RBS 6000 Overview

STUDENT BOOK
LZT1239270 R5A

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1 Radio Access Network, RBS Site Solutions and RBS 6000 Basic Functions

Objectives

Upon completion of this chapter, the learner will be able to:

1 Recognize and identify the main components of Radio Access Network, RBS Site Solutions and RBS 6000 basic functions.

1.1 Give a high level overview on the GSM, WCDMA and LTE Network nodes

1.2 Introduce the RBS 6000 family

1.3 Discuss the migration and substitution scenarios

1.4 Describe the indoor and outdoor site support portfolio

1.5 Describe Distribution Frame (DF), Antenna near parts such as Tower Mounted Amplifier (TMA) and Remote Electrical Tilt Unit (RETU)

Figure 1-1: Chapter 1 Objectives

1 INTRODUCTION

The chapter describes the equipment found in a radio site. Basic equipment is described, as well as additional indoor and outdoor equipment. Some aspects of site sharing GSM, UMTS and LTE are discussed.

1.1 GSM RAN System Introduction

The GSM Radio Access Network (RAN) consists of Base Station Controller (BSC), Transcoder Controller (TRC) which can be standalone or combined with BSC, Radio Base Stations (RBS), the Operation Support System for Radio and Core (OSS-RC), Test Mobile System (TEMS) and the Operation and Maintenance Common Infrastructure (COMINF).

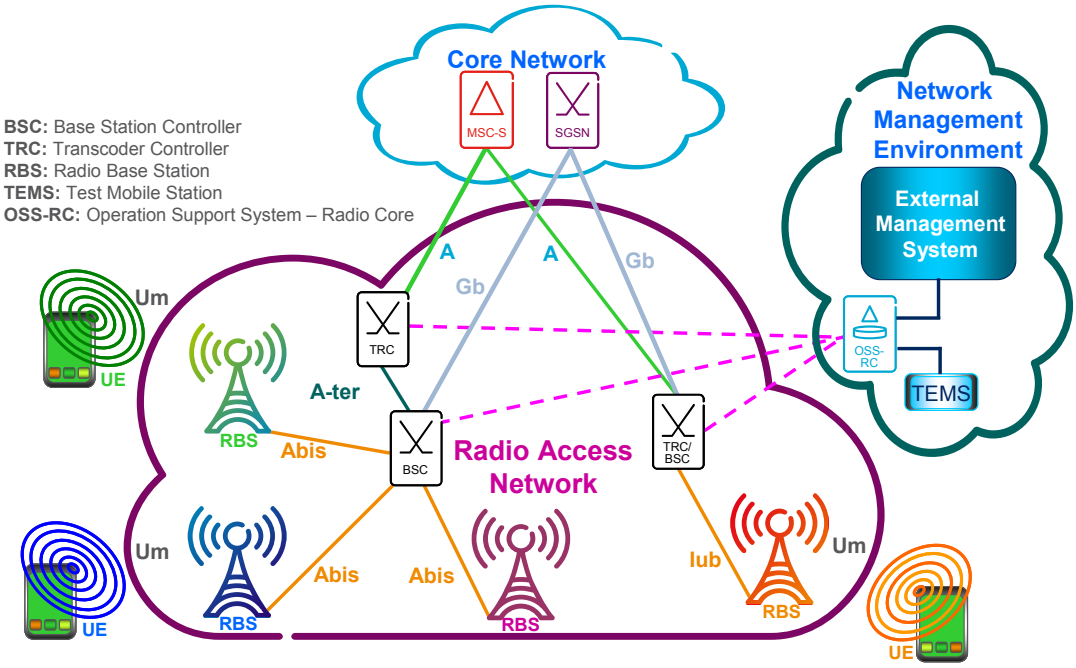


Figure 1-2: GSM RAN Overview

1.1.1 GSM RAN System

The Base Station Controller (BSC) manages all the radio-related functions of a GSM network. It is essentially a high-capacity switch that provides functions such as MS handover, radio channel assignment, and the collection of cell configuration data. A number of BSCs may be controlled by each MSC.

The BSC could be standalone with remote connection to or combined with Transcoder Controller, TRC. The interface from the standalone TRC to the BSC is called Ater.

On the other hand, the Evo Controller 8200 is a multi-controller. The Evo Controller 8200 is a vital component of the RAN evolution strategy. It combines the functions of the GSM base station controller (BSC) and the UMTS radio network controller (RNC) in one common network controller. The Evo Controller 8200/MULTI provides the possibility to combine BSC, RNC and Wi-Fi controllers with a few common building blocks. Smart MBB capabilities can also be added into the same Evo C cabinet. For CDMA networks, an all-IP base station controller for supporting voice, and a high-capacity network controller for EV-DO packet data.

The BSC/Evo C is connected to the core network via the A interface, and the Mobile Station, MS, is connected to the RBS via the Um interface (the radio interface). Internally within RAN, the RBSs connect to the BSC/Evo C via the Abis interface Abis over IP interface.

Operation Support System for Radio and Core (OSS-RC) is a set of software for handling operation and maintenance tasks for the WCDMA Network. OSS-RC supports Core network and radio network for both 2G and 3G. OSS-RC gives a consolidated view of RAN information such as alarms, configurations and basic performance.

The **O**peration & **M**aintenance **C**ommon **INF**rastructure (COMINF) is a type of infrastructure solution required for the Operation and Maintenance Intranet. OMINF is intended for O&M data traffic only.

1.2 WCDMA RAN System Introduction

The WCDMA Radio Access Network (RAN) consists of Radio Network Controllers (RNC), Radio Base Stations (RBS), the Operation Support System for Radio and Core (OSS-RC), Test Mobile System (TEMS) and the Operation and Maintenance Common Infrastructure (COMINF). The Radio Access Network Aggregator is optional. The RAN is connected and controlled by the Core Network (CN).

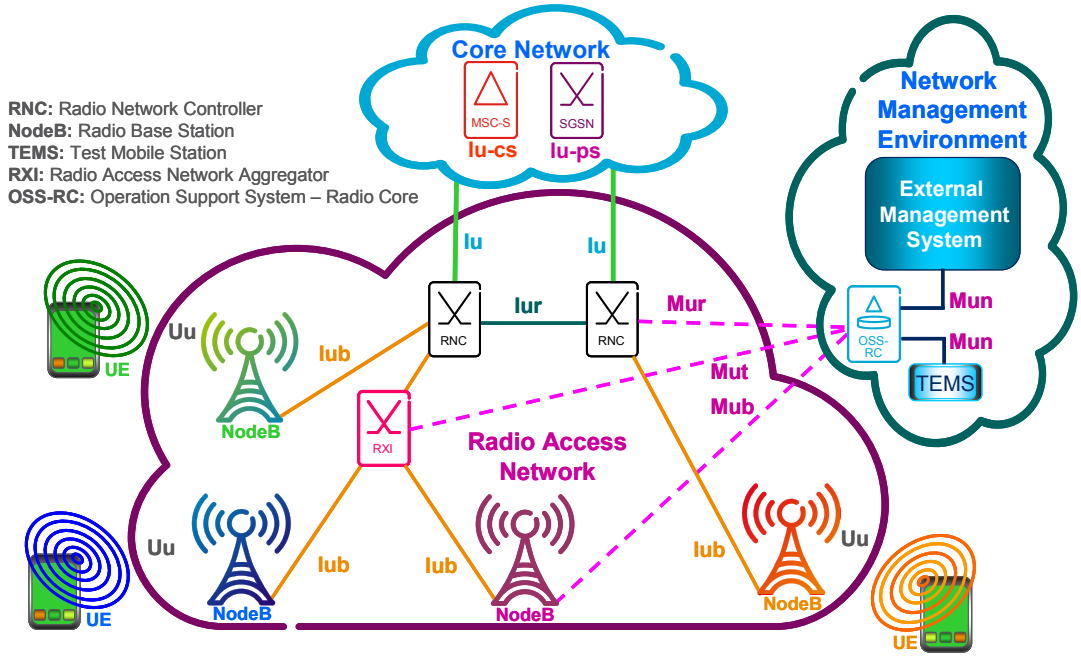


Figure 1-3: WCDMA Radio Access Network Overview

1.2.1 WCDMA RAN System

The main tasks of the RNC is to manage Radio Access Bearers for user data transport, manage and optimize the radio network resources and control mobility while the RBS provides the actual radio resources and maintains the radio links.

The RNC is connected to the core network via the Iu interface, and the User Equipment (UE) is connected to the RBS via the Uu interface (the radio air interface). Internally within RAN, the RNC's are interconnected via the Iur interface and the RBS's to the RNC via the Iub interface.

An optional product is the RXI 800, which will be a stand-alone IP router. At the moment, and for the first implementation of ATM-based WCDMA RAN, this product will play the role of an ATM aggregator of the hundreds of RBS's E1 interfaces to concentrate them to a few lines to the RNC. In this way the transmission costs will be reduced dramatically.

Operation Support System for Radio and Core (OSS-RC) is a set of software for handling O&M tasks for the WCDMA RAN. The OSS-RC is designed for handling daily network operation and maintenance tasks. It complements the Software Hardware Manager (SHM) functions implemented in the nodes to create a complete Network Element (NE) management environment for the network.

The **O**peration & **M**aintenance **C**ommon **INF**rastructure (COMINF) is a type of infrastructure solution required for the Operation and Maintenance. All NEs in the WCDMA O&M system are interconnected by the O&M Intranet, which is an IP-based network reserved for data transfer and signaling. To carry and route IP traffic between the NEs and the OSS-RC, the O&M Intranet needs to be supported by using equipment, such as network routers, switches and hubs. This is provided in the OSS-RC product as the COMINF.

The TEMS WCDMA portfolio is positioned to lead the world in helping wireless operators plan, optimize, and expand WCDMA networks. Whether an operator is migrating an existing 2G network into 3G or needs to immediately plan and optimize a new WCDMA network, TEMS has the appropriate tools.

1.3 LTE System Introduction

The LTE Radio Access Network (RAN) consists of Radio Base Stations (RBS), the Operation Support System for Radio and Core (OSS-RC), Test Mobile Systems, (TEMS) and the Operation and Maintenance Common Infrastructure (COMINF).

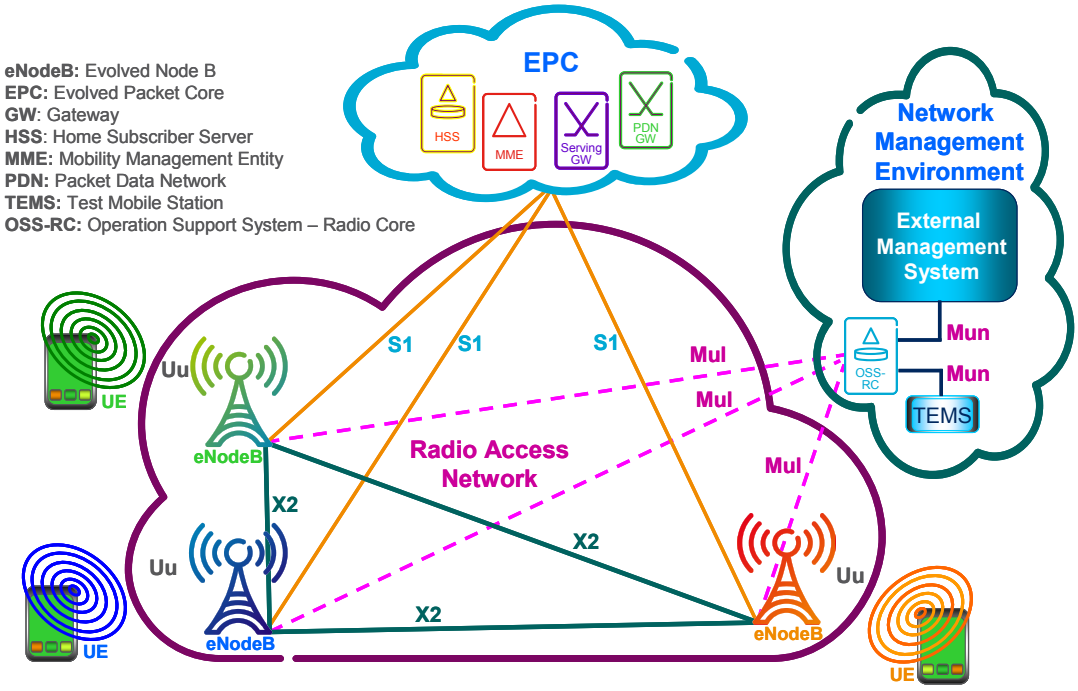


Figure 1-4: LTE RAN Overview

1.3.1 LTE RAN System

The main tasks such as management of Radio Access Bearers for user data transport, managing and optimizing the radio network resources and control mobility, while the RBS provides the actual radio resources and maintains the radio links.

Ericsson's LTE RBS types implement the 3GPP eNodeB concept, also known as eNB. The eNodeB is connected to the core network via the S1 interface, and the User Equipment (UE) is connected to the RBS via the Uu interface (the radio interface). Internally within RAN, the RBS's are interconnected via the X2 interface. In idle mode the UE is responsible for mobility while in active mode the eNodeB does the work.

Operation Support System for Radio and Core (OSS-RC) is a set of software for handling operation and maintenance tasks for the LTE Network. OSS-RC supports Core network and radio network for 2 G, 3G and 4G. OSS-RC gives a consolidated view of network information such as alarms, configurations and performance indicators. OSS-RC also provides several interfaces for easy integration with other network management environments. Operators in network management centers use OSS-RC to perform network management tasks.

The **O**peration & **M**aintenance **C**ommon **INF**rastructure (COMINF) is a type of infrastructure solution required for the Operation and Maintenance to cater for GSM, WCDMA and LTE. All NEs in the O&M system are interconnected by the O&M Intranet, which is an IP-based network reserved for data transfer and signaling. To carry and route IP traffic between the NEs and the OSS-RC, the O&M Intranet needs to be supported by using equipment, such as network routers, switches and hubs. This is provided in the OSS-RC product as the COMINF. The IP transport network has no functions specifically for LTE. The RBS is the only E-UTRAN specific node in the LTE network carrying and controlling payload traffic.

The TEMS LTE portfolio is positioned to lead the world in helping wireless operators plan, optimize, and expand LTE networks. Whether an operator is migrating an existing 2G network into 3G or needs to immediately plan and optimize a new LTE network, TEMS has the appropriate tools.

2 Operation Support System for Radio and Core, OSS-RC

Operation Support System for Radio and Core (OSS-RC) is a set of software for handling operation and maintenance tasks for the WCDMA Network. OSS-RC supports Core network and radio network for 2 G, 3G and 4G. OSS-RC gives a consolidated view of RAN information such as alarms, configurations and basic performance.

The **O**peration & **M**aintenance **C**ommon **Inf**rastructure (COMINF) is a type of infrastructure solution required for the Operation and Maintenance Intranet. OMINF is intended for O&M data traffic only.

The TEMS portfolio is positioned to lead the world in helping wireless operators plan, optimize, and expand networks. Whether an operator is migrating an existing 2G network into 3G or 4G, or needs to immediately plan and optimize a new network then TEMS has the appropriate tools.

2.1 Site Introduction

The Figure 1-5 below illustrates what we can find at a typical radio site:

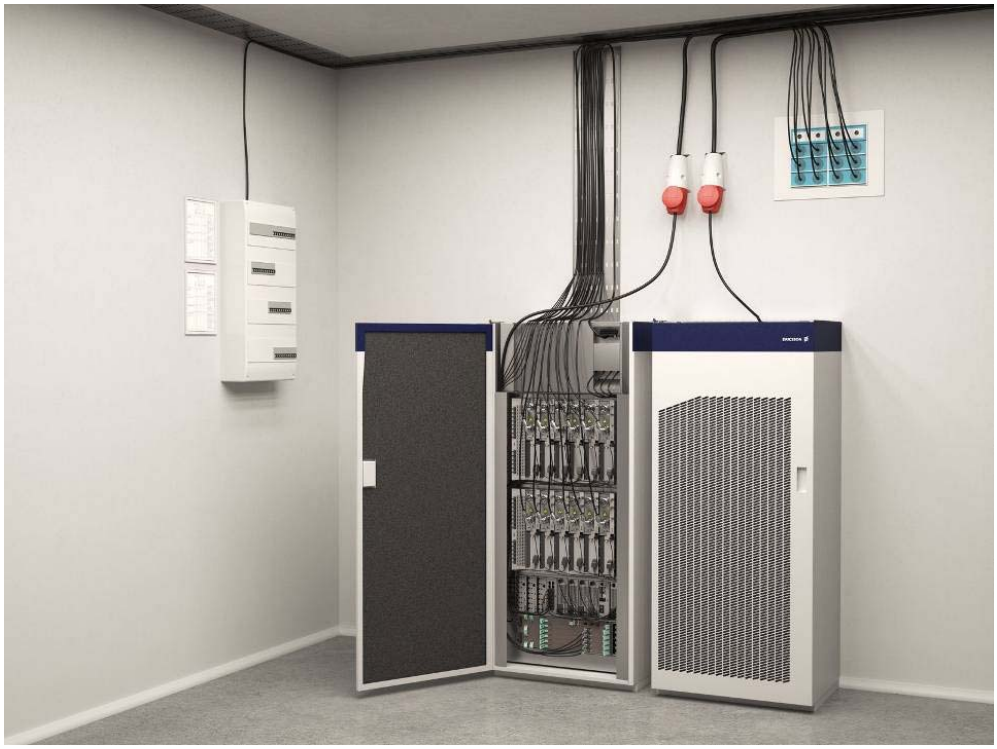


Figure 1-5: Typical Radio Site

Optional equipment Power and Battery Cabinet (PBC) or Battery Backup System (BBS) and Support Alarm Unit, SAU, is explained in this module, some optional outdoor equipment will also be described.

The Figure 1-6 below illustrates the RBS 6000 Portfolio.

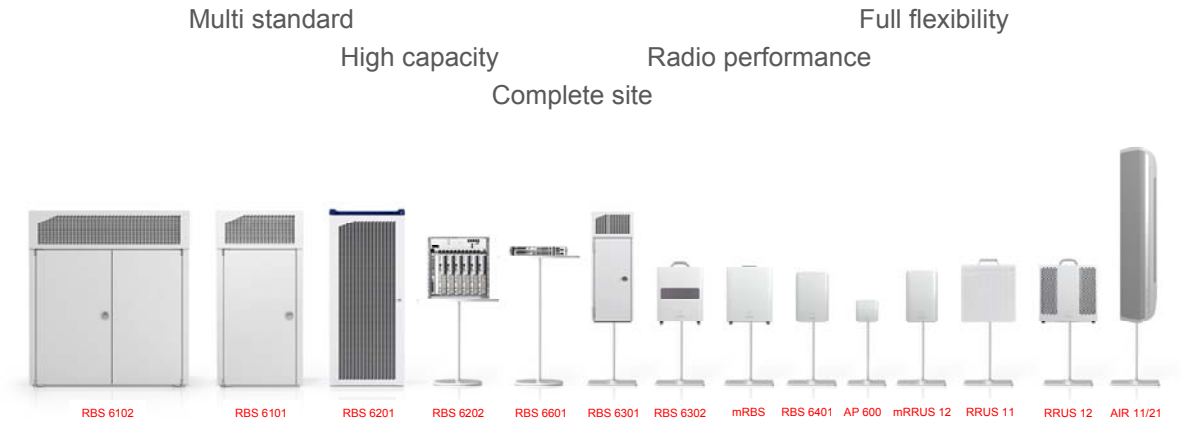


Figure 1-6: RBS 6000 Portfolio

3 MIGRATION SCENARIOS

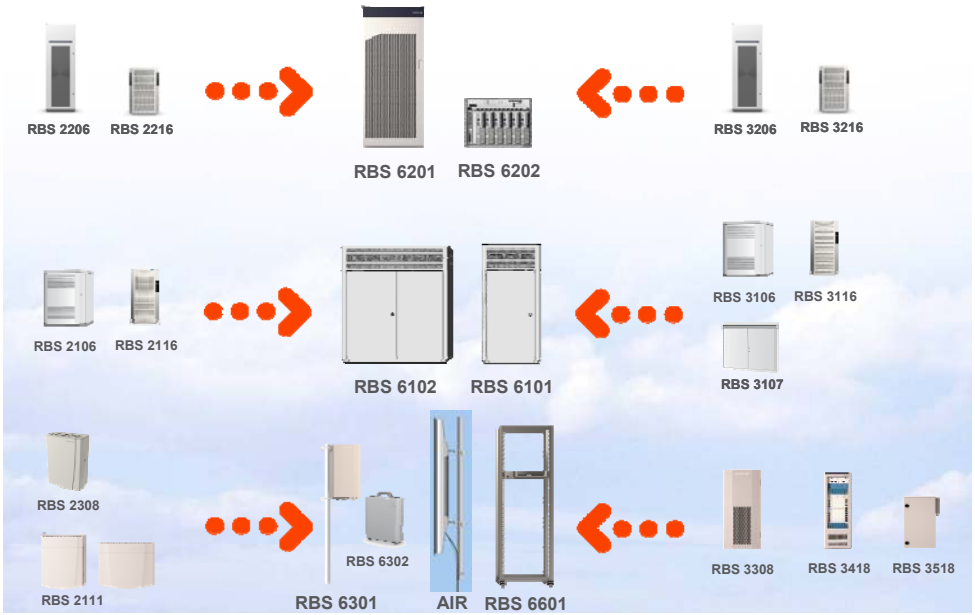


Figure 1-7: Cabinet Vision.

The picture above shows the migration and substitution scenarios for the existing models and their successors to the RBS 6000 family.

3.1 Site Support Portfolio

The site power systems (PBC) and battery backup systems (BBS) for RBS 6000 provide easily configurable and expandable power and battery backup capacities. One or several RBS cabinets can be supported, as well as providing extra-long (priority) backup times for the sites' important transmission equipment in or outside the RBS cabinets. Different models provide different capabilities and capacities, suitable for different RBS models and applications.

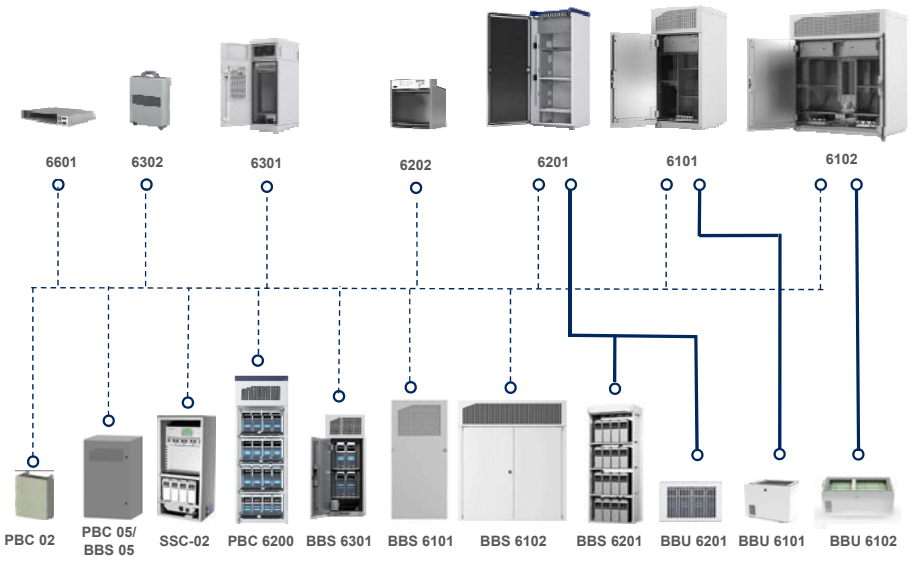


Figure 1-8: Site Power and Battery Backup Solution

Some of the products are designed for working together with a specific radio base station. The majority of the products are however possible to use in a flexible way together with any of the RBS 6000 base stations, although some of the combinations are the preferred ones. This is shown in the Figure 1-8 above.

3.1.1 Battery Base Units, BBU

The battery base units (BBU) are each designed for a specific radio base station. They are installed below the RBS in question, which means that a complete site, including transport network equipment, power and backup is managed on one ordinary RBS footprint. The BBUs are easily installed and connected to the RBS.

The BBUs are available for the base stations RBS 6201, RBS 6101 and RBS 6102. They are used in applications with moderate battery backup needs. If additional battery capacity is required, it is possible to expand the BBU with battery backup systems (BBS).

3.1.2 Battery Backup System, BBS

For longer battery backup requirements, a battery backup system (BBS) is preferred. There are a wide range of different BBS systems available to suit the actual need.

BBS 6201 is the preferred battery backup system for the indoor RBS 6201. For outdoor macro base stations (RBS 6101 and RBS 6102) there are two preferred solutions: BBS 6101 and BBS 6102. BBS 6101 has a similar size as RBS 6101. BBS 6102, with a size similar to RBS 6102, provides twice the battery backup capacity as BBS 6101.

For the compact outdoor main-remote base stations, it is proposed to use the BBS 6301 featuring the same basic hardware design as RBS 6301, or alternatively the larger capacity BBS 05.

3.1.3 Site Support Cabinet, SSC

The SSC 02 site solution cabinet supplies –48 V DC power to 19” main units in the 9U SSC-02 compartment as well as remote radio units outside the cabinet. The separated compartment features active cooling for best possible battery life and supports capacity expansion with one BBS 6101.

3.1.4 Power and Battery Cabinet, PBC

The PBC 02 supplies –48 V DC in outdoor environments. PBC is a very flexible and easily scalable solution consisting of a main unit providing the DC outputs and one or two battery backup units.

3.1.5 Distribution Frame, DF

The DF-OVP is an interface between the RBS cabinet and incoming alarm, transmission and Global Positioning System (GPS) cables. All lines are protected with lightning arrestors. The DF supports G.703 transmission standards with transmission speed up to 2Mb/s.

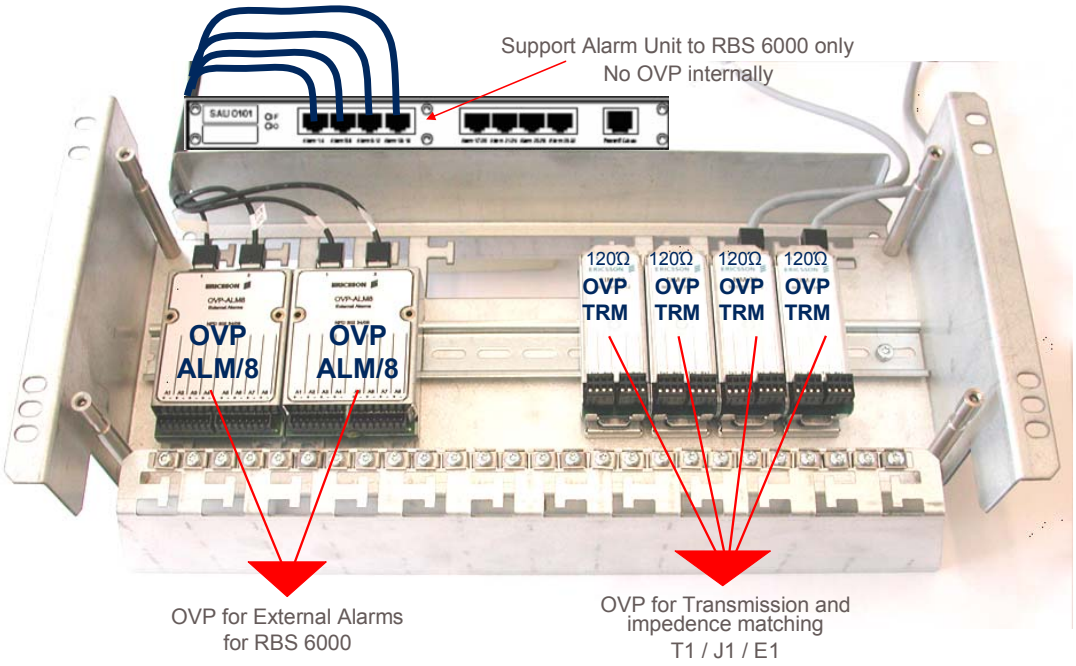


Figure 1-9: Distribution Frame

The DF is designed for indoor installation in a 19-inch rack or on a wall. The DF can be equipped with up to eight pre-connected PCM cables going to the RBS. The DF is required when PCM impedance matching with OVP is required i.e. 75 ohms to 120 ohms with OVP or 120 ohms to 120 ohms with OVP. Note that the PCM input to DXU is type RJ-45. Additionally, there is also an option for up to 8 external alarm connections for RBS 2000 or 3000 while the SAU with 32 external alarms can be used for the RBS 6000 if required.

3.2 Antenna and antenna near products

Figure 1-10: Antenna systems and near products

The pictures above show a variety of different types of antenna such as Omni and Sector, single and tri-band antennas. Some of them also have Manual Electrical Tilt, MET, to which Remote Electrical Tilt Units could be connected. Antenna System Controller (ASC)

The Antenna System Controller (ASC) is an auxiliary unit of the RBS, mounted close to the antenna system. The ASC is used on the receiving paths in order to lower the overall receiver noise figure.

The ASC consists of two dual duplex TMA (Tower Mounted Amplifier) units for the support of two antenna branches. Each TMA unit supports one combined Rx/Tx antenna and is connected to a single combined Rx/Tx RBS feeder. The ASC thus has two antenna ports and two Rx/Tx feeder ports.

The diagram below illustrates the Tower Mounted Amplifier (TMA) and the other on how DDTMA is implemented in an ASC.

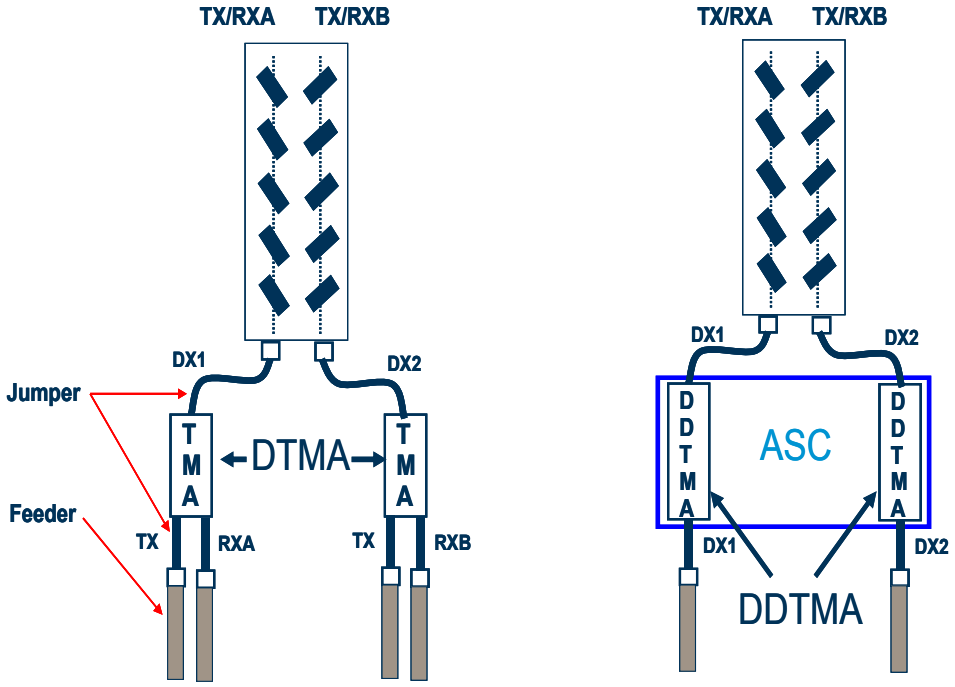


Figure 1-11: Tower Mounted Amplifier (TMA)

A dual duplex TMA unit has low insertion loss in the RBS DL band and a high gain with a low noise figure in the RBS UL band. The TMA unit thus improves the system noise figure of the RBS Rx chain and thereby the reception sensitivity. The TMA unit also provides a prescribed attenuation of signals outside of the UMTS UL and DL bands.

The ASC unit has 5 ports, which consist of:

- *Two antenna ports*; these ports are used for both RF signals (Rx/Tx) and for supervision of the antenna.
- *Two RBS feeder ports*; the RBS feeders are used for distribution of both RF signals and DC power. For the later models both ports could communicate while on the first model only one RBS port is used for communication RBS-ASC.
- *One EXT AUX unit port*; the EXT AUX port is used for control and powering of an optional AUX unit.

The ASC is supervised, and power is supplied to it, by the RU in the RBS, via the RF feeder.

The ASC also supports the RET function in the antenna. The ASC shall be mounted close to the antenna and connected via feeder cables to the RBS.

The main features of the ASC are:

- Compensation for feeder loss
- Adjustable pre amplification of RX signals
- Increased coverage
- Antenna Supervision

The ASC in the normal housing (left) and without cover or installation inside antenna radomes (right).

Figure 1-12: Antenna System Controller (ASC)

Similar to TMA it includes duplex filters and Low Noise Amplifier, LNA. The RBS supports ASC with 30 V DC and it controls the Remote Electrical Tilt Unit RETU. The dimensions are 312mm x 160mm x 83mm with a weight: <5kg.

In cases where the ASC is within an antenna radome i.e. in Antenna Integrated Radio (AIR), then the ASC is fitted without the housing inside the radome.

It is assumed that the RBS to which the ASC will be connected meets the requirements.

3.2.1 Remote Electrical Tilt (RET)

An antenna can have either a Fixed Electrical Tilt angle (FET antenna) or an adjustable electrical tilt angle. The adjustable electrical down tilt antennas can be adjusted manually (MET antennas) by turning the phase shifter on the antenna. Some MET antennas can also connect to a remote-controlled motor that turns the phase shifter. These antennas are called MET/RET antennas. The motor and control parts are regarded as the RET unit (RETU).

Characteristics:

- Needs a specific RET compatible antenna
- Allows network tuning remotely
- Minimizes site visits
- Nominal power supply: 28 V DC
- Maximal downtilt angle depends on antenna type

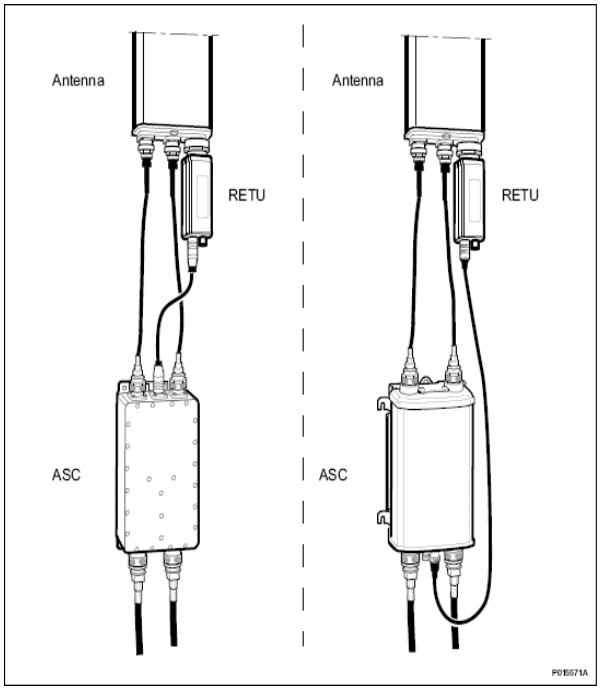


Figure 1-13: Remote Electrical Tilt, RET

The RET unit is a separate unit from the antenna and is connected via a cable to the ASC for DC supply and control signaling.

The diagram below illustrates 3 RETUs fitted to an antenna.

- Optional Unit physically mounted together with selected antenna types.
- Requires ASC/RIU for Power and Signaling extraction from feeder.
- Adjustment of tilt performed via the Element Manager in the RBS.

