

An aerial photograph of a winding asphalt road that curves through a dense, green forest on a mountain slope. The road is light-colored and contrasts with the dark green trees. The background shows more of the forested hills under a clear sky.

INTRO TO DMR

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AGENDA

01

OVERVIEW

02

DMR PROGRAMMING

03

TERMINOLOGY

04

HOTSPOTS

05

**TIPS, TRICKS, AND
ETIQUETTE**

Analog

- Audio quality degrades as a station's signal into the repeater (uplink) gets weaker
- As you move further from the repeater you will start hearing the same noise bursts into your receiver as a repeater's signal gets weaker (downlink) until you can no longer hear the repeater
- A combination of a station's weak signal into a repeater and a repeater's weak signal to the listener can make the usability degrade faster

Digital

- Analog static is a thing of the past using DMR
- Audio quality remains the same on the uplink and downlink until the very end of the coverage range
- Audio starts sounding broken (missing portions of the speech) on DMR systems caused by lost packets
- Forward Error Correction (FEC) can correct small bit errors, slightly extending the usable range and improving communication quality
- Better quality receivers can operate at a lower noise floor, higher power transmitters, and higher gain antenna systems will also extend coverage of both analog and digital systems.
- The Internet can also drop the UDP packets used for moving traffic between repeaters and bridges, causing the same broken audio affect

LMR (Land Mobile Radio) Solutions

- DMR
 - Commercial Standard
 - Limited use in Public Safety
- P25
 - Public Safety Standard
 - Phase I (narrowband - 12.5 kHz)
 - Phase II (TDMA - two channels - $6.25 \text{ kHz} * 2 = 12.5 \text{ kHz}$)
- EDACS ProVoice - 6.25 kHz 4.8kbit/s trunking on 12.5 kHz wide channels
- NXDN (FDMA)
- TETRA - Terrestrial Trunked Radio (TDMA)
- SmartNet

DMR Overview

FDMA - Frequency Division Multiple Access - dPMR - ETSI Standard
Single Channel

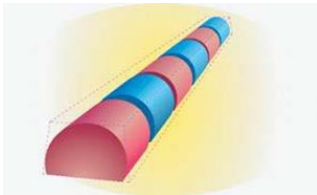
TIER 1

TDMA - Time-Division Multiple Access
2 Timeslots
Site-Linking

TIER 2

TDMA - Time-Division Multiple Access
Introduces Trunking: Multiple Repeaters - Single Site
Vendor Specific implementations common - lack of interop

TIER 3



DMR

12.5 KHz total bandwidth

$6.25 \text{ KHz} * 2 = 12.5$

TDMA = 30 ms time slices

Analog

Wideband

25 kHz Channel Bandwidth

DMR NETWORKS



- DMR-MARC - Motorola Amateur Radio Club (est. 2009)
 - First DMR network in the US
- DMR-X
 - Connects selected hotspots to DMR-MARC network
- Brandmeister
 - Russian developers
 - Worldwide support
- TGIF
 - Operated by team that defected from Brandmeister
- c-Bridge based networks
 - IPSC standard
 - Commercial grade solution
 - Allows bridging of multiple DMR networks

Codeplugs

- Originally, a codeplug was a piece of hardware - an actual plug that contained jumpers and would be connected to a jack in order to enable certain options. The term has stuck to the file used to set programming in any radio.
- Configuration file for your radio
- Used to configure channels & operating parameters of your radio
- Can take many hours to build
- There is NO ONE CORRECT WAY to build a codeplug - highly individualized
- Building your own is the BEST way to learn DMR!

