

# D-Star, DMR and Fusion Which One is Right for You?

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2017 TMRA Hamfest



# Overview

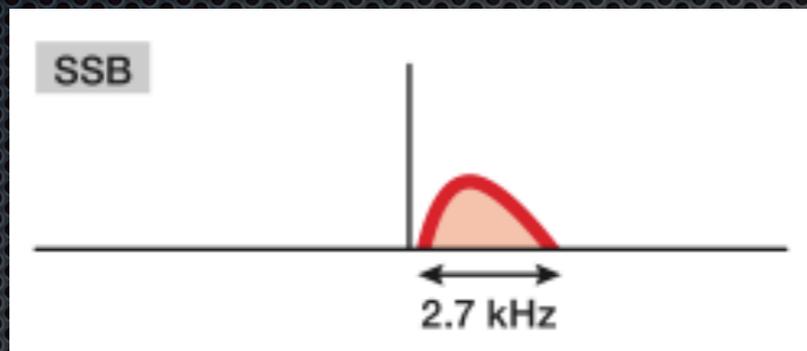
- ✦ How Digital Voice Works
- ✦ D-Star
- ✦ DMR
- ✦ Yaesu System Fusion
- ✦ Other Hardware Options



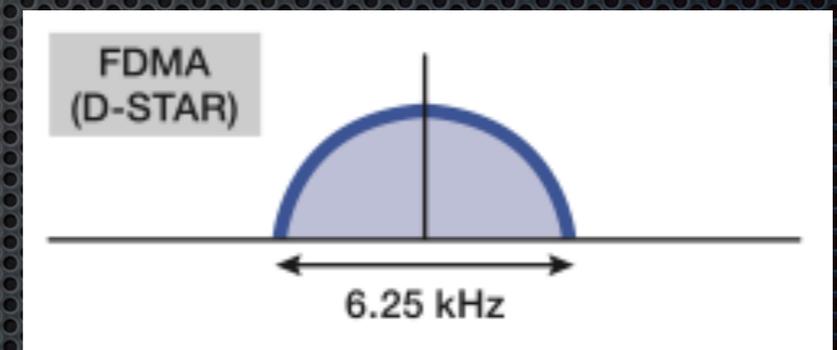
# Bandwidth Review

- CW

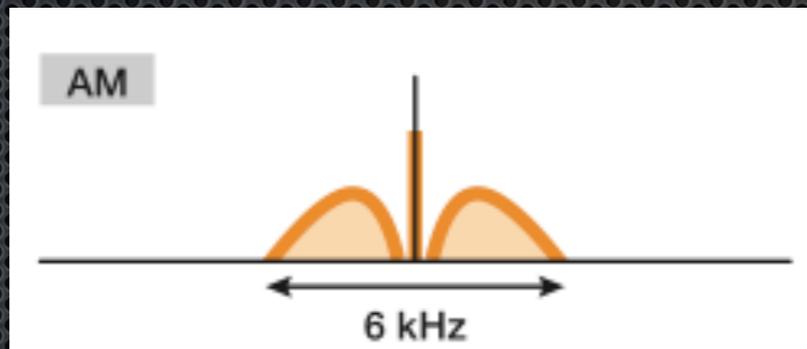
- SSB



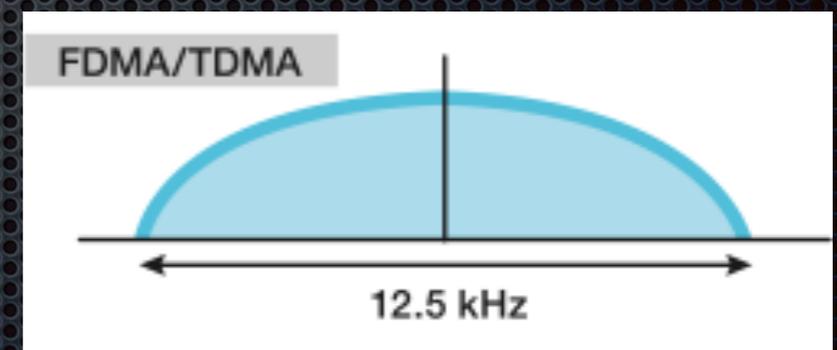
- GMSK



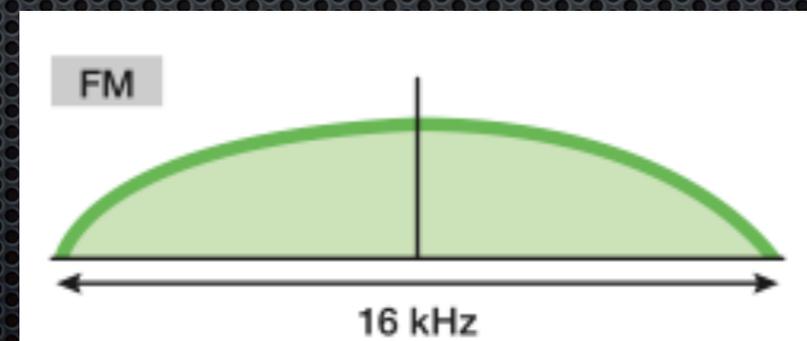
- AM



- TDMA



- FM



# How Digital Voice Works

- ✦ Overview
