

3GPP TR 25.802 V6.0.0 (2004-09)

Technical Report

3rd Generation Partnership Project; Technical Specification Group TSG RAN; Remote control of electrical tilting antennas; (Release 6)



The present document has been developed within the 3rd Generation Partnership Project (3GPP™) and may be further elaborated for the purposes of 3GPP.

The present document has not been subject to any approval process by the 3GPP Organizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPP only. The Organizational Partners accept no liability for any use of this Specification. Specifications and reports for implementation of the 3GPP™ system should be obtained via the 3GPP Organizational Partners' Publications Offices.

Keywords

UMTS, radio, antenna

3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

<http://www.3gpp.org>

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© 2004, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TTA, TTC).
All rights reserved.

Contents

Foreword	8
1 Scope	8
2 References.....	8
3 Definitions, symbols and abbreviations	9
3.1 Definitions.....	9
3.2 Symbols	10
3.3 Abbreviations	10
4 Introduction	11
5 Requirements.....	11
5.1 General.....	11
5.2 UTRAN Architecture.....	11
5.3 Protocols.....	11
5.4 Network wide Control of RET Antennas	11
6 Study Areas.....	12
6.1 Proposal One.....	12
6.1.1 UTRAN Architecture Aspects	12
6.1.2 Interface Aspects	14
6.1.2.1 General	14
6.1.2.2 Physical Layer.....	14
6.1.2.2.1 RS485 Serial Data Bus	14
6.1.2.2.2 Coaxial Interface: Modem Characteristics.....	14
6.1.2.3 Signalling Transport.....	16
6.1.2.3.1 HDLC Format	16
6.1.2.3.2 Frame Checking Sequence Field	16
6.1.2.3.3 HDLC Command Sub-set.....	16
6.1.2.3.4 HDLC Address	19
6.1.2.3.5 Window Size	21
6.1.2.3.6 Connection Establish	21
6.1.2.3.7 Disconnect.....	21
6.1.2.3.8 Polling	21
6.1.2.3.9 Information	22
6.1.2.3.10 Message Timing	22
6.1.2.3.11 Frame Error Rate.....	22
6.1.3 Functions of Interface.....	22
6.1.4 Protocol Structure.....	22
6.1.5 Application Protocol signalling procedures.....	23
6.1.5.1 Command Format.....	23
6.1.5.2 Response Format and Return Codes	23
6.1.5.3 Overview of Commands.....	24
6.1.5.4 Control Commands	24
6.1.5.4.1 Get Device Type.....	25
6.1.5.4.2 Reset Software	25
6.1.5.4.3 Get Error Codes.....	25
6.1.5.4.4 Read Hardware and Software Information	26
6.1.5.4.5 Poll Response from Secondary Device	26
6.1.5.4.6 Enable Device	27
6.1.5.4.7 Disable Device.....	27
6.1.5.4.8 Self Test.....	27
6.1.5.4.9 Read Memory	28
6.1.5.4.10 Write Memory	28
6.1.5.4.11 Get Supported Bit Rates.....	28
6.1.5.4.12 Set Device Data	29
6.1.5.4.13 Get Device Data	29

6.1.5.4.14	Software Download	29
6.1.5.4.15	Set Bit Rate.....	31
6.1.5.4.16	RET Calibration	32
6.1.5.4.17	RET Send Configuration Data	32
6.1.5.4.18	RET Set Tilt	32
6.1.5.4.19	RET Get Tilt.....	33
6.1.5.5	Implementation Specific Commands	33
6.1.5.6	Unknown Commands	33
6.1.6	Return Codes for Secondary Devices (normative Annex)	34
6.1.7	Assigned Fields for Additional Data (normative Annex).....	35
6.1.8	Command Sequence for Download of Software to a Secondary Device (normative Annex)	37
6.2	Proposal Two.....	38
6.2.1	General comments.....	38
6.2.2	UTRAN Architecture Aspects	39
6.2.3	Interface Aspects	40
6.2.3.1	General	40
6.2.3.2	Physical Layer.....	40
6.2.3.2.1	RS485 Serial Data Bus	41
6.2.3.2.2	Coaxial Interface: Modem Characteristics.....	41
6.2.3.3	Signalling Transport.....	42
6.2.3.3.1	HDLC Format	43
6.2.3.3.2	Frame Checking Sequence Field	43
6.2.3.3.3	HDLC Command Sub-set.....	43
6.2.3.3.4	HDLC Address	45
6.2.3.3.5	Window Size	47
6.2.3.3.6	Connection Establish	47
6.2.3.3.7	Polling	47
6.2.3.3.8	Information	47
6.2.3.3.9	Message Timing	48
6.2.4	Functions of Interface.....	48
6.2.4.1	Software Download.....	48
6.2.4.2	Error Subscription	48
6.2.5	Protocol Structure.....	48
6.2.6	Application Protocol signalling procedures	49
6.2.6.1	Architecture	49
6.2.6.1.1	Client-Server Architecture.....	49
6.2.6.1.2	Multi-Antenna Units	49
6.2.6.2	Command Format	49
6.2.6.2.1	Commands from Primary Device	49
6.2.6.2.2	Response Format and Return Codes	50
6.2.6.3	Overview of Commands.....	50
6.2.6.4	Control Commands	51
6.2.6.4.1	Reset Software	51
6.2.6.4.2	Get Error Status	51
6.2.6.4.3	Read Hardware and Software Information	52
6.2.6.4.4	Poll Response from Secondary Device: Alarm.....	52
6.2.6.4.5	Get Device Data	53
6.2.6.4.6	Software Download	53
6.2.6.4.7	RET Calibration	54
6.2.6.4.8	RET Set Tilt	55
6.2.6.4.9	RET Get Tilt.....	55
6.2.6.4.10	Set Antenna Data.....	55
6.2.6.4.11	Get Antenna Data.....	56
6.2.6.4.12	Poll Response from Secondary Device: Antenna Alarm	56
6.2.6.5	Implementation Specific Commands	57
6.2.6.6	Unknown Commands	57
6.2.7	Return Codes for Secondary Devices (normative Annex)	57
6.2.8	Assigned Fields for Additional Data (normative Annex).....	58
6.2.9	Command Sequence for Download of Software to a Secondary Device (normative Annex)	60
6.3	Proposal Three.....	61
6.3.1	General comments.....	61
6.3.2	UTRAN Architecture Aspects	61

6.3.3	Interface Aspects	63
6.3.3.1	General	63
6.3.3.2	Physical Layer.....	63
6.3.3.2.1	RS485 Serial Data Bus.....	63
6.3.3.2.2	Coaxial Interface: Modem Characteristics.....	63
6.3.3.2.3	RET Antenna DC supply	66
6.3.3.3	Signalling Transport.....	66
6.3.3.3.1	HDLC Format	66
6.3.3.3.2	Frame Checking Sequence Field	66
6.3.3.3.3	HDLC Command Sub-set.....	67
6.3.3.3.4	HDLC Address	69
6.3.3.3.5	Window Size	71
6.3.3.3.6	Connection Establish	71
6.3.3.3.7	Disconnect.....	71
6.3.3.3.8	Polling	71
6.3.3.3.9	Information	72
6.3.3.3.10	Message Timing	72
6.3.3.3.11	Frame Error Rate.....	72
6.3.4	Functions of Interface.....	72
6.3.5	Protocol Structure	72
6.3.6	Application Protocol signalling procedures.....	73
6.3.6.1	Command Format.....	73
6.3.6.2	Response Format and Return Codes	73
6.3.6.3	Overview of Commands.....	74
6.3.6.4	Control Commands	74
6.3.6.4.1	Get Device Type.....	75
6.3.6.4.2	Reset Software	75
6.3.6.4.3	Get Error Codes.....	75
6.3.6.4.4	Read Hardware and Software Information	76
6.3.6.4.5	Poll Response from Secondary Device	76
6.3.6.4.6	Enable Device	77
6.3.6.4.7	Disable Device.....	77
6.3.6.4.8	Self Test.....	77
6.3.6.4.9	Read Memory	78
6.3.6.4.10	Write Memory	78
6.3.6.4.11	Get Supported Bit Rates.....	78
6.3.6.4.12	Set Device Data	79
6.3.6.4.13	Get Device Data	79
6.3.6.4.14	Software Download	79
6.3.6.4.15	Set Bit Rate.....	81
6.3.6.4.16	RET Calibration	82
6.3.6.4.17	RET Send Configuration Data	82
6.3.6.4.18	RET Set Tilt	82
6.3.6.4.19	RET Get Tilt.....	83
6.3.6.5	Implementation Specific Commands	83
6.3.6.6	Unknown Commands	83
6.3.7	Return Codes for Secondary Devices (normative Annex)	84
6.3.8	Assigned Fields for Additional Data (normative Annex).....	85
6.3.9	Command Sequence for Download of Software to a Secondary Device (normative Annex)	87
6.4	Comparison of Layer 1 Modulation Methods.....	87
6.5	Open Issues.....	89
7	Agreements and associated Contributions	89
7.1	UTRAN Architecture for Control of RET Antennas.....	89
7.2	Interface Aspects.....	91
7.3	Protocol Structure	91
7.4	Physical Layer.....	92
7.4.1	RS485 Serial Data Bus	92
7.4.2	Coaxial Interface: Modem Characteristics.....	93
7.4.2.1	Interference with Existing Systems	93
7.4.2.2	Recovery Time.....	93
7.4.2.3	Impedance.....	93

7.4.2.4	Modulation.....	93
7.4.2.5	Modulator Characteristics	93
7.4.2.6	Demodulator Characteristics	94
7.4.2.7	Duty Cycle Variation	94
7.5	Data Link Layer	94
7.5.1	HDLC Format	95
7.5.1.1	Operating Mode	95
7.5.1.2	Control octet transparency.....	95
7.5.2	Frame Checking Sequence Field	95
7.5.3	HDLC Command Sub-set	95
7.5.4	HDLC Address.....	97
7.5.4.1	Address configuration.....	97
7.5.4.1.1	Address Assignment Command	98
7.5.4.1.2	Address Assignment Response.....	98
7.5.4.1.3	Device Scan Command	100
7.5.4.1.4	Line Data Rate	101
7.5.5	Window Size	101
7.5.6	Connection Establish	101
7.5.7	Disconnect.....	101
7.5.8	Polling	101
7.5.9	Information	101
7.5.10	Message Timing.....	101
7.6	Functions of the Interface.....	102
7.6.1	Software Download.....	102
7.7	RET Control Application Part	102
7.7.1	Command Format	102
7.7.2	Response Format and Return Codes	102
7.7.3	Multi-Antenna Units	102
7.7.4	Overview of Commands.....	102
7.7.5	Control Commands	103
7.7.5.1	Reset Software	104
7.7.5.2	Get Error Codes	104
7.7.5.3	Read Hardware and Software Information.....	104
7.7.5.4	Clear Stored Alarms	105
7.7.5.5	Poll Response from Secondary Device: Alarm.....	105
7.7.5.6	Self Test	105
7.7.5.7	Set Device Data	106
7.7.5.8	Get Device Data.....	106
7.7.5.9	RET Calibration	106
7.7.5.10	RET Send Configuration Data	107
7.7.5.11	RET Set Tilt	107
7.7.5.12	RET Get Tilt.....	108
7.7.6	Multi-Antenna Commands.....	108
7.7.6.1	Multi-Antenna Calibration	108
7.7.6.2	Multi-Antenna Set Tilt.....	108
7.7.6.3	Multi-Antenna Get Tilt	109
7.7.6.4	Multi-Antenna Set Data.....	109
7.7.6.5	Multi-Antenna Get Data	109
7.7.6.6	Poll Response from Secondary Device: Multi-Antenna Alarm	110
7.7.7	Implementation Specific Commands	110
7.7.8	Unknown Commands	110
7.8	Return Codes for Secondary Devices (normative Annex).....	111
7.9	Assigned Fields for Additional Data (normative Annex)	112
7.10	New Technical Specifications for RET Control	113
8	Specification Impact and associated Change Requests	113
8.1	Impact on existing Specifications	113
8.2	New Specifications.....	113
9	Project Plan	114
9.1	Schedule	114
9.2	Work Task Status.....	114

Annex A: Change history.....115

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document is for the Release 6 work item "Remote Control of Electrical Tilting Antennas" (see [1]).

The objectives of this work item are the specification of a standardised open interface to enable local RET antenna-controlling functionality situated in the Node B to allow the RET antenna system being provided by a third party vendor and to enable the control of the antenna from the Network Manager, so that the operator is able to control the RET antenna remotely and consistently across the network.

The purpose of the present document is to record the required changes of the specifications and to gather all information in order to trace the history and the status of the Work Task in RAN WG3. It is not intended to replace contributions and Change Requests, but only to list conclusions and make reference to agreed contributions and CRs. When a solution for the remote control of electrical tilting antennas is sufficiently stable, the needed CRs can be issued.

Therefore, this document identifies the affected specifications with related Change Requests.

It also describes the schedule of the Work Task.

This document is a 'living' document, i.e. it is permanently updated and presented to TSG-RAN meetings.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TD RP-030193: "Work Item Description for Remote Control of Electrical Tilting Antennas".
- [2] ISO/IEC 13239 (2nd Edition, March 2000): Information Technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures
- [3] ISO/IEC 8482 (1993): Information technology – Telecommunications and information exchange between systems - Twisted pair multipoint interconnections
- [4] 3GPP TS 25.104: Base Station (BS) radio transmission and reception (FDD)
- [5] 3GPP TS 25.401: UTRAN overall description
- [6] Chia-Liang Liu, Dr. Kamilio Feher (1991) $\pi/4$ -QPSK Modems For Satellite Sound/Data Broadcast Systems. IEEE Transactions On Broadcasting, Vol.37, No. 1, March 1991
- [7] Chennakeshu S., Saulnier G. (1993) Differential Detection of $\pi/4$ -Shifted-DQPSK for Digital Cellular Radio. IEEE Transactions on Vehicular Technology, Vol. 42, No. 1, February 1993, pp. 46-57
- [8] 3GPP TS 25.442: "UTRAN Implementation Specific O&M Transport"
- [9] 3GPP TS 25.460: "UTRAN Iuant Interface: General Aspects and Principles"
- [10] 3GPP TS 25.461: "UTRAN Iuant Interface: Layer 1"
- [11] 3GPP TS 25.462: "UTRAN Iuant Interface: Signalling Transport"
- [12] 3GPP TS 25.463: "UTRAN Iuant Interface: Remote Electrical Tilting (RET) Antennas Application Part (RETAP) Signalling"
- [13] 3GPP TD S5-048176: "Work Item Description for Remote Control of Electrical Tilting Antennas OAM & P Impacts".
- [14] 3GPP TR 32.804: "Remote Control of Electrical Tilting Antennas OAM & P Requirements".
- [15] Antenna Interface Standards Group: "Control Interface for Antenna Line Devices". Standard No. AISG1

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the [following] terms and definitions [given in ... and the following] apply.

<defined term>: <definition>

ASCII character: A character forming part of the International Reference Version of the 7-bit character set defined in ISO/IEC 646:1991

Bus address: The HDLC address of each device connected to an RS485 bus

Calibrate: Exercise the antenna drive unit over its entire range of travel to ensure fault-free operation and synchronise the measured and actual beam tilt of the antenna

Configuration data: A stored table or function defining the relationship between the physical position of the drive and electrical beam tilt

Device type: A 1-byte field identifying the type of a device

Little-endian: The order of transmission in which the least-significant bytes of a multi-byte representation of a number are transmitted first

On-Off keying: A modulation system in which a carrier is switched between two states, ON and OFF

Return code: A response to a command contained in a single hex byte. (See Appendix C for a list of assigned return codes.) Most return codes indicate either successful completion of a command or a reason for its failure

Reset: A process by which a processor, flash memory, FPGA or other device is returned to a known state of initialisation. This normally includes initialising ports, clearing the FPGA RAM, and for processors following the reset vector and commencing execution at that address

Text: Characters part of ASCII table with ASCII value ≥ 32 , and ≤ 126

Tilt (also downtilt, tilt angle, beamtilt): The elevation angle between the direction orthogonal to the antenna element axis and the maximum of its main beam in the elevation plane. A positive electrical tilt angle means that the antenna beam is directed below the direction orthogonal to the antenna axis. An antenna has separate values for electrical and mechanical tilt. The mechanical tilt is fixed by the geometry of the installation. In this TR the tilt referred to is always the electrical tilt unless otherwise stated

Vendor code: A unique ASCII 2-character code assigned to each vendor in [15]

3.2 Symbols

For the purposes of the present document, the following symbols apply:

(void)

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ADDR	Address
BER	Bit Error Rate
BTS	Base Transceiver Station
CRC	Cyclic Redundancy Check
DISC	Disconnect (frame type)
DM	Disconnected Mode (frame type)
DQPSK	Differential Quadrature (Quaternary) Phase Shift Keying
FCS	Frame Checking Sequence
FRMR	Frame Reject (frame type)
FSK	Frequency Shift Keying
HDLC	High-Level Data Link Control
I	Information (frame type)
INFO	Information (field name)
NMS	Network Management System
NRM	Normal Response Mode
NRZ-L	Non-Return-to-Zero Level
OOK	On-Off Keying
OSI	Open Systems Interconnection
RBS	Radio Basestation
RET	Remote Electrical Tilting
RNR	Receive Not Ready (frame type)
RR	Receive Ready (frame type)
SNRM	Set Normal Response Mode (frame type)
TWA	Two Way Alternate
UA	Unnumbered Acknowledgement (frame type)
UNC	Unbalanced Operation Normal Response Mode Class
XID	Exchange ID (frame type)

4 Introduction

Because of the interference limitation property of the CDMA based UTRAN, the tilting of antennas is essential for the successful operation and optimisation of UMTS network coverage. It would be very beneficial if it were possible to remotely control the tilting of antennas in order to optimise radio coverage areas.

The ability for the operator to control the electrical tilt of the antennas remotely from the O&M Network is currently possible via the implementation-specific interfaces between Node B Element Manager and Node B. A “remote control” mechanism decreases the costs incurred on the operator for site visits to change the tilt of the antennas manually and simplify the redeployment of antennas in a large network.

Remote electrical tilting (RET) solutions to date are proprietary, and hence interfacing a mix of antennas and Node Bs from different vendors is not possible without a standardised interface. Therefore, in order to enable flexibility for the operator in choosing their antenna supplier(s), a new interface is required between RET antenna and Node B to control the electrical tilting.

Additionally, RET functionality in the UTRAN accompanied by an appropriate set of signalling commands and control parameters from the Network Manager over the Itf-N interface would allow the operator to optimise the whole network using consistent commands – even in a multi-vendor environment. TSG SA WG 5 should provide the parameters and functionality across the Itf-N interface needed for a network wide controlling of RET antenna devices. For this purpose a TSG SA WG 5 Work Item on RET [13] was approved at SA5#37 and TR 32.804 [14] captures the requirements for this work.

5 Requirements

5.1 General

- Specification of open interfaces between RET and Node B to ensure multi-vendor operability with a mix of antennas and Node Bs from different vendors
- Support of error and alarm handling
- Align with already existing solutions as much as possible
- Control of downtilt settings and variations remotely both from Network Management system and locally from the Node B

5.2 UTRAN Architecture

- Minimise impact on existing UTRAN architecture and network/element management architecture

5.3 Protocols

- Interface protocols terminate at Node B and RET antenna
- Protocol Stack needs to be standardised
- Efficient protocol means shall be provided to enable the simultaneous control of several RET antennas
- Transport protocol stack of the RET antenna control interface shall be future-proof in terms of availability, compatibility, performance, capacity and addressing capabilities, allowing the same transport protocol stack to be used for other controlling purposes than RET antenna control.

5.4 Network wide Control of RET Antennas

- Centralised and network wide remote control of RET antennas with downtilt settings and variations of the downtilt

6.1.2 Interface Aspects

6.1.2.1 General

For the control of RET antennas a standard data interface between the Node B Implementation Specific O&M function and the Node B RET Antenna Control function according to [5] is defined by means of which functional parameters of the device can be remotely controlled. This interface for the RET antenna control is based on a three-layer protocol model. The three-layer model is a compact form of the OSI seven-layer reference model and includes only layers 1, 2 and 7:

- The Physical Layer (Layer 1) defines the signalling levels and basic data characteristics including the data rate
- The Signalling Transport (Layer 2) is based on a custom subset of the HDLC standard as defined in [2]
- The RET Control Application Part (Layer 7) defines the data payload format and the required command set

The advantage of this compact model for the control interface is that it provides an efficient protocol stack suitable for implementation on a single embedded micro-controller.

6.1.2.2 Physical Layer

There are two layer 1 options:

- A screened multicore cable, which supports a conventional RS485 serial multi-drop bus
- A connection to a RET control unit by way of a coaxial cable which is shared with DC supply and RF signals

Both layer 1 options support the connection of two-way serial data and DC power to the RET antenna device.

The default data rate for both layer 1 options shall be 9.6 kbps. Higher data rates of 38.4 kbps and 115.2 kbps may optionally be supported. The operating data rate on a bus is established using the procedure described in section 6.1.5.4.15 of this TR.

The format of the data shall be:

- 8 data bits No parity
- 1 start bit NRZ-L encoding
- 1 stop bit

6.1.2.2.1 RS485 Serial Data Bus

The data bus shall be a two wire bi-directional multi-drop configuration conforming to [3].

6.1.2.2.2 Coaxial Interface: Modem Characteristics

6.1.2.2.2.1 Interference with Existing Systems

The modem must not interfere with existing communications in BTS systems, so a unique carrier frequency for each different communication channel on a common feeder cable is necessary.

The modem circuit must be capable of managing its transmitting characteristic according to section 6.1.2.2.2.5 and providing filtering for its receiver according section 6.1.2.2.2.6.

The following frequency (referred to as f_0 in figure 6.1) should be used for this application:

2.176 MHz +/- 100 ppm

6.1.2.2.2.2 Recovery Time

Due to hardware limitations a minimum recovery time must be allowed between transmitting and receiving messages on the bus. For this reason a minimum permitted response time is specified in section 6.1.2.3.10.

6.1.2.2.2.3 Impedance

The modem transceiver shall provide constant impedance in both transmitting and receiving modes:

- Nominal impedance Z_0 : 50 Ω
- Return loss at nominal carrier frequency > 6 dB

6.1.2.2.2.4 Modulation

On-off-keying: Logical 1: Carrier OFF Logical 0: Carrier ON

6.1.2.2.2.5 Modulator Characteristics

➤ Levels

ON-Level: +3 dBm \pm 2 dB OFF-Level: \leq -40 dBm

➤ Spurious Emissions

Spurious emissions shall not exceed the mask shown in figure 6.1. Intermediate values may be obtained by linear interpolation between the points shown. In addition, out-of-band emissions must conform to the requirements in [4].

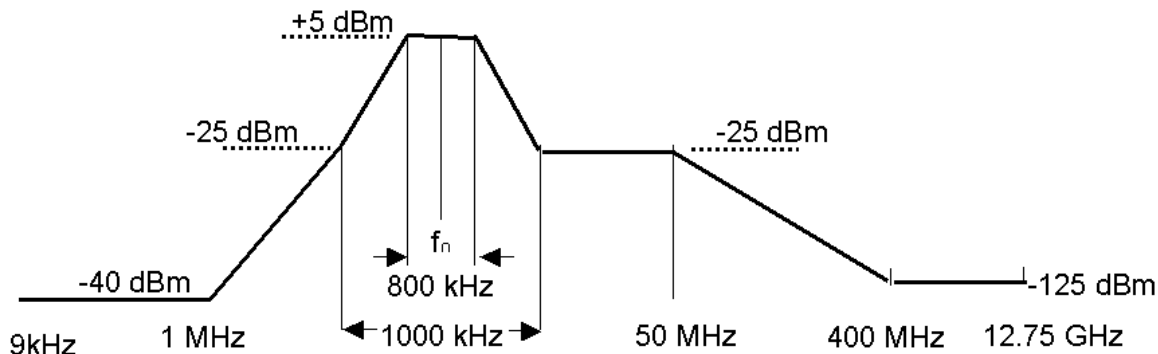


Figure 6.1: Spectrum Mask for OOK-Modems

6.1.2.2.2.6 Demodulator Characteristics

The demodulator characteristics have been defined on the assumption of a minimum separation of 2 MHz for adjacent carriers of other communication channels on the same coaxial cable.

➤ Threshold

Threshold: -15 dBm \pm 3 dB

6.1.2.2.2.7 Duty Cycle Variation

In order to guarantee proper transmission of data bits through the processes of modulation and demodulation, the duty cycle of the received binary data stream may not vary too much from that of the transmitted duty cycle. Specifically the following limit must be met:

$$\Delta DC_{\text{SYSTEM}} = |DC_{\text{RX}} - DC_{\text{TX}}| \leq 10 \%$$

Where: $\Delta DC_{\text{SYSTEM}}$ is the difference between the duty cycles of the transmitted and received bit streams,

DC_{TX} = Duty cycle for the input bit stream, and

DC_{RX} = Duty cycle for the output bit stream.

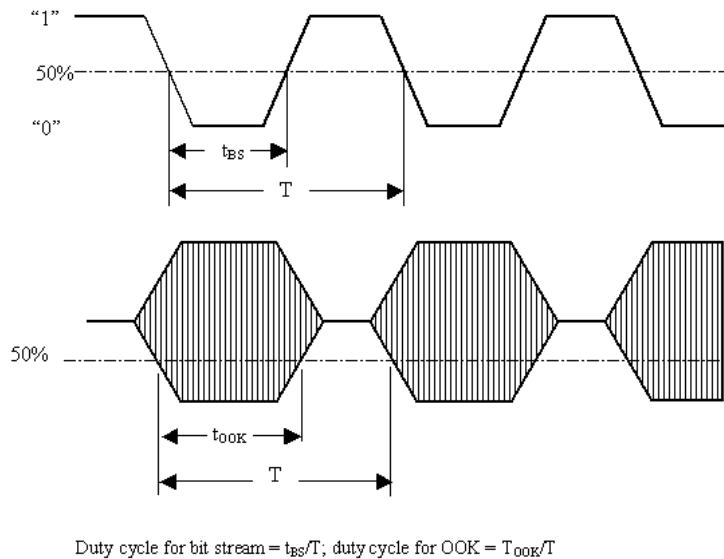


Figure 6.2: Duty Cycles of the Bit Stream and OOK Modulated Subcarrier

For transmission through a coaxial cable, two converters are required, one from a bit stream to OOK (modulator) and one from OOK back to a bit stream (demodulator), so for each converter half of the total duty cycle tolerance is available.

For an input bit stream with a duty ratio of 50 %, the cascaded modulator and demodulator must provide an output bit stream with a duty ratio within the limits 40 % – 60 %, measured in each case at 0.5 times peak amplitude (see figure 6.2).

6.1.2.3 Signalling Transport

The data link layer is based on a subset of the standardised ISO HDLC which conforms to the requirements in [2].

6.1.2.3.1 HDLC Format

6.1.2.3.1.1 Operating Mode

The operating mode shall be normal response mode (NRM) with two way alternate (TWA) communication. This mode requires that the primary device as a master is always in control of the bus and the secondary device only answers frames sent by the master. The secondary device cannot send any frame independently. The primary device is the Node B Implementation Specific O&M function whereas the secondary device is the Node B RET Antenna function often physically located at the top of the antenna mast.

The channel state shall be start/stop transmission.

6.1.2.3.1.2 Control octet transparency

Control octet transparency shall be implemented in accordance with Paragraph 4.3.2.2 in [2]. This requirement applies to all frame types.

6.1.2.3.2 Frame Checking Sequence Field

The Frame Checking Sequence Field (FCS) shall be calculated in accordance with [2] on all bytes following the start flag up to, but not including, the CRC field.

