Network Data Recorder

Chapters 22-26 and Chapters 9-11

Discussions and a look toward 2019

Telemetry Network Standards

Standards implement a layer architecture approach through using an Open Systems Interconnection (OSI) model where information moves through the OSI stack from a communication layer to the complementary communication layer on the receiving side

1. Chapter 21: Telemetry Network Standards Introduction
   - Introduces fundamental concepts and terminology used in the chapters
   - Provides guidance or framework for other chapters
2. Chapter 22: Network-Based Protocol Suite
   - Identifies existing Internet Protocols which serve as the core set of communication protocols
   - Large portion of the TCP/IP Protocol Suite plus other supporting technologies
3. Chapter 23: Metadata Configuration
   - Describes system configuration data for TmNS-based systems
   - Provides the means for describing the configuration of the components in a telemetry system, as well as their logical and physical interrelationships in a common fashion
   - Defines a language, the Metadata Description Language (MDL)
   - MDL provides a common exchange language that facilitates the interchange of configuration information between telemetry system components
4. Chapter 24: Message Formats
   - Describes the message formats of TmNS-specifc messaging

Telemetry Network Standards

1. Chapter 25: Management Resources
   - Defines Management Resources as resources that contain application-specific data accessible via an application layer protocol
   - Provides the details concerning the standardized application resources
2. Chapter 26: TmNS Data Message Transfer Protocol
   - Defines how TmNS-specific messages (TmNS Data Messages) are transferred between TmNS Applications
3. Chapter 27: RF Network Access Layer
   - Defines the standard for managing the physical layer of RF links with the RF Network
4. Chapter 28: RF Network Management
   - Defines the mechanisms and processes for managing RF links within the RF Network

Discussion Categories

1. Configuration, Command, Control, and Status
2. Message Data Formats
3. Metadata
4. Real-time and Post Test Processing
5. Hardware – Interface, Performance, and Environmental
6. Cybersecurity
7. eQDR
8. Transfer File Formats

1. Configuration, Command, Control, & Status

1. Discussion points
   - How are networks and devices on the network identified and configured?
   - How are “non-native” devices handled?
   - What is a “non-native” device?
2. Telemetry Network Standard Devices
   - Systems Management Resources and Systems Management software.
     - SNMP for control and status
     - MDL for configuration
     - Can be utilized anytime (preflight, execution, post)
   - System uses secure communications
   - Non-Native devices can be proxied and be detected via scans
     - Custom proxies can be used for legacy devices
3. Chapter 10 Recorder
   - TMATS for configuration either pre-flight or real-time via CH6 commands
   - CH6 “dot commands” for real-time control and status
   - Unofficially, vendors support all flavors of standard Networking protocols for TMATS and CH6 commands
   - Discretes are still available but used less and less

2. Message Data Formats

1.Discussion points

- How to decode data?
- How are new data types (formats) added?
- How is data transported?

2.Telemetry Network Standard Devices

- TmNS data messages include header information
  - Timing, Sources, Contents, Size, etc.
- Data is decoded via MDL
- Data is created and described ON THE FLY with “well known” formats as first class citizens
  - MDL flexibility limits the need for proprietary solutions
- Data is transported via TCP and UDP with included metadata
  - Timing, Contents, Priorities, Latency, etc.
- Data can be retrieved in real-time
  - Read data while recording

2. Message Data Formats (Continued)

1.Chapter 10 Recorder

- CH11 (Formally CH10) Data types are (mostly) fully self documenting
  - TMATS, Header Word
- New data types are defined via a formal Committee Process (CR)
  - “SPEED OF GOVERNMENT”
  - Minimizes ambiguities, Limits proprietary solutions
- There is a provision for “V-Specs” – Vendor Spec
  - Not encouraged. But popular
- Some recorders have real-time read-while-write capability
  - “Could” be leveraged to perform real-time “TM Dropout” functions
- Data is transported via various methods
  - UDP, TCP, CH7, native streams

3. Metadata

1.Discussion points

- How is data described/decoded?
- Predefined or Meta-Described
- Is it Extensible?
- How are files created?

