

DMR Digital Radio

The power of DMR digital radios comes from interconnecting the local base repeater radio via internet to other repeater radios. The Calgary DMR repeater VE6RYC is connected to other repeaters throughout the world through the CAN-TRBO network. Users select a channel with a specific talkgroup on their radios in order to be connected to various groups of repeaters. Talkgroups (TG's) on VE6RYC include:

Local—only the local repeater (TG 2)

Alberta—only repeaters in Alberta (TG 3026)

Canada—repeaters all across Canada (TG 302)

North America—repeaters across Canada and the United States (TG 3)

World Wide—repeaters around the world (TG 1)

Quadnet Array – interconnects repeaters and hotspots on DMR, D-star, Fusion, and Wires-X networks (TG 320)

Users in Alberta can also connect to the repeaters in another province, say BC (TG 3027).

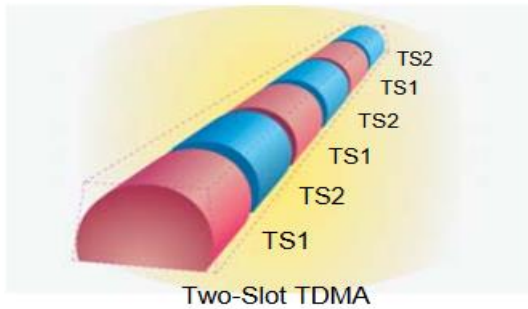
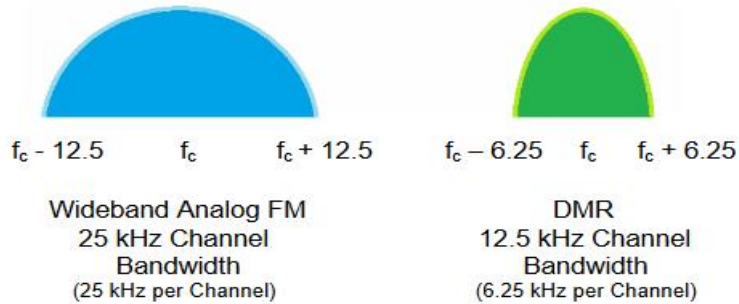
Talkgroups can be static or “user activated”. Static talkgroups are always active on the repeater, while user activated (UA) ones are active only when a user presses PTT. Typically, UA TG's stay active for

10 to 15 minutes. TG 13 World Wide English and TG 320 Quadnet are examples of UA talkgroups on VE6RYC.

DMR users can also talk to each other directly without going through a repeater (simplex).

Another feature of the DMR system is that all radios and repeaters have 2 “timeslots”, 1 and 2. Timeslot 1 is typically used for “wide area” connections while timeslot 2 is used for local and provincial talkgroups. One user can be using the repeater for a local conversation on timeslot 2 at the same time as another user is talking on Canada wide on timeslot 1.

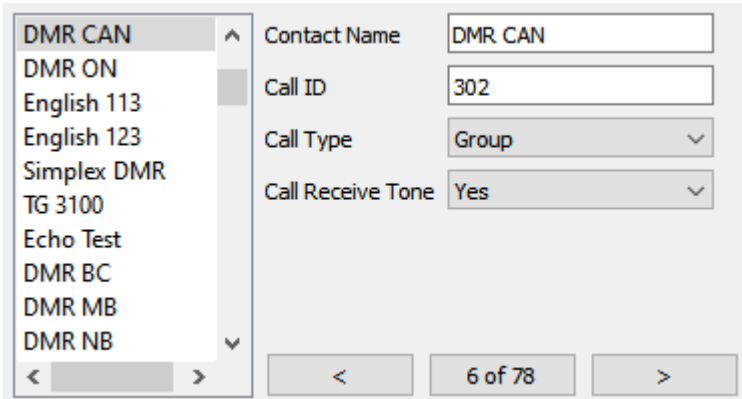
DMR transmissions have a 30ms window for each time slot. That window is further divided into a 27.5ms frame followed by a 2.5ms gap. For each 60ms, the radio is only transmitting for 27.5ms, which results in extended battery life and less heat.



DMR uses Color Codes (CC) much like analog repeaters use CTCSS or DCS. The color code programmed in your radio has to match the CC programmed in the repeater, otherwise your signal will be ignored. The same holds true for transmissions coming from the repeater to your radio (like tone squelch for FM). Most of the time for amateur radio, CC 1 is used.

