**3GPP T****SG-RAN WG2 Meeting#109e R2-200xxxx**

**Athens, Greece, 24th – 6th March 2020**

**Agenda item: 6.16.4**

**Source: Samsung**

**Title: Offline Discussion 112: Beam Management Enhancements**

**Document for: Discussion and Decision**

# Introduction

[AT109e][112][EMIMO] Beam management enhancements (Samsung)

Initial scope: Continue the discussion on beam management enhancements, based on [R2-2001672](file:///C:\Data\3GPP\Extracts\R2-2001672_Summary%20of%20Beam%20Management%20Enhancements.docx)

Initial intended outcome:

* + - Set of proposals with full consensus (aim to agree to those over email)
    - Set of proposals that need further (online) discussion

Initial intermediate deadline (for companies' feedback): Tuesday 2020-02-25 20:00 CET

Initial intermediate deadline (for rapporteur's summary): Wednesday 2020-02-26 01:30 CET

Revised scope: Continue the discussion on beam management aspects which are still open after the discussion on [R2-2001678](file:///C:\Data\3GPP\RAN2\Inbox\R2-2001678.zip) as well as BFR MAC CE aspects listed in [R2-2000227](file:///C:\Data\3GPP\RAN2\Docs\R2-2000227.zip)

Final intended outcome:

* + - Set of proposals with full consensus (aim to agree to those over email) to be reflected in an updated MAC CR
    - Set of proposals with almost full consensus and easy to agree
    - Set of open issues and proposals to postpone to next meeting
    - Open issues that should no longer be pursued

Final deadline (for companies' feedback): Friday 2020-02-28 12:00 CET

Final deadline (for rapporteur's summary): Monday 2020-03-02 12:00 CET

# Issues

## SCell Beam Failure Recovery

### Information about the failed SCell index

According to email discussion [108#70] as summarised in [R2-2000227](file:///C:\Data\3GPP\RAN2\Docs\R2-2000227.zip), 12 companies prefer to include a bitmap to indicate failed SCell indices. 2 companies prefer to include a include a 5 bit Serving Cell ID field for indicating the failed SCell. So conclusion of the email discussion was to include a bitmap in SCell BFR MAC CE to indicate failed SCell indices.

According to the contribution [1] submitted to this meeting, the bitmap approach is not efficient. It proposes to include Serving Cell ID instead.

**Q 1. Do you agree to include a bitmap in SCell BFR MAC CE to indicate failed SCell indices (as concluded in** [**R2-2000227**](file:///C:\Data\3GPP\RAN2\Docs\R2-2000227.zip)**)?**

Note: Serving Cell ID (s) will be explicitly included if this is not agreed.

