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Contents

Foreword

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

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- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document is an introduction to the 3GPP TS 37.46x series of Technical Specifications that define the Iuant Interface. The Iuant interface is applicable for UTRAN, E-UTRAN and NG-RAN. In this specification UTRAN, E-UTRAN and NG-RAN are denoted as "RAN", whereas the corresponding network entities Node B, eNB, en-gNB and NG-RAN node are denoted as "RAN Node". The logical Iuant interface is an interface internal to the RAN Node and defined to reside between the implementation specific O&M function and the RET antennas together with the TMAs control unit function of the RAN Node.

The present document is applicable for UTRAN, E-UTRAN and NG-RAN and specifies the *Remote Electrical Tilting Application Part (RETAP)* and the *Tower Mounted Amplifier Application Part (TMAAP).* In this specification UTRAN, E-UTRAN and NG-RAN are denoted as "RAN", whereas the corresponding network entities Node B, eNB, en-gNB and NG-RAN node are denoted as "RAN Node". RETAP supports the functions of the Iuant interface between the implementation specific O&M transport function and the RET Antenna Control unit function, TMAAP supports the functions of the Iuant interface between the implementation specific O&M transport function and the TMA control function.

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] Void

[2] Void

[3] 3GPP TS 37.462: "Iuant Interface: Signalling Transport".

[4] 3GPP TS 37.461: "Iuant Interface: Layer 1".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

Active alarm: An alarm which has an alarm state that has been raised, but not cleared

Alarm: Persistent indication of a fault

Alarm code: A code that identifies a specific alarm. The alarm code set is a subset of the return code set. The alarm codes are listed in annex A of this TS

Alarm state: A condition or state in the existence of an alarm. Alarm states are raised and cleared

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

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

Data type: A definition determining the value range and interpretation of a series of octets. The following specified data types are used in this TS:

Name:	Definition:
AlarmCode	1 octet unsigned enumerated code All AlarmCode values are listed in annex A of this TS
FieldNumber	1 octet unsigned enumerated code All field number values are listed in annex B of this TS
ProcedureCode	1 octet unsigned enumerated code
ReturnCode	1 octet unsigned enumerated code All ReturnCode values are listed in annex A of this TS
TextString	Octets with integer values in the range of 32 to 126 to be interpreted as ASCII characters

Elementary procedure: The RETAP and TMAAP protocol consists of elementary procedures (EPs). An elementary procedure is a unit of interaction between the primary device (RAN Node) and the secondary devices (RET or TMAs devices)

An EP consists of an initiating message and possibly a response message.

Two kinds of EPs are used:

- **Class 1**: Elementary procedures with response (success or failure).
- **Class 2**: Elementary procedures without response.

For **Class 1** EPs, the types of responses can be as follows:

Successful

- A signalling message explicitly indicates that the elementary procedure has been successfully completed with the receipt of the response.

Unsuccessful

- A signalling message explicitly indicates that the EP failed.

Class 2 EPs are considered always successful.

Error: Deviation of a system from normal operation

Fault: Lasting error condition

Little endian: The order of transmission in which the least-significant octets of a multi-octet representation of a number are transmitted first. Little endian only applies to binary integer representations

MaxDataReceiveLength: SecondaryPayloadReceiveLength minus 3 octets (see subclause 4.8.1 in TS 37.462 [3])

MaxDataTransmitLength: SecondaryPayloadTransmitLength minus 3 octets (see subclause 4.8.1 in TS 37.462 [3])

Procedure code: A code identifying an elementary procedure

Reset: A process by which the device is put in the state it reaches after a completed power-up

Return code: A code which defines information about the outcome of an elementary procedure execution

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 TS the tilt referred to is always the electrical tilt unless otherwise stated

Tilt value: A signed integer used in elementary procedures to define the electrical tilt setting of the antenna. The tilt value is 10 times the antenna electrical tilt angle in degrees.

TMA: A TMA comprises a low noise amplifier together with its control and monitoring electronics and optional antenna modem.

TMA subunit: A TMA may comprise more than one TMA subunit. All TMA subunits within one TMA have the same HDLC address and are addressable by an index via the application layer procedures.

