Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	Technical Changes of IEEE C802.16j-06/013 (Multi-hop System Evaluation Methodology)
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Re:	Technical changes on IEEE C802.16j-06/013
Abstract	This document captures the technical changes for the Multi-hop System Evaluation Methodology.
Purpose	Technical modification for IEEE C802.16j-06/013
Notice	
Release	
Patent Policy and Procedures	

Technical Changes of IEEE C802.16j-06/013

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Nortel

1 Introduction

To the Editor: ~~xxxxx~~ is the text deletion, xxxxx is the text insertion

2 Detailed Changes

Page 3, Section 2.1.2.1
Delete
~~$PL = A + 10 \cdot \gamma \cdot \log_{10}(d/d_0) + \Delta PL_f + \Delta PL_h + s\ dB$ (1)~~
~~where d_0=100m and $d>d_0$. A=20·$\log_{10}(4\pi d_0/\lambda)$ and $\gamma=(a - b \cdot h_b + c/h_b)$.~~

Insert

$$PL \quad \begin{matrix} A \quad 10 \quad \log \dfrac{d}{d_0} \quad PL_f \quad PL_{ht} \quad s & \text{for } d \quad d_0' \\ 20 \log \dfrac{4 \quad d}{} \quad s & \text{for } d \quad d_0' \end{matrix}$$

where;

$$A \quad 20 \log \frac{4 \quad d_0'}{}$$

$$d_0 \quad 100m$$

$$d_0' \quad d_0 10^{\frac{PL_{ht} \quad PL_f}{10}}$$

$$a \quad bh_b \quad \frac{c}{h_b}$$

d distance between base and terminal

h_b height of basestation

s shadowing

Comment: The modified IEEE 802.16d path loss model should be used in this section. This is to allow for distances less than d_0 to be used, and more importantly to ensure consistency at the breakpoint when the antenna and frequency correction factors are used.

Page 4, Section 2.1.2.1
Delete:
~~ΔPL_h = - 10.8 · $\log_{10}(h/2)$ dB ; for Terrain Type A and B (3)~~
~~ΔPL_h = - 20 · $\log_{10}(h/2)$ dB ; for Terrain Type~~

Insert:

$$PL_{ht} \quad \begin{array}{ll} 10.8\log\frac{h_t}{2} & \text{Categories A \& B} \\ 10\log\frac{h_t}{3} & \text{Category C, } h_t \quad 3 \\ 20\log\frac{h_t}{3} & \text{Category C, } h_t \quad 3 \end{array}$$

Page 5, Section 2.1.2.2

Replace equation by

$$PL\ dB \quad \begin{array}{ll} 20\log\frac{4\ d}{} & \text{for } d \quad d_0^{'} \\ A \quad 10 \quad \log\frac{d}{d_0} \quad PL_f \quad PL_{ht} & \text{for } d \quad d_0^{'} \end{array}$$

where,

$$A \quad 20\log\frac{4\ d_0^{'}}{}$$

$$d_0 \quad 100m$$

$$d_0^{'} \quad d_0 10^{\frac{PL_f \quad PL_{ht}}{10}}$$

$$a \quad bh_b \quad \frac{c}{h_b}$$

$$PL_f \quad 6\log\frac{f\ MHz}{2000}$$

$$PL_{ht} \quad \begin{array}{ll} 10\log\frac{h_t}{3} & \text{for } h_t \quad 3m \\ 20\log\frac{h_t}{3} & \text{for } h_t \quad 3m \end{array}$$

d distance between basestation and terminal

h_b height of basestation

h_t height of terminal

a 3.6

b 0.005

c 20

Comment: This equation has been edited to ensure that the inequalities given are correct. These should be d

d_0' and $d > d_0$'. This ensures that the model has the correct breakpoint.

