D-STAR

Digital Voice + Digital Data

WELCOME !

D-STAR Workshop
Ottawa Valley Mobile Radio Club
Zoom Club Meeting

VE3RXR D-Star System & Reflectors

March 17, 2021

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VE3AJB
President
Manitoulin Amateur Radio Club Inc.

D-STAR

Digital Voice + Digital Data

What Does ***"D-STAR"*** Stand For?

- ***D - Digital***
- ***S - Smart***
- ***T - Technology*** ***for***
- ***A - Amateur***
- ***R - Radio***

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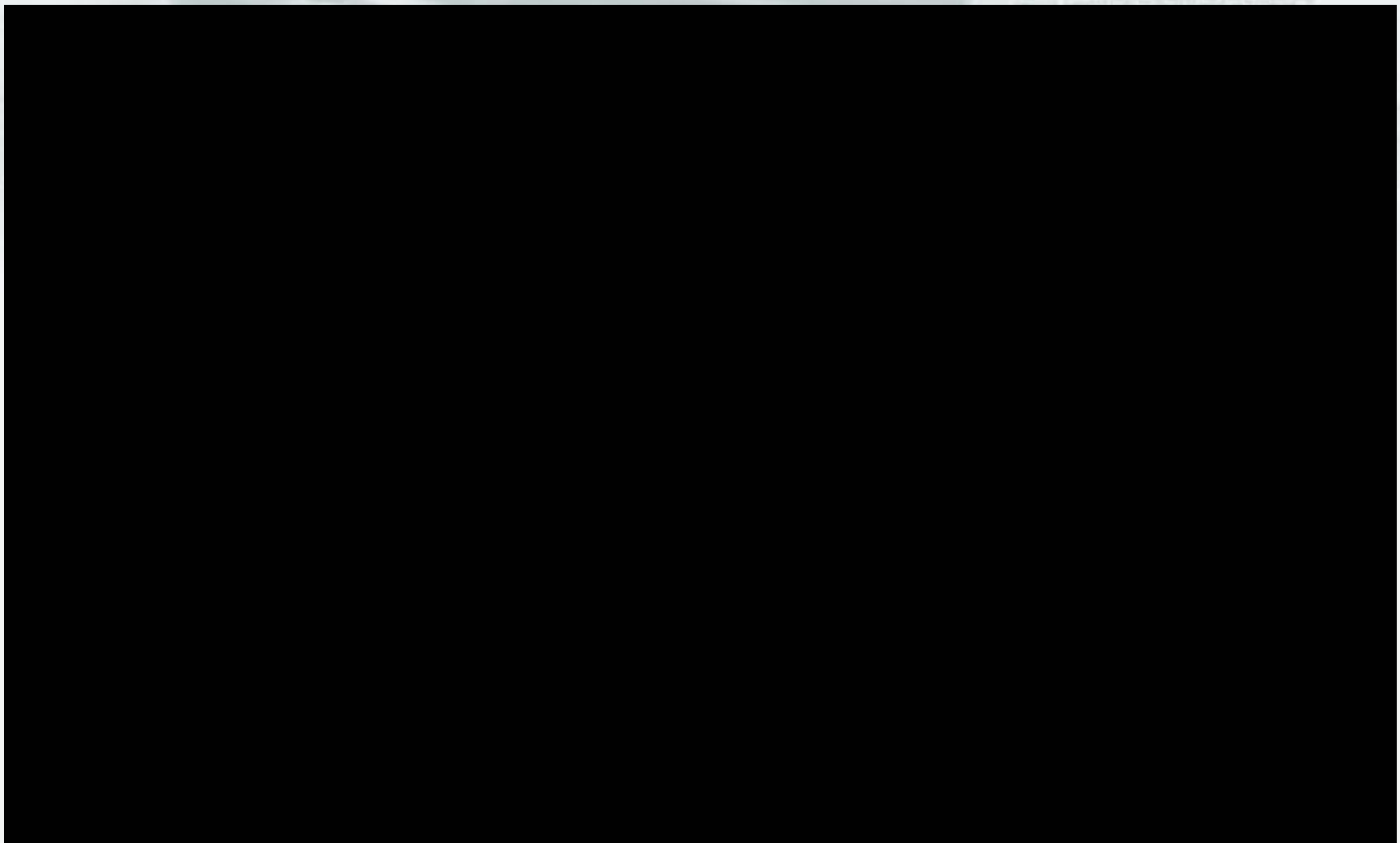
Let's Take A Look At *"D-STAR"*



- **What is D-STAR?**
  - Digital Smart Technology for Amateur Radio
  - JARL
    - Japanese Amateur Radio League
  - Goal
    - Advancement of the hobby
    - Spectrum Efficiency
    - Experiment with Voice and Data

- **History of D-STAR**
  - 1999 Funded by the Japanese Government and administered by the Japanese Amateur Radio League (JARL)
  - 2001 Open Specification Published – anyone can implement

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Coming to North America…

- December 2003 - 1st System installed in Dallas
- Feb 2005 – 1st Gateway installed in Dallas
- Dayton ‘05 - ID1/RP2 promotion
- Additional systems & gateways installed at K2DIG (NYC) & W1AW (donated)
- Spring ’06 – Introduction of RP2000V & RP4000V
- Dayton ’06 – 48 Users on 4 Gateways in USA
- 1st phase of rapid growth begins

