

Digital Voice Modes

Presented to Overlook Mountain Amateur Radio Club

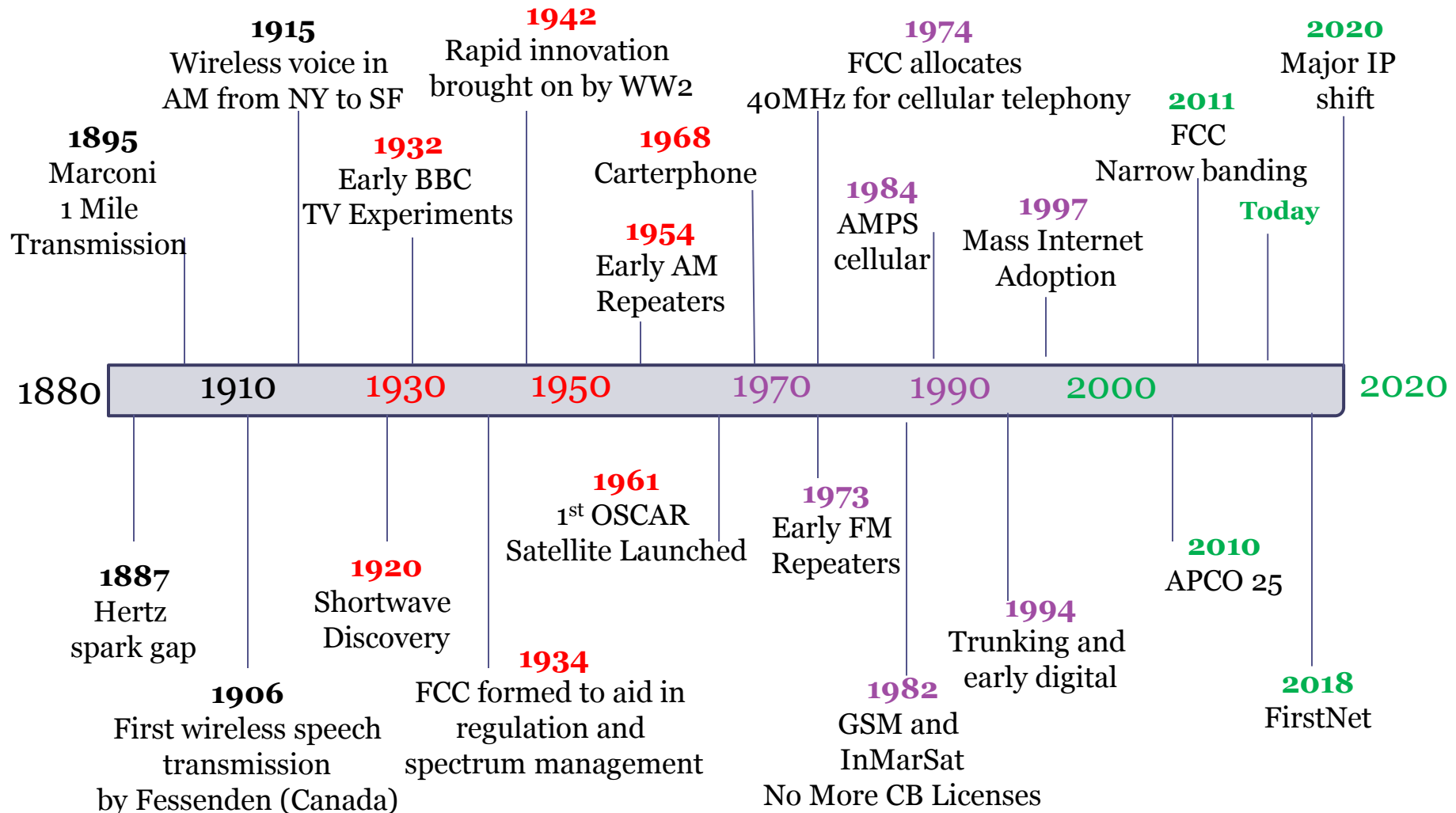
10/20/16

Steve Bossert
K2GOG@yahoo.com
+1-914-573-1799

Survey of Digital Voice Mode Users

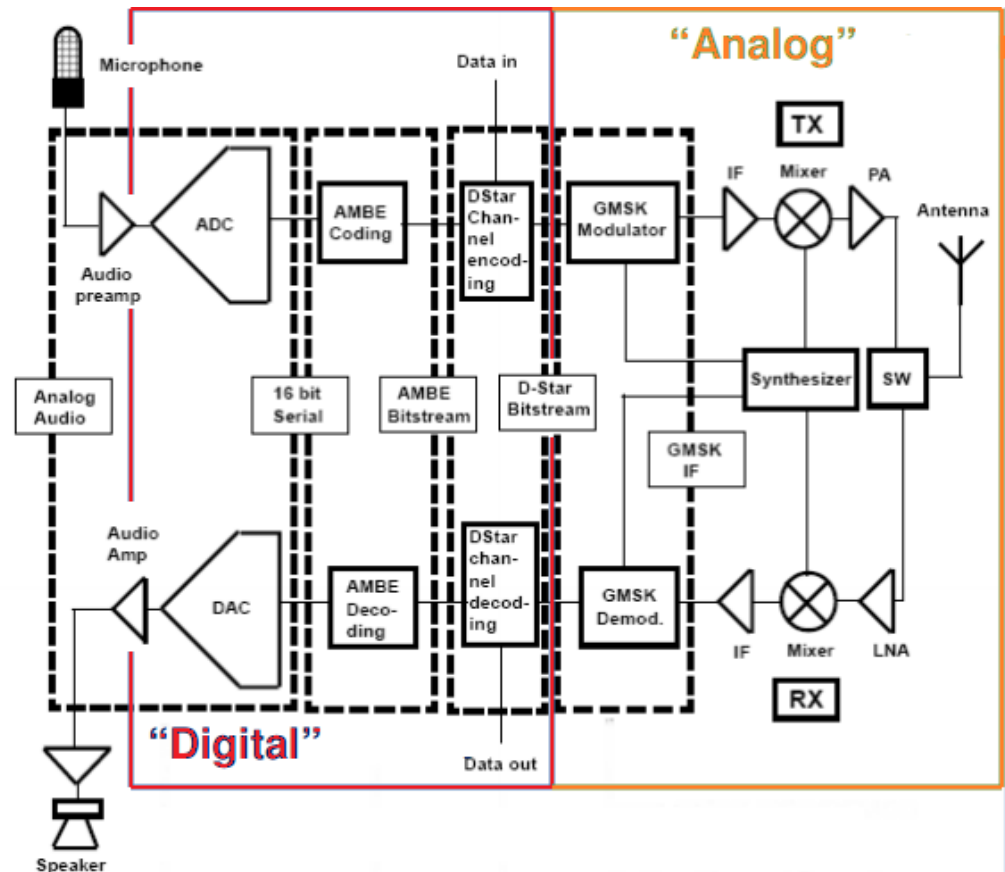
- ☐ Do you own a radio that transmits digital voice?
- ☐ What type of digital voice?
- ☐ Last time you used it FOR THAT FUNCTION?
- ☐ For a repeater contact?
- ☐ Point to Point?
- ☐ Via internet linking?
- ☐ Use other features?

