



3.65-3.7 Ghz Spectrum Experimental Project

Ing. Jose J. Muñiz Padilla
Director of Business Development
Neptuno Networks

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About Neptuno Networks

Neptuno Networks, Inc., based in Puerto Rico, is a telecommunications and broadband systems integration and service provider company offering the most advanced technology in wireless broadband systems. Neptuno Networks focuses on each client's specific needs to develop innovative, customized solutions. Neptuno's wide-ranging portfolio of services help customers build a solid business infrastructure and contribute to every stage of a customer's networking projects.

I. Objective:

The purposed of this document is to a description for the use of 3.65-3.7 Ghz Spectrum in Puerto Rico for Experimental Purpose with Wimax Technology. The objectives for this project are:

- 1) Test Wimax Technology to provide Internet and Data Service in rural areas or area with high density of obstruction where current Fixed Wireless Solution can't reach.
- 2) Test new features and enhancement of Wimax Technology as quality of service and the capability of using Voice and Video over IP.
- 3) Test roaming capability so a customer can use the same device to get internet in different areas of the island.

II. Background of 3650-3700 Mhz band

In April 2004, the FCC initiated a proceeding to foster the introduction of wireless broadband operations in the 3650-3700 MHz band. The Commission proposed to allow unlicensed devices to operate in some or all of the 3650 MHz band with higher power than currently authorized under Part 15 of the rules, subject to cognitive technology safeguards. The Commission also sought comment on options that would allow for licensed operations in this band, or for segmenting the band between licensed and unlicensed uses. The explanation for the use of this frequency is explained on the FCC document FCC-05-56 that was release on March 2005. The permits for the use of this spectrum were place on hold by FCC during 2005.

III. Wimax technology

WiMAX is an acronym that stands for Worldwide Interoperability for Microwave Access, a certification mark for products that pass conformity and interoperability tests for the IEEE 802.16 standards. WiMAX is a wireless metropolitan area network (MAN) technology that can connect IEEE 802.11 (Wi-Fi) hotspots with each other and to other parts of the Internet and provide a wireless alternative to

cable and DSL for last mile (last km) broadband access. IEEE 802.16 provides up to 50 km (31 miles) of linear service area range and allows connectivity between users without a direct line of sight. Note that this should not be taken to mean that users 50 km (31 miles) away without line of sight will have connectivity. Practical limits from real world tests seem to be around "3 to 5 miles" (5 to 8 kilometers). The technology has been claimed to provide shared data rates up to 70 Mbit/s, which, according to WiMAX proponents, is enough bandwidth to simultaneously support more than 60 businesses with T1-type connectivity and well over a thousand homes at 1Mbit/s DSL-level connectivity. Real world tests, however, show practical maximum data rates between 500kbit/s and 2 Mbit/s, depending on conditions at a given site.

It is also anticipated that WiMAX will allow interpenetration for broadband service provision of VoIP, video, and Internet access—simultaneously. Most cable and traditional telephone companies are closely examining or actively trial-testing the potential of WiMAX for "last mile" connectivity. This should result in better pricepoints for both home and business customers as competition results from the elimination of the "captive" customer bases both telephone and cable networks traditionally enjoyed. Even in areas without preexisting physical cable or telephone networks, WiMAX could allow access between anyone within range of each other. Home units the size of a paperback book that provide both phone and network connection points are already available and easy to install.

There is also interesting potential for interoperability of WiMAX with legacy cellular networks. WiMAX antennas can "share" a cell tower without compromising the function of cellular arrays already in place. Companies that already lease cell sites in widespread service areas have a unique opportunity to diversify, and often already have the necessary spectrum available to them (i.e. they own the licenses for radio frequencies important to increased speed and/or range of a WiMAX connection). WiMAX antennae may be even connected to an Internet backbone via either a light fiber optics cable or a directional microwave link. Some cellular companies are evaluating WiMAX as a means of increasing bandwidth for a variety of data-intensive applications. In line with these possible applications is the technology's ability to serve as a very high bandwidth "backhaul" for Internet or cellular phone traffic from remote areas back to a backbone. Although the cost-effectiveness of WiMAX in a remote application will be higher, it is definitely not limited to such applications, and may in fact be an answer to expensive urban deployments of T1 backhauls as well. Given developing countries' (such as in Africa) limited wired infrastructure, the costs to install a WiMAX station in conjunction with an existing cellular tower or even as a solitary hub will be diminutive in comparison to developing a wired solution. The wide, flat expanses and low population density of such an area lends itself well to WiMAX and its current diametrical range of 30 miles. For countries that have skipped wired infrastructure as a result of inhibitive costs and unsympathetic geography, WiMAX can enhance wireless infrastructure in an inexpensive, decentralized, deployment-friendly and effective manner.

