D-STAR Advanced Topics

Presented by

Greg Sarratt, W4OZK
Alabama D-STAR Group
Alabama ARRL Section Manager

D-STAR

Digital Voice + Digital Data

Agenda

- Modes
- Protocol
- Repeaters
- Gateway
- Registration
- Data
- Applications
- Computer to Computer

D-STAR Modes

DV – Digital Voice - Combined voice-and-data mode

DD – Digital Data - High-Speed data-only stream

Digitization is performed by a device called a codec, stands for coding-decoding

Digital Voice (DV)

The D-STAR codec digitizes voice by using the AMBE 2020 codec. AMBE stands for **Advanced Multiple Band Encoding** and 2020 designates the particular variation used by D-STAR. (Detailed technical information about AMBE 2020 is available at http://www.dvsinc.com/products/a2020.htm).

Digital Data (DD)

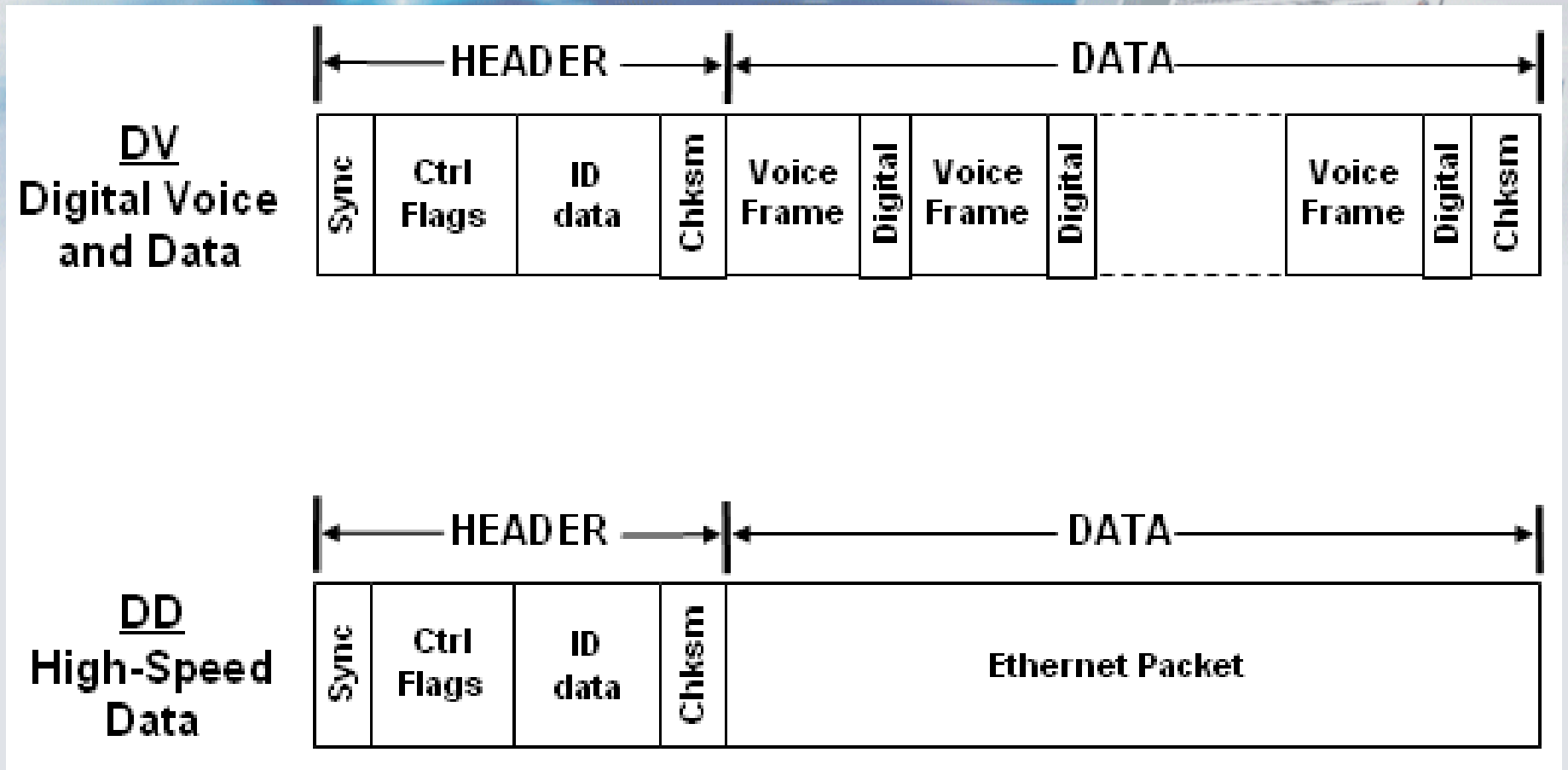
In this mode, the voice signal is dropped and the packets are dedicated completely to digital data. The packets sent across the air link at a raw data rate of 128k bps, but since that includes the packet header and the delay between packets, the net data rate is somewhat lower.

Feature	D-STAR DV	D-STAR DD
Voice Codec	2.4k bps AMBE	None
Data Speed	1200 bps	128k bps (raw)
Data Format	8-bit ASCII	8-bit ASCII
Data Interface	RS-232 or USB 1.0	Ethernet bridge
Bandwidth	6.25 kHz	130 kHz
Frequency	Any VHF/UHF band	902 MHz and higher

D-STAR

Digital Voice + Digital Data

D-STAR Protocol Basics

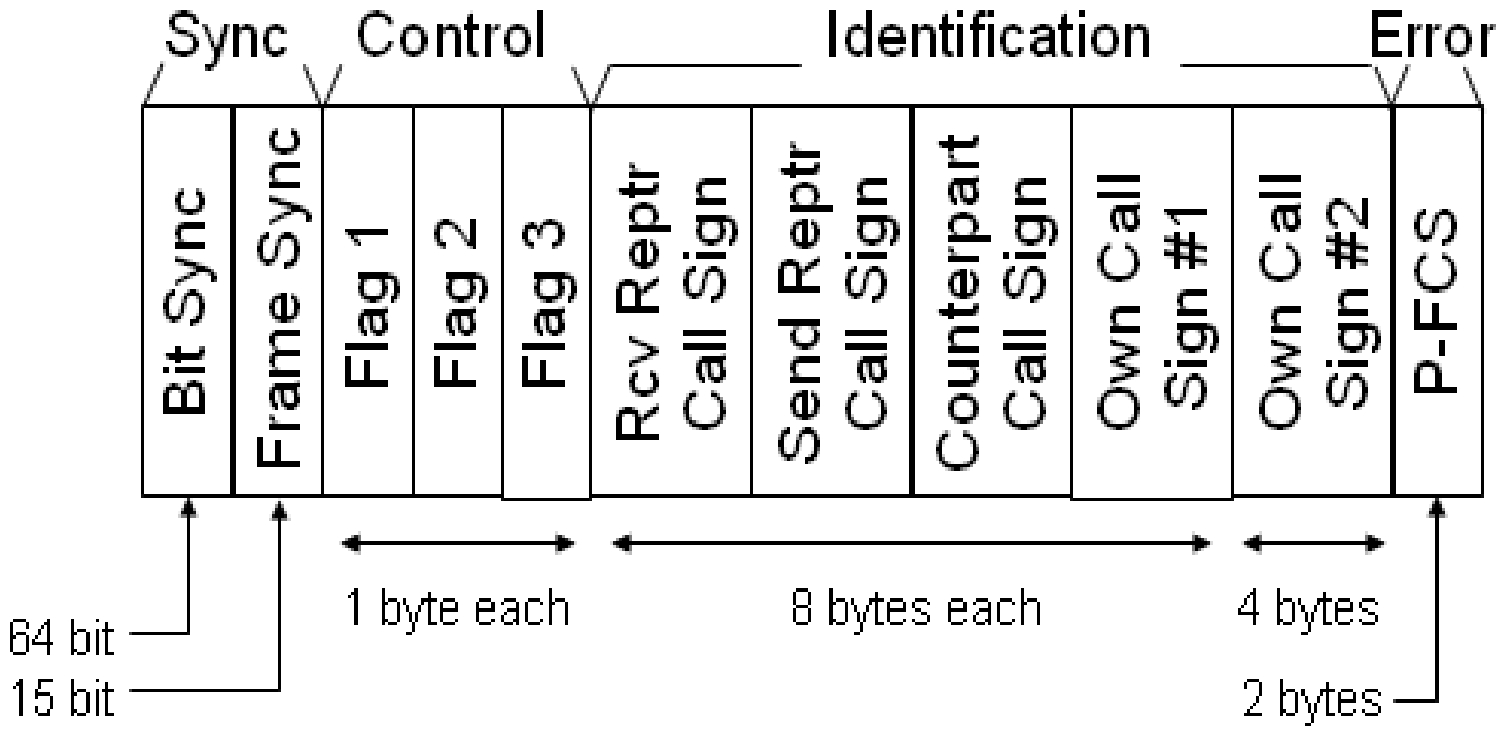


D-STAR Protocol Overhead

Protocol	Header (bytes)[1]	Data (bytes)	Packet Size (bytes)	Overhead	
				Bytes	Pct (%)
DV	51	1056	1107	51	4.6
DD (min data)[2]	51	66	117	51	43.5
DD (max data)[2]	51	1520	1571	51	3.2

[1] - the header size is rounded up to the next full byte because of the 15-bit sync field
[2] - data size includes the terminating checksum (see error detection)

