Overview of the current CCSDS Program of Work

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Some Of The Groups Working in Space Standardization

- **CCSDS**: open international standards for space mission interoperability
- **OMG**: industry standards for exchange of application information among vendor products
- **IRTF**: open international standards for Disruption Tolerant Networking (DTN)
- **ECSS**: European regional standards for space missions
- **AIAA**: North American regional standards for space missions
International Space Standards

ISO: International Organization for Standardization

Technical Committee 20 (ISO/TC20): Aircraft and Space Vehicles
(Secretariat: U.S. Aero. Industries Assoc.)

(Secretariat: AIAA)

Subcommittee 13 (ISO/TC20/SC13): Space Data and Information Transfer Systems
(Secretariat: NASA)

- Space Debris
- Interfaces, Integration & Test
- Operations & Ground Support
- Design Engineering & Production
- Environment (natural & induced)
- Program Management
- Materials and Processes
- Systems Engineering
- Space Link Services
- Space Internetworking Services
- Cross Support Services
- Mission Operations & Info. Management
- Spacecraft Onboard Interface Services

Other TCs
Consultative Committee for Space Data Systems (CCSDS)

http://www.ccsds.org
CCSDS Technical Context: Six Focus Areas

- Spacecraft Onboard Interface Services
- Space Internetworking Services
- Mission Operations and Information Management Services
- Systems Engineering
- Cross Support Services

Space Link Services
Current CCSDS Technical Program of Work: 25 Standards under development

- Systems Architecture
- Security Architecture
- Information Architecture
- Space Assigned Numbers
- Onboard LANs
- Onboard Apps.
- RF & Modulation
- LDPC Coding
- Data Compression
- Space Link Protocols
- Telecommand Coding
- Ranging
- Proximity links
- High Rate Uplink
- CFDP
- Asynch. Messaging
- Cislunar Internet
- IP-over-CCSDS Links
- Data Archive Ingest
- Info. Pack. & Registries
- Navigation
- Spacecraft Control
- Cross Support Service Mgmt
- Cross Support Transfer Services
End-to-end Internetworked Space Applications

- Internet-based ground mission operations systems
- Long delay near-Earth and deep space links
- Short delay proximity links
- in-situ surface links
- Spacecraft buses and LANS

Terrestrial Internet
Long-Haul Space Backbone
Short-Haul Proximity Operations
Surface Operations
Spacecraft Onboard Operations
Why SLE?

• “SLE” was not a new architectural capability that was introduced by CCSDS; it responded to a legacy space mission culture:
  ➢ Namely, to keep ground stations “relatively dumb” and to focus mission-unique capability in the control center
    - It caters to the desires of projects to have “both ends of the space link” directly under their control
    - It supports an architecture whereby the control center become the “secure gateway” between the outside world and the space systems

• So “SLE” was initially designed to allow the space link to be “extended” beyond the ground station (by “tunneling” across the ground communications network) and terminated centrally. SLE simply standardized this dialog

• “SLE” is now being generalized to handle many types of ground station (service provider) ↔ control center (service user) information interchanges, including the management of the service provider/user interface
CROSS SUPPORT TRANSFER SERVICE MODEL

Service User

Major Cross Support Interface

Service Provider

Agency A

Agency B

Space Link Data

Service Management

Space Link Service User

Service

Space Link Service Provider

Ancillary Data

Cross Support Service

Local Communications Technology

(Gateway)

Local Communications Technology

RAF
RCF
RAD
FSP
CLTU
Radio Metric etc.

CROSS SUPPORT TRANSFER SERVICE MODEL
For space/ground data transfer, “SLE” responds to a significant architectural issue.

**OPTION 1:**
- Terminate space Link at every ground station.
- Users interface with ground stations at Network layer (“IP”).

**OPTION 2:**
- Terminate space Link centrally at a control center gateway.
- Users interface with control center at Network layer (“IP”).

The diagram illustrates the network layers and the concept of space link “tunnels” across the ground network inside SLE (Space Link Environment).
Networking Services?

CCSDS Packet

CCSDS Long-haul Link

CCSDS Space Link Extension (SLE)

TCP, UDP

IPSEC

IP

Local Terrestrial Link

Onboard bus or LAN

Local Terrestrial Wired

Surface wired/wireless

CCSDS Long-Haul Link and Coding

CCSDS Proximity Link and Coding

CCSDS S, X, Ka Band

CCSDS UHF

Onboard wired/wireless
Onboard Services

SOIS Service Architecture

User Applications

Application Support Layer
- Cmd & Data Acquisition Services
- Time Access Service
- File Services
- Message Transfer Service

Transfer Layer
- Transport Protocol
- Network Protocol

Network Management Services
- Packet Transfer Service
- Get/Set Service
- Memory Access Service
- Time Distribution Service
- Device Discovery Service
- Test Service

Sub-Network Layer
- Generic Data Link Convergence Sublayer

Data Link Layer
- Ethernet
- SpaceWire
- IEEE1394
- CAN
- 1553
- IEEE-802.11
- USB
- ONE Wire

Plug and Play Services

- Device Enumeration Service

Denotes service access point
Next Generation CCSDS Wireless Standards?

CCSDS Short Haul Radio Links:
- Proximity-1

CCSDS Long Haul Radio Links:
- TM
- TC
- AOS

Are new CCSDS 802-series based wireless standards needed for:
- Surface <-> surface comm.?
- Relay <-> surface comm.?
- Intra-vehicle comm. (onboard)?
- Inter-vehicle comm. (offboard)?

Adopt -> Adapt -> Develop
• **New networked architectures:**
  • NASA Space Communications Architecture
    - Lunar relays and surface communications
    - Mars relays and surface communications
    - Plug-and-Play spacecraft
    - Software defined communications terminals
    - Ground network consolidation, arraying
  • NASA Exploration initiative
    - Cislunar internetworking

• **New networking protocols:**
  • CFDP build-up
  • AMS
  • DTN
  • LTP
  • Onboard wired buses and LANs
  • Onboard, proximity and surface wireless