

DMR OPERATING BASICS & BEST PRACTICES

KØNGA MIKE

ROCKY MOUNTAIN HAM RADIO



MIKE'S DMR DOCTRINE

If something about using DMR for Amateur Radio doesn't make sense, remember that DMR was created for commercial use, and was never designed nor intended for Amateur Radio use.



WHAT IS DMR/TRBO?

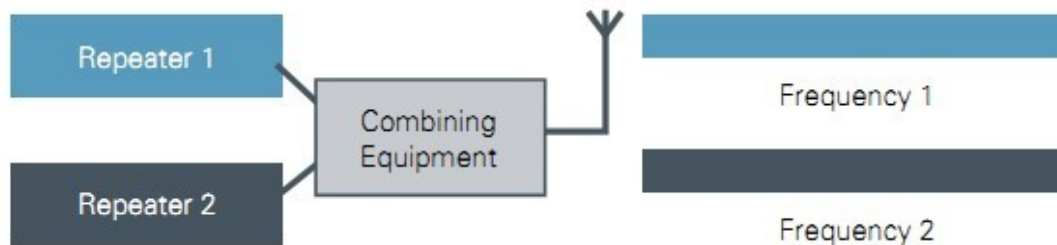
- DMR (Digital Mobile Radio) is an international commercial digital radio standard that originated in Europe
- TRBO refers to MotoTRBO which is Motorola's implementation of the DMR standard
- Many Amateur Radio repeater networks use MotoTRBO equipment, which is why they are commonly referred to as "TRBO"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



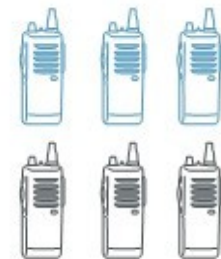
TWO REPEATERS IN ONE!

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



Radio Groups

Two-channel Digital TDMA System



Two calls per repeater and channel



Radio Groups

*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



GET A RADIO

- You must have a Tier 2 DMR Radio (very common)
- You get what you pay for
 - Low cost radios on the market are not created equal
 - Ask around about user experience
 - Check the radio list at rmham.org
- Feature sets can vary widely among manufacturers
- Choice of radio is mainly a matter of what is important to you. I'm a contact list junkie.
- Recommendation: Get a radio that has sample codeplugs available, or is supported by the NOGSG utility.



GET A RADIO ID

- <https://www.radioid.net/> -> Register ID -> User Registration (at the bottom of the page)
- Everything works best when each radio has a unique ID
- Put your Radio ID in the codeplug and upload to the radio
- Radio ID is NOT a replacement for ID'ing. You must still ID vocally every 10 minutes per FCC regulations.



RADIO ID

The screenshot displays the 'Setting' window for a radio model CS750. The 'Basic' settings tab is active, and the 'Radio ID' field is highlighted with a red circle. The value entered is '3108111'. Other visible settings include 'Radio Alias [P.O.M Line 1]' set to '-> KONGA Mike <-', 'Power On Message Line 2' set to 'HELLO HAMCON!', '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 shows 'Analog Hang Time [ms]' and 'Digital Hang Time [ms]' both set to 500. The 'Channel Display Mode' section has 'Auto Lock Keypad' unchecked and 'Auto Lock Delay Time [s]' set to 5. The 'Battery Save' section has 'Save Preamble' and 'Save Mode Receive' both checked. The 'Power-On Screen' section has 'Channel Display Mode' set to Alias, 'Power Up Designated Zone' set to Zone 1, and 'Designated Home Zone' set to Zone 1. The status bar at the bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and the date '2016-04-04 08:45:06'. A red circular logo is visible in the bottom right corner.

Customer Programming Software - HAM2000 [Untitled.rdb] - [Setting]

File Edit Program Option View Tools Window Help

Setting

CS750

- Radio Information
- General Settings
 - Setting
 - Menu
 - Microphone/VOX
 - Buttons
 - One Touch Call
 - User Defined Tone
 - UI Indication
- Conventional

Basic

Radio Alias [P.O.M Line 1] -> KONGA Mike <-

Power On Message Line 2 HELLO HAMCON!