A Brief 136 Year History of Wireless Communications



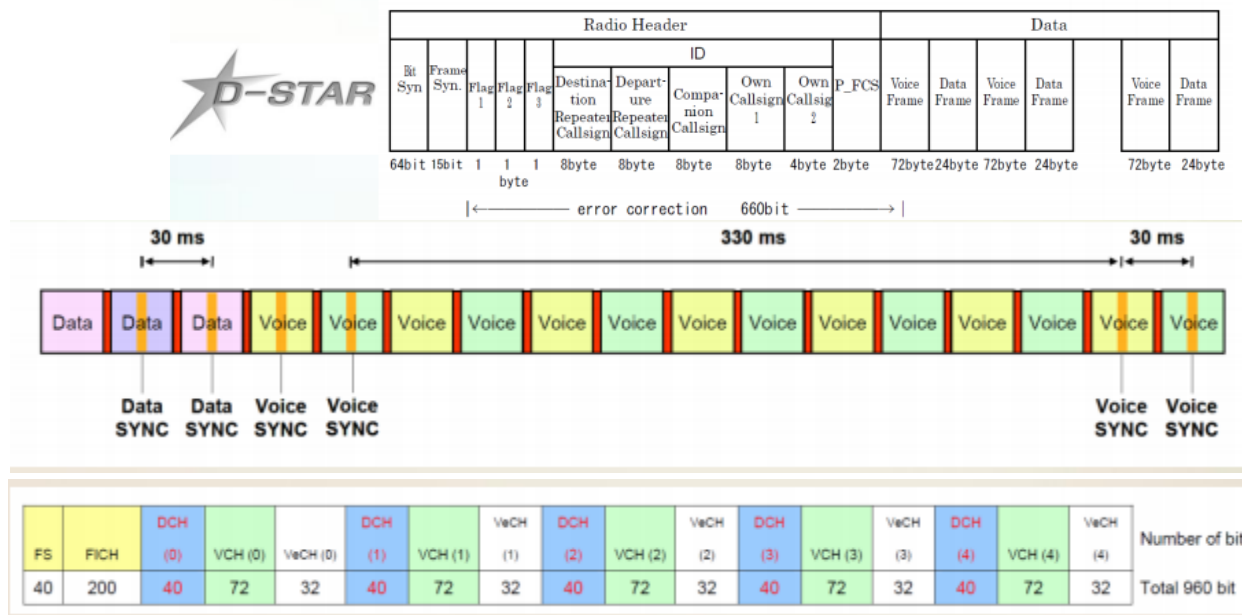
What is Digital Voice (Part 1)

- Digital data modulating an RF carrier
- The data is digitized audio from an A/D converter
- Then it is passed to a vocoder to compress the data and add error correction



What is Digital Voice (Part 2)

- This processed data is ALWAYS sent in uniform length packets
- The header data is pre-pended to provide synchronization, including destination (QSO direct, through or to a repeater, etc) and identity (K2GOG)
- There is also the ability to interleave/substitute voice with text, photo or data.



Current Digital Voice Infrastructure

Global Repeater Count as of 10/20/2016 (9/14/2016)



Find specialized searches and information for D-Star-equipped repeaters.

Newest D-Star Repeaters		
Click a row to view the repeater		
WX4ATL	Atlanta	Georgia (US)
OE7XLI	Lienz	Austria (AT)
OE7XLI	Lienz	Austria (AT)
SR4UBI	Bialystok	Poland (PL)
KB2WF	Spring	Texas (US)
I26BGQ	Preturo (AQ)	Italy (IT)
IR9P	Pizzo Manolfo (PA)	Italy (IT)
IR0AY	Monte Subasio	Italy (IT)
IR0UEI	Monte San. Pancrazio	Italy (IT)
IR0UGG	Monte Martano	Italy (IT)

Welcome to the D-Star Area

Total worldwide tracked repeaters: 2036

Search for D-Star-equipped Repeaters
(North America)

Choose State or Province Choose Band

--ALL--

--ALL--

Search Repeaters

Search for D-Star-equipped Repeaters
(Outside North America)

Choose Country

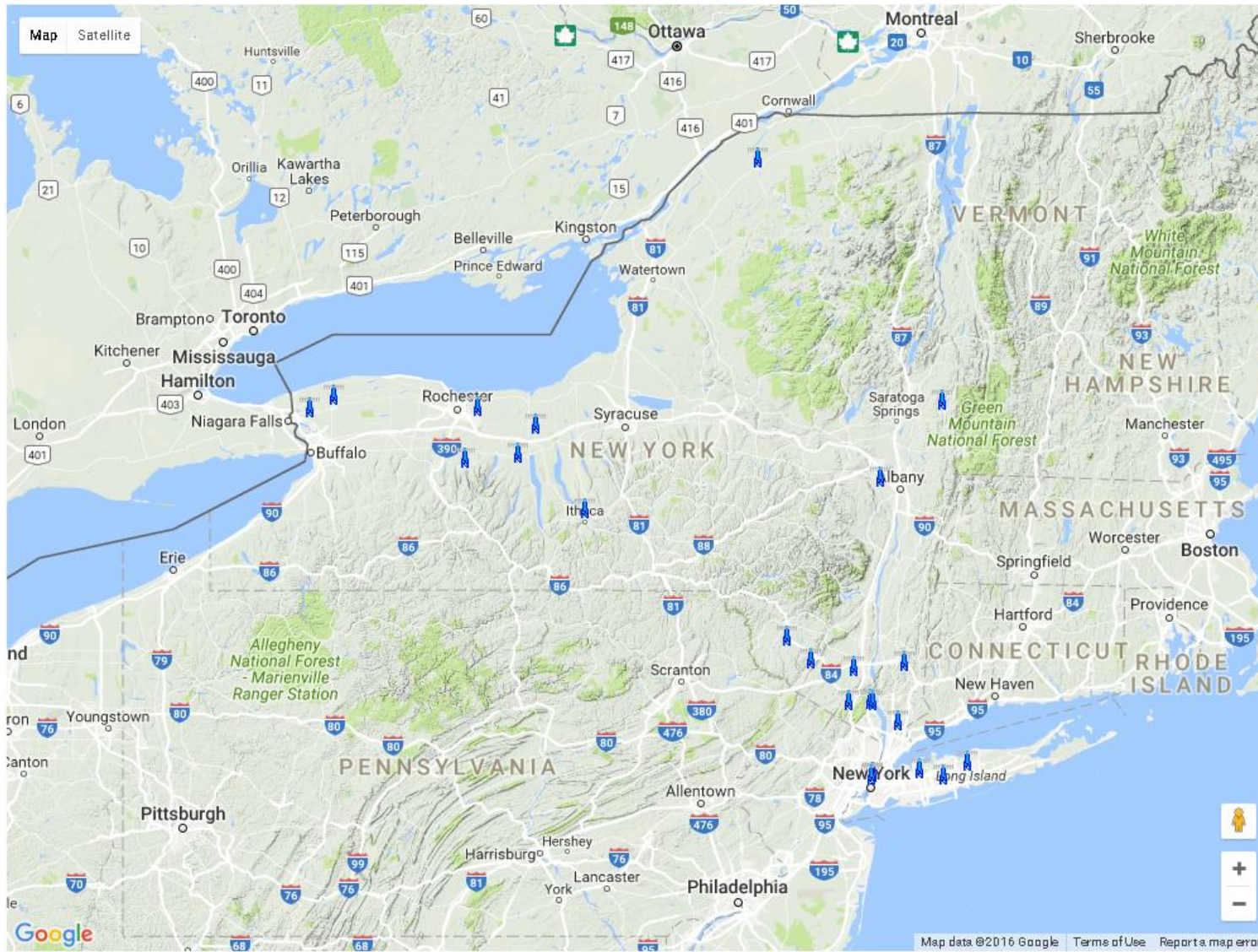
Choose Band

- D-Star Repeaters **2051 (2036)**
- DMR Variant Repeaters **1493** (1462)**
- Yaesu Fusion Repeaters **1431 (1401)**
- P25 Repeaters **213 (211)**
- NXDN Repeaters **82 (81) Negative growth?**

