D-STAR | welcome to the D-STAR academy

New Mexico D-STAR Academy
February 18, 2012

New Mexico D-STAR Academy

Welcome!

- **Sponsors:**
  - Sandia National Laboratories ARC, Los Alamos D-STAR Repeater Association, Tech Amateur Radio Association, Upper Rio FM Society
- **Special thanks to:**
  - New Mexico Tech, Dave Johnson KB5YIW, Colorado Council of Amateur Radio Clubs, ARRL, Georgia D-STAR, John Davis WB4QDX, Icom America, Pat Mileshosky W5RMY, Carol James N5ZYP, Kathy James KE5WKW, Mike Pendley K5ATM
- **Generous prize donors:**
  - MoenComm – Star*Board GMSK Node Adapter hot spot
  - Nifty EZ Guide – Nifty E-Z Guide to D-STAR Operation (2 copies)
  - ARRL – $100 worth of gift certificates

New Mexico D-STAR Academy

Purpose of this event

- **Many-fold:**
  - Provide an introduction to D-STAR to those curious about it
  - Cut through common misunderstandings and rumor; provide real information so hams can make informed decisions
  - Advance the knowledge of our growing D-STAR community
  - Demonstrate new applications that leverage this technology
  - Get our creative juices flowing
  - Meet new friends; forge new relationships
  - Have fun

- **What this event won't do**
  - Dive deep into communication theory
  - Claim that D-STAR is the end-all, be-all of ham radio technologies
    - However…it is another great tool in the toolbox, a great source of fun, and a great mechanism for innovation within ham radio

Housekeeping Items

- **Restrooms and Water fountains**
  - **Located down the hallways at the east and west ends of building**
- **In case of emergency…**
- **Lunch**
  - **Will be served at around 11:00am in parallel with interesting High Speed 1200 MHz Applications presentation and demo**
- **Courtesies**
  - **Please turn your HTs off**
  - **Please put phone into vibrate mode; answer calls *outside* of room**
  - **Please keep any side-discussion at a whisper, or step outside**

Prize Drawing Policy

- One ticket provided to each attendee
- Prize drawing to be held at end of Academy
- Must be present at time ticket is drawn to win
- Name/callsign/ticket number will be announced two times; if not present, ticket will be placed back into bucket and another will be drawn
- Winner's name and callsign will be included in Academy's thank you letter to prize donor

Agenda

8:00-8:55am	Welcome, D-STAR introduction and background
9:00-9:55am	Linking, functions, and memories
10:00-10:55am	Third party hardware and software, demo
11:00-11:55am	Working lunch, High speed 1200 MHz applications, demo
12:00-12:55pm	D-STAR and Emergency Communications
1:00-1:55pm	Hardware and software brainstorm session
2:00-2:55pm	Ins and outs of repeater maintenance
3:00-3:55pm	Overflow, other topics, prize drawing, wrap-up

D-STAR | ham radio's latest shot in the arm

Brian Mileshosky N5ZGT

New Mexico D-STAR Academy
February 18, 2012

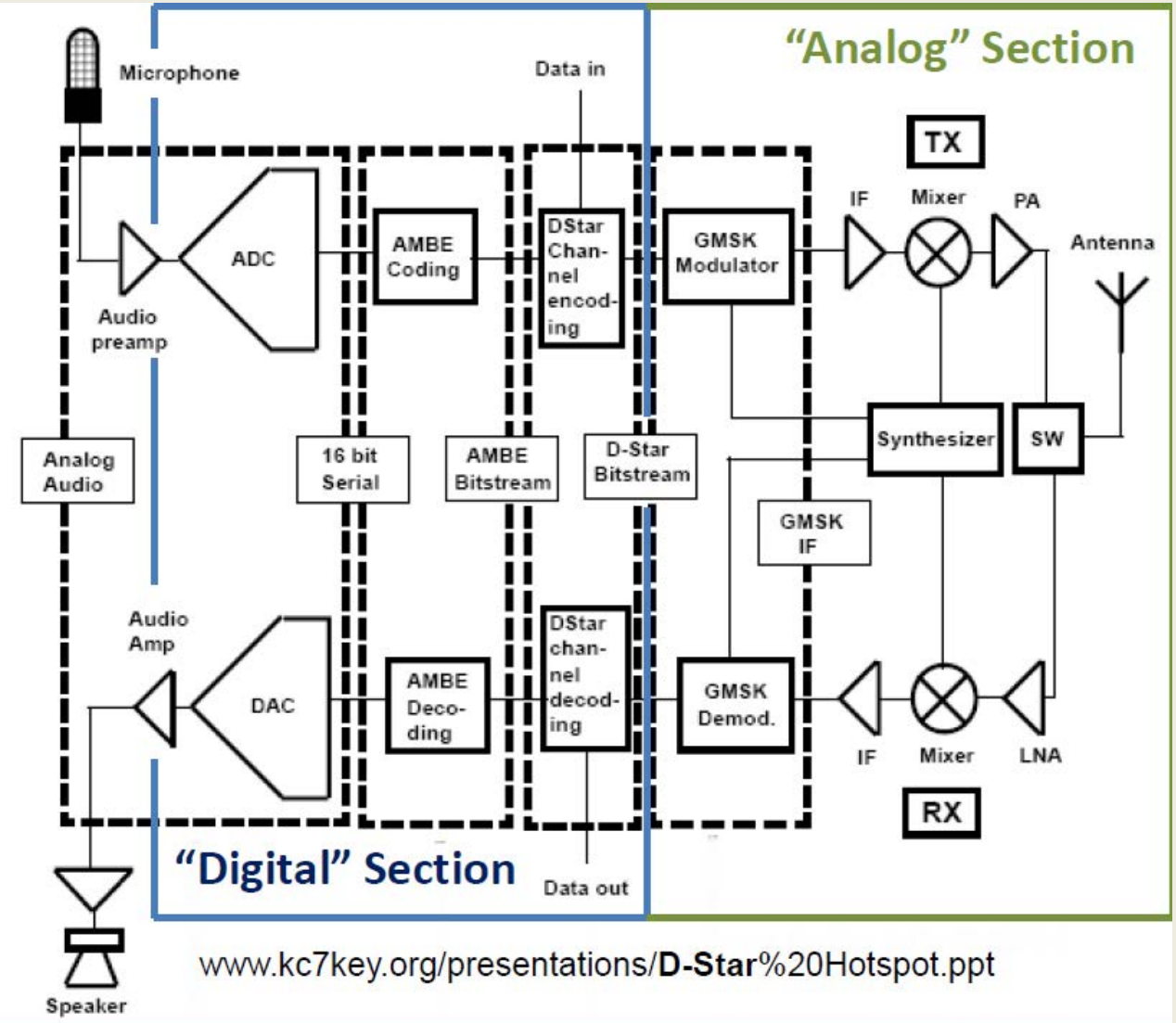
D-STAR: What is it?

- D-STAR = Digital Smart Technology for Amateur Radio
- Developed by Japanese Amateur Radio League (JARL), published in 2001
- Digital protocol – data and voice transmitted simultaneously
- Designed specifically for amateur radio use
- Normal on-air bit rate: 4800 bits/sec
- Higher bit rate available on 1200 MHz: 128 kb/sec
- Modulation types supported
  - GMSK
  - QPSK
  - 4FSK
- Protocol is wide open despite rumors to the contrary
  - www.jarl.com/d-star/shogen.pdf

D-STAR: What is it?

- AMBE vocoder chip is licensed, like many under the hood of any ham radio
  - Can be purchased by anybody for a mere $25
- Icom began producing D-STAR capable radios in 2004
- Kenwood also selling D-STAR radios (overseas)
- Numerous third-party hardware and software solutions exist or are being developed by hams
  - Hence the “Ham radio’s latest shot in the arm” description
  - More on this later…

D-STAR: What is it?



The Myths…

"D-STAR depends on the Internet"

The D-STAR technology has many features and capabilities with its ability to transmit voice and data communications. D-STAR systems can connect to the Internet to link repeaters and provide wireless access to the Internet. If an Internet-connected system loses its connectivity, all of the voice and data features of D-STAR are *still* available within the coverage area of the local repeater. Should the *repeater* fail, the same features are available in simplex mode. This is similar to FM communications, but the additional features of D-STAR are available with every transmission.

"D-STAR is too complicated"

Just like any new mode or any new radio, there are differences that must be understood. Operating a D-STAR radio has the same things that are required for any QSO. You must set the frequency, offset and split to access another person or repeater. D-STAR involves three additional parameters (UR, RPT1 and RPT2). Understanding these parameters is quite simple. There are documents available (including this NM D-STAR Academy presentation) that fully explain these parameters and make understanding them easy. To make things even easier, the latest handheld D-STAR radio (Icom ID-31) has a built-in GPS and on-board database of every D-STAR repeater in the world. The radio automatically lists the closest repeaters based on its GPS location, and pre-configures these parameters automatically for you. Just press the PTT button and start talking.

The Myths…

"D-STAR is proprietary"

D-STAR is an open standard developed by the Japan Amateur Radio League (JARL). Anyone or any manufacturer may develop equipment using the standard. The only proprietary component of D-STAR is the AMBE vocoder chip from DVSI ($25, and in stock for anyone to buy, even in low quantity). The AMBE vocoder was chosen because DVSI is the leader in voice coding technology. The DVSI family of chips is used in every major digital system worldwide including D-STAR, P25, MotoTRBO and AOR. The alternative to using the AMBE chip would be to develop a software vocoder (an effort that is currently underway) which would require much more processing power in the radio (resulting in shorter battery life) and may not provide the quality as the commercially available chip.

"Icom is the only equipment manufacturer"

At the present time, Icom is the first major Amateur Radio equipment manufacturer to develop equipment for D-STAR. In years past, Alinco developed a digital handheld radio, but it was based on a proprietary standard and only the handheld radios were available. Icom chose to produce a family of mobile and handheld radios based on an open standard. In addition, Icom developed repeaters to support the full capabilities of D-STAR. Kenwood D-STAR radios have been sold overseas. With D-STAR's open technology, numerous other manufacturers have developed hardware and software solutions for D-STAR including the DV Dongle from Internet Labs and DV adapter boards from various manufacturers for making analog FM radios D-STAR capable for hotspots and repeaters.

The Myths…

"D-STAR equipment is too expensive"

Most D-STAR radios are more expensive than their analog-only counterparts, but as with all new technologies economics is pushing that price down. D-STAR radios also operate in both analog FM and D-STAR modes. In addition, radios for the 2m, 70cm and 23cm bands operate voice and low speed (1200 baud) data in the same radio without an external TNC. Every transmission includes both voice and data allowing applications such as geolocation (position reporting) and short messaging or data-only transmissions for messaging, file transfer and other data applications. To duplicate the capabilities of one D-STAR radio, one would require two analog radios and a TNC. Newer D-STAR radios are available at lower prices more closely in line with their equivalent FM counterparts.

"D-STAR signals don't go as far as analog FM signals"

Digital signals do behave differently than analog FM signals, but under most conditions are comparable in range. With FM signals, as the distance between stations increases, static and noise gradually increase until the other station is unreadable. In digital modes, the voice quality stays the same as the distance increases and the signal strength degrades. However, the voice quality does not degrade until the signal is so weak that the signal cannot be decoded and the user hears garbling (or "R2D2" as D-STAR users say) or no voice at all. Typically, this occurs at the same point the FM signal becomes unreadable. A superb comparison between the sensitivity of a D-STAR signal versus the sensitivity of an analog FM signal, including measured data, has been published in the TAPR Status Register (see pages 4 and 5 of http://www.tapr.org/psr/psr105.pdf).

The Myths…

“D-STAR voice quality is bad”

All low bit rate speech encoding used in digital systems, even cell phones, can sound slightly different than analog voice. Some say it has a tendency to sound “mechanical” as it does not translate the full range of speech frequencies and levels. However, digital technologies produce a clear and consistent voice quality that the ear becomes accustomed to. This becomes very evident in listening multiple stations on simplex, repeaters or linked repeater networks. Everyone has the same consistent, clear voice quality whether local or around the world.

“D-STAR data does not have error correction”

On D-STAR, the voice portion of the signal employs Forward Error Correction (FEC) to faithfully reconstruct the voice packets in fading and weak signal conditions experiencing packet loss. The 1200 baud data does not use Forward Error Correction in the transmitted packets. However, most data applications, such as D-RATS, use error correction techniques within the software to faithfully reproduce the data. Packet retransmission similar to AX.25 Packet Radio systems is typically used.

“D-STAR will never replace FM”

This probably true just as SSB and FM have not replaced AM. D-STAR and other digital modes are another mode available on Amateur Radio. Most Amateurs involved in Emergency Communications utilize multiple modes and technologies depending on the situation and requirements. D-STAR brings new digital capabilities to Amateur Radio to explore and utilize. Not everyone will use every mode, but it’s “another tool in the toolbox”.

The Myths…

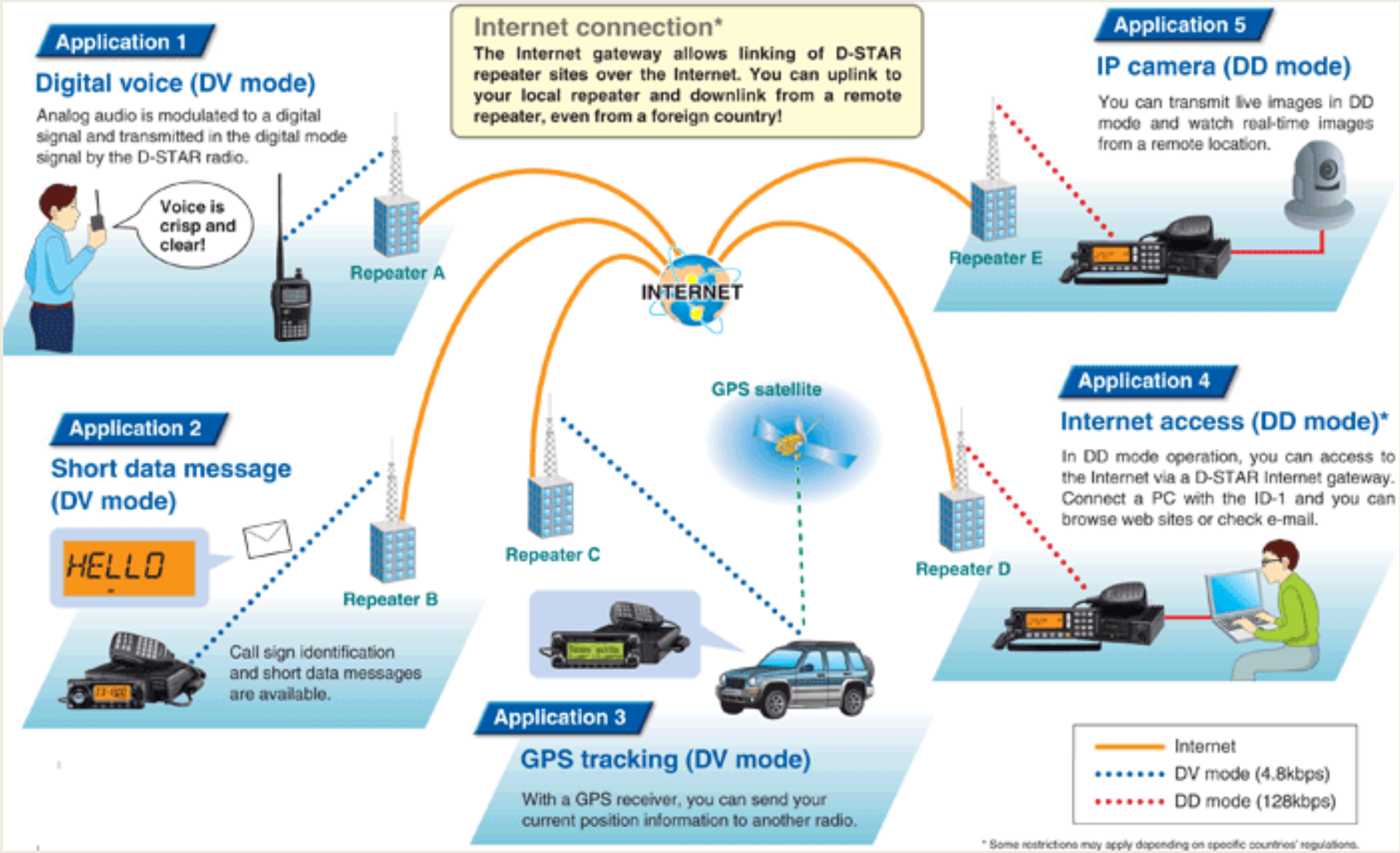
"D-STAR is a fad"

D-STAR is still considered a relatively new technology at less than a decade old. However, it has experienced significant growth in the number of users worldwide and the number of repeater systems on the air. Presently, there are over 20,000 D-STAR users and over 1,500 repeaters with over half in the United States. While it can be argued that analog FM activity is showing signs of stagnation or is perhaps declining, the D-STAR user and repeater base continue to grow.

D-STAR: Why?

- It's fun and interesting
- It's a shot in the arm for ham radio
- It's an enabling technology for improved emergency communications
- It enables both voice and data communications at the same time
- It enables linking of systems worldwide
  - With consistent audio quality (unlike Echolink and IRLP)
- It's narrowband
  - 6.25 kHz bandwidth vs. 15 kHz that analog systems consume
  - Spectrum efficient

D-STAR: What can I do with it?



(Definitely not an exclusive list…)

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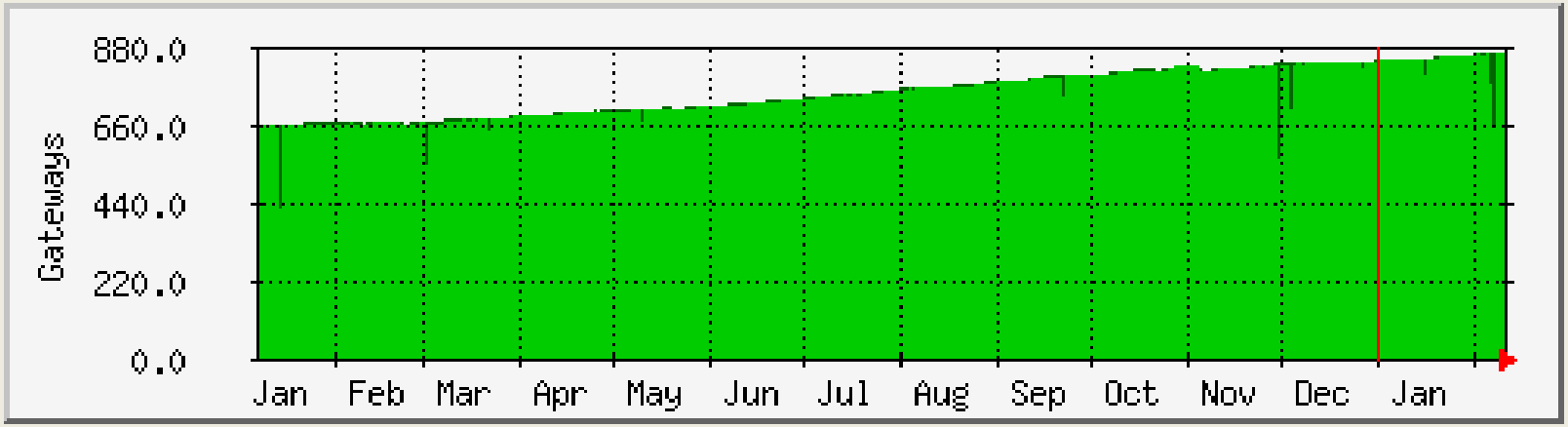
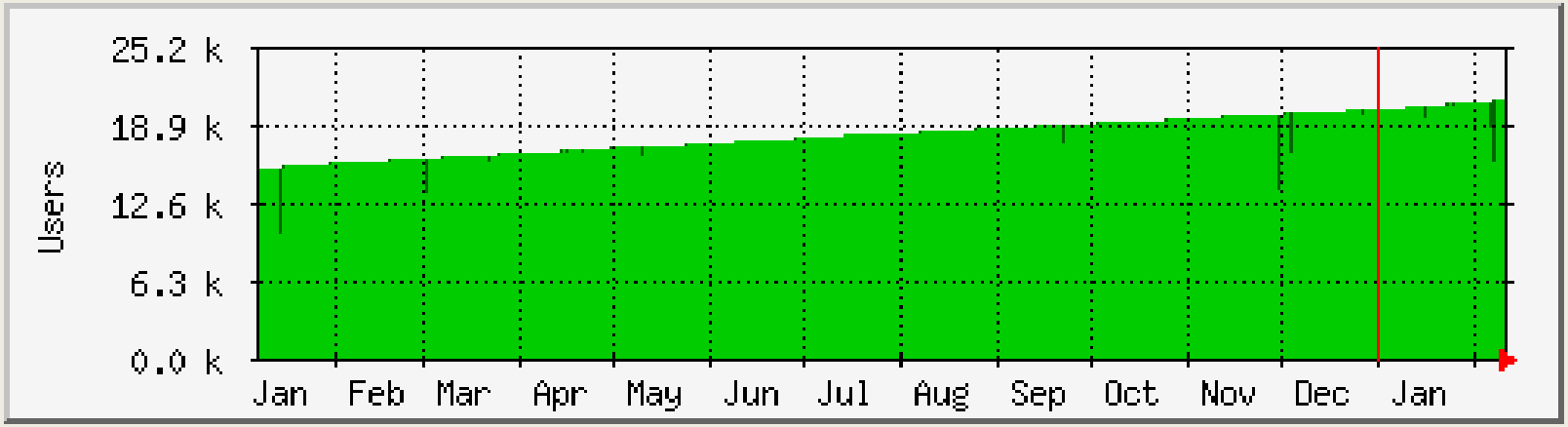
D-STAR Continues to Grow

Growth of fully-functional D-STAR systems (Feb 2011-Feb 2012)



- Each "system" can contain up to four operational RF modules (2m, 70cm, 1200 MHz voice, 1200 MHz HS data)

Growth of registered D-STAR users (Feb 2011-Feb 2012)



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D-STAR in New Mexico

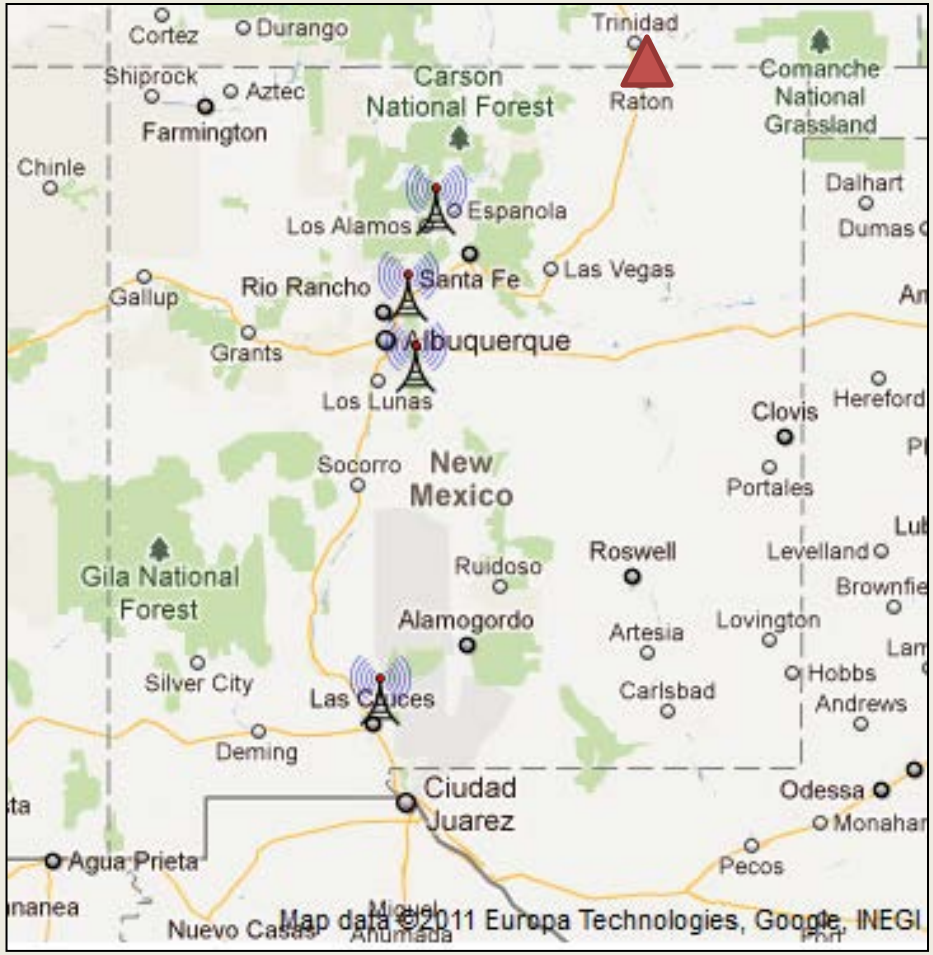
- **Approx 70% of NM ham community blanketed by D-STAR coverage**
- **Four repeaters active and on the air**
  - **Los Alamos – NM5WR, Los Alamos D-STAR Repeater Association**
  - **Sandia Crest – W5MPZ, Sandia National Laboratories ARC**
  - **Capilla Peak – W5URD, Upper Rio FM Society**
  - **Las Cruces – W5GB, NM State University ARC / Mesilla Valley Radio Club**

D-STAR in New Mexico

- **Approx 70% of NM ham community blanketed by D-STAR coverage**
- **Four repeaters active and on the air**
  - **Los Alamos – 442.425 MHz, NM5WR module B**
  - **Sandia Crest – 443.80 MHz, W5MPZ module B**
  - **Capilla Peak – 444.525 MHz, W5URD module B**
  - **Las Cruces – 146.84 MHz, W5GB module C**

D-STAR in New Mexico

- **At least one new repeater on the way!**
  - **Raton Pass (to be fielded in spring by the Cheyenne Mountain Repeater Group)**
  - **Two other NM clubs also in various stages of pursuing/fielding repeaters**



How Can I Get Started?

