

HIPAA-COMPATIBLE WIRELESS COMMUNICATIONS

EMERGENCY DIGITAL VOICE/DATA

D-STAR

The effectiveness of any voice or data communications system is directly influenced by those it serves. While there are many communications tools available, D-STAR is the newest tool for both tactical and strategic communications in our emergency communications (EmComm) toolbox. Turn the page and discover a whole new perspective on amateur radio...

- Deployment Concepts
- Practical Applications
- Spectrum Usage

The logo for iCOM, featuring a stylized 'O' above the word 'iCOM' with a registered trademark symbol.

DIGITAL

Putting D-STAR to work...

The Three P's of EmComm

Some would say the three P's of EmComm are Planning, Planning, and more Planning. While Planning is extremely important, equal consideration to Preparation and Practice must be observed. The most well thought out plans can make a simple situation a complete disaster without the right execution.

So, how do the three P's tie into D-STAR? Many clubs already include D-STAR as well as other Digital Voice (DV) modes in their EmComm readiness.

Types of EmComm

EmComm can be broken down into two main categories: Tactical and Strategic.

Tactical Communications: Deals with short term needs or immediate action items to achieve an objective, milestone, or goal.

Whether it is to dispatch hot shot crews and aerial water tankers for fire suppression, food deliveries for shelters, or areas requiring immediate medical crews, precision is key here. Unfortunately, inflections in a voice, radio operator experience, or things beyond our control can slow things down. Therefore, to be effective we must always utilize the three P's and look to new ways to improve.

With the capability of combining voice and data in the same transmission, as well as adding a faster data stream with universal standards such as serial and Ethernet data, D-STAR can greatly increase radio's effectiveness and efficiency.

Strategic Communications: Deals with long term, broad of scope needs. These items do not require immediate action.

While not as time sensitive as tactical comms, strategic communication plans and practice solve emergency issues. We will commonly see communications such as shelter plans and locations, or safety warnings, as well as items required for problem solving.

Why say what you can send?

As technology evolves, so do the comm requirements in times of an emergency. Many of us have become extremely reliant on these new technologies. Just

think back to the last time you tried to purchase groceries and the computer system was down. A normal daily process – simply buying food – probably ground to a halt. Many of us, especially the younger generations, are not reliant on data communications. Data comms, such as text messaging, e-mail, and document transfers are common in both our personal and professional worlds. Now, Amateur Radio will be tasked to maintain this level of “connectivity”. So, new tools to assist in keeping us connected to the rest of the world must be developed and adopted. And they are!

We as amateur radio operators are seeing changes in our role from communicators to IT solution technicians. The new mantra is “Why send what you can show?”

Additionally, we see voice comm improvements as we migrate to digital communications. Due to the inherent nature of RF physics, analog radio will suffer from several limitations that affect the range and clarity of voice. Environmental and range factors will effect every RF transmission. But, in an analog system, everything in the environment that disrupts or interferes with the signal itself has a direct effect to the voice quality at the receiving end. While technology exists to boost and retransmit an analog signal, what comes in, goes out. Which means a degraded signal in will remain a degraded signal as there is no way to recover the original voice quality.

Digital systems incorporate built-in error-correction techniques that reconstitute the voice at nearly its original fidelity throughout most of the RF coverage area.

D-STAR: Let's Get Digital

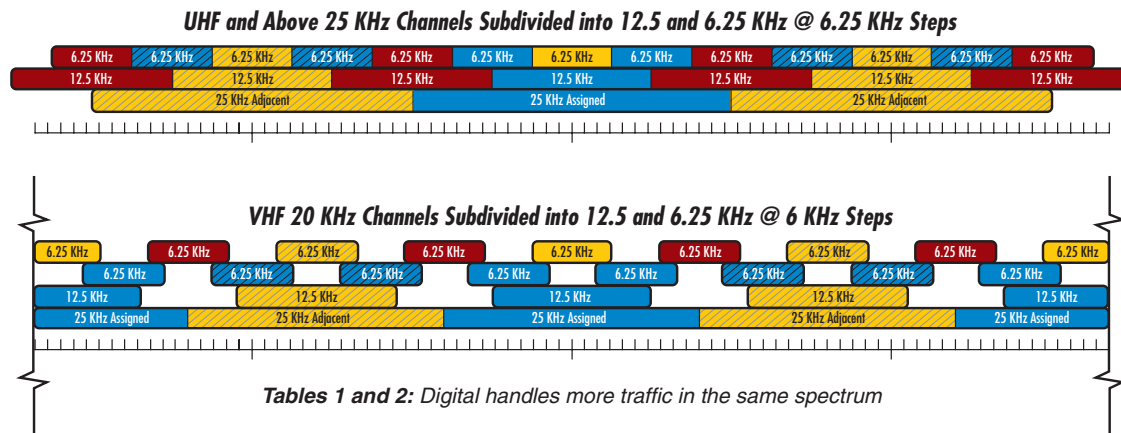
With all the infrastructure supporting analog FM communications, why would anyone want to change or implement digital voice (DV)? Really there are four reasons:

