

Operating Your DMR Radio

Excerpts from a presentation by John S. Burningham, W2XAB

Talk Groups

Talk Groups (TG) are a way for groups of users to share a time slot (one-to-many) without distracting and disrupting other users of the time slot. It should be noted that only one Talk Group can be using a time slot at a time. If your radio is not programmed to listen to a Talk Group, you will not hear that Talk Group's traffic.

The DMR-MARC Mototrbo™ network supports three Talk Groups on TS1; World Wide (TG1, PTT), North America (TG3), and World Wide English (TG13). TS2 is for Local, state, and regional Talk Groups [<http://www.dmr-marc.net/TG.html>]. The DCI/TRBO network uses TG3163 for North America and TG3161 for World Wide, and TG3 for World Wide English on TS2 [<http://trbo.info/dci/talkgroups/index.html>]. Check with your local repeater operator to find out what Talk Groups are available on its repeater.

The DMR standard also supports private calls (one-to-one), encryption, and data. Private calls are not allowed by most of the amateur networks and many consider private calls not amateur friendly; private calls tie up a large number of repeater time slots across the network. Encryption is not legal on amateur radio! Data and text messaging is supported on some networks.

For simplex traffic, the accepted standard in the amateur community is to use TG99 on TS1 with CC1.

When programming your DMR radio, you may find it easier to program multiple Talk Groups for receive. I have two RX Group lists programmed in my radios, one for TS1 and one for TS2; this allows my radio to listen to all the possible Talk Groups used on a time slot when I have my radio set to any channel.

There are Talk Groups implemented for individual states and regional on many networks. Some Talk Groups are available all the time, while others only at preprogrammed times. Some Talk Groups require a local user to PTT on the Talk Group to activate it for a period of time. Since only one Talk Group can be active at a time on a time slot, many systems will disable other Talk Groups when a local user is active on a different Talk Group on the time slot. Be ham friendly and try to use Talk Groups that tie up the fewest number of repeaters if you are going to have a long QSO. Further information about specific Talk Groups can be found on the DMR-MARC, DCI, and regional group websites.

<http://www.dmr-marc.net>

<http://www.trbo.org>

Zones

User DMR radios support Zones. A Zone is just a grouping of individual channels. Some model radios may limit the number of channels per Zone and the number of Zones allowed.

You could program Zones for local channels (DMR or analog), another Zone for a neighboring state, and a Zone for business and government channels. If you do program non-amateur channels in your radio, make sure they are RX only unless you are licensed or authorized to use them as per FCC 90.427(b); otherwise you will be in violation of FCC R&Rs and enforcement action could be taken against you. If you have a VHF model, you could program a Zone for all the possible NWS Weather Channels (again, make sure you program the channels as receive only). Zones are just a way to manage large number of channels, much like file folders or directories on your computer.

Color Codes

DMR repeaters use Color Codes (CC) much like analog repeaters use CTCSS (PL) or DCS. To access a repeater you must program your radio to use the same CC as the repeater. There are 16 different CCs (CC0-CC15). The use of Color Codes is not optional on DMR systems. If your Color Code is not set correctly, you will not be able to access the repeater. The only real purpose of using different Color Codes is when multiple repeaters operating on the same frequency have

overlapping coverage areas.

Code Plugs

A code plug is simply a radio's configuration file. Using a manufacturer's programming software you configure the channels and operating parameters of a radio. This file is uploaded to the radio and typically should also be saved on your computer as a backup. You can also download the code plug from a radio to modify it. Building a code plug can take many hours, especially if you want to program hundreds of channels. The code plug can also contain a Contact List of Radio IDs, call signs, and names to be displayed. You can find copies of configured code plugs on the web for different models of radio; check out the different Yahoo DMR groups. All DMR radios support a limited number of entries in the Contact List; you can download Code Plugs with the Contact List populated using a generator on the DMR-MARC home page.

Simplex

On the professional side of DMR, Talk-Around refers to operating simplex on a repeater output channel. This allows a direct communication while still being able to hear the repeater. This allows users to directly contact other users listening on the repeater output frequency. Amateurs typically use dedicated simplex channels so as not to interfere with repeaters. The amateur DMR community has published a list of recommended simplex frequencies to be used instead of operating simplex on repeater outputs:

UHF 1) 441.000 2) 446.500 3) 446.075 4) 433.450

VHF 1) 145.790 2) 145.510

[Use TG99 / CC1 / TS1 / Admit Criteria: Always / In Call Criteria: TX or Always]

Do not use 146.520 or 446.000; they are the national analog simplex channels and operating DMR on these common analog use frequencies will just cause disharmony within the amateur community. Also, avoid repeater inputs and outputs, locally used non-DMR simplex channels, satellite sub-bands, and any other frequencies that could disrupt other amateur communications.

