

D-STAR

DV + DD
Digital Voice + Digital Data



D-STAR

Digital Voice + Digital Data
DV + DD

D-STAR Amateur Radio Next GEN



Tucson Possibilities



D-STAR

Digital Voice + Digital Data

Agenda

- Overview of D-STAR Technology
- Introduction to D-STAR System
- Introduction to D-STAR Equipment
- Getting Started
- Radio Programming
- DSTAR Resources
- Question/Answer

D-STAR

Digital Voice

+ Digital Data

DV + DD

- What is D-STAR?

- Digital Smart Technology for Amateur Radio

- JARL

- OPEN STANDARD

- Japanese Amateur Radio League

- **NOT** Manufacturers

- No ICOM does NOT own the standard!

- No ICOM does NOT own the CODEC

- Same CODEC is used for P25, DMR, Fusion and DSTAR

- Goal

- Advanced Local Communication

- Digital is the future

- Spectrum Efficiency

- Experiment with Simultaneous Voice and Data

- D-STAR Gateway Originally owned by Icom

- Not Public Domain or Open Source

- May not be copied, shared or redistributed

- D-STAR NON-ICOM Projects Available

- Repeaters/Gateways

- ircDDB

- Dongles/DVAPS

- Actual User Radios

MIC
SP

AMP

100 W



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Digital Voice + Digital Data



Technical Overview

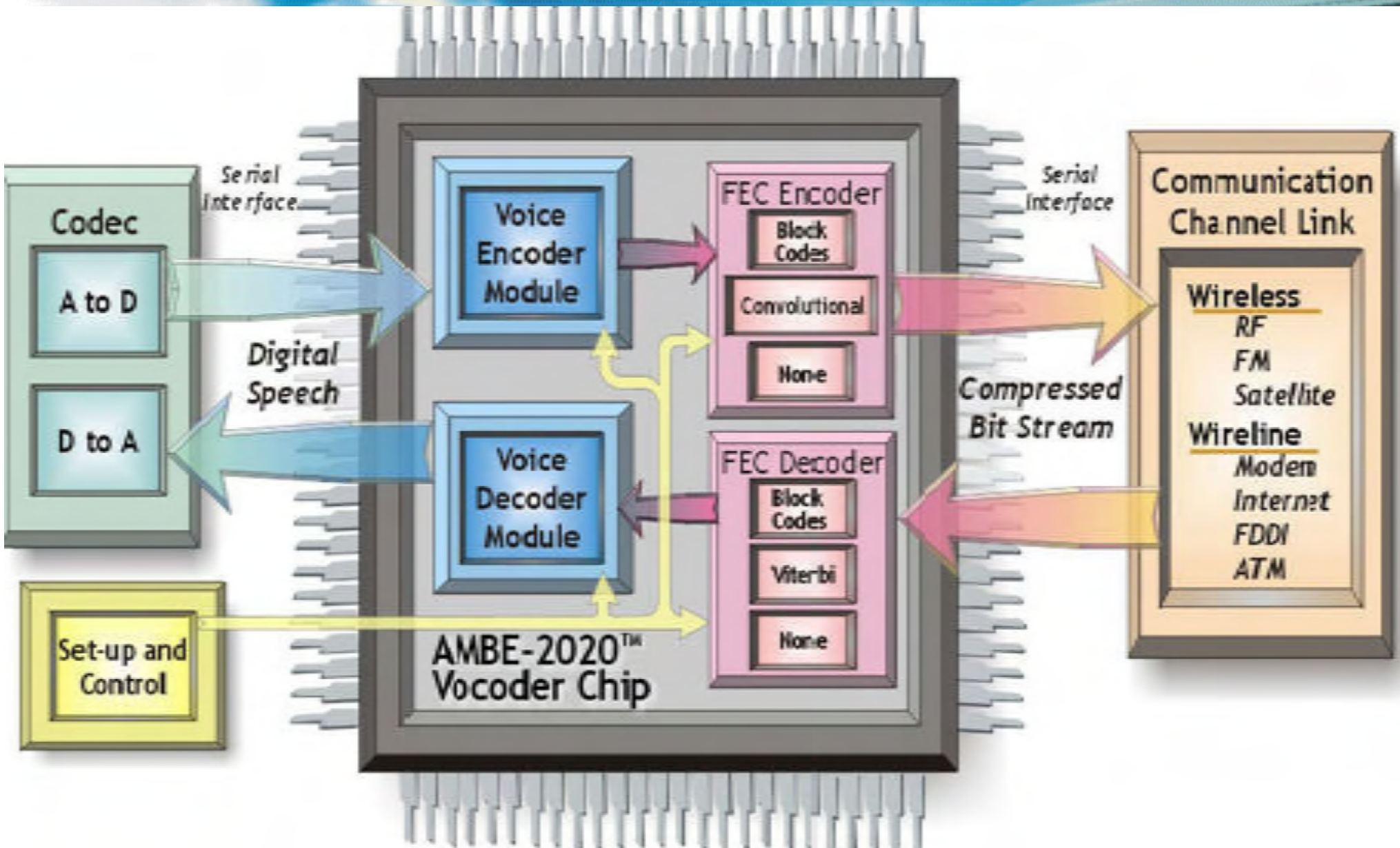


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Digital Voice 101



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Digital Voice

+ Digital Data

Terminology

- **AMBE**

- **A**dvanced **M**ulti-**B**and **E**xcitation (**AMBE**) is a very powerful proprietary speech coding standard developed by Digital Voice Systems, Inc.

(From: http://en.wikipedia.org/wiki/Advanced_Multi-Band_Excitation)

- Converts audio to and from the digital format used in D-Star Digital Voice at 2400 bps with 1200 bps of FEC.

- **FEC**

- Forward Error Correction

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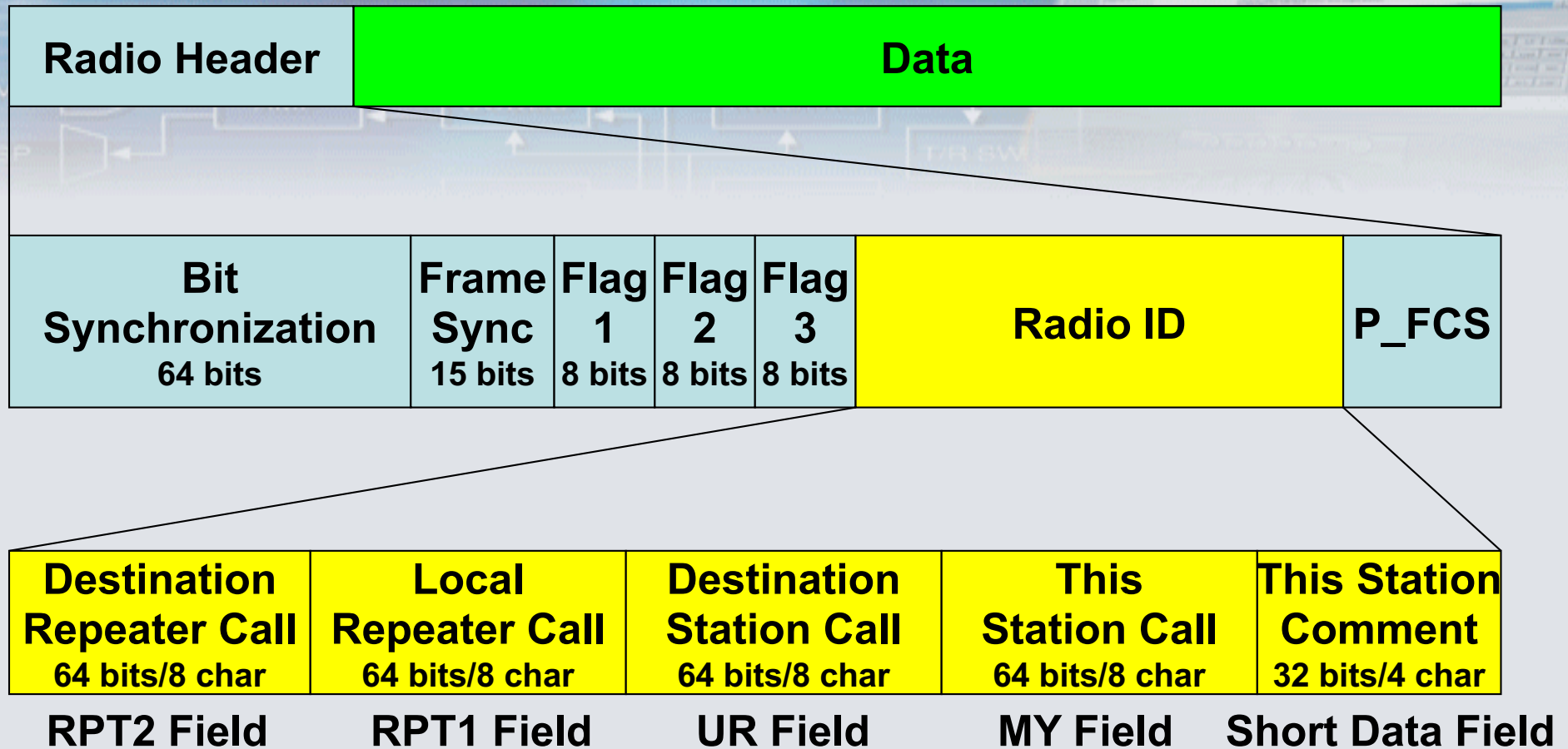
Digital Voice + Digital Data

