# CCSDS Report

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# CCSDS Overview

## The Consultative Committee for Space Data Systems

- The goal: For Space Data Systems, enhance ***interoperability*** and cross-support, while also reducing risk, development time and project costs, for government, industry, agencies, vendors and programs.
- ***Interoperability*** between agencies & teams translates to ***operational*** flexibility, capability and access to additional resources
- CCSDS Started in 1982 developing at the lower layers of protocol stack (Layers 1 to 3)
- Scope has grown to cover standards throughout the ISO communications stack layers, plus other Data Systems areas (architecture, archive, security, XML exchange formats, etc.)

# CCSDS composition

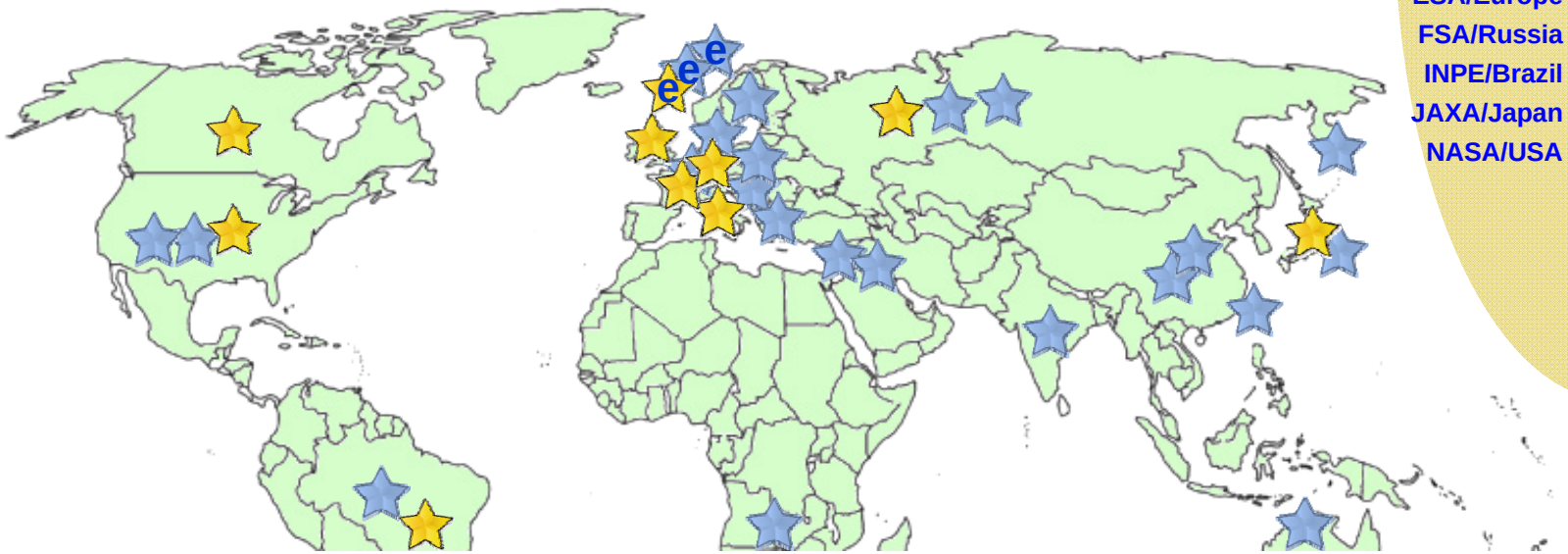
- Produces International Voluntary Consensus Standards
- Agency-led international committee
  - Currently 10 Member agencies (11th arriving soon)
  - Currently 24 Observer Agencies
  - Currently 118 commercial Associates
  - ~180 attendees at the Spring 08 Technical meeting
- Also functions as an ISO Committee
  - TC20/SC13
  - Represents 17 nations

