Introduction to Digital Voice Modes

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Who are these guys?

- Jay, KD4BPZ
  - Amateur since 1991
  - Diverse amateur interests: DX, digital HF modes, 6m SSB, weak signal, beacons, repeaters, digital voice
- Jim, K8OI
  - Amateur since 2010
  - Likes American Pale Ale and Dopplebock
  - Hates long walks on the beach and looking for sea shells
  - Enjoys 6m, VHF+, & non-FM activity

Objectives

- Learners will be:
  - Able to describe basic characteristics of DSTAR, P25, and DMR
  - Able to understand basic differences between the systems
  - Able to understand local options for trying these systems
  - Create awareness of new and used gear that can be used
  - Be aware of common myths that relate to digital communications

Why consider digital voice modes?

- "New" technology – but not really…
- Opportunities to experiment and pioneer
- Audio Quality
- Networking / linking capability

Quick Overview

D-STAR - Digital Smart Technologies for Amateur Radio is an open standard digital communication protocol established by the Japan Amateur Radio League (JARL). This protocol was designed for the Amateur Radio Service and ICOM is currently the only major equipment manufacturer making D-STAR gear. See “D-STAR, Digital Voice for VHF/UHF,” CQ VHF magazine, Winter 2006.

APCO 25 - The Project 25 radio standard was developed by the Association of Public-Safety Communications Officials-International (APCO) primarily for the Public Safety Spectrum. A primary goal of this standard is to enable intercommunication between multiple public safety organizations (e.g., fire, police, medical). Uses both FMDA and TDMA in different parts of the standard (phase I vs phase II). Can be used trunked or non-trunked.

DMR - Digital Mobile Radio standard was developed by the European Telecommunications Standards Institute (ETSI). This standard uses TDMA to allow two communication links simultaneously on a single 12.5-kHz channel. See “TRBO Hits the Amateur Bands,” CQ VHF magazine, Spring 2012.

