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CANDIDATE FOR 5G CHANNEL MODEL – A SUMMARY FROM METIS

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OUTLINE

- Background, METIS project
- 5G channel model requirements
- Measurement campaigns
- Channel model proposal
- Summary

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METIS 2020 PARTNERS
11/2012 – 4/2015

METIS OBJECTIVES

- Develop a concept for the beyond 2020 world based on future scenarios and use cases
- Identify the technology components addressing the efficiency, versatility and scalability needed in the future mobile and wireless communications system
- Research new means and develop such technology components

- *Channel modelling*: To ensure availability of relevant propagation models for the new scenarios defined in METIS
  - Task leader: Anite
  - ICT-317669 METIS project, "METIS Channel Models", Deliverable D1.4, March 2015.

5G CHANNEL MODEL REQUIREMENTS

- Wide range of propagation scenarios
- High frequencies (1-60GHz) and wide bandwidth (15kHz-4.5GHz)
  - For high bitrates with sufficient spectrum
- Support for very large antenna arrays (e.g. 256 elements)
  - For high spatial resolution
- Spatial consistency and mobility
  - For highly dense scenarios and co-existence of different link types
- Specular scattering
  - For high frequencies. Different characteristics from diffuse scattering
- Dual mobility
  - For D2D/V2V communications and moving base stations
- Flexible trade-off between accuracy and complexity
  - For diverse simulation requirements

➔ None of the existing models address all the 5G channel model requirements

COMPARISON OF EXISTING CHANNEL MODELS

Feature	3GPP SCM	WINNER II / WINNER+	IMT-Advanced	3GPP D2D	3GPP 3D	IEEE 802.11ad
Frequency Range (GHz)	1 – 3	1 – 6	.45 – 6	1 – 4	1 – 4	60 – 66
Bandwidth (MHz)	5	100	100	100	100	2000
Support massive-MIMO	no	limited	no	no	limited	yes
Support spherical waves	no	no	no	no	no	no
Support extremely large arrays beyond stationarity interval	no	no	no	no	no	no
Support dual mobility	no	no	no	limited	no	no
Support Mesh networks	no	no	no	no	no	no
Support 3D (elevation)	no	yes	no	no	yes	yes
Support mmW	no	no	no	no	no	yes
Dynamic modelling	no	very limited	no	no	no	limited
Spatial consistency	no	no	no	no	no	no

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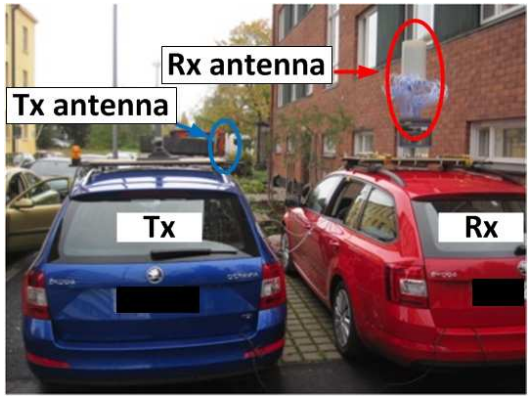
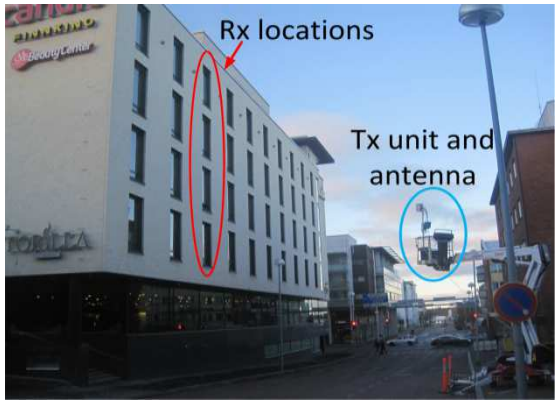
MEASUREMENT CAMPAIGNS: OVERVIEW

Examples:



