

**ORGANIZATION AND
PROCESSES FOR THE
CONSULTATIVE COMMITTEE
FOR SPACE DATA SYSTEMS**

CCSDS RECORD

CCSDS A02.1-Y-3

YELLOW BOOK

July 2011



The Consultative Committee for Space Data Systems

**ORGANIZATION AND
PROCESSES FOR THE
CONSULTATIVE COMMITTEE
FOR SPACE DATA SYSTEMS**

CCSDS RECORD

CCSDS A02.1-Y-3

YELLOW BOOK

July 2011

FOREWORD

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This document is therefore subject to CCSDS document management and change control procedures. Current versions of CCSDS documents are maintained at the CCSDS Web site:

<http://www.ccsds.org/>

Questions relating to the contents or status of this document should be addressed to the CCSDS Secretariat at the address indicated on page i.

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

Member Agencies

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

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- China Satellite Launch and Tracking Control General, Beijing Institute of Tracking and Telecommunications Technology (CLTC/BITTT)/China.
- Chinese Academy of Sciences (CAS)/China.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- CSIR Satellite Applications Centre (CSIR)/Republic of South Africa.
- Danish National Space Center (DNSC)/Denmark.
- Departamento de Ciência e Tecnologia Aeroespacial (DCTA)/Brazil.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Geo-Informatics and Space Technology Development Agency (GISTDA)/Thailand.
- 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.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic and Atmospheric Administration (NOAA)/USA.
- National Space Agency of the Republic of Kazakhstan (NSARK)/Kazakhstan.
- National Space Organization (NSPO)/Chinese Taipei.
- Naval Center for Space Technology (NCST)/USA.
- Scientific and Technological Research Council of Turkey (TUBITAK)/Turkey.
- 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 A00.0-Y-4 | Procedures Manual for the Consultative Committee for Space Data Systems, Issue 4 | September 1990 | Superseded. |
| CCSDS A00.0-Y-5 | Procedures Manual for the Consultative Committee for Space Data Systems, Issue 5 | May 1992 | Superseded. |
| CCSDS A00.0-Y-6 | Procedures Manual for the Consultative Committee for Space Data Systems, Issue 6 | May 1994 | Superseded. |
| CCSDS A00.0-Y-7 | Procedures Manual for the Consultative Committee for Space Data Systems, Issue 7 | November 1996 | Superseded. |
| CCSDS A00.0-Y-8 | Procedures Manual for the Consultative Committee for Space Data Systems, Issue 8 | July 2002 | Superseded. |
| CCSDS A02.1-Y-1 | Proposal for Restructuring the CCSDS Organization and Processes, Issue 1 | March 2003 | Superseded. |
| CCSDS A00.0-Y-9 | Procedures Manual for the Consultative Committee for Space Data Systems, Issue 9 | November 2003 | Superseded. |
| CCSDS A02.1-Y-2 | Restructured Organization and Processes for the CCSDS, Issue 2 | April 2004 | Superseded. |
| CCSDS A02.1-Y-3 | Organization and Processes for the Consultative Committee for Space Data Systems, Issue 3 | July 2011 | Current Issue. <i>Merges Restructured Organization and Processes for the CCSDS (CCSDS A02.1-Y-2) and Procedures Manual for the Consultative Committee for Space Data Systems (CCSDS A00.0-Y-9); updates contents to reflect current CCSDS organization and processes.</i> |

CONTENTS

| <u>Section</u> | <u>Page</u> |
|---|-------------|
| 1 INTRODUCTION..... | 1-1 |
| 1.1 PURPOSE..... | 1-1 |
| 1.2 SCOPE..... | 1-1 |
| 1.3 APPLICABILITY..... | 1-1 |
| 1.4 REFERENCES | 1-1 |
| 2 CCSDS MANAGEMENT PRINCIPLES | 2-1 |
| 2.1 PURPOSE..... | 2-1 |
| 2.2 CCSDS STAKEHOLDERS | 2-2 |
| 2.3 CCSDS ORGANIZATION | 2-4 |
| 2.4 CCSDS POLICIES | 2-18 |
| 3 CCSDS TECHNICAL STRUCTURE..... | 3-1 |
| 3.1 OVERVIEW | 3-1 |
| 3.2 TECHNICAL ORGANIZATION OF THE CESG | 3-1 |
| 3.3 SYSTEMS DOMAIN | 3-2 |
| 3.4 INFORMATICS DOMAIN | 3-2 |
| 3.5 TELEMATICS DOMAIN | 3-3 |
| 4 PARTICIPATION | 4-1 |
| 4.1 CATEGORIES OF PARTICIPATION | 4-1 |
| 4.2 MEMBERSHIP LISTS..... | 4-2 |
| 5 OPERATIONS | 5-1 |
| 5.1 TOOLS OF OPERATION..... | 5-1 |
| 5.2 MEETINGS | 5-3 |
| 5.3 ONLINE VOTING | 5-10 |
| 5.4 ACTION ITEM TRACKING AND DISPOSITION..... | 5-13 |
| 5.5 ONLINE CHARTERING AND PROJECT APPROVAL | 5-13 |
| 6 CCSDS STANDARDIZATION PROCESS..... | 6-1 |
| 6.1 OVERVIEW OF CCSDS DOCUMENT FLOW | 6-2 |
| 6.2 PUBLICATION, DISTRIBUTION, AND MAINTENANCE..... | 6-5 |
| 6.3 DOCUMENT IDENTIFICATION..... | 6-10 |
| 6.4 SPECIAL STATUS DESIGNATIONS..... | 6-11 |

CONTENTS (continued)

| <u>Section</u> | <u>Page</u> |
|---|-------------|
| ANNEX A CCSDS ARCHITECTURE PRINCIPLES..... | A-1 |
| ANNEX B EXPANDED DISCUSSION OF CCSDS DOCUMENT TYPES..... | B-1 |
| ANNEX C DOCUMENT TYPE CONTENT EXAMPLES | C-1 |
| ANNEX D SECRETARIAT FORMS | D-1 |
| ANNEX E CCSDS DOCUMENT NUMBERING SYSTEM..... | E-1 |
| ANNEX F CCSDS PICS PROFORMA..... | F-1 |

Figure

| | |
|------------------------------------|-----|
| 2-1 CCSDS Structure | 2-2 |
| 3-1 CESG Structure | 3-1 |
| 6-1 CCSDS Document Taxonomy | 6-1 |
| 6-2 Initial Red Book Approval..... | 6-7 |

Table

| | |
|---|------|
| 6-1 ‘C’ Designations for Document Type..... | 6-11 |
|---|------|

1 INTRODUCTION

1.1 PURPOSE

This CCSDS Record describes the principles and details governing the Consultative Committee for Space Data Systems (CCSDS) and addresses the objectives, organization, participation, operations, and management of CCSDS activities. It has been prepared by the CCSDS Management Council (CMC) and is maintained by the CCSDS Secretariat.

Questions about the contents or status of this document should be directed to the CCSDS Secretariat (contact information for the CCSDS Secretariat can be found on the CCSDS Web site: www.ccsds.org).

1.2 SCOPE

This document is intended to serve as a guide for the development, review, acceptance, and distribution of CCSDS products, and for the management of those activities.

1.3 APPLICABILITY

This document applies to all CCSDS-related activities.

1.4 REFERENCES

The following documents are referenced in this Record. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this Record are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS documents.

