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To FCC,

This is with regard to Green Packet OX350I device (proposed FCC ID: W9V-OX350I-GP) for FCC grant of 3675-3700MHz range. FCC contends that FCC may grant certification of 802.16e outdoor subscriber device in the 3675-3700MHz range only if it supports "Listen Mode" to minimize interference; that is, unless it has the ability to detect other transmitters in the region and thereby postpone or terminate transmission to avoid interference, in compliance with Unrestricted Certification under Part 90Z (3650-3700 Band) of FCC Publication 552295.

In fact, an 802.16e subscriber device will never make its own decisions about when to transmit. The base station to which it is connected schedules those transmissions in both frequency and time. In simplified terms, a base station certified by the FCC for Unrestricted Operation in the 3650-3700 Band will 'listen' for potentially interfering transmissions, and will schedule its own as well as subscriber device transmissions only when no competing transmissions are detected. Detailed descriptions used for the certification process are contained in PureWave Networks Contention Based Algorithm (attached).

In other words, the combination of the standard 802.16e subscriber device with a base station running this unrestricted operation protocol will together perform in compliance with Unrestricted Operation under Part 90Z (3650-3700 Band) of FCC Publication 552295.

Of course, transmit power and other RF parameters must additionally comply with the FCC regulations for the entire 3650-3700MHz band. Assuming a subscriber device meets that criterion across the entire 3650-3700 band, we do not see any reason why it should not be FCC certifiable over that entire band. This is because a network legally operating from 3650-3700MHz must employ base station(s) that are FCC certified for Unrestricted Operation.

We hope this helps to clarify things. PureWave Networks is in the final stages of certification for Unrestricted Operation in the 3650-3700 Band for our PureWave Quantum 6636 and 2236 Base Stations (FCC ID: XN3-QUANTUM6636). FCC administrative review was completed on Aug 29 and it is now pending technical review, which in our experience should complete within 3-4 weeks. The existing certificate and datasheet are attached. We expect to be granted approval and will provide an updated certificate which covers the 3650~3700 band very soon.

We look forward to being able to deploy our base stations in the entire 3650-3700MHz band along with Greenpacket's OX350I outdoor subscriber devices.

Best Regards,

A handwritten signature in black ink, appearing to read "Dan Picker", is written over the typed name.

Dan Picker, Ph.D.  
Chief Technical Officer, PureWave Networks  
2660-C Marine Way  
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Sep 1<sup>st</sup>, 2011



# PureWave Quantum Family

## Contention Based Algorithm

### **1) INTRODUCTION**

PureWave Networks develops high performance, compact outdoor base stations for the 4G marketplace. PureWave Networks is the only company that utilizes smart antenna technology to achieve the coverage and capacity of a macro base station in a small form factor that can be deployed anywhere. Our solutions are versatile enough to be deployed for small cell urban coverage or for macro base station rural coverage.

PureWave Networks is submitting this document as part of the FCC certification for PureWave Quantum family of base stations. These base stations are sharing the same software and should all be certified together. Specifically the implementation will be used in the 3675-3700MHz band.

### **2) BACKGROUND**

FCC opened up the availability of a frequency range of 3.650 to 3.700 GHz in the United States as a semi-licensed band.

Each User is required to register and specify the frequency, location of operation but any user is allowed to operate the spectrum.

In order to allow a fair chance of operation of any user FCC defined the “contention based” mode of operation in order to give equal chance for any user to utilize the spectrum.

### **3) DEFINITION OF CONTENTION BASED PROTOCOL**

A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate.

Such a protocol may consist of procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel. Contention-based protocols shall fall into one of two categories:

- (1) An unrestricted contention-based protocol is one which can avoid co-frequency interference with devices using all other types of contention-based protocols.
- (2) A restricted contention-based protocol is one that does not qualify as unrestricted.

WiMAX based products using a “scheduled protocol” fall under the “restricted” definition. Those are allowed to use only the lower end of the 3.65GHz spectrum and are given only 25 MHz of spectrum (3.650-3.675GHz). PureWave Quantum family was certified to support that area of the band.