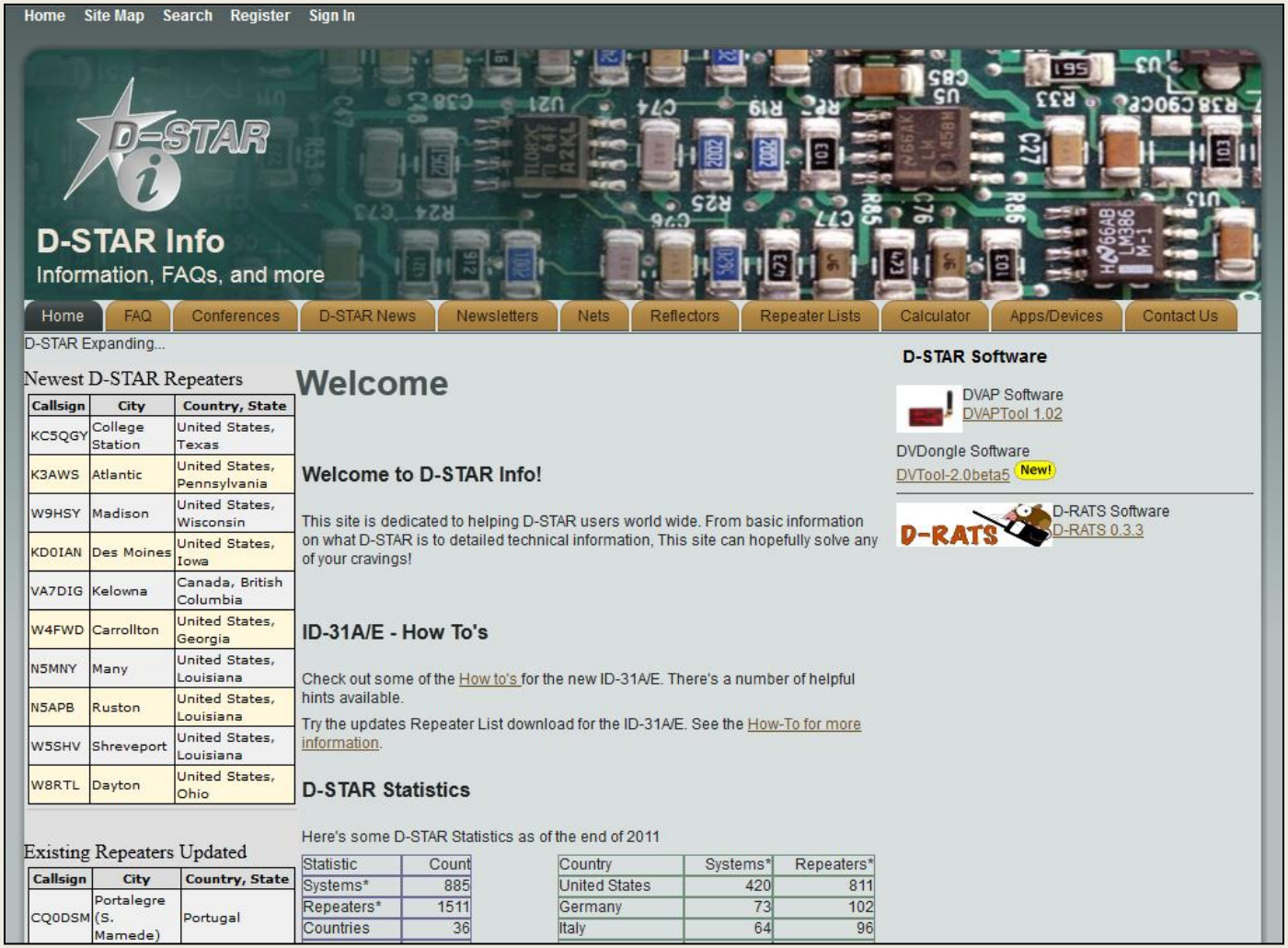
- You've taken a great step by attending this Academy
- Purchase/borrow a D-STAR radio or DV Dongle
- Register on the world-wide D-STAR network
  - Visit www.dstargateway.org/D-Star_Registration.html for general registration overview
  - Look up your nearby repeaters at DSTARInfo.com or DSTARUsers.org, and follow the link to that repeater's registration page
  - Follow instructions as explained in overview above
  - *NOTE*: Only register on **ONE** repeater. Once registered, you can fully utilize any D-STAR repeater in world.
- Learn how to use your radio or DV Dongle; ask for help if necessary
- Get on the air, don't be afraid to make mistakes, learn, and Have Fun!

D-STAR Information Resources

- **New Mexico D-STAR listserve (NM-DSTAR)**
  - A state-wide resource for collaboration, Q&A, upcoming activities, etc.
  - 80+ hams subscribed across New Mexico
    - Prospective and curious users
    - Current users
    - All of New Mexico's D-STAR repeater admins
    - ARES members/leaders
    - New Mexico's frequency coordinator chairman
  - Visit http://groups.yahoo.com/group/nm-dstar
  - Or…simply Google "nm-dstar"

D-STAR Information Resources

D-STAR Info (www.dstarinfo.com)



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D-STAR Information Resources

D-STAR Users (www.dstarusers.org)

D-STARusers.org

Your Source for D-Star DIGITAL Information!

Current Time is 02/12/2012 19:01:30 UTC [Click here to disable refresh]

Home
Last Heard
JFindU D-Star Maps
Repeater Directory
D-Star Solutions
Watch D-Star Grow
Forums
Updated Site
Joining The Network (Now Automated) (Updated 01/10/2012
Japan D-Star Repeaters
NEW App for Iphones
Updated Site
Nifty E-Z Guide to D-STAR Operation
The first published book on D-Star!
AdChoices
FCC Narrowbanding
Free webinar from EWA, BearCom, and Motorola! Step-by-step guidelines.
www.Narrowbanding.com

Callsign	Time Heard	Reporting Node	360 Unique callsigns heard in the last hour
AB9DO	02/12/12 19:05:54 UTC	KC9OKW B 440 MHz	Lake County, IL, USA
W8JXH	02/12/12 19:01:30 UTC	W8ZX A 1.2GHz	Stone Creek , OH, USA
K9QZI	02/12/12 19:01:29 UTC	W4DOC B 440 MHz	Atlanta, GA, USA
KA9ZYL	02/12/12 19:01:27 UTC	W9ICE C 2 Meters	Indianapolis, IN, USA
EA7AEB	02/12/12 19:01:26 UTC	ED7ZAD B 440 MHz	Cordoba, Spain
MM6BFH	02/12/12 19:01:25 UTC	REF001 C 2 Meters DVD	Aurora, Illinios, USA
VE2BHH	02/12/12 19:01:24 UTC	VE2RM B 440 MHz	Rigaud Mountain, Quebec, Canada
N1JMM P	02/12/12 19:01:20 UTC	K1DIG C 2 Meters DVD	East Hampton, CT, USA
N6WY	02/12/12 19:01:19 UTC	K8DXA B 440 MHz	Auburn Hills, MI, USA
SP9ACQ	02/12/12 19:01:17 UTC	SR9UVM B 440 MHz	Krakow / Choragwica, Malopolskie, Poland
IK0YYY	02/12/12 19:01:17 UTC	IR0MA B 440 MHz	Roma, Lazio, Italy
KD4NOQ	02/12/12 19:01:16 UTC	W4LET B 440 MHz	MEMPHIS, TN, USA
EA3FHB	02/12/12 19:01:15 UTC	EA3RCC B 440 MHz DVD	Castellar del Valls, Barcelona JN11BO, Spain
SM3DYE	02/12/12 19:01:15 UTC	REF043 Dongle User DVD	Unknown
M6ALM	02/12/12 19:01:15 UTC	REF001 C 2 Meters DVD	Aurora, Illinios, USA
SG3BDF	02/12/12 19:01:10 UTC	REF031 Dongle User DVD	Unknown
ZL2ARN	02/12/12 19:01:09 UTC	ZL2VH C 2 Meters	Upper Hutt, Wellington, New Zealand
W1AW	02/12/12 19:01:04 UTC	W1HQ A 1.2GHz	Newington, Connecticut, USA
M5GHT	02/12/12 19:01:04 UTC	GB7NE Dongle User DVD	Ashington, Nothumberland, UK
WD5GIC I	02/12/12 19:01:00 UTC	K1DRP A 1.2GHz	Granbury, Tx, USA
N1OTW	02/12/12 19:00:59 UTC	K1DIG C 2 Meters DVD	East Hampton, CT, USA
N3KDA D	02/12/12 19:00:59 UTC	K3PDR Dongle User DVD	Philadelphia, PA, USA
OE8WLK	02/12/12 19:00:49 UTC	OE8XKK C 2 Meters	Keutschach, Austria
SV4NLX	02/12/12 19:00:48 UTC	SV4J B 440 MHz	Volos - Mt. Pilio, R.A.C.M., Greece
W9DLK	02/12/12 19:00:41 UTC	W9ICE C 2 Meters	Indianapolis, IN, USA
HB9DNX	02/12/12 19:00:41 UTC	HB9AW C 2 Meters	Willisau (Twerenegg), LU, Switzerland
AC7II	02/12/12 19:00:39 UTC	NU7TS Dongle User DVD	Wellsville, UT, USA
KJ1Q	02/12/12 19:00:39 UTC	K1DIG C 2 Meters DVD	East Hampton, CT, USA
OE8HJK	02/12/12 19:00:38 UTC	OE8XKK C 2 Meters	Keutschach, Austria
SM6KYP	02/12/12 19:00:36 UTC	SK7MQ B 440 MHz	Glumslöv, Skåne, Sweden

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D-STAR Information Resources

- **D-STAR Repeater Lists**
  - http://www.dstarinfo.com/repeater-lists.aspx
  - http://dstarusers.org/repeaters.php

- **D-STAR Nets**
  - Open to any ham from anywhere
  - Feel free to link your local repeater to these nets so you can participate
  - http://www.dstarinfo.com/nets.aspx
  - A very neat net: http://www.dstarinfo.com/se-d-star-wx-net.aspx

- **D-STAR Reflectors**
  - Open to any ham from anywhere
  - Feel free to link your local repeater to any of these to have fun
  - http://www.dstarinfo.com/reflectors.aspx

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D-STAR | linking, functions, and memories

Brian Mileshosky N5ZGT

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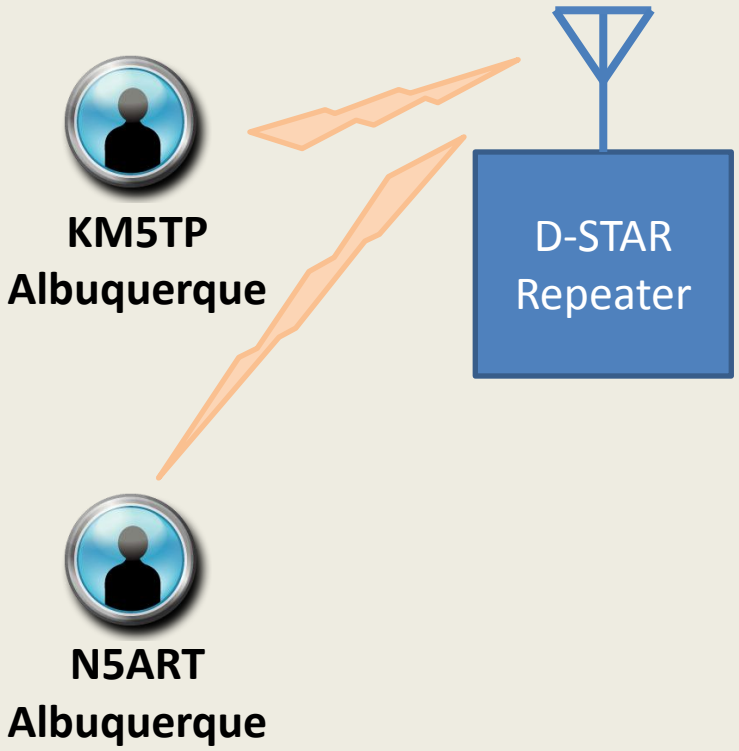
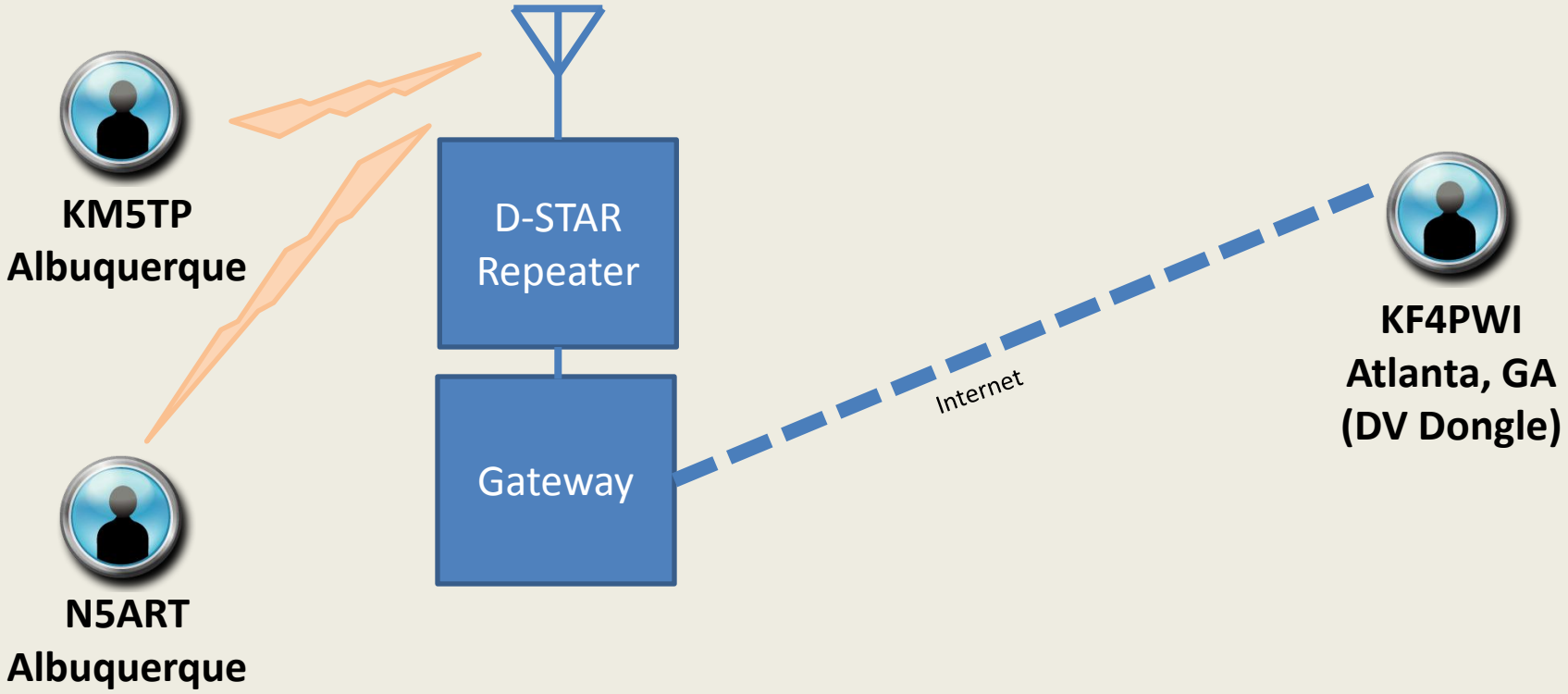
What Can I Do?

- **Talk with someone local via your D-STAR Repeater**



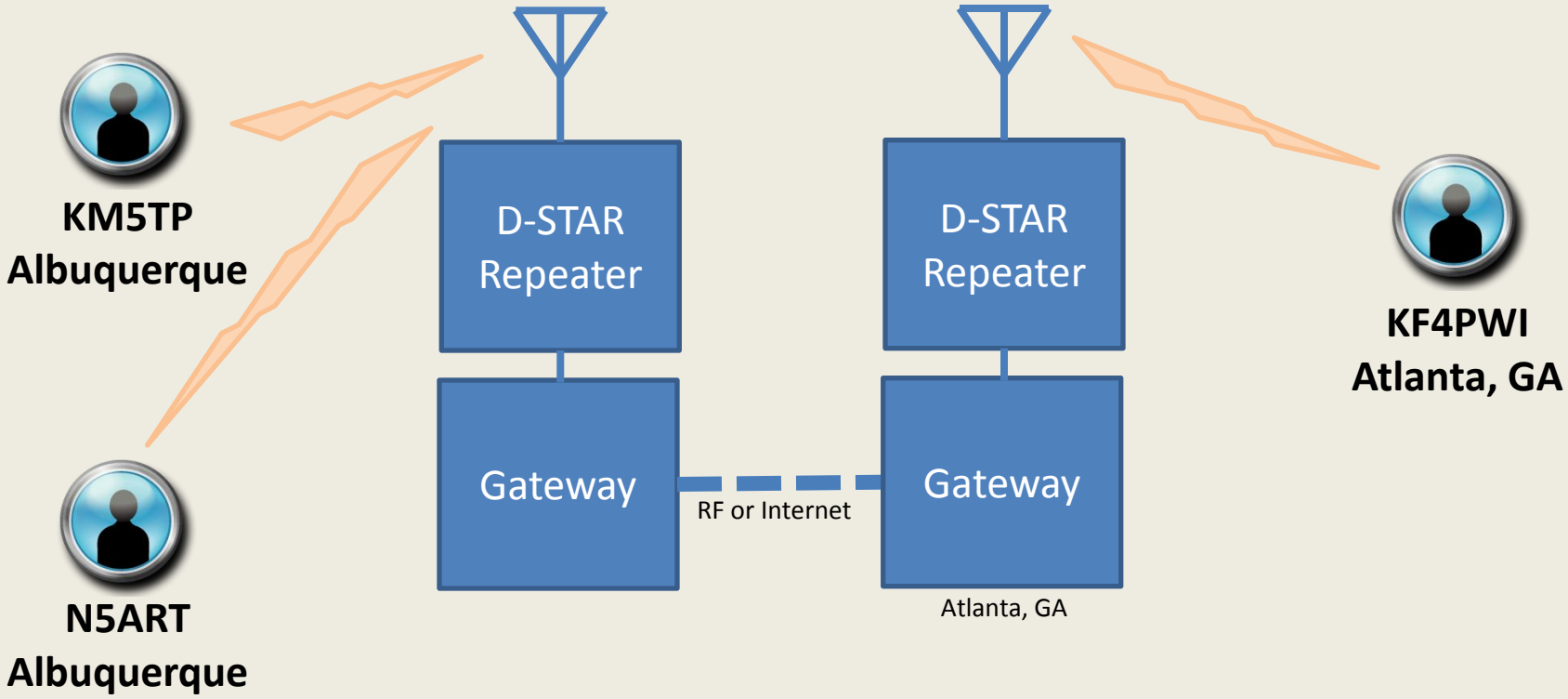
What Can I Do?

- **Talk with someone local and elsewhere in world via your local D-STAR repeater and gateway**



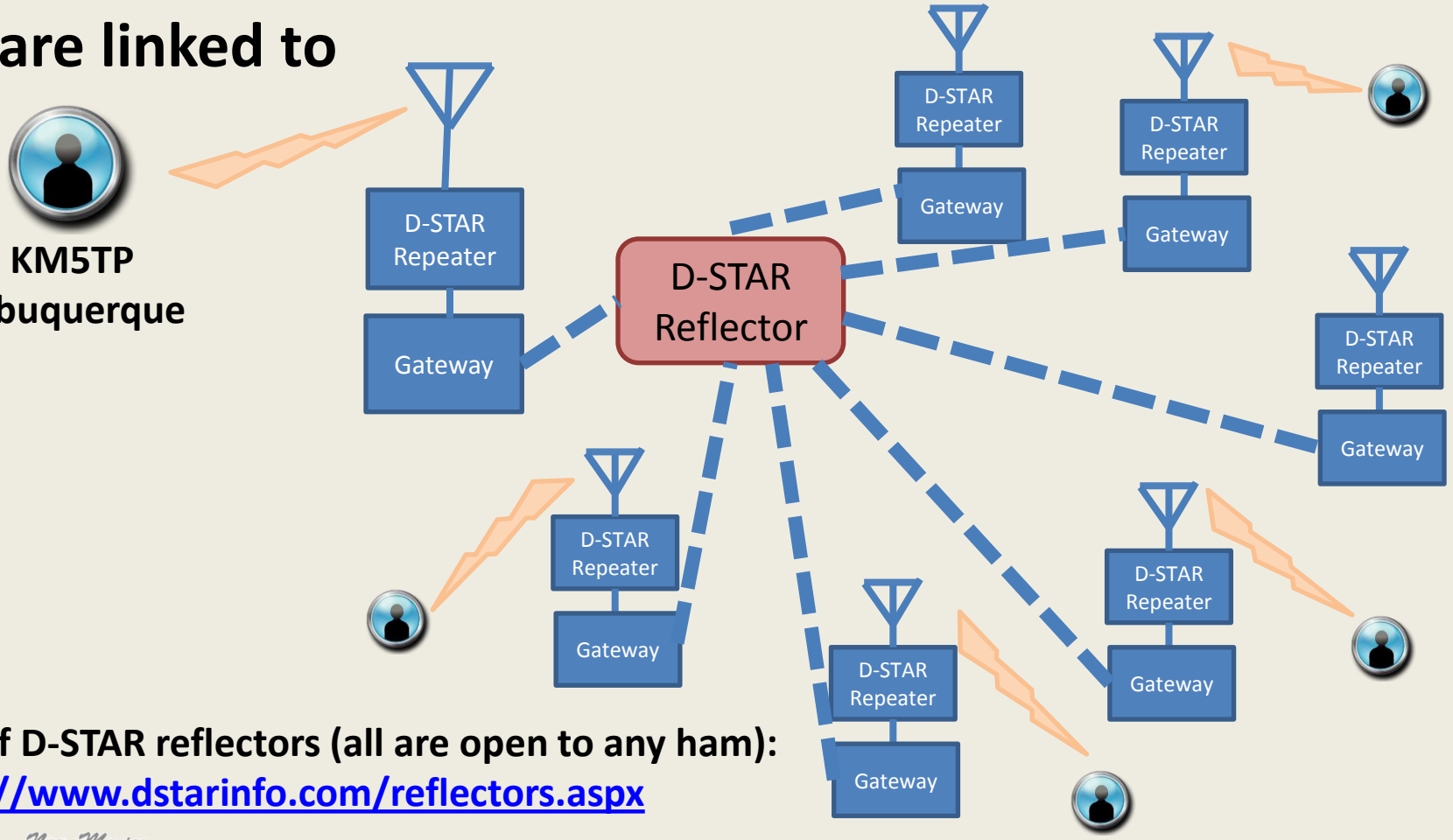
What Can I Do?

- **Link your local D-STAR repeater to another repeater in the world and talk with a friend**



What Can I Do?

- **Link your local D-STAR repeater to a Reflector, which numerous D-STAR repeaters around nation and world are linked to**



List of D-STAR reflectors (all are open to any ham):
http://www.dstarinfo.com/reflectors.aspx

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Setting up your Analog FM Radio

- **Set the Frequency**
- **Set the Repeater offset**
- **Set the PL/CTCSS tone**
  - **If you don't know the repeater's tone, you may be out of luck…**

Setting up your D-STAR Radio: Option 1

- **Set the Frequency**
- **Set the Repeater offset**
- **Set Mode to DV (Digital Voice)**
- **Simply kerchunk the repeater. That's it.**
  - **If you have the "RPT W" command turned on, the repeater will automatically program itself within your D-STAR radio**

When Auto Repeater callsign write command ("RPT W") is enabled, the repeater's signal will automatically populate RPT1 and RPT2 in your radio.

Command name for various Icom radios (Default setting is *OFF*; consult your manual):

IC-91AD	RXRPT WRITE
IC-80AD	RPT W
IC-92AD	RXRPT WRITE
ID-880H	RPT W
IC-2820H	RXRPT WRITE
IC-9100	RXRPT WRITE

Setting up your D-STAR Radio: Option 2

This option is a bit more involved, but you'll do yourself a huge favor by learning it and practicing it so you'll remember how to manipulate your radio in an emergency, if you're caught without its manual, are using somebody else's radio, etc.

- **Set the Frequency**
- **Set the Repeater offset**
- **Set Mode to DV (Digital Voice)**
- **Set your callsign into "MY" field**
- **Put "CQCQCQ" into "UR" field**
- **Set repeater callsign into "RPT1" and "RPT2" fields**
  - **In last character (8th) of the RPT1, place repeater module (A, B, or C)**
  - **In last character (8th) of the RPT2, place "G"**

The Key to Mastering D-STAR

MY

UR

RPT1

RPT2

Simply learn about these four parameters, and D-STAR will become second nature.

New Mexico D-STAR Academy

D-STAR Module Lettering Standard

- **A = 1200 MHz voice**
- **B = 440 MHz voice**
- **C = 144 MHz voice**

This standard is used worldwide except, for some cases, in Japan.

Example: To key up / talk on repeater

W5MPZ repeater (443.8 MHz, +5 MHz offset)

- **MY N5ZGT**
- **UR CQCQCQ**
- **RPT1 W5MPZ▪▪B**
- **RPT2 W5MPZ▪▪G**

Always in 8th character position

Each " ▪ " represents a space

Using DPLUS Features on Repeater

DPLUS is a program developed by Robin Cutshaw, AA4RC, which adds linking functions and the use of DV Dongles and DV Access Points to D-STAR. DPLUS is active on most gateway-equipped repeaters.

Functions available with DPLUS

- **G – Gateway**
- **E – Echo Test**
- **I – Identification**
- **L – Link Repeater**
- **U – Unlink Repeater**

Example: Echo Test

W5MPZ repeater (443.8 MHz, +5 MHz offset)

- **MY N5ZGT**
- **UR ▪▪▪▪▪▪▪E**
- **RPT1 W5MPZ▪▪B**
- **RPT2 W5MPZ▪▪G**

Each " ▪ " represents a space

What happens: Repeater will record whatever you transmit and automatically replay it back over the air when you release your PTT button.

Example: Make Repeater Identify

W5MPZ repeater (443.8 MHz, +5 MHz offset)

- **MY N5ZGT**
- **UR ▪▪▪▪▪▪▪I**
- **RPT1 W5MPZ▪▪B**
- **RPT2 W5MPZ▪▪G**

Each " ▪ " represents a space

What happens: Repeater will respond with "Not Linked" if not linked, or "Remote System Linked" if linked, and repeater or reflector callsign displayed on radio.

Example: Link to Repeater

W5MPZ repeater (443.8 MHz, +5 MHz offset)

- **MY N5ZGT**
- **UR NM5WR▪BL**
- **RPT1 W5MPZ▪▪B**
- **RPT2 W5MPZ▪▪G**

Always in 7th and 8th character positions

Each " ▪ " represents a space

What happens: W5MPZ repeater will be linked to the 440 MHz module of the NM5WR repeater. Voice prompt: "Remote system linked"

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Example: Link to Reflector

W5MPZ repeater (443.8 MHz, +5 MHz offset)

- **MY N5ZGT**
- **UR REF030CL (Module C)**
- **RPT1 W5MPZ▪▪B**
- **RPT2 W5MPZ▪▪G**

Each " ▪ " represents a space

What happens: W5MPZ repeater will be linked to Module C of Reflector 30. Voice prompt: "Remote system linked"

New Mexico D-STAR Academy

Example: Unlink Repeater

W5MPZ repeater (443.8 MHz, +5 MHz offset)

- **MY N5ZGT**
- **UR ▪▪▪▪▪▪▪U**
- **RPT1 W5MPZ▪▪B**
- **RPT2 W5MPZ▪▪G**

Each " ▪ " represents a space

What happens: W5MPZ repeater will be unlinked from whatever repeater/reflector it's tied to. Voice prompt: "Remote system unlinked"

Interactive Practice

Scenario #1

N5ART bought his first D-STAR radio and wants to key up or talk on the W5MPZ repeater.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	?
Offset	?
Mode	?

MY	UR	RPT1	RPT2
?	?	?	?

New Mexico D-STAR Academy

Scenario #1 - Solution

N5ART bought his first D-STAR radio and wants to key up or talk on the W5MPZ repeater.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	443.800
Offset	+5.000
Mode	DV

MY	UR	RPT1	RPT2
N5ART	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G

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Scenario #2

WA5DJJ wants to test his D-STAR radio and hear his signal echoed back from the W5GB repeater.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	?
Offset	?
Mode	?

MY	UR	RPT1	RPT2
?	?	?	?

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Scenario #2 - Solution

WA5DJJ wants to test his D-STAR radio and hear his signal echoed back from the W5GB repeater.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	146.840
Offset	-0.600
Mode	DV

MY	UR	RPT1	RPT2
WA5DJJ	▪▪▪▪▪▪▪E	W5GB▪▪▪C	W5GB▪▪▪G

New Mexico D-STAR Academy

Scenario #3

W5FHA wants to link the W5URD repeater to the W5GB repeater.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	?
Offset	?
Mode	?

MY	UR	RPT1	RPT2
?	?	?	?

New Mexico D-STAR Academy

Scenario #3 - Solution

W5FHA wants to link the W5URD repeater to the W5GB repeater.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	444.525
Offset	+5.000
Mode	DV

MY	UR	RPT1	RPT2
W5FHA	W5GB▪▪CL	W5URD▪▪B	W5URD▪▪G

New Mexico D-STAR Academy

Scenario #4

N5ART wants to link the W5MPZ repeater to the National Capital Region D-STAR Association net on Reflector 25C.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	?
Offset	?
Mode	?

MY	UR	RPT1	RPT2
?	?	?	?

New Mexico D-STAR Academy

Scenario #4 - Solution

N5ART wants to link the W5MPZ repeater to the National Capital Region D-STAR Association net on Reflector 25C.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	443.800
Offset	+5.000
Mode	DV

MY	UR	RPT1	RPT2
N5ART	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G

New Mexico D-STAR Academy

Scenario #5

After a great net N5ART wants to unlink W5MPZ repeater from REF025C.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	?
Offset	?
Mode	?

MY	UR	RPT1	RPT2
?	?	?	?

