or IP

The GE MDA supports the following features or is a precondition for them:
- Native IP Iub: The complete Iub is transported completely via the IP network.
- Secure transport for IP Iub
- Synchronization of the clock of the NodeB via the IP network (via optical SFPs or via RJ45)
- Ethernet hubbing for daisy chaining of NodeBs via the IP network
- Port-resiliency via LAG
- Connectivity checks

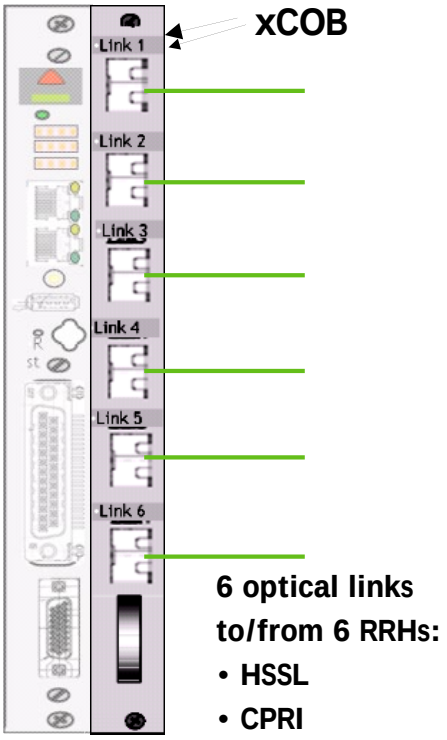
The GE MDA possesses three physical interfaces on the front plate: An electrical interface RJ45 and two optical interfaces carried by small form-factor pluggable transceivers (**SFP**). Only two interfaces can be active simultaneously:
- Either both optical interfaces on SFP1 and SFP2
- or SFP1 and RJ45
- or SFP2 and RJ45

This GE MDA is compatible with the xCCM, xCCM-U, eCCM and eCCM-U controller boards. It will replace the 4E1/T1 MDA on the NodeB sites where the Iub transport is via ATM/PCM is reduced or completely removed as consequence of the Iub backhauling evolution to Hybrid or Full IP.

The xCCM (and eCCM-u) equipped with the GE MDA supports a throughput of 320 Mbps of aggregated UL+DL.

2.7 xCOB carries the optical CPRI interfaces

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



The xCCM Optical Board (**xCOB**) is the Optical Interface Module for the eXtended Core Controller Module. It fulfils the standard Common Public Radio Interface (**CPRI**) and transports the High-Speed Serial communication Links via an optical fiber to the remote radio part of distributed BTSs, for example to a Remote Radio Head (**RRH**) or to a rCompact NodeB.

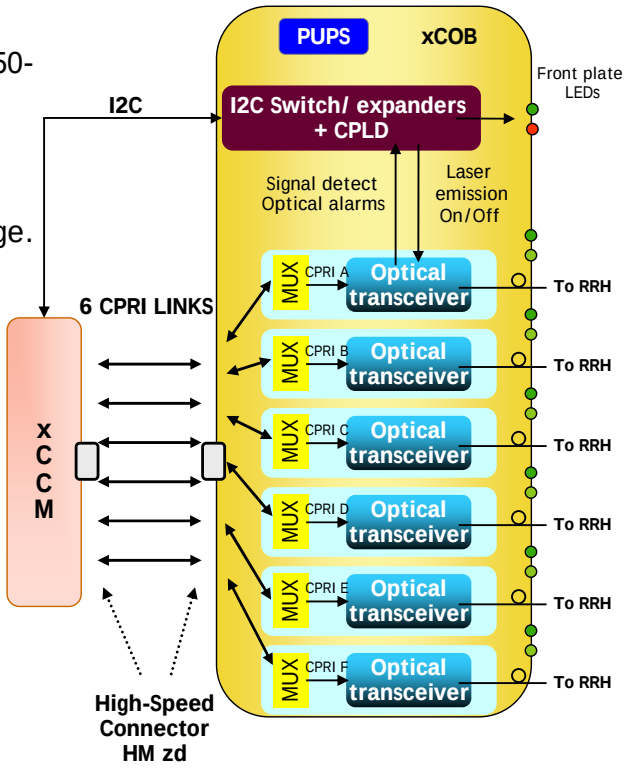
In downlink direction, this module module converts the electrical signals coming from the eXtended Core Controller Module into optical signals, to send them towards for example the Remote Radio Head. In uplink, the xCOB supports the conversion of optical signals coming from the from the remote radio part into electrical signals and forwards them to the eXtended Core Controller Module. One xCOB drives up to 6 optical fibers.

From the existing variants of Core Controller Modules only the xCCM supports this xCCM Optical Board. It is mounted inside the 50-mm mini backplane of the eXtended Core Controller Module.

This feature enables a BTS equipped with eXtended Core Controller Modules to support CPRI Remote Radio Heads. Up to 6 Remote Radio Heads in star configuration are supported.

2.7 xCOB carries the optical CPRI interfaces [cont.]

- 25-mm board which can be plugged in the 50-mm shelf.
- Support six 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.



The xCCM Optical Board (**xCOB**) can work in simplex mode or duplex mode.

In **Simplex Mode** one eXtended Core Controller Module works alone.

For each fiber, the xCOB receives signals from this xCCM via one Common Public Radio Interface (CPRI) link. In downlink – towards the remote radio part - the Optical Board board xCOB sends this data stream to the optical transceiver. In uplink – from the remote radio part - the xCCM Optical Board sends the received bit streams to the eXtended Core Controller Module.

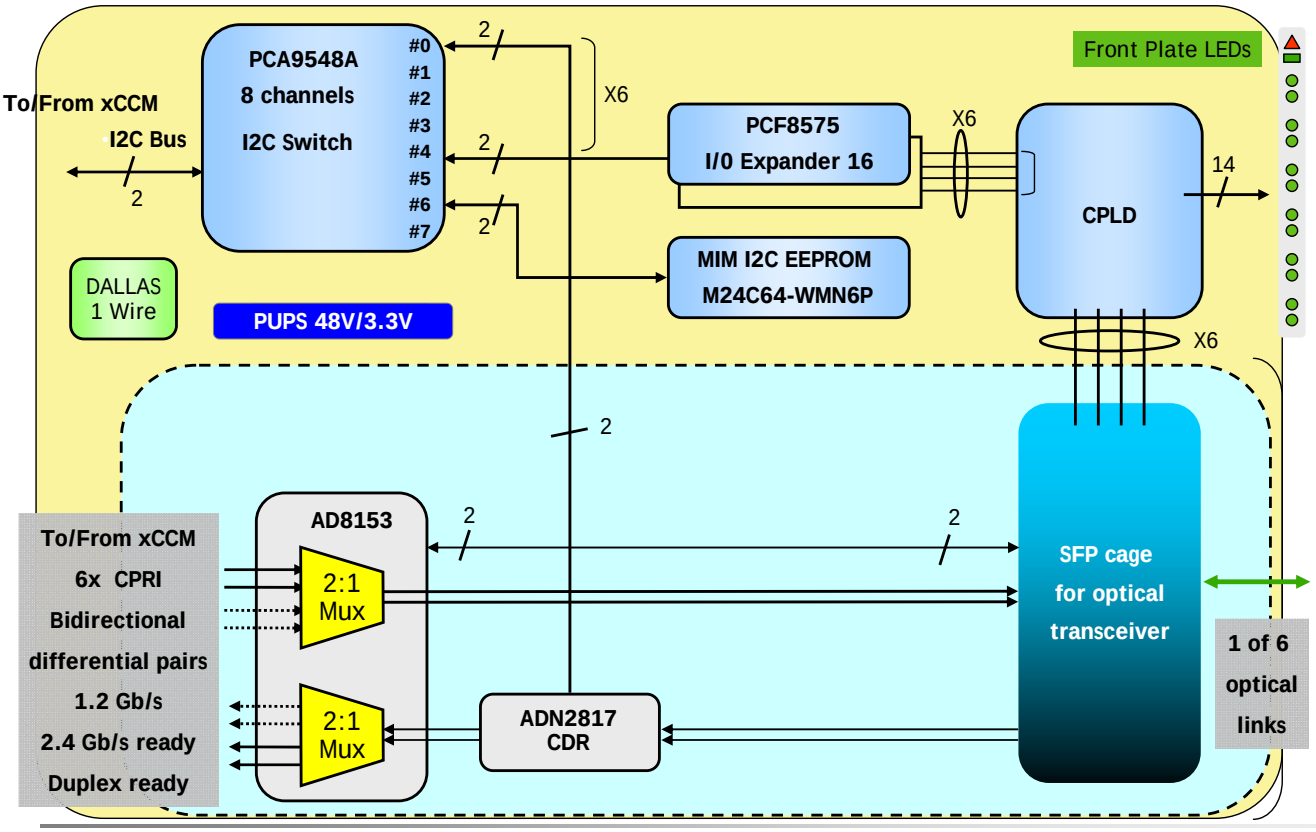
In **Duplex Mode** two eXtended Core Controller Module cooperate. One works in active mode, the other is working in standby mode and protecting the partner.

For each fiber the xCCM Optical Board board connect to both, active and standby xCCM. In downlink direction, the xCCM Optical Board selects the signal from the active xCCM and forwards this data stream to the optical transceiver. In uplink, the xCCM Optical Board forwards the received bit streams to the active eXtended Core Controller Module.

In this way the duplex mode can protect the BTS from a single failure of an eXtended Core Controller Module.

For duplex mode, an additional High-Speed connector must be equipped.

2.8 xCOB – the components



xCOB must handle the optical transmission of 6 CPRI links in 6 single bidirectional optical fiber interfaces towards the RRHs. 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.

2.9 iCCM-U/xCCM-U: Only for the 9326 digital 2U NodeB versions

iCCM-U

- GPSAM and OaM functions
- Network interface: up to 8 E1/T1 on backhaul
- OIM: Equipped with one to three optical transceivers supporting HSSL or CPRI
- Up to three wide-band carriers in three sectors
- Support of up to 3 RRHs or rCompact

xCCM-U enhancements:

- OIM: Equipped with one to six optical transceivers supporting HSSL or CPRI
- Up to six wide-band carriers in three sectors
- Support of up to 6 RRHs or rCompact

iCCM-U in both 9326 digital 2U NodeB versions
xCCM-U only in the 9326 digital 2U NodeB Version **2**

The boards integrated Core Controller Module-U and eXtended Core Controller Module-U are used in the 9326 digital 2U NodeB shelves.

The integrated Core Controller Module-U **(iCCM-U)**, first, is a single board with a height of 21 millimeters. It supports the following functions:

- GPSAM
- Optical interface towards remote radio units
- Operation and Maintenance functions (OaM)
- Part of call processing
- Switching and combining of internal and external data flow
- Forwarding of external and internal alarms
- Interfacing to an external synchronization reference
- Protection of the PCM links with a lightning protection kit (**LPPCM**).

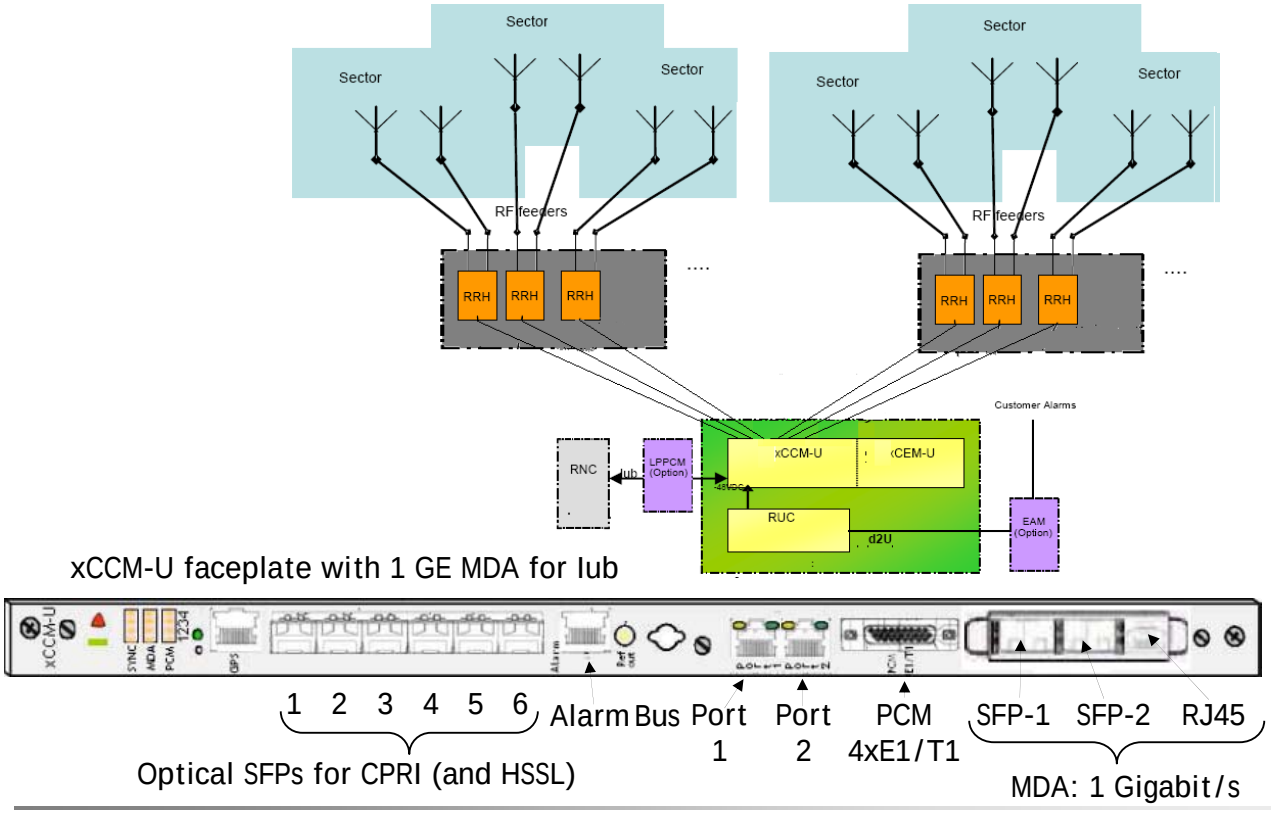
It supports up to three wide-band carriers with transmit and receive diversity in a tri-sectored carrier configuration. It can be used in both versions of 9326 digital 2U NodeB.

The eXtended Core Controller Module-U is an enhanced version of the integrated Core Controller Module-U with increased processing capabilities. It is based on a mother board and a Media Dependent Adaptor (MDA), allowing for future evolutions and support of additional backhauling options.

The eXtended Core Controller Module-U does not support the rack master feature (i.e control of Evolium BTS cabinet alarms and cabinet inventory through the BTS Control Bus (BCB). Only one RS232 link is provisioned to be connected to the Station Unit Module (SUMA) of GSM BTS which is in charge of this function It can be used only in the version 2 of 9326 digital 2U NodeB.

CPRI - Common Public Radio Interface HSSL High Speed Serial Link

2.10 xCCM-U: Support of 6 RRH per NodeB



One single digital NodeB site with Remote Radio Head supports 2 clusters with 3 sectors. This reduces the total cost of ownership in dense areas. For instance, with only one NodeB site, the network operator is able to deploy outdoor coverage and simultaneously hot-spot or indoor coverage.

In the future this feature will enable dual-band or STSRx+y for distributed BTSs.

With this feature one digital NodeB (9326 d2U) can support up to six 9341 Remote Radio Heads.

Up to 6 sectors - including 4 and 5 sectors – and up to 2 carriers are supported.

For a configuration of 3+3 sectors – this means two clusters with three sectors per cluster - it is possible to have different carriers between the 2 clusters. For example the first 3 sectors use the frequency pair F1 and F2, the last 3 sectors use two another frequency pair F2 and F3.

Mobility between sectors is realized using Soft handover between the two clusters - or Softer handovers inside a cluster.

Each fiber link drives only one 9341 Remote Radio Head (**RRH**), so that one digital NodeB can manage up to 6 optical and up to 6 Remote Radio Heads.

It is not possible to mix different types of 9341 Remote Radio Head on the same digital NodeB, for example if they differ in maximal output power or frequency band.

This support of 6 RRH per NodeB is for example supported with the eXtended Core Controller Module-U in the 9326 digital 2U NodeB Version 2 together with the 9341 RRH 40 Watts.

2.11 Quiz about the Core Control Modules

1. Which features are common for all variants of Core Control Modules?

A. They contain an ATM switch.

B. A receiver for the Global Position System signals is integrated in the Core Control Modules.

C. All variants of the CCM possess PCM interfaces.

D. The terminal for local operation and maintenance is connected to the CCM via a RS232 link.

E. They support optical links to connect remote radio parts.

2.11 Quiz about the Core Control Modules [cont.]

2. Which sentences about the the advantages of the most modern variant - the eXtended Core Controller Module (xCCM) – against the very first variant – the classical Core Controller Module (CCM) – are true?

A. The transport capacity on Iub can be increased by adding Ethernet links.
B. In the case of distributed BTSs it supports the connection of remote radio units via optical links.
C. It supports equipment protection, that means two xCCMs can cooperate and protect the CCM-functions in the case of a malfunction of a single xCCM.

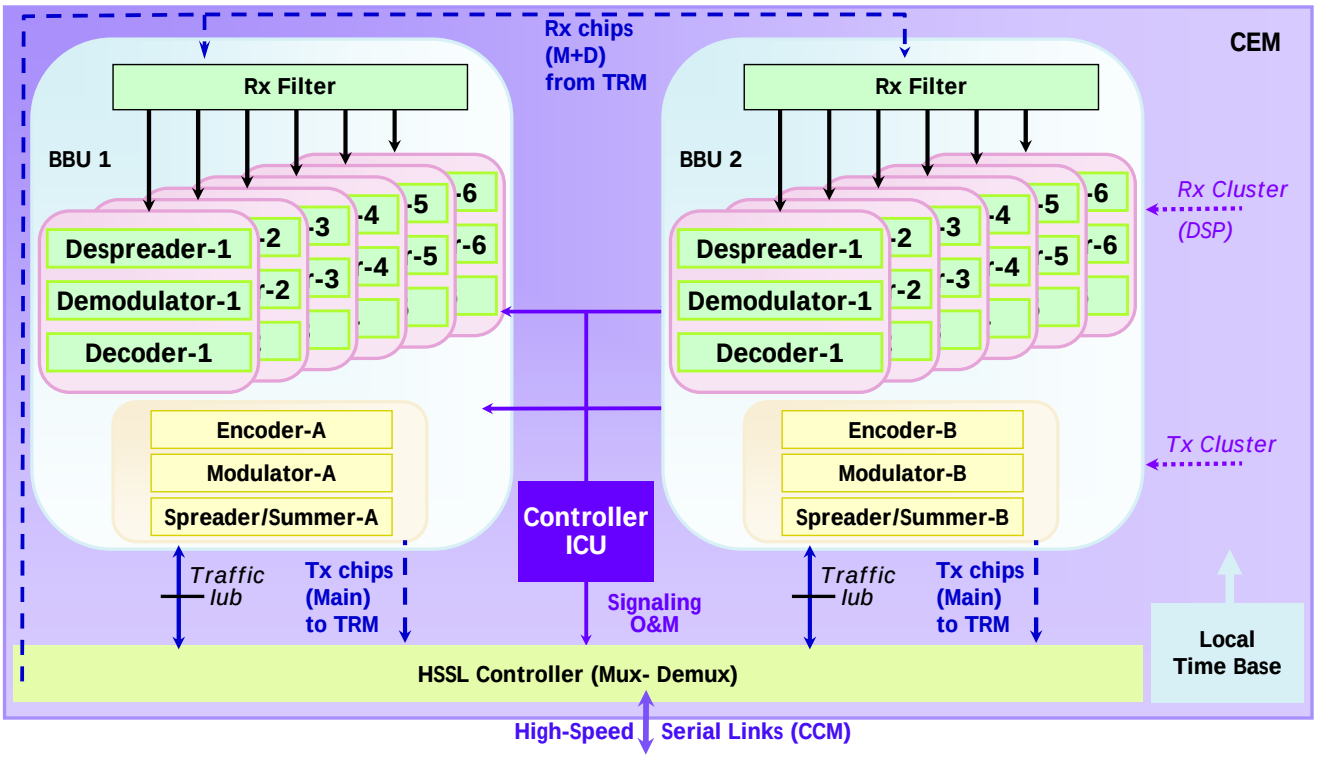
3 Channel Element Modules (CEM)

One main function of the Channel Element modules is the processing of traffic signals due to the Wide-band Code Division Multiple Access method.

The following variants of Channel Element boards exist:

iCEM - integrated Channel Element Module
iCEM-U **-** integrated Channel Element Module **U** for the 9326 digital 2U NodeB versions
iCEM-2 - integrated Channel Element Module - 2nd generation
xCEM - extended Channel Element Module
xCEM-U **-** extended Channel Element Module U for the 9326 digital 2U NodeB version 2

3.1 iCEM: Architecture



A integrated Channel Element Module (**iCEM)** board is composed of two or three blocks:

1. The Interface and Control Unit (**ICU**)

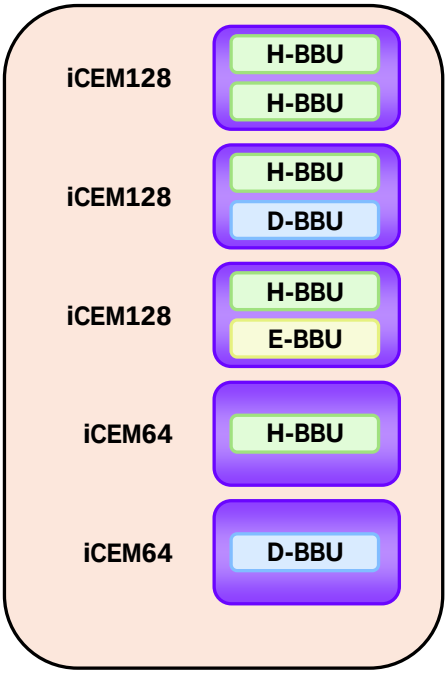
   It performs several main functions of the CEM. Indeed, it does the physical data interface for the entire CEM, the call processing functions (NBAP), the Operation and Maintenance (OaM)functions of the CEM and the Baseband signal processing of some common channels.

2. One or two Base Band Units (**BBU**) that perform all transmit and receive base band signal processing functions, in other words the layer 1 functions of the UMTS radio network.

3.2 iCEM: Base Band Unit types

Limitations

- iCEM (64/128) is HSDPA 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

According to their capacity, the integrated Channel Element Modules are composed of one or two Base Band Units (BBUs). The version iCEM64 contains one BBU whereas iCEM128 contains two BBUs.
Several types of Base Band Units exist. In the iCEM the following three can be used: D-BBU, H-BBU and E-BBU.

1.) A **D-BBU** is a Base Band Unit supporting Dedicated Channels (**DCH**). The D-BBU is in charge of the "R99/R4" channel processing. So, channel processing only applies to the Dedicated Channels including Signaling Radio Bearers (**SRB**), Traffic Radio Bearers (**TRB**) and to the common control channels. The D-BBU also processes the Dedicated Channels associated to High Speed Downlink Packet Access (**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).

2.) The second type of BBU is the **H-BBU**. It is a Base Band Unit dedicated to process the High Speed Downlink Packet Access (**HSDPA)** channels and is in charge of the new channels introduced by HSDPA. The H-BBU has four limitations:

a) The maximum number of cells is limited to 3 HSDPA cells.
b) Then there can be only a maximum of 48 simultaneous HSDPA users.
c) Moreover, the maximum throughput allowed is 10.2 Mbps at the level of the Radio Link Control protocol.
d) The last limitation concerns the number of Orthogonal Variable Spreading Factor (**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 receives data.

3.) **E-BBU** is another type of BBU. An E-BBU is a BBU supporting Enhanced Dedicated channels (**E-DCH**). E-BBUs can be inserted into iCEM64 and iCEM128

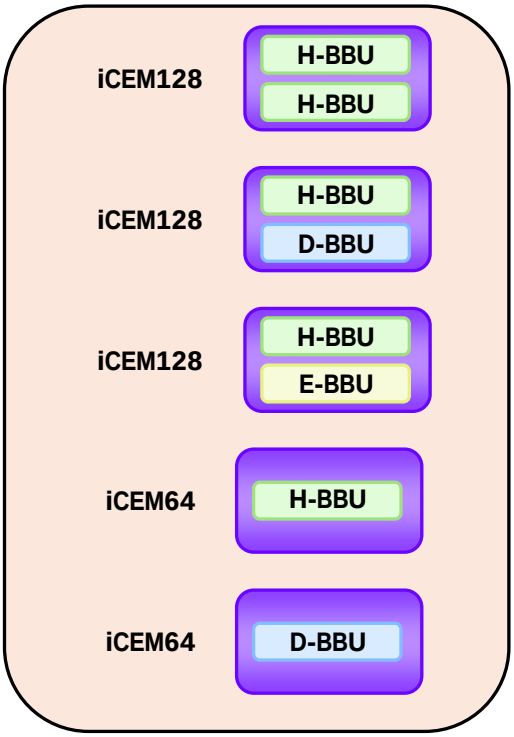
3.3 iCEM: HSDPA scalable configuration

H-BBU Limitations

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

E-BBU Limitations

1 E-BBU per BTS



The support of the High Speed Downlink Packet Access (**HSDPA**) on a UMTS BTS requires the second generation of Channel Element Modules i.e. iCEM64 or iCEM128.

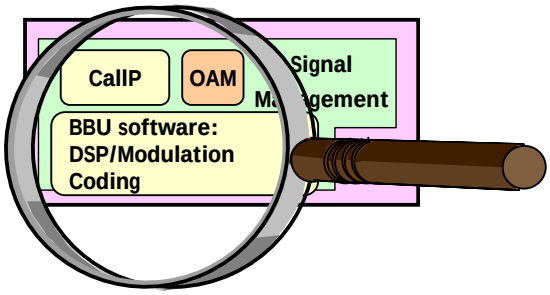
The Base Band signals are processed by the Base Band Units in the integrated Channel Element Module. One restriction of the current Base Band Units is that one BBU cannot process both Dedicated services and High Speed Downlink Packet Access services simultaneously.

At startup time the BTS partitions the BBUs between Base Band Unit dedicated to High Speed Downlink Packet Access on one side (H-BBU) - and Base Band Unit supporting Dedicated Channels on the other side (D-BBU). This partitioning is configured at the OMC-B.

Once this allocation is done, it can only change after a reset of the integrated Core Controller Module in the BTS or an plug-out and plug-in of the iCEM.

3.4 iCEM with H-BBU

Enhanced iCEM BBU capacity for HSDPA mode:
One H-BBU supports up to 48 simultaneous HSDPA users



- In HSDPA mode (i.e. H-BBU) a single iCEM BBU supports the demodulation of up to 48 simultaneous mono-flows in uplink direction of the channels DPCCH/HS-DPCCHs.

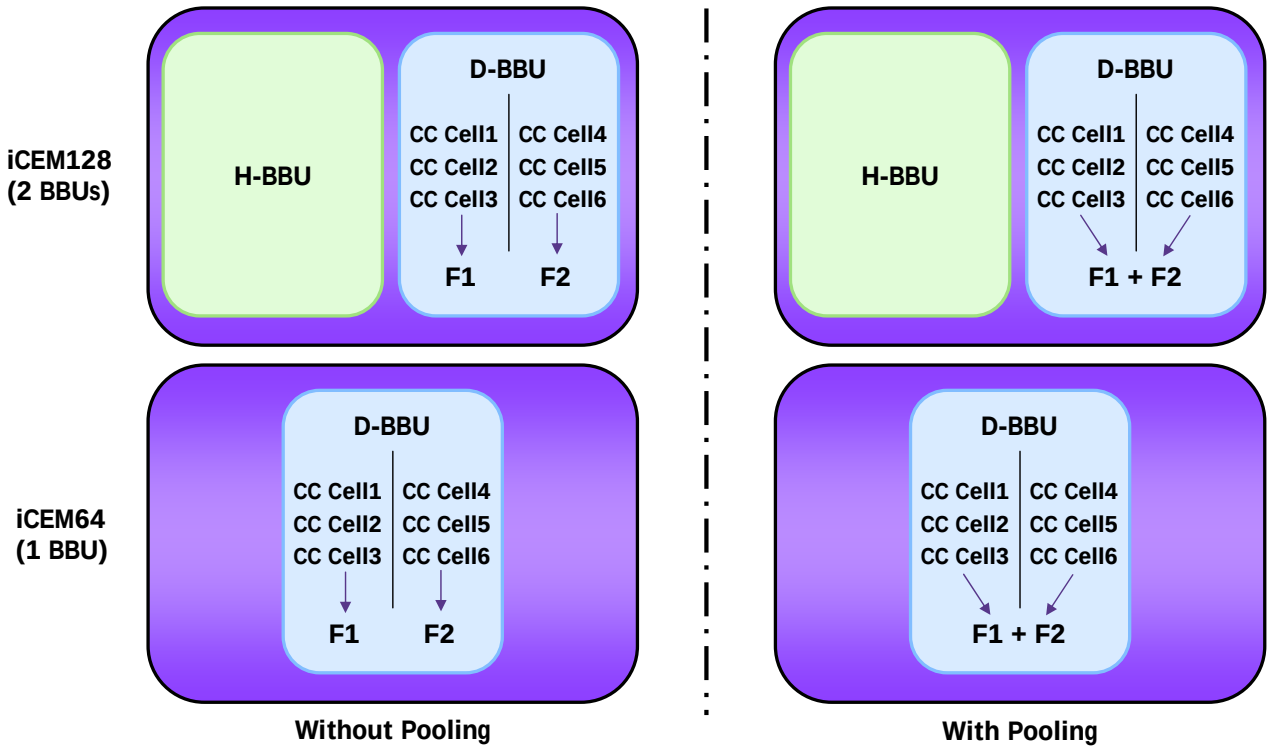
- In Rel'99 mode a single H-BBU can process the associated Dedicated Channels in downlink direction of up to 48 simultaneous HSDPA users over 3 (Tri-cell H-BBU mode) or one cell (Mono-cell H-BBU mode).

FEATURE BENEFITS :

- The capacity of an iCEM H-BBU can be enhanced by a software upgrade. This upgrade increases the capacity for High Speed Downlink Packet Access traffic compared to earlier releases without requiring the addition of any new iCEM.

- In short, this feature increases the Node-B capacity by upgrading the software without the addition of a new iCEM.

3.5 iCEM: D-BBU frequency pooling

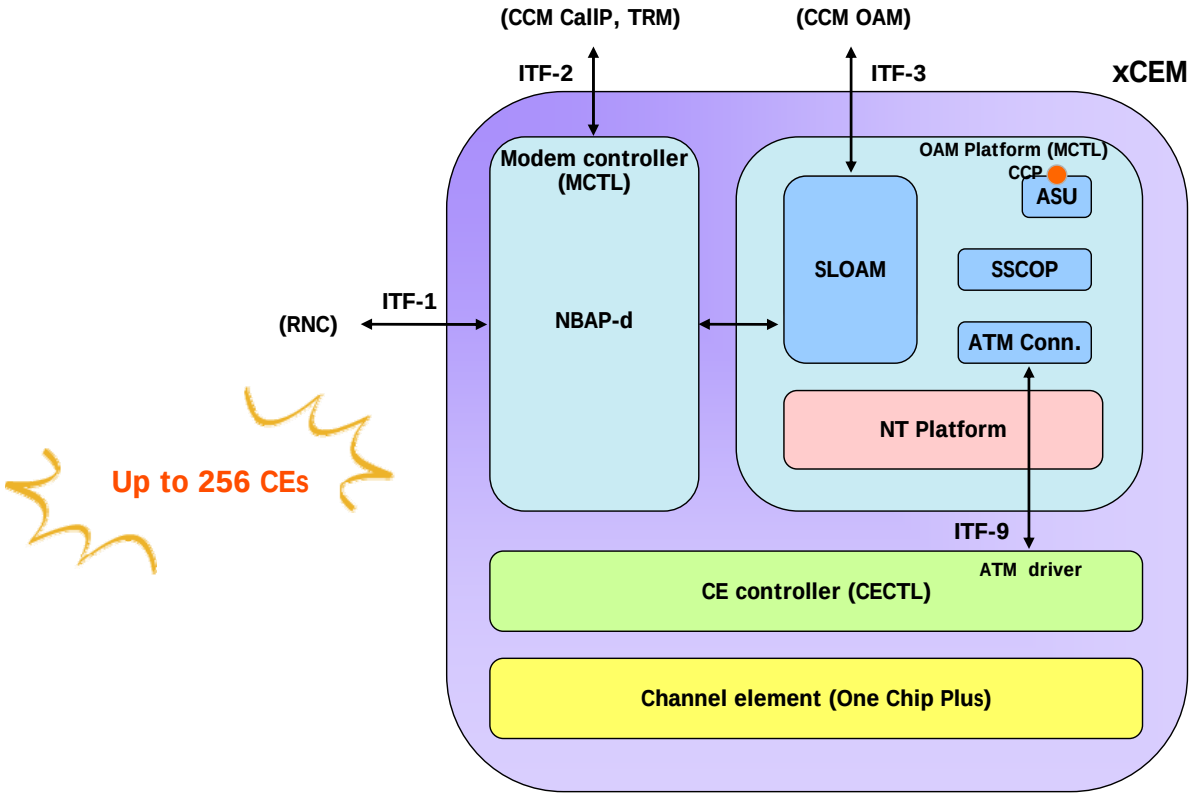


Inside a Base Band Unit supporting Dedicated Channels (**D-BBU**) , the available capacity is pooled between two frequencies. This feature is called **D-BBU** frequency pooling. It allows to optimize the use of BBU capacity for configurations with strictly more than one frequency.

D-BBU frequency pooling is applicable to all R99 Radio Access Bearers (RABs) whatever the way D-BBUs are distributed on the Channel Element Module. This feature is not applicable to High Speed Downlink Packet Access (with H-BBUs) or High Speed Uplink Packet Access (with E-BBUs).

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

3.6 xCEM: Architecture



The extended Channel Element Module **(xCEM)** provides higher performance and capacity compared to older generations of this module, in particular for high-speed data services.

Its capacity is expressed in different ways, depending whether we consider Dedicated Channels (**DCHs**), High Speed Downlink Packet Access (**HSDPA**) traffic or High Speed Uplink Packet Access (**HSUPA**) traffic. The extended Channel Element Module 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 9311 Macro NodeB Indoor and Outdoor, 9322 digital Compact NodeB Indoor and Outdoor and UMTS BTS 6020 (Street).

The extended Channel Element Module fully interoperates with the previous versions of Channel Element Module types which are iCEM 64 and iCEM 128.

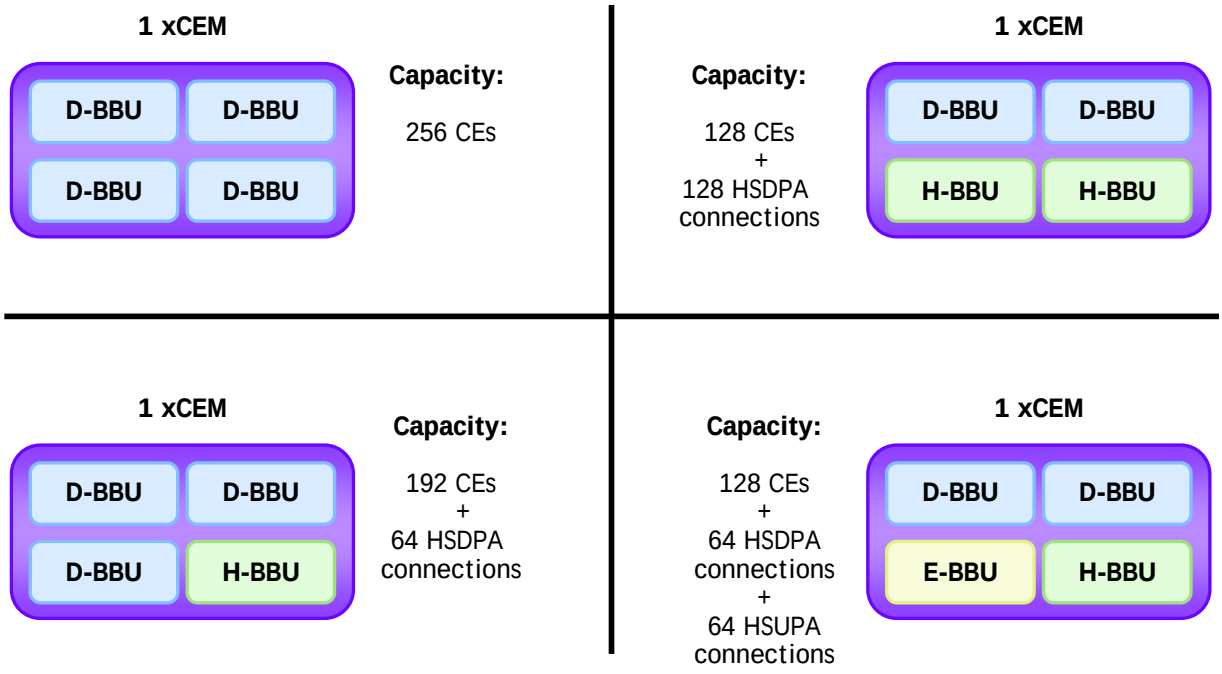
xCEM is compatible with all supported variants of Core Controller Module, that are iCCM and xCCM.

xCEM is also compatible with all supported variants of Transmitter Receiver Modules which are iTRM, xTRM, Remote Radio Head and Repeaters.

The software architecture of the extended Channel Element Module consists at the top-level of three main components.

1. The first component is the Operation and Maintenance (**OaM**) platform.
2. The second component is the Modem Controller in charge of implementing the 3GPP NBAP-d functionality.
3. The CE Controller is the third component. It function implements the lower layers L1 and L2 of the UTRAN.

3.7 xCEM: Standard BBU types



The extended Channel Element Module 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).

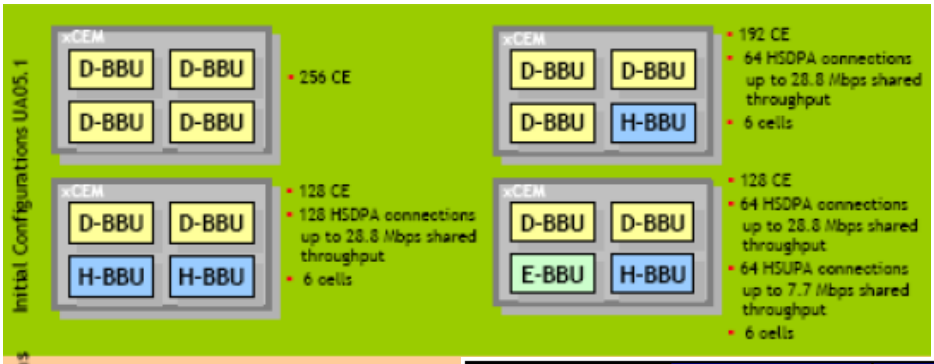
Each D-BBU (respectively H-BBU or E-BBU) will support up to 64 DCHs (respectively HSDPA or E-DCH) users.

The extended Channel Element Module supports up to **6 cells** on D-BBU, H-BBU and E-BBU, so a configuration equipped with a single xCEM can feed up to 2 carriers in 3 sectors.

A capacity licensing scheme is introduced, applied to the extended Channel Element Modules installed in this BTS. Due to the number of bought licenses the limit of the following items varies:

- The number of channel elements
- It limits the number of HSDPA and HSUPA users
- The HSDPA and HSUPA throughput per board: –0%, 25 %, 50 %, 75 %, 100 % of total capacity

3.8 xCEM: Multi-mode BBU



WARNING

256 CE for DCH
With a max of 128 CE for signaling

Example: if 64 DCH
Nb. CE = 256 – 64
=192 CE for HSDPA

Limited before
in the previous release

2D + 1H + 1E	2 x iCEM128	xCEM (UA05.1)	xCEM UA06.0 w MM
DCH # of CE	128	128	256
HSDPA # of connections	Up to 48	Up to 64	Up to 128
DL shared throughput *	Up to 10.8 Mbps	Up to 28.8 Mbps	Up to 28.8 Mbps
# of cells	Up to 3	Up to 6	Up to 6
# of SF16 3 active cells 2 active cells 1 active cell	7 + 7 + 7 10 + 10 15	15 + 15 + 15 15 + 15 15	15 + 15 + 15 15 + 15 15
# of HS-SCCH	Up to 4	Up to 4	Up to 4
HSUPA i.e. E-DCH	10 ms TTI only	10 & 2 ms TTI	10 & 2 ms TTI
# of connections	Up to 15	Up to 64	Up to 128
UL shared throughput **	Up to 2.1 Mbps	Up to 7.7 Mbps	Up to 7.7 Mbps
# of cells	Up to 3	Up to 6	Up to 6
# of E-AGCH	Up to 2	Up to 4	Up to 4
# of E-HICH/E-RGCH	Up to 2	Up to 4	Up to 4
# of signatures	15	Up to 40	Up to 40

The extended Channel Element Module supports multi-mode Base-band Units (**m-BBU**).

Multi-mode is understood as simultaneous support of DCH + HSDPA + HSUPA channel types by the same BBU.

This includes support of channel combinations {HSD+HSU}, {DCH+ HSDPA }, {DCH+ HSUPA }, and {DCH+ HSDPA + HSUPA } for a given user.

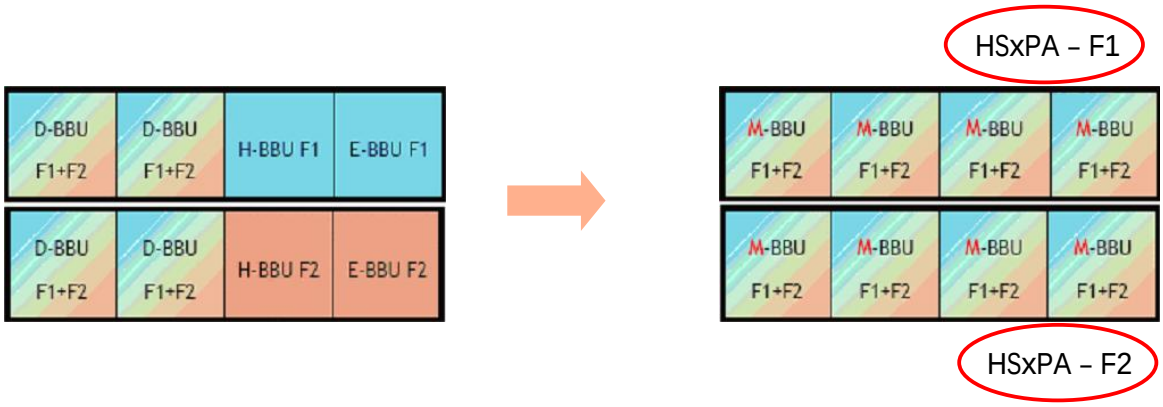
Multi-mode support includes the change from triple to single decoding.

The extended Channel Element Module supports 256 Dedicated Channels, with any 128 of them supporting High Speed Downlink Packet Access (HSDPA) and/or High Speed Uplink Packet Access (HSUPA).

This means that the initial extended Channel Element Module capacity will be doubled with this feature by means of a software upgrade.

The additionally available capacity can be activated through the capacity licensing mechanism and requires purchase of respective licenses.

3.9 xCEM - increased capacity for HSPA



xCEM configuration example Strategy : STSR 2, 2xCEM, 2 carriers HSDPA + E-DCH

The xCEM offers a great capacity and performance to support the High Speed Packet Access (HSPA), in particular

- the Queuing Delay, if many HSUPA users want to become active at the same time in the uplink direction
- the number of HSUPA users supported per cell in uplink direction
- the performance for HSDPA traffic that does not conform to FTP/HTTP, in particular for traffic with very short packets in downlink direction.

This will become essential for Voice over (VoIP) traffic in a future release.

For HSUPA,

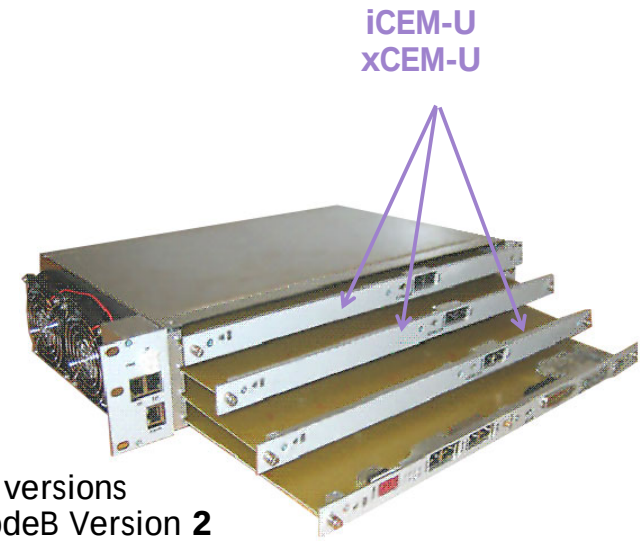
- the MAC-e scheduler on the extended Channel Element Module supports at least 2 E-AGCH channels per cell – target is 48 E-AGCH channels per extended Channel Element Module;
- the NodeB supports at least 4 E-HICH Channelisation codes per cell;
- the NodeB provides a signature administration for 40 signatures per E-HICH channelisation code. A pre-defined number of 1..4 signatures will be reserved for common E-RGCH usage, the remainder is available for dedicated E-RGCH/E-HICH usage on each E-HICH Channelisation code.

For HSDPA,

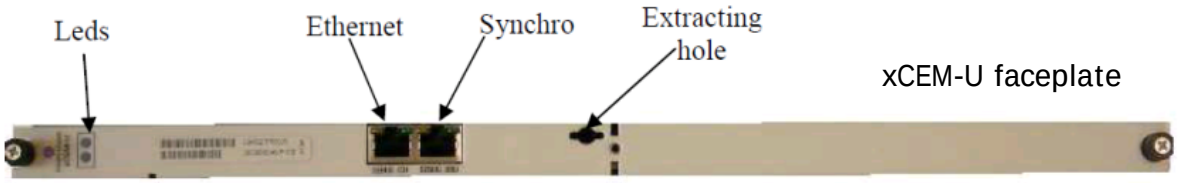
- the extended Channel Element Module will support 4 HS-SCCH channels per cell (24 HS-SCCH channels per board).
- In release UA07 the radio interface Uu can apply the modulation type 64-QAM for HSDPA. This modulation is done in the Transmitter Receiver Modules (TRM), but the support of 64-QAM depends also on the correct type of Channel Element Module. The board xCEM is one of the cards that support this 64-QAM, the modules CEM and iCEM can't do it.

3.10 iCEM-U/xCEM-U: Only for the 9326 digital 2U NodeB versions

- iCEM-U
  - A total of 384 CEs
  - Up to 3 RRHs
- xCEM-U enhancements:
  - A total of 768 CEs
  - Up to 6 RRHs



iCEM-U in both 9326 digital 2U NodeB versions
xCCM-U only in the 9326 digital 2U NodeB Version **2**



The boards integrated Channel Element Module-U (**iCEM-U**) and eXtended Channel Element Module-U (**xCEM-U**) are used in the 9326 digital 2U NodeB shelves.

The **iCEM-U** is based on the integrated Channel Element Module - 2nd generation 128 and supports up to 128 channel elements. Its hardware consists of a mother board and a daughter board with the following blocks:

1. The Interface and Control Unit (**ICU**) is located on the mother board. It provides data, control and timing interfaces and control and management functions.
2. A Base-Band Unit (**BBU**) on the mother board that performs all the transmit and receive base-band signal processing functions for each of the UMTS channels supported (layer 1 of the UMTS radio network).
3. An additional **BBU** on the daughter board that doubles the processing power

The extended Channel Element Module-U (**xCEM-U)** is an enhanced version of the integrated Channel Element Module U and supports up to 256 channel elements.

It supports R99, HSDPA and HSUPA in up to six cells and two frequencies. It can be used only in the version 2 of 9326 digital 2U NodeB.

The **xCEM-U** supports the modulation 64-QAM , the module **iCEM-U** can't do it.

Up to 3 iCEM-U modules can be used in the first version of 9326 digital 2U NodeB.

Up to 3 extended Channel Element Modules-U (or mixed configurations xCEM-U and iCEM-U) can be used in the 9326 digital 2U NodeB Version 2

CE - Channel Element

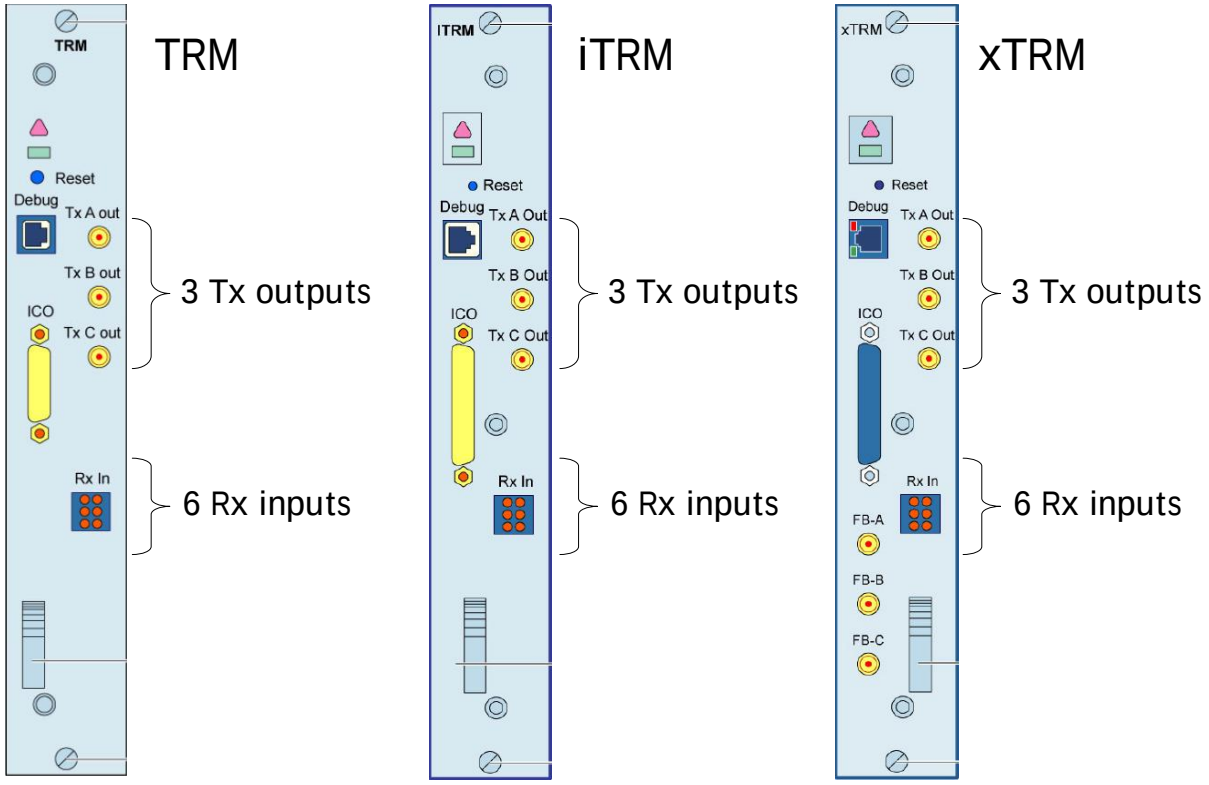
4 Transmit Receive Modules (TRM)

The main function of the Transmit Receive Modules is the exchange of signals between the base band and radio frequency band.

The following variants exist:

TRM - classical Transmit Receive Module with the variants TRM 1900 and TRM 2100
iTRM - integrated Transmit Receive Module
xTRM - expandable TRM
xTRM-2 - expandable TRM second generation

4.1 TRM/iTRM/xTRM: Front plates



Each Transmit Receive Module does the interface between the base band and the radio band.

