CHAPTER TWO: MATERIALS AND METHODS.

2.1. *CELL PLANNING PROCESS*

Cell planning can be described briefly as all the activities involved in determining which sites will be used for the radio equipment, which equipment will be used, and how the equipment will be configured. In order to ensure coverage and to avoid interference, every cellular network needs planning. The major activities involved in the cell planning process are depicted in Figure 3.1.

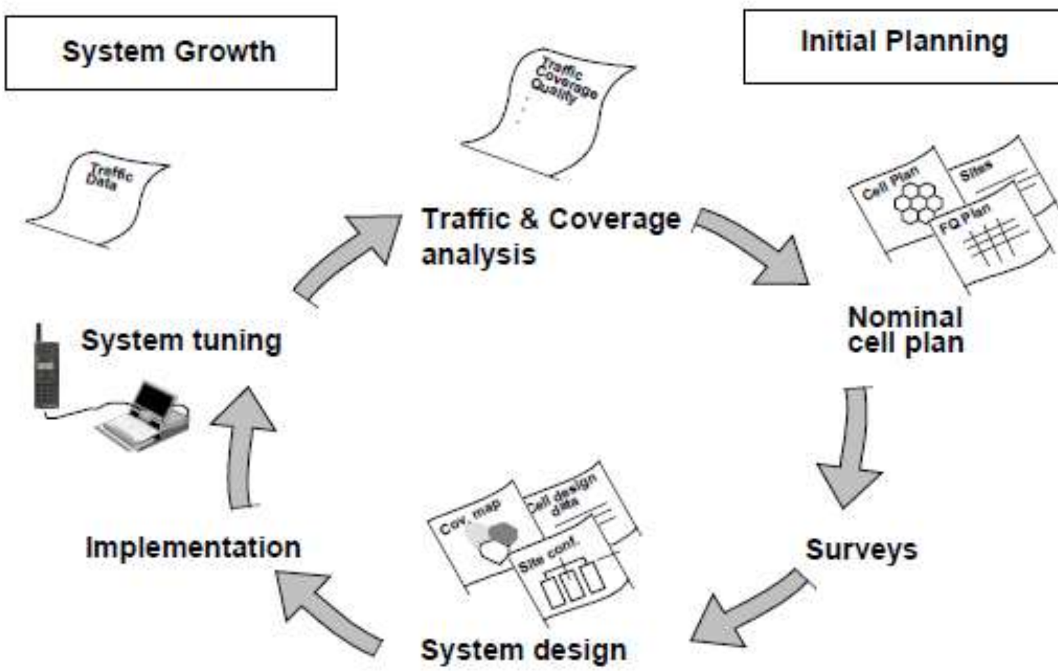


Figure 3.1 The cell planning process.

2.2. STEP 1: THE CELLPLANNING PROCESS TRAFFIC AND COVERAGE ANALYSIS (SYSTEM REQUIREMENTS)

The cell planning process starts with traffic and coverage analysis. The analysis should produce information about the geographical area and the expected need of capacity. The types of data collected are:

- Cost
- Capacity
- Coverage
- Grade of Service (GoS)

- Available frequencies
- Speech Quality Index
- System growth capability

The traffic demand (i.e. how many subscribers will join the system and how much traffic will be generated) provides the basis for cellular network engineering. Geographical distribution of traffic demand can be calculated by using demographic data such as:

- Population distribution
- Car usage distribution
- Income level distribution
- Land usage data
- Telephone usage statistics
- Other factors such as subscription charges, call charges, and price of mobile stations.

2.3. *STEP 2: NOMINAL CELL PLAN*

Upon compilation of the data received from the traffic and coverage analysis, a nominal cell plan is produced. The nominal cell plan is a graphical representation of the network and simply looks like a cell pattern on a map. However, a lot of work lies behind it (as described previously). Nominal cell plans are the first cell plans produced and form the basis for further planning. Quite often a nominal cell plan, together with one or two examples of coverage predictions, is included in tenders.

At this stage, coverage and interference predictions are usually started. Such planning needs computer-aided analysis tools for radio propagation studies, e.g. Ericsson's planning tool known as the Ericsson Engineering Tool (EET).

2.4. *STEP 3: SURVEYS (AND RADIO MEASUREMENTS)*

The nominal cell plan has been produced and the coverage and interference predictions have been roughly verified. Now it is time to visit the sites where the radio equipment will be placed and perform radio measurements. The former is important because it is necessary to assess the real environment to determine whether it is a suitable site location when planning a cellular network. The latter is very important because even better predictions can be obtained by using field measurements of the signal strengths in the actual terrain where the mobile station will be located.

2.5. *STEP 4: (FINAL CELL PLAN) SYSTEM DESIGN*

Once we optimize and can trust the predictions generated by the planning tool, the dimensioning of the RBS equipment, BSC, and MSC is performed. The final cell plan is then produced. As the name implies, this plan is later used during system installation. In addition, a document called Cell Design Data (CDD) containing all cell parameters for each cell is completed.

2.6. *STEP 5: IMPLEMENTATION*

System installation, commissioning, and testing are performed following final cell planning and system design. This step will be further explained later in this chapter.

2.7. *STEP 6: SYSTEM TUNING*

After the system has been installed, it is continually evaluated to determine how well it meets the demand. This is called system tuning.
It involves:

- Checking that the final cell plan was implemented successfully
- Evaluating customer complaints
- Checking that the network performance is acceptable
- Changing parameters and performing other measures (if needed)

The system needs constant re-tuning because the traffic and number of subscribers increases continuously. Eventually, the system reaches a point where it must be expanded so that it can manage the increasing load and new traffic. At this point, a coverage analysis is performed and the cell planning process cycle begins again.

2.8. *DESCRIPTION OF REPLACEABLE UNITS (RUS) AND BUSES IN RBS 2000 MACRO.*

The hardware consists of a number of Replacable Units (RUs) and buses, which are briefly described in the following sections. The RU is the smallest hardware part that can be swapped when doing repair at the site. This can be e.g. a Tranceiver Unit
(TRU), cable, fan etc.

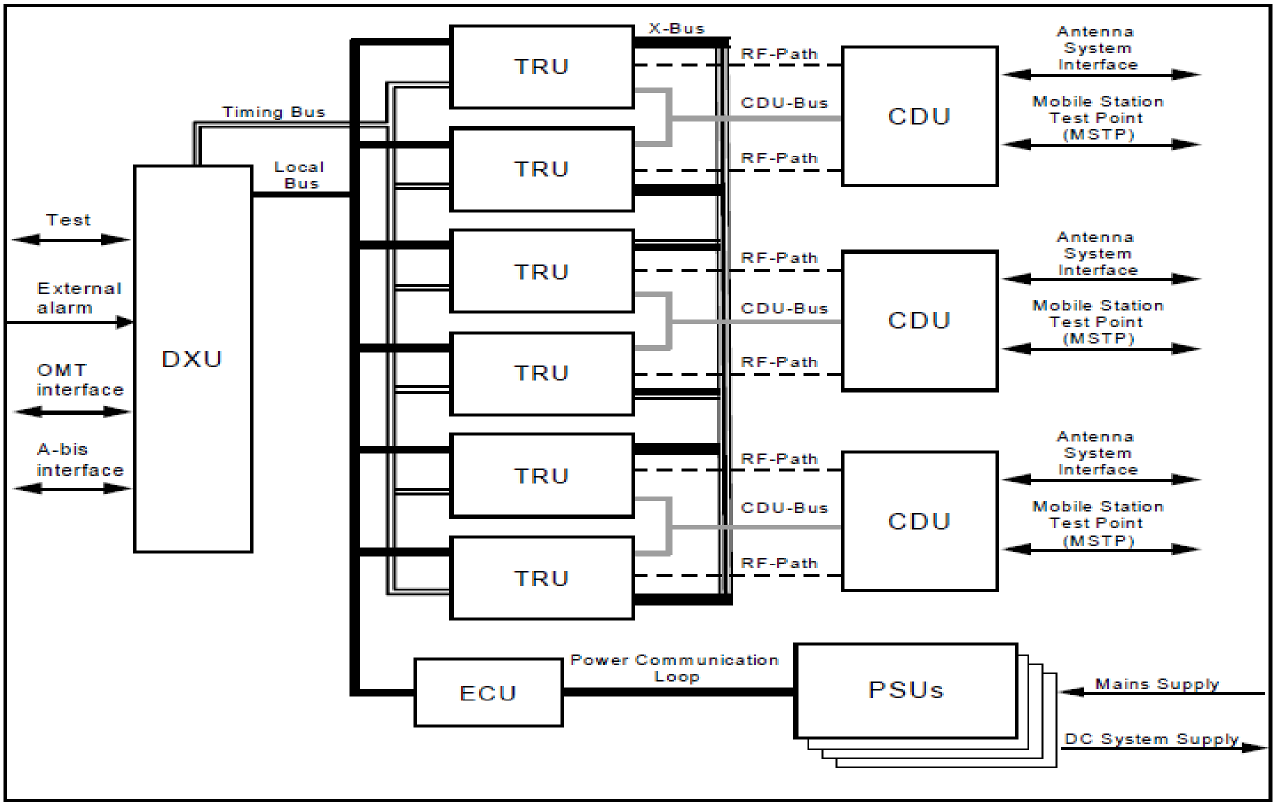
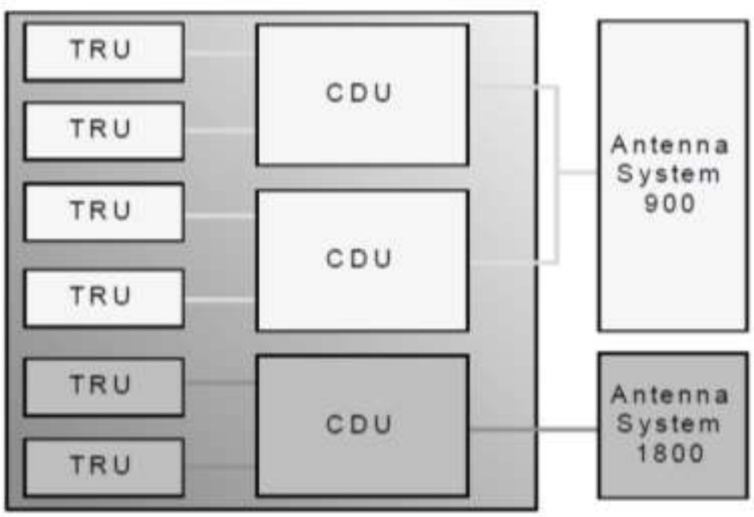


Figure XX Replaceable Units (RUs) and buses in RBS 2000.