**MEMBER AGENCIES**

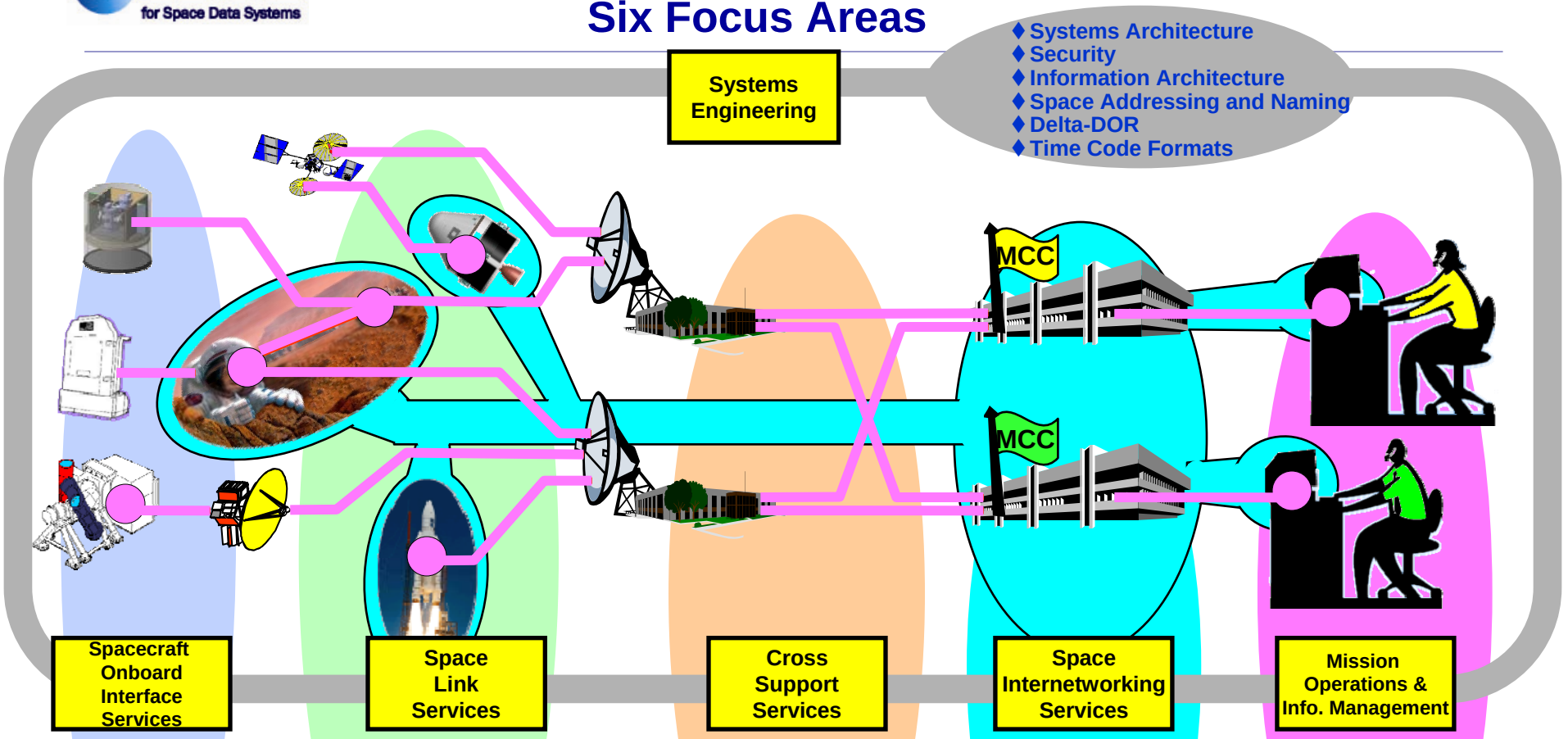
**ASI/Italy**
**BNSC/UK**
**CNES/France**
**CSA/Canada**
**DLR/Germany**
**ESA/Europe**
**FSA/Russia**
**INPE/Brazil**
**JAXA/Japan**
**NASA/USA**

