**3GPP TSG RAN WG1 Meeting #103-e R1-200xxxx**

**e-Meeting, October 26 – November 13, 2020**

**Source: Moderator (Intel Corporation)**

**Title: 38.808 TR Text Proposal Discussion**

**Agenda item: 8.2.1**

**Document for: Discussion**

# Introduction

This document is to facilitate discussion of text proposal for the TR38.808. Please note evaluation assumption related agreement made in the previous meeting should have been already incorporated in the endorsed TR and is omitted in the discussion below.

# Agreements from RAN1 #101-e and #102-e

### Agreement #1:

For NR system operating in 52.6 GHz to 71 GHz,

* NR should be designed with maximum FFT size of 4096 and maximum of 275RBs per carrier;
* Candidate supported maximum carrier bandwidth(s) for a cell is between 400 MHz and 2160 MHz;
* If subcarrier spacing 240 kHz or below are supported, NR in 52.6 to 71 GHz is expected to use normal CP length only (does not have any implications on whether ECP is supported for the higher subcarrier spacings, if supported).

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture under 4.1.2 Candidate numerology and bandwidth**   + **In order to bound implementation complexity, it is recommended to limit the maximum FFT size required to operate system in 52.6 GHz to 71 GHz frequency to less or equal to 4096 and to limit the maximum of RBs per carrier to 275 RBs.**   + **The candidate supported maximum carrier bandwidth(s) for a cell should be between 400 MHz and 2160 MHz.**   + **It is recommended that for subcarrier spacing 240 kHz or below, normal CP length is utilized for candidate subcarrier spacings.** | |
| **Company** | **Comments** |
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### Conclusion #2:

RAN1 continues study and specification effort for both licensed and unlicensed operation for supporting NR from 52.6 GHz to 71 GHz SI.

* RAN1 strives for maximum commonality for the system design for licensed and unlicensed operation for NR from 52.6GHz to 71GHz, and for maximum re-use of the existing NR design

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture under 4.1.1 General description of study in RAN1**   + **It is recommended to strive for maximum commonality for the system design for licensed and unlicensed operation for NR from 52.6GHz to 71GHz, and maximize re-use of the existing NR design.**   **Moderator note: Not entire sure if the conclusion should be captured in TR or not. Please provide comments on what you think.** | |
| **Company** | **Comments** |
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### Agreement #3:

* Instruct rapporteur to create dedicated (sub-)section for set of identified issues for physical layer NR design.
* Endorse following text proposal as introduction to the (sub-)sections for discussing identified issues for physical layer.
  + For supporting NR operation in both licensed and unlicensed band in the frequency range from 52.6 GHz to 71 GHz, FR2 numerologies and additional numerologies beyond that supported currently in NR are studied. Existing framework for numerology scaling is considered i.e. 2μ ×15 subcarrier spacing to select the candidates. For SSB transmissions, it is investigated whether or not µ>4 (larger than 240 kHz) is needed and corresponding impacts, if any, on the aspects including at least SSB pattern, multiplexing of other signal/channels, and transmission window, if supported. For data and control channel transmissions, it is investigated if µ>3 (larger than 120 kHz) is needed and corresponding impacts, if any, on aspects including at least processing timelines, PDCCH monitoring capability (BD/CCE), scheduling enhancements, beam-management, and reference signal design. For investigating the need for higher numerologies, some of the key aspects that are studied are the impact due to phase noise, delay spread, TAE, analog beam switching delay, and impact to coverage, spectral efficiency and peak data rates, and relative delay in intra-cell/inter-cell multi-TRP operations.

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| ***Rapporteur suggestion for capturing agreement/conclusion:***   * **Capture as is (text above) under 4.1.1 General description of study in RAN1** | |
| **Company** | **Comments** |
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### Agreement #4:

* Study whether or not different SSB patterns should be supported for licensed and unlicensed bands.
* For each licensed and unlicensed band, if issues are identified for reuse of existing SSB, consider at least the following aspects for SSB
  + Beam switching gap between SSB(s) and between SSB and other signal(s)/channel(s)
  + SSB pattern in time domain
  + Whether or not it is needed to define a transmission window (such as DRS window), and if needed, number of SSB transmission opportunities within a transmission window
* For each licensed and unlicensed band, if issues are identified for reuse of all or some of the existing SSB and CORESET#0 multiplexing pattern, consider at least the following aspects for SSB, CORESET#0, and other signal/channel design
  + Supported multiplexing pattern type(s) (Pattern 1, 2, and/or 3) for SSB and CORESET#0 multiplexing.
  + Multiplexing of other signal/channels (e.g. RMSI, paging, CSI-RS) with SSB
  + Configuration of Type0-PDCCH search space set

