Consultative Committee for Space Data Systems

CCSDS
OPERATING PLAN
FOR
STANDARDS DEVELOPMENT

CCSDS A01.2-Y-3

DRAFT YELLOW BOOK

November 2004

FOREWORD

At time of publication, the active Member and Observer Agencies of the CCSDS were:

Member Agencies

- Agenzia Spatiales Italiana (ASI)/Italy.
- British National Space Centre (BNSC)/United Kingdom.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Federal Space Agency (FSA)/Russian Federation.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- Centro Tecnico Aeroespacial (CTA)/Brazil.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- Communications Research Laboratory (CRL)/Japan.
- Danish Space Research Institute (DSRI)/Denmark.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Federal Science Policy Office (FSPO)/Belgium.
- Hellenic National Space Committee (HNSC)/Greece.
- Indian Space Research Organization (ISRO)/India.
- Institute of Space Research (IKI)/Russian Federation.
- KFKI Research Institute for Particle & Nuclear Physics (KFKI)/Hungary.
- MIKOMTEK: CSIR (CSIR)/Republic of South Africa.
- Korea Aerospace Research Institute (KARI)/Korea.
- Ministry of Communications (MOC)/Israel.
- National Oceanic & Atmospheric Administration (NOAA)/USA.
- National Space Program Office (NSPO)/Taipei.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

Document	Title	Date	Status
CCSDS A01.2-Y-1	CCSDS Operating Plan for Standards Development	December 1999	Original Issue 1
CCSDS A01.2-Y-2	CCSDS Operating Plan for Standards Development	May 2004	Issue 2
CCSDS A01.2-Y-3	CCSDS Operating Plan for Standards Development	November 2004	Draft Issue 3

CONTENTS

1 SYSTEMS ENGINEERING AREA

1.1 SYSTEMS ARCHITECTURE WORKING GROUP

Title of Group	**1.1 Systems Architecture Working Group**
Chair	**Takahiro Yamada**
Area Director	**Peter Shames**
Mailing List	**sea-sa@mailman.ccsds.org**

1.1.1 RATIONALE

The work done in the other Working Groups is focused upon services and protocols provided by specific components of space data systems. In order for these Working Groups to generate standards in such a way that every standard is consistent and coherent with any other standard generated by CCSDS, CCSDS requires a reference architecture that can be used as a common framework by all the Working Groups of CCSDS and also by engineers in the member Agencies who use CCSDS standards to build systems and to provide services. The reference architecture should encompass both informatics and telematics aspects of space data systems and cover all problem areas associated with space data systems (such as organizational, functional, operational and cross support issues).

1.1.2 GOALS

The goals of this Working Group are to:

1. Define a reference architecture that provides a framework for generation of space data systems standards and development of space data systems. This reference architecture should define a set of architectural views that encompass organizational, functional, informational, operational, security, communications, and cross support aspects;

2. Document the reference architecture identifying basic elements in each of the views mentioned above;

3. Develop a document that provides to the other Working Groups and BOFs, guidelines on how to apply the reference architecture;

4. Develop formal methods for representing space data systems architectures that will enable sharing of architectural information among engineers;

5. Develop tools that will facilitate design, modeling, and simulation of system architectural designs;

6. Provide a consistent set of views and terminology across all of the other Areas and Working Groups. Use existing CCSDS terms where they are clear and unambiguous. Resolve to develop a single agreed approach where there are ambiguous or conflicting uses of terms or definitions.

1.1.3 SCHEDULE AND DELIVERABLES

Date	Milestone
19 May 2003	WG established
30 November 2003	Publish a revised version of the reference architecture document (Issue 0.8) that identifies basic elements in the architecture in a more concrete way
October 2003	Selection of candidate languages and tools. Prototyping (phase 1) of selected languages and tools starts WG meeting. Reports of prototyping (phase 1). Publish a draft report (Issue 0.1) on guidelines on how to apply the reference architecture. Coordination meetings with at least one other working group on use of Reference Architecture
January 2004	Publish a revised version of the reference architecture document (Issue 0.9), a representation method document (Issue 0.1), and a tool usage guideline document (Issue 0.1). Prototyping (phase 2) starts
March 2004	In collaboration with at least one other Working Group, develop a domain specific reference architecture and publish the resulting document
April 2004	WG meeting. Reports of prototyping (phase 2). Coordination meetings with at least one other working group on use of Reference Architecture to develop or revise domain specific architecture. Publish the final version of the reference architecture document (Issue 1.0 Red Book), the report on guidelines (Issue 1.0), the representation method document (Issue 1.0), and the tool usage guideline document (Issue 1.0)

Date	Milestone
July 2004	In collaboration with at least one other Working Group, develop a domain-specific reference architecture and publish the resulting document
October 2004	WG meeting. Reports of prototyping (phase 3). Coordination meetings with at least one other working group on use of Reference Architecture to develop or revise domain specific architecture. Review the final version of the reference architecture document (Issue 1.0) and revise it as necessary. Publish as Blue Book., Review the report son guidelines, representation methods. and tool usage guidelines and revise as needed based upon experience. Publish these as Green books

1.1.4 RISK MANAGEMENT STRATEGY

1.1.4.1 Technical Risks

Languages and tools that can be used in our work are still under development in other standards bodies and it may not be possible to select the best languages and tools at the time we need to make the selection.

1.1.4.2 Management Risks

Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

Use of ambiguous or conflicting terms, definitions, and/or viewpoints in other WGs may result in impact on those WGs to resolve same.

1.1.5 RESOURCE REQUIREMENTS

Lead agency	ISAS: 1 person @30% commitment for architecting and document generation
Participating Agencies	NASA: 3 persons @20% commitment for architecting and document review ESA: 2 persons @30% commitment for architecting and prototype development CNES: 2 persons @30% commitment for architecting and prototype development

	BNSC: 1 persons @10% commitment for architecting and document review INPE: 1 persons @10% commitment for architecting and document review

1.2 SYSTEMS ARCHITECTURE WORKING GROUP

Title of Group	**1.2 Security Working Group**
Chair	**Howard Weiss**
Area Director	**Peter Shames**
Mailing List	**sea-sec@mailman.ccsds.org**

1.2.1 RATIONALE

CCSDS develops communications and mission operation standards that support inter and intra agency operations and cross support. CCSDS standards include elements of flight and ground systems that are developed and operated by different agencies and organizations.

Over the years, ubiquitous network connectivity among principal investigators and mission operations has become the norm, which makes mission operations more dangerous than in the past when operations were carried out over closed, mission-only networks. The security risks to both spacecraft and ground systems have increased to the point where CCSDS must adopt existing or develop (as necessary) Information Security standards in order to protect both flight and ground mission critical resources and protect sensitive mission information.

As a result, a mission threat statement for CCSDS should be developed in order to allow mission planners to better understand the threats that they should plan to counter via security requirements. CCSDS also requires a Security Architecture as part of its overall System Architecture. CCSDS must promote secure interoperability for space missions. CCSDS also requires Information Security standards as part of, or as an accompaniment to its communications and mission operations standards.

1.2.2 GOALS

The goals of this Working Group are to:

1. Provide advice and guidance on information security to all CCSDS activities;

2. Identify data protection, information assurance, and information security issues across the full spectrum of CCSDS activities and provide solutions;

3. Formulate courses of actions to incorporate security policies, security services, and security mechanisms into CCSDS work items across all Working Groups;

4. Develop the security architecture portion of the overall CCSDS System Architecture being developed by the Systems Architecture Working Group;

5. Develop and maintain an Information Security threat statement for CCSDS;

6. Develop an information security guide for mission planners;

7. Formulate a policy framework for developing trust agreements, rules for operational engagement, ensuring security compliance of legacy systems, and standard, secure interfaces between systems and across security domains;

8. Adopt or develop (as necessary) interoperable security standards for CCSDS and CCSDS cross support infrastructure (e.g., authentication, encryption, integrity, key management, key distribution, etc.);

9. Develop reference implementations and perform interoperability testing;

10. Write a Green Book to describe security guidelines for implementation;

11. Hold working meetings with other Working Groups to develop agreed approaches and formulate the plans for integrating them into the work of these other Working Groups.

1.2.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
30 May 2003	WG established
August 2003	Establish a Security Working Group with firm staff commitments by August 2003
July 2003	Update and circulate for comments the CCSDS Security Green Book (CCSDS-350.0-G-1)
October 2003	Sec WG meeting: Review and ready for publication updated Security Green Book. Meet with at least one other working group to identify critical elements that need to be worked Develop detailed plans for SecWG work items identified as TBD and update charter

Date	**Milestone**
December 2003	Issue revised Security Green Book for CCSDS review Work with the Architecture WG to develop the CCSDS Security Architecture
February 2004	Develop an information security threat statement for CCSDS. Review with other working groups as needed using telecoms or other means
May 2004	Sec WG meeting: Review Security Architecture and security threat assessment and publish as draft Green Book. Meet with at least one other working group to identify critical elements that need to be worked
March 2005	Formulate a security policy framework document to be published as a Green Book
October 2004	Sec WG meeting: Finalize Security Architecture reference and publish as Red Book. First draft of space adaptation of Common Criteria-based Protection Profiles. Finalize security threat assessment and publish as Green Book. Review security guidelines for interoperability and publish as draft Green Book. Meet with at least one other working group to identify critical elements that need to be worked
December 2004	Develop an information security guide to include threat/risk analysis, security planning, and contingency and disaster recovery planning for mission planners
April 2005	Sec WG meeting: Publish Security Architecture reference Blue Book. Finalize security guidelines for interoperability and publish as Green Book. Meet with at least one other working group to identify critical elements that need to be worked
May 2004	White book - Recommend a CCSDS authentication standard including draft APIs White book - Recommend a CCSDS encryption standard including draft APIs
August 2004	White book - Recommend a CCSDS key management standard including draft APIs

Date	Milestone
After each fall CCSDS meeting	Review CCSDS draft recommendations for information security content (or lack thereof)
November 2004	Develop Security Guidelines for Interoperability and publish as a Green Book
February 2005	Red book - Recommend a CCSDS authentication standard. Develop reference implementations and perform interoperability testing Red book - Recommend a CCSDS encryption standard. Develop reference implementations and perform interoperability testing Red book - Recommend a CCSDS key management standard. Develop reference implementations and perform interoperability testing
March 2006	Blue book - Recommend a CCSDS authentication standard Blue book - Recommend a CCSDS encryption standard Blue book - Recommend a CCSDS key management standard

1.2.4 RISK MANAGEMENT STRATEGY

1.2.4.1 Technical Risks

Security is still a different and often obtuse part of CCSDS' work and is often treated as an "outsider." It is not "mainstream" CCSDS nor is it "traditional" CCSDS. In the past, it has been met with resistance. This is changing and there is now general acceptance of the need for security services. But it is yet to be seen whether necessary resources will be continued to be made available.

Given different policies in various countries toward import, export and use of security technology choosing an acceptable set for adoption may be somewhat problematic.

1.2.4.2 Management Risks

Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

Identification of specific security guidelines may result in additional work items being agreed upon with other working groups.

1.2.5 RESOURCE REQUIREMENTS

Lead Agency	NASA: 1 person at 40% commitment
Participating Agencies	NASA: 3 people at 10% commitment
	ESA: 2 people at 10% commitment
	CNES: 2 people at 10% commitment
	BNSC: 1 person at 20% commitment

1.3 INFORMATION ARCHITECTURE WORKING GROUP

Title of Group	**1.3 Information Architecture Working Group**
Chair	**Dan Crichton**
Area Director	**Peter Shames**
Mailing List	**sea-ia@mailman.ccsds.org**

1.3.1 RATIONALE

In the absence of information system standards for interoperability and cross-support we have seen systems be developed that do not allow the exchange of information across ground and flight systems and across agency data systems.

The focus of this working group is to define a reference Space Information Architecture that encompasses the capture, management and exchange of data for both flight and ground environments across the operational mission lifecycle. The includes standard functional components for information management, definition of standard interfaces for information management, standards in information representation (data structuring and packaging mechanisms) and standard definitions of information processes (how the users and the systems interact).

This includes defining how existing standards fit into an overall reference architecture. The reference architecture should encompass informatics aspects of space data systems and cover all problem areas associated with space data systems (such as organizational, functional, operational and cross support issues). This working group has been delegated responsibility for elaborating the Information Architecture for the Information Viewpoint in the System Architecture being developed in the SAWG. The products of this working group will be integrated into the Reference Architecture for Space Data Systems (RASDS).

1.3.2 GOALS

The goals of this Working Group are to:

1. Define a reference end-to-end space information architecture for interoperability and cross support that encompasses both flight and ground data system operations and provides a common framework for use by standards and systems developers. The reference space information architecture includes:

    a. Standard functional components for information management;

    b. Definition of standard interfaces for information management;

c. Standards in information representation;

d. Standards in defining information processes.

2. Define and leverage common methods for representing information architectural views;

3. Address application layer information management issues including application protocols and data handling, and ensure that they are dealt with in a clear and consistent way throughout the end-to-end system;

4. Work with the SEA System Architecture Working Group to provide the Information Architecture elements for the Reference Architecture for Space Data Systems (RASDS) and with the MOIMS Working Groups to develop the specific standard interfaces and protocols. Make recommendations to the other Working Groups and BOFs regarding architectural choices and options.

