# Digital

## The Future of Communications

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# The Digital Future

- More powerful DSP
  - Faster processors, better algorithms, better filters and more features
- Software Defined Radio (SDR)
  - Download the latest filters, features and modes to your radio/computer
- Digital Voice and Data
  - Already implemented in every cell phone, satellite radio, TV, DRM shortwave and many commercial radios (RDS)

# Digital Radio Features

- Better spectrum efficiency
- Better audio performance (good until gone)
- Ability to send data (callsign/unit ID, GPS location, pictures, text messages, files, etc.)
- Routing of calls to other systems, users, conference bridges (reflectors)
- Features like emergency mode, nearest repeater, logging of calls and location

# Digital Radio Options

- APCO Project 25 (P25) - 1989
  - Standard for Federal agencies, now WSP
- DSTAR - 2002
  - Demonstrated by Icom and Kenwood in Japan, now Icom and smaller companies
- MotoTRBO/DMR - 2005
  - Lower-end commercial system being adopted for amateur radio
- Yaesu System Fusion - 2013
  - Recent release from Yaesu for the amateur market

# Digital Voice/Data = DSTAR

- Digital Smart Technology for Amateur Radio
- Joint venture between Japanese government and Japanese Amateur Radio League (JARL)
- Open specification
- Icom is the only current vendor although other products coming
- Radio products all offer FM analog mode for backward compatibility

# DSTAR Modes

- Digital Voice (DV Mode)
  - 3600 baud AMBE encoded
- Low-speed Digital Data (DV Mode)
  - 1200 baud available simultaneously on “voice” channel or 4800 baud as data-only
  - 3-wire “com port” interface via submini jack
  - VHF/UHF
- High-speed Digital Data (DD Mode)
  - 128K baud through RJ-45 Ethernet jack
  - Available at 1.2 GHz

# DSTAR Topologies

- Radio to Radio Simplex (RF)
  - Voice
  - Data
  - Voice with Data
- Radio to Repeater (RF)
  - Same modes as above
- Repeater Gateway (Internet)
  - Link to Repeaters(s)
  - Link to Reflector
  - DV Dongle/DV Access Point users




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# Why use Digital Voice?

- Spectral efficiency
  - Same reason as cellular service providers
  - FM voice is 15-20 kHz bandwidth
  - DSTAR digital voice has a 6 kHz bandwidth
  - TWICE as many repeaters in the same spectrum!
- Shares spectrum with data
  - Callsigns, DPRS position data and messages can transmit WITH voice signal, unlike APRS
- Voice QSOs are “routable”
  - Voice can be directed to another radio, repeater or gateway




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# What does this mean to me?

- Call ***Anyone***
  - Radio knows your callsign
  - Your callsign appears on other radios when receiving
  - Can enter other callsign for “callsign squelch”
- Call ***Anywhere***
  - Voice can be sent through repeater or routed through a gateway via RF or the Internet
  - DSTAR users are registered with local repeaters for cellular-like service
- Call ***Anytime***
  - Some even include an answering system

# How does it work?

## Let's try connecting!

- User Callsigns
  - –N7SS: Snohomish, WA
  - –N5MIJ: Dallas, TX
  - –VK8HF: Darwin, Australia
- Repeater Callsigns
  - –WC7SO: Bellingham, WA
  - –NR7SS: Everett, WA
  - –REF035C: WA Reflector