Page 7, Section 2.1.2.4

Delete

~~The model is identical to that given in section 2.1.2.1 except for the following changes to allow for three different environment types: see [6]~~

~~Category A: Hilly terrain with moderate-to-heavy tree densities~~
~~Category B: Mostly flat terrain with moderate-to-heavy tree densities, or hilly terrain with light tree densities~~
~~Category C: Flat terrain with light tree densities~~

Delete this equation:

$$PL_{ht} \quad \begin{array}{ll} 10.8\log\dfrac{h_t}{2} & \text{Categories A \& B} \\ 10\log\dfrac{h_t}{3} & \text{Category C, } h_t \quad 3 \\ 20\log\dfrac{h_t}{3} & \text{Category C, } h_t \quad 3 \end{array}$$

Page 12, Section 2.2.1
Insert
Note: These are fixed values. The Okumura model should also be considered as this gives the variation of lognormal shadowing standard deviation with frequency.

Start page 26

3 B Link Budget

Insert

B.1 Introduction

The link budget can be divided into two parts: The system gain reflects the performance of the transmitter and receiver, including aspects such as antenna gain and noise figure. A multi-hop system has an additional set of parameters related to the design of the RSs, which are not present in a conventional system. The way that the system interacts with the propagation environment is addressed by the second part, which includes interference and shadow margins. In addition to the alternative ways in which BS operation can influence this aspect (e.g., MDHO) multi-hop system performance is influenced by the way in which the RSs are operated.

Link Budget should include all the key items defined below

Si = Pout + Gt - $A_{Backoff}$ - Pl - Ls + Gr - Ml + Fm

Pout Output power of transmitter in dBm
Ntx Number of transmitters (MIMO configuration)
Power allocation to traffic and to pilots
Gt Transmitting antenna gain in dBi
$A_{Backoff}$ Amplifier Backoff
Pl Path loss in dB
Ls Shadowing loss in dB (lognormal shadow fade margin)
Gr Receiving antenna gain in dBi
Nrx Number of receivers (MIMO configuration)
Ml Miscellaneous losses (include cable losses, nonlinearity, body loss, polarization mismatch, other losses etc.)
Fm Fade Margin in dB

NF Receiver noise figure dB
kT Thermal noise dBm/Hz
B Channel bandwidth
SNR Required SNR for the data rate in question

Si Received power level at receiver input in dBm

B.2 Scenarios

The shadow margin depends critically on the scenario and the way in which the BSs and RSs are operated and interact. For example, a coverage of say 95% may be obtained by setting the shadow margin for a direct link from the BS to the MS appropriately or alternatively by setting a lower value to give say 80% coverage for the BS to MS link but achieving 95% coverage overall by combining this with a 2-hop link via a RS that provides similar coverage of 80%. Examples of the scenarios that should be considered are given below:

BS Environment

1. A single isolated cell
   - Communication is between a BS and a MS
   - There is no interference
2. A single cell adjacent to other cells
   - Communication is between a BS and a MS
   - Interference is from adjacent cells
3. Two-way MDHO between uncorrelated BSs
   - The MS communicates with the strongest BS of two
   - The boundary of the cells is midway between the two BSs
   - Interference is from adjacent cells

4. Two-way MDHO between correlated BSs
    - The MS communicates with the strongest BS of two
    - The boundary of the cells is midway between the two BSs
    - The pathloss from the two BSs is assumed 50% correlated
    - Interference is from adjacent cells

Multihop Environment

1. The MS can only receive a signal from a BS (as in scenarios 1 and 2)
2. The MS has the choice of receiving a signal from multiple BSs
    - E.g., two-way soft handoff (as in scenarios 3 and 4)
3. The MS can receive a signal from a RS but not a BS
    - The RS is providing coverage in an area outside the coverage of the BS
4. The MS can receive a signal either from a BS or from a RS but not both simultaneously
    - The RS is providing enhanced coverage within the BS coverage area, resulting in a larger cell area
    - No cooperative relaying / multihop diversity
5. The MS has the choice of receiving a signal either from a BS or from one of many RSs
    - Increased diversity of indirect, multihop paths within the coverage area of the BS results in a further increase in cell area
    - No cooperative relaying / multihop diversity
6. As 8 and 9 but including 6 (choice of signals from multiple BSs)