In the downlink direction one board receives up to six Base Band signals from the Core Control Module, transforms them into radio block (RF) signals and forwards them to the power amplifier.

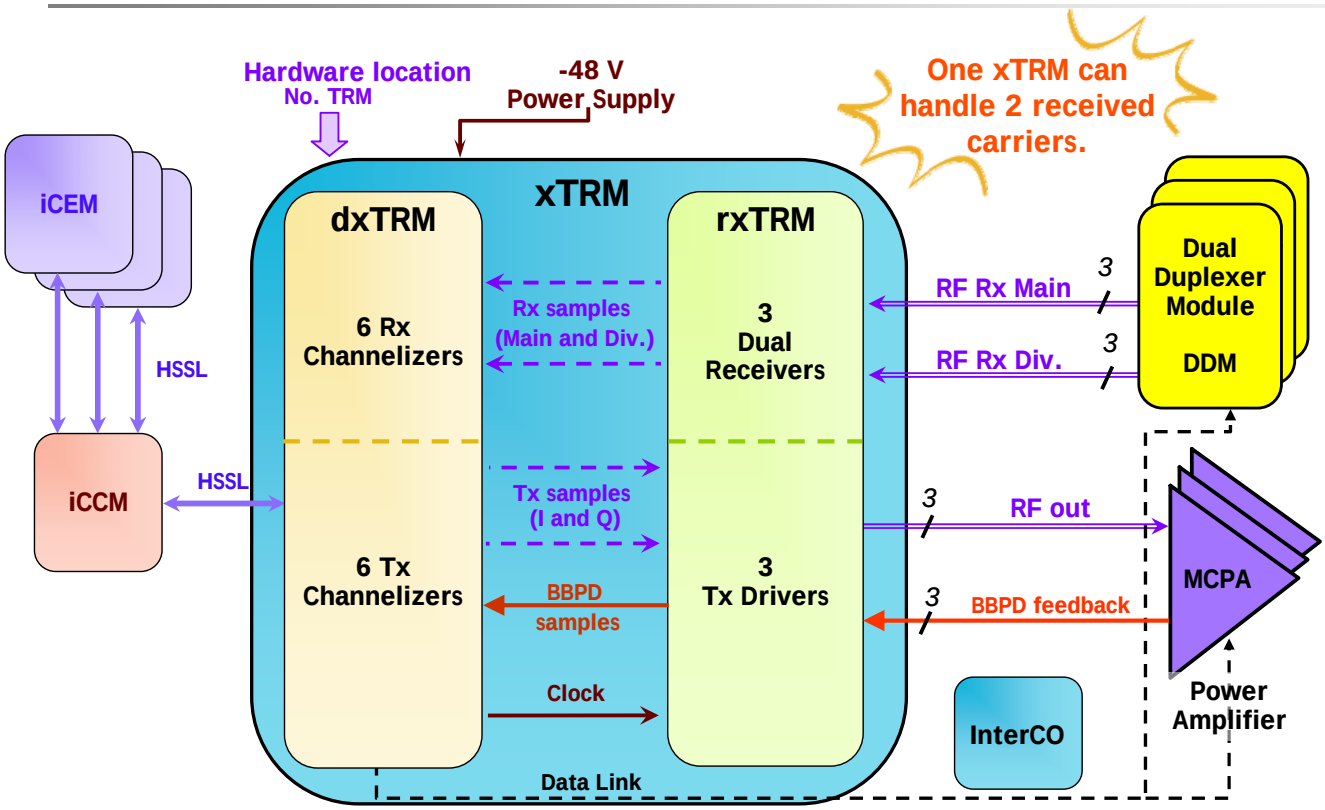
In uplink direction it handles three pair-received signals (main and diversity) that come from the antenna via a coupling system. It processes the data and forwards them to the Core Control Module.

The oldest type of these boards is the classical Transmit Receive Module (**TRM**).

The second generation is the integrated Transmit Receive Module (**iTRM**). Its advantage against the classical TRM is the direct modulation and demodulation.

The expandable Transmit Receive Module (**xTRM**) is the third generation of the Alcatel-Lucent TRM types.

4.2 TRM/iTRM/xTRM: Architecture



The expandable Transmitter Receiver Module (**xTRM**) can be used in all Alcatel-Lucent UMTS BTSs, except the BTS 1020. By default, the functions of iTRM are applicable to xTRM.

xTRM has the following advantages against the iTRM:

- Cooperation with the new Multi-carrier Power Amplifier 60 Watts (MCPA-60)
- [1] Reception of **two** UMTS frequency carriers, instead of one.
- [2] Integration of the Base Band Pre-Distortion (**BBPD**) linearization technique.
- [3] In uplink direction, the xTRM can be configured with one carrier only which is called xTRM-1R configuration, or with two carriers. In this case, we call it an xTRM-2R configuration.

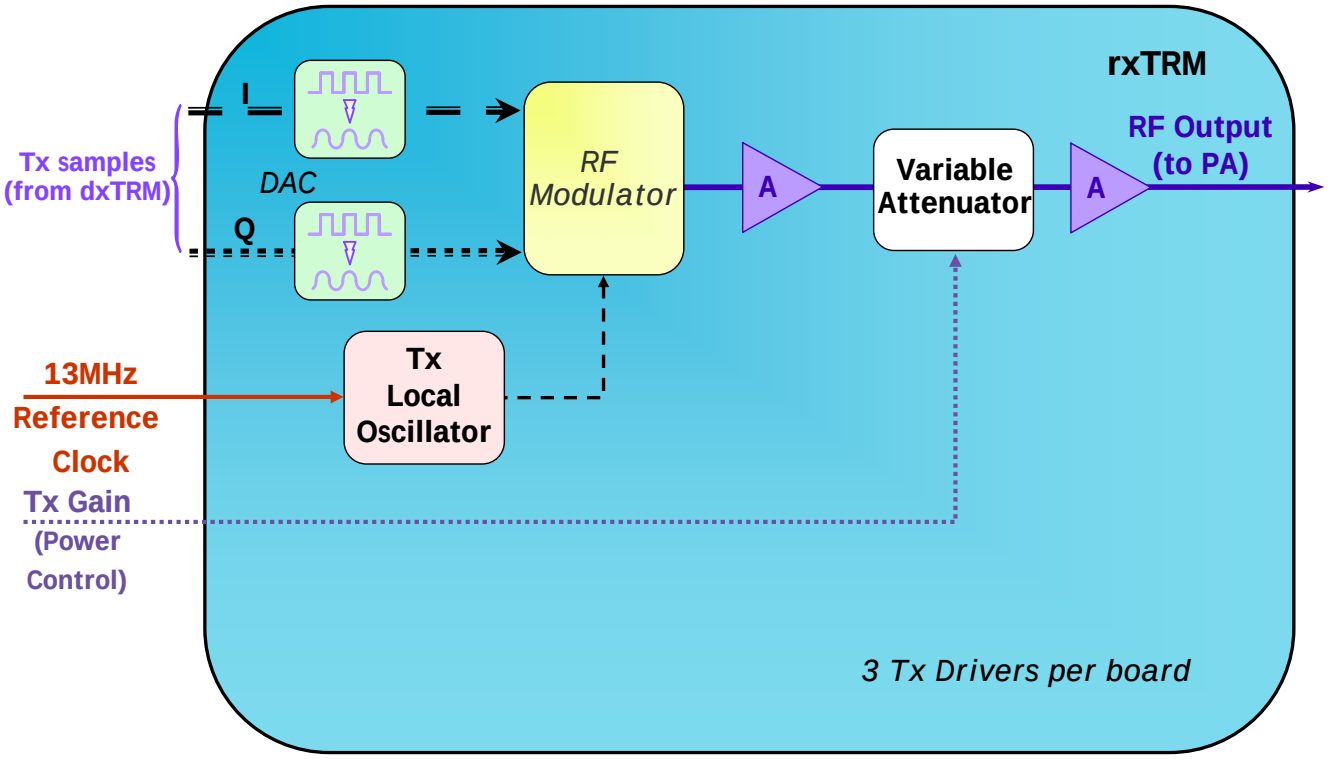
[4] The expandable Transmitter Receiver Module (xTRM) contains the transmit and receive circuitry for six transmit chains and six receive chains. It performs Digital-to-Analog (DAC) and Analog-to-Digital (ADC) Conversion as well as up and down frequency conversion. The low frequency is used for internal processing within the BTS whereas the high frequency is used for external transmission by the antenna. The xTRM also controls the emitted power and [5] assures clock recovery and synchronization

Each xTRM consists of two boards:

[6] **dxTRM** - The digital Transmit Receive board performs signal processing (in transmission and reception) by means of channelizers.

[7] **rxTRM** - The radio Transmit Receive board consists of three transmit chains and three dual receive chains.

4.3 The transmit part of rxTRM



The radio part of the expandable Transmitter Receiver Module (**rxTRM**) board consists of three Tx drivers and three dual receivers.

[1] This diagram illustrates only the transmission part of rxTRM board with 3 Tx Drivers.

[2] In the transmit direction the digital part of the TRM – the dxTRM – processes the W-CDMA signals coming the CEMs and forwards the TX samples at a chip rate of 3.84 MHz into the two branches I and Q.

[3] The rxTRM board performs the Digital-to-Analog Conversion (DAC) and [4] the radio frequency modulation – either QPSK, 16QAM or 64QAM.

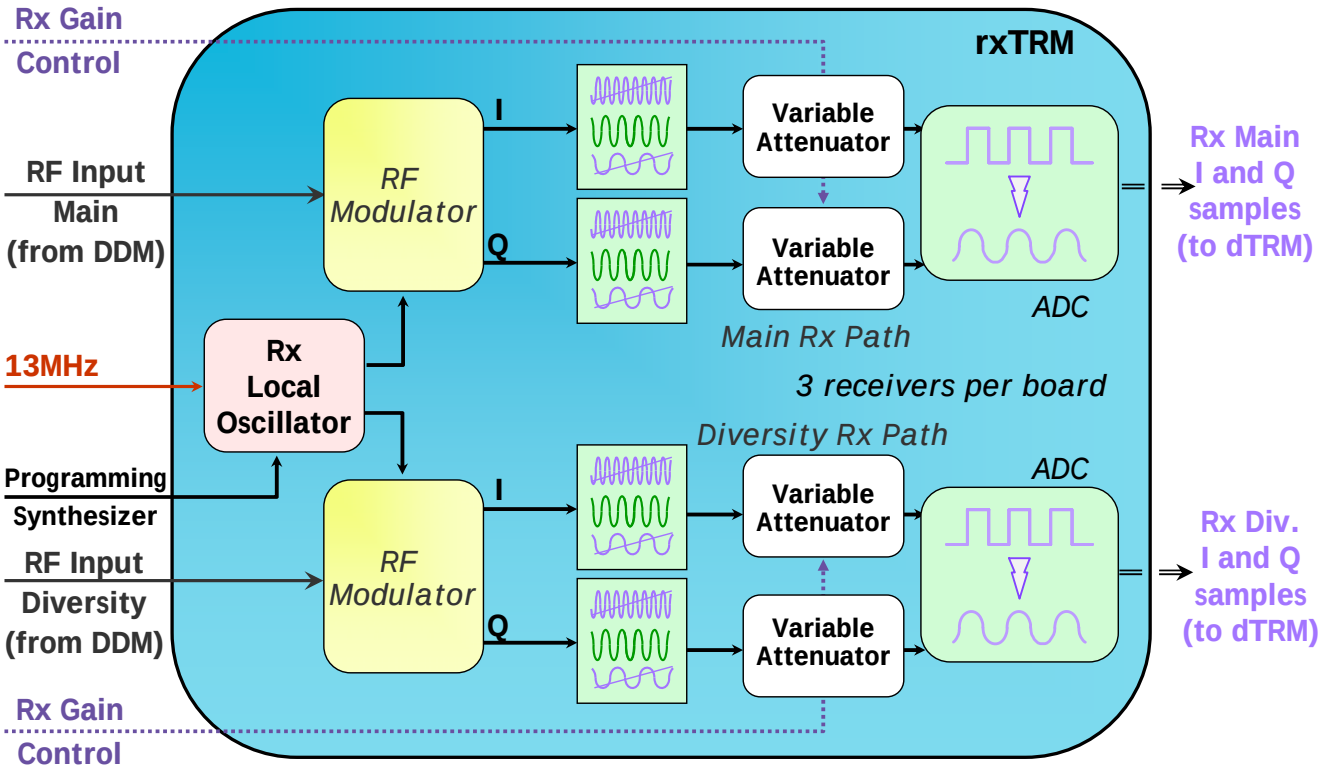
[5] A Gain Control Loop takes into account the variations of the driver and the Power Amplifier, to obtain the nominal output power at the antenna, by means of a variable attenuator.

[6] The power control function adjusts each radio frequency signal level to optimize the total interference level noise between the BTS and the UE.

DAC - Digital Analog Converter

PA - Power Amplifier

4.4 The receive part of rxTRM



In the receive part, the radio part of the expandable Transmitter Receiver Module (**rxTRM**) board handles up to three pairs of received signals (UMTS carriers). The rxTRM performs demodulation, base band filtering, gain control and Analog-to-Digital Conversion (ADC).

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

[2] The main and diversity radio frequency signals come from the receive part of the coupling system, that is the Dual Duplexer Module which provides filtering.

[3] The demodulators process either QPSK, 16QAM or 64QAM.

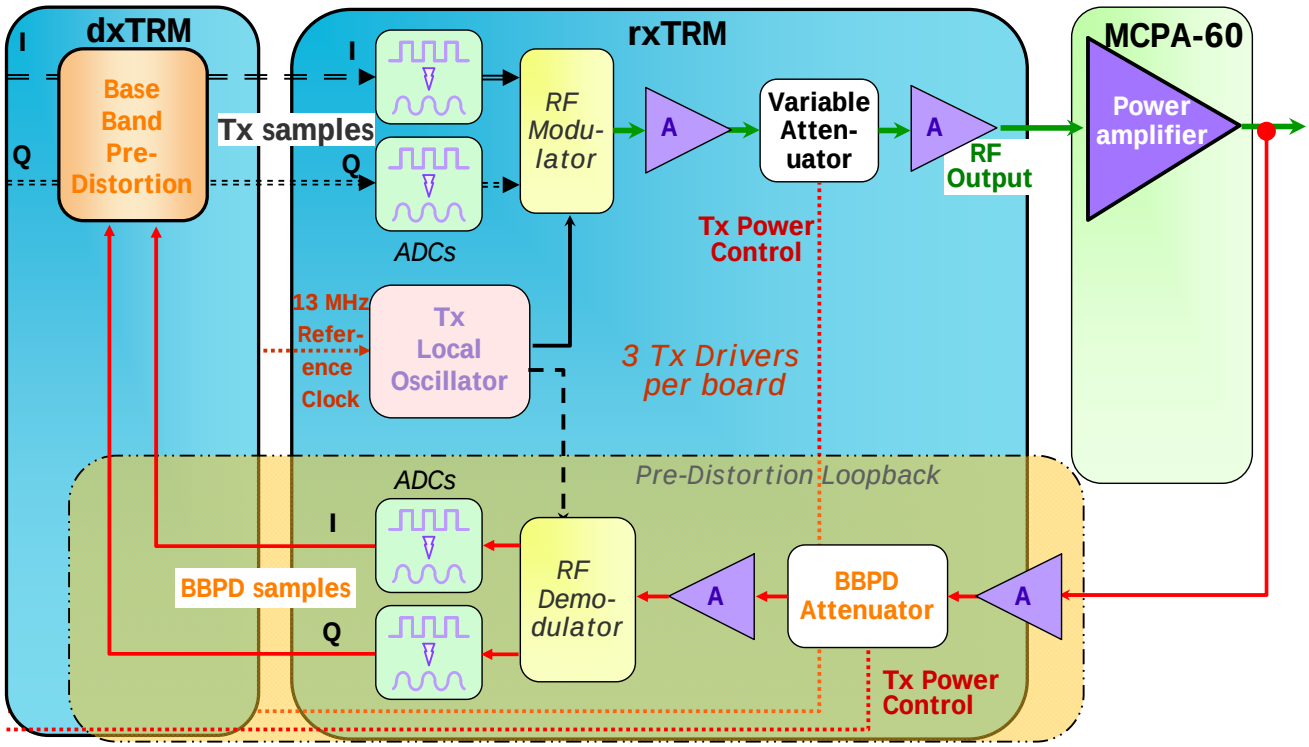
[4] The gain control range provided by the variable attenuator is defined to allow correct operation of the ADC, whatever the input level signal is.

[5] Then the baseband I and Q signals are sampled in the ADC which provides I and Q multiplexed data.

[6] This data is then sent to the Rx channelizer of the digital part of Transmitter Receiver Modules.

ADC - Analog Digital Converter

4.5 xTRM: The Tx pre-distortion loopback



The Base Band Pre-Distortion (**BBPD**) feature reduces the complexity of the Power Amplifier (PA) but needs the usage of a new type of amplifier: [1] The Multi carrier Power Amplifier (**MCPA**).

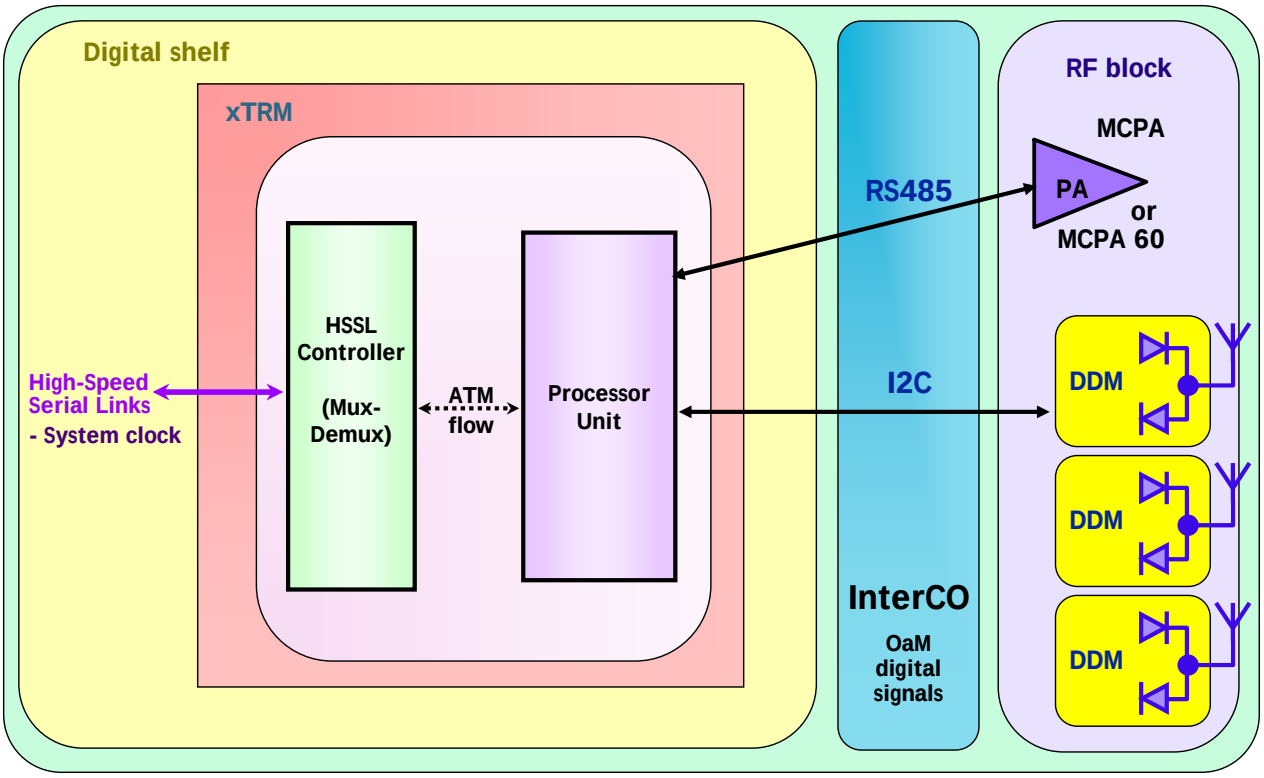
[2] The radio board of Transmitter Receiver Modules (**rxTRM**) includes 3 Tx drivers with their own local oscillators. Hence the need for a common local oscillator.

[3] In the digital part of the Transmitter Receiver Modules (**dxTRM**), [4] the Base Band Pre-Distortion algorithm detects the radio block (RF) power received on each feedback input per sector and computes the distortion introduced by the analog section (rxTRM). This algorithm also applies a pre-distortion 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.

BBPD - Base Band Pre-Distortion

MCPA - Multi carrier Power Amplifier

4.6 xTRM: Management of PA and DDM



The InterCOnnection module [1] (or InterCO) carries digital signals [2] for the management of the expandable Transmitter Receiver Modules (**xTRM**), the Multi-carrier Power Amplifier (**MCPA**) and the Dual Duplexer Module (**DDM**).

As regards the management of the Multi-carrier Power Amplifier, the expandable Transmitter Receiver Module controls up to three Multi-carrier Power Amplifiers. [3] To do this, the xTRM uses the dedicated RS485 bus. This bus reads the output power, enables or disables the MCPA, reads temperature sensors, queries the alarm status and reads the inventory information.

The digital part of the Transmitter Receiver Module (dxTRM) can also independently enable each of these six MCPAs.

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

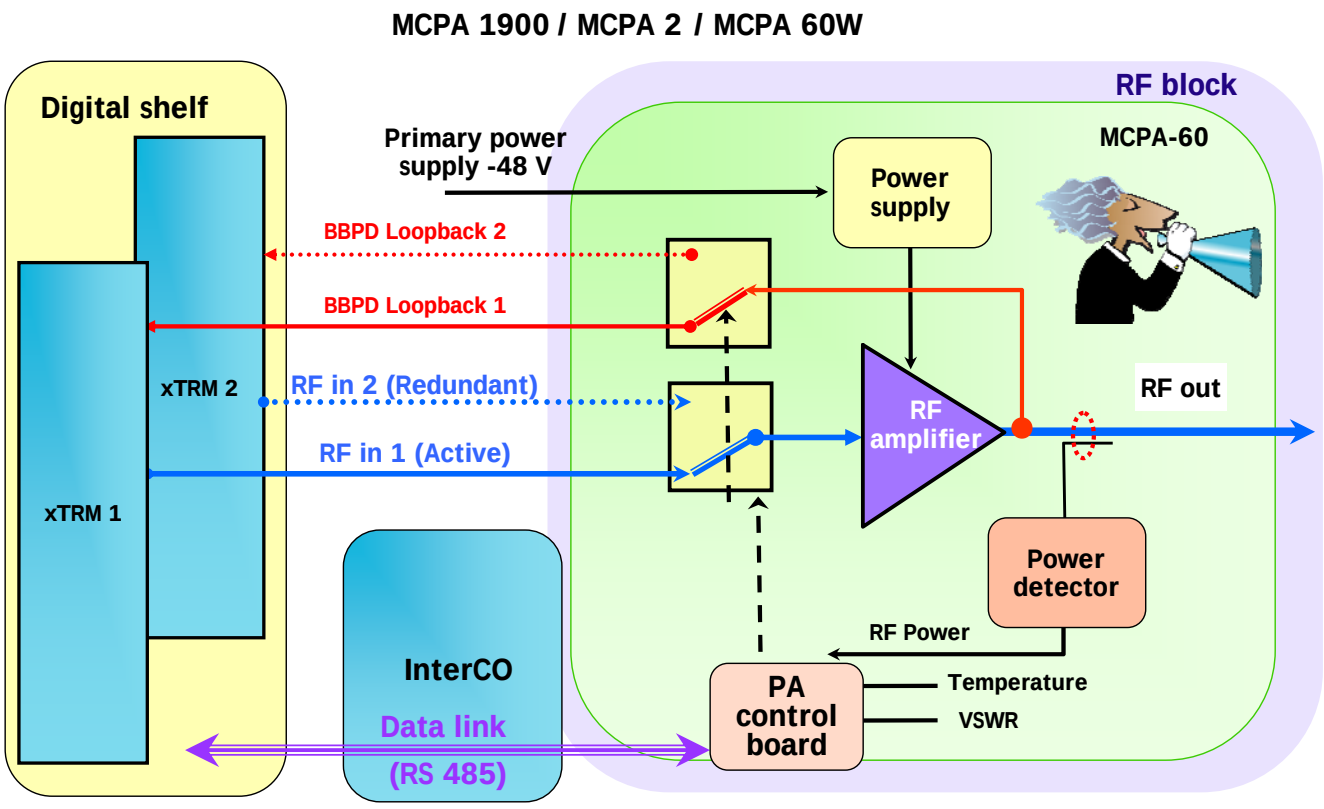
The xTRM can also reset the MPCA.

[4] As regards the management of the Dual Duplexer Module, the xTRM controls it via the I2C bus. Three signals are available on the DDM connector to detect the presence of a DDM. Moreover the xTRM reads the alarm register and configures the Dual Duplexer Module.

5 Radio power amplifiers (PA)

Now, let's describe the radio power amplifier. It amplifies the radio signal in downlink direction and feeds it into the coupling system.

5.1 MCPA/MCPA-60 block diagram



The expandable Transmitter Receiver Module (**xTRM**) can control up to six Multi-carrier Power Amplifiers (MCPA) [1] through the data bus ICO. Its digital part (dxTRM) can independently enable each of these six Multi-carrier Power Amplifiers.

Each Multi-carrier Power Amplifier can be connected to two xTRMs for redundancy purposes (but this is not the case for MCPA-60).

Alcatel-Lucent provides three types of Power Amplifiers (PAs) for Tx amplification:

1. [2] The MCPA 1900 operates within a bandwidth ranging from 1930-1990MHz (for UMTS 1900).
2. [3] The MCPA-2 2100 module operates within a bandwidth ranging from 2110-2170MHz (for UMTS 2100).
3. [4] The MCPA-60 module operates within a bandwidth ranging from 2110-2170MHz (for UMTS 2100) and supports up to two carriers per sector in reception.

   [5] Two types of MCPA 60 Watts exist: MCPA-L 60W and MCPA 60W BBDP. MCPA-L 60W is different from the MCPA60W that is a [6] Base Band Predistortion PA (BBPD PA). MCPA-**L** 60W is self-**L**inearized while the BBPD MCPA60W is linearized through the xTRM.

Alcatel-Lucent recommends not to mix together two different Multi-carrier Power Amplifier 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.

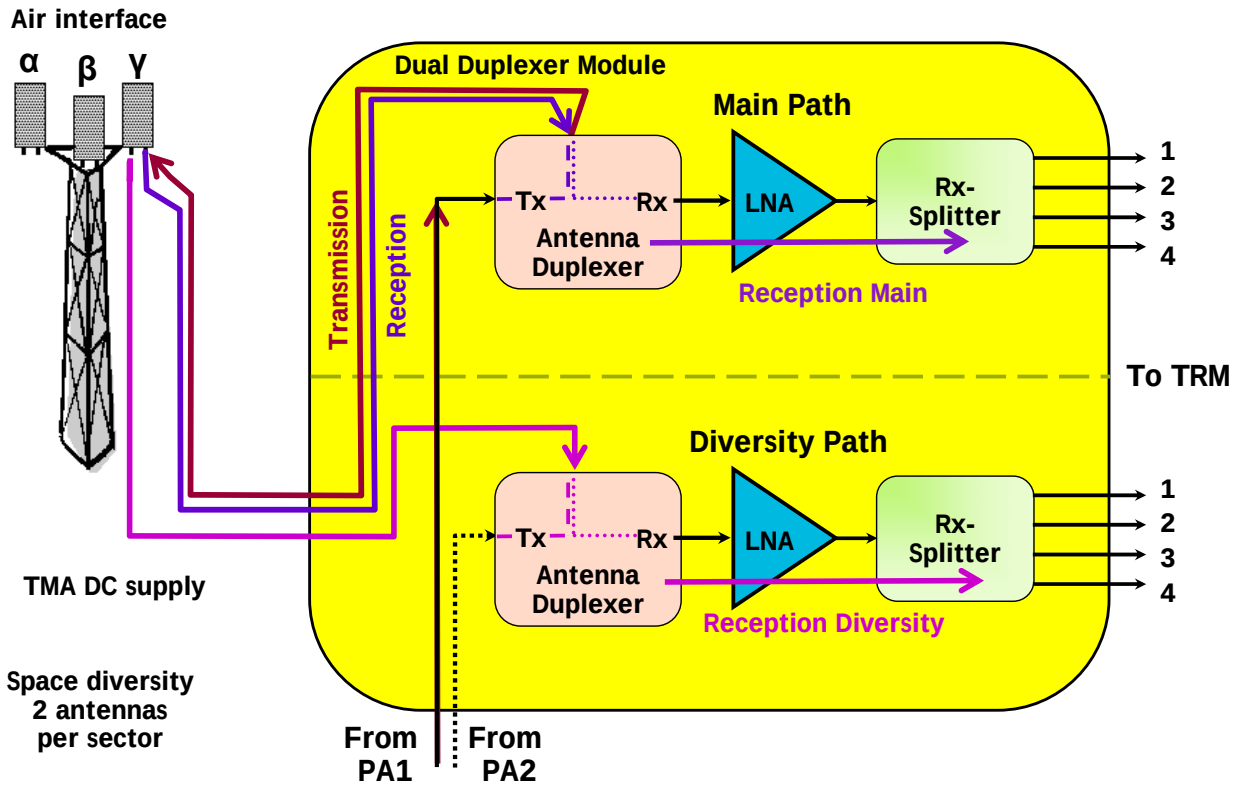
[] The new MCPA-60 is a module which includes a 60W Power Amplifier with a PA Controller (PAC). The MCPA-60 is only supported with an xTRM. The MCPA-60 is only compatible with BTS 6020 (Street), 9311 Macro NodeB Indoor and Outdoor.

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).

6 Coupling modules

We continue with the coupling modules or duplexers. They connect the power amplifier or power splitter to the antennae in downlink direction. In uplink direction they pass the received signals to an integrated low noise amplifier and feed the transmit receive modules.

6.1 Functions of the Dual Duplexer Module (DDM)

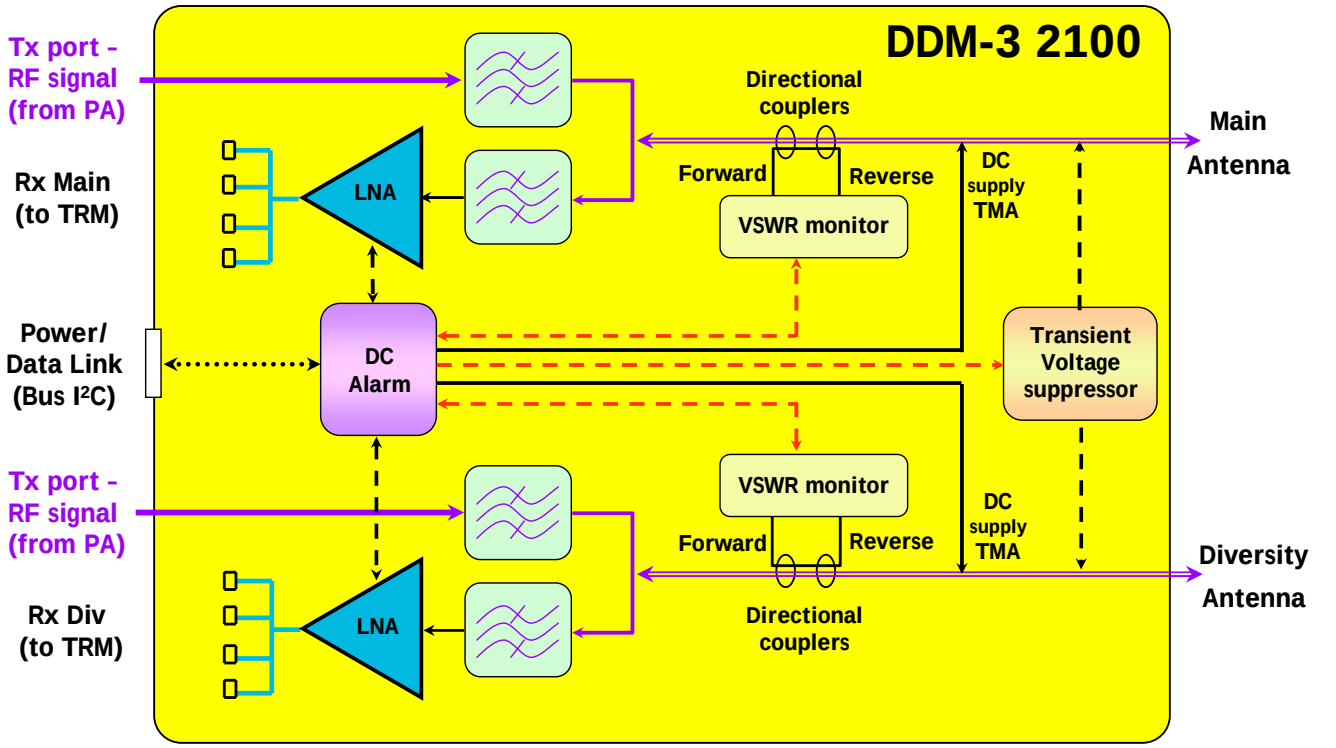


The Dual Duplexer Module (**DDM**), houses [1] two full assemblies with a duplexer and a low noise amplifier: One is used for the [2] main path and the other [3] for the diversity path. [4] Diversity in transmission direction for the same frequency is not supported. So there is just one way for the transmission.

The main functions of the Dual Duplexer Module are the provision of one single antenna port per assembly used for both transmission and reception paths, dedicated isolation between transmit and receive frequency bands and out-of-band filtering

[5] The Dual Duplexer Module also performs low noise amplification in Rx frequency bands and signal splitting into four local outputs, and has VSWR alarm monitoring capability. [6] Next the Dual Duplexer Module supplies the TMA with DC and monitors the alarms of the TMA. Finally, the Dual Duplexer Module suppresses any transient voltage coming from the antenna port after external lightning protection.

6.2 DDM-3 2100: Block diagram



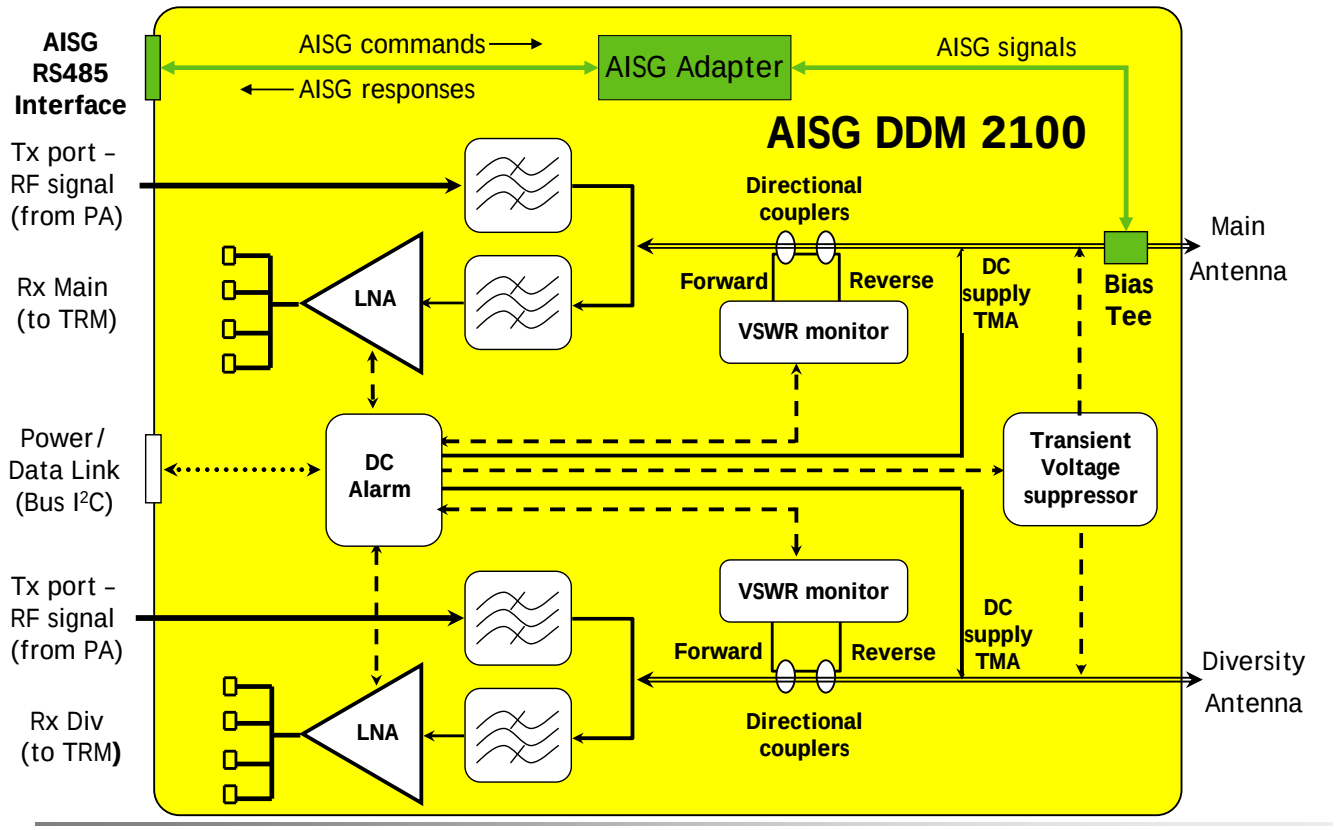
The variant DDM-3 2100 supports the radio frequency range of 2100 MHz. It houses [1] two full duplexer/LNA assemblies: one for the main path and the other for the diversity path.

[2] The LNA provides its amplification at the system front end, thereby reducing the overall effects of noise. For the DDM-3, the gain of the LNA is variable. After the LNA, [3] the received band signals are split into four local outputs prior to distribution to the TRMs via coaxial cables.

[4] A circuit monitors the Voltage Standing Wave Ratio, it detects reflected power from the antenna port and supervises the connection between the BTS and the antenna. Matching is deduced and compared to three fixed values. In case of problems this circuit creates an alarms with a severity level, depending on the value of the Voltage Standing Wave Ratio.

[5] The Dual Duplexer Module includes two DC/DC converters, one supplies direct current to the TMA of the main branch and the other supplies the diversity branch. This again works as equipment protection. The DDM detects problems of the TMAs by monitoring their current, the alarms are forwarded to the Central Control Module.

6.3 AISG DDM 2100: Block diagram



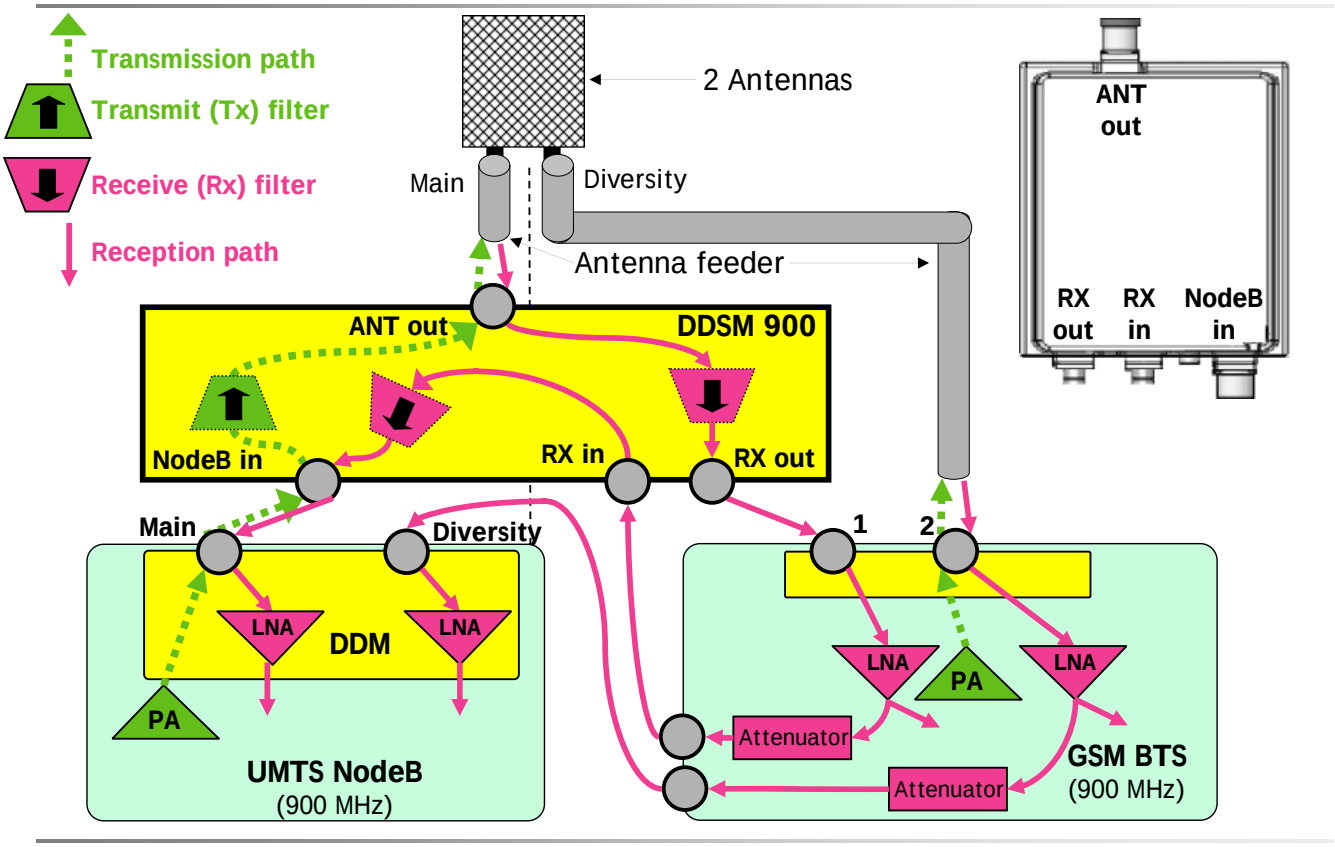
Beneath the standard functions of a Dual Duplexer Module the variant AISG DDM supports an AISG Tower Mounted Amplifier plus the RETA functions to tilt remotely antennas. Via the AISG RS485 interface it exchanges data with the AISG controller. The AISG commands and responses are multiplexed via a bias tee to the antenna feeder of the main path. At the top of the tower the AISG signals are demultiplexed by the AISG TMA.

There are some other differences to the DDM-3: First the gain of the LNA is not variable like in the case of DDM-3 but it is fixed at 15.5 dB. Second the problems of TMAs are not detected by the AISG DDM, but by the AISG controller.

This hardware variant supports again the radio frequency range of 2100 MHz.

AISG - Antenna Interface Standards Group
RETA - Remote Electrical Tilt Antenna
TMA - Tower Mounted Amplifier

6.4 Dual Duplexer Sharing Module 900 MHz (DDSM 900)



The Dual Duplexer Sharing Module operates in the following paired band:

· 880 – 915 MHz: Up-link (UL) / · 925 – 960 MHz: Down-link (DL)

It supports the antenna sharing of a UMTS 900 NodeB simultaneously with a indoor or outdoor GSM BTSs by reusing the already available GSM antenna line system (including the feeders, antennas and potentially TMA) for the UMTS 900 MHz base station. It can only be used if the antenna diversity path is not used for the GSM Tx path.

The DDSM is made of one Transmit (Tx) filter and two Receive (Rx) filters. It operates passively and is inserted on the antenna diversity path.

On the UMTS Tx path, the transmit signal of the NodeB leaves the DDM on the “Main” path. It enters the port “NodeB in” of the DDSM and is filtered by the transmit filter. It leaves at the port “ANT out”, the “main” antenna feeder guides it to the main antenna. Tx Diversity is not supported in this configuration.

On the GSM Tx path the diversity antenna feeder guides the transmit signal to the diversity antenna, where it is emitted.

The main antenna receives the mixed uplink signals – GSM plus W-CDMA. The antenna feeder guides them to the port “ANT out” of the DDSM. The right most receive filter passes them to the GSM BTS where a LNA amplifies and distributes them. An attenuator weakens this mixed signals, before they enter via an extra cable the DDSM at the port “RX in”. The second receive filter in the middle of the DDSM passes the received signal of the main path to the LNA of the UMTS NodeB.

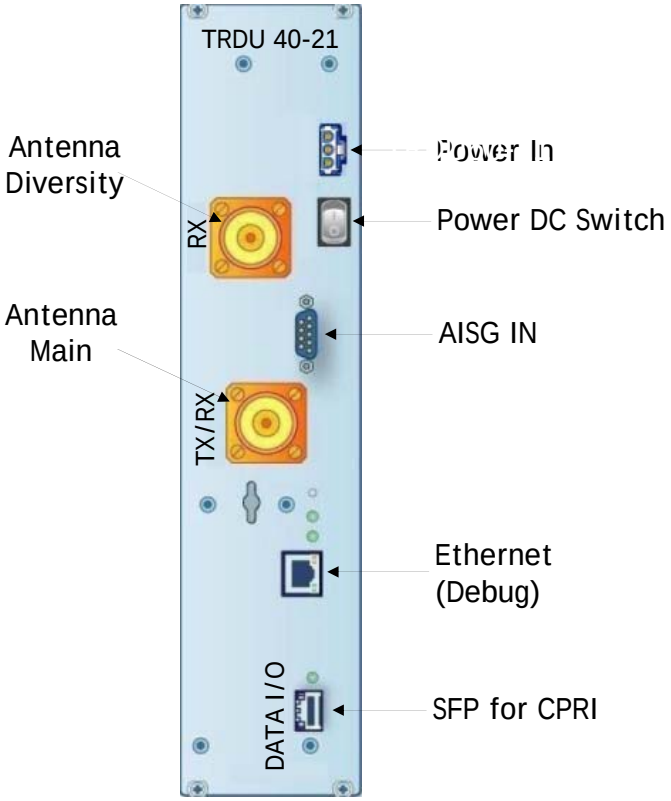
The diversity antenna receives the mixed uplink signals, too. They enter the GSM BTS and are amplified by the LNA. Again an attenuator weakens the signals before they reaches via a cable the LNA for the diversity path in the UMTS NodeB.

DDM - Dual Duplexer Module
LNA - Low Noise Amplifier
PA - Power Amplifier
TMA - Tower Mounted Amplifier

7 Combined Modules

We continue with a module that combines both coupling and transmit receive functions in a very compact hardware.

7.1 Transmitter Receiver Duplexer Unit (TRDU)



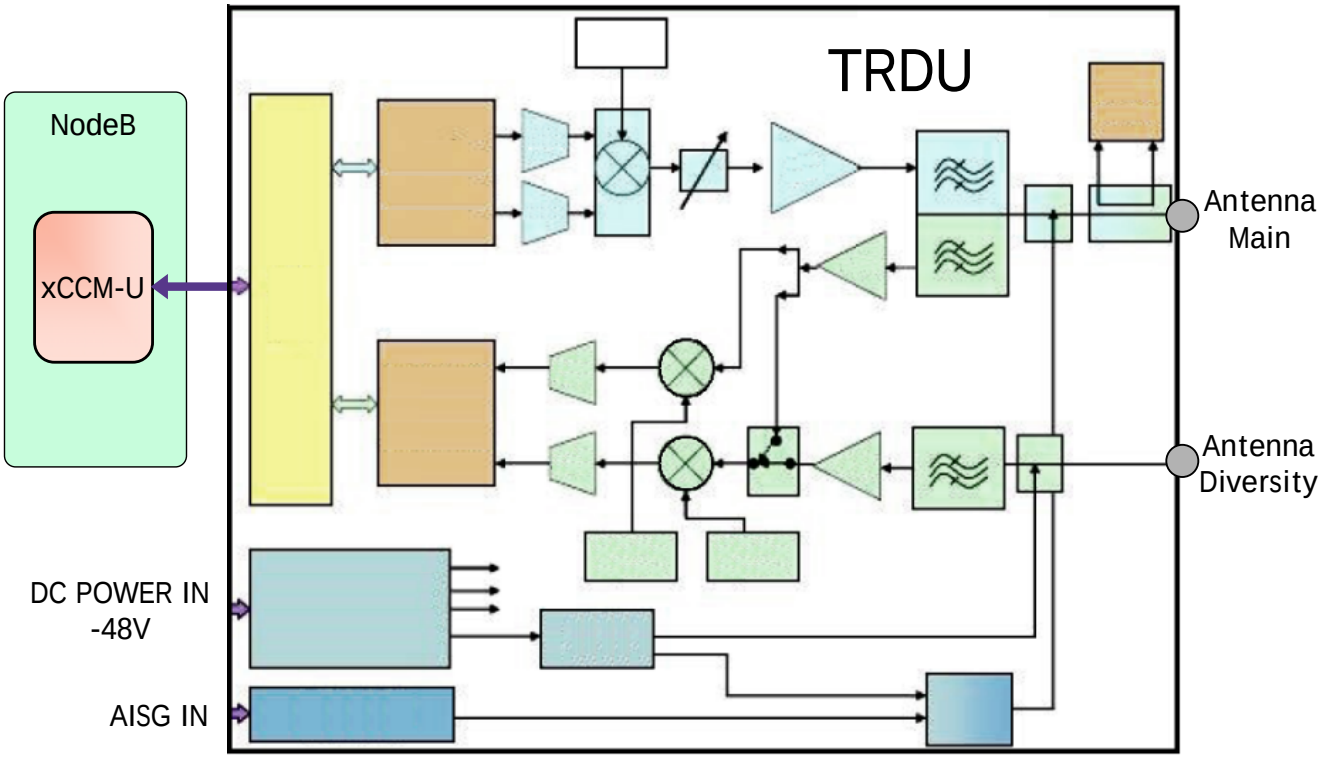
- The Transmitter Receiver Duplexer Unit (TRDU) module is a complete UMTS Radio Equipment, designed to operate in the full UMTS band 1 [Downlink UMTS Band 1: 2110-2170 MHz / Uplink: 1920-1980 MHz / Carrier spacing between 4.6 MHz and 5.2 MHz].
- The TRDU manages up to two adjacent UMTS carriers. Dependent on the variant the total RF output power is limited to 40 W or 60 W. This power can be concentrated onto one single carrier, or it can evenly distributed into 2 carriers.
- The radio frequency air interface is supported through two RF coaxial antenna connections:
  - One duplexed antenna connection supporting transmit and receive main paths (Antenna Main)
  - One single antenna connection supporting receive diversity path (Antenna Div).
- The TRDU is connected via an electrical or optical CPRI link to the eXtended Core Controller Module-U board of the 9312 Compact OD, also called Radio Equipment Control (**REC**). The TRDU supports only one slave port at CPRI line bit rate option 2 1228.8 Mbit/s. The used interface module is either a modern type SFP, but the older type MSA is supported, too.

Limitations:

- Up to 6 TRDU per NodeB are supported; there is a restriction to 3 TRDU only in the Multistandard cabinets already deployed with 2G.
- UP to 3 CPRI RRH and up to 3 TRDU can be supported from one single 9326 d2U equipped with xCCM-U. This configuration is only applicable to 9941 Smart NodeB and 9100 Multistandard Indoor (MBI3).

AISG - Antenna Interface Standards Group
CPRI - Common Public Radio Interface
SFP - Small Form-factor Pluggable optical transceiver
MSA - Multi Source Agreement optical transceiver

7.2 TRDU: Block Diagram



The TRDU module integrates the following three functions in a single module:

- Transceiver
- Multi-carrier power amplifier
- Duplexer/filter

The TRDU module incorporates a Voltage Standing Wave Ratio (VSWR) meter to monitor RF mismatching between antenna and TRDU main antenna connection. This VSWR meter monitors Return loss at the antenna main port connection..