1. Spectrum efficiency
2. Greater range and clarity
3. Routing of voice and data communications
4. Simultaneous data and voice communications

Spectrum Congestion

We all understand the pitfalls of population growth; in many areas, what was once a 10 minute trip

...during emergencies!



across town now takes a half hour! We see a similar congestion issue in amateur radio, but rather than a trip taking longer, we hear “Sorry, there are no repeater pairs available.”

The migration to more efficient modes of communication helps open up repeater pairs. Repeater councils are adopting and implementing new band plans as the ham radio community migrates to address the more efficient DV modes. Tables 1 and 2 demonstrate how many 6.25kHz digital systems can be deployed in the place of a single analog repeater.

In addition to the increased repeater pairs, the Digital Voice mode increases the number of simplex frequencies that can be used in an emergency. Frequency management becomes more important as we see our roles increase in proportion to the size of the incident and the number of agencies increases.

Frequency Coordination

In many emergency plans, both Amateur Radio Emergency Service (ARES) and Radio Amateur Civil Emergency Service (RACES) members will assist in emergencies. ARES operates under written “Statements of Understandings” with these “Served Agencies”:

- The Federal Emergency Management Agency (FEMA)
- The American Red Cross
- The Salvation Army
- The National Weather Service (NWS/NOAA/Skywarn)
- The Association of Public-Safety Communications Officials International, Inc. (APCO)
- The National Communications System (NCS)

With so many different entities, you can see why frequency coordination is important!

Many organizations look at a primary and secondary frequency, some will go as far as a third. But what happens in a situation that covers a thousand plus miles, multiple counties, states, even multiple branches of the same organizations? How important does an efficient EmComm plan become?

Multiple agencies will require separate frequencies for their local traffic, yet, there are times when communications to coordinate efforts of various counties and agencies will be required.

Routing of Voice and Data Communications

There are two types of routing in amateur radio: **site routing** and **user routing**. Site routing is used in technologies such as EchoLink® and IRLP. While this has opened VHF and UHF global communications, one downside is if you are looking for a specific person....you have to know where they are!

User routing was introduced to the amateur radio community with the introduction of D-STAR. With D-STAR, the signal will be routed to the last location where that user was heard.

D-STAR radios require 4 call signs to be programmed into the radio for communications other than simplex communications. These four call signs are:

1. Mycall
2. Urcall
3. RPT 1
4. RPT 2

Putting D-STAR to work.

While the Mycall and Urcall are self explanatory, RPT 1 is the call sign of the local system you use, while RPT 2 directs what type of communications are used. RPT 2 will be one of three choices:

1. Not Used. *Signal repeated on the same band*
2. Port Address. *Signal repeated on the same band and band assigned to the port address.*
3. Gateway. *Signal repeated on the same band and routed to location of call sign in the Urcall location.*

D-STAR Factoid: *Did you know that a user can select whether their communications are repeated on a single repeater pair or multiple repeater pairs?*

Either the RPT 2 or Urcall can route a transmission to another repeater pair. As an example, say we're working with two separate agencies for shelter and food coordination. One organization is operating on VHF (2m) and the other organization is on UHF (70cm). I have an immediate need for an available bed count from both. I can make my request simultaneous to both organizations!:

Mycall:	N9JA	N7IH B	70cm DV
RPT1:	N7IH B	N7IH C	2m DV
RPT2:	N7IH C		
Urcall:	CQCQCQ		

The UHF call from N9JA would be heard on both VHF (2m) as well as UHF (70cm). Note: any 4 modules can be used on a single controller, therefore a system could consist of 2 (VHF) 2m and 2 (UHF) 70cm systems, or any band combinations.

