

Slides for “Channel Models and Performance Metrics for IEEE 802.16j Relay Task Group ”

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I-Kang Fu, presenter
National Chiao Tung University /
Industrial Technology Research Institute
ED922, 1001 Ta Hsueh Road,
Hsinchu , Taiwan 300, ROC

Voice: +886 3 5712121 ext. 59237

E-mail: apatch.cm91g@nctu.edu.tw

See second page for complete list of co-authors.

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Purpose:

The purpose of this slide set is to introduce our contribution C802.16j-06_020r1. This contribution proposes the channel models and performance metrics to be used in IEEE 802.16j Relay Task Group for performance evaluation in urban environment.

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Contribution Authors

David Chen

Motorola Inc
1441 W. Shure Drive,
Arlington Heights, IL 60004 USA

david.t.chen@motorola.com

I-Kang Fu

National Chiao Tung University /
Industrial Technology Research Institute
1001 Ta Hsueh Road,
Hsinchu , Taiwan 300, ROC

apatch.cm91g@nctu.edu.tw

Mike Hart

Fujitsu Laboratories of Europe Ltd.
Hayes Park Central
Hayes End, Middx., UK, UB4 8FE

Mike.Hart@uk.fujitsu.com

Wendy C Wong

Intel Corporation
2200 Mission College Blvd.,
Santa Clara, CA 95054.

wendy.c.wong@intel.com

Outline

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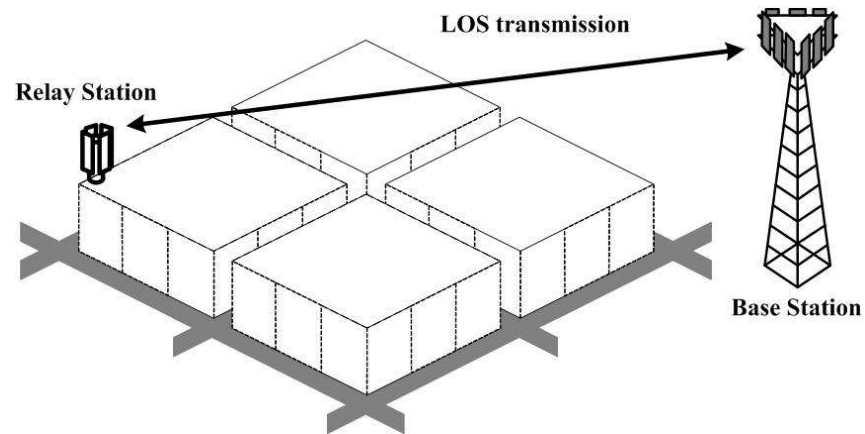
Introduction

- This contribution proposes the channel models and performance metrics to be used in IEEE 802.16j Relay Task Group for performance evaluation.
- The channel models for urban environment is proposed in this version and will be updated to include other environments in the future.
 - The models in this contribution are mostly referenced from [1], which specifies the channel models for various relay transmission scenarios.

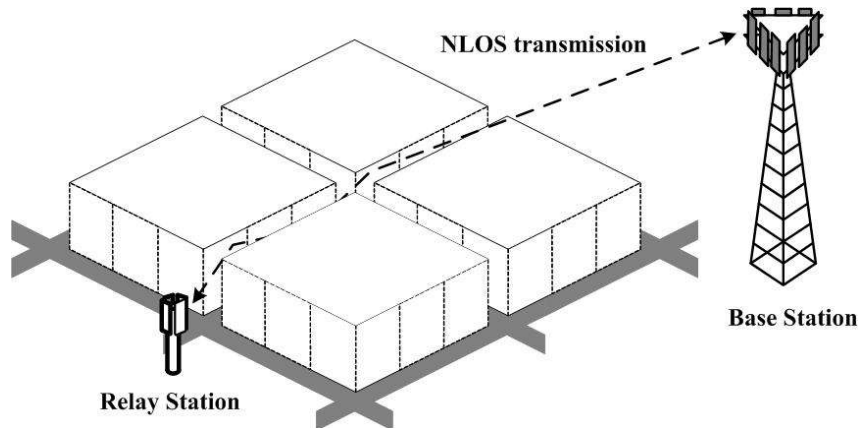
Classification of Propagation Scenarios

- The propagation scenarios are classified by the type of each hop and LOS/NLOS (Non-Line-Of-Sight) condition. Following scenarios are considered:

- Scenario 2.1 BS↔RS, LOS



- Scenario 2.2 BS↔RS, NLOS

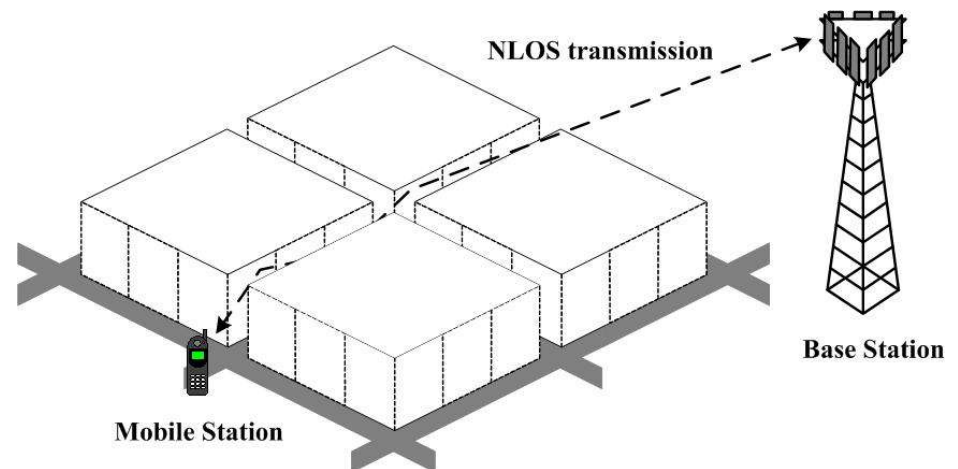


Classification of Propagation Scenarios

– Scenario 2.3 BS↔MS, LOS

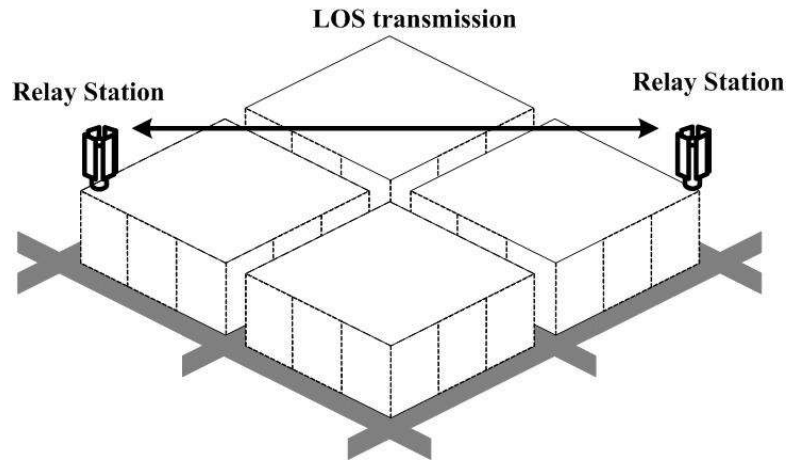
- The probability to have LOS condition between BS and MS is considered as zero in urban environment [1], therefore, there is no specific channel model for this scenario.
- Our interpretation is that the occasional gain from LOS condition between BS↔MS is included in log-normal shadow fading effect in NLOS environment with corresponding low probability.