Admit Criteria

The Admit Criteria determines when your radio is allowed to transmit. The recommended setting for repeater channels is Color Code Free; this configures your radio to be polite to your own digital system. You should configure your In Call Criteria to Follow Admit Criteria. Simplex channels should be configured as Always for both Admit Criteria and Always or Follow TX for In Call Criteria.

Accessing a DMR Repeater

When you want to access a DMR repeater, you must have the frequency, Color Code, and Talk Group set correctly. When you key your transceiver, you send a signal to the repeater and the repeater responds back to you to acknowledge you can transmit your message. If you do not receive the repeater's acknowledgement, your radio will stop transmitting and you will hear a negative confirmation tone. This is one of the advantages of TDMA: allowing bidirectional communications between user and the repeater when transmitting. The repeater can also signal your radio to stop transmitting if there is contention on the network because more than one station is transmitting at a time. Not all DMR repeaters are interconnected on the Internet. Internet connectivity may not be available at the repeater site, or not available at a reasonable cost. Some repeater operators may just prefer to keep their repeater for local usage only, or maybe only want it connected to a small local/regional network, without connecting to the larger world wide networks.

IPSC and Bridges

IP Site Connect (IPSC) is a vendor specific repeater feature offered by some manufacturers. Note that Mototrbo™ repeaters will only interconnect over the Internet with other Mototrbo™ repeaters because it is not part of the ETSI specifications and the manufacturers don't want to interconnect their infrastructures.

Motorola Solutions Mototrbo™ IPSC implementation allows up to 15 Mototrbo™ repeaters operating in DMR mode to be connected on a fully meshed IP network, with one of the repeaters (or a c-Bridge™) serving as a Master and all of the others are Peers. Any traffic originating on one of the interconnected repeaters is relayed over the IP network to each of the other repeaters. The Peers will first establish a connection with the Master and obtain the database of the other Peers along with their IP and port addresses.

The more repeaters in this fully meshed IPSC network, the more IP network bandwidth required for each repeater. A single Peer connected to a Master requires 15 kbps for each time slot participating in the IPSC network, 6 kbps for link management, and 55 kbps for RDAC (Remote Diagnostics and Control) traffic; if both time slots are participating in IPSC, 91 kbps bandwidth is required; each additional Peer requires 36 kbps bandwidth. The Master requires an additional 3 kbps bandwidth for each Peer in the network. The Mototrbo™ System Planner has full details about calculating necessary bandwidth for repeater operators.

To expand beyond the limits of basic IPSC network requires the utilization of a bridge to interconnect the different IPSC networks. Rayfield Communications c-Bridge™ [<http://rayfield.net>] is the current preference in North America. In the European market, SmartPTT [<http://smartptt.com>] is common. These bridges require static IP addresses and larger IP network bandwidths than individual repeaters.

The c-Bridge™ supports individual managers for each repeater (micro-segmentation), which is an improvement over having the c-Bridge™ manager connected to a network of repeaters; this gives the ability to reduce bandwidth requirements and customize Talk Group availability for individual repeaters. The c-Bridge™ manager can serve as either a Master or Peer on an IPSC network.

The c-Bridge™ allows for network connections to other IPSC networks, and other c-Bridges™ utilizing Control Center (CC) connections. The c-Bridge™ allows for the management of Talk Groups on an always-on, scheduled, or on-demand (PTT) basis. Models (upgradeable) are available to support 5, 15, 30, and 50 repeaters and they also support 100 CC connections between c-Bridges™.

The c-Bridge™ also supports the interconnection of non-DMR audio sources utilizing an optional USB analog dongle and vocoder module.

Remember, someone is paying for all of the infrastructure and monthly operating costs. If a club is operating your local DMR repeater, join and support the operation. If an individual is operating the local repeater, donate to support his ongoing expenses. Repeater operators should also be supporting their bridge operators. Besides the cost of the infrastructure equipment, there are also recurring monthly expenses for rent, utilities (power and Internet), insurance, and maintenance.