Simultaneous Voice and Data Communications

In addition to all the routing capabilities of the DV mode, the simultaneous transmission of serial data is possible while operating in the DV mode. While the data rate is not plausible for large data transfers, this feature allows simple serial communications, such as keyboard-to-keyboard text messaging to occur on the same infrastructure as the voice communications.

DV Benefits Over Packet Radio

As the 1kbps data stream is part of the entire DV data stream; if voice gets through, the data will get through. Also, there is only one infrastructure system to maintain. Thus it reduces the head count required to support the voice and data systems.

DV + GPS

While hams have had both voice and position reporting capability for years, D-STAR combines these two communication methods into one seamless system. Knowing where your in-the-field workers are offers a variety of benefits to dispatchers, supervisors and managers, and offers an extra level of safety for in-the-field workers as well as faster extradition of any victims being rescued. GPS data is extremely helpful in SAR/USAR activities.

Ham-Brewed Software & Hardware

Integrating D-STAR Position Reporting System (D-PRS[®]) information into older, existing systems becomes a challenge. Fortunately, several people have stepped up the challenge and have solved the issues of compatibility with legacy technology.

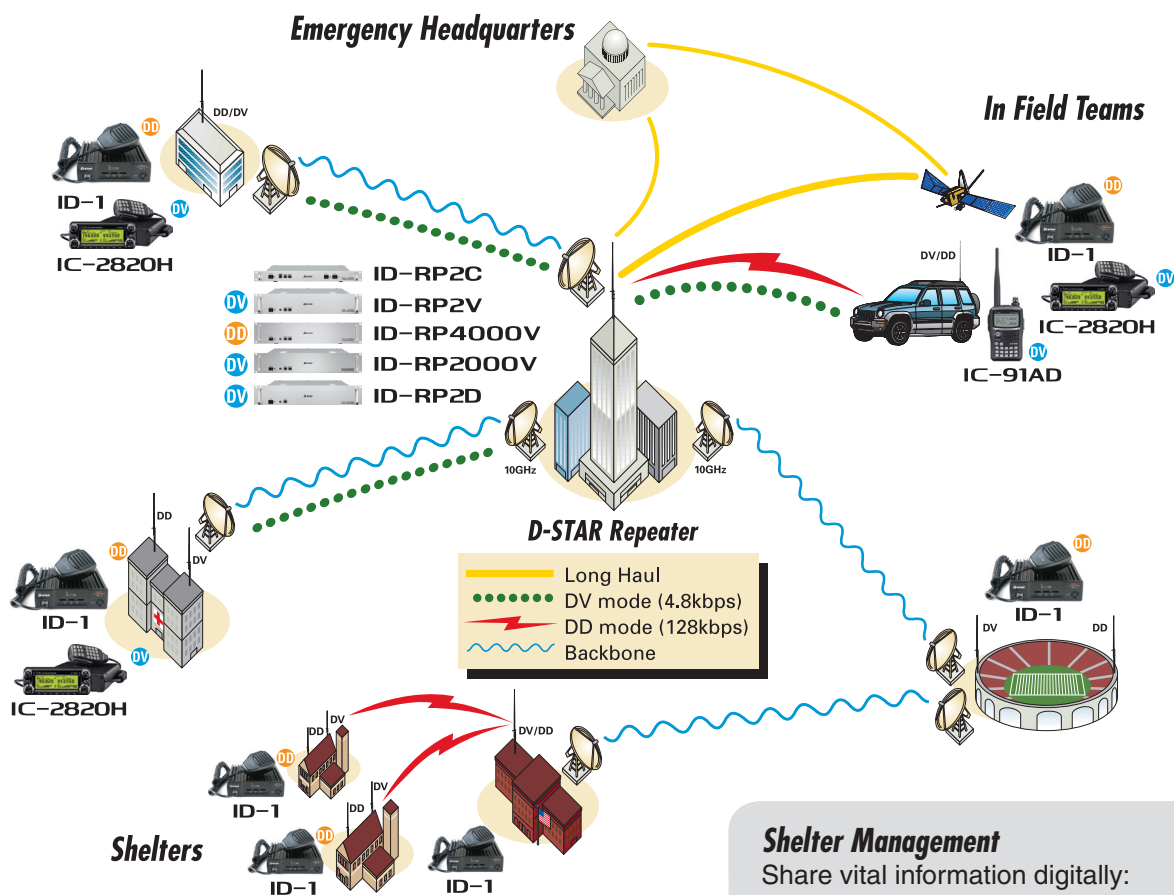
D-PRS Interface/javAPRSSrvr: D-PRS applications allowing the use of standard APRS clients to map D-STAR GPS activity. Both applications have the ability to gate the translated D-STAR->APRS packets to APRS-IS where they can be displayed by remote clients or gated to the local APRS frequency. *More information @ <http://www.dstarusers.org/solutions>*

