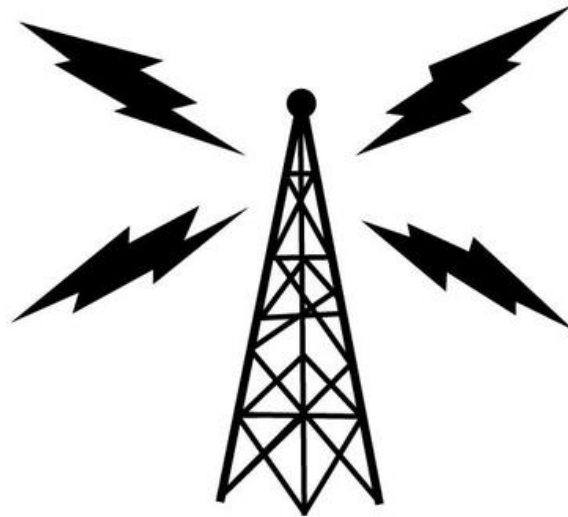


The Other Shoe

D-Star, DMR, and the Rest



Sierra Foothills ARC

April 10, 2020

Greg KO6TH

Recap of February's Talk

https://www.youtube.com/watch?v=tXSray0_5qg

- Yaesu Fusion test on SFARC 70cm repeater
- Local and remote communications
- Links to 2 other repeaters in the area
- YFS / FCS Rooms attached
- Hot Spot access when on the road

What about...

- Other digital voice “things” mentioned
 - D-Star
 - DMR
 - C4FM
 - AMBE
 - P25
 - Rooms, Talk Groups, Reflectors, Gateways

Back to Basics: What is Digital Voice?

- It's like listening to streaming audio, but through the radio
 - Analog signal converted to a stream of data bytes
 - Bytes get compressed (think “zip”) to minimize bandwidth
 - “MP3” includes a LOT of understanding of human perception
- Compressed stream is chopped into data packets, along with additional information (call sign, GPS, etc)
- Resulting bits are fed to a modulator (think “modem”)
- Modulated RF signal sent to antenna

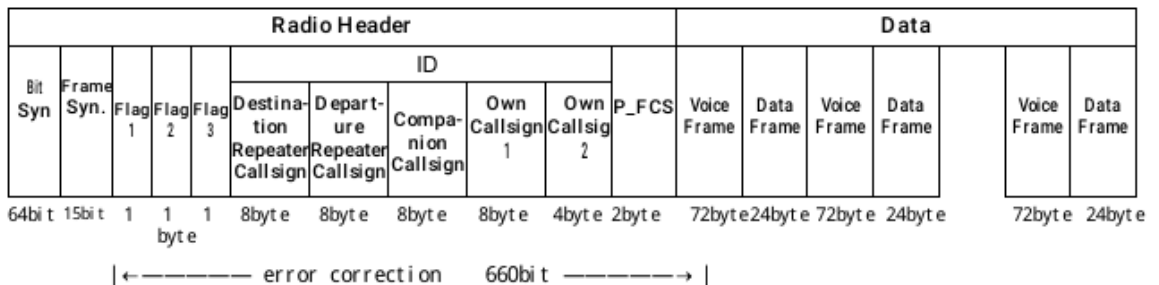
Receiver does the reverse

Easy, no?

Standards are Wonderful

Because we have so many to choose from

- Voice is converted to digital (byte stream) by a Codec
 - Codec is a COder / DECoder
 - AMBE, IMBE, Codec2, and others exist
 - Must have same one at each end of the “conversation”
- D-Star, Yaesu Fusion, DMR, P25 all use “AMBE”
 - AMBE is proprietary, patented, not free, and there are several incompatible versions. D-Star uses one, Fusion and DMR use another
 - Other stuff is also added in (e.g. call sign, GPS, serial data), but not in the same way
 - So the resulting packet formats are specific to platform, mode, etc.
- Packets chopped into bits, bits are modulated onto RF carrier
 - Modem is a MOdulator / DEModulator
 - D-Star uses GMSK
 - Fusion uses C4FM
 - DMR uses FSK / TDMA
 - P25 uses FSK