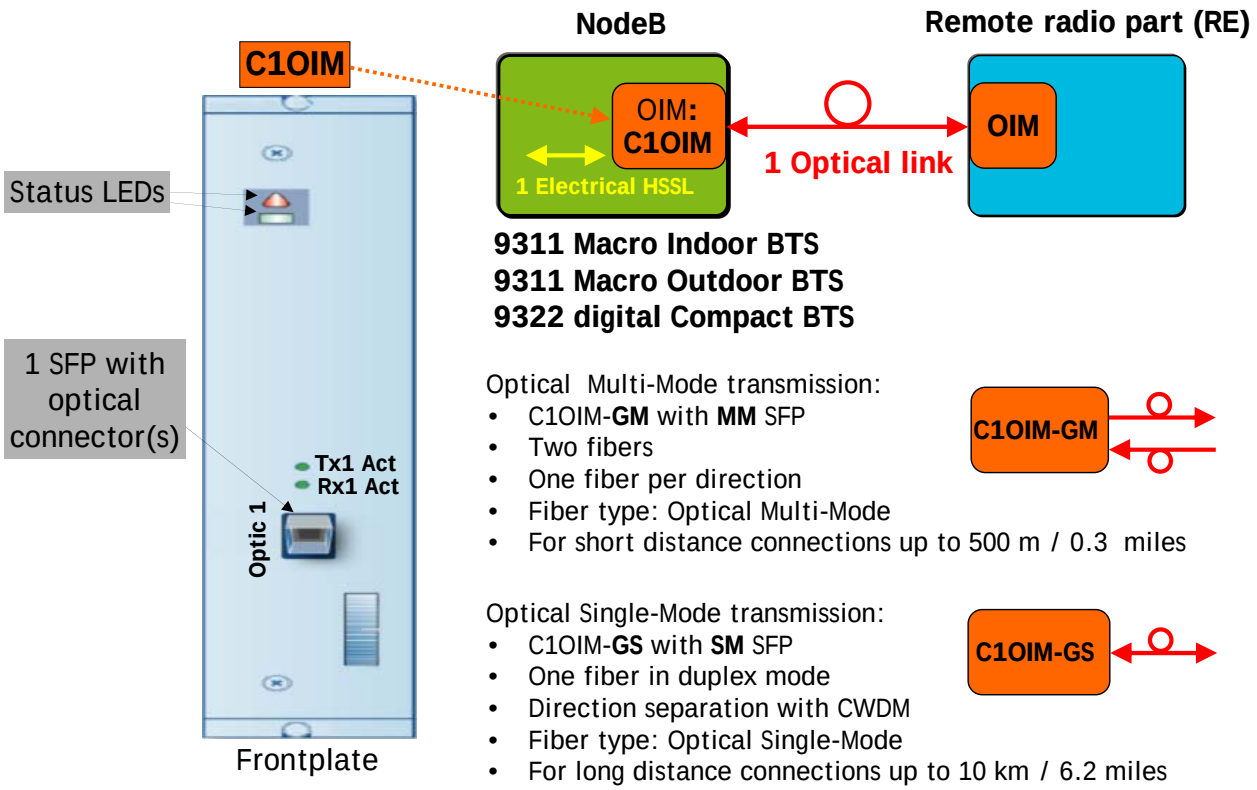
The TRDU also provides an Antenna Interface Standard Group (AISG) functionality and can support TMAs.

ADC - Analog Digital Converter
DAC - Digital Analog Converter
LNA - Low Noise Amplifier
LO - Local Oscillator
PA - Power Amplifier
VSWR - Voltage Standing Wave Ratio

8 Optical Interface Modules

The next slides describe the modules that support the used for distributed NodeBs.

8.1 Compact Optical Interface Module C1OIM



The "Compact Optical Interface Module with connectivity for one optical link" works in the Digital NodeB as a transparent electrical-optical gateway between the Digital NodeB and the Remote Radio Equipment.

A C1OIM is equipped with one optical head - a Small Form-factor Pluggable. It multiplexes and demultiplexes the electrical High Speed Serial Links and converts this multiplex towards a optical HSSL signal and vice versa.

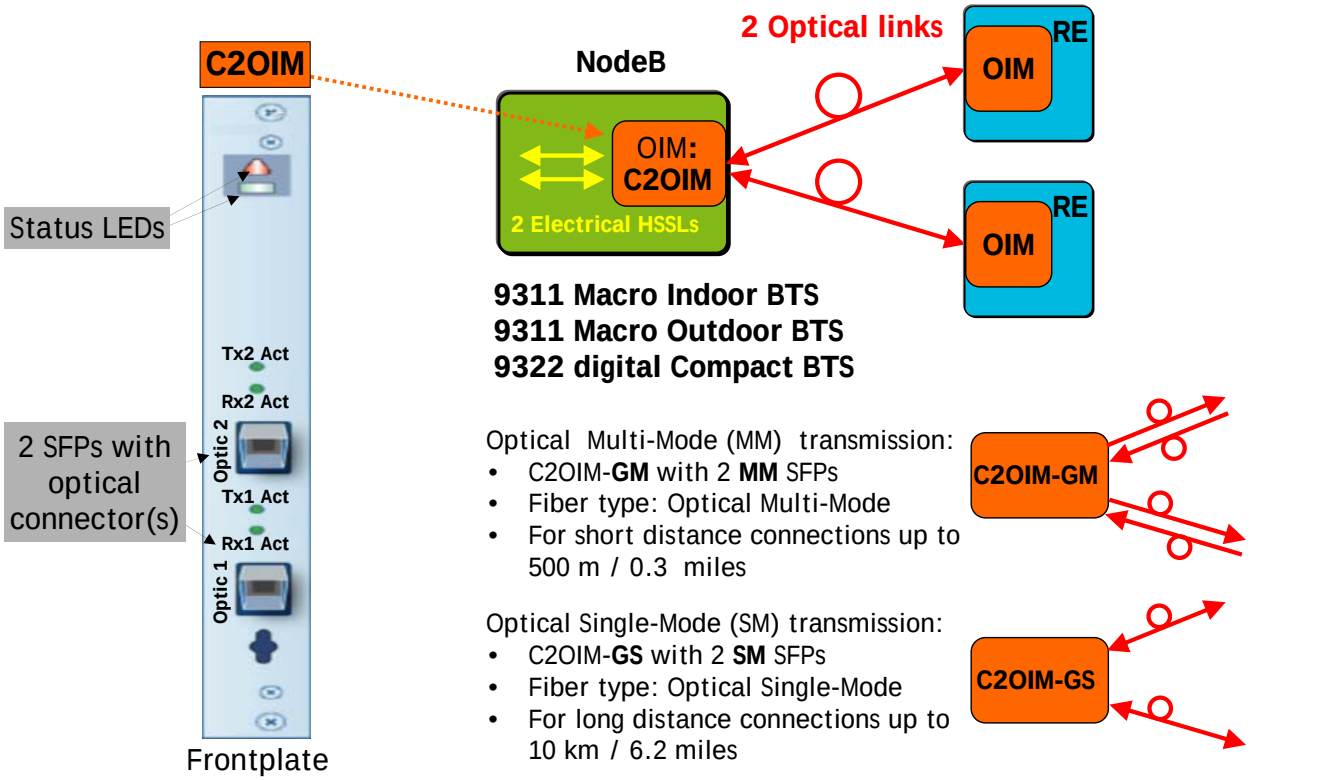
Depending on the distance two optical transmission types and two C1OIM variants are used:

- For up to 500 meters or 0.3 miles the multimode transmission can be used. The module variant C1OIM-GM is equipped with a Multi-Mode optical transceiver with two optical connectors, each one operates one Multi-Mode fiber. So the optical link is carried by two fibers: One fiber carries the downlink, the other one the uplink.
- For longer distances – up to 10 km or 6.2 miles – an optical link consisting of only one fiber of type optical Single-Mode is used. The module variant C1OIM-GS is equipped with a Single-Mode optical transceiver with only one optical connector. The fiber is operated in both directions, uplink and downlink are separated by using coarse wavelength division multiplexing: A first wavelength is used for the optical downlink, a second one is used for the uplink.

The C1OIM can be installed in the 9311 Macro Indoor, 9311 Macro Outdoor or in the 9322 dCompact BTS.

C1OIM-GM - C1OIM variant to use 1 optical link carried by 2 Multi-Mode fibers
C1OIM-GS - C1OIM variant to use 1 optical link carried by 1 Single-Mode fiber
OIM - Optical Interface function
CWDM - Coarse Wavelength Division Multiplexing
SFP - Small Form-factor Pluggable optical transceiver
MM - optical Multi-Mode propagation
SM - optical Single-Mode propagation
RE - Radio Equipment

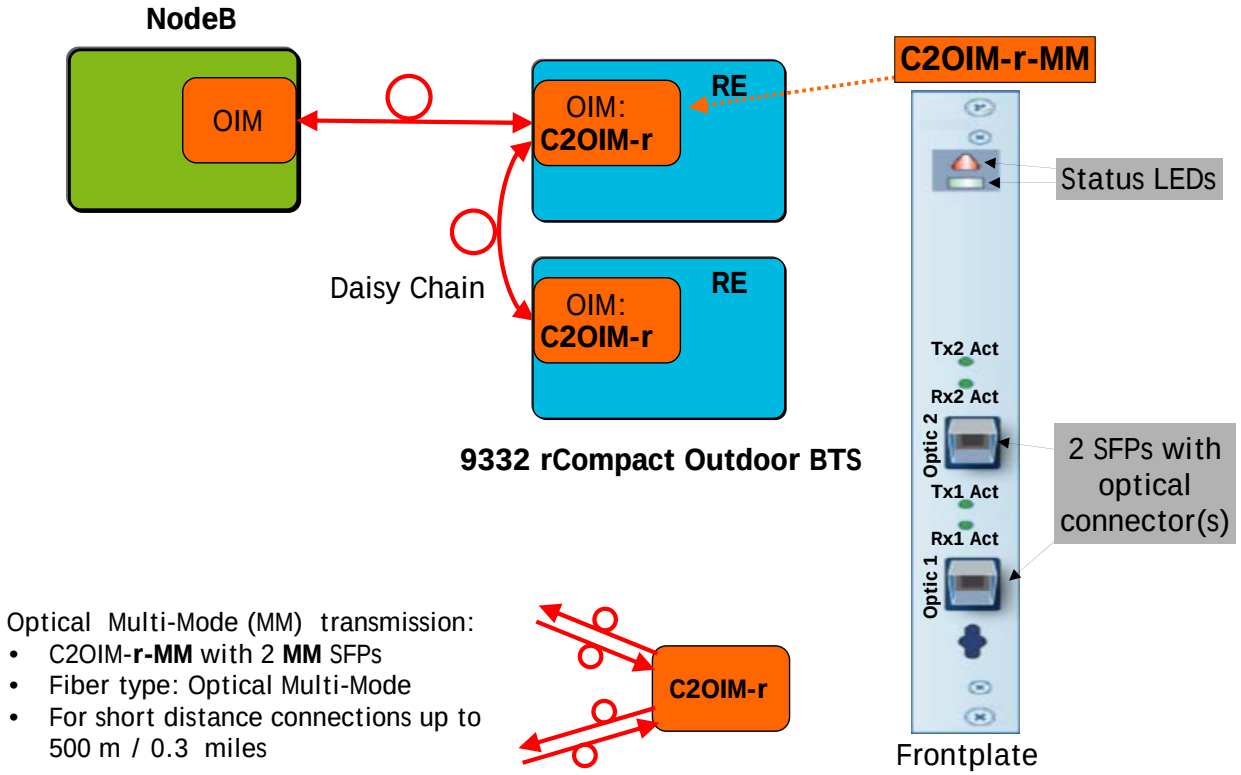
8.2 Compact Optical Interface Module C2OIM



The C2OIM works similar to the module C1OIM. It is equipped with two Multi-Mode or Single-Mode SFPs, it can be installed in the 9311 Macro Indoor, 9311 Macro Outdoor or in the 9322 dCompact BTS.

C2OIM-GM - C2OIM variant to use 2 optical links carried by Multi-Mode fibers
C2OIM-GS - C2OIM variant to use a 2 optical links carried by Single-Mode fibers
MM - optical Multi-Mode propagation
OIM - Optical Interface function
RE - Radio Equipment
SFP - Small Form-factor Pluggable optical transceiver
SM – optical Single-Mode propagation

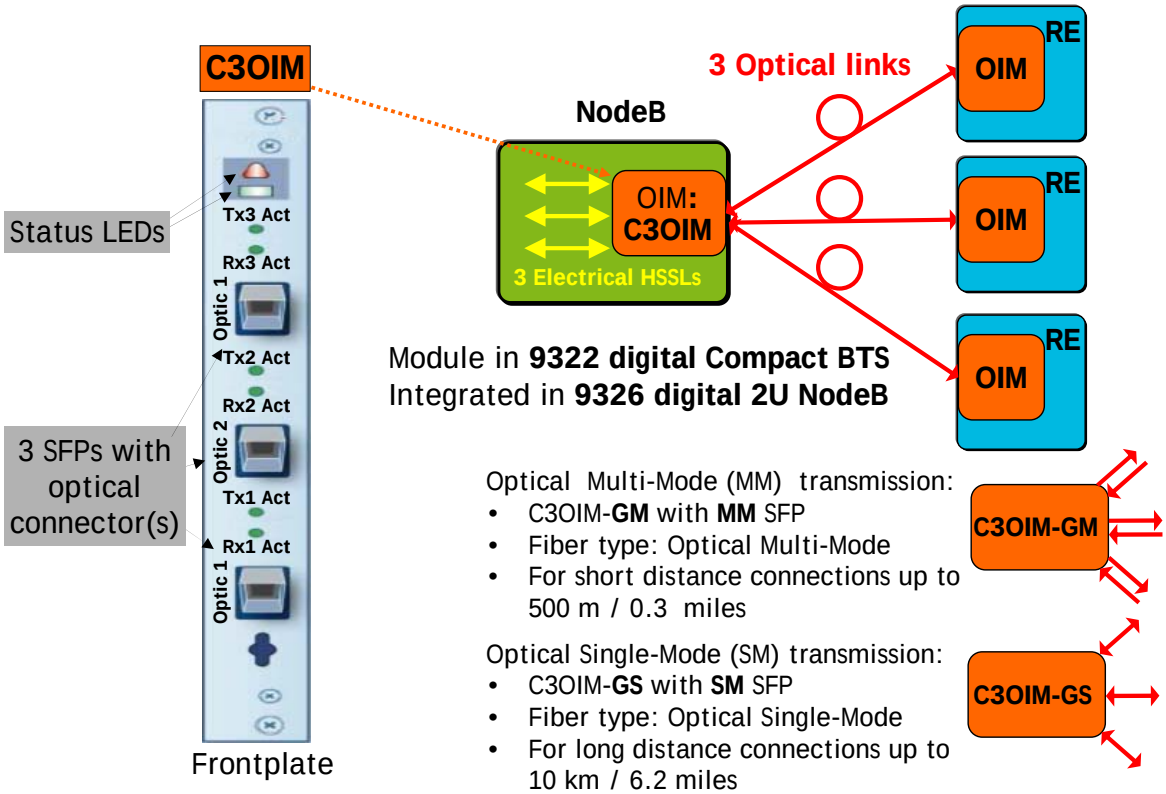
8.3 Compact Optical Interface Module C2OIM-r-MM



The C2OIM-r works similar to the module C2OIM. It is equipped with two Multi-Mode SFPs, it can be installed only in the 9332 rCompact Outdoor BTS.

C2OIM-GM - C2OIM variant to use 2 optical links carried by Multi-Mode fibers
C2OIM-GS - C2OIM variant to use a 2 optical links carried by Single-Mode fibers
MM - optical Multi-Mode propagation
OIM - Optical Interface function
RE - Radio Equipment
SFP - Small Form-factor Pluggable optical transceiver
SM – optical Single-Mode propagation

8.4 Compact Optical Interface Module C3OIM



The C3OIM works similar to the module C1OIM. It is equipped with three Multi-Mode and a Single-Mode SFPs, it can be installed in the 9322 dCompact BTS.

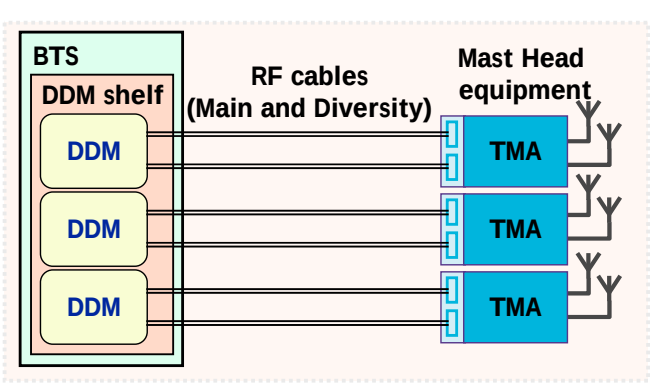
It is also used in the 9326 digital 2U BTS. Here it is not a replaceable module but it is a integrated part of the Core Control Modules iCCM-U and xCCM-U.

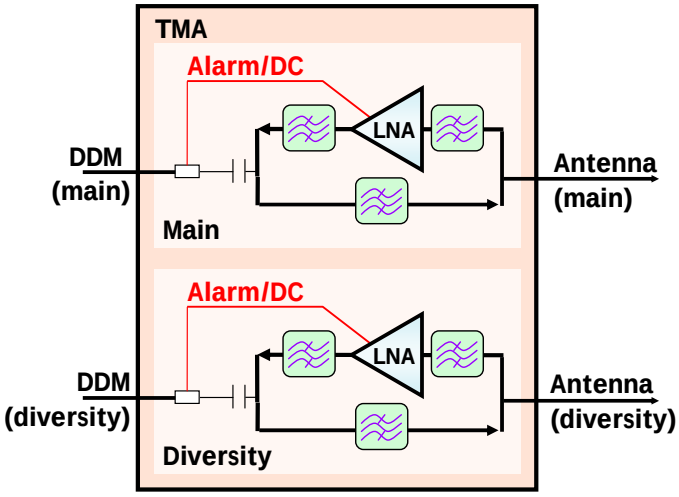
C3OIM-GM - C2OIM variant to use 3 optical links carried by Multi-Mode fibers
C3OIM-GS - C2OIM variant to use 3 optical links carried by Single-Mode fibers
MM - optical Multi-Mode propagation
OIM - Optical Interface function
RE - Radio Equipment
SFP - Small Form-factor Pluggable optical transceiver
SM – optical Single-Mode propagation

9 Modules supporting the optional antenna functions

The next slides lists the optional antenna support functions of the BTS. The BTS controls the tower mounted amplifiers for pre-amplification and via a system of remotely controlled motors the direction of the antennas. The application of antennas that can be redirected remotely from the OMC saves a lot of travel and installation costs.

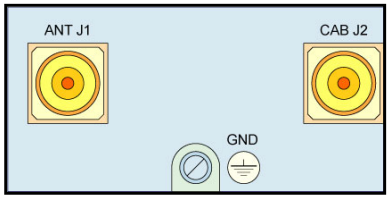
9.1 Tower Mounted Amplifier (TMA)





Light TMA 2100 module

Double TMA 2100 module



Single TMA 1900 module
(Macro Outdoor)

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 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 Low Noise Amplifiers (**LNA**) in the TMA are powered from the BTS through the antenna feeder.

The monitoring of conventional Low Noise Amplifiers is integrated in the BTS cabinet. Alarms are monitored by the Dual Duplexer Modules (**DDM**) and reported to the Digital part. Newer variants – the AISG TMAs can report via a so-called RETA network, we will see this later.

The following categories of TMA are provided:

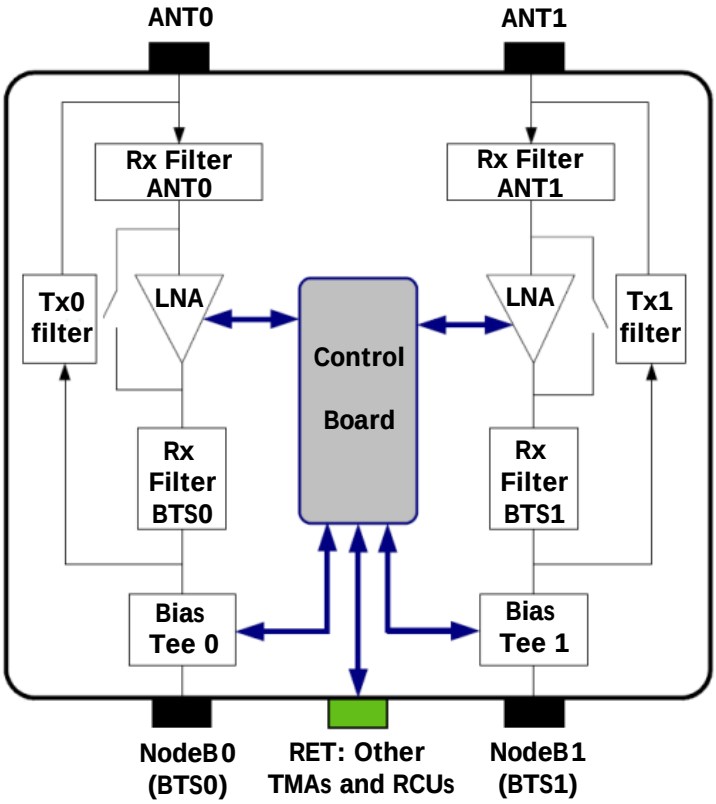
- TMA 2100, split into three types
  - light TMA
  - double TMA
  - AISG TMA
  - AISG TWIN TMA
- TMA 1900 (single TMA).

In UMTS 1900 two single TMAs are used per sector: One TMA for the transmission/reception for the main path and another TMA for the diversity path.

In UMTS 2100 one TMA with two LNA functions is used per sector.

9.2 AISG UMTS 2100 TWIN TMA – Block Diagram

AISG UMTS 2100 Twin TMA



The AISG UMTS 2100 Twin Tower Mounted Amplifier uses the AISG communication protocol v1.1 and supports one sector of a Alcatel-Lucent 9311 Macro Node B Indoor or Outdoor.

The TMA consists of two parallel branches with band pass filters, low noise amplifiers and a current extractor. Only the left branch is explained, the right branch works in the same way.

The UMTS downlink signal arrives from the NodeB duplexer and enters the TMA at the port BTS0. The Tx0 filter bypasses the downlink signal around the LNA, and the signal leaves the TMA at port ANT0 towards the antenna of the main path.

At ANT0 the UMTS uplink signal enters the TMA. The Rx filter passes the uplink signal to the LNA while blocking the downlink signal to avoid a saturation of the LNA. The uplink signal is filtered again and leaves the TMA at port BTS0. The Tx0 filter blocks the uplink signal to avoid a feedback from the output of the LNA back to its input, that would generate an oscillation.

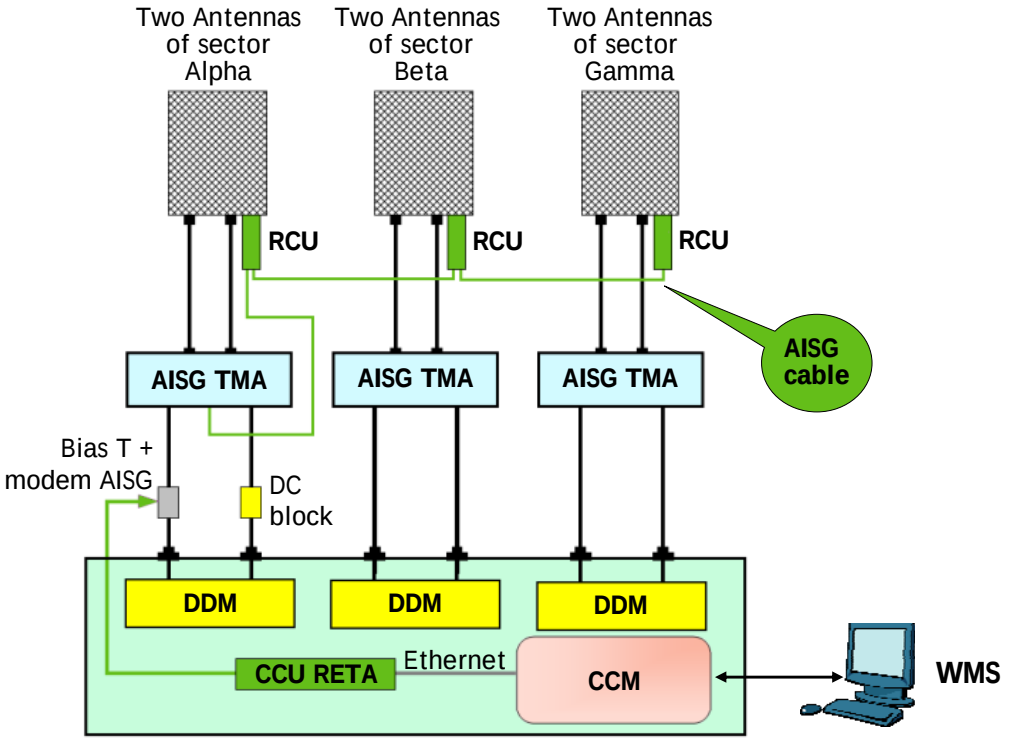
The LNA circuits are monitored and an alarm is activated is case of internal failure. Two alarm modes are implemented in this TMA:

- In case AISG communication is present on the feeder, alarm will always be reported through this protocol.
- If no AISG communication is present, DC alarm mode is activated and alarm reported through current window (CWA).

In case of failure of the TMA or the DC supply, a bypass switch secures basic function.

AISG - Antenna Interface Standards Group
CWA - Current Window Alarm
LNA - Low Noise Amplifier
DC - Direct Current
RCU - AISG Remote Control Unit
RETA - Remote Electrical Tilt Antenna
TMA - Tower Mounted Amplifier

9.3 RETA Network with AISG 2100 Twin TMA



This configuration shows an example how the AISG twin TMA supports a remote access from the WMS that is used to monitor the TMAs and to tilts the antennas. The operation and maintenance commands arrive at the controller of the NodeB – the Core Control Module. An Ethernet link passes the AISG signals to the AISG controller CCU. The AISG signals are then multiplexed together with the UMTS signals into one of the cables between Dual Duplexer Module and Tower Mounted Amplifier. This multiplexing can be done by a Bias T with an AISG modem.

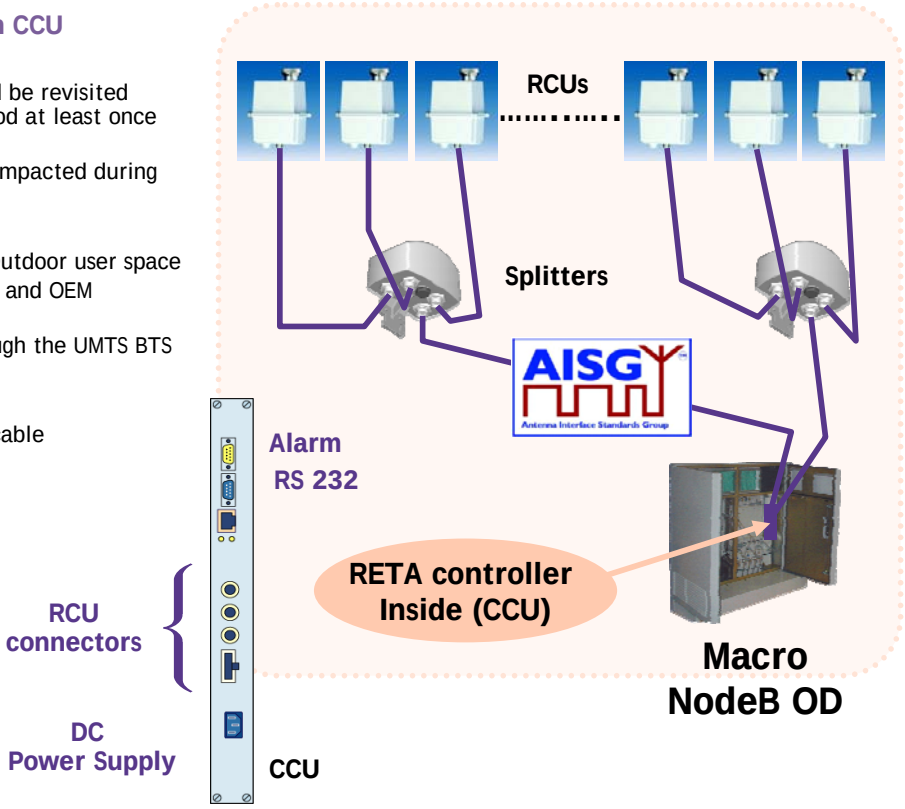
At the top of the antenna tower the AISG TMA extracts the AISG signals, they are connected via cables to other TMAs and Remote Control Units. In this way the WMS can monitor all sectors of a NodeB and tilt remotely the antennas.

AISG - Antenna Interface Standards Group
CCM - Core Control Module
CCU - AISG Central Control Unit
DDM - Dual Duplexer Module
DC - Direct Current
RCU - AISG Remote Control Unit
RETA - Remote Electrical Tilt Antenna
TMA - Tower Mounted Amplifier
WMS - Wireless Management System

9.4 Remote Electrical Tilt Antenna (RETA)

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 Macro NodeB Outdoor 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



The Remote Electrical Tilt Automatic (RETA) feature allows the user to adjust remotely the tilt of any antenna sector from the OMC-B 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 Macro NodeB Outdoor, the CCU module is integrated in the User Space.

For the Macro NodeB Indoor, the CCU module is located outside the cabinet.

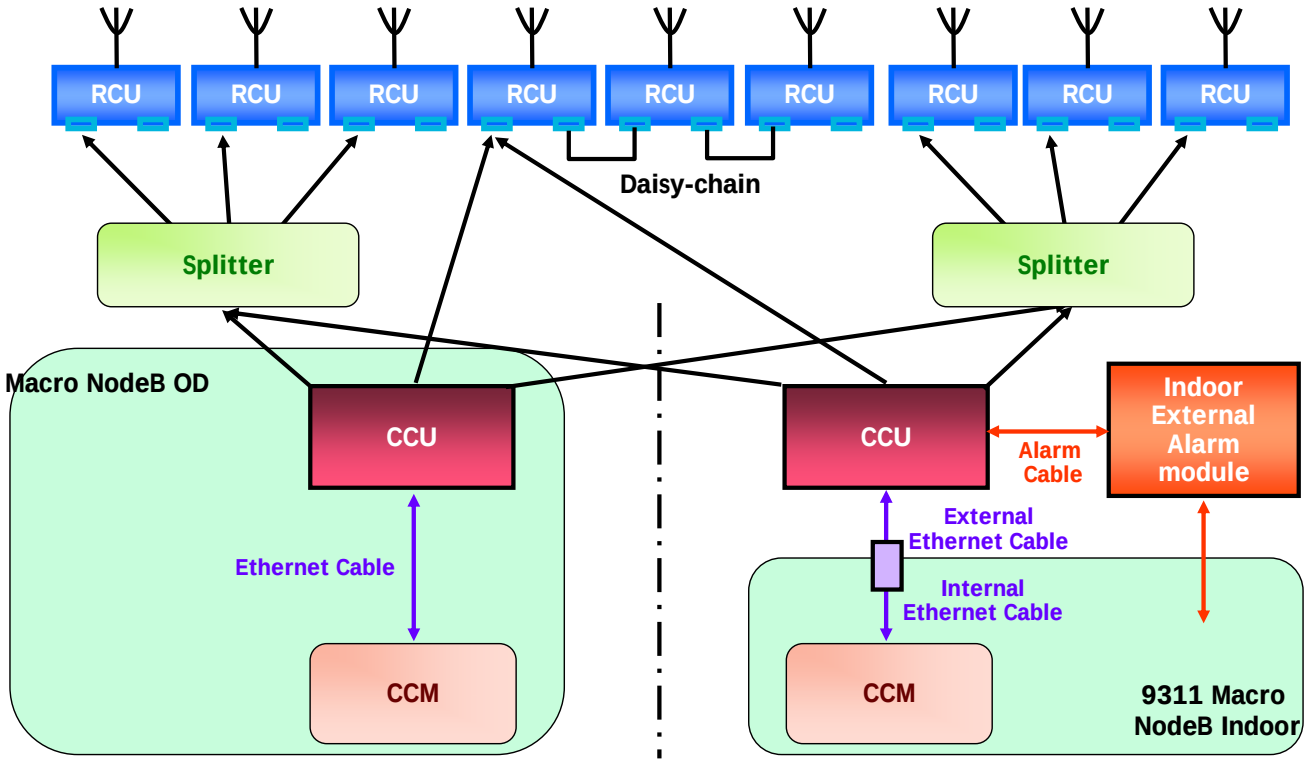
AISG - Antenna Interface Standards Group

CCU - Central Control Unit

RCU - Remote Control Unit

RETA - Remote Electrical Tilt Antenna

9.4 Remote Electrical Tilt Antenna (RETA) [cont.]



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.

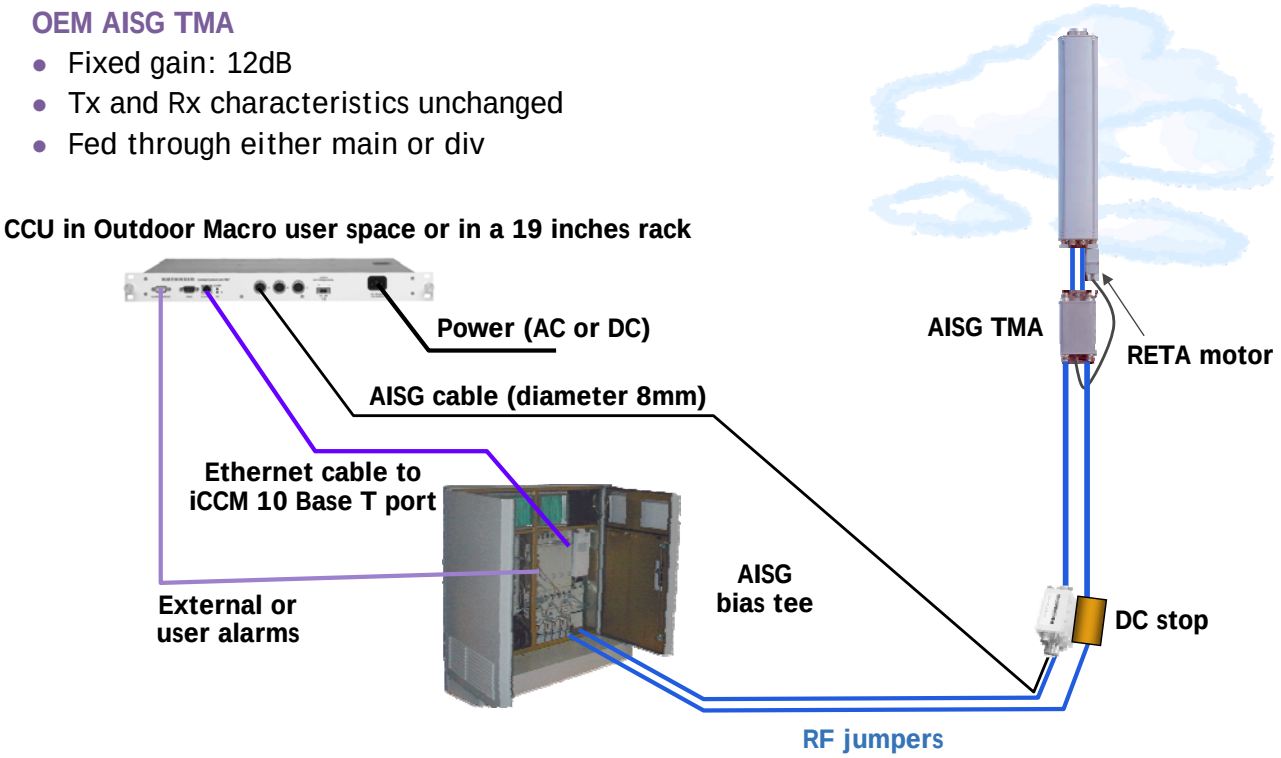
The CCU module is connected to the CCM module via the Ethernet 10BASE-T link on one side and the RCU module via control cables on the other side.

AISG - Antenna Interface Standards Group
CCM - Core Control Module
CCU - Central Control Unit
RCU - Remote Control Unit
RETA - Remote Electrical Tilt Antenna

9.5 RETA Integration with AISG TMA and 1st generation DDM

OEM AISG TMA

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

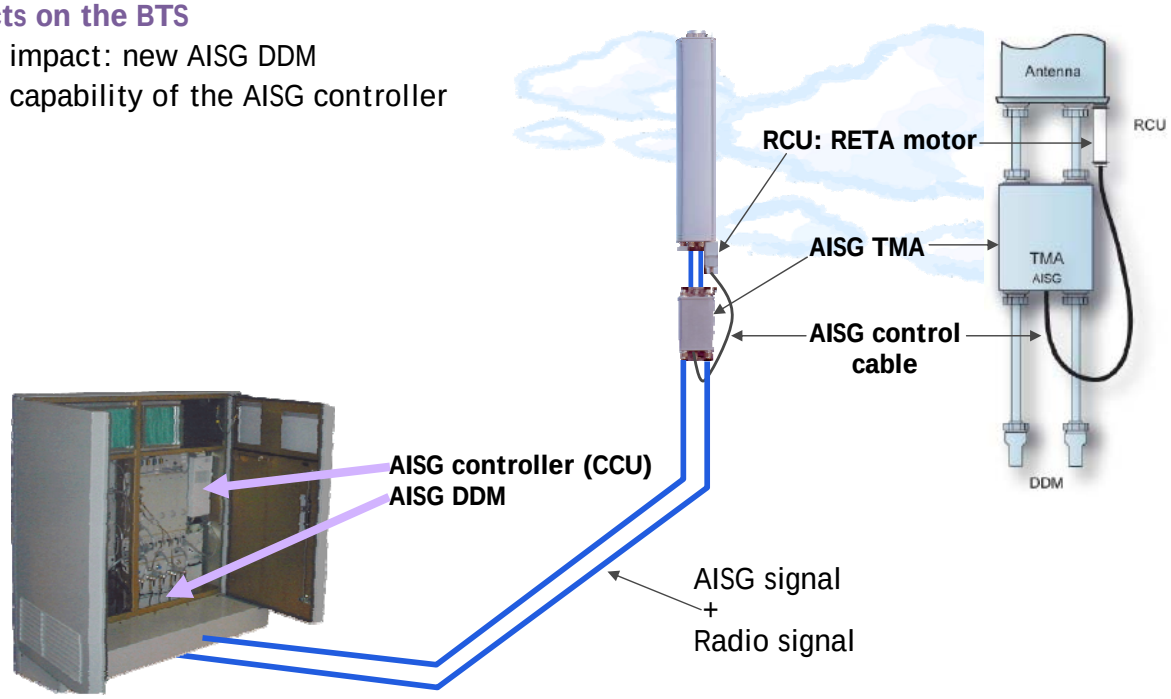


This diagram shows the integration of RETA together with AISG TMA with the support of the 1st generation Dual Duplexer Module inside the outdoor macro BTS. Three cables must be linked to the CCU board: first the AISG cable, then the Ethernet cable to the integrated Core Controller Module and finally the external or user alarms cable.

9.6 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 Dual Duplexer Module are integrated to the BTS contrary to the previous configuration. The AISG controller is installed in a user slot.

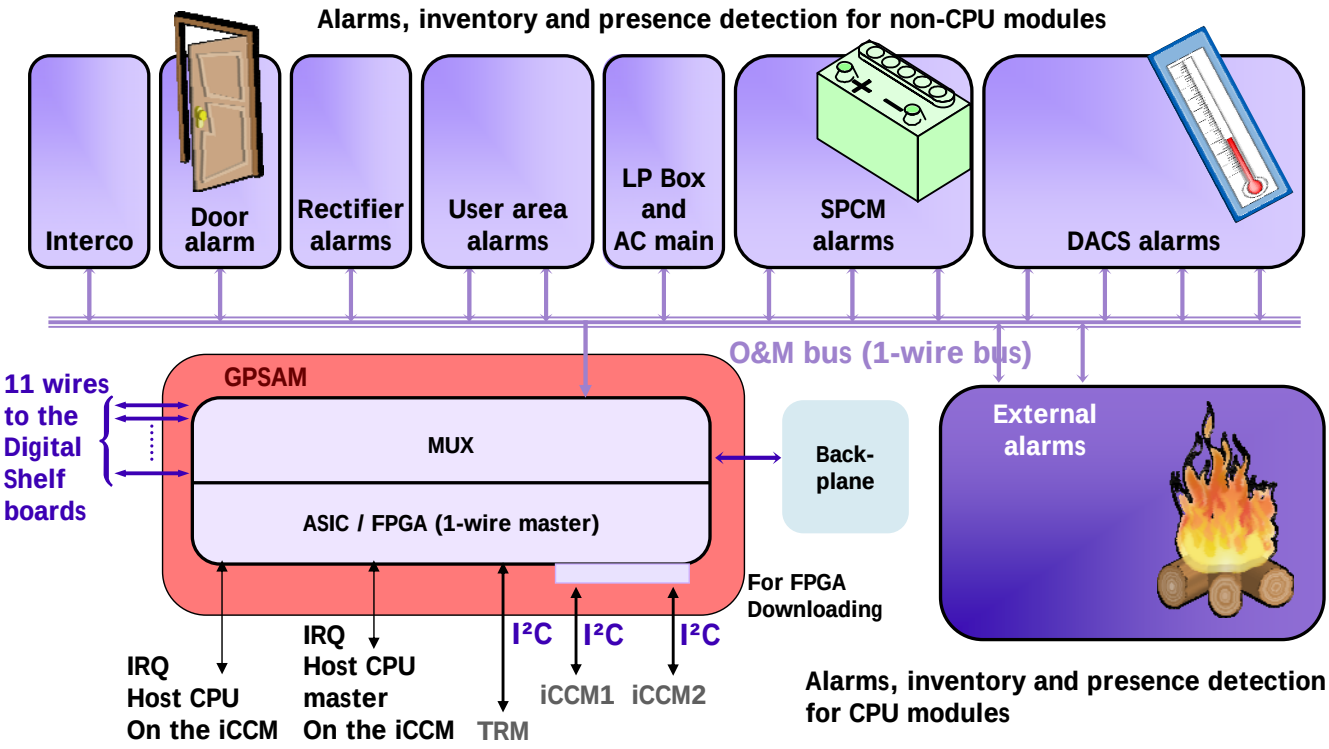
The AISG signal is multiplexed with the UMTS signal in the RF feeder. The multiplex is performed on BTS side by a special variant of the DDM – the so-called AISG DDM - and the AISG TMA on antenna side.

This solution is available for the 9311 Macro NodeB Indoor and Outdoor and the 9332 Radio Compact NodeB.

10 Modules supporting station functions

- The next slides show modules with some station functions that support the BTS in a general way and are not directly related to the traffic: Power supply, clock generation, clock synchronization, alarming, storage of configuration and commissioning data.

10.1 GPSAM: Alarms, inventory and presence of boards



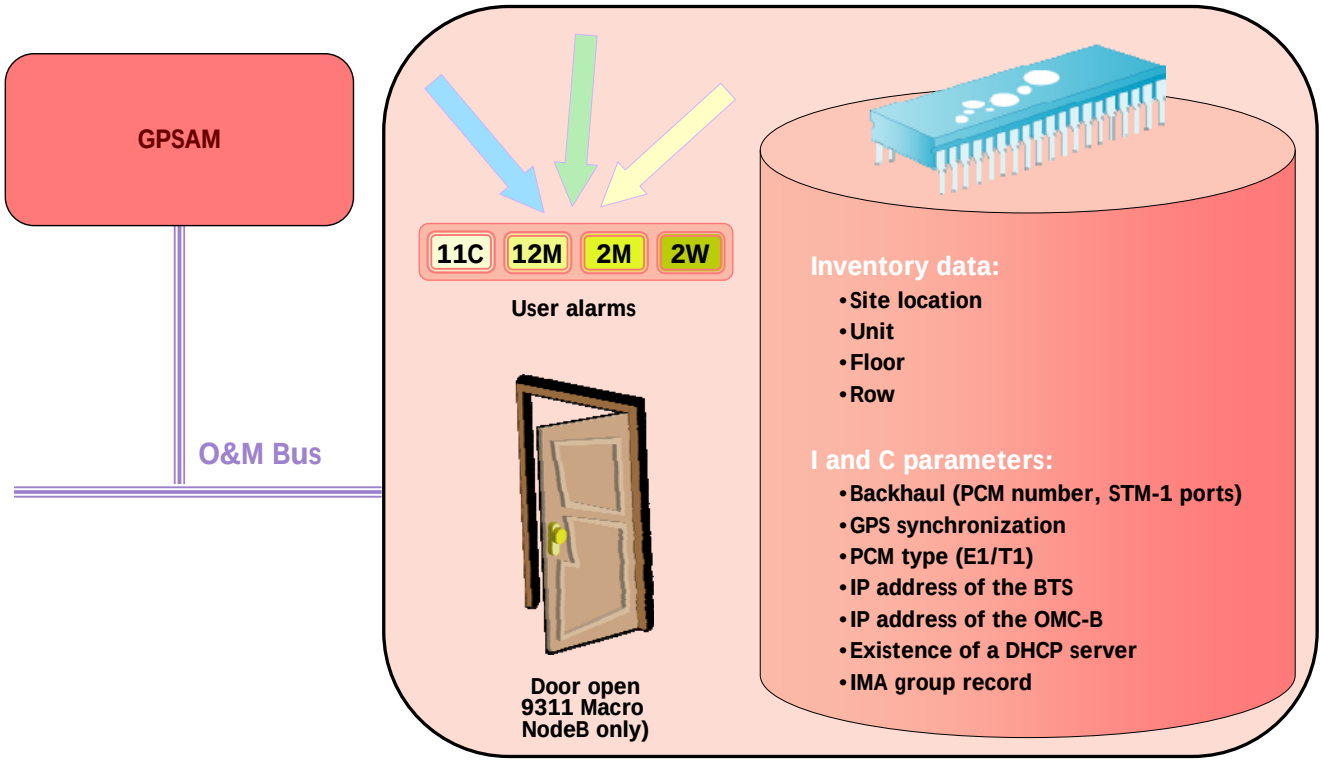
The GPS and Alarm Management module (GPSAM/cGPSAM) provides two functions. The first function is the collection of information about the state of the BTS, in other words alarms, inventory and commissioning information. The second function of this module is to supply timing information. This latter function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

The GPSAM only collects the alarms and the inventory information of some of the BTS modules. The inventory information allows the Operation and Maintenance function to detect whether a configured board is plugged in and its hardware composition.

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

This Operation and Maintenance bus is connected to the internal modules of the BTS as the GPSAM, the cooling unit, the rectifiers and the Manufacturing, Commissioning and Alarm Module (MCA).

10.2 MCA: Manufacturing, commissioning and alarm



The Manufacturing, Commissioning and Alarm (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 and C information is downloaded from the Manufacturing, Commissioning and Alarm module to the Core Control Module, via the Operation and Maintenance 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.

11 Appendix

11.1 Overview on equipment protection

	Module	Redundancy Policy
Digital shelf	CCM	No redundancy
	iCCM	1+1 Active/Standby
	GPSAM	No redundancy
	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.

Module Summary

- Now that you have competed this module, you should be able to
  - Identify the different module types
  - List the main features and characteristics of the modules
  - Identify the optional equipment

End of module
Description of the BTS Modules

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1.2 Description of the BTS Types TMO18252 D0 SG DEN I1.0

This training documentation describes a subset of the total portfolio of Alcatel-Lucent BTS.

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Document History			
Edition	Date	Author	Remarks
1.0	2008-12-12	Kieslich, Roland	First edition in Release UA06
1.9 Draft	2010-05-12	Kieslich, Roland	Upgrade to Release UA07.1: Daisy chain using d2u and RRHs GE interface RRH features

Module objectives

Upon completion of this module, you should be able to:

- Describe the Alcatel-Lucent BTS portfolio.
- Identify the different types of BTS within the UTRAN portfolio.
- List the main features and characteristics of each BTS type.
- Understand the Remote Radio Head functionality.
- Explain the benefit of the distributed NodeB solutions.
- List the Alcatel-Lucent Remote Radio Head products.

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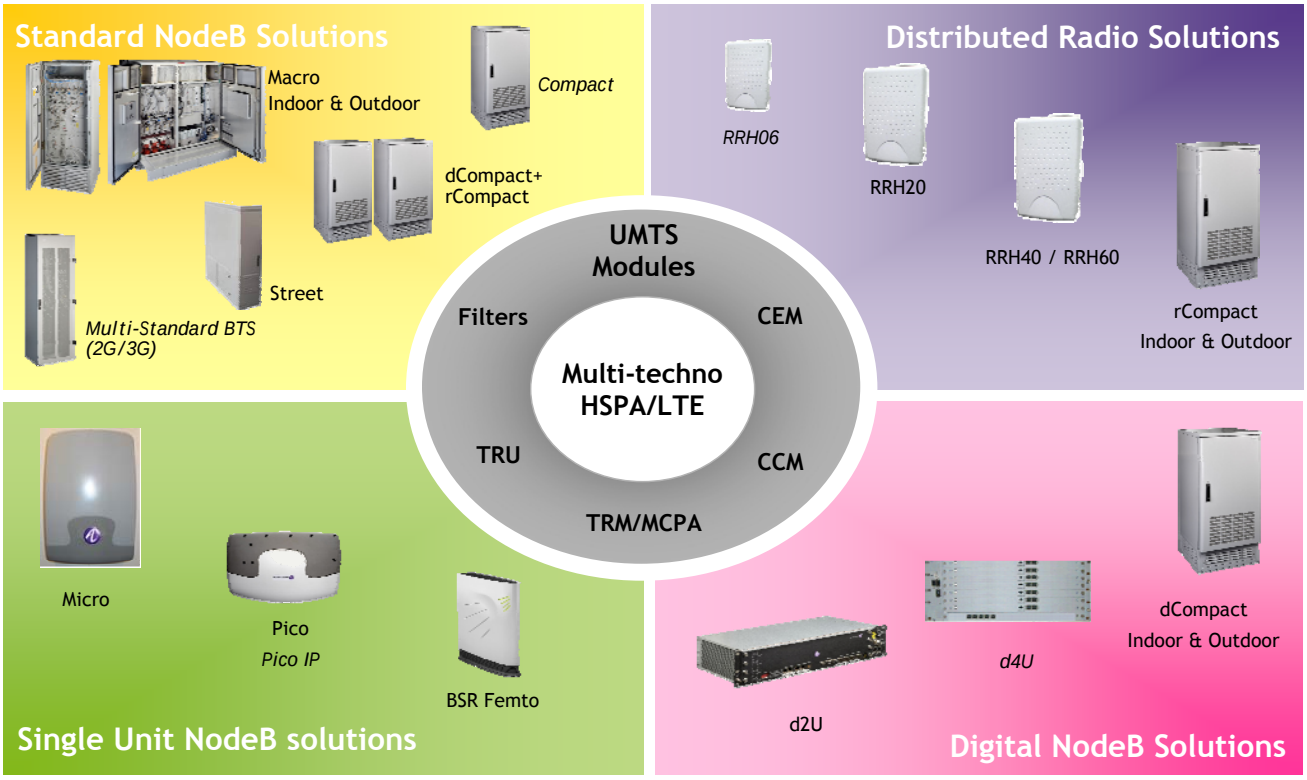
1 High-Level view on the Alcatel-Lucent UMTS BTSs

This part gives first an overview on the portfolio of Alcatel-Lucent BTSs. Afterwards two types of BTS architectures are shown, the conventional BTS and the distributed BTS.

1.1 Alcatel-Lucent 9300 W-CDMA NodeB product family



In the Alcatel-Lucent portfolio, a large range of BTS product exists. There is always a BTS solution whatever the coverage or the capacity issue the operator is facing.

The Macro BTS solution allows to provide high capacity and large coverage with indoor and outdoor solutions. The compact BTS solution also exists when the operator is facing space issue on site.

The radio and digital BTS solutions allow to optimize power and capacity at the antenna when facing coverage issue such as high feeder length.

