IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TGah Outdoor Channel Models – Revised Text | | | | |
| Date: 2011-05-09 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Vish Ponnampalam | Mediatek | 2860 Junction Ave, San Jose, CA 95131 | 408-526-1990 | [Vish.ponnampalam@mediatek.com](mailto:Vish.ponnampalam@mediatek.com) |
| James Wang | Mediatek | 2860 Junction Ave, San Jose, CA 95131 | 408-526-1990 | [James.wang@mediatek.com](mailto:James.wang@mediatek.com) |
| Ron Porat | Broadcom | 16340 West Bernardo Dr., San Diego, CA 92127 | 858-521-5409 | [rporat@broadcom.com](mailto:rporat@broadcom.com) |

# 3.0 Channel models

The outdoor channel models for TGah are based on channel models used by 3GPP and 3GPP2. Two catagories of channel models are defined below. The first category, Multipath Channel Models consists of simple SISO models which will facilitate rapid generation of early simulation results. The second category, Spatial Channel Models (SCM), provides detailed modeling of the spatio-temporal characteristics of the multi-antenna propagation channel. The SCM is fully described in [1] and a freeware Matlab implementation can be downloaded from [2].

We provide here a brief description of the model and simulation assumptions for TGah below.

**3.1 Multipath Channel Models for Early Simulations**

The multipath channel channel models presented in this section provide temporal characterization of SISO links between an AP and a STA. Simulations based on these channel models will be used to evaluate and select fundeamental PHY features and parameters, such as the preamble fields, OFDM parameters, coding and modulation.

Four multi-path channel profiles, namely, Pedestrian A, Pedestrian B, Vehicular A and Typical Urban may be used for generating early non-MIMO simulations. The models represent low (Pedestrian A), medium (Pedestrian B/Vehicular A) and high (Typical Urban) delay spreads.

Each channel model consists of either 4 or 6 independent channel taps with fixed tap delays and fixed average power values, as given in Table 1. Each tap is modelled by a complex Gaussian variable, weighted by the corresponding average power. Doppler spread will be modelled using the Jakes model with a speed of TBD kmph.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PDP | | Pedestrian A | | Vehicular A | | Pedestrian B | | Typical Urban | |
| # of Paths | | 4 | | 6 | | 6 | | 6 | |
| Relative Path Power (dB) | Delay (ns) | 0 | 0 | 0 | 0 | 0.0 | 0 | -3 | 0 |
| -9.7 | 110 | -1 | 310 | -0.9 | 200 | 0 | 200 |
| -19.2 | 190 | -9 | 710 | -4.9 | 800 | -2 | 600 |
| -22.8 | 410 | -10 | 1090 | -8.0 | 1200 | -6 | 1600 |
|  |  | -15 | 1730 | -7.8 | 2300 | -8 | 2400 |
|  |  | -20 | 2510 | -23.9 | 3700 | -10 | 5000 |

**Table 1 Multi-path channel model parameters**

**3.2 Spatial Channel Model for Detailed Simulations**

The spatial channel model presented in this section provides spatio-temporal and interference characterization of MIMO links between multiple APs and STAs. These channel models will be typically used to evaluate 11ah system performance. In addition, the Spatial Channel Model can be also used to evaluate the 11ah PHY link performance.

The Spatial Channel Model is fully described in [1] and a freeware Matlab implementation can be downloaded from [2].

**Simulation Assumptions for TGah**

Tgah use cases involve up to pedestrian mobility. However as reported in [3] and [4], reflections from cars cause higher Doppler and can be represented by assigning one of the six paths in the SCM model a higher Doppler.

The following two simulation scenarios represent all outdoor TGah scenarios:

1. SCM with speed up to 2mph for all paths
2. SCM with the fourth path assigned a speed of 40mph (rest of the paths are assigned 0mph).

**Example Usage of SCM**

1. Download Matlab code from [2]. Main function is scm.m
2. Define some parameters
   1. scmpar.CenterFrequency=0.9e9;
   2. scmpar.Scenario='urban\_macro';
   3. scmpar.BsUrbanMacroAS='eight';
   4. scmpar.NumBsElements=4; (number of BS antennas)
   5. antpar.BsElementPosition=0.5; (antenna spacing)
   6. scmpar.NumMsElements=1;
   7. Call main function [H delays out]=scm(scmpar,linkpar,antpar); H is a time domain MIMO channel between all Tx and Rx antennas
3. Calculate frequency response

**References**

[1] 3GPP TR 25.996 - Technical Specification Group Radio Access Network; Spatial channel model for Multiple Input Multiple Output (MIMO) simulations

[2] Link to Matlab implementation of [3]

<http://radio.tkk.fi/en/research/rf_applications_in_mobile_communication/radio_channel/scm-05-07-2006.zip>

[3] 11-03-0940-04-000n-tgn-channel-models.doc – channel model F

[4] 15-09-0742-01-004g-fading-in-900mhz-smart-utility-radio-channels.pdf – Steve Shearer