Repeater counts were taken from the  **RepeaterBook** website

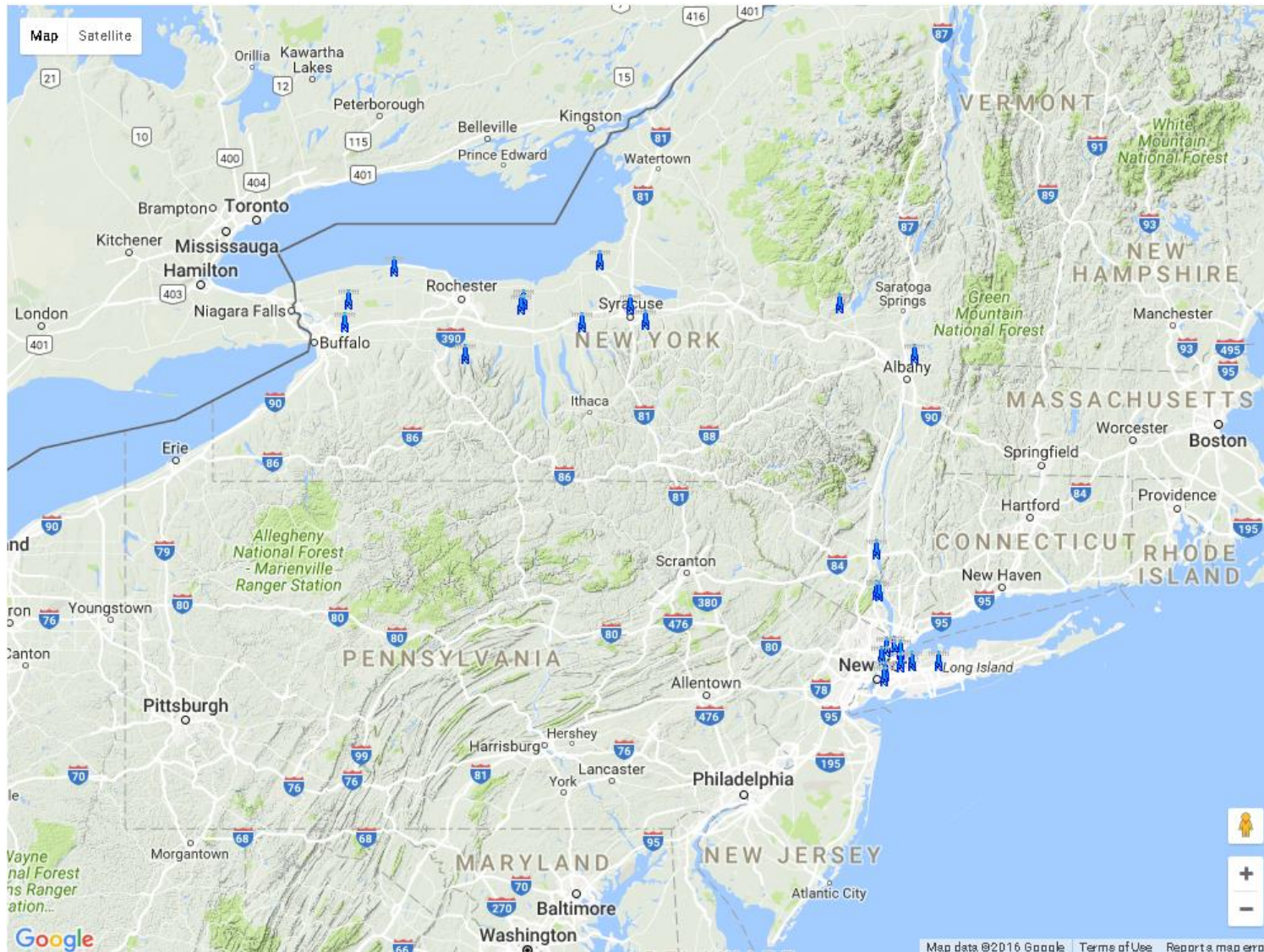
** Confirmed does not include the Brandmeister Network 416 Industrial Repeaters and 135 Homebrew Repeaters

New York D-Star Repeater Locations



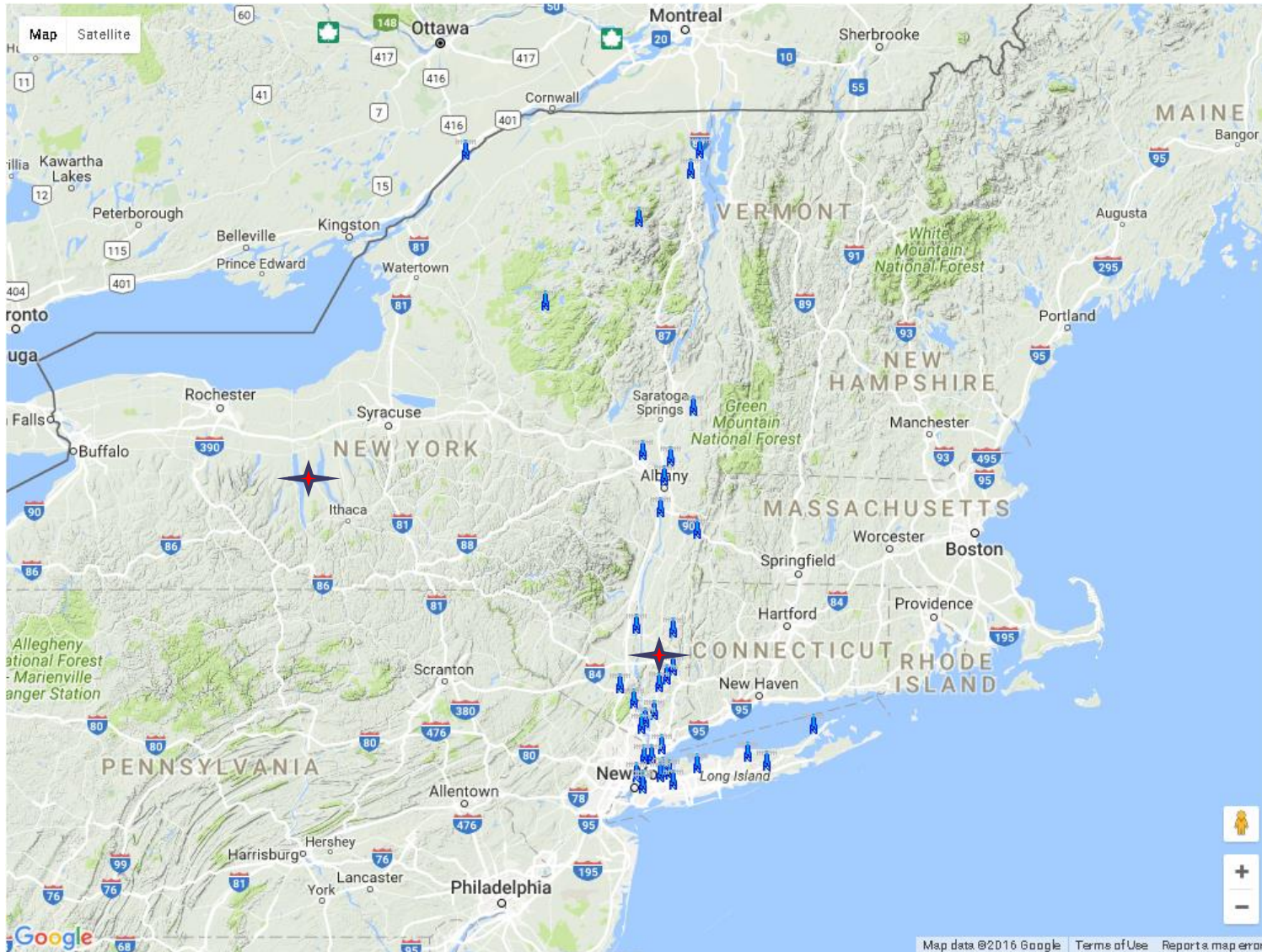
29

New York Fusion Repeater Locations



32

New York DMR Repeater Locations



45

Current Digital Voice Terminal Roundup

Current “On Market” Terminals as of 9/14/2016

universal radio inc.