DISTRIBUTION SWITCH UNIT (DXU)

The Distribution Switch Unit (DXU) is the RBS central control unit. There is one DXU per RBS. It provides a system interface by cross connecting either a 2Mbit/s or 1.5 Mbit/s transport network and individual time slots to their associated
transceivers.

TRANSCEIVER UNIT (TRU)

It is a transmitter/receiver and signal processing unit which broadcasts and receives the radio frequency signals that are passed to and from the mobile station. Each TRU handles 8 air time slots.

COMBINING AND DISTRIBUTION UNIT (CDU)

A combiner is a device, at the base station, that allows connection of several transmitters to one antenna. It allows each transmitters RF energy out to the antenna, while blocking the RF energy from the other transmitters utilizing the same antenna. There are two types of combiners:

- Hybrid
- Filter

ENERGY CONTROL UNIT (ECU)

The ECU controls and supervises the power and climate equipment to regulate the power and the environmental conditions inside the cabinet to maintain system operation. It communicates with the DXU over the Local Bus. The main units in the power and climate system are:

- Power Supply Units (PSU)
- Battery and Fuse Unit (BFU) with batteries
- AC Connection Unit (ACCU)
- Climate subcabinet with Climate Control Unit (CCU), heater,
active cooler and heat exchanger (outdoor cabinets only)
- Fans controlled by Fan Control Units (FCU)
- Climate sensors, i.e. temperature and humidity sensors.

LOCAL BUS

The local bus offers internal communication between the DXU, TRUs and ECU. Examples of information sent on this bus are TRX Signaling, speech and data.

TIMING BUS

The timing bus carries air timing information from the DXU to the TRUs.

X-BUS

The X-bus carries speech/data on a time slot basis between the TRUs. This is used for base band frequency hopping.

CDU BUS

The CDU Bus connects the CDU to the TRUs and facilitates interface and O&M functions e.g. transfers alarms and RU specific information.

POWER COMMUNICATION LOOP

The power communication loop consists of optical-fiber cables and carries control and supervision information between the ECU, PSUs, and the BFU. E.g., the output current is regulated due to the traffic load of the RBS.

2.9. OPERATION AND MAINTENANCE TERMINAL (OMT*)*

Operation and Maintenance Terminal (OMT) is a software tool specifically designed for the RBS 2000 family of base stations. It is used to perform a number of Operation and Maintenance tasks on site or remotely from the BSC. OMT is a PC program that runs under Microsoft Windows 95 or Windows NT.

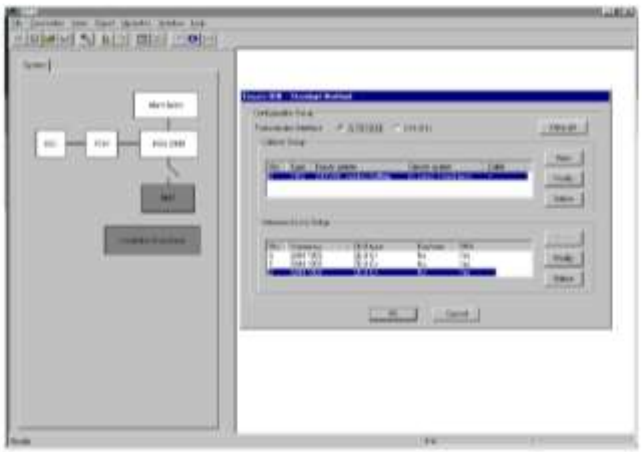


Figure XXX Operation and Maintenance Terminal (OMT).

OMT is used during the Radio Base Station (RBS) testing process, both in the warehouse and on-site. It is used for updating and maintaining the RBS Installation DataBase (IDB), defining RBS external alarms, and during the performance of preventive and corrective maintenance functions on the RBS 2000. The primary functions that OMT will be used to perform are; Monitoring the cabinets Internal Alarms in the troubleshooting process, performing IDB operations, defining the External Alarms and Antenna Related Auxiliary Equipment (ARAE), and monitor the hardware and configuration status of the RUs in the cabinet.

Internal Alarms

During the base station repair process, the Monitor function can be used to collect information about the fault status of the RBS. This will provide the RBS technician the ability to check for faults when no MMI indications are present, and to confirm repair actions after an RU has been replaced.

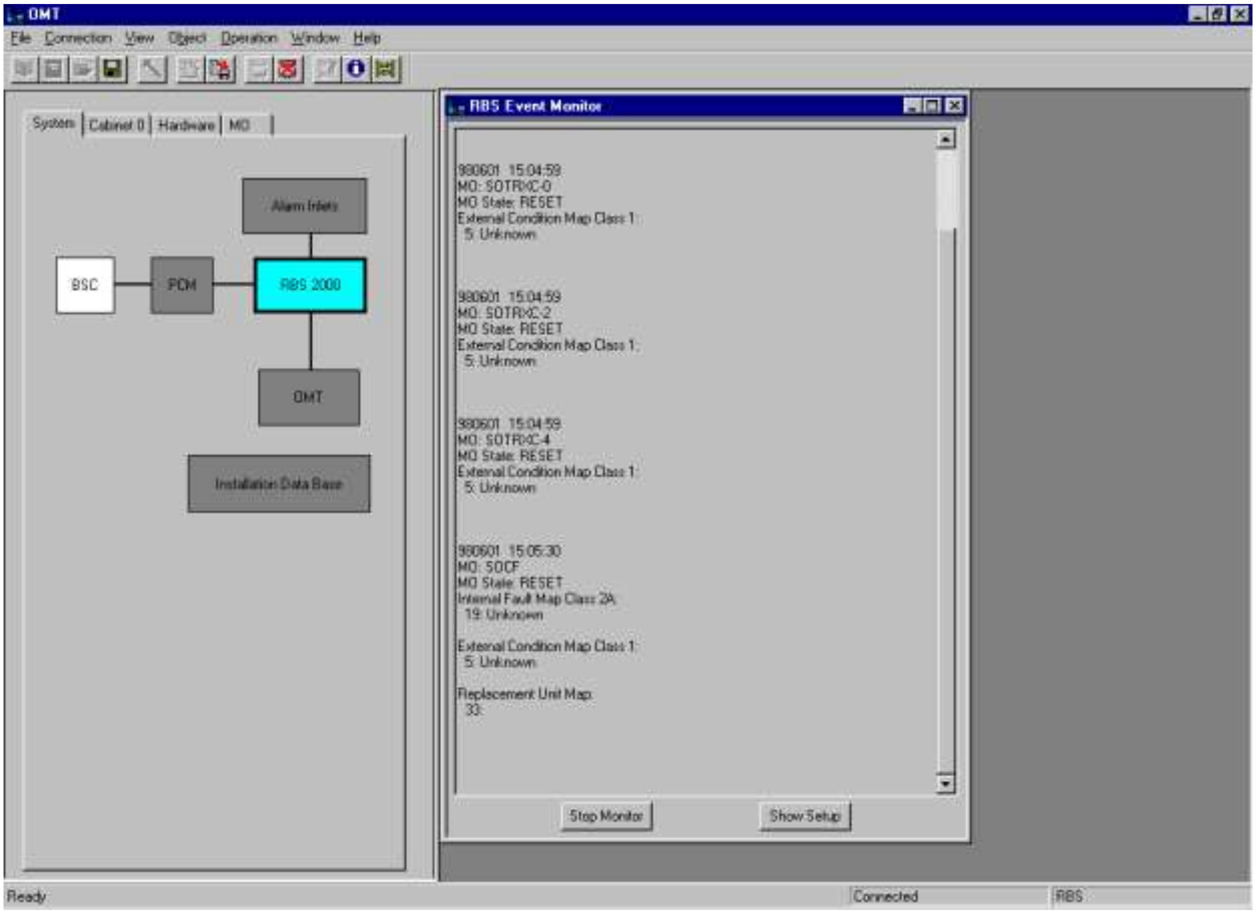


Figure 3-23 Internal Alarms

External Alarms/Antenna Related Auxiliary Equipment (ARAE)

The OMT is used to define external alarms for the base station. It is also used to define Antenna Related Auxiliary Equipment (AREA) alarms, e.g the active antenna in the Maxite. Even though they are binary alarms these alarms will be handled more like an internal alarm in the BSC. It is important to note that during the alarm definition process the OMT must be disconnected. In order to load the newly defined alarms, the base station needs to be placed in the local mode, precluding any traffic while the new IDB is being.

