Applying DMAIC to a campus-wide wireless network

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ABSTRACT

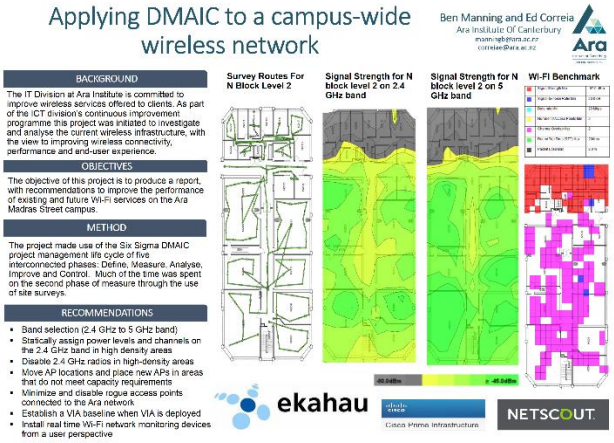
This poster paper outlines the detailed analysis of an enterprise wireless network that led to a number of recommended changes being made at the main (Madras Street) campus of Ara Institute of Canterbury. It made use of the data-driven approach DMAIC (Define, Measure, Analyse, Improve and Control) to improve the network. Ekahau Pro, a tool that records Wi-Fi metrics, was used to produce a site survey with certain points plotted throughout the campus. Key issues were found and these needed to be addressed, especially as increasingly more devices connected to the wireless network. The project concluded with a number of recommended changes, which have been implemented, and significantly improved the delivery of wireless services on the campus. As a result, this solution is now currently being deployed to other campuses.

Keywords: Wi-Fi, wireless, DMAIC, 802.11, IEEE

1. INTRODUCTION

Ara institute of Canterbury (Ara), formerly known as Christchurch Polytechnic Institute of Technology (CPIT), is a tertiary provider, with its main campus located in the Christchurch city centre, New Zealand. The institution aims to provide high quality, resilient wireless connections to end users, and it currently has 317 wireless access points (APs), with 186 located at the Madras Street campus. Cisco equipment and protocols are used, and this integrates with monitoring and management tools, one being Cisco Prime Infrastructure.

Anecdotal evidence from Ara staff and students suggested that many people have a negative perception of the quality of Wi-Fi at the campus.



2. METHOD

The project made use of the Six Sigma DMAIC project management life cycle (Gitlow, Melnyck, & Levine, 2015; Vanvant, 2015; Kliem, 2015). This acronym stands for the five interconnected phases; **Define**, **Measure**, **Analyse**, **Improve** and **Control**. DMAIC is a data driven strategy used to improve processes. The approach traditionally applies to an existing product, process or service. Unknown variables and variations are detrimental to project success. Variations to the project include, exceeding cost or time, changing targets and faults.

DMAIC involves three key principles.

- Outcomes and results are data driven and supported by metrics and factual evidence.
- It is project based
- Tools, objectives and deliverables are employed in combination throughout each phase of the project

The project first **defined** the issue and scope of the work, including defining milestones, key deliverables, and processes, such as a risk management plan and a quality assurance plan. It then **measured** the issues in a way that generated factual data against a baseline to see if performance is meeting current user requirements. A number of tools were used for this, including the Ekahau Site Survey (Vanhatupa, 2015) and the Cisco Prime Infrastructure, NetScout and the Cisco WLC5520 (Cisco, 2010; Cisco, 2015a; Cisco, 2015b).

The causes of the issue were then **analysed**, with the result that a number of areas were identified: a lack of coverage in places, a lack of coverage hierarchy and channel overlap. The next task was to identify the actions that **improved** the delivery of service to the point where it would meet customer requirements. This included setting criteria for the improvements.

The final phase involved implementing the actions necessary for the infrastructure to be **controlled**, so as to ensure that the improvements were continued and sustained. This included a control plan.

3. USER REQUIREMENTS

Several user requirements were identified, namely

- Wi-Fi services across all sites with an average of 4000 - 5000 connections per day
- Wi-Fi connectivity through 802.11 b/g/n/ac protocols
- Secure network connectivity (malware, Identity theft, viruses)
- Campus wide connectivity (802.1x)

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- A point of contact for connectivity issues (Tier one: Helpdesk, Tier two: Service Delivery, Tier three: Infrastructure)
- End to end connectivity, with IT managing maintenance and monitoring
- WLAN provisioned for guest and visitor connections (BYOD)
- Support for high density in teaching areas

2.4 GHz and 5 GHz are the common frequencies used to transmit Wi-Fi (802.11). The 2.4 GHz channel provides wider coverage but lower data rates, compared to 5 GHz, which provides a smaller coverage but faster data rates. This is due to the higher frequency of 5 GHz not being able to penetrate solid objects as well as the 2.4 GHz channels (Cisco, 2015).

It is important to provide dual band support on APs as older client devices do not have the ability to connect to the 5 GHz frequency.

4. SITE SURVEYS

In Ekahau Site Survey Pro, signal strength is visualized by showing a heat map of coverage (Vanhatupa, 2015). By setting requirements in the network benchmark, the map shows green squares for healthy areas of coverage.

Overlap is one of the most important Wi-Fi measurements as it is one of the leading causes of interference on the network. IEEE 802.11 uses the clear channel assignment, which waits to listen for other APs transmitting before communicating on a channel. Therefore, if an AP is transmitting on channel 1, APs nearby must wait their turn to transmit. However, Clear Channel Assignment (CCA) is less of an issue until many devices are transmitting on the same channel. Another issue is Adjacent Channel Interference (ACI), which negatively affects Wi-Fi performance even more than CCA.

There were also areas which were found to have no Wi-Fi coverage or very poor Wi-Fi coverage, in that they did not pass the -67dbm benchmark.

5. RECOMMENDATIONS

Several recommendations were made. These included

- Band selection, namely moving clients from 2.4 GHz to the less congested 5 GHz band
- Statically assign power levels and channels on the 2.4 GHz band in high density areas
- Disable identified 2.4 GHz radios in high-density areas
- Disable Cisco Aironet IE
- Move AP locations and place new APs in areas that do not meet capacity requirements
- Minimize and disable rogue access points connected to the Ara network
- Establish a VIA baseline, as the VIA Connect Pro wireless collaboration tool will be deployed throughout Ara
- Install real time Wi-Fi network monitoring devices from a user perspective

6. CONCLUSION

A detailed fifty-two page report was delivered to the IT Division at the conclusion of the project. They have started implementing the recommendations contained in the report and are impressed so far with the improvements in the delivery of wireless services around the main Ara campus. This solution is therefore now being deployed to the other campuses.

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