OBSERVER AGENCIES

ASA/Austria
BFSPO/Belgium
CAS/China
CAST/China
CSIR/South Africa
CSIRO/Australia
CTA/Brazil
DNSC/Denmark
EUMETSAT/Europe
EUTELSAT/Europe
HNSC/Greece
IKI/Russia
ISRO/India
KARI/Korea
KFKI/Hungary
MOC/Israel
NCST/USA
NICT/Japan
NOAA/USA
NSPO/Taipei
SSC/Sweden
SUPARCO/Pakistan
TsNIIMash/Russia
USGS/USA



# CCSDS Technical Context: Six Focus Areas




- ♦ Onboard Subnet. Services
- ♦ Onboard Application Services
- ♦ Wireless WG
- ♦ Onboard Plug-n-Play

- ♦ RF & Modulation
- ♦ Space Link Coding & Sync.
- ♦ Multi/Hyperspectral Data Compression
- ♦ Space Link Protocols
- ♦ TC Channel Coding
- ♦ Ranging
- ♦ High Rate Uplink
- ♦ Long Erasure Codes

- ♦ CS Service Management
- ♦ CS Transfer Services
- ♦ Cross Support Architecture

- ♦ Space Packet Protocol
- ♦ Asynch Messaging
- ♦ IP-over-CCSDS Links
- ♦ Mars 2015 Interop
- ♦ Motion Imagery & Apps
- ♦ Delay Tolerant Networking
- ♦ Voice

- ♦ Data Archive Ingestion
- ♦ Navigation
- ♦ Info. Pack. & Registries
- ♦ Spacecraft Monitor & Control

**Thirty-two working groups (some in formative stages ♦)**

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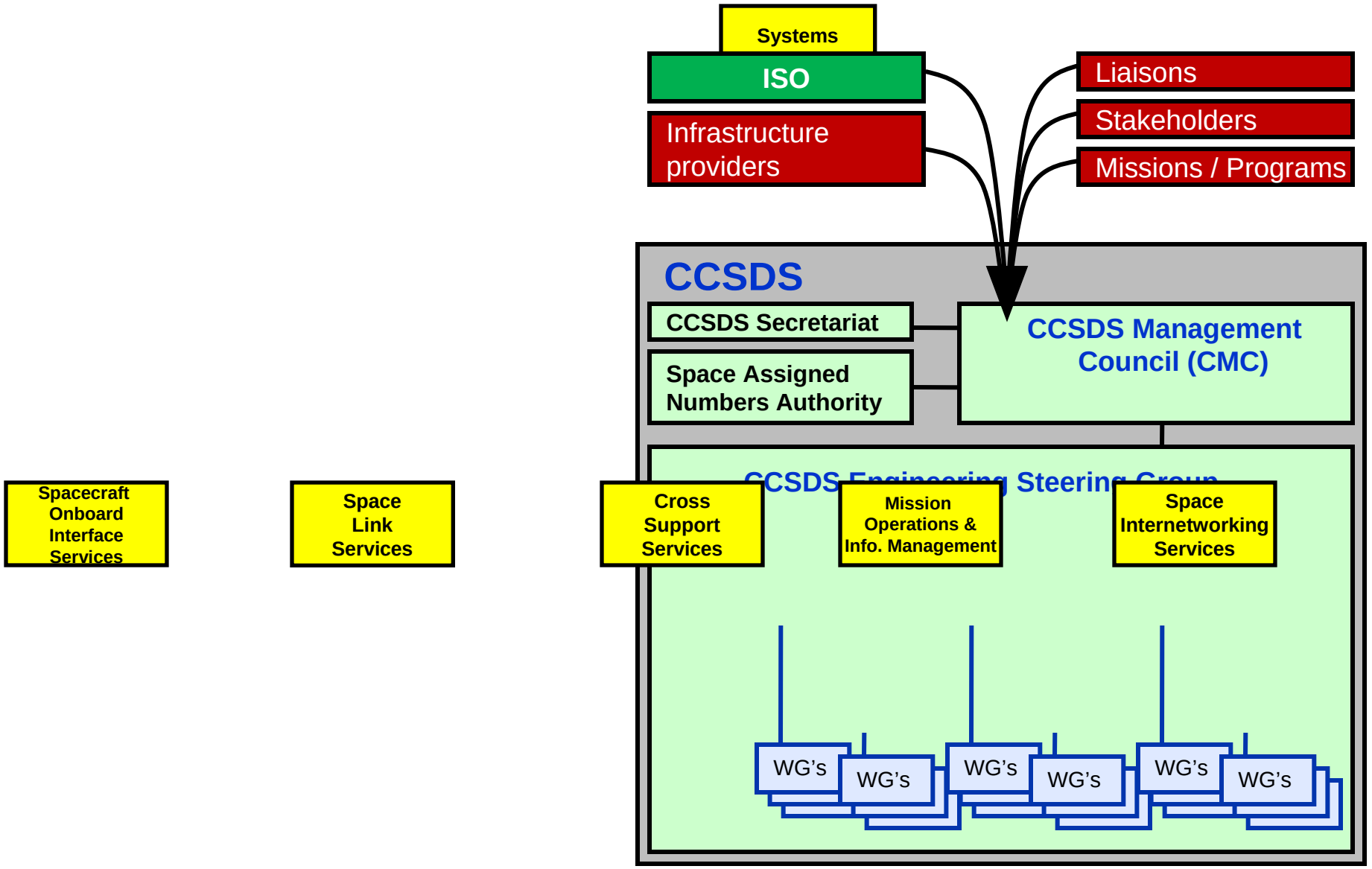