1.3.3 SCHEDULE AND DELIVERABLES

1. Define how component and interface information standards within CCSDS fit into the Reference Architecture for Space Data Systems (RASDS);

2. Identify formal representation methods, tools, and approaches that will permit design, modeling, and simulation of information architectural designs;

3. Write a CCSDS space information architecture recommended standard that includes:

   a. A set of functional information infrastructure components;

   b. A set of information infrastructure interfaces for information management;

   c. A set of information descriptors that are capable of representing data across the mission life cycle;

   d. Set of interfaces for cross support services, application program interfaces, and information management and access protocols.

Date	**Milestone**
28 May 2003	BOF established
October 2003	BoF meeting. Update on initial architecture and mapping of CCSDS standards. Coordination meeting with MOIMS
November 2003	BoF is chartered as a full WG
December 2003	Publish an initial version of the reference Information Architecture document that identifies basic elements in the architecture. Review with relevant experts and MOIMS
February 2004	Publish a revised version of the reference information architecture document
March 2004	Working meeting with IAWG and MOIMS
April 2004	IAWG meeting. Publish the final version of the reference information architecture document, its mapping to CCSDS existing standards efforts, and to a prototype implementation
May 2004	Working meeting with IAWG and MOIMS Agree on IA terms of reference and on specific interfaces and protocols to be developed
June 2004	Draft of best current practices document on information architectures
October 2004	IAWG meeting Publish red book version of Information Architecture Reference document, ensure integration with RASDS and MOIMS development plans. Final of best current practices document on information architecture
February 2005	Publish blue book version of Information Architecture Reference document

1.3.4 RISK MANAGEMENT STRATEGY

1.3.4.1 Technical Risks

Languages and tools that can be used in our work are still under development in external standards bodies and it may not be possible to select the best languages and tools at the time we need to make the selection.

Standards for interfaces and protocols for distributed services are still under development in external standards bodies and it may be difficult to select a final set of approaches without some significant evaluation and prototyping efforts.

1.3.4.2 Management Risks

Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

There is an open issue between the IAWG and MOIMS / IPRWG as to the most appropriate distributed information architecture. This will have to be resolved before this work can be concluded.

Agencies and projects that implement their own architectures and do not choose to coordinate or adopt any interoperable standards or reference architectures.

1.3.5 RESOURCE REQUIREMENTS

Lead Agency	NASA: 1 person at 40% commitment for architecture work and document generation
Participating Agencies	NASA: 3 people at 30% commitment for architecture work and prototype development
	ESA: 1 person at 20% commitment for architecture work and prototype development
	CNES: 1 person at 20% commitment for architecture work and document review
	BNSC: 1 person at 10% commitment for architecture work and document review
	INPE: 1 person at 10% commitment for architecture work and document review

1.4 SPACE ASSIGNED NUMBERS AUTHORITY SANA BIRDS OF A FEATHER

Title of Group	**1.4 Space Assigned Numbers Authority Birds of a Feather**
Chair	**Peter Shames**
Area Director	**Peter Shames**
Mailing List	**sea-sana@mailman.ccsds.org**

1.4.1 RATIONALE

CCSDS A02.1-Y-2. *Restructured Organization and Processes for the Consultative Committee for Space Data Systems*. Yellow Book. Issue 2. April 2004:

> **1.4.6 Space Assigned Numbers Authority (SANA)**. The core registrar for the CMC's activities is the SANA. Many space mission protocols require that someone keep track of key protocol numbering assignments that were added after the protocol came out. Typical examples of the kinds of registries needed are for Spacecraft IDs, protocol version numbers, reserved APIDs and SFDU Control Authorities. The SANA provides this key configuration management service for CCSDS. The CMC approves the organization that will act as the SANA. Its public interface is focused through web-based services provided by the Secretariat.

At present the SANA exists only as a concept. There are many different data objects that need to be globally accessible within the CCSDS in order to support mission planning and operations and the activities of CCSDS itself. A "Data Object", within this context, is defined as any known or imagined participant in mission communications, planning, and operations or trajectory propagation, tracking, attitude determination and orbit determination. Examples include:

1. Protocol entities and assigned numbers;
2. Radiometric tracking stations (individual antennas; maybe complexes);
3. Orbiters, Rovers, landers, balloons, airplanes, small stations;
4. Multi-part spacecraft that substantially separate sometime during the mission.
5. Orbiters, Rovers, landers, balloons, airplanes, stations;
6. Multi-part spacecraft and constellations that substantially separate sometime during the mission.

Like the IANA, on which it is patterned, the SANA has a few different aspects:

1. The SANA is an information registry, access, and management service to handle assigned numbers, identifiers and descriptions for CCSDS, its member agencies, and their operational missions;

2. The SANA manages certain sets of CCSDS developed global information;

3. The SANA provides a registry service for other relevant integrated information sets and a framework for making these information sets available through a common web-based interface;

4. The SANA web interface will also provide pointers to other relevant space operations information registries;

5. The SANA web interfaces will be linked into the CCSDS web site.

We propose to define the SANA requirements, functionality, processes, contents, implementation approach, and to develop a functioning prototype of this service. The SANA will develop specific databases of CCSDS owned global information. Existing information sources and their control authorities shall be maintained and their information will be integrated into the common SANA framework. With support from the SANA WG, other WGs within CCSDS and in external organizations are expected to provide the detailed specifications and processes for their data holdings. Operation of the final SANA will be delegated to some CMC designated organization

1.4.2 GOALS

The goals of this Birds of a Feather include:

1. Define the SANA requirements, operations concept, and functionality, including security;

2. Define a viable implementation approach for the SANA, leveraging current work in the SEA IA WG, the Grid, and associated web service communities;

3. Develop a prototype of the SANA using the selected technologies, providing at least three different sets of relevant data objects from different organizations;

4. Define and document SANA architecture, infrastructure, contents, procedures, and processes;

5. Transition SANA into operational status under Secretariat (or other) responsibility, identify FTEs to sustain and support deployment into any cooperating organizations.

1.4.3 SCHEDULE AND DELIVERABLES

Date	Milestone
13 August 2004	SANA Charter submitted to CESG
30 September 2004	Requirements, ops concept, and functionality documented in draft Green Book
1 October 2004	Initial SANA Prototype available with three different data sets at two different organizations
29 October 2004	White Book for SANA Architecture, Procedures, and Installation and Operational Processes
14-19 November 2004	SANA WG meeting, review available documents
February 2005	Working meeting with SANA WG, coordinate final White Book (draft BB), review final Green Book
18 March 2005	Final Green Book on SANA Requirements, ops concept, and functionality
May 2005	SANA WG meeting finalize Red Book and Yellow Books for review by agencies
June 2005	Agency review of Red and Yellow Books
August 2005	Start transition of SANA to operational status
1 September 2005	All major databases installed in central SANA site, at least one other external database connected
16 September 2005	Final SANA Architecture & standards Blue Book, Procedures, Installation and Operational Processes Yellow Books
30 September 2005	Transition to full operational status

1.4.4 RISK MANAGEMENT STRATEGY

1.4.4.1 Technical Risks

Technical risks are low since there is already broad technical support for a variety of web based service technologies. Another challenge is to make sure that we can update underlying technologies, if and when we decide it is necessary, while not disturbing the on-going delivery of services. While there is still a lot of technical development, and

new approaches are being invented regularly, there is already more than one proven approach to accomplishing this using currently available technologies. Dealing with data integrity issues is a risk to the quality of the provided information.

1.4.4.2 Management Risks

The biggest management challenges are likely to come from existing organizations who already manage some of these data sets using existing technologies, but who may not wish to make the effort to put them on-line or to integrate them into the structure. We will make every effort to work with these groups and to assist with the integration of these data if they are deemed useful to the global CCSDS organization and the space community.

1.4.5 RESOURCE REQUIREMENTS

WG Lead, 0.25 FTE	NASA/JPL
Prototype, 0.5 FTE	NASA/JPL
Database integration, 0.1 FTE	NASA/JPL
Database integration, 0.2 FTE	NASA/GSFC
Database integration, 0.1 FTE	ESA/ESOC
Database integration, 0.2 FTE	NASA/MSFC
Database integration, 0.1 FTE	JAXA/ISAS
Database integration, 0.1 FTE	CNES

2 MISSION OPERATIONS AND INFORMATION MANAGEMENT SERVICES AREA

2.1 DATA ARCHIVE INGEST WORKING GROUP

Title of Group	**2.1 Data Archive Ingest Working Group**
Chair	**Donald Sawyer**
Area Director	**Nestor Peccia**
Mailing List	**moims-dai@mailman.ccsds.org**

2.1.1 RATIONALE

Agencies need to reduce the cost and increase the automation associated with acquiring and ingesting data and metadata to archives. Archives, including both mission and final, need appropriate metadata to accompany data objects to facilitate long term preservation. Currently submission requirements are usually totally ad hoc by mission, or by a given multi-mission archive or final archive. Producers of information for archives often seek guidance on how to submit such information. The OAIS reference model and the Producer-Archive Interface Methodology Abstract Standard set a context for all archives. Further, registries are of increasing importance as the holders of re-usable metadata in the exchange of information. This work will establish an extensible framework for a Submission Information Package (SIP). It will include mandatory and optional elements, with the ability to recognize categories of information and relationships.

2.1.2 GOALS

1. Definition of the main metadata categories and attributes;

2. Define a way to create a dictionary of various classes of objects that will be considered (with the CCSDS Data Entity Dictionary Specification Language [DEDSL] standard), taking into account the general metadata identified above, and metadata specific to each given context;

3. Define a method for creating a model of the instances of objects to be transferred during operations (from producer to archive);

4. Map instances in the existing XML Structure and Construction Rules (XFDU) Package paper with the model and the dictionary.

5. Develop two implementations of the *Specification for the Formal Definition and Transfer Phase of a Producer-Archive Interface;*

6. Complete the review and progression of the *Specification for the Formal Definition and Transfer Phase of a Producer-Archive Interface* to full CCSDS and ISO standards;

7. Monitor and report on archive issues and implementation at Agencies;

8. Complete the review and progression of the *Producer-Archive Interface Methodology Abstract Standard* to full CCSDS and ISO standards.

2.1.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
19 May 2004 Completed	WG chartered and active
September 2003 Completed	Complete review comments on the Producer-Archive Interface Methodology Abstract Standard (PAIMAS) document and resolve as many RIDs as possible prior to the fall WG meeting
October 2003	Results from a survey of metadata categories and attributes used within a SIP by various Agencies
May 2004 Completed	Submit revised PAIMAS Standard as a final CCSDS Standard
September 2004 Completed	Submit CCSDS PAIMAS Standard for review as ISO Standard
October 2004 Completed	Proposed metadata categories, optional and mandatory, with specific attributes for the SIP
March 2005	Add updated metadata categories and attributes with proposed mapping to the XFDU package
May 2005	PAIMAS Standard finalized as an ISO Standard
July 2005	Generate CCSDS SIP “Proposed Standard” and initiate review
December 2005	Generate CCSDS SIP “Draft Standard” and initiate review. Begin two draft Agency implementations
July 2006	Generate CCSDS Recommended Standard and two implementations (or a second round for a Draft Standard)

2.1.4 RISK MANAGEMENT STRATEGY

2.1.4.1 Technical Risks

Technical risks are low since there is already broad activity in this area and many years of experience of ad hoc non-standardized activities meeting the needs of individual archives.

The initial scoping is the Space agency archives and their Producers. It may also be expanded if reviewers outside the proposed scope find it relevant and useful. However, past reluctance of CCSDS and some CCSDS Member Agencies to support archive standardization activities have limited participation by outside parties. The lower level of participation in CCSDS standardization activities may result in standards that are less well accepted outside the CCSDS community. It also introduces more possibilities for outside standards that may overtake or conflict with CCSDS activities. Working group members continue to network with their colleagues outside the CCSDS to mitigate as much of the risk as possible.

The SIP standard and implementations have some dependence on the development of the XFDU standard and implementations by the MOIMS-IPR Working Group. Management of XFDU development risk is left to be addressed by the MOIMS-IPR Working Group.

2.1.4.2 Management Risks

Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

CCSDS CESG opposition to the PAIMAS standard resulted in at least a 6 month slippage in reaching the final CCSDS and ISO Standards. Approved CCSDS Operating Procedures that are informed by and reviewed by CCSDS Working Group participants would be useful for limiting this type of risk in the future.

Due to problems confirming PAIMAS, Lead Agencies did not initially allocate resources to the follow-on work (SIP Standard). This has resulted in about a 6 month slippage from the original estimate for most of the deliverables.

CCSDS Secretariat procedural problems have resulted in an additional slippage of 6 months to reach the final ISO Standard. We will continue to monitor ISO progress ourselves as we have been doing to identify future problems. This monitoring resulted in raising the current issue and preventing even more slippage. We understand that the CCSDS Secretariat has implemented new CCSDS Resolution tracking procedures which will mitigate future problems.

