TSG-RAN WG1 #85
Nanjing, China, May 23 – 27, 2016

R1-165350

Source: Ericsson, AT&T, ETRI, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung
Agenda Item: 7.2.1
Document for: Discussion, Decision

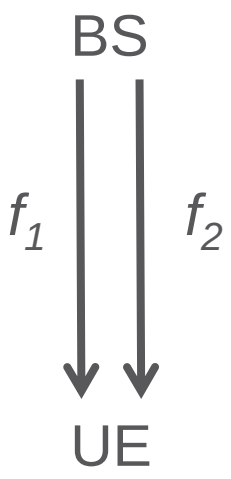
Clarifications on frequency correlation

Background

- To support simulations with multiple sites, base stations, UEs, and frequencies, some clarification of how these links are correlated is needed
- Some new procedures may be needed to support new model features
  - Frequency consistency (multi-band simulations)
  - Spatial consistency (additional parameters may be correlated)

Correlation between links at different frequencies

- No procedure defined in 36.873 or 38.900
- Measurements have shown that cluster delays and angles are very similar over frequency
  - Examples given in the Appendix
  - Natural and intuitive since delays and angles depend on geometry of environment
  - Powers may sometimes be different, since reflection/diffraction/scattering coefficients etc may be frequency dependent



- Proposal: Cluster delays and angles are frequency-independent

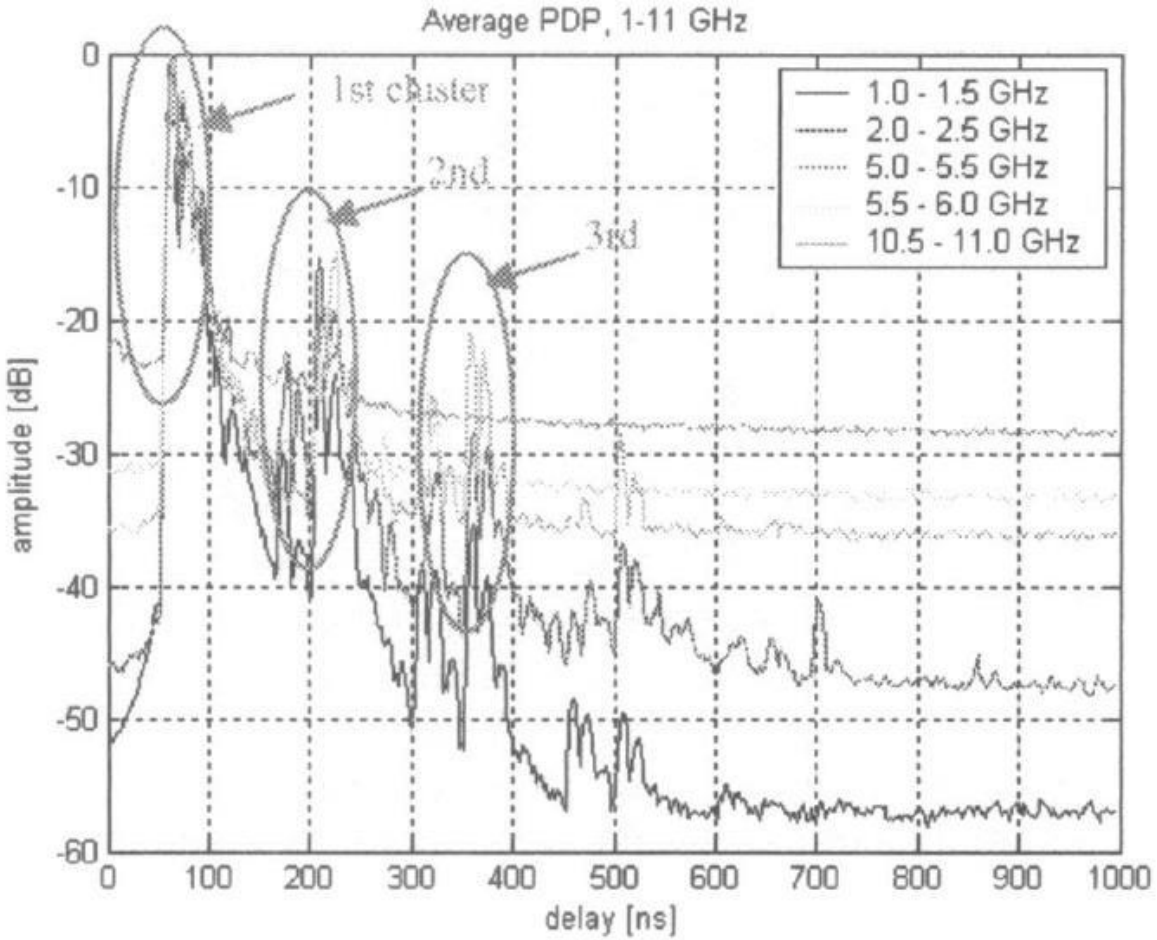
Summary

› Proposal: Cluster delays and angles are frequency-independent

Appendix: Examples from measurements

T. Jämsä, V. Hovinen, A. Karjalainen, J. Iinatti, “Frequency dependency of delay spread and path loss in indoor ultra-wideband channels”, in Proc. of IET UWBSTA, 2006

› First, second, and third cluster at same delay for all frequency bands



R. Müller, S. Häfner, D. Dupleich, et al., “Simultaneous multi-band channel sounding at mm-wave frequencies”, in Proc. EuCAP 2015

- All clusters have same delays at both frequency bands
  - Cluster powers may be frequency-dependent

