EPM in WLAN paper analysis

1. Investigating Depth-Fanout Trade-Off in WiMAX Mesh Networks

In a more recent release WiMAX (IEEE 802.16d),the standard has been extended, introducing the mesh mode to let Subscriber Stations (SSs) communicate through multi-hop transmissions. In its basic version, the mesh mode relies on a centralized approach that organizes all the nodes of a WiMAX network in a tree structure rooted at a particular node, namely the Base Station (BS).

The length of the links (in meters) significantly affects the bitrate.

We model the traffic demands of a WiMAX mesh tree architecture and we evaluate the trade-offs between the depth and the fanout of such a structure. Deeper trees have shorter links with higher bitrate.

Knowing the importance of allowing simultaneous transmissions in WiMAX mesh networks, we focus our work on exploring the impact of splitting direct long communications of fat trees (small depths) into multiple shorter ones (deep trees). We show by simulation that increasing the depth while reducing the fanout may increase, at least in some cases, the capacity of the WiMAX backbone even without allowing concurrent transmissions.

WiMAX mesh trade-offs

When mesh mode is employed, the network is still formed by a BS and many SSs.

The traffic can now occur directly between SSs and may be relayed by intermediate nodes (both uplink and downlink). The BS can also be the gateway between the WMN backbone and the Internet.

SS communicate with each other and transfer their neighbors' traffic through these links. Each SS must have at least one path towards the BS. In our study, we consider the WiMAX mesh tree on which the BS schedules the transmissions in a centralized manner. We suppose that all SSs are in the BS range and we study the depth-fanout trade-off of this architecture.

Increasing the depth (i.e., decreasing the fanout) reduces the distance and hence increases the bitrate on the different links. Moreover, it lowers the transmission power needed and hence interference decreases, which may improve spatial reuse for concurrent transmissions.

Reducing depth (i.e., increasing fanout) reduces the number of relay transmissions of the same data packet as well as control overhead.

Bitrate vs. Distance

IEEE 802.16 standard adapts different modulations and coding techniques on different transmissions, which implicitly implies different bitrates that can be attained. In other words, the data rate decreases as the link distance increases. On the other hand, increasing the tree depth means increasing the number of hops required to reach the BS, which in turn reduces the average hop distance (in km) leading to an increase in the average link bitrate. Moreover, it also affects the transmission power needed to attain the next hop, which becomes smaller reducing the interference.

The overall bitrate on some long links would be better if they are split, in other words, if the communications between sources and destinations on these links utilize intermediate SSs to rely their data.

2. Hybrid WiFi-WiMAX Network Routing Protocol