Figure 1-14: RET: Antenna with RET Unit

4 SUMMARY

Upon completion of this chapter, the learner should be able to:

1 Recognize and identify the main components of Radio Access Network, RBS Site Solutions and RBS 6000 basic functions.

1.1 Give a high level overview on the GSM, WCDMA and LTE Network nodes

1.2 Introduce the RBS 6000 family

1.3 Discuss the migration and substitution scenarios

1.4 Describe the indoor and outdoor site support portfolio

1.5 Describe Distribution Frame (DF), Antenna near parts such as Tower Mounted Amplifier (TMA) and Remote Electrical Tilt Unit (RETU)

Figure 1-15: Summary of Chapter 1

2 RBS 6000 Platform

Objectives

Upon completion of this chapter, the participants will be able to:

2 Describe on an overview level the RBS 6000 Platform and understand how Radio Access for various radio technologies is implemented in the RBS 6000

2.1 Understand the RBS 6000 Full Freedom, Hybrid Concept and the Unit migration

2.2 Describe the single, multi standard and mixed mode in RBS 6000

2.3 Describe on block level the Digital Unit and Radio Unit for GSM, WCDMA and LTE

2.4 Understand how CDMA is now added into RBS 6000

2.5 Understand the Transport Units such as the Site Integration Unit (SIU), Transport Connectivity Unit (TCU) and Indoor Pico Gateway (IPG 6440)

Figure 2-1: Chapter 2 Objectives

1 INTRODUCTION

The RBS 6000 base station family is designed to meet the increasingly complex challenges facing operators today. RBS 6000 is built with tomorrow's technology and at the same provide backwards-compatibility with the highly successful RBS 2000 and RBS 3000 product lines. RBS 6000 base stations offer a seamless, integrated and environmentally friendly solution and a safe, smart and sound roadmap for whatever tomorrow holds.

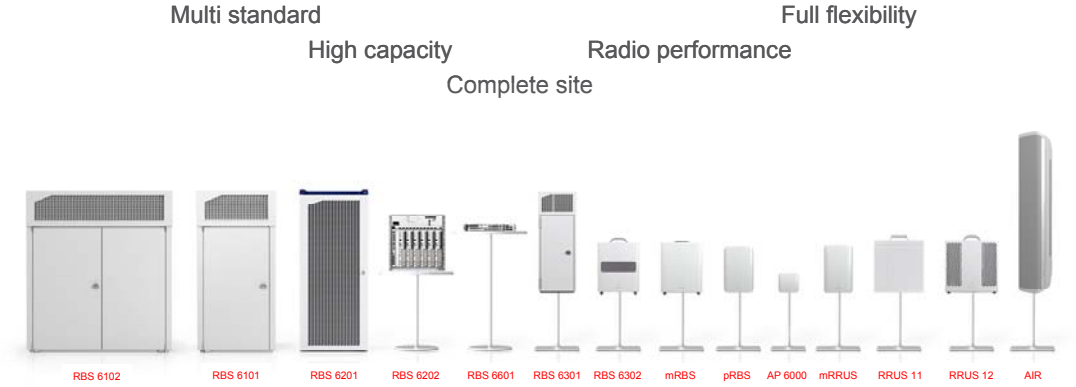


Figure 2-2: RBS 6000 Family

2 RBS 6000 SITES

In order to provide an optimized radio network, several different site types have to be supported by the radio base stations. In the RBS 6000 product portfolio there are base stations for virtually every site build strategy, from small cells to high capacity macro cells. This is to provide modularity at the right level and to provide the most cost effective complete site solution for every site need.

Figure 2-3: Full Freedom

2.1 Macro Sites

Sites providing macro coverage are the basic building block in an effective radio network. Macro sites are characterized by scalability, flexibility and centralized site management while using space efficiently. RBS 6000 includes a complete range of macro base stations for all applications. They are scalable in terms of capacity, at the same time maintaining the excellent coverage capabilities which is one of the key parameters of the RBS 6000 family.

The macro base stations available in the RBS 6000 portfolio are:

RBS 6102: The high capacity outdoor macro base station

RBS 6101: The small outdoor macro base station

RBS 6201: The high capacity indoor macro base station

RBS 6202: The zero footprint indoor macro base station

Figure 2-4: RBS 6000 Macro Cabinets

For these base stations, there are also tailor-made systems available for the provision of site power, battery backup, mast-mounted amplifiers and backhaul solutions.

2.2 Main-Remote Sites

At main-remote sites the radio parts of the base station are separated from the baseband parts. The radio parts are preferably located close to the antennas, or are integrated in the antenna itself in order to minimize the feeder losses. The baseband parts (the main unit) are located where it is suitable from an installation and accessibility point of view. Main-remote sites reduce feeder losses and enable the system to use the same high-performance network features at lower output power, thereby lowering power consumption and both capital and operational expenditure.

The RBS 6000 family comprises the following dedicated main units:

RBS 6601: The zero footprint main unit

RBS 6301: The small outdoor main unit

RBS 6302: The super compact outdoor main unit

In addition, the outdoor macro RBSs 6101, 6102 and 6202 can be used as main units in main-remote configurations.

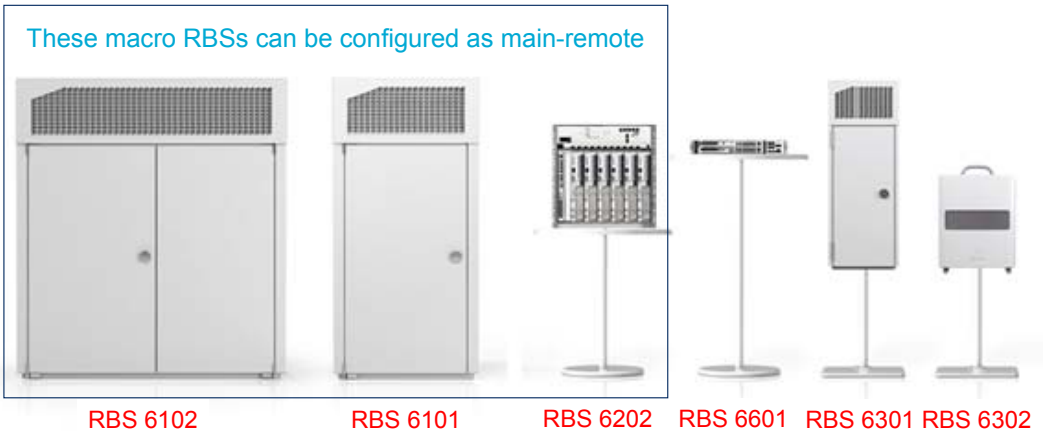


Figure 2-5: RBS 6000 Main-Remote

2.3 Remote Radio Unit Types

The remote radios in a main-remote configuration can be of two types: remote radio units (RRU) and antenna integrated radio units (AIR). The remote radio units (RRUs) are designed to be installed close to the antennas, and can be either wall or pole mounted. In the AIR units on the other hand, the radio unit and the antenna are combined into one single unit and installed in the usual antenna location. Both the RRU and AIR are available in different versions, depending on frequency band, capacity and output power.

Figure 2-6: RBS 6000 Remote Radios

For the main-remote base stations there are also, exactly as is the case for the macro base stations, tailor-made systems available for the provision of site power, battery backup and backhaul solutions.

2.4 Small Cell Sites

The addition of small cells is one of the three components in the Ericsson hetnet toolbox. For this purpose, the RBS 6000 portfolio also includes a range of products supporting the addition of these small cells. The products have output power and capacity suitable for the application as well as a non-obtrusive design, making them ideal for installation in almost every environment.

The small cell product range consists of the following products:

mRBS: The micro base station

pRBS: The Pico base station with optional Wi-Fi

mRRU: The micro RRU

Figure 2-7: Products for small cells

3 UNIT MIGRATIONS

The Figure 2-8 below shows the migration from the existing units to the system unique Digital Units and Radio Units to the multi-standard software defined units.

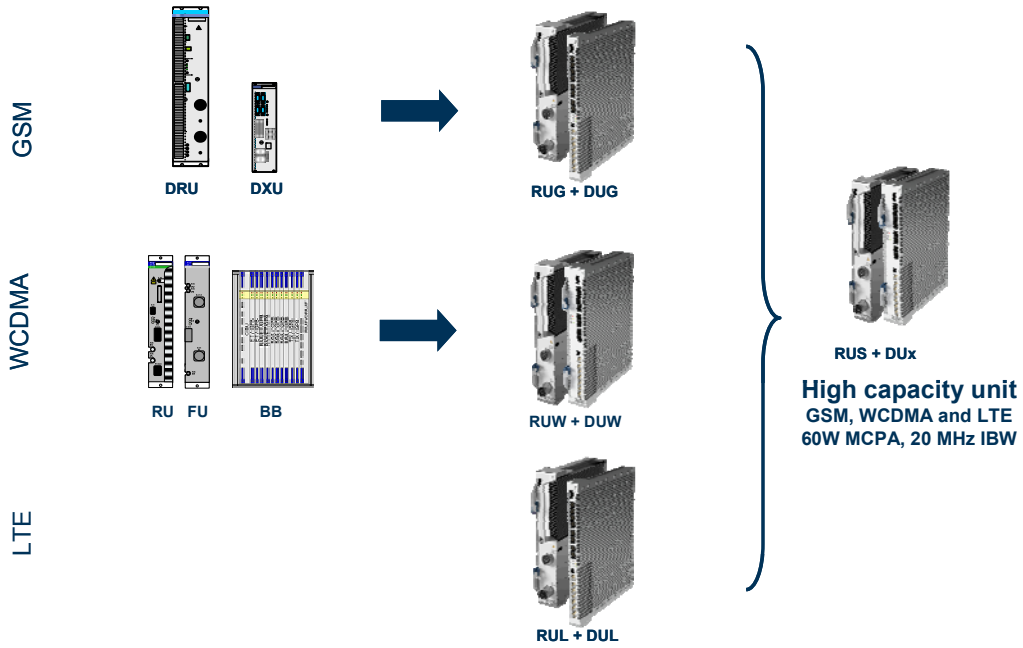


Figure 2-8: Unit Migration

4 SINGLE & MULTI STANDARD CONFIGURATION

RBS 6201 can be configured to constitute either a single standard or a multi standard base station. There is also freedom to configure different frequency bands within the base station, e.g. a dual-band base station.

4.1 Single Standard

A **Single Standard** Base Station consists of radio units configured to one of the available radio standards GSM, WCDMA or LTE. Please note that when RUS is used, the same radio unit is used irrespective of standard. This makes RBS 6201 a true future-proof base station, in that the installed radio hardware can be used also when a change of standard is foreseen in the future.

A multi standard base station can be defined in two ways. Both are supported in RBS 6201.

4.2 Multi Standard Single Mode

Multi Standard Single Mode (MSSM) where the base station is configured for operation of more than one standard. In this case each radio unit is solely configured for operation of one standard. For example, if a multi standard single mode base station runs both GSM and WCDMA; one set of the installed radio units operates on GSM only, the other radio units operate on WCDMA only. A typical application for this mode is when the different standards operate on different frequency bands.

4.3 Multi Standard Mixed Mode

Multi Standard Mixed Mode (MSMM) where the base station is configured for operation of more than one standard. In this mode **more than one standard** is in operation on the same radio unit. Again, with the example of GSM and WCDMA, the radio unit (RUS) is shared between GSM and WCDMA. A typical application for this mode is when two standards are operating in the same frequency band.

Figure 2-9: SINGLE AND MULTISTANDARD RBSs

4.4 Example of MSMM

The Figure 2-10 below shows an example of Mixed Mode Multi Standard. We can see GSM and LTE in 1800 band sharing RUS 1800 while GSM and WCDMA sharing RUS 900.

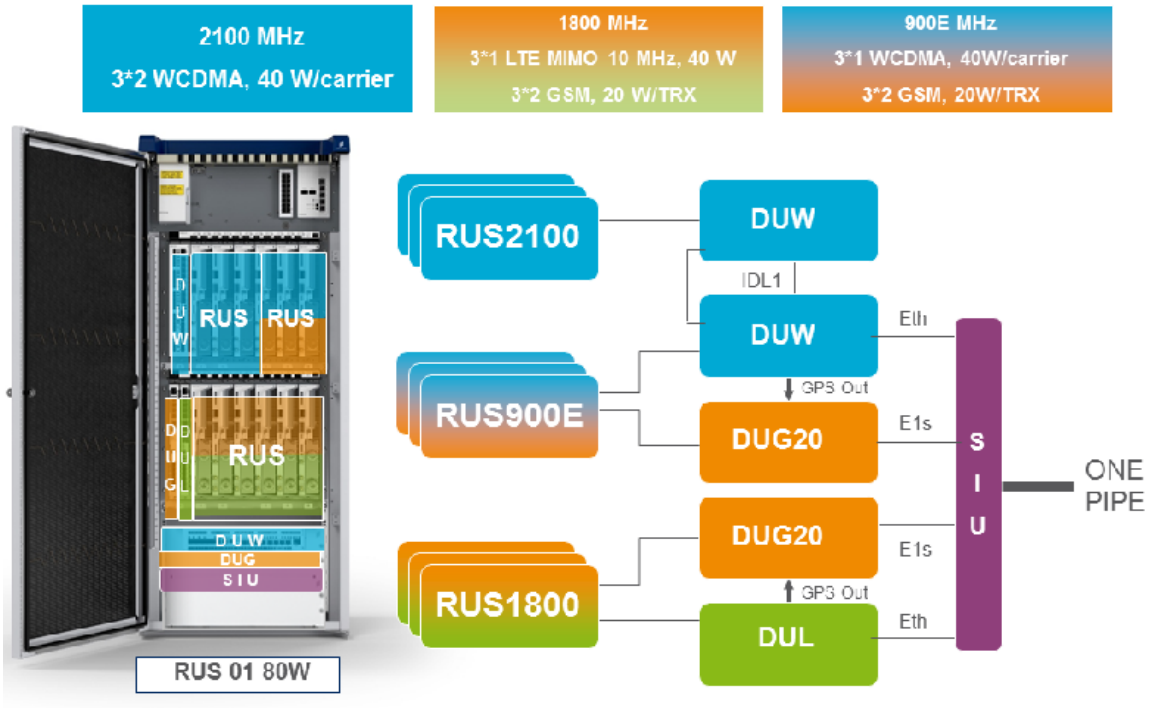


Figure 2-10: MULTISTANDARD MIXED MODE LIVE ON AIR

5 FULL FREEDOM

The basic selection to make when deciding on a base station application is a three step process: “RADIO, DIGITAL AND WHERE TO PUT IT”.

First select which radio units needed (RU for installation in macro cabinets, RRU or AIR for installation close to the antenna or integrated in the antenna itself). The second step is deciding which baseband capacity needed for your application (selection of digital units). Finally, decide where to put the equipment: is a macro cabinet preferred or shall main units in a main-remote configuration be used? Is the base station going to be deployed indoor or outdoor?

Figure 2-11: Three Step Process

5.1 Hybrid Sites

Thanks to the modular design of RBS 6000, the macro and main-remote sites can be combined. In this case the macro base station can also act as a main unit in a main-remote configuration. This provides an excellent opportunity for the addition of a new frequency band and/or radio standard at an existing site.

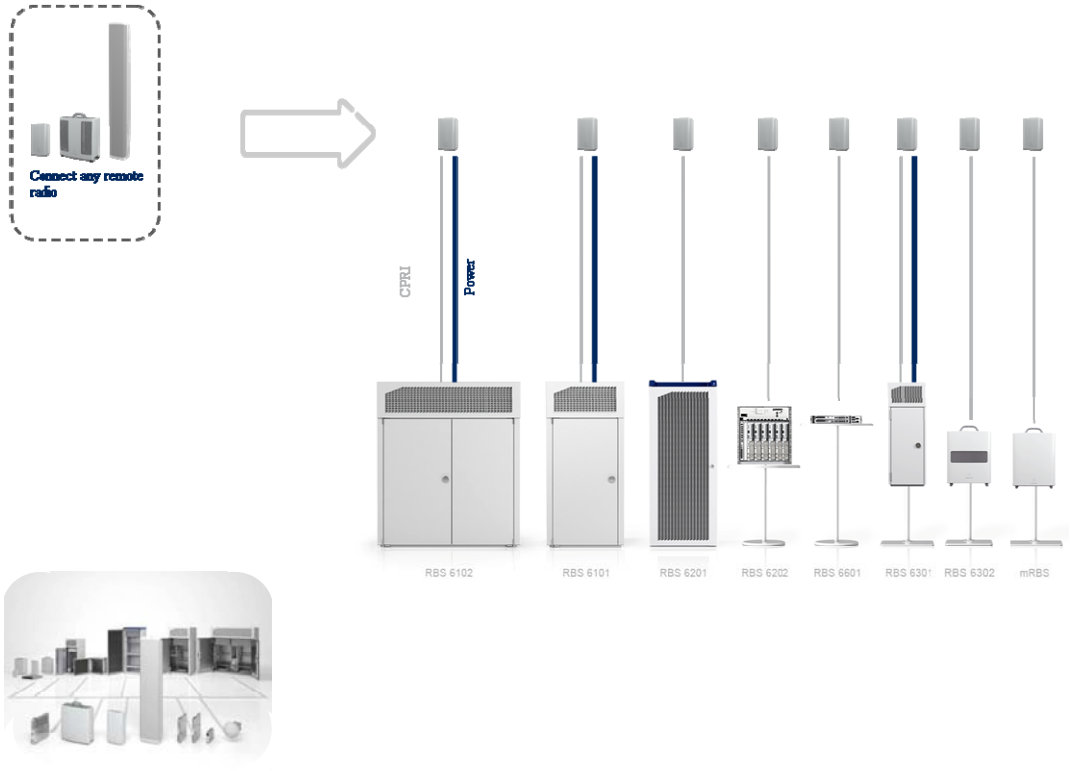


Figure 2-12: Three Step Process

The baseband units can be installed in the existing macro cabinet and connected to the remote radios with fiber optic and power cables. The remote radios can be either remote radio units (RRUs) or antenna integrated radio units (AIR). The power supply for the remote radios is in some cases provided by the macro cabinet.

6 RADIO SHELF

The RBS 6000 family uses the following main radio components for GSM, WCDMA and LTE:

6.1 RU – Radio Unit

- Transceiver (TRX)
- Transmitter (TX) amplification
- Transmitter/Receiver (TX/RX) duplexing
- TX/RX filtering
- Voltage Standing Wave Ratio (VSWR) support

6.2 DU – Digital Processing Unit

- Control processing
- Clock distribution
- Synchronization from transport i/f or GPS
- Baseband processing
- Transport network interface
- RU interconnects
- Site Local Area Network (LAN) and maintenance interface

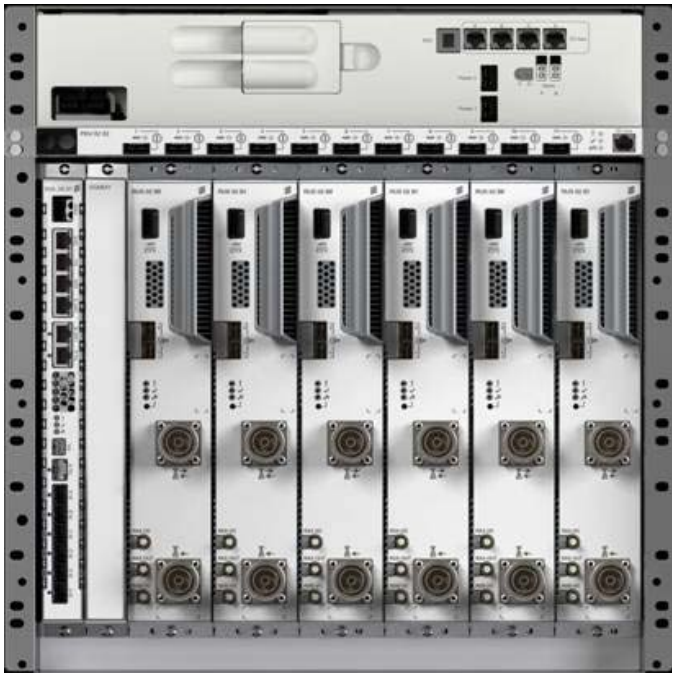


Figure 2-13: Radio shelf.

The radio shelf in RBS 6000 base stations supports a wide variety of RU's and DU's for all main frequency bands and any combination of Radio Frequency (RF) technologies (GSM, WCDMA, or LTE). Each radio shelf supports up to 6 RU's and a fully configured macro RBS can house up to 12 RU's.

7 DIGITAL UNIT for GSM (DUG)

The Digital Unit GSM (DUG) can control up to 12 GSM carriers. If more than 12 TRX's are required, then an additional DUG can be installed in the radio shelf and synchronized with other DUG's in the cabinet using TG Sync.

The DUG comes in two variants; DUG10 supports RUG whereas DUG20 supports RUS and RRUS.

The DUG supports the cross-connection of individual time slots to specific TRX's and extracts the synchronization information from the PCM link to generate a timing reference for the RBS.

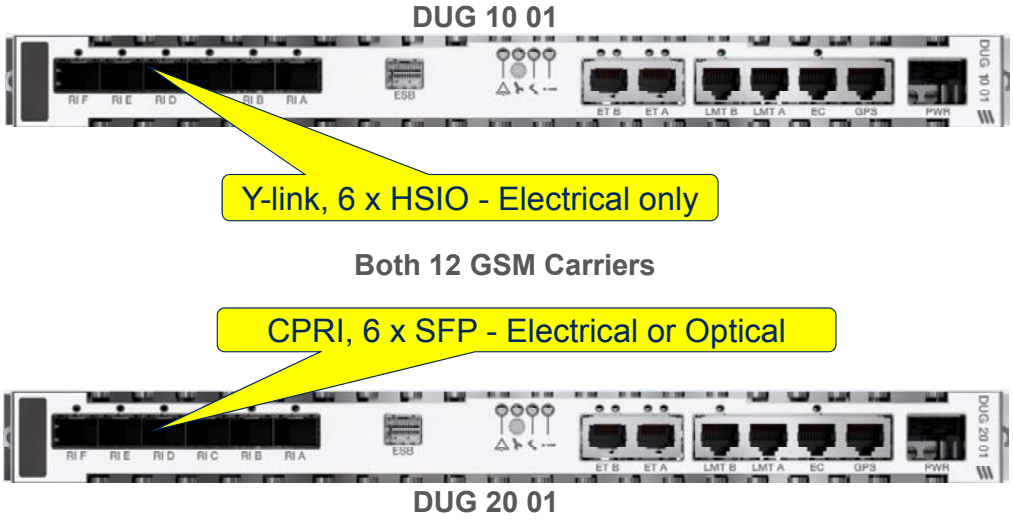


Figure 2-14: Digital Unit GSM, DUG

The DUG supports:

- E1/T1 transport interface
- Baseband processing (DUG20)
- LAPD concentration / multiplexing
- Abis optimization
- Multi-drop (cascading)
- Synchronized radio network, through an external GPS signal

- Transceiver Group (TG) synchronization
- Site LAN

To handle IP, a combination with optional equipment such as TCU, SIU, MINI-LINK or OMS is recommended.

7.1 DUG variants

DUG 10 01 and DUG 20 01 are the two variants of the DUG. They have the same capability in terms of maximum number of carrier capacity, measured in carrier elements, which is 12 GSM carrier, they differ in terms of *Interfaces*.

DUG 10 01 and DUG 20 01 have different radio interfaces. This is because the DUG 10 01 uses the architecture from RBS 2000, with the baseband circuitry on the Radio Unit (RU) (the RUG 11). Instead of a separate unit for TMA-CM (as in RBS 2000), this functionality is included in the DUG 10 01, and could be used for antenna supervision. Only electrical connection between the DU and RU is supported.

DUG 20 01 uses the same architecture as the other radio standards in RBS 6000 (WCDMA and LTE), with the baseband circuitry on the DU connected over the standardized Common Public Radio Interface (CPRI) 2.5 Gbps interface to a Radio Unit Multi-standard (RUS). In this case the RU includes the TMA-CM functionality and the CPRI interface supports both electrical and optical connection (the latter for main-remote configurations).

8 DIGITAL UNIT for WCDMA (DUW)

The Digital Unit WCDMA (DUW) is available in three variants, to match different capacity demands. The DUW contains the baseband, control, and switching, as well as the Iub and Mub interfaces. The DUW can handle different time-varying traffic mixes consisting of voice circuit-switched data, packet-switched data, and high-speed data such as High-Speed Packet Access (HSPA).

Baseband resources are pooled in the DUW and the number of Channel Elements (CE) and high-speed data capacity can be optimized to fit operator requirements for user type and number of services.

The baseband capacity is pooled independently of sectors and frequencies, and up to two baseband pools can exist (two DUW units) in the same node.

The baseband complies with 3GPP standards and is fully integrated with the same Operation and Maintenance (O&M) system as the RBS 3000 family. The software can be downloaded through the Operations Support System for Radio and Core (OSS-RC) interfaces, either locally or through the Radio Network Controller (RNC), and is stored in non-volatile memory in the RBS.

The RBS 6000 family software platform provides generic support for the application software and includes an execution platform with operating system, ATM and IP transport, and O&M infrastructure.

The DUW stabilizes the clock signal extracted from the transport network connection or optional external GPS equipment and uses it to synchronize the RBS.

DUW= CBU+ ET +TXB+RAXB+RUIF

The DUW provides:

- ATM connectivity
- Fast or Gigabit Ethernet (100/1000 Base-T)
- Channelized STM-1
- Four IMA capable E1/T1/J1 ports
- Additional interfaces and transport network configurations are available as options.

8.1 DUW Variants

DUW 10 01 (Version 2), DUW 20 01 (Version 1 and Version 2) and DUW 30 01 (Version 2) are the different variants of the DUW. The newer version is DUW 11, 31, 41 and all of which are version 1.

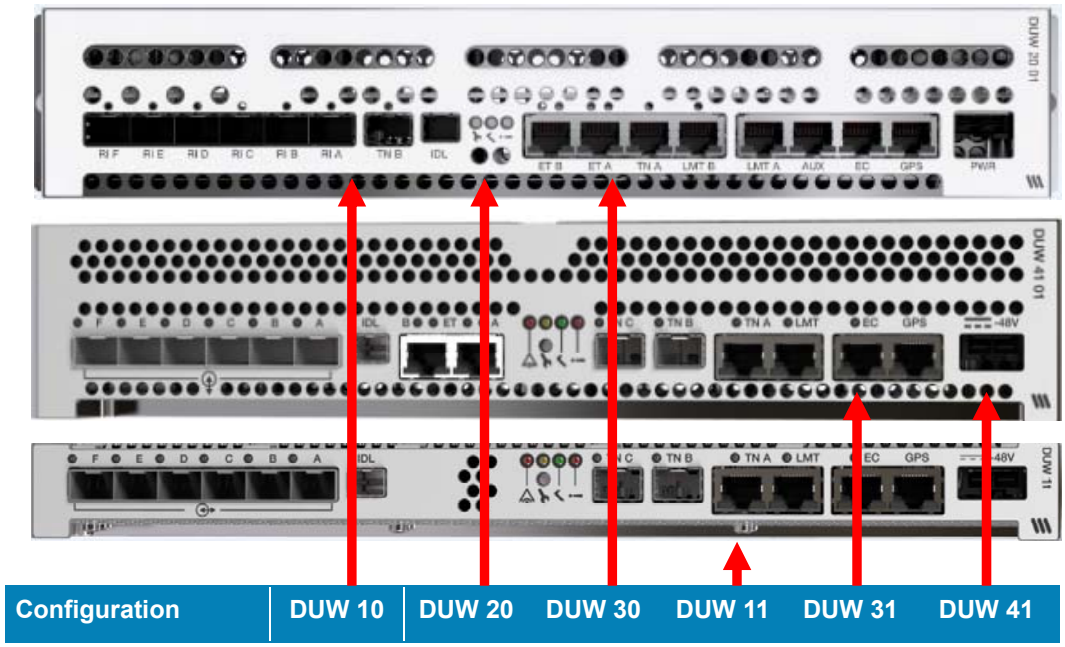


Figure 2-15: Digital Unit WCDMA, DUW

The Figure 2-16 below illustrates the Channel Elements for the various DUW variants.

Digital Unit	Capacity Data Maximum DCH (1) Capacity (Measured in Channel Elements)	Supported Radio Interface Connections CPRI
DUW 10 01	128 DL 128 UL, 192 EUL (2)	1.25 Gbps, 2.5 Gbps
DUW 11 01	128 DL 128 UL, 192 EUL (2)	1.25 Gbps, 2.5 Gbps, 5 Gbps (3), 10 Gbps (3)
DUW 20 01	384 DL 384 UL, 576 EUL (2)	1.25 Gbps, 2.5 Gbps
DUW 30 01	768 DL 512 UL, 768 EUL (2)	1.25 Gbps, 2.5 Gbps
DUW 31 01	768 DL 512 UL, 768 EUL (2)	1.25 Gbps, 2.5 Gbps, 5 Gbps (3), 10 Gbps (3)
DUW 41 01	768 DL 768 UL, 1152 EUL (2)	1.25 Gbps, 2.5 Gbps, 5 Gbps (3), 10 Gbps (3)

(1) Dedicated Channel.
(2) FAJ 121 2598, CE extension for EUL, is required for the 50% additional Dynamic Channel Elements.
(3) Depending on the Software Package.

Figure 2-16: DUW Technical Data

9 CBU BASED WCDMA RBS (HARDWARE)

9.1 Control Base Unit (CBU)

The Control Base Unit (CBU) is the central control unit of the RBS. It handles several control functions and provides for the most common transport network connectivity requirements. The CBU also contains power distribution and filtering.

Number of units: 1

9.2 Transmitter Boards (TX or TX-HS)

The baseband Transmitter Board (TXB) is fully HSDPA capable and available with different HSDPA (code) and R99 Channel Element (CE) capacities.

The TXB consists of the baseband TX part, taking care of the following cell splitting, channel combining, encoding, and modulation and spreading as well as handling transport channels.

Number of units: 1-2

9.3 Random Access and Receiver Boards (RAX)

The baseband Random Access and Receiver Board (RAXB) consists of the baseband RX part and handles cell combination for softer handover, decoding, RAKE receiving, searching as well as dedicated and random access transport channels.

The RAXB in RBS 6102 is fully Enhanced Up-Link (EUL) compatible, with 2 and 10 ms Transmit Time Interval (TTI).

Number of units: 1-6

9.4 Radio Unit Interface (RUIF)

The Radio Unit Interface (RUIF) contains point-to-point connections through cables to the RUs. The RUIF carries both signals for transmit and receive paths, as well as the digital control signals and timing signals.

Number of units: 1

9.5 Exchange Terminal Boards (ET)

The Exchange Terminal Boards (ETBs) provide additional or other types of transport network connection ports. The use of ETBs is optional since the CBU already provides 4 E1/T1-ports.

It is possible to equip the cabinet with transmission options such as: E1/J1/T1, E3/J3/T3, and STM-1 (channelized and non-channelized) and Ethernet.

Number of units: 0-4

The Figure 2-17 below illustrates the Control Base Unit which is the earlier version before being replaced by Digital Units.

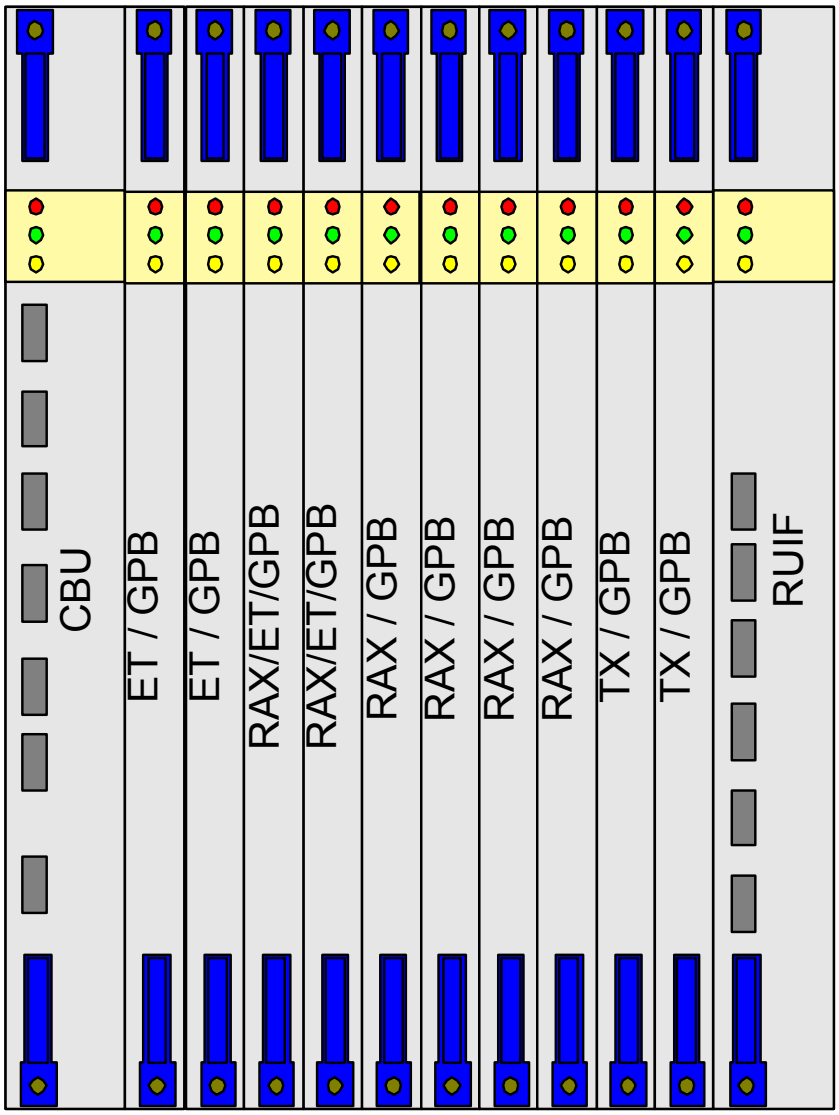


Figure 2-17: CBU Based Digital Sub-rack.

10 DIGITAL UNIT for LTE (DUL)

The single version DUL contains the baseband, control, and switching, as well as the S1 and Mub interfaces for LTE RBSs. The DUL supports different time-varying traffic mixes over the LTE high-speed data interface.

The baseband capacity is pooled independently of sectors and frequencies, and up to two baseband pools can exist (two DUL units) in the same node.

The baseband complies with the 3GPP standards. The O&M is fully integrated into the same O&M system as the RBS 3000 family (OSS-RC). The software can be downloaded through the OSS-RC, either locally or through an access gateway, and is stored in non-volatile memory in the RBS.

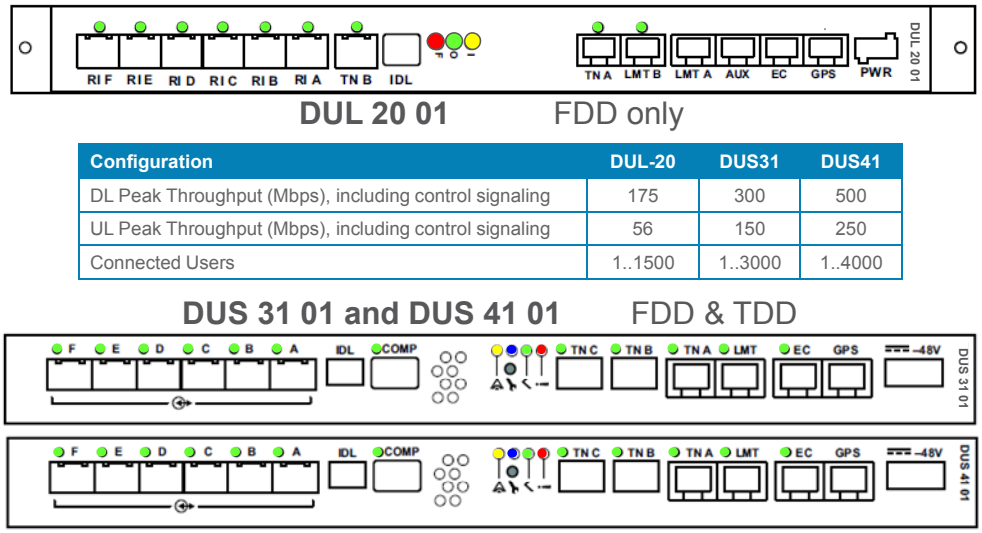
The RBS 6000 family software platform provides generic support for the application software and includes an execution platform with operating system, IP transport, and O&M infrastructure.