CPS

- Customer Programming Software
- Manufacturer Specific
- Several open-source options have become available
- Most is poor quality - gets the job done

DMR PROGRAMMING

TALKGROUPS

- Group Call - One to Many
- Private Call - One to One
- All Call - One to All (not found in amateur radio)

TIMESLOT

- Two timeslots in DMR
- Must match the timeslot for the given Talkgroup in a channel

COLOR CODE

- DMR equivalent to CTCSS (PL) or DCS
- Only real purpose is for when multiple repeaters are operating on the same frequency in overlapping coverage areas
- There are 16 different Color Codes (0 to 15)
- The Color Code on the channel in your radio must be equal to the Color Code on the Repeater or Hotspot

CHANNELS

- Includes the TX and RX frequencies
- Contains the combination of all of the aforementioned elements required to transmit/receive on a DMR system

RECEIVE GROUP

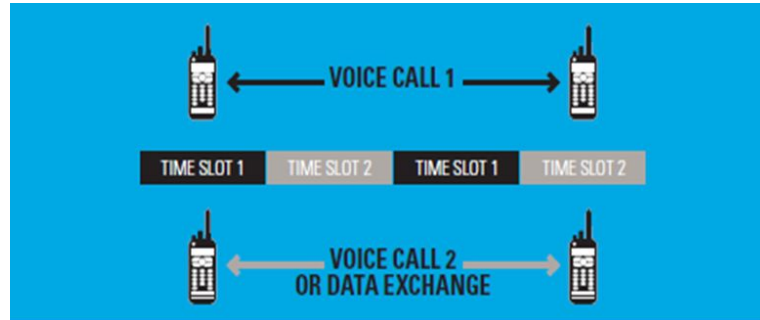
- Optional on most radios
- Some radios require them before you can hear anything
- Contains one or more talkgroups
- Allows you to listen to multiple talkgroups without creating Scan Lists

ZONES

- A grouping of individual channels
- Think of it as a folder for organizing channels

TIMESLOTS

- Operate independently of each other
- TDMA
 - 30 ms timeslices alternating between timeslot 1 and timeslot 2
 - Our ears can't hear the difference but the repeaters and radios can
- General Rule of Thumb
 - Timeslot 1 - typically reserved for wide-area talkgroups
 - Timeslot 2 - typically reserved for localized communications
 - Historic carryover from DMR-MARC
- Only one Talkgroup per Timeslot can be used at any given time
- The more Talkgroups available on a Timeslot, the greater the contention for the Timeslot



- Understanding Timeslot Provisioning on DMR Repeaters
 - Repeaters are relatively dumb devices
 - Talkgroups cannot be configured on a repeater *
 - Talkgroups are configured on the network/bridge (c-Bridge or equivalent)
 - Brandmeister allows any talkgroup to be used on either timeslot - by default
 - Many repeater operators are using *hblink* to have more fine-grained control (whitelisting)
 - Becoming increasingly common to see one timeslot restricted to one or two talkgroups while the other timeslot is open for use on any TG
- Repeater Tricks
 - Any timeslot and talkgroup combination can be used by stations that coordinate with each other
 - The RX frequency, TX frequency, and Color Code have to match
 - Example
 - If I want to talk to someone via the W4DOC DMR repeater, as long as everyone I want to talk to agrees to use the same timeslot and talkgroup number, the repeater will repeat it!
 - If Rob, Steven, Bill, and I decide to use TGID 999 on TS 2, as long as there's no activity on the timeslot, we'll be able to communicate with each other
 - NOTE: *DON'T DO THIS!:-)*

TALKGROUPS & CONTACTS

- Talkgroup Modes
 - Full Time
 - Always available
 - Does not require key-up to activate
 - Part-Time Talkgroup (PTT)
 - Requires key-up to activate
 - Deactivated after period of inactivity (usually 5 to 15 minutes)
- Contact Types
 - Group = Talkgroup
 - One to Many - think of a chat room
 - Private Contact
 - 1:1
 - DMR Radio ID of another user
 - All Call - one to many - used in commercial and public safety (limited)
 - 16777215 (decimal) or 0xFFFFF (hexadecimal) = BROADCAST
- Provide a way to separate traffic on the same physical channel
- Similar to PL or DPL - but not exactly the same
- Brandmeister - use your own DMR ID as a talkgroup ID!

