3GPP TSG-RAN WG2 Meeting #118 Electronic R2-220xxxx

Online, May, 2022

**Agenda item: 6.17.3**

**Source: Apple**

**Title: DRAFT Summary of [AT118-e][075][feMIMO] BFD Resource Handling (Apple)**

**WID/SID: NR\_feMIMO-Core**

**Document for: Discussion and Decision**

# 1 Introduction

This document reflects the content and outcome of the following email discussion:

* [AT118-e][075][feMIMO] BFD Resource Handling (Apple)

Scope: Applies to MAC and RRC. Await info from RAN1. Take into account incoming LSes (or RAN1 decisions) when applicable/available. Address Open issues. Attempt to converge, Identify agreements and discussion points. The discussion should assume that R2 will follow R1 requests.

Intended outcome: Report for CB (maybe multiple revisions, as it may need to be updated multiple times dep on R1 progress).

Deadline: Set by rapporteur, for CB W2 Wednesday

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
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# 3 Discussion

## 3.1 RAN1 LS (R2-2206359 / R1-2205168)

RAN1 provides the answers to the BFD resources handling in their LS as below:

|  |
| --- |
| **Issue 7: Max values FFS in Rel-17 TS 38.331**  Some maximum values are still missing from RRC configuration and RAN2 needs those for ASN.1 freezing.  **Question 8:** Please provide value for maxNrofCandidateBeams-r17 and maxNrofBFDResourcePerSet-r17.  **Answer 8**:   * maxNrofCandidateBeams-r17 is 64 per set per CC according to the latest LS reply * Regarding maxNrofBFDResourcePerSet-r17, RAN1 has agreed to introduce MAC-CE for BFD-RS activation (in addition to RRC configuration):   + If UE supports MAC-CE based BFD RS activation, maxNrofBFDResourcePerSet-r17 is 64     - The intended operation is for MAC-CE to activate 1 or 2 out of the (maximum of) 64 configured BFD-RS resources from the set   + Otherwise, maxNrofBFDResourcePerSet-r17 is 2 |
| **Issue 8: Possibilities for BFD-RS configuration**  The existing RRC signalling for BFD-RS configuration allows the following possibilities:   * Alt.1: Two explicit BFD-RS sets: e.g. failureDetectionSet1-r17 and failureDetectionSet2-r17 with respective bfdRSSetId-r17 * Alt.2: Only one explicit BFD-RS set: e.g. failureDetectionSet1-r17 or failureDetectionSet2-r17 with bfdRSSetId-r17. It requires that the UE determines BFD-RS for the other BFD-RS set, e.g. according to TCI state(s) for PDCCH reception and the corresponding coreset pool index. * Alt.3: BFD-RS without explicit BFD-RS set: e.g. failureDetectionSet1-r17 or failureDetectionSet2-r17 without bfdRSSetId-r17. It requires that the UE determines the BFD-RS set which each BFD-RS belongs to.   RAN2 thinks that at least Alt.1 is possible, but would like to understand whether RAN1 specifications support Alt.2 or Alt.3.  **Question 9:** Please confirm whether Alt.2 and Alt.3 are allowed configurations according to the existing RAN1 specifications, or whether RRC signalling for BFD-RS configuration should exclude Alt.2 and Alt.3.  **Answer 9**: Based on RAN1 agreements and Rel-17 RAN1 specification,   * Alt1 is allowed. * Alt2 is excluded.   The current formulation of Alt3 in the LS is unclear. If the only difference between Alt1 and Alt3 is that Alt1 includes an explicit bfdRSSetId parameter in BeamFailureDetectionSet-r17 IE whereas Alt3 doesn’t, Alt3 is excluded. |

## Clarification on the BFD-RS sets configuration

According to the RAN1 answer 9 on Issue#8, only Alt 1 is allowed, so we can clarify in RRC that the two sets (i.e. failureDetectionSet1-r17 and failureDetectionSet2-r17) are always provided together;