The DUL stabilizes the clock signal extracted from the transport network connection or optional external GPS equipment and uses it to synchronize the RBS.

The DUL provides:

- Full IP connectivity
- A Gigabit Ethernet transport network interface

Additional interfaces and transport network configurations are available as options.



Configuration	DUL-20	DUS31	DUS41
DL Peak Throughput (Mbps), including control signaling	175	300	500
UL Peak Throughput (Mbps), including control signaling	56	150	250
Connected Users	1..1500	1..3000	1..4000

Figure 2-18: Digital Unit LTE, DUL

11 RADIO UNIT ARCHITECTURE

The RU consists of a filter and a multi-carrier power amplifier. The radio has a 20 MHz bandwidth and up to 60 W of output power, with the latter available in steps of 20 W by hardware activation keys. The antenna system interfaces with a TX/RX port and an RX port. The radio (RUS) can transmit two standards simultaneously.

The RU contains co-sitting ports, for example, for GSM/WCDMA antenna sharing, and cross-connection that minimizes the number of feeders if more than one RU per sector is used.

The antenna jumper cable that interfaces the RU should have a straight 7/16" connector.

12 RADIO UNIT for GSM (RUG)

Two GSM variants are offered: one low to mid-capacity (2 TRX's per radio) and one high-capacity version with (4 TRX's per radio).

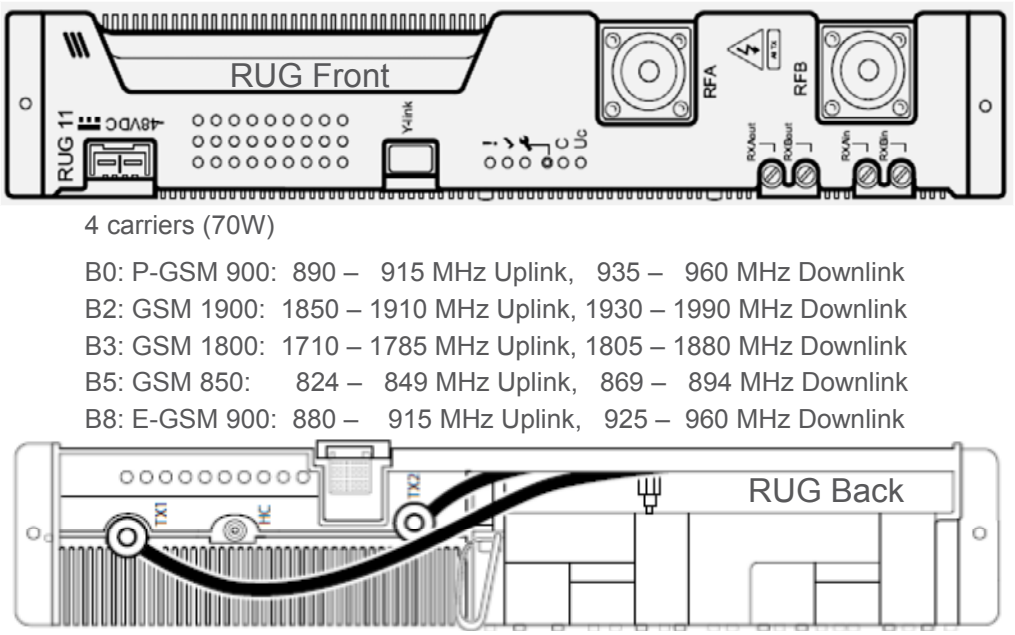
The low-to-mid capacity radio (RUG) consists of two GSM TRX's, one hybrid combiner; two duplex filters, and two bias injectors. The radio supports 2×40 W un-combined or 2×20 W combined configurations. Up to six RUs can be installed in one radio shelf; enabling up to 12 TRX's per radio shelf or 24 TRX's in an enclosure with two radio shelves. The low to mid capacity radio also supports supreme coverage mode by use of Transmitter Coherent Combining (TCC), which provides an increased cell radius for the downlink. The result is 6 dB higher signal output power compared with the combined version. To compensate the uplink when TCC is used, 4-way RX diversity can be configured.

The high-capacity radio (RUS) consists of four GSM TRX's and a 60 W Multi-carrier Power Amplifier (MCPA). High-capacity GSM radio configurations such as 3×8 to 3×12 requires only 2 antenna branches per sector when the MCPA version is used. Statistical use of power over the TRX's

A mixed mode of low-to-mid and high capacity RU's can be used for a coverage/capacity RBS site.

All GSM radio supports all time slots for General Packet Radio Services (GPRS) and Enhanced Data Rate for Global Evolution (EDGE), including EDGE Evolution enhancements.

The Figure 2-19 below illustrates the RUG11 Technical data.



4 carriers (70W)

B0: P-GSM 900: 890 – 915 MHz Uplink, 935 – 960 MHz Downlink
B2: GSM 1900: 1850 – 1910 MHz Uplink, 1930 – 1990 MHz Downlink
B3: GSM 1800: 1710 – 1785 MHz Uplink, 1805 – 1880 MHz Downlink
B5: GSM 850: 824 – 849 MHz Uplink, 869 – 894 MHz Downlink
B8: E-GSM 900: 880 – 915 MHz Uplink, 925 – 960 MHz Downlink

Figure 2-19: Radio Unit GSM, RUG

12.1 Combining types

There are four types of different configurations to use depending on preference. The different configurations are given from how the transmit signals are combined. The combining types to choose between: uncombined, combined and TCC / 4WRD.

12.1.1 Uncombined Mode

Uncombined mode means that the GSM carriers are not subject to any combining at all. The output power is 3.5 dB higher than combined mode. The drawback is that it requires more feeders and antennas compared with combined mode. Uncombined mode is normally used for coverage applications such as rural, highway and suburban environments. Uncombined capacity is added in steps of two carriers. Configurations based on uncombined mode sometimes referred to as “Coverage Mode”.

12.1.2 Combined Mode

Combined mode means that the GSM carriers are subject to hybrid combining inside the RU. The output power is reduced with 3.5 dB compared with uncombined. The advantage with combined mode is that it reduces the number of feeders and antennas compared with uncombined mode. Combined mode is normally used in capacity applications such as dense urban, urban and suburban environments. Combined capacity is added in steps of two carriers per sector. Configurations based on combined mode are sometimes referred to as “Capacity Mode”.

12.1.3 Transmitter Coherent Combining

TCC / 4WRD or “Transmitter Coherent Combining and Four Way Receiver Diversity” is a mode where two GSM carriers are coherently combined into one GSM carrier with 2.5 dB higher output power than uncombined mode. In order to achieve a balanced link budget, 4WRD is used on the uplink together with TMAs. The uplink improvements will then be in the range of 3.4 – 5 dB. The configuration of TCC and 4WRD is sometimes referred to as “Supreme Coverage Mode”. TMA supporting is ordered as a separate SW feature.

Available options are:

- Uncombined
- Combined
- TCC/4WRD
- N/A (for RUS 01)

12.2 Abis over IP and Abis Local connectivity prepared

The optional features Abis over IP, Abis Optimization and Abis Local connectivity will require a Site Integration Unit (SIU). More information about the SIU is available towards the end of this chapter. Selecting this option, you will have the Site Integration Unit with accessories to install it in an RBS 6000 Macro Site.

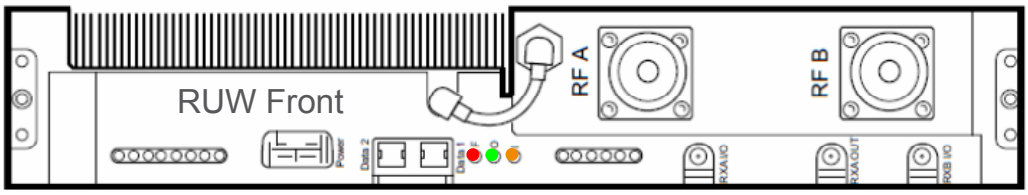
13 RADIO UNIT for WCDMA (RUW)

The RU for WCDMA (RUW and RUS) is an evolution of the current RU/FU concept, which combines the previously separate RU and Filter Unit (FU) in one unit. The radio supports 60 W of output power with a bandwidth of 20 MHz. Each unit is capable of handling four cell carriers in both downlink and uplink. Multiple radio units can be combined to create various single- or dual-band configurations with 1–6 sectors and 1–4 carriers.

With two units per sector the radio is prepared to support MIMO, transmitter diversity, and 4-way RX diversity. It also supports 3GPP/AISG-compatible TMA/ ASC/RET Interface Unit.

13.1 RUW Variants

RUW has two variants depending on the frequency band as illustrated below.



RUW 01 B1 (2100) 20/60W:
1920 – 1980 MHz Uplink
2110 – 2170 MHz Downlink

RUW 02 B11 (1500) 20/60W:
1427 – 1437 MHz Uplink
1475 – 1485 MHz Downlink

Figure 2-20: Radio Unit WCDMA, RUW

14 RADIO UNIT for LTE (RUL)

The RU for LTE (RUL and RUS) supports 60 W output power with a bandwidth of 20 MHz. Multiple radio units can be combined into different radio configurations from 1–6 sectors and up to 20 MHz for single or dual band configurations.

With two units per sector the radio is prepared to support MIMO, transmitter diversity, and 4-way RX diversity. It also supports 3GPP/AISG-compatible TMA/ASC/RIU.

14.1 RUL Variant

RUL has only one variant as illustrated below with one frequency band.

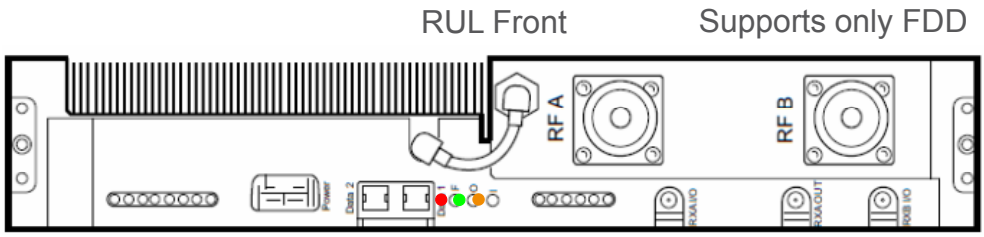


Figure 2-21: Radio Unit LTE, RUL

15 MULTI STANDARD RADIO (RUS)

The RUS supports 60W output power for any standard with a bandwidth of 20MHz. However the newer RUS 02 has the capability to support up to 100W output power. Each unit is capable of handling four cell carriers in both downlink and uplink. Multiple RU can be combined to create various single- or dual-band configurations with 1–6 sectors and 1–4 carriers.

With two units per sector the radio is prepared to support MIMO, transmitter diversity, and 4-way RX diversity. It also supports 3GPP/AISG-compatible TMA/ASC/RIU.

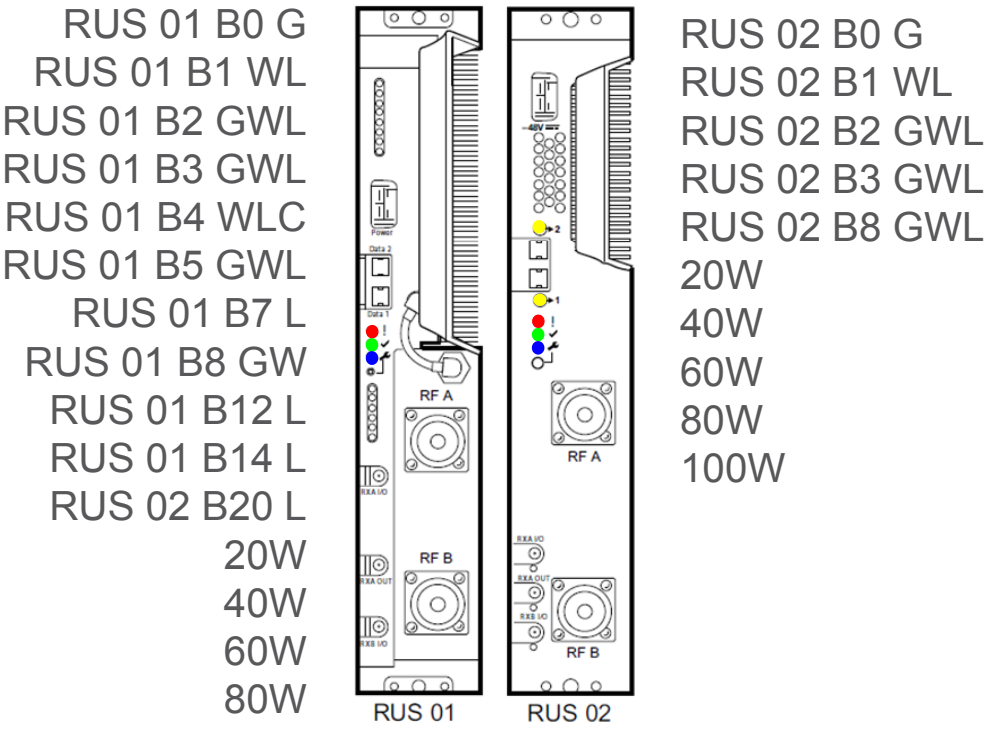


Figure 2-22: Radio Unit Multistandard, RUS

16 CDMA ADDED TO RBS 6000

With the addition of CDMA, the RBS 6000 portfolio now includes four radio standards: GSM, WCDMA, LTE and CDMA. CDMA Network Modernization is underway and same radio parts can be used for all these standards in mixed mode operation. The CDMA baseband DBA is compatible with the RBS 6000 radio.

The drivers for introducing CDMA in RBS 6000:

- To retain CDMA customer base for migration to LTE
- For CDMA network modernization
- To win new CDMA market share
- Reduced cell site footprint (Multi-Modal RBS6000)
- Efficient use of spectrum (MSMM)
- Improved RF Performance (AIR etc.)
- To modernize and improve competitiveness of CDMA portfolio

Figure 2-23: CDMA added to RBS 6000 G / W / L & C

For CDMA, digital baseband combining is used. This is accomplished in a special unit, the XMU. Mode operation of LTE and CDMA in the radio is then enabled.

16.1 Digital Baseband Advanced (DBA)

The DBA (Digital Baseband Advanced) is Ericsson's newest CDMA baseband module for CDMA 1X, 1X Advanced and and EV-DO support. It is a high capacity, technologically advanced module that has been size reduced to a thickness of 2U (3.5 inches) to facilitate its integration into the RBS 6000 product family. It has on-board QC 8700 (for 1X-Advanced) and QC 6850 (for EV-DO) chipsets. This on-board H/W will support 2 carriers of 1X Advanced upon initial availability, and will support 2 carriers of EV-DO through a planned software upgrade. Additional on-board EV-DO carrier expansion may be possible via future software upgrades. The DBA supports a maximum of 6 carriers when combined with a Channel Element Expansion Module (CEEM) and pluggable 1X and/or DO modules.

The Figure 2-24 below illustrates the Digital Baseband Combining for CDMA RBS.

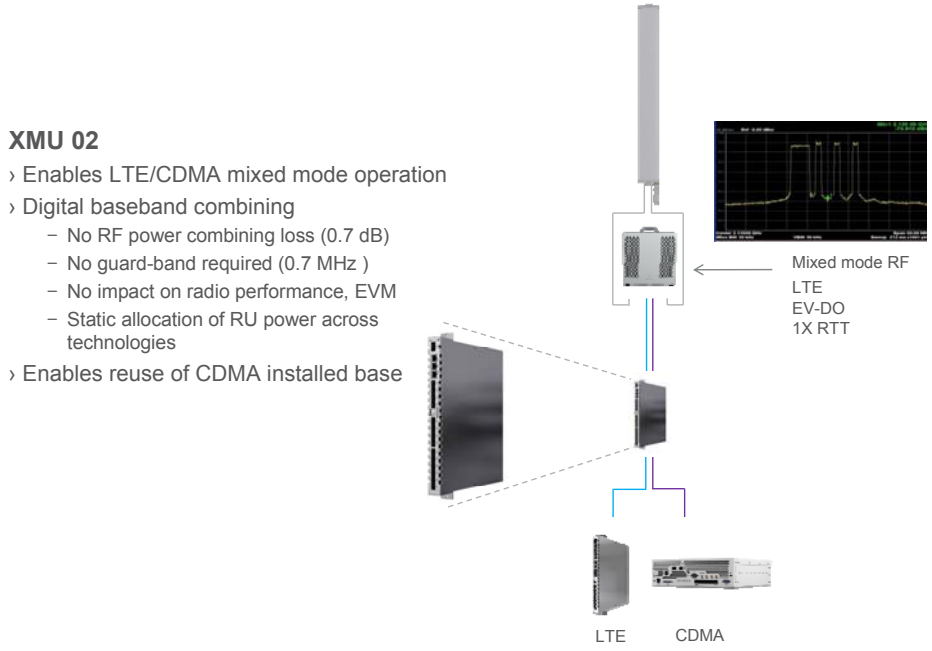


Figure 2-24: Digital Baseband Combining

17 SITE INTEGRATION UNIT

The Site Integration Unit (SIU) acts as a cell-site gateway combining and optimizing all traffic from site to maximize usage of backhaul resources. In addition it supports connection of modern Ethernet based surveillance, alarm and other site equipment without requiring an extra line to the site. Towards the backhaul network it supports Ethernet, IP and PDH networks with both single and redundant circuits. Examples of applications for the SIU are:

- Abis Optimization - Reduces GSM backhaul bandwidth with 35- 50 %
- Abis Local Connectivity - All local GSM voice traffic is switched locally in SIU, thereby reducing backhaul bandwidth with 100% for this traffic.
- Transport sharing - All RBSs (GSM, WCDMA and LTE) on site share dynamically the available backhaul bandwidth. This enables the operator to e.g. launch HSPA services with minimal backhaul capacity increase
- IP over E1/T1 - makes it possible to deploy WCDMA Iub IP and LTE everywhere in the network, even when Ethernet services are not available. Combined with Transport sharing this gives a very efficient way of launching HSPA and LTE everywhere

- Security Gateway - protects the all site traffic with IPsec. Also enables efficient tunneling of traffic through service provider's network.
- Cell site router - Routing and VLAN capability to prioritize QoS enabled traffic over backhaul network.

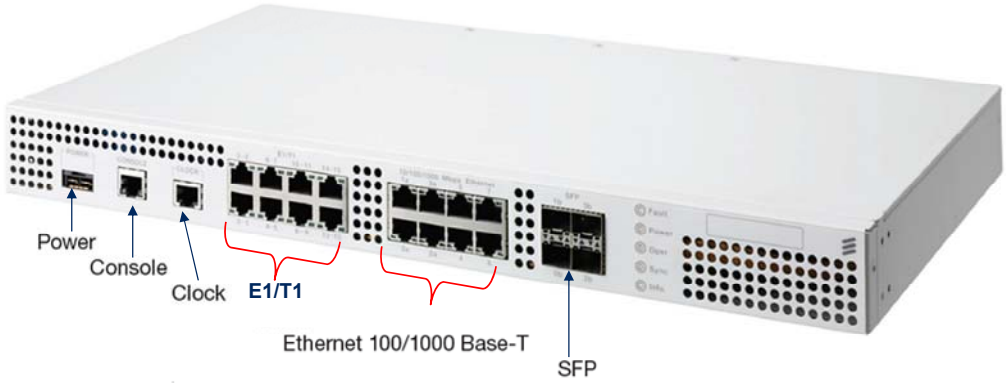


Figure 2-25: Site Integration Unit.

The SIU is a 1 U high, 19 inch wide, mobile site router and optimization/aggregation unit dedicated for efficient deployment of mobile sites.

The SIU has an Ericsson unique synchronization solution that works over virtually any backhaul technology, including Satellite backhaul, without the need for a GPS solution at the RBS site.

The SIU also has four Site-LAN Ethernet ports for connecting local site equipment.

18 TRANSPORT CONNECTIVITY UNIT, TCU 02

The TCU is the common transmission module in a Multi Standard RBS6000, used to realize a common transmission node for GSM, WCDMA and LTE. The TCU is a separate node and does not communicate with the RBS except for transmission.

For single standard radio operation only, the transmission interface in the digital unit is normally sufficient. For multi standard radio operation the TCU can be used to support one common backhaul interface. The common transmission interface can be either Ethernet or IP over E1/T1. The TCU natively supports GSM migration from E1/T1 transmission to Ethernet transmission with the BSS feature "Packet Abis over IP". The TCU 02 has the same form factor as e.g. a DUG.

The Figure 2-26 below illustrates the TCU 02 labelling details.

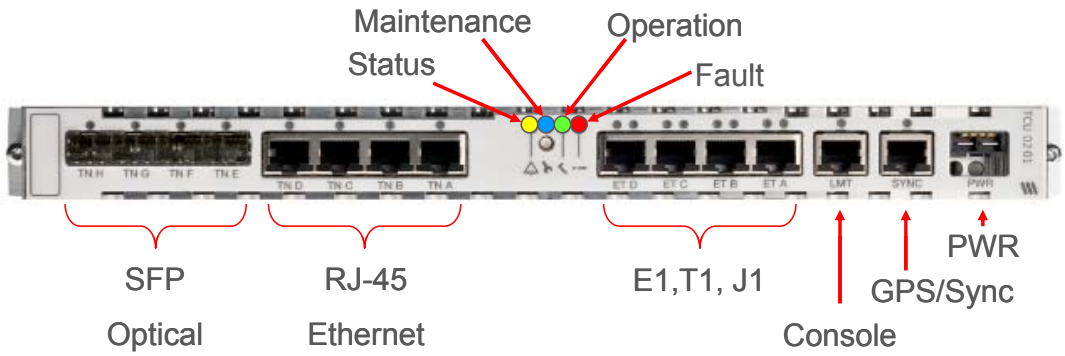


Figure 2-26: Transport Connectivity Unit, TCU 02

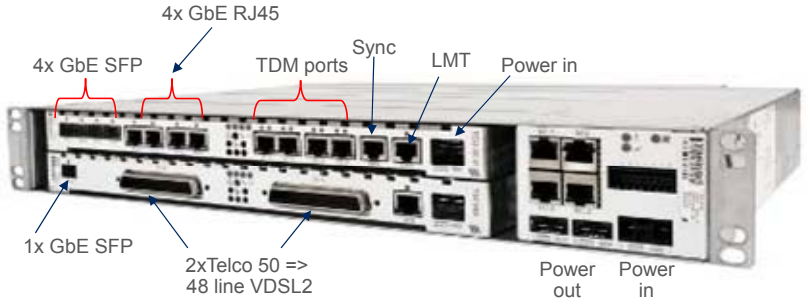
For single standard radio operation only, the transmission interface in the digital unit is normally sufficient. For multi standard radio operation the TCU can be used to support one common backhaul interface. The common transmission interface can be either Ethernet or IP over E1/T1. The TCU natively supports GSM migration from E1/T1 transmission to Ethernet transmission with the BSS feature "Packet Abis over IP". The TCU 02 has the same form factor as e.g. a DUG.

19 INDOOR PICO GATEWAY, IPG 6440

The IPG 6440, Indoor Pico Gateway, is part of Ericsson's leading multi-standard RBS 6000 product family. It is a modular aggregation solution designed for indoor small cells based on micro RRU, Pico RBS, and stand-alone Wi-Fi Access Points.

It supports mobile operators combining the best characteristics from both Distributed Antenna Systems and Small Cells Radio nodes, providing significant cost savings and performance enhancements due to fully coordinated radio layers, deployment flexibility and re-use of existing in building infra-structure.

The Figure 2-27 below illustrates the IPG 6440 labelling details.



- TCU 02 for synchronization, provisioning, security, observability, traffic management, robustness and routing functionality
- 48-line Transmission Interface Unit, co-developed with pRBS transport solution for Vectorized VDSL2 with NTR packet sync
- Digital Units for mRRU CPRI links by cascading additional 6601

Figure 2-27: Indoor Pico Gateway, IPG 6440

IPG 6440 is part of Ericsson's new small cell indoor offering. With this, operators are given a new highly effective way to build indoor data coverage for meeting the demands of smartphone driven mobile broadband traffic growth. IPG supports coordinated clusters of indoor small cells with the outdoor macro network, since it combines Radio Baseband and Transport Aggregation with key features such as:

- RAN synchronization over packet backhaul
- Transmission interface flexibility
- Backhaul bandwidth dynamically shared between radio technologies, optimizing peak capacity for HSPA and LTE
- Ethernet bridge and IP routing functions
- Rapid fault detection and fail over to an alternative transport link via Bidirectional Forwarding Direction, BFD
- IPv6 capabilities including support for IPv4 and IPv6 dual stack
- L2/L3 transport sharing with QoS for multi-standard radio deployments
- OSS-RC Management System support guarantees smooth operations

20 SUMMARY

Upon completion of this chapter, the participants should be able to:

2 Describe on an overview level the RBS 6000 Platform and understand how Radio Access for various radio technologies is implemented in the RBS 6000

2.1 Understand the RBS 6000 Full Freedom, Hybrid Concept and the Unit migration

2.2 Describe the single, multi standard and mixed mode in RBS 6000

2.3 Describe on block level the Digital Unit and Radio Unit for GSM, WCDMA and LTE

2.4 Understand how CDMA is now added into RBS 6000

2.5 Understand the Transport Units such as the Site Integration Unit (SIU), Transport Connectivity Unit (TCU) and Indoor Pico Gateway (IPG 6440)

Figure 2-28: Summary of Chapter 2

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3 RBS 6000 Portfolio

Objectives

Upon completion of this chapter, the participants will be able to:

1 Detail the RBS 6000 portfolio for compact macro, full-size macro, main-remote and micro RBS

3.1 Describe the full size macro base station RBS 6102

3.2 Describe the compact outdoor macro base station RBS 6101

3.3 Describe the full size macro base station RBS 6201

3.4 Describe the compact indoor macro base station RBS 6202

3.5 Describe the compact main-remote base station RBS 6601 with Remote Radio Units (RRU) and Antenna Integrated Radio (AIR)

3.6 Describe the compact main-remote base station RBS 6301 and 6302

3.7 Describe the micro RBS 6501 and pico RBS 6401

3.8 Understand the site power for all RBS 6000

Figure 3-1: Chapter Objectives

1 RBS FAMILY OVERVIEW

The RBS 6000 series is designed to support multiple radio technologies. All common GSM, WCDMA, LTE and CDMA frequencies are supported in a single cabinet with common support equipment and can be mixed in virtually any combination. As the first mainstream commercial product to include LTE, the RBS 6201 ensures a smooth transition to tomorrow's technology, while providing exceptional GSM, WCDMA, LTE and CDMA capacity to meet today's market needs.

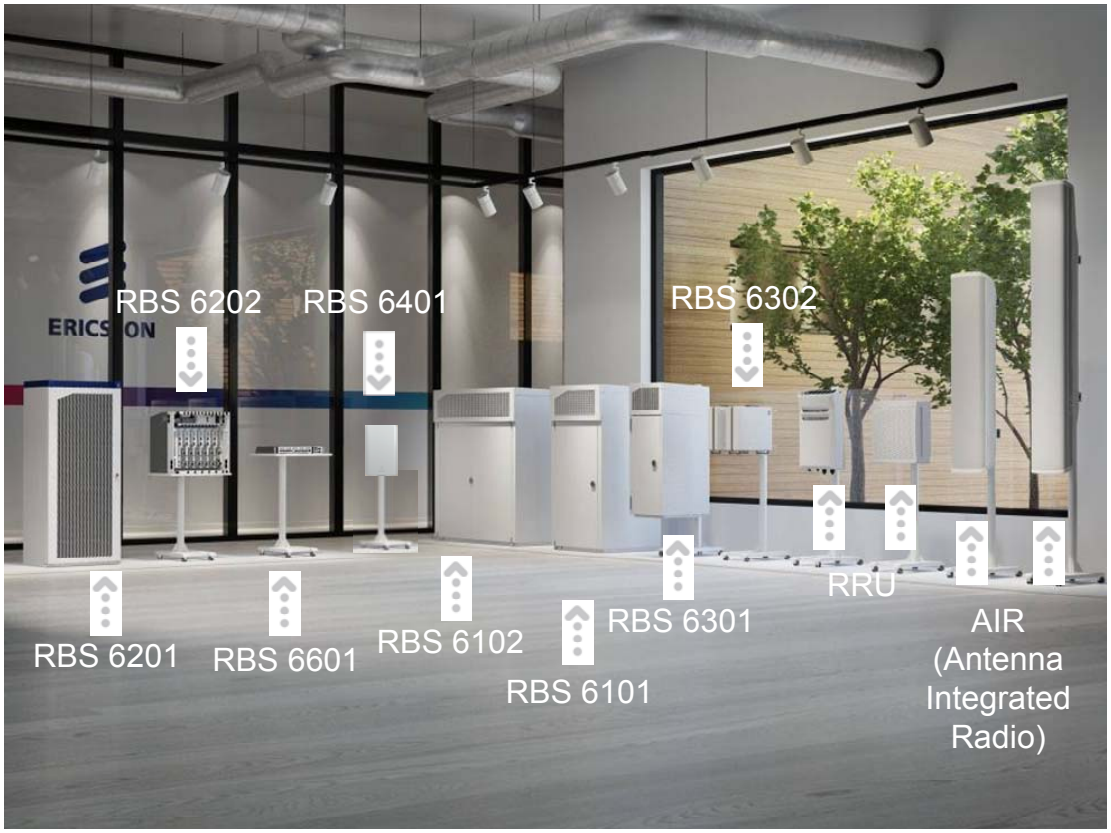


Figure 3-2: RBS 6000 Family

2 INTRODUCTION

Mobile broadband traffic is growing rapidly, driven by the increasing popularity of connected devices, such as smartphones and tablets. User expectations for mobile broadband are on the rise as people rely more and more on mobile applications, video content, cloud-based services and staying connected anywhere, anytime. Consumers have come to expect a consistent, high-quality and seamless mobile broadband experience wherever they are.

Meeting these expectations is a key priority for operators looking to differentiate themselves in the Networked Society, in which everything that can benefit from a connection will be connected. To provide the right mobile broadband experience, networks need sufficient capacity and coverage to deliver high data throughput with very low latency. One approach is to deploy a heterogeneous network, commonly referred to as a hetnet.

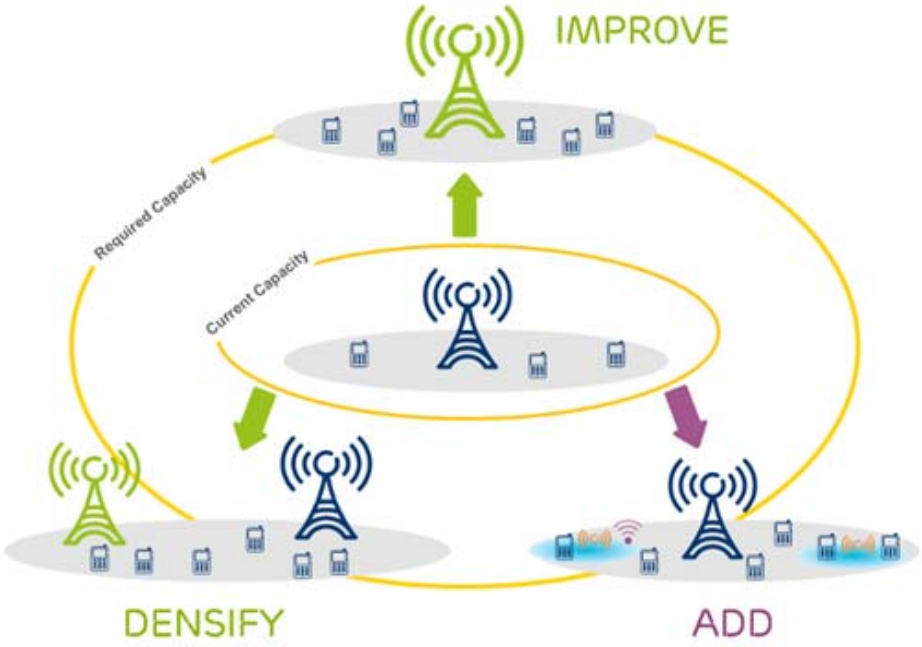


Figure 3-3: Hetnet toolbox

To prepare networks for surging traffic demand, operators should improve and densify their existing mobile broadband networks and add small cells in an optimal way. How, when and where operators migrate to heterogeneous networks will be dictated by their mobile broadband services and their existing networks, as well as broader market, technical and economic considerations. One size does not fit all, and flexibility is needed to ensure that customer expectations are met in the most cost effective, spectrum-efficient and future-proof way.

Users are increasingly aware of the connection speed, data rate, coverage and availability of their mobile broadband services. To ensure that subscribers remain satisfied, operators must deliver a consistent, high-quality and seamless mobile broadband experience that meets or exceeds their expectations.

To obtain maximum value from the radio spectrum, operators will need flexible base-station site solutions that allow for ideal placement of the radio site. Operators may need to consider alternatives for site location by connecting with new partners such as municipalities, retailers and external agencies rather than traditional deals made with landlords and tower-approval committees. In metropolitan areas, complementing an already dense macro network with additional small cells at street level needs to be implemented using small antennas in such a way that equipment is almost invisible.

For most operators, radio spectrum is a limited resource and one of the most strategic and important investments. Naturally, this fact leads to a demand for spectrum to be used as efficiently as possible – especially in densely populated areas.

The performance of a heterogeneous network depends greatly on the degree of radio coordination. If the underlaid small-cell layer is uncoordinated, spectrum needs to be partitioned to avoid interference, which leads to inefficient use of radio spectrum and a direct loss in achievable user bit-rates. By using coordinated embedded cells instead, the spectrum can be fully reused in both layers – macro and small-cell underlay – which means the same services can be delivered using half the spectrum, simply because the achievable user bit-rate is proportional to spectrum bandwidth. Coordinated embedded cells also increase capacity so that only 30-50 percent as many smaller cells are needed to provide the same total network traffic and increase user bit-rates for devices limited by transmission power or interference by a factor of two to ten (source: Ericsson). The performance of coordinated embedded cells is enabled by efficient spectrum reuse across layers and radio coordination functionality. Consequently, single-vendor solutions for heterogeneous networks make sense from a coordination and interworking perspective – saving spectrum and reducing the total cost of ownership for the small-cell layer by at least 50 percent (source: Ericsson) as the result of reduced infrastructure (fewer cells needed), rollout, operation and maintenance costs.

Designing a heterogeneous network in the most effective way involves improving, densifying and adding to the mobile broadband infrastructure:

2.1 Improve Existing Macro Cell Sites

By enhancing macro cells with more spectrum, advanced antennas, increased order of diversity on the receiver and/or the transmitter, and greater baseband processing capacity within and between nodes. Continued evolution of HSPA and LTE technology will drive macro network efficiency through specialized features, such as higher-order modulation, higher sectorization, multi-carrier and multi-antenna solutions, as well as spectrum refarming using hybrid radio solutions. Increasing capacity and data rates in this way reduces the need for new sites.

2.2 Densify the Macro Network

The capacity and data rates achieved by enhancing the macro network alone will eventually prove insufficient to meet demand. The targeted addition of strategically located small cells can improve capacity. This approach keeps the total number of sites relatively low, while network performance becomes less sensitive to traffic location. A simple way to densify a network could be a cell-split, which enables a site to transition from a three-sector site to a six-sector site. These strategic cells could use macro equipment or even micro equipment.

2.3 Add Small Cells

Complement macro cells with small cells and dedicated indoor solutions based on the 3GPP standard. This approach can include the use of micro cells, Pico cells or low-power remote radio units (mRRUs), as well as Wi-Fi. It delivers high per-user capacity and rate coverage in areas covered by the small cells, with the potential to improve performance in the macro network by offloading traffic generated in hotspots. The degree of integration that can be achieved throughout the heterogeneous networks will determine the overall network performance.

