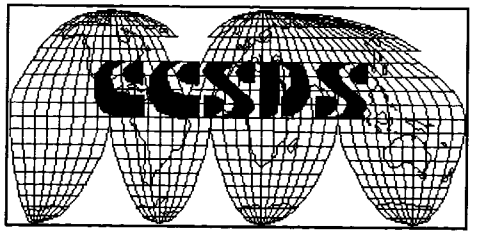
Interplanetary Network Directorate

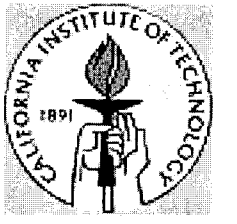
JPL

CCSDS Reorganization & Status Report

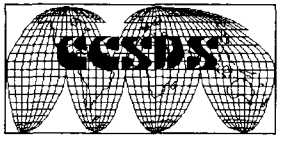


10 September 2003

Peter Shames



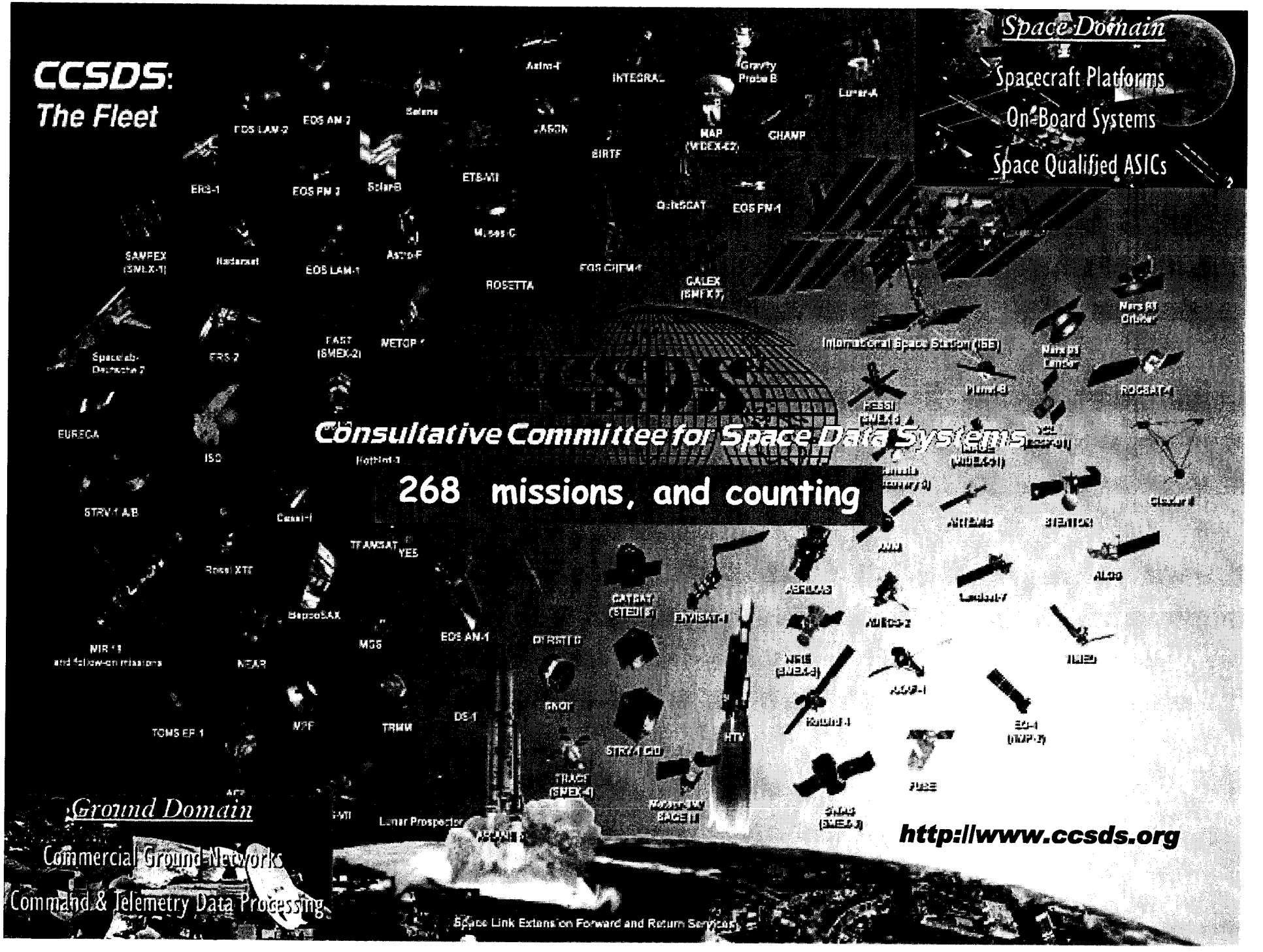
Agenda



- **Introduction to CCSDS**
  - Just why do we need standards
- **Reorganization**
  - Motivation
  - Status
- **CCSDS Standardization Efforts**
- **Relationship to Other Organizations**
  - OMG and others

