

**BSS10
BSS10.5**

**New Features Document (NF)
Version 1.0.0**

NOKIA

The information in this document is subject to change without notice and describes only the product and its version defined in the introduction of this document. This document is intended for the use of Nokia Networks' customers only for the purposes of the agreement under which the document is submitted, and no part of it may be reproduced or transmitted in any form or means without the prior written permission of Nokia Networks. The document has been prepared to be used by professional and properly trained personnel, and the customer assumes full responsibility when using it. Nokia Networks welcomes customer comments as part of the process of continuous development and improvement of the documentation.

The information or statements given in this document concerning the suitability, capacity, or performance of the mentioned hardware or software products cannot be considered binding but shall be defined in the agreement made between Nokia Networks and the customer. However, Nokia Networks has made all reasonable efforts to ensure that the instructions contained in the document are adequate and free of material errors and omissions. Nokia Networks will, if necessary, explain issues which may not be covered by the document.

Nokia Networks' liability for any errors in the document is limited to the documentary correction of errors. Nokia Networks WILL NOT BE RESPONSIBLE IN ANY EVENT FOR ERRORS IN THIS DOCUMENT OR FOR ANY DAMAGES, INCIDENTAL OR CONSEQUENTIAL (INCLUDING MONETARY LOSSES), that might arise from the use of this document or the information in it.

This document and the product it describes are considered protected by copyright according to the applicable laws.

NOKIA logo is a registered trademark of Nokia Corporation.

Other product names mentioned in this document may be trademarks of their respective companies, and they are mentioned for identification purposes only.

Copyright © Nokia Networks Oy 2003. All rights reserved.

No. of Pages	Edited by	Checked by	Approved by	Previous issue
90	Chuan Li	H.Annala	R. Juntto	

BSS10/BSS10.5 New Features– Table of Contents:

1	Introduction	2
2	Base Stations	2-0
2.1	BSS10031 SW Support for AFC	2-0
2.2	BSS10041 TRX Monitoring by RSSI	2-2
2.3	BSS10063 Rx Antenna Supervision by Comparing RSSI Value for Nokia UltraSite	2-2
3	Base Station Controller	3-0
3.1	Minimum BSC Hardware Requirements in S10	3-0
3.2	Minimum BSC Hardware Requirements in S10.5	3-1
3.3	Minimum BSC Hardware Requirements in S10.5 ED	3-2
3.4	NEBS Compliance for BSC2i and TCSM2A	3-2
3.5	High Capacity Signalling Links on A interface	3-2
4	Radio network Performance	4-0
4.1	BSS10072 Automated Planning	4-0
4.2	BSS10069 Synchronised BSS	4-4
4.3	BSS10068 Double Mobile Allocation (MA) List Amount	4-7
4.4	BSS10033 TSC Different from BCC	4-7
4.5	BSS10022 FER Measurement	4-8
4.6	BSS10004 Adaptive Multi Rate Codec, AMR	4-9
4.6.1	Generic AMR description	4-10
4.6.2	Nokia BSS10 AMR Solution	4-16
4.7	BSS10005 Reversed Hunting	4-18
4.8	BSS10101 GSM-WCDMA Interworking (BSS10.5)	4-20
4.8.1	Idle mode Support for both Circuit Switched and Packet Switched	4-21
4.8.2	Active mode support	4-22
4.8.2.1	Circuit Switched	4-22
4.8.2.2	Packet Switched	4-23
5	Data Solutions	5-0
5.1	BSS10091 Enhanced Data Rates for Global Evolution, EDGE (BSS10.5 ED)	5-0
5.1.1	8-PSK and GMSK modulation	5-1
5.1.2	EGPRS MCS-1...MCS-9	5-2
5.1.3	Incremental Redundancy, IR	5-2
5.1.4	Link Adaptation, LA	5-3
5.1.5	Radio resource management	5-4
5.1.6	Packet Control Unit (PCU) Hardware in BSC	5-7
5.2	BSS10104 Nokia Smart Radio Concept for EDGE (Nokia SRC)	5-9
5.3	BSS10045 Dynamic Abis Allocation (BSS10.5 ED)	5-12
5.4	BSS10074 Support of PCCCH/PBCCH (BSS10.5)	5-15
5.5	BSS10084 Priority Class based Quality of Service (BSS10.5)	5-16
5.6	BSS10089 System Level Trace (BSS10.5)	5-18
5.7	GPRS Non_DRX mode on CCCH	5-20
5.8	TBF Pending state	5-20
6	Operaterability	6-23
6.1	Nokia Power System Management (PSM) Enhancements	6-23
6.2	Remote BTS Manager for UltraSite and MetroSite BTS	6-23
6.3	Interim Intelligent Shutdown Solution for Nokia UltraSite (IIS)	6-24
7	Macrocellular	7-26
7.1	BSS10016 PGSM900/EGSM900/GSM1800 Common BCCH	7-26
7.2	BSS10087 GSM/EDGE 800	7-27
7.3	BSS10087 GSM/EDGE 800/1900 Dual Band (BSS10.5)	7-28
7.4	BSS10087 GSM/EDGE 800/1900 Common BCCH (BSS10.5)	7-28
7.5	BSS10046 Multi BCF Control (BSS10.5)	7-29

8	Microcellular	8-0
8.1	BSS10102 Chaining of Nokia MetroSite Base Station	8-0
9	Value Added Services	9-0
9.1	BSS10012 Nokia mPosition™ rel 2.0 Location Services for E-OTD phones	9-0
9.2	BSS10112 Text Telephony (TTY)	9-8
9.3	Support for Noise Suppression (NS) and Dual Rate Codec (DR) in the same pool.....	9-9
9.4	Wireless Priority Services (WPS).....	9-10
9.4.1	Supervision of access class control.....	9-11
9.4.2	WPS user identifying in BSC.....	9-11
9.4.3	Queue management.....	9-11

1 INTRODUCTION

This document describes new features for the Nokia GSM/EDGE BSS system release BSS10 and BSS10.5. The BSS10 system features are available in the following network element releases: S10, DF6.0, B13, CX3.0 and CXM3.0. BSS10.5 system features are available in the following network element releases: S10.5, DF6.0_1, B13, CX3.0, CXM3.0 and I3.

Features BSS10091 Enhanced Data Rate for Global Evolution EDGE and BSS10045 Dynamic Abis will be available once S10.5 ED and CX (M) 3.3 are released.

The new BSS O&M functions that are managed solely at the OSS have been omitted from this document. We have also omitted the BSS O&M functions that are managed locally but have been complemented recently to include additional OSS management. These functions are described in the Nokia NetAct™ (OMC) product documentation.

The compatibility for individual NE releases is as follows:

- BSS10 consists of following NE releases: BSC S10, Nokia Talk-family and PrimeSite DF6.0, Nokia 2nd generation B13, Nokia UltraSite CX3.0, Nokia MetroSite CXM3.0.
- BSS10.5 consists of following NE releases: BSC S10.5, , Nokia Talk-family and PrimeSite DF6.0_1, Nokia 2nd generation B13_1, Nokia UltraSite CX3.0, CX3.3, Nokia MetroSite CXM3.0, CXM3.3 and Nokia InSite I3.
- BSS10 and BSS10.5 are supported by following NE releases: Nokia NetAct™ OSS3.1 (former Nokia NMS/2000) and EDs (Enhance Delivery), MSC M11 and M12, SGSN SG2, Totem Access 4.0.

S10 compatibility matrix:

Release	S10	S9	DF6	DF5	B13	B12	CXM3.0	CX2	I2	CX3.0	SG2	OSS3.1	T12	M11	M10
S10	-	-													
DF6.0			-	-	-	-	-	-	-	-					
B13			-	-	-	-	-	-	-	-					
CXM3.0			-	-	-	-	-	-	-	-					
I1			-	-	-	-	-	-	-	-					
CX3.0			-	-	-	-	-	-	-	-					
SG2											-				
OSS3.1												-	-		
M11														-	-

S10.5 compatibility matrix:

Release	S10.5	S10	S9	DF6.0_1	DF6.0	B13	CX(M)3.0	I3	SG2	SG1	OSS3.1	T12	M11	M10
S10.5	-	-	-											
DF6.0_1				-		-	-	-						
B13				-		-	-	-						
I3				-		-	-	-						
CX (M)3.0				-		-	-	-						
SG2									-	-				
M11													-	-

S10.5 ED compatibility matrix:

Release	S10.5 ED	S10.5	DF6.0_1	DF6.0	B13.1	B13	CX(M)3.3	CX(M)3.0	I3	SG3	SG2	SG1	OSS3.1	T12	M12	M11	M10
S10.5 ED	-	-															
DF6.0_1			-	-	-	-	-	-	-								
B13			-	-	-	-	-	-	-								
I3			-	-	-	-	-	-	-								
SG2										-	-	-					
CX (M)3.3			-	-	-	-	-	-	-								
M12															-	-	-

The meaning of the colours in the compatibility matrix:

-	Compatibility not applicable
-	Compatibility not supported
-	Secondary compatibility
-	Primary compatibility

Primary compatible: The releases are completely compatible with each other.

Secondary compatible: The releases are compatible to certain extend, e.g. some features may not be supported.

This document also includes the hardware requirements and planned system compatibility information for the features under development. The different BTS generations (Nokia 2nd generation, Talk-family, PrimeSite, MetroSite, InSite and UltraSite base stations) are mentioned so that any limitations are highlighted. If no exceptions are mentioned, the feature applies to all generations.

Notations used in dependency tables

The table is used to relate the described BSS features to required system components:

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT

In the table we use the following notations:

SUPPORTED IN:

GSM 800	This feature is supported in the GSM/EDGE 800 MHz system (Y= yes, N= no).	Nokia MetroSite	This feature is supported by Nokia MetroSite (Y= yes, N= no). (Y) in parentheses indicates that the BTS is not actually applicable with this feature.
GSM 900	This feature is supported in the GSM/EDGE 900 MHz system (Y= yes, N= no).	Nokia InSite	This feature is supported by Nokia InSite (Y= yes, N= no). (Y) in parentheses indicates that the BTS is not actually applicable with this feature.
GSM 1800	This feature is supported in the GSM/EDGE 1800 MHz system (Y= yes, N= no).	Nokia UltraSite	This feature is supported by Nokia UltraSite (Y= yes, N= no). (Y) in parentheses indicates that the BTS is not actually applicable with this feature.
GSM 1900	This feature is supported in the GSM/EDGE 1900 MHz system (Y= yes, N= no).	BSC MMI	This feature has parameters that are managed with the BSC MMI (Y= yes, - = not applicable).
MSC	This feature is supported in the Nokia MSC (xxx = Nokia MSC release/feature nbr., N= no, - = not applicable).	BTS MMI	This feature has parameters that are managed with the BTS MMI (Y= yes, - = not applicable).
Nokia NetAct	This feature is supported in the Nokia NetAct (Y= yes, xxx = Nokia NetAct release/feature nbr., - = not applicable).	MS	The feature sets special requirements to mobile stations (Y = yes, see the note; - = no requirements).
BSC	This feature is supported by the BSC (Y= yes, N= no). (Y) in parentheses indicates that the BSC is not actually applicable with this feature.	HW/FW DEPENDENCY:	
SGSN	This feature is supported by the SGSN (Y= yes, N= no). (Y) in parentheses indicates that the SGSN is not actually applicable with this feature.	BSC HW/FW	This feature requires additional or alternative BSC hardware or firmware (Y= additional, A= alternative, or - = not applicable).
NetAct Planner	This feature is supported in Nokia NetAct Planner, (Y= yes, xxx = Nokia Totem Access release/feature nbr., - = not applicable).	BTS HW/FW	This feature requires additional or alternative BTS hardware or firmware (Y= additional, A= alternative, or - = not applicable).
Nokia 2nd Gen.	This feature is supported by the 2nd gen. BTS (Y= yes, N= no). (Y) in parentheses indicates that the BTS is not actually applicable with this feature.	TC HW/FW	This feature requires additional or alternative transcoder hardware or firmware (Y= additional, A= alternative, or - = not applicable).
Nokia Talk-family	This feature is supported by Nokia Talk-family of base stations (Y= yes, N= no). (Y) in parentheses indicates that the BTS is not actually applicable with this feature.	SGSN HW/FW	This feature requires additional or alternative SGSN hardware or firmware (Y= additional, A= alternative, or - = not applicable).
Nokia PrimeSite	This feature is supported by Nokia PrimeSite (Y= yes, N= no). (Y) in parentheses indicates that the BTS is not actually applicable with this feature.	STD/ OPT	BSS OPTIONALITY: Indicates whether this feature is an optional or a standard BSS feature (S = standard, O = optional).

2 BASE STATIONS

2.1 BSS10031 SW Support for AFC

AFC is GSM900 Antenna Filter Unit with 4-way hybrid combiner and 8 Rx multicoupler outputs. Initial use of this will be to support 8 TRX configurations, with 2 AFCs, using 2 Antennas, with DF4.0 or DF5.0 BTS SW, declaring the AFCs as AFEs. This has a minor problem with the O&M. In that any Rx LNA faults or Tx VSWR alarm will each be reported twice at the OMC.

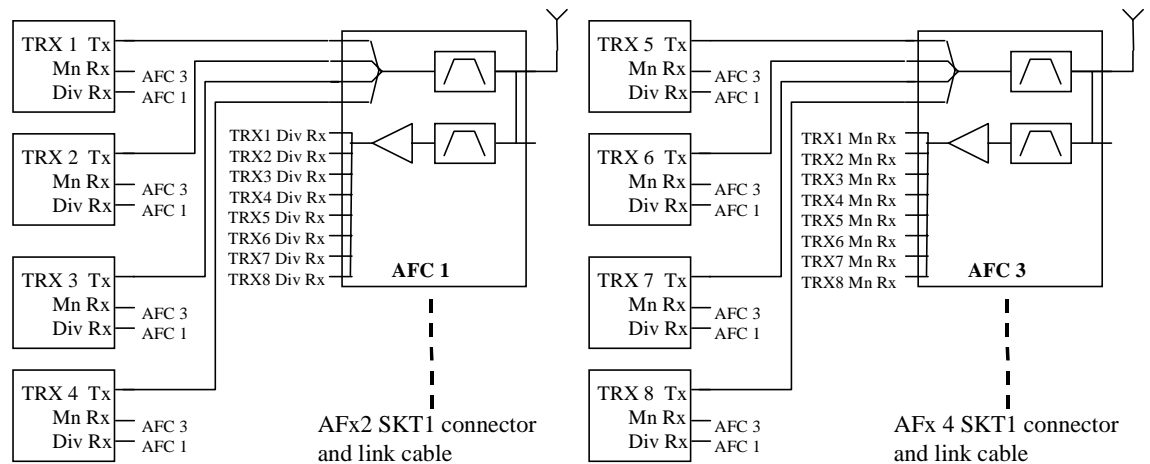
BSS10 will have the full support for the following configurations:

- Up to 8 TRX cells with 2 AFCs
- Up to 12 TRX cells with 3 AFCs
- Cells with 2 AFCs and 2 AFEs to give 8 TRXs (low power) + 4 TRXs (high power) on 4 antennas.

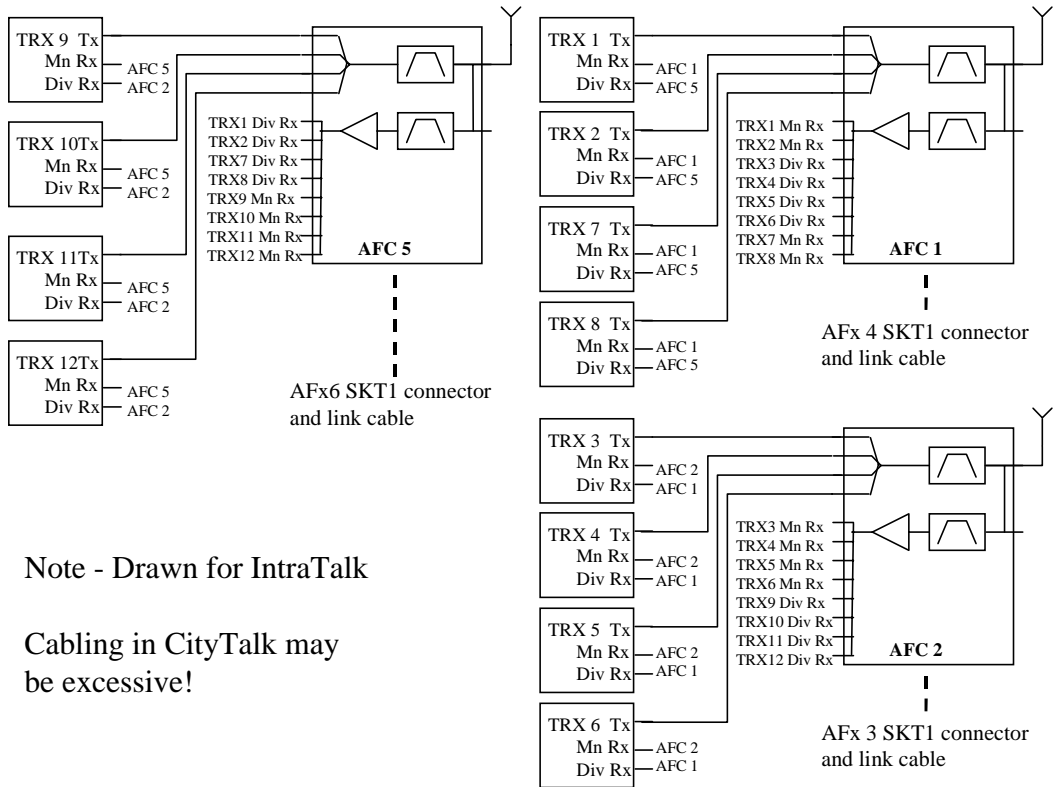
This feature allows operators to use RF hopping with 8 or 12 TRXs and only 2 or 3 antennas. Many operators are limited in the number of antennas that they can use. RF hopping allows easier network planning and more capacity in a given bandwidth.

The following pictures show principal connections for the above mentioned configurations.

8 TRX AFC



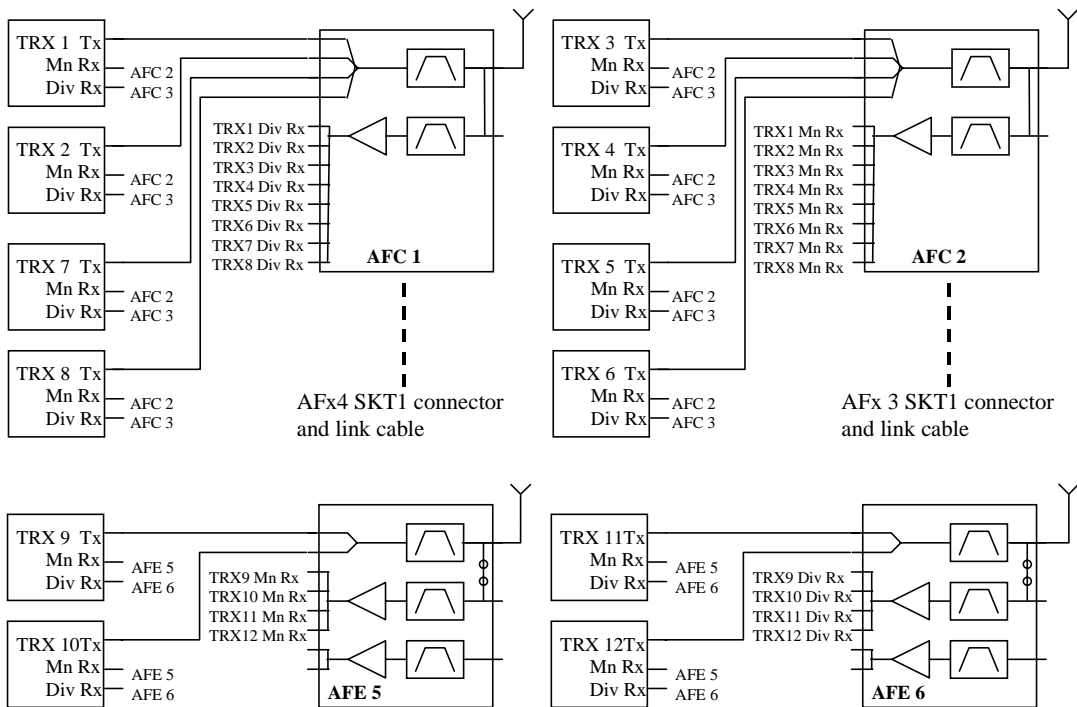
12 TRX AFC



Note - Drawn for IntraTalk

Cabling in CityTalk may be excessive!

4 TRX AFE + 8 TRX AFC ICE+



SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	Nokia NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
N	Y	N	N	-	-	(S10)	-	-	N	DF6	N	N	N	N

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	-	-	-	Y	-	-	S

Note(s):

2.2 BSS10041 TRX Monitoring by RSSI

BSS9001 feature Rx Antenna Supervision by Comparing RSSI Value will be enhanced so that O&M unit of the BTS compares RSSI values from different TRXs connected to the same antennas. If some of the TRXs has lower signal level than the average value a non-blocking alarm will be sent to the BSC indicating the faulty TRX.

This method brings a possibility to supervise TRXs also when they are used in a BB-hopping cell.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
N	Y	Y	Y	-	-	(S10)	N	-	N	DF6	N	N	N	N

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	Y	-	-	-	-	-	S

Note(s):

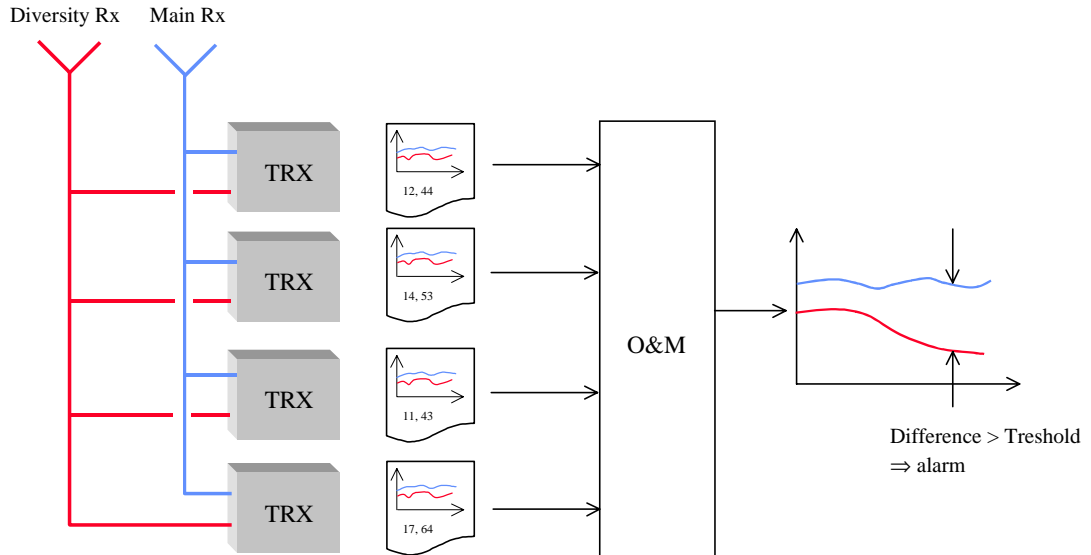
2.3 BSS10063 Rx Antenna Supervision by Comparing RSSI Value for Nokia UltraSite

This feature is an enhancement to the BSS9001 Rx Antenna Supervision by Comparing RSSI Value.

The purpose of this feature is to monitor the Rx antenna condition. Rx antennas can be monitored for major problems by taking a long-term average of the difference between Main Rx RSSI and Div Rx RSSI (Received Signal Strength Indication). This feature will provide continuous antenna supervision for the BTSs, which have main and diversity in use. It also offers an alternative solution for Tx monitoring in cells that use duplexing. This will detect antennas with poor VSWR and inadequate feeders, for example.

The monitoring is based on the principle that all received bursts where the Rx level of main or diversity branch is above the defined limit value (-95dBm), the bursts are accepted as samples and used in the averaging process. The differences of the TRXs connected to the same antennas are counted up and the average difference per main and diversity antennas is calculated. If the difference is above the threshold (default value 10 dB), an alarm will be activated. For the Nokia PrimeSite base station, the Rx branch difference is calculated separately per TRX. The threshold default value of 10 dB can be changed by a parameter at the BSC between 5-64. The functionality of the feature can be disabled by using the maximum value.

It is still possible that both antennas are damaged simultaneously and the difference algorithm cannot detect the fault. For this reason, the BTS will also observe the assignment and handover success rate per antenna. Excessive failures will be detected by bias T unit, and an SWR alarm will be raised.



SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC (S9)	SGSN	NetAct Planner	Nokia 2nd Gen. (B12)	Nokia Talk-family (DF5)	Nokia PrimeSite (DF5)	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	-	(S9)	-	-	(B12)	(DF5)	(DF5)	N	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	Y	-	-	-	-	-	S

Note(s):

3 BASE STATION CONTROLLER

3.1 Minimum BSC Hardware Requirements in S10

General hardware requirements set for the BSC S10 software release includes changes in BCSU computer units (max. 8+1 per BSC) and MCMU computer units (max.1+1 per BSC).

Compared with previous releases all BSCE and BSC2E/A products needs to be configured with at least CP4HX (Intel 486 100 MHz) or newer CPU units with at least 64MB memory for OMU unit and BCSU units, and 128 MB memory for MCMU units. Therefore older CP4C32 CPU-units (Intel 486 33MHz) can not be used anymore since the memory of CP4C32 cannot be extended. The memory extensions to 64 MB for BCSU and 128 MB for MCMU are needed due to the new functionalities and increased memory consumption.

- **BCSU configuration**

BCSU configuration requires memory upgrade to be implemented for the existing CP4HX units having 32MB of RAM memory. Necessary memory upgrade from 32MB to 64MB is similar to previous memory upgrade required for OMU and MCMU units from BSC S8 SW release onwards.