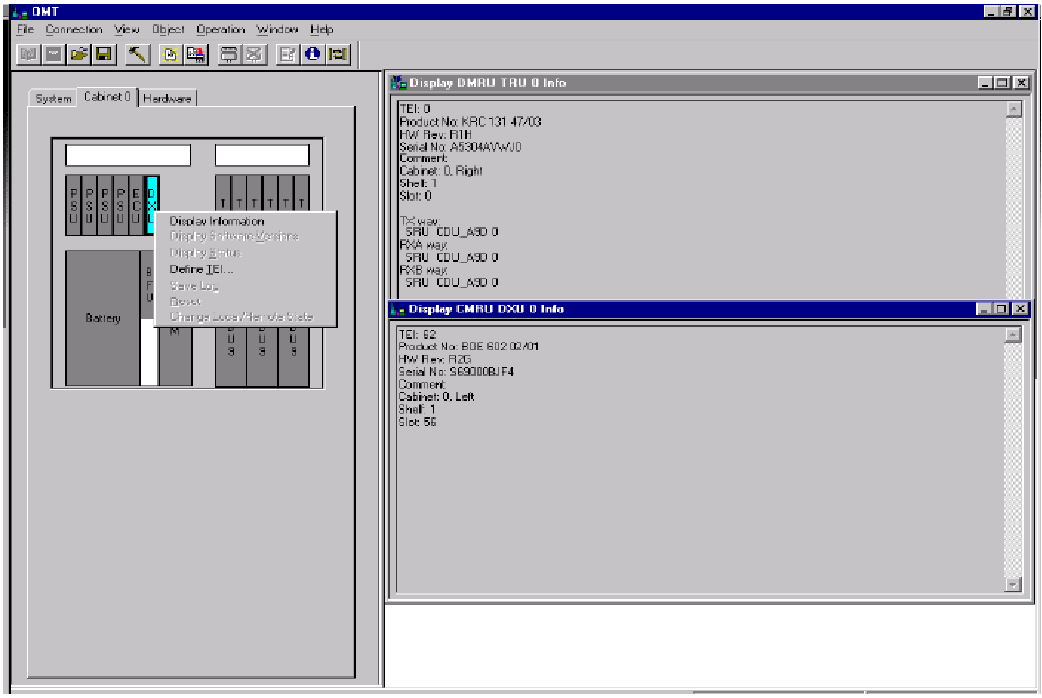


Figure 3-25 Installation Data Base (IDB).

Monitor functions

The monitor function in the OMT makes it possible to check the configuration of RUs and MOs, read sensor outputs and read fault status on RUs. This function belonged to OMT2 in the old SW-releases, but has now been implemented in the new OMT version.

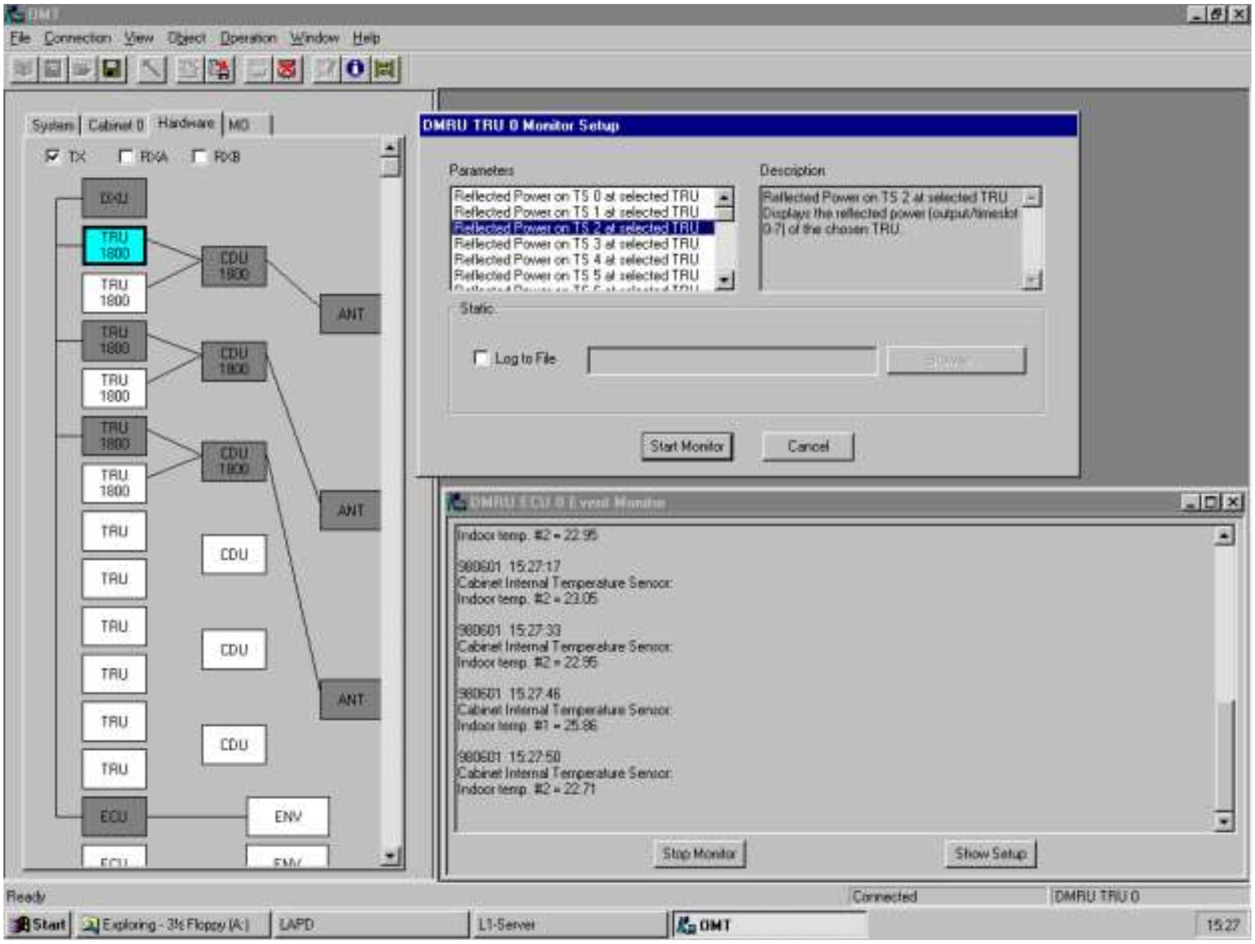
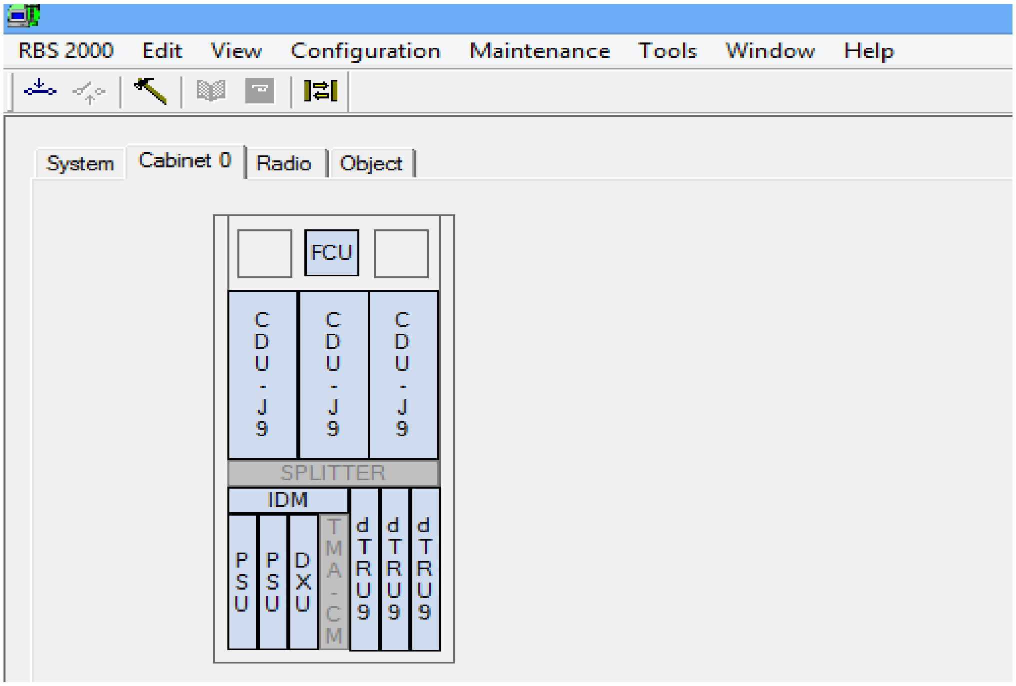


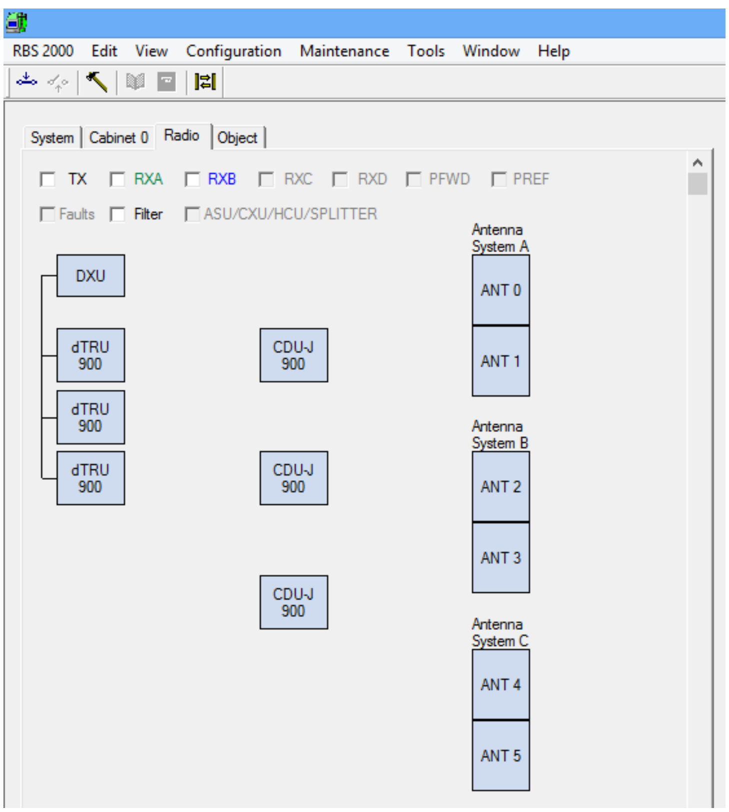
Figure 3-26 Monitor functions.

