The Consultative Committee for Space Data Systems

CCSDS OPERATING PLAN FOR STANDARDS DEVELOPMENT

Draft Record

CCSDS A01.2-Y-4.1

Draft Yellow Book

December 2006

FOREWORD

The top level CCSDS administrative documents that control the operations of CCSDS, and their different purposes, are shown in figure 1.

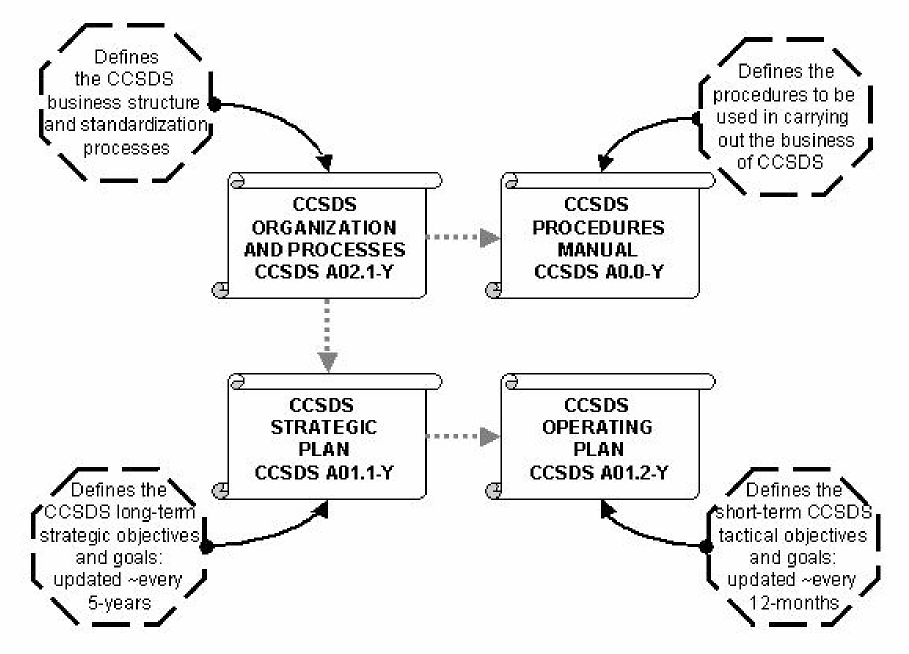
Defines the CCSDS business structure and standardization processes
CCSDS ORGANIZATION AND PROCESSES CCSDS A02.1-Y
Defines the procedures to be used in carrying out the business of CCSDS
CCSDS PROCEDURES MANUAL CCSDS A0.0-Y
CCSDS STRATEGIC PLAN CCSDS A01.1-Y
CCSDS OPERATING PLAN CCSDS A01.2-Y
Defines the CCSDS long-term strategic objectives and goals: updated ~every 5-years
Defines the short-term CCSDS tactical objectives and goals: updated ~every 12-months

Figure 1: CCSDS Controlling Documents

This document (CCSDS A01.2-Y) is the CCSDS Operating Plan. It is formally updated approximately once per year to reflect the current program of work for CCSDS, and it covers roughly a future 24-month period.

The Operating Plan contains the charters of all of the CCSDS Working Groups that have been approved by the CCSDS Management Council. As Working Groups are added or retired, this document may be periodically revised.

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

Member Agencies

- Agenzia Spaziale 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 (Roskosmos)/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.
- Belgian Federal Science Policy Office (BFSPO)/Belgium.
- 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.
- Danish Space Research Institute (DSRI)/Denmark.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- 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.
- Korea Aerospace Research Institute (KARI)/Korea.
- MIKOMTEK: CSIR (CSIR)/Republic of South Africa.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- 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 (superseded)
CCSDS A01.2-Y-2	CCSDS Operating Plan for Standards Development	May 2004	Issue 2 (superseded)
CCSDS A01.2-Y-3	CCSDS Operating Plan for Standards Development	November 2004	Issue 3 (superseded)
CCSDS A01.2-Y-4	CCSDS Operating Plan for Standards Development	July 2005	Current Issue: – updates active Working Group (WG) and deletes dissolved WG charters; – removes Birds of a Feather charters (relocated to on-line work areas)
CCSDS A01.2-Y-4.1	CCSDS Operating Plan for Standards Development, Draft Record, Issue 4.1	December 2006	Current draft: – adds Working Groups approved since issue 4; – deletes dissolved Working Groups

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1 SYSTEMS ENGINEERING AREA

1.1 SYSTEMS ARCHITECTURE WORKING GROUP

Title of Group	**1.1 Systems Architecture Working Group**
Chair	**Takahiro Yamada/JAXA**
Area Director	**Peter Shames/NASA**
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.
October 2003	Selection of candidate languages and tools. Prototyping (phase 1) of selected languages and tools starts WG meeting. Coordination meetings with at least one other working group on use of Reference Architecture.
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.
January 2004	Publish a revised version of the reference architecture document (Issue 0.9).
May 2004	WG meeting. Reports of prototyping (phase 1). Coordination meetings with at least one other working group on use of Reference Architecture to develop or revise domain specific architecture.
November 2004	WG meeting. Review the reference architecture document (Issue 0.10) and revise it as necessary.
April 2005	WG meeting. Review the reference architecture document (Issue 0.11) and revise it as necessary.
August 2005	Publish the reference architecture document as a Best Current Practice document and an accompanying Report as a Green Book.
April 2006	*Publish a document on formal methods for representing space data systems architectures.*

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.

1.2 SECURITY WORKING GROUP

Title of Group	**1.2 Security Working Group**
Chair	**Howard Weiss/NASA**
Area Director	**Peter Shames/NASA**
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 a security architecture;
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) investigate and identify how to integrate the use of the Common Criteria (ISO 15408) into the development of mission security requirements;

10) develop reference implementations and perform interoperability testing;

11) revise and maintain current a Green Book to describe security guidelines for implementation;

12) 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.
January 2005	Deliver revised Security Green Book.
February 2005	Circulate Security Architecture White Book to working group for comments. Circulate Threat Document for final WG review.
April 2005	Security WG meeting in Athens. Review final comments on Threat Document. Review Security Architecture White Book.
May 2005	Publish completed Threat Document as a Green Book. Issue Security Architecture as Red-1. Develop an encryption standard trade study proposal.
July 2005	Develop an authentication standard trade study proposal.
September 2005	Review RIDS on Security Architecture Red-1 at Sec WG meeting.
October 2005	Issue draft Policy Guidelines document based on NIST document.
December 2005	Mission Planners Guideline—maybe based on tailored version of Common Criteria.
January 2006	Issue encryption Red-1.
February 2006	Issue authentication Red-1.

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 and interactions with other working groups are increasing. Working group resources have increased but are still not entirely adequate.

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 will 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.

1.3 INFORMATION ARCHITECTURE WORKING GROUP

Title of Group	**1.3 Information Architecture Working Group**
Chair	**Dan Crichton/NASA**
Area Director	**Peter Shames/NASA**
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

1.3.3.1 Deliverables

1) Space Information Architecture Green Book detailing best current practices and core information architectural principles, including:
   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 lifecycle;
   d) a set of interfaces for cross support services, application program interfaces, and information management & access protocols.

2) Information Architecture and Grid Comparison Study White book outlining the alignment of information architectural principles and the current state of the practice in grid computing. Compare and contrast differences and similarities in approach, technical methodology, and data representation used in each community.

3) OWL-based ontology developed in Protégé to capture and describe Information Architecture concepts and principles.

4) Standards that support implementation of the information architecture including registries and repository standards for the software components based on industry best practice approaches. IAWG will support other groups in definition, implementation and prototyping of these standards and ensure that they fit against the architectural model.

1.3.3.2 Schedule

Date	Milestone
28 May 2003	BOF chartered and active.
October 2003	BOF meeting. Update on initial architecture and mapping of CCSDS standards. Coordination meeting w/ 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 & 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. Protégé Ontology of IA concepts developed and sent out for review.
September 2004	Information Architecture and Grid Comparison study white book published on CCSDS Web site.
October 2004	IAWG meeting. Ensure integration with RASDS and MOIMS development plans. Final of best current practices document on information architecture.
April 2005	IAWG meeting at CCSDS Spring Meetings in Athens, Greece. Joint registry working meeting between IA and IPR.
July 2005	Technical Interchange Meeting between IA and MOIMS IPR.
September 2005	Publish green book version of Information Architecture Reference document.
November 2005	Registry White Paper based on requirements. Scenarios and best practices.

Date	**Milestone**
November 2005	CCSDS XML Registry Prototype.
May 2006	Initial XML Registry White Book.
August 2006	Update to information models in IA Green Book.
November 2006	Final XML Registry White Book.
August 2007	Update to information models (data, software) in IA Green Book.
November 2007	XML Registry Red Book.
May 2008	XML Registry Blue Book.

