DIGITAL MOBILE RADIO

A BRIEF INTRODUCTORY PRESENTATION TO THE BASIC CONCEPTS OF DMR RADIO FOR EPARA

DE KD2FTA

FIRST AND FOREMOST

- The majority of this presentation is put together from other presentations created by:
- KB5RAB Russel Biggs
- KF5IW Jim Blocker
- W2XAB John Burningham

Thank you for your dedication to the "art" of the DMR experience

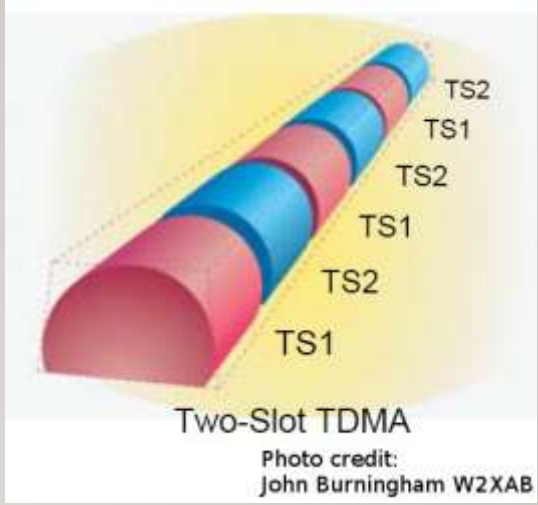
WHAT IS DIGITAL MOBILE RADIO ? (DMR)

Digital Mobile Radio (DMR) was developed by the European Telecommunications Standards Institute (ETSI) and is used worldwide in professional mobile radio services.

- DMR is divided into three tiers.
- Tier I (single channel)
- **Tier II (2-slot TDMA– the standard for Amateur Radio) What HAMs use**
- Tier III (trunking protocol)

credit- KF5IVV

WHAT IS DIGITAL MOBILE RADIO ? (DMR)



- DMR uses a digital Vocoder employing Forward Error Correction providing for enhanced signal reliability and superior voice fidelity.
- DMR signals occupy a 12.5 kHz bandwidth shared by two “channels” (Time Slots) using Time-Division Multiple Access (TDMA), this results in a spectrum efficiency of 6.25 kHz per channel.
- Each Time Slot can carry either voice and/or data depending on system design.
- The two time slots are called Time Slot 1 (TS1) and Time Slot 2 (TS2)

credit- KF5IVV

FIRST STEPS…..

Register and receive a DMR User ID!

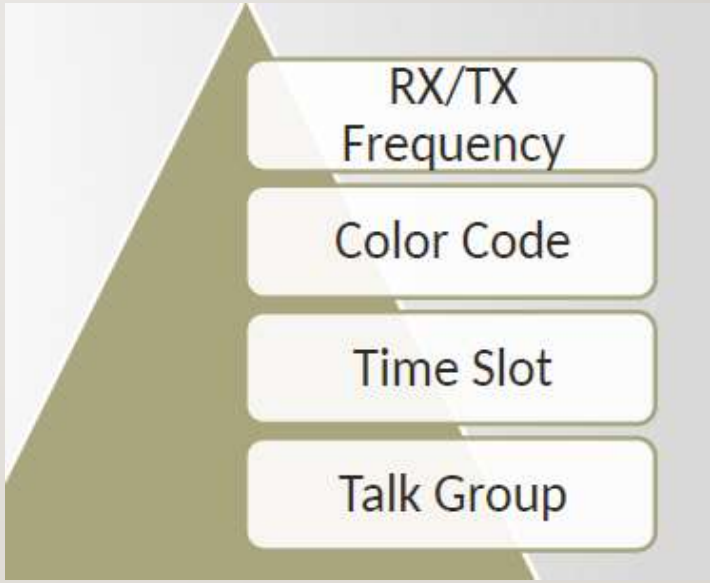
DMR-MARC.net - Register ID

- Determine frequency band(s) in use in your local area. 70cm is most common.
- Purchase a radio (BridgeCom, HRO, others)
- Install programming software – varies by radio manufacturer
- Obtain a local/regional Code Plug (Here's where a local club or others can help)
- **Change the Radio ID to your assigned ID**
- Program your radio – this task can take awhile, once more depending on your radio. The old adage applies…ELMERs can be beneficial, seek them out.

