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Abstract	This document provides the proposed areas of focus and the scope of the performance evaluation methodology document for multihop systems. The titles provides here provide a guideline for the required inputs. Contributions from the members can be consolidated into this document as the document evolves.
Purpose	The objective is to discuss the structure of the evaluation methodology document and to allow participants to contribute to the document with focus.
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Multi-hop System Evaluation Methodology

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1 Introduction

[Editor's notes: This document provides the proposed areas of focus and the scope of the performance evaluation methodology document for multihop systems. The titles provides here provide a guideline for the required inputs and various contributions can be consolidated into this document as the document evolves. The objective is to discuss the organization of the evaluation methodology document and to allow participants to contribute to the document with focus.]

1.1 Objective and Scope

The purpose of this document is to provide a set of definitions and assumptions, and a general framework for simulating multihop relay systems to arrive at system wide voice, data, video or mixed data, voice, video performance on the forward and reverse links.

First, a framework of the document is provided with some initial views on the overall simulation components.

Channel models, antenna patterns and traffic modeling and performance metrics have been provided under separate contributions which could later be integrated into this document [3][4].

1.2 Simulation Overview and areas covered by this document

Determining voice, video and high rate packet data system performance requires a dynamic system simulation tool to accurately model feedback loops, signal latency, protocol execution, and random packet arrival in a multipath-fading environment. The packet system simulation tool will include Rayleigh and Rician fading and evolve in time with discrete steps (e.g. time steps of 2 ms, 5 ms and 10 ms). The time steps need to be small enough to correctly model feedback loops, latencies, scheduling activities, and measurements of the proposed system. The simulator should be able to evaluate the performance with and without multihop, and may compare the multi-hop performance with other methods of coverage and throughput improvement. Various components of the simulation are illustrated in Figure 1.

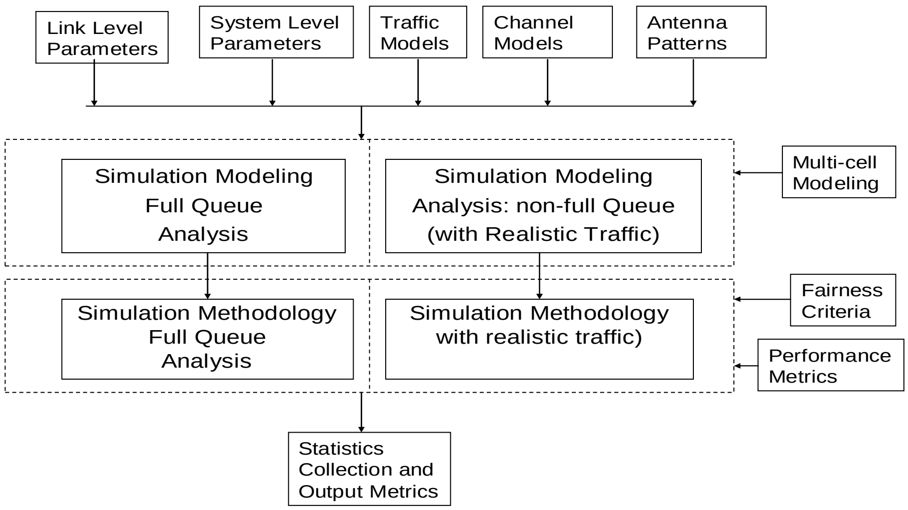

Figure 1 Simulation Components and Overall Methodology

The simulations could be done at two levels. A quick view of system performance is obtained using full queue analysis (e.g. assuming availability of sufficient amount of traffic at each node point which does not need realistic traffic models). The second set of simulations is done with realistic traffic (non- full queue).
The full queue analysis is indicative of the actual performance and useful to carry out quick performance evaluations in the initial design validations. The extension to realistic traffic model increases complexity of the simulations and it increases the simulation run time. However, it produces results that are more indicative of the actual performance in practice.

1.3 *Multi-Cell Layout*

In figure 2 below, a network of cells is formed with 7 clusters and each cluster consists of 19 cells. Depending on the configuration being simulated and required output, the impact of the outer 7 clusters may be neglected. In those cases, only 19 cells and associated relays may be modeled. These cases are identified in the sections below.
For the cases where modeling outer-cells are necessary for accuracy of the results, the 7 cluster network can be used. However, the six of the seven clusters are just virtual clusters repeating the middle cluster in its surroundings as shown in the figure. This way simulation run time and memory requirements will be reduced and more accurate results can be obtained.
Each cell with generic hexagonal grid is separated to 3 sectors, each is formed by a panel directional antennas.