Overview comments are from CQ Amateur Radio - Mar-Apr-2014

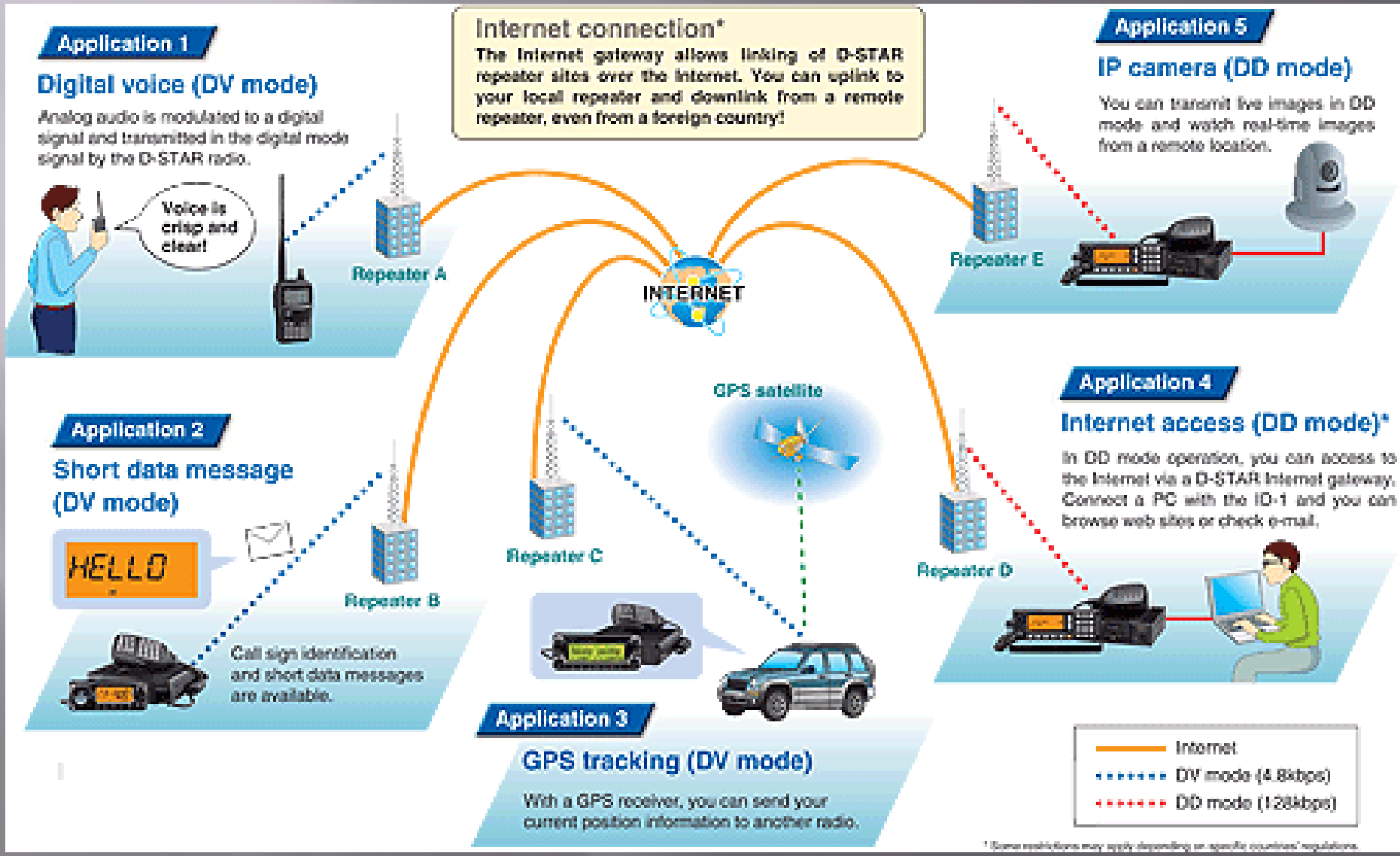
DSTAR - Richmond

- 3 Repeaters in the “Stack”
  - Each repeater is connected to the Gateway
  - The Gateway allows each repeater independent access to the D-Star Network
- Located in downtown Richmond
- W4FJ C is 2m, 147.255+
- W4FJ B is 70cm, 443.7125+
- W4FJ A is 23cm, 1,284 -20Mhz
- Internet Gateway is available for linking
- W4FJ C is automatically “linked” during the work week to REF025C (N. Va Repeaters)

- W4FJ D-Star Repeater Stack

- Controller
- 2m Module
- 70cm Module
- 23cm Module
- Gateway
- Power Supplies
- Duplexers
- Amplifiers

