**3GPP TSG RAN meeting #89e RP-200xxx**

**Electronic Meeting, September 14 - 18, 2020**

## Status Report to TSG

**Agenda item:** 9.7.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI / SI Name** | **Study on supporting NR from 52.6 GHz to 71 GHz** | | | | |
| included in this status report | Study Item:  Yes | Core part:  No | Performance part:  No | | Testing part:  No |
| **Acronym** | FS\_NR\_52\_to\_71GHz | | | | |
| **Unique ID** | 860037 | | | | |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-200902 | | | | |
| **Target Completion Date**  **(indicate if changed)** | Study Item:  03/2021  (updated from 12/2020) | Core part: mm/yyyy | Performance part: mm/yyyy | Testing part: mm/yyyy | |
| **Overall Completion level** | Study Item:  50 % | Core part:  xx% | Performance Part: xx% | Testing part: xx% | |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |  |
| --- | --- | --- |
| **Leading WG** | | RAN1 |
| **Rapporteur** | **Name** | Lee, Daewon (RAN1); Vintola, Ville (RAN4) |
| **Company** | Intel Corporation; Qualcomm |
| **Email** | daewon (dot) lee (at) intel (dot) com; vvintola (at) qti (dot) qualcomm (dot) com |

## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | Yes |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.  
 One time unit (TU) corresponds to ~ 2 hours in the meeting.  
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.  
 Note: If no Excel table is attached, then this means no time budget change.*

**Additional explanations/motivations for the time budget changes in the attached Excel table:**

Due to challenges in progressing with electronic meetings, the suggestion to move the SI completion to March 2021.

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

### 2.1 RAN1

#### 2.1.1 Agreements

Agreement:

* 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).

Conclusion:

* 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

Agreement:

* 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.

Agreement:

* 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

Agreement:

* 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.)

Agreement:

* 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)

Agreement:

* 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)

Agreement:

* 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)

Agreement:

* 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

Agreement:

* 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

Agreement:

* 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

Agreement:

* 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.

Agreement:

* 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.

Agreement:

* 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

Agreement:

* 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.

Conclusion:

* 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:

* 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

Agreement:

* 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)

Agreement:

* 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.

Agreement:

* For link level evaluation purpose, keep 1920 KHz subcarrier spacing as optional in Table 1.
* For link level evaluation purpose, keep 320 PRB for 480 kHz subcarrier spacing for 2000 MHz bandwidth as optional in Table 1.
  + Note: A BW of 2 GHz can be achieved with a smaller number of PRBs
* Add to the note in the number of RBs column: “Other BW and sub-carrier spacing combinations can be optionally used.”

Agreement:

* Keep modification CDL-B/D model in Table 2 as optional and add 20 ns DS to the baseline TDL-A channel model in addition to 5 ns and 10 ns.
  + FFS in this meeting whether to add 40 ns DS to the baseline TDL-A channel model

Agreement:

* For SLS performance evaluations purpose, keep 120, 240 and 480 kHz as optional subcarrier spacing for 2000 MHz BW and keep 240, 480 and 960 kHz as optional subcarrier spacing for 400 MHz BW in Table 4.
* For SLS performance evaluations purpose, keep 400 MHz as baseline bandwidth in Table 4.
* For SLS performance evaluations purpose, keep 320 PRB for 480 kHz subcarrier spacing for 2000 MHz bandwidth as optional in Table 4.

Agreement:

* For indoor SLS performance evaluations, Indoor-A for the two operator case and Indoor-C for the single operator case are baseline scenarios in Table 5.
  + Indoor-A for the single operator case can be optionally used in the evaluations
* For indoor SLS performance evaluations purpose, the minimum distance between BS of different operators is 2 m for indoor-A and indoor-B scenario in Table 5.

Agreement:

* Indoor scenario area reduction for indoor-A and indoor-C in Table 5 is not discussed further
  + Remove FFS in the table corresponding to this

Agreement:

* The actual coding rate should be reported
* In LLS evaluation, TRS/CSI-RS is assumed to be OFF for RS overhead.
* In LLS evaluation, the assumed value of the higher layer parameter



Agreement:

* For SLS performance evaluations purpose, -71 dBm + 10 log10 (BW/2GHz) is the baseline RSRP threshold for cell selection (UE with RSRP below this threshold are not considered in simulation and not counted toward UE distribution count) in the Cell selection criteria field of Table 6.

