HD Radio

Defining the Canadian Technical Framework for HD Radio

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About the author

François Gauthier completed his bachelor's degree in Electrical Engineering at the University of Sherbrooke (Quebec) in 1995. His passion for astronomy, astronautics and music led him to become an engineer in radiofrequency.

From 1995 to 1998, he worked as a research engineer in digital audio broadcasting (DAB) at the Communications Research Center (CRC) in Ottawa. He joined CBC/Radio-Canada in 1998, where he became Director of Broadcast Systems and Frequency Engineering from 2004 to 2007. He worked on frequency studies, RF measurements, audio and video codec research, new digital audio and video IP data broadcasting systems on DAB and DTV, as well as new media research. He presented and participated in numerous conferences and seminars in Canada, USA, England, Tunisia, Poland and at the IBC in Amsterdam. He regularly represented Radio-Canada at the ITU and NABA. He was a vice-president on the RABC (Radio Advisory Board of Canada). In 2007 he worked for Kangaroo Media Inc. as Director of Transmission Engineering where he was responsible for DVB-T transmissions and frequency management for various worldwide events including Formula 1, NFL and PGA.

His career as a consultant began in 2007, when he founded Spectrum Expert Inc. and worked as the Chief Executive Officer of the company, until 2013. The same year, looking to take on new challenges, he launched Octave Communications and is currently the President of the company. His expertise includes frequency coordination, project engineering, Non-Ionising Radiation evaluation and advanced broadcasting systems such as DVB-T2, ATSC 3.0, HD Radio, DAB+, etc.

