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Interim Technical Guidelines for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV Channels 21 to 51)

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1. Intent

The intent of this guideline is to provide technical guidance for remote rural broadband systems (RRBS) that may be authorized to operate in the frequency bands 512-698 MHz in accordance with Radio Systems Policy 06, *Policy for the Use of 700 MHz Systems for Public Safety Applications and Other Limited Use of Broadcasting Spectrum* (RP-06), released in June 2006.

At this time, only fixed service applications are eligible for licensing.

This document is intended to be an interim guideline while a Standard Radio System Plan (SRSP) and a Radio Standard Specification (RSS) are being developed in consultation with the industry.

Licensing procedures for RRBS can be found in Client Procedures Circular 2-1-24, *Licensing Procedure for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV Channels 21 to 51)* (CPC-2-1-24).

2. Frequency Availability

Frequencies shall be assigned on a 6 MHz block basis concurrent with upper and lower boundary frequencies identical to the 6 MHz broadcast channel plan. A maximum of 2 channels can be assigned to each RRBS using frequency division duplex (FDD) technology, and a maximum of 1 channel can be assigned to each RRBS using time division duplex (TDD) technology.

Industry Canada will first consider applications in the frequency channels shown in Table 1. However, in cases where these channels are not available, other channels within channel range 21 to 51 (512-698 MHz) (excluding channel 37¹ (608-614 MHz)) may be assigned on a case-by-case basis.

Table 1: Channels for RRBS Licensing

TV Channels	Frequency Range (MHz)
43	644-650
35	596-602
34	590-596
25	536-542

3. Technical Limits

3.1 RRBS Base Stations

The maximum e.r.p. of each RRBS base station transmitter shall not exceed 305 W (e.i.r.p. 500 W) and the e.r.p. spectral density shall not exceed 17 dBW/MHz. The height above average terrain² (HAAT) in

¹ Channel 37 is allocated to the radio astronomy service, and is neither available for broadcasting, nor RRBS.

² HAAT is the height of the centre of radiation of the antenna above the average elevation of the terrain between 3 and 16 km from the antenna along a given azimuth.

the direction from the transmitter to the receiver(s) as well as in the direction from the transmitter to any affected TV station(s) (see Section 6) shall not normally exceed 30 m. The transmitting antenna located at a HAAT of greater than 30 m, to a maximum of 100 m, may be authorized with e.r.p. reductions as shown below:

Table 2: RRBS Base Station HAAT vs. Maximum e.r.p.

RRBS Base Station HAAT (m)	Maximum e.r.p. (W)
0-30	305
31-40	186
41-50	124
51-60	87
61-70	64
71-80	50
81-90	40
91-100	31

The Department may permit, on a case-by-case basis, base stations with higher antenna heights without a reduction in e.r.p., provided that the broadcasting service is adequately protected. The broadcast protection criteria including desired field strength, broadcast protected contours, carrier-to-interference ratio, antenna front-to-back ratio and undesired field strength, are shown in Appendix 1.

3.2 RRBS Subscriber Stations

The transmitter power of each RRBS subscriber station shall not exceed 4 W and the e.r.p. shall not exceed 24 W (e.i.r.p. 40 W). The e.r.p. spectral density shall not exceed 6 dBW/MHz. The antenna height above ground shall not exceed 30 m.

4. Emission Limits

An out-of-band emission mask will be developed and included in an appropriate Radio Standard Specification (RSS). Until such time, RRBS stations (including base and subscriber stations) shall meet the Digital TV (DTV) mask (i.e. the Canadian Relaxed Mask) as described in Appendix 3 of Broadcasting Procedures and Rules 7, *Application Procedures and Rules for Digital Television (DTV) Undertakings* (BPR-7).

5. Polarization

RRBS stations shall employ vertical polarization.

6. Protection of Broadcasting Service

6.1 Broadcast Protected Contours

For the purposes of protecting the broadcasting service from RRBS, the following broadcast protected contours, as shown in Table 3, shall be used.

Table 3: Broadcast protected Contours in Kilometres

		Regular Class ³ TV	Class B TV	Class A TV	LPTV
Co-channel	DTV	96	53	34	18
	NTSC				
1 st Adjacent Channels	DTV	96	53	34	18
	NTSC				
Taboo Channels	DTV	Not Applicable			
	NTSC	70	45	25	12

The actual protected contours for DTV and NTSC are different. However, in the majority of cases, an NTSC channel of a TV station will be used for DTV post-transition. Since the protected contour is larger for DTV stations than for NTSC stations, the protected contours for DTV are used.

