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

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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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Outline

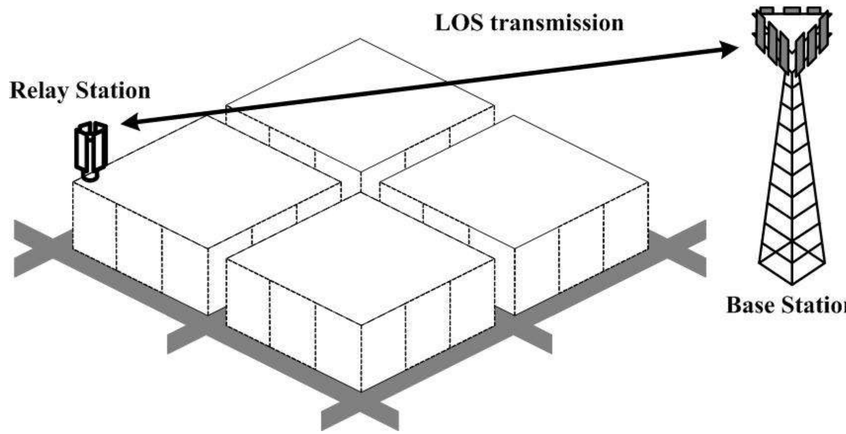
- **Introduction**
- **Classification of Propagation Scenarios**
- **Channel Model for Each Propagation Scenario**
- **Performance Metrics and Presentation**
- **Reference**

Introduction

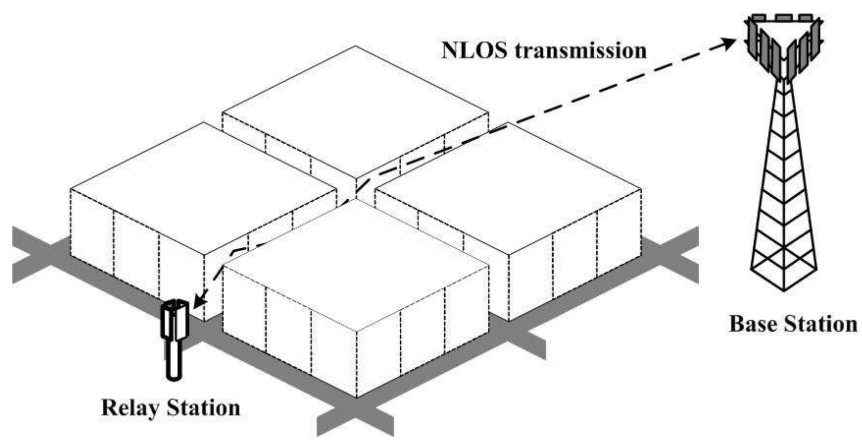
- This contribution proposes the channel models and performance metrics to be used in IEEE 802.16j Relay Task Group for performance evaluation.
- The channel models for **urban** environment is proposed in this version and will be updated to include other environments in the future.
  - The models in 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



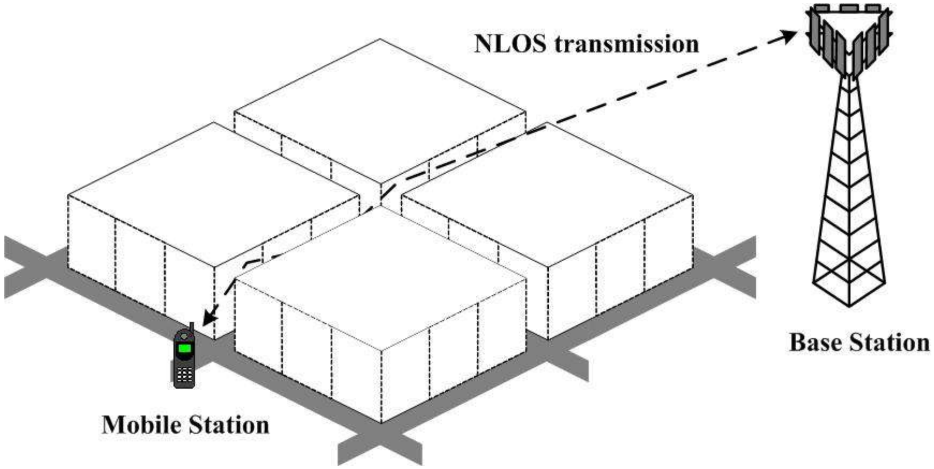
Classification of Propagation Scenarios

– 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.

