A Comparison of Amateur Radio Digital Voice Systems

presented by
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Charlotte Digital Radio Group
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Topics

- Digital voice description
- Technical comparison
- Operational features
- Programmability
- Radio choices
- Charlotte DV repeaters
- Information sources
- Q & A

See p30 April 2015 QST
What is Digital Voice?

- Digital data modulating an RF carrier
- The data is digitized audio from an A/D converter
- It is processed through a vocoder to compress the data and add forward error correction
- The data is sent serially in uniform length packets
- Header data is pre-pended to provide sync bits, routing instructions and user identity
- Other data is often interleaved or substituted for the voice to send text, pictures or other files
Pictorial view
# Tech Spec Comparison

<table>
<thead>
<tr>
<th></th>
<th>D-STAR</th>
<th>DMR</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vocoder</strong> (see note)</td>
<td>AMBE+</td>
<td>AMBE+2</td>
<td>AMBE+2</td>
</tr>
<tr>
<td><strong>Forward Error Corr.</strong></td>
<td>Voice Only</td>
<td>Voice Only</td>
<td>Voice Only</td>
</tr>
<tr>
<td><strong>Modulation</strong></td>
<td>GMSK</td>
<td>4FSK</td>
<td>C4FM</td>
</tr>
<tr>
<td><strong>Multiplex Method</strong></td>
<td>FDMA</td>
<td>TDMA</td>
<td>FDMA</td>
</tr>
<tr>
<td><strong>Transmission Rate</strong></td>
<td>4.8 kbps</td>
<td>4.8 kbps x 2</td>
<td>9.6 kbps</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>6.25 kHz</td>
<td>12.5 kHz</td>
<td>12.5 kHz</td>
</tr>
<tr>
<td><strong>Channels supported</strong></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Standard Developer</strong></td>
<td>JARL</td>
<td>ETSI</td>
<td>Yaesu</td>
</tr>
</tbody>
</table>

GMSK = Gaussian Minimum Shift Keying  
4FSK = 4-level Frequency Shift Keying  
C4FM = Continuous 4-level Frequency Modulation  
FDMA = Frequency Division Multiple Access  
TDMA = Time Division Multiple Access

Note: Newer radios implement the vocoder in the DSP chip
Bandwidth Comparison

- **D-STAR**: 6.25 kHz
- **DMR**: 12.5 kHz
- **Fusion**: 12.5 kHz
## User Identification

<table>
<thead>
<tr>
<th></th>
<th>D-STAR</th>
<th>DMR</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration required?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>User identity</td>
<td>Call sign</td>
<td>Subscriber ID</td>
<td>Call sign</td>
</tr>
<tr>
<td>ID displayed on radio’s display</td>
<td>Call sign</td>
<td>Subscriber ID*</td>
<td>Call sign</td>
</tr>
<tr>
<td>Other text display options</td>
<td>4 characters 20 characters</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Adequate for FCC ID?</td>
<td>Yes†</td>
<td>No</td>
<td>Yes†</td>
</tr>
</tbody>
</table>

* Call sign displayed if the receiving station’s subscriber ID is in the radio’s contact list; otherwise subscriber ID appears.

† IDing by voice is still a good idea for the benefit of everyone listening.
## Repeater Connectability

<table>
<thead>
<tr>
<th>Feature</th>
<th>D-STAR</th>
<th>DMR</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talk locally</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Link to another repeater</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Multi-repeater connection</td>
<td>Reflectors</td>
<td>Talk Groups</td>
<td>WIRES-X Rooms</td>
</tr>
<tr>
<td>Selection method</td>
<td>UR entry</td>
<td>Channel Dial</td>
<td>Room name</td>
</tr>
<tr>
<td>Route to another ham</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Echo test</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Request link status</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
## Radio Operating Features

<table>
<thead>
<tr>
<th></th>
<th>D-STAR</th>
<th>DMR</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Memory selection</strong></td>
<td>Dial or GPS search</td>
<td>Key Press</td>
<td>Dial</td>
</tr>
<tr>
<td><strong>Repeater connection selection</strong></td>
<td>Dial</td>
<td>Dial</td>
<td>Key press</td>
</tr>
<tr>
<td><strong>Mode selection method</strong></td>
<td>Key press</td>
<td>Fixed in memory</td>
<td>Key press *</td>
</tr>
<tr>
<td><strong>Radio programming complexity</strong></td>
<td>Difficult/Easy ◊</td>
<td>Difficult</td>
<td>Easy</td>
</tr>
<tr>
<td><strong>Newbie learning curve</strong></td>
<td>Steep</td>
<td>Fairly easy</td>
<td>Fairly easy</td>
</tr>
<tr>
<td><strong>User manual pages - older HT</strong></td>
<td>131 (IC-91)</td>
<td>65 (CS-700)</td>
<td>247 (FT-1DR)</td>
</tr>
<tr>
<td><strong>User manual pages - newer HT</strong></td>
<td>425 (ID-51)</td>
<td></td>
<td>340 (FT-2DR)</td>
</tr>
</tbody>
</table>

* Fusion radios have AMS (automatic mode select)

◊ Older D-STAR radios are more difficult to program. Newer ones are pre-programmed, but must be updated as repeaters change.
# Signal Readability

<table>
<thead>
<tr>
<th></th>
<th>FM</th>
<th>D-STAR</th>
<th>DMR</th>
<th>Fusion *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice naturalness</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Narrow - good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wide - very good</td>
</tr>
<tr>
<td>Signal noise</td>
<td>Varies</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Sync robustness</td>
<td>N/A</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Sync recoverability</td>
<td>N/A</td>
<td>Poor</td>
<td>Best</td>
<td>Best</td>
</tr>
</tbody>
</table>

* Fusion has two bandwidth voice modes. Wide sounds slightly better than narrow.

