**3GPP TSG RAN WG1 #104b-e R1-20xxxxx**

**e-Meeting, April 12th – 20th, 2021**

**Agenda Item: 7.2.11**

**Source: Moderator (AT&T)**

**Title: Summary of UE features for AT&T moderated topics**

**Document for:** **Discussion/Decision**

# Introduction

This document was drafted by the moderator of the agenda item under the direction of the RAN1 Chairman following the below guidance whose purpose it serves:

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| * For LS & Maintenance, similar preparation management as in previous meetings:
	+ April 7th – 9th: preparation phase
		- April 7th: FLs to prepare summary
		- April 8th – 9th: FLs to lead the discussion identifying the set of email threads
		- A single email thread is used for each of the Rel-16 WIs
			* In the email approval phase, multiple email threads may be used & announced accordingly – detailed budget shown later
		- **Note:** PLEASE KEEP THE EMAIL DISCUSSION **SCOPE** PER EMAIL THREAD **REASONABLE!**
			* **Too much scope will force Chairman/Vice Chairman to step in to do the necessary cut down using the best judgement** 🡪 **if so, no complaints please.**
 |

For each topic, the moderator provides a summary of contributions submitted to RAN1 #104bis-e in this agenda item according to the Chairman’s guidance. During the preparation phase, companies are given the opportunity to revise their views in the moderator’s summary using revision marks as shown below, if any. During the preparation phase of RAN1 #104bis-e the moderator will also propose issues for discussion based on the aforementioned summary and companies can present their views on the moderator’s proposals according to the Chairman’s guidance above. After conclusion of the preparation phase, the moderator will submit the final document as input to RAN1 #104bis-e with recommendations captured in Section 3. All proposals are based on the latest RAN1 UE features list for Rel-16 NR in [1].

# NR\_eMIMO

## Summary

The following is the moderator’s summary of contributions submitted to RAN1 #104bis-e in this agenda item on this topic.

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| 16-1a-1 | SSB/CSI-RS for L1-SINR measurement | Per slot limitations:1. The max number of SSB/CSI-RS (1Tx) for CMR
2. The max number of CSI-IM/NZP-IMR resources
3. The max number of CSI-RS (2Tx) resources for CMR

Memory limitations:1. The max number of SSB/CSI-RS resources as CMR
2. The max number of CSI-IM/NZP IMR resources

Other limitations:1. Supported density of CSI-RS (CMR)
2. The max number of aperiodic CSI-RS resources across all CCs configured to measure L1-SINR (including CMR and IMR) shall not exceed MD\_1
3. Supported SINR measurements
 | 2-21, 2-22 or 2-23, 2-23a | Yes  | N/A |  | Per band | No | No |  | Component 1: Candidate values {8, 16, 32, 64}Component 2: Candidate values {8, 16, 32, 64}Component 3: Candidate values {0, 4, 8, 16, 32, 64}Component 4: Candidate values {8, 16, 32, 64 , 128}Component 5: Candidate values {8, 16, 32, 64 , 128}Component 6: Candidate values {‘1 only’, ‘3 only’, ‘1 and 3’}Component 7: Candidate values {2, 4, 8, 16, 32, 64}Component 8: Candidate values: bitmap with entries {SSB as CMR with dedicated CSI-IM, SSB as CMR with dedicated NZP IMR, CSI-RS as CMR with dedicated NZP IMR configured, CSI-RS as CMR without dedicated IMR configured} If a UE supports FG 16-1a-1 it must support CMR(CSI-RS) + dedicated CSI-IM Note1: The reference slot duration is the shortest slot duration defined for the FR where the reported band belongsNote2: For component 4 and 5 the configured CSI-RS resources for both active and inactive BWPs are countedNote3: For components 1, 2 and 3, CSI-RS resources configured as CMR without dedicated IMR are counted both as CMR and IMRNote4: For components 1, 2, 3, 7, a SSB/CSI-RS resource is counted within the duration of a reference slot in which the corresponding reference signals are transmitted | Optional with capability signalling |
| 16-1g | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification  | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification

 The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification | 2-24, 2-31 | Yes | N/A |  | Per UE | No | Yes |  | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128}Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256}Note: For RS configured for new beam identification, they are always counted regardless of beam failure eventNote: The “configure to measure” RS (component1) only counts those in active BWP but the configured RS (component2) counts all configured including both active and inactive BWPNote: the reference slot duration is the shortest slot duration defined for the reported FR supported by the UENote: The “configured to measure” RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted | Optional with capability signaling |
| 16-1g-1 | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification across frequency ranges | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification
2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification
 | 2-24, 2-31, 16-1g | Yes  | N/A |   | Per UE | No | No |   | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128}Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256}Note: This FG indicates the maximum number of resources across all FR(s) that are supported by the UENote: The signalled values apply to the shortest slot duration defined in any FR(s) that are supported by the UE Note: The “configured to measure” RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted | Optional with capability signaling |

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| Company | Summary |
| OPPO [2] | In RAN1#104 meeting, the following conclusion on UE capability of RS used for beam management were agreed:

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| **Conclusion:** * If one resource is used for one or multiple of BFD/RLM, it is counted as one (basic usage1)
* If one resource is used for one or multiple of NBI/PL-RS/RSRP, add 1 (basic usage 2)
* If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings
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**Proposal: Update the notes of FG 16-1a-1 to capture the agreed conclusion*** **Note5: For components 1, 2, 3, 7, if one SSB or CSI-RS resource used for L1-SINR measurement is referred N times in one or more CSI reporting settings with reportQuantity-r16= ssb-Index-SINR-r16 or cri-SINR-r16, that resource is counted as N times.**

**Proposal: Update the notes of FG 16-1g to capture the agreed conclusion*** **Note: If one SSB or CSI-RS is used in one or more of BFD/RLM, it is counted as one (basic usage 1).**
* **Note: If one SSB or CSI-RS is used in one or more of NBI, PLRS or L1-RSRP, the counting for that resource is added by one (basic usage 2). Here L1-RSRP measurement includes the use cases of reportQuantity set to ‘ssb-Index-RSRP’ or ‘cri-RSRP’ or 'none'.**
* **Note: If one resource is used for L1-SINR measurement, the counting for this resource is added by N if this resource is referred N times in one or more CSI Settings with reportQuantity-r16= ‘ssb-Index-SINR-r16’ or ‘cri-SINR-r16’.**

**Proposal: Update the notes of FG 16-1g-1 to capture the agreed conclusion*** **Note: If one SSB or CSI-RS is used in one or more of BFD/RLM, it is counted as one (basic usage 1).**
* **Note: If one SSB or CSI-RS is used in one or more of NBI, PLRS or L1-RSRP, the counting for that resource is added by one (basic usage 2). Here L1-RSRP measurement includes the use cases of reportQuantity set to ‘ssb-Index-RSRP’ or ‘cri-RSRP’ or 'none'.**
* **Note: If one resource is used for L1-SINR measurement, the counting for this resource is added by N if this resource is referred N times in one or more CSI Settings with reportQuantity-r16= ‘ssb-Index-SINR-r16’ or ‘cri-SINR-r16’.**
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| vivo [3] | During email discussion after RAN1 #104e, the following part achieved common understanding among companies for UE feature 16-1a-1. It is reasonable to adopt.**Proposal: Adopt the following note for 16-1a*** **Note5: For components 1, 2, 3, 7, if one resource used for L1-SINR measurement is referred N times by one or more CSI reporting settings with reportQuantity-r16= ssb-Index-SINR-r16 or cri-SINR-r16, it is counted N times.**

For UE feature 16-1g and 16-1g-1, the major controversial part lies in PLRS measurement, how to count more than 2 ports and whether more than 2 port RS measurement is supported or not.* Whether more than 2 ports PLRS is supported
	+ Current measurement defines RSRP measurement using port 3000.

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| CSI reference signal received power (CSI-RSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements of the antenna port(s) that carry CSI reference signals configured for RSRP measurements within the considered measurement frequency bandwidth in the configured CSI-RS occasions.For CSI-RSRP determination CSI reference signals transmitted on antenna port 3000 according to TS 38.211 [4] shall be used. If CSI-RSRP is used for L1-RSRP, CSI reference signals transmitted on antenna ports 3000, 3001 can be used for CSI-RSRP determination. |

* + PLRS measurement is based on RSRP, and is not L1-RSRP.
	+ The following case is not supported by the specification: configuring PLRS with more than 2 ports, while measurement is based on 3000 and 3001 is allowed by the specification.
		- * If allowed, “CSI reference signals configured for RSRP measurement” would have larger than 2 ports. This is against “CSI reference signals transmitted on antenna port 3000”.
			* Such configuration for PLRS is never discussed.
* Whether UE capability is needed to differentiate 1 port or 2 port PLRS
	+ It is not needed to differentiate 1 port and 2 port case. UE feature 2-24 already counts L1-RSRP not differentiating 1 port and 2 ports.

