Digital Mobile Radio

DMR 101

Before We Begin…..

- Amateur Radio is Experimental
- Amateur Radio is Learning and Fun!
- Amateur Radio is pushing the boundaries in technology
- Amateur Radio is Amateur Radio and Fun!
- DMR is not the replacement of Analog, DStar, IRLP, Echolink, Packet Radio, HF Radio, Moonbounce, Scatter, Contesting, Electronics, the universe….

What is **D**igital **M**obile **R**adio

- Commonly Known as "DMR"
- A Standard for Digital Voice Communications
- Published by the European Telecommunications Standards Institute (ETSI) in 2005 (Tier 1 & Tier 2) | 2015
- The goal of the standards to create a digital systems are:
  - Low Cost
  - Low Complexity
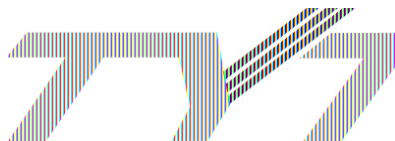 - Interoperable Between Vendors

DMR Association

- A Global Organization Focused on Growing the DMR Market
- Provides
  - Interoperability Testing
  - Certification
  - DMR Education, Promotion and Encourages Discussion

DMR Association Members

The DMR Standard

- Specifies the Air Interface Between Radios
- 2-Slot Time Domain Multiple Access (TDMA)
- 12.5 kHz Channel Width
- Digital Modulation (4FSK)
- Frequencies Between 30MHz - 1 GHz
- DMR Association Members Have Agreed to Use the AMBE +2 Vocoder

Benefits of Using DMR

- Allows 2 Simultaneous Voice Conversations using a Single Repeater
- Improved Audio Performance Over Analog
- More Efficient Use of Radio Spectrum vs Analog
- Longer Battery Life vs. Analog
- Lowest Total Cost of Ownership for Clubs - Compared to Other Ham Digital Modes
- +12 DMR Radio Manufactures = Lower Radio Prices
- Capable of Being Linked to Over 1,800 Repeaters Worldwide

