SIEMENS

NANO-BTS 139-SERIES

(multi-TRX capable products including 139_, 140_, 177_, 178_)

Technical Specification

Document CENG0101
Version XC
November 2004

Important Notice on Product Safety

Elevated voltages are inevitably present at specific points in this electrical equipment. Some of the parts may also have elevated operating temperatures.

Non-observance of these conditions and the safety instructions can result in personal injury or in property damage.

Therefore, only trained and qualified personnel may install and maintain the system.

The system complies with the standard EN 60950 / IEC 60950. All equipment connected has to comply with the applicable safety standards.

The same text in German:

Wichtiger Hinweis zur Produktsicherheit

In elektrischen Anlagen stehen zwangsläufig bestimmte Teile der Geräte unter Spannung. Einige Teile können auch eine hohe Betriebstemperatur aufweisen.

Eine Nichtbeachtung dieser Situation und der Warnungshinweise kann zu Körperverletzungen und Sachschäden führen.

Deshalb wird vorausgesetzt, dass nur geschultes und qualifiziertes Personal die Anlagen installiert und wartet.

Das System entspricht den Anforderungen der EN 60950 / IEC 60950. Angeschlossene Geräte müssen die zutreffenden Sicherheitsbestimmungen erfüllen.

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Technical modifications possible.
Technical specifications and features are binding only insofar as
they are specifically and expressly agreed upon in a written contract.

REVISION HISTORY

Version	Change Summary	Date
00.00	Created from existing internal sw and hw TRS documentation	7th September 2004
00.01	Review comments	13th Sept 2004
00.02	Review for Issue	27th Sept 2004
00.03	Fixed missing references and Issue for OEM review	5th October 2004
XA	Update file name to CENG0101	14th October 2004
XB	Corrected file name and incorporate OEM review comments	26th October 2004
XC	Further review comments incorporated	5th November 2004

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1 INTRODUCTION

1.1 Overview

This document gives the technical specification of the 139-series nanoGSM nanoBTSs.

1.2 Purpose and Scope

This document is created to support contractual relationships with OEM and end-customers. It gives the basic properties and functionality of the series in hardware and software. It includes information on the management model supported by the BTS. It does not go into detail on GSM service support beyond the most basic. This is described in the range of Feature Description documents.

Specification is included to a level of detail sufficient to judge effect on declared product specification. The right is reserved to make changes to this specification at any time, under change control procedures agreed with its OEM partners where necessary.

Sections are considered normative unless otherwise marked. In general, these are sections describing external interfaces or behaviour, and are managed under change control. Informative sections are intended for background, are subject to change without notice and therefore may be out of date with respect to a particular release level. In general, informative sections deal with internal behaviour or interfaces and are not held under change control.

1.3 Terminology

AMR	Adaptive Multi-Rate
ARFCN	Absolute Radio Frequency Channel Number
AWG	American Wire Gauge
BA list	Basestation Allocation
Backhaul processor	Synonym for PPC in this document

BHCA	Busy-Hour Call Attempts
BSC	Basestation Controller
BSIC	Basestation Identity Code
BTS	Base Transceiver Station
CA List	Channel Allocation
CBCH	Cell Broadcast Channel
CCCH	Common Control Channel
CEM	Contract Electronics Manufacturer
CGI	Cell Global Identity
Codec	Coder-Decoder
CRC	Cyclic Redundancy Check
DAC	Digital to Analog Converter
DHCP	Dynamic Host Configuration Protocol
DLP	Downlink Processor (baseband processor responsible for transmit processing)
Dongle	Hardware plug used to reset the BTS to factory default settings
EEPROM	Electrically Erasable Programmable Read Only Memory
EFR	Enhanced Full Rate (GSM Speech coding)
ESD	Electro-static Discharge
FCC	Federal Communications Commission
FEC	Fast Ethernet Controller, or Forward Error Correction
FER	Failure Event Report
FPGA	Field Programming Gate Array
FR	Full rate (GSM Speech coding)
GPIO	General Purpose Input-Output
GPRS	General Packet Radio Service
HR	Half Rate (GSM Speech Codec)
HTTP	Hypertext Transfer Protocol
IP	Internet Protocol

LED	Light Emitting Diode
MAC	Media Access Control. Signifies a particular layer in the ANSI standard protocol model for GPRS. Also used in this document is the phrase "MAC Address"
MAC Address	The physical (hardware) address of the Ethernet interface.
MS	Mobile Station (= handset + SIM)
NACK	Negative Acknowledge
NCELL	Neighbour Cell
NV	Non-volatile
NWL	Network Listen
O&M	Operations and Maintenance
OCXO	Oven Controlled Crystal Oscillator
OEMid	Original Equipment Manufacturer Identifier
OML	Operations and Maintenance Link
OOL	Out-of-lock
OPLL	Output PLL
PA	Power Amplifier (final internal amplification stage in the nanoBTS)
PCB	Printed Circuit Board
PCU	Packet Control Unit
PLL	Phase-Locked Loop
POST	Power-on Self Test
PPC	Power PC (particular device used for Ethernet interface processing)
RACH	Random Access Channel
RSL	Radio Signalling Link
SABM	Set Asynchronous Block Mode (a message indicating the establishment of the radio data link)
SACCH	Slow Associated Control Channel
SCH	Synchronisation Channel

SDP	Software Download Package (proprietary format for software download to the BTS)
SI	System Information
SMS-CB	Short-message service – cell-broadcast
SMS-PP	Short-message service – point-to-point
SNMP	Simple Network Management Protocol
SoLSA	Support of Local Service Area
TA	Type Approval (an obsolete term used to signify testing against the harmonised 3GPP compliance specifications for the purposes of CE marking)
TCU	Timing and Control Unit (a subsystem of the nanoBTS baseband processor)
TFTP	Trivial File Transfer Protocol
TIB	Timing Interface Bus
TRX	Transceiver
UL	Underwriters Laboratory
ULM	Uplink Master (baseband processor responsible for receive processing)
ULS	Uplink Slave (baseband processor – controlled by ULM – also performing receive processing)
VBS	Voice Broadcast Services
VGCS	Voice Group Call Services

2 SERIES MEMBERS

The 139 series consists of the following products for the GSM band shown in brackets.

- 139_ (GSM1800)
- 140_ (GSM1900)
- 177_ (GSM850)
- 178_ (EGSM900)

3 HARDWARE SPECIFICATION

3.1 External

3.1.1 Appearance (informative)

The 139 series nanoBTS is shown in Figure 1 and Figure 2.

Figure 1 nanoBTS

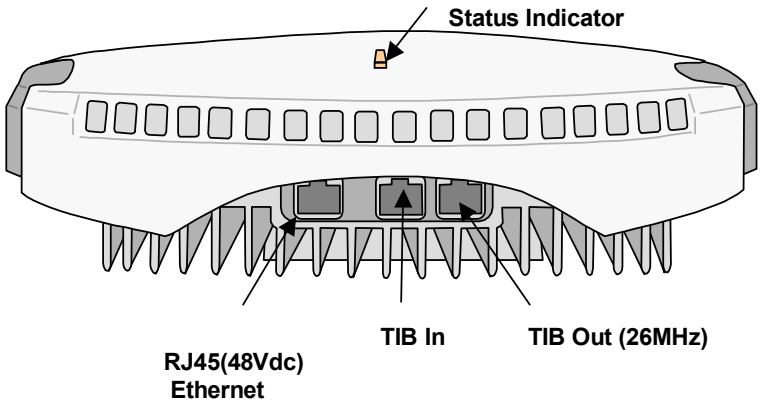


Figure 2 nanoBTS connectors

3.1.2 Size, Shape and Weight

The 139 series nanoBTS fits in an envelope approximately 275mm long, 210mm wide and 75mm deep. The plan shape is roughly elliptical. These dimensions should not be used for space planning in installation. See BTS Installation Manual for more information on space requirements of the 139 series.

Heavy finning on the back of the unit is provided for convective cooling when vertically mounted. When wall mounted, these fins are intended to be vertical.

Fins are also provided on the front of the unit, normally obscured by the plastic cosmetic cover. When ceiling mounted or in any other horizontal situation, the plastic cosmetic cover is intended to be removed to allow airflow across the front fins.

The unit weighs less than 3kg.

3.1.3 GSM Standards

Standards	Parts	Date
3GPP 11.21	Essential Compliance	v8.8.0
3GPP 05.05	EGSM, Power Class P1, as called up by 3GPP 11.21/Essential Compliance	v8.14.0
ETS 301 489	Part 8 – specific requirements for GSM basestations	v1.1.1

3.1.4 Environmental

Operational:	Temperature	-5 ~+45C ambient
	Humidity	5-90% non-condensing
Storage:	Temperature	-20 ~ +80C ambient
	Humidity	5-90% non-condensing
Cold Start:	Warm-up period from cold	In-spec operation within 10 minutes

Hot Start:	System reset without loss of power supply	In-spec operation within 3 minutes
Standards:	ETS 300-019-1-1	Storage Class 1.1
	ETS 300-019-1-2	Transport Class 2.3
	ETS 300-019-1-3	Operation Class 3.1
	EN55022 class B	EMC general
	EN60950 / IEC 60950 /UL1950	Safety

Note that the 139 series is not hermetically sealed.

3.1.5 Ethernet Interface

The Ethernet connector is 8-way RJ-45 female.

The Ethernet physical layer is 10/100baseT, full-duplex, auto-negotiate.

3.1.6 DC Power

Power is expected by the unit on the Ethernet connector, according to IEEE802.3af option B or A. Option A is implemented with Or-ing diodes from the unused wires, and results in reduced supply margin and efficiency. Option B is preferred, therefore. See section 3.2.1 for more information.

The 139 series is designed to meet IEEE802.3af. Interoperability with 3rd party 802.3af supply equipment is not warranted. The unit is sold with its own mains power supply (Product 109), which inserts power onto the Ethernet cable.

DC Power consumption is less than 13W.

3.1.7 TIB (Timing Interface Bus)

The TIB consists of two 10-way RJ45 connectors, a TIB-in and a TIB-out.

The TIB is required to synchronise the GSM frames between nanoBTS units acting together as a single multi-TRX BTS. TIB-in accepts GSM-frame timing from a preceding TRX and TIB-out generates it for the next TRX.

TIB-out	Current-mode LVDS drive, transformer coupled. Clock is divided system clock (26MHz/16).
TIB-in	LVDS, internal termination gives typically 300mV peak-to-peak when driven by TIB-out.
Reference Clock Input	External reference clock (10MHz), with detect circuit.
Frame Sync	Via removable link (for development / TA testing)
Security dongle	Support for detection of external dongle on TIB, connected to GPIO on PPC.
Maximum TIB cable length	5m
Drive control	Clock output to be enabled by software. This facilitates detecting position within a chain of BTS's.
Serial Interface	From PPC / ULM (via link on PCB).
FPGA Serial Output	For development logging output (via link on PCB).
TIB Spare 1 and 2	From FPGA (via link on PCB).
Connector	10 way RJ-45 with polarisation key to prevent insertion of standard Ethernet connector. Connectors and internal circuitry tolerant to hot insertion, removal and reversal of TIB in and TIB out cables.
Accessibility	Accessible in-situ. No protective cover.
ESD protection	Protected to Human Body / Equipment Level discharges and line induced surges. Protected against forced insertion of 48V Ethernet into TIB connectors, when debug links removed.

TIB out	
1	TIB SPARE 1 (to FPGA via link on PCB)
2	TIB SPARE 2 (to FPGA via link on PCB)
3	26MHz OUT -
4	26MHz OUT +
5	GSM SYNC OUT +
6	GSM SYNC OUT -
7	PPC Serial interface OUT (via link on PCB)
8	PPC Serial interface IN (via link on PCB)
9	FPGA SERIAL OUT (via link on PCB)
10	Ground

TIB in	
1	10MHz IN-
2	10MHz IN+
3	26MHz IN-
4	26MHz IN+
5	GSM SYNC IN+
6	GSM SYNC IN-
7	TRX FRAME SYNC (via PCB link)
8	Not connected
9	Security
10	Ground

3.1.8 Antennas

The 139 series is normally used with its own internal antennas, of which there is one for transmit and one for receive. The units can be supplied with an optional external antenna kit, which allows the unit to be connected to an external duplexer, booster system, distributed antenna system or other external radio system See BTS Installation Manual for more details on the external antenna kit.

Figure 3 shows the unit with external antenna kit fitted.

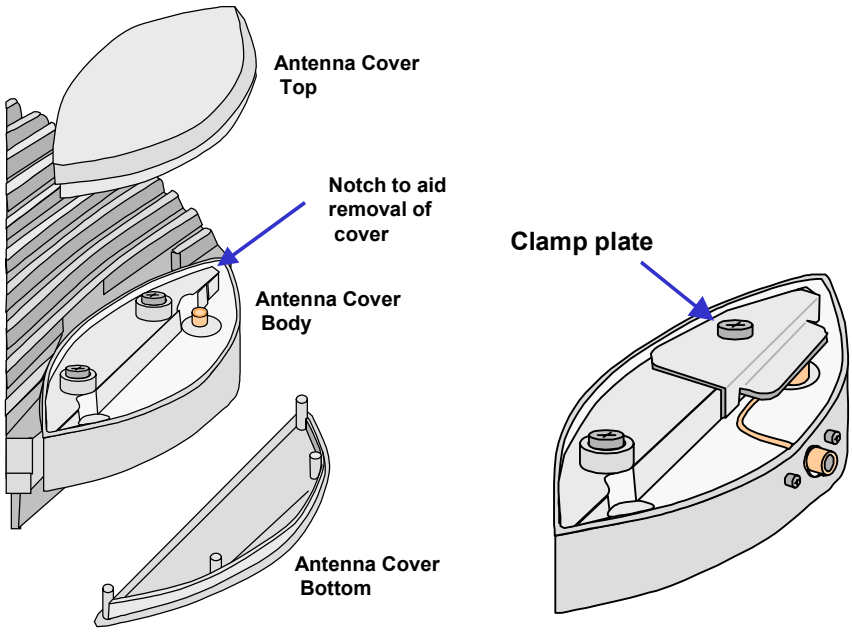


Figure 3 External Antenna Kit

3.1.8.i Internal Antennas

internal receive aerial	0 dBi nominal printed omni-directional
internal transmit aerial	0 dBi nominal printed omni-directional
Isolation (Tx to Rx)	30dB

3.1.8.ii External Antenna Ports

Provision	Option kit – one connector each for transmit and receive
Connectors	SMA female
ESD Protection	None – external cavity duplexer required

The procurement specification for the external cavity duplexer is CENG0150.

3.1.9 LED Indicator

Two LEDS are provided on the PCB. These can provide three colours (red, green, orange) in various flash codes, as specified in section 5.8.2.

3.1.10 Labelling

TA/CE certification	Product 139	CE mark with associated devices. UL mark with associated devices. (FCC not appropriate for 1800MHz devices)
	Product 140	FCC mark with associated devices. UL mark with associated devices. (CE not appropriate for 1900MHz devices)
	Product 177	FCC mark with associated devices. UL mark with associated devices. (CE not appropriate for 850MHz devices)
	Product 178	CE mark with associated devices. UL mark with associated devices. (FCC not appropriate for 900MHz devices)
Product identification	Serial number in text and bar code, product code in text only	
MAC address	in text and bar code	
Positioning	visible when mounted. Not positioned on front face.	
OEM label	Subject to separate specification and positioning	

3.1.11 Chassis Ground

Located on rear of BTS	BTS's must be connected with 16AWG earth cables when operated as a multi-TRX.
Cable length	Maximum cable length is 5m. Cable length must not exceed TIB cable length.

3.2 Internal

Figure 4 shows the internal architecture of the 139 series nanoBTSs.