With above understanding, the following note can be added.**Proposal: Adopt the following note for 16-1g and 16-1g-1*** **Note: Regarding the "configured to measure” RS counting**
* **If one  1-port  or 2-port resource is used for one or multiple of BFD/RLM, it is counted as one (basic usage1)**
* **If one 1-port or 2-port  resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add 1 (basic usage 2)**
	+ **L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘ssb-Index-RSRP’, ‘cri-RSRP’ or with reportQuantity set to  'none' and CSI-RS-ResourceSet with higher layer parameter trs-Info is not configured**
* **If one 1-port or 2-port resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity-r16= ‘ssb-Index-SINR-r16’ or ‘cri-SINR-r16’.**
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| Apple [4] | In RAN1 #104e meeting, regarding the RS counting rule for FG16-1a-1, FG16-1g, FG16-1g-, we reached the following conclusion

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| Conclusion: * If one resource is used for one or multiple of BFD/RLM, it is counted as one (basic usage1)
* If one resource is used for one or multiple of NBI/PL-RS/RSRP, add 1 (basic usage 2)
* If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings
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In our view, there are still two issues remaining regarding the supporting and RS counting for >1 port CBD and PL-RS, more specifically * How to count >1 port CBD (NBI)
* How to count >1 port PL-RS

Note that to support >1 port CSI-RS as CBD or PL-RS, UE may need to perform additional OCC de-spreading before UE can estimate the RSRP on the corresponding ports, this may introduce additional UE processing complexity compared to processing a single port CSI-RS. Below is our view in general * UE shall not be mandated to support >1 port CBD or PL-RS
	+ >1 port L1-RSRO and L1-SINR is already UE optional feature with capability signalling
	+ RLM and BFD is limited to1 port RS only
* When UE supports >1 port CBD or PL-RS, the counting rule should be relaxed at least for some UEs

**Proposal: Regarding the active RS counting rule for FG16-1g, FG16-1g-1*** **UE shall not be mandated to support >1 port CBD or PL-RS**
* **When UE supports >1 port CBD or PL-RS, the counting rule should be relaxed at least for some UEs**
* **Introduce the following FGs**

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  | 16-1j-1 | Support of 2 port CSI-RS for new beam identifications | The resource counting for 2 port CSI-RS for new beam identification in FG16-1g, FG16-1g-1 | 2-31 | Yes | N/A |  | Per UE | N/A | N/A  | N/A |  | Candidate value set {1, 2} |
|  | 16-1j-2 | Support of 2 port CSI-RS for pathloss estimation  | The resource counting for 2 port CSI-RS for new beam identification in FG16-1g, FG16-1g-1 | 8-3 | Yes | N/A |  | Per UE | N/A | N/A  | N/A | UE is not expected to support CSI-RS with > 2 ports for pathloss estimation  | Candidate value set {1, 2} |

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| Nokia/Nokia Shanghai Bell [5] | The following conclusion has been agreed upon:

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| **Conclusion:** * If one resource is used for one or multiple of BFD/RLM, it is counted as one (basic usage1)
* If one resource is used for one or multiple of NBI/PL-RS/RSRP, add 1 (basic usage 2)
* If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings
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Unfortunately, RAN1 was unable to conclude on the exact way to capture the conclusions above in the feature list, as some companies still showed concerns on how the resources are counted in some cases. In one attempt to simplify the definition it has been proposed to limit the definition to 1-port RS and leave the other RS definitions open. However, this is incomplete, given that in TS 38.215 CSI-RSRP is defined for 1 and 2 ports:

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| For CSI-RSRP determination CSI reference signals transmitted on antenna port 3000 according to TS 38.211 [4] shall be used. If CSI-RSRP is used for L1-RSRP, CSI reference signals transmitted on antenna ports 3000, 3001 can be used for CSI-RSRP determination. |

It is our understanding that the main concern raised by companies is for the cases where more than 1-port RS may be configured, as the UE would then need to process a CDM operation in addition to regular CSI-RS processing. A simple way to address this issue is to consider the CDM operation as one factor in determining the resource counting. **Proposal: Consider the CDM operation as one factor in determining the resource counting.****Proposal: Add the following note to FG 16-1a:*** **Note5: For components 1, 2, 3, 7, if one resource used for L1-SINR measurement is referred N times by one or more CSI reporting settings with reportQuantity-r16= ssb-Index-SINR-r16 or cri-SINR-r16, it is counted N times.**