← back

View Your SHOPPING CART

FLAT RATE SHIPPING
Based on the total order
Up to \$50.00 \$ 6.95
\$50.01 to \$100 \$ 8.95
\$100.01 to \$500 \$ 9.95
\$500.01 to \$1000. \$14.95
For USA customers
(except: AK/HI/PR)
Insurance included

Mobile FM Transceivers

Alinco **DR-03T** 10M Mobile
DR-06T 6M Mobile 4
DR-135T/TG/TP/TPG 2M Mobile 4
DR-135T VHF Mobile
DR-235T/TG 220 Mobile 4
DR-635T 2M/440 Mobile 4
DR-635T VHF/UHF Mobile **NEW!**
DR-735T 2M/440 Mobile 4 **NEW!**
DR-B185TH 2M Mobile **NEW!**

Icom **IC-2300H** 2M Mobile
IC-2730A DLX 2M/440 Mobile **NEW!**
ID-S80H 2M/440 Mobile
ID-S100A DLX 2M/440 Mobile

Jetstream **JT222M** 220 Mobile

Kenwood **TM-281A** 2M Mobile
TM-D710A & TM-710A 2M/440 Mobiles
TM-V71A 2M/440 Mobile

TYT **TH9000V** 2M Mobile
TH9000D220 220 Mobile
TH930 2M Mobile

Yaesu **FT-2900R** 2M Mobile **SPECIAL OFFER!**
FT-2900R 2M/440 Mobile **SPECIAL OFFERS!**
FT-2900R 10M/2M/440 Mobile **TWO SPECIAL OFFERS!**
FTM-100DR 2M Mobile **NEW!**
FTM-400XDR 2M/440 Mobile
FTM-100DR 2M Mobile **NEW!**
FTM-100DR 2M Mobile **NEW!**

Digital Mode Le... Fusion ♦ DMR ♦ GMSK (Option)

Icom D-Star (6 Total, 2 Vendors)

- 1 Mobile/Base HF/VHF/UHF
- 2 Mobile VHF/UHF
- 1 Handheld VHF/220/UHF*₁
- 1 Handheld VHF/UHF
- 1 Handheld UHF

DMR (48 Total, 9 Vendors)

- 16 Handheld VHF or UHF
- 8 Mobile VHF or UHF

Yaesu Fusion (7 Total, 1 Vendor)

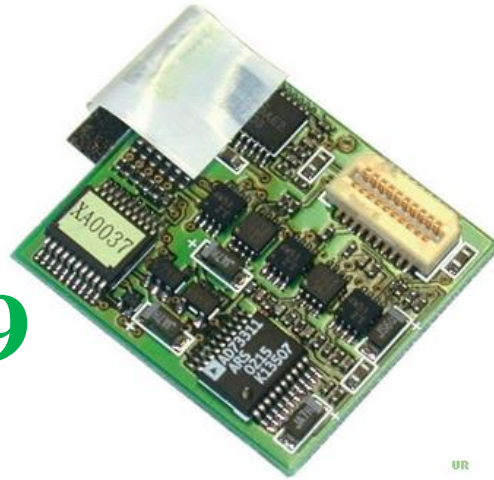
- 2 Mobile/Base HF/VHF/UHF*₂
- 2 Mobile VHF/UHF
- 1 Mobile VHF
- 2 Handheld VHF/UHF

Alinco GFSK

Since 2002 to Present

D.O.A

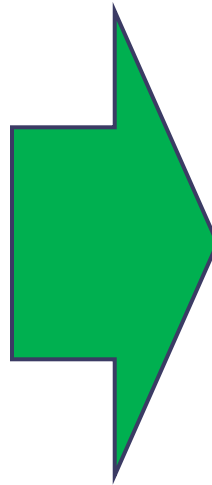
\$199



Icom D-Star

- Icom licensed Alinco's GFSK and improved upon it
- Icom ACTUALLY had a plan!!
- First REAL Amateur Vendor with DIGITAL circa 2004.....

Started With....



... And Now



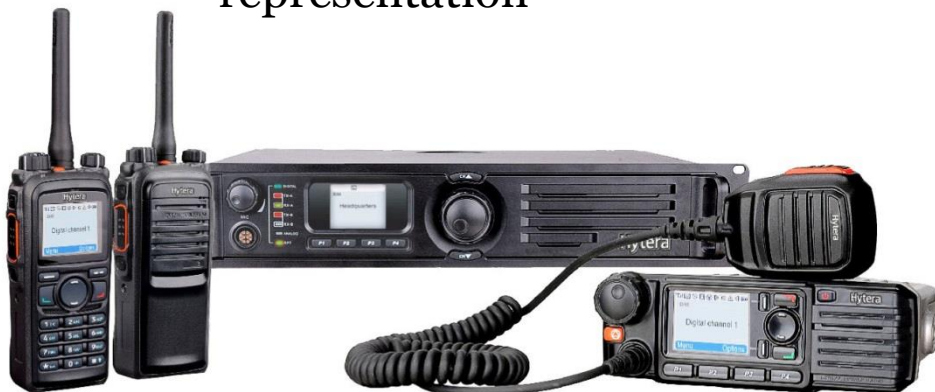
Yaesu Fusion

- Good progress for a one vendor ecosystem since 2011
- First REAL Amateur Vendor with affordable mobile radio
- Price drop strategy
- Past Strategic partnership



Digital Mobile Radio (DMR)

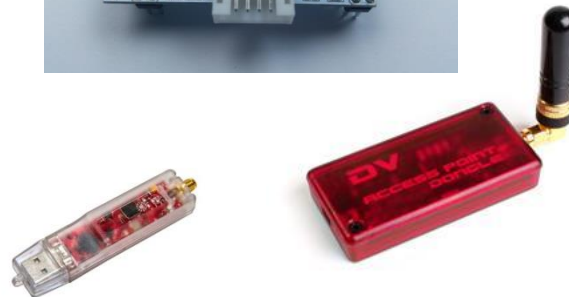
- Started life as **MOTOTRBO™**
Professional Digital Two-Way Radio System
- Motorola opened its intellectual property (IP) to make it an open standard through European Telecommunications Standards Institute (ETSI) Standard TS 102 361
- Sample vendor ecosystem representation



Who else and WHAT else is out there?

Ever hear of Wireless Hold, BlueSPOT, Dvmega, DV4Mini?

- Growing domestic vendors
- Software Defined Radio is the future
- Multimode Hot spots and Radios
- Upgrade existing “select” infrastructure
- What happened to **KENWOOD**?



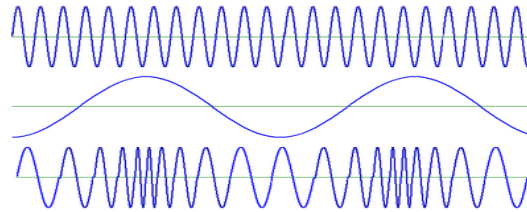
Enter the Baofeng



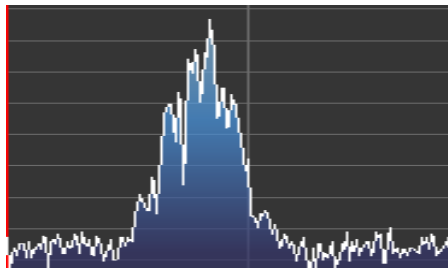
- DM-5R not true DMR (Tier 2) yet
- Upgradeable via flash update
- Low price (USD 70)
- Dual band
- Do not rush to buy this radio

What does it look like?

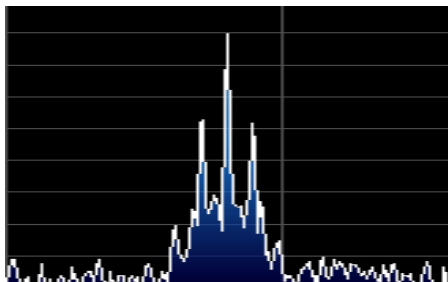
Good Ole' FM



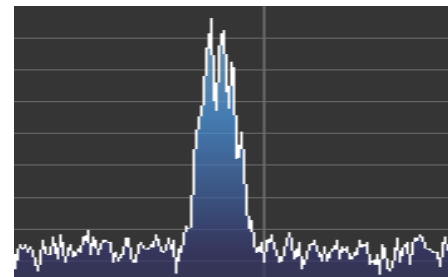
Frequency Modulation
(FM on WA2MJM Repeater)



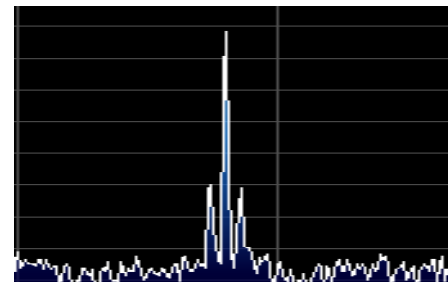
1200 Baud AFSK over FM
(APRS on 144.390MHz)