- [1] *CCSDS Publications Manual*. CCSDS Record, CCSDS A20.0-Y-2. Yellow Book. Issue 2. Washington, D.C.: CCSDS, June 2005.
- [2] *Information Technology—Open Systems Interconnection—Basic Reference Model: The Basic Model*. International Standard, ISO/IEC 7498-1:1994. 2nd ed. Geneva: ISO, 1994.
- [3] *Information Technology—Open Systems Interconnection—Conformance Testing Methodology and Framework—Part 7: Implementation Conformance Statements*. International Standard, ISO/IEC 9646-7:1995. Geneva: ISO, 1995.

2 CCSDS MANAGEMENT PRINCIPLES

2.1 PURPOSE

The CCSDS Management Council has patterned the new CCSDS organization to adopt what is perceived to be the best common structural features of the World Wide Web Consortium (W3C) and the Internet Engineering Task Force (IETF) organizations, i.e., highly focused product-oriented “Working Groups” collected into functional “Areas” that cluster within broad discipline-oriented “Domains.”

At the top level, the work of CCSDS logically cleaves into three abstract *domains* that enclose the principal technical disciplines of the organization:

SPACE INFORMATICS DOMAIN: the web of applications, distributed across the spacecraft and their ground support systems, which are used to actually fly missions (mission planning, navigation, mission control, scientific data processing, etc.). Typically, the Informatics Domain primarily is concerned with the semantic interpretation of information rather than its physical movement from place to place. The Informatics Domain is the rough “space analog” of the diverse and complex set of applications that form the terrestrial World Wide Web.

SPACE TELEMATICS DOMAIN: the communications protocols by which these applications exchange information. It is assumed that nearly all ground communications are commercially based, with more specialized protocols being employed when crossing into space regions. Typically, the Telematics Domain is concerned primarily with how data units are moved from place to place rather than how they are converted into user information within the applications. The Telematics Domain is the “space analog” of the communications networks by which the Web applications exchange information over the terrestrial Internet.

SPACE SYSTEMS DOMAIN: the high-level functions that cut across both of the other domains; e.g., the global architecture of how space-mission information systems are constructed and how information is represented, and cross-cutting issues such as security.

Within the umbrellas of these three abstract domains, five concrete organizational constructs exist:

Special Interest Groups (SIGs) provide an ad-hoc forum for the discussion and coordination of topics that affect multiple Working Groups and BOFs.

BIRDS-OF-A-FEATHER groups (BOFs) that perform start-up studies and gestate technical proposals to the point where establishment of a Working Group may be decided.

WORKING GROUPS (WGs) that are chartered to produce specific standards on a specific schedule and within specific resource envelopes, and then go out of business.

AREAS that contain WGs and BOFs that are closely related to a particular technical discipline, under the coordination of an expert Area Director.

CCSDS ENGINEERING STEERING GROUP (CESG) that is the forum whereby the Area Directors synchronize the overall technical program of work.

The top-level organization for CCSDS is shown in figure 2-1. Starting at the top of the figure, descriptions of the major organizational functions follow.

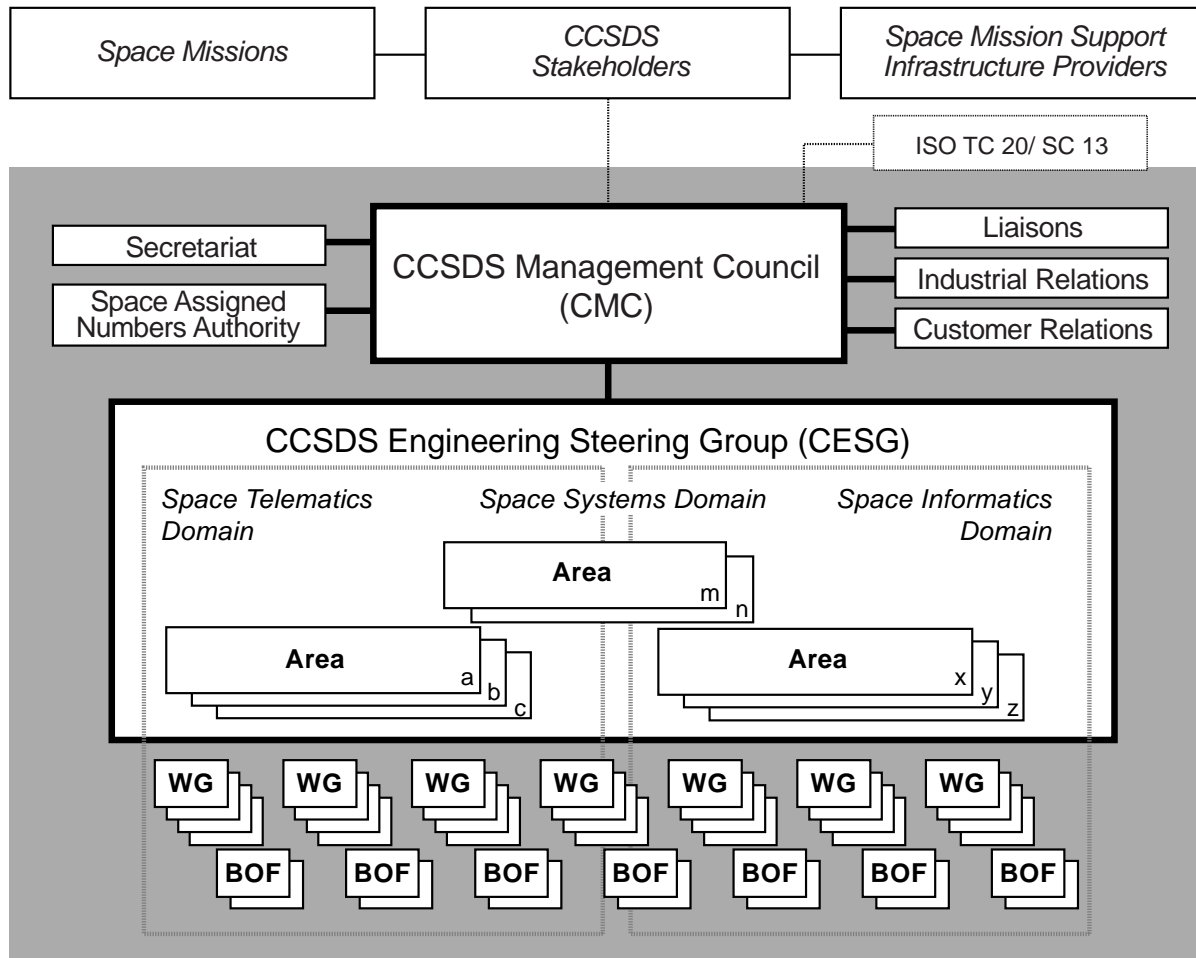


Figure 2-1: CCSDS Structure

2.2 CCSDS STAKEHOLDERS

While the terrestrial Internet has exploded in 20 years from a research activity to an indispensable component of world commerce, by and large “space” still leans toward the research end of the spectrum. Primary stakeholders in the work of CCSDS therefore continue to be either:

- a) *Space-mission organizations* that directly execute scientific and applications space missions;
- b) *Space-mission support infrastructure provider organizations* that design, operate, and maintain the worldwide tracking, data acquisition, mission control, data processing, and data archiving networks that are exposed to space-mission organizations for the purposes of “cross support”; or
- c) *Space data user organizations* representing the utilization community who consume the information generated by the space mission.

