STANDARD THINKING...EXTRAORDINARY RESULTS

CCSDS LINK

VOLUME 3 ISSUE 3 — DECEMBER 2008

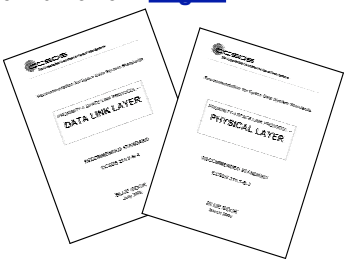
INPE and ISRO Cooperation
Read about the Brazilian National Institute of Space Research's (INPE) support of the Indian Space Research Organisation (ISRO) Chandrayaan-1 mission. **Page 3**

Working Group Updates

Three CCSDS working groups have provided updates on their work. **Page 2**

For Your Information
We've gathered information about upcoming meetings and other items that you may find of interest. **Page 5**

New and noteworthy
Take a look at the CCSDS documents that have recently been published or released for formal review. **Page 6**



Welcome to the CCSDS *Link*

The *Link* is intended to serve as a communication forum for the CCSDS community. Through content developed by CCSDS technical experts, members of the CMC and CESG, and by secretariat staff we hope to provide readers with a wealth of information about the organization and its work. Information in the *Link* is aimed at CCSDS participants as well as users of CCSDS specifications and technical information.

The CCSDS working groups and management bodies had the opportunity to meet at the Berlin facilities of the German Standardization Institute (DIN) in October. Our DLR hosts for the two week cycle provided meeting accommodations that allowed all of the groups to hold productive and efficient discussions. We've included updates from some of the WGs and the CESG and CMC in this issue.

In our previous issue we reprinted an article in which Dr. Vint Cerf detailed the ongoing work to create an interplanetary internet. While meeting in Berlin in October NASA representatives received word from home that its first space-based test of the Delay Tolerant Networking specification had been successful, a crucial first step in creating this new communication infrastructure. One of numerous news pieces about this milestone from November has been reprinted beginning on page 3.

Finally, this month marked the 10th anniversary of the joining of the first two ISS modules in orbit, beginning an unprecedented era of international cooperation in space. The image to the right captures this moment.

As always, we hope you find this issue of the *Link* informative and welcome any feedback you may have. Please do not hesitate to contact the CCSDS Secretariat staff with your comments or suggestions for content.

Happy Holidays!

Happy Birthday ISS

In December 1998, the crew of Space Shuttle Mission STS-88 began construction of the International Space Station, joining the U.S.-built Unity node to the Russian-built Zarya module. The crew carried a large-format IMAX® camera from which this picture was taken. - Astronauts Ross (left) and Newman looking over work completed on Zarya and Unit.

Photo credit: NASA

CCSDS Working Group Updates

In future issues of the Link we will include updates on various working group activities. This quarter features updates on the service management, systems architecture, multispectral and hyperspectral data compression, and the asynchronous message service working groups.

Service Management Working Group

The Service Management Working Group is finalizing its work on a Recommended Standard (Blue Book). This new document will defines a set of Service Management services by which space link service providers and space missions exchange information needed to arrange spacecraft contact periods. The document also establishes the operating parameters of the space link services and space link extension transfer services during those contact periods.

The draft recommended standard has recently gone through a thorough review by CCSDS agencies that resulted in a number of comments on the content of the document. All of those comments must now be dispositioned by the working group. Before any CCSDS recommended standard may be published it is necessary for at least two independent prototypes to successfully implement the standard in order to verify its utility. This work is currently on schedule for this book. The document is currently projected to be published in the March 2009 timeframe.

Systems Architecture Working Group

In September the Systems Architecture WG (SAWG) published a Recommended Practice (Magenta Book) that describes the Reference Architecture for Space Data Systems (RASDS). RASDS provides a framework for describing the architecture of various space data systems in a coherent way so that the architecture of any space data system can be understood easily and unambiguously. RASDS is already used by several CCSDS WGs and some CCSDS member agencies to describe space data system architectures. It is also used as the foundation of NASA's Space Communications and Navigation Architecture and CCSDS/IOAG's Cross Support Service Architecture.

Upon publication of the RASDS document, the SAWG was disbanded, but the work of defining architectural framework will continue in the newly created Cross Support Service Architecture WG.

To download the RASDS Recommended Practice click here.