Narrow Frequency Modulation
(Simplex on 146.520MHz)

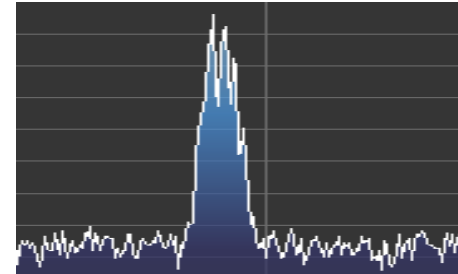
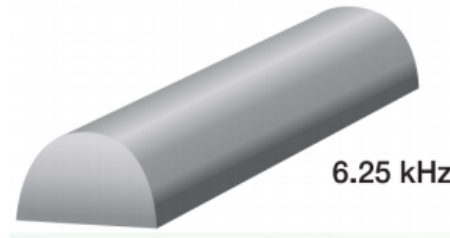


9600 Baud FSK over FM
(High Speed Packet on 70cm)

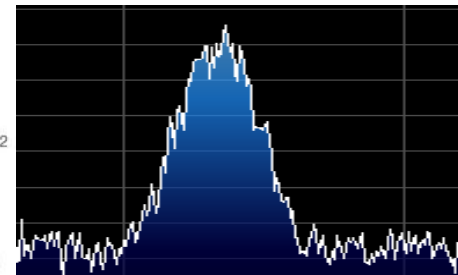
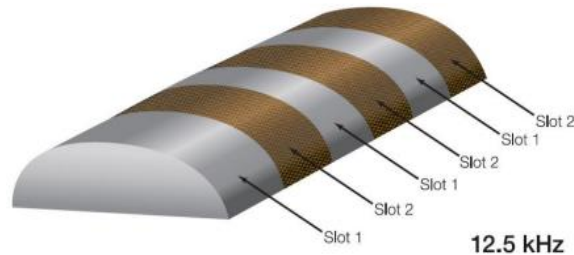


Digital Voice (DV)... Under the hood

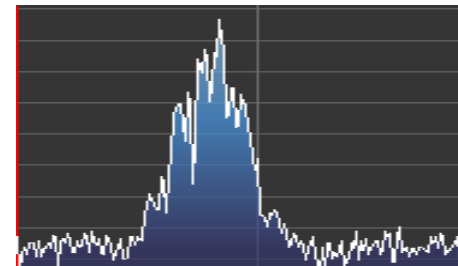
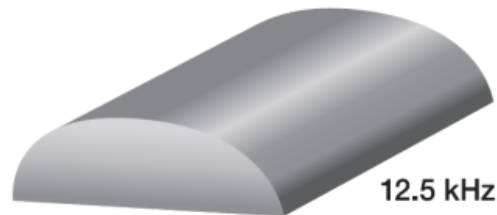
GFSK



TDMA



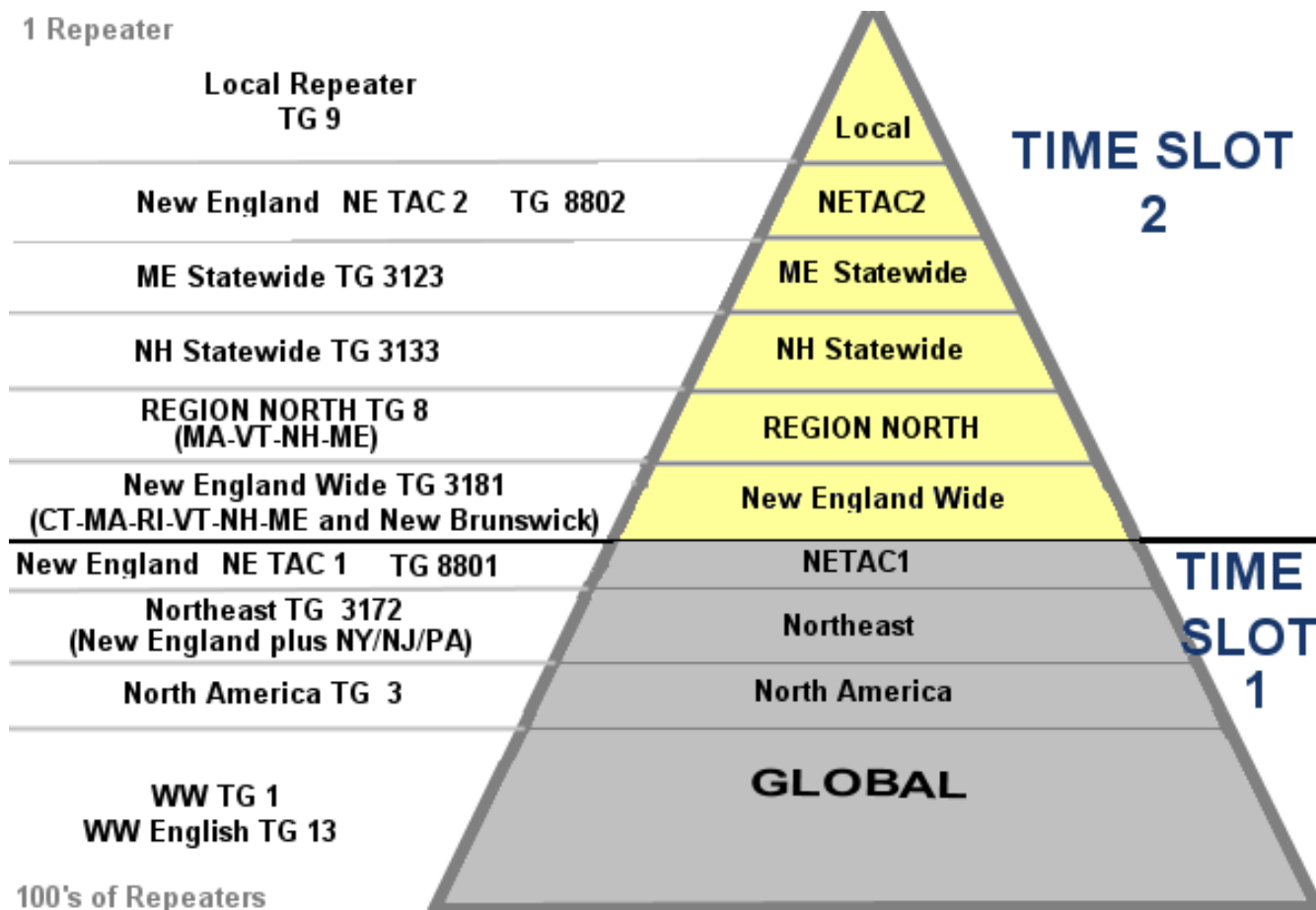
FDMA




Digital Voice (DV)... Under the hood

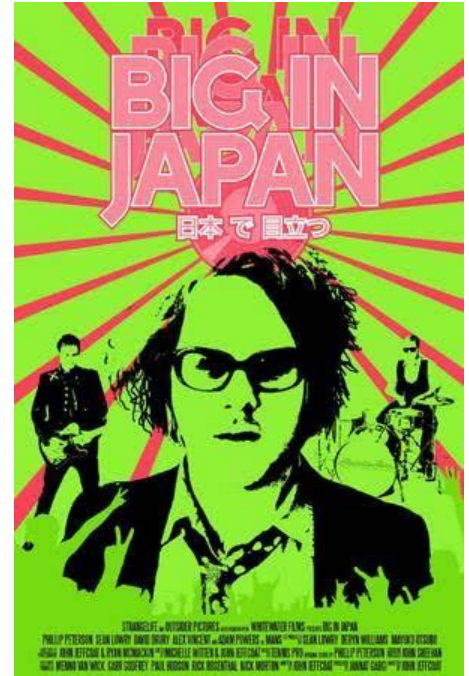
It is not just about something new solving a problem that does not exist to just have a more complicated or expensive product to sell