2.4 Summary

RBS 6000, the Ericsson radio base station family, provides all necessary components for a successful deployment of a heterogeneous network. The products range from high-capacity base stations for macro coverage to products specifically targeted for small cell deployment. The RBS 6000 base station family is designed to meet the increasingly complex challenges facing operators today

The RBS 6000 series ensures a smooth migration to new functionality and new technologies with existing sites and cabinets, thus providing a path to sustained revenues and profits. Multi-purpose cabinets, an innovative common building practice for all components, modular design, and an extremely high level of integration bring the functionality and capacity of an entire site down to the size of a cabinet.

All RBS 6000 base stations support multiple radio technologies. The same radio hardware is used irrespective of standard, which means that an investment in RBS 6000 is an investment in the future, as it offers a seamless, integrated and environmentally friendly solution and a safe, smart and sound roadmap for whatever tomorrow holds.

3 RBS 6102 – OUTDOOR MACRO BASE STATION

RBS 6102 is the high capacity outdoor base station belonging to the highly successful RBS 6000 family of state-of-the-art, multi standard base stations. The RBS 6000 series is designed to support a flexible mix of GSM, WCDMA, and LTE in the same base station, thereby ensuring a smooth transition between the radio technologies. RBS 6102 provides world-leading performance when it comes to radio performance, capacity capabilities and flexibility. RBS 6102 can be used in a wide range of different applications. All equipment needed for constituting a complete site, such as power supplies and transmission equipment, is integrated in the single cabinet. Battery backup can be supplied either internally or externally.

RBS 6102 can be configured as a complete macro site with two shelves of internally installed radio units. Used as a macro site, RBS 6102 can be equipped to provide virtually any combination of digital and radio units, available for all relevant radio standards and frequency bands. RBS 6102 can also be used as a main unit in a main-remote configuration. Here, the radios are remotely installed in order to provide the best radio link budget possible. The remote radios can be of two types: remote radio units (RRU) installed close to the antenna, or antenna integrated radio units (AIR) where the radio parts and the antenna are integrated in one single unit. The remote radios are connected with optical fiber CPRI links. RBS 6102 also provides power supply to up to eighteen remote radios. The cabinet contains two radio shelves and all power, transport network and supporting equipment needed.

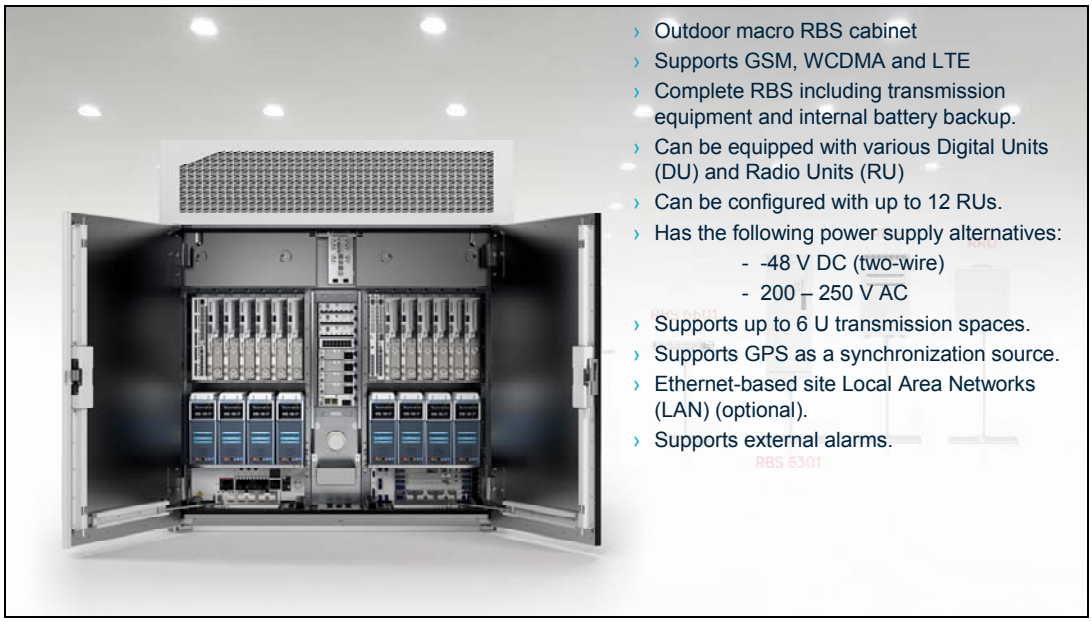


Figure 3-4: RBS 6102

RBS 6102 houses a complete site in a single cabinet. RBS 6102 has two radio shelves, thereby providing double radio capacity compared with RBS 6101 (12 radio units). This gives an extraordinary capacity as each radio shelf is capable of providing e.g. 3 x 16 GSM carriers. In the cabinet there is also space for two strings of batteries. This makes it possible to integrate a complete high-capacity site into a single cabinet.

RBS 6102 can be powered by AC or –48 V DC. Optimal operating conditions are secured by a modular climate system consisting of external and internal fans, a heat exchanger and an optional heater. RBS 6102 supports up to 32 external alarms via an optional support alarm unit.

Like the other members of the RBS 6000 family, RBS 6102 provides an additional continuous space for a common transport network solution. With fully equipped radio shelves there is space for up to 3U together with two strings of batteries and up to 6U with one string of batteries.

RBS 6102 can also be used in hybrid configurations, where RBS 6102 can act as a main unit in a main-remote configuration at the same time as being equipped with macro radio units. It can also act as a pure main unit. Up to 18 remote radios with power feeding can be connected to RBS 6102.

The two types of configurations, macro and main-remote, can be combined in the RBS 6102 cabinet. In these hybrid configurations, RBS 6102 is equipped both with internal radio units as well as connected to remote radios.

RBS 6102 Hybrid is available for CDMA.

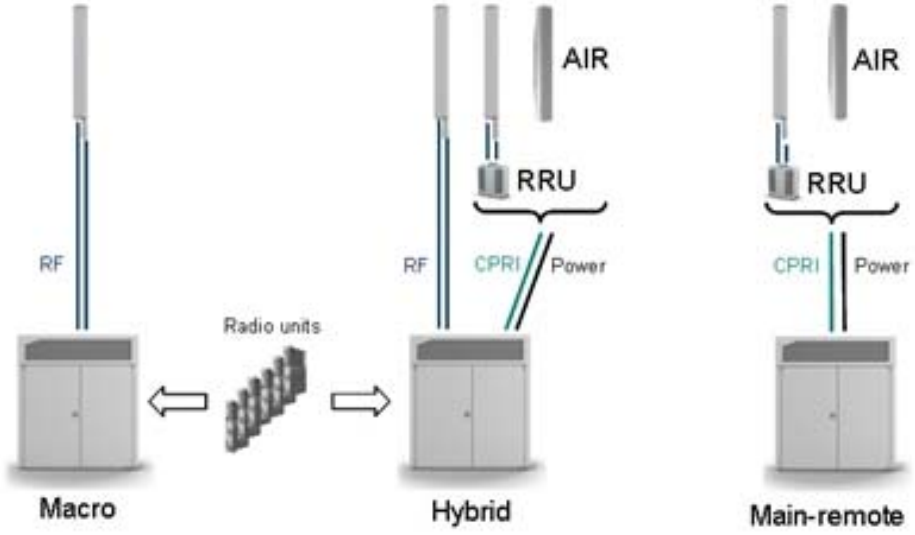


Figure 3-5: Configuration options for RBS 6102

3.1 Hardware Architecture

The hardware architecture allows for different site deployments but the main components constituting RBS 6000 and specifically the RBS 6102 are:

- Support for radio, battery, power and transmission in a single cabinet
- Radio capacity given by combination of Radio Units and Digital Units
- Power supply system for the total site need
- Enclosure including climate system

The Figure 3-6 below illustrates the outdoor RBS 6102.

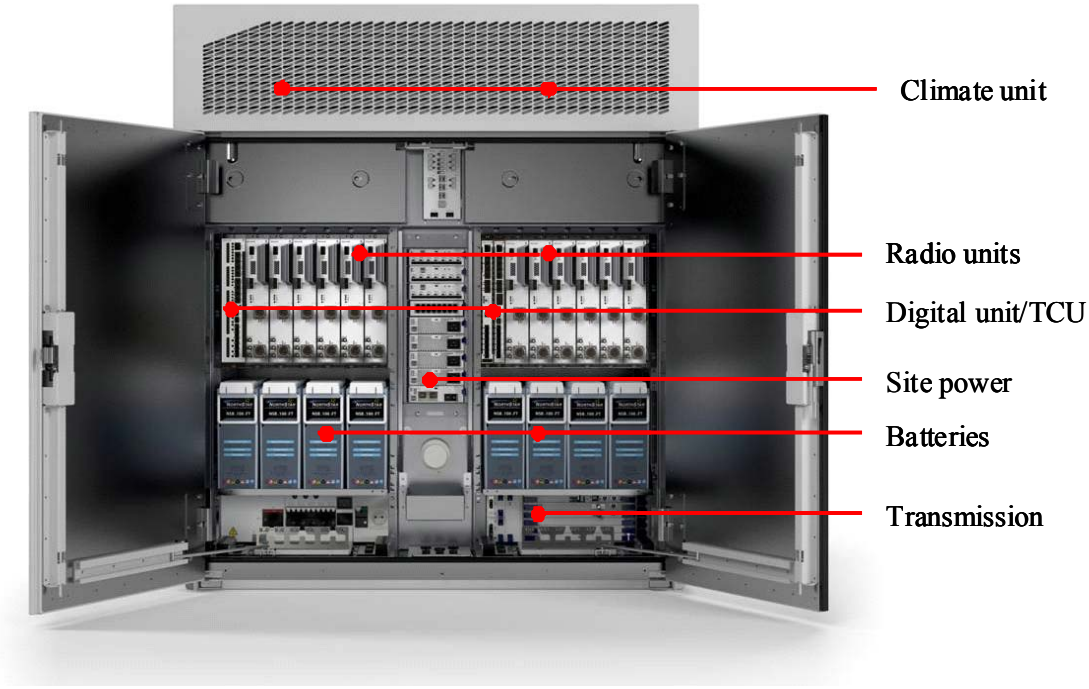


Figure 3-6: RBS 6102 hardware architecture

3.2 RBS Power System

RBS 6102 uses the latest technology in power conversion and control. This includes high density AC power modules and electronically controlled distribution fuses. The latter allows software managed shutdown of units and system parts in order to save energy and extend battery operation.

The built-in site power system eliminates the need for a separate site power plant. The system can handle battery charging of selected lead acid batteries.

The RBS power system is normally fed by AC, but can also support DC supply. The AC power system can, by means of software, control power delivery to selected units. The tolerant rectifiers (PSU AC) allow great voltage variation which eliminates the need for external voltage stabilization devices.

The RBS can also run directly on −48V DC, if existing site powers exist. The integrated RBS power system can also power external units with −48 V DC.

3.2.1 Enhanced Power Efficiency:

The improvements in the energy efficiency are based in three main areas:

- Intelligent stand-by operation of one (or more) individual PSU's can be performed in order to increase the power efficiency.
- The new RBS power solution gives an efficiency improvement for the power system in range of 10% compared with RBS 2000.
- There is a possibility to shut down power to site units for selected periods, e.g. night time, to reduce power consumption.

3.2.2 Battery Backup

The following battery backup solutions are available for the RBS 6102 and its site. The internal battery backup solution can supply up to three battery strings (100 Ah capacities per string). The internal space available for batteries is depending upon the radio configuration and used space for transport network equipment.

The BBU 6102 and BBS 6101/6102 are external battery backup solutions.

4 BBU 6102

The Battery Base Unit, BBU 6102 with up to 340 Ah, installed under the RBS, is an excellent choice for large battery backup requirements where the internal space for batteries is too small. The beauty with the BBU is that the complete site fits on the RBS footprint.

The BBU exist in two versions, one with free cooling and the other with active cooling. The active cooling reduces the battery temperatures in high temperature installations.

Figure 3-7: BBU 6102

4.1 BBS 6101/6102

The Battery Backup System, BBS 6102 with up to 1020 Ah, is ideal where large battery backup is required or for installations where a separate cabinet is preferred.

The BBS 6101 and BBS 6102 exist in two versions, one with free cooling and the other with active cooling. The active cooling reduces the battery temperatures in high temperature installations.

Figure 3-8: BBS 6101/6102

4.2 Transport Network Functionality

The RBS 6000 features integrated support for any type of transport network media (microwave, optical fiber or copper) in combination with the various technologies (IP/Ethernet, ATM, PDH/SDH, next gen SDH, xDSL etc.), redundancy schemes, aggregation methods and other functionalities that supports the Operator's choice of transport network.

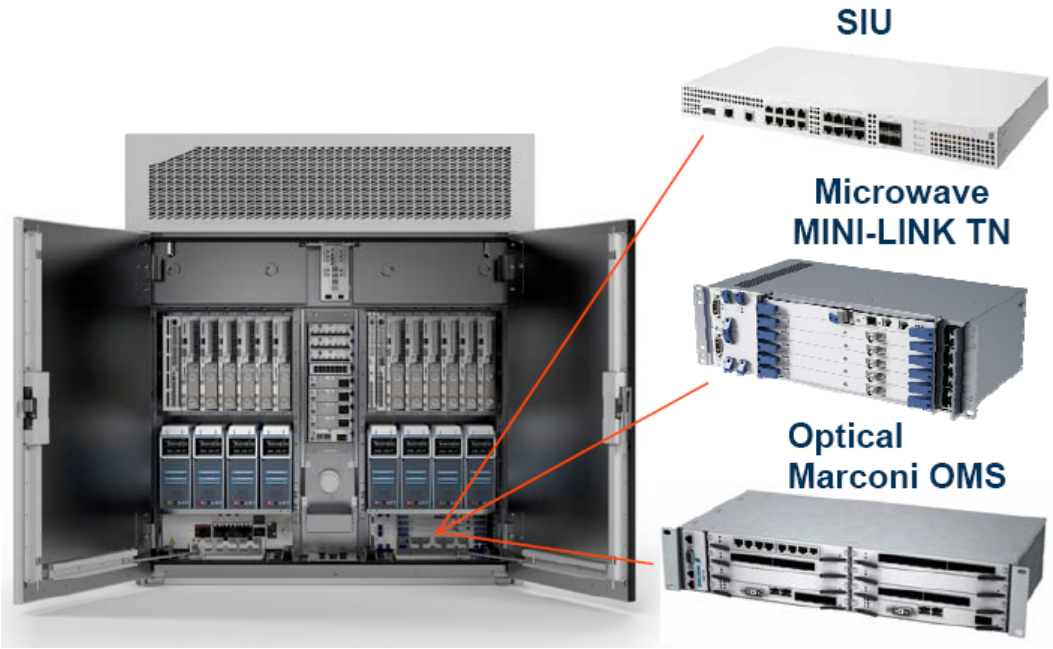


Figure 3-9: Transport Network Functionality RBS 6102

5 RBS 6101 – OUTDOOR MACRO BASE STATION

RBS 6101 is the small outdoor base station belonging to the highly successful RBS 6000 family of state-of-the-art, multi standard base stations. The RBS 6000 series is designed to support a flexible mix of GSM, WCDMA and LTE in the same base station, thereby ensuring a smooth transition between the radio technologies. RBS 6101 provides world-leading performance when it comes to radio performance, capacity capabilities and flexibility. RBS 6101 can be used in a wide range of different applications. All equipment needed for constituting a complete site, such as power supplies and transmission equipment, is integrated in the single cabinet. Battery backup can be supplied either internally or externally.

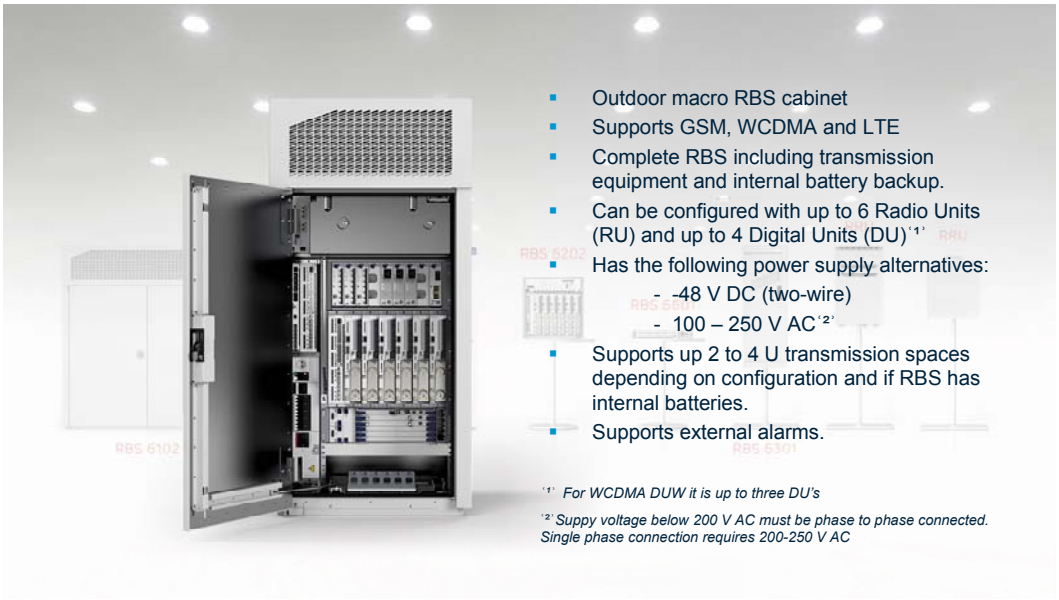


Figure 3-10: RBS 6101

RBS 6101 can be configured as a complete macro site with internally installed radio units. Used as a macro site, RBS 6101 can be equipped to provide virtually any combination of digital and radio units, available for all relevant radio standards and frequency bands. RBS 6101 can also be used as a main unit in a main-remote configuration. Here, the radios are remotely installed in order to provide the best radio link budget possible. The remote radios can be of two types: remote radio units (RRU) installed close to the antenna, or antenna integrated radio units (AIR) where the radio parts and the antenna are integrated in one single unit. The remote radios are connected with optical fiber CPRI links. RBS 6101 also provides power supply to up to nine remote radios.

The two types of configurations, macro and main-remote, can be combined in the RBS 6101 cabinet. In these hybrid configurations, RBS 6101 is equipped both with internal radio units as well as connected to remote radios.

The diagram below illustrates the configuration options for RBS 6102.

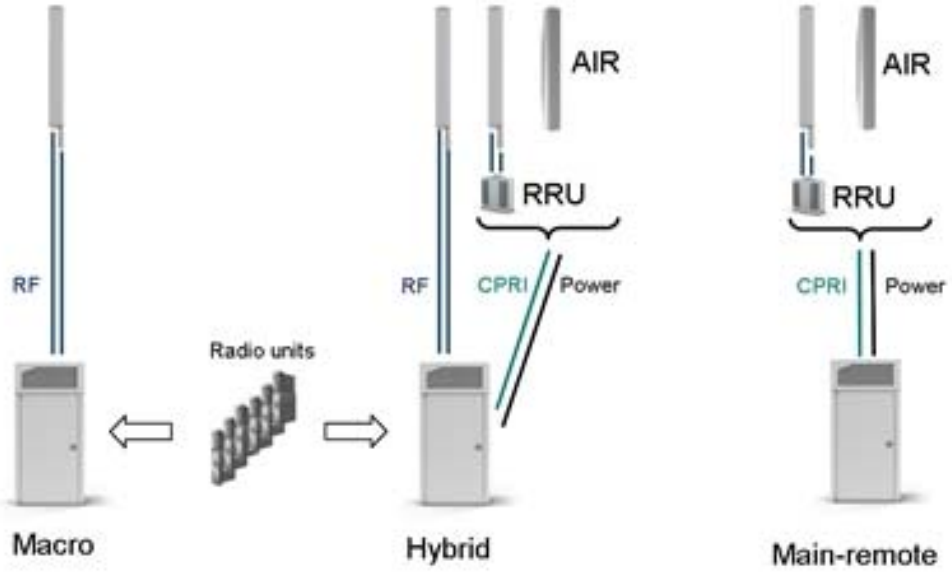


Figure 3-11: Configuration options for RBS 6101

5.1 Hardware Architecture

The hardware architecture allows for different site deployments but the main components constituting RBS 6000 and specifically the RBS 6101 are:

- Radio capacity given by combination of Radio and Digital Units
- Power supply system for the total site need
- Enclosure including climate system
- Supports up to 16U of continuous space for transport equipment inside the cabinet

The figure shows two different configurations of the RBS 6101. The configuration to the left shows a macro base station and the right shows the RBS 6101 as a main remote base station.

The Figure 3-12 below illustrates the RBS 6101 hardware architecture.

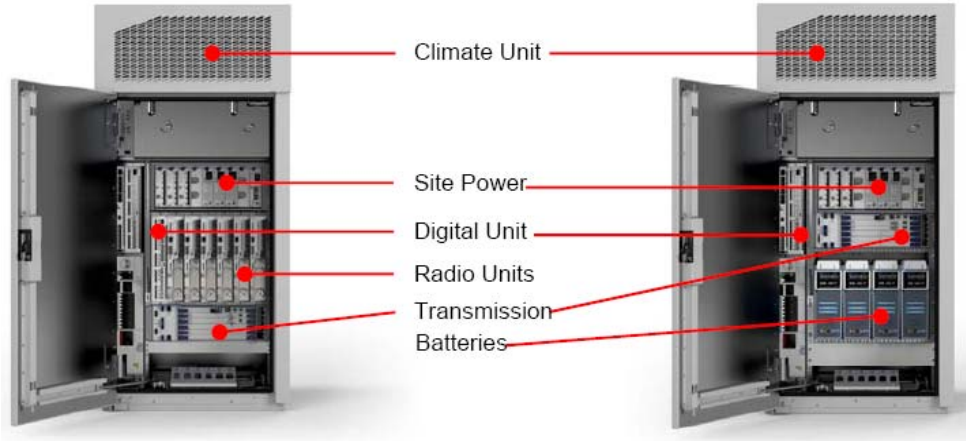


Figure 3-12: RBS 6101 Hardware Architecture

5.2 Extra Digital compartment

There is an extra compartment for up to 3 digital units top the left of the 19" columns. The RBS 6101 becomes then a combined RBS and main remote solution.

These extra places are also used when the RBS becomes a Main Unit in a Main Remote installation so the main 19" compartment can be used more freely without reducing the overall capacity of the RBS 6101.

Figure 3-13: Extra Digital Compartment

5.3 RBS Power System

RBS 6101 uses the latest technology in power conversion and control. This includes high density AC power modules and electronically controlled distribution fuses. The latter allows software managed shutdown of units and system parts in order to save energy and extend battery operation.

The built-in site power system eliminates the need for a separate site power plant. The system can handle battery charging of selected lead acid batteries (VRLA).

The RBS power system is normally fed by AC, but can also support DC supply. The AC power system can, by means of software, control power delivery to selected units. The tolerant rectifiers (PSU AC) allow great voltage variation which eliminates the need for external voltage stabilization devices.

The RBS can also run directly on −48V DC, if existing site powers exist. The integrated RBS power system can also power external units with −48 V DC.

5.3.1 Enhanced Power Efficiency:

The improvements in the energy efficiency are based in three main areas:

- Intelligent stand-by operation of one (or more) individual PSUs can be performed in order to increase the power efficiency.
- The new RBS power solution gives an efficiency improvement for the power system in range of 10% compared with RBS 2000.
- There is a possibility to shut down power to site units for selected periods, e.g. night time, to reduce power consumption.

5.3.2 Battery Backup

The following battery backup solutions are available for the RBS 6101 and its site.

There are 2 internal battery backup solutions. The limited internal battery backup solution can supply up to 20 minutes of battery backup. The second internal battery backup solution can supply one battery string of max 100Ah. The internal space available for batteries is depending upon the radio configuration and used space for transport network equipment.

The BBU 6101 and BBS 6101/6102 are external battery backup solutions.

6 BBU 6102

The Battery Base Unit, BBU 6101 with up to 170 Ah, installed under the RBS, is an excellent choice for large battery backup requirements where the internal space for batteries is too small. The beauty with the BBU is that the complete site fits on the RBS footprint.

The BBU exist in two versions, one with free cooling and the other with active cooling. The active cooling reduces the battery temperatures in high temperature installations.

Figure 3-14: BBU 6101

6.1 BBS 6101/6102

BBS 6101 is a smaller option for a separate backup system. Several cabinets can be connected to extend capacity even further.

The BBS 6101 and BBS 6102 exist in two versions, one with free cooling and the other with active cooling. The active cooling reduces the battery temperatures in high temperature installations.

Figure 3-15: BBS 6101/6102

6.2 Transport Network Functionality

The RBS 6000 features integrated support for any type of transport network media (microwave, optical fiber or copper) in combination with the various technologies (IP/Ethernet, ATM, PDH/SDH, next gen SDH, xDSL etc.), redundancy schemes, aggregation methods and other functionalities that supports the Operator's choice of transport network.

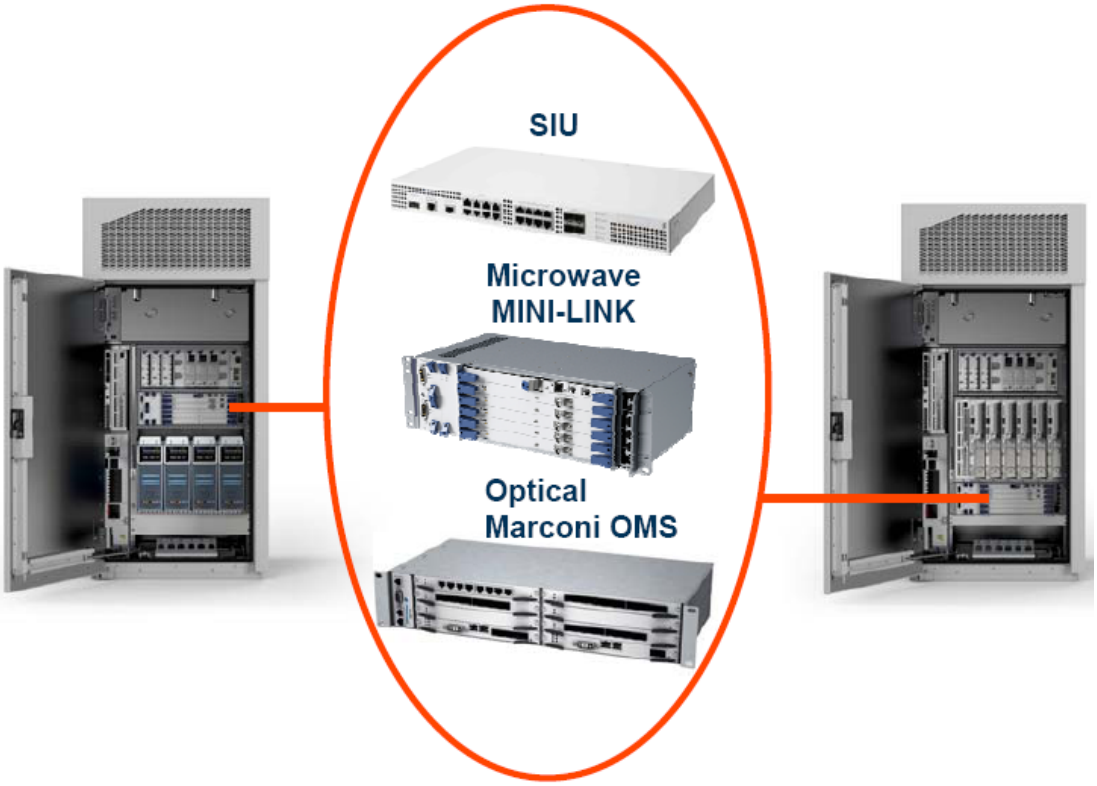


Figure 3-16: Transport Network Functionality RBS 6101

7 RBS 6201 – INDOOR MACRO BASE STATION

The RBS 6201 is an indoor macro base station that is part of the next-generation, multi-standard RBS 6000 family that also includes two outdoor macro base stations, micro base station a main-remote configuration and several Remote Radio Units (RRU).

Employing a simplified cabinet design and an innovative modular building practice, the RBS 6201 integrates a complete high-capacity site into a single cabinet. The cabinet contains two radio shelves and all power, transport network and supporting equipment.

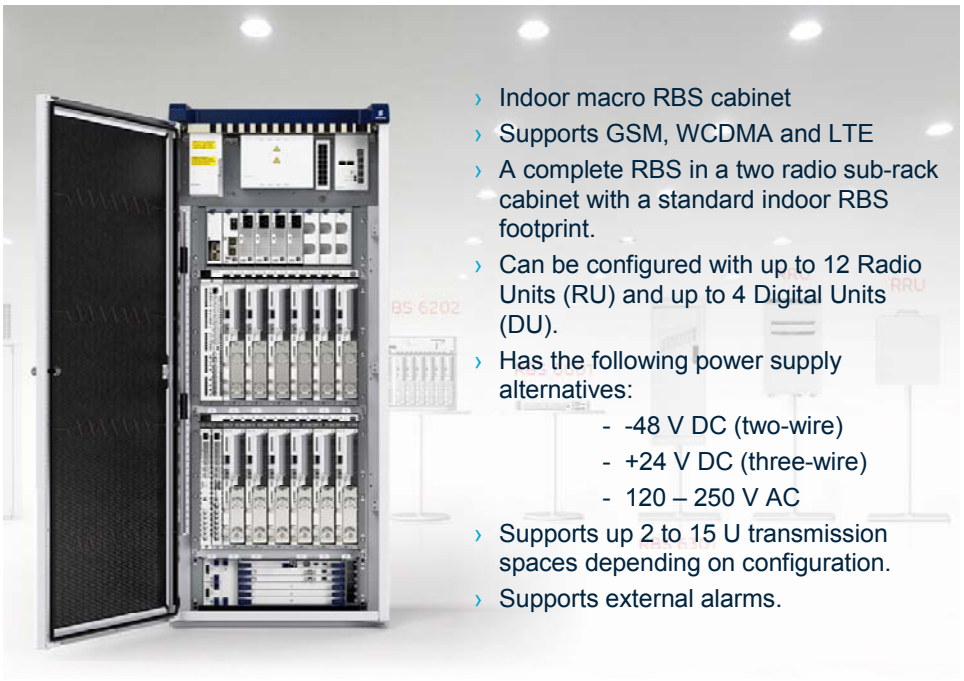


Figure 3-17: RBS 6201

The RBS 6201 two radio shelves can be equipped with virtually any combination of GSM, WCDMA and LTE, which are available for all common frequencies. A single radio shelf can provide up to 3×8 GSM or 3×4 MIMO WCDMA or 3×20 MHz MIMO LTE or a combination of above standards.

Providing a complete multi-standard site in a single cabinet is possible thanks to the modular building practice and an extremely high degree of integration. There are simply fewer parts, which are shared across all technologies, making the site easier to install, manage and maintain.

The two types of configurations, macro and main-remote, can be combined in the RBS 6201 cabinet. In these hybrid configurations, RBS 6201 is equipped both with internal radio units as well as connected to remote radios.

The Figure 3-18 below illustrates the configuration options for RBS 6102.

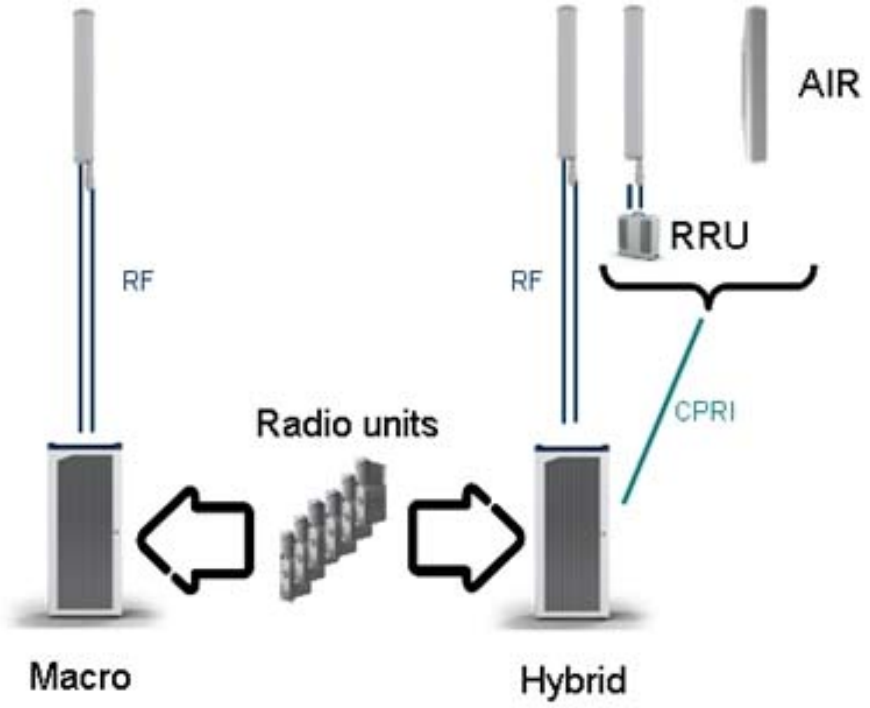


Figure 3-18: Configuration options for RBS 6201

7.1.1 Hardware Architecture

The flexible hardware architecture enables a variety of site deployments and consists of the following main components:

- Radio shelf – combination of Radio Units (RU) and Digital Units (DU)
- Power shelf – Power Supply Units (PSU) dimensioned for the specific site
- Transport shelf – for transport network equipment up to 4U high
- Enclosures – including climate system

The Figure 3-19 below illustrates the hardware architecture for RBS 6201.

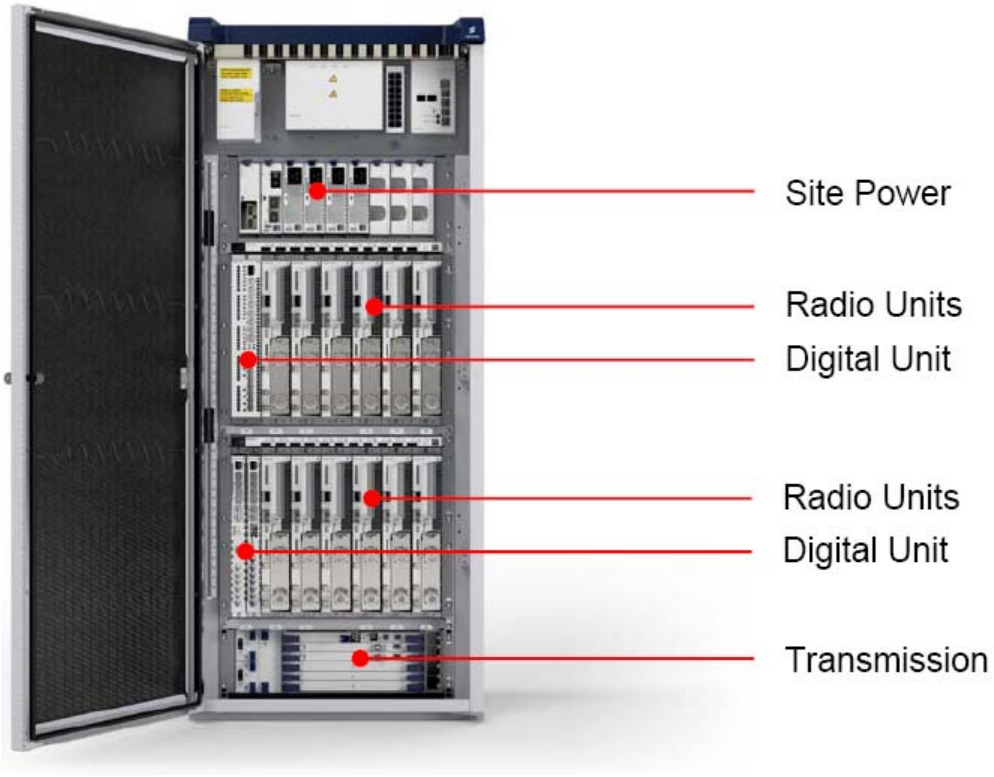


Figure 3-19: RBS 6201 Hardware Architecture

8 RBS POWER SYSTEM

RBS power system is a modern efficient solution for delivering power to the RBS and in the evolution the system will also be able to deliver power to other equipment at the site. The stem uses high-density Power Distribution Units (PDU) controlled by circuit breakers. Software algorithms can switch off AC and DC units and other components temporarily not in use to save energy and increase battery capacity.