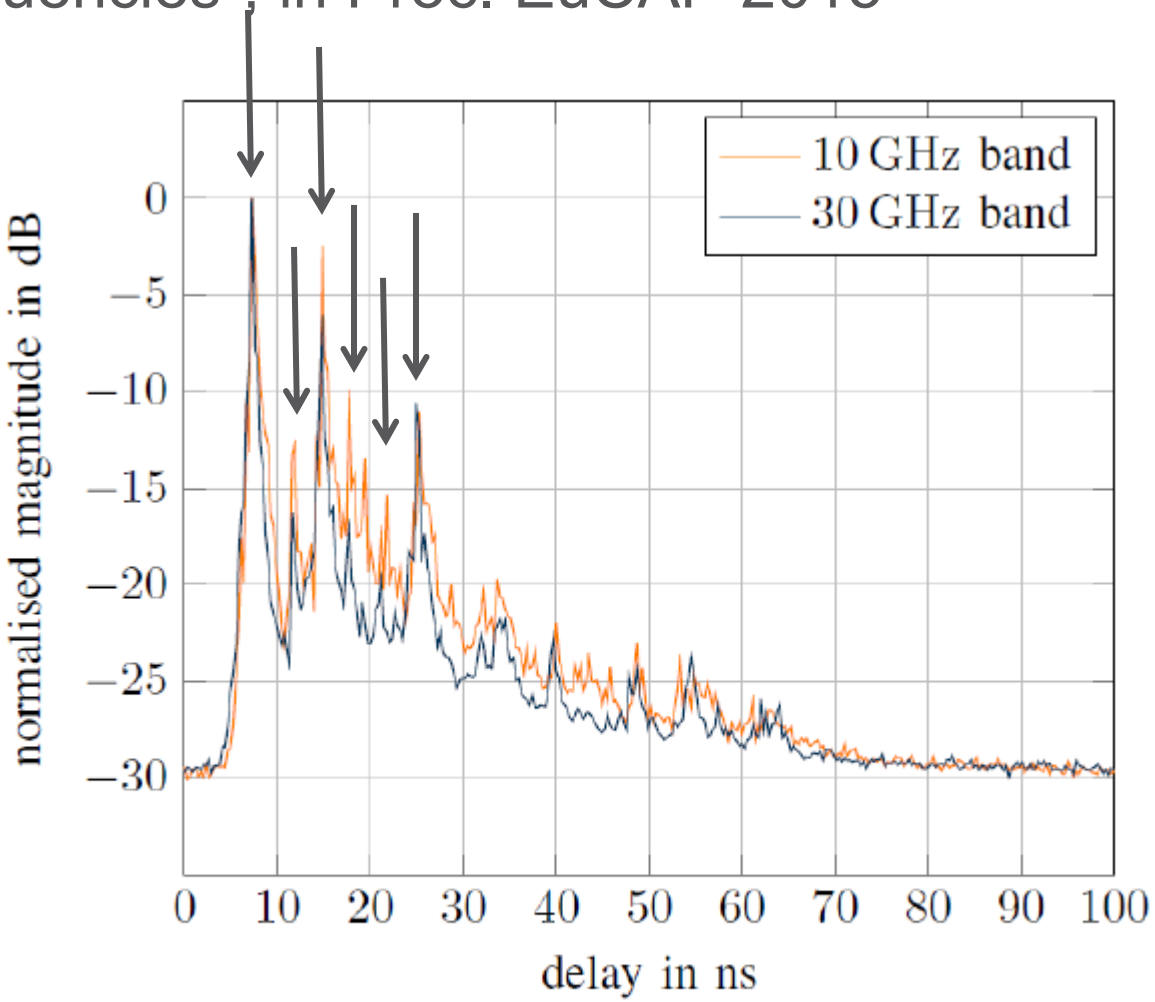


Figure 3. Omni-directional PDP at rail position 1

Weiler, “Simultaneous millimeter-wave multi-band channel sounding in an urban access scenario”, in Proc. EuCAP 2015

- Prominent clusters at identical delays
  - Cluster powers may be frequency-dependent