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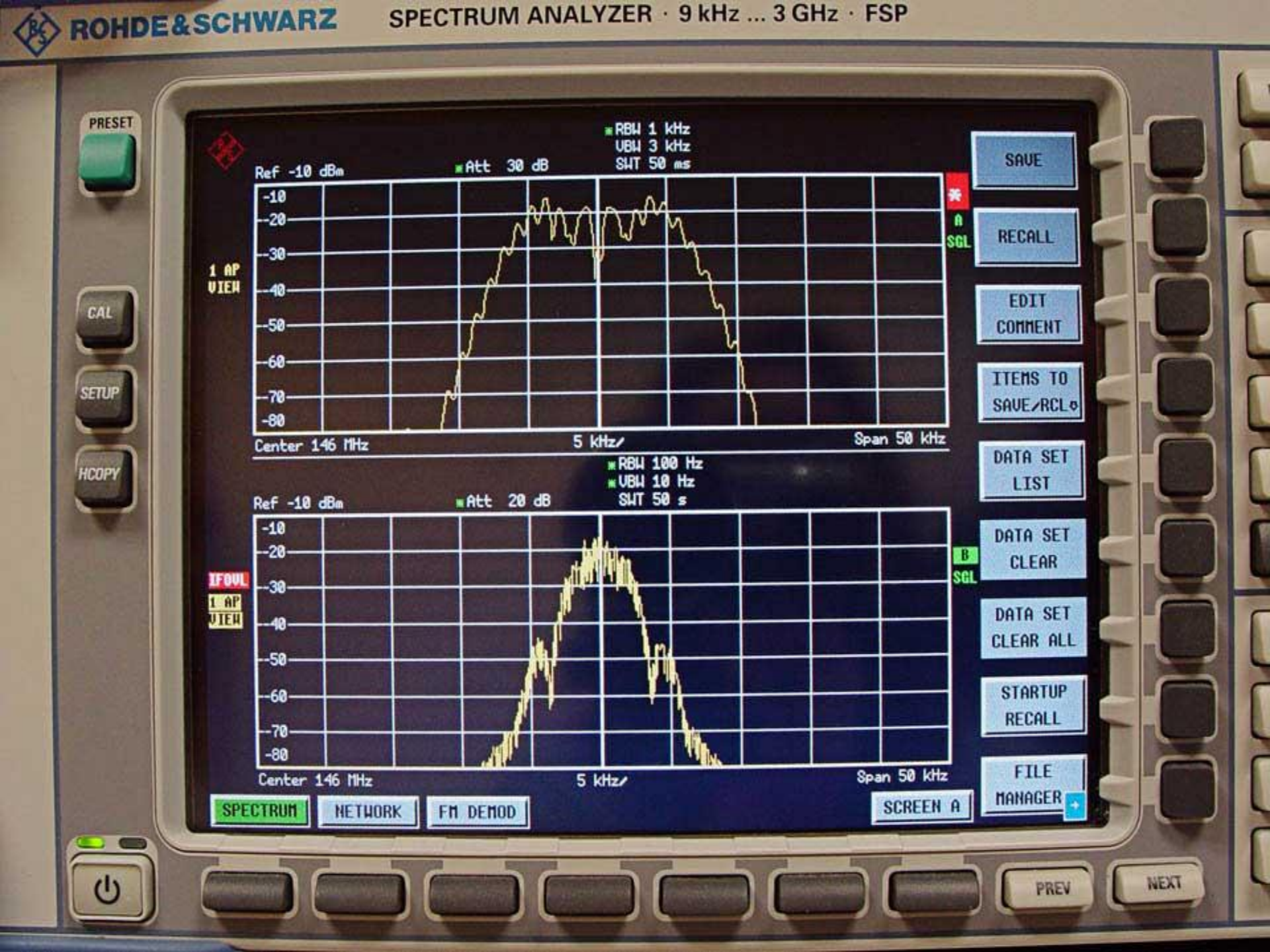
False D-STAR Rumors:

- D-STAR is just another digital voice mode
- D-STAR is just like EchoLink or IRLP
- D-STAR is proprietary to Icom
- D-STAR won't last because of the proprietary AMBE chip
- D-STAR is very expensive
- D-STAR is too complicated to use

- Why is D-STAR interesting?

– Spectral Efficiency

- 6.25 kHz emission
- 10 kHz channel spacing (reasonable)
- More efficient use of available bandwidth
- Allows more channels in crowded spectrum


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
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

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- Why is D-STAR interesting?
  - **Simultaneous Voice and Data capability**
    - 2m & 70cm
    - 4800bd Data Stream
      - 2400bd Digital Voice
      - 1200bd FEC on Digital voice
      - 1200bd Serial Data

- Why is D-STAR interesting?

  - **High-Speed Data capability**

    - 23cm (1.2 GHz)
      - 128kb Ethernet
      - Transparent Bridge

- Why is D-STAR interesting?

  - **Internet Linking capability**

    - User linking vs. Site linking
    - Can cause confusion for uninformed
    - Allows “roaming”

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How Does DV Sound?

FM vs. D-STAR - Round One (courtesy of KC5ZRQ)

FM vs. D-STAR - Round Two (courtesy of K7JL)

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How Does D-Star Sound Here!

- VE3BEK & VE3AJB Sudbury to Little Current 146.520 FM Simplex
- VE3BEK & VE3AJB Sudbury to Little Current 145.670 DV Simplex
- VE3BEK & VE3AJB Sudbury to Little Current FM vs DV Simplex

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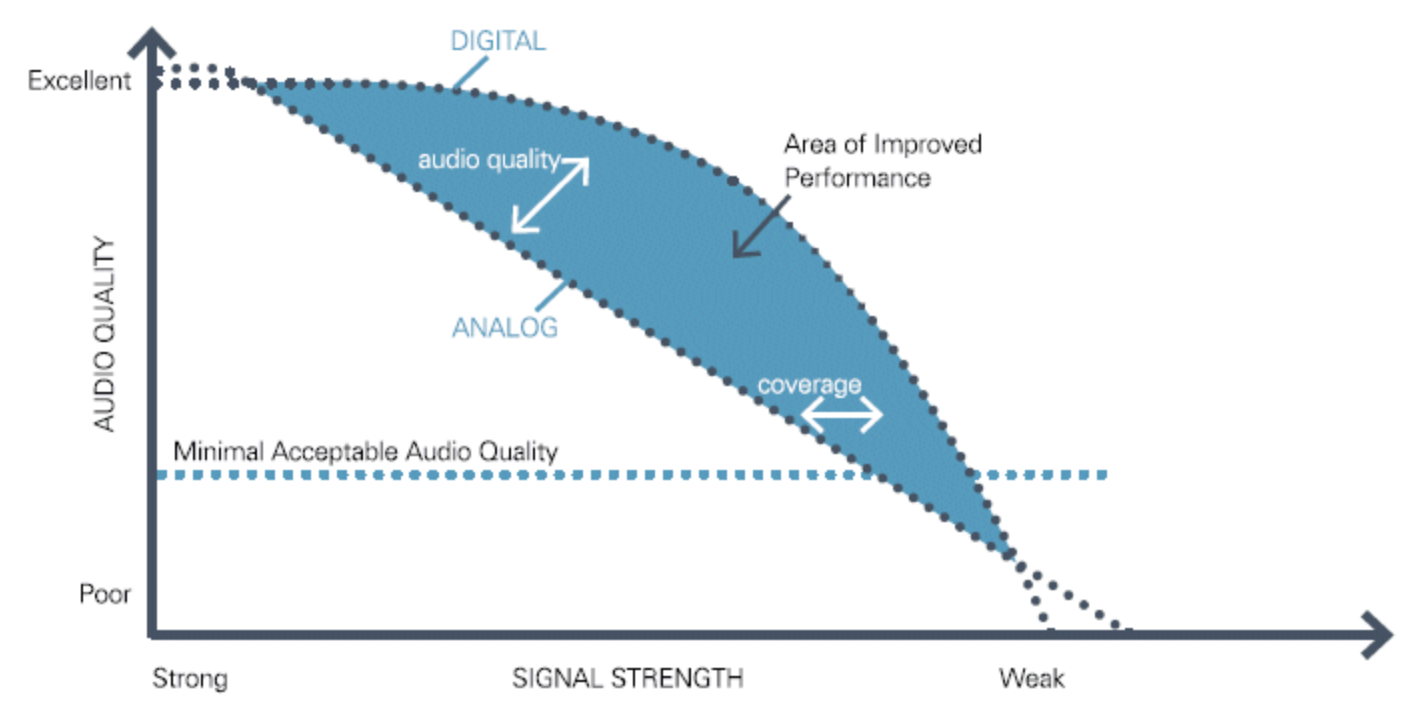
Digital vs. Analog FM



