Comparison of multipath channel models for IEEE 802.16j

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Purpose:
The purpose of this document is to summarize the multipath channel model comparison results described in IEEE C802.16j-06/044.

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Contents

• Multipath channel characteristics
  – Mean and RMS delay spread;
  – Coherence bandwidth;
  – Coherence time.

• Three channel models compared
  – 802.16 (SUI);
  – ITU;
  – WINNER.
Mean & RMS Delay Spread

• RMS delay spread is defined as

\[ t_{rms}^2 = \sum_j P_j t_j^2 - (t_{mean})^2 \]

- \( t_{rms} \) is the mean delay spread
- \( t_j \) is the delay of the \( j^{th} \) delay component and \( P_j \) = (power in the \( j^{th} \) delay component) / (total power of all components).

• 802.16 SUI channel 6 has worst RMS delay spread followed by ITU vehicular channel B.

• WINNER channels have the smallest RMS delay spread.
Mean & RMS Delay Spread Results

mean delay spread for SUI, ITU and WINNER fading channels

RMS delay spread (us) for SUI, ITU and WINNER fading channels
Coherence Bandwidth

• Coherence BW characterizes the channel responses.
  – Frequency flat or selective fading.
• 802.16 (SUI) channels have the narrowest coherence BW while ITU channels generate deeper fades.
• WINNER channels have wider coherence BW and mild fades.
Spaced-frequency correlation function for SUI channel models

Coherence BW - 802.16 (SUI)
Coherence BW - ITU

Spaced-frequency correlation function for ITU channel models

- ITU Indoor Office Environment Channel A
- ITU Indoor Office Environment Channel B
- ITU Outdoor to Indoor and Pedestrian Environment Channel A
- ITU Outdoor to Indoor and Pedestrian Environment Channel B
- ITU Vehicular Environment (High Antenna) Channel A
- ITU Vehicular Environment (High Antenna) Channel B

frequency (Hz)
Spaced-frequency correlation function for WINNER channel models
Coherence Time

• Coherence time characterizes the channel responses.
  – Slow or fast fading.

• It is affected by the Doppler spread & the Doppler spectrum.

• ITU model provides the shortest coherence time while the 802.16/WINNER models provides longer coherence time.
## Coherence time comparison result

<table>
<thead>
<tr>
<th>Speed (km/h)</th>
<th>802.16</th>
<th>ITU Flat</th>
<th>ITU Classical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Channel Coherence time (ms)</td>
<td>Number of OFDMA symbol durations assuming a CP of 1/8</td>
<td>Channel Coherence time (ms)</td>
</tr>
<tr>
<td>20</td>
<td>6.4795</td>
<td>57.8295</td>
<td>4.6282</td>
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<tr>
<td>40</td>
<td>3.2402</td>
<td>28.9188</td>
<td>2.3145</td>
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<td>60</td>
<td>2.1600</td>
<td>19.2780</td>
<td>1.5429</td>
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<tr>
<td>80</td>
<td>1.6200</td>
<td>14.4585</td>
<td>1.1571</td>
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<tr>
<td>100</td>
<td>1.2960</td>
<td>11.5668</td>
<td>0.9257</td>
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<td>120</td>
<td>1.0800</td>
<td>9.6390</td>
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<td>7.2293</td>
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<tr>
<td>180</td>
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<td>6.4260</td>
<td>0.5143</td>
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<tr>
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<td>5.7834</td>
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<tr>
<td>220</td>
<td>0.5891</td>
<td>5.2577</td>
<td>0.4208</td>
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<tr>
<td>240</td>
<td>0.5400</td>
<td>4.8195</td>
<td>0.3857</td>
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<tr>
<td>260</td>
<td>0.4985</td>
<td>4.4491</td>
<td>0.3560</td>
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<tr>
<td>280</td>
<td>0.4629</td>
<td>4.1314</td>
<td>0.3306</td>
</tr>
</tbody>
</table>
Summary

• Three channel models compared
  – 802.16 (SUI), ITU and WINNER.
  – If OFDMA PHY parameters can satisfy the worst case of 802.16 (SUI) models, they can satisfy ITU & WINNER models.

• Plan to add more channel models & compare them in the future.

• Channel model chosen for 802.16j shall reflect the propagation environment expected.