

3GPP TSG-RAN WG2 #63
August 18th – 22nd 2008
Jeju Island, Korea

R2-084156

Agenda item: 6.1.1.4
Source: Qualcomm Europe
Title: NDI and Message 3
Document for: Discussion, Decision

1. Introduction

The agreed in principle CR [1] is capturing the handling of NDI for the UL grant corresponding to message 3 by stating that:

1. the HARQ entity shall request a new transmission in response to a grant in random access response
2. when determining if NDI has been incremented compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI
3. uplink grant to Temporary C-RNTI trigger retransmissions.

2. Discussion

Points 1 and 2 seem to have an undesirable side effect for the HARQ process interrupted by a Message3 transmission as illustrated with the scenario below:

1. UL HARQ process #A has data “blah” in the buffer for a transmission
2. A random access response is received containing a grant for Message3, to be transmitted by UL HARQ process #A
3. Message 3 overwrites “blah” and is transmitted
4. A PDCCH for the UE’s C-RNTI for an UL grant where NDI is the same as the NDI associated with step 1) is received. What happened? UE lost contention; eNB never saw that UE’s message 3; eNB thinks it can ask for “blah”. Or eNB takes some time to decode MAC UE ID control element in Message 3 and happens to resume UL retransmission for HARQ process #A at this time.
5. What should UE do:
 - a. Retransmit Message3
 1. makes no sense: retransmissions of Message3 happen only with Temporary C-RNTI
 2. eNB is expecting a retransmission of “blah” since it schedules UE on C-RNTI
 - b. Retransmit “blah”

1. impossible: “blah” was overwritten by Message 3 in UE’s buffers
 - c. Perform a new transmission
6. What will eNB do when receiving
- a. Retransmission of Message3
 1. eNB will attempt to combine “blah” with “Message 3” and fail
 2. eNB may try to decode “Message3” alone and will get useless information
 - b. Retransmission of “blah”
 1. this cannot happen because “blah” was overwritten by Message3
 - c. A new transmission
 1. eNB will combine “blah” with “new message” and fail
 2. under some conditions, eNB may try to decode “new message” alone and succeed
7. What behaviour does the current state of specification (after RAN2#62bis) CRs dictate?
- a. RACH is still ongoing, there is a Message3 in Message3 buffer so should retransmit Message3
 - b. But most likely size of TB for Message3 and grant on C-RNTI do not match
 - c. MAC PDU to retransmit does not fit in provided TB: Undefined UE behaviour?

Of all options above, we note that the only option that give eNB a chance to cleanly handle this case is option c). Therefore we propose:

Proposal 1: The first use of an HARQ process following its use for a message 3 transmission, in response to a grant on C-RNTI or SPS-C-RNTI always starts a new transmission (irrespective of NDI).

In addition, we note that the Message3 buffer is populated when a Random Access Response is received. Therefore the MAC PDU in Message3 buffer only fits in a TB of the appropriate size. If a grant to C-RNTI with NDI flipped is received in the middle of RACH, UE should not send the Message3 on that grant, even if RACH is ongoing. Therefore we propose:

Proposal 2: HARQ should obtain the MAC PDU to transmit from the [Message3] buffer only in response to UL grant in a Random Access Response.

On a more editorial note we also propose:

Proposal 3: Use terminology “grant received on the PDCCH for the UE’s x-RNTI” in 5.4.2.1 for consistency with text in 5.4.1

Proposal 4: add missing “Semi-Persistent Scheduling C-RNTI” in 5.4.1 (an old oversight)

3. Conclusion

We propose to agree to the changes implementing proposals 1/2/3/4 as illustrated in the Annex. Changes compared to the CR [1] are highlighted for easier tracking.

4. References

- [1] R2-083723 NDI and Msg3, LGE CR approved in principle at RAN2#62bis

Annex [changes to R2-083723]

5.4 UL-SCH data transfer

Editor's note: Current text applies to, at least, FDD.

5.4.1 UL Grant reception

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI:

- if an uplink grant for this TTI has been received on the PDCCH for the UE's C-RNTI, **Semi-Persistent Scheduling C-RNTI**, or Temporary C-RNTI; or
- if an uplink grant for this TTI has been received in a Random Access Response:
 - indicate a valid uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if an uplink grant for this TTI has been configured:
 - indicate an uplink grant, valid for new transmission, and the associated HARQ information to the HARQ entity for this TTI.

NOTE: The period of configured uplink grants is expressed in TTIs.

NOTE: If the UE receives both a grant for its RA-RNTI and a grant for its C-RNTI, the UE may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI.

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5.4.2 HARQ operation

5.4.2.1 HARQ entity

There is one HARQ entity at the UE. A number of parallel HARQ processes are used in the UE to support the HARQ entity, allowing transmissions to take place continuously while waiting for the feedback on the successful or unsuccessful reception of previous transmissions.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. It also routes the receiver feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process.

If TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. If a transmission is indicated for the TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. The next TTI_BUNDLE_SIZE uplink TTIs are subsequently used for transmissions for the identified HARQ process. HARQ retransmissions within a bundle shall be performed without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The UE expects feedback only for the last transmission of a bundle.

For transmission of an uplink message containing the C-RNTI MAC control element or an uplink message including a CCCH SDU during Random Access (see section 5.1.5) TTI bundling does not apply.

The number of HARQ processes is equal to [X] [FFS]. Each process is associated with a number from 0 to [X-1].

At the given TTI, the HARQ entity shall:

- if an uplink grant indicating that the NDI has been incremented compared to the value in the previous transmission of this HARQ process is indicated for this TTI; or
- ~~if an uplink grant for this is the very first transmission of~~ this HARQ process (i.e. a new transmission takes place for this HARQ process) ~~is indicated for this TTI; or~~
- ~~if an uplink grant received in a Random Access Response is indicated for this TTI; or~~
- ~~if the last use of this HARQ process was for transmission of a MAC PDU from the [Message3] buffer and an uplink grant on the PDCCH for the UE's C-RNTI or Semi-Persistent Scheduling C-RNTI is indicated for this TTI; or~~

- if there is an ongoing Random Access procedure and there is a MAC PDU in the [Message3] buffer and the uplink grant is received in a Random Access Response:
 - obtain the MAC PDU to transmit from the [Message3] buffer.
- else, if the "uplink prioritisation" entity indicates the need for a new transmission:
 - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
 - instruct the HARQ process corresponding to this TTI to trigger a new transmission using the identified parameters.
- else:
 - flush the HARQ buffer.
- else:
 - if an uplink grant, indicating that the NDI is identical to the value in the previous transmission of this HARQ process (i.e. a retransmission takes place for this HARQ process), is indicated for this TTI; or
 - if an uplink grant on the PDCCH for the UE's addressed to a Temporary C-RNTI is indicated for this TTI:
 - instruct the HARQ process to generate an adaptive retransmission.
- else, if the HARQ buffer of the HARQ process corresponding to this TTI is not empty:
 - instruct the HARQ process to generate a non-adaptive retransmission.

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When determining if NDI has been incremented compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

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NOTE: A retransmission triggered by the HARQ entity should be cancelled by the corresponding HARQ process if it collides with a measurement gap or if a non-adaptive retransmission is not allowed.