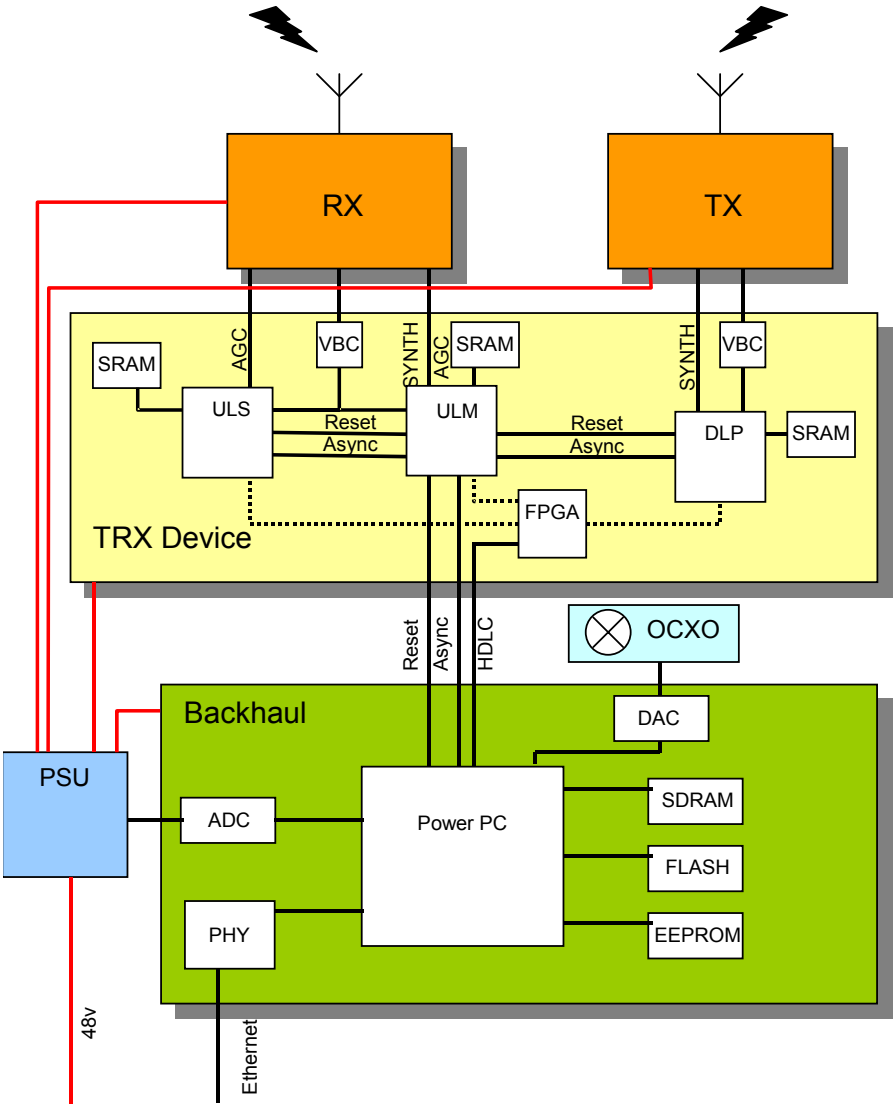


Figure 4 Internal Architecture of the nanoBTS

3.2.1 Power Supply

Input Voltage		36-57VDC (to cover power-over-ethernet range)
Input current	max.	500mA from an input voltage of 37V. Input capacitor <180uf when operating (less during signature detect – see below).
Efficiency	min.	80%
Signature		Power input signature to comply with 802.3af rel 3 V_I slope (at 2.7 to 10.1V) 23.75K to26.25K ohms. V offset <1.9V. I offset <10uA. Input capacitance 50 to 110nf. Input inductance >100uH.
IEEE802.3af wiring		Option B or A (B is preferred).
Isolation		1500V at 50-60Hz for 60S, resistance >2M ohms at 500V
Turn on Voltage		<44V
Turn off Voltage		>30V

3.2.2 OCXO

Frequency	26MHz
Accuracy (all causes)	$\pm 100 \times 10^{-9}$ per two years
Adjustment / calibration	Under processor DAC control or PLL locked to a TIB input with ability to calibrate free run frequency to a TIB input or NWL.
Adjustment DAC	12 bits +/- 0.5LSB differential non linearity
PLL Control Signals	LOCKED (PLL is in lock) XSENSE_1 (inverted PLL error analog value to ADC) XSENSE_2 (non inverted PLL error analog value to ADC) PLL_CE (tristates PLL to allow OCXO to free run at DAC value)

3.2.3 Backhaul sub-system

Processor	MPC855T	50MHz core and bus (32bit A&D)
Memory	Flash	8M
	SDRAM	8M
	EEPROM	64kbit

3.2.4 TRX baseband sub-system

Processors	Msp430 (3-off: ULM, ULS DLP)	ARM
		DSP
Memory	ULM	SRAM 256k x 16 bit (3 wait state)
	ULS	SRAM 256k x 16 bit (3 wait state)
	DLP	SRAM 256k x 16 bit (3 wait state)

3.2.5 Transmitter

	Frequency Range	Maximum o/p power
139_ (GSM1800)	1805-1880MHz	+23dBm
140_ (GSM1900)	1930-1990MHz	+23dBm
177_ (GSM850)	869-894MHz	+20dBm
178_ (GSM900)	925-960MHz	+20dBm

channel spacing	200 kHz
static power control	6 steps (2 dB each)
dynamic power control	6 steps (2dB each)
power level error signal	single bit – signals PA loop out of lock
OPLL unlock indicator	Single bit - S/w detects unlocked condition

Note that in static power applications (single TRX and C0 carrier) the dynamic power steps can be used statically to give a total static power control range of 12 steps of 2dB each.

3.2.6 Receiver (uplink)

frequency range	139_ (GSM1800)	1710-1785MHz
	140_ (GSM1900)	1850-1910MHz
	177_ (GSM850)	824-849MHz
	178_ (GSM900)	880-915MHz
channel spacing	200 kHz	
Performance	essential conformance to GSM 11.21 and GSM05.05	
Diversity	None	
AGC	only baseband control	
Gain control steps	26, digitally controlled from ULS/ULM	
Gain settling time	5us	

3.2.7 Receiver - downlink

frequency range	139_ (GSM1800)	1805-1880MHz
	140_ (GSM1900)	1930-1990MHz
	177_ (GSM850)	869-894MHz
	178_ (GSM900)	925-960MHz
channel spacing	200 kHz	
Performance	Normal MS specifications, derated by 10dB across the board	

4 MTBF

The 139 series has an MTBF greater than 120,000 hours.

5 SOFTWARE SPECIFICATION

5.1 Top Level Feature Overview

The nanoBTS:

- supports DHCP for IP configuration
- supports TFTP and 12.21 mechanisms for software upgrades
- supports a single boot code storage bank
- supports two application code storage banks
- only supports a single "base-band transceiver" GSM 12.21 managed object instance
- supports configuration of the BTS via GSM 12.21 messages
- supports nanoGSM"A-bis over IP Interface"
- supports "typical" GSM BTS operations such as
    - measurement pre-processing
    - handover
    - cell broadcast
    - transmission of system information
    - transmission and reception of "Full rate" or "Enhanced Full rate" speech traffic
    - transmission and reception of circuit switched data
    - A5/1 and/or A5/2 or "no encryption" algorithms over the air interface
- incorporates the GPRS Packet Control Unit (PCU) to deliver GPRS service to mobiles up to class 10 capability, with Coding Schemes 1-4.
- supports the nanoGSM "Network Listen" feature to monitor and decode other GSM base-stations
- performs regular monitoring of its operating conditions (e.g. temperature and voltage) and warn an O&M system if it exceeds its operating limits
- reports error conditions to the O&M system
- supports SNMP Gets and Traps for SNMPv2C
- controls an LED to provide feedback to the user as to the state the BTS is in
- interworks with the nanoGSM nanoBSC product
- stores non volatile parameters in EEPROM

These features are described in more detail in the following sections.

5.2 Explicitly Not Supported

- Multi-Slot Circuit Switched Data
- EDGE
- Half-rate speech codec (HR)
- Advanced Multi-Rate speech codec (AMR)
- IP Security
- IP Version 6
- HTTP server
- VGCS & VBS
- SOLSA

5.3 Standards

The base software support level is 3GPP Release 99 unless otherwise stated.

5.4 Reset Behaviour

5.4.1 Boot

On Power on, the bootstrap code changes the LED to state LED_SELF_TEST (note that this may actually mean that the LED is turned 'off' if the LED is disabled in EEPROM config – see section 5.8.2).

The bootstrap code performs Power-On-Self-Test (POST) on "cold" boot (if "Disable POST" flag is cleared in EEPROM). Warm boots do not perform POST.

The POST procedures check

- RAM on all processors
- Code Memory on all processors – checksum verification of code banks
- EEPROM Memory – checksum verification of attribute blocks

5.4.2 Software Code Banks and Software Bank Activation

nanoTRX software is stored in two banks, and the active bank is indicated by a EEPROM switch. If the active bank POST fails, then the inactive bank will be booted – with an associated Failure Event Report. If the inactive bank POST also fails, then the LED indicates LED_SELF_TEST_FAILURE.

nanoTRX software is downloaded to the inactive bank using either TFTP or the software download tool BtsInstaller (see BTS_INSTALL_UG, CENG0048). Software download proceeds without interrupting the operation of the BTS. The active bank flag is then altered. The next time the BTS restarts, the new software will be run.

5.4.3 Reset Reason

If the BTS undergoes a fatal software reset of any sort, a byte indicating the "reset reason" is stored in memory before the reset is initiated. During the reset procedure, this "reset reason" byte is read out , and sent to the management system as a Failure Event Report.

5.5 Configuration

5.5.1 DHCP

The BTS supports the nanoGSM specific implementation of DHCP as defined in Annexes E, F and G.

5.5.2 Fallback OML link

The BTS supports a fallback link to its BSC, by configuring the "Primary OML Fallback Address" and "Port" and the associated "Fallback Timeout". If the fallback address and port are configured, then the BTS will behave as follows

- On startup, the primary, non-fallback address is repeatedly tried, until either connection succeeds or the fallback timer expires
- If the fallback timer expires, then the fallback address is repeatedly tried, until either connection succeeds or the fallback timer expires
- If the fallback timer expires, then the non-fallback address is tried again, and so on

If the fallback timer is zero (its default value) then the non-fallback and fallback addresses are tried alternately.

If the fallback address and port are unconfigured, then the non-fallback address is tried repeatedly for ever.

5.5.3 Management Model and Attributes

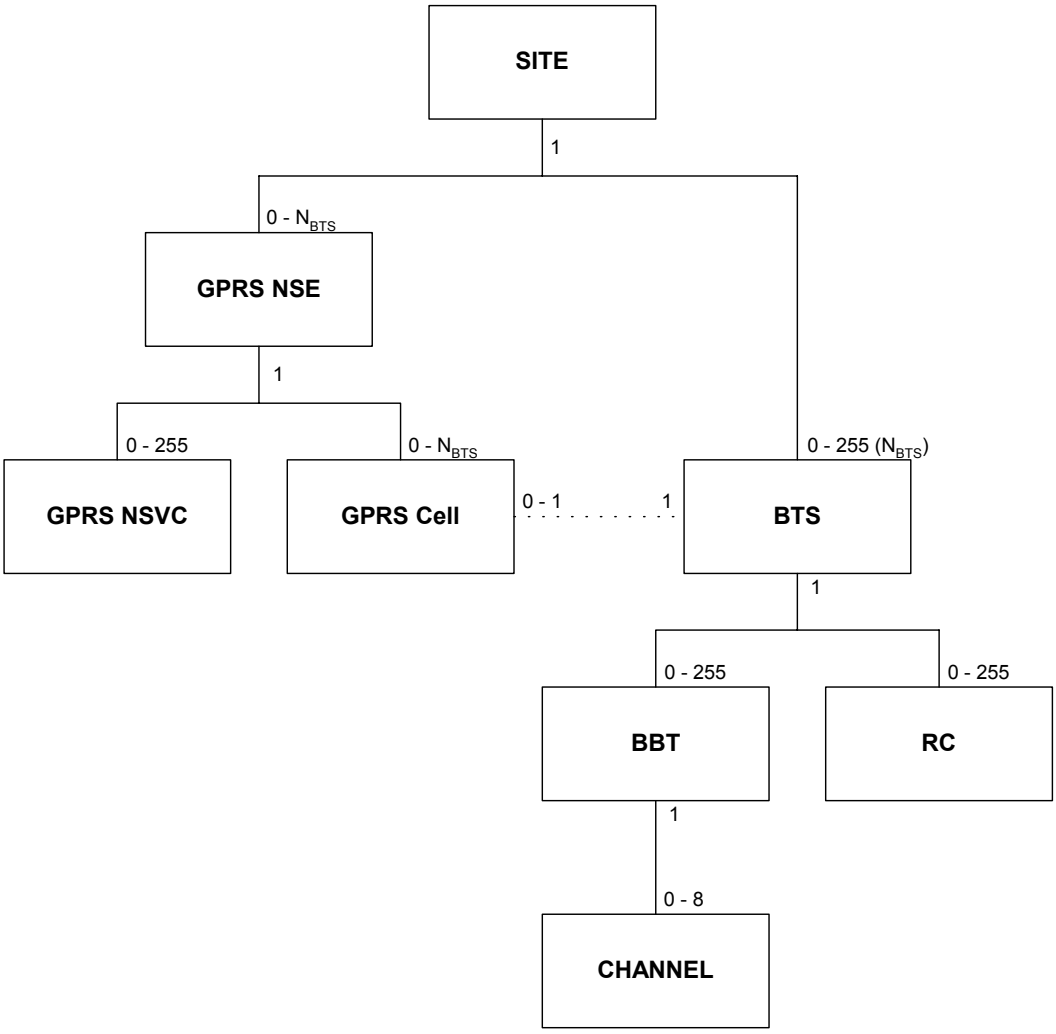


Figure 5 - the nanoGSM nanoBTS management model

The tables in the following sub-sections list each of the attributes as defined in GSM 12.21 plus the manufacturer specific items, plus the GPRS attributes, as shown in Figure 5 - the nanoGSM nanoBTS management model. It states if the attribute is derived from 12.21 and whether or not the BTS SW shall support the setting / getting of the attribute. It also states which "managed object" the attribute is associated with. In the "storage" column an entry

"V" means that the value is volatile, and "P" means that the value is permanent. The "Set" column dictates how the attribute value is derived, and the "Get" column defines the mechanisms or messages that are permitted to "get" the value.

Note that the SiteId, which limits the number of Sites that can connect to a BSC is a 16 bit value. At nBR1.5 and nBR2.0, the BtsId is always zero – so there can only be one BTS per Site. The TrxId at always 0 at nBR1.5, and can be 0..3 for nBR2.0.

5.5.3.i Object Class: Site Manager

Attributes	12.21?	supported	Storage	Set	Get	Notes
Abis Channel	Y	N				For circuit-switched Abis - not relevant for us
Availability Status	Y	Y	V	Internally	Get Attributes	
HW Configuration	Y	Y	P	See IE Details	Get Attributes	
Manufacturer Dependent State	Y	N				No such states defined so far
Manufacturer Id	Y	Y	P	Hard coded	Get Attributes	Value = com.ipaccess
Operational State	Y	Y	V	Internally	Get Attributes	
Site Inputs	Y	N				We don't have any
Site Outputs	Y	N				We don't have any
SW Configuration	Y	Y	P	Via sw download	Get Attributes	boot and backhaul only
NV Config Flags	N	Y	P	Set NV Attributes	Get NV Attributes	
Frequency Control	N	Y	P	Set NV Attributes	Get NV Attributes	
Primary OML Config	N	Y	P	Set NV Attributes	Get NV Attributes	Only one entry supported
Secondary OML Config	N	Y	P	Set NV Attributes	Get NV Attributes	Only one entry supported
IP Interface Config	N	Y	P	Set NV Attributes	Get NV Attributes	

IP Gateway Config	N	Y	P	Set NV Attributes	Get Attributes	NV Only one entry supported
Unit Name	N	Y	P	Set NV Attributes	Get Attributes	NV Used as hostname in DHCP messages
BTS Location	N	Y	P	Set NV Attributes	Get Attributes	NV Location appears in HW Description too…
In Service Time	N	Y	P	Internally	Get Attributes	NV This is updated once every hour.
Manufacturer Dependent Thresholds	Y	Y	PV	Set Alarm Thresholds	Get Attributes	If NV Flag "Alarm Thresholds NV" is true, Set Alarm Thresholds applies to both volatile and persistent thresholds, otherwise to volatile thresholds only. Get Attributes always returns volatile thresholds.

