An Introduction Digital Mobile Radio (DMR)

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What is DMR

- Like D-Star™ (Icom) and Fusion™ (Yaesu), Digital mobile radio (DMR) is another digital transmission mode. DMR is an open digital mobile radio standard defined by the European Telecommunications Standards Institute ETSI.
- 4 Level FSK TDMA “constant envelope” modulation. [Tier II] 30 Ms Window , 27.5 mS transmission with 2.5 mS gap.
- 6.25 KHz bandwidth per “Time Slot”, with two Time Slots per repeater.
- Requires more involved radio programming than analog radios.

DMR Tiers

- There are 3 "tiers" of DMR
  - Tier I is for license free use in the European 446 Mhz band. This part of the standard provides for consumer applications and low power commercial applications, using a maximum of 0.5 watt RF power. There have been no commercial launches of DMR Tier I products to date.
  - Tier II covers licensed conventional radio systems, mobiles and portables. The ETSI DMR Tier II standard is targeted at those users who need spectral efficiency, advanced voice features and integrated IP data services. All amateur networks have adopted and are using the Tier II standard.
  - Tier III covers trunking operation. This standard is mainly meant for commercial use as "true" trunking is not allowed under Part 97 of the FCC rules

DMR Tier II

- For Amateur Radio networks, the Tier II standard has been adopted and is in use worldwide with several networks
- Occupies 12.5Khz of channel space and is a two "slot" TDMA based system that uses an AMBE+2 vocoder
- Two slots = two separate talk paths! Data is also usable on either timeslot, but voice is the primary function

for DMR Tier II

- Each timeslot occupies 6.25 Khz of space for a total of 12.5 Khz of channel bandwidth

Time Division Multiple Access

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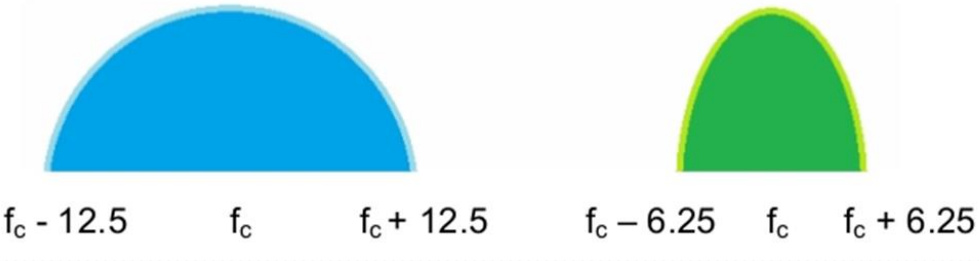
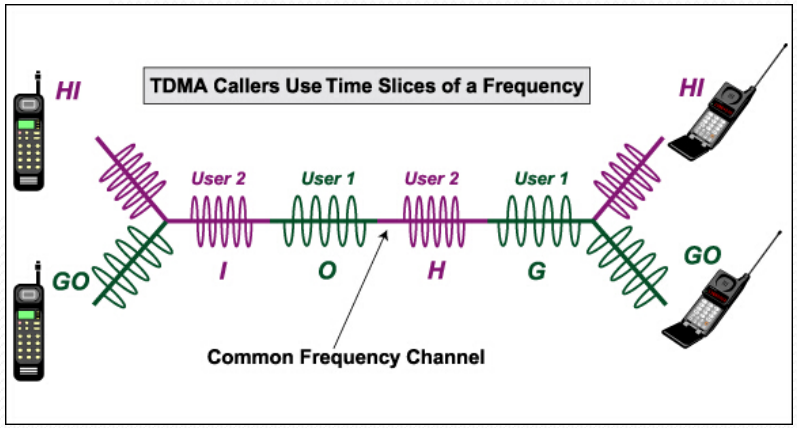
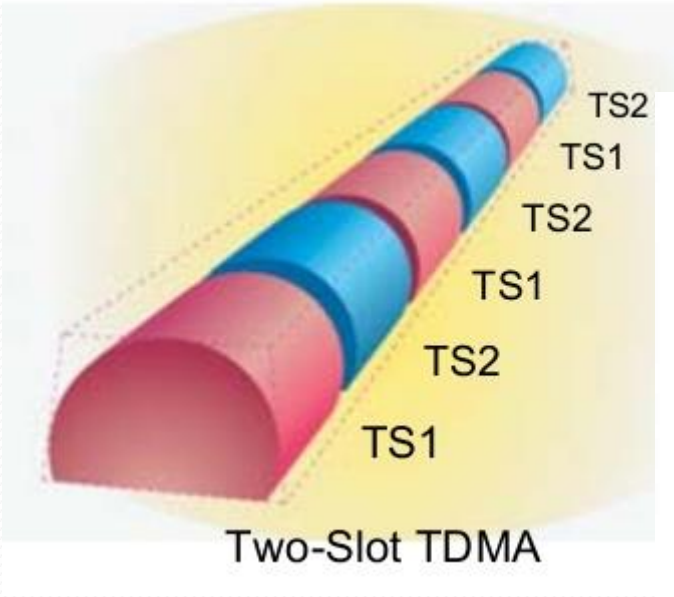
1600' Above the C



