CCSDS Reorganization & Status Report

10 September 2003
Peter Shames
Agenda

• Introduction to CCSDS
  – Just why do we need standards

• Reorganization
  – Motivation
  – Status

• CCSDS Standardization Efforts

• Relationship to Other Organizations
  – OMG and others
INTERPLANETARY NETWORK DIRECTORATE

Rationale
(or, Why do we need standards?)

• Cross-support
  – Ground assets (e.g. DSN)
  – Space assets (e.g. Mars relay)

• Interoperability
  – Multi-agency support agreements
  – Multi-mission support arrangements

• Reduce costs
  – Shared (expensive, scarce) resources
  – S/W and H/W reuse
  – Commercial implementations

• Increase reliability / reduce risks
  – Through use of well tested local and commercial implementations
Enterprise View
Complex Organizational Relationships

Agency ABC
- Mission A
- GTN B
- Prog C

Mars Exploration Program Federation
- Mission Q
- Proj R
- Prog S

Agency QRS

Enterprise Concerns:
- Objectives
- Roles
- Policies
- Activities
- Configuration
- Contracts
- Lifecycle / Phases

Mission BFD Development & Operations Domain
- Company XYZ
- Organization PDQ

Cross-Support Agreement

JPL Standards Program

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Future Mission Drivers

• INCREASED SPACE SEGMENT CAPABILITIES
  – More miniaturization, more missions, more bang for the buck
  – Higher date rates, more powerful onboard processing
  – Constellations and Formation Flying
    • Inter Spacecraft Communications
    • Positioning Relative to Each Other
  – Autonomous Exploration
    • Less reliance on “Joystick Operations.”
    • Dynamic Response to Environment (Precision EDL, Rendezvous & Docking)
  – Highly networked
    • Re-configurable web of orbiting and landed sensors for in-situ, long-term and detailed observation, prediction and analysis.

• HIGHLY DISTRIBUTED MULTI-ORGANIZATION DESIGN AND OPERATIONS TEAMS
## Member Agencies

<table>
<thead>
<tr>
<th>ASI/Italy</th>
<th>ESA/Europe</th>
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<tbody>
<tr>
<td>BNSC/UK</td>
<td>INPE/Brazil</td>
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<tr>
<td>CNES/France</td>
<td>NASA/USA</td>
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<td>CSA/Canada</td>
<td>NASDA/Japan</td>
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<td>DLR/Germany</td>
<td>RSA/Russia</td>
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## Observer Agencies

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<tr>
<th>ASA/Austria</th>
<th>CTA/Brazil</th>
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<td>CRC/Canada</td>
<td>EUMETSAT/Europe</td>
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<td>KFKI/Hungary</td>
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<td>MOC/Israel</td>
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Motivation for Reorganization

- Better alignment with customers
  - Recognition of more complex mission set
  - Future mission drivers

- Align organization with work in new areas
  - Flight and ground elements
  - Internetworking and space links
  - Application level services
  - End to end system engineering

- Desire for more streamlined organization processes
  - Improved flow and visibility
  - Patterned after IETF processes
  - New mechanisms for creating new work items
## New CCSDS Areas & Chairs

<table>
<thead>
<tr>
<th>Area</th>
<th>Working Group or BOF</th>
<th>Chair</th>
<th>Deputy</th>
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<tbody>
<tr>
<td><strong>Systems Engineering</strong></td>
<td>Systems Architecture WG</td>
<td>Yamada</td>
<td>Soerensen</td>
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<td>AD: Shames, NASA</td>
<td>Information Architecture WG</td>
<td>Crichton</td>
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<td>DAD: Yamada, ISAS</td>
<td>Security WG</td>
<td>Weiss</td>
<td>Kenny</td>
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<td><strong>Mission Ops. &amp; Info. Management Services</strong></td>
<td>Data Archive Ingestion WG</td>
<td>Sawyer</td>
<td>Huc</td>
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<td>AD: Peccia, ESA</td>
<td>Navigation WG</td>
<td>Flores</td>
<td>Pallaschke</td>
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<td>Info. Packaging &amp; Registries WG</td>
<td>Reich</td>
<td>Hughes</td>
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<td><strong>Cross Support Services</strong></td>
<td>Cross Suppt. Concept &amp; Ref. Model WG</td>
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<td>AD: Brosi, NASA</td>
<td>Data Transfer Services WG</td>
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<td>Service Management WG</td>
<td>Pietras</td>
<td>Barkley</td>
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<td>Onboard Bus + LAN WG</td>
<td>Schnurr</td>
<td>Plummer</td>
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<td>AD: Plancke, ESA</td>
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<td>DAD: Plummer, ESA</td>
<td>Time Critical Onboard Applications WG</td>
<td>Smith</td>
<td>Fowell</td>
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<td>RF &amp; Modulation WG</td>
<td>Vassallo</td>
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<td>AD: Gerner, ESA</td>
<td>Space Link Coding and Synchron. WG</td>
<td>Calzolari</td>
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<td>DAD: Moury, CNES</td>
<td>Data Compression WG</td>
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<td>Carper</td>
<td>Ciccone</td>
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<td>DAD: Stanton, BNSC</td>
<td>Next Gen. Space Internet. WG</td>
<td>Scott</td>
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**CCSDS Engineering Steering Group**