DSTAR - Applications



D-STAR - Radios

ICOM

D-STAR Handheld Radio Selection Chart

full-featured radios; Icom has the right radio for the right job

RADIO/FEATURES	ID-51A	ID-31A	IC-80AD	IC-92AD
GENERAL				

ICOM

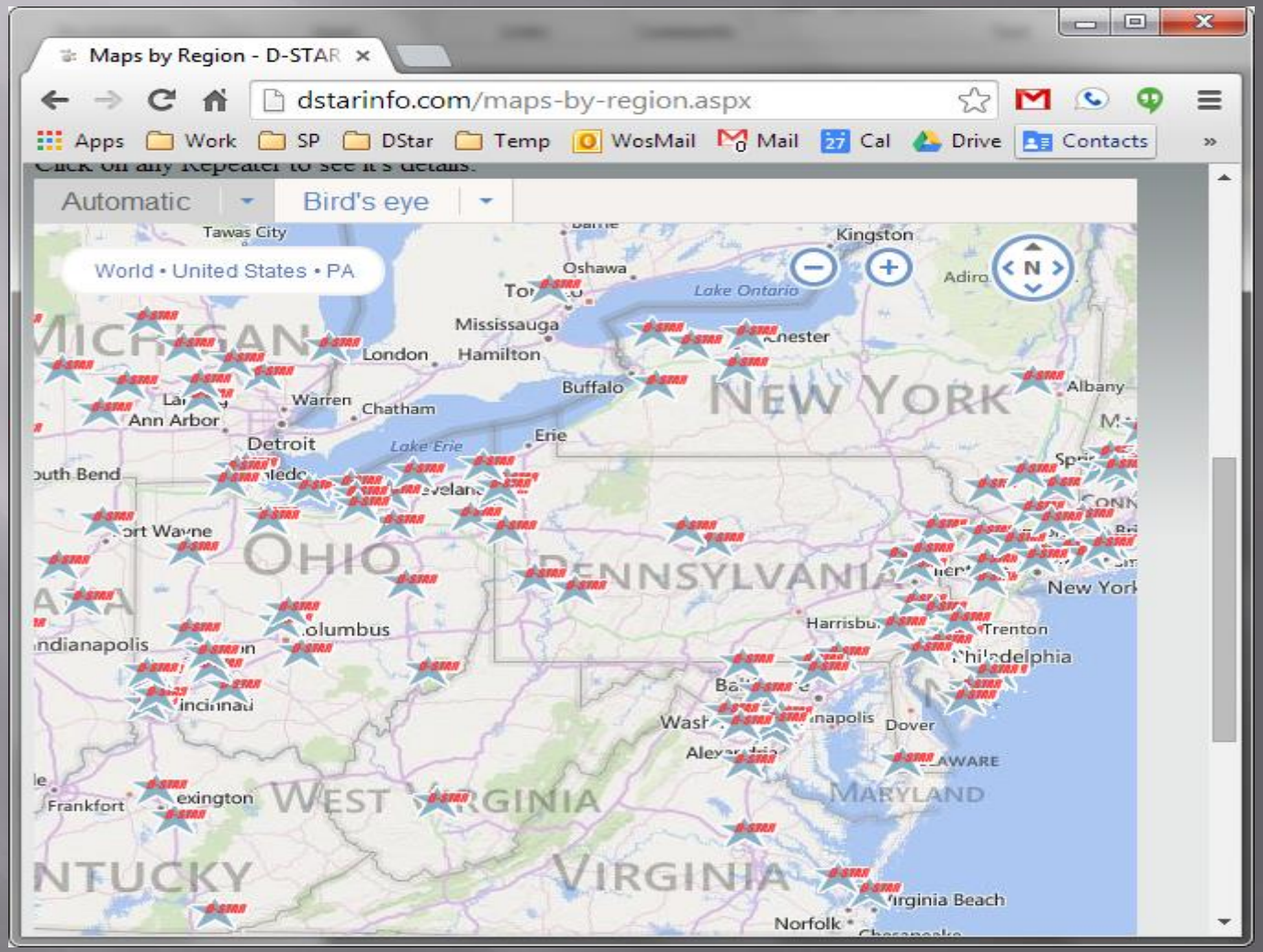
D-STAR Mobile Radio Selection Chart

full-featured radios; Icom has the right radio for the right job

RADIO/FEATURES	ID-880H	IC-2820H	ID-1
GENERAL			
Digital Functionality	D-STAR Upgradable	D-STAR Upgradable	D-STAR Compatible
DD Mode (Digital Data Mode)	N/A	N/A	Yes

