Digital Mobile Radio (DMR) in Amateur Radio

and

PNW System Update

Brad Estill, N7ER

"70% DMR Expert"

DMR Overview

DMR Technical information, and PNW DMR update.

Q&A

Dave/W7NCX with setting up a hotspot.

DMR Overview

Background

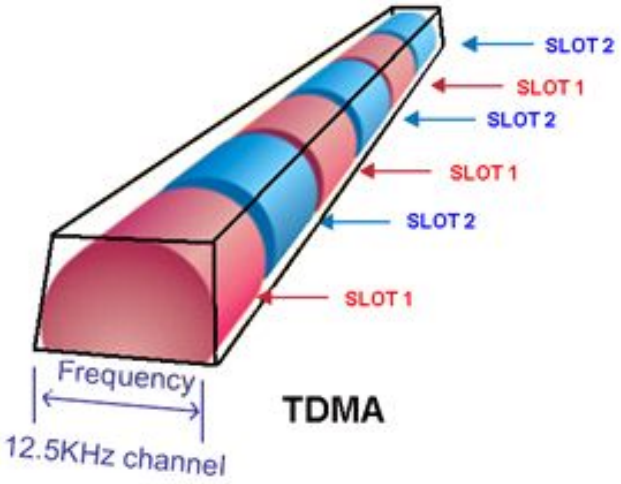
- ETSI (European) standard for Digital Mobile Radio
  - Open Standard
  - Ratified in 2005
- Three (3) Tiers, I, II, III
  - Tier I Unlicensed (dPMR)
  - **Tier II Conventional, direct or repeater, non-trunked**
  - Tier III Trunked
- Hams started to use it in the mid 2000's after surplus DMR radios were made available to them.
- The Amateur Radio DMR system(s) do not utilize proprietary features, so any DMR handheld that will work on Tier II systems will work on PNW DMR.

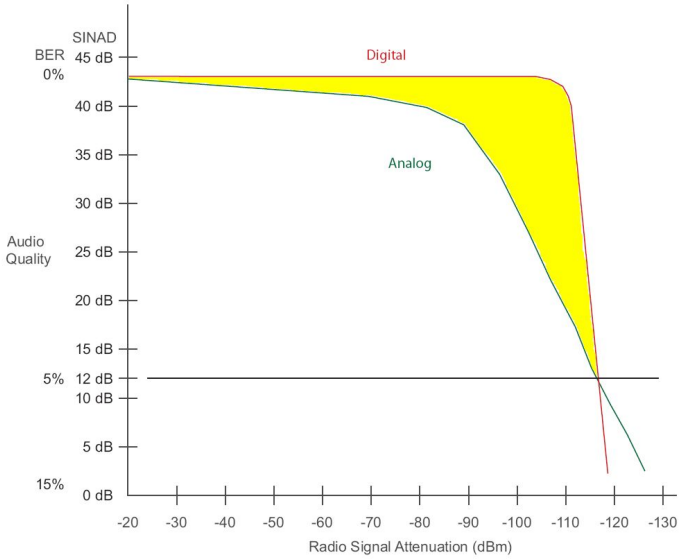
DMR Tech Overview

Technical Background

- 12.5 kHz BW (narrowband), with two time slots an equivalent of 6.25 khz per talk path
- 50% duty cycle, easier on the battery
- C4FM (“4FSK”) Modulation
  - same as P25P1, NXDN, and Yaesu Fusion
- **State-of-the Art Forward Error Correction (FEC)**
- DVSI AMBE++ VOCODER
  - very high voice quality
  - robust against strong background noise

- Time synchronization with repeater – beyond 70 miles, may have some performance anomalies. NO7RF reports 123 miles with no issues.





DMR Overview

Call Types and Features

- Group Call on a talkgroup (the vast majority of amateur DMR conversations)
- Individual Call (acknowledged and unacknowledged)
  - Discouraged or outright disabled, depending on the C-Bridge manager settings
- Short Data Messaging (Status, SMS, defined)
- Radio Check with Parrot and Audio Check TG's
- Location (Available on Brandmeister, not yet on PNW DMR)

- With two time slots on the DMR repeater, there can be two independent, simultaneous, conversations carried on the repeater (one per time slot).

