

Digitally modulated voice and High Speed Data

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What is D-STAR

- D-STAR is a standard developed by ICOM for the Japanese Government, that has been adopted by the JARL.
- The D-STAR standard has been endorsed by ICOM and Kenwood at JAIA in August 2002.
- The D-STAR standard defines how Digital Voice and High Speed data can be transmitted.
- D-STAR has been in development for several years and will be released for sale starting with the ID-1 in 3rd Q of 2004, The repeaters IDRP2 will be released shortly after.

Potential Uses

- Wireless Internet
- APRS
- SKYWARN
- HOMELAND SECURITY
- Infrastructure Backup
- Hurricane Nets
- Enhanced Packet

Building the Data Infrastructure

- Data will be the most popular part of the D-STAR system to be implemented.
- Digital Voice to be combined with the data system.
- Eventually a hybrid Analog and Digital Voice systems will be put in place to bridge the gap and ease the transition.

Data Infrastructure Features

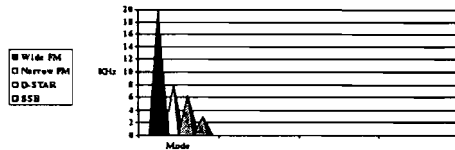
- High Speed Data 128Kb/s
- Frequency 1.2GHz (23cm)
- Acts as an access point
- Internet accessible Network

Data Infrastructure Features

- Backbone Frequency 10GHz (3cm)
- Backbone Data Speed 10Mb/s
- Very High Speed and Capacity
- Site link and data backup
- Approx 6 ½ times the speed of T1

Voice Infrastructure Features

- Ability to transmit low speed data and voice simultaneously at 2.4Kb/s
- Very efficient 6.25KHz total bandwidth



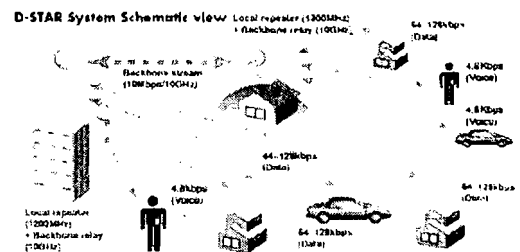
Voice Infrastructure Features

- Stations are accessed by their call sign
- Advanced features beyond EchoLink® and IRLP®
- Cellular like roaming

D-STAR Components

- Present
 - Mobile/Base ID-1
 - D-STAR Repeaters
- Future
 - Handheld devices
 - Analog to Digital Voice Gateways

Communications Outline



System Interconnection

- Can be linked via Microwave or Internet
- Microwave
 - Provides very high bandwidth
 - Not dependant on public infrastructure
- Internet
 - Inexpensive
 - Allows linking or great distances, i.e. world wide

ID-1 Specifications

- Frequency: 1240-1300MHz 23cm Amateur
- Power Output: 10W/1W
- Mode: FM (Analog Voice) GMSK (Digitally modulated voice and data)
- Data Rate: 4.8Kbps (Voice/Data), 128Kbps (High Speed Data)
- Codec: AMBE 2.4Kbps
- Data Interface: IEEE802.3 (10Base-T) Ethernet
- Control Interface: USB

ID-1 and D-STAR

Clearing the confusion

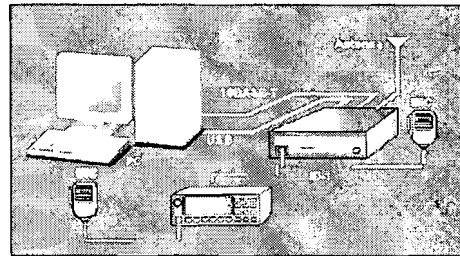
What is the ID-1

- The ID-1 is a digital transceiver with legacy Analog FM
- Based on the JARL D-STAR standard for digital amateur radio.
- Digitally modulated voice mode (4.8kbps, GMSK), High-Speed Data communication (128kbps, GMSK) as well as analog voice mode communication (FM)
- Connecting the ID-1 to a PC with a USB cable and 10BASE-T Ethernet cable, full operation is carried out by PC or the remote head.
- Wireless Internet access can be made easily over the air.

ID-1 Digital Voice Terminal



ID-1 Data Terminal



ID-1 connected to a PC using USB and Ethernet. Note the control head is optional in this configuration, as total control can be handled from the PC.

ID-1 “Ultimate Black Box” RIG

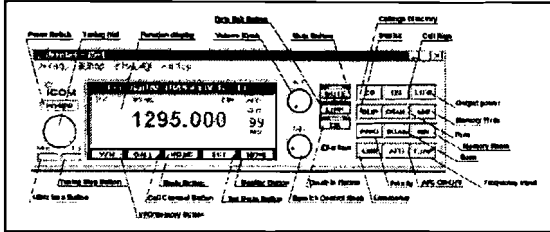
- Once programmed, no need for control head or PC
- Microphone can plug directly into radio
- Control head and mic not needed for Data
- Deploy pre programmed data or voice rigs in a “black box” mode for nearly tamper proof operation

ID-1 networking

- Simple network bridge
- IP and MAC address handled by the PC
- You can use any protocol supported by Ethernet.
- Use a standard CAT 5 cable for connection to a PC, and use a Crossover cable for connection to a HUB or WAP

Computer interface

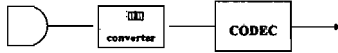
Controller View Of The PC Display



Technical Data

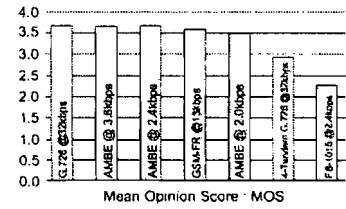
Types of codec's

Microphone



- VSELP (Vector Sum Excited Linear Prediction)
- RELP (Residual Excited Linear Prediction)
- IMBE (Improved Multi-Band Excitation)
- **AMBE (Advanced Multi-Band Excitation)**

