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**470318A
Nokia Flexi EDGE Base Station, Rel. EP1,
Product Documentation, v.1**

Nokia Flexi EDGE BTS Product Description

Contents

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1 CE marking

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DN02246819

Figure 1. CE marking

Hereby, Nokia Siemens Networks declares that this Nokia Base Station is in compliance with the essential requirements and other relevant provisions of Directive: 1999/5/EC.

2 FCC Part 15 compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. Changes or modifications not expressly approved by the party responsible for compliance could void the user´s authority to operate the equipment.

3 Environmental information

3.1 Environmental information for Nokia Flexi EDGE Base Station

3.1.1 Introduction

The purpose of this document is to provide Nokia customers with environmentally relevant information about Nokia products. It shall not be interpreted as a specification, modification or amendment to the specification, or additional or other warranty of any kind. In case of discrepancy between this document and the Product specification or terms and conditions of the valid supply agreement between Nokia and the customer, the supply agreement and Product specification shall always prevail over this document.

The contents of this document are provided on "as is" and "as available" basis. Nokia does not warrant that this document is exclusive on all material information of the defined Nokia product. Nokia reserves the right to revise this document or withdraw access to this at any time.

3.1.2 Product information/description

This environmental information is for a typical Nokia Flexi EDGE BTS. The configuration is 2+2+2 by-pass. For actual detailed product and configuration information for each frequency variant, see the latest Nokia Flexi EDGE BTS user manual document *Requirements for Installation and Operation*.

3.1.3 Company information

3.1.3.1 Environmental policy of Nokia corporation

Table 1.   Environmental policy of Nokia corporation

Basic principles
1. A successful business requires a solid, product life cycle based environmental performance.
2. The Nokia Way means an active, open and ethically sound approach to environmental protection.
3. The objective of Nokia's environmental policy is sustainable development in accordance with the ICC (International Chamber of Commerce) business charter.
Implementation
1. The environmental policy is an integral part of general management process.
2. Line organisations plan and implement the action programs by using environmental specialists and the best available technology.
3. The action programs are based on a thorough understanding of the environmental impacts of a product throughout its life cycle.
4. Minimising the environmental impacts requires continuous efforts and follow-up of the results; it is thereby a part of the total improvement activities.

3.1.3.2 Design for environment

Our approach to product design is to make our products more environmentally efficient through our Design for Environment program. This program is based on an analysis of the life cycle of the product from the extraction of materials to product disposal at end of life. Design for Environment is integrated into the Product Creation Process (PCP) and thus is an integral part of day-to-day decision-making. Nokia also has a network of specialists who support product designers in taking environmental issues into account.

3.1.3.3 ISO 14001

Nokia uses Environmental Management Systems (EMS) as a management method for controlling and improving the environmental performance of our own operations. As of 2001 Nokia Corporation, Networks had a global certified EMS covering all our production sites, including joint ventures. (ISO14001: 1996 certificate number EMS 72988 by British Standards Institute (BSI).)

3.1.3.4 Suppliers

Environmental issues are an integral part of supplier management and contractual agreements. Nokia has a set of comprehensive Supplier Requirements where environmental issues are included. To ensure compliance trained Nokia personnel conduct regular supplier assessments.

3.1.3.5 Environmental reporting

Nokia publishes environmental reports with a focus on our policy and strategy for reducing adverse environmental impacts and the environmental aspects of our products and operations as well as for implementing policy and strategy.

The latest report can be found on the Nokia Internet pages in the Environment section.

3.1.4 Product description

3.1.4.1 Power consumption

The power consumption depends on input voltage, ambient temperature and traffic load. The following values are calculated for an operational typical configuration 2+2+2 by-pass, + 48 V DC.

Table 2.   Power consumption

Frequency band	800/900	1800	1900
Min.	265 W (all timeslots on idle)	270 W (all timeslots on idle)	270 W (all timeslots on idle)
Typical	695 W (50% of timeslots on max. power)	750 W (50% of timeslots on max. power)	780 W (50% of timeslots on max. power)
Max.	1055 W (all timeslots on max. power)	1160 W (all timeslots on max. power)	1220 W (all timeslots on max. power)

For actual detailed product and configuration information for each frequency variant, see the latest Nokia Flexi EDGE BTS user manual document *Requirements for Installation and Operation*.

3.1.4.2   Materials

Nokia has compiled a Nokia Substance List (NSL) based on regulatory requirements and reasonable facts. The NSL identifies substances that Nokia has banned, restricted or targeted for reduction in products/ components delivered to Nokia. Download the Nokia Substance List from Nokia the Internet pages in the Materials Use section.

EU RoHS compliance

Nokia considers the EU RoHS directive important and beneficial for the environment, customers and manufacturers. Nokia products are compliant with the EU RoHS directive.

3.1.4.3   Batteries

Flexi EDGE includes batteries, when used with 48V minute level battery back up unit FPBA. It does not include accumulators.

3.1.4.4   Noise

The following sound power values are calculated for an operational typical configuration 2+2+2 by-pass:

Table 3.   Sound power values

Min.	54 dB (A) in 15°C, 100 % RF load
Typical	58 dB (A) in 23°C, 100 % RF load
Max.	66 dB (A) in 50°C, 100 % RF load

For actual detailed product and configuration information for each frequency variant, see the latest Nokia Flexi EDGE BTS user manual document *Requirements for Installation and Operation*.

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3.1.4.5 Product packaging

All Flexi EDGE BTS packaging materials are compliant with EU directive 94/62/EC for Packaging and Packaging Waste. Packaging materials are marked according to CR 14311 recommendations in order to ensure the identification of the material in the post-use chain.

Recycling labels are also in accordance with China RoHS standard GB18455-2001.

The transportation packagings include:

- Plug-in unit package made of corrugated cardboard

- Container made of corrugated cardboard

- Pallets made of wood (pine or spruce) or plywood

- Straps and antistatic bags made of polyethene (PE)

- Lower and upper cushion made of expanded polystyrene (EPS)

In addition, the packaging may include dehydrant bags, ID-stickers, tape and staples.

3.1.4.6 End of life

Nokia supplies information supporting environmentally sound and safe recycling of Nokia products to recycling service providers. The separate Material Declaration document includes information on the main material fractions and substances that may require special handling in the end-of-life process.

3.1.5 Nokia Equipment Take Back Service

Nokia offers its customers Nokia Equipment Take Back Service as a complete solution for removal, collection and recycling covering the end-to-end workflow of the end-of-lifecycle process. Customers may elect to perform one or more of the services themselves and procure others from Nokia, as needed to meet their obligations. The Service pricing is scaleable according to the Service Modules selected.

3.2 EU RoHS statement

Nokia Flexi EDGE BTS complies with the European Union RoHS Directive 2002/95/ EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment 1 July 2006 at the latest. The directive applies to the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE) in electrical and electronic equipment put on the market after 1 July 2006.

3.3 Product collection and disposal within the European Union

Product collection and disposal within the European Union
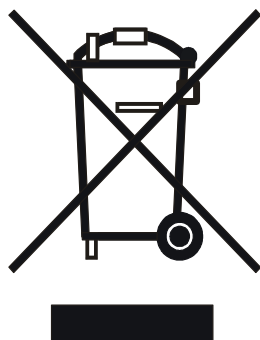
Do not dispose of the product as unsorted municipal waste. The crossed-out wheeled bin means that at the end of the product's life it must be taken to separate collection.

Note: this is applicable only within the European Union (see WEEE Directive 2002/96/EC)

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Figure 2.   Product collection and disposal within the European Union

4 Technical overview of Flexi EDGE BTS

This section gives a technical overview of Nokia Flexi EDGE BTS.

Introduction

Nokia Flexi EDGE BTS is a modular base station for GSM/EDGE capacity and coverage. Its modular design makes site acquisition and installation easier, reducing the time needed for rolling out network coverage in a new area. Nokia Flexi EDGE BTS allows using existing site space sparingly and efficiently.

Nokia Flexi EDGE BTS introduces GSM/EDGE modules to the Nokia Flexi BTS family. Nokia Flexi EDGE BTS is based on the same Nokia Flexi platform as Nokia Flexi WCDMA BTS, enabling efficient multiradio sites including GSM/EDGE and WCDMA/HSPA and other radio technologies such as WiMAX in the future.

Easy installation

With Nokia Flexi EDGE BTS, weatherproof modules and casings are used to build base stations and a dedicated BTS cabinet is not necessary. The modules used without a cabinet are environmentally protected (IP55 compliant) and, due to a broad operational temperature range, suitable for varied climatic conditions. A fully functional macrocellular BTS consists of only two logical modules which can be carried by one person. Capacity can be expanded simply by adding modules. With Flexi EDGE BTS, it is possible to upgrade remotely with the license mechanism, provided the HW required for the configuration is already installed. For example, if an upgrade configuration is installed and one DTRX is split in two sectors as decribed in *Nokia Flexi EDGE Dual TRX Module (EXxA)* section in this document.

The same modules are used in indoor and outdoor sites for macrocellular and microcellular solutions. The modules can be installed on floor, wall, or pole.

Nokia Flexi EDGE BTS also suits well for replacing previous generation BTSs, such as Nokia Talk Family BTSs, 2nd Gen BTSs and other BTSs. The fixings of the plinth in stacked installations or Nokia Flexi cabinet plinth are in the same places as in previous Nokia BTS generations. Nokia Flexi EDGE BTS modules can also be installed into existing site support cabinets having 19 inch space available and where cooling requirements are fulfilled.
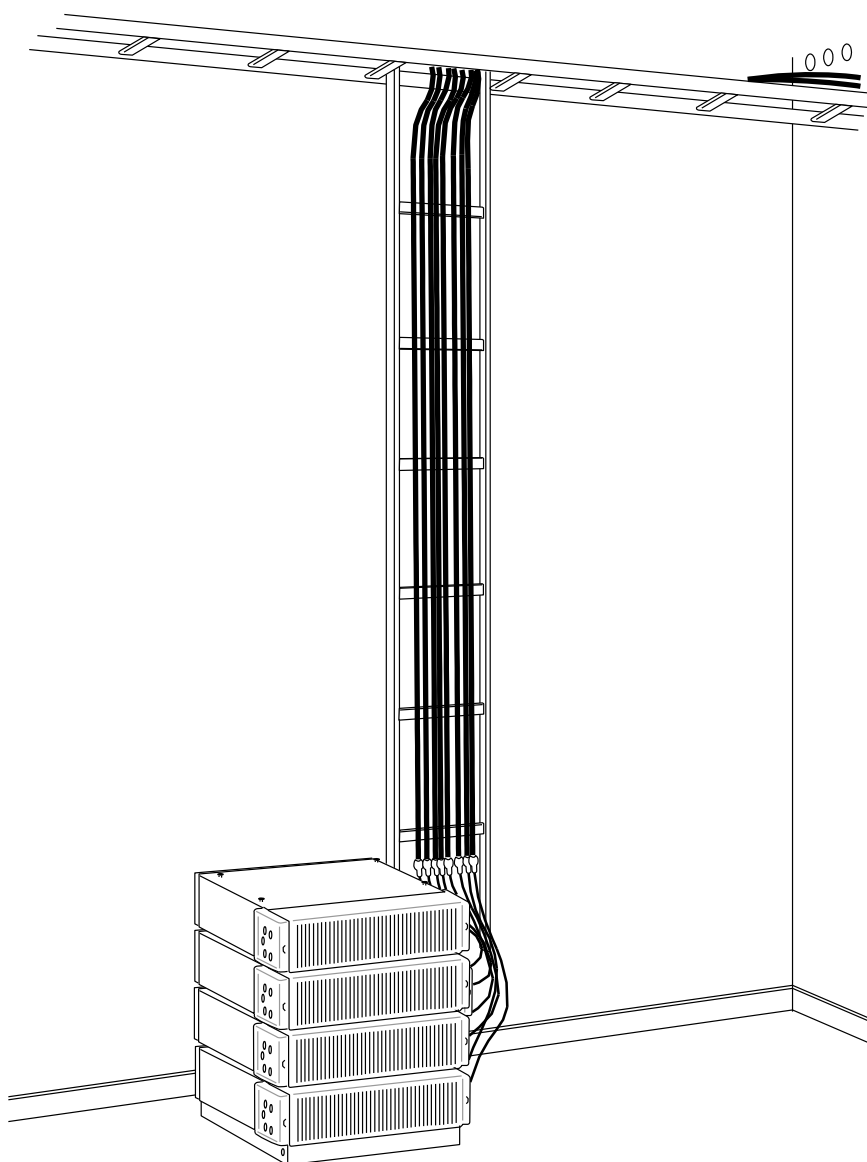
Figure 3.   An example of 2+2+2 floor installation