2.1.5 RESOURCE REQUIREMENTS

WG Lead	0.20 FTE/Year	NASA/GSFC
WG Deputy	0.20 FTE/Year	CNES
Archive Architect	0.25 FTE/Year	
SIP Editor	0.30 FTE/Year	CNES
SIP Assistant Editor	0.20 FTE/Year	NASA/GSFC
SIP Implementers	0.20 FTE/Year	CNES(2) NASA/GSFC(1)
WG Participants/Reviewers (if possible providing individuals with knowledge of OAIS, PAIMAS, XFDU, and existing archive interfaces with ability to do surveys, contribute material and review drafts. The more diverse archival interface experience we have the more likely the resulting drafts will find acceptance during the reviews)	0.10 FTE/Year	NASA/GSFC (3) NASA/JPL(1) NASA/Life Sciences(1) CNES(2) ESA(3) BNSC(1) NARA(2)
WG Participant/Tracker	0.05 FTE/Year	NASA/LARC(1) OCLC(2?) RLG(1) US LOC(2?) Leeds(1?) Lockheed/Martin(1) Other Agencies(?)

2.2 NAVIGATION WORKING GROUP

Title of Group	**2.2 Navigation Working Group**
Chair	**Felipe Flores-Amaya**
Area Director	**Nestor Peccia**
Mailing List	**moims-nav@mailman.ccsds.org**

2.2.1 RATIONALE

The Navigation Working Group provides a discipline-oriented forum for detailed discussions and development of technical flight dynamics standards.

2.2.2 GOALS

1. Development of a Recommendation for the agency-to-agency exchange of orbit (trajectory) data. Deliverable: ODM Blue Book;

2. Development of a Recommendation for the agency-to-agency exchange of tracking data. Deliverable: Green Book and Red Book;

3. Development of a Recommendation for the agency-to-agency exchange of spacecraft attitude data. Deliverable: Green Book and Red Book;

4. Specification of NAV-related requirements for a future, comprehensive object identification scheme. Deliverable: NAV White Paper on Object Identification Requirements;

5. Specification of NAV-related requirements associated with timing issues being addressed by another WG. Deliverable: NAV White Paper on timing issues to Time Services Architecture WG (whichever deals with time).

2.2.3 SCHEDULE AND DELIVERABLES

Date	Milestone
May 2003	WG chartered and active
May-January 2004	Complete the Orbit Data Message Red Book to achieve Blue Book status
May-July 2003	Finalize a proposal for spacecraft and other object identification requirements
May-December 2003	Complete concept of operations for timing services
May-December 2003	Complete description of operational characteristics for tracking data exchanges
2004-2005	Develop new Recommendations for tracking and attitude data messages. Add XML schema to Orbit Data Messages Red Book

2.2.4 RISK MANAGEMENT STRATEGY

2.2.4.1 Technical Risks

The problem and proposed solution are well understood, as they are derived from existing and tested navigation data support functions. Technical risk is minimal.

2.2.4.2 Management Risks

Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

2.2.5 RESOURCE REQUIREMENTS

Lead Agency	NASA (GSFC). Staffing needed: 1 flight dynamics engineer at 30% time commitment per year
Participating Agencies	NASA (JPL). Staffing needed: 2 flight dynamics engineers at 10% time commitment per year
	ESA (ESTEC). Staffing needed: 1 flight dynamics engineers at 10% time commitment per year
	ESA (ESOC). Staffing needed: 1 flight dynamics engineer at 10% time commitment per year
	DLR. Staffing needed: 1 flight dynamics engineer at 10% time commitment per year
	CNES. Staffing needed: 1 flight dynamics engineer at 10% time commitment per year
	NASDA. Staffing needed: 1 flight dynamics engineer at 10% time commitment per year

2.3 INFORMATION PACKAGING AND REGISTRY WORKING GROUP

Title of Group	**2.3 Information Packaging and Registry Working Group**
Chair	**Louis Reich**
Area Director	**Nestor Peccia**
Mailing List	**moims-ipr@mailman.ccsds.org**

2.3.1 RATIONALE

Agencies need to reduce the cost and increase automation among applications associated with the exchange of information applications and those facilities that produce, distribute, and store information. CCSDS has been a leader in developing data packaging techniques and their association with the registration of schemas/data definitions. CCSDS has produced several standards in this area that are in active use within agencies, and include those known as Standard Formatted Data Units, Parameter Value Language, Control Authority Procedures; and Control Authority Data Structures; however, the speed of technology change including the emergence of XML as a standard data description language, the vast increase in the size and interrelationships of space data, and the emergence of the Internet as a data delivery mechanism requires that vastly different versions of these documents be written. Also, the vast increases in space-hardened computer power and communications bandwidth allow techniques that previously were considered ground system only to be utilized in end-to-end space data systems. The large size and binary nature of space prevents the direct usage of commercial or international earth-based standards.

2.3.2 GOALS

The goals of this Working Group include:

1. Collect use cases from the space operations community and develop requirements for XML data packaging;

2. Develop a set of recommendations that specify an extensible framework for packaging data and metadata that can contain an object physically, by Universal Resource Locator (URL), by Universal Resource Identifier (UR), or by Universal Resource Name (URN). This includes the ability to express appropriate relationships using XML and related techniques, and the implementation of the packaging format in an appropriate set of network and file protocols;

3. Oversee the deployment of at least two implementations of the packaging framework;

4. Conduct the implementation and interoperability tests in many areas of space data systems (refer to the Resource Requirements paragraph);

5. Based on testing, develop a second version of the recommendations;

6. Based on testing experience and requirements from various space data and operations groups, establish a registry/repository standard that is extensible, addressing data structures and information modeling. This registry/repository will leverage the more widely based registry work such as ebXML and also support the data packaging registry/repository requirements.

2.3.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
19 May 2003	WG established
10 August 2003	XFDU White Book created Use case requirements available
Overtaken by events	Prototyping for XML packaging starts
Overtaken by events	XFDU final draft document for CESG approval to proposed document (White Book)
Overtaken by events	Prototyping reports
October 2003	MOIMS Area meeting Registry/Repository Concept Paper based on currently implemented standards and requirements from XFDU prototyping environments and further implementation and prototyping
May 2004	Generate CCSDS XFDU Proposed Recommended Standard (Red Book) and initiate review and further implementation and prototyping Joint FTF meeting with Systems Engineering and Information Architecture team to develop works plans in this area
May 2005	Generate CCSDS Recommended Standard and two interoperable reference implementations (or a second round for a draft standard)

Date	Milestone
2005 - 2006	Develop registry/repository data structures, interfaces, and procedure recommendations for the appropriate space operations and data domains. Develop enhancements for the XFDU packaging recommendations based on the planned Version 2 enhancements

2.3.4 RISK MANAGEMENT STRATEGY

2.3.4.1 Technical Risks

The Packaging Recommendation functionality has been split between two planned releases of the XFDU Packaging Recommendation to allow early prototyping of required capabilities. This should allow lessons learned in the prototyping to influence the design of the more complex capabilities

A wide variety of use cases and testing environments including but not limited to:

1. NASA PDS;
2. NASA/EOSDIS Libraries;
3. NASA SLE implementations;
4. CNES SLE implementations;
5. CNES Archive Ingest SIP development;
6. ESA Data Distribution System
7. ESA CAOS.

Overlapping membership, frequent discussions and a minimum of one FTF meeting with the Information Architecture BOF/WG in the Systems Engineering area to avoid significant duplication of effort or significant divergence of concepts.

2.3.4.2 Management Risks

Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

2.3.5 RESOURCE REQUIREMENTS

Lead Agency	NASA or CNES editor. Staffing needed: WG lead (NASA 20%) WG deputy (NASA 15%) Recommendations Editors (CNES 30%, NASA 30%) WG Contributors 10%
Participating Agencies	Testing Coordinator 20% Testers 30%-50% 4-6 months 20% continuing, at least 1 per environment (NASA –3+ CNES 2+, ESA 2+)

2.4 SPACECRAFT MONITORING AND CONTROL WORKING GROUP

Title of Group	**2.4 Spacecraft Monitoring and Control Working Group**
Chair	**Mario Merri**
Area Director	**Nestor Peccia**
Mailing List	**moims-sc@mailman.ccsds.org**

2.4.1 RATIONALE

The ability to standardize the interfaces for Spacecraft Monitoring and Control (SM&C) will allow significant saving in the development of the flight components and the ground segment of future space missions. In fact, it will be possible to use standardized SM&C infrastructure systems, to seamlessly transfer data across systems, and to adopt commercial-off-the-shelf applications for monitoring and control. The high-level goal of this standardization effort is to make economies by:

1. Allowing interoperability with partner system and infrastructure;

2. Reducing the risk of space missions by reusing systems and operational concepts, thus increasing their reliability;

3. Facilitating the development of generic (infrastructure) onboard and ground software that can be shared by multiple projects via simple reconfiguration;

4. Applying the SM&C approach and systems throughout all mission phases and to other M&C domains (e.g., ground stations, control centers, test facilities, etc.).

The scope of the SM&C WG includes:

1. Operational Concept: definition of an operational concept that covers a set of standard operations activities related to the monitoring and control of both ground and space segments;

2. Core Set of Services: definition of an extensible set of services to support the operational concept together with its information model and behaviours. This includes (non exhaustively) ground systems such as Automatic Command and Control, Data Archiving and Retrieval, Flight Dynamics, Mission Planning, Automation, and Performance Evaluation.

3. Application-Layer Information: definition of the standard information set to be exchanged for SM&C purposes.

2.4.2 GOALS

The goals of the WG include:

1. Paving the way for the technical work that will be performed in the context of spacecraft monitoring and control. This will be done by defining the technology-independent framework to be used in future work. It is noted that this activity also involves the space segment, and therefore requires close coordination with the SOIS Area. This will be done by initially producing a White Book, and to bringing it to Green Book status;

2. Specifying the Common SM&C Protocol Service and the core SM&C Application Services as the baseline for further specification;

3. Updating the XTCE standard with the result of the public review together with the OMG;

4. Specifying the other high-level services identified in the Green Book.

2.4.3 SCHEDULE AND DELIVERABLES

GOAL 1

Date	**Milestone**
5 November 2003	Telecon #3: Status Report
3 December 2003	Telecon #4: Status Report
5 January 2004	White Book – Draft 0.1
28 January 2004	Telecon #5: Review
18 February 2004	White Book – Draft 0.2
3 March 2004	Telecon #6: Status Report
28 May 2004	White Book – Draft 0.5
4 June 2004	Telecon: Agreement on White Book Draft 0.5
26 August 2004	Deadline for comments to White Book after 3-month informal Agency review
2 September 2004	Telecon: Agreement on comment disposition
15 September 2004	Submission of White Book to CCSDS as proposed Green Book

GOAL 2

Date	Milestone
14 July 2004	Delivery of concept paper
21 July 2004	Telecon: Agreement on concept paper
October 2004	Delivery of Common SM&C Protocol Service Draft 0.1 and the Core SM&C Application Services Draft 0.1
Next CCSDS WS	Delivery of Common SM&C Protocol Service Draft 0.2 and the Core SM&C Application Services Draft 0.2

GOAL 3
Estimated elapsed time of approximately four months to start after an agreement is reached between CCSDS and OMG.

GOAL 4
To be determined following the successful completion of Goals 1 and 2.

2.4.4 RISK MANAGEMENT STRATEGY

2.4.4.1 Technical Risks

No technical risks are identified.

2.4.4.2 Management Risks

An identified management risk for this effort is a lack of NASA and U.S. support. To mitigate this risk, NASA/JPL has agreed to attempt to broker a review of this proposal to establish if there is sufficient interest to support it over the next three months (i.e., by the end of August 2004).

2.4.5 RESOURCE REQUIREMENTS

May 2004 – December 2004

Name and Associated "Man Months"	**Agency**
M. Merri (0.7mm) M. Schmidt (0.7mm) A. Ercolani (0.3mm) S. Cooper/I. Dankiewicz (9mm)	ESA
Brigitte Béhal (1.0mm) E. Poupart (0.7mm)	CNES
R. Thompson (1.0mm)	BNSC
A. Oyake (0.7mm)	JPL
D. Lokerson (2.1mm)	NASA
T. Yamada (0.7mm)	JAXA
H. Hofmann (0.7mm) TBC	DLR

Agency Total = 8.6mm
Contractor Total = 9mm
Total = 17.6mm

3 CROSS SUPPORT SERVICES AREA

3.1 CROSS SUPPORT CONCEPT AND REFERENCE MODEL WORKING GROUP

Title of Group	**3.1 Cross Support Concept and Reference Model Working Group**
Chair	**Hugh Kelliher**
Area Director	**Fred Brosi**
Mailing List	**css-crm@mailman.ccsds.org**

3.1.1 RATIONALE

The successful use of Space Link Extension (SLE) services in mission operations has resulted in modifications to the SLE Transfer Services. Also, specification of SLE Service Management has progressed significantly since the SLE Reference Model Blue Book and SLE Concept Green Book were published. Feedback is now available from implementers suggesting changes to the SLE Reference Model; it has been more than five years since the SLE Reference Model was published and it should therefore be updated now.

3.1.2 GOALS

1. Review suggested changes to the SLE Reference Model Blue Book and revise it as necessary;

2. Revise the SLE Concept Green Book to make it consistent with the revised SLE Reference Model Blue Book and with the current concept for SLE Service Management.

