

3GPP TSG RAN Meeting #102 meeting
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Edinburgh, GB, December 11–15, 2023
Agenda item: 9.1.1.9
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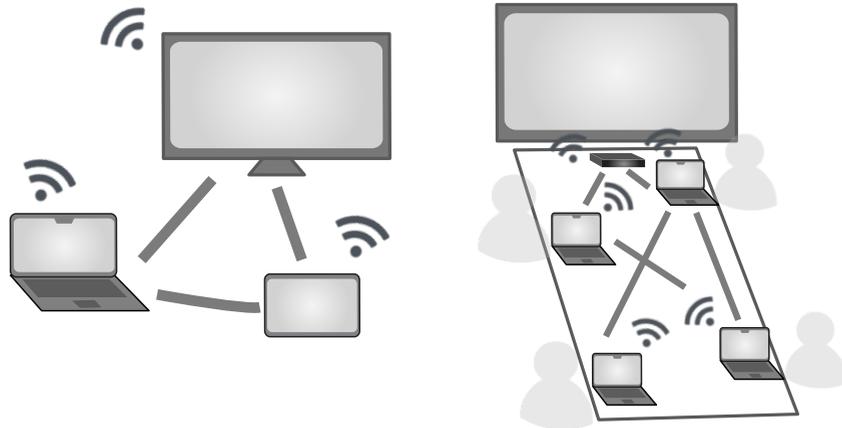
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Views on Additional RAN1-led Topics: Study Proposal of Sidelink Evolution above 30 GHz For Internet of Everything

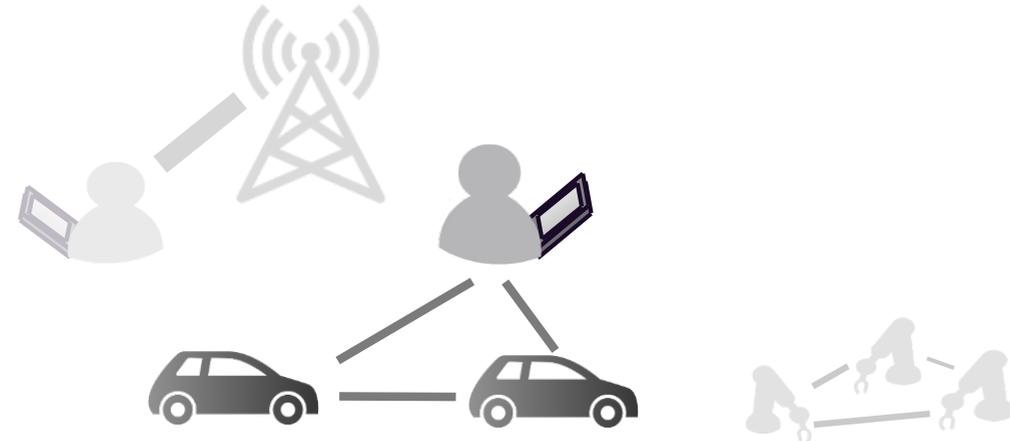
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We consider **sidelink with a higher frequency band should be used to connect things (i.e., **IoE**)** with high rate and/or low latency, thereby creating new NR use cases and markets.

Examples



Short-range personal area networking



V2X communications

and more

This contribution proposes to recheck and study the applicability of the evaluation methodology to upcoming IoE applications with the usage of band sidelink communications above 30 GHz.

□ Evaluation methodology [1, RAN1#110bis-e]