COLOR CODES

- Use is mandatory in DMR
- Helpful when multiple repeaters are operating on the same frequencies and have overlapping coverage areas
- Valid Color Codes are 0 (zero) to 15
- Similar to CTCSS or DCS
- Ensure your transceiver is programmed to use the correct Color Code for the repeater you want to use

RECEIVE GROUPS

- Receive Groups are nothing more than a list of talkgroups
- Optional in most cases - most radios will automatically receive on the same TGID automatically
- Some radios require a Receive Group for each channel in order to hear any traffic
- Great for receiving traffic for multiple talkgroups
- Common source of confusion for those that are new to DMR
 - Monitor the display on your radio or hotspot to see which TGID is active when you hear traffic
 - If the desired TGID is different than the one configured on the active channel, ensure you switch to the appropriate channel before responding
- Helpful when using hotspots
 - Most hotspots will provide verbal responses via TG 9
 - Every channel used with hotspots has a Receive Group with TG 9 (ONLY)

Provides Methods for Minimizing Collisions

Always

- Radio will transmit anytime you press PTT
- Default value in most radios
- Not recommended - incredibly impolite

Channel Free

- Radio will not transmit if there is any activity on the repeater
- Can only transmit when there's no activity on both timeslots

Color Code Free

- Radio will only allow you to transmit if the selected timeslot is available
- Ensures you will not interrupt a QSO in-progress
- PREFERRED



TIP:

- Keep an eye on the activity light on your radio!
- When it's on and you don't hear anything, the timeslot is in use by another station

NOTE: these are not bulletproof and their effectiveness when on a network is minimal at best

Follow these guidelines when configuring codeplugs:

Repeater Channels

- Use Color Code Free
- In Call Criteria - Follow Admit Criteria

Simplex Channels (Digital)

- Use Always
- In Call Criteria - Follow Admit Criteria

Analog Channels

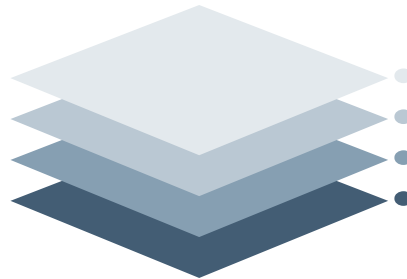
- Use Channel Free

Most Commonly Used

- Channel mode - analog or digital
- Bandwidth
 - Digital - 12.5 kHz
 - Analog - 12.5 kHz for narrowband or 25 kHz for wideband
- Scan List - if applicable
- RX Frequency
- TX Frequency
- Timeslot
- Color Code
- Admit Criteria
- Contact Name - talkgroup
- Receive Group
- TOT - Time-Out Timer