2.Telemetry Network Standard

- MDL is used to describe data
- MDL is extensible and interoperable
- MDL syntax defines vocabulary and sentence structure, while the MDL semantics provide meaning
- Well known formats are recognized
- Temporary extensions can be used and/or prompted to first class citizens
- System Manager application is used for authoring MDL files

3. Metadata (Continued)

1.Chapter 10 Recorder

- ZERO extensibility by DESIGN
  - Fully Interoperable vs Fully Extensible – PICK ONE AND ONLY ONE…
- All data types are first class citizens.
  - Even V-Specs, sadly
- The Metadata is contained mostly in the data type header.
  - Some Metadata is defined in TMATS
  - Metadata and Acquisition data are tightly coupled
- Generation of TMATS Files
  - Externally generated then uploaded to recorder
  - By the recorder as record button is pressed
- TMATS. Two flavors
  - Traditional ASCII Based
    - 100% supported
    - Mostly interoperable
  - Modern XML Based
    - << 1% supported
    - “Should Be” the path forward……should be…..someday

4. Real-time and Post Test Processing

1. Discussion points
   - How extensive?
   - What level of Interoperability?
2. Telemetry Network Standard Data Processing
   - Currently supported by MCS at Edwards
   - In work to be supported by RTPS V at Pax River
   - Vendor's are independently developing their own systems
   - Some level of interoperability has been demonstrated at iSIL and various vendors
   - System provides the ability to request only the data of interest
3. Chapter 11 Data Processing
   - Real-time processing of CH10 UDP streaming has been operational from numerous vendors for some time. This is a very MATURE technology.
   - Real-time processing of CH7 streaming is in early development

5. Hardware – Interface, Performance, & Environmental

1.Discussion points

- How are “interfaces” standardized?
- How are Environmental and Performance requirements controlled?

2.Telemetry Network Standard Devices

- Physical and logical interfaces are standardized
- Environmental requirements are left to procurement specifications

3.Chapter 10 Recorder

- HW I/O Interfaces are standardized
- SW protocols are standardized
- Environmental and Performance requirements are left to procurement specifications

6. Cybersecurity

1. Discussion points
   - Authentication, Authorization?
   - Access Controls, Segmentation?
   - Documentation?
2. Telemetry Network Standard Devices
   - Provides for secure communications
     - System utilizes type I & type III Encryption
   - Flight Tested
3. Chapter 10 Recorder
   - TCP and UDP streaming, C&C are currently WIDE OPEN
     - OUR BAD!!!
   - CH7 uses existing, fielded, authorized, certified hardware.
     - ZERO infrastructure changes or cost
   - TMATS has fields for documenting security

eQDR

1. Used as a part of the Demonstration Flight Test (DFT) at Edwards
2. Developed by Laulima Government Systems
3. Software – based
   - Windows
   - Raspbian (Raspberry Pi)
   - Red Hat Enterprise Linux 7
   - MySQL / java / apache tomcat
4. Intel Mobile i7 620 @ 2.0 GHz, 4GB RAM, OCZ Vertex 3 SSD (20,000 IOPS random 4k read, 60,000 IOPS random 4k write) the EQDR can record 480 Mbits/sec of data while keeping the CPU utilization between 45% and 50%
5. Intel Core i7-4770K CPU @ 3.5 GHz, 16GB RAM,Samsung 840 pro SSD (100,000 IOPS random read, 90,000 IOPS random write) the EQDR can record 600 Mbits/sec of data while keeping the CPU utilization between 13% and 15%

Network File Transfer Format

1. New RCC task in the proposal phase
2. Will seek to define / adopt a format for the exchange of recorded network packets
3. PCAP not sufficient for large volumes of data
4. HDF5-HL Packet Table
   - Originally developed in 2005 as a joint project between Boeing and NCSA
   - May not be sufficient for “Big Data” quantities of data
5. CMU paper on collection and storage of network traffic data
   - Cloud storage
   - File-based storage
   - Database storage

Questions?