DMR Radios

- Motorola used to be the only radio available
- Now “inexpensive” options from Connect Systems, Anytone, Btech, Alinco, Radioddity
- These radios can also be used on analog FM, and most have Part 90 Type Acceptance
- Most are single band, but now more dual-band options

DMR Radios

- Motorola MotoTRBO, including all original generation 1 handhelds and mobiles
- Anytone - AT-868UV, AT-878UV
- Connect Systems - CS-800D, CS-580, CS-750
- Radioddity
- Hytera, Vertex-Standard, also has Tier II radios suitable for amateur DMR
- These radios can also be used on analog FM, and most have Part 90 Type Acceptance

DMR Radios

Per the PNW DMR website:

Do Not Use List:

- Any Tier I modes; Baofeng DM-5R and DMR-5R Plus model
- Koytone
- If not on this list, generally OK to use.

DMR Radios

The DMR radios do have the ability to display a name and callsign on the display, but this "contacts list" has to be loaded into your radio.

- **The radio only transmits your ID number, and the other users will only see that number – unless your callsign and/or name is loaded into their radio.**
- **This differs from Dstar or Fusion, where your radio transmits your callsign.**

DMR radios also have audible feedback - Talk Permit Tones, out of range tones, end of transmission tones.

PNW DMR

So, what is the PNW DMR system?

- A system of approximately 31 DMR repeaters around Washington, Oregon, and Idaho on VHF and UHF provided for general Amateur Radio use.
- Many of these repeaters are owned by individuals or clubs, and those entities are free to dictate the supported talkgroup deck to satisfy their own needs.
- A system of MMDVM servers that allow various hotspots to connect into the system by users with no or poor coverage.

PNW DMR

Many of the PNW DMR repeaters are owned by a few individuals that buy the equipment, have it installed, and pay for their site fees.

There is (for now) no formal organization efforts (incorporation, LLC, 501(c)(3))

Thousands of hours are put in each year by various people to insure that all of this stuff continues to work - coding the c-Bridge, networking, site power, equipment failures, trips to hilltop to fix.

A big thanks to the HamWan community for offering to host many of our sites on their robust data backbone around the region.

Though there are no membership “dues”, we do encourage users to register on our Groups.io site - so that we can disseminate information to you about system issues. For access to our MMDVM servers, registration is mandatory and access credentials disseminated to registered users (this keeps the MMDVM server access controlled, so local users can have unfettered access to the system)

Local Systems affiliated with PNW DMR

- OR SAR has 9 repeaters in and around Portland metro and rural areas that were acquired and implemented specifically for SAR and EMCOM use. Those repeaters have a vastly different operating procedure than the main PNW DMR repeaters. Long conversations are discouraged. Refer to the OR SAR page at PNW DMR for those rules

- The Oregon South (OR-S) system has three repeaters around Newberg and Salem are NOT part of OR-N (OR-SAR), and use the same access rules as the rest of PNW DMR

- Four repeaters around Vancouver BC are on the BC-TRBO system, and have shared talkgroups with PNW DMR.

- Seattle ACS will have several repeaters on the air, and will likely have it's own manager to control Seattle ACS specific roles.

PNW DMR

The PNW DMR Admin Team

Mike NO7RF - c-Bridge Administrator and repeater owner

Rob AF7PR - Multiple repeater owner

Rod KC7AAD - Repeater Owner, c-Bridge host, and the really smart networking guy that answers most questions from users.

Lenny N7MOT - Repeater Owner, retired from the commercial radio industry - very knowledgeable about equipment and the DMR protocol

Brad N7ER - Early adopter and 70% Expert, user outreach and presenter for events like this.

