



Basic Introduction to DMR

Columbia Amateur Radio Club
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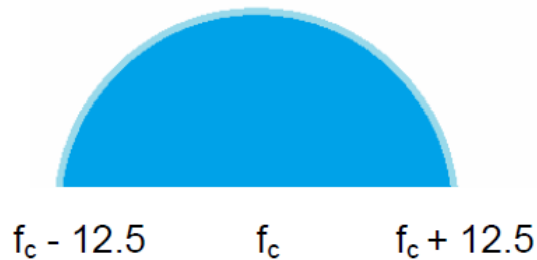
What is DMR?

- Digital Mobile Radio is an European Telecommunications Standard Institute protocol for transmitting information. Standard support a single 6.25 kHz channel or 2 channels with 12.5 kHz transmission bandwidth.
- Uses the DVS1 AMBE+2 voice encoder decoder (vocoder) to digitize audio and compress the data.
- Standard provides for two simultaneous conversations over one repeater frequency.
- Internet Connection allows repeaters over wide areas to link together supporting regional, national or world wide coverage

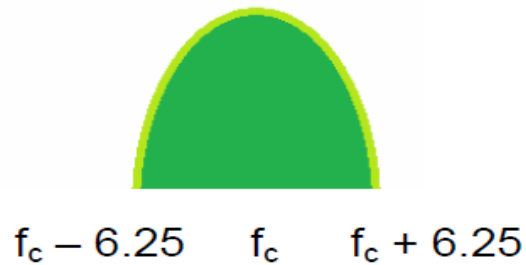
Why DMR or Digital Modes?

- Improved coverage over analog system
- Improved battery life for portables (40% less)
- Uses less bandwidth on crowded spectrum
- Eliminate noisy audio on weak receive signals
- Combines voice and data on same infrastructure
- Supports two simultaneous conversations over the same repeater. Double capacity
- Internet can provide multi-state coverage and local access
- Access to many repeater systems
- DMR Relative Signal Strength (RSSI) availability

Analog VS Digital



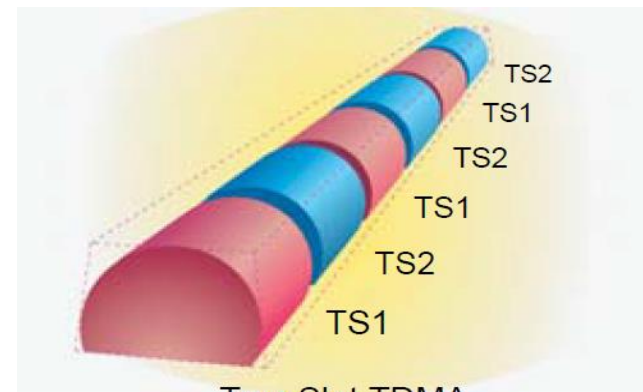
Wideband Analog FM
25 kHz Channel
Bandwidth
(25 kHz per Channel)



DMR
12.5 kHz Channel
Bandwidth
(6.25 kHz per Channel)



DMR uses ½ bandwidth of conventional repeater, supports two conversations via time multiplexing. Effectively 6.25 kHz of spectrum per user



Two-Slot TDMA

DMR Networks

Repeaters are linked via Internet Connections (vendor specific)

Multiple bridge networks are available for linking (bridges are either computer or hardware switch that connects repeaters to data streams)

Repeater owner selects the local/regional network they wish to join and coordinates with a bridge manager

Network bridge programs various “talk group” access and management

New Brandmeister bridge provides universal translator for DMR, D-STAR, and Hytera systems. (DCI and Tac1 talk group on our system)

