

# Introduction to Amateur DMR

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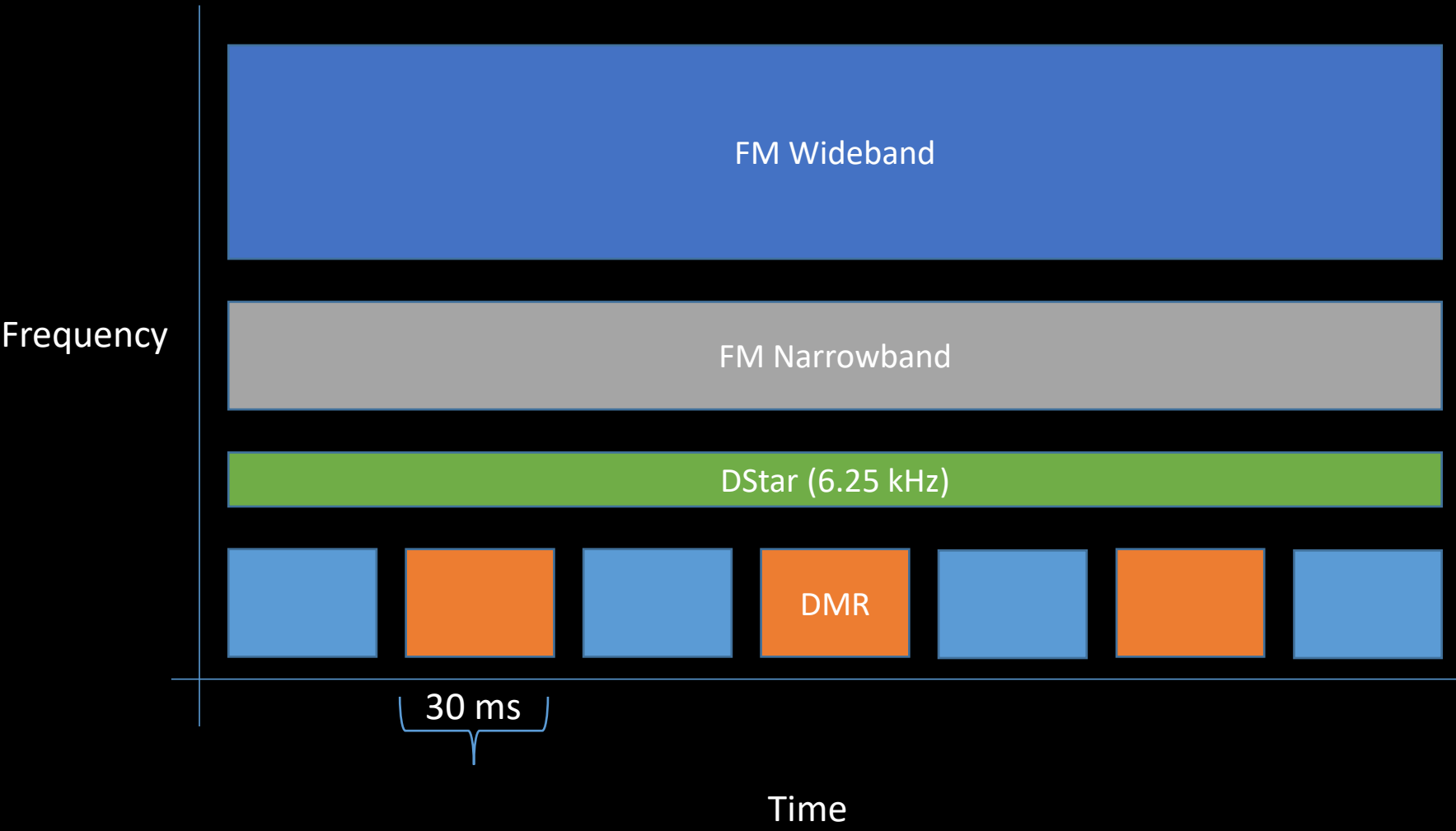
# Disclaimer

