Performance Impact of More than 2-Hop Relay

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IEEE 802.16 Session #xx, xxx, xxx
Base Document: C80216j-06_040:" Multi-hop System Evaluation Methodology (Channel Model and Performance Metric)"
Purpose:
To recommend performance metrics for multihop systems

Introduction and Background

- In this contribution we present the simulation study on the impact of multi-hop in particular for the case of more than 2 Hops
- This usage model is the in-cell coverage hole improvement, to demonstrated trade effectiveness of multi-hop relay, the coverage data rate is defined as 384kbps

Simplified System Model (1)

- We model the downlink of a macro-cellular wireless network in which the source is a BS and the destination is a MS. The path between the BS and the MS may be direct, comprising a single hop, or may be indirect via a RS. Initially we restrict an indirect or multihop path to a single RS and thus to two hops
- For a particular 2-hop multihop path, the RS chosen for inclusion in the path is the one which provides the best signal quality of those available. Only those RSs included in multihop paths are assumed to transmit signals; therefore, the density of active RSs (wanted plus interfering) will be in general lower than the density of RSs
- The BSs are assumed to be deployed in a tri-cellular arrangement with various BS separations between 1000m and 400m in both the multihop and the conventional cellular networks.
- We do not restrict a MS to be served by the BS in the same geographic cell but assume that the MS will be served by the BS providing the best signal irrespective of its location

Simplified System Model (2)

- The density of RSs is an input variable and thus the number to be deployed in a given area is determined. This number of RSs is randomly deployed within this area
- We assume that the system is partitioned into one group of orthogonal channels that are used for direct paths and a second group of orthogonal channels that are used for multihop paths
- Furthermore, we assume that the timeslots are synchronised between cells, so that the BS transmission on a multihop path coincides with all other BS transmissions on other multihop paths and similarly the RS transmission on a multihop path coincides with all other RS transmissions on other multihop paths
- Consequently, interference to a signal from a BS, whether intended for a RS or a MS, arises only from other BSs; and interference with a signal from a RS arises only from other RSs

RF Parameters

- Carrier bandwidth 5MHz
- Bit rate 128kbps

- MS receiver noise figure 7dB
- RS receiver noise figure 7dB
- E_b/N_0 7.5dB
  - An SINR greater than this value is assumed necessary for successful reception i.e. to be in coverage

- RS transmit power 21dBm
- BS transmit power 21dBm

- BS antenna gain 18dB
- RS antenna gain 0dB
- MS antenna gain 0dB

- BS to MS/RS system losses 4dB
- RS to MS system losses 2dB
- Interference margin 1dB

Path Selection Algorithm – Direct / 2-hop

- The algorithm compares the SINR on each hop of each potential multihop path and sets the SINR of the path to be the minimum of the SINRs of the two hops
- The multihop path with the highest SINR is selected if this is greater than the SINR of the direct path between the BS and the MS, otherwise the direct path is chosen

$$snir \quad \max \min \; BStoRS_i, RStoMS_i \;, \text{BStoMS} \qquad i$$

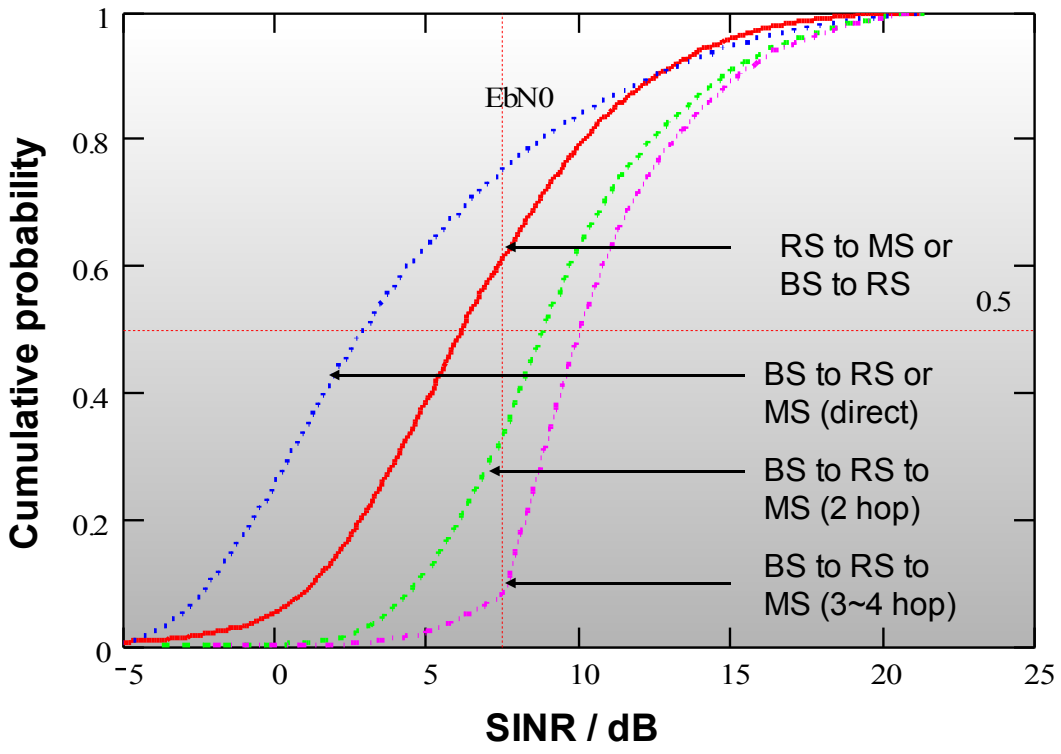
- All possible paths can be included because the number of RSs visible to a given MS is restricted by the propagation environment

Simulation Assumptions

- RS density 32 per km^2
- Active RS density 6 per km^2
  - ~1 per sector
- BS separation 750m
- RS and MS outdoors
- Urban propagation environment
- Uncorrelated lognormal fading
- Load factor variable between 2 and 20 simultaneous users per sector
- Path selection criterion is improved path SINR
  - SINR of the multihop path must be greater than the SINR of the direct path it replaces and the SINR of the direct path must be less than E_b/N_0

SINR Cumulative Density

Example of multihop system performance with multihop diversity for a load factor of 20 simultaneous users per cell



SINR Improvement

the improvement in SINR of the multihop path compared to the direct path