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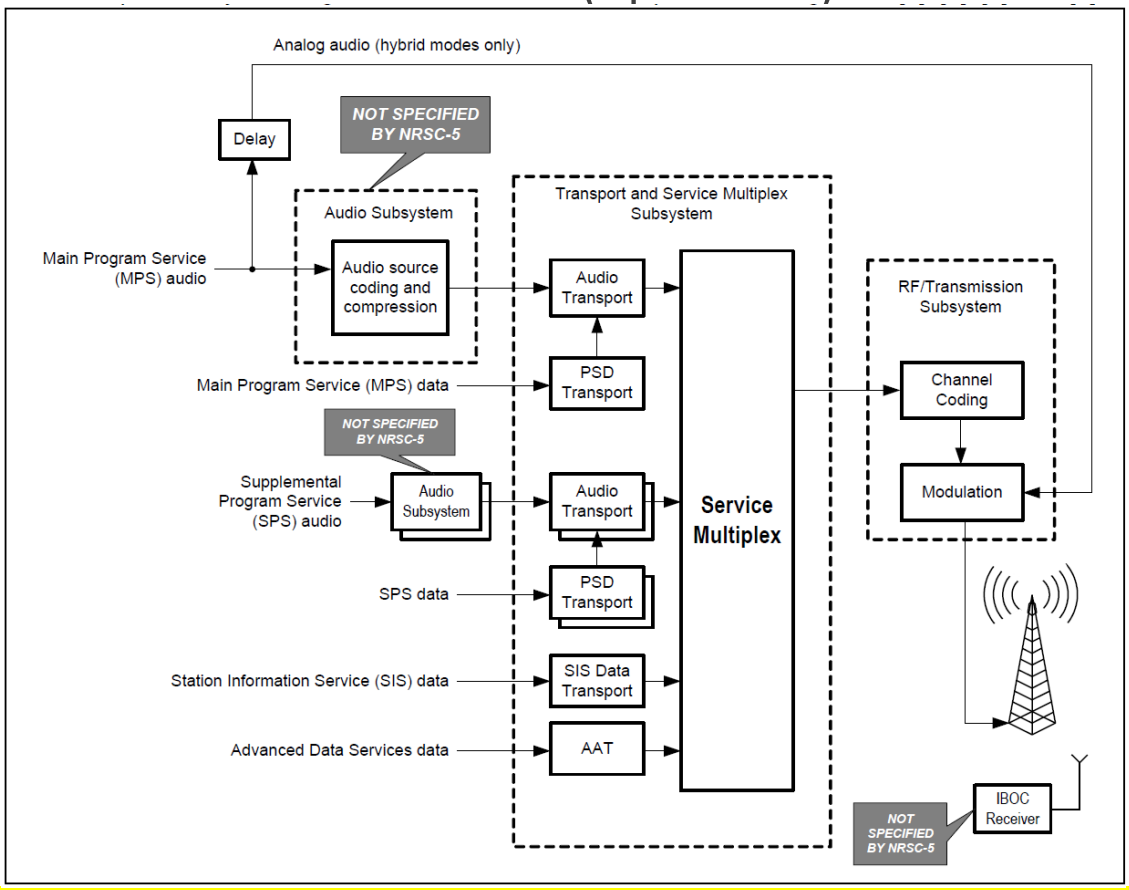
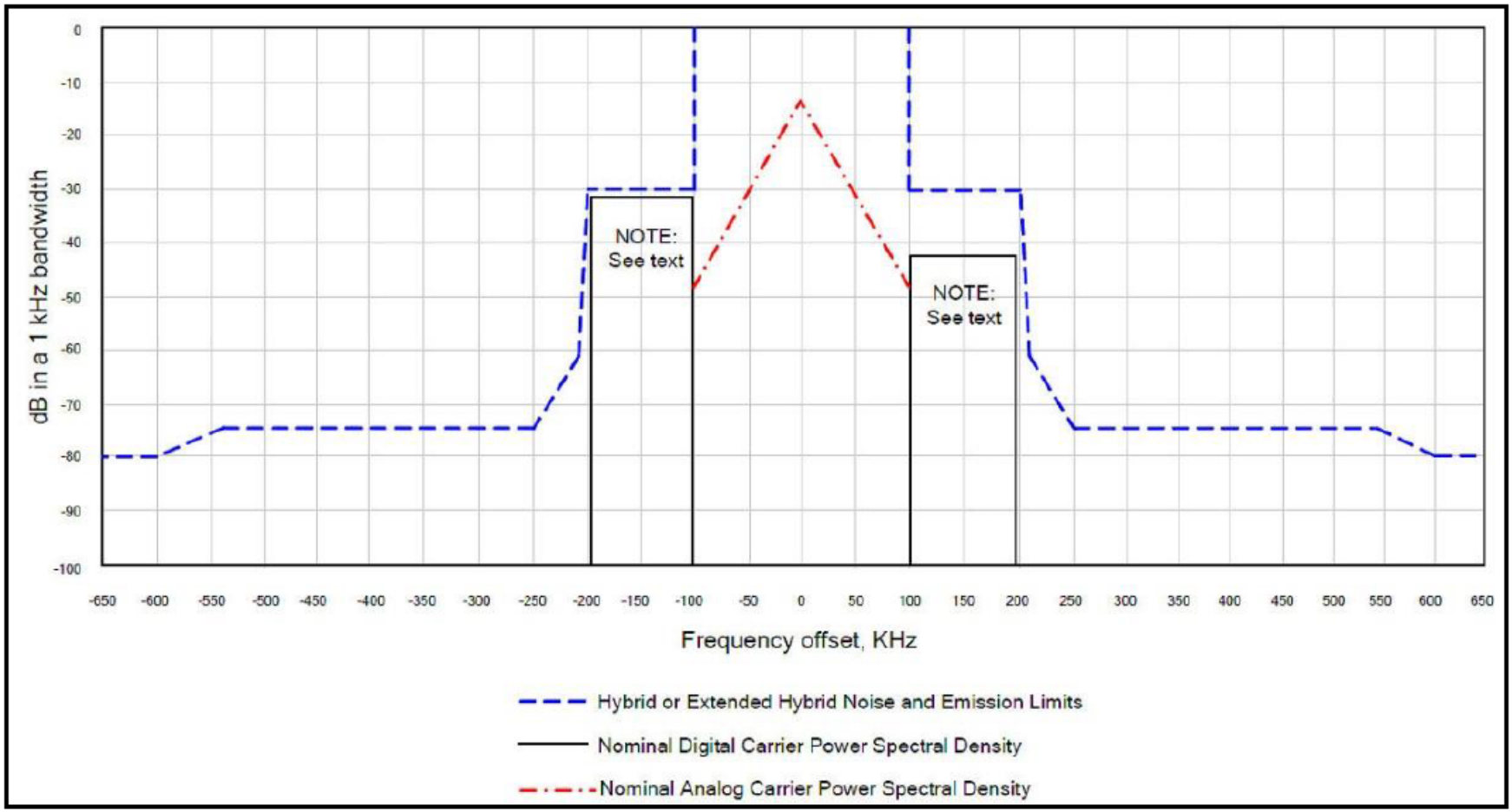
HD Radio Basics