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.

1.4 SPACE ASSIGNED NUMBERS AUTHORITY WORKING GROUP

Title of Group	**1.4 Space Assigned Numbers Authority Working Group**
Chair	**Robert Bradford/NASA**
Area Director	**Peter Shames/NASA**
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 CCSDS Management Council (CMC) approves the organization that will act as the SANA. Its public interface is focused through web-based services provided by the Secretariat.

The purpose of the Space Assigned Numbers Authority (SANA) Working Group is to focus on generating the technical analysis and requirements for SANA.

A SANA registry will register information about protocols and standards, as they relate to spaceflight, that need updating or extension more frequently than is practical in a CCSDS standard or report.

There are four prioritized categories of work which need to be either investigated for registry requirements or assessed for possible adjustment. These categories start with the officially sanctioned CCSDS processes/technologies and extend to those process/technologies that are not covered. Category four will be addressed only as it relates to specific spaceflight related requirements either identified in categories one through three or required by new or impending technologies (generally identified but not assessed in any detail).

Category one (1) is current CCSDS registries, namely SCIDs and SFDU CA.

Category two (2) is the set of protocol identifiers, assigned numbers, port numbers and reserved APIDs that are currently documented within CCSDS approved documents and

SCPS protocol numbers including other current deployments like SLE service providers. This would include existing elements e.g. glossary, ground data systems and acronym lists.

Category three (3) is the list of current CCSDS working groups e.g. SM&C, XML schema and namespaces, and birds of a feather that may require registries and also includes current CCSDS developments.

Category four (4) is the catch all for all other activities which may possess a registries requirement, e.g. information models, reference software, but currently do not fall under CCSDS and/or do not currently operate under a registry.

1.4.2 GOALS

Provide the mechanisms, processes and documentation required for a CCSDS registry capability.

– Objective 1: Provide detailed requirements for a CCSDS registry.

– Objective 2: Coordinate and integrate current CCSDS registry processes and other operational information into a unified standardized framework.

– Objective 3: Propose a SANA advisory group and develop rules and processes to operate and support the SANA and identify the resources needed for the continuing operation, deployment, outreach, and evolution.

1.4.3 SCHEDULE AND DELIVERABLES

1.4.3.1 Deliverables

1) Provide an assessment of categories 1 through 4 information sources for registry requirements in a SANA Green Book and present findings in an informal requirements review prior to further activities. The working group will document (possibly via a CCSDS White Paper/Report) the existing identifier spaces that CCSDS requires, according to the categories identified above, and to identify any special constraints imposed by those identifier spaces (e.g. that a particular registry exists and procedures for interaction with it are already defined).

2) Define processes to include a process that an organization can request assignment of numbers from the space(s) managed by CCSDS and a process that enables an organization to cause the CCSDS SANA to manage a particular identifier space within a SANA framework in a Magenta Book(s) also addressing security. In defining these processes, the working group will address transition issues that result from moving from existing processes to the new proposed SANA processes.

3) Define and document a statement of work for the ongoing operation of the SANA function. This statement of work will be delivered to the CCSDS Management Council (CMC) for their consideration in formulating a follow-on effort to actually

implement and operate the SANA function. The statement of work will identify specific tasks (processes and system development, etc.) that need to be accomplished to implement and operate the SANA function.

1.4.3.2 Schedule

Date	**Milestone**
Mar 2006	SANA WG Charter approved
Aug 2006	Requirements assessment complete
Oct 2006	Green Book Requirements Review complete
Nov 2006	Magenta Book complete
Dec 2006	Statement of Work complete
Jan 2007	Statement of Work, Green and Magenta Books approved

1.4.4 RISK MANAGEMENT STRATEGY

1.4.4.1 Technical Risks

Risks: No significant technical risk is involved. Technical risks are low since this is essentially process based.

Mitigation: None required

1.4.4.2 Management Risks

Risks: Some management risk is involved including the usual politics and consensus building necessary for success.

- Issues of privacy, ownership
- Issues of security and access to aggregated information
- International resources for the WG and operations team

Mitigation: Work as required

2 MISSION OPERATIONS AND INFORMATION MANAGEMENT SERVICES AREA

2.1 DATA ARCHIVE INGEST WORKING GROUP

Title of Group	Error! Reference source not found. Error! Reference source not found.
Chair	**Donald Sawyer/NASA**
Area Director	**Nestor Peccia/ESA**
Mailing List	**moims-dai@mailman.ccsds.org**

2.1.1 RATIONALE

Agencies need to reduce the cost and increase the automation associated with acquiring, ingesting, managing, and disseminating data and metadata to, within, and from archives. Archives, including both mission archives, final archives and repositories performing long-term preservation, 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, registry/repositories are of increasing importance as the holders of re-usable metadata in the exchange of information.

2.1.2 GOALS

Goal 1: Complete the ISO review of the CCSDS “Producer-Archive Interface Methodology Abstract Standard” (PAIMAS) Blue Book:

1) review and respond to any comments;
2) update the PAIMAS book as appropriate to achieve ISO standardization.

The PAIMAS has been approved as International standard ISO 20652

Goal 2: 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:

1) define the main metadata categories and attributes;
2) define a way to create a dictionary of various classes of objects that will be considered (e.g., 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 plan 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 SIP standard.

Goal 3: While this working group exists, support CCSDS archival requirements:

– monitor and report on Agency archival issues and implementations;

– perform the required 5-year CCSDS and ISO reviews on existing archive related standards, beginning with the “Reference Model for an Open Archival Information System (OAIS).

2.1.3 SCHEDULE AND DELIVERABLES

2.1.3.1 Goal 1: PAIMAS

Date	**Milestone**
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.
May 2004 Completed	Submit revised PAIMAS Standard as a final CCSDS Standard.
September 2004 Completed	Submit CCSDS PAIMAS Standard for review as ISO Standard.
November 2005, assuming ISO comments received by 1 September 2005	Complete review of ISO comments on PAIMAS and provide responses.
January 15 2006 completed	Assuming only editorial changes are needed, update the PAIMAS document appropriately for final ISO approval and request FDIS review be waived.

2.1.3.2 Goal 2: SIP

Date	**Milestone**
19 May 2004 Completed	SIP Goal accepted and active.
October 2004 Completed	Proposed metadata categories, optional and mandatory, with specific attributes for the SIP.
July 2005 Completed	Revised draft SIP white book – high level view, and begin generating test cases.
December 2005 Completed	Generate CCSDS SIP “Proposed Standard” White Book and initiate review.
June 2006	Generate revised CCSDS SIP “Proposed Standard” White Book, taking account the XFDU red book and initiate review
December 2006	Generate CCSDS SIP “Draft Standard” Red Book and initiate review. Begin two draft Agency implementations.
May 2007	Generate CCSDS Recommended Standard Blue Book and two implementations (or a second round for a Draft Standard).

2.1.3.3 Goal 3: CCSDS Archival Requirements

Date	**Milestone**
June 2006	WG approved notice of need to review status of OAIS reference model is distributed by Agencies to solicit comments on the need for updates.
December 2006	WG begins review of comments to determine extent, if any, of need for updates.
May 2007	WG reaches recommended approach to any needed updates,.
TBD	Depends on results of previous step.

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.

There is the potential that one or more active experts from various agencies may become unavailable and, this could impact the schedule if the timeline slips substantially

2.1.5 RESOURCE REQUIREMENTS

WG Lead	0.20 FTE/Year	NASA/GSFC
WG Deputy	0.10 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) 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 a tracking data message (TDM). Deliverable: TDM Blue Book.

2) Development of a Recommendation for the agency-to-agency exchange of spacecraft attitude data messages (ADM). Deliverable: ADM Blue Book.

3) Development of XML specification corresponding to the ADM, ODM (orbit data messages) and TDM Recommendations. Deliverable: XML Blue Book.

4) Update NAV data green book with additional material for ADM, ODM and TDM Recommendations, as required. Deliverable: Updated Green Book.

5) Support SANA efforts pertaining to NAV-related requirements for a future, comprehensive object identification scheme. Deliverable: NAV feedback per request.

6) Support Time Services Architecture WG efforts pertaining to NAV-related requirements associated with timing issues being addressed by CCSDS. Deliverable: NAV feedback per request.

7) Support efforts pertaining to NAV-related requirements associated with orbit data transfer issues being addressed by CCSDS SLE management. Deliverable: NAV feedback per request.

8) Investigate requirements to support the Delta Differential One-Way Ranging (DDOR) processing and interfaces. Deliverable: ODM and TDM Blue Books.

9) Investigate requirements to support the ISO SC14 effort to develop a Common Data Format for collaborative operations in Earth orbit. Deliverable: Activity Plan and enhanced ODM Blue Book.