– Scenario 2.4 BS↔MS, NLOS

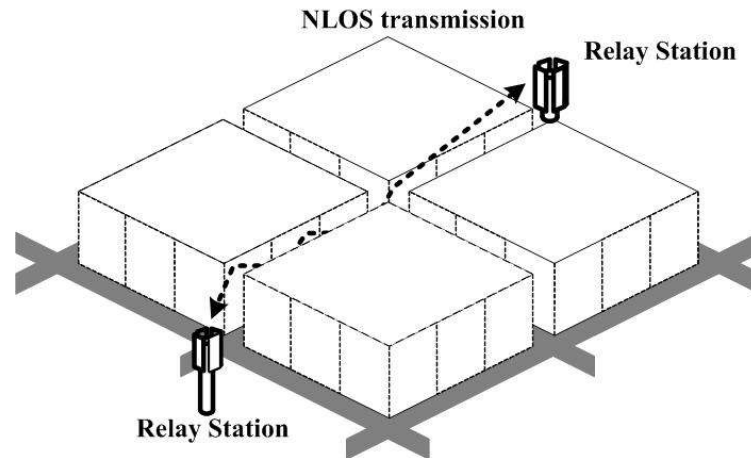


Classification of Propagation Scenarios

- Scenario 2.5 RS \leftrightarrow RS, LOS

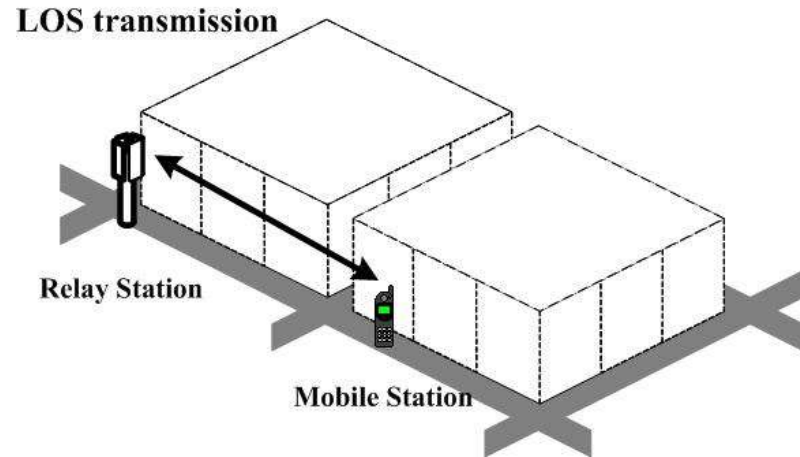


- Scenario 2.6 RS \leftrightarrow RS, NLOS

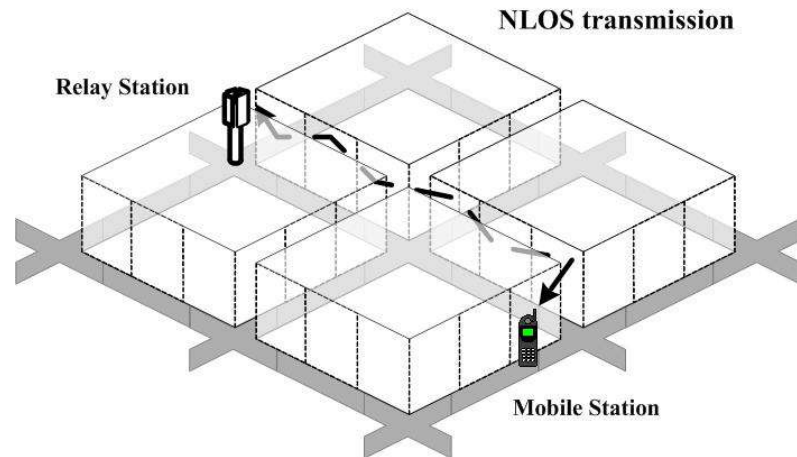


Classification of Propagation Scenarios

- Scenario 2.7 RS↔MS, LOS



- Scenario 2.8 RS↔MS, NLOS



Channel Model for Each Propagation Scenarios

- The channel model for each scenario is characterized by four parts: pathloss, shadow fading, multi-path fading and antenna pattern.
- Pathloss model [1]

