

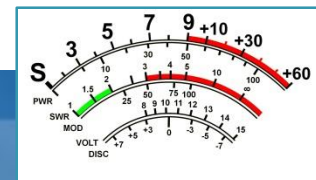
DMR

Digital Mobile Radio

The fastest growing digital format on VHF/UHF

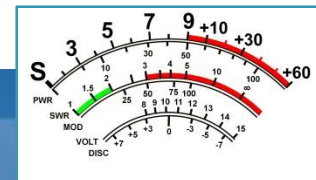
Bob Witte, KØNR
bob@k0nr.com
Monument, CO

Some material courtesy of
hamradioschool.com
rmham.org
Bill NE1B, John W2XAB, Mike AA9VI



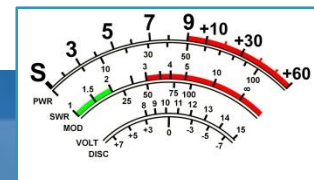
Agenda

- DMR: Digital Mobile Radio
 - What is it? Why should I care?
- DMR radios
- Rocky Mt Ham Radio DMR System
- Brandmeister network
- openSPOT hotspot



Why Should I Care About DMR?

- It's New Technology.
- It's Digital. Digital is Cool.
- Rocky Mt Ham Radio statewide DMR System
- Simple HotSpot Connections (connect worldwide via Brandmeister)
- Did I mention it's Digital?



What is DMR?

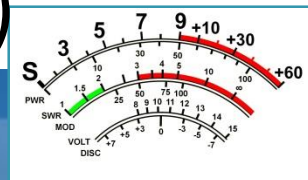
Not Compatible with
other digital formats:

D-STAR

Yaesu Fusion

APCO P-25

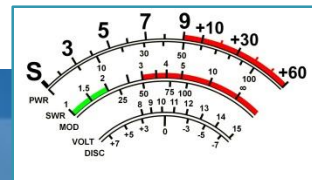
- Commercial radio industry standard
- True open standard
- Spectrally efficient
(12.5 kHz bandwidth for 2 channels)
- Supported by many radio vendors
- Improved codec for better audio
- Better tolerance of bit errors (than D-STAR)
- Amateur radio use is growing fast
(mostly 70 cm band, some 2 meter band)