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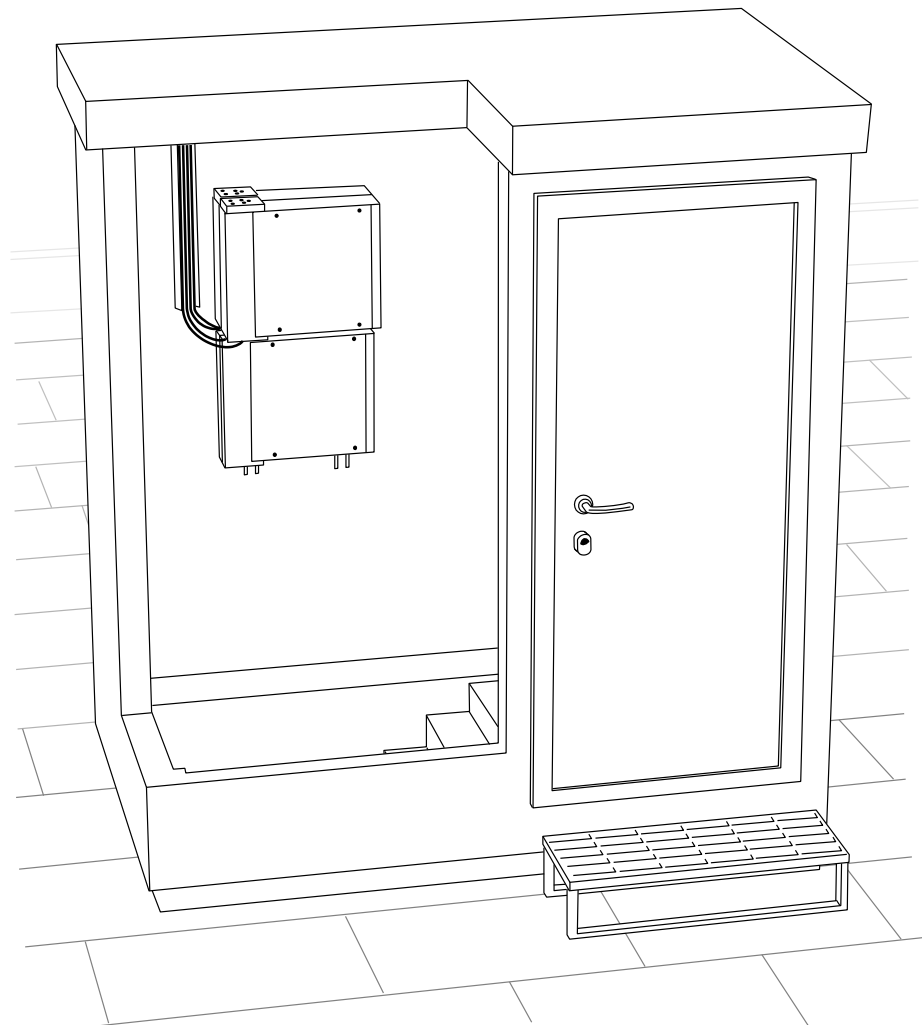
Figure 4.   An example of wall installation
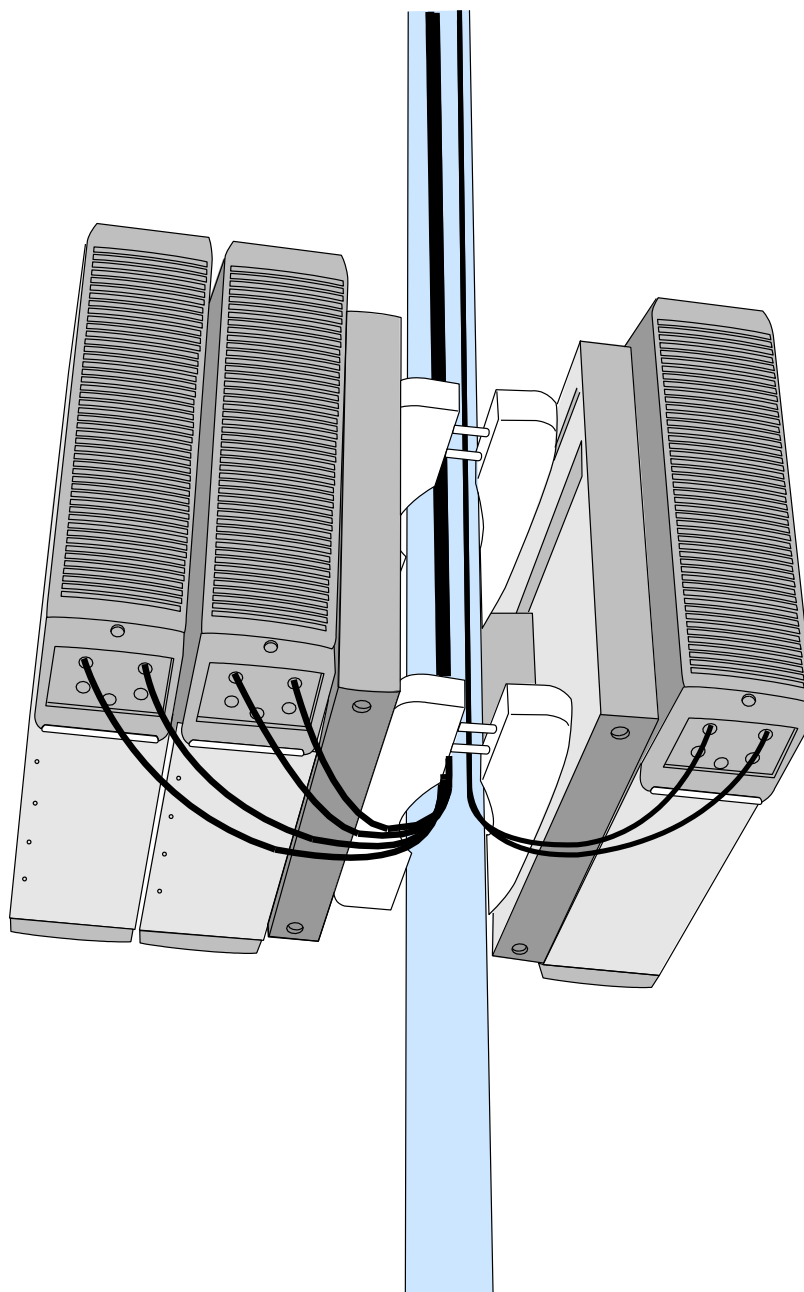
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Figure 5.   An example of pole installation

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Optional Nokia Flexi cabinets are available for indoor and outdoor sites. Nokia Flexi EDGE BTS allows effective use of BTS footprint supporting expansion to up to 24 TRX per cabinet when HW is considered. The modules may also be installed in older BTS (for example Nokia CityTalk BTS) or site support cabinets or in standard 19" racks, when space and cooling allows. However, installation in site support ExtraTalk is not recommended. Installation in CityTalk outdoor cabinet can only be implemented with an optional HW kit.

Capacity and performance

Nokia Flexi EDGE BTS is highly integrated. For example, it supports up to 24 TRXs (12 Dual TRXs) in the volume of a traditional single BTS cabinet. There is virtually no limit to site capacity, due to synchronised Nokia Flexi EDGE BTS chaining.

Nokia Flexi EDGE BTS provides top-of-class RF performance with balanced link, similar to existing Nokia UltraSite EDGE BTS. In standard Capacity mode, it provides TRX output power of 47 dBm and system sensitivity of -115.5 dBm. Double Power TRX and coverage features secure an even higher performance for coverage-limited environments.

Increased speed of network roll-out and reduced operating costs

Nokia Flexi EDGE BTS can minimise BTS site rental costs as a BTS-specific cabinet is no longer needed. The floor space required for large configurations is reduced, or in case of wall installation, not needed at all. The existing site support and auxiliary cabinets with sufficient space and cooling can be used to house the modules, further increasing the efficiency of site space.

When it comes to rectifier and battery maintenance, the reduced power consumption enables the use of smaller power systems with fewer batteries. If lithium batteries are used, the maintenance interval is longer. The traditional batteries require regular maintenance twice a year.

When it comes to site maintenance, there are advantages compared to the current BTS solutions. Diesel generators need to be started less frequently, as the batteries supply the base station for a longer period of time compared to old BTSs. New installation options make it possible to install the base stations to places that are better protected against vandalism and natural catastrophes. This means that less shelter maintenance is required.

Common Nokia Flexi platform for efficient multiradio sites

Common Nokia Flexi multimode platform for GSM/EDGE and WCDMA/ HSPA ensures that high capacity multimode sites can be built smoothly and cost-effectively. Evolution from GSM/EDGE to WCDMA/HSPA and to further radio technologies such as WiMAX can be ensured rapidly and with minimal effort.

With Nokia Flexi platform, the site design and capacity expansion principles are the same. GSM/EDGE and WCDMA/HSPA modules are the same size and follow the same installation principles, which increases efficiency, as the same installation teams can be used for different radio technologies. The modules can be installed into the same stack or they can share the same BTS cabinet. Battery backup systems (BBU), site accessories, and transmission can also be shared.

5 Construction and modules

5.1 Main modules

A functional Nokia Flexi EDGE BTS can be built with just two logical modules: Nokia Flexi EDGE System Module and Nokia Flexi EDGE Sector Module. The Sector Module is a logical unit consisting of two building blocks: Dual TRX Module (DTRX) and Dual Duplexer Module. Typically one Sector Module is needed per sector. Sector extensions are done just by adding more Dual TRXs and optional Wideband Combiners (WBCs). Another option is to use the Remote Tune Combiner Module together with Dual TRX Modules; the Dual Duplexer Module is then not needed.