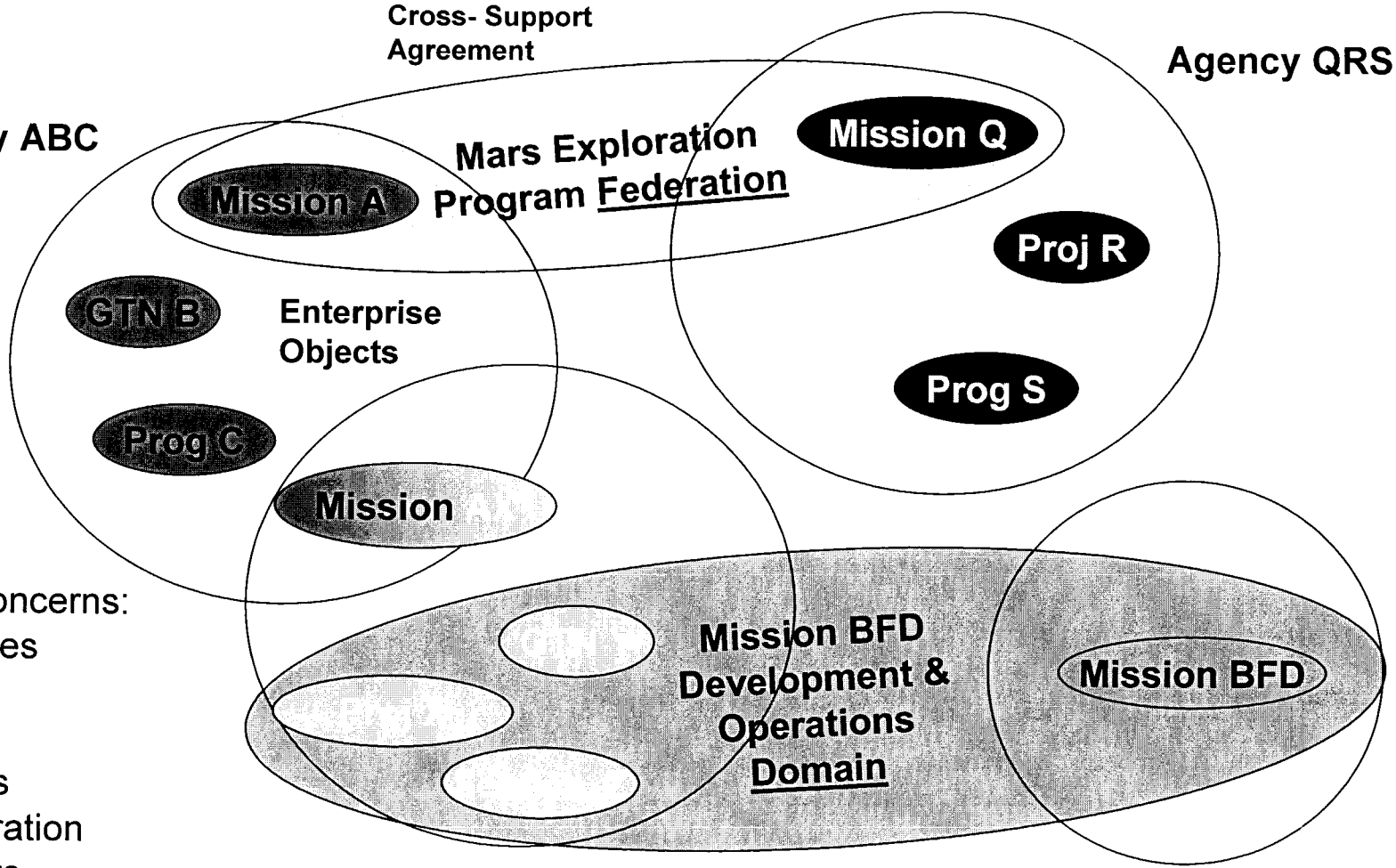
Rationale
(or, Why do we need standards?)

- **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


CCSDS:
The Fleet
Space Domain
Spacecraft Platforms
On-Board Systems
Space Qualified ASICs
Consultative Committee for Space Data Systems
268 missions, and counting
Ground Domain
Commercial Ground Networks
Command & Telemetry Data Processing
Space Link Extension Forward and Return Services
http://www.ccsds.org

Enterprise View

Complex Organizational Relationships



Enterprise Concerns:

- Objectives
- Roles
- Policies
- Activities
- Configuration
- Contracts
- Lifecycle / Phases

Future Mission Drivers

- **INCREASED SPACE SEGMENT CAPBILITIES**
  - 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**

CCSDS Member Space Agencies

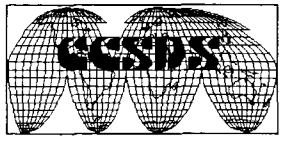
Member Agencies

ASI/Italy
BNSC/UK
CNES/France
CSA/Canada
DLR/Germany
ESA/Europe
INPE/Brazil
NASA/USA
NASDA/Japan
RSA/Russia