AMBE Codec

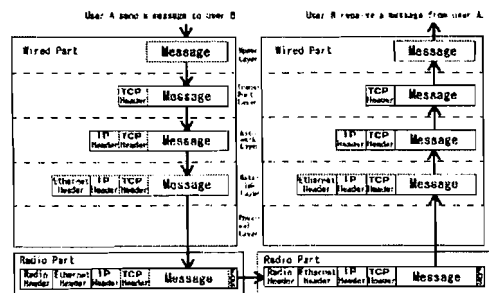


- Discriminate each voice segment for frequency band.
- Decide voice/non-voice for each frequency band.
- Mix voice and noise of excitation signal versus specified voice

Data Header Information

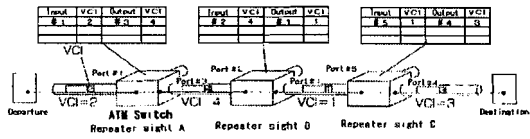
Header of Wireless Data							DATA				FCS		
Bit Sync	Frame Sync	Flag	Destination Repetier	Originator Repetier	Destination Station Callign	Departure Station Callign	FFCS	ELAN	SA	DA		Type	Data Frame

Message Transportation



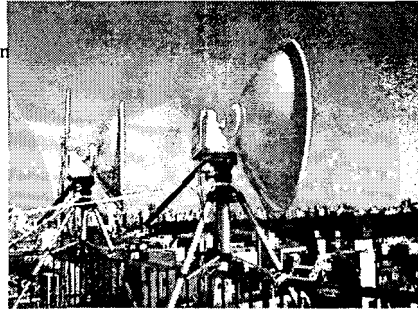
ATM Asynchronous Transfer Mode

ATM Cell (53 bit)		ATM Cell (53 bit)		ATM Cell (53 bit)	
Header	Payload	Header	Payload	Header	Payload
5 bytes	48 byte	5 bytes	48 byte	5 bytes	48 byte



Backbone antenna view

Pre production tests in Japan



Voice Operation

- Analog
 - CTCSS
- Digital
 - Unique Signaling
 - Digital ID Code, CSQ
 - Callsign defined listening list, DSQ

D-STAR

Software Application Development

D-STAR Flexibility

- D-STAR maps to the OSI model
- Physical Layer
- Datalink Layer
- Ethernet
- Since D-STAR is an open standard, anyone can develop software for it.

Physical Layer

- Defines specifications about physical signal characteristics.
 - Example
- GMSK modulation
- 1.2GHz frequency for radios and repeaters
- Above 5GHz for Backbone link

Datalink Layer

- Organizes raw data into frames.
 - Example
- Ethernet uses frames to send data between nodes using MAC addresses
- D-STAR appends a radio header to the Ethernet header to facilitate intersystem communications.

Flexibility within the system

- Application developers have a structure to work from
- Developers can work with higher layers
- Commonplace and simple standards to work with. i.e. Internet and Ethernet
- Complete control from the software interface

D-STAR

Practical applications and uses

ID-1 Uses

- Extend networking functions in the field for emergency use
- Link multiple ID-1's for increased bandwidth
- Connect two ID-1's back to back to form a digipeater
- Remote Rig control

D-STAR and ID-1 Applications

- APRS with simultaneous voice and data
- D-STAR chat client
- Emergency uses
 - Nearly unlimited potential
- Traditional analog FM

Support

- ICOM provides free technical support on all of its products
- ICOM user group
- <http://www.icomamerica.com/d-star>
- D-STAR RFC's
 - prevent broadcast seizures
 - 802.3ad link aggregation
 - Linking two ID-1's to form a digipeater

D-STAR Structure

- D-STAR system will be coordinated for both frequency use and IP address
- Private Class A Address Scheme
- Repeaters go along with analog voice systems
- Data will be at the bottom of the band

Comparison to 802.11 “Hinternet”

- D-STAR - Plug and Play availability
 - Part 97 802.11 requires many pieces from different vendors
- D-STAR - exclusive/primary frequency use
 - Part 97 802.11 should only use ch 2-5, which are prone to interference
- D-STAR - Long Range
 - Part 97 802.11 can achieve long range, but not designed for it
 - Long distance links can NOT maintain full speed. Limited by MAC layer timing in the 802.11b specification

Comparison to 802.11 “Hinternet”

- D-STAR – Natively supports call sign
 - Part 97 802.11 has no provision to support call sign identification
- Not likely to get “bumped” by state/federal

Legal Issues

- Internet over amateur radio is legal
- Rules put all responsibility on the control operator
- Encryption not normally allowed

Funding

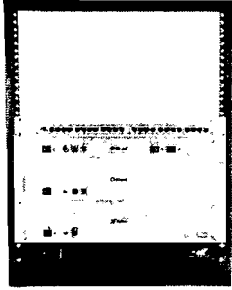
- Some Amateur clubs are 501 c 3
- Government grants
 - FEMA
 - Home Land Security
- Hospital/Local community

ID-1 trivia

- The ID-1 head has been remoted with a 150' CAT 5 cable*1
- The ID-1 can be used as an access point

• *1 Not officially supported

ID-RP2 Repeater System



- ID-RP2C
 - Controller
- ID-RP2D
 - Data access point
- ID-RP2V
 - Voice repeater

ID-RP2 Repeater System

- ID-RP2C
 - Allows for up to 2 microwave links
 - Supports any combination of Voice and Data Repeaters, up to 4
- ID-RP2D
 - Data access point
 - Necessary for multi-site configurations
- ID-RP2V
 - Voice repeater
 - Allows for roaming