Recognizing that CCSDS has a “dual role” as ISO TC20/SC13, and that ISO intends that the ISO customer base is very broad and intended to benefit much more than just the ISO development community, CCSDS therefore adopts the same principal. The intended beneficiaries of CCSDS and ISO TC20/SC13 standards are all organizations and teams worldwide who endeavor to develop spaceflight capabilities. Besides the obvious beneficiaries of CCSDS member agencies, observer agencies and associates, CCSDS encourages adoption of CCSDS standards by any other organization that falls in the three categories of stakeholders described above. As a result, CCSDS policies and processes shall be structured so as to encourage broad adoption. Besides the rationale that it follows the ISO philosophy, this will bring future benefit to the CCSDS organizations when other spaceflight missions can rapidly (and inexpensively) adapt to joint operations with other spaceflight missions for both nominal and contingency operations.

Although private industry is an emerging and significant customer, both classes of stakeholders currently tend to be dominated by national or international civil space agencies because of the high costs involved. In recent years a strong military customer base is also starting to appear, driven toward open and unclassified standardization by needs for interoperability and lowered costs. All of these organizations represent future sources of sponsorship, and so a primary challenge for the CCSDS will be to put in place mechanisms to focus on stakeholder development and tightening-up of these currently diffuse relationships. Serendipitously, the stakeholders themselves are in some cases beginning to mobilize. For instance, following an “interoperability plenary” that was held in Paris in June 1999, the *Interagency Operations Advisory Group* (IOAG) has emerged to provide leadership in addressing issues that confront international space mission cross support. CCSDS will maintain a closely coordinated liaison relationship with the IOAG, considering the IOAG to be a very important source of multiagency cross-support requirements. The IOAG charter and more information on the group is available at www.ioag.org.

2.3 CCSDS ORGANIZATION

2.3.1 CCSDS MANAGEMENT COUNCIL (CMC)

2.3.1.1 General

The CCSDS Management Council (CMC) is the executive management oversight group of the organization. The CMC is populated by *principal delegates* who are independently supported by each of the *member agencies*. These members may select the CMC chairman as needed. In practical terms, the Chairman should come from the agency that provides the Secretariat functions and resources, because of the close coordination and management control that the Chairman must have over direct Secretariat resources.

The CMC is responsible for staying technically and politically informed about important long-term issues in the field of international space mission cross support and for keeping an eye on the “big picture” of the CCSDS program of work. It therefore focuses on long-range planning and coordination among the various CCSDS discipline-oriented domains, on making sure that adequate resources exist to do work, and on timely satisfaction of stakeholder requirements.

2.3.1.2 CMC Responsibilities

The CMC is specifically responsible for

- a) being the final executive decision-making body of the organization;
- b) identifying the different CCSDS stakeholder communities, developing good customer/provider relationships with each one, and making sure that their requirements are satisfied by developing and delivering standards that are responsive to their technical and schedule imperatives;
- c) approving the program of work and products of the organization, resolving appeals in cases of disagreement, and authorizing the transition of documents from one designation to another as they move along the various document tracks, including verifying that Normative Track documents have been subjected to satisfactory formal review by the agencies;
- d) making sure that adequate resources are provided to execute the approved CCSDS program of work;
- e) managing the special relationship between CCSDS and ISO;
- f) managing the relationships between CCSDS and other standards organizations, via liaisons; and
- g) providing the overall administration of the organization, including the very important function of the Secretariat;

- h) promoting CCSDS activities by conducting outreach within their agencies to increase the adoption of CCSDS standards by missions, and also to recruit broader participation in CCSDS standards development by other agencies;
- i) approving membership requests.

2.3.1.3 CMC Functions

The CMC's responsibilities map into CMC functions in terms of running the CCSDS organization as follows:

- a) **Standards Process Oversight, Waivers, and Appeal:** The CMC provides management oversight of the process used to create CCSDS Recommended Standards and Practices and, based on recommendations from the CESG, approves all final products. Waivers that are being sought to deviate from standardization requirements must be decided by the CMC. The CMC serves as the final appeal board for complaints of improper execution of the standards process.
- b) **Formal Review Administration:** As documents progress along the various document tracks, key transitions in their status and designations may require that they are first formally reviewed by all of the agencies. The CMC delegates are individually responsible for ensuring that such reviews are properly and successfully conducted by their agencies, if necessary, by committing the resources required to allow other organizations to assimilate and comment on the contents of the items under review.
- c) **Work Approval and Electronic Balloting:** Many CCSDS work items require specific CMC approval before they can be initiated or progress along the various document tracks. The CMC does not have to meet in person to grant such approval; electronic balloting mechanisms have been established to avoid delays in obtaining approvals. Whenever feasible (based on schedule needs, etc.) the CMC shall conduct their balloting online to improve the traceability of CMC resolutions and decisions.
- d) **Resource Administration:** The CMC coordinates the allocation of the necessary resources to Areas and WGs. Before allowing the CESG to form a new WG or start the development of new documents, the CMC must work with the CESG to ensure that a credible staffing plan exists to support the development on the negotiated schedule.
- e) **CCSDS Engineering Steering Group (CESG) Selection:** The CMC appoints the CESG chair and the Area Directors, as well as their deputies.

2.3.1.4 CMC ADJUNCTS

2.3.1.4.1 General

The responsibilities of the CMC also map directly into the administration of some important organizational units.

2.3.1.4.2 ISO Technical Committee 20, Subcommittee 13

Under an agreement entered into between CCSDS and ISO in the mid 1990s, CCSDS acts as the principal technical engine of ISO TC20/SC13, and most CCSDS Recommended Standards are processed into full ISO standards via this relationship. The charter of TC20/SC13 can be accessed at <http://isotc.iso.org/livelink/livelink/open/tc20sc13>.

2.3.1.4.3 CCSDS Liaisons

The CMC acts as representative of the interests of the CCSDS in formal liaison relationships with other organizations concerned with standards. Liaison organizations are those governmental or private enterprises that have their own developmental programs in the area of space data and information transfer systems and who wish to establish formal information-sharing relations with CCSDS.

A special technical liaison exists between CCSDS and ISO/TC20/SC14, the ISO subcommittee for Space Systems and Operations. Since CCSDS functions as ISO TC20/SC13, it is a peer organization to ISO TC20/SC14. The two organizations will strive to insure that their work in the standards world is not competitive, but rather is complimentary and cooperative. More information on TC20/SC14, including their working group structure, is available at <http://isotc.iso.org/livelink/livelink?func=ll&objId=8791028&objAction=browse&sort=name>.

CCSDS also has additional liaison relationships with other organizations. More information is available at <http://public.ccsds.org/participation/liaisons.aspx>.

2.3.1.4.4 Industrial Relations

Achieving space-mission cost reductions via standardization significantly relies on the willingness and ability of the commercial supplier base to invest in providing standards-compatible systems and equipment. Although CCSDS has historically (and of economic necessity) been agency-centric, a formal mechanism is provided whereby the industrial support base of all CCSDS agencies can become more proactively involved with standardization activities.

At present, industrial relationships are primarily administered on a local basis, with each agency supporting its own interfaces with its national industry. However, this arrangement does not properly cater to the emerging transnational nature of space commerce and lacks a strong central focus within the CCSDS organization. This is remedied by formalizing the

International Associates Program, using Web-based information interchange services provided by the Secretariat as a day-to-day focal point for two-way information exchange. A prominent and dedicated area of the CCSDS Web site is provided to handle this dialog. Industrial user groups and interest groups will be encouraged, and newsletters, workshops, etc., will be regularly scheduled to ensure that their needs and inputs are acknowledged. CCSDS information booths will be provided at major space industry conferences and trade shows. New relationships and Web-based links with existing national trade associations, professional societies, and multinational bodies such as the European Coordination for Space Standardization (ECSS) will be developed to encourage a free flow of awareness and information between commercial providers and the CCSDS standardization community.