**Proposal: Add the following note to FG 16-1g:*** **Note:**
	+ **If one CSI-RS/CSI-IM resource is used for one or multiple of BFD/RLM, it is counted as (1 x the CDM order for the RS) (basic usage1)**
	+ **If one CSI-RS/CSI-IM resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add (1 x the CDM order for the RS) (basic usage 2)**
		- **L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘cri-RSRP’ or with reportQuantity set to  'none' and CSI-RS-ResourceSet with higher layer parameter trs-Info is not configured**
	+ **If  one resource is used for L1-SINR in addition to basic usage 1 & 2, add (N times the CDM order for the RS) if referred N times by one or more CSI Reporting Settings with reportQuantity-r16=  ‘cri-SINR-r16’**

**Proposal: Add the following note to FG 16-1g-1:*** **Note:**
* **If one CSI-RS/CSI-IM resource is used for one or multiple of BFD/RLM, it is counted as (1 x the CDM order for the RS) (basic usage1)**
* **If one CSI-RS/CSI-IM resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add (1 x the CDM order for the RS) (basic usage 2)**
	+ **L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘cri-RSRP’ or with reportQuantity set to  'none' and CSI-RS-ResourceSet with higher layer parameter trs-Info is not configured**
* **If  one resource is used for L1-SINR in addition to basic usage 1 & 2, add (N times the CDM order for the RS) if referred N times by one or more CSI Reporting Settings with reportQuantity-r16=  ‘cri-SINR-r16’**
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| Huawei/HiSilicon [6] | The following issues were raised but no agreement/conclusion was reached in the email discussion on FGs 16-1a-1 and 16-1g in RAN1#104-e meeting:* Whether PL-RS with more than 2-port is supported by NR specification
* Whether UE is mandated to support 2-port PL-RS and CBD-RS
* If UE supports 2-port PL-RS and CBD-RS, should the counting rule in FG 16-1g be relaxed

In this section, our views and proposals towards above questions are provided.According the definition in TS 38.213, the calculation of pathloss requires ‘higher-layer filtered RSRP’, and as described in TS 38.215, the calculation of CSI-RSRP is based on 1-port or 2-port CSI-RS. Therefore, the current NR specification support at most 2-port CSI-RS for pathloss estimation purpose. **Observation 1: The current NR specs support at most 2-port CSI-RS for pathloss estimation purpose.**In our understanding, UE is not and should not be mandated to support 2-port PL-RS and CBD-RS since the support of 2-port PL-RS is implicitly restricted/represented by UE capability reporting on the support of using 2-port CSI-RS for L1-RSRP measurement. Similarly, candidate beam detection (CBD) is performed based on L1-RSRP measurement, and the support of 2-port CBD-RS is also represented by UE capability reporting on the support of using 2-port CSI-RS for L1-RSRP measurement. **Observation 2: Support of using 2-port CSI-RS for pathloss estimation and candidate beam detection are optional UE features reported by UE feature on the support of using 2-port CSI-RS for L1-RSRP measurement.** Considering that the computational complexity associated with 2-port CSI-RS is twice that with 1-port CSI-RS for L1-RSRP/L1-SINR measurement, we propose that for FG 16-1g, a 2-port CSI-RS is double counted.**Proposal: For FG 16-1g, double-counting is applied if one CSI-RS resource is configured with 2 ports.*** **Adopt the following note corresponding to the above**
	+ **Note: For component-1, a 2-port CSI-RS resource is counted twice.**
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## Issues for discussion during the preparation phase

After review of contributions submitted to RAN1 #104bis-e in this agenda item on this topic, the following has been identified by the moderator as candidates for discussion/approval during RAN1 #104bis-e. Companies are invited to express their views in the table below. Note that the proposals are based on [7] and can serve as starting point for further discussions. They are not meant for agreement during the preparation phase.

