Status of 802.20 Channel Models

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Qiang Guo
Editor, Channel Modeling Correspondence Group
Current Status of 802.20 Channel Models

• A conference call has been held since July plenary

• Consensus reached on a few channel model issues:
  – Inclusion of outdoor-to-indoor model into channel model set
  – Unifying MIMO/SIMO/MISO/SISO channel models

• Open issue
  – Two discrepant views on the maximum delay spread in MBWA channel models and the frequency of occurrence of such channels in the real world

• Two more conference calls scheduled
  – October 14, 2003, 2:00 - 3:00pm EDT
  – October 29, 2003, 2:00 - 3:00pm EDT
Outdoor-to-Indoor Model

- Decided to examine the ITU pedestrian model as starting point and then look into how to extrapolate it to the outdoor-to-indoor model.
- There was also a consensus that very little is known about the MIMO nature of outdoor-indoor model.
ITU Outdoor-to-Indoor and Pedestrian Model [1]

- BS with low antenna heights, located outdoor
- Small cell size
- Low transmit power
- Pedestrian users located on streets and inside building
- Doppler rate set by walking speeds, with occasional higher rates due to vehicular reflections
- Geometrical path loss rule of $R^{-4}$ is appropriate, but $R^{-6}$ may be encountered due to trees and other obstructions
- Building penetration loss averages 12 dB with a standard deviation of 8 dB
MIMO/SIMO/MISO/SISO Models

- Decided to specify MIMO channel model first, and then tweak the parameters so that it will approximate the characteristics of SIMO/MISO/SISO models.
- Need to specify guidelines for setting the key parameters of model based on a selected set of test environments, such as micro/macro, typical urban/suburban/rural, outdoor-to-indoor, etc.
- Making sure the model have appropriate delay spread, Doppler spread, and spatial characteristics that are typical of licensed bands below 3.5 GHz.
MIMO/SIMO/MISO/SISO Models (Cont)

• Considering separate SISO models would confuse the process of comparing SISO techniques to MIMO/MISO/SIMO techniques, because it would be difficult to guarantee a fair comparison between the two

• The spatial characteristics of MIMO model will heavily influence the Doppler characteristics, which would make it difficult to compare a Jakes-faded SISO model to a spatial MIMO model
Maximum Delay Spread

• Two different opinions on the maximum delay spread in MBWA channel models and the frequency of occurrence of such channels in the real world
  – Need to define a vehicular channel model for MBWA, which would have power delay profile less than ITU Vehicular B
  – Satisfy ourselves with the ITU Vehicular B model

• In order to accurately evaluate candidate physical-layer technologies, it is desirable to model the variety of delay spreads, which is justifiable based on real world channel measurements.

• Information regarding delay spread measurement campaign would help 802.20 Channel Modeling CG understand the issue and reach group consensus
Delay Spread Measurements on a Mobile Broadband Channel at 3.6 GHz [2,3]

- As reported in [2,3], an experimental mobile broadband communication system developed for the purpose of evaluating candidate physical-layer technologies.
- Data collected by this experimental system also used to characterize the 2x2 MIMO channel impulse responses.
- The delay spread characteristics of a 20MHz channel at 3.675 GHz is summarized here, based on a series of field experiments conducted in a suburban area.
- As described in [3], outdoor measurements were performed on various driving routes around the base.
- Vehicle speed varies from 0 to 60 mph.
Delay Spread Measurements on a Mobile Broadband Channel at 3.6 GHz [Cont]

- Delay spread measurements are calculated from power delay profiles given by the magnitude squared of the estimated channel impulse response.
- The channel impulse response is determined with a frequency-domain channel estimator designed using the fact that all the transmitted data is known.
- A correlator operating in the time-domain was also designed to detect multi-path components with delays of up to 25 µS.
- With this correlator, it was observed that the maximum delay spread beyond 10 µS is statistically insignificant.
  - A total of 5474 profiles, including 2142 profiles captured at LOS locations and 3332 profiles captured at NLOS locations.
Statistics of RMS and MAX Delay Spread
(in micro-second)

<table>
<thead>
<tr>
<th></th>
<th>ALL</th>
<th>LOS</th>
<th>NLOS</th>
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</thead>
<tbody>
<tr>
<td>RMS Delay Spread in 95%</td>
<td>1.75</td>
<td>0.90</td>
<td>2.0</td>
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<tr>
<td>Max Delay Spread in 95%</td>
<td>5.3</td>
<td>2.3</td>
<td>6.1</td>
</tr>
</tbody>
</table>
References

2. C802.20-03/12, “Antenna Arrays for MBWA: Overview and Field Experiments”.
3. C802.20-03/19, “Frequency-Domain-Oriented Approaches for MBWA: Overview and Field Experiments”.