credit- KF5IVV

DMR TERMINOLOGY AND HIERARCHY

- Color Codes
- Time Slots
- Talk Groups
- Zones
- Code Plugs
- FT / PTT Talk Groups



credit- KF5IW

COLOR CODES

- DMR repeaters use Color Codes (CC) much like analog repeaters use CTCSS 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 factory default is CC1
- 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

credit- KF5IVV

TIME SLOTS

Each DMR repeater can service two Time Slots simultaneously

- They are referred to as Time Slot 1 or Time Slot 2
- Time Slots may also be referred to as “Repeater Slot” in your radio’s programming software

In order to access a specific Talk Group, the Time Slot must be set correctly

- International and National Talk Groups are typically on TS1 (It depends)
- Regional and Local Talk Groups are typically on TS2

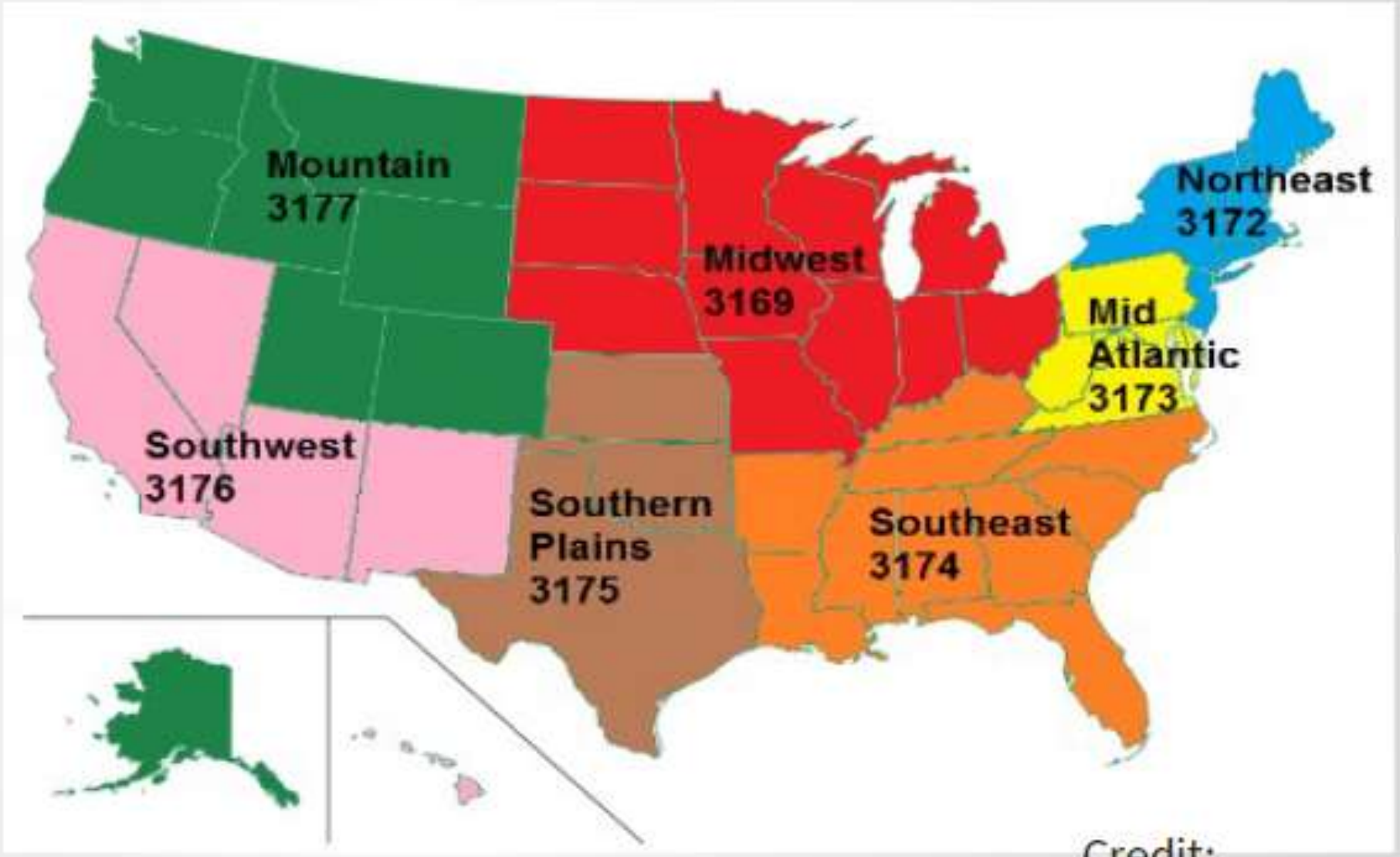
credit- KF5IW

TALK GROUPS

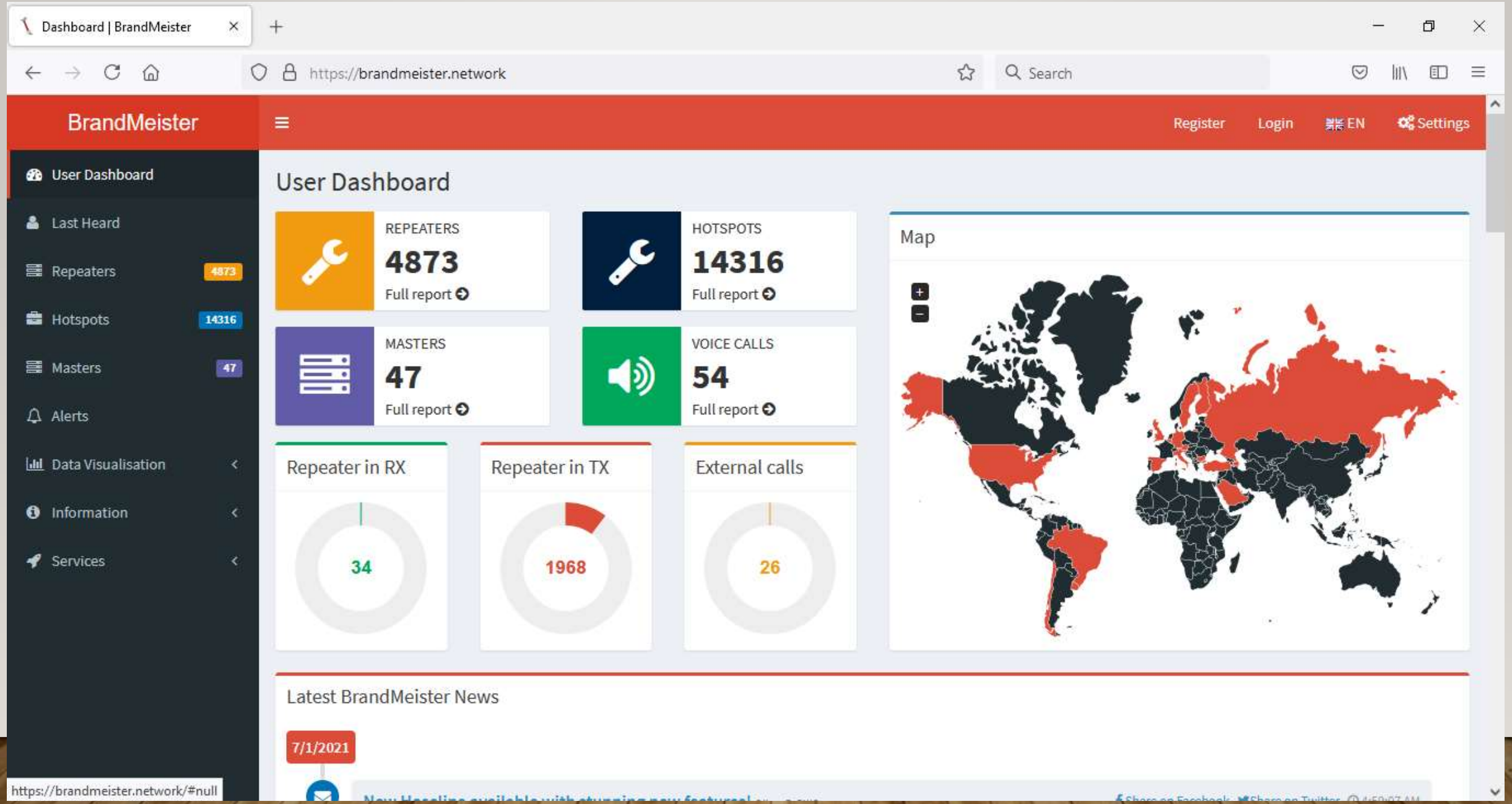
- Talk Groups (TG) are a way for groups of users to share a time slot (one-to-many) without distracting and disrupting other users of the time slot.
- **Only one talk group can be using a time slot at a time.**
- If your radio is not programmed to listen to a talk group, you will not hear that talk group's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