Unique Radio ID 00

Radio ID 3108111

Squelch Normal Level 3

Squelch Tight Level 9

Radio Language English

Monitor Type Open Squelch

Tx Preamble Duration [ms] 960

Digital RX Voice Gain Level 6

Scan

Analog Hang Time [ms] 500

Digital Hang Time [ms] 500

Channel Display Mode

Auto Lock Keypad

Auto Lock Delay Time [s] 5

Battery Save

Save Preamble

Save Mode Receive

Power-On Screen

Channel Display Mode Alias

Power Up Designated Zone Zone 1

Designated Home Zone Zone 1

Close Print Help

Edit - General settings - Setting - Basic Setting - Radio ID

Ready CS750 400-470 MHz USB 2016-04-04 08:45:06

LEVERAGE THE SAMPLE CODEPLUGS

- Available on the RMHAM Website
 - www.rmham.org
 - MotoTRBO/DMR -> Sample Codeplugs
- All RMHAM TRBO repeaters programmed in
- Quickest way to get on the air
- Use as a foundation for your own codeplug
- Use as a starting point for the N0GSG utility



ID YOUR TALK GROUP

- When calling, identify which talk group you are transmitting on.
- “This is K-0-N-G-A on Rocky Mountain”
- Many Hams scan various channels and may want or need to turn scan off and tune to your channel to respond.
- If you don’t ID the talk group, the responding ham may not know which channel to tune to.



TALK GROUPS AND REPEATER SLOTS

- Each repeater has 2 repeater slots (time slots)
- Each slot can handle 1 conversation at a time. Thus, each repeater can handle 2 simultaneous separate conversations
- Some networks allow multiple talk groups on the same repeater slot
- Only one talk group can be transmitting at a time on a single repeater slot
- It may be necessary to monitor the other talk groups on a repeater slot to determine if the slot is free to operate on



DMR NETS

- RMHAM TRBO Tech Net
 - First Saturday of the Month, 7:00 PM, Rocky Mountain talk group
- World Wide DMR-MARC Net
 - World Wide talk group, Saturdays, 16:00 UTC Summer, 17:00 UTC Winter
- DMR-MARC Tech Net
 - North America talk group, Thursdays, 01:00 UTC Summer, 02:00 UTC Winter (This translates to Wednesday Night in the States)



QUESTIONS?



