TSG-RAN Meeting #19 ***RP-030115***
Birmingham, UK, 11 - 14 March 2003

Title: **CRs (Rel-5) on TS 25.321**

Source: **TSG-RAN WG2**

Agenda item: **8.2.5**

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc-2nd-Level	Workitem
25.321	159	-	Rel-5	TDD HCSN determination in MAC-hs	F	5.3.0	5.4.0	R2-030540	HSDPA-L23
25.321	160	-	Rel-5	Correction to the use of Transport Block Size index equal to 111111 for TDD	F	5.3.0	5.4.0	R2-030541	HSDPA-L23
25.321	163	-	Rel-5	Editorial changes to MAC-hs	D	5.3.0	5.4.0	R2-030544	HSDPA-L23
25.321	170	-	Rel-5	Re-ordering entity corrections	F	5.3.0	5.4.0	R2-030610	TEI5

3GPP TSG-RAN WG2 Meeting #34
Sophia Antipolis, France, 17-21 February 2003

Tdoc ⌘R2-030540

CR-Form-v7

CHANGE REQUEST

⌘ **25.321** **CR** **159** ⌘ **rev** **-** ⌘ Current version: **5.3.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	TDD HCSN determination in MAC-hs
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	HSDPA-L23
Date:	⌘	20/02/2003
Category:	⌘	**F**
Release:	⌘	Rel-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
Rel-4 (Release 4)
Rel-5 (Release 5)
Rel-6 (Release 6)

Reason for change:	⌘	In TDD a UE specific HS-SCCH Cyclic Sequence Number (HCSN) is added to each HS-SCCH transmission to assist in estimation of HS-SCCH BLER, which is used to determine TDD HS-SICH TPC. It is necessary to determine the UE specific HCSN in MAC-hs where transmissions to individual UE's are realized.
Summary of change:	⌘	In TDD when MAC-hs scheduler determines HS-DSCH & HS-SCCH transmission, the HCSN is set for that transmission. The UE specific HCSN is incremented for each HS-SCCH transmission.
Consequences if not approved:	⌘	Setting of the HCSN is not clear for TDD

Clauses affected:	⌘	3.2, 4.2.4.3 & 11.6.1.1			
Other specs affected:	⌘	**Y** / **N**	Other core specifications	⌘	25.302
		[X] / [ ]	Test specifications		
		[ ] / [ ]	O&M Specifications		
Other comments:	⌘				

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

3.2 Abbreviations

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

ASC	Access Service Class
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
C-	Control-
CCCH	Common Control Channel
CPCH	Common Packet Channel (UL)
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DSCH	Downlink Shared Channel
DTCH	Dedicated Traffic Channel
FACH	Forward Link Access Channel
FDD	Frequency Division Duplex
HARQ	Hybrid Automatic Repeat Request
HCSN	HS-SCCH Cyclic Sequence Number
HS-DSCH	High Speed Downlink Shared Channel
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)
MAC	Medium Access Control
PCCH	Paging Control Channel
PCH	Paging Channel
PDU	Protocol Data Unit
PHY	Physical layer
PhyCH	Physical Channels
RACH	Random Access Channel
RLC	Radio Link Control
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RNTI	Radio Network Temporary Identity
RRC	Radio Resource Control
SAP	Service Access Point
SDU	Service Data Unit
SHCCH	Shared Channel Control Channel
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TSN	Transmission Sequence Number
U-	User-
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
USCH	Uplink Shared Channel
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4.2.4.3 MAC-hs entity – UTRAN Side

There is one MAC-hs entity in the UTRAN for each cell that supports HS-DSCH transmission. The MAC-hs is responsible for handling the data transmitted on the HS-DSCH. Furthermore it is responsible for the management of the physical resources allocated to HSDPA. MAC-hs receives configuration parameters from the RRC layer via the MAC-Control SAP. There should be priority handling per MAC-d PDU in the MAC-hs. The MAC-hs is comprised of four different functional entities:

- Flow Control:
  This is the companion flow control function to the flow control function in the MAC-c/sh in case of configuration with MAC-c/hs and MAC-d in case of configuration without MAC-c/hs. Both entities together provide a controlled data flow between the MAC-c/sh and the MAC-hs (Configuration with MAC-c/sh) or the MAC-d and MAC-hs (Configuration without MAC-c/hs) taking the transmission capabilities of the air interface into account in a dynamic manner. This function is intended to limit layer 2 signalling latency and reduce discarded and retransmitted data as a result of HS-DSCH congestion. Flow control is provided independently by MAC-d flow for a given MAC-hs entity.

- Scheduling/Priority Handling:
  This function manages HS-DSCH resources between HARQ entities and data flows according to their priority. Based on status reports from associated uplink signalling either new transmission or retransmission is determined. Further it determines the Queue ID and TSN for each new MAC-hs PDU being serviced, and in the case of TDD the HCSN is determined. A new transmission can be initiated instead of a pending retransmission at any time to support the priority handling.

- HARQ:
  One HARQ entity handles the hybrid ARQ functionality for one user. One HARQ entity is capable of supporting multiple instances (HARQ process) of stop and wait HARQ protocols. There shall be one HARQ process per HS-DSCH per TTI.

- TFRC selection:
  Selection of an appropriate transport format and resource for the data to be transmitted on HS-DSCH.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].

11.6.1.1 Scheduler

The scheduler performs the following functions:

- Schedules all UEs within a cell;

- Services priority queues:

  - The scheduler schedules MAC-hs SDUs based on information from upper layers. One UE may be associated with one or more MAC-d flows. Each MAC-d flow contains HS-DSCH MAC-d PDUs for one or more priority queues.

- Determines the HARQ Entity and the queue to be serviced;

- Sets the TSN for new data blocks being transferred from the selected queue;

    - set the TSN to value 0 for the first MAC-hs PDU transmitted for each Queue ID within an HS-DSCH;

    - increment the TSN with one for each transmitted MAC-hs PDU on each Queue ID within an HS-DSCH.

- Indicates the Queue ID and TSN to the HARQ entity for each MAC-hs PDU to be transmitted;

- Schedules new transmissions and retransmissions:

    - Based on the status reports from HARQ Processes the scheduler determines if either a new transmission or a retransmission should be made. A new transmission can however be initiated on a HARQ process at any time. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-hs SDU.

- Determines the redundancy version:

    - The scheduler determines a suitable redundancy version for each transmitted and retransmitted MAC-hs PDU and indicates the redundancy version to lower layer.

- Determines the TDD HCSN;

    - Increment UE specific HCSN for each HS-SCCH transmission.

3GPP TSG RAN2 Meeting #34 ***Tdoc ⌘R2-030541***
Sophia, France, 17-21 February 2003

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CHANGE REQUEST

⌘ **25.321** **CR** **160** ⌘ **rev** **-** ⌘ Current version: **5.3.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [ ] Core Network [ ]

Title:	⌘	Correction to the use of Transport Block Size index equal to 111111 for TDD
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	HSDPA-L23
Date:	⌘	17/02/2003
Category:	⌘	**F**
Release:	⌘	REL-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
Rel-4	*(Release 4)*
Rel-5	*(Release 5)*
Rel-6	*(Release 6)*

Reason for change:	⌘	In the MAC spec., the particular actions of the HARQ process at the UE when a Transport Block Size index is equal to 111111 are described. This is applicable to FDD but not to TDD. In TDD there is no signalling implied linkage between physical resources and the Transport Block Size index signalled to the UE therefore the need for actions specified for FDD when Transport Block Size index is set to 111111 is not required.
Summary of change:	⌘	Bracketed notes are added to identify the actions as for FDD only.
Consequences if not approved:	⌘	For TDD, the use of Transport Block Size index equal to 111111 will produce spurious actions at the UE. When used with the first transmission of a HS-DSCH PDU, the block will be ACKed but also discarded, irrespective of the CRC flag. **Isolated Impact Analysis** Functionality corrected: HARQ process at the UE in TDD mode Isolated impact statement: Correction to a function where specification was not sufficiently precise. The change is isolated to TDD.