D-Star Overview

Digital Smart Technologies for Amateur Radio

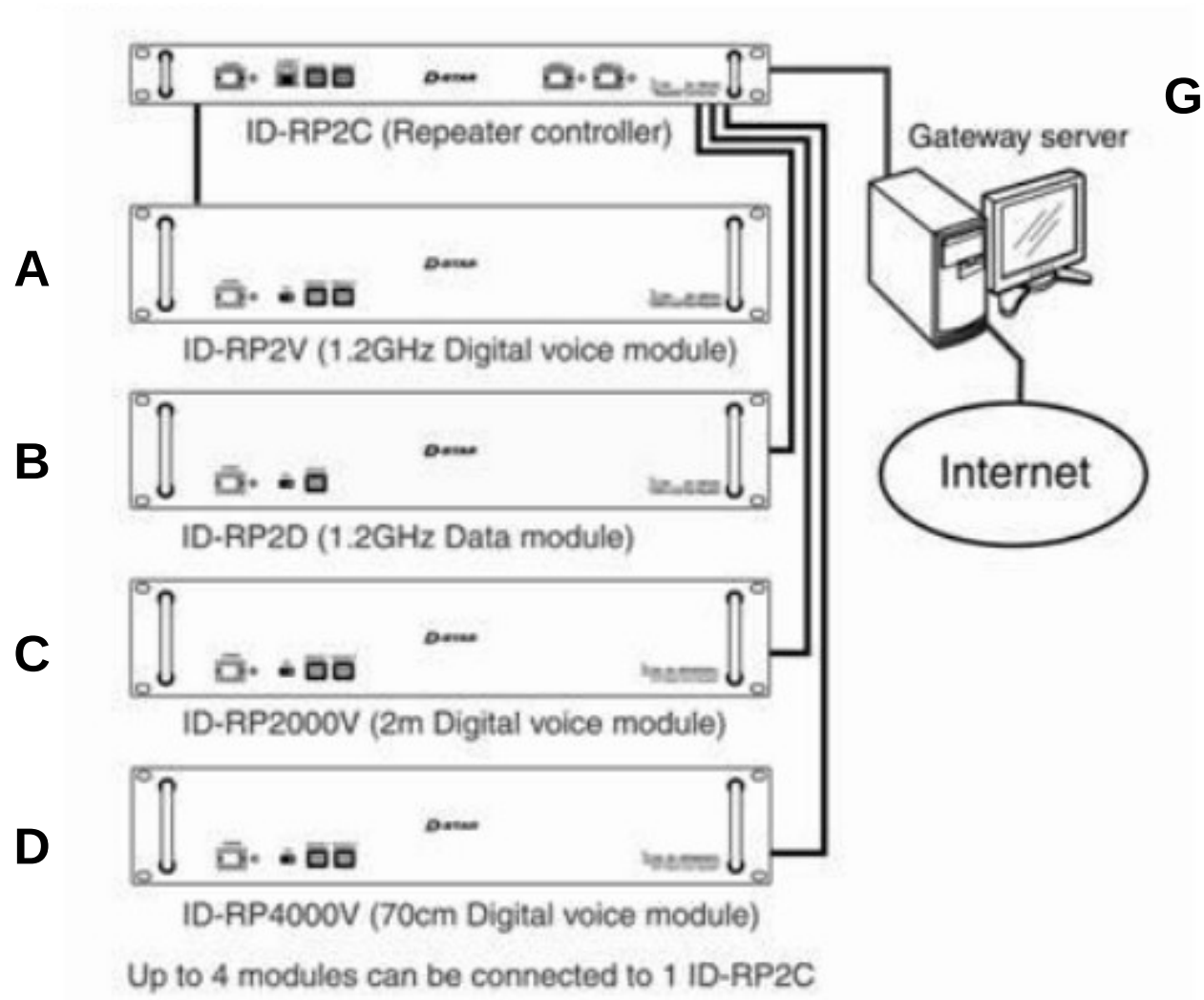
- Considered to be the first digital voice system for Amateur Radio
 - Created by JARL, first published in 2001, First hardware by ICOM in 2004
- D-Star (digital voice)
 - Voice communication between radios & devices
 - Includes simultaneous low bandwidth (900-ish bps) data channel
- D-Rats (data link) *Not going to cover this in this presentation...*
 - High bandwidth, non-voice, data channel (128k bps)
 - Provides access to internet backbone to transfer data, and services between stations
 - May be manufacturer-dependent (e.g. not Kenwood D74?)
- D-PRS
 - ICOM-defined GPS Position strings encoded into low bandwidth data channel
 - Conversion spec by Pete Loveall (AE5PL), takes GPS info to make APRS-like reports
 - Implemented on many D-Star gateway systems, but doesn't inter-operate with APRS
 - ICOM and Kenwood radios do slightly different things with this (of course)