Pete Loveall, AE5PL, developed several software packages to integrate D-PRS[®] with APRS[®].

μSmartDigi™ D-Gate™ D-STAR Gateway: a compact, portable TNC designed to gateway position packets between a D-STAR digital network and a conventional analog APRS network via a D-STAR radio and a conventional radio. *More information at: <http://www.dstarusers.org/solutions>*

Rich Painter, ABØVO, developed a hardware solution to integrate D-PRS[®] with APRS[®].

Example System



Shelters

128kbps, 23cm wireless data, allows faster communication over areas of several miles* for Ethernet-based communications while offering HIPAA-compatible receive and transmit information.

*Line of sight communications.

Shelter Management

Share vital information digitally:

- Inventory, such as medical supplies, fuel supplies, food and water availability, bed counts, etc.
- Logistics and Coordination
- Staff and Schedule

Determine if shelters are filled or empty, in need of supplies or can spare them. Personal information is not transmitted in the clear, satisfying HIPAA standards.

Repeater compatibility chart with Icom digital transceivers

	ID-1	IC-2820H*	ID-800H	IC-91A*/AD	IC-V82*	IC-U82*	IC-2200H*
ID-RP2000V	-	✓	✓	✓	✓	-	✓
ID-RP4000V	-	✓	✓	✓	-	✓	-
ID-RP2V/IDRP2D	✓	-	-	-	-	-	-

*Optional plug-in digital module is required. Check with your authorized Icom dealer for details.

Putting D-STAR to work...

While the entire data stream is 4800kbps, this is split into three areas:

2400kbps	Voice
1200kbps	Voice FEC
1200kbps	Serial Data

(Note: Actual data throughput is approximately 1kbps.)

While it does not sound very fast, the data stream that is available in the DV mode of D-STAR offers many possibilities.

What We Learned

During the introduction of the first D-STAR system in the U.S., K5TIT in Dallas, TX, one of the local amateur radio operators who attended the unveiling asked the question, "Why would I want Internet connectivity in my vehicle?" Now, Hurricane Katrina has helped answer that question: The value of being able to show real-time data being generated from the in-field 1st responders is obvious. Additionally, the ability to access information from

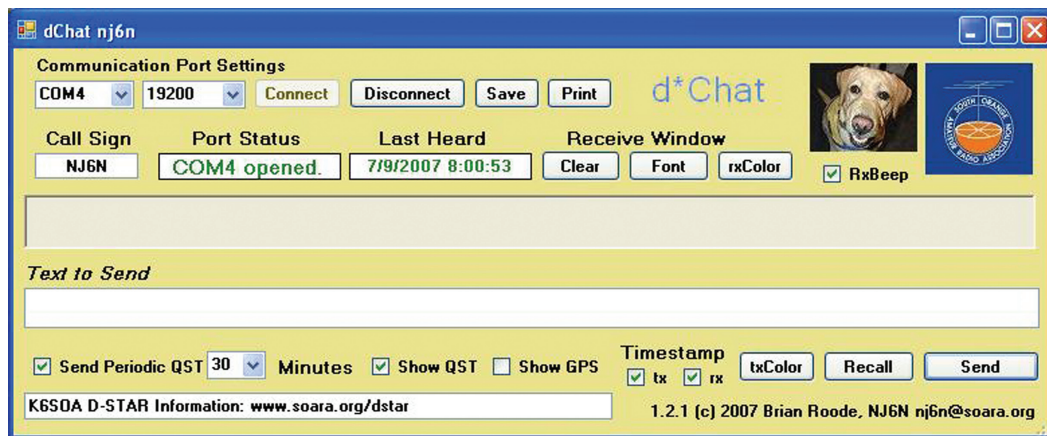


Figure 1:
D*Chat's user-friendly interface contains the critical info needed to make a D-STAR call.