A single unit BTS solution such as micro and pico BTSs allows to efficiently provide hot spot (like wall or street market) and indoor location solutions.

1.2 Extended UMTS BTS portfolio

9313 Micro NodeB

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

Capacity hot spots
Coverage cold spots

9314 Pico

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

Indoor coverage
Indoor capacity

RRH 20W/40W/60W

- 1…4 carriers x 1 sector
- Macrocellular coverage
- Cost-effective deployment (CAPEX/OPEX savings)
- Peak powers 20W, 40W, 60W
- 2100 – 900 MHz

Rooftop.
Used with Macro BTS, digital BTS

9326 digital 2U NodeB (d2U)

- 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

Macro in GSM sites
Use with RRH

9322 dCompact

- 2 carriers x 3 sectors (linked to 3 RRH)
- Macrocellular coverage
- Very flexible configurations
- Up to 640 CEs (future 1280)
- In UA5.1 compact BTS = 9322 dCompact + 9332 rCompact

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 NodeB 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 NodeB. 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 d2U NodeB, 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 UA5.1, the d4U NodeB 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 9322 digital Compact NodeB Indoor (dCompact Indoor) and 9322 digital Compact NodeB Outdoor (dCompact Outdoor) can also be used with the RRH. In UA5.1, note that the Compact NodeB can also be associated with a remote part called the rCompact NodeB, 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: dCompact + rCompact.

1.3 Distributed NodeB Portfolio for all environments

Radio Solutions

9332 Radio Compact NodeB (9332 rCompact)

9341 RRH20-21 (2100 MHz only)

- Output power: 20W , 2 carriers
- 185W power consumption
- 27 litres - 19 kg

9341 RRH40-21 (2100 MHz and AWS) / RRH40-19 (1900 MHz)

- High power compact RRH: 40W, 3 carriers
- 230W power consumption
- 24 litres – 19 kg

Digital Solutions

9322 Digital Compact NodeB (9322 dCompact)

9341 RRH40-08 (850 MHz)

- High power compact RRH: 40W, 2 carriers
- 34 litres – 22 kg

9326 Digital 2U NodeB (9326 d2U)

For locations with limited space such as urban rooftops, at top mast near the antenna or water tower sites, where installation of macro equipment is difficult.

9326 Digital 2U NodeB (9326 d2U)

- Rackable solution that can be integrated into existing cabinets for easy and quick deployments
- Used in combination with the 9332 rCompact or the 9341 RRH modules

9341 Remote Radio Head (9341 RRH)

- Enables remote placement of the radio modules and filter functions
- Can be used near the radiating antenna, the rooftop or at ground level, connected with any digital unit

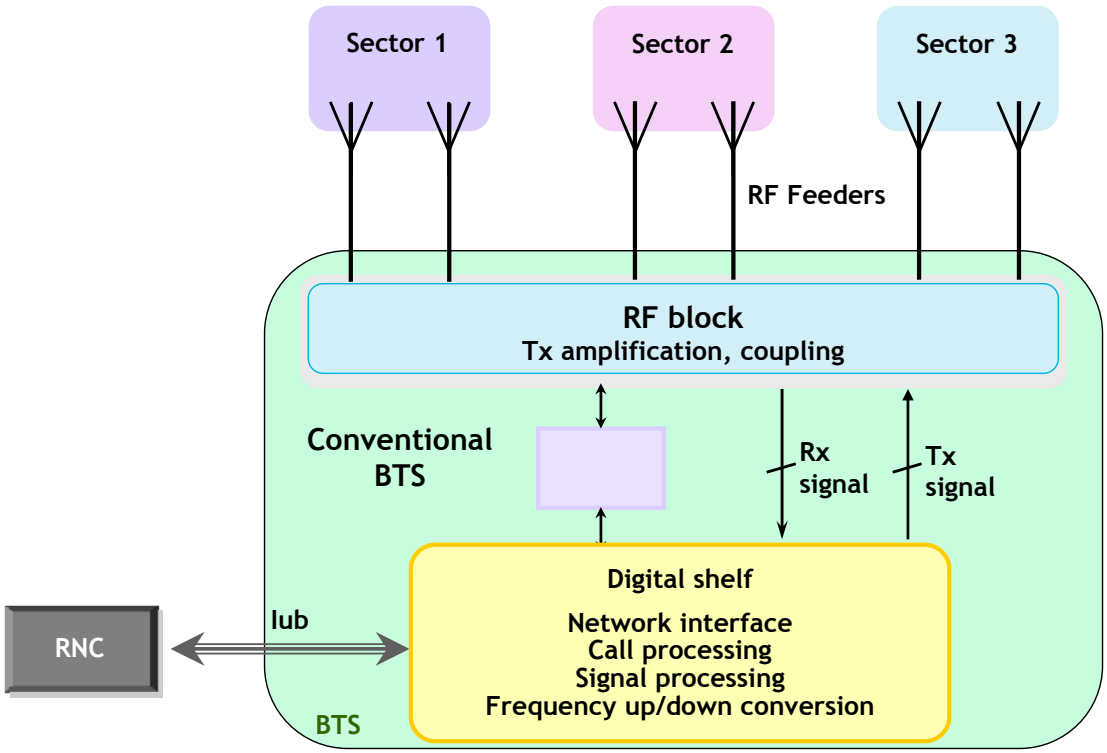
9322 Digital Compact NodeB (9322 dCompact)

- High capacity/density, easy to deploy macro-cellular applications
- Can be connected to radio unit 9332 rCompact or can be used with 9341 RRH modules

9332 Radio Compact NodeB (9332 rCompact)

- To achieve high capacity in sites with installation constraints
- Can be connected to a digital unit – 9322 dCompact or 9326 d2U

1.4 Architecture of a conventional BTS

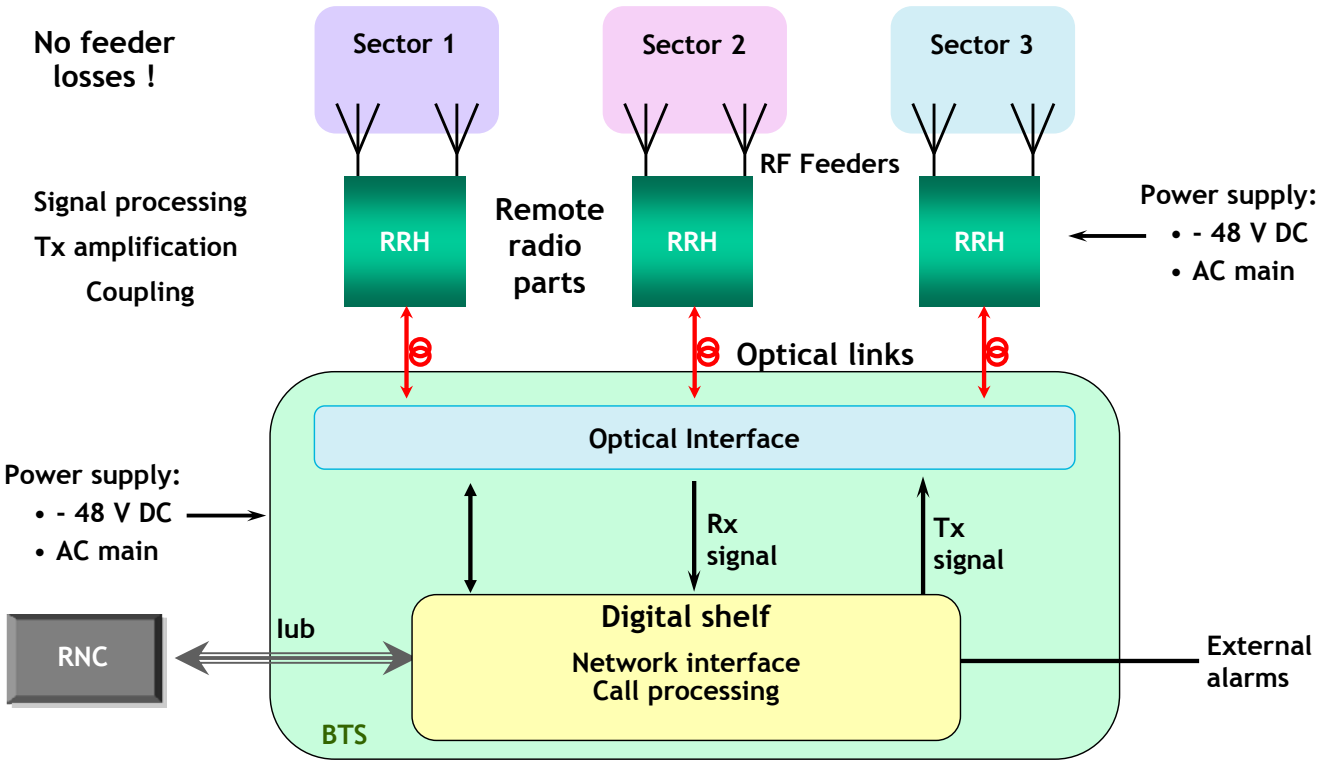


We continue with the architecture of a conventional BTS. It consists of one cabinet that contains all boards. The boards can be sorted into two groups depending on the role they play in the BTS:

- Digital Modules are housed in the digital rack. These are the Channel Element Module, Core Control Module, Transmitter Receiver Module, GPSAM etc.
- Radio frequency Modules are mounted in the RF block: Dual Duplexer Module (DDM) and Multi-carrier Power Amplifier. Here exist several types adapted to the radio frequency bands and the desired transmission power levels.

And on the next slide we see the distributed architecture.

1.5 Architecture of a distributed BTS



This slide presents the architecture of a distributed BTS.

[1] The BTS digital shelf does the main functions network interface and call processing. This digital part is located at a central site and connected [2] via optical links to remote radio parts, mounted nearby the antennae to short the length of the antenna feeders.

[3] The main functions of these remote radio parts signal processing, up and down frequency conversion, transmission amplification and antenna coupling. Two main types of remote radio parts exist:

1. The Remote Radio Head (RRH) and
2. the 9332 radio Compact NodeB Outdoor

Several types of remote radio parts exist adapted to the radio frequency bands and the desired transmission power levels.

2 Alcatel-Lucent 9311 Macro NodeB family

We continue with two members of the Macro NodeB Family:
The 9311 Macro NodeB Indoor (Macro Indoor) and
The 9311 Macro NodeB Outdoor (Macro Outdoor)

These are conventional BTSs containing all modules in one rack.

2.1 Characteristics of Macro BTS solutions

9311 Macro Indoor

- High capacity
  - 4 carriers x 3 sectors
  - 2 carriers x 6 sectors
  - Rx Diversity and Tx Diversity
- Large coverage
- 768 CE (future 1536)
- High power (Up to 6 MCPAs 45W – 60W)
- 2100/1900 MHz – 900/850 MHz

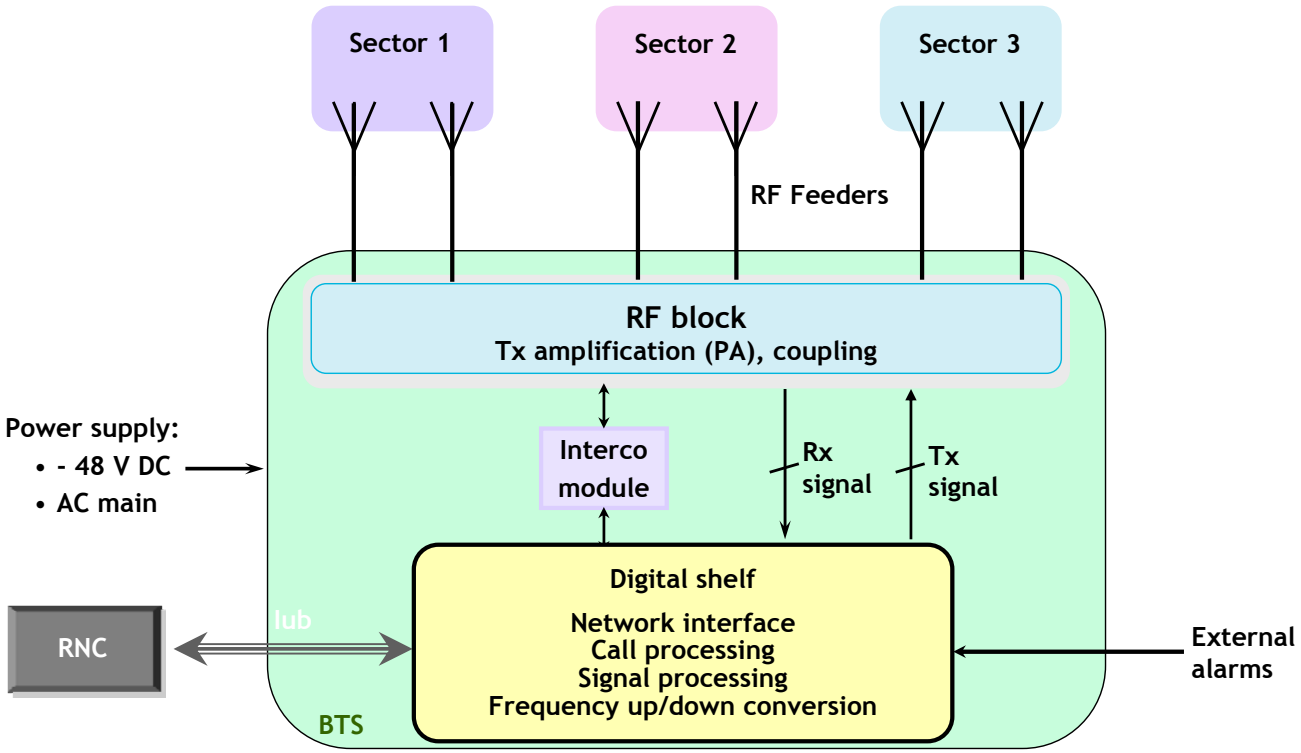
Rural, Suburban, Urban, Highways, Rooftop

9311 Macro Outdoor

The Macro BTS solutions are composed of 2 main configurations of Macro NodeBs.

The 9311 Macro NodeB family supplies an indoor solution (**ID**) and an outdoor solution (**OD**). Both provide high capacity, large coverage, support of high power solution (up to 60W) and full UMTS frequency ranges (2100 or 900 Megahertz).

2.2 Block diagram of 9311 Macro NodeB family



The Alcatel-Lucent 9311 Macro NodeB Family is built around two main blocks: The digital shelf and the radio block (**RF**) block.

The main functions of the digital shelf are network interface, call processing, signal processing and up and down frequency conversion. This work is done by the digital modules

- Channel Element Module,
- Core Control Module,
- Transmitter Receiver Module and
- GPSAM.

The main functions of the radio frequency block are transmission amplification with the Power Amplifier (PA) and coupling with the duplexer. It contains the radio frequency modules

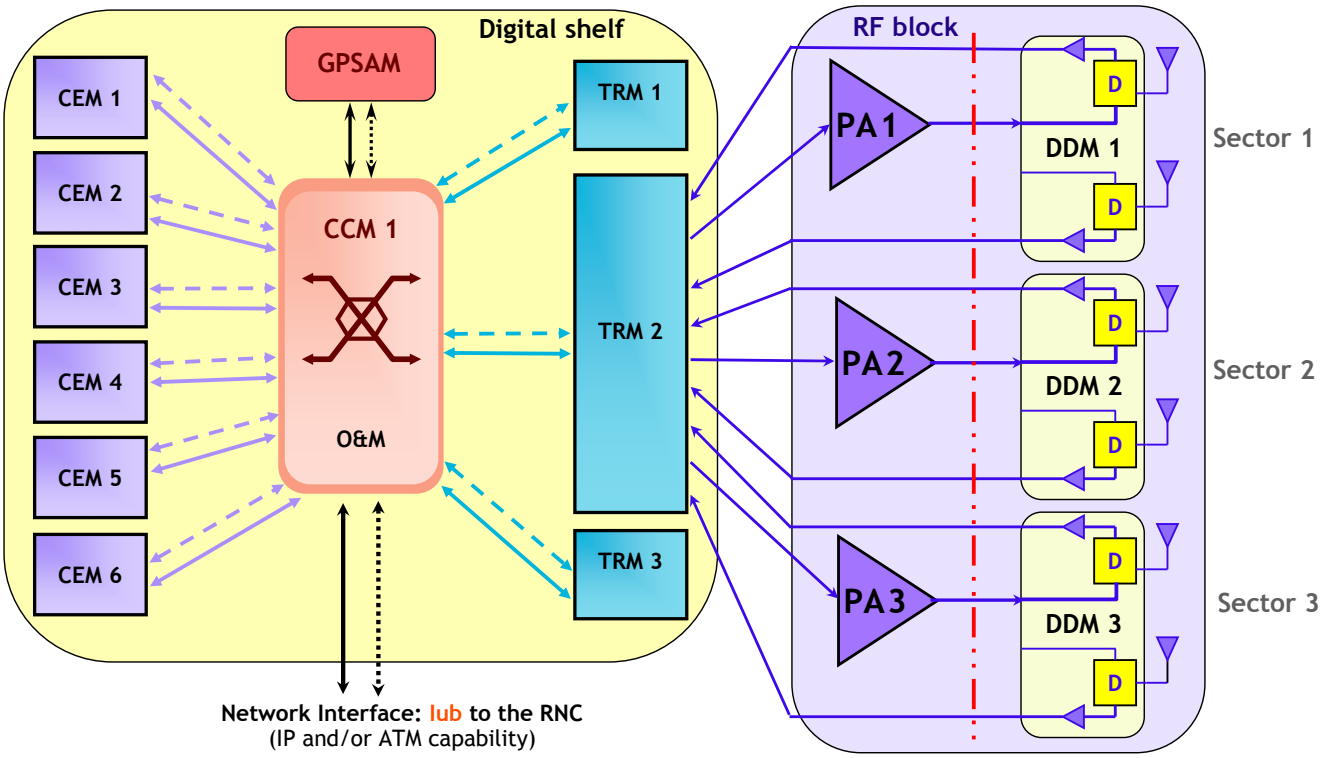
- Dual Duplexer Module (DDM) and
- Multi-carrier Power Amplifier (MCPA).

There exist variants of the module depending on the frequency band and the maximum radio output power.

The Interco module carries digital signals between the two blocks.

Please notice that there are 2 antennas per sector.

2.3 9311 Macro NodeB family detailed architecture



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

The digital shelf includes four types of modules:

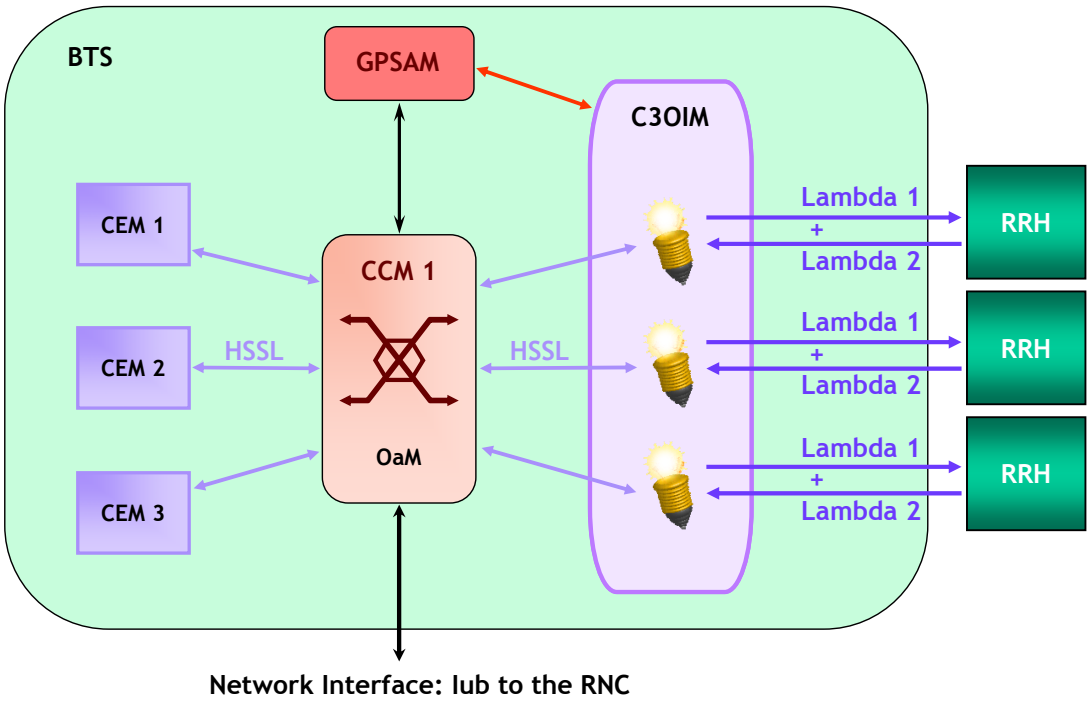
- Either one classical Core Control Module or two integrated Core Controller Modules,
- up to 6 classical or up to 2 integrated Channel Element Modules,
- up to 3 Transmitter Receiver Modules, either classical or expandable type and
- one GPSAM.

The radio frequency block contains the radio block modules

- with 1 to 6 Multi carrier Power Amplifiers,
- 3 or 6 Dual Duplexer Modules and, only in OTSR configuration
- 1 or 2 Tx splitters.

The radio block ports are connected to the two antenna connectors of the three Dual Duplexer Modules.

2.4 Optical Interface Module (OIM)



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

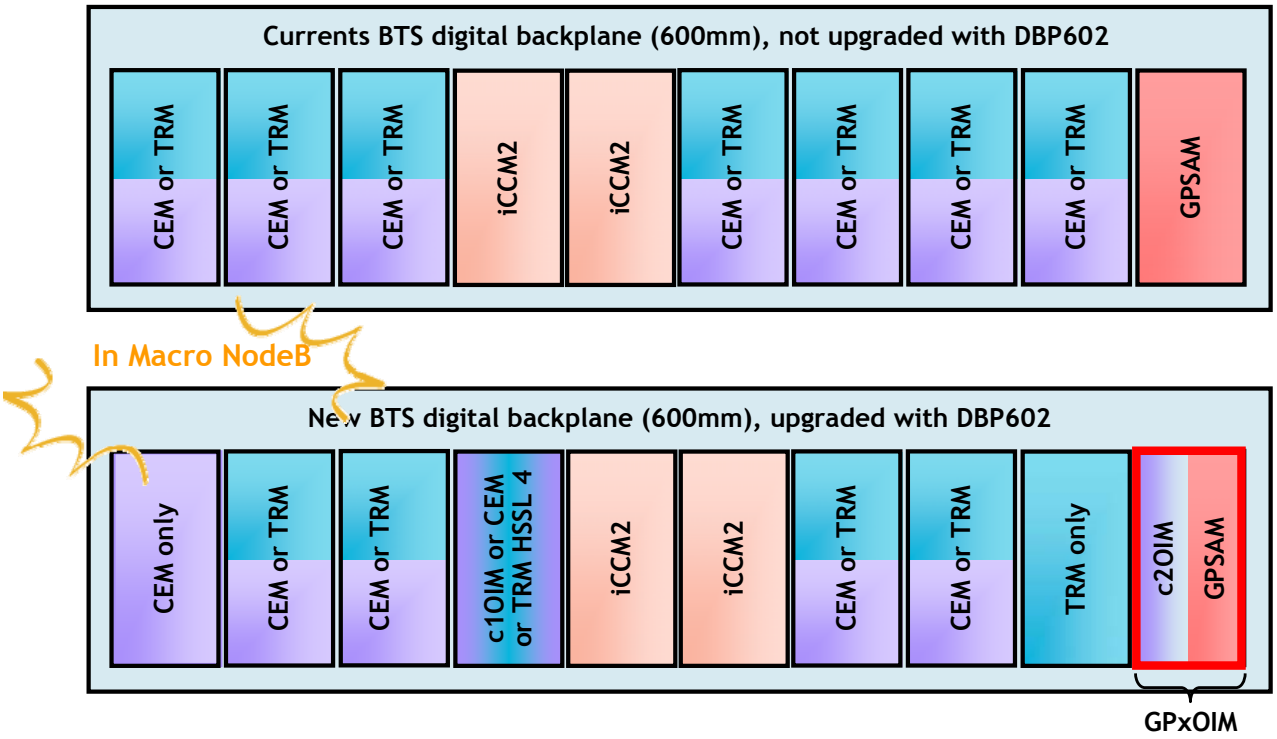
OIM converts digital signals coming from integrated Core Controller Module into optical signals in downlink and does the reverse operation in uplink.

In the BTS, there is one high-speed link for each digital board (CEM, Transmitter Receiver Module), 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 signal. The OIM sends the received bit streams to both iCCM2 boards.

2.5 GPxOIM and new backplane DBP602



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.

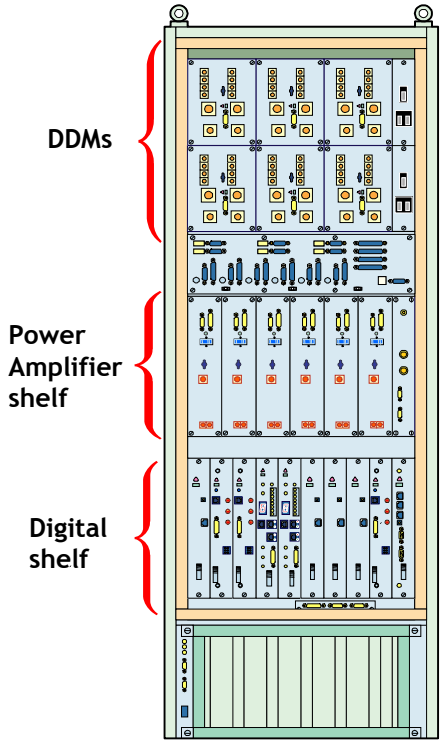
GPxOIM is only supported by 9311 Macro NodeB equipped with a **new digital backplane DBP602** and by 9322 dCompact NodeB.

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 Remote Radio Head requires the replacement of one CEM by one C1OIM.

2.6 Macro NodeB Indoor: Cabinet description

Characteristics (Indoor-2)

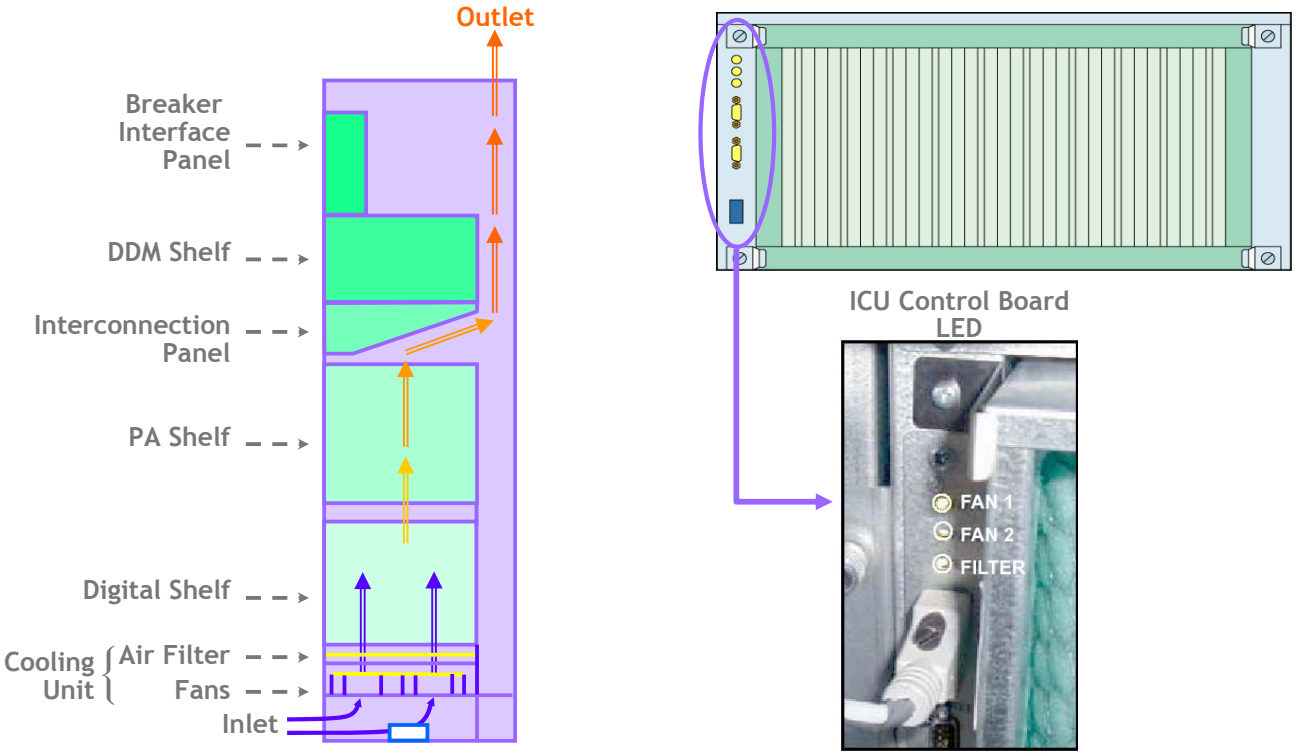
- Fully-integrated self-contained cell site: Up to 3 sectors and 3 carriers in a single cabinet
- Optimized ratio size versus capacity:
  - Cabinet size (HxWxD): 165 x 60 x 60cm
  - Volume: 594L
- DC Power: -48V DC (optional +24V DC)
- Operational Temperature Range:
  - Short term: -5°C to +45°C
  - 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 9311 Macro NodeB Indoor offers several advantages. Indeed, this BTS allows front access only and generates less acoustic noise. The noise level 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 Macro NodeB Indoor has some additional physical characteristics. First this BTS is equipped with standard E1/T1 connections with up to 8 E1/T1, with drop and insert capability. Then its operational range is -40.5 to -57V DC and up to -60V DC for abnormal conditions. Finally, the BTS supports the power supply by an external battery for AC version, if the normal power supply fails.

2.7 Macro NodeB Indoor : Cooling unit



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

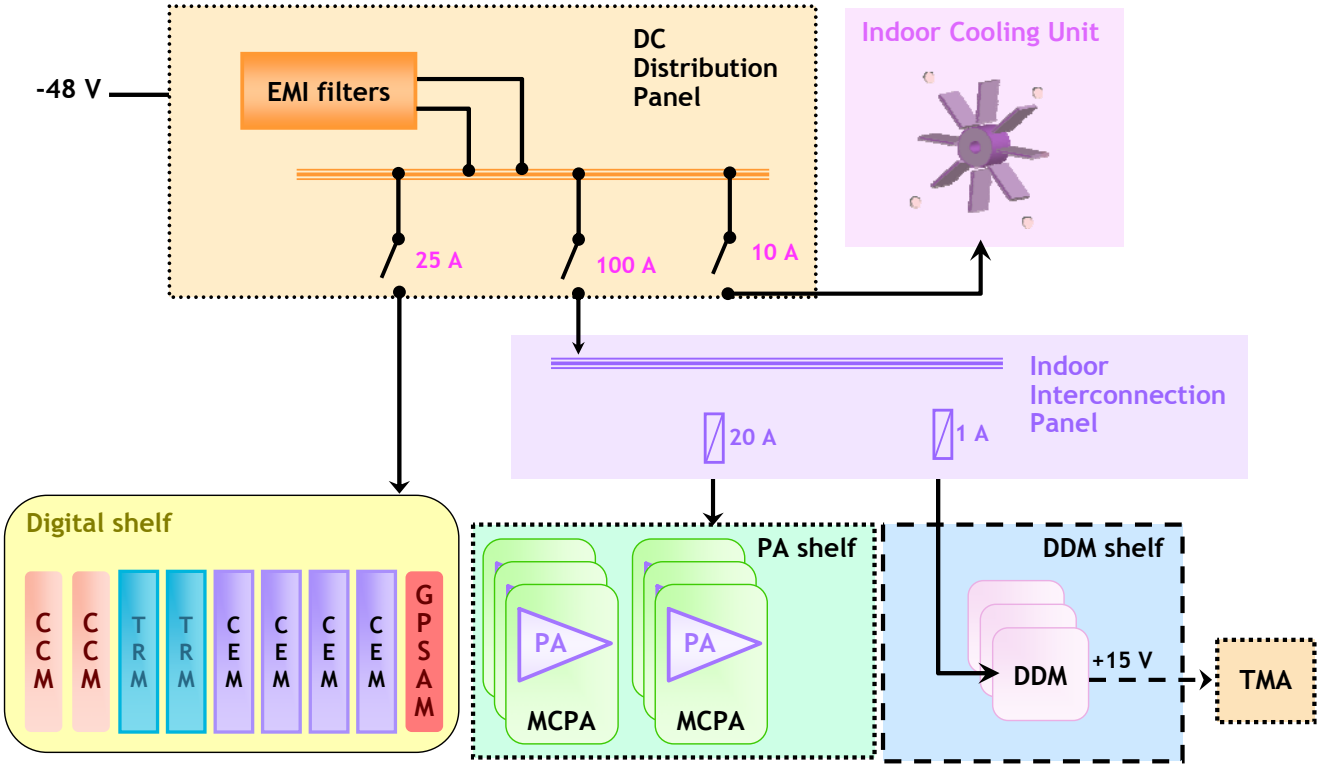
The ICU is composed of two variable speed fans, one Control board and some temperature control sensors.

The 9311 Macro NodeB Indoor (ID) 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 Multi-carrier Power Amplifier shelf. Finally, the air is released at the top rear section of the cabinet.

2.8 Macro NodeB Indoor : Direct current (DC) distribution



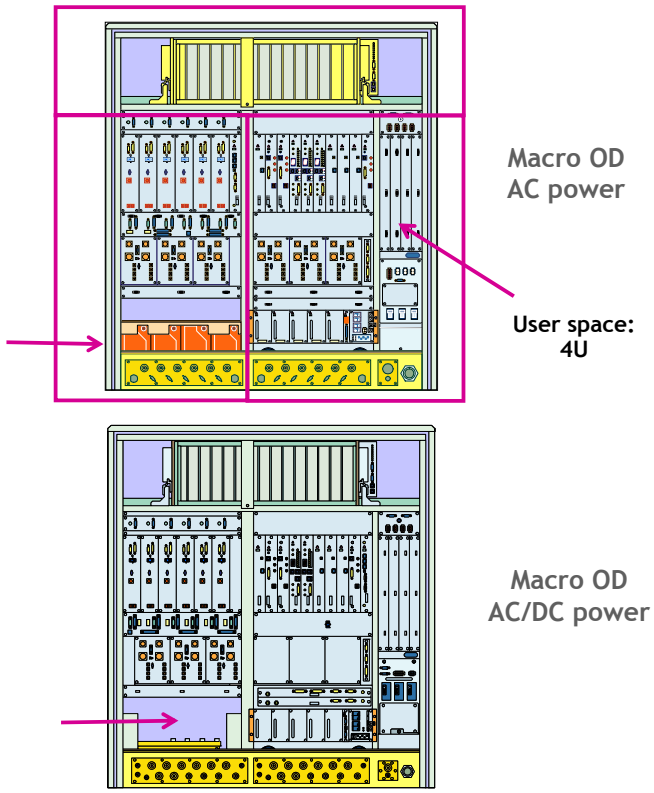
The Macro NodeB Indoor cabinet supplies a fixed -48V DC electrical distribution system, in order to power the installed electronic equipment.

This distribution system is designed with three separate DC output connections. The "INTERCO" DC output is used to supply electrical power to Multi-carrier Power Amplifiers and Dual Duplexer Modules, 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).

2.9 Macro NodeB Outdoor : 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 (H x W x D): 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



The Macro NodeB Outdoor for AC power cabinet is divided into three parts. The upper compartment comprises the climatic unit. The left compartment includes the power amplifiers, the radio frequency combiners and the battery. The right compartment includes the functional modules, the radio frequency 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 Macro NodeB Outdoor 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.

2.10 Macro NodeB Outdoor - characteristics

Dimension (H x W x D)

- 150 x 135 x 74 cm
- 500kg (203kg empty)

Power supply

- AC 110-240V, DC -48V (opt.), AC+DC (opt.)

Consumption

- 1131VA (U222 @32W toc)
- Internal batteries, no need for extra cabinet. Backup time is 2h (U222 @32W)

Configuration

- OTSR up to 6 sectors
- Up to 88W (120w in the future)
- E1/T1, Hybrid Iub

Environmental

- -40°C to +50°C under solar load 1120W/sqm

Application

- High Capacity Outdoor
- Ultra Dense Urban, Dense Urban, Urban
- Rural (as OTSR)

The 9311 Macro NodeB Outdoor cabinet is divided into three parts:

- the upper compartment comprises the climatic unit,
- the left compartment includes the power amplifiers, the radio frequency combiners, the battery,
- the right compartment includes the functional modules, the radio frequency combiners, the User space (4xU), the rectifiers (UCPS rack), and the AC filtering.

- The main enhancements are:
- Energy system: rectifiers and DC distribution are located in a rack, common with the 18020 GSM/UMTS.
- Cooling system: two fans (one for each compartment) instead of one.
- User space: four modules instead of three.

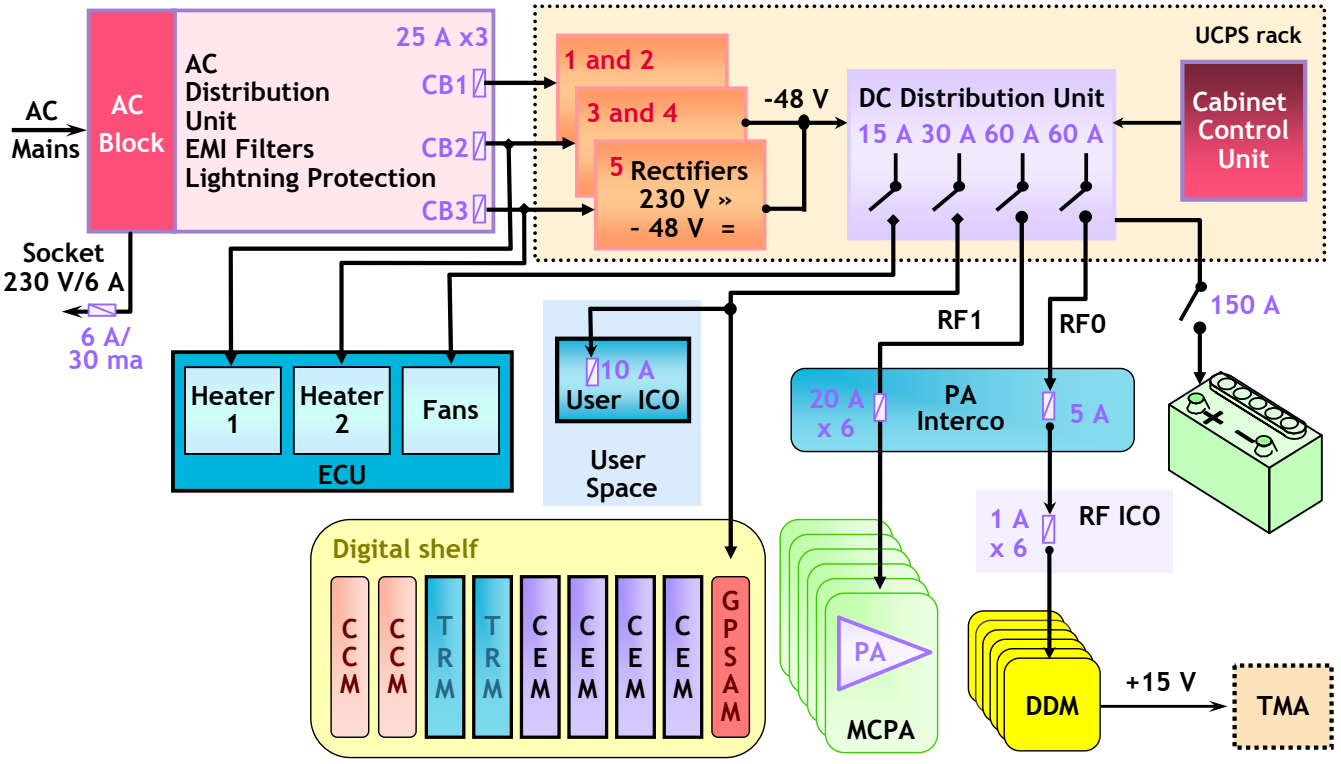
Compared to the AC only variant, the AC/DC integrates the following changes:

- The internal batteries are removed;
- The battery space houses a DC Connection Block;
- The rectifiers are replaced by fillers.

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

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

2.11 Macro NodeB Outdoor : Power supply (AC only)



The 9311 Macro NodeB Outdoor supports Alternative Current power supply.

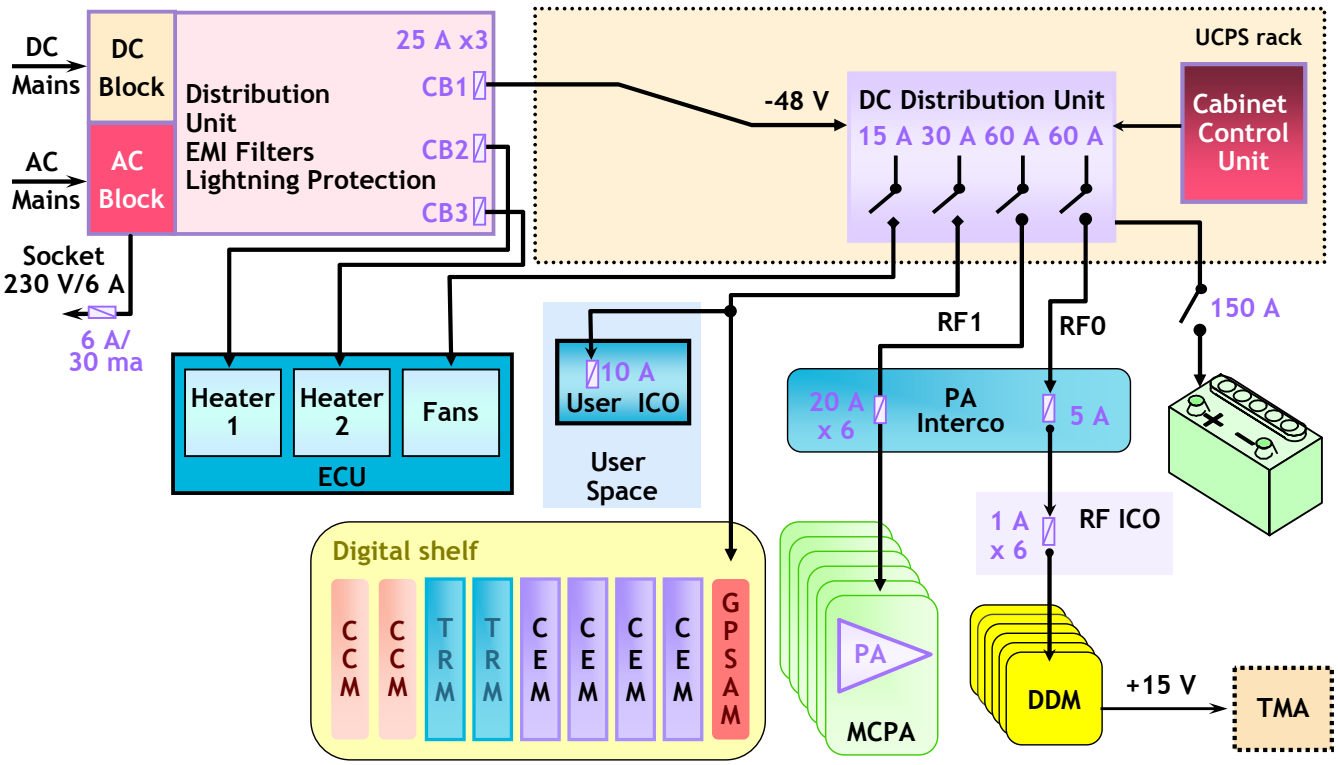
The two main power supply units are the AC Distribution Unit (ADU) and the Universal Common Power System (UCPS) rack.

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.

2.12 Macro NodeB Outdoor : Power supply (AC/DC)



The 9311 Macro NodeB Outdoor (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 Alcatel-Lucent 9322 digital Compact NodeB (dCompact)

Let's move on to one of the new family of BTSs - the digital Compact (dCompact) NodeB that does only the "digital" processing of the traffic in the base band. The missing radio functions will be added by an external radio part. Two members exist:

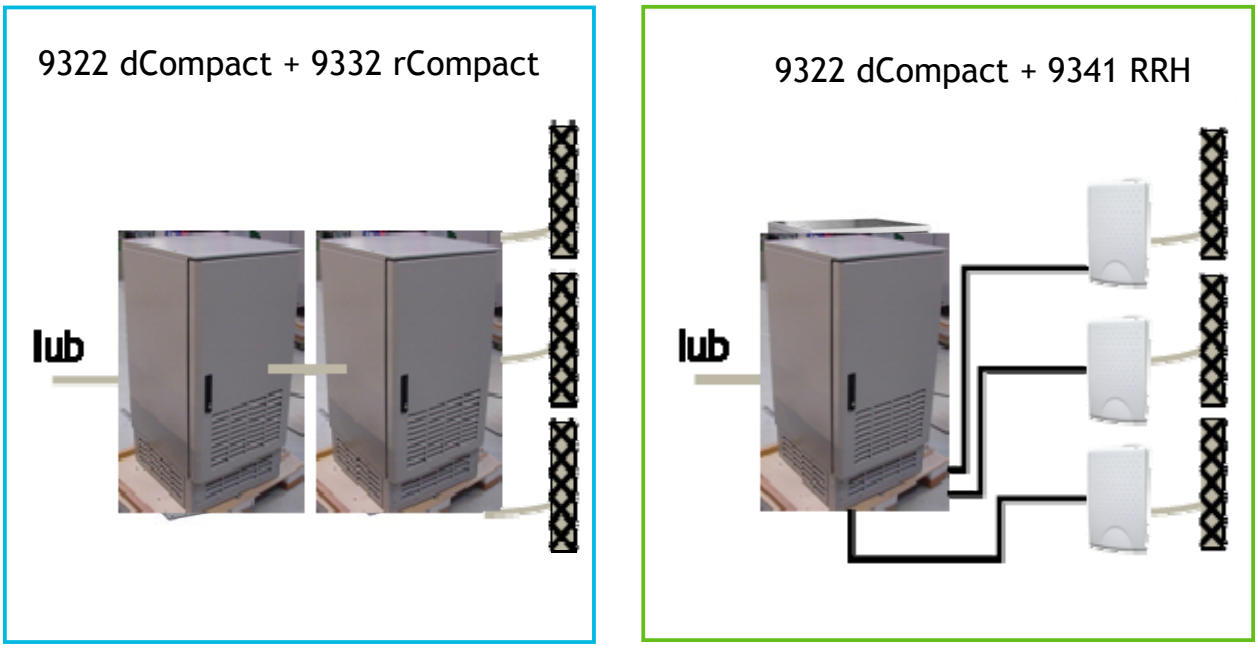
The 9322 digital Compact NodeB Indoor (dCompact Indoor)

and

the 9322 digital Compact NodeB Outdoor (dCompact Outdoor)

3.1 A compact cabinet-based distributed system

Same form factor for digital and radio compact NodeBs



dCompact + rCompact to provide a hand portable macro-like solution

This slide shows how the digital Compact NodeB cooperates with remote radio units like the 9332 rCompact or the Remote Radio Heads. These remote radio parts are explained later.

9322 dCompact

- Indoor and outdoor
- 5 * 128 CEs (5 * 256 CE planned Q4 07)
- Up to 6 fibers, i.e. 6 sectors x 2 carriers or 3 sectors x 4 carriers
- 418 liters
- 2h battery backup
- Support of rCompact

Value:
- Best integrated solution for urban or rural sites with higher base band capacity than d2U
- Best power supply with battery backup to Remote Radio Head
- Easy to install: No craning, zero footprint (wall mountable)

9332 rCompact

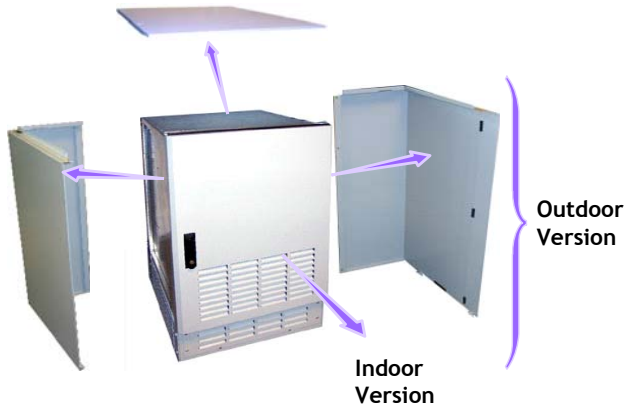
- Outdoor (1100x580x656mm)
- Up to STSR-3, 3 carriers X 3 sectors
- Up to 3 sectors w/ 60W output
- Includes battery backup shared between cabinets
- Uses same standard UMTS Modules (xTRM, Multi-carrier Power Amplifier, Dual Duplexer Module (DDM)) to facilitate spares management

Value:
- rCompact provides a complete solution for urban or rural sites with higher power scalability than Remote Radio Head
- Easier site acquisition and installation due to its low volume and footprint. No need to crane the cabinet

3.2 dCompact versions: Indoor and Outdoor

Characteristics

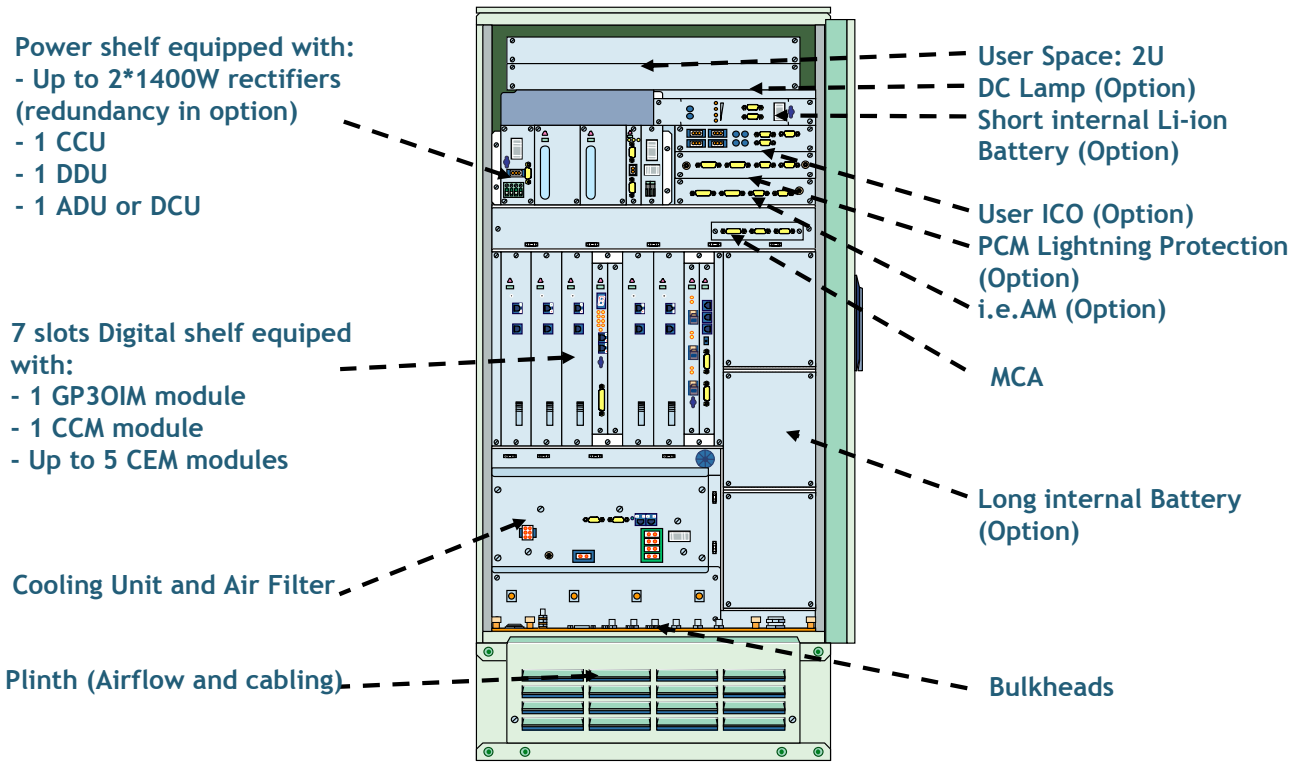
- Compact BTS:
  - High density indoor and outdoor BTS
  - Up to S222 in 1 cabinet / Up to S666 in 3 cabinets
  - Standard power Tri-TRX modules
  - 60W high power modules
- Optimized size versus capacity ratio:
  - Footprint: 0.38m^2
  - Cabinet size (H x W x D): 108 x 58 x 65cm
  - Volume: 408L
- Evolution:
  - Hardware ready to support HSDPA/HSUPA
  - Optical OC-3/STM-1, IP/Ethernet



The 9322 digital Compact NodeB in association with the UMTS Remote Radio Head, 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 temperature control. The outdoor version comprises heaters, unlike indoor version.