DIGITAL VOCODER

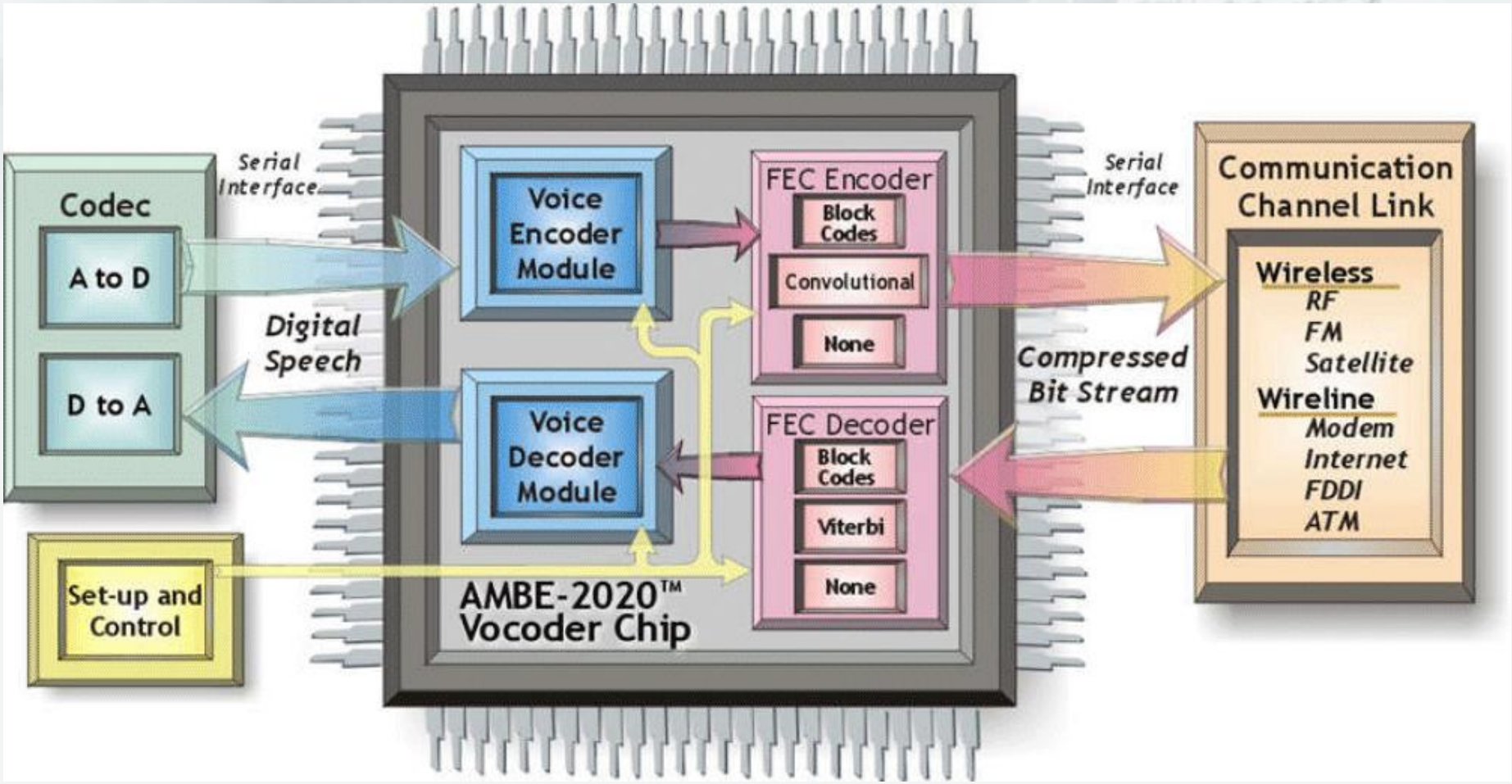
What is a digital vocoder?

- A digital vocoder reduces a complex speech signal into a small number of parameters.
- Rather than transmitting the analog speech in its entirety, which requires a relatively large amount of bandwidth, a digital radio transmits only the important parameters. Because these parameters can be represented by small number of digital bits they require less bandwidth.

The vocoding process

- The vocoding process begins by dividing the speech into short segments, typically 20 to 30 milliseconds in length. Each segment of speech is analyzed and the important parameters such as pitch, level, frequency response are extracted. These parameters are then encoded using a small number of digital bits.
- Before transmission, the encoded speech parameters are also protected by the addition of Forward Error Correction (FEC) bits.
- During reception, the FEC is used to correct bit errors that may have occurred due to RF channel impairments. While the FEC cannot correct all errors that may occur, it can completely correct a reasonable number of bit errors, providing minimal audio degradation through much of the coverage area.

The “infamous” proprietary Vocoder chip!



- AMBE
  - **Advanced Multi-Band Excitation** (**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

Digital Voice Communication Systems

Quick List

System	Originator	Modulation	Vocoder	Spacing	Comments
		Amateur Systems			
D-Star	Icom	0.5-GMSK	AMBE	7.5 kHz	Class C OK
AOR	AOR	SSB	AMBE	3.0 kHz	HF use
		Trunked Systems			
P25 Phase 1	APCO/ Motorola	C4FM	IMBE	12.5 kHz	Class C OK Astro series
P25 Phase 2	APCO/ Motorola	CQPSK	IMBE	6.25 kHz	Class AE req'd
TETRA	Nokia	π/4 DQPSK	A-CELP	6.25 kHz	Class AE req'd
TETRAPOL	Matra	F4FM	IMBE	10 kHz	Class C OK
DIMRS	Canada	16QAM	V-SELP	4 kHz	Class AE req'd
IDRA	Japan	16QAM	V-CELP	4 kHz	Class AE req'd
EDACS	Ericsson	DQPSK	IMBE	12.5 kHz	Class C OK
TDRS	NASA	0.5-GMSK	IMBE	-	Shuttle Relay
Iridium	Motorola	QPSK	AMBE	-	Sat Phone
Passport	Icom/ Kenwood/ Trident	?	?	6.25 kHz	Class C OK
	plus many more in broadcast and telephony				

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ICOM D-STAR Radios

IC-2820

UT-123 D-STAR / GPS option

IC-V/U82

IC-91AD

ID-800H

ID-1

IC-2200

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IC-80A & ID-880H

The above photo includes optional HM-189GPS.

