

DMR: Introduction to a New DV Mode for AMATEUR RADIO

BARA Presentation 09-2016 Kai Chen, K2TRW



Presentation Summary



Digital Mobile Radio

- An ETSI published global standard
- Over a DOZEN manufacturers of radios (Hytera, Vertex, Motorola, Tait, BFDX, ...)
- Superior voice quality (AMBE+2) vs older digital modes (AMBE, IMBE, GMSK)
- Longer battery life!
- Supports multiple talk groups
- Supports data applications (txt,gps)



Intellectual Property Licensing



MOTOROLA SOLUTIONS

MOTOROLA DMR LICENSEES

(as of 01 July 2016)

	 Alfacom S.r.I. (f/k/a EMC S.p.A.)
	 ASELSAN Elektronik Sanayi ve Ticaret A.Ş.
	 Excera Technology Co., Ltd.
BFDX	 Fujian Beifeng Telecom Technology Co., Ltd.
	 Guangzhou Victel Technology Co., Ltd.
lytera	 Hytera Communications Corporation Limited
	 JUSTON Electronic Equipment Co., Ltd.
enwood	JVCKENWOOD Corporation
	Kirisun Communications Co., Ltd.
	 Lisheng (Euijan) Communications Co. Ltd.
nytone	Oixiang Electron Science & Technology Co. 1 td
S Radio	Quansheng Electronics Co. Ltd
ydera	Ouanzhou City New Century Communication Electronics Co. Ltd
	Quanzhou Eeije Electron Co. Ltd
	Ouanzhou SEE Electronic Technology Co. Ltd.
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series	Shenzhen COVALUE Communications Co., Ltd.
	Shenzhen Samnoo Science & Technology Co., Ltd.
	lait Electronics, Ltd.
imoco	TTG Global Ltd.
	TYT Electronics Co., Ltd.
	Uniden America Corporation
Puxing	 Xiamen Puxing Electronics Science & Technology Co., Ltd.

DMR Standards



DMR Standard

DMR Tier II: Conventional

- Licensed conventional radio systems, mobiles and hand portables operating in PMR frequency bands 30 to 1000 MHz
- Targeted at users who need in licensed bands:
 - Spectral efficiency
 - Advanced voice features
 - Integrated IP data services.

DMR Standards Public Access



DMR Main Characteristics

- 12,5 kHz channel
- 9,6 kbps gross bit rate
- 4-FSK modulation (constant envelope)
- 2-slot TDMA channel
 - Built around a 30 ms slot structure
 - 50% duty cycle slot structure
 - Forward and reverse transmission on a time division basis
- Voice, data or generic signaling
- Designed for frequency bands from 30 to 1000 MHz

Half the Channel Bandwidth



 $f_c - 12.5$ f_c $f_c + 12.5$ $f_c - 6.25$ f_c $f_c + 6.25$

Traditional Analog 25 kHz Channel Bandwidth DMR <u>12.5 kHz</u> Channel Bandwidth

1 Channel 1 Repeater

2 Channels 1 Repeater

More Spectrum Efficient than Older Digital Modes

f_c - 6.25

 $f_c - 11.25$ f_c $f_c + 11.25$

Guard Band as large as 10 kHz between channels Total BW= 22.5 kHz No Guard Band between 2 channels Total BW= 12.5 kHz

 $f_c = f_c + 6.25$

TWO Repeaters in One!



Longer Battery Life





Older Digital Modes (FDMA) DMR (TDMA)

"For each hour of usage the TDMA radios show between 19% and 34% less battery capacity is required than for the FDMA models."

"40 percent improvement in talk time in comparison with analog radios "

http://dmrassociation.org

Better Signal Quality



- No hiss/pop/static
- Forward Error Correction (FEC), Cyclic Redundancy Check (CRC) encoding
- Better RF range due to processing gain

S unit, dBm, milliWatt

<u>S</u>	<u>dBm</u>	<u>mW</u>	mV at 50 ohms
S0	-127	0.00000000000199526	0.00009988149
S1	-121	0.00000000000794328	0.00019928977
S2	-115	0.00000000003162278	0.00039763536
S3	-109	0.00000000012589254	0.00079338686
S4	-103	0.00000000050118723	0.00158301490
S5	-97	0.00000000199526231	0.00315852997
S6	-91	0.00000000794328235	0.00630209582
S7	-85	0.00000003162277660	0.01257433430
S8	-79	0.00000012589254118	0.02508909536
S9	-73	0.00000050118723363	0.05005932649

Better Audio Quality

 Listen for yourself. DMR <u>does</u> sound better than older digital technologies.



Better Performance

- DMR radios share basic processing, resulting in
 - Better sensitivity;
 - Better selectivity;
 - Better intermodulation rejection;
 - Better spurious rejection;
 - Better blocking;
 - Better adjacent channel power;
 - Better adjacent transient channel power.
- More rugged
 - IP54/IP65/IP67 (dust tight/splash to immersion)

Amateur Digital Voice Systems

• D-STAR (Icom)

- GMSK/AMBE Vocoder
- P25 Phase 1 (Multi-Vendor)
 - FDMA/IMBE Vocoder
- System Fusion (Yaesu)
 - FDMA/C4FM/AMBE+2 Vocoder
- DMR (Multi-Vendor)
 - 2-slot TDMA/AMBE+2 Vocoder
- Digital Voice System outside of DMR Standard

Data and Voice at the Same Time





Slot 2 GPS Location

(or second channel voice when not sending GPS data)



Give your location WHILE talking!

Dynamic Mixed Mode: First in – First Out Analog Analog

OR

Slot 1 TDMA

Slot 2 TDMA

Repeater dynamically detects the type of input IP site connect is supported on digital modes

This is an option for a phased migration from analog to networked DMR repeaters.

Slot 1 TDMA

Slot 2 TDMA

IP Site Connect 1 or 2 slots (channels)



IP Site Connect

- A peer can participate with one or both time-slots
- Peers register with the Master
- Master keeps peers informed about other peers
- Master/Peers function as a fully meshed network for voice and data traffic
- If the Master fails, the fully mesh network continues to operate, but new peers can not join nor are changes announced
- A third-party bridge (c-B or SmartPTT) is used to interconnect IP Site Connect networks

TRBO Repeater Bridges

- Links master repeaters (groups of 15-20), and bridges
- Manufacturers: Rayfield; Bridgecom
- Provides arbritration. If two users key up simultaneously, one gets denied and immediately is notified to prevent dual transmissions.

Rayfield TRBOLink (C-Bridge)

TRBOLink



TRBOLINK an IP-based networking controller designed to enhance wide-area system capabilities and to provide interoperability functionality between and non-particular (for example, analog and P25) systems in commercial (business and public safety) systems.

TRBOLink controllers connect into 📄 IP Site Connect (IPSC) systems through IP network connections (private or internet).

Whereas IPSC systems are limited to a maximum of 15 repeaters in one network, **TRBOLINK** controllers can be used to expand IPSC systems into very large systems, with hundreds of repeaters connected if needed. They also alow for dynamic bridging between repeaters or groups of repeaters and between time slots, based on talkgroup ID codes or pre-programmed "patches".

TRBOLINK systems handle voice (group, private and All Calls), GPS and ARS data, text messaging, Call Alerts, Radio Query, Radio Enable/Disable and Emergency Calls. This allows for a fantastic amount of flexibility in the operation of an IPSC system. For example, Emergency Calls and All Calls can be transmitted on one time slot, but be received on both time slots.

Analog interfaces are available to tie into the accessory ports on repeaters, base stations, control stations or analog dispatch consoles, providing interoperability between a systems and conventional analog, P25 conventional or trunking or other non- systems.

TRBODispatch, PC-based Radio Dispatch Client software, allows for computer workstation voice dispatching and manual remote bridging control. **TRBODispatch** connects directly into a system, through an IP network connection (private or internet) to a **TRBOLINK** controller. No control station radios are needed.

More information about the TRBOLink can be found Here in our Library section.

Bridgecom TL-Net

Home > Products > TL-NET MV-DMR



TL-NET MV-DMR

\$ 1,295.00

MV-DMR 2U Chassis

5 License 🔻





Add to cart

Interested in linking your MOTOTRBO repeaters to the DMR-MARC or DCI network?

Is your Amateur Radio Club, Business, or Public School District interested in creating its own wide-area DMR Network?

TL-NET MV-DMR is 100% compatible on the DMR-MARC and DCI network and can stand alone to create your own.

MV-DMR is a hardware solution (2U rack mountable) to connect several peers (repeaters) together. Choose the product that provides you with the number of peers (repeaters) you want to connect: 5 peer, 15 peer, 30 peer, or 50 peer.

TL-NET started as a wide-area site linking product for LTR in 2006. Since that time it has grown to include the linking of repeaters used for conventional CTCSS/DCS/CSQ and DMR digital.

Text Messaging



Send to one person, or a group of people.

- Weather Alerts
- Club Meetings
- Announcements



- 1500+ Site network in 45 US States, 46 Countries
 - ND(3), SD(10), LA(31) not [yet] deployed
- Also bridged to other Motorola Repeater-Based DMR networks
- 100% Pure Digital
- 20,000+ registered user IDs
- To register or learn more
 - http://dmr-marc.net

DMR-Plus Network

- <100 Site network in the US and Europe</p>
- Bridged to other Hytera repeater-based DMR networks
- 100% Pure Digital
- Allows interface to Motorola Repeaters (via R-pi & app)
- Allows data dongle into network -<u>http://www.dj0abr.de/english/technik/dstar/dv4/dv4_roadmap.htm</u>
- Shares user and repeater registration with DMR-MARC
- To register or learn more http://ham-dmr.de

BrandMeister Network

- Quickly supplanting DMR+
- Bridged to other non-Motorola DMR networks
- 100% Pure Digital
- Allows Motorola, Hytera, Radio Activity, Kirisun repeaters
- Allows APRS, texting, dongles, homebrew into network -<u>http://www.dj0abr.de/english/technik/dstar/dv4/dv4_roadmap.htm</u>
- Scanner-like monitoring via PC and Internet link
- Shares user and repeater registration with DMR-MARC
- This is the network to watch in 2016!
- To learn more https://brandmeister.network

DMR-MARC WW Repeaters



BrandMeister Home Page



NYC Metro Digital Network



Repeater Listing

West Orange, NJ KC2NFB 446.225 -5 MHz Color Code 1

Time Slot #1 - Group Call TG 444 Bronx Trbo System Wide - FT #2 - member only private Talk Groups

East Meadow, NY KC2NFB 444.400 +5 MHz Color Code 1

Time Slot #1 - Group Call TG 444 Bronx Trbo System Wide - FT #2 - member only private Talk Groups

Manahawkin , NJ K2HR 445.4250 - 5 MHz Color Code 3

Time Slot

- #1 Group Call TG 444 Bronx Trbo System Wide FT
- #1 Group Call TG 1 = World Wide -PTT
- #1 Group Call TG 3 = North America PTT
- #1 Group Call TG 13 = World Wide English-PTT
- #1 Group Call TG 3172 = NE / Regional-PTT
- #1 Group Call TG 310 = Tac 310 PTT
- #1 Group Call TG 311 = Tac 311 -PTT
- #1 Group Call TG 9998 = Parrot , Audio Test Server-PTT
- #2 member only private Talk Groups

Motorola CPS

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TYT and CS GEN1 (Generic)CPS

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XPR4550 Mobile



MD782 mobile





SL+XPR7550 Portables





PD782 portable



MTR-3000 100 w.Repeater



XPR-8400 50 w. Repeater





K1MOT Hudson Site

145 and 447 MHz MotoTRBO

- 50 watt Repeaters on
- 1400 VA UPS
- Kohler 14 KW Auto-start Generator

SLR-5000 50W Repeater



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SLR 5000 SERIES REPEATER



For your business to be successful, you need dependable voice and data communications that reach every corner of your operations. The MOTOTRBO SLR 5000 Series Repeater delivers high performance, high reliability two-way radio service with all the features you need to connect your workplace whether you're in the field or on the factory floor.

With its sleek form factor and low power consumption, the MOTOTRBO SLR 5000 Series is engineered for low cost of ownership. And with a huge leap forward in technology, it represents the next generation in repeaters as the cornerstone of a MOTOTRBO professional two-way radio system.

Whether you need the simplicity of a single site conventional system, or the powerful trunking capabilities of Capacity Plus, Linked Capacity Plus or Connect Plus, the SLR 5000 Series delivers the power of digital two-way radio to your workforce.

SLR-8000 100W Repeater



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SLR 8000 REPEATER



For better safety and efficiency throughout your organization, you need reliable voice and data communications that connect everyone and everything. The MOTOTRBO SLR 8000 Repeater delivers high performance, high reliability two-way radio service, optimized for your workplace. With its small outline and high reliability, it's engineered for low cost of ownership. And with a huge leap forward in technology, it represents the next generation in repeaters.

Versatile and powerful, MOTOTRBO combines the best of twoway radio functionality with the latest digital technology. It integrates voice and data seamlessly, offers advanced features that are easy to use and delivers increased capacity to meet your communication needs from the field to the factory floor.

Whether you need the simplicity of a single site conventional system or the powerful trunking capabilities of Capacity Plus, Capacity Max or Connect Plus, the SLR 8000 delivers the power of digital two-way radio to your workforce.

Tait TB9300 DMR Repeater

Dual 50W Repeaters Dual 100W Repeater 1000 Channels; uses modules of TB9100 for P25 to DMR conversion! Should support Conventional DMR (Tier2) in 2nd firmware revision!



RD-982 50 w. Repeater



Ham Friendly Dealers

- Sandy's Comm., contact Jeff, 866-993-9011
- KB Cubed LLC*, Barbara KD2JCK, 201-660-5051
- Amazon/Ebay sellers (no support)

Amateur DMR Growth by # Repeaters



Amateur DMR Growth by # Radio IDs



Some DMR Web Sites (check out the links at these web sites)

- <u>http://www.dmr-marc.net/</u> (great general info)
- <u>http://groups.yahoo.com/group/MOTOTRBO/</u> (need to join the group to access some links)
- <u>http://brandmeister.network</u> (Brandmeister)
- <u>http://trbo.org</u> (Independent Digital Network)
- <u>http://n2jti.net</u> (NJ-TRBO DMR Network)

DMR: A NEW MODE FOR AMATEUR DIGITAL RADIO

- Spectrum Efficient!
- Supported by multiple manufacturers!
- Longer Battery Life!
- Resilient Networks (no internet needed)
- To learn more http://dmr-marc.net

Questions?

Contact Kai Chen, <u>k2trw@arrl.net</u>

- Or <u>http://dmr-marc.net/contact.html</u>
 - Reserve your DMR Identification Number
 - For your next DMR radio