Digital From The Beginning

Radio Header											Data					
Bit Syn	Frame Syn.	Flag 1	Flag 2	Flag 3	ID					P_FCS	Voice Frame	Data Frame	Voice Frame	Data Frame	Voice Frame	Data Frame
8bit	15bit	1	1	1	Destination Repeater Callsign	Depart-ure Repeater Callsign	Compa-nion Callsign	Own Callsign 1	Own Callsign 2	2byte	72byte	24byte	72byte	24byte	72byte	24byte

Both Voice and Data Share The Packet

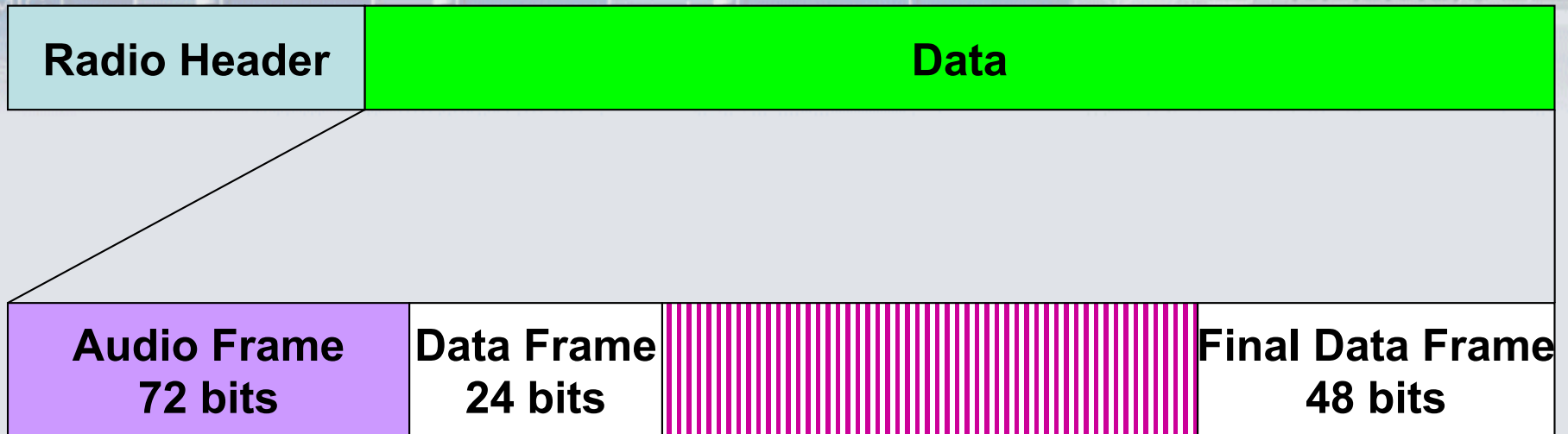
Header Care Abouts



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The DV Packet Care Abouts



Alternating Audio/Data

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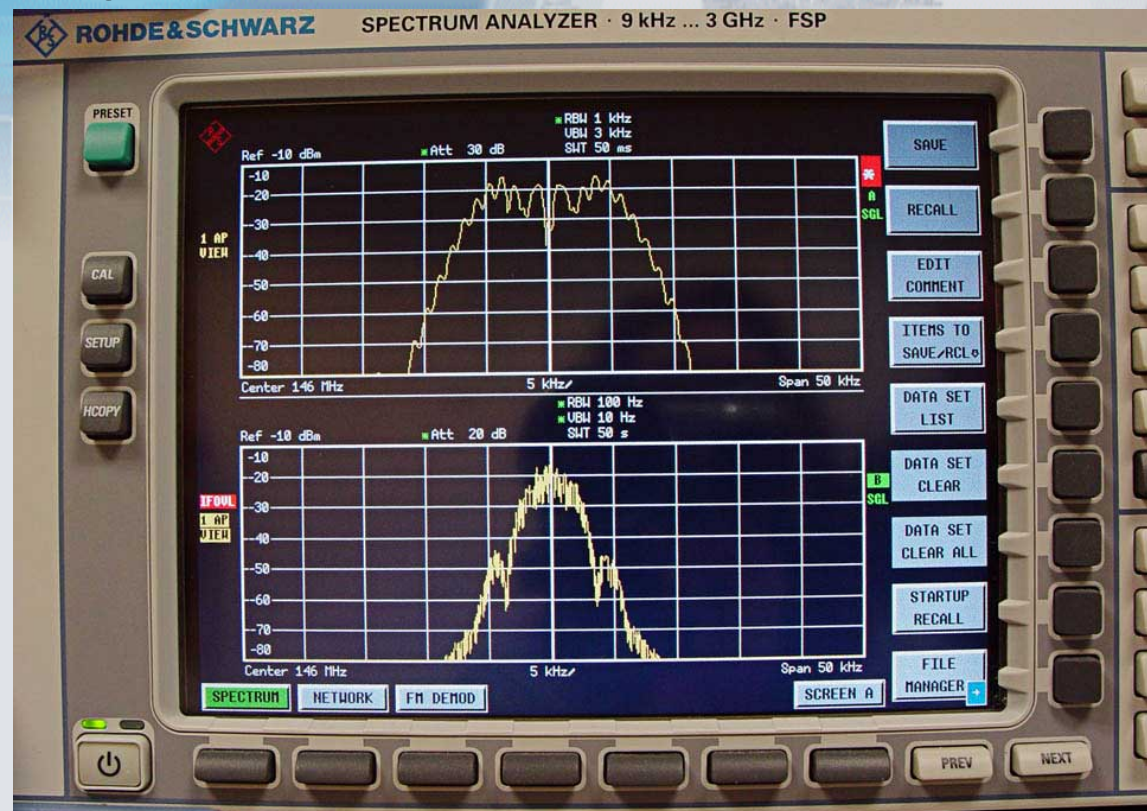
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Spectral Efficiency Vs FM