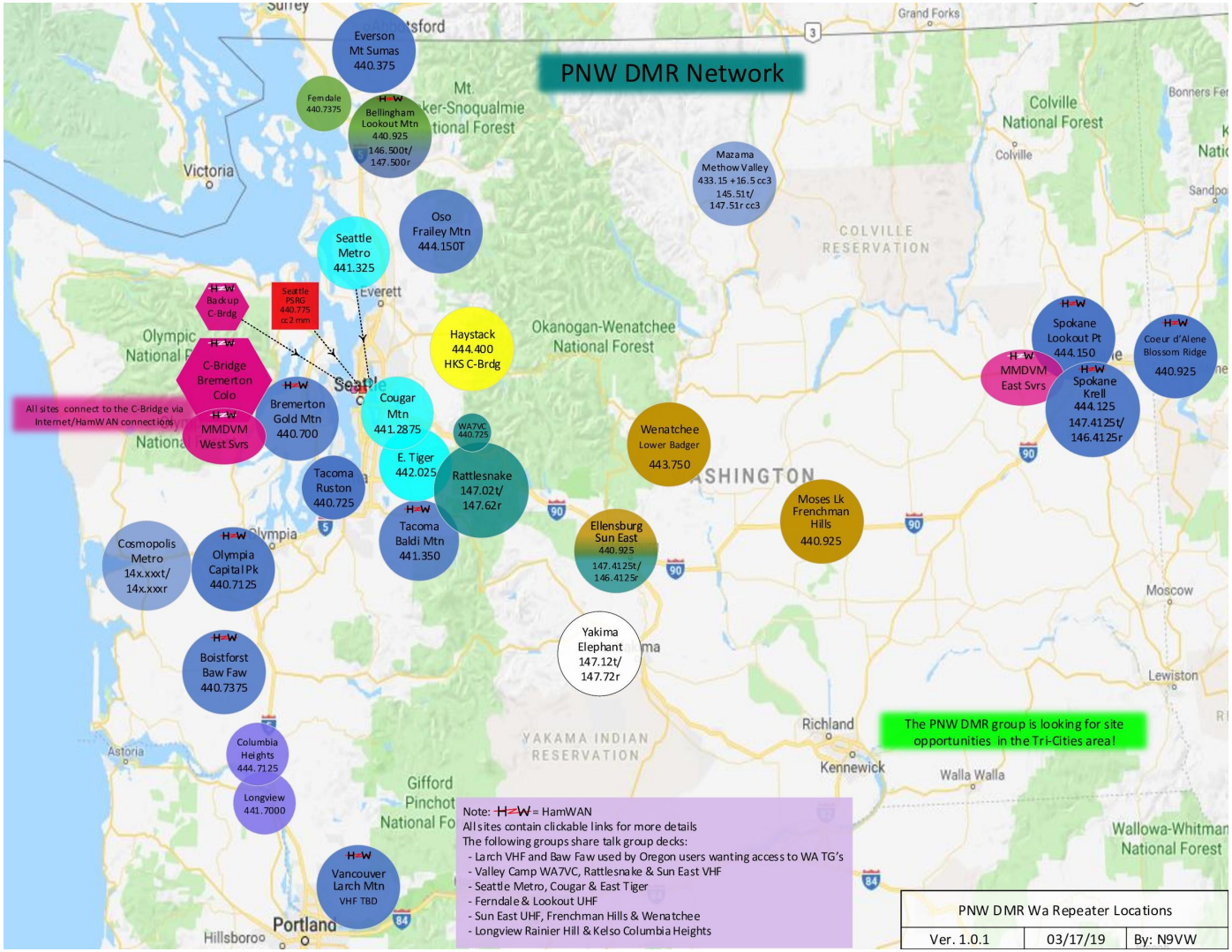
Others in the mix:

Dave W7NCX - Has been holding down the “Not a Net” gathering most Wednesdays since it’s inception. Has also created the cool Audio Level metering system that tells you if you’re too loud or too soft.

Dylan KI7SBI - Networking with Hamwan, 2nd c-Bridge host, MMDVM’s server creator, assigning IP addresses to our various assets through HamWan.

Mike KG7HQ - webmaster for new website.

Local DMR Repeaters



Other Local DMR Repeaters

There are a few Non PNW DMR repeaters in the region:

- Two repeaters on the Peninsula around Pt. Angeles are on Brandmeister
- The Ferndale repeater has elected to leave PNW DMR, and switch to Brandmeister
- Others?

Local DMR Repeaters

PNW DMR Repeater List

PNW Repeater Map

DMR Networking - c-Bridge

The PNW DMR repeaters are linked with a device called a C-Bridge

- Distributed by Rayfield Communications. Can be either hardware or virtual (PNW DMR has one of both).
- PNW repeaters are controlled by two C-Bridges - most repeaters are on the “PNW 1” C-Bridge, and a few other repeaters and the MMDVM servers are on the “PNW 2” C-Bridge (these names have nothing to do with the PNW talkgroups).
- Allows for better local control of the various PNW repeaters
- Each repeater can be on it’s own “manager” (set of rules), and be potentially independent from other nearby repeaters (“Local 1” generally means LOCAL to that repeater….there are a few exceptions).
- Also allows for talkgroups to be switched on or off for specific, scheduled events, on individual repeaters or network wide

DMR Networks

Other C-Bridges:

- HKS (for Haystack near Monroe, WA)
- DMR MARC (California)
- DMR-MARC Canada
- DMR Montana
- DCI Network (USA)
- Rocky Mountain Ham Radio (Colorado)
- Michigan TRBO
- VA3XPR (Toronto)
- New England DMR
- DMR UK, DMR France, DMR Italia
- Many others…..