#### **Question 1: Do you agree with the following RRC design for the BFD-RS configuration?**

* The two sets (i.e. failureDetectionSet1-r17 and failureDetectionSet2-r17) are always provided together.

|  |  |  |
| --- | --- | --- |
| Company | Agree or not? | Comments |
| OPPO | Agree |  |
| LGE | Agree |  |
| Intel | Agree |  |
| vivo | Agree |  |
| Ericsson | agree | But we should clarify do we really need the ID even that is RAN1 input. It does not seem to have any function. There is RILI109 about this: “bfdRSSetId-r17 is not used. Remove it.” |
| Docomo | Agree |  |
| ZTE | Agree |  |
| Qualcomm | Agree | And with respective bfdRSSetId-r17. i.e., adopt the alt 1. |
| Samsung | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Xiaomi | Agree |  |
| Fujitsu | See comments | We agree with the RRC design if it is the RAN1 intention although we think that it’s better to allow reconfiguring one BFD-RS set when beam failure is detected only on the set. |
| CATT | Agree |  |
| Apple | Yes |  |

**Summary:**

Based on RAN1 answer 9 in the LS, all companies agree that the two sets (i.e. failureDetectionSet1-r17 and failureDetectionSet2-r17) are always provided together.

**Proposal 1(for agreement): For BFD-RS set configuration, the two sets (i.e. *failureDetectionSet1-r17 and failureDetectionSet2-r17*) are always provided together.**

**The RRC TP for proposal 1:**

|  |
| --- |
| ***failureDetectionSet1, failureDetectionSet2***  Configures parameters for beamfailure detection towards beam failure detection resources configured in the set. If additionalPCIList is configured for the serving cell, each RS in one set can be associted only to one PCI. *failureDetectionSet1* are *failureDetectionSet2*are always configured together. |

For **the explicit configuration of *bfdRSSetId-r17*,** since the two sets are always configured together, the bfdRSSetId can be implicitly indicated by the *failureDetectionSet1 and failureDetectionSet2*. Therefore, it’s unnecessary to explicitly configure the *bfdRSSetId* parameter.

About the spec impact by the removal of *bfdRSSetId* parameter, after further check with RAN1 spec, the *bfdRSSetId-r17* parameter is not used in current RAN1 spec (see below), removal of the *bfdRSSetId-r17* has no impact in RAN1 spec. From RAN2 perspective, we can use the *failureDetectionSet1-r17 and failureDetectionSet2-r17*to indicate the BFD-RS set used in MAC CE instead of the *bfdRSSetId-r17*. Therefore, there is no problem to remove the explicit configuration of *bfdRSSetId-r17.*

|  |
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| RAN1 spec: |

**Proposal 1a (for discussion): For the BFD-RS set configuration, *bfdRSSetId-r17*** **is removed from *BeamFailureDetectionSet-r17*.**

**The RRC TP for proposal 1a:**

BeamFailureDetectionSet-r17 ::= SEQUENCE {

bfdResourcesToAddModList-r17 SEQUENCE (SIZE(1..maxNrofBFDResourcePerSet-r17)) OF RadioLinkMonitoringRS

OPTIONAL, -- Need N

bfdResourcesToReleaseList-r17 SEQUENCE (SIZE(1..maxNrofBFDResourcePerSet-r17)) OF RadioLinkMonitoringRS-Id

OPTIONAL, -- Need N

beamFailureInstanceMaxCount-r17 ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10} OPTIONAL, -- Need R

beamFailureDetectionTimer-r17 ENUMERATED {pbfd1, pbfd2, pbfd3, pbfd4, pbfd5, pbfd6, pbfd8, pbfd10} OPTIONAL, -- Need R

...

