Presentation of Specification to TSG or WG

Presentation to:	**TSG RAN Meeting #25**
Documents for presentation:	**TS 25.462: UTRAN Iuant Interface: Signalling Transport** **Version 1.0.0**
Presented for:	**Approval**

Abstract of document:

At TSG-RAN#19 the "Work Item Description for Remote Control of Electrical Tilting Antennas" (RP-030193) was approved. The new Technical Specification 25.462 specifies the signalling transport related to RETAP signalling to be used across the Iuant interface. The logical Iuant interface is a Node B internal interface between the implementation specific O&M function and the RET Antenna Control unit function of the Node B.

Changes since last presentation to TSG RAN Meeting #24:

- The open issues in the draft versions of the specifications were solved in RAN3

- Technical Specification 25.462 for Iuant was prepared for approval at TSG-RAN#25

Outstanding Issues:

Some minor open issues were identified which can be handled via CRs during the next WG meetings:

- Change Requests for the TSs can be expected in the next RAN3 meetings to solve editorial mistakes.

- The WI level of completion is 95%.

Contentious Issues:

No contentious issues are open.

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Technical Specification

**3rd Generation Partnership Project;
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Contents

Foreword

This Technical Specification 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 specifies the signalling transport related to RETAP signalling to be used across the Iuant interface. The logical Iuant interface is a Node B internal interface between the implementation specific O&M function and the RET Antenna Control unit function of the Node B.

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 TS 25.460: "UTRAN Iuant Interface: General Aspects and Principles".

[2]   ISO/IEC 13239 (2nd Edition, March 2000): Information Technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures

[3]   3GPP TS 25.461: "UTRAN Iuant Interface: Layer 1".

[4]   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 apply.

Octet: 8 bits as used in [2]

Device type: One octet identifying the type of a device

Vendor code: A unique ASCII 2-character code assigned to each vendor in [4]

3.2 Symbols

Void

3.3 Abbreviations

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

ADDR	Address
ACK	Acknowledgment
CRC	Cyclic Redundancy Check
DISC	Disconnect (frame type)
DM	Disconnected Mode (frame type)
FCS	Frame Checking Sequence

FRMR	Frame Reject (frame type)
HDLC	High-Level Data Link Control
I	Information (frame type)
INFO	Information (field name)
NAK	Non Acknowledgment
NRM	Normal Response Mode
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 Iuant Data Link Layer

The Data Link Layer uses HDLC UNC 1,4,15.1 Class (see 6.10 in [2]) TWA according to [2].

4.1 Invalid Receptions

Frames shall be discarded if a framing error or data overrun occurs.

4.2 Frame Lengths

HDLC frame lengths may vary between 4 and N octets.

All secondary stations shall support an N of 78 octets. A secondary station may, after XID negotiation, support an N of not more than 65543 octets.

4.3 Default Address

After reset, a secondary station shall use the no-station address (0x00). While it has the no-station address, it may only respond to device scan and address assignment messages.

4.4 Windows Size

All stations shall support a window size of 1. A station may, after XID negotiation, support any window size up to 7.

4.5 Message Timing

A minimum of 3 ms shall elapse between receiving and transmitting messages.

A secondary station shall, after reception of a command with the P/F bit set, start transmitting a response within 10 ms from the time the final flag octet of that command frame was received.

4.6 State Model

The connection state model for the layer 2 of the secondary station is shown in figure 4.1. The events written in *italic* are procedures from higher levels e.g. link establishment. The HDLC frames that correspond to the events are written in bold as **command** (from primary station) **/ response** (from secondary station) messages.
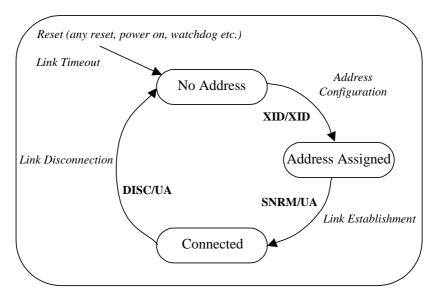
Figure 4.1: Connection State Model

4.7 Device Types

Two device types are defined and identified by the assigned 1-octet hexadecimal code.

