**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.15.1

**Source:** ZTE

**Title:** Email discussion summary for RAN4#94e\_#63\_NR\_RRM\_Enh\_RRM\_Part\_2

**Document for:** Information

# Introduction

The scope of this email discussion summary covers following agenda items.

8.15.1.1 SRS carrier switching requirements

8.15.1.3 CGI reading requirements with autonomous gap

8.15.1.6 Mandatory MG patterns

The sub topics for agenda 8.15.1.1 SRS carrier switching requirements are

* Applicability of NR SRS carrier switching time
* SRS carrier switching interruption requirements
* Impact to RRM measurement requirements due to SRS carrier switching

The candidate target of this email discussion for 1st round is to collect comments from companies on the open issues. The scope of 2nd round and necessity of CR depending on outcome of 1st round.

The sub topics for agenda 8.15.1.3 CGI reading requirements with autonomous gap are

* Known cell condition for CGI reading
* Delay requirements for CGI reading
* Interruption requirements for CGI reading
* Requirements structure

The candidate target of this email discussion for 1st round is to collect comments from companies on the open issues. The scope of 2nd round and necessity of CR depending on outcome of 1st round.

The sub topics for agenda 8.15.1.6 Mandatory MG patterns are

* UE capability and applicability of additional mandatory measurement gaps
* Mandatory MG patterns for Rel-16

The candidate target of this email discussion for 1st round is to collect comments from companies on the topic. The scope of 2nd round depending on outcome of 1st round.

# Topic #1: SRS carrier switching requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2000658](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000658.zip) | Nokia, Nokia Shanghai Bell | Proposal1: The applicability of SRS carrier switching time shall be explicitly defined in RAN4 spec:   * 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2. * 200us, 500us and 900us SRS carrier switching time apply to inter-band CA in FR1 and between FR1 and FR2.   Proposal2: A LS shall be sent to RAN2 informing the applicability of the SRS carrier switching time.  Proposal3: The interruption requirements shall be defined dependent on the numerologies of both SwitchTo and SwitchFrom or interrupted cells.  Proposal4: The Maximum Receive Timing Difference (MRTD) shall be considered when deriving the interruption requirements.  Proposal5: It is proposed to define the interruption requirements for intra-band CA as:  The interruption on PCell and each of the activated SCells during the switching to the PUSCH-less SCell shall not exceed X1 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.  The interruption on PCell and each of the activated SCells during the switching from the PUSCH-less SCell shall not exceed X1 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell.  Where X1 is defined in Table 1 and Table 2 for FR1 and FR2 respectively.  Table 1. Interruptions (X1 #slots) at SRS carrier switching for intra-band CA in FR1    Table 2. Interruptions (X1 #slots) at SRS carrier switching for intra-band CA in FR2    Proposal6: It is proposed to define the interruption requirements for inter-band CA as:  The interruption on PCell and each of the activated SCells during the switching to the PUSCH-less SCell shall not exceed X2 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.  The interruption on PCell and each of the activated SCells during the switching from the PUSCH-less SCell shall not exceed X2 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell.  Where X2 is defined in Table 4 for inter-band CA within FR1 and inter-band CA between FR1 and FR2.  Table 4. Interruptions (X2 #slots) at SRS carrier switching for inter-band CA within FR1 and inter-band between FR1 and FR2    Proposal7: For FR1+FR1 EN-DC, the interruption on LTE serving cells due to NR SRS carrier switching is defined as:  The interruption on PCell and each of the activated SCells in MCG during the switching to the PUSCH-less SCell shall not exceed Y subframes including the first subframe where SRS transmission is configured on the PUSCH-less SCell.  The interruption on PCell and each of the activated SCells in MCG during the switching from the PUSCH-less SCell shall not exceed Y subframes including the last subframe where SRS transmission is configured on the PUSCH-less SCell. Where Y is defined in Table 5.  Proposal8: For FR1+FR2 EN-DC, there is no interruption on LTE serving cells due to NR SRS carrier switching.  Proposal9: The interruption on LTE serving cells due to NR SRS carrier switching in NE-DC is defined as:  The interruption on PSCell and each of the activated SCells in SCG during the switching to the PUSCH-less SCell shall not exceed Y subframes including the first subframe where SRS transmission is configured on the PUSCH-less SCell.  The interruption on PSCell and each of the activated SCells in SCG during the switching from the PUSCH-less SCell shall not exceed Y subframes including the last subframe where SRS transmission is configured on the PUSCH-less SCell. Where Z is defined in Table 5.  Table 5. Interruptions (Y #subframes) on LTE serving cells at NR SRS carrier switching for EN-DC and NE-DC    Proposal10: For FR1+FR1 EN-DC, the interruptions on NR serving cells due to LTE SRS carrier-based switching is defined as:  The interruption on PSCell and each of the activated SCells in SCG during the switching to the PUSCH-less SCell shall not exceed X3 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.  The interruption on PSCell and each of the activated SCells in SCG during the switching from the PUSCH-less SCell shall not exceed X3 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell. Where X3 is defined in Table 6.  Proposal11: For FR1+FR2 EN-DC, there is no interruption on NR serving cells due to LTE SRS carrier switching.  Proposal12: The interruptions on NR serving cells due to LTE SRS carrier-based switching in NE-DC is defined as:  The interruption on PCell and each of the activated SCells in MCG during the switching to the PUSCH-less SCell shall not exceed X3 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.  The interruption on PCell and each of the activated SCells in MCG during the switching from the PUSCH-less SCell shall not exceed X3 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell. Where X3 is defined in Table 6.  Table 6. Interruptions (X3 #slots) on NR serving cells at LTE SRS carrier-based switching for EN-DC and NE-DC    Proposal13: The interruptions on LTE serving cells due to LTE SRS carrier-based switching in EN-DC ad NE-DC is defined as:  The interruption on PCC and each of the activated SCCs during the switching to the PUSCH-less SCC shall not exceed 2 subframes including the first subframe where SRS transmission is configured on the PUSCH-less SCC.  The interruption on PCC and each of the activated SCCs during the switching from the PUSCH-less SCC shall not exceed 2 subframes including the last subframe where SRS transmission is configured on the PUSCH-less SCC. |
| [R4-2001033](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001033.zip) | MediaTek inc. | Observation 1: RAN1 had agreed that SRS carrier switching shall avoid the collision with SSB and CORSETs.  Observation 2: In EN-DC/NE-DC, from network’s view, owing to no effective coordinate mechanism, it’s very hard to avoid the NR SRS carrier switching configuration from one CG to collide with LTE measurement in the other CG.  Proposal 1: Define carrier-based SRS switching interruption in FR2 base on 200us RF transition time only.  Proposal 2: Define carrier-based SRS switching interruption both in intra-band and inter-band.   * Intra-band, the interruption shall be 200us+6 SRS symbols * Inter-band, the interruption shall be 200us, 500us, 900us+6 SRS symbols for FR1 and 200us+6 SRS symbols for FR2   Proposal 3: SRS Carrier switching shall avoid the collision with SSBs or RSs for any L1 measurements.  Proposal 4: The SRS carrier switching interruption requirement from NR to LTE is shown as follow.  Table 1. Interruption length (subframes) due to SRS carrier switching   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Interruption  Length(subframes) | RF transition time(us) | Aggressor cell SCS (kHz) | | | | | 15 | 30 | 60 | 120 | | Victim Cell | 200 | 2 | 2 | 2 | 2 | | 500 | 2 | 2 | 2 | 2 | | 900 | 3 | 3 | 3 | 2 |   Proposal 5: The SRS carrier switching interruption from LTE to NR is shown as follow.  Table 2. Interruption length (slots) due to SRS carrier switching   |  |  | | --- | --- | | Victim Cell SCS(KHz) | Interruption Length (slot) | | 15 | 2 | | 30 | 3 | | 60 | 5 | | 120 | 9 |   Proposal 6: When SRS carrier switch from carrier 1 to carrier 2 in one CG, the UE shall drop the measurement for the other CG and there is also an interruption for other CG’s reception and transmission. |
| [R4-2001275](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001275.zip) | ZTE | Proposal 1. All of the SRS carrier switching time is applicable for both FR1 and FR2.  Proposal 2. Interruption length on NR victim cells during NR SRS carrier switching in EN-DC, NE-DC, NR-DC and SA operation is as in Table 1.  Table 1. Interruption length on NR victim cell during NR SRS carrier switching   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | NR Slot length (ms) of victim cell | SRS carrier switching time (us) | Interruption length X (slots) | | | | | Sub carrier spacing for agressor cell (kHz) | | | | | 15 | 30 | 60 | 120 | | 0 | 1 | 200 | 2 | 2 | 2 | 2 | | 500 | 2 | 2 | 2 | 2 | | 900 | 3 | 3 | 3 | 2 | | 1 | 0.5 | 200 | 3 | 2 | 2 | 2 | | 500 | 3 | 3 | 3 | 3 | | 900 | 4 | 4 | 4 | 3 | | 2 | 0.25 | 200 | 4 | 3 | 3 | 3 | | 500 | 5 | 4 | 4 | 4 | | 900 | 7 | 6 | 6 | 5 | | 3 | 0.125 | 200 | 7 | 5 | 4 | 4 | | 500 | 9 | 7 | 6 | 6 | | 900 | 12 | 10 | 10 | 9 |   Proposal 3. In EN-DC, NE-DC, interruption length on LTE victim cells during NR SRS carrier switching is 2 subframes, 2 subframes and 3 subframes for 200us, 500us and 900us NR SRS carrier switching time respectively.  Proposal 4. In EN-DC and NE-DC, the interruption requirements are specified for 500us LTE SRS carrier switching time only.  Proposal 5. In EN-DC and NE-DC, interruption length on NR victim cells during NR SRS carrier switching are as in Table 3.  Table 2. Interruption length on NR victim cell during LTE SRS carrier switching   |  |  |  | | --- | --- | --- | |  | NR Slot length (ms) | Interruption length X (slots) | | | 0 | 1 | 2 | | 1 | 0.5 | 3 | | 2 | 0.25 | 5 | | 3 | 0.125 | 9 |   Proposal 6. In EN-DC, NE-DC, interruption length on LTE victim cells during LTE SRS carrier switching is 2 subframes.  Proposal 7. In EN-DC, NE-DC, NR-DC and NR SA operation, requirements relevant to measurements on SSB/PBCH/CSI-RS are NOT impacted due to NR SRS carrier switching.  Proposal 8. In EN-DC and NE-DC operation, requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching.  Proposal 9. In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching. |
| [R4-2001661](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001661.zip) | Huawei, HiSilicon | Proposal 1: RAN4 shall define interruption requirements for sync and async case  - Requirements are based on sync case in CA scenario  - Requirements are based on async case in DC scenario  Proposal 2: In CA case, the interruptions on the active serving NR cells during the switching to the PUSCH-less NR SCC shall not exceed X1 slots including the first slot where NR carrier SRS transmission is configured on the PUSCH-less SCC. The interruptions on the active serving NR cells during the switching from the PUSCH-less NR SCC shall not exceed X1 slots including the first slot where NR carrier SRS transmission is configured on the PUSCH-less SCC (X1 just consider 500us SRS carrier switching time).   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Interruption length X1 (slots) | | | | | | Victim cell SCS () | Aggressor Cell SCS () | | | | | 0 | 1 | 2 | 3 | | 0 | 1 | 1 | 1 | 1 | | 1 | 2 | 2 | 2 | 2 | | 2 | 5 | 4 | 4 | 4 | | 3 | 9 | 7 | 6 | 5 |   Proposal 3: The interruption time (one-way) for NR SRS carrier switching impacting NR CC in NR-DC is shown as below (taking 500us SRS carrier switching time as an example).   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Victim cell SCS () | Aggressor Cell SCS () | | | | | 0 | 1 | 2 | 3 | | 0 | - | - | 2 | 2 | | 1 | - | - | 3 | 3 | | 2 | 5 | 4 | 4 | 4 | | 3 | 9 | 7 | - | - |   Proposal 4: The interruption on the LTE active serving cells during NR SRS switching to the PUSCH-less NR CC shall not exceed 2 subframes including the first slot where SRS carrier transmission is configured on the PUSCH-less NR CC.  The interruption on the LTE active serving cells during NR SRS switching from the PUSCH-less NR CC shall not exceed 2 subframes including the first slot where SRS carrier transmission is configured on the PUSCH-less NR CC.  Proposal 5: In ENDC and NEDC, the interruption on the NR serving cells during the switching to the PUSCH-less LTE SCC shall not exceed X2 slots including the first slot where LTE carrier SRS transmission is configured on the PUSCH-less SCC.  The interruption on the NR serving cells during the switching from the PUSCH-less LTE SCC shall not exceed X2 slots including the first slot where LTE carrier SRS transmission is configured on the PUSCH-less SCC.   |  |  |  | | --- | --- | --- | |  | NR Slot length (ms) | Interruption length X2 slot | | 0 | 1 | 2 | | 1 | 0.5 | 3 | | 2 | 0.25 | 5 | | 3 | 0.125 | 9 |   For a UE which does not support per-FR measurement gaps, interruptions to the NR serving cells caused by EUTRA SRS carrier switching are on any frequency range. For UE which support per-FR gaps, only interruptions to FR1 NR serving cells are specified. |
| [R4-2002058](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002058.zip) | Qualcomm Incorporated | Proposal 1: The interruption lengths due to NR SRS switching on NR victim cells are as given in Table 2-2    Proposal 2: The interruption lengths due to NR SRS switching on NR victim cells are as given in Table 2-3    Proposal 3: The interruptions on NR cells due to LTE SRS carrier switching are given in Table 2-4    Proposal 4: UE to prioritize measurements over SRS switching. If the SRS switching interruptions collide with measurements, UE to drop SRS switching. |
| [R4-2001267](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001267.zip) | ZTE | CR to TS 38.133 on SRS carrier switching interruption requirements |
| [R4-2001268](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001268.zip) | ZTE | CR to TS 36.133 on SRS carrier switching interruption requirements |
| [R4-2001662](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001662.zip) | Huawei, HiSilicon | CR to TS 36.133 on NR SRS carrier switching interruption |

## Open issues summary

### Applicability of NR SRS carrier switching time

Issue 1-1-1: How to capture applicability of SRS carrier switching time

* Proposals
  + Option 1 (Nokia)
    - The applicability of SRS carrier switching time shall be explicitly defined in RAN4 spec:
      * 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2.
      * 200us, 500us and 900us SRS carrier switching time apply to inter-band CA in FR1 and between FR1 and FR2.
  + Option 2 (MedieTek)
    - For FR1
      * Intra-band CA: 0us, 30us, 100us, 140us and 200us
      * Inter-band CA: 0us, 30us, 100us, 200us, 300us, 500us and 900us
    - For FR2
      * Intra-band CA: 0us, 30us, 100us, 140us and 200us
    - Inter-band CA: FFS
  + Option 3 (Intel)
    - RF switching time depends on UE capability, which applies to both intra/inter-band. Therefore, 500us and 900us SRS carrier switching time should also apply to intra-band CA in both FR1 and FR2.
* Recommended WF:
  + FFS

Issue 1-1-2: Whether LS RAN2 if RAN4 agrees to capture the applicability of SRS carrier switching time

* Proposals
  + Option 1 (Nokia, Intel)
    - A LS shall be sent to RAN2 informing the applicability of the SRS carrier switching time.
  + Option 2 (MediaTek, QC, ZTE)
    - No LS is needed.
* Recommended WF:
  + No need LS to RAN2

Issue 1-1-3: Applicability of SRS carrier switching for FR2

* Proposals
  + Option 1 (ZTE, Qualcomm, Nokia, Huawei, Apple, Intel)
    - All applicable
  + Option 2 (MediaTek )
    - 200us only
* Recommended WF:
  + Option 1

### SRS carrier switching interruption requirements

Background: In the last meeting it was agreed that RAN4 to define unified interruption requirements for sync and async case and the interruption requirements are based on async case (R4-1915930).

Issue 1-2-1: Whether to define requirements for both sync cases and async cases separately

* Proposals
  + Option 1 (Huawei, Nokia, Ericsson)
    - Define requirements for CA (sync) and DC (async) separately
  + Option 2 (QC, MediaTek, ZTE, Intel)
    - Define requirements for async case only. (Agreements in the last meeting)
* Recommended WF:
  + FFS. If no agreements then follow the agreements in the last meeting.

Issue 1-2-2: Interruptions due to SRS carrier switching in different frequency range

* Proposals
  + Option 1 (ZTE, Qualcomm, Apple)
    - Interruptions are always allowed
  + Option 2 (Huawei, MediaTek, Ericsson)
    - Interruptions are allowed based on UE capability
      * Allowed if UE supports per-UE measurement gap only
      * Not allowed if UE supports per-FR measurement gap
  + Option 3 (Nokia)
    - Interruptions are not allowed for FR1+FR2 EN-DC
  + Option 4
    - Interruptions are always not allowed
* Recommended WF:
  + FFS

Issue 1-2-3: Interruptions on NR serving cells during NR SRS carrier switching in async operation

* Proposals
  + Option 1 (ZTE, Qualcomm, MediaTek)

Table 1. Interruption length on NR victim cell during NR SRS carrier switching

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **NR Slot length (ms) of victim cell** | **SRS carrier switching time (us)** | **Interruption length X (slots)** | | | |
| **Sub carrier spacing for agressor cell (kHz)** | | | |
| 15 | 30 | 60 | 120 |
| 0 | 1 | 200 | 2 | 2 | 2 | 2 |
| 500 | 2 | 2 | 2 | 2 |
| 900 | 3 | 3 | 3 | 2 |
| 1 | 0.5 | 200 | 3 | 2 | 2 | 2 |
| 500 | 3 | 3 | 3 | 3 |
| 900 | 4 | 4 | 4 | 3 |
| 2 | 0.25 | 200 | 4 | 3 | 3 | 3 |
| 500 | 5 | 4 | 4 | 4 |
| 900 | 7 | 6 | 6 | 5 |
| 3 | 0.125 | 200 | 7 | 5 | 4 | 4 |
| 500 | 9 | 7 | 6 | 6 |
| 900 | 12 | 10 | 10 | 9 |

Note 1: If requirements for sync operation were defined, the interruptions would be 1 slot less than that in the table 1.

Note 2: The table can be further revised depending on decisions on applicability of SRS carrier switching and on interruptions due to SRS carrier switching in different frequency range.