KNOW YOUR NETWORK

DMR LINKED REPEATER NETWORKS

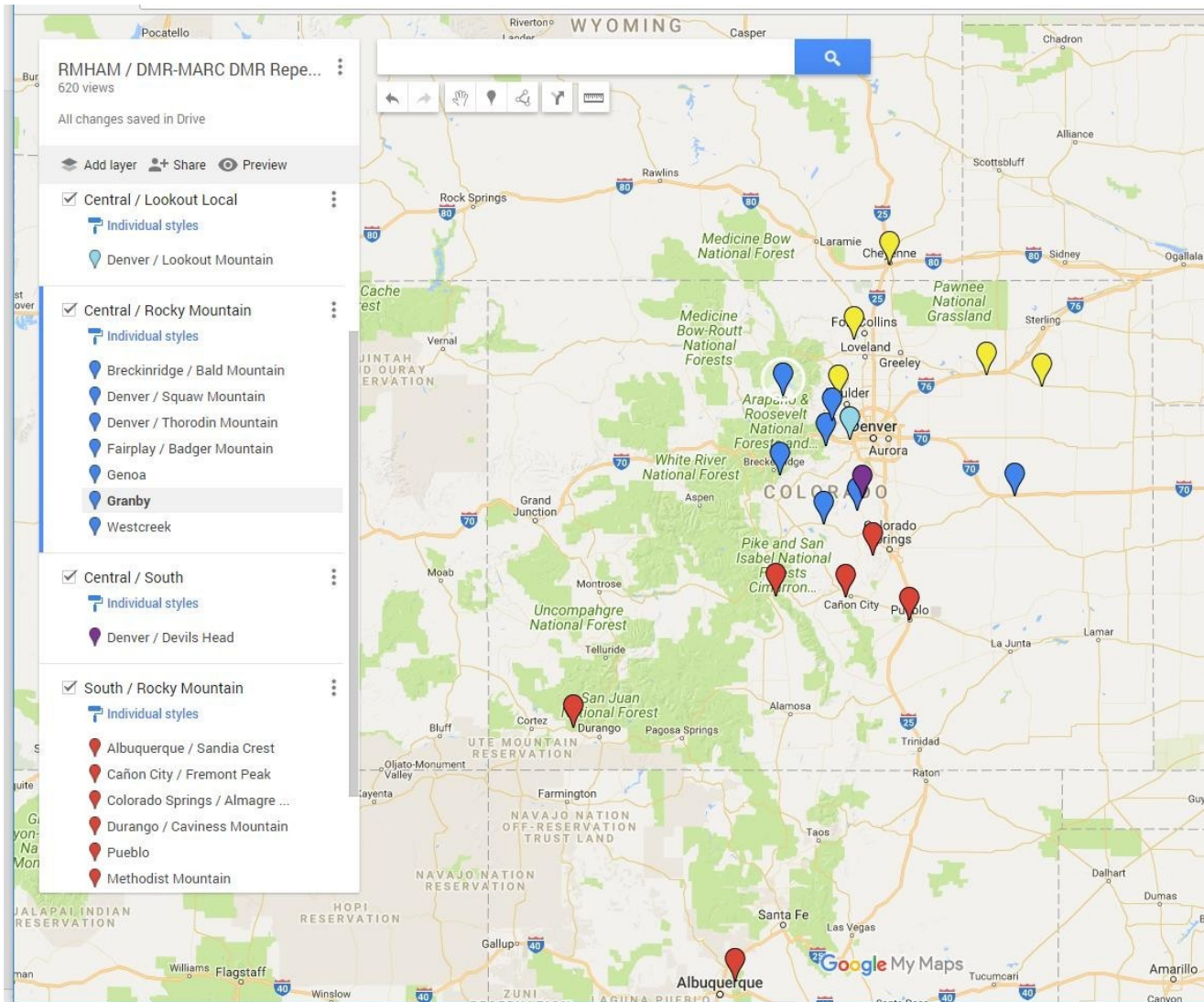


AGENDA

- RMHAM DMR Network
- Network Map
- Operating Practices
- DMR-MARC
- Brandmeister
- Concepts
- Access Options



RMHAM DMR MAP



RMHAM DMR NETWORK

- Five Talk Groups: Rocky Mountain (wide), North, South, Central, and Lookout Local
- When contacting another ham, use the smallest coverage talk group possible
- If necessary, use Rocky Mountain to make contact, then move to a smaller coverage talk group if possible



ID YOUR TALK GROUP (REVISITED)

- When calling, identify which talk group you are transmitting on.
- “This is K-0-N-G-A on Rocky Mountain”
- Many Hams scan various channels and may want or need to turn scan off and tune to your channel to respond.
- If you don’t ID the talk group, the responding ham may not know which channel to tune to.