3.1.3 SCHEDULE AND DELIVERABLES

Date	Milestone
Spring 2004	Space Link Extension — Cross Support Reference Model. Recommendation for Space Data Systems Standards, CCSDS 910.4-B-1. Pink Sheets Issue 1.1. (deliverable A)
Spring 2005	Space Link Extension — Cross Support Reference Model. Recommendation for Space Data Systems Standards, CCSDS 910.4-B-1. Blue Book. Issue 2. (deliverable B)
Spring 2005	Space Link Extension — Cross Support Concept Green Book, CCSDS 910.3-G-2 (deliverable C)

3.1.4 RISK MANAGEMENT STRATEGY

3.1.4.1 Technical Risks

The SLE Reference Model is being revised in line with changes to the SLE Transfer Services and SLE Service Management specifications. Since the latest versions of these specifications do not cover the complete range of SLE services addressed in the SLE Reference Model, there is risk that technical decisions may have been made at the detailed specification level that are inconsistent with the SLE Reference Model as a whole.

The SLE Reference Model and SLE Concept tie together the work on SLE Transfer Services and SLE Service Management. It is possible that there may be inconsistencies in the way the groups working in these two areas have approached the interface between data transfer and service management. This may have an impact on the SLE Reference Model.

These risks have been mitigated in the past by individuals within each of the other working groups assessing impacts on the SLE Reference Model, and by joint meetings of the groups at the spring and fall workshops. In the future, the risk will be mitigated by the fact that the members of the Cross Support Concept and Reference Model Working Group are drawn from the Cross Support Data Transfer Working Group and the Cross Support Service Management Working Group.

3.1.4.2 Management Risks

The Cross Support Concept and Reference Model Working Group depends on individuals whose primary task is to support one of the other Cross Support working groups. Therefore, it is possible that the resources available to update the SLE Reference Model and SLE Concept may be unavailable due to the understandable priority of work in the other working groups.

SLE recommendations have been difficult to pitch at the right level for every type of reviewer: management, user and provider. The existing SLE Reference Model may need substantial modifications if it is to be accepted by agency reviewers. This would drive up the time and effort needed to complete the revision.

3.1.5 RESOURCE REQUIREMENTS

Lead Agency	BNSC will chair the working group and undertake to lead the production of the Cross Support Concept Green Book, Issue 2, i.e., deliverable C
	NASA will undertake to lead the production of the Cross Support Reference Model Pink Sheets, i.e., deliverable A
	ISAS will support the production of the Cross Support Reference Model Pink Sheets, i.e., deliverable A
	NASA will undertake to lead the production of the Space Link Extension — Cross Support Reference Model Blue Book. Issue 2, i.e., deliverable B
	CNES will undertake to support the production of the Cross Support Green Book, Issue 2, i.e. , deliverable C
Participating Agencies	NASA will support deliverables A and B
	ISAS will support deliverable A
	BNSC will support deliverable C
	CNES will support deliverable C

3.2 DATA TRANSFER SERVICES WORKING GROUP

Title of Group	**3.2 Data Transfer Services Working Group**
Chair	**Yves Doat**
Area Director	**Fred Brosi**
Mailing List	**css-dts@mailman.ccsds.org**

3.2.1 RATIONALE

The successful use of Space Link Extension Transfer Services in mission operations resulted in the initiation of further implementations of SLE capabilities. Such projects demand a stable set of standards as well as a dependable framework for a cost effective implementation. The currently available set of Transfer Services is not fully satisfactory for certain missions, as it does not permit to fully benefit from features offered by the existing Space Link Protocols (e.g. COP-1). Feedback is now available from real world operations so that now the Recommendations can be finalized taking into account the hands-on experience gained. SLE API implementations have been successfully used as the basis for several SLE implementations and therefore the investments made both for the API as well as for the applications using it ought to be protected by means of standardizing the relevant interfaces.

3.2.2 GOALS

The goals of this Working Group include:

1. Complete at least the Transfer Service Specifications for Return Channel Frames, Return Operational Control Field, and Forward Space Packet, and advance them to Blue Book status;

2. Adapt the API recommendations to the latest issues of the Transfer Service Specifications, and advance them to Blue Book and Green Book status;

3. Pursue the correction of some minor errors found in the Blue Books in the context of ongoing implementation endeavors by means of Pink Sheets.

3.2.3 SCHEDULE AND DELIVERABLES

Date	Milestone
Spring 2004	Space Link Extension – Forward Space Packet Service Specification, CCSDS 912.3-R-2 with a due date of Fall 2003 CMC Meeting; CCSDS 912.3-B-1
Fall 2003	Space Link Extension – Return Channel Frames Specification, CCSDS 911.2-B-1
Spring 2004	Space Link Extension – Application Program Interface for Transfer Services – Summary of Concept and Rationale, CCSDS 913.0-G-1
Spring 2004	Space Link Extension – Core Specification of the Application Program Interface for Transfer Services, CCSDS 913.1-R-1
Fall 2004	CCSDS 913.1-B-1
Spring 2004	Space Link Extension – Application Program Interface for Transfer Services – Technology Mapping, CCSDS 913.2-R-1
Fall 2004	CCSDS 913.2-B-1
Fall 2003	Space Link Extension – Application Program Interface for Transfer Services – Application Programmer's Guide, CCSDS 913.3-G-1
Spring 2004	Space Link Extension – Application Program Interface for Return Link Services, CCSDS 914.1-R-1
Fall 2004	CCSDS 914.1-B-1
Spring 2004	Space Link Extension – Application Program Interface for Forward Link Services, CCSDS 915.1-R-1
Fall 2004	CCSDS 915.1-B-1
Spring 2004	Space Link Extension – Return Link Transfer Services Specification, CCSDS 911.9-R-1
Fall 2004	CCSDS 911.9-B-1
Fall 2003	Pink Sheets for 'Space Link Extension – Return All Frames Specification', CCSDS 911.1-B-1

Date	Milestone
Spring 2004	CCSDS 911.1-B-2
Fall 2003	Pink Sheets for 'Space Link Extension – Forward CLTU Service Specification', CCSDS 912.1-B-1
Spring 2004	CCSDS 912.1-B-2

3.2.4 RISK MANAGEMENT STRATEGY

3.2.4.1 Technical Risks

1. **Backward Compatibility**. The SLE Data Transfer Services are now in use and have demonstrated their usefulness throughout various missions. In the context of the CCSDS those services will evolve and corrections will be introduced or new functionality will be added. Depending on how the modifications are introduced, the resulting implementation may not be backward compatible and as a result interoperability would no longer be ensured. The Working Group shall ensure a smooth transition between versions and avoid whenever possible non-backward modifications.

2. **Version of the Recommendation Supported by the Agencies**. The Recommendation will evolve to introduce corrections and possibly new functionality. Some Agencies may decide to use the newest versions while some other may decide to stay with previous versions. As a consequence the services required by one Agency may not be in line with the services offered by another.

3.2.4.2 Management Risks

Lack of resources or reassignment of previously-committed is a constant risk to all standards-making processes. The approach to mitigating this risk is to ensure that the right priority is given to the on-going work. The constraints of the implementers should drive this priority. Lack of mission budget ensuring the Working Group members to participate in all meetings. As an alternative videoconferences will be considered to cover specific topics.

3.2.5 RESOURCE REQUIREMENTS

Lead Agency	ESA will undertake to lead the production of the Forward Space Packet Transfer Service Specification
	DLR will undertake to lead the production of the Return Channel Frames Transfer Service Specification
	ESA will undertake to lead the production of all SLE Transfer Service Application Program Interface Documents
	CNES will undertake to lead the production of the SLE Return Link Transfer Services Specification
	DLR will undertake to lead the compilation of the Pink Sheets on the Return All Frames Transfer Service Specification and on the Forward CLTU Service Specification
Participating Agencies	CNES will support deliverables A to H and J and K
	DLR will support deliverable A and deliverables C to I
	ESA will support deliverables B and I to K

3.3 CROSS SUPPORT SERVICES WORKING GROUP

Title of Group	**3.3 Cross Support Services Working Group**
Chair	**John Pietras**
Area Director	**Fred Brosi**
Mailing List	**smwg@mailman.ccsds.org**

3.3.1 RATIONALE

The use of Space Link Extension services require the exchange of information that will allow a space flight mission to acquire those services from SLE service providers. The current ad hoc mechanisms for arranging, scheduling, control, and monitoring of SLE services are fragile and manually intensive. Production of the currently-specified suite of SLE services is coupled to the underlying radio frequency, modulation, coding, and link characteristics. There are no current standards for arranging, scheduling, control, and monitoring of TT&C services. The potential user base for a *service management* standard for arranging, scheduling, control, and monitoring of SLE and TT&C services is larger than the space Agencies that constitute the CCSDS membership.

3.3.2 GOALS

The goals of this Working Group include:

1. Develop a conceptual service management framework for that identifies the categories of interactions between a spaceflight mission and a provider of TT&C and SLE services that are carried out for the purposes of arranging, scheduling, monitoring, and possibly controlling the provision of TT&C and SLE services;

2. Within the scope of the conceptual service management framework, develop a unified standard for the exchange of information by which a spacecraft mission requests SLE and TT&C services from a provider of such services, and ancillary information necessary to make such *service requests* realizable;

3. The service management service request standard is to have the following characteristics:

    a. It will support the request for provider services conforming to CCSDS RF, modulation, coding, space link, SLE transfer service, and orbit and trajectory data Recommendations;

    b. It can be implemented at multiple levels of automation, up to and including the fully automated exchange of all service management

service request information between space flight mission and TT&C/SLE service provider;

c. It will be developed using widely-used, commercially-supported standard methodologies and technologies;

d. It will be organized in a way that will permit future addition of standard interchanges of other categories of information identified in the conceptual service management framework;

e. It will be possible to extend the standard to support the interoperable management of additional services, or refinements to the management of the baseline set of TT&C and SLE services.

3.3.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
W-1.1, July 2003 G-1, May 2004 G-2, October 2004	Space Link Extension — Service Management — Service Request Operations Concept (CCSDS 910.14)
W-2, July 2003 R-1, May 2004 B-1, October 2004	Space Link Extension — Service Management — Service Request Service Specification (CCSDS 910.11)
W-1, July 2003 R-1, October 2004 B-1, October 2004	Space Link Extension — Service Management — Service Request XML Schema Specification (CCSDS 910.?)
W-1.5, March 2004 R-1, July 2004 B-1, December 2004	Space Link Extension — Service Management — Authentication for SLE Services (CCSDS 910.8)

Date	Milestone
Note: The following product is being held in a suspended state, with final resolution pending completion of the Service Request Service Specification and Service Request XML Schema Specification Version 1 Recommendations	Space Link Extension — Service Management Specification (CCSDS 910.?).Formal Specification

3.3.4 RISK MANAGEMENT STRATEGY

3.3.4.1 Technical Risks

The risk that the technology needed to implement the standard will not be available (or too expensive) has been significantly reduced by the adoption of XML as the representation language. XML is the de facto standard data structure specification language, and there is a large and growing number of commercial and free development tools and support by data system products such as DBMSs. The risk that specifications will be incorrect or not feasible for implementation is reduced by concurrent development of several prototypes. SLE Service Management prototypes under way for the QinetiQ ground station in West Freugh, UK, the JPL Deep Space Network (DSN), the NASA Ground Network (GN) Wallops (Island) Flight Facility, and the US Air Force Satellite Control Network Interoperability Project. Plans are to have at least some of these prototypes interoperate prior to release of the specifications as Red Books.

3.3.4.2 Management Risks

Lack of resources or reassignment of previously-committed personnel is a constant risk to all standards-making processes. The approach to mitigating this risk is to define the minimal set of capabilities that constitute a "SLE Service Management Service Request" capability, and then adjust the deployment of available resources to ensure that those capabilities are addressed at a minimum. Of course, if the available resources fall below even that minimally-required level, a schedule slip may be required.

A CCSDS standard has two audiences: the eventual users of the systems that are built in conformance to the standard, and the implementers of those systems. If the standards are aimed exclusively at the eventual users, there is a risk that the standard will lack many of the low-level details required for true interoperability of independent implementations. If the standard attempts to address these myriad low-level details (which system implementers will need), there is the risk that the user reviewers will judge the result too

complicated. The approach to mitigating these risks is to develop the standard via a two-tiered set of specifications: a "service specification" of the functional and performance capabilities as viewed from the users' perspective; and an "XML Schema specification" that defines the data representation and protocol for the interactions between the interoperating systems necessary to provide those functional and performance capabilities.

The service request standard is being developed as a consolidation and evolutionary refinement of best practices of SLE and TT&C service providers. As such, it will define "standard" versions of capabilities that in many cases already exist in at least some of the CCSDS member agency networks. If the standard is interpreted to be an "all or nothing" proposition, there is a risk that it will be judged as requiring unnecessary costs to replace those legacy capabilities, resulting in the rejection of the standard. The approach to mitigating this risk is to identify legacy capability interoperability points, and structure the specifications so that legacy capabilities can be used in place of their standardized counterparts. This will allow an SLE/TT&C service provider to substitute existing capabilities where they are functionally equivalent to the standard-based ones, allowing an evolutionary adoption of the standard. (Of course, use of such legacy capabilities will come at the loss of standardized interoperability in those functional areas, and this will be a trade-off that any service provider must make in deciding which legacy capabilities to retain vice replace with the standardized versions).

