

Amateur Radio Voice and Data Network Interconnection

BRINGING SANITY TO A DISJOINTED LANDSCAPE



John Hays, K7VE

First licensed in 1973

VP of Information Technology at MaverickLabel.com

Founder and Director at Northwest Digital Radio

Early VADG Packet user, moved to AX.25

NEPRA, NAPRA, UPRA

Architect for STARnet Digital on D-STAR

Involved with TCP/IP networking since late 1970s

Operate many Digital Voice and Digital Data Modes

Created and operate real-time websites for digital voice modes

The Landscape Digital Data Networks

- High Speed and Bandwidth (> 1 Mbps)
 - HamWan, Mesh, HamNET, Canopy, ...
 - Microwave, often repurposed consumer equipment
- Mid Tier (56kbps -> 1 Mbps)
 - WA4DSY Modems, Icom ID-1, UDRx, HamNET, ...
 - 219 Mhz and above (in US)
- Low Speed (< 56kbps)
 - Traditional Packet Radio 1200/9600/19200 AX.25
 - APRS, Beacon Net, WSPR, ...
 - Various low speed modulations, PSK, OFDM, BPSK, JTxx, ...

The Landscape

Digital Voice and Analog Transport Networks

- Vocoder Based Systems (Digital Voice)
 - AMBE+ (D-STAR, Alinco, ARD modems, ...)
 - AMBE+2 (DMR, Fusion, dPMR, P25 Phase 2, ...)
 - IMBE (P25 Phase 1)
 - Codec-2 (FreeDV)
- Analog over Digital Transport (CODECs)
 - Echolink
 - IRLP
 - AllStar (Asterisk)
- Others

Amateur Digital Experimenters

- Create software and hardware
- Develop Protocols
- Spend their time in the hobby learning and implementing systems
- Seek to understand how things work and how they can be improved
- Care more about how the bits get from point A to point B, than what those bits represent

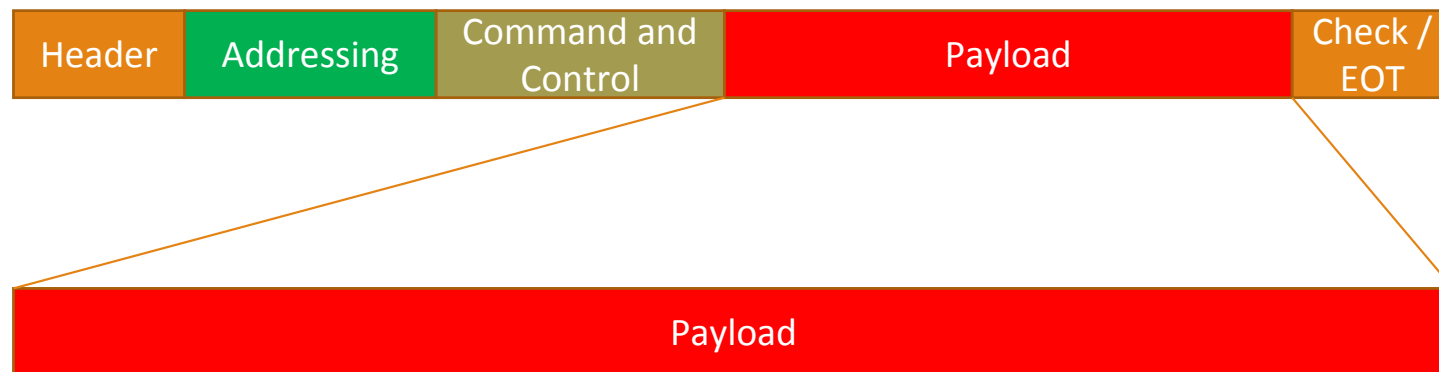
Amateur Digital Users

- Want software and hardware that is 'plug and play'
- Some are interested in integration and some are interested in how networks operate
 - Have a need for good documentation include tutorials, manuals, video, etc.
- Are more interested in the content than the mechanism for delivery
 - Can you hear and understand me?
 - Did the data arrive accurately and timely?

