Airspan
Interference Detection in Unrestricted FCC Band

Guidance regarding contention based protocol for devices operating in the 3650-3700 MHz Band under Part 90Z.

1 Document Overview

This document identifies several questions / information to help determine the contention based protocol capability of a device that may operate in the 3650 – 3700 MHz under part 90Z of our rules. These questions are intended to be used as a guide by the applicant to describe how their system meets the requirements for 3650-3700 contention based protocol.

This device is WiMAX fixed remote terminal station. The base station enables fixed remote terminal station and ensures CBP implementation. In order to start any transmission of WiMAX fixed remote terminal station, it first has to be synchronized with the transmission of the base station. In order to be synchronized with the base station, the terminal station has to detect the preamble transmitted by the base station every frame and to decode the DL and UL MAP messages which are broadcasted by the base station. It then has to verify that the base station identity (BSID), which is broadcasted by the BS matched the BSID that the terminal station is configured to work with. The UL MAP messages contains transmission allocations for the terminals station, therefore, without synchronization to the base station transmission, without validation of the BSID and without decoding of the UL MAP, terminal station is not able to transmit.

This device is WiMAX fixed remote terminal station intended for operation with Base station FCC ID: **PIDMMAX3605** or Base station FCC ID: **O2J-365AS** (Airspan's BS).

Answers to FCC Technical questions in KDB 552295 for devices operating in the 3650-3700 MHz Band under Part 90Z.

2 Unrestricted Certification under Part 90Z (3650-3700 Band)

In order to ensure that a device complies with the requirements of unrestricted contention based protocol, the following information should be provided in the application.

2.1 Unrestricted Protocol Description

2.1.1 Address the key requirements for operation using unrestricted contention based protocol. Please note that this requires recognizing other systems (both similar to yours and different from yours) that operate on a co-channel. Indicate the strategy for sharing the spectrum in terms of: Does the system use spectrum sensing to determine if the other devices are transmitting and then find ways to share the bandwidth, or have some other strategy?

The base station employs a "listen before transmit" function whose purpose is to detect co-channel transmissions above a configurable detection threshold. The detection circuitry measures power level irrespective of the transmitting system's air interface type (i.e. technology agnostic). Detection is made at the start of each WiMAX frame (typically every 5 or 10ms). Upon detection of a transmission above the configured threshold, the base station creates a "contention allocation slot" that allows other systems access by creating gaps in it's transmission (both the BS and associated CPE **which is scheduled by the BS**). Note that the number of frames over which transmission is stopped is operator configurable (Netspan "carrier Sense backoff Frames") from a minimum value of 2 frames and the default value is typically 4-5 frames (20-25ms), but can be much longer. Transmissions continue after the channel is clear (i.e. the other system's transmissions stop), as the Base Station repeats the detection measurement at regular intervals and adjusts the contention slots accordingly.

2.2 Threshold Detection to Determine Occupancy

2.2.1 Describe how your system determines if another system is using the spectrum. At what detection level – relative to 0 dBi receive antenna gain (busy channel threshold) does the device determine if another system is operating on the spectrum?

The base stations transceiver design includes additional circuitry for performing an in-band interference measurement. This makes measurements of the co-channel power within allotted "listen" periods at the start of each frame. The power threshold above which a "contention allocation slot" will be triggered is configurable through SNMP commands to the Base Station. Airspan's element manager software allows the operator to set threshold levels between –65dBm and –96dBm (relative to a 0dBi antenna gain). This is set by the "Carrier Sense Threshold" parameter in the Netspan Management software.

2.2.2 How long does the system observe to determine if the channel is busy – at the initial time and in between communications?

The base station makes a measurement every frame (typically 5 or 10ms). The measurement period is 20us. The Base station creates "Contention slots". These slots are typically 20-25ms.

2.2.3 What is the bandwidth being monitored versus bandwidth occupied for all modes of operation?

The measurement is made over the bandwidth of operation as detection is made after the appropriate channel bandwidth filter.

2.2.4 How much variability is provided to the system operator to adjust busy channel detection threshold?

The normal operating receive threshold varies depending upon the modulation and coding scheme that the CPE is using. This will range from approx. -96dBm and -70dBm for low and high order modulations respectively. The operator has no control over the upper level and we therefore regard the maximum operating receive threshold to be around -70dBm. To provide the operator with some margin whilst ensuring that the threshold cannot be set at a level that might prevent the system from operating "fairly", the maximum level that can be set by the operator is limited by the Netspan

Management software to -65dBm. Hence, the operator can set threshold levels between -65dBm and -96dBm (relative to a 0dBi antenna gain) in steps of 1dB.

