NOKIA

Nokia MetroSite Base Station Product Description

Company confidential

Contents

Summary of changes

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1 About this document

This document describes the hardware, software and function of Nokia MetroSite Base Transceiver Station (BTS). Use this document as a reference for the following information:

- Nokia MetroSite BTS features
- Nokia MetroSite BTS applications
- Nokia MetroSite BTS software
- Nokia Site Manager
- Nokia MetroSite BTS general function, construction and units
- Nokia MetroSite BTS technical data
- Nokia MetroSite BTS design standards

2 Introduction to Nokia MetroSite BTS

This chapter describes the Base Station System and Nokia MetroSite BTS generally.

2.1 Base Station System

In general terms, base stations perform the radio function for the Base Station System (BSS). A Base Transceiver Station (Nokia MetroSite BTS, for example) is connected to a Transmission Node (Nokia MetroHub, for example) or directly to the Base Station Controller (BSC) via the Abis interface and to the Mobile Stations (MS) via Air interface (refer to Figure 1). The BSC is further connected to the Mobile Switching Centre (MSC) and to the Network Management System (NMS).

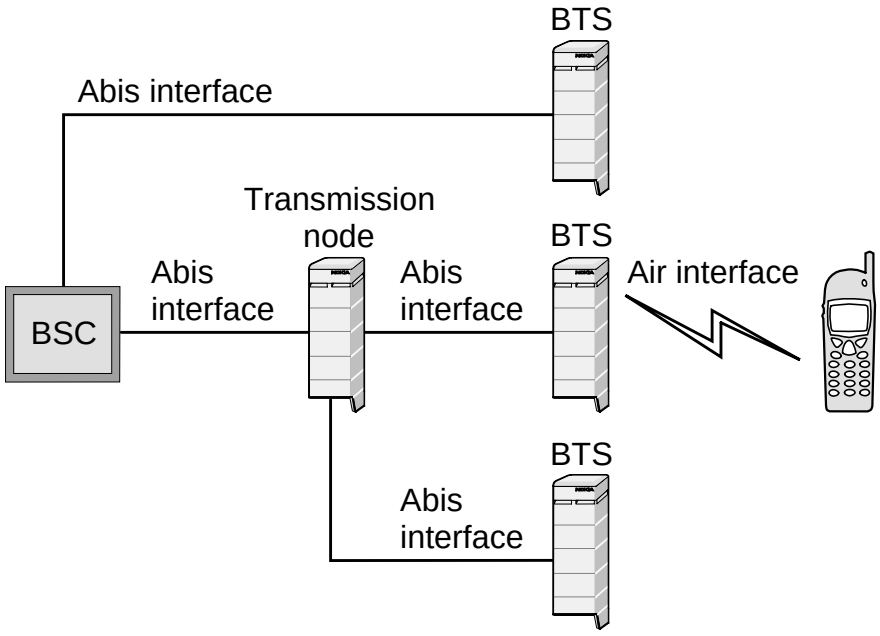

Figure 1. Base station system

2.2 Nokia MetroSite BTS

Nokia MetroSite BTS is a complete, all-climate microcellular base transceiver station. It can be used in GSM 900, GSM 1800, GSM 1900 systems, or as a GSM 900/GSM 1800 Dual Band BTS. Both omni and sectored configurations are supported. The small-sized Nokia MetroSite BTS cabinet accommodates up to four transceiver units (TRXs).

Figure 2. Nokia MetroSite - an ideal solution for dense, urban environment.

Nokia MetroSite BTS is the core element in Nokia MetroSite Capacity Solution which comprises not only the BTS but completely equipped sites with transmission and auxiliary equipment. However, Nokia MetroSite BTS can be integrated into other mobile network applications as well.

The optimised RF performance, the versatile installation options, and the flexible radio transmission solution, Nokia MetroHopper last-kilometer access (for more information, refer to Nokia MetroHopper Radio documentation), allow for a very large number of BTSs being installed in a small area. Consequently, Nokia MetroSite BTS is an ideal solution for special hot spots - like downtown areas, sports arenas, shopping centres, underground stations and office buildings - where high capacity is needed.

In order to ensure high quality of calls, Nokia MetroSite BTS supports versatile features, such as frequency hopping and receiver diversity.

Due to its compact size, low weight, and high level of integration, Nokia MetroSite BTS is fast and easy to install either indoors or outdoors with minimal preparations. Both wall and pole installations are supported. From the network planning point of view, Nokia MetroSite BTS can be installed at the most optimal locations. Moreover, the plug-in construction of Nokia MetroSite BTS provides great flexibility when, for example, capacity expansion is considered.

In addition to its other versatile and advanced properties, Nokia MetroSite BTS is designed for easy commissioning. This has been achieved by Nokia MetroSite BTS Manager, which incorporates a commissioning wizard and BTS configuration autodetection.

Nokia MetroSite BTS’s size and ease of deployment help the operator to reduce site planning and site acquisition costs. The fast start-up and the quick integration into network enable immediate revenue flow to the operator. The smooth step-by-step expansion facility keeps the revenue flow uninterrupted at the times of system upgrades, and eventually increases the operator’s profit. Furthermore, the operational costs are low as the BTS management is to a large extent carried out remotely from the NMS.

3 Nokia MetroSite BTS features

This chapter describes the technical properties of Nokia MetroSite BTS that contribute to:

- microcellular capacity
- network quality
- data services
- deployment
- operation and maintenance

Moreover, a description of advanced telecom features is presented here. A detailed description of technical features supported by Nokia MetroSite BTS can be found in the *Feature Descriptions* document delivered in the *Nokia MetroSite BTS Software Release Binder*. For the list of Nokia MetroSite BTS properties, see also Chapter 8 in this document.

3.1 Building capacity with Nokia MetroSite BTS

The features described in this section accommodate efficient building of microcellular capacity.

3.1.1 Four TRX BTS with flexible sectoring and dual band operation

One Nokia MetroSite BTS incorporates up to four TRXs and thus provides sufficient capacity to handle a large amount of telecommunication traffic. Nokia MetroSite BTS can be sectored very flexibly. Every TRX always has its own antenna connector. Every TRX also incorporates a duplex filter, therefore, one antenna handles both transmitting and receiving. On one hand, any cell can incorporate up to four TRXs. On the other hand, every TRX can form a sector of its own. Consequently, the maximum number of sectors for a stand-alone BTS is four.

The Dual Band feature enables the operator to configure any sector to operate either on a GSM 900 or GSM 1800 frequency, thus increasing the capacity of the GSM network.

More information on the coverage areas created with different sectoring options can be found in Section 4.1 in this document.

3.1.2 RF power and sensitivity optimised for microcellular applications

The RF performance of Nokia MetroSite BTS is optimised for microcellular applications. Maximum RF power of Nokia MetroSite BTS transmitter is 1W at the antenna connector in all conditions. The RX sensitivity is better than -106 dBm. The output power and the receiver sensitivity of Nokia MetroSite BTS together with the use of surrounding buildings to limit the cell size allow efficient frequency reuse with minimised interference.

The dynamic power control range of the transmitter is 30 dB / 15 x 2 dB steps. The static broadcast control channel (BCCH) power control range is 30 dB.

3.1.3 Smooth capacity expansion

As the operator's demand for capacity grows, additional TRXs can be installed to Nokia MetroSite BTS during operation without interrupting the BTS service.

3.2 High network quality

Nokia MetroSite BTS not only increases the capacity of the network but also maintains the quality of telecommunication traffic. This section describes the features that contribute to the high network quality.

3.2.1 Receiver diversity

Receiver diversity (also known as uplink diversity) is available in Nokia MetroSite BTS when two or more TRXs belong to the same cell.

Multipath propagation of radio signal may cause local variations of signal strength. Deep fades, particularly when the mobile station is near a cell border, reduce the quality of the received signal. To minimise this effect, a spatial or polarisation receiver diversity can be used, which means that two different paths are used for the received signals.

Antennas are placed physically apart or they employ different polarisation so that correlation between received signals is minimised. It is probable that even if one of the receiver branches suffers from a deep fading drop, the other receives a signal with sufficient quality. The two separate paths are processed in the baseband section of the BTS transceiver, and the pre-detection weighted summing method is used to combine the signals of the two branches.

Diversity can be enabled or disabled from the BSC. When diversity is employed, the BTS must be physically equipped according to the logical sector configuration at the BSC.

3.2.2 Frequency hopping

Nokia MetroSite BTS supports synthesised frequency hopping when there are at least two TRXs in the same cell.

The most significant property of frequency hopping is that it enables averaging of the interference to RF signal between network users. Frequency hopping can be used to minimise signal quality degradation caused by frequency selective fading especially for slow moving MSs and narrow band interfering signal.

Synthesised frequency hopping enables each TRX to change frequency on successive time slots, so that a given carrier can hop at several frequencies in a quick succession.

It is possible to use either cyclic or random frequency hopping scheme as defined in GSM 05.02, 05.08 recommendations.

3.2.3 Antenna solution

The MetroSite Antenna is a small and unobtrusive Dual Band antenna designed for microcellular applications. It is a directional two-port antenna with two antenna elements in one casing. This means that two TRXs can be connected to one antenna. The gain of the antenna is 6dBi and it provides 130˚ coverage.

Other directional, omnidirectional and cross-polarised antennas can be used with Nokia MetroSite BTS, too. Furthermore, distributed antenna systems, which are primarily used for building fill-in coverage, can be employed.

When Nokia MetroSite BTS itself is installed inside a building, the antennas can be located outdoors. Also the size of antenna feeders, 1/4” and 3/8”, support the flexibility of installation.

TRX test includes an antenna cable detection feature which, in most of the cases, verifies whether the cable connection between the TRX and antenna is free of faults.

More information on the antennas used with Nokia MetroSite BTS can be found in *Nokia MetroSite Accessories*.

3.3 New and advanced telecom features

The new or advanced telecom features supported by Nokia MetroSite BTS software are described in this section. A comprehensive list of basic telecom features supported by Nokia MetroSite BTS can be found in Section 8.3 in this document.

Half Rate Speech coding

The use of Half Rate coding makes it possible to almost double the amount of available traffic channels on radio path. This is achieved with the existing transmission lines on the Abis interface. Half Rate coding enables the use of 8 kbit/channels.

Enhanced Full Rate Speech coding

Enhanced Full Rate coding improves the voice quality in all channel conditions. The coding is based on the existing GSM Full Rate channel coding.

Support for data services

Nokia MetroSite BTS supports a number of features that enable an efficient data traffic. Here, the most advanced of those features are dealt with. See also Section 3.6.2 in this document.

- *High Speed Circuit Switched Data* (HSCSD) feature provides accelerated data rates for the end-user applications such as World Wide Web, file transfer and facsimile.
- *14.4 kbit/s GSM data services* provide accelerated user data rate at 14.4/ kbits level. The feature can be combined with HSCSD.
- *Non-transparent and transparent data* (9600, 4800, 2400 bit/s); non-transparent means that the data rate can be changed automatically during the call (due to increased traffic, for example), transparent data uses fixed data rate throughout the duration of a call.

3.4 Easy and fast deployment

This section describes the installation and commissioning procedures of Nokia MetroSite BTS. The detailed task-oriented instructions can be found in *Nokia MetroSite Base Station Installation* and in *Nokia MetroSite Base Station Commissioning*.

3.4.1 Installation

Variety of installation possibilities

Thanks to its small size, unnoticeable appearance, low weight, and high level of integration, Nokia MetroSite BTS accommodates a variety of new installation possibilities. The extended environmental performance of Nokia MetroSite BTS enables installation indoors and outdoors, even in extreme climatic conditions. Mounting options are available for both wall and pole installations. Both vertical and, in certain positions, horizontal mountings are possible.

Delivery and installation procedure

Nokia MetroSite BTS is delivered to the site with the ordered plug-in units preinstalled. Shield units are installed in those unit slots that are not occupied by functional units. The purpose of shield units is to provide protection for the backplane connectors, ensure optimal air flow inside the cabinet and provide EMC and weather shielding for the BTS.

After unpacking the delivery, a sufficient number of units can be removed from the BTS in order to make the BTS easier to handle. Usually, removing the TRXs only makes the Nokia MetroSite BTS light enough to handle.

An optional lifting rack, which further eases the handling and lifting of Nokia MetroSite BTS, can be installed to the BTS at this phase.

Nokia MetroSite BTS is then installed on a wall or a pole. In wall mountings, the mounting rack included in the delivery can be used as a template for drilling the anchor screw holes to the wall. In pole mountings, an additional pole mounting kit is used to attach the BTS to the installation pole.

After the removed plug-in units are reinstalled, the cabinet ground and power cables are connected. Next step is to connect the diversity cables, transmission cables and antenna cables. Then the BTS is powered up and commissioning is started. Finally, the lock and the cover are installed to the BTS.

3.4.2 Commissioning with Nokia BTS Manager

There are two ways to commission Nokia MetroSite BTS; in manual mode or using the automatic commissioning. Currently, as the autoconfiguration feature is not yet available, the user performs commissioning in the manual mode. In the near future, when the network supports the autoconfiguration, the automatic commissioning can be employed. Nokia BTS Manager, a PC-based tool, provides a commissioning wizard that guides the user throughout the whole commissioning process.

Autodetection

The BTS software includes an autodetection feature which identifies the BTS hardware. This reduces the time spent for commissioning as the user does not have to create a separate HW database for the BTS. The system data is replicated to each TRX so that none of the BTS parameters will be lost when the units are replaced.

No external measuring devices are needed for BTS commissioning tests.

The task-oriented instructions for each step can be found in *Nokia MetroSite Base Station Commissioning* document.

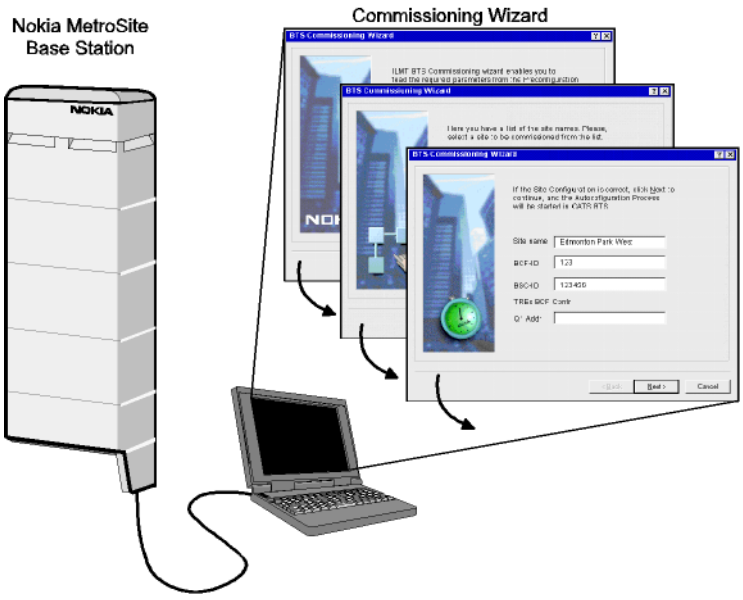

Figure 3. Nokia BTS Manager Commissioning Wizard

Manual commissioning

Before the commissioning at the BTS site can be started the following tasks must be performed:

- The LAPD links must be created at the BSC.
- The PCM port at the BSC must be set active.