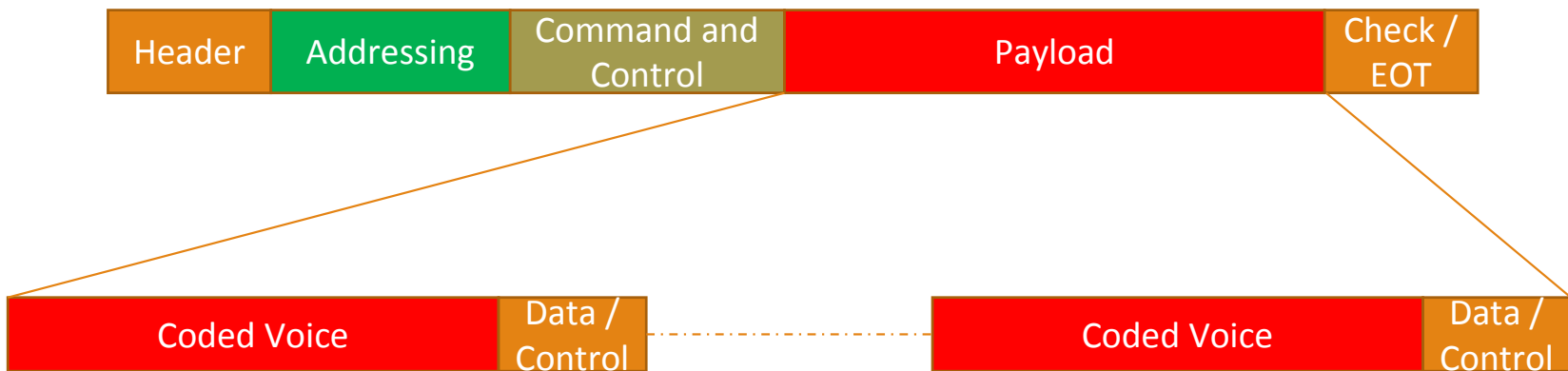
Generic Transmission Unit



Generic “Data” Transmission Unit



Generic Digital Voice Transmission Unit



How We Have Done it in the Past

“Cowboy” Development – Leading to “Point” Solutions

- Experimenter gets an idea and builds an application from the ground up.
 - Sometimes out of necessity
 - Completely new idea / never been done before
 - Not available in an Amateur Radio friendly way
 - Price, constraints, ...
 - Not available on platform of choice
 - Sometimes for personal / ideological reasons
 - Doesn't like previous implementer's approach
 - Not “open” enough
 - Missing desired feature or features
- Ignores standards and interoperability

How We Have Done it in the Past

To a Specification or Standard – Creating a Framework or Platform

- Amateur Generated
 - TAPR AX.25
 - JARL D-STAR
 - ARDOP
 - APRS
 - ... (BBS, Digital SSTV, ...)
- Vendor Specification
 - Fusion Digital (open specification)
 - Pactor (closed specification)
- Industry Specification
 - DMR, TCP/IP, MPEG, IETF, ...

Bridging, Conferencing and Talk Groups

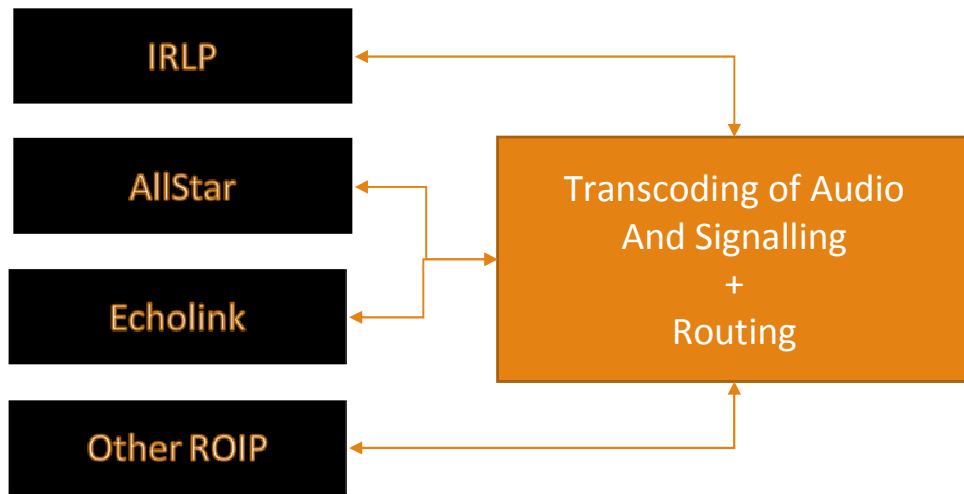
Point-to-Point Linking or Routing

- Same System (e.g. IRLP, D-STAR*, ...)
 - Use native modes between systems
- Cross System (e.g. IRLP <-> DMR, ...)
 - If shared Codec or Vocoder
 - No transcoding
 - Translate transport / addressing / routing
 - If no shared Codec or Vocoder
 - Direct transcode (if possible)
 - Translate transport / addressing / routing
- “Receiver Makes Right”