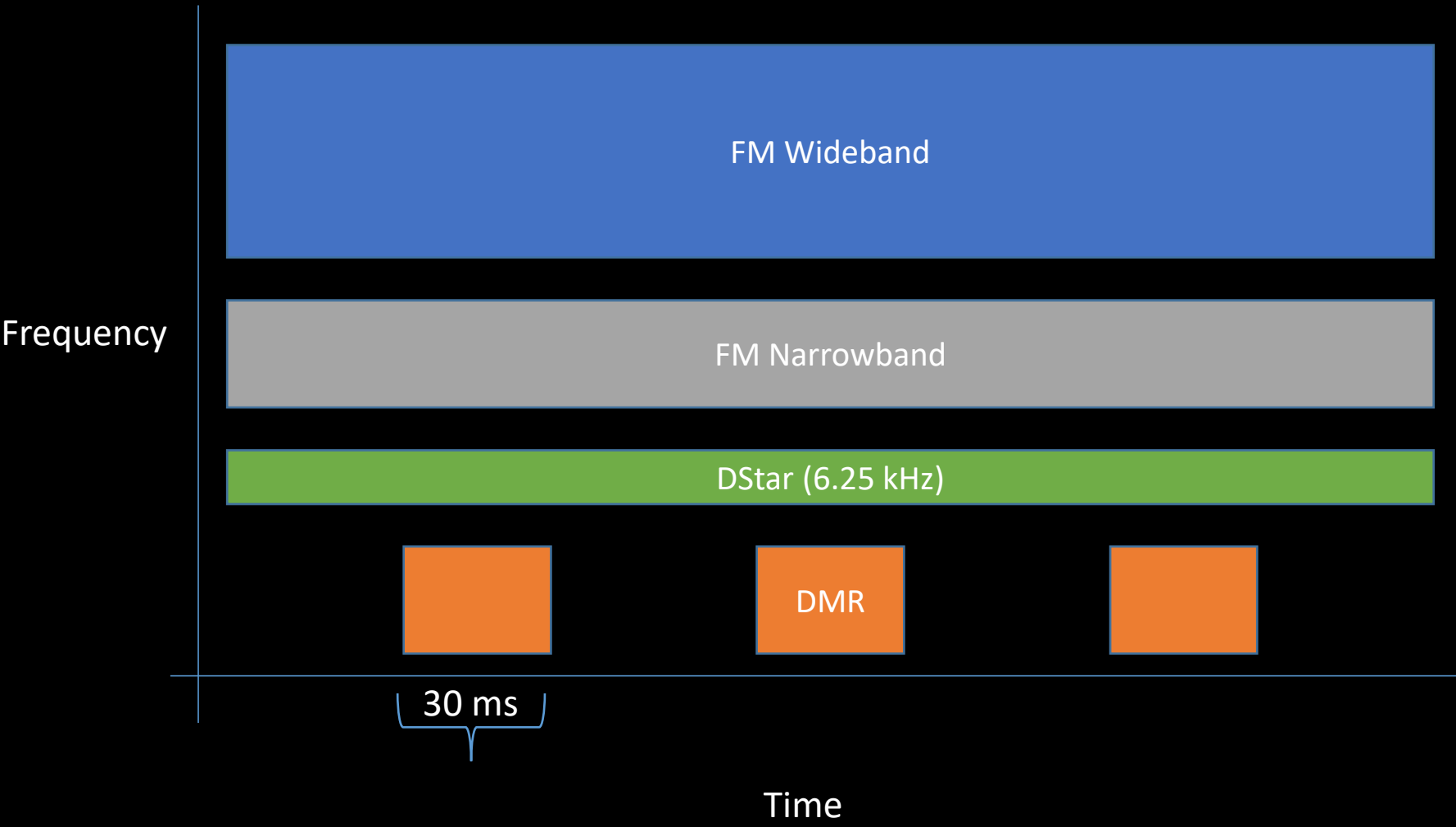
- I am not an expert
- I passed my Technician exam in August 2016
- I purchased my first DMR radio in October 2016
- Everything I say here could be (and probably is) completely wrong



# Basics

- Usually associated with Motorola, but there are many DMR vendors
- Used on VHF and UHF bands, but more amateur use on UHF
- Primarily a commercial spec. Make sure your radio supports amateur frequencies!
- Three types of DMR
  - Tier I: Simplex
  - Tier II: Repeater
  - Tier III: Trunking