- **Spectral Efficiency**

- Gaussian Minimum Shift Keying (GMSK)
- Continuous Phase Modulation
- 6.25 kHz emission
- 10 kHz channel spacing (reasonable)
 - 12.5 Narrowband FM
 - 25 kHz Wideband FM (Ham Channels)
- More efficient use of available bandwidth
- Allows more channels in crowded spectrum
- Better performance compared to analog FM
 - Same power in less bandwidth (SSB vs. AM)
 - 30 dB processing gain of digital signal



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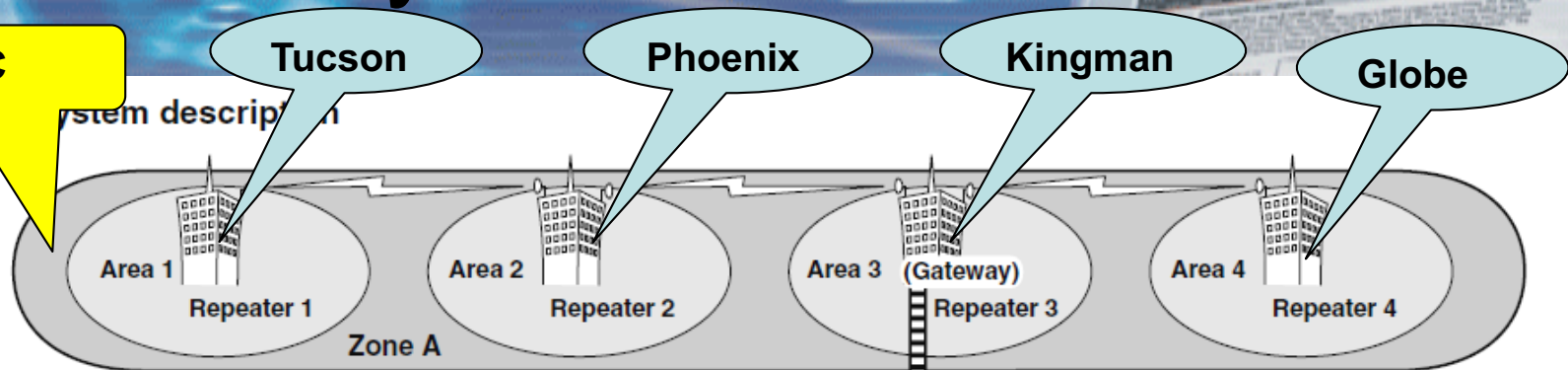


DSTAR System Overview

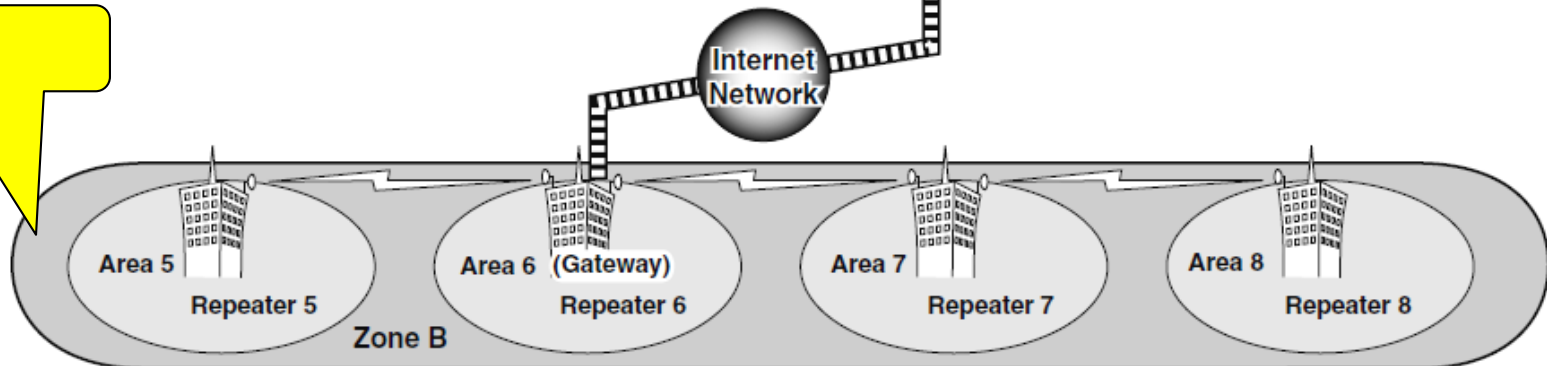
DSTAR System Overview

• D-STAR System Overview

AZ REF 009C



AZ REF 001C



Area:

The Area is the communication range that is covered by a single repeater. The repeater is called an area repeater in the D-STAR system.



Link repeater:

The microwave (10 GHz) link repeater provides to linking with another repeater site (Area) for zone construction.



Zone:

The Zone is composed of several areas, that are linked by a 10 GHz microwave link. The areas 1 to 4 and 5 to 8 make up a zone at the example above.

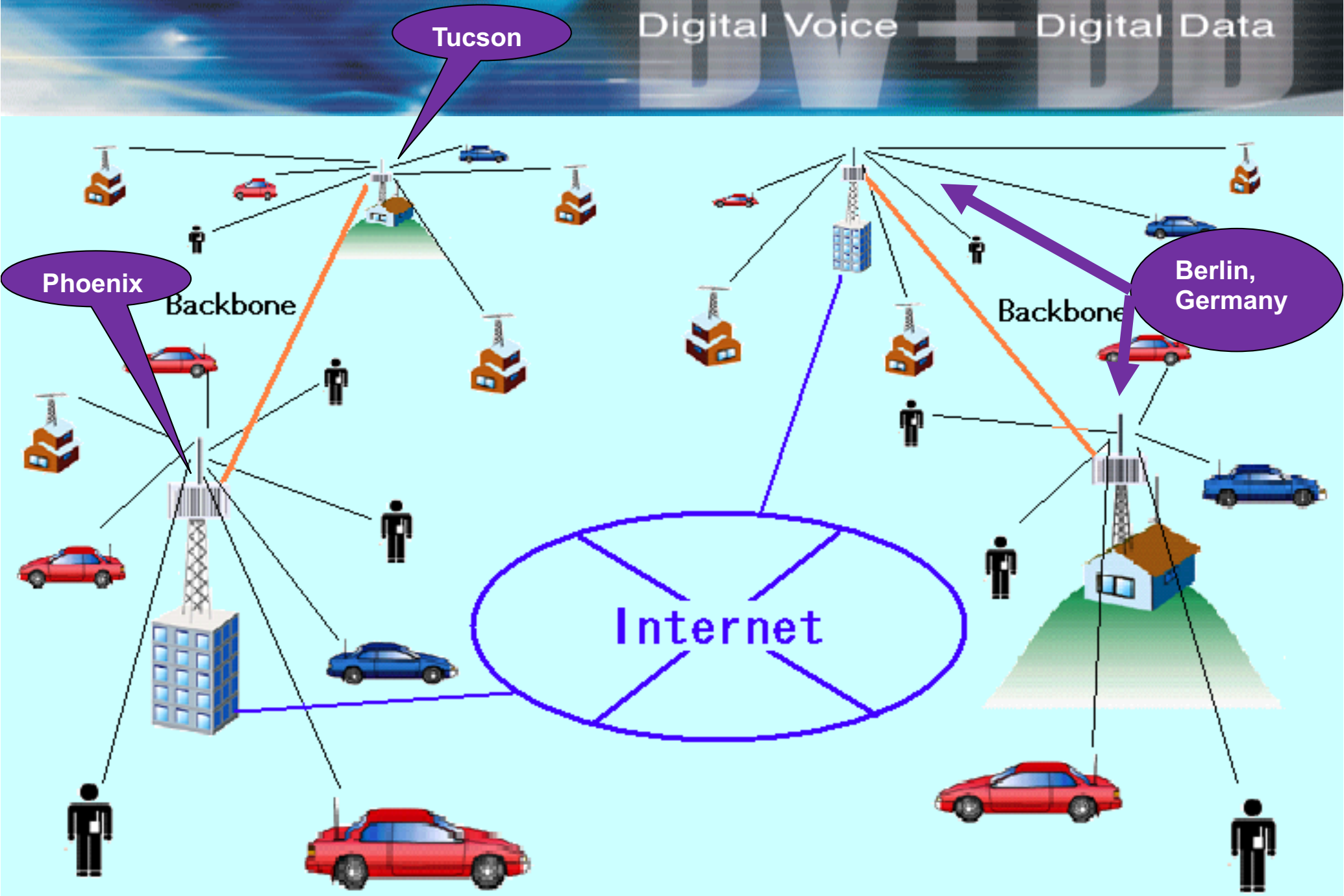


Gateway repeater:

Gateway repeaters provide communications between different zones via the internet. The repeater 3 and 6 are gateway repeaters at the example above.