IV. Project Purposed and Plan

The ratification of Wimax 802.16d technology on 2005 promises new opportunities of development for wireless technologies strategic. One of the new features is the Non line of Sight capability. This is supposed to provide the capacity to extend Wireless Internet and Data Services throughout rural areas and buildings obstruction. Because of the topography of the island, Puerto Rico can be consider rural in most of the areas around and for this reason is very difficult to implement a Fixed Wireless Network. Also majority of the construction on the is land are made of concrete. The main idea of experimenting with the 3650-3700 Mhz spectrum is to provide Internet and Data transport services on rural areas or areas with a high density construction obstruction in order to reach places where current Fixed Wireless or Wired technologies can't reach today.

Some of the main features from Wimax we are interested to test are the follow:

- 1) Non line of sight penetration in concrete infrastructure.
- 2) Making roaming of client between cellsites
- 3) Quality of Service to provide Voice over IP functionality and Video.
- 4) Security of a Wimax network
- 5) Spectrum performance based on Wimax modulation
- 6) Test Wimax reliability
- 7) Test different models of Wimax CPE.

Neptuno plan for the experiment is to have availability of the spectrum in 10 cellsites on around the next municipalities:

- 1) San Juan
- 2) Bayamon
- 3) Carolina
- 4) Caguas
- 5) Humacao
- 6) Ponce
- 7) Mayaguez

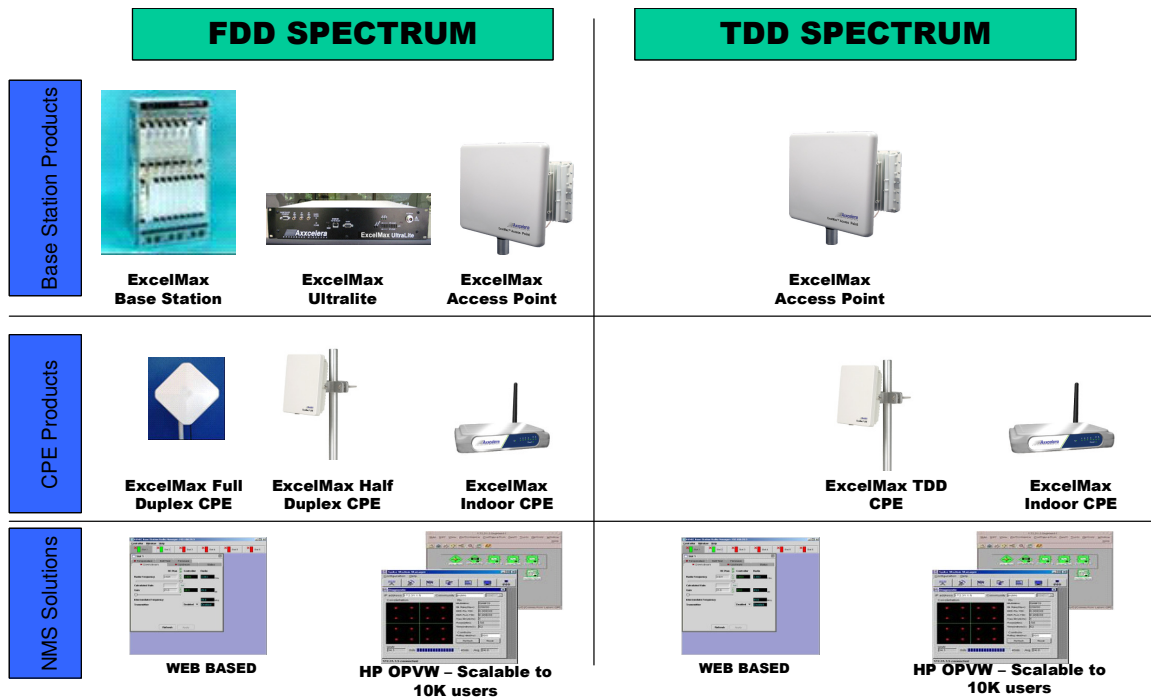
Most of these municipalities are rural areas; others are areas with high density concrete obstructions. Each cellsite will have up to 4 Access Points antennas for coverage. We will be using no more than 200 Subscriber Units (CPEs) to perform the tests. This project will also help as a demonstration of a Wimax functionality of 3.5 Ghz spectrum for other islands on the Caribbean.