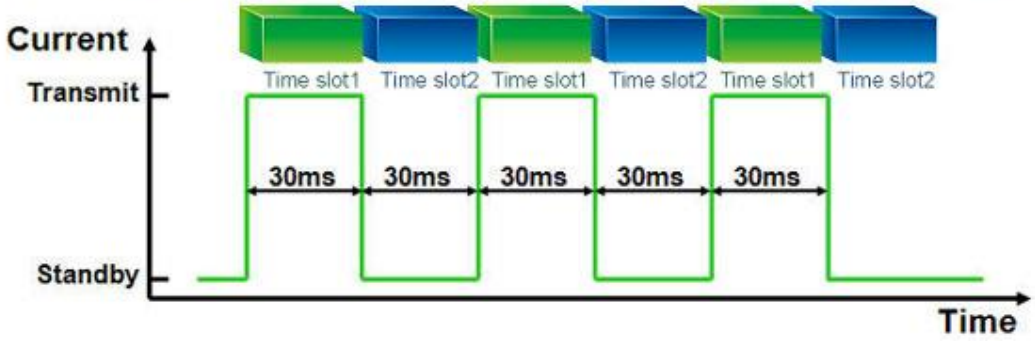
FM Analog 25 kHz

DMR 12.5 kHz





Voice Call 1



Several Radio Choices

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DMR Operation

- When you want to access a DMR repeater, you must have the frequency, Color Code, and Talk Group set correctly. When you key your transceiver, you send a signal to the repeater and the repeater responds back to you to acknowledge you can transmit your message. If you do not receive the repeater's acknowledgement, your radio will stop transmitting and you will hear a negative confirmation tone. This is one of the advantages of TDMA: allowing bidirectional communications between user and the repeater when transmitting. The repeater can also signal your radio to stop transmitting if there is contention on the network because more than one station is transmitting at a time.

DMR Operation (cont)

- DMR radios do not transmit Call sign – Instead radios transmits "Unit ID" numbers. **You must ID.**
- DMR repeaters ID in FM CW during which time DMR time packets can not be received/transmitted.
- DMR's TDMA modulation yields about a 40% extension on battery life.

DMR Programming

- You obtain a no-cost “User ID” from “www.dmrmarc.net” to use DMR on ham repeaters.
- You program a series of “Contacts” of Talk Groups you want to talk to. Lists all person and group contacts
- You build Digital Channels - Repeaters, or simplex frequencies you are going to use including each transmit and receive frequency, Color Code, Time Slot.
- You build a list of “Zones”. A Zone is just a grouping of individual channels. Some model radios may limit the number of channels per Zone and the number of Zones allowed.
- You program a series of “Digital Receive Groups” on who you want to receive a call.

Talkgroups

- Talk Groups (TG) are a way for groups of users to share a time slot (one to- many) without distracting and disrupting other users of the time slot. It should be noted that only one Talk Group can be using a time slot at a time. If your radio is not programmed to listen to a Talk Group, you will not hear that Talk Group's traffic.
- They are numerically identified and alphanumerically identified in the radio's codeplug

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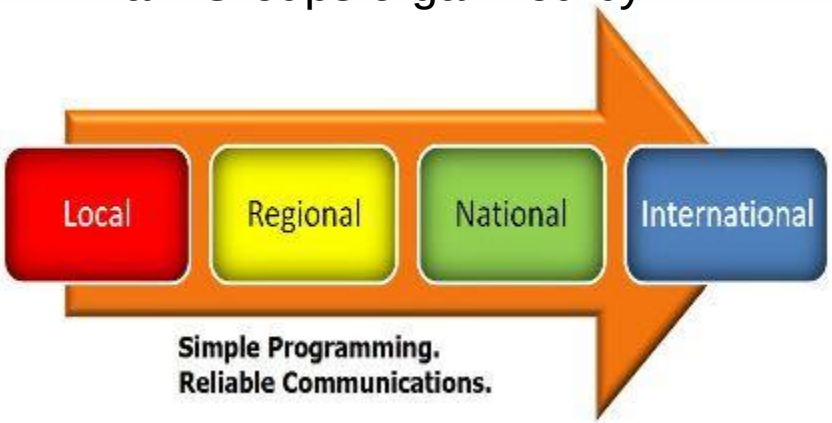
- Call routing is based on "**Talk Groups**"
- Talk Groups organized by:



TG2 = Local (Single Rptr)
TG3101 = Alabama
TG3100 = North America
TG91 = Worldwide