TALK GROUP COURTESY

- Use the smallest area coverage talk group necessary for contact
- For example: In Denver, the smallest talk group coverage is “Lookout Local” (one repeater)
- Use Rocky Mountain to initiate contact, then move to a “smaller” talk group if possible
- This leaves Rocky Mountain open for other Hams to make contact

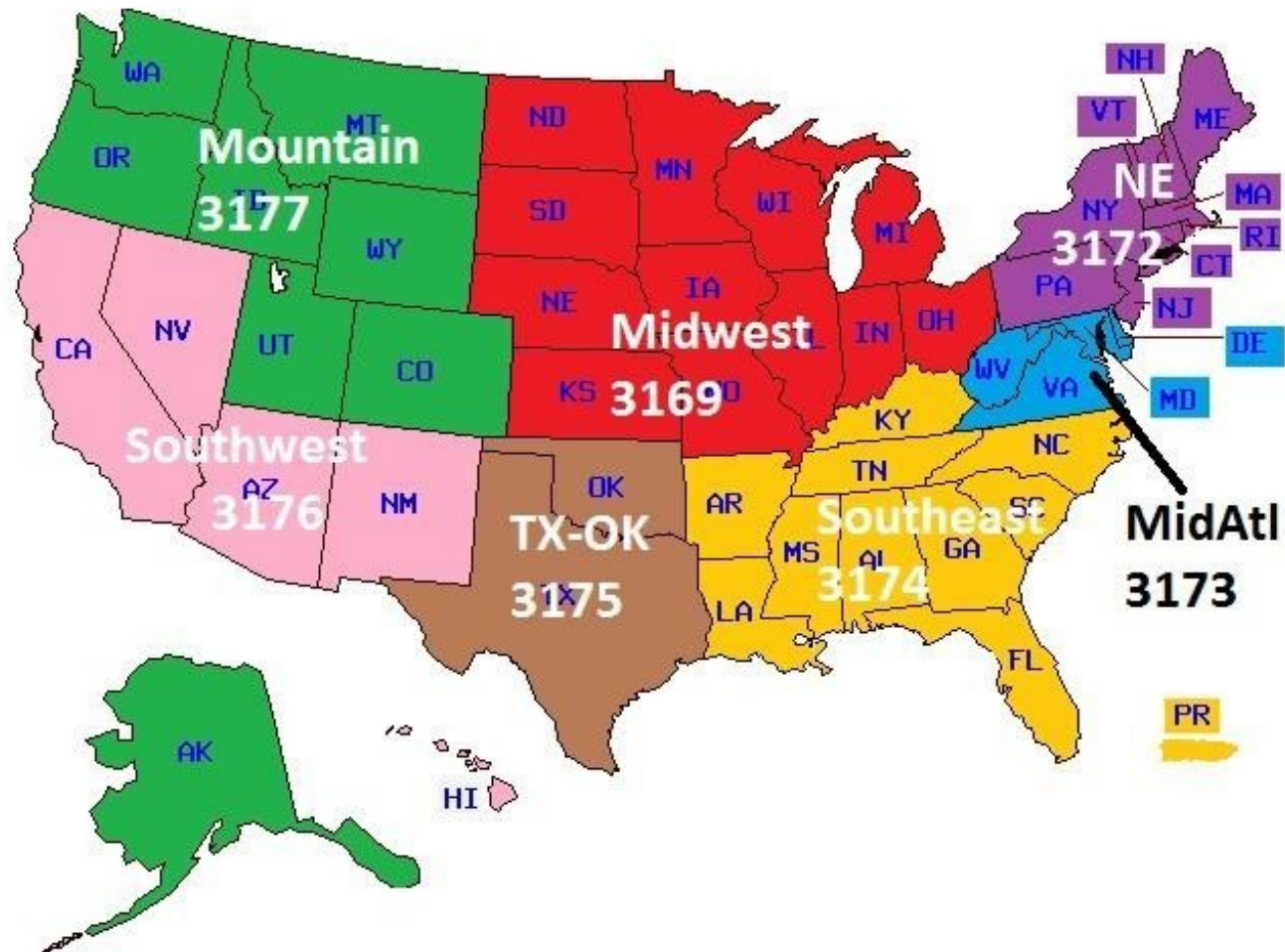


DMR-MARC

- World Wide, MANY talk groups
- Most Talk Groups are static
- World Wide, World Wide English, North America, Local, US Regionals
- Colorado is in the Mountain regional talk group
- Also has User Activated Talk Groups, sometimes called Tactical Talk Groups (e.g., TAC310), which are only active when you transmit on them.