2.2.5 What is the operating system threshold (receive threshold) compared to the monitoring threshold (busy channel threshold)?

The base station receive threshold for a 10MHz channel is -96dBm. The detection circuitry has a similar dynamic range.

2.2.6 What additional checks does the system perform to determine if the spectrum is being used before initiating a transmission?

No additional checks are made.

2.2.7 Does the master and the client perform the threshold detection? If master only performs the detection how does it determine if the client may interfere with the other system (hidden node detection mechanism)?

The system uses standard WiMAX compliant client devices. The system is a scheduled air-interface protocol where all client devices require MAP information from the base station in order to schedule uplink transmissions. In the case that the base station ceases transmissions (ie. initials a “contention slot”), the client devices will receive no MAP information, and therefore will not (cannot) transmit any signals. The base station is designed to provide wide area (macro) coverage from a “high-site” base station location. This deployment mode allows the base station to detect the presence of other channel users with negligible risk of hidden node issues. Hidden node problems are generally associated with pico or micro coverage systems (eg. WiFi).

2.3 Action Taken when Occupancy is Determined

2.3.1 What action does your system take when it determines occupancy? Does it vacate the channel or does it have some back-off and retry strategy? What is the impact of traffic on the spectrum sensing or avoidance performance?

Upon detection of a transmission above the configured threshold, the base station will cease transmissions (from BS and associated CPE) and repeat the measurement at the start of the next frame. The number of frames over which transmission is ceased is configurable and planned. Transmissions will not start until the channel is clear.

2.3.2 If you use other means, please describe how the device determines the existence of other systems and what steps it takes to either share the channel or avoid its use.

Not Applicable.

2.3.3 Describe any mechanism that would limit a transmission from a remote station if only the master detects occupancy (hidden node avoidance mechanism).

The system is a scheduled air-interface protocol where all client devices require MAP information from the base station in order to schedule uplink transmissions. In the case that the base station ceases transmissions, the client devices will receive no MAP information, and therefore will not transmit any signals.

2.4 Opportunities for Other Transmitters to Operate

2.4.1 When describing occupancy profile, clarify any differences between start-up acquisition mode of spectrum and operational modes.

At “start up” or after the system has been rebooted, the detection mechanism is activated prior to any transmission from base station or CPE.

2.4.2 In operational mode, how long does the system transmit before stopping giving others a reasonable time to transmit before continuing?

Transmissions are scheduled in blocks of 5 or 10ms frame duration. The “contention slots” for other systems are typically 4-5 frames (20-25ms). The frame duration includes both downlink and uplink transmissions. Detection is performed by the base station at the start of each frame.

2.4.3 Does the system (master and / or client) listen prior to every transmission? If no, explain.

Yes, the base station detects at the start of every frame.

2.4.4 Describe how the operational spectrum usage (on air time) is dependent on system load conditions (no load, typical and overload). For example, if a station does not have any information to transmit describe any regular or recurring transmission that may take place?

The base station transmits at the start of every “clear” frame (following detection period). CPE only transmit when scheduled by the base station. With no load, the majority of the frame is transmission-less. In overload condition, the frame is filled according to the base station scheduler protocols. In extreme overload conditions, a period of continuous transmission may occur. The creation of “contention slots” based on the detection of other activity, reduces the load that is programmed to be delivered over the system.

2.4.5 Describe if there are any limitations imposed by the contention protocol on what applications are used (i.e. limitations on Quality of Service).

There are no limitations imposed by the system. When sharing channel occupancy, system capacity will reduce. In this case the base station scheduler will prioritize traffic (based on packet classification rules) accordingly.

2.4.6 Describe how applications or configuration of services can affect spectrum usage. To describe your occupancy sharing capability you can assume that two systems on a co-channel are the same (your systems being described). How would they share the spectrum?

Each system will only transmit when it has detected that the channel is clear. If one system is transmitting, the second system will have its opportunity to transmit when the data transfer is complete. With evenly loaded systems, the opportunities to transmit will statistically be equal for both.

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Date: September 26, 2012