6.1.2.3.3 HDLC Command Sub-set

The protocol shall support the following HDLC commands, which are based upon the TWA, UNC (no options) commands list provided in Annex D of [2].

Table 6.1.2.3.3.1: Frame Types used for the Transport Layer

Commands (Primary Device)	Responses (Secondary Device)
Frame type I	Frame type I
Frame type RR	Frame type RR
Frame type SNRM	Frame type UA
Frame type DISC	Frame type DM
Frame type XID	Frame type RNR
	Frame type FRMR (optional)

The I-frame and INFO field formats for both primary and secondary devices shall be as illustrated in figure 6.3. INFO fields are only used with I-frames.

The Frame Control Field shall be formatted in accordance with Paragraph 5.3.1, Table 3 in [2].

HDLC-Frame:

Flag 8bit	ADDR 8bit	Control 8bit	INFO N x 8bit	CRC 2 x 8bit		Flag 8bit
0x7E	Device Address	Control bits	Variable length (must support a maximum length of at least 74 bytes)	CRC1 low byte	CRC2 high byte	0x7E

3GPP Release	Command ID	Number of data bytes		Data bytes
Release-ID 1 byte	1 byte	low byte	high byte	Variable length (must support a maximum length of at least 70 bytes)

Figure 6.3: Format of the I-Frame and INFO Field

Devices shall support the following data length:

- Mandatory: $0 \leq \text{data bytes} \leq 70$ bytes
- Optional: $0 \leq \text{data bytes} < 65,535$ bytes

To allow for the use of frames longer and window sizes larger than the default sizes the following transport layer XID-frame may be sent by the primary device to determine the maximum information field length and window size supported by a secondary device. (Refer also to Paragraph 5.5.3 in [2].)

XID Frame from primary device:

Table 6.1.2.3.3.2: XID Frame from Primary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command

FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	1	Length of the parameter field (PI)
PI	5	Maximum I Field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I Field length Transmit
PI	6	Maximum I Field length Receive
PL	Nrx	Length of the bytes value
PV	Value	Maximum I Field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field
PV	Value	Maximum window size Transmit
PI	8	Maximum window size Receive
PL	N	Length of the window size
PV	Value	Maximum window size Receive

Response from secondary device:

The secondary device checks to see if it can support the values provided in the command. If the secondary device can support the values then it replies with the same value. If the secondary device can not support these values then it replies with the maximum values that can be supported.

Table 6.1.2.3.3.3: UA Frame from Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	UA	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	Length	Length of the PI field
PI	5	Maximum I field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	6	Maximum I field length Receive
PL	Nrx	Length of the PV field (bytes)
PV	Value	Maximum I field length Receive
PI	7	Maximum window size Transmit

PL	N	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	8	Maximum window size Receive
PL	N	Length of the PV field (bytes)
PV	Value	Maximum window size Receive

If the secondary device does not provide a valid response, then the default frame length and window size are to be used.

The Release-ID shall be used to identify the 3GPP Release of the RET Application Part supported by the secondary device.

6.1.2.3.4 HDLC Address

The HDLC address shall be stored in non-volatile memory and restored on power-up. The secondary device compares its own address with the Address field of the received frames from the bus. If the addresses are equal the frame is accepted and will be processed.

Two addresses are reserved for device management, these are:

- Address 0x00
Address 0x00 is the initial state during installation. It is recommended that all devices be assigned this address by the manufacturer prior to shipment to the customer unless otherwise agreed by prior arrangement.
- Address 0xFF
Address 0xFF is a broadcast address. All devices connected shall process commands received via a broadcast.

There is no response from secondary devices to broadcast addresses.

6.1.2.3.4.1 Address configuration

Before communication can be established on a bus it is necessary to configure the addresses of the devices connected to it. Address assignment is mediated by the use of an XID frame carrying data fields as specified in Paragraph 5.5.3 of [2].

6.1.2.3.4.1.1 Address Assignment Command

The format of the XID frame originated by the primary device shall be as follows:

Table 6.1.2.3.4.1: Format of the Address Assignment Command from the Primary Device

Field	Content	Description
ADDR	0xFF	Broadcast
CTRL	XID	Command
FI	0x81	Format identifier
GI	0xF0	User defined parameter set
GL	n+5	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	n	Length of PV field in bytes
PV	unique ID	Vendor id/serial number (n bytes)

PI	2	Parameter id 2 = address
PL	1	Length of PV field in bytes
PV	1 – 254	Assigned address

6.1.2.3.4.1.2 Address Assignment Response

The secondary device verifies FI, GI, GL and PI, PL for the two parameters. It then checks the first PV to see if it contains its own unique ID. If so it changes its address to the one supplied in the second PV. It then responds with a UA frame transmitted from its new address.

Table 6.1.2.3.4.2: Format of Address Assignment Response from the Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	UA	Command

If the first PV does not match its unique ID, but the secondary device already uses the address specified in the second PV, it changes its address to zero in order to remove itself from the bus. This prevents a situation in which two devices have the same address. This mechanism may be used to reset a device's HDLC address to zero if it is to be removed from the bus.

If neither the first PV nor the second PV matches, the secondary device does nothing.

After the assignment of its address a secondary device remains in the disconnected state.

6.1.2.3.4.1.3 Device Scan Command

In some situations it may be found that the unique ID of a bus device is unknown or has been inaccurately recorded. This HDLC command exchange is used by the primary device to perform a binary tree scan of the bus, in order to identify all connected devices, and is always carried out at 9.6 kbps.

Table 6.1.2.3.4.3: Primary Device Scan Command (XID Frame)

ADDR	0xFF	Broadcast
CTRL	XID	Command
FI	0x81	Format identifier
GI	0xF0	User defined parameter set
GL	2*n+4	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	n	Length of PV field in bytes
PV	unique id	Vendor id/serial number (n bytes)
PI	3	Parameter id 3 = bit mask

PL	n	Length of PV field in bytes (same as for PI=1)
PV	bit mask	Bit mask (n bytes)

➤ Device Scan Response

When each secondary device receives the command it masks its unique id with the bit mask and compares the result with the unique id supplied. If they match, the secondary device responds using any unnumbered format frame according to table 8 of section 5.5 of [2]. It is recommended that the response of individual devices is subject to a random delay (within the permitted response time) to aid collision detection at the primary device.

If there is no response, the primary device knows that no secondary device had those bits in its unique id, so the tree scan can be truncated at that branch.

If multiple secondary devices respond, the messages may arrive after each other or at the same time. In the first case multiple responses will arrive before the timeout, in the second case the responses might garble each other, unless one secondary device is close enough to overpower the signal from the other(s).

If any response arrives, a single frame, multiple frames or frames with incorrect checksums or framing errors, the primary device must assume that that branch of the tree is inhabited and scan through it.

6.1.2.3.5 Window Size

The minimum window size is 1.

6.1.2.3.6 Connection Establish

The primary device sends an SNRM-frame to the secondary device. The secondary device responds with a UA-frame, its message buffers are emptied, HDLC sequence numbers are reset and it enters the connected state. After the primary device receives the UA-frame, the corresponding secondary device is administered as connected.

6.1.2.3.7 Disconnect

The primary device sends a DISC-frame to the secondary device. The secondary device responds with a UA-frame and enters the disconnected state. After the primary device receives the UA-frame, the corresponding secondary device is administered as disconnected.

If the secondary device is in disconnected mode, it shall respond as defined in Paragraph 5.2.2.1 of [2].

6.1.2.3.8 Polling

Before any secondary device can be polled, it must first be placed in the connected state.

On reception of a frame with correct FCS and matching address and with the poll-bit set as specified in [2], the secondary device is required to transmit frames on the bus within the times defined in section 6.1.2.3.10.

If the secondary device has an I-frame to transmit it shall do so. If it does not have an I-frame to transmit it shall respond with either an RR or RNR frame. If it is unable to receive I-frames, for instance because it has run out of empty buffers, it shall respond with RNR. Otherwise it shall respond with RR (see also Appendix B in [2])

This polling procedure provides the application part of the protocol with a full-duplex link, allowing the application part to spontaneously transmit messages, such as alarm messages.

If the secondary device does not receive a poll within 3 minutes of the previous poll, it may optionally perform a reset.

NOTE: In the event that the primary device receives no responses from a secondary device, it is recommended that it signals loss of connection to its Element Manager.

6.1.2.3.9 Information

Before any secondary device can be required to send or receive an I-frame, it must first be placed in the connected state. One I-frame is used for one message, so fragmentation is not required. If the primary device sends a command to the secondary device, one I-frame is generated and sent. The secondary device can respond with any valid HDLC response belonging to the subset of RET control commands.

6.1.2.3.10 Message Timing

A minimum of 3 ms must elapse between transmitting and receiving messages on a bus.

The primary device should receive a complete response frame within 10 ms plus the time taken for the transmission of 100 bytes from the time the final flag byte is transmitted. The secondary device should start to transmit a response within 10 ms. The time occupied by the transmission of 100 bytes allows time-outs to include transmission time, with 10 ms allowed for processing.

6.1.2.3.11 Frame Error Rate

The number of frames detected with incorrect checksums shall be less than 1 frame in 5000 frames.

6.1.3 Functions of Interface

Editor's note: This subsection should capture issues regarding the functions of the interface

6.1.4 Protocol Structure

The protocol structure of the Iuant Interface described in section 6.1 of this TR is shown in figure 6.4 and figure 6.5 for both Implementation Specific O&M Transport options. The protocol stack consists of the two layer 1 options RS485 and coaxial cable as described in section 6.1.2.2, the signalling transport based on a subset of HDLC according to section 6.1.2.3 and the RET Control AP which is defined in section 6.1.5 of this TR.

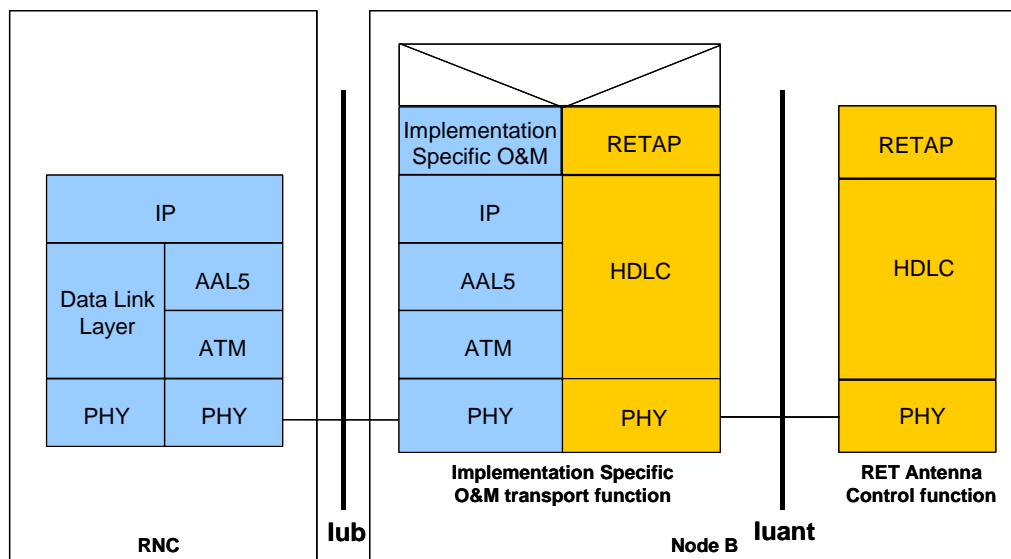


Figure 6.4: Protocol Structure for Implementation Specific O&M with ATM-Transport Option

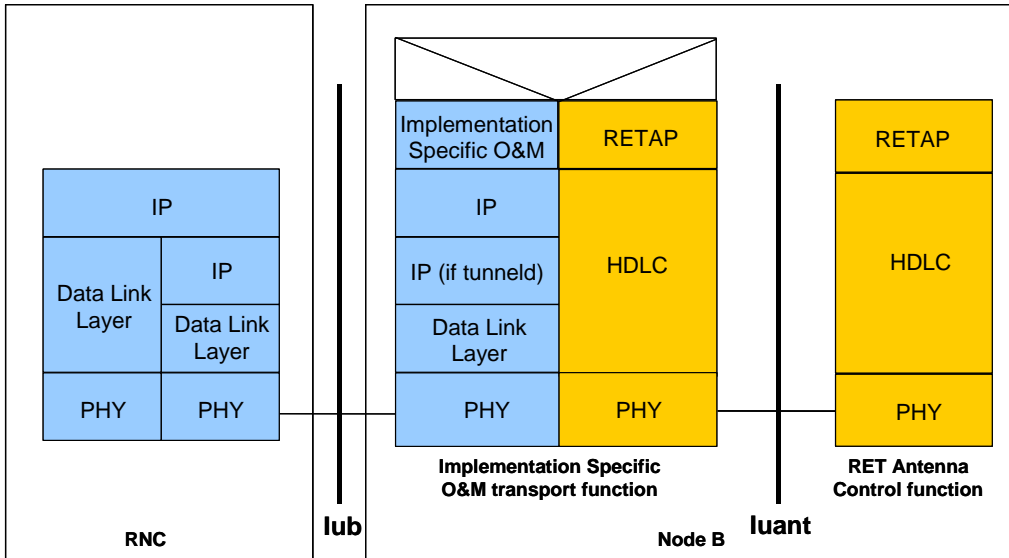


Figure 6.5: Protocol Structure for Implementation Specific O&M with IP-Transport Option

As the Iuant and the Implementation Specific O&M transport are different interfaces with e.g. different addressing schemes a mediation function is needed. This mediation function uses on one side a protocol that uses the implementation specific O&M bearer (e.g. IP) and on the other side the Iuant protocol.

6.1.5 Application Protocol signalling procedures

6.1.5.1 Command Format

Apart from address configuration, which uses the XID frame, commands to devices are transmitted within the HDLC INFO field. The general format for all commands is the following:

Table 6.1.5.1.1: General Format for all Commands

Command	Number of data bytes	Data bytes
1 byte	2 bytes	max 70 bytes (basic implementation)

6.1.5.2 Response Format and Return Codes

All responses from devices are transmitted in the HDLC INFO-field. The general format for all responses is the following:

Table 6.1.5.2.1: General Format for all Responses

Command	Number of data bytes	Data bytes
1 byte	2 bytes	max 70 bytes (basic implementation)

The maximum time for all responses shall be 1 second unless specified in the individual command. Tilt setting, calibration and self test will typically require a longer period for completion of the command.

One or more return codes are transmitted in the data bytes.

A complete annotated table of all available return codes with their corresponding hexadecimal numbers is provided in section 6.1.6 of this TR.

6.1.5.3 Overview of Commands

The set of commands for RET antenna control provides command-oriented instructions and also facilities to read and write data to specified locations in the memory of the secondary devices.

Table 6.1.5.3.1: Command Set and Command Numbers

Command	Command number	Comment
(Reserved)	0x01	Device operation, mandatory
Get Device Type	0x02	Device operation, mandatory
Reset	0x03	Device operation, mandatory
Get Error Codes	0x04	Device operation, mandatory
Get H/W & S/W Info	0x05	Device operation, mandatory
Alarm	0x07	Device operation, mandatory
Enable Device	0x08	Device operation, mandatory
Disable Device	0x09	Device operation, mandatory
Self Test	0x0A	Device operation, mandatory
Read Memory	0x0B	Device operation, mandatory
Write Memory	0x0C	Device operation, mandatory
Get Supported Bit Rates	0x0D	Device operation, mandatory
Set Device Data	0x0E	Device operation, mandatory
Get Device Data	0x0F	Device operation, mandatory
Download Start	0x2E	Device maintenance, optional
Store Data Start	0x20	Device maintenance, optional
Store Data Block Seg	0x21	Device maintenance, optional
Download End	0x22	Device maintenance, optional
Set Bit Rate	0x24	Device maintenance, optional
Calibrate	0x31	RET control, mandatory
Send Config data	0x32	RET control, mandatory
Set Tilt	0x33	RET control, mandatory
Get Tilt	0x34	RET control, mandatory

6.1.5.4 Control Commands

In response to all Application Part commands from the primary device, the addressed secondary device shall respond with <OK> whenever a normal outcome to the command has resulted, and <FAIL> otherwise. Additional parameters may be associated with the response <OK> and a variety of defined return codes (error messages) with the response <FAIL> as described in the following paragraphs. Return codes are also used as autonomous alarm responses (see section 6.1.5.4.5 for details).

A summary table and interpretation of all defined return codes is provided in section 6.1.6 of this TR. When return codes are used, they shall have meanings consistent with those described.

A primary device (i.e. any control equipment, Node B) must execute two procedures for a RET antenna as secondary device (RET) before control of the secondary device is possible:

1. The HDLC address must be assigned to the secondary device
2. The device type of the secondary device must be requested, so the primary device can identify the appropriate command set to be used to communicate with the secondary device.

6.1.5.4.1 Get Device Type

Command Name: GetDevType

This command requests the type of a device. A scan of all correctly configured and connected devices connected to the RS485 bus may be initiated by sending the command GetDevType to each address and evaluating the responses.

Data field command to secondary device:

0x02 0x00 0x00

Data field response from secondary device:

0x02 <LengthLowByte> <LengthHighByte> <OK> <VendorLowByte> <VendorHighByte> <DeviceType>

Vendor codes are given in [15]. The device type for RET is 0x01.

Data field response from secondary device in case of error in performing the command:

0x02 <LengthLowByte><LengthHighByte><FAIL> <ReturnCode1>...<ReturnCodeN>

6.1.5.4.2 Reset Software

Command Name: Reset

This command resets the device software, restarts the software and places the device in the disconnected state.

Data field command to secondary device:

0x03 0x00 0x00

Data field response from secondary device before the reset command is executed:

0x03 0x01 0x00 <OK>

The device must not execute the reset before transport layer acknowledgement through sequence number update is received for the response. (See Appendix B in [2]).

The Reset command must be executed in all situations. The secondary device must not fail to reset because it is busy or for any other reason of its software state.

6.1.5.4.3 Get Error Codes

Command Name: GetErrorCodes

This command requests remotely the error codes supported by a secondary station.

Data field command to secondary device:

0x04 0x00 0x00

Data field response from secondary device:

0x04 <LengthLowByte> <LengthHighByte> <OK> <ErrorCode1><ErrorCode2>...<ErrorCodeN>

This is a normal response. The request to get supported error codes has been executed correctly and the supported error codes are returned.

Data field response from secondary device in case of error in performing the command:

0x04 <LengthLowByte> <LengthHighByte> <FAIL>

This is an abnormal response.

6.1.5.4.4 Read Hardware and Software Information

Command Name: GetInfo

This command reads hardware information and the software version from a secondary device. The software version must indicate the version number of the currently installed software, whether installed at the time of manufacture or during subsequent upgrade.

Data field command to secondary device:

0x05 0x00 0x00

Data field response from secondary device:

0x05 <LengthLowByte> <LengthHighByte> <OK> <Length> <Prod Nr> <Length> <SerNo> <Length> <HW Version> <Length> <SW Version>

ProdNr is the product type number and SerNr is the unique serial number of the individual unit.

HW Version and SW Version refer to the version designators of the hardware and installed software of the secondary device. If the application is missing or no version number is found, then an empty string shall be returned as the version number.

Data field response from secondary device in case of error in performing the command

0x05 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1> ... <ReturnCodeN>

6.1.5.4.5 Poll Response from Secondary Device

Response Name: Alarm

The Transport Layer provides a virtual full-duplex link to the Application Part. This virtual full-duplex link is used to simplify alarm reporting.

The secondary device reports every change in error status by transmitting an alarm message in response to a poll. Formally this is a response message, even though (on Application Part level) it is a spontaneous message. There is no Application Part command to request an alarm response message.

The alarm message contains a list of error-code/state-flag pairs. The state flag indicates that an error has occurred (StateFlag = 1) or cleared (StateFlag = 0).

Only error codes whose state has changed shall be included in the list. The secondary device may group several error codes into one message, but their sequence in the message must then reflect the sequence in which they occurred.

A rapid setting/clearing sequence of the same alarm may be reported in the same alarm message in the order in which they occurred (FIFO).

In the event that the rapid state changes cause overflow of the available buffers, the oldest error code changes shall be discarded and the later ones retained for transmission.

Autonomous data field response from secondary device if an error state has changed since the previous poll from the primary device:

0x07 <LengthLowByte> <LengthHighByte> <Return Code1> <StateFlag1> ... <ReturnCodeN> <StateFlagN>

Alarm return codes are defined in section 6.1.6 of this TR.

6.1.5.4.6 Enable Device

Command Name: Enable

This command enables a secondary device for operation. If a secondary device is enabled, all commands are executable; if it is already enabled, a second enable command will be accepted without error and the device will remain enabled. Internally, the status of the device is always set to **enabled** after the command is received.

Data field command to secondary device:

0x08 0x00 0x00

Data field response from secondary device:

0x08 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x08 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.1.5.4.7 Disable Device

Command Name: Disable

This command secures secondary devices against unauthorised or accidental change of operational parameters. When a secondary device is disabled, commands which SET parameters will not be accepted and an DeviceDisabled error will be returned. If it is already disabled, a second disable command will be accepted without error and the secondary device will remain disabled. Internally, the status of the device is always set to **disabled** after the command is received.

All secondary devices shall be delivered by vendors with their status set to 'disabled'. The status of every device after reset shall default to 'disabled'.

Data field command to secondary device:

0x09 0x00 0x00

Data field response from secondary device:

0x09 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x09 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.1.5.4.8 Self Test

Command Name: SelfTest

This command executes a test function at the device which may include a check of physical and processor functions.

The response from the command provides the user with information on detected faults or, if no fault is detected, with confidence that the operation of the device is normal in all respects.

During the test the operational parameters of the device shall not change beyond operationally acceptable limits and on completion all parameters shall be returned to their initial values.

Data field command to secondary device:

0x0A 0x00 0x00

Data field response from secondary device:

0x0A <LengthLowByte><LengthHighByte><OK><Return Code1>...<Return CodeN>

This is a normal response in which the self test was executed with return codes set to report possible detected functional errors during the test. If no errors are detected, this shall be signalled by no return codes following <OK>.

Data field response from secondary device in case of error in performing the command:

0x0A <LengthLowByte><LengthHighByte><FAIL><Return Code1>...<ReturnCodeN>

In this case the self test could not be executed and the return codes relate to the inability of the device to perform the requested self-test operation.

6.1.5.4.9 Read Memory

Command name: ReadMemory

Data field command to secondary device:

0x0B <LengthLowByte> <LengthHighByte> <MemoryAddressByte1> <MemoryAddressByte2>
<MemoryAddressByte3> <MemoryAddressByte4> <N = number of bytes to read>

Data field response from secondary device:

0x0B <LengthLowByte> <LengthHighByte><OK> <MemoryAddressByte1> <MemoryAddressByte2>
<MemoryAddressByte3> <MemoryAddressByte4> <byte1> ... <byteN>

Data field response from secondary device in case of error in performing the command:

0x0B <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

MemoryAddress bytes are transmitted in little-endian order.

6.1.5.4.10 Write Memory

Command name: WriteMemory

Data field command to secondary device:

0x0C <LengthLowByte> <LengthHighByte> <MemoryAddressByte1> <MemoryAddressByte2>
<MemoryAddressByte3> <MemoryAddressByte4> <byte1> ... <byteN>

MemoryAddress bytes are transmitted in little-endian order.

Data field response from secondary device:

0x0C 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x0C <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.1.5.4.11 Get Supported Bit Rates

Command Name: GetBitRates

This command is used to determine which bit rates are supported by any device connected to a bus. All systems shall respond to this command, but support for bit rates other than 9.6 kbps is optional. Devices which support multiple bit rates will reply with multiple values.

Data field command to secondary device :

0x0D 0x00 0x00

Data field response from secondary device:

0x0D <LengthLowByte> 0x00 <OK> <BitRateByte1> <BitRateByte2> <BitRateByte3>

Bit rate byte:

- 0x00 : 9.6 kbps

- 0x01 : 38.4 kbps
- 0x02 : 115.2 kbps

Data field response from secondary device in case of error in performing the command:

0x0D <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.1.5.4.12 Set Device Data

Command name: SetDeviceData

This command is used to write data into the fields optionally provided for configuration data and listed in section 6.1.7 of this TR. If an attempt is made to write to fields which are not supported by a particular device no error is returned but the data for those fields is ignored.

Data field command to secondary device:

0x0E <LengthLowByte> <LengthHighByte> <FirstParameterNumber> <data bytes for first parameter>
<SecondParameterNumber> <data bytes for second parameter> <ThirdParameterNumber>
<data bytes for third parameter>...<Nth ParameterNumber> <data bytes for Nth parameter>

Data field response from secondary device:

0x0E 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x0E <LengthLowByte> <LengthHighByte><FAIL> <Return Code1>...<Return CodeN>

6.1.5.4.13 Get Device Data

Command Name: GetDeviceData

This command is used to read data stored in the fields optionally provided for configuration data and listed in section 6.1.7 of this TR. If an attempt is made to read fields which are not supported by a particular device no data is returned for that field. The command contains a list of the field numbers of those fields whose contents are to be returned in the response from the secondary device. The field numbers are not necessarily contiguous or ordered.

Data field command to secondary device:

0x0F <LengthLowByte> <LengthHighByte> <0x01> <0x02> <0x03>...<0x0N>

Data field response from secondary device:

0x0F <LengthLowByte> <LengthHighByte> <OK> <0x01> <data bytes for parameter 1>
<0x02> <data bytes for parameter 2> <0x03> <data bytes for parameter 3>...<0x0N> <data bytes for parameter N>

Data field response from secondary device in case of error in performing the command:

0x0F <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.1.5.4.14 Software Download

If software download is supported, then the following commands are used to download new software releases to a secondary device. The sequence of the following commands must be strictly observed. After the complete sequence a reset command is necessary to activate the new software.

For implementations in which more than one software data file will be downloaded to a secondary device, the address of the memory locations to be erased shall be transmitted in the header of the first data block of each data file.

The sequence of commands to effect a software download to a secondary device is illustrated in section 6.1.8 of this TR.

6.1.5.4.14.1 Download Start

Command Name: DownloadStart

This command initiates internal copy and execution of software routines and may delete parts of the flash memory. An <OK> response indicates that any flash erasure has been successfully executed.

Data field command to secondary device:

0x2E 0x00 0x00

Data field response from secondary device:

0x2E 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x2E <LengthLowByte> <LengthHighByte> <FAIL><ReturnCode1>...<ReturnCodeN>

6.1.5.4.14.2 Store Data Start

Command Name: StoreDataStart

This command specifies the block-number of the block which will be transferred and the number of bytes within this block.

Data field command to secondary device:

0x20 0x04 0x00 <BlockNrLSB> <BlockNrMSB> <BlockLengthLSB> <BlockLengthMSB>

Data field response from secondary device:

0x20 0x03 0x00 <OK> <BlockNrLSB> <BlockNrMSB>

Data field response from secondary device in case of error in performing the command:

0x20 <LengthLowByte> <LengthHighByte> <FAIL> <BlockNrLSB> <BlockNrMSB>
<ReturnCode1>...<ReturnCodeN>

6.1.5.4.14.3 Store Data Block Segment

Command Name: StoreDataBlockSeg

This command transfers data segments to the secondary device.

Data field command to secondary device:

0x21 <LengthLowByte> <LengthHighByte> <SegmentNumber> <data 1>...<data n>

NOTE: n <= 69 if 74-byte I-fields are used

Data field response from secondary device:

0x21 0x02 0x00 <OK> <SegmentNumber>

Data field response from secondary device in case of error in performing the command:

0x21 <LengthLowByte> <LengthHighByte> <FAIL> <SegmentNumber> <ReturnCode1>...<ReturnCodeN>

The segment number commences at 0 and is incremented in steps of 1 to a maximum value of 255. If more than 256 segments are required, a new block must be started which in turn resets the segment number to 0.

