

Agenda Item: 10.4.1.6.6
Source: Intel Corporation
Title: Remaining issues on on-demand System Information
Document for: Discussion and Decision

1 Introduction

In this contribution, the remaining issues related to the on-demand SI are discussed below:

2 Discussion

2.1 Contents of SIB1 for on demand SI

It is agreed that there will be a bit in SI scheduling information whether other SI is periodically broadcast or provided on demand. It is FFS on whether there is a need for additional indication whether the on demand SI is actually being broadcast at this instant in time:

3: The scheduling information for other SI includes SIB type, validity information, periodicity, and SI-window information in minimum SI irrespective of whether other SI is periodically broadcasted or provided on demand.
FFS Whether there is an additional indication that an on demand SI is actually being broadcast at this instant in time.

In RAN2 Ad-hoc June 2017, there was an offline on this but no conclusion was made. There were 3 options on the table:

Option 1: Use the existing bit indicating whether the SI is on-demand or periodic broadcast to also indicate whether the on-demand SI is currently being broadcast (i.e. if it is currently being broadcast, it will indicate it as periodic broadcast even though it is an on-demand SI)

Option 2: Include an additional indication to specifically indicate whether an on-demand SI is actually being broadcast at this instant in time. If the additional indication indicates that an on-demand SI is being broadcast, the UE will not perform UE SI request.

Option 3: Use the presence of the Scheduling Information of the on-demand SI to indicate whether it is currently being broadcast

The issue we see in (1) is that a UE may enter the cell at any time. With the existing indication being dynamically switch between on-demand and periodic broadcast, there will be possibility that a UE may not have realised that it needs to request a SI on demand (e.g. during the transient period where the network stop the periodic broadcast of the on-demand SI and setting the indication back to on-demand). It may result in SI acquisition failure for such UE.

The issue with Option 2 is mainly on the extra overhead of adding an additional bit for each on-demand SI. We do not see a need to page UE when this bit is changed. Hence there is no additional signalling issue.

The issue with Option 3 is that the UE has to read SIB1 after requesting a SI. This results in further delay and also extra power consumption for acquiring on-demand SI.

Comparing the 3 options, Option 2 does not have the ambiguity as in Option 1 and is more efficient in terms of latency of acquiring on demand SI and less UE power consumption than Option 3. Hence it is proposed:

Proposal#1: Include an additional indication to specifically indicate whether an on-demand SI is actually being broadcast at this instant in time, on top of the indication whether the SI is on-demand or periodic broadcast. If the additional indication indicates that an on-demand SI is being broadcast, the UE does not perform UE SI request.

In order to prevent further need of the UE to acquire the SIB1 before acquiring the on-demand SI, it is also proposed that:

Proposal#2: The scheduling info of the on-demand SI is always present in SIB1.

Also PRACH configuration (i.e. the preamble mapping to the SI) for Msg1 based request has to be included in the Scheduling information of the on-demand SI:

Proposal#3: The PRACH configuration (i.e. the preamble mapping to the SI) for Msg1 based request is included in the Scheduling Information of the on-demand SI.

2.2 Msg3 based UE request

The following is agreed for Msg3 based UE request:

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

It is agreed that RRC signalling is used for SI request in Msg3. There are 2 ways to request the SIB required in Msg3: (1) list/bitmap of SIBs or (2) list/bitmap of SI. Since SIB1 contains the scheduling information of SI and the mapping of SIB to SI, it would be difficult to change this on the fly without having to change scheduling info of SIB1 and UE having to read SIB1 perform it can read the requested SI in the broadcast. Hence it is clear that UE SI request in Msg3 should contain list/bitmap of SI requested.

Since this is a contention based PRACH, it is needed to decide on how contention resolution is done in Msg4 for SI UE request. There are 2 cases where contention resolution is done in LTE:

Case 1: In the scenarios of initial access, RRC Connection Re-establishment and Resume, UE ID is sent in the RRC message and contention resolution is done through sending the UE Contention Resolution ID MAC CE in Msg4. The UE Contention Resolution ID MAC CE contains the first 48bits of UL CCCH SDU (which normally contains the RRC UE Identity such as S-TMSI, random number, Resume ID or the ReestabUEID and some other bits of Msg3). UE ID in Msg3 of the RRC message can be used to identify the UE context by the RRC or NAS.