Basic Structure of the Channel

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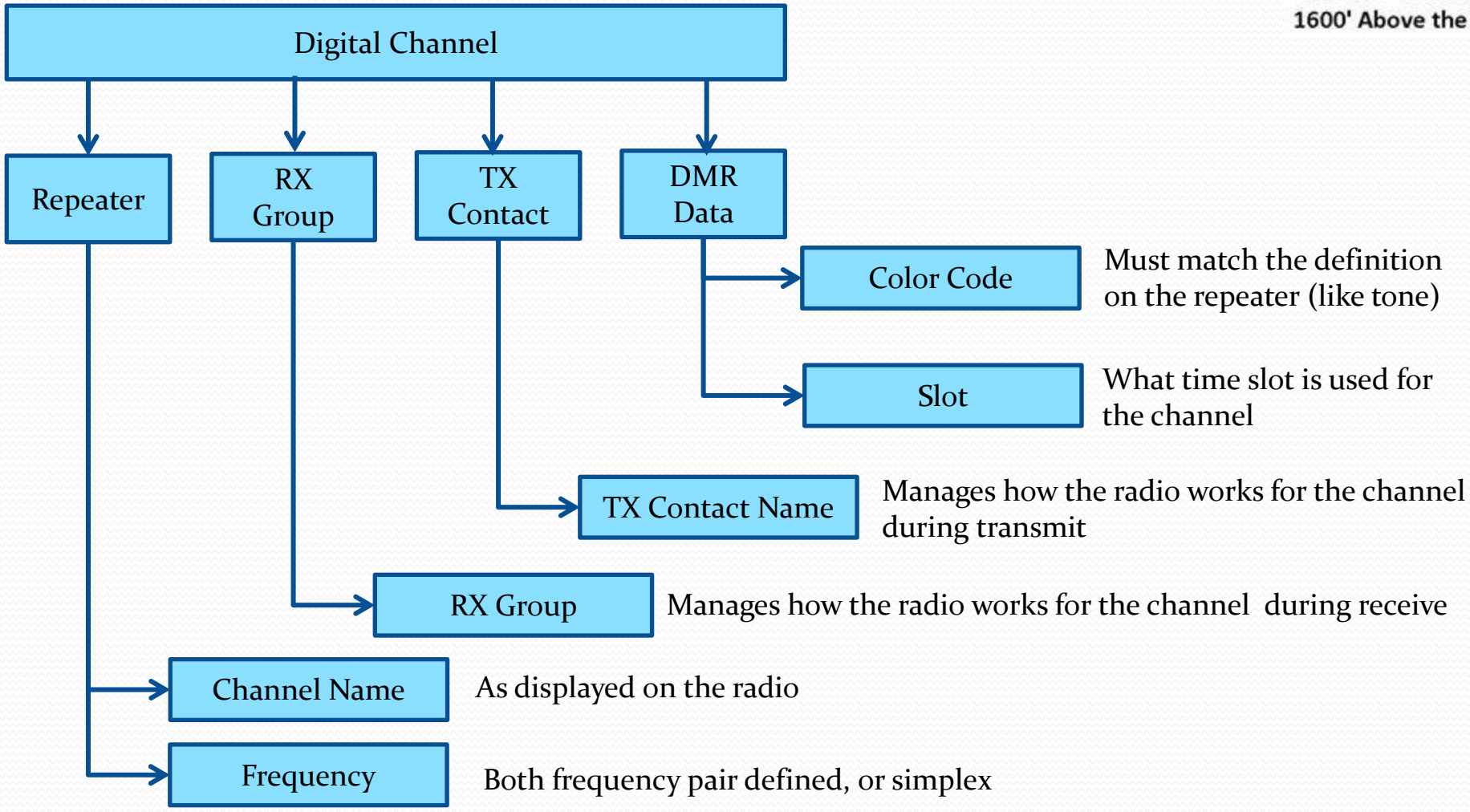
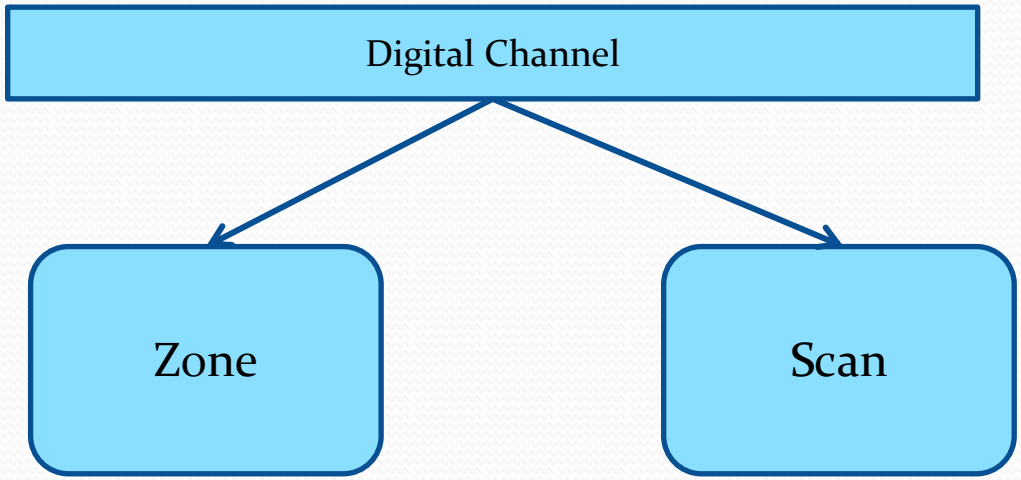


Basic Structure of the Channel



Groups of Digital channels for a purpose

Groups of Digital channels for scanning

- Repeater
- Talk Group Type
- Simplex
- Service (ARES, Bike Race, Weather, etc.)
- Region