- ✦ Modulation Methods
- ✦ Communication Types
- ✦ Communications Protocol/Implementation

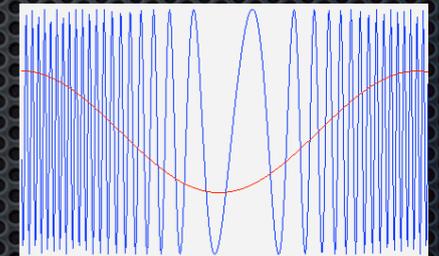
# Overview - How DV Works



```
0101010100110  
100110011010100  
101001101011010  
111011110101001  
100010110010010  
001001000010001
```

100110011010100

```
100110011010100  
101001101011010  
100110011010100
```



Audio  
(Speech)  
-and/or-  
Data  
(Photo, etc)

Analog to  
Digital  
Encoder/  
Decoder

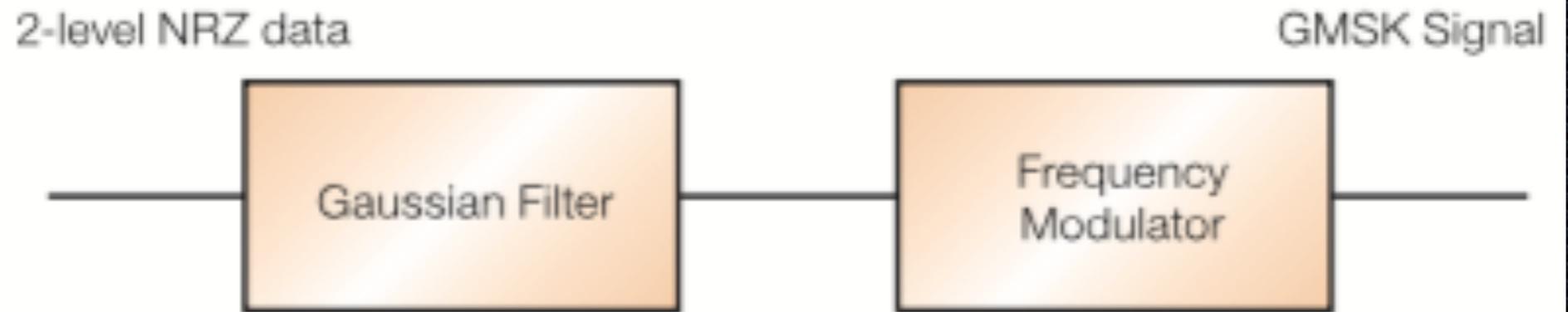
Vocoder  
(typically an  
AMBE chip)