3.2 Abbreviations

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

EP	Elementary Procedure
HDLC	High-Level Data Link Control
RET	Remote Electrical Tilting
TMA	Tower Mounted Amplifier
RETAP	Remote Electrical Tilting Application Part
TMAAP	Tower Mounted Amplifier Application Part
TCP	Time-Consuming Procedure

4 General

4.1 Procedure specification principles

The principle for specifying the procedure logic is to specify the functional behaviour of the RET antenna control unit and TMA Subunits exactly and completely. The RAN Node functional behaviour is left unspecified.

The following specification principles have been applied for the procedure text in clause 6:

- The procedure text discriminates between:

1) Functionality which "shall" be executed

The procedure text indicates that the receiving node "shall" perform a certain function Y under a certain condition. If the receiving node supports procedure X but cannot perform functionality Y requested in the REQUEST message of a Class 1 EP, the receiving node shall respond with the message used to report unsuccessful outcome for this procedure, containing an appropriate cause value.

2) Functionality which "shall, if supported" be executed

The procedure text indicates that the receiving node "shall, if supported," perform a certain function Y under a certain condition. If the receiving node supports procedure X, but does not support functionality Y, the receiving node shall proceed with the execution of the EP, possibly informing the requesting node about the not supported functionality.

4.2 Forwards and backwards compatibility

The forwards and backwards compatibility of all versions of the protocol shall be assured by a mechanism in which all current and further messages will not be changed in the future. These parts can always be decoded regardless of the standard version.

New functionalities are added into the specification by introducing new procedures and thus the existing messages are not changed in the future.

4.3 Multi-antenna units

The RETAP elementary procedures are split into a single-antenna oriented part, a multi-antenna oriented part and a common part for both device types in order to support RET units controlling single- or multi-antenna devices. The RET unit responds, upon request, the number of antennas it controls. All multi-antenna oriented elementary procedures include a parameter stating which antenna the elementary procedure addresses. Antennas are numbered 1 and upwards.

4.4 Integer representation

Multi-octet integer values are transmitted in little endian order. Signed integers are represented as 2-complement values.

4.5 TMA Subunits

TMA subunits shall be numbered starting with 1 and proceeding upwards. The error message format for TMA procedures follows that of multiple RET devices.

5 Services expected from signalling transport

RETAP and TMAAP requires an assured in-sequence delivery service from the signalling transport and notification if the assured in-sequence delivery service is no longer available.

5.1 Elementary procedure format

Layer 2 provides a full-duplex link for the transmission of RETAP and TMAAP messages.

There are two types of RETAP and TMAAP elementary procedures:

Class 1: Initiating messages are sent either from the primary to a secondary device, or from a secondary to the primary device, in order to initiate some action within the receiving device. The other device sends a response message completing the procedure.

Class 2: Initiating messages are sent either from the primary to a secondary device, or from a secondary to the primary device. No response message is expected.

All RETAP and TMAAP messages use the same basic format:

Table 5.1.1: Basic format for all RETAP and TMAAP messages

Elementary procedure	Number of data octets	Data
1 octet	2 octets	MaxDataReceiveLength or MaxDataTransmitLength.

NOTE: Response messages have the same basic format as initiating messages. The elementary procedure code shall be the same in the response message as in the associated initiating message.

5.1.1 Initiating message

The data part of an initiating message may contain parameters as specified in clause 6 of this TS.

5.1.2 Response message

Elementary procedures shall, unless otherwise specified, provide a response message within 1 second. The response time is measured from the time the message frame was received by the transport layer to the time the response message is ready for transfer by the transport layer.

If the class1 elementary procedure requested by the initiating message was successfully executed, the response message data part from a single-antenna device shall contain return code <OK>. Additional information may follow in the data part. The response message data part from a multi-antenna device starts with the antenna number followed by return code <OK> and optional additional information.

If the elementary procedure requested by the initiating message was not successfully executed, the response message data part from a single-antenna device shall contain return code <FAIL>.

The following octet shall contain a second return code which describes why the execution of the requested procedure failed. The response message data part from a multi-antenna device starts with the antenna number followed by return code <FAIL> and a second return code which describes why the execution of the requested procedure failed.