Also for existing CP4HL units memory upgrade is not needed since all CP4HL plug-in units already include 64MB of RAM memory. Correspondingly BSCi and BSC2i products do not require additional memory upgrade since delivered CP6LX units include needed 64MB of memory.

- **MCMU configuration**

MCMU configuration requires memory upgrade for existing CP4HX, CP4HX and CP6LX to 128 MB. Necessary memory upgrade is similar to previous memory upgrade required for OMU and MCMU units from BSC S8 SW release onwards.

CP6MX units do not need memory upgrade since they already include 128 MB of RAM memory.

Allowed BSC CPU types and memory amounts for OMU, MCMU and BCSU units:

CPU type	Micro-processor	Clock Frequency, MHz
CP4HX	486	100
CP4HL	486	100
CP6LX	Pentium II	266
CP6MX	Pentium III	500

Required memory amount per computer unit:

Computer unit	Current S9 Memory amount, Mbytes	Required S10 Memory amount, Mbytes
OMU	64	64
MCMU	64	128
BCSU	32	64

BSC HW requirements set by optional software features are described in details in relevant chapters.

3.2 Minimum BSC Hardware Requirements in S10.5

General hardware requirements set for the BSC S10.5 software release includes changes in MCMU and OMU computer units. Compared with previous releases, MCMU and OMU in BSC need at least 128MB memory. The memory extension to 128 MB in MCMU and OMU is needed due to the new functionalities and increased memory consumption in S10.5. In BCSUs the minimum memory amount will stay in 64 Mbytes.

CP4HX, CP4HL and CP6LX type CPUs used in OMU and MCMUs need to be upgraded in all BSC variants (BSCE, BSCi, BSC2, and BSC2i). CP6MX introduced with S10 deliveries does not require any change no matter in which computer unit it is used since CP6MX has already equipped with 128Mbytes memories.

Memory configuration can be flexibly extended to 128Mbytes in existing CPU types in all BSC variants. However, concerning the HW requirements in forthcoming SW releases Nokia recommends upgrades to High Capacity HW level. As example existing BSC2E/A products utilising CP4HX or CP4HL processors can be upgraded with high capacity upgrade kits. Upgraded BSC2i with CP6MX CPUs corresponds the S10 new delivery of BSC2i product from memory capacity (128Mbytes) point of view.

Nokia High Capacity BSC feature enables more powerful and efficient BSC usage and also full use of the existing BSCs. The traffic handling capacity of the High Capacity BSC is 3040 Erlangs and 91000 BHCA's (Busy Hour Call Attempts) with the reference call mix described in BSC2i Product Description.

Required memory amount per computer unit:

Computer unit	Current S10 Memory amount, Mbytes	Required S10.5 Memory amount, Mbytes
OMU	64	128
MCMU	64	128
BCSU	64	64

Allowed Central Processing Unit (CPU) types:

CPU type	Micro-processor	Clock Frequency, MHz
CP4HX	486	100
CP4HL	486	100
CP6LX	Pentium II	266
CP6MX	Pentium III	500

3.3 Minimum BSC Hardware Requirements in S10.5 ED

The hardware requirements for S10.5 ED are the same as for S10.5. Please see 3.2.

3.4 NEBS Compliance for BSC2i and TCSM2A

NEBS stands for Network Equipment Building System. It is a set of Bellcore Standards, the purpose of which is to unify HW requirements and help Telephone companies to evaluate the suitability of products for use in their networks. Compliance to NEBS is required by RBOCs (Regional Bell Operator Company) in the USA.

The requirements are detailed in two Bellcore standards:

- GR-63-CORE, "Network Equipment-Building System (NEBS) Requirements: physical protection", contains for examples fire resistance, earthquake endurance, environmental endurance (transport, storage and use) and
- GR-1089-CORE, "Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment", contains for example EMC, Electrical Safety and Telecommunications interfaces requirements.

Both standards have together some 260 specific requirements. The application of a requirement depends on what kind of equipment is in question and what is the intended application. SR-3580 groups the requirements into four groups, NEBS levels 1, 2, 3 and "Other Criteria".

BSC and TCSM2 in S10 are for "Central Office" uses and all external interfaces are "type 2" according to GR-1089-CORE.

Nokia provides NEBS3 kits as upgrade items for obtaining an applicable (limited) NEBS Level 3 compliance for DX200 based BSC2i (ANSI) and TCSM2A Network Elements. There are dedicated kits for both BSC2i and TCSM2A products.

Basic content of NEBS3 kits includes following items:

- new door set for earthquake support
- new side plates for earthquake support
- Installation Set with ESD Stickers
- Installation Instructions

3.5 High Capacity Signalling Links on A interface

The GSM network has been originally specified (GSM 08.08) and designed to use 64 kbit/s CCS7 links in the A-interface. Due to various reasons, the CCS7 links can be congested in the A-interface. The situation could be improved with higher capacity CCS7 links on the A-interface.

In BSS10, higher capacity CCS7 links (128, 256 kbit/s) between the BSC and MSC are supported. They require the use of Nokia BSC2i with plug-in-unit AS7-V and Nokia MSCi with plug-in-unit AS7-A.

Normally, there are 4 timeslots reserved for 64kbit/s CCS7 links. However, with high capacity CCS7 link feature, there are always 16 timeslots reserved for CCS7 usage regardless how many timeslots are actually needed, so having high capacity CCS7 links on A interface may have impact on the maximum LapD capacity of BSC depending on the configuration.

Table: Number of LapD links and CCS7 links per BCSU with or without High capacity CCS7 link for high capacity BSC:

	64kbit/s CCS7 link	128 kbit/s CCS7 link	256 kbit/s CCS7 link
Maximum Number of CCS7 links	4	4	4
Maximum Number of BCFSIG LapD links	32	32	32
Maximum Number of TRXSIG LapD links	64	64	64
Maximum number of LapD links (BCFSIG+TRXSIG+ISDN+ET-LapD)	124	112	112

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
N	Y	Y	N	M9 1)	-	S10 3)	-	-	-	-	-	-	-	-

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	-	-	Y2)	-	-	-	S

Note(s):1) MSCi with AS7-A, 2) BSC2i with AS7-V. 3) ETSI feature

4 RADIO NETWORK PERFORMANCE

4.1 BSS10072 Automated Planning

This feature is targeted to increase the automation and planning accuracy in the mobile networks. This reduces the operational costs and increases the revenues of the operator.

The Target Areas for Automation in Planning

By employing a high degree of automation it will be possible to reduce the operating cost associated with running a network that grows both in size and in complexity. In the future automation of the network will be one, if not the main enabler that allows operators to reduce operating costs and thus gain a competitive advantage. The aim is to automate those tasks that have the largest impact on network performance and those that required the highest manpower. In addition, it is not only aimed to automate existing methods, but also to improve these methods in order to provide network quality improvements.

Automation Tasks

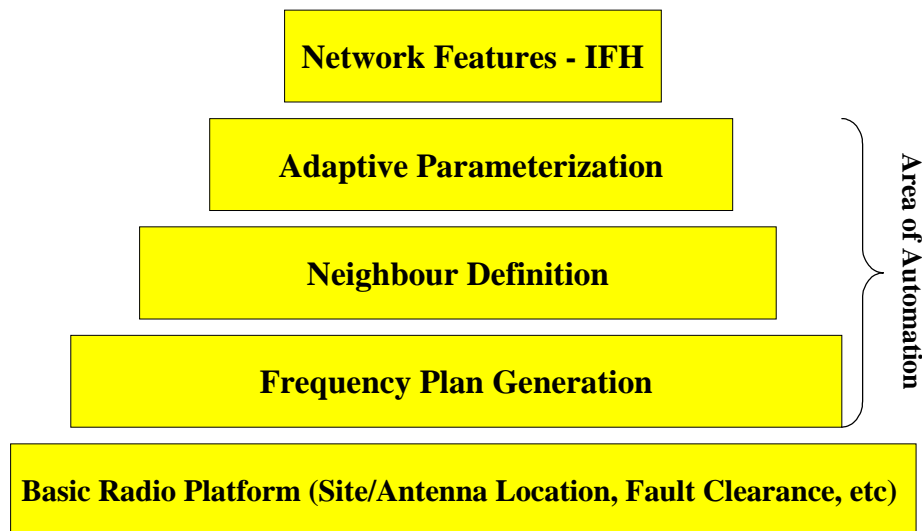


Figure: Tasks to which Automation will be applied in GSM/EDGE Networks

Above Figure displays the areas to which automation will be applied. In GSM/EDGE systems these areas are:

- frequency planning
- neighbour planning
- adaptive setting of parameters on a cell-by-cell basis.

It can also be seen in this figure that in order to obtain the maximum gain from network, features such as IFH, all supporting tasks have to be mastered at first.

By providing operators with the tools that enable the automation of network planning or optimisation tasks the following targets will be reached:

- improve network performance
- reduce operational costs (OPEX)
- reduce need for highly trained personnel
- speed-up implementation time of new features.

In S10 time frame one new BSC measurement is created. This measurement, Defined Adjacent Cell Measurement, complements the S9 Channel Finder Measurement by providing the required information for frequency and neighbour planning for the defined adjacencies of all BTS under a BSC.

The Need for Increased Automation in Mobile Networks

Since the introduction of GSM the number of installed network elements (TRX, BTS, BSC, etc) has increased several-fold. Today, trend for cellular networks is to consist of all the time growing number of base stations and transceivers. Fuelled by the continuing growth of subscriber number and the uptake of new services the amount of installed hardware is continuing to increase rapidly over the coming years. In order not to sacrifice network quality operators used to increase the number of personnel to cope with the increased requirement of the growing network. However, it is impossible to continue increasing the number of personnel in line with the increase in hardware. In addition, packet switched data services on second-generation mobile systems is being introduced via features such as GPRS and EDGE. The introduction of these new features requires the dedication of key personnel from the operator to address the design needs of these features. With the imminent deployment of third generation of mobile systems (WCDMA) it becomes clear that a different approach is needed to cope with the requirements of the growing complexity of cellular networks.

The Need for Increased Accuracy in Planning Networks

With the increasing introduction of cells that cover small geographical areas such as microcell and picocells it is important that the accuracy of the frequency plan is increased to ensure adequate call quality in each of these cells. However, current methods to create the frequency plan for these cell types have generally not improved and are virtually identical to those used to plan macrocells. Thus the existing approach leads to in adequate call quality unless a high number of frequencies are dedicated to these cell types.

In order to improve the quality of the frequency plan for all cell types, mobile measurements will replace inaccurate propagation predictions to build the Interference Matrix on which the frequency plan is based.

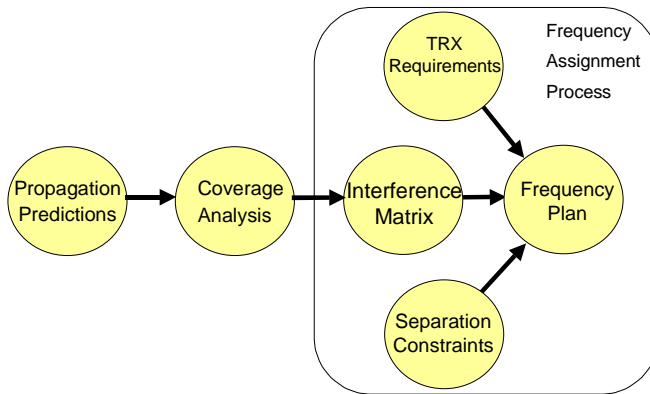


Figure: Existing Frequency Planning Approach

The above figure displays the conventional approach of using propagation predictions to create an interference matrix and subsequently a frequency plan.

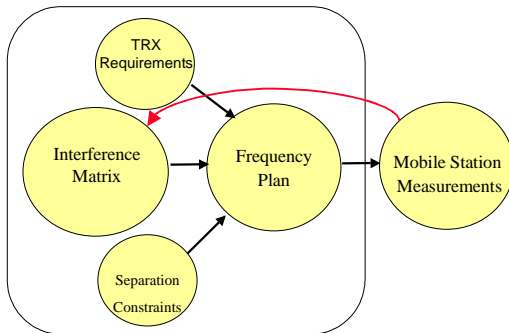


Figure: Improved Frequency Planning Approach

In the other figure the improved approach is displayed. Here the Interference Matrix is based on mobile station measurements. Thus more accurate information, including subscriber density, is utilised to build the Interference Matrix leading to the better network quality.

The new defined adjacent cell measurement (DAC) registers statistics on defined cells. This measurement data is collected in cell level. Measurement data is collected from all mobiles on defined cells. Measurement consist of next (set of 6 counters * 32 + 6 counters) information:

- Used blocks (Updated only one time in record)
- Lower dB value (Updated only one time in record)
- Higher dB value (Updated only one time in record)
- Average downlink signal strength in serving cell
- Denominator of Average downlink signal strength of serving cell
- Sum of squares of signals of serving cell

These counters are repeated until the results of the 32nd cell are reached:

- Average downlink signal strength in defined adjacent cell
- NCC (Network colour code identification)
- BCC (BTS colour code identification)
- BCCH (BCCH frequency = absolute radio frequency number)
- Sum of squares of signals
- Number of samples in class 1 of adjacent cell 1-32
- Number of samples in class 2 of adjacent cell 1-32
- Number of samples in class 3 of adjacent cell 1-32.

Information is collected by BSC from Measurement Report –messages, which are received by the BSC in 0.48 seconds period during the call.

To get the reports also from undefined adjacent cells, the Channel Finder Measurement should be activated simultaneously.

Example of Automation: Frequency Planning

To provide insight on how automation can be applied to one of the above-mentioned area, an example on the automatic creation of a frequency plan in a GSM network is presented.

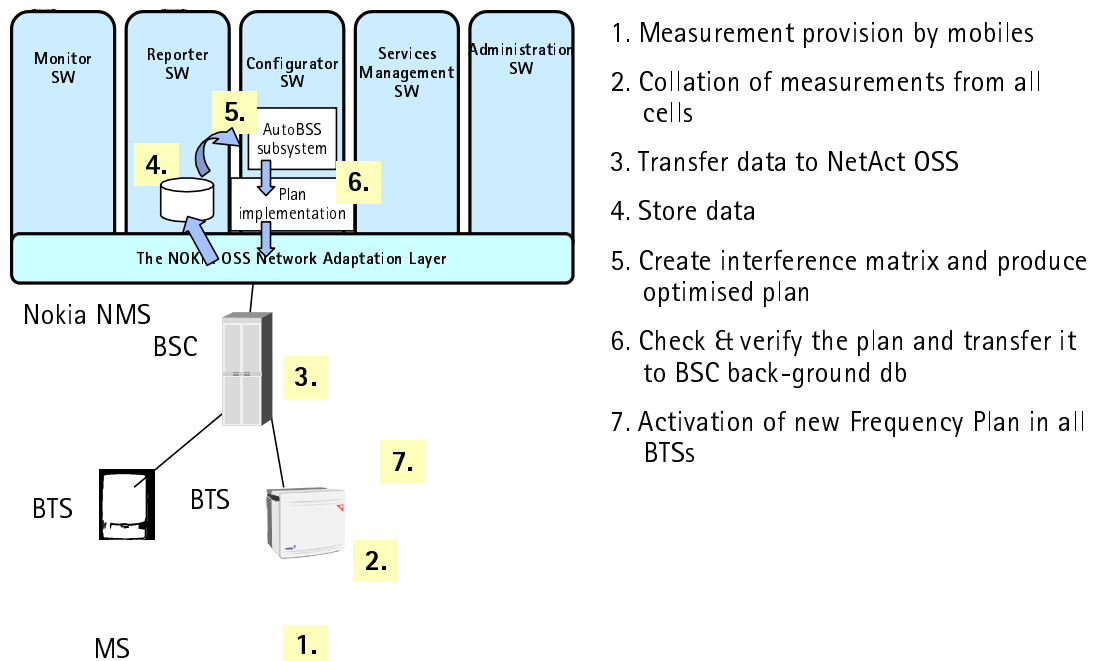


Figure: Network Elements involved in creation of Frequency Plan in GSM/EDGE network

The above Figure provides insight into the creation of a frequency plan that is based on mobile measurements. The tasks associated with this activity are also shown in the same figure. The most important feature of this figure is that a closed-loop approach is applied to the area of frequency planning: information from the network is used to plan the network. This feature is typical for all other areas within the field of automation: modifications in the network are based on the current condition in the network.

This principle can also be applied to other areas of automation such as neighbour planning and the adaptive setting of parameters. The closed-loop approach enables the setting of parameters on a cell-by-cell basis and thus helps providing optimum performance. Attempting to manually parameterise on a cell-by-cell basis is almost impossible due to the manpower required. This approach can be applied to a large number of parameters thus further increasing network performance when compared to the traditional approach of using global parameter settings. Furthermore, what is required to apply this method is to decide on the relationship between a KPI, Key Performance Indicators that is being monitored and the parameter that is controlling the KPI. Once the relationship is established it can be applied to all cells. Moreover, by providing several different relationships between two values, it will be possible to have customised parameter settings for certain cell types or certain geographical areas.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1	S10	-	-	(B12)	(DF5)	(DF5)	(CX2)	(I2)	(PU1)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	-	-	-	S 1)

Note(s): 1) Nokia NetAct optionality.

4.2 BSS10069 Synchronised BSS

This feature is considered to provide the enabling synchronisation functionality required for other key functionalities, such as Dynamic Frequency and Channel Allocation, to be developed. However, it brings also some direct performance benefits and gives more accuracy for MS Location functionality.

There are different levels of synchronisation that can be implemented in a GSM/EDGE BSS. Currently the achievable synchronisation is limited to the synchronisation of the cells (BTS) belonging to the same site. This is possible as the different logical cells within use the same existing site “master clock”.

If all the clocks of the different sites along the network were synchronised, then a “Network Level Synchronisation” would be achieved. This is the type of synchronisation achieved with the Synchronised BSS feature. The most effective method to achieve this level of synchronisation is via GPS time reference. This time reference is acquired via the Location Measurement Unit, which supports both the Location and Synchronisation functionality.

Additionally, once the Network Level Synchronisation is achieved, further levels of synchronisation are achievable by the control of the TSL number alignment (TSL Alignment Synchronisation) and the Frame Number (FN) used in every site.

The synchronisation achieved with the BSS10 Synchronised BSS feature is the Frame Number (FN) Synchronisation. This synchronisation guarantees that connections in different cells are aligned and hence synchronised in a burst level. The FN used by different sites may be different. These FN values can be controlled by the FN offset parameter to ensure maximum performance.

The figure below shows this concept. The Guard Period within each burst is the existing margin in the synchronised network to guarantee that a certain connection only causes interference to the coincident broadcast connections in other cells which are using a TCH physically located in the same TSL number.

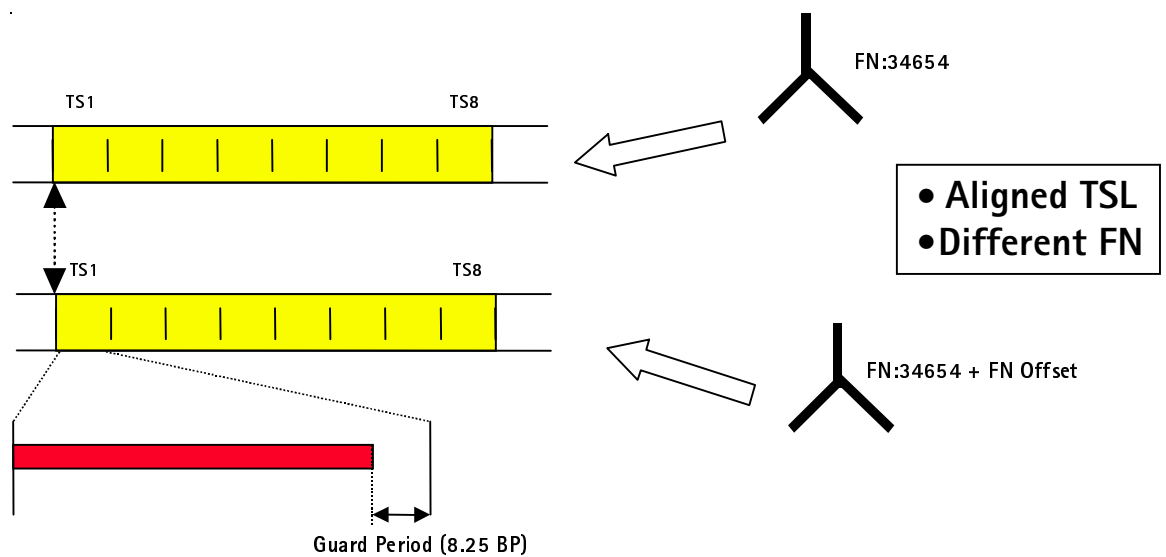


Figure: FN Alignment Synchronisation

Performance Benefits

Even though this functionality has been classified as an enabling functionality some immediate performance benefits will be achieved when a system is synchronised.

- Higher Location accuracy
- More stable reference clock for the base stations.
- Higher Tolerance to Interference.

When a burst is causing interference to a serving connection, the FER degradation of the serving connection will increase as the interfering and serving bursts overlapping increases. When the overlapping is low, below 20%, the degradation is small.

When the overlapping is above 40%, the training sequence starts to be affected, and the degradation starts to become equivalent to the one suffered with full overlapping.

This means that the worst performance case is the 50/50 case (two serving connection bursts being 50% interfered by the interfering burst), because in that case there is more than 40% overlapping in two consecutive timeslots. The interference is effectively twice as large as when the whole burst (or more than 80%) is interfered.

Simulation results have shown that in a synchronised network the overall gain over the network could be 0.5 dB. This means that the network FER (Frame Erasure Rate) versus C/I performance will be shifted by 0.5 dB.

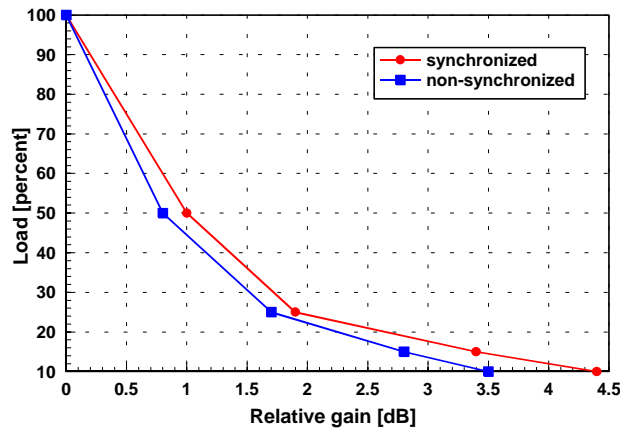
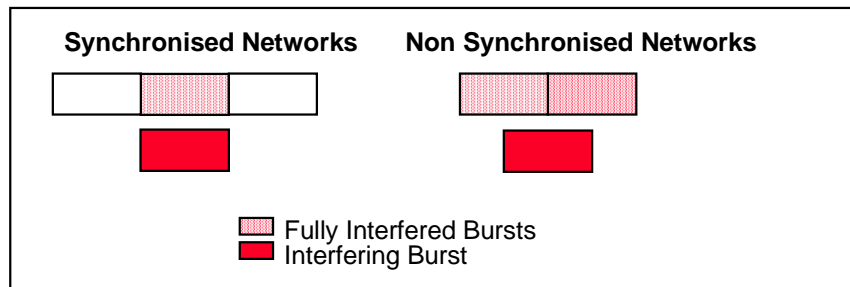


Figure: The relative gain in dB of synchronisation in a GSM network. Note: Gain in real Network may differ depends on the configuration

The figure below illustrates this concept.



Increased neighbouring monitoring performance. BSIC Broadcast De-Phasing.

The control of the Frame Numbers of different cells will provide with the ability to maximise the BSIC decoding mechanism of the mobiles in the system. The reselection and handover processes can be enhanced by diminishing the problems associated to the often too slow BSIC decoding mechanism (especially in very fast changing propagation environments such as indoors).

The implementation in BSS10 does not include automatic recovery of the synchronisation chain in the case of temporarily losing clock signal from LMU. When the clock is lost and regained from LMU, only the first BCF next to LMU reset is automatic. A manual reset to the BCFs is needed to get the other BCFs in the chain to work.

Recovery for BSS and Site Synchronisation is a feature under development in BSS11. Detailed description please see BSS11 Features under Development document.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1	S10	-	-	N	DF6 2)	N	N	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	Y 1)	-	-	S

Note(s): 1) Additional BTS hardware required (LMU) 2). FlexiTalk BTS does not support this feature.

4.3 BSS10068 Double Mobile Allocation (MA) List Amount

Heuristic planning improves frequency allocation in terms of capacity and quality. Due to that the number of MA lists will be increased (comparing to easy planning (1/1 or 1/3)). Intelligent Frequency Hopping with double number of hopping groups and High Capacity BSC (512 TRXs/248 BTSs) together with heuristic planning increases the number of MA-lists further.

By doubling the number of MA-lists from 128 to 255 both the frequency planning and implementation of new frequency plan become easier.

Heuristic planning of IFH, will lead to a slightly higher capacity than can be obtained via the easy IFH approach. Operators that do not want to use the heuristic approach will have to customise the MA list for each cell in order to take the interference and hopping conditions into consideration on a cell by cell basis. It is thus important to be able to offer a sufficient large number of MA lists so that heuristic planning is possible.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1	S10	-	-	(B12)	(DF5)	(DF5)	(CX2)	(I2)	(PU1)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	-	-	-	S

Note(s):

4.4 BSS10033 TSC Different from BCC

Nowadays, the Nokia BSS does not allow to define a TSC (Training Sequence Code) different from the BCC (BTS Colour Code) on the TRXs not carrying broadcast or common control channels.

According to the GSM standard 05.02, "for broadcast and common control channels, the TSC must be equal to the BCC. some configurations, to use TSC different from BCC on TCH and SDCCH channels situated in TS0 would allow to avoid Random Access interference. For example: a Random access sent on TCH on TS0 (for handover) could be detected as valid on the RACH. Apparently, this could happen when frequency channels in use in the TS0 in non-BCCH TRX are quite close to BCCH frequency channel (400 kHz or 600 kHz spacing).