Packaging/  
Framing for  
Modulation

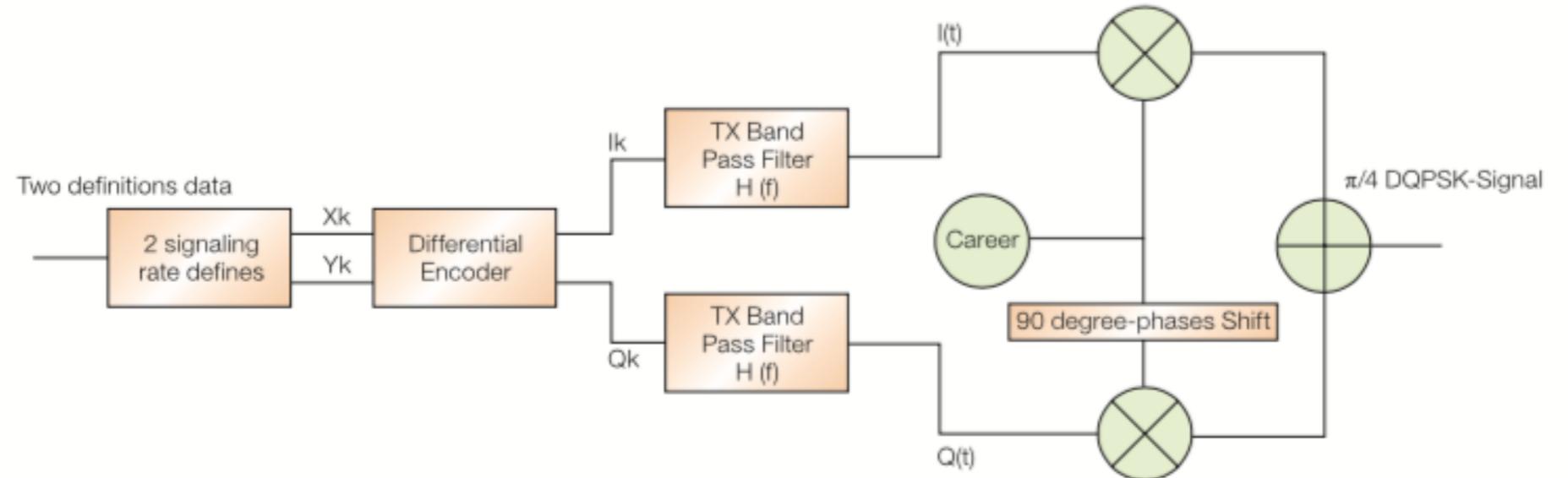
Modulation

# DV Modulation Methods

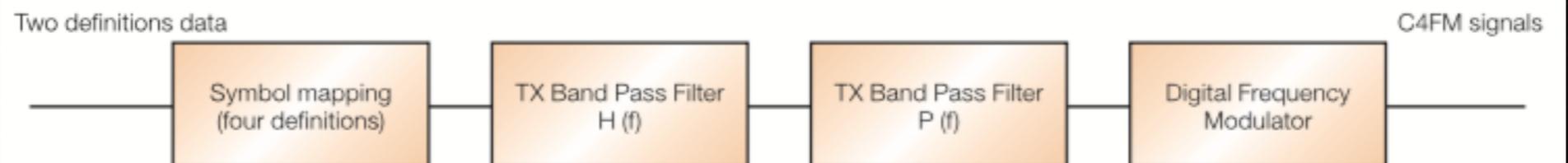
- GMSK



- DQPSK