Car-to-car 2.3/ 5.25 GHz

Shopping Mall 60 GHz



UMi Outdoor-to-Indoor

D2D Crowd Area, daytime & midnight

Indoor office, 60 GHz

UMi, 26, 37 GHz

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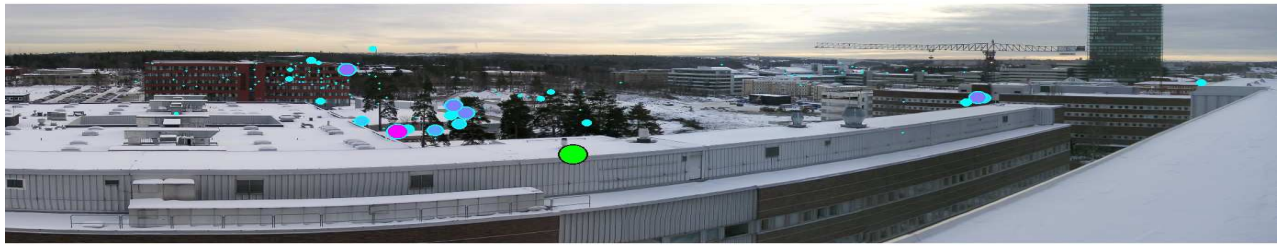
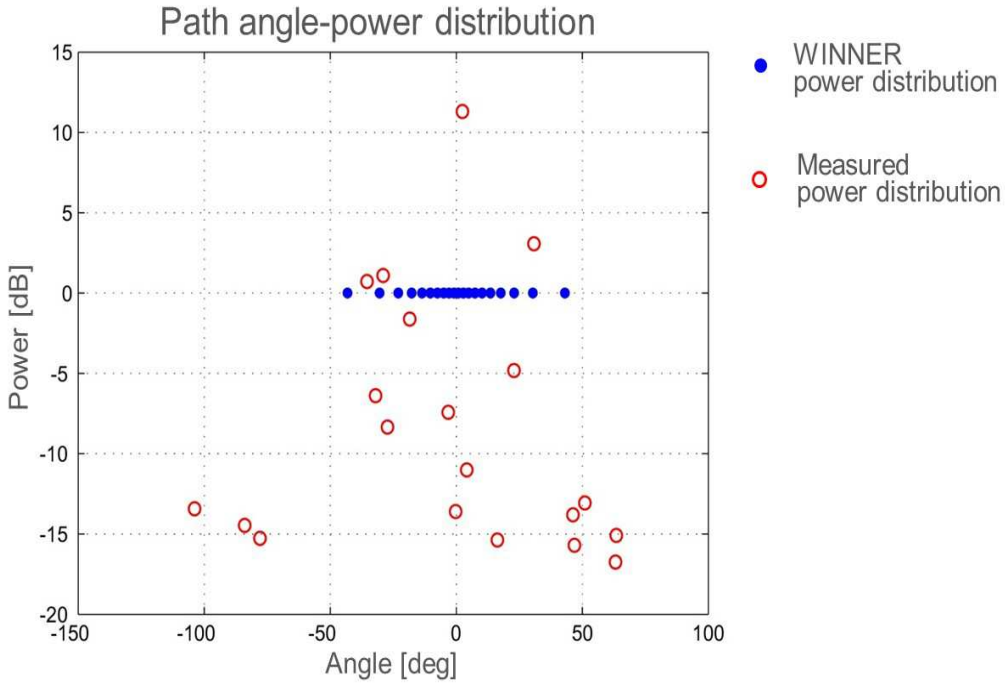
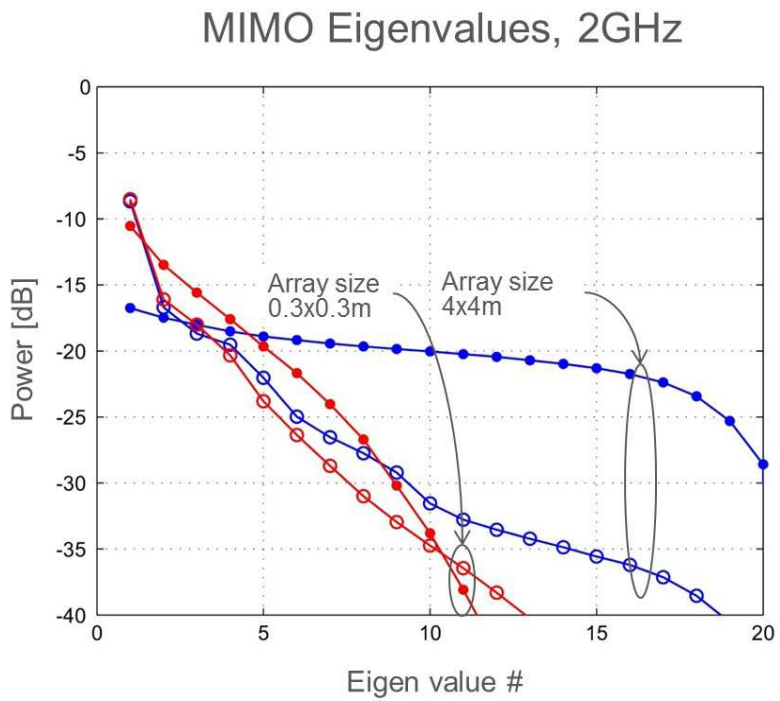
FINDINGS FROM METIS MEASUREMENTS







