CCSDS contribution to the long-term sustainability of Outer Space Activities: DLR View

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Background

- Request from COPUOS to CCSDS on the 6th of September 2011 by Niklas Hedman
- Answer from CCSDS to COPUOS on the 4th of November by CCSDS Secretary

To provide information on their experience and practices that might relate to the long-term sustainability of outer space activities, and on their experiences and practices in the conduct of sustainable space activities.
Consultative Committee for Space Data Systems (CCSDS) - why and what

- The goal: For Space Data Systems, enhance interoperability and cross-support, whilst 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 – who

- Produces International Voluntary Consensus Standards
- Agency-led international committee
  - 11 Member agencies
  - 28 Observer Agencies
  - 145 Commercial Associates
  - ~180 workers at the autumn 2011 technical meeting
- Also functions as an ISO Committee
  - TC20/SC13 - Space Data & Info Transfer Systems
  - Represents 18 nations (13 members, 5 observers)
CCSDS - Architecture

29 Working Groups (some in formative stages)
CCSDS - Relationships

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

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

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

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

AIAA: North American
regional standards for
space mission support
CCSDS – Standards Review

Welcome to CCSDS.org

Founded in 1982 by the major space agencies of the world, the CCSDS is a multi-national forum for the development of communications and data systems standards for spaceflight.

Today, leading space communications experts from 26 nations collaborate in developing the most well-engineered space communications and data handling standards in the world.

The goal? To enhance governmental and commercial interoperability and cross-support, while also reducing risk, development time and project costs.

More than 500 space missions have chosen to fly with CCSDS-developed standards, and the number continues to grow.

Interested in CCSDS?

- Click "Publications" above to visit the library of CCSDS standards.
CCSDS – Products

Normative:
- Blue Books – Recommended Standard (55)
- Magenta Books – Recommended Practice (19)

Non Normative:
- Green Books – International report (44)
- Orange Books – Experimental specification (3)
- Silver Books – Historical document (111)

Administrative:
- Yellow Books – Administrative document (12)

Changes are done via Pink Sheets.
Review of Normative Books is done in a 3/5 year cycle
ISO TC20/SC13 published 44 Standards, 9 are currently under development
Major points of the Scope of ToR of the WG on the Sustainability of Outer Space Activities

- Sustainable space utilization supporting sustainable development on Earth
- Space Debris
- Space Weather
- Space Operations
- Tools to support collaborative space situational awareness
- Regulatory regimes
- Guidance for actors in the space arena
Sustainable space utilization supporting sustainable development on Earth

Compliance with CCSDS standards gives

- developed countries
  - Lower costs by joint collaboration and cost sharing
- developing countries
  - Entering into exploitation of space
    - compatible systems to those of developed countries
    - access to the same communications infrastructure as developed countries

Non DLR owned ground stations are used (especially during the launch and early operation phase (LEOP)).

- Frequency-, coding- and so called space-link-extension (SLE) - standards used for integration
Space Debris

- CCSDS Navigation WG:
  - discipline-oriented forum for detailed discussions
  - development of technical flight dynamics standards

- CCSDS Conjunction Data Messages (CDM):
  promote long-term sustainability of the space environment by contributing to efforts to prevent collisions before they happen.

- Available Navigation Standards implemented by DLR.
- For CDM DLR will provide prototyping.
- Collision avoidance: DLR supports own and missions from other agencies.
- Radar measurements provided today via the GRAVES and TIRA systems as stated by the French/German Warsaw (autumn 2011) initiative on SSA
Space Weather

- Traditional CCSDS protocols provide capabilities and benefits to solar research spaceflight missions that improve space weather prediction capabilities.

- New advanced space internetworking protocols have the potential of providing “sensorweb” capabilities to automate the reaction of multiple orbital research spacecraft for faster responses to space weather events.

  - Space Weather Application Center Ionosphere (SWACI) delivers data from CCSDS compliant Grace and Champ mission.
  - Data routinely provided via the Space Weather European Network (SWENET/ESA)
Space Operations

- Compliance with CCSDS standards can enable short-notice contingency support (e.g. UK’s STRV, ESA’s XMM-Newton).

- Operational efficiencies are achieved when standards are used
  - operations and maintenance teams become familiar with the characteristics of the protocols,
  - protocols and the associated experience carries over to new missions.
Tools to support collaborative space situational awareness

- existing standardized navigation message formats
- new message formats as conjunction data message
- enhanced communication between Mission Control teams using other ground-to-ground standards

All this increases situational awareness by spacecraft flight control teams, onboard crews and collaborating control centers

- Support of all developed NAV standards
- other ground-to-ground standards (e.g. voice and video standards) used to enhance ground communication.
Regulatory regimes

- CCSDS teams perform technology development and standardization. Everyone can benefit from the technical developments, which are part of the process.

- For the upcoming age of the Solar System Internet (SSI) coordination functions will be needed (address assignments, etc.)
  
  • CCSDS standards undergo a prototyping by at least two independent agencies. Prototyping implies technical developments, which are available for the space community.
  
  • All DLR spacecraft have a registered Spacecraft ID given by the CCSDS SANA.
Guidance for actors in the space arena

- Technical standards development and compliance is an asset that all agencies need. **This includes not only CCSDS!**
- Interoperability in the area of communications and data exchange provides the greatest benefit to collaborating entities of all the potential technology areas employed for spaceflight.

**COPUOS should actively promote standards for specific technology touch-points where they most enable cooperative missions. COPUOS should promote that guidance to actors in the space arena, as mankind begins in earnest to explore the Solar System.**
**Conclusion**

Use of standards are one issue in strengthening sustainability of outer space activities

**Others could include:**

- Development of additional SSA capacities, especially in Europe
- Use of a bond system to enforce compliance in debris mitigation practices as proposed by R.A. Opperman, during IAC 2010 Prague