2.2.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
May 2006	Working on RIDs to ADM, TDM and NDM/XML RBs from CCSDS review completed March 2006
June 2006	CCSDS Series Spring 2006
July 2006	Complete Activity Plan for ISO SC14 effort with request to CMC to proceed
Summer 2006	Finalize updates to ADM, TDM and NDM/XML RBs
Fall 2006	Conduct another CCSDS review of the TDM.
Fall 2006	Conduct ADM related implementation tests.
Fall 2006	CCSDS Fall Series: Submit ADM for approval to BB status.
Winter 2006	Finalize updates to TDM, based on second review, then conduct implementation tests.
Spring 2007	CCSDS Spring Series: Submit TDM for approval to BB status. Conduct second CCSDS review of NDM/XML document.
Summer 2007	Finalize updates to NDM/XML doc, then conduct implementation tests.
Fall 2007	Submit NDM/XML for approval to BB status.
June 2006 – Dec 2008	Work on DDOR effort Work on enhancement to ODM to develop a revised Blue Book to support ISO SC14 and DDOR efforts.

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 @ 30% time commitment per year
Participating Agencies	CNES. Staffing needed: 1 flight dynamics engineer @ 10% time commitment per year
	ESA (ESOC). Staffing needed: 1 flight dynamics engineer @ 10% time commitment per year (deputy)
	DLR. Staffing needed: 1 flight dynamics engineer @ 10% time commitment per year
	NASA (JPL). Staffing needed: 2 flight dynamics engineers @ 10% time (each) commitment per year
	JAXA. Staffing needed: 1 flight dynamics engineer @ 10% time commitment per year
	NASA (GSFC). Staffing needed: 1 flight dynamics engineer @ 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; Based on these requirements, develop a set of recommendations and best practices documents that specify an extensible framework for packaging data and metadata that can contain an object physically, or by reference (e.g., Universal Resource Locator (URL), 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;

2) Oversee the deployment of at least two independent implementations of the packaging framework; Conduct prototyping and interoperability tests in many areas of space data systems (refer to the Resource Requirements paragraph);

3) Based on the experience gained from the interoperability testing of the XML packaging software and use cases and requirements from various space data and

operations groups, develop a set of registry/repository specifications that are extensible, addressing interfaces, data structures and information modeling. This registry/repository should leverage the more widely based registry work such as ebXML and UDDI while supporting any special space-based operations registry/repository requirements.

4) Transfer any XML tools and best practices developed for the XML Packaging and Registry/Repository tasks to the MOIMS Area Director for use in other CCSDS Working Groups

5) Act as the responsible Working Group for any CCSDS Recommendations in the area of Information Understanding(Structures and Languages (formerly CCSDS Panel 2). This includes performing any CCSDS or ISO 5 year reviews of existing standards and monitoring any new activities by CCDS member agencies in this area.

Schedule and Deliverables

Goals 1 and 2:XML Packaging Recommendations and Interoperable Independent Software Implementations

Date	**Milestone**
19 May 2003	WG chartered and active.
30 June 2003	XFDU draft ‘proposed’ document (WB) With use cases/requirements available
November 2004 Complete	Submit CCSDS XFDU ‘Proposed Standard’ (RB) and Reference Implementation for CESG Review.
June 2006	Generate first draft of XML Packaging Best Practices Green Book
July 2006 Complete	Generate CCSDS Proposed Standard (Redbook V2), Best Practices Green Book and two interoperable reference implementations for submission to CESG for agency review
December 2006	Received Agency RID package

Date	**Milestone**
January 2007	Deliver editor’s proposed RID responses, at IPR WG at Fall CCSDS Workshop
April 2007	Develop XFDU CCSDS Recommended Standard and new issue XFDU Green Book based on Agency review comments and user feedback for CESG review
TBD	White Papers on proposed enhancements for the XFDU packaging recommendations based on the planned Version 2 enhancements
TBD	XFDU V2 White Book‘ (WB) and proof –of-concept prototypes
As required	Develop XFDU Version 2 Redbook and Bluebook((or Pink Pages), update XFDU Greenbook and implement two interoperable implementations

Goal 3:Registry and Repository Recommendations and Software

Date	**Milestone**
April 2005 Complete	Joint FTF meeting with Systems Engineering, Information Architecture team to develop registry work plan in this area
June 2006	White Papers on the Scope, Use Cases and Requirements for Registries and Repositories in the Space Information and Operations domains
1-August-2006	Use Cases and Requirements on CCSDS Usage of XML Schema Registries
15-October-2006	**Workshop/telecons to establish agreed use case sand Requirements for XML Schemas and Repositories and Share Agency Contributions should include XSG IA SANA**
15-January-2007	**White Papers and Agency Prototypes on CCSDS Schema Registries**
June- 2007	**Draft White Book(s) on CCSDS XML Schema Registry**

Date	**Milestone**
January-2008	**XML Schema Registry White Book and Prototypes**
January-2009	**XML Schema Registry Red Book/Green Book/Reference Implementation for CESG Review**
2010	XML Schema Registry Draft BlueBook/GreenBook and two Interoperable, Independant Implementation for CESG Review

2.3.3 RISK MANAGEMENT STRATEGY

2.3.3.1 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

Also a wide variety of use cases and testing environments have been identified for the Interoperability Testbed for XFDUs:

- NASA PDS;
- NASA/EOSDIS Libraries;
- NASA SLE implementations;
- CNES SLE implementations;
- CNES Archive Ingest SIP development;
- ESA Data Distribution System
- ESA CAOS.

This range of environments should identify any efficiency or operability problems that must be solved either in the best practices document or by further implementations.In the area of Registries and Repositories, overlapping membership, frequent discussions and a minimum of one FTF meeting with the Information Architecture BOF/WG and the SANA WG in the Systems Engineering area to avoid significant duplication of effort or significant divergence of concepts. It is recommended that only one WG be tasked with the development of specifications in the area of Registries and repositories.

2.3.3.2 Management Risks

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

There may be a conflict for resources between the Registry/Repository activities and the XFDU V2 activities. Fallback would be to do the activities in sequence with the member agencies deciding on priority

Based on Agency Representative Input at the June 2006, the IPR has decided to allocate available resources to the development of CCSDS XML Schema Registry/Repository .Recommendations and reference implementations after the current XFDU Version 1 release

2.3.4 RESOURCES

Under separate cover

2.4 SPACECRAFT MONITORING AND CONTROL WORKING GROUP

Title of Group	**2.4 Spacecraft Monitoring and Control Working Group**
Chair	**Mario Merri/ESA**
Area Director	**Nestor Peccia/ESA**
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 re-using systems and operational concepts, thus increasing their reliability.
3) facilitating the development of generic (infrastructure) on-board and on ground software that can be shared by multiple projects via simple re-configuration
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 SM&C 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 AND DELIVERABLES:

The goals of the working group are

1) to pave 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 involves also the space segment and therefore requires close coordination with the SOIS. This will be done by initially producing a white book and to bring it to Green status.

2) to specify and produce the corresponding Reed Books for the following initial set of services:

   - SM&C Protocol

   - SM&C Common Services

   - SM&C Core Services

3) to update the XTCE standard with the result of the public review together with the OMG. To update the XTCE Green Book from presentation format to actual book. To produce the XTCE Magenta Book as recommended practice on how to tailor XTCE for a CCSDS-enabled mission.

4) to specify the other high level services identified in the Green Book.

2.4.3 SCHEDULE:

2.4.3.1 GOAL 1 (GB)

Date	Milestone
5 Nov 03	Telecon#03: status report
3 Dec 03	Telecon#04: status report
5 Jan 04	White Book – draft 0.1
28 Jan 04	Telecon#05: Review
18 Feb 04	White Book – draft 0.2
3 Mar 04	Telecon#06: status report
28 May 04	White Book – draft 0.5
4 Jun 04	Telecon: agreement on WB draft 0.5
26 Aug 04	Deadline for comments to WB after 3-month informal agency review

2 Sep 04	Telecon: agreement on comment disposition
23 Sep 04	Submission of WB to CCSDS as proposed GB
4 April 05	Updated GB (integrating changes from CCSDS review) available
15 April 05	Submission of SM&C GB 1.0 to CCSDS for approval
May 05	Published GB issue 1.0
03 Oct 05	Internal responses to NASA issues on GB available
12 Oct 05	Telecon#18: Internal discussion on responses to NASA issues on GB
24 Oct 05	Agreed responses to NASA issues back to CESB with proposed GB ToC
28 Nov 05	GB draft 1.1 available
12 Dec 05	Comments due to GB draft 1.1
20 Dec 05	Telecon#23: agreement on new SM&C GB and disposition of RIDs from 1st Internal Agency Review of the 3 HP RBs
14 Feb 06	Submission of GB 2.0 to CCSDS for approval