5.1.1 Nokia Flexi EDGE System Module (ESMA)

The System Module is a unit providing BTS common functionalities and external and internal connections for the whole BTS. The BTS software is stored in the System Module.

The System Module also receives and stores the unit identification information of all other units of the BTS. The System Module supports configurations to up to 12 TRXs. For larger configurations, the System Extension Module is used.

The main functions of the System Module are:

- BTS O&M

- BTS integrated transport

- System bus control and module synchronisation

- Power distribution (48 VDC) to other modules

5.1.2 Nokia Flexi EDGE Dual TRX Module (EXxA)

The Dual TRX Module (DTRX) is a two-carrier TRX unit. The module contains the common (2 carrier) baseband part and two separate RF parts for two transceivers (transmitter and receiver chains) and space for two optional Wideband Combiners (WBC).

The Dual TRX Module is used as:

- a combined module with the Dual Duplexer Module, making a logical Sector Module

- or a stand-alone TRX module with the Remote Tune Combiner (RTC) module

- or a stand-alone extension TRX module.

The Dual TRX Module and System Module communication is managed through a single Ethernet interface. Each transceiver within the Dual TRX Module can be separately activated with a licence key at the BSC.

The Dual TRX Module contains two transceivers that can be used:

- as a separate TRX in the same sector (TRXs in the Sector Module are always in the same sector),

- as a separate TRX in different sectors (the TRX in the extension Dual TRX Module can be connected to two sectors via different Sector Modules)

- or as a Double Power TRX (synchronised combining of transmitters of both TRXs gives a TRX with double output power and single TRX capacity).

There are separate Dual TRX Modules for each frequency band that Nokia Flexi EDGE BTS supports:

- EXTA – GSM800

- EXGA – GSM900

- EXDA – GSM1800

- EXPA – GSM1900

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5.1.3 Nokia Flexi EDGE Dual Duplexer Module (ERxA)

The Dual Duplexer Module and the Dual TRX Module create one Sector Module. A minimum of one Dual Duplexer Module is needed per sector to enable diversity. The Dual Duplexer Module is always attached to the Dual TRX Module, which provides the Dual Duplexer Module with power feeding and O&M link. Extension Dual TRX Modules are installed without the Dual Duplexer Module.

The role of the Dual Duplexer Module is to provide the duplex functionality to combine TX and RX signals in a common antenna feeder. The Dual Duplexer Module provides two antenna connections (configured from 1 or 2 sectors) of Nokia Flexi EDGE BTS for by-pass and wideband combined configurations. The Dual Duplexer Module supports antenna sharing (co-siting) with another BTS.

The Dual Duplexer Module contains two duplex filters: two Low Noise Amplifiers (LNAs), two Bias-Ts, voltage standing wave ratio (VSWR) measurement functionality, and a common TRX loop for TRXs in one sector. The TRX loop is controlled through the Sector Module.

As Bias-T and VSWR measurement functionality is now integrated in the Dual Duplexer Module, a separate unit on top of BTS cabinets common in traditional solutions is no longer needed.

The LNAs have high and low gain states for supporting both high gain Nokia Mast Head Amplifiers (MHA) as well as more traditional MHAs.

There is a separate Dual Duplexer Module for each frequency band:

- ERTA – GSM800

- ERGA – GSM900 full band

- ERHA – GSM900 SB-H

- ERJA – GSM900 SB-J

- ERDA – GSM1800 full band

- ERPA – GSM1900 full band

5.2 Optional modules

This section describes the optional modules in Nokia Flexi EDGE BTS.

5.2.1 Flexi EDGE Wideband Combiner Sub-module (EWxx)

Two optional Wideband Combiner (WBC) Sub-modules can be attached to the Dual TRX Module. One Wideband Combiner combines two TX signals together. The module can be used for combining carriers that have the same or different frequencies. Double power TRX uses same frequencies.

5.2.2 Flexi EDGE Remote Tune Combiner (Cavity Combiner) Module (ECxA)

The optional Remote Tune Combiner (RTC) Module combines up to six TX signals from the Dual TRX Modules together into a single TX antenna with a minimum loss in large configurations. It also provides the antenna connections for duplexed RX and TX signals, as well as antenna connection for RX diversity signal. The Remote Tune Combiner Module is always used together with Dual TRX Modules; the Dual Duplexer Module is then not needed. The System Extension Module is needed with the Remote Tune Combiner Module. The Remote Tune Combiner Module supports antenna sharing (co-siting) with another BTS.

The Remote Tune Combiner Module contains one duplex filter and one RX filter: two Low Noise Amplifiers (LNAs), two Bias-Ts, one voltage standing wave ratio (VSWR) measurement functionality in the duplexed branch, and a common TRX loop for TRXs in one sector. The TRX loop is controlled through the Dual TRX. As Bias-T and VSWR measurement functionality is integrated in the RTC Module, a separate unit on top of BTS cabinets common in traditional solutions is no longer needed.

5.2.3 Flexi Power Module (FPMA)

The optional Flexi Power Module (FPMA) includes AC connection box, DC cable set, and a support frame for the actual power sub-modules (FPAA and FPBA).

5.2.3.1 Flexi Power AC-DC Sub-Module (FPAA)

The main function of the FPAA is to provide the BTS modules with 48 V DC power from AC supply. The FPMA can house up to four AC/DC rectifiers, each having output power of 1 kW 48 V DC power.

5.2.3.2 Flexi Power Battery Sub-Module (FPBA)

The Flexi Power Battery Sub-Module (FPBA) is a separate optional sub-module used together with the AC-DC Module (FPAA). The FPMA can house up to three Battery sub-modules.

5.2.4 Flexi Power DC/DC 24 V Module (FPDA)

The function of the optional Power DC/DC converter (FPDA) is to generate BTS internal 48 V DC power from the external 24 V DC supply. The FPDA is a stand-alone 2 kW DC/DC converter.

5.2.5 Flexi EDGE System Extension Module (ESEA)

A System Extension Module is required for large Nokia Flexi EDGE BTS configurations (more than 12 TRX), and always in RTC configurations. The functionalities of the System Extension Module are:

- Handling the power distribution for additional modules (from the seventh Dual TRX Module). The power distribution unit has six 48V outputs.

- Providing all 12 Ethernet and synchronisation connections to the Dual TRX Module and a connection to the System Module.

5.2.6 Flexi System External Alarm Module (FSEB)

The System Module has 12 external alarm inputs and 6 control outputs. An optional System External Alarm Module is used when up to 24 external alarm inputs and 6 control outputs need to be supported with Nokia Flexi EDGE BTS.

The System External Alarm Module is connected to the EAC interface in the System Module. The System External Alarm Module provides ingress-protected screw terminals for the single alarm and control lines.

5.3 Optional cabinets

Nokia Flexi EDGE BTS modules can be installed in optional indoor and outdoor BTS cabinets. The capacity can be smoothly expanded from one TRX up to 24 TRX per single cabinet. The carriers come in groups of two (two carriers per Dual TRX). With licensing keys (pooled at the BSC), it is possible to employ a single TRX of the DTRX module if necessary.

The same optional cabinets can house Nokia Flexi WCDMA and BBU modules. Therefore, it is possible to build GSM/EDGE, WCDMA/HSPA or multiradio (GSM/EDGE/WCDMA/HSPA) configurations.

5.3.1 Flexi Cabinet for Outdoor (FCOA)

Nokia Flexi BTS outdoor cabinet is an optional sales item for new sites where a cabinet is needed. It includes a lock and a door alarm switch that is connected to the BTS System Module EAC connector. The outdoor cabinet can also be used in indoor locations where a low, locked multi-purpose equipment cabinet is needed.

The optional outdoor cabinet can include the following optional items:

- Outdoor Site Support Module (FCSA)

- Integrated battery back up unit (IBBU)

- Air filter (FCFA)

- Heat detector (FCDA)

- EAC and Over-voltage Protector (OVP) connection box (FSEB)

5.3.2 Flexi Cabinet for Indoor (FCIA)

Nokia Flexi BTS indoor cabinet is an optional sales item for new indoor sites where a cabinet is needed.

The optional indoor cabinet can include the following optional items:

- Heat detector (FCDA)

- EAC and Over-voltage Protector (OVP) connection box (FSEB)

5.4 Optional items

This section describes the optional items in Flexi EDGE BTS.

5.4.1 Flexi Module Casings (EMxA)

Optional Nokia Flexi Module Casings (EMxA) are used to fix the modules to floor, wall, or pole. Module casings enable module replacement without the need to completely dismantle the BTS installation and ensure environmental protection (IP55) against different environments.

5.4.2 Flexi Mounting Kits for floor, wall, and pole (FMFA and FMPA)

Flexi mounting kits for floor and wall (FMFA), and pole (FMPA) are plinths that are needed when modules are installed without a cabinet. The plinth provides grounding points for BTS and module grounding.

5.4.3 Pole Mounting Kit (WPMB)

The pole mounting kit enables BTS installation on a pole 60 - 300 mm (2.4 - 11.8 in.) in diameter.

5.4.4 Flexi Mounting Covers for Back and Front (FMCB)

Flexi mounting covers for back and front is an optional 2U (FMCB) module cover that is required in FPDA installations without a cabinet. The primary functions of the covers are to provide protection against wind-driven rain, visual protection, and mechanical protection for the cables. Furthermore, the back cover protects the installer's fingers from the rotating fans.

5.4.5 Flexi Cabinet Air Filter (FCFA)

An optional Nokia Flexi Cabinet Air Filter (FCFA) is available for the Nokia EDGE BTS Outdoor cabinet to filter items such as salt, dust and insects out of the fresh air through the cabinet cooling input. A cabinet filter is required on oceanic and coastal areas where salt deposition is high.

5.4.6 Flexi Cabinet Heat Detector (FCDA)

An optional Nokia Flexi Cabinet Heat Detector (FCDA) is available for Nokia Flexi Cabinet for Outdoor. It is connected to one of the BTS EAC alarm lines.

5.4.7 Talk Conversion Kit (EMIA)

Nokia Flexi EDGE BTS modules can be installed into the CityTalk cabinet by using the Talk conversion kit EMIA. The inner parts of the CityTalk cabinet will be stripped out before the Nokia Flexi EDGE BTS modules are installed and certain parts of the CityTalk cabinet will be replaced with new parts belonging to the EMIA kit.

5.4.8 Upgrade Cable Kit (EUCA)

The Upgrade Cable Kit is used for the stack 4+4+4 expansion case or custom configurations requiring extra long RF cables. It can also be used for 12+12+12 RTC with two cabinets.

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6 Applications and configurations

6.1 Capacity solutions

In urban and suburban areas, operators typically provide the mobile services, including voice and data, from high capacity macrocellular sites. In urban environments, large mobile traffic hot spots must be covered, often requiring very high site configurations. In suburban locations, there is a simultaneous need for high capacity and cost-effective area coverage. The radio equipment best suited for these locations has excellent radio performance. In addition, it has the ability to expand smoothly from small to very large capacities, using the site space sparingly in order to keep site-running costs at minimum.