New Mexico D-STAR Academy

Scenario #5 - Solution

After a great net N5ART wants to unlink W5MPZ repeater from REF025C.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	443.800
Offset	+5.000
Mode	DV

MY	UR	RPT1	RPT2
N5ART	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G

New Mexico D-STAR Academy

Scenario #6

Ed KA8JMW is on travel somewhere. AD5RB wants to call him from the NM5WR repeater, but doesn't know what repeater Ed is on.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

General Radio Settings	
Frequency	?
Offset	?
Mode	?

MY	UR	RPT1	RPT2
?	?	?	?

New Mexico D-STAR Academy

Scenario #6 - Solution

Ed KA8JMW is on travel somewhere. AD5RB wants to call him from the NM5WR repeater, but doesn't know what repeater Ed is on.

Callsign	City	Country/State	Gateway	C Module (MHz)	B Module (MHz)	A Module (MHz)	High Speed Data
NM5WR	Los Alamos	USA New Mexico	Gateway		442.4250 +5.000		
W5MPZ	Albuquerque	USA New Mexico	Gateway		443.8000 +5.000		
W5URD	Belen	USA New Mexico	Gateway		444.525 +5.000		
W5GB	Las Cruces	USA New Mexico	Gateway	146.840 -0.600			

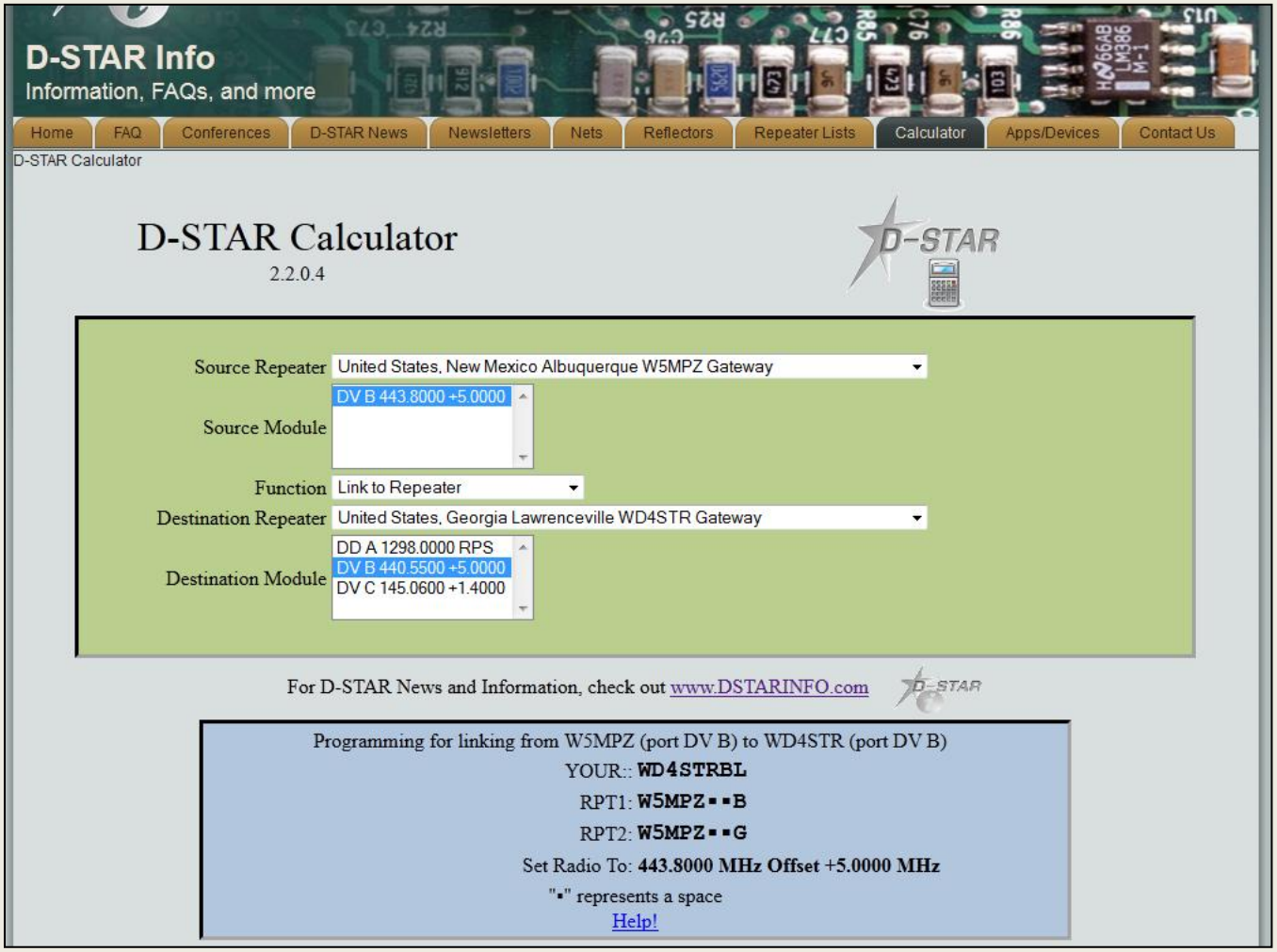
General Radio Settings	
Frequency	442.425
Offset	+5.000
Mode	DV

MY	UR	RPT1	RPT2
AD5RB	KA8JMW▪▪	NM5WR▪▪B	NM5WR▪▪G

New Mexico D-STAR Academy

Need a Hint? (*Don't use as crutch!*)

D-STAR Calculator (www.dstarinfo.com/dstar-web-calculator.aspx)



New Mexico D-STAR Academy

Organizing Your Radio's Memories

A potential source of difficulty with using D-STAR comes from *how* to store the parameters (UR, MY, RPT1, RPT2) in your radio so you don't have to manually enter them each time you want to do something on the air.

There are two ways to organize these parameters:

- **Create a memory group or "bank" for each repeater**
  - **Cumbersome, but some hams actually like this method**
- **Store various "UR" settings in radio's "UR" memories**
  - **Far easier and more straight-forward – *we recommend this approach***

The approach you decide to take is up to you.

Organizing Your Radio's Memories

Example of creating a memory group or "bank" for the W5MPZ repeater

- Note: You would need to create a similar bank for *every* additional D-STAR repeater you store in memory (NM5WR, W5URD, W5GB, etc.)

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	443.800	DUP+	5.0	DV	W5MPZ C	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
2	443.800	DUP+	5.0	DV	UNLINK	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G
3	443.800	DUP+	5.0	DV	W5MPZ ID	▪▪▪▪▪▪▪I	W5MPZ▪▪B	W5MPZ▪▪G
4	443.800	DUP+	5.0	DV	NM5WR L	NM5WR▪BL	W5MPZ▪▪B	W5MPZ▪▪G
5	443.800	DUP+	5.0	DV	W5URD L	W5URD▪BL	W5MPZ▪▪B	W5MPZ▪▪G
6	443.800	DUP+	5.0	DV	W5GB L	W5GB▪▪CL	W5MPZ▪▪B	W5MPZ▪▪G
7	443.800	DUP+	5.0	DV	REF002A L	REF002AL	W5MPZ▪▪B	W5MPZ▪▪G
8	443.800	DUP+	5.0	DV	REF025C L	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G
9	443.800	DUP+	5.0	DV	REF030C L	REF030CL	W5MPZ▪▪B	W5MPZ▪▪G
10	443.800	DUP+	5.0	DV	ECHOTEST	▪▪▪▪▪▪▪E	W5MPZ▪▪B	W5MPZ▪▪G

Organizing Your Radio's Memories

Use this channel for general QSOs

- For when you just want to pick up the mike and chat
- CQCQCQ in UR field

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	443.800	DUP+	5.0	DV	W5MPZ C	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
2	443.800	DUP+	5.0	DV	UNLINK	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G
3	443.800	DUP+	5.0	DV	W5MPZ ID	▪▪▪▪▪▪▪I	W5MPZ▪▪B	W5MPZ▪▪G
4	443.800	DUP+	5.0	DV	NM5WR L	NM5WR▪BL	W5MPZ▪▪B	W5MPZ▪▪G
5	443.800	DUP+	5.0	DV	W5URD L	W5URD▪BL	W5MPZ▪▪B	W5MPZ▪▪G
6	443.800	DUP+	5.0	DV	W5GB L	W5GB▪▪CL	W5MPZ▪▪B	W5MPZ▪▪G
7	443.800	DUP+	5.0	DV	REF002A L	REF002AL	W5MPZ▪▪B	W5MPZ▪▪G
8	443.800	DUP+	5.0	DV	REF025C L	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G
9	443.800	DUP+	5.0	DV	REF030C L	REF030CL	W5MPZ▪▪B	W5MPZ▪▪G
10	443.800	DUP+	5.0	DV	ECHOTEST	▪▪▪▪▪▪▪E	W5MPZ▪▪B	W5MPZ▪▪G

Organizing Your Radio's Memories

Use any of these channels to establish a link

- Just tune to this channel, hit and release your PTT button
- System will announce "Remote System Linked"
- Return to CQCQCQ (channel 1) to begin talking

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	443.800	DUP+	5.0	DV	W5MPZ C	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
2	443.800	DUP+	5.0	DV	UNLINK	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G
3	443.800	DUP+	5.0	DV	W5MPZ ID	▪▪▪▪▪▪▪I	W5MPZ▪▪B	W5MPZ▪▪G
4	443.800	DUP+	5.0	DV	NM5WR L	NM5WR▪BL	W5MPZ▪▪B	W5MPZ▪▪G
5	443.800	DUP+	5.0	DV	W5URD L	W5URD▪BL	W5MPZ▪▪B	W5MPZ▪▪G
6	443.800	DUP+	5.0	DV	W5GB L	W5GB▪▪CL	W5MPZ▪▪B	W5MPZ▪▪G
7	443.800	DUP+	5.0	DV	REF002A L	REF002AL	W5MPZ▪▪B	W5MPZ▪▪G
8	443.800	DUP+	5.0	DV	REF025C L	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G
9	443.800	DUP+	5.0	DV	REF030C L	REF030CL	W5MPZ▪▪B	W5MPZ▪▪G
10	443.800	DUP+	5.0	DV	ECHOTEST	▪▪▪▪▪▪▪E	W5MPZ▪▪B	W5MPZ▪▪G

Organizing Your Radio's Memories

Use this channel to unlink from repeater or reflector

- Just tune to this channel, hit and release your PTT button
- System will announce "Remote System Unlinked"
- Return to CQCQCQ (channel 1) to begin talking

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	443.800	DUP+	5.0	DV	W5MPZ C	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
2	443.800	DUP+	5.0	DV	UNLINK	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G
3	443.800	DUP+	5.0	DV	W5MPZ ID	▪▪▪▪▪▪▪I	W5MPZ▪▪B	W5MPZ▪▪G
4	443.800	DUP+	5.0	DV	NM5WR L	NM5WR▪BL	W5MPZ▪▪B	W5MPZ▪▪G
5	443.800	DUP+	5.0	DV	W5URD L	W5URD▪BL	W5MPZ▪▪B	W5MPZ▪▪G
6	443.800	DUP+	5.0	DV	W5GB L	W5GB▪▪CL	W5MPZ▪▪B	W5MPZ▪▪G
7	443.800	DUP+	5.0	DV	REF002A L	REF002AL	W5MPZ▪▪B	W5MPZ▪▪G
8	443.800	DUP+	5.0	DV	REF025C L	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G
9	443.800	DUP+	5.0	DV	REF030C L	REF030CL	W5MPZ▪▪B	W5MPZ▪▪G
10	443.800	DUP+	5.0	DV	ECHOTEST	▪▪▪▪▪▪▪E	W5MPZ▪▪B	W5MPZ▪▪G

Organizing Your Radio's Memories

Use this channel to perform echo test

- Just tune to this channel, key up repeater and say something
- System will echo back your transmission
- Return to CQCQCQ (channel 1) to begin talking

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	443.800	DUP+	5.0	DV	W5MPZ C	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
2	443.800	DUP+	5.0	DV	UNLINK	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G
3	443.800	DUP+	5.0	DV	W5MPZ ID	▪▪▪▪▪▪▪I	W5MPZ▪▪B	W5MPZ▪▪G
4	443.800	DUP+	5.0	DV	NM5WR L	NM5WR▪BL	W5MPZ▪▪B	W5MPZ▪▪G
5	443.800	DUP+	5.0	DV	W5URD L	W5URD▪BL	W5MPZ▪▪B	W5MPZ▪▪G
6	443.800	DUP+	5.0	DV	W5GB L	W5GB▪▪CL	W5MPZ▪▪B	W5MPZ▪▪G
7	443.800	DUP+	5.0	DV	REF002A L	REF002AL	W5MPZ▪▪B	W5MPZ▪▪G
8	443.800	DUP+	5.0	DV	REF025C L	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G
9	443.800	DUP+	5.0	DV	REF030C L	REF030CL	W5MPZ▪▪B	W5MPZ▪▪G
10	443.800	DUP+	5.0	DV	ECHOTEST	▪▪▪▪▪▪▪E	W5MPZ▪▪B	W5MPZ▪▪G

Organizing Your Radio's Memories

Use this channel for Repeater ID

- For when you just want to pick up the mike and chat
- Return to CQCQCQ (channel 1) to begin talking

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	443.800	DUP+	5.0	DV	W5MPZ C	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
2	443.800	DUP+	5.0	DV	UNLINK	▪▪▪▪▪▪▪U	W5MPZ▪▪B	W5MPZ▪▪G
3	443.800	DUP+	5.0	DV	W5MPZ ID	▪▪▪▪▪▪▪I	W5MPZ▪▪B	W5MPZ▪▪G
4	443.800	DUP+	5.0	DV	NM5WR L	NM5WR▪BL	W5MPZ▪▪B	W5MPZ▪▪G
5	443.800	DUP+	5.0	DV	W5URD L	W5URD▪BL	W5MPZ▪▪B	W5MPZ▪▪G
6	443.800	DUP+	5.0	DV	W5GB L	W5GB▪▪CL	W5MPZ▪▪B	W5MPZ▪▪G
7	443.800	DUP+	5.0	DV	REF002A L	REF002AL	W5MPZ▪▪B	W5MPZ▪▪G
8	443.800	DUP+	5.0	DV	REF025C L	REF025CL	W5MPZ▪▪B	W5MPZ▪▪G
9	443.800	DUP+	5.0	DV	REF030C L	REF030CL	W5MPZ▪▪B	W5MPZ▪▪G
10	443.800	DUP+	5.0	DV	ECHOTEST	▪▪▪▪▪▪▪E	W5MPZ▪▪B	W5MPZ▪▪G

Organizing Your Radio's Memories

Example of storing various "UR" settings in radio's dedicated UR memories

- A simpler and cleaner approach – *we recommend this approach*
- You'll discover that the D-STAR parameter you'll most frequently change (in order to link, unlink, etc) is "UR", so this method takes advantage of your radio's ability to tuck various UR settings into their own dedicated memories
- Permits you to store each repeater in memory only *once*, unlike previous approach
- Consult your radio's manual to learn how to save and recall UR memories

Organizing Your Radio's Memories

Example of storing various "UR" settings in radio's dedicated UR memories

- This is how you might store D-STAR repeaters into memory
- Note only one repeater per memory, unlike previous approach
- Note the default UR, RPT1, and RPT2 settings for each repeater; once you set these (particularly RPT1 and RPT2) you don't have to worry about them again

CH No	Frequency	Dup	Offset	Mode	Memory Name	UR	RPT1	RPT2
1	442.425	DUP+	5.0	DV	NM5WR	CQCQCQ	NM5WR▪▪B	NM5WR▪▪G
2	443.800	DUP+	5.0	DV	W5MPZ	CQCQCQ	W5MPZ▪▪B	W5MPZ▪▪G
3	444.525	DUP+	5.0	DV	W5URD	CQCQCQ	W5URD▪▪B	W5URD▪▪G
4	146.840	DUP-	0.6	DV	W5GB	CQCQCQ	W5GB▪▪▪C	W5GB▪▪▪G

Organizing Your Radio's Memories

Example of storing various "UR" settings in radio's dedicated UR memories

- This is how you might store the various "UR" settings into your radio's dedicated UR memories; set these up according to your preferences
- Now all you need to do is change this depending on what you want to do (link, echo test, etc), regardless of what D-STAR repeater you are using

UR Memory #	Entry
U01	CQCQCQ
U02	▪▪▪▪▪▪▪U
U03	▪▪▪▪▪▪▪I
U04	▪▪▪▪▪▪▪E
U05	NM5WR▪▪BL
U06	W5MPZ▪▪BL
U07	W5URD▪▪BL
U08	W5GB▪▪▪CL
U09	REF002AL
U10	REF025CL
U11	REF030CL

Agenda

8:00-8:55am	Welcome, D-STAR introduction and background
9:00-9:55am	Linking, functions, and memories
10:00-10:55am	Third party hardware and software, demo
11:00-11:55am	Working lunch, High speed 1200 MHz applications, demo
12:00-12:55pm	D-STAR and Emergency Communications
1:00-1:55pm	Hardware and software brainstorm session
2:00-2:55pm	Ins and outs of repeater maintenance
3:00-3:55pm	Overflow, other topics, prize drawing, wrap-up

D-STAR | third party hardware and software

Ed James KA8JMW

New Mexico D-STAR Academy
February 18, 2012

D-STAR: Lots of Development by Hams…

- **AMBE 2000 / 2020 chip available from DVSI for approximately $25**
  - **www.dvsinc.com**
  - **In stock; no lead-time**
  - **Interesting fact: The Telecommunications Industry Association (TIA) selected DVSI's vocoder as the standard for the APCO Project 25 North American land mobile radio communication system. DVSI vocoders also used in APCO-25, MotoTRBO, NXDN, DMR, and other systems**

Hams are developing numerous third-party hardware and software solutions to make D-STAR even easier, more flexible, and cheaper. Some examples follow…

DV Dongle & DV Access Point

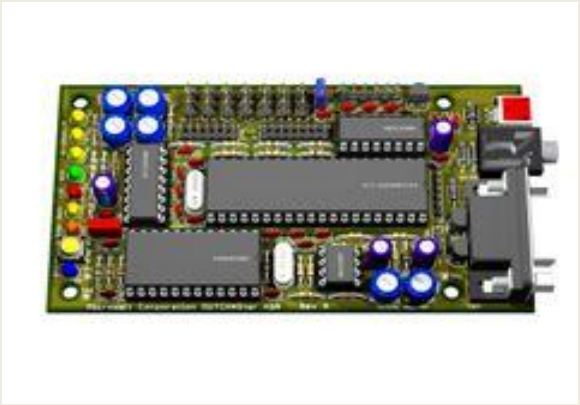
- Developed by Robin Cutshaw AA4RC
- DV Dongle (www.dvdongle.com):
  - Enables any internet-connected computer to communicate via D-STAR network
  - Can communicate on any D-STAR repeater or reflector worldwide
- DV Access Point (www.dvapdongle.com):
  - Excellent for those not located near an RF repeater
  - Turns any internet-connected computer into a short-range D-STAR "repeater"
  - Access any D-STAR repeater or reflector worldwide with your 2m D-STAR radio
  - Pout = -12 to +10 dBm (63uW to 10mW)

Demonstration

D-STAR HotSpots

The First

Dutch-Star



Fred PA4YBR's Mini Hot Spot Board:
www.dutch-star.eu

Satoshi's GMSK DV Node Adapter:
www.d-star.asia

Made in the USA

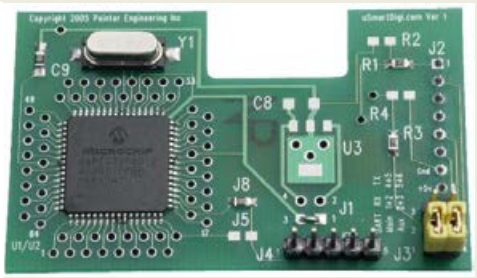
Matrix Circuits Star*Board:
www.moencomm.com

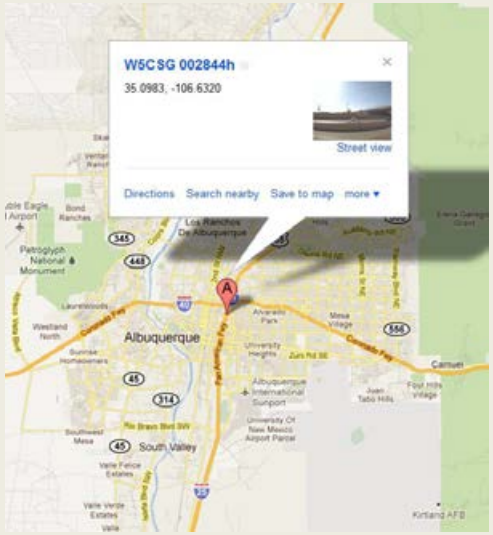
Step by step instructions setting up a D-STAR Hot Spot can be found at:
www.k6jm.com/hs-setup.htm

DV RPTR Open Source Modem

- Made for use as hotspot, or for DV repeaters in various operating modes.
- Board and corresponding software is open source and available for everybody.
- Future plans: Stand-alone openDV repeater firmware; analog / FM repeater firmware, C4FM / 4FSK 4800 baud (i.e. APCO-P25 Phase I); and more.
- www.dvrptr.de

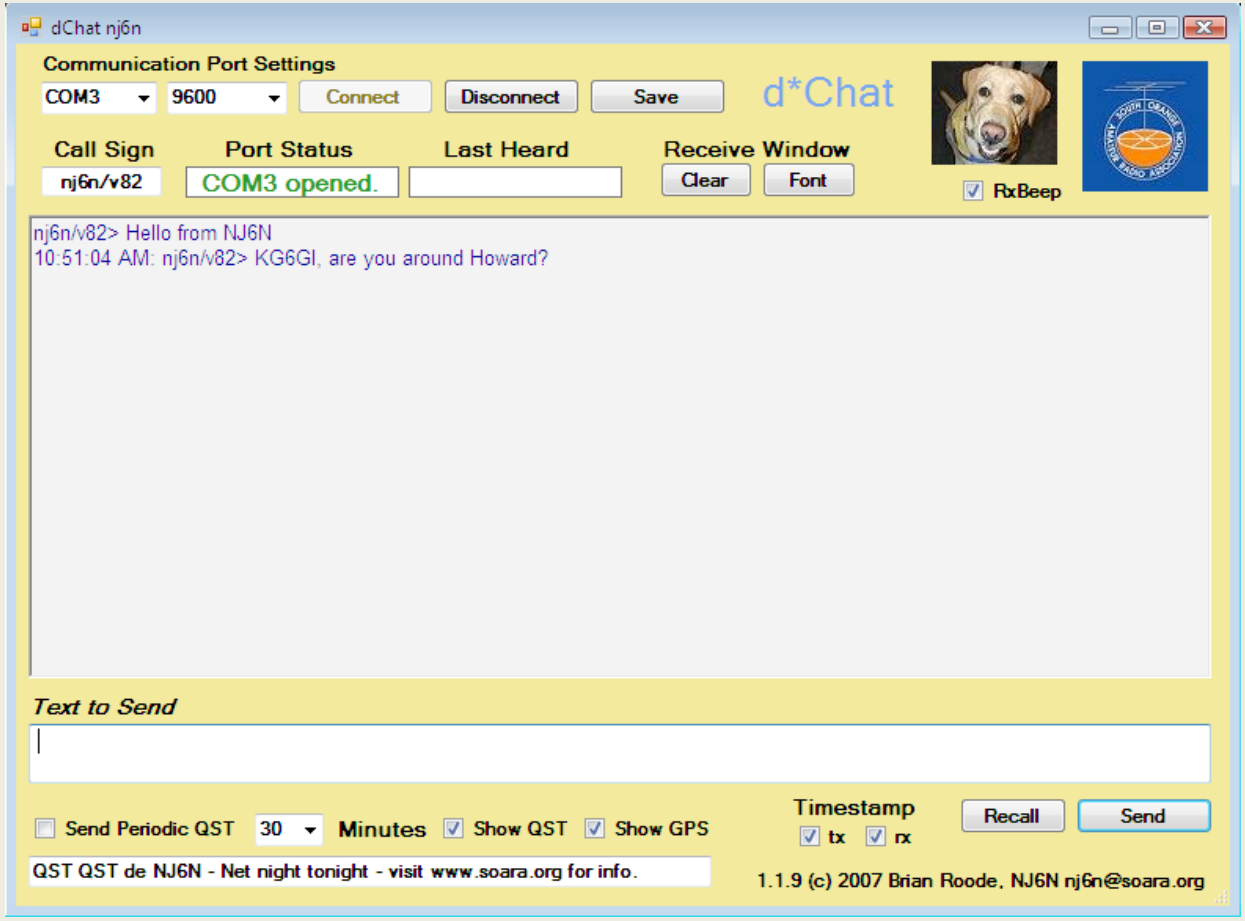
µSmart Digi D-Gate





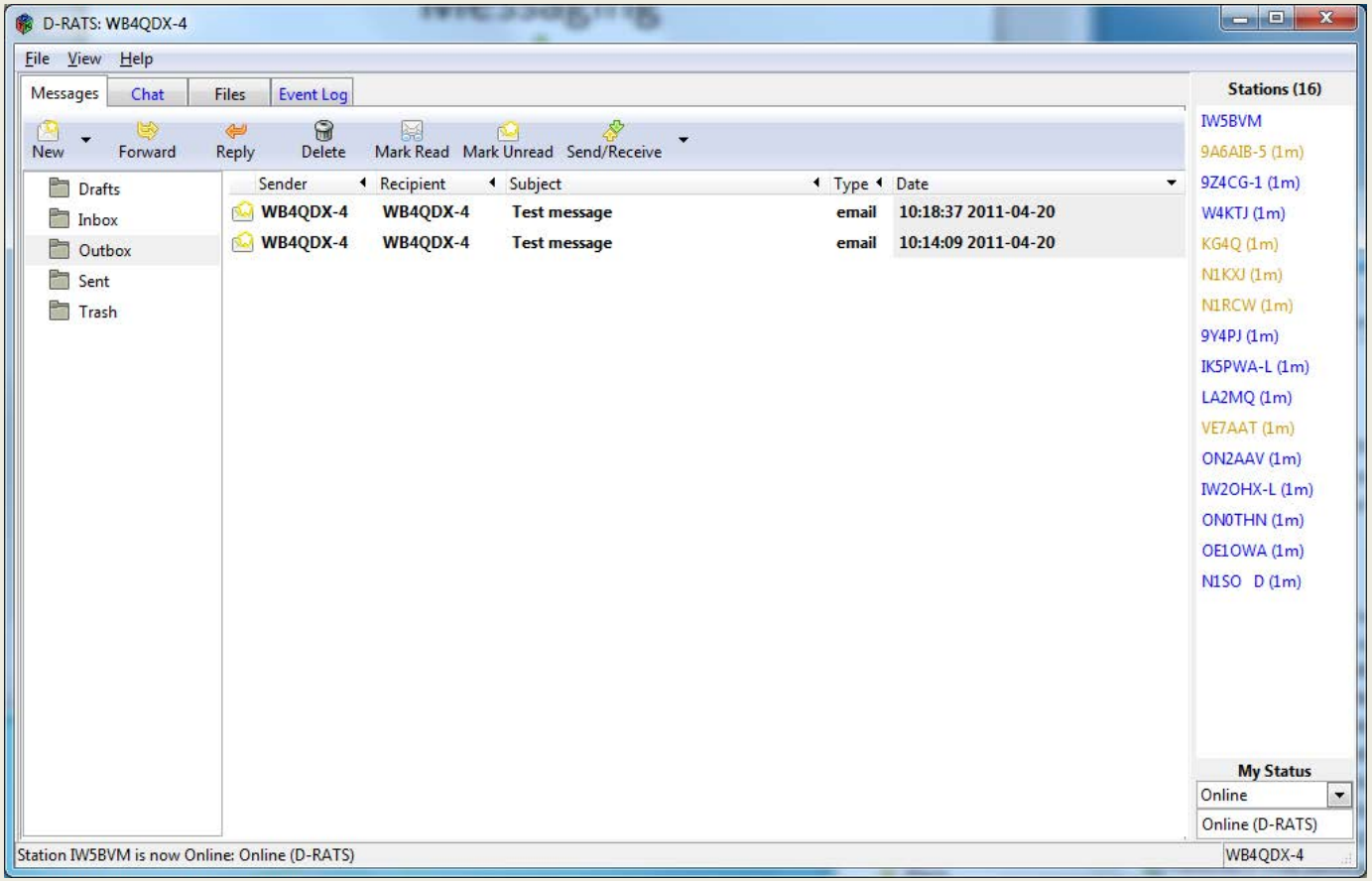
- Developed by Rich Painter AB0VO
- Daughtercard placed within Coastal ChipWorks TNC-X packet TNC
- Captures D-STAR position data from a D-STAR radio
- Convert it to the APRS format
- Gates it to an analog RF transmitter for transmission onto analog APRS network
- www.usmartdigi.com