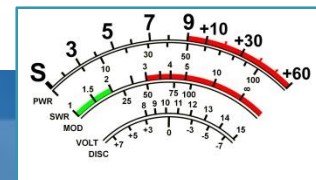
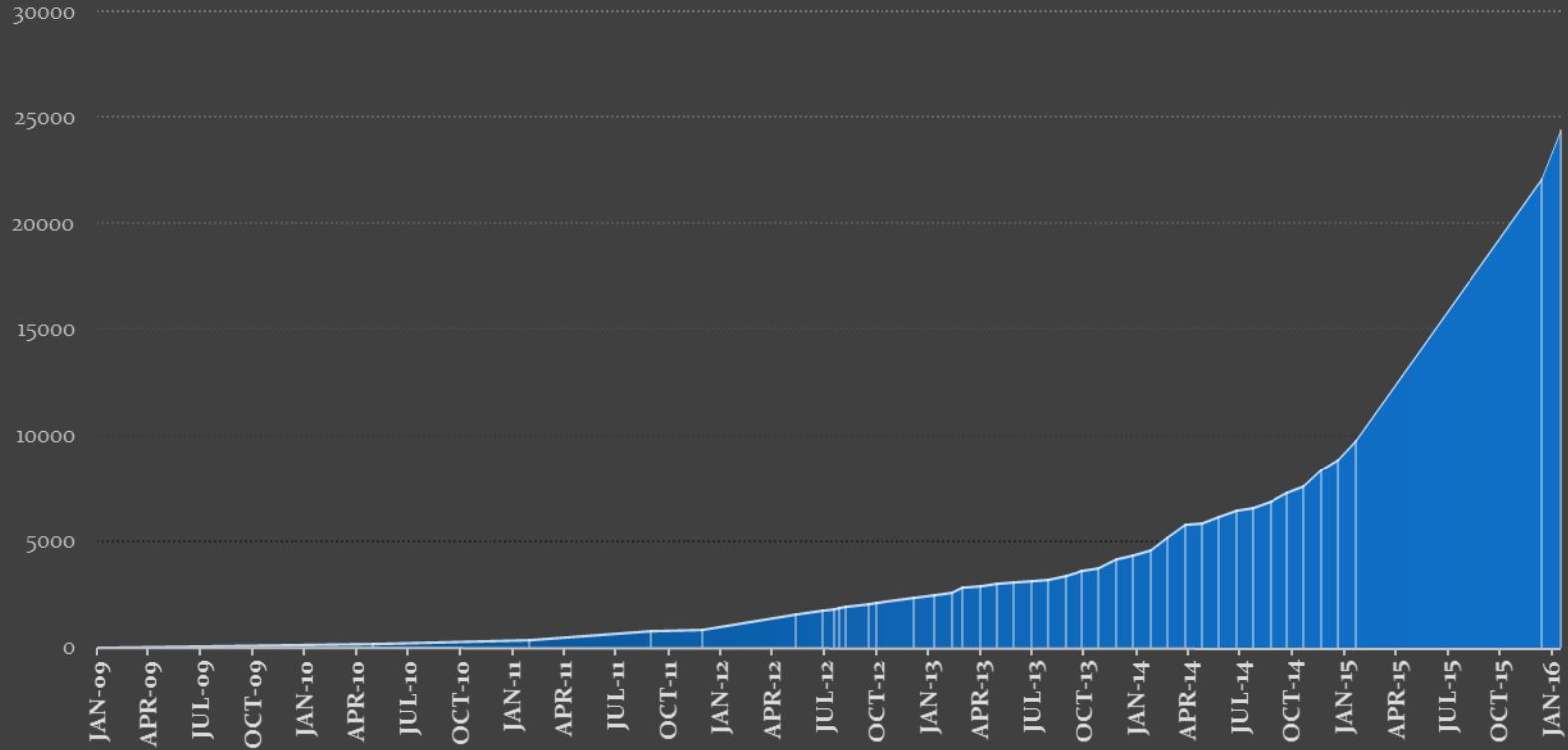
DMR Standard-ETSI TS 102 361

- Tier 1 (Unlicensed)
 - FDMA, Consumer applications, .5 watt
 - dPMR (446 MHz European unlicensed service)
- Tier 2 (Conventional)
 - 2-slot TDMA
 - IP Site Connect (Vendor specific)
- Tier 3 (Trunked)
 - 2-slot TDMA
 - Multi-channel, Multi-Site