2.4.3.2 GOAL 2a (High Priority (HP) RBs)

Date	**Milestone**
14 Jul 04	Delivery of concept paper
21 Jul 04	Telecon#11: agreement on concept paper
15 Oct 04	Delivery of 3 HP RBs draft 0.1
27 Oct 04	Telecon#13: Discussion 2 HP RBs draft 0.1
14 Jan 05	Delivery of 3 HP RBs draft 0.2
26 Jan 05	Telecon#14: discussion on 3 HP RBs drafts 0.2
16 Mar 05	Telecon#15: discussion on general status
4 Apr 05	Delivery of 3 HP RBs draft 0.3
6 Jun 05	Availability of TN on feasibility of AMS for SM&C
15 Jun 05	Telecon#16: discussion on 5 RBs + prototype approach + AMS

20 Jul 05	Telecon#17: discussion on 3 HP RBs
31 Aug 05	Delivery of 3 HP RBs draft 0.4
30 Nov 05	End of 1st internal Agency review of 3 HP RBs draft 0.4
7 Jan 06	Comments of 1st internal Agency review of 3 HP RBs draft 0.4 due
26 Jan 06	Response to comments of 1st review due. Comments on new 3 HP RBs (Protocol 0.7, Common 0.4, Core 0.5) due
31 Jan 06	Telecon#25: - Prototype kick off - Discussion on the comments of the 3 HP RBs following internal Agency review - Discussion on the comments of the new versions of the 3 HP RBs
21 Feb 06	Telecon#26: - Prototype kick off - Discussion on the comments of the 3 HP RBs
20 Mar 06	Telecon#28: - Discussion on the comments of the 3 HP RBs from NASA and JPL - Discussion on the TN on the prototype.
31 Mar 06	Delivery of prototype components: - SM&C Protocol C API (AO/JPL) - Common Java API (ID/SC/SciSys) - Core Java API (BH/Logica)
26 Apr 06	Telecon#29: - Discussion on the comments of the 3 HP RBs from NASA and JPL - Report on status of the TN on the prototype - Agenda for CCSDS workshop
24 May 06	Telecon#31: - Discussion on the comments of the 3 HP RBs from NASA and JPL - Report on prototype status - Agenda for CCSDS workshop
1 Dec 06	Delivery of final drafts of 3 HP RBs (review + prototype feedback) for WG review
Fall WS 06 (Jan 07)	Start of public review of 3 RBs

2.4.3.3 GOAL 2b (Prototype)

Date	**Milestone**
31 May 05	Prototype Concept Paper available
31 Oct 05	Delivery of prototype SoW draft 0.1 (MM)
1 Mar 06	Start prototype work (estimated duration 6m)
1 Jun 06	Some co-working component of prototype available
15 Jun 06	Preliminary prototype demonstration @ CCSDS workshop
15 Nov 06	Prototype integration testing
Fall WS 06 (Jan 07)	Final prototype demonstration @ CCSDS workshop

2.4.3.4 GOAL 3 (XTCE Review)

Date	**Milestone**
15 Feb 05	Submission of XTCE review datapackage to CCSDS Secretariat for initiation of the Public Review
11-15 Apr 05	Disposition of XTCE RIDs
12 Oct 05	JMu to draft and distribute XTCE MB ToC with highlights of the content of each chapter
14 Oct 05	CF+KR draft and distribute XTCE GB ToC with highlights of the content of each chapter
19 Oct 05	Telecon#19 to discuss comments and Kick off work
01 Nov 05	Deadline for submission of OMG issues towards XTCE 1.1 draft
02 Nov 05	CF+KR+JMu+JMo distribute XTCE GB draft 0.1
08 Nov 05	Telecon#20 to discuss XTCE GB draft 0.1
16 Nov 05	JMu+JMo distribute XTCE GB draft 0.2
22 Nov 05	Telecon#21 to discuss XTCE GB draft 0.2
30 Nov 05	JMu+JMo distribute XTCE GB issue 1.0
12 Dec 05	CF+KR+JMu+JMo distribute XTCE MB draft 0.2
13 Dec 05	Delivery of XTCE 1.1 draft (CCSDS RIDs + all OMG issues up to 1st Nov)

14 Dec 05	Telecon#22 to discuss XTCE MB draft 0.2
19 Dec 05	Start of 2nd CCSDS Agency review (end 28 Feb 06)
16 Jan 06	CF+KR+JMu+JMo distribute XTCE MB draft 0.3
19 Jan 06	Telecon#24 to discuss XTCE MB draft 0.3
30 Jan 2006	MM to submit XTCE GB (draft 1.1) + comments/responses matrix to CESG via AD
15 Feb 06	CF+KR+JMu+JMo distribute XTCE MB issue 1.0
22 Feb 06	Telecon#27 to discuss XTCE MB draft 1.0
20 Mar 06	End of 2nd CCSDS Agency review (start 01 Dec 05)
19 May 06	Telecon#30 (CCSDS+OMG/SDTF): preliminary discussion on RID dispositions
1 Jun 06	Telecon#32 (CCSDS+OMG/SDTF): final discussion on RID dispositions
30 Sep 06	Delivery of XTCE 1.1 final (BB) and submission to CESG of XTCE MB

2.4.3.5 GOAL 4 (Other SM&C Services)

Date	**Milestone**
4 Apr 05	New drafts of the RBs as follows: - SM&C Time Service - SM&C Remote Software Management Service
1 Sep 05	Availability of revised versions of: - SM&C Time Service - SM&C Remote Software Management Service - SM&C Automation Service (NEW)
Falls WS 2006 (Jan 07)	Availability of the consolidated RBs for: - SM&C Time Service - SM&C Automation Service - Availability of concept and scope of planning and scheduling services

2.4.4 RISK MANAGEMENT STRATEGY:

2.4.4.1 Technical Risks

None.

2.4.4.2 Management Risks

1. Risk 1: Unavailability of resources to finalise started work and the relative prototypes
2. Mitigation: Reduce individual agencies costs by distributing work across several agencies participating to the WG. Bring issue to CMC so as to raise awareness of contributing agencies. In the worst case, descope the work.
3. Risk 2: Limited support by NASA to WG.

Mitigation: Involve key people from the NASA future programs such as Constellation missions and Crew Exploration Vehicle.

2.4.5 RESOURCE REQUIREMENTS:

Under separate attachment.

3 CROSS SUPPORT SERVICES AREA

3.1 [DELETED - CROSS SUPPORT CONCEPT AND REFERENCE MODEL WORKING GROUP – WORK COMPLETE]

3.2 [DELETED: SLE DATA TRANSFER SERVICES WORKING GROUP—WORK COMPLETE, ABSORBED INTO CROSS SUPPORT TRANSFER SERVICES WG]

3.3 CROSS SUPPORT SERVICE MANAGEMENT WORKING GROUP

Title of Group	**3.3 Cross Support Service Management Working Group**
Chair	**Erik Barkley/NASA**
Area Director	**Gerard Lapaian/CNES**
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 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 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;

f) it will be organized in a way that allows for incremental adoption, implementation in conjunction with existing ad-hoc mechanisms such that an incremental migration path from legacy ad-hoc methods to standardized service management can be accommodated.

3.3.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
W-1., March 2006 G-1, May 2006	Space Link Extension — Service Management — Concept of Operations Concept (CCSDS 910.14) (Green Book).
W-1, March 2005 R-1, September 2005 R-2, May 2006 B-1, September 2006	Space Link Extension — Service Management — Service Management Service Specification (CCSDS 910.11) (Blue Book).
R-1, September 2006 M-1, December 2006	Space Link Extension — Service Management — Technology Mapping Recommendations (CCSDS 910.?) (Magenta Book).
September 2004	Inter-operable prototype demonstrations with respect to W-1 for 910.11 (CCSDS Record).
October 2005	Inter-operable prototype demonstrations with respect to R-1 for 910.11 (CCSDS Record).
May 2006	Inter-operable prototype demonstrations with respect to R-2 for 910.11 (CCSDS Record).
December 2006	Retirement of SMWG.

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 multiple prototypes. SLE Service Management prototypes are under way for the JPL Deep Space Network (DSN), in a service provider role, , the European Space Agency (ESA) in a service user role, and the US Air Force Satellite Control Network Interoperability Project in a service user role.. Plans are to have at least the service user prototypes interoperate with the service provider in support of Red Book validation and review.

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).

3.4 [DELETED: SLE NAVIGATION SERVICES BOF—ABSORBED INTO CROSS SUPPORT TRANSFER SERVICES WG]

3.5 [DELETED: SLE RETURN ALL DATA BOF—ABSORBED INTO CROSS SUPPORT TRANSFER SERVICES WG]

3.6 CROSS SUPPORT TRANSFER SERVICES WORKING GROUP

Title of Group	**3.6 Cross Support Transfer Services Working Group**
Chair	**Yves Doat/ESA**
Area Director	**Gerard Lapaian/CNES**
Mailing List	**css-csts@mailman.ccsds.org**

3.6.1 RATIONALE

The CCSDS has published recommendations for five Space Link Extension (SLE) Transfer Services. Each of these recommendations contains nearly identical specifications for association, operations, and communications management. Recently a number of new cross support services have been requested by member Agencies. Recommendations for these new services would repeat the redundant sections of the earlier recommendations if specified in the conventional manner. Figure 1 illustrates a conventionally specified transfer service.

