Telemetry Network Standards (TmNS)

Scheduled for Release in 2017

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Standardization Process

• Standards for telemetry networks
  • Included stakeholders:
    • users, vendors, designers, military, commercial
  • Standards cover a wide variety of options

• TmNS encompasses 8 chapters
  • Chapters 21-28 of IRIG 106
  • Pink sheets distributed to members/community to provide comments and feedback
    • Feedback has been mitigated and incorporated
    • Formally released in IRIG-106-17

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
Core TmNS Technologies and TmNS-Specific Protocols

TCP/IP Model
- Application Layer
  - HTTP
  - FTP
  - SNMP
  - DNS
  - PTP
  - RTSP
  - TLS
  - RTP
  - SIP
- Transport Layer
  - TCP
  - UDP
- Internet Layer
  - ARP
  - IGMP
  - ICMP
  - NDP
  - MLD
  - ICMPv6
  - IPv4
  - DiffServ
  - IPv6
  - DiffServ
- Network Access Layer
  - Ethernet
  - Wireless Technologies

TCP/IP Protocol Suite Major Components

TmNS-Specific Protocols
- Client / Server Apps
- Data Transfer Apps
- Radio Access Network Apps
- MDL Instance Document
- TmNS Messages
- Data Channel Protocols
- RF Network Messages
- Management Resources
- Data Channel Protocols
- RF Net Mgmt Protocols

No TmNS-Specific Transport Layer Protocols

No TmNS-Specific Internet Layer Protocols

RF Link Layer

RF Physical Layer

* Badge number indicates the IRIG 106 chapter that contains information on the associated topic.
Telemetry Network Standard’s

• Chapter 21: Telemetry Network Standards Introduction
  • Introduces fundamental concepts and terminology used in the chapters
  • Provides guidance or framework for other chapters

• 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

• 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
  • MDL syntax defines vocabulary and sentence structure, while the MDL semantics
    provide meaning

• Chapter 24: Message Formats
  • Describes the message formats of TmNS-specific messaging
Telemetry Network Standard’s

- 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

- Chapter 26: TmNS Data Message Transfer Protocol
  - Defines how TmNS-specific messages (TmNS Data Messages) are transferred between TmNS Applications

- Chapter 27: RF Network Access Layer
  - Defines the standard for managing the physical layer of RF links with the RF Network

- Chapter 28: RF Network Management
  - Defines the mechanisms and processes for managing RF links within the RF Network
Standardization-Wide Decisions

• TmNS builds upon an IP network
  • Chosen based on the success of the IETF hourglass
  • Flight test should be a seamless part of the overall range network
• Ample pre-existing tools and libraries for management are available
• Standardized dynamic routing utilized
• Reliable peer-to-peer communication, point to multi-point transmission (multicast/unicast), and broadcast are supported
• Standardized Quality of Service (QoS) via DiffServ
System Management Technology Picture

- Range Users
- Range Applications
- Range Policies

Users ➔ System Management Capabilities ➔ Supporting Technologies ➔ TmNS Components

The colors of the boxes convey a mapping between system management capabilities and the technologies that support them.

Some supporting technologies can be used for several of the capabilities.
TmNS Configuration Negotiation Protocol Diagram

**Describe Measured Parameters**
- Create & store measurements
- Create & store transducers

**mNSAppManager**

**Acquire DAU Inventory**
- Send inventory MDL request
- Retrieve Inventory MDL from HTTP message <body>

**MDL**
- <TmNSDAU>
- <TmNSAU>

**Apply Measured Parameters**
- Bind measurements to ports
- Create MDL & PortMappings

**Validate DAU MDL**
- Send configuration MDL in HTTP message <body>

**Vendor Specific UI**
- HTTP Client
- index.html

**MDL**
- <Measurements>
- <Network>
- <NetworkNode>
- <TmNSDAU>
- <Device>
- <PortMappings>

**MDL**
- Retrieve configuration MDL from HTTP message <body>

**DAU NetworkNode (actual or emulated)**

**DAU NetworkNode (actual)**

**Configure DAU**

**Export DAU Configuration**

**Export DAU Inventory**
- Create inventory MDL
- On success, send 200 OK with inventory MDL in the HTTP message <body>
- On error, send 4xx or 5xx status

**Validate Configuration MDL**
- Retrieve configuration MDL from HTTP message <body>
- Validate MDL for vendor specifics

**HTTP Server**
- Serve vendor specific UI
- Retrieve vendor configuration
- Compile if needed (for validation only)
- Store configuration MDL

**MDL**
- Set configurationURL configure
- MDL
- <NetworkNode>
- <TmNSDAU>
- <Module>
- <Device>
- <PortMappings>

**HTTP GET**
- configurationURL configure

**HTTP PUT**
- configurationExportURL exportConfiguration

5/10/2017

IRIG-106-17
TmNS Messages and Delivery Methods

Latency Time Critical (LTC)

Reliability Critical (RC)

Figure 24-3. TmNSMessage Structure

Figure 26-1. Unicast DataChannel

Figure 26-2. Multicast or Broadcast DataChannel

Figure 26-3. Request-Defined Data Channel

TCP

UDP

5/10/2017
Some Categories of Capabilities

• Configuration, Command, Control, & Status
  • Systems Management Resources and Software
    • SNMP for control and status
    • Hooks for Restful
    • MDL for configuration
    • Can be utilized anytime (preflight, execution, post)
  • Provides secure communications
  • Non-Native devices can be proxied and be detected via scans
    • Custom proxies can be used for legacy devices

• Message Data Formats
  • 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
    • 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
Some Categories of Capabilities

• **Metadata Configuration**
  • MDL is used to describe data
  • MDL is extensible and interoperable
    • Well known formats are recognized
    • Provides temporary extensions as needed
  • Manager applications are used for creating MDL files

• **Real-time and Post Test Processing**
  • Provides the ability to request only the data of interest
    • Currently supported by MCS
    • In work to be supported by RTPS V
  • MDL is used to decode the data

• **Spectrum Efficiency/Sharing**
  • Provides the means to access **all** data on demand
    • Direct access to data sources
  • Provides means to manage resources
    • Divides up network capacity among resources
LDPC Code Block Encapsulation of IP Packet

IP Packets

MSDU Blocks

RF MAC Frame (512 bytes)

RF Burst

Optional AES Encryption

N configurable
N=1 ... 16

2 bits (zeros)
RF Multicast Diagram
A2A Handoff with Multicast RF

Radio ID: 1
Transmits to: MULTICAST GROUP 1
Listens to: MULTICAST GROUP 2

Radio ID: 2
Transmits to: MULTICAST GROUP 2
Listens to: MULTICAST GROUP 1

Radio ID: 3
Transmits to: NOT CURRENTLY ACTIVE
Listens to: MULTICAST GROUP 2

Ethernet Receive Source 1
Ethernet Receive Source 2

Link Management Selection Process

Radio ID 1 is selected for Transmit Prior to Handover
Radio ID 3 is selected for Transmit After Handover

Directed Broadcast
Wide Range Broadcast

Gnd Radio Stats

Ethernet Transmit Source
Example TmNS-Based System