Some DMR Repeaters

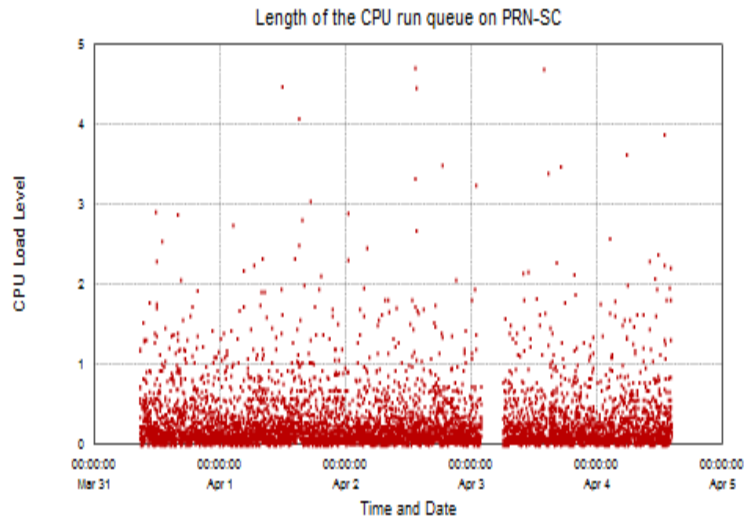
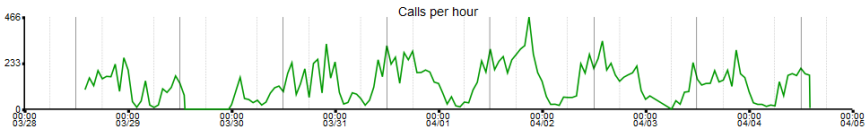


NCPRN DMR Network

- Inter Connects roughly 60 repeaters across 4 states
 - South/North Carolina, Virginia, West Virginia and District of Columbia
- Standard- 2 talk groups (local and PRN) that are always “ON”
- Provides user access to dynamic talk groups via PTT
 - Tac1 (Brandmiester), Tac310, DCI (Brandmiester),
Echotest, Chat 1, Chat 2
- Repeater owner determines which talk groups are available on their machine

C-Bridges

- Commercial conference units being used in Amateur Application
- Manage talk groups and repeater connections
- Multiple bridges operate NCPRN switching. Primary Bridges in Charlotte and Columbia
- Columbia bridge on SCETV Microwave system provides for statewide traffic even if Internet fails
- Bridges provide gateways to other DMR networks
- Provides data for Last Heard listing on NCPRN.NET



Greenville SC	1314501	WR45C - Greenville South Carolina USA -- 314501
West Columbia SC	1314502	N4UHF - Little Mountain South Carolina USA -- 314502
East Columbia SC	1314503	WR45C - Columbia South Carolina USA -- 314503
Myrtle Beach SC	1314504	WR45C - Myrtle Beach South Carolina USA -- 314504
North Charleston SC	1314505	WR45C - North Charleston South Carolina USA -- 314505
South Charleston SC	1314506	WR45C - South Charleston South Carolina USA -- 314506
Walhalla SC	1314507	KN45WB - Walhalla South Carolina USA -- 314507
Dillon SC	1314508	
Downtown Charleston SC	1314509	WR45C - Charleston South Carolina USA -- 314509
Sumter SC	1314510	WR45C - Sumter South Carolina USA -- 314510
Greenwood SC	1314511	WR45C - Greenwood South Carolina USA -- 314511
Florence SC	1314512	WR45C - Florence South Carolina USA -- 314512
Rock Hill SC	1314514	WR45C - Rock Hill South Carolina USA -- 314514
Spartanburg SC	1314515	
Orangeburg SC	1314516	WR45C - Orangeburg South Carolina USA -- 314516
Columbia SC	1314517	WR45C - Columbia South Carolina USA -- 314517
Beech Island SC	1314518	WR45C - Beech Island South Carolina USA -- 314518
Barnwell SC	1314519	
Lake City SC	1314520	
Hilton Head SC	1314521	
Bluffton SC	1314522	
Aiken County Trailer	1314597	
SC HEART Trailer	1314596	












Some New Terms

- Talk Group- a predefined digital code for a group of users. Only users who have this code programmed in their radio will hear traffic.
 - Example: Local -27500, PRN -2, PRN-CHAT1 27501, Simplex -99
- Contact- digital talk group number or user
- Zone- Grouping of desired talk groups and other analog repeaters for a geographic area
- Roaming- ability of some DMR radios to pick the best repeater for a conversation based on received signals
- Color Code- a digital code similar in function as CTCSS (PL)

Zone vs Talk Group ?