D*Chat



- **Developed by Brian Roode NJ6N (http://nj6n.com/dstar/dstar_chat.html)**
- **Free Windows based keyboard to keyboard application that uses the D-STAR "DV" data capability.**
- **Used to enable text-based communication between multiple stations on a simplex frequency or through a repeater.**

D-RATS



- **Developed by Dan Smith KK7DS**
- **Absolutely FREE.**
- **All-in-one tool for data ops, gear especially towards EMCOMM use**
- **www.d-rats.com**

D-RATS

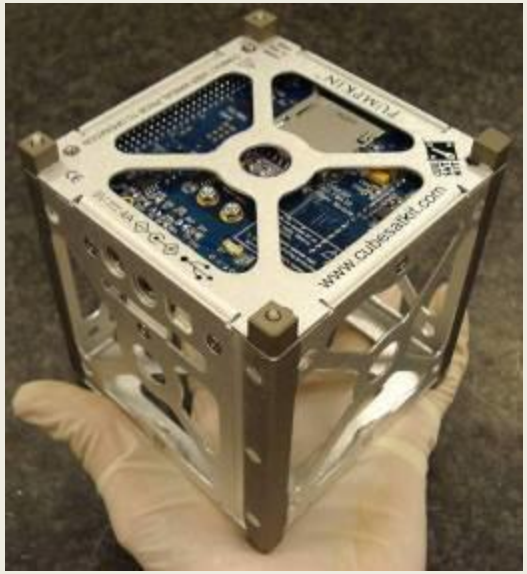
- **Messaging**
  - Radio messages, forms, email, Winlink 2000
- **Chat**
  - Quick, simple keyboard-to-keyboard, multi-user, private channels
- **File Transfer**
  - Unattended file sharing, upload/download from common shared site
- **Mapping/Position Reporting**
  - Map download, GPS position reporting on map
- **Forms**
  - Fully printable ICS-213, ARRL Radiogram and NTS Forms included
  - Includes form editor to create any form
  - Only data is sent
- **Multi-platform**
  - Windows (2000, XP, 7), Mac OS, Linux

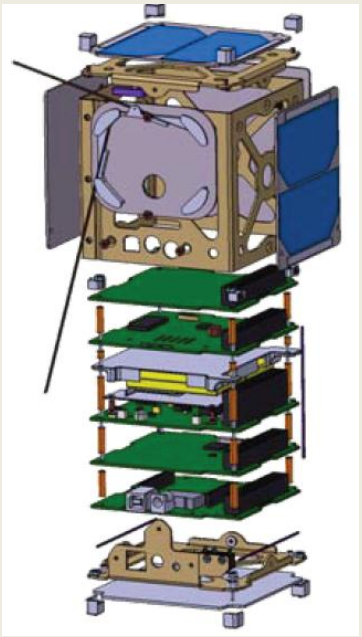
Demonstration

Codec2

- Effort to develop software equivalent to AMBE vocoder
- Open source low bit rate speech codec designed for communications quality speech at 2400 bit/s and below.
- Applications include low bandwidth HF/VHF digital radio and VOIP trunking.
- www.rowetel.com/blog/?page_id=452

OUFTI-1 Nanosatellite





- Cubesat (10x10x10 cm, or approx 4x4x4 in)
- First satellite to test the use of the D-STAR communication protocol in space.
- Developed by engineering students at Universitede Liege–Belgium
- Scheduled for launch via Vega rocket in 2012
- One year expected lifetime

D-STAR HotSpot in More Detail

What is it?

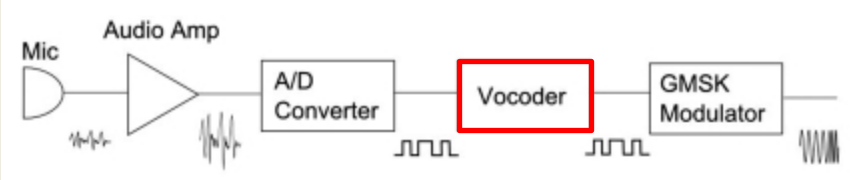
- ***A D-STAR Hot Spot is a 'point of presence' (or hot spot) utilizing an analog radio and a GMSK DV node adapter. The hot Spot creates RF access to the D-STAR network where none previously existed. With a hot spot set up, you can use your D-STAR radio to listen to, and talk on, any D-Plus equipped D-STAR repeater or reflector.***

D-STAR HotSpot in More Detail

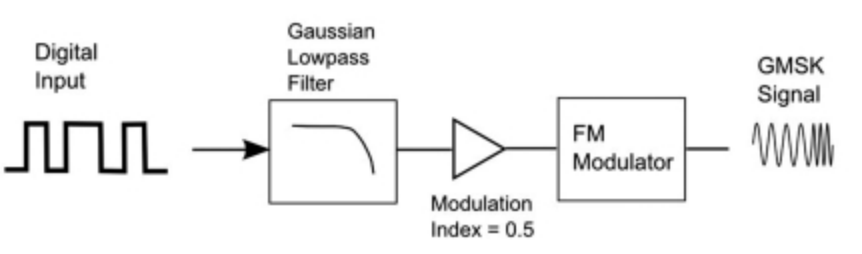
- **Extends the reach of the D-STAR network**
  - **Ideal for locations without RF access to a D-STAR repeater**
- **Uses inexpensive hardware**
  - **Node adapter**
    - **Dutch-Star firmware**
  - **Use any 9600 baud-capable analog FM 2m or 70cm radio**
- **Utilizes free software**
  - **Windows**
  - **Linux**
  - **Mature and stable**
- **Can be converted into a D-STAR repeater**

D-STAR HotSpot in More Detail

- **AMBE-2020® vocoder**
  - Advanced Multi-Band Excitation (AMBE)
  - Digital Voice Systems , Inc (DVSI)
  - The Vocoder is a licensed component
    - 8kHz sampled audio to 3600bps data

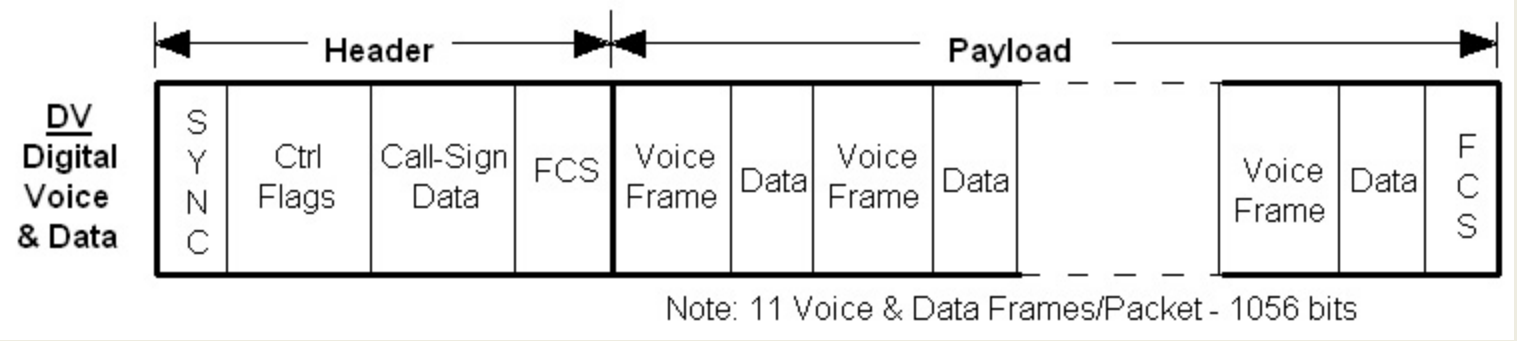


- **GMSK**
  - Gaussian Minimum Shift Keying
  - Essentially MSK with a Gaussian filer applied



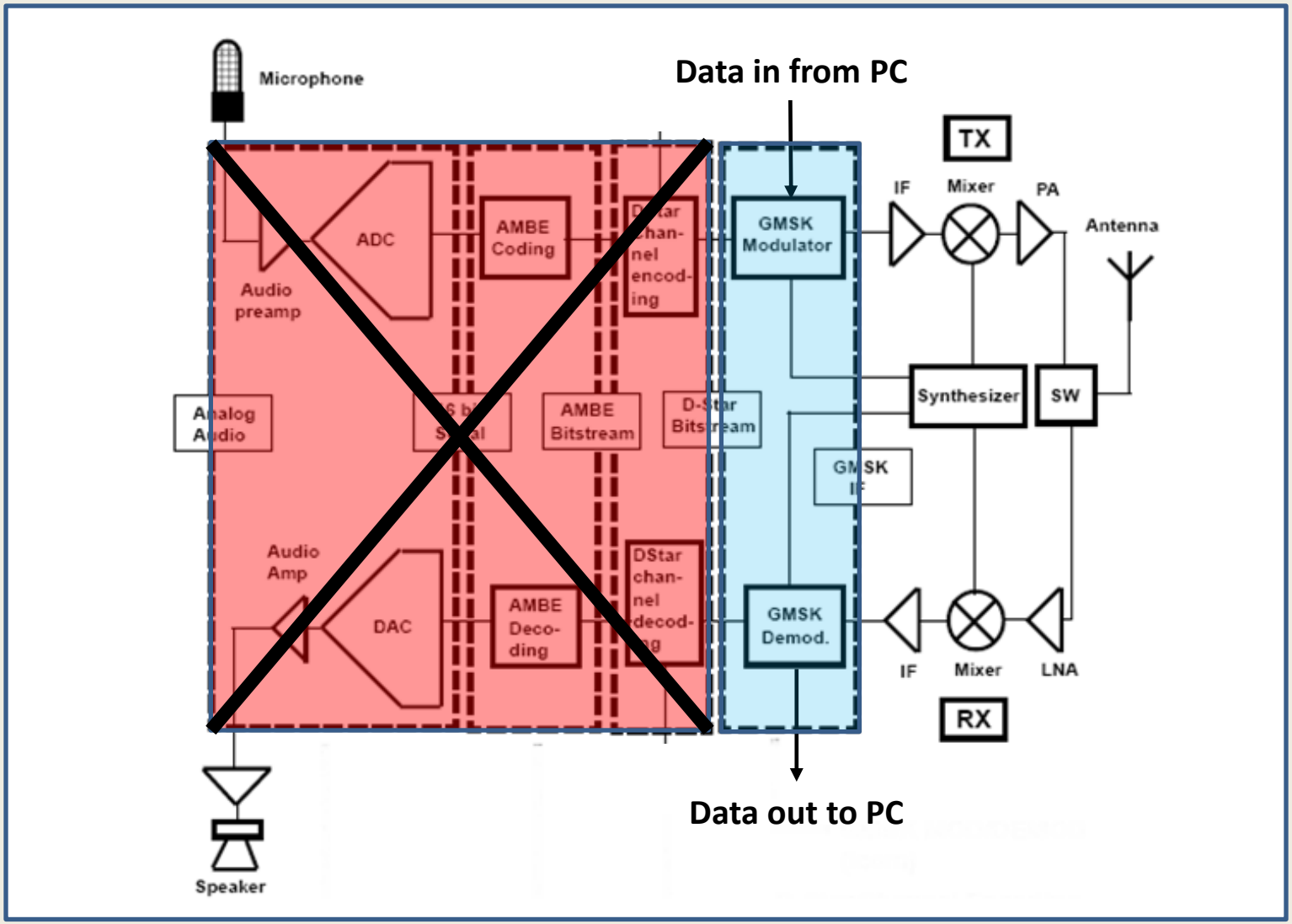
D-STAR Protocol at a Glance

- D-STAR DV (Data and Voice) packet contains both voice and data for a total of 4800bps
  - 2400bps Digital Voice + 1200bps FEC (Forward Error Correction)
  - 1200bps low speed data

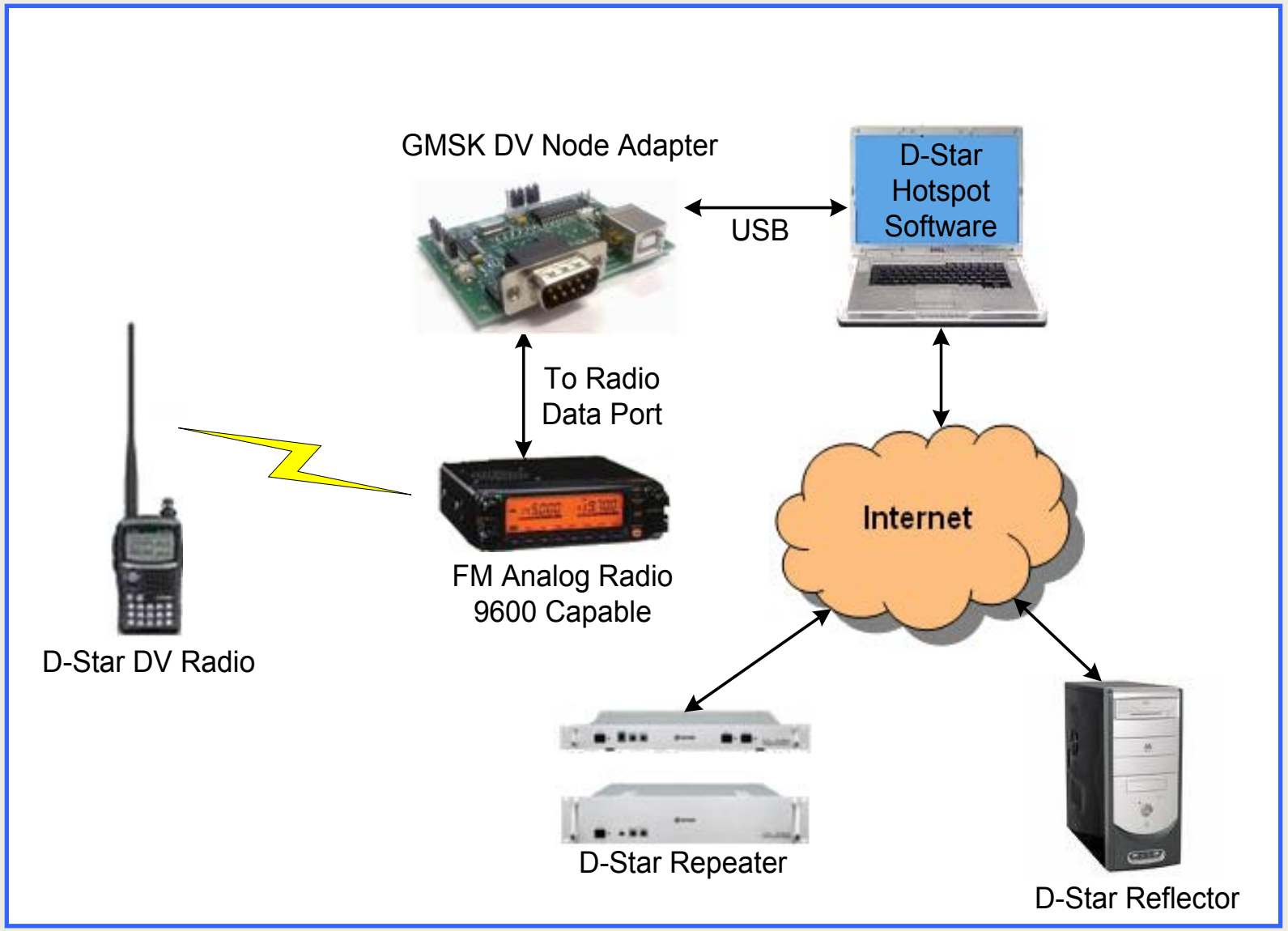


- Voice portion of the DV payload is created by the codec in AMBE® chip
- Header and data are not encoded
- Hot spot passes the DV payload as a bit stream without decoding
  - Software on the PC processes the Header and routes the packets

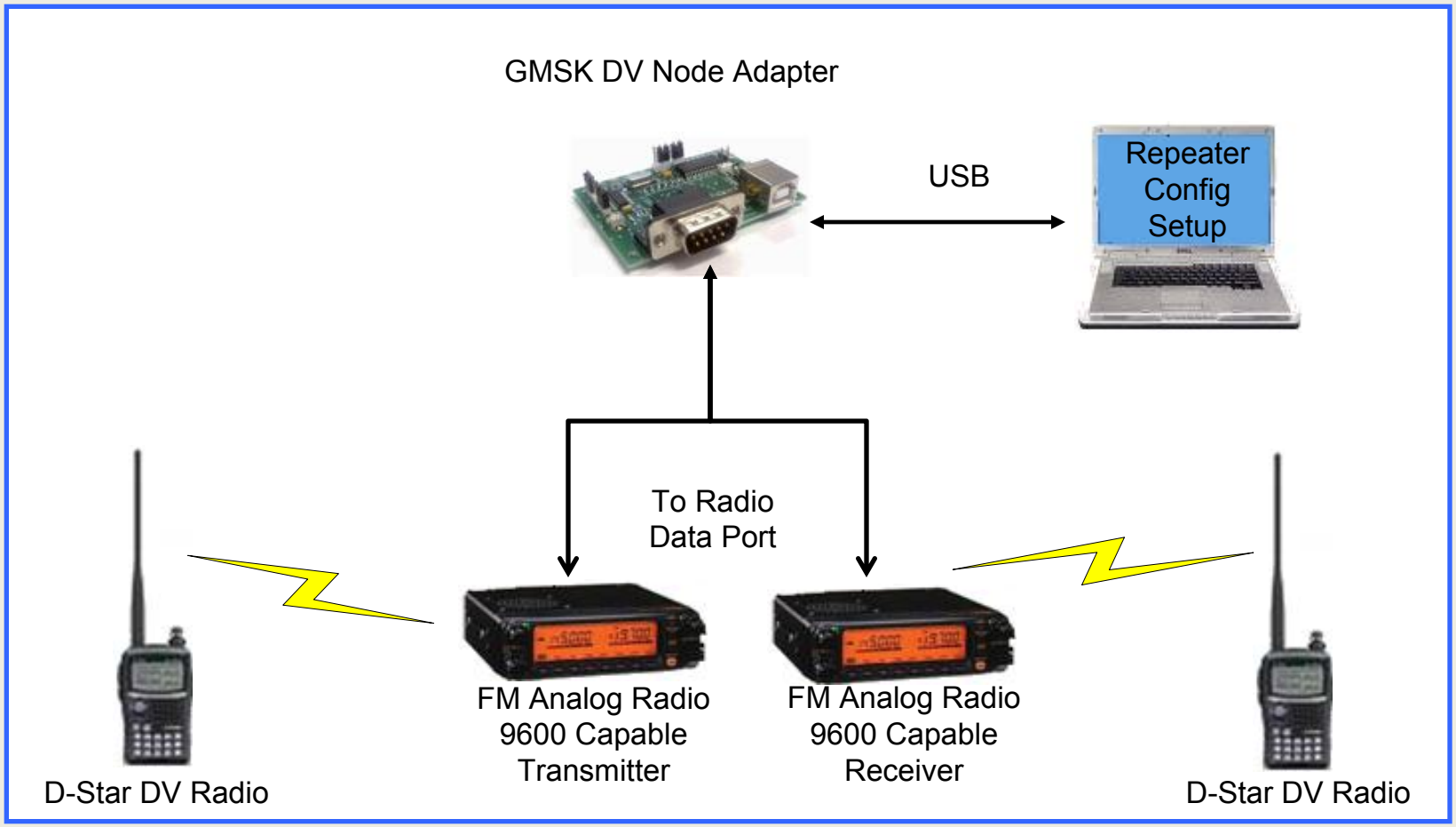
D-STAR HotSpot Block Diagram



D-STAR HotSpot System Diagram



D-STAR HotSpot Repeater System Diagram



D-STAR HotSpots

The First

Dutch-Star

Fred PA4YBR's Mini Hot Spot Board:
www.dutch-star.eu

Satoshi's GMSK DV Node Adapter:
www.d-star.asia

Made in the USA

Matrix Circuits Star*Board:
www.moencomm.com

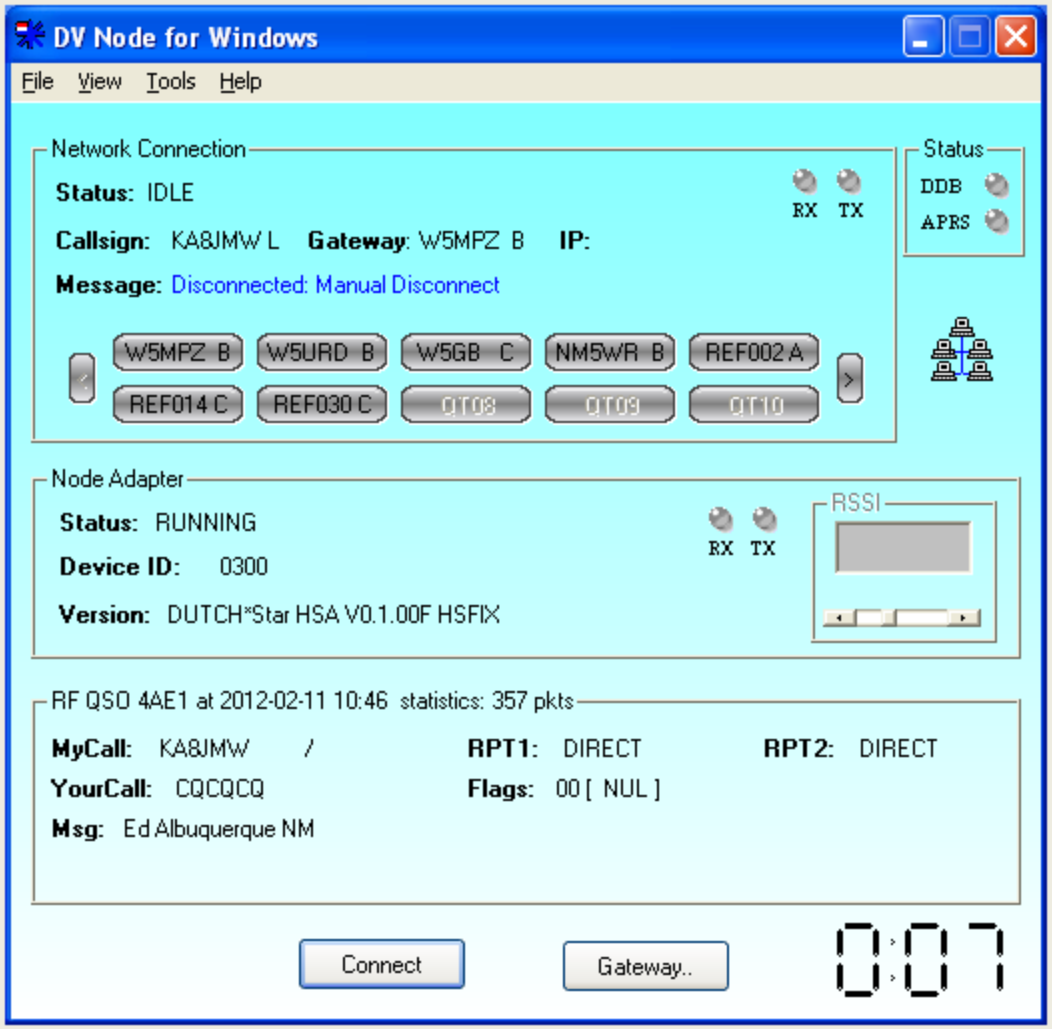
Any one of these boards can be used to build a D-STAR Hotspot or D-STAR repeater

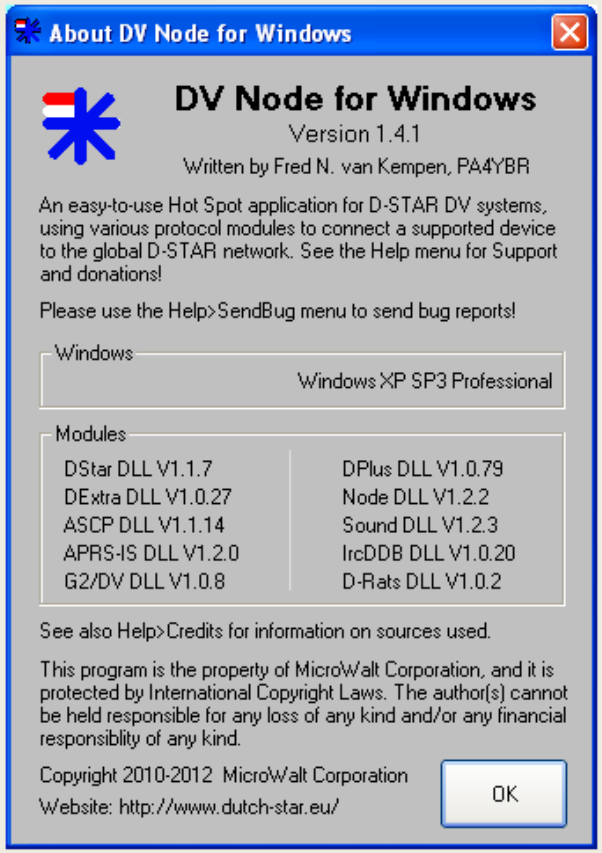
Five Simple Steps to Set Up a Node Adapter

1. **Register on the D-STAR network**
2. **Install software to configure and test the Node Adapter**
3. **[Load firmware on Node Adapter]**
4. **Configure and test the Node Adapter**
5. **Install and Configure the software**
   - **WinDV**
   - **DVAR**

Step by step instructions setting up a D-STAR Hot Spot can be found at:
www.k6jm.com/hs-setup.htm

