Performance Optimisation of the AIT Campus Wireless Mesh Network Deployment

Eduardo Brito  
_Athlone Institute of Technology_

Robert Stewart  
_Athlone Institute of Technology_

John Allen  
_Athlone Institute of Technology_

M. H. Hassan  
_Athlone Institute of Technology_

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PERFORMANCE OPTIMISATION OF THE AIT CAMPUS WIRELESS MESH NETWORK DEPLOYMENT

Eduardo Brito, Robert Stewart, John Allen, MN Hassan
Athlone Institute of Technology

Abstract

The deployment of an 802.11x wireless mesh network in urban areas is a complex task and is traditionally based on an exhaustive site survey, rules-of-thumb or past experiences. In this research we propose exploring the spatial distribution of the clients, the topology and the clutter using software tools from Motorola in a VoWiFi mesh network before deployment. The objective is to obtain the optimal position for the wireless access points that allows an increase in the overall capacity and performance. The cost savings inherent in running real-time applications over IP based wireless mesh networks will be of interest to industry, especially as AIT is the first in Ireland to utilize the Motorola Mesh Planner software. Initial results are presented from the recently installed mesh network on the AIT campus.

Introduction

The 802.11 technology has become an ubiquitous solution for wireless LAN’s in the home and offices. Using the two-tier mesh network technology the WLANs have been considered as a practical solution to wide area coverage. A two-tier mesh network has an access tier that integrates the clients, and a backhaul tier which forwards the clients packages in a multi-hop architecture to a wired gateway. A two-tier mesh network compared with wired access points network has a lower deployment cost, is easily scalable, better coverage and is robust to general individual node failure [1].

The deployment of an 802.11x wireless mesh network in urban areas is a complex task and traditionally based on exhaustive site survey, rules-of-thumb or past experiences. The topology, foliage and architectural characteristics of the buildings are all sources of uncertainty in terms of the range and capacity of these mesh networks. With ever increasing constraints on network infrastructure budgets efficient methods of planning and performance evaluation in advance of deployment are now required. The utilization of software tools such as the Motorola Mesh planner can reduce the deployment time, and enable network optimization through pre deployment evaluations of performance. For example in [4] by properly exploring the client’s spatial distribution information in allocating the access points, an increase in the overall voice capacity is achieved.

Initial results are presented from the deployed wireless mesh network at the AIT campus. The main wireless network will be integrated with a secondary 802.11n wireless network for use with a Real Time Location System (RTLS) from Ekahau. An evaluation of the capacity and resilience of the deployed network will be of interest for health and safety applications, emergency services support and routine campus communication.
Architecture

The main wireless network is designed to use industry grade equipment from Motorola and was deployed based on predictions using the mesh planer software. Real-time performance monitoring using clients attached to the network and a main server connect to the wired backbone will be performed. One AP is fixed on the main building and connected to the wired network, the other two are mounted on mobile mast’s and powered by a UPS (Figure1). The Figure 2 shows the Wireless Mesh Network Architecture.

Figure 1: Mobile Mast deploying AP’s

Fig 2: AIT wireless network architecture
**Mesh Planner tool**

Motorola provides a software package for designing outdoor wireless mesh networks efficiently and cost-effectively. Optimized to work with Motorola Motomech products, MeshPlanner allows designers to create networks on their PC and validate performance with the software's measurement functionality, eliminating the costly on-site work that accompanies traditional site survey-based design methods. This reduces labour and planning costs and enables quicker implementation of a high-performance network. The aim of this research is to use the software to plan the deployment of the Motorola Mesh Network on the AIT campus.

![Figure 3 : Meshplanner RF-Intelligent map](image)

The planning software creates an RF-intelligent map by importing the following:

- A digital elevation model in GeoTIFF format
- Deployment drawing via satellite image
- Scanned image or digital photograph
- Buildings, structures or foliage in ESRI shape file format
- Clutter data in GeoTIFF format;

**Rate adaptive MAC**

Rate adaption is the process of dynamically switching data rates to match the channel conditions and therefore provide optimum throughput. The channel conditions are influenced by the carrier frequency, client speed, interference, etc. In 802.11 networks the adaptation occurs at the MAC layer [2].
Meshplanner have the capability to simulate the throughput based on satellite maps and corresponding to the parameters set.

**Results of the simulations**

Figure 5 shows the service coverage considering a RSSI cut off -75dBm. The coverage is not available in only a small area of the campus in the main entrance. The foliage is blocking the signal to residential estates around the campus.

*Figure 4 : Predicted throughput for the wired AP using satellite maps of the AIT campus*

*Figure 5 : Predicted Service Coverage*
Conclusion and Future Work

A RSSI survey using 802.11g receiver in conjunction with the Netstumbler tool showed that the simulated results are coherent with the measured value [3]. The end-to-end throughput measured using the IxChariot software shows a throughput drop from 15 to 7 Mb/s adding 1 hop (connected on the 2nd AP) and from 7 to 2 Mb/s with 2 hops (connected on the 3rd AP). Further simulations and tests should be carried out with different transmitter heights in order to offer a ubiquitous service. The throughput predicted is not taking into account the hops in the mesh network. In our tests the mesh backhaul was configured to use the 802.11g radio, the same for the receiver. We are expecting to implement the 802.11a radio, carry on with the tests and compare the results with the single radio results. The implementation of a location based service (LBS) based on 802.11g tags is also under consideration for inventory tracking.

References