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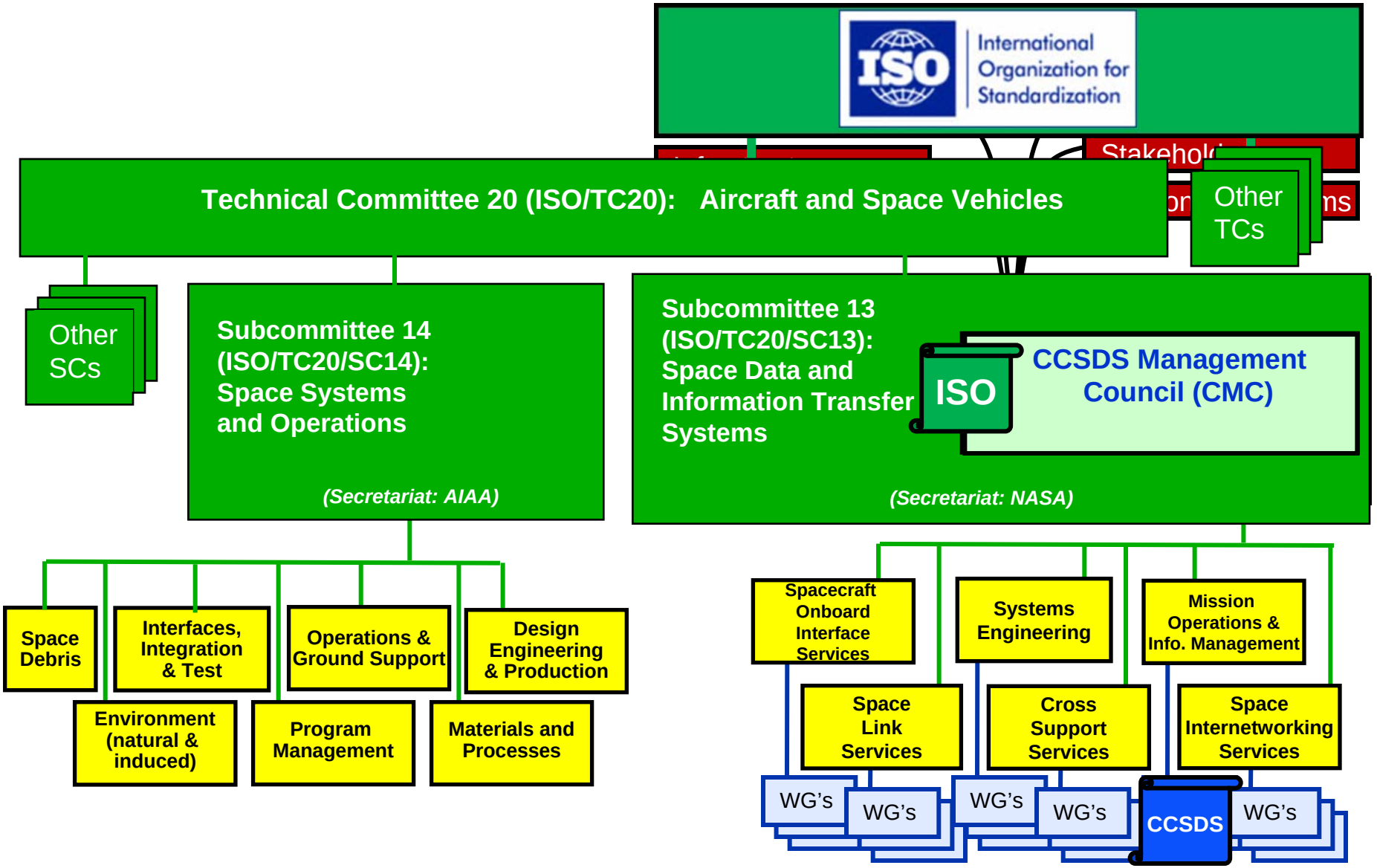