Clauses affected:	⌘	11.6.2.2

		Y	N		
Other specs affected:	⌘		X	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	

Other comments: ⌘

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

11.6.2.2 HARQ process

A number of parallel HARQ processes are~~is~~ used in the UE to support the HARQ protocol. The number of HARQ processes is configured by upper layers.

The HARQ process processes the New Data Indicator indicated by lower layers for each received MAC-hs PDU.

The UE shall:

- if the New Data Indicator has been incremented compared to the value in the previous received transmission in this HARQ process or this is the first received transmission in the HARQ process:
  - replace the data currently in the soft buffer for this HARQ process with the received data.
  - if the Transport Block Size index value is equal to 111111 (FDD only):
    - generate a positive acknowledgement (ACK) of the data in this HARQ process;
    - discard the received data;
    - assume that the data has been successfully decoded.

NOTE: alternative solutions for the use of the New Data Indicator are FFS.

- if the New Data Indicator is identical to the value used in the previous received transmission in the HARQ process:
  - if the Transport Block Size index value is equal to 111111 (FDD only):
    - assume that the transport block size is identical to the last valid transport block size signalled for this HARQ process.
  - if the data has not yet been successfully decoded:
    - combine the received data with the data currently in the soft buffer for this HARQ process.
- if the data in the soft buffer has been successfully decoded and no error was detected:
  - deliver the decoded MAC-hs PDU to the reordering entity;
  - generate a positive acknowledgement (ACK) of the data in this HARQ process.
- else:
  - generate a negative acknowledgement (NAK) of the data in this HARQ process;
- schedule the generated positive or negative acknowledgement for transmission and the time of transmission relative to the reception of data in a HARQ process is configured by upper layer.

The HARQ process processes the Queue ID in the received MAC-hs PDUs. The UE shall:

- arrange the received MAC-hs PDUs in queues based on the Queue ID.

3GPP TSG-RAN2 Meeting #34
Sophia Antipolis, France, 17-21 February 2003

Tdoc ⌘R2-030544

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CHANGE REQUEST

⌘ **25.321** **CR** **163** ⌘ **rev** **-** ⌘ Current version: **5.3.0** ⌘

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Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Editorial changes to MAC-hs
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	HSDPA-L23
Date:	⌘	26/Feb/2003
Category:	⌘	**D**
Release:	⌘	Rel-5

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F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
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D *(editorial modification)*
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Use one of the following releases:
2 (GSM Phase 2)
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R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
Rel-4 (Release 4)
Rel-5 (Release 5)
Rel-6 (Release 6)

Reason for change:	⌘	- Somewhat ambiguous specification of Release 5. - Removal of FFS
Summary of change:	⌘	- In the section 4.2.4.3 the term MAC-c/hs is erroneously used instead of MAC-c/sh - The description in 11.6.1.3 specifies that the New Data Indicator shall not be incremented for subsequent transmissions of a MAC-hs PDU. This may give the impression that the new data indicator is also not incremented for any new MAC-hs PDU. It is clarified that the New Data Indicator shall only remain unchanged if a MAC-hs PDU is retransmitted. - The definition of the New Data Indicator can be seen as stable. The FFS in section 11.6.2.2 for the definition of the New Data Indicator has been removed
Consequences if not approved:	⌘	- Ambiguous description of flow control mechanism in the section 4.2.4.3. Flow control cannot be implemented correctly. - Unclear description of updating New Data indicator in the section 11.6.1.3. The implementation of MAC-hs on UTRAN side is not straight-forward. - Incorrect note that alternative use of New Data Indicator is FFS in the section 11.6.2.2 because definition of New Data Indicator is stable.

