3GPP TSG-RAN WG Meeting #90-e
e-Meeting, December 7th–11th, 2020

RP-202643

WID scope for Rel-17 NR from 52.6GHz to 71 GHz

TR conclusion and recommendation

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- RAN1 part of study item on supporting NR from 52.6 GHz to 71GHz is completed. The outcome of SI is captured in TR38.808
- The study included
  - applicable numerology including subcarrier spacing, channel BW (including maximum BW), and their impact physical layer design
  - channel access mechanism, considering potential interference to/from other nodes, assuming beam-based operation.
- TR recommends to support 120 kHz subcarrier spacing with normal CP length, and at least one and at most two additional subcarrier spacing among 240 kHz, 480 kHz, and 960 kHz. It is not recommended to consider support of only 240 kHz SCS for PDCCH/PDSCH/PUCCH/PUSCH in addition to 120 kHz in TR38.808.
- TR recommends to support both channel access with LBT mechanism(s) and a channel access mechanism without LBT for gNB and UE to initiate a channel occupancy.

WID Scope

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- It is suggested to down select the subcarrier spacing candidates in RAN#90e to ease discussion in WG.
  - Dependent on the subcarrier spacing candidate, the list of potential physical layer impacts has different scope even though some potential physical layer impacts maybe common to several candidates
  - Without down selection of subcarrier spacing candidate, the expected work in WI would be prolonged considering the wide and different scope of areas and further investigation/study phase due to candidate list
  - If a down selection of subcarrier spacing candidate cannot be done in RAN#90e, then it is suggested to state a completion time (i.e., the 1st quarter of the WI) to finalize the selection of subcarrier spacing so that the scope of further study and specification work can be reduced.
- Support enhancement on the following areas in addition to current WID RP-193229:
  - PRACH design including RO configuration
  - Multi-PDSCH/PUSCH scheduling
  - PDCCH monitoring and coverage enhancement, if needed
  - Enhancements to PTRS and DMRS, if needed
  - PUCCH enhancement, if needed
- Support both channel access with LBT mechanism(s) and a channel access mechanism without LBT

WID revision based on RP-193229

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- Physical layer aspects including [RAN1]:
  - New numerology or numerologies (μ value in 38.211) for operation in this frequency range. Addressing impact on physical signals/channels if any, as identified in the SI.
    - Finalize the selection of one or two new numerologies among 240, 480 and 960KHz SCS in addition to 120KHz by RAN#91e
    - PRACH design including RO configuration
    - Multi-PDSCH/PUSCH scheduling
    - Enhancements to PTRS and DMRS, if needed
    - PDCCH monitoring and coverage enhancement, if needed
    - PUCCH enhancement, if needed
  - Time line related aspects adapted to each of the new numerologies, e.g., BWP and beam switching times, HARQ scheduling, UE processing, preparation and computation times for PDSCH, PUSCH/SRS and CSI, respectively.
  - SSB enhancements (SSB pattern in time domain, multiplexing pattern and etc.) for new subcarrier spacing(s) to support of up to 64 SSB beams for licensed and unlicensed operation in this frequency range.
- Physical layer procedure(s) including [RAN1]:
  - Channel access mechanism assuming beam based operation in order to comply with the regulatory requirements applicable to unlicensed spectrum for frequencies between 52.6GHz and 71GHz. Specify, if needed, the details of LBT bandwidth, mode switching, ED threshold, relationship between LBT beam(s) and transmission beam(s), receiver assistance in channel access.
- Radio interface protocol architecture and procedures [RAN2]:
  - For operation in unlicensed spectrum in this frequency range: Protocol aspects, as required, to specify the channel access mechanism for unlicensed operation in this frequency range.
- Core specifications for UE, gNB and RRM requirements [RAN4]:
  - Specify new band(s) for the frequency range from 52.6GHz-71GHz. The band(s) definition should include UL/DL operation and excludes ITS spectrum in this frequency range.
  - Specify gNB and UE RF core requirements for the band(s) in the above frequency range, including a limited set of example band combinations (see Note 1).
  - Specify RRM/RLM core requirements.
- Note 1: The WI can be completed provided requirements for at least one band combination involving a new NR-U band is specified as long as it is in line with country-specific regulatory directives.

