

# Channel modelling for 7-24 GHz, sensing and RIS

Taipei, 15<sup>th</sup> – 16<sup>th</sup> June, 2023

Agenda item: 5

Source: Nokia, Nokia Shanghai Bell

The Nokia logo is displayed in white, consisting of the word "NOKIA" in a bold, sans-serif font. It is positioned on the right side of the slide, within a large white arrow graphic that points to the left.

# Overview

- It is expected that technology studies for 6G will start around Rel-20 timeframe in 3GPP, and hence it is important to have a well-established channel modelling framework before that.
- For 6G, the frequency range 7-24 GHz is of particular interest<sup>1</sup>
- In principle, 3GPP channel models cover this range, but in practice there are not enough studies to validate such models, as this range is not part of either FR1 or FR2.
- 3GPP must undertake all the necessary work to fully support cellular operation in the 7-24 GHz range to further motivate WRC global IMT allocation in this range.
- New emerging technologies such as sensing and RIS have raised interest recently
  - However, before any work in RAN WGs, it is critical to establish a channel model framework covering those technologies.

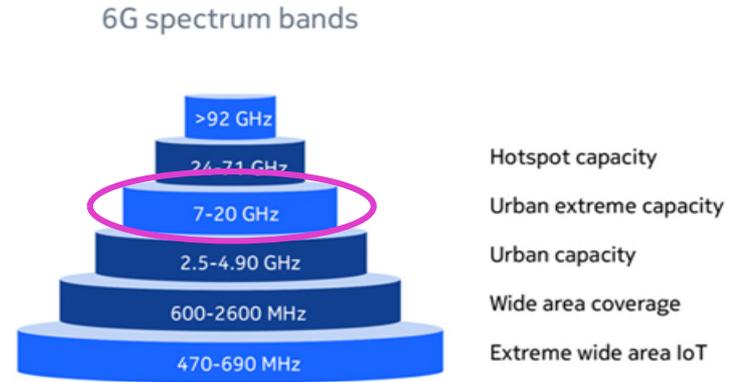
## **Main objectives of channel model studies in Rel-19 are as follows, in order of priority:**

- Channel model validation and, if necessary, update, for 7-24GHz
  - Further motivate WRC global IMT allocation in this range
- Channel model extensions for sensing
- Channel model extensions for RIS

<sup>1</sup><https://www.nokia.com/about-us/newsroom/articles/6g-explained/>

# Why channel model studies for 7-24GHz?

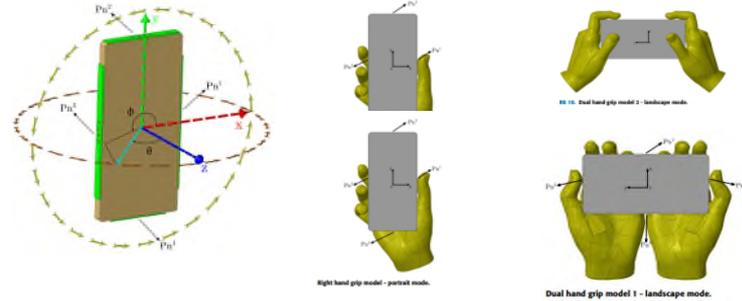
- Spectrum is a crucial element in providing radio connectivity. Every new mobile generation requires some new pioneer spectrum that helps fully exploit the benefits of a new technology
- The new pioneer spectrum blocks for 6G are expected to be at mid-bands 7 – 24 GHz for urban outdoor cells enabling higher capacity through Extreme Massive MIMO
- 3GPP must give a strong commitment towards WRC-23 that it will undertake all necessary work to support cellular operation in 7-24GHz
- 3GPP TR 38.901 V15.1.0 (2019-09) already covers frequencies from 0.5 to 100 GHz, however:
  - 6G poses new challenges with Extreme Massive MIMO that will test the limits of the existing channel model
  - Lessons learned from 5G may help improve the models for the new mid-band of 7-24 GHz which falls between FR1 and FR2