Current standard in force: NRSC-5-D (April 2017)



HD Radio Emission Mask



RABC Radio WG

The RABC (Radio Advisory Board of Canada) had its first meeting on Sept 13th (2017).

Working Group Chair: François Gauthier

Objectives of the committee:

- Review of ISED's Broadcasting Circular – 21
- Monitor US activities
- Gather information on HD Radio deployment and testing
- Definition of "Canadian made" HD Radio tests
- Advise ISED / CRTC on HD Radio deployment in Canada

ISED BC-21

Current version: Issue 1 (August 2008)

Basic coordination requirements:

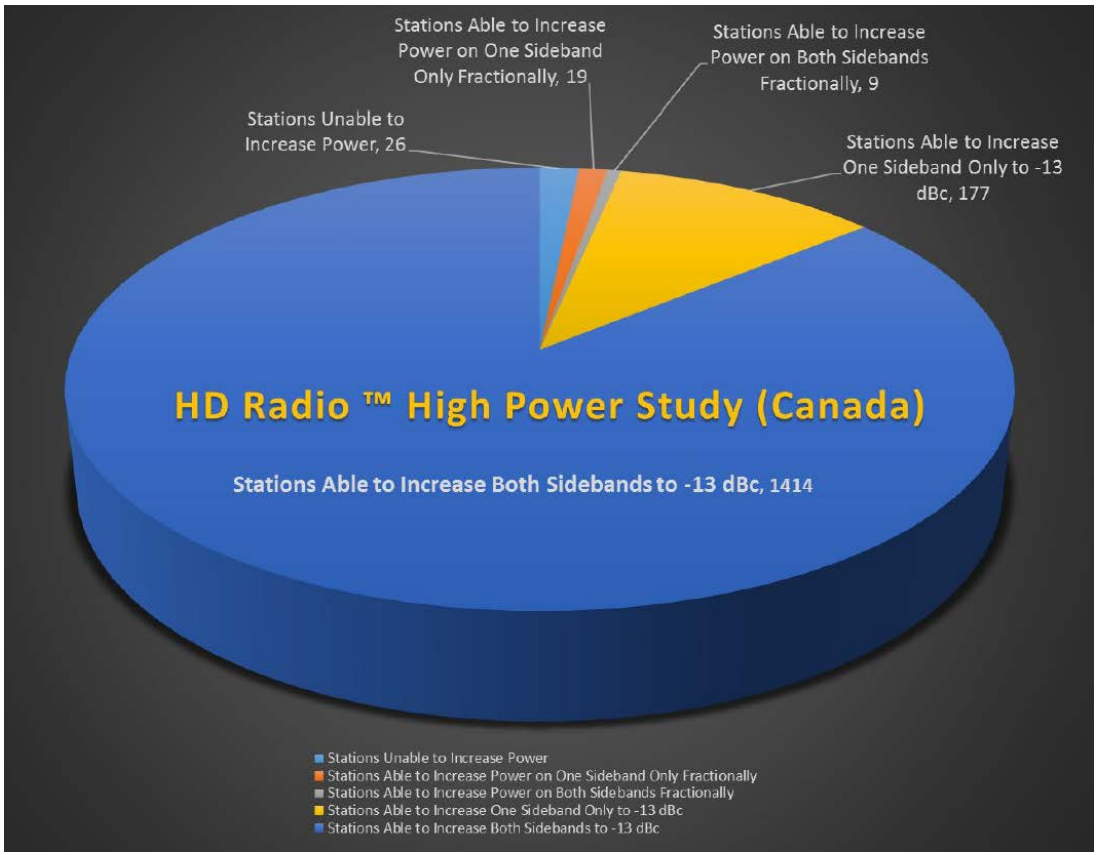
- For MP1 operation, the total power of each sideband must be 23 dB below the unmodulated FM carrier
- For MP4 (now MP11): the total power of each sideband must be 21.6 dB below the unmodulated FM carrier
- No provision for higher power or asymmetrical: the on air tests must demonstrate that no harmful interference is created.