6.1.5.4.14.4 Download End

Command Name: DownloadEnd

With this command the primary device signals the end of software transfer to the secondary device. The secondary device responds after verifying the checksum of the whole data transferred to memory.

Data field command to secondary device:

0x22 0x00 0x00

Data field response from secondary device:

0x22 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x22 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code 1> ... <Return Code N>

6.1.5.4.15 Set Bit Rate

Command name: SetBitRate

This broadcast command informs all connected secondary devices that the primary device has been ordered to switch to the specified bit rate. The message shall not be repeated.

Data field command to secondary devices:

<0x27> 0x01 0x00 <bit rate byte>

Bit rate byte:

- 0x00 : 9.6 kbps
- 0x01 : 38.4 kbps
- 0x02 : 115.2 kbps

There is no response from secondary devices to this broadcast command until 5 further frames have been received.

Bit rate change procedure

It is mandatory that any secondary device that supports multiple bit rates is capable of supporting this procedure.

The primary device is not allowed to change the bit rate autonomously; it will generally be set during system configuration, or as an operator-mediated response to a communications failure, perhaps caused by physical damage to the bus. Secondary devices will operate at the specified bit rate and will check briefly for communication at other bit rates only if the bus has been quiet for a long period. The system provides a stable and reliable bit rate fallback scheme.

A secondary device that supports bit rates other than the mandatory 9.6 kbps must have a 1-minute LineIsDead timeout. This timeout must be reset whenever the secondary receives a valid HDLC frame, regardless of its address. It must also have a FramingError counter and a BytesReceived counter. Both these counters must be reset to zero whenever a valid HDLC frame is received, regardless of its address.

As all devices support a bit rate of 9.6 kbps, communication can be established on the bus before a higher rate is set. The primary device should first use the GetBitRates command to determine which higher bit rate(s) can be supported by all connected devices, as the maximum bus bit rate is determined by the slowest connected device. The primary device is then set to operate at the new bit rate. It may be preferred to send a SetBitRate command before the primary device rate is changed; this makes the subsequent procedure at the secondary devices faster but its use is optional.

If the LineIsDead timeout occurs at a secondary device its current bit rate is assumed to be invalid and the secondary device shall initiate the bit rate test sequence as follows:

1. Set the bit rate to the maximum supported rate
2. Clear the FramingError and BytesReceived counters
3. Wait 10 seconds, or until a valid HDLC frame is received
4. If any valid HDLC frame is received (regardless of its address) the sequence is terminated, but the bit rate is not stored until 5 further frames (regardless of their address) have been received

5. If the FramingError and BytesReceived counters are zero, the bit rate is restored to the last stored bit rate and the sequence is terminated
6. If the FramingError counter is at least 10 or the BytesReceived counter is at least 10 the bit rate is assumed to be wrong. If the bit rate is greater than 9.6 kbps the bit rate is reduced and the sequence continues with Step 2.
7. If the bit rate is already 9.6 kbps the bit rate is restored to the last stored bit rate and the sequence is terminated.

6.1.5.4.16 RET Calibration

Command Name: Calibrate

This command is sent after installation of a RET. Calibration entails ensuring that the actuator is driven through its whole tilt range.

After reset or power failure no calibration is normally required. There may occasionally be unforeseen errors where calibration could be required to return the RET to a correct no-error status.

The response time shall be less than 4 minutes.

Data field command to secondary device:

0x31 0x00 0x00

Data field response from secondary device:

0x31 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x31 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

6.1.5.4.17 RET Send Configuration Data

Command Name: SendConfigData

This command may be required after installation of any RET unless already performed by the vendor before delivery. It loads vendor and antenna specific configuration data to establish the relationship between the movement of the drive system and the beam tilt position of the antenna.

When specified by the vendor the data must be loaded during the installation procedure. (Typically this may be necessary because the same type of drive unit (RET) may be used in association with different antenna types, each requiring different configuration data.)

Data field command to secondary device:

0x32 <LengthLowByte> <LengthHigh Byte> <DataByte1>...<DataByteN>

Data field response from secondary device:

0x32 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x32 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

6.1.5.4.18 RET Set Tilt

Command Name: SetTilt

This command sets the electrical tilt value in increments of 0.1°. The electrical tilt value describes the elevation angle between the direction orthogonal to the antenna element axis and the maximum of its main beam in the elevation plane. A positive electrical tilt angle means that the antenna beam is directed below the direction orthogonal to the antenna axis. An antenna has separate values for electrical and mechanical tilt. The mechanical tilt is fixed by the geometry of the installation. In this TR the tilt referred to is always the electrical tilt unless otherwise stated.

The response time shall be less than 2 minutes.

The format of the demanded tilt shall be a 2-complement 16 bit signed number sent in little-endian order.

Data field command to secondary device:

0x33 0x02 0x00 <TiltLowByte> <TiltHighByte>

Tilt values are specified in 0.1° increments starting from zero, for example: Tilt 3.2° is 0x0020 (stored as <0x20> <0x00>), Tilt – 3.2° is 0xFFE0, stored as <0xE0> <0xFF>).

Data field response from secondary device:

0x33 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x33 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code 1>...<Return Code N>

6.1.5.4.19 RET Get Tilt

Command Name: GetTilt

This command requests the current tilt value.

The response is made in increments of 0.1° in the format specified in section 6.1.5.4.18.

Data field command to secondary device:

0x34 0x00 0x00

Data field response from secondary device:

0x34 0x03 0x00 <OK> <TiltLowByte> <TiltHighByte>

Data field response from secondary device in case of error in performing the command:

0x34 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code 1>...<Return Code N>

6.1.5.5 Implementation Specific Commands

Implementation specific commands are internally implemented but not used for control or telemetry functions. These commands are used for test and development, and are not specified. All control and telemetry functions shall be accomplished using the specified commands defined in section 6.1.5.4.

Implementation Specific Commands and responses shall be formatted as follows:

0xFF <LengthLowByte> <LengthHighByte> <VendorID> (remaining format and content vendor specific.)

6.1.5.6 Unknown Commands

If a secondary device is unable to recognise a command, the secondary device shall respond as follows:

INFO field command to secondary device:

<Unknown Command> <LengthLowByte> <LengthHighByte> <Data 1> ... <Data N>

INFO field response from secondary device:

<unknown command> 0x02 0x00 <FAIL> <Return Code>

6.1.6 Return Codes for Secondary Devices (normative Annex)

Table 6.1.6.1: Return Codes for Secondary Devices

Code	Meaning	
0x00	OK	Normal response
0x01	Actuator Detection Fail	Signals from the actuator are detected but are abnormal, for example due to failed calibration.
0x02	Actuator Jam Permanent	Actuator cannot be moved
0x03	Actuator Jam Temporary	Actuator jam has been detected. No movement was detected in response to the normal stimulus.
0x04	Block Number Sequence Error	Used in combination with software download; block number sequence is wrong.
0x05	Busy	The device is busy and cannot respond until an activity is complete.
0x06	Checksum Error	Used in combination with software download; checksum incorrect.
0x07	Command Sequence Error	Used in combination with software download; command sequence is not permitted, e.g. a SetTilt command is received during software update sequence.
0x08	Data Error	RET AP data fault, e.g. length of data is inconsistent with length fields.
0x09	Device Disabled	Device is in logical Disabled state and cannot execute Set commands.
0x0A	EEPROM Error	EEPROM error detected
0x0B	Fail	Abnormal response. Indicates that a command has not been executed.
0x0C	Flash Erase Error	Used in combination with software download; indicates error when erasing flash memory.
0x0D	Flash Error	Used in combination with software download; indicates error when writing to flash memory.
0x0E	Not Calibrated	The device has not completed a calibration operation, or calibration has been lost.
0x0F	Not Scaled	No setup table has been stored in the device.
0x11	Other Hardware Error	Any hardware error which cannot be classified.
0x12	Other Software Error	Any software error which cannot be classified.
0x13	Out of Range	Value specified by a Set Tilt command is not supported by the device.
0x14	Position Lost	RET controller is unable to return a correct position value, for example there was a power failure while a SetTilt command was being executed.
0x15	RAM Error	An error was detected in reading data to/from RAM
0x16	Segment Number Sequence Error	Used in combination with software download; block sequence number is wrong.

0x17	UART Error	Hardware specific. This error may be sent after recovery from a temporary error which has prevented the sending or receiving of data.
0x19	Unknown Command	Received command is not defined in the 3GPP release version transmitted in the frame header, or the device has received a vendor-specific command with a vendor ID different from its own.

6.1.7 Assigned Fields for Additional Data (normative Annex)

The following standard fields are used by the commands SetDeviceData and GetDeviceData. Little-endian order is used for storage of multiple-byte numbers. Where ASCII variables are shorter than the assigned field lengths the characters are right aligned and leading blanks are filled with null characters (0x00).

Table 6.1.7.1: Assigned Fields for Additional Data

Field No.	Length (bytes)	Format	Description
0x01	15	ASCII	Antenna model number
0x02	17	ASCII	Antenna serial number
0x03	2	16-bit unsigned	Antenna frequency band(s): see below
0x04	3	3 x 8-bit unsigned	Beamwidth for each band in frequency order (deg) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x05	3	3 x 8-bit unsigned	Gain for each band in frequency order (dB/10) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x06	2	16-bit signed	Maximum supported tilt (degrees/10), Format as in section 6.1.5.4.18
0x07	2	16-bit signed	Minimum supported tilt (degrees/10), Format as in section 6.1.5.4.18
0x21	6	ASCII	Installation date
0x22	5	ASCII	Installer's ID
0x23	12	ASCII	Base station ID
0x24	4	ASCII	Sector ID
0x25	2	16-bit unsigned	Antenna bearing
0x26	1	8-bit signed	Installed mechanical tilt (degrees/10)

Table 6.1.7.2: Coding for Antenna Frequency Bands in Field 0x03

Bit No	Frequency band(MHz)
1	800
2	900

3	1500
4	1800
5	1900
6	2100
7 and above	Reserved

Examples of frequency bands:

0000 0000 0001 0000 = 1800MHz,

0000 0000 0001 1100 = 1800, 1900 and 2100MHz

6.1.8 Command Sequence for Download of Software to a Secondary Device (normative Annex)

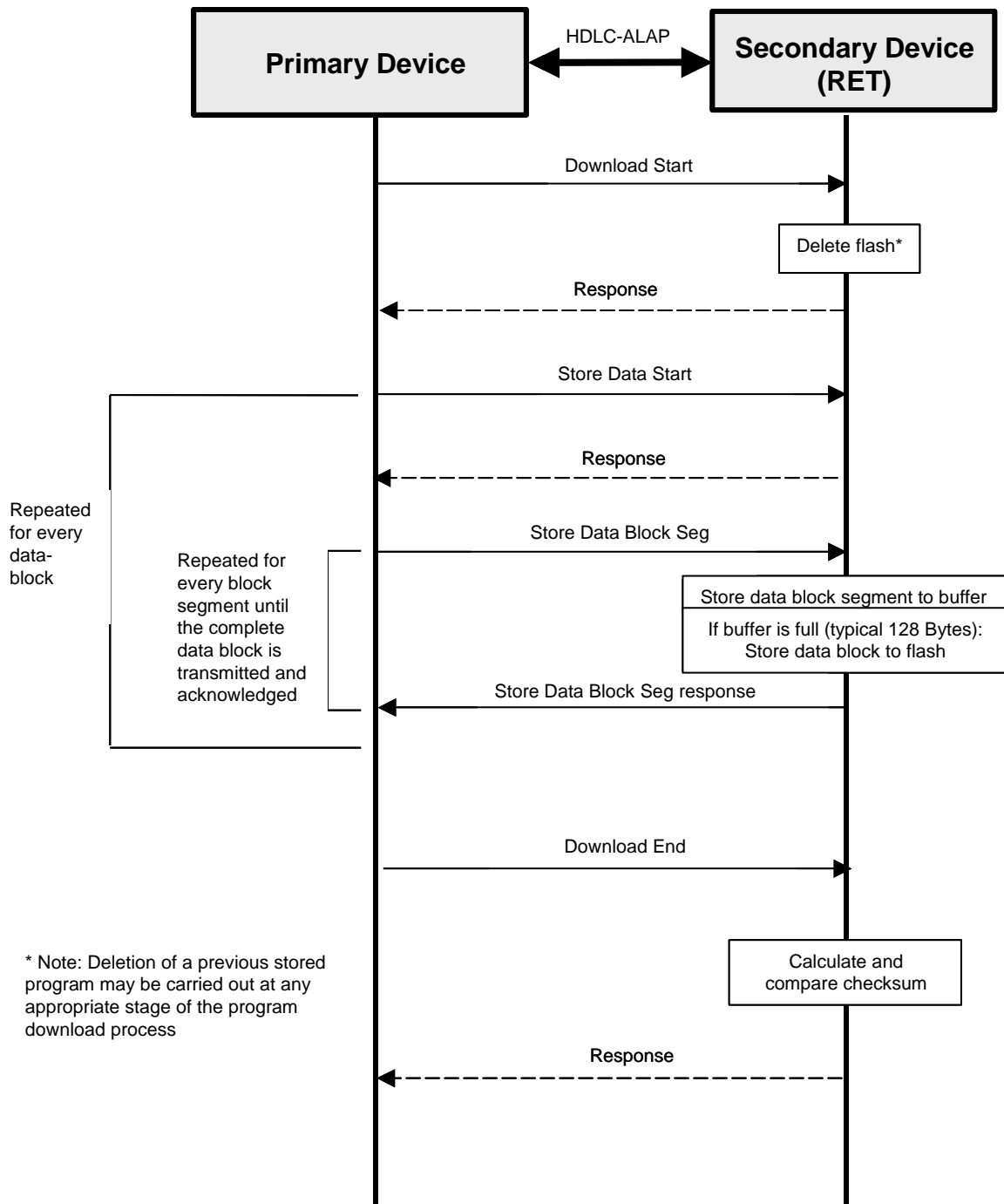


Figure 6.1.8.1: Procedure Sequence for Software Download

6.2 Proposal Two

6.2.1 General comments

This section contains some general comments on the first proposal for the Iuant interface described in section 6.1.

Changed coaxial communication method

The coaxial communication method is changed to a more robust communication scheme, namely FSK. The FSK has two main benefits compared to ON/OFF keying:

- It supports three states: Undriven, 1, 0, which corresponds to the states of RS485. It is therefore more suited as a RS485 repeater/modem.
- It is less sensitive to antenna system variations. There is a big difference between the signal level at the receiver of a straight antenna system and a shared antenna system (e.g. with GSM). The use of an FSK communication removes the need of defining a threshold level.

Together, this makes FSK more suited. It also supports 115.2 kbps communication.

General clean-up

The interface does not need all the state handling defined in proposal 1. The RET shall be ready for operating directly after communication is established (address is assigned). There is no need for “enable” signalling on layer 2 and layer 7.

There is no need for an unspecified Write and Read message in the standard.

There is no need for a device scan procedure. It adds a lot of complexity HW and SW wise. Instead, a more versatile interpretation of the Address Assignment message is proposed: The installation engineer only needs to write down enough characters of the serial number to identify the antennas, not the complete number.

A few violations to the HDLC standard are removed.

Split between functional and HW messages

The messages are resorted according to if they operate on a single antenna (the function) or on the RET control unit. The antenna-oriented messages have an extra field, namely the antenna number the message addresses (2nd level of address).

Client-Server architecture

To ensure a more robust operation of the RET control, all commands are associated with a “client” on the Node B side. The corresponding response is addressed to the “client” by echoing a 4 byte field from the command to the response.

The Link ID is therefore added to the HDLC INFO field, see section 6.2.3.3.3.

The field for the Link ID is located immediately before the FCS field to handle the compatibility issue with secondary devices without support for the Link ID.

Protocol Revision

The protocol revision referring to the supported 3GPP Release version should not be stated by message-to-message basis, as specified in the HDLC frame INFO field. The supported protocol revision should instead be part of the link establishment and address assignment procedure and be valid for all messages stated in a specified 3GPP release.

Multiple bit rate

To minimize the complexity of the bit rate negotiations, the interface may operate at two bit rates at the same time, 9.6 kbps to some devices and 115.2 to some devices. A device supporting two bit rates shall listen alternating on the two bit rates. The default bit rate is 115.2 kbps.

Data bit rate:

115.2 kbps +/- 3%

9.6 kbps +/- 3%

The format of the data shall be:

8 data bits No parity

1 start bit NRZ-L encoding

1 stop bit

6.2.3.2.1 RS485 Serial Data Bus

The data bus shall be a two wire bi-directional multi-drop configuration conforming to [3].

6.2.3.2.2 Coaxial Interface: Modem Characteristics

6.2.3.2.2.1 Interference with Existing Systems

The modem must not interfere with existing communications in BTS systems, so a unique carrier frequency for each different communication channel on a common feeder cable is necessary.

The modem circuit must be capable of managing its transmitting characteristic according to section 6.2.3.2.2.5 and providing filtering for its receiver according section 6.2.3.2.2.6.

6.2.3.2.2.2 Recovery Time

Due to hardware limitations a minimum recovery time must be allowed between transmitting and receiving messages on the bus. For this reason a minimum permitted response time is specified in section 6.2.3.3.9.

6.2.3.2.2.3 Impedance

The modem transceiver shall provide constant impedance in both transmitting and receiving modes:

- Nominal impedance Z_0 : 50 Ω
- Return loss at nominal carrier frequency > 6 dB

6.2.3.2.2.4 Modulation

Modulation type: FSK

Undriven: OFF

Logical 0: 9.69 MHz +/- 100 kHz

Logical 1: 11.07 MHz +/- 100 kHz

6.2.3.2.2.5 Modulator Characteristics

➤ Levels

ON-Level: +4 dBm \pm 2 dB OFF-Level: \leq -60 dBm

➤ Spurious Emissions

Spurious emissions shall not exceed the mask shown in figure 6.6. Intermediate values may be obtained by linear interpolation between the points shown. In addition, out-of-band emissions must conform to the requirements in [4].

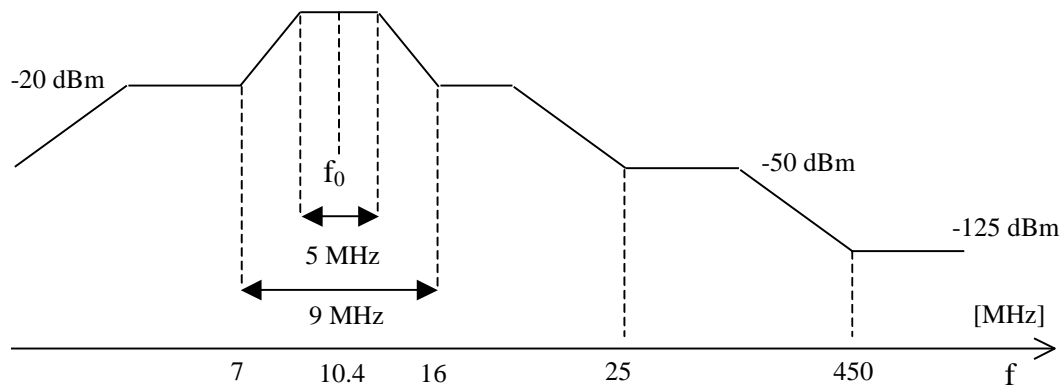


Figure 6.6: Spectrum Mask for FSK-Modems

6.2.3.2.2.6 Demodulator Characteristics

Requirements for demodulators operating with different frequencies on the same coaxial cable need further study.

➤ **Threshold**

Sensitivity level: < -35 dBm

Off threshold: -55 dBm

6.2.3.2.2.7 Duty Cycle Variation

In order to guarantee proper transmission of data bits through the processes of modulation and demodulation, the duty cycle of the received binary data stream may not vary too much from that of the transmitted duty cycle. Specifically the following limit must be met:

$$\Delta DC_{SYSTEM} = |DC_{RX} - DC_{TX}| \leq 5\%$$

Where: ΔDC_{SYSTEM} is the difference between the duty cycles of the transmitted and received bit streams,

DC_{TX} = Duty cycle for the input bit stream, and

DC_{RX} = Duty cycle for the output bit stream.

6.2.3.3 Signalling Transport

The data link layer is based on a subset of the standardised ISO HDLC which conforms to the requirements in [2].

Any device on the interface shall have full performance and functionality also when:

- Other devices communicate on the interface, assuming their communication fulfil section 6.2.3.3.1.
- Other devices communicating on the interface uses another bit rate.

6.2.3.3.1 HDLC Format

6.2.3.3.1.1 Operating Mode

The operating mode shall be normal response mode (NRM) with two way alternate (TWA) communication. This mode requires that the primary device as a master is always in control of the bus and the secondary device only answers frames sent by the master. The secondary device cannot send any frame independently. The primary device is the Node B Implementation Specific O&M function whereas the secondary device is the Node B RET Antenna function often physically located at the top of the antenna mast.

The channel state shall be start/stop transmission.

6.2.3.3.1.2 Control octet transparency

Control octet transparency shall be implemented in accordance with Paragraph 4.3.2.2 in [2]. This requirement applies to all frame types.

6.2.3.3.2 Frame Checking Sequence Field

The Frame Checking Sequence Field (FCS) shall be calculated in accordance with [2] on all bytes following the start flag up to, but not including, the CRC field.

6.2.3.3.3 HDLC Command Sub-set

The protocol shall support the following HDLC commands, which are based upon the TWA, UNC (no options) commands list provided in Annex D of [2].

Table 6.2.3.3.3.1: Frame Types used for the Transport Layer

Commands (Primary Device)	Responses (Secondary Device)
Frame type I	Frame type I
Frame type RR	Frame type RR
Frame type SNRM	Frame type UA
Frame type XID	Frame type RNR
	Frame type XID

The I-frame and INFO field formats for both primary and secondary devices shall be as illustrated in figure 6.7. INFO fields are only used with I-frames.

The Frame Control Field shall be formatted in accordance with Paragraph 5.3.1, Table 3 in [2].

HDLC-Frame:

Flag 8bit	ADDR 8bit	Control 8bit	INFO N x 8bit	CRC 2 x 8bit		Flag 8bit
0x7E	Device Address	Control bits	Variable length (must support a maximum length of at least 74 bytes)	CRC1 low byte	CRC2 high byte	0x7E

Command ID	Link ID	Number of data bytes	Data bytes
------------	---------	----------------------	------------

1 byte	4 bytes	low byte	high byte	Variable length (must support a maximum length of at least 66 bytes)
--------	---------	----------	-----------	--

Figure 6.7: Format of the I-Frame and INFO Field

Devices shall support the following data length:

- Mandatory: $0 \leq \text{data bytes} \leq 70$ bytes
- Optional: $0 \leq \text{data bytes} < 65,535$ bytes

To allow for the use of frames longer and window sizes larger than the default sizes the following transport layer XID-frame may be sent by the primary device to determine the maximum information field length and window size supported by a secondary device. (Refer also to Paragraph 5.5.3 in [2].)

XID Frame from primary device:

Table 6.2.3.3.2: XID Frame from Primary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	1	Length of the parameter field (PI)
PI	5	Maximum I Field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I Field length Transmit
PI	6	Maximum I Field length Receive
PL	Nrx	Length of the bytes value
PV	Value	Maximum I Field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field
PV	Value	Maximum window size Transmit
PI	8	Maximum window size Receive
PL	N	Length of the window size
PV	Value	Maximum window size Receive

Response from secondary device:

The secondary device checks to see if it can support the values provided in the command. If the secondary device can support the values then it replies with the same value. If the secondary device can not support these values then it replies with the maximum values that can be supported.

Table 6.2.3.3.3.3: XID Frame from Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	Length	Length of the PI field
PI	5	Maximum I field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	6	Maximum I field length Receive
PL	Nrx	Length of the PV field (bytes)
PV	Value	Maximum I field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	8	Maximum window size Receive
PL	N	Length of the PV field (bytes)
PV	Value	Maximum window size Receive

If the secondary device does not provide a valid response, then the default frame length and window size are to be used.

The 3GPP Release field in the INFO frame shall not be used. The 3GPP protocol version supported by the secondary device is reported in the XID frame response during the address assignment procedure.

6.2.3.3.4 HDLC Address

After power-up the HDLC address shall be set to No-station address (0x00). The secondary device compares its own address with the Address field of the received frames from the bus. If the addresses are equal or an All-station address is received the frame is accepted and shall be processed.

Address 0xFF is an All-station address. All devices connected shall process commands received on this address.

6.2.3.3.4.1 Address configuration

Before communication can be established on a bus it is necessary to configure the addresses of the devices connected to it. Address assignment is mediated by the use of an XID frame carrying data fields as specified in Paragraph 5.5.3 of [2].

6.2.3.3.4.1.1 Address Assignment Command

The format of the XID frame originated by the primary device shall be as follows:

Table 6.2.3.3.4.1: Format of the Address Assignment Command from the Primary Device

Field	Content	Description
ADDR	0xFF	All-station address (Broadcast)
CTRL	XID	Command
FI	0x82	Format identifier
GI	0xF0	User defined parameter set
GL	n+14	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	N	Length of PV field in bytes
PV	unique ID	Vendor id/serial number (n bytes)
PI	2	Parameter id 2 = address
PL	1	Length of PV field in bytes
PV	1 – 254	Assigned address
PI	3	Parameter id 3 = Vendor Code as given in [15]
PL	2	Length of PV field in bytes
PV	Vendor Code	Unique assigned vendor code
PI	4	Parameter id 4 = Device Type
PL	1	Length of PV field in bytes
PV	Device Type	Device Type: RET = 0x01
PI	5	Parameter id 5 = 3GPP Release-ID
PL	1	Length of PV field in bytes
PV	Release-ID	Latest supported 3GPP Release version

6.2.3.3.4.1.2 Address Assignment Response

The secondary device verifies the validity of the XID command. Thereafter the secondary device matches PV1, PV3 and PV4.

➤ To fulfil the PV1 match, the following two rules must be valid:

1. Length of given unique ID shall be less or equal to the length of its own unique ID.
2. When compared character by character, from right to left, they shall match.

➤ To fulfil the PV3 match, one of the following two rules must be valid:

1. The given PV3 is a wild card.
 2. The given PV3 matches exactly
- To fulfil the PV4 match, one of the following two rules must be valid:
1. The given PV4 is a wild card.
 2. The given PV4 matches exactly.

In case of a match it changes its address to the one supplied in the second PV. It then responds with a XID frame transmitted from its new address. The XID response shall contain the following information: unique-ID, Vendor Type, Device Type and Release-ID. (XID layout TBD.)

Table 6.2.3.3.4.2: Format of Address Assignment Response from the Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command

If the match fails, the secondary device does nothing.

After the assignment of its address a secondary device enters the connected state.

6.2.3.3.4.1.3 Line Bit Rate

A secondary device supporting both line bit rates listens alternating on the high bit rate and on the low bit rate until a valid Address Assignment command is detected. The secondary device then remains on that bit rate.

6.2.3.3.5 Window Size

The default window size is 1.

6.2.3.3.6 Connection Establish

Once the secondary device is assigned an address, the SNRM message is used to establish the connection, see paragraph 5.5.3.3.1 in [2].

6.2.3.3.7 Polling

On reception of a frame with correct FCS and matching address and with the poll-bit set as specified in [2], the secondary device is required to transmit frames on the bus within the times defined in section 6.2.3.3.9.