credit- KF5IVV

DMR MARC REGIONAL TALK GROUPS EXAMPLE



BRANDMEISTER GLOBAL DASHBOARD EXAMPLE



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.

credit- KF5IW

CODE PLUGS

A code plug is simply a radio's configuration file. That's it, however….

- **Building a code plug can take many hours, especially if you want to program hundreds of channels**
- Using a manufacturer's programming software you configure the channels and operating parameters of a radio, this file is uploaded to the radio
- The code plug can also contain a Contact List of Radio IDs, call signs, and names to be displayed
- All DMR radios support a limited number of entries in the Contact List, but typically you can place hundreds in the current radios offered by manufacturers

credit- KF5IVV

PUSH TO TALK (PTT) TALK GROUPS

Individual Talk Groups may be designated as Full Time (FT) or Push-to-Talk (PTT)

- A Full Time Talk Group will be broadcast by the repeater whenever there is activity on that Talk Group anywhere on the network
- A PTT Talk Group requires a local user to transmit on that Talk Group before it becomes active on that local repeater
- A PTT Talk Group remains active on the local repeater for about 5 minutes after the last transmission is received by that repeater
- PTT TGs are designed to reduce Time Slot congestion by broadcasting that TG only when desired by a local user

credit- KF5IVV

WORKING WITH REPEATERS

- Listen for the beep when keying your PTT switch. A high pitched beep indicates a successful connection to the repeater, whereas a low beep indicates a connection failure (depends on radio / repeater)
- Remember that on most Full Time Talk Groups, your QSO is being transmitted by dozens if not thousands of repeaters across the world
- Be courteous to others and leave ample time for break-ins to be heard
- If your QSO is becoming or will become lengthy, consider moving to a TAC or User Accessible Talk Group
- Remember to properly identify with your callsign. Your DMR ID is not a legal callsign!

credit- KF5IW

WORKING WITH REPEATERS – CON'T

- When calling another station, please specify which Talk Group you are using. The other party may be scanning and not looking at their radio's display
- Examples:
  - **KD2FTA calling KG3I on TG2**
  - **This is KD2FTA listening PA state**
- When building scan lists, you may want to include only Full Time Talk Groups as PTT Talk Groups are normally inactive

credit- KF5IW

AND NOW A WORD FROM OUR NETWORKS!