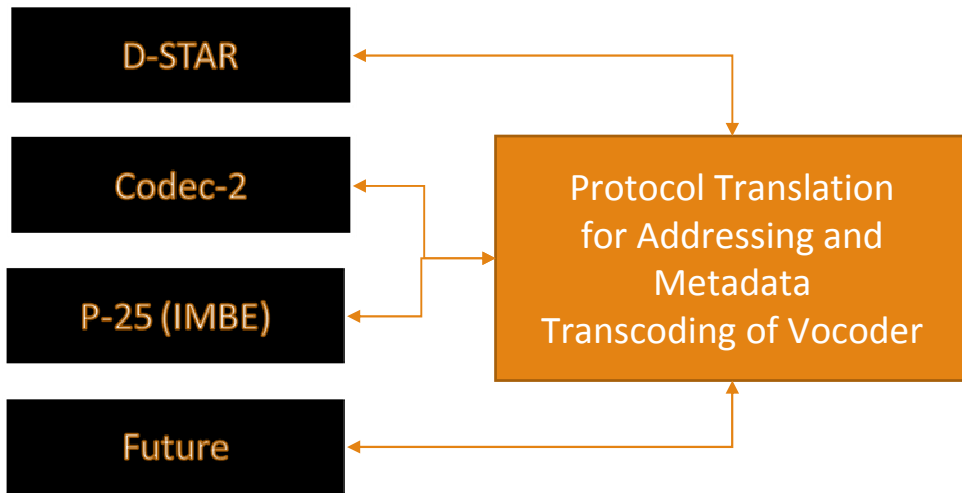
Conferencing (Reflectors, Rooms, ...)

- Same System
 - Use “native” protocols
- Cross System (e.g. DMR <-> D-STAR, ...)
 - Conference / Talk Group per protocol/encoding
 - Bridge Conference / TG between technologies
 - “Bridge Makes Right”
 - Vocoder/Codec to Vocoder/Codec translation (direct)
 - Translate transport / addressing /routing