D-STAR Packet Header



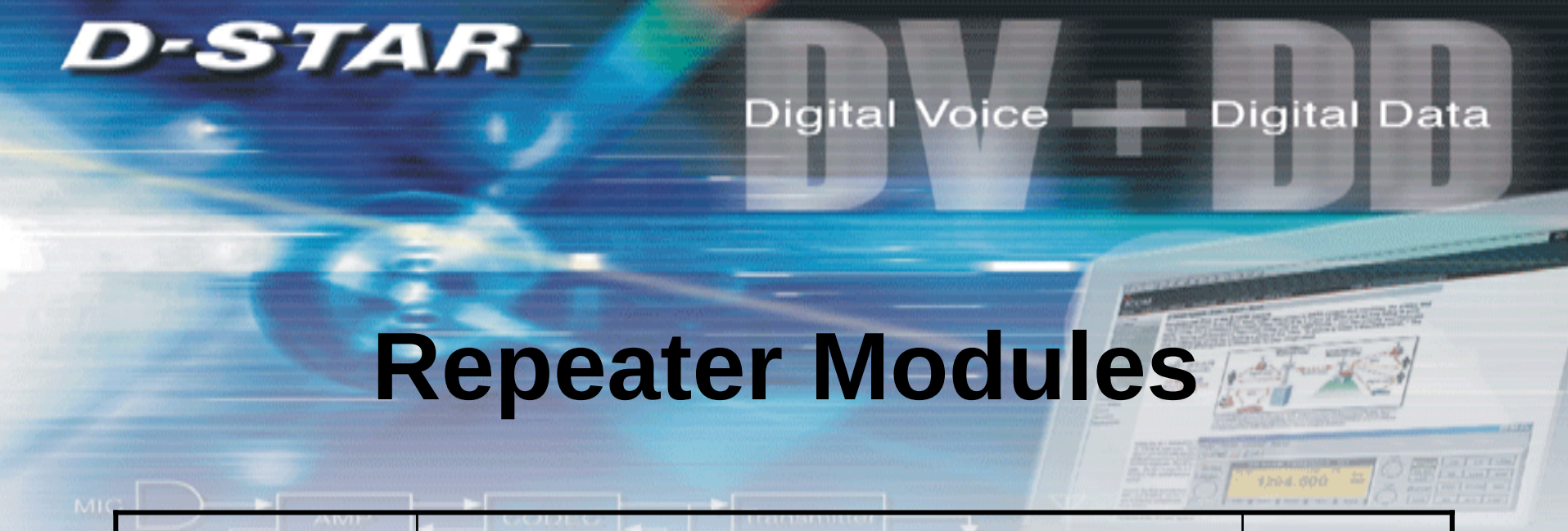
Error Correction (convolution - Viterbi)

Interleave (matrix swap)

Scramble (distribute ones and zeros)


D-STAR
Digital Voice + Digital Data
DV + DD
MIC
AMP
CODEC
Transmitter
SP
T/R SW

Repeaters



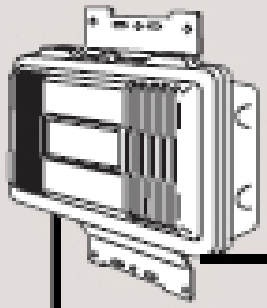
Repeater Modules

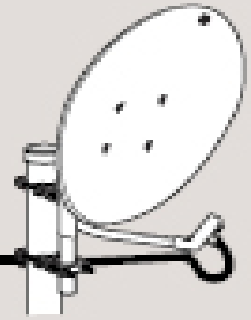
ID-RP2C	Repeater Controller, 4 Ports	Port
RP2D	1.2GHz, 128k Digital Data (DD)	1
RP4000V	440MHz Digital Voice (DV)	2
RP2000V	144MHz Digital Voice (DV)	3
RP2V	1.2GHz Digital Voice (DV)	4

SYSTEM OVERVIEW

AH-108
(1.2GHz
Collinear
antenna)

ID-RP2L
(10GHz Microwave
link repeater)





AH-106 or
AH-107
(10GHz
Parabola
antenna)

ID-RP2C (Repeater controller)

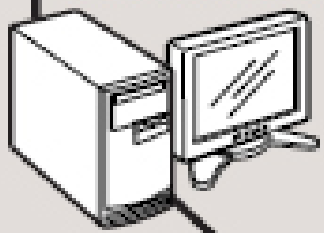
Duplexer

ID-RP2V (1.2GHz Digital voice repeater)

Antenna
filter

ID-RP2D (1.2GHz Data repeater)

Gateway server



Internet

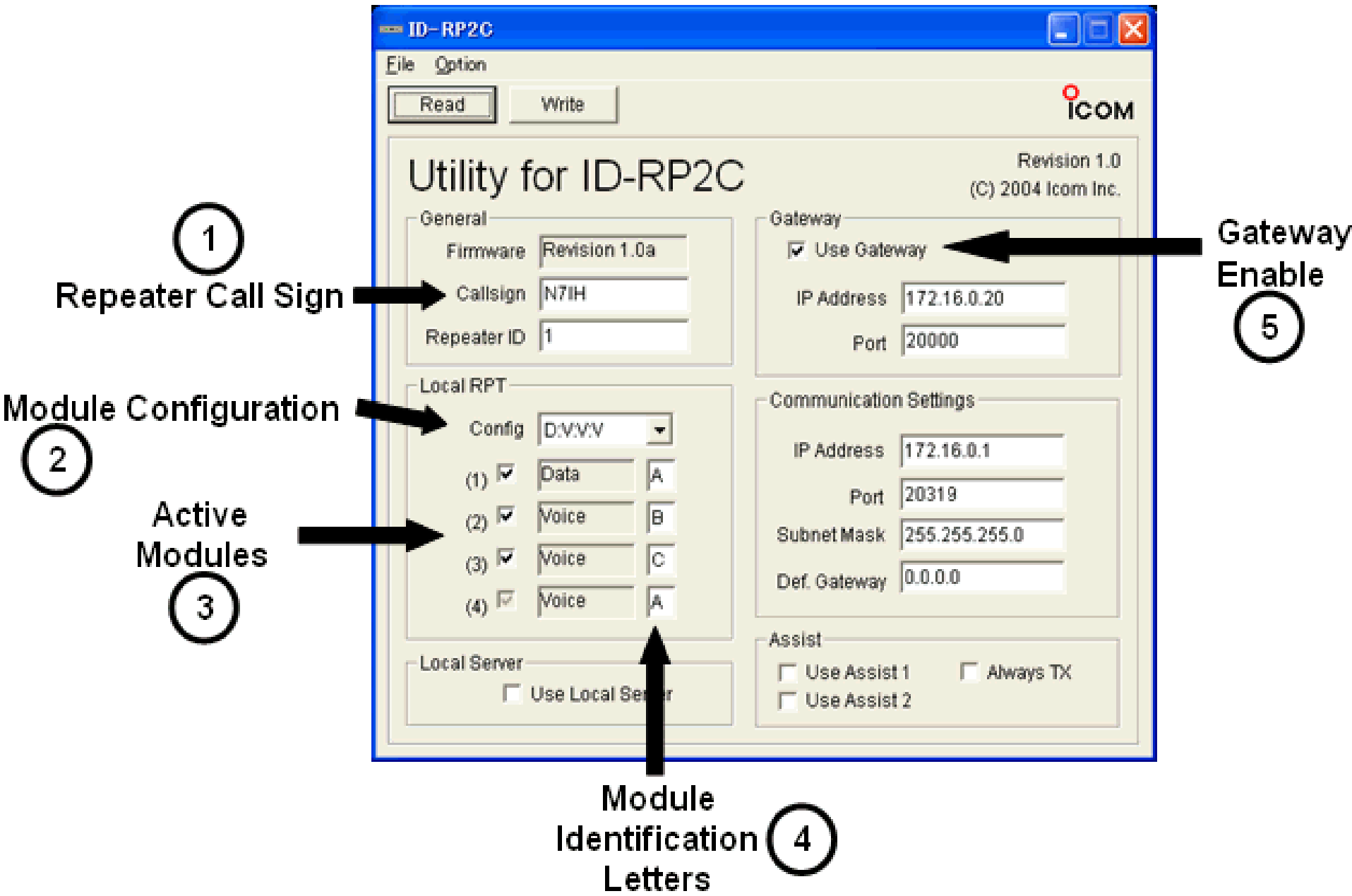
Duplexer

ID-RP4000V (UHF (440MHz) digital voice repeater)