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| **Company** | **Preference** | **Detailed Comments** |
| Samsung | Yes | We have initially proposed to include Serving Cell ID. However, for the sake of progress we are ok with this approach as this is preferred by significant majority of companies. |
| CATT | Yes | This is majority’s view, of which no critical issue was found. |
| OPPO | Yes | We prefer bitmap |
| Sharp | Yes |  |
| Qualcomm | - | It seems a popular argument given by proponents of the bitmap design is that bitmap is more efficient in handling simultaneous beam failure on multiple SCells. And if bitmap is used, then this BFR MAC CE should follow the same design as existing SCell related MAC CEs such as SCell activation MAC CE and PHR.  In our understanding, the most common reason for simultaneous failure on SCells is that those SCells share a common beam (in typical mmW deployment, a single beam is configured for all carriers in intra-band CA, and up to two beams in inter-band CA). When that happens, UE does not need to report beam failure on all the affected SCells. This is the same reason why RAN1 introduced simultaneous de/-activation of TCI states for PDCCH and PDSCH. Therefore, we think an alternative design which can result in smaller MAC CE in most cases can be:   * Use the CC list for simultaneous de/-activation of TCI states (1 bit) to indicate which beam has failed; * Use a bitmap to indicate which SCells have new candidate RS available. This avoids sending dummy bytes for SCells without available candidate RS.   If majority of companies still prefer associating bitmap with SCells (as captured in [R2-2000227](file:///C:\\Data\\3GPP\\RAN2\\Docs\\R2-2000227.zip" \o "C:Data3GPPRAN2DocsR2-2000227.zip)), we’d like to suggest the following enhancements to that design as a way-forward:   * Length of the bitmap should be determined based on number of SCells configured with BFD. **The bits in the bitmap should correspond to those SCells assorted according to their ServCellIndex, instead of their ServCellIndex directly as in the current running CR. For example, suppose only SCell 31 is configured with BFR. In the current running CR, the bitmap will be 4 bytes long. But clearly the bitmap does not need to be longer than one byte.** * Maximum length of the bitmap should be 16 instead of 32, as NR R16 supports at most 16 DL carriers in a single cell group. |
| ASUS | Yes |  |
| APT | Yes | We are also fine with the suggestion provided by Qualcomm for the bitmap design. |
| MediaTek | Yes |  |
| vivo | Yes |  |
| LG | No | We think typically only one cell has beam failure, so we prefer Serving Cell ID.  However, we are OK to have bitmap as long as truncated format is not introduced. |
| Apple | Yes |  |
| ZTE | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | As explained previously, bitmap format with 1 octet bitmap leads to equal or less overhead with the explicit serving cell ID solution. When the bigger bitmap is employed, obviously, the likelihood for more than one simultaneously failed SCells increases and this does not lead to any increase in overhead.  About the Qualcomm’s proposal on enhancing the design in R2-2000227:  - Length of bitmap is already determined based on the SCells configured with BFD – not based on the number of configured SCells. “A single octet bitmap is used **when the highest *ServCellIndex* of this MAC entity's SCell configured with beam failure detection** is less than 8”. |
| Ericsson | Yes | We can accept the bitmap format over doing a redesign at this late stage. However, some optimizations should be considered to make the MAC CE more efficient:   * 16-bit bitmap instead of 32 * Indexing only SCells configured with BFD. |
| Futurewei | Yes |  |

**Summary:** There is a significant majority (almost consensus) to follow the bitmap approach as concluded in [R2-2000227](file:///C:\Data\3GPP\RAN2\Docs\R2-2000227.zip). Three companies have suggested to consider optimising the solution in R2-2000227 with respect to the length of bitmap. Note that optimising the length of bitmap as proposed in the comments (above) was also discussed during email discussion [108#70] and was the least preferred option. So it is proposed to agree the following proposals (as concluded in R2-2000227).

**Proposal 1: A bitmap is included in SCell BFR MAC CE to indicate failed SCell indices.**

**Proposal 2: The length of the bitmap is either 1 or 4 octets. A single octet bitmap is used when the highest *ServCellIndex* of the MAC entity's SCell configured with beam failure detection is less than 8, otherwise four octets are used.**

**Proposal 3:One bit field is included in SCell BFR MAC CE to indicate whether candidate beam is available or not. This field is included only for failed SCell.**

**Proposal 4: 6 bit candidate RS ID field is included in SCell BFR MAC CE for failed SCell. The field is set to index of candidate RS in candidate RS list. The field is included only if new candidate beam is available for failed SCell.**

**Proposal 5: Adopt the TP in section 5 of R2-2000227.**

**Proposal 6: Truncated SCell BFR MAC CE format:**

* + **Ci field is included (as in non-truncated format) but octet(s) containing candidate beam availability indication (AC) and Candidate RS ID fields of one or more SCells are truncated in order not to exceed remaining UL resource.**
  + **LCID for Truncated BFR MAC CE is different from non-truncated BFR MAC CE**

### Priority of SCell BFR MAC CE

*Issue: Based on phase 1 discussion it is agreed that SCell BFR MAC CE has higher priority than BSR MAC CE. Open issue whether SCell BFR MAC CE has higher priority than Configured Grant Confirmation MAC CE or not.*

**Q2. Which option do you prefer for prioritisation of SCell BFR MAC CE with respect to Configured Grant Confirmation MAC CE?**

* Option 1: SCell BFR MAC CE has lower priority than Configured Grant Confirmation MAC CE
* Option 2: SCell BFR MAC CE has higher priority than Configured Grant Confirmation MAC CE