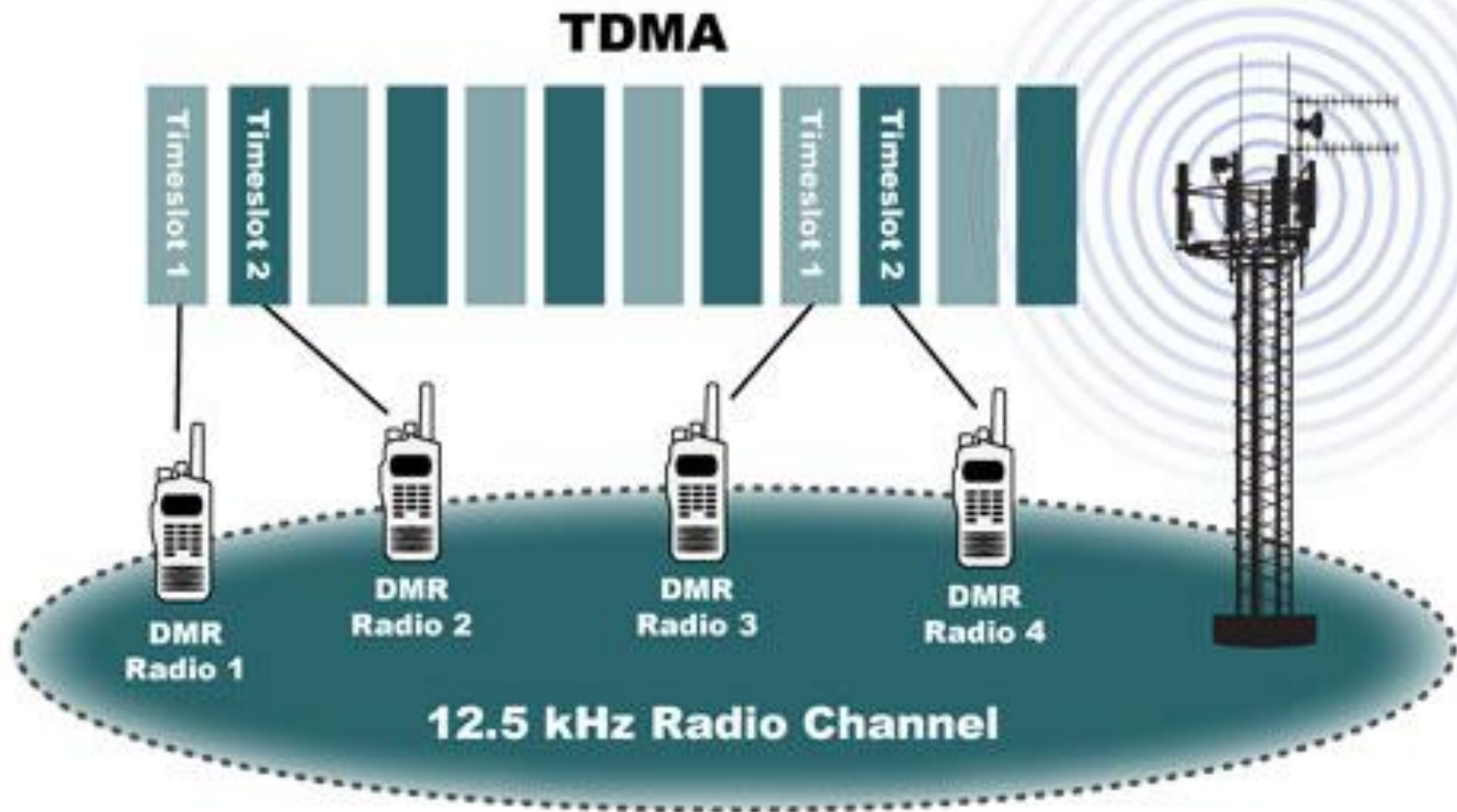
**Amateur
Radio Use**



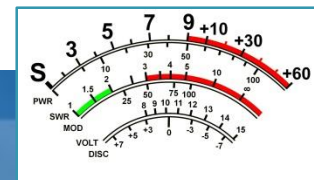
Amateur DMR Growth by # Radio IDs



Two channels – One frequency



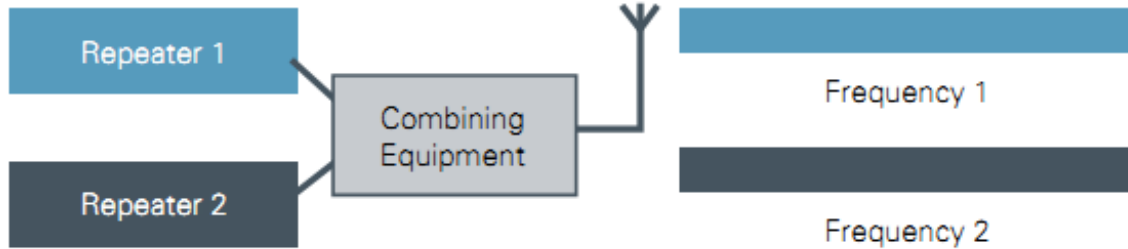
Each TDMA cycle is 60msec long, containing two 30 msec time slots



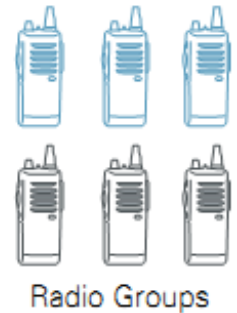
TWO Repeaters in One!