DMR Channel Example

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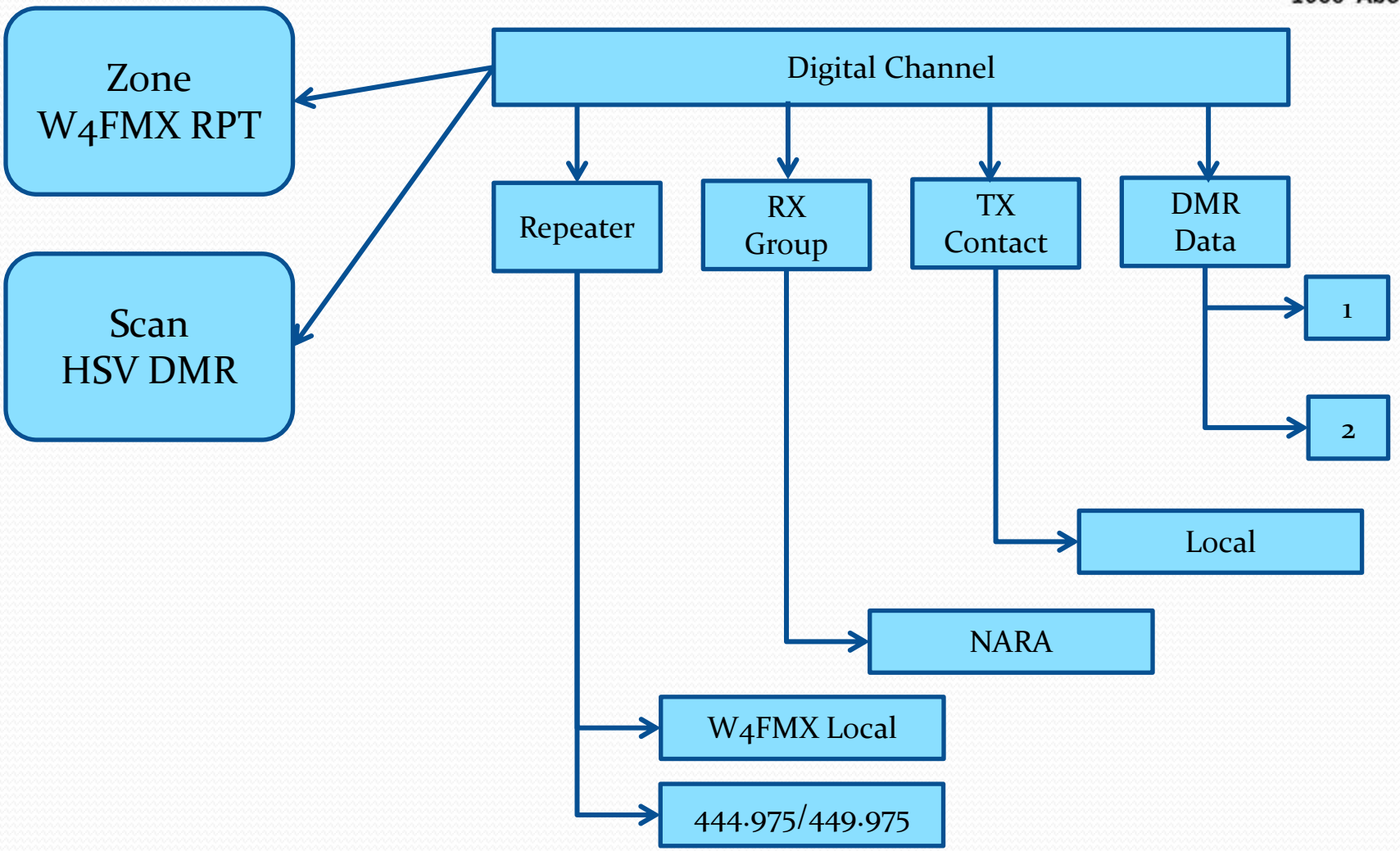

Code Plug

- A code plug is simply a radio's configuration file. Using a manufacturer's customer programming software (CPS) you configure the channels and operating parameters of a radio. This file is uploaded to the radio and typically should also be saved on you computer as a backup. You can also download the code plug from a radio to modify it.