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| --- | --- | --- |
| **Company** | **Preference** | **Detailed Comments** |
| Samsung | Option 1 |  |
| CATT | Option 1 |  |
| OPPO | Option 1 | We prefer to make confirmation MAC CE priority higher than the SCell BFR MAC CE, since it’s not sure whether there is any issue when CG is (re-)activated with different TBS. |
| Sharp | Option 2 | Considering Scell BFR MAC CE is for link recovery, we prefer it has higher priority. |
| Qualcomm | Option 1 |  |
| ASUS | Option 1 |  |
| APT | Option 2 |  |
| MediaTek | Option 1 |  |
| vivo | Option 2 |  |
| LG | Option 1 |  |
| Apple | Option 2 | SCell BFR procedure is to recover the link for both control and data channel transmission, the procedure is more important than the configured grant activation procedure, especially when the activated configured grant is on the failed SCell. Hence, the SCell BFR MAC CE should have the higher priority.  In addition, if the SCell BFR MAC CE can be extended for PCell BFR information transmission, it should be more important, otherwise, the RRC Connection will be broken. |
| ZTE | Option 2 | Agree with apple. If we can support the SCell BFR MAC CE applying to PCell, maybe the priority level of this MAC CE is more clear |
| Nokia, Nokia Shanghai Bell | Option 2 | We think we should enable the reporting of SpCell failure with the BFR MAC CE, hence, to include the MAC CE into MsgA/Msg3, the priority should be higher than CG Confirmation MAC CE. |
| Ericsson | Option 2 |  |
| Futurewei | Option 2 |  |

**Summary:** According to 8 companies SCell BFR MAC CE should have higher priority than Configured Grant Confirmation MAC CE. Some companies argue that this is needed when BFR MAC CE is also applied for SpCell. One company indicated that this is at least needed when Configured Grant Confirmation MAC CE is for the activated configured grant on the failed SCell. 7 companies are against this.

Since there is no consensus or significant majority to prioritise SCell BFR MAC CE over Configured Grant Confirmation MAC CE, one way forward would be to have same priority for SCell BFR MAC CE and Configured Grant Confirmation MAC CE. Note that the case where both SCell BFR MAC CE and Configured Grant Confirmation MAC CE are pending at the same time can be rare and can be left to implementation.

**Proposal 7: SCell BFR MAC CE has same priority as Configured Grant Confirmation MAC CE.**

### Cancellation of SR triggered for SCell BFR

Pending SR for SCell beam failure recovery triggered prior to the MAC PDU assembly shall be cancelled and the respective *sr-ProhibitTimer* shall be stopped when the MAC PDU is transmitted and this PDU includes a Scell BFR MAC CE which contains beam failure recovery information of Scell(s) for which BFR was triggered prior to the MAC PDU assembly.

*Issue: The issue is whether all pending SR(s) which were triggered before the MAC PDU assembly are cancelled or only those pending SR(s) which were triggered before the MAC PDU assembly and which were triggered for BFR of Scell(s) whose beam failure recovery information is included in BFR MAC CE are cancelled.*

In [8] it is proposed that pending SR for SCell BFR is not cancelled if only truncated format is sent by the UE. According to [9], the transmission of the beam failure information of a certain Scell only cancels the pending BFR SR triggered by this Scell. In [11] it is proposed that all triggered BFR SR(s) prior to MAC PDU assembly should be cancelled when the MAC PDU including a BFR MAC CE is transmitted.