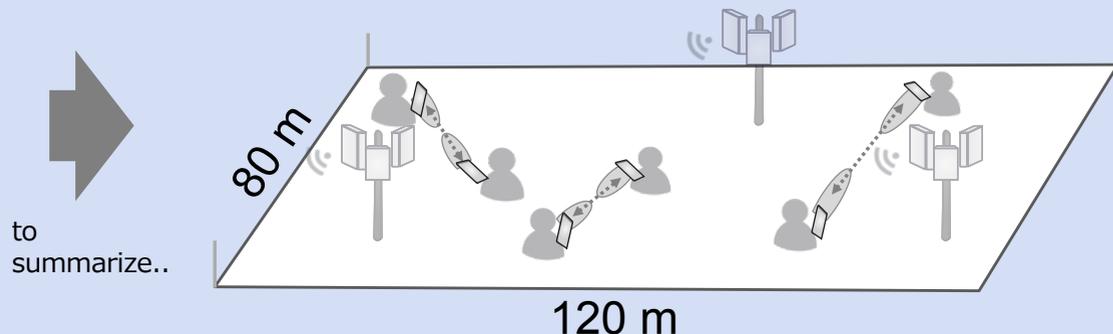
- ◆ Channel Model: Reusing InH office & UMi street canyon in TR 38.901 [2], Rejection of V2X channel
- ◆ System parameters: Carrier 30GHz, SCS 120kHz (baseline) or 60kHz (optional), BW 100MHz (baseline) or 200MHz (optional), UE speed 3km/h, TP 23dBm
- ◆ Topology: Consideration on UE pairs, Rejection of cluster-based topology.

Observation 1

Channel Model: The current evaluation methodology for FR2 sidelink is largely based on the channel model in TR38.901. Moreover, inclusion of V2X channels were rejected.

System Parameters: Lower SCS and bandwidths for mmWaves, human walking speed, and higher TP for commercial devices are observed.

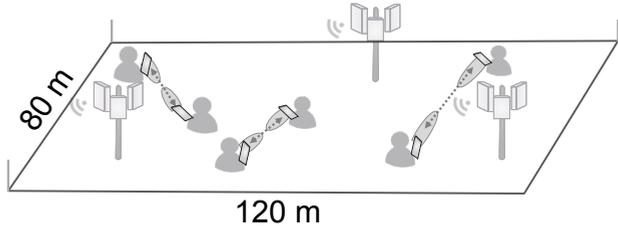
Topology: Only point-to-point communication. Point-to-multipoint topology is not considered.



◆ Forecasted systems:

- Operated in licensed band,
- Used in a large office
- Data rate of 100 Mbps-1Gbps order,
- Capability of tracking mobility,
- Large battery usage. Point-to-point

Methodology led by RAN1 in Rel. 18



◆ Channel model: TR 38.901 (Large room for indoor)

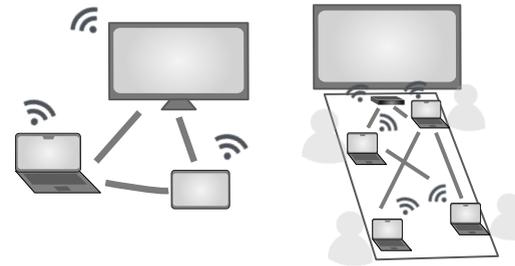
◆ Parameters:

- Carrier: 30 GHz, BW: 100MHz, SCS: 120kHz, UE speed: 3km/h, TP 23 dBm

◆ Forecasted systems:

- Operated in licensed band,
- Used in a large office
- Data rate of 100 Mbps-1Gbps order,
- Capability of tracking mobility,
- Large battery usage.
- Point-to-point

Requirements and required parameters for short-range personal area networking



Short-range personal area networking

◆ System requirements:

- Data rate of 1Gbps-10Gbps order (to transmit 4K streaming data).
- Low battery usage
- Operated in short-range, small room/personal area
- w/o mobility
- Point-to-multipoint

◆ Required parameters:

- should include **unlicensed band** to reach the data rate;
- should use **X GHz** BW and **XX MHz** SCS to reach data rate and low FFT size;
- need **not intensively track mobility**
- should **not be w/ large TP**
- should include **cluster-based topology**

◆ Channel Model:

- should be applicable to **smaller room**

Methodology led by RAN1 in Rel. 15



◆ **Channel model:** TR 38.901
(Large room for indoor)

◆ **Parameters:**

- Carrier: 30 GHz, BW: 100MHz, SCS: 120kHz, UE speed: 3km/h, TP 23 dBm

◆ **Forecasted systems:**

- Operated in licensed band,
- Used in a large office
- Data rate of 100 Mbps-1Gbps order,
- Capability of tracking mobility,
- Large battery usage.
- Point-to-point

Observation 2

Current channel model & considered parameter largely fall short of indoor short-range applications.