TDMA saves licensing and equipment costs by enabling the equivalent of two 6.25 kHz channels within a single licensed 12.5 kHz channel

Two-channel Analog or Digital FDMA System



One call per repeater and channel



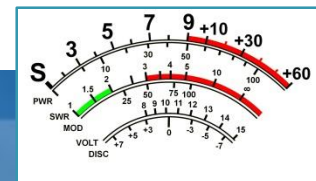
Two-channel Digital TDMA System



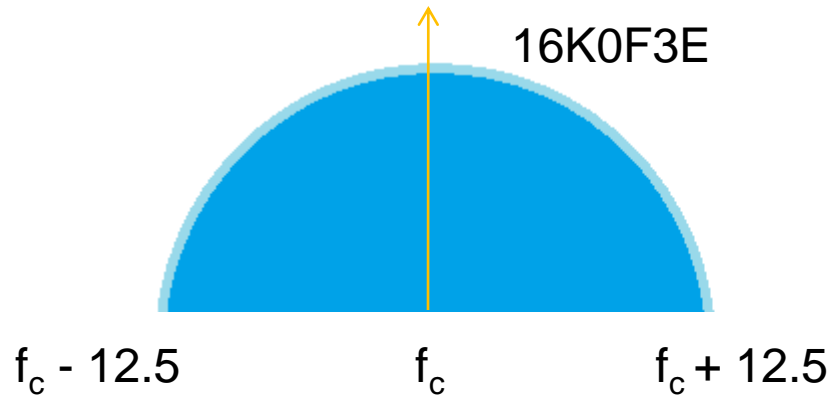
Two calls per repeater and channel



Lower infrastructure cost, 1 box in rack
TWO voice/data channels from one repeater

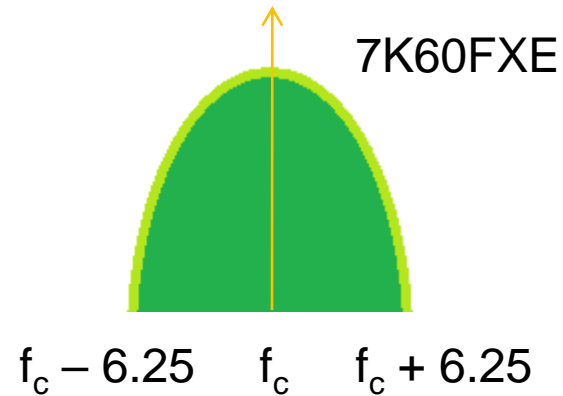


Half the Channel Bandwidth



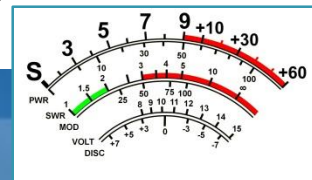
Traditional Analog
25 kHz
Channel Bandwidth

1 Channel
1 Repeater



DMR
12.5 kHz
Channel Bandwidth

2 Channels
1 Repeater



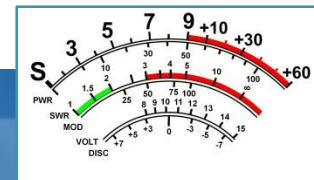
Setting up a channel

Analog FM:

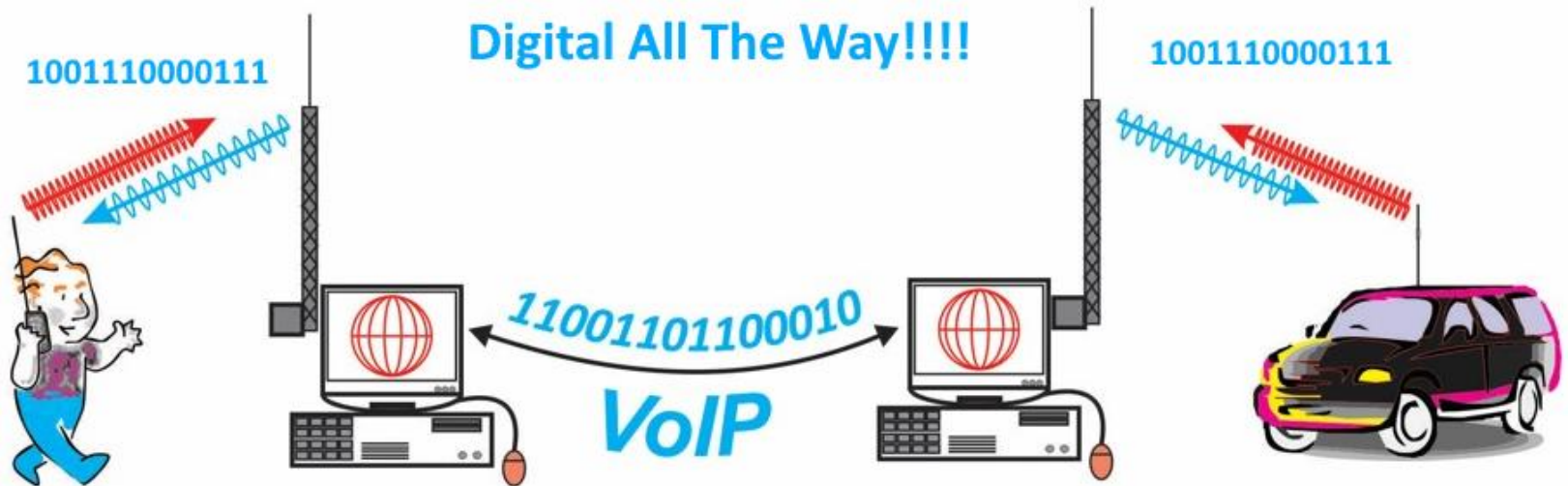
- Frequency
- Offset
- CTCSS Tone (repeater access)

DMR

- Frequency
- Offset
- Color Code (repeater access)
- Time Slot (TS 1 or 2)
- Talk Group (group of users)



DMR: Digital RF Transmission



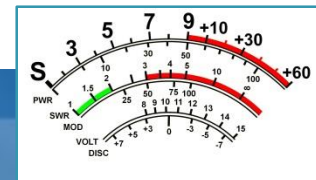
All of these systems use VoIP:

RF = Analog FM

EchoLink, IRLP, All Star

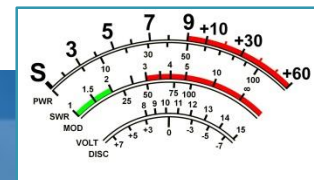
RF = Digital

DMR, D-STAR, Yaesu Fusion



DMR vs Analog FM

- DMR basically noise free until digital error correction breaks down
- Radio ID is encoded into the RF signal
- DMR Spectral efficiency is much better than FM
- DMR Repeater operator gets two channels from one installation
- DMR Repeater linking is just a network connection
- Talkgroups allow for almost unlimited grouping of users
- Some DMR radios support roaming (automatically finds the repeater as you move)
- DMR has digital text messaging
- EchoLink can do some of the VoIP repeater linking and conferencing, but introduces analog noise, individual radios are not identified, talkgroups not supported
- TDMA Futures:
 - Repeater operation on one frequency using TDMA
 - ReverseChannel operation using the second timeslot



DMR: Living in the commercial world

- Codeplugs
- Radio ID# instead
- Radios do not have
Easy frequency entry
- Only single-band

Some local Radio IDs:

Bob K0NR (portable): 3108275

Bob K0NR (mobile): 3108410

Joyce K0JJW: 3108385

Kyle K0YLE: 3108941

Robert KD0YMC: 3108817

Radio ID#s are assigned by the DMR-MARC club: <http://www.dmr-marc.net/>



Popular DMR User Radios



Tytera
MD-380
\$100



Connect
Systems
CS750
\$240



Connect Systems
CS800
\$280



Motorola
XPR6550
\$350
(used)