3.3.5 RESOURCE REQUIREMENTS

Lead Agency	NASA is committed to lead the production of: 1. Service Request Operations Concept Green Book 2. Service Request Service Specification Recommendation 3. Service Request XML Schema Specification Recommendation 4. Authentication for SLE Services Recommendation *Commitments to lead the completion of the production of the full service suite of service management specifications are TBD*
Participating Agencies	BNSC is committed to support the development of: 1. Service Request Operations Concept Green Book 2. Service Request Service Specification Recommendation 3. Service Request XML Schema Specification Recommendation

Participating Agencies	CNES is committed to support the development of: 1. Service Request Service Specification Recommendation 2. Service Request XML Schema Specification Recommendation
	ESA is committed to support the development of: 1. Service Request Operations Concept Green Book 2. Service Request Service Specification Recommendation 3. Service Request XML Schema Specification Recommendation
	NASA is committed to support the development of: 1. Service Request Operations Concept Green Book 2. Service Request Service Specification Recommendation 3. Service Request XML Schema Specification Recommendation 4. Authentication for SLE Services Recommendation

3.4 SLE NAVIGATION SERVICES BIRDS OF A FEATHER

Title of Group	**3.4 SLE Navigation Services Birds of a Feather**
Chair	**David Berry**
Area Director	**Fred Brosi**
Mailing List	**TBS**

3.4.1 RATIONALE

TBD

3.4.2 GOALS

The goals of this Birds of a Feather include:

1. Collect requirements for SLE Navigation Services;
2. Produce a draft SLE-NAV Working Group charter.

3.4.3 SCHEDULE AND DELIVERABLES

TBD

Date	Milestone

3.4.4 RISK MANAGEMENT STRATEGY

3.4.4.1 Technical Risks

TBD

3.4.4.2 Management Risks

TBD

3.4.5 RESOURCE REQUIREMENTS

TBD

3.5 SLE RETURN ALL DATA BIRDS OF A FEATHER

Title of Group	**3.5 SLE Return All Data Birds of a Feather**
Chair	**Fred Brosi**
Area Director	**Fred Brosi**
Mailing List	**TBS**

3.5.1 RATIONALE

TBD

3.5.2 GOALS

The goals of this Birds of a Feather include:

1. Collect requirements for SLE Return All Data transfer service;
2. Produce a draft SLE-RAD Working Group charter.

3.5.3 SCHEDULE AND DELIVERABLES

TBD

Date	Milestone

3.5.4 RISK MANAGEMENT STRATEGY

3.5.4.1 Technical Risks

TBD

3.5.4.2 Management Risks

TBD

3.5.5 RESOURCE REQUIREMENTS

TBD

Status: Active – Draft charter circulated in March 2004

4 SPACECRAFT ONBOARD INTERFACE SERVICES AREA

4.1 ONBOARD BUS AND LAN WORKING GROUP

Title of Group	**4.1 Onboard Bus and LAN Working Group**
Chair	**Rick Schnurr**
Area Director	**Patrick Plancke**
Mailing List	**buslan.sois@mailman.ccsds.org**

4.1.1 RATIONALE

The Onboard Bus and LAN Working Group is concerned with the transfer of data over onboard buses and individual onboard LANs that constitute a single sub-network. The working group will define the data transfer services that must be provided by the sub-network, bearing in mind requirements on reliable delivery and security that may need to be met at the sub-network level. The working group will also define the service interface that is provided by the sub-network to higher layers of the communication stack.

The implementation of these sub-network services is highly dependent on the actual underlying physical connections that are used. The working group will investigate whether it is desirable to achieve interoperability at the electrical interface level as well as at the service interfaces, and may publish guidelines for achieving electrical interface compatibility for a limited set of popular onboard buses

4.1.2 GOALS

The goals of this Working Group are to:

1. Define a set of standard services that enable protocol multiplexing across a variety of real onboard buses and data links;

2. Define standard interfaces to those services such that overlying entities are shielded from the details of the real underlying onboard buses and links;

3. Specify the layer management parameters that may be used to control the operation of the data link and physical layers of the onboard communication stack;

4. Define layer management procedures for the control of configurable parameters, the reporting of errors, and redundant link switching;

5. Make representations to the other Working Groups and BOFs about the use of the onboard bus and LAN services in real systems. This will take

the form of inter working group sessions during the area meetings, and a workshop to demonstrate the use of the services;

6. Negotiate with other working groups and BOFs to determine what qualities of service need to be provided within the onboard data link and physical layers particularly, but not exclusively, in respect of reliable transfer of data and security. This will take the form of inter working group sessions during the area meetings;

7. Identify the potential benefits of interoperability at the electrical interface level and make recommendations accordingly for popular onboard buses;

8. Simulate and/or prototype the proposed services over a selection of popular onboard buses in order to verify functionality and to demonstrate the benefits of the proposed services, and to demonstrate the operation of other CCSDS protocols (such as CFDP) over the proposed service;

9. Identify aspects of physical layer standardization that may be of interest to the CCSDS in the future. Where potentially interesting activities are identified, they will be reported to the CESG in the form of "technology watch" bulletins.

4.1.3 SCHEDULE AND DELIVERABLES

Date	Milestone
1 January 2004	Identification of Services requirements: draft Green Book
1 April 2004	Specification of Service(s): draft sub-network service(s) Red Book
1 July 2004	Service Managements requirements: updates of Green and Red Books
1 October 2003 – 1 April 2005	Simulation and prototyping
1 July 2005	Red Book, Issue 1

4.1.4 RISK MANAGEMENT STRATEGY

4.1.4.1 Technical Risks

The proposed sub-network services are typically not inherently provided by popular onboard bus specifications such as MIL-STD-1553B and ESA OBDH. Therefore, the primary concern here is the risk associated with the invention of an entirely new set of

services. However, this risk can be minimized by keeping the requirements modest, i.e. by providing the minimum capability that is needed by overlying protocols and services.

Another risk is the feasibility of implementing the proposed services over a specific, real onboard bus. This risk is ameliorated by early simulation and prototyping, particularly on flight representative hardware. Finally, the capabilities of real underlying buses are vastly different, particularly in terms of reliable transfer and security, but also in terms of frame size and bandwidth. The risk here is that the service is over-specified for some underlying buses, while being underspecified for others. The risk management strategy in this case is to ensure that the service can be appropriately profiled to suite the given underlying bus while still providing a common service interface to the overlying services and protocols.

4.1.4.2 Management Risks

The quality of the end product relies heavily on the commitment of Agencies to provide support for the simulation and prototyping work.

4.1.5 RESOURCE REQUIREMENTS

Working Group Chair: lead working groups - prepare for and attend meetings, present material at working group meetings, write green and red books. Effort estimated at around 40 man-days per year assuming two meetings per year of one week duration each.	NASA, ESA
Research and prototyping activities: Initial estimate is around 2.5 man-years effort for the research and prototyping activities.	NASA, ESA

4.2 TIME CRITICAL ONBOARD NETWORK SERVICES WORKING GROUP

Title of Group	**4.2 Time Critical Onboard Network Services Working Group**
Chair	**Steve Parkes**
Area Director	**Patrick Plancke**
Mailing List	**network.sois@mailman.ccsds.org**

4.2.1 RATIONALE

The Time Critical Onboard Network Working Group addresses the problem of transfer of information across a spacecraft onboard network comprising one or more sub-networks where the sub-networks may be of different types (e.g. SpaceWire and Mil-Std-1553). It proposes to solve this problem using Transport and Network layers akin to TCP/IP or SCPS-TP/NP and a corresponding Network Management application. The Working Group will define a set of services that the Transport and Network layers and Network Management application are to provide. These services may be implemented in a number of different ways but will be interoperable if the service definition provided is followed. The Time Critical Onboard Network Working Group will liaise with the Time Critical Onboard Applications and Time Critical Onboard LAN working groups to ensure that a coherent set of onboard communications protocols are specified, and with the Space Link Services and Space Internetworking Services areas to ensure compatibility with other CCSDS standards.

4.2.2 GOALS

The goals of this Working Group are to:

1. Identify and document the requirements for the Time Critical Onboard Network services covering transport layer, network layer and related network management services. Deliver draft Transport layer and Network layer green books detailing the requirements;

2. Identify, define and document a set of network and transport layer services for spacecraft onboard communication which support time critical onboard applications and which permit interoperability and hence inter-agency cross support. Deliver draft Transport and Network layer red books defining the transport and network layer services;

3. Specify the layer management parameters that may be used to control the operation of the network and transport layers of the onboard communication stack. Deliver revised draft Transport and Network layer green books which include a description of the managed parameters;

4. Define layer management services for the control of configurable parameters and the reporting of errors. Deliver revised draft Transport and Network layer red books which include the definition of the Transport and Network layer management services;

5. Simulate, prototype and otherwise prove the proposed Time Critical Onboard Network services. Consolidate results of simulation and prototyping activities by different groups. Deliver the consolidated results of the simulation and/or prototyping activities in the form of a green book;

6. Ensure that the proposed Transport and Network layer red books are coherent with the red books provided by other CCSDS working groups. In particular:

   a. Make representations to the other Working Groups and BOFs about the use of the onboard network and transport layer services in real systems;

   b. Consider the integration of the Time Critical Onboard Network services with the Time Critical Onboard Applications and Time Critical Onboard LAN;

   c. Address the issue of onboard to off-board communication and develop recommendations for inter-operation between the onboard systems with other off-board systems, including the ground.

7. Consider integration and test issues and how the Time Critical Onboard Network services can support efficient and effective integration and test activities;

8. Deliver a revised final draft set of the Transport and Network layer Red Books for approval and issue by CCSDS.

4.2.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
1 January 2004	Network requirements – draft Green Book
1 April 2004	Managed parameter specifications – draft Green Book
1 January 2005	Network service specifications – draft Red Book
1 October 2003 – 1 July 2005	Simulation and prototyping
1 January 2006	Red Book, Issue 1

4.2.4 RISK MANAGEMENT STRATEGY

4.2.4.1 Technical Risks

The lowest risk approach to providing an onboard network is to adopt an existing communication network standard, avoiding the "reinvention of the wheel." The problem is that onboard communication has a number of requirements that are not met in existing standards like TCP/IP. These requirements that are not implemented in standard communications protocols are the main areas of risk to the planned onboard network and include:

1. Overhead – TCP/IP has a large overhead which means that small packets are inefficient, wasting communication bandwidth. This is why TCP/IP has a MTU of 1500 bytes: with that packet size the overhead becomes insignificant (<5%);

2. Performance – performance issues include communications bandwidth, latency, and determinism. Communications bandwidth is important in group applications but the ground-space technology gap may inhibit the use of the latest high performance ground network technology for spaceflight applications. Latency and determinism are important in some ground networks which may provide a useful basis for including these features in the onboard network;

3. Functionality – Onboard networking requires guaranteed, timely communication of chunks of information (messages) and it needs to provide or support fault tolerance. TCP/IP does not support guaranteed delivery of messages. It supports a guaranteed stream service (TCP) and non-guaranteed datagram delivery service (UDP). Little support for fault tolerance is available in existing ground based networks;

4. Compatibility – there is an implied requirement to be compatible with TCP/IP or SCPS-TP/NP to ease the onboard to off-board communication.

The risk management approach is to wherever possible use existing communication network standards. Where this is not possible concepts from more than one existing network standard will be combined. Where there are still deficiencies new approaches will be considered. From requirements detailed in the Transport and Network green books candidate, protocols will be considered and a set of services defined. Prototyping activities will be used to support the analysis, to evaluate the effectiveness of the defined services and to assess the feasibility of implementing protocols to fulfill the defined services. Results of various prototyping activities will be consolidated during the definition of the final Transport and Network Green Books.

4.2.4.2 Management Risks

The quality of the end product relies heavily on the commitment of Agencies to provide support for the simulation and prototyping work.

4.2.5 RESOURCE REQUIREMENTS

Working Group Chair: lead working groups - prepare for and attend meetings, present material at working group meetings, write green and red books. Effort estimated at around 40 man-days per year assuming two meetings per year of one week duration each.	BNSC-ESA-NASA
Research and Prototyping Activities: Initial estimate is around 2.5 man-years effort for the research and prototyping activities.	ESA-NASA-BNSC

4.3 TIME CRITICAL ONBOARD APPLICATION SERVICES WORKING GROUP

Title of Group	**4.3 Time Critical Onboard Application Services Working Group**
Chair	**Abhijit Sengupta**
Area Director	**Patrick Plancke**
Mailing List	**appli.sois@mailman.ccsds.org**

4.3.1 RATIONALE

The Time Critical Onboard Application Services Working Group defines standard services that are provided to onboard software applications. These services isolate the flight software from the underlying hardware details and thereby increase the portability and reuse potential of the flight software. Furthermore, the service access points constitute cross support interfaces.

