Digital Mobile Radio (DMR) Primer:

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Dedicated to Anna Oakley 3/19/25-2/19/15
DMR:

- Like D-Star™ (Icom) and Fusion™ (Yaesu), DMR is another digital transmission modes, it is codified in a Standard. (ETSI-TS 102 361 parts 1-4)
- 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.
  
  — [Remember the old days of the IC-2AT.]
A Few Words About DMR:

- A DMR repeater’s bandwidth is 12.5 KHz wide and contains two simultaneous “Time Slots”, TS1 & TS2. (6.25KHz/TS)
- Each TS can support a unique QSO without interfering with the other transport stream. (TDMA = Time Division Multiple Access)
- DMR repeaters ID in FM CW during which time DMR time packets can not be received/transmitted.
- **DMR radios do not transmit Call sign, Name and GPS like D-Star.**
  - Instead radios transmits “Unit ID” numbers.
- **Without the DMR repeater’s control channel being received, you cannot transmit to the repeater, except to make a “transmit request”.
- DMR’s TDMA modulation yields about a 40% extension on battery life.
- **Yaesu’s new “Fusion” systems is a variant of true DMR.**
  - “Fusion” uses C4FM (4 level FSK) modulation
DMR v. D-Star

**DMR:**
- Repeaters
- Talk Groups
- Radio transmits Unit ID only
- Radio can send short text messages to other radios or to Talk Groups
- User can not reconfigure connectivity of the repeater
- 40%+ battery saving when transmitting DMR
- Each repeater frequency supports two (2) simultaneous time slots or transport streams. [TIME SLOTS]
- *No alternate technology, to get into DMR systems, but very close!*

**D-Star:**
- Repeaters
- Reflectors
- Radio transmits call sign, name, statement, GPS
- Using D-Rats message, and files can be sent to another D-Star user
- User can quickly reconfigure repeater to connect to a different Reflector.
- Repeater supports (1) QSO.
- Access to D-Star network can be made via DV Dongle™ and DVAP™.

Remember to ID ever 10 minutes on DMR.
A Few Words About DMR:

- DMR stands for Digital Mobile Radio, a.k.a. “MotoTurbo” (TDMA)
- Similar to D-Star, DMR uses a DVSI AMBE chip but instead uses the AMBE+2™ series 3000 chip,
- Better digitalization of audio on transmit and receive,
- DMR repeaters controls DMR radios,
  - When you start transmitting the receiver continues to receive timing information from the DMR repeater.
  - In case of a “double” the DMR repeater can signal the transmitters to stop transmitting.
- Call routing based on “Talk Groups” instead of “Reflectors”
  - Talk Groups based on:
    - TG9      =  Local (Single Rpt)
    - TG3172 = New England
    - TG3      =  North America
    - TG1      =  Worldwide
    - TG99    =  Simplex
Partial List of Talk Groups:

<table>
<thead>
<tr>
<th>TG</th>
<th>Continent</th>
<th>Language</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Worldwide</td>
<td>All</td>
<td>Calling Channel only. 2 mins max. all networks, all repeaters, all languages</td>
</tr>
<tr>
<td>2</td>
<td>Europe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>North America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Asia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Oceania</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Africa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>South America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>regional</td>
<td></td>
<td>regional repeater groups</td>
</tr>
<tr>
<td>9</td>
<td>local</td>
<td></td>
<td>local repeater only</td>
</tr>
<tr>
<td>10</td>
<td>Worldwide</td>
<td>German</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Worldwide</td>
<td>French</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Worldwide</td>
<td>English</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Worldwide</td>
<td>Spanish</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Worldwide</td>
<td>Portugese</td>
<td></td>
</tr>
</tbody>
</table>

FULLTIME and routed to specific regions unless noted.
Partial List of Talk Groups:

<table>
<thead>
<tr>
<th>Network</th>
<th>Region</th>
<th>Talk Group ID</th>
<th>Assignment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3100</td>
<td>DCI Bridge</td>
<td>TS2</td>
</tr>
<tr>
<td>NorCal</td>
<td>N. America</td>
<td>3106</td>
<td>CA Statewide</td>
<td>TS2</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3109</td>
<td>S. New England</td>
<td>TS2</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3133</td>
<td>N. New England</td>
<td>TS2</td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3160</td>
<td>DCI 1</td>
<td>TS1</td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3161</td>
<td>DMR-MARC World</td>
<td>TS2</td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3162</td>
<td>DCI 2</td>
<td>TS2</td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3163</td>
<td>DMR-MARC N. Am.</td>
<td>TS2</td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3166</td>
<td>Test1</td>
<td></td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3167</td>
<td>Net1</td>
<td></td>
</tr>
<tr>
<td>DCI</td>
<td>N. America</td>
<td>3168</td>
<td>I-5</td>
<td>CA, OR, WA</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3169</td>
<td>Midwest USA</td>
<td>TS2, Midwest stations only</td>
</tr>
<tr>
<td>N. Colorado</td>
<td>N. America</td>
<td>3171</td>
<td>N. Colorado</td>
<td>TS2</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3172</td>
<td>Northeast USA</td>
<td>TS2, Northeast stations only</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3173</td>
<td>Mid-Atlantic USA</td>
<td>TS2, Mid-Atlantic Stations only</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3174</td>
<td>Southeast USA</td>
<td>TS2, Southeast stations only</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3175</td>
<td>TX/OK Regional USA</td>
<td>TS2, TX-OK stations only</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3176</td>
<td>Southwest USA</td>
<td>TS2, Southwest Stations only</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3177</td>
<td>Mountain Reg. USA</td>
<td>TS2, Mountain Reg. stations only</td>
</tr>
<tr>
<td>DMR-MARC</td>
<td>N. America</td>
<td>3181</td>
<td>New England &amp; New Brunswick</td>
<td>TS2 NewEng, TS2 NB. Only avail. in those areas.</td>
</tr>
</tbody>
</table>
More Spectrum Efficient than Older Digital Modes