Clauses affected:	⌘	11.6.1.3 ; 11.6.2.2			
Other specs	⌘	Y: [ ] N: [X]	Other core specifications	⌘	

affected:	X	Test specifications
	X	O&M Specifications
Other comments: ⌘		

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4.2.4.3 MAC-hs entity – UTRAN Side

There is one MAC-hs entity in the UTRAN for each cell that supports HS-DSCH transmission. The MAC-hs is responsible for handling the data transmitted on the HS-DSCH. Furthermore it is responsible for the management of the physical resources allocated to HSDPA. MAC-hs receives configuration parameters from the RRC layer via the MAC-Control SAP. There should be priority handling per MAC-d PDU in the MAC-hs. The MAC-hs is comprised of four different functional entities:

- Flow Control:
  This is the companion flow control function to the flow control function in the MAC-c/sh in case of configuration with ~~MAC-c/hs~~MAC-c/sh and MAC-d in case of configuration without ~~MAC-c/hs~~MAC-c/sh. Both entities together provide a controlled data flow between the MAC-c/sh and the MAC-hs (Configuration with MAC-c/sh) or the MAC-d and MAC-hs (Configuration without ~~MAC-c/hs~~MAC-c/sh) taking the transmission capabilities of the air interface into account in a dynamic manner. This function is intended to limit layer 2 signalling latency and reduce discarded and retransmitted data as a result of HS-DSCH congestion. Flow control is provided independently by MAC-d flow for a given MAC-hs entity.

- Scheduling/Priority Handling:
  This function manages HS-DSCH resources between HARQ entities and data flows according to their priority. Based on status reports from associated uplink signalling either new transmission or retransmission is determined. Further it determines the Queue ID and TSN for each new MAC-hs PDU being serviced. A new transmission can be initiated instead of a pending retransmission at any time to support the priority handling.

- HARQ:
  One HARQ entity handles the hybrid ARQ functionality for one user. One HARQ entity is capable of supporting multiple instances (HARQ process) of stop and wait HARQ protocols. There shall be one HARQ process per HS-DSCH per TTI.

- TFRC selection:
  Selection of an appropriate transport format and resource for the data to be transmitted on HS-DSCH.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].

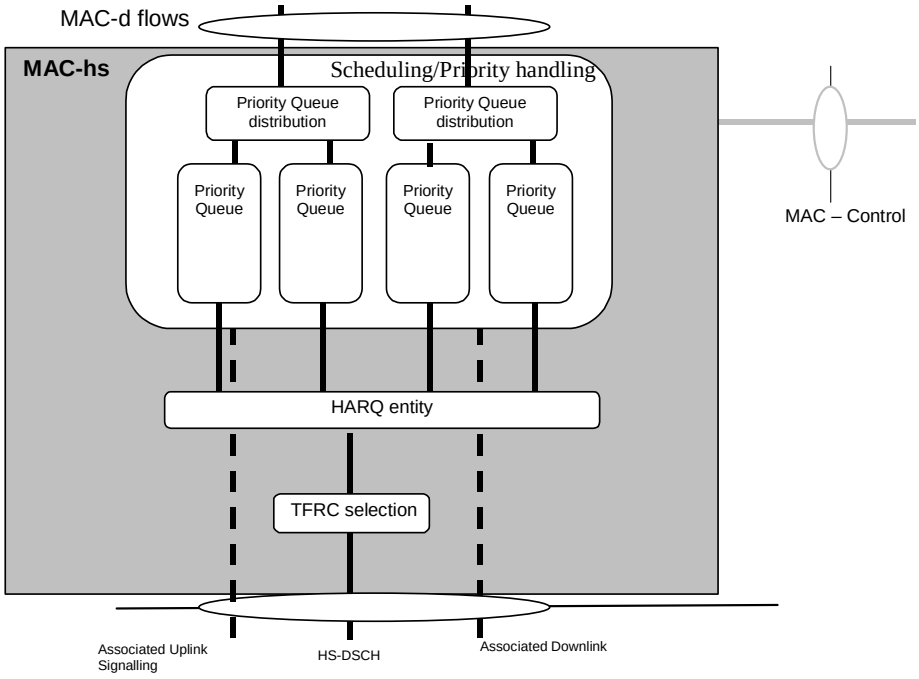

Figure 4.2.4.3.1: UTRAN side MAC architecture / MAC-hs details

…….