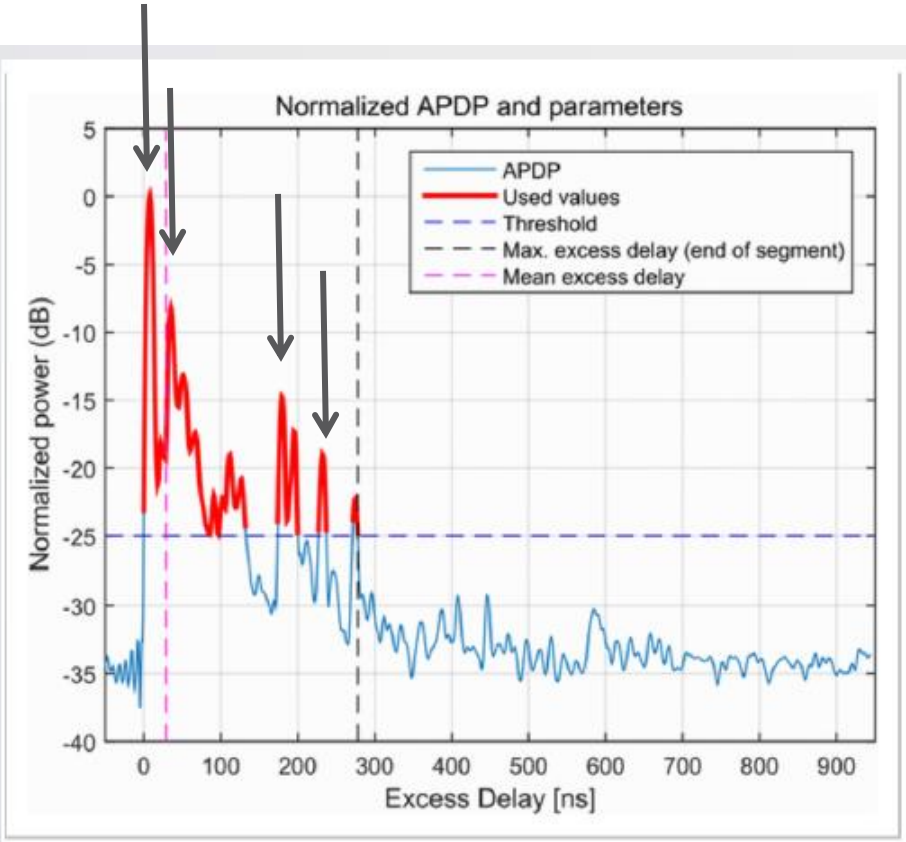


Figure 8. Normalized APDP and excess delay, 10 ghz, 25 db threshold

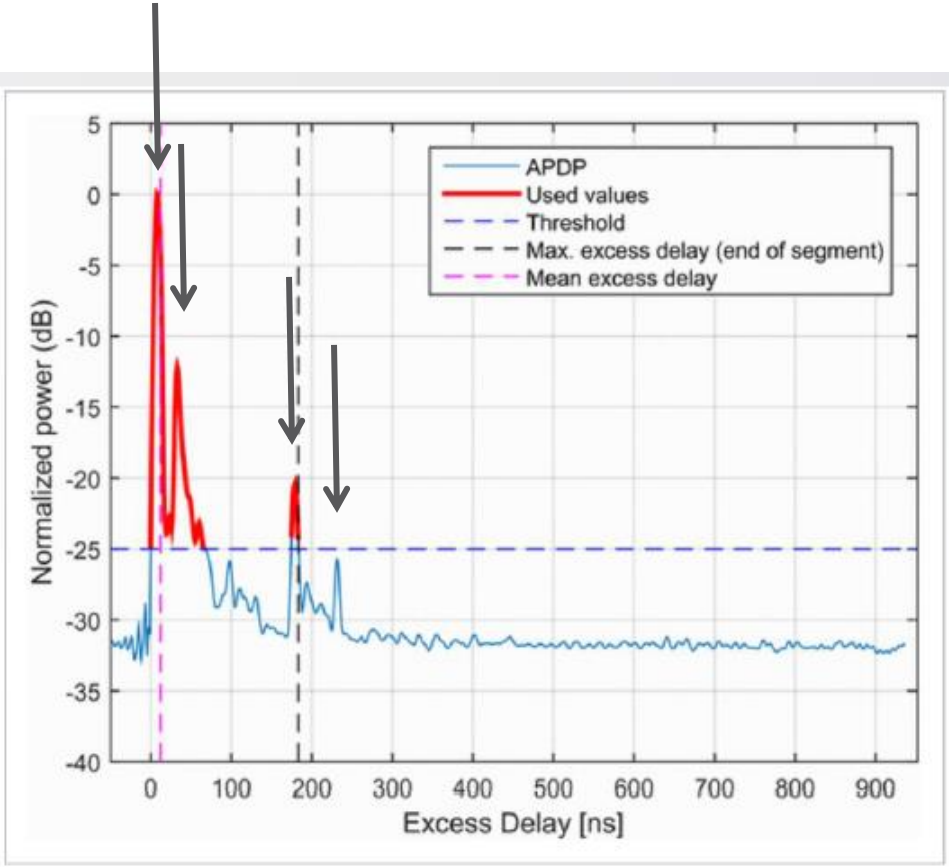