The site power system, which eliminates the need for a separate site power plant, can charge batteries.

The RBS power system can use either AC or DC power. The AC power system can control power to selected units by means of applications. The tolerant rectifiers (PSU AC) allow large voltage variations, which eliminates the need for external voltage stabilizers.

The RBS can run directly on -48 V DC or, by means of DC/DC converters (PSU DC), on +24 V DC or -60 V DC.

Energy efficiency has been improved by:

- New RBS power system with an improved efficiency
- Intelligent standby operation of one or more PSU's
- Selective shutdown of units

8.1 BATTERY BACKUP

The following battery backup solutions are available for the RBS 6201 and its site.

8.1.1 BBU 6201

In case of moderate battery backup needs, a small battery backup unit can be installed under the RBS. This means that a complete site, including transport network equipment, power and backup, is managed on one normal RBS footprint. The system's battery capacity ranges from 48V/40 Ah up to 48V/190 AH.

The BBU acts as a base frame of the RBS and hence adds very little work to the site installation. The BBU is prepared for a quick and easy connection to the RBS.

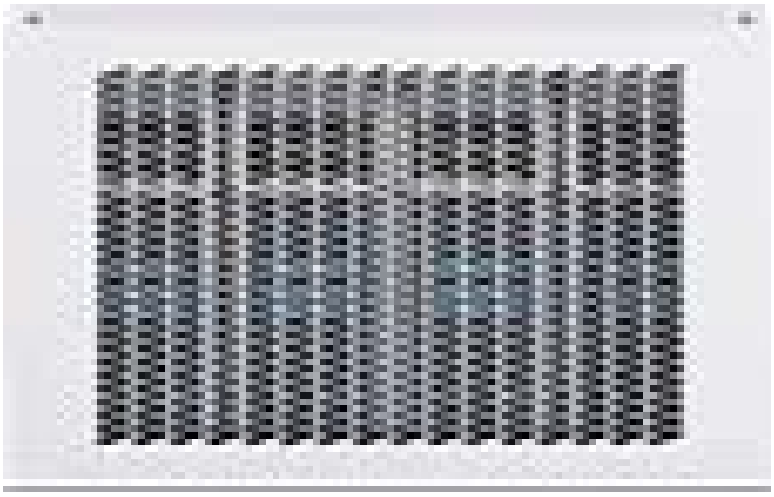


Figure 3-20: BBU 6201

8.1.2 BBS 6201

For demanding backup requirements, a larger battery rack (RBS size) is preferred. The BBS 6201 can support up to 680 Ah (−48V) in one cabinet. 680 Ah gives up to 18 h backup time. Several RBS cabinets can share the capacity of one BBS.

Figure 3-21: BBS 6201.

8.2 Transport Network Functionality

The RBS 6000 features integrated support for any type of transport network media (microwave, optical fiber or copper) in combination with the various technologies (IP/Ethernet, ATM, PDH/SDH, next gen SDH, xDSL etc.), redundancy schemes, aggregation methods and other functionalities that supports the Operator's choice of transport network. The RBS 6201 has space for 4U of transport network equipment.

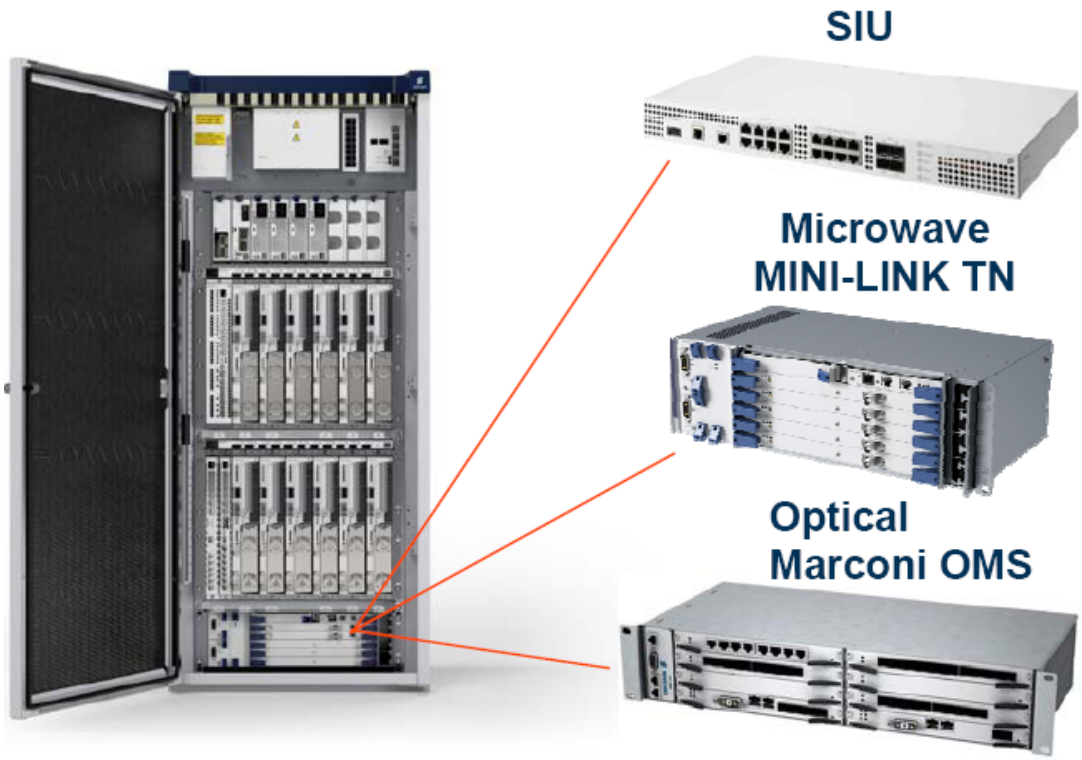


Figure 3-22: Transport Network Functionality RBS 6201

9 RBS 6202 – INDOOR MACRO BASE STATION

The RBS 6202 is compact indoor macro multi standard base station that is supposed to be installed within 19 inches compatible enclosures.

Employing a simplified cabinet design and an innovative modular building practice, the RBS 6201 integrates one single radio shelf and a power distributing panel with S/W controlled circuit breakers.

The radio shelf of RBS 6202 can be equipped with virtually any combination of GSM, WCDMA and LTE, which are available for all common frequencies. A single radio shelf can provide up to 3×20 MHz MIMO LTE or a combination of above standards.

Providing a complete multi-standard site in a single cabinet is possible thanks to the modular building practice and an extremely high degree of integration. There are simply fewer parts, which are shared across all technologies, making the site easier to install, manage and maintain.

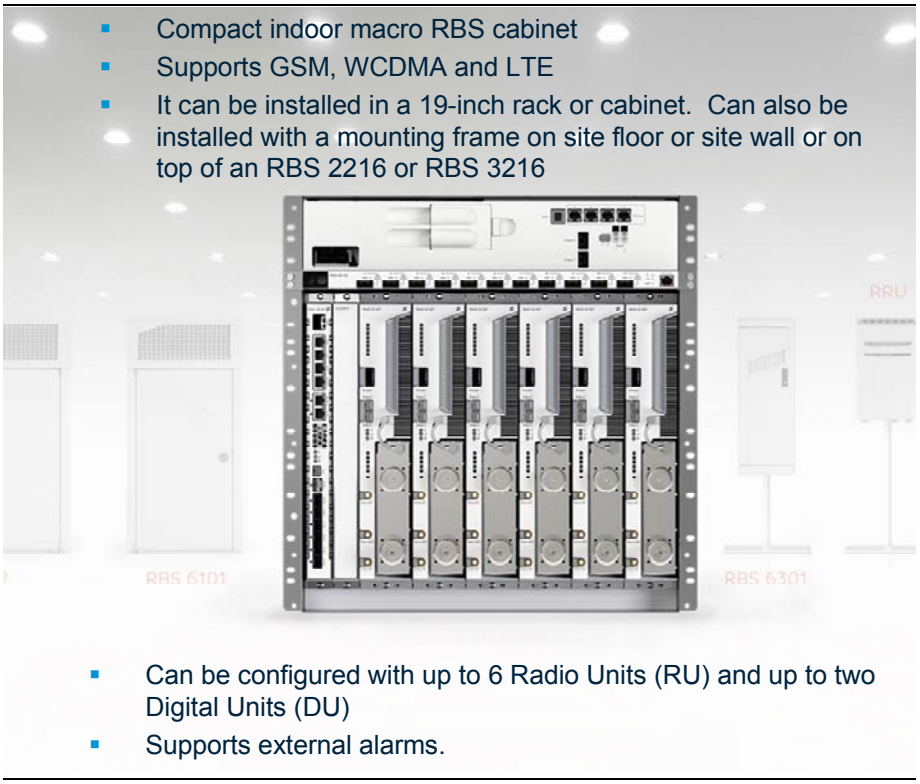


Figure 3-23: RBS 6202

The two types of configurations, macro and main-remote, can be combined in the RBS 6202 cabinet. In these hybrid configurations, RBS 6201 is equipped both with internal radio units as well as connected to remote radios.

The Figure 3-24 below illustrates the configuration options for RBS 6202.

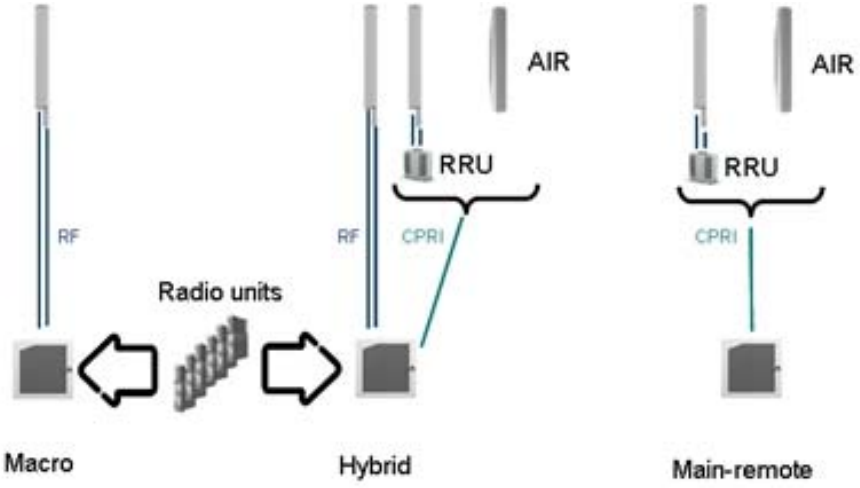


Figure 3-24: Configuration options for RBS 6202

9.1 Hardware Architecture

The flexible hardware architecture enables a variety of site deployments and consists of the following main components:

- Radio shelf – combination of Radio Units (RU) and Digital Units (DU)
- Power interconnect unit – PDU

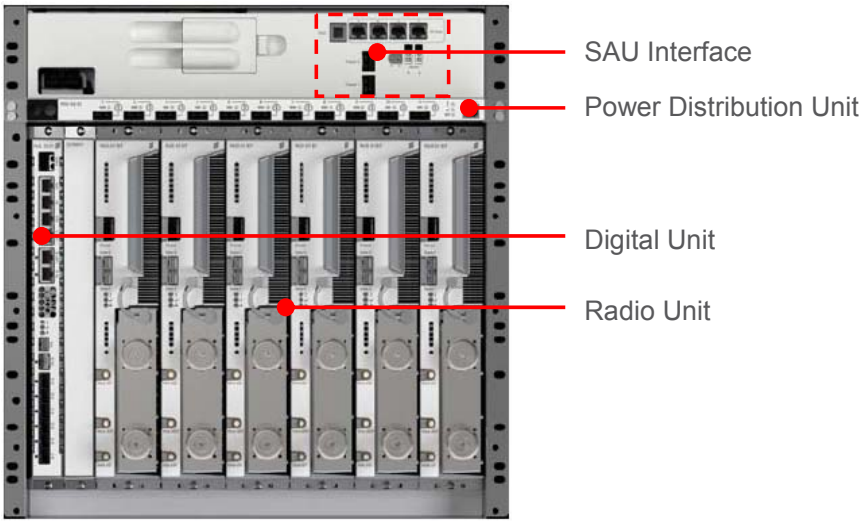


Figure 3-25: RBS 6202 Hardware Architecture

9.2 RBS 6202 Integrated systems

9.2.1 Climate system (SCU)

The basic principle for the climate system is that any unit that needs cooling has to request if from the Support Control Unit (SCU). The main advantage of this is that the fans in the cooling system always work at an optimized level, which means that for any given operational condition, the RBS has minimal power consumption with minimal noise generation.

9.3 Power system

The RBS 6202 operates on -48 V DC.

The RBS 6202 includes a PDU (Power Distribution Unit) that distributes the -48V to the Radio and digital units.

9.3.1 PDU

The Power Distribution Unit is integrated in the RBS 6202 (PDU) and has two functions:

- Distribute power to the RBS internal units
- Provide power to customer specific equipment

The PDU contains circuit breakers and distributes -48 V DC power distributions of the Climate System Unit (SCU), RU and DU.

The Circuit Breaker (CB) rating of the electronic fuses can be set by software. The PDU also supports remote controlled connect and disconnect of selected units.

The PDU ports can individually also be configured for prioritized power output. This is a desired function in case of a battery backup system in place together with a desire to prolong the transmission equipment availability as long as possible in case of a power failure.

10 RBS 6601 – MAIN REMOTE SOLUTION

RBS 6601 is a Main Remote solution, optimized to deliver high radio performance for efficient cell planning in a wide range of indoor and outdoor applications. The Main Remote RBS, in which each RRU is located near an antenna, reduces feeder losses and enables the system to use the same high-performance network features at lower output power, thereby lowering power consumption and both capital and operational expenditure. Up to 12 Remote Radio Units (RRU) can be connected to a Main Unit (MU) to match any site requirements. The small, lightweight units are easily carried to site and offer simple and discrete installation where space and access are decisive issues.

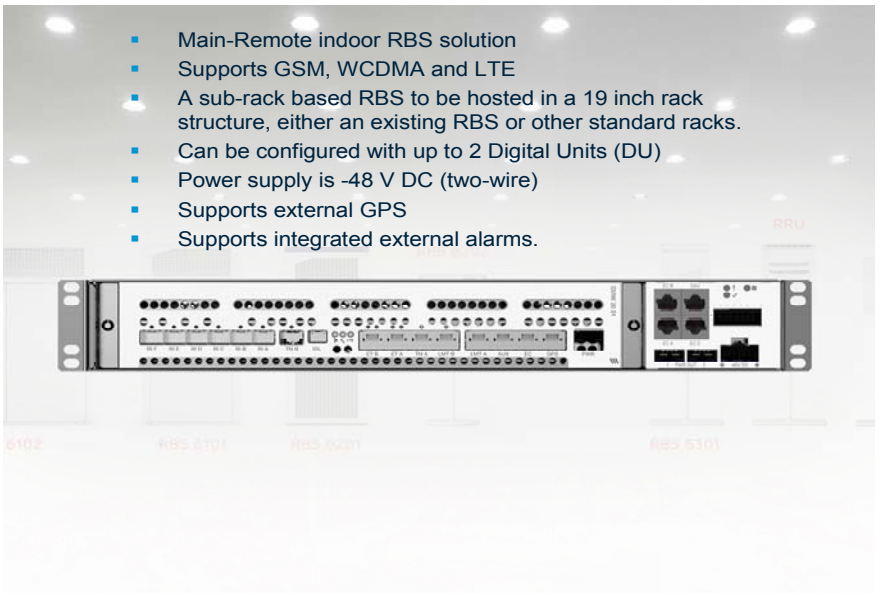


Figure 3-26: RBS 6601

The radio units connected to the RBS 6601 main unit can be either remote radio units (RRU), designed to allow easy deployment, preferably close to the antennas for pole, wall or tower installation, thereby minimizing feeder losses. The other alternative is to use antenna-integrated radio units (AIR), where the radio unit and the antenna are combined into a single unit and installed in the usual antenna location.

The Figure 3-27 below illustrates the configuration options for RBS 6601.

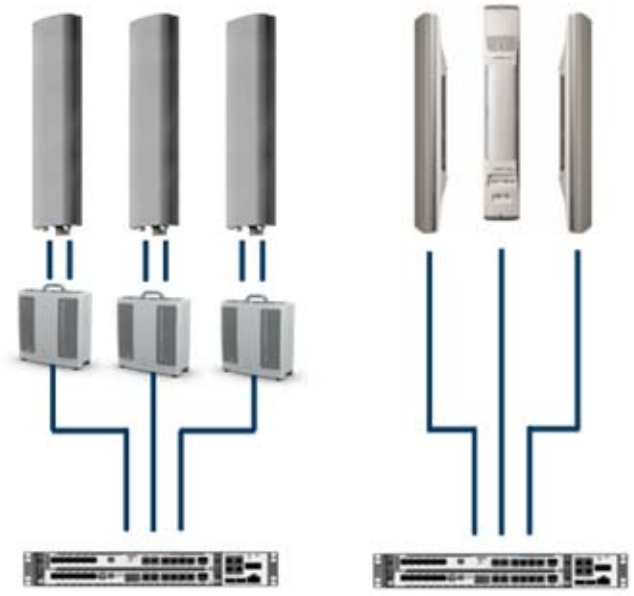


Figure 3-27: Configuration options for RBS 6601

10.1 RBS 6601 Hardware Architecture

The Main–Remote solution has the similar architecture as the other products in the RBS 6000 family.

The main Remote Solution is divided into a Main Unit (MU) and multiple Remote Radio Unit (RRU) that are connected to the MU through optical fiber cables.

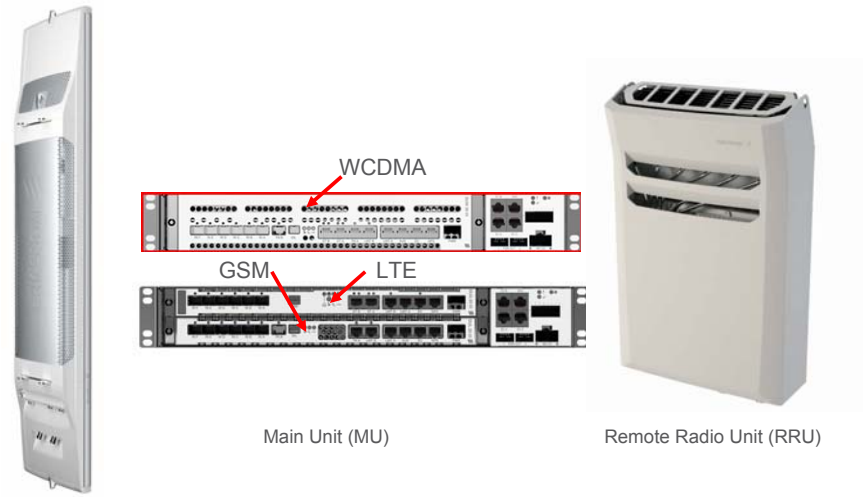


Figure 3-28: Hardware Architecture.

The Figure 3-29 below illustrates the RBS 6601 3-sector configuration.

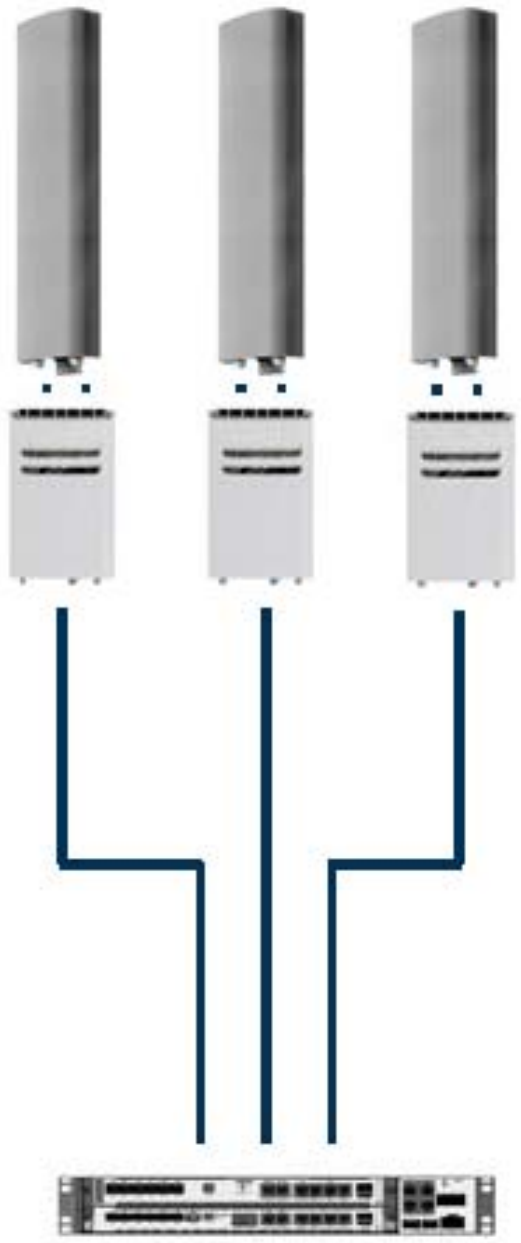


Figure 3-29: RBS 6601 3-sector site

10.2 RBS 6601 Main Unit

The RBS 6601 Main Unit is an indoor specified.

10.2.1 RBS 6601 - Indoor Main Unit

The RBS 6601 Main Unit is designed for indoor environments, preferably mounted in a 19-inch rack. One DUW or two DUG/DUL can be housed in one RBS 6601 Main Unit.

Some of the key characteristics of the RBS 6601 Main Unit are:

- Power distribution of -48 VDC to Digital Units
- Climate system including built-in fans and control part

In addition to the above RBS 6601 Main Unit also provides a limited number of built-in 8 customer alarm connections as well as connection to an external Support Alarm Unit (SAU).

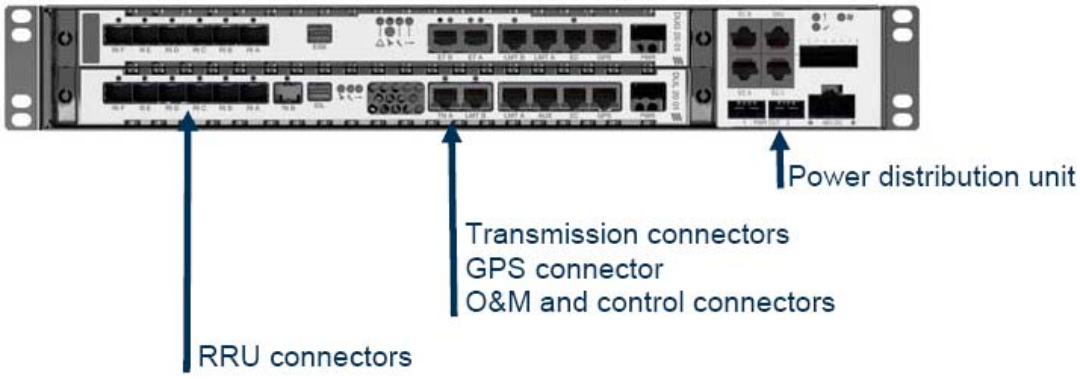


Figure 3-30: RBS 6601 Main Unit with DUG/DUL

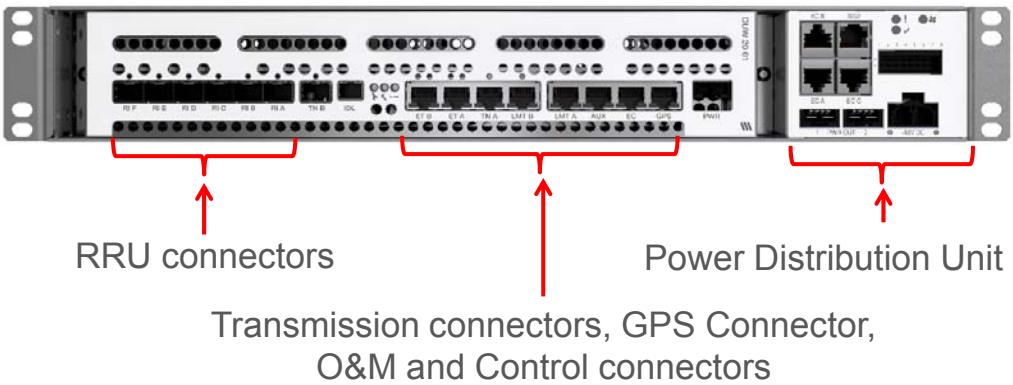


Figure 3-31: RBS 6601 Main Unit with DUW

11 REMOTE RADIO UNIT

11.1 RRUW and RRUS 01

RRUW and RRUS are designed to be installed close to the antennas, and can be either wall or pole mounted. The RRUW has got WCDMA capability. RRUS is Multi Standard Radio, MSR, capable. This means that RRUS is capable of running GSM, WCDMA and LTE on the same RRU HW. Standard can be changed by software reload.

The RRUS exists in 2 different models. RRUS 01 means support for 1 Tx branch per RRU and RRUS 11 means support for 2 Tx branches (MIMO/Tx div) per RRU.

The RRUS is HW prepared for running mixed mode configurations, i.e. to run 2 standards simultaneously. The standards supported in each frequency variant of RRUS depend on which frequencies each standard is defined in 3GPP.

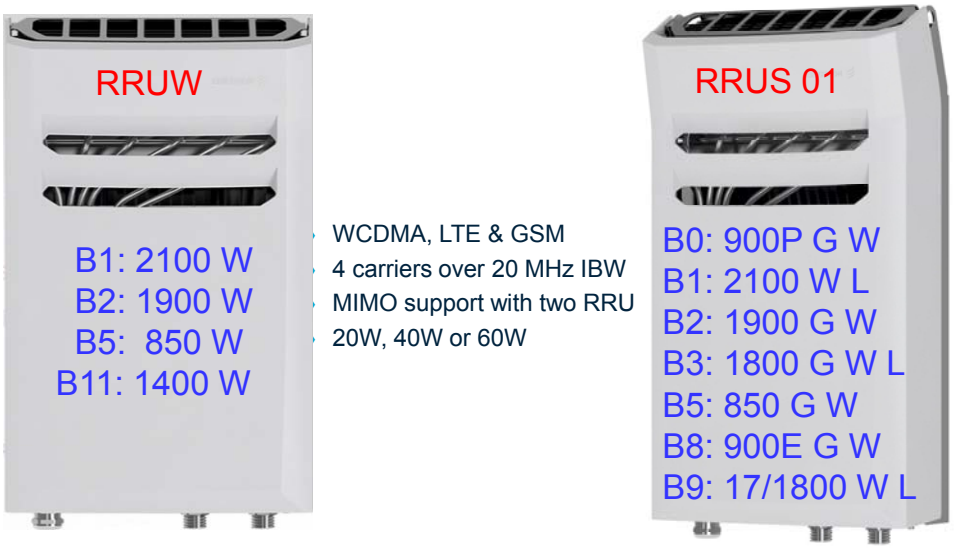


Figure 3-32: RRUW/RRUS 01

For GSM and LTE, up to 12 RRUS can be connected to one MU. For WCDMA, up to 12 RRUW or RRUS can be connected to the same MU.

The RRUW & RRUS sustainable average output power is 60 W, for very large coverage and high capacity requirements. Dual band configurations are also supported by connecting RRUW or RRUS for different frequency bands to the same MU.

The RRUW & RRUS contain most of the radio processing hardware. The main parts of the RRU are the:

- Transceiver (TRX)
- Transmitter (TX) Amplification
- Transmitter/Receiver (TX/RX) duplexing
- TX/RX filtering
- Voltage Standing Wave Radio (VSWR) support
- ASC, TMA & RET support
- Optical interface

All connections are located at the bottom of the RRUW & RRUS. TMA or ASC are normally not needed when the RRU is mounted near the antenna. Still to maximize the flexibility at site RRUW & RRUS has support for ASC, TMA and Remote Electrical Tilt (RET).

11.1.1 RRUS11/61

The remote radio unit (RRUS) is designed to be installed close to the antennas, and can be either wall or pole mounted. The units support multi standard operation. This means that they can operate on GSM, WCDMA, LTE or CDMA on the same RRUS hardware. Two standards can operate simultaneously on each unit if required.

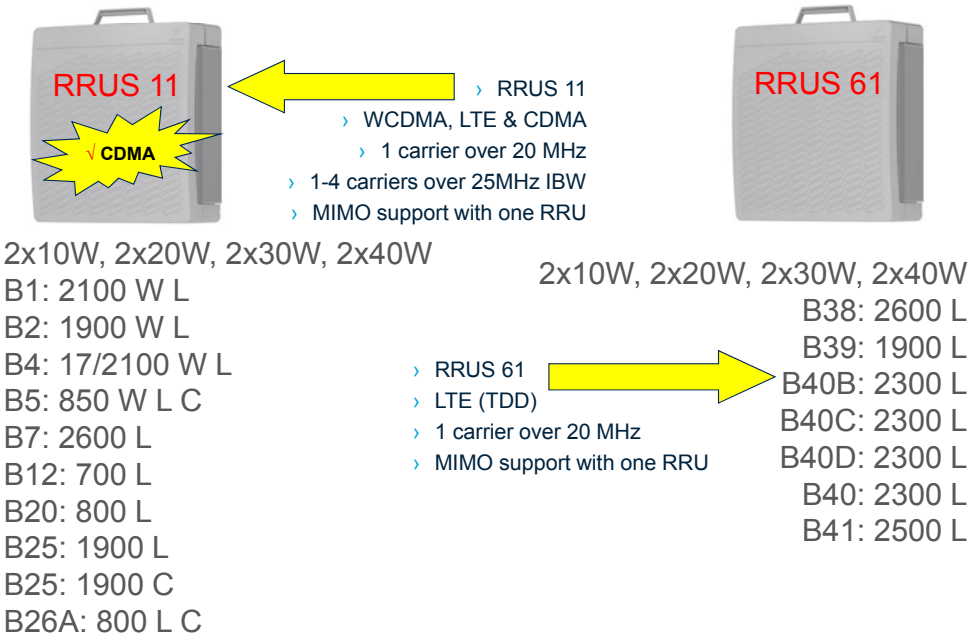


Figure 3-33: RRUS 11 and RRUS 61

11.1.2 RRUS 02/12

RRUS 02/12 is a new multi-standard Remote Radio Units (RRUs) with some new features and higher max output power than the existing RRUS 01, RRUS 11 and RRUS 02.

RRUS 02 is a single TX remote radio unit. There will be two versions of these RRUS's, one with slightly bigger cooling flanges and therefore somewhat thicker and heavier called Type B. The reasons for having a lighter Type A version is that the Type B exceeds the maximum weight for lifting by one person in some countries.

RRUS 12 is a double TX remote radio unit. There will be two versions of these RRUS's, one with slightly bigger cooling flanges and therefore somewhat thicker and heavier called Type B. The reasons for having a lighter Type A version is that the Type B exceeds the maximum weight for lifting by one person in some countries.

Figure 3-34: RRUS 02 and RRUS 12

11.1.3 mRRUS 12

The mRRUS 12 is a new multi-standard Remote Radio Units (RRUs) with some new features and higher max output power than the existing RRUS 01 and RRUS 11.

RRUS 12 is a double TX remote radio unit. There will be two versions of these RRUS's, one with slightly bigger cooling flanges and therefore somewhat thicker and heavier called Type B. The reasons for having a lighter Type A version is that the Type B exceeds the maximum weight for lifting by one person in some countries.

2x5 W
W & L: Up to 4 carriers over 20 MHz IBW
B1: 2100 WL
B3: 1800WL
B4: 1700W W L
B13: 700 L (5 and 10MHz, 1 or 2 carriers)

Figure 3-35: mRRUS 12

11.2 Antenna Integrated Radio (AIR)

The AIR architecture is similar to that of the RRU except that all tower-mounted equipment for a single cell is merged into a single unit. This unit replaces the antenna, RRUs, Tower Mounted Amplifiers (TMAs), and feeder jumpers. AIR can also act as a regular passive antenna on a second frequency band while at the same time being an integrated radio/antenna on the first band.

Up to 8 carriers in GSM
Up to 4 carriers in WCDMA IBW 25MHz
LTE over 20MHz

AIR 11: 2X10W, 2X30W
B8 : W G 900 Active, B20: Passive
B20: L 800 Active, B8 : Passive

AIR 21: 2X10W, 2X30W
B1: W L 2100 active, B3 Passive
B2: G W L 1900 active, B4 Passive
B3: G W L 1800 active, B1 Passive
B3: G W L 1800 active, B0,B5,B8, B12, B13, B14, B20, B26 Passive
B4: W L 17/21 Active, B2 Passive
B4: W L 17/21 Active, B2,B12, B13, B14, B20 Passive
B7: L 25/26 Active, B1-4 Passive

Figure 3-36: Antenna Integrated Radio, AIR 11/21

One AIR unit can handle one frequency band in one sector. The AIR unit supports GSM, WCDMA, and LTE. Each AIR unit can support one or a combination of two of the standards.

The AIR units are available in a number of configurations depending on frequency band (active/passive), capacity and radio characteristics. The AIR units are available in different lengths: 1.3, 2.0 or 2.4 m.

AIR 11 is a unit supporting 2 transmit branches and 2 receive branches. This is used in a traditional antenna arrangement with 2-way receiver diversity.

AIR 21 is a unit supporting 2 transmit branches and 4 receive branches. This unit is used where built-in MIMO support and 4-way receiver diversity is needed.

12 RBS 6301 - Compact Main-Remote RBS

The multi-standard outdoor main-remote base station RBS 6301 is the outdoor “carry-to-site” main-remote base station belonging to the highly successful RBS 6000 family of state-of-the-art, multi-standard base stations. The RBS 6000 series is designed to support a mix of GSM, WCDMA and LTE in the same base station cabinet, thereby ensuring a smooth transition between the radio technologies, without compromising the exceptional capacity, in order to meet current and future needs.

Carry-to-site solution RBS 6301 is made for easy “carry-to-site” installations. The compact size and low weight simplifies passages through doors, tight corridors, staircases, elevators, man-holes etc. An optional battery backup equipment, BBS 6301 can be connected to the base station. The backup system shares the basic hardware design with RBS 6301.

The climate system is based on a new highly efficient heat exchanger, the thermosiphon. The closed forced convection climate system secures optimal environment for the electronic equipment by keeping it protected from dust and moisture from the outside of the cabinet; no filter maintenance is required. Together with the battery backup system BBS 6301, RBS constitute one complete site.

The Figure 3-37 below illustrates the RBS 6301 together with BBS 6301 in a typical RBS site.

Figure 3-37: BBS 6301 and RBS 6301

The radio units can be either radio units installed close to the antenna (remote radio units, RRU) or they can be integrated in the antenna itself (antenna integrated radio unit, AIR)

The Figure 3-38 below illustrates the RBS 6301 with RRU configuration and another option with AIR configuration.

Figure 3-38: RBS 6301 with RRU or AIR

The small units are easily carried to site and offer simple and discrete installation where space and access are decisive issues.

RBS 6301 is available in an AC and a DC (–48 V) version depending on incoming power supply. Optimal operating conditions are secured by a climate system consisting of external and internal fans, a heat exchanger and an optional heater. RBS 6301 supports up to 32 external alarms via an optional support alarm unit.

The Figure 3-39 below illustrates the RBS 6301with AC or a DC version.

Figure 3-39: RBS 6301 AC and DC version

The RBS 6301 is made for easy “carry-to-site” installations. The compact size and low weight simplify passages through doors, tight corridors, staircases, elevators, man-holes etc. Ergonomic design, integrated handles and hoisting points further simplify the cabinet handing to its installation site. At site, the RBS 6301 is easily installed on the ground, or left/right/rear side onto an equipment pole/mast/wall. The AC version support battery charging and provides nine –48 V DC outputs.

RBS 6301 has 19” space available for installation of digital units and backhaul equipment. The AC version has 3U available space, whereas the DC version has an available space of 6.5U.