➔ WINNER type of channel model is not realistic for large array antennas in 5G

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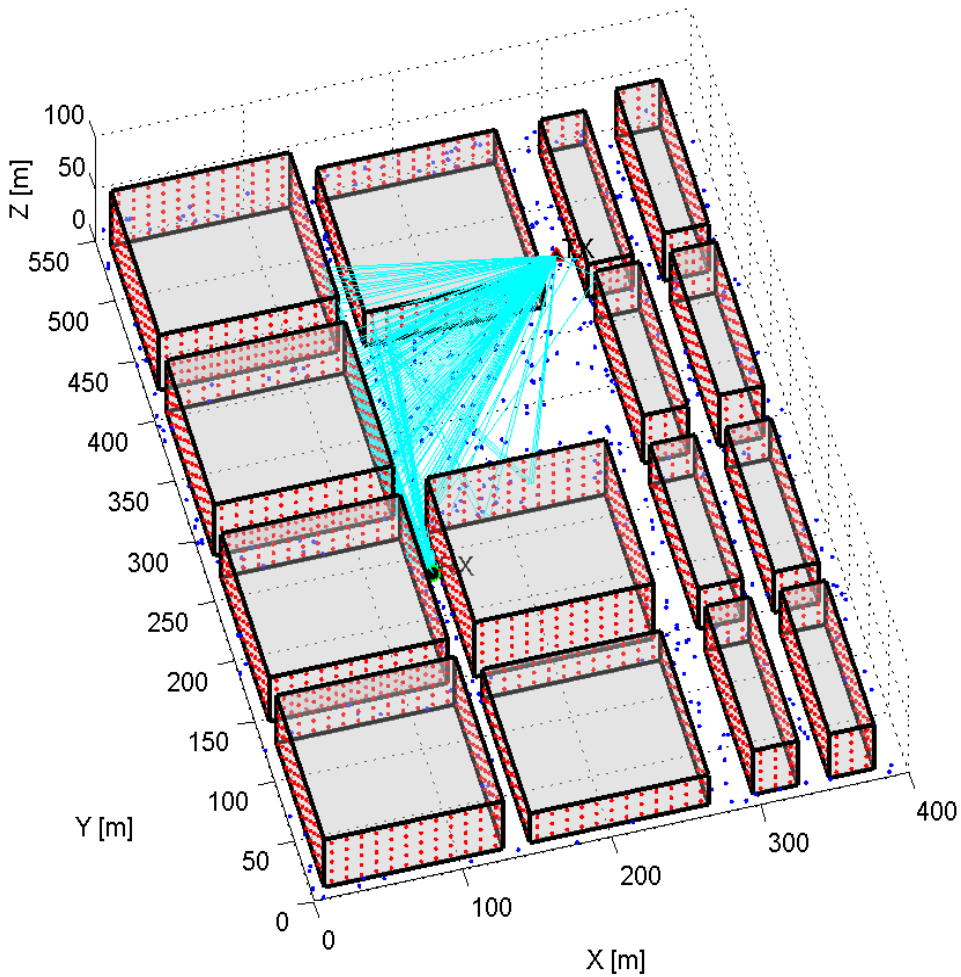
CANDIDATE: MAP-BASED MODEL