(c.f.) IEEE 802.15.3c OFDM [3], which targets same use case.

- Carrier: 60 GHz
- BW: 2.16 GHz
- SCS: 5.15 MHz
- Topology: Star (cluster-based) topology
- TP: approx. 10 dBm

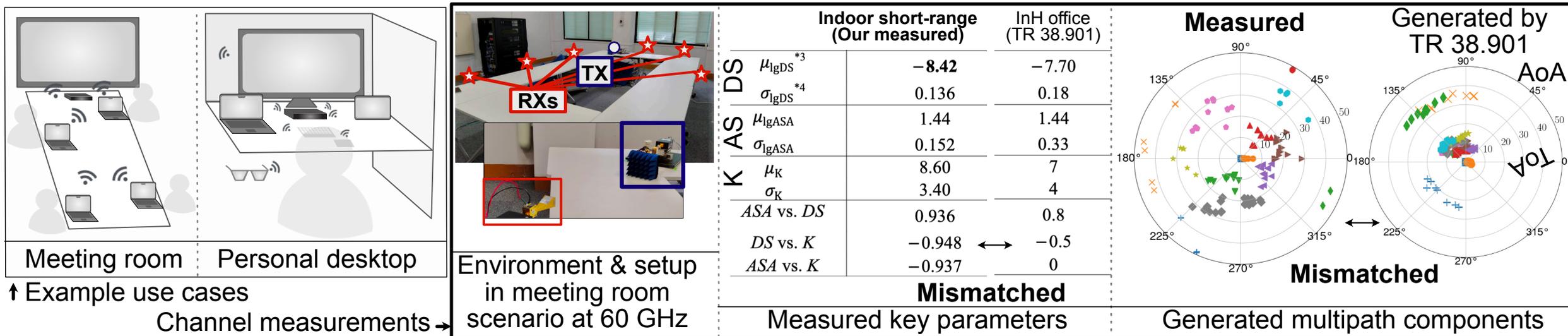
◆ **Required parameters:**

- should include **unlicensed band** to reach the data rate;
- should use **X GHz** BW and **XX MHz** SCS to reach data rate and low FFT size;
- need **not intensively track mobility**
- should **not be w/ large TP**
- should include **cluster-based topology**

◆ **Channel Model:**

- should be applicable to **smaller room**

Our recent channel measurement [4, 5] dictates Observation 3.