Case 2: In the scenarios of contention based handover, UE initiated UL out-of-sync recovery and SR transmission, C-RNTI is sent as a MAC CE in Msg3. The contention resolution and UE context identification is based on the C-RNTI in the PDCCH in Msg4 which corresponds to the C-RNTI MAC CE in Msg3.

Case 2 is not relevant for UE in idle mode. Based on Case 1, one approach to perform contention resolution is to also provide UE ID in Msg3. Alternatively, contention resolution can be done just via the list/bitmap of SI requested that are sent in Msg3. If it is not needed for the UE to go into connected mode for on-demand SI, the latter approach (using the list/bitmap of SI) is sufficient. Also including UE ID in Msg3 **will not leave space to also carry the requested list/bitmap of SI**. On the other hand, if the network can decide whether the on-demand SI is to be broadcast or sent via dedicated signalling, then the former approach (UE ID) is required. However, for Rel-15, we think that a simple approach that the on-demand SI is always broadcast when it is requested should be taken and the latter approach using list/bitmap of SI should be adopted.

The contention resolution in Msg4 can be done through sending the UE Contention Resolution ID MAC CE in Msg4. In LTE, the UE Contention Resolution ID MAC CE contains the first 48bits of UL CCCH SDU (which normally contains the RRC UE Identity such as S-TMSI, random number, Resume ID or the ReestabUEID and some other bits of Msg3). The same concept can also be used in this case (i.e. the list/bitmap of SI is provided as part of the UE Contention Resolution ID MAC CE for contention resolution in Msg4).

Proposal#4: UE SI request in Msg3 contains list/bitmap of SI requested. The RRC Msg3 size for Msg3 UE SI request should be made to align with the RRC UE Identity in other Msg3 RRC Message for contention resolution.

Proposal#5: Contention resolution in Msg4 for UE SI request in Msg3 is performed via UE Contention Resolution ID MAC CE which contains the first 48 bits of UL CCCH SDU (i.e. UE SI request in Msg3).

2.3 Initiation of the on-demand SI UE request

UE will initiate an on-demand SIB request for a particular SI/SIB if the SI scheduling info in SIB 1 for this SIB indicates that a UE request is required.

In the case the UE request fails during RACH procedure (MAC indicates a RACH failure to RRC for the SI request), the UE RRC should backoff for 1 full BCCH Modification period before attempting again. During this period, the UE should monitor SIB1 to find out whether the required SI is being broadcast. If so, it can perform SI (re)acquisition procedure for the SI once SIB 1 indicates that the SI is broadcast. If not, the UE can attempt again.

Proposal#6: If MAC indicates to RACH failure for the SI request to RRC, the UE RRC should backoff for 1 full BCCH Modification period before attempting UE request again. During the backoff period, the UE should monitor SIB 1 to find out whether the required SI will be broadcast.

Proposal#6_1: During the backoff period, if the SIB 1 indicates the required SI is broadcast, the UE can perform SI (re)acquisition procedure

Proposal#6_2: At the expiry of the backoff period, the UE can attempt the UE request again for the required SI.

2.4 SI (re)acquisition for on-demand SI

For the (re)acquisition for on-demand SI message, it is agreed that the UE performs SI acquisition once it receives acknowledgement from the network. For Msg1 based SI request, the acknowledgement is via receiving Msg2 while for Msg3 based SI request, the acknowledgement is via receiving Msg4. However for both cases, it is not yet decided when the UE will start SI acquisition, when the UE will decide that SI acquisition failed and how the UE can recover from SI acquisition failure.

2.4.1 When the UE will start SI acquisition

There are 2 ways where the UE can start SI (re)acquisition of a SI after a UE request:

- a. At the next BCCH modification period
- b. Immediately at the next SI window where the SI is scheduled

To prevent delay in acquiring the SI, it is natural to perform the SI acquisition immediately at the next SI window where the SI is scheduled. We do not see a benefit to delay to the next BCCH Modification period. If in the same BCCH Modification period, the UE receives via paging that there is a change in the SI, it can acquire again the corresponding SI in the next BCCH Modification period as normal.

Proposal#7: Upon successful receiving the acknowledgement of the on-demand SI request, the UE performs SI acquisition immediately at the next SI window where the SI is scheduled as indicated in SIB1.

As in LTE, it is not specified that the UE is required to soft combine over multiple SI windows as the contents of the SI may change from SI window to the next, particularly when 2 SI windows cross a BCCH Modification period. In some cases (e.g. cell barring and access class barring etc.), it can also occur within BCCH Modification period.