Nokia Flexi EDGE BTS allows building very high capacity macrocellular sites, taking only little site space even with large configurations. Up to 24 TRX configurations can be built in the volume of a traditional BTS and with one BCF object.

The carrier capacity of Nokia Flexi EDGE BTS can be flexibly dimensioned according to the expected traffic by increasing the number of Dual TRX Modules. Each Dual TRX Module supports two GSM/EDGE TRXs. When expanding capacity, the two TRXs in one Dual TRX Module can be connected to different sectors. With licence keys, it is possible to commission a single TRX of the DTRX module if necessary.

Nokia Flexi EDGE BTS offers flexible combining options to increase the BTS capacity without a need to add the number of BTS antennas.

Transport capacity can be configured independently of the air interface capacity. This enables building initial coverage with limited capacity transmission infrastructure.

Nokia Flexi EDGE BTS supports virtually unlimited site capacity. Up to nine BCFs can be chained.

6.2   Coverage solutions

In case of initial deployment of GSM/EDGE network in a new coverage area, operators usually seek maximum cost efficiency and wish to minimise the number of BTS sites required. This can be achieved by optimising the radio performance of the BTS for coverage. In a wireless network, the BTS uplink and downlink performance should be balanced. In order to increase coverage, both need to be improved so that neither of them is limiting the coverage.

In Coverage mode (CoM), Nokia Flexi EDGE BTS supports several options for enhancing both downlink and uplink in order to boost cell size and reduce the number of sites per coverage area.

Double Power TRX and 2-way uplink diversity

Double Power TRX (DPTRX) doubles the TRX output power by synchronisously combining the two transmitters of the Dual TRX. The Double Power TRX has a single TRX capacity.

The solution can be supported with one Dual TRX module and two antennas/sector (TX/RX and RX): one TX antenna for the Double Power TRX in downlink direction, and two RX antennas for 2-way uplink diversity. Double Power TRX increases the BTS TX output power typically by 2.5 dB, and 2-way uplink diversity with MHA improves the uplink performance.

Double Power TRX and 4-way uplink diversity

For even a bigger improvement in uplink and coverage, the Double Power TRX (DPTRX) can be implemented with 4-way uplink diversity. It requires two Sector modules per sector. This solution requires four antennas: one for transmit/receive and three for receive.

The Double Power TRX with 4-way uplink diversity increases the coverage area by up to 40%, significantly reducing the number of sites needed.

Intelligent Downlink Diversity and 2-way uplink diversity

The intelligent Downlink Diversity feature extends the cell coverage area by sending simultaneously the same downlink signal through two separate transmitters and antennas. IDD provides one logical TRX capacity with two physical TRXs. IDD and 2-way uplink diversity can be implemented with minimum one sector module/sector.

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For downlink, the Intelligent Downlink Diversity feature requires the implementation of a Dual TRX with two TX antennas, and for uplink, 2-way diversity with two RX antennas, meaning that two (2TX/RX) antennas are required. Intelligent Downlink Diversity with 2-way uplink diversity increases the downlink performance by up to 5 dB with two RX antennas, meaning that two (2TX/RX) antennas are required (one X-polarized antenna can also be used).

Nokia Smart Radio Concept (SRC)

The Nokia Smart Radio Concept provides the maximum coverage area from a base station site.

The Smart Radio concept consists of :

- downlink enhancing features: Intelligent Downlink Diversity (IDD)
- uplink enhancing features: Mast Head Amplifier (MHA), Interference Rejection Combining (IRC), 4-way diversity (4UD)

The Nokia Smart Radio Concept can be implemented with 2 sector modules/sector. It is based on Intelligent Downlink Diversity (IDD) and uplink enhancement with MHA and 4-way uplink diversity.

For downlink, it requires the implementation of a Dual TRX Module with two TX antennas, and for uplink, 4-way diversity with four RX antennas, meaning that four (2TX/RX+2RX) antennas are required.

Nokia Smart Radio Concept results in up to 8-9 dBm coverage gain in suitable conditions. The average gain is 5 dBm compared to using no diversity. With Nokia Smart Radio Concept, up to 50% less sites are required for building coverage.

Extended Cell Range

The maximum supported cell range is normally 35 km. With the Extended Cell feature, the maximum cell range is extended up to 70 km. The Extended Cell feature in Nokia Flexi EDGE BTS is based on the same method as in Nokia UltraSite EDGE BTS, that is, the delayed reception of the signal. This means that it provides the same capacity as the normal range TRX, and minimum traffic capacity is wasted. The Extended Cell feature can be used to efficiently provide coverage in coastal and rural areas where high capacity or high data rates are not needed.

Mast Head Amplifier (MHA)

The Mast Head Amplifier is located next to the antenna which uses Low Noise Amplifier (LNA) to improve the receiver performance by reducing the noise figure and compensating the antenna line losses. Mast Head Amplifier support (power feed, alarms) is integrated in the Duplex Filter and alarms are generated based on adjustable MHA current consumption window. Nokia Flexi EDGE BTS supports Mast Head Amplifiers with duplexed or only RX antenna feeders.

Both high gain (32/33dB) and low gain (12dB) Mast Head Amplifiers are supported. When using a high gain Mast Head Amplifier, the LNA gain in the RF Dual Duplexer Module or the Cavity Combiner Module can be adjusted to match the overall RX chain gain and thus to provide the optimum performance. Sensitivity and nominal error rate (NER) match Nokia UltraSite EDGE BTS performance when compensating for the feeder loss with a high gain Mast Head Amplifier.

6.3 Configurations and site expansion

Nokia Flexi EDGE BTS is optimised for high capacity as well as high coverage for macrocellular applications. It also enables evolution paths by providing a flexible expansion capability. It is possible to expand sector by sector so that traffic in only one sector is impacted at the time, and the traffic in the whole BTS is not affected.

Modules can be used as such without a cabinet, or with an indoor or outdoor cabinet according to prevailing conditions. The carrier capacity of Nokia Flexi EDGE BTS can be flexibly dimensioned according to the expected traffic by increasing in a number of TRX modules. Each Dual TRX module supports two GSM/EDGE carriers.

Nokia Flexi EDGE BTS offers flexible combining options to increase the BTS capacity without a need to increase the number of BTS antennas. There are also combining options to maximise the cell coverage or capacity.

Nokia Flexi EDGE BTS supports:

- 1 ... 6 sectors

- Up to 24 carriers/BCF

- Up to nine cabinets can be synchronised with the Multi BCF feature

- Multiple TX antennas for any sector and band

- TX combining to minimise the number of antennas and to maximise coverage and capacity:
  - Double Power TRX
  - By-pass combining
  - 2-way combining
  - 4-way combining
  - 6-way Remote Tune Combining (RTC)
  - Intelligent Downlink Diversity (IDD)
- Supported dual band BTS configurations:
  - GSM900/1800
  - GSM800/1800
  - GSM800/1900

The same Nokia Flexi BTS cabinets and common electro-mechanics support multiradio configurations. In addition to symmetrical configurations between the sectors, also unsymmetrical combinations, such as 1+2+3, are supported.

6.4 Transmission

This section describes Flexi EDGE BTS transmission.

6.4.1 Network topologies

Various different transmission network topologies are supported:

- point-to-point
- chain
- loop
- star

Transmission grooming down to 16 kbit/s level is supported, as well as Nokia PDH loop protection.

6.4.2 Transmission interfaces

Nokia Flexi EDGE BTS supports different transmission sub-modules depending on the interface used. There are four different network interface alternatives:

- E1 symmetric

- T1 symmetric

- E1 asymmetric

- Nokia FlexBus for Nokia microwave radios

The interfaces come as three separate plug-in sub-module variants inserted into the System Module. There is space for one transmission sub-module in the System Module. The following table summarises the physical interfaces that the System Module integrated transport supports.

Table 4.   Alternative transport sub-modules and supported interfaces

Sub-module type	Interface	Number of interfaces per System Module
E1/T1 transmission sub-module (FIPA)	E1/T1 (symmetric)	8
E1 transmission sub-module (FIEA)	E1 (asymmetric)	8
FlexBus transmission sub-module (FIFA)	FlexBus (integrated coaxial copper interfaces for Nokia microwave radios)	2

The existing FIU 19 or new FlexiHub can be used as a transmission hub for Nokia Flexi BTS product family.

Transmission sharing in co-sited Nokia Flexi EDGE BTS and Nokia Flexi WCDMA BTS is described in *Nokia Flexi EDGE BTS Co-siting*.

6.5   Management and software

Nokia Flexi EDGE BTS is managed from Nokia NetAct™ via the BSC or by a remote or local Nokia Flexi EDGE BTS Element Manager.

6.5.1   Nokia Flexi EDGE BTS Element Manager

Nokia Flexi EDGE BTS Element Manager software is used for local and remote management and for controlling the BTS and the E1/T1 transport. The main functions of the manager are:

- BTS commissioning

- BTS supervision

- BTS maintenance

- BTS testing

Nokia Flexi EDGE BTS Element Manager is running on a laptop PC on the latest Windows OSs (Windows 2000 or later version). It starts and runs as a single application. Nokia Flexi EDGE BTS Element Manager can be connected locally to an Ethernet port on the BTS or it can be connected remotely to the BTS from Nokia NetAct™.

6.5.2   Software updates

Nokia Flexi EDGE BTS only uses downloadable SW. The software can be loaded either locally, with the element manager software, or remotely from Nokia NetAct™. Site visits are unnecessary for routine O&M tasks.

All software can be downloaded and updated from Nokia NetAct™. This procedure is centralised, meaning that several BTSs can be upgraded with the new software either simultaneously or one by one, depending on what the operator prefers. Nokia Flexi EDGE BTS software can be downloaded as a background operation without interrupting the operation of the BTS. The new software can be activated at any time suitable for the operator.

Typically, local software downloading is done only when the Nokia NetAct™ connection is missing, for instance during commissioning.

Nokia Flexi EDGE BTS can store two software packages in its memory; the current software package and the old software package. Either of these software versions can be activated at any time.

6.5.3   TRX licensing

Dual TRX capacity licensing is handled from the BSC. Nokia Flexi EDGE BTS enables TRX licence handling with the BSC. Each BSC has a pool of TRXs that can be allocated to the BTSs. If the relevant TRX cabling is already done, an unused TRX can be brought into service without a site visit. Double Power TRX is also a licensed feature, controlled by the BSC.

7 Co-siting

Nokia Flexi EDGE BTS can be co-sited with the following BTSs:

* Nokia Flexi WCDMA BTS

* Nokia UltraSite WCDMA BTS

* Nokia UltraSite EDGE BTS

In addition, Nokia Flexi EDGE BTS can also be co-located with Nokia and other vendors' GSM or WCDMA BTSs on a shared site. Nokia Flexi EDGE BTS also supports the use of existing site support systems in co-located cases.