**Q3. Which option do you prefer for cancelling SR triggered for Scell BFR?**

* **Option 1: All triggered BFR SR(s) prior to MAC PDU assembly should be cancelled when the MAC PDU including a BFR MAC CE is transmitted.**
* **Option 2: The transmission of the beam failure information of a certain SCell only cancels the pending BFR SR triggered by this SCell.**
* **Option 3: Pending SR for SCell BFR is not cancelled if only truncated format is sent by the UE.**

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| **Company** | **Preference** | **Detailed Comments** |
| Ericsson | 2, 1 (in that order) | We have a slight preference for option 2, as later BFRs on some Scells might not be transmitted otherwise. |
| Qualcomm | Depends | If bitmap based format is agreed, we can support Option 1. |
| Samsung | 2 | Example:  BFR for Scell 1 is triggered at time ‘t1’ and BFR for Scell 1 is triggered at time ‘t2. MAC PDU is assembled at time ‘t3’.  T3>t2>t1  At ‘t1’, UE does not trigger SR as UL grant is available (for which MAC PDU is assembled at t3) and based on LCP BFR MAC CE including Scell 1 information can be included in MAC PDU.  At ‘t2’ UE trigger SR as UL grant is available (for which MAC PDU is assembled at t3) but based on LCP BFR MAC CE including Scell 2 information cannot be included in MAC PDU.  In this case, MAC PDU assembled at time ‘t3’, includes BFR MAC CE including Scell 1 information but does not include Scell 2 information. According to option 1, SR triggered for Scell2 BFR is cancelled, In our view it is incorrect to cancel the SR triggered for Scell2 BFR as Scell2 information is not transmitted in BFR MAC CE. |
| CATT | 3 | We would like to add to this.  Looking at comments from some companies, it seems option 3 and 2 have some part in common. For example, there are cases when in truncated format, BFR info of one Scell is included but the other not. In this case I guess the intention of option 2 is that only the pending BFR SR for the former shall be cancled. If this is the correct interpretation of option 2 then we are also willing to accept it. |
| OPPO | 1 | Truncated Scell BFR MAC CE can implicit indicate that whether the UL grant is enough for a UE for BFR reporting. Thus all triggered BFR SR(s) prior to MAC PDU assembly can be cancelled when the MAC PDU including a BFR MAC CE is transmitted. |
| SHARP | Option 2 |  |
| Nokia, Nokia Shanghai Bell | Option 1/3 | Same approach with BSR SR. |
| Lenovo | 2 |  |
| APT | 2 | If only truncated format is transmitted, the UE still needs to transmit the remaining BFRQ information via another UL resource. |
| ZTE | Option 2 |  |
| LG | Option 1 + Option 3 | In the current specification, SR is not cancelled when Truncated BSR is transmitted. We prefer the consistency with SR behaviour, i.e., BFR-SR is cancelled when a normal BFR MAC CE is transmitted, but BFR-SR is not cancelled when a Truncated BFR MAC CE is transmitted. |
| MediaTek | Option 2 | For option 1, we think those triggered BFR SR(s) whose BFR information is not yet included into the MAC PDU (e.g. due to UL grant size limit) should not be cancelled. For option 3, we think a pending SR for Scell BFR can be cancelled as long as the beam failure information of the corresponding Scell is included in the truncated format. |
| Intel | Opt 2 |  |
| InterDigital | Option 2 | This is aligned with cancelling SRs triggered by BSR (i.e. only BSRs reflected in the MAC CE are cancelled). |
| v**ivo** | Option 2 |  |
| Apple | Option 2 |  |
| Futurewei | Option 2 |  |

**Summary:** 4 companies prefer option 1; Option 2 is supported by 12 companies. Option 3 is supported by 2 companies.

**Proposal 8: The transmission of the beam failure information of a certain SCell only cancels the pending BFR SR triggered by this Scell.**

### Handling pending BFR upon SCell deactivation

*Issue: Whether to cancel the ongoing BFR procedure upon deactivation of Scell or not.*

According to [6], a BFR triggered Scell, may be deactivated before a beam failure recovery procedure initiated for the BFR is consider completed. For example, the gNB may deactivate the Scell for the UE if the gNB considers the quality of the Scell is too low for the UE or if the gNB attempts to reduce power usage of the UE. Alternatively, the UE may deactivate the Scell due to expiry of *ScellDeactivationTimer* associated with the Scell. The timer may expire due to no successful PDCCH reception from a BFR-triggered Scell. In [6] it is proposed to cancel the ongoing BFR procedure upon deactivation of Scell.

