

# Development of an Optimal Wireless Network Solution to Connect End-User Devices in a Bush Environment

Jagdees Pillai  
Student – Master of IT  
Whitireia New Zealand  
+64 21 133 5776

jagdees.pillai@whitireianz.ac.nz  
z

Steve Cosgrove  
Whitireia New Zealand  
Wi Neera Drive, DX Box: SX33459  
Porirua 5022  
+64 4 237 3100 Ext. 3606

steve.cosgrove@whitireia.ac.nz  
z

Dr. Diane Strode  
Whitireia New Zealand  
Wi Neera Drive, DX Box: SX33459  
Porirua 5022  
+64 4 237 3100 Ext. 5184

diane.strode@whitireia.ac.nz  
z

## ABSTRACT

This is a Postgraduate Diploma in Information Technology (PGDIT) Level 8 project paper undertaken by a student at Whitireia New Zealand. This project used wireless network (Wi-Fi) technologies in New Zealand native bush environment and to observe wireless radio propagation behaviours in this type of environment.

The research work was done at ZEALANDIA Eco-Sanctuary in Wellington, New Zealand where a large number of research projects are taking place and evolving conservation research technology makes use of tools that can generate very large quantities of data. In many locations, getting this data to a location for processing can be a challenge. [1]

Commonly used 2.4 GHz and 5 GHz Wi-Fi radio frequencies are providing up 155m and 90m coverage at the speed of 1-5 Mbps respectively on average.

## 1. CATEGORIES AND SUBJECT DESCRIPTORS

K.3.1 [Computers and Education]: Computer Uses in Education

### General Terms

Management, Measurement, Documentation, Performance, Design, Reliability, Experimentation, Human Factors,

### Keywords

Big Data, Conservation, Outdoors, Wildlife, Wi-Fi, Wireless Ethernet, Client, STA, IT. 802.11

## 2. INTRODUCTION

The poster describes a wireless networking research project developed by a Postgraduate Diploma in Information Technology (PGDIT) student at Whitireia New Zealand as the final double credit project paper of the program. The first author is the student of this project and the others are academic supervisor and coordinator respectively for the project.

ZEALANDIA is the trading name of the public resources operated by the Karori Sanctuary Trust of Wellington New Zealand. The ZEALANDIA website describes the project as a community-driven eco-sanctuary project, comprising a valley of 225 hectares of regenerating native bush. It is less than ten minutes' drive from the centre of Wellington. The valley is home to a large number of native New Zealand birds and animals found nowhere else on the three main islands of the country. The Karori Sanctuary Trust was founded in 1995 and there have been a significant number of academic studies in the valley since. The current research adds to a large body of knowledge built from research in this environment [3].

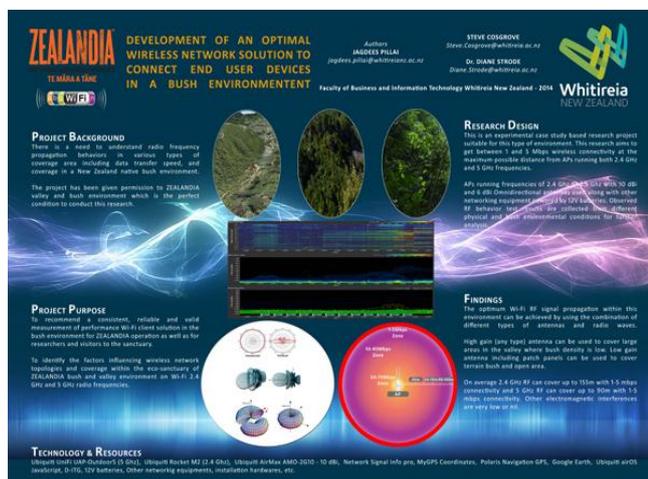


Figure 1 Typical bush density at ZEALANDIA

## 3. OBJECTIVES

ZEALANDIA provides an environment of interest to a range of people with different motivations. In the same way, this research is a part of a larger wireless network study that can provide useful outcomes in a number of areas. The outcomes will benefit researchers, conservation workers, and visitors.

## 4. PROJECT BACKGROUND

There is a need to understand radio frequency propagation behaviour including data transfer speed in various types of

This poster paper appeared at ITX 2014, incorporating the 5<sup>th</sup> annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2014) and the 27<sup>th</sup> Annual Conference of the National Advisory Committee on Computing Qualifications, Auckland, New Zealand, October 8-10, 2014. Mike Lopez and Michael Verhaart, (Eds).

coverage area in a New Zealand native bush environment. The project has been given permission to access ZEALANDIA valley and bush environment which is the perfect condition to conduct this research.