2.3.1.4.5 Stakeholder Relations

Whereas the Industrial Relations function described in the previous section is intended to improve relationships with suppliers, CCSDS also needs to pay significant attention to formalizing its relationships with its various direct stakeholder communities. The IOAG is obviously one important current stakeholders of CCSDS, but the CMC will identify, develop, and nurture stakeholder (and therefore sponsorship) relations in many other areas, including the commercial and military space mission communities, and thus provide a forum for those groups to feed requirements and support into the standardization process.

The Stakeholder Relations function acts as a source of advice and guidance to stakeholders concerning architectural, procedural, and (where appropriate) policy matters pertaining to international space-mission interoperability and cross support, and their enabling technologies. It focuses on two-way information exchange, explaining existing CCSDS capabilities to potential stakeholders and gathering requirements from them for expanding the suite of CCSDS standards to meet their needs. Stakeholder inputs that are gathered via this function are translated into a proposed work item and often cause a BOF to be initiated. The BOF develops the work proposal and resource estimates so that stakeholder deliverables can be negotiated and resources can be lined up to support the necessary development. Throughout the development process, this function provides the formal interface between the developer and the stakeholder, so that stakeholder satisfaction can be both measured and assured.

2.3.1.4.6 CCSDS Secretariat

The CCSDS Secretariat edits, formats, and publishes CCSDS Recommended Standards (in their various stages of maturity—see 6.2) and provides one definitive repository for all CCSDS documentation (see 5.1.5.2). The Secretariat also assists in scheduling and supporting all CCSDS meetings (see 5.1.5.5). The CMC approves the organization that will act as the CCSDS Secretariat.

An important role of the Secretariat is to support the CMC process of formal agency review (see 6.2.5). The vehicle for such review is the Review Item Disposition, or RID. When a document requires formal review, the Secretariat will announce the review opportunity to the

CCSDS agencies and will provide instructions that define how, when, and to whom the agency comments (in the form of completed RID forms) are to be submitted.

Two significant requirements for the Secretariat exist. The first is to provide a wide range of Web-based information services in support of the technical development work of CCSDS. These include archived mailing lists (see 5.1.5.4), document manipulation and sharing services (see 5.1.5.3), document libraries, electronic balloting facilities (see 5.3), and a system to log and distribute concept papers that are derived early in the development process (see B1). The second is to provide Web-based information services that cater to the two-way flow of information between CCSDS and its customers and industrial suppliers.

2.3.1.4.7 Space Assigned Numbers Authority (SANA)

The core registrar for the CMC's activities is the SANA. Many space-mission protocols require that someone keep track of key protocol numbering assignments that were added after the protocol came out. Typical examples of the kinds of registries needed are for spacecraft IDs, protocol version numbers, reserved APIDs, and SFDU control authorities. The SANA provides this key configuration management service for CCSDS. The CMC approves the organization that will act as the SANA. Its public interface is focused through Web-based services provided by the Secretariat.

The day-to-day operation of the SANA is conducted by the SANA Operator. The SANA Operator manages the web site, located at <http://sanaregistry.org>, and performs registrar services for CCSDS as defined in the SANA Procedures Yellow Book, CCSDS 313.0-Y-0.3. In the event of issues with registries, policies, or practices, the SANA operator may ask the SANA Steering Group (SSG) for guidance. The SSG will provide oversight of SANA operations, validate and confirm SANA operations, and be the first level of appeal for issues. The SSG can be reached at ssg@sanaregistry.org.

2.3.2 CCSDS ENGINEERING STEERING GROUP (CESG)

2.3.2.1 General

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

The CESG consists of a chairman, the Area Directors (ADs), and their deputies, who are elected by the CMC and are appointed for renewable two-year terms. The chairman also may be an Area Director.

2.3.2.2 CESG Operating Principles

- a) *Area Directors.* The ADs for a particular Area are expected to know more about the combined work of their WGs than anyone else. While they may on occasions draw upon expert assistance from WG members as necessary to resolve detailed issues at the CESG level, they are generally expected to be able to independently represent all work within their Area at CESG meetings.
- b) *Consensus.* The entire CCSDS technical organization is run by a process of consensus, and it is the CESG that decides if the standardization process has come up with a result that reflects a real consensus.

Consensus does not necessarily mean that unanimous agreement has been reached, but that the result incorporates the best set of compromises that all parties can agree to. Generally speaking, when a group votes using majority rule or “parliamentary procedure,” an adversarial dynamic is created within the group because it is being asked to choose between two (or more) competing possibilities. The consensus process, on the other hand, creates a cooperative dynamic. Issues are identified and the chairman or facilitator outlines candidate solutions in the form of neutral proposals. During discussion of a proposal, everyone works to improve the proposal to make its adoption or rejection the best-achievable decision to which the whole group can agree. Interim voting may be used to judge the degree to which the group is converging on consensus, but the final outcome must reflect a true consensus result.

Working Groups must demonstrate that consensus processes were followed when drafting documents. The entire CESG must review each CCSDS document prior to its entering a track, and CESG consensus is required before that document can move forward. One of the main reasons that the CESG might block something is that the WG was unable to show that true consensus was reached or that the result did not really gain consensus in the CCSDS as a whole, that is, among all of the WGs in all Areas. For instance, the result of one WG might clash with a technology developed in another, or an AD might try to force through a “pet project” that has a negative effect on the rest of the CCSDS capability suite.

In the event that the process of reaching consensus was unusually contentious at either the WG or CESG level, the CESG chairman shall raise the proposed outcome for review by the CMC before making a final determination.

- c) *Formal Review.* Before they can be approved for final publication, Normative Track documents must be submitted to the member agencies of CCSDS for formal review. The CESG will specifically look for evidence that all review comments have been properly dispositioned in a consensus environment before permitting such transitions.

- d) *Consistency.* An important job of the CESG is to watch over the output of all of the WGs to help prevent CCSDS specifications that are at odds with each other. This is why ADs and DADs are required to review the drafts coming out of Areas other than their own as part of the consensus process leading up to their adoption into the program of work. The quality of the CCSDS Recommended Standards comes both from the review that they get in the WGs and the review that the WG products get from the CESG.
- e) *Anticipation.* The CESG must be able to look ahead and anticipate new standards that stakeholders will most likely require, and begin prospective planning for their development so that there is sufficient time to complete them once a hard requirement emerges. This implies working with technology and experimental communities to vector research resources into the standardization process.

2.3.2.3 CESG Responsibilities

The CESG is specifically responsible for the following:

- a) maintaining and upholding the overall technical quality and consistency of the evolving set of CCSDS Recommended Standards and Practices;
- b) providing the CCSDS-wide forum where the work programs of the Areas may be coordinated and synchronized in the context of an overall architecture for space-mission cross support and the needs of individual customers;
- c) reviewing the proposed composition and program of work of all new WGs in each Area to ensure that they are technically consistent, contribute to a cohesive set of CCSDS architectural concepts, properly respect the need for smooth evolution of the large installed base of CCSDS-compatible systems, and are not otherwise disruptive to the needs of customers;
- d) making recommendations to the CMC concerning which new WGs should be approved;
- e) ensuring that the resource requirements of all WGs are addressed, identified, and approved by the CMC prior to initiating new work;
- f) hearing appeals from any BOF whose proposal to form a WG was rejected by an AD;
- g) deciding and recommending to the CMC the appropriate “track” assignment for a particular work item, and monitoring the work item’s progression through various stages of maturity;
- h) reviewing requests from ADs to advance specifications in their Areas along the various document tracks, and making consensus recommendations to the CMC when it feels that documents and related materials are ready for publication as CCSDS products, in their various interim and final stages of maturity;

- i) periodically reviewing the technical work of each Area to ensure that it is progressing toward common goals, that the process of consensus is being observed and that customer requirements are being satisfied in a timely manner (the ADs shall be responsible for reporting on all work items within their Area);
- j) identifying “red flag” items where technical work in a proposed CCSDS document is not of the required quality or nature, where technical work is not progressing satisfactorily, where resources are inadequate, or where significant issues exist, and raising these to the attention of the CMC for corrective action;
- k) maintaining records of the status of all CCSDS work items, including completed WG deliverables that have been deployed into operational use;
- l) making recommendations to the CMC concerning when to reconvene a WG to refresh a standard that has been finalized and deployed into operational use;
- m) making recommendations to the CMC concerning when to retire a standard based on its obsolescence;
- n) approving WG Chairs and Deputy Chairs;
- o) monitoring the need for and triggering periodic maintenance of published CCSDS documents.