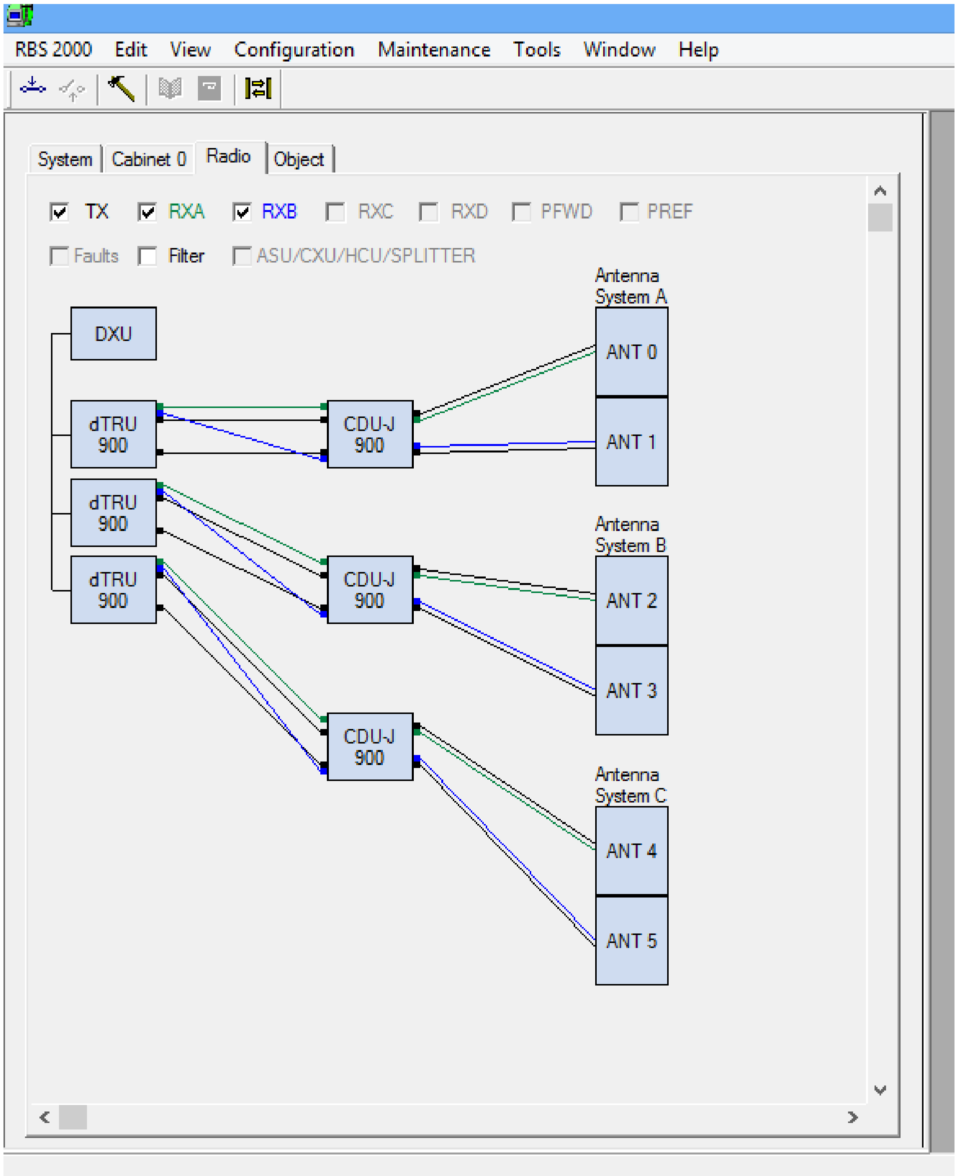
2.10. *RADIO BASE STATION (RBS) CONFIGURATION*

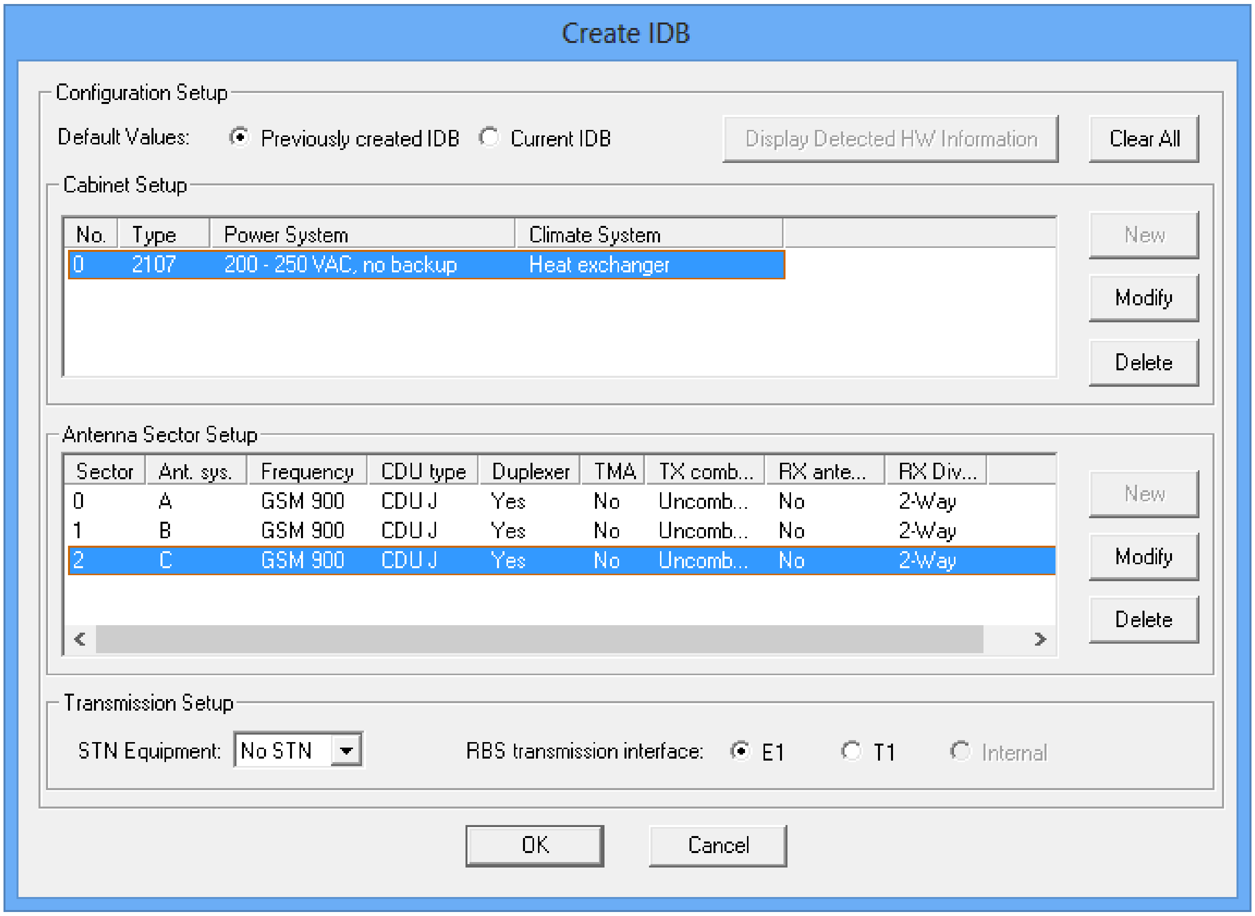
- **RBS configuration:** This involves the allocation of frequencies to channel combinations and power levels for each cell according to available equipment. If equipment becomes faulty causing the loss of important channels, reconfiguration of the remaining equipment is activated, sacrificing less important channels.
- **RBS software handling:** this involves the control of program loads.
- **RBS equipment maintenance:** RBS faults and disturbances are recorded and logged continuously.

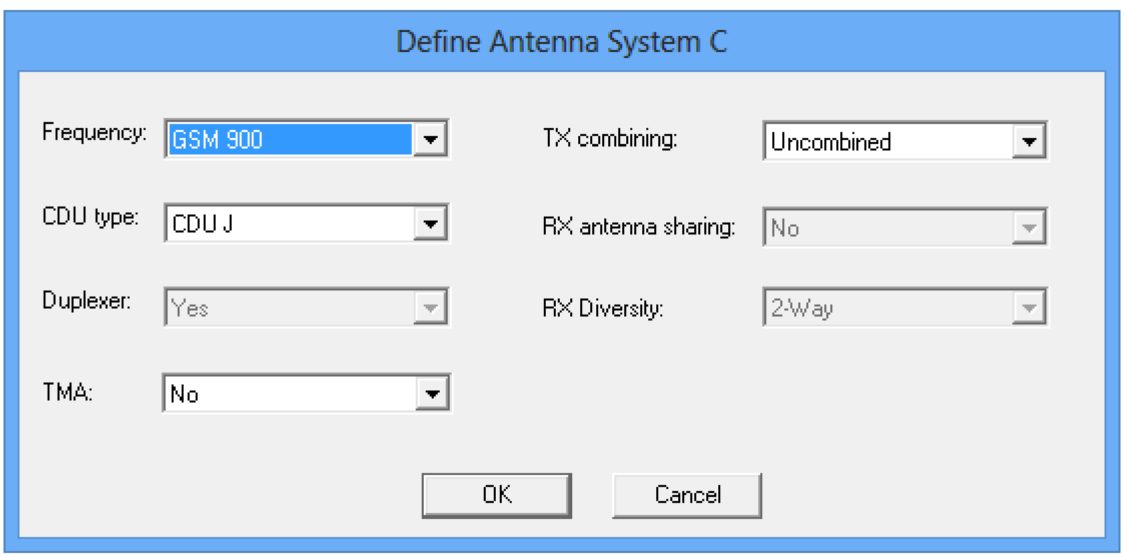
2.11. *CONFIGURATION RBS 2207 2+2+2 900Mhz.*