This feature will remove the TRX specific constraint: TSC = BCC. Exception for this limitation is BCCH and PBCCH TRXs and also Base Band hopping cell (or Base band hopping layer in IUO case).

This would lead to following network quality improvements:

- Less Ghost CHANNEL REQUEST on RACH => better SDCCH efficiency
- Less misbehaviour on TS 0 during handovers.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1	S10	-	-	B13	DF6	DF6	CXM4.0	N	CX4.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	-	-	-	S

Note(s):

4.5 BSS10022 FER Measurement

FER Measurement provides an ability to report the UL FER from the BTS to the BSC. This provides more realistic measure of voice quality in the system and enables to perform handovers and power control based in FER rather than BER-based RxQuality. This feature can then provide more capacity and better quality.

Additionally, DL FER is estimated using the correlation between UL FER and UL BER values and applying these to the DL BER values. Both UL FER values and estimated DL FEP (Frame Erasure Probability) values are available in the new FER measurement. In addition to handover and power control algorithms, feature provides also significant improvements to network quality statistics.

Frame Erasure Rate is the best available indicator in a GSM system to assess the Voice Quality provided in a network. It represents the percentage of frames being dropped due to high number of non corrected bit errors in the frame.

The BER figure currently reported to the system is not a good indication of the quality of the network, especially when efficiency of the error correction mechanism changes due to functionality introduced in the network such as frequency hopping or dynamic channel coding. Hopping spreads out the fading and interference problems, effectively allowing the decoding mechanism to restore the original information via the Error Correction process. Not only the correlation between BER and FER will change when Frequency Hopping is in use, but different frequency hopping schemes (depending in the reuse and number of frequencies to hop over) will have a different BER to FER correlation. The figure below shows this effect measured in a real operational network for the DL path. The area of interest is the one showing the correlation of RXQUAL 4 to 6 and the voice quality degradation (FER>5%).

There are 7 class defined for FER measurement. The class boundaries B1..B7 (FER %) and averaging window size (SACCH frames) are defined in the measurement set-up. B0 and B8 are fixed. Class0 is between boundary 0 (B0) and boundary 1 (B1) etc. Occurrences gives the number of records where the setting is met. If there are more than one line then different settings are used in the area.

Boundaries used in the selected area for defining the classes:

B0	B1	B2	B3	B4	B5	B7	B8	Ave Win Size	OCCURENCES
0	2%	4%	6%	8%	10%	12%	14%	2	31

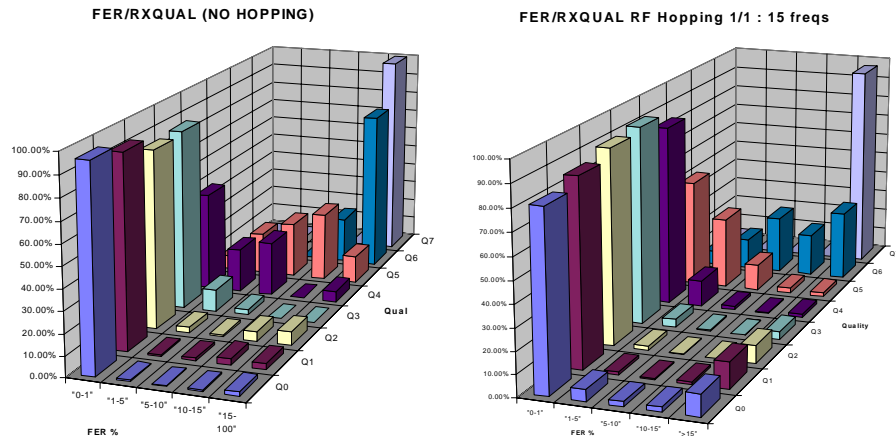


Figure: RX Quality / FER Correlation for hopping and non-hopping cases.

The Channel Coding algorithm in use has a direct impact in the Error Correction performance. Depending how robust the channel coding is, its associated performance will vary. A clear example of this will take place when different coding schemes are implemented simultaneously in AMR networks. Again the correlation between BER and FER will change, and this time it will potentially do it dynamically according to the conditions.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1	S10	-	-	N	DF6	DF6	CXM3.0	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	-	-	-	S

Note(s):

4.6 BSS10004 Adaptive Multi Rate Codec, AMR

Adaptive Multi Rate Codec (AMR) introduces a new set of codecs and adaptive algorithm for codec changes and thus can provide significantly better speech quality and more capacity.

With AMR we can achieve very good speech quality in full rate (FR) mode even in low C/I conditions or increase the speech capacity by using the half rate (HR) mode and still maintain the quality level of current FR calls. Optimal interworking with power control and handover algorithms together with enhanced quality measurements (FER Measurement feature) will provide full benefits and interworking with prior Nokia top-of-the-world capacity features including Intelligent Frequency Hopping (IFH).

The Adaptive Multi Rate (AMR) codec consists of a family of codecs (source and channel codecs with different trade-off bit-rates) operating in the GSM FR and HR channels.

The idea behind the AMR codec concept is that it is capable of adapting its operation optimally according to the prevailing channel conditions.

AMR Full Rate performance compared to Full Rate EFR in Clean Speech

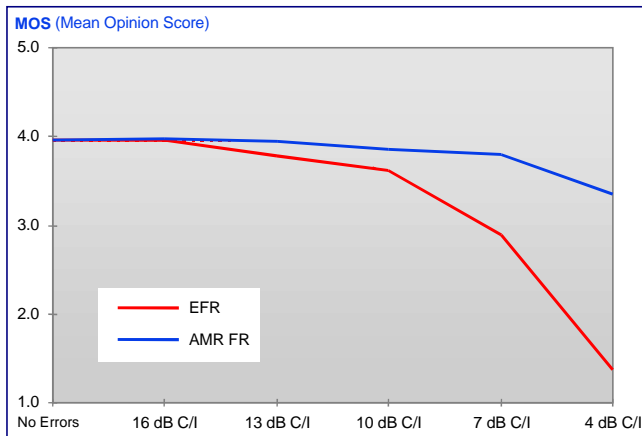


Figure: ETSI Mean Opinion Score test results for current FR and AMR HR

AMR Half Rate performance compared to Full Rate in Clean Speech

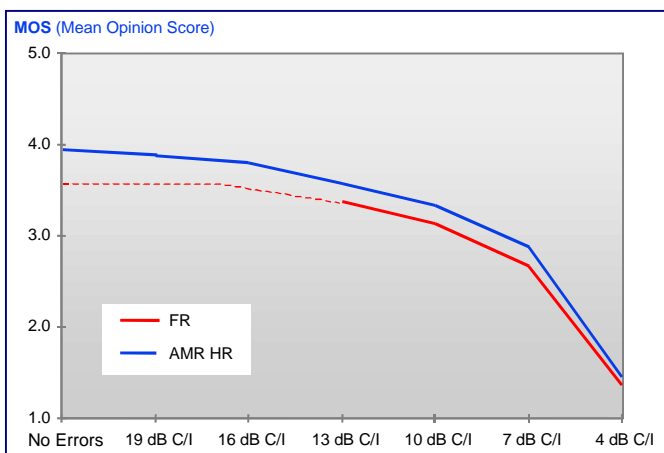


Figure: ETSI Mean Opinion Score test results for current FR and AMR HR

4.6.1 Generic AMR description

AMR consists of 8 different speech codec modes with total of 14 channel codec modes, which are listed, in the following Table:

channel code	channel code	Source coding bit-rate, speech	Net bit-rate, in-band channel	Channel coding bit-rate, speech	Channel coding bit-rate, in-band
TCH/FR	CH0-FS	12.20kbit/s (GSMEFR)	0.10 kbit/s	10.20 kbit/s	0.30 kbit/s
	CH1-FS	10.20 kbit/s	0.10 kbit/s	12.20 kbit/s	0.30 kbit/s
	CH2-FS	7.95 kbit/s	0.10 kbit/s	14.45 kbit/s	0.30 kbit/s
	CH3-FS	7.40 kbit/s (IS-641)	0.10 kbit/s	15.00 kbit/s	0.30 kbit/s
	CH4-FS	6.70 kbit/s	0.10 kbit/s	15.70 kbit/s	0.30 kbit/s
	CH5-FS	5.90 kbit/s	0.10 kbit/s	16.50 kbit/s	0.30 kbit/s
	CH6-FS	5.15 kbit/s	0.10 kbit/s	17.25 kbit/s	0.30 kbit/s
	CH7-FS	4.75 kbit/s	0.10 kbit/s	17.65 kbit/s	0.30 kbit/s
TCH/HR	CH8-HS	7.95 kbit/s (*)	0.10 kbit/s	3.25 kbit/s	0.10 kbit/s
	CH9-HS	7.40 kbit/s (IS-641)	0.10 kbit/s	3.80 kbit/s	0.10 kbit/s
	CH10-HS	6.70 kbit/s	0.10 kbit/s	4.50 kbit/s	0.10 kbit/s
	CH11-HS	5.90 kbit/s	0.10 kbit/s	5.30 kbit/s	0.10 kbit/s
	CH12-HS	5.15 kbit/s	0.10 kbit/s	6.05 kbit/s	0.10 kbit/s
	CH13-HS	4.75 kbit/s	0.10 kbit/s	6.45 kbit/s	0.10 kbit/s

Table: Channel and speech codec modes for AMR

(*) Requires 16 kbit/s TRAU. Therefore it is not seen as a feasible codec mode and will not be supported by Nokia BSS10.

Codec mode adaptation for AMR is based on received channel quality estimation in both MS and BTS, followed by a decision on the most appropriate speech and channel codec mode to apply at a given time. In high-error conditions more bits are used for error correction to obtain error robust coding, while in good transmission conditions only low amount of bits is needed for sufficient error protection and more bits can therefore be allocated for source coding.

An inband-signalling channel is defined for AMR that enables the MS and the BTS to exchange messages on applied or requested speech and channel codec modes. The above mentioned selected speech codec mode is then sent, by using the inband signalling channel, to the transmitting side, where it is applied for the other link. BTS commands the MS to apply a particular speech codec mode in the uplink, but MS can only request BTS to apply a particular speech codec mode in the downlink because BTS has an option to override the MS's request.

MS shall support all speech codec modes, although only a set of up to 4 speech codec modes is used during a call. BSC supports all of speech codec modes, except 7.95 kbit/s on HR channel, and it has one default set for each channel mode. The default codec sets include also a default set of decision thresholds and hysteresis. The initial codec mode and codec set with thresholds and hysteresis are transferred between network elements and MS by using the existing layer 3 signalling, i.e. the basic principles for EFR are reused. Only a few add-ons are needed.

The AMR system makes use of the inband signalling for the link adaptation, for each codec mode set there is an associated set of decision thresholds for mapping the channel quality measurements to the Mode Commands/Requests.

Link adaptation (LA)

There are two link adaptation (LA) modes; the Standard specified fast LA and the Nokia proprietary slow LA. Fast LA BTS allows inband codec mode change on every other TCH frame, but in Nokia proprietary slow LA BTS allows inband codec mode change only on SACCH frame interval. During both LA modes BTS indicates the first and the last used codec during the last measurement interval and the average quality. Reactions are the following in Rx quality cases of power control (PC) and handover (HO) algorithms in BSC:

- If the quality is below lower thresholds, then PC (more power) or HO is triggered depending on the current threshold values. Otherwise if quality is above lower thresholds, nothing is done.
- Respectively if the quality is above upper thresholds, then PC (less power) is triggered. Otherwise if quality is below upper thresholds, nothing is done.

Above cases are valid only in quality HOs, not for, for example, in power budget HOs.

All the information (codec usage and quality) goes to BSC statistics part for further processing.

BSC indicates to BTS about which LA mode is used. Fast LA is the default mode of BSS. The octet defining the LA mode used is not sent to MS by BTS.

Initial codec mode selection by BTS and MS at call set-up and handover

The Initial Codec mode to start the speech coding operation at call set-up and after handover is signalled by layer 3 signalling, in which case is used by BTS and MS.

If the Initial Codec mode is not signalled, the Initial Codec mode, which is used by BTS, and MS is given by the following rules:

- If the codec mode set contains 1 mode, then it is the Initial Codec mode,
- If the codec mode set contains 2 or 3 modes, then the Initial Codec mode is the most robust mode of the set with lowest bit rate,
- If the codec mode set contains 4 modes, then the Initial Codec mode is the second most robust mode of the set with second lowest bit rate.

Channel allocation depends on the new parameter *Initial AMR channel rate*, which default value is Any Rate. Any Rate means that the chosen channel rate is defined by taking into account the currently used information (Channel Type IE, resource situation on radio interface, circuit pool, current channel rate, handover parameters, etc.). The other option is AMR FR, which means that full rate channel is allocated despite of the values of the currently used information. If AMR FR cannot be allocated, then allocation is continued with the currently used information. Parameter is valid in call set-up (except FACCH call set-up), internal inter cell handover and external handover.

The reason behind this new parameter is that quality may not be sufficient for HR AMR call set-up (radio measurement is done on SDCCH).

AMR capable TRXs are allocated first for AMR speech call use and then for other speech calls.

RxQual thresholds

New RxQual thresholds are specified for AMR FR and AMR HR sets. Default values for these new thresholds are set according to the default AMR codec sets. Current Nx and Px values of RxQual thresholds are used.

When replacing or removing a most robust mode on AMR set, the corresponding PC and HO RxQual thresholds needs to be edited manually. This also applies to the least robust mode. Replacement or removal of a middle mode on AMR set does not effect on the new PC and HO thresholds.

Handovers between AMR FR and AMR HR

New RxQual HO thresholds are specified for AMR FR and AMR HR and they are taken into account when making intra-cell handovers between AMR FR and AMR HR:

- *intra HO threshold Rx qual for AMR FR*
- *intra HO threshold Rx qual for AMR HR*

Current Nx and Px values of RxQual thresholds are used.

Packing of AMR FR calls to AMR HR calls due to cell load

Spontaneous packing of AMR FR calls to AMR HR calls is triggered when the cell load is high enough, i.e. the number of free full rate resources reduces below the value of the parameter *Lower limit for FR TCH resources* *amrHandoverFR* (BTS level parameter) and *amrHandoverHR* (BSC level parameter). The decision will be made according to the BTS level parameter, if it contradicts with the BSC level parameter. The current Nx and Px values of RxQual thresholds are used. With these parameters it is possible to define the threshold level of the signal quality down-link and up-link measurements for triggering the intra-cell handover process for an AMR FR call in order to switch it to an AMR HR call and vice versa.

The BSC performs the ordered HOs for FR AMR calls, the quality of which is above the *amrHandoverFR* (the intra HO threshold RxQual for AMR FR) and which use the least robust codec mode. A packing request is valid until it is overwritten by a new one. A packing request, which indicates the amount N as 0, is used to remove any pending packing requests. Moreover, algorithm tries to fill the timeslots in HR channel pairs or tries to find an empty half for one HR channel allocation. Before the FR _ HR handover decision the number of timeslots having only one HR connection are measured. For example, if there is only one half timeslot available, that is allocated first. If more FR _ HR handovers are required, they are made in pairs so that two FR connections are selected and allocated to the same timeslot.

Packing continues until the cell load is low enough, i.e. the number of free full rate resources increases above the value of the parameter *Upper limit for FR TCH resources* (according to the BTS level parameter, if it contradicts with the BSC level parameter).

Unpacking of AMR HR calls to AMR FR calls due to call quality

Spontaneous unpacking of AMR HR calls to AMR FR calls is triggered when the quality of a AMR HR call degrades below the *intra HO threshold Rx qual for AMR HR*. Cell load does not have an effect.

When Rx level is good, BSC performs intra-cell HOs for AMR HR calls one by one according to the new threshold. Otherwise inter-cell HOs are performed according to the current threshold parameters.

AMR FR and AMR HR call counters of BSC are again updated during channel allocations and releases.

Prioritisation of AMR capable cells during internal and external handovers

In order to support AMR call continuation also after internal or external HO, the handover target cell list is manipulated so, that AMR capable cells which load is low, are on the top. The candidate cells on the target list are already pruned by the *adjacent cell parameter HOMarginPBG* (PMRG).

AMR capable cells are verified by the new adjacent cell parameter *AMR target cell of direct access to desired layer* and those AMR capable adjacent cells are prioritised that are below the threshold of BTS parameter *BTS load threshold* (BLT). Prioritisation is only done when AMR call is the current call type.

About finding AMR capable cell in call set-up, see chapter Direct Access to Desired Layer/Band (DADL/B).

IFH and IUO

New AMR specific good and bad C/I thresholds are specified for AMR HR and AMR FR:

- *super reuse good C/I threshold for AMR HR*
- *super reuse bad C/I threshold for AMR HR*
- *super reuse good C/I threshold for AMR FR*
- *super reuse bad C/I threshold for AMR FR*

Current Nx and Px values of C/I thresholds are used.

The new threshold values for AMR HR serve also the basic HR.

The current good and bad threshold pair (*super reuse good C/I threshold* and *super reuse bad C/I threshold*) is going to serve the basic FR. With these new thresholds, operator can control which type of speech calls are preferred to enter the super layers cells, e.g. AMR HR calls could be packed to the super layer in order to increase the capacity of cells (good value for AMR HR e.g. - 5 dB (compared to the current value) and good value for AMR FR e.g. + 5 dB).

FER estimation

FEP, when available (FER estimation is optional), will replace RxQual in Power Control and Handover algorithms.

Measurements

The last used uplink and downlink AMR codec mode in the last measurement interval is added to the Handover Measurement and to the Power Control Measurement.

Direct access to desired layer/band (DADL/B)

In order to support 2nd generation BTSs in AMR environment, DADL/B is used to handover AMR calls to co-located AMR capable cells during call set-up phase. Both intra and inter BSC DADL/B handovers are possible and preferably inside one frequency band as the failure probability is higher with DADL/B handovers between bands.

TCH assignment vs. DADL/B handover start:

- If AMR call is the aim and there are no TCHs available in the accessed cell, then Directed Retry (DR) due to congestion, with or without queuing, is made.
- If on the other hand there are TCHs available in the accessed cell and there are adjacent cells defined as DADL/B handover target cells with the new parameter *AMR target cell of direct access to desired layer*, then the DADL/B handover is applied. Adjacent cells are not verified according to the MS capabilities (single band, dual band or tri-band), but they have to fulfil the current signal level requirements in order to be considered as a target cell for DADL/B handover. Current method for sorting the target adjacent cells is used.

If there are no DADL/B handover target cells defined, the TCH is allocated from the accessed cell and another speech codec than AMR is chosen.

Default AMR codec sets for FR and HR

BTS-MML is used to take care of entering, modifying and displaying the new multi-rate configuration, i.e. AMR codec sets, for BTS. The AMR codec set modification does not require the locking of BTS. The AMR set includes AMR codecs, their threshold and hysteresis values and initial codec mode definition. The basic AMR set for FR channel on BSC:

Codec Mode	Threshold (C/I)	Hysteresis (C/I)	Lower threshold (C/I)	Upper threshold (C/I)	BER (%)	FER (%)
12.2	11	1	11	-	2.97	0.08
7.4	7	1	7	12	6.72	0.15
5.9	4	1	4	8	10.83	0.98
4.75			-	5		

The basic AMR set for HR channel on BSC:

Codec Mode	Threshold (C/I)	Hysteresis (C/I)	Lower threshold (C/I)	Upper threshold (C/I)	BER (%)	FER (%)
7.4	14	1	14	-		0.62
5.9	11	1	11	15		1.08
4.75			-	12		

Lower threshold in the tables above means towards more robust codec and upper threshold means towards less robust codec.

4.6.2 Nokia BSS10 AMR Solution

AMR codecs are supported by different Nokia base station generations as follows:

- Nokia 2nd Generation base stations:
 - Nokia 2nd generation DE21 BTS will not support AMR.
- Nokia Talk-family base stations:
 - Nokia Talk-family BTS will have AMR support for AMR FR modes 4.75, 5.9, 7.4 and 12.2 as well as for AMR HR modes 4.75, 5.9 and 7.4. With this approach, the link adaptation between full scale of AMR FR modes and almost full scale of AMR HR can be achieved.
- Nokia PrimeSite base station:
 - Nokia PrimeSite base station AMR support is similar to that of Nokia Talk-family base stations. Due to limited DSP processor/memory capacity the frequency hopping functionality will be removed from PrimeSite BTSs to enable this SW modification. This means that the last PrimeSite SW release supporting frequency hopping will be DF5.0.
- Nokia InSite base station:
 - Nokia InSite BTS will not support AMR.
- Nokia MetroSite GSM and MetroSite EDGE and UltraSite EDGE base stations:
 - Nokia MetroSite and UltraSite base stations will have full AMR support in CX3 software release.
- AMR codecs support in Nokia BSC and TCSM:
 - All the Nokia BSCs will have full AMR support. Except 7.95 kbit/s on AMR HR channel
 - Nokia TCSM2/E will have full AMR support.
 - New TC PCM pool type which supports AMR FR and AMR HR (pool 23) is implemented in A-interface.

Submultiplexing on highway PCM is 8/16 kbit/s, e.g. if AMR FR (16 kbit/s) is used in Abis interface, then Ater interface rate is also 16 kbit/s.

Supported codecs and features	Supported A-interface pools
FR, HR, EFR, AEC, HSCSD, NS	3, 7, 10, 13, 20, 21, 22 (DR, EFR&DR, HS2, HS4, EFR&DR&D144, HS2&D144, HS4&D144)
FR, EFR, AEC, TFO, NS	1, 5 (FR, EFR&FR)
HR, AEC, TFO, NS	2 (HR)
AMR, AEC, NS	23 (AMR)
FR, HR, EFR, AEC, HSCSD, TTY	3, 7, 10, 13, 20, 21, 22 (DR, EFR&DR, HS2, HS4, EFR&DR&D144, HS2&D144, HS4&D144)
FR, EFR, AEC, TFO, TTY	1, 5 (FR, EFR&FR)
AMR, AEC, TTY	23 (AMR)

Figure. Allowed TCSM2 Pools

Respectively if AMR HR (8 kbit/s) is used in Abis interface, then Ater interface rate is 2 * 8 kbit/s (BSC transmits ones (= bit value 1) on the unused 8 kbit/s sub-timeslot).

Nokia TCSM will not support AMR.

With the AMR HR implementation BSCs maximum channel capacity 4096 must be taken into the account in BSCs TRX amount dimensioning. For example the BSC2i provides with 512 full-rate TRXs capacity or 256 half-rate TRXs.

BSC TRX capacity can be maintained by using FR to HR load threshold parameters described in earlier chapters.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M10	OSS3.1	S10	-	-	N	DF6	DF6 1)	CXM3.0	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 2)	-	-	A 3)	-	O

Note(s): 1) FH will be removed if AMR is implemented. 2) AMR capable MS required. 3) TCSM2 with new pools required.

4.7 BSS10005 Reversed Hunting

In the current GSM system, the MSC always allocates A-interface circuits. The MSC also must know TC-configuration (pools, which circuits are FR, which EFR...). With Reversed Hunting feature, the BSC allocates A-interface circuits. All circuits are similar in the MSC and pools are not needed in the MSC but they are still needed in the BSC.

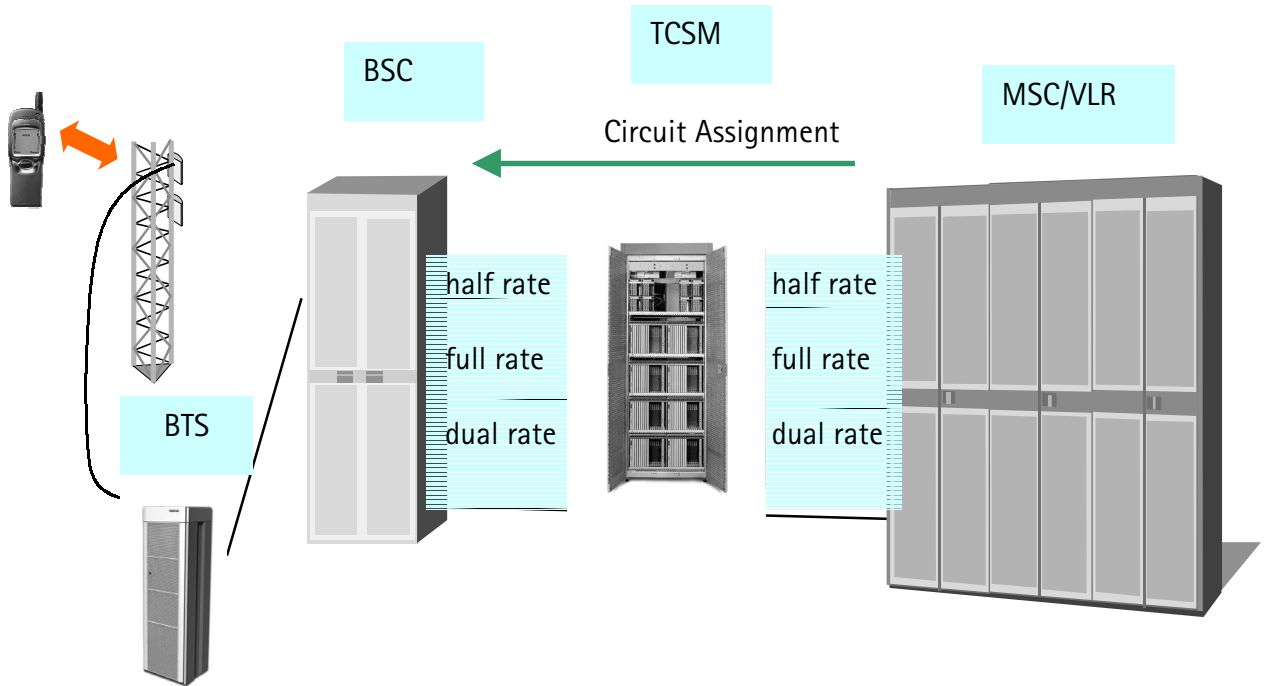


Figure: Current Configuration: MSC gives the circuit assignment order to BSC

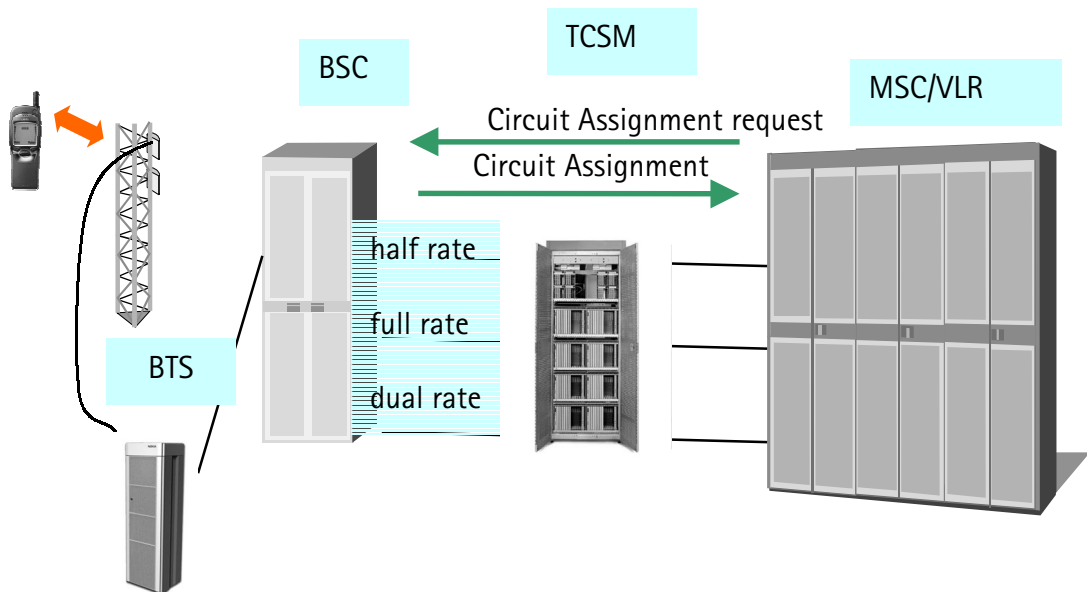


Figure. Reversed Hunting: BSC will give Circuit Assignment order.