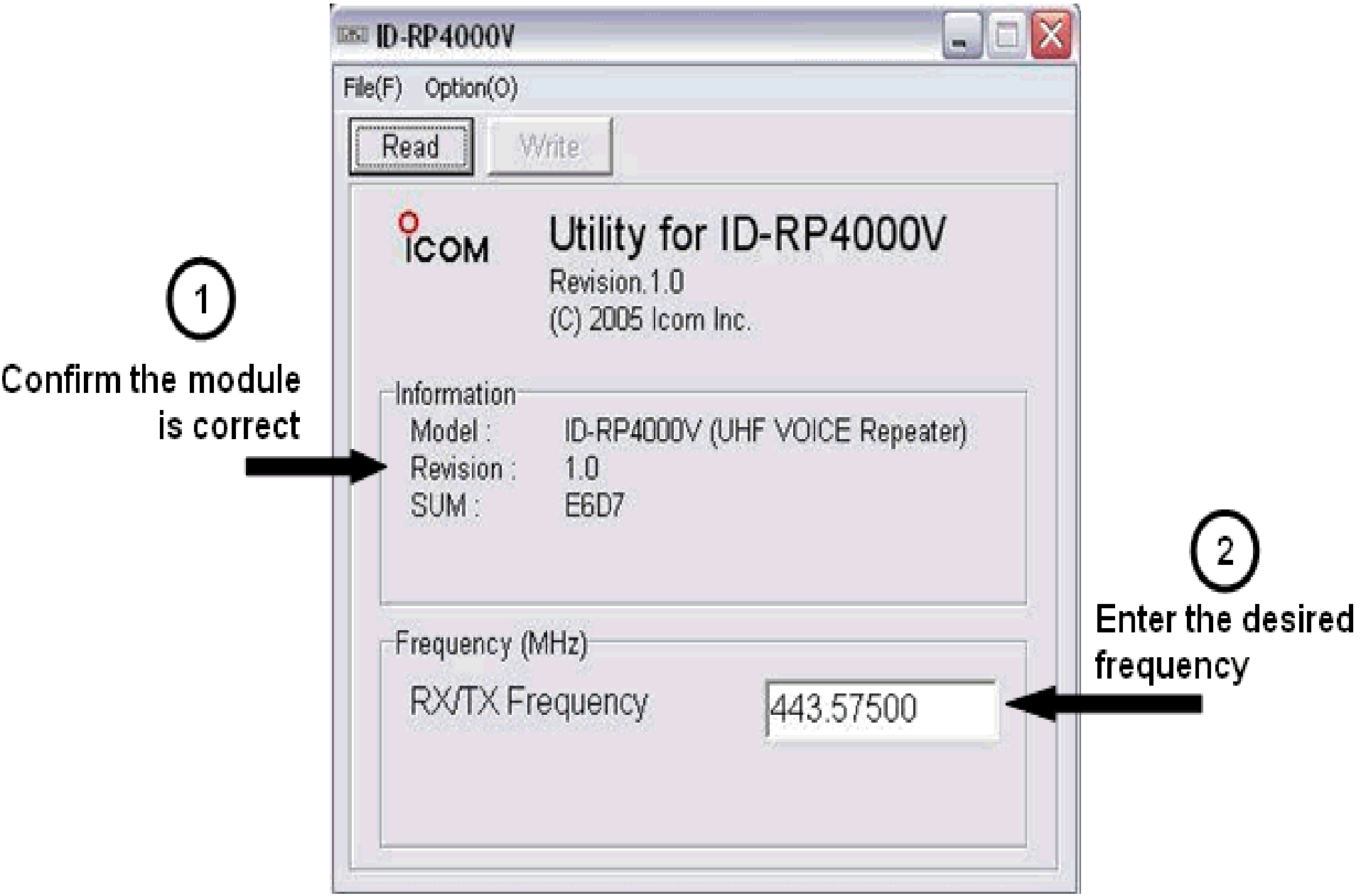
Duplexer

ID-RP2000V (VHF (144MHz) digital voice repeater)

RP2C Configuration Software

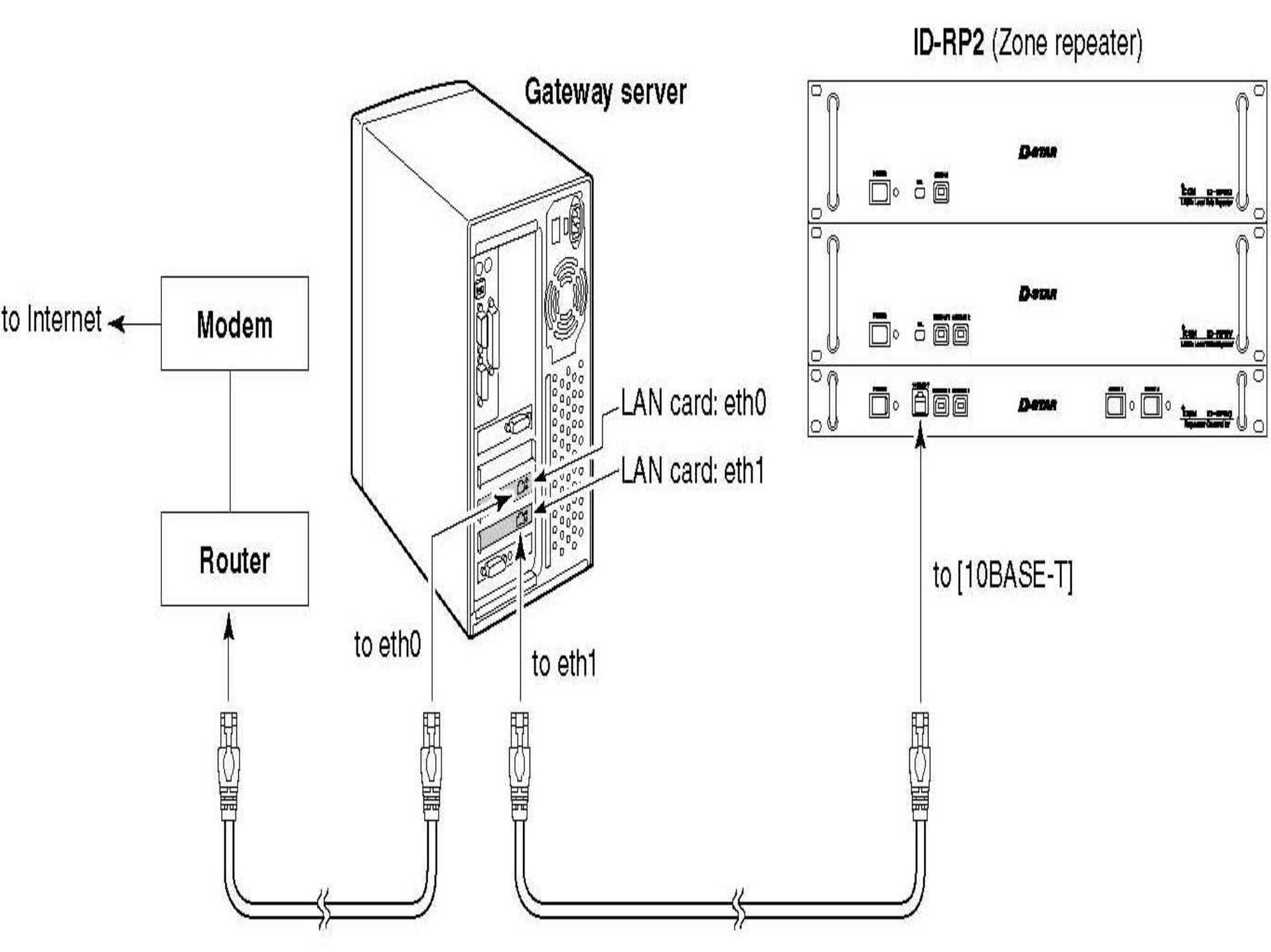


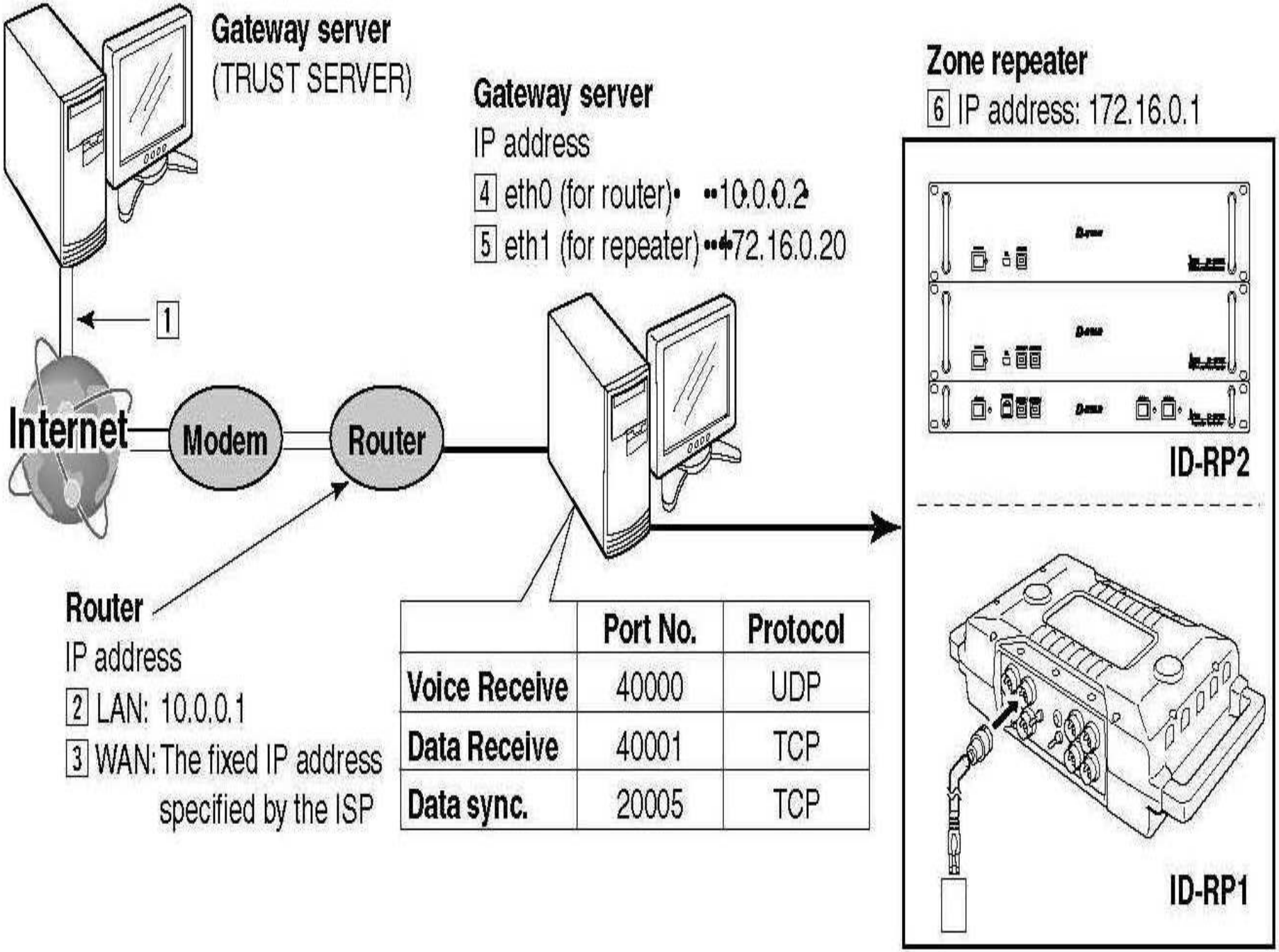
Repeater Module Frequency Selection




D-STAR
Digital Voice + Digital Data
DV + DD
MIC
AMP
CODEC
Transmitter
SP
T/R SW

Gateway


ID-RP2 (Zone repeater)
Gateway server
to Internet
Modem
Router
LAN card: eth0
LAN card: eth1
to eth0
to eth1
to [10BASE-T]



	Port No.	Protocol
Voice Receive	40000	UDP
Data Receive	40001	TCP
Data sync.	20005	TCP

■ System requirements

The following units and/or environments are required to build D-STAR gateway server.