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ID-51AD & ID-4100A

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ID-4100A & ID-5100A

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IC-7100 & IC-9700

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NEW ICOM IC-705 D-STAR

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NEW ICOM ID-52A D-STAR NOT RELEASED YET

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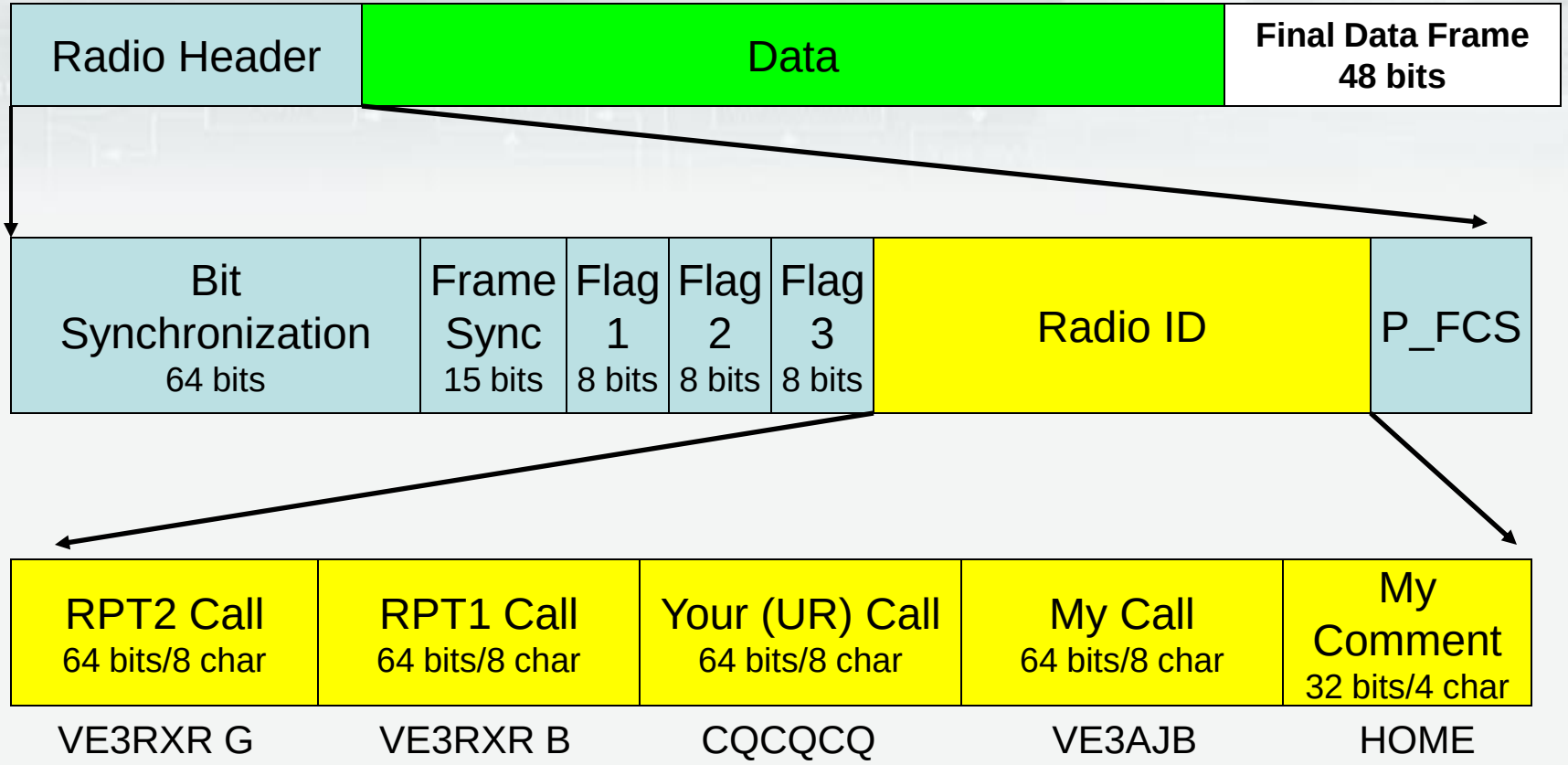
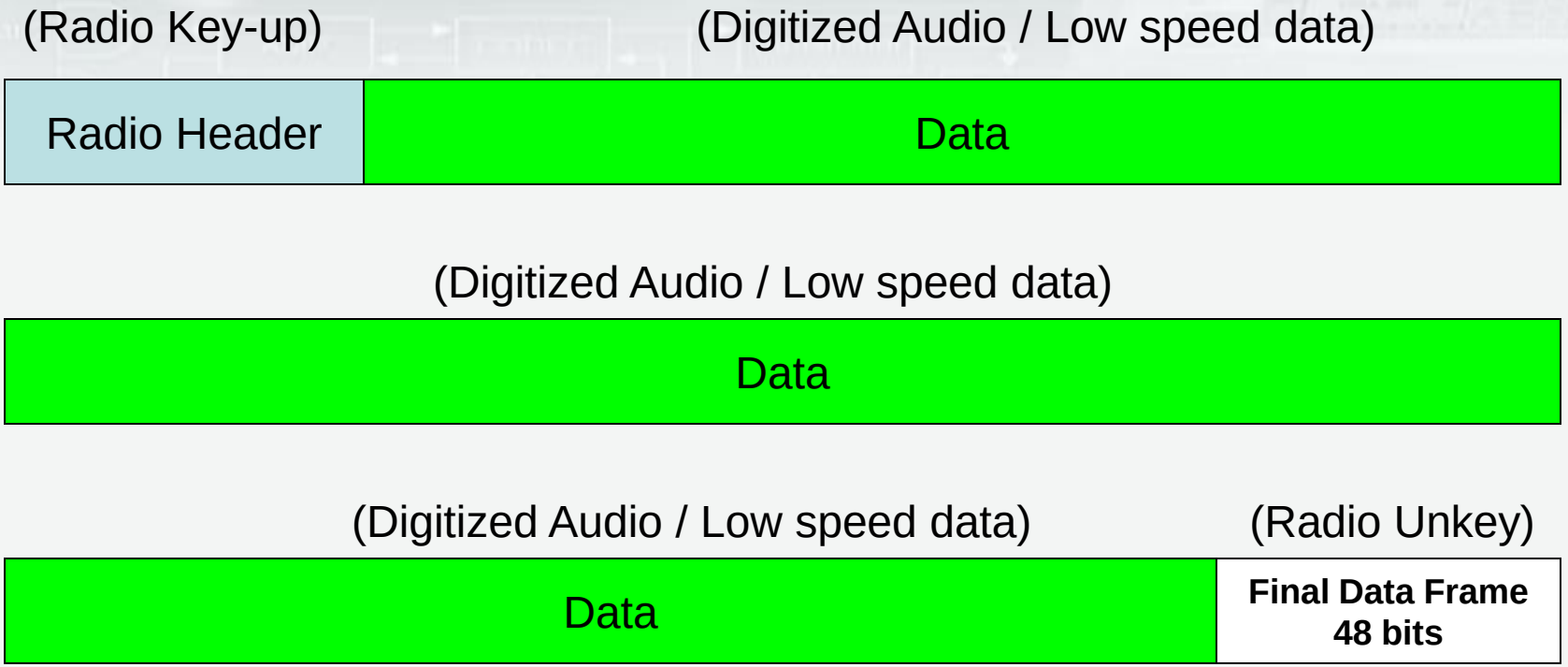
The DV Protocol



Typical DV Transmission



(last data frame contains a unique terminating bit pattern)

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How big is D-STAR locally?