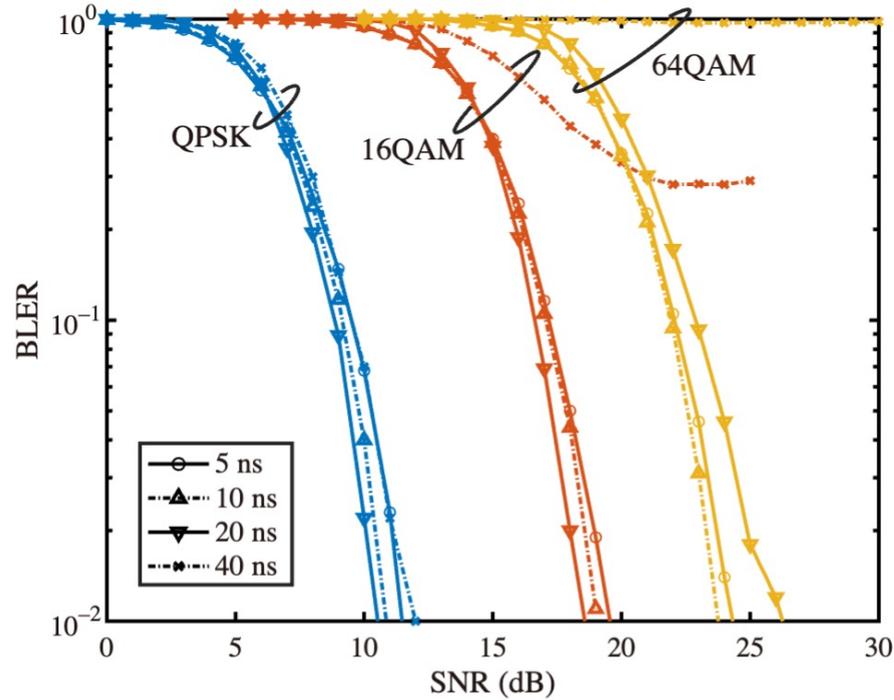


Observation 3

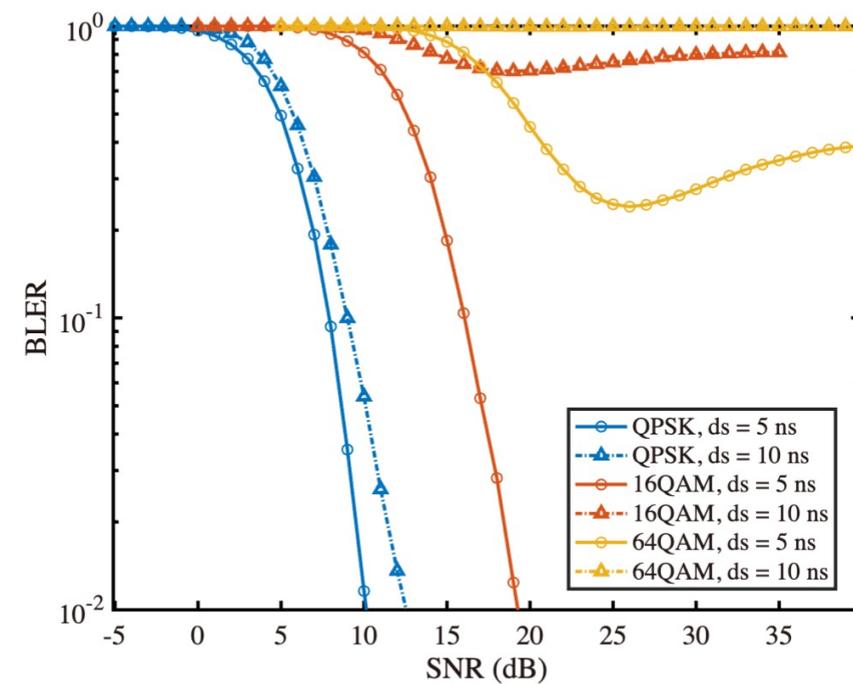
The channel parameters and generation framework of TR 38.901 InH office are **not applicable to the personal area sidelink communication in indoor short-range.**

The applicability of the channel parameters and channel generation framework in TR 38.901 to indoor short-range sidelink communications should be rechecked and studied. Thereby, the need for new parameter definitions should be clarified.

□ SCS: 960 kHz, BW: 2 GHz, FFT size (2048)



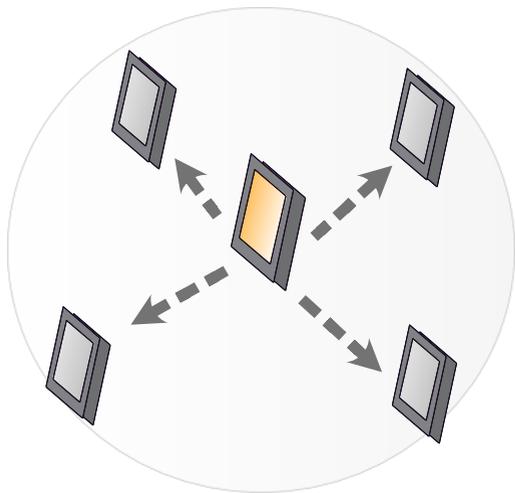
□ SCS: **5.15 MHz**, BW: 2 GHz, FFT size (**512**)