Table 4.1: Device Types and Codes

Device Type	1-octet hexadecimal code
Single-Antenna RET Device	0x01
Multi-Antenna RET Device	0x11

4.8 XID Negotiation

XID negotiation shall use the standard format (see 5.5.3.1-5.5.3.2.3.2 in [2]). See Annex B for a brief description of XID negotiation and Annex C to E for examples of XID negotiations. All GL fields have a size of 1 octet.

4.8.1 HDLC Parameters

Format Identifier (FI) shall be 0x81 and Group Identifier (GI) shall be 0x80. All secondary stations shall support the following parameters:

Table 4.2: HDLC Parameters for Secondary Stations

PI	PL	Description of PV
5	4	Maximum information field length – transmit (bits)
6	4	Maximum information field length – receive (bits)
7	1	Window size – transmit (frames)
8	1	Window size – receive (frames)

4.8.2   Protocol Version

Format Identifier (FI) shall be 0x81 and Group Identifier (GI) shall be 0xF0. All secondary stations shall support the following parameter:

Table 4.3: HDLC Parameter: Protocol Version

PI	PL	Description of PV
5	1	3GPP Release Id

4.8.3   Addressing

The primary station broadcasts the XID commands. The secondary station(s) which match shall respond. The primary shall ensure that only one secondary matches the supplied parameter(s). See below for details.

Format Identifier (FI) shall be 0x81 and Group Identifier (GI) shall be 0xF0. All secondary stations shall support the following parameters:

Table 4.4: HDLC Parameters for Addressing

PI	PL	Description of PV
1	1 to 19	Unique ID
2	1	HDLC Address
3	1 to 19	Bit Mask (for Unique ID), indicates a device scan
4	1	Device Type (see table 4.1)
6	2	Vendor Code as given in [4]

The XID message can be used to assign HDLC addresses or to scan for devices. If parameter 3 is present, the XID message is used for a device scan. If parameter 3 is not present, the XID message is used for an address assignment.

An address assignment XID command shall contain at least PI=2 (HDLC Address) and may not contain PI=3 (Bit Mask). During an address assignment all secondary stations first assume a match and then carry out the following steps:

-   If PI=1 (Unique ID) is supplied, the right most PL octets of the secondary station's Unique ID is compared to the Unique ID in the XID command. If they are different, the secondary station does not match, and the message is ignored.

-   If PI=4 (Device Type) is supplied, the device type of the secondary station is compared to the device type in the XID command. If they are different, the secondary station does not match, and the message is ignored.

-   If PI=6 (Vendor Code) is supplied, the vendor code of the secondary station is compared to the vendor code in the XID command. If they are different, the secondary station does not match, and the message is ignored.

If the secondary station still matches after these steps, the secondary station sets its HDLC address to the address specified in PI=2 and responds with an XID response which contains PI=1 and PI=4.

NOTE: Unlike the normal XID negotiation, in this XID negotiation, the XID response message returns a different set of parameters than the XID command message.

A device scan XID command shall only contain PI=1 (Unique ID) and PI=3 (Bit Mask). PI=1 and PI=3 shall be of equal length L. The secondary station masks its Unique ID with the bit mask in the XID command, and compares the first L octets of the result with the L octets of the Unique ID supplied in the XID command. If they match, the secondary station transmits an XID response message with PI=1 (Unique ID), PI=2 (HDLC Address) and PI=4 (Device Type).

For the device scan comparison, the Unique ID of the secondary station shall be padded with spaces (character code 0x20) to a length of 19 bytes.

The device scan messages may be utilised by the primary to identify all secondary stations on an interface.

4.9 Link Establishment

Once the secondary station has been assigned an HDLC address, the primary station initiates the link establishment by sending the SNRM command frame. The secondary station responds with an UA frame and enters the state *Connected*.

4.10 Link Timeout

Whenever a secondary station receives an HDLC frame addressed to itself, i.e. not an all-station address (0xFF), it shall restart a 3 minute timer. If this 3 minute timer expires, the secondary station shall enter the state *No Address*.

Annex A (informative):
HDLC Description

HDLC is defined in [2]. This description only covers the aspects of HDLC which are used by this TS.

The HDLC definition "UNC 1,4,15.1 Class TWA" can be broken down to:

- UNC;
    - o Unbalanced operation (master slave operation);
    - o Normal response mode (sequence numbers used in data frames);
    - o Class.
- Option 1 means use of XID negotiation;
- Option 4 means use of UI frames;
- Option 15.1 means use of start/stop transmission with basic transparency;
- Two Way Alternate is the HDLC term for half duplex.

