IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TGah Channel Model – Proposed Text | | | | |
| Date: 2011-05-10 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| 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 model for TGah is based on the SCM channel model. This model is adopted by 3GPP and 3GPP2 as the model to assess MIMO channel performance in cellular systems.

It is fully described in [1] and a freeware Matlab implementation can be downloaded from [2].

Channel realizations are generated through the application of the geometrical principle by summing contributions of rays (plane waves) with specific small-scale parameters like delay, power, angle-of-arrival (AoA) and angle-of-departure (AoD). Superposition of rays generates correlation between antenna elements and temporal fading with geometry dependent Doppler spectrum.

The SCM model assumes 6 paths each of which consists of 20 subpaths.

The model can be used to generate SISO or MIMO links. Co-polarized antennas or cross polarized antennas are implemented in the model and enable most types of antennas to be simulated.

The model describes three environments that represent Suburban Macro, Urban Macro and Urban Micro deployments and determine the simulation parameters.

**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).

The Doppler effect manifests itself as time varying channel. The amount of variation, or channel innovation, will be lower when Doppler is applied to only one path and depends on that path’s relative power to the others.

Annex A shows the amount of channel innovation when Doppler is applied to all paths or just the fourth path in the SCM Urban Macro scenario.

**Alternative PDP**

Alternatively the following power delay profiles can be substituted into the SCM instead of the random PDP defined in SCM. They are described in table 1 and represent PDP values for low (Pedestrian A), medium (Vehicular A and Pedestrian B) and high delay spread (Typical Urban) channels.

Link level simulations can also use these PDP.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**

**Example Usage of SCM**

1. Download Matlab code from [4]. 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 [1]

<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

**Annex A – Channel Innovation**

The following plot shows channel innovation - the expected value of the channel variation over certain period of time (Tau) assuming certain Doppler (Fd):.

As an example, assuming 40mph @ 900MHz translates to 53Hz of Doppler yielding channel innovation of about -10dB at 3.5mS delay with Doppler on 4th path and -10dB at 1.3mS with Doppler on all paths.

****