3GPP TSG-RAN WG2 Meeting #101 **R2-1801831**
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Title: **Remaining issues of on-demand SI**
Agenda Item: **10.4.1.6.6**
Document for: **Discussion and Decision**

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1. Introduction

In RAN2 Adhoc NR#2 meeting, the email discussion of on-demand SI has been discussed and some agreements are achieved as follows.

> Agreements for Msg1 based SI request method:
> 1: RAPID is included in Msg2.
> 2: Fields Timing Alignment Information, UL grant and Temporary C-RNTI are not included in Msg2.
> 3: RACH procedure for SI requests is considered successful when Msg2 containing a RAPID corresponding to the transmitted preamble is received.
> 4: Msg2 reception uses RA-RNTI that corresponds to the Msg1 transmitted by the UE (details of RA-RNTI selection left to UP discussion)
> 5: UE retransmits RACH preamble according to NR RACH power ramping
> 6: Msg1 for SI request re-transmission is continued until reaching max preamble transmissions. Thereafter, a Random Access problem to upper layers is indicated. (depending on the NR RACH procedure design)
> FFS: Upper layer actions when MAC reports Random Access problem. To be discussed in CP session.
> 7: Back off is applicable for Msg1 based SI requests but no special Back off subheader/ procedure is required.

> Agreements for Msg3 based SI request method:
> 1: UE determines successful Msg3 based on reception of Msg4
> FFS Details of the Msg4 content used to confirm successful Msg3. To be discussed initially CP.
> 2: Preamble(s) for SI request using Msg3 based Method are not reserved.
> 3: RRC signalling is used for SI request in Msg3.
> FFS: RRC signalling how to indicate the requested SI/SIB details left to ASN.1 work.
> 5: Temporary C-RNTI received in Msg2 is used for Msg4 reception

In this contribution we analyze the remaining issues for Msg1 and Msg3 based SI request procedures.

2. Discussion

2.1. Msg1 based SI request procedure

In [1], when Msg1 for SI request re-transmission is continued until reaching max preamble transmissions, a random access problem from MAC is indicated to upper layers. Therefore, what actions the upper layer performs are discussed, and 4 possible alternatives are:

- Alternative 1: UE shall treat the cell as barred.
- Alternative 2: Depends on the SI/ SIBs being requested. If these are not the essential SIBs, then UE refrains from retrying until a certain time. The prohibit timer, if any, might be specified or be configurable. In case of essential SIBs, the UE shall treat the cell as barred.
- Alternative 3: Up to UE implementation – some UEs, who need certain non-essential feature-specific SIBs that are important/ critical for its operation, may treat the cell as barred while other UEs may prefer to resend SI request after certain prohibit timer.
- Alternative 4: Do nothing – MAC continues Msg1 transmission endlessly.

Since Alt4 is not advantageous for UE power consumption, we preferred to exclude it. For Alt1 and Alt2, something needs to be specified for upper layers while Alt3 is up to UE implementation. For Alt2 and Alt3, on-demand SIs are divided into essential SIBs and no-essential SIBs while Alt1 is the unified solution for all on-demand SIs.

It is agreed that scheduling information in minimum SI includes an indicator whether the concerned SI-block is periodically broadcasted or provided on demand. So UE knows what on-demand SIs there are and requests what it is needed. If network is provisioning some SIs while UE cannot acquire them, then there is radio link quality problem to the cell.

For connected mode, upon radio link quality problem, UE can receive PBCH but no dedicated data in case that UE is downlink synchronized but not uplink synchronized to the cell. Then UE does not treat the cell as barred, but perform RRC connection reestablishment. For idle mode, UE does not have a specified procedure. And RRC connection reestablishment cannot work for on-demand SI random access (RA) problem. This is why a new procedure is required.

If on-demand SI request is failed and there is RA problem, UE cannot obtain the desired SIs. We prefer to specify the unified upper layers actions for all on-demand SIs without additional complexity in categorizing on-demand SIs into essential SIBs and no-essential SIBs. Thus, we propose Alt1 that UE shall treat the cell as barred and perform cell re-selection, when MAC reports random access problem to upper layer for Msg1 based SI request procedure.

Proposal1: UE shall treat the cell as barred and perform cell re-selection, when MAC reports random access problem to upper layer for Msg1 based SI request procedure.

2.2. Msg3 based SI request procedure

It is agreed that RRC signalling is used for SI request in Msg3, and RRC signalling how to indicate the requested SI/SIB details is left to ASN.1 work. Here we'd like to clarify what RRC message is used for SI request in Msg3, and there are 2 cases as below.