A.1 Basic Structure

In unbalanced operation, there is one primary station (master) which controls the bus and a number of secondary stations (slaves) which only are allowed to transmit when the primary station gives them permission to do so.

All messages are transmitted as frames with the layout show in table A.1:

Table A.1: Format of an HDLC Frame

Flag 1 octet	ADDR 1 octet	Control 1 octet	INFO N octets	FCS 2 octets	Flag 1 octet
0x7E	Secondary Station Address	Control bits	Variable length	CRC	0x7E

HDLC frames begin and end with a Flag (0x7E) (see A.5 for details).

The transmitting station calculates a Frame Check Sequence (CRC16) on all octets which follow the starting flag but not including the FCS octets. The checksum is transmitted as FCS in little endian order and followed by the closing flag.

The receiving station calculates the checksum on all octets between the flags. When it finds the closing flag, it compares the checksum to a 0xF0B8. If it is a match, the HDLC frame is processed.

The address field contains the HDLC address of the secondary station. If the primary station sents the message, it is called a command and the address field contains the address of the secondary station as destination. If the secondary station sents the message, it is called a response and the address field contains the address of the secondary station as source. Secondary stations cannot communicate directly to each other.

The control field defines one of three frame types:

- I frames contain data as well as a send and receive counter;
- S frames contain a receive counter;
- U frames contain unnumbered commands.

The INFO field is only present in I frames and XID frames. The INFO field in an I frame contains the layer 7 payload.

A.2 UNC Commands

According to 6.6.2.1 in [2] the following commands in shall be supported in UNC mode:

Table A.2: Commands required by UNC

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

A.2.1 Set Normal Response Mode (SNRM)

This command is used to set the secondary station in connected mode and reset its sequence number variables.

A.2.2 Disconnect (DISC)

This command is used to terminate the connection.

A.2.3 Unnumbered Acknowledge (UA)

This response is used to confirm that the secondary received and acted on an SNRM or DISC command.

A.2.4 Disconnected Mode (DM)

This response is used to inform the primary station that the secondary is disconnected.

A.2.5 Receiver Ready (RR)

This command and response is used to inform the opposite station (primary or secondary) that the transmitting station has empty buffers, i.e. is ready to receive an I frame. This aspect is used for flow control.

It also contains the sequence number of the next frame the transmitting station expects to see. This works both as an ACK and a NAK depending on the value.

A.2.6 Receiver Not Ready (RNR)

Just like RR, except it informs the opposite station that the transmitting station does not have empty buffers, i.e. that it is not ready to receive an I frame. This aspect is used for flow control.

A.2.7 Information (I)

This command and response is used to transfer a block of data together with its sequence number. The command also includes the sequence number of the next frame the transmitting station expects to see. This way, it works as an RR. Like RR, it enables transmission of I frames from the opposite side.

A.2.8 Frame Reject (FRMR)

This response is used to indicate an error condition. The two most likely error conditions are:

- Invalid command;

- Sequence number problem.

The latter is used when the primary station has requested retransmission of a sequence number which it has already acknowledged.

A.3 Option 1

Option 1 means the addition of the XID command/response, which is used for parameter negotiation.

A.4 Option 4

Option 4 means the addition of the UI command/response, which is used to transfer information without changing the sequence numbers used by I frames.

A.5 Option 15.1

Option 15.1 means that the serial link is not synchronous and start/stop flags are used (asynchronous serial link). The flags are coded as 0x7E and basic transparency is used.

This means that all octets between the flags are part of the frame and shall not be transmitted as 0x7E. Since the frame may contain 0x7E, basic transparency is used, which means that 0x7E is transmitted as 0x7D 0x5E and 0x7D is transmitted as 0x7D 0x5D. The receiving station converts back on reception.

All checksum calculations are done on unconverted data.

A.6 Link Safety

HDLC provides the upper layer with a safe link between two stations.

Unless excessive frame lengths are used, the CRC16 checksum provides excellent protection against transmission errors. At worst, 10^{-5} of the bit errors will not be detected. The likelihood of an undetected error in a frame can be calculated by multiplying 10^{-5} with the Bit Error Rate (at least 10^{-9} for a reasonable link) and the frame length.

The sequence numbers provide protection against:

- Message duplication;

- Message deletion;

- Message re-ordering.