DMR Talkgroups

A DMR talkgroup is a “virtual” channel on the DMR system.

- Controlled by the c-Bridge, the talkgroup tells the c-Bridge how to handle your call
- Can go either local (one repeater), or be routed to (potentially) every repeater in the world.
  - Dstar comparison – could be like being able to PTT and bring up different reflectors.

Some talkgroups are turned on full time; others are activated by the user by doing a “PTT” on the desired TG channel. That activates the TG on that repeater for a length of time determined by the c-Bridge.

The PNW DMR website has a talkgroup matrix shows the supported talkgroups on the system, and how the c-Bridge manages them.

Full Time vs PTT

F/3 = Fulltime TG with 3 minute hold off

- Will always activate the repeater, and will hold off other TG's coming up on that timeslot for 3 minutes after last PTT.
- After 3 minutes, other TG's on that timeslot will start coming through again.
- Another PTT on that timeslot and repeater for another TG will over-ride

P15/3 = PTT (Part Time Talkgroup)

- Will only come through repeater when someone hits their PTT and activates it.
- When PTT'd, will only be active for 15 minutes after last transmission on that talkgroup.
- Other TG's on same timeslot will be held off from repeater for 3 minutes.
- After 15 minutes with no PTT's on that TG on that repeater, the TG will turn off and no longer be heard.

Special Talkgroups

PNWR 2 - A regional talkgroup that is linked to Brandmeister

EmComm 1 and EmComm - Public Service Groups, on select repeaters as a local talkgroup, restricted to ACE/EMcomm users.

PS 1 and PS 2 - Regional, for EmComm and Public Service events, long hold off timers and activate most repeaters in region. Long hold off timers

TAC 1, TAC 2, TAC 3 - Tactical talkgroups for PNW DMR areas only. Operate just like TAC-310, but with a lot less noise. Only activates on repeaters that are "kerchunked".

Net 1 and Net 2 - Nets from around North America, only active during actual net event.

TAC-8 - PTT activated - if connected to a PNW MMDVM server, lets you talk to another station on the MMDVM server(s). Your radio traffic does not get passed onto any RF repeater.

Recommended Talkgroups

Recommended TG's for general use around PNW DMR?

Local 1 and Local 2
WA 1 and WA 2
PNW 1 and PNW 2
PNWR 2
OR 1
ID 1
Cascades East 1
Audio Test
Parrot
TAC-1

Talkgroups (Cont'd)

TAC talkgroups (TAC 1, TAC 2, TAC 3, TAC 310, TAC 311, etc). Special groups, only activated on the repeaters that have been PTT'd. Allows more of a "direct" link between operators. Doesn't tie up local/regional/national repeaters.

Before getting on the system - Get a DMR Radio ID

Each radio has a **unique ID that is registered** before accessing the networks

- ID numbers issued by RadioID.net.

Most users only need one ID number.

Ok to use the same ID number in all of your radios, as long as you're not using both radios (like giving one to a spouse). Could confuse c-Bridge.

DMR Programming

- Today's session is NOT a radio programming class.
  - Too many radio types out there to adequately cover all of them in one 50 minute block.
  - Groups.io has a "CPS-Programming-Codeplugs" reflector that you can sign up for and either search for answers, or pose the question yourself.
  - Group.io also has sample templates for some popular radios

- A couple of programming tools:
  - N0GSG Utility - takes an existing codeplug and allows you to manipulate the zone positions, scan list settings, RX groups, and allows the easy import of radio ID numbers.
  - K7ABD has created a utility that allows you to upload CSV files and have the utility create a codeplug for you - saving a lot of time with manual entry and debugging of the data.

https://www.k7abd.net/anytone-config-builder/

DMR Programming

The basic information needed to access a talkgroup?

- Repeater output/input frequencies
- Color Code (kind of like a PL tone)
- Time slot of the talkgroup (1 or 2)
- Talkgroup ID

Analog frequencies can be loaded into the radio along with digital TG's

"Zones" can be created, grouping specific channels together for easy access

Pay attention to the Matrix, and only program in the talkgroups supported by that repeater. Each repeater is different, and using a non-supported talkgroup on a repeater will just be an "Unresolved" call on the network. Heard locally, but not passed into the network.