DV Node for Windows - Software





Also works with the DV Dongle and DVAP

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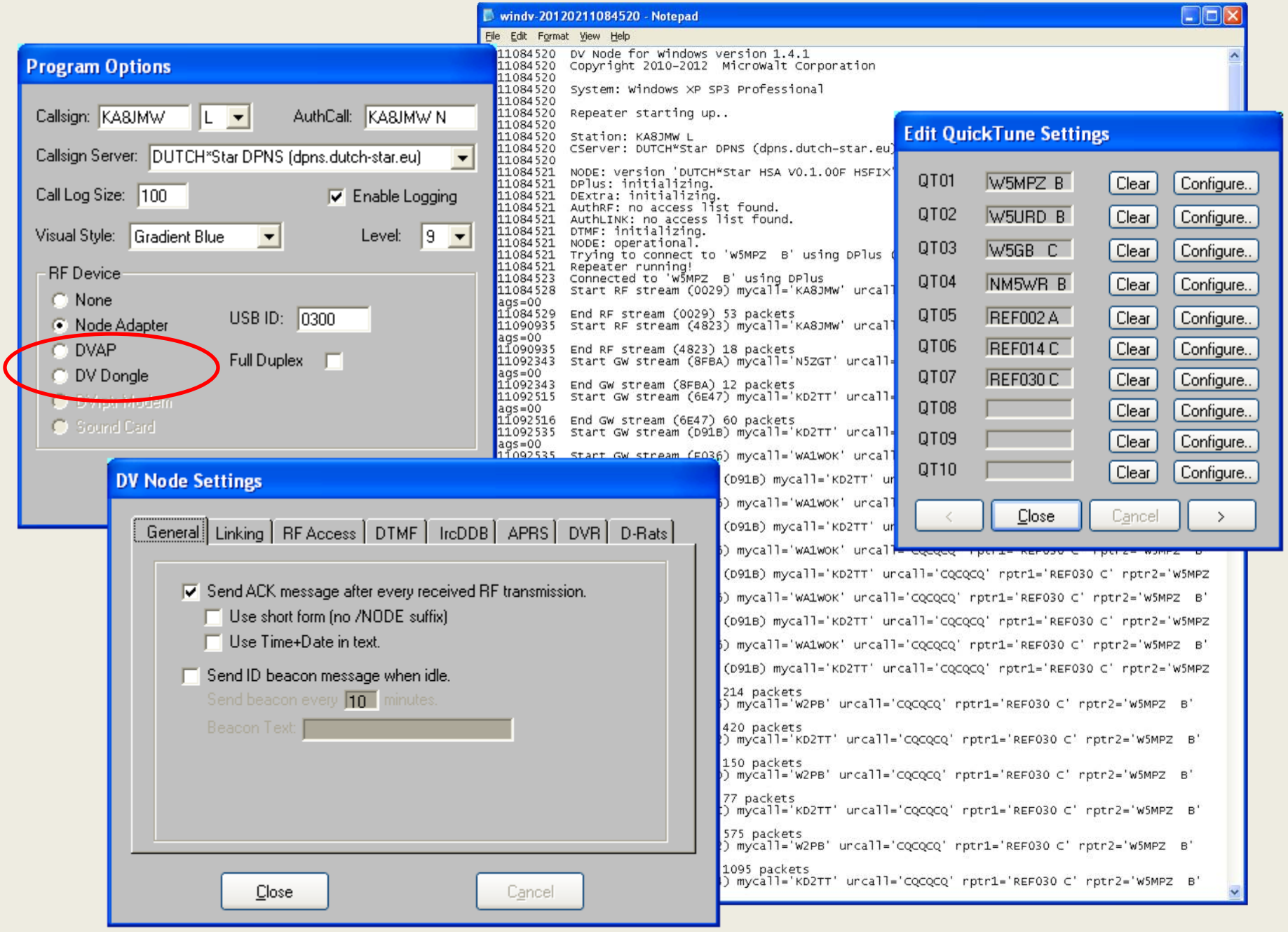
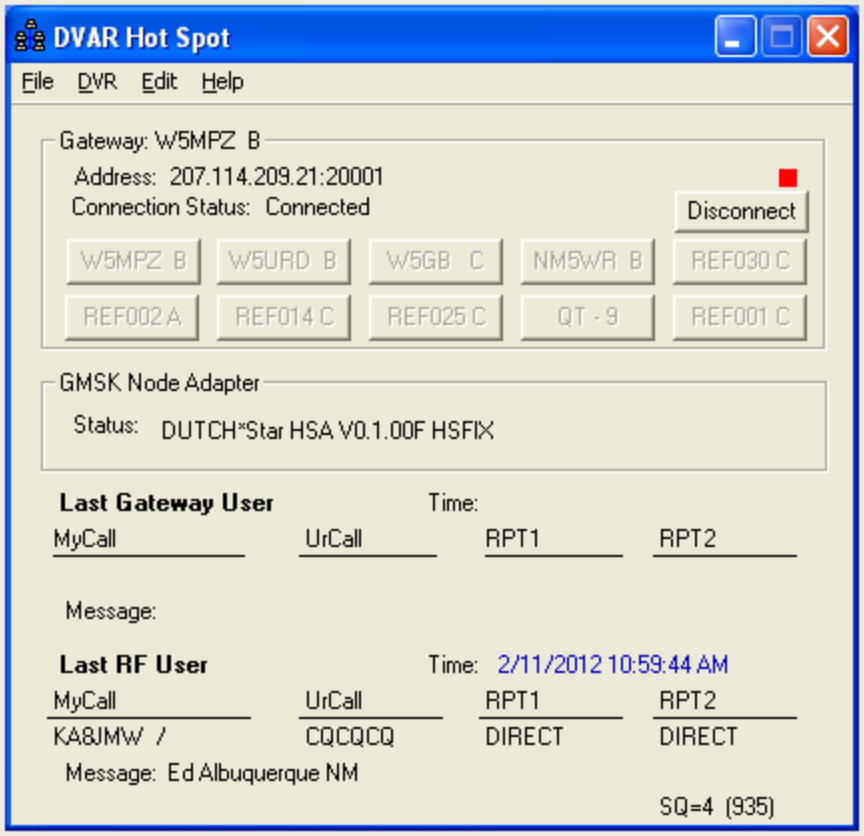
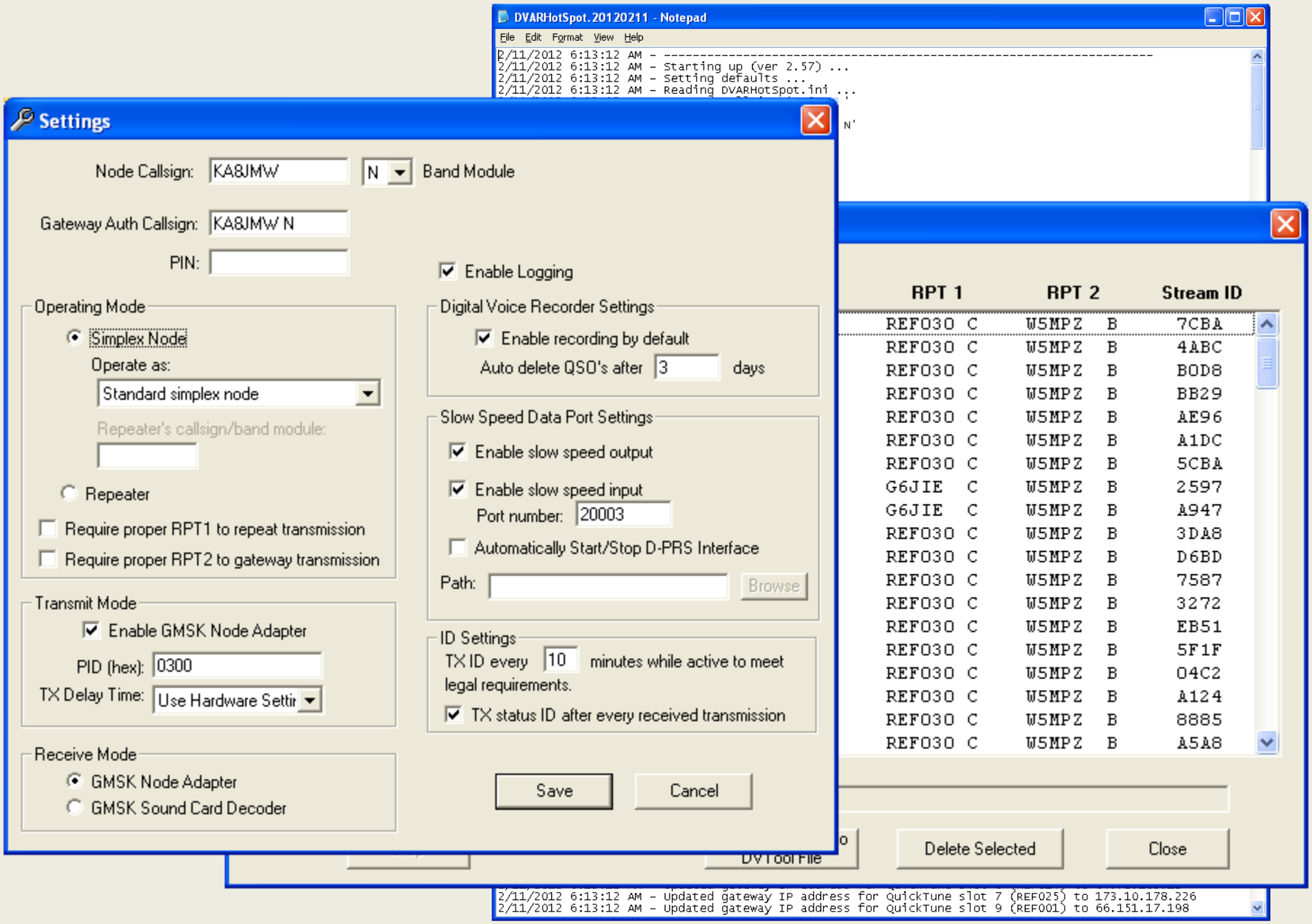

Program Options
Callsign: KA8JMW L AuthCall: KA8JMW N
Callsign Server: DUTCH*Star DPNS (dpns.dutch-star.eu)
Call Log Size: 100 Enable Logging
Visual Style: Gradient Blue Level: 9
RF Device
None
Node Adapter
DVAP
DV Dongle
DVRPTR Modem
Sound Card
USB ID: 0300
Full Duplex
windv-20120211084520 - Notepad
File Edit Format View Help
11084520 DV Node for Windows version 1.4.1
11084520 Copyright 2010-2012 Microwalt Corporation
11084520 System: Windows XP SP3 Professional
11084520 Repeater starting up..
11084520 Station: KA8JMW L
11084520 CServer: DUTCH*Star DPNS (dpns.dutch-star.eu)
11084521 NODE: version 'DUTCH*Star HSA V0.1.00F HSFIX'
11084521 DPlus: initializing.
11084521 DExtra: initializing.
11084521 AuthRF: no access list found.
11084521 AuthLINK: no access list found.
11084521 DTMF: initializing.
11084521 NODE: operational.
11084521 Trying to connect to 'W5MPZ B' using DPlus
11084521 Repeater running!
11084523 Connected to 'W5MPZ B' using DPlus
11084528 Start RF stream (0029) mycall='KA8JMW' urcall
11084529 End RF stream (0029) 53 packets
11090935 Start RF stream (4823) mycall='KA8JMW' urcall
11090935 End RF stream (4823) 18 packets
11092343 Start GW stream (8FBA) mycall='N5ZGT' urcall
11092343 End GW stream (8FBA) 12 packets
11092515 Start GW stream (6E47) mycall='KD2TT' urcall
11092516 End GW stream (6E47) 60 packets
11092535 Start GW stream (D91B) mycall='KD2TT' urcall
Start GW stream (F036) mycall='WA1WOK' urcall
(D91B) mycall='KD2TT' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ
mycall='WA1WOK' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
(D91B) mycall='KD2TT' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ
mycall='WA1WOK' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
(D91B) mycall='KD2TT' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ
214 packets
mycall='W2PB' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
420 packets
mycall='KD2TT' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
150 packets
mycall='W2PB' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
77 packets
mycall='KD2TT' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
575 packets
mycall='W2PB' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
1095 packets
mycall='KD2TT' urcall='CQCQCQ' rptr1='REF030 C' rptr2='W5MPZ B'
Edit QuickTune Settings
QT01 W5MPZ B Clear Configure..
QT02 W5URD B Clear Configure..
QT03 W5GB C Clear Configure..
QT04 NM5WR B Clear Configure..
QT05 REF002 A Clear Configure..
QT06 REF014 C Clear Configure..
QT07 REF030 C Clear Configure..
QT08 Clear Configure..
QT09 Clear Configure..
QT10 Clear Configure..
< Close Cancel >
DV Node Settings
General Linking RF Access DTMF IrcDDB APRS DVR D-Rats
Send ACK message after every received RF transmission.
Use short form (no /NODE suffix)
Use Time+Date in text.
Send ID beacon message when idle.
Send beacon every 10 minutes.
Beacon Text:
Close Cancel

DVAR Hot Spot for Windows - Software



DVAR Hot Spot linking/repeater software:
http://w9arp.com/HotSpot/

Works with both software and soundcard based GMSK modems.
DV recorder function can be used to capture and playback hot spot activity.



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What's in the Works

- Several new DSP boards with powerful CPUs
  - Fewer dedicated chips, software does the work
- DV-RPTR
  - Open source firmware and hardware
  - $65
- ON8JL's standalone D-STAR Node
  - Large processor, Ethernet connectivity
  - $430

DV-RPTR, an Open Source Modem

- DSP Based
  - Traditional GMSK modem replaced by DSP and software
- Integrated boot loader
- USB interface
- Open source software
- Work in progress
  - Analog/FM repeater
  - Ultra-narrow Band FM
  - C4FM/4FSK 4800 baud (APCO P.25 Phase I)
  - OpenDigi C4FM 8000baud modem
  - AMBE Speech Codec ADD-ON board:
    - Plugged into the DV-RPTR board.
    - Connectors for microphone and speaker.
    - Used with an 9k6 FM transceiver you get a real DV transceiver
    - Can also be used as a DV dongle to talk via Reflectors in the internet

DV-RPTR DV Modem:
http://www.dvrptr.de/

http://tech.groups.yahoo.com/group/DVRPTR/

ON8JL Standalone D-STAR Node

- HARDWARE:
  - STR912 ARM9 processor @ 96MHz
  - 96KB RAM, 512KB ROM
  - CMX589A based GMSK modem
  - STE100 based ethernet interface
  - Backlit PC2004 4x20 LCD display
  - DC/DC power supplies
  - 4 layers PCB
- EMBEDDED SOFTWARE (FIRMWARE):
  - FreeRTOS real time multitask operating system
  - UIP tcp/ip stack with http server & dhcp client
  - Bootloader for on-site firmware upgrading
  - written in C language
- DSTAR COMPATIBILITY:
  - DStar DV gmsk modem
  - G2 gateway protocol
  - DPlus protocol (client only)
  - DExtra protocol (client only)
  - full ircDDB gateway
  - StarNet compatibility
  - DPRS i-gate

http://on8jl.dyndns.org/

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HotSpot Legal Considerations

- **Except for when in repeater configuration…**
  - **Falls somewhere between a simplex link and digital store and forward**
  - **Similar to Echolink and IRLP simplex link operations**
- **Stay within the rules, monitor continuously!**

Agenda

8:00-8:55am	Welcome, D-STAR introduction and background
9:00-9:55am	Linking, functions, and memories
10:00-10:55am	Third party hardware and software, demo
11:00-11:55am	Working lunch, High speed 1200 MHz applications, demo
12:00-12:55pm	D-STAR and Emergency Communications
1:00-1:55pm	Hardware and software brainstorm session
2:00-2:55pm	Ins and outs of repeater maintenance
3:00-3:55pm	Overflow, other topics, prize drawing, wrap-up

D-STAR | high speed 1200 mhz applications

Brian Mileshosky N5ZGT
Richard Browning AD5RB

New Mexico D-STAR Academy
February 18, 2012

1200 MHz Basics

- 23cm band – 1240 to 1300 MHz
- Band plan allows multiple bandwidths
- Used for ATV, cross-band links, some repeaters
- Line-of-sight behavior more apparent than 2m, 70cm
- Effects of obstructions more apparent than 2m, 70cm
- Path loss vs. frequency comparison at 5 miles
  - 146 MHz: 94 dB
  - 445 MHz: 104 dB
  - 1296 MHz: 113 dB

Rule of thumb: For every 3-dB increase/decrease in frequency, RF path loss increases/decreases by approximately 6-dB

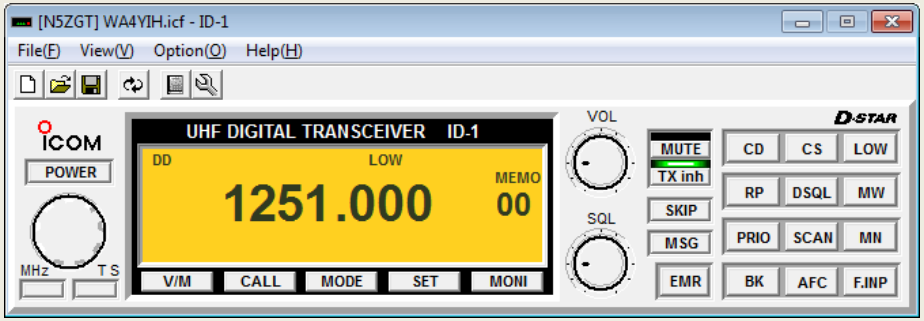
- Path loss can be compensated for with proper antenna and feedline selection
  - 1200 MHz antennas (yagis) generally provide high-gain, yet remain small

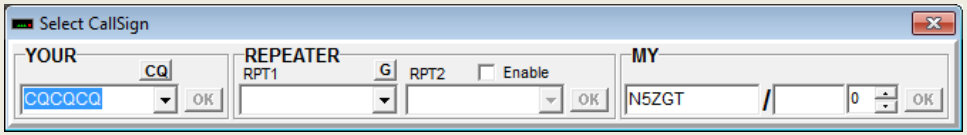
D-STAR's 1200 MHz Radio

- **Icom ID-1 Transceiver**
  - **Operates FM Voice and GMSK (D-STAR) modes**
  - **D-STAR modes include voice, low speed data (1200 bps) and high speed data (128 kbps)**
  - **Up to 10W transmit output**
  - **Doesn't require control head for operation if not desired**
  - **MIL-STD-810F qualified**

Configuring the ID-1 for Digital Voice

- **Controlling radio via software on PC is extremely easy via USB port (can also use radio's display module)**





- **Voice channels and memories are setup just like on 2m and 70cm (MY, UR, RPT1, RPT2)**
- **Mode is DV (Digital Voice)**
- **Low speed data uses USB connection from PC via assigned COM port**

Configuring the ID-1 for High Speed Data

- Radio acts as wireless Ethernet bridge
- Controlling radio via software on PC is extremely easy via USB port (can also use radio's display module)
- Data channels and memories are setup just like on 2m and 70cm (MY, UR, RPT1, RPT2)
- Mode is DD (Digital Data)
- High speed data uses Ethernet connection from PC
- When communicating through DD repeater, local user must know their assigned IP address (10.x.x.x)
  - Every user who registers on D-STAR network is assigned their own unique IP address. If you don't know/remember yours, contact the administrator of the D-STAR repeater you registered on.

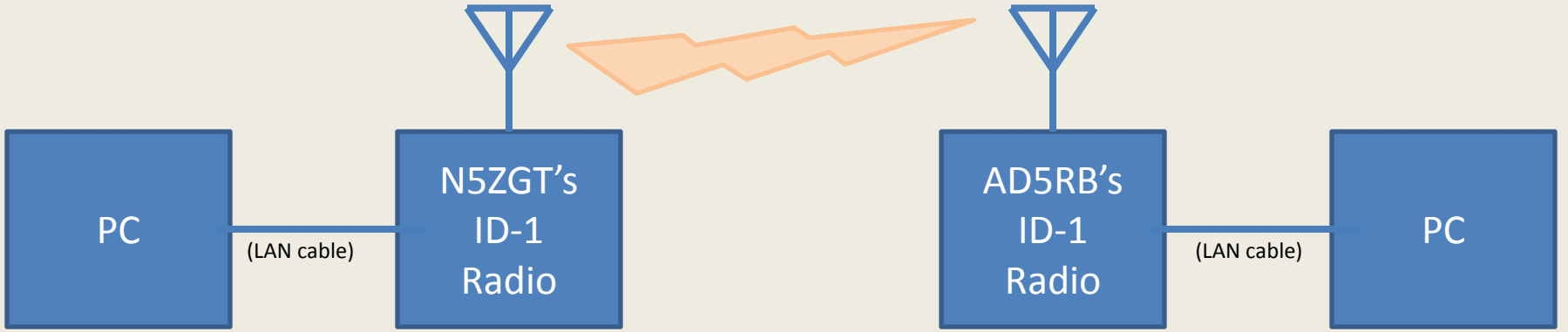
High Speed Data Applications

- Transfer files, photos, and other information
- Set up wireless network between two or more geographical locations
- Internet connectivity where none may exist (i.e., the “last mile”)
- Value added, especially for EmComm
  - Unlike other ham radio data modes and the software applications that support them, D-STAR enables the Ham to transfer files, photos, send email, and access the internet using the same software and operating system functions that they use every single day.
  - Why manually type information or copy-and-paste into a ham program as plain-text when you can instead simply drag-and-drop that shelter roster, resource needs list, or document in its native Excel, Word, or PDF file onto the remote station’s hard drive via RF?

High Speed Data Configurations

- **Point-to-Point**
  - Computers using ID-1 transceivers would have the same functionality as two computers networked via Ethernet
  - Can access email, web, drag and drop files on shared hard drives/folders, and much more
- **Via 1200 MHz DD module installed at repeater site**
  - Extends range and permits multiple users to leverage capability
  - Remember, in absence of internet at repeater the 1200 MHz module still provides ability for high speed data applications between D-STAR stations in coverage area

High Speed Data (Point to Point)



Example setup:
IP: 10.0.0.214
Subnet: 255.0.0.0
Workgroup: XYZ
Share drive or folder(s)

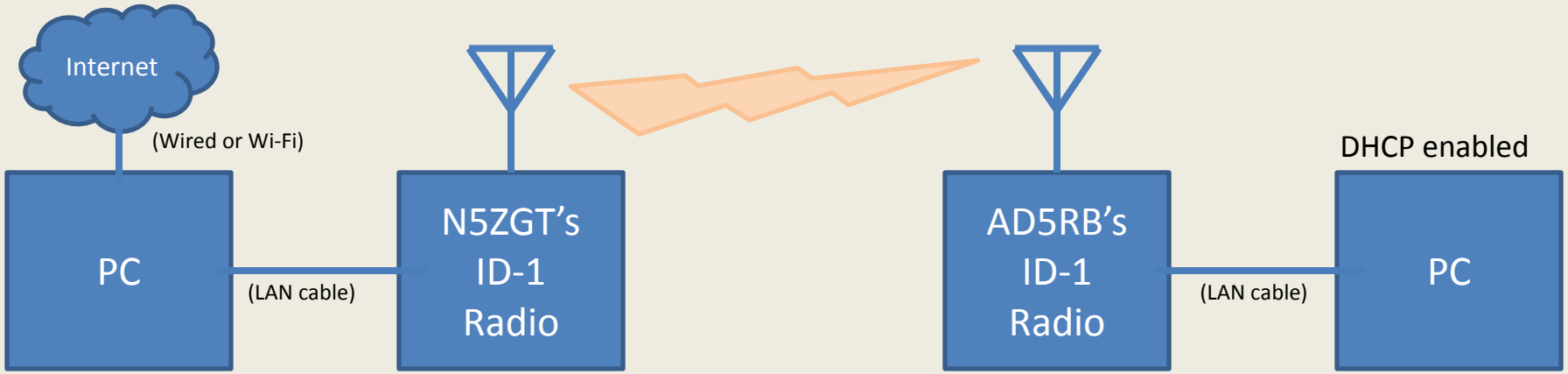
Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): Simplex
MY: N5ZGT
UR: CQCQCQ or AD5RB
RPT1: (not used)
RPT2: (not used)

Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): Simplex
MY: AD5RB
UR: CQCQCQ or N5ZGT
RPT1: (not used)
RPT2: (not used)

Example setup:
IP: 10.0.0.215
Subnet: 255.0.0.0
Workgroup: XYZ
Share drive or folder(s)

- The 10.0.0.x IP addresses and corresponding subnet above are only examples; any valid fixed IP addresses and corresponding subnet can be used.

Internet Connectivity (Point to Point)



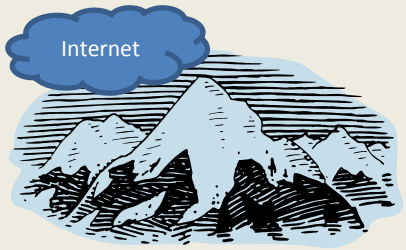
Example setup:
IP: 192.x.x.x
Subnet: 255.255.255.0

Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): Simplex
MY: N5ZGT
UR: CQCQCQ or AD5RB
RPT1: (not used)
RPT2: (not used)

Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): Simplex
MY: AD5RB
UR: CQCQCQ or N5ZGT
RPT1: (not used)
RPT2: (not used)

- If using Wi-Fi, set Internet Connection Sharing (ICS) under "Wireless Network Connection Properties" to share with Local Area Connection (LAN)

Internet Connectivity (via Repeater)



Example:
WD4STR Repeater
1298.0 MHz

AD5RB's
ID-1
Radio

(LAN cable)

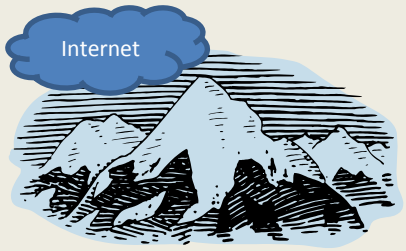
PC

Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): RPS
MY: AD5RB
UR: WD4STR
RPT1: WD4STR▪A
RPT2: WD4STR▪G

IP: 10.x.x.x
Subnet: 255.0.0.0
Gateway: 10.0.0.1
DNS: Use any

- The 10.x.x.x IP address used above represents the unique IP address assigned to the user's specific callsign when originally registered on the worldwide D-STAR network. If you don't know/remember yours, contact the administrator of the D-STAR repeater you registered on for guidance.

Internet Connectivity (via Repeater)



Example:
WD4STR Repeater
1298.0 MHz

AD5RB's ID-1 Radio

(LAN cable)

Router

DHCP enabled

PC

Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): RPS
MY: AD5RB
UR: WD4STR
RPT1: WD4STR▪A
RPT2: WD4STR▪G

WAN
IP: 10.x.x.x
Subnet: 255.0.0.0
Gateway: 10.0.0.1
DNS: Use any

LAN
DHCP Enabled
192.168.0.x

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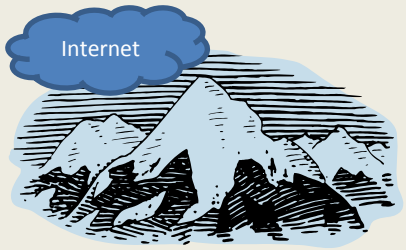

Example:
WD4STR Repeater
1298.0 MHz

AD5RB's
ID-1
Radio

(LAN cable)

Router

(LAN cable)

(LAN cable)

DHCP enabled

PC

DHCP enabled

PC

Example setup:
Frequency: 1298.0000
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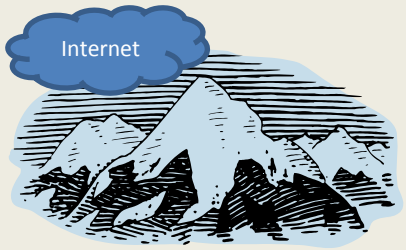


Example:
WD4STR Repeater
1298.0 MHz

AD5RB's
ID-1
Radio

(LAN cable)

Wireless
Router

(WiFi)

(WiFi)

DHCP enabled

PC

DHCP enabled

PC

Example setup:
Frequency: 1298.0000
Mode: DD
RP (Shift): RPS
MY: AD5RB
UR: WD4STR
RPT1: WD4STR▪A
RPT2: WD4STR▪G

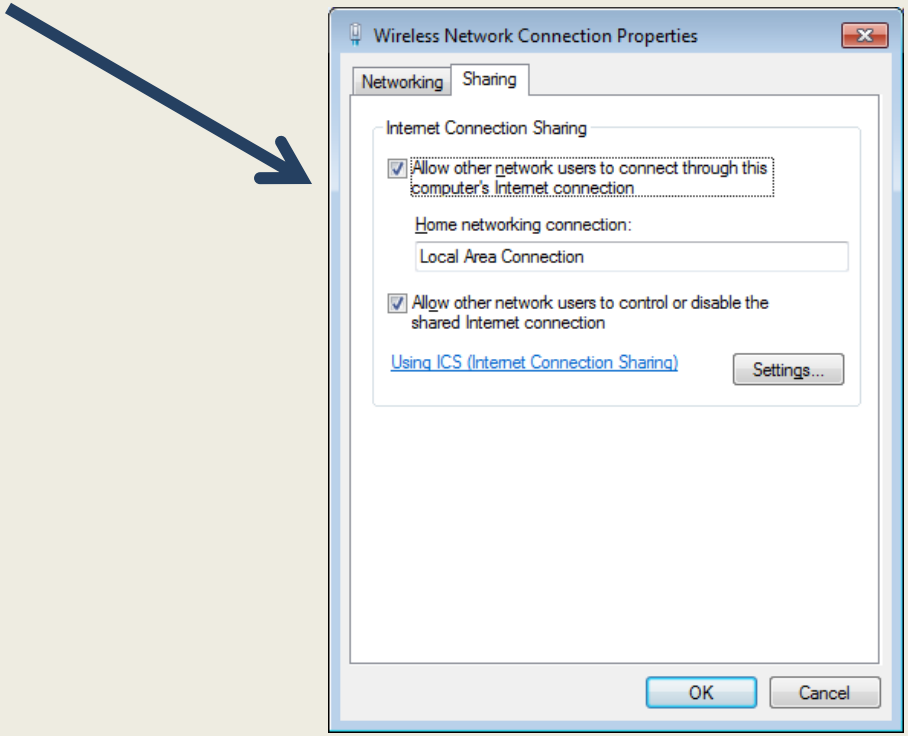
WAN
IP: 10.x.x.x
Subnet: 255.0.0.0
Gateway: 10.0.0.1
DNS: Use any

LAN
DHCP Enabled
192.168.0.x

- The 10.x.x.x IP address used above represents the unique IP address assigned to the user's specific callsign when originally registered on the worldwide D-STAR network. If you don't know/remember yours, contact the administrator of the D-STAR repeater you registered on for guidance.