7.1 Multiradio sites with Nokia Flexi WCDMA BTS

Nokia Flexi EDGE BTS and Nokia Flexi WCDMA BTS use the same platform, which allows building cost-efficient multiradio sites. The common platform offers the following benefits in addition to efficient and flexible multiradio sites:

Common installation principles

The installation requirements are the same. GSM/EDGE and WCDMA/ HSPA modules can be installed into the same stack and they can share the same BTS cabinet. Common installation kits and accessories can be used.

Common powering principles

The same connection types and power supply types can be used. Nokia Flexi EDGE BTS and Nokia Flexi WCDMA BTS utilise the same Nokia Flexi power modules and can share the same site support system.

Transmission

There are a number of options for sharing transmission capacity with the Nokia Flexi EDGE BTS and Nokia Flexi WCDMA BTS.

The BTSs can be interconnected with the n x E1/T1 or Nokia FlexBus connection. The BTSs share a common physical transmission connection, but separate logical E1/T1-level connection to the upper network layer (BSC and RNC).

If the GSM/EDGE BTS is used for TDM transmission connection to the upper network layer, IMA can be used for n x E1/T1 WCDMA ATM transport. In GSM/EDGE network, E1/T1 TDM transport is usually used if the WCDMA BTS provides the physical connection. If the ATM connection is used all the way to the site, circuit emulation service (CES) can be used for GSM/EDGE traffic.

Antennas

Antenna line sharing with Nokia Flexi WCDMA BTS can be arranged with a diplexer for combining and splitting of different antenna signals, if different frequency bands are used for GMS/EDGE and WCDMA/HSPA traffic.

7.2   Co-siting with Nokia UltraSite BTS

Nokia Flexi EDGE BTS can be co-sited with Nokia UltraSite EDGE BTS. Nokia UltraSite EDGE and Nokia Flexi EDGE BTS can be chained to form a synchronised BTS site. Nokia UltraSite EDGE BTS Site Support cabinet can be shared between Nokia UltraSite EDGE or UltraSite WCDMA BTS and Nokia Flexi EDGE BTS. Battery backup systems can also be shared, provided that the power feeding and backup capacity of the BBU is adequate.

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8 Technical data

8.1 Operating range

The operating ranges of Nokia Flexi EDGE BTS are shown in the table below.

Table 5. Operating range

Property	Temperature
Low air temperature limit	-35 °C (-31 °F)
High ambient air temperature limit (temporary)	+55 °C (131 °F)
High ambient air temperature limit with guaranteed performance	+50 °C (122 °F)

8.2 BTS power consumption

Table 6. Power consumption of Nokia Flexi EDGE BTS with 2-way uplink diversity

Site configuration	Combining method	Power consumption (W)		
		Frequency band		
		800 and 900	1800	1900
1+1	By-pass	480	520	540
2+2+2	By-pass	1055	1160	1220
8+8+8	4-way	3795	4215	4455

8.3 RF performance

The RF performance of Nokia Flexi EDGE BTS is specified at the antenna ports of the Dual Duplexer Module (ERxA) or Remote Tune Combiner Module (ECxA).

Table 7. RF performance of Nokia Flexi EDGE BTS

BTS receiver sensitivity, with Nokia High Gain MHA	Sensitivity 800/900/1900 (dBm)	Sensitivity 1800 (dBm)
4-way diversity	-118	-118.5
2-way diversity	-115.5	-116
Single branch	-112.5	-113

8.4 Compliance with EMC, RF and safety

In Europe, this means compliance with Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

In other market areas additional compliance is fulfilled according to relevant authority requirements.

EMC emission

- ETSI EN 301 489-1: Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements.

- ETSI EN 301 489-8: Part 8: Specific conditions for GSM base stations.

- EN55022: "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".

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- FCC Code of Federal Regulations (CFR) 47, Part 15 "Radio Frequency Devices".

- ICES-003: Digital Apparatus.

EMC immunity

- ETSI EN 301 489-1: "Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements".

- ETSI EN 301 489-8: Part 8: Specific conditions for GSM base stations.

- IEC 1000-4-9: Pulse magnetic field immunity test.

- IEC 1000-4-8: "Electromagnetic Compatibility (EMC) Part 4. Testing and measurement techniques Section 8: Power frequency magnetic field immunity test, Basic EMC Publication".

RF

- ETSI EN 301 502: Harmonized EN for Global System for Mobile communications (GSM) - Base Station and Repeater equipment covering essential requirements under article 3.2 of the R&TTE directive.

- FCC Code of Federal Regulations (CFR) 47, Part 22 "Public Mobile Services".

- FCC Code of Federal Regulations (CFR) 47, Part 24 "Personal Communication Services".

- FCC Code of Federal Regulations (CFR) 47, Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations".

- RSS-132: 800 MHz Cellular Telephones Employing New Technologies.

- RSS-133: 2 GHz Personal Communication Services.

Safety

- IEC 60950-1/ EN 60950-1: "Safety of Information Technology equipment including electrical business equipment".

- EN 50383: Basic standard for the calculation and measurement of the electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunications system (110 MHz - 40 GHz).

- EN 50384: Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunications systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) - Occupational.

- EN 50385: Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunications systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) - General public.

- UL 60950-1: Safety of Information Technology Equipment.

- CSA C22.2 No. 60950-00: Safety of Information Technology Equipment.

9   Product Description for FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS

9.1   Overview of FIFA Flexbus Transmission sub-module

FIFA Flexbus Transmission sub-module for Nokia Flexi EDGE BTS (later referred to as FIFA) provides radio transmission interface functionality and power supply and control to Nokia microwave radios. FIFA is an optional sub-module. In this document Nokia FlexiHopper (Plus) refers to all Nokia FlexiHopper microwave radios.

FIFA allows the operator to connect Nokia Flexi EDGE BTS to any microwave radio unit with a Flexbus interface using a single Flexbus cable. The supported microwave radios are Nokia FlexiHopper (Plus) and Nokia MetroHopper microwave radios. Nokia FlexiHopper (Plus) microwave radios support capacities of 2 x 2, 4 x 2, 8 x 2 or 16 x 2 Mbit/s whereas Nokia MetroHopper capacity is fixed to 4 x 2 Mbit/s. See microwave radio documentation for more detailed information about Nokia microwave radios.

FIFA can also be used to connect BTS either to a standalone indoor unit or to another BTS integrated indoor unit. The supported indoor units are FIU19, FIU 19E, FXC RRI, IFUE, and RRIC. FIFA uses 48 VDC derived from backplane and distributes the supply voltage to microwave radios (outdoor units) through a Flexbus cable.

FIFA provides the following external and internal interfaces:

- Two external Flexbus interfaces. The use of second Flexbus interface is a licenced feature.

- Internal 2 Mbit/s interfaces (up to 16) towards Nokia Flexi EDGE System Module (ESMA).

Flexbus 1 can be used without any licence and Flexbus 2 usage requires a separate *Additional Flexbus (FB) interface* licence to be installed.
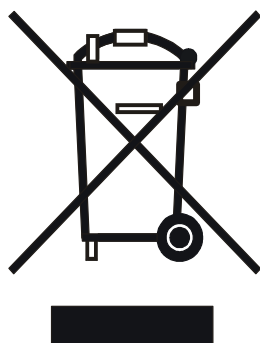
FIFA supports both single and protected operation modes. FIFA and the connected microwave radios are commissioned, monitored, and administered with Nokia FlexiHub Manager.

RoHS compliance, EU

FIFA Flexbus Transmission sub-module for Nokia Flexi EDGE BTS complies with the European Union RoHS Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The standard applies to the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE) in electrical and electronic equipment put on the market after 1 July 2006.

Product collection and disposal within the European Union

Product collection and disposal within the European Union

Do not dispose of the product as unsorted municipal waste. The crossed-out wheeled bin means that at the end of the product's life it must be taken to separate collection.

Note: this is applicable only within the European Union (see WEEE Directive 2002/96/EC)

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FIFA Flexbus Transmission sub-module for Nokia Flexi EDGE BTS complies with the standard SJ/T 11364-2006 in the People's Republic of China on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The standard applies to the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE) in electrical and electronic equipment put on the market after 1 March 2007.

The following figures present FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS.
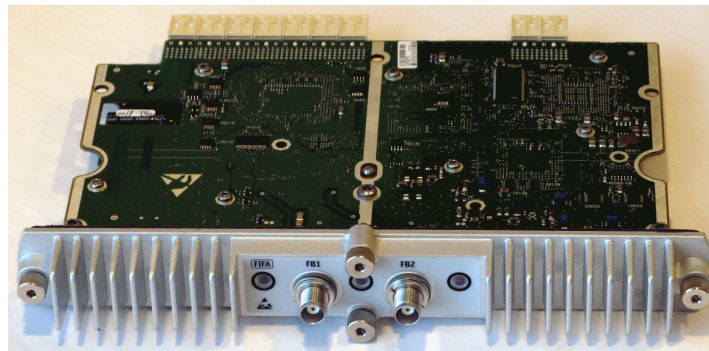
Figure 6.   FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS
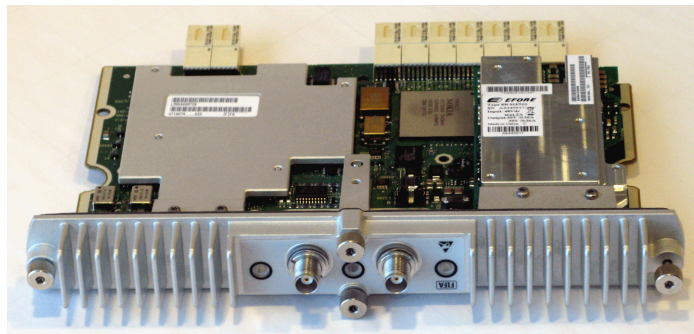
Figure 7. Underside of FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS

The following figure illustrates FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS integrated into Nokia Flexi EDGE System Module (ESMA).

Figure 8. FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS integrated into Nokia Flexi EDGE System Module (ESMA)

9.2 General information

Microwave radio outdoor units are powered through FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS. The Power block generates the +55 V supply voltage from the 48 V input voltage derived from the unit backplane connectors. The outdoor unit power feed is short-circuit protected.

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The power feed can be controlled by Nokia FlexiHub Manager. If the
Flexbus is connected to another indoor unit, the power feed should be
turned off. The Flexbus power feed is also indicated by the front panel
LEDs.

All needed operating voltages of the sub-modules, other than 3.3 V from
the backplane, are generated locally in FIFA.

FIFA implements two identical Flexbus interfaces. The Flexbus interface
consists of the physical interface (Flexbus PHY) and the framing and
deframing (Flexbus interface) blocks. The physical interface implements
the bidirectional coaxial interface including overvoltage and overcurrent
protection. Outdoor unit DC feed is connected in the physical interface.
Overcurrent protection ensures that a short circuit in one Flexbus interface
does not affect the other Flexbus interface or the other functionality of
FIFA.

Flexbus framing block frames data towards the radio path. In the receive
direction data is deframed from the radio frame.

The following signals are framed and deframed:

- 2M signals

- communication channels

- parity bit for Flexbus statistics

- frame alignment word.