**Proposal 1: The following changes highlighted in red are adopted**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 16-1a-1 | SSB/CSI-RS for L1-SINR measurement | Per slot limitations:1. The max number of SSB/CSI-RS (1Tx) for CMR
2. The max number of CSI-IM/NZP-IMR resources
3. The max number of CSI-RS (2Tx) resources for CMR

 Memory limitations:1. The max number of SSB/CSI-RS resources as CMR
2. The max number of CSI-IM/NZP IMR resources

 Other limitations:1. Supported density of CSI-RS (CMR)
2. The max number of aperiodic CSI-RS resources across all CCs configured to measure L1-SINR (including CMR and IMR) shall not exceed MD\_1
3. Supported SINR measurements

  | 2-21, 2-22 or 2-23, 2-23a | Yes | N/A |   | Per band | No | No |   | Component 1: Candidate values {8, 16, 32, 64} Component 2: Candidate values {8, 16, 32, 64} Component 3: Candidate values {0, 4, 8, 16, 32, 64} Component 4: Candidate values {8, 16, 32, 64 , 128} Component 5: Candidate values {8, 16, 32, 64 , 128} Component 6: Candidate values {‘1 only’, ‘3 only’, ‘1 and 3’} Component 7: Candidate values {2, 4, 8, 16, 32, 64} Component 8: Candidate values: bitmap with entries {SSB as CMR with dedicated CSI-IM, SSB as CMR with dedicated NZP IMR, CSI-RS as CMR with dedicated NZP IMR configured, CSI-RS as CMR without dedicated IMR configured}  If a UE supports FG 16-1a-1 it must support CMR(CSI-RS) + dedicated CSI-IM Note1: The reference slot duration is the shortest slot duration defined for the FR where the reported band belongs Note2: For component 4 and 5 the configured CSI-RS resources for both active and inactive BWPs are counted Note3: For components 1, 2 and 3, CSI-RS resources configured as CMR without dedicated IMR are counted both as CMR and IMR Note4: For components 1, 2, 3, 7, a SSB/CSI-RS resource is counted within the duration of a reference slot in which the corresponding reference signals are transmitted Note5:  For components 1, 2, 3, 7, if one resource used for L1-SINR measurement is referred N times by one or more CSI reporting settings with reportQuantity-r16= ssb-Index-SINR-r16 or cri-SINR-r16, it is counted N times. | Optional with capability signaling |

**Proposal 2: The following changes highlighted in red are adopted**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 16-1g | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification
2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification
 | 2-24, 2-31 | Yes  | N/A |   | Per UE | No | Yes |   | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128} Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256} Note: For RS configured for new beam identification, they are always counted regardless of beam failure event Note: The “configure to measure” RS (component1) only counts those in active BWP but the configured RS (component2) counts all configured including both active and inactive BWPNote: the reference  slot duration is the shortest slot duration defined for the reported FR supported by the UE Note: The “configured to measure” RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted Note: Regarding the "configured to measure” RS counting* If  one resource is used for one or multiple of BFD/RLM, it is counted as one (basic usage1)
* If  one resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add 1 (basic usage 2)
	+ L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘ssb-Index-RSRP’, ‘cri-RSRP’ or with reportQuantity set to  'none' and CSI-RS-ResourceSet with higher layer parameter trs-Info is not configured
* If  one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity-r16= ‘ssb-Index-SINR-r16’ or ‘cri-SINR-r16’
 | Optional with capability signaling |

**Proposal 3: The following changes highlighted in red are adopted**

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| 16-1g-1 | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification across frequency ranges | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification
2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification
 | 2-24, 2-31, 16-1g | Yes  | N/A |   | Per UE | No | No |   | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128} Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256} Note: This FG indicates the maximum number of resources across all FR(s) that are supported by the UE Note: The signalled values apply to the shortest slot duration defined in any FR(s) that are supported by the UE Note: The “configured to measure” RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted Note: Regarding the "configured to measure” RS counting* If  one resource is used for one or multiple of BFD/RLM, it is counted as one (basic usage1)
* If  one resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add 1 (basic usage 2)
	+ L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘ssb-Index-RSRP’, ‘cri-RSRP’ and with reportQuantity set to  'none' and CSI-RS-ResourceSet with higher layer parameter trs-Info is not configured
* If  one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity-r16= ‘ssb-Index-SINR-r16’ or ‘cri-SINR-r16’
 | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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# Conclusion

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# References

1. R1-2102006, Updated RAN1 UE features list for Rel-16 NR after RAN1#104-e, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2102557, Discussion on NR Rel-16 UE Features, OPPO
3. R1-2102950, Remaining issues on Rel-16 eMIMO UE features, vivo
4. R1-2103087, Discussions on NR Rel-16 UE features, Apple
5. R1-2103197, Remaining issues on NR Rel-16 UE features, Nokia/Nokia Shanghai Bell
6. R1-2103399, Remaining details of Rel-16 NR UE features, Huawei/HiSilicon
7. R1-2102051, Summary of email discussion/approval [104-e-NR-UEFeatures-eMIMO-04], Moderator (AT&T)