- Ray tracing
- Simplified 3D geometric description of the environment
- Building walls are modelled as rectangular surfaces
- Random objects
- Deterministic modelling of propagation in terms of rays
  - diffraction, specular reflection, diffuse scattering, blocking etc.
- **Input:**
  - Simple layout/map describing buildings in xyz coordinates
  - Frequency
  - TX & RX locations [x,y,z]
  - Random object density & sizes
  - Antennas
- **Output:**
  - Path loss & shadowing
  - Large & small scale propagation parameters
  - MIMO channel impulse responses matrices over time/route



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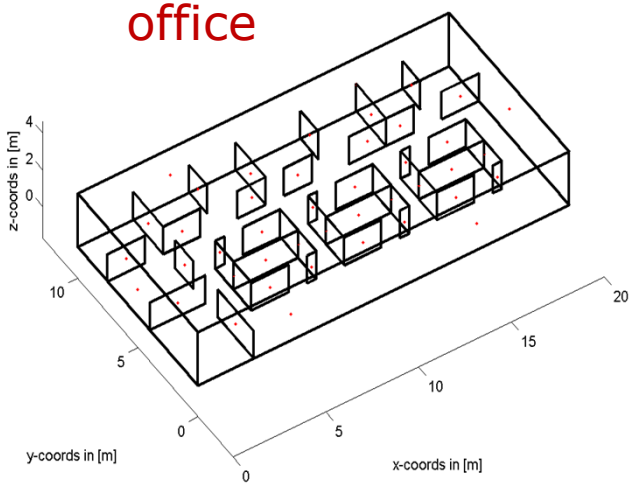
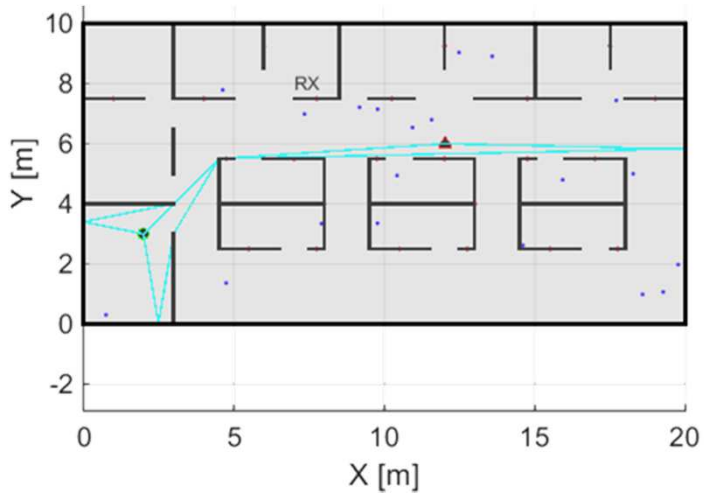
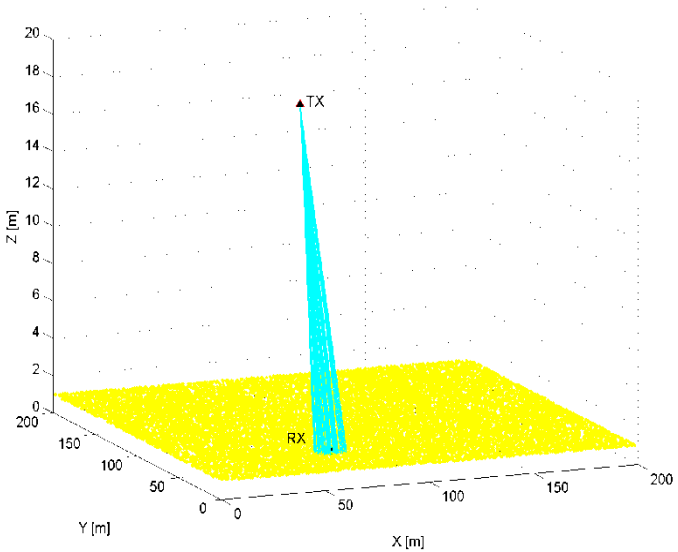
EXAMPLE SCENARIOS