“WiFi like” products using a CSMA/CA contention based protocol are allowed to use the entire 50MHz (3.650-3.700GHz) band if they meet the criteria. The products need to conform to FCC part 90.

#### **4) TYPE OF CONTENTION BASED PROTOCOL USED BY QUANTUM FAMILY OF PRODUCTS**

In order to enable the users to utilize the whole 50MHz of spectrum PureWave is implementing a “Contention Based Mode” of operation and re-certifying the product to extend the frequency range.

In that mode the Base Station will use a CSMA/CA like implementation and performs Carrier Sense (Listen before Talk) method on top of the WiMAX standard protocol.

PureWave Networks’ Quantum family of products allows the use of an unrestricted contention based protocol as it operates in a “listen before transmit” mode:

When the Quantum base station operates in the unrestricted contention based mode, it continuously measures the external noise across the operating channel bandwidth and when a signal received with energy level exceeding the user configured Carrier Sense threshold will stop transmission and perform a back-off. The back-off is comprised of transmit-off state followed by transmit-on state. During the transmit-off state the base station allows other spectrum users to utilize the spectrum.

As other users of the spectrum are likely to be operating in TDD modes with differing frame lengths it is quite likely that they will not be transmitting when the Base Station checks for other signals prior to transmitting in the next scheduled timeslot a few milliseconds later.

## 5) IMPLEMENTATION

### SPECIFIC IMPLEMENTATION OF THE UPPER 25MHZ CONTENTION ALGORITHM

The following is a written description of the algorithm:

- Base station periodically (Parameter called “Scan Interval”) scans for noise on the Uplink channel.
- If noise is detected above the defined threshold, the Base station stops transmitting.
- After the expiry of the back-off timer, the base station transmits for very short time (4/8 frames) to keep current CPEs connected. This is intended for control messages and DCD/UCD. This step is repeated continuously.
- During this period the Base station scans for noise on the Uplink channel every 2 frames.
- If the noise drops below the threshold, the Base station resumes full transmission.

#### CONFIGURATION PARAMETERS:

Under Sector->1->Advanced->Radio:

- **Contention Based Mode** - Type: Boolean (checkmark), Range: Enable/Disable
  - Help: Set Contention based mode operation used when central frequency is set within 3.675-3700MHz range in US.
- **Carrier Sense Threshold** - Type: Signed Integer, Range: -96 to -64
  - Help: Define the energy level used for carrier sense detection threshold. Units are in dbm per full channel bandwidth. NOTE: Set the appropriate value according to the configured channel bandwidth.
- **Carrier Sense Back-off Frames** - Type: Unsigned Integer, Range: 2 to 65535
  - Help: Define the amount of frames (5msec) for no transmit after an energy exceeding the CS threshold is detected. 65535 means stop transmission permanently until energy is not detected.
- **Carrier Sense Resume Frames**- Type: Unsigned Integer, Range: 4 to 65535
  - Help: Defines the amount of frames (5 msec) to resume transmission after a CS back-off. After expiry of this period another back-off will be performed.

#### HIDDEN CONFIGURATION:

The following fields are hidden from the user interface:

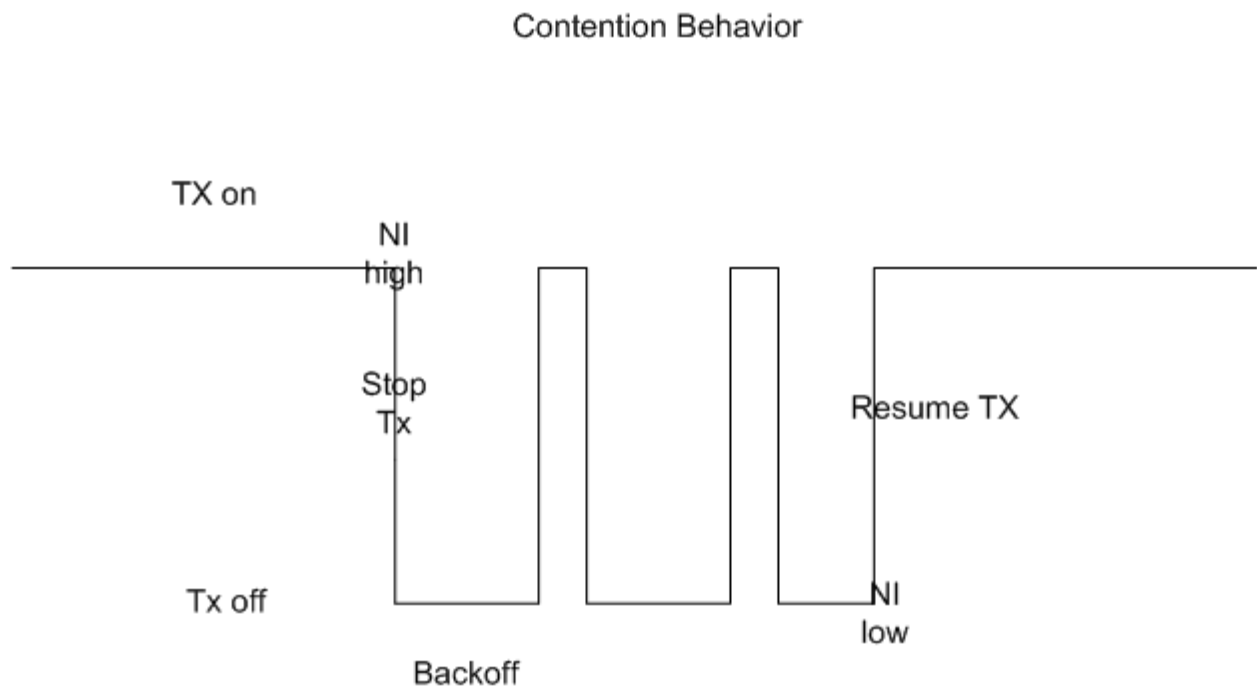
- **Slots to be allocated for the NI burst during scanning.**
- **How long to transmit after the back off.**
- **Scan interval during the back-off.**

## 6) DEMONSTRATION OF COMPLIANCE OF THE “LISTEN BEFORE TRANSMIT” MODE

### CONTENTION BEHAVIOR DIAGRAM

The following diagram demonstrates how the algorithm is implemented to prove that indeed the base station would be able to share the media with other base stations operating in the same band.

This diagram demonstrates the implementation given in section 5.



**CONTENTION BEHAVIOR TABLE**

The following table demonstrates the results achieved with the algorithm are allowing the user to comply with the FCC requirements in the upper 25MHz of the 3650-3700 band.

A signal was generated and given to the Equipment Under Test (EUT) with different values. The transmission disablement (Yes/No) was recorded in the last column.

EUT Center Freq(MHz)	EUT Channel Bandwidth (MHz)	EUT Carrier Detect turn-off level	Interferer Frequency relative to EUT (MHz)	Carrier Detect Level Per Tone	Carrier Detect Level Full BW	Tx Disabled
3680	10	-60	0	-89	-60	Yes
3680	10	-60	0	-94	-65	No
3680	10	-80	+5	-109	-80	Yes
3680	10	-80	+5	-114	-85	No
3687.5	10	-60	0	-89	-60	Yes
3687.5	10	-60	0	-94	-65	No
3687.5	10	-80	+5	-109	-80	Yes
3687.5	10	-80	+5	-114	-85	no
3687.5	10	-80	-5	-109	-80	Yes
3687.5	10	-80	-5	-114	-85	no
3695	10	-80	-5	-109	-80	Yes
3695	10	-80	-5	-114	-85	no
3680	5	-60	0	-86	-60	Yes
3680	5	-60	0	-91	-65	no
3687.5	5	-80	-5	-76	-50	no
3687.5	5	-80	+5	-76	-50	no

# PureWave Quantum 6636

High performance, all outdoor  
Mobile WiMAX base station

## Making Mobile WiMAX Profitable

PureWave Quantum base stations are a family of carrier grade, outdoor 802.16e compliant compact base stations that combine power and performance in a small package and at a great price.