VE3RXR System - Little Current

- 145.310- VE3RXR C
- 442.050+ VE3RXR B

30 or so local users on VE3RXR

128,527 D-STAR users accessible via 540 Gateway systems world-wide!

How has D-STAR Grown?

Dayton 2006

- 48 Users on 4 Gateways
  - only 23cm (1.2 GHz) systems

Dayton 2007

- 539 Users on 36 Gateways, including:
  - 3 in Canada
  - 1 in UK
  - 1 in Australia

- Almost 100 Repeater Systems deployed
  - Now includes 2M, 70cm, 23cm systems

How has D-STAR Grown?

June 2008

- 3253 registered Gateway users
- 190 systems on the Gateway

January 2009 ***(7 months later)***

- **6527** registered Gateway users
- **349** systems on the Gateway
- Average number of unique D-STAR users on the air (using Gateway connected systems) in any given 24 hour period: **1200**

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How has D-STAR Grown?

October 2009 (9 months later)

- **17,326** registered Gateway users
- **570 repeater** systems on the Gateway
- Average number of unique D-STAR users on the air (using Gateway connected systems) in any given 24 hour period: **3200**
- **Estimated about 250 new D-Star users registered each week in the world**

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How Has D-STAR Grown In Canada?

February 2009

- **24 Registered repeater call signs for D-Star in Canada**
- **60 Repeaters using D-Star on 2 M, 70 cm and 23 cm**
- **10 Repeaters in Ontario alone**

October 2009

- **32 Registered repeater call signs for D-Star in Canada**
- **79 Repeaters using D-Star on 2 M, 70 cm and 23 cm**
- **23 Repeaters in Ontario alone**

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D-STAR In Canada Today March 2021

- **80** Registered repeater call signs for D-Star in Canada
- **120** Repeaters using D-Star on 2 M, 70 cm and 23 cm
- **28** Repeaters in Ontario alone

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D-Star Repeaters In Canada

Callsign	City	State	2m	70cm	23cm	23cmDD
VA2LX	Trois-Rivi&#65533;res	Qu&#65533;bec	145.10000MHz -0.600	448.67500MHz -5.000		
VA2RKA	Montr&#65533;al	Quebec		446.15000MHz -5.000		
VA2RKB	Saint-Calixte	Quebec	144.91000MHz +0.600			
VA3NAG	Niagara on the Lake	Ontario			1282.50000MHz -12.000	1299.15000MHz
VA3ODG	Ottawa	Ontario	145.53000MHz -0.600	444.85000MHz +5.000	1282.00000MHz -12.000	1299.20000MHz
VA3YYZ	Temporary	Demo	145.00000MHz +0.600	441.10000MHz +5.000		
VA7DSR	Victoria	BC				
VA7ICM	Vancouver	British Columbia	145.04000MHz +0.600	442.00000MHz +5.000	1247.00000MHz +12.000	1293.15000MHz
VE1FO	Halifax	Nova Scotia	145.25000MHz +0.600			
VE2LKL	Trois-Rivi&#65533;res	Quebec	147.27000MHz +0.600	449.17500MHz -5.000		1246.00000MHz
VE2RIO	Montr&#65533;al	Quebec	144.95000MHz -0.600	449.92500MHz -5.000	1283.00000MHz -12.000	1247.00000MHz
VE2RMF	Quebec		144.95000MHz -0.600	449.92500MHz -5.000	1283.00000MHz -20.000	1243.00000MHz
VE2RQF	Sherbrooke	Quebec	147.06000MHz +0.600			1248.00000MHz
VE2RTO	Mont-Orford	Quebec		442.00000MHz +5.000		
VE2RVR	Mont-Saint-Gr&#65533;goire	Quebec		444.20000MHz +5.000		1248.00000MHz
VE2TXD	Victoriaville	Quebec	144.81000MHz +0.600	441.17000MHz +5.000		
VE3LSR	Simcoe County	Ontario	145.19000MHz -0.600	444.35000MHz +5.000		
VE3RPT	Toronto (Uxbridge)	Ontario	145.25000MHz -0.600	443.22500MHz +5.000		
VE3RTR	Cobourg (East of Toronto)	Ontario	146.89500MHz -0.600			
VE3RXR	Little Current	Ontario	145.31000MHz -0.600	442.05000MHz +5.000		
VE3SSF	PeterBorough	Ont	147.36000MHz +0.600			
VE3TTT	London	Ontario		442.30000MHz +5.000		
VE3WIK	Hamilton	Ontario	146.71500MHz +0.600	443.63750MHz +5.000		
VE3YYZ	Toronto	Ontario	144.93000MHz +0.600	442.70000MHz +5.000	1287.50000MHz -12.000	1250.00000MHz
VE6GHZ	Calgary	Alberta	147.09000MHz +0.600	444.95000MHz +5.000	1287.97500MHz -20.000	1253.00000MHz
VE6IPG	Calgary	Alberta	147.28500MHz +0.600	444.96250MHz +5.000	1275.95000MHz +12.000	1248.05000MHz
VE6KM	Edmonton	Alberta	145.47000MHz -0.600	444.90000MHz +5.000	1287.50000MHz -12.000	1248.50000MHz
VE6WRN	Calgary	Alberta	146.80500MHz -0.600	444.92500MHz +5.000	1287.50000MHz -20.000	1247.50000MHz
VE7RAG	Vancouver	British Columbia	147.02000MHz +0.600	443.40000MHz +5.000	1291.94000MHz -20.000	1251.94000MHz
VE7VIC	Victoria	British Columbia	145.08000MHz +0.600			1291.50000MHz
VE9SJN	Saint John	New Brunswick	145.29000MHz -0.600			
VO1ILP	St Johns	Newfoundland		443.40000MHz +5.000		1251.94000MHz

