Cache Assisted Wi-Fi Mesh Networking

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Overview

Wi-Fi Mesh Network is a form of ad hoc network made up of radio nodes. In a mesh topology, most nodes are connected by wireless connections. A typical wireless mesh network consists of clients, mesh access points (AP) and gateways. The clients are, often laptops and cell phones. Mesh routers are typically the nodes that forward the traffic to and from the gateway. A gateway node is often connected to the Internet.

A Wi-Fi standard, IEEE 802.11, has been made by IEEE as an amendment of IEEE 802.11 regarding mesh network. The standard describes a self-configuring multi-hop network that supports broadcast and multicast data delivery.

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The performance of the current Wi-Fi mesh network was greatly improved by the decrease of the average number of hops. The decrease is in the range of the client in a position rather far away from the gateway, several hops are needed before the message can arrive at the gateway. Besides that, the number of gateways is rather small compared to the network scale. Traffic congestion can be found near the gateway, which makes the throughput of the network relatively low compared with wireless network topology because of the collision.

The project takes the idea of MIDs Coded Caching Scheme to try to avoid this situation, reducing the average number of hops for clients, and try to spread the traffic through the network.

MIDS-Coded Caching Scheme has been proposed to alleviate the situation mentioned by my supervisor Prof. Vincent LAU. When it generates an arbitrarily long sequence of parity bits from an information packet of 1 bit. The decoder can recover the original information bits after it returns any 1 parity bits from this infinite sequence of parity bits.

Methodology

The designed system block diagram is as follows:

- Offline Cache Table Update
- Online Cache Table Update
- Online-Cache-Assisted Wi-Fi Mesh Networking

The basic concept is simple. First, the network topology remains unchanged. Each AP is one equipped with a cache in some part of the file. When user requests a file, the file is divided into blocks. Each block is sent to the gateway. The gateway sends the requested content when all blocks of cache arrives. Second, a cache table is constructed after the cache is initialized which contains the information for user to know where are the contents cached.

Component Flow Chart

- Offline Cache Table Update
- Online Cache Table Update
- Online-Cache-Assisted Wi-Fi Mesh Networking

With both UDP and Wi-Fi, cache-assisted Wi-Fi Mesh increases the performance greatly. The throughput is increased by roughly 30% and the average packet delay is decreased by roughly 50%. This is due to the decrease of average number of hops before the packet reaches the user and the spread of heavy traffic near the gateway in the entire mesh network.

Conclusion

The objective of the project is to design the detailed protocol using the existing 802.11s standard to make a robust and efficient cache scheme and have some simulation test on the performance of this scheme.

The simulation results show that the scheme increase the performance of the network in terms of throughput, average delay and video interruption percentage substantially.

Further work can focus on the implementations of the protocol, and have some test on the real-world behaviors of the overall design and the efficiency of the protocol.