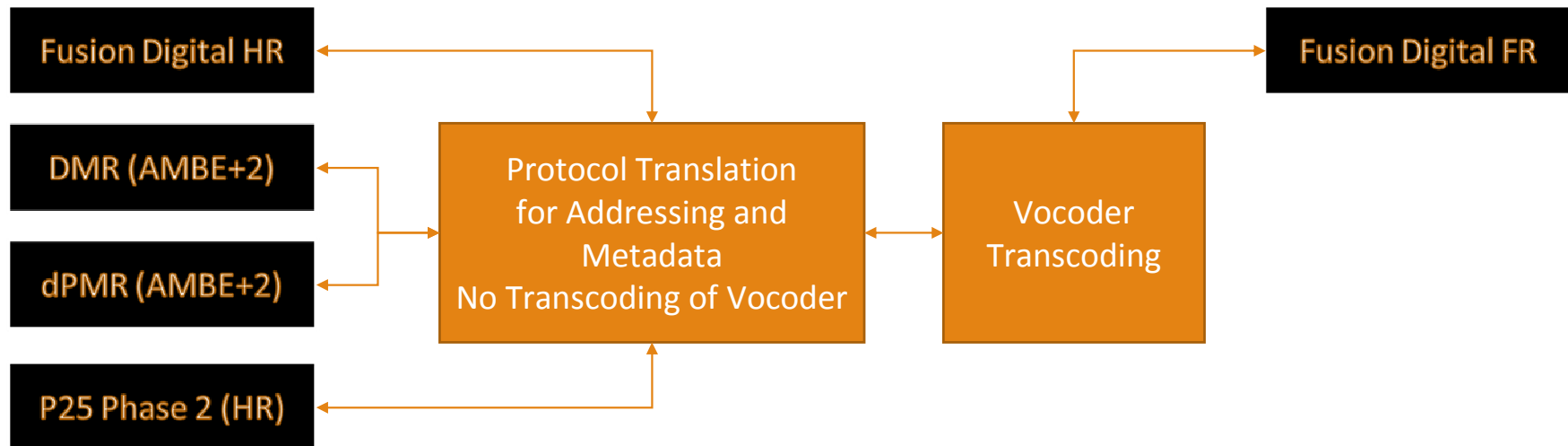
Analog over Digital Transport



Digital Voice Modes – Non AMBE+2



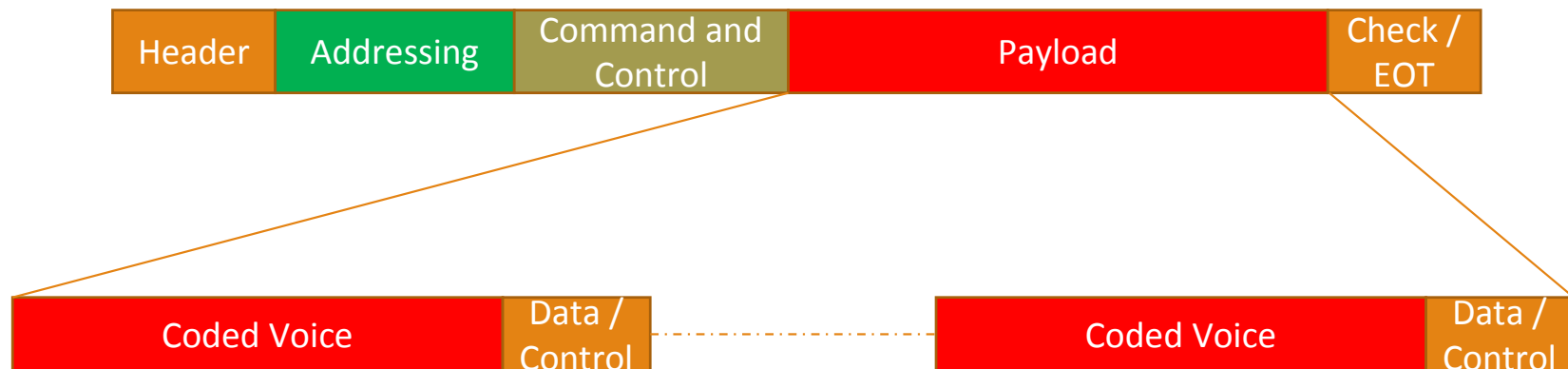
Digital Voice Modes – AMBE+2



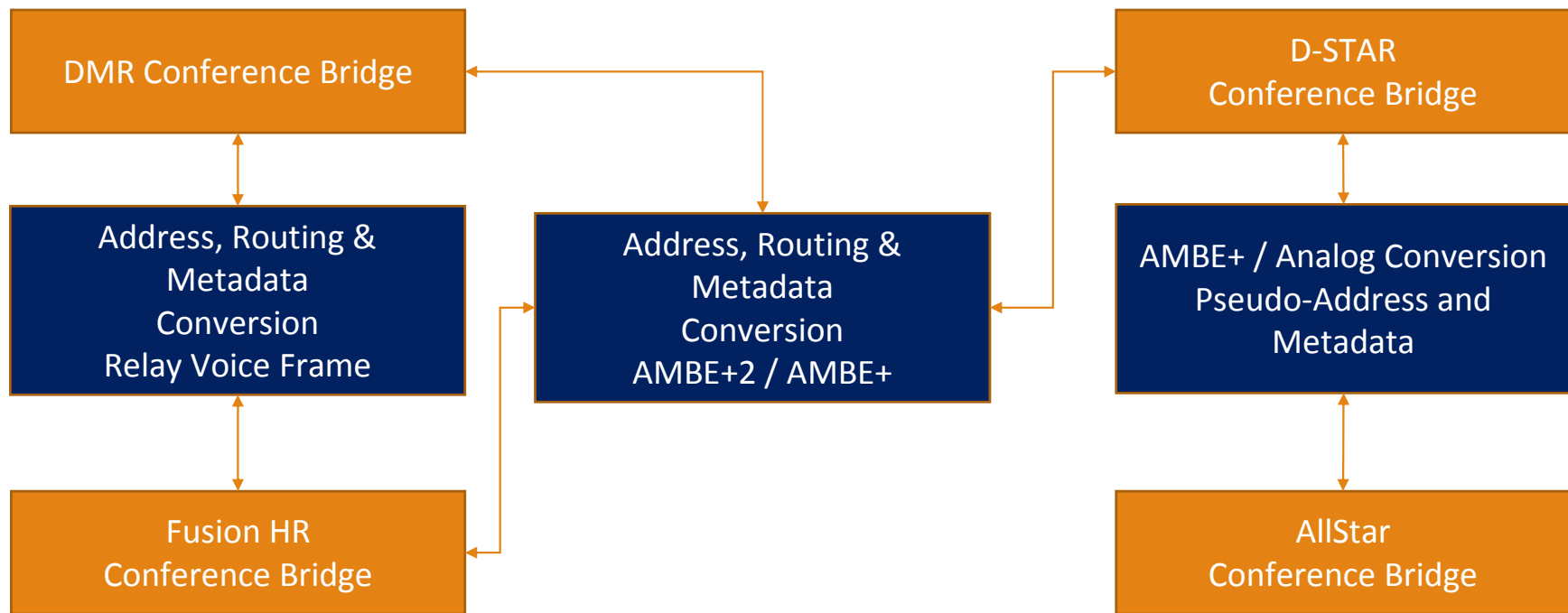
Remember Me?