Table 1 - 12.21 'Site' Attributes definitions

5.5.3.ii Object Class: BTS

Attributes	12.21?	supported	Storage	Set	Get	Notes
Administrative State	Y	Y	V	Change Admin State	Get Attributes	
Availability Status	Y	Y	V	Internally	Get Attributes	
BCCH ARFCN	Y	Y	V	Set BTS Attributes	Get Attributes	
BSIC	Y	Y	V	Set BTS Attributes	Get Attributes	
BTS Air Timer	Y	Y	V	Set BTS Attributes	Get Attributes	T3105
CCCH Load Ind. Period	Y	Y	V	Set BTS Attributes	Get Attributes	Ack - but ignore
CCCH Load Threshold	Y	Y	V	Set BTS Attributes	Get Attributes	Ack - but ignore
Connection Failure Criterion	Y	Y	V	Set BTS Attributes	Get Attributes	
GSM Time	Y	Y	V	Internally	Get Attributes	
HW Configuration	Y	Y	P	See IE Details	Get Attributes	
Intave Parameter	Y	Y	V	Set BTS Attributes	Get Attributes	
Interference Level Boundaries	Y	Y	V	Set BTS Attributes	Get Attributes	
Manufacturer Dependent State	Y	N				No such state defined so far
Manufacturer Id	N	Y	P	Hard coded	Get Attributes	Value = com.ipaccess (added for consistency)
Max Timing Advance	Y	Y	V	Set BTS Attributes	Get Attributes	Ack - but ignore
Ny1	Y	Y	V	Set BTS Attributes	Get Attributes	
Operational State	Y	Y	V	Internally	Get Attributes	
Overload Period	Y	Y	V	Set BTS Attributes	Get Attributes	Ack - but ignore
RACH Busy Threshold	Y	Y	V	Set BTS Attributes	Get Attributes	Ack - but ignore
RACH Load Averaging	Y	Y	V	Set BTS Attributes	Get Attributes	Ack - but ignore

Slots						
SW Configuration	Y	Y	P	Via sw download	Get Attributes	boot and backhaul only
T200	Y	Y	V	Set BTS Attributes	Get Attributes	
Paging Configuration	N	Y	V	Set BTS Attributes	Get Attributes	
Unit Id	N	Y	P	Set NV Attributes	Get NV Attributes	Maps on to BTS Id in EEPROM

Table 2 - 12.21 'BTS' Attributes definitions

5.5.3.iii Object Class: Radio Carrier

Attributes	12.21?	supported	Storage	Set	Get	Notes
Administrative State	Y	Y	V	Change Admin State	Get Attributes	
ARFCN List	Y	Y	V	Set Radio Carrier Attributes	Get Attributes	
Availability Status	Y	Y	V	Internally	Get Attributes	
HW Configuration	Y	Y	P	See IE Details	Get Attributes	
Manufacturer Dependent State	Y	N				No such states defined so far
Manufacturer Id	Y	Y	P	Hard coded	Get Attributes	Value = com.ipaccess
Operational State	Y	Y	V	Internally	Get Attributes	
Power Class	Y	N				Uses Power Class message as defined in Abis over IP for Pico Cell.
RF Max Power Reduction	Y	Y	V	Set Radio Carrier Attributes	Get Attributes	
SW Configuration	Y	Y	P	Via sw download	Get Attributes	Boot + backhaul + TRX

Table 3 - 12.21 'Radio Carrier' Attributes definitions

5.5.3.iv Object Class: Baseband Transceiver

Attributes	12.21?	supported	Storage	Set	Get	Notes
Abis Channel	Y	N				For circuit-switched Abis - not relevant for us
Administrative State	Y	Y	V	Change Admin State	Get Attributes	
Availability Status	Y	Y	V	Internally	Get Attributes	
HW Configuration	Y	Y	P	See IE Details	Get Attributes	
Manufacturer Dependent State	Y	N				No such states defined so far
Manufacturer Id	Y	Y	P	Hard coded	Get Attributes	Value = com.ipaccess
Operational State	Y	Y	V	Internally	Get Attributes	
SW Configuration	Y	Y	P	Via sw download	Get Attributes	boot + backhaul + TRX

Table 4 - 12.21 'Baseband Transceiver' Attributes definitions

5.5.3.v Object class: Channel

Attributes	12.21?	supported	Storage	Set	Get	Notes
Abis Channel	Y	N				For circuit-switched Abis - not relevant for us
Administrative State	Y	Y	V	Change Admin State	Get Attributes	
ARFCN List	Y	N				Only needed if Frequency Hopping used
Availability Status	Y	Y	V	Internally	Get Attributes	
Channel Combination	Y	Y	V	Set Channel Attributes	Get Attributes	
HW Configuration	Y	Y	P	See IE Details	Get Attributes	
HSN	Y	N				Only needed if Frequency Hopping used
MAIO	Y	N				Only needed if Frequency Hopping used
Manufacturer Id	N	Y	P	Hard coded	Get Attributes	Value = com.ipaccess
Operational State	Y	Y	V	Internally	Get Attributes	
SW Configuration	Y	Y	P	Via sw download	Get Attributes	boot + backhaul + TRX
TSC	Y	Y	V	Set Channel Attributes	Get Attributes	

Table 5 - 12.21 'Channel' Attributes definitions

5.5.3.vi Object Class: GPRS NSE

Attributes	12.21?	supported	Storage	Set	Get	Notes
Administrative State	N	Y	V	Change Admin State	Get Attributes	only Locked and Unlocked are supported
Availability Status						
HW Configuration						
Operational State						
SW Configuration						
Current SW Configuration						
Object Version						
NSEI						two bytes value of the Network Service Endpoint Identifier for this PCU
NS Configuration						see below
BSSGP Configuration						see below

Table 6 – GPRS NSE Object Attributes definitions

NS Configuration	Min	Max
(Un)Blocking Timer	0	120
(Un)Blocking Retries	0	255
Reset Timer	0	120
Reset Retries	0	255
Test Timer	0	60
Alive Timer	0	10
Alive Retries	0	255

BSSGP Configuration	Min	Max
Blocking Timer (T1)	0	30
Blocking Retries	0	255
Unblocking Retries	0	255
Reset Timer (T2)	0	120
Reset Retries	0	255
Suspend Timer (T3) Units 100ms	0	100
Suspend Retries	0	255
Resume Timer (T4) Units 100ms	0	100
Resume Retries	0	255
Capability Update Timer (T5)	0	30
Capability Update Retries	0	255

5.5.3.vii Object Class – GPRS Cell

Attributes	12.21?	supported	Storage	Set	Get	Notes
Administrative State	N	Y	V	Change Admin State	Get Attributes	only Locked and Unlocked are supported
Availability Status						
HW Configuration						
Operational State						
SW Configuration						
Current SW Configuration						
Object Version						
BVCI						two byte value for the PTP-BVCI of the cell.
RAC						single byte value for the GPRS Routing Area Code for the cell
RLC Configuration						see table below
GPRS Paging Configuration						see table below

Table 7 – GPRS Cell Object Attributes definitions

RLC Configuration	Min	Max
T_3142	1	255
T_3169	1	255
T_3191	1	255
T_3193	1	255
T_3195	1	255
N_3101	8	255
N_3103	1	255
N_3105	1	255
Countdown Value	1	15

GPRS Paging Configuration	Min	Max
GPRS Paging Repeat Time	0	250
Paging Repeat Count	0	40

5.5.3.viii Object Class: GPRS NSVC

Attributes	12.21?	supported	Storage	Set	Get	Notes
Administrative State	N	Y	V	Change Admin State	Get Attributes	only Locked and Unlocked are supported
Availability Status						
HW Configuration						
Operational State						
SW Configuration						
Current SW Configuration						
Object Version						
NSVCI						two byte value of the Network Service Virtual Circuit Identifier
NS Link Configuration						see table below

Table 8 – GPRS Object Attributes definitions

NS Link Configuration	Min	Max
Remote UDP Port	0	65535
Remote IP Address	four byte value	
Local UDP Port	0	65535

5.5.3.ix Generic Configuration Features

The valid channel combinations on a "standalone" nanoBTS or on the Site Master TRX of a Multi-TRX configuration are:

Timeslot	Channel Types Allowed	Restrictions
TS0	Full BCCH	
	Combined BCCH	
	Combined BCCH with CBCH	
TS1	SDCCH/8	
	SDCCH/8 with CBCH	Only if TS0 is Full BCCH
	TCH/F	
	Dynamic PDCH/TCH	
	PDCH	
TS2-7	TCH/F	
	Dynamic PDCH/TCH	
	PDCH	

The valid channel combinations on a Slave TRX of a Multi-TRX configuration are:

Timeslot	Channel Types Allowed	Restrictions
TS0 and TS2-7	TCH/F	
TS1	SDCCH/8	Must be without CBCH
	TCH/F	

The BTS supports different Training Sequence Codes (TSC) on each channel.

The BTS does not support

- BCH,
- combinations requiring frequency hopping
- the "Starting Time" attribute

Messages invoking these shall be NACK'd.

5.5.4 Code Download

The BTS supports code download by either TFTP as part of the DHCP procedure at startup, or by using the software download function of the BtsInstaller tool (BTS_INSTALL_UG, CENG0048).

The BTS examines the header of the downloaded file to determine if the BTS hardware is compatible with the SW. If any part of the code download is incompatible with the hardware, then the code download is NACK'd and the transfer is aborted, without affecting the running or the stored code.

For DHCP triggered TFTP, once the code has been successfully downloaded and the TFTP is complete, then the BTS shall set an internal flag (not set / get able from the outside world) to "disable DHCP triggered TFTP on reboot" in EEPROM. The BTS shall change the "Default" index to the index that it has just successfully downloaded. Then the BTS should reset itself. Once reset the BTS shall clear this flag (so that on the next reboot a DHCP triggered TFTP download is permitted) and begin executing this code.

If a code download fails or is aborted for any reason, then a Failure Event Report is sent to the management system.

5.6 Air Interface

5.6.1 Power Control & Handover

The BTS supports MS Power Control algorithm.

The BTS supports "Non Synchronised" handover.

The BTS does not support "Synchronised" handover of any variant.

The BTS performs Measurement Pre-processing to determine when a handover should occur and provides an ordered candidate list of Neighbour Cells to handover to (according to GSM 05.08 Annex A). The algorithm may be configured via "Measurement Pre-Process defaults" message (see ABIS-IP and §5.14.2) in which case it is enabled. Configuration is BSC specific. Handovers can occur between different bands (e.g. 900MHz & 1800MHz).

The BTS sends RfResourceInds to monitor the background RF received power on unused timeslots.

The BTS supports the "Directed Retry" procedure on a particular MS to produce a list of candidate NCELLs that it can be handed over to.

5.6.2 Cell Broadcast

The BTS supports the “SMS-CB Default” message

The BTS supports the “SMS-CB Normal” message

The BTS does not support the “SMS-CB Scheduled” message

The BTS does not support the CBCH Flow control. The BTS sends an 08.58 ErrorInd upon receipt and throws a warning level FER (see section 5.7).

5.6.3 CCCH

The BTS supports Paging Re-organise and shall autonomously detect this by monitoring the System Information.

CCCH load management is not supported.

RACH load management is not supported.

Paging messages are repeated with configurable “Repeat Count” and “Repeat Period”.

Paging repeats do not automatically terminate on receipt of the SABM.

5.6.4 System Information

The BTS transmits System Information (SI) messages as part of the BCCH channel (as defined in GSM 04.08 & 05.02).

The BTS supports SI 1, 2, 2bis, 2ter, 3, 4, 5, 5bis, 5ter, 6 (on SACCH), 7, 8, 13

The BTS does not support SI 9, 10, 16, 17.

All other System Information messages are not supported.

5.7 Error Handling

All software errors generate a “Failure Event Report” (FER) with manufacturer specific “Probable Cause”. SW warnings include module and line number in the “Additional Text” IE’s.

The BTS supports SNMP traps for all errors. Within the SNMP MIB there will be an entry of “last reported error”.

There is a HW watchdog shall reset the system in case of unhandled errors.

Fatal Software errors store the error code in memory, and send a FER after reboot.

The BTS keeps a log of the last 10 SW and the last 10 HW errors in EEPROM including time and date of occurrence.

The BTS supports the GSM 12.21 (Version 5) “Request Outstanding Errors” procedure so that a BSC can list the state of all possible faults.

The BTS detects the loss of Ethernet connection by sending “keep-alive pings”.

5.8 System Monitoring

The BTS monitors the Radio Synthesiser OPLL to ensure that it is transmitting on frequency. This will be done once per GSM frame. If an error is detected then the BTS will autonomously attempt to relock the OPLL. If the synthesiser does re-lock then a warning level FER shall be sent and immediately ceased. If the synthesiser fails to lock then a critical level FER on the radio carrier object is sent.

The BTS monitors the transmitter Power Amplifier OOL signal once per GSM Frame. If the BTS detects that the PA OOL signal is in error then the BTS shall send a major failure FER for the radio carrier object (the BTS does not reboot).

The BTS monitors its internal temperature. This is represented as a percentage of the nominal operating range. If the reading exceeds the “Temperature Alarm Thresholds” that are set in EEPROM then a FER shall be sent. It shall also send an SNMP trap. The default alarm thresholds are 0% and 100%. The percentages can go below 0% and are indicated as a signed number between –128% and +127%.

The BTS monitors its Input Voltage. If the result exceeds the “Voltage Alarm thresholds” then the BTS shall send an FER. It shall also send an SNMP trap. The default alarm thresholds are 0% and 100%.

5.8.1 SNMP specific features

The BTS supports SNMP v2C (Community-based) only.

The BTS supports the

- SMIv2 "Interfaces" MIB (see SMIv2 - Interfaces MIB - RFC 2233)
- SMIv2 "IP" MIB (see SMIv2 - IP MIB (IPv4) - RFC 2011)
- SMIv2 "TCP" MIB (see SMIv2 - TCP MIB - RFC 2012)
- SMIv2 "UDP" MIB (see SMIv2 - UDP MIB - RFC 2013)
- "Ethernet Interface MIB" – iso88023-csmacd group (see SNMP Ethernet Interface (EtherLike) MIB – RFC 1643)
- SNMPv2 MIB. (see SMIv2 – SNMPv2 MIB – RFC 1907) with System group, SNMP group & MIB Objects group.

The BTS does not support SNMP "Sets". These shall be responded with the appropriate "SetResponse".

The BTS supports SNMP "Get", Get Next and "Get Bulk" on the supported MIBS

The BTS supports SNMP "Traps" on the supported MIBS.

The BTS supports SNMP enterprise "Traps" on all 12.21 failure event reports (except "Warning" or "Logged Warning" level failures) as the "last reported error" in the ip.access.v1 MIB. If the trap address is not NULL then a trap should be sent to the SNMP management agent.

The BTS supports setting of the SNMP "Community string" EEPROM parameter via 12.21 extensions only.

The BTS supports setting of the SNMP "Community string IP address" (that shall be used to limit SNMP gets by IP address) EEPROM parameter via 12.21 extensions only.

The BTS supports setting of the SNMP "SysContact" EEPROM parameter via 12.21 extensions only.

The BTS supports setting of the SNMP "trap address" EEPROM parameter via 12.21 extensions only.

The SNMP "SysLocation" shall be derived from 12.21 "location" string stored in EEPROM. Similarly the SNMP "SysName" shall be derived from the 12.21 "name" string stored in EEPROM.

The BTS supports the "ipaccess.v1" enterprise MIB that includes:

- description (of hardware)
- partNumber (hardware part number)
- partNumber (software part numbers and versions)
- serial number
- date & time of manufacture
- date & time of calibration
- input voltage (Volts)
- current draw (Amps)
- temperature (°C) – signed number
- power (Watts)
- array of alarm states (for "input voltage", "current draw", "temperature" & "power")
- last reported error

5.8.2 LED states

It is possible to Disable the LED output (using 12.21 Set NV Attributes), however for some critical errors and for visual indication of on-site procedures (e.g. factory reset of database) the LED will still come on (see below).

In general, the LED states have a concept of precedence. Higher priority LED states take precedence over lower priority states.

With LED flag = ENABLED:

State	Pattern	When	Precedence
LED_SELF_TEST_FAILURE	Red Steady	In boot or application code when a power on self test fails.	1 (High)
LED_UNSPECIFIED_FAILURE	Red Steady	On s/w fatal errors.	2
LED_NO_ETHERNET	Orange Slow Flash	Ethernet disconnected.	3
LED_DOWNLOADING_CODE	Orange Fast Flash	Code download procedure is in progress.	4
LED_ESTABLISHING_OML	Orange Slow Blink	OML not yet established (via primary or secondary OML port) but is needed in order for the BTS to become operational.[1]	5
LED_FACTORY_RESET	Red Fast Blink	Dongle detected at start up and the factory defaults have been applied.	6
LED_SELF_TEST	Orange Steady	From power on until end of backhaul power on self-test	7
LED_NWL_TEST	Green Fast Flash	OML established, NWL test in progress	8
LED_LOCKED	Green Slow Flash	OML established, but an MO is locked that will prevent C0 being transmitted.	9
LED_OPERATIONAL	Green Steady	Default condition if none of the above apply.	10 (Low)

Table 9 - LED states when LED Enabled

[1] Once the nanoBTS is operational, it should continue to operate even if the OML connection is lost, and the LED should continue to show steady green.

With LED flag = DISABLED:

State	Pattern	When	Precedence
LED_SELF_TEST_FAILURE	Red Steady	In boot or application code when a power on self test fails.	1 (High)
LED_UNSPECIFIED_FAILURE	Red Steady	On s/w fatal errors.	2
LED_NO_ETHERNET	Off	Ethernet disconnected.	3
LED_DOWNLOADING_CODE	Off	Code download procedure is in progress.	4
LED_ESTABLISHING_OML	Off	From power on until OML established	5
LED_FACTORY_RESET	Red Fast Blink	Dongle detected at start up and the factory defaults have been applied.	6
LED_SELF_TEST	Off	From power on until end of backhaul power on self-test	7
LED_NWL_TEST	Off	OML established, NWL test in progress	8
LED_LOCKED	Off	OML established, but an MO is locked that will prevent C0 being transmitted.	9
LED_OPERATIONAL	Off	Default condition if none of the above apply.	10 (Low)

Table 10 - LED states when LED Disabled

The non-steady LED states are defined as:

	Mark	Space
Slow Flash	1s	1s
Fast Flash	0.5s	0.5s
Slow Blink	1.9s	0.1s
Fast Blink	0.3s	0.1s

Table 11 - LED flash and blink timings

5.9 Traffic

5.9.1 Channel Types

The BTS supports the transport of

- Full Rate (FR)
- Enhanced Full Rate (EFR) GSM speech.
- BS20 (14.4k) single slot circuit switched data.
- BS21-26 (up to 9600) single slot circuit switched data
- BS61 and BS81 speech-then-data and alternate-speech-and-data.

The BTS does not perform any transcoding, but it does perform rate adaption for circuit switched calls to deliver all CSD bearers in V.110 frame format, for compatibility with the nanoGSM Circuit BSC.

5.9.2 Encryption

The BTS supports A5/1 and A5/2 encryption, as well as no-encryption. Some units may be not be supplied with encryption in the software load, because of export restrictions or other reason. The BTS rejects attempts to set up channels with encryption scheme not supported in a particular software build.

5.9.3 Traffic Frame Formats

The BTS supports the TFO frame format carried by RTP for Data calls on the IPA builds.

The BTS supports the TIPHON frame format carried by RTP for Speech calls on (see "draft-ietf-avt-profile-new-version.txt").

5.10 Performance

The BTS is rated to support a loading of 600 BHCA with <1% error rate of call set-up failures, directed retries, handovers and location updates due to internal performance constraints of the BTS.