The 2M signals are framed to the Flexbus frame with bit stuffing. This
allows clock transparency for all 2M signals.

The 2M cross-connection block cross-connects 2M signals between the
Flexbus interfaces and towards the Nokia Flexi EDGE System Module
(ESMA). Cross-connections are used to drop capacity towards the local
base station and to bypass the rest of the capacity to the next microwave
radio. Cross-connections are managed with Nokia FlexiHub Manager. 2M
level cross-connections in FIFA are transparent, this means that FIFA does
not terminate any 2M signal framings. (Timeslot 0 is not regenerated in
FIFA in any case.)

The control block is processor-based and it controls the functionality of FIFA autonomously. FIFA has memory for two software images. Active software is being executed and at the same time the passive software can be updated either locally or remotely. The passive software is taken into use with Nokia FlexiHub Manager. The control block also calculates G.826 statistics of the received Flexbus signals. The calculation is based on parity errors in the Flexbus frame.

FIFA does not have a separate management connector, it is managed through the Local Management Port (LMP) of the base station.

See *Local management* for more information.

9.3   Protection methods

The protection modes protect the transmission link against equipment failures and disturbances in the radio path. The equipment failures mean degraded transmission quality due to transmitter or receiver defects. The disturbances in the radio path are usually caused by flat or multipath fading that degrades the signal quality in such a way that there are bit errors in the received data or the receiver cannot lock onto the received signal. In single use, the transmission is not protected against equipment failures or propagation disturbances. If a fault occurs, the transmission remains cut until the faulty device is repaired or replaced with a functional one or the disturbance in the radio path disappears.

The protection methods supported with FIFA and Nokia FlexiHopper (Plus) microwave radios are the following:

- hot standby

- hot standby with space diversity

- frequency diversity

- polarisation diversity

Outdoor units are fully protected, but in FIFA only the Flexbus interface is protected.

Nokia MetroHopper only supports single configuration.

In HSB use, both Flexbus interfaces must be active and therefore the *Additional Flexbus (FB) interface* licence must be installed.

9.4   Configuration backup

The Nokia FlexiHopper (Plus) outdoor unit, starting from releases FH
3.3.4, FH 5.2.4, FH 6.6 and FHP 2.6 and Nokia MetroHopper, starting from
release 4.0 as well as FIFA support configuration backup. This feature
makes it possible to create a backup copy of important unit configurations
to other connected units. That information can be restored to recover from
error situations or to quickly commission a unit which has been replaced.

Backups can be made automatically or manually with Nokia FlexiHub
Manager.

The following backup cases are possible:

- Outdoor unit settings are backed up to the indoor unit.

- Indoor unit settings are backed up to all outdoor units.

9.5   Licensing

FIFA has 2 Flexbus interfaces. Flexbus 1 can be used without any licence
and Flexbus 2 usage requires a separate licence.

To activate Flexbus 2 interface an *Additional Flexbus (FB) interface* licence
must be ordered and installed for FIFA.

The file is delivered through Nokia software delivery channels and can
easily be installed either locally or remotely over the Q1 management
channel using Nokia FlexiHub Manager.

Licence is implemented using secure plain text files generated and
authorised by Nokia. If the licence file gets lost or becomes corrupted, the
valid licensed user can get a replacement from Nokia without paying for
the feature twice. The licence is bound to the unit's serial number and
cannot be used in another unit. If FIFA hardware is swapped by Nokia in a
hardware failure case, a new licence file is generated.

Additional Flexbus (FB) interface licence for FIFA is permanent and, once
installed, will not expire.

Note that FIFA includes an introductory time-limited trial licence (60 days)
for the Flexbus 2 interface. Once the licence is bought, the licenced
feature can be activated or deactivated as often as needed.

For more information about Nokia microwave radio licences, see *Nokia FlexiHopper (Plus) Product Documentation*.

9.6 FIFA Flexbus Transmission Sub-module compatibility

FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS is compatible with the following transmission units (product releases).

Indoor units

- FIU 19E 2.1 or later

- FIU 19 4.7.2 or later

- FXC RRI ITN2.2 or later

- AXC 2.7 (IFUE 2.2) or later

- RRIC 3.3-2 or later

- FTFA (FIFA) 1.0 or later

Outdoor units

- Nokia FlexiHopper 3.3.4 or later

- Nokia FlexiHopper 5.2.4 or later

- Nokia FlexiHopper 6.6 or later

- Nokia FlexiHopper 4E1 2.6 or later

- Nokia FlexiHopper Plus 2.6 or later

- Nokia MetroHopper 4.0 or later

9.7 Network applications

FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS is mainly used in macrocellular sites. It can also be used in the microcellular layer when there is a need for higher capacities or longer radio hops.

After the initial rollout phase the required capacity may increase. The capacity of Nokia FlexiHopper (Plus) microwave radios with FIFA are configurable and can be extended up to 16 x 2 Mbit/s as capacity needs grow with the evolving network.

The following figure illustrates an example of transmission in a cellular
network implemented using FIFA.
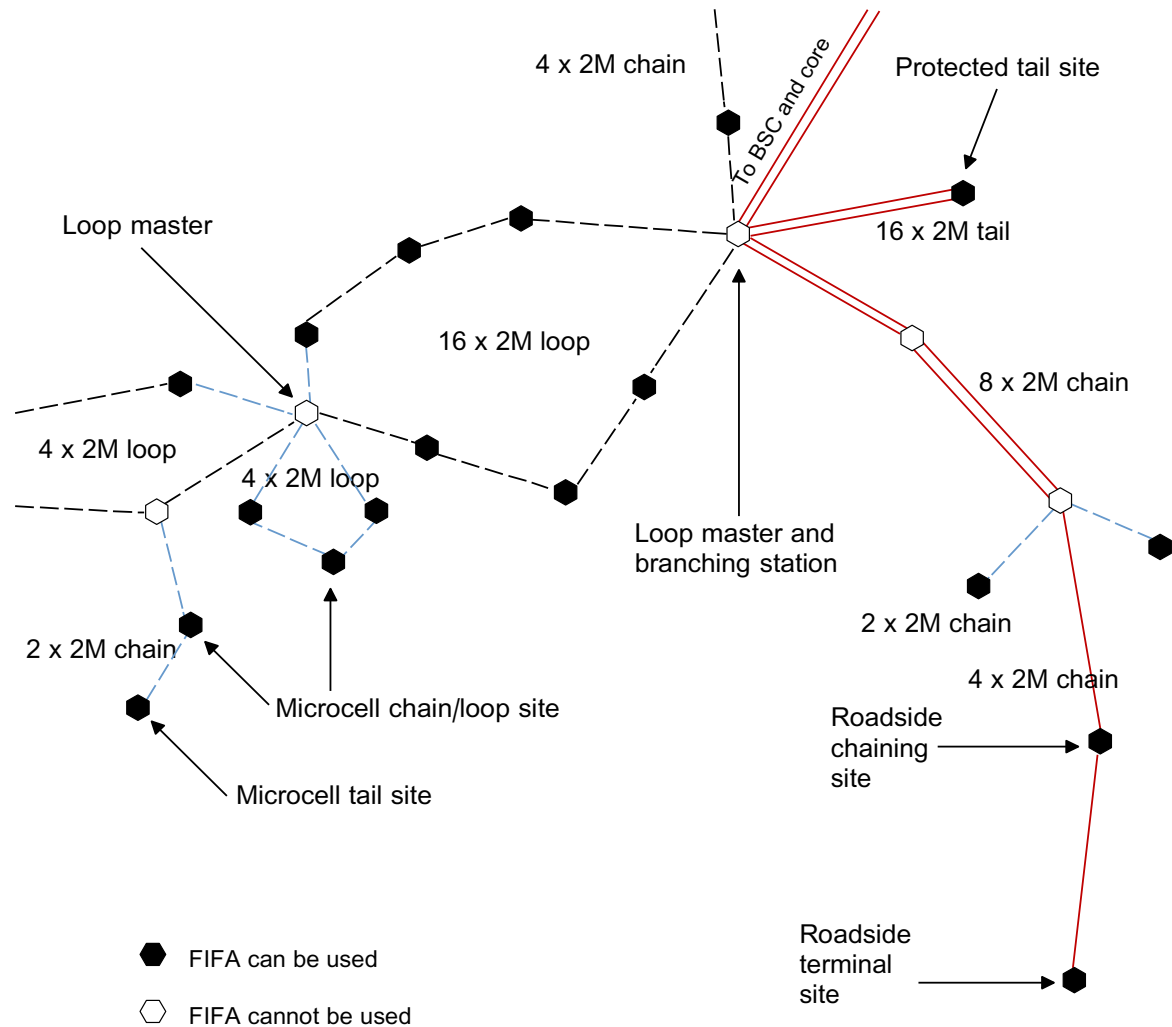
Figure 9.   Example of applications with Nokia Flexi EDGE BTS and FIFA
             Flexbus Transmission Sub-module in cellular network

9.8   Site configurations

Here are some examples of the site configurations which can be
implemented when using FIFA with various outdoor units. The following
figure presents the symbols used for the units.
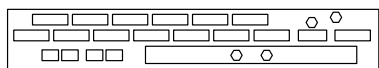
Nokia Flexi EDGE BTS system module with FIFA
Flexbus Transmission Sub-module
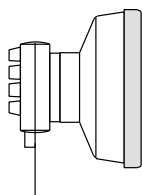
FlexiHopper (Plus) or
MetroHopper microwave radio

Tail site

BTS Site with transmission

Figure 10.   Key symbols

FIFA offers different configuration possibilities. It has a total of two Flexbus
interfaces. Through these interfaces FIFA can be chained to a practical
limit, for example, up to 8 sites. When two outdoor units are connected, the
transmission can be protected.