2.3.2.4 CESG Chairman and Area Directors

2.3.2.4.1 General

Nominations for CESG positions are made by the principal delegates from each of the agencies. Appointees may come from any organization (including industry) and do not have to be employees of space agencies. All CESG appointees must have a sponsor who will commit to support their salary and travel to CESG and Area coordination meetings.

A candidate for selection as CESG chair, Area Director, or their deputies must have demonstrated the ability to function independently of his/her own agency's agenda and to be able to fairly lead the development of international consensus.

A candidate for selection as CESG chair (or deputy chair) must be an internationally recognized technical expert with broad expertise in the standardization aspects of space missions and their supporting infrastructure, plus extensive prior experience working within the CESG (such as having served as an Area Director or WG chair or having served as deputy CESG chair prior to succeeding to chair).

A candidate for selection as an AD (or deputy AD) must be recognized as leading technical expert in the field covered by that Area and must have extensive prior experience leading a specific standards development task within the CCSDS, such as having served as a WG chair or deputy chair.

2.3.2.4.2 CESG Chair Responsibilities

The CESG chair is specifically responsible for the following:

- a) being a member of the CMC as the single representative of the entire CCSDS technical organization;
- b) setting the date, location, and agenda for each CESG meeting and communicating this information to the Area Directors so that they may schedule the completion of their work prior to this time;
- c) chairing the CESG meetings, ensuring that every Area presents its work in a satisfactory manner, and ensuring that CESG decisions are made in a consensus setting;
- d) ensuring that all CCSDS work follows the agreed set of architectural principles and is properly synchronized with the smooth evolution of the large installed base of CCSDS-compatible mission support infrastructure;
- e) working with the ADs to prepare detailed reports of overall status, progress, and problems for presentation at CMC meetings. As necessary, the CESG chair may request specific ADs to attend CMC meetings to discuss difficult issues;
- f) maintaining the master-tracking list of all CCSDS specifications as they progress through the document tracks, and making recommendations to the CMC for the approval and progression of documents as they approach key decision gates;
- g) verifying that formal review procedures have been properly followed prior to recommending the advancement of a document;
- h) making sure that technical cross-pollination occurs among the various Areas and WGs, which will be accomplished by encouraging ADs to hold Area meetings and by seeking opportunities to hold occasional CCSDS plenary meetings that are attended by all participants (such opportunities may be arranged in conjunction with major conferences); and
- i) seeking opportunities to advertise and promulgate the work of CCSDS by alerting ADs to opportunities to publish results or participate in relevant conferences.

2.3.2.4.3 Area Director Responsibilities

An Area Director is responsible for the work done in his or her WGs, BOFs, and SIGs and is specifically responsible for the following:

- a) being a member of the CESG as the single representative of the CCSDS technical Area;

- b) screening all proposals to form new WGs that are brought forward by BOFs to make sure that they are supported by required documentation and their technical focus is vectored toward the goals and objectives of CCSDS;
- c) making recommendations to the CESC concerning approval for the chartering and formation of WGs and for the authorization of BOFs;
- d) ensuring that CCSDS documents are properly categorized and that they embody the content and quality expected of documents of their type;
- e) making recommendations to the CESC for the progression of WG documents as they approach key decision gates along the various document tracks;
- f) demonstrating and certifying that formal review procedures have been properly followed prior to recommending the advancement of a document;
- g) communicating the dates of CESC meetings to the WG, BOF, and SIG chairs so that they may schedule the completion of their work prior to this time;
- h) notifying the WG, BOF, and SIG chairs as to how and when their work is to be presented to the AD for review;
- i) deciding if Area meetings are to be held, and if so, setting the date, location, and agenda for each Area meeting (it is strongly recommended that periodic face-to-face co-located meetings of the WGs, BOFs, and SIGs in a particular Area should be held to maximize opportunities for cross-pollination of ideas);
- j) chairing Area meetings, ensuring that every WG, BOF, or SIG presents its work in a satisfactory manner and that Area decisions are made through a process of consensus;
- k) ensuring that all Area work follows the set of architectural principles agreed to by the CESC and is properly synchronized with work in other areas and with the smooth evolution of the large installed base of CCSDS-compatible mission-support infrastructure;
- l) working with the WG, BOF, and SIG chairs to prepare detailed reports of overall status, progress and problems for presentation at CESC meetings (as necessary, the AD may request specific WG, BOF, or SIG chairs to attend CMC meetings to discuss difficult issues);
- m) verifying that all Normative Track documents are subject to the proper process of formal agency review by the WG chair;
- n) maintaining the Area master-tracking list of relevant specifications as they progress through the standardization tracks;
- o) making recommendations to the CESC to reconvene a WG to refresh a standard that has been finalized and deployed into operational use, and for which the WG is no longer active;

- p) making sure that technical cross-pollination occurs among the various WGs by seeking frequent opportunities to hold Area meetings; and
- q) seeking opportunities to advertise and promulgate the work of the Area by alerting WG, BOF, and SIG chairs to opportunities to publish results or participate in relevant conferences.

2.3.3 WORKING GROUPS

2.3.3.1 General

The vast majority of the work of CCSDS is done in many Working Groups (WGs) that are clustered into closely related technical Areas. Each WG has a specific published and approved charter and schedule that it is required to follow and a set of associated resources that must be committed by a sponsor to do the work.

No WG will be initiated by CCSDS unless a credible resource plan has been prepared and at least two agencies have agreed to provide the necessary support. The charter states the scope of discussion for the WG, as well as its goals and deliverable products. The charter's list of products will indicate what kinds of standards or practices are to be produced along with any descriptive or rationale documents. When a WG has fulfilled its charter, it is supposed to cease operations or to submit a rechartering proposal for approval. The WG's activities are supposed to focus on just what is in the charter, and not to wander off onto other "interesting" topics. In fact, some WG charters will specify what the WG will *not* do, particularly if there were some attractive but nebulous topics brought up during the drafting of the charter.

The WG charters, including the list of documents/products of the WG, and the schedule for those products are maintained in the on-line Framework. The data is entered by the WG chairs, approved by the CMC, and configuration-managed by the Secretariat in the Framework.

2.3.3.2 Working Group Operating Procedures

Each WG's charter and membership list must be published by the Secretariat on the open CCSDS Web site. Each WG will be allocated both a public and private working area within the CCSDS Web site and a set of CCSDS Web-based information services will be made available by the Secretariat that support structured online document storage and exchange. Public access shall be provided to its meeting minutes, formal documents, presentations and other material necessary to track the broad progress of the WG. Private Web areas shall be used as needed to capture and exchange working documents, drafts, and other information of a more developmental nature that is only exposed to WG members. All members of the WG will have access to the private Web areas, using a user ID issued by the Secretariat.