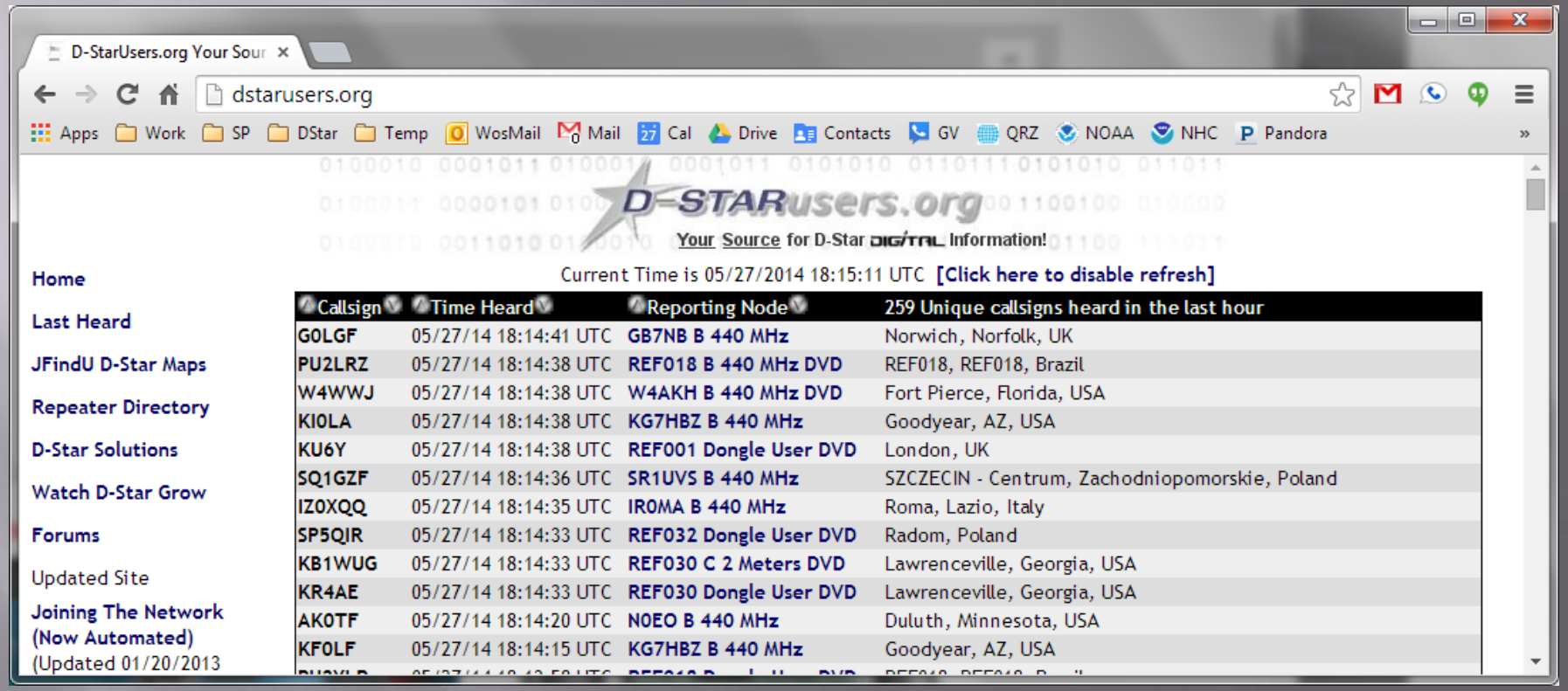
DSTAR – Overview

www.dstarinfo.com



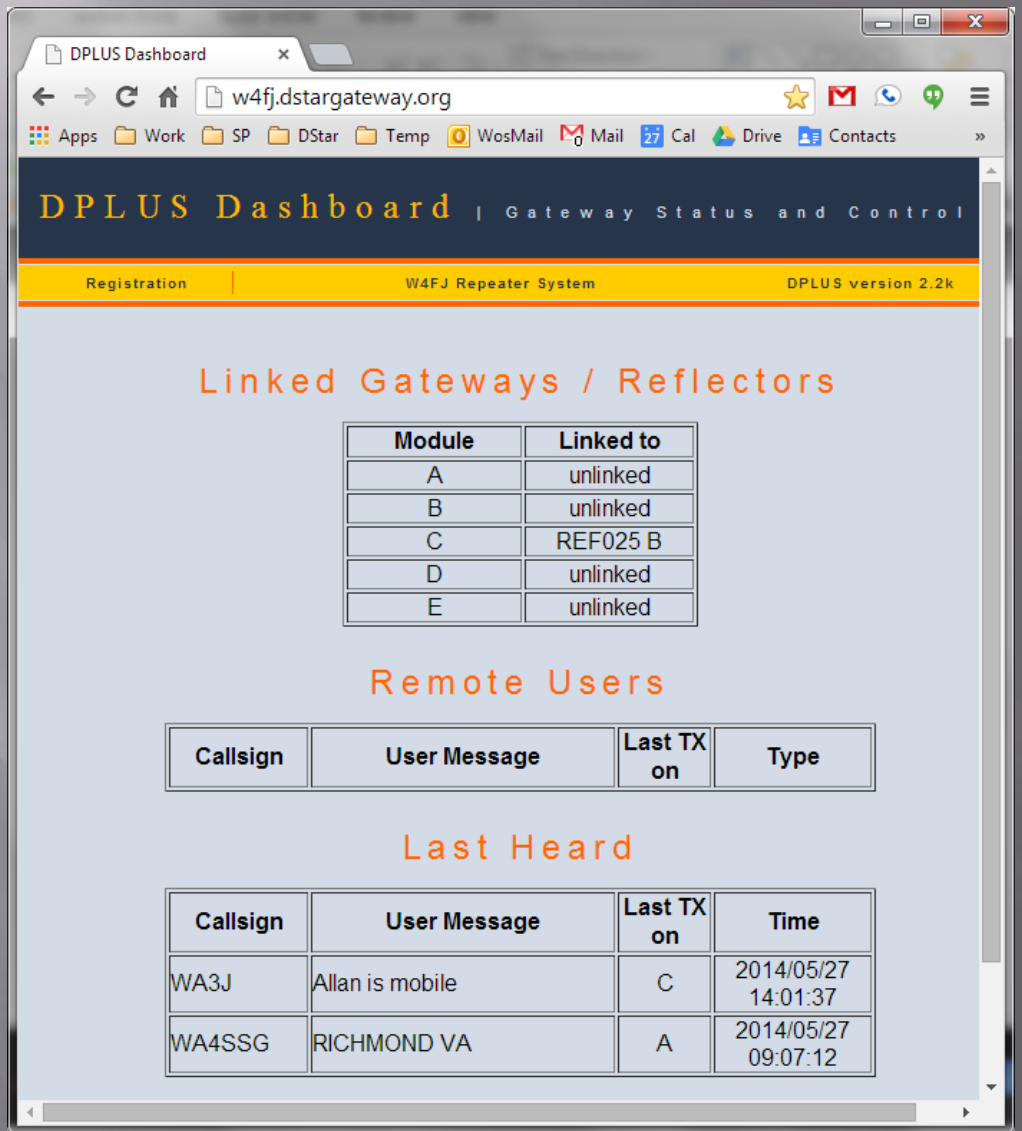
DSTAR – Overview

www.dstarusers.org



DSTAR – Overview

w4fj.dstargateway.org



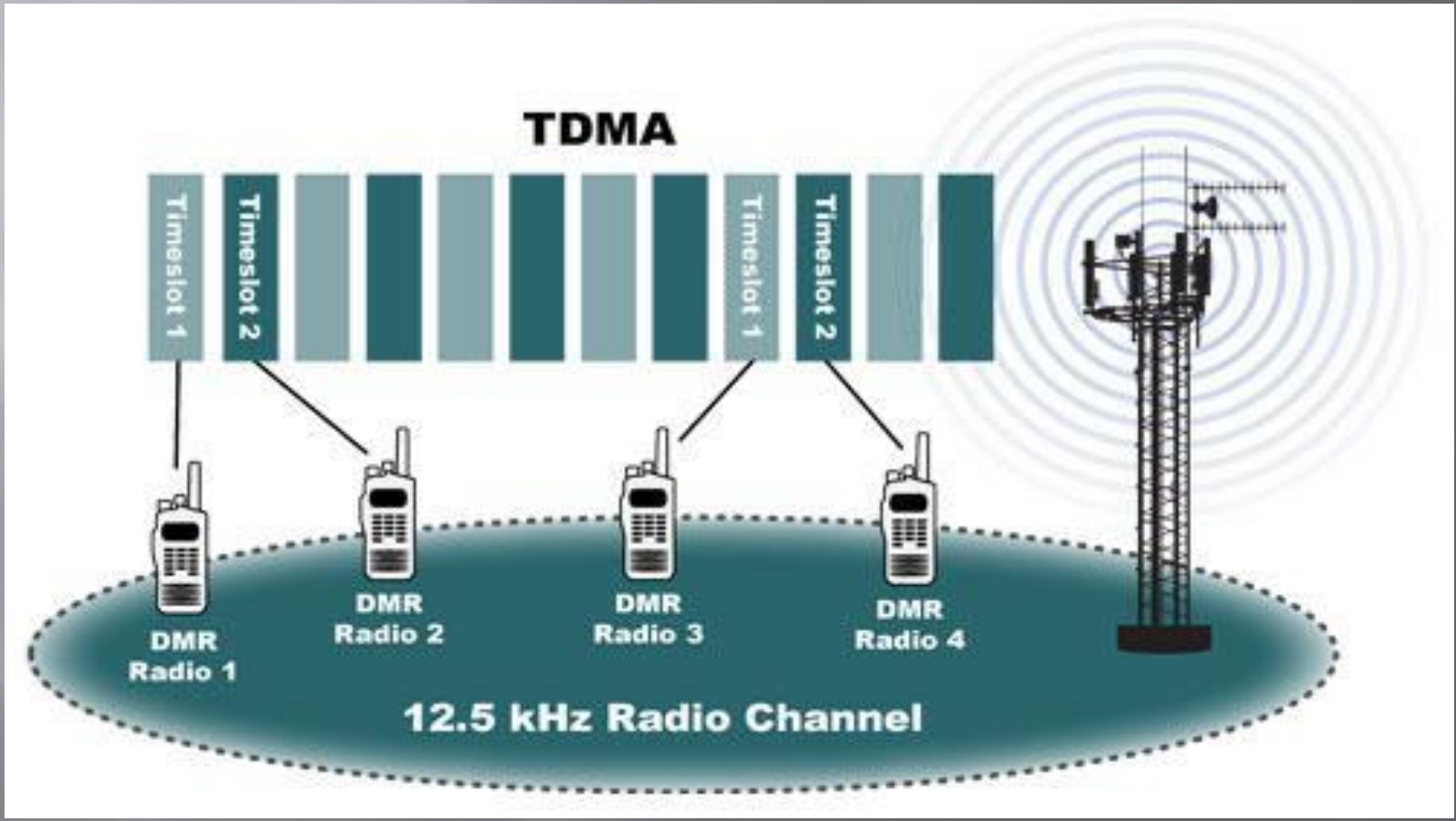
DMR Overview and qualities

- Basic technology info
  - Open digital standard – adopted by numerous manufactuers
  - Designed to be spectrum efficient
  - Radios are generally backwards compatible with FM operation
  - Error correction protocols used in audio processing
  - Ongoing and flexible standards development

DMR Overview and qualities

- Basic technology info
  - Allows 2 simultaneous voice conversations using a single repeater
    - 12.5 khz segment of spectrum can hold two simultaneous conversations
  - Multiple talk paths possible (talkgroups)
  - High quality audio performance
  - More efficient use of radio spectrum
  - Longer battery life