A Code Plug is the configuration file for a radio. All the settings needed to make the radio work properly are configured by the code plug. Analog parameters include Tx and Rx frequencies, bandwidth, and CTCSS/DCS codes. Digital parameters include Tx and Rx frequencies, Color Code, Timeslot, Contact (Tx talkgroup), and Receive Group (Rx talkgroup). Other parameters include your DMR ID, Zones, and radio button definitions.

Contacts are where you name and define your talkgroups.



Here we are defining TG 302 for the Canada wide talkgroup.

Channels are where many of the parameters come together. Below is an example of the channel configuration for the Canada wide talkgroup on VE6RYC:

Channels Information

Digital/Analog Data

Channel Mode: Digital
 Band Width: 12.5kHz
 Scan List: Calgary
 Squelch: Normal
 RX Ref Frequency: Low
 TX Ref Frequency: Low
 TOT[s]: 120
 TOT Rekey Delay[s]: 0
 Power: High

Channel Name: RYC CAN
 RX Frequency(MHz): 444.00000
 TX Frequency(MHz): 449.00000
 Admit Criteria: Color Code
 Auto Scan:
 Rx Only:
 Lone Worker:
 VOX:
 Allow Talkaround:
 Send GPS Info:
 Receive GPS Info:

Digital Data

Private Call Confirmed:
 Emergency Alarm Ack:
 Data Call Confirmed:
 Compressed UDP Data Header:
 Emergency System: None
 Contact Name: DMR CAN
 Group List: DMR CAN
 Color Code: 1
 Repeater Slot: 1
 Privacy: None
 Privacy No.: 1
 GPS System: 1

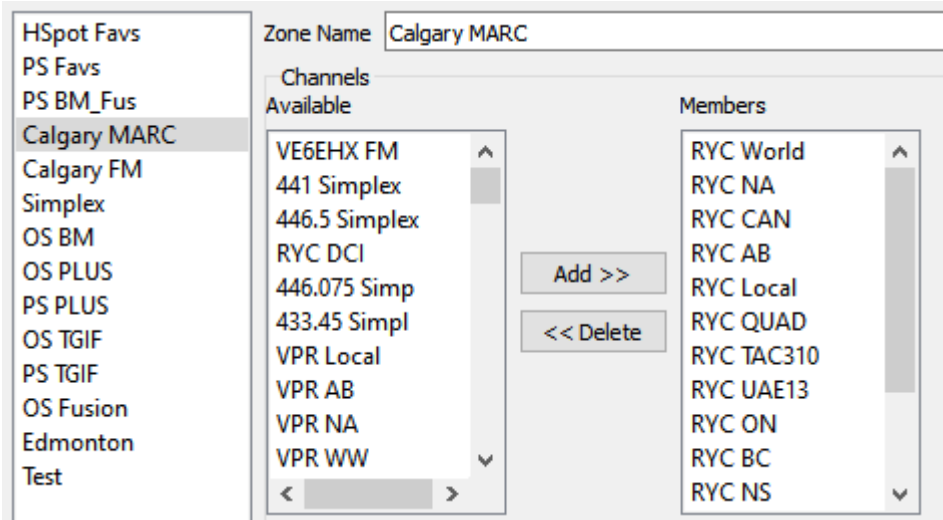
Analog Data

CTCSS/DCS Dec: None
 CTCSS/DCS Enc: None
 QT Reverse: 180
 Tx Signaling System: Off
 Rx Signaling System: Off
 Reverse Burst/Turn-off Code
 Display PTT ID

Decode 1:
 Decode 2:
 Decode 3:
 Decode 4:
 Decode 5:
 Decode 6:
 Decode 7:
 Decode 8:

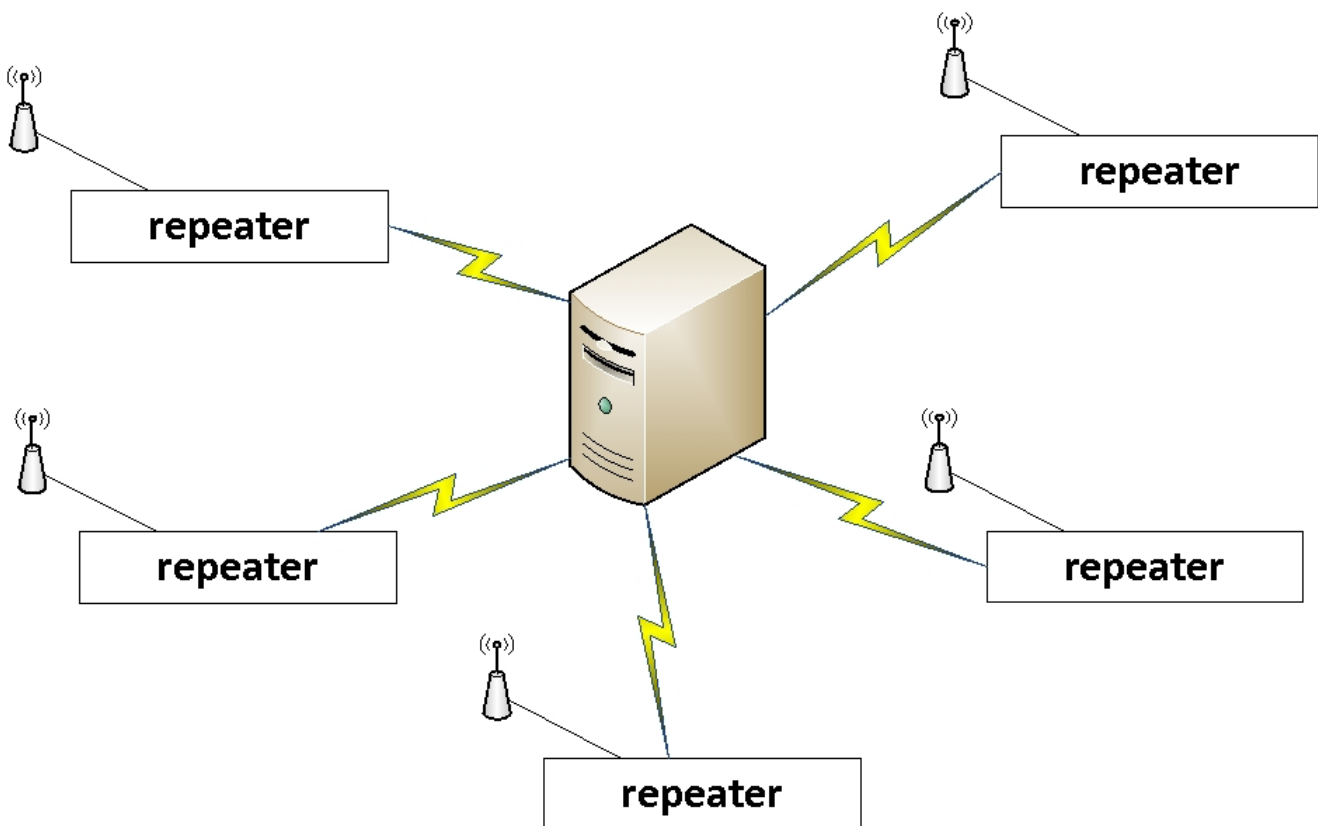
6 of 90

Zones are groups of channels. How channels are grouped depends on the user. For example, a Calgary Zone could include the channels on repeater VE6RYC. You could have a separate Zone for analog repeaters in and around Calgary. A separate Zone or Zones might be used with a hotspot.



So far, we have been talking primarily about DMR Radio to DMR Repeater situations. Hotspots provide access to DMR networks without the need of a repeater. Where a repeater is usually connected to only one DMR network, a hotspot can be connected to various DMR networks. A hotspot can also connect your DMR radio to the Fusion network. The Openspot 3 hotspot will also connect your DMR radio to D-star networks. Using a hotspot really opens up the DMR world. VE6RYC is connected to the DMR MARC network, which doesn't allow hotspots to be directly connected to it. Hotspot friendly DMR networks include DMR Plus, Brandmeister, and TGIF. MARC and Plus have some interconnected TG's, like Canada wide TG 302 and the provincial talkgroups, as well as many of the state and regional TG's in the US. Unlike with a repeater, the hotspot end user has complete control over what TG on what network they connect to.

Repeaters and hotspots connect to a server. The server looks at the incoming data and forwards the packets to the appropriate destinations based on the TG. Unlike when you connect to a web site from your computer or phone, which is a one to one connection, when you connect your DMR radio to a talkgroup, you have a one-to-many connection. When you transmit, every repeater, hotspot, and radio that is connected to that TG will receive your transmission.