WG chairs are free to conduct day-to-day WG business by whatever media are most effective, including online document interaction, teleconferences, videoconferences, interim

face-to-face meetings, etc. However, it is mandatory that the results of these discussions be made available to all members via a formal WG mailing list.

A minimum requirement for the day-to-day activities of a WG is therefore that it must maintain an official moderated and archived CCSDS mailing list. Every WG will be provided with its own list capability by the Secretariat and a person “joins” a WG by subscribing to the mailing list. It is required that all WG members must follow the discussions on the mailing lists of the WG to which they are assigned. The mailing lists also provide a forum for those who wish to follow, or contribute to, the WG’s efforts, but cannot attend face-to-face meetings, teleconferences, videoconferences, etc. Mailing lists may continue on after a WG has been formally closed.

2.3.3.3 Area and Working Group Meetings

Each WG chair is responsible for synchronizing the activities of the WG so that the status of its work is presented to and reviewed by the AD in time for the AD to report progress and problems at the CESG meeting. The AD will decide if this review is to occur as follows:

- a) at an Area meeting where all of the WGs and BOFs are co-located; or
- b) via individual face-to-face meetings with each WG; or
- c) via a telecommunicated medium.

If Area meetings are held, the AD shall determine their date and location.

In the absence of requirements for an Area meeting, the WG chair will decide if, when, and where face-to-face WG meetings are to be held. As a general guideline, WG meetings shall be held in the vicinity of institutions where a significant staff participation in the group exists. Alternative locations are permissible if approved by the Area Director. The most important thing that everyone (newcomers and seasoned experts) should do before coming to a face-to-face meeting is to read the WG documents beforehand.

ADs and WG Chairs can decide to hold Area and WG meetings at any time. However, the need for joint meetings to integrate across Areas and WGs drives the minimum meetings for those Areas and WGs to be held in conjunction with the biannual plenary meetings organized by the CMC. Most WGs are required to meet at the plenary (and not at alternate locations/schedules) because some agencies can afford only travel for the plenary meetings, where they send fewer representatives to cover many areas. Also, the pressure of travel expenses generally drives this to be the maximum meeting plan for most WGs. In practice, few Area or WG meetings are held outside of those biannual meetings.

2.3.3.4 Working Group Chairs

Working Group chairs are nominated by an Area Director and approved by the CESC. Candidates for selection as WG chairs must be recognized as a leading technical expert in the field covered by that WG. Candidates may come from any organization (including industry) and do not have to be employees of space agencies.

The role of the WG chair is to keep the discussion moving forward toward the milestones in the WG charter, usually publication of one or more CCSDS Recommended Standards or Practices. They are not meant to be taskmasters but are responsible for ensuring positive forward motion and preventing random wandering. A WG chair is specifically responsible for

- a) creating a charter, work plan, and resource plan for the WG and getting it approved by the Area Director and the CESC;
- b) publishing the approved work plan, showing the scope of its tasks, their schedule, and the nature and source of the resources (e.g., which agencies are providing staffing support) that are needed for their completion;
- c) making sure that necessary resources are committed by someone during the initiation and conduct of new work or the modification of work in progress;
- d) managing the day-to-day activities of the WG so that its chartered products are delivered on a negotiated schedule and within a set of negotiated resources;
- e) ensuring that documents developed by their WG are properly categorized and that they embody the content and quality expected of documents of their type;
- f) deciding which documents should get published as official WG drafts and which should not;
- g) managing the progression of documents along the various document tracks and securing the approval of the AD before advancing them toward finalization;
- h) obtaining specific CMC authorization, via the CESC and the AD, for initiating document transitions that require a formal agency review;
- i) making sure that the review comments resulting from formal agency reviews are properly dispositioned in a consensus environment before a document's designation is changed;
- j) reporting status, progress, and "red flag" items to the AD in a timely manner;
- k) working with the AD to synchronize WG activities with the CCSDS meeting and reporting cycle established by the CMC;
- l) publishing detailed WG meeting agendas, usually a few weeks in advance of meetings;

- m) chairing WG meetings and making sure that the proceedings follow a process of consensus;
- n) appointing document “rapporteurs” as necessary to be the focal points for making progress on a specification;
- o) ensuring that the activities and progress of the WG are made visible to all WG members (and to the public, as appropriate) by requiring the use of Web-based information services provided by the Secretariat (as a minimum, the WG chair must ensure that all major WG discussions and decisions are captured and archived via an official WG mailing list);
- p) maintaining the WG tracking list of relevant specifications as they progress through the document tracks, and making recommendations to the AD for the progression of documents as they approach key decision gates;
- q) seeking opportunities to advertise and promulgate the work of the WG by alerting WG members to opportunities to publish results or participate in relevant conferences;
- r) asking, where appropriate, at a sensible time in each meeting, whether anyone has knowledge of patents, the use of which may be required to utilize or implement the recommendation/deliverable being considered. The fact that the question was asked shall be recorded in the meeting report, along with any affirmative responses;
- s) obtaining the required clearances and conditions with respect to patent and conflict-of-interest issues.

2.3.4 BIRDS-OF-A-FEATHER GROUPS

The sole purpose of a Birds-Of-a-Feather group (BOF) is to do the necessary work to form a WG. The work of the BOF is to articulate the technical concept, usually in the form of a brief white paper, draft a charter for the proposed WG, appoint someone who is able to be chair, and demonstrate that resources can be secured to do the work. BOFs are formed to get support for establishing an eventual CCSDS WG, not to work the details of a particular technical concept. In the process of determining the technical content of the proposed WG a BOF is expected to identify and disclose any potential patent issues. Many BOFs do not turn into WGs for a variety of reasons, such as lack of agreement by enough people on a focus for the work, a lack of credible sponsorship, or a lack of alignment with the overall goals of CCSDS.

Although many BOFs will be initiated from inside the CCSDS organization in order to respond to concrete or prospective customer needs, anyone (from any organization and not necessarily already affiliated with CCSDS) can start a BOF with a view towards convincing an AD that the project is worthwhile and is a positive contribution to the work of CCSDS. A face-to-face meeting is useful for this, although it is not necessary to wait for a meeting opportunity to get some work done, such as setting up an informal mailing list, writing and circulating a CCSDS concept paper that outlines the proposed technical scope of the work,

and starting to discuss a charter. BOF meetings have a very different tone than WG meetings; their focus is to create a good charter with good milestones, and to prove that there are enough resources potentially available to do the work needed in order to create standards.

At such time as a BOF feels that it has enough agreement to propose formation of a WG, it must schedule a meeting with an AD to present its case. The AD makes the initial determination as to whether to advocate the work further, to recommend more BOF work on the charter and resource plan, or to reject the proposal. If the AD recommends acceptance of the proposal, the draft charter and resource plan, accompanied by a CCSDS concept paper outlining its technical scope, is forwarded to the CESG for a decision. If the AD rejects the proposal, the BOF can appeal to the CESG chairman for a wider hearing, or it can simply dissolve. BOFs initiated from inside the CCSDS organization have a lifetime of no more than one year.

2.3.5 SPECIAL INTEREST GROUPS (SIGS)

Special Interest Groups (SIGs) provide an ad-hoc forum for the discussion and coordination of topics that affect multiple WGs and/or Areas. SIGs are convened by ADs and composed of representatives from existing WGs. Final products of SIGs consist of a report or guidelines that provide guidance for the WGs. If the SIG determines that standard or Non-Normative Track documentation is needed, then a BOF will be initiated to develop an official charter.