6.2 Minimum Separation Distance

RRBS base stations/subscribers and broadcasting stations (assignment or allotments) must be separated by at least the following distances to avoid interference into broadcasting stations.

³ Regular Class TV includes Classes C, VL and VU.

Table 4: Minimum Separation Distance (Note 1) Between TV Stations (assignments and allotments) and RRBS Stations

		Regular Class TV		Class B TV		Class A TV		LPTV	
		Distance to RRBS base station (km) (Note 2)	Distance to RRBS subscriber station (km) (Note 3)	Distance to RRBS base station (km) (Note 2)	Distance to RRBS subscriber station (km) (Note 3)	Distance to RRBS base station (km) (Note 2)	Distance to RRBS subscriber station (km) (Note 3)	Distance to RRBS base station (km) (Note 2)	Distance to RRBS subscriber station (km) (Note 3)
Co-channel (N*)	DTV assignment or allotment (Note 4)	121	96	78	53	59	34	43	18
	NTSC assignment or allotment (Note 5)								
J th adjacent channels (N±1 channels)	DTV assignment or allotment (Note 4)	99	96	56	53	37	34	21	18
	NTSC assignment or allotment (Note 5)								
Taboo channels (N±2, 3, 4, 7, 8; N-14, 15 channels)	DTV assignment or allotment	Not applicable							
	NTSC assignment (Note 6)	72	70	47	45	27	25	14	12
	NTSC allotment (Note 7)	0							

*where N is the channel under consideration for RRBS operation

Notes:

Note 1: The separation distances between RRBS base stations/subscribers and broadcasting TV stations are based on the protected contours shown in Table 3 in Section 6.1. The contours represent the nominal distance at which a broadcast assignment or allotment is protected. Some TV stations may have contours larger than what is stated in Table 3 due to terrain or other reasons. These stations must be protected to the full extent of their contours. Conversely, some TV stations may operate with reduced parameters or with directional antennas and have contours smaller than what is stated in Table 3. In such cases, if no other suitable channel can be found and upon presentation of proper engineering studies, the Department may permit RRBS to deploy at distances closer than what is indicated in Table 4. However, should the same TV station change its deployment in the future to utilize the maximum permissible parameters, RRBS stations may need to alter their parameters so as to not cause interference to the TV station.

Note 2: Distance to RRBS base station is calculated based on the maximum permissible parameters given in Section 3.1 and according to the method shown in Appendix 1. These distances may be reduced if lower e.r.p. (in the direction of the broadcasting station) and/or HAAT are used, provided that broadcast protection criteria are met. The broadcast protection criteria including desired field strength, broadcast protected contours, carrier-to-interference ratio, antenna front-to-back ratio and undesired field strength are shown in Appendix 1.

Note 3: Distance to RRBS subscriber stations is based on the broadcast protected contours shown in Table 3 in Section 6.1.

Note 4: DTV operation is protected from RRBS operation during and post NTSC to DTV transition (“transition period”).

Note 5: NTSC operation is protected until the end of the NTSC to DTV transition. However, as stated in Section 6.1, in the majority of cases, an NTSC channel of a TV station will be used for DTV post-transition; thus NTSC assignments and allotments operating in the co-channel or in the 1st adjacent channels are protected according to the DTV parameters during and post-transition.

Note 6: NTSC assignments are protected from the RRBS use of taboo channels ($N\pm 2, 3, 4, 7, 8; N-14, 15$ channels) until the end of the transition period only. Although these assignments will likely be used for DTV post-transition, RRBS operation in taboo channels is not expected to impact DTV reception.

Note 7: RRBS base stations and subscribers may use the taboo channels of NTSC allotments. However, in the event that such an allotment becomes an NTSC assignment during the transition period, the RRBS operator must cease operation for the duration of the transition period, or work in collaboration with the affected broadcast channel licensee(s) to avoid interference. It is noted that the operation of RRBS in the taboo channels of DTV stations is not expected to affect the operation of DTV. Therefore, should such an allotment become a DTV assignment, there is no requirement for the RRBS operator to cease operation.

