DIGITAL HAM RADIO DISCUSSION
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This report is not intended to instruct you how to set up and use digital radio, but rather help you understand how they work and decide which one you might want to try out.

A digital radio has a “VOCODER” between mic and amplifier it can be switched in or out allowing radio to be digital or analog. A vocoder takes analog audio from mic amp and converts in to ones and oh’s the computer language. Vocoders are made in different computer or internet languages, there is DMR, D-Star,Fusion,P-25 and more, they can not talk to one another. The vocoder of course is also connected in receiver to decode the digital stream. Some of these systems are “open” which means any manufacturer can use them others are closed and the owner only allows them on his radios (Motorola, GE). The P-25 was purposely designed for public safety as an open code so any manufacturer could use it and bid on Public Safety contracts. These systems should not be confused with PSK-31 or FT8 where the digital signal is created by a computer and the radio is analogue.

Advantages of digital radio are: When decoded the audio is very clear as any noise is eliminated. Being digital they can use the internet and be manipulated by computer. Prices vary by manufacturer. DMR generally more expensive then D-Star and Fusion.

The most popular current systems are DMR, D-Star, Fusion, and APRS. These systems operate a lot alike but all have different terms for same action. Most all will have talk groups.

DMR

DMR is an open Standard and used by Yaseu and Baeofeng and is most complex. Hand helds are from $75 to $$150. DMR uses 12.5 khz band width. DMR uses TDMA which means “Time Division Multiple Access”. As an example imagine a digital stream split in two the first set of digits is a channel called Tier 1 and the second half of digits is another channel called Tier 2. These are referred to as “time slots’. So there are two separate channels in each repeater. Tier 2 is most used.

Radio must be programmed, Code Plug is soft ware to tell radio what to do, here are some of the things you will select.
DMR ID, which is unique ID to each user. You can get it from RadioID.Net. You still need to use your call sign to identify your station.

ZONE groups together related channels.

Color Code is same as tone control you are familiar with. Always use, allows you to transmit only when the time slot id available. Channel Free allows you to transmit when the channel is clear. Always is impolite to use it allows you to transmit even if there is a QSO going on. Use only in simplex or analog.,

TALKGROUP
A DMR talkgroup is simply a way of grouping many Radio IDs into a single digital contact. Or put another way, a talkgroup is a method of organizing radio traffic specific to the DMR users that all want to hear the same thing and not be bothered by other radio traffic on a DMR network that they are not interested in hearing.

Talk groups can exist for many purposes. You can have talk groups for countries, states, counties, regions, cities, special interest groups etc. Just about any group of DMR users could have a talkgroup assigned to them if they wished to organize traffic that they can all monitor and take part in, without having to talk to each other one by one.

REPEATERS: digital repeaters work basically the same as analog repeaters you are familiar with they take in the DMR digital signal and transmit it out and often hooked to the internet and sent on to other repeaters and hot spots.

HOTSPOTS: If you do not have a DMR repeater in your area you can install a hot spot in your shack. A hot spot is like a mini repeater or wifi, it is hooked to the internet and allows you to talk to the DMR network within its range. Often a hot spot will work on other digital modes.

D-STAR

With D-Star you can link your radio to a local repeater, or link to two repeaters, link to a reflector and get several repeaters and call a specific person. Excellent reference is “D-Star User Guide For Beginners” on line through Google.

D-Star and Fusion are both simpler systems, D-Star is used by Icom and was developed by Japan Amateur Relay League. D-Star stands for Digital Smart Technology For Amateuer Radio. D-Star is an open standard and can be used by any company. Icom and Kenwood make radios for D-Star (Kennwood TMW-7065 50 watts, TMW-70672 20 watt). Using simplex the D-Star range is about 30% farther than analogue.