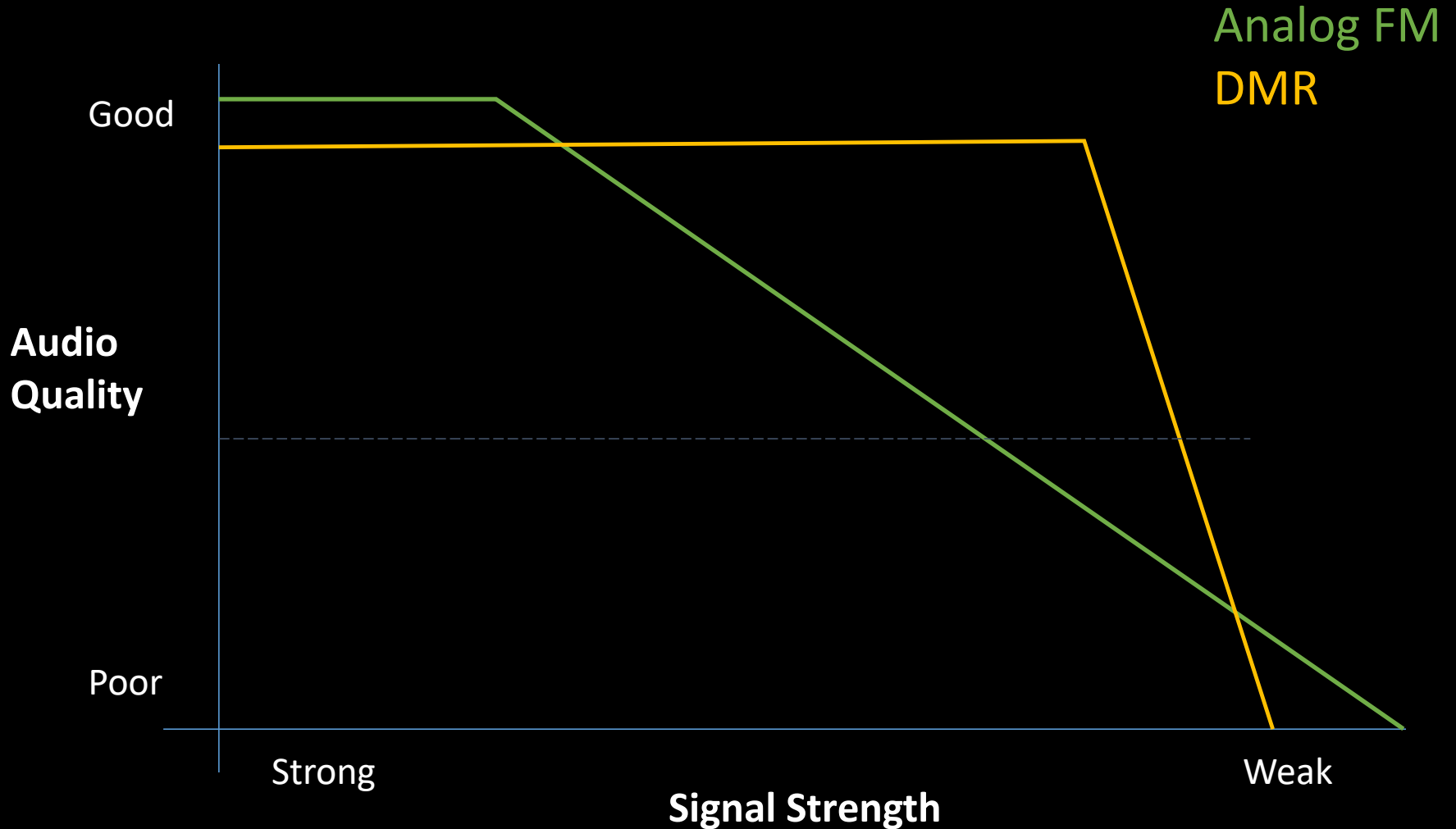




# AMBE+2 Codec

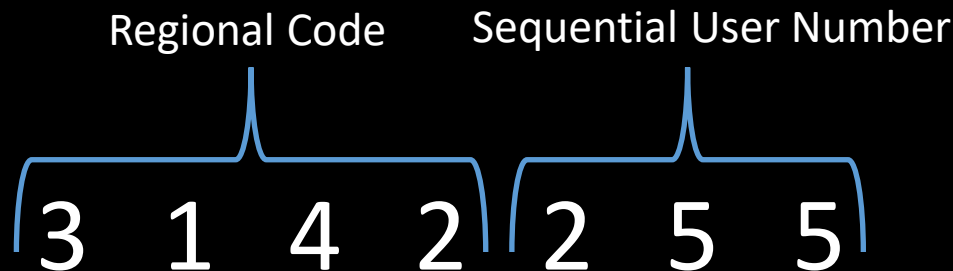
- Not part of the DMR spec, but used by all conventional DMR systems
- Slightly newer version of the codec used for DStar that includes better forward error correction
- Proprietary codec, and only available in hardware
- Arguments that use of a proprietary codec constitutes encryption (not encoding)

# DMR Audio Quality vs Analog FM



# DMR IDs

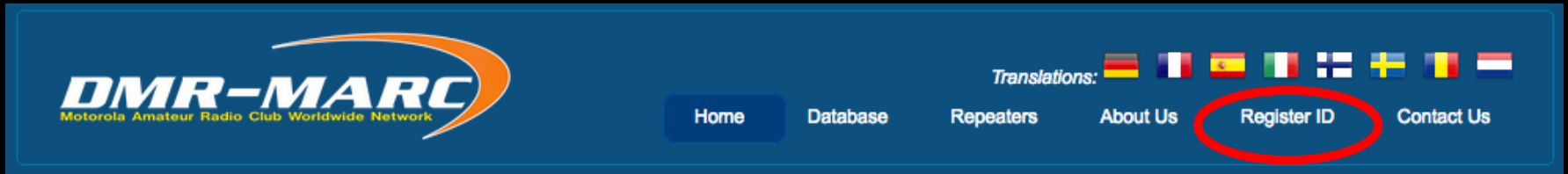
- Every user has a unique 7-digit number that identifies them
- Amateur DMR: Linked to a name and a callsign



- Repeaters use a similar 6-digit convention with the same regional code
- Every transmission is tagged with a user ID
- List of IDs, callsigns, and locations is public



www.dmr-marc.net



- Regardless of the network, all amateur IDs are managed by DMR-MARC
- DMR IDs are free, and you don't need a radio to register
- Fill out the form
- You will need a callsign
- Takes about 3 days to get a response via email
- *That ID MUST be programmed into your DMR radio*

# Repeater Linking

- Analog FM repeater, frequency with offset and maybe PL tone
- Linked analog repeaters are exceptions, not the rule
- DMR linking is formalized, occurs via TCP/IP (over the Internet)
- Step one, separate the conversation from the repeater
- Core concept of DMR Tier II

# Talk Groups

- All client transmissions are coded with a single Talk Group (TG)
- Repeaters send TGs they're configured to repeat
- In amateur use, usually organized by area or language
- Supported talk group can be static (always connected) or dynamic (PTT)
- Dynamic groups are linked temporarily when a client transmits a messages coded to that TG