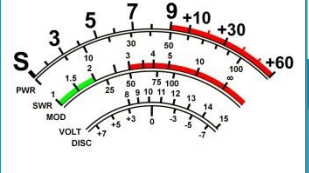
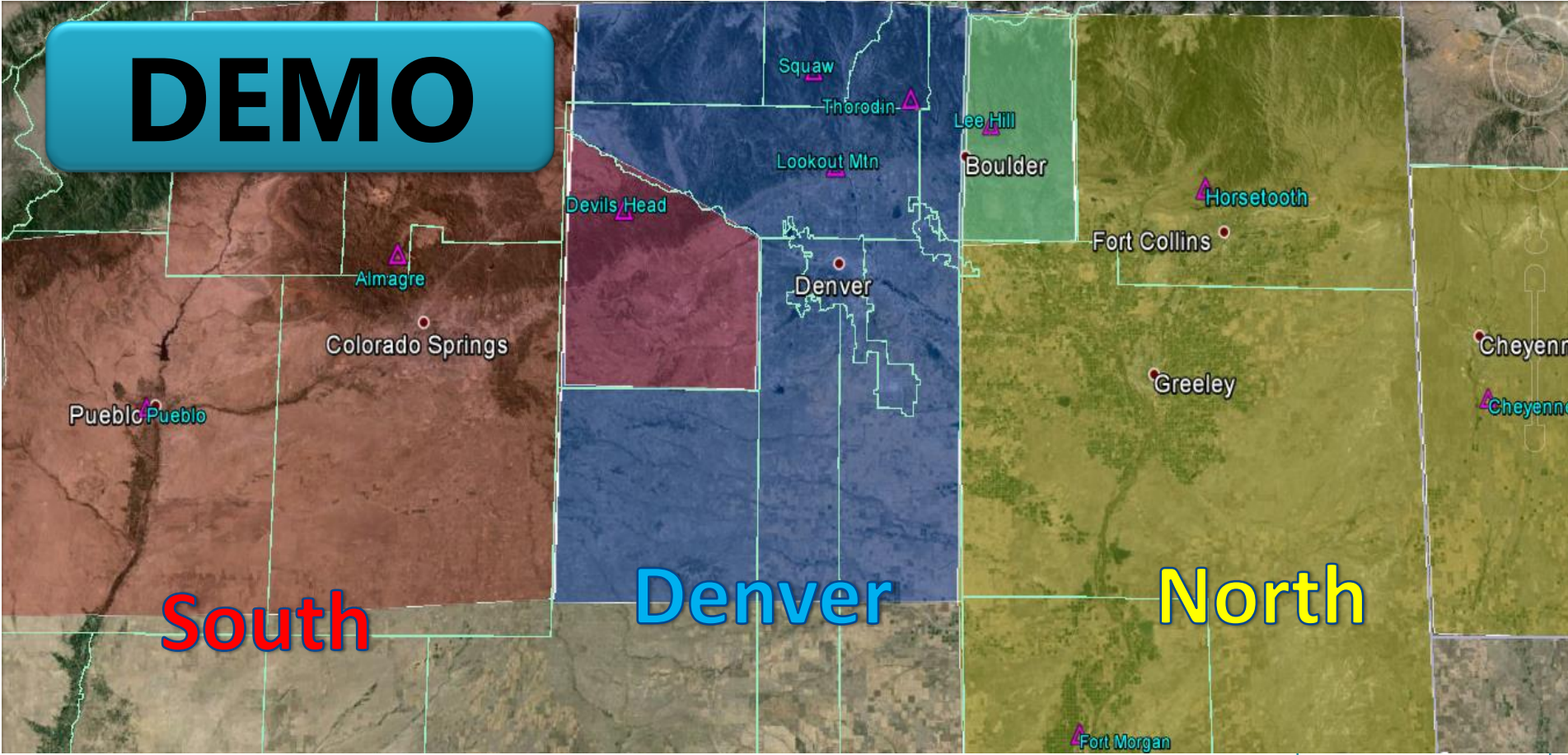
Motorola
XPR4550
\$400
(used)