Annex: Selected RAN1 conclusions

Annex: Identified PHY impacts for subcarrier spacing candidate (1)

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- A list of potential physical layer impacts for each subcarrier spacing candidate is identified
- For 120 kHz subcarrier spacing:
  - Potential consideration of PTRS enhancement for CP-OFDM and DFT-s-OFDM, if needed.
- For 240 kHz subcarrier spacing:
  - Potential consideration of PTRS enhancement for CP-OFDM and DFT-s-OFDM, if needed,
  - If common SSB/CORESET#0 numerology (240/240) is supported, SSB patterns, and CORESET#0 configuration,
  - RO configuration,
  - Timelines for scheduling, processing and HARQ,
  - Potential enhancement to DM-RS, if needed,
  - PDCCH monitoring.

Annex: Identified PHY impacts for subcarrier spacing candidate (2)

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- For 480 kHz subcarrier spacing:
  - If 480 kHz SSB is supported, SSB patterns, and CORESET#0 configuration,
  - Timelines for scheduling, processing and HARQ,
  - RO configuration,
  - Potential enhancement to DM-RS, if needed,
  - PDCCH monitoring,
  - Potential consideration of PTRS enhancement for CP-OFDM and DFT-s-OFDM, if needed.
- For 960 kHz subcarrier spacing:
  - Potential consideration of ECP, if needed, depending on deployment scenarios,
  - If 960 kHz SSB is supported, SSB patterns, and CORESET#0 configuration,
  - Timelines for scheduling, processing and HARQ,
  - RO configuration,
  - Potential enhancement to DM-RS, if needed,
  - PDCCH monitoring,
  - Potential updates to smallest time unit, Tc, used in specifications depending on supported maximum carrier BW.

Annex: Physical layer impacts to synchronization and random access

- SSB enhancements for subcarrier spacing larger than 120kHz includes
  - 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 PRACH enhancement:
  - TR recommends support of longer PRACH sequence lengths, L=571 and L=1151, defined in Rel-16 NR specification, to be used for NR operating in 52.6 GHz to 71 GHz.
  - TR recommends not to support interlace design for PRACH for NR operating in 52.6 GHz to 71 GHz.
  - TR recommended to further investigate whether or not to support configurations that enable non-consecutive RACH occasions in time domain to aid LBT processes if LBT is required.

Annex: Physical layer impacts to control and data channels

- For PDCCH enhancement:
  - TR identified that the potential enhancements to PDCCH monitoring including potential limitation to UE PDCCH configuration, multiple PDSCH/PUSCH scheduling with a single DCI (using existing DCI formats or new DCI format(s)), spatial relation management for GC-PDCCH, capability related to PDCCH monitoring, and PDCCH coverage should be further investigated for higher subcarrier spacing, including the need for such enhancements.
- For PUCCH enhancement,
  - it is suggested to further investigate potential enhancements to PUCCH to enable higher transmission power when regulatory limits apply.
  - Further potential enhancements to spatial relation management for configured and/or semi-persistent UL signals/channels may be considered.
- For PDSCH/PUSCH
  - TR recommends to study frequency and/or time domain scheduling enhancements for PDSCH/PUSCH, if needed. It is also suggested to further investigate multi-PDSCH/PUSCH scheduling and standardization, if needed
  - Potential changes to PTRS, if needed
  - Potential changes to DMRS, if needed

Annex: Physical layer impacts to beam management and procedure

- For beam management enhancement:
  - Further investigate potential enhancements, if needed, to beam management at least considering one or more of potentially narrower beamwidths, CP duration, multiple beam indications for multi-PUSCH/PDSCH scheduling, triggering of reference signals for beam management, enhancements to beam management for random access procedure, intra- and/or inter-cell mobility, and adaptation to LBT failures.
- For procedure enhancement:
  - Potential enhancements, including, LBT mode and no-LBT mode support, LBT bandwidth, ED threshold definition, short control signal usage, relationship between LBT beam(s) and transmission beam(s), receiver assistance in channel access.

THANK YOU