D-Star Configuration

- 4 fields
 - My call (this is your own call sign)
 - Ur call (call of person you are talking to, or CQCQCQ for “all”)
 - Rpt 1 call sign (local repeater + module) or “/” prefix for “Zone”
 - Rpt 2 call sign (local repeater + module or “G” gateway)
- Repeater callsigns have “module” designations (A, B, C, G)
 - These are “ports”, for example the link between 2m and 70cm
 - Module letter must go in 8th character position
- ICOM exposes these fields directly
- Kenwood hides them, manages them by Mode
 - DV mode is like Simplex – station to station directly
 - DR mode is through Repeaters



D-Star Repeater Ports



Getting on D-Star

- First: Register your call sign with network

- <http://www.mdarc.org/activities/repeaters/dstar>

- Click “New users: Register your Call Sign”

- Find a repeater to connect to

- <http://www.dstarusers.org>

- Locally, this is just the Concord (on Mt. Diablo) and Folsom repeaters

- Radios can have internal database with frequency & call signs

- Lookup based on menu tree or GPS

- Kenwood database and other software available on Kenwood Support site
https://www.kenwood.com/i/products/info/amateur/software_download.html

- ICOM database: <http://dstarinfo.com/RepeaterDownloads.aspx>

- Or you can enter stuff manually (but it’s a pain...)

The W6CX Advanced D-STAR Gateway

NOTE: With Yahoo Groups scaling back, we have set up a "groups.io" group for fans of DStar at W6CX. This is like the old Yahoo Groups, but better.

[Click here to join](#)

New users: [Register your Callsign](#)

DMR Overview

Digital Mobile Radio

- System based on commercial radio use profiles
 - Intended to replace Trunked Analog systems
 - Better battery life due to short digital burst transmissions
 - Narrower channels than “regular” NBFM
 - Adapted for Amateur Radio (e.g. Radio ID based on call sign)
- Basic Handy-Talkie operation, plus
 - Can be used simplex or duplex (through repeaters)
 - Various configurations for individual and group calling
 - Has been extended to connect to Internet-based rooms
- Some data modes, but not universal
- Some scanners can decode DMR



DMR Configuration

- Radios and repeaters have a numeric ID
- Repeater “Color Code” assigned (like a PL tone)
- Digital Voice traffic has two “Time Slots”
 - Repeater can send two voice streams simultaneously
 - Connects repeater to Talk Groups (aka room, reflector)
 - One slot generally fixed, one dynamic
- Radios configured by software, not front panel
 - PC software used to load “Code Plug” into radio
 - Radio/brand-specific software comes with the radio
 - Can download plugs from Internet for some areas
 - Configures radio “channel” to a frequency, color code, and time slot

Getting on DMR

- Get a DMR Radio ID
 - <https://www.radioid.net/register>
 - 7 digit number, based on your Amateur Radio call sign
 - One per radio (so, you can have more than one registered)
- Radio programming
 - Get radio-specific configuration software
 - Create and install “Code Plug” (configuration file)
 - Can start with a regional file, modifying to your preferences
- Find a repeater
 - <https://www.radioid.net/database/search>
 - Only local repeater appears to be in Auburn