The standard services that are addressed by this working group are those that have been identified during previous CCSDS SOIF activities as being common requirements in all spacecraft missions, and providing the maximum benefit for flight software development. Furthermore, it is explicitly recognized that interoperability and cross support capabilities need to be provided throughout the project lifecycle, and particularly during application development, integration, and testing, not just during operations.

4.3.2 GOALS

The goals of this Working Group are to:

1. Produce a document to describe the concepts of onboard time critical applications, showing the interfaces needed for inter agency cross support and interoperability, and showing clearly the relationship between the onboard application services and other CCSDS standards;

2. Produce a specification for a spacecraft command and data acquisition service that enables onboard applications to read and write simple onboard devices, and define the service interface used to access that service (previously referred to as SOIF C&DA capability set 1);

3. Produce a specification for the onboard time distribution service that enables flight applications located on any node of the spacecraft to obtain the onboard time with bounded accuracy, and define the service interface used to access that service;

4. Produce a specification for the onboard messaging service that enables applications hosted onboard a spacecraft to communicate with each other

using asynchronous ad hoc messaging, and define the service interface used to access that service;

5. Negotiate with other working groups and BOFs to determine what qualities of service need to be provided by the onboard application services;

6. Make representations to the other Working Groups and BOFs about the use of the onboard application services in real systems. **Note**: This will take the form of a workshop to which all interested working groups will be invited.

4.3.3 SCHEDULE AND DELIVERABLES

Date	Milestone
1 January 2004	Concept document
1 July 2004	C&DA CS1 definition
1 July 2004 1 April 2005	C&DA prototyping
1 July 2004	Time distribution specification
1 July 2004 1 April 2005	Time distribution prototyping
1 July 2004	Messaging and file transfer services definition
1 July 2004 1 April 2005	Messaging and file transfer services prototyping
1 July 2005	Red Book 1

4.3.4 RISK MANAGEMENT STRATEGY

4.3.4.1 Technical Risks

The services that are to be defined by this working group have already been discussed extensively in previous SOIF activities, and a number of prototype and demonstration models have been developed. The lowest risk approach to developing these standards formally under CCSDS is to capitalize on these activities by taking them fully into account, and recruiting the personnel who have previously been involved into the new working group.

4.3.4.2 Management Risks

The Working group addresses several topics, in particular Command and Data Acquisition and Messaging that should require full availability of the members of the working group. To this one could be added the 'plug and play applications services' if the outcome of the corresponding BOF is positive. Maintaining the schedule may require continuous and possibly an increasing support of Agencies.

4.3.5 RESOURCE REQUIREMENTS

Working Group Chair: Effort estimated at around 40 man-days per year assuming two meetings per year of one week duration each.	NASA, BNSC
Research and Prototyping Activities: Initial estimate is around 2.5 man-years effort for the research and prototyping activities.	NASA, ESA BNSC

4.4 ONBOARD PLUG AND PLAY BIRDS OF A FEATHER

Title of Group	**4.4 Onboard Plug and Play Birds of a Feather**
Chair	**Philippe David**
Area Director	**Patrick Plancke**
Mailing List	**TBS**

4.4.1 RATIONALE

There is a strong belief that plug and play concepts could beneficially be applied to spacecraft onboard systems. The benefits are expected to include increased re-use potential for flight software and hardware components, and improved quality and maintainability of flight software.

4.4.2 GOALS

The BOF will investigate the application of plug and play onboard spacecraft, identifying the potential benefits to onboard systems, and the technological barriers that must be overcome. If as a result of these considerations onboard plug and play is deemed to be of overall benefit, a program of work will be defined and a proposed working group charter will be produced.

4.4.3 SCHEDULE AND DELIVERABLES

TBD

Date	**Milestone**

4.4.4 RISK MANAGEMENT STRATEGY

4.4.4.1 Technical Risks

TBD

4.4.4.2 Management Risks

TBD

4.4.5 RESOURCE REQUIREMENTS

TBD

4.5 ONBOARD SPACECRAFT TRANSDUCER SYSTEMS BIRDS OF A FEATHER

Title of Group	**4.5 Onboard Spacecraft Transducer Systems Birds of a Feather**
Chair	**Chris Plummer**
Area Director	**Patrick Plancke**
Mailing List	**TBS**

4.5.1 RATIONALE

One of the major problems with current onboard systems is the interfacing of sensors and actuators (transducers). The vast majority of these transducers are very simple devices such as temperature sensors, but account for a very significant proportion of the interfacing hardware and software required onboard. There is a conviction that a more systematic approach to onboard transducers would be beneficial in many respects, including increased potential for re-use of components across missions, simplified interfacing software, and significant reduction in harness mass, bulk, and complexity.

4.5.2 GOALS

The BOF will investigate the application of terrestrial transducer system concepts to spacecraft onboard systems. The potential benefits will be evaluated against the costs of developing transducer system technologies for flight use, and an initial program of work will be proposed as a working group charter.

4.5.3 SCHEDULE AND DELIVERABLES

TBD

Date	**Milestone**

4.5.4 RISK MANAGEMENT STRATEGY

4.5.4.1 Technical Risks

TBD

4.5.4.2 Management Risks

TBD

4.5.5 RESOURCE REQUIREMENTS

TBD

5 SPACE LINK SERVICES AREA

5.1 RF AND MODULATION WORKING GROUP

Title of Group	**5.1 RF and Modulation Working Group**
Chair	**Enrico Vassallo**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-rfm@mailman.ccsds.org**

5.1.1 RATIONALE

Agencies' new generations of space missions require telecommand and telemetry capabilities beyond current technologies to interconnect a spacecraft with its ground support system, or with another spacecraft. These new needs are for higher data rates, better link performances, more performing ranging systems, together with lower cost, mass and power and higher security.

This work will concentrate on updating the existing RF and Modulation Book to cope with these new needs; this includes in particular the updating of the recommendations addressing modulation techniques and the review and updating of the whole book to align it with any relevant decision taken at WRC 2003. The update work includes also the extraction of the physical layer out of CCSDS 211.0-B Prox-1 Protocol.

5.1.2 GOALS

The goals of this Working Group are to:

1. Update the RF and Modulation Book CCSDS 401.0-B set of recommendations on modulation techniques;

2. Update the RF and Modulation Book CCSDS 401.0-B to align it on decisions of ITU WRC 2003 and SFCG 23 and 24;

3. Extract the physical layer out of CCSDS 211.0-B Proximity-1 Protocol into a separate book.

5.1.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
15 June 2003	Reviewed standalone Proximity-1 RF and Modulation Book
June 2003	Draft Proximity-1 RF and Modulation Book

Date	Milestone
November 2003	Compiled review of WRC 2003 output affecting CCCSDS 401.0-B
November 2004	Proposed updates of CCSDS 401.0-B Recommended Standard on modulation Compiled review of SFCG-24 output affecting CCSDS 401.0-B
August 2005	Draft update of CCSDS 401.0-B Recommended Standard

5.1.4 RISK MANAGEMENT STRATEGY

5.1.4.1 Technical Risks

No technical risks have been identified.

5.1.4.2 Management Risks

Schedules are dependent upon Agency participation until August 2005.

5.1.5 RESOURCE REQUIREMENTS

Drafting work for 0.4 man year	All
Review support as required	All

5.2 SPACE LINK CODING AND SYNCHRONIZATION WORKING GROUP

Title of Group	**5.2 Space Link Coding and Synchronization Working Group**
Chair	**Gian Paolo Calzolari**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-cc@mailman.ccsds.org**

5.2.1 RATIONALE

Agencies' new generations of space missions require telecommand and telemetry capabilities beyond current technologies to interconnect a spacecraft with its ground support system, or with another spacecraft. These new needs are for higher data rates, better link performances, together with lower cost, mass and power and higher security.

The wide range of environment (space-Earth or space-space, near Earth congested bands and deep space link operations in extreme conditions of SNR, links dependent of atmospheric conditions in the new high frequency bands, optical links) requires coding systems with different levels of power efficiency and bandwidth efficiency, or different levels of link reliability or delivered data quality;

This work will concentrate on updating the existing set of Channel Coding Blue Books to incorporate recommended coding scheme for new bandwidth efficient codes with low complexity. The update work includes also the extraction of the coding layer out of CCSDS 211.0-B Prox-1 Protocol.

5.2.2 GOALS

The goals of this Working Group are to:

1. Develop recommended coding schemes with high power and spectral efficiency, with low decoding complexity, and with low residual frame and bit error rate, by comparing existing and newly proposed schemes and carrying out a final selection;

2. Update of the set Telemetry Channel Coding Blue Book and Telemetry Channel Coding Green Book;

3. Extract the coding layer out of CCSDS 211.0-B Proximity-1 Protocol into a separate book.

5.2.3 SCHEDULE AND DELIVERABLES

Date	Milestone
June 2003	Proposed standalone Proximity-1 Coding and Synchronization Book
November 2003	Review/Approve Proximity-1 Coding and Synchronization Blue Book
August 2004	Select the candidate coding scheme(s) with high power and spectral efficiency, with low decoding complexity, and with low residual frame and bit error rate. Appoint Editor(s)
November 2004	Issue CCSDS Proposed Standard
February 2005	Review CCSDS Proposed Standard. Approve correction for CCSDS Draft Standard
April 2005	Issue Draft Standard for WG review
August 2005	Review Draft Standard. Approve correction for Agency review
October 2005	Issue Draft Standard for Agency review
February 2006	Final Review. Approve corrections for CCSDS Recommended Standard
April 2006	Issue CCSDS Recommended Standard Issue Draft Informational Book (Green Book)
August 2006	Review Draft Informational Book. Approve correction for Agency review
October 2006	Issue Draft Informational Book for Agency Review
February 2007	Final Review. Approve corrections for CCSDS Informational Book
April 2007	Issue CCSDS Informational Report

5.2.4 RISK MANAGEMENT STRATEGY

5.2.4.1 Technical Risks

No technical risks have been identified.

5.2.4.2 Management Risks

The schedule is very dependent upon Agency commitment of resources and the use of the same personnel working on concurrent CCSDS tasks.

5.2.5 RESOURCE REQUIREMENTS

Drafting work for 0.4 man year	All
Review support as required	All

5.3 DATA COMPRESSION WORKING GROUP

Title of Group	**5.3 Data Compression Working Group**
Chair	**Pen-Shu Yeh**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-dc@mailman.ccsds.org**

5.3.1 RATIONALE

There is a need for data reduction on-board spacecraft in order to make full use of limited on-board resources like data storage and downlink capacity. Images represent a vast amount of the data collected on-board spacecraft and that significant compression can be obtained on images while preserving acceptable image quality for the user.

Cooperative mission scenarios exist where cross-support is needed for the handling of the compressed telemetered data. Industry, principal investigators, instrument developers, etc., will welcome an international standard for image compression that would meet the unique requirements of space missions together with state of the art performances level. However, implementation constraints severely limit the complexity of on-board processing and that existing international standards do not meet the performance versus complexity requirements of space missions. CCSDS has developed a recommendation for lossless data compression only and that lossless compression is inherently very limited in terms of compression ratios achievable. Furthermore, this lossless algorithm is not specifically tailored to image data. Finally, the current CCSDS 121.0.B.1 Lossless Data Compression (May 97) needs to be reviewed for either update, reconfirmation or retirement.

5.3.2 GOALS

The goals of this Working Group are to:

1. Specify an image compression algorithm fulfilling identified space mission requirements;

2. Develop a subsequent recommendation together with the supporting information (performances, usage, reference software;

3. Review CCSDS 121.0.B.1 Lossless Data Compression (May 97) for either update, reconfirmation or retirement.

5.3.3 SCHEDULE AND DELIVERABLES

Data	Milestone
July 2005	Image compression recommendation (Blue Book)
July 2005	Image compression Green Book supporting above recommendation
July 2005	Open source reference software for the image compression recommendation, including reference data set.
July 2005	Outcome of review of CCSDS 121.0.B.1 (either statement of reconfirmation or pink sheets or proposal for retirement)

5.3.4 RISK MANAGEMENT STRATEGY

5.3.4.1 Technical Risks

TBD

5.3.4.2 Management Risks

Refer to Section 5.3.5, Resource Requirements.

5.3.5 RESOURCE REQUIREMENTS

The availability of the outputs in due time is subject to agencies manpower availability

Agencies committed to lead the production of the deliverables:

NASA is leading the production of image compression recommendation (Blue Book)
CNES is leading the production of the image compression Green Book
ESA is leading the production and delivery of reference software

Agencies participating in the deliverables: NASA, ESA, CNES, ASTRIUM (ASSOCIATE MEMBER) will participate in production of all deliverables (all other CCSDS member agencies are welcomed to contribute to the effort).

Image Compression Blue Book	NASA + All
Image Compression Green Book	CNES + All
Reference Software	ESA + All

CCSDS 121.0.B.1 review	All

Agencies manpower commitment:

Manpower commitments from participating agencies are based on Full Time Employees (FTE):

NASA-GSFC:	0.4
NASA-JPL:	0.1
CNES:	0.15
ESA-IMEC:	0.2
ASTRIUM:	0.1

Total manpower commitment is 0.95 FTE.