- Building a code plug can take many hours, especially if you want to program hundreds of channels. The code plug can also contain a Contact List of Radio IDs, call signs, and names to be displayed.
- You can find copies of configured code plugs on the web for different models of radio.
- NARA has made available code plugs configured for our repeaters for several popular radios. Visit the NARA website at www.n4hsv.net to download a code plug for your radio.

Call Sign and ID Programming

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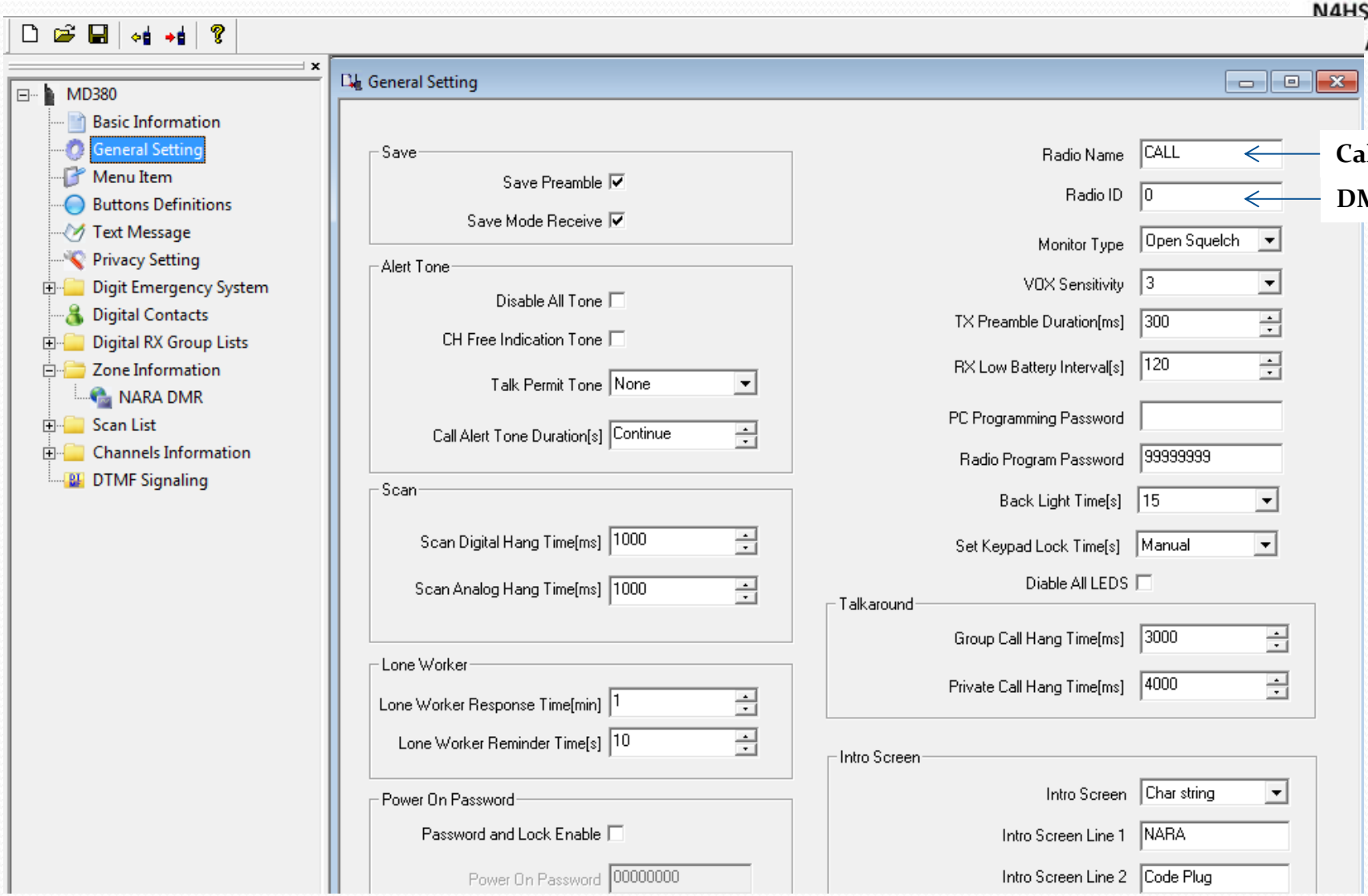