Agreement:

* For SLS performance evaluations purpose, 1 with wrap-around is an optional number of sites in outdoor scenarios-A and B in the deployment scenario field of Table 5.
* For SLS performance evaluations purpose, the minimum distance between micro gNBs’ of the same operator is 10 m for outdoor scenarios in the deployment scenario field of Table 5.

Agreement:

* 8 Mbytes is an optional FTP traffic model packet size for SLS.

Agreement:

* Companies are encouraged to submit RSRP distribution (e.g. serving BS to UE links, BS-to-BS links, UE-to-UE links) for the evaluated scenario in SLS.

Agreement:

* Add (Mg,Ng,M,N,P) = (1,1,8,16,2) per pol with (0.5 dv, 0.5 dH) as an optional antenna setting for gNB for indoor environment.

Conclusion:

* Contributions based on optional model/scenario/parameter are not precluded from being considered for discussion and decisions on design to support NR from 52.6 GHz to 71 GHz.

Agreement:

* Proposal #9a in Section 4 of R1-2007126 is agreed.

Agreement:

* Proposal #10 in Section 4 of R1-2007126 is agreed.

Agreement:

* Fixed UE antenna orientation should be used for Indoor factory scenario
* UE antenna orientation should be randomized between [0°, 360°) in the horizontal plane in each SLS evaluation simulation drop for scenarios other than the Indoor factory scenario.
  + Fixed UE antenna orientation can be optionally used in SLS evaluations

Agreement:

* For SLS evaluation purpose, the following is assumed as the channel model for UE-to-UE links.
  + InH open office: InH – office channel model with LOS probability for indoor - mixed office from TR38.901

Agreement:

* For SLS evaluation purpose, the following is assumed as the channel model for gNB-to-UE and gNB-gNB links.
  + InH open office: InH – office channel model with LOS probability for indoor - open office from TR38.901
    - Indoor – mixed office from TR38.901 can be optionally used for the LOS probability

Agreement:

* For SLS evaluation purpose, the following is assumed as an optional model for UE-to-UE links in Dense Urban scenario.
  + UMi street canyon channel & PL model from TR38.901

Working assumption:

* For SLS evaluation purpose, for the D2D channel model for UE-to-UE links in Dense Urban scenario, the outdoor to outdoor model should be used.
  + Companies should report how they scaled the model to 60 GHz.

#### 2.1.2 Remaining Open issues

Study of required changes to NR using existing DL/UL NR waveform to support operation between 52.6 GHz and 71 GHz

* Study of applicable numerology including subcarrier spacing, channel BW (including maximum BW), and their impact to FR2 physical layer design to support system functionality considering practical RF impairments [RAN1, RAN4].
* Identify potential critical problems to physical signal/channels, if any [RAN1].

Study of channel access mechanism, considering potential interference to/from other nodes, assuming beam based operation, in order to comply with the regulatory requirements applicable to unlicensed spectrum for frequencies between 52.6 GHz and 71 GHz [RAN1].

### 2.2 RAN2

#### 2.2.1 Agreements

#### 2.2.2 Remaining Open issues

### 2.3 RAN3

#### 2.3.1 Agreements

#### 2.3.2 Remaining Open issues

### 2.4 RAN4

#### 2.4.1 Agreements

Agreement (R4-2011837)

* WF#1: Analysis of the BS antenna array (including its size, configuration, achievable gains, etc.) to be captured in the TR 38.808, considering RAN1 LL/SL assumptions on the BS antenna arrays as the starting point for further study on practical aspects of the BS antenna arrays design.
* WF#2: 52.6 – 71 GHz frequency range extract from the PA survey in [6] to be captured in the TR 38.808, to depict the achievable saturated output power versus frequency for various RF technologies.
* WF#3: It is proposed to capture in the TR 38.808 that the AAS BS architecture is considered as the baseline design for the BS operating in 52.6 – 71 GHz frequency range. Further analysis on other BS architecture options is not precluded next meeting.
* WF#4: It is proposed to capture in the TR 38.808 an observation on the BS classes. Further inputs on the BS classes analysis for 52-71 GHz range are encouraged from interested companies.
* WF#5: It is proposed to capture information on the achievable NF range values in the RAN4 part of the TR 38.808, based on reference to ETSI TR 101 854 or other technical input provided..
* WF#6: For the next meeting, collects further inputs on the key RF characteristics in 52.6-71 GHz range, as well as inputs on the (selected) BS RF requirements. Related TP(s) to be TR to be provided for next meeting, considering work-split.

