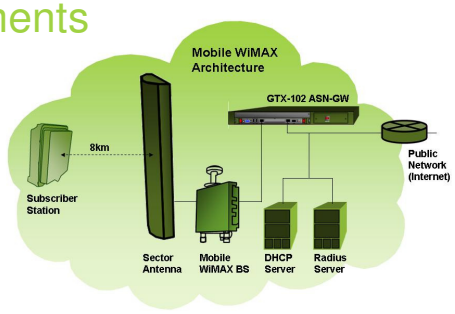
White Paper

Using Mobile WiMAX Technology for Fixed Broadband Deployments

White Paper

Version: 1.3



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1 PREFACE

This section describes the objectives and audience of this White Paper.

1.1 Objectives

This document describes the use of the RuggedMAX™ WiN7200 WiMAX Pico Base Station in combination with the GATIX GTX-102 Compact Access Service Network Gateway to offer a fixed wireless broadband network.

1.2 Audience

This document is intended for the person wanting to deploy a fixed wireless broadband network using readily available mobile WiMAX equipment.

2 INTRODUCTION

The deployment of wireless networks based on WiFi (802.11) or Fixed WiMAX (802.16d) technology to address the "last mile" access has been successful in the last few years and that model is reasonable well understood. However, with more and more operators wanting to build future proof wireless networks the question was raised as to why not use the latest Mobile WiMAX (802.16e) technology? This question is valid since Mobile WiMAX is a superset of fixed WiMAX and supports fixed and mobile deployments simultaneously.

Mobile WiMAX is the technology that has been designed for wireless broadband services based on IP traffic. It provides seamless services to people on the move like the existing wireless Internet does and offers high-speed data services comparable to high speed Internet. WiMAX technology supports optimized handover schemes with latencies less than 50 ms to help ensure real-time applications such as Voice over Internet Protocol (VoIP) are efficiently supported. Although designed with mobility in mind, mobile WiMAX is equally applicable to fixed as well as mobile environments. This is due to the fact that the requirements for a fixed device are a subset of those for a mobile device.

This paper provides a recipe for using Mobile WiMAX Pico Base Station technology for fixed Broadband deployments.

2.1 Mobile WiMAX Debunked

A commonly-held misconception is that WiMAX will deliver 70 Mbit/s over 50 kilometers (~31 miles). In reality, WiMAX can either operate at high bit rates or over long distances. However, it can not achieve both at the same time. Operating at the maximum range of 50 km increases bit error rate and thus results in a much lower bit rate. Conversely, reducing the range (to <1 km) allows a device to operate at higher bit rates.

So how do we create a reasonable tradeoff between long range and high bit rates? Since the antenna gain of the average Mobile Station is fixed, the maximum distance between the Pico Base Station and each Mobile Station is to a large extent dependent on the antenna used on the base station. By sectorizing the Pico Base Station, higher gain antennas can be used per sector of the cell, thereby increasing the distance that can be covered in that cell. At the same time, because the cell is now sectorized, more radio's can be added. Typically, one 3.XGHz radio in a Pico Base Station can serve up to 512 customers (or service flows) simultaneously. By increasing the amount of radios in a single cell the amount of simultaneously connected Mobile Stations in the cell can be increased.

2.2 Increasing the LoS Range for Fixed Installations

Consider the 3.XGHz RuggedMAX™ WiN7200 mobile WiMAX Pico Base Station. This Pico Base Station is factory fitted with two 8dBi omni antennas. When communicating with a fixed outdoor Mobile Station, for example the RuggedMAX™ Win5300, the maximum Line-of-Sight (LoS) distance between the two is 4km (~2.5miles).

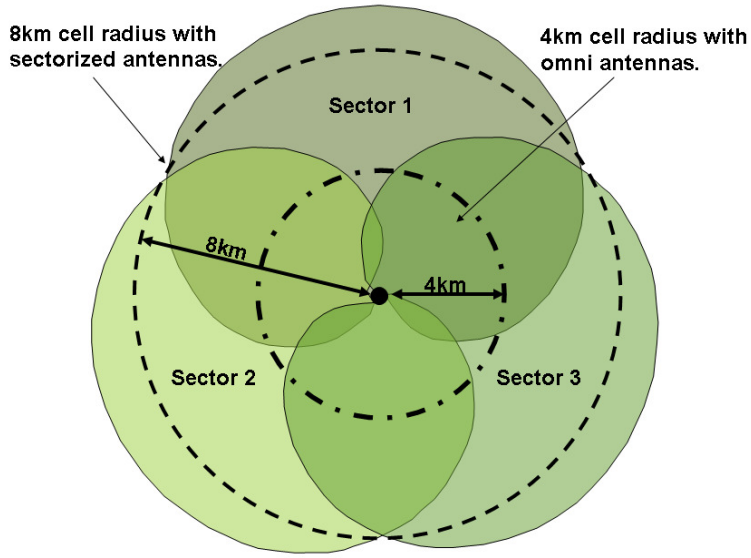

Figure 1: Using Sector Antennas the cell radius can be increased

To increase the LoS distance the two omni antennas on the Pico Base Station can be replaced by a Dual Polarization Broadband Sector Panel Antenna. In this configuration the LoS distance is increased to a maximum of 8km (~5miles). At the same time a three fold increase in capacity can be achieved so that more customers can be served from the same broadcast tower.