Contacts

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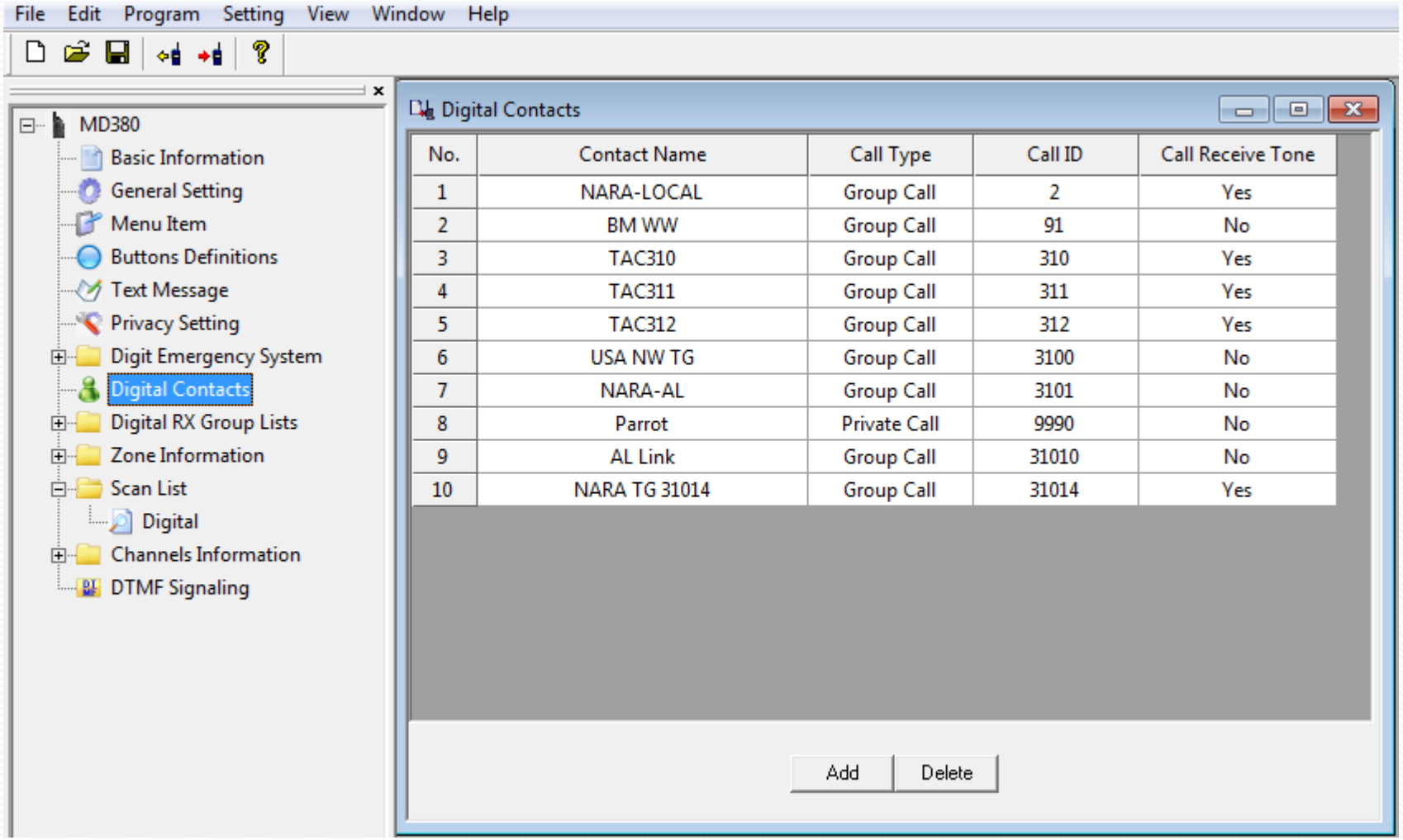
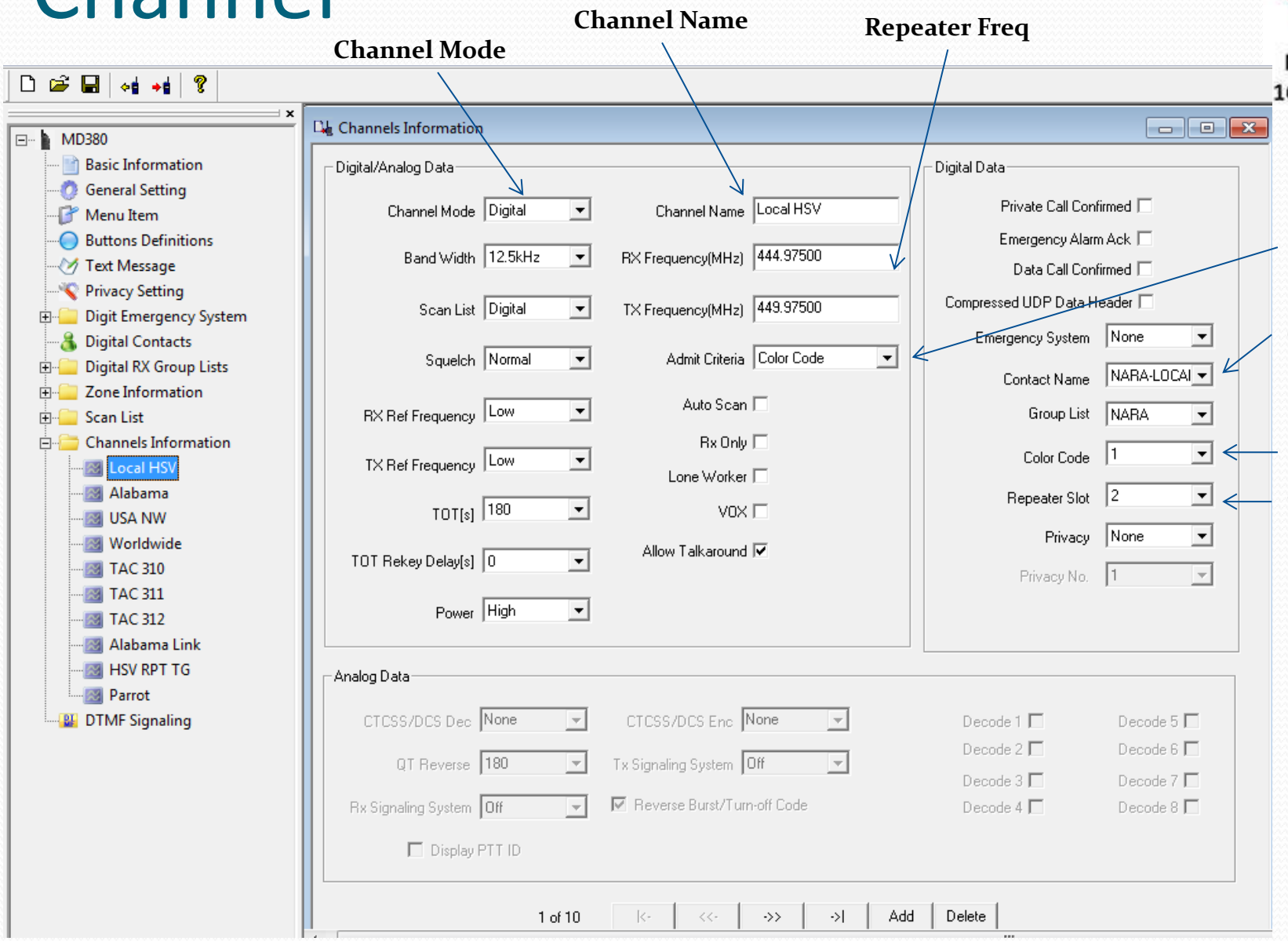