The PureWave Quantum 6636™ series of Mobile WiMAX base stations offers operators unmatched range and capacity through the use of smart antenna technology. Each 6636 series base station uses up to six antennas operating in concert on both uplink and downlink, greatly improving link budgets, and enabling operators to deliver advanced broadband services over vast distances and in non-line-of-sight (NLOS) conditions.

The 6636 series is ideally suited for rural broadband coverage, deployment in difficult terrain, utility and smart grid applications, military applications, and any other application which requires superior link budgets and coverage over the widest possible distances.

The 6636 series is part of the PureWave Quantum family of advanced, compact Mobile WiMAX base stations. PureWave Quantum base stations come in a fully integrated, small, elegant, yet rugged package. They are designed to be deployed outdoors without the need for a shelter and can be easily mounted on utility poles, walls, rooftops, cell towers – virtually anywhere – without the need for expensive remote radio heads.

PureWave Quantum base stations operate as part of an open, standards based eco-system that allows our customers to choose best-of-breed components; from standard Mobile WiMAX CPEs to ASN-GW. PureWave Quantum base stations are designed to support large mobile deployments but, uniquely, can also be deployed in “stand alone” mode without an ASN-GW, offering a simpler and more cost effective solution for operators that are interested in initially rolling-out fixed or nomadic services.

The PureWave Software Defined Radio (SDR) architecture allows operators to upgrade their networks by means of remote software updates. As new features and functionality become available, operators are assured of long term investment protection. All PureWave Quantum base stations are compatible with the powerful PureView Network Management System.





### SUPERIOR RANGE

The 6 antenna system significantly improves uplink and downlink performance.

### EASY DEPLOYMENT

Field deployable by a single technician in well under 2 hours.

### ASN-GW OPTIONAL

Can operate in stand-alone mode, without an ASN-GW, making even small deployments affordable.

### GREATER CAPACITY

Improved link performance increases throughput at any range.

### FLEXIBLE MOUNTING

Can be deployed on towers, utility poles, walls, roof tops, etc. without the need for remote RF heads.

### COMPLETELY WEATHERPROOF

No shelter required.

### SOFTWARE DEFINED RADIO

Supports remote field upgrades of new functionalities and standards.

### POWERFUL MANAGEMENT OPTIONS

Fully supported by PureView NMS.

## Specifications

### Radio

<b>Frequency Bands</b> 3.65 GHz	<b>Number of Tx/Rx Antennas</b> 6x6	Delay Diversity, MRC, UL Collaborative Spatial Multiplexing*
<b>Channel Size</b> 3.5*, 5, 7, 10 MHz	<b>Tx Power per Antenna</b> 33dBm *** (RMS data power at maximum MCS level)	<b>Air Link Optimization</b> HARQ, CTC, UL sub-channelization
<b>Duplex Method</b> TDD	<b>Smart Antenna Capabilities</b> MIMO Matrix A, MIMO Matrix B, Cyclic	

### Capacity

<b>Active Users</b> 200	<b>Service Flows per User</b> 16	<b>Peak Throughput/Sector</b> Aggregate: Up to 53Mbps, DL: Up to 43Mbps, UL: Up to 20Mbps
	<b>Idle-Mode Users</b> 1000*	

### General

<b>Standards Compliance</b> IEEE 802.16e-2005	<b>Modulation</b> QPSK, 16QAM, 64QAM	<b>VoIP MOS</b> up to 4.3
<b>Backhaul Interface Options</b> 2x Gig-E RJ-45, 2x Multi-Mode Optical Fiber, or 2x Single-Mode Optical Fiber, all with inter-sector daisy-chain support.	<b>QoS</b> BE, UGS, rtPS, ErtPS, nrtPS	<b>Security</b> AES-128, EAP-TLS, EAP-TTLS, PKMv2
<b>Inter-BS Synchronization</b> Integrated GPS	<b>Convergence Sublayer</b> IP-CS, Eth-CS, PHS*, IPv4, IPv6*, IPv6 Pass-Through	<b>Management</b> PureView EMS/NMS, Remote CLI, Web Interface, SNMP v2c & v3