When using Reversed Circuit Allocation the MSC configuration maintenance is easier since no need for circuit pools. The circuit pools are however needed in the BSS. Remote TC will still be possible to be used.

The feature Reversed Hunting has impact on the following connection-oriented and connectionless procedures on A-interface:

Connection-oriented:

- Assignment
- Handover
- Circuit Re-selection (new procedure)
- Call Clearing procedure

Connectionless:

- Blocking and Unblocking
- Circuit Group Blocking and Circuit Group Unblocking
- Reset
- Reset Circuit
- Unequipped Circuit

New messages and information elements are also introduced to fulfil the requirements for this functionality.

When Reversed Hunting is enabled in GSM system, it needs to be taken into account already when creating A-interface connection between MSC and BSS which both must support the feature. Circuits must be created as outgoing in the BSS and also routes for every pool must be created towards the MSC and only one route per pool is defined. It is also recommended that the route number should be the same as pool number.

A Conversion program in BSC will be provided for making the changes for the current configuration to reversed hunting.

In the current network, all A interface external circuits are incoming type. They need to be changed to outgoing by the conversion program. Also creating of routes according to existing circuit groups must be done by the conversion program. All existing external circuit pools (for example FR, HS4, and EFR) need own route.

Reference: GSM 08.08 ver 5.6.3: MSC - BSS interface; Layer 3

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M10	OSS3.1	S10	-	-	-	-	-	-	-	-

HW/FW DEPENDENCY:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	-	-	-	S

BSS OPT.:

Note(s):

4.8 BSS10101 GSM-WCDMA Interworking (BSS10.5)

GSM-WCDMA Interworking in GSM means Inter System handover from GSM BSS to WCDMA RAN and the same vice versa.

In order for an operator to provide seamless coverage in areas where WCDMA is not available, for example in rural areas, inter-system handovers must be introduced. Inter-system handovers provide a method of extending the radio network coverage area by making a handover from the WCDMA network to the GSM network.

Additionally, in situations where the WCDMA network and GSM network overlap, an inter-system handover from GSM to WCDMA can be made to release the traffic load in GSM system.

Network Architecture

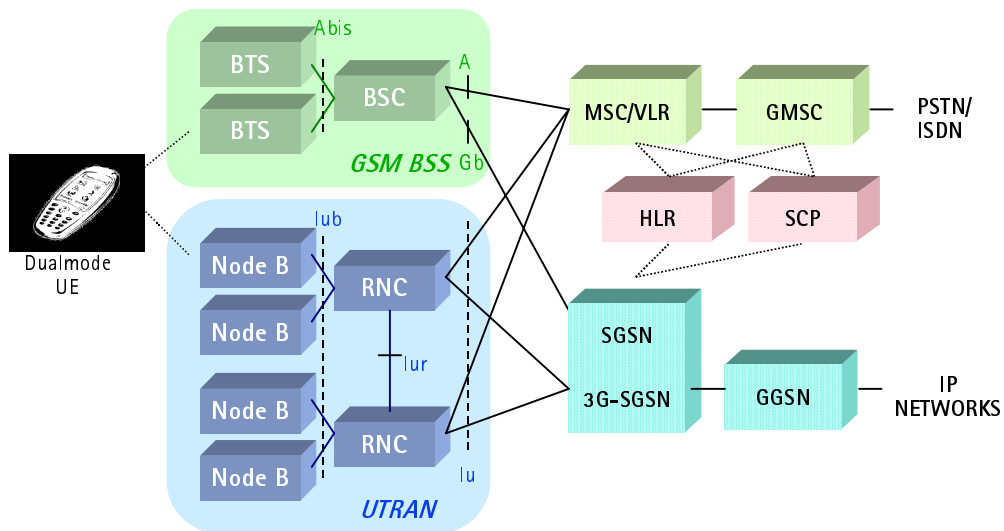


Figure: GSM/W-CDMA network architecture.

There are quite substantial benefits of having inter-system handovers in place. The benefits include:

- seamless coverage extension for 3G with existing GSM network (or vice versa)
- capacity extension for GSM with load sharing between 3G and GSM
- 3G services to all dual-mode subscribers.

Both the circuit switched (handover and MS cell re-selection) and packet switched (MS cell re-selection modes) are supported. Packet switched Network Controlled cell re-selection will be supported in future releases.

4.8.1 Idle mode Support for both Circuit Switched and Packet Switched

Cell Reselection from GSM to WCDMA in Idle State

The mobile performs cell reselection from the GSM network to the 3G network in the idle state. Cell reselection is based on the parameters sent by the network to the mobile. The parameters are sent in the messages:

- System Information Type 2 quarter (idle state)
 - Non-GPRS capable mobiles
 - GPRS capable mobiles, PBCCH not allocated
- System Information Type 2 ter (idle state)
- Packet System Information Type 3 bis

GPRS capable mobiles, PBCCH allocated

The main principles in idle mode cell reselection is that:

- the operator is able to define the cell reselection thresholds by the RNW parameters
- those parameters are sent to the mobile in the System Information messages or in the Packet System Information messages.

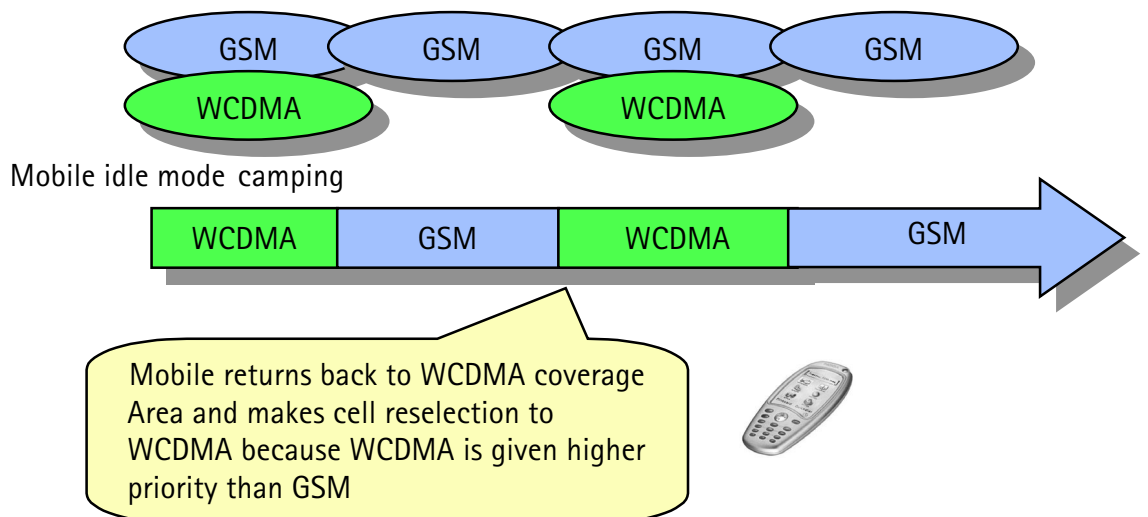


Figure: Idle mode MS cell reselection

If the operator wants the mobile not to reselect a WCDMA neighbouring cell, the way to do that is:

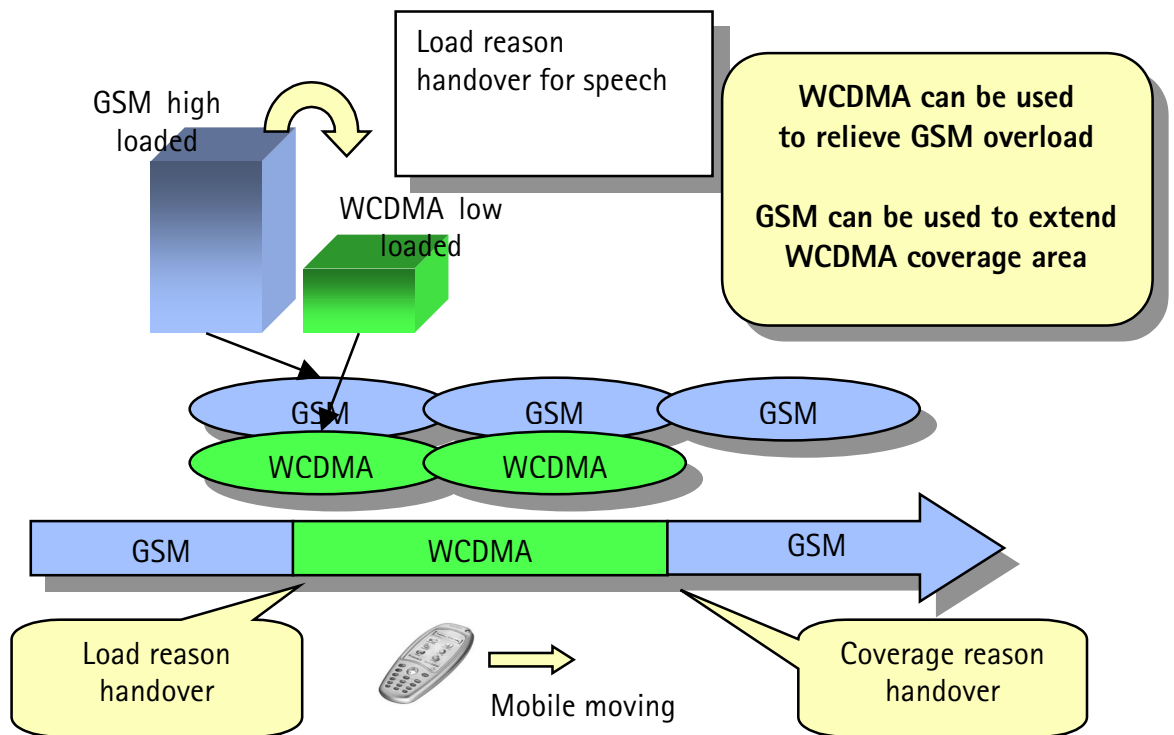
- not to send information about the WCDMA adjacent cells in the System Information messages or in the Packet System Information messages to the mobile
- set the value of the parameter, which controls the measurements for reselection (**Qsearch_I** and/or **Qsearch_P**) so that the mobile will not start the measurements.

In BSS10.5, the operator is able to deny sending of the WCDMA information in the System Information messages to the mobile or to change the values of the parameters mentioned above by the MMI.

4.8.2 Active mode support

4.8.2.1 Circuit Switched

In BSS10.5, the coverage based handover (from WCDMA to GSM) combined with the load based handover (from GSM to WCDMA) are supported.



Handover attempt from GSM to WCDMA is initiated by BSC:

- if the signal strength of the adjacent WCDMA cell is greater than operator defined threshold "Min Ec/No threshold for handover to the UTRAN";
- if the load of the serving GSM cell exceeds the load threshold for speech and transparent data calls. The load threshold is defined by the handover parameter "LOAD_THRESHOLD_FOR_SC_IS_HO".

Note: Procedure of the load checking is similar to the "BSC initiated Traffic Reason Handover". BSC will initiate only as many inter-system handovers as the number of ongoing calls in the serving GSM cell which are over the load threshold. That is, the serving GSM cell is not emptied to the WCDMA.

Handover from WCDMA to GSM is seen as an inter BSC handover in the target system.

Circuit Switched Data

In BSS10.5, handover between GSM and WCDMA for Circuit Switched Data is not supported.

4.8.2.2 Packet Switched

MS will perform cell reselection autonomously. Parameters C32/C31, which are broadcasted on PBCCH, are provided as a complement to the current GSM PS cell reselection criteria. C31/C32 provide a more general tool, which makes cell planning for GPRS is similar to existing planning in GSM. For more information, please refer to BSS10074 PBCCH/PCCCH support.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M11	OSS3.1 2)	S10.5	-	Planner V	B13-1	DF6	DF6	CXM3.0	I3	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	-	-	-	O 3)

Note(s): 1) Dual mode (GSM-WCDMA) MS(UE). 2) OSS3.1 ED1 (Enhancement Delivery). 3) WCDMA RAN and GSM BSS optionality.

5 DATA SOLUTIONS

5.1 BSS10091 Enhanced Data Rates for Global Evolution, EDGE (BSS10.5 ED)

The Nokia BSS10.5 EDGE Solution includes EGPRS for the packet switched data. EGPRS uses nine modulation and coding schemes (MCS) which vary from 8.8 kbit/s up to 59.2 kbit/s with one time slot in the radio interface.

Enhanced Data Rates for Global Evolution (EDGE) will enhance the data capabilities of GSM networks towards 3rd generation services. With new modulation, EDGE increases the Air interface data throughput in average three-fold compared to today's GSM and boosts both circuits switched and packet switched services. Additionally EDGE will be the 3rd Generation radio technology for the TDMA/EDGE operators thus it will converge the radio networks of GSM/EDGE and TDMA/EDGE.

EDGE is being specified in such a way that it will enhance the throughput per time slot triple-fold. In EGPRS, the maximum standardised data rate per time slot will triple and the peak throughput, with eight time slots in the radio interface, will be up to 473 kbit/s.

The Nokia EDGE solution is implemented on top of the existing GSM network and requires only minimal hardware and software upgrades to support the new air interface modulation and the increased data rates. EDGE transceivers will be able to support today's mobile terminals with GSM modulation as well as new enhanced data services on a time slot basis.

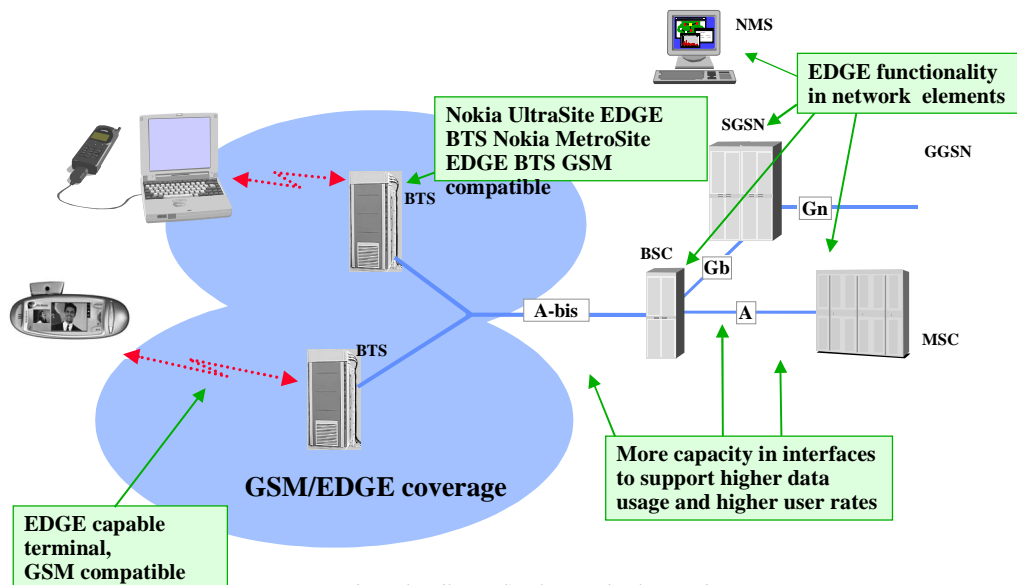


Figure describes ETSI release 99 implementation.

Figure: Impacts of EDGE on the mobile network

Due to new air interface modulation and a lot higher data rates, transceiver units in the base station need to be changed to make it EDGE capable. These base stations will simultaneously support also current GMSK modulation since the modulation choice can be done per time slot basis. Also, new mobile terminals are required. However, as an add-on functionality in GSM network, EDGE does not entail any new network elements.

Benefits of EDGE:

- Migration to wireless multimedia services :
 The operator could increase data revenues by offering completely new type of attractive services to end-users
- Improved end user satisfaction:
 Increased data capacity and higher data throughput will decrease response time for all data services, thus keeping the end users satisfied and connected.
- Potentially lower price per bit:
 Lower cost of data capacity for high-speed data applications gives the operator flexibility in pricing.
- Fast network implementation
 EDGE will not require new network elements and EDGE capability can be introduced incrementally to the network
- Optimised network investment as GSM enhancement
- Flexible data capacity deployment where the demand is.

5.1.1 8-PSK and GMSK modulation

The idea behind increasing the data rates is the introduction of 8-PSK (Phase Shift Keying), a linear higher order modulation in addition to the existing GMSK (Gaussian Minimum Shift Keying). An 8-PSK signal is able to carry three bits per modulated symbol over the radio path, while a GMSK signal carries only one bit per symbol. The carrier symbol rate (270.833 ksps) of standard GSM is kept the same for 8-PSK, and the burst length is identical to the current GMSK using the same 200 k carrier spacing. With multi-slot reservation, EDGE offers an evolution path for GSM to support medium rate multimedia applications.

The user can send more data per radio time slot with the same amount of air time used and operators do not need to invest in another frequency band and license to offer higher data rate services like mobile multimedia.

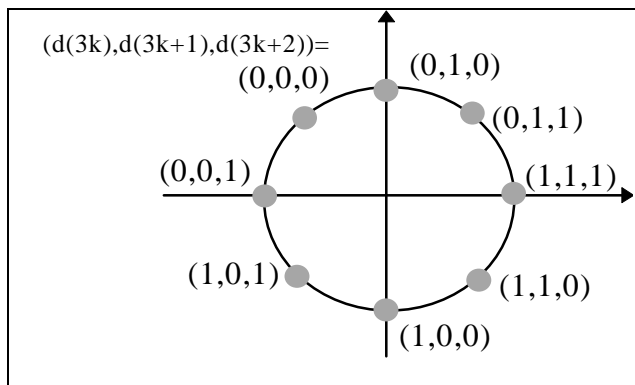


Figure. 8PSK modulation scheme

The table below compares the currently used GMSK modulation with 8-PSK modulation.

	<i>EDGE</i>	<i>GSM</i>
Modulation	8-PSK, 3bit/sym	GMSK, 1 bit/sym
Symbol rate	270.833 ksps	270.833 ksps
Payload/burst	346 bits	114 bits
Gross rate/time slot	69.2 kbps	22.8 kbps

Table. 8PSk and GMSK modulation comparison

5.1.2 EGPRS MCS-1...MCS-9

EGPRS is built on top of GPRS, which is a packet switched data service offering services like web browsing, internet / intranet access etc. EGPRS uses several modulation and coding schemes (MCS) which vary from 8.8 kbit/s up to 59.2 kbit/s in the radio interface.

MCS	Modulation	Code rate	Family	User Rate
1	GMSK	.53	C	8.8 kbit/s
2	GMSK	.66	B	11.2 kbit/s
3	GMSK	.80	A	14.8 kbit/s
4	GMSK	1	C	17.6 kbit/s
5	8PSK	.37	B	22.4 kbit/s
6	8PSK	.49	A	29.6 kbit/s
7	8PSK	.76	B	44.8 kbit/s
8	8PSK	.92	A	54.4 kbit/s
9	8PSK	1	A	59.2 kbit/s

Table: Peak data rates for single slot EGPRS.

GMSK modulation provides the robust mode for wide area coverage while 8-PSK provides higher data rates. The MCSs are organised in families in order to allow re-segmentation of the data block for link adaptation. The protection that best fits the channel condition is chosen for maximum throughput, as higher protection means lower throughput.

5.1.3 Incremental Redundancy, IR

In incremental redundancy (also known as Type II Hybrid ARQ), upon reception failure, (re)transmissions of the data block is different to the initial transmission, but includes additional redundancy, which when combined with the earlier (re) transmission(s), can be used to correct errors. Consequently, IR needs no information about the link quality in order to protect the data. In fact, the correct data block protection is obtained incrementally, after transmitting additional redundancy and combining it with the prevailing (re)transmission(s).

The IR mechanism in EGPRS is designed with the nine MCSs described earlier. The basic characteristic of each MCS is its fixed data rate, hence a fixed protection level. For each of the MCSs, it is possible to reach the same data rate with the same protection level but with another protection scheme (there are 2 or 3 different protection schemes for each of the MCSs).

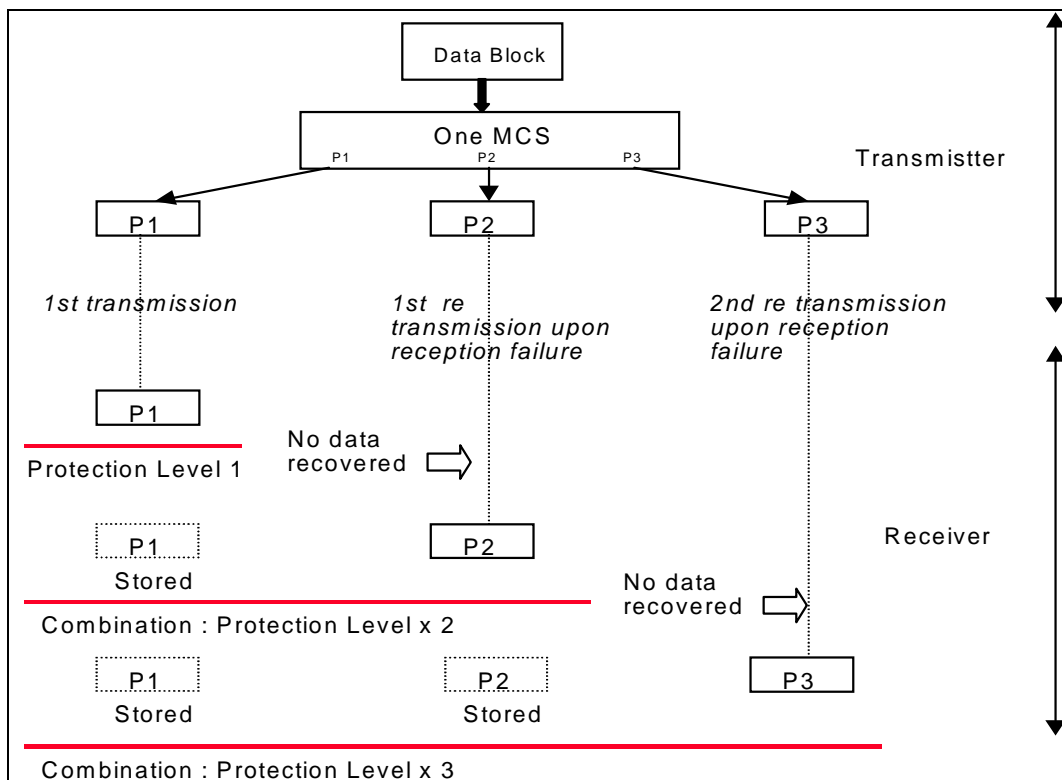


Figure: Incremental Redundancy, IR

There are 3 protection schemes P1, P2 and P3 for a MCS as shown in figure 4. The data block is first protected with the P1 of a certain MCS, and sent over the air to the receiver, which tries to recover the data. If this phase fails, the received P1 is stored in the receiver's memory for future use, and the transmitter sends the data block protected with the P2 of the same MCS. The receiver combines the received P2 with the stored P1 and tries to recover the data from the combination of P1, P2 and so on.

Note: If after P3, the data still cannot be recovered, P1 is sent again, and combined with the stored P1, P2 and P3 (which reaches a protection level of about 4 times the protection level of P1), and so on.

5.1.4 Link Adaptation, LA

The Link Adaptation mechanism works by adapting the protection of the information to be sent, according to the link quality. The upcoming channel quality is predicted accurately from various measurements of the past one. From this prediction the relevant protection of the information to be sent is decided. Therefore, enabling LA requires:

- **Accurate measurements of the link quality**

New efficient measurements have been designed for EGPRS to accurately predict the upcoming link quality in several propagation channels (Typical Urban, Rural Area, Hilly Terrain, etc.) with various speeds.

- **A finite set of protection of the information**

For each user, the smallest allocated resource to send/receive some information is defined as one radio block (20ms). Since the resources are limited, the higher the level of protection for information, the less information is sent.

EDGE uses an enhanced 8-PSK modulation in addition to GMSK. Hence, different protection sets are available in GMSK and 8-PSK as these modulations do not have the same robustness to the propagation channel.