◊ PC

- OS : Linux® (updated)
  Compatible distribution:
  Fedora Core 2 or RedHat® Linux® 9
  Compatible software version
  Linux® Kernel 2.4.20 or later
  glibc 2.3.2 or later
  BIND 9.2.1 or later
- CPU : Pentium® grade 2.4 GHz or faster
- Memory : At least 512 MB
- LAN board : 2 (NIC from Intel® is recommended)
- HDD : At least 10 GB of free space (incl. OS installation)

◊ Internet line

- Line speed : 750 kbps or more (recommended effective speed*) for both uplink/downlink
  *Ask the ISP for effective speed.

◊ Fixed IP address

- Apply to the ISP to acquire a fixed global IP address.

◊ Router

Following functions are required for the router.

- Remote access function (the port forward, DMZ etc.)
- Capability of setting a fixed IP address, such as PPPoE for WAN
- NAT/IP masquerade
- Static IP masquerade/DMZ
- IP filtering function
- DNS answering function
- Static DHCP server setting for LAN
- Class A subnet mask (255.0.0.0) can be set for LAN
  (For your information: The router, WRV54G from LINKSYS, covers all the requirements as above.)

*Ask the ISP for recommended router model.

Gateway Requirements

- Fixed, Routable Internet IP Address **WAN**
- Router must support Class ‘A’ Port **10.0.0.1 LAN**
- Internal Subnet **255.0.0.0**
- Router must support Port Forwarding
- PC, with two NIC’s, Linux, as specified
- Unique call required, club call (**NOT** Trustee!)

Gateway PC and RP2C must be co-located

D-STAR

Digital Voice + Digital Data

Gateway Requirements

- Users all have Fixed IP Addresses
- IP Address only used on device on other side of ID-1
- Radios are transparent bridges
- IP address not used for voice or low-speed data
- Use of multiple ID’s
- Use when multiple radios in use at same time

  (ie: ID-800 for voice, ID-1 for data)
- Routing all done by Call Sign, must differentiate

Gateway driven by 3 data tables

GIP - list of known Gateway systems

RIP - list of IP Block reservations for users

MNG - list of users and most recent Gateway

Network Corruption Possible

Details in Gateway Class

Gateway Process Overview

- Build System
- Test & Validate with Icom Test System
- Completely clear the system
- Change to Production SERVER
- Reboot
- Test & Validate

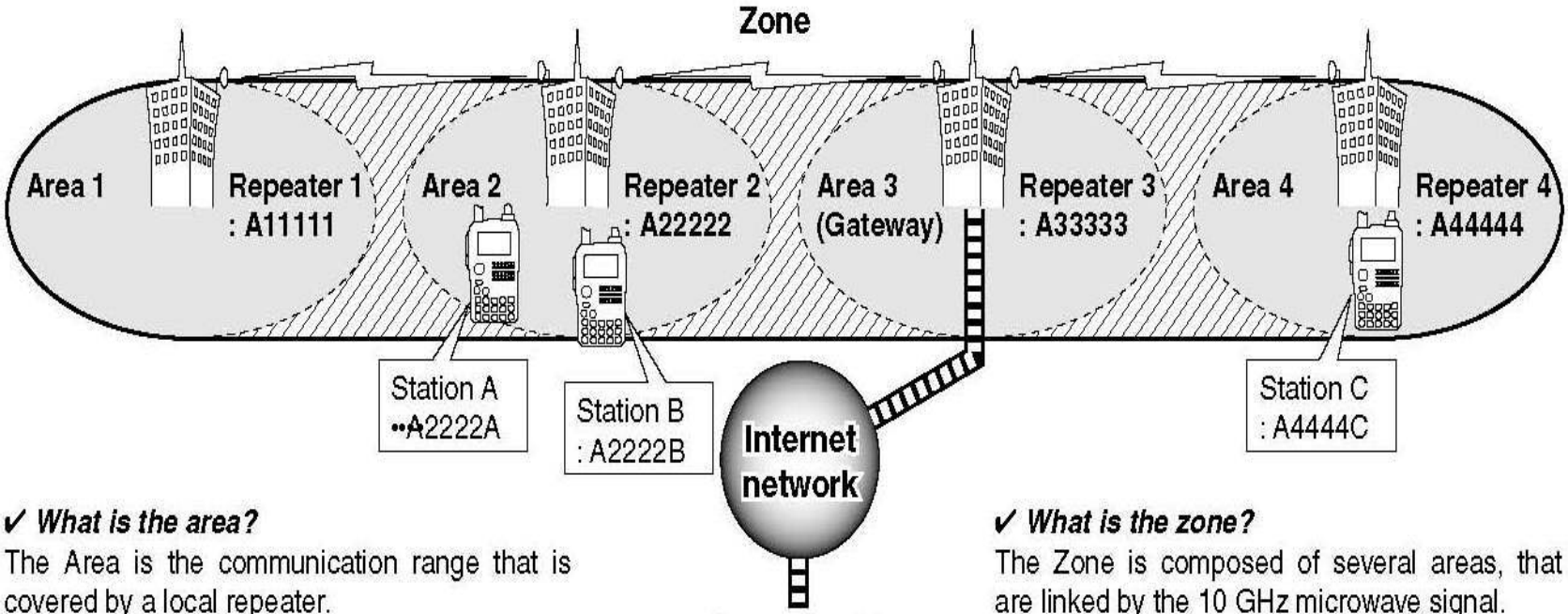
Importance of Validation on Test System vs. Production

D-STAR Backbone

The "invisible" mode of D-STAR is the system backbone with which repeater systems are connected together. Backbone connections can be made by any combination of Internet (a broadband connection is required) or radio links. Users do not use the backbone directly, it is only used by the D-STAR repeater gateways.

Gateways communicate over the D-STAR backbone using the Asynchronous Transfer Mode (ATM) protocol. The backbone operates at data rates of up to 10 Mbps, depending on the connection available. If the radio link backbone is used, signal bandwidth can be as high at 10.5 MHz, so these links are restricted to the amateur microwave bands.

Icom currently provides a 10.7 GHz microwave point to point radio link.



✓ What is the area?

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

✓ What is the zone?

The Zone is composed of several areas, that are linked by the 10 GHz microwave signal.
The areas 1 to 4 make up a zone in the example above.

❑ The setting when Station A is calling Station B

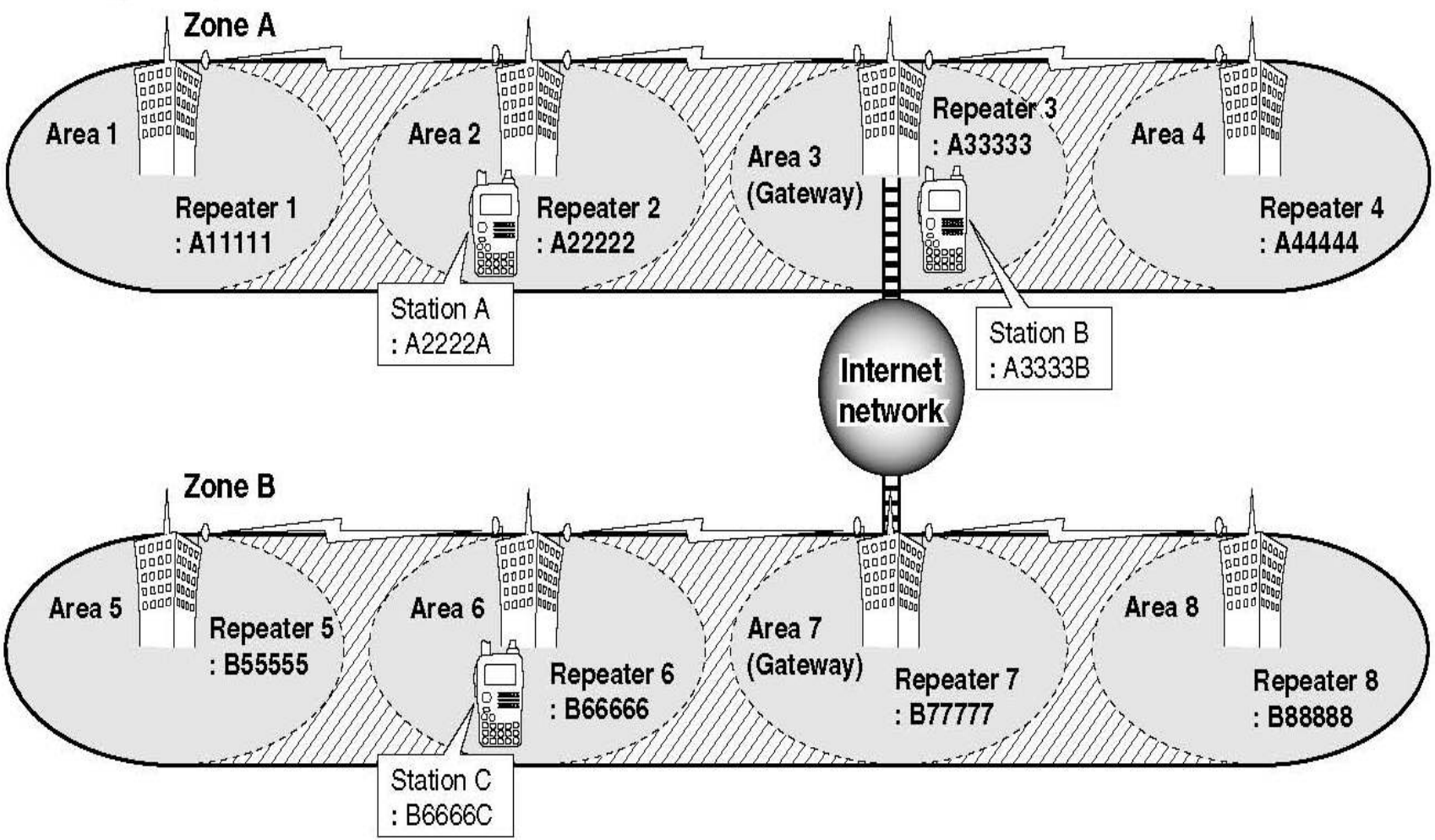
UR	: A2222B
R1	: A22222
R2	: NOT USEQ
MY	: A2222A