“Last Heard” is your friend. DMR repeaters don’t have a squelch tail to tell you that you are “hitting” the repeater. That is where Last Heard or Monitor pages on the internet come in handy. For VE6RYC, the Last Heard page is at <https://www.ve2tax.com/lastheard.aspx>. It

shows the activity on the network, specifically, the call sign of the station and the repeater being used to access the network, how long the transmission lasted, The Talkgroup ID, the received signal strength into the repeater, and the rate of digital packet loss.

Last Heard on ▼	Repeater ↕	Station ↕	Duration ↕	Group Id ↕	RSSI ↕	Loss Rate ↕
2020-09-16 20:47:15	K6EH - Palos Verdes CA USA	K6QXG - Jon R - Bakersfield CA USA	39	310	0.000	0.0%
2020-09-16 20:47:09	NY4Z - Jeffereson Valley NY USA	W2PDX - Craig M - Yorktown NY USA	34.5	444	-78.1	0.2%
2020-09-16 20:46:55	K2HR - Mahopac NY USA	NY4Z - Bernie - Mahopac NY USA	8.3	1	-84.8	1.4%

An often asked question by new DMR users is: “Why does the green receive indicator come on even when I can’t hear anything?” The Rx indicator lets you know that there is an incoming signal, period. If the talkgroup number, the color code number, and the timeslot of the incoming signal don’t match with what is configured in the channel you have selected in your radio, then your radio won’t decode the signal. Some radios have what is called a monitor or promiscuous mode that will decode any signal coming in on the selected timeslot, regardless of TG and CC. Just remember, when in monitor mode, that if you hear someone on a different talk group than the one you have selected, you need to change to their TG before transmitting back to them. Some radios will make the change for you, but not all, so be aware. I speak from experience!

Hotspots can go mobile quite easily by using the internet sharing ability of most smart cell phones. The data stream between the hotspot and the cell phone is relatively small, especially when compared to streaming video. If your hotspot has WiFi capability, it can be linked to your smartphone so that when you leave home with your DMR radio, your hotspot, and your smartphone, your favourite hotspot talkgroups can go with you.



The Raspberry Pi Zero with WiFi and the smaller MMDVM board is very popular and makes for a good mobile/portable hotspot. It is available under many names from multiple sources.



SharkRF Openspot (original). The original Openspot did not have WiFi. Later models added WiFi and removed the cabled ethernet capability.



Raspberry Pi 3 with full size MMDVM board. I am using a GD-77

radio with custom OpenGD77 firmware in “hotspot” mode as the transceiver instead of the transceiver on the MMDVM board. The RPi handles the network connection and the web-based user interface, the MMDVM board handles the digital encoding and decoding, and the GD-77 transmits and receives the RF signals.

The DMR page on the CCC web site has more information and some links to other useful sites: ccc.myrac.ca/dmr

DMR Page

VE6RYC is the first DMR repeater in Calgary and it is proving to be a very interesting addition to the amateur radio scene in Calgary. Thanks to CARA for getting it on the air! The information below is provided to help people get started with the world of amateur radio DMR.

Usefull Links

- **DMR-MARC Worldwide Network** The Motorola Amateur Radio Club are leaders in the use of DMR technology for amateur radio.
- **VA3XPR Digital Radio** VA3XPR's site has a lot of useful information on setting up DMR radios and repeaters.
- **CAN-TRBO Home** provides general information about the DMR-MARC Canada CAN-TRBO Amateur radio network
- **DMR at Foxhollow** This site focuses on the Tytera MD-380 radio: programming software, codeplugs, contact lists, getting started.
- **DMR Demystified Presentation** Download this PDF file of a presentation given in November 2015 by VA3XPR.
- **Operating Your DMR Radio** PDF file with information on using your DMR radio. Excerpts from a presentation by W2XAB.
- **QuadNet Array** This site has information on the QuadNet Array, which can be used to connect operators on DMR MARC (TG 320 - PTT access with 15 minute timeout), DMR Plus (TG 320 or reflector 4541), DMR Brandmeister (TG 31012), D-Star (reflector depends on whether you are connected to DSTAR1, 2, 3, or 4), Fusion (reflector 35947), and Wires-X room 45058 together. Check it out if you have access to any of those digital networks through a repeater or hotspot.
- **TGIF Network** Started in 2018, TGIF's goal is to be less formal than other DMR networks. It is already supported in Pi-Star hotspots and by both versions of the SharkRF Openspot.