1 Repeater



DV Misconceptions

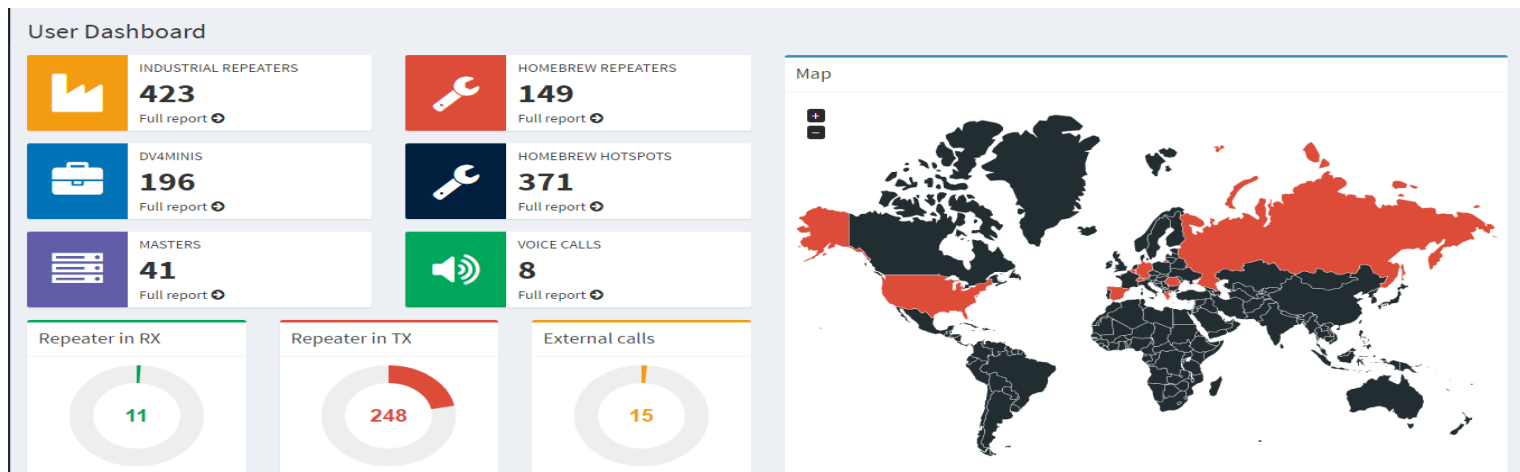
1. DMR is just commercial equipment, like Motorola
2. Icom D-Star is only Icom infrastructure and terminals
3. Yaesu Fusion is only 
4. The repeater needs internet access
5. It is expensive to get active on Digital Voice
6. What is the PL tone?
7. There is no local DV, I am not wasting the money



1. DMR is just commercial equipment, like Motorola
2. Icom D-Star is only Icom infrastructure and terminals

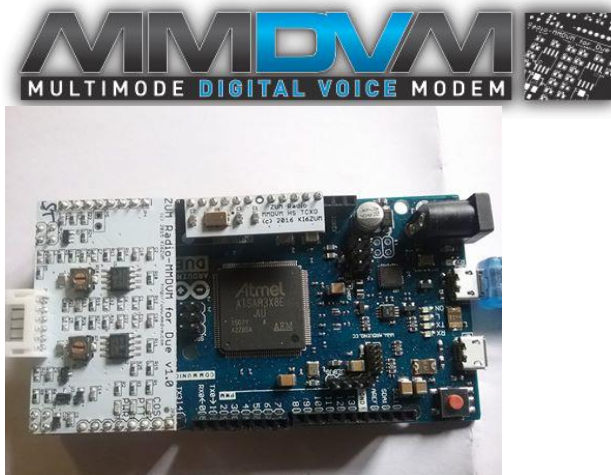
One of the answers.... **BRANDMEISTER?**

www.brandmeister.network



Still do not understand what is Brandmeister?

- D-Star does **NOT** work with Fusion
- DMR does **NOT** work with D-Star
- Fusion does **NOT** work with D-Star
- Brandmeister **DOES** allow all DV to “mostly” talk to each other



Motorola			
Model	RX	TX	Notes
CDM1250	✓		(RX bcr)
CDM-1550LS	✓		N3FE
GM1200	⚠	✓	D-Star works with some dropouts, DMR does not
GM350 / GM950	✓	✓	PCB Mod. VHF RX TX work (SQ9MYX)
GM340 / GM360 / GM380	✓	✓	
CM140 / 160 / 340	✓	⚠	EM200(CM140) Very low BER at Rx (SV4QXF)
MCS2000	⚠	✓	Unstable BER at Rx 1,2~5% (SV4QXF)
GR1225	✓	✓	N9KRG
GM300/Maxtrax	✓	✓	N3FE
GM600		✓	TX UHF Work (SQ9MYX)
Kenwood			
Model	RX	TX	Notes
TM-V71A/E		✓	TX Has a timeout of Max 10 min and its impossible to change this.
THF7E	✓	✗	(CT1HDC) (IW9GRL - Good reception but unstable BER 0.3~5%)
YAESU			
Model	RX	TX	Notes
DR-1X	✓	✓	TX/RX audio is excellent (W2GLD)
FT-7900	✓	✓	
FT-7800	✓	✓	
FT-8800	✓	✓	
FT-100D		✓	(CT1HDC)
FT-8900	✓	✓	(DMR CT1JIB)
FT-817	✓	✓	RX also looks to work (PD0ZRY)
HYT			
Model	RX	TX	Notes
TM-600U	✓	✗	RX work perfect. TX not work! (SQ9MYX)

Yaesu Fusion is only.....

Yeeeeeaaah...

- Only one commercial repeater, but made from two ham grade mobiles
- Only Yaesu equipment but really cool and THAT. IS. TOO. BAD.

Did you know?

- Yaesu's \$500 discounted Fusion repeater backfired.
- Motorola had a 30% equity stake in Yaesu

Result:

- More analog FM only repeaters
- More multimode repeaters
- No major lift in sales of terminals (for digital)
- Motorola trying to gain market share back



The repeater needs internet access

It helps, but not 100% needed (yet)

N2DXL DMR Repeater
Clove Mountain Dutchess County
449.975 MHz



KC2OBW DMR Repeater
Highland, WRWD Tower Ulster County
440.3125MHz

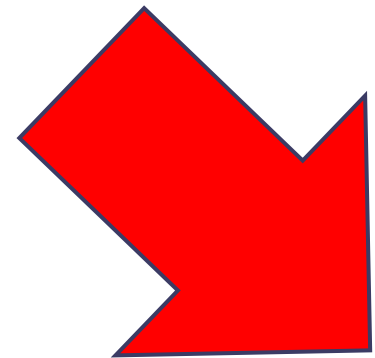


The repeater needs internet access

Connection. YES.

N2LEN DMR Repeater
New Baltimore Green County
449.025 MHz

Brad?



The repeater needs internet access

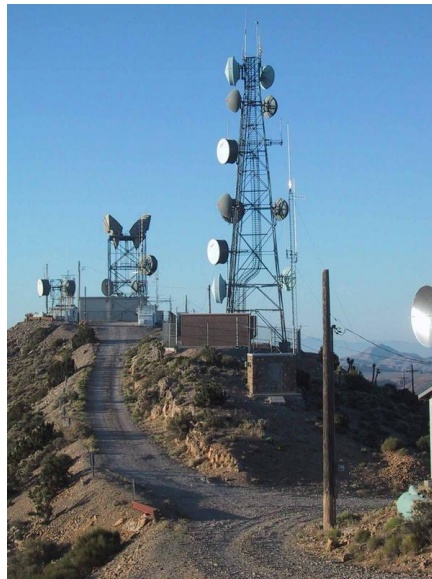
Connection. Soon.

K2ATY

Mt. Beacon, Dutchess County

441.01875 (Input 446.01875)

Color Code 10, Talk Group 9, Time Slot 2



STATUS: MINUTES AGO

It is expensive to get active on Digital Voice

Only if you buy the radio just for that

Only if there is no one good to speak to or listen to

Only if you don't sell some of your old AM only 6m equipment

Only if you think \$110-150 is expensive for a single band radio

Only until more people buy them

What is the PL tone?