If the secondary device has an I-frame to transmit it shall do so. If it does not have an I-frame to transmit it shall respond with either an RR or RNR frame. If it is unable to receive I-frames, for instance because it has run out of empty buffers, it shall respond with RNR. Otherwise it shall respond with RR (see also Appendix B in [2])

This polling procedure provides the application part of the protocol with a full-duplex link, allowing the application part to spontaneously transmit messages, such as alarm messages.

If the secondary device does not receive a poll within 3 minutes of the previous poll, it shall perform a software reset.

NOTE: In the event that the primary device receives no responses from a secondary device, it is recommended that it signals loss of connection to its Element Manager.

6.2.3.3.8 Information

One I-frame is used for one message, so fragmentation is not required. If the primary device sends a command to the secondary device, one I-frame is generated and sent. The secondary device can respond with any valid HDLC response belonging to the subset of RET control commands.

6.2.3.3.9 Message Timing

A minimum of 3 ms must elapse between transmitting and receiving messages on a bus.

The primary device should receive a complete response frame within 10 ms plus the time taken for the transmission of 100 bytes from the time the final flag byte is transmitted. The secondary device should start to transmit a response within 10 ms. The time occupied by the transmission of 100 bytes allows time-outs to include transmission time, with 10 ms allowed for processing.

The interface must be driven for at least 200 μ s before the start bits are transmitted to ensure a proper settling of the receiver UART.

6.2.4 Functions of Interface

6.2.4.1 Software Download

The interface provides means for downloading new Software to a secondary device. The support of Software Download to a secondary device is optional.

Class 1 secondary devices: Support of Software Download.

Class 2 secondary devices: No support of Software Download.

The Software Download may be done as a background load during normal operation, or as a forced load directly following the establishment of the connection.

A class 1 secondary device shall ensure a fail-safe Software management where the forced Software Download is never compromised. A minimal command set (a safe mode) shall always be supported, as a Boot Application.

6.2.4.2 Error Subscription

The secondary device shall spontaneously report faults, starting from when the Error Report message is sent from the primary device.

6.2.5 Protocol Structure

The protocol structure of the Iuant Interface described in section 6.2 of this TR is shown in figure 6.8 and figure 6.9 for both Implementation Specific O&M Transport options. The protocol stack consists of the two layer 1 options RS485 and coaxial cable as described in section 6.2.3.2, the signalling transport based on a subset of HDLC according to section 6.2.3.3 and the RET Control AP which is defined in section 6.2.6 of this TR.

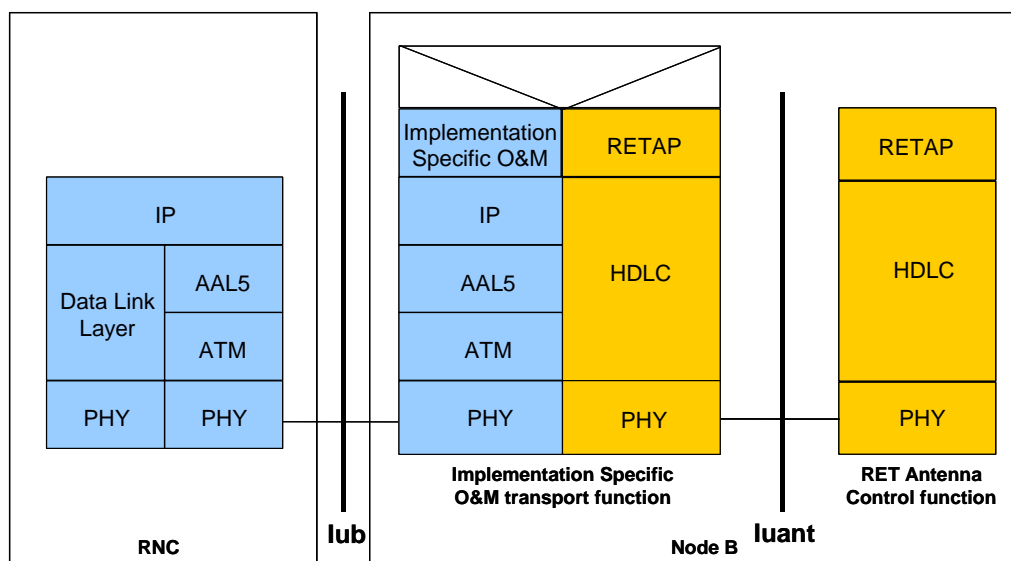


Figure 6.8: Protocol Structure for Implementation Specific O&M with ATM-Transport Option

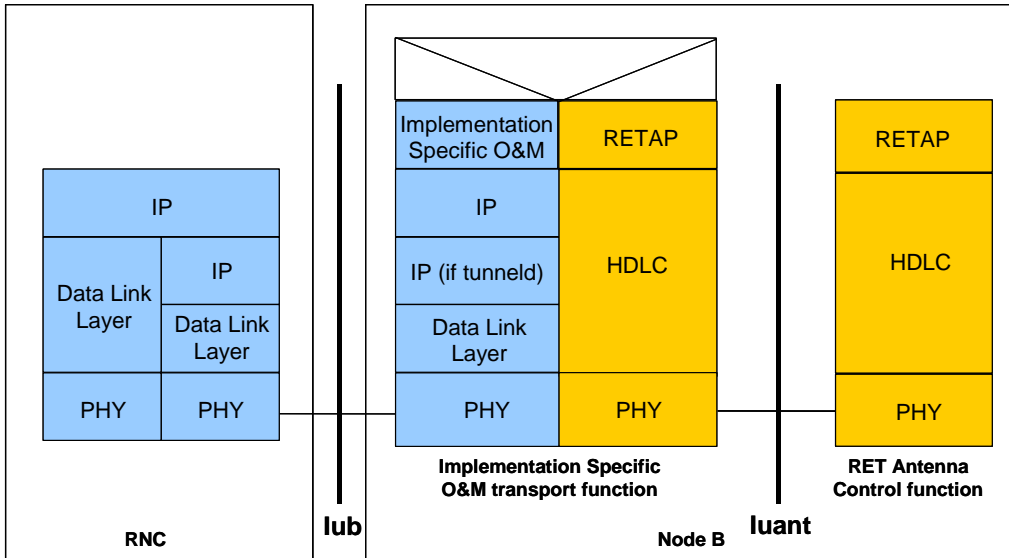


Figure 6.9: Protocol Structure for Implementation Specific O&M with IP-Transport Option

As the Iuant and the Implementation Specific O&M transport are different interfaces with e.g. different addressing schemes a mediation function is needed. This mediation function uses on one side a protocol that uses the implementation specific O&M bearer (e.g. IP) and on the other side the Iuant protocol.

6.2.6 Application Protocol signalling procedures

6.2.6.1 Architecture

6.2.6.1.1 Client-Server Architecture

The RETAP termination point of the secondary device is the sole controller of the RET unit, HW and SW. The RETAP protocol presents a number of services which can be accessed by the Implementation Specific O&M parts of the Node B.

Once the connection is established, different parts of the Implementation Specific O&M can send RETAP messages, which are executed and responded to.

6.2.6.1.2 Multi-Antenna Units

To support RET units controlling multiple antennas, the RETAP is split into one RET unit-oriented part and one antenna-oriented part. The RET unit responds, upon request, then number of antennas it controls. All antenna-oriented commands include a parameter stating which antenna the command addresses.

6.2.6.2 Command Format

6.2.6.2.1 Commands from Primary Device

Apart from address configuration, which uses the XID frame, commands to devices are transmitted within the HDLC INFO field. The general format for all commands is the following:

Table 6.2.6.2.1.1: General Format for all Commands

Command	Link ID	Number of data bytes	Data bytes
1 bytes	4 byte	2 bytes	max 66 bytes (basic implementation)

6.2.6.2.2 Response Format and Return Codes

All responses from devices are transmitted in the HDLC INFO field. The general format for all responses is the following:

Table 6.2.6.2.2.1: General Format for all Responses

Command	Link ID	Number of data bytes	Data bytes
1 bytes	4 byte	2 bytes	max 66 bytes (basic implementation)

The maximum time for all responses shall be 1 second unless specified in the individual command. Tilt setting, calibration and self test will typically require a longer period for completion of the command.

One or more return codes are transmitted in the data bytes.

A complete annotated table of all available return codes with their corresponding hexadecimal numbers is provided in section 6.2.7 of this TR.

The Link ID in the response message shall be a bit-exact copy of the Link ID in the corresponding command, unless otherwise specified.

6.2.6.3 Overview of Commands

The set of commands for RET antenna control provides command-oriented instructions. An overview of the commands are found in table 6.2.6.3.1, sorted on RET unit oriented commands and Antenna oriented commands. For each class of RET Unit, the commands mandatory to be supported are marked with an "M". For Class 1 RET Units, commands mandatory to support the Boot Application (safe mode) are marked with a "B".

Table 6.2.6.3.1: Command Set and Command Numbers

Command	Command number	Class 1	Class 2	Comment
<u>RET UNIT COMMANDS</u>				
(Reserved)	0x01			Device operation
Get Device Type	0x02	M, B	M	Device operation
Reset	0x03	M, B	M	Device operation
Get Error Status	0x04	M, B	M	Device operation
Get H/W & S/W Info	0x05	M, B	M	Device operation
Alarm	0x07	M	M	Device operation
Self Test	0x0A	M	M	Device operation
Get Device Data	0x0F	M	M	Device operation
Download Start	0x2E	M, B		Device maintenance
Store Data Start	0x20	M, B		Device maintenance
Store Data Block Seg	0x21	M, B		Device maintenance
Download End	0x22	M, B		Device maintenance
<u>ANTENNA COMMANDS</u>				
Calibrate	0x31	M	M	RET control, mandatory

Set Tilt	0x33	M	M	RET control, mandatory
Get Tilt	0x34	M	M	RET control, mandatory
Set Antenna Data	0x35	M	M	RET operation
Get Antenna Data	0x36	M	M	RET operation
Antenna Alarm	0x37	M	M	RET operation

6.2.6.4 Control Commands

In response to all Application Part commands from the primary device, the addressed secondary device shall respond with <OK> whenever a normal outcome to the command has resulted, and <FAIL> otherwise. Additional parameters may be associated with the response <OK> and a variety of defined return codes (error messages) with the response <FAIL> as described in the following paragraphs. Return codes are also used as autonomous alarm responses (see section 6.2.6.4.4 for details).

A summary table and interpretation of all defined return codes is provided in section 6.2.7 of this TR. When return codes are used, they shall have meanings consistent with those described.

6.2.6.4.1 Reset Software

Command Name: Reset

This command resets the device software, restarts the software, sets the HDLC address to the No-station address and places the device in the disconnected state.

Data field command to secondary device:

0x03 0x00 0x00

Data field response from secondary device before the reset command is executed:

0x03 0x01 0x00 <OK>

The device must not execute the reset before transport layer acknowledgement through sequence number update is received for the response. (See Appendix B in [2]).

The Reset command must be executed in all situations. The secondary device must not fail to reset because it is busy or for any other reason of its software state.

6.2.6.4.2 Get Error Status

Command Name: GetErrorStatus

This command requests the error status information from a secondary device

Data field command to secondary device:

0x04 0x00 0x00

Data field response from secondary device:

0x04 <LengthLowByte> <LengthHighByte> <OK> <ReturnCode1>...<ReturnCodeN>

This is a normal response. The request to get status has been executed correctly and the response codes relate to parameters which relate to the operational parameters of the device. If there are no operational errors, no return codes follow <OK>.

Data field response from secondary device in case of error in performing the command:

0x04 <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

This is an abnormal response. The error codes relate to the reason for the inability of the unit to correctly execute the command and return the requested information.

The Link ID of the GetErrorStatus command shall be stored by the RET unit and be used as Link ID in the Alarm spontaneous response (see section 6.2.6.4.4).

6.2.6.4.3 Read Hardware and Software Information

Command Name: GetInfo

This command reads hardware information and the software version from a secondary device. The software version must indicate the version number of the currently installed software, whether installed at the time of manufacture or during subsequent upgrade.

Data field command to secondary device:

0x05 0x00 0x00

Data field response from secondary device:

0x05 <LengthLowByte> <LengthHighByte> <OK> <Length> <Prod Nr> <Length> <SerNo> <Length> <HW Version> <Length> <SW Version>

ProdNr is the product type number and SerNr is the unique serial number of the individual unit.

HW Version and SW Version refer to the version designators of the hardware and installed software of the secondary device. If the application is missing or no version number is found, then an empty string shall be returned as the version number.

Data field response from secondary device in case of error in performing the command

0x05 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1> ... <ReturnCodeN>

6.2.6.4.4 Poll Response from Secondary Device: Alarm

Response Name: Alarm

The Transport Layer provides a virtual full-duplex link to the Application Part. This virtual full-duplex link is used to simplify alarm reporting.

The secondary device reports every change in error status by transmitting an alarm message in response to a poll. Formally this is a response message, even though (on Application Part level) it is a spontaneous message. There is no Application Part command to request an alarm response message.

The alarm message contains a list of error-code/state-flag pairs. The state flag indicates that an error has occurred (StateFlag = 1) or cleared (StateFlag = 0).

Only error codes whose state has changed shall be included in the list. The secondary device may group several error codes into one message, but their sequence in the message must then reflect the sequence in which they occurred.

A rapid setting/clearing sequence of the same alarm may be reported in the same alarm message in the order in which they occurred (FIFO).

In the event that the rapid state changes cause overflow of the available buffers, the oldest error code changes shall be discarded and the later ones retained for transmission.

Autonomous data field response from secondary device if an error state has changed since the previous poll from the primary device:

0x07 <LengthLowByte> <LengthHighByte> <Return Code1> <StateFlag1> ... <Return CodeN> <StateFlagN>

Alarm return codes are defined in section 6.2.7 of this TR. Only return codes valid for alarms on the complete RET unit are valid in this message. See also 6.2.6.4.12.

The spontaneous poll response Alarm may only be sent after an Get Error State command (see section 6.2.6.4.2) have been received. The Link ID of the Alarm response shall be the same Link ID as that received in the last Error Detection Command.

6.2.6.4.5 Get Device Data

Command Name: GetDeviceData

This command is used to retrieve the number of antennas controlled by the RET control unit.

Data field command to secondary device:

0x0F 0x00 0x00

Data field response from secondary device:

0x0F 0x02 0x00 <OK> <Number of antennas>

Data field response from secondary device in case of error in performing the command:

0x0F <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.6 Software Download

If software download is supported (class 1 secondary device), then the following commands are used to download new software releases to a secondary device. The sequence of the following commands must be strictly observed. After the complete sequence a reset command is necessary to activate the new software.

The sequence of commands to effect a software download to a secondary device is illustrated in section 6.2.9 of this TR.

NOTE: The sequence described below must be clarified with respect to error situation such as recovery upon communication failure, escape mechanism from the sequence, CRC errors, and with respect to sequence of block and segment transfer. This needs more studying.

6.2.6.4.6.1 Download Start

Command Name: DownloadStart

This command initiates internal copy and execution of software routines and may delete parts of the flash memory. An <OK> response indicates that any flash erasure has been successfully executed.

The command includes the size of the file to transfer in bytes.

Data field command to secondary device:

0x2E 0x02 0x00 <SizeLowByte> <SizeHighByte>

Data field response from secondary device:

0x2E 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x2E <LengthLowByte> <LengthHighByte> <FAIL><ReturnCode1>...<ReturnCodeN>

6.2.6.4.6.2 Store Data Start

Command Name: StoreDataStart

This command specifies the block-number of the block which will be transferred and the number of bytes within this block.

Data field command to secondary device:

0x20 0x04 0x00 <BlockNrLSB> <BlockNrMSB> <BlockLengthLSB> <BlockLengthMSB>

Data field response from secondary device:

0x20 0x03 0x00 <OK> <BlockNrLSB> <BlockNrMSB>

Data field response from secondary device in case of error in performing the command:

0x20 <LengthLowByte> <LengthHighByte> <FAIL> <BlockNrLSB> <BlockNrMSB>
<ReturnCode1>...<ReturnCodeN>

6.2.6.4.6.3 Store Data Block Segment

Command Name: StoreDataBlockSeg

This command transfers data segments to the secondary device.

Data field command to secondary device:

0x21 <LengthLowByte> <LengthHighByte> <SegmentNumber> <data 1>...<data n>

NOTE: n <= 69 if 74-byte I-fields are used

Data field response from secondary device:

0x21 0x02 0x00 <OK> <SegmentNumber>

Data field response from secondary device in case of error in performing the command:

0x21 <LengthLowByte> <LengthHighByte> <FAIL> <SegmentNumber> <ReturnCode1>...<ReturnCodeN>

The segment number commences at 0 and is incremented in steps of 1 to a maximum value of 255. If more than 256 segments are required, a new block must be started which in turn resets the segment number to 0.

6.2.6.4.6.4 Download End

Command Name: DownloadEnd

With this command the primary device signals the end of software transfer to the secondary device. The secondary device responds after verifying the checksum of the whole data transferred to memory.

Data field command to secondary device:

0x22 0x00 0x00

Data field response from secondary device:

0x22 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x22 <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.7 RET Calibration

Command Name: Calibrate

This command is sent after installation of a RET. Calibration entails ensuring that the actuator is driven through its whole tilt range.

After reset or power failure no calibration is normally required. There may occasionally be unforeseen errors where calibration could be required to return the RET to a correct no-error status.

The response time shall be less than 4 minutes.

Data field command to secondary device:

0x31 0x01 0x00 <Antenna Number>

Data field response from secondary device:

0x31 0x02 0x00 <Antenna Number> <OK>

Data field response from secondary device in case of error in performing the command:

0x31 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.8 RET Set Tilt

Command Name: SetTilt

This command sets the electrical tilt value in increments of 0.1°. The electrical tilt value describes the elevation angle between the direction orthogonal to the antenna element axis and the maximum of its main beam in the elevation plane. A positive electrical tilt angle means that the antenna beam is directed below the direction orthogonal to the antenna axis. An antenna has separate values for electrical and mechanical tilt. The mechanical tilt is fixed by the geometry of the installation. In this TR the tilt referred to is always the electrical tilt unless otherwise stated.

The response time shall be less than 2 minutes.

The format of the demanded tilt shall be a 2-complement 16 bit signed number sent in little-endian order.

Data field command to secondary device:

0x33 0x03 0x00 <Antenna Number> <TiltLowByte> <TiltHighByte>

Tilt values are specified in 0.1° increments starting from zero, for example: Tilt 3.2° is 0x0020 (stored as <0x20> <0x00>), Tilt - 3.2° is 0xFFE0, stored as <0xE0> <0xFF>).

Data field response from secondary device:

0x33 0x02 0x00 <Antenna Number> <OK>

Data field response from secondary device in case of error in performing the command:

0x33 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.9 RET Get Tilt

Command Name: GetTilt

This command requests the current tilt value.

The response is made in increments of 0.1° in the format specified in section 6.2.6.4.8.

Data field command to secondary device:

0x34 0x01 0x00 <Antenna Number>

Data field response from secondary device:

0x34 0x04 0x00 <Antenna Number> <OK> <TiltLowByte> <TiltHighByte>

Data field response from secondary device in case of error in performing the command:

0x34 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.10 Set Antenna Data

Command name: SetDeviceData

This command is used to write data into the fields optionally provided for configuration data and listed in section 6.2.8 of this TR. If an attempt is made to write to fields which are not supported by a particular device no error is returned but the data for those fields is ignored.

Data field command to secondary device:

0x35 <LengthLowByte> <LengthHighByte> <Antenna Number> <FirstParameterNumber> <data bytes for first parameter> <SecondParameterNumber> <data bytes for second parameter> <ThirdParameterNumber> <data bytes for third parameter>...<Nth ParameterNumber> <data bytes for Nth parameter>

Data field response from secondary device:

0x35 0x02 0x00 <Antenna Number> <OK>

Data field response from secondary device in case of error in performing the command:

0x35 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.11 Get Antenna Data

Command Name: GetDeviceData

This command is used to read data stored in the fields optionally provided for configuration data and listed in section 6.2.8 of this TR. If an attempt is made to read fields which are not supported by a particular device no data is returned for that field. The command contains a list of the field numbers of those fields whose contents are to be returned in the response from the secondary device. The field numbers are not necessarily contiguous or ordered.

Data field command to secondary device:

0x36 <LengthLowByte> <LengthHighByte> <Antenna Number> <0x01> <0x02> <0x03>...<0x0N>

Data field response from secondary device:

0x36 <LengthLowByte> <LengthHighByte> <Antenna Number> <OK> <0x01> <data bytes for parameter 1> <0x02> <data bytes for parameter 2> <0x03> <data bytes for parameter 3>...<0x0N> <data bytes for parameter N>

Data field response from secondary device in case of error in performing the command:

0x36 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.2.6.4.12 Poll Response from Secondary Device: Antenna Alarm

Response Name: Antenna Alarm

The Transport Layer provides a virtual full-duplex link to the Application Part. This virtual full-duplex link is used to simplify alarm reporting.

The secondary device reports every change in antenna error status by transmitting an antenna alarm message in response to a poll. Formally this is a response message, even though (on Application Part level) it is a spontaneous message. There is no Application Part command to request an alarm response message.

The antenna alarm message contains a list of error-code/state-flag pairs. The state flag indicates that an error has occurred (StateFlag = 1) or cleared (StateFlag = 0).

Only error codes whose state has changed shall be included in the list. The secondary device may group several antenna error codes into one message, but their sequence in the message must then reflect the sequence in which they occurred.

A rapid setting/clearing sequence of the same alarm may be reported in the same alarm message in the order in which they occurred (FIFO).

In the event that the rapid state changes cause overflow of the available buffers, the oldest error code changes shall be discarded and the later ones retained for transmission.

Autonomous data field response from secondary device if an antenna error state has changed since the previous poll from the primary device:

0x37 <LengthLowByte> <LengthHighByte> <Antenna Number> <ReturnCode1> <StateFlag 1> ... <ReturnCodeN> <StateFlag N>

Alarm return codes are defined in section 6.2.7 of this TR. Only return codes valid for a single antenna operation are valid in this report.

The spontaneous poll response Antenna Alarm may only be sent after an Get Error State command (see section 6.2.6.4.2) have been received. The Link ID of the Antenna Alarm response shall be the same Link ID as that received in the last Error Detection Command.

6.2.6.5 Implementation Specific Commands

Implementation specific commands are internally implemented but not used for control or telemetry functions. These commands are used for test and development, and are not specified. All control and telemetry functions shall be accomplished using the specified commands defined in section 6.2.6.4.

Implementation Specific Commands and responses shall be formatted as follows:

0xFF <LengthLowByte> <LengthHighByte> <VendorID> (remaining format and content vendor specific.)

6.2.6.6 Unknown Commands

If a secondary device is unable to recognise a command, the secondary device shall respond as follows:

INFO field command to secondary device:

<UnknownCommand> <LengthLowByte> <LengthHighByte> <Data1> ... <DataN>

INFO field response from secondary device:

<unknown command> 0x02 0x00 <FAIL> <Return Code>

6.2.7 Return Codes for Secondary Devices (normative Annex)

Table 6.2.7.1: Return Codes for Secondary Devices

Code	Meaning	
0x00	OK	Normal response
0x01	Actuator Detection Fail	Signals from the actuator are detected but are abnormal, for example due to failed calibration.
0x02	Actuator Jam Permanent	Actuator cannot be moved
0x03	Actuator Jam Temporary	Actuator jam has been detected. No movement was detected in response to the normal stimulus.
0x04	Block Number Sequence Error	Used in combination with software download; block number sequence is wrong.
0x05	Busy	The device is busy and cannot respond until an activity is complete.
0x06	Checksum Error	Used in combination with software download; checksum incorrect.
0x07	Command Sequence Error	Used in combination with software download; command sequence is not permitted, e.g. a SetTilt command is received during software update sequence.

0x08	Data Error	RET AP data fault, e.g. length of data is inconsistent with length fields.
0x09	Device Disabled	Device is in logical Disabled state and cannot execute Set commands.
0x0A	EEPROM Error	EEPROM error detected
0x0B	Fail	Abnormal response. Indicates that a command has not been executed.
0x0C	Flash Erase Error	Used in combination with software download; indicates error when erasing flash memory.
0x0D	Flash Error	Used in combination with software download; indicates error when writing to flash memory.
0x0E	Not Calibrated	The device has not completed a calibration operation, or calibration has been lost.
0x0F	Not Scaled	No setup table has been stored in the device.
0x11	Other Hardware Error	Any hardware error which cannot be classified.
0x12	Other Software Error	Any software error which cannot be classified.
0x13	Out of Range	Value specified by a Set Tilt command is not supported by the device.
0x14	Position Lost	RET controller is unable to return a correct position value, for example there was a power failure while a SetTilt command was being executed.
0x15	RAM Error	An error was detected in reading data to/from RAM
0x16	Segment Number Sequence Error	Used in combination with software download; block sequence number is wrong.
0x17	UART Error	Hardware specific. This error may be sent after recovery from a temporary error which has prevented the sending or receiving of data.
0x19	Unknown Command	Received command is not defined in the 3GPP release version transmitted in the frame header, or the device has received a vendor-specific command with a vendor ID different from its own.

6.2.8 Assigned Fields for Additional Data (normative Annex)

The following standard fields are used by the commands SetDeviceData and GetDeviceData. Little-endian order is used for storage of multiple-byte numbers. Where TEXT variables are shorter than the assigned field lengths the characters are right aligned and leading blanks are filled with null characters (0x00).