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Application 1

Digital voice (DV mode)

Analog audio is modulated to a digital signal and transmitted in the digital mode signal by the D-STAR radio.



Repeater A

Internet connection*

The Internet gateway allows linking of D-STAR repeater sites over the Internet. You can uplink to your local repeater and downlink from a remote repeater, even from a foreign country!



INTERNET

Application 5

IP camera (DD mode)

You can transmit live images in DD mode and watch real-time images from a remote location.



Repeater E

Application 2

Short data message (DV mode)



Call sign identification and short data messages are available.



Repeater B



Repeater C

GPS satellite



Application 3

GPS tracking (DV mode)

With a GPS receiver, you can send your current position information to another radio.

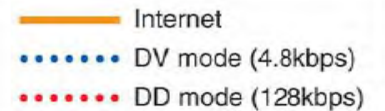
Application 4

Internet access (DD mode)*

In DD mode operation, you can access the Internet via a D-STAR Internet gateway. Connect a PC with the ID-1 and you can browse web sites or check e-mail.



Repeater D



* Some restrictions may apply depending on specific countries' regulations.

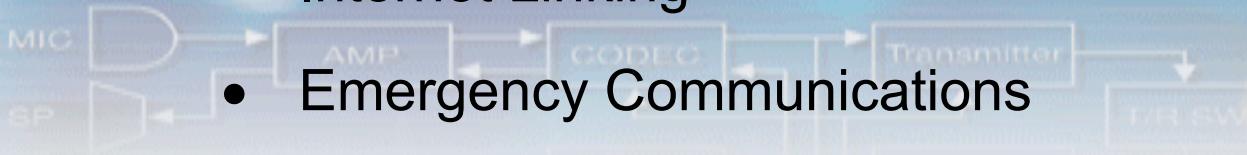
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How will it be used?

- Regular use, like FM (Enhanced)
 - Data/Voice Simultaneously
- Internet Linking
- Emergency Communications
- Linking Emergency Operations Centers
- New Applications
 - Applications are the BIG DEAL
 - DPRS/APRS
 - D-RATS (Files, APRS, ICS-Forms)
 - RS-MS1

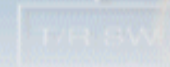


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EmComm Applications

- Ends needless chatter
 - Data rather than voice
 - Improved Efficiency
 - Immediate identification
 - Callsign
 - Short Text Messages – Tactical ID's
 - GPS Coordinates
 - Tracking rescue teams
 - Tracking supply vehicles
 - Etc.
 - Voice is still available when needed
 - Dispatch assets accurately



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System Break Down

- Local
 - Club Repeater
 - Area Repeater Group
 - Covers a larger area than one repeater
- Region
 - Capable of covering a metropolitan region
 - Similar to how a cell network would



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System Break Down (Cont)

- Statewide, Nationwide, Worldwide
 - Can use the Internet
 - Several DSTAR Satellites up now

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System Break Down (Cont)

- Statewide, Nationwide, Worldwide
 - Can use the Internet
 - Several DSTAR Satellites up now

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System Networking

- User Configurable
 - User decides how to connect
- Network Connects the Local User to the World
- Expands Coverage
- Internet Reflectors most common
- Callsign Routing Capable

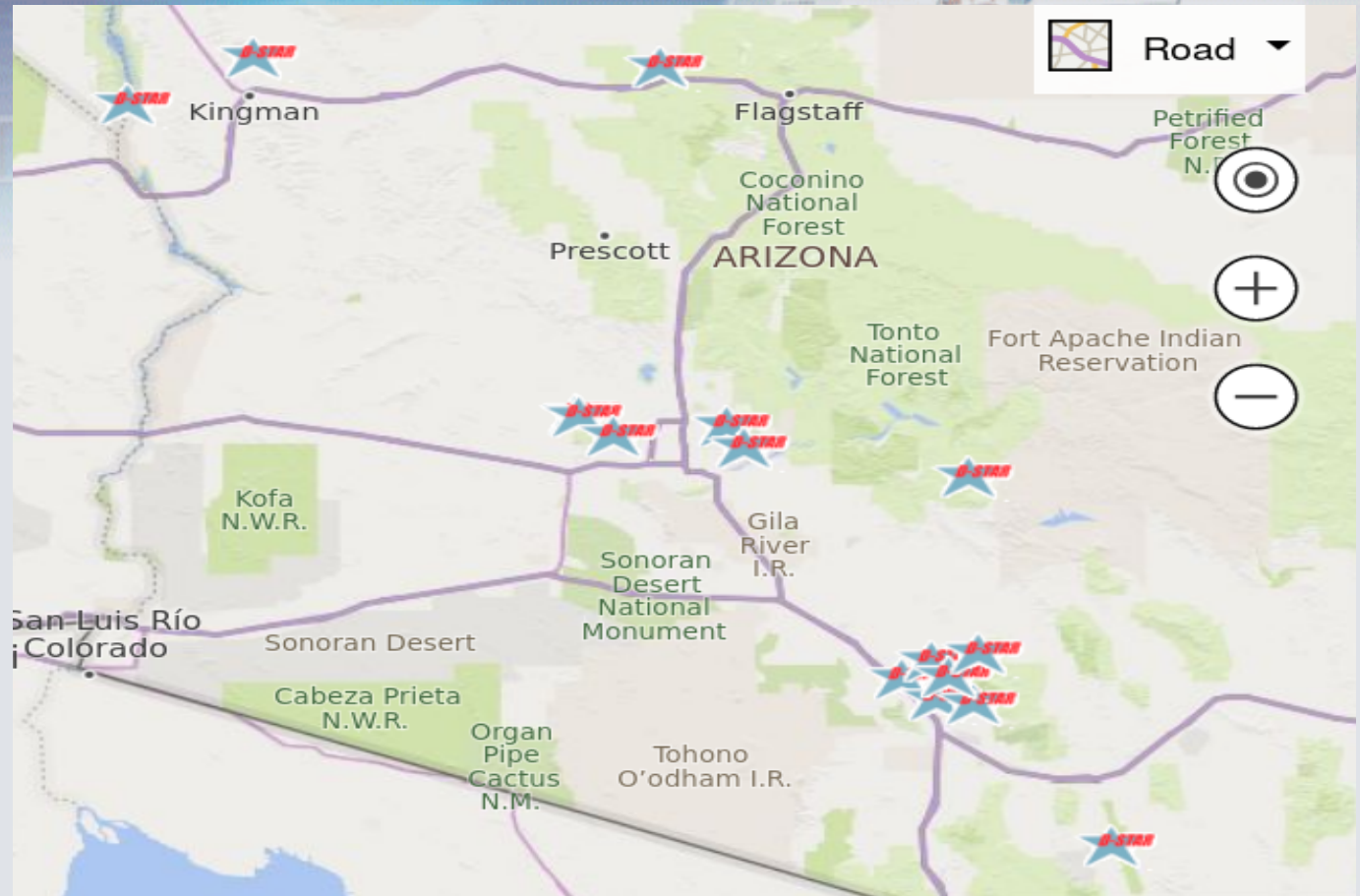
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DW + DD

Digital Voice + Digital Data

- Arizona D-STAR!!