## 5. PROJECT PURPOSE

To recommend a consistent, reliable and valid measurement of performance Wi-Fi client solution in the bush environment for ZEALANDIA operation as well as for researchers and visitors to the sanctuary. To identify the factors influencing wireless network topologies and coverage within the eco-sanctuary of ZEALANDIA bush and valley environment on Wi-Fi 2.4 GHz and 5 GHz radio frequencies.

## 6. RESEARCH DESIGN

This is an experimental case study based research project suitable for this type of environment. This research aims to get between 1 and 5 Mbps wireless connectivity at the maximum possible distance from APs running both 2.4 GHz and 5 GHz frequencies.

APs running frequencies of 2.4 Ghz and 5 Ghz with 10 dBi and 6 dBi Omnidirectional antennas used along with other networking equipment powered by 12V batteries. Observed RF behavior test results are collected from different physical and bush environmental conditions for further analysis.

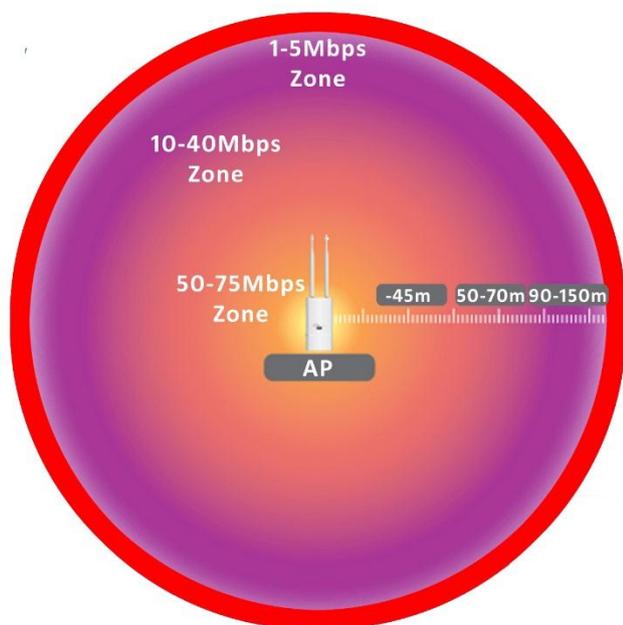


Figure 2 Wireless penetration indications used

## 7. CONCLUSION

In bush area wireless penetration makes difference because of obstructions especially when it gets wet. The optimum Wi-Fi RF signal propagation within this environment can be achieved by using the combination of different types of antennas and radio waves. High gain (any type) antenna can be used to cover large areas in the valley where bush density is low. Low gain antenna including patch panels can be used to cover terrain bush and open area. On average 2.4 GHz RF can cover up to 155m with 1-5 mbps connectivity and 5 GHz RF can cover up to 90m with 1-5 mbps connectivity. Other electromagnetic interferences are very low or nil.

## 8. FURTHER RESEARCH

This project tested the Wi-Fi RF propagation behaviour within New Zealand native bush environment. The findings can be useful for further research and for implementation of Wi-Fi networks within the bush environment.

Furthermore there are few other research project are underway in relation to wireless network in the valley such as possibility of self-powered Wi-Fi access points using wind-turbine and solar panels, Wi-Fi stimulation software development, testing multipath technology within the bush environment, overall system infrastructure and monitoring system including power supply system. In this way researchers and visitors could make use of public Wi-Fi accessibility in the future.

## 9. TECHNOLOGY & RESOURCES USED

Ubiquiti UniFi UAP-Outdoor5 (5Ghz), Ubiquiti Rocket M2 (2.4Ghz), Ubiquiti AirMax AMO-2G10 - 10dBi, Network Signal Info pro, MyGPS Coordinates, Polaris Navigation GPS, Google Earth, Ubiquiti airOS, JavaScript, D-ITG, 12V batteries, other networking equipment, installation hardware, etc.

## 10. REFERENCES

- [1] Digby A P, Bell B D, Teal P D M, 'Kiwi conservation acoustics', eResearch NZ Conference (Wellington, 4 July 2012).
- [2] Cosgrove S, Naik V, Johal R, 'Wireless Network goes bush: Wifi in Zealandia', Computing and Information Technology Research and Education New Zealand (CITREZZ2013) (Hamilton, 6-9 October 2013).
- [3] Research at Zealandia  
<http://www.visitzealandia.com/research/research-at-zealandia/>  
retrieved 10 August 2014