

4.9 GHz Public Safety Broadband Spectrum

Recommended Technical Framework for Canada

July 5, 2005

**Stu Overby
Director, Global Spectrum & Standards Strategy
Motorola, Inc.**

Executive Summary:

In 2003, the International Telecom Union (ITU) adopted a resolution recommending that administrations make additional spectrum available for Public Protection and Disaster Relief (PPDR). ITU Region II and administrations in the Americas took a leadership role in the ITU deliberations on this issue. One of the bands recommended for potential PPDR use in Region II was the 4.9 GHz band. The 4.9 GHz band has already been allocated in the United States and Canada for broadband use specifically for public safety use. In addition, technical rules have been adopted in the United States and are under development in Canada. Industry Canada has now issued a consultation requesting input on recommended technical rules for the 4.9 GHz band. Manufacturers are beginning to announce a variety of 4.9 GHz products, including products based on new mesh architectures.

The 4.9 GHz band is expected to support broadband networks designed specifically for Public Protection and Disaster Relief high rate data and video information transfer. Such networks will need to be highly reliable, secure, and designed with coverage capabilities based on PPDR agency requirements. These networks are expected to include both pre-deployed hotspots throughout a PPDR agency's operational area and temporary ad hoc systems deployed at an incident scene as needed for incident scene management.

This paper provides a recommended technical framework for deployment of 4.9 GHz in Canada. These recommendations provide Industry Canada and public safety users the chance to take advantage of greater economies of scale. At the same time, Industry Canada could adopt assignment policies that best fit the needs of agencies in Canada.

II. Technical Recommendations:

The 4.9 GHz Band: 4940-4990 MHz (50 MHz of spectrum total)

Channel Plan: The channel plan adopted should provide the greatest potential to support the variety of needs across multiple public safety and mission critical agencies. The width of the channels needed and the total amount of spectrum assigned for a given PPDR agency will depend on that agency's operational requirements. The following channel plan, which supports channel widths from 5 MHz to 20 MHz, should provide the flexibility needed for Industry Canada to support a variety of public safety and mission critical operational requirements. Because these channels overlap one another, Industry Canada should take precautions in its assignment procedures to ensure that overlapping channels do not occur in close enough proximity to cause conflicts among multiple licensees.

Channel Numbers * (n..s)	Channel Center 5MHz	Channel Center 10MHz	Channel Center 20MHz
1	4942.5		
2		4945.0	
3	4947.5		
4		4950.0	4950.0
5	4952.5		
6		4955.0	4955.0
7	4957.5		
8		4960.0	4960.0
9	4962.5		
10		4965.0	4965.0
11	4967.5		
12		4970.0	4970.0
13	4972.5		
14		4975.0	4975.0
15	4977.5		
16		4980.0	4980.0
17	4982.5		
18		4985.0	
19	4987.5		

Power Limits: Power limits should be stipulated as a function of channel bandwidth. As discussed more fully in the recommendation on emission masks, “High power” transmitters would require the use of a tighter mask to help prevent adjacent channel interference. “Low power” transmitters would have the option to operate with a less stringent mask. The following power limits are recommended.

The peak transmitter output power should not exceed:

Channel Bandwidth (MHz)	Low power peak transmitter power (dBm) Note: Mask X or Y may be used	High power peak transmitter power (dBm) Note: Mask X Required
5	14	27
10	17	30
15	18.8	31.8
20	20	33

Transmitters under the “High power” category which meet the tighter emission mask should be allowed to use transmit antennas with a directional gain up to 26 dBi at maximum transmit power output. Directional antenna gain could exceed 26 dBi, if both power transmit power and power spectral density are reduced dB-per-dB by the amount that directional antenna gain exceeds 26 dBi.

An antenna gain up to 9 dBi with maximum transmitter output power as shown in the table is recommended for omnidirectional or directional antennas for transmitters falling into the “Low Power” category which use the less stringent emission mask. Directional antenna gain may exceed 9 dBi, if both transmit power and power spectral density are reduced dB-per-dB by the amount that directional antenna gain exceeds 9 dBi.

Emission Masks:

The recommended emission masks for 4.9 GHz are listed below. This recommendation includes a two-tier mask approach. This approach uses a mask for low power devices similar to the mask defined in the IEEE 802.11a standard and a tighter mask for higher power transmitters which provides better adjacent channel protection. The low-to-high power breakpoint, that is, the point at which the high power mask is required, varies by channel bandwidth: 20 dBm (100 milliwatts) for 20 MHz channels, 17 dBm for 10 MHz channels, and 14 dBm for 5 MHz channels.

The less stringent mask for transmitting devices at lower power levels below these points allows existing 5 GHz commercial-off-the-shelf (COTS) wireless LAN equipment to be easily modified to operate in the 4.9 GHz band, thereby reducing costs for PPDR users. At the same time, the tighter mask used for powers above these levels provides additional adjacent channel protection needed to help reduce interference and increase the reliability for PPDR users. Manufacturers would also have the option to use the tighter mask for lower power transmitters as well, but would not be required to do so.

Emission Mask X. For high power transmitters operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

- (1) On any frequency removed from the assigned frequency between 0 - 45 % of the authorized bandwidth (BW): 0 dB.
- (2) On any frequency removed from the assigned frequency between 45 – 50 % of the authorized bandwidth: $568 \log (\% \text{ of } (BW) / 45)$ dB.
- (3) On any frequency removed from the assigned frequency between 50 - 55 % of the authorized bandwidth: $26 + 145 \log (\% \text{ of } BW / 50)$ dB.
- (4) On any frequency removed from the assigned frequency between 55 – 100 % of the authorized bandwidth: $32 + 31 \log (\% \text{ of } (BW) / 55)$ dB.
- (5) On any frequency removed from the assigned frequency between 100 – 150 % of the authorized bandwidth: $40 + 57 \log (\% \text{ of } (BW) / 100)$ dB.
- (6) On any frequency removed from the assigned frequency above 150 % of the authorized bandwidth: 50 dB or $55 + 10 \log (P)$ dB, whichever is the lesser attenuation.
- (7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device.

Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

(1) *Emission Mask Y*. For low power transmitters operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0 - 45 % of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45 – 50 % of the authorized bandwidth: $219 \log (\% \text{ of (BW) } / 45)$ dB.

(3) On any frequency removed from the assigned frequency between 50 - 55 % of the authorized bandwidth: $10 + 242 \log (\% \text{ of (BW) } / 50)$ dB.

(4) On any frequency removed from the assigned frequency between 55 – 100 % of the authorized bandwidth: $20 + 31 \log (\% \text{ of (BW) } / 55)$ dB attenuation.

(5) On any frequency removed from the assigned frequency between 100 – 150 % of the authorized bandwidth: $28 + 68 \log (\% \text{ of (BW) } / 100)$ dB attenuation.

(6) On any frequency removed from the assigned frequency above 150 % of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device.

Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

III. Summary

Defining appropriate rules for the 50 MHz of spectrum in the 4.9 GHz band will be of great benefit to public safety and mission critical agencies in Canada and the public they serve. The technical parameters recommended herein should provide public safety agencies the maximum opportunity to meet specialized operational requirements and at the same time to leverage economies of scale in of technology development occurring in the 5 GHz area and in other regions.