3.3 Layout of the digital Compact NodeB



Compared to the other types of NodeBs, the 9322 digital Compact NodeB is characterized by key construction features.

Indeed, all sub-racks and mechanical supports are an integral part of the cabled cabinet design.

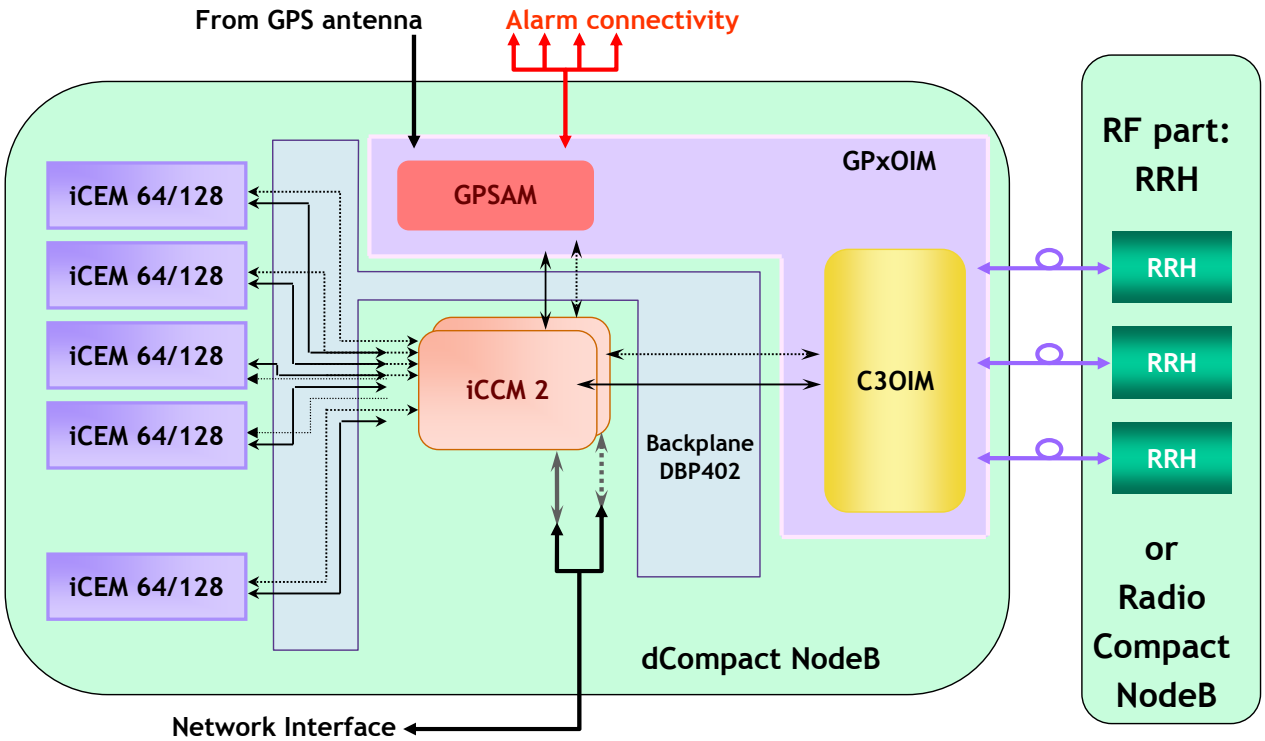
Then a cooling unit (CECU), installed at the bottom of the cabinet, supplies cooling performance regardless of dCompact NodeB configuration.

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.

3.4 Digital shelf of the digital Compact NodeB



The digital shelf of the dCompact NodeB consists of the backplane and four types of modules.

First, the integrated Core Controller Module 2nd generation (iCCM-2)

- manages OAM,
- does a part of call processing and
- switches or combines internal and external data flows.

Then, an integrated Channel Element Module (**iCEM2**) manages the remaining part of the call processing and processes digitally the transmitted and received signals in the base band.

One module for the optical interfaces towards the Remote Radio Head (RRHs) or Radio Compact NodeBs is applied:

- Either the module C**3**OIM if three radio frequency parts are connected or
- the module C**2**OIM if only two radio frequency parts are used.

Finally a module nGPSAM interfaces the external synchronization reference and the external and internal alarms.

The module to connect the radio frequency parts and the nGPSAM are mounted on a module GPxOIM.

4 Alcatel-Lucent 9332 radio Compact NodeB (rCompact)

We have just described the 9322 digital Compact NodeB. As said previously the 9322 digital Compact NodeB is associated with a remote radio part. One possible partner we describe on the following slides:

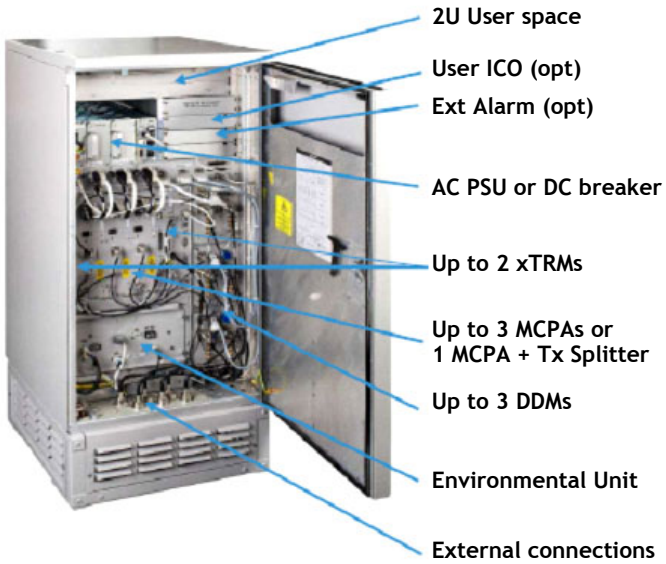
The 9332 radio Compact NodeB Outdoor – shortly rCompact Outdoor.

4.1 Layout of the rCompact NodeB

Characteristics

- Up to 2 xTRM modules
- Up to 3 MCPAs
- Re-use of the same UMTS modules as Macro NodeB
- Optimized ratio size versus capacity:
  - Footprint: 0.377m²
  - Cabinet size (H x W x D): 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



1 · 2 · 32

Macro NodeB UA07 Description · Description of the BTS Types
9300 Node B · Macro NodeB UA07 Description

Alcatel·Lucent UNIVERSITY

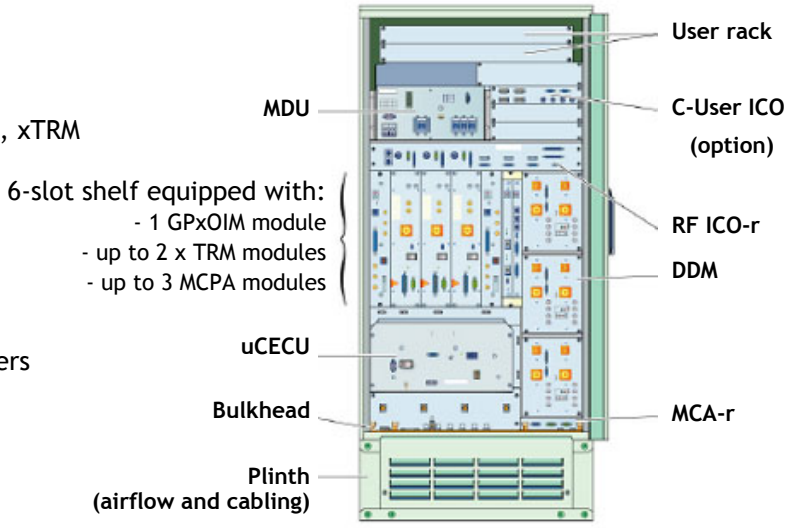
The Alcatel-Lucent Remote Radio solution improves flexibility for deploying mobile broadband base stations in space-constrained locations. It is particularly suited to macro-cellular application in dense areas, where site acquisition is difficult, and on sites where installation constraints prevent the 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 radio frequency power per carrier at the antenna feeder and a reduced radio loss with the use of the remote radio frequency block concept. This latter eliminates the distance between the radio amplifier and the antenna.

The 9332 radio Compact NodeB 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.

4.2 Cabinet description of the rCompact

- Radio part of the NodeB:
  - Up to 3 sectors x 2 carriers
  - MCPA 60W (45W at BTS output)
  - 2100 MHz only
  - Up to 2 xTRMs
- 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:
  - DC input for modules + AC for heaters
  - New variants later pending market request
- Options:
  - DDM AISG
  - TMA: external alarms



The 9332 radio Compact NodeB 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 dCompact NodeB or the d2U NodeB.

One GPxOIM module is required per cabinet. It must be equipped with one optical board **C2OIM-r** (***multi mode***). Previous versions of C2OIM are not supported in rCompact.

The 9332 rCompact NodeB operates in the 2100- MHz band. If combined with the dCompact NodeB or the d2U, it offers Macro NodeB capabilities in a compact NodeB packaging. It constitutes an alternative Macro NodeB solution.

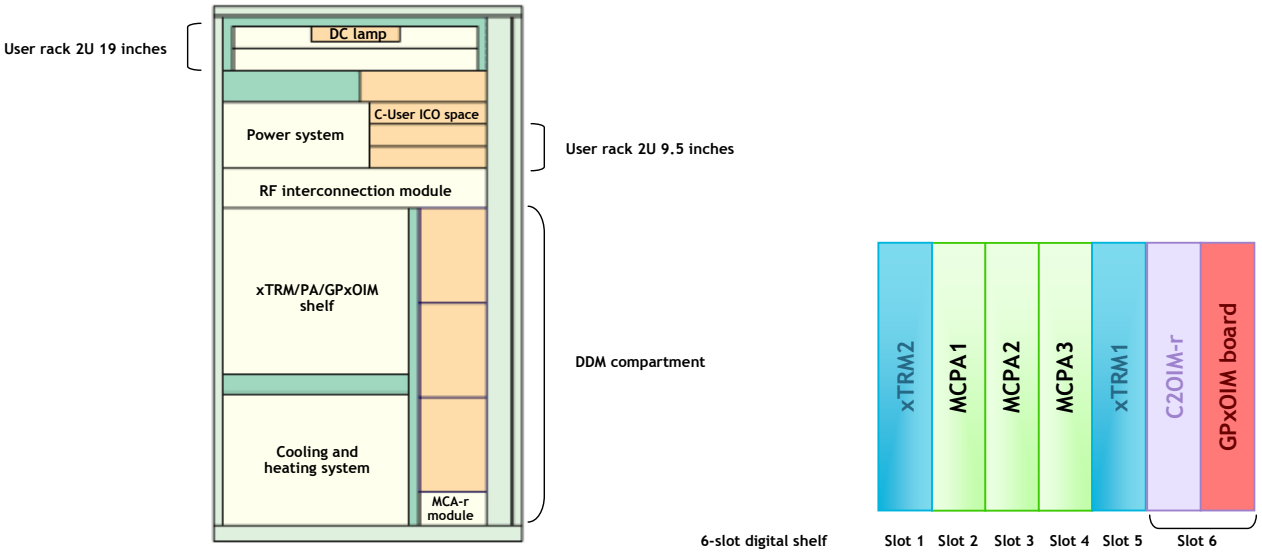
The 9332 rCompact has the following features:

- Outdoor rack (1100x580x656mm)
- Up to STSR-3, 3 carriers X 3 sectors
- Up to 3 sectors w/ 60W output
- Includes battery backup shared between cabinets
- Uses same standard UMTS Modules (xTRM, Multi-carrier Power Amplifier, Dual Duplexer Module (DDM)) to facilitate spares management

Value:

- rCompact provides a complete solution for urban or rural sites with higher power scalability than Remote Radio Head.
- Easier site acquisition and installation due to its low volume and footprint. No need to crane the cabinet.

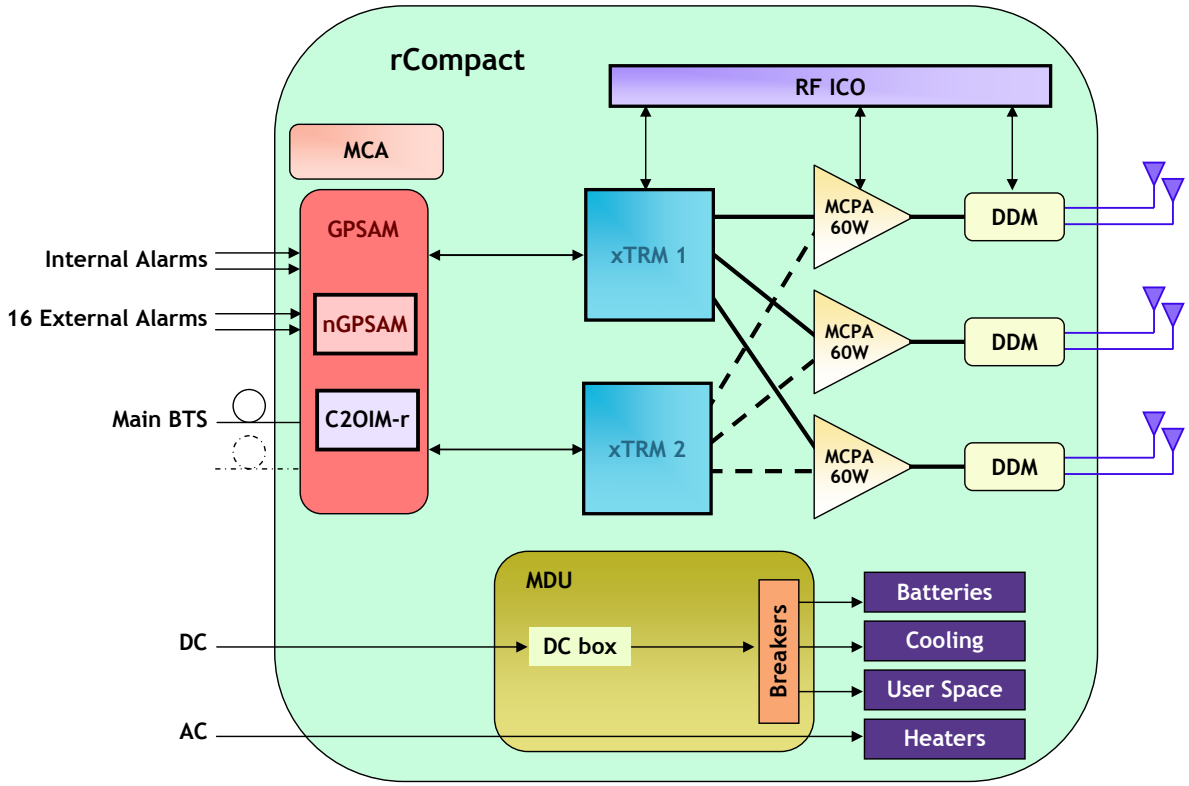
4.3 rCompact NodeB Outdoor AC/DC cabinet layout



The rCompact NodeB is built around the

- xTRM/PA/GPxOIM compartment,
- the Dual Duplexer Module compartment,
- the radio frequency interconnection module,
- the power system, the cooling system,
- the user compartment,
- the associated C-user ICO module and
- the bulkhead.

4.4 Block diagram of the rCompact



The radio shelf of the rCompact NodeB consists of the backplane and four types of modules.

First, the expandable Transmitter Receiver Modules (xTRM) 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 Multi-carrier Power Amplifiers 60W which are used to amplify the signal with a pre-distortion loop.

Next, Dual Duplexer Modules are responsible for coupling to the antenna in main and diversity paths.

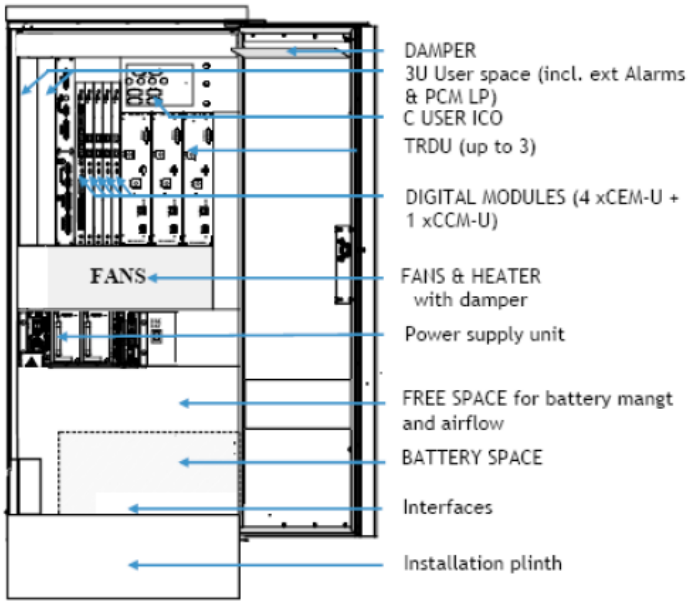
The GPxOIM is composed of 2 slots, one containing nGPSAM and one C2OIM-r. nGPSAM supports any external/internal alarm connections and external synchronization. C2OIM-r provides connections to the digital BTS through optical links.

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.

5 Alcatel-Lucent 9312 Outdoor Compact NodeB

Another possible partner for the 9322 digital Compact NodeB we describe on the following slides:
The 9312 Outdoor Compact NodeB.

5.1 Alcatel-Lucent 9312 Outdoor Compact NodeB



The Compact Outdoor NodeB provides significant benefits to our customers:
Because often the macro solution is deployed to cover 3 sectors and 2 carriers only, this NodeB reduces considerably the footprint and the volume of the solution (divided by more than 3), using the compactness of the new modules, i.e. eXtended Core Controller Module-U, extended Channel Element Module U and Transmitter Receiver Duplexer Unit. The Compact Outdoor NodeB should then be used in the majority of rollouts.

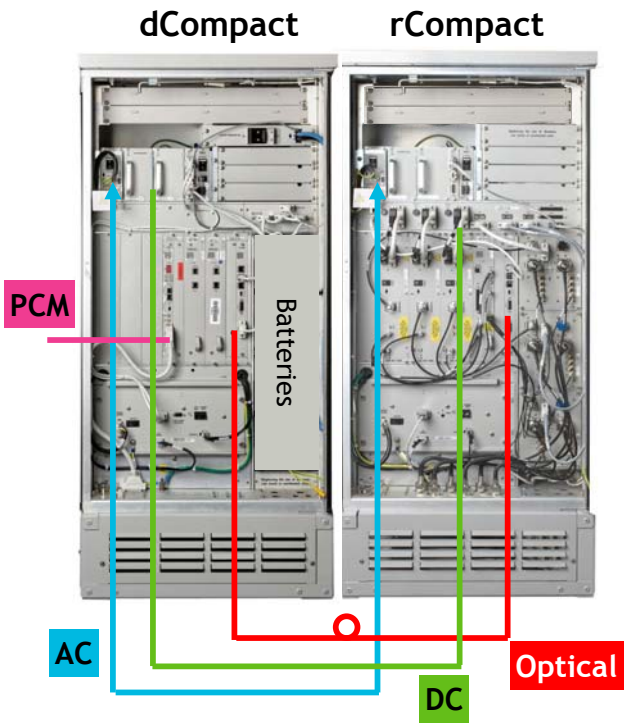
The usage of the Transmitter Receiver Duplexer Unit 40W and optimized cooling system helps to reduce the power consumption by 25%.

Best in class total cost of ownership (TCO) for power consumption, footprint, volume, weight reduction … compared to the Macro solution, but also compared to the combination of dCompact plus rCompact

Note: Configuration upgrade is under study to cover dual-bands and 6 sectors using additional Remote Radio Heads and/or extension cabinet.
The usage of Transmitter Receiver Duplexer Unit 60 Watts will be supported in the future.

Main characteristics
- H x W x D: 1300x580x656mm (TBC)
- Outdoor: IP55
- -40°C..+55°C in normal operating mode with a cold startup limited to -33°C
- AC Power supply
- 1 eXtended Core Controller Module-U
- Up to 3 or 4 extended Channel Element Module U for the 9326 digital 2U NodeB V 2 (TBC)
- Up to 3 Transmitter Receiver Duplexer Units 40-21 (then 60W)
- 1 hour battery backup (full configuration)
- 3U User space (TBC)

5.2 dCompact + rCompact NodeB solution



DESCRIPTION

- Indoor DC & Outdoor AC (1100x1200x656mm)
- Up to 5 CEM (640 CE, future 1536)
- Up to 2 xTRM Modules
- Up to 3 MCPA
  - 44W output ToC
  - up to 60W (future)
- Battery back-up shared between cabinets
- Re-use of the same UMTS Modules than Macro NodeB

VALUE

Reduced footprint, easy to install

→ CAPEX reduction

This slide shows a distributed BTS consisting of one dCompact NodeB plus one rCompact NodeB with the type and number of modules.

6 Radio cell and BTS configurations of conventional NodeBs

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

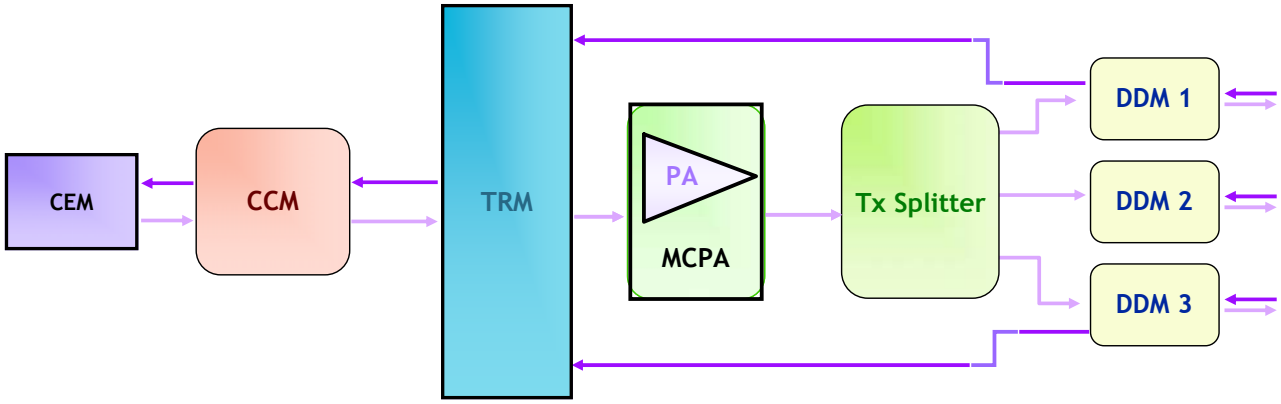
6.1 Alcatel-Lucent implementation: OTSR

Characteristics of OTSR

- Omni directional Tx
- Sectorial Rx
- 1 carrier

Limitations of OTSR

Not supported in UTRAN 04 for 1900 MHz



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

Signals received are transferred to the Transmitter Receiver Module independently.

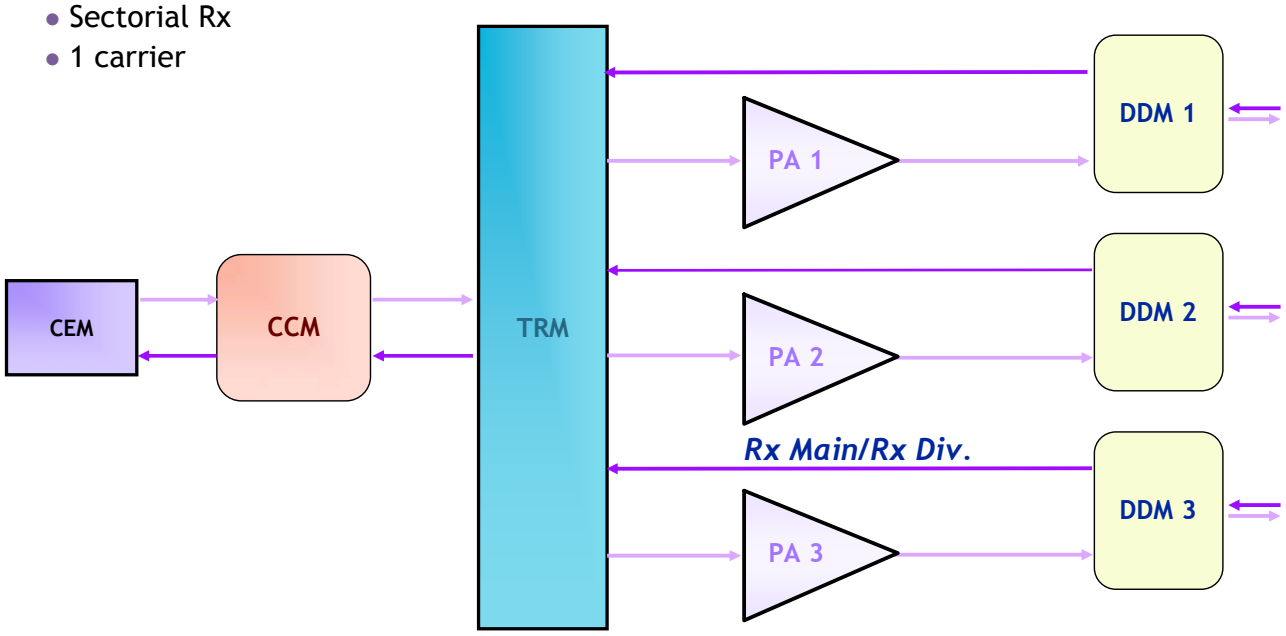
The antenna and the radio frequency feeder configuration in OTSR are identical to the standard STSR devices.

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.

6.2 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, 5 MHz over 3 sectors and the Tower Mounted Amplifier (TMA) option.

Since it requires a full radio frequency configuration, three Dual Duplexer Modules and three Multi-carrier Power Amplifiers are required. The installation cost given, only one frequency carrier is higher than for OTSR.

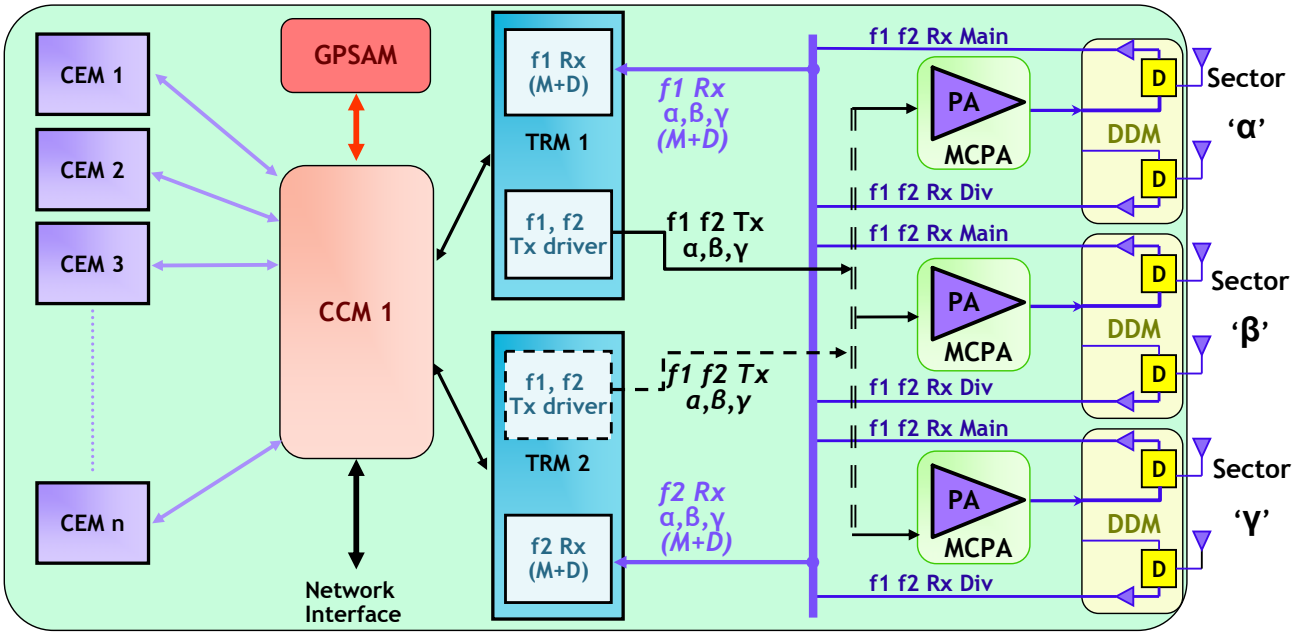
The power allocation in STSR is independent across sectors, as opposed to OTSR. This enables a higher downlink capacity.

The antenna and the radio frequency 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.

6.3 Multi-carrier configuration with TRM

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

1 TRM is mandatory for each received carrier



The BTS is hardware ready to support more than one carrier. This feature is the so-called multi-carrier mode. Multi-carrier configurations of Macro BTSs are limited to two carriers per sector. We name this the **STSR2** configuration.

STSR 1+1 is also a configuration with 2 carriers per sector. In this case, there are 2 Multi-carrier Power Amplifiers per sector.

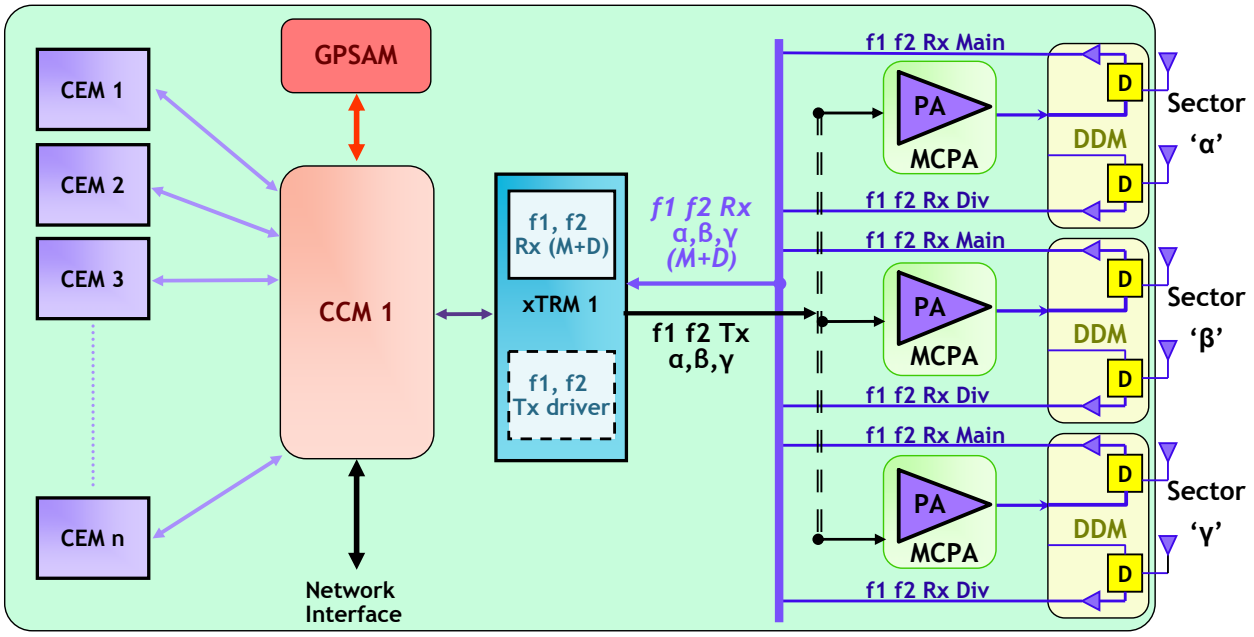
One Transmitter Receiver Module of type TRM or iTRM is mandatory for each RECEIVED carrier. Thus 2 TRMs are needed for STSR2. Then one integrated Channel Element Module can support up to two carriers. Finally, one or two Multi-carrier Power Amplifiers and one Dual Duplexer Module are necessary for each 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 frequencies 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.

6.4 Multi-carrier configuration with xTRM

Main Characteristic of STSR2 with one xTRM board

1 xTRM can support 2 carriers.

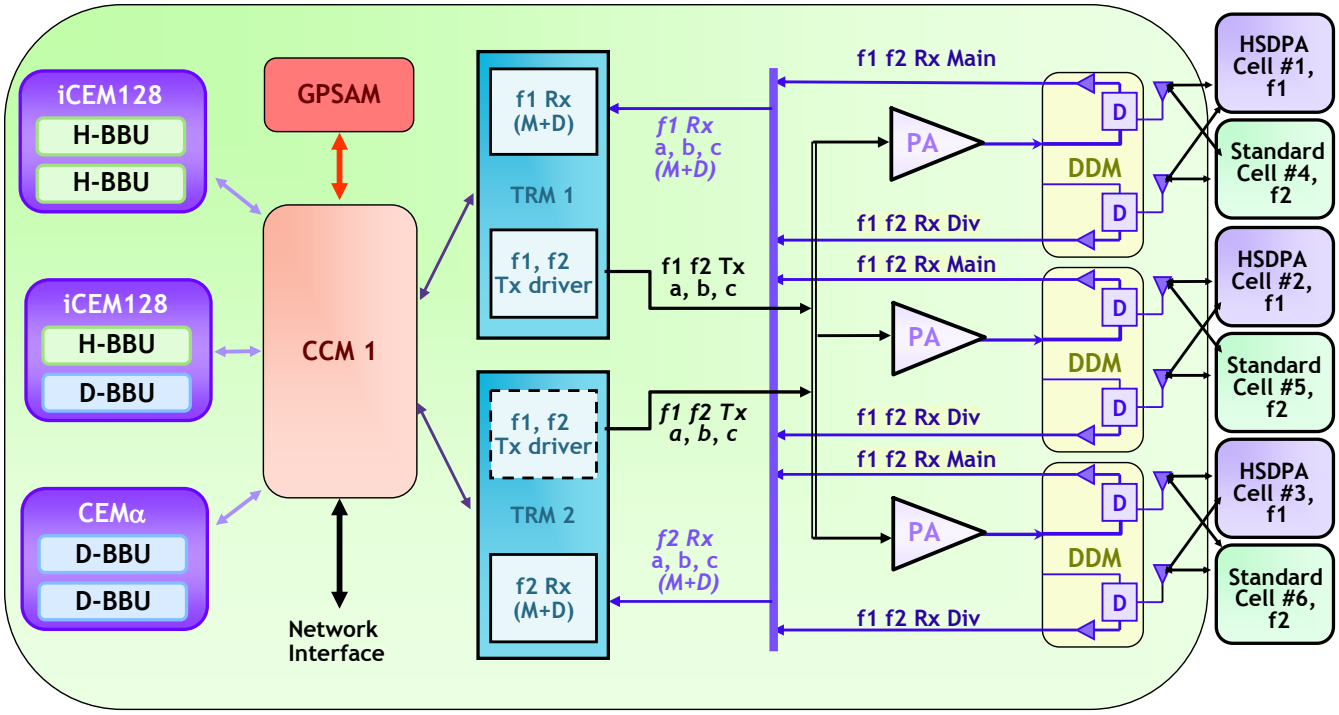


Here is illustrated the STSR2 configuration with one expandable Transmitter Receiver Module (**xTRM**) board.

The configuration is the same as for a configuration with TRM boards with the exception that both generations of the expandable Transmitter Receiver Modules xTRM and xTRM-2 can manage up to 2 carriers in reception and transmission direction.

It is possible as well to add a second xTRM/xTRM-2 for redundancy purposes.

6.5 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.

6.6 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

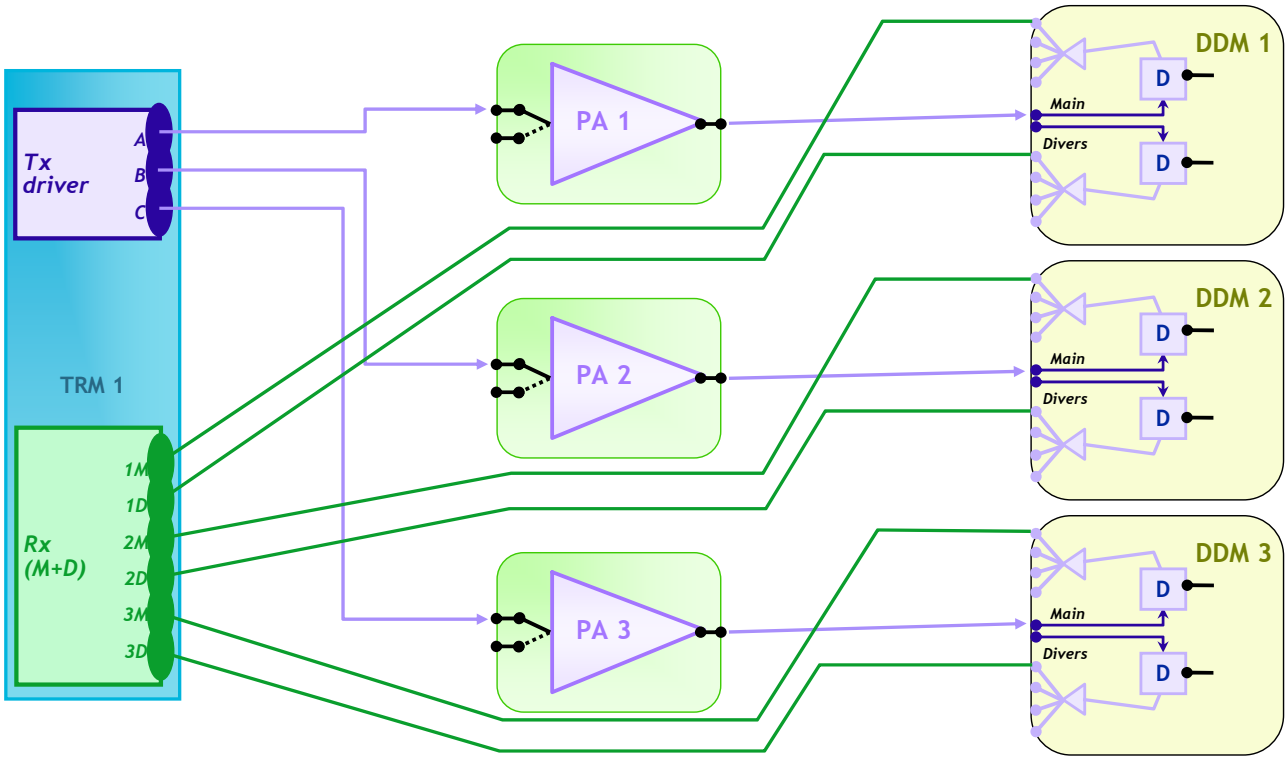
This table gives you the hardware requirements according to the BTS configuration.

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 Transmit Receive Module redundancy.

Only two carriers are supported. However, Tx diversity is not supported yet.

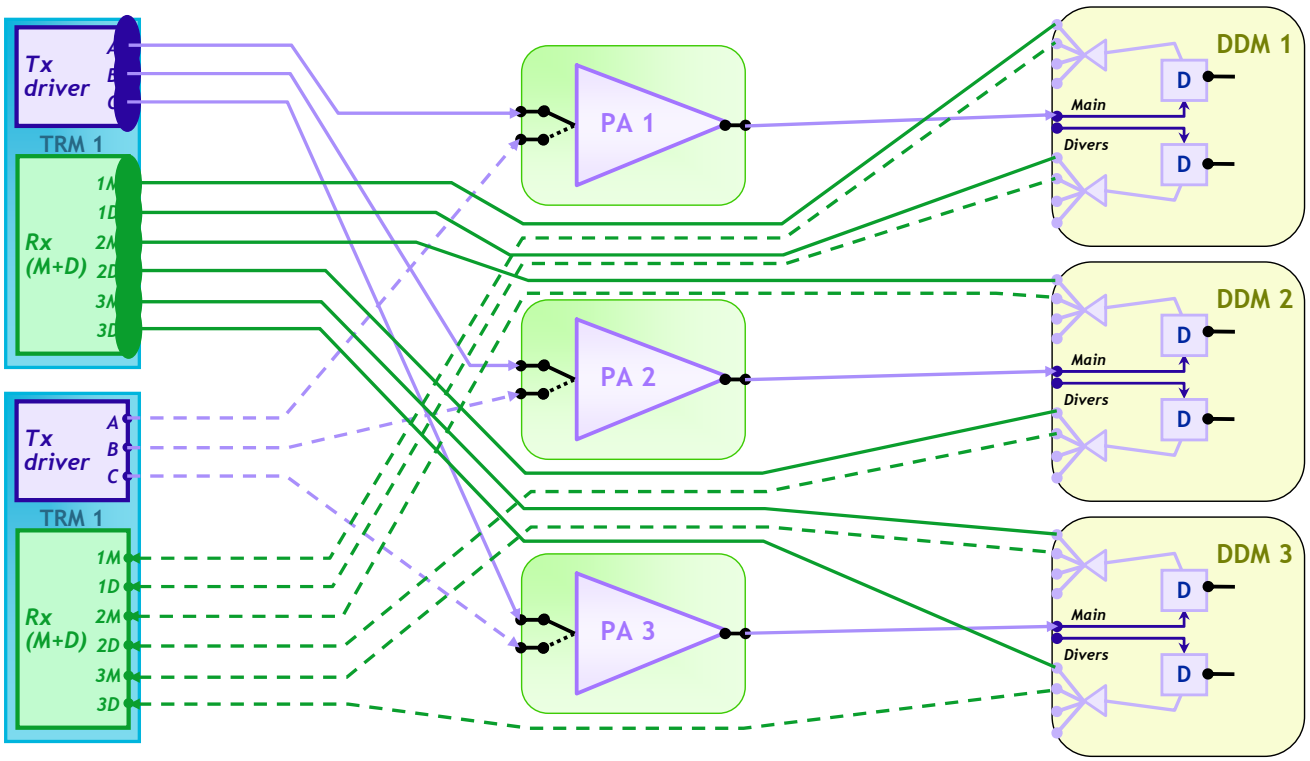
The BTS can be equipped with 2 antennas, for single sector or omni-directional configuration, 4 directional antennas for bi-sector configuration, 6 antennas for tri-sector configuration and 12 antennas for hexa-sector configuration.

6.7 STSR1: 3 Sectors and 1 carrier



Let's examine the radio frequency links between the Transmit Receive Modules TRM/iTRM and Multi-carrier Power Amplifier/Dual Duplexer Module for the STSR1 configuration, without TRM redundancy.

6.8 STSR1R: With redundancy



Let's examine the same configuration, this time with Transmit Receive Module redundancy.

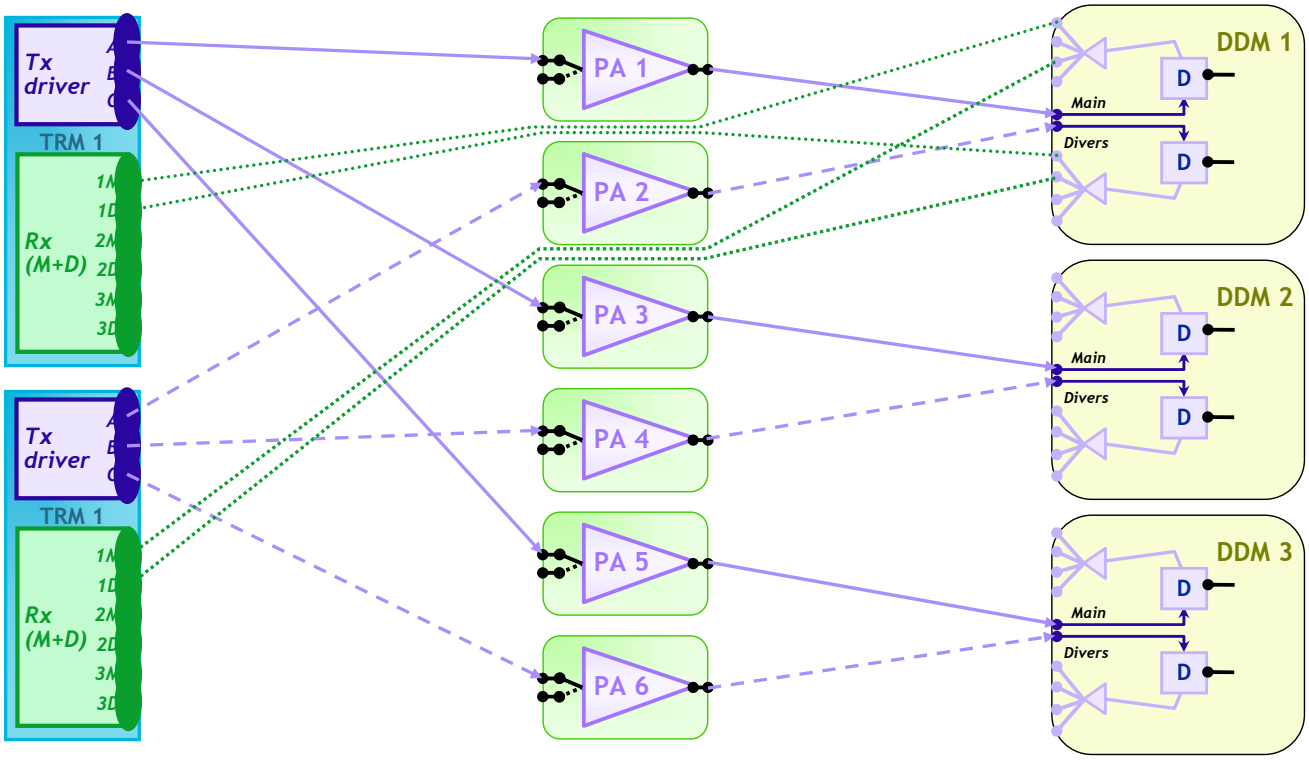
To improve robustness in case of Transmit Receive Module failure, an additional Transmit Receive Module can be added to support STSR1R configuration.

With that arrangement, the failure of a Transmit Receive Module 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 radio frequency cable. Indeed, the additional Transmit Receive Module needed for STSR2 is used in reception and for Tx redundancy.

6.9 STSR 1+1: 3 Sectors and 2 carriers



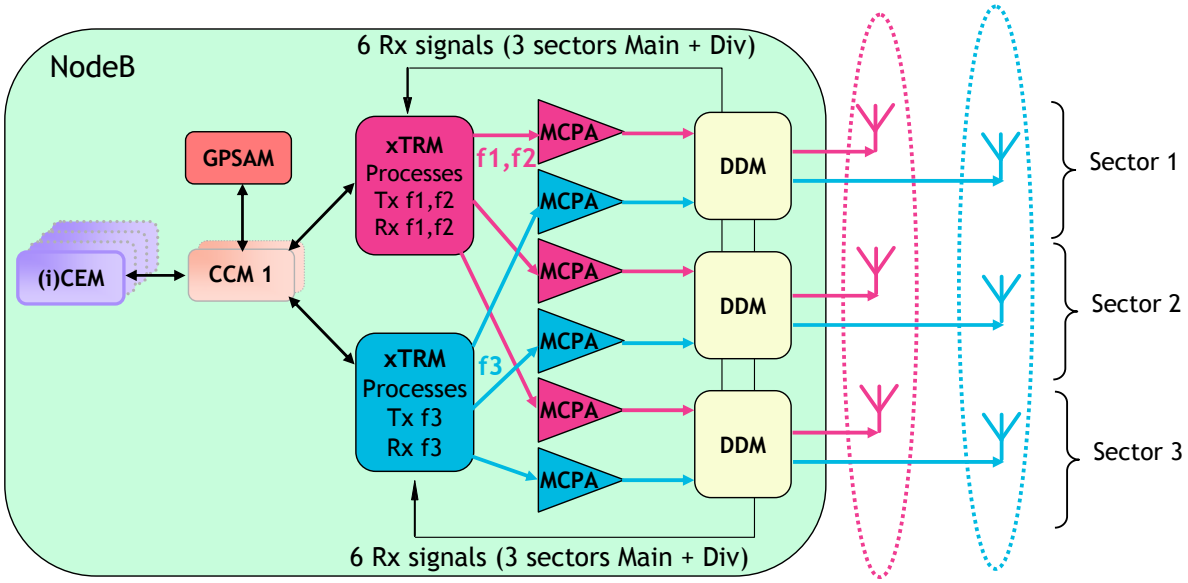
To end, let's see how radio frequency links are connected between Transmit Receive Modules TRM/iTRM and Multi-carrier Power Amplifier/Dual Duplexer Module for the STSR 1+1 configuration.

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

6.10 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 NodeB.



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

What are the main specificities of STSR2+1 ?

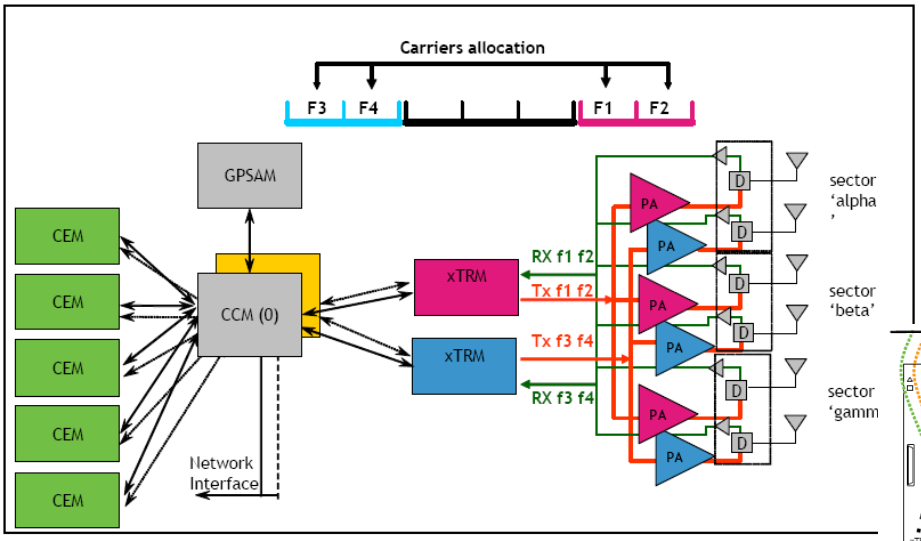
Firstly, the type expandable Transmitter Receiver Module (xTRM) is mandatory and must be configured in 2-carrier mode. Indeed, the STSR2+1 configuration is not compatible with the classical TRM and iTRM.

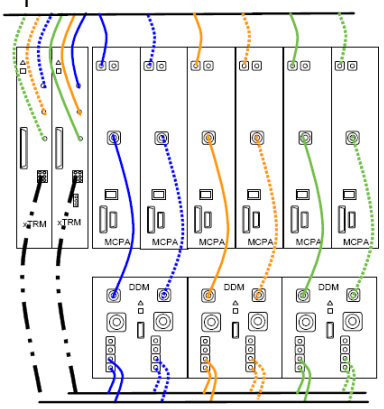
Next, STSR2+1 is supported only in Macro Indoor (Indoor 2) and Macro Outdoor (Outdoor 2).

Then, STSR2+1 is not supported with BTSs having more than 3 local sectors or BTSs with Remote Radio Head 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.