Observer Agencies

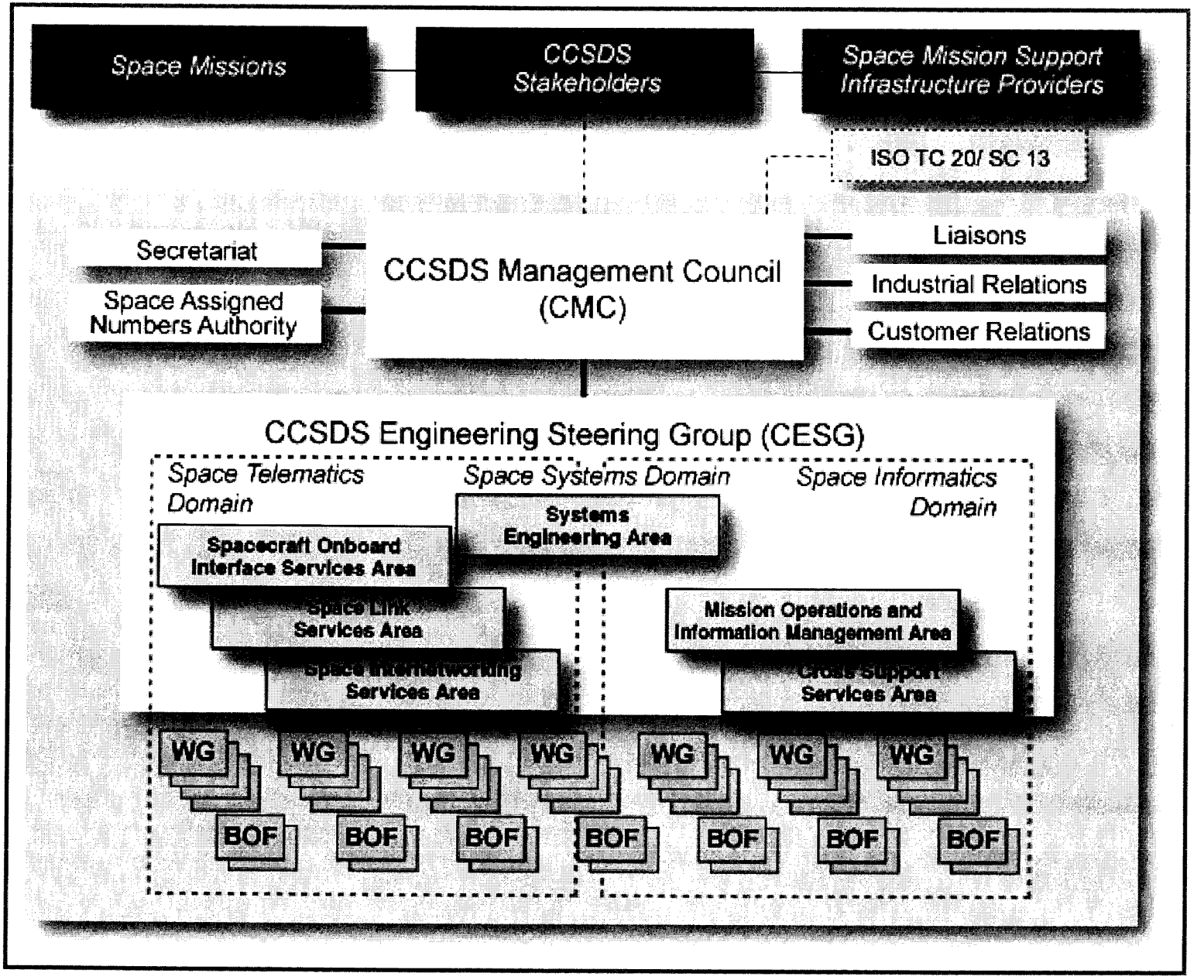
ASA/Austria
CAST/China
CRC/Canada
CRL/Japan
CSIR/South Africa
CSIRO/Australia
CTA/Brazil
DSRI/Denmark
EUMETSAT/Europe
EUTELSAT/Europe
FSST&CA/Belgium
HNSC/Greece
IKI/Russia
ISAS/Japan
ISRO/India
KARI/Korea
KFKI/Hungary
MOC/Israel
NOAA/USA
NSPO/Taipei
SSC/Sweden
TsNIIMash/Russia
USGS/USA

Motivation for Reorganization



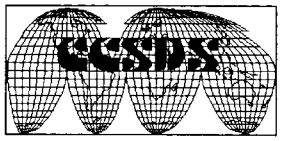
- **Better alignment with customers**
  - **Recognition of more complex mission set**
  - **Future mission drivers**
- **Align organization with work in new areas**
  - **Flight and ground elements**
  - **Internetworking and space links**
  - **Application level services**
  - **End to end system engineering**
- **Desire for more streamlined organization processes**
  - **Improved flow and visibility**
  - **Patterned after IETF processes**
  - **New mechanisms for creating new work items**

