

# **DMR PROGRAMMING**

**WORKSHOP – RMHAM-U**

**KØNGA MIKE**

**ROCKY MOUNTAIN HAM RADIO**



# **MIKE'S DMR DOCTRINE**

**DMR is a commercial radio protocol.**

**It was never designed nor intended for Amateur Radio use.**

**Some things about DMR are not going to make sense.**

**Accept this. It will make your life easier.**



# AGENDA

- Basics Review
- What you need to know
- Programming workflow
- Vendor/CPS differences



# BASICS REVIEW

“No, I will not fix your computer.” -Me, constantly



# WHAT IS DMR/TRBO?

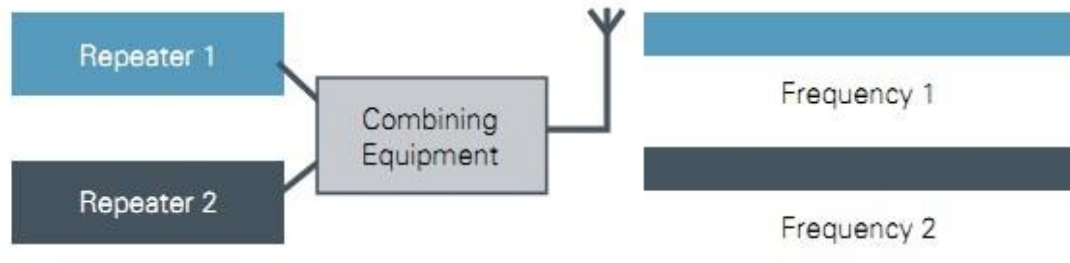
- DMR (Digital Mobile Radio) is an international commercial digital radio standard (ETSI) that originated in Europe
- TRBO refers to MotoTRBO which is Motorola's implementation of the DMR standard
- Many Amateur Radio repeater networks use MotoTRBO equipment, which is why they are commonly referred to as "TRBO" networks
- You do not need to use a Motorola MotoTRBO radio to use these networks



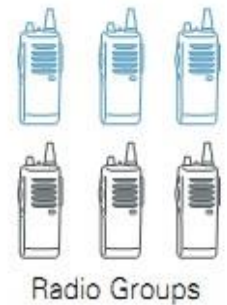
# TWO REPEATERS IN ONE!

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

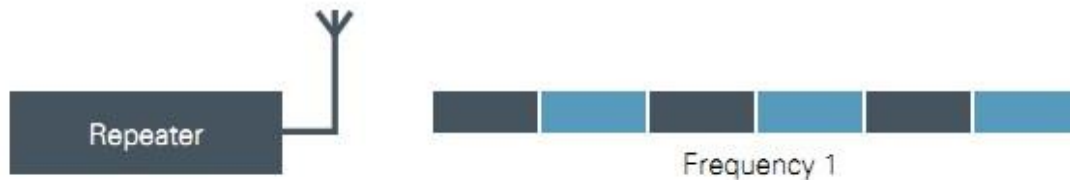
## Two-channel Analog or Digital FDMA System



*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 channels from one repeater*



# NEW CONCEPTS

- Frequency Pair – not new
- Color Code – Functions similar to a CTCSS or DCS access tone
- Repeater Slot – Each DMR Repeater has two, you must specify which one to use
- Talk Group – Each repeater slot can be logically segmented further into talk groups
- Receive Group – List of talk groups to monitor on the channel's assigned repeater slot



# WHAT YOU NEED

**“Yes, you need a computer to run computer software.”  
-Me, on an actual AOL support call.**





# WHAT YOU NEED

- Tier 2 DMR Radio (very common)
  - Programming cable
  - Programming software (Customer Programming Software – CPS)
  - Windows Computer
- Radio ID
  - <https://radioid.net>
  - Create an account
  - You'll need a downloaded copy of your license
- Information about the repeater
  - Frequency pair
  - Color code
  - Talk group(s)
  - Time slot / repeater slot



# PROGRAMMING WORKFLOW

“To experience true DMR freedom, you must learn to program your radio yourself.” -Me, constantly