Technical Requirements for Experimental Authorization:

- HD Radio must follow NRSC-5 standards
- HD Radio broadcasting must demonstrate that no harmful interference will occur to the surrounding broadcasters
  - But, no standard test definition exists

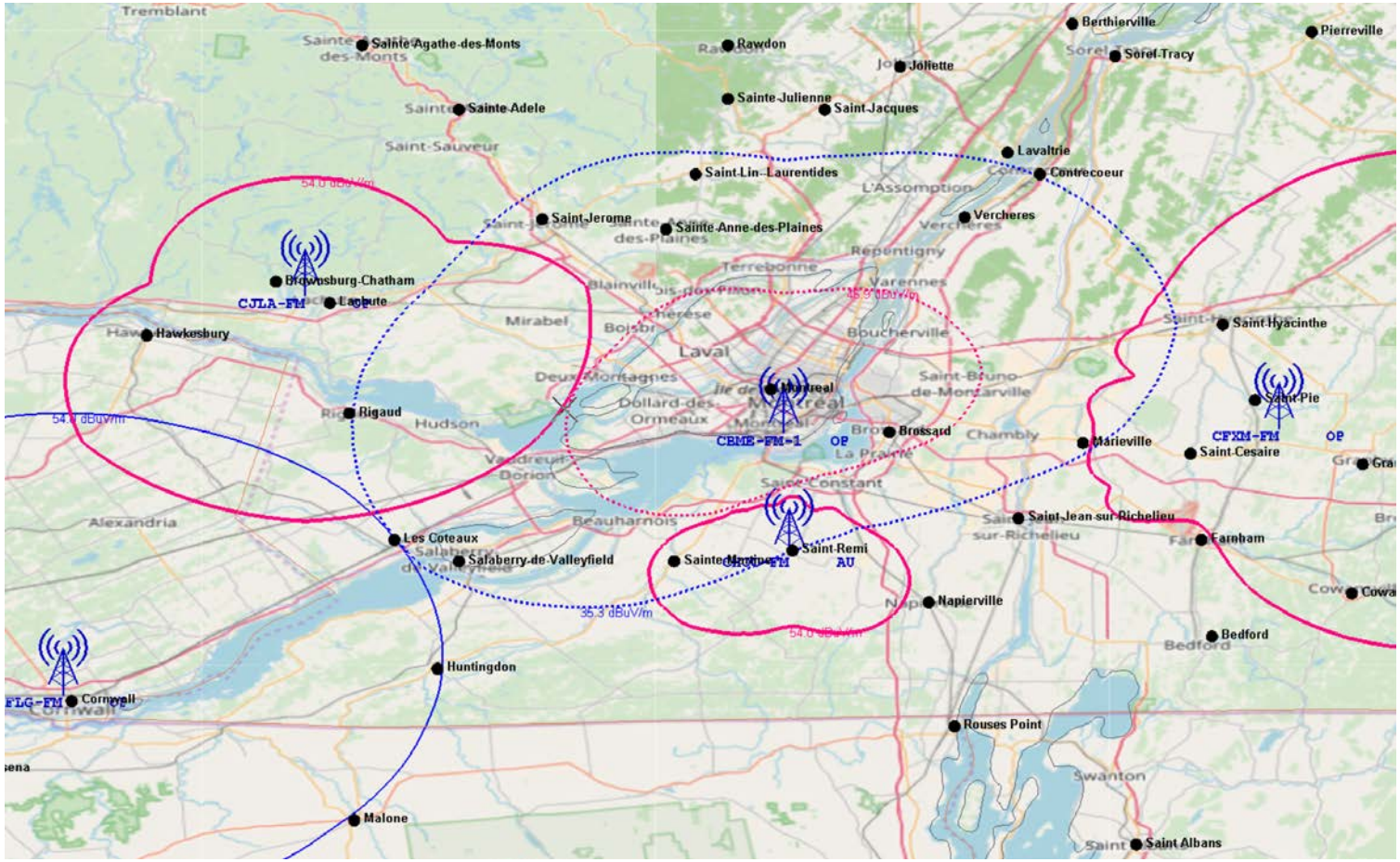
Finally, CRTC must be notified of HD Radio operation

Coexistance with Analog FM ?