- Case1: reuse LTE RRC message, such as RRCConnectionRequest, and a requested SI/SIB indication is included
- Case2: specify a new RRC message, such as RRCSystemInfoRequest, and a requested SI/SIB indication is included

To reuse the LTE RRC message needs to extend the legacy RRC message with additional SI/SIB bitmap, which may introduce confusions to the legacy procedures (e.g. RRC connection establishment procedure). And the network may confuse whether it is for on-demand SI request or for both RRC connection establishment and on-demand SI request. In addition, the reused LTE RRC message for SI request can only be used by idle/inactive UEs. For UEs in connected mode, a new RRC message is anyway needed for SI request.

To specify a new RRC message can avoid confusions between the legacy procedures (e.g. RRC connection establishment procedure) and on-demand SI request procedure, and the new RRC message is specified for different purpose. In addition, it is beneficial for specification simplification that the RRC message for SI request can be used by UEs in both connected mode and idle/inactive mode. And RRC signalling design should be considered such as signalling formats, contents and logical channel, etc.

Proposal2: a new RRC message (RRCSystemInfoRequest) is specified for SI request in Msg3 and it can also be used for UEs in RRC_CONNECTED.

It is agreed that for MSG1 based SI request, the minimum granularity of requested SI is one SI message (a set of SIBs as in LTE). [2] Similar with the agreement, we propose:

Proposal3: for MSG3 based SI request, the minimum granularity of requested SI is one SI message (a set of SIBs as in LTE).

Therefore, a requested SI message indication is included in the RRCSystemInfoRequest message. And we suggest it could be a requested SI message bitmap.

Proposal4: a requested SI message indication is included in the RRCSystemInfoRequest message, e.g. a requested SI message bitmap.

It is agreed that UE determines successful Msg3 based on reception of Msg4, and details of the Msg4 content used to confirm successful Msg3 is FFS. According to the previous agreements, only progress on the two agreed approaches for delivering on-demand system information (via dedicated signalling to RRC_CONNECTED UEs; via SI-Message broadcast to RRC_IDLE and RRC_INACTIVE UEs) and refrain from introducing additional

solution variants, which means Msg4 should not contain the required SIs. So Msg4 is only the response for Msg3, and there are 2 cases as below.

- Case1: Msg4 may only contain MAC CE including the CCCH SDU transmitted in Msg3 and no RRC message is needed.
- Case2: Msg4 may contain MAC CE and a new specified RRC message, such as RRCSystemInfoResponse.

For UEs in connected, dedicated RRC signalling can be used for the request and delivery of other SI. Thus, Msg1 and Msg3 based SI request procedures are used for idle/inactive UEs. In normal RA procedure for idle/inactive UEs, Msg4 containing UE Contention Resolution Identity MAC CE can be transmitted with or without RRC message at the same time. Thus, there is commonality between normal RA and on-demand SI RA in both cases. In addition, a new specified RRC message will increase the specification complexity. Therefore, we propose that Msg4 may only contain MAC CE including the CCCH SDU transmitted in Msg3 for Msg3 based SI request procedure, which has commonality to normal RA procedure. [3]

Proposal5: Msg4 may only contain MAC CE including the CCCH SDU transmitted in Msg3 for Msg3 based SI request procedure, which has commonality to normal RA procedure.

3. Conclusion

According to the analysis in section 2, we propose for Msg1 and Msg3 based SI request procedures:

Proposal1: UE shall treat the cell as barred and perform cell re-selection, when MAC reports random access problem to upper layer for Msg1 based SI request procedure.

Proposal2: a new RRC message (RRCSystemInfoRequest) is specified for SI request in Msg3 and it can also be used for UEs in RRC_CONNECTED.

Proposal3: for MSG3 based SI request, the minimum granularity of requested SI is one SI message (a set of SIBs as in LTE).

Proposal4: a requested SI message indication is included in the RRCSystemInfoRequest message, e.g. a requested SI message bitmap.

Proposal5: Msg4 may only contain MAC CE including the CCCH SDU transmitted in Msg3 for Msg3 based SI request procedure, which has commonality to normal RA procedure.

4. Reference

[1] R2-1707090 Summary of [98#34][NR] On demand SI (Lenovo) Lenovo, Motorola Mobility

[2] 3GPP RAN2 #98 Chairman's note, May, 2017

[3] R2-1800161 RA procedure for Msg3 based SI request CATT