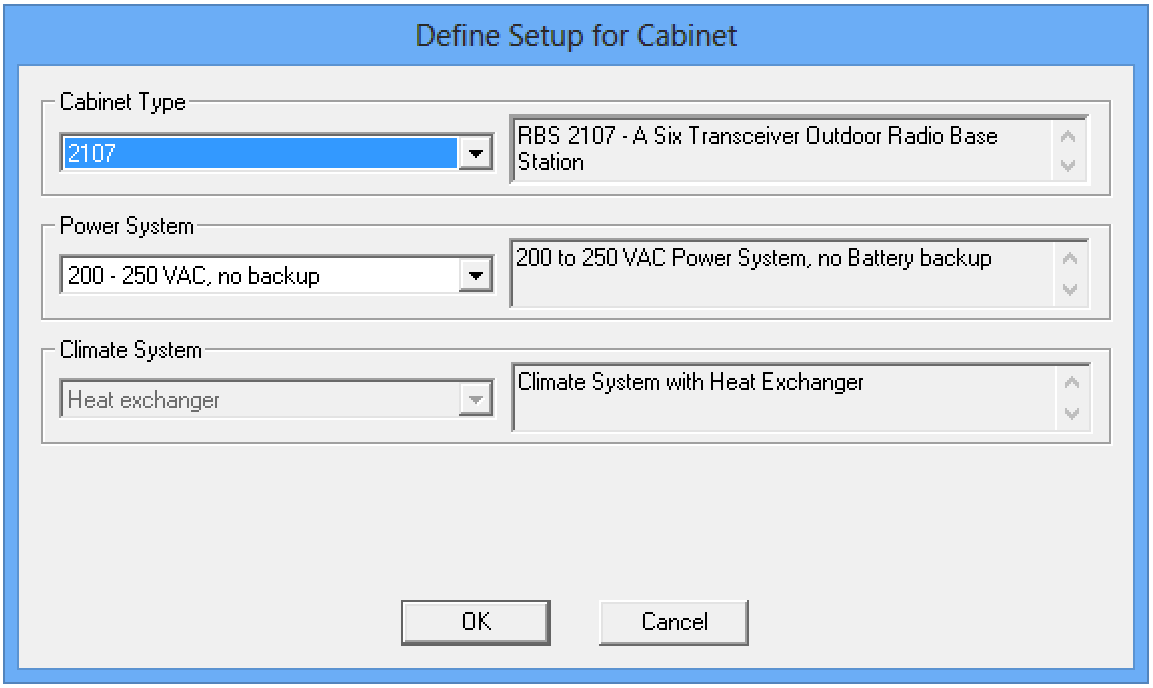

RBS 2000
Edit
View
Configuration
Maintenance
Tools
Window
Help
System
Cabinet 0
Radio
Object
FCU
CDU-J9
CDU-J9
CDU-J9
SPLITTER
IDM
PSU
PSU
DXU
TMA-CM
dTRU9
dTRU9
dTRU9

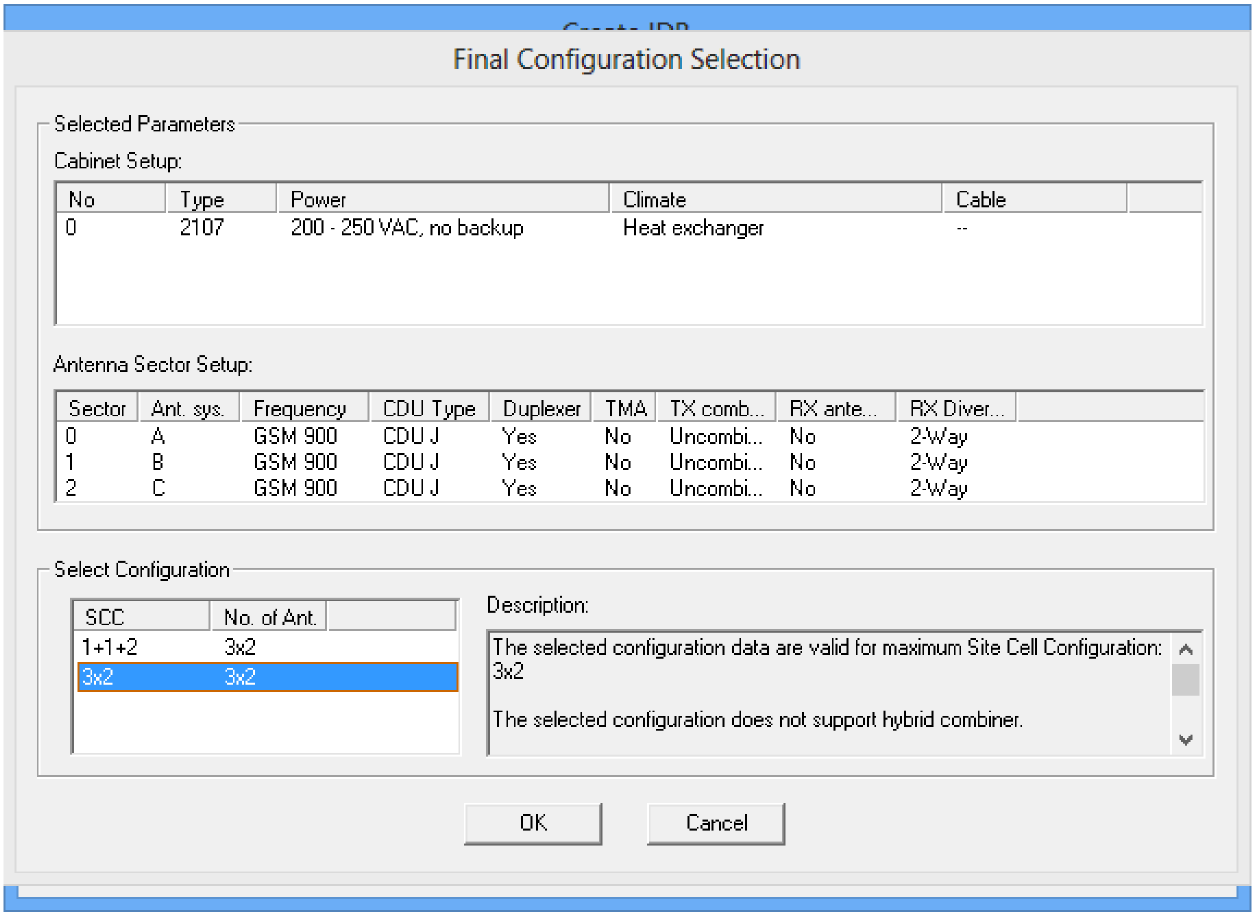

RBS 2000
Edit
View
Configuration
Maintenance
Tools
Window
Help
System
Cabinet 0
Radio
Object
TX
RXA
RXB
RXC
RXD
PFWD
PREF
Faults
Filter
ASU/CXU/HCU/SPLITTER
DXU
dTRU 900
dTRU 900
dTRU 900
CDU-J 900
CDU-J 900
CDU-J 900
Antenna System A
ANT 0
ANT 1
Antenna System B
ANT 2
ANT 3
Antenna System C
ANT 4
ANT 5


RBS 2000
Edit
View
Configuration
Maintenance
Tools
Window
Help
System
Cabinet 0
Radio
Object
TX
RXA
RXB
RXC
RXD
PFWD
PREF
Faults
Filter
ASU/CXU/HCU/SPLITTER
DXU
dTRU 900
dTRU 900
dTRU 900
CDU-J 900
CDU-J 900
CDU-J 900
Antenna System A
ANT 0
ANT 1
Antenna System B
ANT 2
ANT 3
Antenna System C
ANT 4
ANT 5

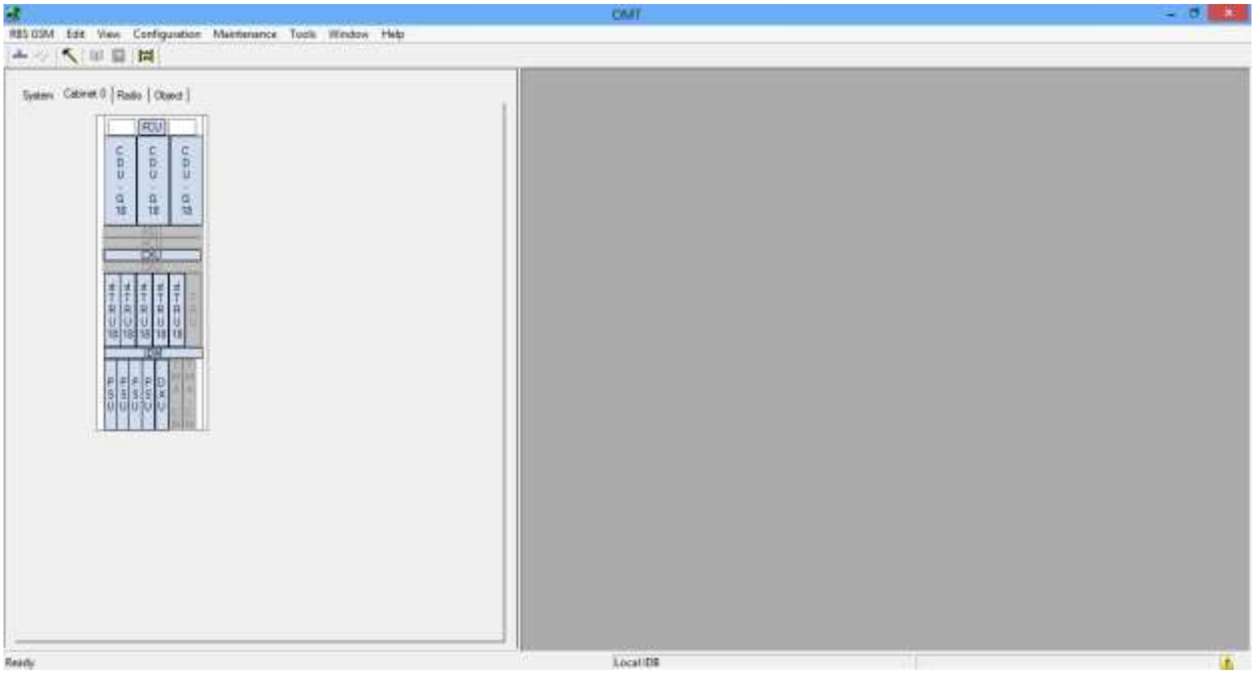

Create IDB
Configuration Setup
Default Values: Previously created IDB Current IDB
Display Detected HW Information
Clear All
Cabinet Setup
No. Type Power System Climate System
0 2107 200 - 250 VAC, no backup Heat exchanger
New
Modify
Delete
Antenna Sector Setup
Sector Ant. sys. Frequency CDU type Duplexer TMA TX comb... RX ante... RX Div...
0 A GSM 900 CDU J Yes No Uncomb... No 2-Way
1 B GSM 900 CDU J Yes No Uncomb... No 2-Way
2 C GSM 900 CDU J Yes No Uncomb... No 2-Way
New
Modify
Delete
Transmission Setup
STN Equipment: No STN
RBS transmission interface: E1 T1 Internal
OK
Cancel