* Recommended WF:
  + Option 1

Issue 1-2-4: Interruptions on LTE serving cells during NR SRS carrier switching in EN-DC and NE-DC operation

* Proposals
  + Option 1 (MediaTek, Qualcomm)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Interruption  Length(subframes) | RF transition time(us) | Aggressor cell SCS (kHz) | | | |
| 15 | 30 | 60 | 120 |
| Victim Cell | 200 | 2 | 2 | 2 | 2 |
| 500 | 2 | 2 | 2 | 2 |
| 900 | 3 | 3 | 3 | 2 |

* + Option 2 (ZTE)
    - 2 subframes, 2 subframes and 3 subframes for 200us, 500us and 900us NR SRS carrier switching time respectively
  + Option 3 (Huawei)
    - 2 subframes
  + Option 4 (Nokia)



* Recommended WF:
  + Option 1 or 2

Issue 1-2-5: Interruptions on NR serving cells during LTE SRS carrier switching in EN-DC and NE-DC operation

* Proposals
  + Option 1 (ZTE, Qualcomm, MediaTek, Huawei, Nokia)

|  |  |
| --- | --- |
| Victim Cell SCS(KHz) | Interruption Length (slot) |
| 15 | 2 |
| 30 | 3 |
| 60 | 5 |
| 120 | 9 |

* Recommended WF:
  + Option 1

### Impact to RRM measurement requirements due to SRS carrier switching

Issue 1-3-1: Impact to NR RRM measurement requirements based on SSB/PBCH/CSI-RS due to NR SRS carrier switching

* Proposals
  + Option 1 (Qualcomm, Intel)
    - UE to prioritize measurements over SRS switching. If the SRS switching interruptions collide with measurements, UE to drop SRS switching.
  + Option 2 (MediaTek)
    - SRS Carrier switching shall avoid the collision with SSBs or RSs for any L1 measurements.
  + Option 3 (ZTE)
    - In EN-DC, NE-DC, NR-DC and NR SA operation, requirements relevant to measurements on SSB/PBCH/CSI-RS are NOT impacted due to NR SRS carrier switching.
* Recommended WF:
  + No impact to NR measurement requirements relevant to measurements based on SSB/CSI-RS due to NR SRS carrier switching

Issue 1-3-2: Impact on NR measurement requirements based on SSB/PBCH/CSI due to LTE SRS carrier switching

* Proposals
  + Option 1 (ZTE)
    - In EN-DC and NE-DC operation, requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching.
  + Option 2 (MediaTek)
    - When SRS carrier switch from carrier 1 to carrier 2 in one CG, the UE is allowed to cause interruption to the measurement, reception and transmission in the other CG.
* Recommended WF:
  + In EN-DC and NE-DC operation, requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching
    - FFS how to address the issue

Issue 1-3-3: Impact to E-UTRA measurement requirements due to NR SRS carrier switching

* Proposals
  + Option 1 (ZTE)
    - In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching.
  + Option 2 (MediaTek)
    - When SRS carrier switch from carrier 1 to carrier 2 in one CG, the UE is allowed to cause interruption to the measurement, reception and transmission in the other CG.
* Recommended WF:
  + In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching.
    - FFS how to address the issue

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 1-1-3: since RF session didn’t differentiate the FR2 from FR1 case on the candidate SRS switching time, we also prefer Option 1.  Issue 1-2-1: Question/comment on Option1: do we need sync DC case as well?  Issue 1-2-2: if SRS is switching from CC on FR1 to CC on FR2, then interruption shall be always allowed although UE support per-FR MG. Only if UE is switching SRS within one FR and supports per-FR MG, the interruption might be not needed to the other FR. But in order to make less subcases for requirement design, we support to use option 1 (Interruptions are always allowed).  Issue 1-3-2 and Issue 1-3-3: in our understanding cross RAT interruption can only be avoided if UE support per-FR MG and SRS switching is performing within one FR which is different from the FR of other RAT CCs. However, that will divide requirement into multiple conditioned subcases, and therefore we agree with ZTE’s recommended WF. |
| QC | Issue 1-1-1:  All switching times as defined in the RF session are valid. We are just going to define interruption requirements for a subset of them with the understanding that if we don’t have interruption time for the time as defined in RF room, the next higher interruption time is the UE shall meet.  Issue 1-1-2:  We question the need to send an LS. Can Nokia say why the LS is necessary.  Issue 1-1-3  We should follow whatever RF room has decided. Any restrictions should come from them  Issue 1-2-1:  Our understanding from last meeting was the we will only define one set of requirements, namely for the asyncy. Even the sync case requirements come out to be pretty much the same once TA is accounted for.  Issue 1-2-2:  Issue 1-3-1  I would like to clarify the WF wording. Does the WF mean that UE to continue with measurements and drop SRS switch in case of conflict.  Issue 1-3-3:  In case of inter RAT (EN-DC) or different CG’s (NR-DC) the SRS interruption on other RAT or CG may cause interruptions to measurements. Agree with WF. |
| Mediatek | Issue 1-1-1:  We agree to define 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2.  But for inter-band FR2, our RF understanding is that these values were for FR1.  Intra-band CA: 0us, 30us, 100us, 140us and 200us  Inter-band CA: 0us, 30us, 100us, 200us, 300us, 500us and 900us  That’s the reason why RAN4 RF continue to discuss the SRS RF switching time in FR2 in RAN4 #88bis and #89 meetings. If the above values also apply for FR2, RAN4 RF didn’t need to discuss the values again.  In the WF R4-1814156 (noted) in RAN4 #88bis meeting, the following values were proposed for FR2,   * Candidate SRS switching time for FR2   + Intra-band CA: 0us, 30us, 100us, 140us     - 0us means no LO retuning is needed     - So far no inter-band CA combinations are supported for FR2.   For inter-band FR2, we think this is a new issue in R16. RAN RF didn’t have a common values for inter-band FR2. Thus, RAN4 RRM doesn’t need to define inter-band FR2 SRS requirement so urgent. Our suggestion is RAN4 RRM just focus on intra-band FR2 only.  Issue 1-1-2:  RAN4 RF already send the LS to clarify the SRS RF switching time. We don’t see any reason to send LS to RAN2 again.  Issue 1-1-3:  As we discussed in Issue 1-1-1, 500us, 900us was defined for FR1. Currently, RAN4 RF didn’t have a common understanding on the values for FR2. RRM session should follow RF session’s agreement.  Technically, if we agree on the values of 500us, 900us, it’s too exaggeration. FR2 SRS switching time is even longer than legacy LTE. If we really want to define FR2 requirement, we suggest to re-use the values 200us for RF retuning time which was already agreed in NR RRM interruption requirement.  Issue 1-2-1:  We have already discussed this issues several meetings. And we already have an agreement on this:   * RAN4 to define unified interruption requirements for sync and async case   + Requirements are based on async case   Since this issue was raised by Mediatek, we would like to explain more here.  In CA(sync.) scenario, generally, the requirement will be shorter than async. scenario for 1 slot. But SRS transmission is an uplink behavior. In NR, the UL TA could be from 0 to at most 2 slots(larger than async. impact). The uncertainty UL TA will anyway result in additional interruption time in victim cells. CA+UL TA will have the same impact as async. case.Thus, we suggest to define the unified requirement.  Issue 1-2-2:  Option 2. We agree with Huawei to consider per-FR gap impact and we think we should follow other interruption requirement for per-FR gap.  Issue 1-2-3:  Option 1.  Issue 1-2-4:  Option 1. Option 2 is also fine for us.  Issue 1-2-5:  Option 1.  Issue 1-3-1:  We think option 1 and option 2 is the same meaning. Measurement priority is higher than SRS Carrier switching.  Issue 1-3-2:  From UE’s perspective, it had to take extra effort to effectively coordinate between an existing legacy LTE modem and a new NR modem. Thus, it’s also difficult to avoid the interruption caused by SRS carrier switching on other RAT’s measurement/reception/transmission from UE side.  LTE SRS carrier switching will result in interruption on NR, including measurement/reception/transmission.  Issue 1-3-3:  From UE’s perspective, it had to take extra effort to effectively coordinate between an existing legacy LTE modem and a new NR modem. Thus, it’s also difficult to avoid the interruption caused by SRS carrier switching on other RAT’s measurement/reception/transmission from UE side.  NR SRS carrier switching will result in interruption on LTE, including measurement/reception/transmission. |
| Intel | Issue 1-1-1: RF switching time depends on UE capability, which applies to both intra/inter-band. Therefore, 500us and 900us SRS carrier switching time should also apply to intra-band CA in both FR1 and FR2.  Issue 1-1-2: support option 1. Network needs to know when to start data scheduling after SRS carrier switching.  Issue 1-1-3: support option 1.  Issue 1-2-1: question needs to be clarified, since we don’t have async CA. Apparently, RAN4 needs to define requirement to cover CA and DC (both sync and async). This question is rather about whether UE is allowed to cause interruption on “additional slot” on serving cell in sync case. Agreements in last meeting at least apply to DC (introduce async based requirement to cover both sync and async deployments). Regarding CA, 1 more slot interruption should be allowed for inter-band CA, since MRTD for inter-band CA is quite large compared with CP duration.  Issue 1-3-1: measurement should have higher priority than SRS carrier switching. Either avoiding colliding configuration or allowing UE to drop SRS switching can solve the issue. To solve this in RAN4, we prefer option 1. |
| ZTE | Issue 1-1-1: In LTE the applicability of SRS carrier switching is almost the same as in NR. However the applicability was captured nowhere in TS 36.133  Issue 1-2-1: We had lots of discussions on if requirements for sync and async cases should be differentiated. The agreements were specifying unified requirements for both cases. We should honor the agreements we have reached. So we follow the agreements on this issue in the last meeting.  Issue 1-2-2: In current 38.133, the interruptions are allowed for victim cell in different frequency range than aggressor cell for many procedures, e.g. SCell activation. We think same applicability rule can be reused for SRS carrier switching.  Issue 1-3-1: Response to QC’s comments: In 38.213, the procedure for SRS carrier switching as follows.  the UE is not expected to be configured or indicated with SRS resource(s) such that SRS transmission on carrier c1 (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters s*witchingTimeUL* and *switchingTimeDL* of srs-*SwitchingTimeNR*) would collide with the REs corresponding to the SS/PBCH blocks configured for the UE or the slots belonging to a control resource set indicated by MIB or SIB1 on serving cell c2  In our understanding, we think NW would try to configure SRS resources avoiding such collision happens. If collision does happen, which is not the typical case, then UE could drop SRS transmission (prioritize measurement). Either way no impact to NR measurement requirements. |
| Ericsson | Issue 1-1-1: We are generally OK with option 1, although further clarification on “explicitly defined” may be good; in our understanding RRM specifications will define delay and interruption for SRS carrier switching in each CA scenario.  Issue 1-1-2: We agree with the recommended WF; no need to send an LS to RAN2  Issue 1-1-3 : Support the recommended WF  Issue 1-2-1 : We agree with Huawei/Nokia proposal for separate requirements for sync and async.  Issue 1-2-2 : We agree with option 2, it depends if UE supports per UE or per FR measurements and has independently operating RF.  Issue 1-2-3: should be smaller than in option 1, SRS transmission is not so far apart as in LTE,  Issue 1-2-4 : Option 4  Issue 1-2-5 : Option 1 appears correct based on the uS interruption times, further detailed checking can be done when CRs are available  Issue 1-3-1 : UE needs to perform SRS carrier switching even if there are measurements, In this case we can allow the UE to use a longer measurement period, in case the interruption happens. This is a similar approach as was used in SRS carrier switching for LTE, and would be aligned with the proposed way forward for issue 1-3-2  Issue 1-3-2 : Agree LTE SRS carrier switching may impact NR measurements. We can allow e.g. the NR measurement period to be extended. We should also consider issue 1-1-2 here, for a UE supporting per FR gaps and performing LTE SRS carrier switching there should not be an impact to FR2 measurements.  Issue 1-3-3 : Agree NR SRS carrier switching may impact LTE measurements, if the interruption happens. We should also consider issue 1-1-2 again here, for a UE supporting per FR gaps and with FR2 SRS carrier switching there should not be impact to LTE measurements, |
| Huawei, HiSilicon | Issue 1-1-1: RAN4 RF had sent the LS about the carrier switching time, the content is duplicated as below (R4-1811534):  Intra-band CA: 0us, 30us, 100us, 140us and 200us  Inter-band CA: 0us, 30us, 100us, 200us, 300us, 500us and 900us  RF switching time depends on UE capability.  Issue 1-1-2: Agree with the recommended WF.  Issue 1-1-3: depending on UE reported capability. Agree with the recommended WF.  Issue 1-2-1: support option 1. Recalling LTE, the SRS carrier switching requirements are specified for both CA and DC. In NR, the SRS carrier switching shall also consider CA scenario (considering NR side in ENDC, NEDC, NR SA and NRDC) and DC scenario (ENDC, NEDC and NRDC). As we know the serving carriers are synchronized in CA. So technically the CA sync and DC async shall be defined.  Issue 1-2-2: support option2. If UE can support per FR gap, it means UE had separate RF chain.  Issue 1-2-3, 1-2-4, 1-2-5: depending on the conclusions of the previous issues. And the detailed value shall be carefully checked.  Issue 1-3-1: in R-15 we discussed the issue that uplink transmission colliding with DL measurement in TDD. In order to avoid the interference, RAN4 had the following requirements:  “The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.”  It means the general restriction on uplink transmission is made for RAN4. So uplink scheduling (including the SRS carrier switching ) shall be forbidden.  Issue 1-3-2: LTE SRS carrier switching may impact the NR measurement requirements. The NR measurement can be relaxed in this case.  Issue 1-3-3: similar view as 1-3-2. Agree with the recommended WF. |
| Nokia | Issue 1-1-1: Support Option1.  The applicability of the switching time can be clearly stated in RAN4 spec.  Issue 1-1-2: It is beneficial to add some texts in RAN2 spec to clarify the configurable values in different scenarios.  Issue 1-1-3: Agree to the proposed WF.  Issue 1-2-1: There is no async case for CA. The requirements shall be defined for CA.  Issue 1-2-2: We support no interruption for FR1+FR2 EN-DC.  In the UE architecture for FR1+FR2, FR1 and FR2 are not tightly coupled and can be considered as independent. There could be no interruption inbetween.  Issue 1-2-3: The value can be decided after we agree on how to handle the CA case.  Issue 1-2-4: Need further discussion on the numbers.  Issue 1-2-5: Agree to FR1 values. We think no interruptions for FR1+FR2 EN-DC.  Issue 1-3-1: Agree to the proposed WF.  Issue 1-3-2/1-3-3: The impact to RRM measurement requirement could be different for FR1+FR2 case. The discussion shall consider different EN-DC/NE-DC scenarios. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going Wis, suggest to focus on open issues discussion on 1st round.*

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic #1-1 Applicability of NR SRS carrier switching time** | *Tentative agreements:*   * The applicability of SRS carrier switching time follows the agreements in LS R4-1811534   + Intra-band CA: 0us, 30us, 100us, 140us and 200us   + Inter-band CA: 0us, 30us, 100us, 200us, 300us, 500us and 900us * The applicability of SRS carrier switching time in LS R4-1811534 applies to both FR1 and FR2   + Interruption requirements are specified for FR2 intra-band CA in Rel-16.   + FFS interruption requirements for FR2 inter-band CA in Rel-16 * Define requirements for 200us, 500us and 900us SRS carrier switching time (agreements in the last meeting)   + FFS if following applicability should be captured in RAN4 spec     - 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2.     - 200us, 500us and 900us SRS carrier switching time apply to inter-band CA in FR1 and between FR1 and FR2. * No LS to RAN2 on the applicability of SRS carrier switching time is needed   + Majority view is no LS is needed.   *Recommendations for 2nd round:*  It is noted that when LS R4-1811534 was agreed, there was no inter-band CA for FR2 in Rel-15. As commented by MediaTek, for inter-band FR2 it is a new issue in R16. RAN RF still doesn’t have a common values for inter-band FR2. Thus, it is necessary to discuss if RRM requirements for FR2 inter-band CA are to be specified.   * Further comments are encouraged on sub-bullet:   + FFS interruption requirements for FR2 inter-band CA in Rel-16   + FFS if following applicability should be captured in RAN4 spec * Confirm if tentative agreements above are agreeable. |
| **Sub-topic #1-2**  **SRS carrier switching interruption requirements** | Issue 1-2-1: Whether to define requirements for both sync cases and async cases separately  *Candidate options:*   * Option 1 (Huawei, Nokia, Ericsson)   + Define requirements for sync case (CA, DC) and async case (DC) separately * Option 2 (QC, MediaTek, ZTE, Intel)   + Define unified requirements only based on async case (Agreements in the last meeting)   *Recommendations for 2nd round:*   * Discuss if UL TA will cause interruption on one additional slot in sync case (CA, DC). If yes the agreements in the last meeting shall remain.   Issue 1-2-2: Interruptions due to SRS carrier switching in different frequency range  *Candidate options:*   * Option 1 (ZTE, Qualcomm, Apple)   + Interruptions are always allowed * Option 2 (Huawei, MediaTek, Ericsson)   + Interruptions are allowed based on UE capability     - Allowed if UE supports per-UE measurement gap only     - Not allowed if UE supports per-FR measurement gap * Option 3 (Nokia)   + Interruptions are not allowed for FR1+FR2 EN-DC   *Recommendations for 2nd round:*   * Further discussion. * Examples of interruptions on a serving cell due to activities in different frequency range in current spec may be used as reference, i.e. same rules can be reused.   *Tentative agreements:*   * Interruption length on NR victim cell during NR SRS carrier switching   + SRS switching time + 6 symbols + 1 slot (victim cell) for async case     - Based on agreements in the last meeting.   + FFS for sync cases     - Depending on outcome of further discussion on Issue 1-2-1 * Interruptions on LTE serving cells during NR SRS carrier switching in EN-DC and NE-DC operation   + 2 subframes, 2 subframes and 3 subframes for 200us, 500us and 900us NR SRS carrier switching time respectively for async case   + FFS for sync case     - Depending on outcome of further discussion on Issue 1-2-1 * Interruptions on NR serving cells during LTE SRS carrier switching in EN-DC and NE-DC operation   + For async case  |  |  | | --- | --- | | Victim Cell SCS(KHz) | Interruption Length (slot) | | 15 | 2 | | 30 | 3 | | 60 | 5 | | 120 | 9 |  * + FFS for sync case     - Depending on outcome of further discussion on Issue 1-2-1   *Recommendations for 2nd round:*   * Confirm if tentative agreements above are agreeable. |
| **Sub-topic #1-3**  **Impact to NR RRM measurement requirements based on SSB/PBCH/CSI-RS due to NR SRS carrier switching** | *Tentative agreements:*   * No impact to NR measurement requirements relevant to measurements based on SSB/CSI-RS due to NR SRS carrier switching   + Note: It is based on SRS carrier switching procedure specified in TS 38.214 and general restriction on uplink transmission in TS 38.133 * In EN-DC and NE-DC operation, NR measurement requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching   + FFS how to address the issue     - Depending on outcome of Issue 1-2-2, FFS scenario that no impact to NR measurement requirement * In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching.   + FFS how to address the issue     - Depending on outcome of Issue 1-2-2, FFS scenario that no impact to NR measurement requirement   *Note: One company pointed out that the impact including measurement/reception/transmission. Since we already agreed to define interruption requirements for SRS carrier switching, here we just need to figure out if the interruption will impact measurement requirements across different RAT.*  *Recommendations for 2nd round:*   * Confirm if tentative agreements above are agreeable. |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on R16 NR RRM enhancements – SRS carrier switching | ZTE |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round