Chair: Hooke, NASA

Deputy Chair: Peccia, ESA

20 June 2003
A Physical View of a Space Data System

One or More Instruments

One or More Spacecraft

Commodity Space Communication Systems
Commodity Space Navigation Systems

A Space Tracking Network

A Spacecraft Control Center

A Ground Tracking Network

A Science Facility

Source: A. Hooke, NASA/JPL
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CCSDS and OMG

- Active liaison relationship from inception
  - CCSDS supported creation of Space DTF
  - Assumption that commercial products would appear

- Loose agreements about working relationships
  - Assumption that CCSDS standards would be adopted where they existed

- General lack of overlap of work items
  - Space DTF focus on applications and ground services
  - CCSDS focus on communications and related standards

- Processes appear rather different
  - OMG has commercial organizations and product focus
  - CCSDS has civil space agencies and standardization focus

- Issue of limited resources and how to allocate them
  - To be discussed ...
The CCSDS is a well established organization with broad participation from the international space agencies and their supporting organizations.

There are emerging requirements for new standards and work to meet them has been identified.

CCSDS and its member agencies have supported the work that has been done in the OMG Space DTF.
- We will examine the current proposed standards to see if they can be adopted as is or if they need to be adapted for our use.

The jury is still out on whether the Space DTF experiment has been a success.
- The hoped for "commercial snowball" has yet to materialize.
- Perhaps the delivery of this first OMG standard will provide the needed nucleation point for this to materialize.
Backup Slides
Number of CCSDS missions relative to total *
number of missions launched per year

- Total Missions
- CCSDS Missions

CCSDS
Market Share
Metrics

Number of NASA CCSDS missions relative to
number of CCSDS missions launched per year

- NASA
- Total

* "Total missions" are all known worldwide space missions (civil, military, commercial, military).

Source, e.g., Jonathan's master list of launches and payloads:
"Pedigree" of Standards

- Agreed by all ten major space agencies and the 23 observer space agencies

- Supported by an active organization and endorsed as NASA preferred and ISO standards

- Implemented by:
  - DSN
  - AMMOS S/W
  - Many commercial products and S/C vendors, see http://ccsds.gst.com/implementations/products.html

- Used by more than 268 space missions

See http://www.ccsds.org
Describes communication stack layers in terms of services provided to the layer above, services required from the layer below, and functions and protocols within the layer that provide the capabilities within the layer. This abstracts the layers, so as to allow each layer to be independent of the specific design of the other layers.
Intro to Core Data Transfer Protocols

- Physical & Link Layers
  - Frequency and modulation
  - Coding gain
  - Logical link between entities
  - Accounting at the link layer

- Packet Layer
  - Merging data onto the link
  - Separation and prioritization of multiple data sources
  - Accounting by data source

- File Delivery Layer
  - Support for file oriented uplink, downlink and onboard file handling
  - Reliable file transfer across proximate & deep space links
FUNCTIONS

- Generate Source Packets
- Multiplex Source Packets into transfer Frames of Virtual Channels
- Apply Coding and modulate RF
- Demultiplex Virtual Channels
- Demultiplex Packets
- Distribute Packets to one or more Sink Processes

DATA UNITS

- Source Packets
- Transfer Frames
- Synchronous Stream of Transfer Frames
- RF Link
- Synchronous Stream of Transfer Frames
- Transfer Frames
- Source Packets
- Source Packets
NOTE: The data field of each CLTU contains the encoded representation of one or more transfer frames.