Two time slot system

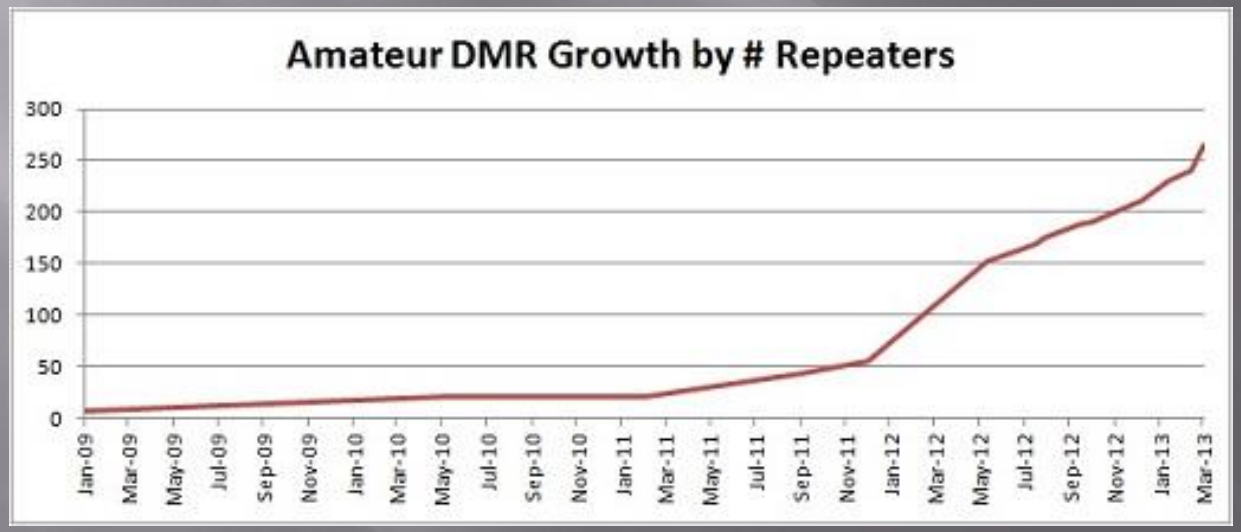


DMR History

- Digital Mobile Radio
  - AKA MotoTRBO
- ESTI Standard
- 2005
- First marketed and intended for land mobile radio
- In USA, has expanded to some public safety utilization
- Three tiers
  - Tier I – intended for personal mobile radio (dPMR) – similar to FRS outside of the USA
    - Not widely implemented
  - Tier II – commonly implemented, repeater and simplex utilization
  - Tier III – trunking, messaging and data expansion on top of Tier II
- Amateur utilization – various networks throughout the world

DMR History in the Amateur World

- Implementations almost immediately in large metro areas
- Several large national and international networks
  - DMR MARC, DCI, PRN, etc
- Virginia since 2010
  - W4YP, WA4FC
- New RATS system April 2014



DMR Equipment Vendors

Typical DMR Hardware

- Commercially available gear from several different manufacturers
- Most DMR infrastructure is built from Motorola hardware, some Hytera
- New and used gear available
- Pictured – Motorola XPR8300 repeater, XPR4550 mobile, XPR6550 portable

Hytera

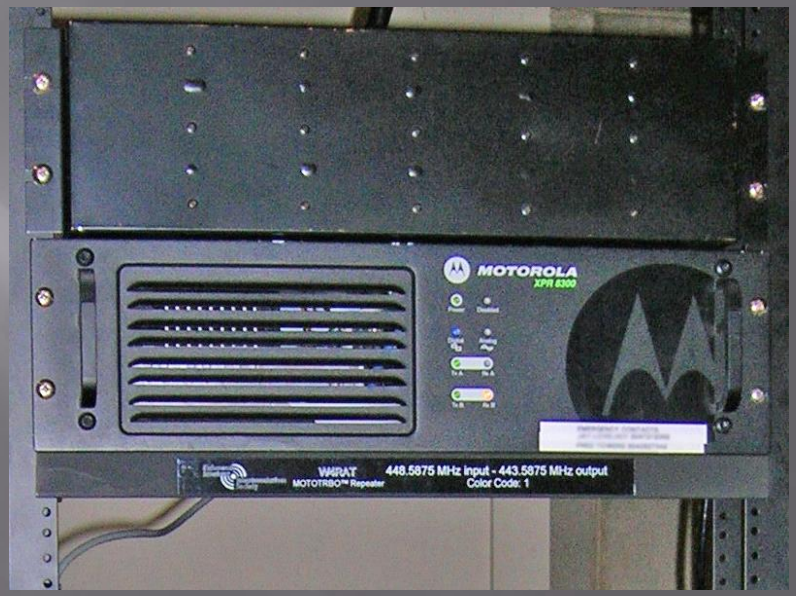
Hytera
Digital channel 1
Menu
Options
Hytera
Digital Channel 1
P1
P2
P3
P4
Hytera
Hytera
Digital channel 1
Menu
Options
P1
P2
P3
P4

Connect Systems CS700

- Entry level DMR radio – under $200 new
- Software – free
- Programming cable – free
- Firmware – new radio
- Very popular in metro Richmond
- Analog and DMR formats
- No field programming

Local DMR Repeater System

- New RATS system
  - 443.5875 MHz
  - Previously on air in Prince George
- Haymarket, Virginia
- Fancy Gap, Virginia
- Washington, DC
- Baltimore, MD
- Dayton, Ohio (3 repeaters)
- Large system across North Carolina
- Many urban areas across the USA