Guard Band as large as 10 kHz between channels

Total BW = 22.5 kHz

No Guard Band between 2 channels

Total BW = 12.5 kHz

Oct. 12, 2013 By Bill Barber, NE1B
DIGITAL VHF/UHF FORMATS:

• D-STAR (Icom)
  – GMSK/AMBE Vocoder
• P25 Phase 1 (Multi-Vendor)
  – FDMA/IMBE Vocoder
• P25 Phase 2 (Multi-Vendor)
  – 2-slot TDMA/AMBE+2 Vocoder
• System Fusion (Yaesu)
  – FDMA/C4FM/AMBE+2 Vocoder
• DMR (Multi-Vendor)
  – 2-slot TDMA/AMBE+2 Vocoder
Battery Current Consumption Example (CS-700):

- Connect Systems CS-700 HT consumes **1600 mA** on transmit in the FM mode for 4 watts output.
- Connect Systems CS-700 HT consumes only **<800 mA** on transmit in the DMR mode for 4 watts output.

**Current Price:** $199 directly from manuf.

- Keypad DOES NOT program radio.
- It is used for Quick Text or Connects only.

*Why?* Because transceiver is Type Accepted in Part 90 and Part 90 prohibits field programmable radios.
DMR Programming:

- You must obtain a no-cost “User ID” from “www.dmr-marc.net” to use DMR on ham repeaters.
- You must program a series of “Contacts” of Talk Groups you want to talk to.
- You must program a series of “Digital Receive Groups” on who you want to receive a call.
- You must build a list of repeaters, or simplex frequencies you are going to use including each transmit and receive frequency, Color Code, Time Slot. {Offsets are not used}
- You must build a list of “Zones” or memory banks with typically sixteen (16) memory positions per Zone.
Requesting a User ID:

• Go to [www.dmr-marc.net](http://www.dmr-marc.net) and click on “Contact Us”

After you click on “Subscriber ID” then you will need to scroll all the way to the bottom of the page that follows to “User Registration” and click on the icon to go to the following page.
Requesting a User ID:

<table>
<thead>
<tr>
<th>Country</th>
<th>Select Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMR ID</td>
<td>Will be emailed to you by the ID Team</td>
</tr>
<tr>
<td>Callsign</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td></td>
</tr>
<tr>
<td>State/Prov</td>
<td>Select Country First</td>
</tr>
<tr>
<td>Home Repeater</td>
<td><strong>WA2VNV</strong></td>
</tr>
<tr>
<td>Radio Type</td>
<td>Select Radio Type</td>
</tr>
<tr>
<td>Email Address</td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td></td>
</tr>
</tbody>
</table>

The correct reCAPTCHA phrase includes all letters or numbers on the white background and those in the image next to it.
DMR Radio Programming (CS-700):

General Settings

Menu Settings
DMR Radio Programming (CS-700):

Quick Text Messages

Contacts
Texting:

Send to one person, or a group of people.

- Weather Alerts
- Club Meetings
- Announcements
DMR Programming (CS-700):
DMR Programming (CS-700):

Channels (Frequency, Talk Group, Color Code and Time Slot)
DMR Programming (CS-700):

Analog Repeater Programming:
If you select an un-programmed channel on the CS-700

• You will be greeted with something like this!
DMR Repeaters:
DMR compared to D-STAR

www.dmr-marc.net  www.dstarusers.org
DMR North America Regions:

- Mountain 3177
- Southwest 3176
- Midwest 3169
- Southeast 3174
- MidAtl 3173
- TX-OK 3175
Additional DMR Concepts:

- Two Time Slots per repeater frequency pair,
- When transmitting your DMR radio continues to receive control information from the repeater you are using.
- Repeater Control Channel can instruct a transmitting radio to stop.
- If you access a DMR repeater there will be a series of three quick tones.
- If you are not successful reaching a repeater you will here a single low frequency tone.
- There is no “doubling” with DMR. Only one radio transmits at a time.
- Range is greater on DMR simplex than analog simplex.