No.	Contact Name	Call Type	Call ID	Call Receive Tone
1	NARA-LOCAL	Group Call	2	Yes
2	BM WW	Group Call	91	No
3	TAC310	Group Call	310	Yes
4	TAC311	Group Call	311	Yes
5	TAC312	Group Call	312	Yes
6	USA NW TG	Group Call	3100	No
7	NARA-AL	Group Call	3101	No
8	Parrot	Private Call	9990	No
9	AL Link	Group Call	31010	No
10	NARA TG 31014	Group Call	31014	Yes

Channel



Admit Criteria

Contact Name

Color Code

Slot

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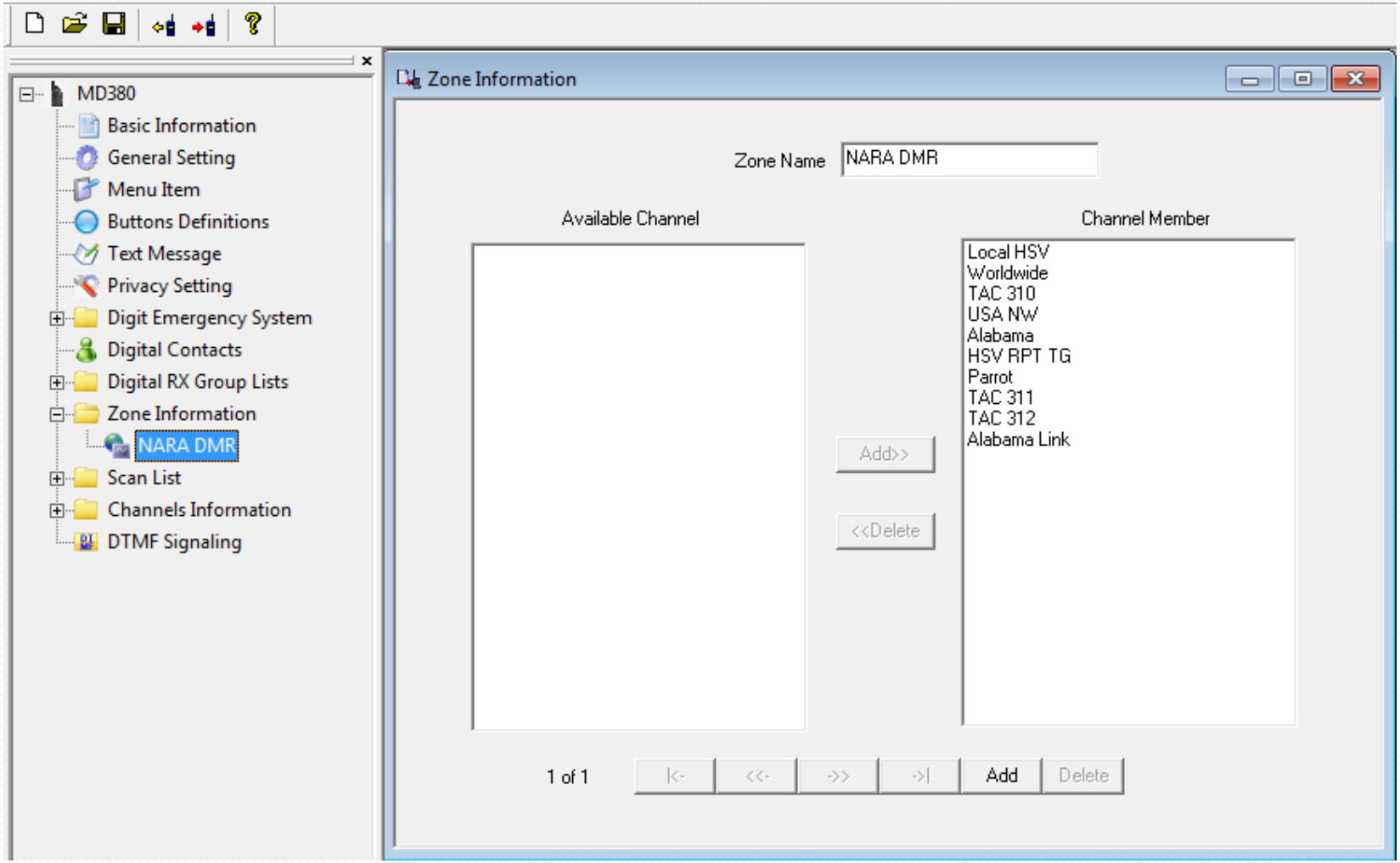
Zone



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NARA Code Plug

W4FMX Repeater
RX 444.975 MHz
TX 449.975 MHz
Color Code 1

NARA Radio Code Plugs Available
Connect Systems 800
Hytera PD683, PD782, MD782
TYT MD380, MD390

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NARA Brand Master Code Plug				
Channel	**Assignment**	**TS**	**TG**	**Access**
1	Local HSV	2	2	Full Time
2	Alabama	1	3101	PTT
3	USA NW	1	3100	PTT
4	Worldwide	1	91	PTT
5	TAC 310	1	310	PTT
6	TAC 311	1	311	PTT
7	TAC 312	1	312	PTT
8	Alabama Link	1	31010	PTT
9	HSV RPT TG	2	31014	PTT
10	Parrot	2	9990	PTT

DMR Networks in Amateur Radio

- DMR-MARC (and C-Bridge based repeaters)
  - Maintains database of user IDs for all DMR networks
  - Repeaters only Connected via C-Bridges to Main network
  - No direct connection of homebrew repeaters or hotspots
- DMRplus
  - Ties to legacy Hytera network
  - Allows connection of hotspots and non Moto repeaters
  - Uses talkgroups and reflectors
- Brandmeister
  - Open network allows homebrew repeaters and hotspots
  - Uses talkgroups and reflectors
  - Decentralized network with Master servers located globally

DMR-MARC and Brandmeister Repeaters

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Motorola C-Bridge Network

Tuscaloosa 444.900+ CC1 - KD9Q

Talkgroups:

World Wide - PTT 10 min - TS1 - TG 1

World Wide Engligh - PTT 10 min - TS1 - TG 13

North America - always on - TS1 - TG 3

South East - PTT 10 min - TS2 - TG 3174

Alabama - always on - TS2 - TG 3101

Georgia - PTT 10 min - TS2 - TG 3113

TAC310 - PTT 10 min - TS2 - TG 310

TAC311 - PTT 10 min - TS2 - TG 311

English 1 - PTT 10 min - TS2 - TG113

English 2 - PTT 10 min - TS2 - TG123

Parrot - PTT 5 min - TS2 - TG 9998

NorCal Audio Test - PTT 5 min - TS2 - TG 9999

Local - always on - TS2 - TG 2 (not linked)

Huntsville 444.975+ CC1 - W4FMX		
Assignment	**TS**	**TG**
Local HSV	2	2
Alabama	1	3101
USA NW	1	3100
Worldwide	1	91
TAC 310	1	310
TAC 311	1	311
TAC 312	1	312
Alabama Link	1	31010
HSV RPT TG	2	31014
Parrot	2	9990

DMR Repeater Do’s and Don'ts

- Never use encryption settings on a radio - Forbidden by the FCC –Part 97
- Wait and listen before transmitting
- Always ID (give you call sign)
- Always enable talk admit criteria on each channel – Prevents you from talking over someone else
- Avoid using Private Call - Occupies a TS which blocks other hams use.
- No GPS Beaconing - set for on demand only
- Never make a DMR emergency call - No emergency systems are configured in this network
- Never use Lone worker settings

Reference Material

- The following is a list of reference material:

http://www.trbo.org/docs/Amateur_Radio_Guide_to_DMR.pdf

http://flarc.net/Programs/DMR-Presentation_FLARC_final.pdf

http://www.larkfield.org/gallery/digital%20mobile%20radio%20(dmr)%20primer.pdf

https://brandmeister.network/

http://www.va3xpr.net/programming-software-firmware/

Questions ?