5.11 Peripherals

5.11.1 Backhaul

5.11.1.i Miscellaneous

The BTS contains a Fast Ethernet Controller IC (FEC) with 10/100 mbps auto-negotiation (auto-negotiation occurs without needing to reboot).

5.11.1.ii EEPROM Storage

The EEPROM structure is protected against bit error using a CRC check mechanism

5.12 NV Configuration

5.12.1 Parameters

The NV management state model for each parameter is as shown in Figure 6. All attributes are initially in the 'illegal' state. This means that the store is completely invalid. If the store is 'illegal' when the software starts up then its structure is written and all attributes are 'defaulted'.

Type 1 attributes will be 'initialised' and cannot be 'modified', for example the MAC address. Type 2 attributes can be 'modified', for example whether DHCP is enabled. To prevent changing read-only 'initialised' values, if the OEMid value is non-null (has been 'initialised') then write access to Type 1 attributes is denied. Given this model, the factory code requirements can be achieved using a single software image and a single defined use of the dongle.

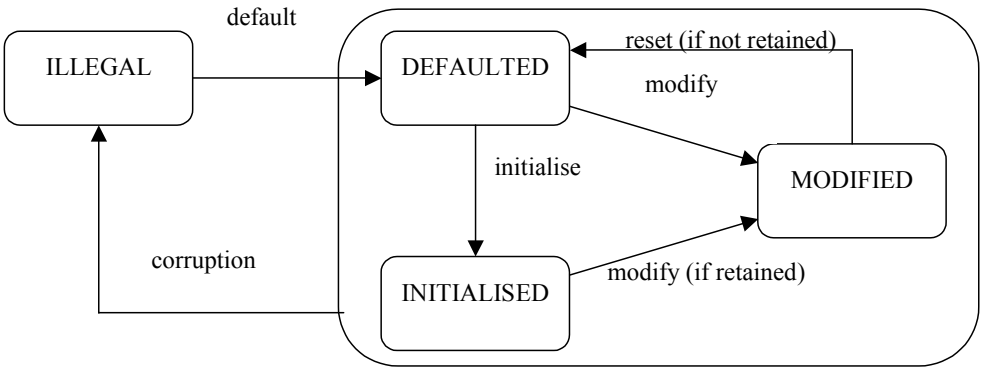


Figure 6 - NV Configuration model

All attributes listed in Table 12 with "Initialised? == Y" are assumed to be type 1 attributes and cannot be overridden once OEMid has been set in the factory (except for the case of "OCXO DAC Value" which can be adjusted using the SetNVAttributes message or as a result of a frequency synchronisation test using NWL). For returned units in the factory, the OemID can be overridden with a special command (see FAT_017).

All other attributes are type 2. Those marked "Retained? == Y" are not reset to factory defaults by insertion of the dongle.

If the EEPROM is deemed to be corrupt then the BTS attempts to send a FER as soon as it connects (or is connected to) an OMC (see ERR §5.7). It shall also set the base-band transceiver managed objects to "Disabled, Failed". The LED state should also be set to "LED_FACTORY_RESET".

Note that not all NV parameters are available for use by end-customers. Some are reserved for factory or other internal use.

Note that the presence of an NV flag does not indicate support of a feature of the same name.

Attribute	Default Value	Initialised?	Retained?
MAC Address	00:02:95:00:00:00	Y	N/A
PCB Assembly Part Number	"108_029"	Y	N/A
PCB Assembly Issue	"X"	Y	N/A
HW/SW Compatibility	0x02	Y	N/A
CEM Id	0xFF	Y	N/A
CEM Serial Number	""	Y	N/A
IPA Serial Number	""	Y	N/A

OEM Id	0xFF[2]	Y	N/A
Date and Time of Manufacture	01/01/1900 00:00:00	Y	N/A
Date and Time of Calibration	01/01/1900 00:00:00[3]	Y	N/A
OCXO Slope	0x0000	Y	N/A
Max OCXO Current (mA)	1000	Y	N/A
Default Gateway	0.0.0.0	N	N
Subnet mask	0.0.0.0[4]	N	N
IP Address	0.0.0.0	N	N
Primary OML Link IP Address	0.0.0.0[5]	N	N
Primary OML Port	0[6]	N	N
Secondary OML Link IP Address	0.0.0.0	N	N
Secondary OML Port	0	N	N
Flags 1 – Static Interface IP Config	FALSE	N	N
Flags 1 – Static IP Gateway Config	FALSE	N	N
Flags 1 – Static Primary OML Config	FALSE	N	N
Flags 1 – Dhcp	TRUE[7]	N	N
Flags 1 – LED	TRUE	N	N
Flags 1 – Alarm Thresholds NV	TRUE[8]	N	N
Flags 2 – Secondary OML Enable	TRUE	N	N
Flags 2 – Diagnostics Enable	FALSE	N	N
Flags 2 – CLI Enable	FALSE	N	N

[2] OEMId is defaulted with its null value 0xFF.
[3] Date and Time of Calibration is re-initialised whenever a full calibration is performed.
[4] Subnet mask is defaulted with its null value – if IP Address is configured and subnet mask is null then use a class mask appropriate for this address.
[5] Primary OML Link IP Address is initialised with its null value. The software must prevent attempts to use this address (NULL value) when connecting to servers.
[6] Primary OML IP port is initialised with its null value. When booting with this null value, the software will choose an appropriate vendor specific value.
[7] Not directly settable. If any of the three static IP config flags (interface, gateway or OML) are false then this is true, otherwise it is false.
[8] Not directly settable. If any of the voltage, current, power or temperature thresholds are set, then this is true, otherwise false.

Flags 2 – HTTP Enable	FALSE	N	N
Flags 2 – POST Enable	FALSE	N	N
Flags 2 – SNMP Enable	TRUE	N	N
OCXO DAC Value	0x0000	Y	Y
Input Supply Voltage Thresh Max Percent	100	N	N
Input Supply Voltage Thresh Min Percent	0	N	N
BTS internal Temperature Max Percent	100	N	N
BTS internal Temperature Min Percent	0	N	N
Input Supply Current Thresh Max Percent	100	N	N
Input Supply Current Thresh Min Percent	0	N	N
Input Supply Power Thresh Max Percent	100	N	N
Input Supply Power Thresh Min Percent	0	N	N
BTS Location	""	N	N
BTS Name	""[9]	N	N
Site Id	0xFFFF	N	N
BTS Id	0xFF	N	N
TRX Id	0xFF	N	N
In Service Time	0	N	Y
Primary OML fallback address	0.0.0.0	N	N
Primary OML fallback port	0	N	N
SNMP community string	"public"	N	N
SNMP Trap Address	0.0.0.0	N	N
SNMP Trap Port	0	N	N
SNMP Manager Address	0.0.0.0	N	N
SNMP System Contact	"Not Known"	N	N

Table 12 - NV Attributes

5.12.2 TRX controlled parameters

Attribute	Default Value	Notes

[9] BTS name is defaulted with its null value. If the software detects this null value then it uses the value "nbts-" concatenated with the '-' separated MAC address.

TRX database schema		
TX Power ramps		13 levels, 32 x UInt16
TX Scale factors		13 levels, UInt16 for each level
TX Frequency compensation		12 ARFCN's, UInt16 for each ARFCN
TX DC Offsets	0x0, 0x0	2 x SInt16
RXGainControlNormal (i.e. uplink receiver)		26 AGC steps UInt16 for each step
RXGainControNWL (i.e. downlink receiver)		26 AGC steps UInt16 for each step
RxAccurateGainNormal (i.e. uplink receiver)		26 AGC steps UInt16 for each step
RxAccurateGainNWL (i.e. downlink receiver)		26 AGC steps UInt16 for each step
RxFreqCompNormal (i.e. uplink receiver)		12 ARFCN's, SInt16 for each ARFCN
RxFreqCompNWL (i.e. downlink receiver)		12 ARFCN's, SInt16 for each ARFCN
RxDC Offsets	0x0, 0x0	2 x SInt16

5.13 Operations

5.13.1 Network Listen

The BTS supports

- the "Channel Usage" test to determine received power on requested ARFCNs.
- the "BCCH Channel Usage" test to determine if the channel contains a FCH and SCH channel. It reports report the power level, BSIC, frame and sub-frame offset if a BCCH is detected.
- the "BCCH Info" test. It decodes SI1 to determine the CA list and SI3 to determine the CGI (Cell Global Identity). It captures SI2, SI2-bis, SI2-ter and sends them as entire SI messages in the result. The test may take up to 35 seconds to pick up all of the system information types off-air.
- the "Frequency Synchronisation" test to measure the frequency offset of other basestations with respect to its own OCXO setting. For each ARFCN it reports a frequency quality metric and the offset in ppb's. When the frequency error is such that the BTS can measure a coarse frequency offset from the FCH, but cannot decode the SCH (because the DSP equaliser cannot resolve the frequency offset) it reports an error with a frequency quality of "0".
- the "Beacon mode" test to enable other basestations to monitor it. This test is configurable to set the BSIC, ARFCN and transmit power to be used. The test continues until a "Stop Test" request is made. The transmitted BCCH information marks the cell as "barred" for all access types.

NWL tests will take the BTS out of service for the duration of the test. The BTS will restart service after the test is complete. A state change event report is generated at the beginning and end of the test.

5.13.2 Normal Operation

After boot-up and POST (if enabled), the BTS attempts to connect to Primary OML (as indicated in IP and Port number settings in database).

Once connection is established, it uses "heart-beat" connection message to detect if connection has gone down.

The BTS starts up a second OML server (if enabled in NV Config flag F9). It uses the second OML port specified in NV, or if this is NULL then assume a default of 3006. If the

second oml IP address field is not NULL then it should reject connections from IP addresses that are not the same. SW activation can occur on either primary or secondary OML.

On loss of the 2nd OML client the BTS doesn't reboot. Interrupted procedures are terminated and do not take effect.

Once the BTS has established any OML connection it performs a "SW Activation Request" for the Site Object.

Once the BTS has performed the "SW Activation" for the Site object it performs a "SW Activation Request" for the Baseband Tranceiver Object.

Once the BTS has performed the "SW Activation" for the Baseband Transceiver object it will perform a "SW Activation Request" for the BTS object.

Once the BTS has performed the "SW Activation" for the BTS object it performs a "SW Activation Request" for the Radio Carrier Object.

The BTS shall send "State Change Event Report" messages at the appropriate times (as defined in GSM 12.21) whenever the managed object state changes.

5.13.2.i SW Activation Procedure

The HW Configuration attribute in the SW Activate Request is the same for all objects, and is the same as would be obtained by sending a Get Attributes message to an object.

The SW Configuration attribute includes at least one SW Description for each type of image that it is dependent on, excluding boot code.[10] If, when an object sends a SW Activate Request, a version of an image that it depends on has already been activated, it only includes that version's SW Description, otherwise it includes a SW Description for each version of the image that is available for activation.

If the same software version is in both banks, then both banks shall be reported where applicable (see above).

Note that the value of the SW Configuration attribute in a SW Activate Request message sent by an object is therefore not the same as that of the SW Configuration attribute obtained by sending a Get Attributes message to the object. i.e. the SW Configuration Attribute reported as a response to the "GetAttributes" message includes the "Boot application"; the "Boot application" is not included in "SW Activate Request" messages.

[10] The boot code has already finished executing by the time software activation occurs, so there is no need to activate it.

Where a SW Activate Request contains more than one SW Description for a given image type, the first one is the "default" image. An image can be selected (eg. under user control) as the default image by sending a manufacturer-defined O&M message, "Set Default SW"[11] to the nanoBTS.

The BTS expects to receive a SW Activate message in response to each SW Activate Request that it sends. The SW Activate message may contain 0, 1, or more SW Descriptions – and each of these must have been present in the corresponding SW Activate Request message. If it contains no SW Descriptions, the object to which it is sent will default to activating the most sensible default set of software. If it contains more than one SW Description, they should be such that they can all be activated (for example, there should not be more than one version for a given File Id).

Each managed object as defined in GSM 12.21 (Site Manager, BTS, Baseband Transceiver, Radio Carrier, and Channel) has a SW Configuration attribute, which is a list of one or more SW Description attributes. In the nanoBTS, each object's SW Configuration will contain a SW Description for each version of each of the images on which the object depends. (An object depends on a software image if the physical item that it represents requires the image to be executed before it can provide any service.)

Each 12.21 managed object has a HW Configuration attribute, which is a list of one or more HW Description attributes. In the case of the nanoBTS, each object's HW Configuration attribute will contain exactly one HW Description, which will have the same value for all objects. This HW Description relates to the PCB assembly inside the nanoBTS.

The BTS's Site Manager object sends a SW Activate Request containing a SW Description for each backhaul software image that is present. The first (and perhaps only) of these refers to the backhaul software that is currently running.

The BTS expects the BSC to send a SW Activate message containing either no SW Descriptions, or one SW Description. If there is no SW Description or there is one and it refers to the version of backhaul software that the BTS is currently executing, that is marked as having been activated, and the procedure continues. If there is one SW Description and it refers to the version of backhaul software in the other bank, the BTS marks that version as the default, and restarts itself. On restart, the BTS executes the

[11] Note that the term "Boot" in "Set Default SW" does not refer to the nanoBTS's boot code image, it refers to the (backhaul and TRX) software that the nanoBTS should run by default the next time it is rebooted.

version marked as the default, and repeats the software activation procedure. Note that it shall not send anything else to indicate that it had to reboot (such as a FER). This time, the Site Manager's SW Activate Request message will include the SW Description for the backhaul software that is now executing before the SW Description for the version that it was previously executing.

The BTS's Baseband Transceiver object sends a SW Activate Request containing a SW Description for the backhaul software image that was activated on the Site Manager object, plus a SW Description for each TRX software image that is present. The BTS expects the BSC to send a SW Activate message, which may contain no, one, or two, SW Descriptions. If there is no SW Description, the nanoBTS will activate the "default" TRX device software. If there is a SW Description for the backhaul, it must match that which was sent in the SW Activate Request. If there is a SW Description for the TRX software, the nanoBTS will load the specified version onto the TRX device and execute it.

The nanoBTS's BTS object sends a SW Activate Request containing a SW Description for the backhaul software image that was activated on the Site Manager object. The BSC should send a SW Activate message to the BTS object containing either no SW Descriptions, or the one SW Description that was in the SW Activate Request. In either case the procedure continues. If the BSC sends a SW Activate message in response that does not match any of its SW Descriptions then the BTS shall N'ACK the message.

The BTS's Radio Carrier object sends a SW Activate Request containing one SW Description for the backhaul software image that was activated on the Site Manager object and one for the TRX software that was activated on the Baseband Transceiver object. The BSC should send a SW Activate message to the BTS object containing either no SW Descriptions, or one or both of the SW Descriptions that were in the SW Activate Request. In either case, this is the end of the software activation procedure, and the other procedures associated with starting up the BTS can be carried out.

5.14 Abis Interface (ABIS)

The BTS conforms to the nanoGSM Abis Over IP specification, according to the profile given later in this document.

5.14.1 O&M Signalling Messages

The BTS supports Abis messages as clarified below on both primary and secondary OML links.

The BTS initiates the “Primary OML Establishment” procedure to the defined “primaryomlipport” parameter in EEPROM configuration. If this is set to the NULL value (see §5.12) then the BTS shall use the vendor specific port number as defined in the software build (IPA BSC = 3002).

The BTS supports the “Connect IP Signalling” message.

The BTS supports the “Set Default SW” message. This has the effect of adjusting the EEPROM parameter so that on the next reboot the BTS will boot the specified Backhaul Index (see 5.4.1). It will also use the “default” set indexes (for Backhaul and TRX) as its first preference offered to the BSC in the SW Activation procedures.

On receipt of new configuration the BTS will immediately use the configuration for the NVConfig Flags F7-F9. Note that in the case of F9 (Second OML Enable) that this does not disconnect current connections, but stops new connections.

The BTS will adjust the Frequency control immediately upon receipt of new configuration of the “Frequency Control” IE.

The BTS does not immediately use the new Primary OML or Secondary OML Configuration if a connection has already been established. It shall use the configuration for all new connections.

The BTS does not immediately action receipt of configuration of new IP Configuration (either from the “IP Interface Config” or “IP Gateway Config”). A reboot is always required.

The BTS immediately actions receipt of configuration of new BTS Location.

The BTS does not immediately use new Unit Id configuration (BTSid & TRXid). A reboot is always required. For single TRX configuration, the TrxId is always be 0.

The BTS supports setting of the “Name” field.

The BTS supports the extension to the “SetBTSAttribute” message for paging configuration. Note that the defaults are hard coded and cannot be adjusted in NV configuration.

The BTS supports the Set Alarm Thresholds. Note that the behaviour depends on the NVConfig flag F8 (“SetAlarmThresholds”).

The BTS supports the “Perform test” message for starting NWL tests.

The BTS supports the “Get Attribute” message.

The BTS supports the “Reinitialise” message.

5.14.2 RSL Signalling Messages

The BTS uses the "Measurement Pre-processing Defaults" messages for configuration of the Measurement Pre-processing algorithm (according to ABIS-IP). The BTS should accept this message at any time and apply new defaults for new dedicated connections. The BTS or any sub-object does not need to be locked for this to take effect.

5.14.3 User Traffic Messages

The BTS supports RTP Traffic format.

The BTS does not support the Traffic Frame Synchronisation Procedure.