5.4 SPACE LINK PROTOCOLS WORKING GROUP

Title of Group	**5.4 Space Link Protocols Working Group**
Chair	**Greg Kazz**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-slp@mailman.ccsds.org**

5.4.1 RATIONALE

In line with the evolutions in the CCSDS link layer protocols which occurred in the recent years, e.g. development of the Proximity-1 Space Link Protocol, it has become necessary to update and complete the Green Books related to these protocols. This work will consist of:

1. Producing an Overview of Space Link Protocols Green Book (requires update due to Proximity-1);

2. Completing the Proximity-1 Green Book (involves more than the data link);

3. Completing the Space Data Link Protocols Green Book;

4. Ensuring that the COP-1 Pink Sheets (July 2003 issue) which have gone through Agency Review have no liens against them. If there are any liens, resolve them per the schedule identified in the following paragraphs.

5.4.2 GOALS

The goals of this Working Group are to complete and in one case simply update, the Link Layer Green Books as indicated in the following items:

1. Overview of Space Link Protocols Green Book (requires update due to Proximity-1);

2. Complete the Proximity-1 Green Book (involves the data link, coding, and physical layers);

3. Complete the Space Data Link Protocols Green Book.

5.4.3 SCHEDULE AND DELIVERABLES

Date	Milestone
December 2003	Updated Space Link Protocols Green Book Release the draft Space Data Link Protocols Green Book to the SLS WG for review Review any liens against COP-1 Pink Sheets (July 2003). Resolve any liens if applicable. Final Pink Sheets to be presented to the SLS AD for submission to the CESG for adoption into the COP-1 Recommended Standard
February 2004	Release the updated Space Data Link Protocols Green Book to the CCSDS Secretariat after approval by the SLS WG, SLS AD, and CESG
31 March 2004	Send the draft Proximity-1 Green Book to the SLS WG for review

5.4.4 RISK MANAGEMENT STRATEGY

5.4.4.1 Technical Risks

No technical risks have been identified.

5.4.4.2 Management Risks

The schedule is very dependent upon Agency commitment of resources and the use of the same personnel working on concurrent CCSDS tasks.

5.4.5 RESOURCE REQUIREMENTS

Overview of Space Link Protocols Green Book (requires update due to Proximity-1)	JAXA
Complete Proximity-1 Green Book (involves more than the data link)	NASA
Complete the Space Data Link Protocols Green Book	JAXA
Review support as required	All

5.5 TELECOMMAND CHANNEL CODING WORKING GROUP

Title of Group	**5.5 Telecommand Channel Coding Working Group**
Chair	**Gian Paolo Calzolari**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-cc@mailman.ccsds.org**

5.5.1 RATIONALE

This WG is currently idle. It will be reactivated when resources are made available for the work.

Agencies new generations of space missions require telecommand and telemetry capabilities beyond current technologies to interconnect a spacecraft with its ground support system, or with another spacecraft. These new needs are for higher data rates, better link performances, together with lower cost, mass and power and higher security.

The wide range of environment (space-Earth or space-space, near Earth congested bands and deep space link operations in extreme conditions of SNR, links dependent of atmospheric conditions in the new high frequency bands, optical links) requires coding systems with different levels of power efficiency and bandwidth efficiency, or different levels of link reliability or delivered data quality. A Telemetry Channel Coding Green Book is available to support designers' choices, while a similar book for Telecommand is not available.

This work will concentrate on the production of a Telecommand Channel Coding Green Book in support to existing Telecommand Blue Books.

5.5.2 GOALS

The goal of this Working Group is to develop a Telecommand Channel Coding Green Book.

5.5.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
TBD	Draft Telecommand Channel Coding Green Book
TBD+3 Months	Revised draft Telecommand Channel Coding Green Book
TBD+6 Months	Issue draft Telecommand Channel Coding Green Book for Agency review

Date	Milestone
TBD+ 1 Year	Issue Telecommand Channel Coding Green Book

5.5.4 RISK MANAGEMENT STRATEGY

5.5.4.1 Technical Risks

TBD

5.5.4.2 Management Risks

No personnel resources have been identified within potentially interested Agencies.

5.5.5 RESOURCE REQUIREMENTS

Drafting work for 0.4 man year	TBD
Review support as required	All

5.6 RANGING WORKING GROUP

Title of Group	**5.6 Ranging Working Group**
Chair	**Enrico Vassallo**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-rfm@mailman.ccsds.org**

5.6.1 RATIONALE

Agencies new generations of space missions require telecommand and telemetry capabilities beyond current technologies to interconnect a spacecraft with its ground support system, or with another spacecraft. These new needs are for higher data rates, better link performances, more performing ranging systems, together with lower cost, mass and power and higher security. This work is dedicated to the development of recommendations for high performance ranging techniques to satisfy the needs of future agencies missions.

5.6.2 GOALS

The goals of this Working Group are to:

1. Review the requirements for navigation/ranging performance in future missions;

2. Review techniques available to meet the requirements (e.g., regenerative ranging, Delta-DOR, high frequency ranging);

3. Issue a draft recommendation for novel ranging techniques.

5.6.3 SCHEDULE AND DELIVERABLES

Date	Milestone
June 2004	Completion a review of requirements for navigation/ranging performance in future missions
December 2004	Review techniques available to meet the requirements (e.g., regenerative ranging, Delta-DOR, high frequency ranging, etc.)
July 2005	Issue a proposed recommendation for novel ranging techniques, White Book, Issue 1
July 2006	Issue a proposed recommendation for novel ranging techniques, White Book, Issue 2

July 2007	Issue a draft recommendation for novel ranging techniques, Red Book

5.6.4 RISK MANAGEMENT STRATEGY

5.6.4.1 Technical Risks

TBD

5.6.4.2 Management Risks

This work requires output from an activity of design and "bread boarding" planned in ESA for completion in 2006; however, funding has not yet been consolidated.

5.6.5 RESOURCE REQUIREMENTS

Drafting work for 0.5 man year	All
Review support as required	All

5.7 PROXIMITY-1, BUILD 2 WORKING GROUP

Title of Group	**5.7 Proximity-1, Build 2 Working Group**
Chair	**Greg Kazz**
Area Director	**Jean-Luc Gerner**
Mailing List	**sls-slp@mailman.ccsds.org**

5.7.1 RATIONALE

Proximity-1 is a bi-directional protocol, for use in short distance (400,000 km), moderate signal strength environments and is primarily based upon the CCSDS Telecommand recommendation. The Proximity-1 (Prox-1) Space Link protocol recommendations consists of three CCSDS Blue Books: 1. Physical Layer; 2. Coding and Synchronization Sublayer; 3. Data Link Layer.

The initial development of Proximity-1 arose from the need for a standard approach for communication in the Mars environment, starting with the NASA/JPL Mars Odyssey project. Proximity-1 is envisioned to develop over a series of "Builds", based upon user projects and programs within the space agencies that use it.

Proximity-1 Build-1 consisted of the Red Book versions of the protocol: Mars Odyssey (Red-1) and Mars Express and Beagle II (Red-2), and NASA/JPL MER I & II (Red-3). In Jan. 2003, Proximity-1 became a CCSDS Blue book. In April 2003, Proximity-1 was restructured (without technical change) into the 3 existing recommendations (Physical Layer, Coding and Synchronization Sublayer, Data Link Layer).

The work objective of this WG will be the completion of the Proximity-1 Space Link Protocol recommendations for "Proximity-1 Build-2". From a flight hardware and software point of view, this build will represent the recommendation from which the NASA/JPL ELECTRA project develops its Proximity-1 compliant NASA/JPL ELECTRA transceiver. This transceiver is envisioned to fly on international missions to Mars on orbiters as well as scaled down mass versions for surface use on e.g., landers/rovers (ELECTRA-LITE).

5.7.2 GOALS

The goals of this Working Group are to:

1. Ensure that current and future Mars missions are backward compatible with the existing long-term infrastructure at Mars (e.g., NASA Mars Odyssey, ESA Mars Express) with respect to frequency channel assignments, clarification of data rate accuracies, values for transmit and

receive mode fields, and clarification of time tag directionality made in the Red version of Proximity-1 documents;

2. Review and correct (if necessary) the draft pink sheets distributed to the Space Link Protocol WG on 26 September 2003;

3. As a part of this review, determine and list any impacts of these draft pink sheets on existing or planned implementations of the Proximity-1 protocol recommendations;

4. As part of this review, determine and list any impacts of these pink sheets on the Draft Proximity-1 Green Book.

5.7.3 SCHEDULE AND DELIVERABLES

Date	Milestone
June-July 2003	Proximity-1 Build-2 BOF identified the problems that are now documented in the Prox-1 Physical Layer and Data Link Layer Draft Pink Sheets
26 September 2003	Draft Pink Sheets to Prox-1 Physical layer and Data Link Layer released for review to SLS-Space Link Protocol WG (in anticipation of new formal WG being approved)
8 October 2003	New Prox-1 Build-2 WG Charter approved; WG opens
27-29 October 2003	Detailed WG review and disposition of Prox-1 Physical Layer and Data Link Layer Draft Pink Sheets at the Fall 2003 CCSDS Meeting
29 October 2003	SLS AD generate a resolution to the CESG to send the finalized pink sheets (Prox-1 Physical Layer + Data Link Layer) to the CMC for Agency review
November 2003 – January 2004	Formal Agency review of Prox-1 Build 2 Pink Sheets
February 2004	Final approval of Pink Sheets by WG WG closed

5.7.4 RISK MANAGEMENT STRATEGY

5.7.4.1 Technical Risks

No technical risks have been identified.

5.7.4.2 Management Risks

The schedule is dependent upon Agencies' participation at the fall 2003 CCSDS meetings.

5.7.5 RESOURCE REQUIREMENTS

Draft Pink Sheets to Proximity-1 Physical Layer and Data Link Layer	NASA
Impact assessment by participating Agencies of these Pink Sheets on current and planned Proximity-1 implementations	All
Review support as required	All

5.8 LONG ERASURE CODES BIRDS OF A FEATHER

Title of Group	**5.8 Long Erasure Codes Birds of a Feather**
Chair	**Gian Paolo Calzolari**
Area Director	**Jean-Luc Gerner**
Mailing List	**TBD**

5.8.1 RATIONALE

This work will investigate long erasure-correction codes suitable for CCSDS environments, and compare them with retransmission schemes. New generations of space missions require telecommand and telemetry capabilities beyond current technologies to interconnect a spacecraft with its ground support system, or with another spacecraft. These new needs are for higher data rates, better link performances, together with lower cost, mass and power and higher security. The wide range of environment (space-Earth or space-space, near Earth congested bands and deep space link operations in extreme conditions of SNR, links dependent of atmospheric conditions in the new high frequency bands, optical links) requires coding systems with different levels of power efficiency and bandwidth efficiency, or different levels of link reliability or delivered data quality.

5.8.2 GOALS

The goals of this Working Group are to:

1. Compare long erasure-correction codes suitable for CCSDS environments with retransmission schemes;

2. Make if conclusive, a proposal for the creation of a WG to investigate the selected application of long erasure-correction codes.

5.8.3 SCHEDULE AND DELIVERABLES

Date	Milestone
May 2004	Initial report on long erasure codes. Agreement for investigation areas and work assignment
November 2004	Report on compared performances of long erasure codes with retransmission schemes for CCSDS Agencies' applications
February 2005	Update report for BOF review

Date	Milestone
May 2005	Complete review of compared performances of long erasure codes with retransmission schemes for CCSDS Agencies' applications
June 2005	Decision for the creation of a WG to investigate the selected application of long erasure codes

5.8.4 RISK MANAGEMENT STRATEGY

5.8.4.1 Technical Risks

No technical risks have been identified at this point in time.

5.8.4.2 Management Risks

The schedule relies upon Agencies' internal efforts on the subject. CCSDS resources identified in the following paragraph do not include the internal work of Agencies.

5.8.5 RESOURCE REQUIREMENTS

Drafting work for 0.2 man years	Resources TBD
Review support as required	All

6 SPACE INTERNETWORKING SERVICES AREA

6.1 CFDP INTEROPERABILITY TESTING WORKING GROUP

Title of Group	**6.1 CFDP Interoperability Testing Working Group**
Chair	**Richard Carper**
Area Director	**Robert Durst**
Mailing List	**sis-cit-all@mailman.ccsds.org**

6.1.1 RATIONALE

In order to aid in the finalization of the protocol specification and to increase the confidence of potential users in the CCSDS CFDP, a series of interoperability tests was designed, documented, and executed among the several different CCSDS member Agencies' implementations of the Core Procedures of the CFDP. This approach was so successful in meeting those objectives that it has been determined to extend such testing to the Extended Procedures and the Store and Forward Overlay Procedures of the CFDP. This Working Group will fulfill that goal.

6.1.2 GOALS

1. Design, document, review, correct, and execute interoperability tests for the CFDP Extended Procedures, and the CFDP Store and Forward Overlay Procedures;

2. Make the resulting test documents ("Test Notebooks"), as well as a report on the results of the testing executed, available on an appropriate CCSDS-sponsored web site for review and use by potential protocol users;

3. Report any problems with the CFDP Extended Procedures identified in testing to the Space Internetworking Services Area for action on correcting the protocol and/or the Blue Book;

4. Report any problems with the CFDP Store and Forward Overlay Procedures identified in testing to the Space Internetworking Services Area for action on correcting the protocol and/or the Blue Book.