Table 6.2.8.1: Assigned Fields for Additional Data

Field No.	Length (bytes)	Format	Description
0x01	15	TEXT	Antenna model number
0x02	17	TEXT	Antenna serial number
0x03	2	16-bit unsigned	Antenna frequency band(s): see below
0x04	3	3 x 8-bit	Beamwidth for each band in frequency order (deg)

		unsigned	(example 800/900MHz, 1800/1900MHz, 2100MHz)
0x05	3	3 x 8-bit unsigned	Gain for each band in frequency order (dB/10) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x06	2	16-bit signed	Maximum supported tilt (degrees/10), Format as in section 6.2.6.4.8
0x07	2	16-bit signed	Minimum supported tilt (degrees/10), Format as in section 6.2.6.4.8
0x21	6	TEXT	Installation date
0x22	5	TEXT	Installer's ID
0x23	12	TEXT	Base station ID
0x24	4	TEXT	Sector ID
0x25	2	16-bit unsigned	Antenna bearing
0x26	1	8-bit signed	Installed mechanical tilt (degrees/10)

Table 6.2.8.2: Coding for Antenna Frequency Bands in Field 0x03

	Field 0x03
Bit No	Frequency band(MHz)
1	800
2	900
3	1500
4	1800
5	1900
6	2100
7 and above	Reserved

Examples of frequency bands:

0000 0000 0001 0000 = 1800MHz,

0000 0000 0001 1100 = 1800, 1900 and 2100MHz

6.2.9 Command Sequence for Download of Software to a Secondary Device (normative Annex)

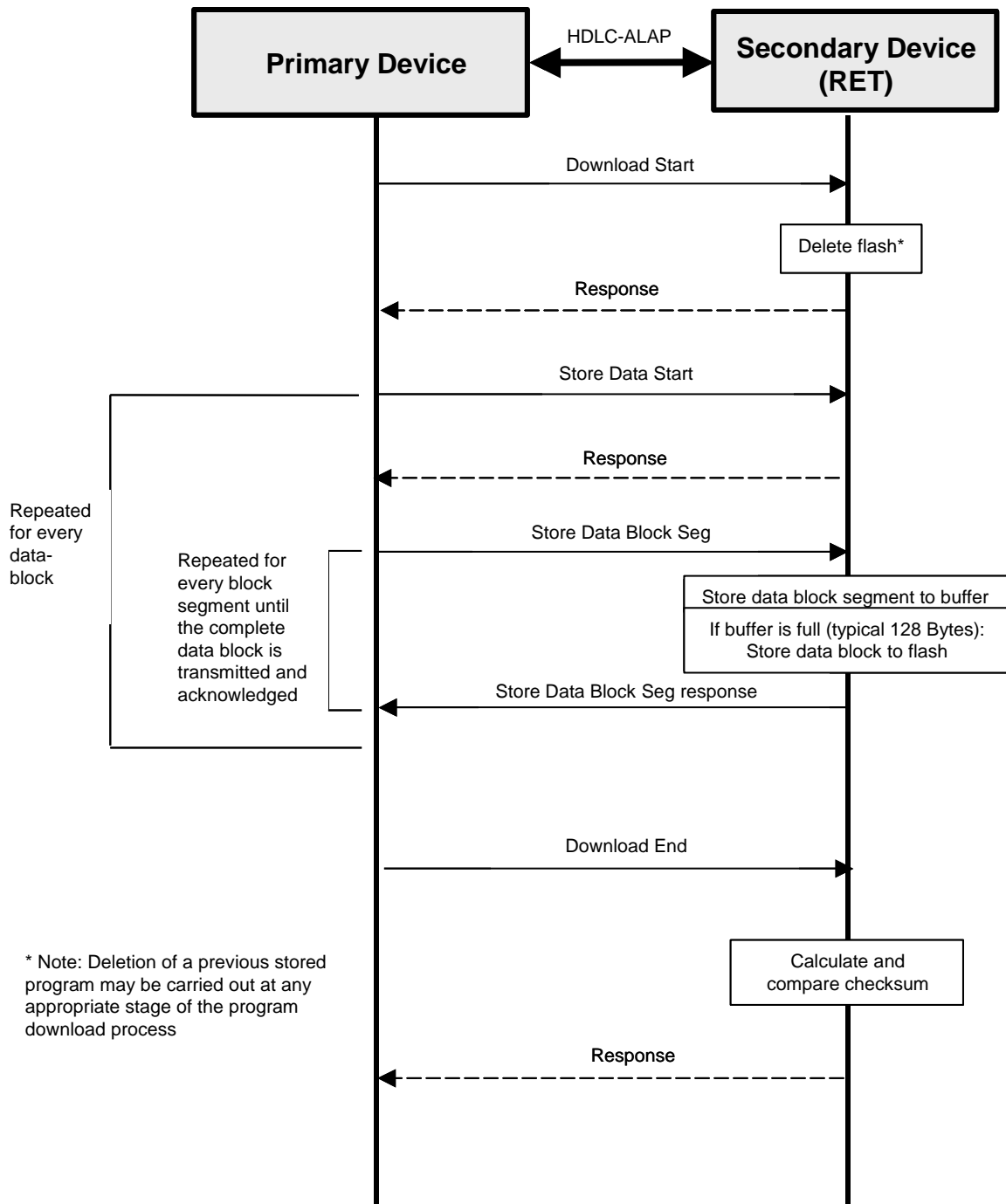


Figure 6.2.9.1: Procedure Sequence for Software Download

10 UTRAN O&M Requirements

10.1 O&M of Node B

The O&M of Node B is separated in two parts: the O&M linked to the actual implementation of Node B, denoted as Implementation Specific O&M, and the O&M which impacts on the traffic carrying resources in Node B controlled from the RNC, denoted *logical O&M*. The RNS architecture with the O&M interfaces is shown in figure 9.

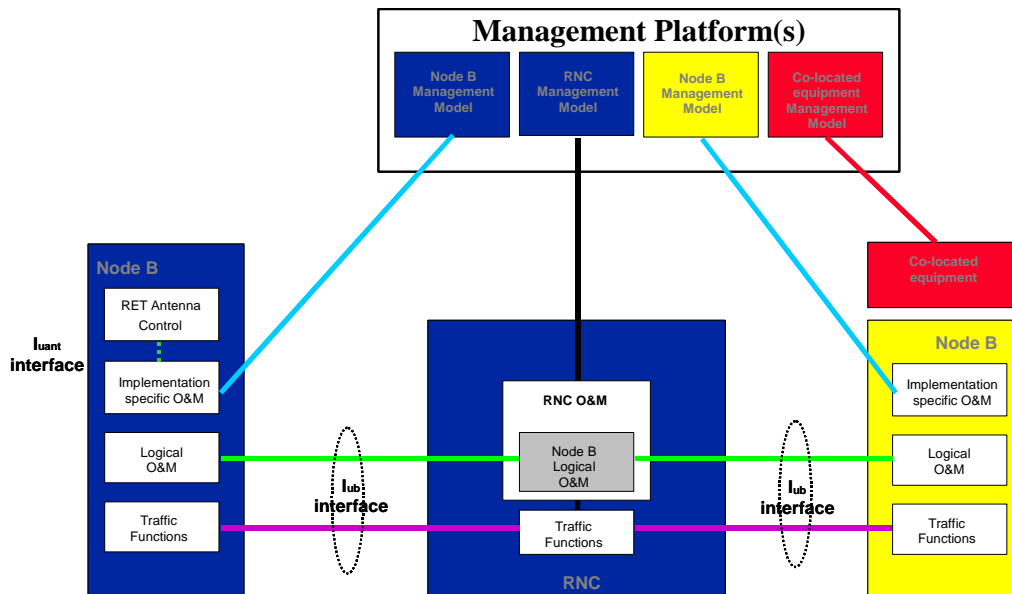


Figure 9: RNS architecture with O&M interfaces

NOTE 1: The concept of an interface from the RNC to the management system is shown for clarity only. Its definition is outside the scope of 3GPP-TSG-RAN-WG3.

NOTE 2: The presentation of the O&M functions within the management system is shown for clarity only. Their actual implementation is outside the scope of 3GPP-TSG-RAN-WG3.

NOTE 3: The standardisation of the Implementation Specific O&M is outside the scope of 3GPP-TSG-RAN-WG3. The 3GPP-TSG-RAN-WG3 should only address the bearer for the Implementation Specific O&M.

NOTE 4: The figure shows only logical connections and does not intend to mandate any physical interfaces.

NOTE 5: The Iuant interface to the control unit of the RET antenna is specified in TS 25.460. The implementation specific O&M function of the Node B is used to translate the control signalling into the "RET Antenna Control" function of the Node B.

10.1.1 Implementation Specific O&M

The Implementation Specific O&M functions are heavily dependent on the implementation of Node B, both for its hardware components and for the management of the software components. It needs therefore to be implementation dependent, and be performed between Node B and the management system.

An Implementation Specific O&M function is needed for the RET antenna control to translate the control signalling from the Node B Element Manager into the control commands of the Iuant interface specified in TS 25.460.

One solution for the transport of Implementation Specific O&M is to route from Node B to the management system via the RNC. In this case, the Implementation Specific O&M interface and Iub interface share the same physical bearer, and [8] specifies the routing function and the transport bearer for this scenario. The deployment of the routing across the RNC in the UTRAN is optional. Where signalling between co-located equipment and its management system is required, this may be carried over the same bearer as Implementation Specific O&M.

10.1.2 Logical O&M

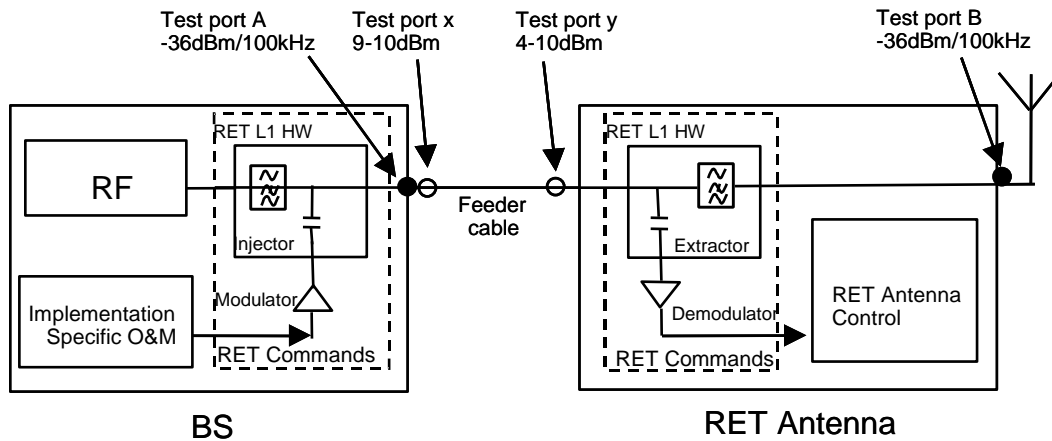


Figure 6.10: Overview of Coaxial Interface Option

The figure 6.10 illustrates the case when the BS sends RET commands to the RET antenna. The modulator in the BS includes the RET commands to the carrier and the injector adds the modulated signal to the feeder cable. The power level in the Test port x has to be in the range of 9-10 dBm and the spectral characteristics according to the section 6.3.3.2.2.5.

When the RET antenna receives the modulated signal in the feeder cable, the power level in the Test port y has to be 4-10 dBm. If the power level is out of this range, it is assumed that extractor and demodulator in the RET antenna cannot extract the RET commands from the modulated signal.

When the RET antenna replies to the BS the extractor/injector and modulator/demodulator position changes. The RET antenna has the modulator and injector, and BS accordingly the extractor and demodulator.

Test port A is assumed to be located in the BS only when the RET related layer one hardware (RET L1 HW) is not functioning. When the RET hardware is included or started in the BS the used test port is Test port B.

NOTE: The DC power supply is not included in the figure 6.10.

6.3.3.2.2.1 Modulator

Modulation method: pi/4-DQPSK:

Carrier frequency: 460.8 KHz +/- (TBD) ppm

Data rates:

9.6 kbps (460.8 KHz/48), 38.4 kbps (460.8 KHz/12), 115.2 kbps (460.8 KHz/4)

Modulator output range: +9 dBm - +10 dBm (~630 mV – 707 mV)

Output waveform: sinusoidal.

Nominal impedance of modulator output is 50 ohm.

6.3.3.2.2.2 Demodulator

Demodulation method: pi/4-DQPSK

Demodulator carrier frequency: 460.8 KHz

Demodulator input range: +4 dBm - +10dBm (~350 mV – 707 mV)

Nominal impedance of demodulator input is 50 ohm.

6.3.3.2.2.3 Bit Encoding

Differential encoder maps two sequential bits into complex symbol $D_\phi(k)$ that indicates the fixed phase shift. Table 6.3.3.2.2.3.1 describes the phase shift for each sequential di-bit combination. $B(2k-1)$ is a previous odd bit and $B(2k)$ is even bit.

Table 6.3.3.2.2.3.1: Mapped bits for DQPSK Modulation

B(2k-1)	B(2k)	$D_\phi(k)$
0	0	$\pi/4$
0	1	$+3\pi/4$
1	0	$-\pi/4$
1	1	$-3\pi/4$

6.3.3.2.2.4 Bit Detection

Either differential (non-coherent) or coherent detection can be used in the receiving side. In differential detection the data is carried as a phase shift between two sequential symbols and symbol timing error recovery is based on the base band algorithm. Therefore the implementation is less complex compared to the coherent detection where an ideal carrier recovery process is required. On the other hand coherent demodulator has better power efficiency and better BER performance [6].

6.3.3.2.2.5 Spectral Characteristics

In transmission the pulse-shaping filter determines the transmitted signal spectral shape. With the $\pi/4$ -DQPSK a root raised cosine filter is usually used at the transmitting and receiving end. While constructing the filter, the inter-symbol interference (adjacent symbols) should be as low as possible and the stop band attenuation low enough so that a fairly good SNR can be achieved [7]. For the transmitted signal bandwidth ($BW = (1+\alpha) * \text{symbol rate}$) a raised cosine filter **roll-off factor** $\alpha = 0.35$ can be used. Figure 6.11 shows the mask for the transmitted signal when 115.2 kbps data rate is used.

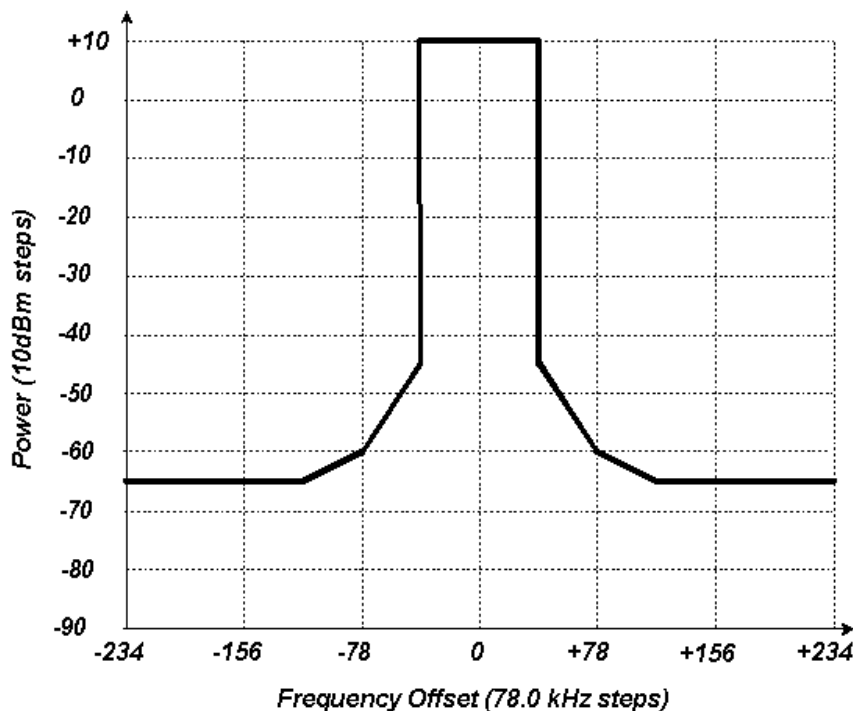


Figure 6.11: Transmission Mask

The emissions shall be measured at nominal center frequency through the raised cosine filter with the roll-off factor $\alpha = 0.35$. Measurements shall be performed from the antenna connector. Measurements shall be referred to the level measured from center frequency offsets listed in table 6.3.3.2.2.5.1

Table 6.3.3.2.2.5.1: Carrier Frequency Offset Power Levels for DQPSK Modulation

Frequency offset	Power level
78 kHz	-60 dBm
156 kHz	-65 dBm
234 kHz	-65 dBm

6.3.3.2.2.6 Spurious Emissions

Transmitted signal is not allowed to disturb the BTS and the antenna-line unit's RF-performance and to radiate from the antenna. The power of any O&M environment (modem, DC/DC -converter etc.) originated spurious emissions shall not exceed levels defined in [4].

6.3.3.2.3 RET Antenna DC supply

➤ Nominal Voltages

For each nominal DC supply voltage all devices must operate over the following range:

24V: 19.0 V to 30.0 V

➤ Current consumption

The RET Antenna device current consumption must operate in the following range:

In operating state < 800 mA

In quiescent state < 100 mA

6.3.3.3 Signalling Transport

The data link layer is based on a subset of the standardised ISO HDLC which conforms to the requirements in [2].

6.3.3.3.1 HDLC Format

6.3.3.3.1.1 Operating Mode

The operating mode shall be normal response mode (NRM) with two way alternate (TWA) communication. This mode requires that the primary device as a master is always in control of the bus and the secondary device only answers frames sent by the master. The secondary device cannot send any frame independently. The primary device is the Node B Implementation Specific O&M function whereas the secondary device is the Node B RET Antenna function often physically located at the top of the antenna mast.

The channel state shall be start/stop transmission.

6.3.3.3.1.2 Control octet transparency

Control octet transparency shall be implemented in accordance with Paragraph 4.3.2.2 in [2]. This requirement applies to all frame types.

6.3.3.3.2 Frame Checking Sequence Field

The Frame Checking Sequence Field (FCS) shall be calculated in accordance with [2] on all bytes following the start flag up to, but not including, the CRC field.

6.3.3.3.3 HDLC Command Sub-set

The protocol shall support the following HDLC commands, which are based upon the TWA, UNC (no options) commands list provided in Annex D of [2].

Table 6.3.3.3.1: Frame Types used for the Transport Layer

Commands (Primary Device)	Responses (Secondary Device)
Frame type I	Frame type I
Frame type RR	Frame type RR
Frame type SNRM	Frame type UA
Frame type DISC	Frame type DM
Frame type XID	Frame type RNR
	Frame type FRMR (optional)

The I-frame and INFO field formats for both primary and secondary devices shall be as illustrated in figure 6.12. INFO fields are only used with I-frames.

The Frame Control Field shall be formatted in accordance with Paragraph 5.3.1, Table 3 in [2].

HDLC-Frame:

Flag 8bit	ADDR 8bit	Control 8bit	INFO N x 8bit	CRC 2 x 8bit		Flag 8bit
0x7E	Device Address	Control bits	Variable length (must support a maximum length of at least 74 bytes)	CRC1 low byte	CRC2 high byte	0x7E

3GPP Release	Command ID	Number of data bytes		Data bytes
Release-ID 1 byte	1 byte	low byte	high byte	Variable length (must support a maximum length of at least 70 bytes)

Figure 6.12: Format of the I-Frame and INFO Field

Devices shall support the following data length:

- Mandatory: $0 \leq \text{data bytes} \leq 70$ bytes
- Optional: $0 \leq \text{data bytes} < 65,535$ bytes

To allow for the use of frames longer and window sizes larger than the default sizes the following transport layer XID-frame may be sent by the primary device to determine the maximum information field length and window size supported by a secondary device. (Refer also to Paragraph 5.5.3 in [2].)

XID Frame from primary device:

Table 6.3.3.3.2: XID Frame from Primary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	1	Length of the parameter field (PI)
PI	5	Maximum I Field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I Field length Transmit
PI	6	Maximum I Field length Receive
PL	Nrx	Length of the bytes value
PV	Value	Maximum I Field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field
PV	Value	Maximum window size Transmit
PI	8	Maximum window size Receive
PL	N	Length of the window size
PV	Value	Maximum window size Receive

Response from secondary device:

The secondary device checks to see if it can support the values provided in the command. If the secondary device can support the values then it replies with the same value. If the secondary device can not support these values then it replies with the maximum values that can be supported.

Table 6.3.3.3.3: UA Frame from Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	UA	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	Length	Length of the PI field
PI	5	Maximum I field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit

PI	6	Maximum I field length Receive
PL	Nrx	Length of the PV field (bytes)
PV	Value	Maximum I field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	8	Maximum window size Receive
PL	N	Length of the PV field (bytes)
PV	Value	Maximum window size Receive

If the secondary device does not provide a valid response, then the default frame length and window size are to be used.

The Release-ID shall be used to identify the 3GPP Release of the RET Application Part supported by the secondary device.

6.3.3.3.4 HDLC Address

The HDLC address shall be stored in non-volatile memory and restored on power-up. The secondary device compares its own address with the Address field of the received frames from the bus. If the addresses are equal the frame is accepted and will be processed.

Two addresses are reserved for device management, these are:

- Address 0x00
Address 0x00 is the initial state during installation. It is recommended that all devices be assigned this address by the manufacturer prior to shipment to the customer unless otherwise agreed by prior arrangement.
- Address 0xFF
Address 0xFF is a broadcast address. All devices connected shall process commands received via a broadcast.

There is no response from secondary devices to broadcast addresses.

6.3.3.3.4.1 Address configuration

Before communication can be established on a bus it is necessary to configure the addresses of the devices connected to it. Address assignment is mediated by the use of an XID frame carrying data fields as specified in Paragraph 5.5.3 of [2].

6.3.3.3.4.1.1 Address Assignment Command

The format of the XID frame originated by the primary device shall be as follows:

Table 6.3.3.3.4.1: Format of the Address Assignment Command from the Primary device

Field	Content	Description
ADDR	0xFF	Broadcast
CTRL	XID	Command
FI	0x81	Format identifier
GI	0xF0	User defined parameter set

GL	n+5	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	n	Length of PV field in bytes
PV	unique ID	Vendor id/serial number (n bytes)
PI	2	Parameter id 2 = address
PL	1	Length of PV field in bytes
PV	1 – 254	Assigned address

6.3.3.3.4.1.2 Address Assignment Response

The secondary device verifies FI, GI, GL and PI, PL for the two parameters. It then checks the first PV to see if it contains its own unique ID. If so it changes its address to the one supplied in the second PV. It then responds with a UA frame transmitted from its new address.

Table 6.3.3.3.4.1: Format of Address Assignment Response from the Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	UA	Command

If the first PV does not match its unique ID, but the secondary device already uses the address specified in the second PV, it changes its address to zero in order to remove itself from the bus. This prevents a situation in which two devices have the same address. This mechanism may be used to reset a device's HDLC address to zero if it is to be removed from the bus.

If neither the first PV nor the second PV matches, the secondary device does nothing.

After the assignment of its address a secondary device remains in the disconnected state.

6.3.3.3.4.1.3 Device Scan Command

In some situations it may be found that the unique ID of a bus device is unknown or has been inaccurately recorded. This HDLC command exchange is used by the primary device to perform a binary tree scan of the bus, in order to identify all connected devices, and is always carried out at 9.6 kbps.

Table 6.3.3.3.4.3: Primary Device Scan Command (XID Frame)

ADDR	0xFF	Broadcast
CTRL	XID	Command
FI	0x81	Format identifier
GI	0xF0	User defined parameter set
GL	2*n+4	Length of parameter field
PI	1	Parameter id 1 = unique id

PL	n	Length of PV field in bytes
PV	unique id	Vendor id/serial number (n bytes)
PI	3	Parameter id 3 = bit mask
PL	n	Length of PV field in bytes (same as for PI=1)
PV	bit mask	Bit mask (n bytes)

➤ Device Scan Response

When each secondary device receives the command it masks its unique id with the bit mask and compares the result with the unique id supplied. If they match, the secondary device responds using any unnumbered format frame according to table 8 of section 5.5 of [2]. It is recommended that the response of individual devices is subject to a random delay (within the permitted response time) to aid collision detection at the primary device.

If there is no response, the primary device knows that no secondary device had those bits in its unique id, so the tree scan can be truncated at that branch.

If multiple secondary devices respond, the messages may arrive after each other or at the same time. In the first case multiple responses will arrive before the timeout, in the second case the responses might garble each other, unless one secondary device is close enough to overpower the signal from the other(s).

If any response arrives, a single frame, multiple frames or frames with incorrect checksums or framing errors, the primary device must assume that that branch of the tree is inhabited and scan through it.

6.3.3.3.5 Window Size

The minimum window size is 1.

6.3.3.3.6 Connection Establish

The primary device sends an SNRM-frame to the secondary device. The secondary device responds with a UA-frame, its message buffers are emptied, HDLC sequence numbers are reset and it enters the connected state. After the primary device receives the UA-frame, the corresponding secondary device is administered as connected.

6.3.3.3.7 Disconnect

The primary device sends a DISC-frame to the secondary device. The secondary device responds with a UA-frame and enters the disconnected state. After the primary device receives the UA-frame, the corresponding secondary device is administered as disconnected.

If the secondary device is in disconnected mode, it shall respond as defined in Paragraph 5.2.2.1 of [2].

6.3.3.3.8 Polling

Before any secondary device can be polled, it must first be placed in the connected state.

On reception of a frame with correct FCS and matching address and with the poll-bit set as specified in [2], the secondary device is required to transmit frames on the bus within the times defined in section 6.3.3.3.10.

If the secondary device has an I-frame to transmit it shall do so. If it does not have an I-frame to transmit it shall respond with either an RR or RNR frame. If it is unable to receive I-frames, for instance because it has run out of empty buffers, it shall respond with RNR. Otherwise it shall respond with RR (see also Appendix B in [2]).

This polling procedure provides the application part of the protocol with a full-duplex link, allowing the application part to spontaneously transmit messages, such as alarm messages.

If the secondary device does not receive a poll within 3 minutes of the previous poll, it may optionally perform a reset.

NOTE: In the event that the primary device receives no responses from a secondary device, it is recommended that it signals loss of connection to its Element Manager.

6.3.3.3.9 Information

Before any secondary device can be required to send or receive an I-frame, it must first be placed in the connected state. One I-frame is used for one message, so fragmentation is not required. If the primary device sends a command to the secondary device, one I-frame is generated and sent. The secondary device can respond with any valid HDLC response belonging to the subset of RET control commands.

6.3.3.3.10 Message Timing

A minimum of 3 ms must elapse between transmitting and receiving messages on a bus.

The primary device should receive a complete response frame within 10 ms plus the time taken for the transmission of 100 bytes from the time the final flag byte is transmitted. The secondary device should start to transmit a response within 10 ms. The time occupied by the transmission of 100 bytes allows time-outs to include transmission time, with 10 ms allowed for processing.

6.3.3.3.11 Frame Error Rate

The number of frames detected with incorrect checksums shall be less than 1 frame in 5000 frames.

6.3.4 Functions of Interface

Editor's note: This subsection should capture issues regarding the functions of the interface

6.3.5 Protocol Structure

The protocol structure of the Iuant Interface described in section 6.3 of this TR is shown in figure 6.13 and figure 6.14 for both Implementation Specific O&M Transport options. The protocol stack consists of the two layer 1 options RS485 and coaxial cable as described in section 6.3.3.2, the signalling transport based on a subset of HDLC according to section 6.3.3.3 and the RET Control AP which is defined in section 6.3.6 of this TR.

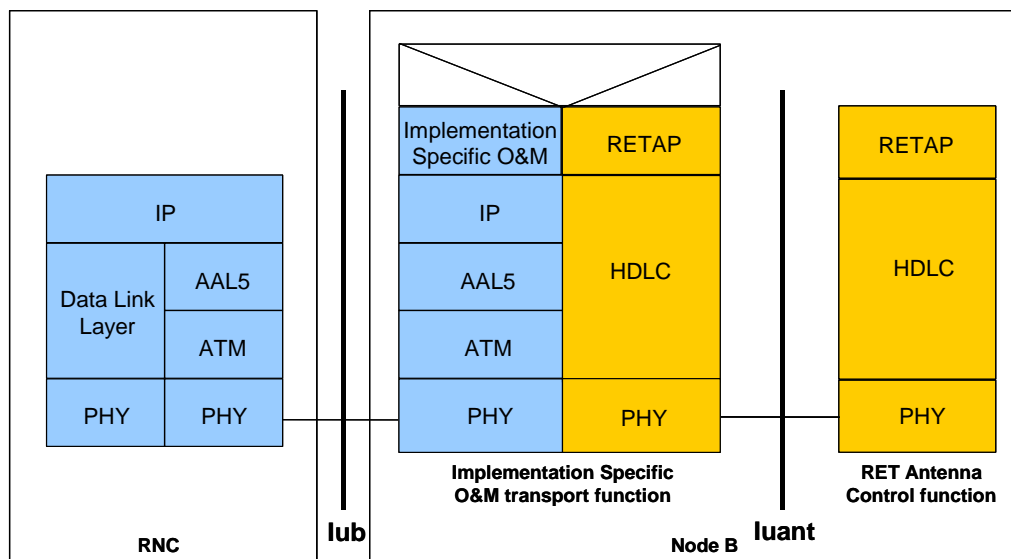


Figure 6.13: Protocol Structure for Implementation Specific O&M with ATM-Transport Option

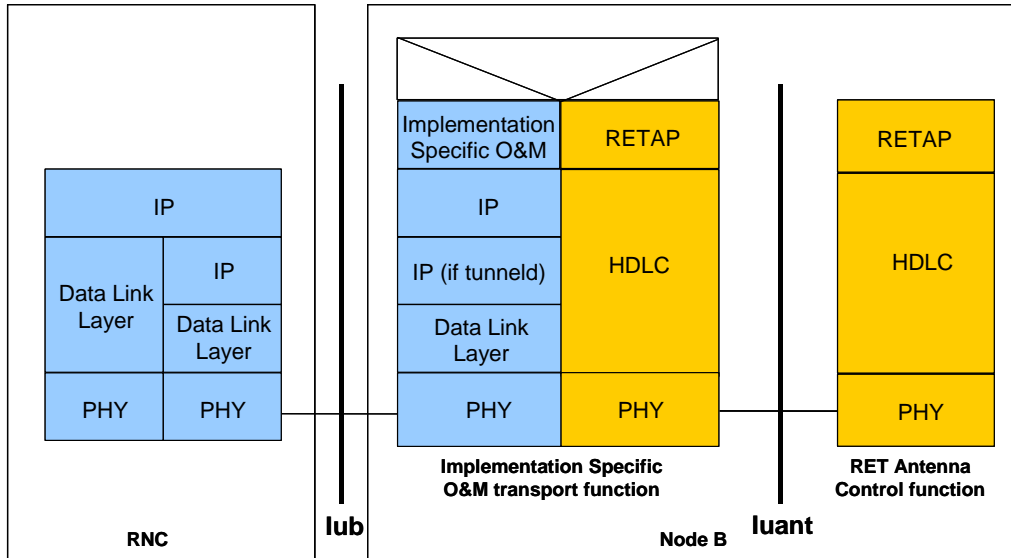


Figure 6.14: Protocol Structure for Implementation Specific O&M with IP-Transport Option

As the Iuant and the Implementation Specific O&M transport are different interfaces with e.g. different addressing schemes a mediation function is needed. This mediation function uses on one side a protocol that uses the implementation specific O&M bearer (e.g. IP) and on the other side the Iuant protocol.