❑ The setting when Station A is making a CQ call in area 1

UR	: CQCQCQ
R1	: A22222
R2	: A11111
MY	: A2222A

❑ The setting when Station A is calling Station C

UR	: A4444C
R1	: A22222
R2	: A44444
MY	: A2222A



❑ **The setting when Station A is calling Station C**

UR	: B6666C
R1	: A22222
R2	: A33333 G
MY	: A2222A

❑ **The setting when Station A is making a CQ call in area 8**

UR	: /B88888
R1	: A22222
R2	: A33333 G
MY	: A2222A

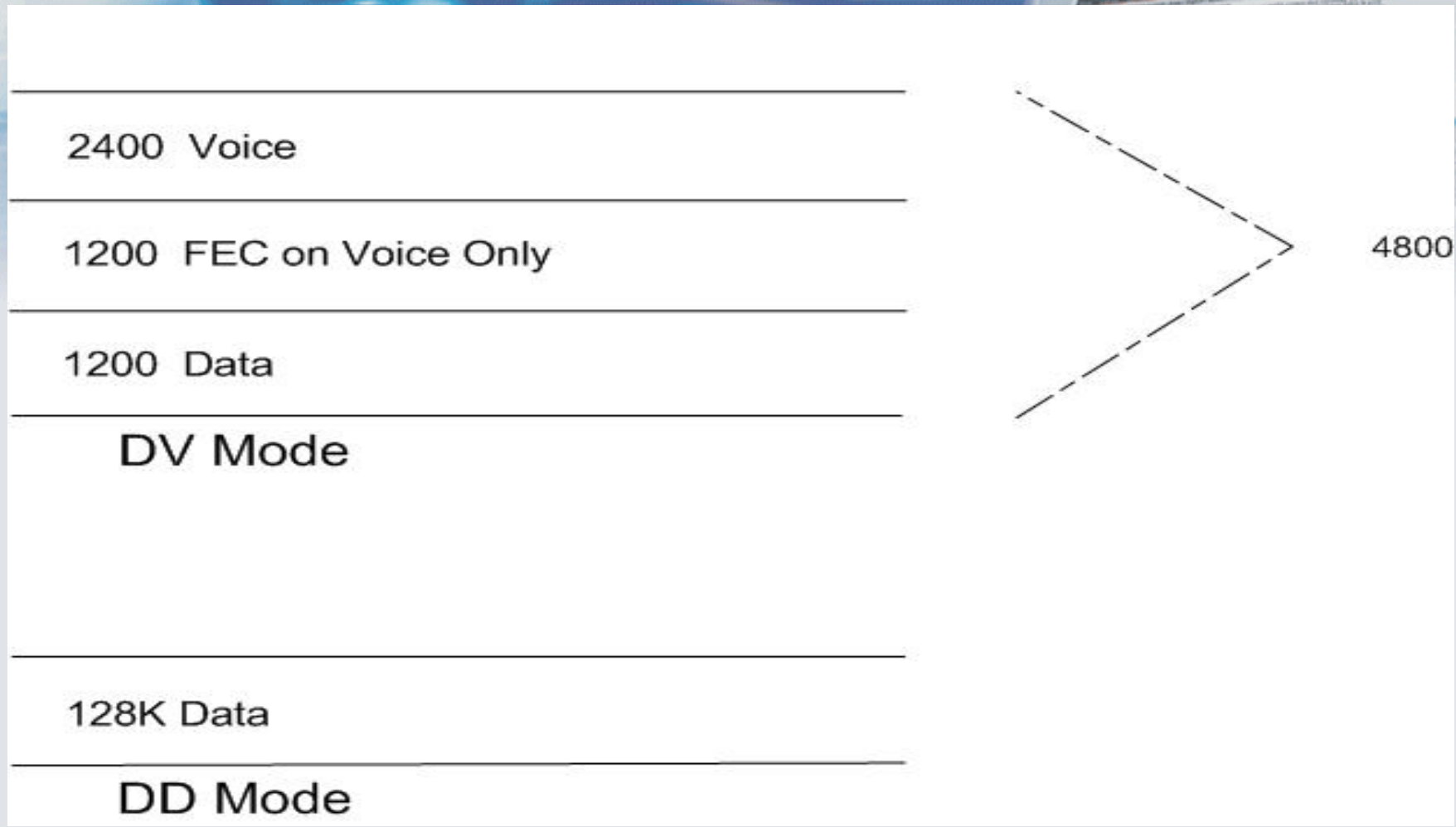
❑ **The setting when Station B is calling Station C**