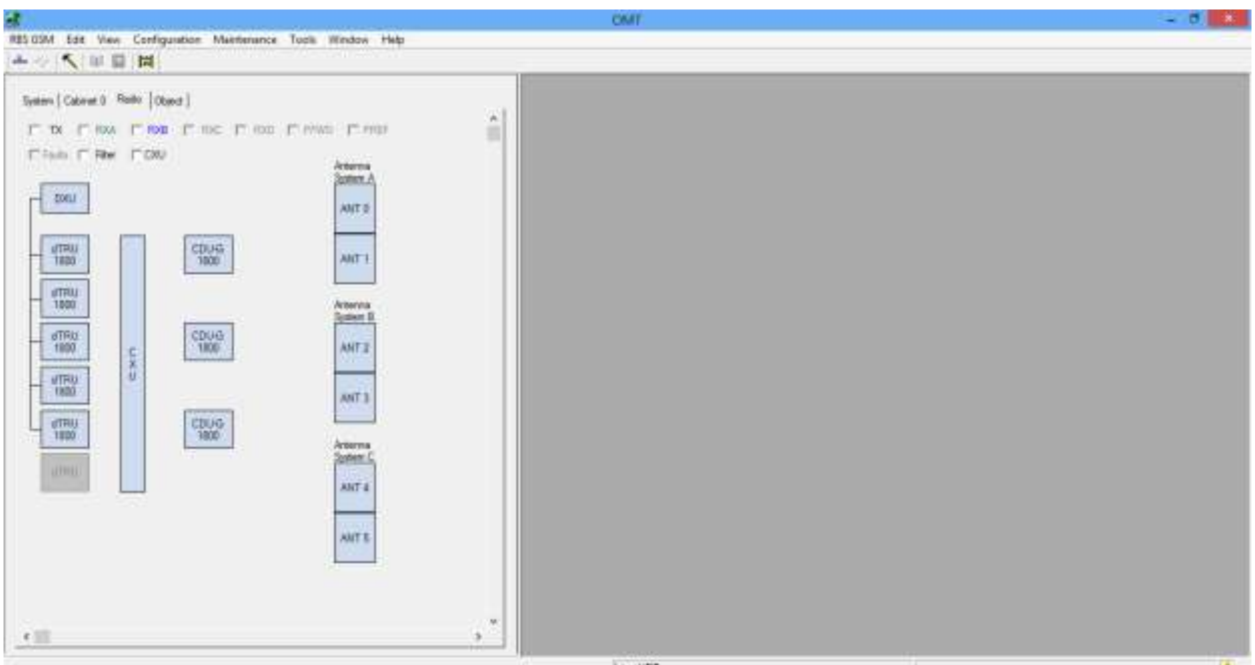

Define Antenna System C
Frequency: GSM 900
TX combining: Uncombined
CDU type: CDU J
RX antenna sharing: No
Duplexer: Yes
RX Diversity: 2-Way
TMA: No
OK
Cancel

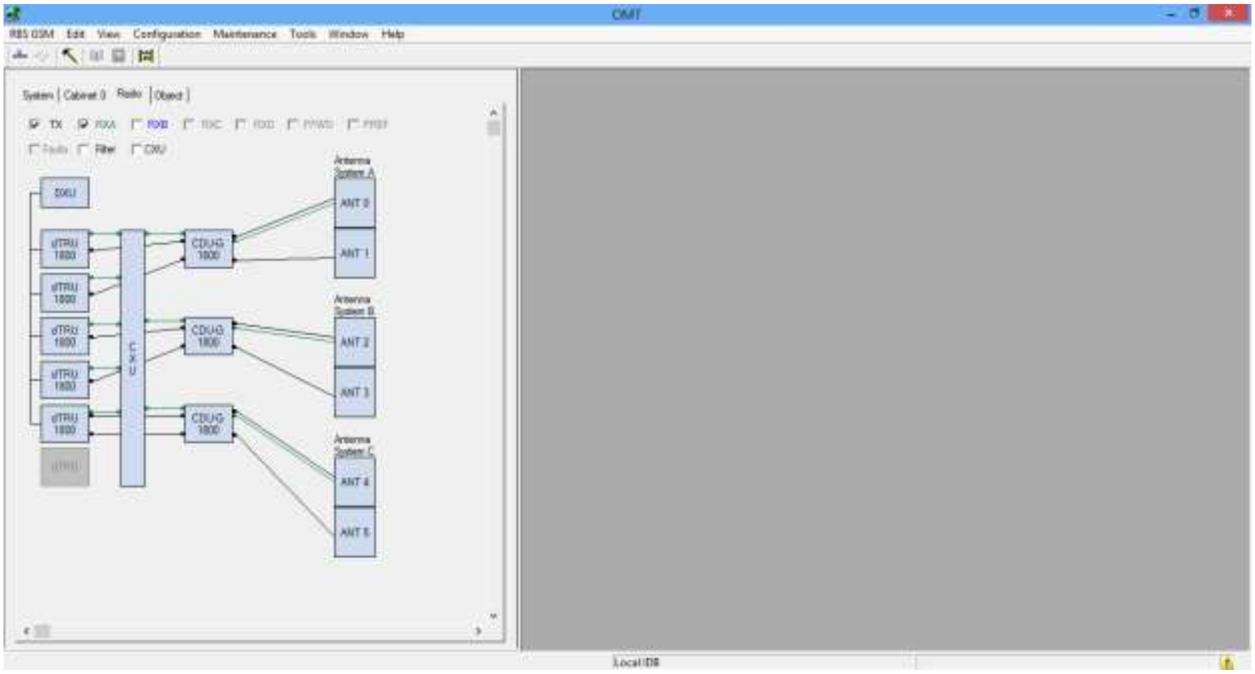

Define Setup for Cabinet
Cabinet Type
2107
RBS 2107 - A Six Transceiver Outdoor Radio Base Station
Power System
200 - 250 VAC, no backup
200 to 250 VAC Power System, no Battery backup
Climate System
Heat exchanger
Climate System with Heat Exchanger
OK
Cancel

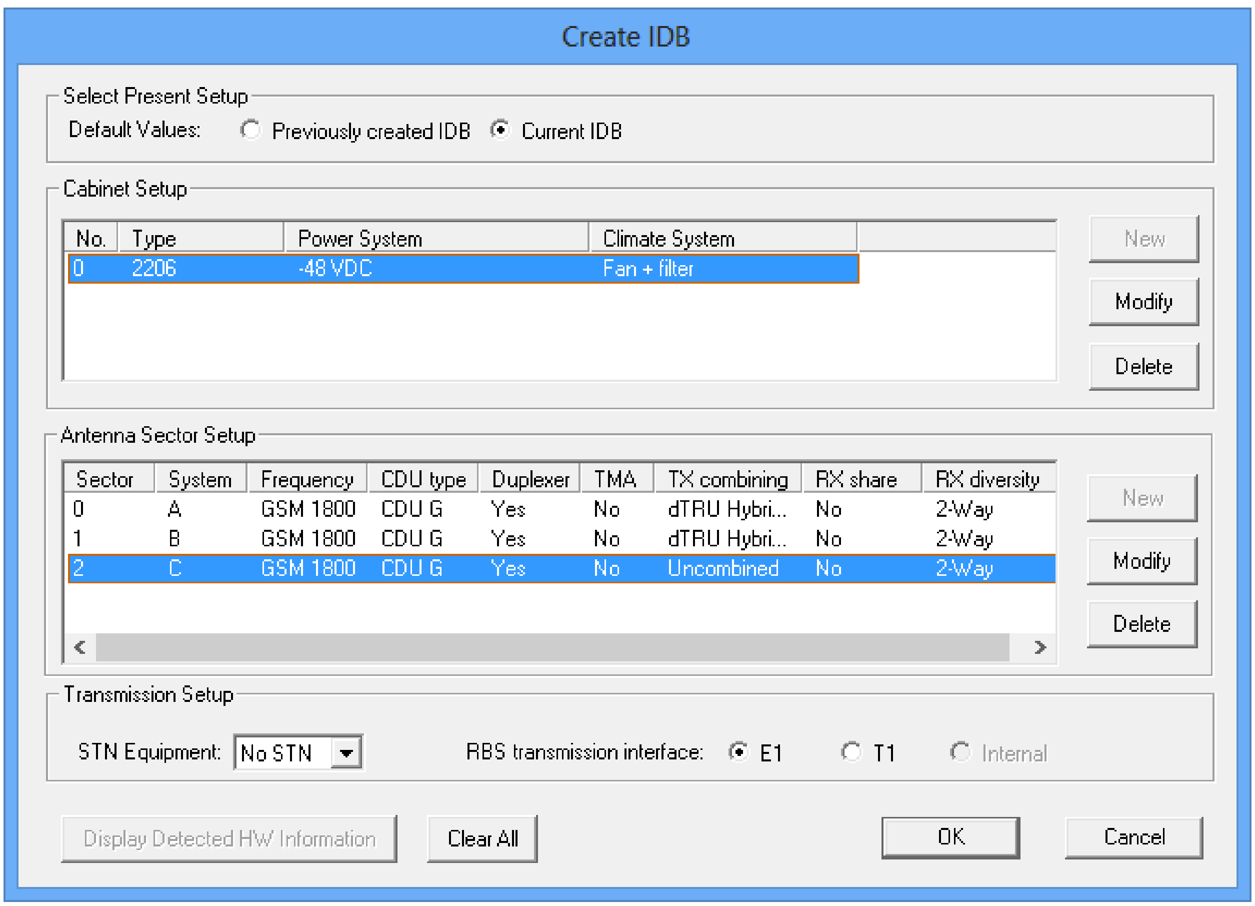

Create IDB
Final Configuration Selection
Selected Parameters
Cabinet Setup:
No Type Power Climate Cable
0 2107 200 - 250 VAC, no backup Heat exchanger --
Antenna Sector Setup:
Sector Ant. sys. Frequency CDU Type Duplexer TMA TX comb... RX ante... RX Diver...
0 A GSM 900 CDU J Yes No Uncombi... No 2-Way
1 B GSM 900 CDU J Yes No Uncombi... No 2-Way
2 C GSM 900 CDU J Yes No Uncombi... No 2-Way
Select Configuration
SCC No. of Ant.
1+1+2 3x2
3x2 3x2
Description:
The selected configuration data are valid for maximum Site Cell Configuration: 3x2
The selected configuration does not support hybrid combiner.
OK
Cancel