- An analog radio's repeater zone and talk group are the same-
Receive/Transmit Frequency and CTCSS Tones
- DMR radios have Zones to organize talk groups together generally by a repeater or town.
- You select a zone like selecting a repeater, then you select talk groups programmed in the zone. For Instance
 - Columbia Downtown Zone holds available talk groups for Downtown
 - “Channels” are: Local, PRN (multi-state), Tac1, Tac310, DCI, Echotest, Rutledge 1, Rutledge 2, D446.075 simplex, etc.
 - PRN always uses Time Slot 2
 - Local always uses Time Slot 1 and shares the time slot with PTT groups: Tac1, Tac310, DCI, etc.

Columbia Downtown Zone

	Position	Channel Name
	1	CAE Dtn LOCAL
	2	CAE Dtn PRN
	3	D446.075
	4	CAE Dtn Tac310
	5	CAE Dtn Tac1
	6	CAE DCI Bridge 2
	7	CAE Dtnw SE
	8	Clear Timeslot
	9	Monitor All CO
	10	RUTLDG1
	11	RUTLDG2

A Zone contains a collection of Talk Groups that has some relation. It may contain Simplex or Analog channels.

Each channel in the zone must contain Frequency, Color Code, Digital Contact Code, & Channel parameters

Analog Channel VS DMR ZONE

	Transmit (f MHz)	tone	Receive (f MHz)	tone
SCHEART Analog UHF	441.725	91.5	446.715	91.5

DMR Columbia East Zone	Transmit (f MHz)	Color	Receive (f MHz)	Color	Contact	Time Slot
Local Talk Group	442.5125	1	447.5125	1	Local	1
PRN Talk Group	442.5125	1	447.5125	1	PRN	2
Tac 1 talk Group	442.5125	1	447.5125	1	TAC1	1
Tac 310 Talk Group	442.5125	1	447.5125	1	TAC310	1
DCI Talk Group	442.5125	1	447.5125	1	DCI	1
Clear Time Slot	442.5125	1	447.5125	1	Clear TS	2