6.11 STSR2+1 and STSR2+2 NodeB configurations

Node B architecture in a STSR2+2 configuration is depicted below:





STSR2+1 cabling configuration

Customers can get 3 or 4 carriers configuration to face UMTS traffic increase, with high capacity per carrier (22W/carrier at NodeB port).

STSR2+1 (resp. STSR2+2) is a SW upgrade from STSR1+1 (resp. STSR2+1) configuration, assuming use of expandable Transmitter Receiver Module (**xTRM**) and the right dimensioning of the Channel Element Modules.

- This feature enables the addition of a third or fourth carrier on HW capable NodeB, and aims at Delivering a high radio frequency capacity 3 or 4 carriers Macro NodeB configuration (Up to 22W/carrier top of cabinet).
- STSR2+2 configuration uses
  - one Multi-carrier Power Amplifier per sector and one xTRM for frequencies F1+F2 (F1 and F2 must be adjacent)
  - one second Multi-carrier Power Amplifier per sector and a second xTRM for frequencies F3+F4 (F3 and F4 must be adjacent)

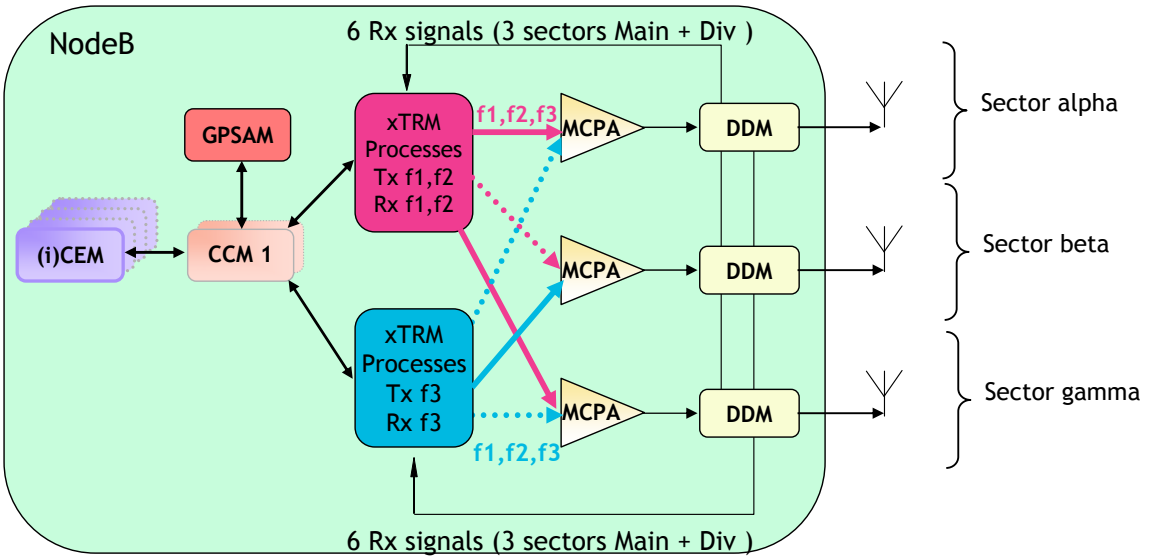
- The Multi-carrier Power Amplifier/xTRM chain supporting F1+F2 is connected to Main path and the second Multi-carrier Power Amplifier/xTRM chain (supporting F3+F4) is connected to Diversity path, STSR2+2 uses 6 Multi-carrier Power Amplifiers and 2 xTRM per cabinet.

- Sub-configurations such as STSR2+1 or STSR1+2 are also supported:
- STSR1+2 configuration makes possible to use iTRM for the first carrier (using Multi-carrier Power Amplifier 45W only).
- Depopulated configurations (one sector or two sectors) are supported as well.

6.12 STSR3 overview

Characteristics of STSR3

- Cabinets supporting STSR3 are Macro Indoor/Outdoor.
- 2 xTRMs and 3 MCPAs 60W are mandatory.



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

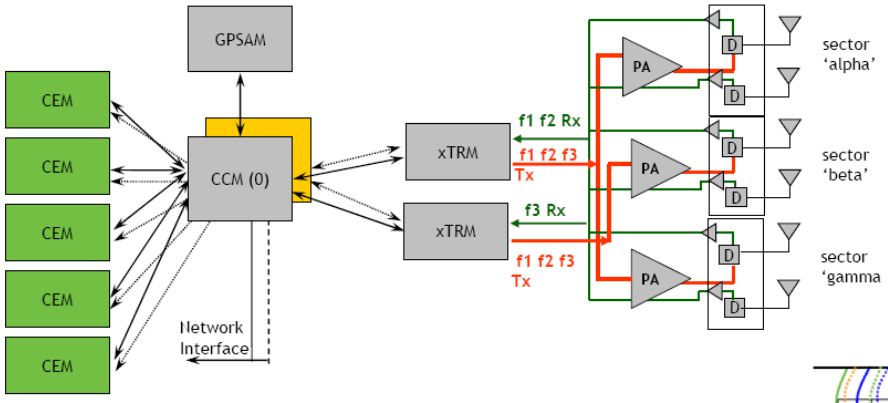
The STSR3 BTS has a capacity of 60 Watts per sector.

f1, f2 and f3 share this 60W Tx capacity: 20W per carrier if equal power is configured per carrier

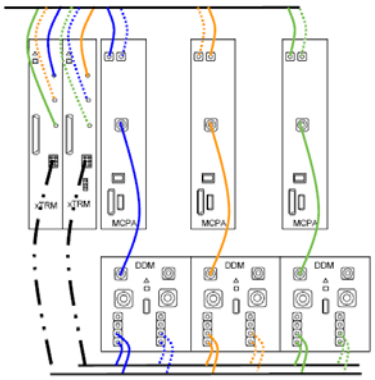
Customers can get a 3-carrier configuration to face up a UMTS traffic increase, with high capacity per carrier : cost ownership (day-to-day operation, fault management, upgrade, preventive/curative maintenance, etc.), capacity and dimensioning (Connectivity, storage capacity, etc.).

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

6.13 STSR3 NodeB configuration



STSR3 Macro Node B architecture (redundancy paths not shown)



STSR3 cabling configuration

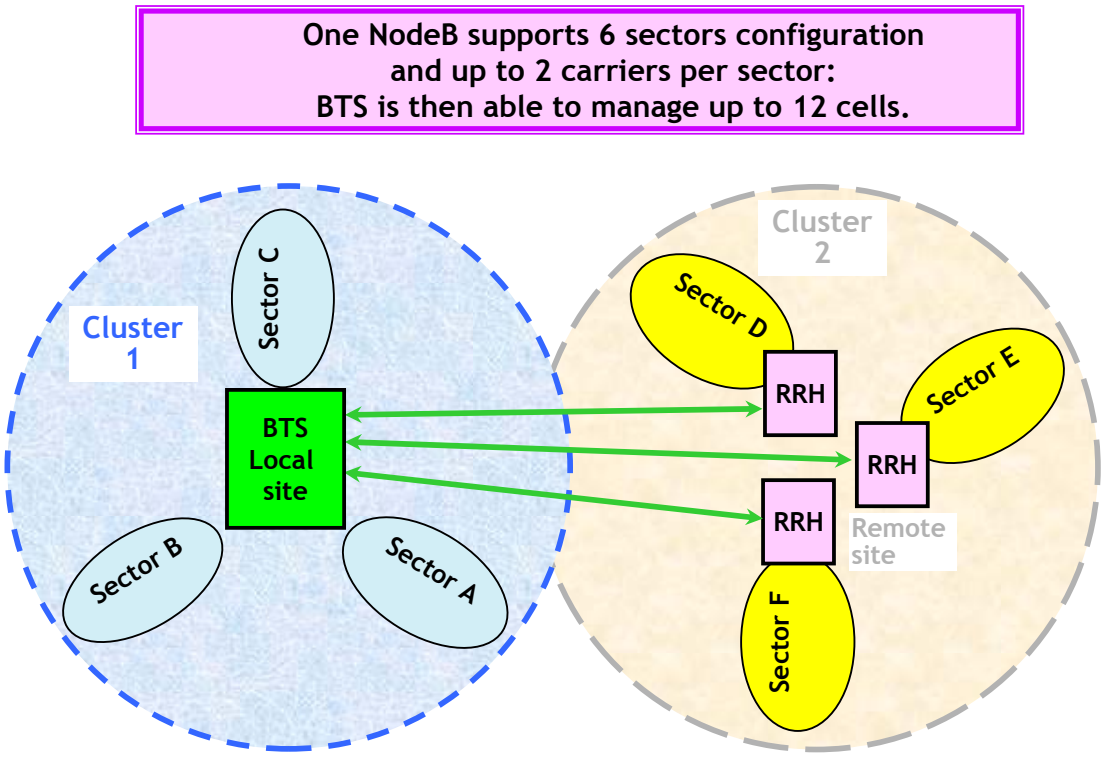
This feature allows the customer to add capacity on existing sites through a minimized additional HW investment, especially on legacy NodeB deployed in the early phases in the very dense areas.

This is also a way to fully use the awarded spectrum for most UMTS Band I operators.

This feature enables the addition of a third carrier on HW capable NodeB.

This third carrier must be contiguous with the other carriers, meaning a block of 15 MHz within the 60 MHz of UMTS Band I.

6.14 NodeB with 6 sectors and 12 cells



- The NodeB supports 6 sectors, and up to 2 carriers per sector: BTS is then able to manage up to 12 cells.

- This 6 sectors configuration is seen as 2 times 3 sectors (2 clusters of 3 sectors):
  - inside each STSR cluster, Softer Handover is allowed,
  - between the two clusters, the mobility is realized using only Soft Handover mechanism.

- The two STSR clusters may be seen as:
  - two STSR conventional cluster supported by the BTS cabinet hardware,
  - one STSR conventional cluster and one STSR remote cluster, using three Remote Radio Heads of type RRH 2020.

- With only one NodeB site, operator is able to deploy outdoor coverage and simultaneously hot-spot, remote or indoor coverage.

- A configuration with 6 local sectors is also possible. In this configuration Remote Radio Heads are not supported

6.15 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 and Div paths)	2 (Main and 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|	4.6 MHz ≤ Δfreq ≤ 5 MHz	4.6 MHz ≤ Δfreq (*)	Notation: F1 and F2 grouped, F3 alone 4.6 MHz ≤ |F1-F2| ≤ 5 MHz 4.6 MHz ≤ |F1-F3| (*) 4.6 MHz ≤ |F2-F3| (*)

(*) upper limit is linked to the frequency bandwidth

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

6.15 STSR configurations [cont.]

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

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 and GPSAM modules.

MCPA 30/45W and MCPA 60W are supported. Restricted mixity between MCPA 30/45 and 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 extended Channel Element Module. For UTRAN sharing case, the 2 adjacent carriers (f1 and f2) must belong to the same operator. E-DCH is supported with integrated Channel Element Module over 2 carriers from 2 different operators (f1 or f2 and f3).

7 Alcatel-Lucent 9326 digital 2U NodeB (d2U)

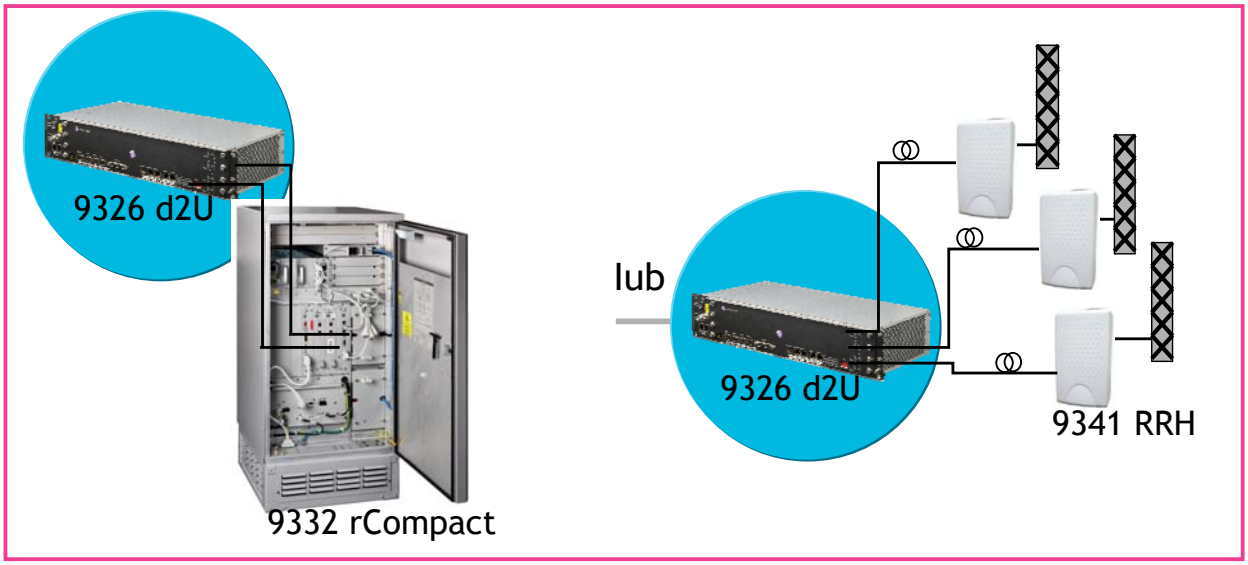
Now, let's see the characteristics of the 9326 digital 2U NodeB (d2U).

The d2U is designed to be installed within a BTS user space, as a standalone product (e.g. 19 inch = 48.3 cm rack), or in another equivalent environment.

It can be easily inserted in an already existing Multi-Standard BTS or any GSM/UTRAN base station, so it can reduce the CAPEX and solve the problem of site lack.

7.1 9326 digital 2U NodeB (d2U)

A **high capacity and density** unit that can be used in combination with RRH units, the rCompact NodeB and multi-standard cabinets in dense areas with site space limitations



This slide shows distributed BTSs consisting of one 9326 digital 2U NodeB combined with a rCompact NodeB or several Remote Radio Heads.

Characteristics

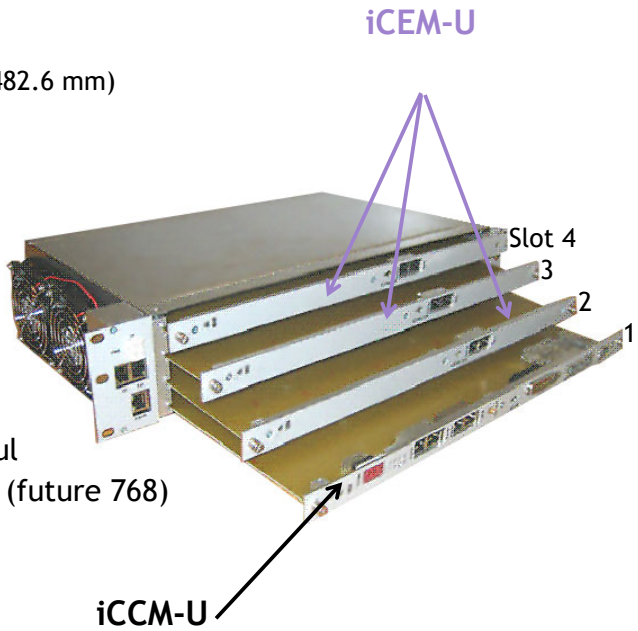
- Indoor environments
- Compact design (2U height) and a minimum weight (<8 Kg)
- Up to 8 E1/T1 and 1 fast Ethernet (eXtended Core Controller Module-U)
- Up to 3 i/extended Channel Element Module U (384 CE, planned 768 CE)
- Provides three ports for optical fibers supporting CPRI interfaces
- It supports the following configurations:
  - Star configuration of up to 3 RRHs: One RRH connected to each fiber port.
  - Star configuration of 6 RRHs: Two RRHs connected to each fiber port in a daisy chain.
  - Daisy chain configuration of 6 RRHs: Three RRHs connected to two fiber ports in a daisy chain.

Value

- Easy to install: It is lightweight so it can be carried by one person
- Zero footprint: No need for an additional base station, installation possible within existing space or inserted in a standard 19-inch rack (Macro in GSM sites)
- Less civil works, no feeders, highest density on the market with x-modules
- No craning, zero footprint (wall-mountable)

7.2 Characteristics of d2U (with iModules)

- Indoor DC
- Dimensions:
  - 2U height equivalent to 88 mm
  - Width according to 19 inches standard (i.e. 482.6 mm)
  - Depth: 240 mm
- Environmental conditions:
  - IP20
  - Operating temperature range: -5°C to +65°C
- Maximum power consumption: 190W when fully equipped (i.e. 3 iCEM128s)
- Airflow managed by fans, powered and controlled from the backplane
- One iCCM-U
- Connectivity: up to eight E1/T1 on backhaul
- Up to three iCEM-Us for a total of 384 CEs (future 768)
- Support of rCompact or up to three RRHs



The 9326 digital 2U NodeB shelf is made up of four different types of modules:

The integrated Core Controller Module-U (**iCCM-U**) is a single board with a height of 21 mm and supports the functions for Core Control, GPSAM and OIM.

The integrated Core Controller Module-U first, is a single board for Core Control, GPSAM and OIM functions in a 21mm-high module. iCCM-U is in charge of Operation and Maintenance (OaM) management, part of call processing and internal/external data flow switching/combining, supporting external/internal alarm connectivity and external synchronization reference interface.

Then the integrated Channel Element Module U (**iCEM-U**) is used. It supports the same features like the **iCEM2-128** but it is re-designed on a new printed circuit board in a module with a height of 21 mm. The iCEM-U is in charge of part of call processing and processes digitally in the base band the transmitted and received signals.

Up to three iCEM-Us can be inserted in the shelf.

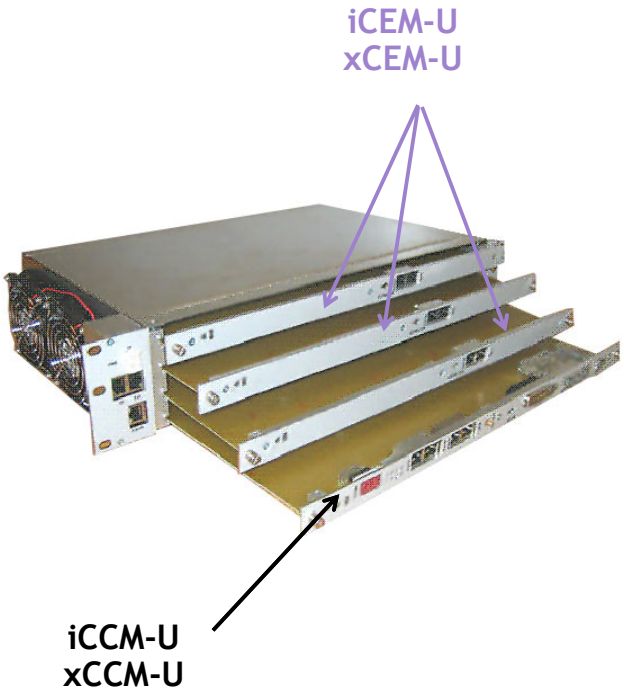
Next the Rack user Back Plane (**RBP**) is in charge of supporting all internal links between modules.

Finally, the Rack User Commissioning (RUC) is in charge of supporting all commissioning non-volatile memories and fan alarms.

7.3 Characteristics of d2U V2 (with iModules or xModules)

- The same characteristics as d2U NodeB, with the possibility of integration of xModules : **xCCM-U** and **xCEM-U:**

- 1 iCCM-U (or 1 xCCM-U)
- Up to 3 iCEM-Us (or xCEM-Us) for a total of 384 CEs (future 768)
  - iCEM: Up to 3 RRHs
  - xCEM: up to 6 RRHs



As you can see, this d2U version 2 has exactly the same size and so the same advantages than the previous d2U.

With the eXtended Core Controller Module-U you can connect up to 6 Remote Radio Heads. This almost doubles the capacity of your NodeB.

The capacity is sufficient to go up to 768 CEs.

This dNodeB 2U Version 2 is composed of:

Up to 3 extended Channel Element Modules U (**xCEM-U**) or mixed configurations (xCEM-U plus iCEM-U): These modules are in charge of part of call processing, base band transmit and receive digital signal processing. The xCEM-U allows the BTS dNodeB 2U version 2 to double the capacity provided by the iCEM-U , because one extended Channel Element Module U supports 256 Channel Elements;

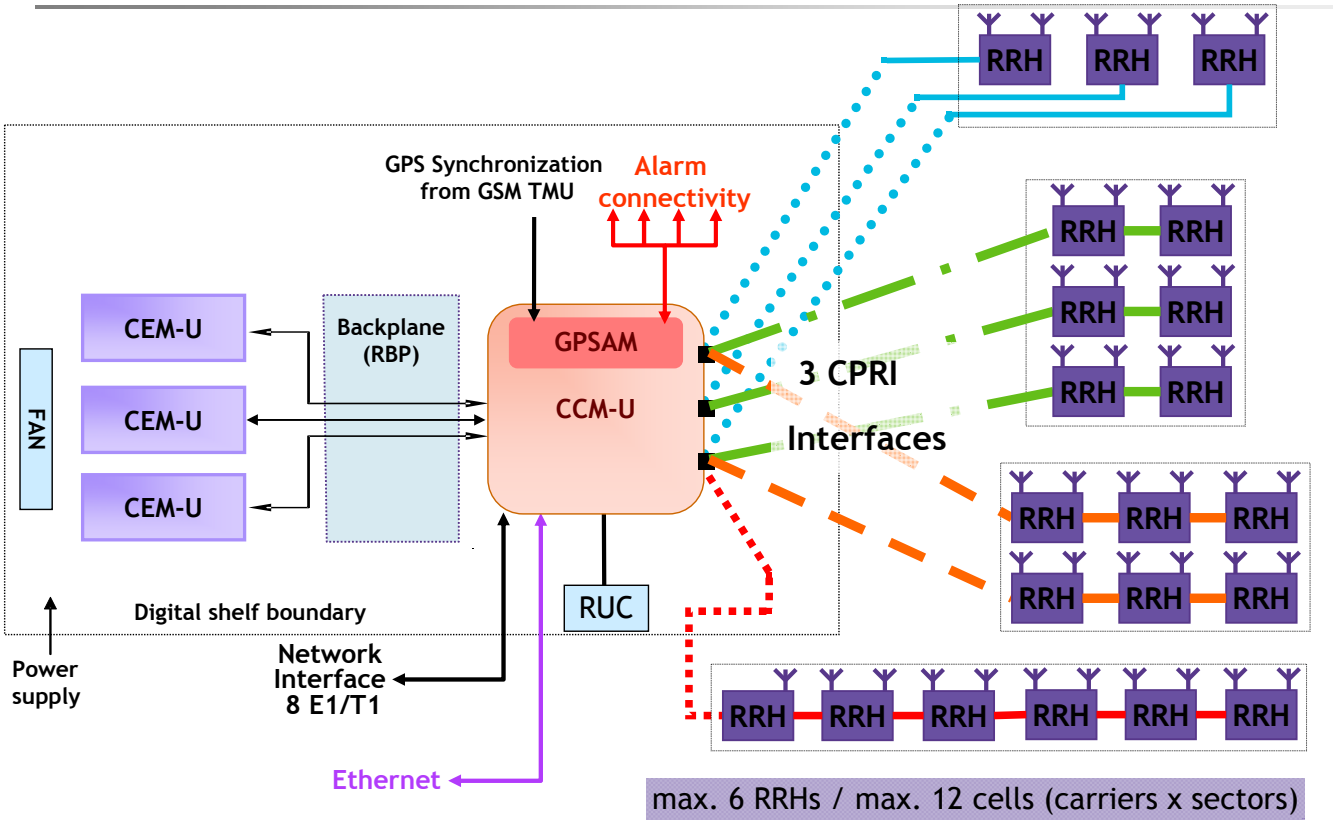
either one xCCM-U or one iCCM-U for the Core Control functions;

a 2U mechanical shelf;

an associated user Rack Back Plane Version 2 (RBP 2U) which is in charge of supporting all internal links between modules;

2 boards: Rack User Commissioning front version 2 and Rack User Commissioning back 2U version 2 which are in charge of supporting all commissioning non volatile memories, and fan alarms. **RUC** front 2U V2 also supports the interface with a 16 external alarms kit. **RUC** back 2U V2 also routes the power supply tracks to the RBP 2U Version 2.

7.4 Architecture of d2U (and d2U V2)



The 9326 digital 2U NodeB (d2U) comprises two functional types of modules:

First, either an iCCM-U or an xCCM-U does the Core Control functions (CCM):
- Operation and Maintenance (OaM) management,
- a part of call processing,
- switching and combining of internal and external data flows,
- support of external and internal alarm connectivity,
- interfacing to an external synchronization reference
- and interfacing three optical links supporting the CPRI interface.

Only one CCM can and has to be installed in the shelf.

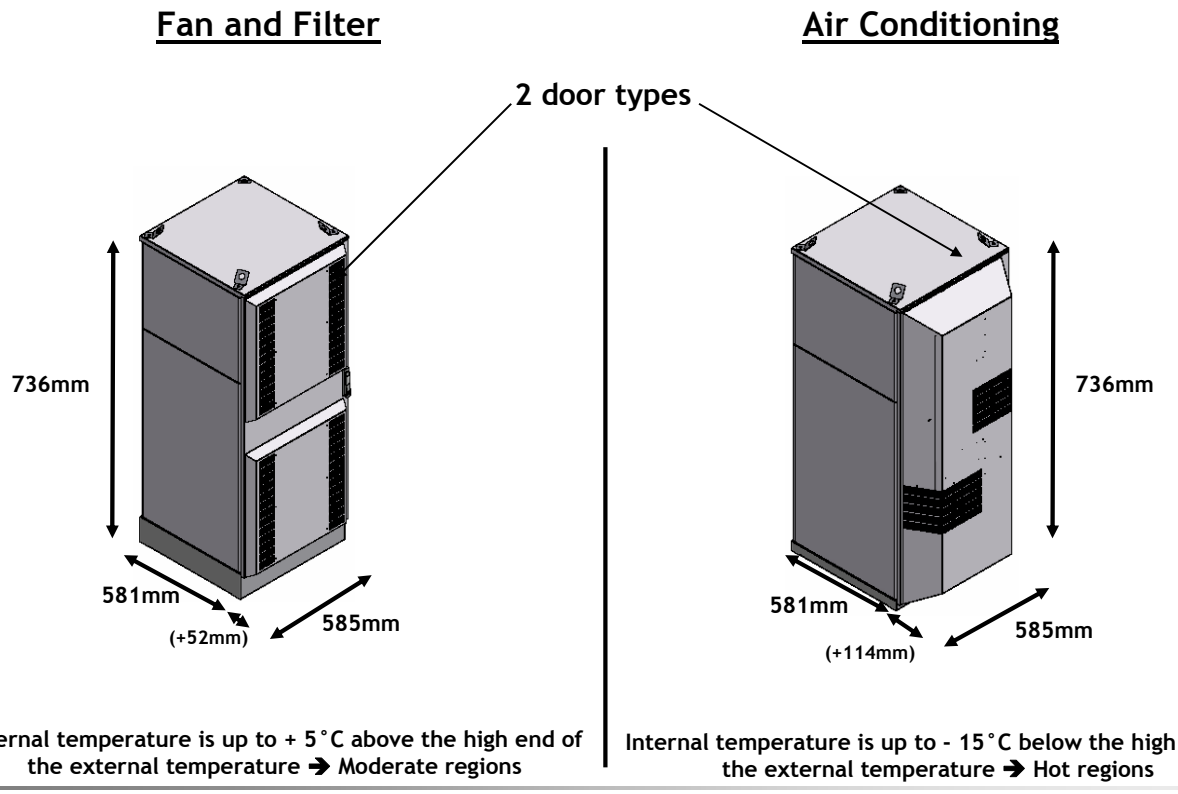
Second, either an iCEM-U or an xCEM-U does the Channel Element functions (CEM):
- a part of call processing and
- the digital processing of the transmitted and received signals in the base band.

Up to 3 of these CEMs can be inserted in the shelf.

The d2U supports up to 3 RRHs. The modern variant – the d2U Version 2 - with the board xCEM is more powerful, it supports up to 6 RRHs with maximal 12 radio cells in the following configurations:
- Star configuration of up to 3 RRHs: One RRH connected to each fiber port.
- Three daisy chains with two RRHs per chain.
- Two daisy chains with three RRHs per chain.
- One Daisy chain configuration with six RRHs

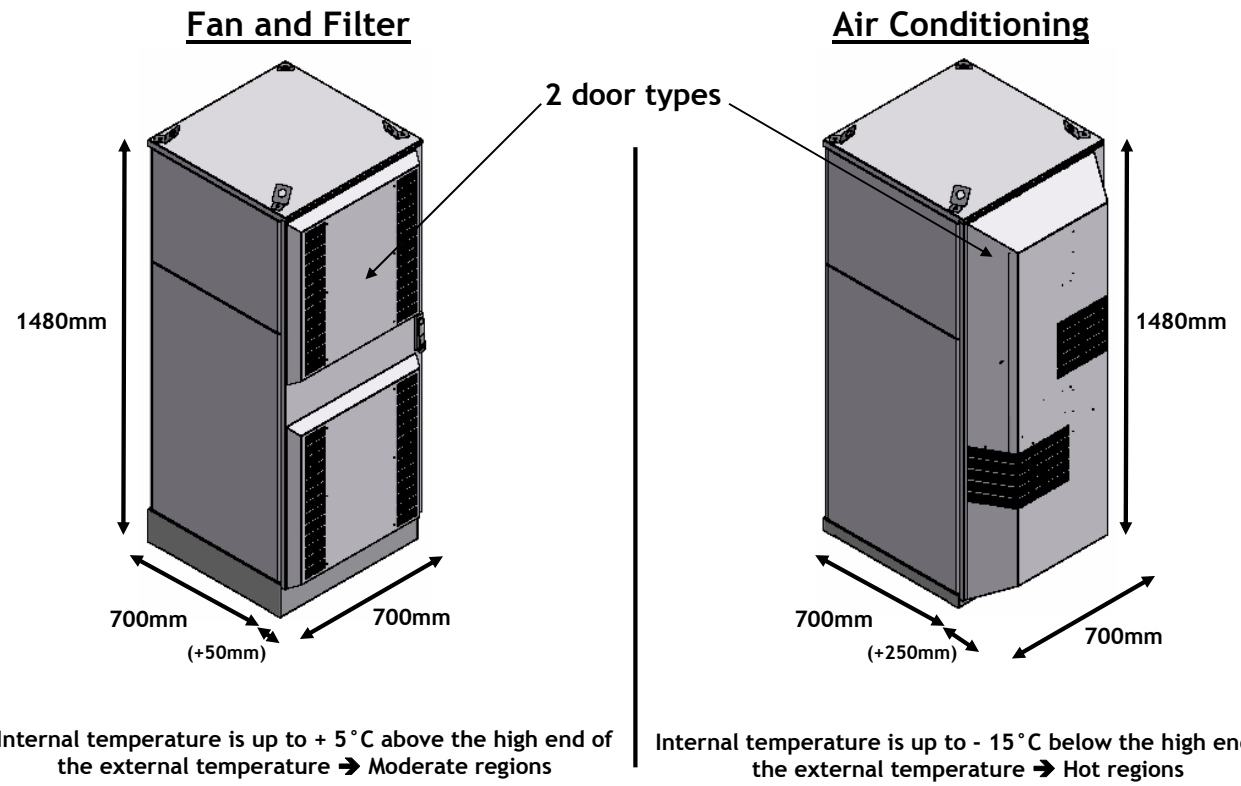
[Restrictions and Limitations:
- Only RRHs using CPRI are supported
- Maximum 6 cells per fiber
- Maximum 12 cells per 9326 d2U V2
- Maximum 6 sectors per 9326 d2U V2
- Maximum 4 Local Cell Groups per 9326 d2U V2
- No mixity of RRH main types on the same fiber (but mixity is allowed between different fibers)
- Maximum distance between d2U and first RRH in the chain: 10 Km / 6.2 miles
- Maximum distance between 2 RRHs in the chain: 10 Km / 6.2 miles
- Maximum distance between d2U and last RRH in the chain: 20 Km / 12.4 miles]

7.5 Small d2U Outdoor cabinet – two types



Two variants of the digital 2U NodeB Outdoor exists. This slide shows the small version with the physical dimensions of the cabinet …

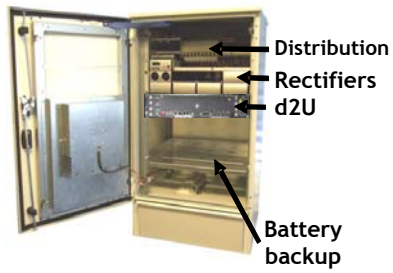
7.6 Medium d2U Outdoor cabinet – two types



… and here we see the medium cabinet.

7.7 Small d2U Outdoor Cabinet – several configurations

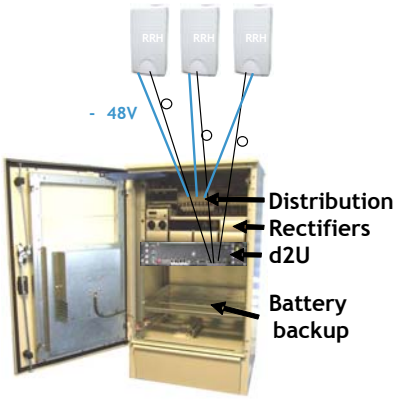
Up to 10 hours battery backup



Several configurations are possible:

1 hour
2 hours
4 hours
8 hours
10 hours

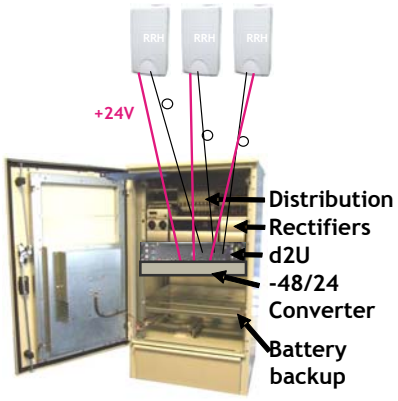
Up to 2 hours battery backup with RRH -48V



Several configurations are possible:

1 hour
2 hours

Up to 2 hours battery backup with RRH +24V



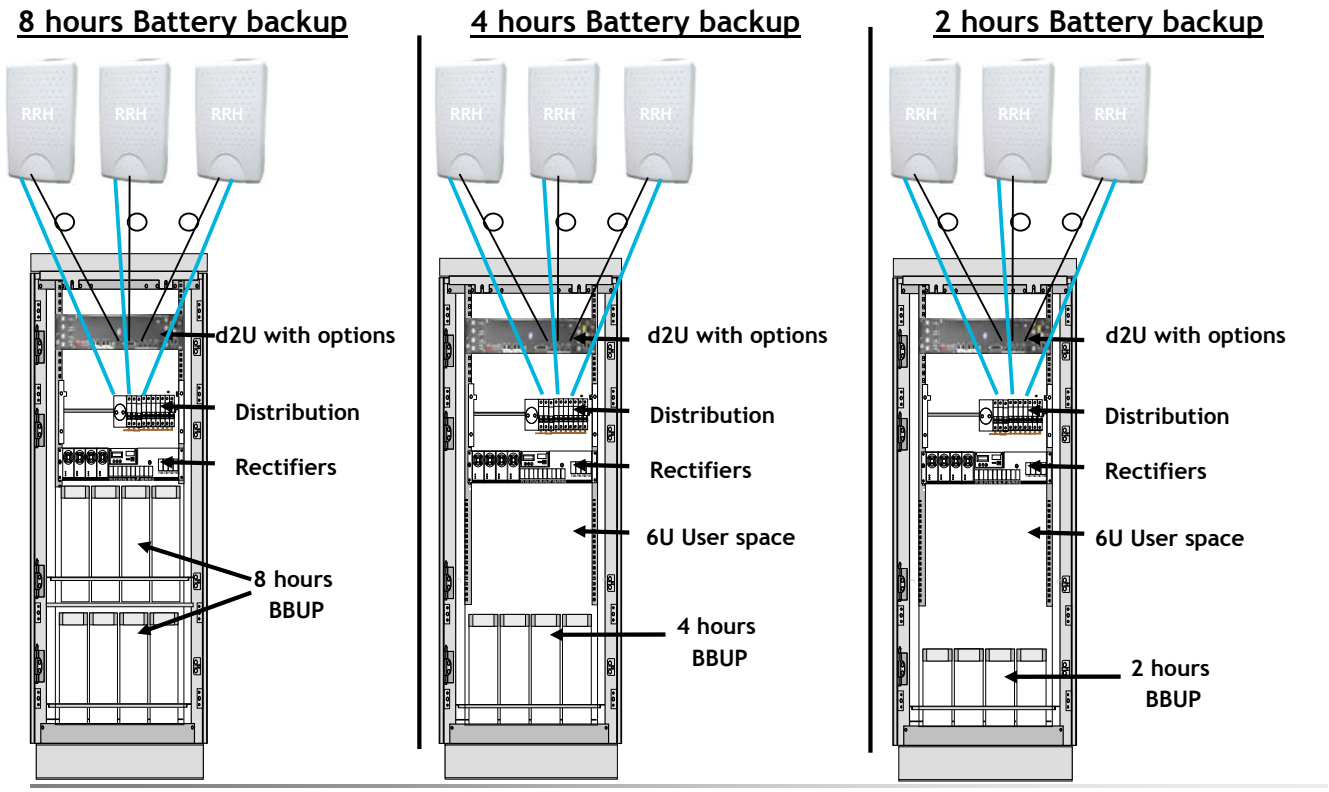
Several configurations are possible:

1 hour
2 hours

In a fully equipped small outdoor cabinet, if the Batteries BackUP (BBUP) are used for the d2U node alone, it can provide up to 10 hours of power backup.

If the batteries are used also to aliment the Remote Radio Head unit the power backup period will be up to two hours.

7.8 Medium d2U Outdoor Cabinet – several configurations



In a fully equipped medium outdoor cabinet, the Batteries BackUP (BBUP) can provide up to 8 hours power backup.

8 Alcatel-Lucent 9341 Remote Radio Head (RRH)

Let's continue in the BTS portfolio with the description of the Remote Radio Heads or RRHs.

We will start by an introduction on “How the RRH” then “Why the RRH”.

The Remote Radio Heads do the role of a remote radio part in case of distributed BTSs. They cooperate with a digital part at a central site and are connected via optical links, compliant with the Common Protocol Radio Interface.

In general one Remote Radio Head supplies one radio sector, both the main path and the diversity path.

Optionally they support RETA equipment.

Three power classes exist: From 20 W total radio power over 40 Watts until 60 Watts.

The total power can be concentrated on one single radio carrier, or it can be split evenly over the carriers in one sector.

In release UA07 up to three carriers per RRH are supported.

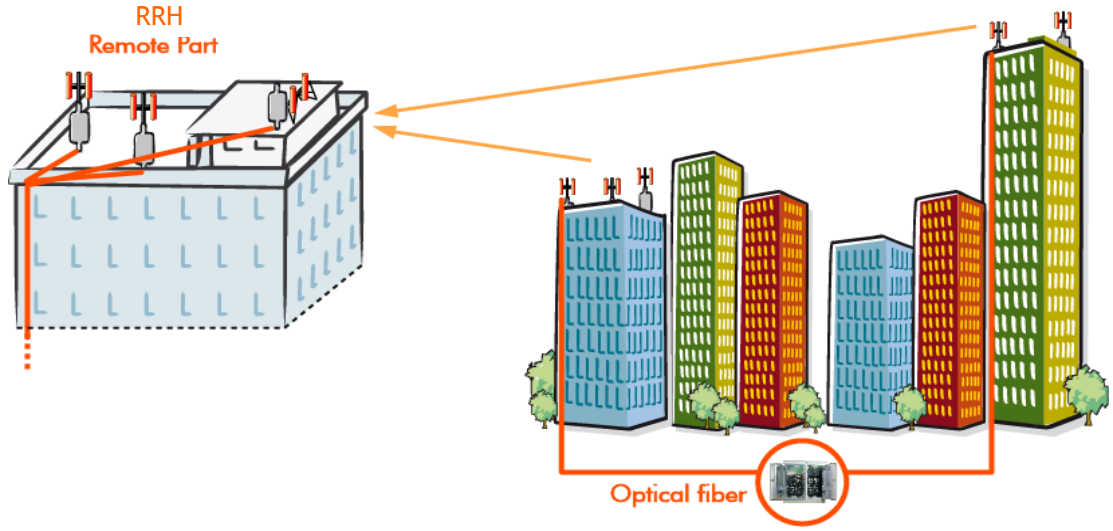
We continue with the motivation to introduce RRH.

8.1 Why Remote Radio Head (RRH)?

Interest

The Remote Radio Head provides operators with a flexible solution to address:

- specific coverage issues (high feeder length),
- specific space issues (NodeB located far from the antenna),
- specific capacity issues (by placing the radio heads close to where the traffic is).



The radio coverage of specific environments such as dense urban areas or high buildings can cause real difficulties at several levels.

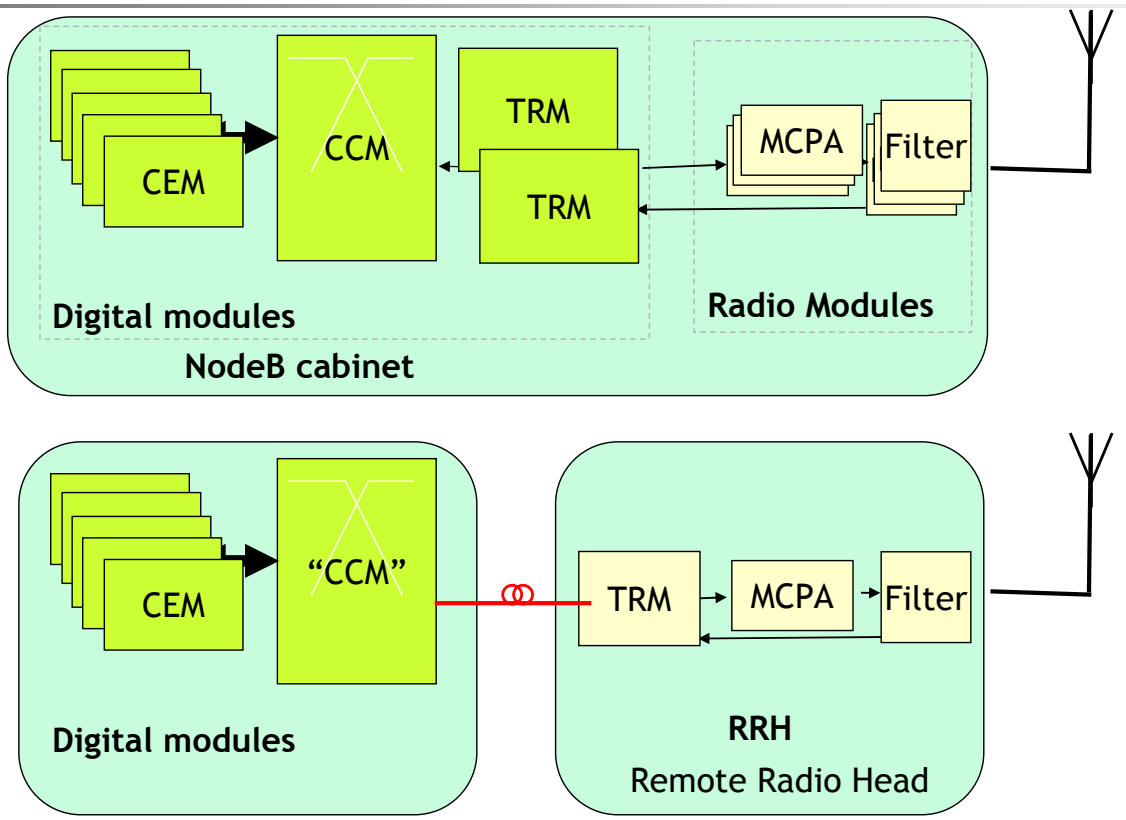
Cells coverage can be drastically degraded because of the power loss due to the length of the feeders since the MBS is generally located far from the antennas (the MBS is in the basement and the antennas are on the roof of the buildings).

You can guess, that this power loss can also have a significant impact on the cells capacity since a part of downlink traffic power is lost before reaching antennas.

To address these issues, Alcatel-Lucent offers the possibility to use the Remote Radio Head.

The Remote Radio Head is located close to the antenna (implying no feeder losses) and is connected to the macro BTS through optical fiber, which hosts the Base Band boards and the transmission interfaces (to allow high traffic capacity). Several remote parts can be connected to one macro BTS (which is the central part).

8.2 What's Remote Radio Head

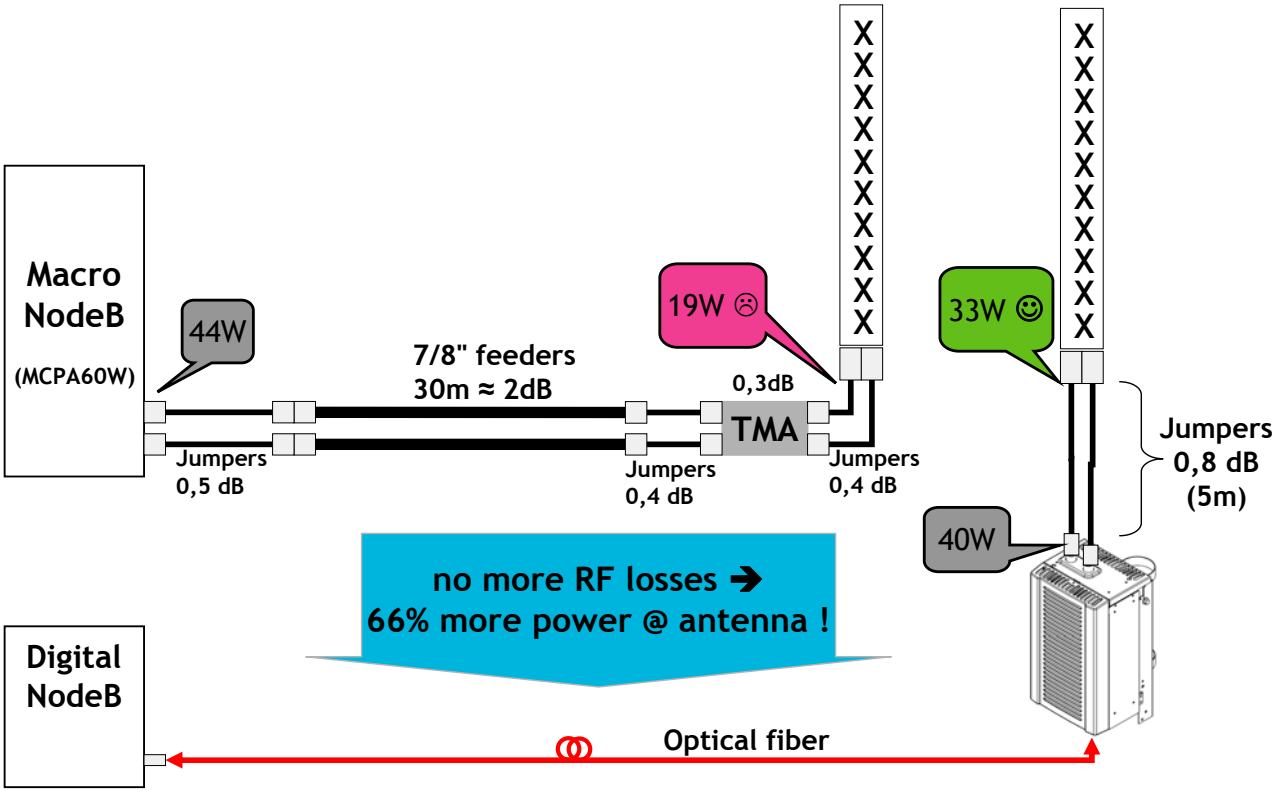


The concept of the **R**emote **R**adio **H**ead (**RRH**) splits the BTS into a digital part and into the radio part, where the radio part is mounted far away from the digital part. The connection with the Digital part is made over an optical fiber (monomode or multimode).

This solution needs to add an "optical port" on the "digital side" of the BTS. The classical CCM card has just the PCM connectors.

For this reason an Optical Interface Module (**OIM**) is introduced.

8.2.1 RRH benefits (close to the BTS)



Great radio frequency performance thanks to the capability of installing Remote Radio Head close to the antenna: No radio frequency feeders are needed, only short jumpers from the RRH to the antenna. This reduces the feeder loss in UL/DL, having several consequences:

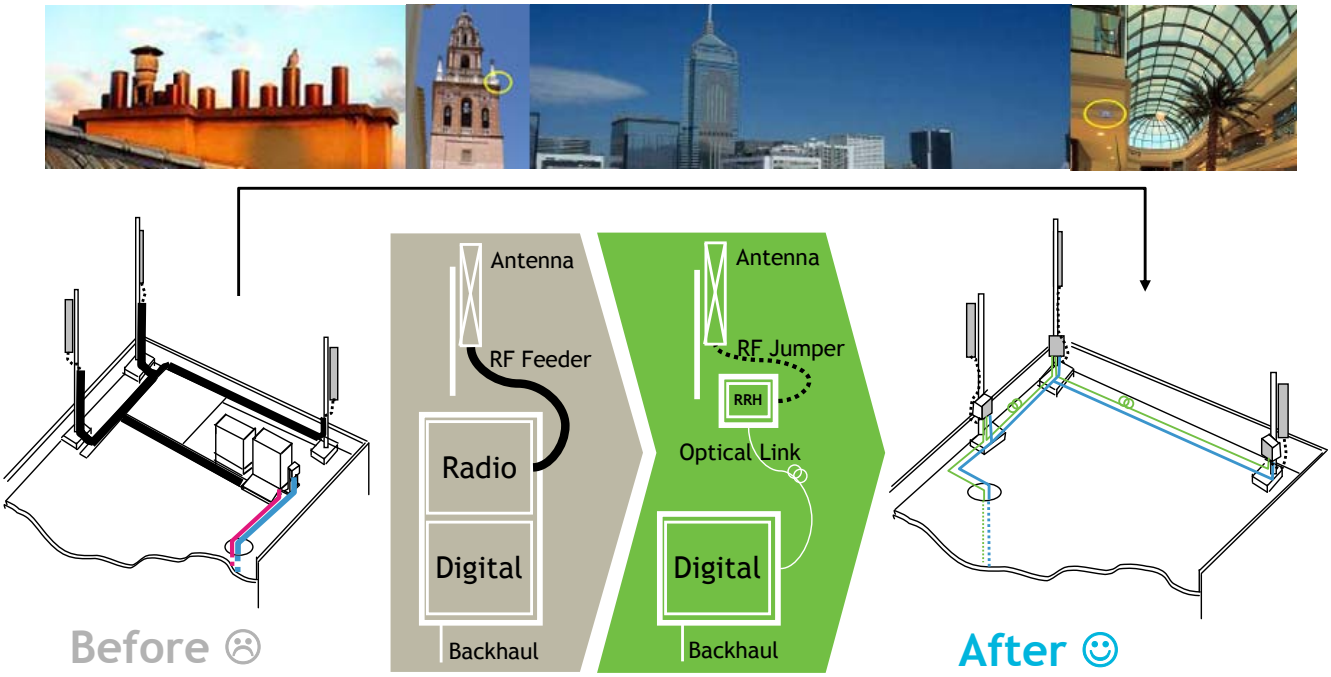
The feeder cost and installation costs are reduced.

- In the UL, often there is no need for a TMA, as the losses introduced by the radio frequency feeder are greatly reduced.

- In the DL, no radio frequency power is dissipated in the feeder runs. The PA power can be reduced while maintaining the same radio frequency power at the antenna. This results in the power consumption of the equipment being reduced.

- Compared to a conventional NodeB (equipped with Multi-carrier Power Amplifier 60W) that delivers about 20W at the antenna level (assuming 3dB feeder+TMA losses), RRH40-21 (assuming 0.8 dB jumper loss) delivers 65% more radio frequency power while consuming half the power.

