**IEEE P802.15**

**Wireless Personal Area Networks**

|  |  |
| --- | --- |
| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | TG3d Channel Modelling Document (CMD) |
| Date Submitted | July 2014 |
| Source | John Notor (editor) | E-mail: gnu@notor.com |
| Re: |  |
| Abstract | The CMD contains descriptions of the propagation characteristics and channel models of the operational environments relevant for the considered applications (e. g. data required to calculate link budgets) |
| Purpose | Supporting document for the development of the amendment 3d of IEEE 802.15.3 |
| Notice | This document has been prepared to assist the IEEE P802.15. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein. |
| Release | The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15. |

Document Overview

The CMD contains descriptions of the propagation characteristics and channel models of the operational environments relevant for the considered applications (e. g. data required to calculate link budgets)

The CMD will support the evaluation of the proposals submitted to P802.15.3d for consideration by the 15.3d task group.

|  |
| --- |
| **List of contributors** |
| Ichiro Seto | Toshiba Corporation |
| Ken Hiraga | NTT Corporation |
| Thomas Kürner | TU Braunschweig |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Table of Contents

[1 Definitions: 5](#_Toc393354292)

[2 Scope 6](#_Toc393354293)

[3 Methodology 6](#_Toc393354294)

[3.1 The channel modeling parameters considered are the following. 6](#_Toc393354295)

[3.1.1 Operating frequency band(s) 6](#_Toc393354296)

[3.1.2 Path loss model 6](#_Toc393354297)

[3.1.3 Fading model 6](#_Toc393354298)

[3.1.4 Temporal Dispersion 6](#_Toc393354299)

[3.1.5 Multipath 6](#_Toc393354300)

[3.1.6 Antenna gain/pattern 6](#_Toc393354301)

[3.1.7 Other 6](#_Toc393354302)

[4 Kiosk Download and File exchange on 60 GHz band 7](#_Toc393354303)

[4.1 Environments 7](#_Toc393354304)

[4.2 Channel Characterization 7](#_Toc393354305)

[4.2.1 Path Loss 7](#_Toc393354306)

[4.2.2 Power Delay Profile 7](#_Toc393354307)

[4.2.3 Fading Model 7](#_Toc393354308)

[4.2.4 Polarization 7](#_Toc393354309)

[4.3 Model Parameterization 7](#_Toc393354310)

[4.3.1 List of Parameters 7](#_Toc393354311)

[The parameters are given in Table x. 8](#_Toc393354312)

[4.3.2 Model Parametrization for 57 – 66 GHz 8](#_Toc393354313)

[4.4 Other 9](#_Toc393354321)

[5 Intra-Device Communication 9](#_Toc393354322)

[5.1 Path Loss Model 9](#_Toc393354323)

[5.2 Fading Model 9](#_Toc393354324)

[5.2.1 Scintillation 9](#_Toc393354325)

[5.2.2 Molecular attenuation 9](#_Toc393354326)

[5.2.3 Doppler 9](#_Toc393354327)

[5.3 Temporal Dispersion 9](#_Toc393354328)

[5.3.1 Angle of arrival/departure 9](#_Toc393354329)

[5.3.2 Time of arrival 9](#_Toc393354330)

[5.3.3 Delay spread 9](#_Toc393354331)

[5.3.4 Coherence time/bandwidth 9](#_Toc393354332)

[5.4 Multipath 9](#_Toc393354333)

[5.5 Antenna Gain/Pattern 9](#_Toc393354334)

[5.6 Other 9](#_Toc393354335)

[6 Backhauling/Fronthauling 9](#_Toc393354336)

[6.1 Path Loss Model 9](#_Toc393354337)

[6.2 Fading Model 9](#_Toc393354338)

[6.2.1 Scintillation 9](#_Toc393354339)

[6.2.2 Molecular attenuation 9](#_Toc393354340)

[6.2.3 Doppler 9](#_Toc393354341)

[6.3 Temporal Dispersion 9](#_Toc393354342)

[6.3.1 Angle of arrival/departure 9](#_Toc393354343)

[6.3.2 Time of arrival 9](#_Toc393354344)

[6.3.3 Delay spread 10](#_Toc393354345)

[6.3.4 Coherence time/bandwidth 10](#_Toc393354346)

[6.4 Multipath 10](#_Toc393354347)

[6.5 Antenna Gain/Pattern 10](#_Toc393354348)

[6.6 Other 10](#_Toc393354349)

[7 Data Center 10](#_Toc393354350)

[7.1 Path Loss Model 10](#_Toc393354351)

[7.2 Fading Model 10](#_Toc393354352)

[7.2.1 Scintillation 10](#_Toc393354353)