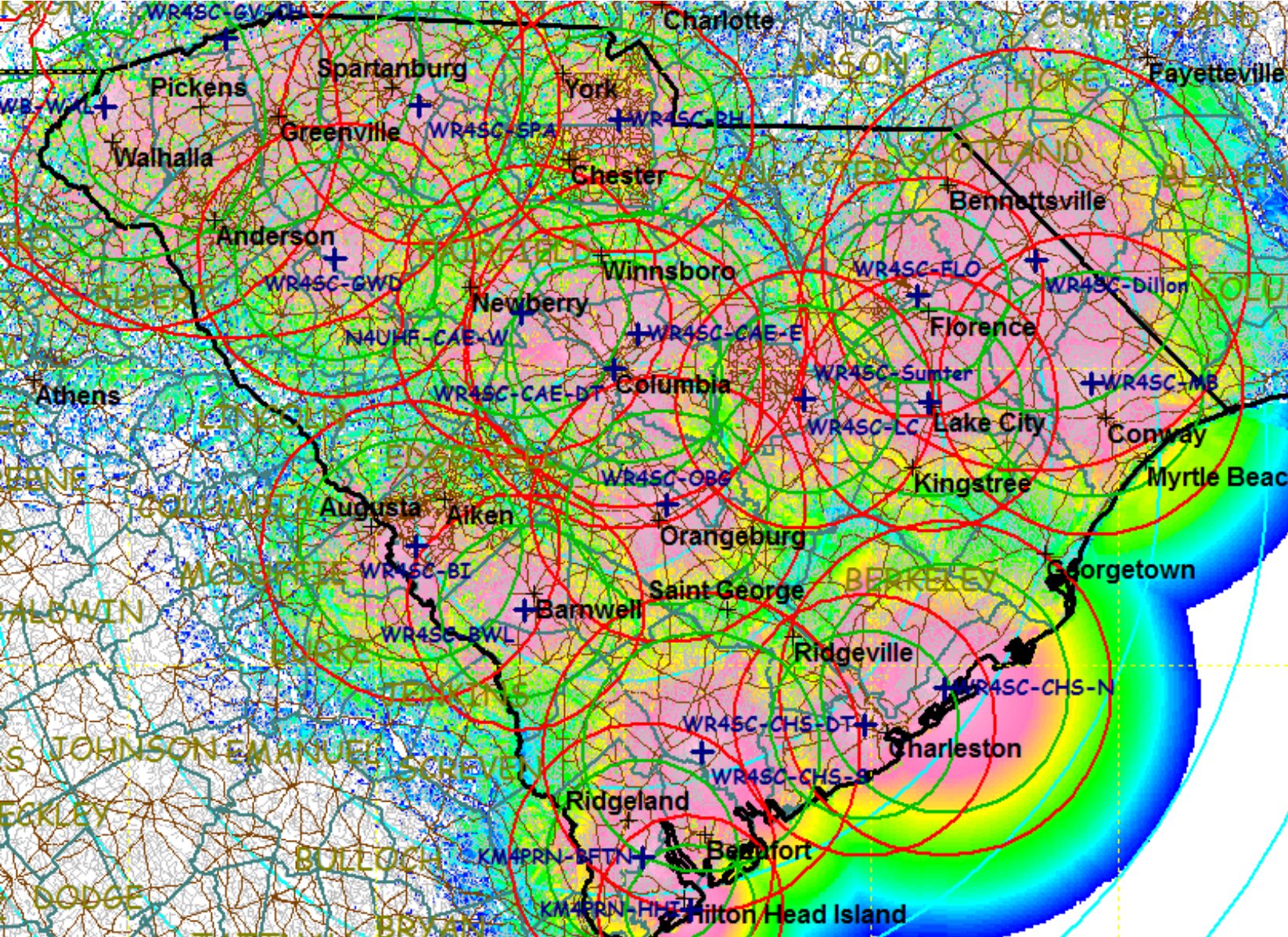
PRN Operating Guidelines

- Monitor the channel (time slot) before using
- Use appropriate talk group: PRN keys 60+ repeaters, SC Local keys 4 to 6, DCI, TAC1, TAC310, SE, Chat 1, Chat 2 keys 1
- PRN Chat 1 and Chat 2 provides users the ability to have a data stream between two repeaters. Shares Local Time Slot
- When using any dynamic talk group (DCI, TAC1, TAC310, Chat, etc.) use PTT Clear Time Slot when finished otherwise slot will be busy for 15 minutes.
- Use common courtesy, do not to have extended conversations on PRN, move it to Chat

SCHEART DMR Repeaters System

- Local Hams Started with Proof of Concept December 2013
 - Columbia West (Little Mountain Site)
- Obtained DHS funding grant for emergency communication support (statewide and regional) with Phase 1 build out
 - Columbia East, Greenville, Myrtle Beach, Dillon, Charleston Downtown, South & North, Florence, Sumter, Greenwood SCHEART trailer
- Phase 2 Grant added repeaters
 - Rock Hill, Spartanburg, Orangeburg, Columbia Downtown, Beech Is, Barnwell*, Lake City*
- Interconnect via SCETV Microwave System
- Private & County owned systems are part of the network
 - Walhalla, Hilton Head, Bluffton, Aiken, Aiken Trailer, Anderson Trailer