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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### Agreement #5:

RAN1 at least considers the following aspects for determination of supported SSB subcarrier spacing

* Detection performance of SSB (including PSS, SSS, PBCH DMRS, and PBCH) and SSB coverage requirement
* Impact on initial cell search complexity due to frequency errors (e.g. carrier frequency offset, Doppler shift, etc)
* Timing detection accuracy and its relation to uplink transmission accuracy
* Signaling design for supporting different subcarrier spacing for SSB and CORESET#0 (if supported)
* Multi-TRP delay considerations
* Consideration of SSB-based RRM/RLM and beam management if the SSB SCS is significantly different from that of the active BWP (e.g., switching gap, scheduling constraint, etc.)

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| **Company** | **Comments** |
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### Agreement #6:

Consider the at least following aspects for PRACH design of NR operating in 52.6 GHz to 71 GHz

* PRACH coverage requirements
* applicable PRACH Sequence length(s) and subcarrier spacing(s) for PRACH, including any impact on PRACH coverage and capacity from the applicable sequence length(s).
* RACH RO configurations with new SCS (if new SCS is supported)
* LBT gap between RACH occasions (RO)

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| **Company** | **Comments** |
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### Agreement #7:

Consider at least the following aspects of PT-RS design for a given SCS

* Phase noise compensation performance of existing PT-RS design
* Study of need of any modification/changes to existing PT-RS design
  + Potential modification to the PT-RS pattern or configuration to aid performance improvement for CP-OFDM and DFT-s-OFDM waveforms (if needed)
  + Potential methods to aid ICI compensation at the receiver (if needed)

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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### Agreement #8:

Consider at least the following aspects of DM-RS design for a given SCS

* Channel estimation performance of existing DM-RS design with existing and new SCSs (if any)
* Study whether there is a need of any modification/changes to existing DM-RS design
  + Potential modification or introduction of new DM-RS pattern, configuration or indication to aid performance improvement for CP-OFDM and DFT-S OFDM waveforms (if needed)

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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### Agreement #9:

Consider at least the following aspects of processing timelines for new SCS (if agreed) that are not currently supported,

* appropriate configuration(s) of k0, k1, k2,
* PDSCH processing time (N1),
* PUSCH preparation time (N2),
* HARQ-ACK multiplexing timeline (N3)
* CSI processing time, Z1, Z2, and Z3, and CSI processing units
* Any potential enhancements to CPU occupation calculation
* Related UE capability(ies) for processing timelines
* minimum guard period between two SRS resources of an SRS resource set for antenna switching

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** * **Note: part of this may be covered by TP by the email discussion thread #1** | |
| **Company** | **Comments** |
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### Agreement #10:

Consider at least the following aspects of PDCCH monitoring for a given SCS

* For new SCS, if agreed, that are not supported in Rel-15/16 NR,
  + investigate on the maximum number of BDs/CCEs for PDCCH monitoring per time unit
    - e.g. slot as Rel-15, or new scheduling/monitoring unit
  + any potential limitation to PDCCH monitoring configurations (e.g. search spaces, DCI formats, overbooking/dropping, etc) to help with UE processing, if needed
    - e.g. increased minimum PDCCH monitoring unit
  + potential enhancements for CORESET, if needed
  + related UE capability(ies) for PDCCH processing

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| **Company** | **Comments** |
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### Agreement #11:

Consider at least the following aspects of scheduling for BWP with a given SCS

* Study of frequency domain scheduling enhancements/optimization for PDSCH/PUSCH, if needed
  + e.g. potential impact to UL scheduling if frequency domain resource allocation with different granularity than FR1/2 (e.g. sub-PRB, or more than one PRB) is supported
* Study of time domain scheduling enhancements for PDSCH/PUSCH, if needed
  + e.g. increasing the minimum time-domain scheduling unit to be larger than one symbol, supporting multi-PDSCH scheduled by one DCI, supporting one TB mapped to multiple slots (i.e., TTI bundling)
* Study potential enhancements or alternatives to the scheduling request mechanism to reduce scheduling latency due to beam sweeping, if needed

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| **Company** | **Comments** |
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### Agreement #12:

Consider at least the following aspects for uplink transmission

* Study of potential enhancements for PUSCH/PUCCH/PRACH transmissions to achieve higher transmit power (when transmit power spectral density limits apply), if needed
* Study whether uplink interlace needs to be supported for unlicensed operation in 60 GHz band.
  + If supported, study uplink PRB and/or sub-PRB based interlace design for PUCCH, PUSCH, and/or SRS.