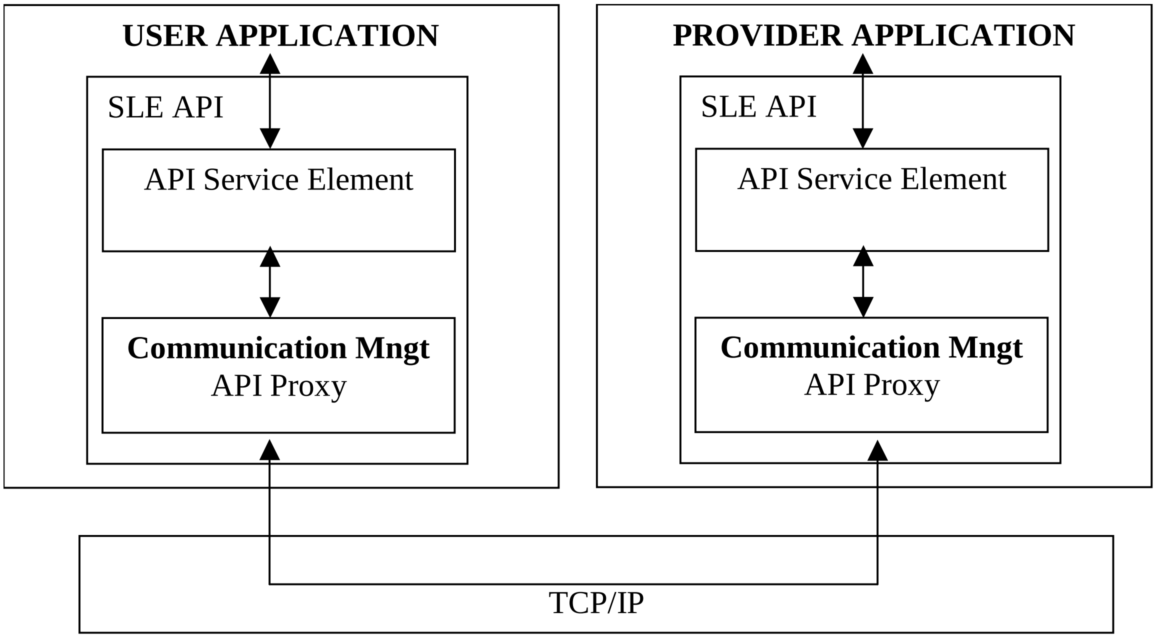
USER APPLICATION
SLE API
API Service Element
Communication Mngt
API Proxy
PROVIDER APPLICATION
SLE API
API Service Element
Communication Mngt
API Proxy
TCP/IP

Figure 3.6-1: Current Transfer Service Specification

The monolithic nature of the current specification also has the more serious disadvantage that it requires changes to the abstract syntax notation specification for each new service. Although the specifications do not strictly require that the transfer syntax be directly derived form routines generated by an ASN.1 compiler, the practical result is the need to recompile the local-to-transfer syntax translation routines for each implementation of each new service definition.

A more efficient method would be to define a transfer service 'tool kit' that provides the common aspects of the association, operations, and communications capabilities. The toolkit transfers all common aspects using ASN.1 while the service specific data types are transferred in a syntax that is independent from the one used by the 'tool kit' for the common aspects. Figure 2 illustrates how such a specification might fit with multiple different data type specific interface specifications to provide services for any type of data.

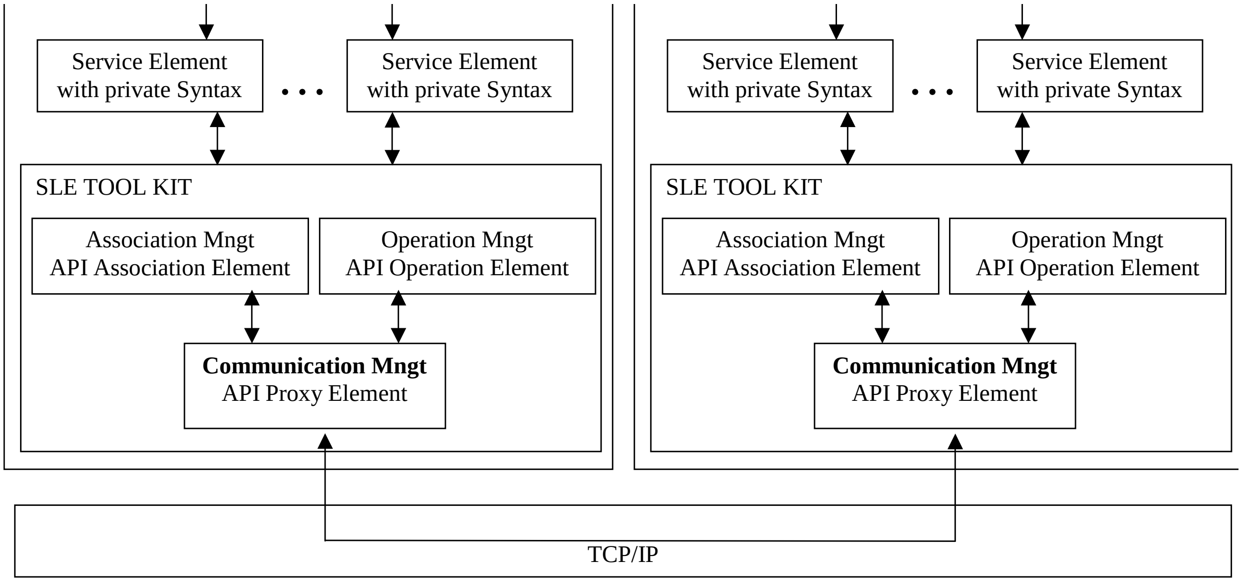
Service Element with private Syntax
. . .
Service Element with private Syntax
SLE TOOL KIT
Association Mngt API Association Element
Operation Mngt API Operation Element
Communication Mngt API Proxy Element
Service Element with private Syntax
. . .
Service Element with private Syntax
SLE TOOL KIT
Association Mngt API Association Element
Operation Mngt API Operation Element
Communication Mngt API Proxy Element
TCP/IP

Figure 3.6-2: Transfer Services Supporting Any Type of Data for New Transfer Specification

The purpose of this Working Group is to develop the specification for a transfer service 'tool kit' capable of supporting new services implementing each their own syntax. This Working Group, to be known as the Cross Support Transfer Service, would provide association, operations, and communications management capabilities for new data transfer service. To demonstrate the use of this data type indifferent specification, this Working Group will develop recommendations for the SLE Tool Kit and the Guidelines describing the definition of new services. Once defined the SLE Tool Kit recommendation will be the basis for the definition of the Return Unframed Telemetry (RUFT) and Radiometric Data intended to be supported by the 'tool kit'.

Justification for RUFT selection: the CLTU service can be used as a transparent forward service. An equivalent return service has been requested by several agencies.

Justification for Radiometric service: the Radiometric service is considered a pure data transfer that would demonstrate the Toolkit approach for non–space link transfer.

Agencies listed other services that are not part of the current work activities. Some of them are listed here for completeness: Monitoring (and Control), Telemetry Catalogue, Off-line Telecommanding.

Once defined, the toolkit specifications will be the baseline for the implementation of a prototype capable of demonstrating their cross supporting data transfer capabilities.

In parallel with this activity, the Cross Support Transfer Service will ensure the maintenance of the existing SLE books: CLTU, FSP, RAF, R-CF and R-OCF. In particular the working group will develop the recommendation for the API Proxy: Mapping to TCP/IP and the best practices related to SLE.

3.6.2 GOALS

The goals of this Working Group include:

1) complete the Cross Support Transfer Service Specification of a Tool Kit and advance it to the CCSDS Recommendation state;
2) complete the Guidelines for the Definition of a new Service based on the Tool Kit;
3) implement a prototype demonstrating the interoperability of the proposed approach;
4) complete the production of Return Unframed Telemetry Specification and advance it to the CCSDS Recommendation state;
5) complete the production of the Radiometric Data Specification and advance it to the CCSDS Recommendation state;
6) complete the SLE API Proxy: Mapping to TCP/IP and advance it to the CCSDS Recommendation state;
7) complete the SLE API Best practices.

3.6.3 SCHEDULE AND DELIVERABLES

Date	Milestone
Spring 2005	Draft Recommendation: SLE API Proxy: Mapping to TCP/IP CCSDS ???.1-R-1.
Spring 2005	Draft Recommendation: SLE API Best practices, CCSDS ???.1-R-1.