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Digital Mobile Radio Operational Etiquette

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DMR Etiquette

Networked DMR communications is a shared resource, with imposed latencies (delays) that require a high level of ETIQUETTE applied to radio operation. Operators must visualize that their communications may not only be heard by hundreds, or thousands of DMR users, but that resources are being tied up by communications and may deny other users access. Users should invoke a higher level of operational courtesy, and a stronger adherence to structured protocols to avoid denying access to other operators.

DMR Etiquette

- Because of latency that is introduced by digitally encoding of digitized voice communications with Forward Error Correction codes at the transmitter, the application of Forward Error Correction to decoded data at the receiver, and the delay inherent in internet traffic, significant and noticeable latency (delay) is inherent in DMR communications. DMR requires that you wait after a transmission stops, and before you start a transmission, to accommodate breaking traffic. It should be noted that there is no repeater squelch tail with DMR. Operators should wait for a minimum of 2-seconds after hearing the end of a transmission before initiating a transmission, and then wait an additional 1-second after keying the transmitter before speaking.

DMR Etiquette

- Nowhere is the importance of listening first more applicable to radio operation as it is with DMR, and especially networked DMR. When you arrive on channel, listen for a minimum of 30-seconds to get a sense as to whether the repeater or the talk-group is in use. If the repeater or talk-group is in use, listen for a while to acquire conversational context, and then intelligently decide whether you can or should interject in the conversation. Do not interject to mislead or take-over a conversation. Rather, wait until the conversation is completed before interjecting if you mean to change topics or focus.

DMR Etiquette

- Remember that there's two different timeslots on each repeater (1 & 2). You may see your radio indicating a receive light, and hear nothing. This traffic may be the CWID, or on the other timeslot, or a talk group that you're not listening to.
- When you press the Push-To-Talk (PTT) button, wait to hear the confirmation tones before you start talking. When you push the button, your radio contacts the repeater, and makes sure it's not busy, and that you can hit the repeater. A long tone, or no tone when you hit the PTT means your transmission won't go through. Ensure to program you digital channel “TX Admit” parameter to ‘color code free’. This will prevent you from doubling with someone.

DMR Etiquette

- Check your audio level. Since the audio is digitized on your radio, and there's no leveling happening in transit, it's very important for you to send a proper audio level. Use the Parrot, or ask your friends to verify that your audio level is proper, and remember the mic to mouth distance for your radio.
- When you wish to talk with anyone on a given talkgroup, it is common to give your callsign, your location, and the talkgroup. For example, "This is KM4CJ, in Huntsville, Alabama on TAC 310".
- If you're in a conversation with another person, and for some reason you lose contact with them, it may be that either end has traffic that blocks your conversation. Watching your receive light will let you know if the blocking is happening at your end. Simply wait for a clear condition, and try again.

DMR Etiquette

- DMR latencies can make it difficult to complete a call if another station responds to a call that is not directed toward them. Unlike other operating modes, such as analog FM simplex or analog FM repeater operations, a station that is not targeted in a call and that responds, even with a simple query to ask if they were called, can cause the targeted station to not be heard. There may be no indication that doubling has occurred. If you think that your station may have been called but are not certain because you did not actually hear the call, it is important that your first response is to wait in order to allow for the targeted station to respond. It is far better to wait 10 or 15 seconds, and then, if the channel is clear, make a query to ask if your station was called than to respond when uncertain and deny the calling station and called station the opportunity to establish contact.

DMR Etiquette

- The DMR-ID of a station appearing on the talk-group may be displayed momentarily on your radio. This can be a consequence of the other station moving a dynamic talkgroup on a repeater, or a hot-spot (such as a SharkRF OpenSpot), to another talk-group, and occurs when the station momentarily keys their transmitter to move the repeater or hotspot to the target talkgroup. Such display of DMR-ID, or additional identifying information that may be programmed into the radio contact list, is not an indication that the station wishes to be called. The station may only wish to monitor the talkgroup. It is difficult to determine what the station intends.

DMR Etiquette

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- Use the smallest area talk group to make the communication work. If you and the person you're talking to are using the same repeater, be sure to use the Local talkgroup. If you're both in AL, use the Alabama Statewide channel. AL/TN area, use Regional, etc.

DMR Etiquette

- The Nationwide talkgroup (TG91) is a wide-area talkgroup available to all USA hams for general QSO at any time. It is encouraged that all hams use this talkgroup for general QSOs spanning across multiple USA repeaters as a way to bridge the distance between us. In addition, we kindly ask that hams respect the fact that this talkgroup is widely distributed and that they keep conversations to a reasonable length and take regular pauses to accommodate others that might want to join the QSO. To continue your conversation if you feel that it is going to be lengthy in nature. You can also arrange to change to a TAC talkgroup, like 310 and 311. Make sure that these talkgroups are clear before you start having your conversation. Asking "Is this talkgroup in use?" is a good way to start that message.

Questions ?

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