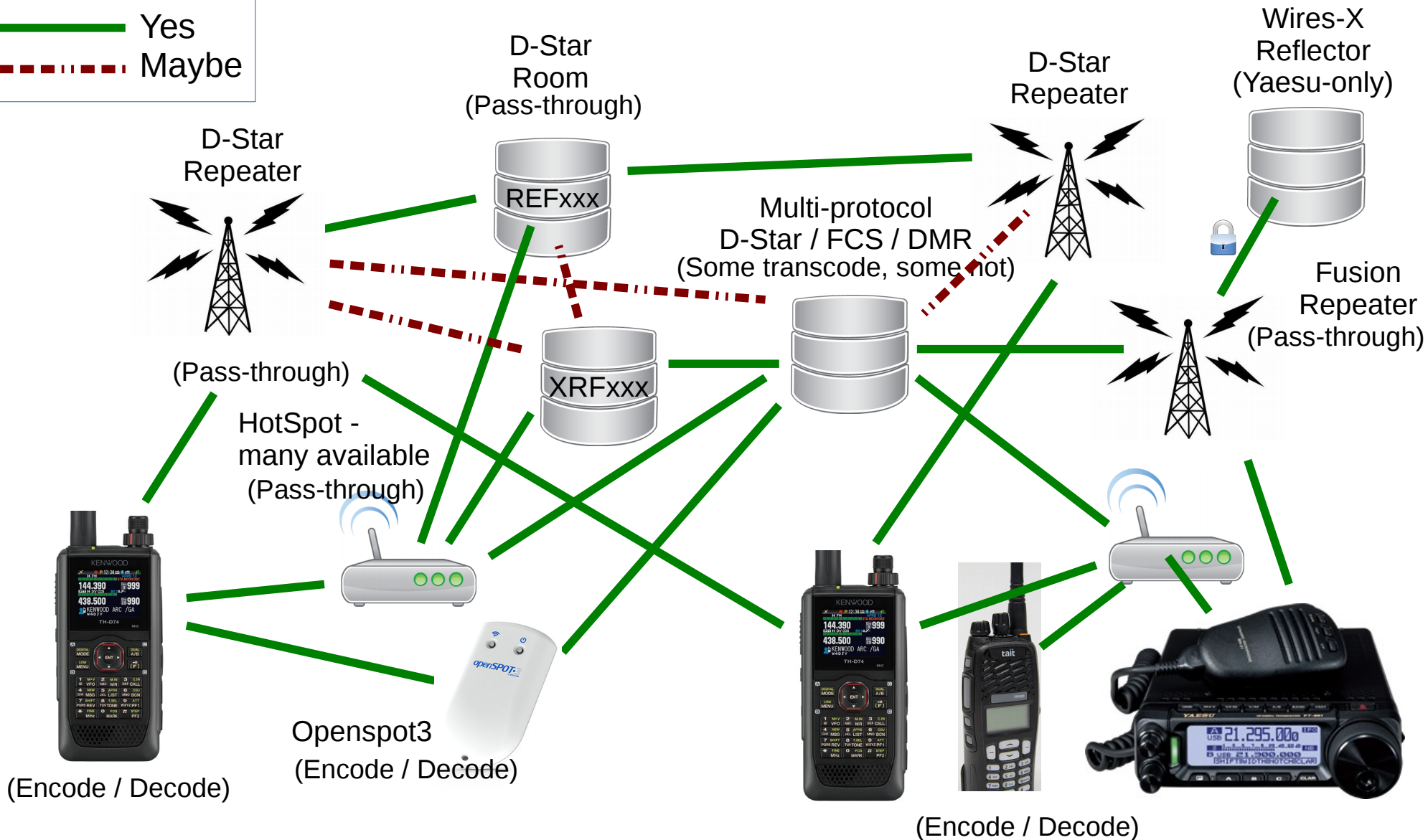
Other Digital Voice Modes

Not going to cover these...

- P25
 - Re-purposed public safety gear
 - Various codecs used over FSK modulation
- NXDN
 - Part 90, Public Land Mobile radio system
 - Open Standard developed by ICOM & Kenwood
 - Announced 2005, 1st products 2006, ITU accepted 2016
 - Include use of FDMA, TDMA, CDMA multi-access protocols (Spread Spectrum)
 - Encryption not allowed for Amateur Radio

Repeaters, Decoders, and Rooms

Where's the Encoder / Decoder?



Repeaters, Decoders, and Rooms

Direct Station to Station



(Encode / Decode)



(Encode / Decode)

