

# DIGITALLY SPEAKING

By Cory GB Sickles WA3UVV

wa3uvv@gmail.com

## DMR Update

Special thanks to:  
The Spectrum Monitor

While System Fusion continues to rapidly grow in popularity, DMR (Digital Migration Radio or Digital Mobile Radio, depending on whose marketing propaganda you're reading) has also been growing rapidly. While this methodology is one borrowed from the LMR (Land Mobile Radio) world, the costs of setting up a repeater and some relatively new flexibilities, along with an increasing number of radios with decreasing prices, have made DMR more and more attractive to many.

Although it still makes use of C4FM modulation, DMR differs from the other DV (Digital Voice) methodologies we use in that it gains advantages by time slicing two signals, in the same 12.5 kHz bandwidth that most of our DV communications use; with the exception of D-STAR and NXDN at 6.25 kHz. This time slicing is more commonly known as TDMA (Time Division Multiple Access).

The DV data is split into 27.5 ms packets, with a 2.5 ms interstitial switching time – yielding a 30 ms window for each of two “slots” (TS1 and TS2) that make up DMR. A more sophisticated TDMA system – known as TETRA – has become popular in Europe for public safety communications and allows for four slots. By the way, if you think the cost of new P25 gear is high - it's “bargain basement pricing” – compared to a new TETRA system.

With the two slots, it's possible to have two different conversations – seemingly simultaneously – on the same repeater. Effectively, this gives you the communications capabilities of two repeater systems (repeater, duplexer, feedline, antenna, etc.) for the price of one. That, in a nutshell, is the real power of TDMA.

In order to achieve this, the repeater generates a clock signal that the user radios synchronize to, in order to stay within the proper slot. This requires some additional sophistication and quality control in the radios, so that they don't “slide” into the adjacent slot's domain.

If you turn on your radio and your selected repeater is not active, then a quick transmission acts as a “transmit request,” in order to get the repeater to generate a signal and get you in sync. Certain things need to be established in the radio's programming, such as a User ID number, Time Slot, Talk Group, Color Code, Frequencies and more. Note that, unlike D-STAR and System Fusion, your call sign is not a supported data field. As this is a technology borrowed from the LMR world, your User ID is what makes you unique. Also, because of this, you must remember to observe the



*Vertex-Standard's EVX line includes several models. The EVX-539 includes a full keypad and backlit display. (Courtesy of Vertex-Standard)*

same identification rules that exist for analog FM voice transmissions.

When you successfully “connect” to a DMR repeater, you will hear a quick set of “happy” tones. If you don't, then a single low frequency “fail” tone is heard. The exception is when you use DMR in a single-slot, simplex mode—handy when no useable repeater in your area or at times when you are close enough to other stations and don't need to engage a repeater.

While DMR is a standard that is supported by many manufacturers, there are DMR “supersets” with enhanced features that are supported by individual manufacturers, in order to give themselves and their products an extra edge in the marketplace. Perhaps the best known of these is MotoTRBO, from Motorola.

As they created a stable networking environment that encouraged hams to try out DMR, we owe a debt of thanks to members of the Motorola Amateur Radio Club ([www.DMR-MARC.net](http://www.DMR-MARC.net)). As you might imagine, this involved Motorola repeaters. Network connectivity was accomplished





*Left: The TYT MD-390 is the latest in a popular line of single-band portables aimed squarely at the amateur radio market. (Courtesy of Universal-Radio) Right: The MMDVM mounts on to an Arduino SBC – then connects through a Raspberry Pi SBC to complete a homebrew DMR repeater with networking capabilities. (Courtesy of gb7dd.co.uk)*

through the use of Rayfield Communications' C-Bridge ([www.Rayfield.net](http://www.Rayfield.net)). Also, a set of very specific parameters was established. While this means that not all features available with DMR (like GPS data) are supported, these are relatively small concessions, given the stability that such an adhered to set of rules allows. Also, while the use of commercial equipment increases the price tag of a given repeater installation, keep in mind that DMR essentially allows you to have the use of two repeaters simultaneously. Thus, the amortized costs are less.

As to equipment, early adopters used gear from Motorola, ([www.motorolasolutions.com/en\\_us/products/two-way-radios/mototrbo.html](http://www.motorolasolutions.com/en_us/products/two-way-radios/mototrbo.html)) such as the XPR4550 mobile and XPR6550 portable. Vertex-Standard ([www.VertexStandard.com](http://www.VertexStandard.com)) VXD7200 and VXD720 are lesser-priced alternatives from a Motorola relative with new VXD pricing closer to typical used pricing of the XPR series. Further, Vertex offers the well-featured EVX series and continues to expand the line. Another advantage with Vertex is found in the programming software, which is included with the radio, from most dealers.