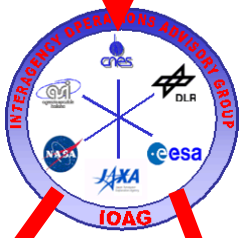
# CCSDS Organizational Interrelationships

## FLOW OF GUIDANCE / REQUIREMENTS

(Note: Agency makeup varies between these groups)

**IOP: Interoperability Plenary – highest space agency agreements on interoperability**


**IOAG: Interagency Ops Advisory Group interoperable mission support infrastructure**

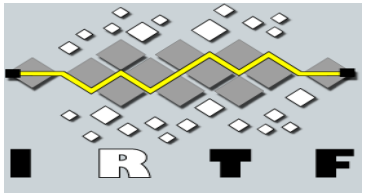



**CCSDS: open international standards for space mission interoperability**

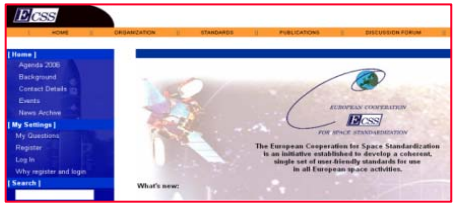
**SFCG: space agency frequency management forum**

## PEER ORGANIZATIONAL RELATIONSHIPS


**OMG: Object Management Group: industry standards for exchange of application information among vendor products**




**IETF/IRTF: open international standards for IP suite and Disruption Tolerant Networking (DTN)**




**ECSS: European Consortium for Space Standards - European regional standards for space mission support**


**AIAA: North American regional standards for space mission support**

# www.ccsds.org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Review Documents

## Review Documents


An important success factor of CCSDS is the role of formal Agency review. The vehicle for such review is the 'Review Item Disposition' or 'RID'. When a document requires formal review, the Secretariat announces the review opportunity to the CCSDS Agencies and provides instructions that define how, when, and to whom the Agency comments (in the form of completed RIDs) are to be submitted.

Anyone is welcomed to provide comments on the draft recommendations below.

For questions, please contact the CCSDS Secretariat secretariat@mailman.ccsds.org.