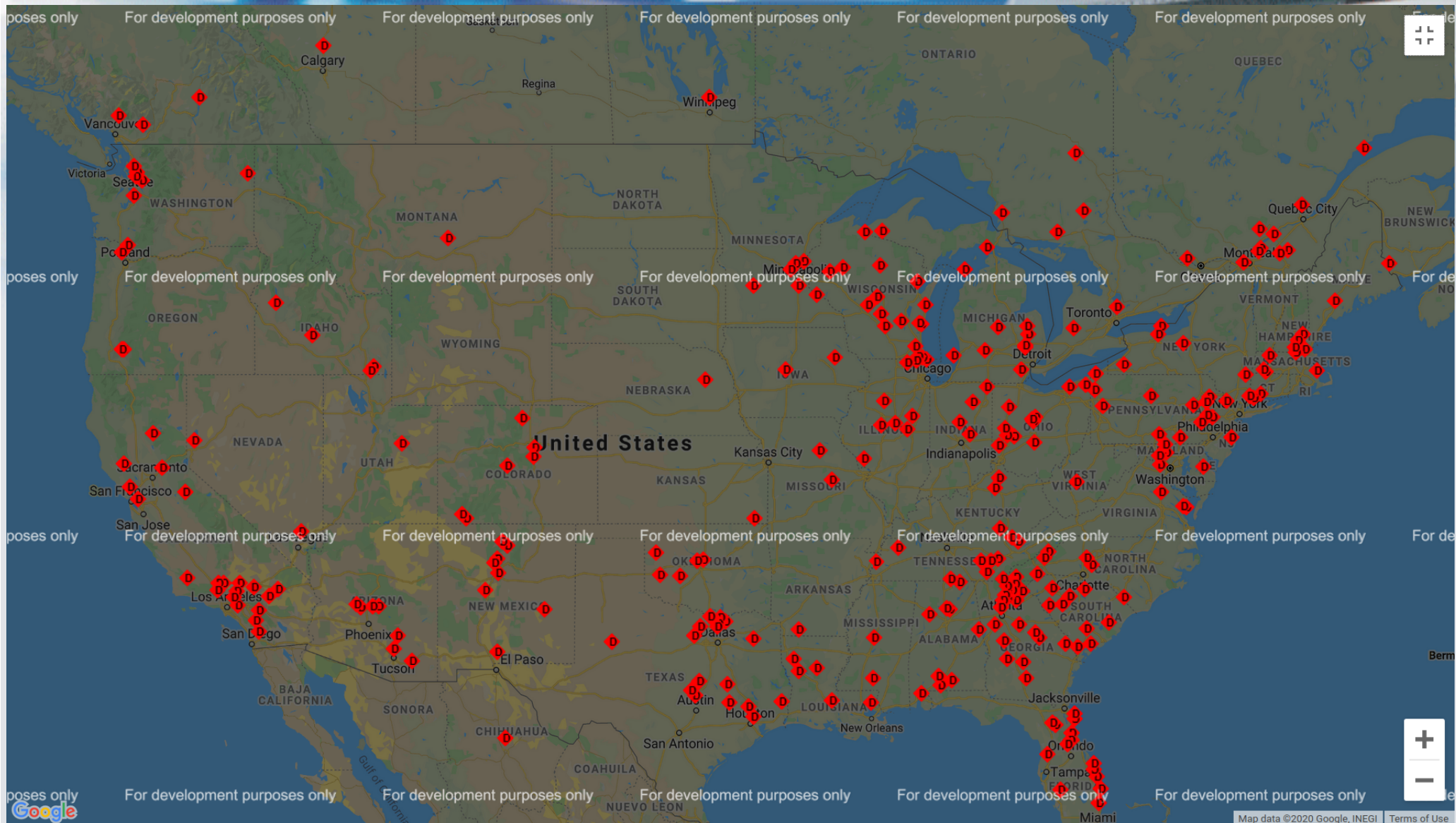
- Reflector 9C



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DStar Repeaters – US/Canada – March 2020



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Digital Voice

Digital Data

International Systems

- Algeria
- Argentina
- Australia
- Austria
- Belgium
- Brazil
- Bulgaria
- Canada
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Italy
- Japan
- Netherlands Antilles
- New Zealand
- Norway
- Poland
- Portugal
- Romania
- Russia
- Slovakia
- Slovenia
- South Africa
- Spain
- Sweden
- Switzerland
- The Netherlands
- Trinidad + Tobago
- UK
- USA

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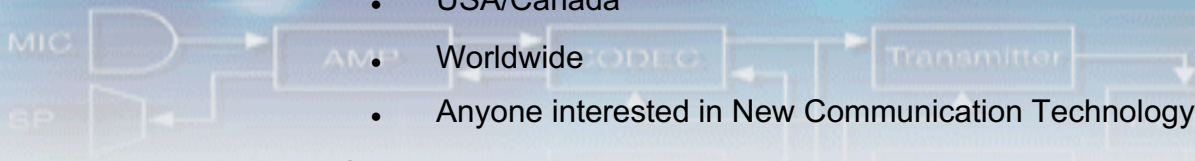
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Who Uses The System

Who uses DSTAR?

- Individuals
- Clubs
 - USA/Canada
 - Worldwide
 - Anyone interested in New Communication Technology
- Served Agencies
 - Department of Homeland Security/FEMA
 - Many Municipal and County ECs (Especially in the South Eastern US)
 - Red Cross
 - ARES/RACES Units Countrywide
- Events
 - Races/Runs/Rides, Parades, Special Events
 - Emergency Communications



Everyone Who Uses Radio For Local And/Or Worldwide Communication

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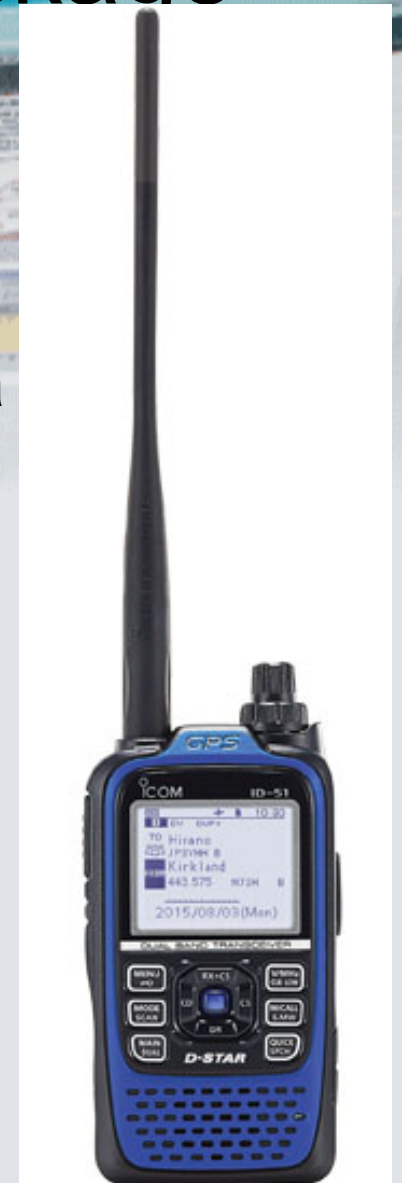
DSTAR Equipment Overview

DSTAR Equipment Overview

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Digital Voice + Digital Data

- DSTAR Does It All In ONE Package
 - Voice (Better than FM)
 - DPRS (APRS in Conventional radios)
 - Don't need to give up half of the radio
 - Internet linking/Voice Over IP
 - File Data transfer/SMS using Slow Speed Data
 - Packet in Conventional FM
 - All in one package