**Callsign Programming**

- MYCALL = **N7SS**
- RPT 1 = **WC7SO--B**
- RPT 2 = **WC7SO--G**
- URCALL = **CQCQCQ**

**Then**

- URCALL = **N5MIJ**

**Then**

- URCALL = **VH8HF**

**Then**

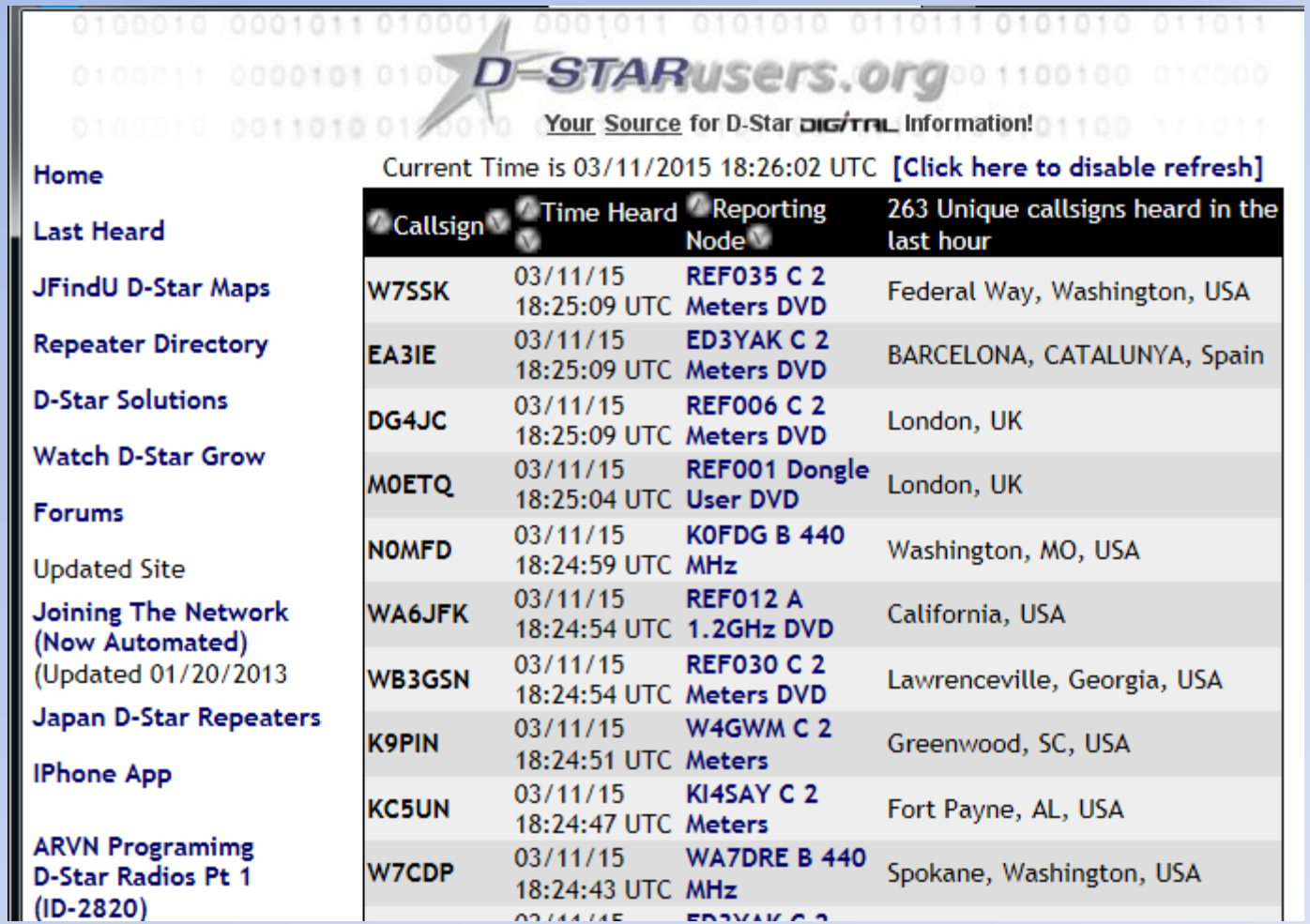
- URCALL = **NR7SS BL**

**Then**

- URCALL = **REF035CL**

- Result
  - Both Voice and Data Communications routed to the appropriate recipient!

# DSTAR User Registry



# Why not IRLP/Echolink?

- No “callsign squelch”
- Cannot call individual user – only links repeaters
- Call routing is not automatic
- Node names are numeric rather than callsigns
- Requires activation via DTMF code sequence
  - DSTAR call information can be stored in memory
- Cannot send callsign/messages/position or other data to remote users
- DSTAR offers some level of secure transmission

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# Why Digital Data?

- DPRS position reports and messages like APRS
- Transfer any type of data (text, photos, email, spreadsheets, etc.)
- Interface as COM port (low speed) or Ethernet port (high speed)
- Routable to other radio anywhere in the system or gateway to Internet
- 1200/3600 baud at VHF/UHF, 128Kb at 1.2GHz
- Plug and play – no extra TNC or radio cabling




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# Why not packet or Winlink?

- Packet is a routing nightmare
  - Who is up, what is the callsign, where to they connect, etc.
- Packet protocols are unique to ham radio
  - DSTAR is either a COM port (low speed) or TCP/IP network (high speed)
- Winlink is only Email (with small attachments)
- Winlink is supported over DSTAR with DRATS
- Off the shelf, single-box solutions for 1200 baud, 3600 baud and 128K baud!




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# What do I need?