D*Chat or DCHAT: Windows® based keyboard to keyboard communication application with the ability to enable text-based communication between multiple stations simultaneously on a single simplex or repeater channel. *More information at:* <http://www.dstarusers.org/solutions>

Brian Roode, NJ6N, developed a software package to integrate keyboard-to-keyboard text messaging via the 1kbps data stream.

DStarQuery: Application that executes predetermined programs and sends the output of the programs to the low speed serial data channel. Using a preformatted query string on the low speed data channel, DStarQuery will look up the command, append any received parameters, execute the program, and send the generated data back to RF. This can be used for simple text responses or can be used to run scripts and programs for more dynamic responses. *More information at:* <http://www.dstarusers.org/solutions>

Pete Loveall, AE5PL, also developed several software packages utilizing text messages.

the National Weather Service and other EmComm related web sites as well as send e-mail and share files with others on the system is most valuable. In addition to being able to connect to the Internet, IT systems like file, e-mail and chat servers, can be deployed.

While working out your deployment strategy, there are key things to remember.

- Propagation on 23cm can be tricky. It is truly line-of-sight, and does not work around buildings and environmental obstructions.
- As the frequency bandwidth of the digital data (DD) mode is 130 kHz, the total data bandwidth is 128kbps, not per user/connection. So deployment plans with multiple DD systems to cover areas with many users should consider expanding to systems operating different frequencies.

...for you!

- Unlike the DV modules on a D-STAR system, the 128kbps module, or the DD module, is really an access point. While the DD module is user programmable for the selected frequency, operation is in a half duplex, single frequency. If deployed in a system with the 23cm DV module, or with other DD modules, a pass band filter is highly recommended. This keeps other 23cm transmissions from interfering.

D-STAR in Action Around the U.S.

(Dallas, TX) In 2003, Jim McClellan, N5MIJ and Bill Moore, N5ZPR, became the first D-STAR customers in the U.S. Since then, Jim and Bill, along with their club, the Texas Interconnect Team, have expanded their D-STAR presence to cover the entire Dallas/Fort Worth area. The club hosts critical functions for the D-STAR network, including the main D-STAR Trust Server, and a popular web site, www.D-STARUsers.org. "Simultaneous voice and data [is] a capability unique to the amateur service today, and gives us the opportunity to provide a service not available anywhere else", says Jim.

(Washington, DC) In 2006, race organizers for the 31st annual Marine Corps Marathon turned to the National Capital Amateur [Radio] Council (NCAC) for race day communications help. D-STAR digital data provided broadband communications support. At 10 to 100 times the bandwidth of previously used packet systems and supporting native TCP/IP applications delivered AID station performance that was so stunning the D-STAR demo stations became the primary method to manage runner medical info using the native, interactive race web application.

(Southeastern U.S.) Hams working with emergency organizations, the Alabama Section of the American Radio Relay League (ARRL) and the Southern Baptist Disaster Relief Group have together launched a D-STAR technology project. This aggressive project is using D-STAR as part of the Disaster Relief package. Internet access, digital data, automatic ID and position coordinates are just a few of the enhanced capabilities provided in disaster relief operations. Alabama is a leader in D-STAR systems, infrastructure, users and activity. Innovation, networks, applications, tools, training, users, and emergency disaster readiness are essential parts of the Alabama project. The team provides expertise to help amateur operators in the Hurricane zone, before the next disaster.