Generic Digital Voice Transmission Unit

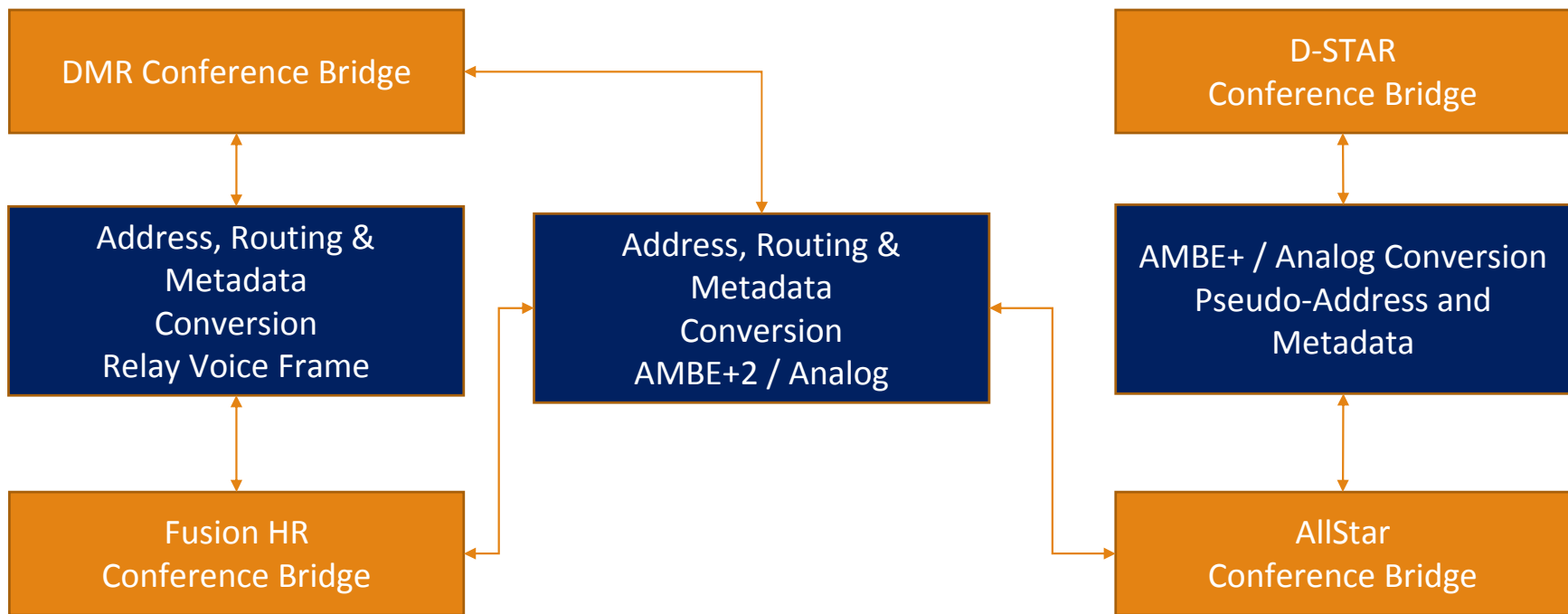
Each one of the Digital Voice protocols are a variation of this --