2.4 CCSDS POLICIES

2.4.1 CCSDS PATENT POLICY AND PROCESS

Recognizing that the CCSDS functions as an ISO subcommittee (ISO TC20/SC13), the CCSDS therefore adopts ISO policy¹ on standardizing patented technologies.

CCSDS also adopts the following further clarifications of the CCSDS policy for standardization of patented technologies:

Patent licensing fees and terms shall be Reasonable And Non-Discriminatory (RAND) and shall be available worldwide to all organizations developing or operating spaceflight missions. This is not interpreted to mean that all licensing fees and terms must be identical for all parties (e.g., commercial vs. non-commercial), but it is required that license fees and terms be reasonable and available worldwide for all organizations involved in spaceflight. In cases where segments of the CCSDS user base may be disadvantaged by license fees and terms, the CCSDS Management Council may make a standardization decision based on priorities and needs of the larger community of CCSDS agencies and ISO member bodies.

At the very earliest stage of the efforts of any CCSDS WG, the potential or certain need to incorporate patented technology in future CCSDS standards shall be disclosed to CCSDS

¹ <http://www.itu.int/en/ITU-T/ipr/Pages/policy.aspx>

management (CESG and CMC). Procedurally, this shall be addressed in the development and approval of charters for CCSDS teams (WGs and SIGs), by documented requests for disclosure of any patents, as appropriate, during each technical meeting, and in the approval process for adding standards documentation projects to WG charters. This effort is not intended to be a formal effort of patent law research, but simply a best effort to identify any patent encumbrances that may exist as known by the CCSDS WG members, and optionally by consulting with other knowledgeable resources in the community.

Confirmation of compliance with CCSDS and ISO patent policy will be verified by a requirement for the applicable CCSDS WG to secure the ISO *Patent Statement And Licensing Declaration* form, signed and submitted by the patent holder. The signed declaration is considered to be sufficient verification of RAND license fees and terms to allow standardization work to proceed. The CCSDS WG shall also have the further goal to secure information from the patent holder concerning exact terms of licenses, so that, when possible, the license terms can be reviewed by the CCSDS WG and CCSDS management, providing greater assurance that the terms of the license are RAND.

Also, at this early stage of a standardization effort, any interests (financial or otherwise) that CCSDS representatives have in a patented technology that is being proposed as a CCSDS Recommended Standard shall be disclosed to the CMC in order to avoid Conflict of Interest (COI) situations, and to insure the integrity of CCSDS processes. The CCSDS representatives to whom this disclosure requirement applies are those who have a role in developing or approving the CCSDS document in question.

In the event that it is discovered at a late stage of development that patented technology encumbers a proposed standard, a notification of such encumbrance shall be immediately raised to the CMC so that the CCSDS agencies can determine if further investment of agency resources will continue before compliance with CCSDS patent policy can be confirmed. CCSDS documents that have known patent issues will not be approved for publication until an ISO Patent Statement and Licensing Declaration Form is signed by the Patent Holder (or is pre-existing in the ISO Patent Database).

The CCSDS Management Council anticipates that a waiver process may be formally established for this policy in the future. Currently, any issues resulting from this Patent Policy will be handled on a case-by-case basis.

3 CCSDS TECHNICAL STRUCTURE

3.1 OVERVIEW

The technical work of CCSDS is centered on the CCSDS Engineering Steering Group as shown in figure 3-1.

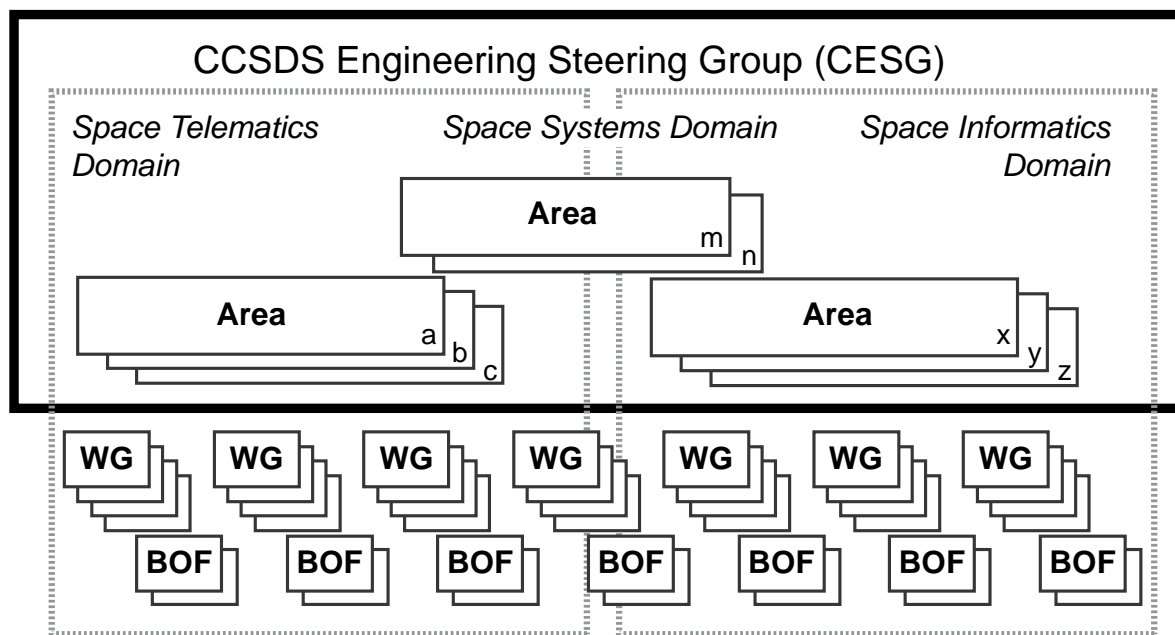


Figure 3-1: CESG Structure

3.2 TECHNICAL ORGANIZATION OF THE CESG

The technical work of the CESG logically cleaves into the three broad domains of Systems, Informatics, and Telematics.

NOTE – The domains are simply logical partitions that differentiate three significantly different engineering disciplines. There are no “domain directors.”

The Areas *are* physical organizations within the CESG. Each Area contains narrowly chartered WGs that concentrate on the production of specific standards. Although they are intended to be relatively stable entities, Areas may be added or deleted in response to a changing space mission environment.

Six Areas (spread across the three logical domains) form the current structure of CCSDS.

3.3 SYSTEMS DOMAIN

3.3.1 GENERAL

The Systems Domain currently contains a single Area: Systems Engineering.

3.3.2 SYSTEMS ENGINEERING AREA

The Systems Engineering Area (SEA) covers system-wide engineering aspects that are so pervasive that they span both the Informatics and Telematics Domains. The AD has the prerogative to define the precise set of work units that this Area contains at any point in time.

3.4 INFORMATICS DOMAIN

3.4.1 GENERAL

The Informatics Domain contains two Areas:

- Mission Operations and Information Management Services;
- Cross-Support Services.

3.4.2 MISSION OPERATIONS AND INFORMATION MANAGEMENT SERVICES AREA

The Mission Operations and Information Management Services (MOIMS) Area includes all of the flight execution phase applications that are required to operate the spacecraft and its ground system in response to mission objectives, and their associated detailed information management standards and processes.