MHDC Working Group

The Multispectral and Hyperspectral Data Compression (MHDC) working group is working towards the development of standard(s) suitable for onboard compression of multispectral and hyperspectral imagery. At its October 2008 meeting, the working group agreed that its first priority would be the development of a compression standard that can provide effective lossless compression for hyperspectral images. The WG agreed on a revised set of milestones to reflect this priority. Work on lossy compression will continue, but proceed at a somewhat slower pace.

Asynchronous Message Service Working Group

The Asynchronous Message Service (AMS) working group continues its development of a draft Recommended Standard defining a CCSDS AMS for mission data system communications. The service and its protocol implement an architectural concept under which the modules of mission systems may be designed as if they were to operate in isolation, each one producing and consuming mission information without explicit awareness of which other modules are currently operating.

The group is currently testing multiple prototype implementations to ensure that the interoperability envisioned by the document is achievable. This testing is expected to wrap up early in the new year. Meanwhile, several hundred AMS messages were carried via Remote AMS in the course of the Deep Impact Network experiment that concluded November 13, the first known exercise of publish-subscribe functionality over interplanetary distances.

Fall 2008 CESG/CMC Meeting Report

The technical steering and management bodies of CCSDS met in Berlin at the German Institute of Standardization (DIN) in October to review the status of the CCSDS standardization work and policies.

The CCSDS Engineering Steering Group (CESG) provides technical management across the various CCSDS areas and ensures top-level technical coordination of the overall international standardization process. It ensures that all developments occur in accordance with procedures, schedules, and resources that have been negotiated with the CMC. To do its job the CESG adopts and applies uniform architectural views that guide the systems protocols, policies and procedures used for international space mission cross support. The CESG is directly responsible for executing the actions associated with entry into and movement along the CCSDS standardization tracks, including making recommendations to the CMC for approval of specifications as they progress through the various stages of standardization.

The CCSDS Management Council (CMC) is the executive management oversight group of the organization. The CMC is populated by Principal Delegates who are independently supported by each of the Members (one per agency). The CMC is responsible for staying technically and politically informed about important long-term issues in the field of international space mission cross support and for keeping an eye on the "big picture" of the CCSDS program of work. It therefore focuses on long-range planning and coordination among the various CCSDS discipline-oriented domains, on making sure that adequate resources exist to do work, and that customer requirements are satisfied in a timely manner.

During a joint session of both bodies in Berlin the CESG members presented a thorough overview of the ongoing work within each CCSDS working group. This bi-annual review provides CMC delegates with a picture of where each topic area is with respect to reaching their standardization goals. This insight allows each CCSDS member agency to efficiently deploy their resources to meet any evolving standardization needs. The CESG and CMC went on to discuss CCSDS's role in an upcoming meeting of the Interoperability Plenary (IOP). The IOP is an international, inter-governmental body formed to address joint space communication and navigation needs for future missions in an effort to broaden international cross support, compatibility, and interoperability. The standards developed by CCSDS are integral drivers to accomplishing IOP goals. The results of the IOP meeting will be used to guide future standardization priorities for CCSDS.

Following the joint session with the CESG, each CMC member agency presented its current and future mission manifest with specific attention on those missions implementing CCSDS specifications. Sharing agency goals and priorities among the member agencies provides context for the standards development done by the CCSDS working groups.

With the week's work out of the way, our DLR hosts in Berlin invited the CCSDS delegates to a reception at the Cecilienhof Castle in Potsdam, the site of the 1945 Potsdam Conference. This social event provided an opportunity for the CCSDS delegates to review the work of the week and begin planning for future meetings. As a special surprise, one of the original CCSDS "founders", Mr. Horst Kummer, was in attendance and shared some of his early memories with the group.

CCSDS Protocols Allow INPE to Provide "Plug & Play" Support for Chandrayaan-1 Mission

The recent Indian Lunar Mission Chandrayaan-1 made use of a kind of "plug & play" cross-support from INPE's Ground Stations during its Orbit Raising Phase. INPE's Ground Stations Network is designed for LEO satellite operations and implements the PCM ESA standards required by its own satellites. However, the recent upgraded capability of both INPE Ground Stations, the one from Cuiaba, MT and that of Alcântara, MA, permitted the use of their new CCSDS protocols based CORTEX baseband equipment, which occurred in the operational scenario of the Chandrayaan-1 mission.