2.3 Maximum LoS Distance and WiMAX Timing Constraints

By using higher gain antennas the distance between the Pico Base Station and the Mobile Station could be increased even further. However, the WiMAX chipset used in the RuggedMAX™ WiN7200 mobile WiMAX Pico Base Station imposes a practical limit to this distance because of timing constraints. The Base Station and the Subscriber Station are synchronized in time in order to communicate with each other. This synchronization takes place via a mechanism called "Ranging".

Ranging is a dynamic time alignment process that allows a Base Station to receive transmitted signals from Mobile Stations in an exact time slot, even though not all Mobile Stations are the same distance from the Base Station. Ranging keeps different Mobile Stations transmit bursts from colliding or overlapping. Ranging is necessary because Mobile Stations may be moving or have been moved, and their radio waves' arrival time at the Base Station depends on their changing distance from the Base Station. The greater the distance, the more delay in the signal's arrival time. Transmission delay is approximately 3 microseconds per km (or 5 microseconds per mile).

To perform time alignment, a Mobile Station can advance or delay its transmission timing relative to the reference message that it receives on the downlink channel. The amount of variation in transmission timing that the chipset in the Base Station can handle is approximately 24 microseconds, this which would give a maximum distance of 8km (~5miles).

2.4 Network Example

Mobile WiMAX allows for the deployment of a single broadband wireless network which caters to multiple subscriber types with varying needs for mobility. One network example providing fixed, portable and mobile usage models is shown below:

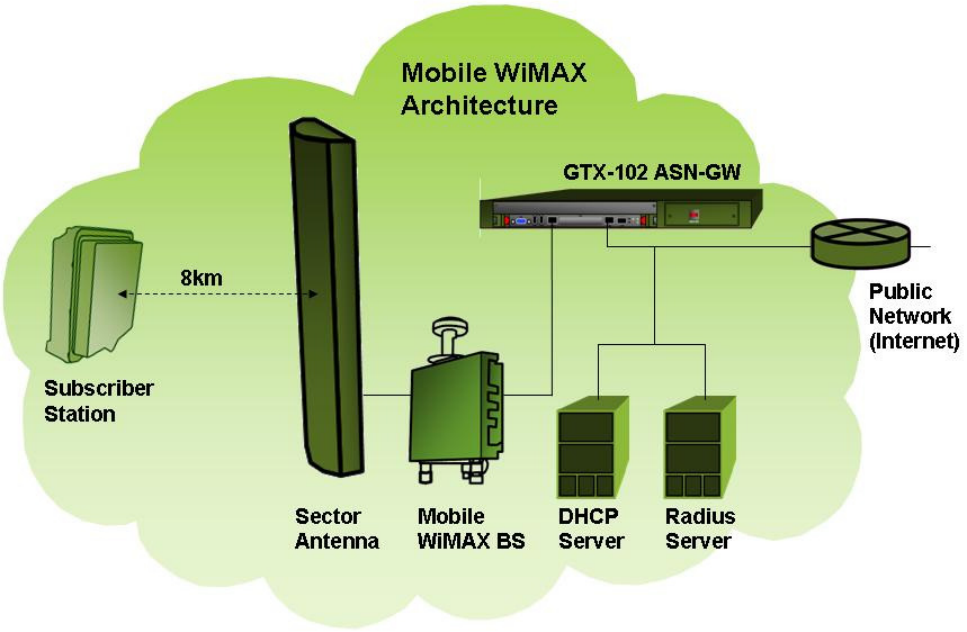

Figure 2: Example of WiMAX Architecture offering fixed and nomadic service

Components used in the diagram, from left to right:

2.4.1 RuggedMax Win5300 mobile WiMAX Subscriber Station

The RuggedMAX™ Win5300 is a high-performance outdoor unit that provides complete 802.16e mobile WiMAX broadband wireless access functionality to a range of indoor multiservice gateways by a standard Ethernet cable. The self learning smart antenna automatically detects the base station on the best signal available allowing for plug-n-play installations and maintenance free operation.

2.4.2 17dBi Dual Polarization Sector Antenna Description

The 3.XGHz 17dBi Dual Polarization Broadband Sector Panel Antenna is a high gain base station antenna designed for use in high density RF environments. The antenna offers high gain for reliable long-range wireless data communication at an economical price. This antenna allows you to operate in both Horizontal AND Vertical Polarization at the same time.

2.4.3 RuggedMax Win7200 mobile WiMAX Pico Base Station

The RuggedMAX™ WiN7200 mobile WiMAX Pico Base Station is a one sector station, which supports up to 512 subscriber units and/or service flows. The low power consumption and small size make it the ideal choice for outdoor or indoor installations where increased network

coverage or capacity is needed. The Pico Base Station provides all the functionality necessary to communicate with fixed and mobile subscriber units according to the service criteria and customer Service Level Agreements (SLA), and to connect to the core network of the Service Provider through the ASN Gateway, supporting the necessary end-to-end Quality of Service (QoS).

2.4.4 GATIX GTX-102 ASN Gateway

The GATIX GTX-102 ASN Gateway is an entry level subscriber mobility access gateway for IEEE 802.16e Mobile WiMAX radio access networks. The ASN Gateway is an entry level subscriber mobility access gateway with integrated Radius server and Subscriber Station Management System for IEEE 802.16e Mobile WiMAX radio access networks. The ASN gateway functions in the gateway role in WiMAX networks, designed as an end-to-end IP architecture.