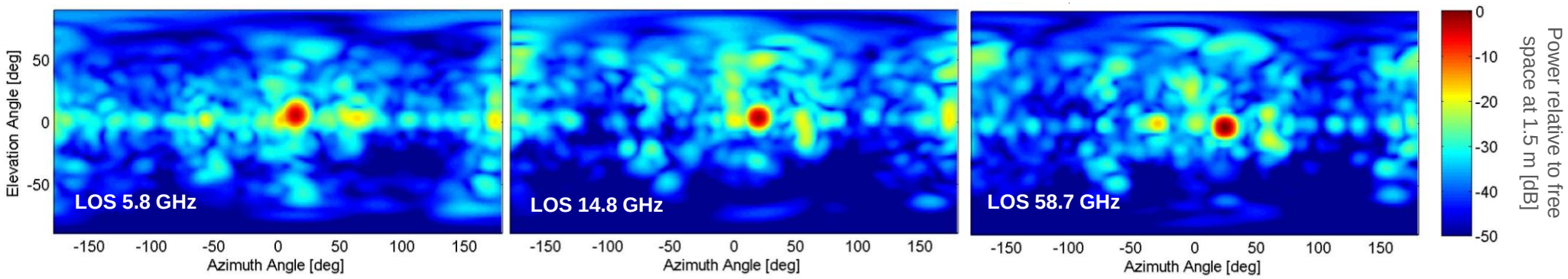
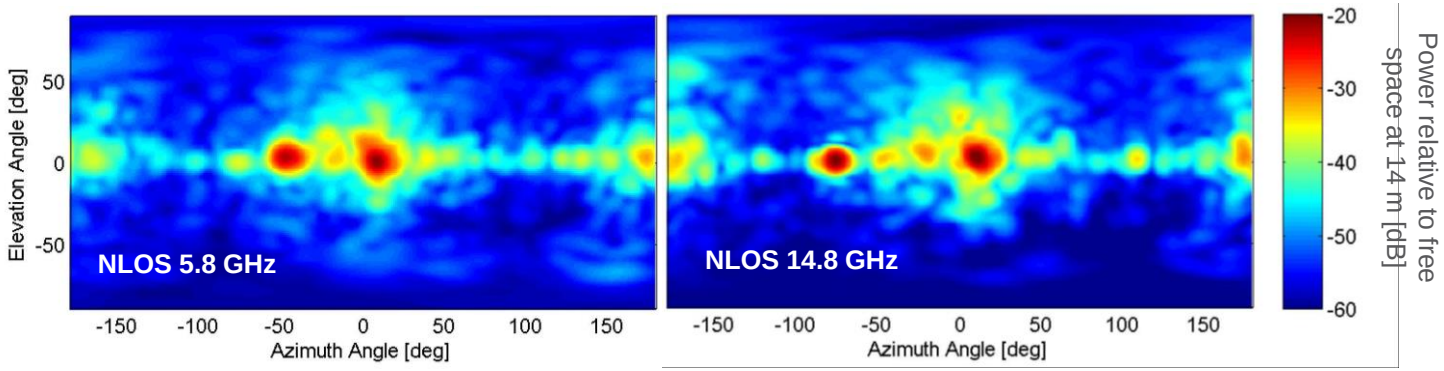
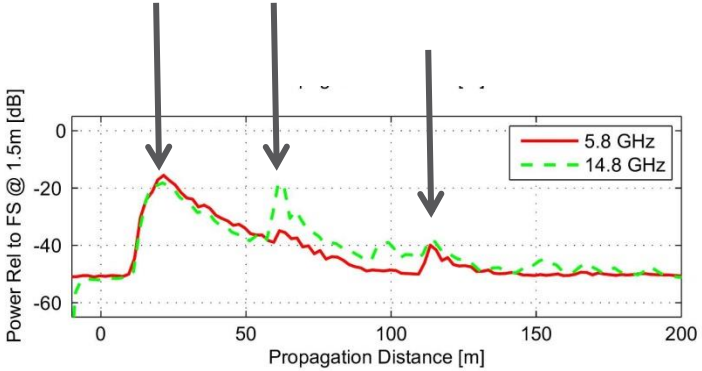