V. Equipment Description - Axxcelera Broadband 3.X Ghz ExcelMax Plaform

A. Axxcelera Overview

Axxcelera Broadband Wireless is a data networking Solutions Company developing leading-edge technology for the deployment of broadband wireless communications over the Internet. The ExcelMax™ broadband wireless platform bridges the last mile, currently replacing the local loop for corporate and small business subscribers and migrating to the residential market and will be certified WiMax compliant. The ExcelMax Technology can be deployed on FDD or TDD, depending on customer requirements and regulatory country permits. Axxcelera is a principal member of the WiMax Forum.

The next Diagrams show the product portfolio scheme for ExcelMax:



Note: For this project we only are going to use the Time Division Duplex (TDD) platform portfolio.

A. Excel Max Access Point



The ExcelMAX Access Point is a Point to Multipoint (PMP) base station product designed to operate between the 3.3-3.8 GHz spectrum range and supports 3 different Duplex architectures – Full Duplex FDD (Frequency Division Duplex), Half Duplex FDD, TDD (Time Division Duplex). The WiMAX-2004 compliant Non Line of Site (NLOS) platform supports a strong suite of Quality of Service (QoS) features and multiple services, which allow a service provider to offer different Service Level Agreements (SLAs) to hundreds of residential, SoHo, MDU and SME users from a single Access Point location. For the purposed of this project the ExMax Access point is going to be restricted to the 3650 – 3700 Mhz. Each Access Point will contain an antenna of 60 degrees. We will need 6 Access Point to make 360 degrees of coverage in a cellsite.

B. ExcelMax Bandwidth Capacity

The next Table Shows the Bandwidth Maximum Capacity for the ExcelMax Depending on the Channel Bandwidth and Modulation Scheme:

ExcelMAX Access Point Net Throughput (TDD Mode)						
Modulation	Code Rate	Spec eff [bps/Hz]	Net Bitrate [Mbps]			
Channel Bandwidth			1.75	3.5	7	
BPSK	1/2	0.3	0.5	1.0	2.1	
QPSK	1/2	0.6	1.0	2.1	4.2	
QPSK	3/4	0.9	1.6	3.1	6.3	
16-QAM	1/2	1.2	2.1	4.2	8.4	
16-QAM	3/4	1.8	3.1	6.3	12.6	
64-QAM	2/3	2.4	4.2	8.4	16.8	
64-QAM	3/4	2.7	4.7	9.4	18.9	

Note: Will are not going to use the 14 Mhz spectrum choice on the radio.

1. ExcelMax Half Duplex FDD (HD-FDD)/TDD CPE:



Axxcelera's ExcelMax HD-FDD/TDD CPE is a Point to Multipoint (PMP) CPE designed to operate in the 3.3-3.8 GHz spectrum and supports a Half Duplex FDD (Frequency Division Duplex) or a TDD (Time Division Duplex) architecture. The WiMax-2004 compliant CPE allows service providers to offer broadband wireless services to customers in Non Line of Site (NLOS) locations. The ExcelMax CPE 3300 supports a strong suite of Quality of Service (QoS) features, including Committed Information Rate (CIR), Peak Information Rate (PIR) and Best Effort services. The CPE supports Call Admission Control (CAC) features, which allows for scalable carrier class VoIP services and the IGMP protocol which supports Video Broadcast services. All CPEs in a service provider network are completely manageable remotely by Axxcelera's carrier-class Network Management System using SNMP protocol. For the purposed of this project the ExMax CPEs are going to be restricted to the 3650 – 3700 Mhz

2. ExcelMax Indoor CPE:



Axxcelera's ExcelMax Indoor CPE is a low cost, self-installable Point to Multipoint (PMP) CPE designed to operate in the 3.3-3.8 GHz spectrum and supports a Half Duplex FDD (Frequency Division Duplex) or a TDD (Time Division Duplex) architecture. The WiMax-2004 compliant Indoor CPE allows service providers to offer broadband wireless services to customers in Non Line of Site (NLOS) locations. The ExcelMax CPE 3400 supports a strong suite of Quality of Service (QoS) features, including Committed Information Rate (CIR), Peak Information Rate (PIR) and Best Effort services. The CPE supports Call Admission Control (CAC) features, which allows for scalable carrier class VoIP services and the IGMP protocol which supports Video Broadcast services. All CPEs in a service provider network are completely manageable remotely by Axxcelera's carrier-class Network Management System using SNMP protocol. For the purposed of this project the ExMax CPEs are going to be restricted to the 3650 – 3700 Mhz