DMR-MARC US REGIONAL TALK GROUPS



BRANDMEISTER

- World Wide, MANY talk groups
- All Talk Groups are dynamic; A Talk Group can be made static on a repeater by the repeater operator
- All Talk Groups (unless made static on a repeater) are user activated
- Remote users cannot activate a Talk Group on a remote repeater
- Desired Talk Group must be programmed into the radio channel (with some advanced exceptions)



BRANDMEISTER

- Two ways to access the Brandmeister network:
- Traditional Repeater
- Brandmeister site has a map of all repeaters
- Work mostly like any other DMR repeater
- Hotspot
- Different types available
- Short-range, only practical for personal use
- OpenSpot currently to most widely used



DMR PROGRAMMING

Learn, you must.

Your own radio, to program.

-Yoda



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



CHANNEL EXAMPLE

The screenshot displays the 'Customer Programming Software - HAM2000 [Untitled.rdb] - [DCH 1]' interface. The main configuration area is titled 'ACH 1 DCH 1'. On the left, a tree view shows the hierarchy: CS750 > Radio Information > General Settings > Conventional > Channel > Digital Channel > DCH 1. The right pane shows the configuration for 'DCH 1' with the following fields and values:

- Channel Alias: DCH 1
- Digital ID: 1
- Color Code: 1 (circled in red)
- Repeater/Time Slot: Slot 1 (circled in red)
- Scan List: None
- Auto Scan Start:
- Rx Only:
- Talk Around:
- Lone Worker:
- VOX:

Below these are 'Receive' and 'Transmit' sections:

- Receive:** Frequency [MHz]: 400.000000 (circled in red); Offset [MHz]: 0.000000; Ref Frequency [MHz]: Middle; Rx Group List: None (circled in red); Emergency Alarm Indication: ; Emergency Alarm Ack: ; Emergency Call Indication:
- Transmit:** Frequency [MHz]: 400.000000 (circled in red); Ref Frequency [MHz]: Middle; Tx Contact: Contact1 (circled in red); Emergency System: None; Power Level: High

At the bottom, there are buttons for 'Close', 'Print', and 'Help', along with a status bar showing '1 of 1' and navigation icons. The system tray at the very bottom indicates 'Ready', 'CS750', '400-470 MHz', 'USB', and the date/time '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



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



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 EXAMPLE

The screenshot displays the 'Customer Programming Software - HAM2000' interface. The main window is titled 'Contact' and shows a tree view on the left with 'Contact' selected under 'DMR Services'. The central area contains a table with 19 rows of contact data. On the right side of the table, 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 very bottom shows '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 |