D-STAR Web Resources

- http://dstarusers.org/
- www.dstarinfo.com
- https://66.186.80.98/
- http://xlx103.xlxreflector.org/index.php
- http://www.ve3rmi.org/

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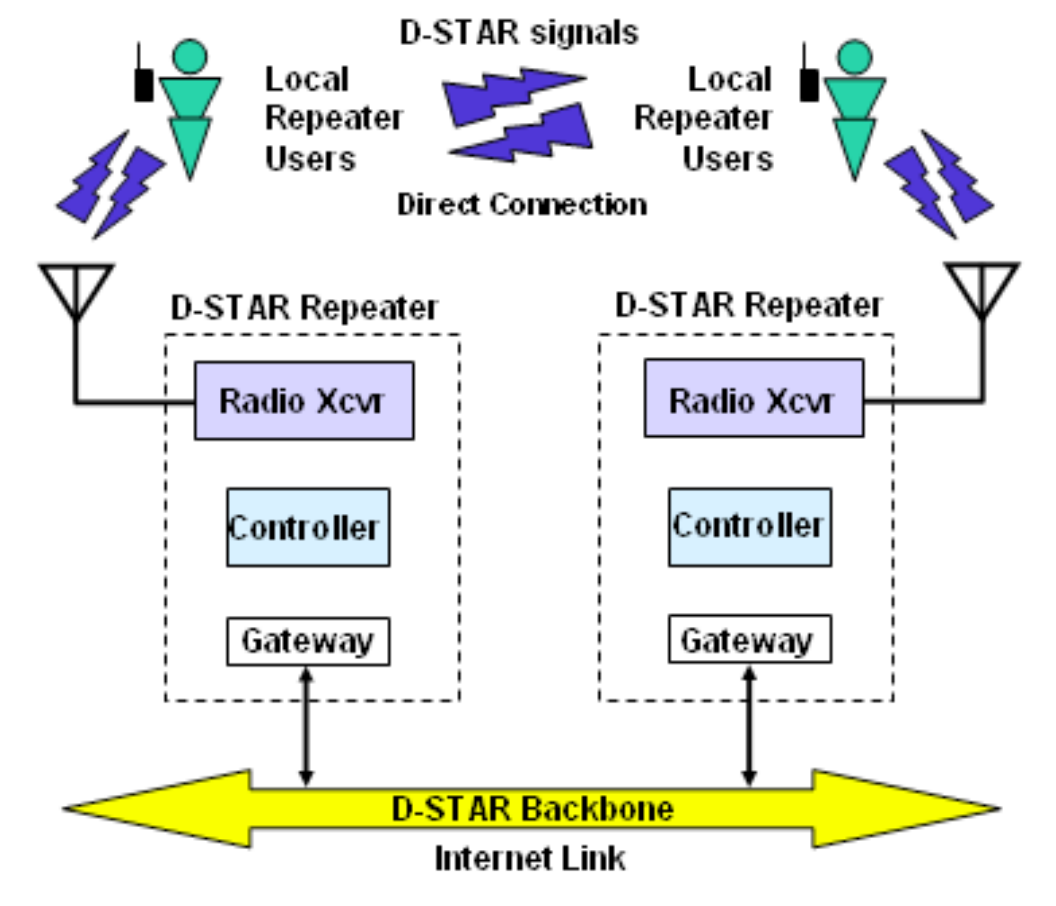
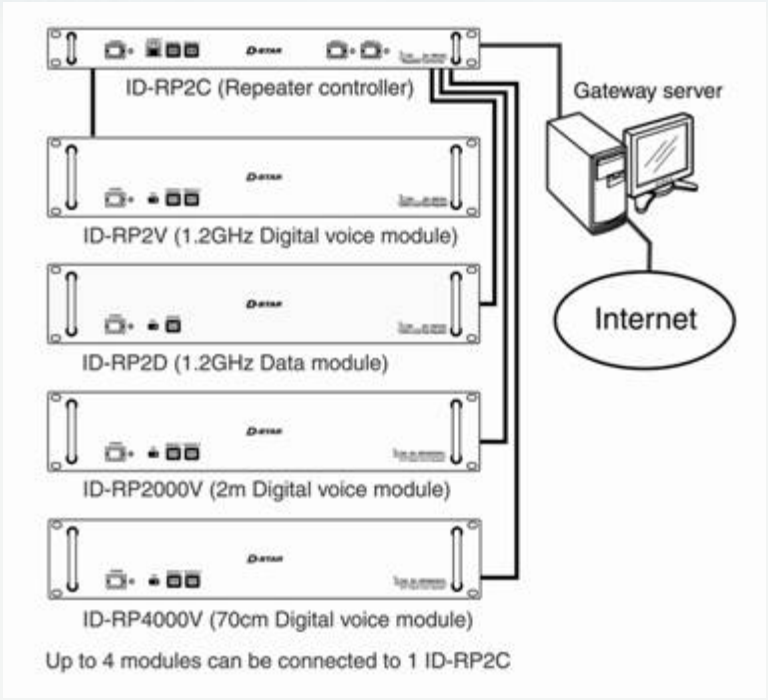
D-Star System Overview





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Callsign Programming

Close your owner's manual and put it away!

It's great for learning how to access the various functions of your radio, and for navigating your way around the programming menu.

But call sign programming has changed from what was known when the manuals were printed.

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Callsign Programming

Each Radio Has 4 Call Sign Fields to be Programmed

- MyCall
- UrCall
- Rpt 1
- Rpt 2
- Source Call sign
- Destination Call Sign
- 1st Module
- 2nd Module

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Callsign Programming

Each Radio Has 4 Call Sign Fields to be Programmed

- **MyCall**
- **UrCall**
- **Rpt 1**
- **Rpt 2**

- **Your I.S.E.D. issued call**
- **Who you want to talk to**
- **Gozinta (at the local system)**
- **Gozouta (at the local system)**

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Simplex

145.670 MHz simplex – DV
UR: CQCQCQ
RPT1: (not used)
RPT2: (not used)
MY: VE3AJB

VE3AJB

145.670 MHz simplex - DV
UR: CQCQCQ
RPT1: (not used)
RPT2: (not used)
MY: VE3WVA

VE3WVA

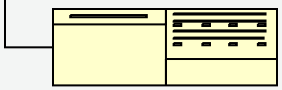
Local contact through D-Star 2 meter repeater

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: (not used)
MY: VE3AJB

VE3AJB

VE3RXR C
145.310-

Controller



VE3RXR G
(Gateway)

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: (not used)
MY: VE3WVA

VE3WVA

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Local contact through D-Star 2 meter repeater

(no gateway access)

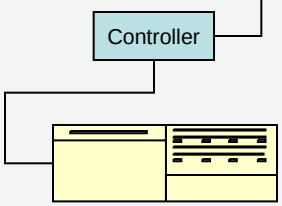
VE3AJB

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: (not used)
MY: VE3AJB

Any repeater on Gateway can't hear you

Dongle users can't hear you!