The RBS 6301 cabinet is also used for a dedicated battery backup system (BBS 6301) and for a transmission rack (TMR 6301).

13 RBS 6302 – SUPER COMPACT MAIN-REMOTE RBS

RBS 6302 is an outdoor convection cooled main-remote solution, optimized to deliver high radio performance for efficient cell planning in a wide range of indoor and outdoor applications.

Figure 3-40: RBS 6302 typical installation

Up to six remote radios, which can be either remote radio units (RRUs) or antenna-integrated radio units (AIR), can be connected to the main unit to match any site requirements. The small units are easily carried to site and offer simple and discrete installation where space and access are decisive issues.

Installation is easy and quick: the unit can be installed on a pole or a wall with the possibility of rear-to-rear installation out from a pole or wall. The unit is convection cooled which means silent operation and no scheduled maintenance. RBS 6302 has an ergonomic design with integrated handle, stands for connector and sunshield protection.

Figure 3-41: RBS 6302

RBS 6302 can be powered by AC or –48 V DC. The AC option comes with an AC/DC converter that is piggy-backed to the MU/RRU. RBS 6302 supports up to 8 external alarms via a built-in port. The number of external alarms can be extended via an optional support alarm unit (installed outside RBS 6302).

Each RBS 6302 main unit is equipped with one digital unit. Two main units can form a WCDMA 3x4 or 6x2 node.

14 mRBS – MICRO RBS 6501

The mRBS is a small standalone radio base station being part of the Ericsson hetnet small cell toolbox. It is suitable for deployment in indoor and outdoor hotspots.

Figure 3-42: Micro RBS6501

The mRBS has an integrated antenna system and supports MIMO, 2x5 W output power, 20 MHz LTE or 4 cell carriers in WCDMA.

The mRBS can be powered by AC or –48 V DC. The mRBS supports up to 6 external alarms via a built-in port. The number of external alarms can be extended via an optional support alarm unit (installed outside the RBS).

mRBS has an interface for connection of an additional remote radio (CPRI) in order to increase carrier power and adding a sector, frequency band or antenna branches. mRBS also has support for optional Wi-Fi.

Some key radio characteristics of the mRBS are shown below:

WCDMA Number of carriers	LTE Bandwidth	Technology	IBW (Instantaneous bandwidth)	Output Power
4	20 MHz	MCPA	25 MHz	2 x 5 W

The mRBS has the following transport interfaces:

Ethernet
2

15 Pico RBS - RBS 6401

RBS 6401 is a small radio base station which is a part of the Ericsson hetnet small cell toolbox. RBS 6401 has support for both 3GPP licensed spectrum and for Wi-Fi which comes as optional. It has a streamlined and non-obtrusive design, making it possible to deploy in virtually any environment. RBS 6401 is used as a complement to the macro network layer in environments with high traffic demand in order to increase the network capacity and performance.

Figure 3-43: RBS 6401

The multi-standard RBS 6401 supports WCDMA, LTE and Wi-Fi in mixed mode operation. The integrated radio supports MIMO with 2x1 W output power. The RBS supports 2 cell carriers in WCDMA, and 20 MHz channel bandwidth with LTE. RBS 6401 supports various transmission options, making it an ideal solution for indoor and outdoor hot spots.

Some key radio characteristics of RBS 6401 are shown below:

WCDMA Number of carriers	LTE Bandwidth	Technology	IBW (Instantaneous bandwidth)	Output Power
2	20 MHz	MCPA	25 MHz	2 x 1 W

In addition to the 3GPP radio, the RBS also has integrated support for Wi-Fi 802.11n.

RBS 6401 has the following transport interfaces:

Ethernet	DSL
1	1

16 SITE SUPPORTING NODES and FUNCTIONS

16.1 Site Power and Battery Backup

The site power systems (PBC) and battery backup systems (BBS) for RBS 6000 provide easily configurable and expandable power and battery backup capacities. One or several RBS cabinets can be supported, as well as providing extra-long (priority) backup times for the sites' important transmission equipment in or outside the RBS cabinets. Different models provide different capabilities and capacities, suitable for different RBS models and applications.

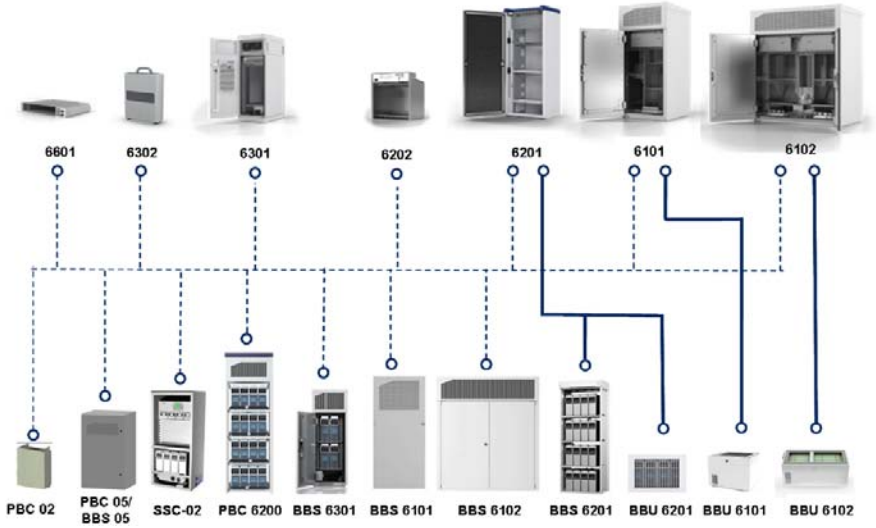


Figure 3-44: Site Power and Battery Backup Solutions

Some of the products are designed for working together with a specific radio base station (the continuous blue line). The majority of the products (dashed lines) are however possible to use in a flexible way together with any of the RBS 6000 base stations, although some of the combinations are the preferred ones. This is shown in the figure above.

16.1.1 Battery Base Units (BBU)

The battery base units (BBU) are each one designed for a specific radio base station. They are installed below the RBS in question, which means that a complete site, including transport network equipment, power and backup is managed on one ordinary RBS footprint. The BBUs are easily installed and connected to the RBS.

The BBUs are available for the base stations RBS 6201, RBS 6101 and RBS 6102. They are used in applications with moderate battery backup needs. If additional battery capacity is required, it is possible to expand the BBU with battery backup systems (BBS).

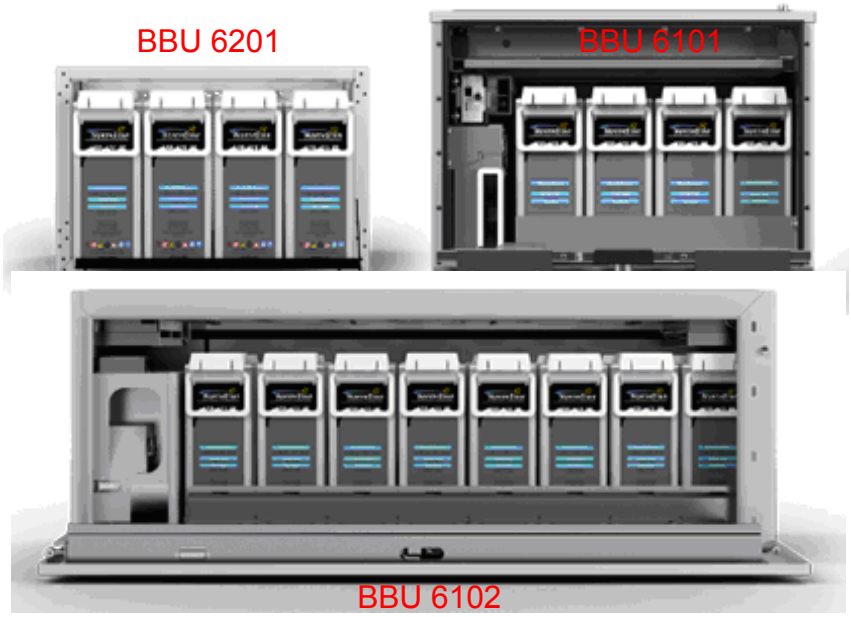


Figure 3-45: BBU 6201, BBU 6101 and BBU 6102

The characteristics of the BBU units are shown in the table below.

BBU unit	Target RBS	Maximum battery capacity	Cooling method
BBU 6201	RBS 6201	48 V / 190 Ah	Free ventilated
BBU 6101	RBS 6101	48 V / 190 Ah	Active cooling
BBU 6102	RBS 6102	48 V / 340 Ah	Active cooling or direct-air

16.1.2 Battery Backup Systems (BBS)

For longer battery backup requirements, a battery backup system (BBS) is preferred. There are a wide range of different BBS systems available to suit the actual need.

BBS 6201 is the preferred battery backup system for the indoor RBS 6201. For outdoor macro base stations (RBS 6101 and RBS 6102) there are two preferred solutions: BBS 6101 and BBS 6102. BBS 6101 has a similar size as RBS 6101. BBS 6102, with a size similar to RBS 6102, provides twice the battery backup capacity as BBS 6101.

For the compact outdoor main-remote base stations, it is proposed to use the BBS 6301 featuring the same basic hardware design as RBS 6301, or alternatively the larger capacity BBS 05.

Figure 3-46: BBS 6201 and BBS 6301

Figure 3-47: BBS 6101 and BBS 6102

The characteristics of the BBS systems are shown in the table below.

BBS	Main target RBS	Maximum battery capacity	Cooling method
BBS 6201	RBS 6201	48 V / 760 Ah	Free ventilated
BBS 6101	RBS 6101/6102	48 V / 570 Ah	Active cooling
BBS 6102	RBS 6101/6102	48 V / 1140 Ah	Active cooling or direct-air
BBS 6301	RBS 6301	48 V / 100 Ah	Active cooling
BBS 05	RBS 6301	48 V / 200 Ah	Direct-air

16.2 Site Power Products

Ericsson provides a comprehensive range of site power products for the supply of –48 V DC power to indoor and outdoor macro as well as main-remote sites. Key characteristics are scalability and high energy efficiency.

For indoor use, **PBC 6200** is the preferred system. Several alternative power system sizes are available to fit any site requirement perfectly. The smallest version is a 2U low rack unit, possible to install in a 19” or 23” rack. It holds up to three 2.0 or 2.7 kW rectifiers. The largest version is a battery rack or wall-mounted system, with space for up to eight 2.0 or 2.7 kW rectifiers. The required battery capacity is installed in one of several available battery racks, ranging from maximum capacities of 400 Ah to 760 Ah. Some battery rack positions can be hardware equipped to hold 19” equipment instead of batteries. Up to three battery racks can be connected to one PBC system. The system's total rectifier and battery capacity is a common resource, which is shared between the connected DC loads at the site. When combined with an external surge protection solution, the PBC 6200 can also be used for the powering of outdoor installed remote radio units (RRU).

The outdoor site power system **PBC 05** provides –48 V DC power to main-remote sites and/or macro RBS sites. Its compact size and installation possibilities make it ideal for RBS 6301 main-remote sites. In many cases, the PBC 05 provides all the power and battery capacity necessary. For larger battery capacities, the site can be complemented with one or two BBS 05 cabinets (see previous section), in which the battery compartment in the PBC cabinet potentially can be used to house 19” equipment.

The **SSC 02** site support cabinet supplies –48 V DC power to 19” main units in the 9U SSC-02 compartment as well as remote radio units outside the cabinet. The separated compartment features active cooling for best possible battery life and supports capacity expansion with one BBS 6101.

The **PBC 02** supplies –48 V DC in outdoor environments. PBC is a very flexible and easily scalable solution consisting of a main unit providing the DC outputs and one or two battery backup units.

Figure 3-48: PBC 6200 (cabinet and rack version), PBC 05, SSC 02 and PBC 02

The characteristics of the site power systems are shown in the table below.

Site power system	Main target RBS	Output	Maximum battery backup	Cooling method
PBC 6200	RBS 6201/6202/6601	Up to 2 * 21,6 kW	2 * 760 Ah	Free ventilated
PBC 05	RBS 6101/6102/6301/6302	Up to 8 kW	100 Ah	Direct-air
SSC 02	RBS 6101/6102/6301/6302	Up to 8 kW	190 Ah	Heat exchanger & active cooling
PBC 02	RBS 6302	Up to 1.2 kW	65 Ah	Convection cooling

17 INTEGRATED SITE TRANSMISSION

In the RSB 6000 family, there is fully integrated support for any type of transport network media (microwave, optical fiber or copper) in combination with various technologies (IP/Ethernet, ATM, PDH/SDH, next gen SDH, xDSL etc.), redundancy schemes, aggregation methods and other functions that support the operator's choice of solution.

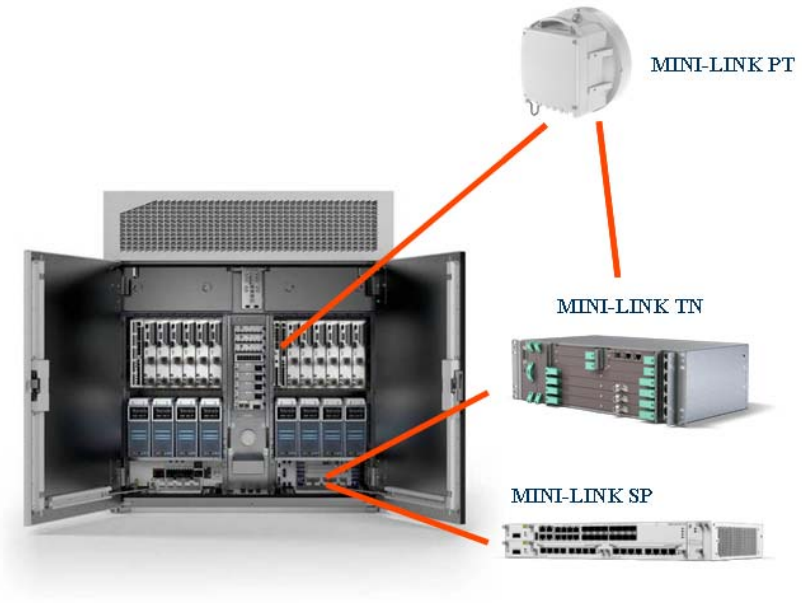


Figure 3-49: Integrated site transmission

The figure shows RBS 6102 as an example.

Since the operator's mobile backhaul solution is often unique and depends on the operator's requirements and market conditions, the RBS 6000 is provided with extra space that can be equipped with a wide range of alternative transport solutions by means of Ericsson's RAN-Transport portfolio, e.g. Site Integration Unit, MINI-LINK and Ericsson SPO products.

Most RBS 6000 base stations have this built-in space for optional transmission equipment. The available space is typically 4U but can vary depending on model, power supply and batteries installed. For larger transmission nodes, or when it is desirable to have the transport network equipment in a separate standalone solution, there are also dedicated flexible TMR products, which can house the required transmission equipment

17.1 MINI-LINK product family

MINI-LINK TN has a complete offering with indoor units to support all needed site configurations, from small edge-nodes to more complex aggregation nodes. The solution is flexible to carry any protocol (Ethernet, ATM, SDH and PDH) and integrated with powerful protection mechanisms. MINI-LINK TN is a Hybrid Node, perfect for migration from all-TDM to all-IP. CES (Circuit Emulation) is an alternative to handle remaining TDM traffic when the migration to Packet only Network is concluded.

The MINI-LINK CN is also a Hybrid Node and provides compact solutions for microwave transport. It is built with simplicity in mind. MINI-LINK CN is a compact Ethernet/PDH centric product with an integrated Ethernet switch, optimized for standalone hops as well as end-nodes in MINI-LINK networks.

The MINI-LINK SP series of packet aggregation nodes for all-packet networks are equally capable of using fiber or microwave as the transportation media. MINI-LINK SP can act as a cell site switch and router. Switching capacity ranges from 16 Gbps to 120 Gbps (8 Gbps to 60 Gbps full duplex, non-blocking). MINI-LINK SP provides multiple advanced synchronization distribution options meeting future LTE requirements as well as advanced Service OAM and PM features for network supervision.

MINI-LINK PT is optimized for Packet only Networks, using native Ethernet over microwave. MINI-LINK PT is a standalone all outdoor solutions, suitable for all outdoor end sites and hop applications. Together with MINI-LINK SP, the product can also be very well suited in aggregation node applications for packet networks. If TDM traffic is required this can be achieved with TDM over CES (Circuit Emulation Service) via MINI-LINK SP.

Different MINI-LINK PT products are optimized for different scenarios, i.e. MINI-LINK PT 2010 with traditional frequency bands optimized for end sites and hop applications. MINI-LINK PT 2010 is hop compatible with MINI-LINK TN & MINI-LINK CN. Therefore it fits very well at a new all outdoor packet end site in an existing MINI-LINK TN/CN network. MINI-LINK PT 6010 reaches even higher capacity with new frequency band (e.g. E-band 70/80 GHz), also suitable for fiber extension applications.

Based on MINI-LINK TN, MINI-LINK LH is providing the same traffic features but in an all-indoor multicarrier version. Up to eight radio channels can be configured and bonded on Layer 1 to create a single, high capacity Ethernet pipe. PDH, SDH and SONET are also supported, as well as integrated short haul links.

As a result, the MINI-LINK product family matches the RBS 6000 family well in capacity and functionality.

Ericsson complements its microwave technology with a leading presence in the optical networking market place. A wide range of network topologies are supported, from star to meshed networks.

17.2 Site Transmission Enclosures

Most radio base stations from Ericsson have a built-in space for optional transmission equipment. The available space is typically 4U but can vary depending on model, power supply and the amount of backup batteries installed. For larger transmission nodes, or when it is desirable to have the transport network equipment in a separate standalone solution, there are dedicated flexible transmission cabinet solutions, which can house the required transmission equipment. The products are available both for indoor and outdoor environments. They differ in terms of environment (indoor/outdoor), application, size and capacity. They basically consist of an enclosure, a power system, a climate system and a site controller. Some of the cabinets can also be equipped for supplying power to external equipment, for example MINI-LINK PT and/or battery backup systems.

Some TMR cabinets can be connected to external battery backup units as well as suitable battery backup systems (BBU and BBS).

Figure 3-50: Site transmission enclosures

TMR 6201 is an indoor solution for high capacity requirements. TMR 6102 and 6101 are outdoor solutions for high capacity outdoor sites. TMR 6101, 6102 and 6201 are based on the corresponding RBS 6101, 6102 and 6201 cabinet design.

TMR 9302 is an outdoor solution, particularly suitable for small sites with restrictions on site space. The compact MPH (MINI-LINK protective housing) is an all outdoor solution with up to two modems. It is particularly suitable for end or repeater sites.

The main characteristics are shown in the table below.

Product	Main application	Available 19" space for transmission equipment	Power supply
TMR 6201	Indoor sites	19U/25U	AC or DC
TMR 6101	Outdoor sites	12U	AC or DC
TMR 6102	Outdoor sites	15+16U	AC or DC
TMR 9302	Outdoor main-remote sites	6U	AC or DC
MPH	Outdoor end or repeater sites	MINI-LINK 2p B / SP / CN	AC or DC

The OMS 800 (Access-Edge) and 1400 (Metro-Edge) products are multi-service (Ethernet and TDM technology based) devices for grooming and transporting of packet data and voice (TDM) traffic in a Metro Access Network. OMS 800 products are small compact (1U) solutions with up-link transport based on NG-SDH with Ethernet. OMS 1410 is a compact (2U) hybrid solution that can either have uplink based on SDH or Ethernet.

18 SUMMARY

Upon completion of this chapter, the participants should be able to:

1 Detail the RBS 6000 portfolio for compact macro, full-size macro, main-remote and micro RBS

3.1 Describe the full size macro base station RBS 6102

3.2 Describe the compact outdoor macro base station RBS 6101

3.3 Describe the full size macro base station RBS 6201

3.4 Describe the compact indoor macro base station RBS 6202

3.5 Describe the compact main-remote base station RBS 6601 with Remote Radio Units (RRU) and Antenna Integrated Radio (AIR)

3.6 Describe the compact main-remote base station RBS 6301 and 6302

3.7 Describe the micro RBS 6501 and pico RBS 6401

3.8 Understand the site power for all RBS 6000

Figure 3-51: Summary of Chapter 3

4 Operation and Maintenance Tools

Objectives

Upon completion of this chapter, the participants will be able to:

4 Outline the main Operation and Maintenance tools for RBS 6000

4.1 Understand HyperTerminal used as Command Line Interface, (COLI)

4.2 Understand Node Command Line Interface, (NCLI)

4.3 Understand the web browser Element Manager, (EM)

4.4 Understand the Operation and Maintenance Terminal, (OMT)

Figure 4-1: Objectives of chapter 4

1 COMMAND LINE INTERFACE, COLI

The COLI is a CPP-specific administrative interface. A UNIX shell-like command interpreter is used to handle a set of shell commands. The COLI can be achieved using the RS232 serial connection towards the CPP Node via the LMT-A interface.

To connect to the Command Line Interface the serial port on the thin client must first be configured. Set up your HyperTerminal/Serial com port com1 connection with the following settings: Bits per second: 9600, Data bits: 8, Parity: None, Stop Bits: 1, Flow control: None see picture on the next page.

You can also select “Restore Defaults” for these settings.

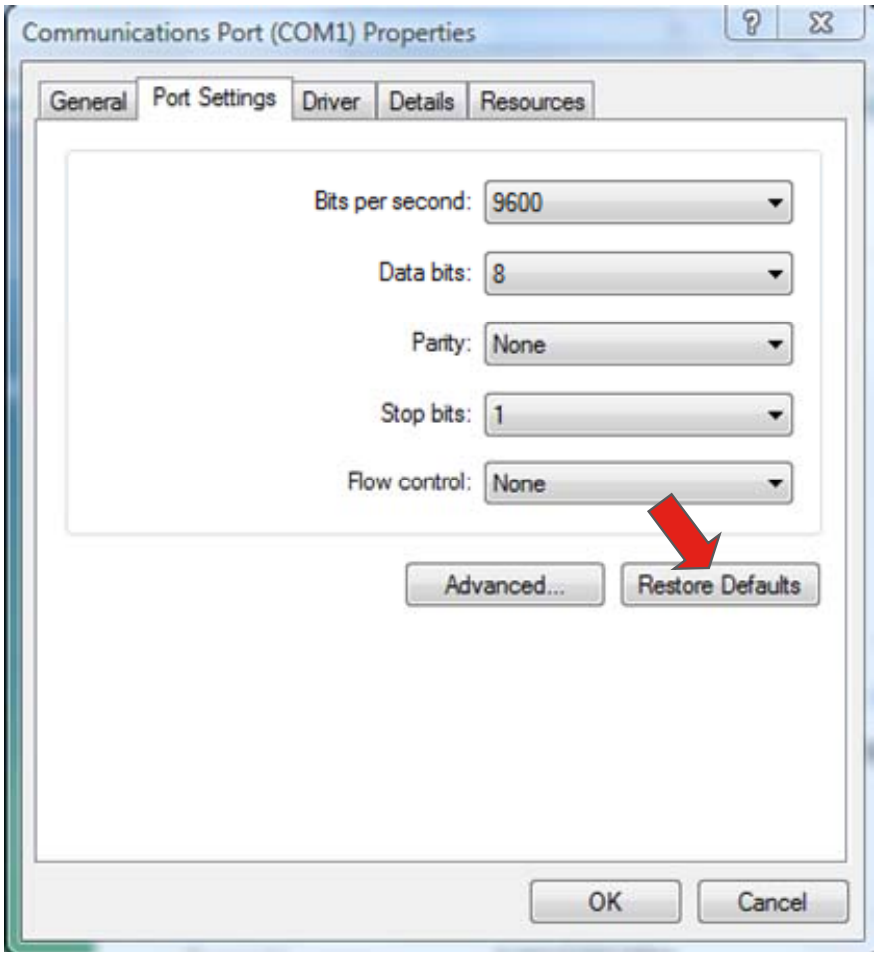


Figure 4-2: Serial Port Configuration

Once connected to the CPP node using HyperTerminal, the following are a list of useful commands which may be entered for display relevant information from the CPP-specific administrative interface. A Set of shell commands which are handled by a UNIX shell-like command interpreter.

The Figure 4-3 below illustrates some useful commands.

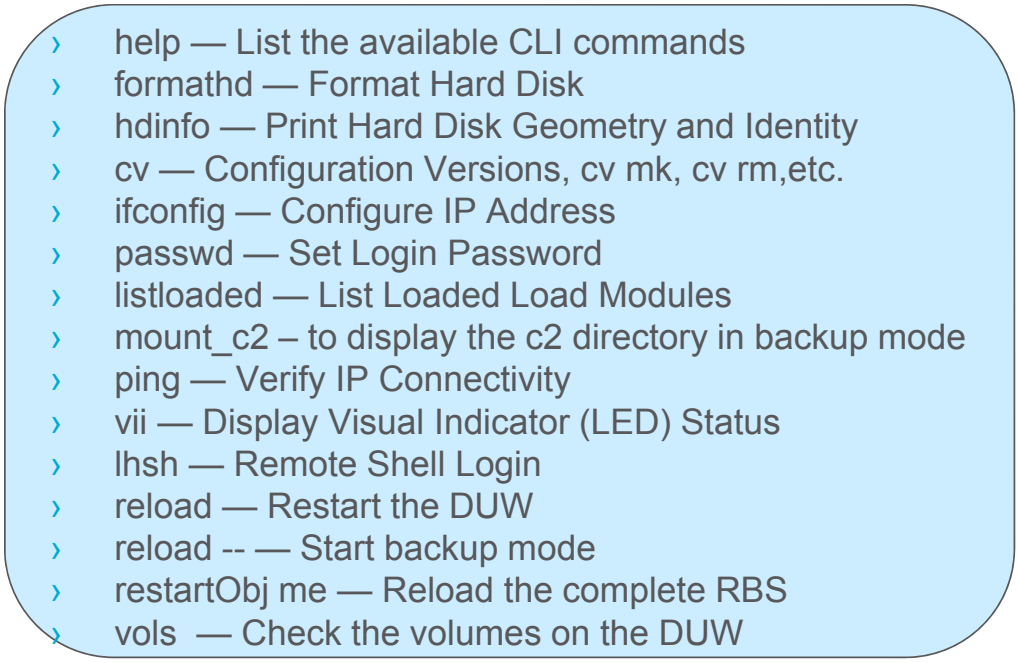


Figure 4-3: Useful commands - CLI

By typing “help” at the command prompt, all the available commands will be listed down.

2 NODE COMMAND LINE INTERFACE, NCLI

The **ncli** mode is a mode used to manage a CPP node in a network, by manipulating Managed Objects (MO).

The interactive **ncli** mode, in combination with shell features such as command completion and command history, gives a tool that is useful for man-machine communication. The **ncli** mode also enables you to perform text-based machine-machine communication toward the node.

The Figure below is a simplified schematic overview of a CPP node, including NCLI, from an Operation and Maintenance point of view.

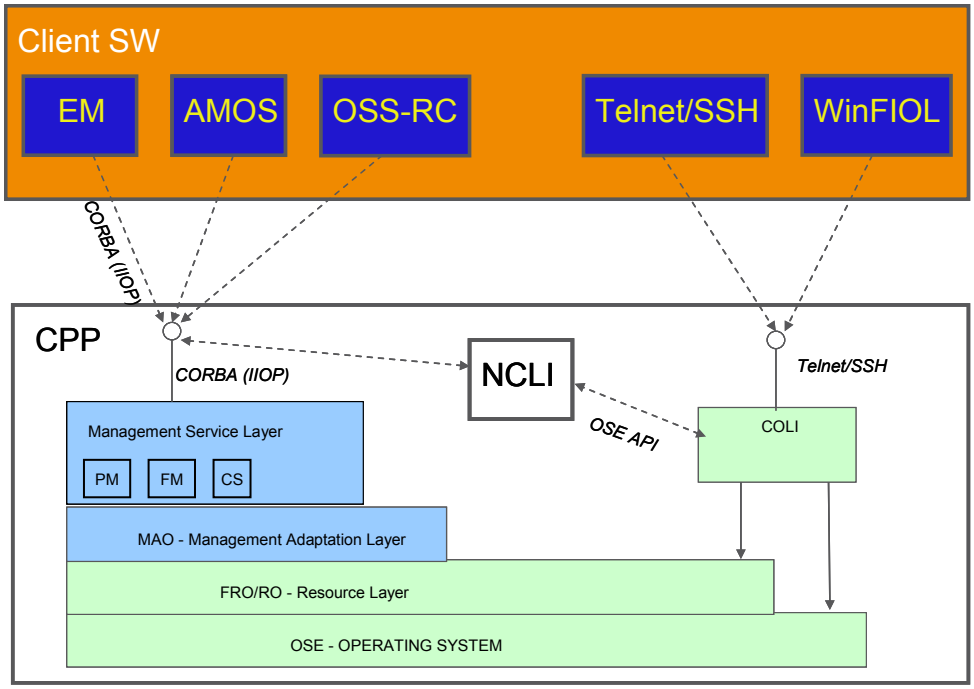


Figure 4-4: Background – NCLI

2.1 NCLI Architecture.

NCLI consists of two load modules, the NCLIServer, implemented in java, and NCLIShell, implemented in C. NCLI enables users accessing CLI to configure Managed Objects (MOs) of the MAO layer, via the Configuration Service (CS) interface.

2.2 CONNECTING TO NCLI

To start an **ncli** session, perform the following steps:

In a shell, enter the command **ncli** and press **Enter**.

The **ncli** mode prompt appears, where the RDN of the working MO `ManagedElement=1` is shown.

```
$ ncli

[ManagedElement=1]>
```

The figure below illustrates the NCLI MOM Top Level.

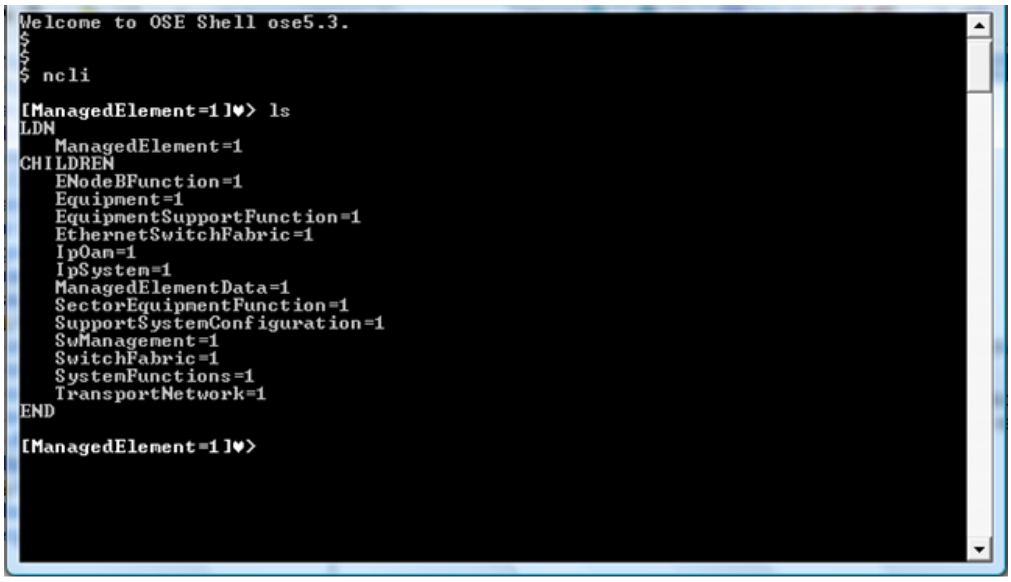


Figure 4-5: NCLI MOM Top Level

Enter the command **man** (with no parameters) to get a list of all available commands, together with a brief explanation.

More information on each command is found in the manual page for the command. Enter **man <*command*>**.

To use NCLI it is essential to have a good knowledge of the MOM and some UNIX background is always useful too. However neither is essential as all one needs to operate this interface can be found in the CPI. Inside any CPI for any of the CPP nodes there will be NCLI information about usage and commands etc. The following illustrates what to look for when surfing the CPI.

The diagram below illustrates the information on NCLI commands that can be found in CPI.

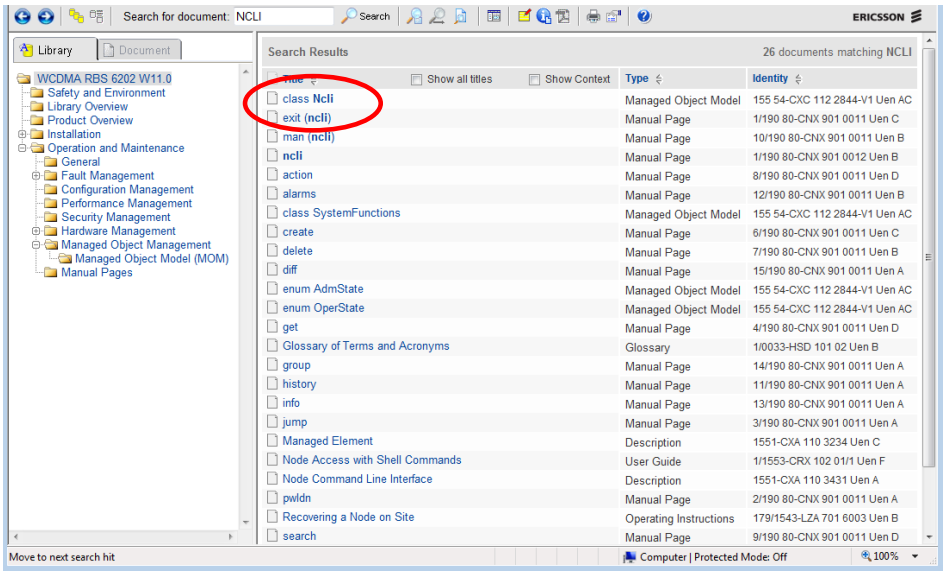


Figure 4-6: Info on NCLI found in CPI

Highlighted in figure below are the main reasons behind the new node command line interface. Operators longed for a command interface which was more functional than NCLI so that they could perform actions without relying on a Java Based GUI such as Element Manager etc. Element Manager is a very good user friendly tool and is what has been used in the past for functions such as retrieving alarm lists and locking boards etc. However for those people addicted to CLI they longed for a command based solution and here it is.

One of the advantages of NCLI is it does not require additional hardware or software from a windows based thin client it can simply be ran from a command window using a telnet session as shown below:

- Main requirement: ”Manage MOs via CLI, Command Line Interface”
- Embedded Management, application part on the node
  - Thin client, e.g. no client JRE dependencies.
  - Accessible via Telnet/SSH/serial port.
  - (almost) no start-up time.
- Alignment with other nodes (2G (AXE), 3G (CPP)).
  - Operators ask for Command Line Interface (CLI)
  - Scripting possibilities, machine-machine interface
- Cost Efficient, once in place it is cheap and fast to add new commands.

Figure 4-7: Why NCLI?

NCLI consist of two load modules, the NCLIServer, implemented in java, and NCLIShell, implemented in C. NCLI enables users accessing CLI to configure Managed Objects (MOs) of the MAO layer, via the Configuration Service (CS) interface.

A unique NCLIShell process will be started by OSE for every COLI user submitting the command ***ncli***. The NCLIShell will emulate a shell by reading all user input and provide all user information; the user is now in *NCLI-mode* where it is only possible to submit NCLI commands.

Commands currently supported in **ncli** can be found by using the search function in the relevant CPI’s. The following are a list of commands supported and examples in which they can be used:

```
!                       Execute command from history
action                  Execute an action on a Mangaged Object
alarms                  Print active alarm list
cd                      alias for jump
create                  Create Managed Object
delete                  Delete Managed Object
exit                    Terminates an NCLI session
get                     Get attributes and children of a particular Managed Obje
ct
group                   Manage group of Managed Objects
help                    alias for man
history                 Display command history
info                    Print information from the Managed Object Model (MOM)
jump                    Change working Managed Object
ls                      alias for get
man                     Display manual pages
pwd                     alias for pwldn
pwldn                   Print working Managed Object
rm                      alias for delete
search                  Search for Managed Objects
set                     Set Managed Object attribute values
tx                      Transaction management
diff                    Compare Managed Objects
```

Figure 4-8: NCLI Commands.