--editor's note: maxNrofBFDResourcePerSet-r17 is said in LS 64 but feature discussion might indicate just max 2 per set

}

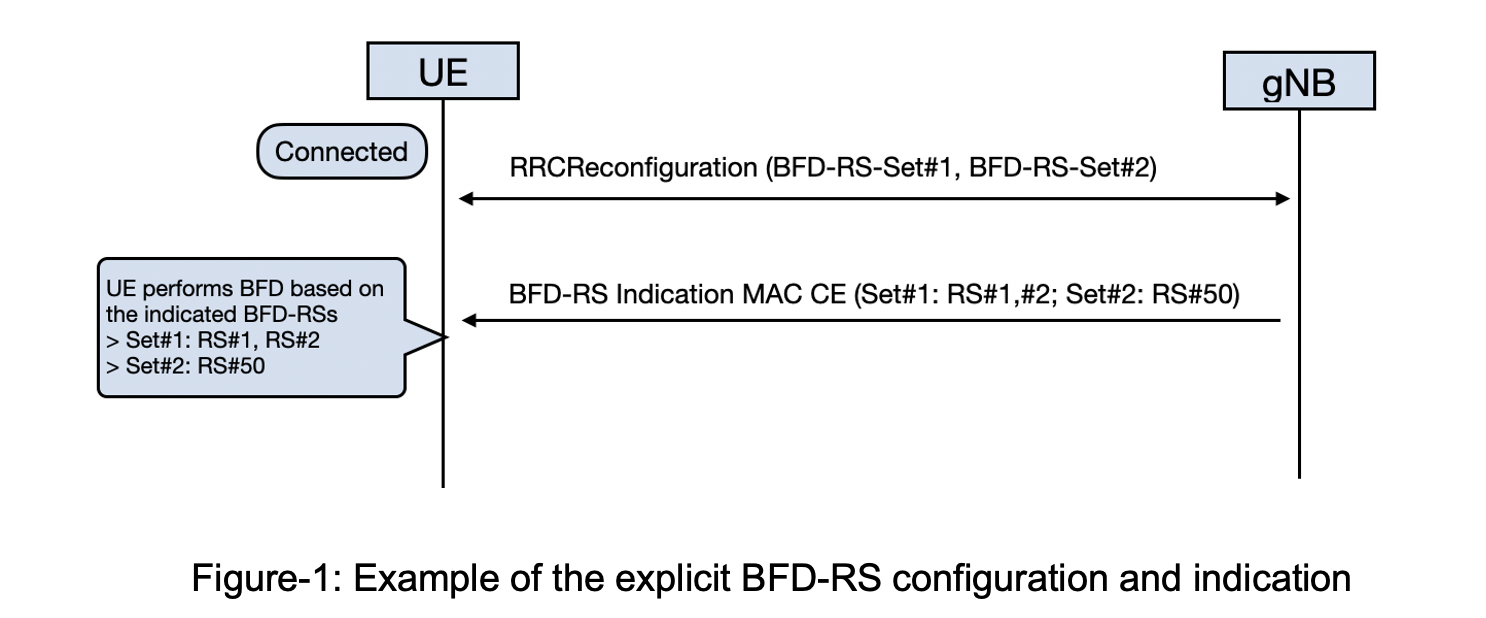
## For the UE who supports the MAC CE based BFD-RS activation

According to the RAN1 answer 8 on Issue#7, UE will indicate the support of the MAC-CE based BFD-RS activation via its UE capability. It’s noted that RAN1 has decided to introduce the new UE capability for it, which is the RAN1 feature **23-5-2c** in the latest RAN1 UE feature list (see below).

|  |
| --- |
| R2-2206472         LS on updated Rel-17 RAN1 UE features list for NR (R1-2205328; contact: NTT DOCOMO, AT&T) |

For the UE who supports the MAC CE based BFD-RS activation, the BFD-RS configuration and activation mechanism can be described as below:

* NW can configure the candidate BFD-RS resources per set via RRC signaling;
  + The max number of the BFD-RS per set (i.e. *maxNrofBFDResourcePerSet-r17*) is 64;
* The new MAC CE is introduced to indicate the actual used BFD-RS resources per set
  + MAC-CE to activate 1 or 2 out of the (maximum of) 64 configured BFD-RS resources from the set.