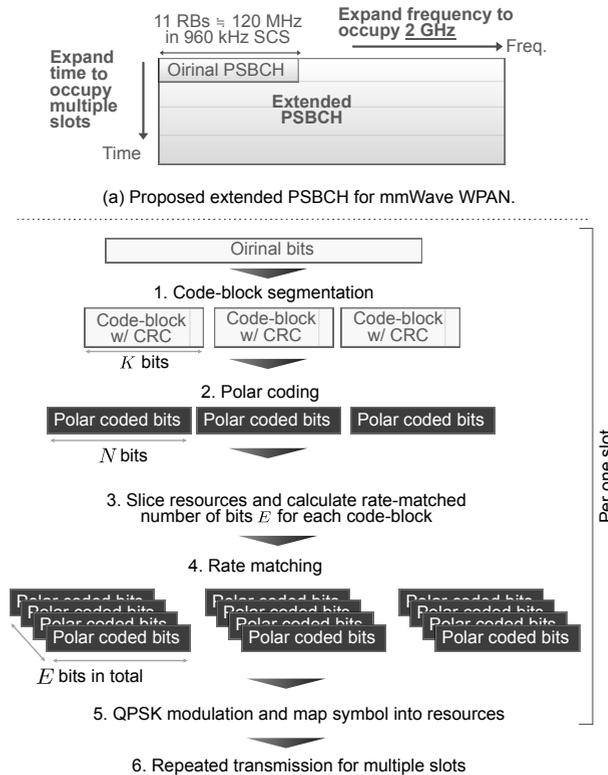
Observation 4

BLER of 10^{-1} is achievable in MHz-level subcarrier spacing in delay spread of up to 10 ns. (NOTE: The value of delay spread is realistic, which was shown in our measurement [4].)

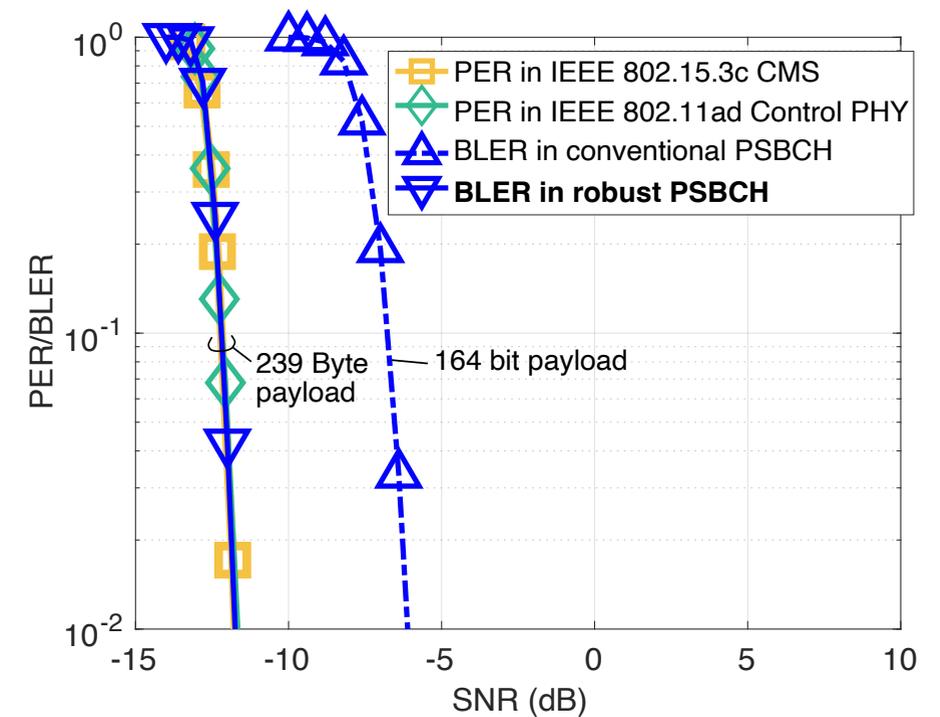
- Scenario: The hub UE broadcasts frames to device discovery and groupcast information



- Robust PSBCH-based broadcast signal transmission



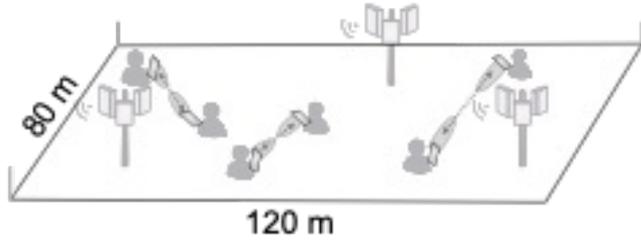
- Link-level simulation results in AWGN



Observation 5

- Current PSBCH is not as robust as the IEEE 802.15.3c/802.11ad broadcast signal.
- The same performance can be achievable by extending the occupied PSBCH resources.