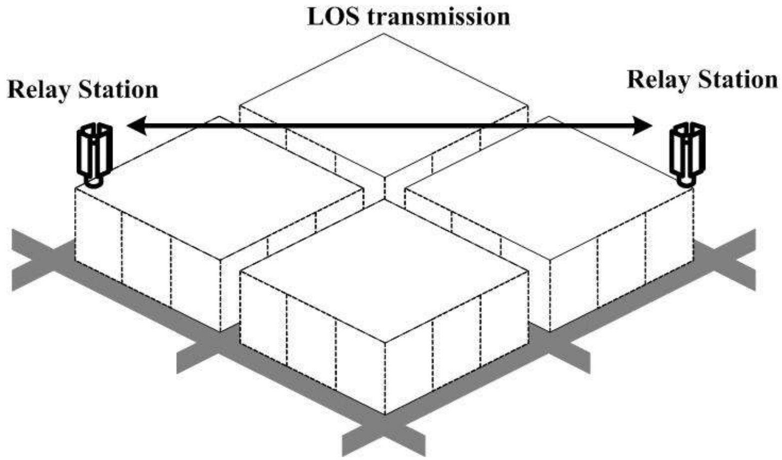
- Our interpretation is that the occasional gain from LOS condition between BS↔MS is included in log-normal shadow fading effect in NLOS environment with corresponding low probability.