Scenario	Pathloss Model	Note
2.1 BS↔RS, LOS 2.5 RS↔RS, LOS	$Pathloss(d) [dB] = 42.5 + 23.5 \cdot \log_{10}(d) + 20 \cdot \log_{10}\left(\frac{f_c}{5}\right)$	d is the distance in meter between transmitter and receiver f_c is the carrier frequency in GHz
2.2 BS↔RS, NLOS 2.4 BS↔MS, NLOS 2.6 RS↔RS, NLOS	$Pathloss(d) [dB] = 38.4 + 35 \cdot \log_{10}(d) + 20 \cdot \log_{10}\left(\frac{f_c}{5}\right) - 0.7 \cdot h_m$	h_m is the height (meter) of the RS below rooftop for scenario 2.2 and 2.6. $h_m = 1.5$ for scenario 2.4.
2.7 RS↔MS, LOS	$Pathloss(d) [dB] = 41 + 22.7 \cdot \log_{10}(d) + 20 \cdot \log_{10}\left(\frac{f_c}{5}\right)$	
2.8 RS↔MS, NLOS	$Pathloss(d_1, d_2) [dB] = 65 + 0.096 \cdot d_1 + (28 - 0.024 \cdot d_1) \cdot \log_{10}(d_2) + 20 \cdot \log_{10}\left(\frac{f_c}{5}\right)$	d_1 and d_2 are the distances along main street and perpendicular street respectively. (see Figure 8)

Channel Model for Each Propagation Scenarios

- Log-normal shadow fading model with correlation [2] is considered in this contribution, which has different parameter for each scenario.
 - Consider the de-correlation distance as 20m [3]
 - Different standard deviation is considered for each propagation scenario [1]:

Scenario	2.1 BS↔RS LOS	2.2 BS↔RS NLOS	2.4 BS↔MS NLOS	2.5 RS↔RS LOS	2.6 RS↔RS NLOS	2.7 RS↔MS LOS	2.8 RS↔MS NLOS
Standard deviation of log-normal shadow fading (σ)	3.4dB	8dB	8dB	3.4dB	8dB	2.3dB	3.1dB

Note: The shadow fading for LOS scenario represents the different level of first Fresnel zone clearance [7]

Channel Model for Each Propagation Scenarios

- Multipath fading model
 - The tapped delay line model for each propagation scenario and Doppler spectrum are listed in section 3.3
- Antenna pattern
 - For omni-directional antenna, the antenna gain is considered as 0 *dBi* for each direction.
 - For 3 or 6-sector antenna, following antenna pattern are considered [4]:

- $-180^\circ < \theta \leq 180^\circ$
- θ is the angle between the direction of interest and the steering direction of the antenna;
- $\theta_{3db} = 70^\circ$ is the 3 dB beam width for 3 sector antenna, $\theta_{3db} = 35^\circ$ for 6 sector antenna.
- $A_m = 20\text{dB}$ maximum attenuation (front-to-back ratio) for 3 sector antenna, 23dB for 6 sector antenna.



Performance Metrics and Presentation

- The following performance metrics are proposed to be considered in IEEE 802.16j Relay TG for performance comparison:
 - ◆ Over the air (OTA) throughput
 - ◆ Packet delay
 - ◆ Throughput for various QoS classes
 - ◆ Throughput outage
 - ◆ Packet call throughput
 - ◆ Sector throughput
 - ◆ BS Duty Factor (Utilization)
 - ◆ RS Duty Factor (Utilization)
 - ◆ Delay per packet, per connection, per application.
 - ◆ Jitter per application
 - ◆ Overhead ratio
 - ◆ Effective spectral efficiency
 - ◆ Fairness
 - ◆ Route discovery/recovery time
 - ◆ Dropped calls due to unsuccessful handover, sleep and idle modes
 - ◆ Packet loss rate

Performance Metrics and Presentation

- ◆ The following metric presentations are proposed for performance comparison in 802.16j Relay TG:
 - CDF of user packet delay for delay sensitive traffics
 - Plot of system throughput vs. average user throughput
 - CDF of normalized user packet call throughput with fairness criterion
 - CDF of user packet call throughput
 - User throughput vs. distance
 - System load vs outage probability
 - CDF of received signal quality
 - Effective spectral efficiency

Reference

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