6.3.6 Application Protocol signalling procedures

6.3.6.1 Command Format

Apart from address configuration, which uses the XID frame, commands to devices are transmitted within the HDLC INFO field. The general format for all commands is the following:

Table 6.3.6.1.1: General Format for all Commands

Command	Number of data bytes	Data bytes
1 byte	2 bytes	max 70 bytes (basic implementation)

6.3.6.2 Response Format and Return Codes

All responses from devices are transmitted in the HDLC INFO field. The general format for all responses is the following:

Table 6.3.6.2.1: General Format for all Responses

Command	Number of data bytes	Data bytes
1 byte	2 bytes	max 70 bytes (basic implementation)

The maximum time for all responses shall be 1 second unless specified in the individual command. Tilt setting, calibration and self test will typically require a longer period for completion of the command.

One or more return codes are transmitted in the data bytes.

A complete annotated table of all available return codes with their corresponding hexadecimal numbers is provided in section 6.3.7 of this TR.

6.3.6.3 Overview of Commands

The set of commands for RET antenna control provides command-oriented instructions and also facilities to read and write data to specified locations in the memory of the secondary devices.

Table 6.3.6.3.1: Command Set and Command Numbers

Command	Command number	Comment
(Reserved)	0x01	Device operation, mandatory
Get Device Type	0x02	Device operation, mandatory
Reset	0x03	Device operation, mandatory
Get Error Codes	0x04	Device operation, mandatory
Get H/W & S/W Info	0x05	Device operation, mandatory
Alarm	0x07	Device operation, mandatory
Enable Device	0x08	Device operation, mandatory
Disable Device	0x09	Device operation, mandatory
Self Test	0x0A	Device operation, mandatory
Read Memory	0x0B	Device operation, mandatory
Write Memory	0x0C	Device operation, mandatory
Get Supported Bit Rates	0x0D	Device operation, mandatory
Set Device Data	0x0E	Device operation, mandatory
Get Device Data	0x0F	Device operation, mandatory
Download Start	0x2E	Device maintenance, optional
Store Data Start	0x20	Device maintenance, optional
Store Data Block Seg	0x21	Device maintenance, optional
Download End	0x22	Device maintenance, optional
Set Bit Rate	0x24	Device maintenance, optional
Calibrate	0x31	RET control, mandatory
Send Config data	0x32	RET control, mandatory
Set Tilt	0x33	RET control, mandatory
Get Tilt	0x34	RET control, mandatory

6.3.6.4 Control Commands

In response to all Application Part commands from the primary device, the addressed secondary device shall respond with <OK> whenever a normal outcome to the command has resulted, and <FAIL> otherwise. Additional parameters may be associated with the response <OK> and a variety of defined return codes (error messages) with the response <FAIL> as described in the following paragraphs. Return codes are also used as autonomous alarm responses (see section 6.3.6.4.5 for details).

A summary table and interpretation of all defined return codes is provided in section 6.3.7 of this TR. When return codes are used, they shall have meanings consistent with those described.

A primary device (i.e. any control equipment, Node B) must execute two procedures for a RET antenna as secondary device (RET) before control of the secondary device is possible:

1. The HDLC address must be assigned to the secondary device
2. The device type of the secondary device must be requested, so the primary device can identify the appropriate command set to be used to communicate with the secondary device.

6.3.6.4.1 Get Device Type

Command Name: GetDevType

This command requests the type of a device. A scan of all correctly configured and connected devices connected to the RS485 bus may be initiated by sending the command GetDevType to each address and evaluating the responses.

Data field command to secondary device:

0x02 0x00 0x00

Data field response from secondary device:

0x02 <LengthLowByte> <LengthHighByte> <OK> <VendorLowByte> <VendorHighByte> <DeviceType>

Vendor codes are given in [15]. The device type for RET is 0x01.

Data field response from secondary device in case of error in performing the command:

0x02 <LengthLowByte><LengthHighByte><FAIL> <ReturnCode1>...<ReturnCodeN>

6.3.6.4.2 Reset Software

Command Name: Reset

This command resets the device software, restarts the software and places the device in the disconnected state.

Data field command to secondary device:

0x03 0x00 0x00

Data field response from secondary device before the reset command is executed:

0x03 0x01 0x00 <OK>

The device must not execute the reset before transport layer acknowledgement through sequence number update is received for the response. (See Appendix B in [2]).

The Reset command must be executed in all situations. The secondary device must not fail to reset because it is busy or for any other reason of its software state.

6.3.6.4.3 Get Error Codes

Command Name: GetErrorCodes

This command requests remotely the error codes supported by a secondary station.

Data field command to secondary device:

0x04 0x00 0x00

Data field response from secondary device:

0x04 <LengthLowByte> <LengthHighByte> <OK> <ErrorCode1><ErrorCode2>...<ErrorCodeN>

This is a normal response. The request to get supported error codes has been executed correctly and the supported error codes are returned.

Data field response from secondary device in case of error in performing the command:

0x04 <LengthLowByte> <LengthHighByte> <FAIL>

This is an abnormal response.

6.3.6.4.4 Read Hardware and Software Information

Command Name: GetInfo

This command reads hardware information and the software version from a secondary device. The software version must indicate the version number of the currently installed software, whether installed at the time of manufacture or during subsequent upgrade.

Data field command to secondary device:

0x05 0x00 0x00

Data field response from secondary device:

0x05 <LengthLowByte> <LengthHighByte> <OK> <Length> <Prod Nr> <Length> <SerNo> <Length> <HW Version> <Length> <SW Version>

ProdNr is the product type number and SerNr is the unique serial number of the individual unit.

HW Version and SW Version refer to the version designators of the hardware and installed software of the secondary device. If the application is missing or no version number is found, then an empty string shall be returned as the version number.

Data field response from secondary device in case of error in performing the command

0x05 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1> ... <Return CodeN>

6.3.6.4.5 Poll Response from Secondary Device

Response Name: Alarm

The Transport Layer provides a virtual full-duplex link to the Application Part. This virtual full-duplex link is used to simplify alarm reporting.

The secondary device reports every change in error status by transmitting an alarm message in response to a poll. Formally this is a response message, even though (on Application Part level) it is a spontaneous message. There is no Application Part command to request an alarm response message.

The alarm message contains a list of error-code/state-flag pairs. The state flag indicates that an error has occurred (StateFlag = 1) or cleared (StateFlag = 0).

Only error codes whose state has changed shall be included in the list. The secondary device may group several error codes into one message, but their sequence in the message must then reflect the sequence in which they occurred.

A rapid setting/clearing sequence of the same alarm may be reported in the same alarm message in the order in which they occurred (FIFO).

In the event that the rapid state changes cause overflow of the available buffers, the oldest error code changes shall be discarded and the later ones retained for transmission.

Autonomous data field response from secondary device if an error state has changed since the previous poll from the primary device:

0x07 <LengthLowByte> <LengthHighByte> <Return Code1> <StateFlag1> ... <Return CodeN> <StateFlagN>

Alarm return codes are defined in section 6.3.7 of this TR.

6.3.6.4.6 Enable Device

Command Name: Enable

This command enables a secondary device for operation. If a secondary device is enabled, all commands are executable; if it is already enabled, a second enable command will be accepted without error and the device will remain enabled. Internally, the status of the device is always set to **enabled** after the command is received.

Data field command to secondary device:

0x08 0x00 0x00

Data field response from secondary device:

0x08 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x08 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.3.6.4.7 Disable Device

Command Name: Disable

This command secures secondary devices against unauthorised or accidental change of operational parameters. When a secondary device is disabled, commands which SET parameters will not be accepted and an DeviceDisabled error will be returned. If it is already disabled, a second disable command will be accepted without error and the secondary device will remain disabled. Internally, the status of the device is always set to **disabled** after the command is received.

All secondary devices shall be delivered by vendors with their status set to 'disabled'. The status of every device after reset shall default to 'disabled'.

Data field command to secondary device:

0x09 0x00 0x00

Data field response from secondary device:

0x09 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x09 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.3.6.4.8 Self Test

Command Name: SelfTest

This command executes a test function at the device which may include a check of physical and processor functions.

The response from the command provides the user with information on detected faults or, if no fault is detected, with confidence that the operation of the device is normal in all respects.

During the test the operational parameters of the device shall not change beyond operationally acceptable limits and on completion all parameters shall be returned to their initial values.

Data field command to secondary device:

0x0A 0x00 0x00

Data field response from secondary device:

0x0A <LengthLowByte><LengthHighByte><OK><Return Code1>...<Return CodeN>

This is a normal response in which the self test was executed with return codes set to report possible detected functional errors during the test. If no errors are detected, this shall be signalled by no return codes following <OK>.

Data field response from secondary device in case of error in performing the command:

0x0A <LengthLowByte><LengthHighByte><FAIL><Return Code 1>...<ReturnCodeN>

In this case the self test could not be executed and the return codes relate to the inability of the device to perform the requested self-test operation.

6.3.6.4.9 Read Memory

Command name: ReadMemory

Data field command to secondary device:

0x0B <LengthLowByte> <LengthHighByte> <MemoryAddressByte1> <MemoryAddressByte2>
<MemoryAddressByte3> <MemoryAddressByte4> <N = number of bytes to read>

Data field response from secondary device:

0x0B <LengthLowByte> <LengthHighByte><OK> <MemoryAddressByte1> <MemoryAddressByte2>
<MemoryAddressByte3> <MemoryAddressByte4> <byte1> ... <byteN>

Data field response from secondary device in case of error in performing the command:

0x0B <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

MemoryAddress bytes are transmitted in little-endian order.

6.3.6.4.10 Write Memory

Command name: WriteMemory

Data field command to secondary device:

0x0C <LengthLowByte> <LengthHighByte> <MemoryAddressByte1> <MemoryAddressByte2>
<MemoryAddressByte3> <MemoryAddressByte4> <byte1> ... <byteN>

MemoryAddress bytes are transmitted in little-endian order.

Data field response from secondary device:

0x0C 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x0C <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

6.3.6.4.11 Get Supported Bit Rates

Command Name: GetBitRates

This command is used to determine which bit rates are supported by any device connected to a bus. All systems shall respond to this command, but support for bit rates other than 9.6 kbps is optional. Devices which support multiple bit rates will reply with multiple values.

Data field command to secondary device:

0x0D 0x00 0x00

Data field response from secondary device:

0x0D <LengthLowByte> 0x00 <OK> <BitRateByte1> <BitRateByte2> <BitRateByte3>

Bit rate byte:

- 0x00 : 9.6 kbps

- 0x01 : 38.4 kbps
- 0x02 : 115.2 kbps

Data field response from secondary device in case of error in performing the command:

0x0D <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.3.6.4.12 Set Device Data

Command name: SetDeviceData

This command is used to write data into the fields optionally provided for configuration data and listed in section 6.3.9 of this TR. If an attempt is made to write to fields which are not supported by a particular device no error is returned but the data for those fields is ignored.

Data field command to secondary device:

0x0E <LengthLowByte> <LengthHighByte> <FirstParameterNumber> <data bytes for first parameter>
<SecondParameterNumber> <data bytes for second parameter> <ThirdParameterNumber>
<data bytes for third parameter>...<Nth ParameterNumber> <data bytes for Nth parameter>

Data field response from secondary device:

0x0E 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x0E <LengthLowByte> <LengthHighByte><FAIL> <Return Code1>...<Return CodeN>

6.3.6.4.13 Get Device Data

Command Name: GetDeviceData

This command is used to read data stored in the fields optionally provided for configuration data and listed in section 6.3.9 of this TR. If an attempt is made to read fields which are not supported by a particular device no data is returned for that field. The command contains a list of the field numbers of those fields whose contents are to be returned in the response from the secondary device. The field numbers are not necessarily contiguous or ordered.

Data field command to secondary device:

0x0F <LengthLowByte> <LengthHighByte> <0x01> <0x02> <0x03>...<0x0N>

Data field response from secondary device:

0x0F <LengthLowByte> <LengthHighByte> <OK> <0x01> <data bytes for parameter 1>
<0x02> <data bytes for parameter 2> <0x03> <data bytes for parameter 3>...<0x0N> <data bytes for parameter N>

Data field response from secondary device in case of error in performing the command:

0x0F <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<Return CodeN>

6.3.6.4.14 Software Download

If software download is supported, then the following commands are used to download new software releases to a secondary device. The sequence of the following commands must be strictly observed. After the complete sequence a reset command is necessary to activate the new software.

For implementations in which more than one software data file will be downloaded to a secondary device, the address of the memory locations to be erased shall be transmitted in the header of the first data block of each data file.

The sequence of commands to effect a software download to a secondary device is illustrated in section 6.3.10 of this TR.

6.3.6.4.14.1 Download Start

Command Name: DownloadStart

This command initiates internal copy and execution of software routines and may delete parts of the flash memory. An <OK> response indicates that any flash erasure has been successfully executed.

Data field command to secondary device:

0x2E 0x00 0x00

Data field response from secondary device:

0x2E 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x2E <LengthLowByte> <LengthHighByte> <FAIL><ReturnCode1> <ReturnCodeN>

6.3.6.4.14.2 Store Data Start

Command Name: StoreDataStart

This command specifies the block-number of the block which will be transferred and the number of bytes within this block.

Data field command to secondary device:

0x20 0x04 0x00 <BlockNrLSB> <BlockNrMSB> <BlockLengthLSB> <BlockLengthMSB>

Data field response from secondary device:

0x20 0x03 0x00 <OK> <BlockNrLSB> <BlockNrMSB>

Data field response from secondary device in case of error in performing the command:

0x20 <LengthLowByte> <LengthHighByte> <FAIL> <BlockNrLSB> <BlockNrMSB>
<ReturnCode1>...<ReturnCodeN>

6.3.6.4.14.3 Store Data Block Segment

Command Name: StoreDataBlockSeg

This command transfers data segments to the secondary device.

Data field command to secondary device:

0x21 <LengthLowByte> <LengthHighByte> <SegmentNumber> <data 1>...<data n>

NOTE: n <= 69 if 74-byte I-fields are used

Data field response from secondary device:

0x21 0x02 0x00 <OK> <SegmentNumber>

Data field response from secondary device in case of error in performing the command:

0x21 <LengthLowByte> <LengthHighByte> <FAIL> <SegmentNumber> <ReturnCode1>...<ReturnCodeN>

The segment number commences at 0 and is incremented in steps of 1 to a maximum value of 255. If more than 256 segments are required, a new block must be started which in turn resets the segment number to 0.

6.3.6.4.14.4 Download End

Command Name: DownloadEnd

With this command the primary device signals the end of software transfer to the secondary device. The secondary device responds after verifying the checksum of the whole data transferred to memory.

Data field command to secondary device:

0x22 0x00 0x00

Data field response from secondary device:

0x22 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x22 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code1>...<ReturnCodeN>

6.3.6.4.15 Set Bit Rate

Command name: SetBitRate

This broadcast command informs all connected secondary devices that the primary device has been ordered to switch to the specified bit rate. The message shall not be repeated.

Data field command to secondary devices:

<0x27> 0x01 0x00 <bit rate byte>

Bit rate byte:

- 0x00 : 9.6 kbps
- 0x01 : 38.4 kbps
- 0x02 : 115.2 kbps

There is no response from secondary devices to this broadcast command until 5 further frames have been received.

Bit rate change procedure

It is mandatory that any secondary device that supports multiple bit rates is capable of supporting this procedure.

The primary device is not allowed to change the bit rate autonomously; it will generally be set during system configuration, or as an operator-mediated response to a communications failure, perhaps caused by physical damage to the bus. Secondary devices will operate at the specified bit rate and will check briefly for communication at other bit rates only if the bus has been quiet for a long period. The system provides a stable and reliable bit rate fallback scheme.

A secondary device that supports bit rates other than the mandatory 9.6 kbps must have a 1-minute LineIsDead timeout. This timeout must be reset whenever the secondary receives a valid HDLC frame, regardless of its address. It must also have a FramingError counter and a BytesReceived counter. Both these counters must be reset to zero whenever a valid HDLC frame is received, regardless of its address.

As all devices support a bit rate of 9.6 kbps, communication can be established on the bus before a higher rate is set. The primary device should first use the GetBitRates command to determine which higher bit rate(s) can be supported by all connected devices, as the maximum bus bit rate is determined by the slowest connected device. The primary device is then set to operate at the new bit rate. It may be preferred to send a SetBitRate command before the primary device rate is changed; this makes the subsequent procedure at the secondary devices faster but its use is optional.

If the LineIsDead timeout occurs at a secondary device its current bit rate is assumed to be invalid and the secondary device shall initiate the bit rate test sequence as follows:

1. Set the bit rate to the maximum supported rate
2. Clear the FramingError and BytesReceived counters
3. Wait 10 seconds, or until a valid HDLC frame is received
4. If any valid HDLC frame is received (regardless of its address) the sequence is terminated, but the bit rate is not stored until 5 further frames (regardless of their address) have been received

5. If the FramingError and BytesReceived counters are zero, the bit rate is restored to the last stored bit rate and the sequence is terminated
6. If the FramingError counter is at least 10 or the BytesReceived counter is at least 10 the bit rate is assumed to be wrong. If the bit rate is greater than 9.6 kbps the bit rate is reduced and the sequence continues with Step 2.
7. If the bit rate is already 9.6 kbps the bit rate is restored to the last stored bit rate and the sequence is terminated.

6.3.6.4.16 RET Calibration

Command Name: Calibrate

This command is sent after installation of a RET. Calibration entails ensuring that the actuator is driven through its whole tilt range.

After reset or power failure no calibration is normally required. There may occasionally be unforeseen errors where calibration could be required to return the RET to a correct no-error status.

The response time shall be less than 4 minutes.

Data field command to secondary device:

0x31 0x00 0x00

Data field response from secondary device:

0x31 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x31 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

6.3.6.4.17 RET Send Configuration Data

Command Name: SendConfigData

This command may be required after installation of any RET unless already performed by the vendor before delivery. It loads vendor and antenna specific configuration data to establish the relationship between the movement of the drive system and the beam tilt position of the antenna.

When specified by the vendor the data must be loaded during the installation procedure. (Typically this may be necessary because the same type of drive unit (RET) may be used in association with different antenna types, each requiring different configuration data.)

Data field command to secondary device:

0x32 <LengthLowByte> <LengthHigh Byte> <DataByte1>...<DataByteN>

Data field response from secondary device:

0x32 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x32 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

6.3.6.4.18 RET Set Tilt

Command Name: SetTilt

This command sets the electrical tilt value in increments of 0.1°. The electrical tilt value describes the elevation angle between the direction orthogonal to the antenna element axis and the maximum of its main beam in the elevation plane. A positive electrical tilt angle means that the antenna beam is directed below the direction orthogonal to the antenna axis. An antenna has separate values for electrical and mechanical tilt. The mechanical tilt is fixed by the geometry of the installation. In this TR the tilt referred to is always the electrical tilt unless otherwise stated.

The response time shall be less than 2 minutes.

The format of the demanded tilt shall be a 2-complement 16 bit signed number sent in little-endian order.

Data field command to secondary device:

0x33 0x02 0x00 <TiltLowByte> <TiltHighByte>

Tilt values are specified in 0.1° increments starting from zero, for example: Tilt 3.2° is 0x0020 (stored as <0x20> <0x00>), Tilt – 3.2° is 0xFFE0, stored as <0xE0> <0xFF>).

Data field response from secondary device:

0x33 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x33 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code 1>...<Return Code N>

6.3.6.4.19 RET Get Tilt

Command Name: GetTilt

This command requests the current tilt value.

The response is made in increments of 0.1° in the format specified in section 6.3.6.4.18.

Data field command to secondary device:

0x34 0x00 0x00

Data field response from secondary device:

0x34 0x03 0x00 <OK> <TiltLowByte> <TiltHighByte>

Data field response from secondary device in case of error in performing the command:

0x34 <LengthLowByte> <LengthHighByte> <FAIL> <Return Code 1>...<Return Code N>

6.3.6.5 Implementation Specific Commands

Implementation specific commands are internally implemented but not used for control or telemetry functions. These commands are used for test and development, and are not specified. All control and telemetry functions shall be using the specified commands defined in section 6.3.6.4.

Implementation Specific Commands and responses shall be formatted as follows:

0xFF <LengthLowByte> <LengthHighByte> <VendorID> (remaining format and content vendor specific.)

6.3.6.6 Unknown Commands

If a secondary device is unable to recognise a command, the secondary device shall respond as follows:

INFO field command to secondary device:

<Unknown Command> <LengthLowByte> <LengthHighByte> <Data 1> ... <Data N>

INFO field response from secondary device:

<unknown command> 0x02 0x00 <FAIL> <Return Code>

6.3.7 Return Codes for Secondary Devices (normative Annex)

Table 6.3.7.1: Return Codes for Secondary Devices

Code	Meaning	
0x00	OK	Normal response
0x01	Actuator Detection Fail	Signals from the actuator are detected but are abnormal, for example due to failed calibration.
0x02	Actuator Jam Permanent	Actuator cannot be moved
0x03	Actuator Jam Temporary	Actuator jam has been detected. No movement was detected in response to the normal stimulus.
0x04	Block Number Sequence Error	Used in combination with software download; block number sequence is wrong.
0x05	Busy	The device is busy and cannot respond until an activity is complete.
0x06	Checksum Error	Used in combination with software download; checksum incorrect.
0x07	Command Sequence Error	Used in combination with software download; command sequence is not permitted, e.g. a SetTilt command is received during software update sequence.
0x08	Data Error	RET AP data fault, e.g. length of data is inconsistent with length fields.
0x09	Device Disabled	Device is in logical Disabled state and cannot execute Set commands.
0x0A	EEPROM Error	EEPROM error detected
0x0B	Fail	Abnormal response. Indicates that a command has not been executed.
0x0C	Flash Erase Error	Used in combination with software download; indicates error when erasing flash memory.
0x0D	Flash Error	Used in combination with software download; indicates error when writing to flash memory.
0x0E	Not Calibrated	The device has not completed a calibration operation, or calibration has been lost.
0x0F	Not Scaled	No setup table has been stored in the device.
0x11	Other Hardware Error	Any hardware error which cannot be classified.
0x12	Other Software Error	Any software error which cannot be classified.
0x13	Out of Range	Value specified by a Set Tilt command is not supported by the device.
0x14	Position Lost	RET controller is unable to return a correct position value, for example there was a power failure while a SetTilt command was being executed.
0x15	RAM Error	An error was detected in reading data to/from RAM
0x16	Segment Number Sequence Error	Used in combination with software download; block sequence number is wrong.

0x17	UART Error	Hardware specific. This error may be sent after recovery from a temporary error which has prevented the sending or receiving of data.
0x19	Unknown Command	Received command is not defined in the 3GPP release version transmitted in the frame header, or the device has received a vendor-specific command with a vendor ID different from its own.

6.3.8 Assigned Fields for Additional Data (normative Annex)

The following standard fields are used by the commands SetDeviceData and GetDeviceData. Little-endian order is used for storage of multiple-byte numbers. Where ASCII variables are shorter than the assigned field lengths the characters are right aligned and leading blanks are filled with null characters (0x00).

Table 6.3.8.1: Assigned Fields for Additional Data

Field No.	Length (bytes)	Format	Description
0x01	15	ASCII	Antenna model number
0x02	17	ASCII	Antenna serial number
0x03	2	16-bit unsigned	Antenna frequency band(s): see below
0x04	3	3 x 8-bit unsigned	Beamwidth for each band in frequency order (deg) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x05	3	3 x 8-bit unsigned	Gain for each band in frequency order (dB/10) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x06	2	16-bit signed	Maximum supported tilt (degrees/10), Format as in section 6.3.6.4.18
0x07	2	16-bit signed	Minimum supported tilt (degrees/10), Format as in section 6.3.6.4.18
0x21	6	ASCII	Installation date
0x22	5	ASCII	Installer's ID
0x23	12	ASCII	Base station ID
0x24	4	ASCII	Sector ID
0x25	2	16-bit unsigned	Antenna bearing
0x26	1	8-bit signed	Installed mechanical tilt (degrees/10)

Table 6.3.8.2: Coding for Antenna Frequency Bands in Field 0x03

Bit No	Frequency band(MHz)
1	800
2	900

3	1500
4	1800
5	1900
6	2100
7 and above	Reserved

Examples of frequency bands:

0000 0000 0001 0000 = 1800MHz,

0000 0000 0001 1100 = 1800, 1900 and 2100MHz

6.3.9 Command Sequence for Download of Software to a Secondary Device (normative Annex)

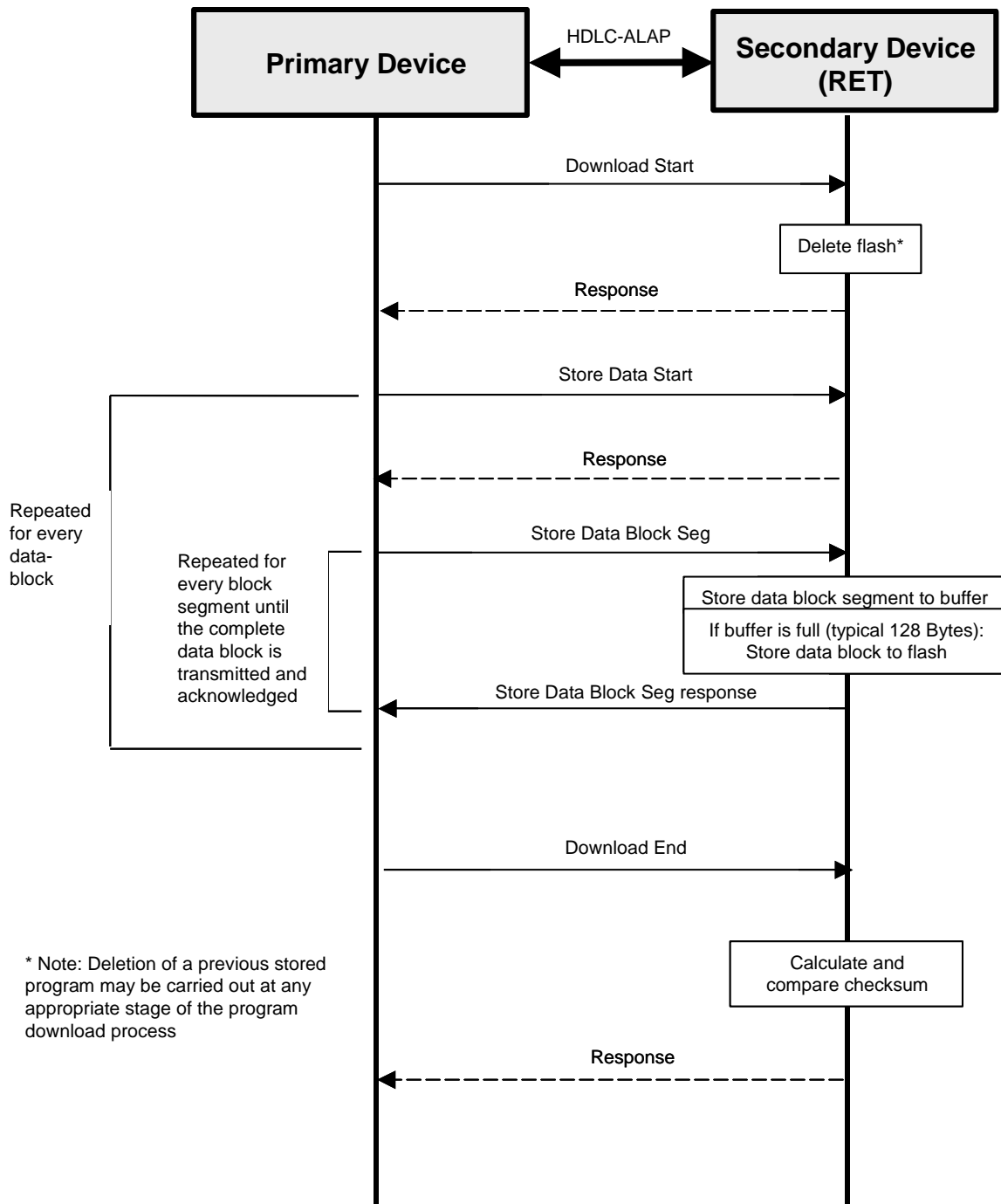


Figure 6.3.9.1: Procedure Sequence for Software Download

6.4 Comparison of Layer 1 Modulation Methods

There are three modulation proposals for the coaxial interface option defined in the RET TR25.802. To help to make the decision between them, some points are highlighted below w.r.t. OOK (On-Off Keying) and D-QPSK (Differential Quadrature Phase Shift Keying) modulations.