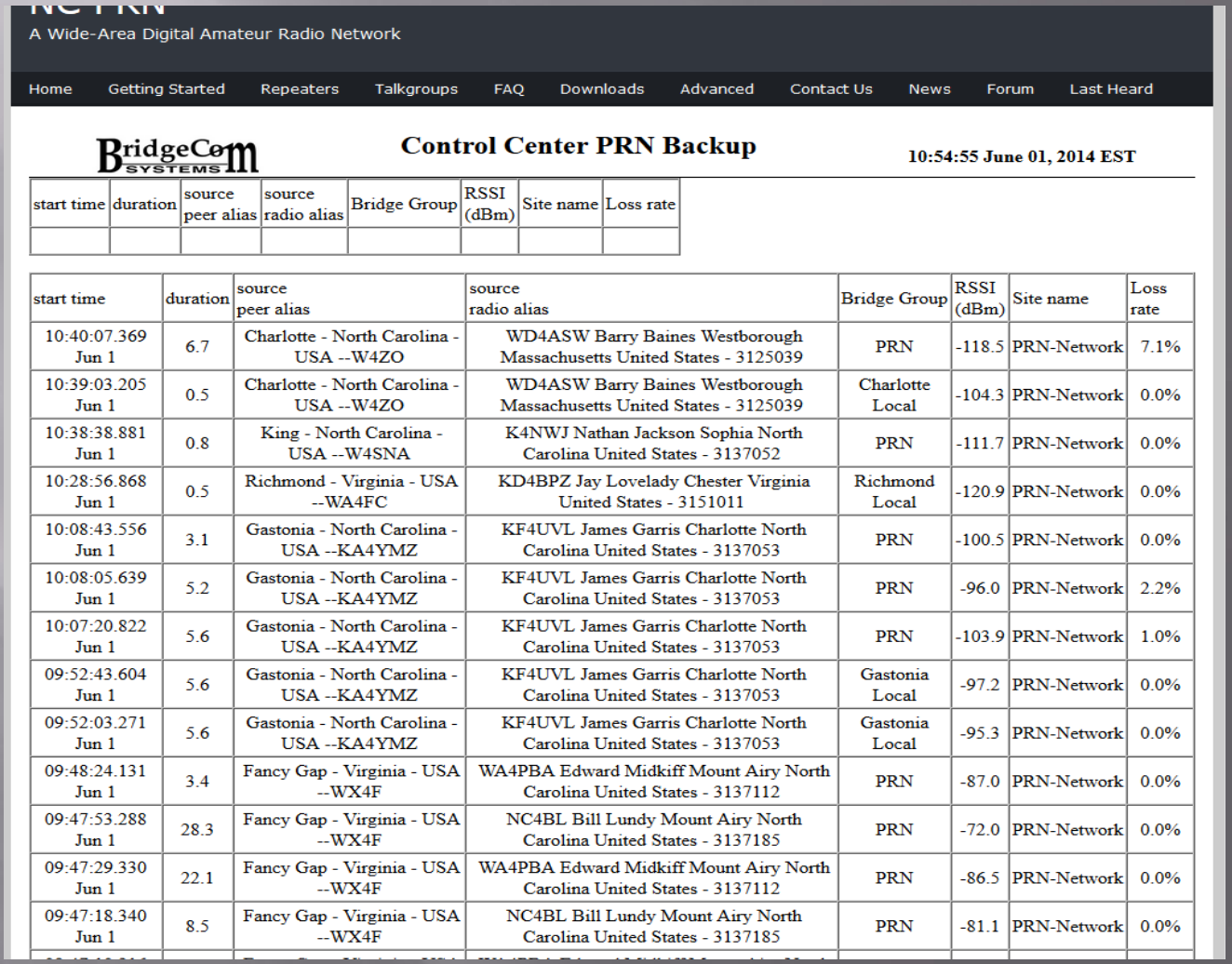


DMR – National Overview

- DMR MARC Network
  - Cooperative effort between various segments of Motorola Amateur Radio Club and others
- Over 300 repeaters in 21 countries
- All digital (DMR) network
- Weekly nets
- Technical oriented users

DMR-MARC
Motorola Amateur Radio Club Worldwide Network

DMR Last Heard List



NC PRN

A Wide-Area Digital Amateur Radio Network

Home | Getting Started | Repeaters | Talkgroups | FAQ | Downloads | Advanced | Contact Us | News | Forum | Last Heard

BridgeCom SYSTEMS

Control Center PRN Backup

10:54:55 June 01, 2014 EST

start time	duration	source peer alias	source radio alias	Bridge Group	RSSI (dBm)	Site name	Loss rate

