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Title	**Comments on Mobility Modeling in Draft IEEE 802.16m Evaluation Methodology Document (Section 9.1)**
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Re:	Call for Comments and Contributions on Project 802.16m Evaluation Methodology, 2007-04-09
Abstract	This document highlights several areas where the Evaluation methodology is not adequately defined for mobility analysis, proposes modifications for some and suggested course of action for mobility environment definition.
Purpose	Propose changes to mobility movement and RF environment modeling in Section 9.1.
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Comments on Mobility Modeling in Draft IEEE 802.16m Evaluation Methodology Document (Section 9.1)

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Draft IEEE 802.16m Evaluation Methodology section 9.1 identifies an optional simplified mobile modeling environment. The proposed model further defines a relatively rich set of metrics to be collected on failure and delay characteristics. Unfortunately, the simplified mobility model contained within the Draft is inadequately specified to produce repeatable and comparable simulation results to conduct an evaluation. The remainder of this document will highlight several of these key areas and propose solutions.

1.0 Mobility, User Movement, and Initial User Placement

The model of 9.1 defines two travel segments (9.1.2.1 and 9.1.2.2) and limits statistics collection to the center cell for HO operations. Section 9.1.1 further suggests that only a single user per simulation drop is used to collect the array of statistics identified in sections 9.2.1 through 9.2.6. Several problems exist with this technique, of which two are outlined below:

- System is under sampled geographically
- To generate enough HO samples to be statistically significant, the user would have to traverse the stated trajectory many times. Since the path is the same, the failure statistics would be dominated by a very limited sample set of log-normal behaviors. The end result can significantly skew the end HO related statistics to either good or bad extremes. This fundamentally results in the inability to compare results from different vendors reliably

At the other extreme of modeling mobility is random walk, Brownian type motion. This technique requires a moderate set of variables to determine the behavior, adding to complexity. An approach that falls between these two extremes is described in the following section and is a proposal for section 9.1 of the evaluation methodology. The proposal uses multiple MSs traveling in random directions and speed to alleviate the problems noted.

Current section 9.1 also describes a generic pathloss scenario for the two defined trajectories. Lacking in this description though is specifics on how the parameters angle of arrival, delay spread, and shadowing are modulated as the user moves through the environment. The text instead refers to the RF modeling contained elsewhere. Unfortunately, the RF modeling specified is tailored to the methodology of dropping a user at a location and calculating a set of parameters for the user at the location.(see Step 3 on pg. 34 and Appendix A.) The currently specified models only define the relative correlation between BSs and correlation between angle spread and shadowing.

In summary, we propose to add the following two sections to model mobility and RF for handover.

2.0 Mobility

The following sections describe the initial placement and movement for mobile users with in the simulation environment. Users are uniformly placed over the simulation environment and given a random trajectory and speed. The parameters selected remain in effect until a drop is completed.

2.1.1 Mobile Placement

A TBD number of MSs are uniformly placed within the 19 cell, wrap around simulation space defined within Appendix G.

2.1.2 Trajectory

A dropped MS is assigned an angle of trajectory at the beginning of a call. The assigned angle is picked from a uniform distribution across the range of 0-359 degrees in one degree increments. The angle of zero degrees points directly North in the simulation environment.

Movement of the MS is established by selecting a random speed for the users according to profiles in section 4.3.1 such that the population of MS users meets the desired percentages. The MS remains at the selected random speed and direction for the duration of the simulation drop. When a MS crosses a wrap around boundary point within the simulation space, the MS will wrap around to the associated segment identified within Appendix G, continuing to keep the same speed and trajectory. Figure 1 depicts an example of the movement process.