Codeplug work is time intensive - if you take some work, share some work!

DMR Talkgroups

Some talkgroups are PNW DMR specific, others are national and others are international:

PNW DMR specific talkgroups (that may be carried outside the area by special arrangement)
**The 1 and 2 are generally used to identify the assoicated timeslot that talkgroup occupies*:*

WA1 and WA2, PNW1 and PNW2, PNWR 2, PS1 and PS2, Cascades East 1, EmComm 1 and EmComm 2, Oregon 1, Idaho 1, TAC 1, TAC 2, TAC 3

National and International talkgroups:

Bridge 2, California 1, Canada 2, Comm 1, Comm 2, DCI 1, DCI 2, Fusion 2, Hawaii 1, I-5, Montana 2, Mountain 2, Net 2, North America 2, SNARS 2, TAC 310 thru TAC 319, USA 2, WW 2, WW Eng 2

RX Lists

If no RX groups enabled, you can only hear the traffic from the talkgroup that's active on the channel you are monitoring.

Your radio "busy" light may be on during reception, but no traffic heard. It's almost like a PL tone (rough comparison).

Create an RX list of common Talkgroups carried on that timeslot, and your radio will "open up" it's speaker when those TG's become active.

You still have to dial up the right TG to answer back correctly. That's why it's important to announce what TG you are on when making a general "is anyone out there" call.

Most newer radios have some kind of "digital monitor" function to listen to traffic on one/both timeslots. Still good to have an RX list designated.

Can also use "Scan", however it's much slower on most radios.

MMDVM

PNW DMR offers MMDVM Servers for hotspot devices

Bridget - PNW
Wes - Western WA
Suzy - Eastern WA
Rex - 2-slot devices
Peter - Public Access server, for visitors from outside of PNW DMR
Emma - EmComm access

These servers have their own C-Bridge managers, and have unique talkgroups they support.

All of the servers (except Rex) are single slot devices, so not so critical in programming the radios to work (The server will do the timeslot work).

These MMDVM servers are for PNW DMR members. This prevents the servers from being tied.

MMDVM will be covered in more detail by Dave/W7NCX

Brandmeister

Yes, there is some ability to link into the DMR system with hotspots, and through a server called “Brandmeister”.

I don’t use Brandmeister, so I don’t know much about it’s application

The Brandmeister Server is a “virtual” DMR network. It can also support GPS location functions (with appropriate equipment).

Brandmeister requires the use of a DV4Mini, OpenShark ZumSpot, or other MMDVM-type hotspot.

Some talkgroups on Brandmeister are linked to the PNW DMR system:

- WA 1 (some support)
- PNWR 2
- OR 1, ID 1, MT 2
- TAC 310 thru TAC 312
- Bridge 2
- MPRG 2

Netwatch

A utility that allows you to monitor activity on PNW DMR networks - what repeaters are being used, the callsigns of users, and their signal strength into the network.

Makes it easy to monitor your own performance

Accessed from the top line of the PNW DMR page.

PNW DMR Updates

First Annual DMR Gathering at Valley Camp was well attended, and the post event reviews were favorable. Thanks to Thom (K7FZO) and Teena (K9HAV) Proehl for hosting at their facility, and to Bob, AF9W for organizing.

The “Audio Meter” project developed by Dave W7NCX is progressing nicely. It can be seen at http://www.w7ncx.com/levels.php. The utility will monitor audio levels on the Audio Test, WA 2, Parrot, and PNW Reg 2 talkgroups. Not real time, but gives you an idea of your “average”.

Recently, a replacement VHF repeater was activated NE of Portland, hopefully to provide some general purpose PNW DMR coverage in the area. Look for the “Ariel” repeater for programming information.

Rattlesnake (Snoqualmie) VHF repeater back on the air as of early May.

Tri-Cities expansion still in process.

Any other cool news and updates?

PNW DMR website

Since most of you are in the PNW, I will direct you to the PNW DMR website:

http://www.pnwdigital.net

Maintained by Mike, NO7RF. Extensive local information on the PNW-DMR system. The first place to go for answers. Also has Groups.io signup information.

Admin Team - pnw@pnwdigital.net

PNW DMR website

Hopefully, time for Q & A

THANK YOU !

Dave W7NCX is next to talk about MMDVM servers

Brad Estill

N7ER