# RADIO ID

The screenshot displays the 'Customer Programming Software - HAM2000 [Untitled.rdb] - [Setting]' window. The interface includes a menu bar (File, Edit, Program, Option, View, Tools, Window, Help) and a toolbar with icons for file operations. A left-hand navigation pane shows a tree structure for 'CS750' settings, including 'Radio Information', 'General Settings', 'Setting', 'Menu', 'Microphone/VOX', 'Buttons', 'One Touch Call', 'User Defined Tone', 'UI Indication', and 'Conventional'. The main area is divided into several sections: 'Basic', 'Scan', 'Channel Display Mode', 'Battery Save', 'TalkAround', and 'Power-On Screen'. In the 'Basic' section, the 'Radio ID' field is highlighted with a red circle and contains the value '3108111'. Other fields in 'Basic' include 'Radio Alias [P.O.M Line 1]' (set to '-> KONGA Mike <-'), 'Power On Message Line 2' (set to 'HELLO HAMCON!'), 'Unique Radio ID' (set to '00'), 'Squelch Normal Level' (set to '3'), 'Squelch Tight Level' (set to '9'), 'Radio Language' (set to 'English'), 'Monitor Type' (set to 'Open Squelch'), 'Tx Preamble Duration [ms]' (set to '960'), and 'Digital RX Voice Gain Level' (set to '6'). The 'Scan' section has 'Analog Hang Time [ms]' and 'Digital Hang Time [ms]' both set to '500'. 'Channel Display Mode' has 'Auto Lock Keypad' unchecked and 'Auto Lock Delay Time [s]' set to '5'. 'Battery Save' has 'Save Preamble' and 'Save Mode Receive' both checked. 'TalkAround' has 'Group Call Hang Time [ms]' set to '3000' and 'Private Call Hang Time [ms]' set to '4000'. 'Power-On Screen' has 'Channel Display Mode' set to 'Alias', 'Power Up Designated Zone' set to 'Zone 1', and 'Designated Home Zone' set to 'Zone 1'. At the bottom, there are 'Close', 'Print', and 'Help' buttons. The status bar at the very bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and '2016-04-04 08:45:06'. A red circular logo is visible in the bottom right corner.

# BASIC PROGRAMMING CONCEPTS

- In order to program a DMR radio for repeaters, you must know:
  - Repeater frequencies
  - Repeater Color Code
  - Desired Talk Group/Receive Group
  - The Repeater Slot that Talk Group is on
- The order you need to add them to your codeplug:
  - Talk Groups
  - Receive Groups
  - Create Channels where you bring it all together
  - Add Channels to Zones so your radio knows what to do



# EXAMPLE CHANNELS

Channel	Color Code	Time Slot	Receive Frequency	Transmit Frequency	Talk Group
Squaw Rky Mtn	7	Slot 1	446.9375	441.9375	Rocky Mountain
Squaw Central	7	Slot 2	446.9375	441.9375	Central DMR MARC
Lee Hill WW	1	Slot 1	445.05	440.05	WW DMR MARC
Lee Hill WW Eng	1	Slot 1	445.05	440.05	WW Eng DMR MARC
Lee Hill NA	1	Slot 1	445.05	440.05	NA DMR MARC
Lee Hill LCL	1	Slot 2	445.05	440.05	LCL DMR MARC
Lee Hill MTN	1	Slot 2	445.05	440.05	MTN DMR MARC



# TALK GROUPS

- Access Control (analogous to tones on analog radios) is accomplished with Talk Groups
- If a repeater uses Talk Groups, you must know which Talk Groups the repeater uses in order to use the repeater with your radio
- Talk Groups are assigned to a Repeater Slot in a repeater
- More than one Talk Group can be assigned to a single Repeater Slot, but only one Talk Group can use the slot at any given time



# CONTACT LIST

- DMR radios use a Contact List for:
  - Private Call (used for Radio IDs)
  - Talk Groups (required for most repeaters)
  - All Call (often used for simplex)
- Radios with displays will show the Radio ID of person who is transmitting
- If you have the Radio ID in your radio's Contact List, the contact name or tag will display instead of the Radio ID
- Typical contact names include call sign and name



# CONTACT LIST EXAMPLE

The screenshot shows the 'Customer Programming Software - HAM2000' interface. The main window displays a contact list with the following columns: No., Contact Name, Call Type, Call Id, and Receive Tone. The list contains 19 entries, including group calls and private calls. A sidebar on the left shows a tree view of settings, with 'Contact' selected under 'DMR Services'. On the right side of the contact list, there are buttons for 'Add', 'Insert', 'Delete', 'Sort By Name', and 'Sort By Id'. At the bottom of the window, there are 'Close', 'Print', and 'Help' buttons. The status bar at the bottom indicates 'Ready', 'CS750', '400-470 MHz', 'USB', and '2016-04-04 09:49:01'.

No.	Contact Name	Call Type	Call Id	Receive Tone
1	DMR MARC WW	Group Call	1	No
2	DMR MARC LCL	Group Call	2	No
3	DMR MARC NA	Group Call	3	No
4	DMR MARC WW Eng	Group Call	13	No
5	DMR MARC Simplex	Group Call	99	No
6	Rocky Mountain	Group Call	700	No
7	Lookout Local	Group Call	710	No
8	South	Group Call	719	No
9	Denver	Group Call	720	No
10	North	Group Call	721	No
11	NoCo Net	Group Call	3171	No
12	DMR MARC MTN	Group Call	3177	No
13	NR2Y Marinus	Private Call	3108001	No
14	WA2YZT Paul	Private Call	3108002	No
15	K0JSC Jeff	Private Call	3108003	No
16	N2PDQ Dirk	Private Call	3108004	No
17	KF0KR Thomas	Private Call	3108005	No
18	N0GQX Gerald	Private Call	3108006	No
19	N0VBY Mike	Private Call	3108007	No