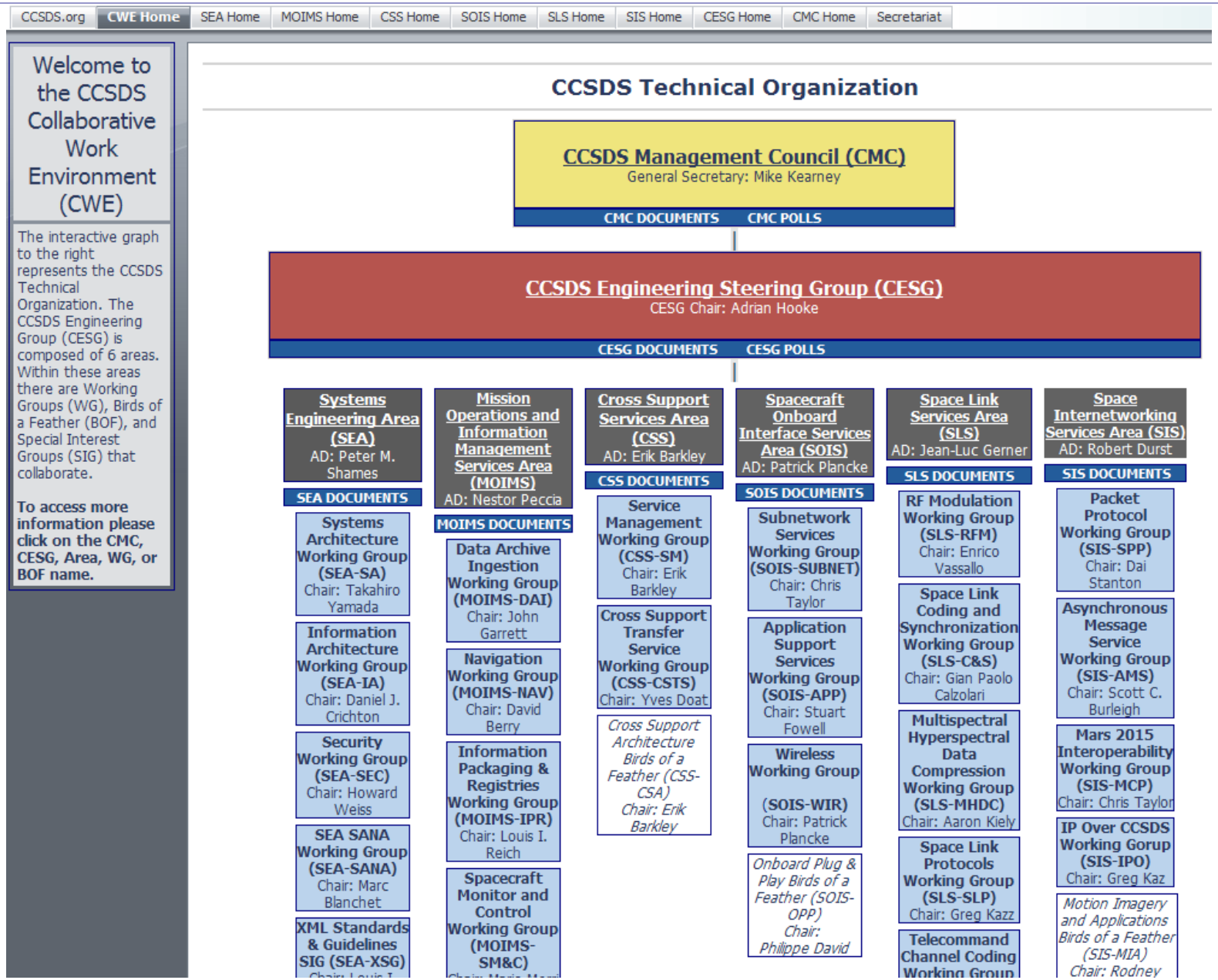
### Currently in Review

| | Document # | Document Name | Type | Date | Issue | Comments Due By |
|---|---|---|---|---|---|---|
| Click Here to Review | CCSDS 644.0-P-2.1 | The Data Description Language EAST Specification (CCSD0010) | Pink Sheets | 2/2007 | 2.1 | 6/21/2007 |
| Click Here to Review | CCSDS 401.0-R/P-17.1 | Radio Frequency and Modulation Systems--Part 1: Earth Stations and Spacecraft | Pink Sheets | 05/2007 | 17.1 | 7/16/2007 |