VE3RXR C
145.310



VE3RXR G
(Gateway)

VE3WVA

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: (not used)
MY: VE3WVA

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Local contact through D-Star 2 meter repeater (with gateway access)

THE RIGHT WAY!

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: **VE3RXR G**
MY: VE3AJB

VE3AJB

Any repeater can hear you!

Dongle users can hear you!

VE3RXR C
145.310

Controller

VE3RXR G
(Gateway)

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: **VE3RXR G**
MY: VE3WVA

VE3WVA

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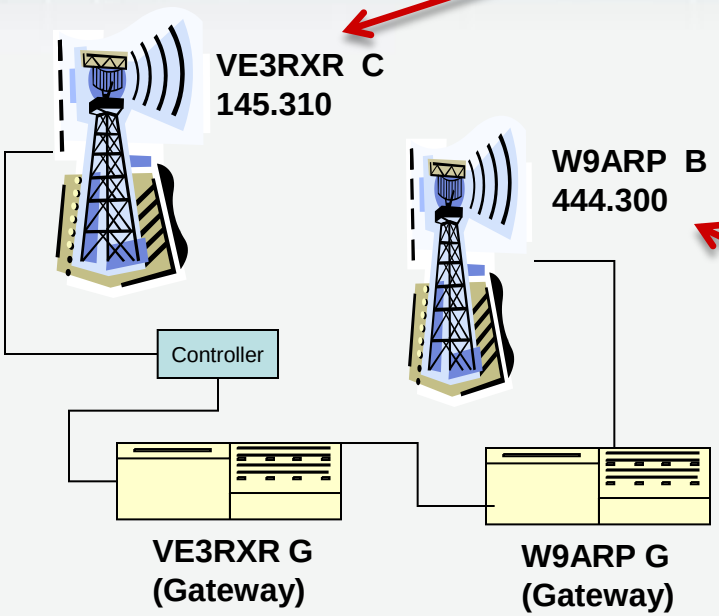
Will VE3AJB and W9DF be able to talk to each other?

144.310 MHz - / DV mode
UR: W9DF
RPT1: VE3RXR C
RPT2: VE3RXR G
MY: VE3AJB

VE3AJB



YES!

444.300 MHz + / DV mode
UR: VE3AJB
RPT1: W9ARP B
RPT2: W9ARP G
MY: W9DF

W9DF

Callsign Programming

MYCALL

- **It won’t change**

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Callsign Programming

YOURCALL (UR)

- **CQCQCQ** (for most all local contacts)
- **Callsign of a particular station** (VE3BEK, VE3WVA, W9DF, etc.)
- **/repeater callsign & port** (callsign of another repeater module)
- **special call** (repeater linking, reflector linking, special routing)

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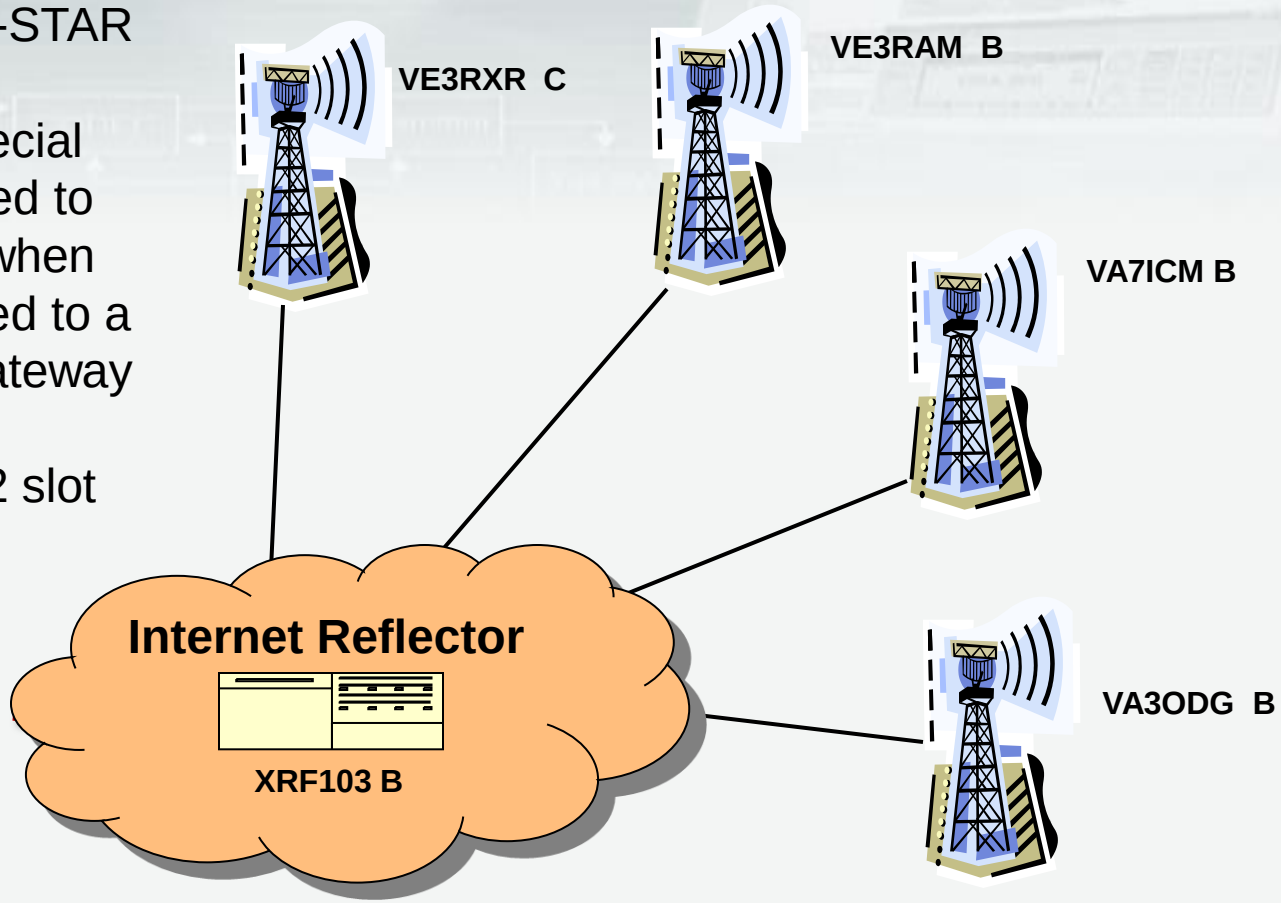
D-STAR Reflector

Repeaters linked via a D-STAR reflector act as one large repeater to users. No special call sign routing is required to talk to anyone you hear when your repeater is connected to a reflector; just have the gateway of your local system programmed in the RPT2 slot of your radio.