# RECEIVE GROUPS

- Receive Groups are how DMR radios use Talk Groups when receiving signals
- Talk Groups are assigned to Receive Groups. Receive Groups are assigned to the receive frequency on the channel in your radio.
- More than one Talk Group can be assigned to a Receive Group
  - Recommended config by DMR-MARC
  - Can cause confusion when scanning
- Remember Mike's DMR Doctrine





# CHANNEL EXAMPLE

Customer Programming Software - HAM2000 [ Untitled.rdb ] - [DCH 1]

File Edit Program Option View Tools Window Help

ACH 1 DCH 1

CS750

- Radio Information
- General Settings
- Conventional
  - Zone
  - Channel
    - Analog Channel
    - Digital Channel
      - DCH 1
- Scan
- DMR Services
- Emergency
- Personality
- DTMF Services
- MDC Services
- 2Tone Services
- 5Tone Services
- Smart Call

Channel Alias: DCH 1

Digital ID: 1

Color Code: 1

Repeater/Time Slot: Slot 1

Scan List: None

Auto Scan Start:

Rx Only:

Talk Around:

Lone Worker:

VOX:

Receive

Frequency [MHz]: 400.000000

Offset [MHz]: 0.000000

Apply

Transmit

Frequency [MHz]: 400.000000

Ref Frequency [MHz]: Middle

Rx Group List: None

Tx Contact: Contact1

Emergency Alarm Indication:

Emergency Alarm Ack:

Emergency System: None

Emergency Call Indication:

Power Level: High

Close Print Help 1 of 1

Ready CS750 400-470 MHz USB 2016-04-04 09:41:07



# COLOR CODE

- DMR repeaters use a Color Code as the first access point after the receive frequency
- Color Codes are designed to allow two repeaters with the same frequency to operate effectively if they are relatively close to each other
- You must know the Color Code of the repeater in order to successfully use the repeater



# REPEATER SLOTS

- DMR repeaters have 2 “time slots” that share a frequency, allowing for two separate, simultaneous conversations
- This means one repeater can do the work of two while using less bandwidth than a single analog repeater
- You must know which Repeater Slot you wish to use in order to set up your radio (more on this later)



# EXAMPLE CHANNEL - RMHAM

The screenshot displays the 'Customer Programming Software - HAM2000' interface. The window title is 'Customer Programming Software - HAM2000 [ C:\Users\michael\CloudStation\RMHAM\Connect Systems\RMHAM\_CS750\_SampleCodeplug\_2016-03-31\_Ne...'. The menu bar includes 'File', 'Edit', 'Program', 'Option', 'View', 'Tools', 'Window', and 'Help'. The toolbar contains icons for file operations and help. The main window is titled 'Contact | DMR MARC WW | Thorodin Rk Mtn'. On the left, a list of contacts is shown, with 'Thorodin Rk Mtn' selected. The right pane shows configuration settings for the selected contact:

- Digital ID: 12345
- Color Code: 7
- Repeater/Time Slot: Slot 1
- Scan List: TRBO Denver
- Auto Scan Start:
- Rx Only:
- Talk Around:
- Lone Worker:
- VOX:

Receive and Transmit sections:

- Receive Frequency [MHz]: 446.800000
- Offset [MHz]: 0.000000
- Transmit Frequency [MHz]: 441.800000
- Apply button
- Ref Frequency [MHz]: Middle
- Rx Group List: Rocky Mountain
- Emergency Alarm Indication:
- Emergency Alarm Ack:
- Emergency Call Indication:
- Encrypt:
- Ref Frequency [MHz]: Middle
- Tx Contact: Rocky Mountain
- Emergency System: None
- Power Level: High
- Tx Admit: Color Code Free
- Tx Time-Out Time [s]: Infinite

At the bottom, there are buttons for 'Close', 'Print', and 'Help', along with a status bar showing '29 of 69' and navigation icons. The system tray at the very bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and the date/time '2016-04-04 09:53:56'.



# ZONES

- Channels are assigned to Zones
- Only one (1) Zone can be in use at a time
- On HTs (and some mobiles), corresponds with channel selection dial
- Radios can have numerous zones
- Channels can be a member of more than one Zone



**QUESTIONS?**





# STUFF AND THINGS

- RMHAM Website – <http://www.rmham.org>
- Interactive DMR repeater map: <http://bit.ly/rmham-trbo-map>
- Radio ID – <https://www.radioid.net/>
- DMR-MARC Website – <http://www.dmr-marc.net>
- Brandmeister
  - Dashboard: <https://brandmeister.network/>
  - Audio Feeds: <http://hose.brandmeister.network/>
  - Wiki: <https://wiki.brandmeister.network>
- Contact Me: [KONGA@arrl.net](mailto:KONGA@arrl.net)