Nine protection schemes are designed for EGPRS from MCS-1 to MCS-9. The information is encoded to resist channel degradation and modulated before transmission over the air interface. MCS1 to MCS9 range from high protection/low bit rate to no protection/high bit rate, as summarised in the table below:

Scheme	Modulation	Data Rate (kbit/s)	
MCS-9	8PSK	59.2	Protection + ↓
MCS-8		54.4	
MCS-7		44.8	
MCS-6		29.6 (27.2)	
MCS-5		22.4	
MCS-4	GMSK	17.6	
MCS-3		14.8 (13.6)	
MCS-2		11.2	
MCS-1		8.8	

Table: Modulation and coding schemes

It should be noted that GPRS is not a subset of EGPRS, i.e. the GPRS coding schemes CS1 to CS4 are different to EGPRS GMSK MCSs.

From one data block to another, it is possible to switch between any of the MCSs, as it is in GPRS. However, in GPRS, once a data block is segmented to fit one particular coding scheme, it is not possible to switch the coding scheme on reception failure and the retransmission takes place with exactly the same protection as for its initial transmission. In EGPRS, it is possible to change the MCS i.e. the data block can be sent again but with better protection than for its initial transmission.

5.1.5 Radio resource management

Segment

Multi BCF feature introduces a new radio network object Segment. Several BTS-objects can belong to one Segment. Only one BTS-object of the Segment can have BCCH. The Segment can have BTS objects, which differ in:

- frequency band (GSM900, EGSM900, GSM1800, GSM800, and GSM1900)
- power levels (Talk-family and UltraSite base stations)
- regular and super-reuse frequencies
- normal and extended cell radius frequencies
- EDGE capability.

TRXs inside BTS-object must have common capabilities. E.g. EDGE capable and non-EDGE capable TRXs must be configured to separate BTS-objects. (E)GPRS territory can be defined to each BTS-object separately.

Super-reuse and extended cell radius frequencies are not supported in (E)GPRS.

	Ultra Site BTS	Talk Family BTS
Segment 1	BTS 1 (sector 1) BCCH EDGE TRX other EDGE TRXs	BTS 1' (sector 1) TRXs (no BCCH)
Segment 2	BTS 2 (sector 2) BCCH EDGE TRX other EDGE TRXs	BTS 2' (sector 2) TRXs (no BCCH)
Segment 3	BTS 3 (sector 3) BCCH EDGE TRX other EDGE TRXs	BTS 3' (sector 3) TRXs (no BCCH)

Figure: Multi BCF and Common BCCH principles for (E)GPRS territories

GPRS preferred BCCH frequency (BFG) is Segment level parameter since there can be only one BCCH-TRX in a segment. Dedicated and Default GPRS capacity can be set separately to each BTS. It is possible to deny GPRS traffic on certain BTS by setting *GPRS Enable TRX* off for all the TRXs of the BTS.

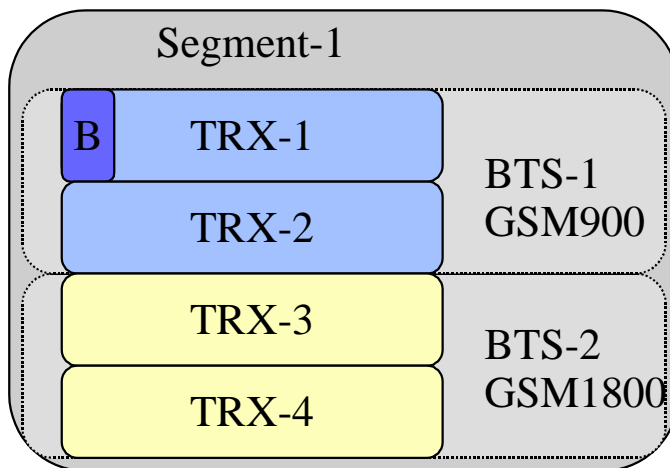


Figure: Example of segment including two BTSs.

There is only one BCCH/CCCH and one or none PBCCH/PCCCH in one Segment. PCU must know the location of BCCH/CCCH and PBCCH/PCCCH and the BTSs that belong to Segment. Segment may have several territories, i.e. one for each BTS. Territory upgrades include both BTS and segment identities. SGSN sees segment as one cell, which has one Cell Identity (CI). PCU indicates the BTS identity when requesting GPRS territory upgrade or downgrade.

In some cases operator may want to restrict the GPRS usage on a certain BTS. For example, if operator has limited use on GSM1800 band and since all the (E)GPRS MSs will be dual band mobiles, the operator wants to direct (E)GPRS Mobiles to GSM1800 band. Since GSM1800 band has smaller cell coverage, operator wants that the connections will do RX_LEV measurements before going to GSM1800 band. In (E)GPRS it means that TBFs should be initiated in GSM900 band. Since GPRS uses full downlink power, operator may want to limit the (E)GPRS GSM900 usage. Due to this, new BTS-level parameter *MaxGPRScapacity* is introduced. It defines the maximum number of PDTCHs allowed in a BTS. This parameter is used in GPRS territory handling.

New parameter *MaxTBFsInPDTCH* defines how many TBFs can be allocated to a PDTCH in average in a GPRS territory. This parameter is used when initial TBF allocation is done. When TBF is reallocated, for example due to GPRS territory downgrade, the parameter is not used.

New parameter *MaxGPRScapacity* defines maximum number of PDTCHs in a BTS-object. Operator can control the GPRS territory sizes in different BTS-objects.

PDTCH allocation

PDTCH allocation is based on the MSs capability to different bands or EDGE and to GPRS-territory load in different BTS-objects in a segment. Initial TBF allocation may not be possible to the most suitable BTS, e.g. GSM1800 band may not be used before having some measurements from the MS. Each TBF is polled periodically to check whether intra BTS-object or inter BTS-object reallocation should be done.

NonBCCHlayer_offset

RXLEV is measured from BCCH. Parameter *NonBCCHlayer_offset* defines the path loss difference when the traffic channel is in different BTS-object. Parameter *GRPSNonBCCHlayerRxlevUpperLimit* defines the threshold when TBF allocation to certain BTS-object is allowed. Allocation to non-BCCH BTS-object is allowed when

$RX_LEV (BCCH) + NonBCCHlayer_offset > GRPSNonBCCHlayerRxlevUpperLimit$

EGPRS/GPRS allocation

EDGE capable MSs are allocated primarily to EDGE capable BTS-objects and non-EDGE capable MSs to non-EDGE capable BTS-objects.

Load based allocation

Number of TBFs on a PDTCH (TBF/PDTCH) is followed

- for each BTS-object (average) and
- for each individual TBF.

Reallocation (to different BTS or within the same BTS) is done when

TBF/PDTCH for a TBF is $>$ average TBF/PDTCH of BTS + TBF/PDTCH reallocation threshold.

Target BTS can be the currently used BTS, which means intra BTS reallocation. TBF/TSL reallocation threshold is PCU fixed parameter.

Reallocation need is checked periodically.

Restrictions:

- PBCCH/PCCCH band should have (E)GPRS territory, even dedicated capacity. Otherwise TBFs can not always be established non-BCCH band territory.
- EGPRS TBF allocation in case of dual band segments.
 - Two phase access is used to get EGPRS TBF, in no PBCCH is present in the cell.
 - If MS RAC is received for all the frequencies of the cell, then the MS can be allocated in other than BCCH band. Not necessarily received in case of UL TBF, depends on the MS implementation.
- TBF mode can not be changed for active TBF. It is decided in the TBF establishment phase. This means that if EGPRS MS gets an GPRS TBF, the mode of it does not change until a new TBF is established for the MS.

5.1.6 Packet Control Unit (PCU) Hardware in BSC

The Packet Control Unit (PCU) is a plug-in unit that controls the (E)GPRS radio resources, receives and transmits TRAU frames to the BTSs and Frame Relay packets to the SGSN.

Nokia Packet Control Unit (PCU) solution has high capacity and reliability. The high capacity is provided through state of art PCU design and with a future extension possibility. The high reliability is achieved by N+1 redundant PCU units.

The operator can share the BTSs for multiple PCUs i.e. the packet switched traffic load can be shared among BCSUs. The operator needs to reserve Gb interface capacity from all the PCUs, which are connected to BTSs, i.e. from the active PCUs.

One logical PCU can manage up to 256 Abis 16k-sub timeslots, which are directly mapped to Air interface PDCH channels. PCU removes the unnecessary TRAU overheads coming from the Abis interface and assembles the data into Frame Relay for the Gb interface. BSC and SGSN are connected to each other with one or more n*64kbit/s Gb interfaces. The number of interfaces is equal to the number of PCUs, i.e. each PCU has its own logical Gb interface. Gb is a Frame Relay interface and it can be configured in 64kbit/s steps from 1 timeslot up to 31 timeslots depending on the capacity requirements.

The design target is that BSS9 level GPRS PCUs can be used with EGPRS. Additionally there is a possibility to add 2nd PCUs per each BCSU units, 8+1 to increase the packet switched capacity. This 2nd PCU requires also GSWB extension from 192 to 256 PCMs. Furthermore the BSCs external connectivity and PCMs can be extended from 112 to 144 external PCMs in BSC2s with 2*ET5C extra cartridges.

Then BSC2's maximum packet switched connectivity is 2 PCU/BCSU x 8 BCSU x 256 channels = 4096 16kbit/s Abis channels towards Abis interface.

Towards Gb interface the maximum connectivity is 2 PCU/BCSU x 8 BCSU x 31 TSL = 496 x 64 kbit/s Gb interfaces (31.74 Mbit/s) (ETSI).

BSC3i's maximum packet switched connectivity is 2 PCU/BCSU x 6 BCSU x 256 x 2 channels = 6144 16kbit/s Abis channels towards Abis interface.

Towards Gb interface the maximum connectivity is 2 PCU/BCSU x 6 BCSU x 31 x 2 TSL = 744 x 64 kbit/s Gb interfaces (47.6 Mbit/s) (ETSI).

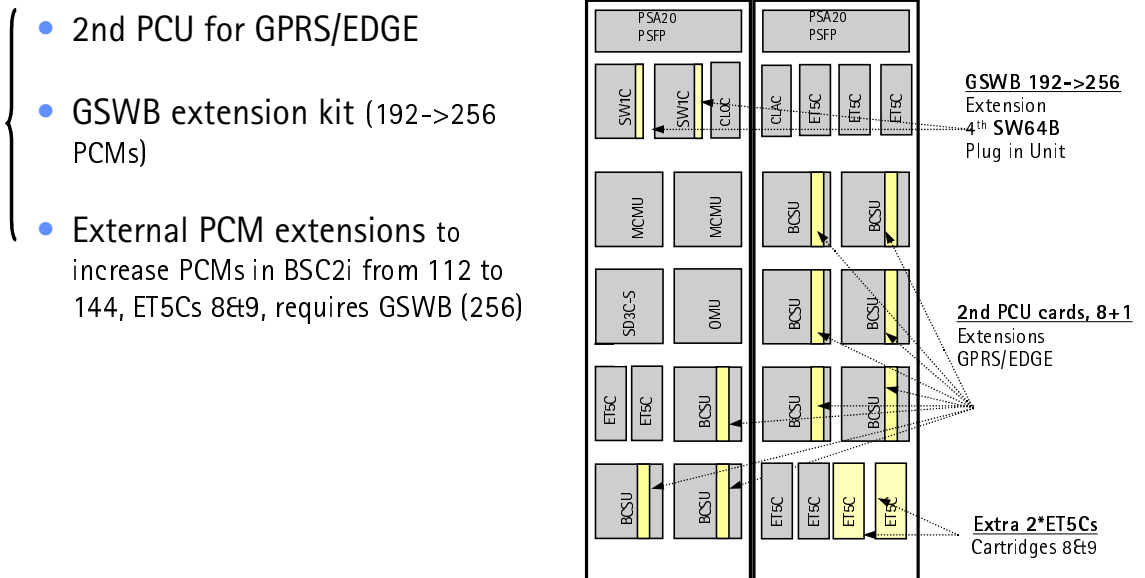


Figure: BSC2i EGPRS HW Extension options

In implementation and network planning, DX200 BSC2i maximum configuration capacity (512 TRX, 248 BTS per fully configured high capacity BSC) should be considered due to non-EDGE and EDGE TRX need to be configured under different BTSs.

Note: Dynamic Abis is needed for transmission when EDGE is taken into use.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1 4)	S10.5ED	SG2	Planner 4	N	N	N	CXM3.3	N	CX3.3

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	Y 2)	A 3)	-	-	O

Note(s): 1) EDGE capable mobiles 2) In BSC2E/A and BSC2i Optional PCU, Packet Control Units (1+8->2+16) and GSWB (192->256) extensions and ETs can be extended (112->144 E1/T1s), BSCE and BSCi do not support 2nd PCUs in BSS10 or BSS10.5 BSCi support for 2nd PCU is under study. BSC3i: 6+1 PCU, 2 logical PCU/physical unit, 3) New EDGE capable transceiver. 4) OSS3.1 ED2 (Enhancement Delivery).

5.2 BSS10104 Nokia Smart Radio Concept for EDGE (Nokia SRC)

Nokia Smart Radio Concept (SRC) is an important new feature for getting the maximum EDGE benefit, first phase supported by Nokia UltraSite EDGE base station with BSS10 hardware and software.

SRC is a novel feature that will enhance the radio performance of the BTS, both in EDGE and GSM mode. The Nokia SRC includes a combination of diversity solutions applied in both uplink and downlink directions. The Nokia SRC for EDGE is used to improve radio link performance to ensure maximum coverage, improved data capacity and high service quality. For utilising the Nokia SRC, EDGE capable equipment is required.

4 way uplink diversity and Interference Rejection Combining, IRC

In the BSS10 the uplink performance (BTS reception) is enhanced with the combination of Interference Rejection Combining via 4-way diversity reception of the BTS and sensitivity optimised high-gain Nokia UltraSite Masthead Amplifiers (UltraSite MHA introduced already in BSS9).

IRC tries to null correlated noise received by both antennas.

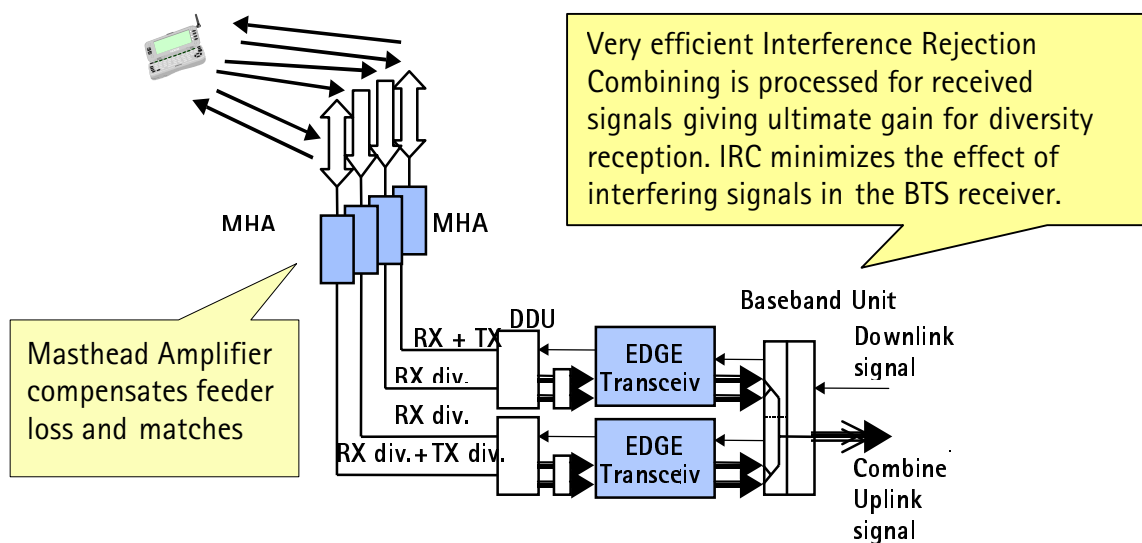


Figure: 4-way uplink diversity and IRC

If there is no correlated noise (interference), then IRC behaves like normal Maximum Ratio Combining.

Gain of IRC depends on Dominant Interference Ratio and angular spread of interference [PAR].

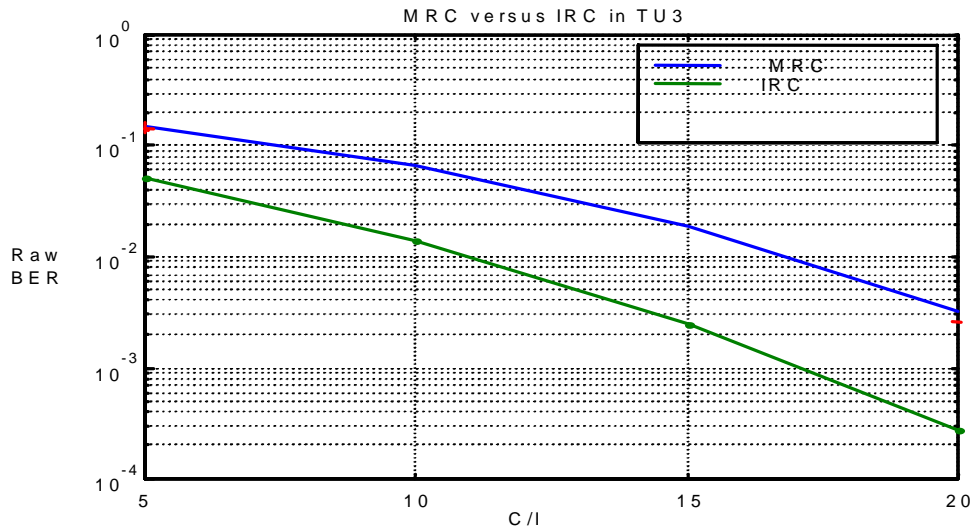


Figure: Gain of Interference Rejection Combining

Post Detection Maximum Ratio Combining is then used for two IRC combined signals providing up to 3dB ideal method for dual X-polarised antenna concept providing capacity and coverage enhancements.

IRC utilises auxiliary transceiver effectively for both the UL and DL.

Intelligent Downlink Diversity, IDD

The antenna diversity gain is also applied in downlink enhancement, through a feature called Intelligent Downlink Diversity (IDD). In IDD the cell coverage area is extended by sending simultaneously the same downlink signal through minimum of two transmitters, with slight delay. Two antennas (or X-polarised antenna) are needed for one cell.

The IDD boosts downlink performance by up to 5 dB (min. 3 dB), in all radio timeslots. The typical configurations in one UltraSite EDGE base station cabinet are, for example: 1+1+1 with combiner by-pass, 2+2+2 with 4-way diversity and 6 TRXs/cell with RTC for large coverage and high capacity needs. In every case additional TRX for diversity transmitting is required.

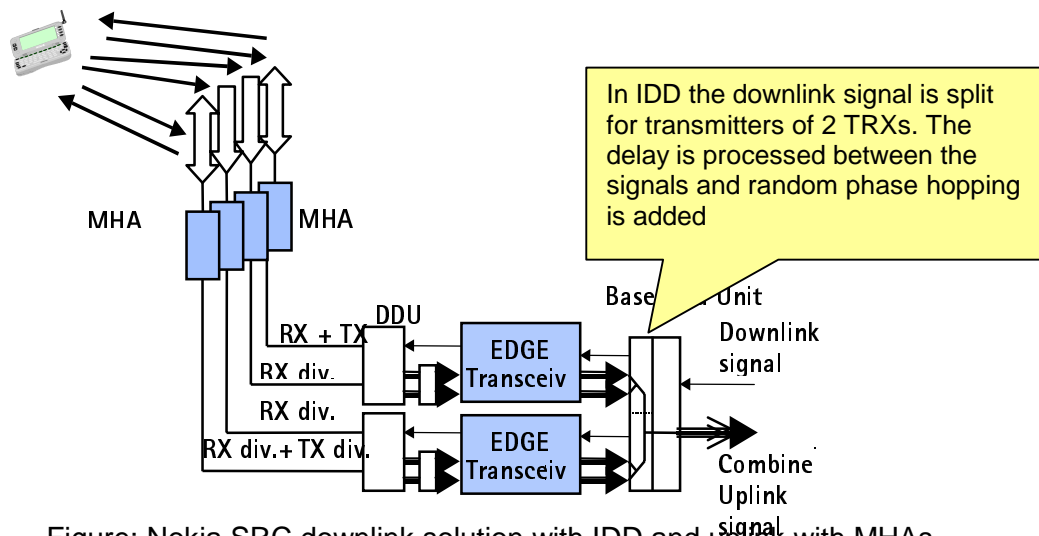


Figure: Nokia SRC downlink solution with IDD and uplink with MHAs

Transmission takes place through two TRXs and antennas. Auxiliary transmission is delayed 1-1.5 symbol periods, which gives good performance for all modulation schemes. Random Phase hopping decreases correlation between the main and auxiliary transmitter. Correlation between the antennas has to be low.

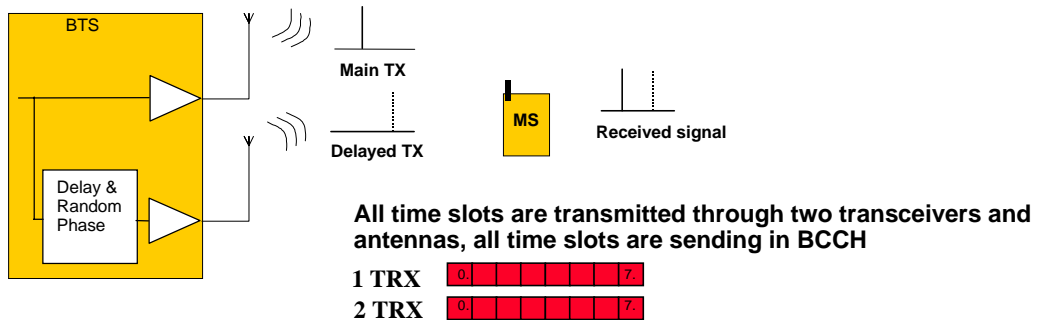


Figure: Intelligent Downlink Diversity for EDGE TRXs

All time slots are transmitted through two transceivers and antennas, all radio timeslots are sending in BCCH carrier.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	-	S10	-	Planner 4	N	N	N	N	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	Y	-	-	Y	-	-	S 1)

Note(s): 1) EDGE HW required.

5.3 BSS10045 Dynamic Abis Allocation (BSS10.5 ED)

Dynamic Abis allocation in BSS10.5 is a solution for higher data rates of EGPRS to ensure cost efficiency and flexible Abis transmission capacity addition. The Dynamic Abis functionality allocates Abis transmission capacity to cells when needed instead of reserving full fixed transmission link per TRX.

As data rates per radio time slot can vary between 8.8 and 59.2 kbit/s, traditional static Abis allocation does not use transmission resources efficiently. The Dynamic Abis feature uses existing Abis more efficiently by splitting PCMs into permanent time slots for signalling and voice or data and a dynamic pool for data. The pool can be shared by a number of transceivers. The Dynamic Abis transmission solution saves up to 70% in the Abis transmission expansion cost as it allows Abis dimensioning to be performed near to the average data rates instead of peak rates. This also applies to the number of 2M BSC interfaces needed.

Dynamic Abis is implemented as a software feature. Quality of service is improved by the Dynamic Abis method, which uses allocation of circuit switched connections under real time centralised control. The implementation of shared transmission channel connection pools is supported by Nokia cellular transmission cross connection products and made easy with the Nokia NetAct transmission network planning tool.

PCU frame is used in PS world in corresponding to TRAU frame in CS. One PCU is 16kbit/s.

With Dynamic Abis, there are following PCU frame types:

- PCU data frame is used when TRX is not in EDGE mode and only is able to carry CS-1 and CS-2
- PCU master data frame is used when TRX is in EDGE mode and carries CS-1 or MCS-1 on its own and CS-2...CS-4 and MCS-2...MCS-9 with the help of slave frame(s). It also includes pointers to the slave frames
- PCU slave data frame carries additional data that does not fit in PCU master data frames
- PCU random access frame
- PCU synchronisation frame

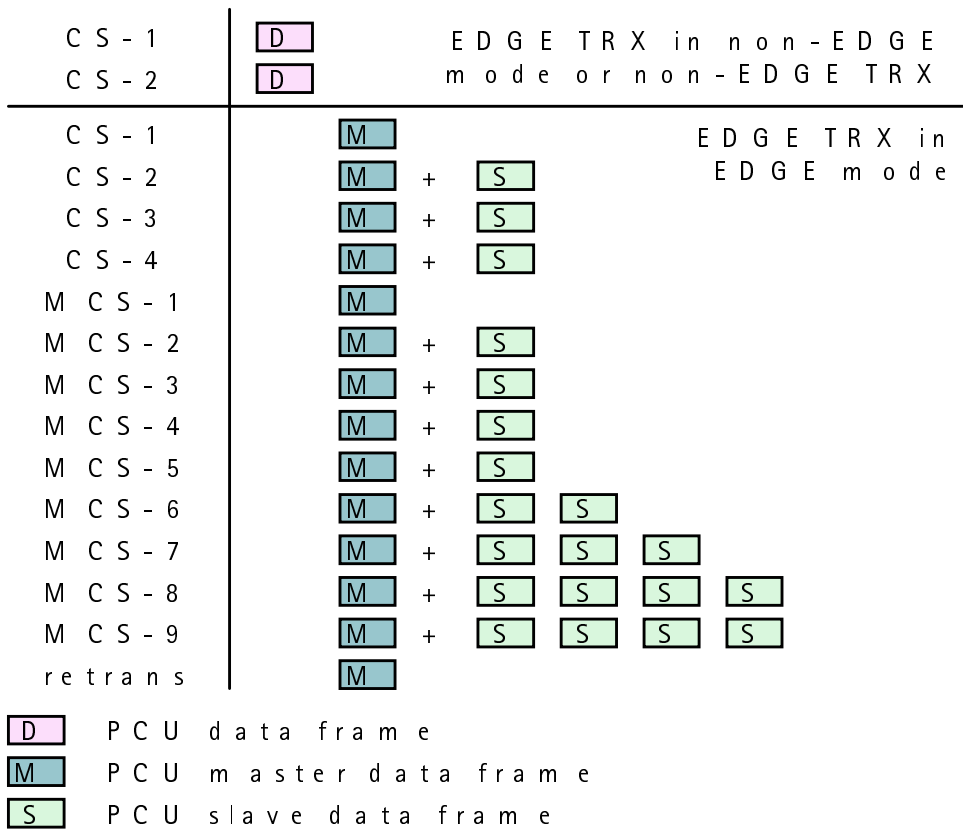


Figure: PCU Data Frames: Data, Master and Slave, each frame is 16 Kbit/s

EDGE TRXs are configured so that signalling (TRXSIG, BCFSIG) is fixed reserved and 1 timeslot for reserved for voice call or master frames is also fixed reserved.