### Recently Completed Reviews

| | Document # | Document Name | Type | Date | Issue | Comments Due By |
|---|---|---|---|---|---|---|
| Click Here to Review | CCSDS 735.1-R-1 | Asynchronous Message Service | Red Book | 2/2007 | 1 | 5/9/2007 |
| Click Here to Review | CCSDS 661.0-R-1 | XML Formatted Data Unit (XFDU) Structure and Construction Rules | Red Book | 1/2007 | 1 | 5/3/2007 |
| Click Here to Review | CCSDS 311.0-R-1 | Reference Architecture for Space Data Systems | Red Book | 1/2007 | 1 | 4/9/2007 |
| Click Here to Review | CCSDS 503.0-R-2 | Tracking Data Message | Red Book | 12/2006 | 2 | 3/30/2007 |
| Click Here to Review | CCSDS 702.1-R-2 | IP over CCSDS Space Links | Red Book | 1/2007 | 2 | 3/7/2007 |

# www.ccsds.org



# Operational Perspectives

## What Standards do for Operations

- Operational benefits
  - Enforce operation's engagement early in the development cycle
  - Standards result from operational "lessons learned" from many groups and organizations, not just a few.
  - Operational Risk reduction achieved because systems and processes are better "wrung out."
- Operational objectives of standards work:
  - Transparency in both design and operations
  - Flexibility in configuration of developed or procured systems
  - Flexibility in adapting programs to allow external/international partnerships
  - Flexibility in planned usage of external (other agency's) assets
  - Ability to rapidly adapt to contingency operations
  - Simplified interface agreements between systems and partners
    - Simplified interfaces contribute to streamlined operations

# Operational Perspectives (cont.)

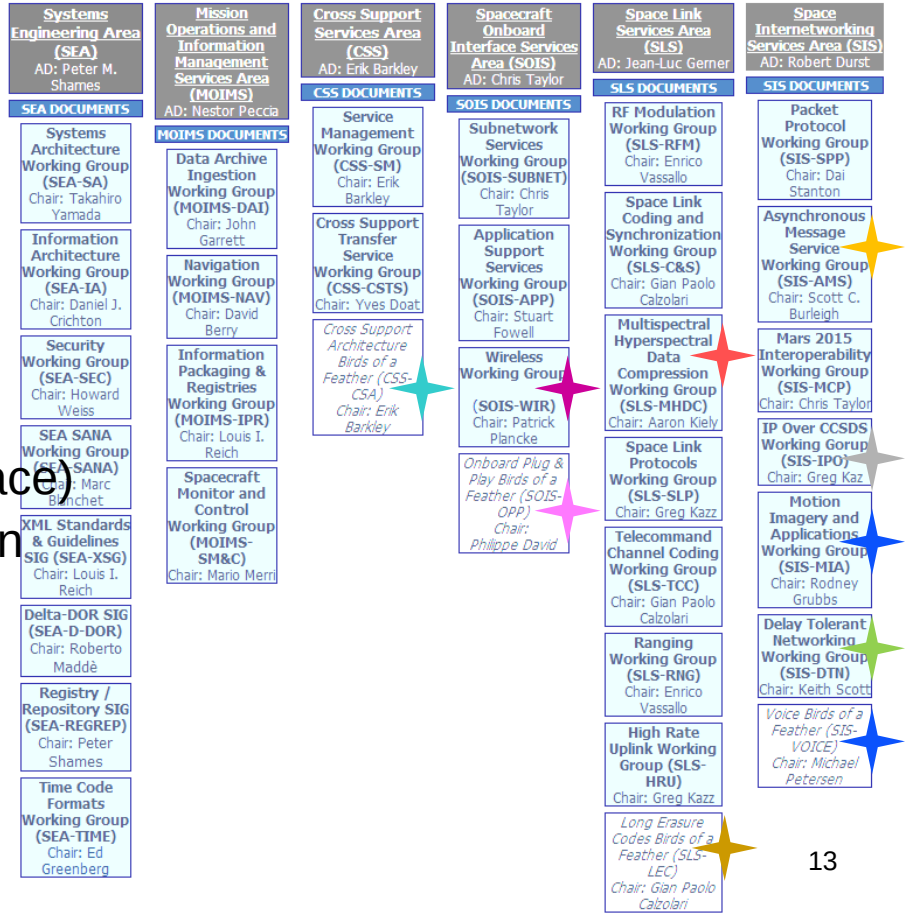
- CCSDS provides these benefits specifically for the Space Data Systems domain
  - Spacecraft and planetary data systems, ground data systems and all in between
- Even if a program doesn't ***plan*** on external or international partners, they need the capabilities that CCSDS brings
  - Keeping options open to adapt a program support plan
  - Allowing rapid configuration for contingency operations options
- Examples from a real program, the UK's Space Technology Research Vehicle (STRV):
  - **Contingency:** In 1995, STRV-1a lost attitude. NASA's DSN was asked to support using CCSDS command formats to send very short packets, banging continuously on the spacecraft. Finally, one of them got in and restored control.
  - **Routine:** DSN supported STRV with Data Acquisition and Tracking
  - **Programmatic change:** In 1996, the STRV program needed to close down the ground station for refurbishment. Control was transferred to the University of Colorado at Boulder, cheaply and quickly.