#### **Question 2: Do you agree with the above BFD-RS configuration and activation mechanism if UE supports it?**

|  |  |  |
| --- | --- | --- |
| Company | Agree or not? | Comments |
| OPPO | Agree |  |
| LGE | Agree | Regarding the time gap between the configuration of BFD-RS sets and the reception of the MAC CE, it should be discussed whether UE considers as no activated BFD-RS as in legacy (i.e., the UE performs beam monitoring based on the activated TCI-State for PDCCH) or UE does not perform beam monitoring. |
| Intel | Agree |  |
| vivo | Agree |  |
| Ericsson | agree | Agree also with LGE comment |
| Docomo | Agree |  |
| ZTE | Agree |  |
| Qualcomm | Agree |  |
| Samsung | Agree |  |
| Huawei, HiSilicon | Agree | About LGE's comment: there is no legacy case where BFD RS are configured but not activated by MAC CE. We could also consider that if there are only one or two RS configured in each set, they are used even without receiving the MAC CE. |
| Xiaomi | Agree |  |
| Fujitsu | Agree |  |
| CATT | Agree |  |
| Apple | Agree |  |

**Summary:**

All companies agree the BFD-RS configuration and activation mechanism, i.e. the BFD-RS set is configured by RRC and activated by MAC CE.

Some companies think UE behavior during the gap between the BFD-RS set configuration and activation should be discussed.

But according to RAN1 spec (see below), the UE behavior is clearly described in this case that the UE starts the BFD measurement based on the activated BFD-RS by MAC CE, which means the UE will considers there is no activated BFD-RS upon receiving the configuration from RRC.

|  |
| --- |
| RAN1 spec: TS 38.213, section 6 |

**Proposal 2 (for agreement): Support the MAC CE based BFD-RS activation mechanism as below:**

* **NW configures the candidate BFD-RS resources per set via RRC signaling;** 
  + **The max number of the BFD-RS per set (i.e. *maxNrofBFDResourcePerSet-r17*) is 64;**
* **The new MAC CE is introduced to indicate the actual used BFD-RS resources per set;**
  + **The MAC-CE is to activate 1 or 2 out of the (maximum of) 64 configured BFD-RS resources from the set.**

#### **Question 3: For RRC configuration, do you agree to set the max number of the candidate BFD-RS per set (i.e. maxNrofBFDResourcePerSet-r17) to 64?**

maxNrofBFDResourcePerSet-r17 INTEGER ::= 64

|  |  |  |
| --- | --- | --- |
| Company | Agree or not? | Comments |
| OPPO | Agree |  |
| LGE | Agree |  |
| Intel | Agree |  |
| vivo | Agree |  |
| Ericsson | Agree | If Ran2 specifies the Mac CE as well |
| Docomo | Agree |  |
| ZTE | Agree |  |
| Qualcomm | Agree |  |
| Samsung | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Xiaomi | Agree |  |
| Fujitsu | Agree |  |
| CATT | Agree |  |
| Apple | Agree |  |

**Summary:**

All companies agree to set the max number of the candidate BFD-RS per set (i.e. maxNrofBFDResourcePerSet-r17) to 64.

**Proposal 3 (for agreement): Set *maxNrofBFDResourcePerSet-r17*** **to 64 in RRC.**

maxNrofBFDResourcePerSet-r17 INTEGER ::= 64

For the MAC CE design, according to RAN1 LS, we can assume the MAC CE design according to the following principles:

1. The MAC CE is designed in the per CC per BWP granularity;
2. The MAC CE always includes the full information of the two sets;
3. The MAC CE includes 1 or 2 BFD-RS resources out of the configured BFD-RS resources from the set;
4. UE deactivates all the previous activated BFD-RS upon receiving the new MAC CE.