Indeed, the new feature of INPE's ground system effectively enabled the provisioning of INPE cross-support to the Chandrayaan-1 mission in its critical, early phase. In this case, the operation of INPE Ground Stations equipment was performed in cross-support configuration from the ISRO-ISTRAC Bangalore Satellite Control Center. The services based on CCSDS standards protocols used in cross-support configurations, were those related to: telemetry reception; telecommanding, with the use of the COP-1 protocol; besides those used for ranging and Doppler measurements.

Led by Dr. Pawel Rozenfeld, Head of the Satellite Control Center and Ground System, INPE cross-support to the Chandrayaan-1 mission effectively contributed to the insertion of the spacecraft in the Lunar Transfer Trajectory, which was attained on November 4, 2008. As mentioned by Dr. S.K. Shivakumar, ISRO ISTRAC Director in his message to INPE "INPE-ISRO cross support and inter-operability and co-operation have been widely demonstrated under this joint effort for Chandrayaan-1 mission".

Interplanetary Internet Passes First Test[1]

19 November 2008, by Rachel Courtland

NASA has finished its first deep-space test of what could become an 'interplanetary internet'. The new networking commands could one day be used to automatically relay information between Earth, spacecraft, and astronauts, without the need for humans to schedule transmissions at each point.

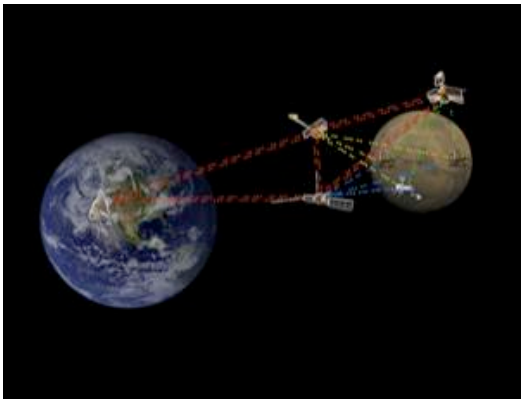
Spacecraft beyond Earth's orbit usually communicate directly with Earth - the first to do so through an intermediary were the Mars Explorations Rovers, which launched in 2003. The Spirit and Opportunity rovers transmit data to orbiters, which then send the data back to Earth.

But human intervention is still required to schedule communications sessions for orbiters and landers. "The traditional method of operations is largely manual," says Jay Wyatt of NASA's Jet Propulsion Laboratory in Pasadena, California.

[1] Reprinted with permission from http://www.newscientist.com/article/dn16086.

"People get in a room and decide when they can send data."

A new method would automate and streamline this process by sending data through an interplanetary 'internet'. Just as data is sent from one point to another on the internet via a linked network of hubs, or nodes, spacecraft scattered throughout the solar system could be used as nodes to transmit data through space.



Last week, NASA completed a month-long test of a simulated network of Mars landers, orbiters and mission operations centers on Earth.

For the test, dozens of images of Mars and its moon Phobos were transmitted back and forth between computers on Earth and NASA's Deep Impact spacecraft. The craft, which sent an impactor into Comet Tempel 1 in 2005, has been renamed "Epoxi" now that it its mission has been extended to search for extrasolar planets.

Internet Pioneer

Also transmitted were a four-node diagram of the internet's ancestor, ARPANET, and a photograph of networking visionary J C R Licklider.

The test was the culmination of a collaboration between internet pioneer Vinton Cerf and NASA that began in 1999.

The new protocol is somewhat different from the one that forms the backbone of the internet, called TCP/IP. On Earth, if some data is lost between a sender and a recipient, the two communicate back and forth until all the information is sent.

That 'handshake' works well on Earth, where the network is almost always continuously connected, says Adrian Hooke, team leader at NASA Headquarters in Washington, DC.

But in space, probes pass behind planets and out of range, power outages are common, and distances between planets vary as the planets move in their orbits. In addition, at distances not far beyond the Moon, the time required to beam data between a sender and a recipient makes back-and-forth communication between the two inefficient, says Hooke.

Space Hackers

To avoid such issues, the new protocol, called Disruption- or Delay-Tolerant Networking (DTN), commands each node in the network to store information until it can find another node that can receive the information.

Data is relayed in a chain and should only need to be transmitted once. "The nodes themselves can take care of making sure the data moves progressively from the source to its destination," Hooke told New Scientist.

To guard against hackers, the data transmitted over DTN is encrypted. In order to transmit or accept data, a node must identify itself to its companion, a concept called 'mutual suspicion.'