**Q4. Do you agree that the triggered BFRs for the Scell are cancelled upon Scell deactivation?**

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| --- | --- | --- |
| **Company** | **Preference (Y/N)** | **Detailed Comments** |
| Ericsson | Y | We agree to this. There is no point in sending MAC Ces for deactivated Scells. |
| Qualcomm | Y |  |
| Samsung | Y |  |
| CATT | Yes |  |
| OPPO | Y |  |
| SHARP | Y |  |
| Nokia, Nokia Shanghai Bell | Yes | It is questionable what the UE reports about an Scell that was deactivated. |
| Lenovo | Yes |  |
| APT | Y |  |
| ASUS | Yes |  |
| ZTE | Yes |  |
| LG | No | Since the network knows whether the Scell is deactivated or not, there is no problem if the triggered BFR is not cancelled. In addition, the triggered BFR MAC CE includes the BFR information for other Scells. Therefore, we think the triggered BFR MAC CE should not be cancelled. |
| MediaTek | Y |  |
| Intel | Y |  |
| InterDigital | Yes |  |
| vivo | Yes |  |
| Apple | Yes |  |
| Futurewei | Yes |  |

**Summary:** All the companies (except one) support the proposal.

**Proposal 9: Triggered BFRs for the SCell are cancelled upon Scell deactivation.**

### Handling measurement gaps

After sending a BFRQ SR, the UE expects to receive a UL grant (i.e. monitor PDCCH addressed to C-RNTI/CS-RNTI) for transmitting subsequent BFRQ MAC-CE. According to [12], if PDCCH monitoring occasion is overlapped with measurement gap, the monitoring may be dropped and extra latency is produced to finish the SCell BFR procedure. It is proposed [12] that after UE transmits a BFRQ SR, UE monitors a PDCCH addressed to C-RNTI/CS-RNTI regardless of measurement gaps.

**Q5. Do you agree that the UE is allowed to ignore measurement gaps while monitoring PDCCH addressed to C-RNTI/CS-RNTI for receiving an UL grant for new transmission after transmitting BFRQ SR and BFRQ MAC CE?**

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| --- | --- | --- |
| **Company** | **Preference (Y/N)** | **Detailed Comments** |
| Ericsson | No, the UE shall… | It is not enough to say that the UE *may* ignore measurement gaps to monitor PDCCH. The network will not know if the UE monitors or not, so what should it do, send the grant or not?  We think the UE *shall* monitor PDCCH regardless of measurement gaps. |
| Qualcomm | Yes, but… | We agree with the intention but think the proposal needs to be made more precise. For example, if the measurement gap is per-FR gap, we do not see why UE needs to ignore that measurement gap, because it can still monitor PDCCH on the cells without measurement gap for possible beam reconfiguration MAC CE. |
| Samsung | N | Note that SR transmission for BFR is also not prioritised over measurement gap. If measurement gap can lead to increased latency, all aspects of BFRQ procedure should be considered, not just reception of ack. |
| Nokia, Nokia Shanghai Bell | No | Since the UE is not decoding for RAR, NW knows the measurement gap occasions. |
| Lenovo | N | Same view as Samsung |
| APT | Y | To reduce the latency for the completion of SCell BFR procedure. |
| ASUS | Yes | We see benefits in reducing latency for SCell BFR. Also, this is a similar behaviour as RA procedure for BFR where the UE monitors Msg2 and Msg4 regardless of measurement gaps. |
| ZTE | No for waiting for PDCCH scheduling after the transmission of SR | We think the measurement reporting for RRM (e.g. for handover, PSCell/SCell management) shall not be delayed due to the BFR on SCell. For example, if the UE is allowed to ignore the measurement gap for the reception of UL grant or ACK for BFR, then the measurement report for handover may be delayed. |
| LG | No | The basic principle for measurement gap is that the UE does not monitor PDCCH during measurement gap. In addition, as mentioned above, we think beam failure recovery is not important since other serving cell is still available. Therefore, we think the basic principle should be kept. |
| MediaTek | N | We don’t see the need to introduce special handling. As Nokia mentioned, NW knows measurement gap occasions, so NW can avoid scheduling BFRQ-required UL resource overlapped with measurement gap. |
| Intel | No |  |
| InterDigital | No | Timing of measurement gaps is known by the UE and the gNB in connected |
| vivo | No |  |
| Apple | No |  |
| Futurewei | No |  |