DMR NETWORKS IN AMATEUR RADIO

- DMR-MARC (and C-Bridge based repeaters) Maintains database of user IDs for all DMR networks
- Repeaters only Connected via C-Bridges to Main network

DMRplus

- Ties to legacy Hytera network
- Allows connection of hotspots and non Moto repeaters (But not many in use here)

Brandmeister

- Open network allows homebrew repeaters and hotspots
- Repeaters all have default set of TG depending on location

credit- KB5RAB

DMR-MARC / C-BRIDGE NETWORKS

DMR-MARC / C-BRIDGE NETWORKS

- All connections through repeaters connected to C-Bridges
- No direct connection of home brew repeaters or hotspots . However… there are some very smart programmers and C Bridge managers that have broken this rule!
- Talk group structure no reflectors used
- Repeaters can offer any TG that is available on their C-Bridge
- Not all TG are available on every C-bridge (state and regional)
- Selection is done via TG settings channels in radio (code Plug)
- Need to know what TG is available and on what Time Slot
- Info must be programmed in radio code plug to access TG

credit- KB5RAB

DMR-MARC RESOURCES

DMR-MARC INFO RESOURCES

http://dmr-marc.net/repeaters.html

- Lists Repeaters on map can drill down
- Zoom in on map to see individual repeaters
- Click on repeater and get specific info
- Call sign and Contact
- Frequency and offset
- Color Code
- Time Slot and Talk Group setup

credit- KB5RAB

DMR-MARC RESOURCES-CON'T

DMR-MARC INFO RESOURCES

http://dmr-marc.net/

- General info on network
- New repeaters and Database

http://www.cqdmrmap.com/

- Similar Map to above but lists all networks
- Is usually more up to date than DMR-Marc site
- Repeater Book DMR Search

http://www.k4usd.org/

http://www.trbo.org/cBridge/netwatch.html

credit- KB5RAB

DMR PLUS

- Allows connection of non Moto Repeaters to network
- Most repeaters in Europe very few left in USA on DMRplus
- Legacy Hytera network
- Allows hotspots
- Uses combination of Talk groups and Reflectors
- Repeaters usually TG on TS1 and TS2 for reflectors.
- TG setup in radio as a group call contact
- Reflectors use TG9 and Private call to reflector number to connect
- Private call to 4000 to disconnect a reflector
- Many reflector numbers mirror Brandmeister reflectors but are not linked

credit- KB5RAB

BRANDMEISTER

- Allows connection of any brand repeater or home brew repeater running MMDVM board
- Allows connection of Host spots via Home Brew protocol
- Use Talk groups via group call programmed in radio
- Repeaters have default configuration based on location
- Repeater owner can request changes to this config
- Decentralized network with Master servers located globally
- BrandMeister website allows monitoring of activities via internet https://brandmeister.network/

credit- KB5RAB

LINKED GROUPS BETWEEN NETWORKS

Name	BM	DMR-Marc	DMR+
USA NW 3100	TG 3100	DCI Bridge TG 3100	NA
TAC 310	TG 310	TG 310 PTT	NA
TAC 311	TG 311	TG 311 PTT	NA
TAC 312	TG 312	TG 312 PTT	NA
DMR+ USA	NA	TG 133	TG 133
DMR+ UK	NA	TG143	TG143
DMR+ S Pacific	NA	TG153	TG 153
31089 HYT USA	TG 31089	NA	TG 31089
BM 3148 TX SW	TG 3148	TG 9000	NA

- Known TG linked between the networks listed here
- The 4 first TG are linked between BM and DMR-Marc at the core level so available to any repeater via their C-bridge on DMR-MARC
- The BM 3148 TX is linked only at the C-Bridge level only on a few so it is only available on repeaters on them.
- Legacy Hytera systems on DMR+ linked to BM TG 31089

credit- KB5RAB

CONNECTING TO OTHER USERS OR TG – SEMI PRIVATE

- You need to know how each person is connecting and which network to know what TG/Ref you could connect on if at all.

  EX1: BM Hotspot to another BM Hotspot

- You can connect on any BM TG you want.
- If you know they monitor their Statewide you could call them there
- You could arrange to meet on one of the BM TAC channels if you like
- You can even make up a number as long as its not used at connect
- You could also use any BM reflector you like

credit- KB5RAB

CONNECTING TO OTHER USERS OR TG – SEMI PRIVATE

- Make a Private call to the their DMR ID number via contacts or manual dial on the radio menu. Use TG 9 and disconnect from reflectors or TG first.