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| **Company** | **Comments** |
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### Agreement #13:

* Study single carrier and multi carrier operations for achieving wide bandwidth utilization, while at least considering aspects such as control signaling overhead, transceiver complexity, spectral efficiency, etc.

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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### Agreement #14:

Consider at least the following aspects in system operations with beams

* Study of BFR mechanism enhancements, if supported
  + e.g., the use of aperiodic CSI-RS for BFR, increased number of RSs for monitoring/candidates and efficient utilization of the increased number of RSs, enhanced reliability to cope with narrower beamwidth
* Study of UE capabilities on beam switch timing in beam management procedure
* Study of enhancements for beam management and corresponding RS(s) in DL and UL are needed further considering at least the following aspects, if supported:
  + beam switching time, beam alignment delay (including initial access), LBT failure, and potential coverage loss (if large SCS is supported)
* Study of beam switching gap handling for signals/channels (e.g. CSI-RS, PDSCH, SRS, PUSCH) for higher subcarriers spacing, if supported

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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### Agreement #15:

* Consider the study of at least the following aspects, including the justification for the features and their potential benefits, if applicable
  + System overhead impact from TDD switching time for larger subcarrier spacing
  + Coverage enhancement mechanisms for control channels and SSB, if larger SCS is supported
  + Any potential modifications to HARQ processes including number of processes, if supported
  + Impact from MAC buffering for larger subcarrier spacing, if any
  + NR channelization/sub-channelization and any potential impact from RAN1 perspective
  + Additional RF impairments that impact evaluations
  + Impact on BWP switching procedure due to new higher SCS, if supported
  + Support of rank 2 transmission for DFT-s-OFDM in the uplink
* Other aspects and impacts due to introduction of higher SCS are not precluded.

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this agreement. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the agreement should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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Conclusion #16:

The OCB requirement of draft version v2.1.20 of EN 302 567 implies that

* Device supports one or multiple declared nominal channel bandwidths.
* For each declared nominal channel bandwidth, RAN1 design should support at least one physical layer signal/channel transmission that occupies at least 70% of the nominal channel bandwidth.
* FFS: Mapping of nominal channel bandwidth to bandwidth definitions in NR.

Conclusion #17:

The RAN1 understanding of the CCA check procedure in draft v2.1.20 of EN 302 567 is as follows:

* When performing CCA before initiating transmission, during count down, when an observation slot fails ED, the counter freezes, and will continue count down 8us after the interference is detected to be gone

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapportuer has yet to provide a correspoding TP for this conclusion. Rapportuer assumes agreement should be captured in some form to correctly represent progress made in RAN1 and RAN4. Please comment on whether you think the conclusion should be not captured in some form to the TR or if you have suggestions on how this can be captured.** | |
| **Company** | **Comments** |
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### Agreement #18:

* For gNB/UE to initiate a channel occupancy, both channel access with LBT mechanism(s) and a channel access mechanism without LBT are supported
* FFS: LBT mechanisms such as Omni-directional LBT, directional LBT and receiver assisted LBT type of schemes when channel access with LBT is used.
* FFS: If operation restrictions for channel access without LBT are needed, e.g. compliance with regulations, and/or in presence of ATPC, DFS, long term sensing, or other interference mitigation mechanisms
* FFS: The mechanism and condition(s) to switch between channel access with LBT and channel access without LBT (if local regulation allows)