### Mechanical, Electrical, and Environmental

<b>Dimensions</b> 17.5" x 16.7" x 5.3" (44cm x 42cm x 13cm)	<b>Humidity</b> 5-100%	<b>Wind Loading</b> 160km/hr operation, 200km/hr survival
<b>Weight</b> 32lbs (14.5kg)	<b>Altitude</b> To 10,000 feet above sea level	<b>Surge Protection</b> UL497B
<b>Power</b> -48 VDC or 110/220 VAC, 180 Watts Max	<b>Weatherproofing</b> IEC IP67	<b>Lightning Protection</b> Min 10kA IEC 6100-4-5 †
<b>Temperature</b> -40C to +55C per ETSI EN 300 019-1.4 Class 4.1E**	<b>Vibration and Dust</b> Meets ETSI EN 300 019-1-4 requirements for Class 4.1E	<b>Safety and IEC IP</b> EN 300 019-2-2, GR487, IEC 60529

### Connectors

<b>DC Power</b> Weatherproof circular connector	<b>Cat-5 Backhaul Port</b> 2x RJ-45, Weatherproof	<b>GPS</b> N-type
<b>AC Power</b> Circular plastic multi-pin connector	<b>Optical Fiber Backhaul Port</b> 2 x LC duplex	<b>Antenna</b> 6x N-type
<b>Grounding</b> M5 ground stud to chassis	<b>RS-232 Maintenance Port</b> RJ-45, Weatherproof	

- \* Future software upgrade
- \*\* An available solar shield is required for ambient temperatures above +45C with full sun exposure
- \*\*\* Transmit power subject to local rules and regulations
- † Optional via external kit

## About PureWave Networks

PureWave Networks develops high performance, compact outdoor 4G LTE & WiMAX base stations. It is the only company that utilizes advanced beamforming technology to achieve the coverage and capacity of a macro base station in a small form factor that can be deployed anywhere.

The PureWave Networks Quantum family of WiMAX base stations offer an open end-to-end solution that also allows customers to select components from the broad WiMAX ecosystem in building their networks. Our solutions are designed for any type of operator, from small WiSPs to large mobile service providers. PureWave provides customers the lowest total cost of ownership in the industry through superior performance, ease of installation, dramatically lower equipment and operational cost, and minimal power consumption. PureWave Networks is headquartered in Mountain View, California. [www.purewavenetworks.com](http://www.purewavenetworks.com)



**Certification  
Issued Under the Authority of the  
Federal Communications Commission  
By:**

**Compliance Certification Services  
47173 Benicia Street  
Fremont, CA 94538**

**Date of Grant: 09/29/2010  
Application Dated: 09/17/2010**

**PureWave Networks  
2660-C Marine Way  
Mountain View, CA 94043**

**Attention: Mark Mendonca , Director RF Engineering**

**NOT TRANSFERABLE**

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

**FCC IDENTIFIER:** XN3-QUANTUM6636  
**Name of Grantee:** PureWave Networks  
**Equipment Class:** Licensed Non-Broadcast Station Transmitter  
**Notes:** 6X6 MIMO WiMAX Base Station

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
BC	90	3652.5 - 3672.5	2.65	6910.0 Hz	4M57G1D
BC	90	3652.5 - 3672.5	2.65	6910.0 Hz	4M56D1D
BC	90	3655.0 - 3670.0	5.57	6910.0 Hz	9M14G1D
BC	90	3655.0 - 3670.0	5.57	6910.0 Hz	9M12D1D

The antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures. RF exposure compliance is addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co-location requirements of §1.1307(b)(3).

BC: The output power is continuously variable from the value listed in this entry to 5%-10% of the value listed.