Agreement (R4-2011838)

* Max FFT size: 4096 (RAN4 baseline assumption and will not be specified in any RAN4 spec)
* Channel BW
  + Maximum CBW is in [400 – 2160] MHz
  + Minimum CBW is in [50 – 800] MHz
* SCS
  + Further evaluation on feasibility of SCS from 120 to 960 kHz in the next meeting
    - Companies are encouraged to evaluate feasibility from RAN4 perspective, i.e., EVM, Timing requirement, etc.
  + FFS on 1920 kHz

Agreement (R4-2011839)

* RAN4 agrees PTRS design is RAN1 responsibility
* RAN4 is the expert group for RF and link performance and can provide feedback to RAN1 from these perspective. Such feedback should be provided when there is possible implications to RAN1 design.
* Based on simulations provided to RAN4#96-e, PTRS enhancements for frequencies > 52.6 GHz may enable better performance especially with high order modulations.
  + Include in the reply LS to RAN1 that RAN4 sees enhancements to PTRS may be useful for > 52.6 GHz and respectfully asks RAN1 to take this into account in their work.

Agreement (R4-2011840)

* WF on UE PA model for RAN4
  + For FR2 Rapp or AM/PM (simulated/measured curves) or even measurements have been used in RAN4, and they can be can be used for 52.6-71GHz range MPR/A-MPR evaluation
  + Other models are not precluded, including assessment on impact of memory effect
  + When presenting results companies should clarify which model is used, how it has been calibrated and discuss potential limitations
  + In absence of fixed requirement in 52.6-71GHz range, FR2 calibration waveform and MPR can be used as the basis for comparison. This can also be used to compare technology capability.
* WF on other UE aspects for MPR/A-MPR
  + Beyond the intrinsic PA performance and its modeling, other aspects should be considered:
    - IQ and DC impairments and their impact to IBE and EVM, and via intermodulation of those with the wanted signal, OOB emissions
    - Assumption on number of antennas and beam forming errors (phase shift errors and/or PA to PA pulling) have an influence on how to calibrate the PA output power and margin needed for a given EIRP and emission requirement
  + Companies are encouraged to provide their view on feasible DC and IQ impairments in the 52.6 to 71 GHz range and report these assumption when providing results.
  + Companies are encouraged to provide their view on practical number of antennas and beamforming errors in the 52.6 to 71 GHz range and report these assumption when providing results.

#### 2.4.2 Remaining Open issues

Study of required changes to NR using existing DL/UL NR waveform to support operation between 52.6 GHz and 71 GHz

* Study of applicable numerology including subcarrier spacing, channel BW (including maximum BW), and their impact to FR2 physical layer design to support system functionality considering practical RF impairments [RAN1, RAN4].