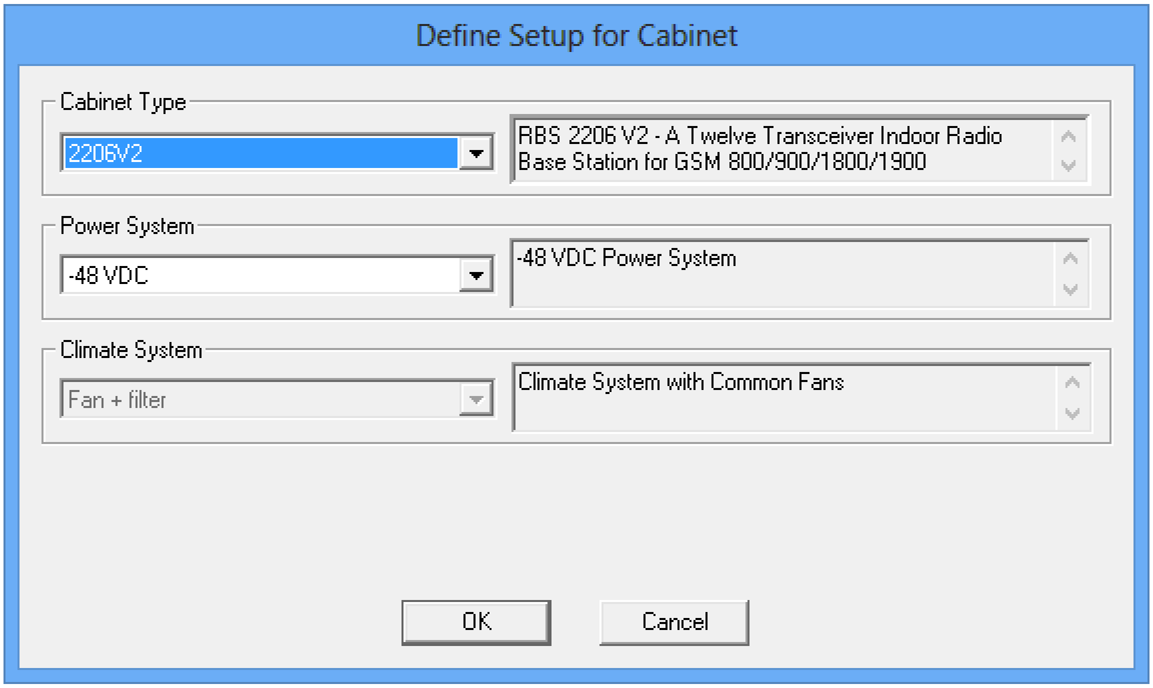
2.12. *CONFIGURATION RBS 2206 4+4+2 1800 Mhz.*