Sync robustness is the tendency to fall out of sync
Sync recoverability is the ability to recover sync quickly

The opinions shown here are highly subjective. Your opinion may differ.
Networking Characteristics

- **D-STAR**
  - User control capability - substantial
  - Networking options - G2, D-Plus, ircDDB
  - Innovation ability - many efforts and accomplishments

- **DMR**
  - Centrally controlled structure - inflexible
  - Networking options - c-bridge, hytera
  - Innovation ability - limited, but not impossible

- **Fusion**
  - Yaesu controlled servers - inflexible
  - Networking options - WIRES-X
  - Innovation ability - limited, but Hams are just getting started
D-STAR HT’s

**ID-31A**
- Single band (70cm)
- 5W
- uSD card record
- 500 memories
- Internal GPS
- Repeater geo search
- $295 new

**ID-51A Plus**
- Dual band
- 5W
- uSD card record
- 1300 memories
- Internal GPS
- Repeater geo search
- $450 new
D-STAR Mobile’s

Older - ID-880H

- Dual band
- 50W
- 1050 memories
- $420 new

Newer - ID-5100A

- Dual band Touch Screen
- 50W
- 1000 + 1500 DR memories
- Internal GPS & DPRS
- SD card recording
- Repeater geo search
- $600 new
DMR HT’s

**MotoTrbo - XPR-7550**
- 440 MHz band
- 4W
- Color screen
- 1000 channels
- $ 700 new

**Hytera PD782G-U1**
- 440 MHz band
- 4W
- Color screen
- 1024 channels
- $ 545 new
DMR HT’s (cont.)

Connect Systems - CS700

- 440 MHz band
- 4W
- 1000 memories
- Chinese copy of XPR6550
- $ 200 new
DMR Mobile’s

MotoTrbo - XPR-5550
- 440 MHz band
- 40W
- 1000 channels
- Color screen
- $ 600 new

Hytera - MD782G-U1
- 440 MHz band
- 45W
- 1024 channels
- Color screen
- $ 530 new
System Fusion HT’s

Yaesu - FT-1DR
- Dual band
- 5W
- Automatic Mode Select
- 900 memories
- GPS & APRS
- $300 new

Yaesu - FT-2DR (new)
- Dual band
- 5W
- Automatic Mode Select
- 1245 memories
- GPS & APRS
- Touch screen
- $550 new
System Fusion Mobile

Yaesu - FT-400DR
- Dual band
- 50W
- Automatic Mode Select
- 1000 memories
- GPS & APRS
- Color Touch screen
- $500 new

Yaesu - FT-100DR (new)
- Dual band
- 50W
- Automatic Mode Select
- 1000 memories
- GPS & APRS
- $400 new
Base Stations

ICOM - IC-7100
- HF + 6M - 100W
- 2M - 50W + 70 cm - 35W
- 1600 memories
- GPS
- Touch screen
- $1,100 new

Yaesu - FT-991
- HF + 6M - 100W
- 2 & 70 cm - 50W
- Color TFT display
- Automatic antenna tuner
- Automatic Mode Select
- 1000 memories
- GPS & APRS
- $1,600 new
Other Digital Voice Suppliers

DV Dongle
- Internet Labs
- D-STAR on your PC
- $200 new

Thumb DV
- Northwest Digital Radio
- D-STAR on your PC
- Uses AMBE 3000
- Other modes?
- $120 new
Other Digital Voice Devices

**DV Access Point**
- Internet Labs
- Hotspot repeater
- Single band
- 2M $240 new
- 70 cm $260 new

**DV Mega**
- Guus van Dooren PE1PLM
- Hotspot repeater
- Dual band
- $180 new
Not near a D-STAR Repeater? Make your own - with this...
Or this...
Or something not yet available...

DV4mini for DMR and D-STAR – 100 euro, available August
Raspberry Pi G4KLX GUI
D-RATS
For More Information

- [www.charlottedstar.org](http://www.charlottedstar.org) - This is our web site. Register for D-STAR here.
- [groups.yahoo.com/neo/groups/clt-dstar/info](http://groups.yahoo.com/neo/groups/clt-dstar/info)
  This is our Yahoo group, but search for other Yahoo groups of interest such as D-STAR, Fusion, DMR, Connect Systems, etc. There’s many.
- [www.dstar101.com](http://www.dstar101.com)
- [www.dstarinfo.com](http://www.dstarinfo.com)
- [www.dstarusers.org](http://www.dstarusers.org)
- [www.maryland-dstar.org](http://www.maryland-dstar.org) - for Raspberry Pi enthusiasts
- [www.ncprn.net](http://www.ncprn.net) - Web site for our area DMR repeaters & code plugs.
- [www.dmr-marc.net](http://www.dmr-marc.net)
- [www.trbo.org](http://www.trbo.org)
- [https://www.youtube.com/watch?v=eOYio06rsuo](https://www.youtube.com/watch?v=eOYio06rsuo) – John Hays K7VE
Charlotte Area Digital Voice Repeater Locations

A – Spencer Mt. – D-STAR (70cm), DMR (70cm Hytera)
B – Hood Rd. – D-STAR (2M & 70cm & 23cm), Fusion (70cm)
C – Wingate – D-STAR (70cm), DMR (70cm)
D – Crowder’s Mt. – D-STAR (23cm), DMR (70cm), NexEdge (70cm)
E – Charlotte – DMR (70cm)
F – Shelby – D-STAR (2m & 70cm)
G – Charlotte (Dallas) DMR (33cm)
Questions?

Roland, W9HPX  
first licensed 1959  
w9hpx@arrl.net

Art, W9HPX (SK)  
first licensed 1933  
my Elmer