SCHEART DMR Statewide



SCHEART DMR Normal Operation

- Standard NCPRN talk groups (Local, PRN, DCI, Tac1, Tac310, Echotest, Clear time slot)
- Local talk group linked by 4 DHEC regions based on repeater location. Full time connected on Time Slot 1
 - Upstate, Midlands, Pee Dee and Low Country
- PRN Talk Group available across the network on Time Slot 2
- Using PTT on a repeater connects Time Slot 1 to a dynamic talk group and will only be heard on the repeater with the link
- Users should monitor repeater for activity before making a connection and use Clear Time Slot when finished

SCHEART DMR Emergency Operation

- Configuration controlled from State EOC
- Delinks SCHEART from the NCPRN network
- Normal dynamic talk groups are not active outside local repeater
- PRN becomes SC Statewide only
- Local talk group remains connected by DHEC regions
- New Talk groups enabled within state
 - Data/ GPS (Time Slot 1 with Local)
 - Command MA1 (PTT dynamic link on Time slot 2)
 - SC EOC to NC EOC talk group

DMR Starting Point

1. Register at DMR-MARC for radio ID
2. Purchase DMR capable radio
3. Program Your Radio with available software
NCPRN.net or SCHEART.us have sample files
4. Using your programmed radio
Select zone for local area
Select your talk group
PTT and Discover Digital Mobile Radio



Step 1: Register for radio ID

- Go to **DMR-MARC.net**. Under Contact select USER ID for my radio
- You need at least 1 ID. Most people get one ID for Portable and one ID for mobile. However, you can use the same ID for both.
- ID instructs the system on owner of the radio

DMR USER Registration - Callsign Validation

Welcome to DMR User registration, before we proceed, we will validate your callsign.

Enter Callsign

Validate

Which Radio Should I buy?



All DMR radios work on the system
Various Manufacturers have implemented
enhancements to the standard
System supports voice, text and alerts
Programming software runs from free to \$169
Radios run from \$140 to \$700 for portables

Vendors

Motorola, Connect Systems
Hytera, Vertex, Tytera, Kirisun



Step 3: Programming Your Radio

- Install the appropriate software for your radio on a computer OR find another ham who will program your radio
- Find a sample base code plug for your model of radio from NCPRN.NET or SCHEART.US site and download
- Open the base code plug and A) Put your assigned radio ID in the appropriate field. B) Modify Zones for additional repeaters or talk groups. C) Delete Zones you don't want
- CONTACTS- Add USER Call Signs / Radio ID number if you want to see their name when they transmit. (Optional step)
- Read your radio first and save the information to your computer. Then Write your modified code plug to the radio

Programming NEW Radio from Scratch*

- Use your software to read the radio and save the file
- Change Radio ID to your assigned number
- Create Digital Contacts for talk groups (Local, PRN, DCI...)
- Create Zone- collection of talk groups
- Populate the Zone with desired Talk Groups
 - Each Group Contains Name: Frequency, Color Code, Contact (Target Group ID), access information, Time Slot, Admit Criteria, Power Level
 - Can have multiple repeaters in one zone
 - Can mix analog and digital channels
- Create Scan or Monitor List (repeaters / talk groups to scan)
- Update Zone with Scan list, save data and program radio

Step 4: Using your radio

- Select the Correct ZONE based on your location.
- Select the Talk Group you want to use
- Base code plugs have a channel called Monitor All or Scan (ZONE NAME). It's always good to check and see if the time slots are in use before starting a call.
- If the Time Slot is not busy, select the talk group you want and PTT and wait to hear a beep (talk permit tone). From this point on, it's like a normal radio.
- If you've used a dynamic talk group, select Clear Timeslot after you finish and key the radio. Once you get permit tone, the system will drop the talk group.

Resources

- **DMR-MARC (Motorola Amateur Radio Club)**
 - <http://www.dmr-marc.net>
- **PRN Wide Area Digital Amateur Radio Network**
 - <http://ncprn.net>
- **SCHEART DMR page**
 - <http://scheart.us>
- **Digital Communications Interconnect Group (DCI)**
 - <http://www.trbo.org>
- **Google DMR and ham**