As DMR increased in popularity, other manufacturers began to take note and started offering their products to hams. While networked repeaters needed to remain Motorola products, the radios did not. Names like Hytera, Tytera (yes, really), Connect Systems and many more have become popular. On top of that, portables like the popular Tytera MD-380 get re-badged under names like Retevis, Puxing and my "tongue in cheek favorite" – Lisheng – a syllabic swap of the word "English."

DMR radios are available to comply with the methodology's three "tiers," or levels of sophistication. Tier I is a single slot mode and is essentially useless for any serious

repeater use. Keep it in mind as this will come up again. Tier II is two-slot "conventional" operation—as we use on the ham bands. Tier III represents all that you can do with Tier II, plus trunking. While the latter is attractive for certain commercial applications, it is less attractive for amateur use.

Also, all DMR radios currently (as I type this) on the market are designed for single band use. They are VHF or UHF, but not both. Further, it is common to see the UHF band split as 400-470 MHz or 450-520MHz. The former is useful for hams, the latter not so much. You can also find gear for the 800 MHz band, but I haven't heard of anyone successfully "stretching" the coverage into our 902-928 MHz allocation. (I believe NXDN and P25 are the only DV methodologies you are going to find available for that band).

There is some hope of dual-band radios on the horizon, however. About a month ago, a Baofeng (yes, the same company that makes the low-end analog portables) announced a dual-band radio, the DM-5R, for a street price of \$70. However, a good look at the fine print revealed it was a Tier I radio only. Some overly energetic hams ordered one as soon as they saw the announcement, only to later realize the folly of their ways. After some negative comments on email reflectors and social media pages, the US dealer Radioddity announced that a Tier II upgrade would be available—for an extra charge.

They also announced that doing the upgrade was a bit tricky and it was rather easy to "brick" your radio if all did not go well. That's another hint that the Tier II functionality was an improvised afterthought. To my knowledge, they haven't shipped anything just yet. With some of the misinformation that was initially floating about this product, I wondered if it was a "real" announcement, or some elaborate joke. Apparently it is real, even if not quite yet ready for





*CS-750 UHF HT (\$239) from Connect Systems is compatible with Motorola and Tytera DMR radios. (Courtesy: Connect Systems)*

prime time.

In the weeks that have followed the initial announcement, more companies such as Anytone, Wouxun and Tera have also made dual-band product announcements for portables and mobiles. Their press releases have also included more realistic pricing. While none of these products are immediately available, it would seem clear that one or more dual-band models will soon be available to hams.

As with many other things, getting the cheapest one should be a lesser goal to getting the best value. For some, it's Motorola or nothing. Others are less concerned about the "Batwing" logo or a hardened case and would rather find somewhat lower priced alternatives.

I already have a CS750 for UHF and MD-380 for VHF, but haven't acquired a mobile DMR rig just yet. With these recent developments, I'm fairly sure I'll be picking up a dual-band mobile, once a good-quality version is available and supported.

If you have a DMR repeater presence in your area and would like to get involved with this particular methodology, you'll need to register with DMR-MARC for a User ID. Each ID is unique, but the same one can be used on all of your DMR equipment, as long as only one is on the air at one time. You do not need one for each and every piece of equipment you have, though. User ID's will be displayed (if the receiving radio has a display) when you transmit. Unlike D-STAR and System Fusion, your call sign is not included in



*Tytera MD-380 VHF DMR TDMA HT (\$129) is also capable of analog FM operation. (Courtesy: Universal Radio)*

any part of the DV data stream.

You will need to identify in accordance with the FCC rules and regulations—through your voice. I know I mentioned this before, but it bears repeating, so that you don't get lulled into a false sense of "the radio is taking care of this for me." Even if you are using System Fusion or D-STAR, which includes your callsign in every transmission, it's still a good idea to identify verbally. Many are using portables as mobile stations and can't safely take their eyes off the road to look at the small displays.

While you're waiting to get your ID (usually within 72 hours) you might want to contact one of your area's "DMR Gurus" to make suggestions about equipment and setup. As we're dealing with something borrowed from the LMR world, you'll need to program your transceiver with software and a cable that may or may not be optional.

Instead of starting from scratch, you will probably be able to easily acquire what is known as a "codeplug," a programming file loaded with all of the repeater frequencies and specific information needed to configure your radio. Just make sure your ID is inserted into the file and then follow your software's programming instructions.