– Scenario 2.4 BS↔MS, NLOS

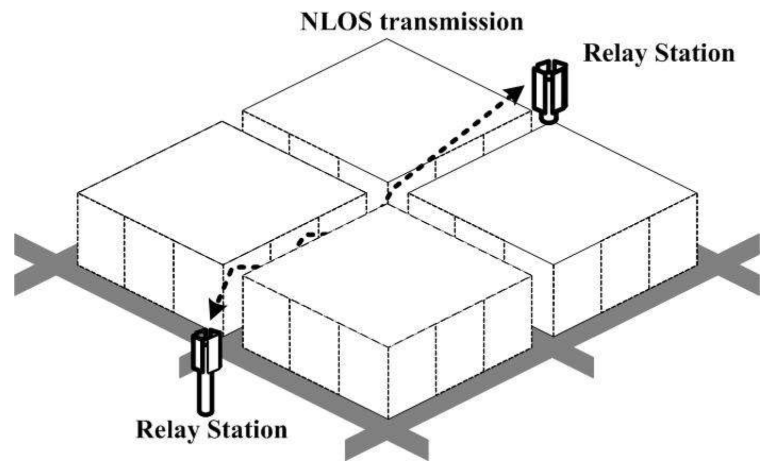


Classification of Propagation Scenarios

– Scenario 2.5 RS↔RS, LOS

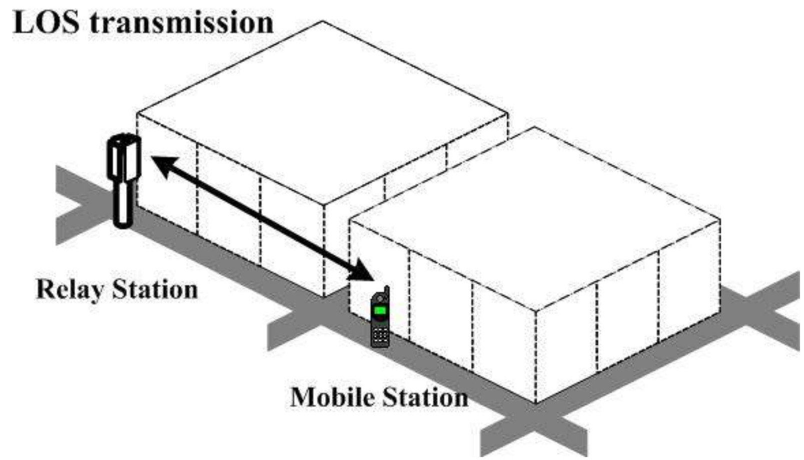


– Scenario 2.6 RS↔RS, NLOS

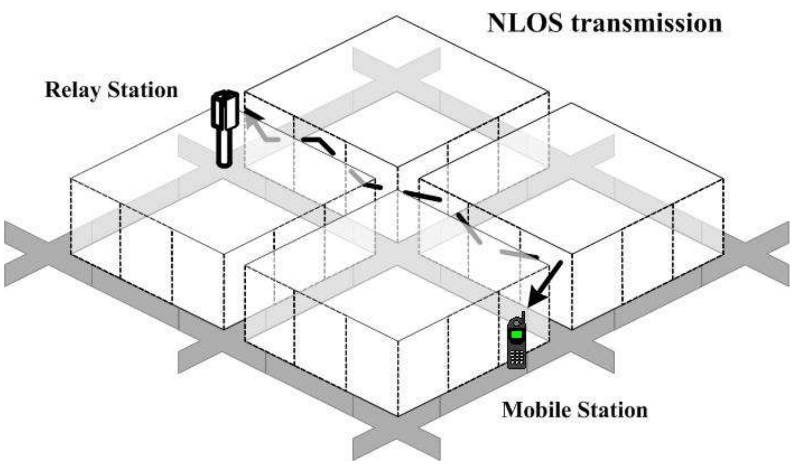


Classification of Propagation Scenarios

– 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	$Pathloss(d)[dB] = 42.5 + 23.5 \cdot \log_{10}(d) + 20 \cdot \log_{10}\left(f_c/5\right)$	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	$Pathloss(d)[dB] = 38.4 + 35 \cdot \log_{10}(d) + 20 \cdot \log_{10}\left(f_c/5\right) - 0.7 \cdot h_m$	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	$Pathloss(d)[dB] = 41 + 22.7 \cdot \log_{10}(d) + 20 \cdot \log_{10}\left(f_c/5\right)$	
2.8 RS↔MS, NLOS	$Pathloss(d_1, d_2)[dB] = 65 + 0.096 \cdot d_1 + (28 - 0.024 \cdot d_1) \cdot \log_{10}(d_2) + 20 \cdot \log_{10}\left(f_c/5\right)$	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]:

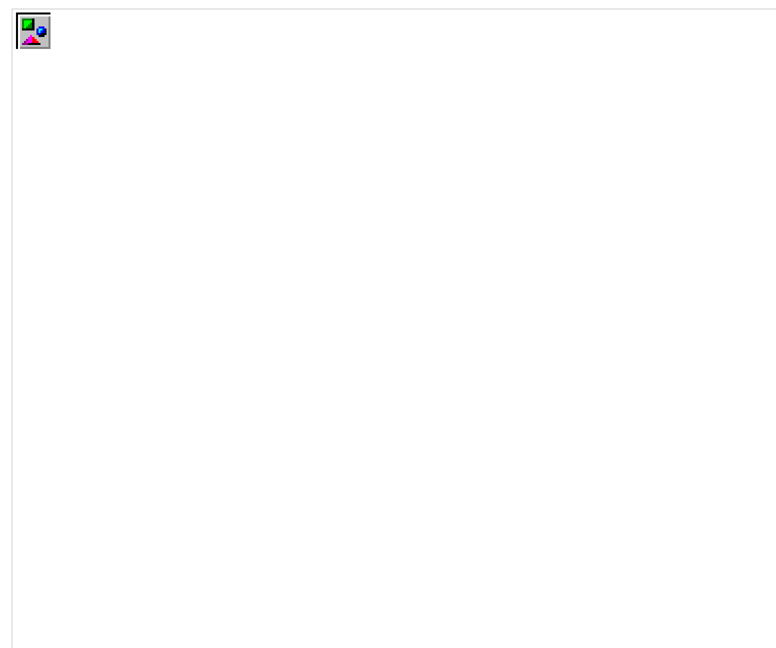
Scenario	2.1 BS↔RS LOS	2.2 BS↔RS NLOS	2.4 BS↔MS NLOS	2.5 RS↔RS LOS	2.6 RS↔RS NLOS	2.7 RS↔MS LOS	2.8 RS↔MS NLOS
Standard deviation of log-normal shadow fading (σ)	**3.4dB**	**8dB**	**8dB**	**3.4dB**	**8dB**	**2.3dB**	**3.1dB**

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]:



- $-180^o < \theta \leq 180^o$
- θ is the angle between the direction of interest and the steering direction of the antenna;
- $\theta_{3db} = 70^o$ is the 3 dB beam width for 3 sector antenna, $\theta_{3db} = 35^o$ for 6 sector antenna.
- A_m = 20dB 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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