11.6 Control of HS-DSCH transmission and reception

11.6.1 Network operation

The following are the functions of the various functional entities at the network in support of the HARQ protocol used on HS-DSCH.

11.6.1.1 Scheduler

The scheduler performs the following functions:

- Schedules all UEs within a cell;
- Services priority queues:
  - The scheduler schedules MAC-hs SDUs based on information from upper layers. One UE may be associated with one or more MAC-d flows. Each MAC-d flow contains HS-DSCH MAC-d PDUs for one or more priority queues.
- Determines the HARQ Entity and the queue to be serviced;
- Sets the TSN for new data blocks being transferred from the selected queue;
  - set the TSN to value 0 for the first MAC-hs PDU transmitted for each Queue ID within an HS-DSCH;
  - increment the TSN with one for each transmitted MAC-hs PDU on each Queue ID within an HS-DSCH.
- Indicates the Queue ID and TSN to the HARQ entity for each MAC-hs PDU to be transmitted;
- Schedules new transmissions and retransmissions:
  - Based on the status reports from HARQ Processes the scheduler determines if either a new transmission or a retransmission should be made. A new transmission can however be initiated on a HARQ process at any time. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-hs SDU.
- Determines the redundancy version:
  - The scheduler determines a suitable redundancy version for each transmitted and retransmitted MAC-hs PDU and indicates the redundancy version to lower layer.

11.6.1.2 HARQ entity

- There is one HARQ entity per UE in UTRAN.
- The HARQ entity sets the Queue ID in transmitted MAC-hs PDUs to the value indicated by the UTRAN scheduler.
- The HARQ entity sets the transmission sequence number (TSN) in transmitted MAC-hs PDUs to the value indicated by the UTRAN scheduler.
- The HARQ entity sets the HARQ process identifier in transmitted MAC-hs PDUs. UTRAN should:
  - determine a suitable HARQ process to service the MAC-hs PDU and set the HARQ process identifier accordingly.

11.6.1.3 HARQ process

- The HARQ process sets the New data indicator in transmitted MAC-hs PDUs. UTRAN should:
  - set the New Data Indicator to the value "0" for the first MAC-hs PDU transmitted by a HARQ process;
  - not increment the New Data Indicator for ~~subsequent~~ retransmissions of a MAC-hs PDU;
  - increment the New Data Indicator with one for each transmitted MAC-hs PDU containing new data.
- The HARQ process processes received status messages. UTRAN should:
  - deliver received status messages to the scheduler.

11.6.2 UE operation

The UE operation in support of the HARQ protocol used on HS-DSCH is split among the following four functional units with their associated functions.

11.6.2.1 HARQ Entity

- There is one HARQ entity at the UE which processes the HARQ process identifiers in received MAC-hs PDUs on HS-DSCH.
- Each received MAC-hs PDU shall be allocated to the HARQ process indicated by the HARQ process identifier of the MAC-hs PDU.

11.6.2.2 HARQ process

A number of parallel HARQ processes is used in the UE to support the HARQ protocol. The number of HARQ processes is configured by upper layers.

The HARQ process processes the New Data Indicator indicated by lower layers for each received MAC-hs PDU.

The UE shall:

- if the New Data Indicator has been incremented compared to the value in the previous received transmission in this HARQ process or this is the first received transmission in the HARQ process:
  - replace the data currently in the soft buffer for this HARQ process with the received data.
  - if the Transport Block Size index value is equal to 111111:
    - generate a positive acknowledgement (ACK) of the data in this HARQ process;
    - discard the received data;
    - assume that the data has been successfully decoded.

