Multi-hop Usage Scenario Modeling

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To clarify the propagation modeling requirements for different usage models and use cases

Introduction

- The type of propagation environments that would be experienced by different usage scenarios are discussed.
- Type of mixed scenarios that can be used to include those use cases are also discussed.
- It is desirable to specify propagation models for performance evaluations under different use cases

Use Cases proposed in [1]

- Cell edge and cell range improvement
- Coverage holes within the cell
  - due to shadowing from trees, buildings valleys.
- In-buildings,
- Underground locations
  - In-tunnels,
  - In-subway,
- Mobile platform
  - In-bus and in-taxis
  - In-train
  - In-ferry
- Emergency disaster recovery and special events

Modelling different Use Cases

- If multiple use cases are applicable to a given solution, how should the user distributions and their propagation/mobility environments are modeled?
  - Simulate individual use cases separately
  - Simulate several test cases each consist of different combinations of use cases
    - The probability of occurrence of a particular use case is a variable – depends on place to place
  - Both methods may be required in order to have a good assessment of a particular proposal or a solution

Use Case Scenario and Associated Propagation Modelling

Use Cases [1]	Propagation Modeling	Comments
(1a) Cell Edge and cell range improvement	ART-ART, ART-BRT, BRT-BRT:	• Can be considered by specifying path loss models and environments (urban, suburban etc)
(1b) Coverage holes in the cell area improvement	ART-ART, ART-BRT, BRT-BRT	• Can be considered by specifying shadowing in the propagation model above.
(2a) In-building	Outdoor (ART/BRT)– indoor: Indoor-indoor:	• using penetration loss, floor loss • special propagation model
(2b) In-Tunnel	Outdoor (ART/BRT)– indoor Indoor-indoor:	• using tunnel penetration loss, • special propagation model
(2c) In-subway	Outdoor (ART/BRT)– indoor: Indoor-indoor:	• using penetration loss, floor loss • special propagation model
(2d) Underground locations	Outdoor (ART/BRT)– indoor: Indoor-indoor:	• using penetration loss, floor loss • special propagation model
(3a) Emergency disaster recovery and special events		• Can be covered by above (1) and (2) as appropriate.
(4a) In-buses and taxis		• Vehicle penetration loss
(4b) In-trains		• Vehicle penetration loss • Inside nodes to inside nodes
(4c) In-ferries		• Similar to in-building case, 2(a)?

ART: Above Roof Top
BRT: Below roof top

Proposed Path Loss Models

No	Propagation Model	Links	Specification
1	ART-to-ART	BS-RS, RS-RS	Modified IEEE 802.16d Category C [1]
2	ART-to-BRT	BS-RS,BS-MS	Modified IEEE 802.16d [1]
3	BRT-to-BRT on same street	RS-MS, RS-RS	Advanced LOS model [2]
4	BRT-to-BRT on different streets	RS-MS, RS-RS	Modified Berg/ETSI ART model [2]
5	ART (outdoor) to in-building /in-ferry/in-tunnel	BS-RS, RS-RS, BS-MS, RS-MS	Penetration loss and floor loss to (2)?
6	BRT (outdoor) to in-building/in-ferry/in-tunnel	RS-RS, RS-MS	Penetration loss and floor loss to (3) and (4)?
7	In-building to In-building	RS-RS, RS-MS	Penetration loss
8	In-subway to in-subway	RS-RS, RS-MS	?
9	Outdoor to in-subway	BS-RS, RS-RS, BS-MS, RS-MS	Penetration loss and floor loss as in (5)?
10	Vehicle top to in-vehicle	RS-RS, RS-MS	Vehicle penetration loss?

Modelling Use Cases – Mixed Use Case Possibilities

The use cases that may be considered jointly or separately are listed below.

Case A: A Mixed Scenario (Cellular layout)

- Both Cell Edge users(1a), and coverage holes (1b) can be covered when users are dropped uniformly.
- Several mobile velocity (pedestrian, vehicle etc) probabilities need to be considered.
- LOS and NLOS probabilities need to be identified.

Case B: In-building, Case C: Inside Tunnels, Case D: Inside Subways

- In order to understand the impact on the specific users by different proposals these three cases may be simulated separately.
- This may also be simulated as a mixed group with certain assigned probabilities (with above case A) to obtain the overall performance impact.

Underground locations (2d) may be either similar to Subways or Tunnels?
Emergency disaster recovery and special events (3a) may be modeled as a special case of Test Case (A).

Modelling Use Cases – Mixed Scenario Possibilities

Mixed Scenarios that can be considered

Case E: In-Bus and in-Taxis

- In order to understand the impact on the specific users by different proposals this may be simulated separately.
- This may be simulated as a mixed group with certain assigned probabilities (with above A) as well to obtain the overall impact.

Cases F: In-Trains

- Similarly both separate as well as mixed scenario may be used.
- **In-Ferries:** This may be similar to inside trains, inside busses or inside buildings

Test Case Examples

Use Cases	User Location	RS Speed	Percentage users from each use case			
			Urban	Sub-Urban	Rural	In building
Cell Edge/Shadowing (separate speed assignments are needed)	Uniform Distribution	Fixed – 86% 3km/h- 10% 30km/h – 3% 100km/h - 1%	50%	70%	95%	5%
In-building	?		45%	26%	3%	94%
In-tunnels	Few specific clustered users	Fixed	1%	1%	0%	1%
In-subway	Few specific clustered users	200km/h	1%	1%	0%	0%
In-Bus and In-Taxis	Random selection	60km/h	3%	1%	1%	0%
In-Trains		200km/h	0%	1%	1%	0%

Summary

- Different propagation, environment, user distribution and user speed modelling may be required for different use cases.
- Certain user cases can be modelled and evaluated under mixed scenarios by assigning probabilities to specific user groups belonging to a specific user scenario.
- Several possibilities have been discussed with respect to the deployment environment such as urban, suburban and rural .

References

[1] 'Multihop Path Loss Model (Base to Relay and Base to Mobile)', Dean Kitchener et al., IEEE C802.16j-06/011, 1/5/2006

[2] 'Below Rooftop Path Loss Model', Dean Kitchener et al., IEEE C802.16j-06/010, 1/5/2006

[3] 'Multihop Network Simulation with Street Layout', Dean Kitchener et al., IEEE C802.16j-06/012, 2/5/06