3 ELEMENT MANAGER, EM

The Element Manager is an application for managing a node through Managed Objects (MOs). The Element Manager is model-driven, which means that the Graphical User Interface (GUI) is generated from information retrieved from the Managed Object Model (MOM). All element management functions are accessed from the main window that is started when the node is accessed.

The EM applications are downloaded from the node and installed on the client/PC.

3.1 Element Manager Introduction

The hardware and software requirements of the Element Manager are as follows:

- Web browser (Netscape, Microsoft Internet Explorer or Mozilla Firefox)
- CPP Nodes operating on P7 level software require an Element Manager running on JRE version 1.5, see http://java.com/en/download/index.jsp
- Windows Vista, English Version, Windows 2000, Service Pack 2, English Version or Windows XP, English Version
- Local Administrative rights
- Ethernet connection for 10/100 BaseT
- FTP Client for functions such as retrieving Product Inventory log files, Uploading basic software to a node or retrieving the dump from the flash disk of the node. Some examples of FTP Clients are File Zilla, FTPPro.

The Element Manager is connected to the O&M Intranet through an Ethernet connection. This connection is established either locally on-site or remotely from a Network Management Center.

A local connection is established using the Ethernet port of the Control Base Unit, CBU or Digital Unit WCDMA, DUW. A remote connection is established by connecting the Element Manager to a LAN, which is connected to the O&M Intranet via a gateway router which in turn is connected to the physical link between the CPP node and the rest of the network i.e. Iu/Iub/Iur link.

Please note the following when using the EM GUI:

Each object's Properties window has a Refresh button that updates the properties of the object.

- Web browser (Netscape, Microsoft Internet Explorer or Mozilla Firefox)
- CPP Nodes operating on W12 level software require a Element Manager running on JRE version 1.5, see http://java.com/en/download/index.jsp
- Windows Vista, English Version, Windows 2000, Service Pack 2, English Version or Windows XP, English Version
- Local Administrative rights
- Ethernet connection for 10/100 BaseT
- FTP Client for functions such as retrieving Product Inventory log files, Uploading basic software to a node or retrieving the dump from the flash disk of the node. Some examples of FTP Clients are FileZilla, FTPPro.
- Any kind of Network Time Protocol, NTP, client.

Figure 4-9: Element Manager Requirements

3.1.1 Connecting the Ethernet Cable to the PC

This section describes the recommended procedure for connecting the Ethernet cable to the Ethernet port on the PC.

A crossed Ethernet cable is required to communicate through the Ethernet port to the RBS cabinet.

To connect the Crossed Ethernet cable to the PC, push the cable connector into the Ethernet port on the PC.

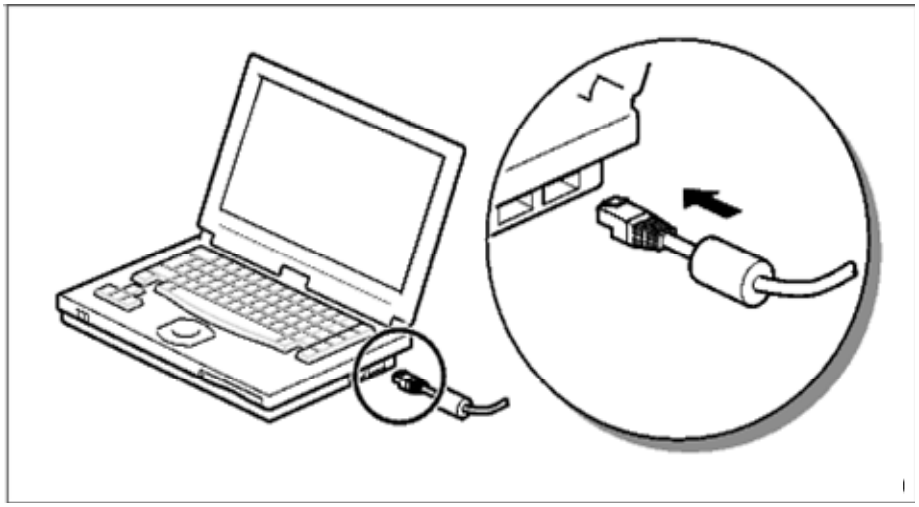


Figure 4-10: Ethernet connection to the PC

3.2 Java Run Time Environment

The Java plug-in 1.5 is required as the Java Runtime Environment (JRE) for the web browser. The Java plug-in can be downloaded, as part of the Java Runtime Environment, from Sun at: http://java.com/en/download/index.jsp

After installing the java plug-in the next step is to edit the Java policy file and then to configure the console.

Note: when using a basic software package use JRE 1.5, other Java versions should work for upgrade packages.

3.2.1 Installation of Element Manager, EM

In the address bar, insert the default IP address from factory is http://169.254.1.1/em/index.html for http://169.254.1.10/em/index.html WCDMA and for LTE.

Replace IP address with the IP address designated for the RBS node.

This will take you to the download page of the Element Manager.

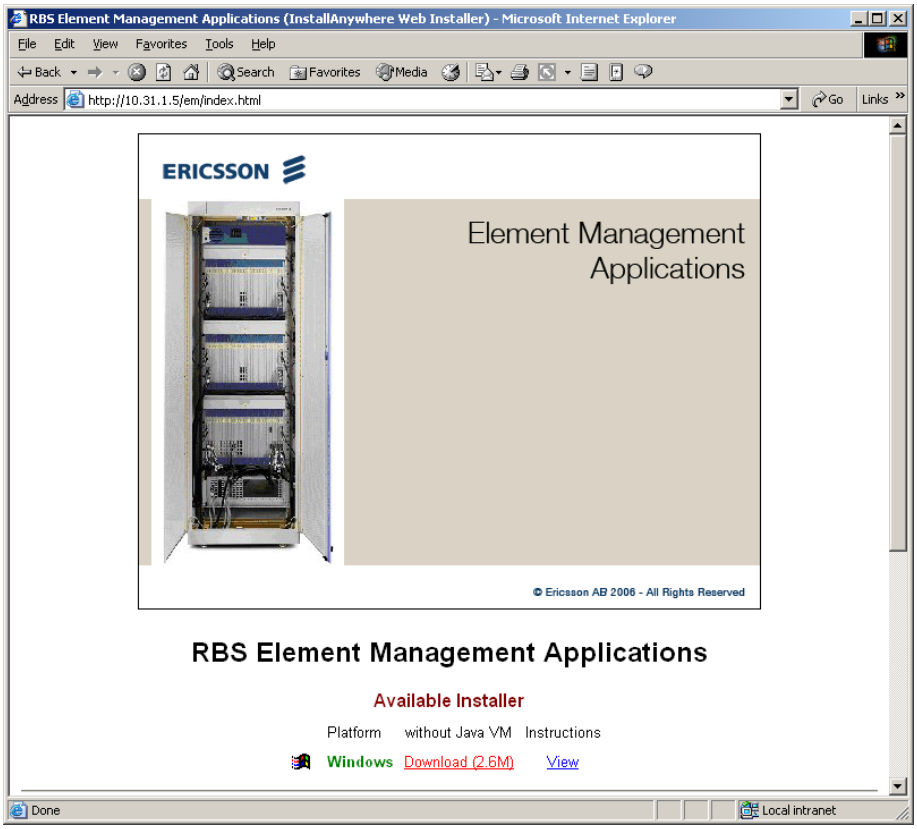


Figure 4-11: Download of Element Manager

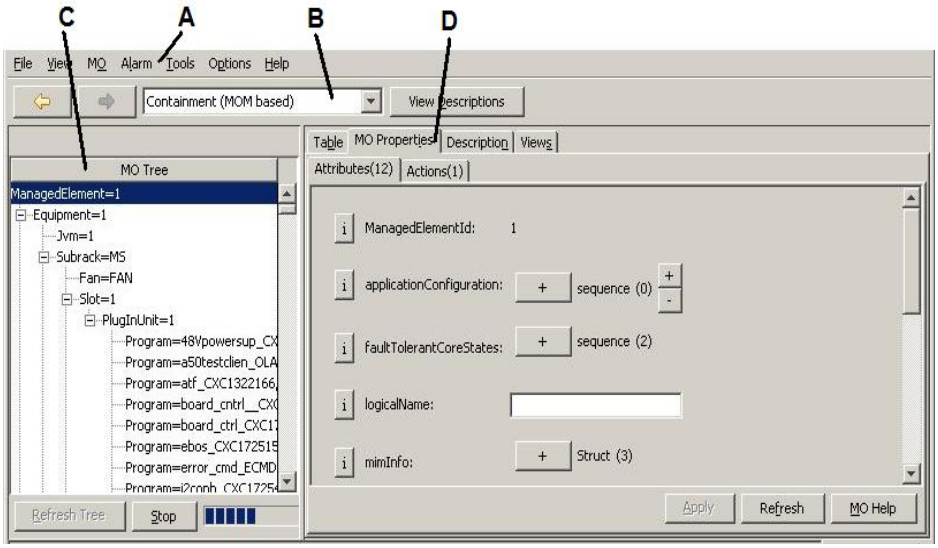
3.2.2 EM View

A view is a graphical representation of an RBS structure. It displays a hierarchy of objects in the left and right panes of the RBS Element Manager window. View objects act as high-level containers with subordinate levels of objects beneath. The following actions can be performed within the EM views:

- Load a view into the RBS Element Manager window
- Expand and collapse the tree structure
- Select an object in a view
- Use shortcut menu applications for selected objects
- View information about selected objects

To load a view into the RBS Element Manager window, select it from the view selector.

To expand an object in a view, click the plus (+) sign or double-click the object. To collapse an object in a view, click the minus (-) sign or double-click the object.



A – Menu Bar
C – MO Tree
B – View Selection Bar
D – Tab Control

Figure 4-12: Element Manager Main Window

3.2.3 Equipment View

Use the Equipment view to view equipment-related objects

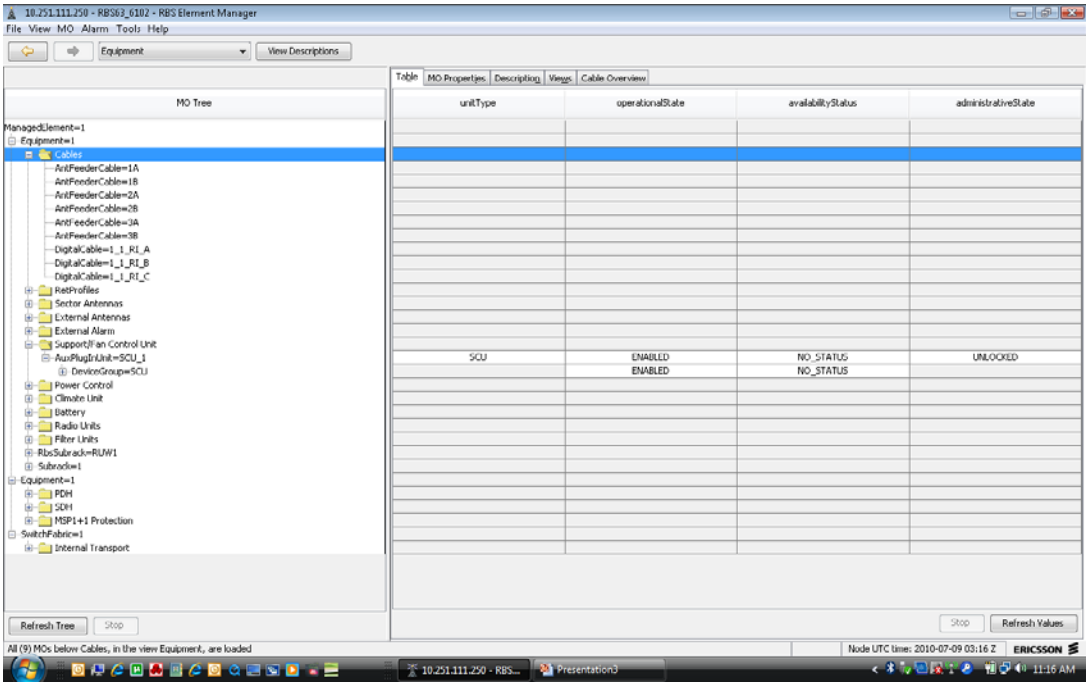


Figure 4-13: Equipment View

The Table below shows the right pane columns that can be displayed in Equipment view. The columns displayed depend on the object selected.

Column	Description
Name	Object name
Operational State	Current operational state of the object: "Enabled" or "Disabled"
Administrative State	Current administrative state of the object; can be set to "Locked" or "Unlocked"

If Operational State or Administrative State is inapplicable for a specific object, no information is displayed in the corresponding column.

3.2.4 IP View

Use the IP view to start an Internet Protocol (IP) system, and to administer IP over Asynchronous Transfer Mode (ATM) links and related properties.

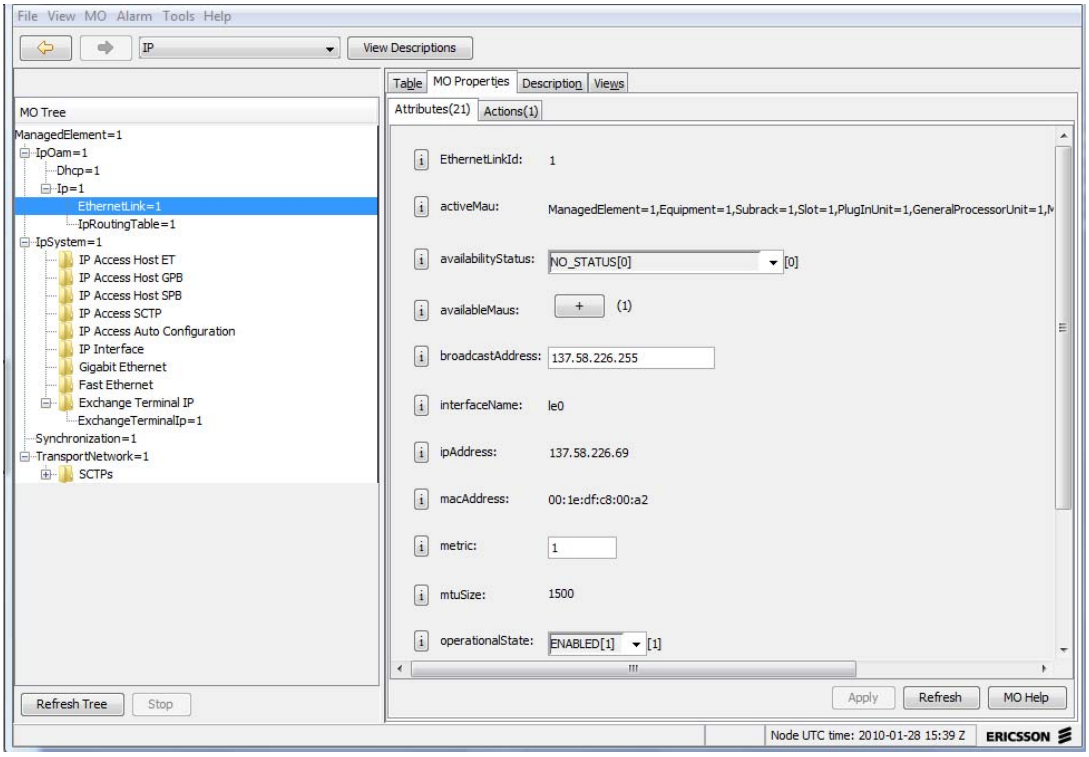


Figure 4-14: IP View

The table below shows the right pane columns that can be displayed in IP view. The columns displayed depend on the object selected.

Column	Description
Name	Object name
Operational State	Current operational state of the object: "Enabled" or "Disabled"
User label	Name of attribute reserved by IP/ATM link

3.2.5 ATM View

Use the ATM view to view and administer Asynchronous Transfer Mode (ATM) settings and only applies for EM used in WCDMA.

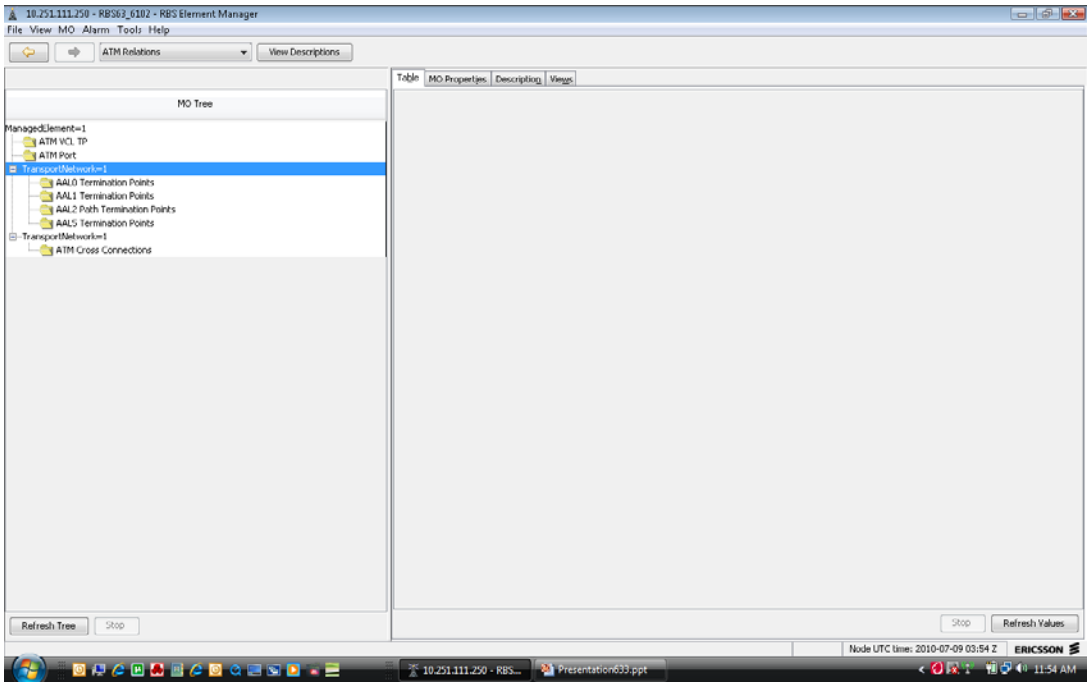


Figure 4-15: ATM View

The table below shows the right pane columns that can be displayed in ATM view. The columns displayed depend on the object selected.

Column	Description
Name	Object name
Operational State	Current operational state of the object: "Enabled" or "Disabled"
Administrative State	Current administrative state of the object; can be set to " Locked" or "Unlocked"
Activity	Activity state of Network Synchronization reference: " Inactive" (synchronization reference is currently not used in system clock generation), "Active" (synchronization reference is used in system clock generation) or "Not Applicable" (no registered synchronization reference exists)
Physical location	Physical location for object
TDM Phys Location	Physical location for Time Division Multiplexing (TDM)
a: Physical Location	Physical location for side A
b: Physical Location	Physical location for side B
a: VPI/VCI	Virtual Path Identifier (VPI)/Virtual Channel Identifier (VCI) for side A

3.2.6 Software View

Use the Software view to manage the RBS software.

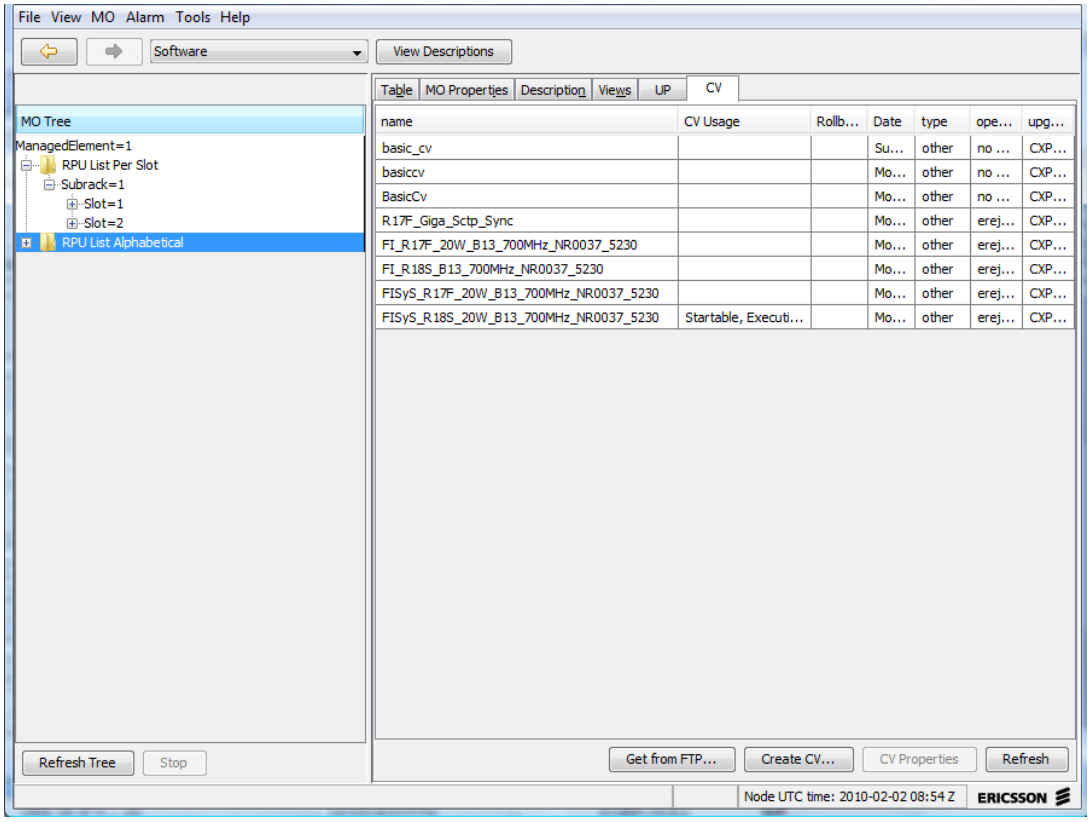


Figure 4-16: Software View

The table below shows the right pane columns that can be displayed in Software view. The columns displayed depend on the object selected.

Column	Description
Name	Object name
Operator	Operator name and designation
UP-Base	Identification of the Upgrade Package (UP) that the CV is based on
Active Slot	Name of the administrative active slot
Passive Slot	Name of the administrative passive slot
Operation	Indicates level of data replication that is associated with the Release Program Unit (RPU): "As configured", " Switched Over" or "Unavailable" (default)
Normalization	Indicates when to switch back the RPU after error recovery: "Automatic" or "Manual" (default)
Replication	Indicates level of data replication that is associated with the RPU: "Always", "At Shutdown" or " Apply Controlled" (default)
Switch Over	Indicates when to switch over the RPU: " at PIU fault" (default) or "at PIU start"
Rollback-List Position	Numerical position of CV in Rollback list
Date	Date and time of object creation
Type	Object type
RP Label	Reliable Program label
Rpu id	Reliable Program Uniter id
#Repertoire(s)	Number of Repertoires in a Software Allocation
#Slots and AuxPluginUnits	Number of Slots and Auxiliary Plug in Units in a Software Allocation
#Allocation(s)	Number of Software Allocations
File name	Upgrade Package name
State	Upgrade Package state: "Not installed", " Installed", "Executing Upgrade" or "Awaiting confirm "
Product ID	Upgrade Package identification
Release Date	Upgrade Package release date
Active	Upgrade Package active or not: "Yes" or blank respectively
Role	Software Allocation role

3.2.7 Radio Network View

Use the Radio Network view to view and manage Radio Network related objects.

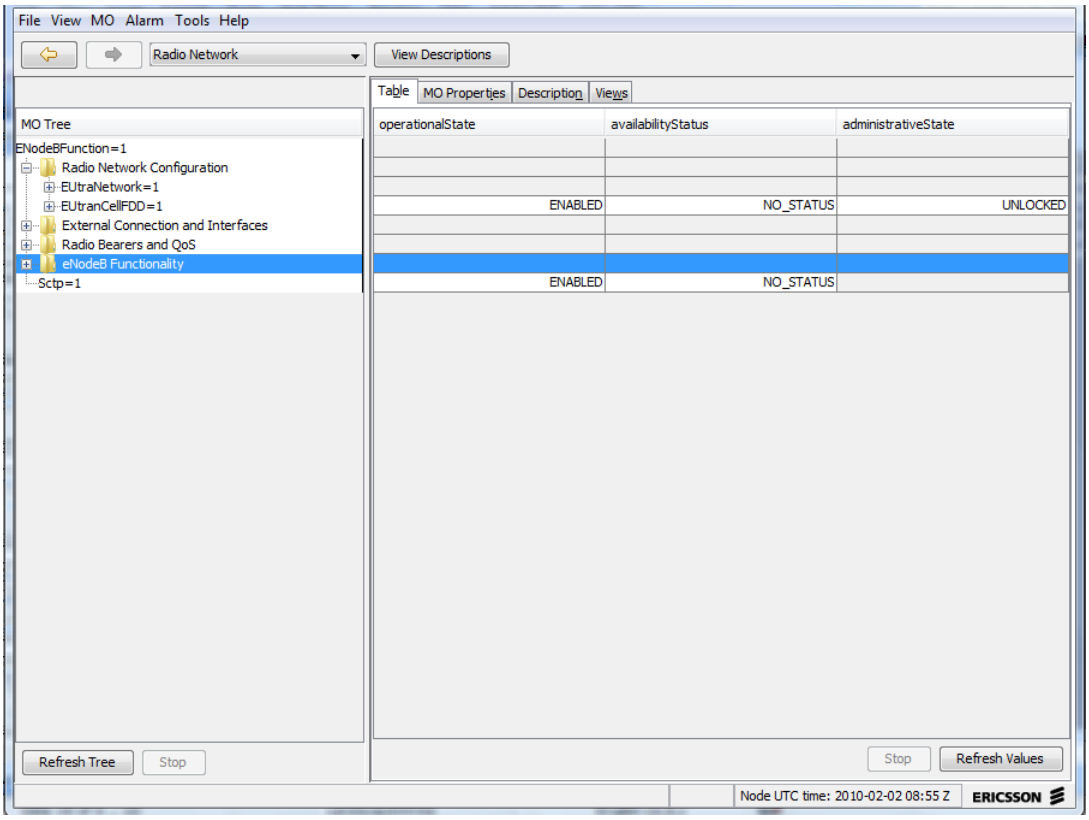


Figure 4-17: Radio Network View

The columns displayed depend on the object selected.

Column	Description
Name	Object name
Operational State	Current operational state of the object: “Enabled” or “Disabled”
Administrative State	Current administrative state of the object; can be set to “Locked” or “Unlocked”

3.2.7.1 Tools Menu

The Tools drop down menu is used mostly for RBS Configuration as seen in this example includes the following options:

- Cabinet Equipment
- Export and Delete
- Integrate RBS
- Modify RBS Equipment Configuration
- O&M Access Configuration
- Performance Data Storage
- Performance Monitoring
- Run Command file
- Site Equipment Configuration
- Test Board

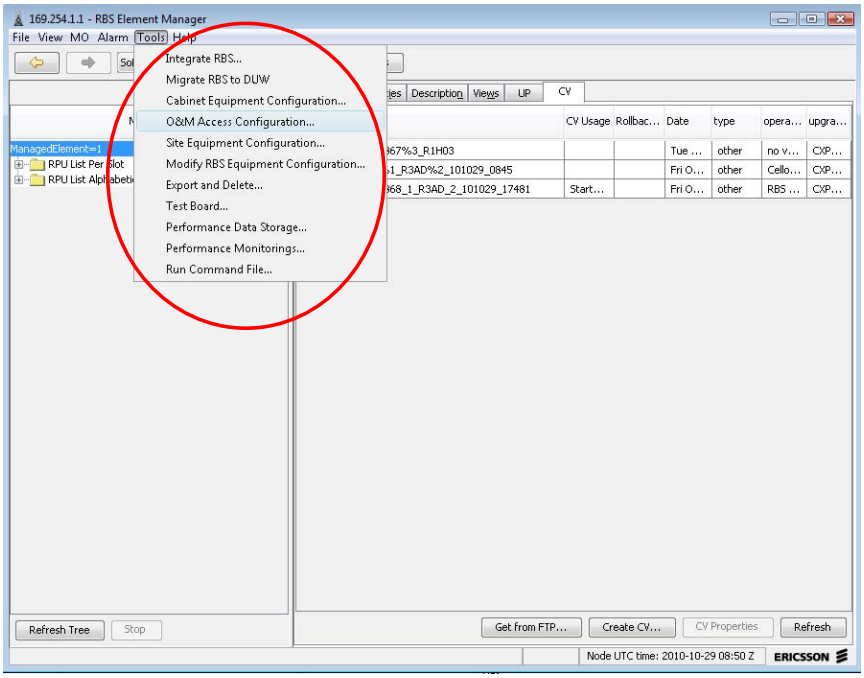


Figure 4-18: Tools Menu

3.2.7.2 Maintenance

The **Tools** menu contains options for performing a number of Maintenance management tasks. The Tools menu has the following submenus for Maintenance**:**

- Test
- Performance

The **Test** submenu contains the **Board** option for performing tests on the RBS hardware, boards and auxiliary units. The test is performed in order to verify that the board or auxiliary unit is functional and can be taken into operation.

The **Performance** submenu contains the **Data Storage** and **Performance Monitoring** options.

3.2.7.3 Supervision

The EM fault supervision system generates alarms if the supervised parameters go beyond their set limits. An alarm is an event that indicates an abnormal condition in the system.

Use the **Supervision** menu to view the active alarm list and perform a number of supervision and alarm management tasks.

The **Supervision** menu contains the following options:

- Alarm list
- Alarm log
- Event log

The **Alarm list** option opens the **Alarm list** window

From the **Alarm list** window, the following tasks can be performed:

- View alarm details
- View specific alarm help instructions
- Print the current alarm list

The alarm list has two sections: an alarm table (displayed in the upper pane), and an alarm information field (displayed in the lower pane).

Alarm severity is reported at four different levels as described in the Table below.

Column	Description
Severity	Relative level of urgency for operator attention

Alarm Severity Level	Definition
Critical	The problem must be solved immediately
Major	It is possible to fix the problem during normal working hours. This is relevant for many of the listed faults
Minor	The problem can wait until scheduled RBS maintenance
Warning	The alarm is for information only and no operator action is necessary

Alarm ID	Unique alarm identification
Time	Time of the occurrence of the event
Name	The name of the alarm
Probable Cause	Information about a probable cause of the alarm - in general terms
Specific Problem	Information about a probable cause of the alarm - in specific terms

The alarm information field contains the above columns as well.

The lists can be sorted by any of the column headings - just click the required heading. Even the order of the columns can be changed - by dragging a column to a new position.

To view more information about an alarm, right-click on the alarm and then select “Details” from the shortcut menu. The Alarm details window opens.

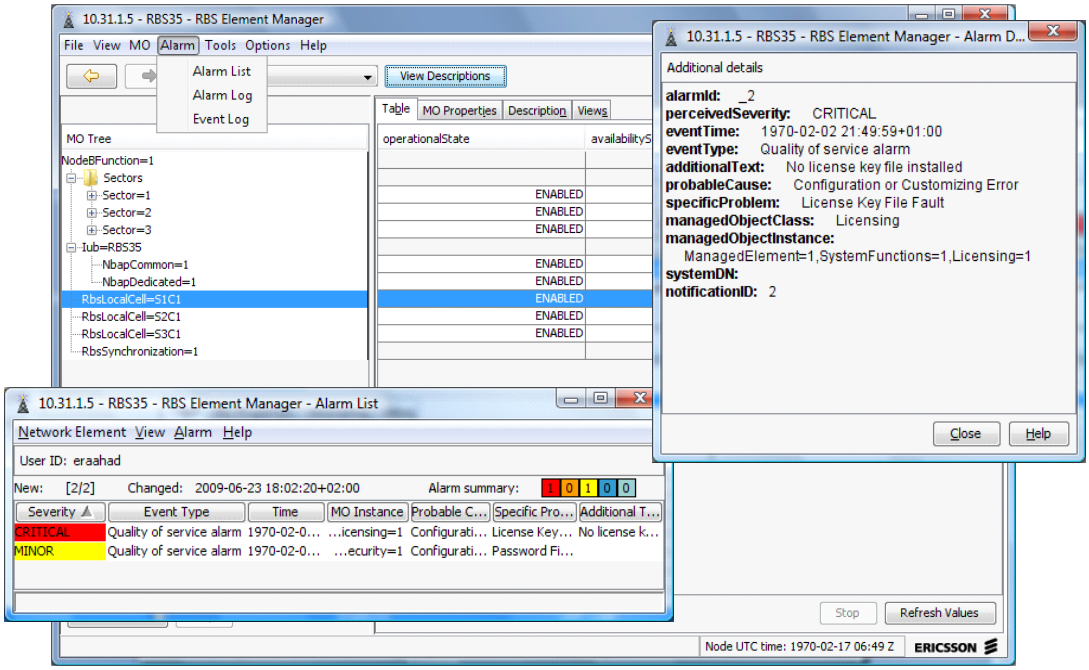


Figure 4-19: Supervision Menu

Alarms generated by specific hardware units are linked to the corresponding object in the Equipment view. Right-click an alarm in the alarm list and select **Hyperlink to...** to access the Equipment view directly.

It is also possible to access the OPI describing the actions to take to clear the alarm by right-clicking an alarm and selecting the **Help on alarm** option.

4 OMT KIT

The Operation and Maintenance Terminal (OMT) is a powerful PC application providing efficient aid for the operation and maintenance of DUG based RBS 6000 base stations. The main areas of OMT usage are DUG based RBS 6000 configuration and fault localization.

The Remote OMT and the Remote OMT over IP have the same functionality as the OMT but can be used remotely from the RBS. The Remote OMT utilizes the regular site transmission via the BSC for communication with the RBS. The Remote OMT over IP can connect to any DUG based RBS 6000 in the network from any remote location with IP access to the serving BSC. The ability to perform OMT operations remotely yields a number of benefits:

- Limited presence at site is needed.
- Faster site configuration.
- Easier site surveillance.

4.1 Managed Object Model G12

Managed objects are logical representations of entities that consist of hardware or software, or both. Hardware can be shared between MOs of different classes.

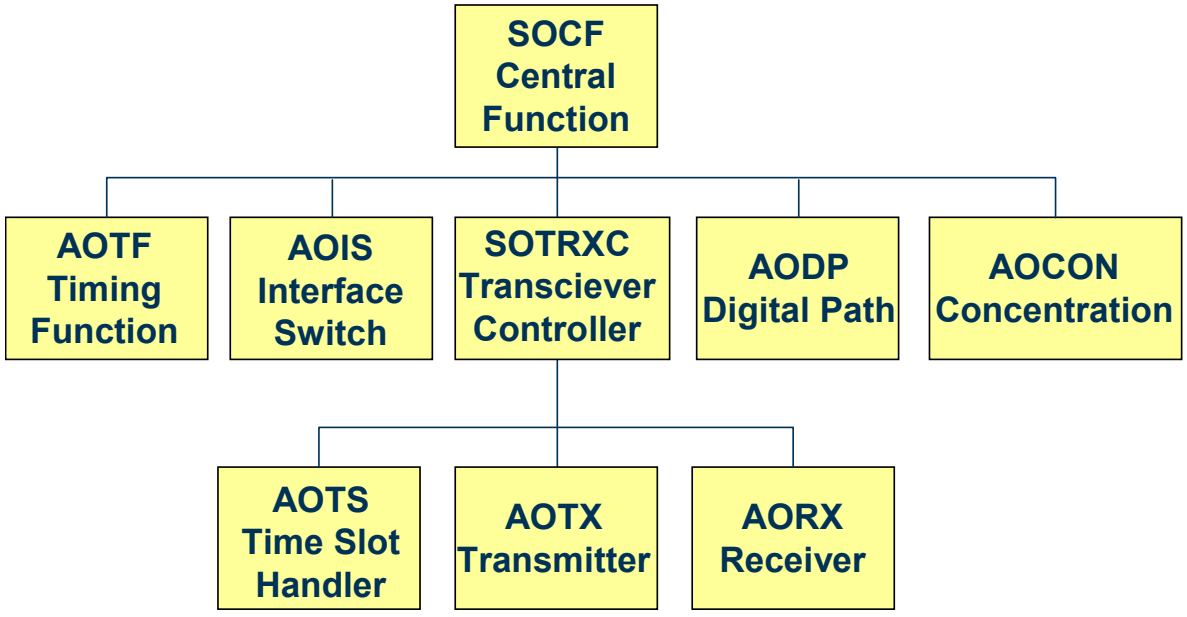


Figure 4-20: Managed Object Model G12

The MOs for DUG based RBS 6000 are divided into two major classes:

- **Service Objects (SOs)** handles functionality and are the owners of specific hardware units in the cabinet.
- **Application Objects (AOs)** handles functionality only and are under the administration of the SOs.