5.14.4 Channel Control Messages

The BTS supports the "Heartbeat" procedure. The BTS requires the Identity Request Message over TCP or UDP. The BTS shall respond to a UDP message to the well-known "second omlipport" number (3006).

Upon heartbeat failure of OML, the BTS shall try to carry on if already operating, keep trying to reopen the connection. Messages should be discarded as required to avoid overflow (e.g. whenever connect returns a failure, discard any queue and immediately retry, if too many things queue whilst awaiting connection, discard as required).

Upon heartbeat failure of RSL, the BTS shall disable the relevant TRX, dropping calls and clearing up as required, (it should act as if locked and then immediately unlocked again). Keep trying to connect, send an alarm to O&M, resume normal operations as soon as link is restored.

5.15 GPRS Feature Support

The BTS supports

- Gb over IP, with NS frames being transported over UDP/IP.
- mobiles up to multislot class 10.
- all coding schemes, CS1 through CS4, with link adaptation.
- Air interface timeslots may be configured statically for GPRS or dynamically for GPRS. In the latter case the timeslots may be used as either TCH or GPRS according to traffic patterns
- NC mode 0.
- MAC dynamic uplink allocation
- circuit mode paging during GPRS transfer
- MAC 2 phase access

6 SOFTWARE IMPLEMENTATION (INFORMATIVE)

6.1 Platform

The hardware platform for the BTS is shown in Figure 4. It consists of three handset baseband devices (ADmsp430), a general purpose communications processor (MPC855T), and an FPGA based interprocessor communications buffer and synchronisation channel.

The ADmsp430 device consists of an ARM7 microcontroller, a Viterbi coprocessor, a ciphering engine, timing and control logic (the TCU), and an Analog Devices 21B series DSP device. The ARM7 runs AMX with application code written in ANSI C. The DSP runs native assembler.

The MPC855T device runs the Nucleus operating system which includes TCP, UDP, IP, ICMP, SNMP, and all MPC855T device drivers (as part of the Board Support Package). Other application code is developed internally, written in ANSI C.

The FPGA is responsible for managing interprocessor communications buffers. An HDLC controller is implemented within it, which communicates directly to a similar sub-system in the MPC855T.

The FPGA also implements GSM frame level synchronisation between the three ADmsp430 devices.

6.2 Functional Partitioning

Broadly speaking, the GSM air interface functionality is managed by the three ADmsp430 devices, designated the ULM (uplink master), ULS (uplink slave) and DLP (downlink processor). These are collectively known as the TRX. The Ethernet interface is managed by the MPC855T, designed the BH (backhaul) processor.

The major functional elements within the nanoBTS are partitioned as follows

Function and sub-function		processor
GSM L1 Receive, including soft-decision equalisation, de-interleave, channel decoding and deciphering	Even slots	ULM
	Odd slots	ULS
GSM L1 transmit, including ciphering, channel coding, interleave	All slots	DLP
GSM L2 processing, including BCCH scheduling		DLP
GPRS PCU	RLC/MAC	BH
GPRS L1		TRX
GPRS Gb	BSSGP and NS/IP	BH
Operations and Management Link (OML) Processing	Abis/IP messages terminate in the BH and generate device driver calls as required	BH
Radio Signalling Link (RSL) Processing	RSL (GSM8.58) messages	BH
	Embedded GSM4.08 messages	TRX (for onward transmission to MS)
Non-volatile storage		BH
Code download management		BH
IP stack and applications	DHCP, ICMP, TCP, RTP, RTCP, UDP	BH

6.3 Interprocessor Communications

Secure communications within the nanoBTS are implemented as follows

BH to TRX	HDLC framing including checksum generation and checking performed in MPC855T and FPGA.
Intra-TRX (GSM L2)	Messages carried and routed through the FPGA.
ARM7 to DSP	Dual-port memory interface
ARM7 to Synthesiser programming registers	DMA

6.4 Process Scheduling

For software tasks running on the ARM7 and MPC855T cores, software processes are scheduled either

- Asynchronously by the OS running on that processor, or
- Synchronously from interrupts generated by the underlying hardware devices or DSP

Software tasks running on the DSP are scheduled synchronously and deterministically using interrupts generated by the TCU. DSP tasks are divided into frame-based and block-based tasks. Frame based tasks have the highest priority, and include

- Burst data read and write
- Modulation and demodulation
- Equalisation, channel decode and deinterleave
- Receiver gain control
- Synthesiser programming
- Transmitter dynamic power control

Note that frame-based tasks occur every timeslot boundary.

Block based tasks execute every four frames, again, at the conclusion of each timeslot and include

- L2 block transfer from DLP
- Channel coding and interleaving
- Viterbi decoding of soft-decision results from equaliser
- L2 block transfer to ULM/ULS

Block based tasks run at lower priority than frame based tasks, and are usually interrupted by them.

6.5 Interprocess Communications and Synchronisation

Software processes within the ARM7 and MPC855T processors communicate with each other exclusively using messages written to and read from OS maintained inter-process message queues. Other methods of interprocess communications (such as semaphores or shared memory) are not used.

The one exception to this rule is the communication between DSP and ARM. Software running on the DSP core reads its data on interrupt generated by the TCU from dual-port memory shared with the ARM.

ANNEX A - PROFILE OF A-BIS_OVER_IP_INTERFACE_V01_00.DOC (INFORMATIVE)

This section specific paragraphs in the Abis over IP interface specification to profile which aspects of it are / are not supported by the BTS software.

'-' indicates that this paragraph does not state a possible requirement.
'Y' indicates that the BTS shall support all elements as described in this section
'N' indicates that the BTS shall NOT support any elements as described in this section.

Section Number	Heading	Comments
1	INTRODUCTION	-
1.1	Overview	-
1.2	Purpose	-
1.3	Scope	-
1.4	Deployment Scenarios	-
1.5	Terminology	-
1.6	References	-
2	Channels	Y
2.1	Physical Layer	The BTS shall only support the Ethernet physical layer.
2.2	Layer 2 Signalling	Y
2.3	Traffic	Y
2.4	Signalling Message Transports	Y
2.4.1	Framed TCP Transport	The BTS shall support Framed TCP transport as described except: OML messages and RSL messages shall be carrier over separate TCP connections only.
2.4.2	SCTP	The BTS does not support SCTP.
2.4.3	UDP Transport	Y
3	O&M Signalling Messages	Y – One caveat though – String type messages (e.g. 'Location String' etc) have a practical limit due to memory requirements. As such a limit of

		80 bytes has been placed on all string fields (including Null terminator). This is the "generally accepted" limit implied in ASN.1 type "GraphicString". Although the BTS will correctly accept the messages, they will be truncated internally so sending messages like this is not encouraged.
3.1	Unsupported O&M messages	Y – however there are more messages than this that are not supported by the BTS (see GSM12.21 profile).
3.1.1	Unsupported O&M Attributes	Y – however there are more messages than this that are not supported by the BTS (see GSM12.21 profile).
3.2	Manufacturer-Defined O&M Messages	Y
3.2.1	Connect IP Signalling	Y
3.2.2	Disconnect IP Signalling	Y
3.2.3	Spare	-
3.2.4	Spare	-
3.2.5	Spare	-
3.2.6	Set NV Attributes	Y – Note that the only object class supported is the "baseband transceiver" object.
3.2.7	Get NV Attributes	Y – Note that the only object class supported is the "baseband transceiver" object.
3.2.8	Set Attributes	
3.2.9	Attribute Value Change Event	
3.2.10	SW Deactivate	
3.3	O&M Signalling Attributes	-
3.3.1	O&M Manufacturer-Defined Message Type	Y
3.3.2	O&M Manufacturer-Defined Attribute	Y

	Identifiers	
3.3.3	Destination IP Address	Y
3.3.4	Destination IP Port	Y
3.3.5	Spare	-
3.3.6	Spare	-
3.3.7	Spare	-
3.3.8	Stream Identifier	Y
3.3.9	NV Config Flags	Y
3.3.10	Frequency Control	Y
3.3.11	Primary and Secondary OML Config	Y – The well-known default port number is 3006.
3.3.12	IP Interface Config	Y
3.3.13	IP Gateway Config	Y – The BTS only supports setting of the default gateway (i.e. the Network address must be NULL).
3.3.14	In Service Time	Y – (This attribute cannot be set – not in the Set NV attributes)
3.3.15	Location	Y
3.3.16	Paging Configuration	Y
3.3.17	Unit Id	Y
3.3.18	Spare	-
3.3.19	Unit Name	Y
3.3.20	SNMP Config	Y
3.3.21	Primary OML Config List	Y
3.3.22	Primary OML Fallback Timeout	Y
3.3.23	Current SW Configuration	Y
3.3.24	Timing Bus	Timing Bus is supported at nBR2
3.3.25	CGI	Y
3.3.26	RAC	Y
3.3.27	Object Version	Y
3.3.28	GPRS Paging Configuration	Y
3.3.29	NSEI	Y

3.3.30	BVCI	Y
3.3.31	NSVCI	Y
3.3.32	NS Configuration	Y
3.3.33	BSSGP Configuration	Y
3.3.34	NS Link Configuration	Y
3.3.35	RLC Configuration	Y
3.3.36	Alarm Threshold List	Y
3.3.37	Monitored Value List	Y
3.4	Manufacturer Dependent Information Elements	-
3.4.1	Additional Info	Y
3.4.2	Additional Text	Y
3.4.3	Event Type	Y
3.4.4	File Data	Y
3.4.5	File Id	Y
3.4.6	File Version	Y
3.4.7	HW Description	Y
3.4.8	List of Required Attributes	Y – The BTS shall NACK any attributes Ids that it does not recognise.
3.4.9	Manufacturer Dependent State	-
3.4.10	Manufacturer Dependent Thresholds	Y- but note that this is now deprecated
3.4.11	Manufacturer Id	Y
3.4.12	Nack Causes	-
3.4.13	Physical Config	Y
3.4.14	Specific Problems	-
3.4.15	Test No	Y
3.4.16	Test Report Info	Y
3.4.17	Perceived Severity	Y
3.4.18	Probable Cause	Y
3.4.19	Channel	Y

	Combination	
3.4.20	Measurement Identifier	Y
3.4.21	Measurement Results	Y
3.4.22	Object Class	Y
3.4.23	Object Instance	Y
3.4.24	SW Configuration	Y
3.4.25	Get Attributes Response Info	Y
3.4.26	Overload Period	Y
3.5	Embedded Information elements	Y
3.5.1	ARFCN Lists	Y
3.5.2	Frequency Error List	Y
3.5.3	Channel Usage List	Y
3.5.4	BCCH Information Type	Y
3.5.5	BCCH Information	Y
3.5.6	RXLEV Threshold	Y
3.5.7	Configuration	N – This is treated as a reserved field for development use only.
3.5.8	Result Details	N – This is treated as a reserved field for development use only and is used in response to the “Configuration” IE.
3.5.9	Frequency Sync Options	Y – except that the “Freq Config Params” field shall not be used and shall be treated as reserved (ignored).
3.5.10	MAC Address	Y
3.5.11	HW-SW Compatibility Number	Y
3.5.12	Manufacturer Serial Number	Y
3.5.13	OEM Id	Y
3.5.14	Date and time of Manufacture and	Y

	Calibration	
3.5.15	Beacon Information	Y – Note that if the unit cannot support an exact power level requested it will NACK the message.
3.5.16	Frequency Error	Y
3.5.17	SNMP Community String	Y
3.5.18	SNMP Trap Address	Y
3.5.19	SNMP Trap Port	Y
3.5.20	SNMP Manager Address	Y
3.5.21	SNMP System Contact	Y
3.5.22	Factory Id	Y
3.5.23	Factory Serial Number	Y
3.5.24	Logged Event Indicator	Y
3.5.25	Localised Additional Text Information	Y
3.5.26	BTS Identifier	Y
3.5.27	Broadcast L3 message	Y
3.6	Manufacturer Extensions to existing O&M messages	-
3.6.1	Set BTS Attributes	Y
3.6.2	Set Alarm Thresholds	Y
3.6.3	Perform Test	Y
3.6.4	Load Data Initiate	Y – In fact the BTS ignores the SW Description. The BTS always retrieves the SW Description from within the SDP file contents downloaded.
3.6.5	Set Radio Carrier Attributes	Y
3.6.6	Set Channel Attributes	Y

3.6.7	State Changed Event Report	Y
3.6.8	SW Activated Report	Y
3.6.9	Get Attributes Response	Y
3.6.10	Measurement Procedure Nacks	Y
3.7	Manufacturer Extensions to existing O&M Attributes	-
3.7.1	Autonomously Report	Y
3.7.2	Power Class	Y
3.8	Object Model and attribute mapping	-
3.8.1	Object Model	Y
3.8.2	Object Attribute Mappings	Y
3.9	Object Version Number Assignments	Y – Objects return their version number in a GetAttributes procedure, but do not yet report their versions at SW_Activation. Objects at this release are generally Version 1.
4	RSL Signalling Messages	Y
4.1	RSL Message Formats and Contents	-
4.1.1	Create Connection	Y
4.1.2	Create Connection Acknowledge	Y
4.1.3	Create Connection Negative Acknowledge	Y
4.1.4	Modify Connection	Y
4.1.5	Modify Connection Acknowledge	Y
4.1.6	Modify Connection Negative	Y

	Acknowledge	
4.1.7	Delete Connection Indication	Y
4.1.8	Delete Connection	Y
4.1.9	Delete Connection Acknowledge	Y
4.1.10	Delete Connection Negative Acknowledge	Y
4.1.11	Measurement Pre-processing Defaults	Y
4.1.12	Directed Retry Enquiry	Y
4.1.13	Handover Candidate Enquire	N
4.1.14	Handover Candidate Response	N
4.1.15	Paging Command	Y
4.1.16	PDCH Activation	Supported at nBR1.5
4.1.17	PDCH Activation Ack	Supported at nBR1.5
4.1.18	PDCH Activation NAK	Supported at nBR1.5
4.1.19	CCCH Load Indication	Supported at nBR1.5
4.2	RSL Information Elements	-
4.2.1	RSL Manufacturer-Defined Identifiers	Y
4.2.2	Destination IP Address	Y
4.2.3	Destination IP Port	Y
4.2.4	Source IP Port	Y
4.2.5	IP Speech Mode	Y – The BTS does not support speech transcoding.
4.2.6	Source IP Address	Y
4.2.7	RTP Payload Type	Y
4.2.8	Connection	Y

	Statistics	
4.2.9	BS Power	N - 119 SW does not implement BTS power control, although reception of this configuration is supported. The BTS shall not support BTS power control on a C0 carrier (as per GSM spec). The "receive only" extensions for downlink NWL are not supported.
4.2.10	Physical Context	N – receipt of the information element is supported but its value is ignored.
4.2.11	Uplink Measurements	N – not sent by the BTS
4.2.12	Message Discriminator	Y
4.2.13	Message Type	Y – Except that "Handover Candidate Enquire" & "Handover Candidate Response" are not supported by the BTS.
4.2.14	Cause	Y
4.2.15	MS Power Parameters	Y
4.2.16	BS Power Parameters	N – Messages are ignored
4.2.17	Pre-processing Parameters	Y
4.2.18	Pre-processed Measurements	Y
4.2.19	Handover Candidate Parameters	N
4.2.20	Connection Id	Y
4.2.21	RTP CSD Format	Supported at nBR1.5
4.2.22	Channel Number	Y
4.2.23	Resource Information	Y
4.2.24	Paging Load	Y
4.2.25	RTP Jitter Buffer Control	Supported at nBR1.5
4.3	08.58 Message Embedded Information Elements	-

4.3.1	RXLEV Embedded Information Element	N – Reserved for future NWL extensions
4.3.2	RXQUAL Embedded Information Element	N – Reserved for future NWL extensions
4.3.3	Frequency Error Embedded Information Element	N – Reserved for future NWL extensions
4.3.4	Frame Timing Error Embedded Information Element	N – Reserved for future NWL extensions
4.3.5	Measurement Averaging Configure	Y – however the BTS shall only support averaging method "0". The MS-BTS distance parameter is ignored.
4.3.6	BS Power Control Thresholds	N – Messages are ignored
4.3.7	MS Power Control Thresholds	Y
4.3.8	Handover Thresholds	Y
4.3.9	NCell Defaults	Y
4.3.10	NCell List	Y
4.3.11	PC Threshold Comparators	Y
4.3.12	HO Threshold Comparators	Y
4.3.13	Handover Cause	Y – although MAX_MS_RANGE will not be sent as a cause value.
4.3.14	Handover Candidates	Y
4.3.15	NCell BA-list Change List	Y
4.3.16	Number of MSs	N – only used in HO candidate enquiry.
4.3.17	Handover Candidates	Y

	Extension	
4.3.18	NCell Defaults Extension	Y
4.3.19	NCell List Extension	Y
5	User Traffic Messages	Y – although strictly correct, we always use RTP over UDP.
5.1	RTP Traffic Packet Format	Y – The 119 SW does not support more than one TRX though. The RTP format only supports a single TS per RTP packet.
5.1.1	RTP Header	Y
5.1.2	Spare	-
5.1.3	Spare	-
5.1.4	Spare	-
5.2	Spare	-
5.3	Spare	-
5.4	Spare	-
5.5	TRAU-like Payload Data	Y
5.6	Non-TRAU-like Payload Data	Y
5.6.1	FR Speech	Y
5.6.2	EFR Speech	Y
5.6.3	HR Speech	N
5.6.4	Idle Speech	Y
5.6.5	Data/16kbps	N
5.6.6	Extended Data/16kbps	N
5.6.7	Idle Data	N
5.6.8	Data/8kbps	N
5.6.9	FR O&M	N
5.6.10	HR O&M	N
5.7	TRAU within the BTS	Supported at nBR1.5
6	Procedures	-
6.1	Channel Establishment procedures	-
6.1.1	Primary OML	Y

	Establishment	
6.1.2	RSL Establishment	Y
6.1.3	Traffic Channel Establishment	Y - Persistent connections not supported.
6.1.4	Secondary OML Establishment	Y – The well-known 2nd OML port number is 3006.
6.1.5	Rules on Usage of Primary and Secondary OML	Y
6.2	Spare	-
6.3	Error Handling	Y
6.3.1	Message Errors	Y
6.3.2	Stream Connectivity Loss and Recovery	Y
6.3.3	Loss of Primary OML	Y
6.3.4	Loss of RSL	Y
6.4	Usage of Stream Ids in A-bis	Y
6.5	NWL Test Procedures	Y
6.5.1	General interaction with normal operation	Y
6.5.2	Channel Usage Test	Y
6.5.3	BCCH Channel Usage Test	Y
6.5.4	Frequency Synchronisation Test	Y
6.5.5	BCCH Information Test	Y
6.5.6	Beacon Transmit Test	Y
6.5.7	SysInfo Monitor Test	
6.5.8	BCCH and CCCH	

	Monitor Test	
6.6	Code Download Procedures	Y
6.6.1	12.21-based Code Download	Y
6.6.2	TFTP Code Download	Y
6.7	Management States	Y – "Usage State" is a concept and not applicable in 12.21 and thus not directly supported in the BTS SW.
6.7.1	Operating normally	Y
6.7.2	Administratively LOCKED	Y
6.7.3	Operationally DISABLED	Y
6.7.4	Administratively SHUTTING DOWN	Y
6.8	Object Initialisation, Creation and Deletion	Y
6.8.1	Initialisation	Y
6.8.2	Creation	Y
6.8.3	Deletion	Y
6.8.4	Set and Get Attributes during Initialisation	Y
6.8.5	Procedures during Initialisation	Y
6.9	Object Versions	N
6.10	Measurement Pre-Processing	Y, but note that the BSC requires measurement pre-processing to be active.
7	Spare	-
8	Assigned Numbers	Y

ANNEX B - PROFILE OF SIGNALLING_OVER_IP_INTERFACE_V00_01.DOC (INFORMATIVE)

This section references specific paragraphs in the Signalling over IP interface specification [SIG_IP] to profile which aspects of it are / are not supported by the BTS software. Where it is not clear, the necessary clarifications are given.