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture under ”5.2 Channel access and interference mitigation techniques” (exact section TBD)**   + **It is recommended to support both channel access with LBT mechanism(s) and a channel access mechanism without LBT for gNB and UE that initiate a channel occupancy. Further studies on:**     - **LBT mechanisms such as omni-directional LBT, directional LBT, and receiver assisted LBT type of schemes when channel access with LBT is used,**     - **whether operation restrictions for channel access without LBT are needed, e.g. compliance with regulations, and/or in presence of ATPC, DFS, long term sensing, or other interference mitigation mechanisms, and**     - **the mechanism and condition(s) to switch between channel access with LBT and channel access without LBT (if local regulation allows)**   + **may be needed in the corresponding WI phase, if approved.** | |
| **Company** | **Comments** |
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### Agreement #19:

Use the LBT procedures in draft v2.1.20 of EN 302 567 as the baseline system evaluation with LBT

* Enhancements to ED threshold, contention window sizes etc. can be considered as part of the evaluations.

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Rapporteur’s understanding is this agreement has been captured into the TR as part of the evaluation assumptions. No need to consider further.** |

# Agreements from RAN1 #103-e

### Agreement #20:

* Numerologies below 120 kHz or above 960 kHz are not supported for any signal or channel.

### Agreement #21:

* For operation in 52-71 GHz:
  + 120 kHz should be supported
  + Up to two additional SCS may be considered and at least one should be supported
  + FFS: Applicability of additional SCS to particular signals and channels

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture under 4.1.2 Candidate numerology and bandwidth**   + **In order to minimize specification effort while maximizing supported use cases and deployment scenarios applicable for 52.6 GHz to 71 GHz frequency, It is recommended to support 120 kHz subcarrier spacing with normal CP length, and at least one more subcarrier spacing. It is recommended to consider supporting at most up to three subcarrier spacings, including 120 kHz subcarrier spacing.** | |
| **Company** | **Comments** |
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### Agreement #22:

* At least when operating with LBT, MCOT is 5ms, including all the gaps inside
* Note: Discussions related to further reductions in MCOT due to potential definition of CAPC will be handled separately.

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture under 5.2.X (exact section TBD)**   + **For NR operating with LBT, maximum channel occupancy time (MCOT) duration is 5 msec, including all gaps inside the COT.** | |
| **Company** | **Comments** |
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# Capturing Evaluation Results

### Agreement #23:

Capture the following observations in the TR. Editorial modifications and changes to references can be made when capturing the observations in the TR.

* Comparison of No-LBT (NLBT) and Tx Side ED based Omnidirectional Sensing (TxED-Omni) for Indoor Scenerio A: 6 Companies have compared No-LBT with Tx Side ED based Omni sensing LBT
  + Vivo, show tail and median benefits of using TxED-Omni LBT on DL, at high loading. In other cases, including all loads for UL and other loads for DL, TdxED-Omni LBT scheme shows losses. All results are at ED threshold -47.
  + Intel shows gains for 5%ile DL throughput at high loads with TxED-Omni LBT. In other cases including all loads for UL and other loads for DL, TdxED-Omni LBT scheme shows losses. All results are at ED threshold -47.
  + Ericsson, HW, Nokia, Qualcomm and Samsung show loss for TxED-Omni LBT with an EDT of -47 or -48 dB for all cases.

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture as is under ”5.2.X observations for evaluations related to channel access” (exact section TBD)** | |
| **Company** | **Comments** |
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### Agreement #24:

Capture the following observations in the TR (updates to references and other editorial modifications can be made for inclusion in the TR):

7 sources ([61, Ericsson], [26, Qualcomm], [56, vivo], [64, OPPO], [21, Apple], [25, NTT DOCOMO], [12, Intel]) reported evaluation results of PSS/SSS detection performance in terms of SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS. 4 sources ([61, Ericsson], [26, Qualcomm], [56, vivo], [21, Apple]) reported PBCH performance in terms of SINR in dB achieving PBCH BLER target of 10%. 2 sources ([5, vivo], [14, 61, Ericsson]) compared link budget of SSB for difference SCS.