Repeaters, Decoders, and Rooms

End-to-end pass through



(Pass-through) "A/B/C" port



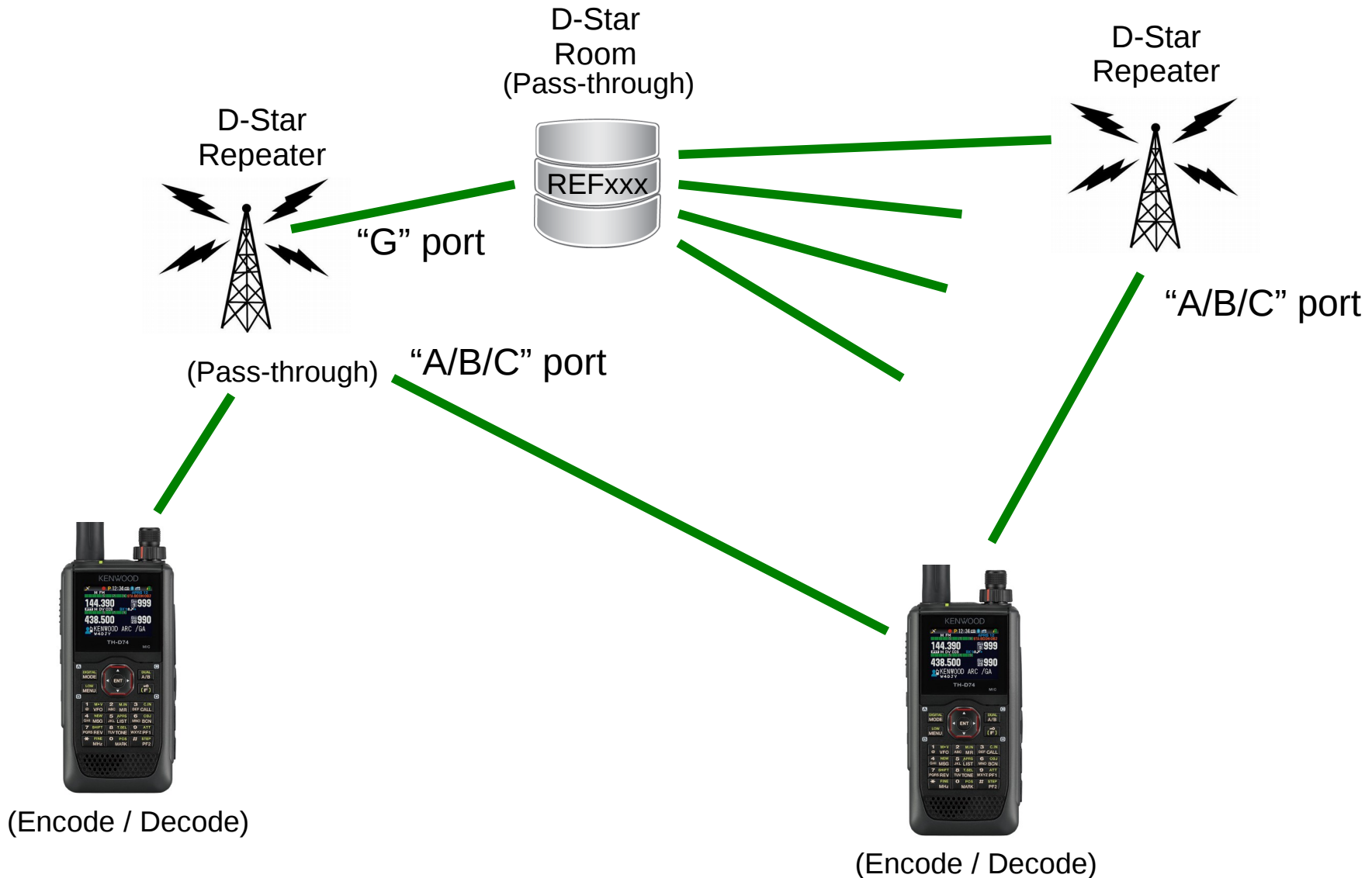
(Encode / Decode)



(Encode / Decode)