Rocky Mt Ham Radio DMR Network

rmham.org

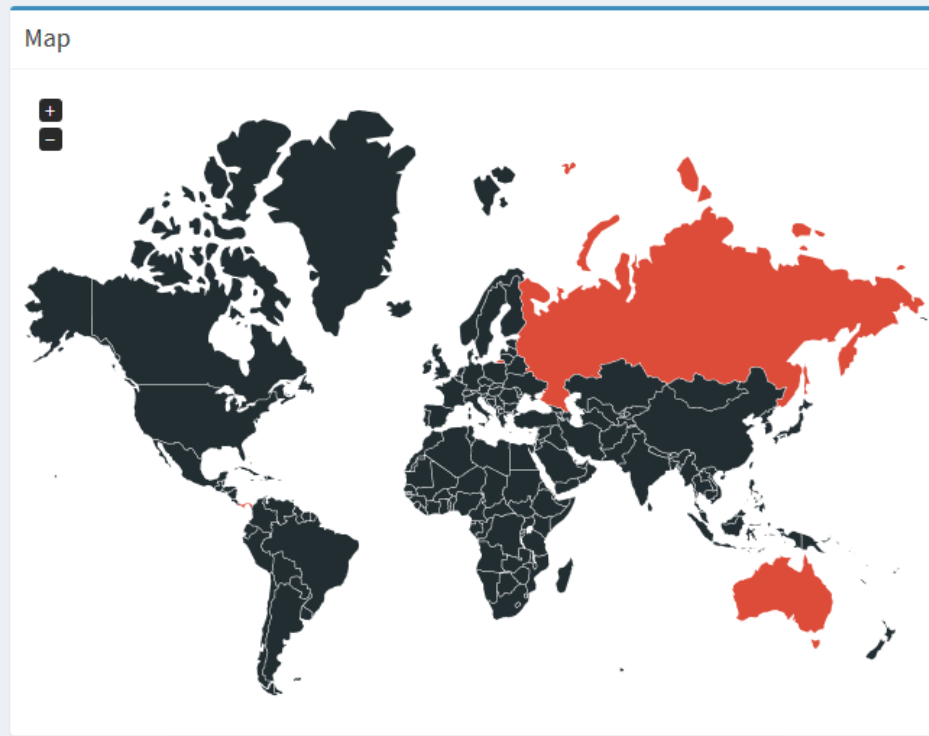
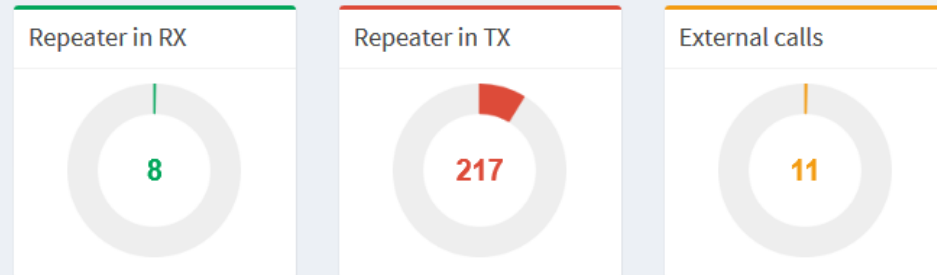
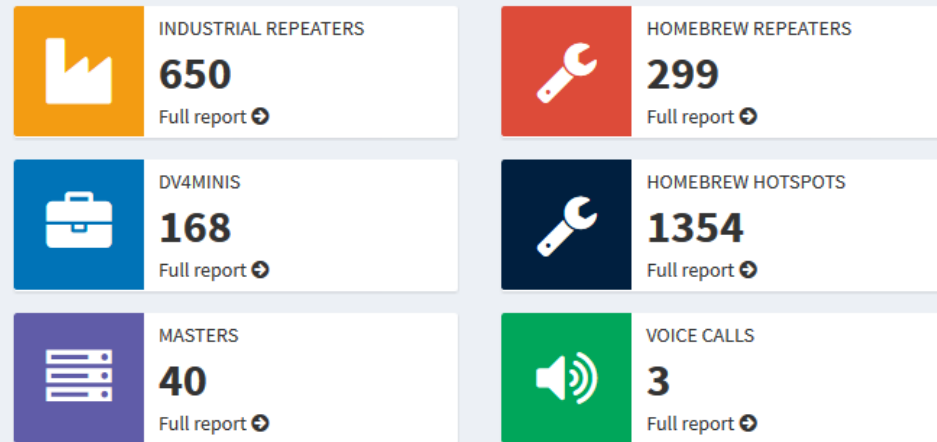
DEMO