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Reflector Linking
(Establishing the link)

145.310 MHz - / DV mode
UR: REF001CL
RPT1: VE3RXR C
RPT2: VE3RXR G
MY: VE3AJB

VE3AJB

VE3RXR C
145>310

Controller

VE3RXR G
(Gateway)

VE3RAM B

VE3TTT B

VA7ICM B

VA3ODG B

Internet Reflector

XRF103 B

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Reflector Linked!

145.310 MHz - / DV mode
UR: CQCQCQ
RPT1: VE3RXR C
RPT2: VE3RXR G
MY: VE3AJB

VE3AJB

VE3RXR C
145.310

VE3RAM B

VE3TTT B

VA7ICM B

VA3ODG B

Controller

VE3RXR G
(Gateway)

Internet Reflector

XRF103 B

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Reflector Unlinking
(Severing the link)

145.310 MHz - / DV mode
UR: -------U
RPT1: VE3RXR C
RPT2: VE3RXR G
MY: VE3AJB

VE3AJB

VE3RXR C
145.310

VE3RAM B

VE3TTT B

VE7ICM B

Controller

VE3RXR G
(Gateway)

Internet Reflector

XRF103 B

VA3ODG B

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DV - DONGLE

- DV Dongle turns your laptop or P/C into D-Star radio
- Inexpensive $200
- Requires high speed internet
- Talk to any D-Star repeater in the world
- Connect to D-Star Reflectors
- Same excellent audio as that of the radio’s

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VE3RXR D-Star Repeater November 2008

- Donated to Club by Dave Filmer W9DF
- 25 Watt VHF D-Star Repeater & Controller
- Internet Connection from MSD Computers

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VE3RXR D-Star Repeater

NEW VE3RXR D-STAR STACK

- VE3RXR housed in Repeater building - one rack D-Star System McLeans Mountain
- Lion’s Club Donation of $5600
- New UHF D-Star repeater with new pre-amps and filters purchased

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NEW VE3RXR D-STAR STACK

- VE3RXR B 442.050 +
- VE3RXR C 145.310 –
- Coverage from Sudbury to Sault Ste Marie
- Connected to Gateway and over 550 D-Star repeaters world wide

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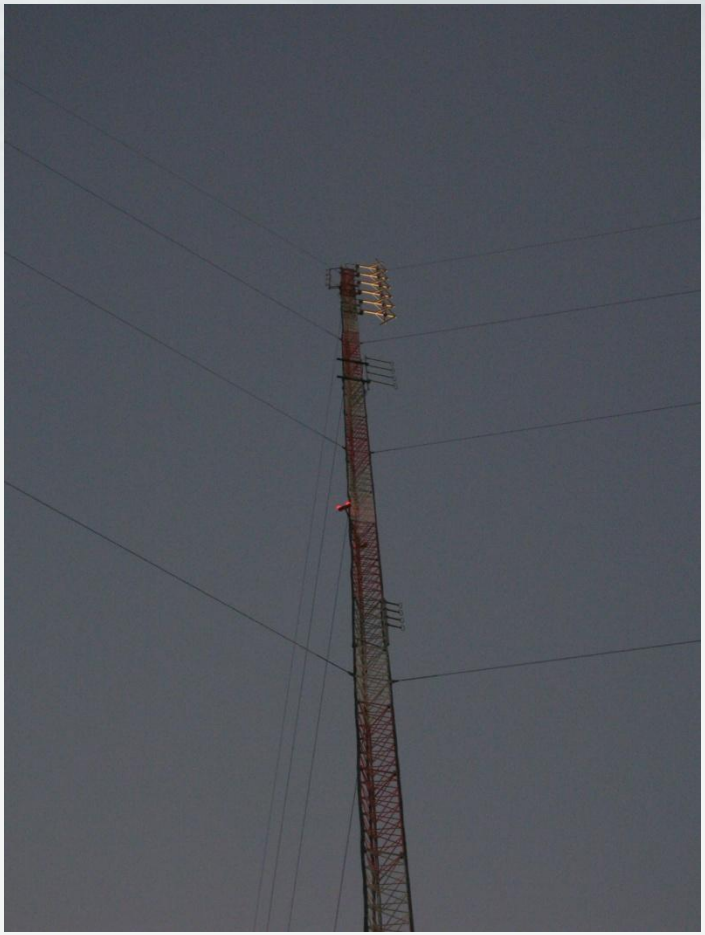
VE3RXR D-STAR SYSTEM



- VHF 210-C4 Sinclair Antenna at 1300 ft ASL
- UHF 310-C4 Sinclair Antenna at 1200 ft ASL
- Both repeaters 25 watts output
- 1.2 GHz Coming????

D-STAR Digital Voice Digital Data

Northern Ontario D-Star Net

- Idea came about connecting D-Star users around northern Ontario.
- Concept took off and became popular to link all of Ontario plus elsewhere.
- Purpose to check-in and share information about D-Star and other digital modes.
- The majority of the users are D-Star fans of the mode and while not opposed to other digital nets they wanted a net that uses only one digital mode.
- With one mode there is not the delay in transcoding other modes and the audio quality of station is much better.
- Since the start of the net other D-star users from across Canada have joined us including stations from the USA.
- Reflector XRF103B on Monday night 8:00 PM E.S.T.

D-STAR Digital Voice Digital Data

Friday Night CANNET Canadian Multi Digital Net

- Started as a D-Star Net on Reflector REF016B from the west coast back in 2009
- In 2011 we switched to XRF021B
- Ramesh VA3UV worked on a network system to link a group of reflectors together which included XRF021, XRF905, XRF005, XRF018,
- Stickley a D-Star net Canada wide 4 and half hour time zones 10:30 PM in Newfoundland and 6:00 PM In British Columbia.
- CANNET expanded to include many stations in the USA with XRF038A joining the group out of Ohio then Australian stations.
- In 2018 the CANNET expanded to include multi digital system VE3TNK XLX416D including the D-star network but now includes Brandmeister Talkgroup 302050 and Yaesu System Fusion YSF reflector 36010 known as (CA ON Pro-Com) channel.
- Nets take place each Friday evening at 9:00 PM EST with the following net controls John VA3WM - Niagara, Doris VE5DJQ – Saskatoon Allan VE3AJB – Manitoulin
- Neat feature is that each week a topic or question is introduced to encourage further discussion among check-ins.
- All are welcome to join us.

VE3TNK NETWORK HUB

- www.va3uv.com
- http://xlx044.va3uv.com/
- http://xlx103.xlxreflector.org/index.php
- http://freestar.homelinux.net/xlx/index.php?show=peers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Thank You For Listening

Any Questions ?????

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CONTACT INFORMATION

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