'-' indicates that this paragraph does not state a possible requirement.
'Y' indicates that the BTS shall support all elements as described in this section
'N' indicates that the BTS shall NOT support any elements as described in this section.

Section Number	Heading	Page	Comments
1	INTRODUCTION	1	-
1.1	Overview	1	-
1.2	Purpose	1	-
1.3	Scope	1	The BTS does not support SCTP
1.4	Terminology	1	-
1.5	References	1	-
2	Channels	3	-
2.1	Basic Principles	3	Y
2.1.1	Physical Layer Replacement	3	The BTS supports a single physical Ethernet connection.
2.1.2	LAPD replacement	3	Y
2.1.3	MTP Replacement	3	Y
2.2	General Conventions	4	Y
2.3	Signalling Message Transports	4	-
2.3.1	Framed TCP Transport	4	The BTS shall use the Framed TCP Transport mechanism as described.
2.3.2	UDP Transport	5	The UDP transport described here is only supported for the basic Identification Procedure used in simple applications like "BTS finder".
2.4	Message Fields	5	-
2.4.1	Connection Frame Length	6	Y
2.4.2	Stream Identifier	6	Y

2.4.3	Version	6	Y
3	Channel Control Messages	7	Y
3.1	Connection Control Messages	7	Y
3.1.1	Heartbeat	7	Y
3.1.2	Heartbeat Ack	7	Y
3.1.3	Identity Request	7	Y
3.1.4	Identity	8	Y
3.1.5	Identity Ack	9	Y
3.1.6	Identity Nack	9	Y
3.2	Information Elements	9	-
3.2.1	Information Element Identifier	9	Y
3.2.2	Message Type	10	Y
3.2.3	Identity Info	10	Y
3.2.4	Identity Type	10	Y – Note that all human readable form strings are limited to 80 bytes (including Null Terminator).
3.2.5	Identity Reason Code	12	Y
4	Procedures	13	-
4.1	TCP Channel Framing procedures	13	Y
4.2	Error Handling	13	Y
4.2.1	Message Errors	13	Y
4.2.2	Stream Connectivity Loss and Recovery	14	Y
4.3	Heartbeat Procedure	14	Y
4.4	Identification procedure	14	Y

ANNEX C - PROFILE OF GSM 12.21 VERSION 5.0.0 (INFORMATIVE)

This section attempts to reference specific paragraphs in the GSM 12.21 specification to profile which aspects of it are / are not supported by the BTS software. Where it is not clear, the necessary clarifications are given.

'-' indicates that this paragraph does not state a possible requirement.
'Y' indicates that the BTS shall support all elements as described in this section
'N' indicates that the BTS shall NOT support any elements as described in this section.

Section Number	Heading	Page	Comments
-	Introduction	7	-
1	Scope	8	-
2	References	8	-
3	Definitions and abbreviations	9	-
3.1	Definitions	9	-
3.2	Abbreviations	9	-
4	Functional Split between BSC and BTS	10	At present the BTS does not collect or report Radio Path Performance Management functions via 12.21. The BTS does not perform Security Management (Access Control to BTS).
5	Information Model	11	-
5.1	Managed Objects	11	The BTS (single TRX unit) supports a site manager object instance within the same physical unit as the BTS, Carrier, BBTRX and Channel instances. The attributes supported by the BTS software for each object class are as listed in tables `Table 1 - Table 5` in the main section of this document. The statement of compliance about Elementary Procedures is detailed below in this table.
5.2	Addressing of Objects	13	Y (except that TEI establishment not

			supported)
5.3	State Management of Objects	13	Y
5.3.1	Administrative State	14	Y
5.3.2	Operational State and Availability Status	14	Y
6	Elementary Procedures	16	Y
6.1	Definition of the Procedures	16	Y (Some references to Layer 2 are not appropriate since these are replaced by the Signalling Over IP procedures).
6.2	SW Download Management Procedures	17	-
6.2.1	Load Data Initiate	17	Y
6.2.2	Load Data Segment	17	Y
6.2.3	Load Data Abort	17	Y - If the BTS cannot download SW into a bank e.g. if the 'active' and 'default' banks are different and there are no free banks to download into, then the BTS should send this message. Note if a 'combined SDP' was downloaded and any part of the download cannot proceed then this message should be sent by the BTS. In particular the unit should not overwrite its Boot region in FLASH if any of the constituent parts of a 'Combined SDP file' fail to download. This is to protect incompatible versions of software from being made the default SW images to run (there is only one Boot image).
6.2.4	Load Data End	18	Y
6.2.5	SW Activate Request	18	Y
6.2.6	Activate SW	18	Y
6.2.7	SW Activated Report	18	Y
6.3	A-bis Interface Management Procedures	18	N – The Signalling Over IP mechanisms do not use this
6.3.1	Establish TEI	19	N
6.3.2	Connect Terrestrial Signalling	19	N – See "Connect IP Signalling" in Abis over IP.

6.3.3	Disconnect Terrestrial Signalling	19	N
6.3.4	Connect Terrestrial Traffic	20	N – See "Connect IP Traffic" in Abis over IP.
6.3.5	Disconnect Terrestrial Traffic	20	N
6.4	Transmission Management Procedures	20	N
6.4.1	Connect Multi-drop Link	20	N
6.4.2	Disconnect Multi-drop Link	20	N
6.5	Air Interface Management Procedures	21	-
6.5.1	Set BTS Attributes	21	Y
6.5.2	Set Radio Carrier Attributes	21	Y
6.5.3	Set Channel Attributes	21	Y
6.6	Test Management Procedures	21	-
6.6.1	Perform Test	21	N – The BTS does not support the loopback and Functional Self Tests as described here. Instead the BTS supports several manufacturer specific tests as defined in Abis Over IP ("Perform Test") for NWL tests.
6.6.2	Test Report	22	Y
6.6.3	Send Test Report	22	Y
6.6.4	Stop Test	22	Y
6.7	State Management and Event Report Procedures	23	-
6.7.1	State Changed Event Report	23	Y
6.7.2	Failure Event Report	23	Y
6.7.3	Stop Sending Event Reports	23	N – The BTS does not support this
6.7.4	Restart Sending Event Reports	24	N – The BTS does not support this
6.7.5	Change Administrative State	24	Y
6.7.6	Change Administrative State Request	24	N – The BTS does not have a mechanism for requesting a change of Admin State.
6.7.7	Report Outstanding Alarms	24	Y
6.8	Equipment Management	25	-

	Procedures		
6.8.1	Change-over	25	N
6.8.2	Opstart	25	Y
6.8.3	Reinitialize	25	Y
6.8.4	Set Site Outputs	26	N
6.9	Measurement Management Procedures	26	-
6.9.1	Measurement Result Request	26	N
6.9.2	Measurement Result Response	26	N
6.9.3	Stop Measurement	26	N
6.9.4	Start Measurement	27	N
6.10	Miscellaneous Procedures	27	-
6.10.1	Get Attributes	27	Y
6.10.2	Set Alarm Threshold	27	Y
6.10.3	Get Attributes Response	27	Y
7	Structured Procedures	27	-
8	Message Details	27	-
8.1	Message Categories	28	N – The BTS does not support the 4 categories described here.
8.1.1	Formatted O&M Messages	28	N – See Abis over IP instead.
8.1.2	MMI Transfer	28	N
8.1.3	TRAU O&M Messages	29	N
8.1.4	Manufacturer-Defined O&M messages	29	N – See Abis over IP instead.
8.2	Structure of Formatted O&M Messages	29	Y
8.3	SW Download Management Messages	30	-
8.3.1	Load Data Initiate	30	Y
8.3.2	Load Data Segment	31	Y
8.3.3	Load Data Abort	31	Y
8.3.4	Load Data End	31	Y
8.3.5	SW Activate Request	31	Y
8.3.6	Activate SW	31	Y
8.3.7	SW Activated Report	31	Y
8.4	A-bis Interface Management Messages	32	-
8.4.1	Establish TEI	32	N

8.4.2	Connect Terrestrial Signalling	32	N
8.4.3	Disconnect Terrestrial Signalling	32	N
8.4.4	Connect Terrestrial Traffic	32	N
8.4.5	Disconnect Terrestrial Traffic	32	N
8.5	Transmission Management Messages	33	-
8.5.1	Connect Multi-drop link	33	N
8.5.2	Disconnect Multi-drop link	33	N
8.6	Air Interface Management Messages	33	-
8.6.1	Set BTS Attributes	33	Y Overload Period, CCCH Load Threshold, CCCH Load Indication Period, RACH Busy Threshold, RACH Load Averaging Slots & Starting time parameters are ignored.
8.6.2	Set Radio Carrier Attributes	34	Y – If more than one entry is provided in the ARFCN list is specified the message will be NACK'd (Frequency hopping not supported)
8.6.3	Set Channel Attributes	34	Y – If more than one entry is provided in the ARFCN list is specified the message will be NACK'd (Frequency hopping not supported). The ARFCN must be consistent with the one sent in the Radio Carrier Attributes for that unit. If HSN or MAIO values are sent then the message shall be NACK'd by the BTS.
8.7	Test Management Messages	35	-
8.7.1	Perform Test	35	Y
8.7.2	Test Report	35	Y
8.7.3	Send Test Report	35	N – The BTS does not support the "Not Autonomously report" option and as such this message is not needed.
8.7.4	Stop Test	35	Y
8.8	State Management and Event	36	-

	Report Messages		
8.8.1	State Changed Event Report	36	Y - See A-bis over IP
8.8.2	Failure Event Report	36	Y
8.8.3	Stop Sending Event Reports	36	N
8.8.4	Restart Sending Event Reports	37	N
8.8.5	Change Administrative State	37	Y
8.8.6	Change Administrative State Request	37	N
8.8.7	Report Outstanding Alarms	37	Y –
8.9	Equipment Management Messages	38	-
8.9.1	Changeover	38	N
8.9.2	Opstart	38	Y
8.9.3	Reinitialize	38	Y
8.9.4	Set Site Outputs	38	N
8.9.5	Change HW Configuration	38	N
8.10	Measurement Management Messages	39	-
8.10.1	Measurement Result Request	39	N
8.10.2	Measurement Result Response	39	N
8.10.3	Start Measurement	39	N
8.10.4	Stop Measurement	39	N
8.11	Miscellaneous Messages	39	-
8.11.1	Get Attributes	39	Y
8.11.2	Set Alarm Threshold	40	Y
8.11.3	Get Attribute Response	40	
9	Coding	40	-
9.1	Message Type	40	Y – Though not all messages listed here are supported (see above). The Identifier values used do not overlap.
9.2	Object Class	44	Y
9.3	Object Instance	44	Y
9.4	Attributes and Parameters	45	Y – Though not all attributes listed here are supported (see below) and extra ones are defined in A-bis over IP. The Identifier values used do not overlap.
9.4.1	Abis Channel	47	N

9.4.2	Additional Info	47	See A-bis over IP
9.4.3	Additional Text	47	See A-bis over IP
9.4.4	Administrative State	48	Y
9.4.5	ARFCN List	48	Y
9.4.6	Autonomously Report	48	Y – But the value of "Not Autonomously Report" is not supported in the available NWL tests.
9.4.7	Availability Status	48	Y
9.4.8	BCCH ARFCN	49	Y
9.4.9	BSIC	49	Y
9.4.10	BTS Air Timer	49	Y
9.4.11	CCCH Load Indication Period	49	Y – But the values are ignored since CCCH Load messages are not supported.
9.4.12	CCCH Load Threshold	49	Y – But the values are ignored since CCCH Load messages are not supported.
9.4.13	Channel Combination	49	Y – But the BTS does not support all channel combinations listed here. See 5.5.3.ix for details.
9.4.14	Connection Failure Criterion	50	Y
9.4.15	Destination	50	N
9.4.16	Event Type	50	See A-bis over IP
9.4.17	File Data	51	See A-bis over IP
9.4.18	File Id	51	See A-bis over IP
9.4.19	File Version	51	See A-bis over IP
9.4.20	GSM Time	51	Y
9.4.21	HSN	52	N – Frequency Hopping is not supported although
9.4.22	HW Configuration	52	Y
9.4.23	HW Description	52	See A-bis over IP
9.4.24	Intave Parameter	52	Y
9.4.25	Interference level Boundaries	53	Y
9.4.26	List of Required Attributes	53	See A-bis over IP
9.4.27	MAIO	53	N – Frequency Hopping is not supported
9.4.28	Manufacturer Dependent State	53	See A-bis over IP
9.4.29	Manufacturer Dependent	54	See A-bis over IP

	Thresholds		
9.4.30	Manufacturer Id	54	See A-bis over IP
9.4.31	Max Timing Advance	54	Y
9.4.32	Measurement Result	54	N
9.4.33	Measurement Type	54	N
9.4.34	Multi-drop BSC Link	54	N
9.4.35	Multi-drop next BTS Link	55	N
9.4.36	Nack Causes	55	See A-bis over IP
9.4.37	Ny1	56	Y
9.4.38	Operational State	56	Y
9.4.39	Overload Period	57	N
9.4.40	Physical Config	57	See A-bis over IP
9.4.41	Power Class	57	Y
9.4.42	Power Output Thresholds	57	N
9.4.43	Probable Cause	58	See A-bis over IP
9.4.44	RACH Busy Threshold	58	N
9.4.45	RACH Load Averaging Slots	58	N
9.4.46	Radio Sub Channel	58	N – HR not supported
9.4.47	RF Max Power Reduction	58	Y
9.4.48	Site Inputs	59	N
9.4.49	Site Outputs	59	N
9.4.50	Source	59	N
9.4.51	Specific Problems	59	See A-bis over IP
9.4.52	Starting Time	60	N
9.4.53	T200	60	Y
9.4.54	TEI	60	N
9.4.55	Test Duration	60	N
9.4.56	Test No	60	See A-bis over IP
9.4.57	Test Report Info	61	See A-bis over IP
9.4.58	VSWR Thresholds	61	N
9.4.59	Window Size	61	Y
9.4.60	TSC	61	Y
9.4.61	SW Configuration	62	Y
9.4.62	SW Description	62	Y
9.4.63	Perceived Severity	62	See A-bis over IP
9.4.64	Get Attribute Response Info	62	Y
9.4.65	Outstanding Alarm Sequence	63	N
9.4.66	HW Conf Change Info	63	N

