

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

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. The list is not intended to be exhaustive and may be modified in the future. There may be follow-up questions based on the responses provide by the applicant for authorization.

Applicants seeking certification for systems as complying with restricted contention based protocol (3650 to 3675 MHz) that permit operation on a co-channel with like systems (similar systems) may seek equipment authorization from a Telecommunications Certification Body (TCB) using the Permit but Ask procedure as described in Section 3 .

Applicants seeking certification for systems as complying with the unrestricted contention based protocol for operation in the 3650 to 3700MHz band that permit operation on a co-channel with similar or different systems (recognizing other systems) must apply to the FCC for equipment authorization.

1 Restricted Certification under Part 90Z (3650-3675 Band)

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

[The equipment in question has already been awarded a grant of equipment authorization for restricted operation, thus no response is provided for this section. Refer to section 2 for unrestricted operational information.](#)

1.1. Restricted Protocol Description

- 1.1.1. Although the restricted protocol does not have the extended requirement to recognize all other systems it is still mandatory to incorporate a contention based protocol that provides satisfactory sharing of spectrum with similar systems.
- 1.1.2. Address the key requirements for operation using restricted contention based protocol opportunities for other transmitters to operate. Please note that this requires recognizing like systems (similar to yours) that permit operation on a co-channel.
- 1.1.3. Provide any additional manuals and operational descriptions to allow the reviewer to understand the product and its operation.

- 1.2 Describe the method to permit occupancy
- 1.3 Describe the action taken if two or more transmitters simultaneously access the same channel by the master and the client devices.
- 1.4 Describe opportunities for other similar systems to operate
Address how or if a different system operator using the same technology can operate in the same band.

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

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 access point (master device) employs a listen-before-talk mechanism to verify the absence of a co-channel signal before transmitting. The airlink is based on the WiMAX protocol and as such organizes the airlink in a TDD structure with a static frame length. The TDD frame is sub-divided into the downlink sub-frame and the uplink sub-frame. The downlink sub-frame contains the access point to client device traffic and leads the uplink sub-frame which contains the client to access point traffic. The access point acts as the master scheduler of all attached client devices and orchestrates the transmission opportunities for all attached client devices.

The access point measures the ambient co-channel signal level at the beginning of each frame to determine if a competing transmitter is active. The access point organizes the transmission schedule of attached client devices to ensure that no transmissions occur during the channel activity sense interval positioned at the beginning of each frame. By scheduling a silent period during the channel activity sense interval, the access point ensures that any detection originates from competing equipment.

If the channel activity measurement exceeds the busy channel threshold then the AP will allocate a contention interval in the sector to allow competing transmissions to complete. The busy channel threshold is user-configurable from -95 dBm to -45 dBm. Neither the access point nor the attached client devices will transmit during the contention interval. The maximum duration of the contention interval is user-configurable from 10 to 250 msec. The access point will continue to measure the channel activity level during the contention interval and will resume normal scheduling if the link is determined to be idle (i.e. channel activity level below busy channel threshold) or if the contention interval expires, whichever occurs first.

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 busy channel threshold is user-configurable in the range from -95dBm to -45 dBm.

- 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 access point measures the channel activity level during a 20 usec interval located at the beginning of each frame to determine if the channel is busy.

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

The monitored channel bandwidth is greater than or equal to the occupied channel bandwidth.

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

The busy channel detection threshold is configurable from -95 dBm to -45 dBm.

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

The operating system threshold is user configurable from -95 dBm to -50 dBm and is normally set to -65 dBm. The busy channel threshold has a comparable dynamic range: -95 dBm to -45 dBm.

- 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 to determine if the spectrum is being used by a third-party system.

- 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 access point/master performs the channel busy detection; the client does not. Since the access point allocates client transmission opportunities, no transmissions occur during a contention interval. Client devices are unable to operate in an ad-hoc manner.

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?

Traffic has no impact on channel activity sensing. Once a busy channel is detected, the access point will defer transmissions in the sector during the contention backoff interval. The access point will continue to measure the channel activity during the contention backoff interval. The access point will resume transmission if the contention backoff interval expires or the channel is determined to be idle (not busy).

- 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.

No other means are used to determine the existence of competing systems.

- 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 transmit opportunities for the remote stations are defined in the uplink bandwidth allocation map which is broadcast by the access point. The access point broadcasts the uplink bandwidth allocation map at the beginning of each frame and remote stations will not transmit unless instructed to do so by the uplink bandwidth allocation map. The uplink bandwidth allocation map will not be sent by the access point if the channel activity detection mechanism determines that the channel is occupied. Thus, remote stations will not transmit during the subsequent contention backoff if the access point detects channel occupancy. Client or remote stations will not operate in an ad-hoc manner.

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.

No distinction is made between start-up mode and operational mode; the access point repeatedly monitors the channel for occupancy during all modes of operation.

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

The maximum burst duration is proportional to the frame duration. The maximum burst duration is approximately 90% of the frame duration. The frame duration can be 5, 8, 10, 12, or 20 msec; thus the maximum burst duration is 4.5, 7.2, 9, 10.8, or 18 msec, respectively.

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

The master/access point listens prior to each downlink transmission.

- 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 access point transmits a frame header at the beginning of each frame. The duty cycle of the spectrum usage varies from approximately 10% for no load, up to 100% for a fully loaded channel.

- 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).

No limitations are imposed by the contention protocol regarding applications of the ExcelMAX system. Link capacity will decrease during contention exercises and the level of capacity loss will depend on the duration of the user-configurable backoff interval. The quality of service mechanisms will continue to operate during the contention exercises so as to prioritize traffic transport.

- 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 implements a listen-before-talk mechanism to verify that the channel is idle before transmitting. If one system detects an active channel, then the idle system will defer transmission for a configurable period of time. The idle system will continue to monitor the channel for activity at the start of each frame during the backoff interval. If the channel is determined to be idle, then the idle system will resume transmission. Assuming both systems are configured with equal backoff intervals, then the systems will share the channel fairly.

3 Procedures for Permit-but-Ask approvals

Applications for equipment based on restricted contention based protocol can be approved by a TCB following the permit-but-ask procedure. An initial inquiry providing the information described in Section 1 above must be submitted to the FCC for review. Once approved, a TCB may file for final approval once the rest of the application has been reviewed for compliance. The TCB is responsible for ensuring a complete review of the application for compliance with all the relevant requirements.

Special note must be made about the power limits specified in the rules for these devices. These devices are subject to transmitted power¹ and power density limits. Also, mobile devices may have to meet special restrictions based on the mode of operation. The grant must also list the note code RS² to denote “restricted contention based protocol”.

Change Notice:

1. **1/13/2010 552295** D01 CBT Guidance for 3650 3700 Band v01 has been changed to 552295 D01 CBT Guidance for 3650 3700 Band v01r01 to correct an error. Section 3 -Procedures for Permit-but-Ask approvals – the first sentence was correct from unrestricted to the restricted based protocol.

¹ Grant comments “Output is EIRP”.

² RS Note Code: This device incorporates a restricted contention based protocol. It is not capable of avoiding co frequency interference with devices using all other types of contention-based protocols. Operation is restricted to the 3650-3675 MHz band.