In some situations an initiating message can cause a change of operating conditions, for instance a SetTilt procedure might cause a RET device to discover that an adjuster is jammed or that a previously jammed adjuster works normally again. In these cases an alarm procedure reporting the change of operating conditions shall be used in addition to the regular <OK> or <FAIL> return codes in response message.

A complete annotated table of all return codes with their corresponding hexadecimal numbers is provided in annex A of this TS.

Return codes marked with an X in the Alarm column of annex A in this TS are used to report operating conditions in alarm procedures (see subclauses 6.6.5 and 6.7.6 for details).

6 Control elementary procedures

6.1 State model

The state model describing the secondary device is shown in figure 6.1 with procedures written in *italic*.

The relation to the connection state model for layer 2 can be found in TS 37.462 [3].

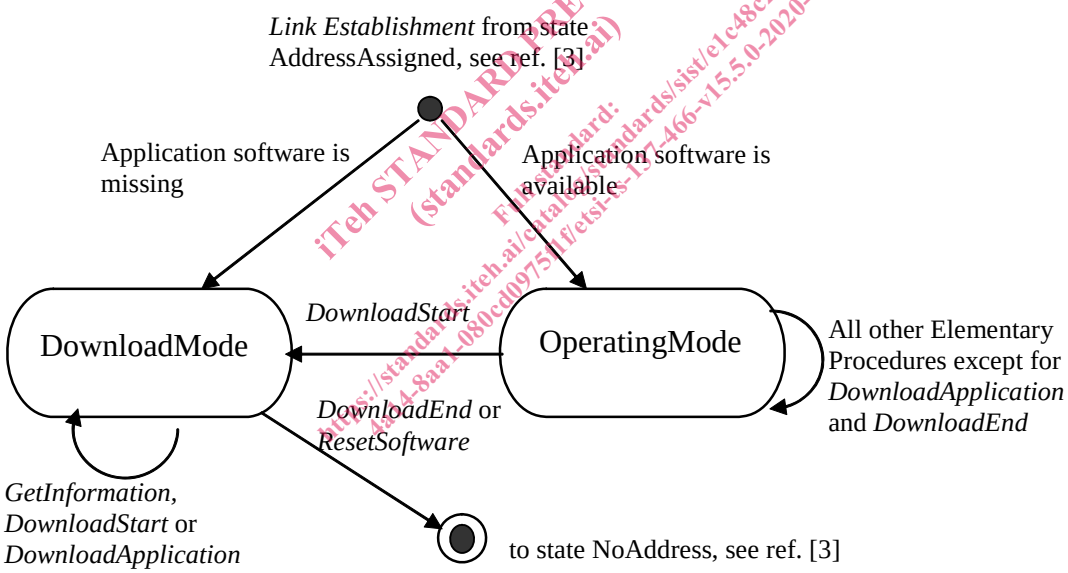

Figure 6.1: State model for the Secondary device

If an application software is not missing the secondary device enters the state OperatingMode.

If an application software is missing, the secondary device enters the state DownloadMode. In this state only software download functionality is supported in order to restore the application software.

The primary device will be notified that the secondary device has entered the state DownloadMode when a procedure which only is supported in the state OperatingMode fails with the return code WorkingSoftwareMissing.

If no software download functionality is supported, then only the state OperatingMode for the secondary device is supported.

6.2 General procedure handling

6.2.1 Alarms

When a fault is detected, the corresponding alarm state shall be changed to state *raised* by the secondary device. When the fault no longer exists, the corresponding alarm state shall be changed to state *cleared* by the secondary device. Alarm changes are reported through the AlarmIndication or AntennaAlarmIndication elementary procedures. Whenever an AlarmIndication or AntennaAlarmIndication elementary procedure message is transmitted, it shall contain all the alarm states changed that have not yet been reported as described in subclauses 6.6.5 and 6.7.6.

All alarm states shall be cleared by any type of reset.