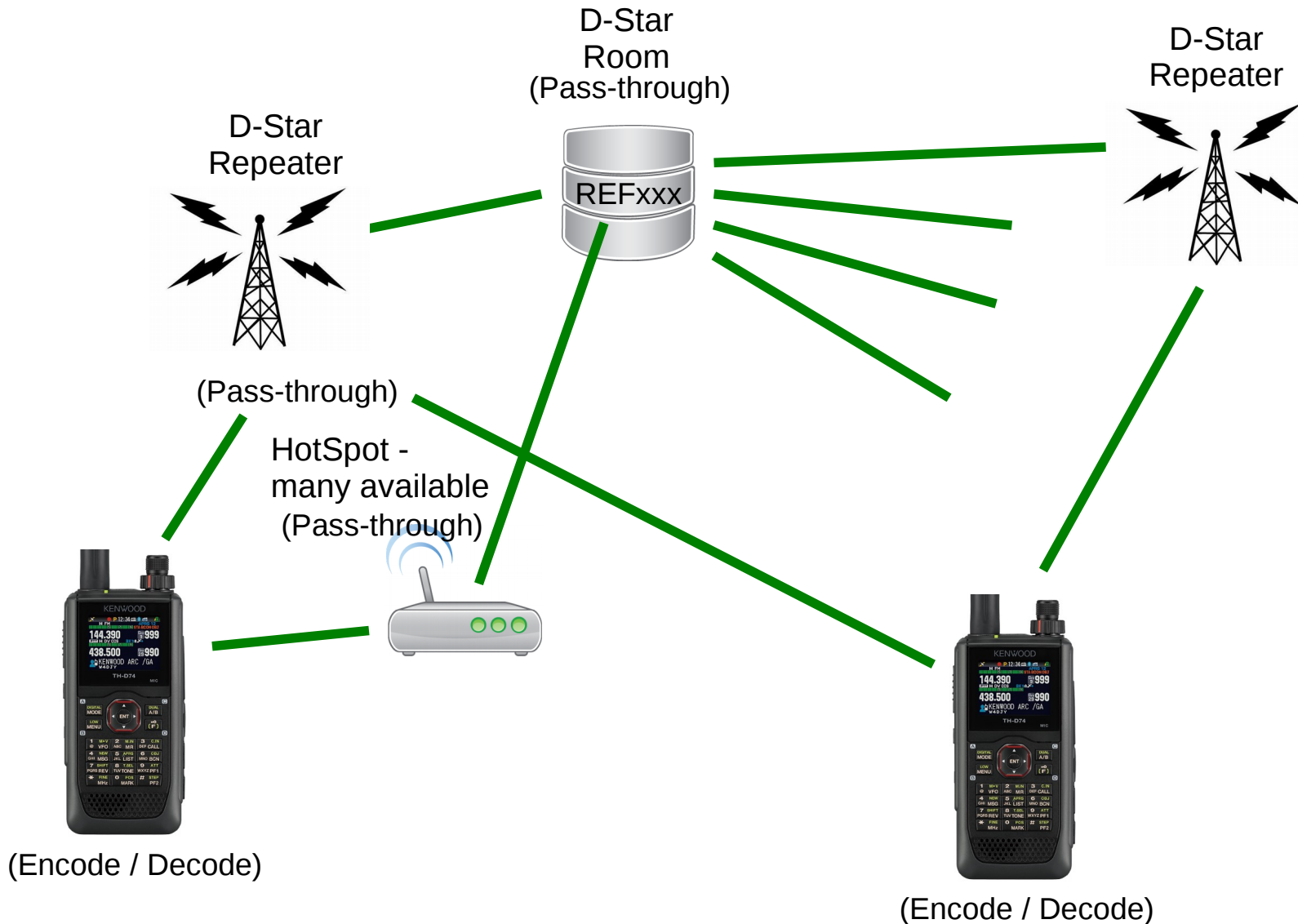
Repeaters, Decoders, and Rooms

End-to-end pass through



Repeaters, Decoders, and Rooms

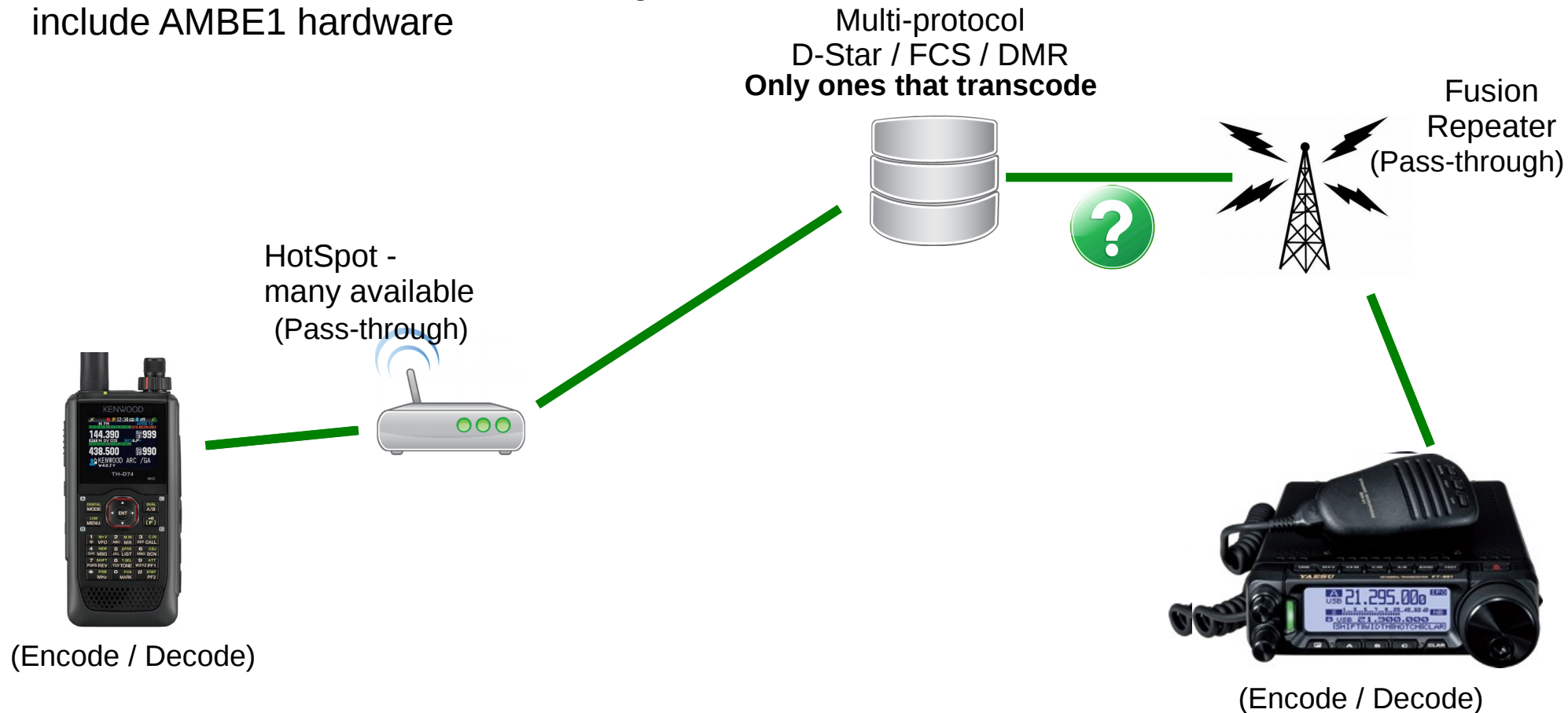
End-to-end pass through



Repeaters, Decoders, and Rooms

Mode conversion by Reflector

- *Some* reflectors can transcode from one DV format to another
- Reflectors that do D-Star transcoding include AMBE1 hardware