Date	**Milestone**
Spring 2006	Draft Recommendation: Cross Support Services—Cross Support Transfer Service Specification—Tool Kit, CCSDS ???.1-R-1.
Spring 2006	Draft Recommendation: Cross Support Services—Guidelines for new Service Definition, CCSDS ???.1-G-1.
Autumn 2006	Prototype demonstration.
Autumn 2006	Draft Recommendation: Space Link Extension—Return Unframed Telemetry Interface Specification, CCSDS ???.1-R-1.
Autumn 2006	Draft Recommendation: Ground Domain—Return Radiometric Data Interface Specification, CCSDS ???.1-R-1.

3.6.4 RISK MANAGEMENT STRATEGY

3.6.4.1 Technical Risks

Because the Cross Support Transfer Service will be based upon existing successful implementations of conventional specifications there is little technical risk to this proposed capability.

3.6.4.2 Management Risks

With the Cross Support transfer Service covering the bulk of the data transfer protocol there may be a temptation to use the service to transfer data types that are not sufficiently documented for cross-support purposes. No CCSDS standard cross-support service can exist unless and until a specification is produced for it.

Lack of resources or reassignment of resources is a constant risk to all standards-development processes.

Lack of sufficient budget to ensure that the Working Group members can participate in all meetings.

As alternatives videoconferences, teleconferences, and email will be utilized whenever possible to reduce costs.

4 SPACECRAFT ONBOARD INTERFACE SERVICES AREA

4.1 SUBNETWORK SERVICES WORKING GROUP

Title of Group	**4.1 Subnetwork Services Working Group**
Chair	**Rick Schnurr/NASA**
Area Director	**Patrick Plancke/ESA**
Mailing List	

4.1.1 RATIONALE

Charter under development

4.1.2 GOALS

4.1.3 SCHEDULE AND DELIVERABLES

Date	Milestone

4.1.4 RISK MANAGEMENT STRATEGY

4.1.4.1 Technical Risks

4.1.4.2 Management Risks

4.2 APPLICATION SUPPORT SERVICES WORKING GROUP

Title of Group	**4.2 Application Support Services Working Group**
Chair	**Stuart Fowell/BNSC**
Area Director	**Patrick Plancke/ESA**
Mailing List	

4.2.1 RATIONALE

Charter under development

4.2.2 GOALS

4.2.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**

4.2.4 RISK MANAGEMENT STRATEGY

4.2.4.1 Technical Risks

4.2.4.2 Management Risks

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/ESA**
Area Director	**Jean-Luc Gerner/ESA**
Mailing List	**sls-rfm@mailman.ccsds.org**

5.1.1 RATIONALE

Agencies are planning demanding missions to the Moon with links at 2 GHz for low data rates and 22 (the band near 22 GHz)/26 GHz for very high data rates, as well as missions to Mars with 32 GHz trunk links. The 22 (the band near 22 GHz), 26 and 32 GHz frequency bands are not covered by the existing RF and Modulation Blue Book (401.0-B-16). New techniques may be needed for the 2 GHz links to the Moon. One Agency is imminently considering the implementation of a scheme based on the SNIP (Space Network Interoperability Panel) format and is planning to propose this technique, based on spread-spectrum.

Additionally, developing requirements on phase/amplitude imbalance and phase noise for the advanced modulation schemes of the current Blue Book (recommendation 2.4.17A) is needed.

The bandwidth-efficient modulations Green Book (413.0-G-1) needs has to be updated to reflect the recent changes in the Blue Book relating to recommendation 2.4.17B, 2.4.18 as well as a number of nomenclature changes (bit and symbol rate definition, OQPSK filtering, T-OQPSK suppression, etc.) Moreover, a mixture of informative and normative information exists in the current Green Book, which is confusing. The normative part has to be removed from the Green Book and inserted in 2.4.17A, 2.4.17B and 2.4.18.

Additionally, 2.4.17A includes a number of modulations that have not been used to date nor are expected to be used in the foreseeable future. Re-opening discussion on 2.4.17A could solve this problem and provide a basis to respond to the request from IOAG on trying to limit the number of schemes allowed by 2.4.17A.

The Green Book (412.0-G-1) on RF Spacecraft-Earth Station Compatibility Test Procedure has to be reviewed and updated in line with current practices.

5.1.2 GOALS

The goals of this Working Group are to:

1) Develop modulation recommendations for 22 (the band near 22 GHz), 26 and 32 GHz high rate links;
2) Develop recommendations for Lunar missions to operate at 2 GHz with other users;
3) Revise the recommended schemes in 2.4.17A and develop necessary companion recommendations on imbalances and other impairments;
4) Update 413.0-G-1 in line with recent changes to 401.0-B-16 and move normative text from 413 to 401 (as attachments to 2.4.17A, 2.4.17B and 2.4.18);
5) Update the RF and Modulation Book CCSDS 401.0-B-16 set of recommendations on modulation techniques as per items 1 to 4 above and possible changes from SFCG-26, SFCG-27 and WRC-07;
6) Review the RF and Modulation Compatibility Test Procedures Book CCSDS 412.0-G-1 and update it.

5.1.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
September 2006	WG kick-off
April 2007	Concept papers for recommendations on 22 (the band near 22 GHz), 26 and 32 GHz modulation, and on 2 GHz modulation for Moon missions; proposals for revised 2.4.17A, and editorially revised 2.4.17B and 2.4.18, and draft companion recommendations; proposals for editorially revised 413.0-G; assessment of amount of work needed and affected sections for a revised 412.0-G.

Date	Milestone
November 2007	Review of SFCG-26/27 and WRC-07 decisions affecting 401.0-B; White-1 recommendation on 22 (the band near 22 GHz), 26 GHz modulation; White recommendations on 32 GHz modulation, and on 2 GHz modulation for Moon missions; Pink 2.4.17A/B, 2.4.18 and Red companion recommendations; draft revised 413.0-G ready for approval by CESG; pre-draft revised 412.0-G.
November 2008	White recommendation on 22 (the band near 22 GHz), 26 GHz modulation; Red recommendations on 32 GHz modulation, and on 2 GHz modulation for Moon missions; Blue 2.417A/B, 2.4.18 and Red companion recommendations; Revised 413.0-G; Draft revised 412.0-G for approval by CESG; Proposed updates (pink) of CCSDS 401.0-B Recommended Standard on modulation from SFCG and WRC-07.
April 2009	Blue 401, Green 412 and Green 413.
November 2009	Red recommendation on 22 (the band near 22 GHz), 26 GHz modulation.
April 2010	Blue recommendation on 22 (the band near 22 GHz), 26 GHz modulation in 401.

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 April 2010.

5.1.5 RESOURCE REQUIREMENTS

Drafting work for 0.4 man year not including 412.0-G revision (to be estimated by April 2007).	CNES, ESA, NASA
Review support as required	CNES, ESA, NASA

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/ESA**
Area Director	**Jean-Luc Gerner/ESA**
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.

5.2.2 GOALS

The goals of this Working Group are to:

- support the development of a CCSDS Experimental (Orange) Book edited by NASA/GSFC and reporting valuable experience with Low Density Parity Check Codes (LDPCC);
- support the development of a CCSDS Experimental (Orange) Book edited by NASA/JPL and reporting valuable experience with Low Density Parity Check Codes (LDPCC);
- support the development of a CCSDS Experimental (Orange) Book edited by ESA/ESTEC and reporting valuable experience with Serially Concatenated Convolutional Codes (SCCC).

Because the Orange Book's funding and other associated resources are independently provided by the organization that initiates the work (i.e., NASA in this case), the Coding and Synchronization WG role is limited to the review(s) before publication.

5.2.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
Fall 2005	Review GSFC Orange Book on LDPCC. Review JPL Orange Book on LDPCC. Review first draft of SCCC Orange Book.
Spring 2006	Final Review GSFC Orange Book on LDPCC. Final Review JPL Orange Book on LDPCC. Review second draft of SCCC Orange Book.
Fall 2006	Issue GSFC Orange Book on LDPCC. Issue JPL Orange Book on LDPCC. Final Review of SCCC Orange Book.
Spring 2007	Issue SCCC Orange Book.

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.

5.3 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
November 2005	Image compression recommendation (Blue Book)
December 2006	Image compression Green Book supporting above recommendation
October 2006	Open source reference software for the image compression recommendation, including reference data set.
July 2006	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

5.3.4.1 Technical Risks

None.

5.3.4.2 Management Risks

Refer to Section 5.3.5, Resource Request.