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| **Company** | **Comments** |
| ZTE | **Sub-topic #1-1**  FFS interruption requirements for FR2 inter-band CA in Rel-16  Since there was no inter-band CA for FR2 when LS R4-1811534 was agreed in Rel-15, It is reasonable to assume the agreed SRS switching time values are not applicable to inter-band CA for FR2.  The technical concern is that the SRS carrier switching time is too long for FR2. For example, the interruptions are 10 slots for 120kHz SCS when SRS switching time is 900us. This will highly limit the use case of SRS carrier switching. For intra-band CA in FR2, the applicable SRS carrier switching time is 200us at maximum and interruptions will be 4 slots for 120kHz SCS, which is reasonable value.  Our proposal is not to define interruption requirements for FR2 inter-band CA unless there are new agreements on SRS carrier switching time for inter-band CA for FR2 to be reached in RF session.  FFS if following applicability should be captured in RAN4 spec  The interruption requirements will be specified for 200us, 500us and 900us SRS carrier switching time. The requirements applies depending on the UE capability indicated to network for a certain band pair. For any indicated SRS carrier switching time value no larger than 200us the interruption requirements for 200us SRS carrier switching time will apply, no matter it is intra-band or inter-band , and so on. So we don’t think the applicability should be captured in RAN4 interruption requirements.  We are also aware that no limitation for UE indicating SRS carrier switching time for a band pair in TS 38.306. If company thinks the restriction is needed the discussion can be triggered in RAN2 directly, rather than being triggered by RAN4 LS.  So our proposal is not to capture the applicability in RAN4 requirements.  As discussed above no LS to RAN2 is needed.  **Sub-topic #1-2**  Issue 1-2-1: option 2.  We agree with MediaTek’s analysis that TA will lead to additional interruption time since TA can be up to 2 slots. So even in CA operation the extra interruptions due to TA should be taken into account. Therefore we support option 2  Issue 1-2-2: option 1.  For the interruption requirements for SCell activation specified in 8.2.2.2.2, the interruptions are always allowed in different frequency range when SCell is activated in on frequency range. We think the same principle can be applied here.  We agree all the tentative agreements in sub-topic #1-2.  **Sub-topic #1-3**  We agree all the tentative agreements in sub-topic #1-3. |
| QC | Issue 1-2-1  For option 1, can the proponents say what the benefit of defining separate requirements are, especially when we need to consider TA  Sub-topic 1-3  Thanks to ZTE/HW for providing clarification to previous concern. For SSB based measurements do we read the above agreement as saying that UE will prioritize measurements in case of collision. We will need to specify same for CSI-RS based measurements too.  Since for NR we have been prioritizing measurements over transmissions, is the understanding of tentative agreements that we will continue to do so in case of LTE SRS switch and NR measurement conflict? |
| ZTE | Sub-topic #1-3:  For the collision of NR SRS switching and NR measurement, we are also fine to have similar requirements as for CSI-RS based L1 measurement to explicitly prioritize measurements as long as it will not contradict NR SRS switching procedures specified in TS38.214.  Regarding the collision of LTE SRS carrier switching and NR measurements, and the collision of NR SRS carrier switching and LTE measurements, we think we might need a lit bit more study. Though this was proposed for several meetings, there are few inputs on this. Unlike collision of NR SRS switching and NR measurements, which there is procedure specified in TS 38.214 that UE is not expecting the collision, there is no procedures being specified for cross RAT collision. In LTE, the LTE SRS carrier switching will impact the LTE measurements. So we do see different solutions in LTE and NR. We think NR measurements should be prioritized always. For LTE measurements since it will be impacted by LTE SRS carrier switching, it may be impacted by NR SRS carrier switching either. However we are open to this. If majority companies think measurements should always be prioritized, It is fine for us. |
| Ericsson | We will provide comments directly on the way forward to avoid duplication here. |
| MTK | Issue 1-3:  From UE’s perspective, it had to take extra effort to effectively coordinate between an existing legacy LTE modem and a new NR modem. Thus, it’s also difficult to avoid the interruption caused by SRS carrier switching on other RAT’s measurement/reception/transmission from UE side.  LTE SRS carrier switching will result in interruption on NR, including measurement/reception/transmission.  NR SRS carrier switching will result in interruption on LTE, including measurement/reception/transmission. |

## Summary on 2nd round

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: CGI reading requirements with autonomous gap

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2001035](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001035.zip) | MediaTek inc. | Observation 1: Whether to allow additional time for AGC and Rx beam switching (in FR2) still depends on the duration between the moment UE sending the last measurement report to the network and the moment UE receiving the CGI request from the network.  Proposal 1: Define the known condition base on reported SSB other than overall SMTC duration in CGI reading.  Proposal 2: For the target CGI reading in FR2 bands, the CGI reading is under the known condition if it has been meeting the following conditions:  - During the period equals to [X ms] from the last transmission of the SSB used for L3-RSRP report to UE receives the target CGI reading command,  - the UE has sent a valid L3-RSRP measurement report with SSB index  - During the period from UE sends a valid L3-RSRP reporting to UE repots a valid CGI,  - the SSBs used for L3-RSRP report remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3  - the MIB information contained in the SSB used for L3-RSRP report remains decodable with the SNR ≥ [-3]dB  - the RMSI CORSETs associated with the SSB used for L3-RSRP report remain detectable with the SNR ≥ [-3]dB  Proposal 3: The Delay of autonomous gap based CGI reading can be divided into the following time units  Proposal 4: In FR1,  - for intra-frequency known CGI reading,  - for inter-frequency known CGI reading.  Where, is the SMTC periodicity of the carrier with target cell.  Proposal 5: In FR2,  - for intra-frequency known CGI reading,  - for inter-frequency known CGI reading.  Where, is the SMTC periodicity of the carrier with target cell.  Proposal 6: When the UE can be guaranteed to use the same Rx spatial filter to finish MIB decoding in FR2, the MIB decoding delay are [5] for both FR1 and FR2, where is the SMTC periodicity of the carrier with target cell.  Proposal 7: The UE’s interruption for RMSI decoding shall base on minimum RMSI scheduling periodicity 20ms. It means 8 interruption occasions shall be counted in each 160ms RMSI periodicity.  Proposal 8: To guarantee the RMSI with the same SSB reporting index can be detected during the whole CGI reading, the potential SNR side condition could be [-3dB].  Proposal 9: The RMSI decoding delay is [7], where is the RMSI scheduling periodicity based on gNB implementation. |
| [R4-2001271](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001271.zip) | ZTE | Updated simulation assumptions for SIB1 decoding for NR CGI reading |
| [R4-2001272](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001272.zip) | ZTE | Observation 1. In FR1 for TDLC 300 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempt of 8 soft combining or by 2 attempts of 4 soft combining at SNR=-6 dB.  Observation 2. In FR2 for TDLC 300 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempt of 4 soft combining at SNR=-4dB.  Observation 3. In FR2 for TDLC 60 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempt of 8 soft combining or by 2 attempts of 4 soft combining at SNR=-6dB.  Observation 4. In FR2 for TDLC 60 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempts of 4 soft combining at SNR=-4dB. |
| [R4-2001273](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001273.zip) | ZTE | Proposal 1. Known cell condition for FR1 is:   * + It has been meeting the relevant cell identification requirement during the last 5 seconds.     - UE sends at least a valid L3-RSRP reporting.   + One of the SSBs measured from the NR target cell remains detectable during CGI reading delay.   Proposal 2. Known cell condition for FR2 is:   * + During the last 5 seconds before the reception of the handover command:     - the UE has sent a valid measurement report for the target cell and     - one of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3 of TS 38.133,   + One of the SSBs measured from the target cell also remains detectable during the CGI reading delay according to the cell identification conditions specified in clause 9.3 of TS 38.133.   Proposal 3. SINR Side condition for CGI reading of NR cell   * + For intra-frequency, Es/Iot = -[6]dB for both SSB and RMSI   + For inter-frequency, Es/Iot = -[6]dB for both SSB and RMSI   Proposal 4. For SIB1 decoding of NR cell in FR1 and FR2, [8] samples are needed for defining measurement time period requirements.  Proposal 5: AGC/AFC time is not considered during MIB and SIB1 decoding delay.  Proposal 6: Rx beam sweeping is needed during MIB decoding in FR2.  Proposal 7: Rx beam sweeping is not needed for SIB1 decoding in FR2.  Proposal 8: Each interruption length during MIB decoding is as in table below.   |  |  |  |  | | --- | --- | --- | --- | |  | NR Slot length (ms) of victim cell | Interruption length (slots) | | | 0 | 1 |  | 2 + TSMTC\_duration \* | | 1 | 0.5 |  | 3 + TSMTC\_duration \* | | 2 | 0.25 | Victim cell is on FR1 | 5 + TSMTC\_duration \* | | Victim cell is on FR2 | 3 + TSMTC\_duration \* | | 3 | 0.125 |  | 5 + TSMTC\_duration \* |   Proposal 9: Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 1 is as in table below.   |  |  |  |  | | --- | --- | --- | --- | |  | NR Slot length (ms) of victim cell | Interruption length (slots) | | | 0 | 1 |  | 4 | | 1 | 0.5 |  | 5 | | 2 | 0.25 | Victim cell is on FR1 | 7 | | Victim cell is on FR2 | 5 | | 3 | 0.125 |  | 7 |   Proposal 10: Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 2/3 is as in table below.   |  |  |  |  | | --- | --- | --- | --- | |  | NR Slot length (ms) of victim cell | Interruption length (slots) | | | 0 | 1 |  | 3 | | 1 | 0.5 |  | 4 | | 2 | 0.25 | Victim cell is on FR1 | 6 | | Victim cell is on FR2 | 4 | | 3 | 0.125 |  | 6 |   Proposal 11: The interruption core requirements for CGI reading of NR cell is specified by ratio of interrupted slots during the MIB decoding and SIB1 decoding time period.  Proposal 12: The ratio of interruption during MIB decoding is interrupted slots during one sample for MIB decoding over SMTC period in slots.  Proposal 13: For multiplexing pattern 1, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over 20ms in slots. For multiplexing pattern 2/3, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over SMTC period in slots.  Proposal 14: For CGI reading of NR cell and LTE cell, separated delay requirements and interruption requirements are specified in different sections.  Proposal 15: Interruption requirements for CGI reading in RSTD can be reused for CGI reading of LTE cell. |
| [R4-2001364](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001364.zip) | Ericsson | Observation 1: For both FR1 and FR2, it requires the soft-combining of 4 PDSCH samples to achieve 90% if SIB1 decoding success rate with the side condition of SNR=-6dB.  Observation 2: Number of SIB1 transmissions within the SIB1 transmission periodicity is up to network implementation.  Observation 3: If gNB does not change the SIB1 information across the SIB1 transmission periodicities, UE may also do the soft-combining of PDSCH samples across the SIB1 transmission periodicities.  Proposal 1: Derive the SIB1 reading delay based on the soft-combining of 4 PDSCH samples. RAN4 discuss further how to ensure UE can soft-combine the PDSCH symbols within the SIB1 transmission periodicity and across the SIB1 transmission periods. |
| [R4-2001403](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001403.zip) | Ericsson | Proposal 1 : Symbol level interruption is assumed for SIB decoding and there and no requirement on UE to decode SSB other than the one best in L3 RSRP report  Proposal 2 : For FR2, the requirements are developed on the basis that RX beam sweeping is not assumed for MIB decoding  Proposal 3 : For FR2, the requirements are developed on the basis that RX beam sweeping is not assumed for SIB1 decoding  Proposal 4 : The known cell condition for FR2 is that an SS block with same SSB index has been meeting the relevant cell identification requirement during the last 5 seconds with the same spatial reception parameters.  Proposal 5: The interruption for each autonomous gap during MIB decoding is 4 symbols (target cell SCS) + 2\*RF tuning time + 1 slot (victim cell SCS)  Proposal 6 : MIB decoding delay is specified as 5 samples for both FR1 and FR2.  Observation 1: Number of SIB1 transmissions within the SIB1 transmission periodicity is up to network implementation.  Observation 2: If gNB does not change the SIB1 information across the SIB1 transmission periodicities, UE may also do the soft-combining of PDSCH samples across the SIB1 transmission periodicities.  Observation 3 : SIB1 payload is not expected to be updated frequently compared with the SIB1 decoding delay  Observation 4 : Worst case requirements for SIB1 reading across multiple transmission periods with identical payload are   * 640ms + 1 slot decoding + UE processing time delay requirement * 48 autonomous interruptions each of duration of (neighbor SIB1 slot duration + serving cell data slot duration)   Observation 5 : Worst case requirements for SIB1 reading across a single transmission period with sufficient (4) PDSCH sample opportunities are   * 320ms + 1 slot decoding + UE processing time delay requirement * 8 autonomous interruptions each of duration of (neighbor SIB1 slot duration + serving cell data slot duration)   Proposal 7 : By default the UE assumes that PDSCH transmissions from different transmission periods can be soft combined for SIB1 decoding, if there are insufficient opportunities from a single transmission period.  Proposal 8:  LS is sent to RAN2 requesting assistance information to be added to the CGI decoding request (or other message e.g. measurement object configuration – the details can be for RAN2 to decide)   * Assistance information is as described above * If the serving cell does not provide information on whether it is safe to soft combine across transmission boundaries, the UE may assume that it is * If the serving cell does not provide information on which PDSCH are transmitted, the UE decodes all valid SIB1 PDCCH using SI-RNTI to determine if it should receive PDSCH.   The requirements for SIB1 decoding in different conditions of assistance information are specified as:   |  |  |  | | --- | --- | --- | | Side condition | SIB1 reading delay requirement | SIB1 interruption requirement | | At least 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, regardless of whether it is indicated as safe to soft combine across transmission periods | 320ms | 4 interruptions | | Bitmap indicates fewer than 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 640ms | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected | | Fewer than 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, but the bitmap indicates that at least 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 800ms | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected | | Fewer than 4 PDSCH can be expected in a single transmission period and it is not indicated safe to soft combine across transmission periods | No requirements e.g. UE may decide not to perform decoding | No requirements e.g. UE may attempt to decode every 20ms |   Proposal 9 : One additional sample (and autonomous interruption) is assumed for implementation aspects such as fine AFC acquisition prior to MIB decoding  Proposal 10 : For inter-frequency CGI reading the side condition is Es/Iot = -6dB for both SSB and RMSI |
| [R4-2001642](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001642.zip) | Huawei, HiSilicon | Proposal 1: For MIB decoding, UE is assumed to attempt decoding on all Tx beams, and with Rx beam sweeping if applicable   * TMIB is 5\*N SMTC periods, where N=1 for FR1 and N=8 for FR2 * For each SMTC period during TMIB, the interruption length is SMTC duration plus RF re-tuning time and time misalignment   Proposal 2: For SIB1 decoding when SIB1 is TDM with SSB, UE is assumed to attempt decoding on a fixed Tx beam, and with fixed Rx beam   * TSIB1 is Y SIB1 scheduling periods, where Y is to be derived from simulation * RMSI/SSB multiplexing pattern 1: For each 20ms period during TSIB1, the interruption length is 2 slots plus RF re-tuning time and time misalignment * RMSI/SSB multiplexing pattern 2/3: For each SMTC period during TSIB1, the interruption length is 4 symbols plus RF re-tuning time and time misalignment   Proposal 3: The known condition for CGI reading is defined as follows.   * During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and * During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and * During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions   Proposal 4: 3 SMTC samples are allowed for AGC settling for SIB1 decoding.  Proposal 5: For CGI reading,   * TMIB should be scaled by the same factors as for L3 RRM measurement of the target carrier, and UE is required to meet the existing RRM and L1 measurement requirements during TMIB. * For SIB1 decoding, TSIB1 should not be scaled, but UE is not required to meet the existing RRM or L1 measurement requirements during TSIB1. |
| [R4-2001643](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001643.zip) | Huawei, HiSilicon | Proposal: The baseband SIB1 decoding delay is 7 SIB1 transmissions, provided that the scheduling periodicity is no larger than 80ms. |
| [R4-2001644](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001644.zip) | Huawei, HiSilicon | How to define LTE CGI reading requirements for different scenarios: |
| [R4-2002046](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002046.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: Reuse known cell condition for NR FR2 handover for CGI reading with autonomous gap.  Proposal 2: SIB1 decoding delay should be 4 \* SMTC period  Proposal 3: Separated delay requirements and interruption requirements in different section for CGI reading of LTE cell is needed in 38.133 and 36.133  Proposal 4: A generic ACK/NACK requirement is derived for the interruption requirements for CGI reading of NR cell like LTE definition.  Proposal 5: Separated delay requirements and interruption requirements in different section for CGI reading of NR cell is needed in 38.133 and 36.133  Proposal 6: Beam sweeping is not needed for MIB and SIB1 decoding.  Proposal 7: AGC/AFC time is not considered during MIB and SIB1 decoding delay.  Proposal 8: CGI reading delay of NR cell should be [9] \* SMTC period |
| [R4-2002053](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002053.zip) | Qualcomm Incorporated | Proposal 1: Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + SMTC duration + 1 slot (victim SCS)  Proposal 2: Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + x slot (target SCS) + 1 slot (victim SCS) where x =1 for multiplexing patter 2/3 and x=2 multiplexing patter 1.  Proposal 3: Re-use the known TCI state definition as known cell for CGI reading.  Proposal 4: Re-using known TCI state definition as known cell, the UE will not need to do any beam sweeping for either MIB or SIB decoding in FR2. |
| [R4-2001263](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001263.zip) | ZTE | CR to 38.133 on CGI reading of NR cell |
| [R4-2001264](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001264.zip) | ZTE | CR to 38.133 on interruption requirements for CGI reading |
| [R4-2001404](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001404.zip) | Ericsson | CR to TS 36.133 on LTE CGI measurements with autonomous gaps |
| [R4-2001405](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001405.zip) | Ericsson | CR to TS 36.133 on NR CGI measurements with autonomous gaps |
| [R4-2001645](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001645.zip) | Huawei, HiSilicon | CR to 36.133 on interruption requirements for CGI reading |
| [R4-2001646](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001646.zip) | Huawei, HiSilicon | CR to 36.133 on CGI reading of LTE cell |