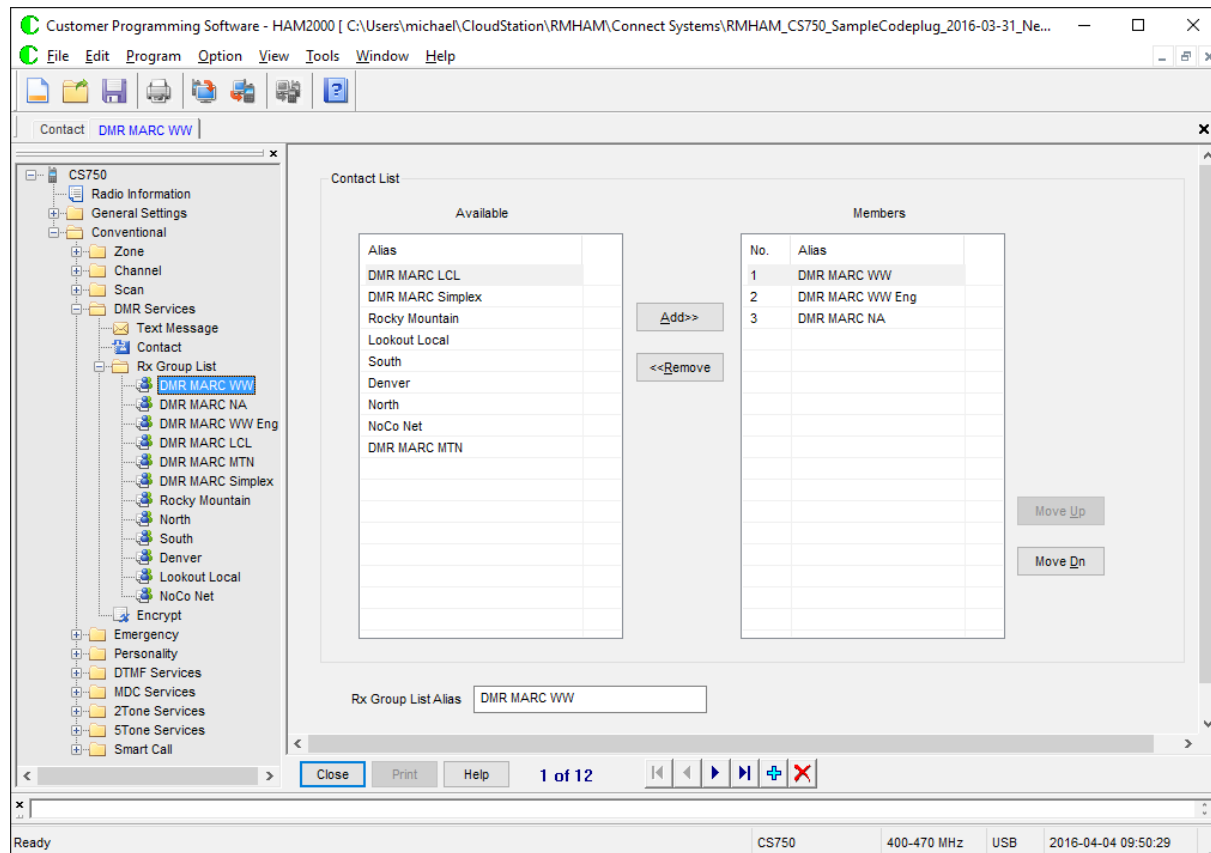


RECEIVE GROUPS

- 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



RECEIVE GROUP EXAMPLE



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 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 |
| Lee Hill WW | 1 | Slot 1 | 445.05 | 440.05 | DMR MARC WW |
| Lee Hill WW Eng | 1 | Slot 1 | 445.05 | 440.05 | DMR MARC WW Eng |
| Lee Hill NA | 1 | Slot 1 | 445.05 | 440.05 | DMR MARC NA |
| Lee Hill LCL | 1 | Slot 2 | 445.05 | 440.05 | DMR MARC LCL |
| Lee Hill MTN | 1 | Slot 2 | 445.05 | 440.05 | DMR MARC MTN |



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 tree view lists various contacts, with 'Thorodin Rk Mtn' selected. The right pane shows configuration settings for this 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
- Ref Frequency [MHz]: Middle
- Rx Group List: Rocky Mountain
- Emergency Alarm Indication:
- Emergency Alarm Ack:
- Emergency Call Indication:
- Encrypt:
- Transmit 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'.