❑ Methodology led by RAN1 in Rel. 18



- ◆ **Channel model:** TR 38.901 (Large room for indoor)

◆ **Parameters:**

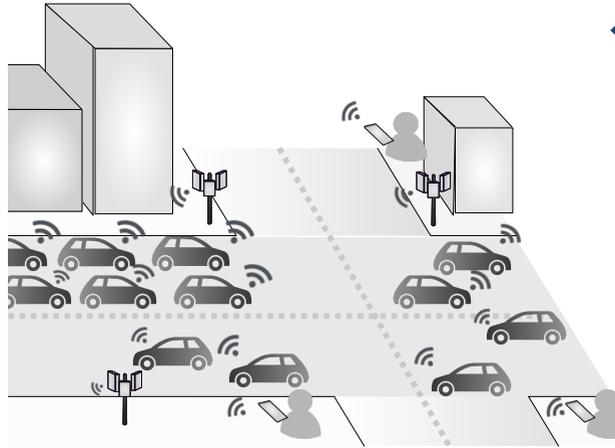
- Carrier: 30 GHz, BW: 100MHz, SCS: 120kHz, UE speed: 3km/h, TP 23 dBm

◆ **Forecasted systems:**

- Operated in licensed band,
- Used in a large office
- Data rate of 100 Mbps-1Gbps order,
- Capability of tracking mobility,
- Large battery usage.
- Point-to-point



❑ Requirements and required parameters for V2X



◆ **System requirements:**

- Data rate depends on carried data
- Operated in urban/highway
- w mobility
- Mix of point-to-point/point-to-multipoint
- Cooperation of 60 GHz radar
- Lower latency

◆ **Required parameters:**

- should include **unlicensed band** to cooperate w/ radar
- should **track mobility of up to 60 km/h (urban) & 100 km/h (highway)**
- should include both point-to-point and cluster-based topology
- should include higher SCS to reach low latency

◆ **Channel Model:**

- should be applicable to **urban and highway as in TR 37.885**

❑ Methodology led by RAN1 in Rel. 14



◆ **Channel model:** TR 38.901
(Large room for indoor)

◆ **Parameters:**

- Carrier: 30 GHz, BW: 100MHz, SCS: 120kHz, UE speed: 3km/h, TP 23 dBm

◆ **Forecasted systems:**

- Operated in licensed band,
- Used in a large office
- Data rate of 100 Mbps-1Gbps order,
- Capability of tracking mobility,
- Large battery usage.
- Point-to-point

Observation 6

Current channel model & considered parameter also largely fall short of V2X applications.



- Operated in urban/highway
- w mobility
- Mix of point-to-point/point-to-multipoint
- Cooperation of 60 GHz radar

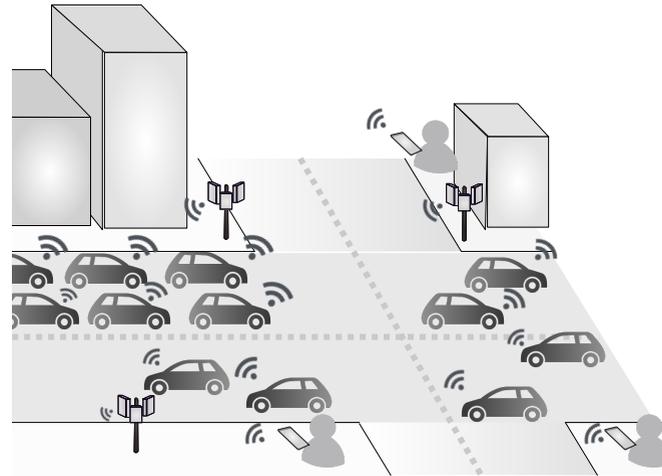
◆ **Required parameters:**

- should include **unlicensed band** to cooperate w/ radar
- should **track mobility of up to 60 km/h (urban) & 100 km/h (highway)**
- should include both point-to-point and cluster-based topology
- should include higher SCS to reach low latency

◆ **Channel Model:**

- should be applicable to **urban and highway as in TR 37.885 [7]**

- One of the main use cases of sidelink communication has been V2X since Release 14. We consider that the high-frequency band can be particularly leveraged in congested intersection areas to provide a sufficient bandwidth to accommodate exchanged V2X data.
- Regarding the current V2X channel model in TR 37.885 [7], we state Observation 3.