~~NOTE: alternative solutions for the use of the New Data Indicator are FFS.~~

- if the New Data Indicator is identical to the value used in the previous received transmission in the HARQ process:
  - if the Transport Block Size index value is equal to 111111:
    - assume that the transport block size is identical to the last valid transport block size signalled for this HARQ process.
  - if the data has not yet been successfully decoded:
    - combine the received data with the data currently in the soft buffer for this HARQ process.
- if the data in the soft buffer has been successfully decoded and no error was detected:

    - deliver the decoded MAC-hs PDU to the reordering entity;
    - generate a positive acknowledgement (ACK) of the data in this HARQ process.
- else:
    - generate a negative acknowledgement (NAK) of the data in this HARQ process;
- schedule the generated positive or negative acknowledgement for transmission and the time of transmission relative to the reception of data in a HARQ process is configured by upper layer.

The HARQ process processes the Queue ID in the received MAC-hs PDUs. The UE shall:

- arrange the received MAC-hs PDUs in queues based on the Queue ID.

3GPP TSG-RAN WG2 Meeting #34
Sophia Antipolis, France, 17th- 21st February 2003

Tdoc ⌘R2-030610

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CHANGE REQUEST

⌘ **25.321** **CR** **170** ⌘ **rev** **-** ⌘ Current version: **5.3.0** ⌘

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Proposed change affects: UICC apps⌘ ☐ ME ☒ Radio Access Network ☒ Core Network ☐

Title:	⌘	Re-ordering entity corrections
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI-5
Date:	⌘	13/02/2003
Category:	⌘	**F**
Release:	⌘	Rel-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
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Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
Rel-4 (Release 4)
Rel-5 (Release 5)
Rel-6 (Release 6)

Reason for change: ⌘ The description of the re-ordering functionality is unclear.

- In the current specification the TRANSMIT_WINDOW and RECEIVE~~W~~_WINDOW referes to both the actual window and the window size
- The signalling of the window size to Node B and UE is no longer FFS
- The section numbering in 11.6.2.3 is confusing. Functional description is placed under the subsection "definitions"
- In the reset procedure the UE is currently specified to initialise the transmitter window which is a Node B variable.
- The TSN of the payload for which the

Summary of change: ⌘

- Separate parameter definitions for TRANSMIT_WINDOW_SIZE and ~~RECEIWE~~RECEIVE_WINDOW_SIZE are introduce to differentiate these with the actual receiver and transmitter window.
- The FFS on the signaling of window sizes to Node B and UE is removed
- A new subsection is introduced
- A new state variable is introduced to track the leading edge of the receiver window
- A new state variable is introduces to track the TSN of the payload for which the timer T1 is started.

		• The reset procedure is corrected to only initialise UE variables • It is clarified that the scheduler may reuse a TSN.
Consequences if not approved:	⌘	The CR contains clarifications of the re-ordering protocol. Incorrect implementation of this protocol would lead to significant increase in delay for delivering data to higher layers and thus seriously impact system performance.

Clauses affected:	⌘	11.6.1.1, 11.6.2.3.1, 11.6.2.3.2 (new), 11.6.2.5			
Other specs affected:	⌘	**Y**	**N**		
			X	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	
Other comments:	⌘				

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

11.6.1.1 Scheduler

The scheduler performs the following functions:

- Schedules all UEs within a cell;
- Services priority queues:
  - The scheduler schedules MAC-hs SDUs based on information from upper layers. One UE may be associated with one or more MAC-d flows. Each MAC-d flow contains HS-DSCH MAC-d PDUs for one or more priority queues.
- Determines the HARQ Entity and the queue to be serviced;
- Sets the TSN for new data blocks being transferred from the selected queue;
  - set the TSN to value 0 for the first MAC-hs PDU transmitted for each Queue ID within an HS-DSCH;
  - increment the TSN with one for each transmitted MAC-hs PDU on each Queue ID within an HS-DSCH.