ADMIT CRITERIA

- Used to prevent transmit when a frequency is in use
- For Digital Channels, use “Color Code”
- For Analog Channels, do not use admit controls.
- Prevents “doubling” or transmitting at the same time without knowing
- Default settings in sample codeplugs



RADIO ID

- Identifies the radio to the DMR Repeater
- Each Radio's ID should be unique on the repeater/network
- Not a replacement for Call Sign
- Required for operation with the repeater



RADIO ID

The screenshot shows the 'Setting' window for a radio model CS750. The 'Basic' section contains the following settings:

- Radio Alias [P.O.M Line 1]: --> KONGA Mike <-
- Power On Message Line 2: HELLO HAMCON!
- Unique Radio ID: [Dropdown]
- Radio ID: 3108111 (circled in red)
- Squelch Normal Level: [Dropdown]
- Squelch Tight Level: 9
- Radio Language: English
- Monitor Type: Open Squelch
- Tx Preamble Duration [ms]: 960
- Digital RX Voice Gain Level: 6

The 'Scan' section contains:

- Analog Hang Time [ms]: 500
- Digital Hang Time [ms]: 500

The 'Channel Display Mode' section contains:

- Auto Lock Keypad:
- Auto Lock Delay Time [s]: 5

The 'Battery Save' section contains:

- Save Preamble:
- Save Mode Receive:

The 'Power-On Screen' section contains:

- Channel Display Mode: Alias
- Power Up Designated Zone: Zone 1
- Designated Home Zone: Zone 1

The 'TalkAround' section contains:

- Group Call Hang Time [ms]: 3000
- Private Call Hang Time [ms]: 4000

The status bar at the bottom shows: Ready | CS750 | 400-470 MHz | USB | 2016-04-04 08:45:06



ZONES

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



SCAN LIST

- Named list of channels grouped together
- List is assigned to a channel
- When that channel is activated, the list assigned to that channel will be scanned
- Lists can contain digital and analog channels
- Some radios have advanced scan list settings



SCAN LIST EXAMPLE

The screenshot displays the 'Customer Programming Software - HAM2000' interface. The main 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 interface is divided into several sections:

- Left Panel (Tree View):** Shows a hierarchical structure under 'CS750'. The 'Scan' folder is expanded, and 'TRBO Denver' is selected.
- Center Panel (Alias List):** A list of aliases for the selected scan. The list includes:

| Alias |
|-----------------|
| 438.225 91.5 |
| 446.000 Simplex |
| 446.000 Smpx PL |
| 446.025 Simplex |
| 446.025 Smpx PL |
| 446.050 Simplex |
| 446.050 Smpx PL |
| 446.075 Simplex |
| 446.075 Smpx PL |
| 446.100 Simplex |
| 446.100 Smpx PL |
| 446.125 Simplex |
| 446.125 Smpx PL |
| 446.150 Simplex |
| 446.150 Smpx PL |
- Right Panel (Scan List):** A table showing the scan list configuration:

| No. | Alias |
|-----|-----------------|
| 1 | Selected |
| 2 | Badger Rk Mtn |
| 3 | Badger Denver |
| 4 | Boulder Rk Mtn |
| 5 | Breck Rk Mtn |
| 6 | Breck Denver |
| 7 | Devils Denver |
| 8 | Genoa Rk Mtn |
| 9 | Genoa Denver |
| 10 | Lookout Local |
| 11 | Lookout Denver |
| 12 | Squaw Rk Mtn |
| 13 | Squaw Denver |
| 14 | Thorodin Rk Mtn |
| 15 | Thorodin Denver |
- Configuration Fields:** Below the lists, there are several configuration options:
 - Scan List Alias: TRBO Denver
 - Priority Channel1: None
 - Priority Channel2: None
 - Tx Designated Channel: Last Active Channel
 - Nuisance Delete:
 - Nuisance Reset:
 - Signaling Hold Time [ms]: 50
 - Look Back Time A [s]: 2.0
 - Look Back Time B [s]: 2.0
 - TalkBack:
 - Channel Marking:

The status bar at the bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and '2016-04-04 09:56:37'.



ROAMING

- Automatic feature available on some radios
 - Motorola, Hytera, Vertex Standard
- Radio measure signal strength of channels in a list, determines the strongest signal, and tunes to that channel
- Best use case is for times when a single talk group needs to be used but the user will be moving through a large area.



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: K0NGA@arrl.net