7. Interference from Broadcasting Stations into RRBS Systems

RRBS operators should take the necessary measures to protect their stations from broadcasting station interference. The required separation distances may vary depending on many factors such as equipment characteristics including antenna characteristics, sensitivity, antenna front-to-back ratio, carrier-to-interference ratio, antenna gain and terrain.

8. Coordination between RRBS Systems

RRBS operators within close proximity should coordinate with each other. The required separation distances may vary depending on many factors such as equipment characteristics, antenna characteristics including sensitivity, antenna front-to-back ratio, carrier-to-interference ratio, antenna gain and terrain.

9. Operation near Canada/U.S. border

In the border area, the sharing and use of the bands 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-746 MHz are currently covered by the Broadcasting Agreement and Broadcasting Letter of Understanding⁴ (LOU). The LOU, which covers areas within 400 km of the border, deals with the sharing and use of the bands by broadcasting services operating in U.S. and in Canada. In addition, the LOU specifies that new services (non-broadcasting) operation shall not claim protection from DTV stations or analogue TV stations. The LOU does not deal with non-broadcasting versus non-broadcasting operations in the border area. As such, until such time as a new agreement can be reached between Canada and the U.S., any authorization issued for non-broadcasting use in Canada within 400 km of the border area must be on a no-interference, no-protection basis with respect to broadcasting services in the United States. Further, licensees will be subject to any future agreements or arrangements between Canada and the U.S. regarding use of these RRBS in the border area and may be required to modify their stations or operations in order to conform to such agreements or arrangements.

At this time, RRBS stations are not permitted to operate within 121 km of the Canada/U.S. border.

⁴ *Agreement Between the Government of Canada and the Government of the United States of America Relating to the TV Broadcasting Service and the Associated Working Arrangement.*

Letter of Understanding Between the Federal Communications Commission of the United States of America and Industry Canada Related to the Use of the 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-806 MHz Bands for Digital Television Broadcasting Service Along the Common Border.

Appendix 1 - Broadcast Protection Criteria and Method to Calculate Separation Distance

The following assumptions were made in order to derive the broadcast protection criteria:

- The spectral density of RRBS is similar to that of DTV, i.e. uniform density and occupying the entire 6 MHz channel.
- Out-of-band (OOB) emissions of the RRBS systems are in compliance with the DTV mask (i.e. Canadian Relaxed Mask) shown in Appendix 3 of BPR-7. If the OOB emissions are in full compliance with the FCC mask shown in the same Appendix, then a C/I of -26 dB can be considered instead of -22 dB as shown below.

Method:

1. The separation distances are calculated using the following relationship and appropriate propagation curves:

$$\begin{aligned} D/U &= C/I - F/B \\ U &= D - C/I + F/B \end{aligned} \quad (1)$$

Where:

U is the undesired (RRBS) signal strength in dB μ V/m;
D is the desired (broadcasting) signal strength in dB μ V/m;
C/I is the carrier to interference ratio (broadcast protection ratio) in dB; and
F/B is the antenna (television receiver) front to back ratio in dB.

2. Given the broadcast protection criteria⁵ for the each broadcasting station as stated in table A.1 below, the undesired field strength is calculated using Equation (1).
3. Using the RRBS parameters including e.r.p. and HAAT, the corresponding distance to the protected contour can be obtained using the F50 propagation curves.
4. The distance between a broadcasting station and a RRBS base station is the sum of the *protected contour* and the *distance to the protected contour*.

⁵ Reference: FCC OET Bulletin No. 69 and Technical Advisory Committee on Broadcasting, B-TAC Subcommittee-17 planning parameters for post-transition DTV.

Table A.1: Broadcast Protection Criteria and Calculation of Separation Distance Between Broadcasting Stations and RRBS Base Stations Operating Co-channel and in 1st Adjacent Channels:

It is assumed that the proposed RRBS base station operates at the maximum permissible power: e.r.p.=305 W (e.i.r.p.=500 W), HAAT=30 m.