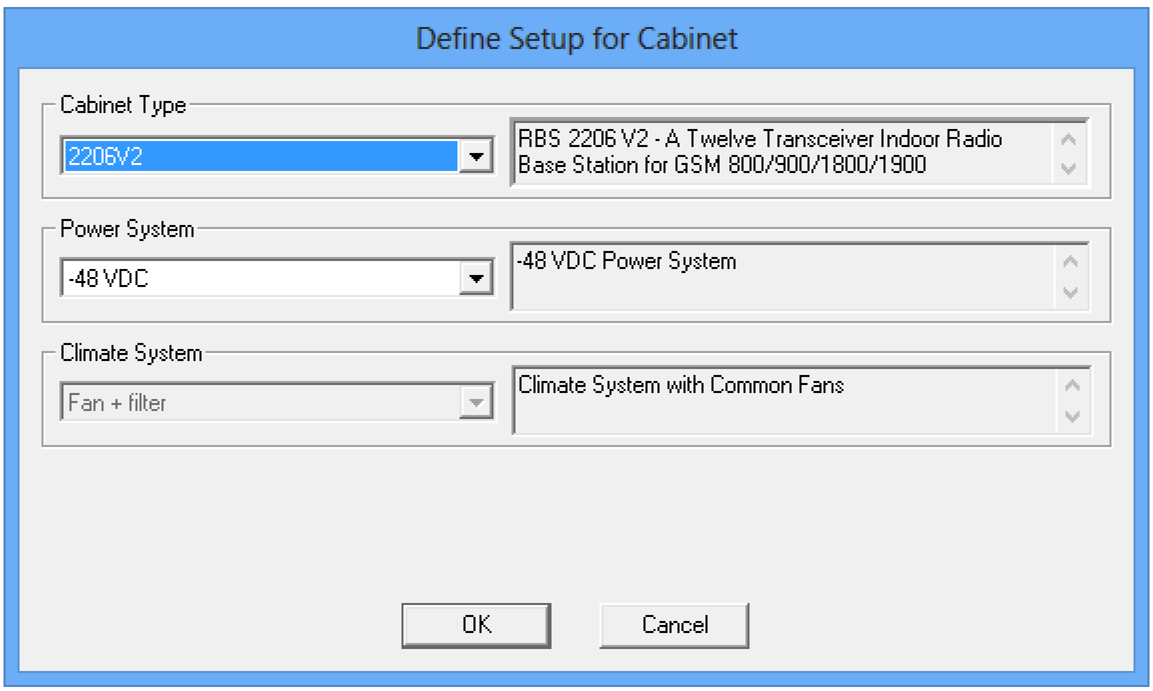


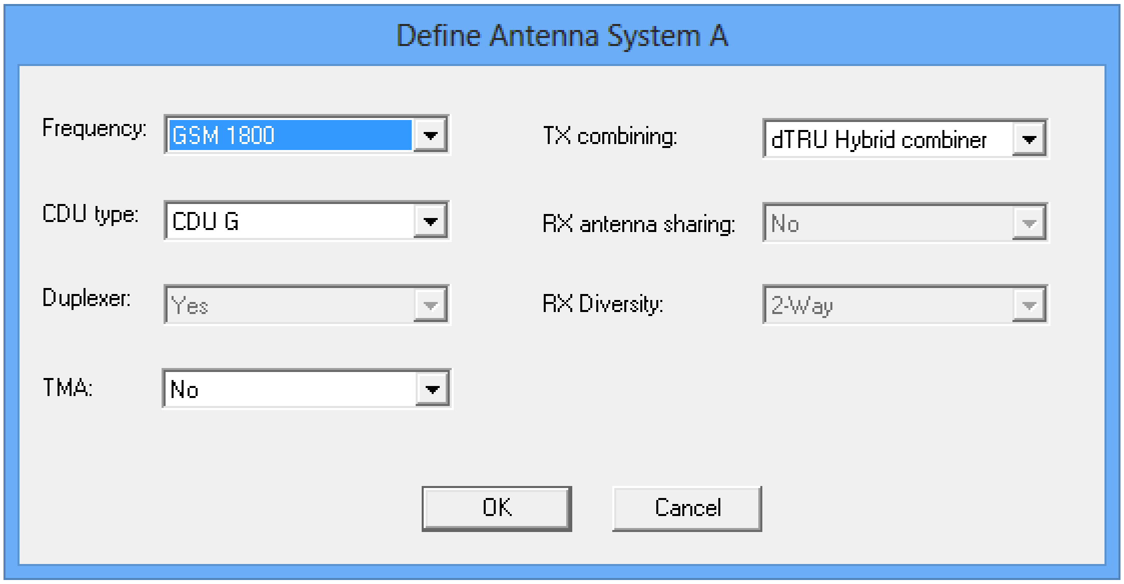


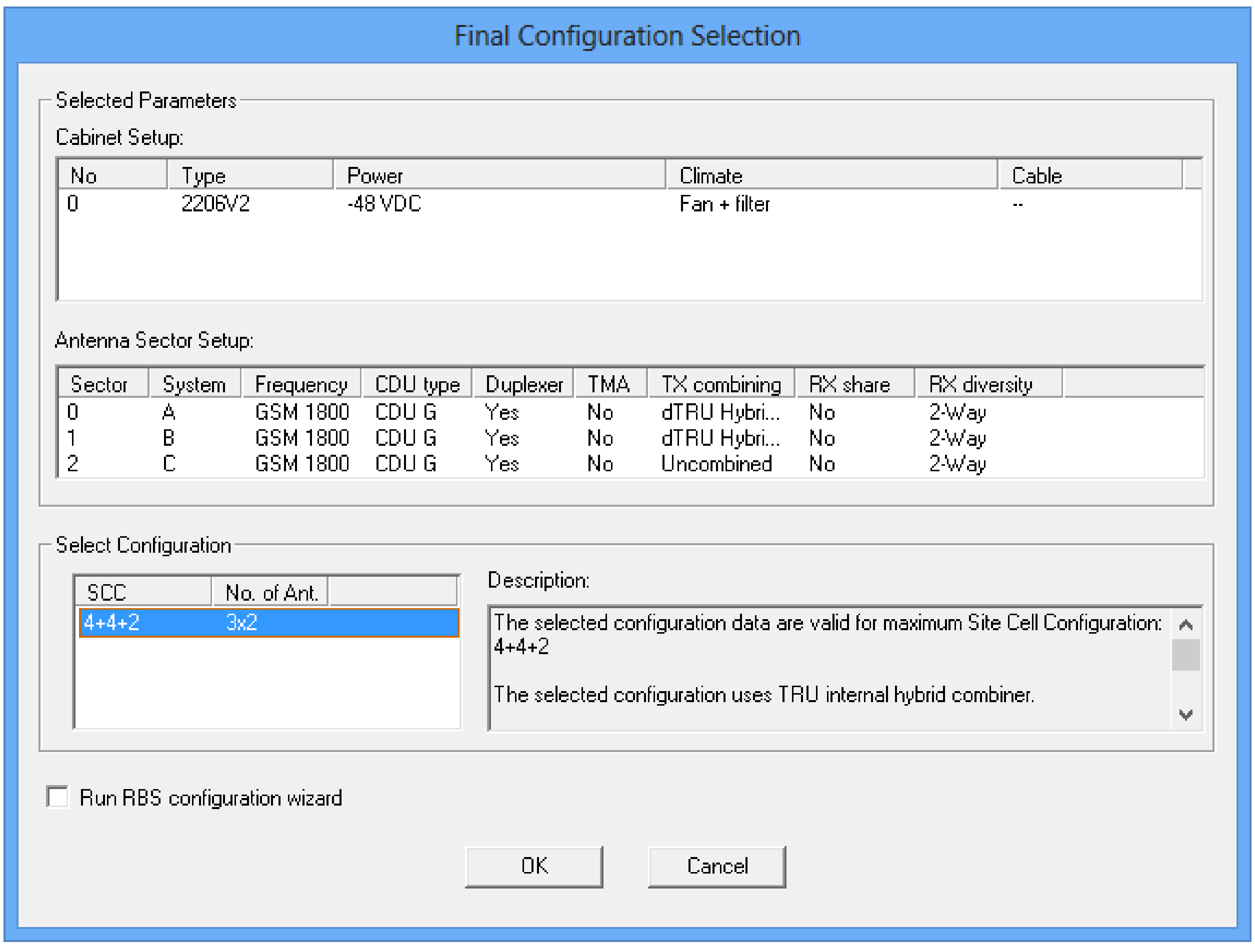

OMT
RBS GSM Edit View Configuration Maintenance Tools Window Help
ANT 0
ANT 1
ANT 2
ANT 3
ANT 4
ANT 5
CDU-G 1800
dTRU 1800
DXU
Local IDB

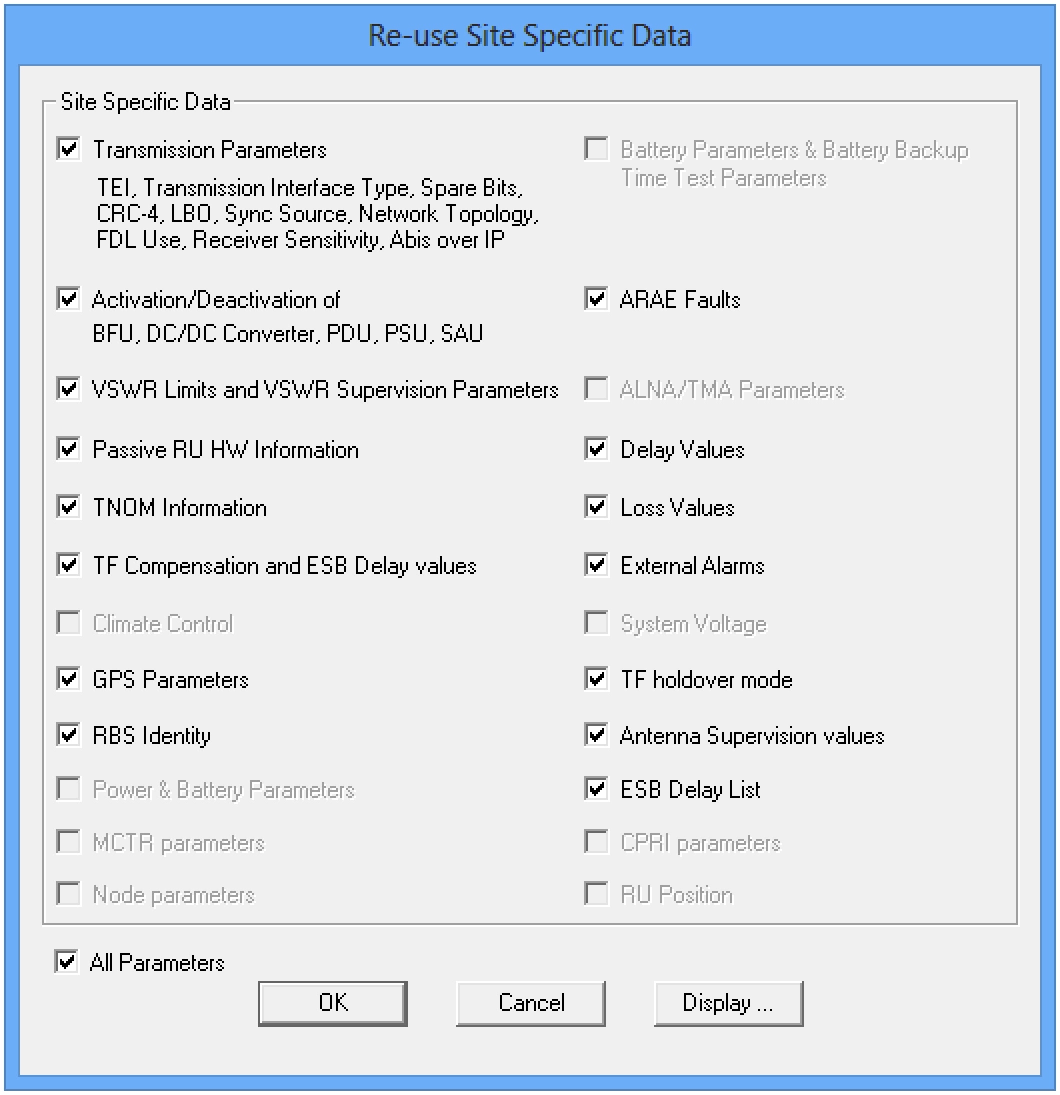

Create IDB
Select Present Setup
Default Values: Previously created IDB Current IDB
Cabinet Setup
No. Type Power System Climate System
0 2206 -48 VDC Fan + filter
New
Modify
Delete
Antenna Sector Setup
Sector System Frequency CDU type Duplexer TMA TX combining RX share RX diversity
0 A GSM 1800 CDU G Yes No dTRU Hybri... No 2-Way
1 B GSM 1800 CDU G Yes No dTRU Hybri... No 2-Way
2 C GSM 1800 CDU G Yes No Uncombined No 2-Way
New
Modify
Delete
Transmission Setup
STN Equipment: No STN
RBS transmission interface: E1 T1 Internal
Display Detected HW Information
Clear All
OK
Cancel


Define Setup for Cabinet
Cabinet Type
2206V2
RBS 2206 V2 - A Twelve Transceiver Indoor Radio Base Station for GSM 800/900/1800/1900
Power System
-48 VDC
-48 VDC Power System
Climate System
Fan + filter
Climate System with Common Fans
OK
Cancel


Define Setup for Cabinet
Cabinet Type
2206V2
RBS 2206 V2 - A Twelve Transceiver Indoor Radio Base Station for GSM 800/900/1800/1900
Power System
-48 VDC
-48 VDC Power System
Climate System
Fan + filter
Climate System with Common Fans
OK
Cancel


Define Antenna System A
Frequency:
GSM 1800
CDU type:
CDU G
Duplexer:
Yes
TMA:
No
TX combining:
dTRU Hybrid combiner
RX antenna sharing:
No
RX Diversity:
2-Way
OK
Cancel


Final Configuration Selection
Selected Parameters
Cabinet Setup:
No | Type | Power | Climate | Cable
0 | 2206V2 | -48 VDC | Fan + filter | --
Antenna Sector Setup:
Sector | System | Frequency | CDU type | Duplexer | TMA | TX combining | RX share | RX diversity
0 | A | GSM 1800 | CDU G | Yes | No | dTRU Hybri... | No | 2-Way
1 | B | GSM 1800 | CDU G | Yes | No | dTRU Hybri... | No | 2-Way
2 | C | GSM 1800 | CDU G | Yes | No | Uncombined | No | 2-Way
Select Configuration
SCC | No. of Ant.
4+4+2 | 3x2
Description:
The selected configuration data are valid for maximum Site Cell Configuration: 4+4+2
The selected configuration uses TRU internal hybrid combiner.
Run RBS configuration wizard
OK
Cancel


Re-use Site Specific Data
Site Specific Data
Transmission Parameters
TEI, Transmission Interface Type, Spare Bits, CRC-4, LBO, Sync Source, Network Topology, FDL Use, Receiver Sensitivity, Abis over IP
Battery Parameters & Battery Backup Time Test Parameters
Activation/Deactivation of BFU, DC/DC Converter, PDU, PSU, SAU
ARAE Faults
VSWR Limits and VSWR Supervision Parameters
ALNA/TMA Parameters
Passive RU HW Information
Delay Values
TNOM Information
Loss Values
TF Compensation and ESB Delay values
External Alarms
Climate Control
System Voltage
GPS Parameters
TF holdover mode
RBS Identity
Antenna Supervision values
Power & Battery Parameters
ESB Delay List
MCTR parameters
CPRI parameters
Node parameters
RU Position
All Parameters
OK
Cancel
Display ...