Radios must have a Gateway Registration which you get from any D-Star repeater administrator . Once registered with one repeater you are good on all. You must program your radio, here are items that will be programmed: My Call CQCQCQ C, The term Port, Module & Node all mean same thing which is the operating band as follows, A port =1.2 GHZ, B Port= 70CM, C Port stands for 2 meters. The port must be in 8th place in call see above. UR Call =N8CFM C, again C in 8th place. RPT 1 local repeater or hot spot, RPT 2 when you want to go to other repeaters put in local repeater or hot spot add G in 8th position again, G stands for Gateway to internet. To help with programming go to D-Star Calculations on the net. Radio must have your call letters programmed in.

Originally set your radio mode to DV which is D-Star. Simplex for D-Star is 145.67 mhz. To find repeaters go to ,www.dstarusers.org.

Hot spots allow access to D-Star when there is no local repeater. It is hooked to internet and has radio xmt and receive and must be programmed. Usually kept in your shack.

A Reflector is a computer that runs a special program and hooks to several repeaters by the internet. You can go to a reflector and on to one or more of its repeaters.

You will need special cable to go from your radio to computer for programming.
RT systems includes cable with software for programming and many radios come with a cable.
ICOM has released free soft ware for programming the IC-80D and the IC-880H radios.

Available radios for D-Star are: Yaseu FT4XR HT $69, Baoefeng HT DMX GFS dual band $81, Motorola D7R700 HT $295, ICOM base M330 $179.99, Baoefeng dual band DM-1701SW $99.99, and many others.

FUSION

Fusion is Yaseu's implementation of digital Amateur Radio, utilizing C4FM 4 level FSK technology to transmit digital voice and data over Amateur Radio Bands. C4FM means Continues Four Level Frequency Modulation, which is a special type of 4FSK(Frequency Shift Keying) used in conjunction with FDMA(Frequency Division Multiple Access) "Say What !!!"

No registration of radio is required as it uses a third party called WIRE-X for internet extended communication.

Repeaters made by Yaseu (DR-1X) are both Fusion and analogue, so only one repeater is required to have digital and FM. (a savings). Fusion operating modes are Analogue FM and V/D which is Digital voice and high speed images. They have Automatic Mode select which will automatically detect incoming signal and convert it to analogue FM and transmit. That way non fusion radios would still get messages. In Group mode , individual groups share text & pictures with everyone in group.

Fusion radios have a microphone available that has built in camera, so pictures can be taken and instantly sent to other Fusion radios. They also have Smart Navigation/Backtrack, it gives you distance and direction to the other station in your QSO. Backtrack navigates you back to registered locations.
Text messaging is allowed to all in a group or individual.
WIRE_X is an internet linking system used by Yaseu. A node is a radio or repeater cabled to a computer running wire-x software and connected to internet. Not all Fusion radios will function as node radio and connect to internet. YSF refers to a system of REFLECTORS which are servers with special software. Fusion seems to require extra equipment to go nation wide using WIRE_X and coverage appears limited.

SUMMARY

Of the three my feeling and recommendations from users is that D-Star gives biggest bang for the buck. I also strongly recommend that before club installed any digital repeater that the majority would pick a system they like so all members would be willing to buy radios on the system. Of course any member is free to go out on there own on any system.

APRS

This system is different than previous three. They were communicating by digital radio and this system sends real time data from many stations.

APRS (Automatic Packet Reporting System) exchanges information among a large number of ham radio stations. It is used to transmit real time data such as location, weather, text messages, and more. The information can be superimposed on a map on a computer screen. APRS uses a nation wide channel- 144.390 mhz.

Most common use is to plot many radios on a map on computer screen such as runners in a race and storm spotters on skywarn. Also will send text messages , weather telemetry and announcements.

Digi Repeaters are used to extend local range. An “I Gate” is used to listen to over the air APRS signals and put on internet APRS stream. This allows world wide contact with text message and location monitoring.

J.C. Duncan, ex president of WAARC has nice APRS set up at his home in Deer Creek.

Radios that include APRS software and a TNC are: Kenwood TMD700A, TDM710A and HT TH-D7. Yaseu VX-8R(G), FTM-350R, FT1DE/DR, FT2 and FT3, and FTM-400DE/DR.

More detailed information to set up and use these systems is available on Google and You Tube.