start time	duration	source peer alias	source radio alias	Bridge Group	RSSI (dBm)	Site name	Loss rate
10:40:07.369 Jun 1	6.7	Charlotte - North Carolina - USA --W4ZO	WD4ASW Barry Baines Westborough Massachusetts United States - 3125039	PRN	-118.5	PRN-Network	7.1%
10:39:03.205 Jun 1	0.5	Charlotte - North Carolina - USA --W4ZO	WD4ASW Barry Baines Westborough Massachusetts United States - 3125039	Charlotte Local	-104.3	PRN-Network	0.0%
10:38:38.881 Jun 1	0.8	King - North Carolina - USA --W4SNA	K4NWJ Nathan Jackson Sophia North Carolina United States - 3137052	PRN	-111.7	PRN-Network	0.0%
10:28:56.868 Jun 1	0.5	Richmond - Virginia - USA --WA4FC	KD4BPZ Jay Lovelady Chester Virginia United States - 3151011	Richmond Local	-120.9	PRN-Network	0.0%
10:08:43.556 Jun 1	3.1	Gastonia - North Carolina - USA --KA4YMZ	KF4UVL James Garris Charlotte North Carolina United States - 3137053	PRN	-100.5	PRN-Network	0.0%
10:08:05.639 Jun 1	5.2	Gastonia - North Carolina - USA --KA4YMZ	KF4UVL James Garris Charlotte North Carolina United States - 3137053	PRN	-96.0	PRN-Network	2.2%
10:07:20.822 Jun 1	5.6	Gastonia - North Carolina - USA --KA4YMZ	KF4UVL James Garris Charlotte North Carolina United States - 3137053	PRN	-103.9	PRN-Network	1.0%
09:52:43.604 Jun 1	5.6	Gastonia - North Carolina - USA --KA4YMZ	KF4UVL James Garris Charlotte North Carolina United States - 3137053	Gastonia Local	-97.2	PRN-Network	0.0%
09:52:03.271 Jun 1	5.6	Gastonia - North Carolina - USA --KA4YMZ	KF4UVL James Garris Charlotte North Carolina United States - 3137053	Gastonia Local	-95.3	PRN-Network	0.0%
09:48:24.131 Jun 1	3.4	Fancy Gap - Virginia - USA --WX4F	WA4PBA Edward Midkiff Mount Airy North Carolina United States - 3137112	PRN	-87.0	PRN-Network	0.0%
09:47:53.288 Jun 1	28.3	Fancy Gap - Virginia - USA --WX4F	NC4BL Bill Lundy Mount Airy North Carolina United States - 3137185	PRN	-72.0	PRN-Network	0.0%
09:47:29.330 Jun 1	22.1	Fancy Gap - Virginia - USA --WX4F	WA4PBA Edward Midkiff Mount Airy North Carolina United States - 3137112	PRN	-86.5	PRN-Network	0.0%
09:47:18.340 Jun 1	8.5	Fancy Gap - Virginia - USA --WX4F	NC4BL Bill Lundy Mount Airy North Carolina United States - 3137185	PRN	-81.1	PRN-Network	0.0%

Project 25 – It's different!

"P25 is a set of standards"

- Project 25 (P25) is a set of standards produced through the joint efforts of the Association of Public Safety Communications Officials International (APCO), the National Association of State Telecommunications Directors (NASTD), selected federal agencies and the National Communications System (NCS), and standardized under the Telecommunications Industry Association (TIA)...
- The P25 suite of standards involves digital Land Mobile Radio (LMR) services for local, state/provincial and national (federal) public safety organizations and agencies...
- Although developed primarily for North American public safety services, P25 technology and products are not limited to public safety alone and have also been selected and deployed in other private system application, worldwide.

Project 25 – Open Interfaces

- Common Air Interface (CAI) – standard specifies the type and content of signals transmitted by compliant radios. One radio using CAI should be able to communicate with any other CAI radio, regardless of manufacturer
- Subscriber Data Peripheral Interface – standard specifies the port through which mobiles and portables can connect to laptops or data networks
- Fixed Station Interface – standard specifies a set of mandatory messages supporting digital voice, data, encryption and telephone interconnect necessary for communication between a Fixed Station and P25 RF Subsystem
- Console Subsystem Interface – standard specifies the basic messaging to interface a console subsystem to a P25 RF Subsystem
- Network Management Interface – standard specifies a single network management scheme which will allow all network elements of the RF subsystem to be managed
- Data Network Interface – standard specifies the RF Subsystem's connections to computers, data networks, or external data sources
- Telephone Interconnect Interface – standard specifies the interface to Public Switched Telephone Network (PSTN) supporting both analog and ISDN telephone interfaces.
- Inter RF Subsystem Interface (ISSI) – standard specifies the interface between RF subsystems which will allow them to be connected into wide area networks

Project 25 – HT's

Common Air Interface (CAI) – Allows ALL these to work seamlessly!

Project 25 – Richmond

KG4MRA Repeater (Used to be W4SQT) 145.430 -

Dual mode operation – Both FM & P25

Covers the entire Richmond area

Project 25 – Richmond

- 927.050 MHz – Downtown

927.025 MHz - Midlo

Common Myths about Digital Modes

- Will D-Star radios talk “D-Star” with DMR or P25 radios?
  - No
- Will DMR radios talk “DMR” to D-Star or P25 radios?
  - No
- Will P25 radios talk “P25” to D-Star or DMR Radios?
  - No
- Will all the radios talk “FM” to each other?
  - YES!
- Will the digital networks talk to each other?
  - Not natively – interop devices exist
- What about programming? Do I have to pay someone? Buy software?
  - It depends.
- Is it legal to use these modes on the ham bands?
  - DMR recently clarified

Yahoo Groups

- richmond-d-star@yahoogroups.com
- richmond-900@yahoogroups.com
- richmond-digital@yahoogroups.com

Demonstration and Questions