NOTE: The scheduler may re-use TSNs by toggling the NDI bit in order to resume pre-empted transmissions or to force the UE to flush the soft buffer. In this case the content of the payload may be changed but care should be taken to preserve the higher layer data order.

- Indicates the Queue ID and TSN to the HARQ entity for each MAC-hs PDU to be transmitted;
- Schedules new transmissions and retransmissions:
  - Based on the status reports from HARQ Processes the scheduler determines if either a new transmission or a retransmission should be made. A new transmission can however be initiated on a HARQ process at any time. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-hs SDU.
- Determines the redundancy version:
  - The scheduler determines a suitable redundancy version for each transmitted and retransmitted MAC-hs PDU and indicates the redundancy version to lower layer.

11.6.2.3 Reordering entity

11.6.2.3.1 Definitions

In the functions described in this section the following ~~variable~~ definitions apply:

Parameters

- Transmitter window size (TRANSMIT_WINDOW_SIZE)
  TRANSMIT_WINDOW_SIZE is the size of the transmitter window according to the definition below. This is a parameter in the Node B and the value of the parameter is configured by higher layers.
- Receiver window size (RECEIVE_WINDOW_SIZE)
  RECEIVE_WINDOW_SIZE is the size of the receiver window according to the definition below. This is a parameter in the UE and the value of the parameter is configured by higher layers.

State ~~V~~variables

- Next_expected_TSN:
  The next_expected_TSN is the Transmission sequence number (TSN) following the TSN of the last in-sequence MAC-hs PDU received. It shall be updated upon the receipt of the MAC-hs PDU with TSN equal to Next_expected_TSN. The initial value of Next_expected_TSN =0.
- ~~Highest_received_TSN~~RcvWindow_UpperEdgeRcvWindow_UpperEdge:
  The ~~Highest_received_TSN~~RcvWindow_UpperEdge is the MAC-hs PDU with the highest TSN of received MAC-hs PDUs. The initial Highest received TSN equals 63. Highest received TSN is updated based on the reception of new payloads according to the procedure given below.

- T1_TSN:
  The TSN of the latest MAC-hs PDU that cannot be delivered to highest layer when the timer T1 is started.

Timers

- Re-ordering release timer (T1):
  ~~-~~The Re-ordering release timer T1 controls the stall avoidance in the UE reordering buffer as described below. The value of T1 is configured by upper layers.

Other ~~D~~definitions

- ~~Transmitter window (TRANSMIT_WINDOW):~~
  ~~The transmitter window defines which MAC-hs PDUs that the transmitter can retransmit without causing an ambiguity of the TSN in the receiver. The size of the transmitter window equals TRANSMIT_WINDOW_SIZE and the maximum value of TRANSMIT_WINDOW is 32. The initial transmitter window equals [0..(TRANSMIT_WINDOW_SIZE-1)31]. The configuration of TRANSMIT_WINDOW by higher layers is FFS.~~

- Receiver window ~~(RECEIVE_WINDOW)~~:
  The receiver window defines ~~which~~ TSNs of those MAC-hs PDUs that can be received in the receiver without causing an advancement of the receiver window according to the procedure below. The size of the receiver window equals RECEIVE_WINDOW_SIZE ~~and the maximum value of RECEIVE_WINDOW is 32.~~ and spans TSNs going from ~~Highest_received_TSN~~RcvWindow_UpperEdge – RECEIVE_WINDOW_SIZE + 1 to ~~Highest_received_TSN~~RcvWindow_UpperEdge included. ~~The initial receiver window equals [0..(RECEIVE_WINDOW_SIZE-1)31]. The configuration of RECEIVE_WINDOW by higher layers is FFS.~~

11.6 2 3.2 Reordering functionality

~~The Re-ordering release timer T1 controls the stall avoidance in the UE reordering buffer. The value of T1 is configured by upper layers.~~

If no timer T1 is active:

- the timer T1 shall be started when a MAC-hs PDU with TSN=SN is correctly received but can not be delivered to the disassembly function ~~due to that the MAC-hs PDU with TSN equal to Next_expected_TSN is missing~~.