Responder Kit Equipment

IC-V82/U82

DIGITAL OPTIONAL WITH UT-118 DV

- 7W output power (IC-V82)
- 5W output power (IC-U82)
- 200 memory channels



IC-91A/AD

ADVANCED ANALOG & DIGITAL DUAL BANDER DV

- 5W (typ.) output power (VHF/UHF)
- V/V, U/U dual watch receive capability
- Optional PC remote control software



ID-800H

2M DUAL BANDER DV

- 55/50W output power (VHF/UHF)
- Wideband receiver
- Detachable front panel



IC-2820H

GO DIGITAL ON 2m & 70cm

UT-123

GPS MODULE AND ANTENNA DV

- 50W output power (VHF/UHF)
- Wideband receiver with V/V, U/U dual watch capability
- D-STAR + GPS receiver capability (UT-123 required)



IC-2200H

DIGITAL UPGRADEABLE FOR 2m DV

- 65W output power
- 207 memory channels
- Simple operation



ID-1

GO DIGITAL ON 1.2GHz DV

- Analog, DV & DD modes available
- PC remote control software included
- Separate remote controller and speaker



Frequently held myths and questions asked...

D-STAR Myths

“D-STAR only works on 1.2 GHz.”

Low-speed DV D-STAR voice and data works fine at 144 and 440 MHz. 1.2 GHz supports the bandwidth needs of high-speed DD data. Choose the technology that meets your needs.

“There’s no difference between D-STAR and packet.”

Even D-STAR’s lowest speed is competitive with the highest-performance packet systems available. (See page 7 for detailed comparisons.) D-STAR’s simultaneous digital voice and data is beyond the capability of any packet technology. High-speed D-STAR systems are ten times faster than the highest packet speeds.

“D-STAR is no different from IRLP or EchoLink®.”

All three use the Internet, but the similarities end there. The crucial differences are two-fold. D-STAR systems provide data transmission at up to 128kbps. IRLP and EchoLink do not transfer data at all. D-STAR routes transmissions from repeater to repeater based on the call signs included in every data packet. Both IRLP and EchoLink utilize site routing. This is where users must know the repeater information of where they want to talk. D-STAR can use both Site and User routing. User routing is where you use an individual’s call sign and the system will route the call based on the last location the call sign was heard.

“D-STAR is just a digital party line!”

The ability of D-STAR repeaters to route data and digitized voice worldwide sets it apart from a simple party line. Sophisticated D-STAR controllers and gateways implement modern telecommunications functions in an amateur package.

“D-STAR is a replacement for broadband home Internet.”

D-STAR can connect a user to the Internet, true, but all of the amateur radio restrictions on commercial activity still remain in place. D-STAR will provide the tools for a lot of great amateur innovation, but it’s not intended to replace Internet providers.

“I’ll be locked into Icom equipment forever.”

While Icom is the first to implement the JARL’s D-STAR protocol, any manufacturer can implement this protocol. As the D-STAR technology grows, look for other manufacturers to implement this protocol into their products.

D-STAR Q & A

How do I get started?

To learn more about amateur radio, or to find a club in your area, contact the American Radio Relay League (ARRL.org). Most amateur radio operators will welcome the chance to discuss emergency communications.

What does D-STAR stand for?

The “D-STAR” stands for Digital Smart Technologies for Amateur Radio. It is an open protocol digital communication established by the JARL.

Who can use D-STAR equipment?

Any ham station requires a licensed operator to act as controller. With a controller present at all times and managing the equipment, anyone may use the amateur airwaves.

Who owns and maintains the system?

While anyone may purchase the D-STAR equipment, by law it takes an amateur radio operator (ham) to transmit. Hams may purchase D-STAR equipment in cooperation with local or state agencies.

What range will the system offer (footprint)?

Range always varies due to terrain and antenna height, but 20-40 miles* from the repeater is normal. Due to digital technology, benefits of up to 20% have been experienced over comparable analog systems.

*20-40 miles is a best case measurement, distances will vary based on frequency used and other terrain obstacles. (23cm can easily be only 2-3 miles based on topography)

Does D-STAR tie-in with P25 interoperability?

D-STAR and P25 are both digital protocols, this is the only similarity between the two protocols and are not compatible protocols. D-STAR compliments agency interoperability. But D-STAR is not compatible with P25 mode communications.

As a collective group, amateur radio operators control the direction of the hobby and its relevance (and service) in today’s world. Get involved! For more information on D-STAR, visit the D-STAR forums pages on www.icomamerica.com/support/forums, check out www.dstarusers.org/solutions, and, most of all, bring it up at your next ham club meeting!

***For free literature: 425.450.6088
or www.icomamerica.com***