Features of HAM DMR Network

| Features	Benefits
Multiple Talk Groups	Allows users to access groups of other users by geography or language by simply keying their rados. No node numbers to dial or remember
Dual Timeslots	Allows 2 simultaneous conversations using a single repeater. Like having 2 repeaters on one frequency.
Text Messaging	A quick and convenient way to send messages to a group or a single person.
Roaming	Allows DMR radios to switch between repeaters automatically, common TG
Remotely IP Programmable Repeaters	Allows the repeater sponsors to make changes remotely
APRS	Radios beacon location (radios with GPS Built in) Brandmeister Network Only
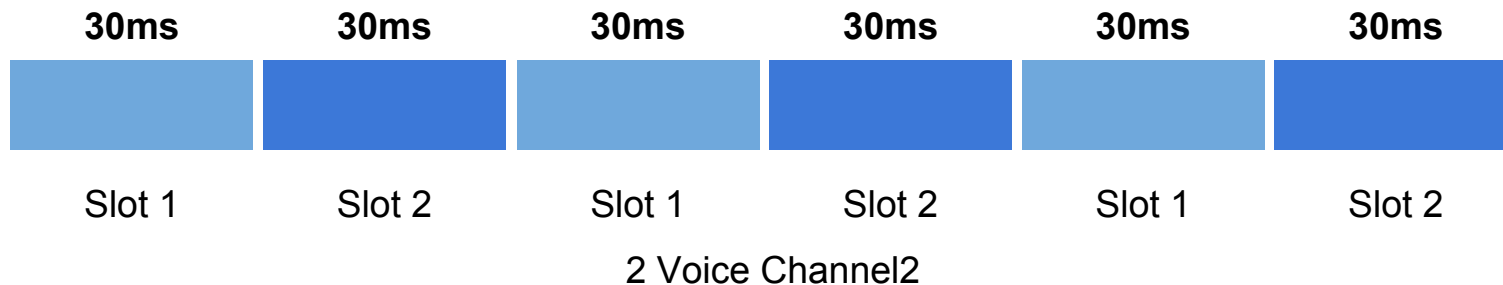
Improved Voice Performance
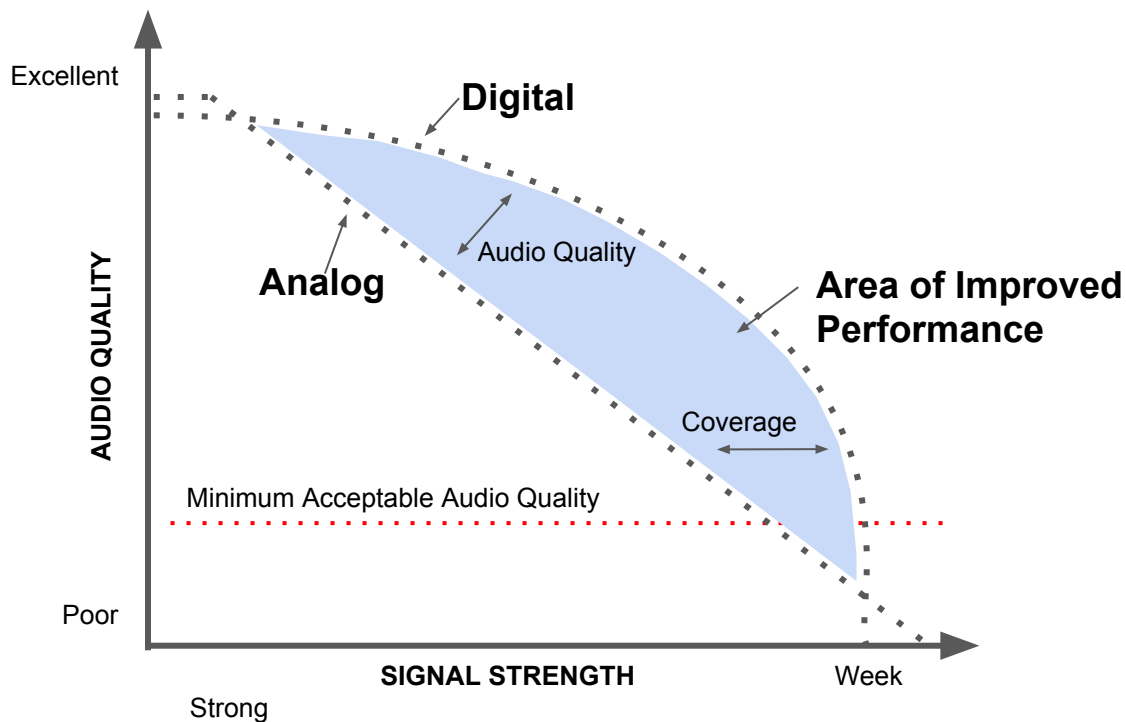
- No Hiss, Popping or Static
- Better RF Range than older digital technologies
- Forward Error Correction and Cyclic Redundancy Check Coders

Improved Voice Performance

Communication Footprint
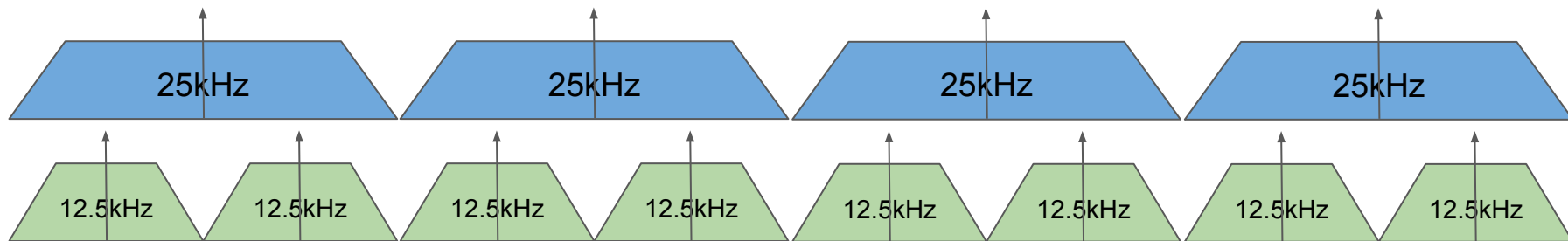
Digital Mode

Analog Mode
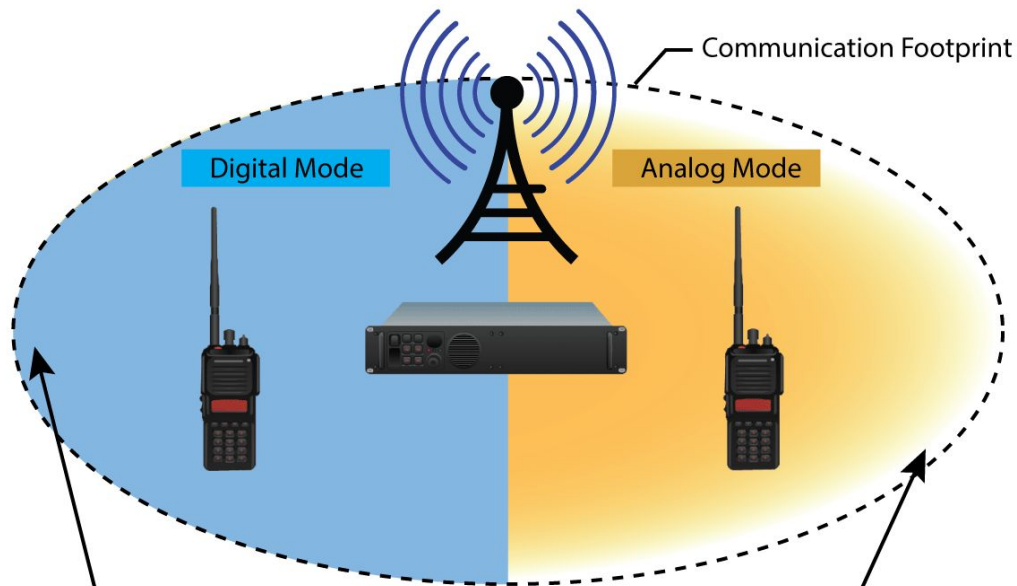
Digital signal is still clearly heard at the fringes of the coverage footprint.

Analog signal becomes harder to hear through noise at the edge of the communcation range.

Longer Battery Life

- Up to 40 percent in talk time compared to analog radios.
- Radio is transmitting half the time due to TDMA
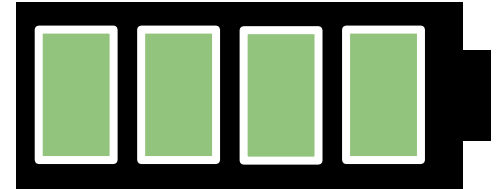
DMR Network Definitions

Term	Definition
Talkgroup	A Virtual Radio Channel, Typically assigned by geography or language.
Timeslot	A brief interval to which a DMR radio, especially a repeater, accepts data from another radio. For DMR there are two (2) 30ms time slots.
Color Code	A number that is analogous to the PL or CTCSS tone used during analog FM Analog Operation.
C-Bridge	A Server that bridges together regional DMR Networks. Or Brandmeister
User ID	A unique number assigned to each radio on the DMR Network. Also known as "Subscriber ID" or a "Radio ID"
CPS	Short for Customer Programming Software, which is the software used to program a DMR Radio.
vocoder	A Synthesizer in DMR Radio that converts analog voice to digital data.
Master	A DMR Repeater that connects to a c-Bridge on a ham DMR Network. All other DMR repeaters that connect to the network through the master are called peers.

Digital Voice Systems

Format Feature	P25 Phase II	DMR	DSTAR	FUSION	NXDN/IDAS
Operating Band	VHF, UHF, 700/800	70cm, 2m, 33cm	2m, 70cm, 33cm	2m, 70cm	70cm, 2m, 33mc
Dual Band	Yes	No	Yes	Yes	No
Battery Life	40% Longer	40% Longer	Normal	Normal	20% Longer
Dual Time Slot	Yes	Yes	No	No	N/A
Range	20-25% over wideband analog				
Manufacture Specific	No	No	Yes, Icom	Yes, Yaesu	Yew, Kenwood, Ritron/Icom
# of Manufactures	>6	25+	1	1	2/1

Digital Voice Systems

Format Feature	P25 Phase II	DMR	DSTAR	FUSION	NXDN/IDAS
Protocal	TDMA	TDMA/4FSK	GMSK	FDMA/C4FM	FDMA
Vocoder	AMBE+2	AMBE+2	AMBE	AMBE+2	AMBE+2
Forward Error Correction	Yes	Yes	No	No	Yes/Yes
Spatial Efficiency	12.5kHz dual 6.25kHz	12.5kHz dual 6.25kHz	6.25kHz	12.5kHz	6.25kHz/12.5Khz
Adopted Worldwide Standard	Yes, Public Safety	Yes, Commercial & Amateur	Yes, Amateur Radio Only	No, Amateur Radio Only	No
# Repeaters in US	170	908	1100	219	52

DMR Standards

- Tier 1
  - FDMA
  - dPMR - 446 MHz European Unlicensed Service
- Tier 2
  - 2 Slot TDMA
  - IP Site Connect (Vendor Specific)
- Tier 3
  - 2 Slot TDMA
  - Trunking

Amateur Radio DMR Networks

- Over 2,100 Repeaters Worldwide
- Over 34,000 Registered Radios Worldwide
- Over 14,700 US Registered Radios
- Networks Divided by Infrastructure
  - CBridge, SmartPTT - Mototrbo (Motorola Solutions)
    - Primarily US/UK
  - Brandmeister - Hytera, Mototrbo, Homebrew, MMDVM, DV4Mini, DVMega
    - Worldwide Growth - Newest System
  - DMR +
    - Original Hytera Network
    - Growth slowing and decreasing in use

Amateur Radio DMR Networks - Nevada

Repeaters

29 Repeaters Statewide

   5   Reno/Tahoe

   2   Elko

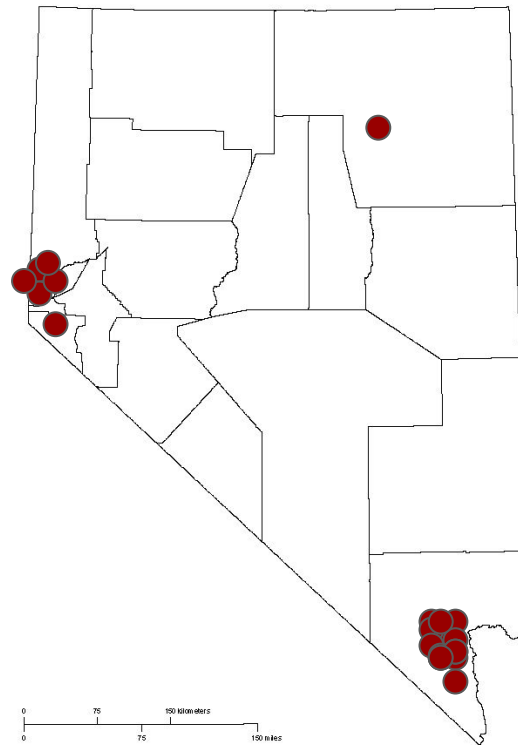22 Southern (LV, Henderson)

Users

364 Registered Radios / IDs

160 Southern Nevada

204 Northern Nevada

   164 Reno / Tahoe Area

Low Cost of Ownership

Example: A Ham Radio Club of 20 Members

	Quantity	FUSION	DSTAR	DMR
Digital Repeater	1	$620[1]	$1,548[6]	$1,800[2]
Programming Cable & Software	1	$0	$0	$375
Digital Portables	20	$6,000[3]	$6,000[5]	$3,980[4]
Total		$6,620	$7,548	$6,155

1. Yaesu club price - $500.00, Wires-X $120.00
2. Motorola XPR 8400 Ham Friendly Dealer
3. Yaesu FT1DR-HD @ $300.00 Each
4. Connect Systems CS750 - 170.00 (Group Order)
5. ICOM IC-ID31A @ $300.00 Each
6. Icom Club Price ID-RP4000V @$700.00 ID-RP2C @$848.00

Mototrbo Repeaters

XPR 8400

SLR 5700

Portable Radios

Connect Systems CS750
$239.00

TYT MD380
$120.00

Motorola XPR6550
$450.00

Motorola XPR7550
$700.00

Vertex/Standard EVX-539
$350.00

Hytera PD-782
$585.00

Mobile Radios

**Vertex/Standard
EVX-5400
$400.00**

**Connect Systems
CS800
$280.00**
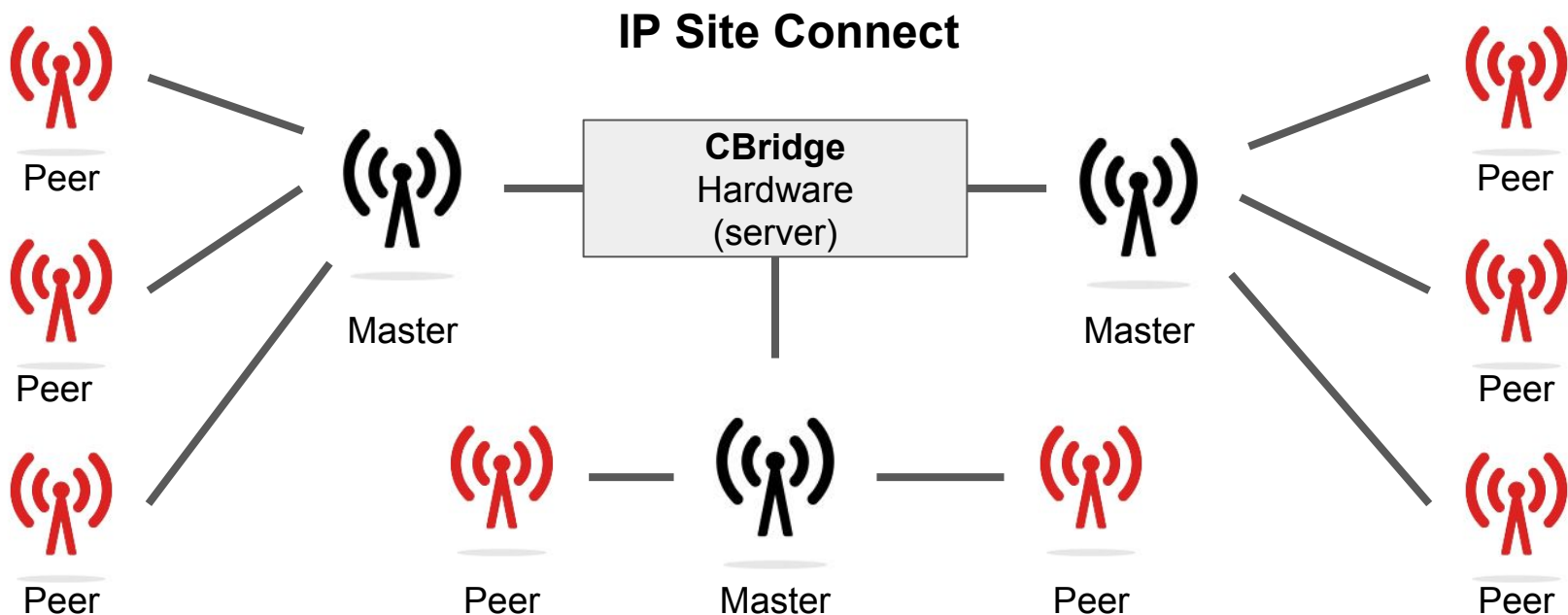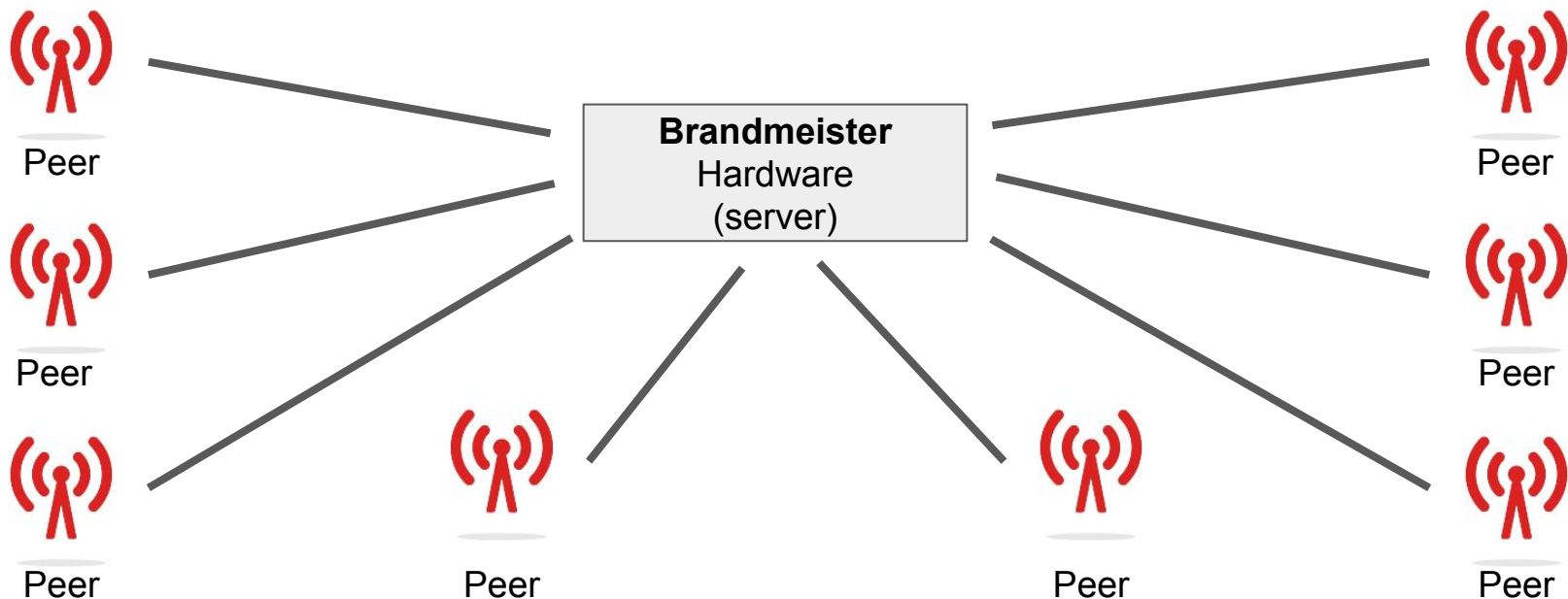
**Motorola
XPR5550
$600.00**

**Hytera
MD782
$565.00**

**Motorola
XPR4550
$450.00**

Network - How it Works

IP Site Connect

Network - How it Works

Common Courtesy

- All Radios Must Register for a 7-Digit DMR ID - http://dmr-marc.net
- **ID** - You Must ID the same as you would on Analog - Per FCC Rules
- Remember you might be keying up 100+ repeaters
- **Test** - If you want to test go to Echo Test (Parrot) and ID
- **Pause** - pause between your communications to allow others to join

Common Courtesy

- What to do when keying up talk group
  - Give your Call and the Talk Group you are on
  - You can simply say "W7XM on SNARS Listening"
  - or "W7XM on SNARS"
  - or "W7XM on SNARS Looking for QSO"
  - Do whatever you feel comfortable

Timeslots and Talkgroups

A Virtual Radio Channel, Typically assigned by geography or language.

Sample Talkgroups on the SNARS Systems

Talkgroup	Time Slot	Name	Connection	Timers
6968	1	SNARS	Always Active	
3132	2	Nevada	Always Active	Hold Off 5 Mins
3107	2	California	Always Active	Hold Off 5 Mins
1	2	World	User Activated	5 Min Activity
3	2	North America	User Activated	5 Min Activity

Getting Started as a DMR User

1. Check that you're within the coverage area of a DMR Repeater
2. Request a User ID
3. Obtain a DMR Radio, programming hardware and software
4. Program your DMR Radio
5. Code Plugs available on websites, groups

Setting up a DMR Repeater

1. Obtain a Motorola MOTOTRBO DMR Repeater
2. Obtain a coordinated repeater frequency
3. Secure Location with Internet Access (500 kpbs minimum)
4. Register for a Repeater ID
5. Apply to join a DMR Network, such as DMR-MARC or Mountainwest

Other ways to Access DMR

DV Mega

$260 Gigaparts
Dual Band
Raspberry PI

DV4 Mini

$129
UHF

MMDVM

$70
Board & DUE
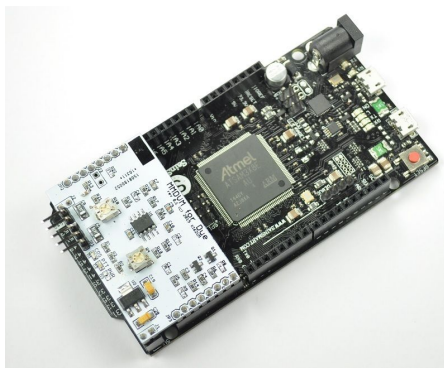
OpenSPOT

$??
UHF
Release in May

Other ways to Access DMR

Brandmeister Network
http://hose.brandmeister.network

- Scanning (5 Talk Groups)
- Archive of Audio (30 Days)
- Audio Meters
- Save Scan List via URL
    - /scan/TG1,TG2, etc

Questions

http://snars.org/dmr

http://dmr-marc.net

http://mountainwestdmr.org

http://norcaldmr.org

http://papasys.com/dmr

http://brandmeister.network

http://hose.brandmeister.network

http://utah-dmr.net

http://www.trbo.net