PCU slave data frames are allocated from a common pool which is called EDAP (EDGE Dynamic Abis Pool).

Each downlink PCU master data frame includes a pointer to downlink slave frames on the same block period, and a pointer to uplink slave frames on the next block period.

The maximum size of EDAP is 12 PCM timeslot. This is because that BTS can transceive 64 16-kbps channels of which 16 are reserved for circuit switched use or for PCU master channels. This leaves 48 16-kbps channels which equals 12 PCM timeslots for EDAP.

A master channel and its slave channels and therefore the entire EDAP must be on the same Abis PCM.

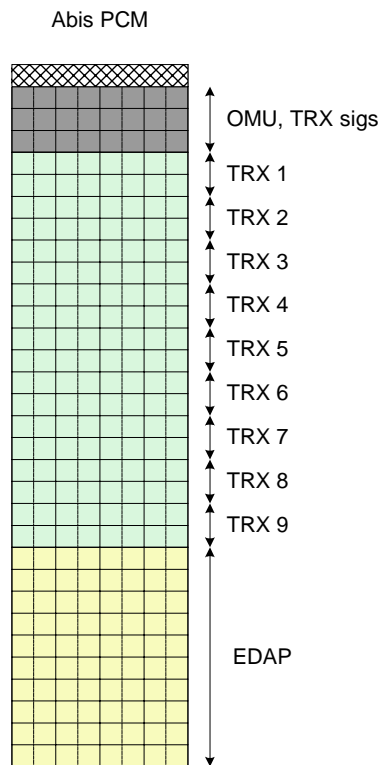


Figure: EGPRS Dynamic Abis Pool (EDAP)

GSM TRXs are connected as before to BSC, with a 16 kbit/s point-to-point link from the TCH to the BSC.

Maximum number of TRXs per Dynamic Abis pool is 20 due to signalling requirements of BCSU unit.

Restrictions

- There can be 16 EGPRS Dynamic Abis Pools per PCU
- 1 EDAP can not be divided to different PCU/PCMs, in other words, BTSs using same EDAP has to be in the same PCU with EDAP.

Interworking with other Nokia features

ISDN Abis

ISDN Abis and Dynamic Abis allocation can not be used together.

GPRS

GPRS territory method and EGPRS use the dynamic Abis.

Compatibility with base stations

BSS10.5ED solution for the Dynamic Abis is compatible with Nokia MetroSite and UltraSite EDGE base station EDGE TRXs.

Note: PCU connectivity needs to be taken into account in dimensioning once Dynamic Abis is taken into use.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1 2)	S10.5ED	-	Planner 4	N	N	N	CXM3.3	N	CX3.3

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	-	-	-	A 1)	-	-	O 3)

Note(s): 1) EDGE capable TRX, 2) OSS3.1 ED2 (Enhancement Delivery), 3) Dynamic Abis is part of EDGE optionality

5.4 BSS10074 Support of PCCCH/PBCCH (BSS10.5)

This feature will bring dedicated CCCH capacity for (E)GPRS services.

PCCCH comprises logical channels for packet common control signalling. The following common control channels are available:

PRACH is used by MS to initiate uplink transfer for sending data or signalling information. Packet Access burst and Extended Packet Access burst are used on PRACH.

Nokia BSS10.5 implementation is based on Network Mode of Operation I(NOM I), the network sends a CS paging message for a GPRS-attached MS, either on the same channel as the GPRS paging channel (i.e., the packet paging channel or the CCCH paging channel), or on a GPRS traffic channel. This means that the MS needs only to monitor one paging channel, and that it receives CS paging messages on the packet data channel when it has been assigned a packet data channel.

PPCH is used to page an MS prior to downlink packet transfer for the packet data services and to page circuit switched services. PPCH uses paging groups in order to allow usage of DRX mode. The paging for circuit switched services on PPCH requires Gs interface between MSC and SGSN.

PAGCH is used in the packet transfer establishment phase to send resource assignment to an MS prior to packet transfer.

PBCCH broadcasts packet data specific System Information (for example C31 and C32 cell selection criteria).

The new cell re-selection criteria C31 and C32 are provided as a complement to the current GSM cell re-selection criteria. C31/C32 provide a more general tool which makes cell planning for GPRS similar to existing planning in GSM. C31 is a signal strength criterion used to decide whether prioritised cell re-selection shall be used. For cells that fulfil the C31 criterion, the cell with highest priority class shall be selected. If more than one cell has the highest priority, the one of those with the highest C32 value shall be selected. If no cell fulfils the C31 criterion, the one among all cells with the highest C32 value shall be selected.

If PBCCH is not allocated, the packet data specific system information is broadcast on BCCH, and existing C1/C2 are used.

Note: PCCCH/PBCCH are mapped to own timeslot. It should be configured on the same TRX as BCCH in the case of Multi-band cell. With BSS10.5 implementation, PBCCH/PCCCH can not carry user data.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M11	OSS3.1 2)	S10.5	SG2	Planner 3.4	B13	DF6	DF6	CXM3.0	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/ OPT
Y	-	Y 1)	-	-	-	-	S

Note(s): 1) (E)GPRS capable terminals. 2) OSS3.1 ED1 (Enhancement Delivery).

5.5 BSS10084 Priority Class based Quality of Service (BSS10.5)

At a system level the concept of 'Priority Class' is introduced. This is based on combinations of GPRS Delay class and GPRS Precedence class values. Packets will be evenly scattered within (E)GPRS territory between different time slots. After that packets having higher 'Priority' are send before those packets having lower 'Priority'.

Currently all TBFs (GPRS calls) have same priority. All users and all applications get same service level. The needs from different applications differ and mechanisms to have separate service levels are required. GSM specifications define QoS functionality, which gives a possibility to differentiate TBFs by delay, throughput and priority. Priority Based Scheduling is introduced as the first step towards QoS. With Priority Based Scheduling operator can give users different priorities. Higher priority users will get better service than lower priority users. There will be no extra blocking to any user, only the experienced service quality changes.

The scheduling algorithm gives each link a so-called latest service time, before which the connection should get a chance to use the radio resource. After the link has used the radio resource it is given a new latest service time, which is the current time plus a predefined step. The connection that has the smallest latest service time gets to use the radio resource. Periodically the scheduling algorithm comes and checks on the queue. In Nokia GRPS Release 1(BSS9), these steps are set to the same constant value for all TBFs. This in effect produces a round robin like queuing system.

The new algorithm is priority based. It selects the best possible time slot within territory and then prioritises the TBFs residing in that time slot so that the TBF with the highest priority gets the most air interface. As the solution does not affect the allocation process the number of customers served stays constant when compared to Nokia GPRS release 1.

Each time slot has a queue in which the TBFs wait for their turn to use the radio air interface. After the TBF has used its air interface time it increases it's latest service time to the current time plus it's scheduling step size. The use of the current time is explained by new TBFs coming in to the system, all TBFs must start from the same situation.

The algorithm has a direct impact on the scheduling algorithm. The sizes of the scheduling steps have to be set so that they reflect the handing out of radio resources, because the time a certain link has control of the radio resource is decided by the scheduling algorithm. Each service class is given fair amounts of radio time. The only exception being best effort customers, who are given a small share of the radio interface. Priorities are implemented by giving different scheduling step sizes for different QoS classes. Scheduling step sizes are operator adjustable. There are 4 QoS classes for uplink, and 3 QoS classes for downlink.

Table below gives some suggested values for the step sizes. The actual parameter values will be operator adjustable and Nokia suggested values will be presented based on simulations.

QoS class	"gold"	"silver"	"bronze"	Best effort
Step size	3	6	9	12

Table: Set of scheduling step sizes.

This algorithm provides priorities between TBFs in the same time slot so that the TBFs that have the same QoS get an equal share of air time. However equal air time does not provide equal data rates for the TBFs in the same time slot, it only guarantees that inside a QoS group the air time is divided equally and that a higher QoS class gets more air time.

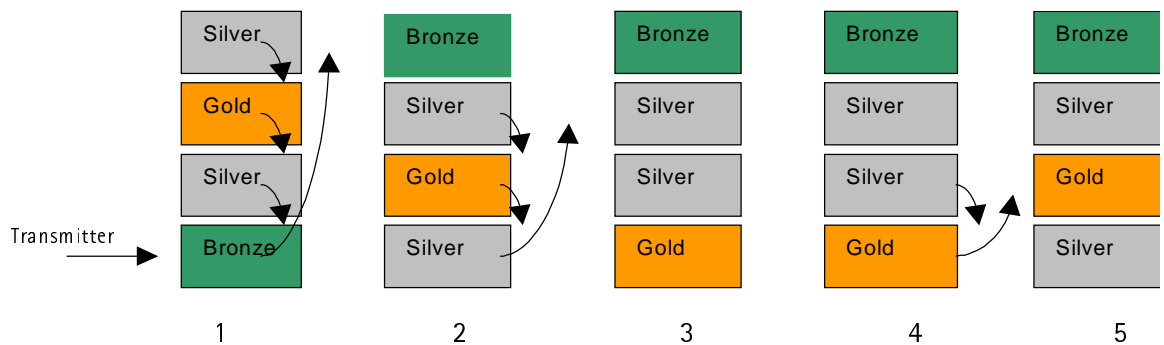


Figure: Example of transmission turns

Mobile specific flow control is part of the QoS solution in the PCU. This feature works together with the SGSN to provide a steady data flow to the mobile from the network. It also is an effective countermeasure against buffer overflows in the PCU.

Priority Based Scheduling in BSC is standard feature and subscriber priority needs to be defined in HLR once this feature is taken into use.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M11	OSS3.12	S10.5	SG2	-	(B12)	(DF5)	(DF5)	(CX2)	(I2)	(PU1)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	-	-	-	S

Note(s): 1) (E)GPRS capable terminals 2) OSS3.1 ED1

5.6 BSS10089 System Level Trace (BSS10.5)

This system level feature extends the current GSM tracing facility to the GPRS service. Currently tracing is available in the network elements of the GSM network to trace circuit switched calls.

The trace facility enables customer administration and network management to trace activities of various entities (IMSI and IMEIs), which result in events occurring in the PLMN. Trace facility is a useful maintenance aid and development tool, which can be used during system testing. In particular, it may be used in conjunction with test-MSs to ascertain the digital cell 'footprint', the network integrity and also the network quality of service, as perceived by the PLMN. The GSM specification specifies the Trace facility for GSM, where it refers to (Figure):

- Subscriber tracing (tracing of IMSI)
- Equipment tracing (tracing of IMEI).

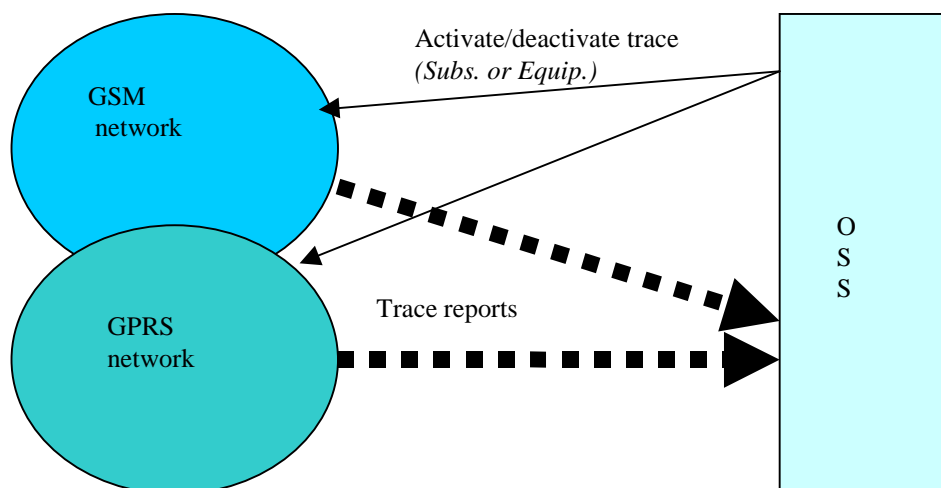


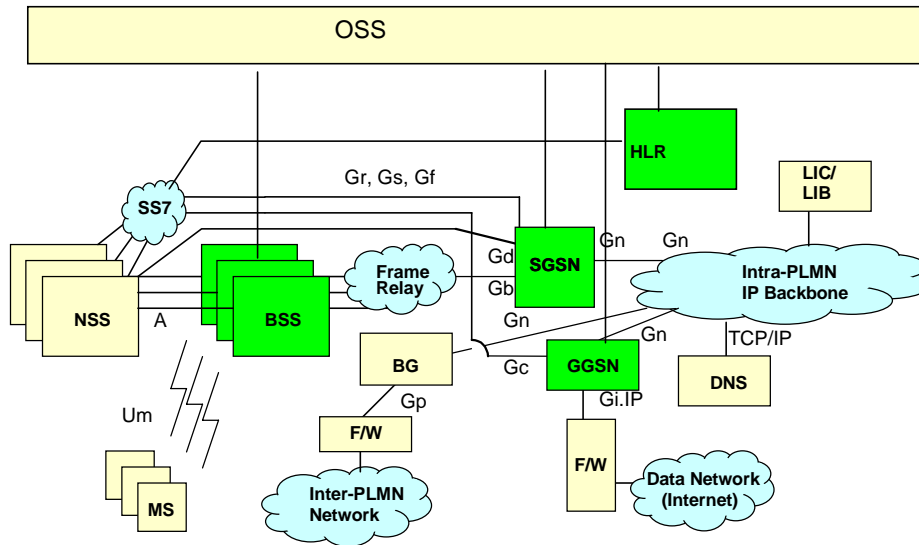
Figure: Trace activation/deactivation and report generation.

The subscriber tracing can be defined for a certain subscriber in the HLR or in a specific SGSN. Equipment tracing can be defined in the SGSN.

Trace is already implemented in GSM network, but introduction of GPRS-service adds new network elements to GSM network (GGSN, SGSN) and changes old principles: existing trace features will to be updated.

The network management can use the facility for subscriber trace, for example, in connection with a customer complaint or if equipment malfunction is suspected.

Below is a picture, which presents the architecture of GPRS network and related network elements. All network elements that can send trace reports to NetAct are darker in this figure.



In figure the overall picture of GPRS trace can be seen. Trace is activated by OSS. HLR, SGSN, GGSN and BSS send trace records to OSS, when invoking event occurs.

In SGSN trace three different scenarios can be identified from operators' viewpoint:

- HPLMN operator traces its own IMSI within the HPLMN
- HPLMN operator wants to trace foreign roaming subscriber (IMSI) within its own HPLMN
- HPLMN operator wants to trace equipment (IMEI).

When operator wishes to trace GPRS subscriber in own (home) network, trace is first activated in HLR. If subscriber is not roaming outside HPLMN and she is register in HLR, HLR activates trace in specified SGSN. Otherwise HLR waits until the subscriber becomes active in HPLMN before it activates trace in SGSN.

When operator wants to trace foreign subscriber, trace is activated directly via MMI commands to all SGSNs in operator's network. Trace of subscriber is in state active pending, until an invoking event occurs. Amount of active trace cases can be limited.

When operator wants to trace equipment, trace is activated directly via MMI commands to all SGSNs in operator's network. Trace of equipment is in state active pending, until an invoking event occurs. Amount of active trace cases can be limited.

The tracing of roaming IMSIs and the exchange of data is subject to bilateral agreements and the request to trace a particular IMSI comes through administrative channels. The HPLMN operator can use the HLR parameters to define whether the trace settings are sent to the VPLMN.

NE's involved

Trace is a system level feature and in order to get full advantage of trace it must be implemented in all main network elements of GPRS network: SGSN, GGSN, BSC, MSC/HLR and OSS.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M11	OSS3.12)	S10.53)	SG2	-	(B12)	(DF5)	(DF5)	(CX2)	(I2)	(PU1)

HW/FW DEPENDENCY: BSS OPT:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	-	Y 1)	-	-	-	-	S

Note(s): 1) (E)GPRS capable terminals 2) OSS3.1 ED2 3) available as a S10.5 CD

5.7 GPRS Non_DRX mode on CCCH

When MS is in DRX (Discontinuous Reception) mode, it is only required to monitor the radio blocks defined by its paging group. DRX mode is used to conserve battery power.

The non-DRX mode period occurs when the mobile station has left the packet transfer mode and enters packet idle mode. This period of time is determined by the non-DRX timer negotiated during the GPRS Attach procedure. The purpose of this period is to minimise delay in establishing this subsequent downlink TBF. During this period the MS is reading all AGCH/PAGCH and PCH/PCCH blocks on its assigned CCCH or PCCCH.

Negotiation of DRX parameters is per MS. DRX parameters are received from SGSN.

There is a new parameter:

DRX_TIMER_MAX: Maximum duration for non drx mode period in the cell. The parameter value is given as two taken to the power of the binary value minus one (2 (bv - 1)) in units of 1 second. The binary value zero indicates that non-DRX mode is not supported in the cell i.e. the parameter takes the values: 'not supported', 1 s, 2 s, 4 s, .. 64 s.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	-	S10	Y	-	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	-	-	-	S

Note(s): 1) GPRS capable MS.

5.8 TBF Pending state

A new TBF pending state is implemented into the beginning of the abnormal release procedure. In the beginning of the abnormal release procedure PCU starts new timer and will not do any further actions for that TBF before timer has expired. If during this timer PCU receives FLUSH-LL message from SGSN or gprs_suspension message from mobile, PCU acts by the message and updates corresponding counters.

If PCU does not receive described messages new MAC_TMR_TDLBLOCK expires and PCU continues abnormal release procedure and updates 072057 counter if eight sequential PACKET_DL_ACK/NACK messages were missing at the time abnormal release procedure was started. Also PCU will not send the RADIO-STATUS message before new timer has expired.

There are 2 reasons for this implementation:

1. TBFs are longer and it is more likely that the mobile will perform cell change during long DL TBF. Cell change may cause PCU to initiate abnormal release procedure after it has not received eight sequential PACKET_DL_ACK/NACK messages from mobile as a response to DL data polling. This case happens if FLUSH-LL message arrives PCU too late and abnormal release procedure has already started. This case is quite usual in real environment.
2. If mobile has to suspend DL data transfer for some reason e.g. periodic location update, mobile should send the gprs_suspension message to PCU. If PCU does not receive gprs_suspension message before eight sequential PACKET_DL_ACK/NACK messages are missing, PCU initiates abnormal release procedure for DL TBF.

This feature helps in two ways:

1. in cell change cases FLUSH message has more time to reach PCU before counter is updated.
2. if PCU receives SUSPEND message too late, this new pending time gives more time for SUSPEND message to reach PCU.

In both situations pending time is interrupted and TBF release is handled with correct procedure which received message requires. Length of the pending timer is related to T3195 defined in 04.60 and as default the length is 5sec. New pending feature is also used if abnormal release for UL TBF occurs when mobile does not have concurrent DL TBF. In this case PCU "blocks" DL direction of the mobile which UL TBF was released abnormally. Only DL direction is blocked so if mobile requests UL TBF during pending timer UL TBF will be established as should. If PCU receives DL data for same mobile after abnormal UL TBF release PCU will not start establishment procedure before pending timer has expired.

RADIO STATUS correction:

If DL TBF was released because all channels were downgraded due to heavy CSW traffic PCU sent RADIO-STATUS message to SGSN. In this case PCU should not send the RADIO-STATUS message because radio connections to mobile is not lost. If this case happened e.g. during FTP download it was possible that SGSN did not restart the DL data transfer when channels were upgraded after short time period. As a correction PCU will not send the RADIO-STATUS message if DL TBF is released because of CS traffic.

Parameter 046:33 correction:

When the parameter 046:33 PCU_DL_BLER_CP_NON_HOP was changed to value 89 or higher, PCU crashed when it received this value and made calculations with it.

This crashing causes alarm 2770 "Preprocessor Failure" and reset of all BCSUs with active GPRS.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	-	S9 CD	Y	-	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)

HW/FW DEPENDENCY:

BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	-	-	-	S

Note(s): 1) GPRS capable MS.

6 OPERATERABILITY

6.1 Nokia Power System Management (PSM) Enhancements

In addition of Battery Back Up/Site Support System (BBU/SiSS) respectively using Q1IA adapter, a CCUA controller with Q1 interface unit is supported. The same management tool, PSMMan, replace all the existing management tools for current Nokia BBU/SiSS and is the management tool also for all UltraSite family power systems. This provides better information, a better user interface and commonality of information between different types of power systems.

The battery management will be upgraded to incorporate multiple test results at the node. Customers have more access with new PSM on local mode. In local mode user have full control to all parameters in case of default parameters need to be changed.

Functionality of PSM has been implemented utilising the existing Q1 bus. A usage of PSM allows software's to be upgraded remotely into Q1IA adapter or CCUA. Software download into BBU/SiSS controller is also supported if it has the facility to be FLASH upgraded.

PSM consists of:

Power systems with Q1IA (Q1 Interface unit version A) adapter

Power systems with CCUA (Cabinet Controller Unit version A) controller with Q1 interface unit

PSM Node Manager (PSMMan) software

NMS/NetAct integration software's.

Power systems using/equipped with Q1IA adapter are compatible from BSS8 onwards and with CCUA from BSS9 onwards excluding Talk BTS support.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1 1)	(S9)	-	-	-	Y	-	-	-	Y

HW/FW DEPENDENCY:

BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	Y	-	-	A 2)	-	-	O 3)

Notes: 1) OSS3.1ED 2) Nokia Battery Back Up/ Site Support System 3) AUX option

6.2 Remote BTS Manager for UltraSite and MetroSite BTS

The Base Transceiver Station (BTS) equipment can be controlled by the user via the Nokia BTS Manager. Controlling can be done locally at the BTS site and also remotely via the OSS.

The remote connection from the BTS Manager to the BTS via Q1 BTS Manager. Remote Connection can be done via BTS Manager application or via Command Line Parameter

With Remote BTS manager, the user will not be able to use the following BTS Manager functionality from the BTS Manager application when the BTS Manager is connected remotely:

- SW loading
- BTS commissioning (Undo Commissioning)
- Abis Disable/Enable
- LMP Speed change
- BCF / Sector / TRX Block and Unblock

The user is able to start a transmission manager from the BTS Manager when the BTS Manager is remotely connected to an UltraSite or MetroSite BTS.

The user is not able to start the HW Configurator application from the BTS Manager when the BTS Manager is remotely connected to an UltraSite or MetroSite BTS. The user is only able to successfully connect to an UltraSite or MetroSite BTS running CX3.3 or later BTS SW. An attempt by the user to connect to any other BTS product (2nd generation, Talk Family, PrimeSite, UltraSite or MetroSite BTS running earlier BTS SW, other manufacturers BTS product) should result in an error being reported to the user.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1 1)	-	-	-	N	N	N	CXM3.3	N	CX3.3

HW/FW DEPENDENCY:

BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	Y	-	-	-	-	-	S 2)

Notes: 1) OSS3.1 ED2, 2) OSS optionality

6.3 Interim Intelligent Shutdown Solution for Nokia UltraSite (IIS)

To maintain and continually improve the requirements for site back-up support systems, Nokia has developed an Interim Intelligent Shutdown (IIS) solution for the UltraSite EDGE BTS based on NetAct and partial load disconnect (PLD) unit.

The IIS is an optional feature that forms part of the UltraSite solution portfolio, and provides key benefits prior to the release of BSS11, in which the full IS support for UltraSite EDGE BTS is introduced. It is designed to provide an additional level of power shutdown functionality in the event of loss of AC mains supply, thus reducing the demand on the site support system back-up capacity, whilst maintaining essential BTS functions.

When an AC mains failure alarm is detected at the BSC, the IIS script is triggered. The IIS script performs the forced handover (FHO) of calls from non-BCCH (traffic) TRX's, to reduce the power consumption to the lowest possible value. Once the calls are handed over, the non-BCCH TRX's are set to a blocked state and the BCCH TRX's are maintained along with the BTS common units (thus maintaining the transmission chain). In multi-cabinet configurations, cabinets containing traffic TRXs can be completely disconnected from DC power by using a PLD unit - this is done after the FHO's have been completed. After AC mains recovery, the script re-activates the blocked TRX's into normal service mode.

Nokia IIS solution is designed to be used with all UltraSite EDGE or UltraSite EDGE / WCDMA co-siting configurations.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	T12 1)	-	-	-	N	N	N	N	N	CX3.3 3)

HW/FW DEPENDENCY:

BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	Y	-	-	-	-	-	O 2)

Notes: 1) supported by T12 and OSS3.1 ED1, 2) Script provided by OSS, 3) not supported by CX4.0

7 MACROCELLULAR

7.1 BSS10016 PGSM900/EGSM900/GSM1800 Common BCCH

The basic idea behind the Common BCCH is to include the GSM 900 (both PGSM 900 and EGSM 900) and GSM 1800 TRXs into one cell with a BCCH allocated from one band used in cell. Common BCCH functionality is introduced in the ETSI GSM specification 03.26 – Multiband operation of GSM 900/1800 by a single operator. The option is to allow GSM 900 and GSM 1800 TRX to share the same BCCH, i.e. to effectively be in the same cell. This functionality could be considered as a progression from the integrated dual band BTS and EGSM 900 frequency band support (Tri Band).

The TCH allocation between GSM 900 and tri band mobiles is made on cell basis by the BSC. The BCCH of the neighbour cell is measured from one band only, which is useful in the IUO & Dual Band case in order to provide more reliable C/I values. Common BCCH in only one of the band of operation when resources across all bands is co-located and synchronised.

