3GPP TSG RAN Rel-18 workshop RWS-210502
Electronic Meeting, June 28 - July 2, 2021
Agenda Item: 4.2
Source: Apple

NR Sidelink Further Enhancement in Rel-18

Apple Confidential

Sidelink| 3GPP Standardizations

R12 WI: LTE D2D
- Synchronization scheme
- Discovery (in coverage, commercial)
- Direct communication: group/broadcast (in/partial/out of coverage, public safety)

R14 WI: LTE V2X
- SC-PTM and MBSFN for V2X
- SL SPS
- Support of P-UEs (random resource allocation, authorization)
- Coexistence with DSRC
- Uu and PC5 signaling
- Tx power and QoS

R16 SI: NR V2X
- Sidelink design
- Uu enhancements
- Uu-based SL resource allocation/configuration
- RAT selection
- QoS management
- Coexistence

R17 WI: NR SL Enh.
- Resource allocation for power saving
- Inter-UE coordination
- SL DRX
- New SL freq. bands

R17 SI/WI: NR SL Relay
- Layer 2 or Layer 3
- UE-to-NW
- Discovery

2014/03 - 2015/03

2016/06 - 2017/03

2018/06 - 2019/03

2020/06 - 2021/06

2012/12 - 2014/03

2014/12 - 2016/06

2017/03 - 2018/06

2019/03 - 2020/06

R12 SI: LTE D2D
- Synchronization scheme
- Discovery (in coverage, commercial)
- Direct communication: group/broadcast (in/partial/out of coverage, public safety)

R13 WI: LTE eD2D
- Discovery (partial/out of coverage, public safety)
- Direct communication: L3 UE to NW relay (unicast, partial/out of coverage, public safety)
- QoS handling on PC5 interface: Prose per-packet priority indication from data packet

R15 WI: LTE V2X Phase 2
- PC5 Enh. (CA, 64QAM, latency reduction, resource pool sharing)
- Transmit diversity

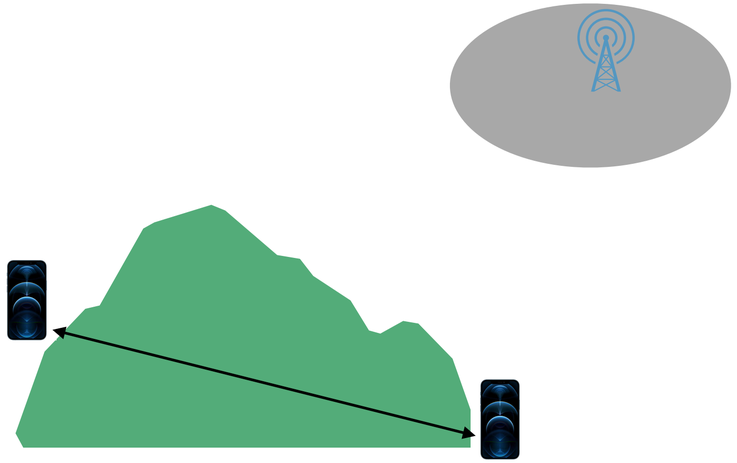
R16 WI: NR V2X
- SL signals, channels, BWP, resource pools
- Resource allocation
- SL synchronization
- In-device coexistence
- Physical layer procedures
- Congestion control
- L2/L3 protocols and signaling