#### **Question 4: For MAC CE design, do you agree with above principles for the BFD-RS indication MAC CE design?**

|  |  |  |
| --- | --- | --- |
| Company | Agree or not? | Comments |
| OPPO | Fine with 1) and 3) are fine  Not sure about 2)  No for 4) | So far such MAC CE is designed with A/D bits. there is some argument on whether explicit activation and implicit deactivation can be done for SP SRS resource for antenna switch but RAN2 agreed not to pursue that way  [Apple] Since the BFD-RS configuration and activation framework is almost same as the unified TCI state activation, the simple way is to define them in the same style. |
| LGE | Agree |  |
| Intel | Agree |  |
| Vivo | Agree |  |
| Docomo | Agree |  |
| Zte | See comments | 1. As (Enhanced) BFR MAC CE, we think the MAC CE shall be designed per CG not per CC/per BWP.   [Apple] The BFD-RS configuration is per CC per BWP, the framework is similar as the unified TCI state configuration and activation, so we think the simple way and flexible way is to design the MAC CE per CC per BWP.   1. Not sure, what does ‘full information’ mean here.   [Apple] “full information” means one MAC CE provides all the activated BFD-RS. We can make it clear.   1. Agree 2. we think the beam failure is occurred per BFD RS Set not per CC/BWP, we think in this part, UE deactivates all the previous activated activated BFD RS upon receiving the new MAC CE for the same BFD RS Set of the same CC/BWP.   [Apple] we can follow the same way as the unified TCI state indication activation. Since TCI state indication seems not have such requirement, maybe we can leave it to RAN1 for further clarification whether it's restricted on the same BWP/same BFD RS set. |
| Qualcomm | Agree | We are OK such MAC CE always update the BFD-RS resource for the two BFD-RS sets.  If there is no explicit A/D bit designed in the MAC CE, 4) is fine. Otherwise, UE behaviour should follow the A/D indication like the way of current SP/AP SRS MAC CE.  [Apple] According to RAN1 LS, the MAC CE design is similar as the unified TCI state indication MAC CE design. |
| Samsung | Agree |  |
| Huawei, HiSilicon | Agree | We think it makes little sense to use A/D given that there is either 1 or 2 activated RS per BFD-RS set.  [Apple] Agree that we need some way to indicate whether 1 or 2 RS per set is activated. |
| Xiaomi | Agree |  |
| Fujitsu | Agree except 2) | For 2), we think that the information of one or two sets can be included in the MAC CE.  [Apple] According to RAN1 LS, the simple way is for NW to provide all the activated BFD-RS in one MAC CE. |
| CATT | Agree |  |
| Apple | Agree |  |

**Summary:**

For MAC design principle 1) and 3), almost all companies agree with them. In addition, according to the companies’ feedback on 3), it’s reasonable to indicate whether 1 or 2 BFD-RS per set are activated in the MAC CE.

**Proposal 4a (for agreement): For the BFD-RS indication MAC CE design, agree the following principles:**

1. **The MAC CE is designed in the per CC per BWP granularity;**
2. **The MAC CE includes 1 or 2 BFD-RS resources out of the configured BFD-RS resources from the set;**
3. **The MAC CE should indicate whether 1 or 2 BFD-RS resources are activated per set.**

For MAC design principle 2) and 4), most companies can accept the design. But some companies have comments on and would like to check whether we can support the BFD-RS activation via MAC CE in the delta way, which means UE doesnot need to implicitly deactivate the previous activated BFD-RS upon receiving the MAC CE.

From Rapporteur’s point of view, since the framework of this BFD-RS configuration and activation is same as that for unified TCI state indication configuration and activation, the simple way is to design them in the same style, i.e. MAC CE always provides the full set for the activation.

**Proposal 4b (for discussion): For the BFD-RS indication MAC CE design, agree the following principles:**

1. **The MAC CE always includes all activated BFD-RS of two sets;**
2. **UE deactivates all the previous activated BFD-RS upon receiving the new MAC CE.**

Figure-2 is provided as the format of the BFD-RS indication MAC CE for discussion.

* NOTE: If NW only provides one BFD-RS for a set, the V-bit is set to 0 for the second BFD-RS ID indication for this set.

