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Document for: Discussion, Decision

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WF on link level models for MIMO simulations

Background

- TDLs and CDLs for NLOS and LOS have been agreed in R1-163476 and R1-163491
  - The link level models can be scaled in delay to represent different levels of time dispersion
  - A filtering approach to go from CDL to TDL has been agreed in R1-163490 – this implicitly captures the effect on delay spread from beamforming
- In the NR study item, evaluations with MIMO are being discussed
- The multiantenna aspects of the link level models have not been paid much attention
- CDLs with fixed DoAs are not very suitable for MIMO simulations for several reasons;
  - The PMI statistics can become very biased
  - A fixed precoder may perform better than open-loop and on par with closed-loop or reciprocity BF
  - A CDL only represents a single channel realization
  - All link simulations would require detailed antenna array assumptions to be made and agreed on

MIMO link level simulations

- Two approaches:
  - 1. Make the CDLs more general by introducing angular translation and scaling
    - Translation: mean angle can be changed by $\Delta\phi$
    - Scaling: angular spread can be changed
      - Typical angular spreads for different scenarios can be obtained from the system-level model
    - Can be applied to some or all of azimuth and zenith AODs and AOAs
    - Note: The angles may need to be wrapped around to be within 0-360 degrees

$$\phi_n = \frac{\sigma_\phi}{\sigma_{\phi,0}}\left(\phi_{n,0} - \Delta\phi\right)$$

$\phi_{n,0}$ is the tabulated CDL angle

$\sigma_{\phi,0}$ is the rms angular spread of the tabulated CDL

$\Delta\phi$ is the translation angle

σ_ϕ is the desired rms angular spread

ϕ_n is the resulting cluster angle

  - 2. Use TDLs in combination with correlation matrices
    - The approach from 36.101/36.104 can be reused
    - Some guidance on selecting correlation parameters α,β,γ needed (36.10x values are not necessarily typical)
    - Typical correlation parameters can be derived:
      - from scaled CDLs according to approach 1 + antenna array assumptions
      - from system-level model + antenna array assumptions
      - by selecting corner cases, e.g. uncorrelated, highly correlated etc.

For the channel spatial correlation matrix, the following is used:

$$R_{spat} = P\left(R_{eNB} \otimes \Gamma \otimes R_{UE}\right)P^T$$

where

- R_{UE} is the spatial correlation matrix at the UE with same polarization,
- R_{eNB} is the spatial correlation matrix at the eNB with same polarization,
- Γ is a polarization correlation matrix, and
- $(\bullet)^T$ denotes transpose.

Proposals

- Proposal 1: Introduce angular translation and angular spread scaling to the agreed CDLs
  - A method for scaling and translation to be described in the TR
  - Guidlines on selecting scaling and translation parameters to be captured in the TR
    - Note: This can be done with a similar approach as the delay scaling
- Proposal 2: Introduce correlation matrices to be used together with the TDLs
  - The correlation matrix construction method from 36.101/36.104 can be reused
  - Guidlines on selecting correlation parameters to be captured in the TR
  - Note: This approach can be applied to TDLs derived from spatially filtered CDLs according to R1-163490 to emulate hybrid BF