3GPP TSG-RAN WG1#80bis **R1-152238**

Belgrade, Serbia, 20-24 April, 2015

ERICSSON

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TITLE: CHANNEL RECIPROCITY MODELLING FOR FDD

AGENDA ITEM: 7.2.5

DOCUMENT FOR: DISCUSSION AND DECISION

BACKGROUND

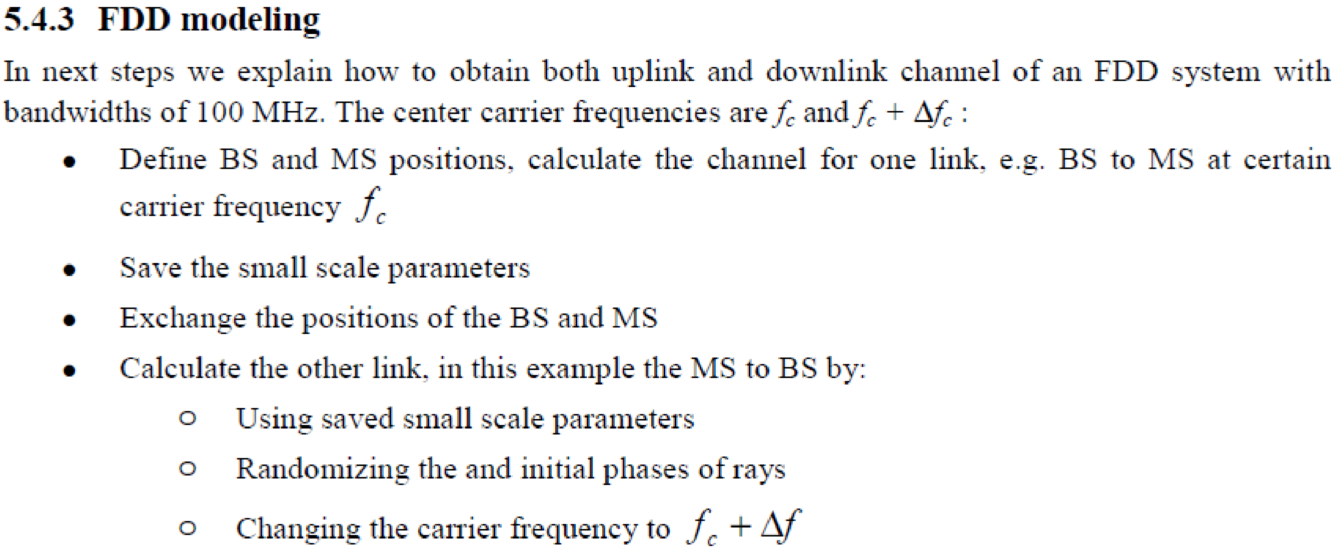
- For evaluations utilizing channel reciprocity, particularly for FDD, there is a need to align the modeling assumptions among companies
  - The purpose of this contribution is to propose such model for agreement
  - The model is to be used for 2DAA evaluations
    - An agreed model can be captured in TR 36.897

OBSERVATION

- The channel differences in Uplink vs. Downlink due to the duplex distance are due to several factors:
  - A phase shift due to the length of the traveled path d_r of the ray: $e^{\frac{j2\pi d_r}{\lambda}}$
  - A frequency dependent Reflection / Diffraction / Scattering of the radio wave
    - Each polarization experiences a phase shift and magnitude scaling
    - Depends on the scattering properties of the reflector

EXTERNAL REFERENCE

- In [1], the following model for handling FDD was proposed:



5.4.3 FDD modeling

In next steps we explain how to obtain both uplink and downlink channel of an FDD system with bandwidths of 100 MHz. The center carrier frequencies are f_c and $f_c + \Delta f_c$:

- Define BS and MS positions, calculate the channel for one link, e.g. BS to MS at certain carrier frequency f_c
- Save the small scale parameters
- Exchange the positions of the BS and MS
- Calculate the other link, in this example the MS to BS by:
    - Using saved small scale parameters
    - Randomizing the and initial phases of rays
    - Changing the carrier frequency to $f_c + \Delta f$

- The proposed model for FD-MIMO evaluations is based on [1]

MODEL PROPOSAL

Model assumptions:

- The duplex distance $\mathrm{f_{DL}} - \mathrm{f_{UL}}$ is larger than the channel coherence bandwidth
- The small scale parameters are modeled as equal in UL & DL
  - Cluster (sub)-ray arrival and departure directions $\theta_{ZOA}, \theta_{ZOD}, \phi_{AOA}, \phi_{AOD}$.
  - The delays and relative powers of the clusters
  - The XPRs κ
- The carrier frequency wavelength λ is changed:
  - New path loss factors are calculated for UL channel.
  - Phase changes between antenna elements and Doppler shift are different and thus modified according to the corresponding carrier frequency wavelength
- Independent random initial phases $\Phi^{\theta\theta}, \Phi^{\theta\phi}, \Phi^{\phi\theta}, \Phi^{\phi\phi}$ are drawn for UL & DL channel.

$$H_{u,s,n}(t) = \sqrt{P_n/M} \sum_{m=1}^{M} \begin{bmatrix} F_{rx,u,\theta}\left(\theta_{n,m,ZOA}, \phi_{n,m,AOA}\right) \\ F_{rx,u,\phi}\left(\theta_{n,m,ZOA}, \phi_{n,m,AOA}\right) \end{bmatrix}^T \begin{bmatrix} \exp\left(j\Phi_{n,m}^{\theta\theta}\right) & \sqrt{\kappa_{n,m}{}^{-1}} \exp\left(j\Phi_{n,m}^{\theta\phi}\right) \\ \sqrt{\kappa_{n,m}{}^{-1}} \exp\left(j\Phi_{n,m}^{\phi\theta}\right) & \exp\left(j\Phi_{n,m}^{\phi\phi}\right) \end{bmatrix} \begin{bmatrix} F_{tx,s,\theta}\left(\theta_{n,m,ZOD}, \phi_{n,m,AOD}\right) \\ F_{tx,s,\phi}\left(\theta_{n,m,ZOD}, \phi_{n,m,AOD}\right) \end{bmatrix} \exp\left(j2\pi\lambda_0^{-1}\left(\hat{r}_{rx,n,m}^{T}.\bar{d}_{rx,u}\right)\right) \exp\left(j2\pi\lambda_0^{-1}\left(\hat{r}_{tx,n,m}^{T}.\bar{d}_{tx,s}\right)\right) \exp\left(j2\pi v_{n,m} t\right)$$

CONCLUSION

- **Proposal:** Agree on the modeling on slide 5 and capture this in TR 36.897.

REFERENCE

- [1] IST-4-027756 WINNER II D1.1.2 V1.2 WINNER II Channel Models, Part 1, Channel models, Section 5.4.3

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