Graphical user interface

Description automatically generated with medium confidence

Figure-2: The BFD-RS indication MAC CE

#### **Question 5: For MAC CE design, do you agree with format of the BFD-RS indication MAC CE as indicated in Figure-2?**

|  |  |  |
| --- | --- | --- |
| Company | Agree or not? | Comments |
| OPPO | No | The detail format is also related to one issue whether BFD resource of both sets will be always in the same MAC CE. If yes the setID could be saved since the order can be used to implicit indicate the setID. |
| LGE | Agree | In our understanding, V field is always set 1 when both BFD-RS set#0 and #1 is configured, and V field is set 0 when BFD-RS set#0 is configured and BFD-RS set#1 is not configured. |
| Intel | Agree | We think that it doesn’t need to activate both sets simultaneously. |
| vivo | Agree |  |
| ZTE | See comments | We think there is a bit needed for indicating whether the second set for a serving cell/BWP is present in the MAC CE. |
| Qualcomm | Agree but | If RAN2 can agree that MAC CE always update the BFD-RS resource for the two BFD-RS sets. The SetID seems not needed.  V bit could be in the Oct 2 and Oct 4. If V is set 1, Oct3 and Oct5 are present. Otherwise, they are absent. Then Oct3 and Oct5 can be optional which can reduce signalling overhead. |
| Samsung | Agree |  |
| Huawei, HiSilicon | See comments | To save some overhead, the MAC CE could have variable length, 3 (one RS for each BFD-RS set), 4 (one RS for one BFD-RS set, two RSs for the other) or 5 octets (2 RSs for each BFD-RS set).  There are enough bits not needed for RS ID to distinguish the cases (no strong preference on the exact way). |
| Xiaomi | Agree |  |
| Fujitsu | Agree but | We think that the first R bit in Oct 1 can be used to indicate whether the information of one or two sets will be included in the MAC CE so that the MAC CE can support BFD-RS update for only one set. |
| CATT | see comments | We also think the exact format can be checked further, as in some cases the overhead can be reduced. For example, if the 1st byte and 2nd byte are for 1st RS ID for the set 1 and 2 respectively, then the R bit in the 1st and 2nd byte and indicate the presence of the byte for the 2nd RS for the corresponding RS set. That way we might have 2, 3 or 4 byte in total, instead of always 4. |
| Apple |  |  |

**Summary:**

For the detailed MAC CE design, companies’ view is diverse, and the comments can be summarized as follows:

* SetID field can be saved if the two BFD-RS sets are always indicated in the MAC CE;
* It should be possible to only indicate the activated BFD-RS info of one set;
* Overhead of the MAC CE can be further reduced.

Taking companies’ comments into account, to support the all the possibility way, the MAC CE format is updated in the following format for discussion.

**Proposal 5 (for discussion): Take the following BFD-RS indication MAC CE format with the variable length design as baseline.**

A picture containing table

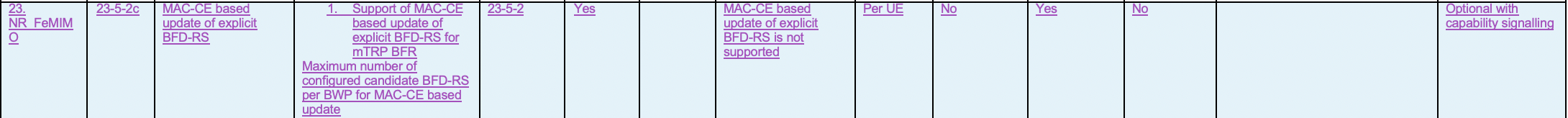
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## 3.3 For the UE who doesnot support the MAC CE based BFD-RS activation

For the UE who doesnot support the MAC CE based BFD-RS activation, NW only configures and activates the BFD-RS resources per set by RRC configuration. NW can configure up to 2 BFD-RS resources per set via RRC configuration based on UE capability.