* For PSS and SSS detection performance, all evaluated candidate SCSs (120, 240, 480 and 960 kHz) show comparable performances with the non-optional (non-optional to be replaced by references to channel model in Tables to be added when capturing in TR) channel models and delay spread values.
  + The performance degrades as the increase of SCS.
  + Note: the following is reference when derive the observations.
  + 6 out of 7 sources reported minor performance difference (< or ~ 1 dB) between adjacent SCS for all evaluated candidate SCSs (120, 240, 480 and 960 kHz). The other source ([21, Apple]) reported more than 3 dB performance gap of 960 kHz SCS compared to other 120, 240 and 480 kHz SCS. It also reported that the gap of 960 kHz increases as the delay spread increases.
* For PBCH BLER performance, all evaluated candidate SCSs (120, 240, 480 and 960 KHz) show comparable performances with the non-optional (non-optional to be replaced by references to channel model in Tables to be added when capturing in TR) channel models and delay spread.
  + The performance degrades as the increase of SCS.
  + All 4 sources reported minor performance difference (< or ~ 1 dB) between adjacent SCS for all evaluated candidate SCSs (120, 240, 480 and 960 KHz).
  + The performance gap between 120 and 960 kHz is up to ~ 1.8 dB.
* In terms of SSB link budget, smaller SCS have better coverage than larger SCS
  + The MCL and MIL difference between 120 kHz SCS and 480 kHz SCS is about 5 dB. The MCL and MIL difference between 120 kHz SCS and 960 KHz SCS is about 8 dB.

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| ***Rapporteur suggestion for capturing agreement/conclusion (actual ordering will be done considering other TP for the same section):***   * **Capture text above under ”4.1.X observations for link level evaluations” (exact section TBD) with appropriate update to the citation references.** | |
| **Company** | **Comments** |
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### References:

Rapporteur: Companies are encouraged to check the correct Tdoc number for referencing the evaluation results. Below are the Reference that will be captured to the TR. Reference are from Summary #3 of the discussion. Reference should have [X+4], where X is the original numbering from the summary #3 of the discussion.

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| 2 References The following documents contain provisions which, through reference in this text, constitute provisions of the present document.  - References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.  - For a specific reference, subsequent revisions do not apply.  - For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.  [1] 3GPP TR 38.913: "Study on Scenarios and Requirements for Next Generation Access Technologies"  [2] 3GPP TR 38.807: "Study on requirements for NR beyond 52.6 GHz".  [3] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".  [4] ETSI EN 302 567 v2.1.20: "Multiple-Gigabit/s radio equipment operating in the 60 GHz band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".  [5] R1-2007549 "Further discussion on B52 numerology" FUTUREWEI.  [6] R1-2007558 "Discussion on physical layer impacts for NR beyond 52.6 GHz" Lenovo, Motorola Mobility.  [7] R1-2007604 "PHY design in 52.6-71 GHz using NR waveform" Huawei, HiSilicon.  [8] R1-2007642 "Physical layer design for NR 52.6-71GHz" Beijing Xiaomi Software Tech.  [9] R1-2007652 "Discussion on required changes to NR using existing DL/UL NR waveform" vivo.  [10] R1-2007785 "Consideration on required changes to NR using existing NR waveform" Fujitsu.  [11] R1-2007790 "Consideration on supporting above 52.6GHz in NR" InterDigital, Inc.  [12] R1-2007847 "System Analysis of NR opration in 52.6 to 71 GHz" CATT.  [13] R1-2007883 "Required changes to NR using existing DL/UL NR waveform" TCL Communication Ltd.  [14] R1-2007926 "Required changes to NR using existing DL/UL NR waveform" Nokia, Nokia Shanghai Bell.  [15] R1-2007929 "On phase noise compensation for NR from 52.6GHz to 71GHz" Mitsubishi Electric RCE.  [16] R1-2009379 "Discussion on Required Changes to NR in 52.6 – 71 GHz" Intel Corporation.  [17] R1-2007965 "On the required changes to NR for above 52.6GHz" ZTE, Sanechips.  [18] R1-2007982 "On NR operations in 52.6 to 71 GHz" Ericsson.  [19] R1-2008045 "Consideration on required physical layer changes to support NR above 52.6 GH" LG Electronics.  [20] R1-2008076 "Discussion on required changes to NR using existing DL/UL NR waveform in 52.6GHz ~ 71GHz" CMCC.  [21] R1-2008082 "Study on the numerology to support 52.6 GHz to 71GHz" NEC.  [22] R1-2008872 "Design aspects for extending NR to up to 71 GHz" Samsung.  [23] R1-2008250 "Discusson on required changes to NR using DL/UL NR waveform" OPPO.  [24] R1-2008353 "Considerations on required changes to NR from 52.6 GHz to 71 GHz" Sony.  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