## Open issues summary

### Known cell condition for CGI reading

Background: agreements in the last meeting on known cell conditions are as follows.

|  |
| --- |
| * *Do not define requirements for unknown cells* * *Known cell condition for FR1*   + *It has been meeting the relevant cell identification requirement during the last 5 seconds.*     - *UE sends at least a valid L3-RSRP reporting.*     - *FFS: The SSB with the same index as the one with best RSRP measurement remains detectable.*       * *Depending on if the interruption is defined in symbol level or SMTC level.*   + *During CGI reading, the SSB [with the same index (in the L3-RSRP reporting)] remains detectable* * *Known cell conditions for FR2*   + *Option 1: reuse known cell condition for NR FR2 handover*   + *Other options are not precluded* |

Issue 2-1-1: How the SSB is selected for MIB decoding

* Proposals
  + Option 1 (MediaTek, Ericsson, Qualcomm, Nokia)
    - the SSB with the same index as in the L3-RSRP reporting
  + Option 2 (ZTE, Huawei)
    - Search the best one of all the SSBs within SMTC window
* Recommended WF:
  + Option 1

Issue 2-1-2: Known cell condition for FR1

* Proposals
  + Option 1 (MediaTek, Ericsson, Qualcomm)
    - It has been meeting the relevant cell identification requirement during the last 5 seconds.
      * UE sends at least a valid L3-RSRP reporting.
      * The SSB with the same index as the one with best RSRP measurement remains detectable.
    - During CGI reading, the SSB with the same index as in the L3-RSRP reporting remains detectable
  + Option 2 (ZTE)
    - It has been meeting the relevant cell identification requirement during the last 5 seconds.
      * UE sends at least a valid L3-RSRP reporting.
    - During CGI reading, one of the SSBs measured from the NR target cell remains detectable
  + Option 3 (Huawei)
    - During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and
    - During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and
    - During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions
* Recommended WF:
  + Option 1

Issue 2-1-3: Known cell condition for FR2

* Proposals
  + Option 1 (ZTE, Nokia)
    - Reuse FR2 handover known cell conditions
  + Option 2 (Qualcomm)
    - Re-using known TCI state definition as known cell
  + Option 3 (Ericsson)
    - The known cell condition for FR2 is that an SS block with same SSB index has been meeting the relevant cell identification requirement during the last 5 seconds with the same spatial reception parameters.
  + Option 4 (Huawei)
    - During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and
    - During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and
    - During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions
  + Option 5 (MediaTek)
    - For the target CGI reading in FR2 bands, the CGI reading is under the known condition if it has been meeting the following conditions:

- During the period equals to [X ms] from the last transmission of the SSB used for L3-RSRP report to UE receives the target CGI reading command,

- the UE has sent a valid L3-RSRP measurement report with SSB index

- During the period from UE sends a valid L3-RSRP reporting to UE repots a valid CGI,

- the SSBs used for L3-RSRP report remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3

- the MIB information contained in the SSB used for L3-RSRP report remains decodable with the SNR ≥ [-3]dB

- the RMSI CORSETs associated with the SSB used for L3-RSRP report remain detectable with the SNR ≥ [-3]dB

* Recommended WF:
  + During the last 5 seconds before the reception of the report CGI command:
    - UE sends at least a valid L3-RSRP reporting.
    - The SSB with the same index as the one with best RSRP measurement remains detectable.
  + During CGI reading, the SSB with the same index as in the L3-RSRP reporting remains detectable

### Delay requirements for CGI reading

Simulation results for SIB1 decoding are summarized in Table 1.

**Table 1. Number of attempts to achieve 90% of SIB1 decoding success rate with SNR=-6dB**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency** | **Channel** | **Soft combining** | **Number of attempts** | | | | |
| **ZTE** | **Huawei** | **Ericsson** | **Nokia** | **MediaTek** |
| 4 GHz | AWGN | Single shot | - | >40 | - |  |  |
| 2 | - | 2 | 1 |  |  |
| 4 | 1 | 2 | 1 |  |  |
| 8 | 1 | 2 | 1 |  |  |
| TDL-C-300 | Single shot | - | 11 | 10 |  | 7 (at -3dB) |
| 2 | - | 6 |  |  |  |
| 4 | 2 | 4 | 1 | 1 |  |
| 8 | 1 | 4 | 1 |  |  |
| 30 GHz | AWGN | Single shot | - | >40 | - |  |  |
| 2 | - | 2 | 1 |  |  |
| 4 | 1 | 2 | 1 |  |  |
| 8 | 1 | 2 | 1 |  |  |
| TDL-C-60 | Single shot | - | 12 | 10 |  | 7 (at -3dB) |
| 2 | 13 | 6 |  |  |  |
| 4 | 2 | 4 | 1 |  |  |
| 8 | 1 | 4 | 1 |  |  |

Note1: - means success rate cannot be achieved no matter how many attempts are tried. Blank cell means no results are provided.

Issue 2-2-1: MIB decoding delay for FR1

* Proposals
  + Option 1
    - [5] \* TSMTC, where TSMTC is SMTC periodicity of target cell.
* Recommended WF:
  + Option 1

Issue 2-2-2: MIB decoding delay for FR2

* Proposals
  + Option 1 (MediaTek, Ericsson, Qualcomm, Nokia)
    - [5] \* TSMTC, where TSMTC is SMTC periodicity of target cell.
  + Option 2 (Huawei, ZTE)
    - [5] \* N \* TSMTC, where N = 8 and TSMTC is SMTC periodicity of target cell.
* Recommended WF:
  + Option 1

Issue 2-2-3: How soft combining can be performed for different SIB1 scheduling periodicity

* Proposals
  + Option 1 (Ericsson)
    - By default the UE assumes that PDSCH transmissions from different transmission periods can be soft combined for SIB1 decoding, if there are insufficient opportunities from a single transmission period.
    - Assistance information is needed
      * A bitmap (e.g. of up to 8 bits) where ‘0’ indicates that the UE may assume that PDSCH is not transmitted in the corresponding PDSCH transmission opportunity, and ‘1’ indicates that the UE should determine via the SI-RNTI on PDCCH whether the PDSCH is transmitted.
      * An indication that the UE may assume that it is safe to combine PDSCH across transmission period boundaries (e.g. no SIB1 payload updates are ongoing across the network)
  + Option 2 (Huawei)
    - Requirements are based on soft combining of 2 SIB1 samples and not applicable to 160ms scheduling periodicity
* Recommended WF:
  + FFS.

Issue 2-2-4: If LS to RAN2 to add assistance information signalling is needed

* Proposals
  + Option 1 (Ericsson)
    - LS is sent to RAN2 requesting assistance information below to be added to the CGI decoding request (or other message e.g. measurement object configuration – the details can be for RAN2 to decide).
      * A bitmap (e.g. of up to 8 bits) where ‘0’ indicates that the UE may assume that PDSCH is not transmitted in the corresponding PDSCH transmission opportunity, and ‘1’ indicates that the UE should determine via the SI-RNTI on PDCCH whether the PDSCH is transmitted.
      * An indication that the UE may assume that it is safe to combine PDSCH across transmission period boundaries (e.g. no SIB1 payload updates are ongoing across the network)
  + Option 2 (MediaTek, ZTE)
    - No LS is needed
* Recommended WF:
  + FFS

Issue 2-2-5: How the SIB1 decoding delay is derived

* Proposals
  + Option 1 (MediaTek, Qualcomm)
    - One shot with -3dB SNR
  + Option 2 (Huawei)
    - Soft combining of 2 SIB1 samples
  + Option 3 (Ericsson, Nokia, ZTE)
    - Soft combining of 4 SIB1 samples
* Recommended WF:
  + FFS

Issue 2-2-6: SIB1 decoding delay for FR1 and FR2

* Proposals
  + Option 1 (MediaTek)
    - [7] \* TSIB1, where TSIB1 is the SIB1 scheduling periodicity
      * [7] is based on one shot decoding.
  + Option 2 (Huawei)
    - [7] \* TSIB1, where TSIB1 is the SIB1 scheduling periodicity
      * [7] is based on soft combining of 2 SIB1 samples
  + Option 3 (ZTE)
    - [8] samples
      * Based on soft combining of 4 SIB1 samples.
  + Option 4 (Nokia)
    - 4 \* SMTC period
      * Soft combining of 4 SIB1 samples
  + Option 5 (Ericsson)
    - The requirements for SIB1 decoding in different conditions of assistance information are specified as:

|  |  |
| --- | --- |
| Side condition | SIB1 reading delay requirement |
| At least 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, regardless of whether it is indicated as safe to soft combine across transmission periods | 320ms |
| Bitmap indicates fewer than 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 640ms |
| Fewer than 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, but the bitmap indicates that at least 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 800ms |
| Fewer than 4 PDSCH can be expected in a single transmission period and it is not indicated safe to soft combine across transmission periods | No requirements e.g. UE may decide not to perform decoding |

* Recommended WF:
  + FFS

Issue 2-2-7: AGC/AFC for MIB decoding

* Proposals
  + Option 1 (Nokia, ZTE)
    - No AGC/AFC is assumed during MIB decoding.
  + Option 2 (Ericsson, Qualcomm, MediaTek)
    - 1 sample for AFC
  + Option 3 (MediaTek)
    - No AGC for intra frequency
    - 1 sample for inter frequency
* Recommended WF:
  + FFS

Issue 2-2-8: AGC/AFC for SIB1 decoding

* Proposals
  + Option 1 (Nokia, ZTE, Ericsson, Qualcomm, MediaTek)
    - No AGC/AFC is assumed during SIB1 decoding.
  + Option 2 (Huawei)
    - 3 sample for AGC.
* Recommended WF:
  + FFS

Issue 2-2-9: SINR Side condition for NR CGI reading

* Proposals
  + Option 1 (Ericsson, ZTE)
    - For inter-frequency CGI reading the side condition is Es/Iot = -6dB for both SSB and RMSI
  + Option 2 (MediaTek, Qualcomm)
    - To guarantee the RMSI with the same SSB reporting index can be detected during the whole CGI reading, the potential SNR side condition could be [-3dB]
* Recommended WF:
  + -6 dB for inter frequency for both SSB and RMSI

Issue 2-2-10: Whether updated simulation assumptions in R4-2001271 is agreeable

* Proposals
  + Option 1 (ZTE, Qualcomm, MediaTek)
    - Updated simulation assumptions for SIB1 decoding for NR CGI reading
* Recommended WF:
  + TBA

### Interruption requirements for CGI reading

Issue 2-3-1: Interruptions during MIB decoding

* Proposals
  + Option 1 (ZTE)
    - Each interruption length during MIB decoding is as in table below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) | |
| 0 | 1 |  | 2 + TSMTC\_duration \* |
| 1 | 0.5 |  | 3 + TSMTC\_duration \* |
| 2 | 0.25 | Victim cell is on FR1 | 5 + TSMTC\_duration \* |
| Victim cell is on FR2 | 3 + TSMTC\_duration \* |
| 3 | 0.125 |  | 5 + TSMTC\_duration \* |

* + Option 2 (Ericsson, MediaTek)
    - The interruption for each autonomous gap during MIB decoding is 4 symbols (target cell SCS) + 2\*RF tuning time + 1 slot (victim cell SCS)
  + Option 3 (Qualcomm)
    - Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + SMTC duration + 1 slot (victim SCS)
  + Option 4 (Huawei)
    - For each SMTC period during TMIB, the interruption length is SMTC duration plus RF re-tuning time and time misalignment
* Recommended WF:
  + Interruption length during each MIB decoding autonomous gap

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) | |
| 0 | 1 |  | TBD |
| 1 | 0.5 |  | TBD |
| 2 | 0.25 | Victim cell is on FR1 | TBD |
| Victim cell is on FR2 | TBD |
| 3 | 0.125 |  | TBD |

Note: Depending on decision on Issue 2-1-1.

Issue 2-3-2: Interruptions during SIB1 decoding

* Proposals
  + Option 1 (ZTE)
    - Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 1 is as in table below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) | |
| 0 | 1 |  | 4 |
| 1 | 0.5 |  | 5 |
| 2 | 0.25 | Victim cell is on FR1 | 7 |
| Victim cell is on FR2 | 5 |
| 3 | 0.125 |  | 7 |

* + - Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 2/3 is as in table below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) | |
| 0 | 1 |  | 3 |
| 1 | 0.5 |  | 4 |
| 2 | 0.25 | Victim cell is on FR1 | 6 |
| Victim cell is on FR2 | 4 |
| 3 | 0.125 |  | 6 |

* + Option 2 (Huawei)
    - RMSI/SSB multiplexing pattern 1: For each 20ms period during TSIB1, the interruption length is 2 slots plus RF re-tuning time and time misalignment
    - RMSI/SSB multiplexing pattern 2/3: For each SMTC period during TSIB1, the interruption length is 4 symbols plus RF re-tuning time and time misalignment
  + Option 3 (Ericsson)
    - The UE’s interruption for RMSI decoding shall base on minimum RMSI scheduling periodicity 20ms. It means 8 interruption occasions shall be counted in each 160ms RMSI periodicity.

|  |  |
| --- | --- |
| Side condition | SIB1 interruption requirement |
| At least 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, regardless of whether it is indicated as safe to soft combine across transmission periods | 4 interruptions |
| Bitmap indicates fewer than 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected |
| Fewer than 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, but the bitmap indicates that at least 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected |
| Fewer than 4 PDSCH can be expected in a single transmission period and it is not indicated safe to soft combine across transmission periods | No requirements e.g. UE may attempt to decode every 20ms |

* Recommended WF:
  + FFS

Issue 2-3-3: How frequently each interruption happens during SIB1 decoding

* Proposals
  + Option 1 (ZTE, Huawei, MediaTek)
    - 20ms for multiplexing pattern 1.
    - SMTC period for multiplexing pattern 2/3.
  + Option 2 (Qualcomm)
    - 20ms based on minimum MSI scheduling periodicity.
* Recommended WF:
  + Option 1

Issue 2-3-4: How are the interruption requirements for NR CGI reading specified?

* Proposals
  + Option 1 (ZTE)
    - The interruption core requirements for CGI reading of NR cell is specified by ratio of interrupted slots during the MIB decoding and SIB1 decoding time period.
      * The ratio of interruption during MIB decoding is interrupted slots during one sample for MIB decoding over SMTC period in slots.
      * For multiplexing pattern 1, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over 20ms in slots. For multiplexing pattern 2/3, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over SMTC period in slots.
  + Option 2 (Ericsson)
    - it would be quite difficult to derive a formula for generic missed ACK/NACK either as an absolute value or as a ratio
  + Option 3 (Nokia)
    - A generic ACK/NACK requirement is derived for the interruption requirements for CGI reading of NR cell like LTE definition.
* Recommended WF:
  + FFS
    - Note: SIB1 decoding delay depending on SIB1 actual scheduling periodicity. The ACK/NACK requirements would be different for different scheduling periodicity. It is very difficult to calculate ACK/NACK for all scheduling periodicities and the requirements will be very complex.

### Requirements structure

Issue 2-4-1: How to capture interruption requirements for CGI reading of NR cell

* Proposals
  + Option 1 (ZTE, Nokia)
    - Separated delay requirements and interruption requirements in different sections for CGI reading of NR cell
* Recommended WF:
  + Option 1

Issue 2-4-2: How to capture interruption requirements for LTE CGI reading in EN-DC and NE-DC

* Proposals
  + Option 1 (ZTE, Nokia)
    - Separated delay requirements and interruption requirements in different sections for CGI reading of LTE cell
  + Option 2 (Huawei)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | Measurement period | Interruption on LTE serving cells | Interruption on NR serving cells |
| EN-DC | | 8.17 of 36.133  Refer to LTE SA requirements | | 8.2.1 of 38.133  Same as requirements for inter-RAT RSTD |
| NR SA (including single carrier, NR CA and NR-DC) | | 9.4 of 38.133 | N.A. | 8.2.2 and 8.2.4 of 38.133  Refer to EN-DC requirements |
| NE-DC | Configured by Pcell |  | 7.36 of 36.133  Same as requirement for LTE SA | 8.2.3 of 38.133  Refer to EN-DC requirements |
| Configured by PSCell | 8.19 of 36.133  Refer to LTE SA requirements | |

* Recommended WF:
  + Option 1 if requirements for CGI reading of LTE cell are introduced without referring to existing requirements

