



Railway Association
of Canada

Association des chemins
de fer du Canada

99 Bank Street, Suite 901, Ottawa, ON Canada K1P 6B9
T 613 567 8591 F 613 567 6726 www.railcan.ca

99 rue Bank, bureau 901, Ottawa, ON Canada K1P 6B9
T 613 567 8591 TÉLÉC 613 567 6726 www.railcan.ca/fr

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**Q & As on the Conversion of Railway Radio Communication to
Narrowband Technology**



Introduction

In the past three decades, the use and demand for telecommunications in North America has experienced unprecedented growth. Because of this growth, wireless communication has faced some physical limitations. There are an absolute number of frequencies physically available in the radio spectrum.

Government regulatory bodies managing the use of the wireless spectrum are faced with burgeoning demand for radio frequencies from various users. Industry Canada and the US Federal Communications Commission (FCC) approved a rule making the conversion to narrowband mandatory for certain portions of the radio spectrum. This conversion is essentially a process of splitting each traditional wideband channel into two or more narrowband channels, as technology now allows voice to be carried on “narrower” channels without degradation.

In the US, radio suppliers are forbidden to manufacture wideband only equipment since January 1st, 2011. The railway radio networks were converted to narrowband as per January 1st, 2013.

In Canada, narrow banding of the railway’s VHF band is not mandatory (for now). However, it is in our industry’s best interest to convert to a narrow band channel plan in a timely manner in order to:

- Address spectrum shortage in urban areas
- Harmonize with the U.S.
- Avoid a WB radio equipment shortage and,
- Allow a smooth migration to more spectrum efficient technologies

As the entity responsible for managing the railway radio spectrum in Canada, the RAC firmly believes that the conversion from wideband to narrow and very narrow band technologies is a necessary exercise towards efficient spectrum management in the railway band.

Although not every Canadian railway will need to convert to narrowband in the short or medium term, the RAC considers that it is the responsibility for each passenger, short line, commuter and class 1 railway to ensure interoperability of their communication system with those of their commercial partners. Interoperability is at the core of railroad safety according to Transport Canada requirements.

The following Q&A is designed to address general concerns about the transition to narrowband. More specific or technical questions should be directed to:

Daniel Lafrenière
Director, Spectrum and Telecommunications
The Railway Association of Canada
99 Bank Street, Suite 901
Ottawa, ON K1P 6B9

Tel : (613) 564.8102
Cell.: (613) 296.0858
Fax: (613) 567.6726
E-mail: dlafreniere@railcan.ca
Web: www.railcan.ca



1. What is radio spectrum?

Radio spectrum consist of electromagnetic frequencies used for communications; it includes frequencies used for radio, radar, cellular phones and television. The railway VHF Spectrum consists of 1.41 MHz of spectrum between 160.1700 and 161.5800 MHz. The federal government regulates the use of the radio spectrum while the Railway Association of Canada (RAC) manages its utilization.

2. What is a radio channel?

A radio channel is the bandwidth allocated in the radio spectrum to transmit one voice channel. Currently, a radio channel is 30 or 25 kHz wide. Railway radio spectrum in the 160 MHz is currently divided into 30 KHz wide channels.

3. What are Narrowband (NB) and Very Narrowband (VNB) technologies?

Narrowband technology allows the reduction by half of the bandwidth allocated to a radio channel, from 25 or 30 kHz to 12.5 KHz, using the same analog FM modulation technique.

VNB is a technology that allows for an even more efficient use of spectrum by reducing the size of a voice channel to 6.25 kHz, using digital modulation techniques such as NXDN, the standard adopted by both the AAR and RAC.

4. Why reducing the bandwidth allocated to a radio channel?

Technology now allows voice to be carried on narrower channels. In the case of railways, the conversions to NB and VNB transmission will potentially double the number of channels available within the same amount of radio spectrum. Note that a similar exercise was performed in 1960, when radio channels went from 60 to 30 kHz.

5. Are Canadian railways required by law to switch to NB?

The federal government does not mandate NB for Canadian railways - yet. However, the RAC is responsible for the efficient use of its radio spectrum and the conversion to NB to replace a 50 year old technology is an expected and normal step toward efficiency and this is why the RAC strongly recommends that its members adopt narrow band technology in a timely matter.

6. How about the U.S.?

NB is mandatory in the U.S.; most radio spectrum users south of the border below 512 MHz, including railways, switched to NB operations on January 1st, 2013.



7. If it's not mandatory in Canada, why would I have to spend money and switch to NB?

There are 3 cases where conversion to NB in the short to mid-term is necessary:

- If you interchange with U.S. railways, you will need to be interoperable with your partners and therefore convert your system to NB.
- Both Canadian Class 1 railways will eventually convert to NB; if you need to do business with them, you will also need to convert.
- Finally, if you operate in the Vancouver, Montreal, Southern Ontario or the Winnipeg area, you might be asked to switch to NB or VNB by the RAC to address spectrum shortage and interference problems and to be compliant with the new AAR/RAC frequency plan.

In addition, there are other incentives to switch to NB:

- There will be an equipment shortage: Equipment manufacturers in the U.S, stopped manufacturing wide band (WB) equipment since January 1st, 2011;
- Availability of radio channels shortages and interference problems in urban areas: more channels will mean less crowded, more secure radio channels

8. I deal a lot with the U.S. railways. When do I need to be NB compatible?

If you go to the U.S., then your locomotive radio, by law, are required to be NB compliant. If U.S. locomotives travel on your lines, it is strongly suggested that your network operates on NB channels: although a NB transmission (12.5 KHz) can be decoded by a WB receiver (30 KHz) and vice versa, the quality of communications can be degraded to the point of becoming being unsafe. As it was the case in the US during the transition period, NB-WB-NB communications should only be used as a temporary solution.

9. I deal regularly with the class 1 railways. When do I need to be NB compatible?

Class 1 railways will convert to narrow band over the next few years. If you need to operate on Class 1 owned railways in Canada, check with them to know when the trunk will be converted to NB communications. Class 1 railways were asked to provide as much notice as possible to their short line and passenger partners before converting to narrow band and to provide a quarterly status report reflecting the progress of their conversion.

10. I operate in a “congested area” (Vancouver, Montreal, Southern Ontario or Winnipeg). When do I need to be NB compatible?

In order to comply with the new frequency plan, you may eventually be asked by the RAC, within a reasonable timeframe, to convert your system to NB or VNB.



11. Does that mean that if I don't meet the above condition, I don't need to switch to NB?

Base and mobile stations that are located in non-congested centers and are involved in domestic operations only (i.e. mainly short-lines), are not required to convert to NB channels in the immediate future. However, since wide-band equipment will not be distributed after January 1st, 2011, it is strongly recommended that railways replace their radios with NB or dual-band radios as the equipment wears out: wideband only equipment will become harder to source and support. They might also need to switch frequencies in order to accommodate the new frequency plan developed by the AAR and the RAC.

12. Are NB, VNB and WB radios compatible?

- A NB transmission can be decoded by a WB receiver and vice versa if they are both using analog FM modulation, which is the standard in the railway industry. However, the quality of communications can be affected to the point that it becomes unsafe for railway operations. NB and wideband equipment should only coexist on a temporary basis to allow for a full transition.
- On the other hand, VNB transmissions using the railway approved NXDN technology is NOT compatible with narrow or wideband analog FM modulation.

Note that many radios have multi bandwidth, multi-mode capabilities.

13. So I have to buy new radios to operate NB?

It depends. Most radios purchased in the last 10-15 years are already NB capable. They only need to be re-tuned. Most locomotive radios are not, however; they will eventually need to be replaced. Note that NB equipment is currently deployed and easily available on the market.

14. Overall, what are the cost elements associated with the conversion to NB?

- The purchase of new radio equipment.
- The labor for installing this equipment.
- The labor for re-tuning existing ancillary equipment such as filters, duplexers, antennas (if applicable).

You may also take advantage and replace some older cables and antennas with more performing equipment while on site. Interference analysis, frequency selection and licensing are parts of RAC's responsibilities and will not be subject of additional fees to its members.



15. Will narrow banding reduce my coverage or the quality of my communications?

Empirical coverage studies demonstrated that, depending on the topography of the terrain and other factors, NB and VNB transmissions might slightly affect coverage, positively or negatively vs WB transmissions. However, the replacement of old, less sensitive equipment and corroded cables and antennas might actually improve your radio coverage.

16. Will this affect annual radio license fees paid by the RAC to Industry Canada?

No. License fees will not be affected.

17. How will the transition occur?

The initiative will be driven by class1 railways. They are the ones who will define the agenda, as per their resources. Shortlines, passenger carriers, commuter and tourist railways operating on their roads will naturally be next. As mentioned previously, Class 1 railways are asked to provide as much notice as possible to their short line and passenger partners before converting to narrow band.

Stand alones railways will need to convert to NB or VNB as their equipment wears out or, if they operate in a congested area, as required by the RAC.