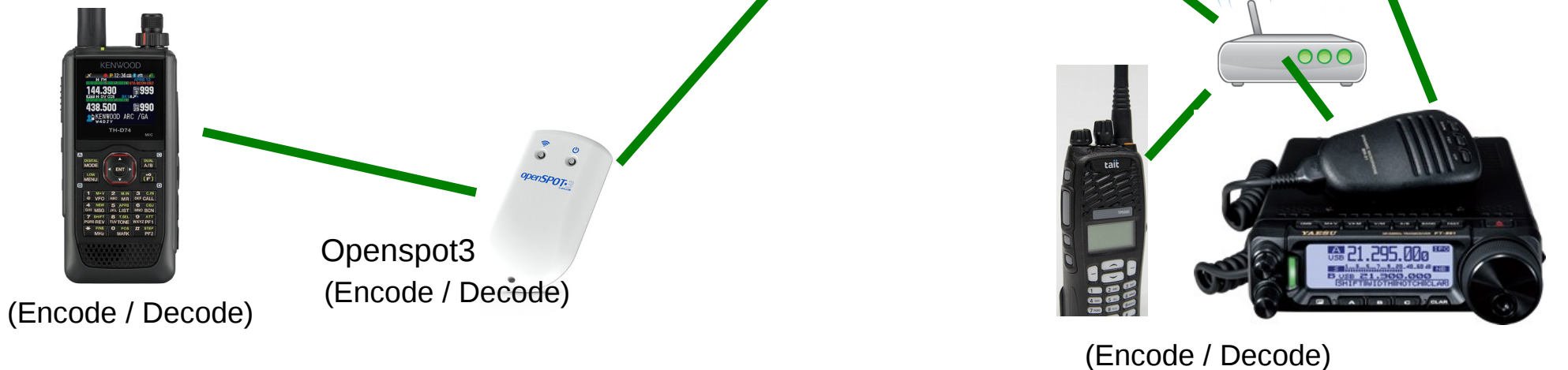
Repeaters, Decoders, and Rooms

Mode conversion by Hotspot or Reflector

- *Some* reflectors can transcode from one DV format to another
- Reflectors that do D-Star transcoding include AMBE1 hardware
- OpenSpot3 includes AMBE1 chip, so can make D-Star work with larger variety of reflectors