UR	: B6666C
R1	: A33333 G
R2	: NOT USE✱
MY	: A3333B

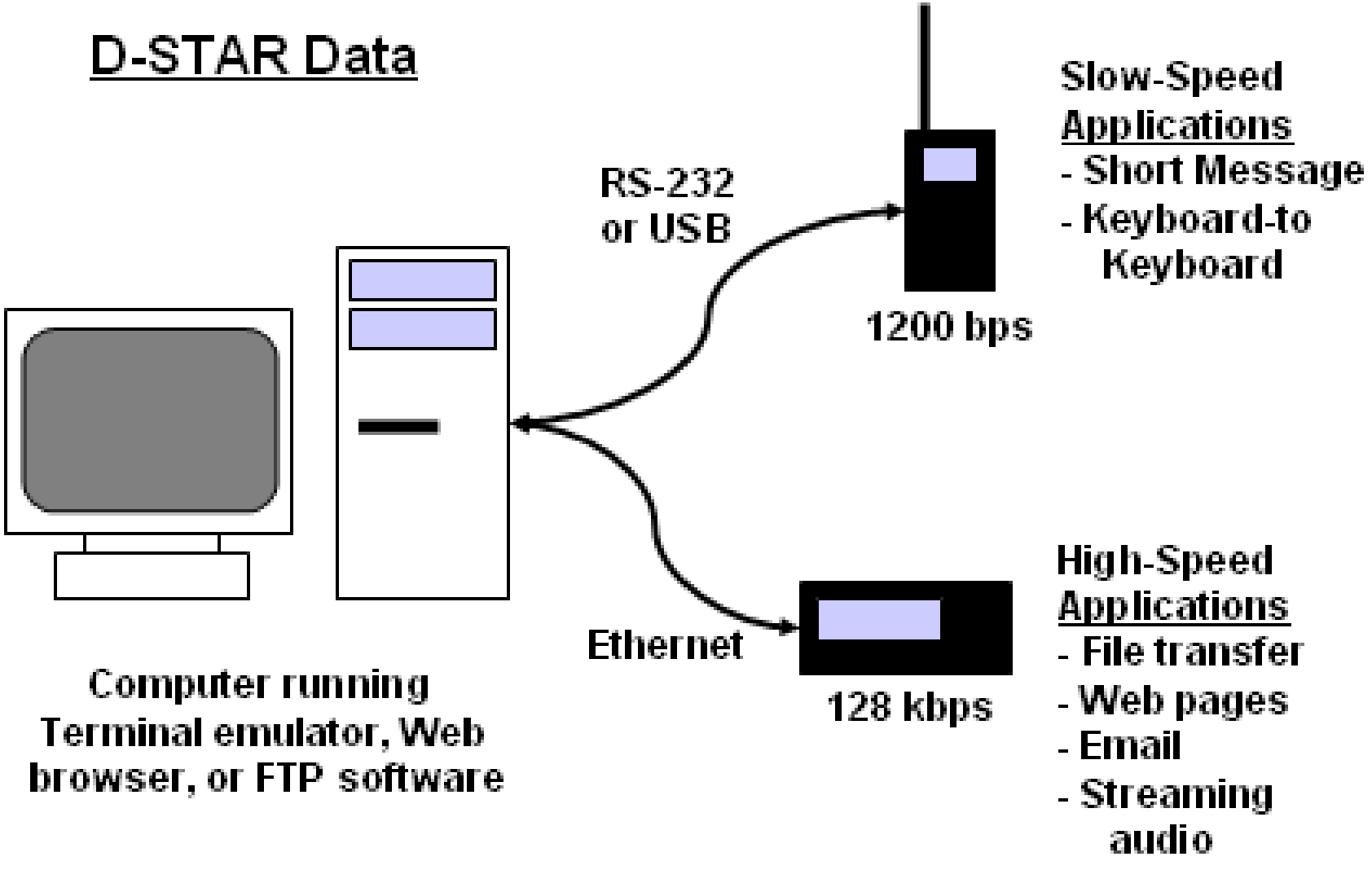
D-STAR

Digital Voice + Digital Data

D-STAR Data Stream



D-STAR Data

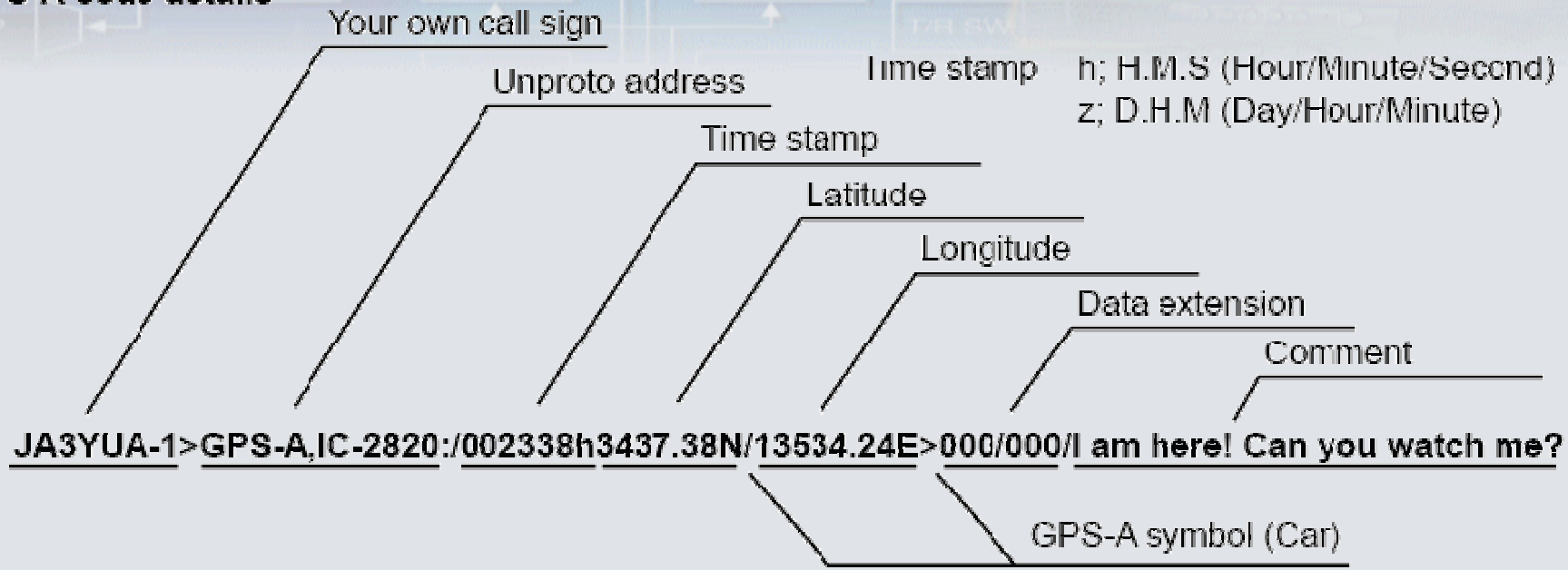

RS-232
or USB
1200 bps
Slow-Speed
Applications
- Short Message
- Keyboard-to
Keyboard
Ethernet
128 kbps
High-Speed
Applications
- File transfer
- Web pages
- Email
- Streaming
audio
Computer running
Terminal emulator, Web
browser, or FTP software

D-STAR

Digital Voice + Digital Data

GPS-A Mode

- **GPS-A code details**



Applications

Applications

- **E-Mail**
- **Internet**
- **Digital Data**
- **Forms**

Applications

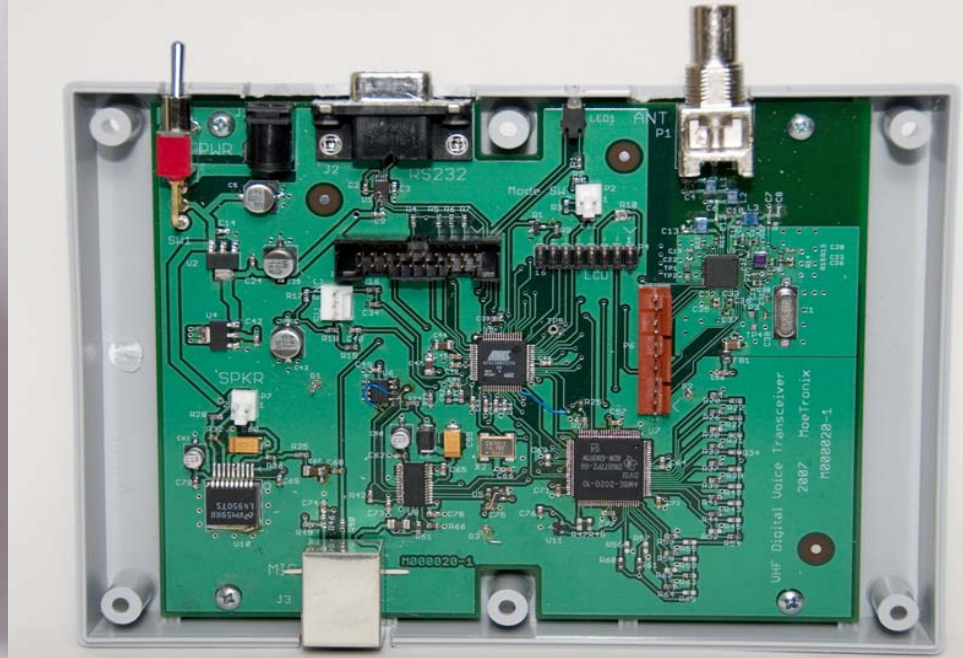
- Text Messaging
- **Home Brew**
- _____
- _____
- _____

DVX - Digital Voice Transceiver

by Moe Wheatley - AE4JY

http://www.moetronix.com

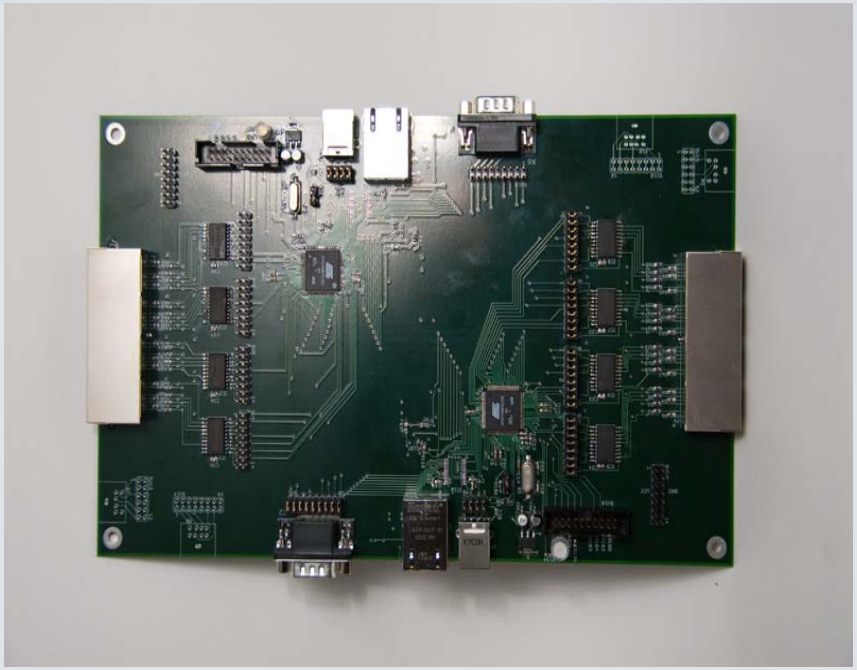
Open Source/Design



D-Star Widget

by Robin Cutshaw – AA4RC

Replaces D-Star Controller or extends distance between controller and repeater modules



Adds

Echo Test

Multicast

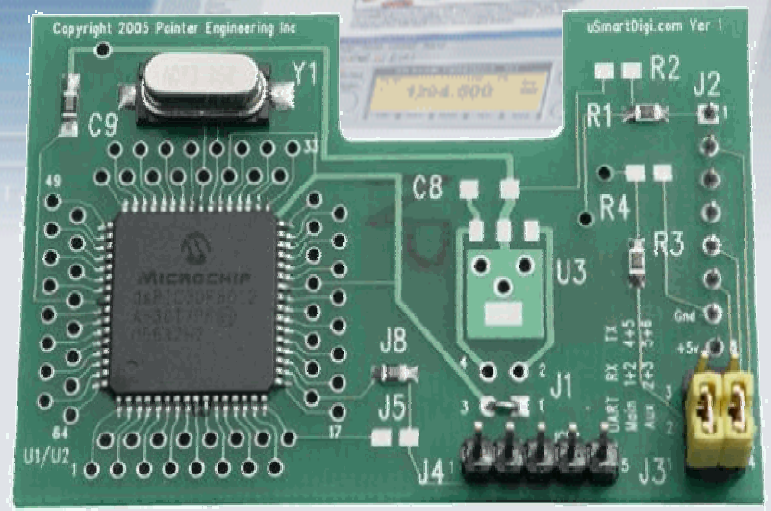
Voice Mailboxes

encodes and decodes raw D-Star frames

D-STAR

Digital Voice + Digital Data

Applications



- **µSmartDigi™ D-Gate**
  - D-PRS® to APRS
  - APRS to D-PRS®
  - Rich Painter, AB0VO