Virtual reality office

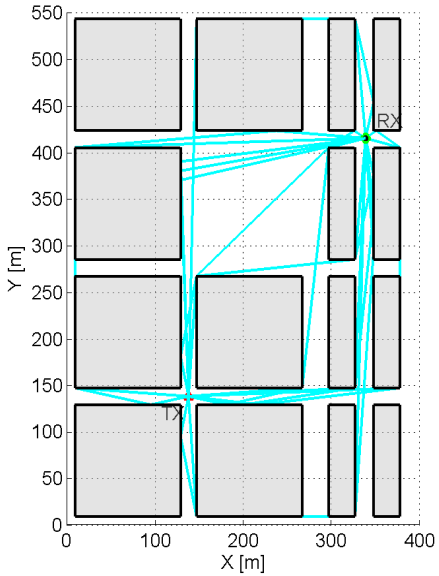




Open air festival



Madrid grid



- PS1: Urban Microcell
- PS2: Urban Macrocell
- PS4: Indoor Office
- PS5: Indoor Shopping Mall
- PS6: Highway
- PS7: Festival (open air)
- PS8: Stadium

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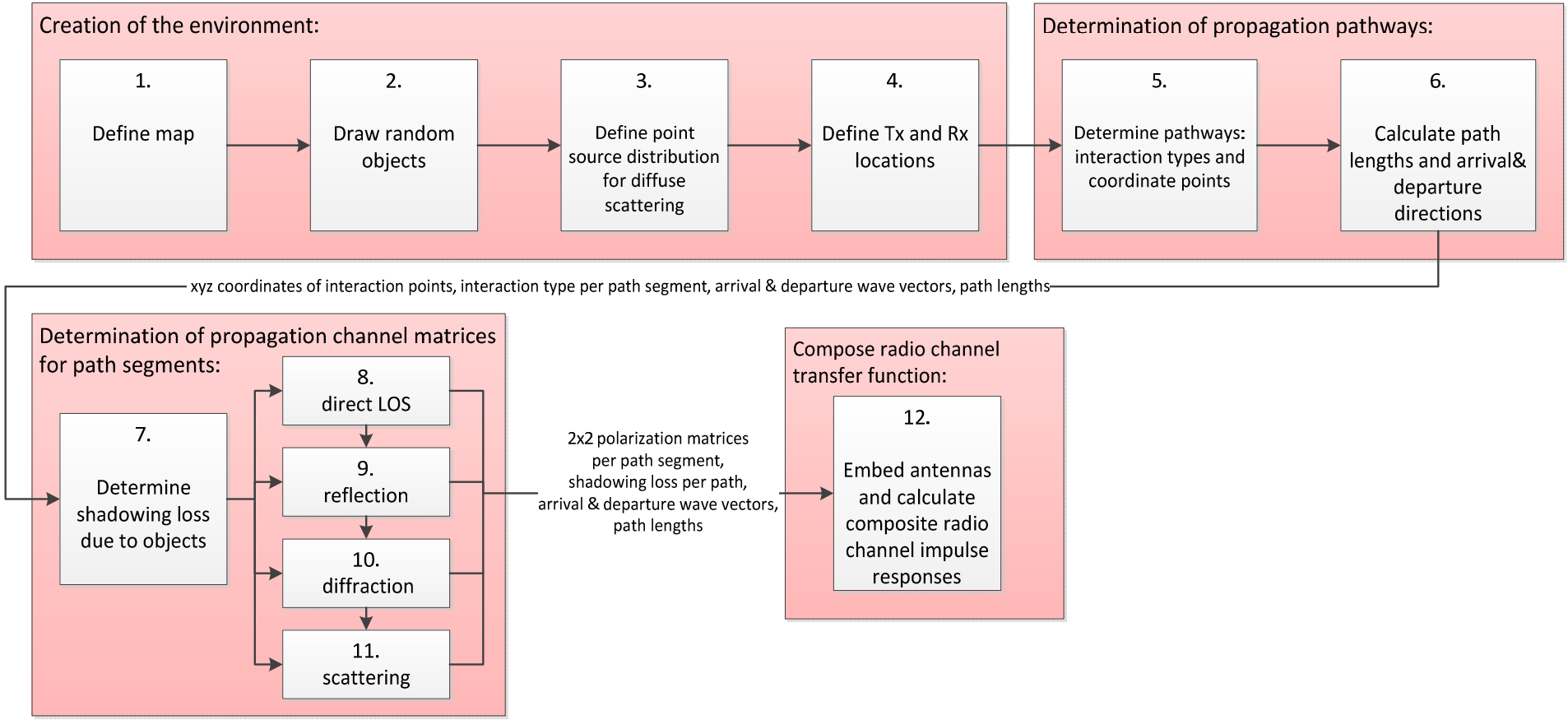
MAP-BASED MODEL