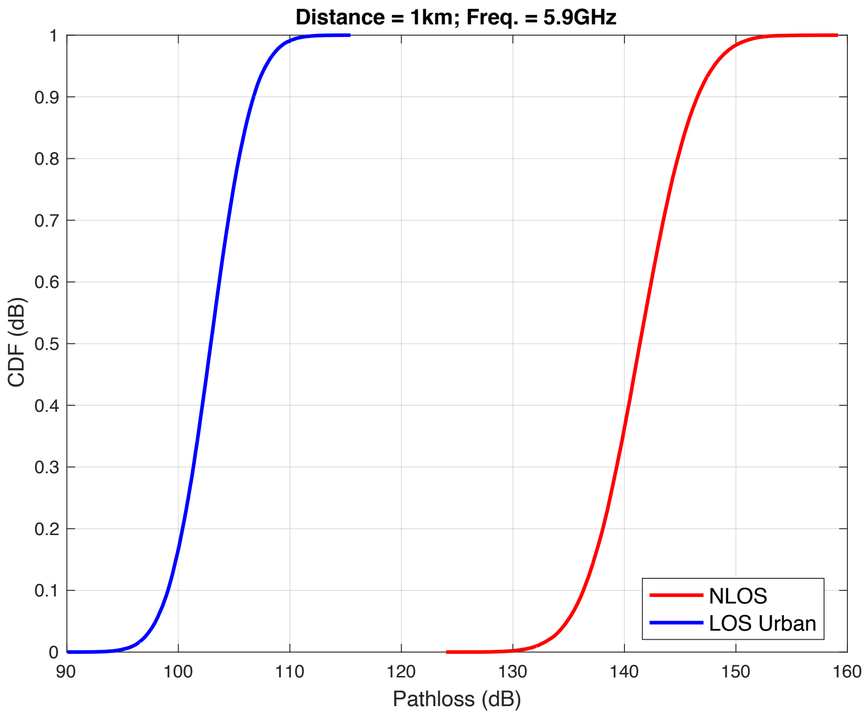
Sidelink | Background

- LTE sidelink
  - Broadcast; periodic traffic
  - R14 V2X
    - Basic sidelink physical layer signals, channels, synchronization and procedures
    - Resource allocation, including supporting power-saving UEs
  - R15 V2X
    - PC5 enhancement: carrier aggregation, 64QAM, latency reduction, resource pool sharing
- NR sidelink
  - Broadcast, groupcast, unicast; both periodic and aperiodic traffic
  - R16 V2X
    - Basic sidelink physical layer signals, channels, synchronization and procedures
    - Resource allocation
    - In-device coexistence; congestion control
  - R17 sidelink
    - Resource allocation for power saving
    - Inter-UE coordination
    - Sidelink DRX

Sidelink | Coverage Enhancement (1/2)

- Justification
  - R16/17 sidelink targets the coverage of 1000m
  - Exist usage scenario requires larger sidelink coverage
    - Without gNB coverage
    - Hiking with friends, cruise ship on the sea





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.

Sidelink | Coverage Enhancement (2/2)

Design Aspect	NR Uu as of Rel-16	NR Sidelink as of Rel-16	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	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	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	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	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	Up to 3 symbols CORESET	Up to 3 symbols PSCCH Stage 1 SCI	-

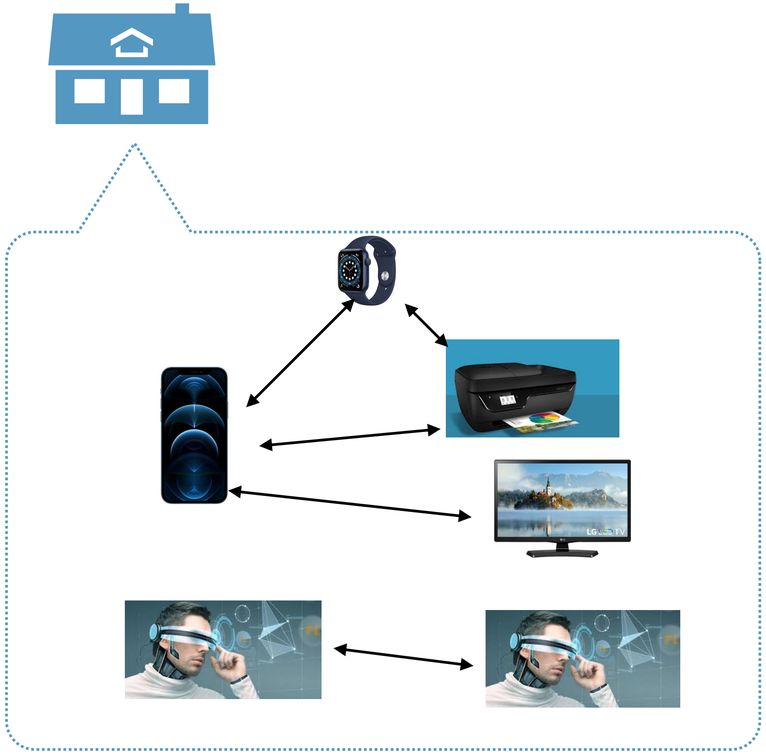
Comparison of NR Uu and NR Sidelink RAN1 Design

- Objectives
  - Long PSFCH format
  - Shorter S-SSB periodicity
  - Sidelink slot aggregation, including PSCCH/PSSCH and PSFCH

Sidelink | Sidelink Multi-carrier Operation

- Justification
  - R16/17 sidelink only focuses on a single carrier
  - Exist some services with higher sidelink data rate requirements (>1 Gbps), more reliable and more spectrum efficient sidelink transmissions
    - NCIS: network control interactive service: SA1 TR 22.842

- Objectives
  - Multiplexing of different services on different carriers
  - S-SSB transmissions over multiple carriers
  - Carrier and resource selection procedure on multiple carriers
  - Packet duplication at PDCP layer



Higher data rate and more reliable sidelink transmissions

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