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Sub topic 2-1:  Issue 2-1-2  Agree with options 1. We would want to ensure the same SSB index that was reported remains detectable.  Issue 2-1-3  We would want to keep the same SSB index in here too. So either we go with approach similar to TCI state or as proposed by MTK in option 5 with small enough value for x.  Sub topic 2-2:  Issue 2-2-2We are ok with the 5 SMTC as long as the TCI state corresponding to the SSB remains known at the UE. Else UE will need to do beam sweeping.  Issue 2-2-3  Additional signalling for just this seems like an overkill. We should balance the need for this feature with the overhead of signalling. Can we just apply the requirements for shorter SMTC periodicities, where UE has better chance of coming before SIB changes.  Also the need for soft-combining could be combined with the side condition. We could do with one-shot decoding with a higher side condition.  Issue 2-2-4  LS needs more discussion.,  Issue 2-2-5  Can go with option 1 with a side condition of -3dB.  Issue 2-2-7, Issue 2-2-8, Issue 2-2-9  One sample for AGC for MIB. For SIB we shouldn’t really need any extra samples since MIB decoding was accomplished, UE should have good AGC/AFC at that point Side condition of -3 dB.  Issue 2-2-10  Ok with updating sim assumptions.  Issue 2-3-3  We would prefer Option 2  Issue 2-3-4  Specify the total number of interruptions and lengths. Generic formula will probably be hard to come by  Others: |
| Medaitek | Issue 2-1-1:  Option 1.  CGI reading is a best effort procedure for UE. Thus, we need a strong known condition restriction and fast processing time.  Issue 2-1-2:  As discussed above.  Issue 2-1-3:   1. For Handover, we just guarantee SSB is detectable. But for CGI reading, we should also guarantee MIB and SIB1 can be detectable by UE, otherwise how can UE decode MIB and SIB1? 2. For the known condition, we have three different time restriction, Handover-5s, Scell activation – 3s, TCI state switch -1.28s. We don’t see any difference for the definition of these known condition. All of them consider the L3 RSRP reporting as the key factor to define known condition.   Considering the CGI reading is a best effort behaviour, we suggest to have a strong restriction on known condition to guarantee no Rx beam sweeping is needed.  For the side condition -3dB or -6dB, we suggest to discuss the SIB1 decoding at first then we can come back on this side condition. From our simulation, UE can’t decode the SIB1 under -6dB.  Issue 2-2-1:  Option 1  Issue 2-2-2:  Option 1 if we agree that only need to consider the SSB with the same index as in the L3-RSRP reporting.  Issue 2-2-3:  We should consider both one shot and soft combing in SIB1 decoding. The SIB1 periodicity is 160ms, the spec. cannot guarantee the SIB1 not changing for 4 times soft combining. For soft-combing solution, 4 times means we should also consider additional 3 shots if these 3 shots decoding didn’t have the same contents as the other 4 shots. Thus, it also need 7 shots for SIB1 decoding.  We notice that E/// has a proposal to send a LS to add some signalling to help to solve this issue, but from our understanding, currently RAN2 may don’t have time to discuss this optimization signalling at this stage. Also considering the schedule restriction, RAN4 can’t wait a long time for RAN2 to discuss whether to optimize the signalling for CGI reading.  If we consider that CGI reading is just a best effort procedure to UE, the UE can use one-shot solution to decode the SIB1 with higher SNR, such as -3dB. We never see any strong view to must define the side condition in -6dB. Then this issue can be solved with 7 one-shot decoding in -3dB.  Issue 2-2-4:  We don’t think sending a LS to RAN2 is a good solution for this issue. A better way is to define a higher SNR and use one-shot solution for SIB1 reading.  Issue 2-2-5:  Option 1. The same reason as issue 2-2-3, 2-2-4.  Issue 2-2-6:  We suggest to pending on this discussion until we have a common understanding on how to deduce the SIB1 decoding performance.  Issue 2-2-7:  Option 3. We can also agree with E///’s option 2 to simplify the requirement.  Issue 2-2-8:  Option 1.  Issue 2-2-9:  At first, we should discuss how to deduce the SIB1 decoding performance.  Issue 2-2-10:  Agree.  Issue 2-3-1:  If we agree on issue 1-1-1, then we can use option 2 Ericsson’s proposal.  Issue 2-3-2:  Before we discuss the interruption of SIB1 decoding, it’s better to agree the SIB1 decoding issues above.  Issue 2-3-3:  Agree on option 1.  Issue 2-3-4:  We don’t think these options said the same things. |
| ZTE | Sub topic 2-1:  Issue 2-1-1  We can compromise to option 1 given that it is majority view.  Issue 2-1-2  For option 1 in Issue 2-1-1, the corresponding known cell condition would be option 1.  Issue 2-1-3  SINR is not necessary to be in the known cell condition. Similar condition as in FR1 can be used.  Sub topic 2-2:  Issue 2-2-3  Soft combining should not be done across SIB1 TTIs. It comes at the cost of signalling overhead and UE complexity. We don’t see the necessity to introduce the indication.  For the soft combining within SIB1 TTI, UE can know if SIB1 is actually transmitted on a SIB1 occasion by decoding PDCCH, so no bit map indication is needed.  In general Option 2 may be a feasible approach given that the difficulties of soft combining due to variable SIB1 transmission periodicity. We can accept option 2.  Issue 2-2-4  Don’t see the necessity of the LS,  Issue 2-2-5  Option 2 can be considered.  Issue 2-2-6  Discuss how many samples are needed for soft combining of 2 repetitions.  Sub topic 2-3:  Issue 2-3-1  If option 1 in Issue 2-1-1 is agreeable, the interruptions can be further calculated.  Issue 2-3-2  For option 2, the interruption length is aligned with ZTE’s proposal for multiplexing pattern 1. However for multiplexing 2/3, ZTE’s calculation is based on 1 slot rather 4 symbols. Not sure how 4 symbols are derived.  Issue 2-3-4  Generic ACK/NACK requirements are very hard to calculate and have very limited use case, i.e. it only for the given conditions.  Others: |
| Ericsson | Issue 2-1-1 : We agree with option 1, the proposed WF  Issue 2-1-2 : The proposed WF is OK for us  Issue 2-1-3 : The proposed WF for us is OK as long as the requirement derived from this known cell condition is not scaled for RX beamsweeping (either MIB or SIB1 reading phase),  Issue 2-2-1 : Agree with the proposed WF  Issue 2-2-2 : Agree with the proposed WF, option 1. We cannot accept solutions based on RX beamsweeping, although the bigger issue for beam sweeping is autonomous interruptions rather than delay  Issue 2-2-3 : We should start by discussing what kind of soft combining assumptions are going to be assumed to derive requirements (eg how many samples are required, N=2 or N=4). Then we should discuss whether it is beneficial to avoid autonomous interruptions on SIB1 transmission occasions where the NW already knows there can be no SIB1 transmission scheduled. We also think that cross TTI soft combining will typically be possible with high probability since SIB1 payload is not very dynamic. So it provides a useful way to minimize delay, interruption and improve the changes of decoding SIB1 (especially if N=4 soft combining is needed). Although there is a small possibility of payload changes, if the procedure fails NW can re-request CGI decoding from either the same or another UE, so the benefit of cross TTI soft combining outweighs the risks.  Related to ZTE comment:SIB combining across TTI could be done with or without an indication. Signalling could improve the success rate (prevent UE soft combing when payload changes) but would need to be optional for the network at any rate since the serving cell may not know if a cell for which it does not have neighbor relations changes its SIB1 payload. The more critical signaling is so the UE knows times when the PDSCH isn’t scheduled. Our concern if we do not assume soft combining across TTI is that the CGI decoding success rate may be very low at -6dB, based on our results and the results of other companies, unless there are at least 4 PDSCH transmissions within 160ms.  Related to Mediatek comment : If we define the side condition as -3dB with one shot detection, we can agree that CGI decoding is a best effort service and we will eventually find a UE that decodes the CGI and helps the network establish the neighbor relationship. However, we are worried that our trigger for CGI decoding in the network side is a UE measurement report (side condition -6dB) and with 3dB mismatch in side conditions we may send very many requests to Ues that fail and as such cause UE power consumption and autonomous interruption with no chance of success. So although we can definitely live with CGI decode failures failures, we have no way to know the receiver side condition at the UE, and we don’t want a totally excessive failure rate.  Issue 2-2-4 : Depends on the outcome of issue 2-2-3  Issue 2-2-5 : Since UE may report a neighbor which the serving gNB has no neighbor relationship with at Es/Iot=-6dB, our view is that -6dB side condition is also needed for CGI decoding, otherwise the UE may often get requested to decode CGI of cells below the side condition. So we do not think it is good to do one shot detection. Serving gNB does not know the SINR condition at the UE, and will send requests which result in autonomous interruptions with little chance of success. Based on our results there is a need for soft combing of 4 sample at -6dB SINR to get good probability of success, so we support option 3.  Issue 2-2-6 : We think progress is needed on the other topics, eg whether assistance information is provided by NW to avoid interruptions, assumptions on soft combining samples, and assumptions on cross TTI soft combining. Once those aspects are agreed, the derivation of corresponding worst case delay for SIB1 reading in different scenarios becomes a calculation.  Issue 2-2-7 : All options would be OK for us. We need to decide if we would have generic CGI reading requirement or different requirement for intra/inter frequency. A generic delay and interruption requirement would be simpler and the differences are likely to be relatively small.  Issue 2-2-8 : Don’t see a need for additional delay / interrupts due to AGC so support option 1. For option 2, it is not completely clear what a “sample” is, an SMTC (SSB) or a SIB1 transmission.  Issue 2-2-9 : As commented earlier, gNB does not know the UE receiver condition, so it will send a request triggered by a report of a physical cell ID that it does not have an established neighbor relationship with. If there is a mismatch between measurement side condition and CGI decoding side condition, there will be many requests sent to Ues which have little chance of success. -6dB side condition is thus needed.  Issue 2-2-10 : Agree with updated assumptions.  Issue 2-3-1 : Depends on the known cell condition. If same SSB is used for MIB as measurement report, RAN4 should assume interruption based on 4 symbol reception, otherwise SMTC is needed  Issue 2-3-2 : Similarly to issue 2-2-3, we should understand the assumptions made. Then deriving corresponding interruptions becomes a calulcation, similarly to delay.  Issue 2-3-3 : This is where we see the key benefit of providing assistance information. Avoiding making interruptions where there is no chance of the UE decoding SIB1since serving gnB already knows it is not transmitted would be highly beneficial and should also be listed as an option.  Issue 2-3-4 : We think that interrupt duration and number of interruptions are the key thing to place requirements on. So it might be enough to say up to X interruptions of duration up to K1 for MIB decoding and additionally up to Y interruptions of up to K2 for SIB decoding. If we agree on assistance information then Y would depend on the information about which SIB1 opportunities the UE needs to decode PDCCH with SI-RNTI.  Issue 2-4-2 : We think it is better to refer to existing LTE SA sections of 36.133 from any added requirements in 36.133. Option 2 generally makes sense to us. One detailed comment on option 2 is that it might be better to define “Interruption on NR serving cells in 38.133 for the SA case” explicitly, and then in EN-DC and NE-DC parts of 38.133 refer to the explicit requirements in the SA section. This would be more consistent with 36.133 where we already have LTE SA CGI reading requirements. |
| MTK | For SIB1 decoding performance, we have further comments below.  To ZTE, the soft combining within SIB1 TTI may not happen because the real SIB1 transmission periodicity is up to the network. We can’t use a possible scenario to define the minimum requirement.  We should consider the worst case.   |  | | --- | | TS38.331  the *SIB1* is transmitted on the DL-SCH with a periodicity of 160 ms and variable transmission repetition periodicity within 160 ms as specified in TS 38.213 [13], clause 13. The default transmission repetition periodicity of *SIB1* is 20 ms but the actual transmission repetition periodicity is up to network implementation. For SSB and CORESET multiplexing pattern 1, *SIB1* repetition transmission period is 20 ms. For SSB and CORESET multiplexing pattern 2/3, *SIB1* transmission repetition period is the same as the SSB period (TS 38.213 [13], clause 13). *SIB1* includes information regarding the availability and scheduling (e.g. mapping of SIBs to SI message, periodicity, SI-window size) of other SIBs with an indication whether one or more SIBs are only provided on-demand and, in that case, the configuration needed by the UE to perform the SI request. *SIB1* is cell-specific SIB |     To Ericsson,  We agree on that the network want to trigger the CGI reporting based on measurement report which side condition is -6dB. However, -6dB is the worst case, most of Ues can actually report a cell with SNR side condition far higher than -6dB. On the other hand, UE may also report a cell in the SNR side condition worse than -6dB (still has a non-zero detection rate). In that case, the same mismatch issue happens.  When UE is reporting RSRP, network does not know the exact SINR side condition of the target cell so the mismatch is always there. If we forced UE to use soft-combing to decode the SIB1, this will result in more power consumption.  On the other hand, we want to emphasize that soft combing is only useful to noise but not to interference. Typically, the UE to report CGI will suffer a strong interference from serving cell. If the interference is the same in every combined sample, we don’t see any help by soft-combing. If we define a very low SINR side condition, we’re pessimistic to say lots of UE whose SINR is between -3dB and -6dB will fail to decode the CGI and waste more power in such higher interference scenario. Currently, the simulation assumption is based on white noise. We also suggest to update the simulation assumption to add a strong interference for further evaluation.  Thus, we still suggest to use one-shot solution and higher SINR to evaluate the SIB1 decoding performance. |
| Huawei, HiSilicon | Issue 2-1-1:  Option 2. One reason is the reliability of the CGI reading – it should be noted that the known cell condition needs to be defined very strict if option 1 is adopted. Another consideration factor is the impact to RRM requirements as we addressed in **Proposal 5 in our paper R4-2001642, which is unfortunately not captured in the issue list**. The question is whether UE needs to meet the existing RRM requirements during CGI reading. If option 1 is adopted this may be impossible.  Issue 2-1-2:  It depends on the outcome of Issue 2-3-1 (Interruptions during MIB decoding).  Issue 2-1-3:  It depends on the outcome of Issue 2-1-1 and 2-3-1.  It should be noted that if UE is not assumed to do Rx beam sweeping for MIB or SIB1 decoding, the known condition needs to reflect that the SSB or RMSI can be received with the same spatial reception parameter determined somewhere else.  On the time between L3 reporting and CGI command, we think it should be short if UE is not assumed to do Rx beam sweeping. We prefer to reuse the 1.28s from TCI state switching.  Issue 2-2-1:  Support the recommended WF.  Issue 2-2-2:  Option 2. This depends on the outcome from Issue 2-1-1.  Issue 2-2-3:  It would be best if the SIB1 decoding delay can be defined without soft combining, as it maximize the applicability, i.e. the requirements also apply when network schedules SIB1 with 160ms period. However, from our simulation, keep-trying does not work for AWGN, so we suggest to go with size-2 soft combining.  We have some comments on Ericsson proposal (option 1),  - “UE assumes that PDSCH transmissions from different transmission periods can be soft combined for SIB1 decoding” is too strong and will limit UE implementation.  - On the assistance information, one question is how the serving cell could obtain the (even dynamic) information about the SIB1 scheduling pattern from a neighbor cell which has no relation with it (we understand ANR is the main use case for CGI reading).  Issue 2-2-4:  We support option 2.  Issue 2-2-5:  We support option 2 but we are also open with option 1.  For option 3, even we assume UE does size-4 soft combining, we still need to consider the case where UE cannot get 4 samples within the SIB1 TTI, and after we account for this margin the requirement will be same as size-2 soft combining, but with narrower applicability.  Issue 2-2-6:  It depends on outcome from Issue 2-2-3/4/5.  Issue 2-2-7:  We support option 2.  Issue 2-2-8:  The reason to consider AGC/AFC for SIB1 decoding is that the RMSI may be transmitted in a different time-frequency resource than SSB, so the AGC/AFC settings from the previous RRM measurement and MIB decoding may not be suitable for SIB1 decoding. Considering the majority view we can compromise to 1 RSMI sample for AGC/AFC, and we are open to further discussions.  Issue 2-2-9:  No strong view but it is related to SIB1 decoding requirements. With -3dB keep-trying may be possible.  Issue 2-2-10:  Option 1  Issue 2-3-1:  Option 3 and option 4 are same and we support them. It is related to discussion about the known cell condition and Issue 2-1-1.  Issue 2-3-2:  For SIB decoding it seems the common view is that UE only decodes one Tx beam without Rx beam sweeping, so we think option 2 may be agreeable.  Issue 2-3-3:  Support option 1.  Issue 2-3-4:  No strong view. |
| Nokia | Issue 2-1-1: We agree with option 1.  Issue 2-1-2: We are fine with option 1.  Issue 2-1-3: We agree with option 1, Since it is similar as NR handover, the FR2 cell known condition in NR handover requirements can be used for CGI reading of NR FR2 target cell.  Issue 2-2-1: We agree with option 1, [5] SMTC periodicity for MIB1 decoding for FR1  Issue 2-2-2: We agree with option 1, [5] SMTC periodicity for MIB1 decoding for FR2  Issue 2-2-5: We agree with option 3. According to our simulation results, soft combing of 4 samples at -6dB SINR have the good probability of success.  Issue 2-2-6: We agree with option 4. From our simulation result on FR1 and FR2, 4 SMTC periodicity is needed for SIB decoding for FR1 and FR2.  Issue 2-2-7: We agree with option 1. No AGC/AFC time should be considered in MIB decoding delay. CGI reading of NR cell is defined for known NR cell, UE should have the information of AGC/AFC with very high probability. The MIB decoding delay is agreed to be [5] samples, it is already included some buffer for additional uncertainty delay.  Issue 2-2-8: We agree with option 1. Similar as issue 2-2-7, no need to consider AGC/AFC time in SIB decoding.  Issue 2-2-9: option 1 is fine for us.  Issue 2-2-10: the updated simulation assumptions are fine.  Issue 2-3-4: we support option 4, A generic ACK/NACK requirement for the interruption requirements for CGI reading of NR cell like LTE definition will be a simple way for the requirement. How to define the value need more thinking.  Issue 2-4-1: Separated requirements in different section will make the specification clear and readable, we can follow the current LTE requirements structure.  Issue 2-4-2: Separated requirements in different section in 38.133 and 36.133 will be a good approach. To avoid duplicated wording, we can specify the requirements in the new section and provide the reference to the existing requirements. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #2-1 Known cell condition for CGI reading** | *The key issue is to decide how to select SSB for MIB decoding first. Huawei has concern to use SSB with the same index as in the L3-RSRP reporting. Further discussion is needed.*  Issue 2-1-1a: Whether UE needs to meet the existing RRM requirements during CGI reading.  *Candidate options:*   * Option 1 (Huawei)   + TMIB should be scaled by the same factors as for L3 RRM measurement of the target carrier, and UE is required to meet the existing RRM and L1 measurement requirements during TMIB.   + For SIB1 decoding, TSIB1 should not be scaled, but UE is not required to meet the existing RRM or L1 measurement requirements during TSIB1.   *Recommendations for 2nd round:*   * Comments on option 1 since it was missed out in the 1st round discussion.   Issue 2-1-1: How the SSB is selected for MIB decoding  *Candidate options:*   * Option 1 (MediaTek, Ericsson, Qualcomm, Nokia)   + the SSB with the same index as in the L3-RSRP reporting * Option 2 (ZTE, Huawei)   + Search the best one of all the SSBs within SMTC window   *Recommendations for 2nd round:*   * Discuss if option 1 has impact to UE for meeting existing L1 and L3 RRM measurement requirements. * If no impact then option 1 is majority view.   Issue 2-1-2: Known cell condition for FR1  *Candidate options:*   * Option 1 (MediaTek, Ericsson, Qualcomm)   + It has been meeting the relevant cell identification requirement during the last 5 seconds.     - UE sends at least a valid L3-RSRP reporting.     - The SSB with the same index as the one with best RSRP measurement remains detectable.   + During CGI reading, the SSB with the same index as in the L3-RSRP reporting remains detectable * Option 2 (ZTE)   + It has been meeting the relevant cell identification requirement during the last 5 seconds.     - UE sends at least a valid L3-RSRP reporting.   + During CGI reading, one of the SSBs measured from the NR target cell remains detectable * Option 3 (Huawei)   + During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and   + During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and   + During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions   *Recommendations for 2nd round:*   * If option 1 in Issue 2-1-1 is agreeable, then option 1 in Issue 2-1-2 is agreeable. * If option 2 in Issue 2-1-1 is agreeable, then option 3 in Issue 2-1-2 is agreeable. Wording can be refined.   Issue 2-1-3: Known cell condition for FR2  *Candidate options:*   * Option 1 (Nokia)   + Reuse FR2 handover known cell conditions * Option 2 (Qualcomm)   + Re-using known TCI state definition as known cell * Option 3 (ZTE, Ericsson)   + During the last 5 seconds before the reception of the report CGI command:     - UE sends at least a valid L3-RSRP reporting.     - The SSB with the same index as the one with best RSRP measurement remains detectable.   + During CGI reading, the SSB with the same index as in the L3-RSRP reporting remains detectable * Option 4 (Huawei)   + During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and   + During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and   + During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions * Option 5 (MediaTek, Qualcomm)   + For the target CGI reading in FR2 bands, the CGI reading is under the known condition if it has been meeting the following conditions:   - During the period equals to [X ms] from the last transmission of the SSB used for L3-RSRP report to UE receives the target CGI reading command,  - the UE has sent a valid L3-RSRP measurement report with SSB index  - During the period from UE sends a valid L3-RSRP reporting to UE repots a valid CGI,  - the SSBs used for L3-RSRP report remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3  - the MIB information contained in the SSB used for L3-RSRP report remains decodable with the SNR ≥ [-3]dB  - the RMSI CORSETs associated with the SSB used for L3-RSRP report remain detectable with the SNR ≥ [-3]dB  *Recommendations for 2nd round:*   * Depending on outcome of Issue 2-1-1 * Option 3 and option 5 can be used as baseline for further improvement of the wording depending on companies’ interest and try to converge. |
| **Sub-topic #2-2**  **Delay requirements for CGI reading** | *The key issue is to decide how to define SIB1 delay requirements. Is it based on one shot or soft combining? How can soft combining be done given SIB1 actual transmission periodicity is up to network implementation?*  *Ericsson provided a solution for soft combining. However, companies concerned about complexity and necessity.*  *Tentative agreements:*   * MIB decoding delay for FR1   + [5] \* TSMTC, where TSMTC is SMTC periodicity of target cell * Updated simulation assumptions in R4-2001271 is agreeable   *Recommendations for 2nd round:*   * No further action. The tentative agreements above is agreeable.   *Tentative agreements:*   * 1 sample for AGC/AFC during MIB decoding * No AGC/AFC is assumed during SIB1 decoding.   *Recommendations for 2nd round:*   * Confirm if the tentative agreement is agreeable since it is based on majority view.   Issue 2-2-2: MIB decoding delay for FR2  *Candidate options:*   * Option 1 (MediaTek, Ericsson, Qualcomm, Nokia)   + [5] \* TSMTC, where TSMTC is SMTC periodicity of target cell. * Option 2 (Huawei, ZTE)   + [5] \* N \* TSMTC, where N = 8 and TSMTC is SMTC periodicity of target cell.   *Recommendations for 2nd round:*   * Depending on outcome of Issue 2-1-1.   + If option 1 in Issue 2-1-1 is agreeable, then option 1 in Issue 2-2-2 is agreeable.   + If option 2 in Issue 2-1-1 is agreeable, then option 3 in Issue 2-2-2 is agreeable.   Issue 2-2-5: How the SIB1 decoding delay is derived  *Candidate options:*   * Option 1 (MediaTek, Qualcomm)   + One shot with -3dB SNR * Option 2 (Huawei, ZTE)   + Soft combining of 2 samples at -6dB SNR     - No CGI reading requirements for 160ms SIB1 scheduling periodicity * Option 3 ()   + Soft combining of 2 samples at -6dB SNR * Option 4 (Ericsson, Nokia)   + Soft combining of 4 samples at -6dB SNR   *Recommendations for 2nd round:*   * This is key issue to SIB1 decoding delay requirements. Try to agree on one option. * If Option 1/2 is agreeable, then Issue 2-2-3 and Issue 2-2-4 are not necessary.   *If option 3 or 4 in Issue 2-2-5is agreeable, then*  Issue 2-2-3: How soft combining can be performed for different SIB1 scheduling periodicity  *Candidate options:*   * Option 1 (Ericsson)   + By default the UE assumes that PDSCH transmissions from different transmission periods can be soft combined for SIB1 decoding, if there are insufficient opportunities from a single transmission period.   + Assistance information is needed     - A bitmap (e.g. of up to 8 bits) where ‘0’ indicates that the UE may assume that PDSCH is not transmitted in the corresponding PDSCH transmission opportunity, and ‘1’ indicates that the UE should determine via the SI-RNTI on PDCCH whether the PDSCH is transmitted.     - An indication that the UE may assume that it is safe to combine PDSCH across transmission period boundaries (e.g. no SIB1 payload updates are ongoing across the network)   *Recommendations for 2nd round:*   * Can be discussed with Issue 2-2-5 as a package.   Issue 2-2-4: If LS to RAN2 to add assistance information signalling is needed  *Recommendations for 2nd round:*   * Depending on outcome of Issue 2-2-5 and 2-2-3.   Issue 2-2-6: SIB1 decoding delay for FR1 and FR2  *Recommendations for 2nd round:*   * Further discussion depending on outcome of Issue 2-2-5 and based on simulation results   Issue 2-2-9: SINR Side condition for NR CGI reading  *Recommendations for 2nd round:*   * Depending on outcome of Issue 2-2-5. |
| **Sub-topic #2-3**  **Interruption requirements for CGI reading** | Issue 2-3-1: Interruption length during MIB decoding  *Candidate options:*   * Option 1   + The interruption for each autonomous gap during MIB decoding is 4 symbols (target cell SCS) + 2\*RF tuning time + 1 slot (victim cell SCS) * Option 2   + Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + SMTC duration + 1 slot (victim SCS)   *Recommendations for 2nd round:*   * Depending on outcome of Issue 2-1-1.   Issue 2-3-3: How frequently each interruption happens during SIB1 decoding  *Candidate options:*   * Option 1 (ZTE, Huawei, MediaTek)   + 20ms for multiplexing pattern 1.   + SMTC period for multiplexing pattern 2/3. * Option 2 (Qualcomm)   + 20ms based on minimum MSI scheduling periodicity.   *Recommendations for 2nd round:*   * The majority view is option 1. * There is one issue that need to be further considered for option 1. Soft combining may be impacted if SIB1 decoding for multiplexing pattern 2/3 is based on SMTC period as the actual scheduling period of SIB1 could be smaller than SMTC period. If should SMTC period be SSB period instead? Further comments on this are encouraged.   Issue 2-3-2: Interruption length during SIB1 decoding  *Recommendations for 2nd round:*   * Depending on outcome of Issue 2-2-5 and 2-2-3. * Depending on outcome of Issue 2-3-3.   Issue 2-3-4: How are the interruption requirements for NR CGI reading specified?  *Candidate options:*   * Option 1 (ZTE)   + The interruption core requirements for CGI reading of NR cell is specified by ratio of interrupted slots during the MIB decoding and SIB1 decoding time period.     - The ratio of interruption during MIB decoding is interrupted slots during one sample for MIB decoding over SMTC period in slots.     - For multiplexing pattern 1, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over 20ms in slots. For multiplexing pattern 2/3, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over SMTC period in slots. * Option 2 (Ericsson)   + Up to X interruptions of duration up to K1 for MIB decoding and additionally up to Y interruptions of up to K2 for SIB decoding * Option 3 (Nokia)   + A generic ACK/NACK requirement is derived for the interruption requirements for CGI reading of NR cell like LTE definition. * Option 4 (Qualcomm)   + Specify the total number of interruptions and lengths   *Recommendations for 2nd round:*   * Elaborate option 4 and try to converge on option 1, option 2 and option 3. Similarities are observed among the three options. |
| **Sub-topic #2-4**  **Requirements structure** | *Tentative agreements:*   * Separated delay requirements and interruption requirements in different sections for CGI reading of NR cell * Separated delay requirements and interruption requirements in different sections for CGI reading of LTE cell   + This is general principle. It can be further discussed case by case during CR phase.   *Recommendations for 2nd round:*   * Confirm if the tentative agreement is agreeable. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on R16 NR RRM enhancements – CGI reading | ZTE |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round