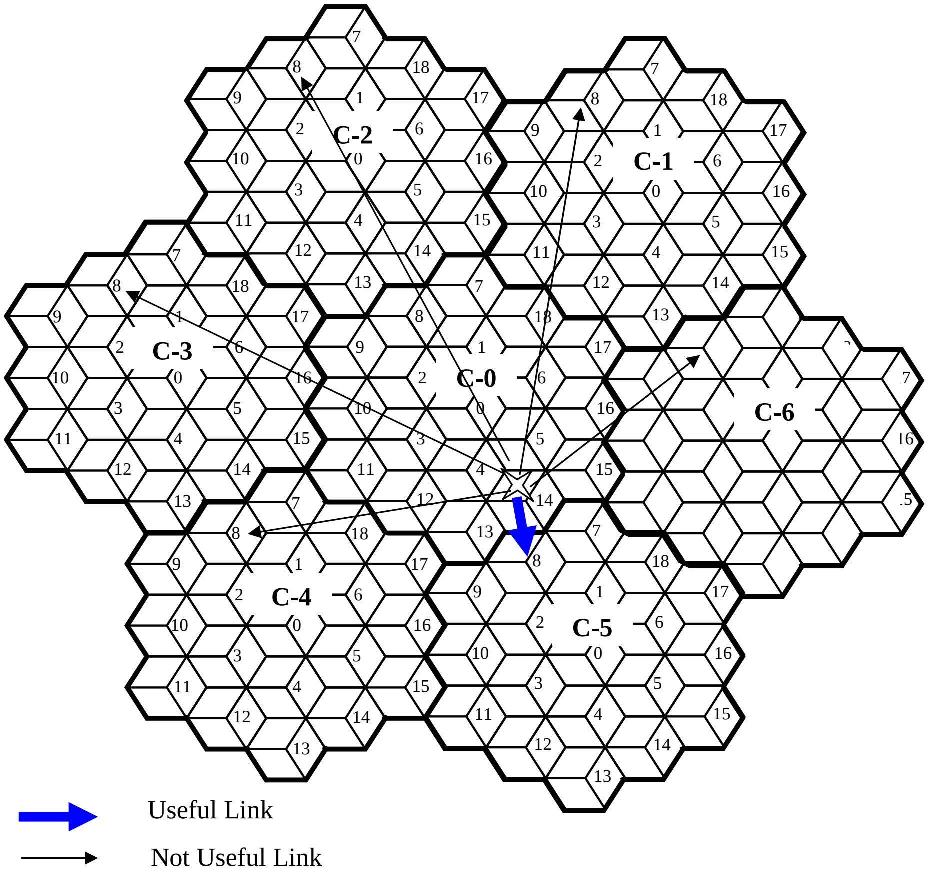

Figure 2 Multi-cell Lay out and Wrap-around Example

1.3.1 Obtaining Virtual UE locations

The number of UEs is predetermined for each sector, where each UE location is uniformly distributed. The UE assignment is only done in the cluster-0 from where the decided UEs are replicated in the other six clusters. The purpose to employ this wrap-around technique, as will be discussed in later section, is to easily model the interferences from other cells.

1.3.2 Determination of Severing Cell for Each UE in a wrap-around multi-cell network

The determination of serving cell for each UE is carried out by two steps due to the wrap-around cell layout; one is to determine the shortest distance cell for each UE from all seven logical cells, and the other is to determine the severing cell for each UE based on the strongest link among 19 cells related to the path-loss and shadowing.

To determine the shortest distance cell for each UE, the distances between the target UE and all logical cells should be evaluated and select the cell with a shortest distance in 7 clusters. Figure 2 illustrates an example for determination of the shortest distance cell for the link between UE and cell-8. It can be seen that the cell-8 located in cluster-5 generates the shortest distance link between UE and cell-8.

To determine the severing cell for each UE, we need to determine 19 links, whereby we may additionally determine the corresponding path-loss, shadowing and transmit/receive antenna gain in consideration of antenna pattern. The serving cell for each UE should offer a strongest link with a strongest received long-term power. It should be noted that the shadowing experienced on the link between UE and cells located in different clusters is the same.

2 Channel Models

[Editor's note: Details of relay to UE, base to UE and base to relay channel models are provided in [2][3][4][5].]

2.1 Base to relay propagation modeling

2.2 Base to UE propagation modeling

2.3 Relay to UE propagation modeling

3 Traffic models

[Editor's note: A proposed set of metrics is submitted [6]]

3.1 Forward link Services

3.2 Reverse Link Services

3.3 Higher layer modeling and network modeling

4 Performance Metrics

[Editor's note: A proposed set of metrics is submitted [7]]

4.1 Single-user performance metrics

4.2 Multi-user performance metrics

4.2.1 Fairness Criterion

4.2.2 Multihop system spectral efficiency

4.2.3 Output metrics

4.2.4 Statistic collection

5 Evaluation Methodology

5.1 Forward link evaluation

5.1.1 Full queue evaluations

5.1.2 Non-full queue evaluations

5.2 Reverse link evaluation

5.2.1 Full queue evaluations

5.2.2 Non-full queue evaluations

5.3 Comparison of multihop solutions with the other solutions that provide additional base stations

5.3.1 Full queue evaluations

5.3.2 Non-full queue evaluations

References

[1] 3GPP2/TSG-C.R1002, “1xEV-DV Evaluation Methodology (V14)”, June 2003.

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[6] IEEE C802.16j-6/024 , “IEEEC802.16j-06/024, “Multihop System Evaluation Methodology: Traffic Models” , May, 2006

[7] IEEE C802.16j-6/025 , “Multihop System Evaluation Methodology – Performance Metrics”, May, 2006

Appendices