ANNEX E - DHCP

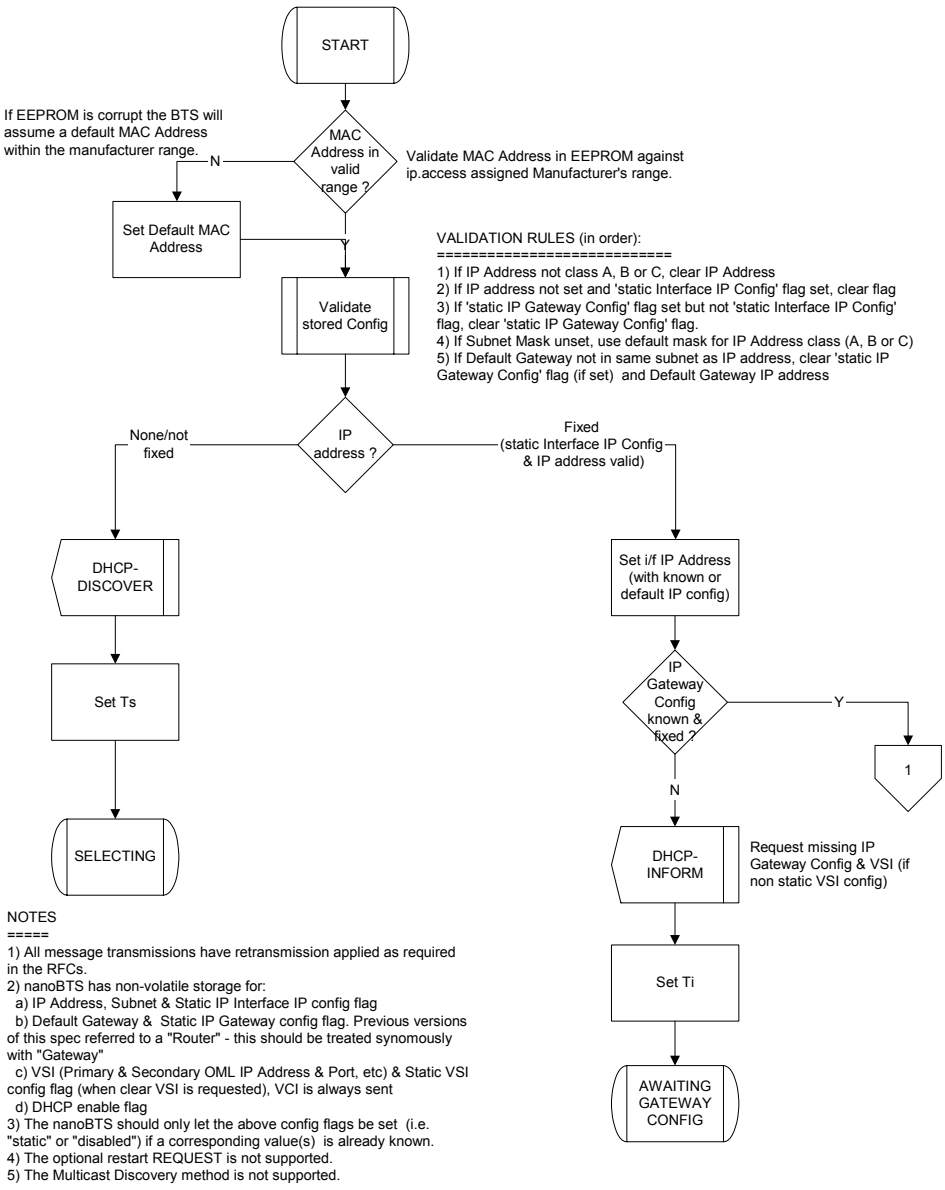


Figure 7 - START state

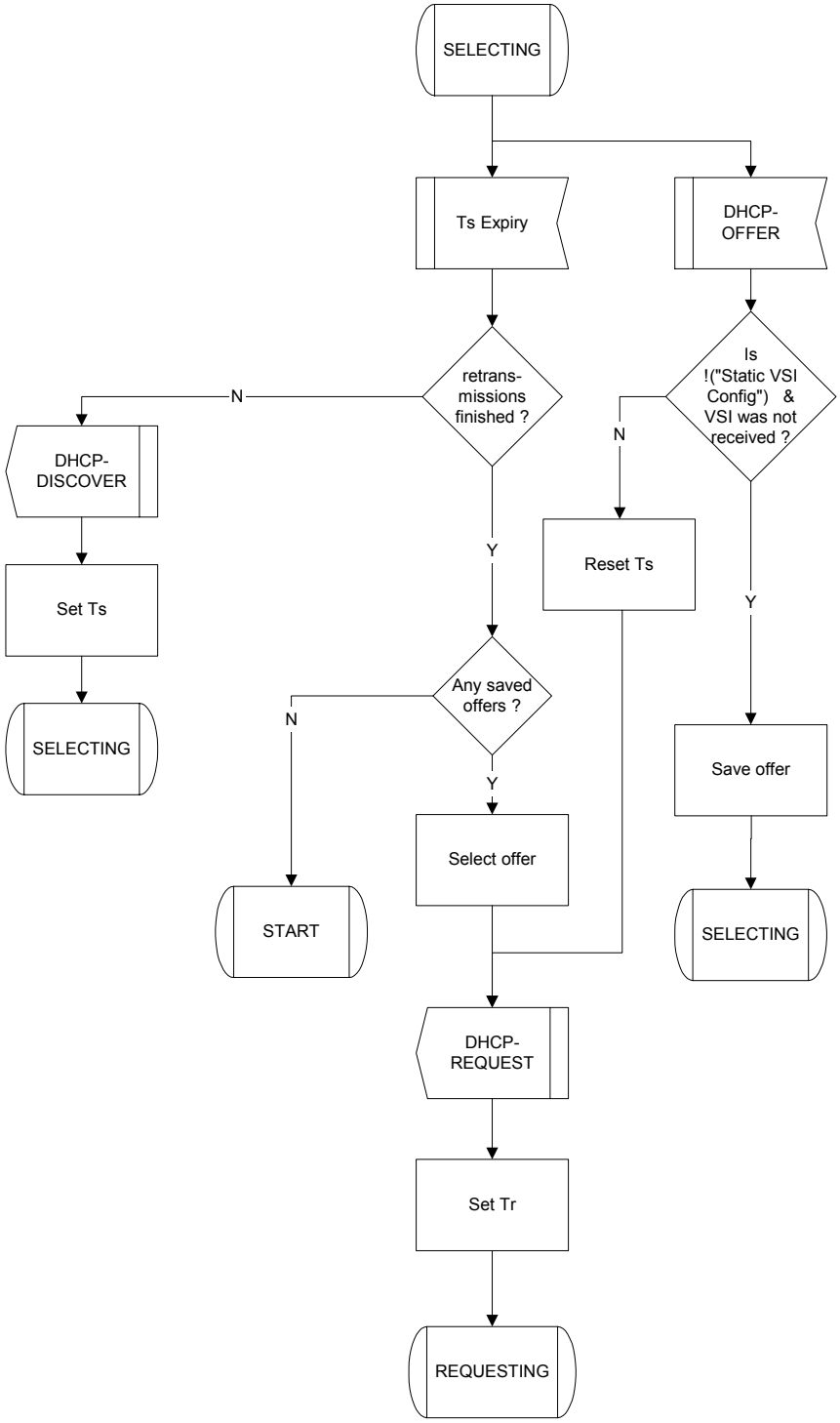


Figure 8 - SELECTING state

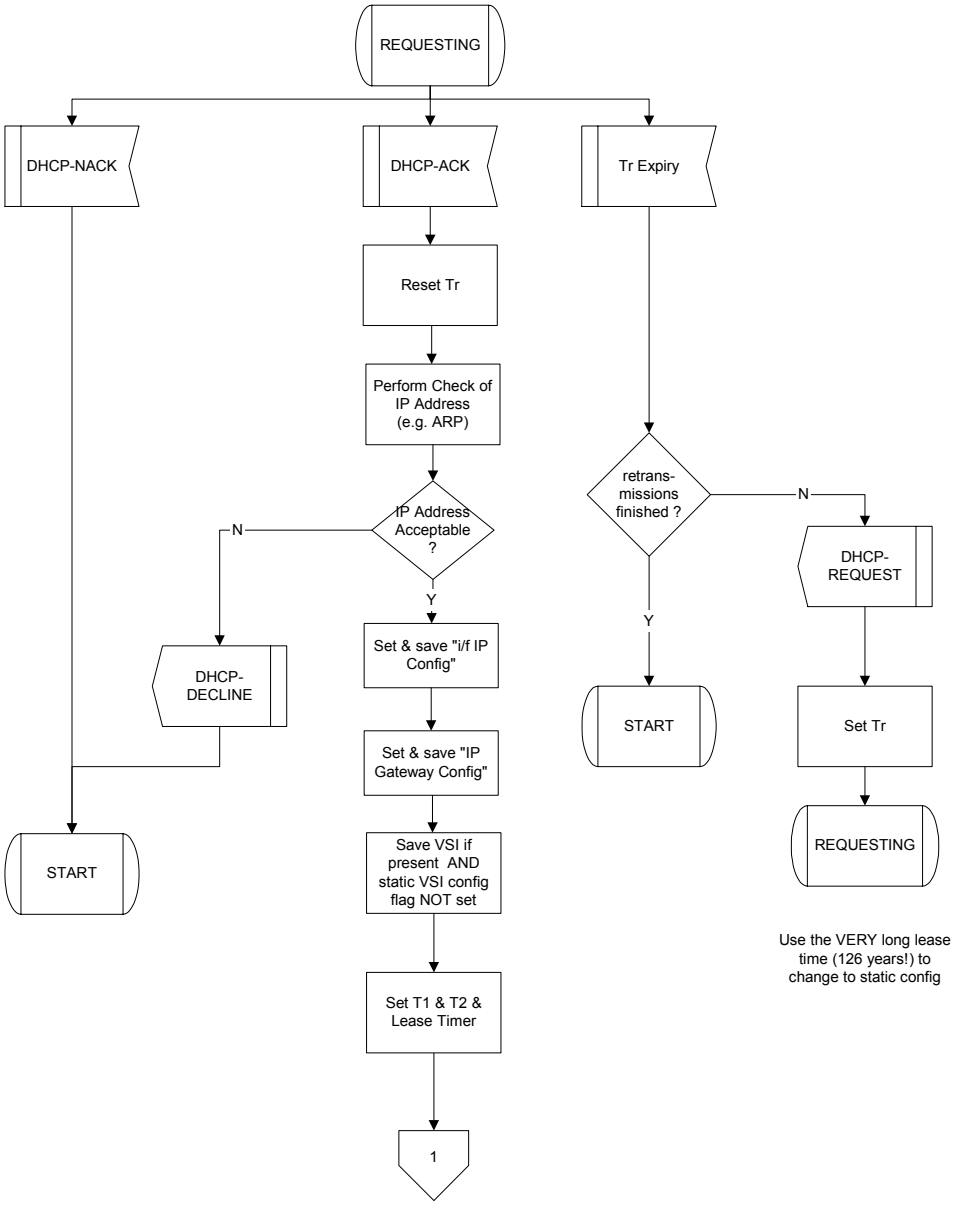


Figure 9 - REQUESTING State

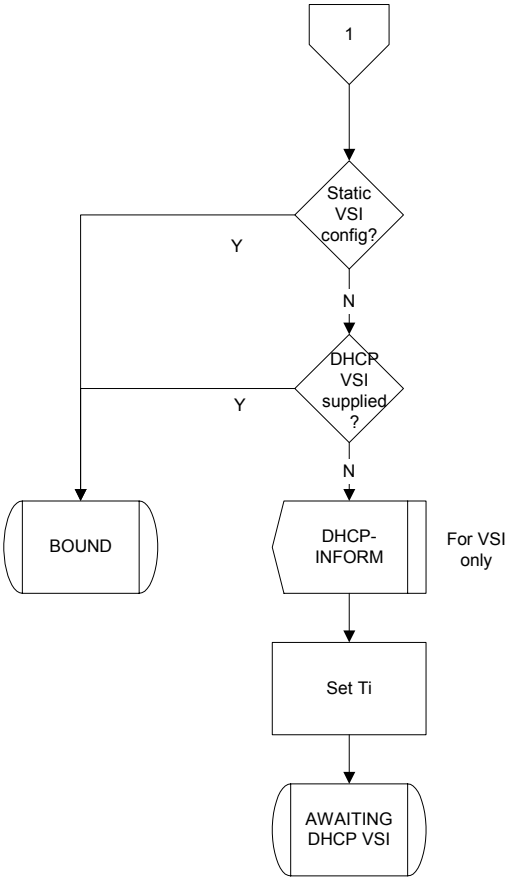
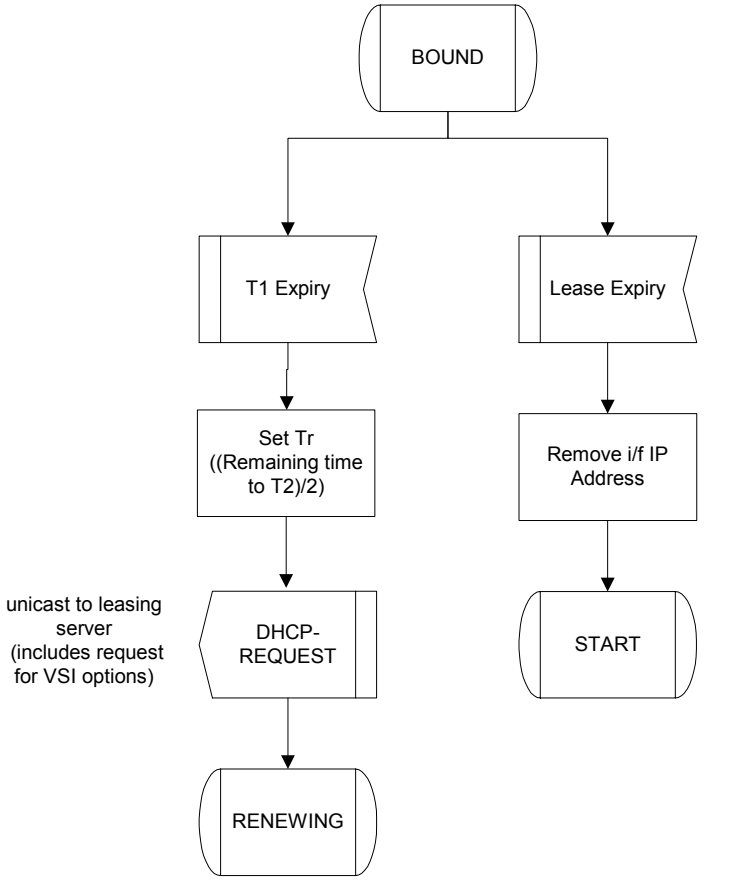


Figure 10 – Connector '1'



NOTES

1) T1, T2 & Lease Timer are not running if using a fixed IP Address

Design assumes that
T1 expiry time < T2 expiry timer < Lease expiry time

2) If the VSI is known, it should be used to attempt to contact the BSC (even if it is known from a previous config).

3) If no VSI is known, the BTS should passively await configuration through the BTS A-bis port.