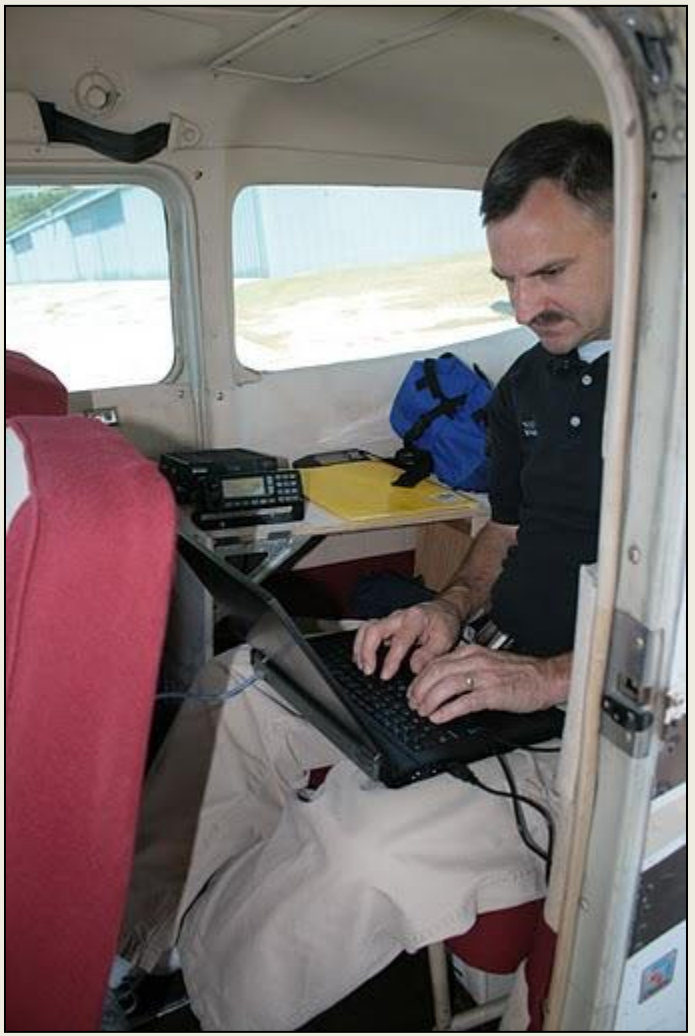
Miscellaneous High Speed Data Notes

- **If PC is connected to the ID-1 via a Gigabit Ethernet (GbE) connection, an auto-baud issue within the GbE port might prevent communications with the ID-1. Simply insert an Ethernet switch or router between PC and ID-1.**
- **If using Wi-Fi, set Internet Connection Sharing (ICS) under "Wireless Network Connection Properties" to share with Local Area Connection (LAN)**



A Neat Practical Use

- **Stay tuned for John Davis WB4QDX's presentation on D-STAR and emergency communications to learn more…**



Demonstration

Agenda

8:00-8:55am	Welcome, D-STAR introduction and background
9:00-9:55am	Linking, functions, and memories
10:00-10:55am	Third party hardware and software, demo
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3:00-3:55pm	Overflow, other topics, prize drawing, wrap-up

D-STAR | emergency communications

John Davis WB4QDX

New Mexico D-STAR Academy
February 18, 2012

About John Davis WB4QDX

- Extra Class license, first licensed in 1969 as WN4QDX
- Serves as ARES Emergency Coordinator, Gwinnett County, Georgia
- Serves as DEC, Georgia ARRL Section, liaison to Georgia Public Broadcasting (GPB) coordinating Amateur Radio installations on GPB television towers
- Secured $165,000 grant from Georgia Emergency Management Agency for build-out of statewide D-STAR repeater network
- Frequent speaker on D-STAR technology at Hamfests and Amateur Radio events around the country
- Participated as instructor for numerous D-STAR training across the country

The EmComm environment has changed

- NIMS/ICS organization in place since 9/11
  - All participating personnel must be trained and able to operate in this structure
- Simple voice communications is not enough
  - EMAs have advanced voice and data communications available
  - Ability to transfer files (any type)
  - Accuracy and timeliness are critical
  - Support of standard ICS forms (ICS-213, etc.)
- Can you communicate beyond your local area?
  - State Emergency Management, FEMA and NWS offices
- Can you provide network backup to critical infrastructure?
  - Data communications
  - Network / internet access

Emergency Communications

- **What do we need for effective Emergency Communications?**

	Need
Simplex voice communications	
Local communications through repeaters	
Flexible wide area communications	
Low speed data communications	
High speed data communications	
Position reporting	
File transfer capability (any type)	
Backup networking for critical infrastructure	

How we have addressed the need

- Voice communications provided by FM mode
- Local communications through FM repeaters
  - Linked repeater networks through fixed linking
  - Use EchoLink or IRLP for voice linking
- Longer distances over HF
- Low speed data provided through Packet mode
  - Requires separate radio and TNC to supplement voice
  - Difficult to route data over wide areas
- Position reporting provided via APRS
  - Requires separate radio, GPS and TNC
- Different tools provide pieces of solution
  - Winlink2000, FLDIGI/NBEMS, MT63
- No mode for higher speed data
- Difficult to provide critical infrastructure backup

Emergency Communications

- **What do we need for effective Emergency Communications?**

	Need	FM
Simplex voice communications	✓	✓
Local communications through repeaters	✓	✓
Flexible wide area communications	✓	
Low speed data communications	✓	**w/Packet**
High speed data communications	✓	
Position reporting	✓	**w/APRS**
File transfer capability (any type)	✓	✓
Backup networking for critical infrastructure	✓	

= With fixed links, IRLP or EchoLink

How D-STAR stacks up for EmComm

- Single radio can provide voice and data
- Digital communications provides clear voice quality
- Voice and data pass through repeaters
- Repeaters can be linked by user to create flexible networks
- Reflectors allow many repeaters to network
- Low speed data built into radio
  - Direct connection from radio to PC (no TNC required)
  - Internal GPS on some models
  - Repeaters gate position data to APRS-IS network
- High speed data (128 kb/sec) available on 1.2 GHz
  - Acts as Ethernet bridge between two radios
  - Provides Internet connectivity through DD repeaters
  - Can provide infrastructure backup to Internet or bridge to alternate location

D-STAR value proposition

- Individual D-STAR radio cost higher than comparable FM only radio ($400 - $900)
- All D-STAR radios do both analog FM and D-STAR
- Voice and data built into every radio
  - Direct serial connection to radio (no interface required)
  - No TNC required for data
- Equivalent analog-only FM configuration:
  - One radio for voice
  - Second radio for packet data
  - TNC
  - Cost = $600-800

Emergency Communications

- **What do we need for effective Emergency Communications?**

	Need	FM	D-STAR
Simplex voice communications	✓	✓	✓
Local communications through repeaters	✓	✓	✓
Flexible wide area communications	✓		✓
Low speed data communications	✓	**w/Packet**	✓
High speed data communications	✓		✓
Position reporting	✓	**w/APRS**	✓
File transfer capability (any type)	✓	✓	✓
Backup networking for critical infrastructure	✓		✓

= With fixed links, IRLP or EchoLink

New Mexico D-STAR Academy

Do we need the Internet for D-STAR?

- **Loss of Internet at repeater site**
  - **Only linking function is lost; repeater *still* operates a standalone system**
  - **Local area coverage *still* available through repeater**
  - **All voice and data capabilities *still* available through local repeater**
- **Loss of local repeater**
  - **All voice and data capabilities *still* available between D-STAR users on simplex**

D-STAR tools for EmComm

- **Handheld radios**
  - IC-91AD (dual band, dual RX)
  - IC-92AD (dual band, dual RX)
  - IC-80AD (dual band)

  - ID-31A (70cm only, built in GPS)

- **Mobile radios**
  - IC-2820H (dual band, dual RX, GPS)
  - IC-880H (dual band)
  - IC-2200H (dual band, 4 memories)

- **1.2 GHz radio**
  - ID-1
- **All band radio**
  - IC-9100 (HF through 23cm)

- **DV Adapters**
  - Convert FM radio to Hotspot or repeater

- **DV Dongle (no radio required)**

- **DV Access Point**

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High Speed Data on 1200 MHz

- Icom ID-1 radio is 1200 MHz only (FM and D-STAR)
- Operates in DV, low speed data and high speed DD modes
- Repeaters can be linked by user to create flexible networks
- Reflectors allow many repeaters to network
- Low speed data built into radio
  - Direct connection from radio to PC (no TNC required)
  - Internal GPS on some models
  - Repeaters gate position data to APRS-IS network
- High speed data (128 Kb) available on 1.2 GHz
  - Acts as Ethernet bridge between two radios
  - Provides Internet connectivity through DD repeaters
  - Can provide infrastructure backup to Internet or bridge to alternate location

D-STAR in use for EmComm

- Link to critical disaster management facilities (FEMA, state or local EMA, NWS)
- Shelter reports, damage assessment via data forms
- Send photos from field
- Near real time airborne photo transmission
- D-RATS program adds functions to data
  - Free program
  - Messaging (email, Winlink, station-to-station, chat)
  - Forms (standard forms included such as ICS-213, ability to add custom forms)
  - Unattended file transfer (any format; drag-and-drop)
  - Position reporting using GPS
  - Mapping

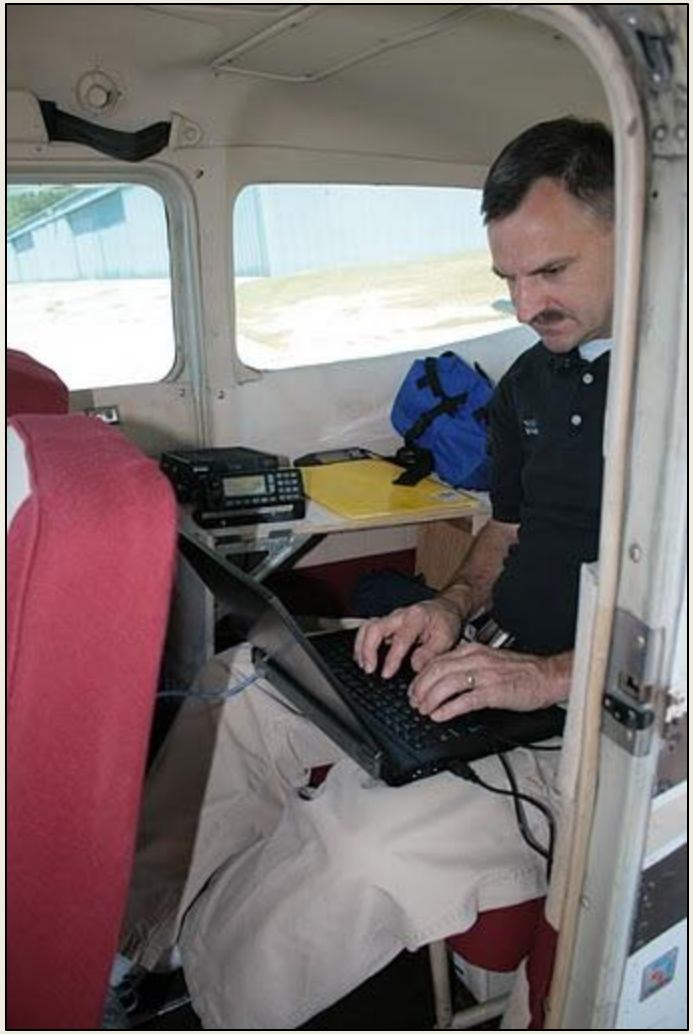
D-STAR is not being advocated as the end-all, be-all of emergency communications. It is being advocated as another tool in the toolbox that can be leveraged if circumstances require or desire its unique capabilities.

Damage Assessment using D-STAR

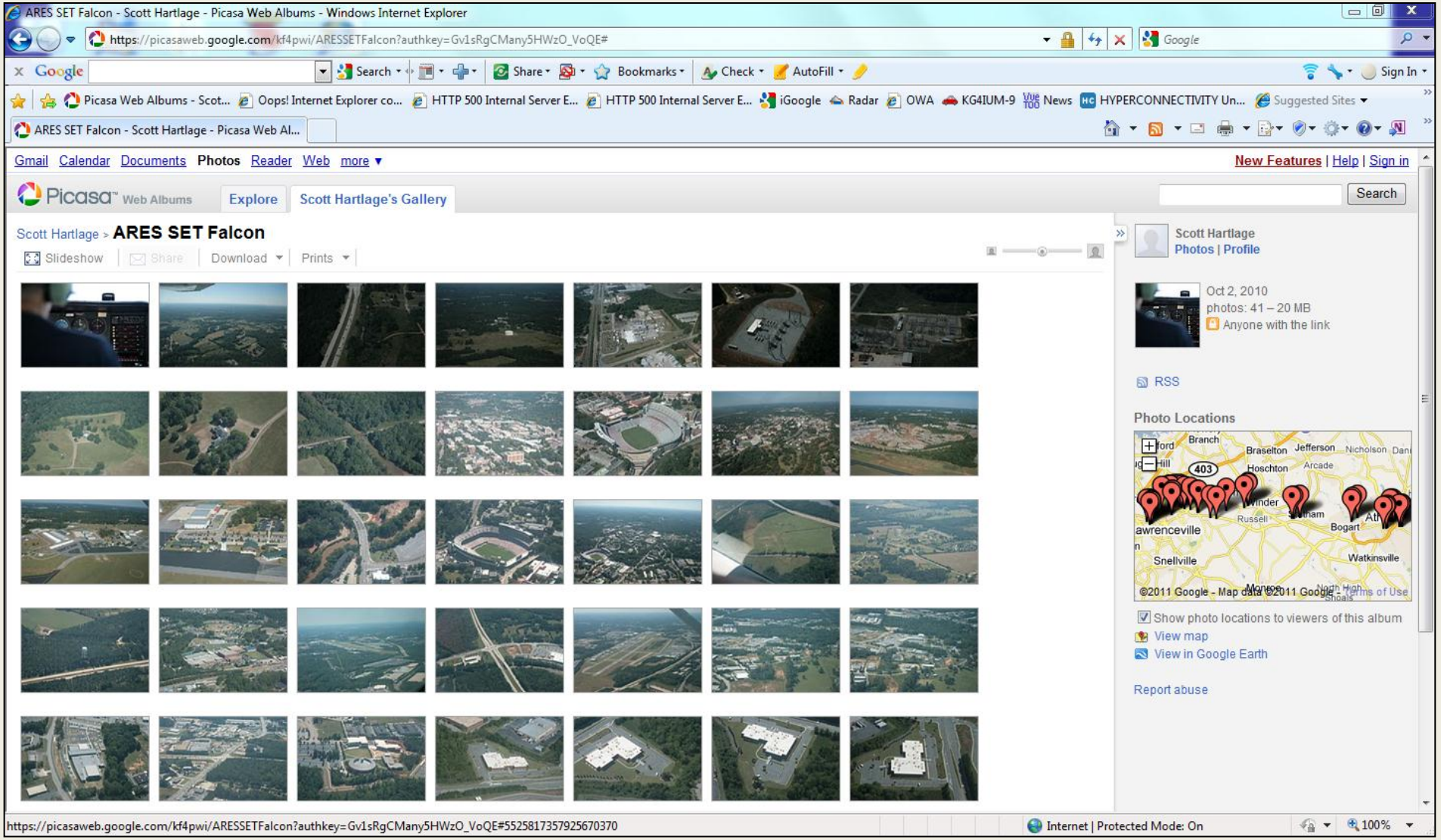
- Use forms to provide field data in agency format
- Transmit photos of damaged areas direct from field locations

Airborne Photo Transmissions via D-STAR

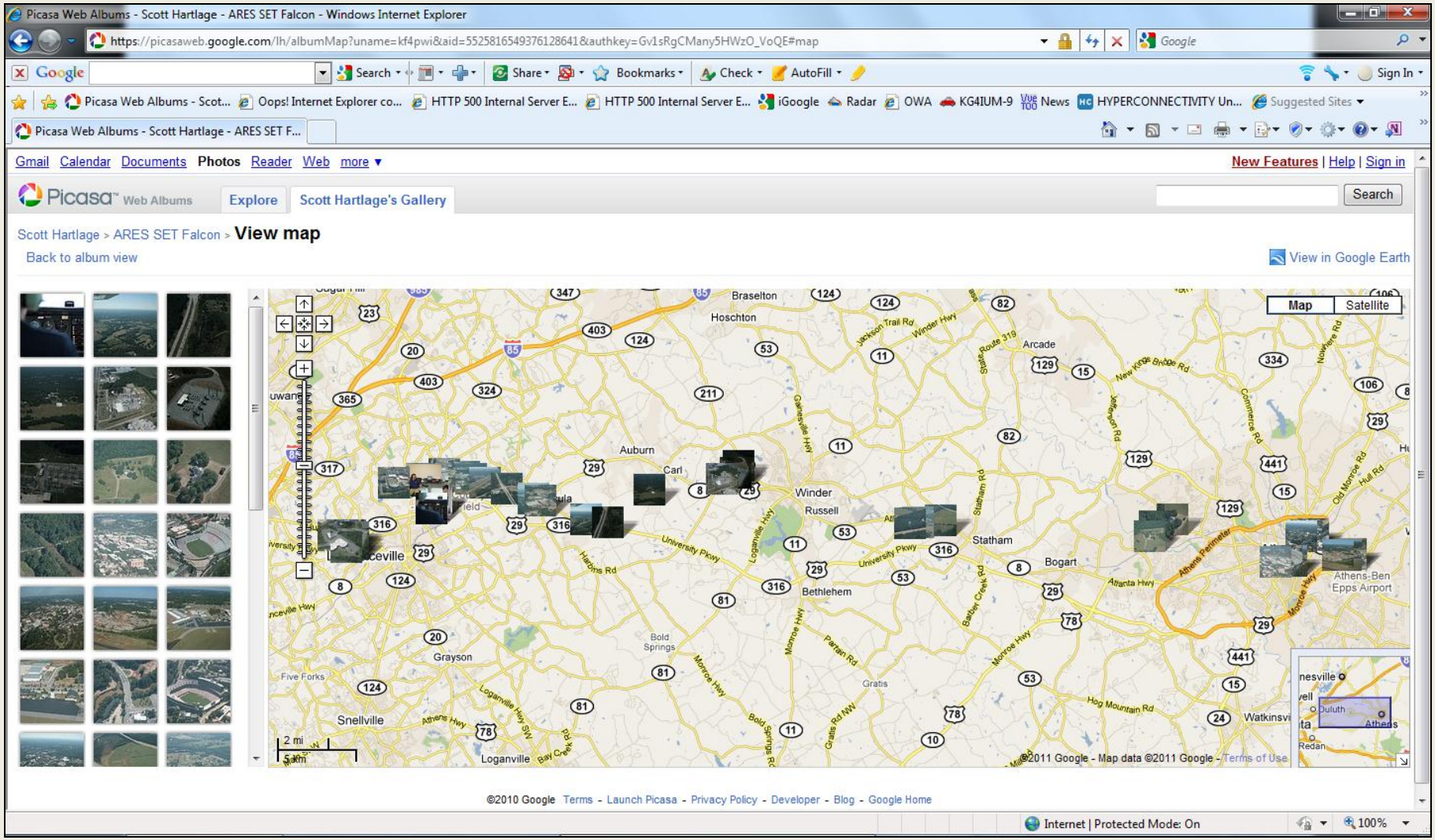
- **What is needed**
  - Icom ID-1
  - D-STAR 1.2 GHz DD repeater or direct to another ID-1 (distance dependent on altitude)
  - Suitable digital camera
  - GPS Unit
  - Airplane with 1.2 GHz antenna attached
  - Pilot (not optional)
- **Sending photos**
  - Take photo
  - Transfer to laptop
  - Send file to Picasa or other location
  - Chat with users on ground via D-RATS