#### **Question 5: For RRC configuration, which way do you prefer to describe the configuration restriction on the max BFD-RS resources per set for the UE who doesnot support the MAC CE based activation?**

* Option 1: describe the restriction in the UE capability part (in 38.306), related to the RAN1 feature 23-5-2c;



* Option 2: describe the restriction in the field description of the set configuration , for example:

|  |
| --- |
| ***failureDetectionSet1, failureDetectionSet2***  Configures parameters for beamfailure detection towards beam failure detection resources configured in the set. If additionalPCIList is configured for the serving cell, each RS in one set can be associted only to one PCI.  NW doesnot configure more than 2 RS in one set for the UE who can not support the MAC CE based BFD-RS activation. |

|  |  |  |
| --- | --- | --- |
| Company | preference? | Comments |
| OPPO |  | We prefer to define one scheme. If RAN2 agree to introduce MAC CE, RRC only solution can be saved.  [Apple] MAC CE based scheme is optional UE feature. For the UE who doesnot support the MAC CE based scheme, the RRC based solution is required. |
| LGE | Option 2 | Option 2 is preferred as it is more familiar to specify in RRC. |
| Intel | Option 2 | It should be described in RRC field description. |
| vivo | Option 2 |  |
| Ericsson |  | Same view as Oppo. Is there optional capability only for the MAC CE based operation?  [Apple] MAC CE based scheme is optional UE feature (23-5-2c). |
| Docomo | Option 2 | The description is more about configuration rather than capability. |
| ZTE | Option 2 | Option 2 is straight forward. |
| Qualcomm | Option 2 |  |
| Samsung | Option 2 |  |
| Huawei, HiSilicon | Option 2 |  |
| Xiaomi | Option 2 |  |
| Fujitsu | No strong view |  |
| CATT | Option 2 |  |
| Apple | Option 2 |  |

**Summary:**

Almost all companies are fine to capture the restriction for the BFD-RS configuration for the UE who doesnot support the MAC CE features in the field description part.

**Proposal 6 (for agreement): Capture the configuration restriction on the max BFD-RS resources per set for the UE who doesnot support the MAC CE based activation in the RRC field description.**

**The RRC TP for proposal 6:**

|  |
| --- |
| ***failureDetectionSet1, failureDetectionSet2***  Configures parameters for beamfailure detection towards beam failure detection resources configured in the set. If additionalPCIList is configured for the serving cell, each RS in one set can be associted only to one PCI.  NW doesnot configure more than 2 RS in one set for the UE who can not support the MAC CE based BFD-RS activation. |

## 3.3 Other issues

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson | There is RILI109 about this: “bfdRSSetId-r17 is not used. Remove it.” We should clarify do we really need the ID even that is RAN1 input. It does not seem to have any function. |
| Fujitsu | As proposed in R2-2205123, the MAC entity will set *BFI\_COUNTER* to 0 when the RS is reconfigured by MAC CE. We should capture this in MAC specification.  The suggested changes to 5.17 of TS 38.321 are shown below:  2> if the *beamFailureDetectionTimer* of this BFD-RS set expires; or  2> if *beamFailureDetectionTimer*or *beamFailureInstanceMaxCount* is reconfigured by upper layers associated with this BFD-RS set of the Serving Cell, or  2> if any of the reference signals used for beam failure detection is reconfigured associated with this BFD-RS set of the Serving Cell:  3> set *BFI\_COUNTER* of the BFD-RS set to 0. |
|  |  |
|  |  |

**Summary:**

For the *bfdRSSetId-r17*, it is reflected in proposal 1a. For the Fujitsu’s comment, it seems related to the BFR procedure, not related to the BFD resource configuration.