**Summary:** 4 companies support the proposal whereas 11 companies oppose the proposal.

**Proposal 10: UE shall not ignore measurement gaps while monitoring PDCCH addressed to C-RNTI/CS-RNTI for receiving an UL grant for new transmission after transmitting BFRQ SR and BFRQ MAC CE.**

### 2.1.9 Others

In the current MAC CE design, octet containing ‘AC’ field is included for each serving cell with Ci bit set to 1, irrespective of whether candidate beam is available or not. According to [2] consecutive octets containing ‘AC’ field at the end of MAC CE can be omitted to reduce overhead. It is proposed that if candidate beam is not available for a failed SCell with serving cell index i, octet containing AC for this SCell is skipped, if candidate beam is not available for all the failed SCell(s) with serving cell index j > i.

**Q6. Do you agree that the consecutive octets containing ‘AC’ field at the end of MAC CE can be omitted?**

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| **Company** | **Preference (Y/N)** | **Detailed Comments** |
| Ericsson | Y | This is a useful optimization to reduce the size of the MAC CE. |
| Qualcomm | - | It seems an optimization to us. |
| Samsung | Y | If there are consecutive octets containing ‘AC’ field at the end of MAC CE, they can be omitted without any loss of information. |
| CATT |  | Sounds like optimization. Can go with majority’s view. |
| OPPO | N | It seems like optimization. |
| Nokia, Nokia Shanghai Bell | No | It is an optimization that may or may not be useful in some scenarios. |
| Lenovo |  | No strong view. But this is an optimization to us. |
| ZTE | No strong view | This is a optimization to us. And the benefit of this optimization is not stable. It is quite related to the failed serving cells situation, for example, if the failed serving cell with the largest ID is able to select a suitable DL beam , all failed serving cells shall report the beam information field regardless of the value of AC field. |
| LG | No | It seems like optimization. |
| MediaTek | Y | Seems useful in some cases to reduce MAC CE size without additional cost. |
| Intel | No strong view |  |
| InterDigital | - | It’s an optimization, though it can be useful. We don’t have a strong view. |
| vivo | No | This seems to be an optimization. |
| Apple | No |  |
| Futurewei | No strong view | It is not critical, but can be useful in some cases. |

**Summary:** 3 companies agree with proposal whereas 5 companies oppose the proposal. 7 companies have not strong view and seems ok to support the proposal.

**Proposal 11: Consecutive octets containing ‘AC’ field at the end of SCell BFR MAC CE can be omitted.**

## SpCell Beam Failure Recovery

*Issue: Upon beam failure detection on SpCell, MAC entity initiates a Random Access procedure on the SpCell. The issue is whether BFR procedure on SpCell needs to be enhanced to use BFR MAC CE.*

*Issue: If BFR MAC CE can be used for BFR on SpCell, when does the UE trigger transmission of BFR MAC CE for BFR on SpCell.*

*Issue: If BFR MAC CE can be used for BFR on SpCell, what should be the format of this BFR MAC CE.*

During Rel-15 it was discussed to introduce a MAC CE for BFR on SpCell for CBRA to enable network to identify whether the random access initiated by UE was for BFR or not. The conclusion of the discussion was that the network could deduce the cause of the random access based on the UE switching beams. According to [3][5] this method is not perfect as there is no requirement for the UE to use the serving beams for CBRA when the random access is not performed for BFR, and consequently, network may unnecessarily reconfigure the UE. According to [1], even if CFRA based BFR is performed, depending on PRACH configuration for BFR, there can be some latency before UE can use the RACH occasion associated with its new candidate beam.