New CCSDS Organization



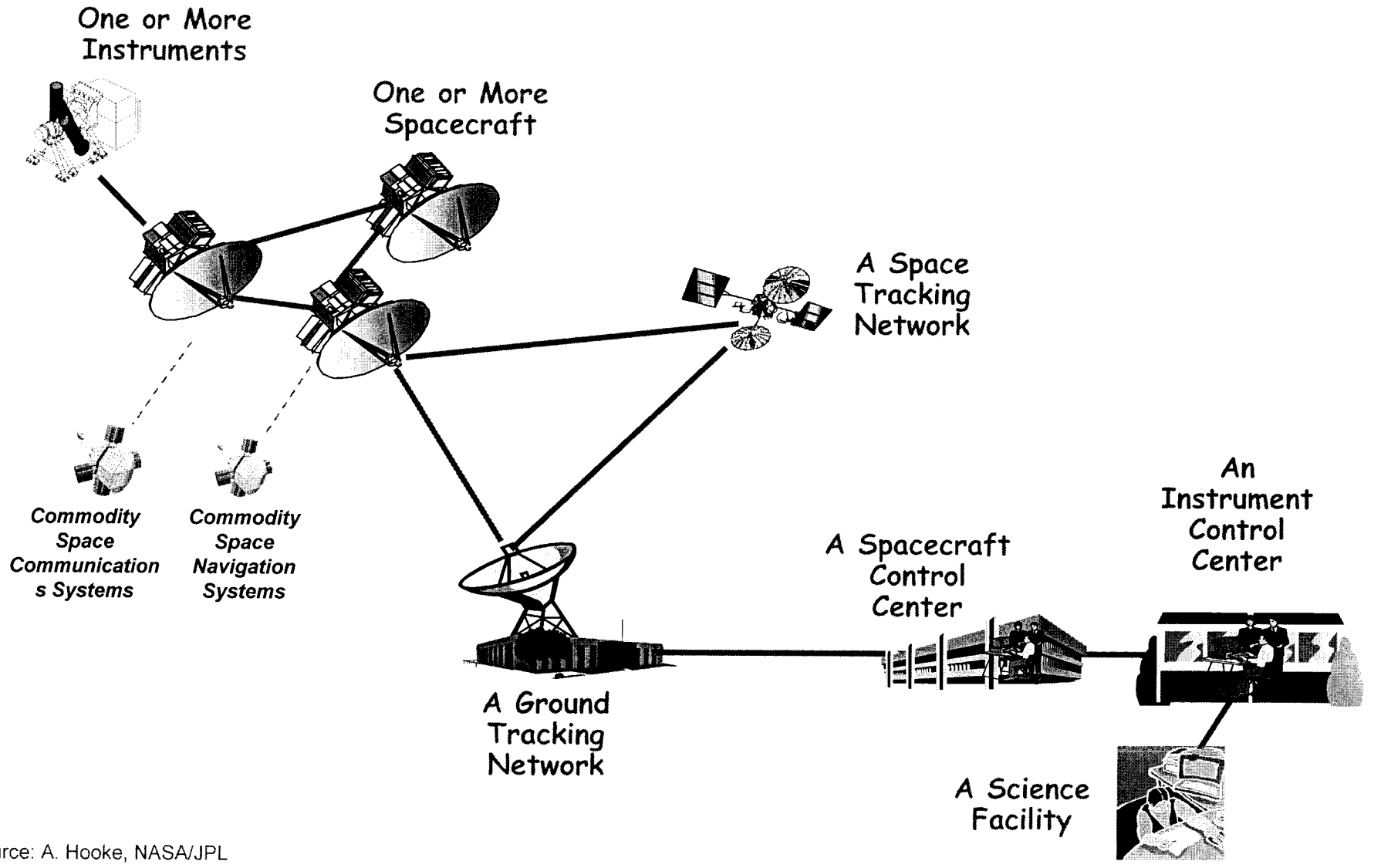
INTERPLANETARY NETWORK DIRECTORATE

New CCSDS Areas & Chairs



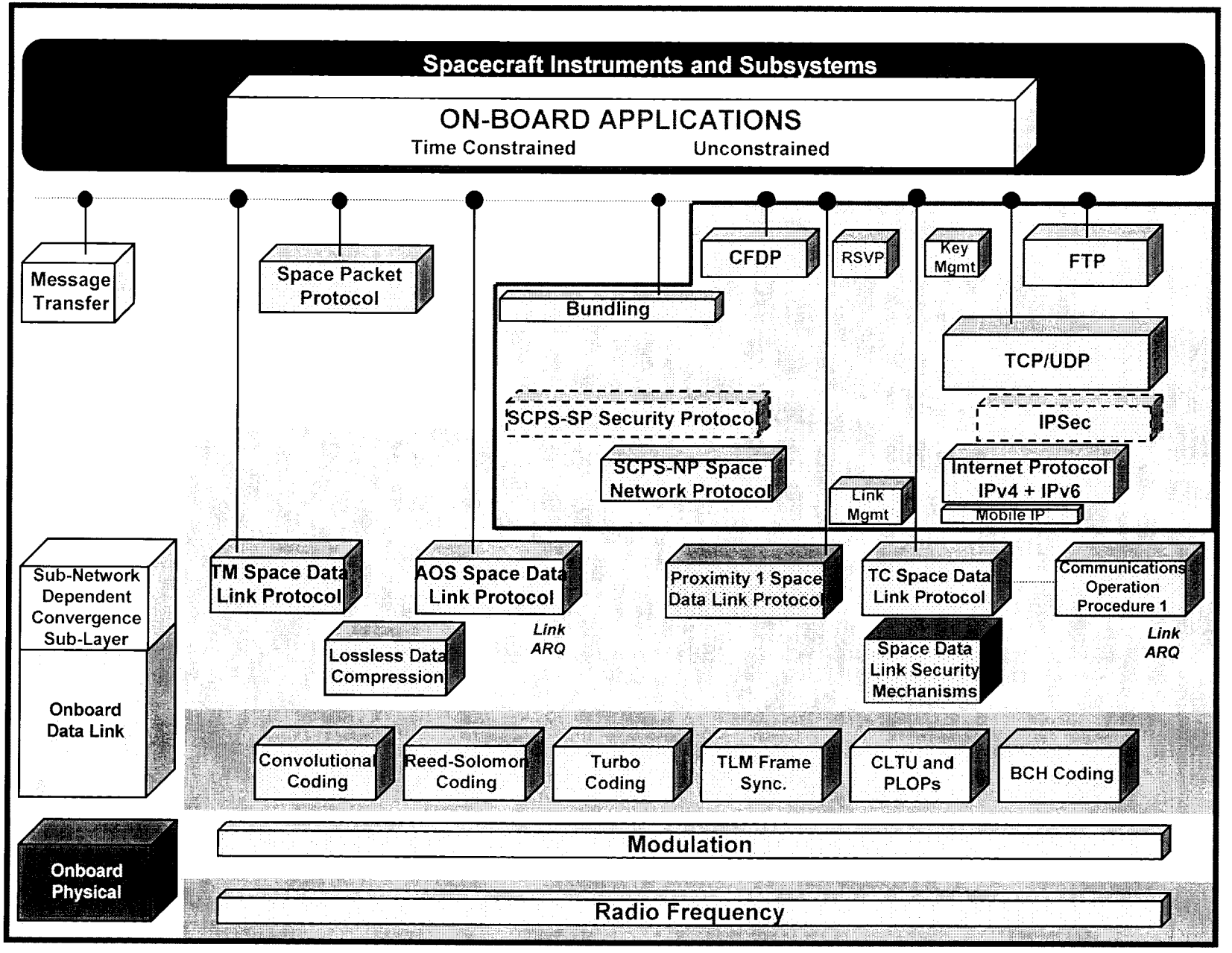
	AREA	WORKING GROUP or BOF	*Chair*	*Deputy*
CCSDS ENGINEERING STEERING GROUP Chair: Hooke, NASA Deputy Chair: Peccia, ESA *20 June 2003*	**SYSTEMS ENGINEERING** AD: Shames, NASA DAD: Yamada, ISAS	Systems Architecture WG	Yamada	Soerensen
		Information Architecture WG	Crichton	-
		Security WG	Weiss	Kenny
	MISSION OPS. & INFO. MANAGEMENT SERVICES AD: Peccia, ESA DAD: Thompson, BNSC	Data Archive Ingestion WG	Sawyer	Huc
		Navigation WG	Flores	Pallaschke
		Info. Packaging & Registries WG	Reich	Hughes
	CROSS SUPPORT SERVICES AD: Brosi, NASA DAD: Lapaian, CNES	Cross Suppt. Concept & Ref. Model WG	Kelliher	-
		Data Transfer Services WG	Doat	-
		Service Management WG	Pietras	Barkley
	SPACECRAFT ONBOARD INTERFACE SERVICES AD: Plancke, ESA DAD: Plummer, ESA	Onboard Bus + LAN WG	Schnurr	Plummer
		Time Critical Onboard Network Svcs. WG	Parkes	-
		Time Critical Onboard Applications WG	Smith	Fowell
	SPACE LINK SERVICES AD: Gerner, ESA DAD: Moury, CNES	RF & Modulation WG	Vassallo	-
		Space Link Coding and Synchron. WG	Calzolari	-
		Data Compression WG	Yeh	-
		Space Link Protocols WG	Kazz	-
		Telecommand Channel Coding WG	Calzolari	-
		Ranging Working Group	Vassallo	-
		Proximity-1 Restructuring WG	Kazz	-
		AOS Space Link Retrans. Protocol WG	Kazz	-
		Space Link Security WG	Vassalo	-
	SPACE INTERNETWORKING SERVICES AD: Durst, NASA DAD: Stanton, BNSC	CCSDS Packet Protocol WG	Stanton	-
		CFDP Interoperability Testing WG	Carper	Ciccone
		Next Gen. Space Internet WG	Scott	-