Proposal#8: The UE soft combines every valid TTI where the SI is PDCCH scheduled within the SI window. It is left to UE implementation whether UE soft combine across over multiple SI windows.

2.4.2 When will the UE decide that SI acquisition fails

In LTE for the periodic broadcast SI, there is no UE behaviour specified on when the UE will consider the SI acquisition as failure. The same can be the case for SI acquisition for on-demand SI (i.e. left to UE implementation on when to consider the SI acquisition as failure, e.g. for on-demand, the UE can base it on SIB 1 indicating again the SI is on-demand etc.). Alternatively, it can be specified/configured number of SI window or BCCH Modification period before the UE decides that SI acquisition fails. Regardless which approach is taken, it is preferred that the same approach on deciding SI (re)acquisition failure is specified for both the on-demand SI case as well as periodic broadcast SI case

Proposal#9: The same UE approach on deciding SI (re)acquisition failure is specified for both the on-demand SI case as well as periodic broadcast SI case.

For on-demand SI which contains only non-essential SIB(s), upon failure to acquire the SI, it is possible for the UE to request again the RAN to broadcast SI. Like in the case of RACH failure during UE request, the UE can backoff for 1 BCCH Modification period before attempting again. During this period, the UE should monitor SIB1 to find out whether the required SI is being broadcast and continue to acquire it as long as the requested SI is broadcast. At expiry, if the requested SI is not broadcast, the UE can attempt the on-demand request again.

Proposal#10: Upon failure to acquire SI which contains only non-essential SIB(s), the UE can backoff for 1 BCCH Modification period before attempting again. During this period, the UE should monitor SIB1 to find out whether the required SI is being broadcast and continue to acquire it as long as the requested SI is broadcast. At expiry, if the requested SI is not broadcast, the UE can attempt the on-demand request again.

2.5 Modification of on-demand SI in Idle Mode

In idle mode, if there is any change of the on-demand SI, there are 2 ways where the UE can acquire the on-demand SI after the gNB notifies the UEs of the SI modification:

1. UE request for the SI using UE request
2. UE acquires the SI without UE request

For 1), this may result in many UE requesting for the updated SI. Hence it may not be efficient in terms of radio resources to go with this approach. 2) seems to be aligned with the SI change for periodic broadcast.

Proposal#11: In idle mode, UE does not perform UE request for on-demand SI after the gNB notifies the SI modification. UE will acquire the on-demand SI as like periodic broadcast SI (i.e. the gNB broadcast the on-demand SI when the SI changes).

2.6 Need of UE request for on-demand SI in Connected mode

In Rel15, the SIBs contain normal operational SIBs (i.e. SIB that all UEs always need in a serving cell, e.g. RMSI (SIB1), cell reselection SIBs (intra-frequency, inter-frequency and inter-RAT to EUTRA cell reselection SIB)) and PWS SIB. RMSI is not on-demand and thus do not need to be requested. Cell reselection SIBs are not needed in RRC Connected. For PWS SIB, it would require the network to push it to the UE, rather than the UE request for it. In the email discussion, it is not concluded whether positioning SIB (i.e. SIB16 containing UTC and GPS time) is needed. This may require UE request. In the future, SIBs related service type such as MBMS, CSG, V2X etc. may also be supported. These SIBs may require UE request. For Rel-15, if it contains only operational SIBs and PWS SIB, there is no need for UE request in RRC Connected.

Proposal#12: For Rel-15, if it contains only operational SIBs(i.e. SIB that all UEs always need in a serving cell, e.g. RMSI (SIB1), cell reselection SIBs (intra-frequency, inter-frequency and inter-RAT to EUTRA cell reselection SIB)) and PWS SIB, there is no need for UE request in RRC Connected.

3 Conclusion and proposals

It is requested that RAN 2 discuss and agree on the following proposals:

Proposal#1: Include an additional indication to specifically indicate whether an on-demand SI is actually being broadcast at this instant in time, on top of the indication whether the SI is on-demand or periodic broadcast. If the additional indication indicates that an on-demand SI is being broadcast, the UE does not perform UE SI request.

Proposal#2: The scheduling info of the on-demand SI is always present in SIB1.

Proposal#3: The PRACH configuration (i.e. the preamble mapping to the SI) for Msg1 based request is included in the Scheduling Information of the on-demand SI.

Proposal#4: UE SI request in Msg3 contains list/bitmap of SI requested. The RRC Msg3 size for Msg3 UE SI request should be made to align with the RRC UE Identity in other Msg3 RRC Message for contention resolution.

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