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- D-Star vs. FM Operation

- FM

- Voice
 - Frequency, Offset, CTCSS/PL
 - Control codes, if available, for linking
 - Echolink/IRLP/WIRES (Yaesu Proprietary)

- D-STAR

- Voice
 - Frequency, Offset, Call Signs (up to 4!)
 - Controls signal routing
 - Gateway Operation
 - User controlled routing/linking
 - Callsign Routing
 - Reflector linking
 - Gateway linking
 - Data
 - No external modems required



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Digital Voice

Digital Data

Radios



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No Repeater – No Problem

- Analog

- Set up a simplex Echolink/IRLP Node

- DStar

- Set up a Hot Spot

- Much easier



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Hot Spots



DV MEGA

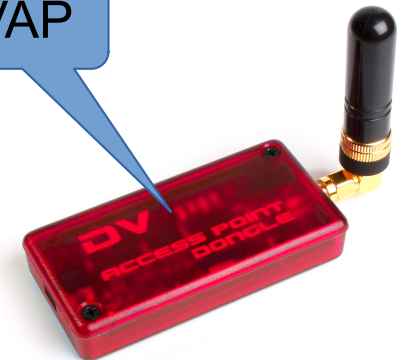


ZUMSPOT

DV MINI



DVAP

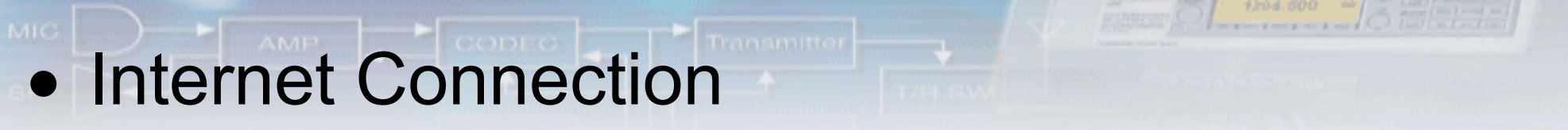


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Hot Spot Requirements

- Internet Connection
 - WiFi
 - Cellular
- HT Radio



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Why is D-STAR interesting?

- Combines so many different modes into one
- Simplifies the equipment you have to carry around
- Spectral Efficiency
- Many Applications
- Simultaneous Voice and Data capability
 - 2m/70cm/23cm
- High-Speed Data capability
 - 23cm
- Internet Linking capability
- Microwave Linking capability

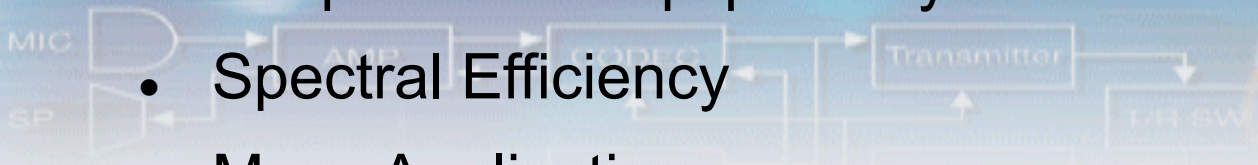
MIC
SP

AMP

CODEC

Transmitter

100 W



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Getting Started

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How To Get Started

- Want to advance Ham Radio
- Buy a radio
 - ICOM
 - Kenwood
 - Flex
 - Homebrew
- How do you want to operate
 - Portable (HT)
 - Mobile
 - Base



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● Registration

- No registration required for SIMPLEX use
- Registration IS required for pretty much everything else
- Only needs to be done once
- Gives you access world-wide to the D-Star Gateway features

● No private conversations

- both ends hear all

● User Routing/Linking

- Callsign Routing
 - Not all users on site can participate
- Reflectors
 - Everyone plays
- HUGE Opportunity for confusion!!!

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- Getting Started is Really Easy!!!
- Don't try to learn everything at once
 - Drinking out of a firehose will make you throw up
- Use as local communication first
- Learn as you go

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Quick Notes On Reflectors

- Simply Internet/Network Chat Rooms

- Several different systems

- US Trust System

- ircDDB/Xreflectors

- XRF/DCS/XLX
- Quadnet System
- Papa System

MIC
SP

AMP

CODEC

Transmitter

T/R SW

- Fixed

- REF009C
- REF030C
- XRF757A
- DCS001C

- Dynamic

- Uses callsign routing
- Connection only remains while in use
- Can follow a user as they move around
- Very efficient to use



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Programming The Radio

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Four call signs used

MIC AMP SW
SP
MYCALL – Call sign of the person pushing the PTT

URCALL – Call sign of the desired target station
'CQCQCQ' or desired remote station for routing

RPT1 – Call sign (& port) of the originating repeater
Where your signal goes
in

RPT2 – Call sign & designator of the gateway
Where your signal goes Out

Can also be used for designated local cross-band use

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Example 1 - SIMPLEX

MYCALL – AC7DS

URCALL – CQCQCQ, or a user's call

RPT1 – Blank

RPT2 – Blank



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Example 1 - Local call on same band - Repeater
This is the most common usage. It's pretty simple, and works as you would expect.

- MYCALL – AC7DS**
- URCALL – CQCQCQ, or a user's call**
- RPT1 – K7RST C (Note that the 'C' is in position #8!)**
- RPT2 – Blank (No audio leaves the gateway)**



Example of Local Call On Same Band



MYCALL: AC7DS
URCALL: CQCQCQ
RPT1: K7RST C



K7RST C
2m Port



MYCALL: AK8E
URCALL: CQCQCQ
RPT1: K7RST C

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So far So Good

This is how we are all used to our repeaters working.....

And this is where D-Star gets confusing.

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Example 2 - Local call on different bands

This is less common, because BOTH parties have to program their radios appropriately to use this feature. But it's still useful. In this example, GMØOPS is going to put out a general CQ call from the local VHF repeater to the local UHF repeater.

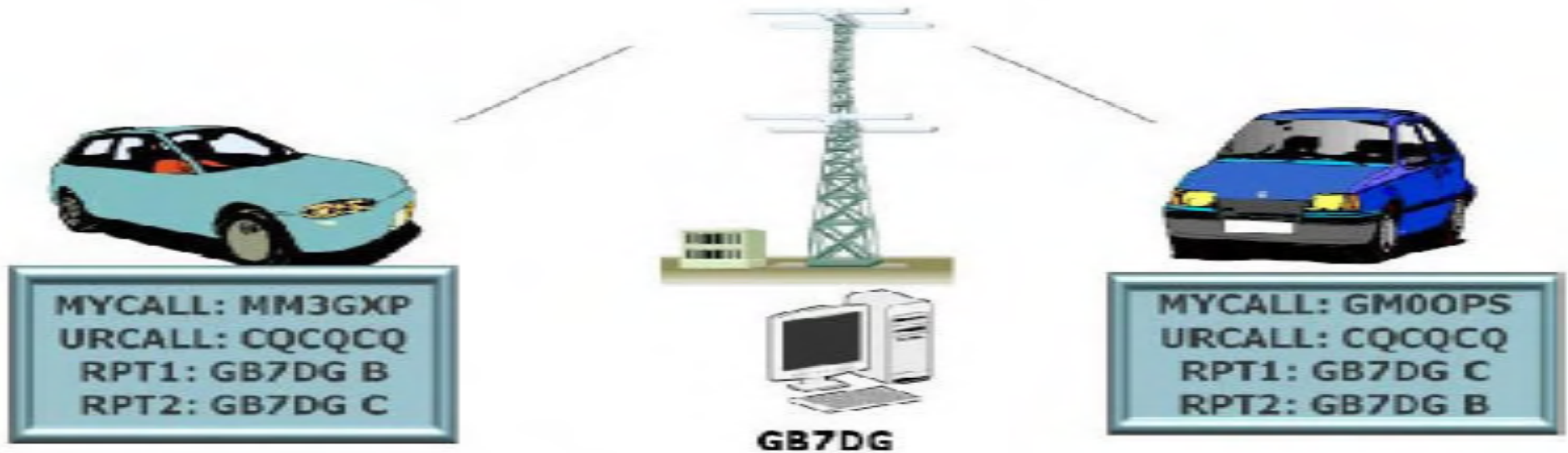
MYCALL – GMØOPS

URCALL – CQCQCQ, or a user's call

RPT1 – GB7DG C (Note that the 'C' is in position #8!)