### 2.5 RAN5

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

### 2.6 RAN6

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

1. R1-2005239 Discussion on potential physical layer impacts for NR beyond 52.6 GHz Lenovo, Motorola Mobility
2. R1-2005240 Discussion on channel access for NR beyond 52.6 GHz Lenovo, Motorola Mobility
3. R1-2005241 PHY design in 52.6-71 GHz using NR waveform Huawei, HiSilicon
4. R1-2005242 Channel access mechanism for 60 GHz unlicensed operation Huawei, HiSilicon
5. R1-2005280 Considerations on phase noise for numerology selection FUTUREWEI
6. R1-2005282 Considerations on directional LBT and spatial reuse FUTUREWEI
7. R1-2005323 Considerations on channel access mechanism Transsion Holdings
8. R1-2005371 Discussion on requried changes to NR using existing DL/UL NR waveform vivo
9. R1-2005372 Discussion on channel access mechanism vivo
10. R1-2005373 Evaluation on different numerologies for NR using existing DL/UL NR waveform vivo
11. R1-2005543 Consideration on required changes to NR using existing NR waveform Fujitsu
12. R1-2005567 Considerations on bandwidth and subcarrier spacing for above 52.6 GHz Sony
13. R1-2005568 Channel access mechanism for 60 GHz unlicensed spectrum Sony
14. R1-2005607 Discussion on the required changes to NR for above 52.6GHz ZTE, Sanechips
15. R1-2005608 Discussion on the channel access mechanism for above 52.6GHz ZTE, Sanechips
16. R1-2005609 Preliminary simulation results for above 52.6GHz ZTE, Sanechips
17. R1-2005643 On required changes to NR using existing DL/UL NR waveform for operation in 60GHz band MediaTek Inc.
18. R1-2005699 System Analysis of NR opration in 52.6 to 71 GHz CATT
19. R1-2005700 Channel Access Mechanism in support of NR operation in 52.6 to 71 GHz CATT
20. R1-2005734 Physical layer design for NR 52.6-71GHz Beijing Xiaomi Software Tech
21. R1-2005735 Channel access mechanism for NR on 52.6-71 GHz Beijing Xiaomi Software Tech
22. R1-2005764 Study on the required changes to NR using existing DL/UL NR waveform NEC
23. R1-2005765 Study on the channel access mechanism NEC
24. R1-2005766 Required changes to NR using existing DL/UL NR waveform TCL Communication Ltd.
25. R1-2005767 Channel access mechanism TCL Communication Ltd.
26. R1-2005787 On phase noise compensation for NR from 52.6GHz to 71GHz Mitsubishi Electric RCE
27. R1-2005866 Discussion on Required Changes to NR in 52.6 – 71 GHz Intel Corporation
28. R1-2005867 Channel Access Procedure for NR in 52.6 - 71 GHz Intel Corporation
29. R1-2005868 Considerations on performance evaluation for NR in 52.6-71GHz Intel Corporation
30. R1-2005920 On NR operations in 52.6 to 71 GHz Ericsson
31. R1-2005921 Channel Access Mechanism Ericsson
32. R1-2005922 On phase noise compensation for OFDM Ericsson
33. R1-2005950 Channel access mechanisms for NR from 52.6-71GHz AT&T
34. R1-2006026 discusson on DL/UL NR waveform for 52.6GHz to 71GHz OPPO
35. R1-2006027 discussion on channel access mechanism OPPO
36. R1-2006028 discussion on other aspects OPPO
37. R1-2006136 Design aspects for extending NR to up to 71 GHz Samsung
38. R1-2006137 Channel access mechanism for 60 GHz unlicensed spectrum Samsung
39. R1-2006138 Remaining details on evaluation assumptions Samsung
40. R1-2006237 Required changes to NR using existing DL/UL NR waveform in 52.6GHz ~ 71GHz CMCC
41. R1-2006274 Discussion on required changes to NR using existing NR waveform Spreadtrum Communications
42. R1-2006275 Discussion on channel access mechanism for above 52.6GHz Spreadtrum Communications
43. R1-2006304 Consideration on required physical layer changes to support NR above 52.6 GHz LG Electronics
44. R1-2006305 Considerations on channel access mechanism to support NR above 52.6 GHz LG Electronics
45. R1-2006452 Consideration on supporting above 52.6GHz in NR InterDigital, Inc.
46. R1-2006453 On Channel access mechanisms InterDigital, Inc.
47. R1-2006454 Evaluation results for above 52.6GHz in NR InterDigital, Inc.
48. R1-2006512 On Required changes to NR above 52.6 GHz using the existing DL/UL NR Waveform Apple
49. R1-2006513 On Channel Access Mechanisms for Unlicensed Access above 52.6 GHz Apple
50. R1-2006571 Channel access mechanism Sharp
51. R1-2006628 On NR operation between 52.6 GHz and 71 GHz Convida Wireless
52. R1-2006629 On Channel Access for NR Supporting From 52.6 GHz to 71 GHz Convida Wireless
53. R1-2006649 60 GHz DL and UL waveform evaluations Charter Communications
54. R1-2006650 Channel access considerations for the indoor scenario Charter Communications
55. R1-2006655 Discussion on channel access mechanism ITRI
56. R1-2006725 Evaluation Methodology and Required Changes on NR from 52.6 to 71 GHz NTT DOCOMO, INC.
57. R1-2006726 Channel Access Mechanism for NR in 60 GHz unlicensed spectrum NTT DOCOMO, INC.
58. R1-2006727 Potential Enhancements for NR on 52.6 to 71 GHz NTT DOCOMO, INC.
59. R1-2006797 NR using existing DL-UL NR waveform to support operation between 52p6 GHz and 71 GHz Qualcomm Incorporated