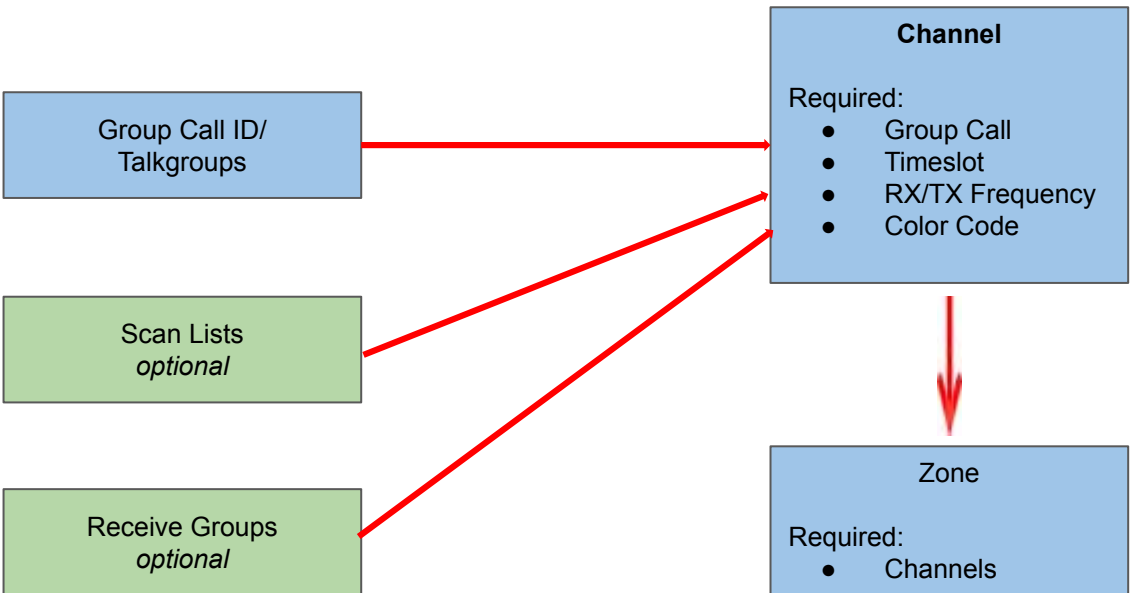
Organizational Object

- A “folder” for channels
- Can be based on
 - Geography
 - Georgia
 - Florida
 - California
 - Repeater or Hotspot
 - W4DOC
 - W4BOC
 - Hotspot 1
 - Hotspot 2
 - Usage
 - TAC
 - Hotspot controls (Pi-Star Remote or OpenSpot commands)
 - Parrot

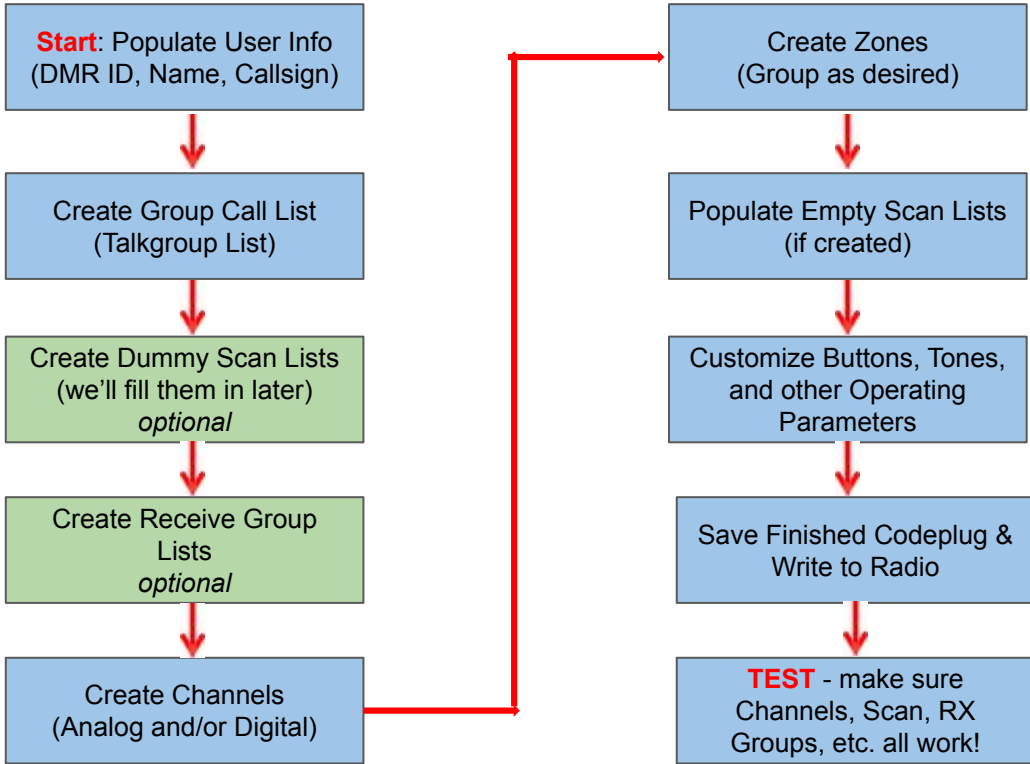


ZONES

CODEPLUG OBJECT RELATIONSHIPS



CODEPLUG WORKFLOW



Scan Lists

- Allow you to scan multiple channels - SLOW
- Radio automatically stops on a channel with activity
- Priority can be assigned to a Primary (and often Secondary) channel
- Usually comes at a cost - decreased operating time on battery

Monitor

- Typically found in commercial systems
- Add a Receive Group with multiple talkgroups you're interested in
- Create a Receive Only channel and associate the Receive Group
- Far more efficient - longer operating time on battery

Promiscuous Mode

- Also called Digital Monitor or DigiMon
- Applies to the RX frequency of the active channel
- Squelch opens for activity any talkgroup
- Single Slot - squelch opens for any talkgroup on a specified timeslot
- Double Slot - squelch opens for any talkgroup on either timeslot