5.3.5 RESOURCE REQUEST

- Red Book Issue 2 editing: Pen-Shu Yeh/NASA, 0.05 FTE, Christoph Schaefer/ASTRIUM, 0.05 FTE, May 2005 – July 2005

- Blue Book Issue 1 editing: Pen-Shu Yeh/NASA, 0.05 FTE, Christoph Schaefer/ASTRIUM, 0.05 FTE, September 2005 – October 2005

- Green Book Issue 1 editing: Carole Tiebaut, Gilles Moury/CNES, 0.2 FTE, Christoph Schaefer/ASTRIUM, 0.05 FTE, Pen-Shu Yeh, Aaron Kiely/NASA, 0.1 FTE, May 2005 – October 2006

- Software cross-verification and open-source software: Pen-Shu Yeh, Aaron Kiely/NASA, 0.3 FTE, May 2005 – November 2006

- CCSDS 121.0.B.1 review and new Issue 2 editing: 0.15 FTE (NASA, CNES, ASTRIUM, ESA), November 2005 – July 2006

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
NASA 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	NASA + All
CCSDS 121.0.B.1 review	All

5.4 SPACE LINK PROTOCOLS WORKING GROUP

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

5.4.1 RATIONALE

This WG develops and adapts wherever possible link layer protocols for new mission environments (proximity communication, formation flying, optical communication, missions utilizing high rate telemetry and telecommand.

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 link layer protocols.

It is important to note that this WG maintains a very close liaison with the related Channel Coding WG and RF & Modulation WG.

5.4.2 GOALS

1) Complete the Proximity-1 Green Book (involves the Prox-1 protocol suite: physical layer, coding and synchronization sublayer and the data link layers).
2) Update the Proximity-1 Space Data Link Protocol to conform to the restructured link layer recommendations (AOS, TC, TM Space Data Link Protocols). In particular, Proximity-1 will conform to the same service specifications where applicable with the other restructured link layer protocols.

5.4.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
1 August 2005	Draft Pink Sheets on Restructured Prox-1 Space Data Link Layer due for WG review.
15 August 2005	Final Version of Proximity-1 Green Book for WG review available for comment.
1 September 2005	Comments on Draft Pink Sheets on Restructured Prox-1 Data Link summarized and reviewed by WG.

Date	**Milestone**
16 September 2005	Resolution on Restructured Prox-1 Pink Sheets at Fall 2005 Meeting.
15 November 2005	Publish the Proximity-1 Green Book.

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 somewhat dependent upon having the members of the Working Group provide a sufficient review of the pink sheets and the draft green book. Another risk involves getting technical editing assistance from the Document Editor on both the Green Book and the Pink Book.

5.5 TELECOMMAND CHANNEL CODING WORKING GROUP

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

5.5.1 RATIONALE

Agencies new generations of space missions require 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**
Nov 2004	Draft Telecommand Channel Coding Green Book.
End of Jan 2005	Revised draft Telecommand Channel Coding Green Book.
May 2005	Issue draft Telecommand Channel Coding Green Book for Agency review.
Fall 2005	Finalize Review and Issue Telecommand Channel Coding Green Book.

5.5.4 RISK MANAGEMENT STRATEGY

5.5.4.1 Technical Risks

Telecommand Channel Coding is stable and well-defined so no specific technical risks are identified. The Draft books have been prepared according to schedule and minor updates are expected before the Green Book can be issued.

5.5.4.2 Management Risks

Manpower is available for the production of the drafts shown in the schedule above.

If adequate manpower is not allocated by reviewing Agencies, delays in comments may defer the finalization of the document.

5.6 RANGING WORKING GROUP

Title of Group	**5.6 Ranging Working Group**
Chair	**Enrico Vassallo/ESA**
Area Director	**Jean-Luc Gerner/ESA**
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.

5.7 [DELETED: PROXIMITY-1, BUILD 2 WORKING GROUP – WORK COMPLETED]

5.8 HIGH RATE UPLINK WORKING GROUP

Title of Group	**5.8 High Rate Uplink Working Group**
Chair	**Greg Kazz/NASA**
Area Director	**Jean-Luc Gerner/ESA**
Mailing List	**sls-hru@mailman.ccsds.org**

5.8.1 RATIONALE

There is renewed activity for further exploration of the moon. This includes both non-manned and manned missions. Furthermore, there is a need to transfer the communication technology developed for lunar missions to deep space whenever possible. In this endeavor, it is prudent for the CCSDS to develop the underlying requirements to enable higher rate uplinks beyond the current CCSDS capability. This WG will develop requirements for achieving increases in uplink data rate by taking an integrated approach in investigating bandwidth efficient modulation techniques, along with the appropriate channel coding methods coupled with the use of the most appropriate link layer protocols.

It is important to note that these higher data rates will be required for normal operations and it is essential to maintain backward compatibility with the present level 1 and

level 2 CCSDS recommendations for operations where lower rates can suffice and for emergency operations.

The rationale for this WG includes the following:

1) The current CCSDS recommendations can only accommodate telecommand rates up to 1 Mb/s.

2) The first Lunar missions requiring uplink data rates in excess of 1 Mb/s are planned for launch as early as 2011.

3) At least four years are required to budget, design, build, and test a new telecommand capability.

4) Uplink rates to 10 Mb/s will be required to support manned missions.

5) High rate downlink missions that use Acknowledged CFDP will increase the uplink data rate requirements. It is calculated that a 5 Mbps downlink could saturate a 4 kbps uplink with CFDP downlink responses (NAKs, FINISHs, EOF ACKs).

6) NASA is moving to replace its aging DSN antennas with Downlink Arrays which will support multiple spacecraft telemetry links within the same aperture. An array is

efficient for supporting telemetry but its utility for uplink is yet to be proven and will certainly be limited to supporting a single spacecraft leaving the remainder unsupported. Thus this process will require uplinks to be shared during their telemetry passes which obviously will result in significantly shorter command passes.

7) Today's spacecraft are storehouses for software which include software for Field Programmable Gate Arrays which are rapidly replacing unique hardware systems. Changes to flight software occasionally requires uplinks to deliver very large volumes of data.

5.8.2 GOALS

The High Rate Uplink WG will have the following objectives:

1) Develop the functional and performance requirements for a CCSDS telecommand standard accommodating data rates up to 10 Mb/s by the year 2007. This work involves integrating the requirements within the following functional areas: RF & Modulation, Coding & Synchronization, and Link Layer protocols.
2) Develop two high rate uplink application profiles with respect to these requirements: One application profile for cislunar and the second for deep space.
3) Ensure that the solutions proposed by this WG provide backward compatibility to the installed CCSDS customer base utilizing the current RF& Modulation, TC Sync and Channel Coding and TC Space Data Link Protocol.

5.8.3 SCHEDULE AND DELIVERABLES

Date	**Milestone**
April 2005	BOF chartered by SLS Area
Sept. 2005	Concept Paper Released – Discussed at Fall 2005 Meeting
March 2006	Draft HRU Requirements - Draft White Book created
June 2006	Spring 2006 Joint CIS-Lunar/HRU Preliminary Design Review
Sept 2006	Draft HRU Design – Red Book created
Oct. 2006	Fall 2006 Joint CIS-Lunar/HRU Detailed Design Review
May 2007	HRU Specifications – Preliminary Blue Book for Review
Oct. 2007	Fall 2007 Joint CIS-Lunar/HRU Final Document Review
Dec. 2007	Publish HRU Blue Book specifications

5.8.4 RISK MANAGEMENT STRATEGY

5.8.4.1 Technical Risks

[Undefined.]

5.8.4.2 Management Risks

Schedule relies upon at least one other CCSDS Agency joining the effort and on the allocation of adequate Agency resources to the WG. This work involves coordination between SLS area and the SIS area Cislunar WG.

6 SPACE INTERNETWORKING SERVICES AREA

6.1 CFDP INTEROPERABILITY TESTING WORKING GROUP

Title of Group	**6.1 CFDP Interoperability Testing Working Group**
Chair	**Massimiliano Ciccone/ESA**
Area Director	**Robert Durst/NASA**
Mailing List	**sis-cit@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

Progress in testing has been slow, primarily due to the lack of face-to-face opportunities for testing. We were unable to conduct face-to-face testing in Athens due to JPL restrictions on foreign travel. Therefore it has been necessary to stretch out the testing schedule (per the

Risk Management Strategy) to allow face-to-face testing to take place at and after the CCSDS Fall meetings in Atlanta, at which the key testing participants will be present. This should allow completion of the testing and the dissolution of the Working Group.

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.
15 May 2005	First test series (SFO) begins.
29 October 2005	First test series complete.
15 June 2005	Second test series (Extended Procedures) begins.
29 October 2005	Second test series complete.
30 December 2005	Test Execution Report and final Test Notebooks available.
1 February 2006	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.