[7.2.2 Molecular attenuation 10](#_Toc393354354)

[7.2.3 Doppler 10](#_Toc393354355)

[7.3 Temporal Dispersion 10](#_Toc393354356)

[7.3.1 Angle of arrival/departure 10](#_Toc393354357)

[7.3.2 Time of arrival 10](#_Toc393354358)

[7.3.3 Delay spread 10](#_Toc393354359)

[7.3.4 Coherence time/bandwidth 10](#_Toc393354360)

[7.4 Multipath 10](#_Toc393354361)

[7.5 Antenna Gain/Pattern 10](#_Toc393354362)

[7.6 Other 10](#_Toc393354363)

[8 Reference 10](#_Toc393354364)

# Definitions:

|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# Scope

This document details the characteristics of the air interface channels for the suite of applications described in the current revision of the 802.15.3d Application Requirements Document, 15-14-304-xx-003d.

# Methodology

Descriptions of the applications and associated channel modeling parameters are listed in paragraphs 4-7.

## The channel modeling parameters considered are the following.

### Operating frequency band(s)

### Path loss model

### Fading model

### Temporal Dispersion

### Multipath

### Antenna gain/pattern

### Other

# Kiosk Download and File exchange on 60 GHz band

## Environments

Regarding to the application requirement document [x1] and the contribution on application usage [x2], environments in where IEEE802.15.3d devices shall be operated can be defined. Two environments are characterized in this report. Table x1 summarizes the two characterized environments.

The scenario can be uniformed to line-of-sight (LOS) channel with transmission distance of a quite short range. Even for LOS scenario, we have to consider the case which metal chassis or metal cover exists on consumer electronics (CE) in which IEEE802.15.3d devices are implemented inside. That metal must be object for the path between the transmitter (TX) and the receiver (RX).

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Model | Scenario | Environment | Description |
| CMx | LOS | Kiosk download |  |
|  |  |  |  |
| CMx | LOSw/o Metal | File exchange |  |
| CMx | LOS w Metal | Fileexchange |  |

## Channel Characterization

###

Molecular attenuation can be ignored because transmission distance along application usage is a short range of up to 50 millimeters.

### Power Delay Profile

###

### Polarization

## Model Parameterization

### List of Parameters

The complete list of parameters used in this report can be summarize as follows:

1. *K*, K factor of Rice distributions for the first arrival path

2. , the cluster decay rate

3. initial decay between the first arrival path and delayed paths

### The parameters are given in Table x.

### Model Parametrization for 57 – 66 GHz

#### Kiosk Downloading

#### File exchange between device to device

## Other

# Intra-Device Communication

## Path Loss Model

## Fading Model

### Scintillation

### Molecular attenuation

### Doppler

## Temporal Dispersion

### Angle of arrival/departure

### Time of arrival

### Delay spread

### Coherence time/bandwidth

## Multipath

## Antenna Gain/Pattern

## Other

# Backhauling/Fronthauling

## Path Loss Model

## Fading Model

### Scintillation

### Molecular attenuation

### Doppler

## Temporal Dispersion

### Angle of arrival/departure

### Time of arrival

### Delay spread

### Coherence time/bandwidth

## Multipath

## Antenna Gain/Pattern

## Other

# Data Center

## Path Loss Model

## Fading Model

### Scintillation

### Molecular attenuation

### Doppler

## Temporal Dispersion

### Angle of arrival/departure

### Time of arrival

### Delay spread

### Coherence time/bandwidth

## Multipath

## Antenna Gain/Pattern

## Other

# Reference

[x1] Application requreiment document

[x2] Ken Hiraga, Masasih Shimizu, Toshimitsu Tsubaki, Hideki Toshinaga and Tadao Nakagawa, “Real usage of the kiosk downloading,” IEEE80.15-14-0298-00-003d, Beijing, Mar 2014.

[x3] technical requirement document

[x4] Su-Khiong Yong, “TG3c Channel Modeling Sub-committee Final Report,” IEEE 802.15-07-0584-01-003c, Orland, Mar 2007.

[x5] Ichiro Seto, Kiyoshi Toshimitsu, Kazuaki Kawabata, Koji Akita and Hideo Kasami, “Radio propagation performance on 60 GHz band,” IEEE802.15.14-0416- 01-003d, San Diego, Jul 2014.

[x6] Koji Akita, Yukako Tsutsui, Takayoshi Itoh, Koh Hashimoto, Hideo Kasami and Koji

Ogura, “Design of a 60 GHz Proximity Communication System: Antenna in Package and Desktop Channel Measurements,” 6th GSMM (global symposium on millimeter wave) 2013 in Sendai, Japan, April 22-23 2013