The following MO classes exist for model G12:

- Central Functions (CF)
- Digital Path (DP)
- Interface Switch (IS)
- LAPD Concentrator (CON)
- Transceiver Controller (TRXC)
    - Timing Function (TF)
    - Receiver (RX)
    - Time Slot (TS)Transmitter (TX)

This information will be useful in the Fault Localization using the Fault List.

4.2 OMT Interface

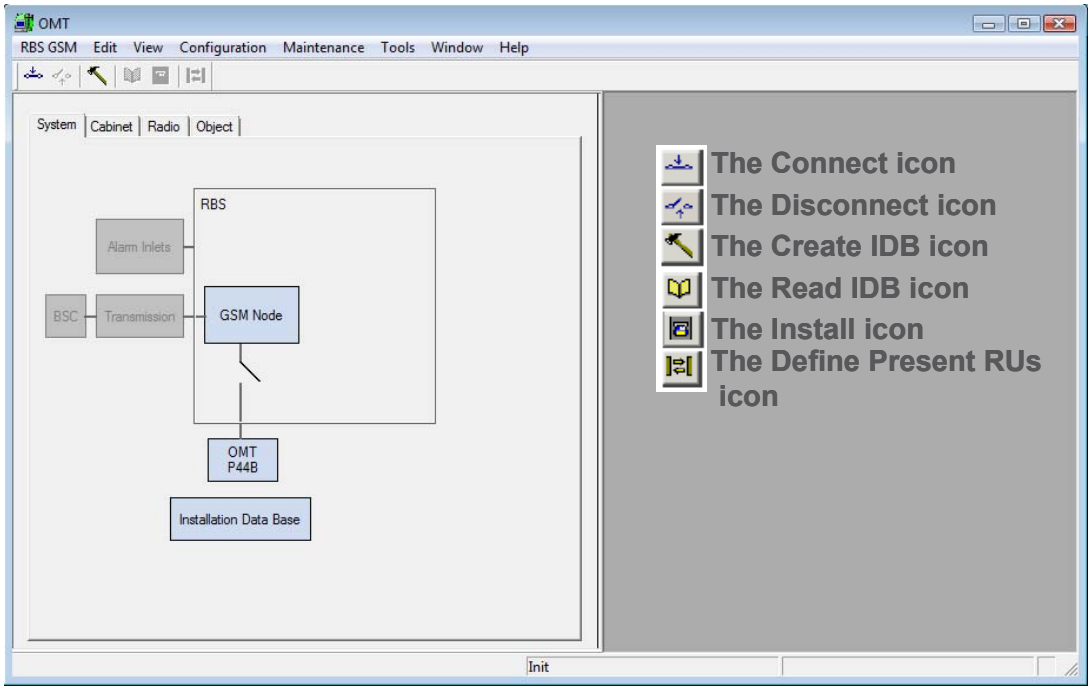


Figure 4-21: OMT Interface

The System view window shows an overview of the RBS and its environment. The System view is displayed when the OMT enters Init state.

4.3 Create IDB

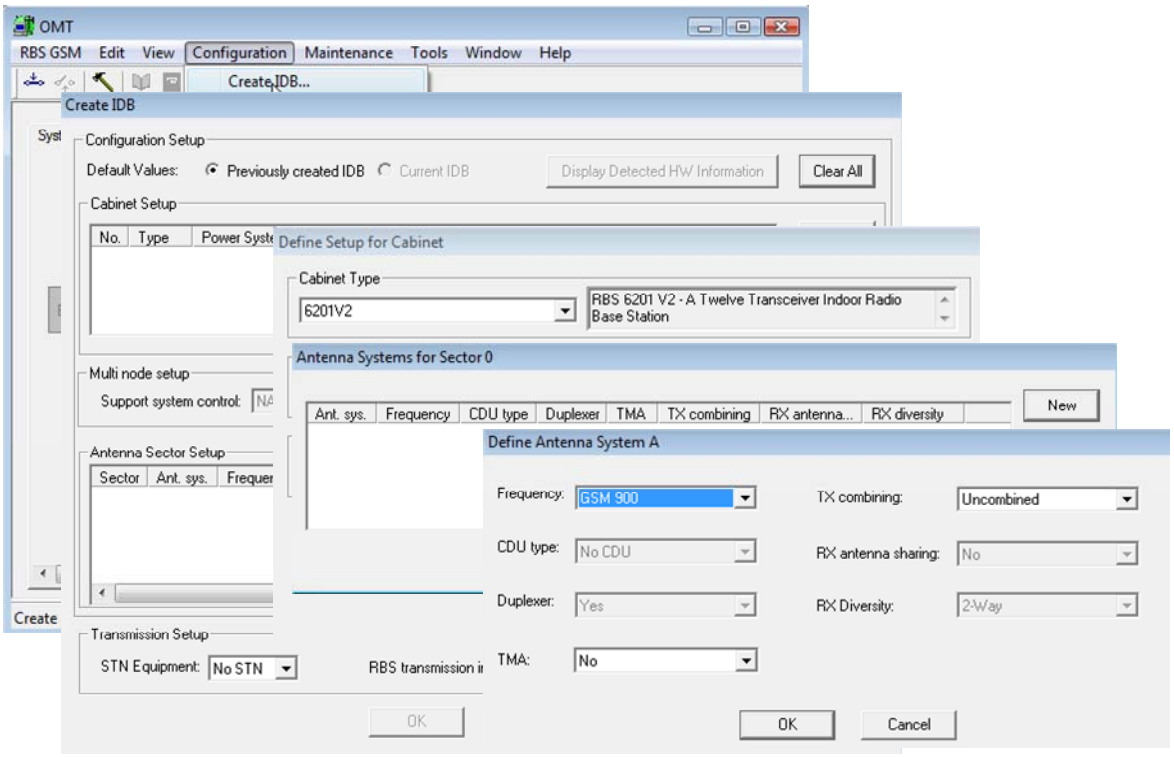


Figure 4-22: Create IDB

The Create IDB command creates a new IDB.

Note: It is important to make the selections in the dialogs from top to bottom, in order to ensure that the filtering of the configuration parameters functions correctly.

Valid OMT states:

- Change to state:
- Init Local IDB
- Local IDB

4.4 OMT Views

There are four types of views:

- System view
- Cabinet view
- Radio view
- Object view

A view contains several objects where each object represents a hardware unit or a logical unit, such as the PCM, Alarm Inlets or objects in the Object view.

The number of objects in the System view is fixed. The number of objects in the other views can change depending on the current IDB configuration.

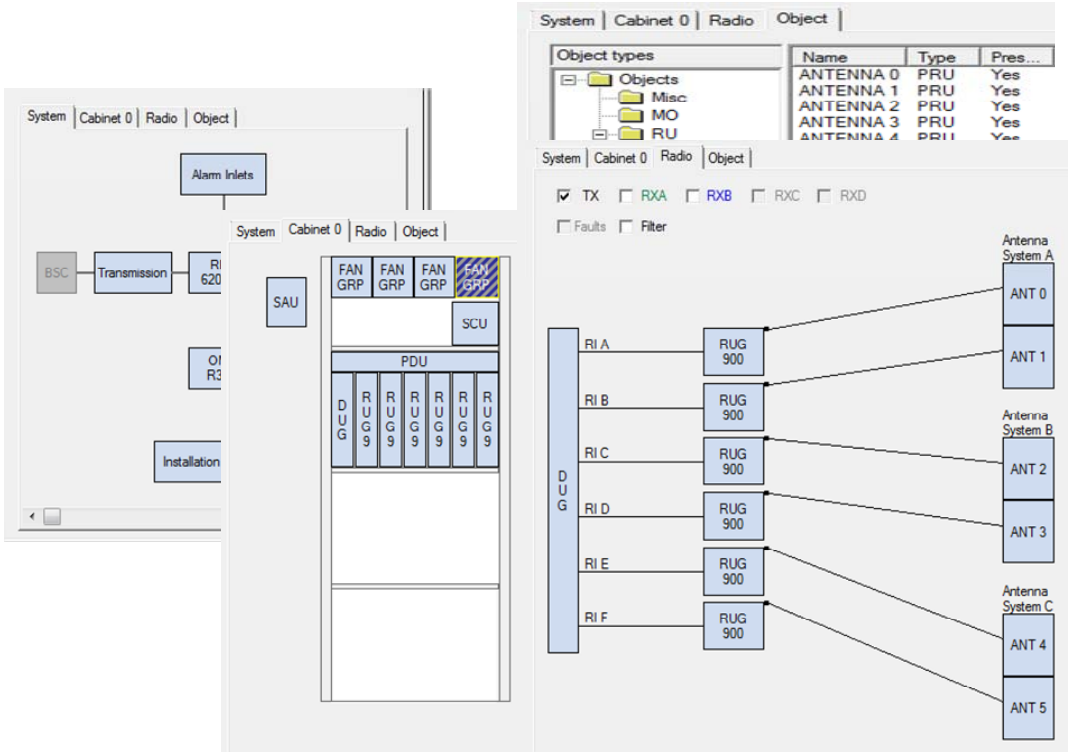


Figure 4-23: OMT Views

4.5 OMT cabinet view

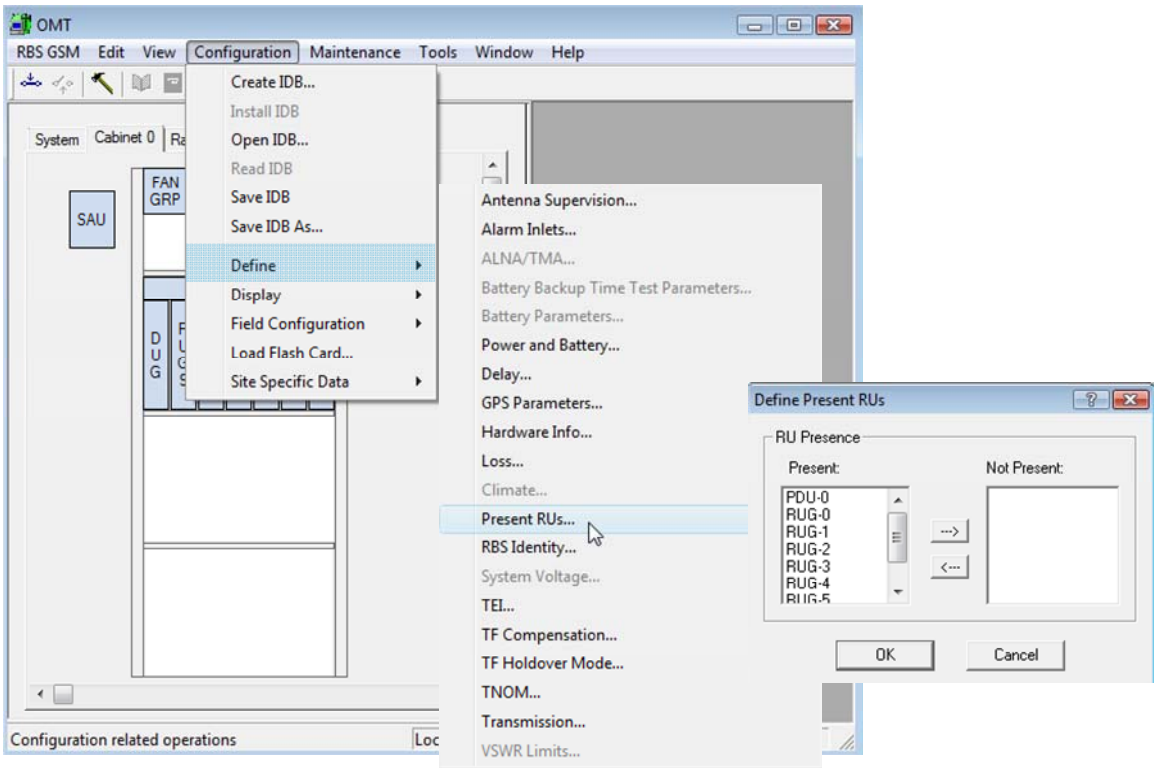


Figure 4-24: OMT Cabinet View

The Cabinet view displays the physical overview of the cabinet.

4.6 Define transmission

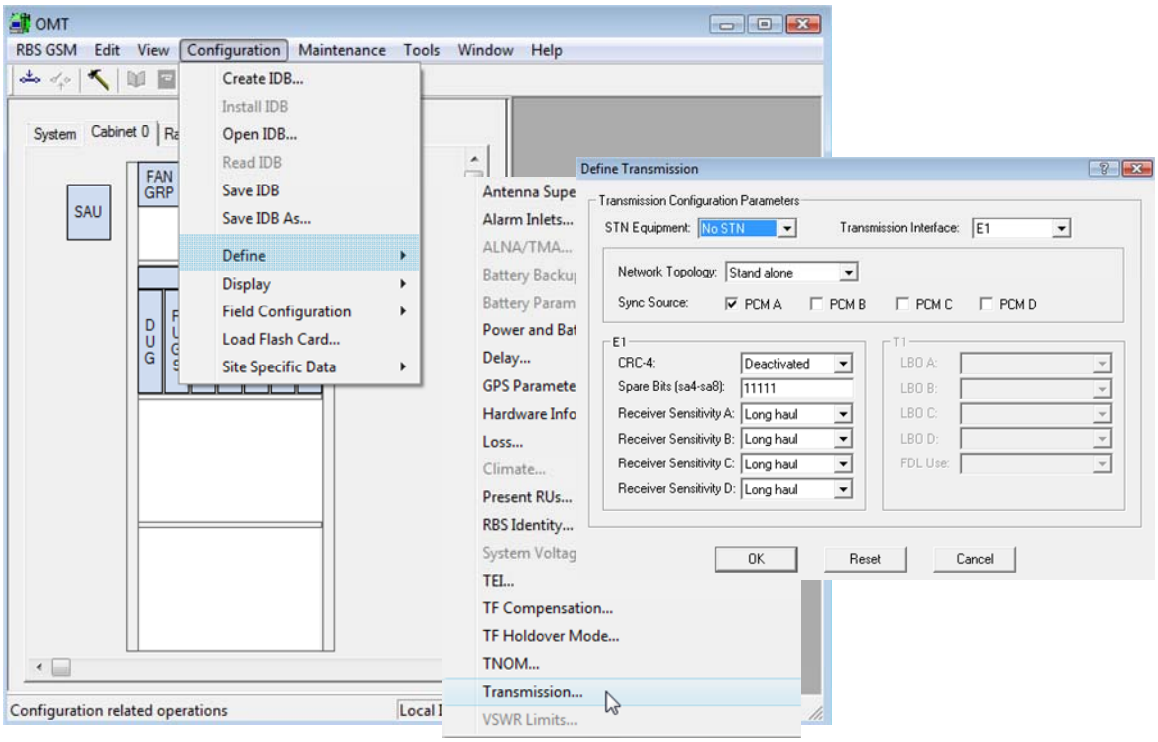


Figure 4-25: Define Transmission

The Define Transmission command defines the Transmission Configuration parameters**.**

Note: Check that the transmission type in the Define PCM dialog box is set to the same rate as the hardware. If it is not, an IDB alarm is presented in the MO fault maps.

Valid OMT states:

- Local IDB
- Connected

4.7 Define Alarm Inlets

The Define Alarm Inlets function is used to enable the supervision of devices connected to the external alarms interface of the RBS.

Different devices can be connected to the inlet ports on the external alarms interface on a DUG BASED RBS 6000 for supervision purposes. Devices for External alarms, ARAE faults, and MCPA faults are supported.

Each device type is handled differently by the RBS. The type of device connected to the inlet ports must therefore be specified by entering inlet usage.

External alarms are reported transparently through the RBS and BSC to the O&M centre. An example is a fire alarm.

ARAE faults and MCPA faults are reported on devices that are part of the radio chain, which when faulty, affect the performance/capacity of the RBS. These types of fault are included in the RBS internal fault analysis and handled in the same way as RBS internal faults.

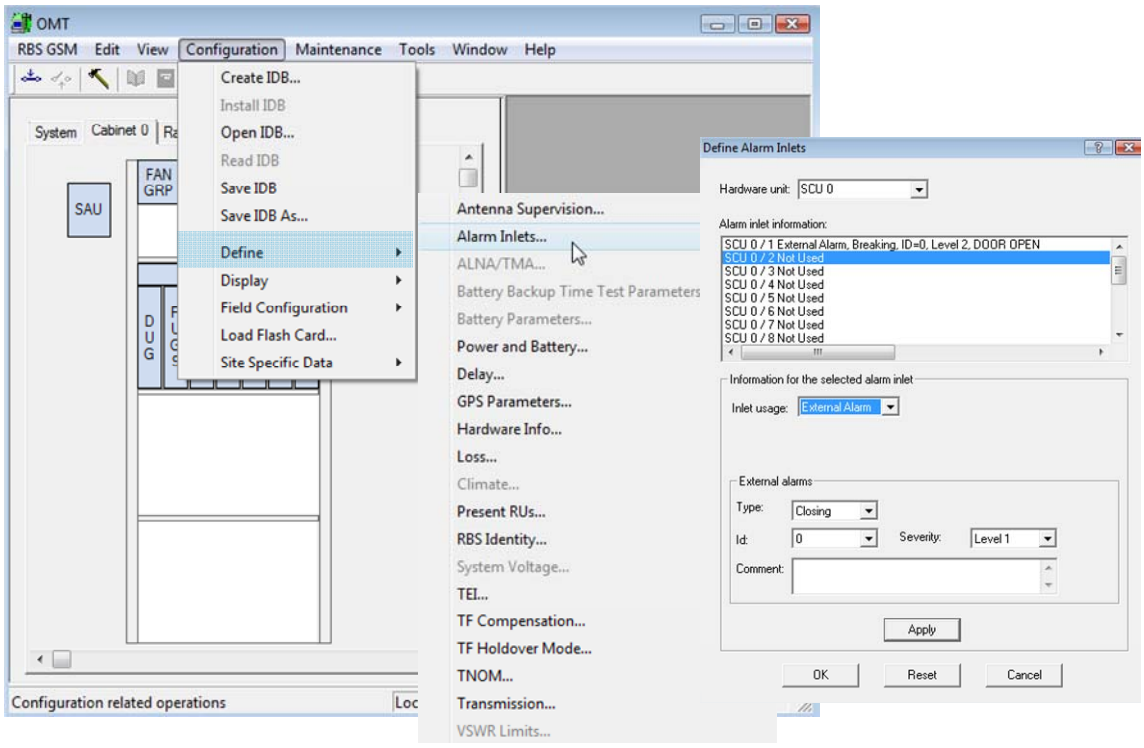


Figure 4-26: Define Alarm Inlets

4.8 Define VSWR Limits

The Define VSWR Limits command changes the VSWR limits for a TX antenna.

To change the VSWR limits for all TX antennas in an antenna system, select the Antenna System object.

The VSWR Class 1 and Class 2 limits can be changed only if VSWR Supervision is set to “User defined”. If VSWR Supervision is set to “Default”, the RBS SW sets the limits for Class 1 and Class 2 to 2.8.

4.9 Power Measurement

The Available monitors list shows all monitors that can be monitored. If a monitor is expanded, all objects supporting the monitor are shown. To add a monitor, select the object to be monitored and click the right arrow button. The selected object is moved to the Monitors to start list. To remove an added monitor, select the monitor and click the left arrow button.

A short description of the selected monitor is given in the Monitor description field.

In addition to reading the monitored data, it can also be saved in a text file (.log) by marking the Log to File check box and entering a file name. Selecting Browse causes a Log to File dialog box to be displayed.

Both forward and reflected power could be measured on time slot bases. VSWR measurements could be activated at the same time.

4.10 OMT Event Monitor

When an MO fault is selected, a corresponding fault description together with an action and related faults are displayed.

The description part is a brief explanation of the MO Fault and its possible cause.

The action part suggests what can be done to correct the fault.

The related faults may be faults that appear as a consequence of the reported fault, or faults that precede the reported fault.

Show Setup displays a window where the chosen monitors are displayed.

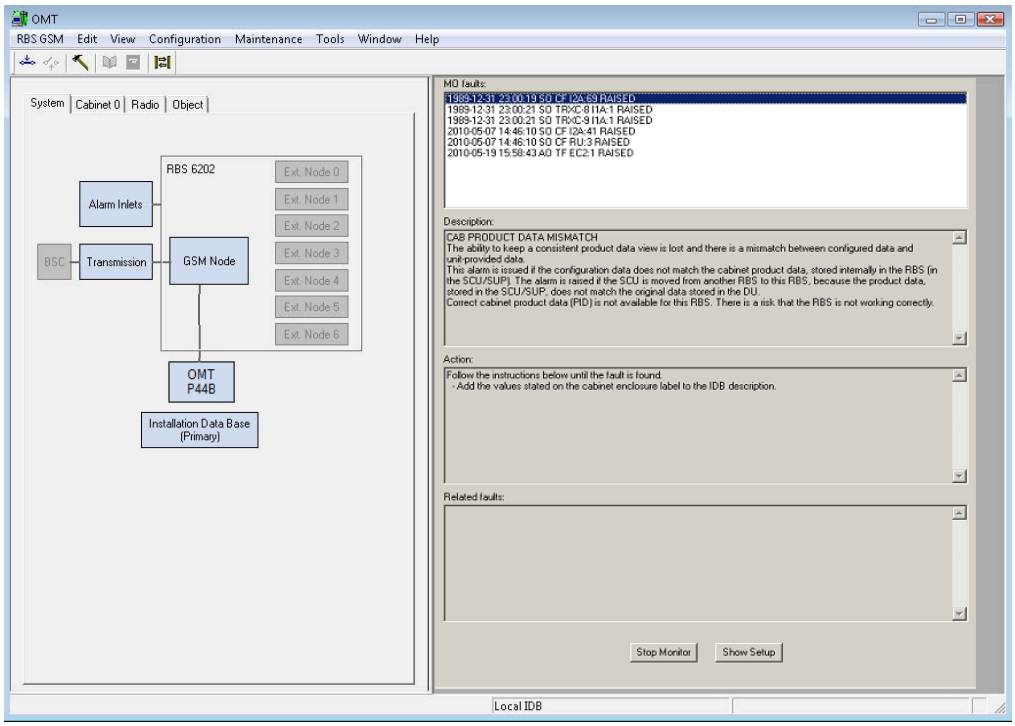


Figure 4-27: OMT Event Monitor

5 SUMMARY

Upon completion of this chapter, the participants should be able to:

4 Outline the main Operation and Maintenance tools for RBS 6000

4.1 Understand HyperTerminal used as Command Line Interface, (COLI)

4.2 Understand Node Command Line Interface, (NCLI)

4.3 Understand the web browser Element Manager, (EM)

4.4 Understand the Operation and Maintenance Terminal, (OMT)

Figure 4-28: Summary of Chapter 4

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5 Acronyms and Abbreviations

16 QAM	16 Quadrature Amplitude Modulation
64 QAM	64 Quadrature Amplitude Modulation
1G	First Generation
2G	Second Generation
3G	Third Generation
3GPP	Third Generation Partnership Program
4G	Forth Generation
4WRD	4 way Receiver Diversity
AAL	ATM Adaptation Layer
AAL0	ATM Adaptation Layer 0
AAL1	ATM Adaptation Layer 1
AAL2	ATM Adaptation Layer 2
AAL5	ATM Adaptation Layer 5
AC	Alternating Current
ADC	Analogue to Digital Converter
A/D	Analog to Digital
Ah	Ampere Hour
AISG	Antenna Interface Standard Group
AIU	Antenna Interface Unit
ALEX	Active Library Explorer
ALM	Alarm
AMOS	Advance Managed Object Scripting
AMPS	Advanced Mobile Phone Service
ANSI	American National Standards Institute
AOCON	Application Object Concentration
AODP	Application Object Digital Path
AOIS	Application Object Interface Switch
AORX	Application Object Receiver
AOTF	Application Object Timing Function
AOTS	Application Object Time Slot Handler
AOTX	Application Object Transmitter
APG	Adjunct Processor Group
ARAE	Antenna Related Auxiliary Equipment
ARIB	Association of Radio Industries and Businesses
ASC	Antenna System Controller

ATM	Asynchronous Transfer Mode
AU	Auxiliary Unit
AUH	Auxiliary Unit Hub
AUX	Auxiliary
BBS	Battery Backup System
BBU	Battery Backup Unit
BEM	Base Station Element Manager
BFD	Bidirectional Forwarding Direction
BP	Board Processor
BTS	Base Station System
BSS	Base Station Sub-system
BSC	Base Station Controller
CB	Circuit Breaker
CBU	Control Base Unit
CC	Common Channel
CCSA	China Communications Standards Association
CCU	Climate Control Unit
CDMA	Code Division Multiple Access
CE	Channel Element
CEEM	Channel Element Expansion Module
CES	Circuit Emulation Service
CF	Central Function
CLI	Command Line Interface
CLU	Climate Unit
CM	Configuration Management
C-MXB	Common/CPP Main Switching Board
CN	Core Network
COLI	COmmand Line Interface
COMINF	Operation and Maintenance Common Infrastructure
CON	Concentration
CORBA	Common Object Request Broker Architecture
CP	Connection Panel
CPI	Customer Product Information
CPM	Communication Processor
CPP	Connectivity Packet Platform
CPRI	Common Public Radio Interface
CPU	Central Processor Unit
CRC	Cyclic Redundancy Check
CRNC	Controlling RNC
CS	Circuit Switch
CSU	Control and Supervision Unit
CV	Configuration Version
DA	Digital to Analogue
DAC	Digital to Analogue Converter
D-AMPS	Digital Advanced Mobile Phone System
dB	Decibel

DB	Dummy Board
DBA	Digital Baseband Advance
DBM	Device Board Processor
DC	Direct Current
DCH	Dedicated Channel
DDTMA	Dual Duplex TMA
DEC	Decoder
DEM	Demodulator
DF	Distribution Frame
DF-OVP	Distribution Frame – Over Voltage Protection
DL	Down Link
DU	Digital Unit
DUG	Digital Unit GSM
DUL	Digital Unit LTE
DUS	Digital Unit MultiStandard
DUW	Digital Unit WCDMA
DXU	Digital Switching Unit
EACU	External Alarm Connection Unit
EC	Extension Cabinet
EC-bus	Enclosure Control bus
EDGE	Enhanced Data Rate for Global Evolution
ELIS	Electronic License Information System
EM	Element Manager
ENC	Encoding
eNodeB	Enhanced Node B (eNB)
EPC	Evolved Packet Core
EPS	Evolved Packet System
ESB	External Synchronization Bus
ESD	Electro Static Discharge
ET A	Exchange Terminal A
ET B	Exchange Terminal B
ET-IPG	Exchange Terminal – IP Gateway Board
ETSI	European Telecommunication Standard Institute
EUL	Enhanced Uplink
E-UL	Enhanced Uplink
E-UTRAN	Evolved- UTRAN
EV-DO	Evolution – Data Optimized
EVO	Evolution
EXT	External
F	Full
FCU	Fan Control Unit
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiplex Access)
FET	Fix Electrical Tilt
FM	Fault Management

FPGA	Field Programmable Gate Array
FTP	File Transfer Protocol
FU	Filter Unit
G.703	Standard to carry voice or data over PCM ie T1 or E1
GB	Giga Byte
GGSN	Gateway GPRS Support Node
GPB	General Purpose Processing Board
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
GUI	Graphical User Interface
GW	Gateway
HCS	High Capacity Subrack
HOM	Higher Order Modulation
HRPD	High Rate Packet Data
HS	High Speed
HSDPA	High Speed Downlink Packet Access
HSPA	High Speed Packet Access
HSUPA	High Speed Uplink Packet Access
HTML	Hyper Text Markup Language
HTTPS	Hyper Text Transfer Protocol Secure
HW	Hardware
ICF	Interface Connection Field
ICF-E	Interface Connection Field Extension Cabinet
ICF-M	Interface Connection Field Main Cabinet
IDB	Internal Data Base
IMA	Inverse Mutliplexing for ATM
IMT-2000	International Mobile Telecommunication - 2000
IOT	Inter Operability Test
IP	Internet Protocol
IPG	Indoor Pico Gateway
IS-95	Interim Standard 95
IS	Interface Switch
ISL	Inter Subrack Links
ISP	Internet Service Provider
ITU-T	International Telecommunication Union
ITU-T	International Telecommunication Union - Telecommunication
JRE	Java Runtime Environment
KAM	Key Account Manager
L2	Layer 2
LAN	Local Area Network
LAPD	Link Access Procedure on D-Channel
LDN	Local Distinguished Name
LED	Light Emitting Diode
LH	Long Haul

LK	License Key
LKF	License Key File
LMT	Local Maintenance Terminal
LNA	Low Noise Amplifier
LTE	Long Term Evolution
MAC	Medium Access Control
MB	Megabyte
MC	Multi Carrier
MC	Main Cabinet
MCPA	Multi Carrier Power Amplifier
MET	Mechanical Electrical Tilt
MET	Main Earth Terminal
MGW	Media Gateway
MIMO	Multiple Input Multiple Output
MMU	Memory Management Unit
MO	Managed Object
MOD	Modulation and spreading
MOM	Managed Object Management
MP	Main Processor
MPH	Mini-Link protective housing
mRBS	Micro RBS
MRC	Maximum Ratio Combining
mRRU	Micro Remote Radio Unit
mRRUS	Micro Remote Radio Unit Multi Standard
MS	Mobile Station
MS	Main Subrack
MSC	Mobile services Switching Centre
MSMM	Multi Standard Mixed Mode
MSP	Multiplex Section **Protection**
MU	Main Unit
MSSM	Multi Single Standard Single Mode
MVAV	Multi Vendor Antenna Verification
NCLI	Node Command Line Interface
ND	Network Design
NE	Network Element
NMT	Nordic Mobile Telephony
NPC	Node Production Centre
NTP	Network Timing Protocol
O&M	Operation and Maintenance
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiplexing Access
OMC	Operation and Maintenance Centre
OMINF	Operation and Maintenance Infrastructure
OMS	Optical
OMT	Operation and Maintenance Terminal

OPI	Operational Instruction
OPzV	Type of Battery (Long Shelf Live)
OSE	Operating System Ericsson
OSS-RC	Operation and Support Radio Core Network
O&M	Operation and Maintenance
OVP	Over Voltage Protection
PA	Power Amplifier
PBC	Power and Battery Cabinet
PC	Personal Computer
PCF	Power Connection Filter
PCM	Pulse Code Modulation
PDC	Personal Digital Communication
PDF	Portable Document Format
PDH	Packet Data Router
PDU	Power Distribution Unit
PIU	Plug In Unit
PFU	Power Filter Unit
pRBS	Pico Radio Base Station
PS	Packet Switched
PT	Packet Terminal
PPS	Pulse Per Second
PSU	Power Supply Unit
PSTN	Public Switched Telephone Network
QAM	Quadrature Amplitude Modulation
O&M	Operation and Maintenance
OMINF	Operation and Maintenance Infrastructure
OMS	Optical Multiservice Core Switch
OPI	Operational Instruction
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
OVP	Over Voltage Protection
RA	Random Access
RAB	Radio Access Bearer
RAM	Random Access Memory
RAN	Radio Access Network
RAP	RBS Antenna Port
RAX	Random Access Receiver
RAXB	Random Access Receiver Board
RBS	Radio Base Station
RCU	Remote Control Unit
RDN	Relative Distinguished Name
RET	Remote Electrical Tilt
RETU	Remote Electrical Tilt Unit
RF	Radio Frequency
RIU	RET Interface Unit
RJ 45	Type of Connector

ROMT	Remote Operation and Maintenance Terminal
RNC	Radio Network Controller
RNS	Radio Network Subsystem
ROM	Read Only Memory
ROP	Result Output Period
RPG	Regional Processor Group
RPU	Release Program Unit
RRU	Remote Radio Unit
RRUS	Remote Radio Unit Multi Standard
RRUW	Remote Radio Unit WCDMA
RU	Radio Unit
RUG	Radio Unit GSM
RUIF	Radio Unit Interface
RUL	Radio Unit LTE
RUS	Radio Unit Multi Standard Radio
RUW	Radio Unit WCDMA
RX	Receiver
RXI	Radio Access Network Aggregator
S1	Interface between EPC and eNodeB
SAE	System Architecture Evolution
SAU	Support Alarm Unit
SC	Single Carrier
SC-FDMA	Single Carrier - FDMA
SCB	Switch Core Board
SCB-DF	Switch Core Board – Dual Feed
SCB-TF	Switch Core Board – Triple Feed
SCCP	Signaling Connection Control Part
SCU	Support Control Unit
SDH	Static Dynamic Random Access Memory
SFP	Small Form Factor
SGSN	Serving GPRS Support Node
SHM	Software Hardware Manager
SIU	Site Integrate Unit
SMO	Software Management Organizer
SMS	Short Message Service
SO	Service Object
SOCF	Service Object Central Function
SONET	Synchronous Optical Networking
SOTRXC	Service Object Transceiver Controller
SPB	Special Purpose Processor Board
SPM	Special purpose Processor Modules
SPP	Special purpose Processor execution Platform
SRAM	Static Random Access Memory
SRNC	Serving RNC
SSC	Site Support Cabinet

SSH	Secure Shell
STM	Synchronous Transfer Mode
STOC	Signaling Terminal for Open Communication
S/W	Software
SW	Software
SXB	Switch Extension Board
TACS	Total Access Communication System
TCC	Transmission Coherent Combining
TCP	TEMS Cell Planner
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TCU	Transmission Control Unit
TD-CDMA	Time Division – Code Division Multiple Access
TDD	Time Division Duplex
TDM	Time Division Multiplex
TDMA	Time Division Multiple Access
TEMS	Test Mobile Station
TF	Timing Funtion
TG	Transceiver Group
TMA	Tower Mounted Amplifier
TMR	Transmission Rack
TN	Traffic Node
TN A	Transmission Network Electrical
TN B	Transmission Network Optical
TSG	Technical Specification Group
TRC	Transcoder Controller
TRM	Transmission Cabinet
TRP	Transceiver Receive Processing
TRX	Transceiver
TRXC	Transceiver Controller
TTA	Telecommunication Technology Association (Korea)
TTC	Telecommunication Technology Committee (Japan)
TTI	Transmission Time Interval
TUB	Timing Unit Board
TX	Transmit
TXB	Transmit Board
UBR	Unspecified Bit Rate
UE	User Equipment
UL	Uplink
ULN	Unique Logical Name
UMTS	Universal Mobile Telecommunication System
UNIX	Operating System
UP	Upgrade Package
UTRA	UMTS Terrestrial Access
UTRAN	UMTS Terrestrial Access Network
V	Voltage

VBR	Virtual Bit Rate
VC	Virtual Channel
VCI	Virtual Channel Identifier
V DC	Voltage Direct Current
VID	VLAN ID
VLAN	Virtual Local Area Network
VLR	Visitor Location Register
VP	Virtual Path
VPI	Virtual Path Identifier
VRLA	Valve-regulated lead-acid
VSWR	Voltage Standing Wave Ration
W	Watts
WARC	World Administrative Radio Conference
WCDMA	Wide-band Code Division Multiple Access
Wi-Fi	Wireless Fidelity
WTMA	WCDMA Tower Mounted Amplifier
X2	Interface between eNode B
xDSL	Digital Subscriber Line
XLAM	External Alarm Module
XMU	Auxiliary Multiplexing Unit
XP	Extreme Programming

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