HD Radio (XPERI) have identified that Canadian stations could operate as per the following sideband levels

Example of a sideband coordination



Legend:
Blue: lower adjacent
Pink: upper adjacent

Protected: F(50,50)
Interfering: F(50,10)

Sideband Analysis (?)

How to calculate the side band:

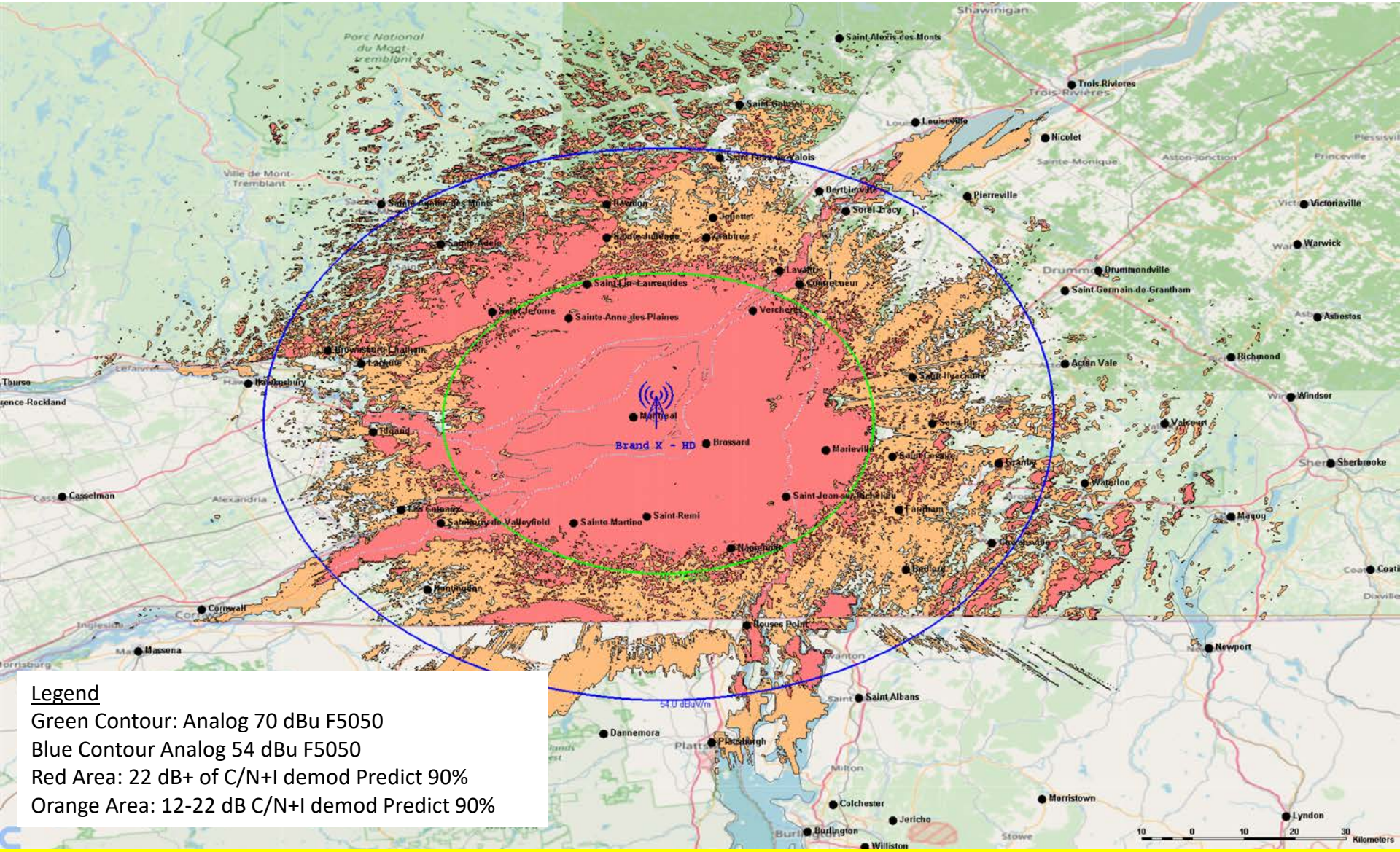
1) Based on first-adjacent rules
   - Lower adjacent maximum permissible contour: 35.3 dBu, which translate to:
     - 54 dBu (protected contour) - 6 D/U - 35.3 dBu = 12.7 dBc (negative) maximum lower sideband
   - Upper adjacent maximum contour: 46.9 dBu, which translate to:
     - 54 dBu – 6 D/U - 46.9 dBu = 1.1 dBc maximum lower sideband