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| **Company** | **Comments** |
| QC | Issue 2-1-1a  CGI reading is not a procedure that should take place often. We should look at it as a procedure that is performed rarely and hence it would be ok if the UE doesn’t satisfy the RRM requirements when the UE is asked to do CGI reading. We can add a line in the spec saying that UE can relax measurements when during CGI reading procedure rather than overly complicating the spec  Issue 2-1-3  The benefit for using option 5 is that UE knows which beams to use and hence doesn’t need to do beam sweeping for MIB decoding.  Issue 2-2-5  We question the need for CGI reading at low SNR’s. The network can always ask a UE that has good SNR to perform this reading rather than one that is seeing poor SNR  Issue 2-3-1  Again since this isn’t really happening that often is it necessary to optimize this. The only difference between 4 symbols or SMTC duration is the case where there is some data FDM’d with SSB. Irrespective of whether we use a given SSB index or any SSB, how much difference does it make in terms of performance if we allow the UE to always blank out entire SMTC.  Issue 2-3-4  Our proposal was similar to what E// has in option 2. We specify the number of interruptions and the lengths rather than trying to come up with percentages. We can agree with option 2 |
| Ericsson | Issue 2-2-1a : If RRM measurements are prioritized, the UE will always prioritize measurement of the target cell over CGI decoding since the MIB is in the same SSB as is used for mobility and CGI decoding. We also agree with Qualcomm’s point here that CGI decoding is an infrequent procedure. In LTE CGI decoding it is not explicitly stated in the spec although our understanding is that an LTE UE may also miss some measurement samples in autonomous gaps. We support not over complicating the spec in this area.  Issue 2-1-1: How the SSB is selected for MIB decoding  We think that either option could have some impact to L1 measurements and RRM measurements since autonomous gaps occur at around the time of the SMTC. Option 2 seems to have greater impact (the UE could make decode attempts from any of the target cell SS blocks, and it can change dynamically. So we still prefer option 1, and think it is particularly important for FR2 to avoid RX beamsweep.  Issue 2-2-2 : We have a big concern withj N=8 due to delay and autonomous interruption  Issue 2-2-5 : We still haver a concern on the mismatch of cell identification and CGI decoding. Although CGI decoding is on a best effort basis, the network will send many CGI decoding requests which would not succeed under -3dB side condition which is a waste of effort for both NW and UE and leads to unnecessary autonomous interruption. Our simulation results (and some others) showed a need to soft combine 4 samples, so we cannot accept other than option 4.  Issue 2-2-3 / Issue 2-2-4 : For the case that sufficient samples are not available in one TTI, the options are either to attempt cross TTI soft combining or for the UE to fail to decode. Our preference would be for the UE to attempt cross TTI soft combining, because it should not make the situation worse unless the payload changes which is a rare case. If companies feel it is too late in R16 for NW assistance signalling then we can assume the UE does this blindly, and make it a side condition of CGI decoding that the SIB1 payload does not change during the decoding/reporting period. For the case that SIB1 is infrequently scheduled, we do not think it is efficient that the UE has to make an interruption every 20ms. If we cannot agree in R16 on the bitmap signaling then we would like to come back to it in R17, for instance in a further RRM enhancements WI.  Issue 2-3-4 : Option 2 and 4 are basically equivalent. For option 1, our comment is that we do not know externally when the UE finishes MIB dedoding and starts SIB1 decoding, so specifying interruption ratios for each phase does not seem to help if we do not know which phase the UE is in. For option 3, our understanding is this is essentially the LTE approach, and our concern is the significantly increased flexibility in NR means that there are many different cases to consider in the generic requirement. |
| MTK | Issue 2-1-1a:  We agree with QC’s argument.  We have discussed the similar issue also on Multiple SCell activation, and we already agreed not to consider RRM measurements together. So we suggest the same rule shall be applied also in CGI reading.  Issue 2-1-3:  We agree on QC and Huawei’s proposal to use 1.28s to evaluate the known condition. Please update our option 5 with 1.28s.  Issue 2-2-5:  We want to repeat our arguments again.   1. Soft combing is only useful to noise but not to interference. Typically, the UE to report CGI will suffer a strong interference from serving cell. If the interference is the same in every combined sample, we don’t see any help by soft-combing. If we define a very low SINR side condition, we’re pessimistic to say lots of UE whose SINR is between -3dB and -6dB will fail to decode the CGI and waste more power in such higher interference scenario. Currently, the simulation assumption is based on white noise. We also suggest to update the simulation assumption to add a strong interference for further evaluation. 2. We agree on that the network want to trigger the CGI reporting based on measurement report which side condition is -6dB. However, -6dB is the worst case, most of UEs can actually report a cell with SNR side condition far higher than -6dB.   On the other hand, UE may also report a cell in the SNR side condition worse than -6dB (still has a non-zero detection rate). In that case, the same mismatch issue happens.  When UE is reporting RSRP, network does not know the exact SINR side condition of the target cell so the mismatch is always there. If we forced UE to use soft-combing to decode the SIB1, this will result in more power consumption.  Thus, we still suggest to use one-shot solution and higher SINR to evaluate the SIB1 decoding performance. |

## Summary on 2nd round

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Mandatory MG patterns

## Companies’ contributions summary

|  |  |  |
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| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2000561](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000561.zip) | NTT DOCOMO INC. | Observation 1: Gap patterns with shorter MGL are valuable in FR2 since the length of SS burst set is within 3ms in most cases.  Observation 2: Gap patterns with longer MGRP are valuable in FR2 considering some scheduling restrictions in FR2.  Proposal 1: Gap patterns from #17 to #19 shall be mandatory support for per-FR gap for FR2 in addition to gap patterns mandated in Rel-15.   |  |  |  | | --- | --- | --- | | Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | | 17 | 3.5 | 40 | | 18 | 3.5 | 80 | | 19 | 3.5 | 160 | |
| [R4-2000638](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000638.zip) | CMCC | Proposal 1: for FR1, at least the gap patterns of 3ms MGL, e.g. gap patterns #2, #3, #10, #11 need to be mandated.  Proposal 2: for FR2, at least the gap patterns of 3.5ms MGL, e.g. gap patterns #16, #17, #18, #19 need to be mandated.  Proposal 3: it is proposed that the additional mandatory gap patterns is applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode. |
| [R4-2000993](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000993.zip) | OPPO | Proposal 1: NR only measurement is a measurement of an NR carrier when at least one NR serving cell is configured.  Proposal 2: Additional mandatory gap patterns should apply for NR SA and NR-DC mode, EN-DC, NE-DC.  Proposal 3: Consider GP2 and GP3 as additional mandatory gap patterns for FR1 in R16.  Proposal 4: Consider GP17 and GP18 as additional mandatory gap patterns for FR2 in R16.  Proposal 5:  The UE shall set the bits corresponding to the measurement gap pattern 13, 14, 17 and 18 to 1 if the UE is an NR standalone capable UE that supports a band in FR2 or if the UE is an (NG)EN-DC capable UE that supports independentGapConfig and supports a band in FR2.  The UE shall set the bits corresponding to the measurement gap pattern 2 and 3 to 1 if the UE is an NR standalone, EN-DC or NE-DC capable UE. |
| [R4-2001274](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001274.zip) | ZTE | Proposal 1. NR measurements only means UE cannot be configured with gap patterns with MGL<6ms for E-UTRA measurements, or for both NR and E-UTRA measurement together.  Proposal 2. New UE capability is used to indicate if a gap pattern among gap patterns #2 ~ #11 can only be configured for NR measurement only.  Proposal 3. No new LTE RRC signalling is to be introduced, i.e. no additional mandatory gap patterns and new UE capability for LTE.  Proposal 4. New UE capability is not applicable for EN-DC.  Proposal 5. Additional mandatory of gap patterns in FR2 is applicable for EN-DC.  Proposal 6. Additional mandatory gap patterns and new UE capability in Rel-16 are applicable for NE-DC mode  Observation 1. There are throughput loss and increased UE power consumption when longer MGL than necessary has to be used if the suitable gap pattern is not supported by UE.  Observation 2. 3ms MGL and 4ms MGL are necessary in FR1 for sync and async network.  Observation 3. No UE complexity issue is identified to support short MGL.  Observation 4. 40/80ms MGRP should be necessarily supported. 160ms MGRP is also preferable to be supported.  Proposal 7. In FR1 gap patterns with 40/80ms MGRP and 3ms/4ms MGL, i.e. GP#2, GP#3, GP#7 and GP#8 should be additionally supported.  Proposal 8. In FR1 gap patterns with 160ms MGRP and 3ms/4ms/6ms MGL, i.e. GP#5, GP#9 and GP#11 are preferably to be supported.  Proposal 9. In FR2 gap patterns with 40/80ms MGRP and 3.5ms MGL, i.e. GP#17 and GP#18 should be additionally supported. Gap pattern with 20ms MGRP and 3.5ms/5.5ms MGL, i.e. GP#12 and GP#16, should also be additionally supported.  Proposal 10. In FR2 gap patterns with 160ms MGRP and 3.5ms/5.5ms MGL, i.e. GP#15 and GP#19 should be additionally supported. |
| [R4-2001345](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001345.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: Discuss and agree on the applicability table for the new mandatory GP.    Proposal 2: New mandatory GP is among GP#2 – GP#11 gap patterns.  Proposal 3: New GP is among GP#6 – GP#9 gap pattern.  Proposal 4: From Rel-16 GP#6 – GP#9 are defined as mandatory GPs. |
| [R4-2001400](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001400.zip) | Ericsson | Proposal 1: Supporting release 16 gaps according to the “new” release 16 capability (NR-only) means that the gap pattern is not required to be used for measurements of LTE cells.  Proposal 2: 6ms legacy gap with the same MGRP and same / near same offset is allowed in LTE serving cells when making measurements according to the new release 16 (NR only) gap pattern  Observation 1: If the centre of LTE and NR gaps is used as a reference for timing, further extension due to asynchronous timing between LTE and NR can be avoided. |
| [R4-2001401](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001401.zip) | Ericsson | Proposal 1: At least GP17 and GP18 are considered in the discussion mandatory for release 16 UEs  Assumption 1: Signaling extensions are separately discussed for rel 16 such that UEs may indicate that they only support NR measurements with GP 2, 3, 4, 6, 7, 8,10.  Proposal 2: If the short measurement gap issue is addressed, at least GP2 and GP3 are considered as additional mandatory gap patterns for R16.  Observation 1: UE computational complexity is not significantly increased by supporting additional(shorter) MGL  Observation 2: An additional UE burden comes from implementing and especially testing of the additional mandatory gap patterns  Observation 3: Network computational complexity is not significantly increased by supporting additional MG patterns  Observation 4: An additional network burden comes from implementing and especially testing of the additional non-mandatory gap patterns |
| [R4-2001665](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001665.zip) | Huawei, HiSilicon | Observation: 3ms MGL for FR1 and 3.5ms MGL for FR2 has wide applicable scenarios in the realistic network.  Proposal 1: Gap pattern #2, 3, 11 can be mandatory for FR1/per UE gap and gap pattern #17, 18, 19 can be mandatory for FR2 in R16.  Proposal2: R15 gap pattern applicability rule for both 36.133 and 38.133 can be reused for R16.  Proposal 3: The new mandatory gap patterns are not mandatory for the case with no NR measurement object.  Proposal 4: The new mandatory gap patterns are mandatory for measurements with NR measurement object in EN-DC/NE-DC/SA NR. |
| [R4-2001799](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001799.zip) | MediaTek inc. | Observation 1: There should be no problem in introducing new UE capabilities for NR only measurement in Rel-16, without changing the Rel-15 capability description and gap pattern applicability rule.  Proposal 1: RAN4 to confirm the definition of NR-only measurement is -- the target measurement objects to be measured within the measurement gap are all NR carriers.  Proposal 1: RAN4 to confirm the scenario of NR-only measurement are all listed in the following table.    Proposal 3: RAN4 to inform RAN2 the necessity of introducing a new UE capability for NR-only measurement in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.  Proposal 4: GP#15, GP#16, GP#17, GP#18, and GP#19 are added as mandatory MGs of NR-only measurement for  • Rel-16 UE who supports per-UE gap or per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.  Proposal 5: GP#2, GP#3, GP#5-11 are added as mandatory MGs of NR-only measurement for  • Rel-16 UE who supports per-UE gap in NR SA and NR-DC mode,  • Rel-16 UE who supports per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode. |
| [R4-2002063](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002063.zip) | Qualcomm Incorporated | Proposal 1: Any gap patterns that are made mandatory in Rel-16, which were not mandatory in Rel-15, will only be mandatory for NR measurements  Proposal 2: In EN-DC, NE-DC and LTE SA, for UE’s that do not support shortmeasurementgap on LTE only GP0 and GP1 should remain mandatory.  Proposal 3: Any new gap patterns to be made mandatory should be mandatory with capability signaling. |
| [R4-2001269](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001269.zip) | ZTE | LS on mandatory of measurement gap patterns |
| [R4-2001402](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001402.zip) | Ericsson | LS on mandatory gap patterns for release 16 |
| [R4-2001666](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001666.zip) | Huawei, HiSilicon | LS on mandatory gap patterns in R16 |
| [R4-2001800](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001800.zip) | MediaTek inc. | LS on new capability for NR measurement and mandatory MG patterns in Rel-16 |