 Ⓒ Nokia Siemens Networks
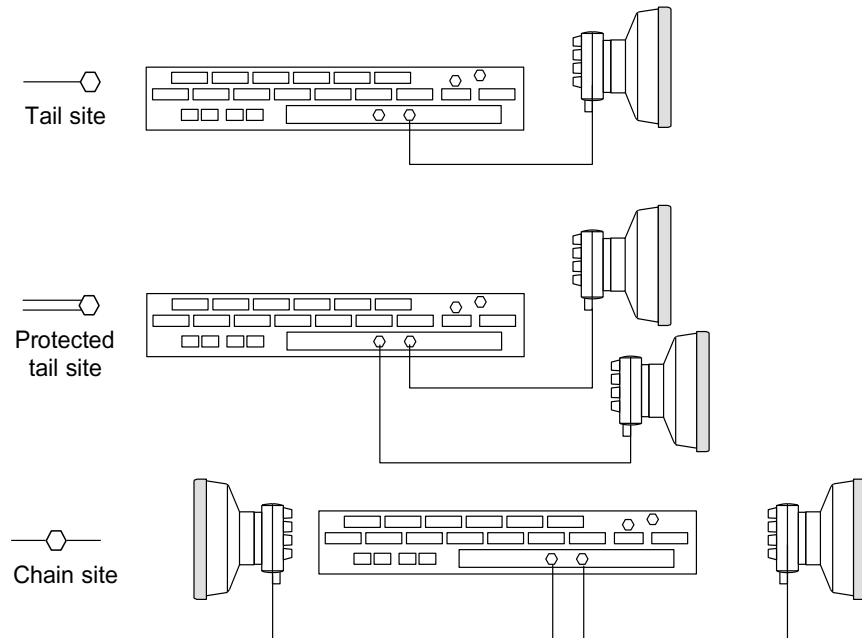
Figure 11.   BTS site configurations

Flexi WCDMA BTS

2G and 3G
tail sites

Flexi EDGE BTS

Flexi WCDMA BTS

2G and 3G
tail sites

Flexi EDGE BTS
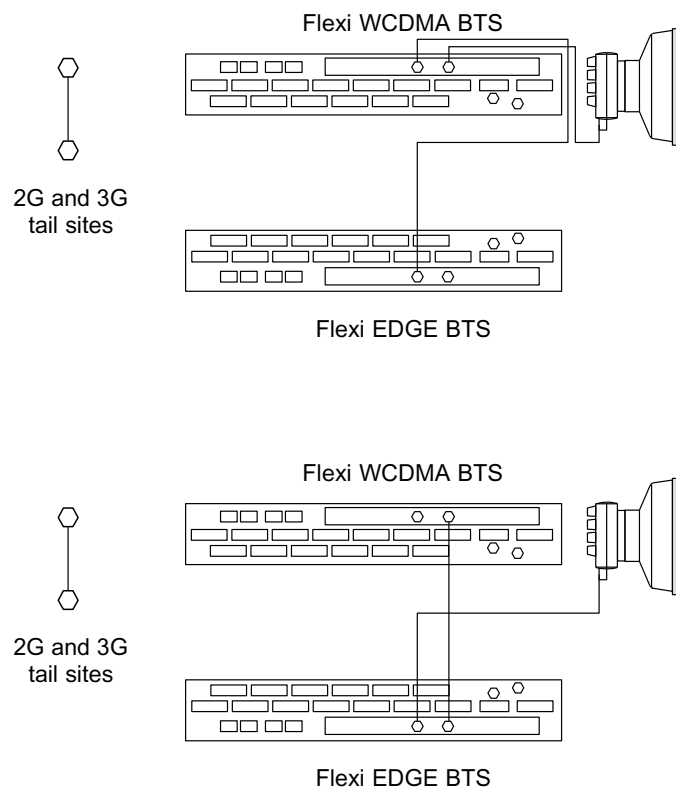
Figure 12.   Co-siting with Nokia Flexi WCDMA BTS and transmission sharing

9.9   Swap cases

This section describes some general cases and procedures for
transmission network evolution where base stations and transmission
elements are updated or replaced.

Typically in these cases base stations and indoor units of microwave
radios are changed, but outdoor units are maintained. Also some of the
configurations and other site related information is maintained.

For detailed information and limitations, see technical documentation and
release notes of the products.

Swap cases are divided into two categories, which are described in the
following.

General

In this category standalone transmission indoor units are replaced with integrated transmission indoor units and Nokia Flexi EDGE BTS transmission unit is replaced with a newer release.

- FIFA -> FIFA (= new release update, see Release Note)

- FIU 19E -> FIFA

2G UltraSite / MetroSite and Nokia Flexi EDGE BTS

In this category 2G UltraSite / MetroSite is replaced with Nokia Flexi EDGE BTS.

- ITN + FXC RRI - > FIFA

Talk BTS and Nokia Flexi EDGE BTS

In this category Talk BTS is replaced with Nokia Flexi EDGE BTS.

- RRIC -> FIFA

9.9.1 Swap procedures

The steps listed in the following should be performed in a swap case.

- Check product releases and their compatibilities. Update the remaining transmission units' software according to the compatibility information.

  For details, see *FIFA Flexbus Transmission Sub-module compatibility*.

- Take configuration backups, in order to save the configuration information for later reference.

  FIU 19(E), RRIC, FXC RRI and IFUE configuration backups are not compatible with FIFA configuration backups. In all swap cases the configuration backups must be done manually with a compatible node manager. The node manager can then be used to display the configuration information, and the relevant configuration data must be entered manually into FIFA using Nokia FlexiHub Manager.

  In case FIFA is updated to a newer release, configuration backup can be used to automatically transfer the configuration information.

- Cut off signals and power down units.

- Replace units.

- Change cabling from older equipment to new equipment. Note that the use of Flexbus Jumper Cable is mandatory.

  For details, see *Mechanical structure and interfaces*.

- Power up and commission new products. Update to new SW release if needed.

- Restore configurations. This must usually be done manually.

- Manually update changed configurations and settings.

- Check transmission functionality and quality.

9.10 Network management using Nokia NetAct

Nokia NetAct is the central network management system for collecting alarms and measurement data from FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS and associated Nokia FlexiHopper (Plus) and Nokia MetroHopper microwave radios in the network. Nokia NetAct also integrates Nokia FlexiHub Manager into the network management system so that configuration management can be performed through Nokia NetAct. Communication between Nokia NetAct and the network element is enabled with Nokia Q1 bus.

The first Nokia NetAct release supporting network management of FIFA is OSS4.1 CD 2.

For more information, see Nokia NetAct documentation.

9.11 Nokia FlexiHub Manager

Nokia FlexiHub Manager is a PC-based software application for controlling and monitoring FIFA and associated Nokia FlexiHopper (Plus) and Nokia MetroHopper microwave radios.

Nokia FlexiHub Manager runs on a PC-compatible computer under Microsoft Windows 98 SE, 2000, XP or Microsoft Windows Server 2003 operating systems.

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Nokia FlexiHub Manager has an easy-to-use graphical user interface with a Commissioning Wizard that guides you through the basic commissioning tasks.

Nokia FlexiHub Manager is 'node manager server' compatible. All 'node manager server' compatible managers can be operated at the same time on a standard PC. Nokia FlexiHub Manager can manage only one node at a time, but several instances of Nokia FlexiHub Manager can be run in parallel to allow management of several nodes simultaneously.

With Nokia FlexiHub Manager you can:

- Commission FIFA and associated radio links.

- Modify already existing configurations.

- Manage 2 Mbit/s cross connections of FIFA. All sub 2 Mbit/s (E1 timeslot / bit) level cross-connections are managed by Nokia Flexi EDGE BTS element manager.

- Monitor the fault status of FIFA.

- Upgrade FIFA software.

- Monitor transmission quality.

- Manage licences related to FIFA and Nokia FlexiHopper (Plus) radios.

Nokia FlexiHub Manager can be connected to FIFA in two different ways:

1. Directly at the site through the Ethernet-based local management port (LMP) or SS port of Nokia Flexi EDGE BTS.

2. Remotely through Nokia Q1 management channels in 2G network.

Nokia FlexiHub Manager is used online. When you use it online, Nokia FlexiHub Manager reads and interprets the information directly from the node and the information can then be easily modified and sent back to the node.

9.12   Local management

The Nokia Flexi EDGE BTS local management port is used for communicating with FIFA locally. The Nokia Flexi EDGE BTS LMP port is an Ethernet-based interface.

Nokia FlexiHub Manager communicates with FIFA using an IP-based protocol.

When connecting locally, the IP address of the PC must be manually configured to the same subnet as FIFA management port. The user must have appropriate Windows access rights to configure the PC's IP address settings. It is recommended that you use IP address 192.168.255.130.

- SS: 192.168.255.126

- LMP: 192.168.255.131

- FIFA: 192.168.255.253

If the LMP port is used, then the PC IP address should be 192.168.254.130 and add routing to PC.

PC command prompt: route add 192.168.255.0 mask 255.255.255.0 192.168.254.129.

9.13   Remote management using Nokia Q1 bus

Q1 bus is used as remote management connection to FIFA.

FIFA has three branches in its Q1 branching bridge: one port towards the BTS and two ports towards the radio interfaces.

Each radio interface has a switch where the user can select whether the Q1 bus is connected to the Q1 channel transmitted in the overhead of the radio frame.

(!) Caution

Careless Q1 bus planning may cause a Q1 bus loop or more than one alarm poller for the same Q1 bus. Take care with Q1 bus planning.

There are two usage scenarios: BTS or BSC polling.

In BTS polling Q1 switch settings must be so that at least the Processor switch is connected so that FIFA can be managed externally. Flexbus switches must be set if a management connection to the far end is needed through a Q1 channel in the radio overhead.

In BSC polling Q1 bus may be carried within a 2 Mbit/s tributary. In this case, Nokia Flexi EDGE BTS extracts the Q1 bus from the 2Mbit/s tributary and routes it further to FIFA.

In both usage scenarios the Q1 bus is routed to FIFA through the backplane.

Alternatively, in BSC polling the Q1 bus may be transported from the BSC to FIFA through the Q1 channel in a radio overhead. The corresponding Flexbus switches must then be set to enable the Q1 connection to the CPU.

See Nokia Flexi EDGE BTS documentation for instructions about how to configure BTS or BSC polling on the BTS side.
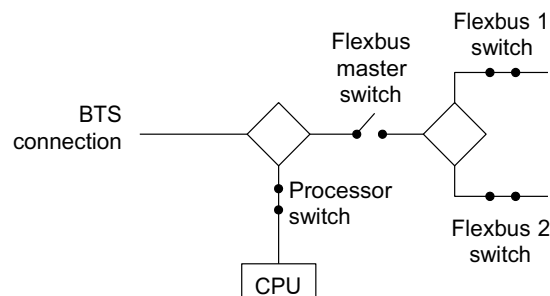
Figure 13.   Logical picture of FIFA Q1 branching bridge

9.13.1   Q1 addresses

Nokia Flexi EDGE BTS as Q1 bus master

Fixed Q1 addressing is used when Nokia Flexi EDGE BTS is Q1 bus master. The fixed Q1 address for FIFA is 4087. Nokia FlexiHub Manager fixes the address to the correct one if the BTS Polling selection is selected on the Q1 settings page.

BSC as Q1 bus master

The user must configure a unique Q1 address for FIFA when the BSC is used as Q1 bus master. Q1 addresses range from 0 to 3999. Each address must be unique on the same Q1 bus starting from the BSC. If multiple units are sharing the same Q1 address on the same Q1 bus, there will be collisions in the protocol and the Q1 bus will not work for those units.

A BSC can have multiple Q1 buses which are independent of each other. The Q1 address range of each of those Q1 buses can be reused.

9.14 Statistics

The statistics that the network element records for signal quality are according to ITU-T recommendation G.826. The values are available as either continuous, or 15-minute and 24-hour histories (last 16 measurements).

Two types of statistics are available: outdoor unit statistics display raw signal statistics before forward error correction is applied. The Flexbus interface statistics indicate the actual transmission quality.

The following statistics are recorded:

Table 8.   Statistics

ID text	Unit	Description
G.826 TT	seconds	Total Time as specified in G.826
G.826 AT	seconds	Available Time as specified in G.826
G.826 ES	seconds	Errored Seconds as specified in G.826
G.826 SES	seconds	Severely Errored Seconds as specified in G.826 [1]
G.826 BBE	counter	Background Block Errors as specified in G.826
G.826 EB	counter	Errored Blocks as specified in G.826
1) G.826 gives two definitions for SES. In Nokia Q1, the definition of SES as "≥30% errored blocks in one-second period" is adopted.		