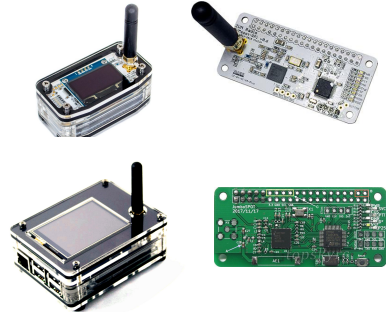
DIGITAL RADIO HOTSPOTS

MMDVM

Open Source MMDVM

DMR Gateway

Includes Zumspot, N5BOC, Jumbo Spot and others



DV4mini

USB Stick

Not widely used anymore

No longer supported by manufacturer



Openspot

SharkRF

OpenSpot 1 - Ethernet only (discontinued)

OpenSpot 2 - Wi-Fi only (still supported)

OpenSpot 3 - Built-in battery First to support DMR to D-Star



Network Radios

Purpose-built devices

Support connectivity via Wi-Fi and/or LTE Cellular

Radio-over-IP (RoIP) natively supported by Brandmeister





Pre-Built

- Ham Radio Outlet - sells pre-built Zumspot (simplex & duplex)
- SharkRF - turnkey - dead-simple to use

Roll Your Own

- Raspberry Pi
 - Full-size: 3B or 3B+ (supports Ethernet and Wi-Fi - faster boot & config changes)
 - Small form-factor: Zero W
 - Don't be tempted to get the 4 - TOO HOT
- MMDVM
 - Zumspot - most popular - available at HRO - duplex now shipping
 - N5BOC - most sought after - HIGH quality - simplex and duplex models
- Case - check out C4Labs
- Micro SD-Card - 32 GB (buy 2 or more)
- Nextion Enhanced Display (2.4 or 3.5") - bundled with case on C4Labs.com
- Power Adapter (at least 2.5 to 3A)
- Small SMA antenna
 - Better quality than what comes with the MMDVM
 - N5BOC includes Diamond SRH805S antennas (if requested)
- USB-to-TTL adapter - configuration of Nextion Display

HOTSPOT - DO'S & DON'T'S

DO

- Pick a unique frequency for your hotspot(s)
 - Consult the Southeastern Repeater Association Bandplan
 - <https://sera.org/wp-content/uploads/2016/11/sera-fup-144.pdf>
 - <https://sera.org/wp-content/uploads/2016/11/sera-fup-440.pdf>
 - <https://sera.org/wp-content/uploads/2016/11/sera-fup-900.pdf>
- Test audio levels (use Parrot)
- Configure a unique hostname (default is *pi-star*)
- Enable CW ID in Expert -> MMDVMHost (off by default)
- Get a Brandmeister API key - allows control of Brandmeister settings directly from the hotspot

DO NOT

- Use the out-of-the-box frequency
- Use a frequency reserved for AMSAT
 - <http://www.arl.org/news/digital-mobile-radio-hotspots-may-be-interfering-with-satellite-uplinks-amsat-reports>
- Operate 2 or more hotspots with
 - The same DMR ID - use SSID value (01 to 99)
 - The same frequency
 - DON'T CREATE LOOPS - or get blocked!
- Expose your hotspot directly on the Internet
- Enable more than two or three static talkgroups unless you have a duplex hotspot