A Physical View of a Space Data System

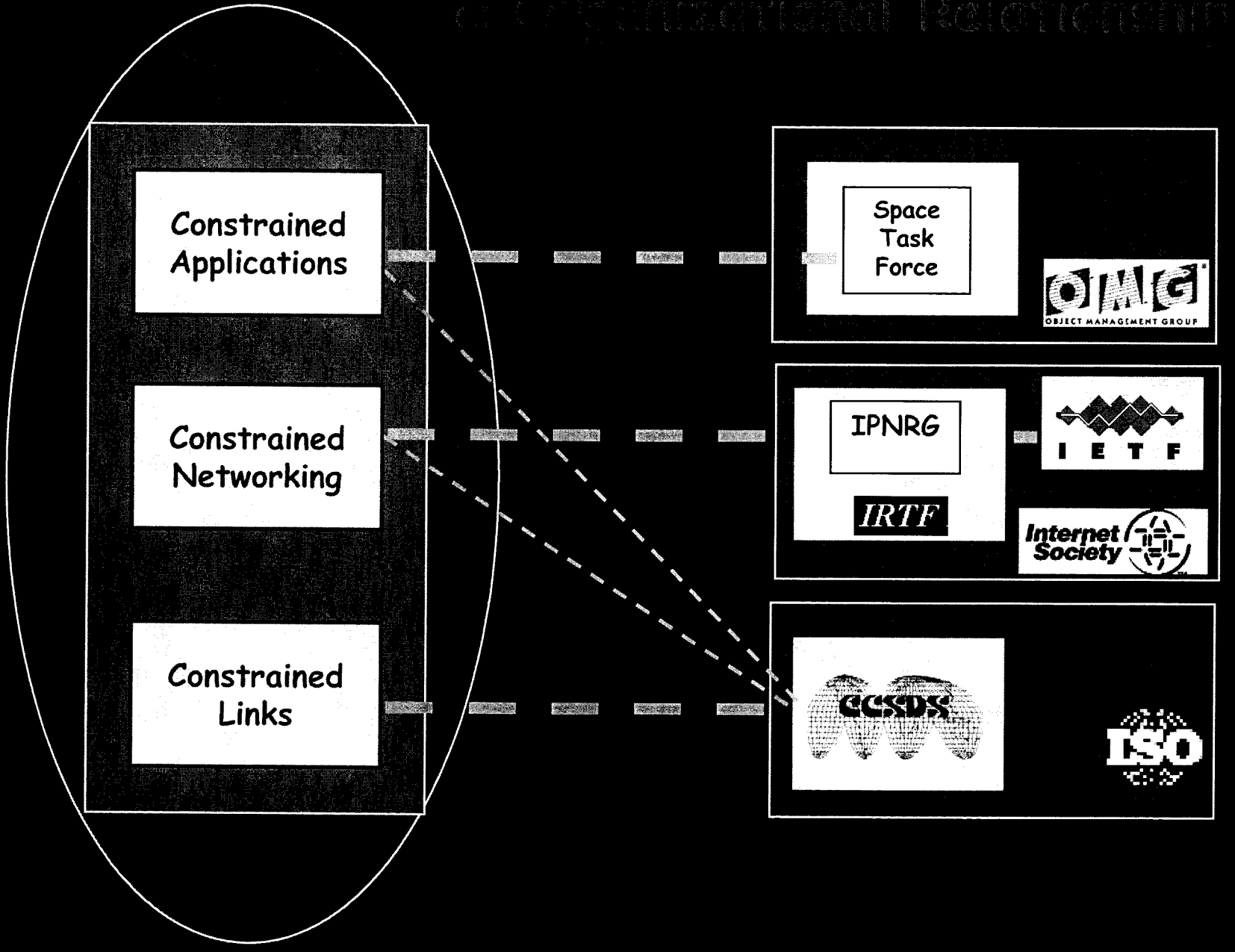


Source: A. Hooke, NASA/JPL

Current & Future CCSDS Standards



Active Standards Tracks & Organizational Relationships



CCSDS and OMG

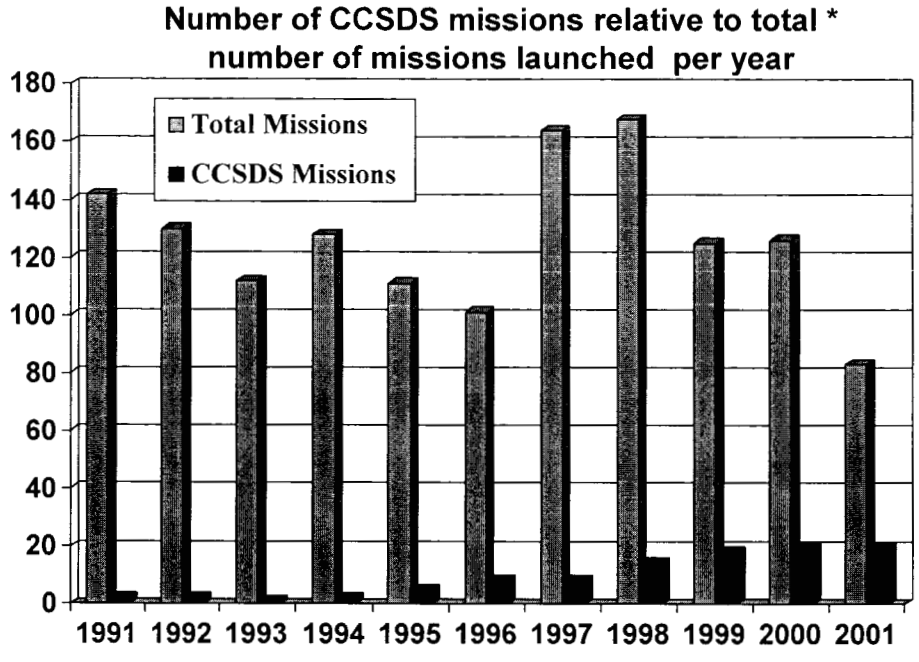
- **Active liaison relationship from inception**
  - CCSDS supported creation of Space DTF
  - Assumption that commercial products would appear
- **Loose agreements about working relationships**
  - Assumption that CCSDS standards would be adopted where they existed