# 4 Conclusion

Based on the above discussions, the following proposals are made:

< RRC related proposals >

**Proposal 1 (for agreement): For BFD-RS set configuration, the two sets (i.e. *failureDetectionSet1-r17 and failureDetectionSet2-r17*) are always provided together.**

**Proposal 1a (for discussion): For BFD-RS set configuration, *bfdRSSetId-r17*** **is removed from *BeamFailureDetectionSet-r17*.**

**Proposal 3 (for agreement): Set *maxNrofBFDResourcePerSet-r17*** **to 64 in RRC.**

maxNrofBFDResourcePerSet-r17 INTEGER ::= 64

**Proposal 6 (for agreement): Capture the configuration restriction on the max BFD-RS resources per set for the UE who doesnot support the MAC CE based activation in the RRC field description.**

|  |
| --- |
| ***failureDetectionSet1, failureDetectionSet2***  Configures parameters for beamfailure detection towards beam failure detection resources configured in the set. If additionalPCIList is configured for the serving cell, each RS in one set can be associted only to one PCI.  NW doesnot configure more than 2 RS in one set for the UE who can not support the MAC CE based BFD-RS activation. |

<MAC related proposals>

**Proposal 2 (for agreement): Support the MAC CE based BFD-RS activation mechanism as below:**

* **NW configures the candidate BFD-RS resources per set via RRC signaling;** 
  + **The max number of the BFD-RS per set (i.e. *maxNrofBFDResourcePerSet-r17*) is 64;**
* **The new MAC CE is introduced to indicate the actual used BFD-RS resources per set;**
  + **The MAC-CE is to activate 1 or 2 out of the (maximum of) 64 configured BFD-RS resources from the set.**

**Proposal 4a (for agreement): For the BFD-RS indication MAC CE design, agree the following principles:**

1. **The MAC CE is designed in the per CC per BWP granularity;**
2. **The MAC CE includes 1 or 2 BFD-RS resources out of the configured BFD-RS resources from the set;**
3. **The MAC CE should indicate whether 1 or 2 BFD-RS resources are activated per set.**

**Proposal 4b (for discussion): For the BFD-RS indication MAC CE design, agree the following principles:**

1. **The MAC CE always includes the all the activated BFD-RS of two sets;**
2. **UE deactivates all the previous activated BFD-RS upon receiving the new MAC CE.**

**Proposal 5 (for discussion): Take the following BFD-RS indication MAC CE format with the variable length design as baseline.**

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# 5 Annex

## 5.1. The MAC TP for proposal 5

### 5.18.xx BFD-RS Indication MAC CE

The network may activate and deactivate the configured beam failure detection resources of a Serving Cell by sending the BFD-RS indication MAC CE described in clause 6.1.3.yy.

1> if the MAC entity receives a BFD-RS indication MAC CE on a Serving Cell:

2> indicate to lower layers the information regarding the BFD-RS Indication MAC CE.

#### 6.1.3.yy BFD-RS Indication MAC CE

The BFD-RS Indication MAC CE is identified by a MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size, and includes a BFD-RS-ID0 field and a BFD-RS-ID1 field (optional) of *failureDetectionSet1*, and a BFD-RS-ID0 field and a BFD-RS-ID1 field (optional) of *failureDetectionSet2*.

It has a variable size consisting of following fields:

- Serving Cell ID: This field indicates the identity of the Serving Cell for which the MAC CE applies. The length of the field is 5 bits;

- BWP ID: This field indicates a DL BWP for which the MAC CE applies as the codepoint of the DCI bandwidth *part indicator* field as specified in TS 38.213 [6]. The length of the BWP ID field is 2 bits;

- S: This field indicates the presence of the octet containing the BFD-RS-ID1 of the same BFD-RS set. The S field set to 1 indicates that the the octet containing BFD-RS-ID1 is included; The S field set to 0 indicates that the octet containing the BFD-RS-ID1 of the same BFD-RS set is not included.

- BFD-RS-IDi: This field indicates the BFD-RS resource from *failureDetectionSet1* or *failureDetectionSet2* as specified in TS 38.331 [5].

- R: Reserved bit, set to 0.

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## 5.2. The alternative MAC CE format for the BFD-RS indication

If the proposed MAC CE format in proposal 5 is not agreed, this alternative MAC CE format can be considered.

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