  EX2: BM Hotspot to a BM Repeater user

- You could connect direct to them on a TG static on their repeater
- Their Statewide group or their Call zone group both are static
- They can activate any BM TG on TS 1 as PTT and call you there

credit- KB5RAB

CONNECTING TO OTHER USERS OR TG – SEMI PRIVATE

EX3: BM Hotspot to DMR-Marc repeater user

- Your options here are a bit more limited
- You could try to call them on TG 3100 if that is static on their repeater
- You could arrange to have them meet you on TG 3100 or one of the TAC channels TAC 310 or the others if they are available on the repeater.
- You could not talk to them on their statewide TG or any of the other DRM-Marc TG that are not linked to BM
  - None of the Hotspots are able to connect to these TG on DRM-Marc repeaters. It is not an issue with the hotspot but a limitation of the network imposed from the DMR-Marc side.
  - This is one of the biggest issues that confuses new users with a hotpot and wondering why they cant talk to all the local repeater users on the local or statewide TG.

credit- KB5RAB

EQUIPMENT – RADIOS & HOTSPOTS

EQUIPMENT – RADIOS & HOTSPOTS

A few fun facts about DMR radios

- The majority of the radios are made in China, in the Wuhan region the same company that makes the Baofeng radios
- The Alinco, Anytone, Motorola, TYT, etc. are made in the same factory, although at last count there were over 12 separate Chinese companies making these radios

  https://www.made-in-china.com/manufacturers/dmr-radio.html
- There are a few major U.S. distributors, HRO, BridgeCom Systems, Amazon*, Gigaparts
- Radios are distinguishable by their features and really not their performance, so for example you may want a colorful display or better sound.

*Amazon sometimes offers through their own resources the same outlets

EQUIPMENT – RADIOS & HOTSPOTS

A few fun facts about Hot Spots

- With Hot Spots the entry to market is easier, and there are **numerous** brands , makes and models to choose from
- Hot spots like radios offer various features to differentiate each other
  - You can purchase a model that plugs directly into the computer and use your PC as the radio.
  - You can purchase models that place a lot of emphasis on the display
  - You can purchase a model whose power output is more than others enabling communication at further distances from your house

EQUIPMENT – RADIOS & HOTSPOTS

A few fun facts about Hot Spots

- Like radios, the major HAM outlets offer a variety of different hotspots for the HAM radio community
- However not all Hot Spots are made in China although their components will most likely be made there (Raspberry Pies for example)
- Hotspots require programing just like the radios having with a code plug, except the hot spot programing is done through an internet interface in most cases.
  - Your Raspberry Pie based hot spots may use for example open source firmware (MMDVM) , called PiStar

EQUIPMENT – RADIOS & HOTSPOTS

A few fun facts about both Radios & Hotspots

- DMR radios require you to program a code plug as we discussed earlier
  - These code plug software vary from radio to radio , and in many cases are not interchangeable
  - Models within a brand however can use older code plugs
  - All DMR radios are made to tell the difference between repeaters and hot spots within the code plug software
- Hot Spots are much easier to program if you are using the PiStar application that configures the hot spot to your radio, network, and internet WiFi

FINAL THOUGHTS

- The trend in HAM radio is increasingly going towards digital applications. DMR is one instance but this is also happening with greater frequency (no pun intended) in the HF bands.
- Wouldn’t be surprised if a voice / phone version of DMR (not internet based) is created for HF in the coming years which prevents jamming
  - Not hard to do, talk groups would be by invitation, and your call sign would be part of the message
- DMR only requires a Technician’s license to operate
  - HOWEVER… To get your DMR ID you’ll need to provide a copy of your FCC license to the regulating DMR group. You’ll need this ID for BrandMeister network registration as well
- **If you have to use your call sign to initiate a call, it’s HAM radio!**