- **General lack of overlap of work 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 …

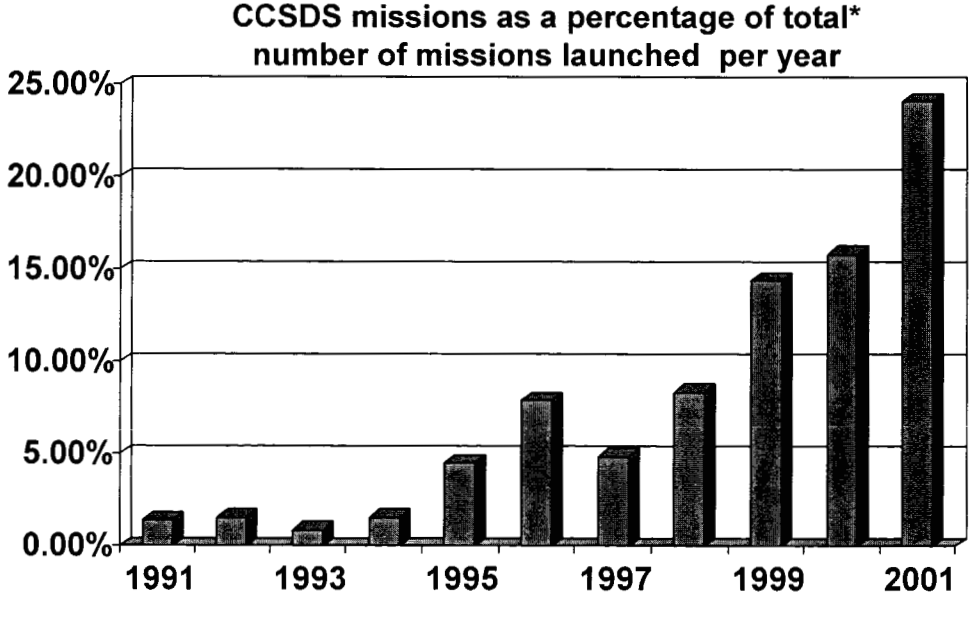
Summary

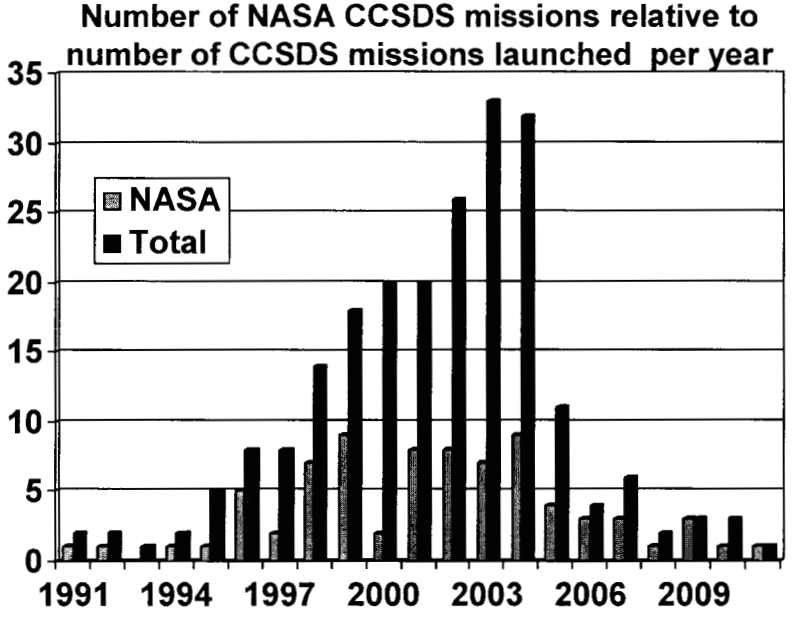
- **The CCSDS is a well established organization with broad participation from the international space agencies and their supporting organizations**
- **There are emerging requirements for new standards and work to meet them has been identified**
- **CCSDS and its member agencies have supported the work 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