# Sampling of technical topics

- New Low-Density Parity Check codes proposed as standard by NASA
  - LDPC codes provide better performance in space environment
  - Single-agency “Orange book” became NASA’s proposal for full “Blue Book” standard
  - Not immediately accepted by other agencies – work to be done.
- XML activities in many areas
  - Data Archive, Registries, Repositories, etc.
  - CCSDS XML Special Interest Group (SIG) working towards consistent approach across multiple standards
- Spacecraft Monitor and Control (SM&C)
  - One of the most active working groups
  - Service Oriented Architecture approach to application-level services
  - Goals: Interoperable monitor/control services, application portability between flight/ground or between partner agencies.
  - New sub-areas starting: Time services, automation services, planning/scheduling services, remote software management services
  - XML Telemetry and Command Exchange (XTCE) also in this area
    - Worked jointly with OMG, getting broad acceptance

# Sampling of Technical Topics (Cont.)

- Recently approved new work areas:
  - Delay Tolerant Networking
  - Voice and Motion Imagery (Video, etc.)
- Proposed new work areas:
  - Optical channel coding (in Space Link Services area)
  - Space Data Link Security
  - Long Erasure Codes
  - Spacecraft Onboard Plug-n-Play
  - Cross Support Architecture
- Other "Hot Topics"
  - IP-over-CCSDS
  - Asynchronous Messaging Service
  - Wireless (onboard and planetary surface)
  - Multi/HyperSpectral Data Compression



# Recent CCSDS Status

- NASA's Constellation program
  - Shuttle replacement, human missions to ISS, Lunar, and beyond
  - Recent efforts in Constellation have enabled better alignment with CCSDS standards
    - Notable recent decision: Internet Protocol (IP) encapsulation in CCSDS as first step towards deep space internetworking
  - CCSDS with Constellation involvement will enable interoperability with internationals in advance of formal intergovernmental program/project agreements
- Membership
  - China expected to accept full membership soon
  - India considering reinitializing full membership

- Next meeting: Berlin, October 13-17 2008.
  - Visit www.ccsds.org for info.

# CCSDS Summary

- Take-home message:  Still much work to be done
  - Enabling interoperability between international agencies for future missions – both Earth-Orbital and Exploration
  - Long-range vision – automated routing and delay tolerant networking for deep space crosslinks between spacecraft and surface systems
  - Near-term need – evolutionary approach to sustain cross-support agreements with other agencies.
- Organizations with a stake in the future of ***Space Operations*** and the expertise to contribute to CCSDS should become engaged.