**Q7. Do you agree to introduce BFR MAC CE for BFR on SpCell in R16?**

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| **Company** | **Preference (Y/N)** | **Detailed Comments** |
| Ericsson | Y | We think there is a strong need to improve the design in Rel-15. Explicit indication in form of a MAC CE would be very beneficial. |
| Qualcomm | Y | We agree with all the arguments listed above and support BFR MAC CE for BFR on SpCell. |
| Samsung | - | 1) There is no common view on detail operation and MAC CE format. In our view, it is not an essential feature as the focus of this WI is Scell BFR. Hence this should be discussed only if time permits.  2) The potential issue with SpCell’s BFR mechanism is that in case of CBRA, network may not be able to identify that RA procedure was initiated for BFR. So if majority view is to support BFR MAC CE for BFR on SpCell, it should be to address this issue. We do not see any issue with CFRA procedure for BFR on SpCell. |
| CATT |  | This is not part of the WI scope. Also there might be ran1 impact. Our preference is not to spend time on this. |
| OPPO |  | Agree with CATT. |
| SHARP | Y but | We think it is necessary to have an MAC CE for BFR on Spcell in R16. But we don’t think it should be the same MAC CE with Scell. It will result complexity.  For example, for a BFR MAC CE with or without Spcell, the same LCP should be applied or not.  And for the RA prioritization, for a BFR MAC CE with or without Spcell, do they share the same RA priority or not?  We prefer to have a separate BFR MAC CE for Spcell to avoid the complexity mentioned above. |
| Nokia, Nokia Shanghai Bell | Yes | The CBRA based BFR specified in Rel-15 is not working well without introducing this. |
| Lenovo |  | Same view as Samsung |
| APT | Y | The bug from R-15 could be fixed in R-16. |
| ASUS |  | The current SpCell BFR procedure seems to work well. We are not sure if this enhancement is needed. |
| ZTE | Y | The BFR MAC CE on SpCell can provide necessary information to complement the drawback of RACH based BFR procedure. |
| LG | No | RAN1 did not introduce BFR MAC CE for SpCell because RAN1 thought that RA procedure is enough to beam failure recovery for SpCell. Our understanding is aligned with RAN1. |
| MediaTek | Y | To reduce unnecessary reconfiguration latency in beam management, we are open for this optimization. |
| Intel | No | Not part of the WI. |
| InterDigital | No | It’s not an essential for the completion of R-16 for this WI, given the focus is Scell BFR. |
| vivo | Y |  |
| Apple | Yes | The CBRA based BFR specified in Rel-15 is not working well. |
| Futurewei | No | We appreciate the intention, but it is too late for this release. |

Summary: 9 companies prefer to introduce BFR MAC CE for BFR on SpCell in R16. 8 companies think that this is not in scope of this WI and/or this enhancement is not needed.There is no consensus or significant majority to introduce this.

Proposal 12: BFR MAC CE for BFR on SpCell is not supported in R16.

**Q8. If BFR MAC CE for BFR on SpCell is supported, which option do you prefer for triggering transmission of the BFR MAC CE?**

* **Option 1: Initiate random access procedure on SpCell and also trigger transmission of the BFR MAC CE.**
* **Option 2: It is up to UE implementation whether to trigger random access procedure or send BFR MAC CE to perform BFR for SpCell.**
* **Option 3: BFRQ MAC CE is generated during CBRA based BFR procedure on SpCell and transmitted in Msg3.**

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| **Company** | **Preference** | **Detailed Comments** |
| Ericsson | 1 |  |
| Qualcomm | 2 and 3 | It seems unnecessary to trigger both RACH and MAC CE for the same purpose. |
| Samsung | Option 3 | The potential issue with SpCell’s BFR mechanism is that in case of CBRA, network may not be able to identify that RA procedure was initiated for BFR. So we prefer option 3 instead of alternate mechanisms (such as option 1/2) for SpCell BFR. |
| SHARP | 1 |  |
| Nokia, Nokia Shanghai Bell | Option 1 | We don’t see a reason to create rules when RA is triggered and when not. Easiest is to always trigger and we could allow to cancel it if BFR MAC CE is transmitted via another serving cell for which ACK is received. |
| Lenovo | 3 |  |
| APT | 1 |  |
| ZTE | 3 | In our understanding , the RACH based BFR procedure can provide the DL beam training which cannot be replaced by MAC CE based BFR procedure . And w.r.t option 1, we can understand the intention, but it should raise more discussion for how to handle two parallel BFR procedures on SpCell. |
| MediaTek | 1 |  |
| v**ivo** | 3 |  |
| Apple | 1 |  |
| Futurewei | 3 | It is not good to have two parallel procedures on-going for BFR. |

Summary: Option 3 is supported by 7 companies. Option 1 is supported by 6 companies. Option 2 is supported by 1 company.