The commissioning procedure performed on site with Nokia BTS Manager includes the following steps:

- transmission configuration
- checking alarms and EACs
- running the tests
- creating the BTS commissioning report

The use of Site Configuration File (SCF) considerably eases the commissioning as most of the parameters can be fed directly from the file, for example, the Abis time slot allocation can be automated.

In the end of the commissioning process the Site Acceptance Report is automatically produced by Nokia BTS Manager.

3.5 Advanced operation and maintenance

The features concerning the operation and maintenance (O&M) of Nokia MetroSite BTS are described in this section.

During operation, Nokia MetroSite BTS is managed remotely from the NMS. Site visits are usually not needed to carry out the routine O&M tasks.

3.5.1 Integration of TRX and Base Control Functions (BCF)

One of the TRXs is configured as the master TRX of the BTS. In addition to the normal TRX functions, the master TRX handles the BTS operation and maintenance functions. Consequently, there is no need for a dedicated plug-in unit to handle these functions. The O&M signalling and TRX signalling can also be combined into one channel to optimise the use of transmission capacity.

3.5.2 BTS diagnostics, alarms and TRX test

Alarm diagnostics

Nokia MetroSite BTS features an advanced BTS diagnostics system that considerably reduces the number of alarms. Relevant alarm information is easily accessible and understandable. The detailed description of MetroSite BTS alarms can be found in software release documentation.

The enhanced alarm diagnostics system filters out spurious alarms, reporting only those alarms that directly affect the BTS service level. The alarms are addressed to the unit level, which helps the maintenance to locate the faulty unit.

A diagnostics report is generated when a fault is detected in a unit. This report can be printed from Nokia BTS Manager and then be sent to service with the faulty unit. The report is also stored at the non-volatile memory of the TRX. The diagnostics report is currently not available in the BSC or NMS.

In the case of a mains power failure, Nokia MetroSite BTS provides a sufficient back-up time for an alarm to be sent to the BSC.

TRX test

The TRX test is a multipurpose test designed for testing the total performance of the intended TRX and Radio Time Slot (RTS). The test can be run locally from Nokia BTS Manager, or remotely from the BSC/NMS when the Abis connection is established. Locally, the TRX test is usually performed during commissioning of MetroSite BTS.

The TRX test covers all functions between the Abis and Air interfaces: digital and RF parts, antenna cable detection, RX sensitivity and TX level. The main reason for providing a single multipurpose test is to minimise the total test time; once the time slot is reserved for testing, the test time is used effectively. The test utilises the multifunctional RF loop and it is automatically performed for both RX branches. The test time is only a few seconds. The test can be used as a RF-performance supervision test when performed according to a regular schedule from the NMS/2000.

3.5.3 Battery backup with Nokia MetroSite BBU

If additional battery backup is needed, Nokia MetroSite BBU can be used for this purpose. Nokia MetroSite BBU provides three hours back-up time for one, four-TRX Nokia MetroSite BTS operating at full power. Nokia MetroSite BBU is based on the same design and mounting options as Nokia MetroSite BTS itself.

For more information on Nokia MetroSite BBU, refer to *Nokia MetroSite BBU User Manual*.

3.5.4 Temperature control

Nokia MetroSite BTS operates in the ambient temperatures ranging from -40ºC to +50ºC (solar radiation 1120 W/m^2).

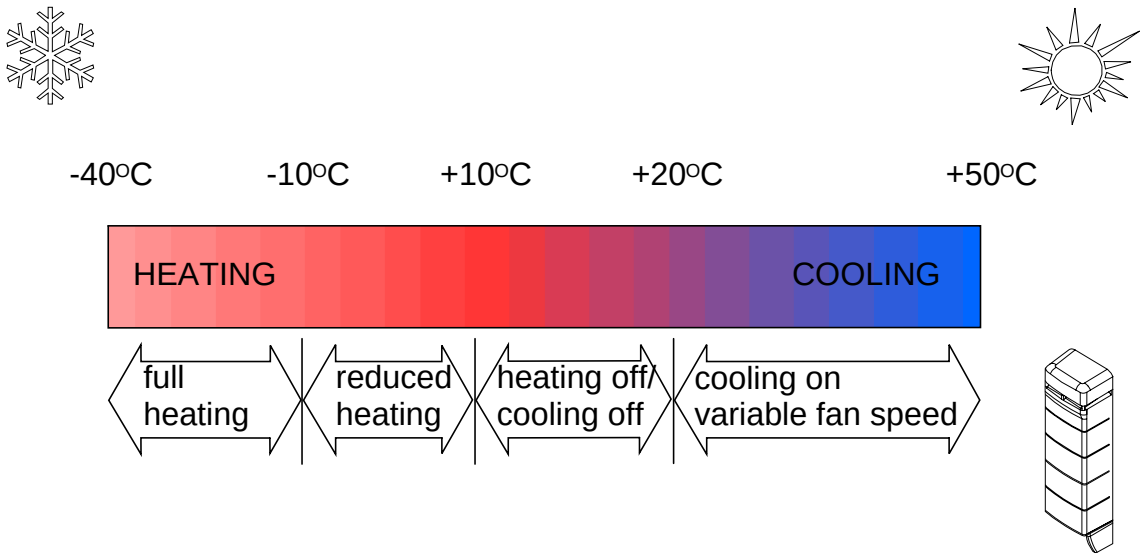

Figure 4. Temperature management diagram

The BTS has a cooling fan and built-in heaters to provide a smooth temperature controlling facility. The BTS SW controls the heating and cooling to provide operation conditions which are as stable as possible. The heating and cooling are adjusted gradually to ensure low temperature gradients and noise level. The temperature is continuously monitored with sensors placed on active units.

The heater elements are located inside transceiver and transmission units. When the BTS starts up in extremely cold environment, the units are warmed up to the operation temperature range before the actual BTS operation starts.

The fan unit generates the cooling air flow inside the BTS. The fan unit has 16 adjustable steps to ensure low temperature gradients and noise level.

If the temperature of any unit rises too high, the TRX issues an analysed temperature alarm to the BSC. The master TRX shuts down the appropriate TRX. Similarly, if the power supply is overheated, the master TRX switches off the power for all units. The power supply switches the power back on after the temperature has reached the operational range.

During operation, the master TRX starts the heating up if the internal temperature drops below the specified limit.

3.6 Future features

There are a number of upcoming features that can be introduced without any hardware changes. Full support for these features will be provided in future SW releases. The most important of these features are described in this section.

3.6.1 Chaining of Nokia MetroSite BTSs

Internal bus and Abis chaining are both possible with Nokia MetroSite BTS. For more information on Abis chaining, refer to Section 4.2.

To further increase the capacity expansion possibilities, Nokia MetroSite BTS cabinets can be chained as one BCF object to include 12 TRXs. The chaining is done by extending the BTS internal buses through the extension interface on the interface unit. Each cabinet is connected to the next cabinet in the chain with only one cable. Only one of the cabinets (the master cabinet) incorporates a transmission unit.

One cabinet acts as the master cabinet, in which the master TRX of the chain is located. However, each cabinet has a dedicated TRX to control the heating and cooling functions.

Nokia MetroSite BTS can also be connected to Nokia MetroHub Transmission Node in the same manner. In this case, the BTS cabinet does not have to incorporate a transmission unit since the transmission will be handled through Nokia MetroHub.

3.6.2 General Packet Radio Service (GPRS)

The GPRS is designed to make the GSM data services more compatible with LAN, WAN and the Internet. In GPRS the radio resources are used only when there actually is data to be sent or received. Consequently, it is well adapted to the high burstiness of data applications. GPRS also provides immediate connectivity and very short set-up for sending a data packet. The throughput is as high as in High Speed Circuit Switched Data (HSCSD). Nokia MetroSite BTS supports GPRS coding schemes 1 and 2.

4 Applications

This chapter describes the typical applications of Nokia MetroSite BTS including the transmission alternatives.

4.1 Building microcells with Nokia MetroSite BTS

Nokia MetroSite BTS is a microcellular base transceiver station and it can be used to build capacity in the areas of heavy telecommunication traffic.

The efficient frequency reuse requires that the size of the coverage areas (cells) is limited. Figure 5 how the buildings surrounding Nokia MetroSite BTS can be used to limit the cell size and shape in an urban environment.

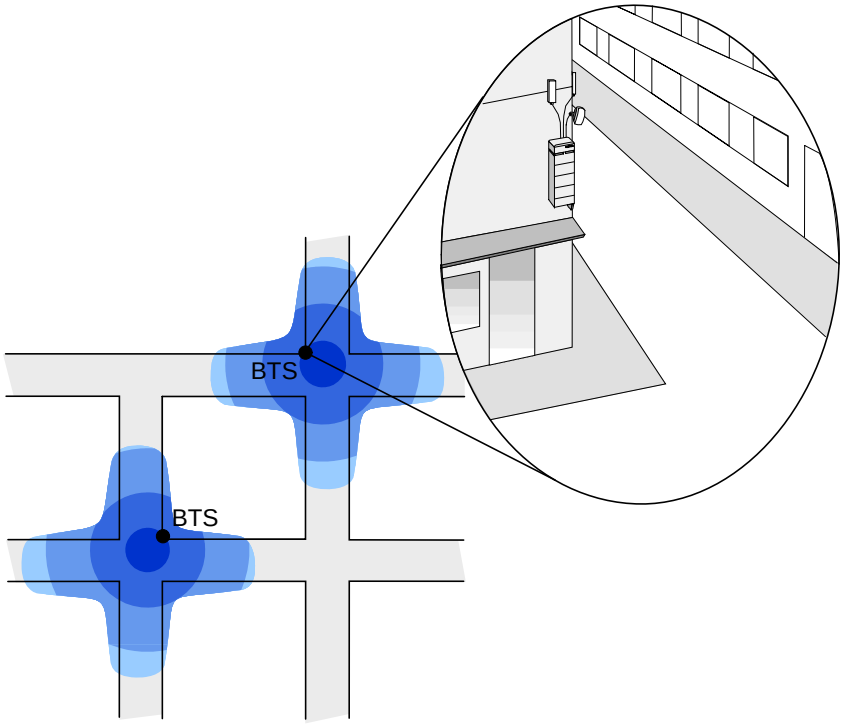

Figure 5. Microcells built with Nokia MetroSite BTSs

Nokia MetroSite BTS can be sectored freely. A sector consists of one broadcast control channel (BCCH) TRX and, often, from one to three traffic channel (TCH) TRXs. Maximum number of TRXs in one sector is four.

By using the different sectoring possibilities provided by Nokia MetroSite BTS and by directing the antennas, different types of coverage areas can be created. The actual shape of the coverage areas vary depending on the environment.

As mentioned earlier, TRXs from different sectors can be connected to one antenna. The following examples assume that the MetroSite Antenna is used; for example, the diversity applications may differ from the ones presented here, if different antenna types are used.

Figure 6 presents a single band (GSM 900) BTS which has four TRXs in one sector. The antennas are directed to the same direction; the resulting coverage area comprises four TRXs. In order to employ the diversity, it is most feasible to connect the TRXs which share the diversity to different antennas.

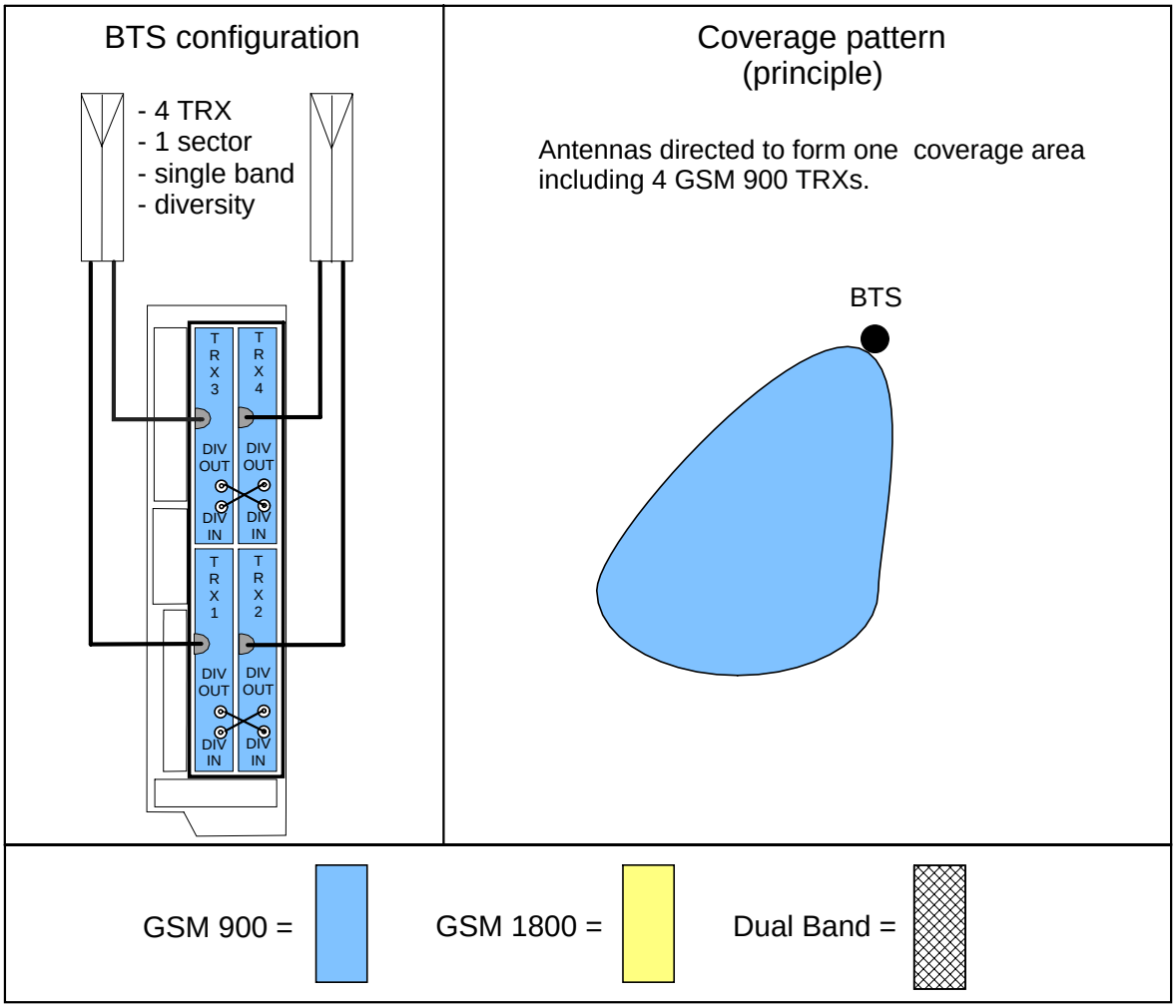

Figure 6. 4 TRXs in one sector single band configuration

With Dual Band antennas, such as the MetroSite Antenna, overlapping GSM 900 and GSM 1800 coverage areas can be created by connecting TRXs from a GSM 900 sector and TRXs from a GSM 1800 sector to one antenna.