Signal spectrum

OOK as a modulation method requires wider signal bandwidth in comparison to the used signal rate than D-QPSK modulation. Also the spurious signals generated in the OOK modulation process will spread to the wider band and to remove them on the receiver side, the signal has to be filtered. Therefore filtering the spurious signals needs more consideration with OOK.

Bit rate

For the software downloads, it is preferred to have a possibility to increase the bit rate temporarily. The proposed D-QPSK can support 115kbps (and even beyond) while the OOK modulation can only support some tens of kbps at maximum. Because of the future proofness, the chosen modulation method should have capability for higher bit rates.

Future proofness of Layer 1

The protocol requirement in the TR 25.802 v0.3.2 says:

- Transport protocol stack of the RET antenna control interface shall be future-proof in terms of availability, compatibility, performance, capacity and addressing capabilities, allowing the same transport protocol stack to be used for other controlling purposes than RET antenna control.

To comply with the existing requirement on future proofness that is there in the TR, the modulation method has to have potential for high bit rates. The coaxial cable itself has potential to very high bit rates, so it can be questioned whether it is reasonable to restrict that capability intentionally with the modulation method. If there is later need to have higher bit rates (we don't know yet what kind of additions antenna interface includes in the future), it will be a big challenge to change the modulation. It would also be a backward incompatible change. This means that all the old equipment would have to be replaced/upgraded to support the new modulation.

D-QPSK modulation supports bit rates up to Mbps, and in that sense it is more future proof. For example the DVB-T uses variant of D-QPSK, and its bit rate is multiple Mbps. There are also many other existing applications that are based on D-QPSK or its variants (TETRA, IS-136, etc.).

Also, even if there would not be any future extensions of Luant defined in 3GPP, there will likely be other devices attached to the Luant interface. The vendors might implement many proprietary extensions to the antenna line and it would be much cheaper to re-use same L1+L2 in the proprietary systems than to develop a new modulation method, in addition to the existing standard based modulation.

The Cost

When the bit rates are very small, the cost benefit is for the OOK modulation. However, when the bit rate increases the cost difference between the OOK and DQPSK modulation implementation will approach each other. When increasing the bit rate, the upper limit is soon reached for OOK due to its physical characteristics (ref. above).

Coaxial Cable length

D-QPSK can support longer coaxial cable feeds than OOK with the same power level. This is one consequence of the spectrum efficiency of D-QPSK.

In TR 25.802 v0.4.0 three bit rates are foreseen but only one is mandatory as basic support: 9.6 kbps in the proposal one. The need of higher bit rates supported by secondary stations is investigated.

Technical requirements

In terms of technical performance, it has been demonstrated at RAN3#41 that 9.6 kbps was sufficient for the need of control of the antenna line devices foreseen such as RET.

The exchange between the primary station and the secondary station is organized around a master-slave communication and therefore the primary interrogates a secondary station and waits for the response. It will not send a new interrogation until it has received the first response.

A request is given to be at maximum 100 bytes long which gives a time taken for the transmission at 9.6 kbps less than 100 ms. Therefore, the primary station will accept the response if received within 10 ms plus 100 ms which equals 110 ms. This is enough considering the critical minimum interval set for the polling i.e. 300 ms. Working at 9.6 kbps will not generate conflicts on the line.

The only feature for which higher bit rates were considered was the software download. But this feature works also on a segment basis after the download start. Also the maximum typical size that was considered as applicable was 50 kbytes

The O&M of Node B is separated in two parts: the O&M linked to the actual implementation of Node B, denoted as Implementation Specific O&M, and the O&M which impacts on the traffic carrying resources in Node B controlled from the RNC, denoted *logical O&M*. The RNS architecture with the O&M interfaces is shown in figure 9.

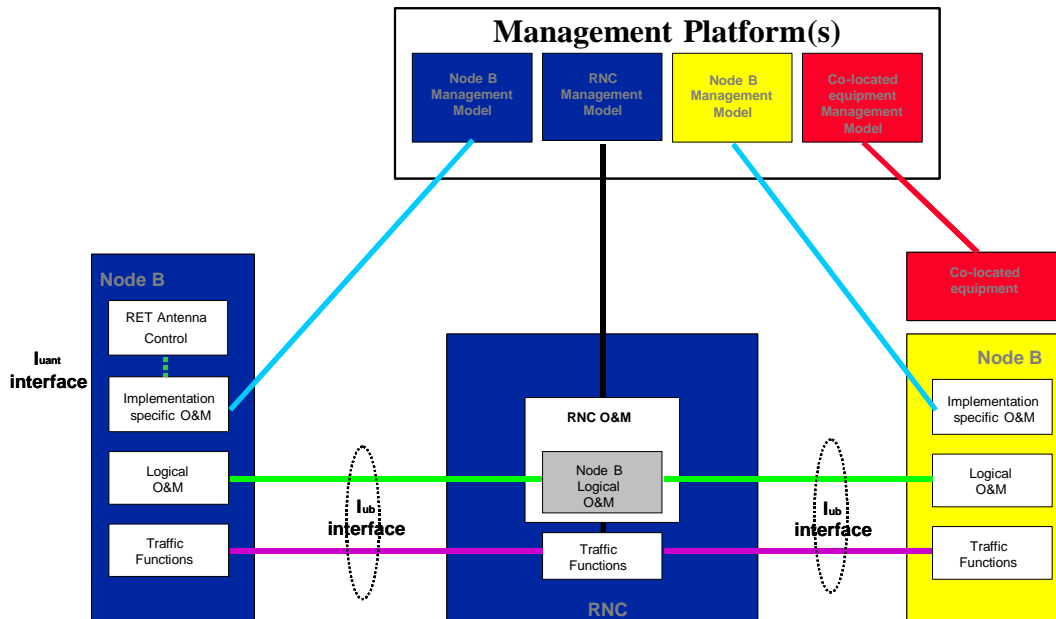


Figure 9: RNS architecture with O&M interfaces

NOTE 1: The concept of an interface from the RNC to the management system is shown for clarity only. Its definition is outside the scope of 3GPP-TSG-RAN-WG3.

NOTE 2: The presentation of the O&M functions within the management system is shown for clarity only. Their actual implementation is outside the scope of 3GPP-TSG-RAN-WG3.

NOTE 3: The standardisation of the Implementation Specific O&M is outside the scope of 3GPP-TSG-RAN-WG3. The 3GPP-TSG-RAN-WG3 should only address the bearer for the Implementation Specific O&M.

NOTE 4: The figure shows only logical connections and does not intend to mandate any physical interfaces.

NOTE 5: The Iuant interface to the control unit of the RET antenna is specified in TS 25.460 [9]. The implementation specific O&M function of the Node B is used to translate the control signalling into the “RET Antenna Control” function of the Node B.

10.1.1 Implementation Specific O&M

The Implementation Specific O&M functions are heavily dependent on the implementation of Node B, both for its hardware components and for the management of the software components. It needs therefore to be implementation dependent, and be performed between Node B and the management system.

An Implementation Specific O&M function is needed for the RET antenna control to translate the control signalling from the Node B Element Manager into the control commands of the Iuant interface specified in TS 25.460 [9].

One solution for the transport of Implementation Specific O&M is to route from Node B to the management system via the RNC. In this case, the Implementation Specific O&M interface and Iub interface share the same physical bearer, and [8] specifies the routing function and the transport bearer for this scenario. The deployment of the routing across the RNC in the UTRAN is optional. Where signalling between co-located equipment and its management system is required, this may be carried over the same bearer as Implementation Specific O&M.

10.1.2 Logical O&M

Logical O&M is the signalling associated with the control of logical resources (channels, cells, ...) owned by the RNC but physically implemented in the Node B. The RNC controls these logical resources. A number of O&M procedures physically implemented in Node B impact on the logical resources and therefore require an information exchange

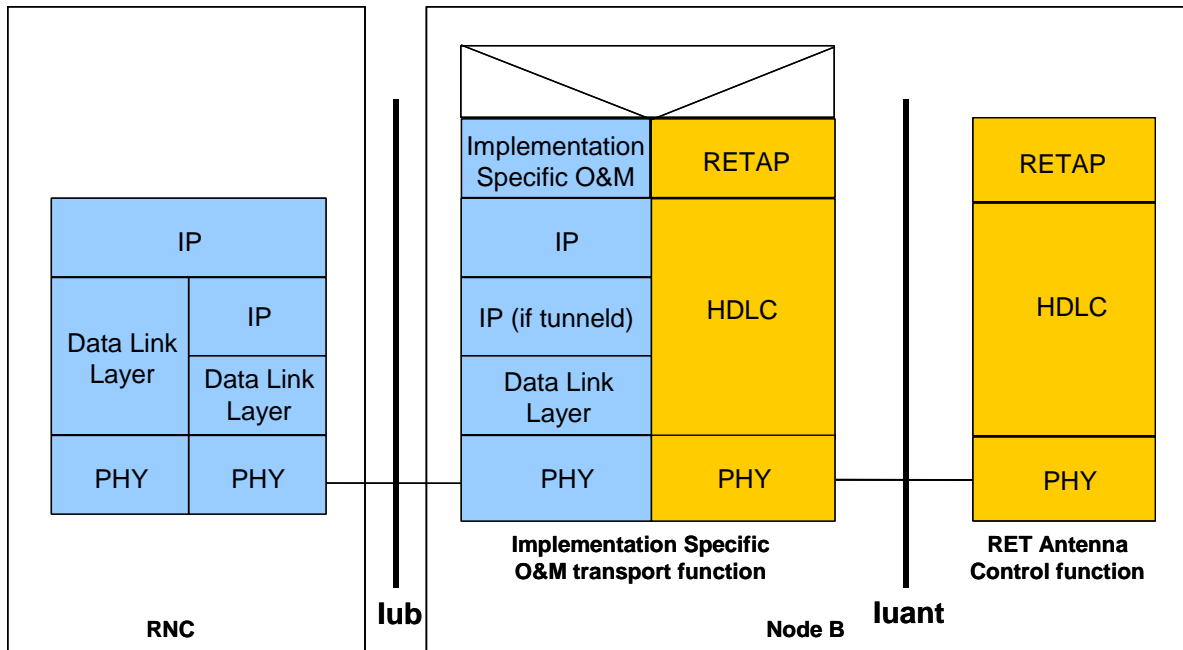


Figure 7.2: Protocol Structure for Implementation Specific O&M with IP-Transport Option

As the Iuant and the Implementation Specific O&M transport are different interfaces with e.g. different addressing schemes a mediation function is needed. This mediation function uses on one side a protocol that uses the implementation specific O&M bearer (e.g. IP) and on the other side the Iuant protocol.

7.4 Physical Layer

There are two layer 1 options:

- A screened multicore cable, which supports a conventional RS485 serial multi-drop bus
- A connection to a RET control unit by way of a coaxial cable which is shared with DC supply and RF signals

Both layer 1 options support the connection of two-way serial data and DC power to the RET antenna device.

At least one of these two layer 1 options needs to be supported.

The default data rate for both layer 1 options shall be 9.6 kbps. Higher data rates of 38.4 kbps for both layer 1 options and 115.2 kbps only for the RS485 layer 1 option may optionally be supported. Each unit communicates on one of the three data rates, but different units on the same interface may use different data rates.

Data rates:

- 9.6 kbps
- 38.4 kbps
- 115.2 kbps

The format of the data shall be:

- 8 data bits No parity
- 1 start bit NRZ-L encoding
- 1 stop bit

7.4.1 RS485 Serial Data Bus

The data bus shall be a two wire bi-directional multi-drop configuration conforming to [3].

7.4.2 Coaxial Interface: Modem Characteristics

7.4.2.1 Interference with Existing Systems

The modem must not interfere with existing communications in BTS systems, so a unique carrier frequency for each different communication channel on a common feeder cable is necessary.

The modem circuit must be capable of managing its transmitting characteristic according to section 7.4.2.5 and providing filtering for its receiver according section 7.4.2.6.

The following frequency (referred to as f_0 in figure 7.3) should be used for this application:

$$2.176 \text{ MHz } \pm 100 \text{ ppm}$$

7.4.2.2 Recovery Time

Due to hardware limitations a minimum recovery time must be allowed between transmitting and receiving messages on the bus. For this reason a minimum permitted response time is specified in section 7.5.10.

7.4.2.3 Impedance

The modem transceiver shall provide constant impedance in both transmitting and receiving modes:

- Nominal impedance Z_0 : 50 Ω
- Return loss at nominal carrier frequency > 6 dB

7.4.2.4 Modulation

On-off-keying: Logical 1: Carrier OFF Logical 0: Carrier ON

7.4.2.5 Modulator Characteristics

➤ Levels

ON-Level: +3 dBm \pm 2 dB OFF-Level: \leq -40 dBm

➤ Spurious Emissions

Spurious emissions shall not exceed the mask shown in figure 7.3. Intermediate values may be obtained by linear interpolation between the points shown. In addition, out-of-band emissions must conform to the requirements in [4].

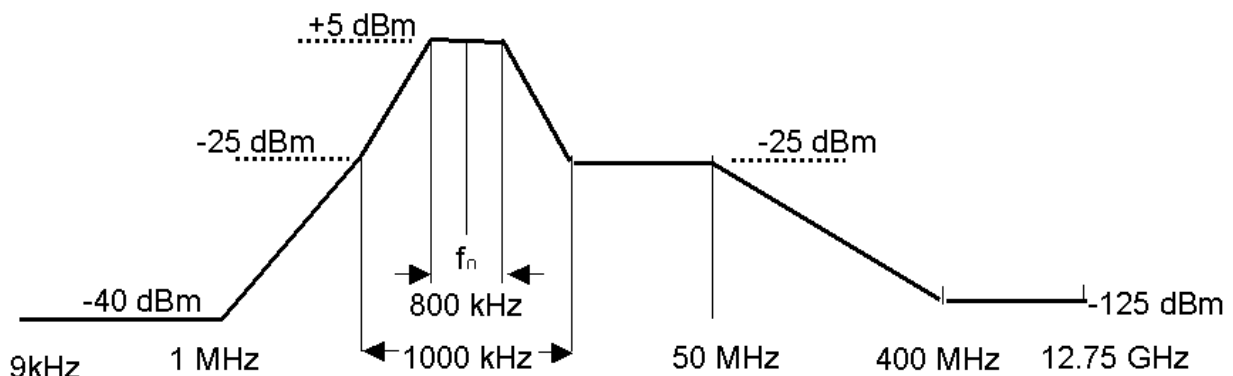


Figure 7.3: Spectrum Mask for Modems

7.4.2.6 Demodulator Characteristics

Requirements for demodulators operating with different frequencies on the same coaxial cable need further study.

➤ **Threshold**

Threshold: $-15 \text{ dBm} \pm 3 \text{ dB}$

7.4.2.7 Duty Cycle Variation

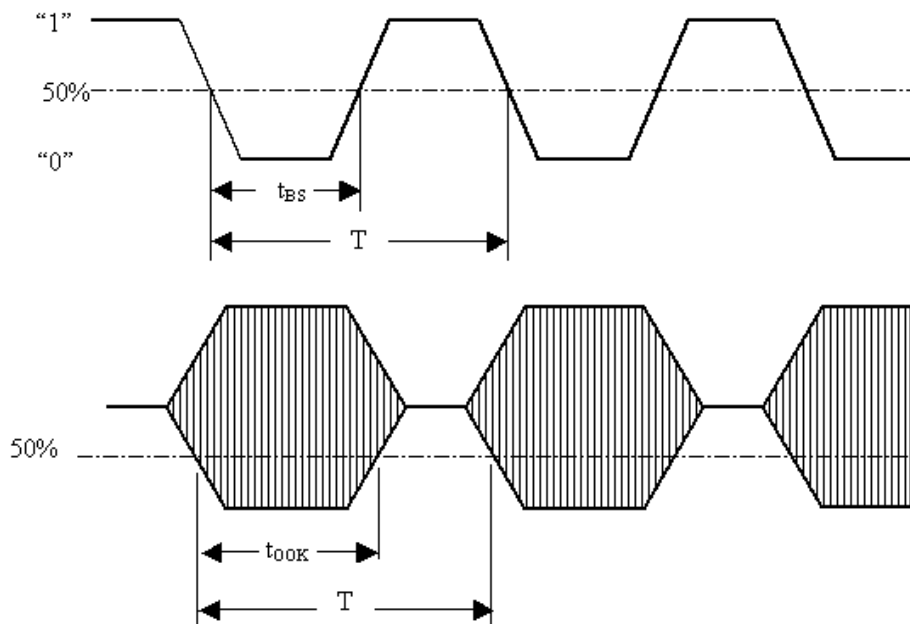
In order to guarantee proper transmission of data bits through the processes of modulation and demodulation, the duty cycle of the received binary data stream may not vary too much from that of the transmitted duty cycle. Specifically the following limit must be met:

$$\Delta DC_{\text{SYSTEM}} = |DC_{\text{RX}} - DC_{\text{TX}}| \leq 10\%$$

Where: $\Delta DC_{\text{SYSTEM}}$ is the difference between the duty cycles of the transmitted and received bit streams,

DC_{TX} = Duty cycle for the input bit stream, and

DC_{RX} = Duty cycle for the output bit stream.



Duty cycle for bit stream = t_{BS}/T ; duty cycle for OOK = T_{OOK}/T

Figure 7.4: Duty Cycles of the Bit Stream and OOK Modulated Subcarrier

For transmission through a coaxial cable, two converters are required, one from a bit stream to OOK (modulator) and one from OOK back to a bit stream (demodulator), so for each converter half of the total duty cycle tolerance is available.

For an input bit stream with a duty ratio of 50%, the cascaded modulator and demodulator must provide an output bit stream with a duty ratio within the limits 40% – 60%, measured in each case at 0.5 times peak amplitude (see figure 7.4).

7.5 Data Link Layer

The data link layer is based on a subset of the standardised ISO HDLC which conforms to the requirements in [2].

Any device on the interface shall have full performance and functionality also when:

- Other devices communicate on the interface, assuming their communication fulfil section 7.5.1.
- Other devices communicating on the interface uses another bit rate.

7.5.1 HDLC Format

7.5.1.1 Operating Mode

The operating mode shall be normal response mode (NRM) with two way alternate (TWA) communication. This mode requires that the primary device as a master is always in control of the bus and the secondary device only answers frames sent by the master. The secondary device cannot send any frame independently. The primary device is the Node B Implementation Specific O&M function whereas the secondary device is the Node B RET Antenna function often physically located at the top of the antenna mast.

The channel state shall be start/stop transmission.

7.5.1.2 Control octet transparency

Control octet transparency shall be implemented in accordance with Paragraph 4.3.2.2 in [2]. This requirement applies to all frame types.

7.5.2 Frame Checking Sequence Field

The Frame Checking Sequence Field (FCS) shall be calculated in accordance with [2] on all bytes following the start flag up to, but not including, the CRC field.

7.5.3 HDLC Command Sub-set

The protocol shall support the following HDLC commands, which are based upon the TWA, UNC (no options) commands list provided in Annex D of [2].

Table 7.5.3.1: Frame Types used for the Transport Layer

Commands (Primary Device)	Responses (Secondary Device)
Frame type I	Frame type I
Frame type RR	Frame type RR
Frame type SNRM	Frame type UA
Frame type DISC	Frame type DM
Frame type XID	Frame type RNR
	Frame type FRMR (optional)
	Frame type XID

The I-frame and INFO field formats for both primary and secondary devices shall be as illustrated in figure 7.5. INFO fields are only used with I-frames.

The Frame Control Field shall be formatted in accordance with Paragraph 5.3.1, Table 3 in [2].

HDLC-Frame:

Flag 8bit	ADDR 8bit	Control 8bit	INFO N x 8bit	CRC 2 x 8bit	Flag 8bit

0x7E	Device Address	Control bits	Variable length (must support a maximum length of at least 74 bytes)	CRC1 low byte	CRC2 high byte	0x7E
------	----------------	--------------	---	---------------------	----------------------	------

Start byte (constant)	Command ID	Number of data bytes		Data bytes
1 byte value tbd	1 byte	low byte	high byte	Variable length (must support a maximum length of at least 70 bytes)

Figure 7.5: Format of the I-Frame and INFO Field

Devices shall support the following data length:

- Mandatory: $0 \leq \text{data bytes} \leq 70$ bytes
- Optional: $0 \leq \text{data bytes} < 65,535$ bytes

To allow for the use of frames longer and window sizes larger than the default sizes the following transport layer XID-frame may be sent by the primary device to determine the maximum information field length and window size supported by a secondary device. (Refer also to Paragraph 5.5.3 in [2].)

XID Frame from primary device:

Table 7.5.3.2: XID Frame from Primary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	1	Length of the parameter field (PI)
PI	5	Maximum I Field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I Field length Transmit
PI	6	Maximum I Field length Receive
PL	Nrx	Length of the bytes value
PV	Value	Maximum I Field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field
PV	Value	Maximum window size Transmit
PI	8	Maximum window size Receive

PL	N	Length of the window size
PV	Value	Maximum window size Receive

Response from secondary device:

The secondary device checks to see if it can support the values provided in the command. If the secondary device can support the values then it replies with the same value. If the secondary device can not support these values then it replies with the maximum values that can be supported.

Table 7.5.3.3: XID Frame from Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	Length	Length of the PI field
PI	5	Maximum I field length Transmit
PL	Ntx	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	6	Maximum I field length Receive
PL	Nrx	Length of the PV field (bytes)
PV	Value	Maximum I field length Receive
PI	7	Maximum window size Transmit
PL	N	Length of the PV field (bytes)
PV	Value	Maximum I field length Transmit
PI	8	Maximum window size Receive
PL	N	Length of the PV field (bytes)
PV	Value	Maximum window size Receive

If the secondary device does not provide a valid response, then the default frame length and window size are to be used.

7.5.4 HDLC Address

After power-up the HDLC address shall be set to No-station address (0x00). The secondary device compares its own address with the Address field of the received frames from the bus. If the addresses are equal or an All-station address (0xFF) is received the frame is accepted and shall be processed.

7.5.4.1 Address configuration

Before communication can be established on a bus it is necessary to configure the addresses of the devices connected to it. Address assignment is mediated by the use of an XID frame carrying data fields as specified in Paragraph 5.5.3 of [2].

7.5.4.1.1 Address Assignment Command

The format of the XID frame originated by the primary device shall be as follows:

Table 7.5.4.1.1.1: Format of the Address Assignment Command from the Primary Device

Field	Content	Description
ADDR	0xFF	All-station address (Broadcast)
CTRL	XID	Command
FI	0x82	Format identifier
GI	0xF0	User defined parameter set
GL	n+14	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	N	Length of PV field in bytes
PV	unique ID	Vendor id/serial number (n bytes)
PI	2	Parameter id 2 = address
PL	1	Length of PV field in bytes
PV	1 – 254	Assigned address
PI	3	Parameter id 3 = Vendor Code as given in [15]
PL	2	Length of PV field in bytes
PV	Vendor Code	Unique assigned vendor code
PI	4	Parameter id 4 = Device Type
PL	1	Length of PV field in bytes
PV	Device Type	Device Type: RET = 0x01
PI	5	Parameter id 5 = 3GPP Release-ID
PL	1	Length of PV field in bytes
PV	Release-ID	Latest supported 3GPP Release version

7.5.4.1.2 Address Assignment Response

The secondary device verifies the validity of the XID command. Thereafter the secondary device matches PV1, PV3 and PV4.

➤ To fulfil the PV1 match, the following two rules must be valid:

1. Length of given unique ID shall be less or equal to the length of its own unique ID.

2. When compared character by character, from right to left, they shall match.
- To fulfil the PV3 match, one of the following two rules must be valid:
1. The given PV3 is a wild card.
 2. The given PV3 matches exactly
- To fulfil the PV4 match, one of the following two rules must be valid:
1. The given PV4 is a wild card.
 2. The given PV4 matches exactly.

Table 7.5.4.1.2.1: Format of Address Assignment Response from the Secondary Device

Field	Content	Description
ADDR	#	Device address
CTRL	XID	Command
FI	0x82	Format identifier
GI	0xF0	User defined parameter set
GL	n+14	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	N	Length of PV field in bytes
PV	unique ID	Vendor id/serial number (n bytes)
PI	2	Parameter id 2 = address
PL	1	Length of PV field in bytes
PV	1 – 254	Assigned address
PI	3	Parameter id 3 = Vendor Code
PL	2	Length of PV field in bytes
PV	Vendor Code	Unique assigned vendor code as given in [15]
PI	4	Parameter id 4 = Device Type
PL	1	Length of PV field in bytes
PV	Device Type	Device Type: RET = 0x01
PI	5	Parameter id 5 = 3GPP Release-ID
PL	1	Length of PV field in bytes
PV	Release-ID	Latest supported 3GPP Release version

NOTE: Details on Format of Address Assignment Response to be verified.

In case of a match it changes its address to the one supplied in the second PV. It then responds with an XID frame transmitted from its new address.

If the match fails, the secondary device does nothing.

After the assignment of its address a secondary station enters the connected state.

7.5.4.1.3 Device Scan Command

NOTE: The Device Scan Procedure is **ffs**. The information given in this section may deal as a basis.