The cells can naturally be allocated as separate cells as in the current Tri Band solution.

The main advantages of the common BCCH functionality are:

- Improved Trunking Gain
- Use of signalling channels is optimised by sharing them between bands
- Tighter reuse of all GSM1800 carriers (as no BCCHs).

In BSS10, the BCCH must be configured primarily in the PGSM900 band but if no PGSM900 resources exist at all the BCCH may be configured on the EGSM900 band as well. In BSS10.5, it is possible to allocate BCCH in both GSM900 and GSM1800 band.

In order to ensure proper operation of the network, the operator should take into account issues related to the difference of propagation between the different bands, e.g. GSM 900 and GSM 1800 when performing cell planning.

Common BCCH cell

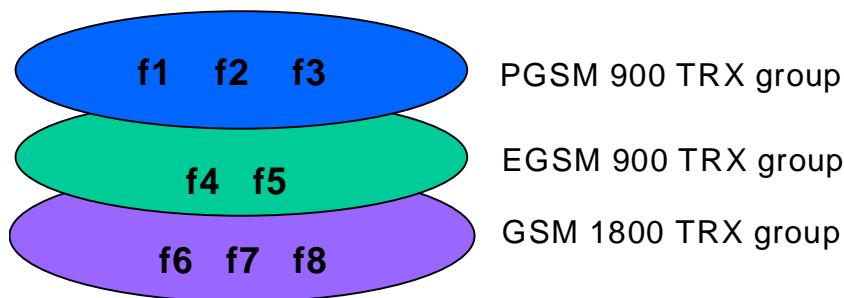


Figure 1. Common BCCH configuration

Note: The GSM 900/1800 Common BCCH support feature requires also GSM900/1800 dual-band feature

For segmentation functionality of common BCCH, please refer to BSS10046 Multi-BCF Control.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	N	-	OSS3.1 2)	S10	-	4.0	N	DF6	N	CXM3.0	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	-	-	-	O

Note(s): 1) Multi band capable terminals. 2) OSS3.1 ED1

7.2 BSS10087 GSM/EDGE 800

This feature supports the use of 800 MHz frequency band in BSS.

For the 800 MHz band, the system will operate in the following frequency bands:

Uplink: 824 - 849 MHz: mobile station transmits, base station receives

Downlink: 869 - 894 MHz: base station transmits, mobile station receives

The carrier frequency is designated by the absolute radio frequency channel number (ARFCN). FI (n) is the frequency value of the carrier ARFCN n in the lower band and Fu (n) the corresponding frequency value in the upper band:

Table 1. Summary of Absolute Radio Frequency Channel Numbering

800 MHz	$FI(n) = 824.2 + 0.2*(n-128)$	$128 \leq n \leq 251$	$Fu(n) = FI(n) +45$
---------	-------------------------------	-----------------------	---------------------

As main rule, all the existing BSS features, which are applicable to MetroSite and UltraSite BTS, will be supported also in 800 MHz band.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	N	N	N	-	OSS3.1	S10	-		N	N	N	CXM3.0	N	CX3.0

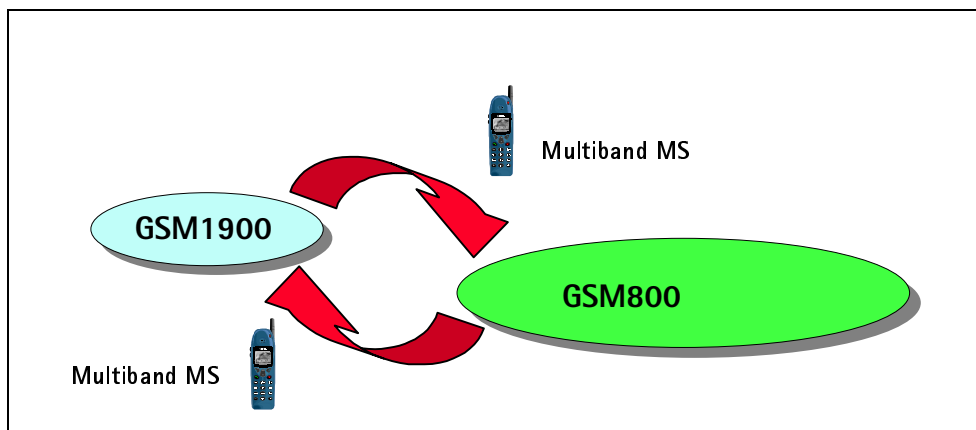
HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	A 2)	-	-	S

Note(s): 1) GSM800 capable terminals 2) GSM800 HW.

7.3 BSS10087 GSM/EDGE 800/1900 Dual Band (BSS10.5)

Dual Band for GSM800/GSM1900 enhances the existing dual band capability of the Nokia BSS to cover the combining of GSM800 and GSM1900 frequency bands into the same network. This feature helps the GSM operators to cope with the GSM traffic when operating with these two frequencies bands in their spectrum limited networks. It will allow dual band mobile stations to use both GSM 800 and GSM 1900 bands of a single operator.



Handovers between GSM 800 and GSM 1900 are possible after GSM 800/GSM1900 Dual Band feature is taken into use.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	N	N	Y	-	OSS3.1 3)	S10.5	-	Planner V	N	N	N	(CXM3.0)	N	(CX3.0)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	A	-	-	O

Note(s): 1) Multi band GSM800/1900 capable terminals. 2) GSM800/1900 HW. 3) OSS3.1 ED1 (Enhancement Delivery)

7.4 BSS10087 GSM/EDGE 800/1900 Common BCCH (BSS10.5)

Common BCCH Control for GSM800/GSM1900 allows the integration of resources from different frequency bands into one cell. TRXs of different frequency bands can be configured in the same cell by letting them share a common BCCH that has been allocated from one frequency band used in the cell.

The BCCH can be configured in either bands, and this should be kept the same throughout the network, i.e., the BCCH should be configured in the same band for all the cells, which are using common BCCH.

The feature enhances the functionality of a cell to offer service to multiband mobile terminals in all the frequency bands, which they support. The feature provides improved trunking gain, tighter reuse of carriers, better quality due to decrease in number of handovers, and improved spectral efficiency.

Common BCCH Control for GSM800/GSM1900 will utilise the segment architecture. TRXs of different frequency bands are gathered as different BTSs within a cell and a cell of this kind is called a segment (for detailed description of segmentation, refer to BSS10046 Mutli BCF Control).

PLMN1

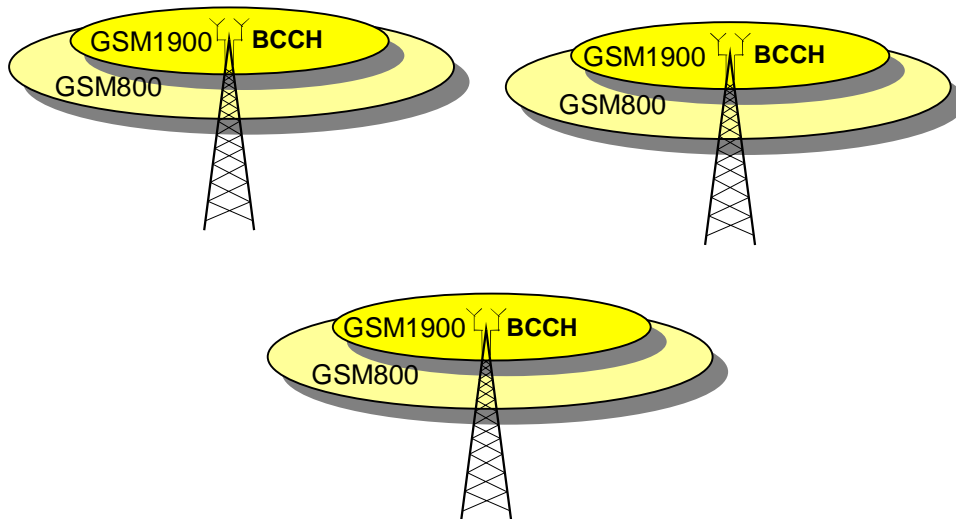


Figure. GSM800/GSM1900 network with Common BCCH Control

Note: GSM/EDGE 800/1900 Dual Band feature is required to have GSM/EDGE 800/1900 common BCCH feature.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	N	N	Y	-	OSS3.1 3)	S10.5	-	Planner V	N	N	N	(CXM3.0)	N	(CX3.0)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	Y 1)	-	A	-	-	O

Note(s): 1) Multi band GSM800/1900 capable terminals. 2) GSM800/1900 HW. 3)) OSS3.1 ED1 (Enhancement Delivery).

7.5 BSS10046 Multi BCF Control (BSS10.5)

Multi BCF Control feature allows the combination of several BTSs into one logical cell, allowing the operator to increase the capacity of a cell while maintaining the maximum spectral efficiency. The feature increases the cell capacity for Nokia Talk-family BTSs to 24 TRXs and for Nokia UltraSite EDGE BTSs to 36 TRXs while requiring no extra BCCH. Multi BCF also provides a path for site expansion from Nokia Talk-family to Nokia UltraSite EDGE BTS and therefore an evolution path to EDGE services.

Operator can arrange base stations so that TRXs in different base stations (operating on the same frequency band) can serve the same cell with single BCCH. At base station site operator makes some installations for example synchronisation is needed between the base stations. All the base stations will have a separate O&M link to BSC. At the BSC operator uses a new SEGMENT (SEG) object where operator sets all BTS objects sharing the same BCCH.

Multi BCFcell (=SEG)

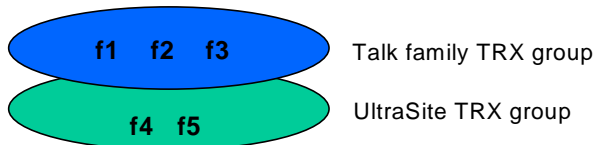


Figure: Multi BCF configuration example

A Nokia Talk-family base station can be upgraded to EDGE by installing a Nokia UltraSite EDGE base station with EDGE capable TRXs on the site as an extension cabinet. Site compatibility is achieved by synchronising these two base stations and using existing antenna and feeder structures. They share a single BCCH (per sector) and function in the network as a single cell. This is valid when TRXs are on the same frequency band. Common BCCH optionality is needed if TRXs from different frequency bands are needed to be operated on a single cell configuration with common BCCH.

In this configuration, the Nokia Talk-family transceivers serve voice, 9.6 data, HSCSD and GPRS. In addition, Nokia UltraSite EDGE Solution provides true mobile multimedia capabilities with EDGE.

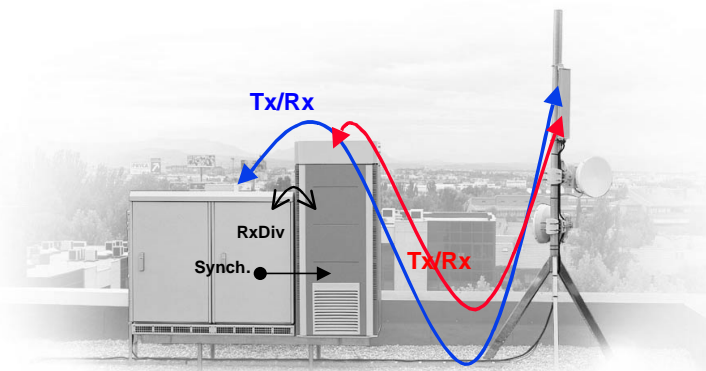


Figure: Nokia Talk-family base station TRXs and EDGE capable Nokia UltraSite EDGE base station TRXs function as a single cell.

Segment functionality

The Multi BCF feature introduces a new architecture and radio network object, called SEGMENT (SEG). The SEG is essentially the same as the "telecom cell". Currently, the BTS object has been the same as a "telecom cell", however this is not the case anymore since the "telecom cell" (SEG) may consist of several BTS objects.

A BTS is a group of similar TRXs. BTS must consist of TRXs of the same frequency band (Common BCCH) and TRXs of the same base station site type (Multi BCF).

The possibility to use the segment structure will not be restricted to the Common BCCH and Multi BCF features but will be an option of its own. An operator can for example create multiple hopping groups in a cell by gathering TRXs of one hopping group into one BTS and have several such BTSs in a segment.

With the common BCCH feature there are couple of possible frequency bands in a SEG: Primary GSM900, Extended GSM900, GSM1800 in ETSI environment, and GSM800 and GSM 1900 in ANSI environment. Each band contains only TRXs of the same frequency in one or several BTSs.

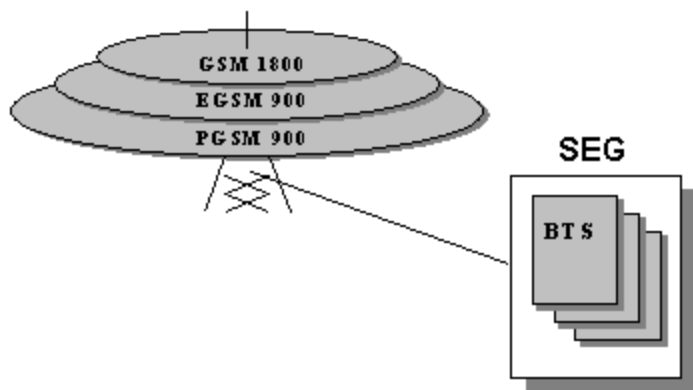


Figure: High level view of a SEG containing three frequency bands.

A SEG must contain a "serving layer", which is the frequency band containing the TRX that has the BCCH/PBCCH channel, and any other combination of TRXs from other frequency bands.

When combined with the Multi BCF feature each band of a segment can have TRXs of different base station types. But as mentioned earlier, TRXs of different base station types must be in different BTSs of a band.

A SEG may also consist of only one BTS/TRX in its simplest form.

The need for dividing GSM900 resources in two different bands in the Common BCCH feature comes from the different capabilities of the terminals. Specifications state that the EGSM900 band includes both the Primary GSM900 frequencies and the extension band. This means that BTSs supporting EGSM900 support also the PGSM900 frequencies. In our segment solution, however, an EGSM900 BTS contains only the extended GSM900 frequencies that are outside the Primary GSM900 band. Using this division the BSC can make sure that only terminals supporting EGSM900 are directed to the EGSM900 BTSs.

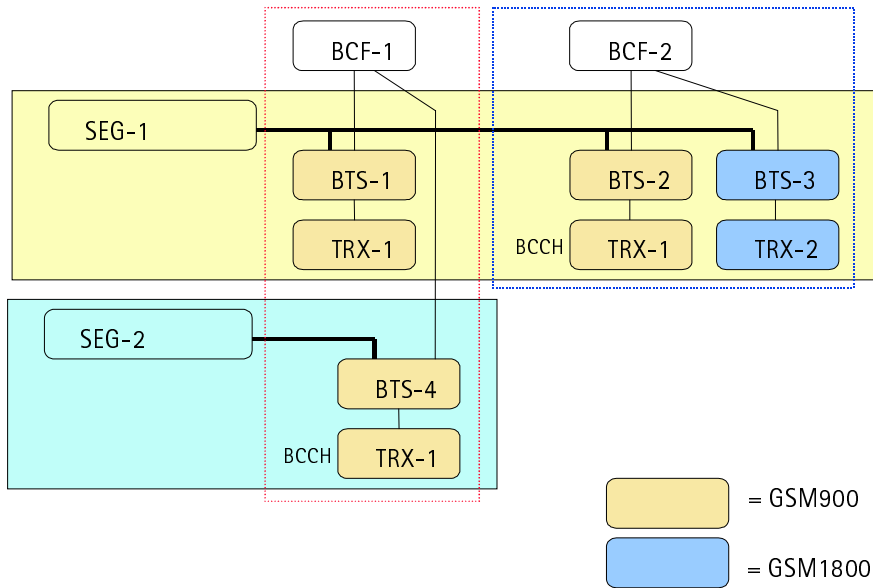


Figure: Example of a SEGMENT radio network object.

In addition to the varying capabilities of terminals in supporting different frequency bands the different GSM bands have to be kept as separate resources because of the different propagation properties of these two bands. In the Multi BCF control Talk-family base stations and UltraSite base stations are regarded as two different layers of a segment because of the 2dB link budget difference between the two base station types.

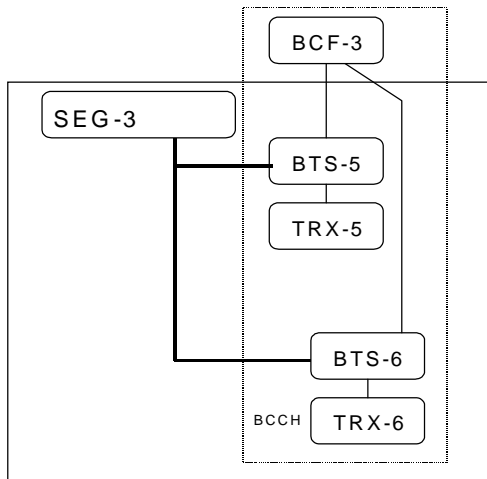


Figure: Another example of a SEG radio network object

The common BCCH SEG is seen as one single cell to the operator even though parameterisation and management must be partly separated for each frequency band. The MS also sees the SEG as one GSM band cell (and many SEGs as one GSM band network) as it has no knowledge of the other frequency bands in a SEG (due to these bands having no BCCH). The MS gains knowledge of neighbouring SEGs by measuring their serving layer's BCCH frequency.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	OSS3.1 3)	S10.5	-	Planner 4	N	DF6 2)	N	N	N	CX3.0

HW/FW DEPENDENCY:

BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	-	-	-	Y	-	-	S 1)

Note(s): 1) Works within same frequency band. Common BCCH feature needed for multi band single cell solutions. 2) FlexiTalk BTS does not support this feature. 3) OSS3.1 ED1

8 MICROCELLULAR

8.1 BSS10102 Chaining of Nokia MetroSite Base Station

Nokia MetroSite GSM and EDGE base stations can be chained in order to build larger configurations for micro cellular environments and still have an easy installation and O&M functions. The chaining is done by synchronising a frame clock between base stations and extending internal D-bus. One transmission unit is saved for each extension cabinet. O&M functionality is centralised to the master cabinet. Only one extension cable between cabinets is needed. The maximum number of combined MetroSite base stations is three and total length of bus cable is limited to five meter.

If a slave base station loses chaining interface, the TRX Faulty alarm is activated for each TRX in it. The chaining is arranged in such a way that centremost cabinet can be un-powered without any problem in case of three cabinet configurations.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	(T12)	(S9)	(SG1)	-	N	N	N	CXM3.0	N	N

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	Y	-	-	Y 1)	-	-	S

Note(s): 1) Extension cable between cabinets

9 VALUE ADDED SERVICES

9.1 BSS10012 Nokia mPosition™ rel 2.0 Location Services for E-OTD phones

MS Location Services allows a GSM subscriber and/or valid mobile equipment to be positioned with a certain Quality of Service. Positioning may be initiated by the subscriber, the network, or an external party utilising the Mobile Positioning Function.

Positioning is subject to various restrictions based on capability, security, service profiles, etc. LCS shall allow the location of a GSM mobile station (MS) to be determined at any time whilst the MS is within the radio coverage area of the GSM HPLMN or VPLMN. Important applications of Location Services are e.g.:

- Government Applications
 - Emergency calls (E911 requirement by FCC in US):
 - location of emergency calls with the RMS accuracy 125m by Oct. 2001
 - Electronic surveillance.
- Operator Applications
 - Home zone calls.
- Commercial Services
 - Fleet management, tracking packages
 - Info of the nearest hotel, gas station,...
 - Car Navigation
 - Emergency roadside service
 - Search of stolen property.

Different MS Location methods have different benefits and drawbacks. No single method is suitable for all applications.

Nokia BSS10 will include the E-OTD (Enhanced-Observed Time Difference) method and to perform legacy (no E-OTD capability) MSs location calculation, the Cell ID+TA method is implemented. The E-TA i.e. TA correction will be done to improve legacy MSs location accuracy. The method includes location calculation using radio interface measurements e.g. RxLev, MS speed information.

Also support for the stand-alone GPS method will be implemented. The signalling between SMLC and MS is similar for E-OTD and stand alone GPS method.

All methods calculate 2-dimension location estimation. 3-dimension location calculation is for further development.

Cell ID + TA

The Cell ID+TA method is used as a backup solution in situations where E-OTD cannot be used e.g. in areas where the MS cannot hear the broadcast channel of at least three cells and for MS which does not support location calculation (E-OTD or stand-alone GPS methods). The Cell ID+TA method is also used if it fulfils the requested QoS. See figure below.

In GSM the delay between the MS and the serving BTS must be known to avoid overlapping time slots and this is called Timing Advance (TA). The TA value can be used to estimate the distance between the MS and the serving BTS. The TA values measured by the BTS have the range between 0-63. One TA measurement value unit represents distance of 550m and thus the TA value can represent the distances between 0-35 km. The TA value and co-ordinates of the cell can be used to estimate the location of the MS. TA value defines distance between BTS and MS twice.

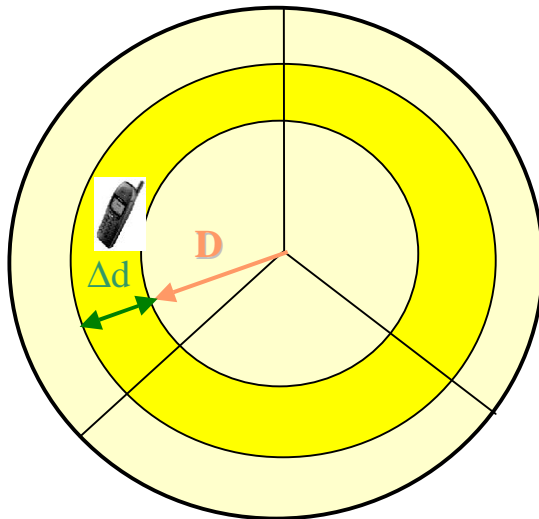


Figure: The location estimate based on Cell ID + TA method.

In the CellId+TA method the location of a handset is calculated based on the following information:

- TA measurement performed by the BTS
- Serving cell identifier
- Co-ordinates of the serving cell
- Sector information
- RxLev measurement.

NOTE: If MS is camped on the Extended-TRX, the TA value calculation differs. Then the extended border will be taken into account. Extended cell radius features will give a little bit more inaccurate location estimation when initial guess or network based software methods is used. The reason for inaccuracy is different antenna direction and output power.

Enhanced Observed Time Difference (E-OTD)

General E-OTD

E-OTD requires E-OTD capable MS although no additional HW is needed to MS. Handsets perform the measurements, location is then calculated either in network (MS Assisted E-OTD) or in handset (Handset Based E-OTD) which means that E-OTD is not capacity limited, thus enabling high capacity operator and mass market applications (e.g. continuous tracking of dropped calls, hot spot detection).

E-OTD Measurement:

- MS measures the TDOAs (= OTDs) of at least 3 BTSs
- The BTS's real time differences in the air interface are measured (RTD)
- Location estimate is based on Geometric Time Differences (GTD= TDOA – RTD)

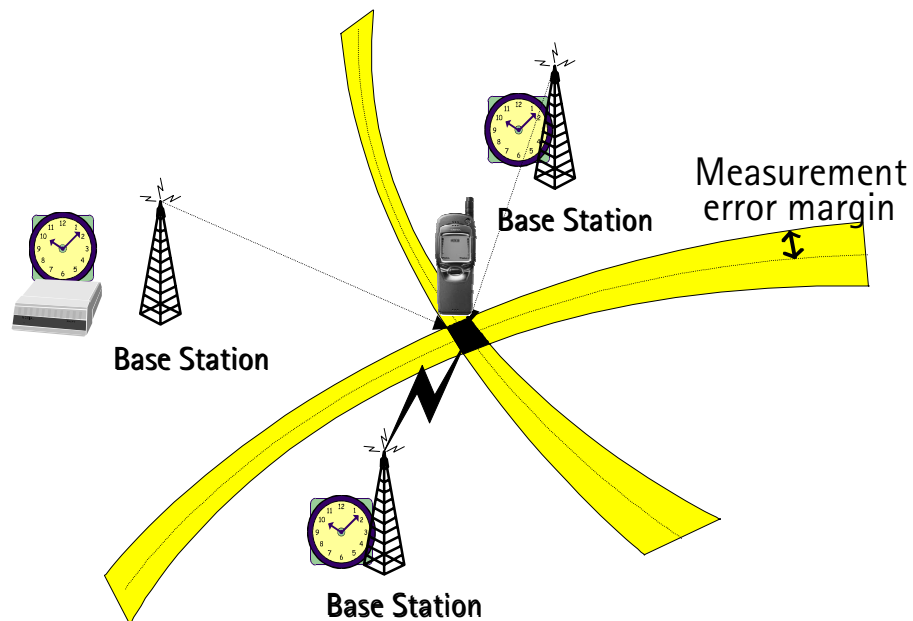
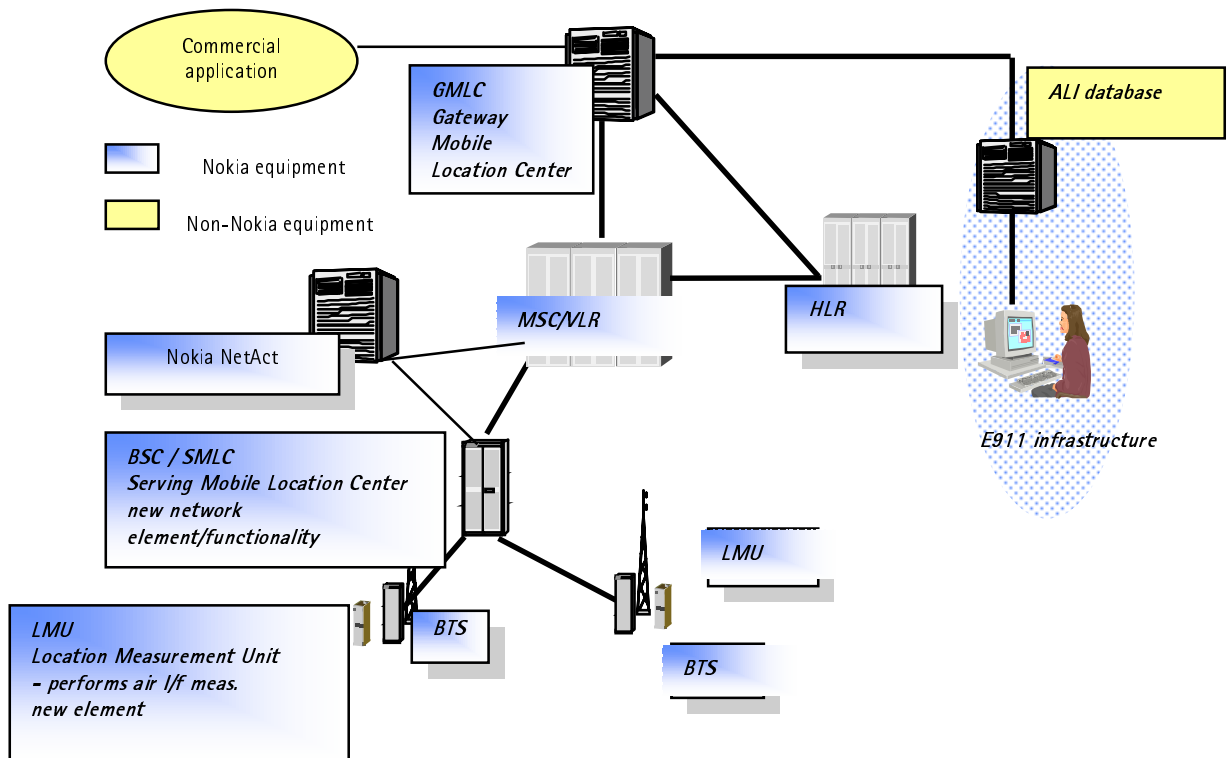


Figure: E-OTD measurement

Position can be calculated by MS in active or in idle mode. Supplementary information (for example BTS co-ordinates, RTD values) is required from the network. Location Measurement Units (LMU) is needed only for every 3-5 BTS sites.