Figure 7 schematically shows the coverage areas created with a BTS that has four sectors (two GSM 900 sectors and two GSM 1800 sectors). In Figure 7one GSM 900 and one GSM 1800 sector are connected to each antenna . The antennas are directed to different directions.

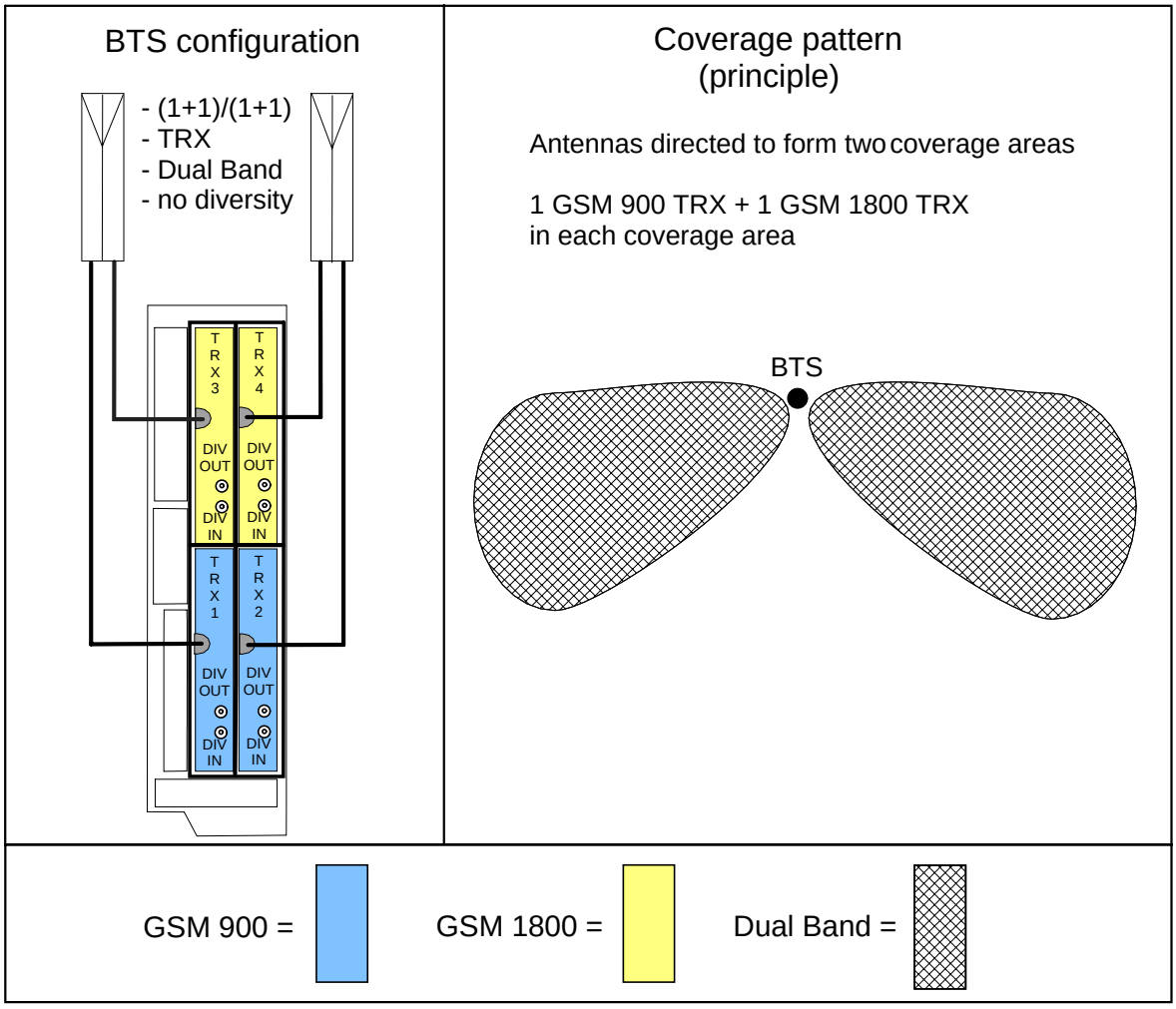

Figure 7. (1+1)/(1+1) Dual Band configuration

The 2+2 Dual Band configuration can be used to build one directional Dual Band coverage. This configuration has one GSM 900 sector which includes two TRXs, and one GSM 1800 sector also including two TRXs. One TRX from the GSM 900 sector and one TRX from the GSM 1800 sector is connected to one antenna. The antennas are directed to the same direction. Consequently, the coverage area comprises four TRXs (two GSM 900 and two GSM 1800 TRXs). In this kind of configuration also diversity can be utilised. Figure 8 schematically shows the coverage area built in that manner.

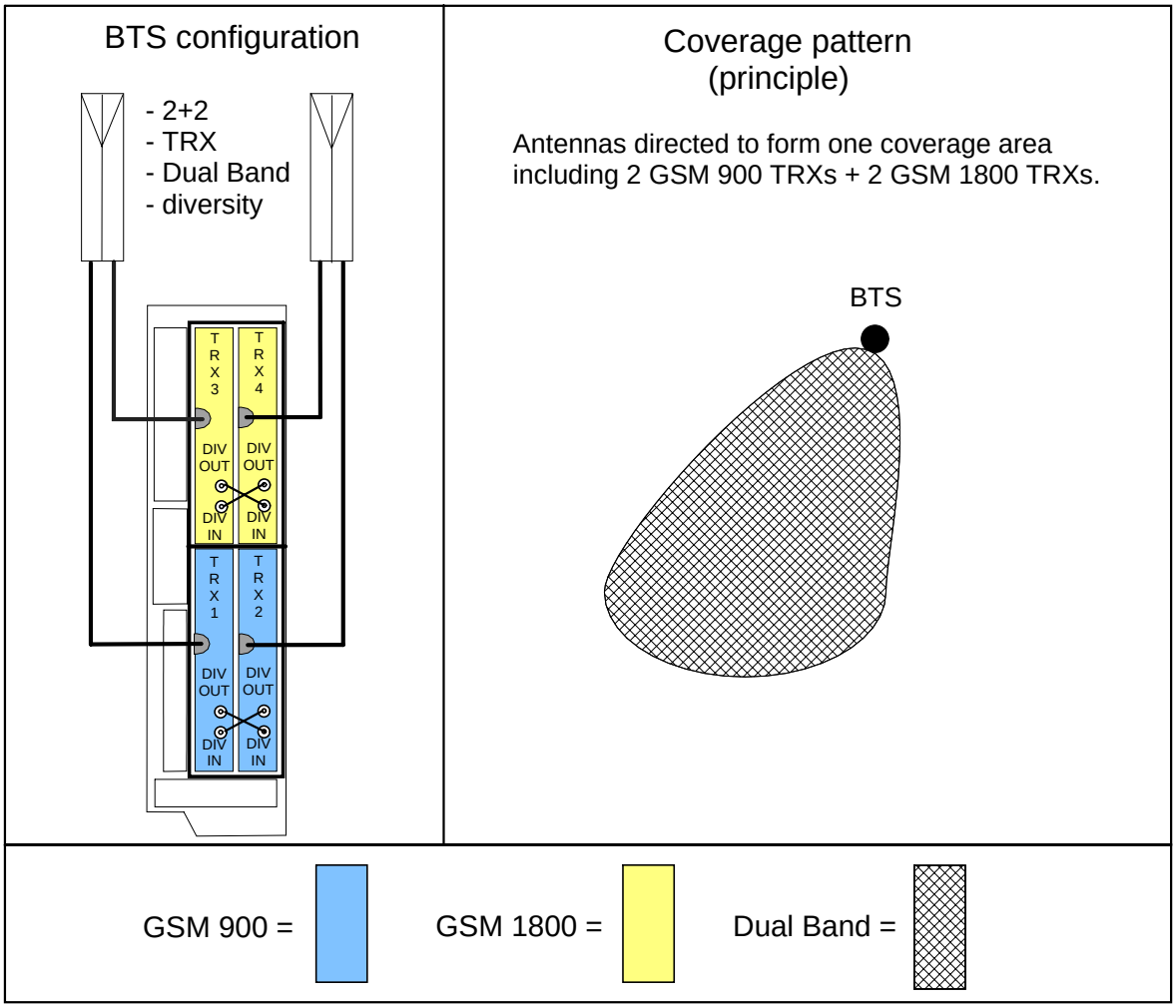

Figure 8. 2+2 Dual band configuration

Another way to build overlapping GSM 900 and GSM 1800 cells, is to direct single band GSM 900 and GSM 1800 antennas towards same direction.

Furthermore, Nokia MetroSite BTS can be used to build fill-in coverage in the areas that are difficult to reach with conventional base stations. In that case, it is recommended that high-gain antennas are used.

4.2 Transmission of Nokia MetroSite BTS

This section describes the transmission topologies that can be build by using the transmission unit capacity of Nokia MetroSite BTS. The transmission node that expands the transmission capacity is typically Nokia MetroHub Transmission Node. For more information on the larger configurations, refer to Nokia MetroHub documentation.

The transmission unit takes care of the transmission between Nokia MetroSite BTS and the BSC through the Abis interface. The transmission media can be either radio link (RRI) or wireline (E1/T1).

The FC RRI and FXC RRI tranmission units are used with Nokia MetroHopper Radios and/or Nokia FlexiHopper Microwave Radios. The FC E1/T1, FXC E1 and FXC E1/T1 transmission units are used for wireline transmission.

The FXC RRI, FXC E1 and FXC E1/T1 transmission units have the cross-connect capability. The bidirectional connection between two interface ports (B2 cross-connection) can be made with 2M, nx64k, 64k, 32k, 16k and 8k granularities. Granularity refers to the number of bits connected into a specific direction in the cross-connection.

The FC RRI and FC E1/T1 transmission units are used in the termination points of the transmission chain. More information on transmission unit alternatives can be found in Chapter 6.

Examples of transmission topologies built with different transmission units are presented in Figure 9. Depending on the type of transmission unit, it is possible to use the following network topologies:

- chain connection (A and B in Figure 9).
- star connection (C and D in Figure 9; with the radio transmission alternative, the centre point of the star is always a transmission node).
- loop connection (E and F in Figure 9)

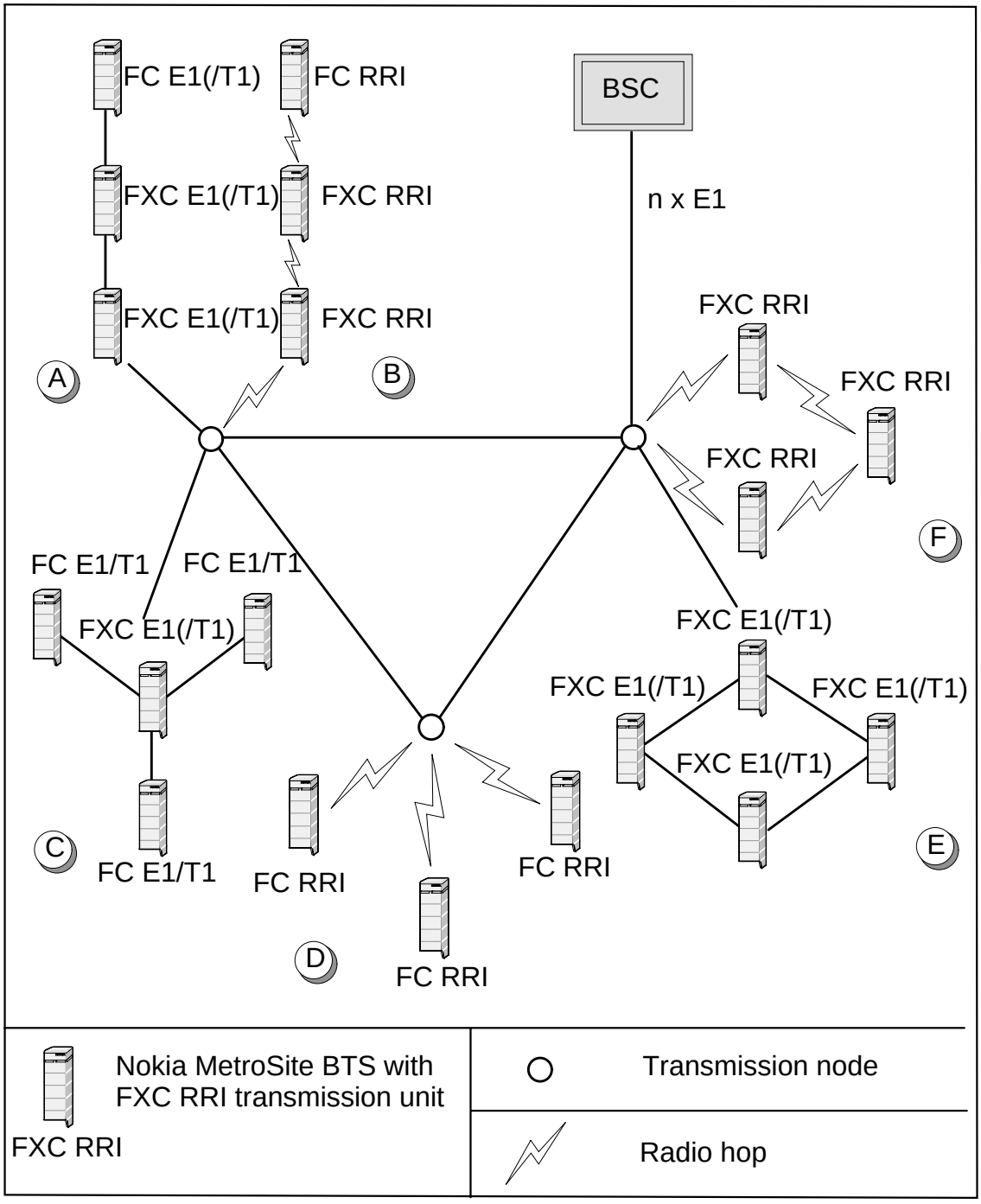

Figure 9. Examples of transmission connections

Furthermore, Nokia MetroSite BTS can be directly connected to the BSC.

Nokia MetroSite BTS supports 16 kbit/s, 32 kbit/s and 64 kbit/s Abis TRX signalling. The O&M signalling speed alternatives are 16 kbit/s, 32 kbit/s and 64 kbit/s. In order to optimise the use of transmission capacity, combined O&M and TRX signalling is also supported at all afore mentioned speeds.

Locally, the transmission configuration is managed with Nokia BTS Manager. The information on how to create different transmission configurations can be found in Manager’s online Help.

5 Nokia MetroSite BTS related software

This chapter describes the Nokia MetroSite BTS SW and Nokia BTS Manager SW.

Generally, Nokia MetroSite BTS is managed remotely from the NMS via the BSC. The management tasks carried out on site are kept to minimum. On site, Nokia Site Manager is used for BTS management.

Nokia MetroSite BTS is delivered to the customer with SW preinstalled in order to support rapid deployment of the BTS. Nokia MetroSite BTS SW is to a large extent based on the fieldproven Nokia Talk-family SW which has been enhanced with new and improved features. The new, highly embedded Nokia MetroSite BTS SW makes it possible to upgrade the BTS online without interrupting the BTS operation. Also the number of alarms sent from the BTS to the BSC is reduced considerably thanks to advanced BTS diagnostics system.

