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Microcell Channel Models for Multi-Hop Relaying
(2GHz & 5GHz)
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- Work performed in the ROMANTIK project is presented that provides an analytical study of peer-to-peer radio channels in an urban micro-cellular environment.
- The work focuses on the 2.1GHz (UMTS) and 5.2GHz (Hiperlan/2 and 802.11a/e) bands and makes use of a detailed three-dimensional ray-tracing tool. Existing models are inappropriate for low mounted transmitters such as those used in multi-hop communications at interested frequency band.
- Propagation analysis reveals that the standard deviation of the shadowing and the rms delay spread are a function of the separation distance between the transmitter and receiver.
- Path loss is seen to increase with lower terminal heights, as is the probability of line-of-sight.

Multi-Hop Models for Urban Environment

- A 3D Ray Tracing model previously developed and validated at the University of Bristol is used to predict power as well as time, frequency and spatial dispersion in the radio channel.
- Simulations are based on a 1.4km x 1.4km map database (terrain, building, foliage and ground cover data) of central Bristol. The urban environment is typical of a European city.
- 26 different transmitter sites were used, a total of 9,003 x 26 channel data are generated for each of the BS-MS, BS-RN, RN-RN, RN-MS and MS-MS link.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>BS height</th>
<th>RN height</th>
<th>MS height</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS-MS</td>
<td>12 m</td>
<td>15 m</td>
<td>1.5 m</td>
</tr>
<tr>
<td>BS-RN</td>
<td>12 m</td>
<td>15 m</td>
<td>1.5 m</td>
</tr>
<tr>
<td>RN-RN</td>
<td>12 m</td>
<td>15 m</td>
<td>1.5 m</td>
</tr>
<tr>
<td>RN-MS</td>
<td>12 m</td>
<td>15 m</td>
<td>1.5 m</td>
</tr>
<tr>
<td>MS-MS</td>
<td>12 m</td>
<td>15 m</td>
<td>1.5 m</td>
</tr>
</tbody>
</table>

2G

LOS and NLOS – A Key Concept

- LOS Probability versus Distance
  - For low mounted transmitters the probability of LOS falls off quickly with distance and this is critical to the radio channel
  - Path Loss parameters and other channel characters, e.g. DS and AS, depend on whether the location is LOS or NLOS – this probability is distance dependent

LOS Probability versus Distance

- In NLOS conditions, shadowing can be characterized by a lognormal distribution (a normal distribution in dB)
- The shadowing standard deviation tends to increase as the distance increase
- The dependent distance shadowing various could be modeled using following function:

$$\text{STD}(d) = S \cdot (1 - e^{-d/d_0})$$

- The RMS DS is seen to increase with increasing separation distance for both LOS and NLOS, particularly for short distance
- And higher antenna elevations result in higher RMS DS
- The median RMS AS remains similar for all distance separations.
- It has been found that the median RMS AS for LOS conditions is much smaller than the NLOS cases, and the higher frequency has lower RMS AS values.