6.1.3 SCHEDULE AND DELIVERABLES

Date	Milestone
1 June 2003	WG established
1 February 2004	Draft Testing Notebooks distributed for review by WG
23 August 2004	Initial interoperability testing ("shakedown testing") begins
6 October 2004	First test series (SFO) begins
15 October 2004	First test series complete
20 October 2004	Second test series (Extended Procedures) begins
29 October 2004	Second test series complete
10 December 2004	Test Execution Report and final Test Notebooks available
30 December 2004	WG dissolved

6.1.4 RISK MANAGEMENT STRATEGY

6.1.4.1 Technical Risks

The task of the WG is well understood and the WG members participated in the Core Procedures testing and are experienced in the work. There is very little technical risk. Schedule risk is as always dependent on a) commitment of resources, and b) interference in the WG members work by higher priority work in their home Agencies. The resources have been committed by NASA and ESA. Interference by higher priority work does not at this time seem a problem. Fallback options are a) extension of the schedule, and/or b) rearrangement of testing participants.

6.1.4.2 Management Risks

Security Issues: There are no security issues within the domain of this WG.

6.1.5 RESOURCE REQUIREMENTS

1. For the generation of the testing and documentation, it is estimated that the test designer/documenter will require approximately 80 hours, and the reviewers 16 hours each;

2. For the shakedown testing, it is estimated that the test monitor will require 24 hours and that each test participant will require 16 hours;

3. For the first test series, it is estimated that the test monitor will require 60 hours and that each test participant will require 40 hours;

4. For the second test series, it is estimated that the test monitor will require 40 hours and that each test participant will require 30 hours;

5. For the final test report and the final version of the Test Notebooks, it is estimated that the documenter will require 40 hours and that each WG member will need 8 hours;

6. The resource requirement per participant is therefore 244 hours for the documenter/monitor and 110 hours for each WG member/test participant. Assuming that the test participants are ESA/ESTEC and NASA/JPL, the total resources required equal 464 hours.

6.2 UNACKNOWLEDGED-CFDP WORKING GROUP

Title of Group	**6.2 Unacknowledged-CFDP Working Group**
Chair	**Scott Burleigh**
Area Director	**Robert Durst**
Mailing List	**sis-uce@mailman.ccsds.org**

6.2.1 RATIONALE

In order to operate properly over unit-data transfer (UT) layer implementations that perform their own retransmission, CFDP in unacknowledged mode must better tolerate the routine arrival of metadata and file data after the arrival of the EOF PDU for the same transaction. A simple solution would be for EOF arrival to trigger a timer cycle, similar to the NAK timer cycle in acknowledged mode, which checks transaction completeness periodically.

6.2.2 GOALS

1. Draft the CFDP Recommendation revisions needed to effect this new behavior;

2. Modify a CFDP implementation to comply with the revised specification. Note: Because the revised procedures are unilateral (there is no reciprocal protocol traffic), there is no interoperability issue;

3. Demonstrate the modified implementation;

4. Submit the revisions for incorporation into the CCSDS Recommended Standard for CFDP.

6.2.3 SCHEDULE AND DELIVERABLES

Date	Milestone
31 October 2003	WG established
14 November 2003	Published proposed revisions to CCSDS 727.0-B-1 as a proposed Standard
19 December 2003	JPL demonstration of initial implementation of the proposed Standard; WG analyzes results
12 November 2004	Publish final revisions ("pink sheets") as a draft Standard
15 November 2004 - 7 February 2005	Agency Formal Reviews
7 February 2005	Submit draft Standard for acceptance as a Recommended Standard, revising CCSDS 727.0-B-2

6.2.4 RISK MANAGEMENT STRATEGY

6.2.4.1 Technical Risks

The problem and proposed solution are well understood, as they are derived from existing, tested CFDP functionality. Technical risk is minimal.

6.2.4.2 Management Risks

Programmatic risks:

- Unavailability of resources could delay achievement of milestones. Fallback option would be to reschedule the milestones.

- Because the proposed solution is backward-compatible with existing implementations, agency opposition should be minimal. In the event of unanticipated opposition from one or more member agencies, achievement of consensus on the proposed revisions to CFDP could be delayed. Fallback option would be to reschedule the milestones or cancel the work item.

6.2.5 RESOURCE REQUIREMENTS

1. Three NASA/JPL protocol engineers at 10% time commitment for five months;

2. One NASA/GSFC protocol engineer at 10% time commitment for five months;

3. One ESA/ESTEC protocol engineer at 10% time commitment for five months.

6.3 CCSDS PACKET PROTOCOL WORKING GROUP

Title of Group	**6.3 CCSDS Packet Protocol Working Group**
Chair	**Dai Stanton**
Area Director	**Robert Durst**
Mailing List	**sis-spp@mailman.ccsds.org**

6.3.1 RATIONALE

The CCSDS Packet Protocol has been drafted as part of the CCSDS subnetwork and network restructuring activity. It defines the Network layer role of the CCSDS Packet. The purpose of this activity is to produce pink sheets relating to a correction to the packet addressing context.

6.3.2 GOALS

The goal of this Working Group is to review and if necessary, revise the CCSDS Packet Protocol and recommend its adoption as a CCSDS standard.

6.3.3 SCHEDULE AND DELIVERABLES

Date	Milestone
17 November 2003	Draft Pink Sheets for SIS review
24 November 2003	Pink Sheets for Agency review
8 December 2003	RID closure
15 December 2003	WG dissolved

6.3.4 RISK MANAGEMENT STRATEGY

6.3.4.1 Technical Risks

Agency review results in extensive or substantial RIDs. Unlikely because only one RID was achieved on the whole recommendation and the Pink Sheet modification is simple, well understood and in line with current practice.

6.3.4.2 Management Risks

Required resources are very scarce (less than half a man day for each of the two participating resources) resulting in low risk.

6.3.4.3 Security Issues

Options for securing CCSDS links are identified in CCSDS 350.0-G-1.

6.3.5 RESOURCE REQUIREMENTS

Lead Agency	BNSC: 16 hours for review
Participating Agencies	JAXA: 8 hours for response to review
	NASA: 4 hours to confirm SIS approval

6.4 CISLUNAR SPACE INTERNETWORKING WORKING GROUP

Title of Group	**6.4 Cislunar Space Internetworking Working Group**
Chair	**Keith Scott**
Area Director	**Robert Durst**
Mailing List	**sis-csi@mailman.ccsds.org**

6.4.1 RATIONALE

The discovery of water ice at the Moon's poles and evidence of a history of water on Mars has prompted increased interest in executing an expanded program of human and robotic exploration missions to the Moon and Mars. A unified data communications architecture and protocol suite is needed to support these new missions, with Lunar infrastructure being forward-compatible to Mars; this will increase opportunities for cross-support and reduce costs.

6.4.2 GOALS

The Cislunar Space Internetworking WG is chartered to perform the following work by 1 April 2007:

1. Create a top-level architecture and operations concept (CCSDS Green Book) for communicating effectively over the whole range of cislunar distances. The architecture will address the projected needs of new lunar exploration programs and their mapping into (and interoperation with) similar capabilities that will be needed on and around Mars;

2. Review current and emerging CCSDS standards and recommend any updates required to keep them current and to support cislunar communication (Green Book, Pink Sheets);

3. Examine the spectrum of new Internet development activities that are proceeding within Internet standardization groups, such as the Internet Engineering Task Force (IETF), and identify where they may be applicable to the operations concept developed above. Candidate activities include:

    a. The Stream Control Transmission Protocol (SCTP);

    b. The Datagram Congestion Control Protocol (DCCP);

    c. Voice Over IP (VOIP);

    d. Disruption Tolerant Networking (DTN);

e. LEMONADE enhancements to Internet email to support diverse service environments;

f. Internet over Digital Broadcast Video Networks.

4. Recommend standards for cislunar communications (CCSDS Red/Orange Books) with the proviso that these standards should, whenever possible, be extensible to larger communications distances such as Earth-Mars.

6.4.3 SCHEDULE AND DELIVERABLES

Date	Milestone
15 November 2004	Draft Green Book describing cislunar communications architecture, operations concept, and protocol suite requirements. This Green Book considers both cislunar and Mars in-situ communications environments Survey document describing candidate protocols
1 April 2005	Draft review of existing CCSDS Standards with proposed plan for updating them Down-selection from protocol survey list to core set for further investigation/performance analysis Begin extensive analysis of down-selected protocol set
1 November 2005	Finalized Green Book describing operations concept and protocol requirements Final report on proposed updates to existing CCSDS protocols Draft report on down-selected protocol set
1 April 2006	Draft 1, Red/Orange Book(s) for recommended protocols. Includes recommendations for updating CCSDS protocols
30 November 2006	Red/Orange Book(s) Issue 1 for recommended protocols. Includes newly adopted/developed protocols and updates to CCSDS protocols
1 April 2007	Draft 2 Red/Orange Book(s) for recommended protocol set

6.4.4 RISK MANAGEMENT STRATEGY

6.4.4.1 Technical Risks

The risk management approach is to wherever possible use existing architectures and standards. Where this is not possible, new architectures will be defined, and efforts will be made to influence existing standards to include features needed by the WG. If existing standards cannot be modified, revisions/updates to existing standards will be considered. Here concepts from one or more existing network standards may be combined, and new protocol specifications will be required. Where there are still deficiencies, completely new approaches will be considered for standardization.

The initial set of candidate protocols will be selected taking into account the requirements detailed in the architecture and operations concept Green Book. This set of protocols will be reduced as necessary, and simulation and/or prototyping activities will be used to evaluate the effectiveness of the reduced set of protocols and the feasibility of deploying them. Results of various prototyping activities will be consolidated during the definition of the final Orange/Red Books.

6.4.4.2 Management Risks

The quality of the end product relies heavily on the commitment of Government Agencies to provide support for the architecture study and protocol evaluations.

The schedule listed in section C of this document assumes that the working group can be formed quickly following the Spring 2004 CCSDS meetings. Delay in forming the working group will slip the entire schedule.

6.4.5 RESOURCE REQUIREMENTS

Function	**% Time Commitment**
Working Group Chair: lead working groups - prepare for and attend meetings, present material at working group meetings, write green and orange books.	0.3
Research and prototyping activities:	
FY04	1.5
FY05	5.0
FY06	7.5
FY07	10.0

6.5 DELAY TOLERANT NETWORKING BIRDS OF A FEATHER

Title of Group	**6.5 Delay Tolerant Networking Birds of a Feather**
Chair	**Scott Burleigh**
Area Director	**Robert Durst**
Mailing List	**TBS**

6.5.1 RATIONALE

Historically, deep space exploration craft have been few in number and have communicated only with operations centers on Earth; such communications have in effect been dedicated interplanetary communication circuits, established and configured by human operators. But as the number of such craft increases and as interactions among them (rather than just directly with Earth) begin to figure prominently in mission operations scenarios, the number of notional communication circuits increases geometrically. The practicality of manually administering each individual circuit diminishes, and the requirement for an automated *network* infrastructure emerges.

The familiar Internet network protocol model is not equal to this task, as it is not designed for effective operations over communication links characterized by very long signal propagation latencies, frequent and prolonged service interruptions, limited and highly asymmetrical transmission rates, and high rates of data corruption. Something new will be needed.

In short, communication with and among a large and growing population of communicating entities (robotic sensors, for example) separated from Earth by interplanetary distances will require deployment of a store-and-forward communication network that is capable of providing reliable data delivery and dynamic routing in a fully automated fashion. The proposed working group will investigate the applicability of the "Delay-Tolerant Networking" (DTN) architecture, derived in part from the design concepts underlying the CCSDS File Delivery Protocol, as a possible standard solution to this problem.

6.5.2 GOALS

1. Discuss the issues identified in the rationale above and in that context, the Delay Tolerant Networking architecture as developed over the past five years under the IRTF and DARPA auspices.

2. Determine whether or not there is agreement within the BOF that a WG should be established to pursue the standardization of DTN protocols within CCSDS.

3. If such agreement is reached, propose to the CESG the establishment of that WG:

   a. Draft a proposal;

   b. Develop a draft charter;

   c. Draft a resource plan;

   d. Draft a Concept Paper outlining the technical scope of the proposed work;

   e. Present these documents to the SIS Area Director for consideration and possible transmission to the CESG.

6.5.3 SCHEDULE AND DELIVERABLES

Date	Milestone
26 November 2004	Report on initial deliberations
7 March 2005	Initial drafts of WG proposal documents ready for internal review by the BOF
11 April 2005	Final WG proposal documents delivered to the SIS Area Director

6.5.4 RISK MANAGEMENT STRATEGY

6.5.4.1 Technical Risks

These will be identified in the course of preparing the WG proposal documents and will be described in the draft charter.

6.5.4.2 Management Risks

These will be identified in the course of preparing the WG proposal documents and will be described in the draft charter.

6.5.5 RESOURCE REQUIREMENTS

One NASA/JPL protocol engineer at 10% time commitment for 12 months.