Q9. Which option do you prefer for BFR MAC CE format for SPCell?

* Option 1: Replace one of the R-bits in the proposed SCell BFR MAC CE with a one-bit field indicating BFR on the SpCell.
* Option 2: New MAC CE of fixed size with zero bits.

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| **Company** | **Preference** | **Detailed Comments** |
| Ericsson | 1 |  |
| Qualcomm | 1 | If bitmap based format is agreed, we think Option 1 is a simpler and cleaner solution for the purpose. If explicit cell ID based format is agreed, we think UE can simply include SpCell’s cell index in the MAC CE. |
| Samsung | 2 | SSB ID is already indicated by Msg1. |
| SHARP | 2 | As commented in Q13, a separate BFR MAC CE for Spcell will make spec easy. And msg1 has already provide the necessary information about best candidate beam. |
| Nokia, Nokia Shanghai Bell | Option 1 | This allows to indicate the Scell that have beam failure at the same time. |
| APT | 2 | Beam information for SpCell is different from Scell case |
| ZTE | Option 2 or others | If we want to support the BFR MAC CE for PCell which can be sent by Msg.3, given that the container of Msg.3 only have 52 bits, and only 28 bits are remaining for accommodate the BFR MAC CE for SpCell since the other 24 bits shall be for accommodating the C-RNTI MAC CE. Thus we can accept all possible structures of BFR MAC CE for SpCell whose payload plus its subheader can be less than 28 bits. |
| MediaTek | 1 | Share same view with Nokia. |
| vivo | 1 |  |
| Apple | 1 |  |
| Futurewei | Option 1 |  |

Summary: Option 1 is supported by 7 companies. Option 2 is supported by 4 companies.

# Conclusion

**Proposals for agreement**

**Proposal 1: A bitmap is included in SCell BFR MAC CE to indicate failed SCell indices.**

**Proposal 2: The length of the bitmap is either 1 or 4 octets. A single octet bitmap is used when the highest *ServCellIndex* of the MAC entity's SCell configured with beam failure detection is less than 8, otherwise four octets are used.**

**Proposal 3:One bit field is included in SCell BFR MAC CE to indicate whether candidate beam is available or not. This field is included only for failed SCell.**

**Proposal 4: 6 bit candidate RS ID field is included in SCell BFR MAC CE for failed SCell. The field is set to index of candidate RS in candidate RS list. The field is included only if new candidate beam is available for failed SCell.**

**Proposal 5: Adopt the TP in section 5 of R2-2000227.**

**Proposal 6: Truncated SCell BFR MAC CE format:**

* + **Ci field is included (as in non-truncated format) but octet(s) containing candidate beam availability indication (AC) and Candidate RS ID fields of one or more SCells are truncated in order not to exceed remaining UL resource.**
  + **LCID for Truncated BFR MAC CE is different from non-truncated BFR MAC CE**

**Proposal 8: The transmission of the beam failure information of a certain SCell only cancels the pending BFR SR triggered by this SCell.**

**Proposal 9: Triggered BFRs for the SCell are cancelled upon Scell deactivation.**

**Proposal 10: UE shall not ignore measurement gaps while monitoring PDCCH addressed to C-RNTI/CS-RNTI for receiving an UL grant for new transmission after transmitting BFRQ SR and BFRQ MAC CE.**

**Proposal 11: Consecutive octets containing ‘AC’ field at the end of SCell BFR MAC CE can be omitted.**

**Proposals for discussion/agreement**

**Proposal 6: SCell BFR MAC CE has same priority as Configured Grant Confirmation MAC CE.**

**Proposal 12: BFR MAC CE for BFR on SpCell is not supported in R16.**

# References

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