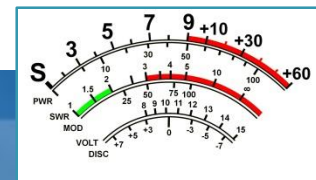
Brandmeister Network

brandmeister.network

User Dashboard



<http://hose.brandmeister.network/scan/>



openSPOT hotspot

DEMO

Supports DMR, D-STAR and Fusion

- UHF
Transceiver
- Digital voice
 - 20mW RF power

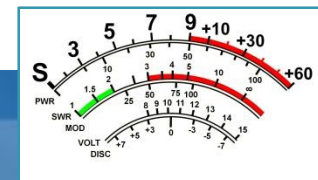


MicroUSB
for power

Ethernet
connection

SharkRF.com

Price: 182 Euros





HACKADAY

HOME BLOG HACKADAY.IO STORE HACKADAY PRIZE SUBMIT ABOUT

March 16, 2017

SHMOOCON 2016: REVERSE ENGINEERING CHEAP CHINESE RADIO FIRMWARE

by: [Brian Benchoff](#)

122 Comments

f t 8*

January 19, 2016



Every once in a great while, a piece of radio gear catches the attention of a prolific hardware guru and is reverse engineered. A few years ago, it was the RTL-SDR, and since then, software defined radios became the next big thing. Last weekend at Shmooccon, [Travis Goodspeed] presented his reverse engineering of the Tytera MD380 digital handheld radio. [The hack has since been published in PoCnGTFO 0x10](#) (56MB PDF, mirrored) with all the gory details that turn a \$140 radio into the first hardware scanner for digital mobile radio.

The Tytera MD380 is a fairly basic radio with two main chips: an STM32F405 with a megabyte of Flash and 192k of RAM, and an HR C5000 baseband. The STM32 has both JTAG and a ROM bootloader, but both of these are protected by the Readout Device Protection (RDP). Getting around the RDP is the very definition of a jailbreak, and thanks



3 DAYS 11 HOURS 40 MINS

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NEVER MISS A HACK



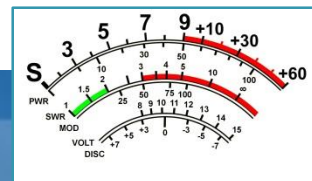
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IF YOU MISSED IT



TWO BITS A GANDER: OF PREMATURE BABIES, INCUBATORS, AND CONEY ISLAND SIDESHOWS

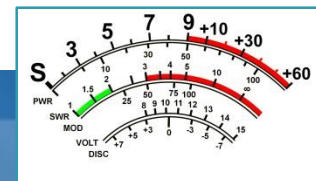


KØNR Blog:

I see some very strong technology and market trends in play here that are going to impact the ham radio world.

- *First off, DMR is a true industry standard ([ETSI](#)), well designed and documented.*
- *Second, we are seeing multiple radio vendors offering competitive, low cost transceivers.*
- *Third, there is high quality commercial repeater gear available from land mobile providers such as Motorola and Hytera.*
- *But there's one more thing that really tops this off: the number of ham-built products emerging that are focused on DMR.*

This is classic ham radio adaptation and innovation that leverages commercial gear for ham radio use.



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