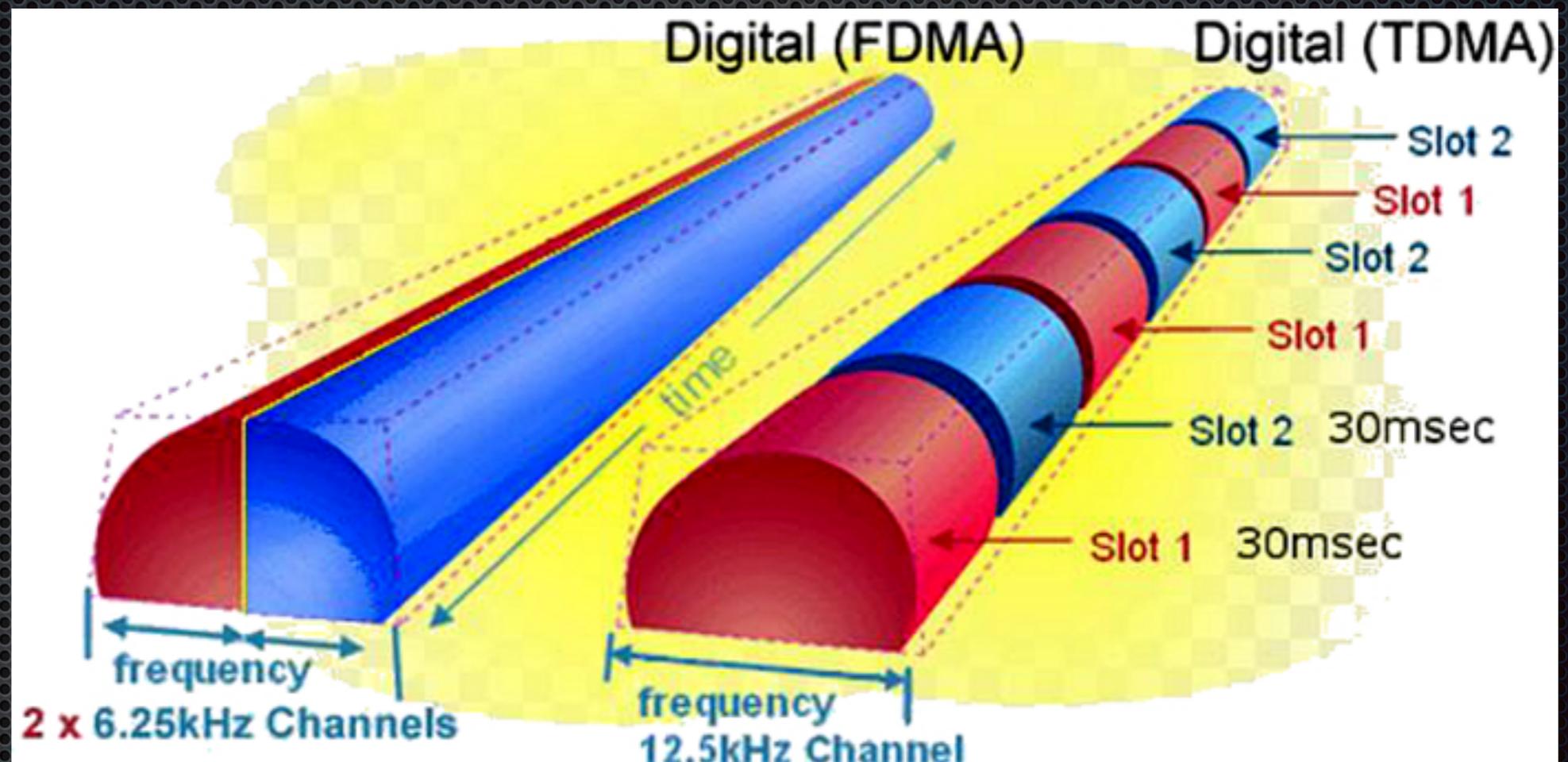


- C4FM



# DV Communication Types

- ✦ FDMA
  - ✦ D-Star
  - ✦ Fusion
- ✦ TDMA
  - ✦ DMR

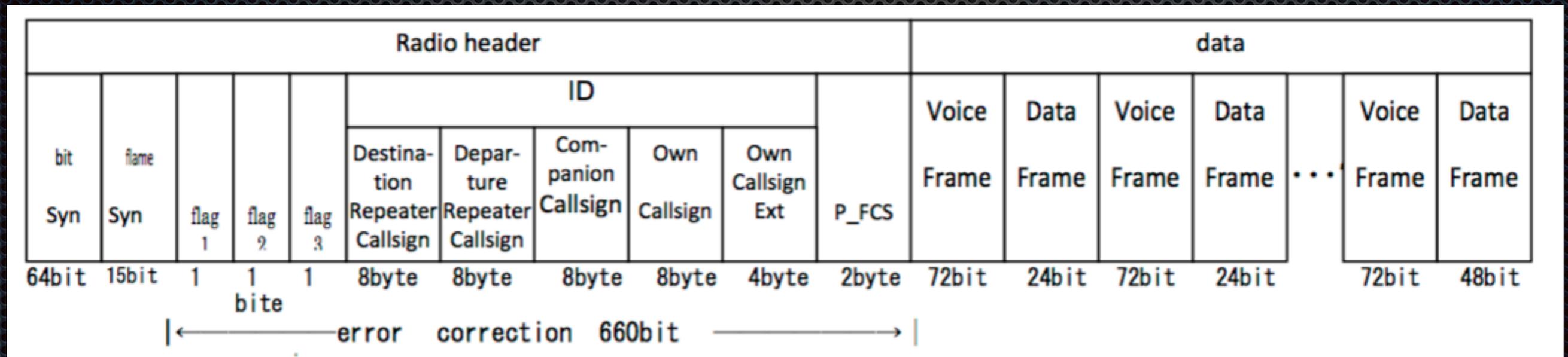




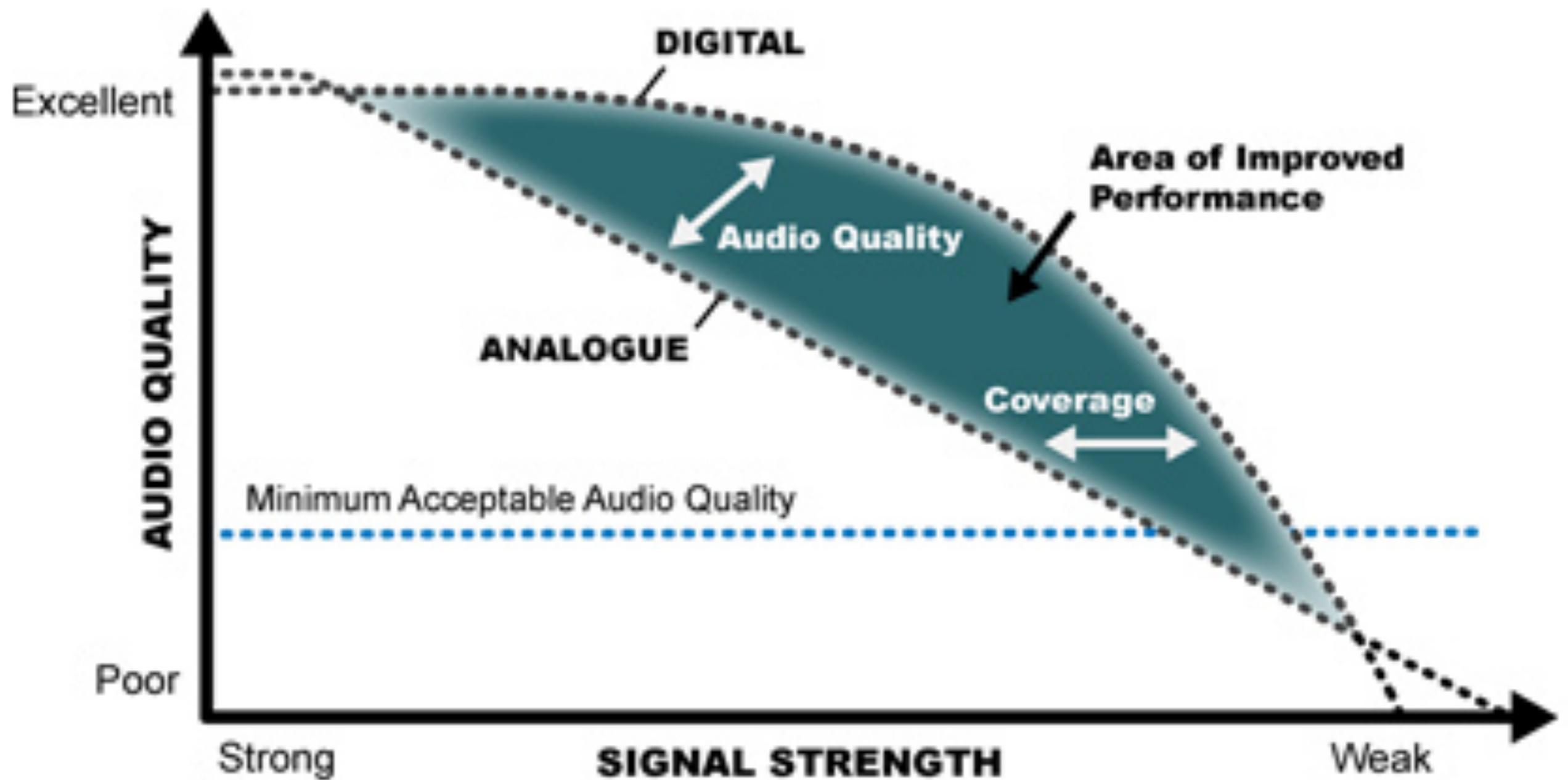
# D-Star

- ✦ Digital Smart Technologies for Amateur Radio
  - ✦ D-Star Origins
  - ✦ How D-Star Works
  - ✦ How D-Star Sounds
  - ✦ Pros/Cons
  - ✦ Product Choices and Prices