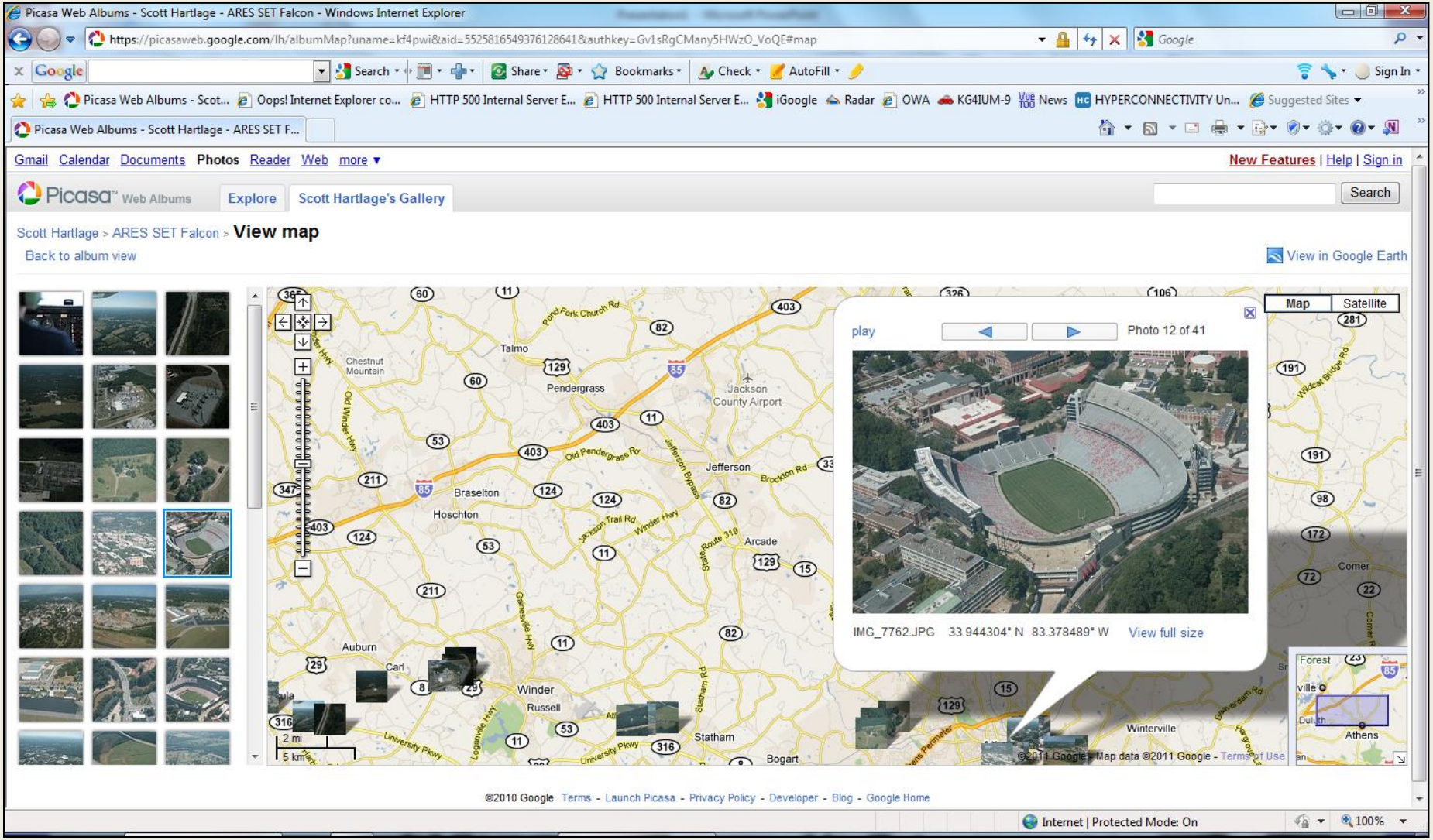
Picasa Volume of Photos



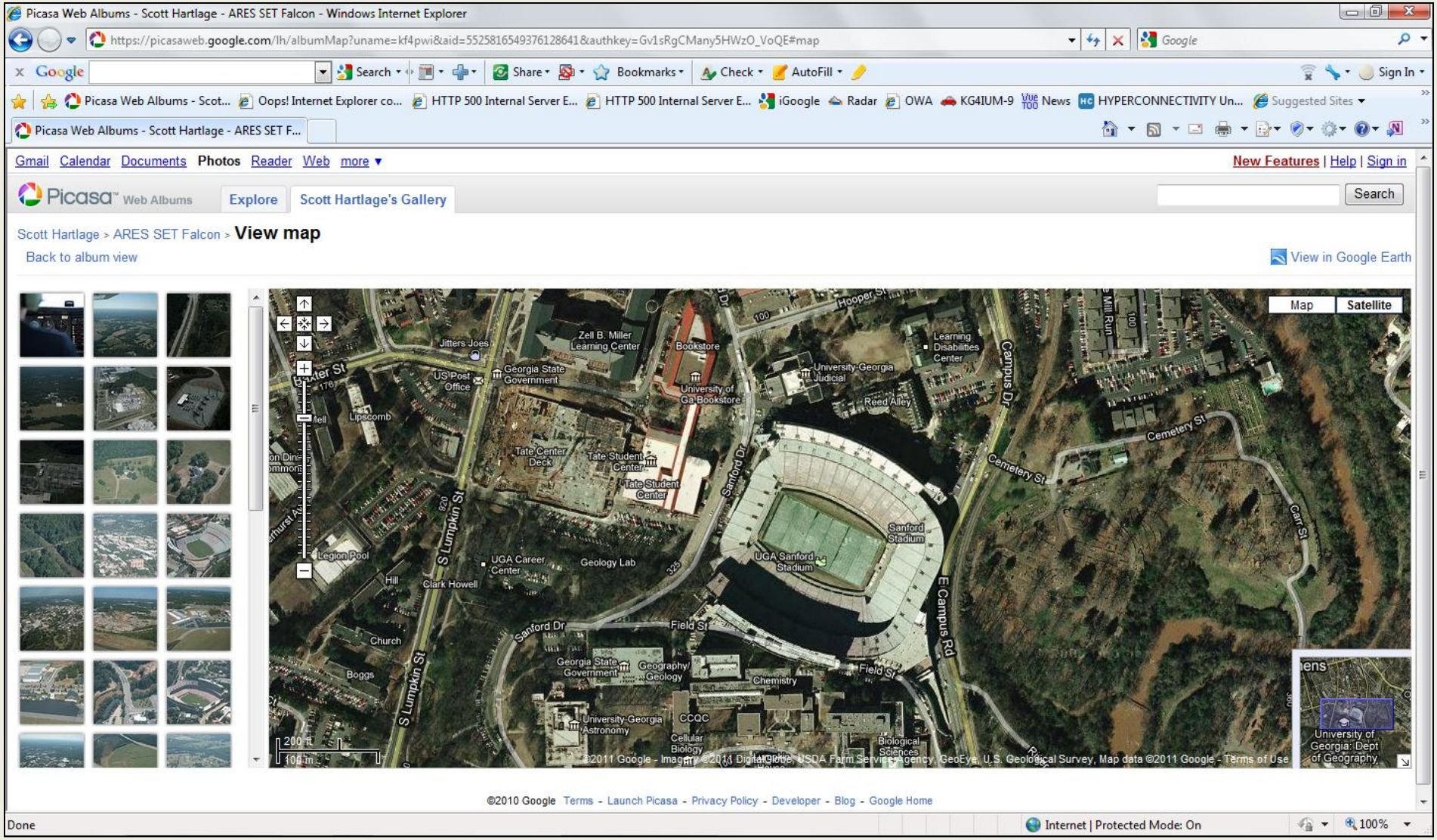
Photos Embedded on Google Maps



Viewing Embedded Photos on Map

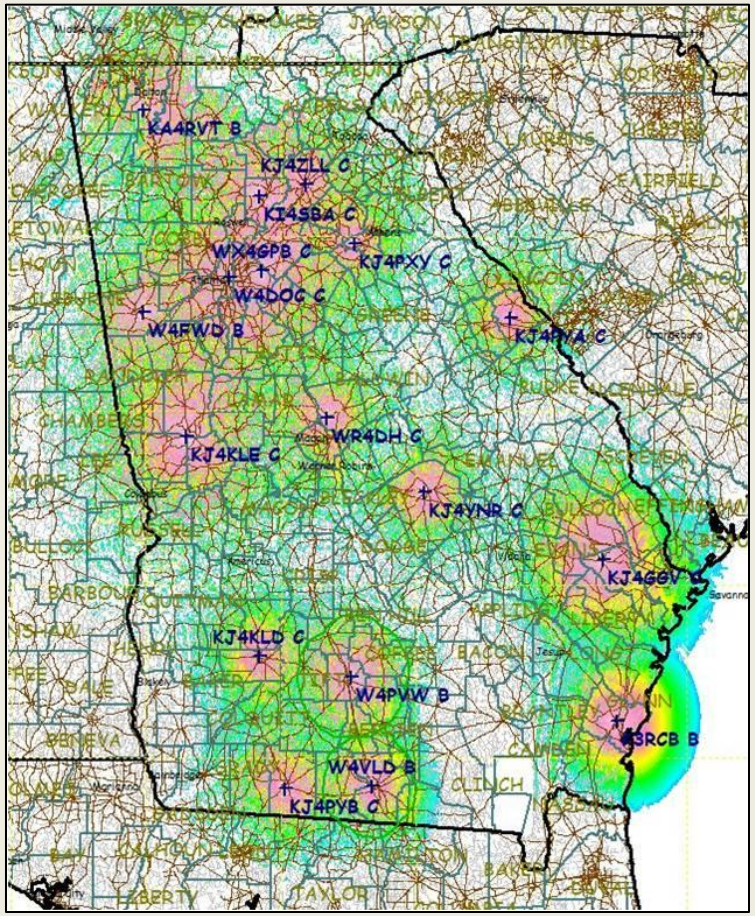


Google Satellite View: Before-Damage Assessment



A D-STAR Perspective from Georgia

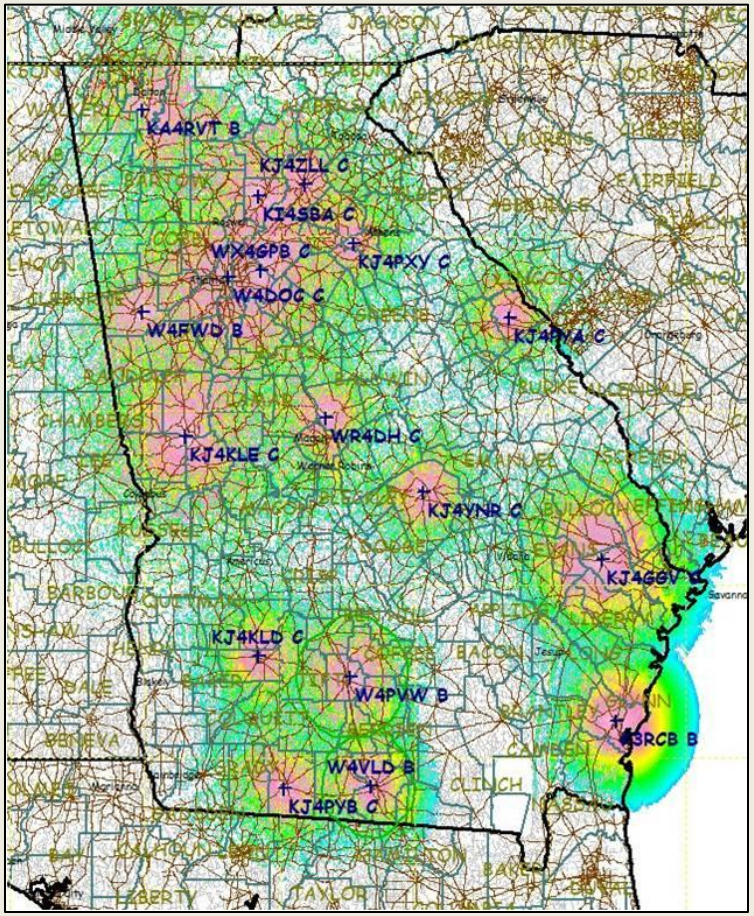
- Before D-STAR, several linked repeater networks existed serving portions of state
- No statewide data network
- Governor wanted aerial photography from disaster sites in real time
- GEMA wanted ability to setup multiple networks during incidents
- Data communications essential



- D-STAR addressed many requirements in one technology
- Provided $165k in funding for D-STAR repeater buildout
- D-STAR radios in SOC, NWS, GEMA-MCV, County EMAs, hospitals
- Wide user adoption across state
- Serves GA as “another tool in the toolbox”

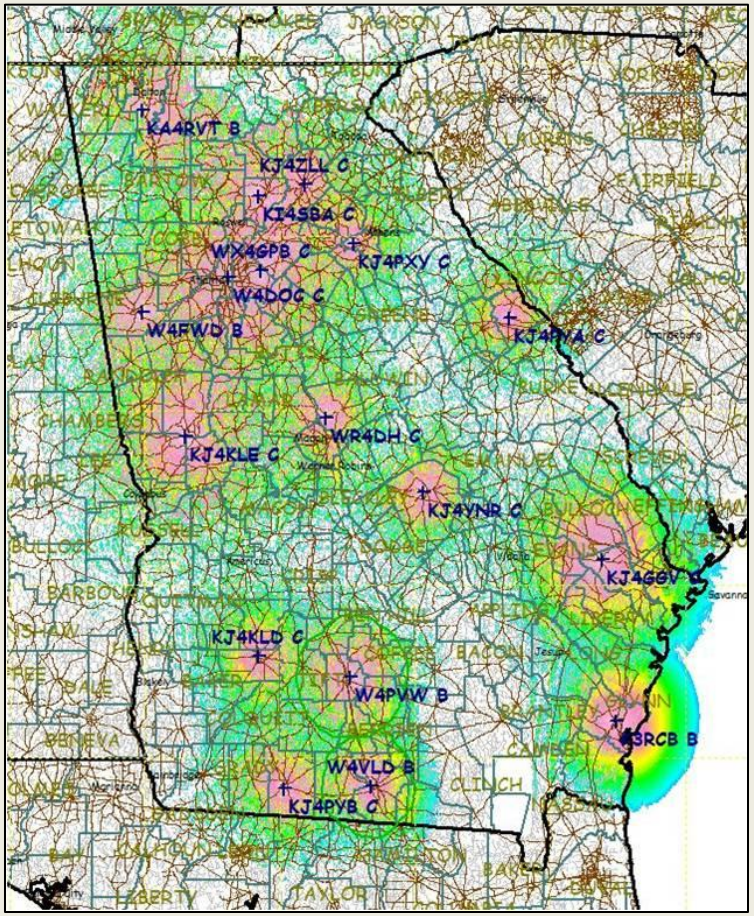
How Much D-STAR Georgia's $165k Bought

- 7 complete D-STAR repeater systems
- Each system included 2-meter, 70-cm, 1200 MHz voice, and high speed 1200 MHz data modules (i.e. a "full stack")
  - Each full stack provides 3 linkable repeaters for independent or simultaneous use, plus a 1200 MHz high speed data module
- Each repeater included controller, all RF modules, power supply, duplexers, 7-foot 19" Dell computer racks, Dell gateway PC, and other piece parts
- All but two repeaters systems procured, integrated, and deployed at state radio sites across Georgia 18 months after funding received



How Much D-STAR Georgia's $165k Bought

- Same grant also purchased…
  - 10 Icom IC-2820 dual-band D-STAR / analog mobile transceivers
  - Power supplies for each mobile radio
  - 10 Icom IC-92AD dual-band D-STAR / analog handheld transceivers
- All Icom equipment was available under GSA contracts for no-bid purchases for government entities



Questions and Discussion

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3:00-3:55pm	Overflow, other topics, prize drawing, wrap-up

D-STAR | brainstorm session

Mike Pendley K5ATM

New Mexico D-STAR Academy
February 18, 2012

Purpose

- **Given what you've learned so far…**
  - **What activities/applications would D-STAR provide value in? Why?**
  - **What improvements to hardware (i.e. Dongles, hot spots, etc) can benefit ham community? Can anything new be created?**
  - **What improvements to software can benefit ham community? Can anything new be created?**

- **Ground rules**
  - **Every idea is a good idea**
  - **Think about every aspect of your ham radio involvement (ARES, contesting, ragchewing, experimenting, homebrewing, etc)**
  - **Don't worry about resource limitations (i.e. money, time, feasibility, etc)**

Interactive Brainstorm Session

Agenda

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D-STAR | ins and outs of repeater maintenance

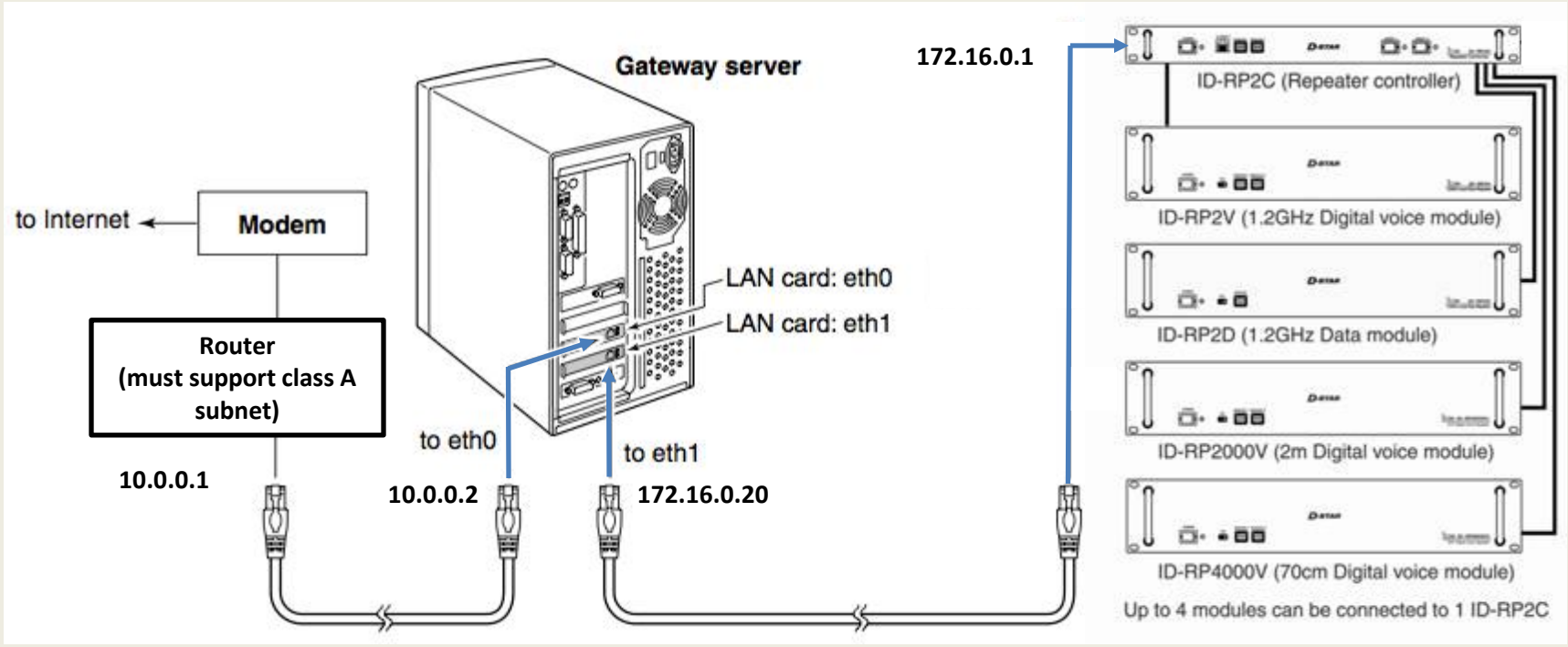
Ed James KA8JMW
Brian Mileshosky N5ZGT
Richard Browning AD5RB

New Mexico D-STAR Academy
February 18, 2012

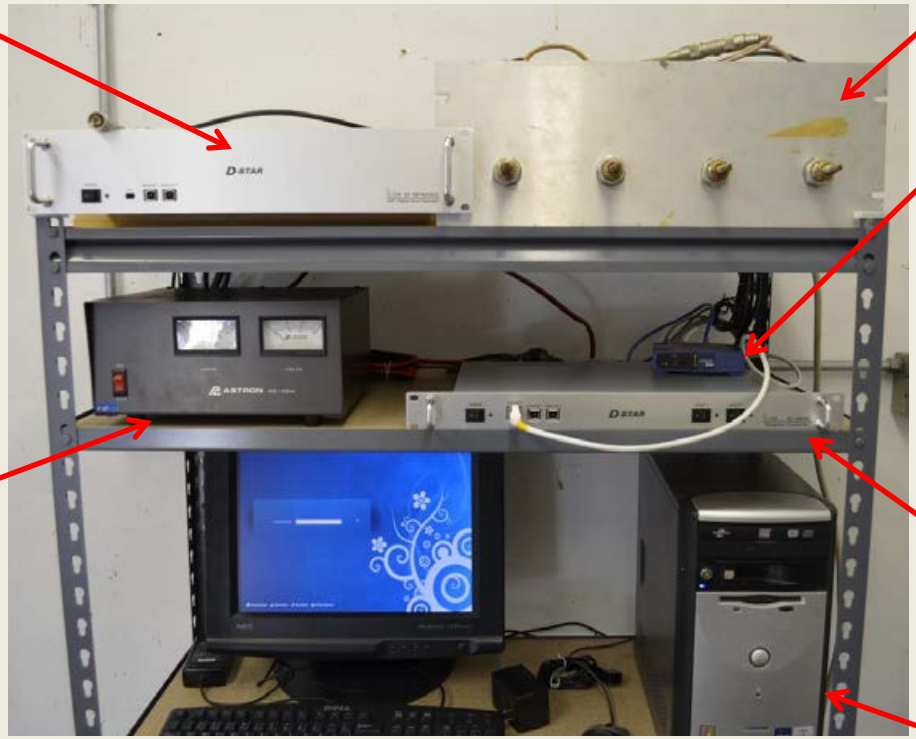
Components of a D-STAR Repeater

- **Good repeater site** – Largely defines your repeater coverage!
- **Controller module** – Icom ID-RP2C
- **RF module(s)** – 144 MHz, 440 MHz, 1200 MHz voice, 1200 MHz data
- **Computer** – 2.4 GHz, 512 MB RAM, running CentOS linux
- **Router** – Linksys WRT54G / WRT54GS (DD-WRT firmware) recommended
- **Internet connection** – At least 256 kbit bandwidth
- **12 VDC Power supply** – 30 amp ideal
- **Backup electricity**
- **Duplexer(s)** – To provide isolation between transmitter and receiver
- **RF isolator (or circulator with load)** – To prevent reflected RF from feeding back into repeater's power amplifier
- **Antenna(s)** – High quality, designed for hostile environments
- **Feedline** – Low loss, high quality

Components of a D-STAR Repeater



Components of a D-STAR Repeater



70cm RF module
Icom RP-4000V

70cm
duplexer

Router
Linksys WRT-54G-TM
Running DD-WRT

Power Supply
Astron RS-35M

Controller
Icom RP2C

D-STAR gateway
server

W5MPZ repeater (initial configuration)

Various other D-STAR Repeaters

K6SOA

NJ2DS

VK5REX

New Mexico D-STAR Academy

Why Quality Matters…

Antenna installation in summer…

Same antenna in winter…loaded with rime ice

D-STAR Gateway Administration

- **Intended Audience**
  - **This information is targeted for:**
    - **Gateway Administrators – those that have root access**
    - **Those that have overall responsibility for the operational status of a D-STAR repeater system.**
    - **Those who may eventually be involved in putting up a D-STAR repeater (you or someone else will appreciate these notes in your D-STAR Academy notebook)**

- **Comfort with Linux is assumed.**

D-STAR Gateway Administration

Now that you have a working D-STAR Repeater…

…What tools are available to keep it working properly and/or add to its functionality?

D-STAR Gateway Fundamentals

- Apply all updates as they are issued
- Having the right tools can make the job easier
- Even the ‘right tool’ can be dangerous in the wrong hands
- Tools (add-ons) fall into two categories
  - Help maintain system health and stability
  - Add functionality

Tools to Help You Maintain Your Gateway

- **Many tools are available and new ones are constantly being developed**
  - **Subscribe to the 'D-STAR_Admins' and 'DStar-Gateway' Yahoogroups for news and tips**
- **Good sources for tools and tips include:**
  - http://groups.yahoo.com/group/D-STAR_Admins/
  - http://groups.yahoo.com/group/DStar-Gateway/
  - http://www.opendstar.org/tools
  - http://wb4fay.com/util
  - http://dsync.dstarusers.org/info/
  - http://www.dstarinfo.com/various-tips.aspx

D-STAR Gateway Tools

- **Log Rotate '/etc/logrotate.d/dstar'**
  - **Some D-STAR related log files will grow without bound unless the logs are rotated periodically**
  - **Will rotate the D-STAR associated logs in /var/log (dscgi.log, dsipsvd.log, dsgwd.log, gw_schedule.log, dplus.log, dstarmon.log and monlink.log)**
  - **After the rotate, it will automatically restart any associated processes**

Can be found at: http://wb4fay.com/util/dstar

D-STAR Gateway Tools

- ‘/dstar/tools/dstarusersls’ – List the users registered on the local gateway.
  - Local users requesting registration
  - Local users registered without a terminal
  - Local users registered with terminals
  - Local users registered on multiple gateways.
- ‘/dstar/tools/dstarpasswd’ – Reset a local user’s registration password.
  - A user’s password cannot be retrieved, howevr you can set a new pasword for them if they have forgotten it
- ‘/dstar/tools/dstaruserfind’- Shows repeater and module where user was last heard.
  - If the user is new and has never keyed a D-STAR radio, it will show as last heard on module A of the system where they are registered

‘fixdns’

- ‘/dstar/tools/fixdns’ – Corrects invalid callsign entries in DNS data
  - Use if ‘named’ is not running and will nor start properly
    - Use ‘/sbin/service named status’ to check if named is running
    - Use ‘dig usroot.dstarusers.org’ to check if it is functioning properly
  - Will remove invalid user defined terminals that prevent ‘named’ from starting
    - ‘named’ will generally continue to run if a bad entry is injected via a trust server sync
    - However, these bad entries sometimes prohibit ‘named’ from being able to start

Not often used, but a lifesaver if needed...

‘monlink’

- ‘/dstar/util/monlink’ – Monitors and manages links
  - Highly configurable by the system admin
  - Can drop inactive or idle links that are up
  - Can automatically attempt to re-established failed links
  - Can make periodic announcements (voice and or text) about link connections
  - Can make periodic general announcements (voice and/or text)
  - Can manage “default links” that some systems keep up to generate activity on the system
  - Configuration controlled by ‘/dstar/util/monlink.conf’

Can be found at: http://wb4fay.com/util/monlink.pdf

‘dplusreport’

- ‘/dstar/util/dplusreport’ – Designed for Net Control Stations
  - Runs on the gateway
  - NCS needs a user level (NOT root level) login to gateway
  - Processes dplus.log file and formats the data for NCS
  - Displays status of links on the system (e.g. Reflector connections)
  - Displays calls of stations that have checked into the net
  - Allows for color coding call sign display based on time since last key up
  - Makes clear user radio programming issues so NCS can help the user with programming
  - Highlights if user has “BREAK” or “EMERGENCY” mode set in their radio
  - Allows for near paperless Net Control functions

Can be found at: http://wb4fay.com/util/dplusreport.pdf

D-STAR Gateway Services

- **Service can be started, stopped, restarted or checked**
  - **Must be logged in as root user**
- **‘/sbin/service *service_name action*’**
  - ***service_name*:**
    - **dstar_gw**
    - **named**
    - **dsm**
    - **dplus**
  - ***action*:**
    - **start**
    - **stop**
    - **status**
    - **restart**

```
[root]# /sbin/service monlink status
monlink is running, PID = 23395, version = 0.4a 12/21/11
[root]# /sbin/service dplus status
dplus is running, PID = 23035, version = 2.2h
[root]# /sbin/service named status
number of zones: 7
debug level: 0
xfers running: 0
xfers deferred: 0
soa queries in progress: 0
query logging is OFF
recursive clients: 0/1000
tcp clients: 0/100
server is up and running
named (pid  2404) is running...
[root]# /sbin/service dsm status
DSM ok (DSM= 2836 APRS= 2862 2867)
[root]# /sbin/service dstar_gw status
postgres is running...
tomcat is running...
httpd is running...
dsipsvd is running...
dsgwd is running…
```

New Mexico D-STAR Academy

Real-time Monitoring of Gateway Logs

- **Regular monitoring of the status of your gateway is crucial to understanding what is normal behavior**
  - **dplus.log**
    - **'tail –f /var/log/dplus.log'**

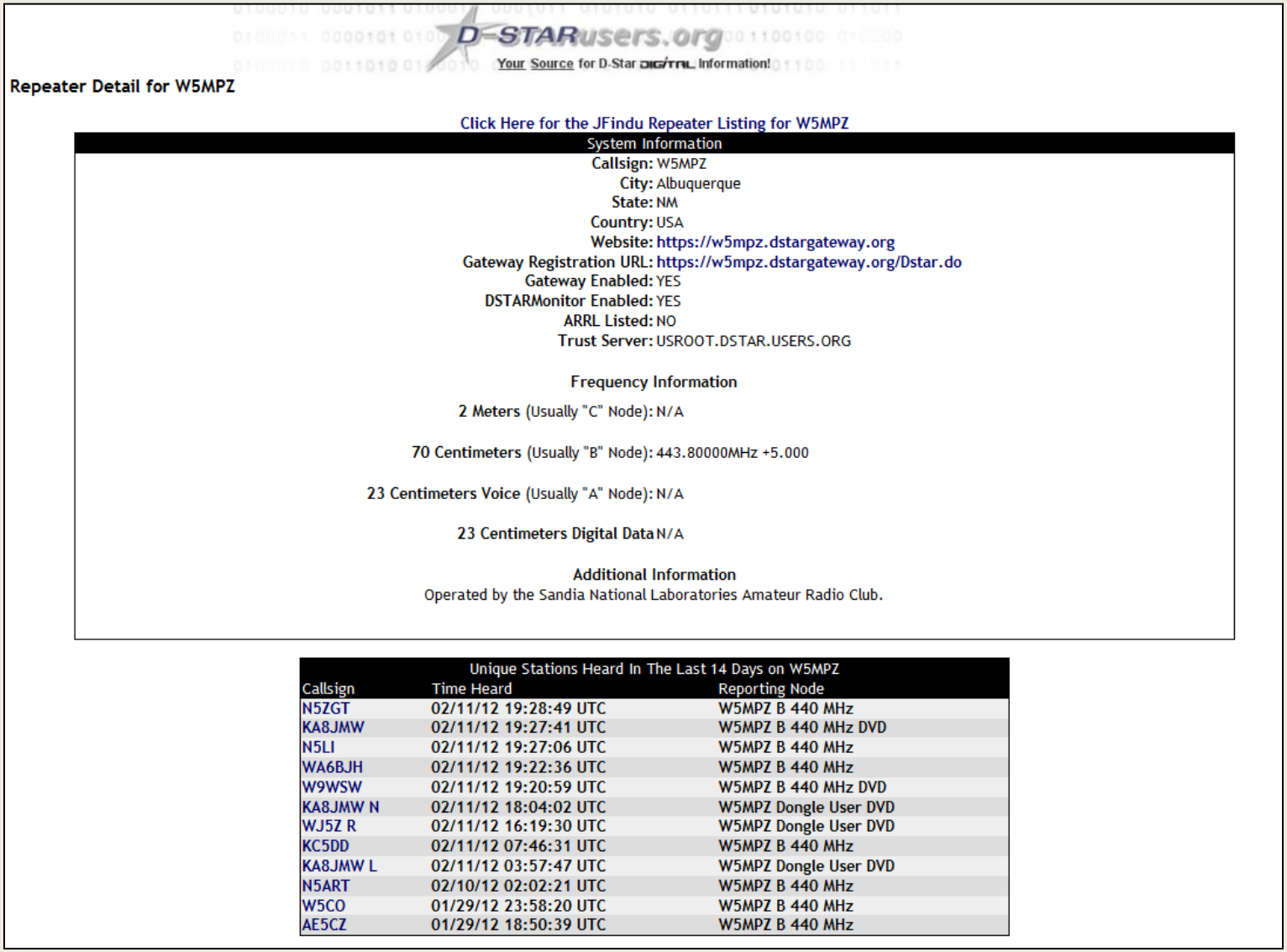
```
$ tail -f /var/log/dplus.log
Linked gateway list: 2012/02/11 15:47:54.017
 gateway NM5WR  B -> B IP 65.19.24.23:20001
Last heard list: 2012/02/11 15:46:53
 user (N5ZGT   ) rpt (W5MPZ  B) type RF     msg (BRIAN / ABQ, NM     ) 2012/02/11 15:38:48
 user (KC5DD/ED) rpt (W5MPZ  B) type RF     msg (                    ) 2012/02/11 15:26:02
 user (KC5DD   ) rpt (W5MPZ  B) type RF     msg (                    ) 2012/02/11 14:04:25
 user (WA6BJH  ) rpt (W5MPZ  B) type RF     msg (KERRY FROM SANTA FE ) 2012/02/11 13:41:44
 user (KA8JMW  ) rpt (W5MPZ  B) type Dongle msg (Ed Albuquerque NM   ) 2012/02/11 13:19:46
 user (W9WSW   ) rpt (W5MPZ  B) type Dongle msg (SCOTT/East Lansing  ) 2012/02/11 12:45:48
 user (KM5TP   ) rpt (W5MPZ  B) type RF     msg (                    ) 2012/02/11 12:30:24
 user (N5LI    ) rpt (W5MPZ  B) type RF     msg (                    ) 2012/02/11 12:27:06
User update (W5MPZ  S) rpt (W5MPZ  S) 2012/02/11 15:47:49.299
Linked user list: 2012/02/11 15:47:54.017
 client  KA8JMW N -> B IP 174.28.103.166:15517  type Dongle
 client  W9WSW    -> ? IP 98.209.42.51:4608     type Dongle
```

Real-time Monitoring of Gateway Logs

- **monlink.log**
  - **'tail –f /var/log/monlink.log'**

```
$ tail -f /var/log/mon.log
ANNOUNCEMENT: /dstar/util/dv/NM5WR_BL.dvtool to Module B
Message Sent: echo Linked to NM5WR -B > /dstar/tmp/message-b
  Link Status - 2012-02-11 16:00:48
   A: not linked
   B: connected to NM5WR  B Duration: 1323 Last send: 1320 Last rcv: 1323
   C: not linked
 Reconnect=yes600Out=3600
 Reconnect=yes600Out=3600
 Reconnect=yes200Out=7200
Maximum Number Reconnect Retries=10
Link Announcement Interval=600
Default links:
 Module:B Days:S------ Start:1850 Stop:2010  REF002A
 Module:B Days:-MTWTF- Start:0600 Stop:0900  REF030C
 Module:B Days:---W--- Start:1850 Stop:2000  REF025C
```

Monitoring Your Repeater and Gateway



D-STARusers.org
Your Source for D-Star DIGITAL Information!