Without sequence numbers, the protection is only given by a checksum and some sort of ACK.

If the original message is lost, there will be no ACK and a timeout will cause retransmission which solves the problem.

If the original message is not lost, but the ACK is lost, the same timeout will cause a retransmission which causes message duplication.

With sequence numbers, the message is still retransmitted, but the receiving station sees that the sequence number is the same, i.e. that the message is a retransmission, and throws it away without processing it further. It does send an ACK which informs the transmitting station that the message got through.

Without sequence numbers, commands such as "Increase by one" cannot be used, since there is no way to know how many times the command will be executed.

A.7 Full Duplex Link

The upper layer sees the HDLC link as a full duplex link, although the actual transmissions on layer 1 are half duplex. The reason for this is that the upper layer is not aware of any restrictions on transmissions or receptions between layer 2 and layer 1 or between the stations.

Whenever the upper layer wants to transmit, it places a message on the queue to layer 2. The message will not be transmitted until the primary station does a poll. Note, that this applies to both the primary and the secondary station.

The same applies to reception. The upper layer will either be told by layer 2 when a message has arrived, or it will periodically check to see if a message has arrived at layer 2. Neither of these two methods will in any way influence the reception of a message. That only depends on when the primary does a poll. Note that this still applies to both the primary and the secondary station.

A poll is a command frame from the primary station where the P/F (Poll/Final) bit in the control field is set to 1. This informs the secondary that it is allowed to transmit response frames.

U frames set the P/F bit, which means that they are polls. However, since the U frames used in UNC 1,4 require a specific U frame response, they are not used for I frame transmission, which is what the upper layer messages depend upon.

An I, RR or RNR frame type with the P/F bit set constitutes a poll as used above. An RNR frame prevents transmission of I frames, so it does not really apply.

Note, that whenever an I or RR poll occurs, the secondary station may transmit whatever I frame it wishes (as long as the window size is not exceeded, i.e. previous messages have been acknowledged). This means that the secondary station does not have to transmit a reply to a layer 7 instruction. It is free to transmit an alarm instruction, if an alarm has occurred. It is also free to transmit any valid reply to an earlier layer 7 instruction, if it has received (acknowledged) more than one.

Annex B (informative):
HDLC Parameter Negotiation

See also sections 5.5.3.1 – 5.5.3.2.3.2 in [2].

Table B.1: Format of XID Parameters

FI	GI	GL	PI	PL	PV	PI	PL	PV

XID parameter negotiation uses a specific format (see table C.1) to transfer parameters.

The parameters are identified by a one octet Format Identifier (FI) code and a one octet Group Identifier (GI) code. The Group Length (GL) is a one octet unsigned integer giving the length in octets of the parameters following it.

The parameters are a sequence of PI/PL/PV values. The Parameter Identifier (PI) is a one octet code identifying the parameter. Parameter Length (PL) is a one octet unsigned integer giving the length in octets of the Parameter Value.

The HDLC parameter negotiation is initiated by the primary station. The primary station transmits an XID frame with the values it suggests. The secondary station can either accept these or lower them. Regardless, it responds with an XID with the appropriate values.

Generally this means that the primary initially uses whatever its maximum limit is for each parameter. If the secondary can accept this, it responds with the same values. If it cannot support that, it lowers the values.

Maximum frame length is a good example. If the primary suggests using a frame length of 28000 octets, the secondary station can respond with 28000, if it can use that much or even more, of maybe 70 if that is its maximum supported frame length.

The same applies to the Release ID. If a release 7 primary station attempts to communicate with a release 6 secondary station, the initial message will suggest release 7 and the response will be release 6.

On the other hand, if a release 6 primary station attempts to communicate with a release 7 secondary station, the initial message will suggest release 6 and the response will release 6.

Regardless, the primary station will have the final decision, since it can refuse to communicate with a station that does not support whatever parameter values it suggests. It can always repeat the XID negotiation with a new value.