9.15 Measuring performance

In addition to statistics, the following measurements are recorded.

- 15 min / 24 h records
  - Rx level min/max
  - Rx level min/max history (16 records)
- Current

- Rx level
- FEC correction rate

In addition to statistics, the indoor unit and Flexbus information is given as follows.

- Indoor unit (IU)
    - + 3.3V
    - + 5.0V
    - - 5.0V
    - Supply voltage

- Flexbus
    - BER
    - Power status
    - Frame synchronisation lost
    - Bit error count

9.16   System requirements for Nokia FlexiHub Manager

Nokia FlexiHub Manager requires the following minimum system configuration:

Table 9.   System requirements

Computer	PC with 1.0 GHz or higher processor PC
Operating system	Windows 2003 server Windows XP (SP1 and later) Windows 2000 (SP3 and later) Windows 98 SE
System memory	minimum 256 MB; recommended 512 MB
Hard disk space	100 MB for the node manager software
Display	1024 x 768 XGA
Accessories	CD-ROM drive Windows compatible mouse or pointing device Windows compatible printer (optional) LMP cable (crossover type RJ-45 Ethernet cable)
Java	Java 5.0 update 6 or later version

9.17 Mechanical structure and interfaces

FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS is 40 mm high and 265 mm wide. The maximum transmission capacity at each interface is 16 x 2 Mbit/s.

Installation

FIFA is installed horizontally into Nokia Flexi EDGE System Module (ESMA). Flexbus cabling can be performed easily as Flexbus interfaces are located on the FIFA front panel.

Connectors and cabling

FIFA has two Flexbus interfaces (FB1, FB2: 50Ω TNC connector) on the front panel. These interfaces also feed power to the outdoor units connected through them.

FIFA outdoor unit interface must always be connected with a flexible Flexbus Jumper Cable because the cable bending radius under Nokia Flexi EDGE System Module (ESMA) front panel cover is too tight for the recommended coaxial cable.

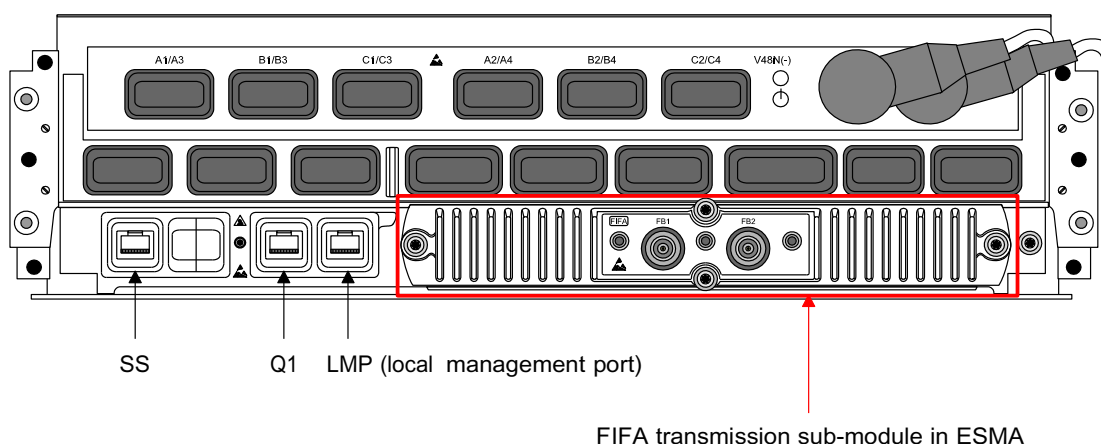Flexbus Jumper Cables are mandatory and must be ordered separately.

Figure 14.   FIFA interfaces

Power supply

FIFA receives its power supply from the BTS. The power consumption of a fully equipped FIFA is less than 76 W. The actual power consumption depends on the site configuration.

FIFA power supply from BTS is protected with a solderable 3A fuse. Flexbus interface power supply has its own integrated overcurrent protection.

The Flexbus interface is also protected with a gas-discharge tube against overvoltage.

Handling requirements

FIFA is sensitive to electromagnetic discharge. The user should be sure that the module is properly grounded and wear an antistatic wrist wrap when handling it.

9.18   FIFA Flexbus Transmission Sub-module

9.18.1   Power requirements for FIFA

The following tables describe the input and output voltages and the maximum power consumption of FIFA.

Table 10.   Input voltages and maximum power consumption

Property	Value for Flexbus	Value for logic circuits
Nominal input voltage	48 VDC	3.3 VDC
Input voltage range	-40.5 … -70 VDC	3.3 +-5% VDC
Maximum power consumption (16x2 Mbit/s)	70 W	6 W

Table 11.   Output voltage and maximum power consumption

Property	Value for Flexbus
Nominal output voltage	55 VDC
Output voltage range	50 … 60 VDC

Table 11.   Output voltage and maximum power consumption (cont.)

Property	Value for Flexbus
Maximum power consumption	60 W (FB1+FB2)

9.18.2   FIFA dimensions and weight

The following table lists the dimensions and weight for FIFA.

Table 12.   Dimensions and weight of FIFA

Property	Value
Height	40 mm
Depth	186 mm
Width	265 mm
Weight	780 g

9.18.3   FIFA interfaces

FIFA has two Flexbus connectors on the front panel of the module. The following table lists the type and purpose.

Table 13.   FIFA front panel connectors

Connector	Type	Purpose
Flexbus 1 and 2	TNC	Outdoor unit interface

The following figure illustrates the FIFA front panel.

Ⓒ **Nokia Siemens Networks**
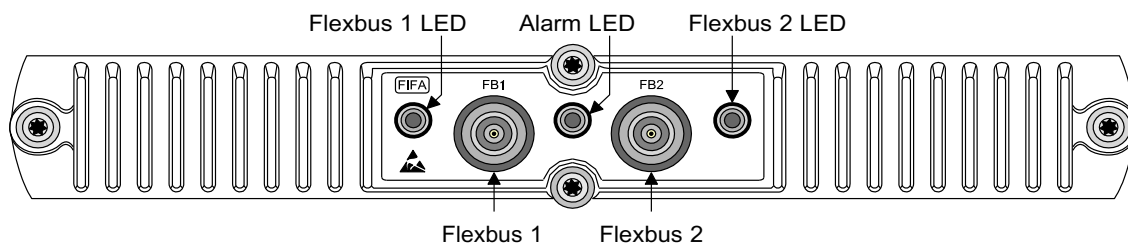
Figure 15.   FIFA front panel

9.18.4   FIFA LED indications

FIFA has three LEDs on the front panel to indicate the operational status of the module and fault conditions during operation.

The LEDs are the following:

- Flexbus interface 1

- Flexbus interface 2

- Alarm

The following table lists the Flexbus LED indications.

Table 14.   Flexbus LED indications

Colour	Explanation
No light	No Flexbus DC power on. No TX signal on Flexbus.
Green, blinking	Flexbus DC power on. No TX signal on Flexbus.
Green	Flexbus DC power and TX signal on.

The following table lists the alarm LED indications.

Table 15.   Alarm LED indications

Colour	Explanation
Red	Fault
Yellow	Alarm
Green	Operation

9.19   Flexbus cable

Table 16.   Flexbus cable requirements

Cable type	Coaxial cable, double shielded or semi-rigid
Characteristic impedance	50 ± 2 Ω
DC resistance	< 4.6 Ω (sum of inner and outer conductors)
Attenuation	< 2.9 dB/100 m at 50 MHz
Flexbus signals	DC power supply
	Bidirectional digital data (37 Mbit/s, NRZ code, 1.4 V pulse amplitude)
Overvoltage protection and cable equaliser are integral parts of the Flexbus interface. Primary overvoltage protection is a 90 V gas-discharge tube.	

Table 17.   Recommended cable types for Flexbus

Cable / 50 Ω	Flexbus cable
Max. length (m)	380
Type	Outdoor use, UV-stabilised, halogen-free. Operational temperature range: -45 - +55 degrees Celsius.
Flame retardancy	IEC 60332-1
Sales item	T55256.01
Reel length (m)	500

Nokia provides the following Flexbus connector kits and Jumper cable:

- • Flexbus TNC Connector, male (T55255.03)

- • Flexbus TNC Connector, male angle (T55255.05)

- • Flexbus Jumper Cable TNC male-TNC female (471391A)

9.20 Standards

This is a list of the standards referred to in the technical specifications.

Table 18.   Signals (ITU-T)

Recommendation	Recommendation name
G.703	Physical/electrical characteristics of hierarchical digital interfaces.
G.704	Synchronous frame structures used at primary and secondary hierarchical levels.
G.823	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.
G.826	Error performance parameters and objectives for international, constant bit rate digital paths at or above primary rate.
G.921	Digital sections based on the 2048 kbit/s hierarchy.
V.11	Data communication over the telephone network; Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s.

Table 19.   Environment

Recommendation	Recommendation name
ETS 300 019-1-1 Class 1.2, 1.3E	Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Storage.
ETS 300 019-1-2 Class 2.3	Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Transportation.
ETS 300 019-1-3 Class 3.2	Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Stationary use at weatherprotected locations.

Table 19.   Environment (cont.)

Recommendation	Recommendation name
ETS 300 019-1-4 Class 4.1E	Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weatherprotected locations.
ETS 300 132-2	Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (DC).
EN 55022 or CISPR22	Limits and methods of measurement of radio interference characteristics of information technology equipment.
EN 61000-4-2	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.
EN 61000-4-3	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio frequency, electromagnetic field immunity test.
EN 61000-4-4	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.
EN 61000-4-5	Electromagnetic compatibility - Basic immunity standard - Surge immunity test.
EN 61000-4-6	Electromagnetic compatibility - Basic immunity standard - Conducted disturbances induced by radio frequency fields.
EN 301 489-1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements.
EN 301 489-4	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific requirements for fixed radio links and ancillary equipment and services.
IEC 60 529	Degrees of protection provided by enclosures (IP codes).
IEC 60 950-1	Safety of information technology equipment.

9.21 Ordering FIFA Flexbus Transmission Sub-module and accessories

The following table lists the product codes for FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS.

Table 20.   FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS product codes

Product code	Product name
471007A	FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS
T55256.01	Flexbus Cable Reel, 500m
471391A	Flexbus Jumper Cable TNC male-TNC female
T55255.03	Flexbus TNC-connector, male
T55255.05	Flexbus TNC-connector, male angle

Table 21.   Nokia FlexiHub Manager programs and accessories product codes

Product code	Product name
P38207.01	Nokia FlexiHub Manager CD ROM x 1
P38207.02	Nokia FlexiHub Manager NOLS delivery
L38207.01	Nokia FlexiHub Manager LTU

Note that an order must include both a software item and the appropriate licence.

Table 22.   FIFA Flexbus Transmission Sub-module for Nokia Flexi EDGE BTS customer documentation product codes

Product code	Product name
C34242.90	FIFA Product Documentation