Nokia NMS incorporates a full range of functions from fault, performance, and configuration management to transmission and security management and trouble shooting. For more information, refer to Nokia NMS documentation.

NMS/2000 SW T11 and BSC SW S8 fully support Nokia MetroSite BTS.

5.1 Nokia MetroSite BTS software

Nokia MetroSite BTS can store two SW packages in its non-volatile memory. The SW can be loaded to the BTS either locally from the Nokia BTS Manager or remotely from the BSC or the NMS/2000. The SW packages are loaded to the non-volatile memory of each TRX.

The BSC updates the BTS SW packages if they are different from the BSC SW. New SW is activated by reset; this will take less than one minute. The BTS and its units can be reset separately for testing purposes locally with Nokia BTS Manager and remotely from the BSC or the NMS/2000.

The BTS start-up procedure has been optimised to shorten the bootup time. No time-consuming tests are done during BTS start-up, which contributes to rapid deployment of the BTS.

Alarms generated by the Nokia MetroSite BTS are radically reduced by advanced diagnostics and alarm management. Only the unit level and BTS level alarms are sent to the BSC. Correlation rules and fault diagnostic procedures ensure that the appropriate recovery procedure is activated automatically. The fault diagnostics makes it possible to locate a fault to a specific unit of the BTS or to a specific part of the BTS system.

5.2 Nokia BTS Manager software

Nokia BTS Manager is primarily used to commission the BTS and carry out maintenance tasks locally. The BTS sectoring and the TRX numbering can be read from Nokia BTS Manager's display. During normal operation Nokia MetroSite BTS is managed remotely from the NMS.

Nokia BTS Manager provides graphical user interface, running in Windows NT or Windows 95 (or later version) environment. Nokia BTS Manager provides a wizard to ease the process of BTS commissioning. Instruction on how to use Nokia BTS Manager is given in context-sensitive online Help.

System requirements for Nokia BTS Manager are detailed in Table 19.

Figure 10 shows an example of Nokia BTS Manager desktop with the following windows opened:

1. Equipment view in Supervision window
2. BTS Events window
3. Alarms window.

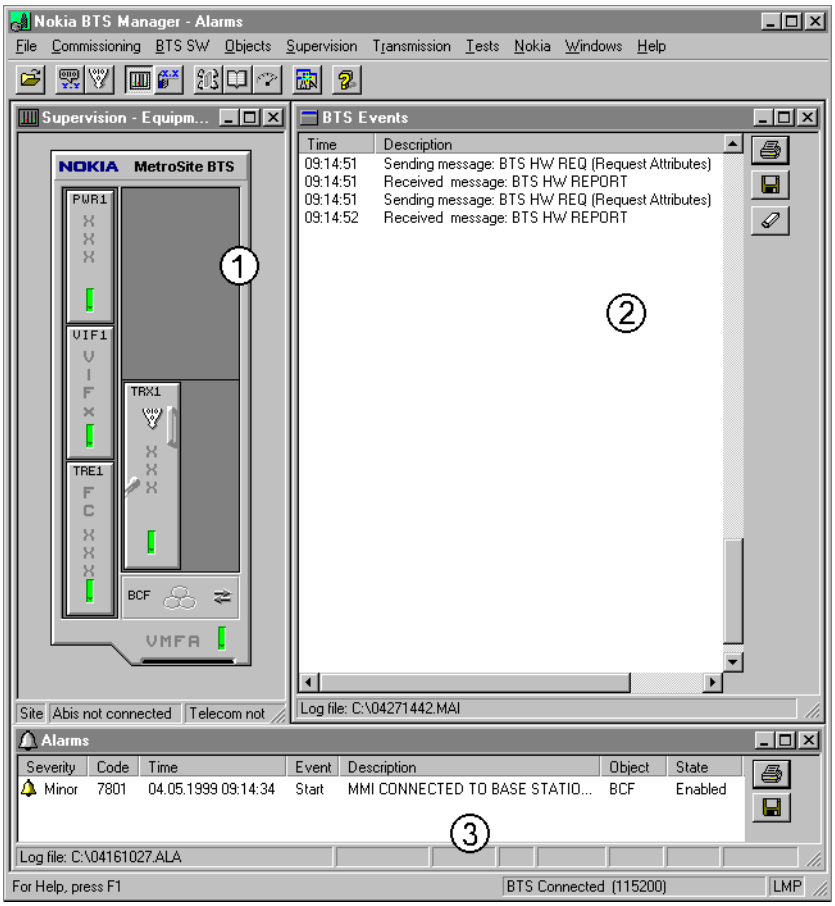

Figure 10. Nokia BTS Manager desktop

5.3 BTS software updates

When Nokia MetroSite BTS SW is updated, it can be loaded either locally with Nokia BTS Manager, or remotely from the BSC or the NMS (via the BSC). The transmission unit SW is downloaded transparently from the NMS or locally from the Nokia BTS Manager.

The BTS SW is loaded to the master TRX which in turn updates the SW in the slave TRXs. When new TRXs are added for more capacity, or when TRXs are replaced for maintenance reasons, the master TRX updates the SW in the new slave TRXs if their SW version is different from the master TRX SW.

Nokia MetroSite BTS SW can be downloaded as a background operation without interrupting the BTS operation. The activation of new SW can be done at any time suitable for the operator.

Nokia MetroSite BTS SW updates are delivered to the customer on diskettes which contain the current version of the BTS SW. The Nokia BTS Manager is delivered on CD-ROM.

For more information on Nokia MetroSite BTS SW, refer to Nokia MetroSite BTS SW Release Documentation.

6 General function, construction and units

This chapter describes the general function, mechanical construction and plug-in units of Nokia MetroSite BTS.

6.1 Nokia MetroSite BTS general function

6.1.1 Signalling between network, BTS and MS

The general principle of signalling between the network, BTS and Mobile Station (MS) is presented in Figure 11. More detailed description of the signal flow within Nokia MetroSite BTS is presented in Section 6.3.

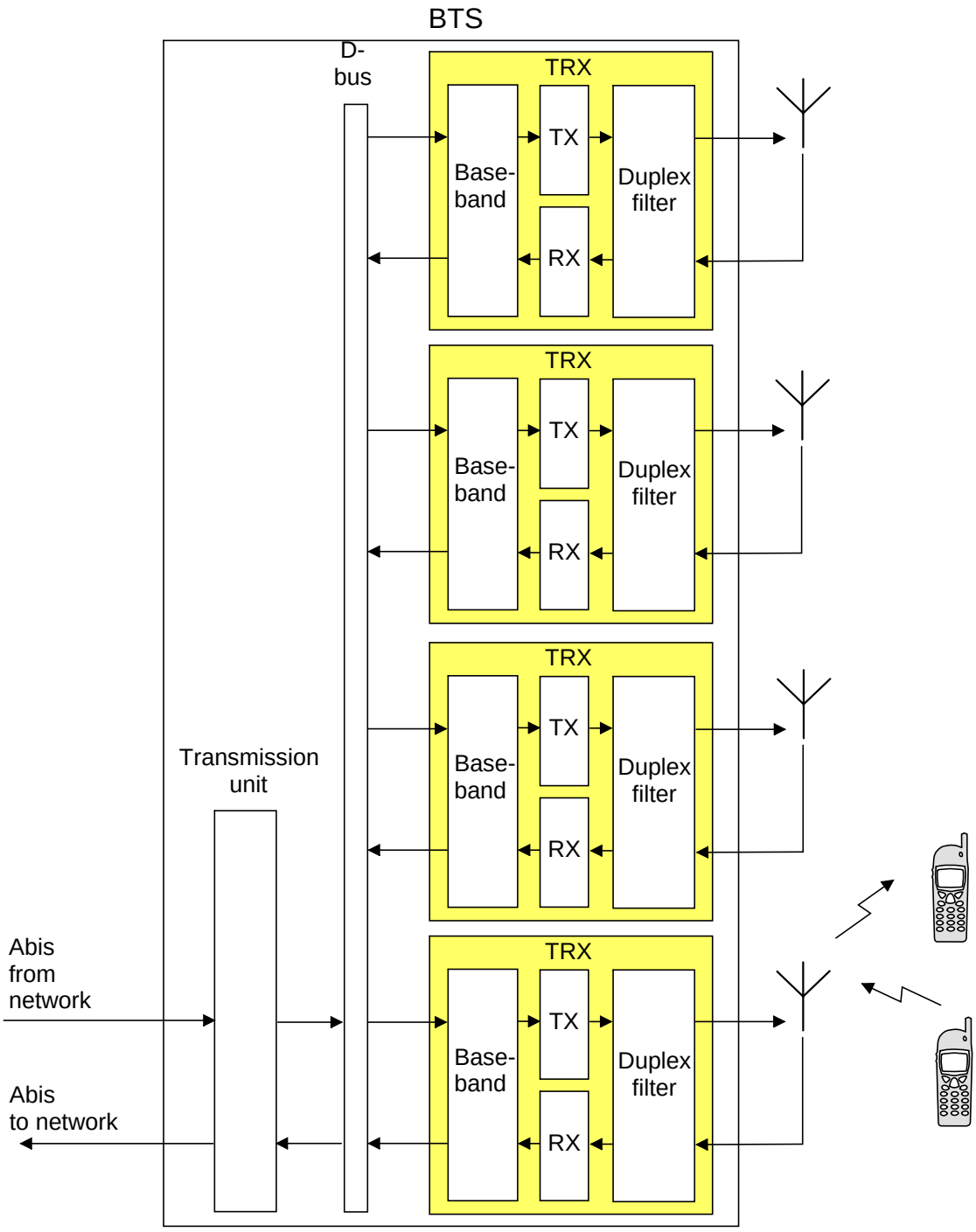

Figure 11. General principle of signalling between network, BTS and mobile station

In uplink direction, the signal from the MS is picked up by the antennas and from thereon the signal goes through the duplex filter to the RX part of the transceiver unit. In the RX part the signal is converted to the Intermediate Frequencies and filtered. The baseband module performs the digital signal processing and sends the signal via the D-bus to the transmission unit. The transmission unit connects the BTS via Abis interface to the BSC. The Abis interface can physically be either cable or radio link.

In downlink direction, the signal from the network is submitted via the transmission unit and D-bus to the baseband module for digital signal processing. The transmitter part of the transceiver unit receives the modulated baseband signal from the baseband module and filters the signal to sufficient output spectrum purity and raises it to the carrier frequency. The signal goes through the duplex filter to antenna, and the antenna sends the signal via Air interface to the receiving MS.

6.1.2 Nokia MetroSite BTS internal function

The block diagram of Nokia MetroSite BTS is presented in Figure 12.

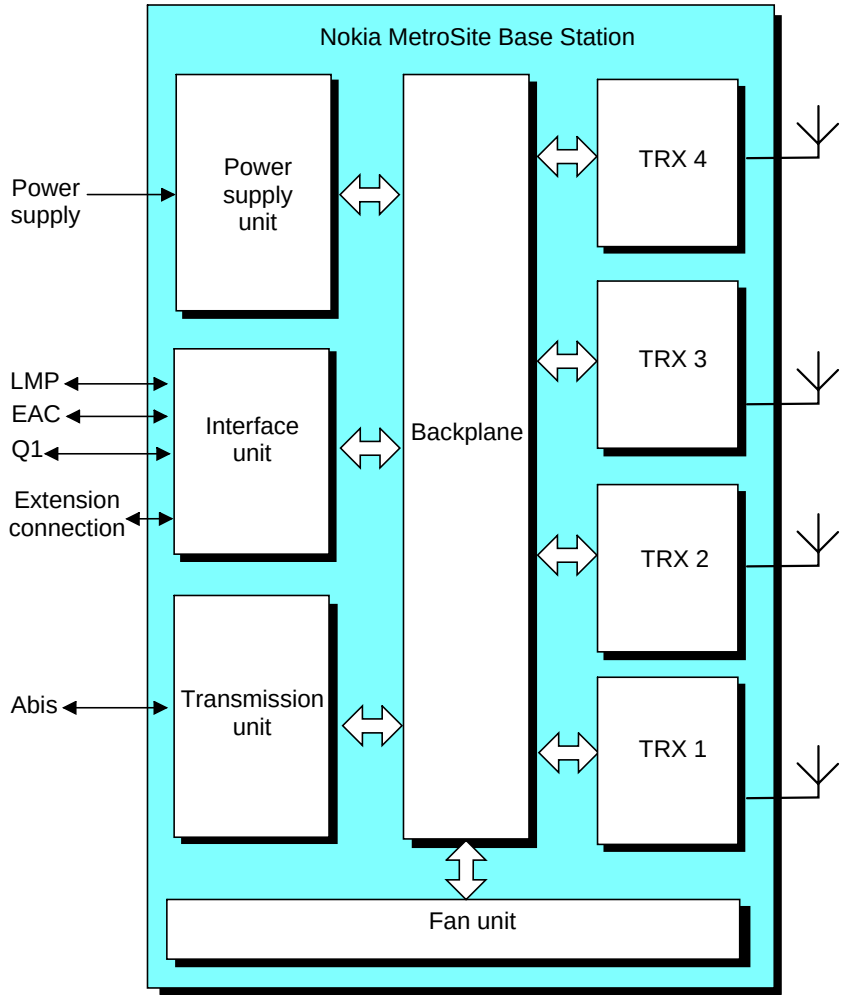

Figure 12. Nokia MetroSite BTS block diagram

BTS internal buses

The BTS internal signalling and signalling between BTS and the adjacent external equipment is handled by the following buses:

- D1-bus which handles the data transfer and signalling between transceiver units and transmission unit.
- D2-bus which is the main communication channel between the units in the BTS. Software downloading is handled through D2- bus.
- Local management bus (LMB) which is used for BTS and transmission units' control.

- Q1int-bus which is used for local transmission management.
- Q1-bus which is used for external equipment management.
- F-bus which is used for data transfer and signalling between transceiver units when baseband frequency hopping is employed (to be supported in future SW releases).
- I^2C-bus (Cabinet management bus) which handles the alarm and control signalling between passive units (all units except for transmission units).

Physically, the buses are located on the BTS backplane.

Base Control Functions

Nokia MetroSite BTS does not have a separate plug-in unit for Base Control Functions (BCF) as one of the TRXs is configured as the master TRX of the BTS. Currently, the master TRX is always located in the TRX slot 1 (in the lower left TRX slot, next to the transmission unit and interface unit slots). The following tasks are handled by the master TRX:

- cabinet control
- message delivery to the BSC
- alarm handling
- site alarm management
- timing functions
- software downloading
- self-testing of the BTS

Power distribution

The electrical power (AC or DC) from the external power source is distributed within Nokia MetroSite BTS by the BTS's power supply unit. The power supply unit distributes DC current to the plug-in units. All electrical connections are conveyed via the backplane. The output voltage loss on the backplane is 0.1 V. For more information on the output voltages, refer to Section 6.6.2.