Programming your Radio

When you get your new radio, it must be programmed before first use. Check the DMR-MARC website for basic parameters that need to be configured to get your radio working correctly on the network.

First, you need a subscriber ID. The DMR-MARC website [<http://www.dmr-marc.net>] handles issuance of all subscriber IDs for amateur users and repeaters. Click on Contact Us in the top right corner of their page and then follow the instructions. IDs are assigned based upon your geographic location (Country/State). You should have your subscriber ID within a few hours of requesting it. If you have ordered your radio, request your subscriber ID and have it ready when your new DMR radio arrives. If you use an unauthorized subscriber ID, you may find that you can't access repeaters or the wide area network.

If you have multiple radios that will be on the air at the same time, you will need a subscriber ID for each. If you have a mobile and portable and are going to be only transmitting on one at a time, they can share subscriber IDs. Some brands of radios (including Mototrbo™) will not listen to traffic from another radio with the same subscriber ID. It can be an advantage if both your mobile and handheld both use the same subscriber ID, as it eliminates issues of audio feedback.

DMR radios have a code plug which contains configuration parameters, including channel information and a contact list

with a limited number of subscriber IDs and call signs/names. Your radio only transmits your subscriber ID and not your call sign or name. You can download code plugs populated with some subscriber IDs already in the database. The complete database is many times larger than any of the radios will support, so you want to limit your code plug to regional users and others you may commonly communicate with.

In the DMR world, repeaters are identified by frequency and by a parameter called a Color Code. There are 16 possible Color Codes (CC0-CC15). You need to have the correct Color Code programmed in order to access a repeater. The repeater database available at the DMR-MARC website lists the frequencies, offsets, and Color Codes for DMR repeaters. You will need to contact another local user or repeater operator to find out which Talk Groups are available on a repeater.

When you press your PTT button, your radio sends a data packet to the repeater, and if it is successfully received by an available repeater, the repeater will send back an acknowledgement signal to your radio, and your radio will generate an audible signal telling you to continue to transmit. If you do not receive an acknowledgement back from the repeater, your radio will signal you that your request was not successful. The use of this hand shaking between your radio and the repeater will give you confirmation that you are making it into the repeater, although you could still be in a fringe coverage area and have too high of packet loss to be understandable. If you are communicating across the IPSC network, wait a second or two for your first transmission to signal all the receiving radios to wake up, as they may be scanning or in a power saving mode.

Your radio may stop transmitting while you are talking because of contention on the network or because you have travelled beyond the repeater's range. Your radio is receiving control information from the repeater when you are talking. Network contention occurs when more than one station is transmitting at the same time on the same Talk Group.

Operating on DMR

When you make an initial transmission to announce your availability, to place a call to another station, or to make a general call, you should also announce what Talk Group you are on because some users may be scanning or have radios without a display. Please avoid calling CQ; DMR is not HF and operating DMR over the network is not DXing.

When you are talking on one of the wide area Talk Groups, hundreds of repeaters will be tied up. If you are unable to move to a more localized Talk Group, be considerate of the other users on the network. Talk Groups share time slots. When one Talk Group is active; other Talk Groups on the same time slot will be blocked. Leave space between transmissions so others can break in. Remember that emergency traffic always has priority over all other traffic.

Examples of good operating practice for initial calls on the DMR networks include:

“This is W2XAB monitoring Southeast Regional.”

“N5ITU this is W9JW on North America.”

“This is WB8VYS for a radio check on Local.”

“WB8FXJ this is WB8SCT on Ohio State.”

A quick reminder of the Amateur's Code by Paul M. Segal, W9EEA (1928) may be helpful to remember.

The Radio Amateur is:

Considerate – never knowingly operating in such a way as to lessen the pleasure of others.

Loyal – offering loyalty, encouragement and support to other amateurs, local clubs and the American Radio Relay League, through which Amateur Radio in the United States is represented nationally and internationally.

Progressive – with knowledge abreast of science, a well built and efficient station, and operation beyond reproach.

Friendly – with slow and patient operation when requested, friendly advice and counsel to the beginner, kindly assistance, co-operation and consideration for the interest of others. These are the hallmarks of the amateur spirit.

Balanced – radio is an avocation, never interfering with duties owed to family, job, school or community.

Patriotic – with station and skills always ready for service to country and community.

Spend most of your time listening, not talking. Be a good neighbor and don't hog the network. Don't over ID! Help new users develop good operating practices. Be polite when informing other users about their poor operating practices or audio levels.