60. R1-2006798 Channel access mechanism for NR in 52.6 to 71GHz band Qualcomm Incorporated
61. R1-2006853 Discussions on required changes on supporting NR from 52.6GHz to 71 GHz CAICT
62. R1-2006854 Discussions on channel access mechanism on supporting NR from 52.6GHz to 71 GHz CAICT
63. R1-2006871 Discussion on channel access mechanism for NR from 52.6GHz to 71 GHz Potevio
64. R1-2006885 Discussion on physical layer aspects for NR beyond 52.6GHz WILUS Inc.
65. R1-2006886 Discussion on channel access for NR-unlicensed beyond 52.6GHz WILUS Inc.
66. R1-2006907 Required changes to NR using existing DL/UL NR waveform Nokia, Nokia Shanghai Bell
67. R1-2006908 NR coexistence mechanisms for 60 GHz unlicensed band Nokia, Nokia Shanghai Bell
68. R1-2006909 Simulation Results for NR from 52.6 GHz to 71 GHz Nokia, Nokia Shanghai Bell
69. R1-2006928 Link level and System level evaluation for NR system operating in 52.6GHz to 71GHz Huawei, HiSilicon
70. R1-2006982 Issue Summary for physical layer changes for supporting NR from 52.6 GHz to 71 GHz Moderator (Intel Corporation)
71. R1-2006986 Discussion on Required Changes to NR in 52.6 – 71 GHz Intel Corporation
72. R1-2006989 On required changes to NR using existing DL/UL NR waveform for operation in 60GHz band MediaTek Inc.
73. R1-2006994 FL summary for channel access mechanism for 52.6GHz to 71GHz Moderator (Qualcomm)
74. R1-2007009 Summary of evaluation related issues on supporting NR from 52.6 GHz to 71 GHz Moderator (vivo)
75. R1-2007038 Discussion summary of [102-e-NR-52-71-Waveform-Changes] Moderator (Intel Corporation)
76. R1-2007046 On NR operations in 52.6 to 71 GHz Ericsson
77. R1-2007047 On phase noise compensation for OFDM Ericsson
78. R1-2007078 Discussion summary of [102-e-NR-52-71-Evaluations] Moderator (vivo)
79. R1-2007094 Email discussion summary on channel access of 52.6-71GHz band Moderator (Qualcomm)
80. R1-2007109 Discussion summary#2 of [102-e-NR-52-71-Waveform-Changes] Moderator (Intel Corporation)
81. R1-2007126 Discussion summary#2 of [102-e-NR-52-71-Evaluations] Moderator (vivo)
82. R1-2007193 Email discussion summary on channel access of 52.6-71GHz band Moderator (Qualcomm)
83. R1-2007246 Discussion summary#3 of [102-e-NR-52-71-Waveform-Changes] Moderator (Intel Corporation)
84. R1-2007289 Discussion summary#4 of [102-e-NR-52-71-Waveform-Changes] Moderator (Intel Corporation)
85. R1-2007292 Discussion summary#3 of [102-e-NR-52-71-Evaluations] Moderator (vivo)
86. R1-2007342 Discussion summary#4 of [102-e-NR-52-71-Evaluations] Moderator (vivo)
87. R1-2007364 Discussion summary #5 of [102-e-NR-52-71-Waveform-Changes] Moderator (Intel Corporation)
88. R1-2007397 Discussion summary #6 of [102-e-NR-52-71-Waveform-Changes] Moderator (Intel Corporation)
89. R4-2009562 Views on the phase noise model above 52 GHz Sony
90. R4-2009757 On phase noise and PA models in 52.6 - 71 GHz Intel Corporation
91. R4-2009758 On numerology and channel bandwidth in 52.6 - 71 GHz Intel Corporation
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93. R4-2009921 Key technology considerations relating to 52-71GHz specification Ericsson Hungary Ltd
94. R4-2009945 Initial considerations on the numerology and channel bandwidth sizes for 60GHz frequency range Apple Inc.
95. R4-2009946 Initial considerations on 60 GHz PN and PA models Apple Inc.
96. R4-2009974 Overview of SI Ericsson
97. R4-2010109 Numerology and channel BW on supporting NR from 52.6GHz to 71GHz CMCC
98. R4-2010176 On 52.6 to 71 GHz phase noise characteristics and draft LS to RAN1 Ericsson
99. R4-2010291 Discussion on system parameters for B52.6G vivo
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101. R4-2010500 Discussion on numerology and channel bandwidth for 52.6 GHz to 71 GHz Huawei, HiSilicon
102. R4-2010726 Applicable numerologies Nokia, Nokia Shanghai Bell
103. R4-2010727 Reply LS to RAN1 and NR evaluations for above 52.6 GHz Nokia, Nokia Shanghai Bell
104. R4-2010845 Key technology considerations relating to 52-71GHz specification Ericsson
105. R4-2010946 Discussion on system parameters for 52.6GHz-71GHz ZTE Corporation
106. R4-2011268 Initial discussion on the BS-related aspects for 52.6 - 71 GHz range SI Huawei
107. R4-2011292 Work plan for Study on supporting NR from 52.6 GHz to 71 GHz Qualcomm Incorporated
108. R4-2011439 Phase noise and RF impairments modeling for beyond 52GHz FUTUREWEI
109. R4-2011440 Numerology considerations for beyond 52GHz FUTUREWEI
110. R4-2011494 on PN model for 60GHz+reply LS RAN1 Huawei, HiSilicon
111. R4-2011573 Email discussion summary for [96e][140] FS\_NR\_52\_to\_71GHz Moderator (Qualcomm)
112. R4-2011837 WF on PA and antenna assumptions for 60 GHz BS Huawei
113. R4-2011838 WF on numerologies for FS\_NR\_52\_to\_71GHz Intel
114. R4-2011839 WF on PTRS evaluation and RAN4 aspects Nokia
115. R4-2011840 WF on power amplifier model in 60 GHz Skyworks
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20.04.2020 minor adaptations for RAN #88e