The power supply unit is capable of feeding power to the maximum BTS configuration which includes either two Nokia MetroHopper Radio outdoor units or two Nokia FlexiHopper Microwave Radio outdoor units.

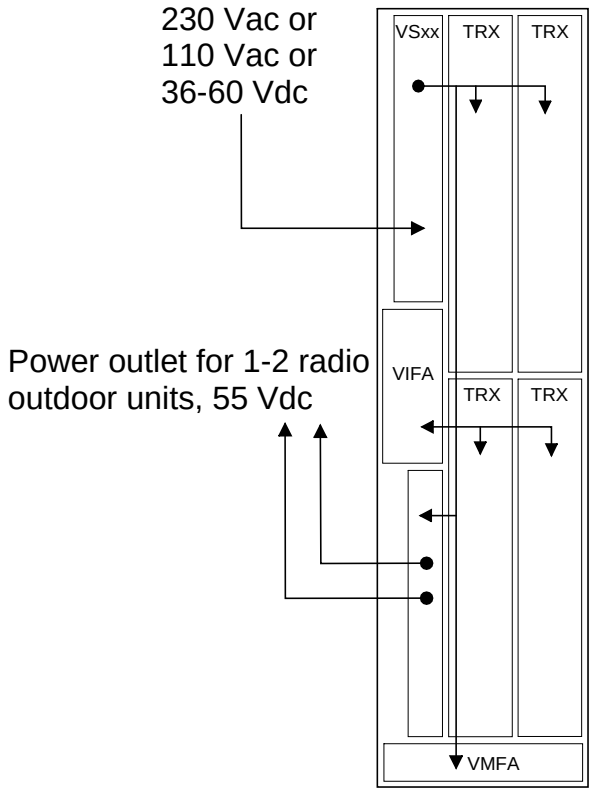

Figure 13. Power distribution of Nokia MetroSite BTS

6.2 Cabinet (VMCA)

Similarly to all the other properties of Nokia MetroSite BTS, its construction has been optimised for microcellular solutions. The chassis and the units are easy to install and move, and the compact structure provides new installation possibilities.

Nokia MetroSite BTS features a light-weight aluminium chassis with a stainless steel sheet metal backplate and aluminium die-cast guides and a backplate cover. Nokia MetroSite BTS mechanics has a compact plug-in construction covered by a separate plastic cover.

The cover shields the BTS against water, snow or solid foreign objects. The actual ingress protection and EMC shielding are provided by the chassis and the units.

The dimensions of Nokia MetroSite BTS are presented in Figure 14.

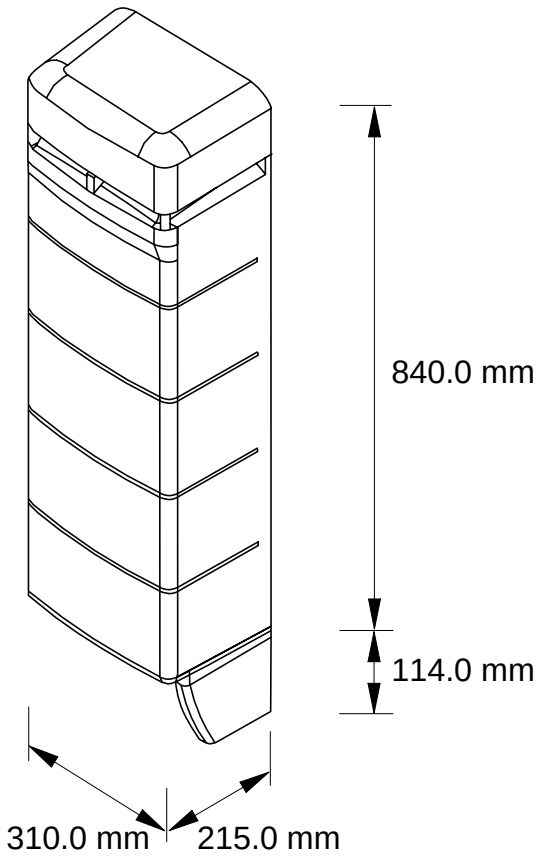

Figure 14. Dimensions of Nokia MetroSite BTS

Plug-in units

The plug-in units are connected to the BTS backplane via the connectors on their back panels. The following plug-in units have been fitted in the cabinet mechanics:

- up to four TRXs
- interface unit
- transmission unit
- power supply unit
- fan unit

In the following sections, the Nokia abbreviations for different units are given in the parentheses after the sections' titles.

Note

The LED indications of the units are presented in *Nokia MetroSite Base Station Maintenance*.

Figure 15 presents the arrangement of units.

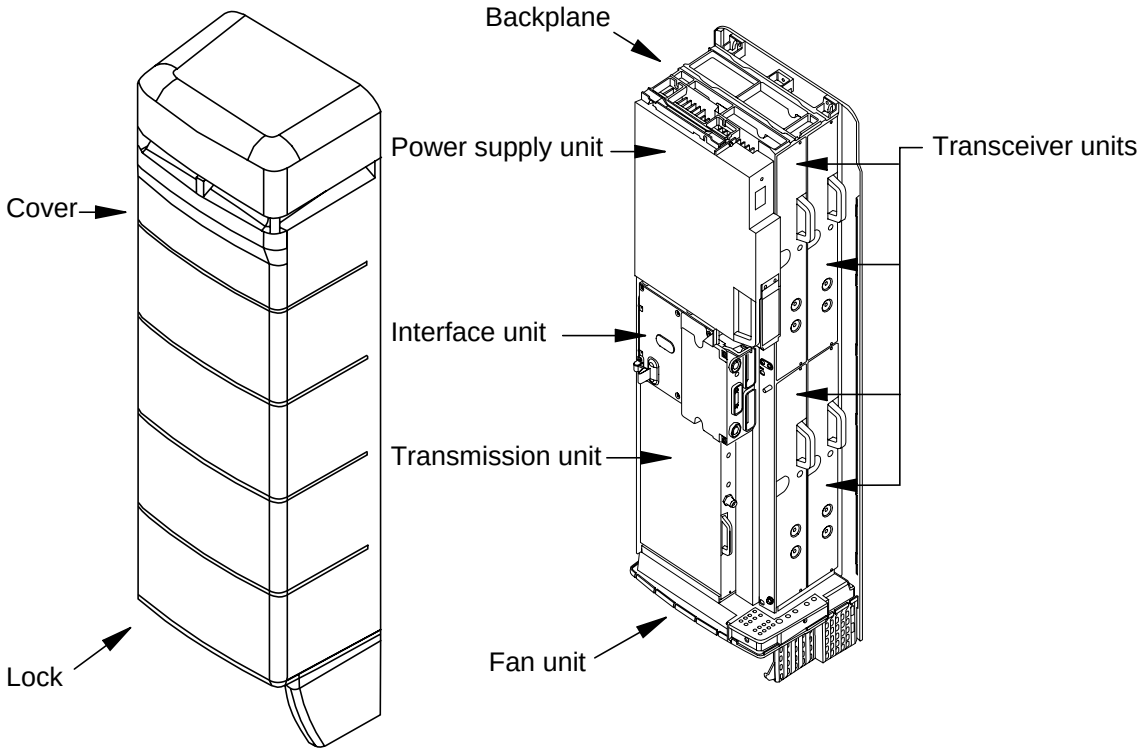

Figure 15. Arrangement of units

6.3 Transceiver unit (VTGx, VTDA, VTPA)

The main function of the transceiver unit (TRX) is to provide analog and digital signal processing required for handling one carrier both in the uplink (MS to network) and the downlink (network to MS) direction. There are TRX versions for GSM 900 (VTGx), for GSM 1800 (VTDA) and for GSM 1900 (VTPA).

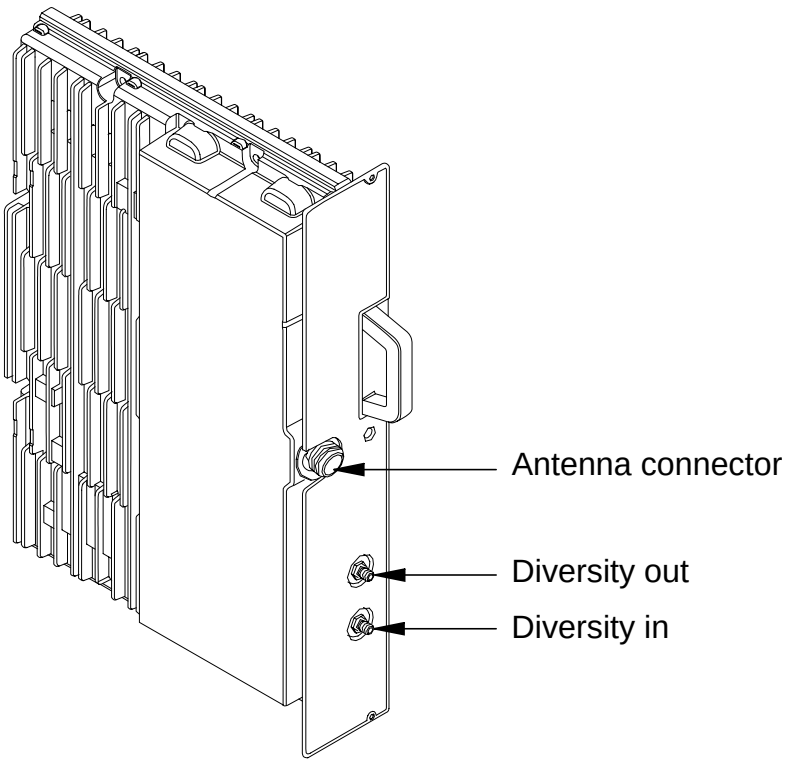

Figure 16. Transceiver unit of Nokia MetroSite BTS

The transceiver unit of Nokia MetroSite BTS consists of digital and analog parts and mechanics. The digital functions are in the baseband module whereas the analog part consists of an RF module and integrated duplex filter.

The block diagram of Nokia MetroSite TRX is presented in Figure 17

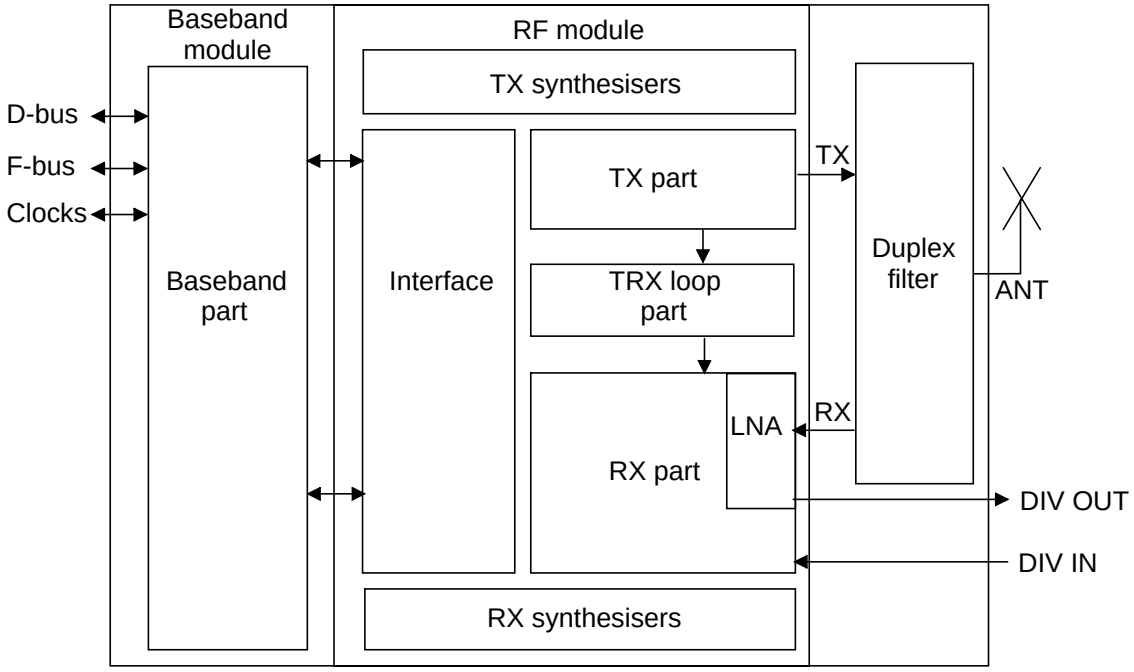

Figure 17. Block diagram of Nokia MetroSite TRX

One of the TRXs is configured as master TRX which manages all O&M functions of the BTS. In order to optimise the transmitter output power, the antennas are directly connected to TRXs.

The nominal transmitter output power at the antenna connector is 1 W (30 dBm). The single branch receiver sensitivity is better than -106.0 dBm.

6.3.1 Baseband module

The primary function of the baseband module is to carry out all digital signal processing of speech and data channels and to manage the signalling for all speech connections. The baseband module is capable of processing eight received and eight transmitted logical channels.

A baseband module in O&M mode acts as the master of the Nokia MetroSite BTS (for more information on the master TRX, refer to Section 6.1.2). The baseband module also performs all the Operation and Maintenance functions (O&M) and digital signal processing functions of the BTS. Physically, the master baseband module and slave baseband module are the same. The selection between the normal mode and the O&M mode is done with the software.

The baseband module has interfaces to the RF module and to the backplane. It is also connected to the transmission unit, power supply unit and the interface unit via the backplane.

The block diagram of the baseband module is presented in Figure 18.

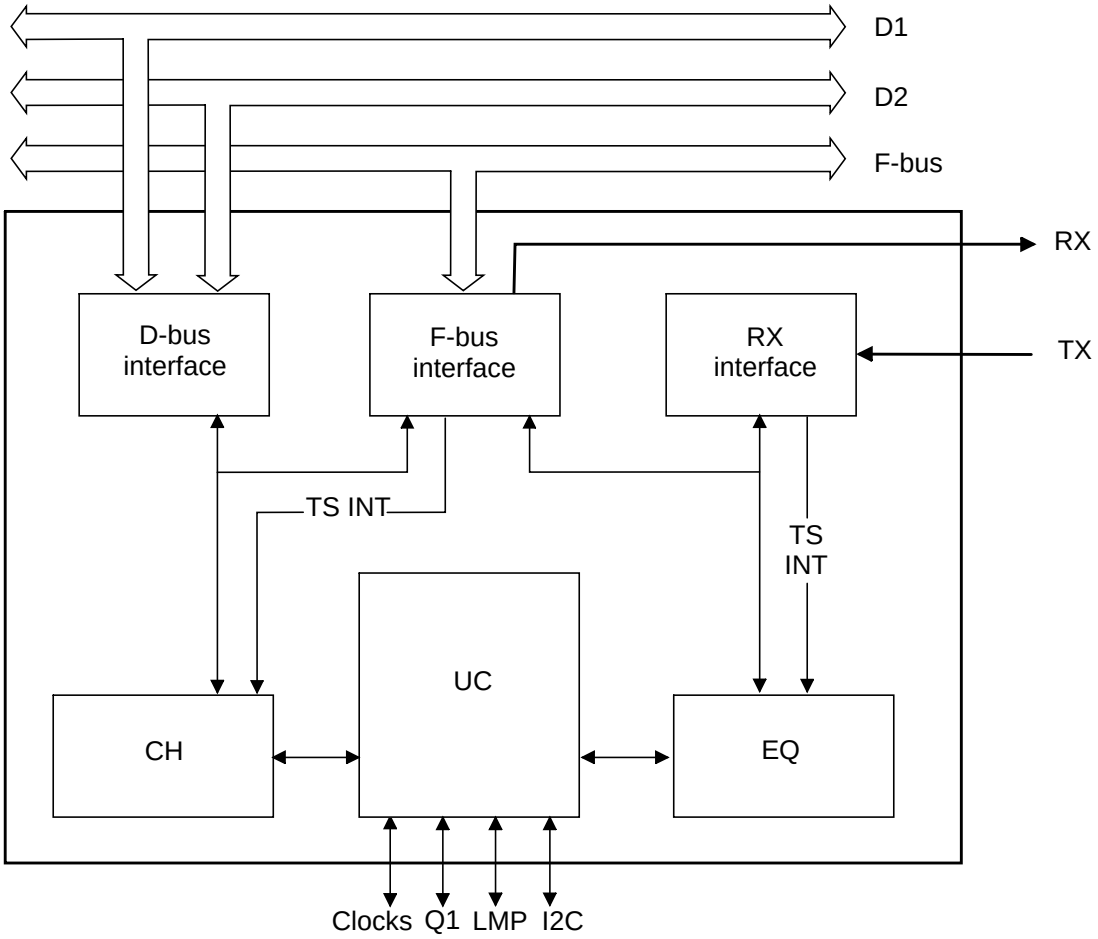

Figure 18. Block diagram of baseband module

Equalizer (EQ) block

The equalizer DSP block handles the sample receiving from RF (I_DATA and Q_DATA), bit detection and channel equalisation functions.

Channel DSP (CH) block

This block handles the sample transmitting to RF (DL_DATA), channel decoding and encoding, ciphering and deciphering functions.

RX interface

The purpose of RX interface is to adapt the receiver signal for EQ block.

D-bus interface

The signal from the baseband module to the transmission unit and from the transmission unit to the baseband module is transmitted through D-bus. The D-bus interface handles data transmitting/receiving and synchronisation of the D-bus, including data between the D-bus and the Unit Controller (UC), and data between the D-bus and the Channel DSP blocks.

F-bus interface

This interface is to be used for baseband frequency hopping purposes (to be supported in later SW releases).

Unit Controller (UC) block

The UC processor, which runs the BTS software, is located in the UC block. UC block hardware handles clock generation and synchronisation, interrupt and alarm handling functions.

6.3.2 RF module

The RF module provides the main RF functions for Nokia MetroSite BTS. The main functional parts of the RF module are the TX part and the RX part. Furthermore, the interface part, duplex filter and TRX loop part are incorporated in the RF module.

These interface to the baseband module via the backplane and provide control and reference signals to, and alarms from the analogue functions of the RF module. One of the ASICs incorporates Direct Digital Synthesis (DDS), generating a Gaussian Minimum Shift Keying (GMSK) signal for the TX.

The parts of the RF module are shown in Figure 19.

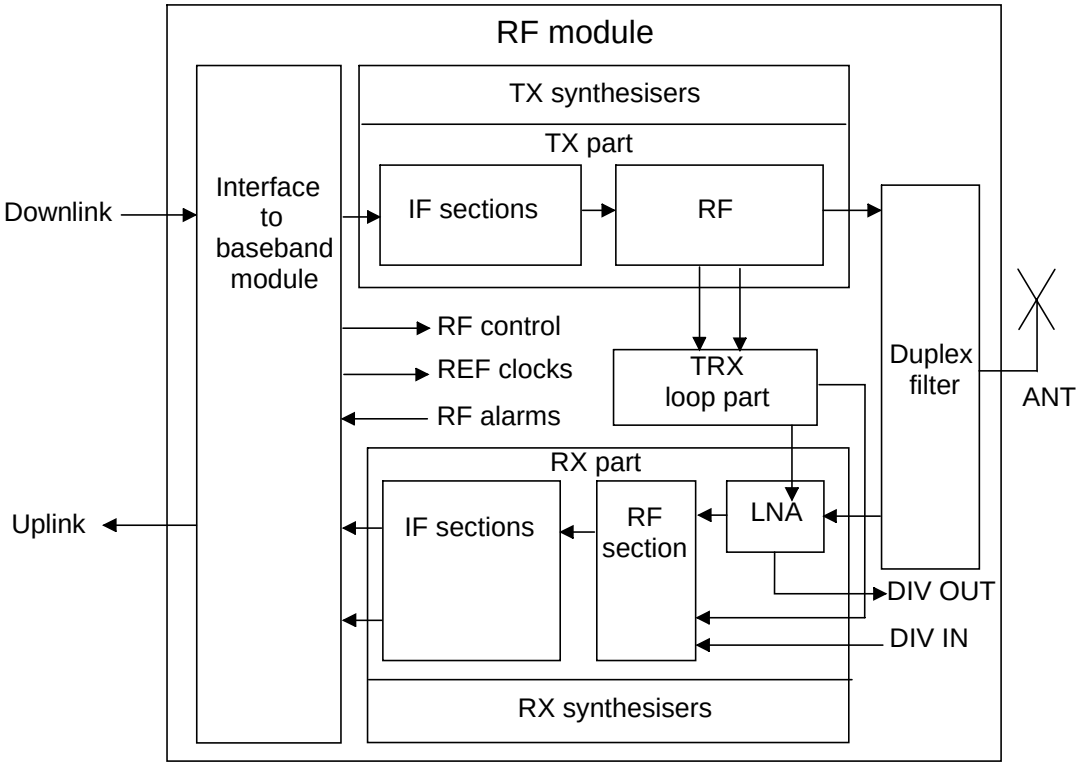

Figure 19. Block diagram of RF module

Interface part

The interface part converts the baseband datastream to the TX part. It also provides the conversion of intermediate frequency RX signal to normal and diversity datastream. Synthesiser control, clock distribution from baseband module, alarm functions and TRX loop control are handled by the interface part.

Transmitter (TX) part

The transmitter (TX) part receives the GMSK modulated baseband signal from the interface part and filters the signal to sufficient output spectrum purity.

The intermediate frequency (IF) sections in the TX part raise the signal to the carrier frequency. Thereafter, the RF section amplifies the signal to the desired output signal amplitude. The RF section also handles the signal power control.

Nokia MetroSite BTS TRX supports 16 power levels with 2 dB steps, with a maximum range of 30 dB.

TX part incorporates two phase-locked synthesisers, for either frequency hopping between adjacent time-slots or providing a fixed-frequency signal (in non-hopping mode). Synthesised frequency hopping is supported by Nokia MetroSite TRX.

The TX part also provides the local oscillator (LO) for the TX IF sections.

Duplex filter part

The duplex filter connects the receiver and the transmitter to a single antenna. The duplex filter module consists of a TX part and an RX part.

The signal from the transmitter part (TX output signal) is fed to the TX part in the duplex filter module, transmitted to the antenna and ultimately to the MS. The TX filter improves the spurious performance of the TX output signal and reduces the noise in the RX band.

The signal from the MS is picked up by the antenna. From there on the signal is sent to the RX part in the duplex filter. The RX part in the duplex filter rejects the TX signal and reduces other interfering signals. Thereafter, the signal is fed to the Low Noise Amplifier (LNA)

Low Noise Amplifier (LNA)

The LNA module incorporates a balanced two stage amplifier, which amplifies the received RF signal after the duplex filter. The LNA has a dual output so that main and diverse RX may be driven. For the diversity RX there is a separate output which can be used for the other TRX diversity RX. The LNA transmits the signal to the RF section of the receiver (RX) part. In the case of diversity, the LNA sends the signal to the RX part of another TRX.

Receiver part (RX part)

The RF section of the RX part converts the carrier frequency signal to the intermediate frequency (IF) levels. The IF sections of the RX part perform the channel filtering and prevent the interfering frequencies from distorting the signal. The IF sections also handle the automatic gain control.

The limiter and a variable gain block in the second stage prevent compression by keeping the signal level within the dynamic range of the output A/D converter.

The RX part incorporates two phase-locked synthesisers, for either frequency hopping between adjacent time slots or providing a fixed-frequency signal (in non-hopping mode). The RX part sends the main and diverse digital signals to the interface part and from there on the signals are transmitted to the baseband module for processing.

The RX part also provides the local oscillator (LO) for the RX IF sections.

TRX Loop part

The RF module supports self test with the TRX Loop. This feature facilitates testing of the TRX RF paths of the RF module. The tests are carried out by downconverting the frequency of the TX signal to the RX band. The signal is coupled from the output of the TX, and the resultant low-level signal subsequently injected back through to the RX path. The signal can be injected either to the main or diversity branches. The TRX Loop is also used to monitor reflected power and to perform antenna cable detection.

6.3.3 External interfaces

The front panel interface connectors are described in Table 1.

Table 1. TRX interface connectors

Connector	Type
Antenna	N (female)
RX diversity	SMA

6.4 Interface unit (VIFA)

The extension and control interfaces of Nokia MetroSite BTS are located on the interface unit. Furthermore, the BTS master clock is provided by the interface unit. The interface unit provides the 26 MHz master clock generation and conversion to 6.5 MHz level.

The door switch and test interfaces are located at the side of the interface unit.

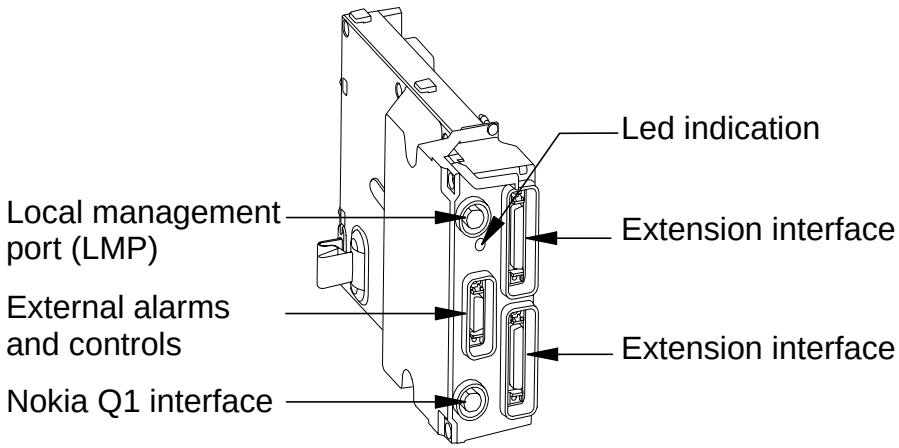

Figure 20. Interface unit of Nokia MetroSite BTS

6.4.1 External interfaces

The interfaces and their connector types are described in this section.

Local Management Port (LMP)

The LMP provides the connection to the Manager-PC. The connector type for LMP is BQ, RS-232. Figure 21 and Table 2 present the pin order and configuration for LMP (and Q1) connector.

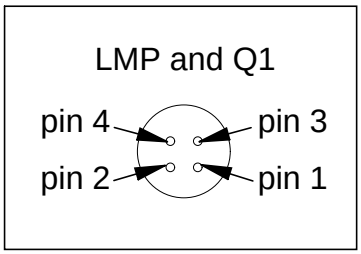

Figure 21. Pin order of LMP and Q1 connectors

Table 2. Pin configuration of LMP connector

Pin	Signal
1	LMP in
2	+5 V
3	LMP out
4	Ground

Nokia Q1 interface

Nokia Q1 interface provides a connection for supervising the Nokia Q1-bus compatible external equipment, such as DMR radios. The Q1 interface connector type is TQ. Figure 21 and Table 3 present the pin order and configuration for Q1 connector.

Table 3. Pin configuration of Nokia Q1 connector

Pin	Signal
1	Q1 in+
2	Q1 in-
3	Q1 out+
4	Q1 out-

Extension interface

This 50 pin mini D-connector will be used for BTS chaining and for connecting Nokia MetroHub Transmission Node. The extension feature is not available yet.

External alarms and controls (EAC)

The external alarms and controls connector provides the interface for 10 customer definable external alarm inputs (EA) and 4 control outputs (ECO). The connector type is 26 pin mini D-connector (female). Figure 22 and Table 4 present the pin order and configuration of the EAC connector.

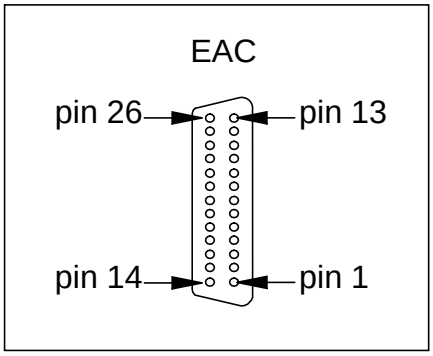

Figure 22. Pin order of EAC connector

Table 4. Pin configurations of EAC connector

Pin	Signal	Pin	Signal
1	EA1	14	GND
2	EA2	15	GND
3	EA3	16	GND
4	EA4	17	GND
5	EA5	18	GND
6	EA6	19	GND
7	EA7	20	GND
8	EA8	21	GND
9	EA9	22	GND
10	EA10	23	GND
11	ECO1	24	ECO3
12	+3V	25	ECO4
13	ECO2	26	+5V

6.5 Transmission unit (VXEA, VXTx, VXRx)

This section provides the technical information on the transmission units used in Nokia MetroSite BTS. The different transmission configurations that can be built with the transmission units described here are presented in Chapter 4. For the transmission interface protocols and standards refer to Section 8.4.5 in this document.

All transmission units can locally be managed with Nokia Site Manager.

6.5.1 Unit alternatives for radio link transmission

The following radio link transmission units are available for Nokia MetroSite BTS:

FC RRI (VXRA)

- support for one microwave radio outdoor unit (one TNC connector)
- one connection on 2 Mbit/s level

FXC RRI (VXRB)

- max. 16 x 2 Mbit/s capacity
- support for two microwave radio outdoor units (two TNC connectors)
- grooming, branching and loop protection support
- cross-connection on 8 kbit/s level

FC RRI and FXC RRI transmission units are used with Nokia MetroHopper Radio and Nokia FlexiHopper Microwave Radio (for more information on the radios and transmission units, refer to *Nokia MetroHopper Radio Product Description* and *Nokia FlexiHopper Microwave Radio Product Description*). The transmission unit is connected to Nokia MetroHopper Radio with a single coaxial cable, referred to as Flexbus (FB) (for more information, refer to Chapter 8 in this document).

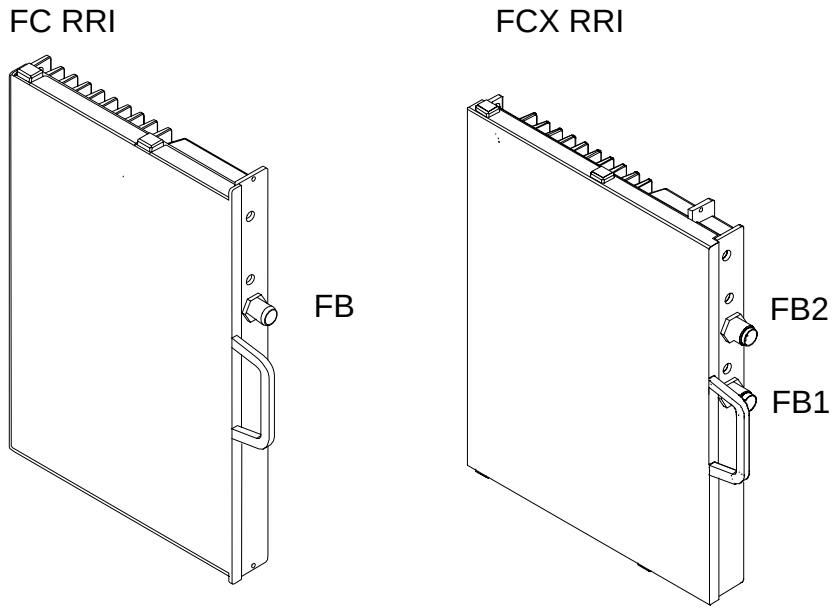

Figure 23. Radio link transmission unit alternatives

6.5.2 Unit alternatives for wireline transmission

The following wireline transmission units are available for Nokia MetroSite BTS:

FC E1/T1 (VXEA):

The FC E1/T1 transmission unit:

- provides one Abis line interface to the 2 Mbit/s (E1) or 1.5 Mbit/s (T1) transmission line.
- operates as the termination point in a chain or star configuration.
- has no cross-connection capability.

On its front panel, the FC E1/T1 has two unbalanced interface connectors (separate TX and RX connectors) for the 75 Ω E1-interface. There is also one balanced connector, which can be configured to be a 120 Ω E1-interface or 100 Ω T1-interface. The balanced connector offers both the TX and RX direction. The pin order and pin configuration of the balanced TQ connector is presented in Figure 24 and in Table 5.

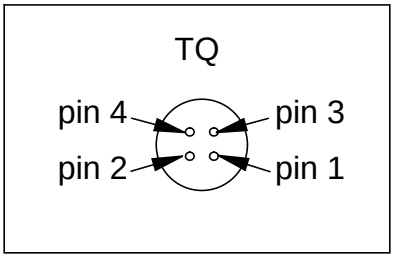

Figure 24. Pin order of balanced TQ connector

Table 5. Pin configuration of balanced TQ connector

Pin	Signal
1	RX+
2	RX-
3	TX+
4	TX-

FXC E1 (VXTA)

In addition to digital speech data, the FXC E1 transmission unit can also transfer operating and maintenance information to other equipment in the network.

The FXC E1 offers the following main features:

- four Abis line interfaces to the 2 Mbit/s (E1) transmission line
- grooming, branching and loop protection support
- 8 kbit/s level cross-connection functions between the four Abis line interfaces and the D-bus
- Nokia Q1 E2E traffic routing model, which allows easy transmission network planning

The front panel of the FXC E1 has four pairs of unbalanced BT-43 interface connectors (separate TX and RX connectors) for the 75 Ω E1-interface.

FXC E1/T1 (VXTB):

In addition to digital speech data, the FXC E1/T1 transmission unit can also transfer operating and maintenance information to other equipment in the network.

FXC E1/T1 offers the following main features:

- four Abis line interfaces to the 2 Mbit/s (E1) or 1.5 Mbit/s (T1) transmission line
- grooming, branching and loop protection support
- 8 kbit/s level cross-connection functions between the four Abis line interfaces and the D-bus
- Nokia Q1 E2E traffic routing model, which allows easy transmission network planning

The front panel of FXC E1/T1 has four balanced TQ connectors (for pin order and configuration refer to Figure 24 and Table 5). The connectors offer both TX and RX direction. Each line interface can be independently configured to be a 120 Ω E1-interface or 100 Ω T1-interface, which enables using the balanced FXC E1/T1 unit as an E1/T1-converter.

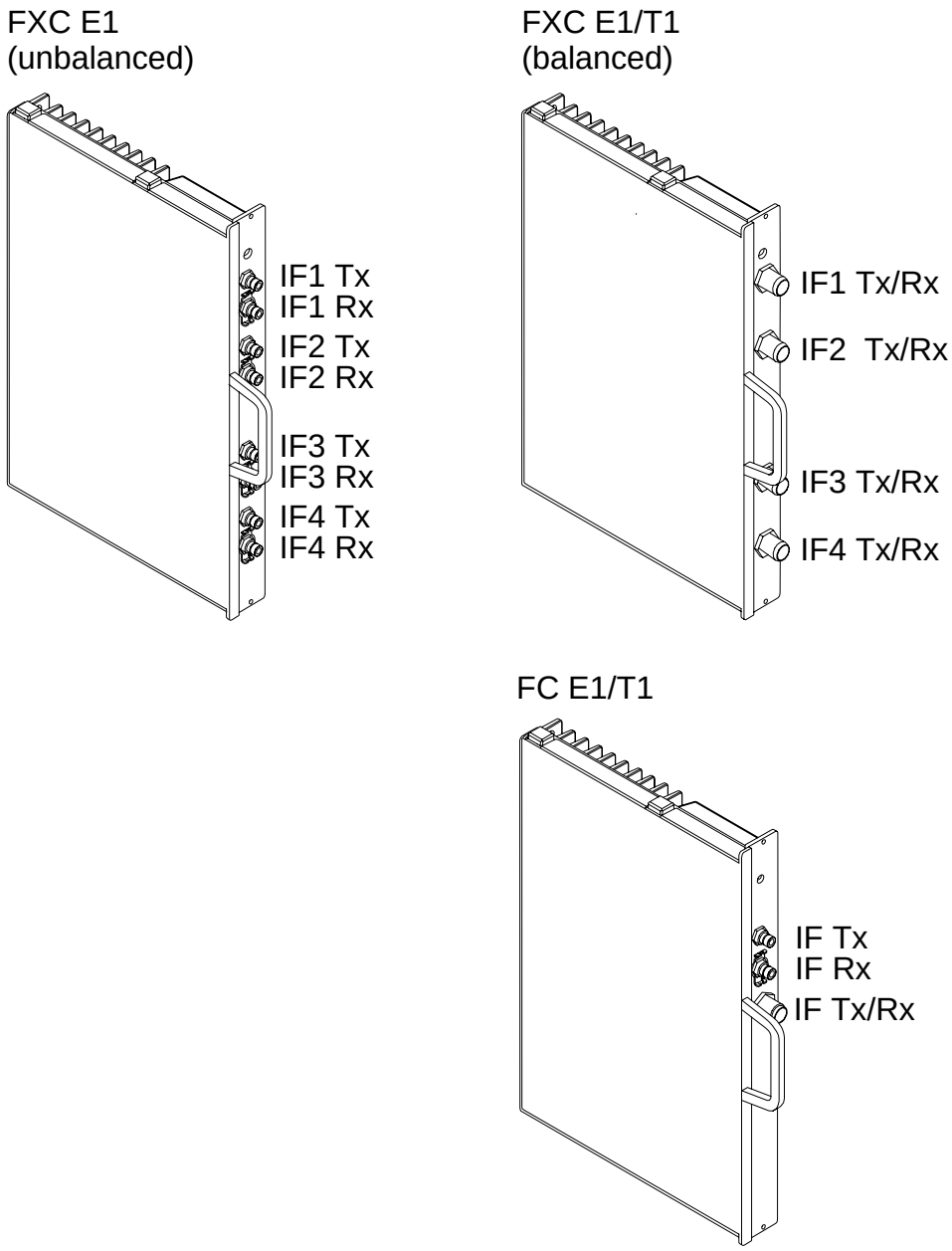

Figure 25. Wireline transmission unit alternatives

6.6 Power supply unit (VSAx, VSDA)

The purpose of the power supply unit is to convert the incoming AC or DC supply voltages into appropriate DC output voltages. The power is distributed to the units of Nokia MetroSite BTS and to radio outdoor units (if used) via the backplane.

In the case of mains power failure, the AC power supply units provide a back-up time of 130 ms during which the alarm can be sent, or, if MetroSite BBU is used, the power supply from the BBU is switched on. The alarm signal appears when the input voltage drops below the specified limit. The limit is dependent on the power supply unit type.

When the input power to the power supply unit is 425 W, the output power from the unit is 340 W (maximum power output).

6.6.1 Power supply unit alternatives

There are three alternative power supply units for different input voltages:

- 230 VAC
- 110 VAC
- DC power supply for 36 VDC/48 VDC/60 VDC voltages

The permitted voltage fluctuation tolerance is ±20%.

6.6.2 Output voltages

The output voltages from the power supply unit are the following:

- +3.4 VDC, +/-5.1 VDC, +/-9.1 VDC, +26.2 VDC and +55 VDC
- 24 VDC for fan unit

When the fan unit is not in use, the same output feeds power to the heating. The output voltage to the fan unit and heating is controlled by the I^2C-bus. The heating voltage is controlled in five steps ranging from 0 VDC (no heating), 24 VDC (full heating), the intermediate voltages being 7.2 VDC, 10.9VDC and 14.7 VDC.

6.6.3 Connector types

All alternative power supply units have the same outside appearance. The connector types, however, are different.

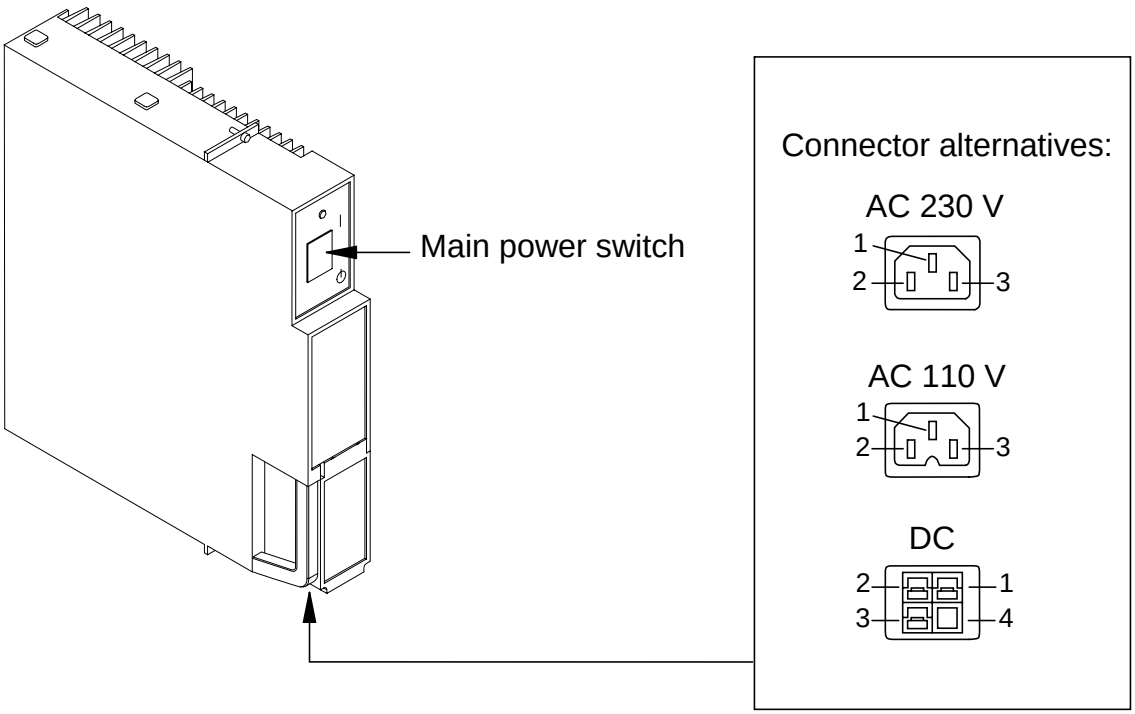

Figure 26. Power supply unit

The connector type of each power supply alternative is presented in Table 6.

Table 6. Power supply connector types

Power supply type	Connector type	Pin configuration
230 VAC	IEC 320 (male)	1 = GND 2 = AC neutral 3 = AC live
110 VAC	IEC 320 (male) with a notch	1 = GND 2 = AC neutral 3 = AC live
DC	Anderson Power pole	1 = GND 2 = Positive input supply voltage +36...60 VDC, permitted fluctuation ±20% (or positive supply voltage 0 V) 3 = negative supply voltage, 0V (or negative input supply voltage -36...60 VDC, permitted fluctuation ±20%). 4 = spacer

6.7 Fan unit (VMFA)

The fan unit is located at the bottom of the cabinet. The master TRX controls the fan unit via I^2C-bus according to temperature information from other units. The cooling is performed by adjusting the rotation speed of the fan. The adjustable speed also minimises the noise generated by the fan unit. The fan unit has 16 gradually adjustable speeds.

For safety reasons, the suction side of the fan unit is equipped with a finger guard mechanism.

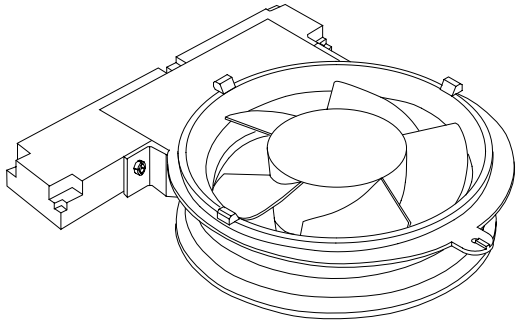

Figure 27. Fan unit

7 Unit alternatives and other delivery items

This chapter details the unit alternatives for Nokia MetroSite BTS.

Table 7. Nokia MetroSite BTS unit alternatives and other delivery items

Unit/Item	Alternatives and Nokia abbreviations
Transceiver unit (TRXs)	GSM 900 TRX: (VTGA, standard filter; customer specific filters H and J) GSM 1800 TRX, (VTDA) GSM 1900 TRX, (VTPA)
Transmission unit	FC RRI (VXRA) FXC RRI (VXRB) FC E1/T1 (VXEA) FXC E1 75 Ω (VXTA) FXC E1/T1 120/100 Ω (VXTB)
Power supply unit	AC 230 V, (VSAA) AC 110 V, (VSAB) DC 36 V/48 V/60 V(VSDA)
Interface unit	VIFA
Fan unit	VMFA

Table 7. Nokia MetroSite BTS unit alternatives and other delivery items (Continued)

Unit/Item	Alternatives and Nokia abbreviations
Nokia Site Manager	-
Customer documents	Nokia MetroSite BTS Product Overview Nokia MetroSite BTS User Manual
Options	Pole mounting kit Lifting rack

Furthermore, prefabricated LMP, EAC, power (AC and DC), Flexbus and Q1 cables for Nokia MetroSite BTS can be ordered from Nokia.

8 Technical specifications

The purpose of this chapter is to provide all necessary technical data of Nokia MetroSite BTS.

Table 8. Common technical data

Property	Value	Note
Height	840 mm	954 mm with the cable cover
Width	310 mm	
Depth	215 mm	
Weight	40 kg with four TRXs	Approximately 18 kg without TRXs. Heaviest single part 8 kg.
Low temperature limit	- 40 ˚C	
High temperature limit	+50 ˚C	
Ingress protection class	IP55	
Acoustic noise, max.	55 dB (A)	Sound power
Nominal voltage (external supply voltage range)	230 VAC 110 VAC 36/48/60 VDC	3 different power supply versions

Table 8. Common technical data (Continued)

Property	Value	Note
Permitted operating voltage fluctuation	184 VAC - 276 VAC 85 VAC - 145 VAC 29 VDC - 72 VDC	(44 Hz-65 Hz) (44 Hz-65 Hz)
Typical power demand (approximate value)	200 W	with 4 TRXs, FC E1/ T1, no heating
Maximum power demand(approximate value)	450 W	with 4 GSM 1900 TRXs, FXC RRI, 2 FlexiHoppers and maximum heating

Table 9. Specific technical data for GSM 900 BTS

Property	Value	Note
TX-frequency range	A: 925 - 960 MHz H: 925 - 960 MHz J: 925 - 960 MHz	Extended GSM H and J are customer specific filters
RX-frequency range	A: 880 - 915 MHz H: 897.5-915 MHz J: 890.1-915 MHz	improved isolation between TX and RX bands
Channel spacing	200 kHz	
Available radio channels	174	
TX output power at antenna connector, nominal	1W (30 dBm)	
Dynamic power control	30 dB (15x2 dB)	
Static RX sensitivity	-108.0 dBm -106.0 dBm	nominal minimum
RX diversity		with two or more TRXs in one cell
Isolation requirement for antenna or external combiner equipment	min 25 dB	

Table 10. Specific technical data for GSM 1800 BTS

Property	Value	Note
TX-frequency range	1805 - 1880 MHz	
RX-frequency range	1710 - 1785 MHz	improved isolation between TX and RX bands
Channel spacing	200 kHz	
Available radio channels	374	
TX output power at antenna connector, nominal	1W (30 dBm)	
Dynamic power control	30 dB (15x2 dB)	
Static RX sensitivity	-108.0 dBm -106.0 dBm	nominal minimum
RX diversity		with two or more TRXs in one cell
Isolation requirement for antenna or external combiner equipment	min 25 dB	

Table 11. Specific technical data for GSM 1900 BTS

Property	Value	Note
TX-frequency range	1930 - 1990 MHz	
RX-frequency range	1850 - 1910 MHz	improved isolation between TX and RX bands
Channel spacing	200 kHz	

Table 11. Specific technical data for GSM 1900 BTS (Continued)

Property	Value	Note
Available radio channels	281 (298)	17 blocked / reduced power channels
TX output power at antenna connector, nominal	1W (30 dBm)	
Dynamic power control	30 dB (15x2 dB)	
Static RX sensitivity	-108.0 dBm -106.0 dBm	nominal minimum
RX diversity		with two or more TRXs in one cell
Isolation requirement for antenna or external combiner equipment	min 25 dB	

Table 12. HW interfaces of Nokia MetroSite BTS

Interface	Number	Connector type/note
Antenna Connectors	1 - 4	N (female), one for each TRX
RX-diversity connectors	2 - 8	SMA (female), two for each TRX
AC supply 230 V	1	IEC 320 (male)
AC supply 110 V	1	IEC 320 (male), with a notch
DC supply DC 36 /48 /60 V	1	Anderson Power Pole
Grounding	1	Cable clamp
External alarms and controls	1	10 alarm inputs 26 pin mini D (female) 4 control outputs
Extension connectors	2	Out/In: 50 pin mini D (female)
13 MHz clock interface	1	MCX (female)

Table 12. HW interfaces of Nokia MetroSite BTS (Continued)

Interface	Number	Connector type/note
Frame clock	1	MCX (female)
Q1 interface	1	TQ
Local management port (LMP)	1	BQ, RS-232

Table 13. Transmission interfaces of Nokia MetroSite BTS

Interface	Number	Connector type/note
FC RRI	1	TNC (50 Ω), flexbus connection to outdoor unit
FXC RRI	2	TNC (50 Ω), flexbus connection to outdoor unit
FC E1/T1	2 1	BT43 (75 Ω) TQ (120/100 Ω)
FXC E1 (75 Ω)	8	BT43
FXC E1/T1 (120/100 Ω)	4	TQ

Table 14. Flexbus cable characteristics

Property	Value
Cable type	Coaxial cable, double shielded or semi-rigid (recommended types RG-223, RG-214)
Characteristic impedance	50 ± 2 Ω
DC resistance	< 4.6 Ω (sum of inner and outer conductor

Table 14. Flexbus cable characteristics (Continued)

Property	Value
Data attenuation	< 9.0 dB at 19 MHz
Flexbus signals	DC power supply Bidirectional data (37 Mbit/s, NRZ code, 1.4 V pulse amplitude)
Length	max 140 m for RG-223 max 300 m for RG-214

8.1 Dimensions and weights of plug-in units

This section presents the dimensions and weights of the plug-in units.

8.1.1 Transceiver unit

Table 15. Dimensions and weight of the TRX

Measure	Value
Height	314 mm
Width	61 mm
Depth	233 mm
Weight	4.5 kg

8.1.2 Interface unit

Table 16. Dimensions and weight of the interface unit

Measure	Value
Height	58 mm

Table 16. Dimensions and weight of the interface unit (Continued)

Measure	Value
Width	152 mm
Depth	200 mm
Weight	1 kg

8.1.3 Transmission unit

Table 17. Dimensions and weight of the transmission unit

Measure	Value
Height	254 mm
Width	28 mm
Depth	164 mm
Weight	0.7 kg

8.1.4 Power supply unit

Table 18. Dimensions and weight of the power supply unit

Measure	Value
Height	245 mm
Width	60 mm
Depth	268 mm
Weight	< 4 kg (depending on the type)

8.2 System requirements for Nokia BTS Manager

System requirements for Nokia BTS Manager are detailed in Table 19.

Table 19. System Requirements for Nokia MetroSite BTS Manager

Computer	Intel Pentium-based IBM-compatible PC
Operating system	Microsoft Windows NT 4.0 (with service pack 4) Microsoft Windows 95 (or Microsoft Windows 98) (with service pack 1)
System memory (minimum)	Windows NT 4.0: 32MB Windows 95 (or Microsoft Windows 98): 16MB
Monitor	SVGA, min 800x600 resolution
Minimum disk space	40MB
Accessories	CD-ROM drive Windows compatible mouse or pointing device Windows compatible printer (optional) Cable (PC - BTS)

8.3 Basic telecom features

Nokia MetroSite BTS supports the following basic telecom features:

- DRX, discontinuous reception
- DTX, discontinuous transmission
- Handover and power control algorithms
- SDCCH handover
- Interference band selection based on MS power
- Mode modify procedure
- Logical channel configurations (based on GSM/DCS recommendation 05.02.)
- Flow control

- Full Rate Speech
- Ciphering (support for A5/0,1,2)
- FACCH emergency call setup
- Bad frame handling

8.4 International recommendations

This section lists the recommendations referred to in the designing of Nokia MetroSite BTS.

8.4.1 Common standards

Table 20 describes the common standards referred to in the designing of Nokia MetroSite BTS.

Table 20. Common standards

Standard	Description
ETSI GSM 05.05/11.20/11.21/11.22/ 11.23	Standard for base station equipment
J-STD-007	Personal Communications Services; Air Interface SpecificationVolume 1;Radio Path Physical Layer
TIA/EIA PN-3777	EMC specific

8.4.2 Electrical standards

The tables of this section describe the electrical standards referred to in the designing of Nokia MetroSite BTS.

Table 21. Input voltage standards

Standard	Description
ETS 300 132-1:1996	Equipment Engineering Power Supply Interface at the input to Telecommunications Equipment Interface Operated by Alternated Current "AC
ETS 300 132-2:1996	Power Supply Interface at the input to telecommunications Equipment Interface Operated by Direct Current "DC"
GSM 11.20	Standard for base station equipment
ETS 300 253, 1995	Earthing and bonding of telecommunication equipment in telecommunication centres

Table 22. Electrical safety standards

Standard	Description
EN 60950: 1992 A1:1992 A2: 1993 A3:1995 A4: 1996 IEC 950: 1991 A1:1992 A2: 1993 A3:1995 A4: 1996	Safety of Information Technology equipment, Including Electrical Business Equipment + Amendments A1, A2, A3 and A4
UL1950: 1995, 3rd edition	Standard for Safety of Information Technology equipment, Including Electrical Business Equipment

Table 22. Electrical safety standards (Continued)

Standard	Description
FCC 68	Rules for Registration of Telephone Equipment PART 68: 1995
GR-1089-CORE: 1994	Electromagnetic Compatibility and Electrical Safety-Generic Criteria for Network Telecommunications Equipment
EN 60215:1988 IEC 215: 1987 BS 3192	Safety requirements for radio transmitting equipment

Table 23. Product specific EMC standards

Standard	Description
ETS 300 342 2, 1994	Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC) for European digital cellular telecommunications system (GSM 900 and DCS 1800 MHz) Part 2: Basestation and ancillary equipment
d-ETS 300 342-3:1997	Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC) for European digital cellular telecommunications system Part 3: Basestation and ancillary equipment and repeaters meeting Phase 2 GSM requirements
ETSI GSM 11.20 ETSI GSM 11.21	Standard for base station equipment Standard for base station equipment
J-STD-007	Personal Communications Services; Air Interface Specification Volume 1;Radio Path Physical Layer
TIA/EIA PN-3777	EMC specific

Table 24. Basic EMC standards based on d-ETS 300 342-3:1997

Standard	**Description**
ETSI GSM 11.20 ETSI GSM 11.21	Standard for base station equipment Standard for base station equipment
EN 55022, class B, 1994 (IEC/CISPR 22, 1993) EN 55022/A1:1995	Limits and methods of measurement of radio interference characteristics of information technology equipment
EN 61000-4-2: 1995 IEC 1000-4-2: 1995	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 2: Electrostatic discharge immunity test Basic EMC publication
EN 61000-4-3: 1995 IEC 1000-4-3: 1995	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 3: Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4: 1995 IEC-1000-4-4: 1995	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 4: Electrical fast transient/burst immunity test Basic EMC publication
EN 61000-4-5: 1995 IEC-1000-4-5: 1995	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 5: Surge immunity test
EN 61000-4-6:1996 IEC 1000-4-6:1996	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 6: Immunity to conducted disturbances, induced by radio-frequency fields
IEC 1000-4-11: 1994 EN 61000-4-11: 1994	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 11: Voltage dips, Short interruptions and Voltage variations immunity tests

Table 25. Additional EMC standards

Standard	Description
FCC 15	FCC Rules for Radio Equipment Devices
IEC 1000-3-2, EN 60555-2 BS 5406 Part 2	Electromagnetic Compatibility (EMC) Part 3: Limits- Section 2: Limits for harmonic current emission (equipment input current ≤16A per phase)
IEC 1000-3-3: 1994 EN 61000-3-3: 1995 EN 60555-3: BS 5406	Electromagnetic Compatibility (EMC) Part 3: Limits- Section 3: Limitation of voltage fluctuation and flicker in low-voltage supply systems for equipment with rated current ≤16A
IEC 1000-4-8: 1993	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 8: Power frequency magnetic field immunity test Basic EMC publication
IEC 1000-4-9: 1993	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 9: Pulse magnetic field immunity test Basic EMC publication
IEC 1000-4-10: 1993	Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques Section 10: Damped oscillatory magnetic field immunity test Basic EMC publication

8.4.3 Environment

The environmental standards referred to in the designing of Nokia MetroSite BTS are described in this section.

Table 26. Environmental standards

Standard	Description
ETS 300 019-1-1:1992	Equipment Engineering (EE);Environmental conditions and environmental tests for telecommunications equipment Part 1-1: Classification of environmental conditions: Storage
ETS 300 019-2-1:1994	Equipment Engineering (EE);Environmental conditions and environmental tests for telecommunications equipment Part 2-1: Specification of environmental tests: Storage
ETS 300 019-1-2:1992	Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment Part 1-2: Classification of environmental conditions: Transportation
ETS 300 019-2-2:1994	Equipment Engineering (EE);Environmental conditions and environmental tests for telecommunications equipment Part 2-2: Specification of environmental tests: Transportation
ETS 300 019-1-4:1992	Equipment Engineering (EE);Environmental conditions and environmental tests for telecommunications equipment Part 1-4: Classification of environmental conditions Stationary use at non-weather protected locations
ETS 300 019-2-4:1994	Equipment Engineering (EE);Environmental conditions and environmental tests for telecommunications equipment Part 2-2: Specification of environmental tests: Stationary use at non-weather protected locations

8.4.4 Mechanical standards

The mechanical standards referred to in the designing of Nokia MetroSite BTS are described in this section.

Table 27. Mechanical standards

Standard	Description
EN 60950: 1992 A1:1992 A2: 1993 A3:1995 A4: 1996 IEC 950: 1991 A1:1992 A2: 1993A3:1995 A4: 1996	Safety of Information Technology equipment, Including Electrical Business Equipment + Amendments A1, A2, A3 and A4
EN 60659 BS 5490	Degree of Protection Provided by Enclosures (IP Code)
ISO 3744, 1988	Acoustics Determination of sound power levels of noise sources Engineering methods for special reverberation test rooms
IEC 68-2-57: 1989	Environmental Testing Part2: Test Methods Ff: Vibration Time-history method.
GR-63-CORE:1995	Network Equipment-Building System (NEBS): Physical Protection

8.4.5 Base station interface equipment - related recommendations and standards

The standards and recommendations related to base station interface equipment are described in this section.

Table 28. Flexbus interface

Standard	Description
ITU-T G.704 (10/94)	Synchronous frame structures used at primary and secondary hierarchical levels
ITU-T G.706 (1991)	Frame alignment and cyclic redundancy check (CGC) procedures relating to basic frame structures defined in Recommendation G.704
ITU-T G.823 (03/93)	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
ITU-T G.826 (08/96)	Error performance parameters and objectives for international, constant bit rate digital paths at or above primary rate
ITU-T G.921	Digital sections based on the 2048 kbit/s hierarchy

Table 29. 2048 kbit/s E1 interface

Standard	Description
CCITT (Blue Book)	
• G.703	• Digital Interface Characteristics
• G.704	• Functional Interface Characteristics
• G.706	• CRC Multiframe structure
• G.711	• PCM Coding Law
• G.732	• Primary PCM Multiplexer
• G.736	• Synchronous 2Mbit/s Digital Multiplexer
• G.823	• Jitter and Wander
• G.826	• Performance parameters
• I.460	• Multiplexing, Rate Adaptation
GSM	
• 03.50	• Transmission Planning Aspects
• 08.51	• BSC BTS Interface, General Aspects
• 08.52	• BSC BTS Interface Principles
• 08.54	• BSC BTS Interface Layer 1, Structure of Physical Circuits

Table 30. 1544 kbit/s T1 interface

Standard	Description
ANSI T1.403 and T1.102	Digital Interface Characteristics
ANSI T1.403	Functional Interface Characteristics PCM Coding Law Primary PCM Multiplexer Synchronous 2Mbit/s Digital Multiplexer Performance parameters
ANSI T1.403	Jitter and Wander Multiplexing, Rate Adaptation
AT&T TR 62411	