## Open issues summary

### UE capability and applicability of additional mandatory measurement gaps

Background: In the last meeting it was agreed

* Decisions on mandatory measurement gap patterns and applicability will be made in the RAN4#94 meeting.
* LS on RAN4 agreements on UE capability and mandatory measurement gap patterns will be send to RAN2 in the RAN4#94 meeting.

Issue 3-1-1: Definition of NR only measurement

* Proposals
  + Option 1 (ZTE)
    - NR measurements only means UE cannot be configured with gap patterns with MGL<6ms for E-UTRA measurements, or for both NR and E-UTRA measurement together.
  + Option 2 (Ericsson)
    - Supporting release 16 gaps according to the “new” release 16 capability (NR-only) means that the gap pattern is not required to be used for measurements of LTE cells.
  + Option 3 (MediaTek, Intel)
    - The definition of NR-only measurement is the target measurement objects to be measured within the measurement gap are all NR carriers.
  + Option 4 (Qualcomm)
    - NR measurements only should mean target cell is NR and that the gap is only needed on NR serving cells
* Recommended WF:
  + When an UE indicates that a gap pattern is for NR only measurement, it means the gap pattern cannot be configured for E-UTRA measurements.

Issue 3-1-2: New UE capability signalling for NR only measurements

* Proposals
  + Option 1 (ZTE)
    - New UE capability is used to indicate if a gap pattern among gap patterns #2 ~ #11 can only be configured for NR measurement only.
    - No new LTE RRC signalling is to be introduced, i.e. no additional mandatory gap patterns and new UE capability for LTE.
    - New UE capability is not applicable for EN-DC.
  + Option 2 (Ericsson)
    - Signaling extensions are separately discussed for rel 16 such that UEs may indicate that they only support NR measurements with GP 2, 3, 4, 6, 7, 8,10.
  + Option 3 (MediaTek)
    - RAN4 to inform RAN2 the necessity of introducing a new UE capability for NR-only measurement in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
    - The scenario of NR-only measurement

|  |  |  |  |
| --- | --- | --- | --- |
| scenario | Applicable gap | Configured MOs | |
| by PCell | by PSCell |
| LTE SA | * Per-UE gap * FR1 gap of per-FR gap | * LTE intra-freq * NR inter-RAT | N.A |
| EN-DC | * LTE intra-freq * NR inter-RAT | * NR intra-freq with or without gap * NR inter-freq |
| NR SA | * NR intra-freq with or without gap * NR inter-freq | N.A |
| NE-DC | * NR intra-freq with or without gap * NR inter-freq | * LTE intra-freq |
| NR-DC | * NR intra-freq with or without gap * NR inter-freq | * NR intra-freq with or without gap * NR inter-freq |

* + Option 4 (OPPO)
    - The UE shall set the bits corresponding to the measurement gap pattern 13, 14, 17 and 18 to 1 if the UE is an NR standalone capable UE that supports a band in FR2 or if the UE is an (NG)EN-DC capable UE that supports independentGapConfig and supports a band in FR2.
    - The UE shall set the bits corresponding to the measurement gap pattern 2 and 3 to 1 if the UE is an NR standalone, EN-DC or NE-DC capable UE.
  + Option 5 (Qualcomm)
    - New capability only for NR target cells and applicability only in case where no LTE serving cells need those gaps.
* Recommended WF:
  + New UE capability is to indicate if a gap pattern among gap patterns #2 ~ #11 with MGL < 6ms can be configured for NR only measurement.

Issue 3-1-3: Applicability of additional mandatory gap patterns and new UE capability signalling

* Proposals
  + Option 1 (ZTE)
    - Additional mandatory of gap patterns in FR2 is applicable for EN-DC.
    - Additional mandatory gap patterns and new UE capability in Rel-16 are applicable for NE-DC mode
  + Option 2 (Ericsson)
    - For EN-DC and NE-DC, 6ms legacy gap with the same MGRP and same / near same offset is allowed in LTE serving cells when making measurements according to the new release 16 (NR only) gap pattern
  + Option 3 (Qualcomm, Apple, Intel)
    - Any gap patterns that are made mandatory in Rel-16, which were not mandatory in Rel-15, will only be mandatory for NR measurements
    - In EN-DC, NE-DC and LTE SA, for UE’s that do not support shortmeasurementgap on LTE only GP0 and GP1 should remain mandatory.
  + Option 4 (CMCC)
    - Additional mandatory gap patterns is applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode
  + Option 5 (Huawei)
    - R15 gap pattern applicability rule for both 36.133 and 38.133 can be reused for R16.
    - The new mandatory gap patterns are not mandatory for the case with no NR measurement object.
    - The new mandatory gap patterns are mandatory for measurements with NR measurement object in EN-DC/NE-DC/SA NR
  + Option 6 (OPPO)
    - Additional mandatory gap patterns should apply for NR SA and NR-DC mode, EN-DC, NE-DC.
  + Option 7 (MediaTek)
    - GP#2, GP#3, GP#5-11 are mandatory MGs of NR-only measurement for
      * Rel-16 UE who supports per-UE gap in NR SA and NR-DC mode,
      * Rel-16 UE who supports per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
    - GP#15, GP#16, GP#17, GP#18, and GP#19 for
      * Rel-16 UE who supports per-UE gap or per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
  + Option 8 (Nokia)
    - Applicability table for the new mandatory GP.

|  |  |  |  |
| --- | --- | --- | --- |
| **Measurement gap pattern configuration** | **Configuration** | **Measurement Purpose** | **Applicability of Gap Pattern Id x** |
| Per UE Gap | EN-DC | any gap assisted measurements | No |
|  | NE-DC | any gap assisted measurements | No |
|  | NR-DC | NR FR1 and FR2 gap assisted measurements | YesNote 1 |
|  | NR SA | NR FR1 and FR2 gap assisted measurements | YesNote 1 |
|  | LTE SA | Any gap assisted measurements | No |
| Per FR Gap Note 3 | EN-DC | FR2 gap assisted measurement | YesNote 2 |
|  | EN-DC | FR2 gap assisted measurements | NoNote 4 |
|  | NE-DC | NR FR2 gap assisted measurements | yes |
|  | NE-DC | FR1 gap assisted measurements | No |
|  | NR-DC | NR FR1 and FR2 gap assisted measurements | YesNote 5 |
|  | NR SA | NR FR1 and FR2 gap assisted measurements | YesNote 5 |
|  | LTE SA | Any gap assisted measurements | No |
| Note 1: provided no LTE gap assisted measurements are configured  Note 2: provided FR2 gap pattern is configured by gNB  Note 3: FR1 and FR2 gap patterns can be configured by either eNB or gNB  Note 4: If gap pattern for FR1 and FR2 are configured by eNB  Note 5: provided no LTE gap assisted measurements are configured in FR1 | | | |

* Recommended WF:
  + Additional mandatory gap patterns and new UE capability in Rel-16 are applicable to NR SA and NR-DC mode
    - Agreements in the last meeting
  + Additional mandatory gap patterns and new UE capability in Rel-16 are applicable to EN-DC, NE-DC and LTE SA mode
    - Conditions are FFS

Issue 3-1-4: Mandatory with capability signalling

* Option 1 (Qualcomm)
  + Any new gap patterns to be made mandatory should be mandatory with capability signaling.
* Recommended WF:
  + FFS

### Mandatory MG patterns for Rel-16

Issue 3-2-1: Mandatory gap patterns for FR1

* Proposals
  + Option 1 (MediaTek)
    - GP#2, GP#3, GP#5-11 are mandatory MGs of NR-only measurement for
      * Rel-16 UE who supports per-UE gap in NR SA and NR-DC mode,
      * Rel-16 UE who supports per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
  + Option 2 (ZTE)
    - GP#2, GP#3, GP#7 and GP#8
    - GP#5, GP#9 and GP#11 are preferably to be supported.
  + Option 3 (CMCC)
    - At least GP#2, GP #3, GP#10 and GP#11
  + Option 4 (Ericsson)
    - At least GP#2 and GP#3
  + Option 5 (Huawei)
    - GP#2, GP#3, GP#11
  + Option 6 (OPPO)
    - GP#2 and GP#3
  + Option 7 (Nokia)
    - GP#6, GP#7, GP#8 and GP#9
* Recommended WF:
  + GP#2 and GP#3 are mandatory in FR1 for Rel-16 UE.
  + GP#7, GP#8, GP#9 and GP#11 are further decided.