RPT2 – GB7DG B (Note that the 'B' is in position #8!)

Example of Local Call On Different Bands



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Digital Voice

Digital Data

Example 3 - Gateway User-Specific Call

These are the settings you would use if you want to talk to someone else but you don't know what system they are on. The system will pick up their callsign and route your connection to them. They will then have to hit their "One touch reply". In this example GMØOPS is calling GM1FML.

MYCALL – GMØOPS

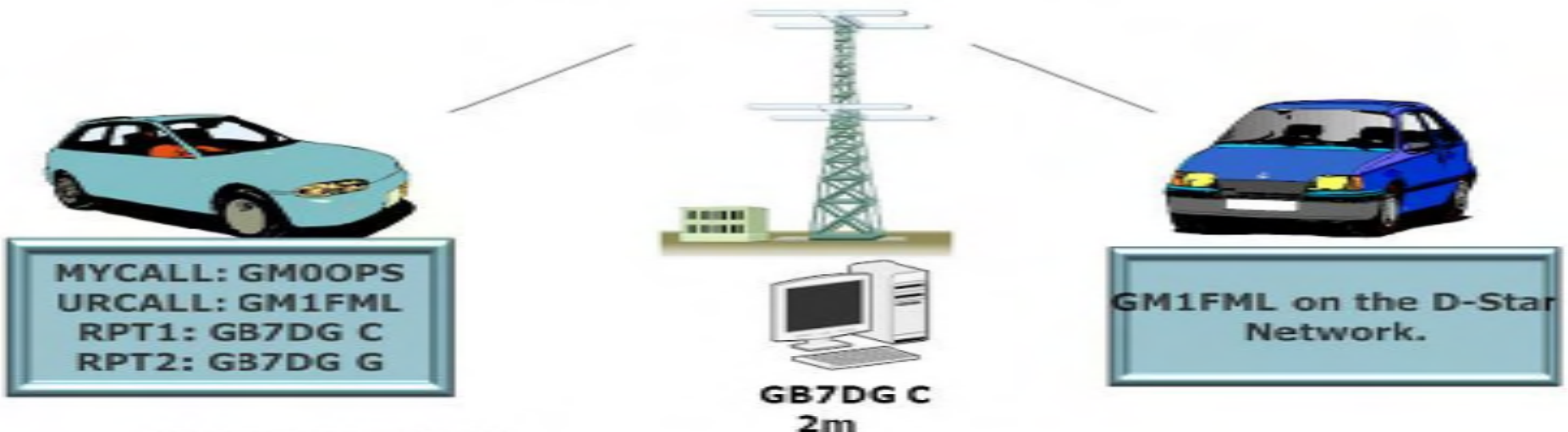
URCALL – GM1FML

RPT1 – GB7DG C (Note that the 'C' is in position #8!)

RPT2 – GB7DG G (Note that the 'G' is in position #8!)



Example of Gateway User Specific Call



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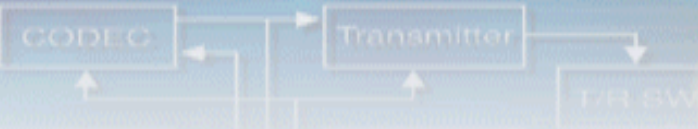
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Example 4 - Gateway Location-Specific Call

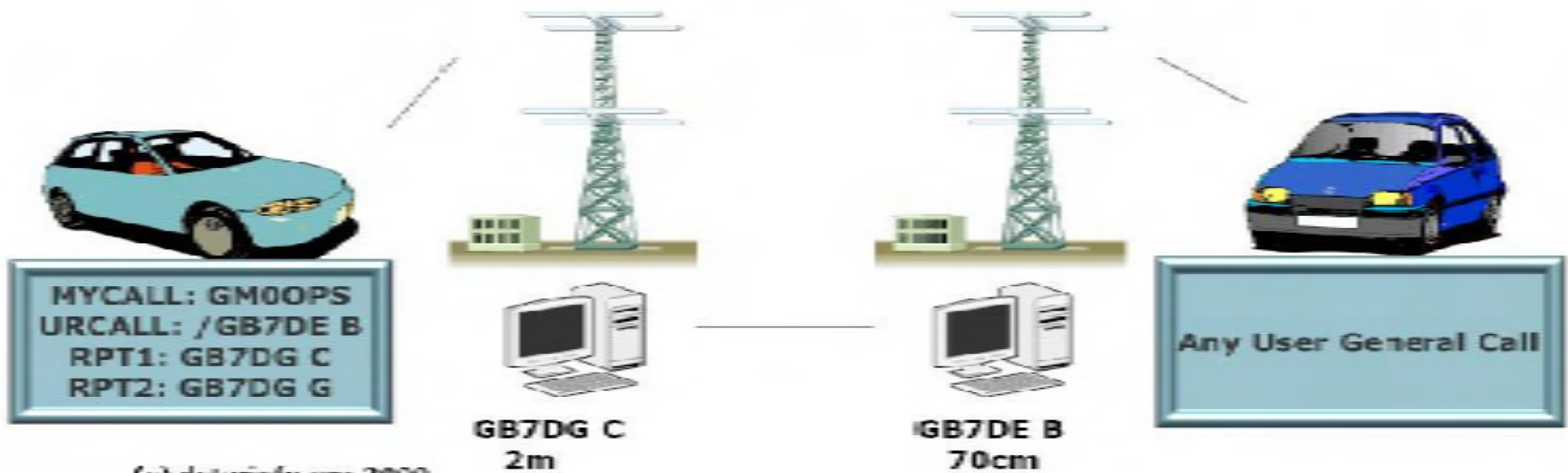
If you want to connect to another system then you would use the settings below. Remember that the people on the other system you connect to will either have to do a "One Touch Reply" or put your systems call into the URCALL field.

This routes the call to the distant system and Port based on the 8th character set).

MYCALL - GM0OPS
URCALL - /GB7DE B



Example of Gateway Location Specific Call



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User radio programming

- Modern Radios have LOTS of memory channels
- DSTAR has potential for almost as many different user configurations
- Many radio features appear only in 'SET' mode or in software
 - Manufacturer programming software
 - RT Systems programming software

Programming software strongly recommended!!

User Concerns

User “error codes”

- **UR?**: Generally means that your call reached it's intended destination
- **RPT?**: Can be an indication that you call did not go through either due to an error in call sign programming or a remote repeater being down. This is generally the case when performing User or port linking and where the URCALL contains something other than CQCQCQ.