Figure 11 - BOUND state

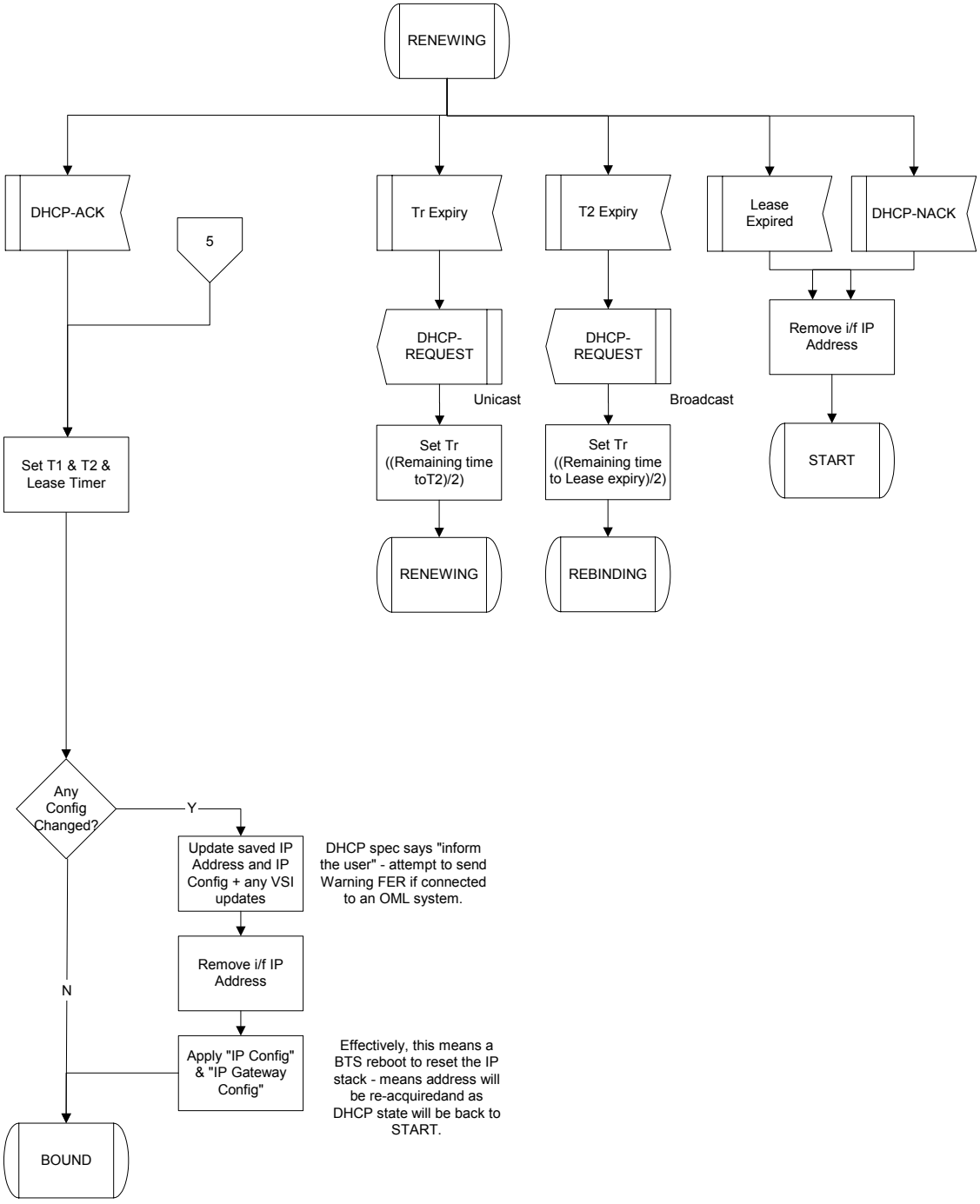


Figure 12 - RENEWING state

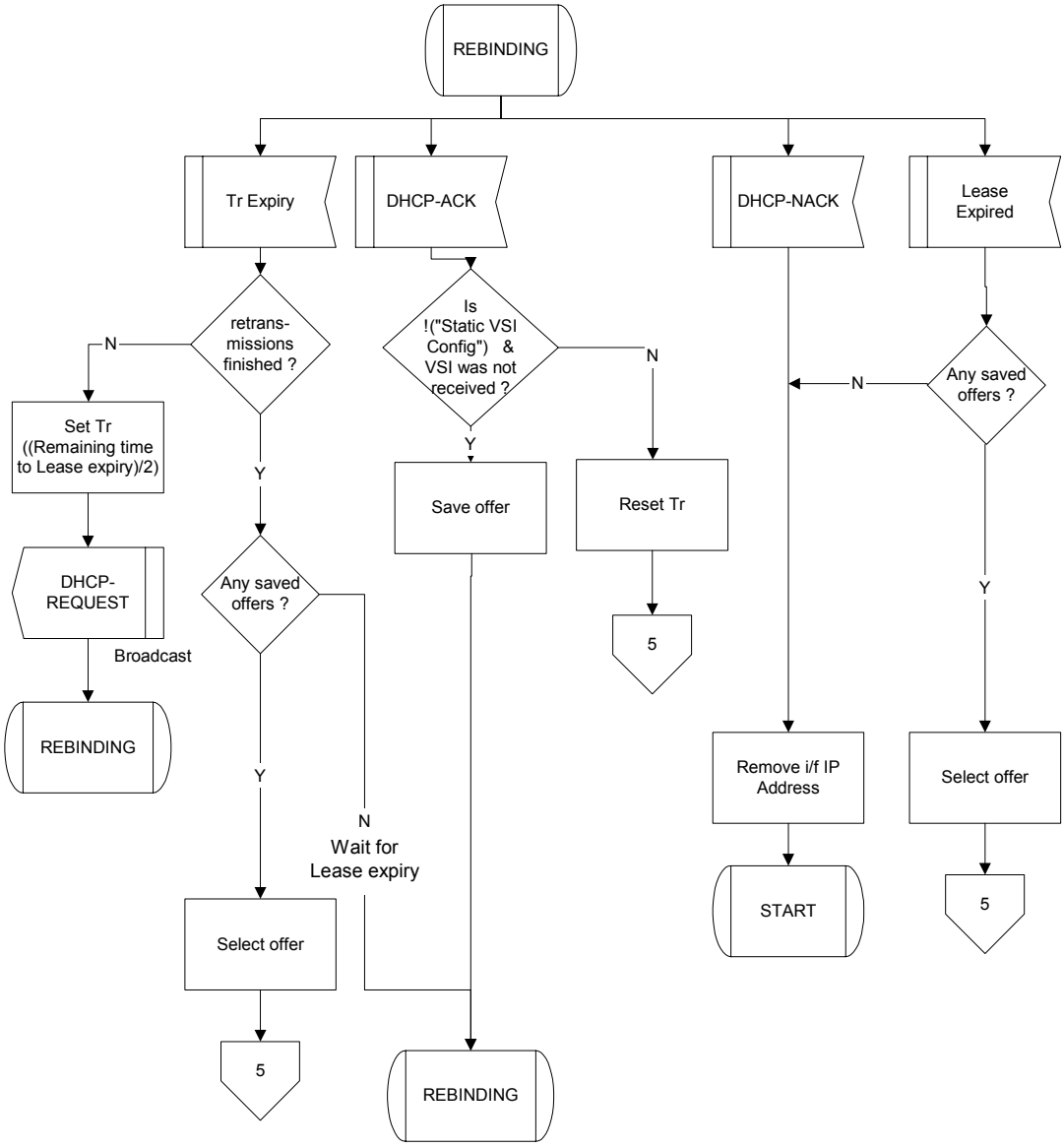


Figure 13 - REBINDING state

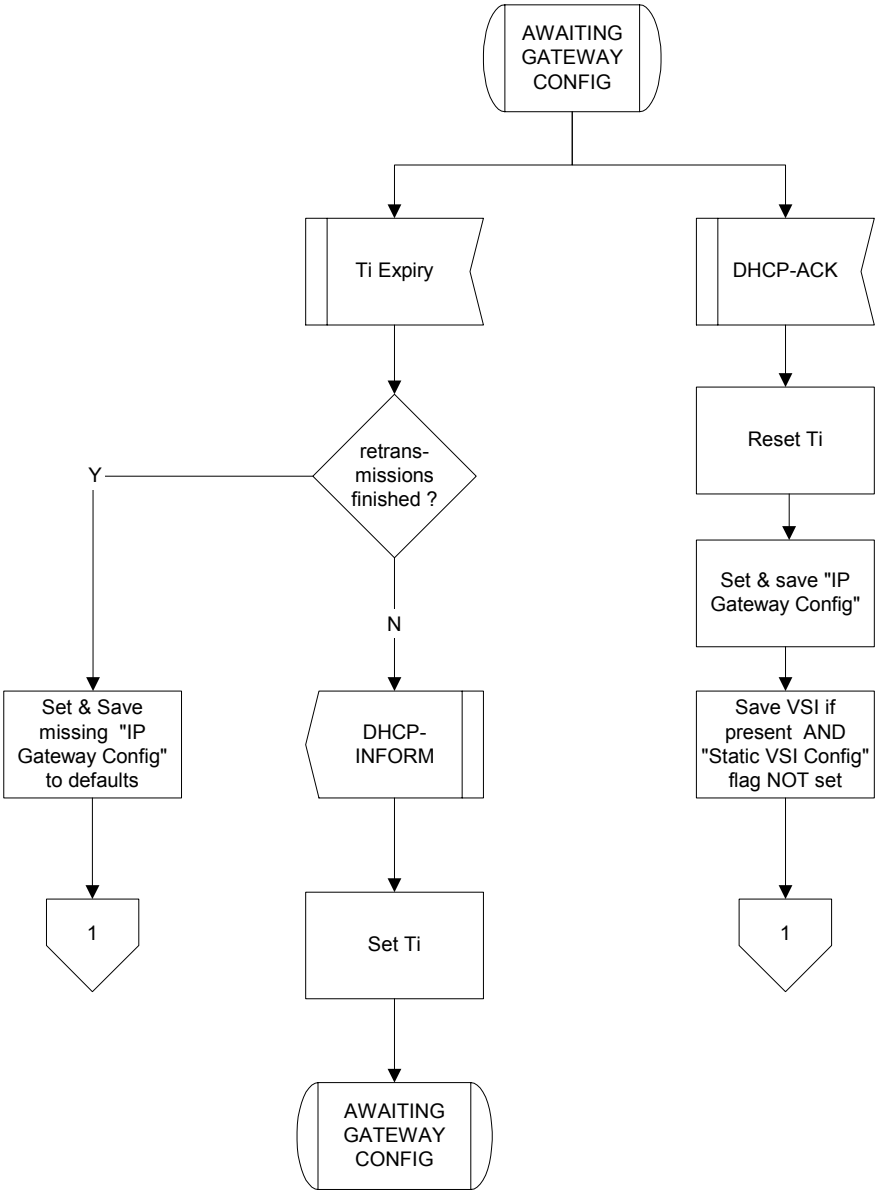


Figure 14 - AWATING GATEWAY CONFIG state

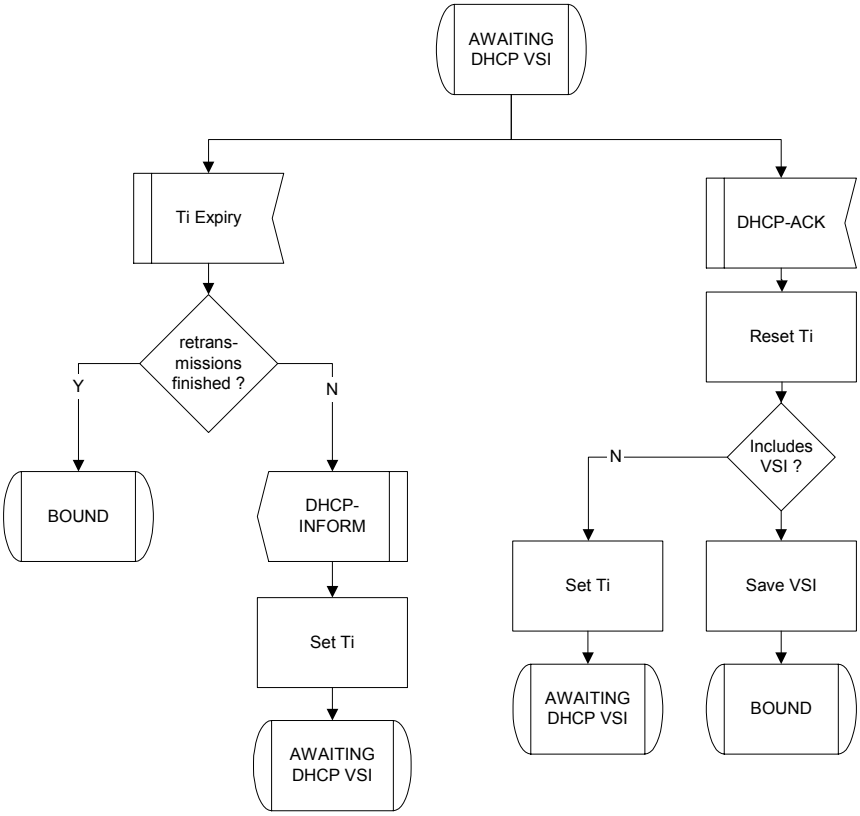


Figure 15 - AWAITING DHCP VSI state

ANNEX F - PROFILE OF RFC 2131 - DYNAMIC HOST CONFIGURATION PROTOCOL

This section attempts to reference specific paragraphs in RFC 2131 to profile which aspects of it are / are not supported by the BTS software. Where it is not clear, the necessary clarifications are given.

'-' indicates that this paragraph does not state a possible requirement.
'Y' indicates that the BTS shall support all elements as described in this section
'N' indicates that the BTS shall NOT support any elements as described in this section.

Section Number	Heading	Page	Comments
1.	Introduction	2 - 6	-
2.	Protocol Summary	8 - 12	Y Conforms to all definitions in this section – (most of it is just explanatory)
3.	The Client-Server Protocol	13	Y
3.1	Client-server interaction - allocating a network address	13	Step 1: Y : no suggestions sent Step 2: - : (Server requirement) Step 3: Y : BTS chooses first Offer received with required VSI options, otherwise the best offer received after 10 retransmissions of the DHCP Discover Subsequent DHCP Request contains desired configuration options Step 4: : - : (Server requirement) Step 5: Y Step 6: N

3.2	Client-server interaction - reusing a previously allocated network address	17	N
3.3	Interpretation and representation of time values	20	Y
3.4	Obtaining parameters with externally configured network address	20	Y
3.5	Client parameters in DHCP	21	Y BTS includes parameter request list option in DHCP Requests, and maximum DHCP message size is included No 'hints' are sent to the server
3.6	Use of DHCP in clients with multiple interfaces	22	N
3.7	When clients should use DHCP	22	N
4.	Specification of the DHCP client-server protocol	22	-
4.1	Constructing and sending DHCP messages	22	Y
4.2	DHCP server administrative controls	25	N client identifier field is not included in BTS messages
4.3	DHCP server behavior	26	-
4.3.1	DHCPDISCOVER message	27	-

4.3.2	DHCPREQUEST message	30	Requirements on fields filled by client – see 4.3.6
4.3.3	DHCPDECLINE message	33	-
4.3.4	DHCPRELEASE message	33	-
4.3.5	DHCPINFORM message	33	-
4.3.6	Client messages	33	Requirements on fields filled by client in state: SELECTING: Y INIT_REBOOT: N (state not supported) RENEWING: Y REBINDING: Y
4.4	DHCP client behavior	34	-
4.4.1	Initialization and allocation of network address	36	Y BTS requests: Subnet Mask; Router; Lease Time; T1; T2; VSI. BTS does not make suggestions. BTS does not include client identifier field. BTS chooses first Offer received with required VSI options, otherwise the best offer received after 10 retransmissions of the DHCP Discover. BTS validates the offered IP Address by sending an ARP request, and then checking the ARP cache.
4.4.2	Initialization with known network address	39	N
4.4.3	Initialization with an externally assigned network address	39	Y Only used if BTS does not have a known, fixed Gateway Config, or static VSI config.
4.4.4	Use of broadcast and unicast	40	Y

4.4.5	Reacquisition and expiration	40	Y BTS does not attempt to renew or extend lease before timeout T1.
4.4.6	DHCPRELEASE	41	N
5.	Acknowledgments	42	-
6.	References	42	-
7.	Security Considerations	43	-
8.	Author's Address	44	-
A.	Host Configuration Parameters	45	-

ANNEX G - PROFILE OF RFC 2132 - DHCP OPTIONS AND BOOTP VENDOR EXTENSIONS

This section attempts to reference specific paragraphs in RFC 2132 to profile which aspects of it are / are not supported by the BTS software. Where it is not clear, the necessary clarifications are given.

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'N' indicates that the BTS shall NOT support any elements as described in this section.

Section Number	Heading	Page	Comments
1	Introduction	2	-
1.1	Requirements	3	-
1.2	Terminology	3	-
2	BOOTP Extension/DHCP Option Field Format	4	Y
3	RFC 1497 Vendor Extensions	5	-
3.1	Pad Option	5	N
3.2	End Option	5	Y
3.3	Subnet Mask	5	Y
3.4	Time Offset	6	N
3.5	Router Option	6	Y
3.6	Time Server Option	6	N
3.7	Name Server Option	7	N
3.8	Domain Name Server Option	7	N
3.9	Log Server Option	7	N
3.10	Cookie Server Option	8	N
3.11	LPR Server Option	8	N

3.12	Impress Server Option	8	N
3.13	Resource Location Server Option	8	N
3.14	Host Name Option	9	Y
3.15	Boot File Size Option	9	N
3.16	Merit Dump File	9	N
3.17	Domain Name	10	N
3.18	Swap Server	10	N
3.19	Root Path	10	N
3.20	Extensions Path	10	N
4	IP Layer Parameters per Host	11 - 13	N
5	IP Layer Parameters per Interface	13 - 15	N
6	Link Layer Parameters per Interface	16	N
7	TCP Parameters	17	N
8.	Application and Service Parameters	18	-
8.1	Network Information Service Domain Option	18	N
8.2	Network Information Servers Option	18	N
8.3	Network Time Protocol Servers Option	18	N
8.4	Vendor Specific Information	19	Y
8.5	NetBIOS over TCP/IP Name Server Option	20	N

8.6	NetBIOS over TCP/IP Datagram Distribution Server Option	20	N
8.7	NetBIOS over TCP/IP Node Type Option	20	N
8.8	NetBIOS over TCP/IP Scope Option	21	N
8.9	X Window System Font Server Option	21	N
8.10	X Window System Display Manager Option	21	N
8.11	Network Information Service+ Domain Option	22	N
8.12	Network Information Service+ Servers Option	22	N
8.13	Mobile IP Home Agent option	22	N
8.14	Simple Mail Transport Protocol (SMTP) Server Option	23	N
8.15	Post Office Protocol (POP3) Server Option	23	N
8.16	Network News Transport Protocol (NNTP) Server Option	23	N
8.17	Default World Wide Web (WWW) Server Option	24	N

8.18	Default Finger Server Option	24	N
8.19	Default Internet Relay Chat (IRC) Server Option	24	N
8.20	StreetTalk Server Option	24	N
8.21	StreetTalk Directory Assistance (STDA) Server Option	25	N
9	DHCP Extensions	25	-
9.1	Requested IP Address	25	Y
9.2	IP Address Lease Time	25	Y
9.3	Option Overload	26	N
9.4	TFTP server name	26	N
9.5	Bootfile name	27	N
9.6	DHCP Message Type	27	Y
9.7	Server Identifier	27	Y
9.8	Parameter Request List	28	Y
9.9	Message	28	Y
9.10	Maximum DHCP Message Size	28	Y
9.11	Renewal (T1) Time Value	29	Y
9.12	Rebinding (T2) Time Value	29	Y
9.13	Vendor class identifier	29	Y
9.14	Client-identifier	30	N
10	Defining new extensions	31	-
11	Acknowledgements	31	-
12	References	32	-

13	Security Considerations	33	-
14	Authors' Addresses	34	-

End of Document