Observation 7

The channel parameters for V2X above 30 GHz in TR 37.885 is based on few measurement campaigns at 50–75 GHz reported in [8] in scarce intersection environments.

The validity and applicability of the channel parameters in TR 37.885 for high frequency band should be rechecked and studied from a more holistic discussion and measurement campaigns.

Conclusion–Proposal of studying foundation for sidelink with high frequency band for upcoming IoT applications

- ❑ The sidelink with higher frequency band in view of IoT applications including indoor-short range and V2X may be a central topic of 6G and will be discussed in later releases.
- ❑ However, according to Nokia's Rel.19 workshop document [9], Release 19 is pre-standards of 6G; hence, Rel. 19 is time to revisit and enhance the current foundations to fit the upcoming IoT applications driven by the sidelink with higher frequency band.

Proposal

Establish a study item to discuss a new evaluation methodology and channel models applicable to upcoming IoT applications (indoor-short range and V2X) driven by the sidelink with higher frequency band above 30 GHz.

- [1] “FL summary #3 for AI 9.4.3 Enhanced sidelink operation on FR2 licensed spectrum,” 3GPP TSG RAN WG1 #110bis-e, R1-2210425, Oct. 2022.
- [2] “Study on channel model for frequencies from 0.5 to 100 GHz,” 3GPP TR 38.901, V17.0.0, Mar. 2022.
- [3] H. Harada, et al., “Design of 3GPP-based millimeter-wave band wireless virtual community network,” in Proc. IEEE VTC2023-spring, Florence, Italy, Jun. 2023, pp. 1–5.
- [4] Y. Koda, et al., “3GPP-Compatible Channel Generation Framework for FR2-2 Indoor Short-Range Communication,” IEEE Open Journal of Antennas and Propagation, vol. 4, pp. 278–293, Mar. 2023.
- [5] Y. Koda, et al., “Survey, Taxonomy, and Unification of Standard mmWave Channel Models for WPAN, WLAN, and Cellular Systems in 6G,” Techrxiv, DOI: 10.36227/techrxiv.21522711.v2, Jun. 2023.
- [6] Y. Koda, et al., “Toward 3GPP sidelink-based millimeter wave wireless personal area network for out-of-coverage scenarios,” Techrxiv, DOI: <https://doi.org/10.36227/techrxiv.24573283.v1>
- [7] “Study on evaluation methodology of new Vehicle-to- Everything (V2X) use cases for LTE and NR,” 3GPP TR 37.885, V15.3.0, Jun. 2019.
- [8] “V2X sidelink channel model,” 3GPP TSG RAN WG1 #93, R1-1805914, May 2018.
- [9] “Nokia’s views and priorities for Release 19,” 3GPP TSG RAN Rel-19 workshop, RWS-2300, Jun. 2023.

Parameters	Value
RF Frequency	58.32 GHz
Center frequency of sounding signal before up conversion (IF at TX side)	3 GHz
Center frequency of sounding signal after down conversion (IF at RX side)	3 GHz
Channel bandwidth	2 GHz
Transmit power	8.6 dBm (approx.)
Receiver sensitivity	–127 dBm
Transmitter antenna gain	Omnidirectional
Receiver horn antenna gain	25 dBi
HPBW of receiver horn antenna	10°
Sampling frequency	16 GHz

Parameters	Value
Carrier Frequency	60 GHz
Waveform	CP-OFDM
FFT size	2048 (SCS 960 kHz) or 512 (SCS 5.15 MHz)
CP length	288 (SCS 960 kHz) or 36 (SCS 5.15 MHz)
Modulation	QPSK (MCS=7), 16QAM (MCS=16), 64QAM (MCS=22)
Channel coding	NR LDPC
Allocated bandwidth	2000 MHz
Antenna configuration	1TX, 1RX, Omnidirectional
Channel estimation	Pilot
DMRS overhead	2/14
Channel model	TDL-A: delay spread: 5, 10, 20, 40 ns
Moving speed	0 km/h