8.2.2 RRH benefits (far from the BTS)

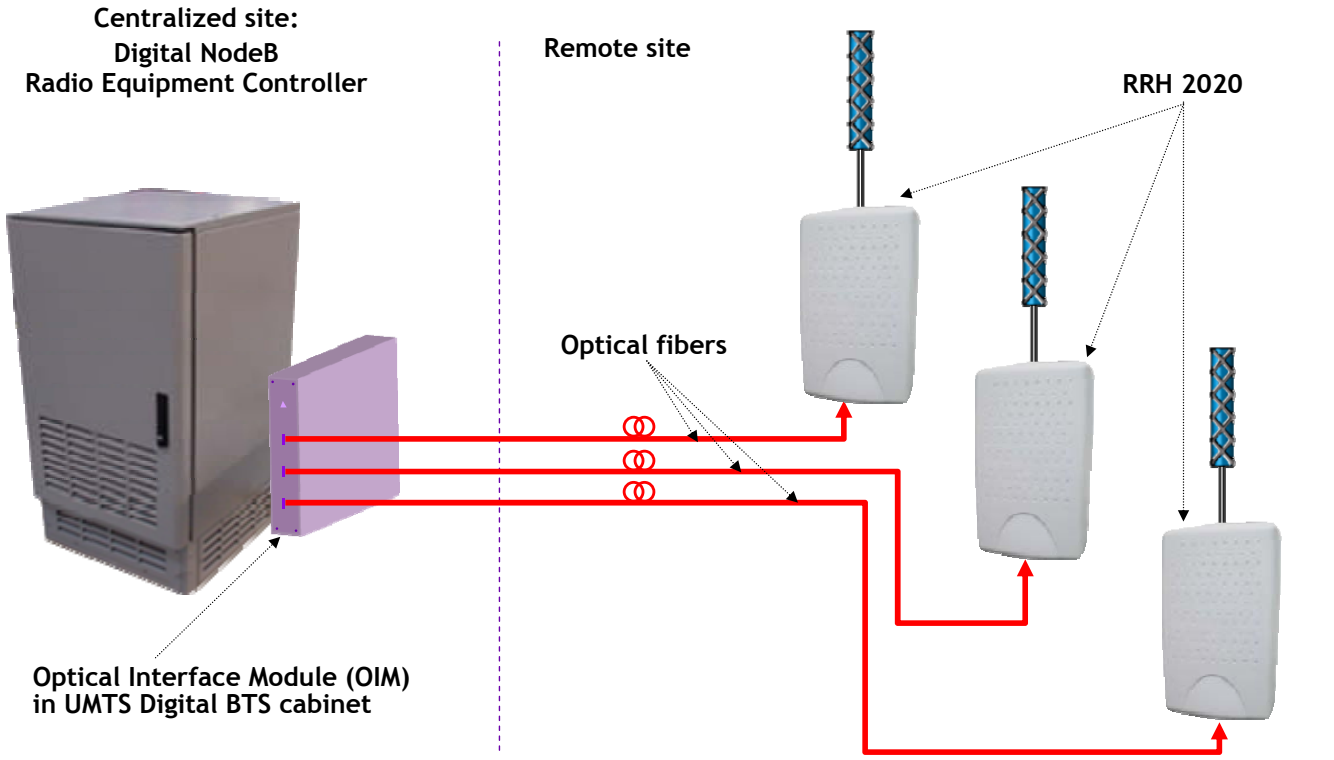


Remote co-location of radio module with the antenna resolves capacity and coverage needs whilst reducing operational and capital expenditure.

The advantages of using an Remote Radio Head to replace a traditional NodeB are most evident in rooftop installations. In fact, the limited space available in some sites may either prevent the installation of traditional Macro NodeB equipment or require costly cranes to be employed, thus coverage holes may appear.

These sites can however host an Remote Radio Head installation providing more flexible site selection and therefore improved network quality. In addition installation times and costs are greatly reduced.

8.2.3 RRH solution overview



Let's complete the review of the BTS portfolio by the description of the Remote Radio Head 2020 / 2040.

[1] 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. [2] Indeed, the coaxial feeder is replaced by optical fiber. So, the radio block losses practically disappear.

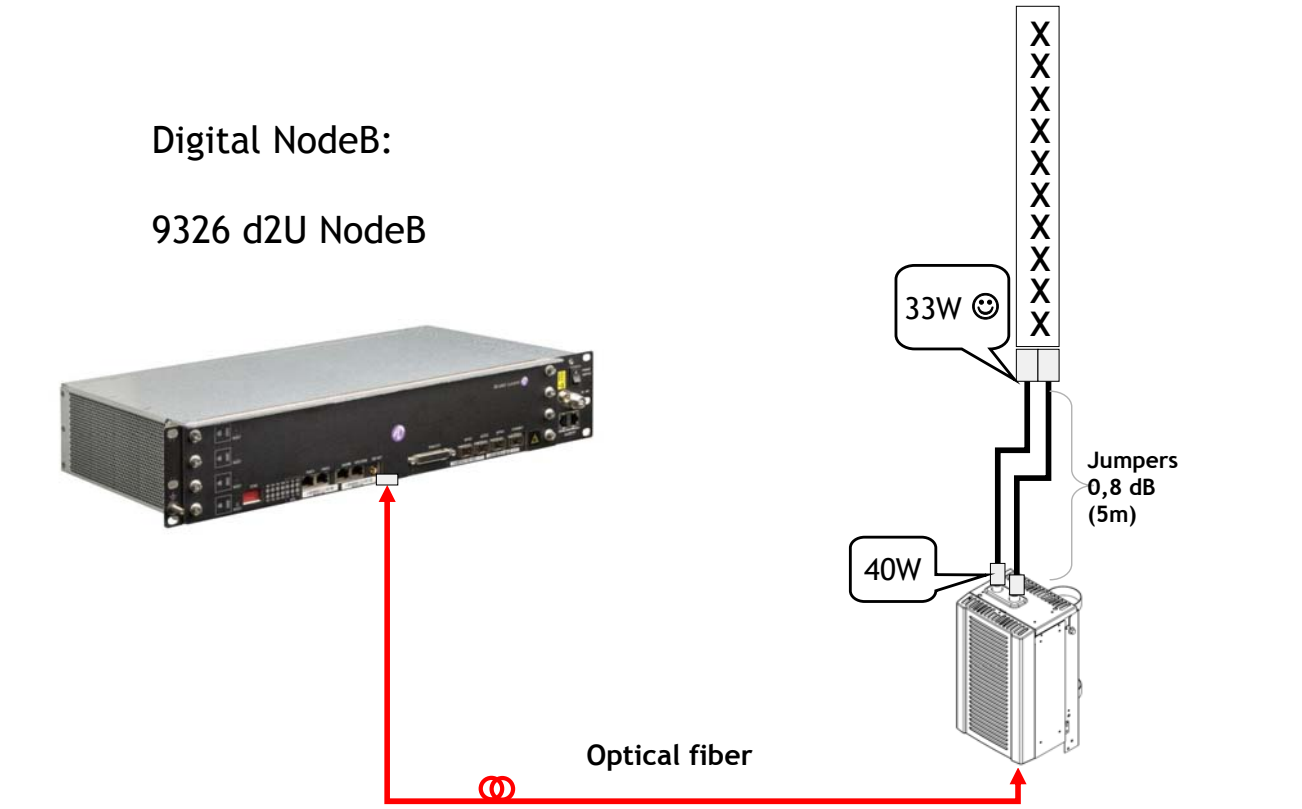
The Alcatel-Lucent Remote Radio Head solution for UMTS is composed of two modules [3]:

1. The Optical Interface Module (**OIM**) and
2. 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, Multi-carrier Power Amplifier and filter functions remotely from the BTS. Its official naming is Alcatel-Lucent UMTS RRH 2020.

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

8.3 Digital NodeB: RRH combined with 9326 d2U

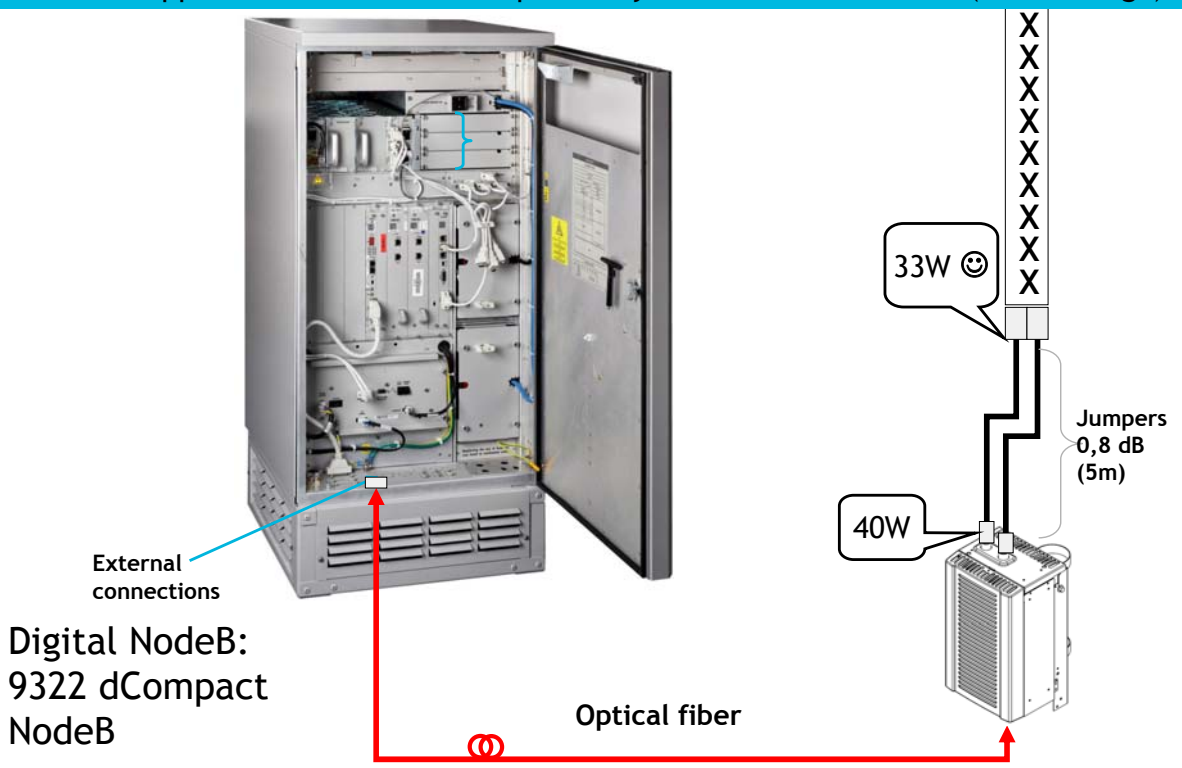


Here we see a a distributed BTS consisting of one Remote Radio Head 2040 together with the digital NodeB.

The Remote Radio Head 2040 supports only the d2U.

8.4 Digital NodeB: RRH combined with 9322 dCompact

Will not support RRH40W ➔ to be replaced by a d2U outdoor cabinet (under design)



This cabinet supports only the Remote Radio Head 20W.

8.5 Some members of the Alcatel-Lucent RRH family

RRH**20-21**: slim form factor
- Up to **2** adjacent carriers
- Optical interface based on HSSL

RRH**40-08**: wide form factor
- Up to **2** adjacent carriers
- Optical interface based on CPRI
  - Rate: 644 or 1229 Mbps
- Interface based on cabling box

RRH**40-19** : slim form factor
- Up to 2 carriers
- Optical interface based on CPRI
  - Rate: 644 or 1229 Mbps
- Interface based on cabling box

RRH**40-21**: slim form factor
- Up to 2 carriers
- Optical interface based on CPRI
  - Rate: 644 or 1229 Mbps
- Interface based on cabling box

RRH**40-AWS**: slim form factor
- Up to 3 carriers
- Optical interface based on CPRI
  - Rate: 644 or 1229 Mbps
- Interface based on cabling box

Here we see photos of 3 members of the Alcatel-Lucent RRH family: The 20 Watt version RRH20-21, the 40 Watt version in the wide form factor and the 40 Watt version in slim form factor.

RRH40-08

Number of carriers:	Up to 2 adjacent carriers (10 MHz)
RF output power / DC input power (typ.):	40W / 250W
Typical sensitivity:	- 125dBm
Sizes (H x W x D) and weight:	50cmx40cmx17cm (volume = 34 l) - 21 Kg

RRH40-21

Number of carriers:	Up to 3 adjacent carriers (15 MHz)
RF output power / DC input power (typ.):	40W / 230W
Typical sensitivity:	-125.5dBm
Sizes (H x W x D) and weight:	46cmx25cmx21cm (volume = 24 l) - 19 Kg

RRH40-19

Number of carriers:	Up to 2 carriers (in 15 MHz)
RF output power / DC input power (typ.):	40W / 230W
Typical sensitivity:	- 125dBm
Sizes (H x W x D) and weight:	46cmx25cmx21cm (volume = 24 l) - 19 Kg

8.6 RRH family: Radio power and frequency bands

9341 RRH <power> <frequency>		Max. Composite Radio Power		
		20 W	40 W	60 W
Frequency Band	3GPP Band **V** (CLR, 850 MHz) UL: 824-849 MHz DL: 869-894 MHz		RRH**40-08**	RRH**60-08**
	3GPP band **II** (PCS, 1900 MHz) UL: 1850-1910 MHz DL: 1930-1990 MHz		RRH**40-19**	RRH**60-19**
	3GPP band **IV** (AWS) UL: 1710 – 1755 MHz DL: 2110 – 2155 MHz		RRH**40-AWS**	
	3GPP Band **VIII** (GSM, 900 MHz UL: 880 - 915 DL: 925 – 960 MHz			RRH**60-09**
	3GPP Band **I** (IMT, 2100MHz UL: 1920 - 1980 DL: 2110– 2170 MHz	RRH**20-21**	RRH**40-21**	RRH**60-21** RRH**60-21A**

This table shows which RRHs are available for the various frequency bands. The Remote Radio Heads are named with the symbol **RRH**, a number indicating the maximal radio power for all carriers in Watts and a symbol for the frequency band. For example RRH20-21 means an RRH with a radio power of 20 Watts for the frequency band 2100 MHz.

8.7 Alcatel-Lucent 9341 RRH20-21 (20W 2100 MHz)

- Description
  - 2 carriers
  - Medium power RRH
    - 20W RF / 185W consumption
    - Power supply
      - AC variant: 100-250V AC, -48V battery back-up interface
      - DC variant: -48V (-40.5V / -57V)
    - 50 x 30 x 18.5 cm (27 l) / 19 kg
  - Supported from any digital NodeB
    - d2U
    - dCompact

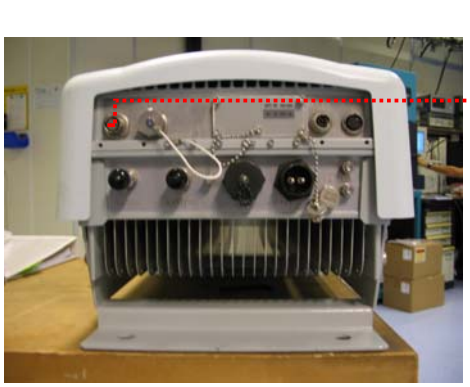
  Value
  - Enables UMTS easy roll-out
  - OPEX reduction

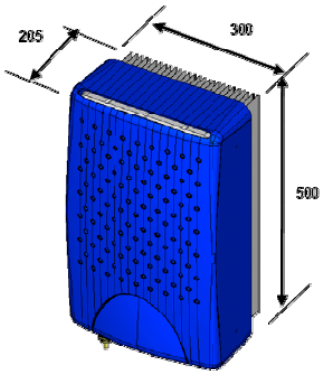
Let's follow the review of the BTS portfolio by the description of the RRH 20W.

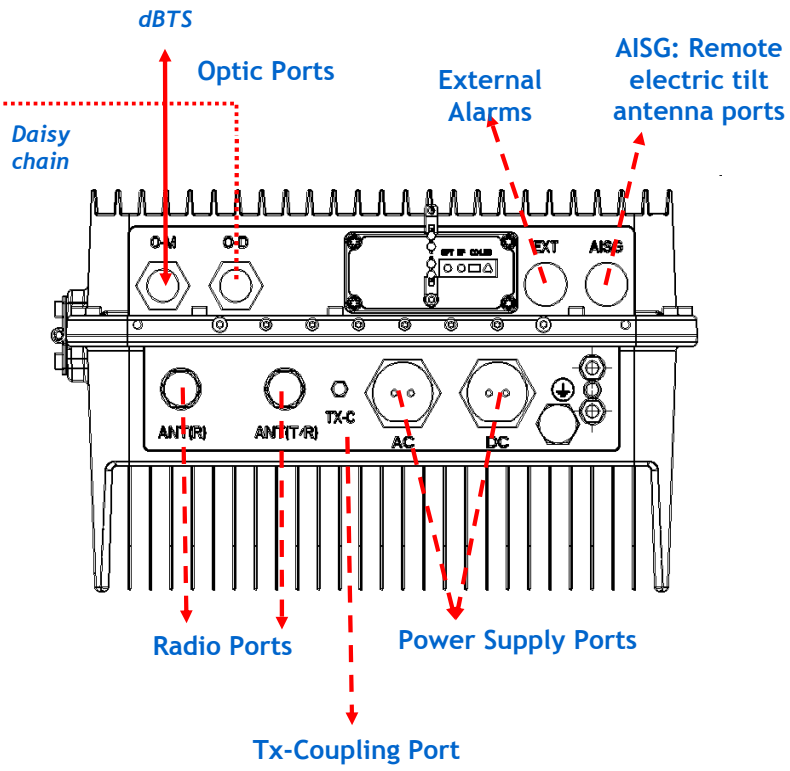
This Remote Radio Head has low radio frequency power and it doesn’t support TMA. It will be replaced by RRH40-21

This Remote Radio Heads uses a High Speed Serial Link with a line rate at 1280 Mbps. This interface is also used between CCM, CEM and Transmitter Receiver Module.

8.7.1 The 9341 RRH20-21 physical description







1 · 2 · 76

Macro NodeB UA07 Description · Description of the BTS Types
9300 Node B · Macro NodeB UA07 Description

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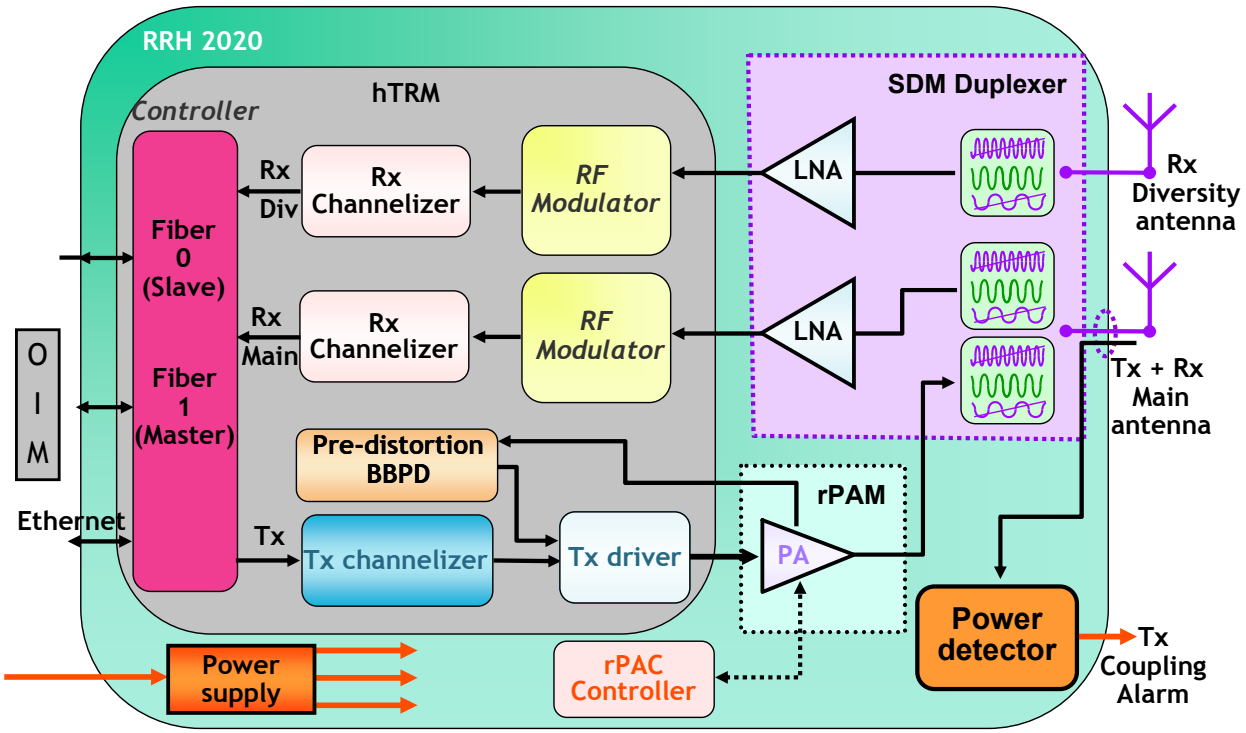
All interface ports are placed on bottom.

Remote Radio Head 2020 is provided with two optical connectors, one to interface with OIM, the other one for daisy-chain.

This RRH provides 3 radio frequency connectors they are 2 antenna ports (for N-type connectors) and 1 Tx test port (for 55dB SMA connector).

The RRH is also equipped with one AISG RS485 connector, to support RET antenna using AISG protocol.
It can manage and report two external alarms to the OMC.

8.7.2 The 9341 RRH20-21 functional architecture



This Remote Radio Head is a single sector and two-carrier 2100 MHz self-contained radio module, including [1] one Power Amplifier (PA) and its controller, the [2] hTRM module, [3] the SDM duplexer and [4] the power supply (AC or DC). The hTRM module is made up of [5] two Rx chains (main and diversity), [6] one Tx chain and [7] the optical interfaces.

[8] In downlink the optical signal arrives for example from the OIM in the d2U. The Remote Radio Head receives this signal at its master port, the slave port can be used for a daisy chain connection to the next RRH.

[9] The signal is converted into an electrical digital base band signal, which is then converted from digital into analog and up converted into an radio frequency signal. The radio frequency signal is [10] amplified through a power amplifier and sent to a [11] duplexer. The Remote Radio Head has the capability to [12] measure the transmit radio frequency power and to monitor VSWR alarms.

In uplink, two signals are received from the main and diversity antennas. Each signal is [13] amplified by an Low Noise Amplifier and [14] 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 Remote Radio Head 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.

8.8 RRH40-21 (40W 2100 MHz) and RRH40-19 (40W 1900 MHz)

Characteristics

- **High power compact RRH:**
  - Up to 3 carriers in 15 MHz
  - RF output power @RRH port 40W nominal
  - RF power shared across operational carriers
  - RF power accuracy ± 0.75 dB
  - VSWR meter: Supported on Tx path
  - 10 MHz LTE ready
  - Noise figure< 3 dB, typ 2,5 dB
  - RSSI accuracy ± 3dB over T° for Rx signal -70dbm to -110dBm
  - Number of Rx channels 2-way Rx diversity
    Up to 6 Rx with flexible allocation:
    2x 15 MHz same frequencies (Main + Div)
    2x 10 MHz different frequencies (for 2+2 daisy chain); distance up to 40 MHz
  - Power consumption 230W
  - 47 x 27 x 23 cm (20 L) / 19 kg
- **Supported from any digital NodeB:**
  - d2U
  - dCompact

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

- **Value:**
  - Enables UMTS easy roll-out
  - OPEX reduction

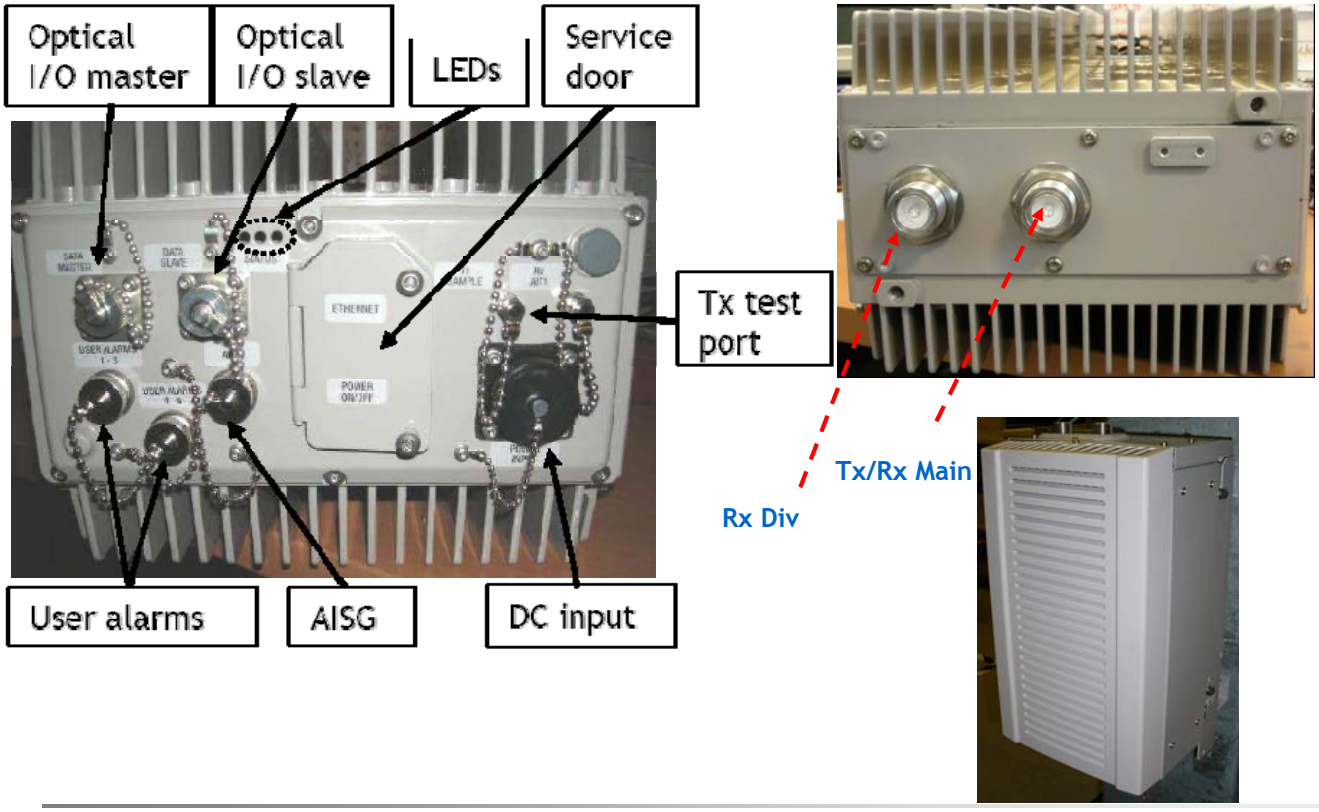
Let's complete the review of the BTS portfolio by the description of the Remote Radio Head 40W.

The main benefits of the RRH 40W are an easier site acquisition and installation, due to small footprint and low weight, significantly reduced radio frequency 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.

The following table lists the available frequency bands for the 9341 RRH40:

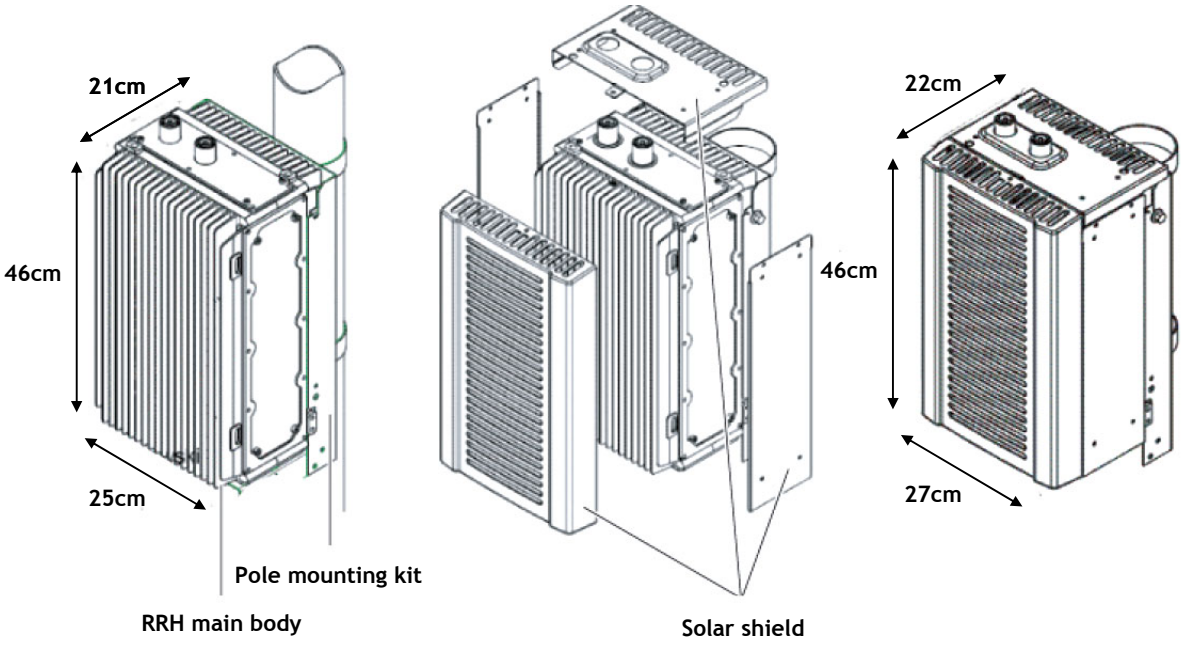
UMTS Standard	Uplink frequency band	Downlink frequency band
UMTS 2100 (band I)	1920-1980 MHz	2110-2170 MHz
UMTS 850 (band V)	824-849 MHz	869-894 MHz
UMTS AWS (band IV)	1710-1755 MHz	2110-2155 MHz

8.8.1 The 9341 RRH40-21 physical views



Sizes (H x W x D) and weight	463 x 260 x 210 mm , i.e. 25 liters w/o solar shield 463 x 268 x 226 mm , i.e. 28 liters w solar shield Less than 19 kg radio frequency ports on top
Fiber interface	1,2 Gbits/s: can support up to 6 cells, e.g. 3 sectors x 2 carriers, or 6 Sectors x 1 Carrier
Daisy Chain	HW ready for daisy chain operation (same optical performance on both optical ports)
Operational features	Tx coupling port - Debug interface – LEDs 6 protected external alarms Full set of internal alarms for internal monitoring radio frequency ports equipped with built-in 1/4 wave surge protection
Environmental	Outdoor (IP 65): -40ºC to +50ºC (up to +55°C with de-rated RF power), adding solar load @1120W/m2 - Max wind speed = 200km/h
Start up time	From -40°C, able to carry traffic after max 1 hour
TMA / RETA	TMA/RET support through AISG port (RS485) Optional external biasT kit for TMA/AISG support through feeder
Type of fiber	Multi-mode (MM) or single-mode (SM)
Number of fibers per RRH	SM: one fiber per RRH (WDM) MM: two fibers per RRH
Optical fiber length	Up to 20 km using Single Mode fiber Up to 500 m using Mono Mode fiber

8.8.2 Hardware description of RRH40-21 and RRH40-19



The Remote Radio Head 40W main body mechanics is built around the solar shield, the bottom protection, the mounting kit and the handle.

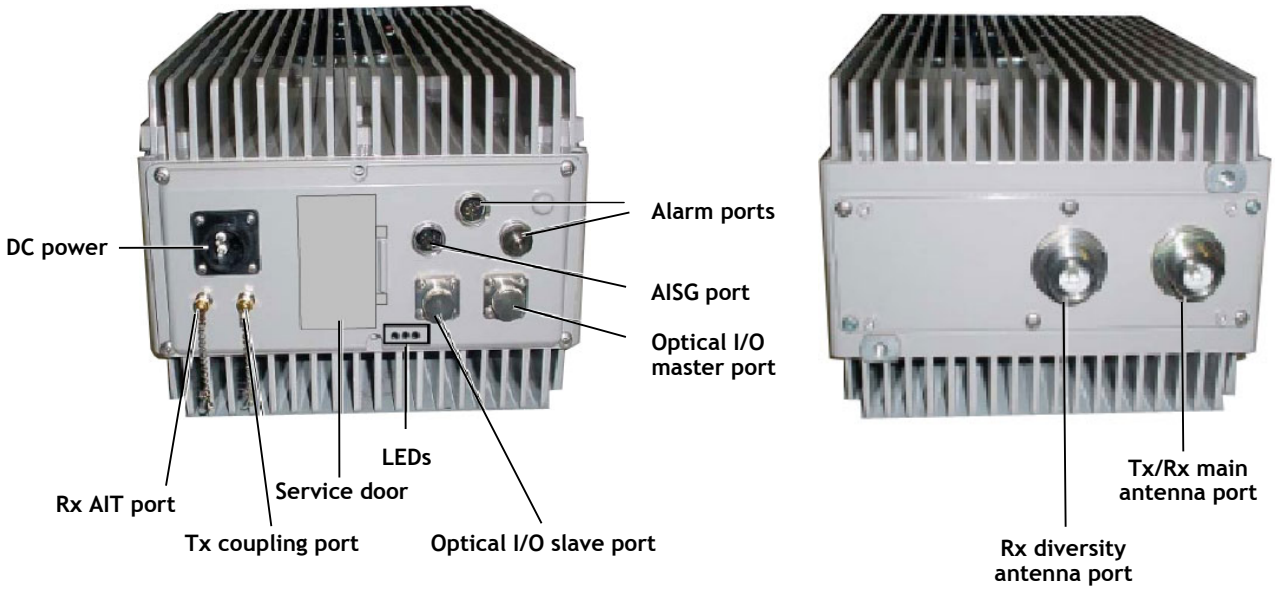
The **solar shield** protects the Remote Radio Head 40W from solar radiation. It is factory-assembled to the RRH 40W main body.

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.

8.8.2 Hardware description of RRH40-21 and RRH40-19 [cont.]



With the help of the above 2 pictures, we are going to locate the input and output ports of the Remote Radio Head 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 output ports: the main and the diversity antenna ports.

8.9 RRH40-AWS (40W)

Characteristics

- High power compact RRH
- 40W RF – less than 230W power consumption
- 47 x 27 x 23cm (20L) / 19 kg (without solar shield, same dimensions as RRH 40-21)
- Support up to 3 carriers
- Supported with digital2U NodeB
- Operates with UMTS band IV (1700/2100)

RRH 40-AWS without solar shield

The Remote Radio Head 40W-AWS is a single sector 1700/2100 MHz (3GPP band IV) self-contained radio module. It is a new type of Remote Radio Head that re-uses the RRH850 and RRH2100 technology and requires that all of its functionality and capabilities be verified. In order for the d2U NodeB, to communicate with the RRH 40W Band IV, the Common Public Radio Interface (CPRI) protocol will be used the same way it was for the RRH850 and RRH2100.

8.10 RRH40-08 (850 MHz 40W)

Characteristics

- **High power compact RRH:**
  - Up to **2** carriers in 10 MHz
  - RF output power @RRH port **40** W nominal
  - RF power shared across operational carriers
  - RF power accuracy ± 0.75 dB
  - VSWR meter
  - 10 MHz LTE ready
  - Noise figure < 3.5 dB, typ. 3 dB
  - typ. sensitivity ≈ -125 dBm
  - RSSI accuracy ± 3 dB over T° for Rx signal – 70 dBm to – 110 dBm
  - Number of Rx channels 2-way Rx diversity

    Up to 6 Rx with flexible allocation:

    2x 10 MHz same frequencies (Main + Div)

    2x 10 MHz different frequencies (for 2+2 daisy chain); distance up to 40 MHz
  - Power consumption 280W
  - 50 x 40 x 17 cm (34 L) / 22 kg

Supported from any digital NodeB:

- d2U
- dCompact

850 MHz band:
824-849 MHz / 869-894 MHz

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

The Remote Radio Head 40W solution is based on the remote radio frequency block concept, and involves the centralized NodeB site and the remote RRH site.

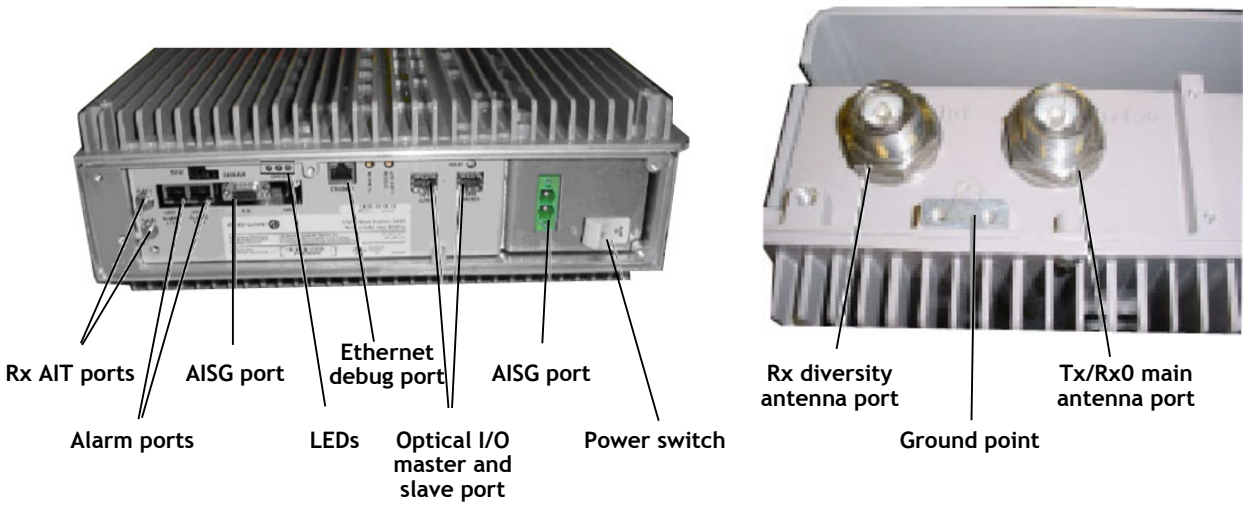
The Remote Radio Head 40W solution provides operators with a suitable solution whatever the site constraints. It is particularly suitable for macro-cellular application in dense areas, where site acquisition is difficult, and on sites where installation constraints prevent the use of regular full size macro NodeB (Indoor (ID) or Outdoor (OD)).

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

The RRH 40W modules deliver 40W nominal composite radio frequency 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).

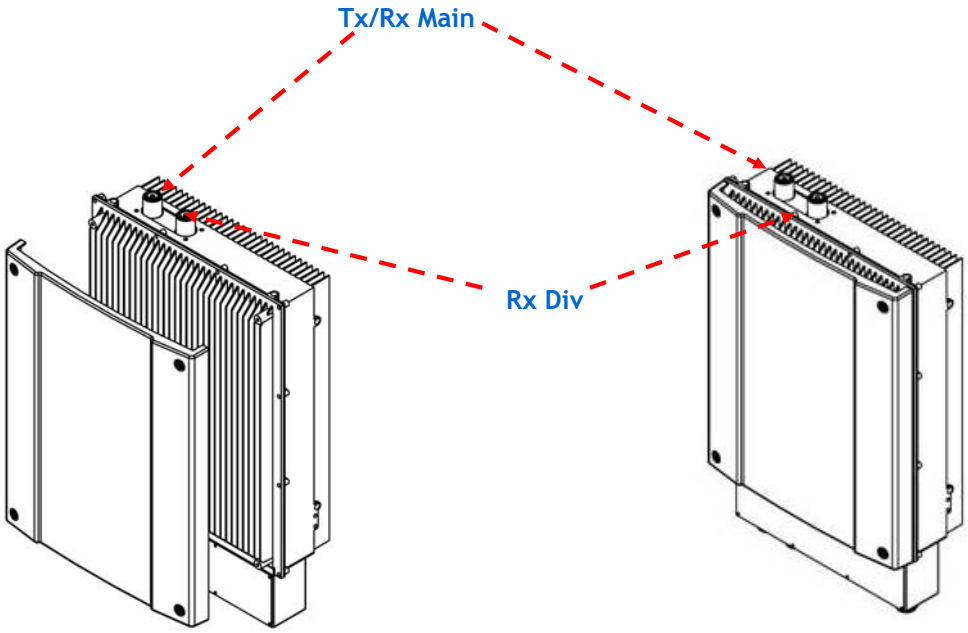
In the RRH 40W solution, the transceiver, power amplifier, and filter functions are located as close as possible to the antenna, on the remote RRH site, far away from a main NodeB cabinet located on the centralized NodeB site. The remote radio frequency part (or Radio Frequency Module, for RRH40-08)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

8.10.1 RRH40-08 hardware description



The Remote Radio Head40-08 is equipped with the same input and output ports as the RRH40-21 and RRH40-19.

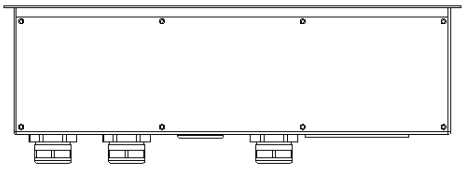
8.10.2 The 9341 RRH40-08 physical views

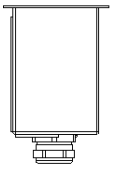


This slide shows the main body of a Remote Radio Head with the antenna connectors for the main and the diversity path.

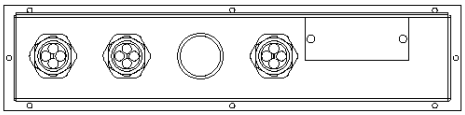
Sizes (H x W x D)	w/o solar shield 500 x 400 x 170 mm , i.e. 34 liters will become same form factor than 2100 MHz in 2008
Weight	21 kg
Fibre interface	With a data rate of 1,2 Gbits/s up to 6 cells can be supported: e.g. 3 sectors x 2 carriers, or 6 sectors x 1 carrier
Daisy Chain	HW ready for daisy chain operation (same optical performance on both optical ports)
Operational features	TX coupling port - Debug interface – LEDs 6 protected external alarms Full set of internal alarms for internal monitoring
Environmental	Outdoor (IP 65): -40°C to +50°C, adding solar load @1120W/m2 – Max. wind speed = 200 km/h
Start up time	From -30C it can carry traffic after max. 1 hour (target 15 min.)
TMA / RETA	TMA/RET support through AISG port (RS485) Optional external biasT kit for TMA/AISG support through feeder
Types of fibers	Multi-mode (MM) Single-mode (SM) single fiber (SF) or Dual Fiber (DF)

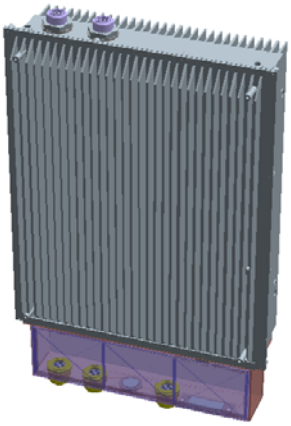
8.10.2 The 9341 RRH40-08 physical views [cont.]

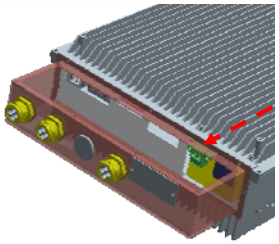




Cable Box views







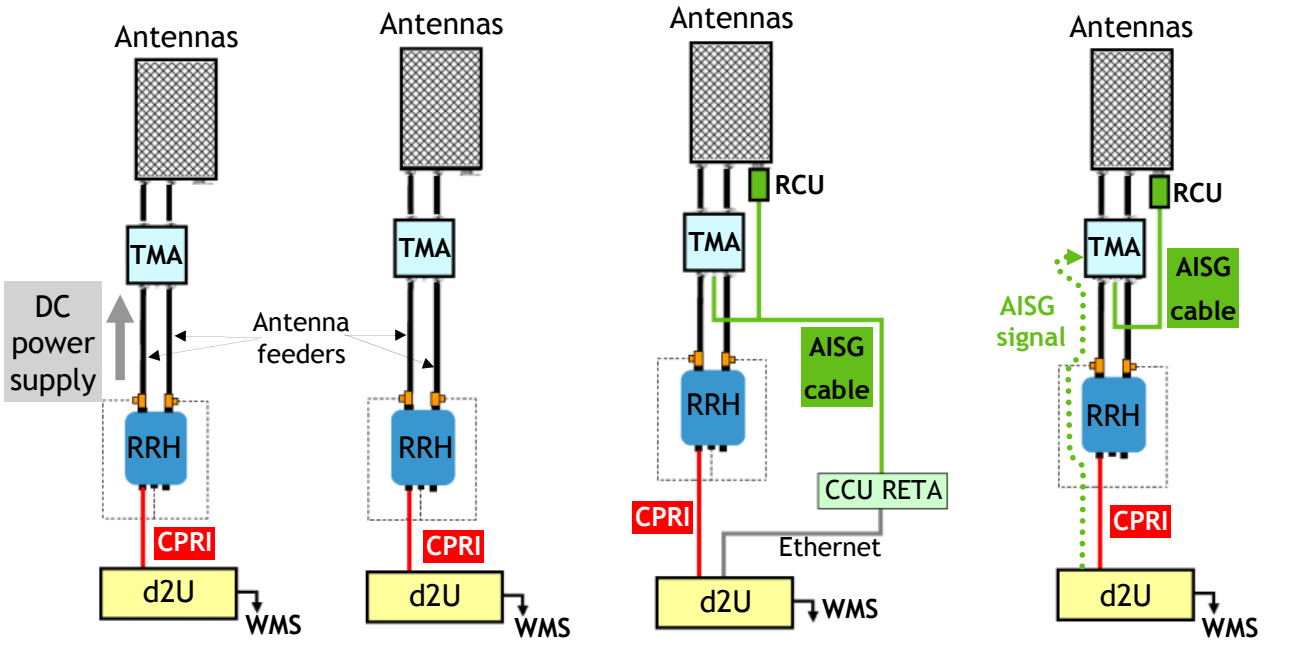
Remember that the Remote Radio Heads are connected to the digital part via optical links, compliant with the Common Protocol Radio Interface. This slide shows the connectors for these links.

Number of fibers per RRH	SM/SF: one fiber per RRH MM, SM /DF: two fibers per RRH
Optical fiber length	SM fiber Up to 15 km MM fiber: Up to 500 m
Unit power supply	DC: +24V (19V / 30V), surge protection included DC: -48V
Typical power consumption:	250W dc @40W RF
AC external adaptor	Option of external additional external box: 100-250V AC or field selectable 115/ 230V (TBD), -48V , surge protection included, optional battery back-up 10 min
Installation	Wall or pole (2 variants) or floor mounting kits – optional solar shield
Reliability	MTBF > 150000 hrs @25°C for ground fixed uncontrolled environment
Connector location	All connectors, but RF (7/16) to ensure slim design, are located on the bottom
Types of fibers	Multi-mode (MM) Single-mode (SM) single fiber (SF) or Dual Fiber (DF)

9 Special RRH features

The next slides show some features of RRHs and the possible solutions.

9.1 RRH and RETA



Sometimes a Tower Mounted Amplifier is used together with the Remote Radio Head. The RRH supplies the TMA with DC power and can supervise in a very primitive way some functions of the TMA by monitoring the amount of the supply current. If the current leaves a certain range called “window” an alarm is created. This very simple mode of supervision is called the Current Window Alarm.

Another method of supervision – it is called AISG-Lite - can be applied in the case of AISG compatible TMAs. The AISG signals are multiplexed together with the UMTS signals on the antenna feeders, they allow a more detailed communication between RRH and TMA. This feature is only supported in AISG v1.1, with TMA AISG 2100 and RRH 40/60W 2100. It is not supported on RRH 2020.

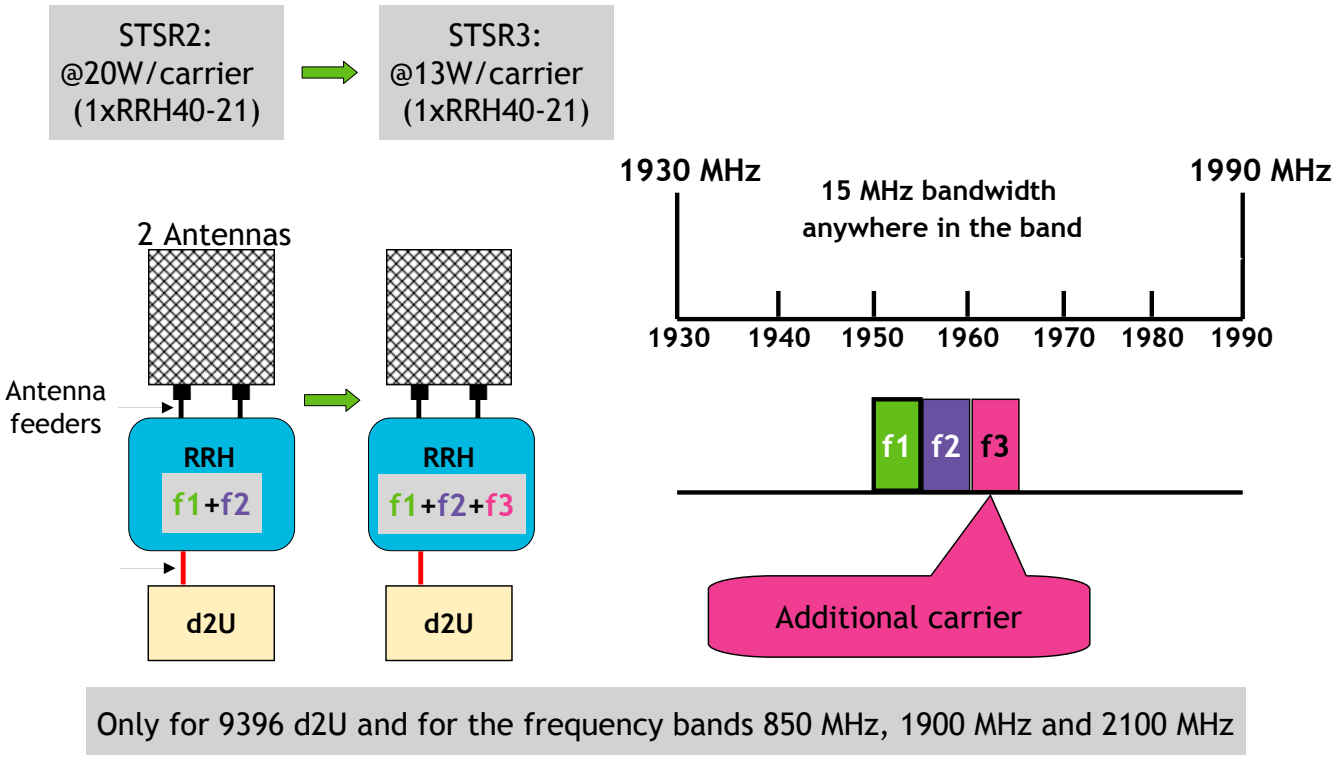
If a remote tilt of the antenna is necessary then the AISG RETA solution is applied. This solution needs an extra controller the so-called Central Control Unit. It controls via AISG signals on a cable the TMA and the motor of the Remote Control Unit. It communicates via an Ethernet link to the d2U and to the WMS.

In the solution RETA for RRH the d2U takes over the controlling of the RETA system. The AISG signals are transported between d2U and Remote Radio Head over the optical CPRI link. The RRH multiplexes them onto the antenna feeder the AISG TMA extracts them and finally forwards them via an AISG cable to the other elements of the RETA system on the top of the tower.