6.2.2 Procedure message interpretation

The following message interpretation rules shall apply to a secondary device in the order mentioned:

- Any message shorter than 3 octets shall be disregarded. In case of Multi-Antenna-Procedures or TMA-Procedures, which uses a subunit field, any messages shorter than 4 octets shall be disregarded;
- If a message has a length inconsistent with its "Number of data octets" field value it shall be responded with a failure message stating "FormatError" as the cause of failure. The response message shall be to the initiating message identified by the procedure code;
- If a secondary device in the OperatingMode state receives a procedure message which is undefined for this device type, it shall respond with "Unknown Procedure";
- If a secondary device in the OperatingMode state is receiving a procedure message of an optional procedure not supported, it shall respond with a failure message stating "UnsupportedProcedure" as the cause of failure;
- If a secondary device receives a procedure message, part of the software download procedure sequence described in Annex C, without having received the previous procedure messages in that sequence it shall respond with a failure message stating "InvalidProcedureSequence" as the cause of failure;
- If a secondary device in the DownloadMode state is receiving a procedure message not supported in that state it shall respond with a failure message stating "WorkingSoftwareMissing" as the cause of failure;
- If a message has a length inconsistent with the defined message length in the procedure definition it shall be responded with a failure message stating "FormatError" as the cause of failure. The response message shall be to the initiating message identified by the procedure code;
- If a secondary device in the OperatingMode state is receiving a procedure message which addressed device subunit does not exist "FormatError" shall be returned.

6.2.3 Parallel procedure handling

The secondary device shall support parallel execution of in maximum one additional EP only in parallel to one of the Time-Consuming Procedures defined in table 6.2.3.1:

Table 6.2.3.1: Definition of TCPs and the execution of procedures in parallel to a TCP

Elementary Procedure	TCP	Execution in parallel to a TCP
Common Procedure Set		
(Reserved)		
Reset Software	No	mandatory
Get Alarm Status	No	mandatory
Get Information	No	mandatory
Clear Active Alarms	No	disallowed
Read User Data	No	optional
Write User Data	No	optional
Alarm Subscribe	No	optional
Self Test	Yes	disallowed
Download Start	No	disallowed
Download Application	No	disallowed
Download End	No	disallowed
Vendor specific procedure	vendor specific	optional
Single-Antenna Procedure Set		
Set Device Data	No	optional
Get Device Data	No	optional
Calibrate	Yes	disallowed
Send Configuration Data	No	disallowed
Set Tilt	Yes	disallowed
Get Tilt	No	optional
Alarm Indication	No	optional
Multi-Antenna Procedure Set		
Antenna Calibrate	Yes	optional
Antenna Send Configuration Data	No	disallowed
Antenna Set Tilt	Yes	optional
Antenna Get Tilt	No	optional
Antenna Set Device Data	No	optional
Antenna Get Device Data	No	optional
Antenna Alarm Indication	No	optional
Antenna Clear Active Alarms	No	disallowed
Antenna Get Alarm Status	No	mandatory
Antenna Get Number of Antennas	No	mandatory

"yes" in the "TCP" column indicates that the procedure is a TCP, "no" in the "TCP" column indicates that the procedure is not a TCP. "mandatory" in the "Execution in parallel to a TCP" column indicates that the procedure shall be executed in parallel to an ongoing TCP. "optional" in this column indicates, that the support of the execution of the procedure in parallel to an ongoing TCP is optional and "disallowed" indicates that the procedure shall not be executed in parallel to a TCP.

If a secondary device receives an initiating message for an EP which cannot be executed due to the ongoing execution of other EPs, the secondary device shall respond with a failure message stating "Busy" as the cause of failure.

Parallel execution of one TCP marked "optional" in the "Execution in parallel to a TCP" column in table 6.2.3.1 may be supported for each antenna by the secondary device. The EPs AntennaSetTilt and AntennaCalibrate shall be executed in parallel only for different antenna numbers. If more than one TCP is executed, ResetSoftware shall be executed anyway and never be responded with "Busy".

If the EPs Get Tilt and Antenna GetTilt are executed in parallel with a TCP, their response message shall deliver a tilt value sampled during their execution.

TMAAP doesn't define any TCPs. Therefore parallel procedure handling is not supported by TMAAP.

6.3 Overview of elementary procedures

The set of elementary procedures for RET antennas and TMAs control provides procedure-oriented instructions. An overview of the procedures is given in annex D. Table 6.3.1 lists all common elementary procedures described in subclause 6.5. Table 6.3.2 lists all RETAP elementary procedures specific for single-antenna device types described in subclause 6.6. Table 6.3.3 lists all RETAP elementary procedures specific for multi-antenna device types described in