CCSDS Market Share Metrics







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

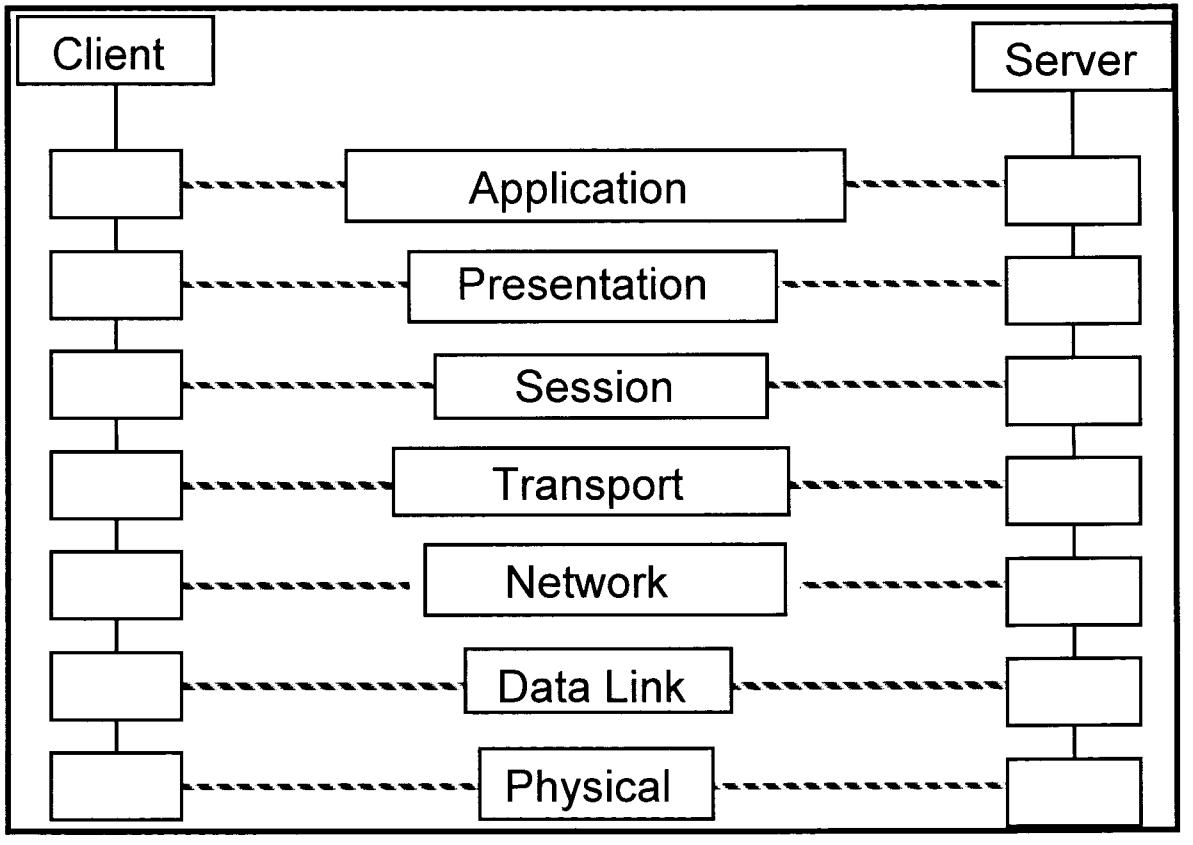
Source, e.g., Jonathan's master list of launches and payloads:

"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

Canonical ISO "7 - Layer" Communications Model



User Applications & Services

Application Services

Data Representation

Connection Management

End to End Data Transfer

Multi-hop Routing

Point-Point Logical Conn

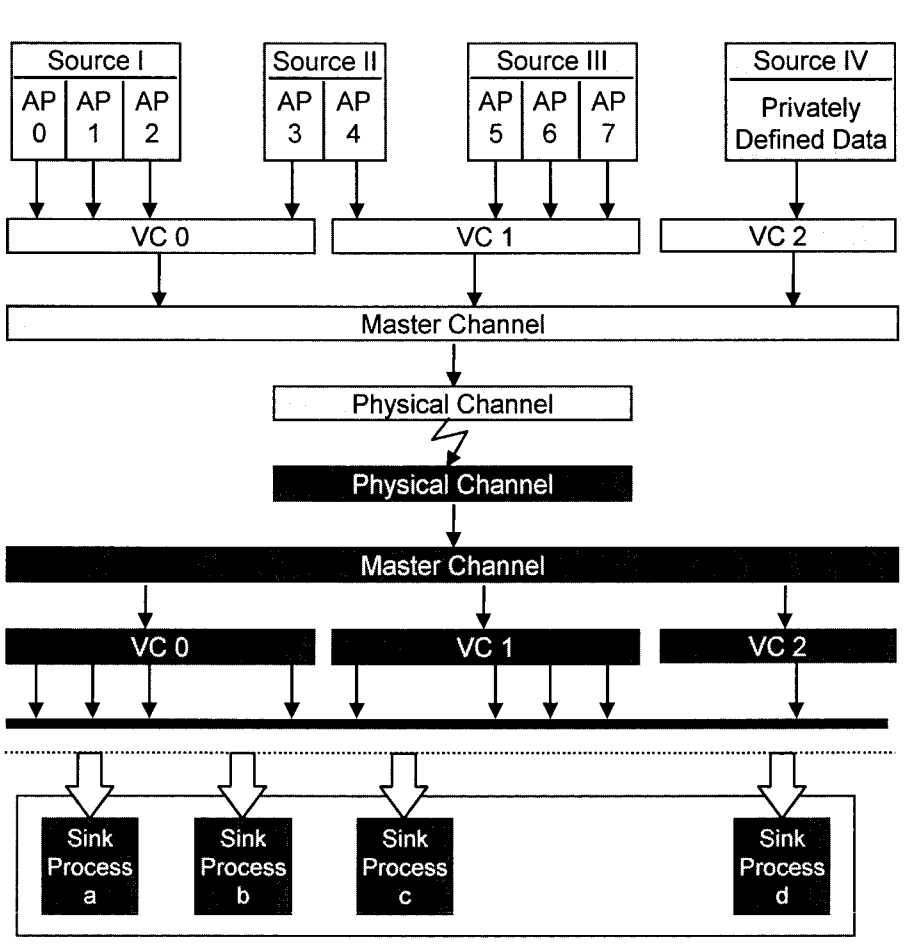
Coding, Modulation & Physical Conn

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.

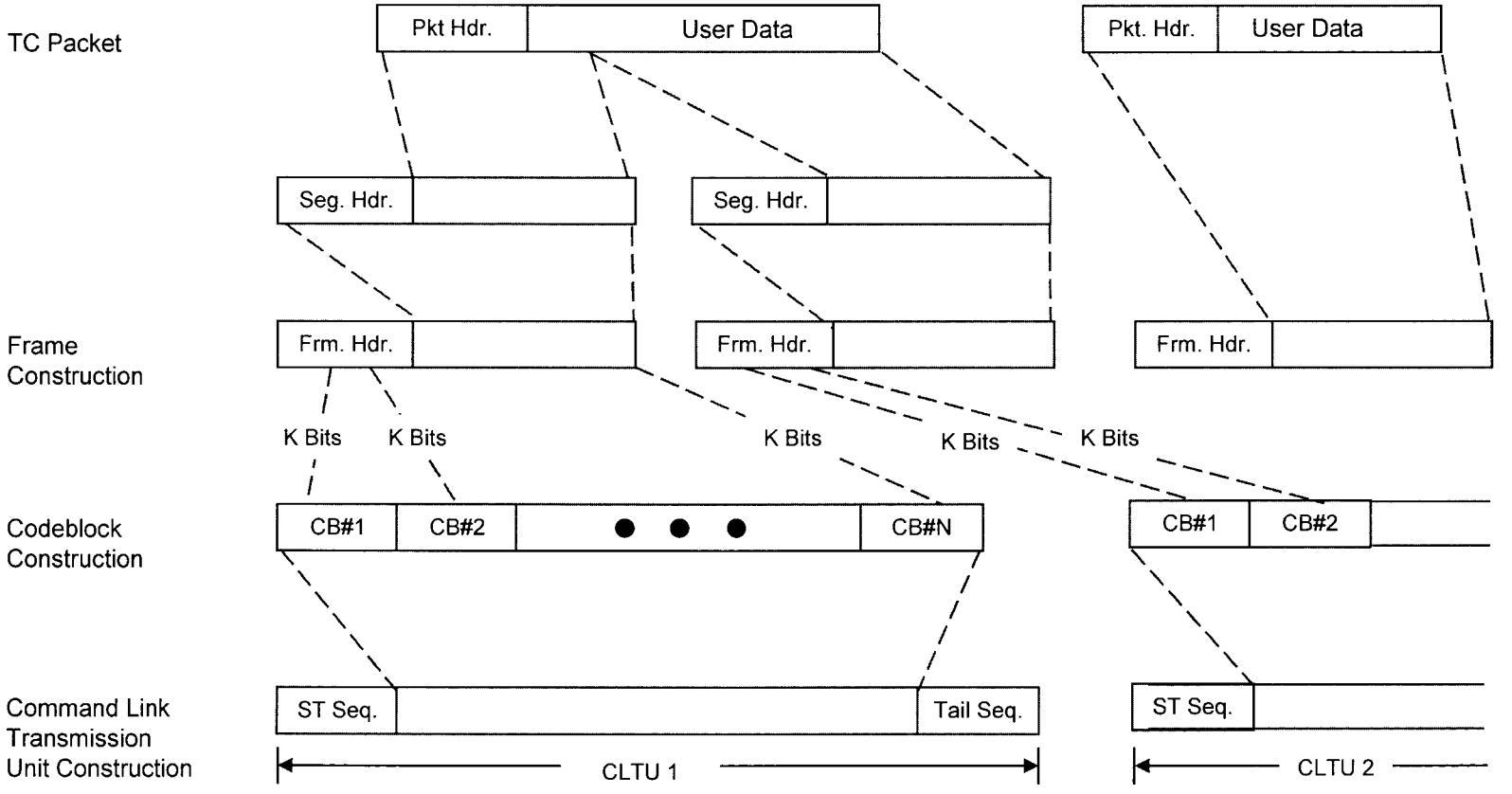
Intro to Core Data Transfer Protocols

- 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

Telemetry Data Flow



Telecommand Packet Transfer Services



NOTE: The data field of each CLTU contains the encoded representation of one or more transfer frames.