- **D-STAR Monitor**
  - Server based software package
  - Display user status

Applications

- www.dstarusers.org
  - Additional Stats for SYSOP

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

TARC - Control Panel

2006-08-12 18:16:04

Servlet is running; Stop connected as KG4MPU to D-Star @ COM1:9600

Refresh every 10 seconds Update

Create Message View Log Help

Precedence	Outgoing Messages TimeStamp	To
Draft		
Outbox		
Sent		
Immediate	2006.0812-1814.33983	W4MD
Priority	2006.0812-1813.36350	W4MD
Routine	2006.0812-1434.33572	W4MD
Routine	2006.0812-1643.38178	W4MD
Routine	2006.0812-1706.37301	W4MD
Routine	2006.0812-1756.36614	W4MD
Failed		

Precedence	Incoming Messages TimeStamp	From
Inbox		
Rcvd		
Routine	2006.0812-1706.09901	W4MD
Routine	2006.0812-1708.40929	W4MD
Routine	2006.0812-1727.04235	W4MD

Applications

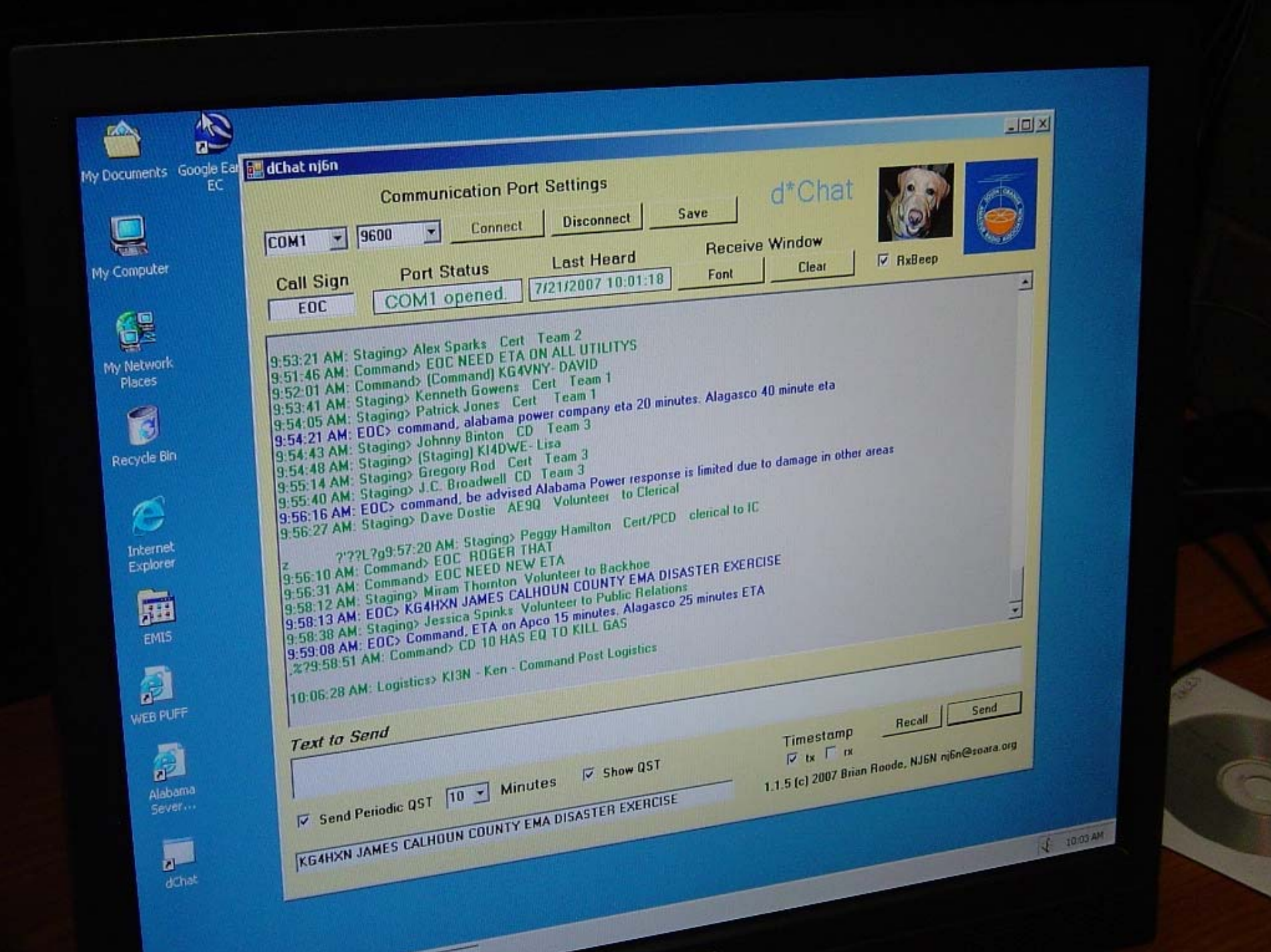
- **d*Chat**

  A keyboard to keyboard chat application for Windows.

  Multiple stations simultaneously on a single simplex or repeater channel.

  Brian Roode, NJ6N

  http://nj6n.com/dstar/dstar_chat.html


My Documents
Google Ear
EC
My Computer
My Network Places
Recycle Bin
Internet Explorer
EMIS
WEB PUFF
Alabama Sever...
dChat
dChat nj6n
Communication Port Settings
d*Chat
COM1
9600
Connect
Disconnect
Save
Call Sign
EOC
Port Status
COM1 opened.
Last Heard
7/21/2007 10:01:18
Receive Window
Font
Clear
RxBeep
9:53:21 AM: Staging> Alex Sparks Cert Team 2
9:51:46 AM: Command> EOC NEED ETA ON ALL UTILITYS
9:52:01 AM: Command> (Command) KG4VNY- DAVID
9:53:41 AM: Staging> Kenneth Gowens Cert Team 1
9:54:05 AM: Staging> Patrick Jones Cert Team 1
9:54:21 AM: EOC> command, alabama power company eta 20 minutes. Alagasco 40 minute eta
9:54:43 AM: Staging> Johnny Binton CD Team 3
9:54:48 AM: Staging> (Staging) KI4DWE- Lisa
9:55:14 AM: Staging> Gregory Rod Cert Team 3
9:55:40 AM: Staging> J.C. Broadwell CD Team 3
9:56:16 AM: EOC> command, be advised Alabama Power response is limited due to damage in other areas
9:56:27 AM: Staging> Dave Dostie AE9Q Volunteer to Clerical
z ?'??L?g9:57:20 AM: Staging> Peggy Hamilton Cert/PCD clerical to IC
9:56:10 AM: Command> EOC ROGER THAT
9:56:31 AM: Command> EOC NEED NEW ETA
9:58:12 AM: Staging> Miram Thornton Volunteer to Backhoe
9:58:13 AM: EOC> KG4HXN JAMES CALHOUN COUNTY EMA DISASTER EXERCISE
9:58:38 AM: Staging> Jessica Spinks Volunteer to Public Relations
9:59:08 AM: EOC> Command, ETA on Apco 15 minutes. Alagasco 25 minutes ETA
.?79:58:51 AM: Command> CD 10 HAS EQ TO KILL GAS
10:06:28 AM: Logistics> KI3N - Ken - Command Post Logistics
Text to Send
Recall
Send
Timestamp
tx
rx
Show QST
Send Periodic QST
10
Minutes
KG4HXN JAMES CALHOUN COUNTY EMA DISASTER EXERCISE
1.1.5 (c) 2007 Brian Roode, NJ6N nj6n@soara.org
10:03 AM

dChat nj6n

Communication Port Settings

COM1 | 9600 | Connect | Disconnect | Save | Print

d*Chat

Call Sign: Logistics

Port Status: COM1 opened.

Last Heard: 7/21/2007 10:59:19

Receive Window: Clear | Font | rxColor

RxBeep

10:12:10 AM: 10:07:06 AM: OPS CHIEF> IC DE OPS: PLEASE GIVE ETA OF EMS TO OPS ON SCENE. END.
10:12:43 AM: 10:05:58 AM: Command> OPS EMT ENROUTE
10:13:25 AM: 10:08:13 AM: EOC> Command, Apco in area... ETA 3 min
110:13:25 AM: 0:08:13 AM: EOC> KG4HXN JAMES CALHOUN COUNTY EMA DISASTER EXERCISE
10:14:18 AM: 10:07:32 AM: Command> STAGING ALSO NEED SAW OPERATOS ENROUTE TO AREA
10:14:40 AM: 10:09:36 AM: OPS CHIEF> IC DE OPS: PLEASE GIVE ETA FOR EMS AND ALABAMA POWER & GAS. END.
10:15:34 AM:
10:08:48 AM: Command> OPS EMS IS IN STAGING
10:16:09 AM: 10:10:57 AM: EOC> Command, Alagasco 5 min ETA in area
10:16:22 AM: 10:09:36 AM: Command> AL POWER IN 3 @COMMAND
10:17:15 AM: 10:12:11 AM: OPS CHIEF> IC DE OPS: SEND EMS TO NE CORNER OF FRANCIS, UPPER PARKING LOT ASAP. END.
10:18:47 AM: 10:12:01 AM: Command> (Command) KG4VNY- DAVID
10:19:58 AM:
10:14:48 AM: Staging> (Staging) KI4DWE- Lisa
10:20:44 AM: 10:15:40 AM: OPS CHIEF> IC DE OPS: NEED ID TAPE TO THE SCENE TO ID TRAILERS THAT HAVE BEEN CHECKED. END.