International Network

On Earth, DTN has been tested in a variety of projects - from boosting cellular connections in remote locations and improving battlefield communications to using snowmobiles to extend internet access to reindeer herders.

Hooke hopes to incorporate the protocol on upcoming space missions, beginning with robotic missions to the Moon. "The goal is by the end of 2011 to have these protocols ready to go out of the box, so we can give them to project managers to load onto spacecraft," Hooke says.

The team is also working to get the protocol accepted by the international community, so that other spacecraft could join the network.

Spacecraft communicating through DTN could also alleviate traffic on NASA's Deep Space Network, a collection of ground-based radio antennas used to communicate with space probes. Some say the network will soon have trouble meeting demands on its time.

The DTN protocol has been erased from Epoxi, one of the conditions for use of the spacecraft, Hooke says. But the team plans to set up a permanent DTN node at the International Space Station. The protocol will be uploaded to a payload aboard the station in mid-2009.

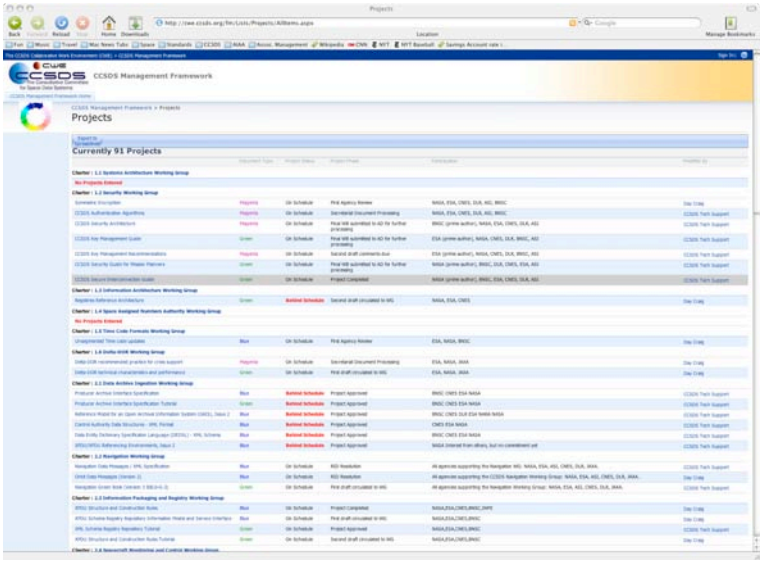
More DTN in the News

The reprinted article above was only one in a series of pieces about the successful DTN test in October that were published recently. Numerous CCSDS experts and WG members were quoted in many of them, with Adrian Hooke doing a number of interviews. NASA has created a page containing links to most of the articles here.

Secretariat Update

With the help and cooperation of the CESG and WG leads, the Secretariat has deployed and populated a new application on the CCSDS website which allows greater visibility into the CCSDS work program. The system allows WGs to maintain their charters and project schedules in an online format that provides real-time data to the general public and the CMC and CESG. This tool is intended to be used to provide a single point of entry to see what standardization projects are currently being addressed. Document development milestone schedules for each project are also included. These schedules will be maintained by the CCSDS WGs and updated as necessary.

The project list can be found here. Your feedback and comments on this new tool would be welcomed and appreciated. Please feel free to pass any thoughts to the secretariat mailing list below.



Of course, we continue to support the day to day work of the CESG, CMC, ISO TC20/SC13, and the CCSDS working groups. To contact the secretariat, simply send an email to secretariat@mailman.ccsds.org.

For Your Information

Save the Date for Future CCSDS Meetings

The Spring 2009 meetings are currently planned to be held at the scenic Penrose House in Colorado Springs, CO, USA. The schedule has the technical meetings being held 20-25 April with the management meetings the following week. Watch the website for more information as it becomes available. Logistics for the meetings are currently being finalized by the secretariat staff and will be announced very soon. Please watch the CCSDS website for the most up-to-date information regarding these meetings.

ESA will host the Fall 2009 meetings at ESTEC in Noordwijk, Holland. Current plans have the WG meetings taking place the last week of October and the management meetings the first week in November. The final meeting venue is still being coordinated as ESTEC may not be able to accommodate the large number of WGs and participants. Again, please watch the website for final plans.