Kerchunking a D-STAR system

- Callsign is always transmitted
- No squelch tail
- Watch for repeater response – visual indication

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DSTAR Resources

DSTAR Resources

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D-STARLet

- A Web-based text messaging application
 - Uses D-STAR Digital technology
- Dean Gibson, AE7Q
- www.dstarlet.com



D-StarLet - Control Panel

2005-10-09 11:42:06

Servlet is stopped, [Start](#) not connected as AE7Q-1 to D-Star @ COM4:9600



Refresh every seconds [Update](#)

[Create Message](#) [View Log](#) [Configure](#) [Help](#)

Precedence	Outgoing Messages TimeStamp	To
Draft		
Routine	2005.0426-1005.06720	AE7Q-2
Outbox		
Sent		
Immediate	2005.0426-2209.45931	AE7Q-2
Immediate	2005.0814-1836.03685	AE7Q-2
Routine	2005.0425-2244.49656	AE7Q-2
Routine	2005.0426-2249.35640	AE7Q-2
Routine	2005.0426-2320.53522	AE7Q-2
Routine	2005.0427-1827.05121	AE7Q-2

Precedence	Incoming Messages TimeStamp	From
Inbox		
Routine	2005.0427-1102.14449	AE7Q-2
Routine	2005.0824-1958.12290	AE7Q-2
Rcvd		
Immediate	2005.0426-0957.16114	AE7Q-2
Priority	2005.0823-1902.44018	AE7Q-2
Routine	2005.0824-1858.52902	AE7Q-2

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D-Rats



A Communications Tool For D-STAR

D-STAR

DV + DD

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D-Rats

D-RATS

File View Help

Messages Chat Files Event Log

New Send Email Reply Delete Mark Read Mark Unread

	Sender	Recipient	Subject	Type	Date
Inbox					
Outbox	K7HIO	KK7DS	D-RATS 0.3.0 Release	memo	21:17:47 2009-07-23
Sent	K7HIO	KK7DS	Need a status report	ICS213_US_OS	21:16:06 2009-07-23
Trash					

Stations

K7HIO
VK3UR (00:03)

My Status

Online
Available

Message "D-RATS 0.3.0 Release" received from K7HIO

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D-Rats

D-RATS [Minimize] [Maximize] [Close]

File View Help

Messages Chat Files Event Log

D-RATS v0.3.0b6
Copyright 2009 Dan Smith (KK7DS)

[2009-05-11 15:06:45] [Ratreflector] CQCQCQ: KK7DS - Ratreflector - ref.d-rats.com:9000 - Please do not link RF to this repeater to keep it clean for testing and training

[2009-05-11 16:12:08] KK7DS: Now Online: Active
[16:12:09] OH3HWX: Now Online: Online (D-RATS)

Main

Ratreflector [v] Send

Quick Messages

Test message

Hello world!

G'day from Dave in Ballarat, Victoria, Australia

QSTs

↑ Add
☰
↓ Remove

Stations

OH3HWX
KK7DS

My Status

Online [v]
Online (D-RATS)

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D-Rats

The screenshot shows the D-RATS software interface. The window title is "D-RATS". The menu bar includes "File", "View", and "Help". There are tabs for "Messages", "Chat", "Files", and "Event Log". The "Files" tab is active, showing a local file list with columns for "Filename", "Size", and "Date". The file "F111.jpg" is listed with a size of 39.0 KB and a date of 08:42:41 2008-05-15. To the right, there are buttons for "Refresh", "Delete", and "Upload". Below these are "Connect", "Disconnect", and "Download" buttons. The "Station" dropdown is set to "KK7DS" and the "Ratreflector" dropdown is set to "Ratreflector". A file list on the right shows various files, with "IMG_0022.JPG" selected, having a size of 3487.0 KB and a date of 23:2. The "Stations" panel on the right lists "KK7DS (00:08)" and "OH3HWX (01:54)". The "My Status" panel shows "Online" and "Online (D-RATS)".

D-RATS

File View Help

Messages Chat **Files** Event Log

Refresh Delete Upload Local

Connect Disconnect Download

Station: KK7DS Ratreflector

Filename	Size	Date
F111.jpg	39.0 KB	08:42:41 2008-05-15
4T5T1-01.txt	473 B	14:4
Ares-sign.png	129.0 KB	16:5
bizcard.png.part	0 B	16:4
d-rats.profile	106 B	14:3
home.JPG	1.0 KB	16:3
IMG_0022.JPG	3487.0 KB	23:2
IMG_0022.JPG.part	0 B	09:4
msg.xml	807 B	19:3
README.txt	76 B	06:4
Test-3.txt	19 B	14:1
WashCo SitRep.txt	7.0 KB	10:4

Stations

KK7DS (00:08)
OH3HWX (01:54)

My Status

Online
Online (D-RATS)

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D-Rats

D-RATS Station Map

Show	Station	Latitude	Longitude	Distance
<input checked="" type="checkbox"/>	Prov. St. Vinc Hosp	45.5094	-122.7716	7.53
<input checked="" type="checkbox"/>	WC Fire			
<input type="checkbox"/>	Stations			
<input checked="" type="checkbox"/>	WC EOCs			
<input checked="" type="checkbox"/>	Washington County ARES			
<input type="checkbox"/>	Misc			

Zoom: Min < > Max

Track center

45.5191, -122.8913

Static position

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Online Discussion Forums

www.icomamerica.com/support/forums

www.K5TIT.Org/Forum

[DSTAR Groups on Groups.io](http://DSTAR.Groups.on.Groups.io)

D-STAR Web Sites

<http://www.d-starusers.org/>

<http://dstarinfo.com/>

<http://www.d-rats.com/>

<https://aprs.fi/>

<http://xrefl.net/>

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Last Heard Report

Current Time is 07/19/2006 03:59:28 UTC

Attention DStarMonitor users, a new version for your gateway is available here 5/29/06

Station	Last Heard	Repeater - Location	Type
NJ1Q	07/18/06 23:30:28 EDST 07/19/06 03:30:28 UTC	W1AW A Newington, CT 1.2 GHz	Voice
N9JA	07/18/06 17:34:36 PDST 07/19/06 00:34:36 UTC	N7IH C Bellevue, Wa 2 Meters	Voice
N5MIJ	07/18/06 19:00:39 CDST 07/19/06 00:00:39 UTC	K5TIT B Dallas 440Mhz	Voice
KV5E	07/18/06 17:47:55 CDST 07/18/06 22:47:55 UTC	K5TIT B Dallas 440Mhz	Voice
N5ZPR.B	07/18/06 16:31:44 CDST 07/18/06 21:31:44 UTC	K5TIT B Dallas 440Mhz	Voice
W7JRL	07/18/06 13:13:21 PDST 07/18/06 20:13:21 UTC	N7IH A Bellevue, Wa 1.2Ghz	Voice
N2QKQ	07/18/06 14:21:57 EDST 07/18/06 18:21:57 UTC	K2DIG A New York, NY 1.2Ghz	Voice
K5BRS	07/18/06 10:51:37 CDST 07/18/06 15:51:37 UTC	K5TIT C Dallas 2 Meters	
N5HEQ	07/17/06 21:09:58 CDST 07/18/06 02:09:58 UTC	K5TIT B Dallas 440Mhz	
AD5NR	07/17/06 19:49:21 CDST 07/18/06 00:49:21 UTC	K5TIT C Dallas 2 Meters	
W2VU	07/17/06 20:47:25 EDST 07/18/06 00:47:25 UTC	K2DIG A New York, NY 1.2Ghz	Voice

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D-STAR

Digital Voice

+ Digital Data

DV + DD

Opportunities with D-STAR

- Rediscover the fun in amateur radio
- Help advance the state of the hobby
- Learn some new techniques
- Help someone else learn what's going on
- Enhanced Emergency Communications

- Welcome the new folks!

D-STAR

DV + DD

Digital Voice + Digital Data

Summary

- Lots of potential for use of simultaneous voice & data
- Spectral efficiency offers opportunity for better utilization
- Better performance from narrow spectrum & FEC
- Distinct operational differences from familiar FM
- New applications will drive acceptance
- EmComm demand for tactical voice and data communications by served agencies

D-STAR

Digital Voice + Digital Data
DV + DD

Portions of this presentation
were adopted from:



D-STAR

Digital Voice + Digital Data
DV + DD

K5TIT



Texas
Interconnect
Team

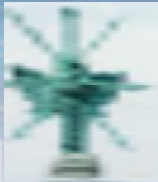
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MIC

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Dundee Amateur Radio Club



Contact us on 0844 684 1449



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Thank You
And
Happy Dstarring..