Figure 9. Normalized APDP and excess delay, 60 ghz, 25 db threshold

R1-163254 “On the frequency dependence of LSPs”, Ericsson, Busan, April 2016







- Very similar cluster DoAs in azimuth, zenith, and delay
- In some cases, cluster powers are frequency-dependent

J. Vehmas, J. Järveläinen, S. Nguyen, R. Naderpour, and K. Haneda, "Millimeter-Wave Channel Characterization at Helsinki Airport in the 15, 28, and 60 GHz", submitted to VTC-Fall 2016.

- Prominent clusters at same delays
  - Cluster powers may be frequency-dependent

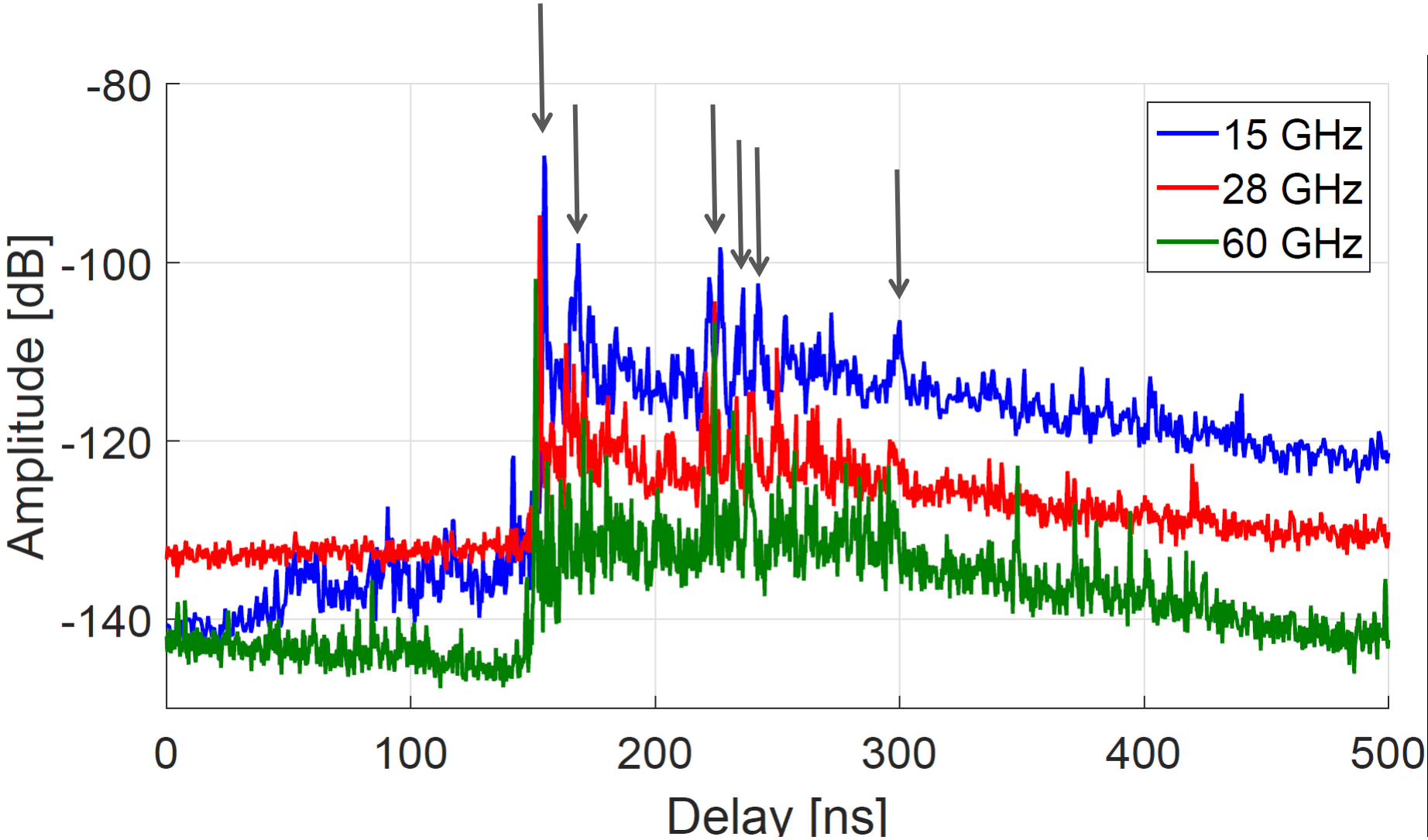


TABLE III
MEAN LARGE SCALE PARAMETERS.

	Frequency band	Delay spread [ns]	Azimuth spread [°]	Elevation spread [°]
LOS	15 GHz	41.3	18.0	7.4
	28 GHz	39.8	20.7	7.7
	60 GHz	38.6	17.5	6.0
NLOS	15 GHz	60.9	30.3	8.7
	28 GHz	N/A	N/A	N/A
	60 GHz	56.4	29.7	10.9