In some situations it may be found that the unique ID of a bus device is unknown or has been inaccurately recorded. This HDLC command exchange is used by the primary device to perform a binary tree scan of the bus, in order to identify all connected devices, and is always carried out at 9.6 kbps.

Table 7.5.4.1.3.1: Primary Device Scan Command (XID Frame)

ADDR	0xFF	All-station address (Broadcast)
CTRL	XID	Command
FI	0x82	Format identifier
GI	0xF0	User defined parameter set
GL	2*n+4	Length of parameter field
PI	1	Parameter id 1 = unique id
PL	n	Length of PV field in bytes
PV	unique id	Vendor id/serial number (n bytes)
PI	3	Parameter id 3 = bit mask
PL	n	Length of PV field in bytes (same as for PI=1)
PV	bit mask	Bit mask (n bytes)

➤ Device Scan Response

When each secondary device receives the command it masks its unique id with the bit mask and compares the result with the unique id supplied. If they match, the secondary device responds using any unnumbered format frame according to table 8 of section 5.5 of [2]. It is recommended that the response of individual devices is subject to a random delay (within the permitted response time) to aid collision detection at the primary device.

If there is no response, the primary device knows that no secondary device had those bits in its unique id, so the tree scan can be truncated at that branch.

If multiple secondary devices respond, the messages may arrive after each other or at the same time. In the first case multiple responses will arrive before the timeout, in the second case the responses might garble each other, unless one secondary device is close enough to overpower the signal from the other(s).

If any response arrives, a single frame, multiple frames or frames with incorrect checksums or framing errors, the primary device must assume that that branch of the tree is inhabited and scan through it.

7.5.4.1.4 Line Data Rate

A secondary device supporting multiple line data rates listens alternating on the supported data rates until a valid Address Assignment command is detected. The secondary device then remains on that data rate until disconnected.

7.5.5 Window Size

The default window size is 1.

7.5.6 Connection Establish

Once the secondary device is assigned an address, the SNRM message is used to establish the connection, see paragraph 5.5.3.3.1 in [2].

7.5.7 Disconnect

The primary device sends a DISC-frame to the secondary device. The secondary device responds with a UA-frame and enters the disconnected state.

If the secondary device is in disconnected mode, it shall respond as defined in Paragraph 5.2.2.1 of [2].

7.5.8 Polling

On reception of a frame with correct FCS and matching address and with the poll-bit set as specified in [2], the secondary device is required to transmit frames on the bus within the times defined in section 7.5.10.

If the secondary device has an I-frame to transmit it shall do so. If it does not have an I-frame to transmit it shall respond with either an RR or RNR frame. If it is unable to receive I-frames, for instance because it has run out of empty buffers, it shall respond with RNR. Otherwise it shall respond with RR (see also Appendix B in [2])

This polling procedure provides the application part of the protocol with a full-duplex link, allowing the application part to spontaneously transmit messages, such as alarm messages.

If the secondary device does not receive a poll within 3 minutes of the previous poll, it shall perform a software reset.

NOTE: In the event that the primary device receives no responses from a secondary device, it is recommended that it signals loss of connection to its Element Manager.

7.5.9 Information

One I-frame is used for one message, so fragmentation is not required. If the primary device sends a command to the secondary device, one I-frame is generated and sent. The secondary device can respond with any valid HDLC response belonging to the subset of RET control commands.

7.5.10 Message Timing

A minimum of 3 ms must elapse between transmitting and receiving messages on a bus.

The primary device should receive a complete response frame within 10 ms plus the time taken for the transmission of 100 bytes from the time the final flag byte is transmitted. The secondary device should start to transmit a response within 10 ms. The time occupied by the transmission of 100 bytes allows time-outs to include transmission time, with 10 ms allowed for processing.

The RS485 interface must be driven for at least 200 μ s before the start bits are transmitted to ensure a proper settling of the receiver UART.

7.6 Functions of the Interface

7.6.1 Software Download

The interface provides means for downloading new Software to a secondary device. The support of Software Download to a secondary device is optional.

NOTE: Details on the Software Download procedure are [ffs](#).

7.7 RET Control Application Part

7.7.1 Command Format

Apart from address configuration, which uses the XID frame, commands to devices are transmitted within the HDLC INFO field. The general format for all commands is the following:

Table 7.7.1.1: General Format for all Commands

Command	Number of data bytes	Data bytes
1 byte	2 bytes	max 70 bytes (basic implementation)

7.7.2 Response Format and Return Codes

All responses from devices are transmitted in the HDLC INFO field. The general format for all responses is the following:

Table 7.7.2.1: General Format for all Responses

Command	Number of data bytes	Data bytes
1 byte	2 bytes	max 70 bytes (basic implementation)

The maximum time for all responses shall be 1 second unless specified in the individual command. Tilt setting, calibration and self test will typically require a longer period for completion of the command.

One or more return codes are transmitted in the data bytes.

A complete annotated table of all available return codes with their corresponding hexadecimal numbers is provided in section 7.8 of this TR.

7.7.3 Multi-Antenna Units

To support RET units controlling multiple antennas, the RETAP is split into one RET unit-oriented part and one antenna-oriented part. The RET unit responds, upon request, then number of antennas it controls. All antenna-oriented commands include a parameter stating which antenna the command addresses.

7.7.4 Overview of Commands

The set of commands for RET antenna control provides command-oriented instructions.

Table 7.7.4.1: Command Set and Command Numbers

Command	Command number	Comment
<u>RET Unit Commands</u>		
(Reserved)	0x01	Device operation, mandatory
Reset	0x03	Device operation, mandatory
Get Error Codes	0x10	Device operation, mandatory
Get H/W & S/W Info	0x05	Device operation, mandatory
Clear Alarms	0x06	Device operation, mandatory
Alarm	0x07	Device operation, mandatory
Self Test	0x0A	Device operation, mandatory
Set Device Data	0x0E	Device operation, mandatory
Get Device Data	0x0F	Device operation, mandatory
<u>Single-Antenna Commands</u>		
		Note 1
Calibrate	0x31	Single-Antenna Control
Send Config data	0x32	Single-Antenna Control
Set Tilt	0x33	Single-Antenna Control
Get Tilt	0x34	Single-Antenna Control
<u>Multi-Antenna Commands</u>		
		Note 1
Antenna Calibrate	0x80	Multi-Antenna Control
Antenna Set Tilt	0x81	Multi-Antenna Control
Antenna Get Tilt	0x82	Multi-Antenna Control
Antenna Set Data	0x83	Multi-Antenna Control
Antenna Get Data	0x84	Multi-Antenna Control
Antenna Alarm	0x85	Multi-Antenna Control

NOTE 1: Single-Antenna commands are not mandatory in case Multi-Antenna devices are implemented and Multi-Antenna commands are optional in case Single-Antenna devices are implemented.

7.7.5 Control Commands

In response to all Application Part commands from the primary device, the addressed secondary device shall respond with <OK> whenever a normal outcome to the command has resulted, and <FAIL> otherwise. Additional parameters may be associated with the response <OK> and a variety of defined return codes (error messages) with the response <FAIL> as described in the following paragraphs. Return codes are also used as autonomous alarm responses (see section 7.7.5.5 for details).

A summary table and interpretation of all defined return codes is provided in section 7.8 of this TR. When return codes are used, they shall have meanings consistent with those described.

7.7.5.1 Reset Software

Command Name: Reset

This command resets the device software, restarts the software, sets the HDLC address to the No-station address and places the device in the disconnected state.

Data field command to secondary device:

0x03 0x00 0x00

Data field response from secondary device before the reset command is executed:

0x03 0x01 0x00 <OK>

The device must not execute the reset before transport layer acknowledgement through sequence number update is received for the response. (See Appendix B in [2]).

The Reset command must be executed in all situations. The secondary device must not fail to reset because it is busy or for any other reason of its software state.

7.7.5.2 Get Error Codes

Command Name: GetErrorCodes

This command requests remotely the error codes supported by a secondary station.

Data field command to secondary device:

0x10 0x00 0x00

Data field response from secondary device:

0x10 <LengthLowByte> <LengthHighByte> <OK> <ErrorCode1><ErrorCode2>...<ErrorCodeN>

This is a normal response. The request to get supported error codes has been executed correctly and the supported error codes are returned.

Data field response from secondary device in case of error in performing the command:

0x10 <LengthLowByte> <LengthHighByte> <FAIL>

This is an abnormal response.

7.7.5.3 Read Hardware and Software Information

Command Name: GetInfo

This command reads hardware information and the software version from a secondary device. The software version must indicate the version number of the currently installed software, whether installed at the time of manufacture or during subsequent upgrade.

Data field command to secondary device:

0x05 0x00 0x00

Data field response from secondary device:

0x05 <LengthLowByte> <LengthHighByte> <OK> <Length> <Prod Nr> <Length> <SerNo> <Length> <HW Version> <Length> <SW Version>

ProdNr is the product type number and SerNr is the unique serial number of the individual unit.

HW Version and SW Version refer to the version designators of the hardware and installed software of the secondary device. If the application is missing or no version number is found, then an empty string shall be returned as the version number.

Data field response from secondary device in case of error in performing the command

0x05 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

7.7.5.4 Clear Stored Alarms

Command Name: ClearAlarms

This command clears alarm information which is stored in the secondary device.

Data field command to secondary device:

0x06 0x00 0x00

Data field response from secondary device after clearing the alarm flags:

0x06 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command

0x06 <LengthLowByte> <LengthHigh Byte> <OK> <ReturnCode1>...<Return CodeN>

7.7.5.5 Poll Response from Secondary Device: Alarm

Response Name: Alarm

The Transport Layer provides a virtual full-duplex link to the Application Part. This virtual full-duplex link is used to simplify alarm reporting.

The secondary device reports every change in error status by transmitting an alarm message in response to a poll. Formally this is a response message, even though (on Application Part level) it is a spontaneous message. There is no Application Part command to request an alarm response message.

The alarm message contains a list of error-code/state-flag pairs. The state flag indicates that an error has occurred (StateFlag = 1) or cleared (StateFlag = 0).

Only error codes whose state has changed shall be included in the list. The secondary device may group several error codes into one message, but their sequence in the message must then reflect the sequence in which they occurred.

A rapid setting/clearing sequence of the same alarm may be reported in the same alarm message in the order in which they occurred (FIFO).

In the event that the rapid state changes cause overflow of the available buffers, the oldest error code changes shall be discarded and the later ones retained for transmission.

Autonomous data field response from secondary device if an error state has changed since the previous poll from the primary device:

0x07 <LengthLowByte> <LengthHigh Byte> <Return Code1> <StateFlag1>...<Return CodeN> <StateFlagN>

Alarm return codes are defined in section 7.8 of this TR.

NOTE: Alarm handling with regards to Multi-Antenna Control is **ffs**.

7.7.5.6 Self Test

Command Name: SelfTest

This command executes a test function at the device which may include a check of physical and processor functions.

The response from the command provides the user with information on detected faults or, if no fault is detected, with confidence that the operation of the device is normal in all respects.

During the test the operational parameters of the device shall not change beyond operationally acceptable limits and on completion all parameters shall be returned to their initial values.

Data field command to secondary device:

0x0A 0x00 0x00

Data field response from secondary device:

0x0A <LengthLowByte><LengthHighByte><OK><ReturnCode1>...<ReturnCodeN>

This is a normal response in which the self test was executed with return codes set to report possible detected functional errors during the test. If no errors are detected, this shall be signalled by no return codes following <OK>.

Data field response from secondary device in case of error in performing the command:

0x0A <LengthLowByte><LengthHighByte><FAIL><ReturnCode1>...<ReturnCodeN>

In this case the self test could not be executed and the return codes relate to the inability of the device to perform the requested self-test operation.

7.7.5.7 Set Device Data

Command name: SetDeviceData

This command is used to write data into the fields optionally provided for configuration data and listed in section 7.9 of this TR. If an attempt is made to write to fields which are not supported by a particular device no error is returned but the data for those fields is ignored.

Data field command to secondary device:

0x0E <LengthLowByte> <LengthHighByte> <FirstParameterNumber> <data bytes for first parameter>
<SecondParameterNumber> <data bytes for second parameter> <ThirdParameterNumber>
<data bytes for third parameter>...<Nth ParameterNumber> <data bytes for Nth parameter>

Data field response from secondary device:

0x0E 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x0E <LengthLowByte> <LengthHighByte><FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.5.8 Get Device Data

Command Name: GetDeviceData

This command is used to read data stored in the fields optionally provided for configuration data and listed in section 7.9 of this TR. If an attempt is made to read fields which are not supported by a particular device no data is returned for that field. The command contains a list of the field numbers of those fields whose contents are to be returned in the response from the secondary device. The field numbers are not necessarily contiguous or ordered.

Data field command to secondary device:

0x0F <LengthLowByte> <LengthHighByte> <0x01> <0x02> <0x03>...<0x0N>

Data field response from secondary device:

0x0F <LengthLowByte> <LengthHighByte> <OK> <0x01> <data bytes for parameter 1>
<0x02> <data bytes for parameter 2> <0x03> <data bytes for parameter 3>...<0x0N> <data bytes for parameter N>

Data field response from secondary device in case of error in performing the command:

0x0F <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.5.9 RET Calibration

Command Name: Calibrate

This command is sent after installation of a RET. Calibration entails ensuring that the actuator is driven through its whole tilt range.

After reset or power failure no calibration is normally required. There may occasionally be unforeseen errors where calibration could be required to return the RET to a correct no-error status.

The response time shall be less than 4 minutes.

Data field command to secondary device:

0x31 0x00 0x00

Data field response from secondary device:

0x31 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x31 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

7.7.5.10 RET Send Configuration Data

Command Name: SendConfigData

This command may be required after installation of any RET unless already performed by the vendor before delivery. It loads vendor and antenna specific configuration data to establish the relationship between the movement of the drive system and the beam tilt position of the antenna.

When specified by the vendor the data must be loaded during the installation procedure. (Typically this may be necessary because the same type of drive unit (RET) may be used in association with different antenna types, each requiring different configuration data.)

Data field command to secondary device:

0x32 <LengthLowByte> <LengthHigh Byte> <DataByte1>...<DataByteN>

Data field response from secondary device:

0x32 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x32 <LengthLowByte> <LengthHigh Byte> <FAIL> <Return Code1>...<ReturnCodeN>

7.7.5.11 RET Set Tilt

Command Name: SetTilt

This command sets the electrical tilt value in increments of 0.1°. The electrical tilt value describes the elevation angle between the direction orthogonal to the antenna element axis and the maximum of its main beam in the elevation plane. A positive electrical tilt angle means that the antenna beam is directed below the direction orthogonal to the antenna axis. An antenna has separate values for electrical and mechanical tilt. The mechanical tilt is fixed by the geometry of the installation. In this TR the tilt referred to is always the electrical tilt unless otherwise stated.

The response time shall be less than 2 minutes.

The format of the demanded tilt shall be a 2-complement 16 bit signed number sent in little-endian order.

Data field command to secondary device:

0x33 0x02 0x00 <TiltLowByte> <TiltHigh Byte>

Tilt values are specified in 0.1° increments starting from zero, for example: Tilt 3.2° is 0x0020 (stored as <0x20> <0x00>), Tilt - 3.2° is 0xFFE0, stored as <0xE0> <0xFF>).

Data field response from secondary device:

0x33 0x01 0x00 <OK>

Data field response from secondary device in case of error in performing the command:

0x33 <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.5.12 RET Get Tilt

Command Name: GetTilt

This command requests the current tilt value.

The response is made in increments of 0.1° in the format specified in section 7.7.5.11.

Data field command to secondary device:

0x34 0x00 0x00

Data field response from secondary device:

0x34 0x03 0x00 <OK> <TiltLowByte> <TiltHighByte>

Data field response from secondary device in case of error in performing the command:

0x34 <LengthLowByte> <LengthHighByte> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.6 Multi-Antenna Commands

7.7.6.1 Multi-Antenna Calibration

Command Name: Antenna Calibrate

This command is sent after installation of a Multi-Antenna device. Calibration entails ensuring that the actuator is driven through its whole tilt range for the antenna given by the Antenna Number.

After reset or power failure no calibration is normally required. There may occasionally be unforeseen errors where calibration could be required to return the Multi-Antenna device to a correct no-error status.

The response time shall be less than 4 minutes.

Data field command to secondary device:

0x80 0x01 0x00 <Antenna Number>

Data field response from secondary device:

0x80 0x02 0x00 <Antenna Number> <OK>

Data field response from secondary device in case of error in performing the command:

0x80 <LengthLowByte> <LengthHighByte> <Antenna Number><FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.6.2 Multi-Antenna Set Tilt

Command Name: Antenna Set Tilt

This command sets the electrical tilt value in increments of 0.1°. The electrical tilt value describes the elevation angle between the direction orthogonal to the antenna element axis and the maximum of its main beam in the elevation plane. A positive electrical tilt angle means that the antenna beam is directed below the direction orthogonal to the antenna axis. An antenna has separate values for electrical and mechanical tilt. The mechanical tilt is fixed by the geometry of the installation. In this TR the tilt referred to is always the electrical tilt unless otherwise stated.

The response time shall be less than 2 minutes.

The format of the demanded tilt shall be a 2-complement 16 bit signed number sent in little-endian order.

Data field command to secondary device:

0x81 0x03 0x00 <Antenna Number> <TiltLowByte> <TiltHighByte>

Tilt values are specified in 0.1° increments starting from zero, for example: Tilt 3.2° is 0x0020 (stored as <0x20> <0x00>), Tilt – 3.2° is 0xFFE0, stored as <0xE0> <0xFF>).

Data field response from secondary device:

0x81 0x02 0x00 <Antenna Number> <OK>

Data field response from secondary device in case of error in performing the command:

0x81 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.6.3 Multi-Antenna Get Tilt

Command Name: Antenna Get Tilt

This command requests the current tilt value.

The response is made in increments of 0.1° in the format specified in section 7.7.5.11.

Data field command to secondary device:

0x82 0x01 0x00 <Antenna Number>

Data field response from secondary device:

0x82 0x04 0x00 <Antenna Number> <OK> <TiltLowByte> <TiltHighByte>

Data field response from secondary device in case of error in performing the command:

0x82 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.6.4 Multi-Antenna Set Data

Command name: Antenna Set Data

This command is used to write data into the fields optionally provided for configuration data and listed in section 7.9 of this TR. If an attempt is made to write to fields which are not supported by a particular device no error is returned but the data for those fields is ignored.

Data field command to secondary device:

0x83 <LengthLowByte> <LengthHighByte> <Antenna Number> <FirstParameterNumber> <data bytes for first parameter> <SecondParameterNumber> <data bytes for second parameter> <ThirdParameterNumber> <data bytes for third parameter>...<Nth ParameterNumber> <data bytes for Nth parameter>

Data field response from secondary device:

0x83 0x02 0x00 <Antenna Number> <OK>

Data field response from secondary device in case of error in performing the command:

0x83 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.6.5 Multi-Antenna Get Data

Command Name: Antenna Get Data

This command is used to read data stored in the fields optionally provided for configuration data and listed in section 7.9 of this TR. If an attempt is made to read fields which are not supported by a particular device no data is returned for that field. The command contains a list of the field numbers of those fields whose contents are to be returned in the response from the secondary device. The field numbers are not necessarily contiguous or ordered.

Data field command to secondary device:

0x84 <LengthLowByte> <LengthHighByte> <Antenna Number> <0x01> <0x02> <0x03>...<0x0N>

Data field response from secondary device:

0x84 <LengthLowByte> <LengthHighByte> <Antenna Number> <OK> <0x01> <data bytes for parameter 1>
<0x02> <data bytes for parameter 2> <0x03> <data bytes for parameter 3>...<0x0N> <data bytes for parameter N>

Data field response from secondary device in case of error in performing the command:

0x84 <LengthLowByte> <LengthHighByte> <Antenna Number> <FAIL> <ReturnCode1>...<ReturnCodeN>

7.7.6.6 Poll Response from Secondary Device: Multi-Antenna Alarm

Response Name: Antenna Alarm

The Transport Layer provides a virtual full-duplex link to the Application Part. This virtual full-duplex link is used to simplify alarm reporting.

The secondary device reports every change in antenna error status by transmitting an antenna alarm message in response to a poll. Formally this is a response message, even though (on Application Part level) it is a spontaneous message. There is no Application Part command to request an alarm response message.

The antenna alarm message contains a list of error-code/state-flag pairs. The state flag indicates that an error has occurred (StateFlag = 1) or cleared (StateFlag = 0).

Only error codes whose state has changed shall be included in the list. The secondary device may group several antenna error codes into one message, but their sequence in the message must then reflect the sequence in which they occurred.

A rapid setting/clearing sequence of the same alarm may be reported in the same alarm message in the order in which they occurred (FIFO).

In the event that the rapid state changes cause overflow of the available buffers, the oldest error code changes shall be discarded and the later ones retained for transmission.

Autonomous data field response from secondary device if an antenna error state has changed since the previous poll from the primary device:

0x85 <LengthLowByte> <LengthHighByte> <Antenna Number> <ReturnCode1> <StateFlag 1>...<ReturnCodeN>
<StateFlag N>

Alarm return codes are defined in section 7.8 of this TR.

NOTE: Alarm handling with regards to Multi-Antenna Control is **ffs**.

7.7.7 Implementation Specific Commands

Implementation specific commands are internally implemented but not used for control or telemetry functions. These commands are used for test and development, and are not specified. All control and telemetry functions shall be accomplished using the specified commands defined in section 7.7.5.

Implementation Specific Commands and responses shall be formatted as follows:

0xFF <LengthLowByte> <LengthHighByte> <VendorID> (remaining format and content vendor specific.)

7.7.8 Unknown Commands

If a secondary device is unable to recognise a command, the secondary device shall respond as follows:

INFO field command to secondary device:

<Unknown Command> <LengthLowByte> <LengthHighByte> <Data1> ... <DataN>

INFO field response from secondary device:

<unknown command> 0x02 0x00 <FAIL> <ReturnCode>

7.8 Return Codes for Secondary Devices (normative Annex)

Table 7.8.1: Return Codes for Secondary Devices

Code	Meaning	
0x00	OK	Normal response
0x01	Actuator Detection Fail	Signals from the actuator are detected but are abnormal, for example due to failed calibration.
0x02	Actuator Jam Permanent	Actuator cannot be moved
0x03	Actuator Jam Temporary	Actuator jam has been detected. No movement was detected in response to the normal stimulus.
0x04	Block Number Sequence Error	Used in combination with software download; block number sequence is wrong.
0x05	Busy	The device is busy and cannot respond until an activity is complete.
0x06	Checksum Error	Used in combination with software download; checksum incorrect.
0x07	Command Sequence Error	Used in combination with software download; command sequence is not permitted, e.g. a SetTilt command is received during software update sequence.
0x08	Data Error	RET AP data fault, e.g. length of data is inconsistent with length fields.
0x09	Device Disabled	Device is in logical Disabled state and cannot execute Set commands.
0x0A	EEPROM Error	EEPROM error detected
0x0B	Fail	Abnormal response. Indicates that a command has not been executed.
0x0C	Flash Erase Error	Used in combination with software download; indicates error when erasing flash memory.
0x0D	Flash Error	Used in combination with software download; indicates error when writing to flash memory.
0X0E	Not Calibrated	The device has not completed a calibration operation, or calibration has been lost.
0x0F	Not Scaled	No setup table has been stored in the device.
0x11	Other Hardware Error	Any hardware error which cannot be classified.
0x12	Other Software Error	Any software error which cannot be classified.
0x13	Out of Range	Value specified by a Set Tilt command is not supported by the device.
0x14	Position Lost	RET controller is unable to return a correct position value, for example there was a power failure while a SetTilt command was being executed.
0x15	RAM Error	An error was detected in reading data to/from RAM

0x16	Segment Number Sequence Error	Used in combination with software download; block sequence number is wrong.
0x17	UART Error	Hardware specific. This error may be sent after recovery from a temporary error which has prevented the sending or receiving of data.
0x19	Unknown Command	Received command is not defined in the 3GPP release version transmitted in the frame header, or the device has received a vendor-specific command with a vendor ID different from its own.

NOTE: Error codes for Multi-Antenna devices are **ff**s.

7.9 Assigned Fields for Additional Data (normative Annex)

The following standard fields are used by the commands SetDeviceData and GetDeviceData. Little -endian order is used for storage of multiple-byte numbers. Where ASCII variables are shorter than the assigned field lengths the characters are right aligned and leading blanks are filled with null characters (0x00).

Table 7.9.1: Assigned Fields for Additional Data

Field No.	Length (bytes)	Format	Description
0x01	15	ASCII	Antenna model number
0x02	17	ASCII	Antenna serial number
0x03	2	16-bit unsigned	Antenna frequency band(s): see below
0x04	3	3 x 8-bit unsigned	Beamwidth for each band in frequency order (deg) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x05	3	3 x 8-bit unsigned	Gain for each band in frequency order (dB/10) (example 800/900MHz, 1800/1900MHz, 2100MHz)
0x06	2	16-bit signed	Maximum supported tilt (degrees/10), Format as in section 7.7.5.11
0x07	2	16-bit signed	Minimum supported tilt (degrees/10), Format as in section 7.7.5.11
0x21	6	ASCII	Installation date
0x22	5	ASCII	Installer's ID
0x23	12	ASCII	Base station ID
0x24	4	ASCII	Sector ID
0x25	2	16-bit unsigned	Antenna bearing
0x26	1	8-bit signed	Installed mechanical tilt (degrees/10)

Table 7.9.2: Coding for Antenna Frequency Bands in Field 0x03

	Field 0x03
Bit No	Frequency band(MHz)

1	800
2	900
3	1500
4	1800
5	1900
6	2100
7 and above	Reserved

Examples of frequency bands: 0000 0000 0001 0000 = 1800MHz,
0000 0000 0001 1100 = 1800, 1900 and 2100MHz

7.10 New Technical Specifications for RET Control

A new series of Technical Specifications for the Iuant interface for RET control will be introduced similar to the existing interfaces under TSG RAN WG3 responsibility:

- TS 25.460: UTRAN Iuant Interface: General Aspects and Principles
- TS 25.461: UTRAN Iuant Interface: Layer 1
- TS 25.462: UTRAN Iuant Interface: Signalling Transport
- TS 25.463: UTRAN Iuant Interface: RETAP Signalling

8 Specification Impact and associated Change Requests

8.1 Impact on existing Specifications

Only the UTRAN overall description in TS 25.401 needs to be updated in order to introduce the new Iuant interface for controlling of RET Antennas into the existing UTRAN architecture:

- TS 25.401 UTRAN Overall Description:
- http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_25/Docs/ZIP/RP-040303 " Introduction of Iuant into UTRAN architecture for control of RET Antennas";

8.2 New Specifications

In order to complete the Work Item on Control of RET Antennas a new series of technical specifications is introduced:

- TS 25.460: UTRAN Iuant Interface: General Aspects and Principles
- TS 25.461: UTRAN Iuant Interface: Layer 1
- TS 25.462: UTRAN Iuant Interface: Signalling Transport
- TS 25.463: UTRAN Iuant Interface: RETAP Signalling

9 Project Plan

9.1 Schedule

Date	Meeting	Scope	[e xpected] Input	[e xpected]Output
June 2004	RAN#24	RAN Information		TR approved
September 2004	RAN#25	RAN Approval		CRs and TSs approved

9.2 Work Task Status

	Planned Date	Milestone	Status
1.			
2.			

Annex A: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
June 2004	TSG-RAN#24	RP-040185			presentation to TSG-RAN for information	-	1.0.0
September 2004	TSG-RAN#25	RP-040305			presentation to TSG-RAN for approval	1.0.0	2.0.0
September 2004	TSG-RAN#25	RP-040305			approved at TSG-RAN#25 and placed under change control	2.0.0	6.0.0