Editing an existing codeplug is far easier than creating one from scratch. However, please don't fall into the rut of relying on others to update codeplugs for you. A little bit of understanding as to what's going on inside your radio and the network can go a long way. Here again, the real value of



a DMR Guru is not in getting them to do the work for you, but teaching you how to set things up and maintain them on your own. With enough experience, you'll be able to soon guide other newcomers, as well.

While DMR-MARC became the standard for DMR repeater connectivity, some hams wanted alternatives with lower costs; using non-Motorola machines and some other way to network. Out of this, BrandMeister ([www.BrandMeister.US](http://www.BrandMeister.US)) was conceived and launched as a stable alternative. Today, many DMR repeaters are being homebrewed from suitable transceivers and various repeaters. The MMDVM interface works with a set of appropriately configured Raspberry Pi and Arduino SBC (single board computer) connections to enable several methodologies – including DMR.

One of the most popular arrangements is to add DMR capabilities onto a Yaesu DR-1X – creating a resource that supports three different ways to communicate. Likewise, there is a way to add the MMDVM to a BridgeComm BCR-series repeater.

While analog FM support is available in such configurations, that is for local communications only. All DMR networking is digital. That's actually good news, as it provides for a consistent signal quality across the connections.

System Fusion's WIRES-X networking supports analog rooms and, while that's nice, the differences in clarity and lack of supporting data is noticeable. It's OK to have, but I find I tend to stay with digital assets, avoiding the analog. So, at least in my opinion, it's not much of a downside.

I've been looking into the monthly growth curves of the three most popular methodologies—DMR, D-STAR and System Fusion. Digging into the numbers, many of the D-STAR repeaters going on the air today are based on non-Icom hardware. A similar trend is occurring with DMR, as repeater owners find alternative ways to join the community of existing assets.

While D-STAR users have had



The screenshot shows the VA3XPR website. At the top is the logo "VA3XPR" in a stylized font. Below it is the text "Software Defined R" and "Prototype next generation wireless cc". A navigation bar contains links: "ABOUT", "REPEATERS", "EVENTS", "REVIEWS", "NEWSLETTER", and "RESOURCES". The main content area features a news article titled "AnyTone announces the AnyTone AT-D868UV dual-band VHF and UHF DMR portable". The article includes an image of the radio and a "Read More" button. The text of the article snippet reads: "Today, Qilang Electron Science & Technology Co., Ltd, the Chinese manufacturer that produces the AnyTone line of two-way radios, announced its intention to release the AnyTone AT-D868UV, a dual-band VHF (136 - 174 MHz) and UHF (403 - ...".

*VA3XPR.net web site is an excellent resource for hams wanting to get involved with DMR. (Courtesy of VA3XPR)*

non-radio ways to connect with reflectors, such as DVAP, DV Dongle, DV, Thumb DV3000 and others, DMR users have traditionally been left out in the proverbial cold. That has recently changed, with availability of the DV4mini ([www.Wireless-Hold.com](http://www.Wireless-Hold.com)) and its resources, plus newly announced support, through the DMRPlus US and UK talkgroups and the VA3XPR-1 repeater. This comes to us from the VA3XPR amateur radio club ([www.VA3XPR.net](http://www.VA3XPR.net)), an excellent resource based in Toronto, Ontario. While their primary mission may be to digital hams in Canada, their outreach, enthusiasm and growing expertise is available to everyone. I'm sure there will be additional announcements, of benefit to many.

As part of their mission to increase the numbers of hams with DMR capabilities, VA3XPR regularly holds small digital workshops (usually at a Tim Hortons coffee shop) to introduce DV concepts and answer questions. This is a nice model for any club to develop additional membership and spread the word about the advantages of any DV methodology. It's another example of the "Evangelists and Cheerleaders" outreach I wrote about a few months ago.

The DMR enthusiasts in Toronto have been doing this for some time and serve as a good example for others. They also have reviews of certain radios on their web site, plus additional resources including codeplugs, activity monitors, repeater map and a place to get your DMR radio ID.

DMR is the most popular of the DV methodologies that amateur radio borrows from the LMR world. It continues to grow at a rapid pace and has an enthusiastic base of users. If your area hasn't yet made their initial venture into DV radio, take a good look at DMR and what it may have to offer your club or area hams.

With options like the MMDVM added onto a Yaesu DR-1X System Fusion repeater, you can experience two different methodologies and still support analog FM. That's just one possibility that supports everyone.