In BSS10, BSS based E-OTD is implemented. The main characteristics of BSS based architecture for E-OTD are: BSS calculates the MS's location (SMLC is situated in BSC) and LMUs will be integrated via cable to BTSs.



Benefits of BSS based E-OTD architecture:

- Minimum impact on MSC
- Supports different implementation possibilities of LMU and SMLC
- Distributed architecture: higher capacity and better reliability
- Less signalling traffic
- Operator applications are easier to implement
- In line with 3G
- Easier support of GPRS (no SMLC-SGSN interface needed)
- Cost effectiveness in a long run
- Simpler O&M
- Better services to customers and wider revenue potential to operator

From BTS, BSC and OSS point of view the operation function is eased a lot when the LMU is connected via cable to BTS. The connection is then more reliable. It will utilise all management type of action easier as if the connection is made via air connection.

It also reduces the amount of traffic in the air interface, thus help to control the air interface interference problems.

When LMU is connected via wire to the BTS it is like one of the BTSs units, so LMU maintenance is part of BTS maintenance.

BTS, BSC and Network management system OSS will see the LMU as functional part of BTS and the SW downloading will take place simultaneously when BTS SW is downloaded.

If the LMU would fail, operator gets the information to network management system automatically via BTS alarms and there is no threat about the air interface functionality and whether there is air capacity available.

E-OTD, Location Calculation

At first SMLC, Serving Mobile Location Centre decides which cells are candidates for OTD calculation. Then SMLC determines and calculates needed assistance data, with which SMLC requests OTD values from MS. Request includes maximum 16 neighbour cells information to measure. From the request MS gets raw interval when serving/neighbour cells send BCCH to the air.

MS receives BCCH signals transmitted by serving BTS and neighbour BTSs. MS determines the time difference between the receptions (serving cell is used as a reference value). Assuming that burst from BTS1 (e.g. serving BTS) and BTS2 (e.g. neighbour BTS) are received at t_1 and t_2 , respectively, the OTD value is given by

$$OTD = t_2 - t_1$$

SMLC needs at least two OTD measurements to be able to perform E-OTD method calculations.

In a synchronous network, OTD values are all needed to calculate position. In a non-synchronous network, information about the synchronisation difference (RIT, Radio Interface Timing) between BTSs is needed. RIT can be informed using Real Time Difference (RTD) or Absolute Time Difference (ATD). In the E-OTD method, LMU measures synchronisation differences. If BTS1 and BTS2 transmit bursts at time t_3 and t_4 , respectively, the RIT value is equal to

$$RTD = t_4 - t_3$$

Real Time Difference (RTD) values are automatically updated to the SMLC by LMU.

To describe the effects of geometry on the burst reception time, Geometric Time Difference (GTD) is described. Denoting the length of the propagation path between BTS1 and MS as d_1 and BTS2 and MS as d_2 , the GTD value is defined as

$$GTD = \frac{(d_2 - d_1)}{c}$$

These three quantities are related as follows

$$OTD = RTD + GTD$$

When locating MS, the MS measures the OTD value, while the cellular network measures the RIT values. The value directly related to the MS position is the GTD, and it is calculated from known OTD and RIT.

From these GTD values we can calculate RDs (Range Difference) between the BTSs.

$$c \times GTD_{ij} = RD_{ij} = \sqrt{(x_i - x_s)^2 + (y_j - y_s)^2}$$

Where

c = speed of radio waves, constant

x_i = co-ordinates of BTS_{*i*}

x_j = co-ordinates of BTS_{*j*}

x_s = MS position

RD_{ij} = range difference between BTS_{*i*} and BTS_{*j*}.

Equation is a hyperbola in which MS is located. Hyperbola is calculated between serving BTS and every neighbour BTSs, which MS reports i.e. if MS reports n BTSs, $n-1$ hyperbolas have to be estimated (one is the serving cell).

Hyperbolas can be calculated between neighbours, also. This is much more complex, but sometimes useful.

MS have to measure at least three BTSs signal and report them to the BSC.

Integration of LMU in the BTS

Nokia LMU is a complete all climates Equipment used with all Nokia Base Stations systems. Base station synchronisation outputs are compatible with all base stations later than Nokia 2nd Generation base station.

Nokia LMU is optimised for E-OTD Location applications. The small sized Nokia LMU Unit accommodates multiband GSM-receiver and Absolute Time GPS-receiver. This together with optimised measurement periods, O&M functions and network planning makes Nokia LMU an efficient solution for building location coverage in mobile networks.

Nokia LMU mechanical properties:

- Outdoor: Height 240 mm, width 130 mm, depth 45 mm, weight max. 0.7 kg.
- Indoor: Height 150 mm, width 90 mm, depth 30 mm, weight max. 0.3 kg.

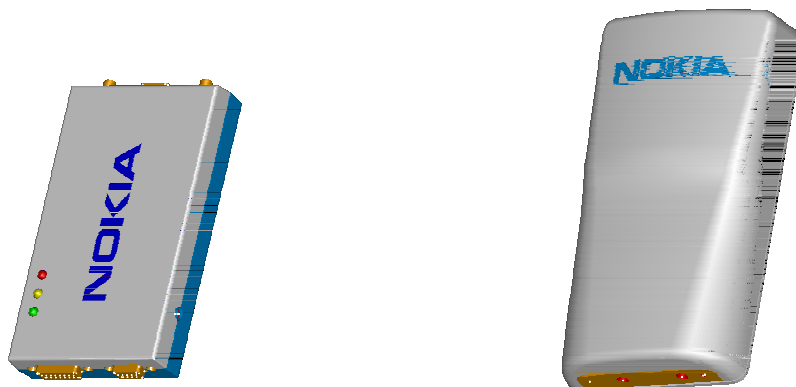


Figure: Nokia LMU Indoor and Outdoor versions

BTS VERSION	LOCATION	Indoor LMU	Outdoor LMU
2nd Gen BTS indoor	On the roof	X	
2nd Gen BTS outdoor	Under the weather proof cover close by the cable feeds	X	
IntraTalk	On the roof	X	
CityTalk	Under the weather proof roof	X	
Flexitalk	Outside the BTS		X
PrimeSite	Outside the BTS		X
MetroSite	Outside the BTS		X
InSite	Not relevant	X	
UltraSite	Under the weather proof roof	X	

Table: Placing the E-OTD LMU

In addition to Location functionality BTS will be able to support LMU in a way that it can be used for BSS synchronisation.

Following BTS generations support LMU equipment for synchronisation:

- Talk-family base stations (IntraTalk, CityTalk)
- UltraSite EDGE base stations

LMU sends global reference Frame Number (based on the GPS time) to BTS. In the case of Frame Number (FN) phasing, BSC sends the FN offset value to the BTS, BTS saves the offset value and according to it BTS increments or decrements reference FN fed by the LMU.

LMU related BSS synchronisation requires new parameter called FNOffset (Frame Number Offset) to BSC. Parameter should be included into LMU area object. Also LMU areas must be created if synchronisation is taken in use.

Integration of SMLC in the BSC

This BSS based architecture means, that BSC contains location calculation function (SMLC). Some upgrading will be needed, but still the HW is part of BSC. SMLC function requires S10 software and new more powerful processors upgraded for MCMUs units. This new processor unit requires also new message bus MBIF-UA (max. 24 units) upgrades (MCMUs, OMU, and BCSUs) for the BSCE/BSC2E/A BSC models.

In new BSC deliveries SMLC can be included from S10 onwards.

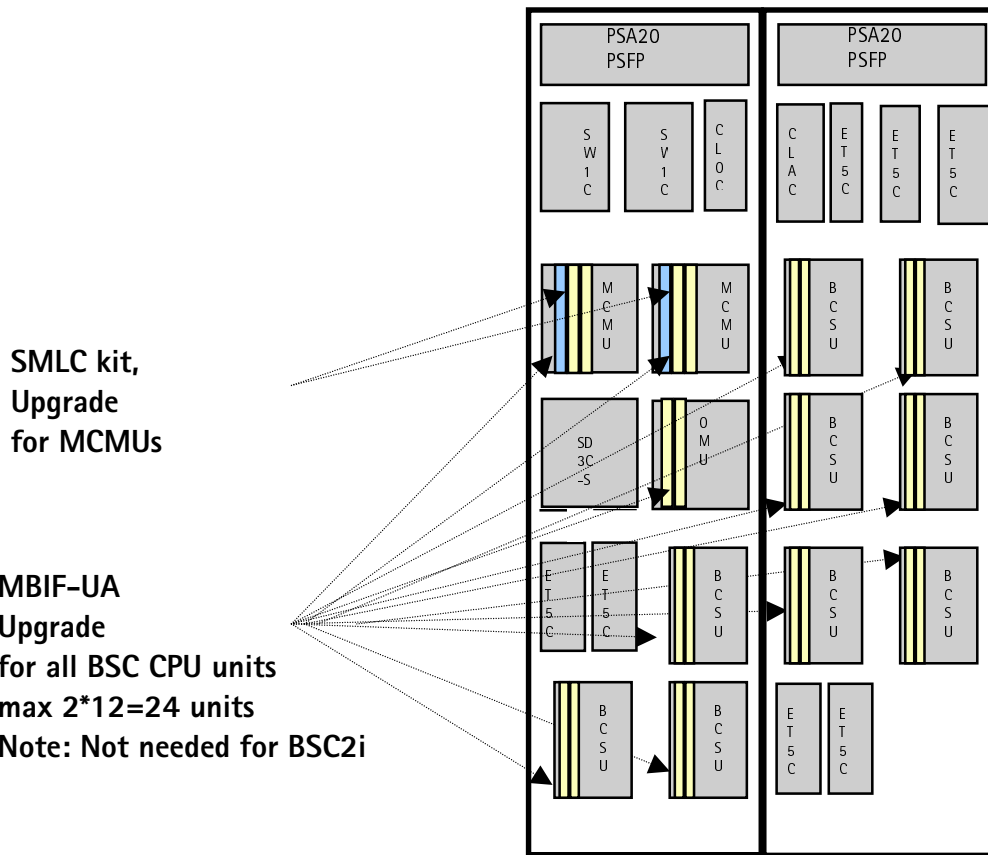


Figure: SMLC and MBIF-UA upgrade in BSC.

SMLC maintenance is integrated to BSC maintenance, so alarms, statistics and SW downloading is handled like a typical BSC without any new network element and without new interfaces between BSC and SMLC. The implementation is easier so it is more cost efficient.

Implementation of operator applications is more feasible with BSS based architecture. Following features based on the location of MS can be implemented much easier:

- Dropped Calls (Identifying problematic areas)
- Handovers
- Signal Level Data
- C/I Matrix generation
- Defining real cell boundaries
- RxQual (poor quality areas identified. Interference zones located)
- Handover types.

New parameters needed for locationing are not defined to BTS object, instead new object 'LCS element' is created for MS locationing. Every SEG used for locationing has to be also defined as a LCS element. LCS elements in serving BSC can be corresponding to SEG in serving BSC (own SEG) or to SEG in another BSC (alien SEG).

LCS element includes all new segment level parameters needed in location calculation.

LCS element contains lobe-related parameters, which are describing BCCH lobe. In case of Common BCCH feature enabled, there can be different bands for serving BTS than for BCCH BTS, which means that serving lobe is not the same as BCCH lobe (lobe's coverage depends on frequency used). This lobe deviation can be taken into account (for location calculation purposes) by help of NonBcchLayerOffset parameter (predefined offset margin is used when evaluating the signal level of the non-BCCH layer).

Summary

As a summary, E-OTD is suitable for high volume commercial applications. For handset assisted and handset based location methods it is beneficial to use the BSS architecture from the beginning to avoid two different implementations of handsets.

For more detailed system level information, please see the mPosition business program documentation in NOLS.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	M10	T12 3)	S10	-	Totem V	B13	DF6	DF6	CXM3.0	N	CX3.0

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y		Y 1)	Y 2)	Y	-	-	O

Note(s):1) E-OTD and GPS require mobile support. 2) Mandatory SMLC (CP6MX card) upgrade for field BSCs and MBIF-UA upgrades for BSCE and BSC2E/A models in OMU, MCMUs and BCSUs units. 3) T12 FN (Functionality Note)

9.2 BSS10112 Text Telephony (TTY)

Hearing impaired and speech-impaired persons have been using specific Text Telephone (referred to as TTY) equipment in the fixed network for many years to transmit text and speech through ordinary speech traffic channels. Modern digital cellular systems, however, do not provide satisfactory character error rates for text transmitted in the speech channel with the traditional modulation developed for the fixed network.

There are two types of text telephones: TTY (TeleType) and TDD (Telecommunications Device for the Deaf). TTYs are basically mechanical teleprinters and TDDs are their electronic counterparts. Virtually all text telephones support "5-bit operational mode" using Baudot code.

The GSM1900 Standards Body, T1P1, has selected and recommended Cellular Text Telephone Modem (CTM) solution to improve TTY/TDD signalling. This solution employs a modulation technique that passes through the speech codec with less distortion and includes error protection, interleaving, and synchronisation.

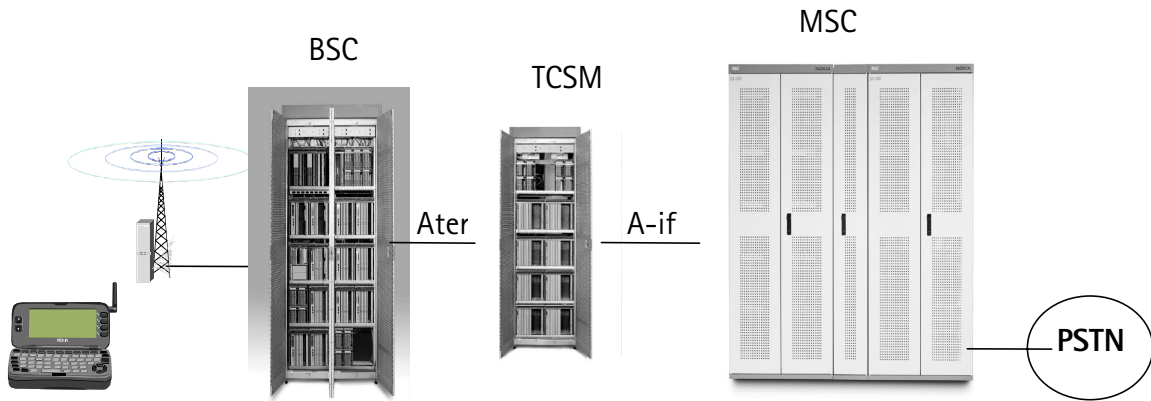


Figure: Functionality is located in TCSM in Nokia's solution

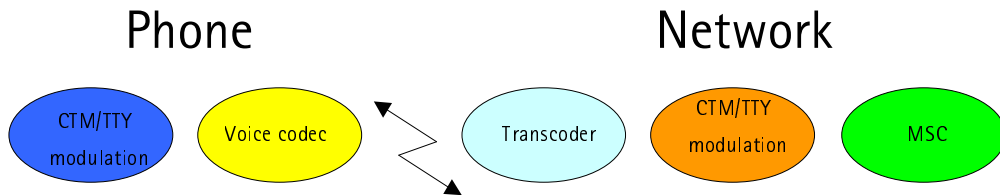


Figure: TTY Functionality

In Nokia's implementation TTY functionality is provided for TCSM2 by software update.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	-	-	S10	-	-	(B12)	(DF5)	(DF5)	(CX2)	(I2)	(PU1)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
Y	N	Y 1)	-	-	-	-	S

Note(s): 1) TTY modems

9.3 Support for Noise Suppression (NS) and Dual Rate Codec (DR) in the same pool

With this enhancement, it is possible to allow NS and DR configured in the same TCSM circuit pool on A interface.

The possible combination of circuit pools:

Supported codecs and features	Supported A-interface pools
FR, HR, EFR, AEC, HSCSD, NS	3, 7, 10, 13, 20, 21, 22 (DR, EFR&DR, HS2, HS4, EFR&DR&D144, HS2&D144, HS4&D144)
FR, EFR, AEC, TFO, NS	1, 5 (FR, EFR&FR)
HR, AEC, TFO, NS	2 (HR)
AMR, AEC, NS	23 (AMR)
FR, HR, EFR, AEC, HSCSD, TTY	3, 7, 10, 13, 20, 21, 22 (DR, EFR&DR, HS2, HS4, EFR&DR&D144, HS2&D144, HS4&D144)
FR, EFR, AEC, TFO, TTY	1, 5 (FR, EFR&FR)
AMR, AEC, TTY	23 (AMR)

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	Y	Y	Y	(Y)	-	S10	(Y)	-	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	-	-	-	-	-	-	O 1)

Note(s): 1) related to the NS optionality

9.4 Wireless Priority Services (WPS)

The deployment of WPS is intended to allow qualified and authorised National Security and Emergency Preparedness (NS/EP) users to obtain priority access to radio traffic channels during situations when Commercial Mobile Radio Service (CMRS) network congestion is blocking call attempts.

The complement of the Initial Operating Capability (IOC) of the Wireless Priority Service (WPS) and the implementation of Full Operating Capability of the Wireless Priority Service (WPS) in BSC means improvements to traffic channel allocation and queuing algorithms. Public Use Reservation by Departure Allocation (PURDA) algorithm has been selected as the implementation alternative.

Wireless Priority Services will be implemented in 2 phases. The first one in BSS10.5 as a S10.5 CD, and the second phase in BSS11.

In BSS10.5 implementation, priority access to congested CMRS network is implemented by using the existing queuing procedures in BSC. The qualified and authorised NS/EP users are allowed to queue in BSC when the radio network is congested.

9.4.1 Supervision of access class control

Supervision of access class control is implemented by introducing a new BTS alarm. This alarm is set every time access class 12, 13 or 14 is set barred in the cell. The barred access class is indicated in the information field of the alarm. The alarm is cancelled by BSC when the access class is in use again.

9.4.2 WPS user identifying in BSC

When WPS feature is in use in BSC the BSC treats a call as a WPS user if the queuing_allowed (qa) indicator is T and the MS_priority_level is 2-6. Other calls are treated as public users.

NS/EP Priority	48.008 Priority	48.008 qa value	Access Class
1 (highest)	2	1	14 AND 13 AND 12
2	3	1	14 AND 13 AND 12
3	4	1	13 AND 12
4	5	1	13 AND 12
5 (lowest)	6	1	12
	7-14	Impl.Dependent	0-10

Table WPS Access Classes and Priority Assignments

9.4.3 Queue management

Queuing of WPS users is implemented using the existing queuing procedures in BSC.

Queue length

Maximum queue length in cell is 32.

Queue length is defined cell specifically using parameter Max queue length (MQL).

Queue time

When WPS user is queued the queuing time is defined by parameter **TimeLimitWPS**. This queue timer applies to both call attempts and HO attempts.

Priorisation in queue

The order of queuers is managed with the following parameters:

- queue priority used (QPU)
- queuing priority call (QPC)
- queuing priority urgent handover (QPH)
- queuing priority non-urgent handover (QPN)
- MS priority used (MPU)

When WPS feature is in use in BSC the parameter MPU should be set to Y which is the default value of the parameter. This way the WPS users in the queue are arranged so that users with highest priority are served first. By setting the parameter QPU to value Y and adjusting parameters QPN, QPH and QPC the operator can prioritise existing calls (handovers) over new calls or vice versa.

Queuing and Directed Retry

In current implementation the queuing is interrupted if the timer max time limit directed retry expires although the queuing timer has not expired yet. This functioning will be changed so that queuing continues after the MADR expires in the next phase.

SUPPORTED IN:

GSM 800	GSM 900	GSM 1800	GSM 1900	MSC	Nokia NetAct	BSC	SGSN	NetAct Planner	Nokia 2nd Gen.	Nokia Talk-family	Nokia PrimeSite	Nokia MetroSite	Nokia InSite	Nokia UltraSite
Y	N	N	Y	M11	-	S10.5 1)	-	-	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)

HW/FW DEPENDENCY: BSS OPT.:

BSC MMI	BTS MMI	MS	BSC HW/FW	BTS HW/FW	TC HW/FW	SGSN HW/FW	STD/OPT
-	-	-	-	-	-	-	O (2)

Note(s): 1) S10.5 CD, 2) ANSI optionality

Document Revision History

DATE	ISSUE	EDITED	SUMMARY OF MAIN CHANGES
11 July 00	0.9.0	T.Karppinen	Ready for approval
4 August 00	1.0.0	R.Juntto	First approved version
11 August 00	1.0.1	T.Karppinen	Editorial modifications
	1.0.2	T.Karppinen	New figures for Nokia Smart Radio Concept. SMLC picture modifications, Dep.table notes text clarifications.
Nov 2000 Dec 2000 Jan 2001	1.0.3	T.Karppinen	SoLSA description taken away. GSM400 description taken away. BSS10033 TSC Different from BCC description added BSS10112 Text Telephony (TTY) description added
September 01	1.1	Chuan Li	BSS10087 GSM800 added, BSS10118 GSM800/1900 dual band, common BCCH added, BSS11112 Network Controlled Cell Re-selection added Dual Control Channel Mode Note added to PBCCH/PCCCH Support BSS10005 Reversed Hunting added BSS10086 TDMA/EDGE removed
September 01	1.1.2	Chuan Li	Dual Control Channel Mode Note removed BSS10005 Reversed Hunting optionality correction: this is a standard feature
September 01	1.1.3	Chuan Li	HW requirement for S10.5 added
November 27	1.2.0	Chuan Li	BSS10046 Multi-BCF Dep. Table improved and moved to Macrocellular section BSS10084 Priority Class Based QoS Dep.table improved BSS10101 GSM-WCDMA interworking clarified BSS11112 Network Controlled Cell Re-selection moved to BSS11 FUD BSS10004 AMR: EDGE-TRX support AMR is clarified Support for NS and DR in the same pool added GPRS non-DRX mode on CCCH added High capacity A interface link added BSS10012 Nokia mCatch™ rel2.0 Location Services for E-OTD Phones have been changed to Nokia mPosition™ rel2.0 Location Services for E-OTD Phones BSS

March 6	1.2.1	Chuan Li	<p>BSS10046 Multi-BCF moved to BSS10.5</p> <p>BSS10084 Priority Class Based QoS moved to BSS10.5</p> <p>BSS10074 PBCCH/PCCCH support moved to BSS10.5</p> <p>BSS10089 System Leve Trace moved to BSS10.5</p> <p>BSS10033 BSS Synchronization Dependency table improved</p> <p>BSS10012 Nokia mPosition™ rel2.0 Location Services for E-OTD Phones description improves.</p> <p>S10.5 compatibility matrix is corrected</p> <p>Minimum BSC Hardware Requirements in S10 is corrected</p> <p>BSS10041 TRX Monitoring by RSSI, GSM 800 support removed</p> <p>BSS10091 EDGE description improved</p> <p>BSS10016 PGSM900/EGSM900/GSM1800 description improved</p> <p>BSS10046 Multi BCF Control description improved</p> <p>Overall improvement on description of the features</p>
August.2002	1.2.2	Chuan Li	<p>BSS10074 PBCCH/PCCCH support description improved</p> <p>BSS10045 Dynamic Abis Allocation description improved</p> <p>Nokia Power system Management Enhancements added</p> <p>Wireless Priority Services description added</p> <p>OSS support for features are updated</p>

February.2002	New Features 1.0.0	Chuan Li	<p>SG1 is added to the compatibility matrix Compatibility level is explained S10.5 ED compatibility matrix is added Hardware Requirement for S10.5 ED is added Remote BTS Manager for UltraSite and MetroSite added BSS10033 TSC different from BCC dependency table changed BSS10069 Synchronised BSS description improved BSS10087 GSM/EDGE 800/1900 Common BCCH description improved BSS10074 PBCCH/PCCCH support description improved. BSS10045 Dynamic Abis Allocation description improved BSS10004 AMR description improved TBF pending state description added BSS10101 GSM-WCDMA Interworking description improved Interim Intelligent Shutdown Solution for Nokia UltraSite was added BSS10022 FER measurement description improved. BSS10091 EDGE description improved</p>
---------------	-----------------------	----------	--