- Full line of products currently available with more coming from Icom and others
  - 70cm HT – ID-31
  - Dual band HT with Dual VFOs – ID-51A/Plus
  - Dual band mobile – ID-880H
  - Dual band, dual VFO Mobile – ID-5100
  - 1.2Ghz mobile – ID-1 (supports high speed data)
  - Base/mobile multiband/mode – IC-9100*, IC-7100
  - VHF, UHF and 1.2GHz repeaters and controller




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# Handheld DSTAR Radios

- Dual band, dual VFO
- Internal GPS
- 1200/3600 baud data
- Recording capability
- MicroSD slot
- FM and DSTAR repeater directory with nearest repeater feature
- Free Android application for control, picture/text transmission and mapping

# Mobile DSTAR Radios

ID-880 Dual-Bander


ID-5100 Dual band Mobile


Bluetooth Option Available


ID-1 1.2Ghz Mobile

# DSTAR Multiband/Multimode


IC-7100 HF-70cm with
Touchscreen and DSTAR

IC-9100 HF-70cm with
Dual VFO - DSTAR and
1.2 GHz optional

# But it's too hard

- Basic simplex and repeater operation is easier
  - Dial the frequency and kerchunk
  - Built-in repeater directory is even easier
- Gateway operations get more complicated
  - Repeater/reflector linking and unlinking
  - Callsign routing
  - Some features may not exist on your repeater
- Data is WAY simpler
  - Plug it in and go – it's a digital radio
  - No levels to set, T/R delay, commands, etc.




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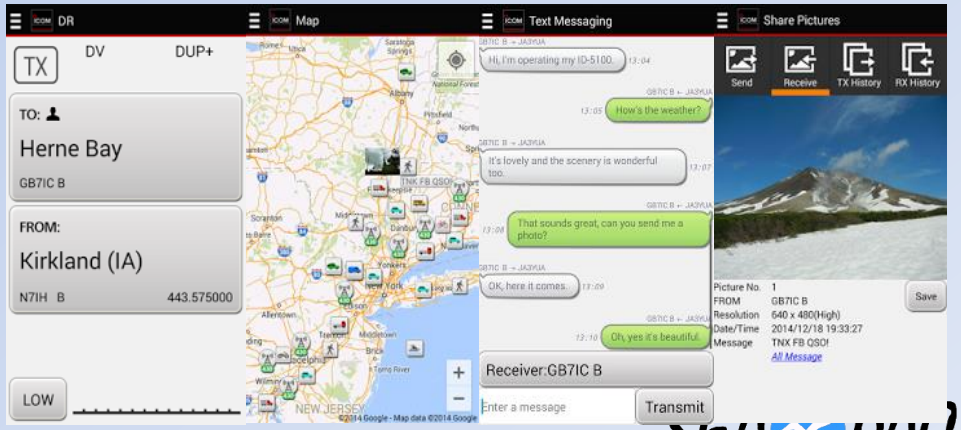
# Latest Developments

- Updated DSTAR Specification includes “Fast Data” (3840bps) in DV mode
  - Supported in ID-51Plus and ID-5100 (with update)
- RS-MS1A Android Application
  - Rig Control
  - Display map of repeater sites or users
  - Text messaging
  - Share pictures
  - Repeater list
  - Transceiver settings

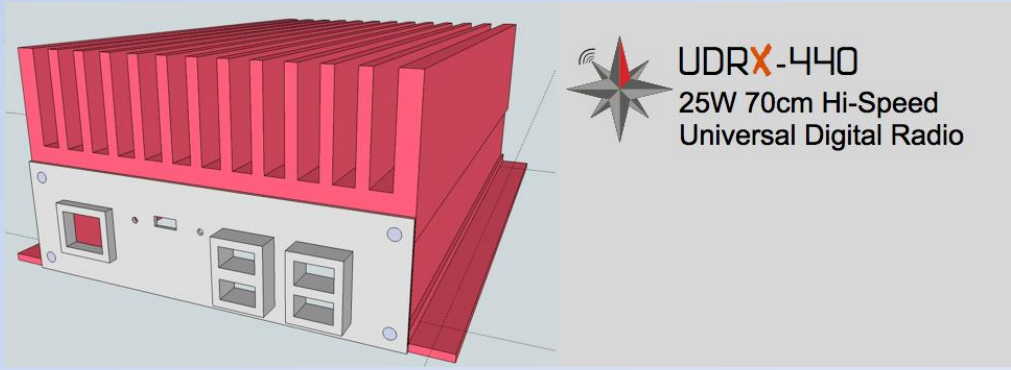


# Internet Labs

- DV Dongle
  - Allows access to the network without a radio
  - USB device off a PC decodes AMBE packets
- DV Access Point
  - USB device with small radio to simulate repeater with gateway

# Northwest Digital Radio

- Thumb DV
  - Similar to DV Dongle
  - Offers AMBE codec to access network
- UDRX
  - Full 25watt UHF data radio with DSTAR voice/data
  - Coming “soon”

# It's a Digital World After All

- "Embrace and Extend" Internet Technologies
  - The Internet is NOT killing ham radio
  - The Internet is ENABLING ham radio
- Most media is now digital
  - Documents, spreadsheets, databases, pictures, etc.
- "Interoperability" is the new buzz word
  - Digital information makes interoperability possible
- Served agencies will demand more than voice
  - They expect email, live video, web interfaces, etc.

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# References

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