TMA/RET support through AISG port (RS485)
Optional external biasT kit for TMA/AISG support through feeder

AISG - Antenna Interface Standards Group
CCM - Central Control Module
CWA - supply Current Window Alarm
CCU - AISG Central Control Unit
CPRI - Common Public Radio Interface
d2U - 9326 digital 2U NodeB
DC - Direct Current
RCU - AISG Remote Control Unit
RETA - Remote Electrical Tilt Antenna
TMA - Tower Mounted Amplifier
WMS - Wireless Management System

9.2 Multi-carrier per RRH on 9396 d2U



Only for 9396 d2U and for the frequency bands 850 MHz, 1900 MHz and 2100 MHz

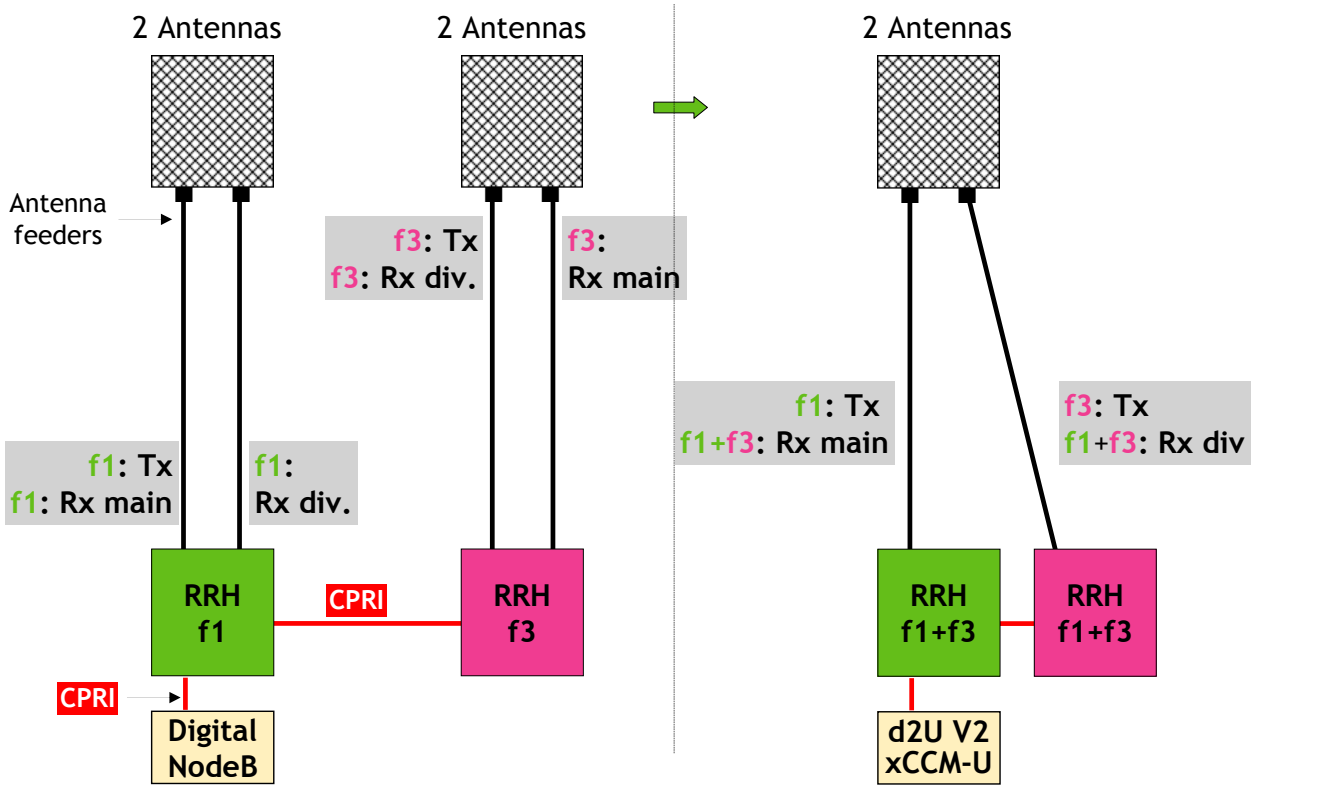
The RRHs supports up to 2 carriers for all frequency bands.

For the frequency bands 850 MHz and 1900 MHz they can transmit on 3 carriers within the operational bandwidth of the RRH, if they are controlled by a 9396 d2U NodeB.

This increases the traffic capacity without needing additional RRHs to be deployed, especially on space and weight constrained sites. The antenna system and the feeders stay unchanged.

The only disadvantage is the reduction of the maximum transmit power, because the total radio power is shared by more carriers.

9.3 Two RRHs per sector

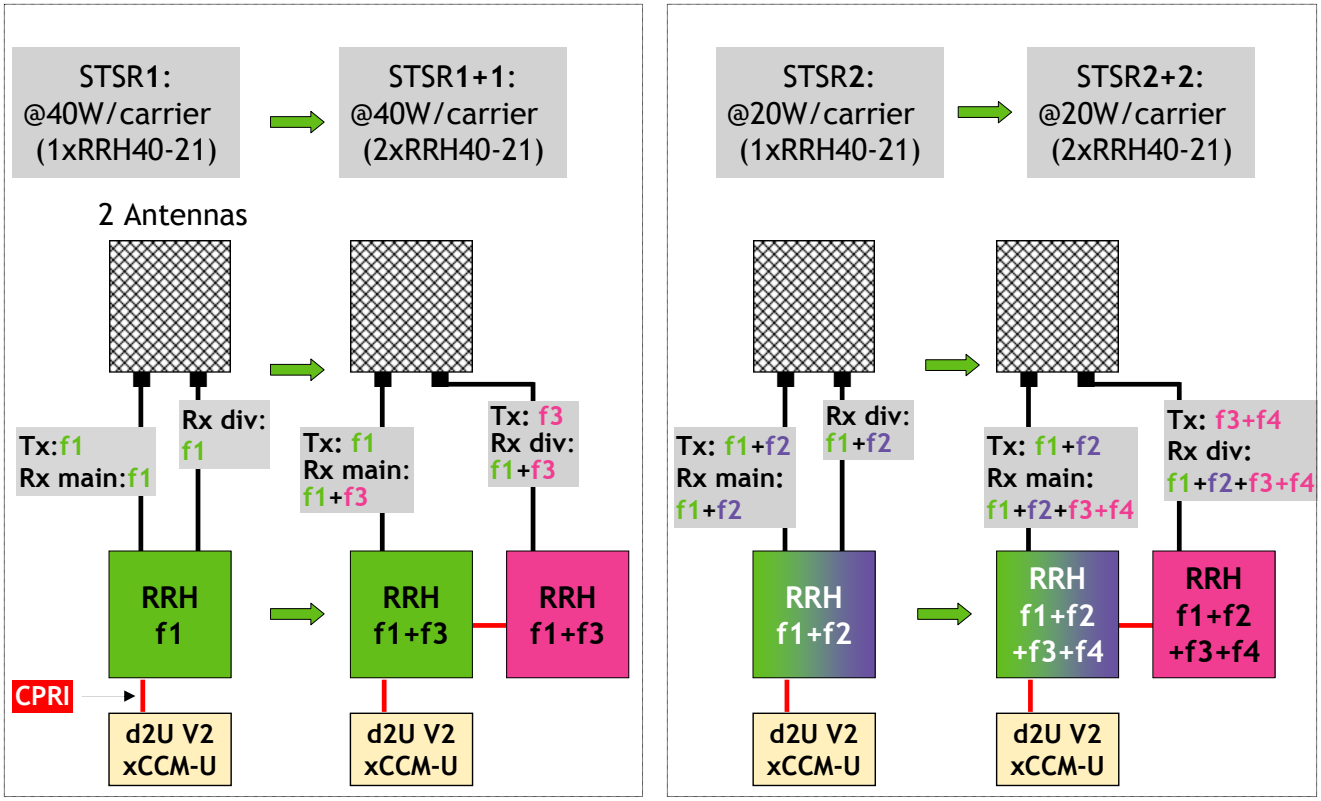


Two RRHs can serve one sector, in this configuration normally 2 antennas per RRH and 4 antennas in total are necessary.

If a d2U is used as Digital NodeB then each RRH provides an Rx Diversity path for the partner RRH. The Rx Diversity signals are combined the channel elements of the d2U and the number of antennas and feeders can be reduced to two by antenna sharing.

Both RRHs have to process the receive signals at the frequencies f1 and f3, so both frequencies must be within one frequency band and inside the operational bandwidth of the RRHs.

9.4 High RF power and STSRx+y configurations



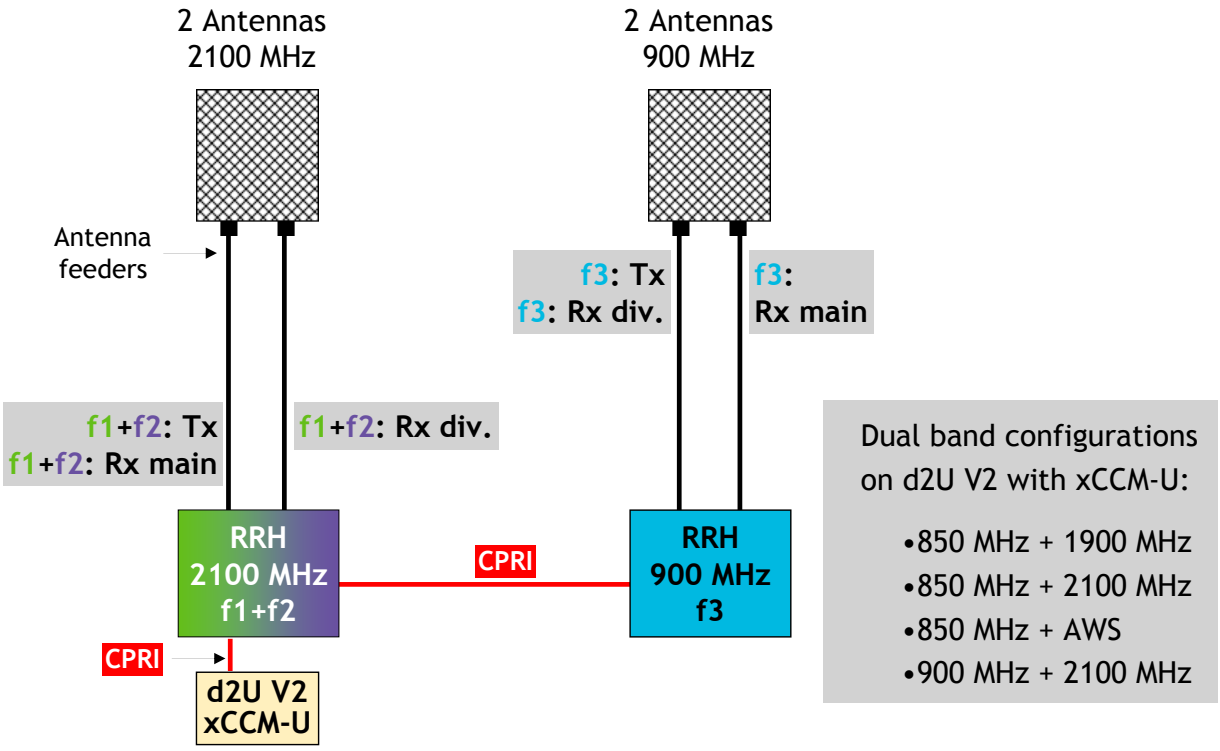
The installation of a second RRH per sector can be used to increase the maximum transmit power per carrier. The modification of the radio part is small: One antenna jumper is reconnected to the new RRH.

One advantage of this solution is the improved defense: If one RRH or one carrier is lost, the sector stays operational.

The additional frequencies f3 and f4 can be non contiguous with the already used ones f1 and f2.

Beside the shown upgrades STSR2 to STSR2+2 also exists the upgrade to the depopulated configuration **STSR2+1**.

9.5 Dual-band operation

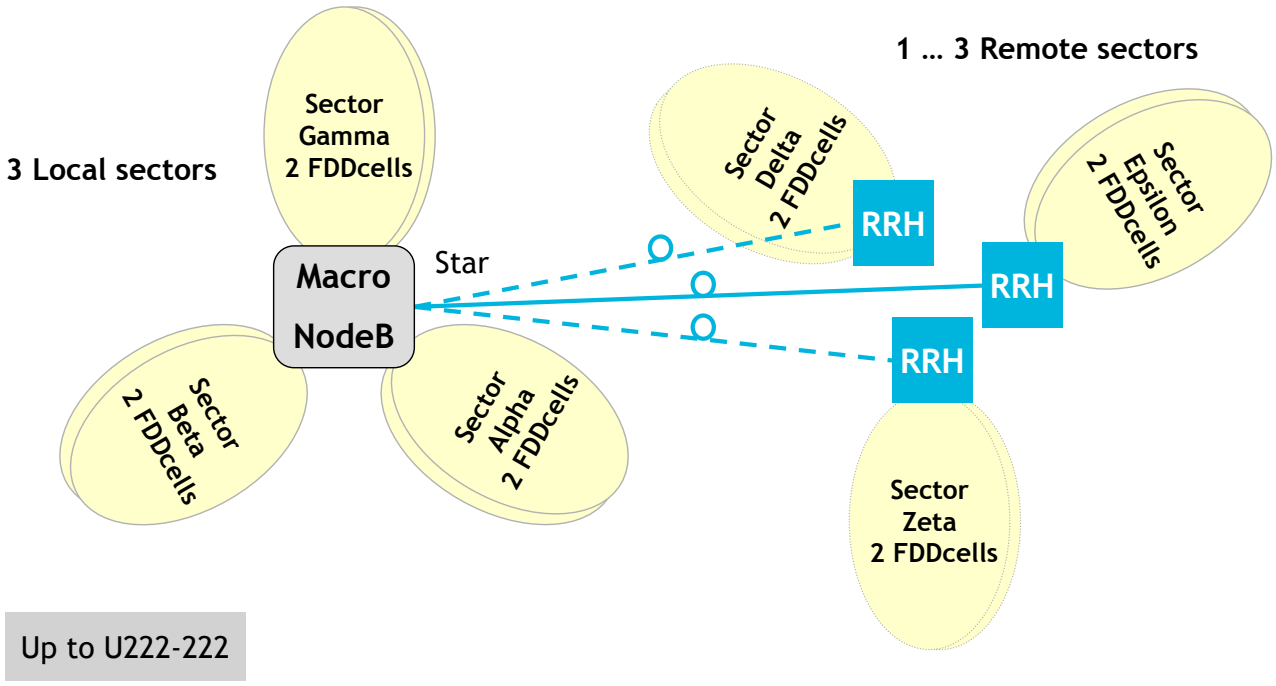


A second frequency band can be easily added. Each sector needs one RRH per frequency band. In by installation of a RRH and an antenna system for this band per sector.

10 Radio Cell and BTS Configurations of Distributed NodeBs

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

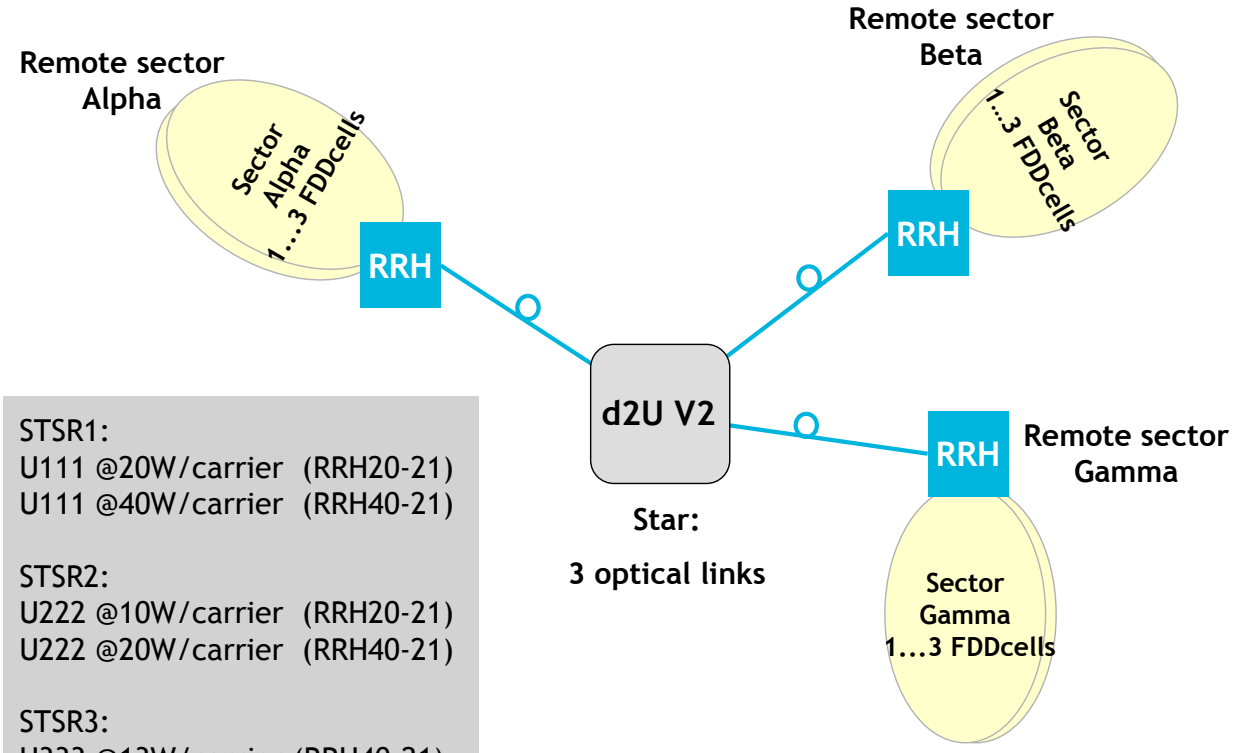
10.1 Macro Node B with RRHs in Star Configuration



A Macro BTS can drive remote sectors via optical links, too. At least one RRH is supported, in some configurations up to 3 RRHs can be connected.

Here we see how a Macro BTS operates 3 local sectors directly with antenna feeders and 3 remote sectors of RRHs.

10.2 Star Transport and STSRx



In this configuration a digital NodeB supports 3 Remote Radio Heads via optical links in the so-called star transport configuration. This means that each Remote Radio Head uses one optical link for its own purpose, it doesn't share this link with other Remote Radio Heads.

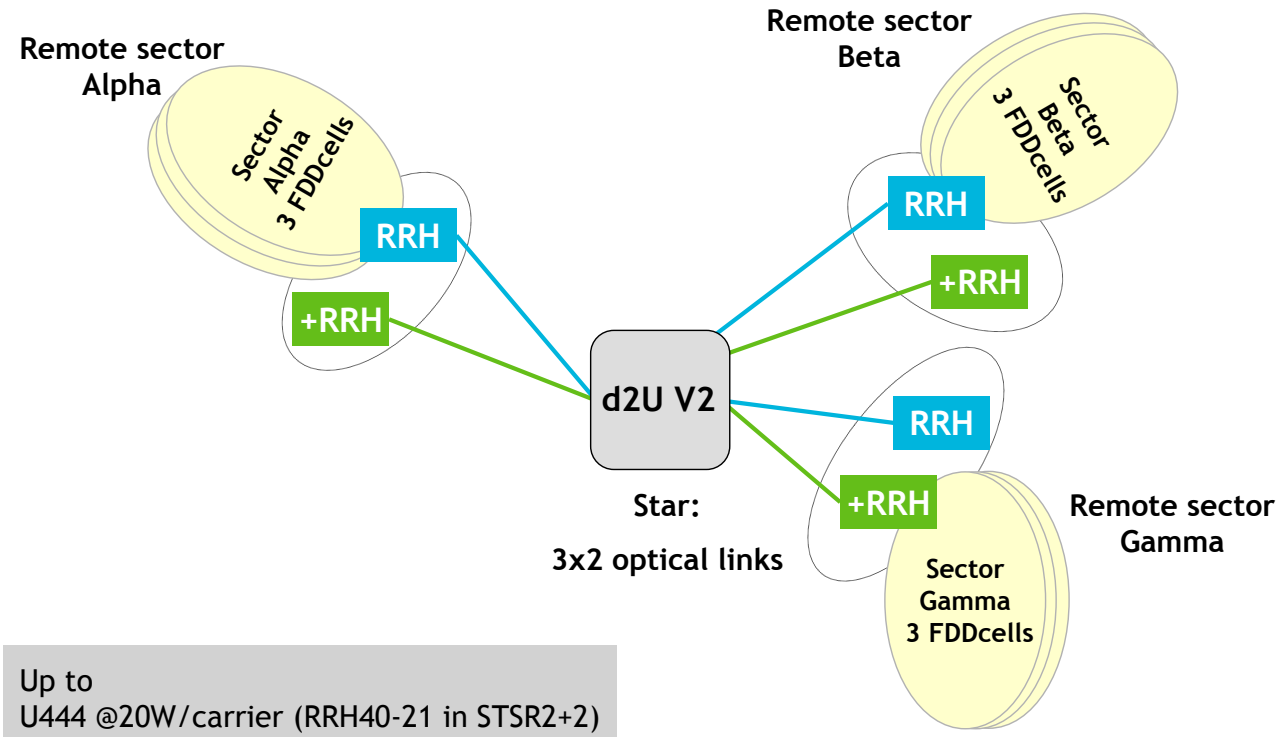
U111 means 3 Remote Radio Heads, each one sets up 1 sector with 1 radio carrier, and this carrier can use the maximal radio power dependent on the RRH type (20 W, 40 W or 60 W).

In U222 again we have 3 sectors, but now with 2 carriers per sector. The carriers share power, each one can use half of the maximal radio power.

In the case of Remote Radio Heads 40 Watts the following configurations are not supported by the d2U:

- Mixity between local and remote cells on a same NodeB.
- Mixity between rCompact and RRH on a same NodeB.

10.3 Star Transport and STSRx+y

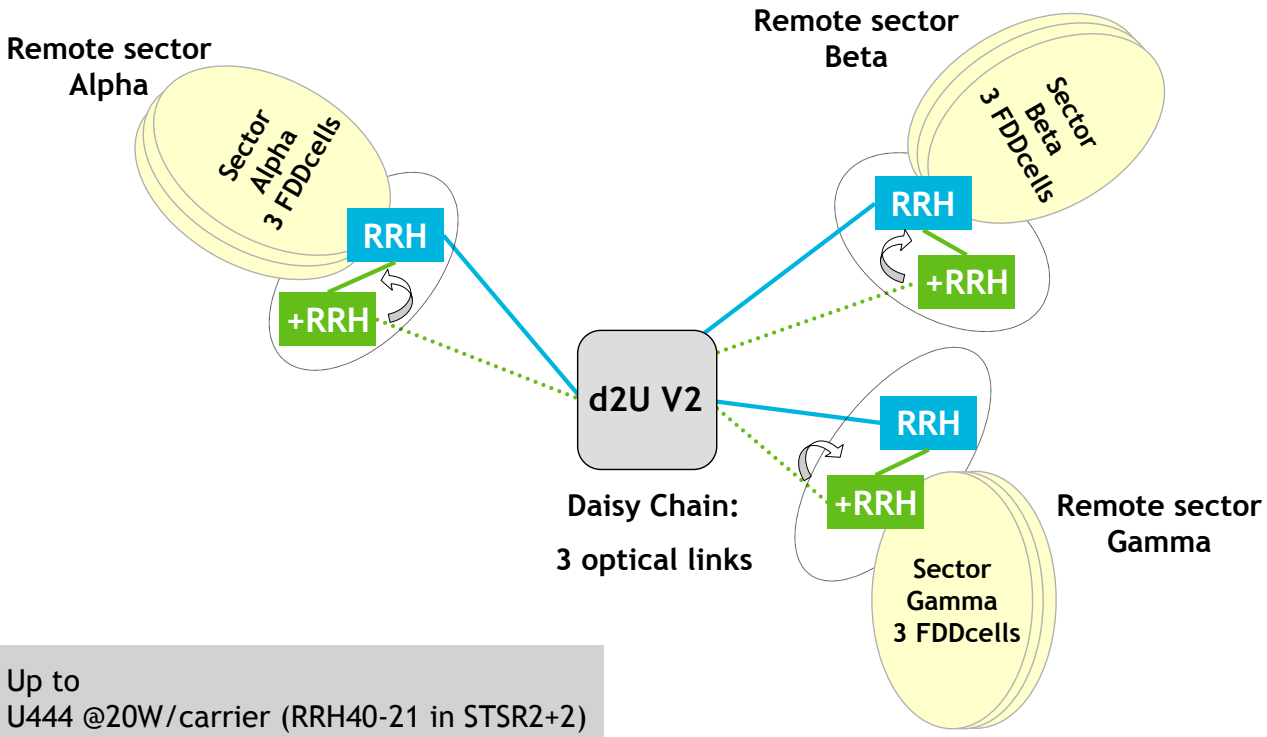


Up to
U444 @20W/carrier (RRH40-21 in STSR2+2)

In this star configuration each sector is build not by a single RRH but by a pair of RRHs. The maximum power per radio carrier increases. With RRH 40 W types the power rises to 20 W per carrier.

In star transmission an additional optical link is necessary, in a daisy chain transmission their costs can be saved. The antenna system and the feeders don't need any change.

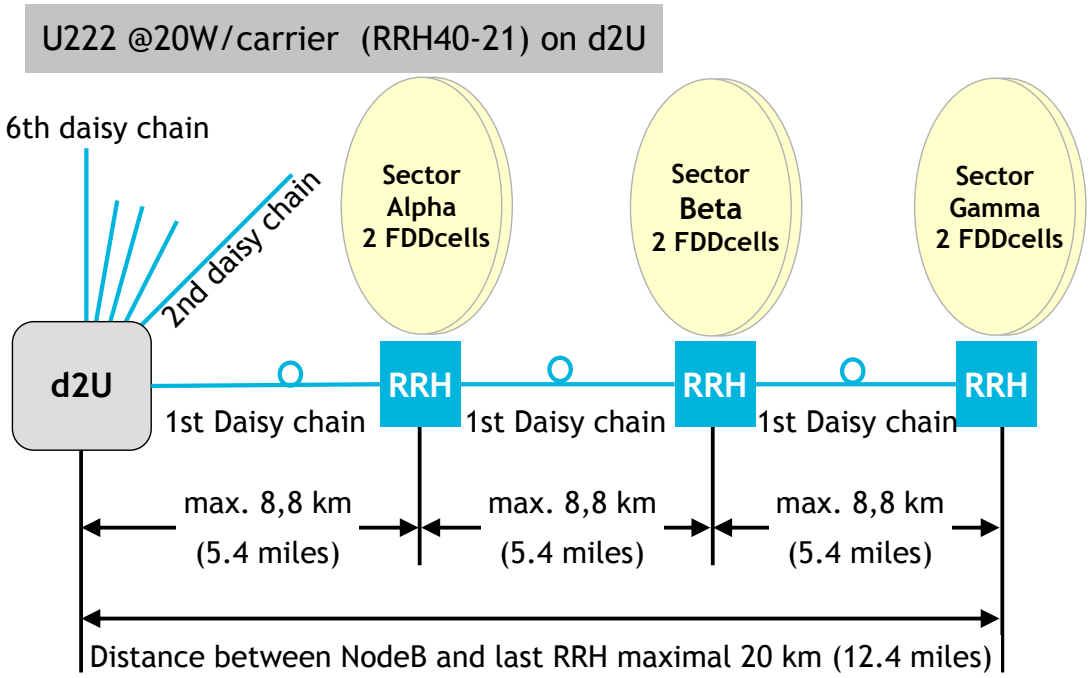
10.4 Daisy Chain Transport and STSRx+y



Up to
U444 @20W/carrier (RRH40-21 in STSR2+2)

Compared to the star configuration the daisy chain can save transmission costs: The long optical links between the d2U and the site of the RRHs are exchanged against short links between the RRHs.

10.5 d2U with RRHs in Daisy Chain Configuration



Example: 3 RRHs in daisy chain support 2 carrier per RRH

In the daisy chain configuration one optical link connects several RRHs to the d2U, and its transport capacity is shared. The number of daisy chain links depends of the number of optical interfaces of the d2U. The board iCCM-U supports up to 3 links, the modern variant xCCM-U connects up to 6 links.

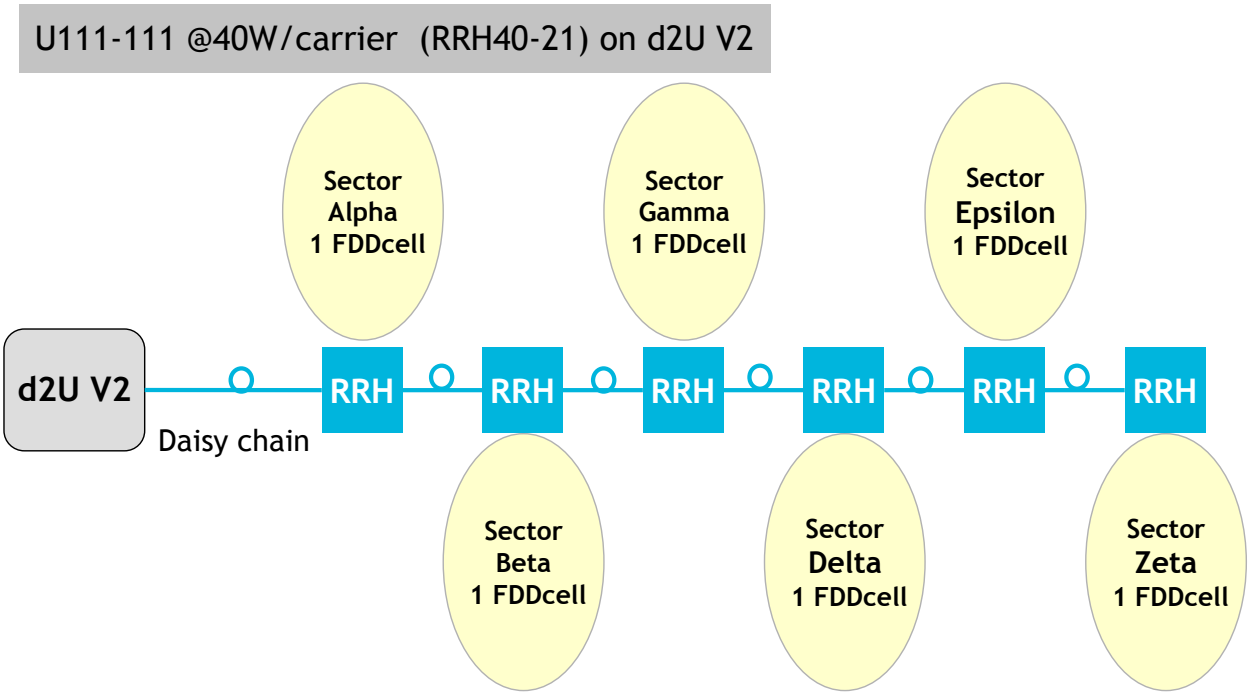
The following capacity limitations are valid for a d2U Version 2 with xCCM-U and xCEM-U:
It supports

- maximal 6 sectors,
- a total of 12 radios cells,
- maximal 6 radio cells per optical link and
- maximal 4 Local Cell Groups [LCG].

The total length of the optical link between d2U and first RRH in the chain can reach 10 Km or 6.2 miles, depending on the used SFPs and optical fibers. This is valid for the distance between 2 RRHs in the chain, too. The maximal distance between d2U and the last RRH in the chain can reach up to 20 Km or 12.4 miles.

A mix of RRH main types on the same optical link is not allowed, but a mix between the optical links is allowed.

10.5 d2U with RRHs in Daisy Chain Configuration [cont.]



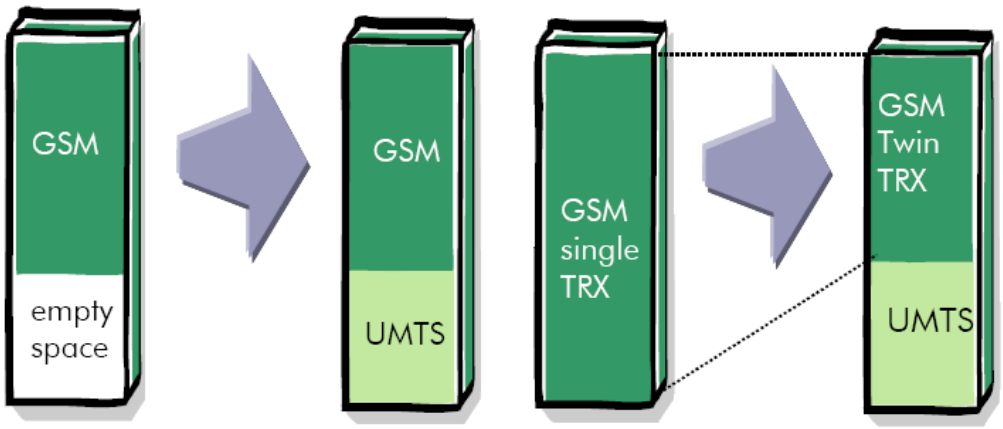
Example: 6 RRHs in daisy chain support 1 carrier per RRH

Here we see a daisy chain with 6 RRHs reaching the limit of 6 sectors and 6 radio cells.

11 Appendix - GSM plus UMTS

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.

11.1 9100 Multi-standard BTS



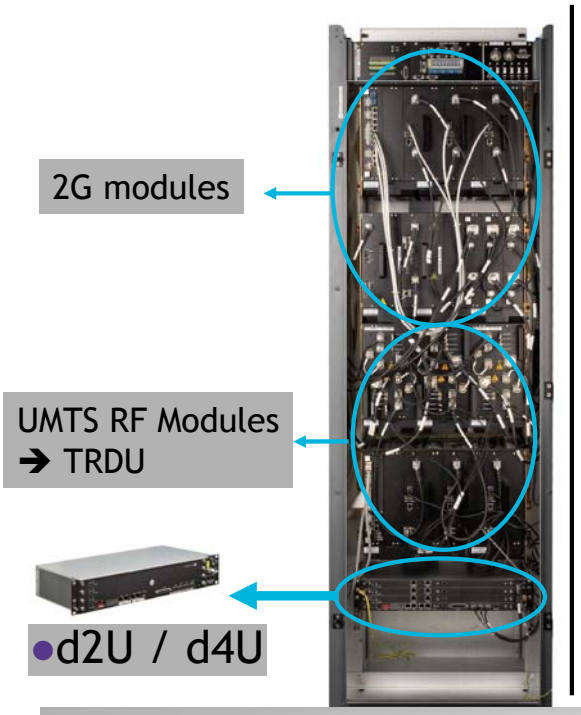
- Alcatel-Lucent Multi-Standard BTS solution is designed to allow customers to install in the same cabinet (MBI5, MBO2, MBO2ev) the 2G and 3G modules to achieve a high quality and capacity coverage with reduced site requirements.

- Because often the space is limited in some sites, it may prevent the installation of an additional dedicated 3G Macro NodeB or may require costly craning.
- The main advantage of using 9100 Base Station MS TRDU40-21 is to add the 3G coverage without any additional footprint with light modules or directly install the 2G+3G coverage with only one Macro cabinet.

- By the way, the total cost of ownership is highly reduced compared to a site with two dedicated cabinets.

- 9100 Base Station MS TRDU40-21 is designed to provide the same capacity and coverage as
- provided by dedicated 2G and 3G base stations, thanks to the Twin TRX for high 2G capacity.

11.1 9100 Multi-standard BTS [cont.]



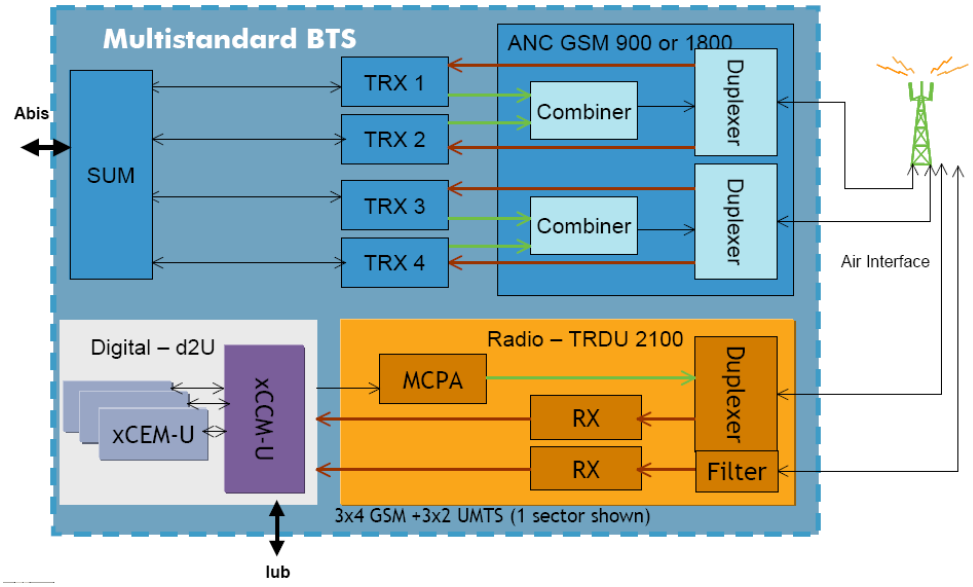
- DESCRIPTION
- Capacity
  - Up to 12 TRX with twin TRX
  - Up to 3 sectors 3 carriers
  - Up to 384 CE (future 768)
- VALUE
- Investment protection
  - Capitalize on existing assets
  - No need for new site acquisition
- Same KPIs and features as Macro NodeB
- Easy 3G introduction at minimum cost: module plug-in
- Additional flexibility with TRDU
- d2U/d4U can also be connected to RRHs or rCompact

Reuse GSM sites, cabinets
Reuse feeders/antennas (900 MHz)

The 9100 Base Station product allows implementation of the UMTS (Universal Mobile Telecommunications System) and GSM (Global System for Mobile Communication) standard

All the 9100 Base Station installed since 1999 are part of the Multi-Standard Product Range and benefit from significant advantages in both technological durability (compatibility with the new EDGE, UMTS and LTE standards) and operational gains.

11.1 9100 Multi-standard BTS [cont.]



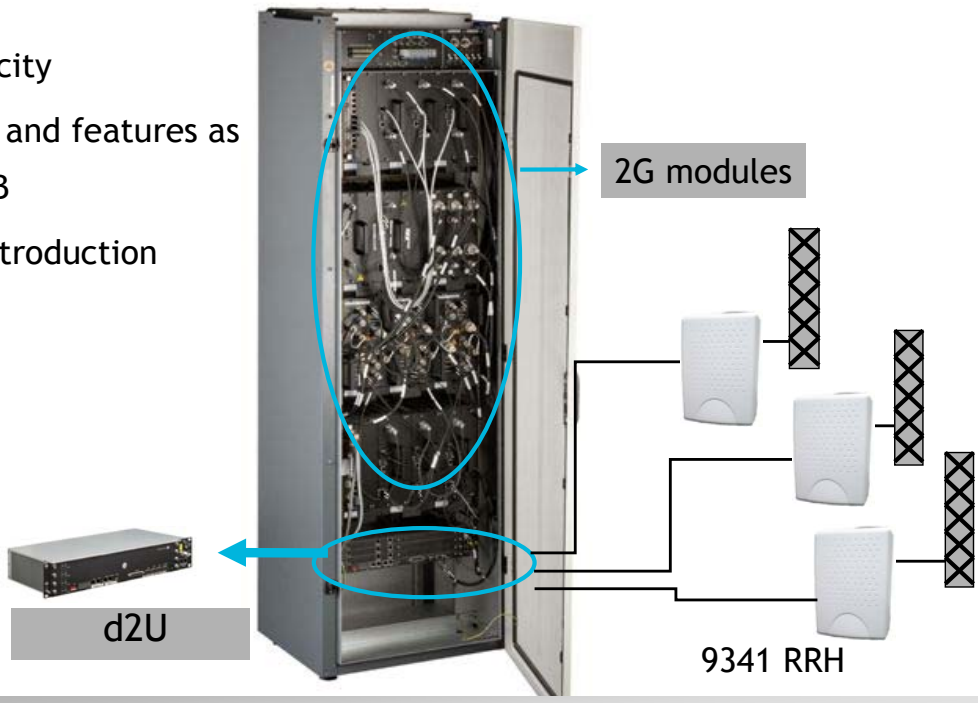
The hardware configuration of the Multi-Standard Base Station is based on a three-level modular architecture

The Alcatel-Lucent Multi-Standard solution is composed of three main parts:

- The 9100 Base Station Indoor and Outdoor - MBI5, MBO2 or MBO2 Evolium - with GSM modules SUM, TRXs, ANC etc.
- The 9326 digital 2U NodeB (**d2U**) provides the controller and base band units for UMTS – the xCCM-U and the xCEM-U.
- The Transmitter Receiver Duplexer Unit40-21 (2100 MHz **TRDU** 40W) provides the UMTS radio functions: Radio transmit-receive function, multi-carrier power amplification, radio coupling and filter functions.

11.2 Distributed Multi-Standard BTS

- High Capacity
- Same KPIs and features as Macro NodeB
- Easy 3G introduction



Reuse GSM sites, cabinets
Reuse feeders/antennas (900 MHz)

Alcatel·Lucent UNIVERSITY

Description

Capacity

- Up to 12 TRX with Twin TRX
- Up to 4 carriers 3 sectors 384 CE
- 8

Value

Investment protection

- Capitalize on existing assets
- No need for new site acquisition

Same KPIs and features as Macro NodeB

Easy 3G introduction at minimum cost: module plug-in d2U connected to Remote Radio Heads or rCompact

12 Appendix - UMTS BTS 6020 (Street)

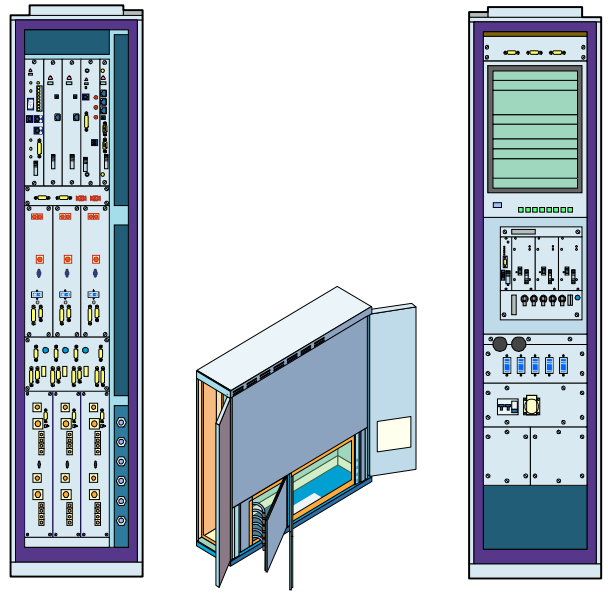
Let's go on with the BTS 6020 (Street).

12.1 UMTS 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: 0.52m^2
  - 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

2100 MHz only



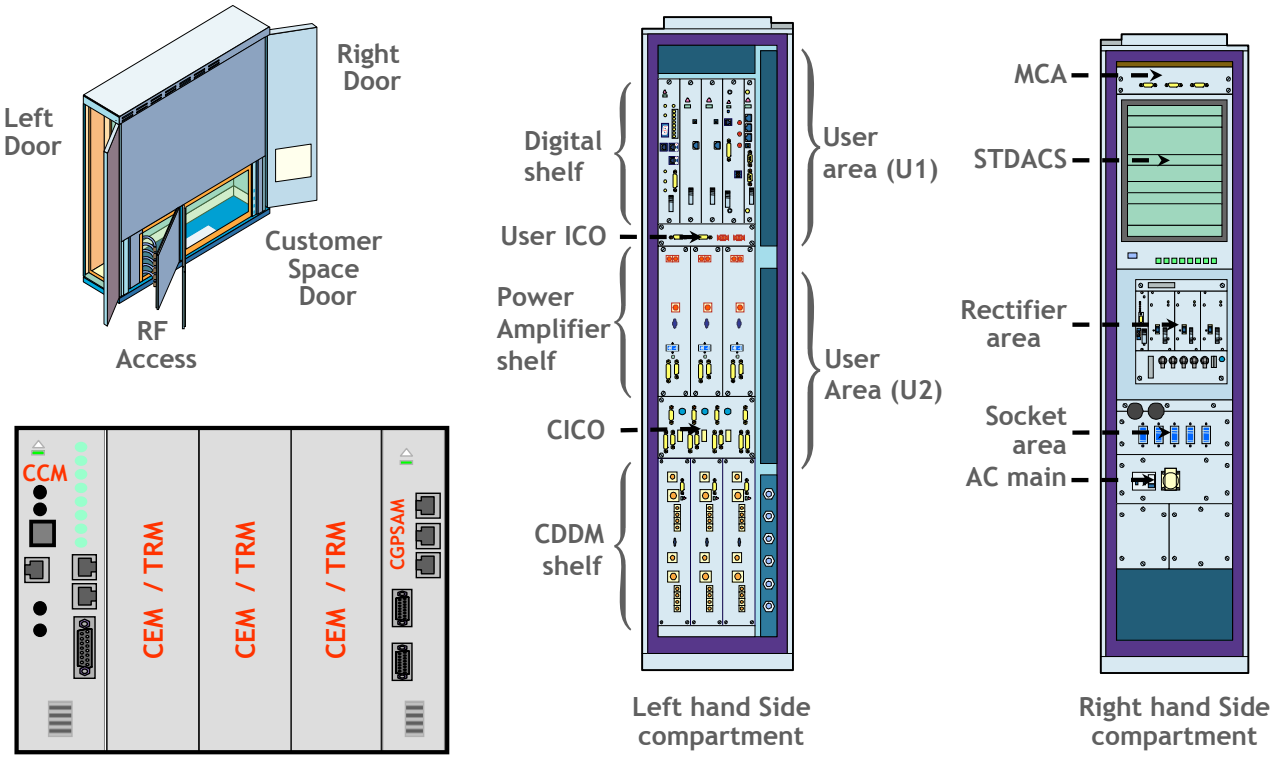
Left hand Side compartment | Front side | Right hand Side compartment

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

It 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 radio frequency combiners area. The right compartment includes the cooling unit, the rectifiers, AC Main. Finally, the front side compartment includes the batteries and radio frequency access.

12.2 UMTS BTS 6020 (Street): Cabinet Description



The modules of the UMTS BTS 6020 (Street) are accessible by side doors.

The left compartment includes the digital shelf, the User space and its interconnection panel User/ICO, the Multi-carrier Power Amplifier shelf, the interconnection module ICO, the Compact Dual Duplexer Module 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.

Its digital shelf is smaller than that of the Macro NodeB (Outdoor and Indoor) but uses the same four modules.

The backplane is a five-slot type. Consequently, the slot numbers have changed as compared to the Macro NodeB Outdoor and/or Indoor racks.

Indeed, the CCM or iCCM is located in slot number 1, doing the Core Control functions.

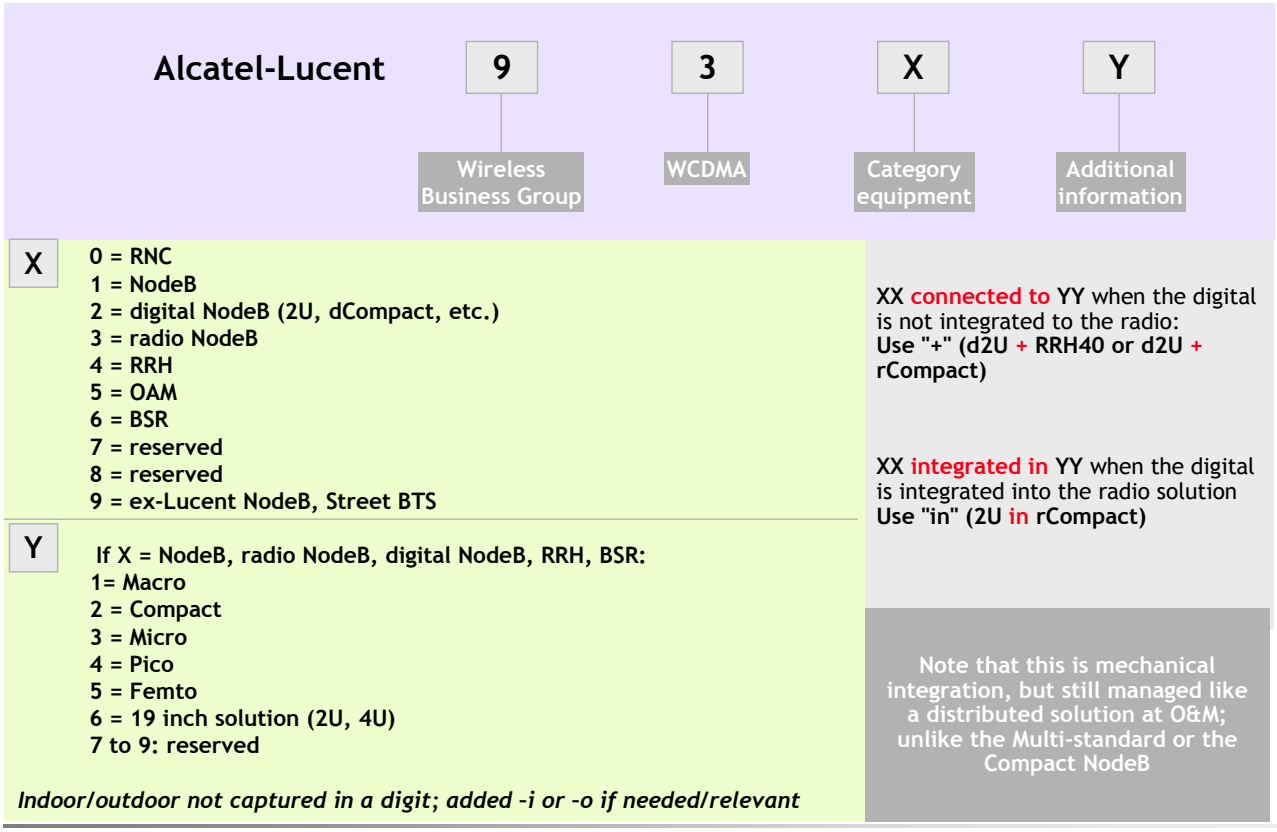
Then, up to two integrated Channel Element Modules can be located in slots number 2, 3 and 4.

Next, up to two classical or integrated Transmitter Receiver Module (TRMs, 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.

13 Appendix - Re-Branding

13.1 Re-Naming and Re-Branding



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 Wireless 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.

13.1 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 2100 MHz	RRH20-21
Alcatel-Lucent 9341 RRH 40w 2100 MHz	RRH40-21
Alcatel-Lucent 9341 RRH 40w 850 MHz	RRH40-08
Alcatel-Lucent 9341 RRH 40w 1900 MHz	RRH40-19
Alcatel-Lucent 9341 RRH 40w 900 MHz	RRH40-09
Alcatel-Lucent 9341 RRH 40w 2100 MHz (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.

13.1 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 6020 (Street)	N/A

This table summarizes all former-Nortel names and the correspondence to the new Alcatel-Lucent names. For example, the former BTS12010 is now named as Alcatel-Lucent 9311 Macro NodeB Indoor. Its quick name is Macro Indoor.

13.2 BTS Models vs. Frequency Bands

	Band			
	850 MHz	900 MHz	1900 MHz	2100 MHz
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 NodeB				X
Alcatel-Lucent 9314 Pico NodeB				X
Alcatel-Lucent 9322 digital Compact NodeB ID	dependent of the radio part			
Alcatel-Lucent 9322 digital Compact NodeB OD	dependent of the radio part			
Alcatel-Lucent 9326 digital 2U NodeB	dependent of the radio part			
Alcatel-Lucent 9326 digital 4U NodeB	dependent of the radio part			
Alcatel-Lucent 9332 radio Compact NodeB 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 NodeB.

Module Summary

Having completed this section, you should be able to …

Describe the Alcatel-Lucent BTS portfolio
Identify the different types of BTS within the UTRAN portfolio.
List the main features and characteristics of each BTS type
Explain the benefit of the distributed NodeB solutions
Understand the Remote Radio Head functionality.
List the Alcatel-Lucent Remote Radio Head products

End of module
Description of the BTS Types

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