There is no PL tone, but there are features like that to allow access



All need to register call sign or user ID for access to IP connected repeaters

☐ Call sign

☐ User ID

☐ Call sign

☐ Source Module

☐ Color Code

☐ Auto Mode Select

☐ Destination Module

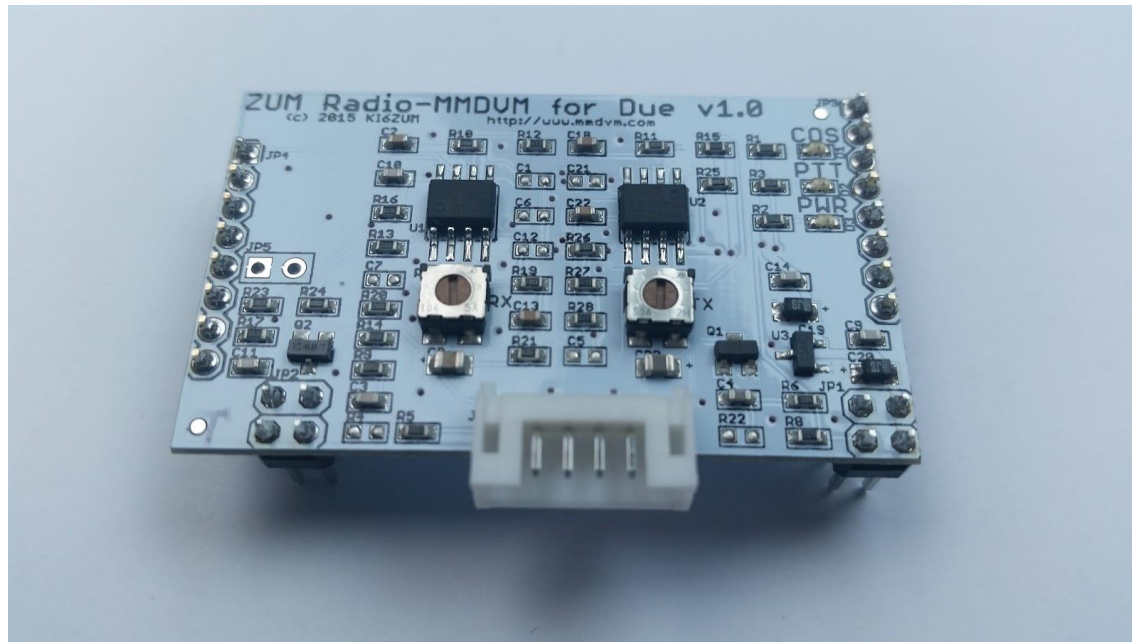
☐ Time Slot

☐ Talk Group

There is no local DV repeater, I am not
wasting the money

MMDVM

Multi Mode Digital Voice Modem



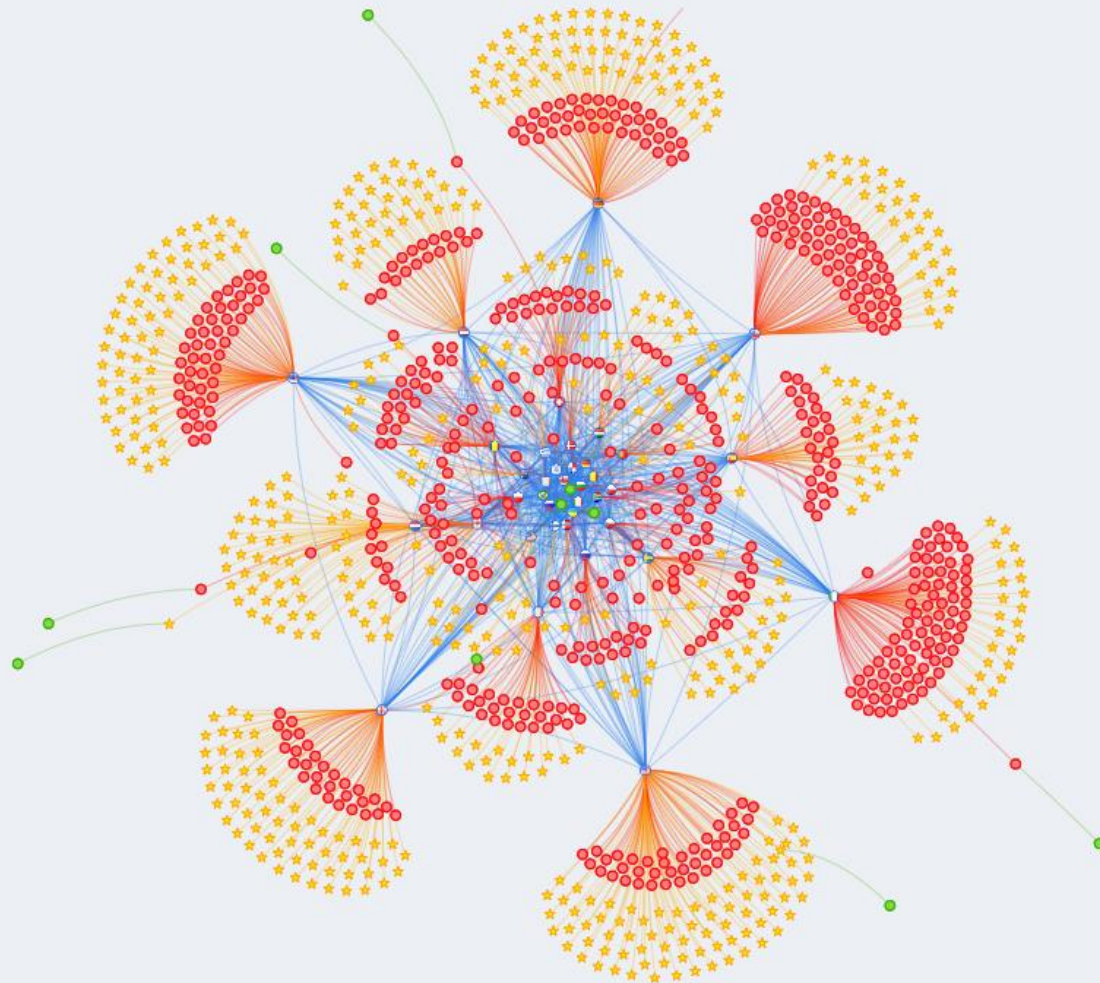
More about Brandmeister (Overview)

Acts as a gateway and bridge for all multimode repeaters or single mode repeaters to act as a node on the Brandmeister Network



More about Brandmeister (Network)

Network Structure - IN DEVELOPMENT



More about Brandmeister (Repeaters)

Acts as a gateway and bridge for all multimode repeaters or single mode repeaters to act as a node on the Brandmeister Network

- The 133 Homebrew repeaters either use commercial equipment without the expensive internet bridges offered by Motorola or Hytera

Repeaters User Dashboard > Repeaters

Show entries

Number	Name	Hardware	Frequency	Mode	Power	Slot	Link	Location
1	My Radio	Hytera RD982						
111201	W4MCO-DMR	Motorola XPR8400						
111204	N4IRS	MMDVM (Repeater)	20160624	444.975 MHz	449.975 MHz	1	Slot 1 & 2 linked	3101
111205	AF4JC	MMDVM (Repeater)	20160419	442.600 MHz	447.600 MHz	1	Slot 1 & 2 linked	3101
113605	WB2ERS	Motorola DR3000	R02.06.00.07	444.750 MHz	449.750 MHz	1	Slot 1 & 2 linked	3101
113609	W2TUP-Tupper	Motorola XPR8400	R02.40.12	446.025 MHz	441.025 MHz	1	Slot 1 & 2 linked	3101
113614	N2LEN NB	Motorola DR3000	R02.40.12	449.025 MHz	444.025 MHz	1	Slot 1 & 2 linked	3101
202101	SW1F	Motorola DR3000	R02.40.12	438.8125 MHz	431.2125 MHz	1	Slot 1 & 2 linked	2021
202601	SV6G	MMDVM (Repeater)	20160816	438.750 MHz	431.150 MHz	1	Slot 1 & 2 linked	2021
204103	PI1WFR	Hytera RD985	A7.00.09.005	438.0125 MHz	430.4125 MHz	1	Slot 1 & 2 linked	2042

