# How D-Star Protocol Works



# Analog vs Digital Drop Off



# How D-Star Sounds

To An FM User

# How D-Star Sounds

N8ZAK In the Shack FM

# How D-Star Sounds

N8ZAK In the Shack

# How D-Star Sounds

Real World  
How it Degrades

# How D-Star Sounds

On the Fringe

# How D-Star Sounds

Weak Signal D-Star

# D-Star Pros/Cons

- ✦ Easy to Program
- ✦ Call-Sign Routing
- ✦ Lots of Infrastructure
- ✦ Voice and Data at the Same Time!
- ✦ Experimenter?
- ✦ Limited Manufacturers\*
- ✦ Have to register
- ✦ Degradation
- ✦ Throw out the Manual!

# D-Star Product Choices and Prices

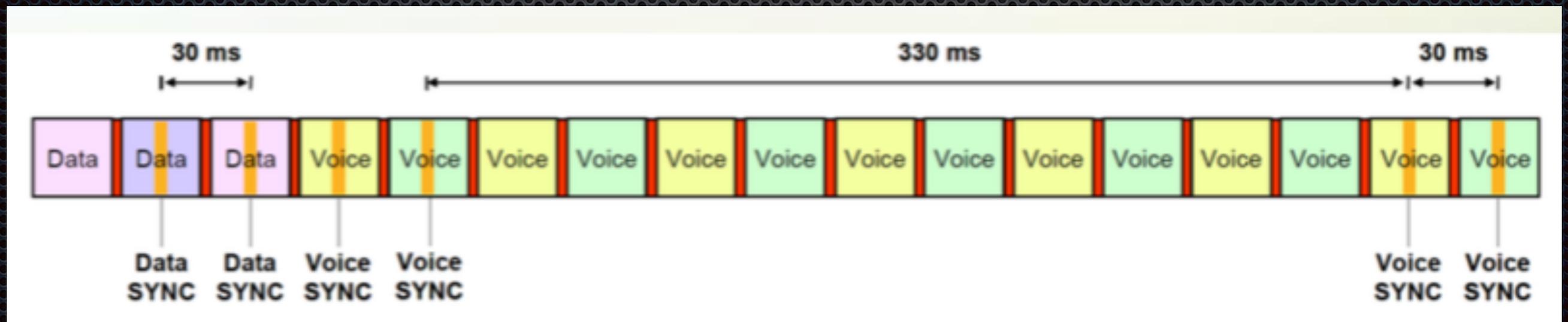
- ✦ Various Manufacturers\*
- ✦ Depending on our desired result pricing can range from \$200-\$1000
- ✦ ICom HT == \$375.00
- ✦ Kenwood HT == \$700



# DMR

- ✦ Digital Mobile Radio
  - ✦ Origins
  - ✦ How DMR Works
  - ✦ How DMR Sounds
  - ✦ Pros/Cons
  - ✦ Product Choices and Prices

# How DMR Protocol Works



# How DMR Sounds

TDMA

To An FM User

# How DMR Sounds

FDMA  
Simplex

To An FM User

# How DMR Sounds

FM vs DMR

# How DMR Sounds

How it degrades

# DMR Pros/Cons

- ✦ Open Protocol
- ✦ Good Sound Quality
- ✦ Degradation Recovery
- ✦ Battery Longevity
- ✦ Easy to Use\*
- ✦ Cost! (New and Used)
- ✦ Impossible to Program without a Computer
- ✦ Limited Infrastructure but Growing Quickly
- ✦ Networks "In Flux"
- ✦ CallSign != DMR ID
- ✦ Terminology
- ✦ Repeater Owner in Control
- ✦ No dual band radios!

