Influence of moving people on the 60 GHz channel –a literature study

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Abstract

This contribution presents results from a literature study on the influence on of moving humans on the 60 GHz channel mainly based on measurements. A couple of parameters describing the shadowing process are presented including some measured numbers for these parameters.

Human induced shadowing events

- **TG3c channel model does not take into account human movement**
- **Statistics about human induced shadowing effects should be included into channel modeling, containing**
  - Amplitude
  - Duration
  - Rising Time
  - Occurence Rate
- **The influence of different parameters should be investigated**
  - Type of antenna
  - Distance
  - …

Overview

- **In [1], the propagation path visibility is investigated by a geometric model for distances up to 10 meters. The authors conclude, that diversity switching between two base stations leads to a 95 % visibility for distances less than 8 meters**

- **In [2], ray tracing in combination randomly walking human obstacles (9 dB attenuation) is used to investigate the effect of human activity on 60 GHz OFDM transmission. Here, also spatial diversity is proposed to overcome the shadowing problem.**

- **In [3-5], amplitude, duration, rising Time and occurence rate are investigated experimentally and a full parameter set for the modeling of these parameters is given. The results are presented on the following slides.**

Human body blockage - Measurements

- **Channel Sounder Measurements (500 MHz bandwidth)**
- **Antennas**
  - 22.4 dBi horn (H)
  - 3 dBi patch antenna (P)
  - HH, PH and PP configuration

- **Room Dimensions: 10 x 13 meters**
- **Three different Tx-Rx combinations**
- **Human activity 0 – 15 persons**
- **20 h total measurement duration**

For more details on the scenario see [3]

Human body blockage - Amplitude

- **Generally more than 20 dB attenuation due to humans**
- **More pronounced for narrow beamwidth antennas, where the LOS component is more pronounced.**
  - Mean value >15 dB for directive antennas (horn, 22.4 dBi)
  - Mean value <15 dB for 3 dBi patch antennas
- **Amplitude does not depend on number of persons**
- **Amplitude decreases with antenna height**

For more details see Table V of [3]

Human body blockage - Dynamics

- **Duration**
  - No clear dependence on antenna configuration
  - Wide spread
  - „Key figures“
    - 300 to 450 ms for 10 dB threshold
    - 100 to 300 ms for 20 dB threshold
    - Dependent on number of persons
  - Good fitting by lognormal or Weibull distribution
  - Higher for NLOS

- **Rising Time**
  - Can be short („worst case“: <30ms)
  - Longer for NLOS than for LOS

For more details see Table IV and VI of [3]

Human body blockage – Occurrence Rate

- **Pseudoperiod I_{SSE}**
  - Describes the inter-arrival time between two successive shadowing events (see also Fig. 3 of [3] *Parameter Definitions*)
  - Spreads from 2 s up to 20 minutes depending on human activity

- **Unavailability Rate**
  - Correction: Long Shadowing events not taken into account
  - Values can vary between 1.7 and 5.2 %
  - Configurations with patch antennas benefit from angular diversity

For more details see Table VII of [3]

Modeling Results from [5]

- **Amplitude**
  - Normal distribution
  - Dependent on antenna configuration
- **Duration**
  - Lognormal distribution
  - Dependent on antenna configuration, Tx-Rx configuration and number of persons
- **Pseudoperiod (Occurence rate)**
  - Lognormal distribution
  - Dependent on antenna configuration, Tx-Rx configuration and number of persons
- **Rising time**
  - Lognormal distribution
  - Dependent on antenna configuration

Ref. [5] contains a full parameter set for the modeling of the parameters listed above

References

- **[1] K. Sato and T. Manabe. Estimation of propagation-path visibility for indoor wireless LAN systems under shadowing condition by human bodies.** ***Vehicular Technology Conference, 1998. VTC 98. 48th IEEE*****, 3, 1998.**
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