- Clearly defined step-by-step instructions

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MAP-BASED MODEL FEATURES

Feature	3GPP SCM	WINNER II / WINNER+	IMT-Advanced	3GPP D2D	3GPP 3D	IEEE 802.11ad	**Map-based model**
Frequency Range (GHz)	1 – 3	1 – 6	0.45 – 6	1 – 4	1 – 4	60 – 66	up to 100 GHz
Bandwidth (MHz)	5	100	100	100	100	2000	10 % of the centre frequency
Support massive-MIMO	no	limited	no	no	limited	yes	yes
Support spherical waves	no	no	no	no	no	no	yes
Support extremely large arrays beyond stationarity interval	no	no	no	no	no	no	yes
Support dual mobility	no	no	no	limited	no	no	yes
Support Mesh networks	no	no	no	no	no	no	yes
Support 3D (elevation)	no	yes	no	no	yes	yes	yes
Support mmW	no	no	no	no	no	yes	yes
Dynamic modelling	no	very limited	no	no	no	limited	yes
Spatial consistency	no	no	no	no	no	no	yes

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SUMMARY

- 5G propagation scenarios and 5G channel modeling requirements were identified
- No existing model fulfills all the identified requirements
- The map-based model proposal fulfills all requirements
- Partly validated the developed map-based model in selected scenarios
- Further efforts of parameterization and validation against measured propagation characteristics are needed

For more details:
ICT-317669 METIS project, "METIS Channel Models", Deliverable D1.4, March 2015, https://www.metis2020.com/documents/deliverables/

SOME THOUGHTS

- There has been a strong push towards continuing with GSCM principle
  - Well adopted by the players on the field (due to 3GPP/WINNER/ITU-R)
  - Practical to parameterize by measurements
  - Acceptable complexity, though stongly resisted at the advent of 4G
  - Cannot fulfill all identified requirements for 5G simulations (not geometry-based enough!)

- Map-based model is a ”new” approach
  - Complexity is expected to be an issue
  - Fulfills all identified requirements for 5G simulations
  - Further work on parameterization, validation and simplification is needed
    - An implementation is a must (under development)

Thank you!

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