Annex C (Informative):
HDLC Parameter Negotiation Example

XID Frame from primary station:

Table C.1: XID Frame from Primary Station

Field	Content	Description
ADDR	12	Station address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	18	Length of the parameter field (PI)
PI	5	Maximum I Field length Transmit
PL	4	Length of the PV field (octets)
PV	65543	Maximum I Field length Transmit
PI	6	Maximum I Field length Receive
PL	4	Length of the octets value
PV	28000	Maximum I Field length Receive
PI	7	Maximum window size Transmit
PL	1	Length of the PV field
PV	7	Maximum window size Transmit
PI	8	Maximum window size Receive
PL	1	Length of the window size
PV	3	Maximum window size Receive

Response from secondary station:

Table C - 2: XID Frame from Secondary Station

Field	Content	Description
ADDR	12	Station address
CTRL	XID	Command
FI	0x81	Format identifier
GI	0x80	HDLC Parameters set
GL	16	Length of the PI field
PI	5	Maximum I field length Transmit

PL	2	Length of the PV field (octets)
PV	400	Maximum I field length Transmit
PI	6	Maximum I field length Receive
PL	4	Length of the PV field (octets)
PV	65543	Maximum I field length Receive
PI	7	Maximum window size Transmit
PL	1	Length of the PV field (octets)
PV	3	Maximum I field length Transmit
PI	8	Maximum window size Receive
PL	1	Length of the PV field (octets)
PV	1	Maximum window size Receive

Annex D (informative): Address Assignment Example

D.1 Address Assignment Command

Table D.1: Format of the XID Frame Originated by the Primary Station

Field	Content	Description
ADDR	0xFF	All-station address (Broadcast)
CTRL	XID	Command
FI	0x81	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 octets
PV	Unique ID	Concatenation of vendor code and serial number (n octets)
PI	2	Parameter id 2 = address
PL	1	Length of PV field in octets
PV	1 – 254	Assigned address
PI	3	Parameter id 3 = Vendor Code as given in [4]
PL	2	Length of PV field in octets
PV	Vendor Code	Unique assigned vendor code as given in [4]
PI	4	Parameter id 4 = Device Type
PL	1	Length of PV field in octets
PV	Device Type	Device Type as defined in table 4.1
PI	5	Parameter id 5 = 3GPP Release-ID
PL	1	Length of PV field in octets
PV	Release-ID	Latest supported 3GPP release version

D.2 Address Assignment Response

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

- ➢ To fulfil the match with the Unique ID given as the first parameter value PV1, the following two rules shall 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 match with the vendor code given as the third parameter value PV3, one of the following two rules shall be valid:

  1. The given vendor code is a wild card coded as 0xFF 0xFF.

  2. The given vendor code matches exactly

- ➢ To fulfil the match with the device type given as the fourth parameter value PV4, one of the following two rules shall be valid:

  1. The given device type is a wild card coded as 0xFF.

  2. The given device type matches exactly.

Table D.2: Format of Address Assignment Response by the Secondary Station

Field	Content	Description
ADDR	#	Station address
CTRL	XID	Command
FI	0x81	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 octets
PV	Unique ID	Concatenation of vendor code and serial number (n octets)
PI	2	Parameter id 2 = address
PL	1	Length of PV field in octets
PV	1 – 254	Assigned address
PI	3	Parameter id 3 = Vendor Code as given in [4]
PL	2	Length of PV field in octets
PV	Vendor Code	Unique assigned vendor code as given in [4]
PI	4	Parameter id 4 = Device Type
PL	1	Length of PV field in octets

PV	Device Type	Device Type as defined in table 4.1
PI	5	Parameter id 5 = 3GPP Release-ID
PL	1	Length of PV field in octets
PV	Release-ID	Latest supported 3GPP Release version

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 station does nothing.

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

NOTE: Some further work on this example might be needed.

Annex E (informative):
Device Scan Example

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 station to perform a binary tree scan of the bus, in order to identify all connected and disconnected devices, and is always carried out at 9.6 kbps.

Table E.1: Primary Device Scan Command (XID Frame)

ADDR	0xFF	All-station address (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 octets
PV	Unique ID	Concatenation of vendor code and serial number (n octets)
PI	3	Parameter id 3 = bit mask
PL	n	Length of PV field in octets (same as for PI=1)
PV	bit mask	Bit mask (n octets)

➢ **Device Scan Response**

When each secondary station 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 station 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 station.

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

If multiple secondary stations 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 station 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 station shall assume that that branch of the tree is inhabited and scan through it.

NOTE: Some further work on the example given here is needed in order to align it with the device scan procedure described in section 4.8.3.

Annex F (informative):
Change history

Change history								
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**		**Old**	**New**
September 2004	TSG-RAN#25	RP-040304	_	_	presentation to TSG-RAN for information		_	1.0.0