



3GPP TSG RAN Rel-19 workshop

Taipei, June 15 - 16, 2023

Agenda Item: 5

Source: Apple

RWS-230278

# Views on Sidelink Enhancements for R19

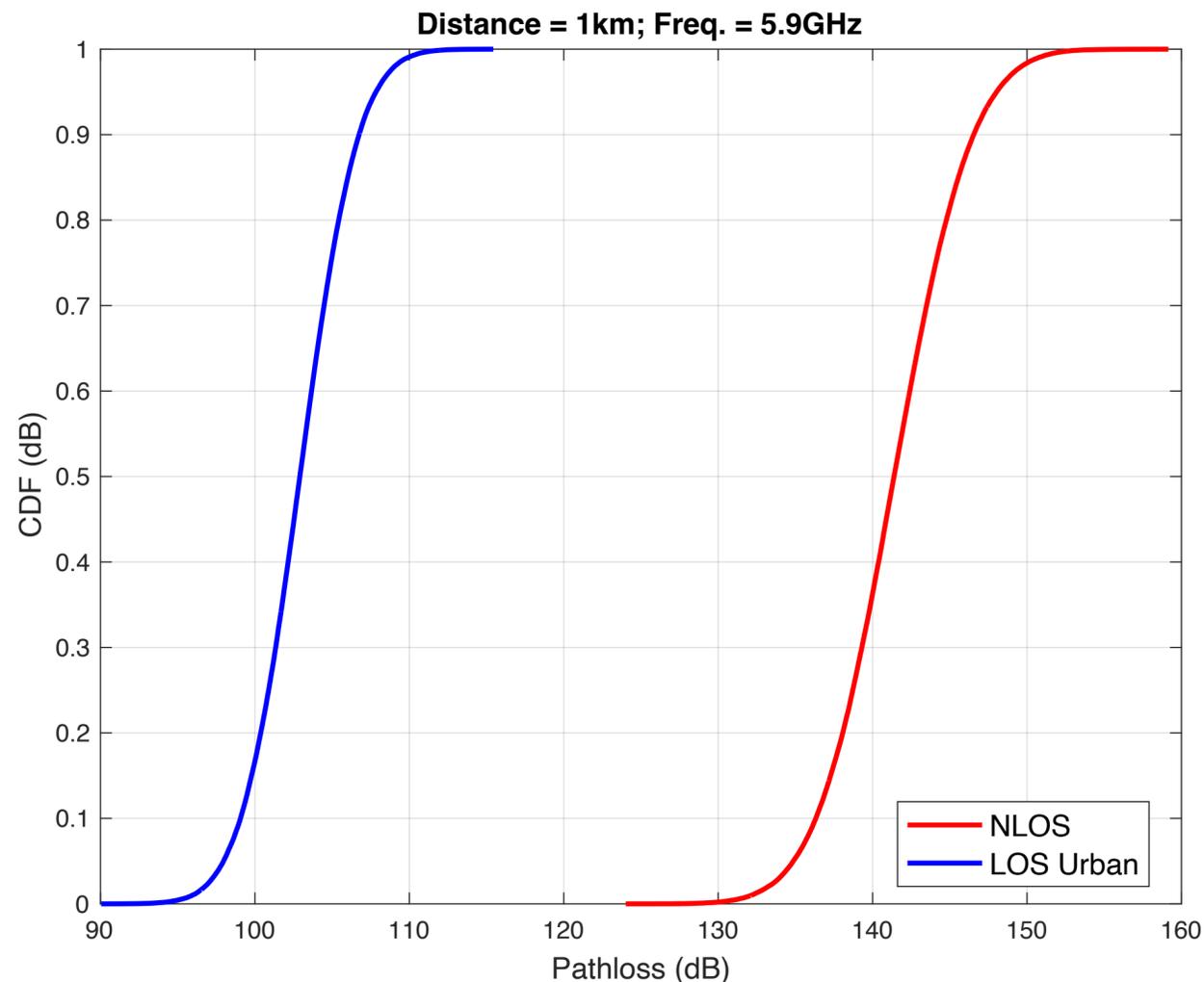
# Rel-19 NR Sidelink | Sidelink Coverage Enhancement

---

- 3GPP (LTE/NR) D2D solutions, designed since 2012, are not adequately commercially deployed, but with great potential
  - NR sidelink enhancement should focus on the new use cases such as
    - New commercial use case including device to device communication with handheld devices
    - New device types such as wearable
- NR sidelink design has **unsolved coverage concern**
  - To achieve 1 km coverage requirement in 5.9GHz ITS band as required by TS 22.186
    - More than **145 dB pathloss** can be expected at 1 km based on channel model in TR 37.885
  - We also need to consider the receiver loss of sidelink device compared to gNB
    - More than **20 dB loss** can be expected, 12-21 dB due to the antenna gain loss and 4 dB noise figure loss
  - **Additional antenna gain loss** for wearable devices due to form factor constraint.
  - NR sidelink PHY channel design cannot even achieve the same coverage as Uu design



# Rel-19 Sidelink | Sidelink Coverage Enhancement



Pathloss for NR V2X at 1000 meters and 5.9GHz frequency band

- For NLOS, even at 90%, the pathloss can be more than 145 dB
- Compared to the Uu channel design, we also need to account for the receiver performance loss especially when the receiver is a normal cellular phone.