18.02.2020 minor adaptations for RAN #87e

14.11.2019 minor adaptations for RAN #86

18.08.2019 minor adaptations for RAN #85

12.05.2019 minor adaptations for RAN #84

27.02.2019 minor adaptations for RAN #83

21.11.2018 completion levels with colours added (for RAN #82)

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects (for RAN #81)

v04.80 21.05.2018 minor adaptations for RAN #80

v04.79 26.02.2018 minor adaptations for RAN #79

v04.78 18.11.2017 minor adaptations for RAN #78

v04.77 06.08.2017 minor adaptations for RAN #77

v04.76 15.05.2017 minor adaptations for RAN #76

v04.75 31.01.2017 minor adaptations for RAN #75

v04.74 28.10.2016 minor adaptations for RAN #74

v04.73 01.09.2016 adaptations for RAN #73 (time units in extra Excel table, RAN6 reporting included)

v04.72 26.05.2016 adaptations for RAN #72 (introduction of NR & GERAN TUs)

v04.71 10.02.2016 minor adaptations for RAN #71

v04.70 30.10.2015 minor adaptations for RAN #70

v04.69 12.08.2015 minor adaptations for RAN #69

v04.68 21.05.2015 minor adaptations for RAN #68

v04.67 01.02.2015 minor adaptations for RAN #67

v04.66 16.11.2014 minor adaptations for RAN #66

v04.65 16.08.2014 minor adaptations for RAN #65

v04.64 22.05.2014 minor adaptations for RAN #64

v04.63 24.01.2014 restructuring for RAN #63 to cover Core & Perf. in one doc file

v03.62 11.11.2013 section 1.2.3 adapted for RAN #62

v03 11.08.2013 section 1.2.3 added on time budget

v02 07.05.2010 history added, some spelling corrections

v01 13.11.2009 First version of the template