<b>Talk Group</b>	<b>TG</b>	<b>TS</b>	<b>F/PTT</b>	<b>Source</b>
World Wide Calling	1	1	PTT**	DMR-MARC
North America Calling	3	1	F	DMR-MARC
WW English Calling	13	1	PTT	DMR-MARC
WW German Calling	10	1	PTT	DMR-MARC
WW Spanish Calling	14	1	PTT	DMR-MARC
WW Nordic Calling	17	1	PTT	DMR-MARC
Local2	2	2	F	Local Network
Local9	9	2	F	Local Repeater
Midwest Regional	3169	2	F/PTT*	DMR-MARC
Northeast Regional	3172	2	F/PTT*	DMR-MARC
MidAtlantic Regional	3173	2	F/PTT*	DMR-MARC
Southeast Regional	3174	2	F/PTT*	DMR-MARC
Southern Plains Regional	3175	2	F/PTT*	DMR-MARC
Southwest Regional	3176	2	F/PTT*	DMR-MARC
Mountain Regional	3177	2	F/PTT*	DMR-MARC
AL State	3101	2	F	AL-DMR (AL Reprtrs only)
FL State	3112	2	F	DMR-MARC-IPSC2 (FL Reprtrs only)
TX State	3148	2	F	LoneStar (TX Reprtrs only)
First Coast(NE FL)	31121	2	PTT***	K4USD
GA State	3113	2	F/PTT*β	DMRX (K4USD)
OH State	3139	2	F/PTT*β	DMRX (CODIG)
MA State	3125	2	F/PTT*	DMRX (MIT)
MN State	3127	2	F/PTT*β	K4USD
TN State	3147	2	F/PTT*	DMRX (VOLNET)
VA State	3151	2	F/PTT*β	K4USD
MD State	3124	2	F/PTT*β	K4USD
DC State	3111	2	F/PTT*β	K4USD

# DMR Channels

- One conversation via one repeater
- Consist of:
  - A repeater frequency and offset
  - A time slot (1 or 2)
  - A talk group
  - A color code (like a PL tone)

# When you press PTT

- Radio sends a packet to the local repeater with user ID, destination TG, CC
- Repeater sends a message back to the user saying if they're permitted or not (may result in a Talk Permit or Denied tone)
- If the repeater isn't current linked to that TG, it will contact the responsible bridge or peer
- Transmission is distributed to other repeaters who are listening to the same TG

# DMR Networks

- DMR-MARC
  - Uses Motorola IP Site Connect (IPSC) for linking
  - Contains K4USD network (including K3UCB in Ashton)
  - No hotspot support
- DMR-plus
- BrandMeister

