1. Preface

The task of evaluation and development for Wi-Fi will be covered in this report for technical requirements.

Since radio devices and applications proliferate in our home and office environments, the demand for a more reliable Wi-Fi coverage goes up. Tens to hundreds of access points may neighbor with highly overlapping ranges to improve the quality of service to the whole covered area. Yet, to ensure the required level of service all these access points need to be properly configured (transmission power, channel, bandwidth etc.) to minimize the adverse effects of density. Configuration of so many access points for optimum performance is a non-trivial task.

A decentralized approach towards Wi-Fi network management will be pursued in this experiment. Certain performance metrics will be evaluated and looked at during the course of study and research leading up to the development phase. The empirical data thus gathered will be used to correlate findings and draw out substantial conclusions from the experiment. The performance metrics outlined in the initial stages of the development tell out about the preliminary metrics that influence Wi-Fi design in dense environment. As the project passes into later stages of development, the performance matrices will be subject to addition depending upon the developmental path followed.

1. Intro

There are different approaches to reduce interference, improve throughput performance and increase the coverage on WLANs. Apart from functionalities based on digital processing (channel coding, multiple input multiple output (MIMO), spatial-temporal block coding). there are methods that dynamically adapt the allocation of available resources based on real-time network state information.

Wi-Fi management for dense environment really comes down to improving the spectral efficiency. This means that the clients or associated stations (STAs) connected to the access points (APs) must be able to transmit with an acceptable amount of throughput and with little interference. Interference arises when a large number of clients is trying to transmit or receive data from the APs. The performance metrics evaluated in the beginning include the TPC (Transmit Power Control) and DFs (Dynamic Frequency Selection).

The TPC is the transmitting power at the antenna of the AP. It is also one of the most influential factors in determining the spectral efficiency of a wireless sensor network. As it stands, the AP starts to transmit to the STA at the maximum power available for transmit. This intuitively makes sense, the greater the power of transmission, the greater would be the coverage area of the transmitting AP. However, this is not always the case. In dense Wi-Fi environments, the transmit power of each AP is crucial because it causes spectral in-efficiency. The signal umbrella for each AP overlaps with the signal umbrella of the other or neighboring APs and causes interference. This interference is encountered in terms of lowered data throughput and transmit latencies if crowded Wi-Fi network is the aim to optimize.

The increased power also ends up interfering with the other APs because of the CCA mechanism (Clear Channel Assessment). This happens when a client or STA looks for available space in the channel to receive or transmit data from the AP. Increasing the transmitting power of the AP results in the AP transmitting further, but the payoff is increased CCA by individual clients, if the transmission is happening on the same channel. This eventually results in a decreased throughput and increased latency in data transmission. If the density of the network is too crowded, the transmission latency can be even worse.

Transmit power control is going to be the first element of the dense Wi-Fi network that we will investigate in conjunction with other combinations. The major source of data collection regarding the empirical methods to test transmit power control theory will come from the RRM (Radio Resource Management). These are the real-time elements that are gathered statistically at the AP and include values like the RSSI (Received Signal Strength Indicator), rate of data transmission and channel capacity depending upon the SNR value taken from the introduction of insertion losses. All these parameters will be described in detail as the development is focused on them one by one.

3.

Transmit Control and IEEE 802.11xx

IEEE 802.11 MCS and data throughputs are directly related to SNR. Specifically, reducing the Tx power can reduce SNR, MCS and data throughputs [refer the paper]. The developed method considers a perspective for managing transmit power level in a wireless link without disturbing the required real-time data rate. The method considers both the real time transmission data rate and physical medium conditions. The parameters for controlling the transmitted power are obtained following rules defined in IEEE802.11n. This implies that this method can be implemented independently of any other specific IEEE 802.11 amendment and number of clients. APs with the DTPC method embedded can obtain the parameters from all IEEE 802.11 standard-based devices, so that the method will work for any STA. The parameters selected account mainly for the state of the physical channel, but also for the state of upper layers, providing a slight comprehensive (cross-layer) touch.

As assessed from the intial investigations, the clients would be independent of the Wi-Fi network. This means that they could accompany any version of variation of the IEEE 802.11 and the same radio parameters can still be extracted with the same principal using any client in the network. The more common IEEE protocols used now a day by clients or STAs include IEEE 802.11 ac/b/g/n.

4.

Technical Requirements

This section deals with drafting out the technical requirements for the project.

The initial developmental stream will see setting up the development environment (discussed in detail later on). Eventually the first iterative steps for experimental work will follow. The initial idea is to set up the cross-platform developmental environment. This will enable the layered access to the parameters of the radio network and hence related data extractions. After the setup, the first phase of development will see configuration settings and a coarse network design, and a scaled down replica of the actual setup.

Once the setup is configured and is put into place, the first round of empirical data collection will commence. The development in this case is only bounded by the hardware or chipset restrictions for the apparatus used. So naturally, the technical requirements will be tailored accordingly in the later stages of the iterative development.

5. Challenges

6.

First stage of development

The initial stage of development will be done around setting up the developmental environment. Genexis is utilizing the Open-WRT platform for firmware development of the Access Points. Open-WRT is the open source Linux platform that used to configure any embedded SoC device into application specific designs.