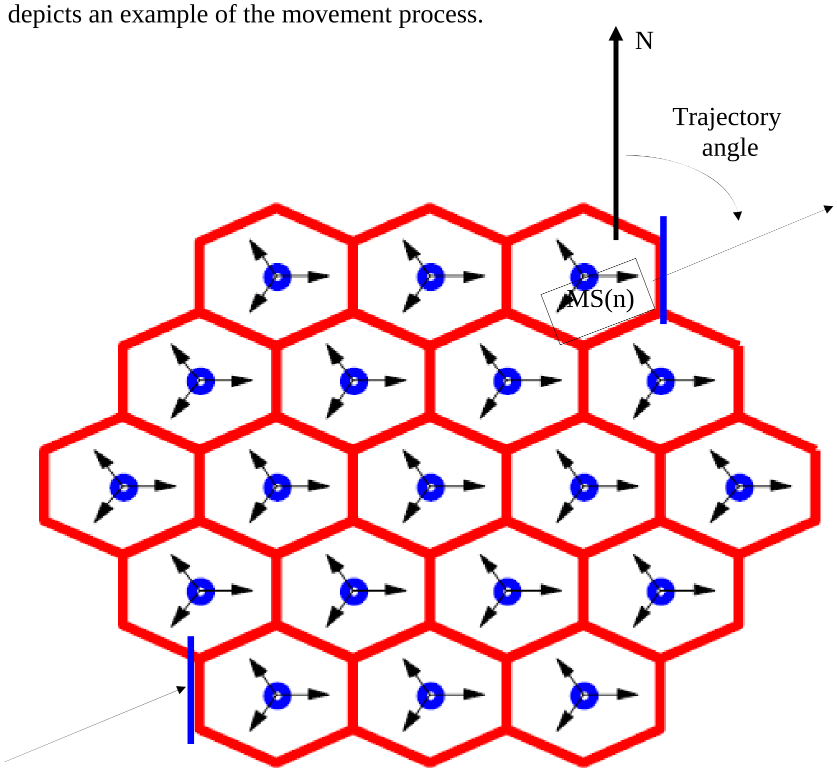

Figure 1. - 19 cell abbreviated example of MS movement in a wrap around environment. Blue lines denote paired wrap around boundary segment.

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3.0 RF Modeling for Mobility

The second part of this proposal is to generate an RF model that reflects the transitional behavior of a real system, including de-correlation distance and the already modeled site to site correlations. One method to accomplish this is through a set of planes, with each plane representing the environment of a given site and/or sector over the simulation space. The planes are divided up in a uniformly spaced grid, using the de-correlation distance to define the desired spacing of sample points. Each point on the grid represents a triplet of angle spread, delay spread, and shadowing parameters. MS locations between the grid points are interpolated. The shadow values are then applied over the defined pathloss models. A visual representation of the model appears in figure 2.

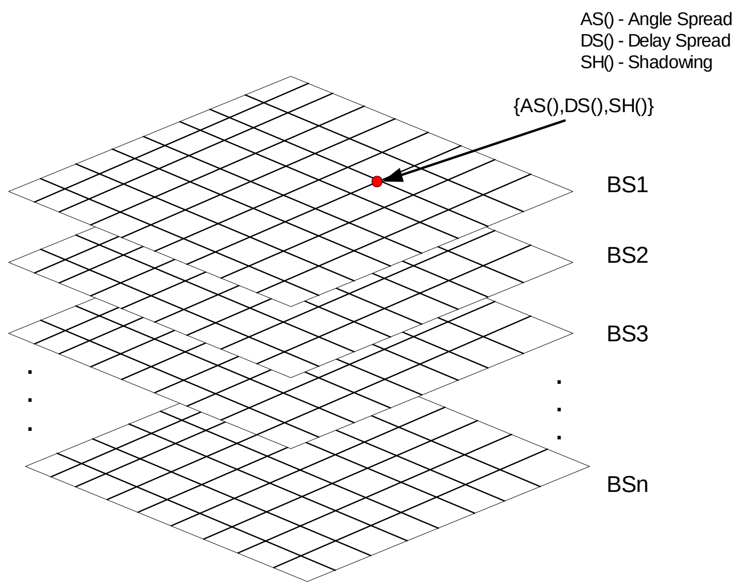

Figure 2 – Simplified representation of plane based approach to RF environment modeling

In addition to the plane representation, a distance_traveled_for_update parameter is also supplied to quantize the RF update interval (based upon distance traveled).