Issue 3-2-2: Mandatory gap patterns for FR2

* Proposals
  + Option 1 (MediaTek)
    - GP#15, GP#16, GP#17, GP#18, and GP#19 for
      * Rel-16 UE who supports per-UE gap or per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
  + Option 2 (ZTE)
    - GP#12, GP#15, GP#16, GP#17, GP#18 and GP#19.
  + Option 3 (CMCC)
    - At least gap patterns #16, #17, #18, #19
  + Option 4 (Ericsson)
    - At least GP#17 and GP#18
  + Option 5 (Huawei)
    - GP#17, GP #18 and GP#19
  + Option 6 (NTT DOCOMO)
    - GP#17, GP#18 and GP#19
  + Option 7 (OPPO)
    - GP#17 and GP#18
* Recommended WF:
  + GP#16, #17, #18, #19 are mandatory in FR2 for Rel-16 UE.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 3-1-3: support Option 3 from Qualcomm. The new mandatory MG pattern may cause different data interruption to LTE RAT compared with legacy LTE mandatory MG, so to consider the all UE implementation, we prefer to apply the new mandatory MG for NR-DC and NR-SA only with NR only MOs.  Issue 3-2-1: propose to have pattern #2 and #3 as a starting point and FFS for other more pattern.  Issue 3-2-2: propose to have pattern #17 and #18 as a starting point and FFS for other more pattern |
| QC | Issue 3-1-1  NR only measurements in an NR SA or NR DC context would mean that the target cell is only NR. In EN-DC or LTE SA context, just the target cell being NR is not sufficient. For example, in LTE SA, the gap capability is only from LTE, so even if the target cell is NR, the UE would need to open up the configured gap on LTE too. Similarly in EN-DC. Thus, NR measurements only should mean target cell is NR and that the gap is only needed on NR serving cells.  Issue 3-1-2  New capability only for NR target cells and applicability only in case where no LTE serving cells need those gaps.  Issue 3-2-1 and 3-2-2  Can only be discussed once Section 3-1 issues are agreed upon. |
| MediaTek | Issue 3-1-1: Definition of NR only measurement  Support option 3  <Comment on option 1&2>  RAN4 has not studied the feasibility for UE to measure 2G or 3G measurement objects within the gap with MGL < 6ms. It exists ambiguity if we claim that the meaning of NR-only measurement gap is “this gap can't be configured for the E-UTRA measurement."  Issue 3-1-2: New UE capability signalling for NR only measurements  Support option 3  < Comment on option 1&4>  In our understanding, when shorter measurement gap is applied for the NR-only measurement in LTE SA, EN-DC and NE-DC mode, it means that UE can obtain more opportunity for intra-frequency measurement and data reception. It eventually benefits the UE. Besides, introducing a new UE capability does not mean UE is mandated to support all the gap patterns. So we prefer to also apply the capability in LTE SA, EN-DC and NE-DC mode.  < Comment on option 2>  Signaling extensions is also acceptable whereas companies still need to achieve consensus on the gap patterns that can be used for NR-only measurement, to ensure the extension will not introduce extra bits.  Issue 3-1-3: Applicability of additional mandatory gap patterns and new UE capability signalling  Support option 7  < Comment on option 3>  Companies might need to discuss if there exist any method to separate the capability between UE who can and can’t apply NR-only measurement gap in LTE SA, EN-DC and NE-DC mode.  Issue 3-1-4: Mandatory with capability signalling  < Comment on option 1>  If this option is agreed, then we don’t have to agree on 2nd proposal of option 3 in Issue 3-1-3  Issue 3-2-1: Mandatory gap patterns for FR1  Agree on recommended WF  Issue 3-2-2: Mandatory gap patterns for FR2  Agree on recommended WF |
| Intel | Issue 3-1-1: prefer option3. The “new” gap cannot be used for measurement of any other RAT.  Issue 3-1-3: support option 3. The new mandatory GP pattern have impact on LTE data reception and intra-frequency measurement. Thus for UE which do not support shortmeasurementgap only GP0 and GP1 should remain mandatory.  Issue 3-2-1: propose to mandate GP#2 and #3.  Issue 3-2-2: propose to mandate GP#17 and #18 |
| ZTE | Issue 3-1-1, 3-1-2, 3-1-3:  For NR SA and NR DC, the NR only measurement means a gap pattern cannot be used for E-UTRAN measurement. It is straightforward.  For EN-DC, per-UE measurement gap pattern can only be configured by E-UTRA PCell. For per-FR gap pattern, FR1 gap pattern can only be configured by E-UTRA PCell. NR PSCell can only configure FR2 gap pattern. So applicability of UE capability for NR only measurement needs further discussion.  The key question is whether the new UE capability will be introduced in LTE RRC signalling. Since *shortmeasurementgap* was introduced in LTE, it seems there is less motivation to introduce another UE capability to indicate whether a gap pattern can be used for LTE measurement. So in this case no UE capability will be introduced in LTE RRC signaling.  The applicability of gap patterns can be different. It can be assumed that all the mandatory gap patterns are all for NR only measurement. However, if NR only measurement means there is no LTE serving cells either, the obviously additional mandatory gap patterns cannot be used in EN-DC, NE-DC and LTE SA.  Since under the case that there are all NR measurements configured and there is LTE serving cells, the impact to LTE side is the interruption. If an UE support *shortmeasurementgap* then a UE can handle short interruptions either.  So our further proposal is that in EN-DC, NE-DC and LTE SA, *shortmeasurementgap* can be used as UE capability to indicate whether gap patterns #2 and #3 can be used as mandatory gap patterns. If UE supports *shortmeasurementgap* then gap patterns #2 and #3 are mandatory. |
| OPPO | Issue 3-1-1: prefer option 3 ‘within the measurement gap are all NR carriers’. Besides, agree with Qualcomm that the gap is only needed on NR serving cells.  Issue 3-1-2: support option 4. Share similar view as ZTE that no UE capability will be introduced in LTE RRC signaling.  Issue 3-1-3: support option 6 and 3. Specifically, the new mandatory gap patterns are not mandatory for the case with no NR measurement object. And additional mandatory gap patterns should apply for NR SA and NR-DC, EN-DC, and NE-DC mode, except LTE SA mode. For EN-DC or NE-DC, no matter if UE supports *shortmeasurementgap*, gap patterns #2 and #3 could be mandatory for NR measurement only.  Issue 3-2-1: agree with recommended WF.  Issue 3-2-2: support option 5 to mandate GP#17 and #18 for FR2. |
| Ericsson | Issue 3-1-1 : Support the recommended WF, although if there is also an issue with NR-only measurement for making short gap <6ms in LTE serving cells, we would want to investigate a solution with 6ms gap on LTE and shorter gap on NR to ensure that NR only gaps can be used with EN-DC and NE-DC. We also think it is fairly clear already that “NR only” measurement excludes a 3G measurement or a GSM measurement object so option 3 seems the most accurate wording when it comes to capturing in specifications, however there has never been any proponent of GSM or WCDMA measurement in <6ms gaps with NR configured (although both were possible in smaller gaps in release 99 days and 25.133 has requirements 😊), so we think that getting the wording exactly correct is more appropriate to the specification phase, and for now we should focus on the discussion on the applicability or otherwise of “NR only measurement” when there is an LTE serving cell).  Issue 3-1-2 : The recommended WF is fine for us, but it depends on understanding of “NR-only” measurement. We do not agree if the “NR-only” excludes any use of these gap capabilities in EN-DC or NE-DC  Issue 3-1-3 : For the conditions (currently shown as FFS in the proposed WF) for EN-DC and NE-DC additional gap pattern applicability would be based on existing gap capability table then remove LTE measurement from any case where it is currently included.  Issue 3-1-4 : Agree with Qualcomm’s proposal. In general, it is highly undesirable to make any rel-16 feature mandatory without capability bits.  Issue 3-2-1, 3-2-2 : In general, we see more use for MGRP=40ms and MGRP=80ms gap patterns. We are OK with the proposed WF, since it is a superset of the GP that we think would be beneficial to mandate. |
| CMCC | Issue 3-1-1: NR only measurement is used to describe the target of measurement, it means that UE is only configured to perform NR measurement in the MG, no matter the serving cell is LTE and/or NR. If option 3 also think the definition of NR only measurement is irrelevant to the serving cell, we are OK with option 3.  Issue 3-1-3: As we mentioned in Issue 3-1-1, we think the new additional MG is used to perform NR measurement no matter the serving cell is LTE and/or NR. In this case, it is preferred that the additional mandatory gap patterns are applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode. However, considering companies’ concern, we think MTK’s suggestion (option 7) to differentiate per UE gap and per FR gap is a good way to move forward.  Issue 3-2-1: in general, we are fine with the recommended WF, but we think GP#10 (3ms MGL + 20ms MGRP) also need to be further decided. Compared with 6ms MGL + 40ms MGRP, GP #10 has the same impact on throughput, but can perform the measurement more quickly, we prefer to consider GP #10 in the discussion of mandatory MG.  Issue 3-2-2: we are OK with the recommended WF |
| Huawei, HiSilicon | Issue 3-1-1: Our view is from implementation point of view, if one gap pattern can be mandatory used for NR MO measurement, it can also be applied for LTE MO measurement. Thus in EN-DC/NE-DC/SA NR, when any NR frequency layer are included in MOs, new mandatory gap patterns can be applied for UE measure. However as a compromise, we can agree with option 3.  Issue 3-1-2, 3-1-3 and 3-1-4: depending on the conclusion of issue 3-1-1.  Issue 3-2-1: agree with the recommended WF.  Issue 3-2-2: based on the proposals, at least GP#17, 18 shall be agreed in this meeting. |
| Nokia | Issue 3-1-1: Our view is that UE indicates support for new mandatory GPs. It would then depend on UE type (Per-UE gap UE or Per-FR gap UE) whether the network can configure the UE with the GP, which would depend on which measurements the network would need to configure. And whether the new mandatory GP can be applied (I.e. configured) for the current measurements will be according to the agreed applicability rules. Our understanding is that new mandatory GPs shall not impact legacy implementation (UE and network) and it also became rather clear during the meeting discussions in Reno that any new mandatory GPs for R16 shall be defined such that they can be used such that do not impact legacy LTE implementation. I.e. it is not enough just to state that the new mandatory GPs cannot be configured for LTE measurements. E.g. New GP cannot be applied for a UE supporting common gaps in EN-DC and NE-DC modes as discussed in our paper. In this case even if the GP is for NR measurement in FR1 it will impact LTE as this is common GP. Recommended WF is not precise and this would need more discussions.  Issue 3-1-2: We cannot agree to this WF. RAN4 should first agree which GP is new mandatory GPs from R16. Secondly RAN4 would need to agree on the applicability. Once this is ready RAN4 can inform RAN2 about the decisions, and RAN2 can design the capability signalling. RAN4 does not need to discuss how the signalling is done (new signalling or something else) as this is RAN2 to decide anyway.  Issue 3-1-3: As analysed in our paper the new mandatory GP can be applied in NR SA with conditions, depending on whether the UE is a per-UE gap UE or Per-FR gap UE and measurement configuration. The same applies for NR-DC. I.e. the initial part of the recommended WF (Additional mandatory gap patterns and new UE capability in Rel-16 are applicable to NR SA and NR-DC mode) is valid but further discussion on additional conditions when the new mandatory GP can be used needs further discussion. Regarding EN-DC, NE-DC and LTE SA mode it seems clear to us that new mandatory GP can at least not be used in LTE SA mode. Conditionally, the new mandatory GPs can be applied in EN-DC mode and NE-DC mode. Conditions, according to our analysis, are captured in our paper. The recommended WF is as not much new compared to agreed WF from last meeting and is as such agreeable.  Issue 3-1-4: Actual signaling is up to RAN2. However, it needs to be clear when the new mandatory GPs are applicable. And then the new mandatory GPs would need to mandatory for all R16 devices. This can be discussed further.  Issue 3-2-1: We are fine also supporting GP#2 and GP#3 for FR1. However, RAN4 should consider the UE switching time the actual measurement time left for the UE during the gap. It is not clear what ‘are further decided’ means in the recommended WF?  Issue 3-2-2: We added the Nokia option as well. Additionally, we are fine also to define the proposed GPs in the recommended WF. However, RAN4 should likely consider the number of new mandatory GPs. |
| NTT DOCOMO, INC. | Issue 3-1-1: Support option 3 from MediaTek. Option 1 and 2 have ambiguity for E-UTRA measurement whether UE performs E-UTRA measurement or not if the target measurement object to be measured within the measurement gap contains E-UTRA carriers.  Issue 3-1-2: Current recommended WF is enough. According to issue 3-1-1, if the target measurement object consists only NR carriers, the discussion about applicable scenario is not needed.  Issue 3-1-3: Additional mandatory gap patterns and new UE capability in Rel-16 should be applicable to EN-DC/NE-DC in accordance with our opinion for issue 3-1-1.  Issue 3-2-2: Current recommended WF is preferable for us. As described in our discusion paper, GP#19 is useful to efficiently perform RLM, intra-frequency measurement and inter-frequency/inter-RAT measurement. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #3-1**  **UE capability and applicability of additional mandatory measurement gaps** | *It is very import to note the agreements in the last meeting:*   * Confirmed R15 gap pattern applicability rule is not changed due to introduction of additional mandatory gap patterns in R16   Issue 3-1-1: Definition of NR only measurement  *Candidate options:*   * Option 1 (ZTE, Ericsson)   + When an UE indicates that a gap pattern is for NR only measurement, it means the gap pattern cannot be configured for E-UTRA measurements. * Option 3 (MediaTek, Intel, OPPO, CMCC, Huawei, NTT DOCOMO)   + The definition of NR-only measurement is the target measurement objects to be measured within the measurement gap are all NR carriers. * Option 4 (Qualcomm, OPPO)   + NR only measurements should mean target cell is NR and that the gap is only needed on NR serving cells   *Recommendations for 2nd round:*   * Discuss and decide if the condition in option 4‘that the gap is only needed on NR serving cells’ is necessary for definition of NR only measurements. This is relevant of applicability of gap patterns either. * Discuss how to provide accurate technical information of NR only measurement to RAN2 for UE capability signaling design.   *In order to facilitate discussion, Issue 3-1-2 and 3-1-3 are re-organized as follows for the purpose to work on what is necessary for LS to RAN2.*  Issue 3-1-2a: Scope of UE capability signalling for NR only measurement  *Candidate options:*   * Option 1 (ZTE, OPPO)   + UE capability signalling for NR only measurement is to be introduced to NR RRC signaling only * Option 2   + UE capability signalling for NR only measurement is to be introduced to both NR RRC signaling and LTE RRC signaling   *Recommendations for 2nd round:*   * Discussion (clarification) and decision on this issue will help discuss the applicability of additional mandatory gap patterns. * Applicability of additional mandatory gap patterns in EN-DC, NE-DC and LTE SA does not have to require the UE capability to be introduced to LTE RRC signaling. Refer to option 3 in Issue 3-1-3 below.   Issue 3-1-2: UE capability signalling for NR only measurements  *Candidate options:*   * Option 1   + UE capability of indicating if a gap pattern among gap patterns #2 ~ #11 can be configured for NR only measurement is necessary.     - The UE capability is applied to NR SA and NR-DC mode * Option 2   + UE capability of indicating if a gap pattern among gap patterns #2 ~ #11 can be configured for NR only measurement is necessary.     - The UE capability is applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode   *Recommendations for 2nd round:*   * Depending on the outcome of Issue 3-1-2a   + If option 1 in Issue 3-1-2a is agreeable, then option 1   + If option 2 in Issue 3-1-2a is agreeable, then option 2   Issue 3-1-3: Applicability of additional mandatory gap patterns  *Candidate options:*   * Option 1   + Additional mandatory gap patterns are applied to NR SA and NR-DC mode * Option 2   + Additional mandatory gap patterns are applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode. * Option 3   + Additional mandatory gap patterns are applied to NR SA and NR-DC mode   + In EN-DC, NE-DC and LTE SA mode     - No additional mandatory gap patterns for UE not supporting *shortmeasurementgap*     - GP#2 and GP#3 are additional mandatory for UE supporting *shortmeasurementgap*   *Recommendations for 2nd round:*   * This is related to Issue 3-1-1 and Issue 3-1-2a. Can be discussed as a package * Focus on discussion related to LS to RAN2. The detailed applicability of additional mandatory gap patterns, e.g. for UE supporting per-UE gap or per-FR gap, for intra-frequency or inter-frequency measurement etc., can be further discussed in RAN4 if companies think it is necessary.   Issue 3-1-4: Mandatory with capability signalling   * Option 1 (Qualcomm, Ericsson, ZTE)   + Any new gap patterns to be made mandatory should be mandatory with capability signaling. * Option 2 (Nokia)   + FFS   *Recommendations for 2nd round:*   * Further discuss and decide. * Note: Comments by Ericsson: In general, it is highly undesirable to make any rel-16 feature mandatory without capability bits. |
| **Sub-topic #3-2**  **Mandatory MG patterns for Rel-16** | Issue 3-2-1: Mandatory gap patterns for FR1  *Candidate options:*   * Option 1   + GP#2 and GP#3 are mandatory in FR1 for Rel-16 UE.   + FFS if GP#7, GP#8, GP#9, GP#10 and GP#11 can be additional mandatory. * Option 2   + FFS depending on outcome of sub-topic 3-1.   *Recommendations for 2nd round:*   * Further discussion. Option 1 seems agreeable   Issue 3-2-2: Mandatory gap patterns for FR2  *Candidate options:*   * Option 1   + GP#16, #17, #18 and #19 are mandatory in FR2 for Rel-16 UE. * Option 2   + GP#17 and #18 are mandatory in FR2 for Rel-16 UE.   + FFS if GP#16 and #19 can be additional mandatory. * Option 3   + FFS depending on outcome of sub-topic 3-1.   *Recommendations for 2nd round:*   * Further discussion. |

*Suggestion on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | LS on mandatory of measurement gap patterns  (revision of R4-2001269) | ZTE |
| #2 | Way forward on R16 NR RRM enhancements – mandatory of gap patterns | ZTE |

## Discussion on 2nd round

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| **Company** | **Comments** |
| ZTE | **Sub-topic #3-1**  Issue 3-1-1: Option 1  According to gap application rule in TS 38.133 in Rel-15,  *Note:* *In E-UTRA-NR dual connectivity mode,* *if GSM or UTRA TDD or UTRA FDD inter-RAT frequency layer is configured to be monitored, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap.*  NOTE 1: In E-UTRA-NR dual connectivity mode, non-NR RAT includes E-UTRA, UTRA and/or GSM. In NR-E-UTRA dual connectivity mode, non-NR RAT means E-UTRA.  For the additional gap patterns, gap patterns #2-#11 other than GP#0 and GP#1, the non-NR measurement is E-UTRA measurement. And most importantly the motivation to have this UE capability is for UE to indicate if the UE can do measurements on E-UTRA carriers with a gap pattern, for example a gap with shorter ML or longer periodicity of 160ms. So it would be more accurate to provide such information to RAN2 for signaling design.  Option 3/4 linked the UE capability to measurement object configurations, which is more like a procedure rather than pure UE capability. UE has no idea what measurement objects will be configured so how can UE indicate this capability to network beforehand. Such definition is more like the applicability definition.  For the conditions in option 4 that all of serving cells should be NR, we think this is related to applicability of a gap pattern that can be used for NR only measurement. It can be further discussed as in Issue 3-1-2a, 3-1-2 and 3-1-3. It would be better to leave it out of definition of NR only measurement.  So our proposal is option 1.  Issue 3-1-2a: Option 1  In TS 36.133 the applicability rule of measurement gap patterns has already be specified. For GP#2 – GP#11, some can be used for inter-RAT NR measurement only and some can be used for both E-UTRA measurement and inter-RAT NR measurement depending on if UE supports shortMeasurementGap-r14. We think current applicability rule in TS36.133 is already enough now, so UE capability or extension of shortMeasurementGap-r14 is not necessary to be introduced in LTE RRC signaling.  Issue 3-1-2:  This is about the UE capability that will be designed in RAN2. Based on analysis of Issue 3-1-1 and Issue 3-1-2a, we proposal to use following wording as option 3.  *UE capability of indicating if a gap pattern among gap patterns #2 ~ #11 can be configured for NR only measurement is necessary.*  *The UE capability is only intended for NR RRC signaling.*  Issue 3-1-3: Option 3  Based on above analysis we think option 3 would be a better solution. On one side it maximize the use cases of additional mandatory gap patterns. On the other side the less change in RRC signaling.  Issue 3-1-4: option 1  Mandatory with capability signaling would be fine.  **Sub-topic #3-2**  Issue 3-2-1: Option 1  Based on our analysis above, option 1 is agreeable.  Issue 3-2-2: Option 1  Option 1 is preferable. Option 2 is also fine at this stage. |
| QC | Issue 3-1-1   * From moderator summary:” Discuss and decide if the condition in option 4‘that the gap is only needed on NR serving cells’ is necessary for definition of NR only measurements. This is relevant of applicability of gap patterns either.”   When defining what NR only measurements mean it is important to consider which tech needs to support those gaps. If it were only NR that needs to support the gaps we would not have any issue. But in EN-DC/NE-DC/LTE SA it would also be LTE that would need to support the given gaps. What we can’t have is an NR mandatory capability that asks the UE to support additional gap patterns in LTE.  One question that we need clarification on is, in LTE SA or EN-DC since we have LTE active, the UE would need to be measuring LTE in addition to NR. Since target LTE measurements can only be done with gp0-1 those are the gaps that would need to given to the UE. So in LTESA and EN-DC what is the use of mandating the shorter gap lengths?  Issue 3-1-2a  It is not clear to me what the consequence of this is. If we only define it in NR RRC or both LTE or NR RRC what is the impact? Is this dependent on the resolution of 3-1-1?  Issue 3-1-3  We would want option 1 but can compromise to option 3 also.  **Sub-topic #3-2**  Any agreements over here can only be made after we have agreements on Issue 3-1-1. Without an agreement on what these gaps are mandatory for there is no way we can agree on which gaps can be made mandatory. |
| ZTE | **Sub-topic #3-1**  Issue 3-1-1: Clarification to QC’s comments.  The purpose of this UE capability for NR only measurements is for UE to indicate if a gap pattern can be used NR only measurements. When UE report this UE capability to network UE has no knowledge of how the gap pattern is to be used, e.g. to be configured for NR measurements w/wo LTE measurements. So how can UE report the UE capability if it depends on how it will be used?  For the case of EN-DC and LTE SA, we proposed following options as option 3 in Issue 3-1-3.   * + In EN-DC, NE-DC and LTE SA mode     - No additional mandatory gap patterns for UE not supporting *shortmeasurementgap*     - GP#2 and GP#3 are additional mandatory for UE supporting *shortmeasurementgap*   So GP#2 and GP#3 can also be mandatory in EN-DC and LTE SA if UE supports shortmeasurementgap. Besides the two gap patterns are proposed to be additional mandatory in FR1 by all the companies. So obviously if UE supports shortmeasurementgap, GP#2 and GP#3 can also be mandatory even if there is LTE serving cells.  Issue 3-1-2a: Clarification to QC’s comments.  In our understanding, the UE capability of NR only measurements functions like shortmeasurementgap in LTE RRC. It’s just covers gap patterns GP#2-GP#11 rather than just GP#2 and GP#3. So in LTE RRC there is capability signalling ‘shortmeasurementgap’ to serve the similar purpose. To cover more additional gap patterns in LTE RRC, e.g. GP#4 – GP#11, a new UE capability or extension of current capability shortmeasurementgap can be considered, of course it is up to RAN2. However there is explicit rule in TS36.133 for how the gap patterns GP#2-GP#11 can be used for EN-DC and NE-DC, so don’t think a new capability or extension of current capability is needed. That’s why we propose to introduce UE capability signaling to NR RRC only.  **Sub-topic #3-2**  If option 3 in Issue 3-1-3 is acceptable to QC, then the additional mandatory gap patterns GP#2 and GP#3 can be mandatory with conditions as in option 3 for LTE SA, EN-DC and NE-DC. |
| Ericsson | **Issue 3-1-1 NR only measurements definition**  If we cannot agree that an NR only measurement depends only on the target cells being measured (no LTE, GSM or WCDMA interfrequency/interRAT measurement objects configured) then we would like companies to consider again the solution for EN-DC/NE-DC of having a 6ms gap for the LTE radio and a shorter gap for the NR radio.  **Issue 3-1-2a**  This is coupled to 3-1-1. In the end it is RAN2 scope to define the signaling, however RAN2 could not do that without agreement on applicability of the new “NR only” measurements in RAN4 which the capabilities refer to support for.  **Issue 3-1-2/3-1-3**  We agree with moderator this is coupled to 3-1-2a, although as indicated we think RAN2 should formally decide on 3-1-2. We have a strong preference to support EN-DC and NE-DC and for those cases apply short gap on the NR serving cells even if the LTE implementation can only support 6ms gap on the LTE serving cells.  **Issue 3-1-4**  Think option 1 (mandatory with capability bit) is the only safe way to proceed with new mandatory gap patterns for release 16 due to IODT consideration.  **Issue 3-2-1, 3-2-2**  The minimum set of additional mandatory gap patterns from our perspective is #2,#3,#17 and #18. We welcome further gap patterns to be additional mandatory gap patterns if they can be implemented without big further burden. |

## Summary on 2nd round

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |