

Metrolinx VHF Radio System Overview

Metrolinx Radio Systems

METROLINX VHF NXDN RADIO SYSTEM

VHF Radio System Overview

- ❖ Conventional VHF Radio System for RTC voice radio communications
 - All new GO channels are digital NXDN 6.25 kHz very narrowband
 - RAN code is set to “None” to simplify configuration of the train radios
 - Two simplex radio channels are implemented in each subdivision:
 - Standby channels** - odd numbered (GO1...GO17) default channels used for radio communications in the rail corridors
 - RTC channels** - even numbered (GO2...GO20) channels dedicated for radio communications with RTC dispatchers
 - DTMF channel** - GO19 will be used by for DTMF control of gates from train radios in all GO rail corridors
- Legacy analog radio channels are available for communications in CN and CP subdivisions
 - CN1 channel** is installed at the radio sites that are close to the subdivisions controlled by CN
 - CP78 channel** is installed at the Oakville radio site for RTC to talk to CP trains in the Canpa subdivision

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- Request To Talk (RTT) process will be utilized by radio users in the rail corridors to contact RTC
- RTT will be sent on RTC channel by dialing DTMF code
- DTMF codes that are currently configured in the system are shown in the table

Type Of Call	DTMF Code	Description
Emergency Call	*0#	Same as CN emergency call for consistency purposes
Call RTC	*782#	General call to RTC for any reason
Train Waiting Signal	*1#	Important to draw RTC's attention for possible need to give train a signal to proceed.
WIS talker failure/not working	*3#	Important as train will slow to 35 MPH until reading is relayed by the RTC.
Foreman request for track time	*7#	Helps draw the RTC's attention to need to facilitate track time for engineering.
Foreman cancel track time	*9#	Helps draw RTC's attention to ability to cancel track time to open up track for trains.

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VHF Radio System Overview

❖ RTC Dispatch Centers

- VHF radio system is integrated into the corporate radio network to support communications with RTC dispatchers and recording of these communications
- Oakville - Main RTC with 9 consoles - operational
- Don Yard - Backup RTC with 4 consoles - built, tested and ready for operation
There were 8 consoles built originally. 4 consoles were temporarily moved to Whitby
- Whitby - Interim RTC with 4 consoles - built, tested and ready for operation
When GTCS will be complete and fully functional these 4 consoles will be moved back to Don Yard RTC

METROLINX VHF NXDN RADIO SYSTEM DEPLOYMENT TIMELINE

VHF Radio Tentative Go-Live Date	Metrolinx Corridor	Subdivision	From		To		Channels
July 25 th 2021	Richmond Hill	Bala	Don	Mile 2.1	Glencrest	Mile 16.02	GO3, GO4
	All Metrolinx-Controlled Corridors as they are commissioned* (DTMF)						GO19
Fall 2021 - To Be Confirmed	Kitchener	Guelph	Silver	Mile 30.0	Sturm	Mile 65.1	GO17, GO18
September 25 th 2021	Lakeshore East	Go	Durham Jct.	Mile 0.0	Oshawa North	Mile 11.7	GO7, GO8
		Kingston	Liverpool	Mile 313.14	Cherry St.	Mile 332.4	GO7, GO8
	Stouffville	Uxbridge	Lincolnville	Mile 38.9	Scarborough	Mile 61.0	GO5, GO6
December 4 th 2021	Lakeshore West	Oakville	Bathurst St.	Mile 1.0	Canpa	Mile 8.4	GO13, GO14
		Oakville	Canpa	Mile 8.4	Burlington West	Mile 32.06	GO13, GO20
December 4 th 2021	Barrie	Newmarket	Parkdale	Mile 3.0	Allandale	Mile 62.8	GO1, GO2
	UP Express	Pearson	Terminal 1	Mile 0.0	Wice	Mile 1.8	GO15, GO16
	Kitchener	Weston	Strachan	Mile 1.9	Halwest	Mile 16.8	GO15, GO16
2023	USRC East	USRC East Zone	Union	Mile 0.0 East Zone	Don & Cherry St.	Mile 2.1 Mile 1.7 East Zone	GO9, GO10
2023	USRC West	Galt	Strachan	Mile 1.9	West Toronto	Mile 4.9	GO11, GO12
		USRC West Zone	Union	Mile 0.0 West Zone	Strachan & Fort York	Mile 1.9 Mile 1.0 West Zone	GO11, GO12

METROLINX VHF NXDN RADIO SYSTEM

VHF Radio System Design Challenges

❖ Spectrum Assignment and Coordination

- Metrolinx began consultations with RAC in 2014 and was assigned 3 frequencies for testing
- RAC has assigned a set of 17 frequencies for Metrolinx in 2017
- Metrolinx has conducted extensive study on interference levels at the planned radio sites
- Frequencies with the lowest interference levels were assigned to the radio sites
- RAC frequency allocation tables were used to maximize frequency and geographical separation of the Metrolinx radio sites from others
- At all radio sites with 3 and more frequencies preliminary intermodulation studies were done
- Based on the frequencies assigned to the radio sites, we engaged Sinclair to conduct final intermodulation analysis and design filters
- When all new VHF radio infrastructure was installed we started operational testing in 2020
- That was an iterative and laborious process that took about 3 years
- In June 2020 we discovered interference problems with CN and CP radio systems.

METROLINX VHF NXDN RADIO SYSTEM

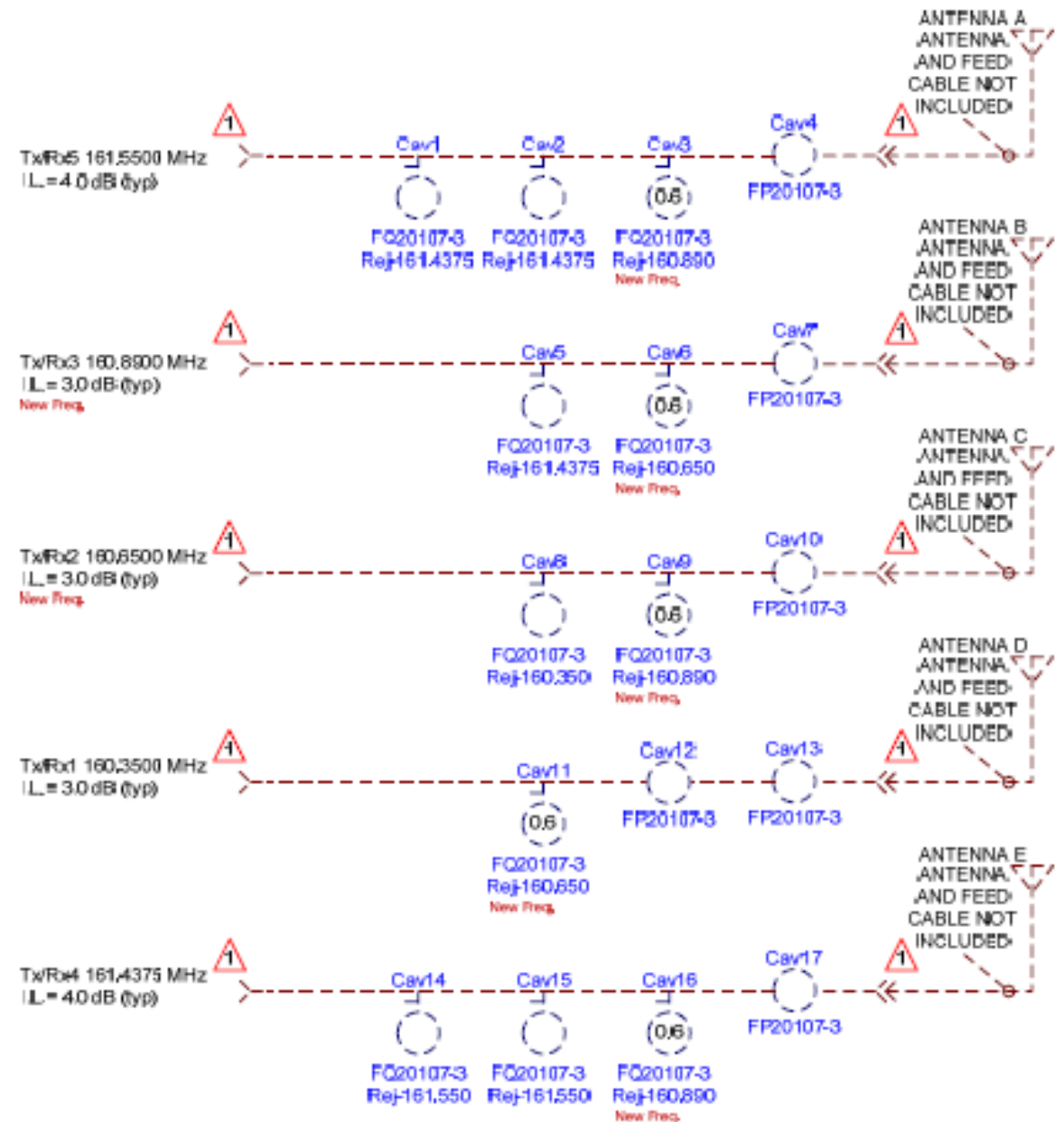
VHF Radio System Design Challenges

❖ Spectrum Assignment and Coordination

- About half of the frequencies were assigned to CN and Metrolinx radio sites
- July 2020 - we modified frequency plan and resubmitted to RAC
- August 2020 - coordinated the frequency plan with AAR and RAC
- August - September 2020 - measured interference level on the new channels at all sites
- Discovered a few more interference problems with CN and CP radio systems
- We have modified frequency plan again and resubmitted to RAC
- To ensure interference free operation we conducted additional field tests with CN and CP in October 2020
- After that we have tuned all radio transceivers to the final frequencies and turned on transmissions for a few weeks to confirm that we are not causing interference problems
- Finally, we have completed retuning of most of the VHF filters and operational tests by April 2021

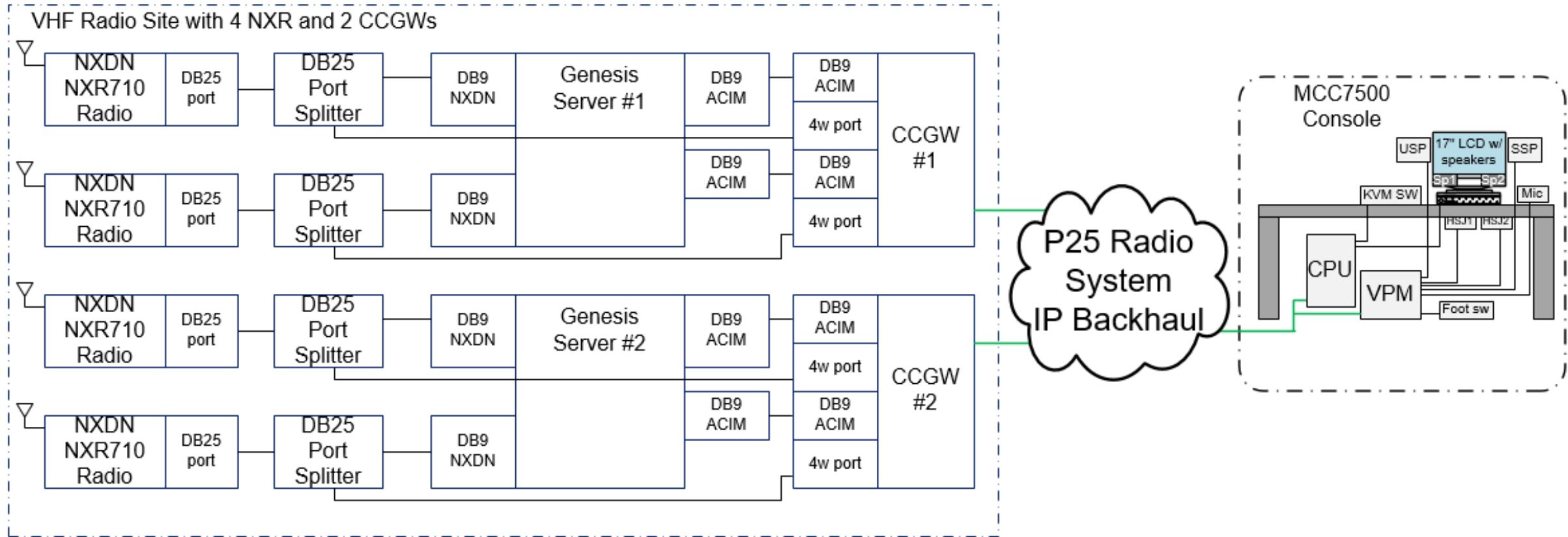
METROLINX VHF NXDN RADIO SYSTEM

Willowbrook VHF Radio Site



METROLINX VHF NXDN RADIO SYSTEM

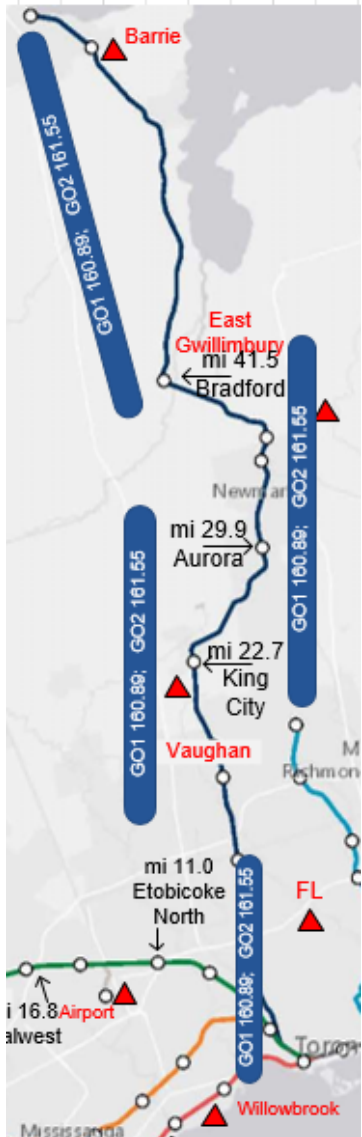
VHF Radio Site Diagram



METROLINX VHF RADIO SYSTEM MAP



METROLINX VHF NXDN RADIO SYSTEM - Barrie Corridor - Newmarket Sub



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
GO1	160.8900	397-397	Willowbrook	WB	BAR	SBY	MAIN	mi 3.0 USRC - mi 22.7 (King City GO)
GO1	160.8900	397-397	Vaughan	VN	BAR	SBY	BKP	mi 3.0 USRC - mi 29.9 (Aurora GO)
GO1	160.8900	397-397	East Gwy	EG	BAR	SBY	MAIN	mi 22.7 (King City GO) - mi 62.8 (Allandale GO)
GO1	160.8900	397-397	Barrie	BR	BAR	SBY	BKP	mi 41.5 (Bradford GO) - mi 62.8 (Allandale GO)
GO2	161.5500	485-485	Willowbrook	WB	BAR	RTC	MAIN	mi 3.0 USRC - mi 22.7 (King City GO)
GO2	161.5500	485-485	Vaughan	VN	BAR	RTC	BKP	mi 3.0 USRC - mi 29.9 (Aurora GO)
GO2	161.5500	485-485	East Gwy	EG	BAR	RTC	MAIN	mi 22.7 (King City GO) - mi 62.8 (Allandale GO)
GO2	161.5500	485-485	Barrie	BR	BAR	RTC	BKP	mi 41.5 (Bradford GO) - mi 62.8 (Allandale GO)

- ❑ Two main radio sites cover Barrie Corridor with switching at King City GO Station
 - Willowbrook site covers mi 3.0 USRC - mi 22.7 (King City GO) and shall be used South of King City GO
 - East Gwillimbury site covers mi 22.7 (King City GO) - mi 62.8 (Allandale GO) and shall be used North of King City GO
 - In case of Willowbrook site failure Vaughan site will provide degraded coverage
 - In case of East Gwillimbury site failure Barrie site will provide degraded coverage

METROLINX VHF NXDN RADIO SYSTEM - Richmond Hill Corridor - Bala Sub



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
CN1	161.4150	87-87	Forest Lwy	FL	BAR, RHL	SBY	MAIN	Barrie mi 10-16, Bala sub mi 16-22
GO3	160.3800	329-329	Forest Lwy	FL	RHL	SBY	MAIN	mi 2.0 (Don) - mi 27.3 (Richmond Hill Layover)
GO4	160.7400	377-377	Forest Lwy	FL	RHL	RTC	MAIN	mi 2.0 (Don) - mi 27.3 (Richmond Hill Layover)

- ❑ One main radio site covers Richmond Hill Corridor
 - Forest Laneway site covers mi 2.0 (Don) - mi 27.3 (Richmond Hill Layover)
- In case of site failure, degraded coverage from adjacent corridors (Barrie and Stouffville) should be considered

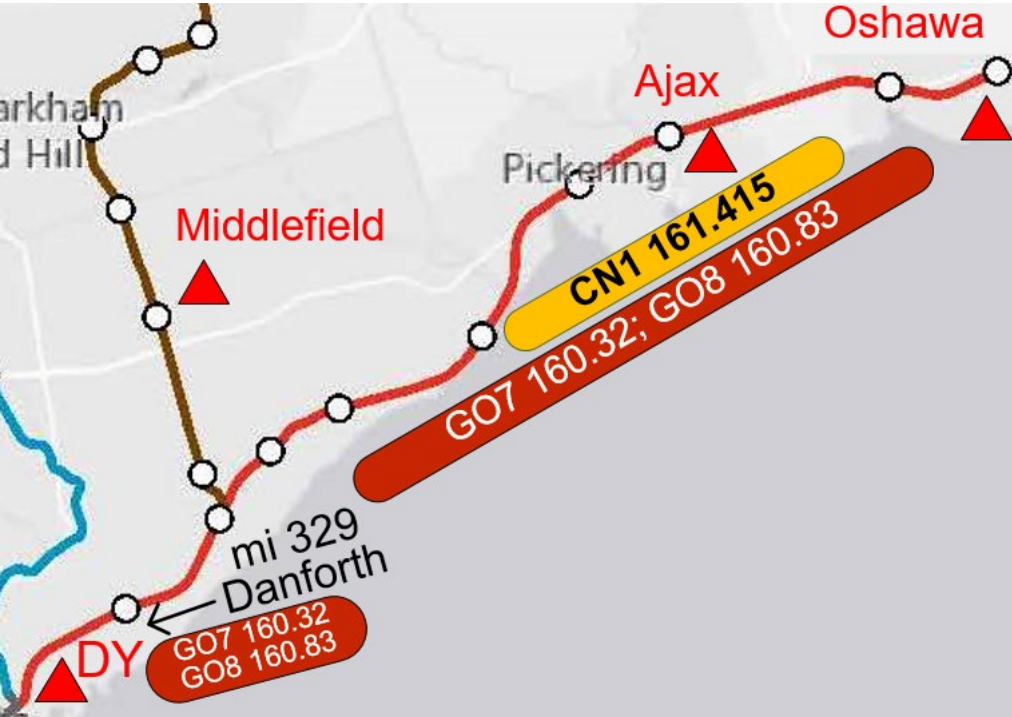
METROLINX VHF NXDN RADIO SYSTEM - Stouffville Corridor - Uxbridge Sub



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
GO5	160.4400	337-337	Uxbridge	UX	STO	SBY	MAIN	USRC - mi 39.0 (Lincolnville Layover)
GO5	160.4400	337-337	Middlefield	MD	STO	SBY	BKP	mi 329.1 Danforth GO - mi 40.7 Stouffville GO
GO6	160.9200	401-401	Uxbridge	UX	STO	RTC	MAIN	USRC - mi 39.0 (Lincolnville Layover)
GO6	160.9200	401-401	Middlefield	MD	STO	RTC	BKP	mi 329.1 Danforth GO - mi 40.7 Stouffville GO

- ❑ Two radio sites cover Stouffville Corridor
 - Uxbridge site is recommended as main site, it covers full corridor from USRC to mi 39.0 (Lincolnville Layover)
 - Middlefield site covers mi 329.1 (Danforth GO) - mi 40.7 (Stouffville GO)
In case of Uxbridge site failure Middlefield site will provide coverage within corridor with degraded performance between mi 40.7 (Stouffville GO) and mi 39.0 (Lincolnville Layover)

METROLINX VHF NXDN RADIO SYSTEM - Lakeshore East Corridor - Kingston / GO Sub



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
CN1	161.4150	87-87	Ajax	AX	LSE	SBY	MAIN	CN Kingston Sub West of mi 313 (Liverpool)
GO7	160.3200	321-321	Don Yard	DY	LSE	SBY	MAIN	USRC - mi 328.6 (Danforth GO)
GO7	160.3200	321-321	Ajax	AX	LSE	SBY	MAIN	mi 328.6 (Danforth GO) - mi 302.2 (Oshawa GO)
GO7	160.3200	321-321	Oshawa	OS	LSE	SBY	BKP	USRC - mi 302.2 (Oshawa GO)
GO8	160.8300	389-389	Don Yard	DY	LSE	RTC	MAIN	USRC - mi 328.6 (Danforth GO)
GO8	160.8300	389-389	Ajax	AX	LSE	RTC	MAIN	mi 328.6 (Danforth GO) - mi 302.2 (Oshawa GO)
GO8	160.8300	389-389	Oshawa	OS	LSE	RTC	BKP	USRC - mi 302.2 (Oshawa GO)

- ❑ Two main radio sites cover LSE Corridor with switching at Danforth GO Station
 - Don Yard site covers from USRC to mi 328.6 (Danforth GO) and shall be used West of Danforth GO
 - Ajax site covers mi 328.6 (Danforth GO) - mi 302.2 (Oshawa GO) and shall be used East of Danforth GO
 - In case of Don Yard and/or Ajax site failure Oshawa site will provide degraded coverage in the LSE Corridor
 - CN1 channel at the Ajax radio site provides communications in the CN Kingston Sub West of mi 313 (Liverpool)

METROLINX VHF NXDN RADIO SYSTEM - USRC Corridor Interim Operation until 2023



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
CN1	161.4150	87-87	Don Yard	DY	USRC	SBY	MAIN	Interim Strachan mi1.9 - Don Yard m i2.1
USRC	160.2600	10-10	CN Tower	CN	USRC	RTC	MAIN	Interim Strachan mi1.9 - Don Yard m i2.1

- ❑ Two legacy channels will be used in the USRC Corridor for interim operation until 2023
 - CN1 channel will be temporary configured at the Don Yard site
 - USRC channel will continue to be used “as is” at CN Tower. RTT DTMF function is not available
 - In case of failure of one channel, another channel could be used for all radio communications
 - In case of failure of both channels, LSW channels GO13, 14 could be used for radio communications

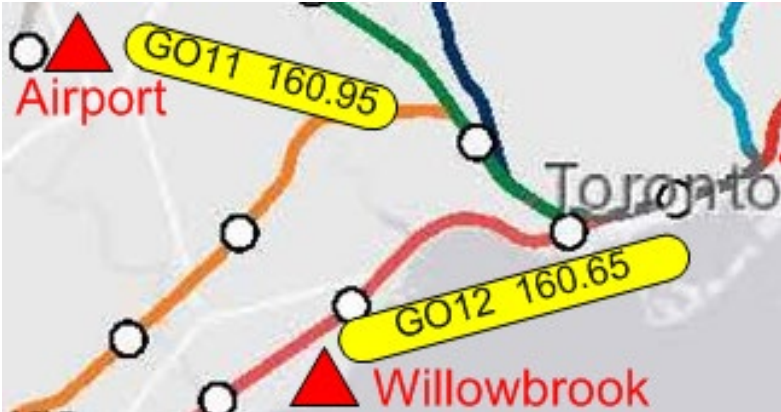
METROLINX VHF NXDN RADIO SYSTEM - USRC East Corridor Future Operation 2023



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
GO9	160.7100	373-373	Don Yard	DY	USRCE	SBY	MAIN	USRC East Union - Don Yard mi2.1
GO10	161.1900	437-437	Don Yard	DY	USRCE	RTC	MAIN	USRC East Union - Don Yard mi2.1

- Don Yard site will cover USRC East Corridor up to Union Station
- In case of Don Yard site failure USRCW channels GO11, 12 could be used for radio communications

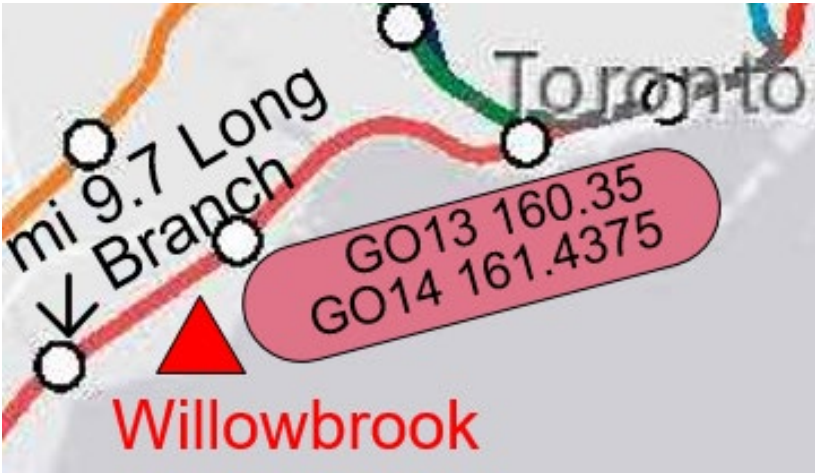
METROLINX VHF NXDN RADIO SYSTEM - USRC West Corridor Future Operation 2023



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
GO11	160.9500	405-405	Airport	AP	USRCW	SBY	MAIN	USRC West Strachan mi1.9 - Union
GO12	160.6500	365-365	Willowbrook	WB	USRCW	RTC	MAIN	USRC West Strachan mi1.9 - Union

- ❑ Two mains radio sites cover USRC West Corridor
 - Airport site provides standby channel GO11
 - Willowbrook site provides RTC channel GO12
 - In case of failure of one or both channels, USRCE channels GO9,10 can be used from Don Yard site
 - Another possibility is using LSW channels GO13, 14 from Willowbrook site

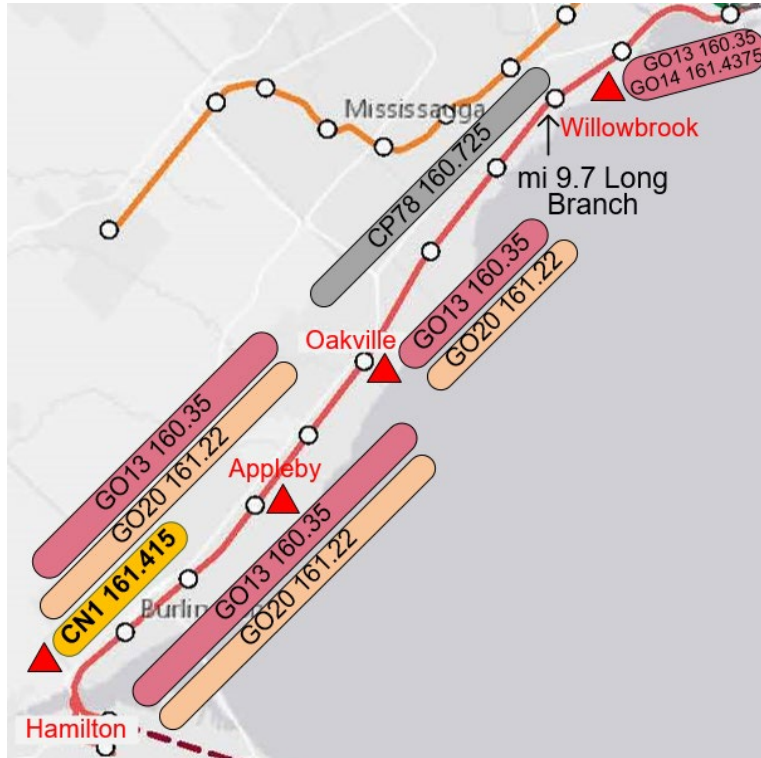
METROLINX VHF NXDN RADIO SYSTEM - Lakeshore West Corridor - Willowbrook, Canpa



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
GO13	160.3500	325-325	Willowbrook	WB	LSW	SBY	MAIN	USRC - mi 27.0 (Appleby GO)
GO14	161.4375	470-470	Willowbrook	WB	LSW	RTC	MAIN	East of Canpa - USRC

- ❑ Willowbrook radio site covers part of Lakeshore West Corridor between Canpa and USRC
 - Willowbrook provides slightly degraded coverage up to Don Yard, possible backup for USRC
 - In case of failure of all USRC channels, channels GO13, 14 from Willowbrook site can be used
 - In case of failure of Willowbrook site, LSW channels GO13, 20 can be used from Oakville site

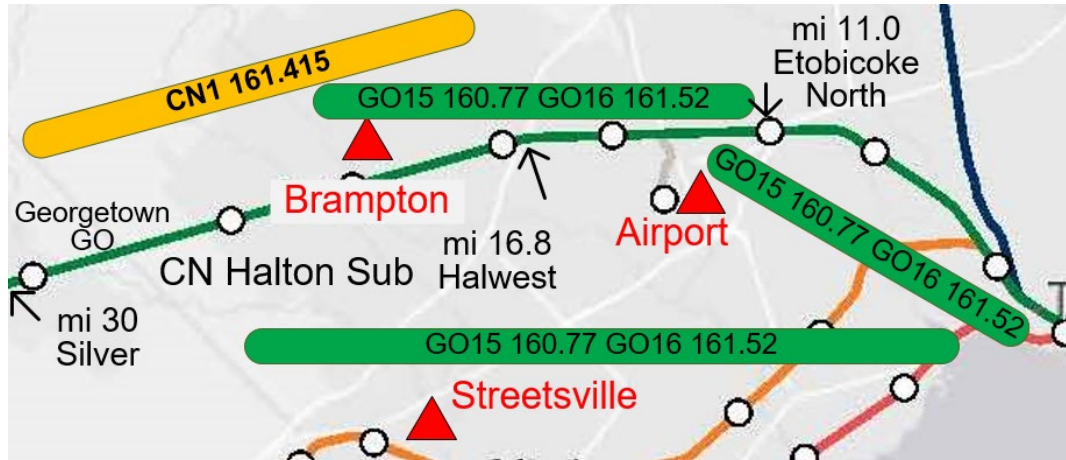
METROLINX VHF NXDN RADIO SYSTEM - Lakeshore West Corridor - Oakville Sub



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
CN1	161.4150	87-87	Hamilton	HT	LSW	SBY	MAIN	Oakville Sub West of mi 32
CP78	160.7250	41-41	Oakville	OV	Canpa	CP	MAIN	Mx RTC to CP trains in Canpa sub
GO13	160.3500	325-325	Willowbrook	WB	LSW	SBY	MAIN	USRC - mi 27.0 (Appleby GO)
GO13	160.3500	325-325	Oakville	OV	LSW	SBY	BKP	USRC - mi 27.0 (Appleby GO)
GO13	160.3500	325-325	Appleby	AB	LSW	SBY	MAIN	mi 9.7 (Long Branch) - mi 39.3 (Hamilton)
GO13	160.3500	325-325	Hamilton	HT	LSW	SBY	BKP	USRC - mi 39.3 (Hamilton GO)
GO14	161.4375	470-470	Willowbrook	WB	LSW	RTC	MAIN	mi 9.7 (Long Branch) - USRC
GO20	161.2200	441-441	Oakville	OV	LSW	RTC	MAIN	mi 5.5 (Gardiner) - mi 27.9 (Appleby GO)
GO20	161.2200	441-441	Appleby	AB	LSW	RTC	MAIN	mi 16.7 (Clarkson GO) - mi 39.3 (Hamilton)
GO20	161.2200	441-441	Hamilton	HT	LSW	RTC	BKP	mi 5.5 (Gardiner) - mi 39.3 (Hamilton)

- On channel GO13 Willowbrook site covers from USRC to Oakville
- On channel GO13 Appleby site covers from Oakville to Hamilton
- On channel GO14 Willowbrook site covers between USRC and mi 9.7 (Long Branch)
- On channel GO20 Oakville site covers between Oakville and Long Branch
- On channel GO20 Appleby site covers from mi 21.4 (Oakville GO) to mi 39.3 (Hamilton GO)
- In case of Willowbrook site failure, Oakville site will provide degraded coverage East of Oakville
- In case of Oakville site failure, Appleby site will provide degraded coverage between Hamilton and Willowbrook
- In case of Appleby site failure Hamilton site will provide degraded coverage between Hamilton and Willowbrook
- Channel CN1 can be used West of mi 32. Channel CP78 is dedicated for CP trains in Canpa Sub.

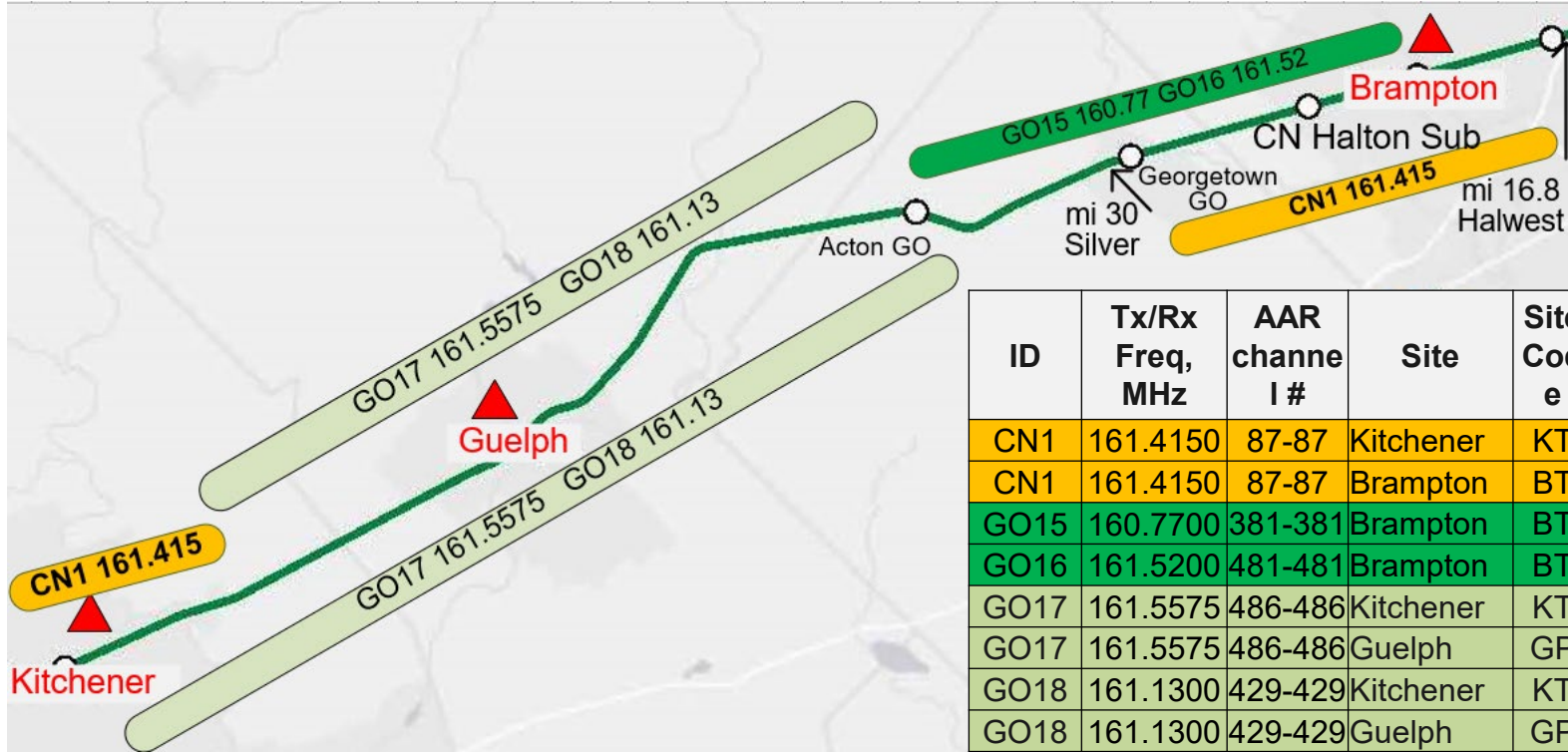
METROLINX VHF NXDN RADIO SYSTEM - Kitchener Corridor - Weston Sub



ID	Tx/Rx Freq, MHz	AAR channel #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
CN1	161.4150	87-87	Brampton	BT	KIT	SBY	MAIN	Halton Sub mi 11.1 to 30
GO15	160.7700	381-381	Airport	AP	UPE, KIT	SBY	MAIN	USRC - mi 15.4 (Brampton GO)
GO15	160.7700	381-381	Brampton	BT	KIT	SBY	MAIN	mi 8.0 (Weston GO) - mi 41.0 (Acton GO)
GO15	160.7700	381-381	Streetsville	SV	KIT	SBY	BKP	USRC - mi 23.5 (Georgetown GO)
GO16	161.5200	481-481	Airport	AP	UPE, KIT	RTC	MAIN	USRC - mi 23.5 (Georgetown GO)
GO16	161.5200	481-481	Brampton	BT	KIT	RTC	MAIN	mi 11.0 (Etobicoke N GO) - mi 41.0 (Acton GO)
GO16	161.5200	481-481	Streetsville	SV	UPE, KIT	RTC	BKP	USRC - mi 30.0 (CN Silver)

- ❑ Two main radio sites cover Weston Sub with switching at Etobicoke North GO Station
 - Airport site covers from USRC to mi 11 Etobicoke North GO Station
 - Brampton site covers West of Etobicoke North GO Station up to Acton GO Station
 - In case of Airport and/or Brampton site failure Streetsville site will provide degraded coverage
 - CN1 channel at the Brampton radio site provides communications in the CN Halton Sub between mi 16.8 (Halwest) and mi 30 (Silver)

METROLINX VHF NXDN RADIO SYSTEM - Kitchener Corridor - Guelph Sub



ID	Tx/Rx Freq, MHz	AAR channel I #	Site	Site Code	Corridor	Chan Use	Site MAIN BKP	Channel operation and service area (coverage limits)
CN1	161.4150	87-87	Kitchener	KT	KIT	SBY	MAIN	Guelph Sub West of mi 65.1
CN1	161.4150	87-87	Brampton	BT	KIT	SBY	MAIN	Halton Sub mi 11.1 to 30
GO15	160.7700	381-381	Brampton	BT	KIT	SBY	MAIN	mi 8.0 (Weston) - mi 41 (Acton GO)
GO16	161.5200	481-481	Brampton	BT	KIT	RTC	MAIN	mi 11.0 Etobicoke - mi 41 (Acton GO)
GO17	161.5575	486-486	Kitchener	KT	KIT	SBY	MAIN	Main site Guelph Sub mi 30-65
GO17	161.5575	486-486	Guelph	GP	KIT	SBY	BKP	Backup site Guelph Sub mi 30-65
GO18	161.1300	429-429	Kitchener	KT	KIT	RTC	MAIN	Main site Guelph Sub mi 30-65
GO18	161.1300	429-429	Guelph	GP	KIT	RTC	BKP	Backup site Guelph Sub mi 30-65

- Brampton site covers West of Etobicoke North GO Station up to Acton GO Station with channels GO15,16
- At Acton GO Station channels GO15,16 from Weston Sub should be switched to the channels GO17,18 Kitchener site
- Kitchener main site covers from Acton GO Station to the Kitchener GO Station with channels GO17,18
- Guelph backup site covers from Acton GO Station to the Kitchener GO Station with channels GO17,18
- In case of Kitchener site failure Guelph site will provide degraded coverage
- CN1 channel at the Kitchener site provides communications West of mi 65 (Strum)