The task is to bring both voice and associated Metadata from One System to Another



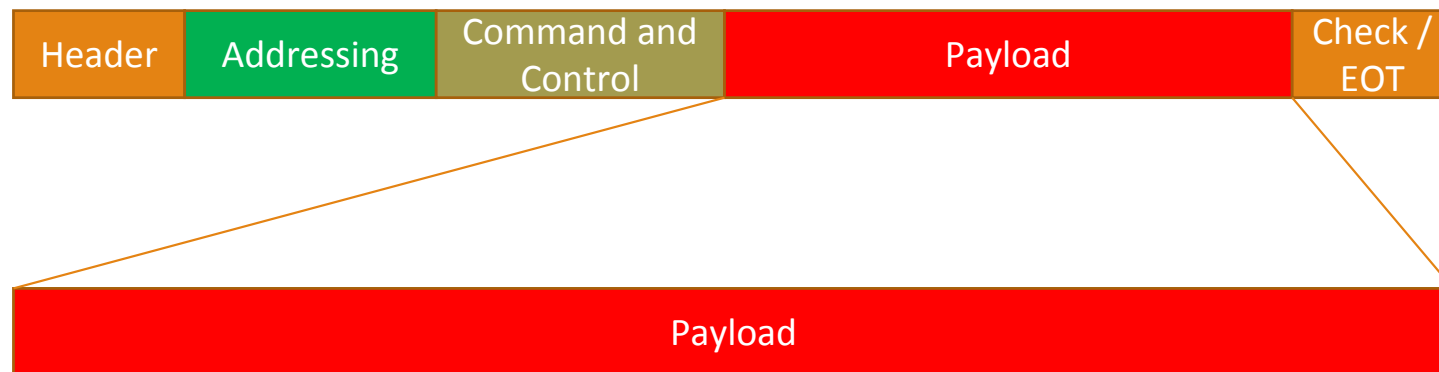
The task is to bring both voice and associated Metadata from One System to Another



What About Me?

Generic “Data” Transmission Unit

It's all 'Data' and for the user It's all about the Payload...
... the network and protocol is for the experimenter and implementer



Digital Data Transmission Unit

- Everything outside the payload is for the “network” including “point-to-point” communications.
- The payload can be anything that can be represented by 1’s and 0’s
 - Voice
 - Image
 - Files and Data
 - Command and Control
 - Metadata and Telemetry
 - Or all of the above and more
- The network may transverse multiple protocols and mediums (IP, AX.25, Fusion, D-STAR, ...)
 - Preserve the original payload and deliver it to the right destination
 - “Any transport in a storm...”

Moving Forward

- We need to work together to develop standards and to interfaces
- Encourage developers and innovative amateurs to explore new and better technologies
 - Media / Transport / Signaling
 - Protocol specifications and interfaces
 - Applications
- Work at what you best understand, enlist others to build where their skills are better
 - Rare that a good low level protocol, network, or DSP engineer is also a great User Experience Designer
- Prototypes should use cross platform technologies.
 - Where possible, use Web-Based interfaces to humans.
 - Use good encapsulation of objects via transport notation (e.g. JSON)

Moving Forward

- Look for vendors that provide good APIs and Documentation
 - “Lock in” solutions don’t expand Amateur Radio knowledge and innovation
 - Reward those vendors who deliver high-quality and value in their products
- Use organizations to create standards – TAPR, ARETF, ...
 - Then implement them

One of My Projects - UDRC

- Obtained a new, good, and low cost repeater platform (VHF and UHF) from Yaesu – DR-1X
 - Natively runs Analog FM and Fusion Digital
 - Added external components to make it run D-STAR Digital Voice
 - Combined all 3 on a single repeater
 - On further examination such a platform could support additional systems
- Designing the UDRC
 - A small Raspberry Pi “Hat”
 - Raspberry Pi and UDRC combine to provide a repeater controller that supports both current and future narrow band communications for both voice and data.
 - Built with a high sample rate chip for ADC and DAC, with DSP for various modems
 - Low cost and easy connection



Questions?



Contact Info