# DMR Product Choices and Prices

- ✦ Many Manufacturers in the commercial space
- ✦ Depending on product pricing can range from \$125-\$1500
- ✦ TYT HT == \$125.00



# Yaesu System Fusion

- ✦ Yaesu System Fusion
  - ✦ Origins
  - ✦ How Fusion Works
  - ✦ How Fusion Sounds
  - ✦ Pros/Cons
  - ✦ Product Choices and Prices



# How System Fusion Sounds

To An FM User

# How System Fusion Sounds

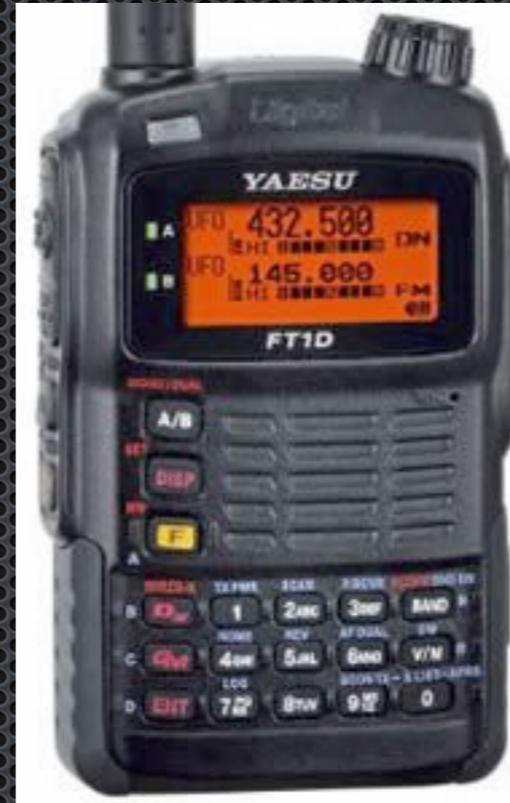


# System Fusion Pros/Cons

- Easy to Program
- Easy to Use
- Degradation Recovery
- Single Manufacturer
- Proprietary
- Repeater Capabilities  
“In Flux”
- FM/Digital Capabilities  
up to Repeater Owner

# Fusion Product Choices and Prices

- ✦ Single Manufacturer
- ✦ Pricing ranges from \$300-\$500
- ✦ FT1XD HT == \$300.00



# Other Hardware Options

- ✦ Ability to Take Existing Digital HT/Mobile and Bridge
- ✦ Purchase 3rd Party Devices
  - ✦ DVMega, DV4Mini, OpenSPOT, etc
- ✦ Hack an MD-380/Connect Systems/Baefong
- ✦ Pros/Cons
- ✦ Product Choices and Prices

# Other Hardware Choices and Prices

- ✦ Multiple Manufacturers
- ✦ Pricing ranges from \$125-\$300
- ✦ Requires additional equipment, computer and Internet connection



# Other Hardware Pros/Cons

- Makes it possible to bridge networks using existing DV radio
- Save money!
- No notable quality differences (receiving party does know)
- Difficult to make portable
- Knowledge of Firewall and Port Forwarding Needed
- Difficult if you travel
- Computer needed to configure

# Summary

- ✦ Explained how Digital Voice communication works
- ✦ Explained and Demonstrated Popular DV Modes
  - ✦ DMR, D-Star, Fusion
- ✦ Other Hardware Options
- ✦ Thank You
- ✦ Questions?



# D-Star External Websites

- <http://www.dstarinfo.com>
- <http://www.icomamerica.com>
- <http://www.dstarusers.org>
- <http://www.dstar101.com>
- <http://www.dstarinfo.com/dstar-web-calculator.aspx>
- [http://www.tmrahamradio.org/D-STAR for Dummies v4.pdf](http://www.tmrahamradio.org/D-STAR%20for%20Dummies%20v4.pdf)

# DMR External Websites

- ✦ <http://www.dmr-marc.net>
- ✦ <http://brandmeister.network>
- ✦ <http://hose.brandmeister.network>
- ✦ <http://www.va3xpr.net>

# Fusion External Websites

- ✦ [https://www.yaesu.com/pdf/System\\_Fusion\\_Text.pdf](https://www.yaesu.com/pdf/System_Fusion_Text.pdf)
- ✦ <https://www.yaesu.com/jp/en/wires-x/index.php>
- ✦ [https://www.hamoperator.com/Fusion/FusionFiles/WB7OEV-Fusion-PDF-0018\\_WiRESX-Install.pdf](https://www.hamoperator.com/Fusion/FusionFiles/WB7OEV-Fusion-PDF-0018_WiRESX-Install.pdf)