DMR AUDIO Range Demo
National DMR Repeaters

DMR-MARC Network = Green / Europe Blue
North Carolina PRN Network = Magenta
DCI Network = Light Blue
Arizona Network = Yellow
NorCal Network = Peach Balloon
KØUSY Kansas Network = Purple
SF-TRBO = Red Tack
Georgia DMR = Blue Tack
DMR-MARC-ANZ = Light Blue Tack
DMR-MARC-Canada = Pink Tack
WØPM = Yellow Tack
Rocky Mtn. Ham Radio = Light Blue/Black Dot
NJ-TRBO = Purple Tack
CMEN/Mi5 = Multiple Lower Michigan Repeaters are connected but unpublished at request of sys admin.
Talking Across Networks

- By using what is called a “C-Bridge” it is possible to talk from one of the Networks from the previous slide to another Network provided “bridging” is supported by the repeater connection.
Local DMR Repeaters:

- Currently, only one local repeater in Selden/Stony Brook area.
- Another DMR repeater is in Mattituck.
- Repeater supports multiple “Talk Groups” on two “Time Slots”
- Only one Talk Group can be active on one Time Slot at a time.
Local DMR Repeaters:
Selden DMR Repeater:

DMR-MARC - Selden, NY

WA2VNV 443.825 - 5MHz, Color Code 1

Time Slot #1 - Group Call 1 = World Wide (PTT activated with 5 min inactivity timeout)
Time Slot #1 - Group Call 13 = WW English
Time Slot #1 - Group Call 3 = North America
Time Slot #1 - Group Call 3172 = Northeast
Time Slot #2 - Group Call 3181 = New England - Wide
Time Slot #2 - Group Call 3109 Southern New England (UHF - CT, RI, Eastern LI)

You Must Have [ARS] Disabled Within Your Radio

Contact: George, WA2VNV
Email: wa2vnv@optonline.net
Website: http://nedcon.org
TAC 310:

- Peer to Peer communications with DMR is also now supported.
- Instead of calling someone on “North America” and tying a lot of repeater resources, if the respective repeaters support “TAC-310” you can have a semi-private conversation between your friend and you by using only your local repeaters.
- TAC 310 is normally not active on repeaters and you must properly configure your radio for the correct Color Code and Time Slot and then key your PTT to activate the TAC310 feature.
DMR™ ≠ FUSION™ ≠ D-STAR™
But Wait!

• One manufacturer has announced that in 2015 they will be releasing “mono-band” VHF or UHF D-Star™ and DMR combination HTs.
• You will be able to use the plethora of D-Star™ repeaters and the growing number of DMR repeaters in on hand-held radio.
• Although I believe the number one seller will be the UHF version since most DMR repeaters are now UHF; except in areas when US radar (PAVE Paws) installations pose a frequency conflict. Amateur use is secondary to radar in those areas.
• There are no plans to make a dual band D-Star/DMR radio. Simply there is no commercial need for such a radio.
CS7000

MULTI PROTOCOL SOFTWARE DEFINED RADIO

This radio is defined for the Amateur Market and will have an introductory price of $249. Capable of doing DMR, NXDN, dPMR, P25, ANALOG, D-STAR, AND FUSION Protocols. This radio is built to commercial standards and will cover commercial frequencies. The first version will ship with Analog, DMR, and D-STAR protocols with future firmware updates allowing other protocols. Because of the current back-log of orders, we probably will not be able to ship new orders until March.

Expected Delivery is January 2015 or before.

Sign up for Yahoo Group CS7000 for Status and Details

Not Yet!
An Amateur Radio Guide to DMR

http://tinyurl.com/dmr-guide

Or, www.dmr-marc.net

The author is not charging for the booklet.
More Information:

- NC-PRN (VA/NC/SC)
  - http://www.ncprn.net
- New England Digital Emergency Communication Network (NEDECN)
  - http://nedecn.org
- NJ-TRBO Network (NJ/NY)
  - http://www.n2jti.net
- NOCO DMR Group (CO/UT)
  - http://nocodmr.kt0l.net:8080/nocodmr/Indext.htm
- NorCAL DMR (Northern California)
  - http://www.norcaldmr.org
- Massachusetts Interconnect Team (MIT)
  - http://www.mitcom.com
- Rocky Mountain Ham Radio
  - http://www.rmham.org

- For Further Information about DMR
- DMR-MARC (Motorola Amateur Radio Club)
  - http://www.dmr-marc.net
- DMR-MARC Canada
  - http://www.va3xpr.net/dmr-marc-canada/
- DMRUK.net (United Kingdom)
  - http://www.dmruk.net
- Digital Communications Interconnect Group (DCI)
  - http://trbo.info
- Digital Mobile Radio Association (Professional DMRA)
  - http://www.dmrrassociation.org
- Regional DMR Groups
- Central Michigan Emergency Network (CMEN MI5)
  - http://w8cmn.net
- K0USY Group (Kansas)
  - http://k0usy.strikingly.com
New England Digital Emergency Communications Network

- http://nedecn.org
- http://www.dmr-marc.net
• That’s It!  Any questions?

• *DEMO TIME*