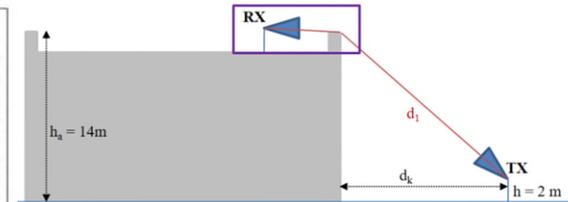
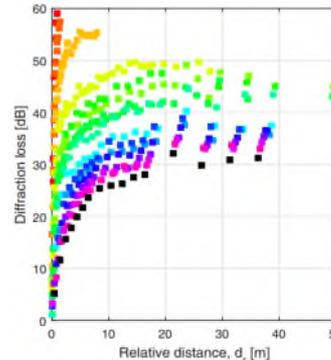
<https://www.bell-labs.com/institute/blog/6g-eras-enormous-capacity-demands-will-require-new-spectrum-and-extreme-massive-mimo/>

# Potential updates to 3GPP channel models for 7 – 24GHz

- Blockage models in 38.901 do not model a human hand accurately
  - Beam shapes at UE are not maintained in realistic model when blocked or partially blocked by hand
- AoA Birth-death continuity of clusters are very different between UMA and field measurements
  - Spatial consistency models could be improved for mobility simulations
- Classical above rooftop deployment leads to large coverage problem in NLOS streets due to rooftop diffraction
  - New or modified scenarios may be necessary to accommodate real deployments for 6G studies



F. Fernandes, C. Rom, J. Harrebek, S. Svendsen and C. N. Manchón, "Hand Blockage Impact on 5G mmWave Beam Management Performance," in *IEEE Access*, vol. 10, pp. 106033-106049, 2022, doi: 10.1109/ACCESS.2022.3211525.



K. -W. Kim, M. -D. Kim, J. -J. Park, J. Lee, J. Liang and K. -C. Lee, "Diffraction Loss Model Based on 28 GHz Over-Rooftop Propagation Measurements," *2017 IEEE 86th Vehicular Technology Conference (VTC-Fall)*, Toronto, ON, Canada, 2017, pp. 1-5, doi: 10.1109/VTCFall.2017.8287881.

# Channel model for sensing

Enabler for any study would be channel model that takes sensing into account

**3GPP RAN1 needs a reliable framework for assessing the performance of communications and sensing solutions jointly<sup>2</sup>**

- Models for sensing channels and communication channels should be spatially consistent and coherent
- Models should reflect not only device mobility but also sensing target mobility
- In order to fairly consider alternative solutions from multiple stakeholders the channel model must support a wide variety of sensing architectures and deployment scenarios

**To support forward-compatible analysis the channel model should be valid over a wide variety of evaluation assumptions not limited to range to target, sounding device height, sensing device height, band of operation, signal bandwidth, target RCS, and target mobility**

- To enable comparison with existing non-3GPP state-of-the-art, the channel model should strive to achieve either empirical validation or validation against known industry standards

<sup>2</sup><https://www.nist.gov/system/files/documents/2023/03/09/Human%20Sensing%20at%20mmWave%20and%20Sub-THz.pdf>

# Channel model for RIS

Reconfigurable Intelligent Surfaces alter characteristics of the signal upon reflection on them, and hence their effects need to be incorporated into the channel model

**Current channel models do not support such changes, and hence it is important to first establish the channel model framework supporting RIS before proceeding with any studies on RIS architectures, deployments, and related optimizations.**

Since RIS is seen as a potential 6G feature, it makes sense to study the required changes to channel models in connection with general channel model studies for 6G, as a second priority.

# Summary

1

Channel model validation and, if necessary, update for 7-24GHz. Further motivate WRC global IMT allocation in this range.

2

Channel model extensions for sensing.

3

Channel model extensions for RIS.

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