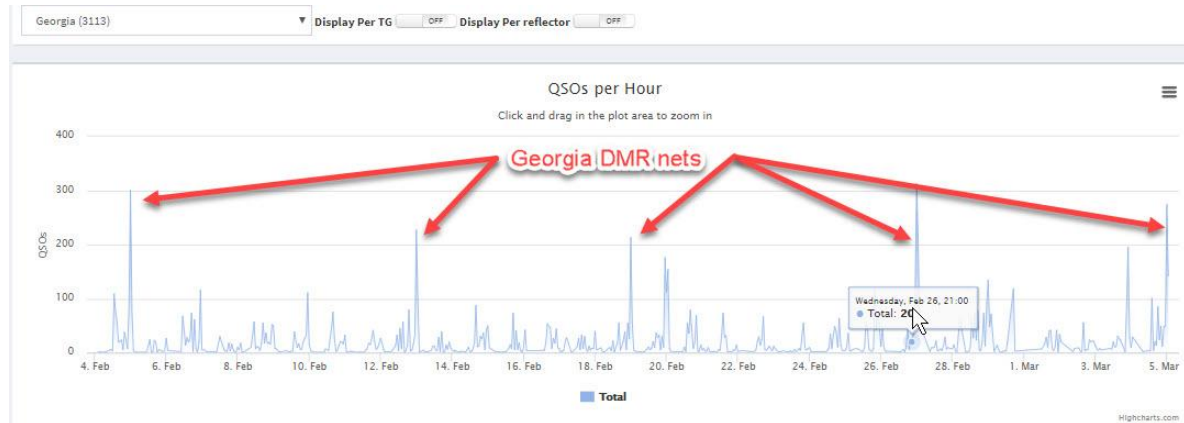
Do Not

- Use wide-coverage Talkgroups for rag chewing
 - Every repeater with that Talkgroup (active) will become tied up
 - This could be hundreds or thousands of repeaters!
- Use publicly available repeaters for experimentation - buy a hotspot
- Test your audio on talkgroups that are heavily utilized - try to use Parrot first
- Repeatedly key-up on PTT talkgroups
- Key-up on PTT talkgroups on both timeslots of a given repeater

Do

- Promote DMR use in your area - use local talkgroups (Atlanta Metro, Georgia, etc.)
 - Minimizes the number of repeaters activated when the Talkgroup is active
- Ensure you ID verbally - your callsign is not transmitted over the air
- Establish a contact on a wide-coverage talkgroup then QSY to a more localized TG
- After keying, wait a second or two before speaking give the various parts of the network time to do their jobs
- TEST YOUR AUDIO LEVELS - one of the most common complaints about DMR
- Set Admit Criteria to Color Code Free - best effort for collision avoidance

- Finding Activity
 - Brandmeister - navigate to Data Visualization -> Call Statistics
 - Drop-down select to choose from the list of available talkgroups
- Talkgroup lists are available:
 - <https://wiki.brandmeister.network/index.php?title=Talkgroups&redirect=no>
 - https://www.pistar.uk/dmr_bm_talkgroups.php
 - <http://tgif.network/talkgroups.php>
 - <http://www.k4usd.org/>



BAYCOM - Operating Tips and Requests

A network of repeaters on Brandmeister

- We politely request that Timeslot 2 be kept as free as possible, other than for Baycom TG 97150
- We also kindly request that Linking and Reflector use be performed on TS 1 only
- We time out Dynamic TG's after 10 min. This is in order to allow other Dynamics to have a chance, due to several limitations of DMR for ham use, namely a lack of TG prioritization, fine grain scheduling, or multiple QoS levels. It's almost a trunked radio system, but not quite. Quite frustrating, to put it mildly.
- We *discourage the use of Private Calls*, as *other hams can't usually see/hear them* and can't figure out why they can't access the Time Slots and become frustrated.
- We really urge folks sending location data (LRRP/APRS) GPS updates to crank down the update frequency to maybe 1 per 5 min to conserve bandwidth, as **they eat both TDMA slots** with these data frames. So how far are you going to go in 5 min? Same with sending SMS, since it uses the whole 12.5kHz, **please be aware you are eating the bandwidth of both slots**
- *Last, if you want to yack with the folks from the old country, why not buy an OpenSpot, a ZumSpot or a MMDVM RaspPi and have at it, there are loads of ways to set up a hotspot at home. Be courteous to your ham neighbors and don't eat up their RF air time, IP network time is free. If you don't know how to set it up, we'll help you, glad to be of service.*



**JEFF
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**BILL
KB4KFT**



<https://www.georgiadmr.net>

<https://groups.io/g/georgiadmr>

Weekly Net - Wednesday Nights - 8:00 PM ET
Georgia Statewide (Talkgroup 3113)



GEORGIADMR.NET

THANKS

Does anyone have any questions?

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