Showing 1 to 10 of 551 entries

Previous **1** 2 3 4 5 ... 56 Next

More about Brandmeister (Status)

Acts as a gateway and bridge for all multimode repeaters or single mode repeaters to act as a node on the Brandmeister Network

Search:

Time	Link name	My call	Source	Destination	Reflector	Options	RSSI	dBm	Duration	Loss rate
4 Hours	Motorola IP Site Connect	 N6JVH [Michael] (3106983)	 N6JVH_Oa (310688)	 (93437)		TS2 DMR	 S6	-87.05		
4 Hours	DV4mini	 KB1O [Jean] (3109427)	 KB1O (3109427)	 Local or Reflector (9)	USA - Nationwide (4639)	DMR			18	0.33% (1/302)
4 Hours	Motorola IP Site Connect	 AA4CD [Chris] (3106267)	 AA4CD (310708)	 (93437)		TS2 DMR	 S8	-77.01	14	0% (0/241)
4 Hours	Homebrew Repeater	 W8FSM [Public] (3126003)	 W8FSM (3126003)	  Mi5-STATEWIDE2 (31262)		DMR			2	0% (0/34)
4 Hours	AutoPatch	Local (1)	TEST (10)	  *RUSSIA* (EchoLink) (9504)		DMR				
4 Hours	D-Extra Link	 XRF250 Bridge (2502)	(0)	  XRF250 Bridge (2502)		D-STAR			2	0% (0/40)
4 Hours	Motorola IP Site Connect	 N6JVH [Michael] (3106983)	 N6JVH_Oa (310688)	 (93437)		TS2 DMR	 S6	-89.8	7	0% (0/127)

More about Brandmeister (Users)

Acts as a gateway and bridge for all multimode repeaters or single mode repeaters to act as a node on the Brandmeister Network

Search: <input type="text"/>										
Time	Link name	My call	Source	Destination	Reflector	Options	RSSI	dBm	Duration	Loss rate
4 Hours	Motorola IP Site Connect	N6JVH [Michael] (3106983)	N6JVH_Oa (310688)	(93437)			S6	-87.05		
4 Hours	DV4mini	KB1O [Jean] (3109427)	KB1O (3109427)	Local or Reflector (9)	USA - Nationwide (4639)				18	0.33% (1/302)
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4 Hours	Homebrew Repeater	W8FSM [Public] (3126003)	W8FSM (3126003)	MI5-STATEWIDE2 (31262)					2	0% (0/34)
4 Hours	AutoPatch	Local (1)	TEST (10)	*RUSSIA* (EchoLink) (9504)						
4 Hours	D-Extra Link	XRF250 Bridge (2502)	(0)	XRF250 Bridge (2502)					2	0% (0/40)
4 Hours	Motorola IP Site Connect	N6JVH [Michael] (3106983)	N6JVH_Oa (310688)	(93437)			S6	-89.8	7	0% (0/127)

More about Brandmeister (Hose)

Acts as aggregator for all traffic on the Brandmeister Network

hose.brandmeister.network

Active calls in the last 15 minutes

Time	Duration	Call	Group
12:12:39	hang	3148711	3100
12:12:27	1s	3148711	3100
12:12:17	2s	2144034	214
12:11:53	0s	3142030	3100
12:11:27	1s	WA8EBM (Michael Penkas)	3148
12:11:25	1s	2352102	2350
12:11:18	3s	3153082	3100
12:11:08	1s	2352600	2350
12:10:51	12s	2222123	214
12:09:48	2s	2352600	2350
12:09:19	2s	2222123	214
12:09:11	1s	WA8EBM (Michael Penkas)	3148
12:09:08	2s	WA8EBM (Michael Penkas)	3148

Talk groups

214

2350

3100

3148

4639

APPLY

Controls

300-12000 Hz BPF

AGC ☒

Bass

Middle

Treble

Audio level

Spectrum

More about DV4MINI (Hot Spot)

DV4MF2 Control Panel (K2GOG Stick ID: 9C-D7-59 V201.73 @ local)

Interface Setup | Gateway Setup | Signal RSSI | Reflector Info | Service | General

DV Operation

Frequency
RX-QRG: 427.505 MHz
TX-QRG: 427.505 MHz
SIMPLEX BER%:

HF Output
HF out: 0 8.8mW 12

Internet Data Quality:

DV Mode
DStar C4FM
DMR+ APCO P25
BrandMaster dPMR(*)
*experimental

DV Network
Current Mode: DMR-BM
TALKGROUP

DV4M XTG:
USA-Nationwide4639
2401
2402
2403
2404
2405
2406
2407
2841
2845
3100
REF XTG

Info
AG5EU - 3140332 > 3100
KB10 - 3109427 > 3100
AG5EU - 3140332 > 3100
KB10 - 3109427 > 3100
NS7C - 3153082 > 3100
AG5EU - 3140332 > 3100
K6R0G - 3107700 > 3100
AG5EU - 3140332 > 3100
KB10 - 3109427 > 3100
AG5EU - 3140332 > 3100
KB10 - 3109427 > 3100
AG5EU - 3140332 > 3100





Message Picture

05:00:35,750861 (1260): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3153082/NS7C
05:00:36,473265 (0723): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3153082/NS7C
05:00:40,706574 (4233): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3140332/AG5EU
05:00:59,954860 (19248): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3107700/K6R0G
05:01:00,692684 (0738): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3140332/AG5EU
05:01:21,981876 (21289): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3109427/KB10
05:02:06,201386 (44220): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3140332/AG5EU
05:02:38,853272 (32652): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3109427/KB10
05:02:51,984074 (13131): DMR ... from Reflector: RX SLOT=2 GROUP=9 REF_ID=#3140332/AG5EU

routing to TG3100 CCS7 AG5EU - 3140332 > 3100 05:03:13 UTC

Data from DMR Reflector - Sequenceerr.: 76 [75]
Data from DMR Reflector - Sequenceerr.: 7D [7C]
Data from DMR Reflector - Sequenceerr.: 84 [83]
Data from DMR Reflector - Sequenceerr.: 8B [8A]
Data from DMR Reflector - Sequenceerr.: 92 [91]
Data from DMR Reflector - Sequenceerr.: 99 [98]
Data from DMR Reflector - Sequenceerr.: A0 [9F]
Data from DMR Reflector - Sequenceerr.: A7 [A6]
Data from DMR Reflector - Sequenceerr.: AE [AD]
Data from DMR Reflector - Sequenceerr.: B5 [B4]

DV Costs

			
\$2400+ for 1 band repeater	\$1200+ for 1 band repeater	\$800+ for DUAL band repeater	\$500+ for 1 band RF Repeater
Limited commercial repeater H/W	Wider range of commercial repeater H/W	Limited commercial repeater H/W	Will work with most commercial repeaters
1 1/2 Vendor terminal ecosystem	More than 9 vendors of significance	1 Vendor terminal ecosystem	Supports everything
Portables start at \$300	Portables start at \$100 (Not including Baofeng or Wouxon)	Portables start at \$300	Supports everything
Mobiles start at \$400	Mobiles start at \$300	Mobiles start at \$150	Supports everything

DV Benefits

- Improved communications for ARES/RACES
- Multiple infrastructure options
- Range of equipment to get started at any budget
- DV has better battery life (FDMA and TDMA, not GFSK)
- DV operates further into the noise floor compared to FM (FDMA/TDMA)
- Identification and location is configurable for specific needs
- Growing network
- What else



Thanks.....

References (For people who need them....)

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2. <https://www.amazon.com/>
3. <https://brandmeister.network/>
4. <http://Brandmeister.us>
5. <http://www.dmr-marc.net/>
6. <http://www.va3xpr.net/>
7. <http://mmdvm.blogspot.com/>
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9. <http://www.dvmega.auria.nl/>
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11. <https://www.yaesu.com/>
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16. <https://www.repeaterbook.com/>