MESH ISLANDS FOR OPTIMIZED WIRELESS NETWORKING

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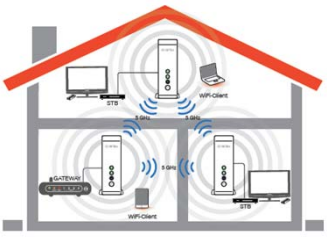
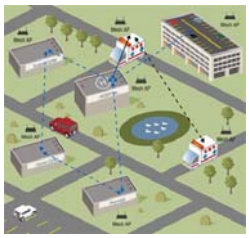
ABSTRACT

In the "Mesh Islands for Optimized Wireless Networking" Project, our concern is a wireless communication system which will be installed in offices, homes, hospitals, schools and other public places. This system will include modems (or routers) that provide internet coming from out of the place via fiber optic cables to the other components of the system called access points (AP). Main task of an access point is to receive and transmit the data coming from the router or another access point so that the stations such as mobile phones, laptops and smart TVs can receive or send data using internet.





The purpose of this project is to setup the system explained above in the most efficient way so that the communication links in the system will be as strong as possible. For this purpose, the communication links between APs can be separated as groups and the provider AP of each group will be interconnected using Ethernet, PLC or MoCA and all of them will be directly connected with the router. These groups are called "Mesh Islands" and the aim is to find out an algorithm that will find out the optimal network partitioning in a mesh network providing the highest signal power and data rate in links as possible.

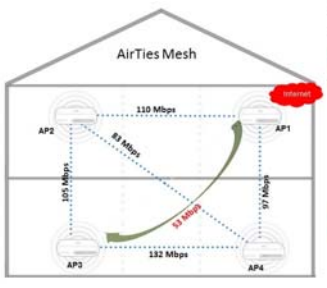
COMPANY INFORMATION

AirTies was founded in the year 2004, as a part of KOSGEB, in İTÜ Maslak Campus and began to Research & Development operations about wireless computer network devices as a technology company. AirTies develops and markets products that wirelessly connect electronic devices to each other, the internet and people. Their product portfolio includes high speed internet access/ ADSL/ FTTx, wireless LANs and internet-based television / IPTV. As from March 2013, they have reached more than 8 million DSL modem, gateways and IPTV device installations.

PROJECT DESCRIPTION

A mesh network is able to construct physical wireless links between the access points in the network. Using mesh data links, the data traffic can be routed from the modem or router (source) to the final destination access point (receiver) via any combination of the communication links. As a result, the network traffic is routed in such a way that end-to-end throughput is maximized. In addition, these mesh networks can determine the routes which takes into account different measures; such as signal power, data rate and end-to-end delay, then tries to optimize them.

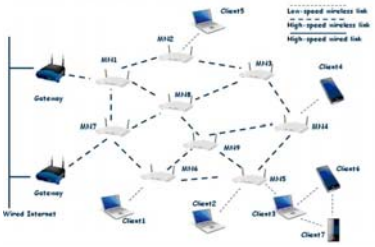
A group of the network that has one or more connections using Wi-Fi, Ethernet, PLC or MoCA to other groups in the network is called a "Mesh Island". Network can be separated on a different interface. A Mesh Island consists of at least an access point and a client (station) that is connected to this access point. If the connection is satisfied among the network, it can be divided into groups, providing that they have at least one common communication link. Grouping the network, in other words constructing the mesh islands, can improve the performance of the communication significantly in terms of signal power, data rate and data loss.



OBJECTIVES

The goal of the project is to develop an algorithm that will find out the optimal network partitioning in a mesh network. This involves the following steps:

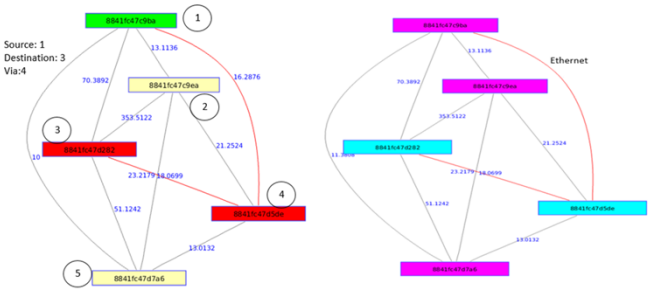
- Preparing the tools and setup for data acquisition. Collecting actual data, such as available airtime in the wireless medium, estimated capacity of the connected stations, from the deployed products.
- Analyzing the collected data.
- Algorithm proposal, and simulation of the algorithm on the collected data.
- Proof of Concept (PoC) implementation of the algorithm in embedded device (Access Point)
- Collecting data from the deployment which runs the PoC implementation
- Evaluating results of the PoC in comparison to a setup without the proposed method.



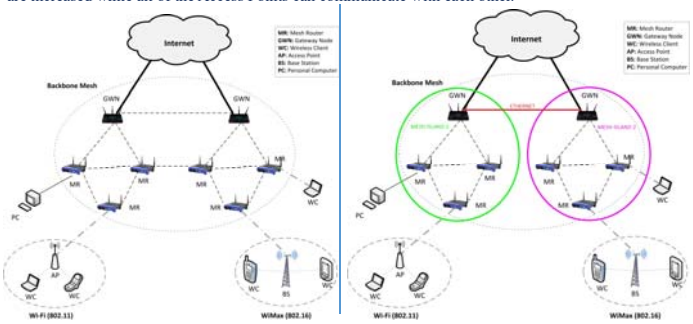
ACHIEVED GOALS & RESULTS

In this project, MATLAB software is used to implement the 'Mesh Islands' algorithm. The program is capable of detecting wireless links between access points and their corresponding data independent from number of access points by using .csv formatted file automatically. The MATLAB code which consists of several functions written by group members, is able to detect number of access points, their MAC addresses and the links between them. For each data needed, there exists a variable, and this makes desired information easy to reach.

Following the derivation of data, project's main purpose is to find the shortest paths between all combinations of access points. In order to pursue this goal, "Distance Vector Routing Protocol" (Bellman- Ford) is adapted to the code. The working principle of this protocol is determining the route with the least cost between the nodes by using any user defined metric for the cost, which is the reciprocal of signal rate in the specific implementation. The metric might be changed according to the further needs and expectations from the user.



The last part of the project is to optimize link rates by dividing network configuration into mesh islands. For this purpose, two nodes are determined as heads of the mesh islands and a very low cost is given for the connection between them as if there is an Ethernet connection. In addition, generated program is able to select the optimum link to place the Ethernet connection if no mesh heads are specified. In order to decide which Access Point belongs to which Mesh Island, the remaining nodes' costs to head nodes are compared and they are matched with the corresponding island which has lower cost. According to the proposal of partitioning the islands, they are assigned to different channels so that their performances are increased while all of the Access Points can communicate with each other.



CONCLUSIONS

This project employs a system which takes large-sized data of wireless communication setup via cloud, in .csv format. Then, it analyzes and processes this data in such a way that; performances of each link, their spatial locations, routing tables and mesh island combinations are visualized. Using these grouping information, system informs firmware in order for carrying out the channel assignments and necessary operating frequency changes continuously. As a result, users have such a system that optimizes itself regularly without any interpretation manually. Once it is installed in the users' setup, it will automatically update itself and maintain its operations.