Design Aspect	NR Uu as of Rel-18	NR Sidelink as of Rel-18	Comments
Waveform & Modulation	Uplink supports DFT-s-OFDM with Pi/2 BPSK modulation	Only CP-OFDM is supported	NR Sidelink suffers additional coverage loss due to increased PAPR
SYNC Signal PSS/SSS for Uu S-PSS/SSS for Sidelink	1 symbol PSS and 1 symbol SSS per SSB Multiple SSBs per transmission Typically 20ms periodicity	2 symbol S-PSS and 2 symbol S-SSS per SSB Multiple SSBs per transmission 160ms periodicity	NR Sidelink may suffer additional coverage loss due to the longer periodicity
Broadcasting Channel PBCH for Uu PSBCH for Sidelink	3 symbol PBCH per SSB Multiple SSBs per transmission Typically 20ms periodicity	7(ECP)/9(NCP) symbol PBCH per SSB Multiple SSBs per transmission 160ms periodicity	NR Sidelink may suffer additional coverage loss due to the longer periodicity
Data Channel PUSCH/PDSCH for Uu PSSCH for Sidelink	Slot aggregation is allowed for up to 16 times	Slot aggregation is not allowed	NR Sidelink suffers additional coverage loss due to the lack of repetition
Feedback Channel PUCCH for Uu PSFCH for Sidelink	Both long format (1, 3, 4) and short format (0, 2) are supported PUCCH repetition up to 8 times	Only short format (like PUCCH format 0) is supported No repetition	NR Sidelink suffers additional coverage loss due to the lack of support of long format and repetition
Control Channel PDCCH for Uu PSCCH for Sidelink	Up to 3 symbols CORESET	Up to 3 symbols PSCCH Stage 1 SCI	-

Comparison of NR Uu and NR Sidelink RAN1 Design



# Rel-19 NR Sidelink | Sidelink Coverage Enhancement

---

- In Rel-19, NR sidelink enhancement shall focus on enhancing the coverage of the sidelink, including the following areas
  - Low frequency license-free bands support, For example:
    - Unlicensed band @2.4GHz
    - 900 MHz ISM in US
    - 446/666 MHz in EU
  - Physical layer enhancement (coverage enhancement technologies for sidelink) including
    - Allow time domain repetition for control and data channel
    - Long PSFCH format
    - Increased repetition and reduced periodicity of SL PSS/SSS/PBCH
    - Consider low PAPR waveform and/or modulation



# Rel-19 NR Sidelink | Sidelink Operation in FR2

---

## ■ Justification

- Enhanced sidelink operation in FR2 licensed spectrum is studied in Rel-18 sidelink
  - Study is limited to the support of sidelink beam management (including initial beam pairing, beam maintenance and beam failure recovery) for sidelink unicast only
- Sidelink operations on FR1 unlicensed spectrum is specified in Rel-18

## ■ Objectives

- Specify enhanced sidelink operations on FR2 licensed spectrum with the support of sidelink beam management for sidelink unicast
  - Reference signals, initial beam pairing, beam maintenance and beam failure recovery.
- Study and specify (if needed) further enhanced sidelink operations on FR2 spectrum
  - Resource allocation enhancement in beam based operations
  - Enhanced sidelink operations on **FR2 unlicensed** spectrum
    - Update **evaluation methodology** for commercial deployment scenario
    - **Channel access** mechanisms
    - **Physical channel design framework**: Required changes to NR sidelink physical channel structures and procedures to operate on FR2 unlicensed spectrum
  - Sidelink beam management for **sidelink groupcast**



# Sidelink Evolution | Sidelink CA Operation

---

- Justification

- Sidelink CA operation was listed as an objective in Rel-18 sidelink WID
  - The specification work was not conducted in RAN1 until sidelink co-channel coexistence objective is finished
- Increased sidelink data rate is an importance requirement for commercial sidelink applications

- Objectives

- Specify mechanism to support NR sidelink CA operation based on LTE sidelink CA operation
  - The work focuses on **FR1 licensed spectrum and ITS band**, with potential extension to FR2 licensed spectrum if time allows
  - Enhance LTE sidelink CA features for NR (e.g., carrier (re)selection, synchronization of aggregated carriers, handling limited capability, packet duplication, power control, etc.)
  - Feedback enhancement (e.g., HARQ-ACK, CSI, power control, etc) in sidelink CA
  - This feature is backwards compatible
    - A Rel-16/17/18 UE can receive Rel-19 sidelink unicast/groupcast transmissions with CA for the carrier on which it receives PSCCH/PSSCH and transmits the corresponding sidelink HARQ feedback