Repeater Detail for W5MPZ

Click Here for the JFindu Repeater Listing for W5MPZ

System Information	
Callsign:	W5MPZ
City:	Albuquerque
State:	NM
Country:	USA
Website:	https://w5mpz.dstargateway.org
Gateway Registration URL:	https://w5mpz.dstargateway.org/Dstar.do
Gateway Enabled:	YES
DSTARMonitor Enabled:	YES
ARRL Listed:	NO
Trust Server:	USROOT.DSTAR.USERS.ORG

Frequency Information

2 Meters (Usually "C" Node):	N/A
70 Centimeters (Usually "B" Node):	443.80000MHz +5.000
23 Centimeters Voice (Usually "A" Node):	N/A
23 Centimeters Digital Data	N/A

Additional Information

Operated by the Sandia National Laboratories Amateur Radio Club.

Unique Stations Heard In The Last 14 Days on W5MPZ

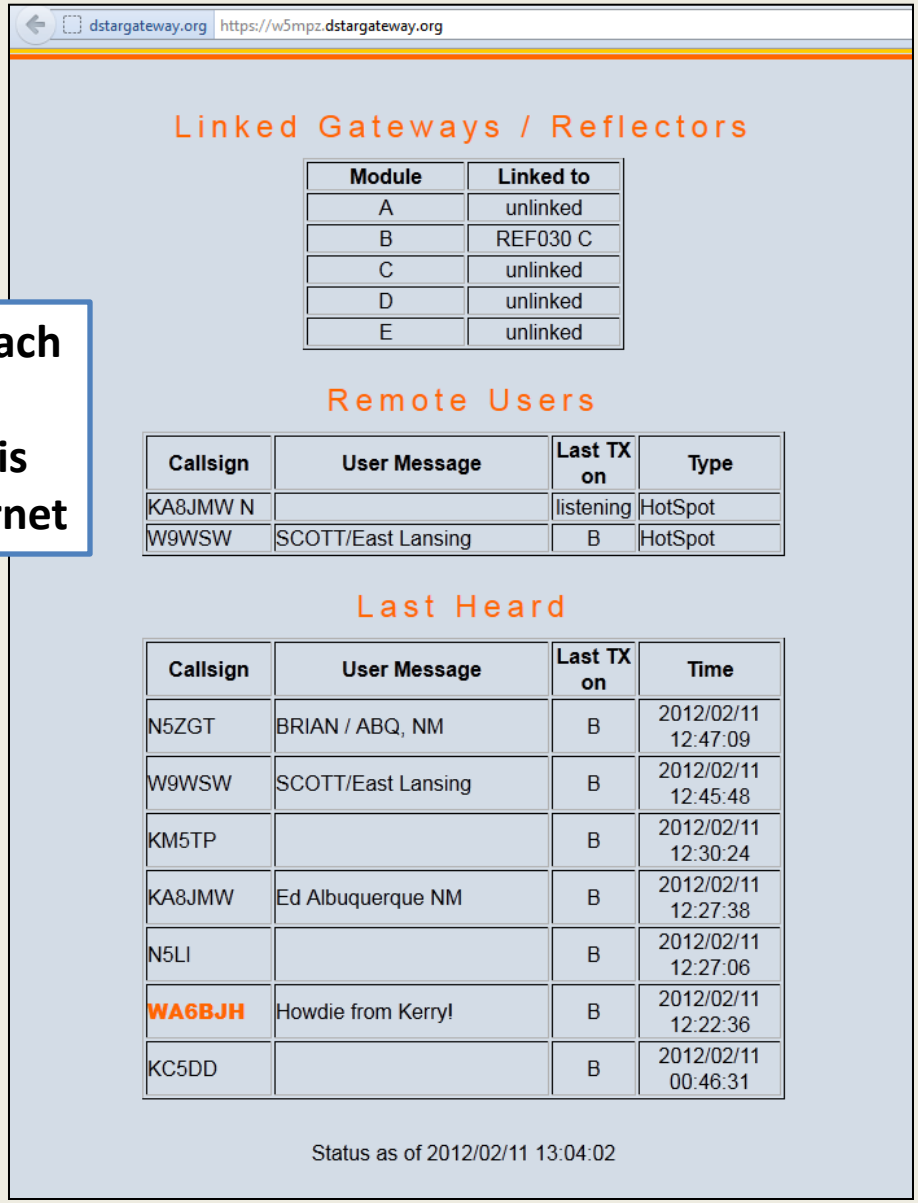
Callsign	Time Heard	Reporting Node
N5ZGT	02/11/12 19:28:49 UTC	W5MPZ B 440 MHz
KA8JMW	02/11/12 19:27:41 UTC	W5MPZ B 440 MHz DVD
N5LI	02/11/12 19:27:06 UTC	W5MPZ B 440 MHz
WA6BJH	02/11/12 19:22:36 UTC	W5MPZ B 440 MHz
W9WSW	02/11/12 19:20:59 UTC	W5MPZ B 440 MHz DVD
KA8JMW N	02/11/12 18:04:02 UTC	W5MPZ Dongle User DVD
WJ5Z R	02/11/12 16:19:30 UTC	W5MPZ Dongle User DVD
KC5DD	02/11/12 07:46:31 UTC	W5MPZ B 440 MHz
KA8JMW L	02/11/12 03:57:47 UTC	W5MPZ Dongle User DVD
N5ART	02/10/12 02:02:21 UTC	W5MPZ B 440 MHz
W5CO	01/29/12 23:58:20 UTC	W5MPZ B 440 MHz
AE5CZ	01/29/12 18:50:39 UTC	W5MPZ B 440 MHz

New Mexico D-STAR Academy

http://dstarusers.org/viewrepeater.php?system=W5MPZ

Monitoring Your Repeater and Gateway

This page resides on each D-STAR repeater's gateway server, and is accessible via the internet



Linked Gateways / Reflectors

Module	Linked to
A	unlinked
B	REF030 C
C	unlinked
D	unlinked
E	unlinked

Remote Users

Callsign	User Message	Last TX on	Type
KA8JMW N		listening	HotSpot
W9WSW	SCOTT/East Lansing	B	HotSpot

Last Heard

Callsign	User Message	Last TX on	Time
N5ZGT	BRIAN / ABQ, NM	B	2012/02/11 12:47:09
W9WSW	SCOTT/East Lansing	B	2012/02/11 12:45:48
KM5TP		B	2012/02/11 12:30:24
KA8JMW	Ed Albuquerque NM	B	2012/02/11 12:27:38
N5LI		B	2012/02/11 12:27:06
WA6BJH	Howdie from Kerry!	B	2012/02/11 12:22:36
KC5DD		B	2012/02/11 00:46:31

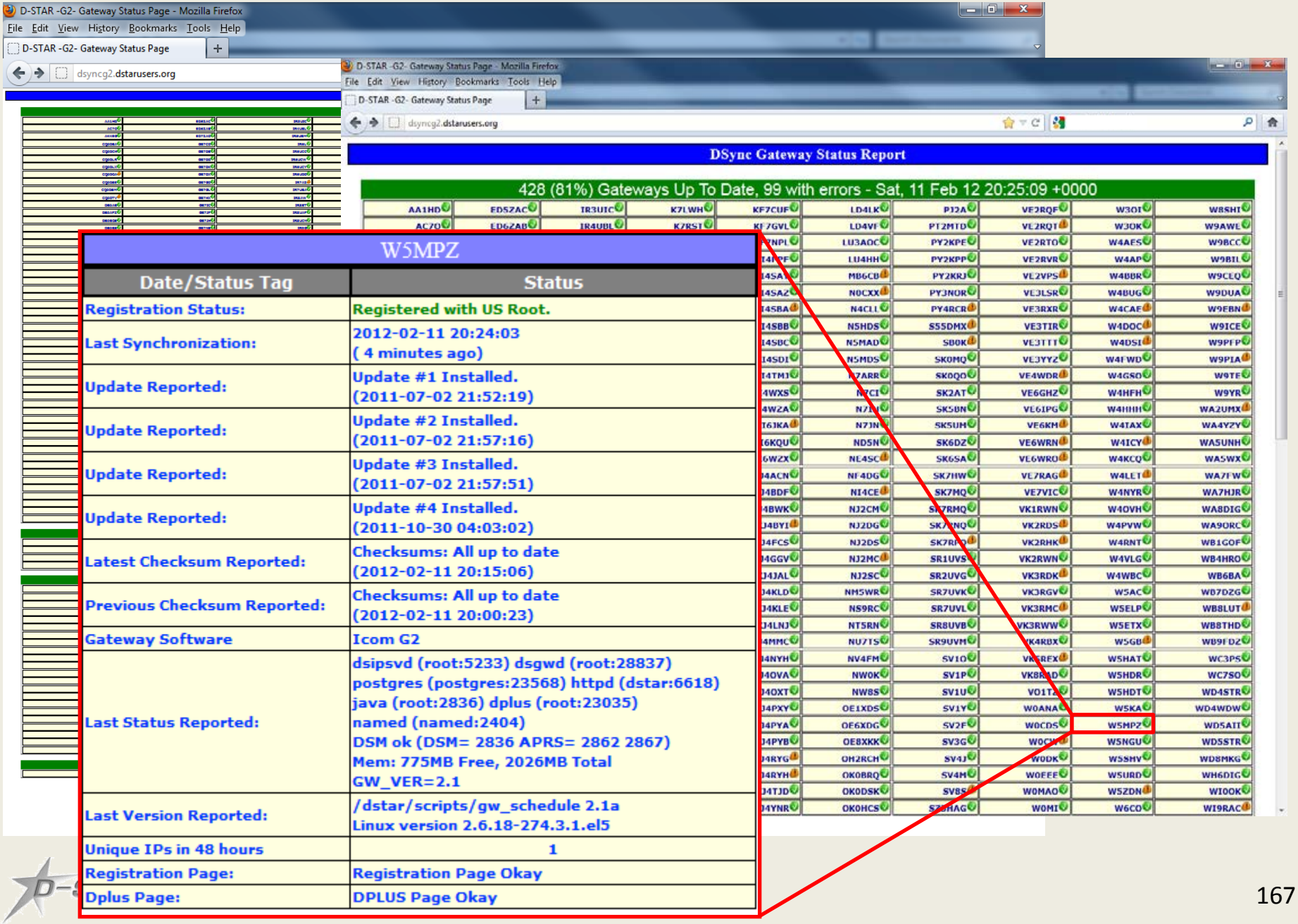
Status as of 2012/02/11 13:04:02

https://w5mpz.dstargateway.org

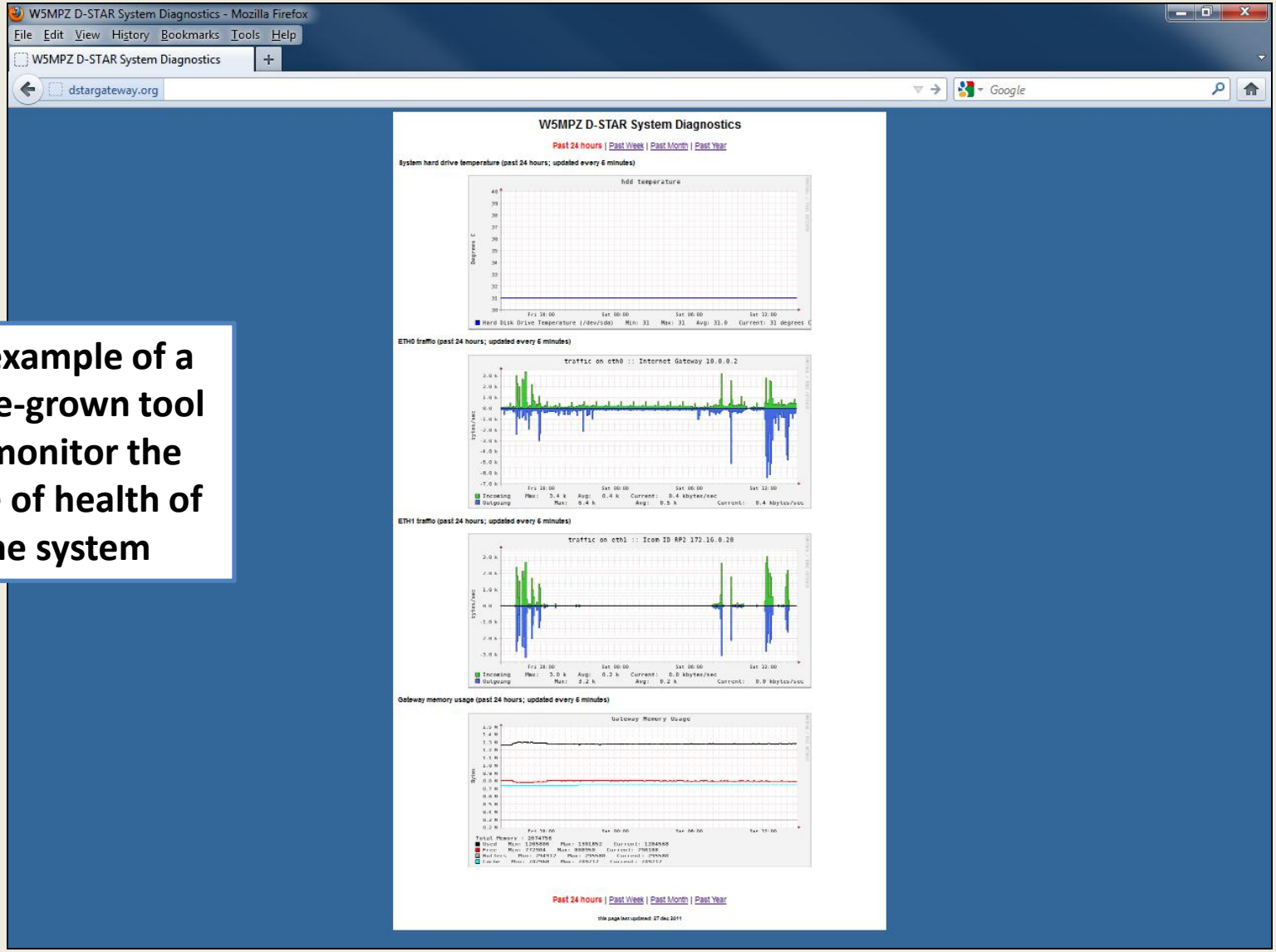
Monitoring Your Repeater and Gateway

- Los Alamos – NM5WR D-STAR repeater
  - http://dstarusers.org/viewrepeater.php?system=NM5WR
  - https://nm5wr.dstargateway.org
- Sandia Crest – W5MPZ repeater
  - http://dstarusers.org/viewrepeater.php?system=W5MPZ
  - https://w5mpz.dstargateway.org
- Capilla Peak – W5URD D-STAR repeater
  - http://dstarusers.org/viewrepeater.php?system=W5URD
  - https://w5urd.dstargateway.org
- Las Cruces – W5GB NM5WR D-STAR repeater
  - http://dstarusers.org/viewrepeater.php?system=W5GB
  - https://w5gb.dstargateway.org

http://dsync.dstarusers.org/gw_status.php?gw=W5MPZ



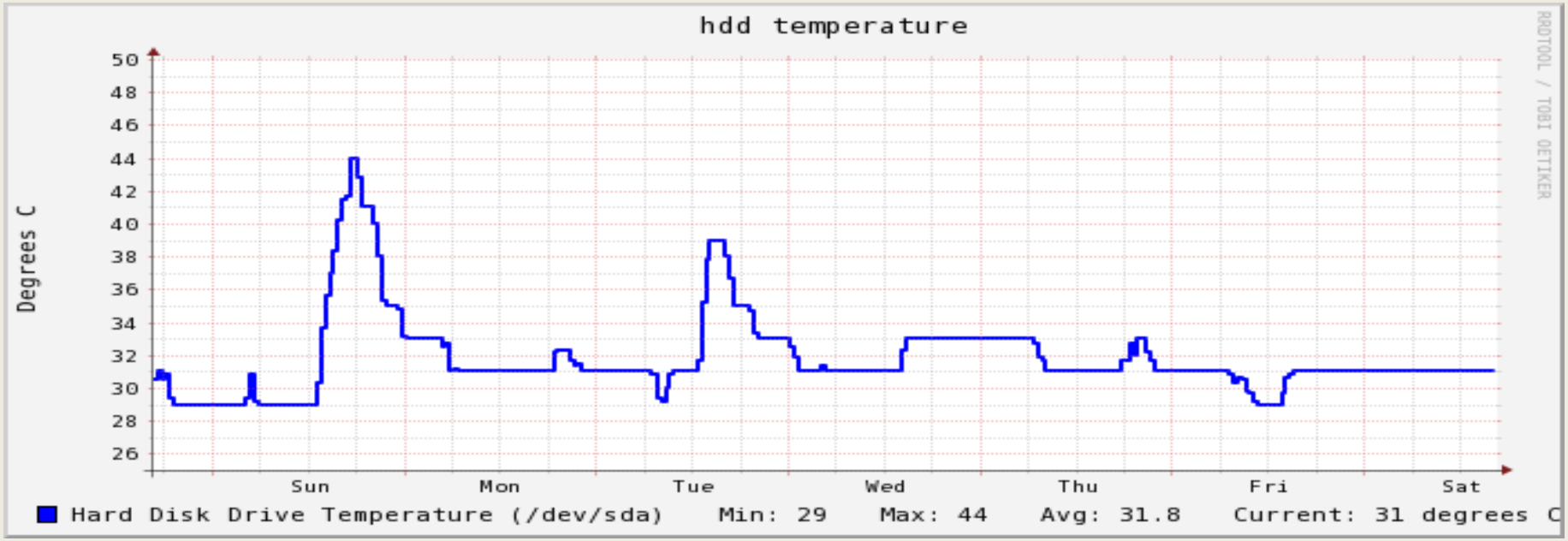
Gateway Monitoring using rrdtools



An example of a home-grown tool to monitor the state of health of the system

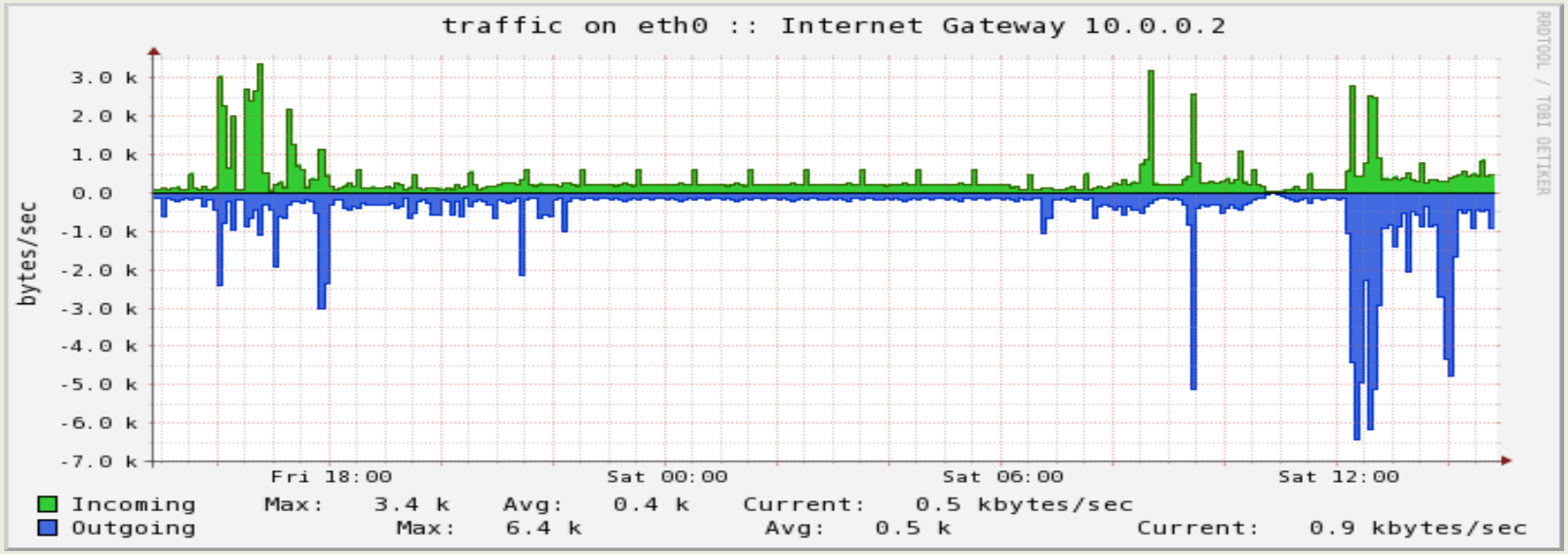
New Mexico D-STAR Academy

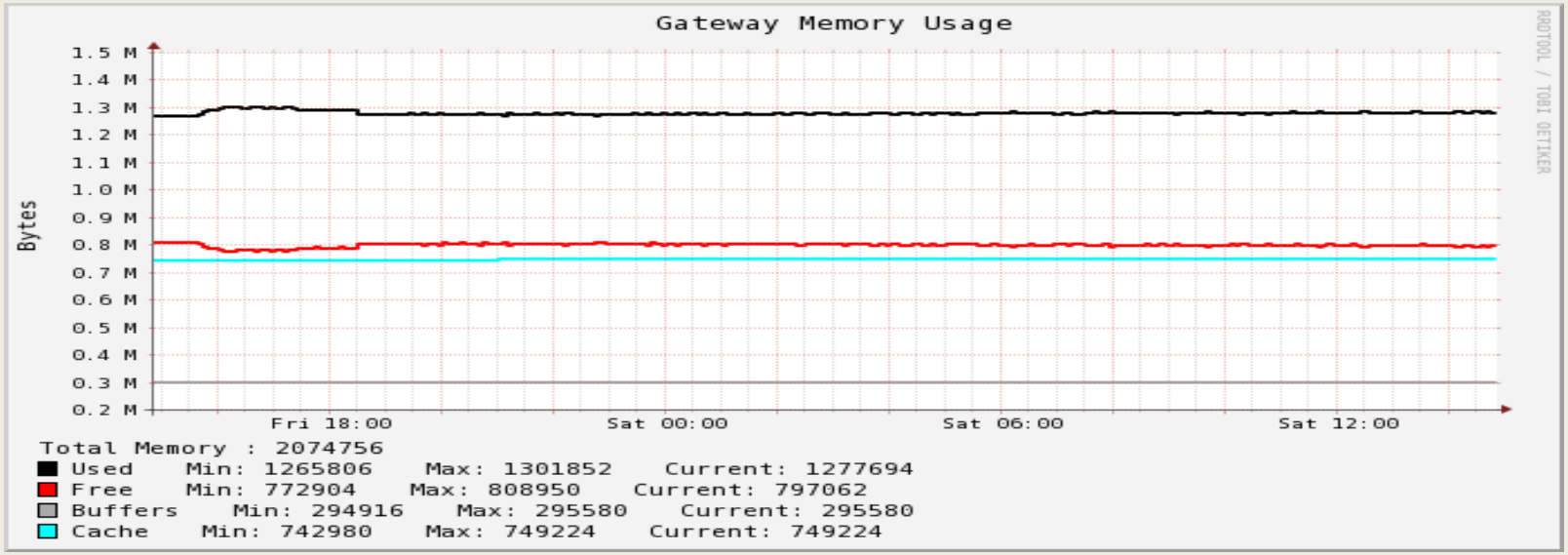
Gateway Monitoring using rrdtools



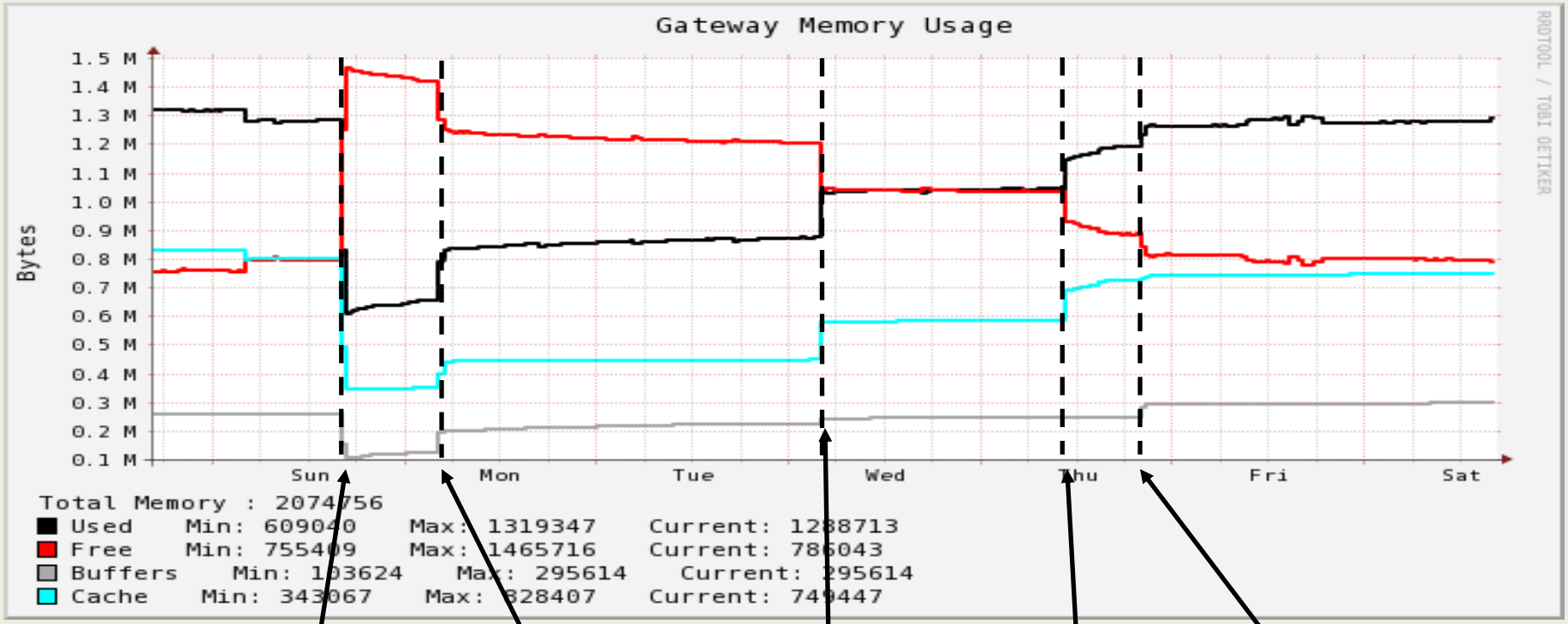
- Plots are generated by a set of Perl scripts
  - Use rrdtools (http://oss.oetiker.ch/rrdtool)
  - Cron job runs every five minutes

Gateway Monitoring using rrdtools





Example: Monitoring Gateway Memory Usage



Weekly log rotation

Internet lost

dplus stopped

Internet restored

dplus started

New Mexico D-STAR Academy

Agenda

8:00-8:55am	Welcome, D-STAR introduction and background
9:00-9:55am	Linking, functions, and memories
10:00-10:55am	Third party hardware and software, demo
11:00-11:55am	Working lunch, High speed 1200 MHz applications, demo
12:00-12:55pm	D-STAR and Emergency Communications
1:00-1:55pm	Hardware and software brainstorm session
2:00-2:55pm	Ins and outs of repeater maintenance
3:00-3:55pm	Overflow, other topics, prize drawing, wrap-up

Prize Drawing Policy

- One ticket provided to each attendee
- Prize drawing to be held at end of Academy
- Must be present at time ticket is drawn to win
- Name/callsign/ticket number will be announced two times; of not present, ticket will be placed back into bucket and another will be drawn
- Winner's name and callsign will be included in Academy's thank you letter to prize donor

A Final Thank You to…

- **Sponsors:**
  - Sandia National Laboratories ARC, Los Alamos D-STAR Repeater Association, Tech Amateur Radio Association, Upper Rio FM Society
- **Special thanks to:**
  - New Mexico Tech, Dave Johnson KB5YIW, Colorado Council of Amateur Radio Clubs, ARRL, Georgia D-STAR, John Davis WB4QDX, Icom America, Pat Mileshosky W5RMY, Carol James N5ZYP, Kathy James KE5WKW, Mike Pendley K5ATM
- **Generous prize donors:**
  - MoenComm – Star*Board GMSK Node Adapter hot spot
  - Nifty EZ Guide – Nifty E-Z Guide to D-STAR Operation (2 copies)
  - ARRL – $100 worth of gift certificates
- **Especially each of you for attending**

73 and see you on D-STAR!