2) Based on co-channel rules
   - Lower adjacent maximum permissible contour: 35.3 dBu, which translate to:
     - 54 dBu (protected contour) - 20 D/U - 35.3 dBu = -1.3 dBc maximum lower sideband
   - Upper adjacent maximum contour: 46.9 dBu, which translate to:
     - 54 dBu - 20 D/U - 46.9 dBu = -12.9 dBc maximum lower sideband

Coordination Questions ?

- Does F(50,10) is sufficient for interfering contour or does F(10,10) should be considered ?
- Can we relax de 20 dB D/U coordination since half of the energy is not interfering the analog modulation ?
- Should we use 6 dB of D/U ? Or something different ?
- Can we consider Longley-Rice population estimation interference ?
- Does LPFM should be protected ?
- Does HD Radio can have a protected status vs LPFM ? vs regular station new comers ?
- What are the D/U for co-channel or 1st adjacent HD Radio to HD Radio coordination ?

HD Radio Coverage



Legend
Green Contour: Analog 70 dBu F5050
Blue Contour Analog 54 dBu F5050
Red Area: 22 dB+ of C/N+I demod Predict 90%
Orange Area: 12-22 dB C/N+I demod Predict 90%

Questions on HD Coverage

Local service availability ? (90,90), (95,95), etc.

Required C/N+I: for which mode ? MP1, MP11, depending on FEC ?

Model losses for indoor reception ? 10 dB ? More ?

Interference from other stations:

- Analog co-channels or first adjacent
- Digital co-channels or first adjacent

Intra-HD Radio interference:

- Interference on Analog host ?
- Using different broadcasting antennas ?

Using HD Radio repeaters:

- All digital or hybrid ?
- Impact on analog service ?

Analysing HD Radio Coverage

Data Aquisition

Data Logger +
Real Time Analysis

Post Processing Analysis

HD Radio Coverage Analysis

Many parameters are available for analysis, such as:

- Basic signals: HD Signal Lock, HD CDNR, HD DAAI
- Analog to digital power ratio
- Upper to Lower Sideband Ratio
- Bit Error Rate

The tested parameters can be compared with analog parameters, such as:

- Analog RF Level
- Stereo Indicator
- RDS bit error rate

HD Radio Performance Testing

The RABC would like to see ISED / CRC to study the performance of HD Radio. The testing objectives (not yet defined), could include the following:

- HD Radio interference level to a set of analog FM receivers (5 types, a least 3-4 receivers per type) and evaluate the audio degradation
- Testing can be made for upper adjacent, lower adjacent, co-channel or “sandwich” situation (where the analog is in between 2 HD Radio)
- Testing of HD Radio performance degradation from analog FM stations (co-channel, first-adjacent, second ?). If possible, 5 receivers type should be tested (but in the HD Radio case, it would be important to identify the different chipset manufacturer)
- Testing of HD Radio performance degradation from HD Radio interferer

Next Steps

RABC Committee will proposed basic contours calculation for the evaluation of the maximum permissible sideband power. These proposal should ensure:

- Adequate protection to surrounding first adjacent analog FM stations
- Harmonization with USA deployment: this will ensure conformity in the HD Radio experience across border.

RABC will propose a standard test methodology to evaluate the potential impact of HD Radio on surrounding first adjacent analog FM stations

Convince ISED/CRC/CRTC to commission HD Radio testing.

Continue monitoring the activities in the USA

Live Demo !

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