# Last Heard (K4USD)



## Control Center K4USD Network

17:14:57 January 2

start time	duration	source peer alias	source radio alias	dest. bridge group	RSSI (dBm)	site name	loss rate
17:14:47.591 Jan 24	9.0	K1DO - Martinsville New Jersey USA -- 313407	WA2MOL - John - New Jersey United States -- 3134690	Tri-State CC	0.000	NJ-TRBO	0.0%
start time	duration	source peer alias	source radio alias	dest. bridge group	RSSI (dBm)	site name	loss rate
17:14:54.575 Jan 24	1.2	WA9VGI - Chicago Illinois USA -- 311731	KC9JZM - Jerry - Illinois United States -- 3117451	TAC317 CC ChicagoLand	-90.0	ChicagoLand	0.0%
17:14:18.775 Jan 24	24.8	WR3IRS - Waterford Works New Jersey USA -- 313411	KD2FQQ - Blake - New Jersey United States -- 3134372	Tri-State 33-66	-83.7	K4USD Network	0.0%
17:14:30.038 Jan 24	5.7	K2JRC - Manhattan West Side New York USA -- 313628	KB2UHD - David - New Jersey United States -- 3134170	TAC310 CC	-87.0	DMRX-P	9.0%
17:14:35.211 Jan 24	1.2	1313601	KB0IAN - Richard - Missouri United States -- 3129225	DMRpUSA CC	N/A	DMR-MARC-CC1	1.4%
17:13:53.826 Jan 24	20.1	K1DO - Martinsville New Jersey USA -- 313407	WA2MOL - John - New Jersey United States -- 3134690	Tri-State CC	-109.8	NJ-TRBO	0.6%
17:14:07.215 Jan 24	4.4	1313601	K9MAR - Omar - Wisconsin United States -- 3155085	DMRpUSA CC	N/A	DMR-MARC-CC1	1.4%
17:13:29.816 Jan 24	20.8	WR3IRS - Waterford Works New Jersey USA -- 313411	KD2FQQ - Blake - New Jersey United States -- 3134372	Tri-State 33-66	-88.5	K4USD Network	0.0%
17:13:03.368 Jan 24	36.4	W5CUI - Roanoke Virginia USA -- 315114	K1SO - Jerry - Virginia United States -- 3151363	Bridge CC	-103.2	DMRX-P	1.5%
17:13:22.390 Jan 24	3.4	K1DO - Martinsville New Jersey USA -- 313407	KB2KOS - Joseph - New Jersey United States -- 3134340	Tri-State CC	-103.9	NJ-TRBO	0.0%
17:13:12.908 Jan 24	3.1	K1DO - Martinsville New Jersey USA -- 313407	WA2MOL - John - New Jersey United States -- 3134690	Tri-State CC	-111.2	NJ-TRBO	0.0%
17:13:06.067 Jan 24	6.0	K1DO - Martinsville New Jersey USA -- 313407	KB2KOS - Joseph - New Jersey United States -- 3134340	Tri-State CC	-103.0	NJ-TRBO	0.0%
17:13:00.057 Jan 24	4.1	WR3IRS - Waterford Works New Jersey USA -- 313411	KD2FQQ - Blake - New Jersey United States -- 3134372	Tri-State 33-66	-93.5	K4USD Network	0.0%
17:11:58.571 Jan 24	60.2	BM Hot Spot -- 1	VE3NY - Thomas - Ontario Canada -- 3023284	Bridge CC	0.000	DMRX-P	0.0%
17:12:47.647 Jan 24	4.2	K1DO - Martinsville New Jersey USA -- 313407	KB2KOS - Joseph - New Jersey United States -- 3134340	Tri-State CC	-103.9	NJ-TRBO	0.0%
17:11:43.820 Jan 24	10.4	W5CUI - Roanoke Virginia USA -- 315114	K1SO - Jerry - Virginia United States -- 3151363	Bridge CC	-99.9	DMRX-P	0.0%
17:10:41.773 Jan 24	59.7	W5CUI - Roanoke Virginia USA -- 315114	K1SO - Jerry - Virginia United States -- 3151363	Bridge CC	-101.8	DMRX-P	0.3%
17:11:26.359 Jan 24	1.7	W8CMC - Detroit Michigan USA -- 312632	N8VIL - Sean - Michigan United States -- 3126970	Parrot CC	-122.3	DMRX-P	34.7%
17:11:05.254 Jan 24	1.0	13105300	Parrot Server	Parrot CC	N/A	DMRX-P	0.0%
17:11:02.527 Jan 24	1.9	W8CMC - Detroit Michigan USA -- 312632	N8VIL - Sean - Michigan United States -- 3126970	Parrot CC	-93.3	DMRX-P	39.5%
17:11:00.617 Jan 24	1.4	W8CMC - Detroit Michigan USA -- 312632	N8VIL - Sean - Michigan United States -- 3126970	Parrot CC	-123.0	DMRX-P	30.8%



# Hotspots

- Low-powered transceiver that connects to a DMR talk group via the Internet
- Many support DMR, DStar, C4FM
- No local repeater needed

SharkRF openSpot



Wireless Holdings dv4mini



PE1PLM DVMega w/ RPi



# Things To Remember

- Airtime is a resource
- You can't (usually) just listen to dynamic talk groups
- TDMA is sensitive
- Beware "Tier 1" or "Slot 1" radios

# Tytera (TYT) MD-380

- Single-band 5W HT
- Available from Amazon for less than \$100
- Most common DMR radio in amateur use
- Modified firmware available (see [md380tools](#))
- MD-390 also available (waterproofing, GPS)
- Rebranded by others (Retevis RT3)



# Other Vendors

- Motorola (MotoTRBO series)
- Connect Systems
- Hytera (PD series)
- Kenwood
- Vertex Standard
- ~~Baofeng~~

# Things That Aren't DMR

- DStar
- C4FM (Fusion) + WIRES-X
- P.25 (Project 25)
- NXDN
- dPMR

# Why DMR?

- Spectral efficiency
- Power efficiency
- Intelligible audio with poor connections
- Repeater and Hotspot linking
- Visibility with Last Heard
- Lower cost than many other digital modes
- Wide compatibility

# Questions?



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# Resources

- [Amateur Radio Guide to Digital Mobile Radio](#) by W2XAB
- [K4USD Network](#)
- [VA3XPR Code of Conduct](#)