Presentations from the International Workshop on Lunar Surface Wireless Communications and Navigation are Now Available

On 13 October, in conjunction with the CCSDS technical working group meetings in Berlin, an international workshop on lunar wireless communications was held. The session was dedicated specifically to addressing planetary surface communication domains as inherently networked segments that will potentially make use of commercially-derived wireless technologies.

The presentations delivered at the workshop have been posted and are available here.

NASA's Paul Gill to Receive AIAA Standardization Award

During the 47th AIAA Aerospace Sciences Meeting in Orlando Florida, 5-8 January 2008, NASA's Paul Gill will be awarded the AIAA Excellence in Aerospace Standardization Award for "original vision and implementation of an outstanding and innovative technical standards initiative to support NASA's engineering and technical staff and the aerospace industry."

Mr. Gill serves as the manager of the NASA Technical Standards Program. During his tenure in this position, through his vision and by his initiative, he has been instrumental in leading the development and implementation of an outstanding and innovative standards initiative that supports NASA's staff in designing and developing the safest and most reliable space hardware possible. This initiative required the development and implementation of original and unique capabilities not otherwise available within the aerospace industry.

Help Spread the Word About CCSDS

In an effort to keep the widespread and continued use of CCSDS work in front of the greater space community, we have developed an organization communication plan. Part of this plan calls for issuing periodic press releases coinciding with significant missions, mission milestones, successes, demonstrations in which CCSDS specifications have played a role.

While we on the Secretariat staff can monitor the U.S.-based missions fairly well, we would very much appreciate your help in keeping us apprised of events worthy of further publicity occurring within your local space programs.

Of course an opportunity for publicity does not necessarily have to be directly mission-related. If you feel that ongoing standard development work may be of interest to a broader audience, let us know and we will help you to get the word out.

Please send any and all suggestions you may have at any time to secretariat@mailman.ccsds.org.

New and Noteworthy

The following documents have recently been released for formal agency review or have been published.

Documents Under Review (beginning October 2008)

The following draft CCSDS documents are currently open for public review and comment. A "Red Book" denotes a new draft CCSDS document released for review while "Pink Sheets" are proposed change pages to be added to currently published documents.

CCSDS 353.0-R-1 (Red Book): *Symmetric Encryption*

CCSDS 135.0-P-3.1 (Pink Sheets): *Space Link Identifiers*

CCSDS 301.0-P-3.1 (Pink Sheets): *Time Code Formats*

CCSDS 132.0-P-1.1 (Pink Sheets): *TM Space Data Link Protocol*

CCSDS 232.0-P-1.1 (Pink Sheets): *TC Space Data Link Protocol*

CCSDS 732.0-P-2.1 (Pink Sheets): *AOS Space Data Link Protocol*

Review instructions as well as document descriptions and comment deadlines can be found on the CCSDS document review website.

Recently Published Documents (since June 2008)

CCSDS 740.0-G-1: Mars Mission Protocol Profiles - Purpose and Rationale
This CCSDS Informational Report provides an operations overview for Mars mission interoperability and gives the supporting rationale for the relevant communications protocols to be used in Mars end-to-end operations for packet or file relaying.

CCSDS 401.0-B-19: Radio Frequency and Modulation Systems - Part 1: Earth Stations and Spacecraft
These Recommendations are developed for conventional near-Earth and deep-space missions having moderate communications requirements.

CCSDS 913.1-B-1: Space Link Extension - Internet Protocol for Transfer Services
This Recommended Standard defines a protocol for transfer of SLE Protocol Data Units using TCP/IP.

CCSDS 914.0-M-1: Space Link Extension - Application Program Interface for Transfer Services - Core Specification
This Recommended Practice defines a C++ Application Program Interface (API) for CCSDS Space Link Extension (SLE) Transfer Services.

CCSDS 914.2-G-2: Space Link Extension - Application Program Interface for Transfer Services - Application Programmer's Guide
This Application Programmer's Guide provides tutorial material for software developers wishing to integrate the API into SLE user applications or SLE provider applications.

The current mission count stands at 351! Please help us to stay on top of this important statistic by informing the Secretariat any time a new program, mission, or vehicle you are working on decides to implement one of our specifications.

CCSDS Leadership

Mike Kearney — CMC Chair and General Secretary
Adrian Hooke — CESG Co-Chair
Nestor Peccia — CESG Co-Chair
Eduardo Bergamini — ISO TC20/SC13 Chair

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Erin Cliggett Kahn — CMC/CESG/SC13 Operations
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Craig Day — Process Support