Text to Send

Send Periodic QST 10 Minutes | Show QST | Show GPS

Timestamp: tx rx | txColor | Recall | Send

KI3N - Ken - Command Post Logistics

1.2.1 (c) 2007 Brian Roode, NJ6N nj6n@soara.org

Start | dChat nj6n | ACDSee Classic - C:\ | 14:44 PM

DStarQuery

- **Java based**

Application monitors the serial data port for text commands or queries

- Command List

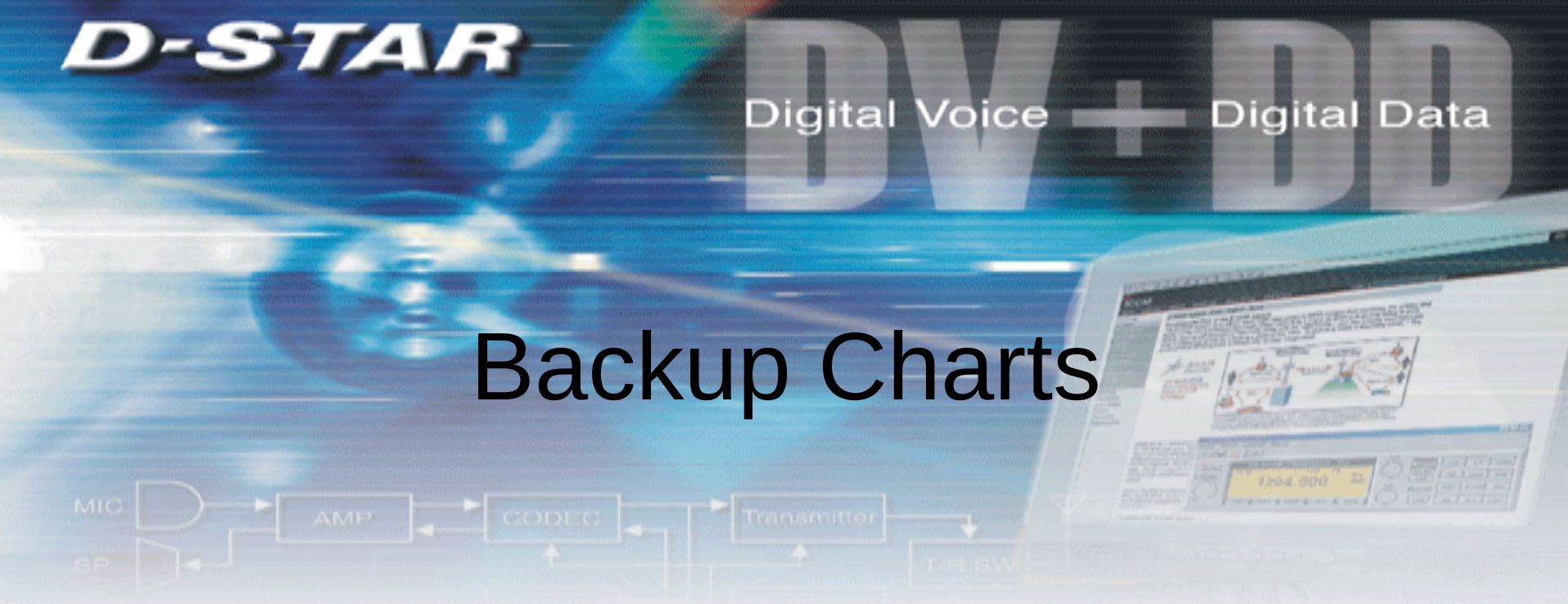
Enter "**?D***enter command here***?**"

- **fon = list of important phone numbers**
- **info = list of available commands**
- **rptrs = list of area repeaters**
- **ufo = current space weather conditions**
- **wx = current weather conditions for your area**
- **wx4 = 5-day weather forecast for your are**

Additional Information

- w4ozk@arrl.org
- www.arrl-al.org
- www.icomamerica.com/dstar

ALABAMA D★STAR



Backup Charts

D-STAR

Digital Voice + Digital Data

GigaParts® Online Superstore!

Cost

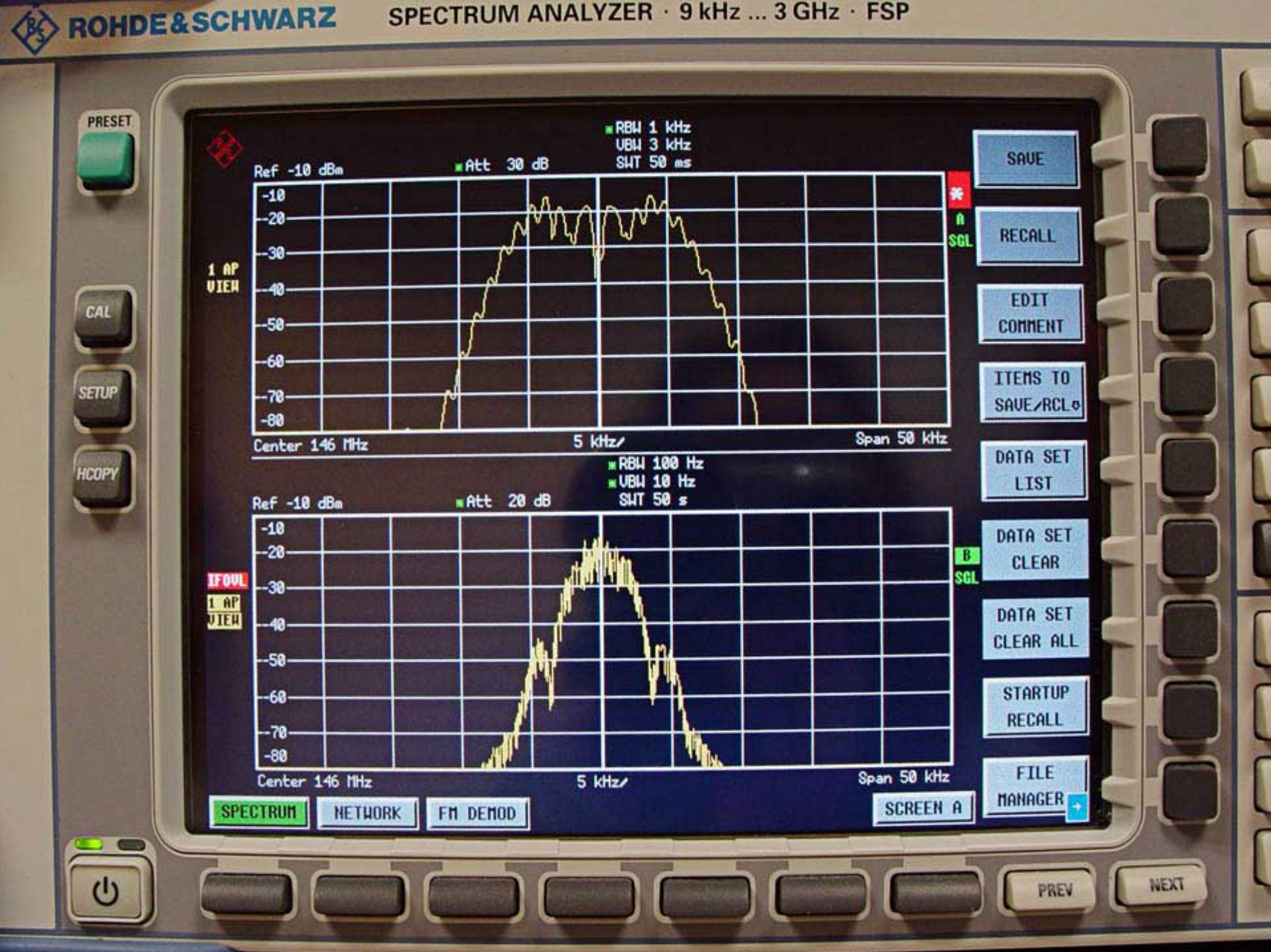
Radios		Repeater	
IC-91A/D	**$449.95**	ID-RP2000V 2m	**$1399.99**
ID-800	**$609.99**	ID-RP4000V 70cm	**$1399.99**
IC-2820	**$950.00**	ID-RP2V 23 cm	**$1559.99**
ID-1	**$979.99**	ID-RP2D 23 cm	**$1112.99**
IC-2200	**$139.95**	ID-RP2C Controller	**$1459.99**
IC-V82&V*83	**$119.95**	**Total =**	**$6933.95**

UT-118 module for IC-2200,

IC-U82, & IC-V82 **$189.00**

+ Antennas, Feed line, Duplexers, Server, Internet connection.

Check for current prices


ROHDE&SCHWARZ
SPECTRUM ANALYZER · 9 kHz ... 3 GHz · FSP
PRESET
CAL
SETUP
HCOPY
RBW 1 kHz
VBW 3 kHz
SWT 50 ms
Ref -10 dBm
Att 30 dB
1 AP
VIEW
-10
-20
-30
-40
-50
-60
-70
-80
Center 146 MHz
5 kHz/
Span 50 kHz
A
SGL
RBW 100 Hz
VBW 10 Hz
SWT 50 s
Ref -10 dBm
Att 20 dB
IFOVL
1 AP
VIEW
Center 146 MHz
5 kHz/
Span 50 kHz
B
SGL
SAVE
RECALL
EDIT COMMENT
ITEMS TO SAVE/RCL
DATA SET LIST
DATA SET CLEAR
DATA SET CLEAR ALL
STARTUP RECALL
FILE MANAGER
SPECTRUM
NETWORK
FM DEMOD
SCREEN A
PREV
NEXT