

Recommendation on Channel Propagation Model for Local Multipoint Distribution Service

Cover Sheet for Presentation to IEEE 802.16 Broadband Wireless Access Working Group (Rev. 1)

Document Number: IEEE 802.16.1pp-00/16

Date Submitted: 2000-05-04

Source:

Wei Zhang

NIST

100 Bureau Drive, Stop 8920

Gaithersburg, MD 20899-8920

Nader Moayeri

NIST

100 Bureau Drive, Stop 8920

Gaithersburg, MD 20899-8920

Voice: 301 975 3443

Fax: 301 590 0932

E-mail: wzhang@antd.nist.gov

Voice: 301 975 3767

Fax: 301 590 0932

E-mail: moayeri@nist.gov

Venue: IEEE 802.16 Session #6 PHY Presentation

Base Document:

IEEE 802.16.1 pc-00/16 <http://grouper.ieee.org/groups/802/16/phy/contrib/802161pc-00_16.pdf>

Purpose: To provide an input to the specific area "Channel propagation model"

Notice:

This document has been prepared to assist the IEEE 802.16. 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 may be made public by 802.16.

IEEE Patent Policy:

The contributor is familiar with the IEEE Patent Policy, which is set forth in the IEEE-SA Standards Board Bylaws

<<http://ieee802.org/16/ipr/patents/bylaws.html>> and includes the statement:

"IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard."

See <<http://ieee802.org/16/ipr>> for details.

Recommendation on Channel Propagation Model for Local Multipoint Distribution Service

Wei Zhang and Nader Moayeri
Wireless Communications Technologies Group
Advance Network Technology Division
Information Technology Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899, USA

Outline

Introduction

Channel Propagation Model and Its Parameters

Relation Between Delay Spread and Excess Path Loss

Summary

Introduction

- Flexible channel propagation model for local multipoint distribution service (LMDS), i.e., flexible parameters: number of taps, tap gains, and tap delays

line-of-sight (LOS) propagation

use of highly directional antennas, at least at the receiver

- Linear relation between the delay spread and the excess path loss (in excess of free-space loss)

Channel Propagation Model and Its Parameters

- Model:
$$h(t) = \sum_{n=0}^{N-1} a_n \mathbf{d}(t - \mathbf{t}_n) \exp(-j \mathbf{v}_c \mathbf{t}_n)$$

$$20 \log_{10} a_0 = 0 \text{ dB and } \mathbf{t}_0 = 0 \text{ ns}$$

- Parameters: $A_{\max} \geq 20 \log_{10} a_1 > 20 \log_{10} a_2 \geq A_{\min}$

$$\mathbf{t}_{\min} \leq \mathbf{t}_1 \leq \mathbf{t}_2 \leq \mathbf{t}_{\max}$$

Table 1: Values derived from measurements

Items	A_{\max} (dB)	A_{\min} (dB)	t_{\min} (ns)	t_{\max} (ns)
Values	-2.8	-20	3	50

Table 2 : Summary of good channel

Tap index	Tap gain(dB)	Delay (ns)
0	0	0

Table 3 : Summary of moderate channel

Tap index	Tap gain (dB)	Delay (ns)
0	0	0
1	-13.7	5.3

Table 4 : Summary of bad channel

Tap index	Tap gain (dB)	Delay (ns)
0	0	0
1	-2.8	3.6
2	-16.2	15.3

Table 5 : Summary of a multipath channel

Tap index	Tap gain (dB)	Delay (ns)
0	0	0
1	-15	20
2	-20	50
-1	-15	-20
-2	-20	-50

Probably the direct LOS path is blocked: it is seen that the shortest propagation path is under non-LOS conditions.

Relation Between Delay Spread and Excess Path Loss

- Relation: $\mathbf{t} = t_0 + t_e L_e$

t_0 and t_e are flexible and can be determined by measurements, e.g., $t_0 = 0.75$ ns and $t_e = 30^{-1}$ ns/dB

derived from measurement data

Delay spread \mathbf{t} increases with the excess path loss L_e , in excess of free-space loss in dB.

- Excess path loss: $L_e = L_R + L_{at} + L_o + L_m$

Rain loss L_R , may need refinements to existing models

Loss L_{at} of atmospheric gases, models available

Obstruction loss L_o , negligible, at least minimized, on
LOS conditions

Loss/fading L_m due to multipath, minimized by highly
directional antennas

Summary

- Flexible channel propagation model: no more than 3 taps, progressive decrease tap gains, progressive increase delays

Assumptions: (1) LOS; (2) Directional antennas at least at the receiver; (3) Heavy-rain effects not included; (4) Threshold -20 dB

- Propagation channel degrades as the excess path loss (in excess of free-space) increases. The excess loss can be minimized by installing highly directional antennas at relatively high locations.