Case		Desired (dBµV/m) (% Location, % Time)	Broadcast Protected Contour (km)	C/I (dB)	F/B (dB)	Undesired (dBµV/m) (% Location, % Time)	Distance to the Protected Contour (km)	Distance between Broadcasting Stn and RRBS Base Stn (km)	
DTV	Regular class ⁶ (e.r.p.=850 kW, EHAAT=300 m)	Co-channel	41 (50,90)	96	15	14	40 (50,10)	25	121
		1 st adjacent channel	41 (50,90)	96	-22	14	77 (50,10)	3	99
	Class B (e.r.p.=6.1 kW, EHAAT=150 m)	Co-channel	41 (50,90)	53	15	14	40 (50,10)	25	78
		1 st adjacent channel	41 (50,90)	53	-22	14	77 (50,10)	3	56
	Class A (e.r.p.=300 W, EHAAT=100 m)	Co-channel	41 (50,90)	34	15	14	40 (50,10)	25	59
		1 st adjacent channel	41 (50,90)	34	-22	14	77 (50,10)	3	37
	LP (e.r.p.=150 W, EHAAT=30 m)	Co-channel	41 (50,90)	18	15	14	40 (50,10)	25	43
		1 st adjacent channel	41 (50,90)	18	-22	14	77 (50,10)	3	21
NTSC ⁷	Class C (e.r.p.=1 MW, EHAAT=300 m)	Co-channel	64 (50,50)	70	34	16	46 (50,10)	17	87
		1 st adjacent channel	64 (50,50)	70	-14	16	94 (50,10)	2	72
	Class B (e.r.p.=100 kW, EHAAT=150 m)	Co-channel	64 (50,50)	45	34	16	46 (50,10)	17	62
		1 st adjacent channel	64 (50,50)	45	-14	16	94 (50,10)	2	47
	Class A (e.r.p.=10 kW, EHAAT=100 m)	Co-channel	64 (50,50)	25	34	16	46 (50,10)	17	42
		1 st adjacent channel	64 (50,50)	25	-14	16	94 (50,10)	2	27
	LP (e.r.p.=5 kW, EHAAT=30 m)	Co-channel	64 (50,50)	12	34	16	46 (50,10)	17	29
		1 st adjacent channel	64 (50,50)	12	-14	16	94 (50,10)	2	14

⁶ Regular class includes Classes C, VL and VU.

⁷ The NTSC parameters are for information only. In the majority of cases, the NTSC channel of a TV station will be used for DTV in post-transition. Since the separation distance is larger for DTV stations than for NTSC stations, the separation distance for DTV should be used in most cases.

Table A.2: Broadcast Protection Criteria and Calculation of Separation Distance Between NTSC Broadcasting Stations and RRBS Base Stations Operating in the Taboo Channels

It is assumed that the proposed RRBS base station operates at the maximum permissible power:
 e.r.p.=305 W (e.i.r.p.=500 W), HAAT=30 m

Case		Desired (dB μ V/m) (% Location, % Time)	Broadcast Protected Contour (km)	C/I (dB)	F/B (dB)	Undesired (dB μ V/m) (% Location, % Time)	Distance to the Protected Contour (km)	Distance Between Broadcasting Stn and RRBS Base Stn (km)	
NTSC	Class C (e.r.p.=1 MW, EHAAT=300 m)	N \pm 2 channels	64 (50,50)	70	-24	16	104 (50,10)	\approx 2	72
		N \pm 3 channels	64 (50,50)	70	-30	16	110 (50,10)	\approx 2	72
		N \pm 4 channels	64 (50,50)	70	-25	16	105 (50,10)	\approx 2	72
		N \pm 7 channels	64 (50,50)	70	-35	16	115 (50,10)	\approx 2	72
		N \pm 8 channels	64 (50,50)	70	-32	16	112 (50,10)	\approx 2	72
		N-14 channel	64 (50,50)	70	-33	16	113 (50,10)	\approx 2	72
		N-15 channel	64 (50,50)	70	-31	16	111 (50,10)	\approx 2	72
	Class B (e.r.p.=100 kW, EHAAT=150 m)	N \pm 2, 3, 4, 7, 8; and N-14, 15 channels	Same as Class C	45	Same as Class C	Same as Class C	Same as Class C	\approx 2	47
	Class A (e.r.p.=10 kW, EHAAT=100 m)	N \pm 2, 3, 4, 7, 8; and N-14, 15 channels	Same as Class C	25	Same as Class C	Same as Class C	Same as Class C	\approx 2	27
	LPTV (e.r.p.=5 kW, EHAAT=30 m)	N \pm 2, 3, 4, 7, 8; and N-14, 15 channels	Same as Class C	12	Same as Class C	Same as Class C	Same as Class C	\approx 2	14