- T1_TSN shall be set to SN.

If a timer T1 is already active:

- no additional timer shall be started, i.e. only one timer T1 may be active at a given time.

The timer T1 shall be stopped if:

- the MAC-hs PDU ~~for which the timer was started~~ with TSN = T1_TSN can be delivered to the disassembly function before the timer expires.

When the timer T1expires:

- all correctly received MAC-hs PDUs up to and including T1_TSN-1 shall be delivered to the disassembly function and they shall be removed from the reordering buffer and be considered as having been received;

- all correctly received MAC-hs PDUs up to the next ~~missing~~ not received MAC-hs PDU shall be delivered to the disassembly function.

- next_expected_TSN shall be set to the TSN of the ~~first~~next not received MAC-hs PDU.

When the timer T1 is stopped or expires, and there still exist some received MAC-hs PDUs that can ~~-~~not be delivered to higher layer:

- timer T1 is started ~~for the MAC-hs PDU with~~

- set T1_TSN to the highest TSN among those of the MAC-hs PDUs that can ~~-~~not be delivered.

Transmitter operation:

After the transmitter has transmitted a MAC-hs PDU with TSN=SN, any MAC-hs PDU with TSN ≤ SN – TRANSMIT_WINDOW_SIZE should not be retransmitted to avoid sequence number ambiguity in the receiver.

Receiver operation:

- MAC-hs PDUs that have been discarded by the timer based mechanism shall be considered as having been received in the following procedure.

When a MAC-hs PDU with TSN = SN is received:

- If SN is within the receiver window and this MAC-hs PDU has not previously been received:
  - the MAC-hs PDU is placed in the reordering buffer at the place indicated by the TSN.
- If SN is within the receiver window, and this MAC-hs PDU has been previously received:
  - the MAC-hs PDU shall be discarded.
- If SN is outside the receiver window:
  - the received MAC-hs PDU shall be placed above the highest received TSN in the reordering buffer, at the position indicated by SN;
  - ~~Highest_received_TSN~~RcvWindow_UpperEdge shall be set to SN thus advancing the receiver window~~the receiver window shall be advanced so that SN forms the upper edge of the receiver window~~;
  - any MAC-hs PDUs with TSN ≤ ~~Highest_received_TSN~~RcvWindow_UpperEdge – RECEIVE_WINDOW_SIZE, i.e. outside the receiver window after its position is updated, shall be removed from the reordering buffer and be delivered to the disassembly entity.
- All received MAC-hs PDUs with consecutive TSNs from next_expected_TSN up to the first not received MAC-hs PDU are delivered to the disassembly entity.
- next_expected_TSN shall be set to the TSN of this first not received MAC-hs PDU.

11.6.2.4 Disassembly entity

For each MAC-hs PDU that is delivered to the disassembly function, the UE shall:

- remove any padding bits if present;
- remove the MAC-hs header;
- deliver the MAC-d PDUs in the MAC-hs PDU to MAC-d.

11.6.2.5 MAC-hs Reset

If a reset of the MAC-hs entity is requested by upper layers, the UE shall:

- flush soft buffer for all configured HARQ processes;
- stop all active re-ordering release timer (T1) and set all timer T1 to their initial value;
- start TSN with value 0 for the next transmission on every configured HARQ process;
- initialise the variables ~~Highest_received_TSN~~RcvWindow_UpperEdge~~RECEIVE_WINDOW~~ and Next_expected_TSN to their initial values~~values for transmit window (TRANSMIT_WINDOW), receive window (RECEIVE_WINDOW) and the next expected TSN (Next_expected_TSN=0)~~;
- disassemble all MAC-hs PDUs in the re-ordering buffer and deliver all MAC-d PDUs to the MAC-d entity;
- flush the re-ordering buffer.

and then:

- indicate to all AM RLC entities mapped on HS-DSCH to generate a status report.