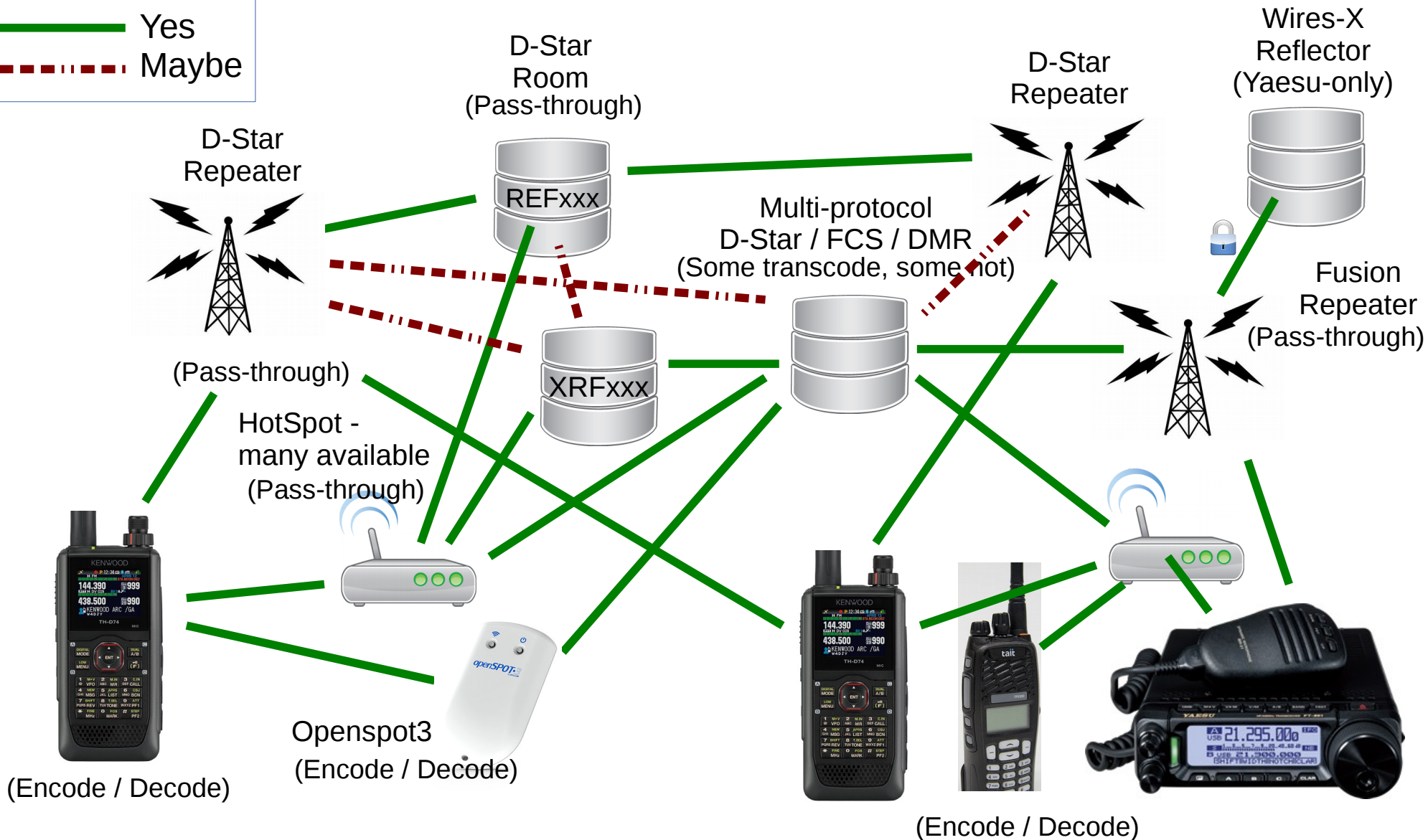
Multi-protocol
D-Star / FCS / DMR
(Some transcode, some not)

Fusion
Repeater
(Pass-through)



Repeaters, Decoders, and Rooms

Where's the Encoder / Decoder?



General Resources

- Comparison: <https://www.youtube.com/watch?v=I3qeWncX5vk>
- Multi-protocol rooms: <https://www.openquad.net/>
- D-Star repeater programming: https://youtu.be/WdkANzu1p_I
- D-Star for Dummies:
http://www.tmrahamradio.org/D-STAR_for_Dummies_v4.pdf