6.2 [DELETED: UNACKNOWLEDGED CFDP EXTENSIONS WORKING GROUP]

6.3 CCSDS PACKET PROTOCOL WORKING GROUP

Title of Group	**6.3 CCSDS Packet Protocol Working Group**
Chair	**Dai Stanton/BNSC**
Area Director	**Robert Durst/NASA**
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 AND DELIVERABLES

Review and, if necessary revise, the CCSDS Packet Protocol and recommend its adoption as a CCSDS standard. Develop Space Packet Protocol Green Book?

6.3.3 SCHEDULE

Date	**Milestone**
17 Nov 2003	Draft Pink Sheets for SIS review
24 Nov 2003	Pink Sheets for Agency Review
8 December 2003	RID Closure
15 December 2003	WG dissolved
	Or not. . . .

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

6.4 CISLUNAR SPACE INTERNETWORKING WORKING GROUP

Title of Group	**6.4 Cislunar Space Internetworking Working Group**
Chair	**Keith Scott/NASA**
Area Director	**Robert Durst/NASA**
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 (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 as appropriate) 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	Draft2 Green Book. Draft review of existing CCSDS Standards with proposed plan for updating them.
1 November 2005	Draft3 Green Book. Report on first round of proposed updates to existing CCSDS protocols. Includes pink sheets or recommendation on reaffirmation without changes for SCPS-NP, SCPS-SP, SCPS-TP, and SCPS-FP. These will require agency review. Down-selection from protocol survey list to core set for further investigation/performance analysis. Begin extensive analysis of candidate protocols. The first step will be to identify existing test reports / testbeds related to or implementing the protocols.
1 April 2006	Finalized Green Book describing operations concept and protocol requirements. Report on protocol analysis / prototyping efforts.
30 November 2006	Draft 1, Red/Orange Book(s) for recommended protocols; Includes any additional recommendations for updating CCSDS protocols. Already identified is the need for at least one Red/Orange book on implementation details of the Green Book Architecture.
1 April 2007	Red/Orange Book(s) Issue 1 for recommended protocols. Includes newly adopted/developed protocols and updates to CCSDS protocols. These books will be ready for agency review.

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.

This task is very synergistic with current work in NASA (Exploration Program) and ESA (Aurora Program). Whenever programmatically possible and technically reasonable, this working group will leverage ongoing work and result from these and other member agencies' work programs. Participation by members from agencies interested in a return to human space flight to the moon is strongly desired.

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.

6.5 ASYNCHRONOUS MESSAGE SERVICE

Title of Group	**6.5 Asynchronous Message Service**
Chair	**Scott Burleigh/NASA**
Area Director	**Robert Durst/NASA**
Mailing List	**sis-ams@mailman.ccsds.org**

6.5.1 RATIONALE

The CCSDS File Delivery Protocol (CFDP) provides file transfer functionality that can offer significant benefits for spacecraft operations. Not all spacecraft communication requirements necessarily fit the file transfer model, however. In particular, continuous, event-driven asynchronous message exchange may also be useful for communications with and among spacecraft. Examples include:

- streaming engineering (housekeeping) data;
- real-time commanding;
- continuous collaborative operation among robotic craft.

NASA’s proposed new Command, Control, Communications, and Information (C3I) architecture for the Crew Exploration Vehicle and other Constellation program elements is based on an asynchronous message exchange framework.

At the same time, large-scale, efficient, robust asynchronous message exchange can be difficult to implement. Among the challenges:

- A successful large-scale message system must tolerate heterogeneity in deployment platforms, security regimes, communication environments, QOS requirements, performance requirements, and levels of cost tolerance.
- In order to support continuous mission-critical operation, a message system must tolerate unplanned changes in application topology. This tolerance of change entails autonomous discovery of communication endpoints and automatic reconfiguration, to minimize operations cost and risk.
- Distributed systems based on asynchronous message exchange are typically less labor-intensive to configure, upgrade, and operate if message transmission conforms to the peer-to-peer ‘publish/subscribe’ (or ‘push’) model rather than the ‘client/server’ model. But publish/subscribe communication is made possible only by extensive underlying automation.

Consequently most existing asynchronous message exchange systems are proprietary, licensed products rather than open international standards. Moreover, no such system is designed for mission-critical operation on deep space robots.

We believe that an open CCSDS standard for large-scale, publish/subscribe-based asynchronous message exchange would be a useful alternative.

6.5.2 GOALS AND DELIVERABLES

AMS-WG is a Standards Track Working Group. The Working Group will:

> Develop a Recommended Standard for an Asynchronous Message Service, based on the Concept Paper submitted with this Charter, that satisfies the requirements identified by the AMS BOF group.

Per standard CCSDS procedure, development of this Recommended Standard will entail demonstration of two interoperable implementations of the protocol and service.

6.5.3 SCHEDULE

Date	**Milestone**
22 July 2005	Formation of working group.
19 December 2005	Publication of Proposed Standard (‘white book’).
19 June 2006	Publication of Draft Standard (‘red book’).
25 September 2006	Demonstration of two interoperable implementations.
2 October 2006	Start of final Agency review.
8 January 2007	Publication of Recommended Standard (‘blue book’).
22 January 2007	Dissolve working group.

6.5.4 RISK MANAGEMENT STRATEGY

6.5.4.1 Technical Risks

The service concept is derived from a design, developed at JPL in the mid-1990s, which has proved efficient and stable in a number of deployments over the past decade; JPL’s initial implementation of AMS will be adapted from that established code base. Technical risk therefore appears to be minimal.

6.5.4.2 Management Risks

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

6.6 IP OVER CCSDS SPACE LINKS WORKING GROUP

Title of Group	**6.6 IP Over CCSDS Space Links Working Group**
Chair	**Greg Kazz/NASA**
Area Director	**Robert Durst/NASA**
Mailing List	**sis-ipo@mailman.ccsds.org**

6.6.1 RATIONALE

It is generally recognized that IP datagram transfers will become more prevalent for both on-board applications as well as off-board for transfer through a network of in-space CCSDS data links.

Although the CCSDS space link protocols can support IP datagram transfer, there is a lack of a clear specification for how to accomplish this. -. Currently, each of the four CCSDS space data link protocols - AOS, TC, TM, Proximity-1 - includes a short section (devoid of any context information) that defines how to carry IP datagrams over that link.

It is the purpose of this WG to clearly define a CCSDS recommended practices document (Magenta Book) for how IP will be carried over CCSDS links, including IP datagrams encapsulated into serial streams (e.g., Bridged Ethernet frames). The recommended practice is envisioned to encompass three major areas: IP over CCSDS links service concept, PDU formats, and transfer service primitives.

This Working Group Charter establishes the detailed steps, personnel, and schedule needed to transform the 'IP over CCSDS Links BOF' White Paper into a formal CCSDS specification that will become the agreed international mechanism for interoperably transferring IP datagrams over CCSDS space links, to ensure cross-support amongst space Agencies requiring this capability.

Figure 6.6-1 shows the sending and receiving side interfaces between the Network (IP) and Link Layers which define the scope of this WG.

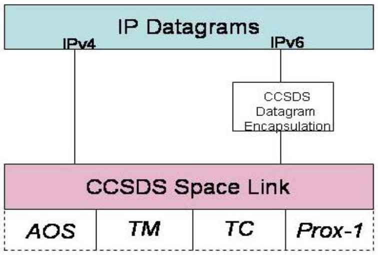

Figure 6.6-1: Context: How IP Interfaces with the CCSDS Link Layer

6.6.2 GOALS AND DELIVERABLES

The IP over CCSDS Space Links WG will have the following objectives:

1) Describe the recommended method(s) of transferring IPv4 and IPv6 datagrams over the four underlying internationally standardized CCSDS link layer protocols:
   - TM Space Data Link Protocol
   - TC Space Data Link Protocol
   - AOS Space Data Link Protocol
   - Proximity-1 Space Data Link Protocol
2) Describe the standard CCSDS options for carrying IP datagrams within those CCSDS frames, including the mode where those IP datagrams are encapsulated within a specific HDLC serial bit stream for interfacing with a COTS router.
3) Utilize the “IP over CCSDS Links BOF” Concept Paper (http://public.ccsds.org/sites/cwe/sis-ipo/default.aspx) as the framework for the content of the CCSDS IP over CCSDS Recommended Practice specification.

6.6.3 SCHEDULE

Date	**Milestone**
June 2005	BOF chartered by SIS Area
Aug. 2005	BOF Concept Paper produced
Sept. 2005	BOF meets in Atlanta to discuss BOF Concept Paper
Oct. 2005	WG Chartered, BOF Concept Paper Updated as Draft Magenta Book Version 1
May 2006	Draft Magenta Book Version 2
Sept. 2006	Magenta Book Version 1

6.6.4 RISK MANAGEMENT STRATEGY

6.6.4.1 Technical Risks

[Undefined.]

6.6.4.2 Management Risks

Schedule relies upon the assistance of BNSC and on the allocation of adequate Agency resources to the WG. This work involves coordination between SLS area SLS-SLP WG and the SIS area Cislunar WG.

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