The focus of this area is primarily on the *mission-operations* functions that occur on a timescale driven by the flight path of the space vehicle. In many cases a dedicated community conducts mission operations, whereas *mission utilization* occurs on a timescale that is convenient for users and is often conducted by a separate community. There is frequently an organizational boundary between these two communities. CCSDS recognizes that there are many diverse mission-utilization communities, supported by their own mature existing standardization groups, all of whom are best equipped to develop the standard mechanisms by which they internally exchange, analyze, share, disseminate and archive space-derived information. The work of the CCSDS Mission Operations and Information Management Services Area therefore will be prioritized to focus on operational processes and also to ensure that standards exist that facilitate a smooth transition of space-mission information between the mission-operations systems and the mission-utilization systems.

It is anticipated that this Area will eventually grow to embrace a wide spectrum of applications that are needed to execute space missions, possibly including the development

of Recommended Operational Practices in conjunction with ISO TC20/SC14. The Area Director has the prerogative to define the precise set of work units that this Area will contain.

3.4.3 CROSS SUPPORT SERVICES AREA

Whereas the Mission Control Applications Area focuses on the internal details of the application processes that are needed to execute a space mission, the Cross Support Services (CSS) Area focuses on how those applications are made available by one organization to another for the purpose of cross support. It therefore defines what services are required at various cross-support interface points, and how those services are exposed, scheduled, and used by organizations who want to confederate their infrastructure in order to execute a mission.

NOTE – A service may be a complex construct that concatenates several mission control applications, and has its own exposed interface. The AD has the prerogative to define the precise set of work units that this Area will contain.

3.5 TELEMATICS DOMAIN

3.5.1 GENERAL

The Telematics Domain contains three Areas:

- Spacecraft Onboard Interface Services;
- Space Link Services;
- Space Internetworking Services.

3.5.2 SPACECRAFT ONBOARD INTERFACE SERVICES AREA

The Spacecraft Onboard Interface Services (SOIS) Area includes all of the onboard communications networks and protocols *within* a single spacecraft, and their time-critical data handling interfaces and applications. The AD has the prerogative to define the precise set of work units that this Area will contain.

3.5.3 SPACE LINK SERVICES AREA

The Space Link Services (SLS) Area includes all of the point-to-point communications links and protocols that interconnect a spacecraft with its ground support system, or with another spacecraft. The AD has the prerogative to define the precise set of work units that this Area will contain.

3.5.4 SPACE INTERNETWORKING SERVICES AREA

The Space Internetworking Services (SIS) Area includes all of the routine communications services and protocols that support end-to-end communications between applications running on a spacecraft and applications running within its ground-support system, or between applications running on two or more spacecraft. The AD has the prerogative to define the precise set of work units that this Area will contain.

4 PARTICIPATION

4.1 CATEGORIES OF PARTICIPATION

4.1.1 GENERAL

Participants in the CCSDS are classified in one of four categories: Member Agency, Observer Agency, Liaison, or Associate. Any organization wishing to participate in the CCSDS activity should petition the CCSDS Secretariat in writing requesting permission to participate in one of the four categories as defined below. In the case of an application for Member Agency, Observer Agency, or Liaison status, the CCSDS Secretariat shall present each request to the CMC for consideration and approval. Following the CMC decision, the Secretariat shall notify the agency or organization of the result.

In the case of a request for CCSDS Associate status, the organization is approved once the application has been

- completed by the applicant;
- approved by the Principal Delegate of the sponsoring Member or Observer Agency;
- signed by the CCSDS Secretariat.

Generally, the sponsoring Agency and CCSDS Associate shall be from the same country; however, multinational organizations (e.g., the European Space Agency) can sponsor Associates provided that the proposed Associate is from a country that is affiliated with the sponsoring Agency.

4.1.2 MEMBER AGENCY

Only agencies having significant responsibilities for space development, operations, or research may participate as CCSDS Member Agencies. Furthermore, Member Agencies shall be governmental or quasi-governmental organizations and shall indicate a willingness to participate substantially in CCSDS activities (including attendance at CMC meetings) and provide a commensurate level of support. They shall notify their approval of the Charter and shall make their best effort to ensure the adherence of their internal standards to the applicable Recommended Standards of the CCSDS.

No more than one agency representing a given country or multinational organization may participate as a Member Agency of the CCSDS. However, the number of such national or multinational agencies that may participate as Observer Agencies is not limited.

4.1.3 OBSERVER AGENCY

Observer Agencies are organizations that have a strong interest in space development, operations, or research. CCSDS Observer Agencies are those agencies that indicate a desire

to participate in CCSDS activities but at a reduced level of effort. Observer Agencies are encouraged to maintain their internal standards so as to be compatible with the applicable Recommended Standards of the CCSDS.

4.1.4 LIAISON

Liaison organizations are those governmental or private activities which have developmental programs in the areas of space-related data and information systems.

Liaison status is open to non-commercial, standards-developing organizations operating in areas similar to those of the CCSDS. Liaison organizations receive all CCSDS documentation released for external dissemination; they are welcome to submit comments or initiate Review Item Dispositions (RIDs) on CCSDS review documents.

4.1.5 ASSOCIATE

Scientific or industrial organizations may participate as Associates, provided they are sponsored by a Member or Observer Agency in their country. CCSDS Associates are those industrial or academic organizations which indicate a desire to monitor closely CCSDS activities. Associates receive all CCSDS documentation released for external dissemination. They are welcome to submit comments or RIDs on CCSDS review documents. The procedure relative to RID submission is at the election of the sponsoring agency. Associates may participate in CCSDS technical meetings and discussion forums with the explicit approval of the sponsoring Member Agency.

4.2 MEMBERSHIP LISTS

The Secretariat shall maintain lists of Member Agencies, Observer Agencies, Liaison organizations, and Associate organizations. These lists are maintained on the CCSDS Web site.

5 OPERATIONS

5.1 TOOLS OF OPERATION

5.1.1 OFFICIAL LANGUAGE

English shall be the official language used at all CCSDS-sponsored meetings. Furthermore, CCSDS correspondence records and all technical documentation shall be in English.

5.1.2 CONSENSUS

The decisions of all CCSDS organizational units shall be reached through consensus. In this context, consensus does not necessarily mean that unanimous agreement has been reached, but that the result incorporates the best set of compromises to which all parties can agree.

5.1.3 CMC RESOLUTIONS

5.1.3.1 CMC resolutions are the executive decisions of the CMC and shall be concise statements of consensus among CMC members.

5.1.3.2 Any CMC resolution affecting the CCSDS organization or processes shall be accompanied by an action on the Secretariat to reflect the resolution in this document.

5.1.4 APPROVAL AUTHORITY

The CMC has final approval authority for all CCSDS documents. The CESG provides technical review of draft CCSDS documents. Only Normative Track documents and updates to Normative Track documents require formal agency review before final CMC approval.

5.1.5 CCSDS WEB SITE

5.1.5.1 General

The Secretariat shall provide a Web site for official CCSDS business.

5.1.5.2 Official CCSDS Document Repository

The CCSDS Web site shall be the official repository for CCSDS documents:

- a) the Secretariat shall be responsible for posting and maintaining all published documents that have completed active WG development and are eligible for dissemination and retention;

- b) the chairs of individual organizational units shall be responsible for posting and maintaining internal documents such as charters, local procedure documents, and meeting minutes; and
- c) document developers shall be responsible for posting and maintaining draft versions of documents under active development within a WG, BOF, or SIG.

NOTE – Access to WG-, BOF-, or SIG-internal drafts may be restricted to group members or some other subset of CCSDS participants.

5.1.5.3 Document Management Tools

The Secretariat shall provide server work areas and document management tools for the CMC, CESG, Areas, WGs, SIGs, and BOFs. Work area owners shall have the ability to set access restrictions on the contents of their work areas.

5.1.5.4 Official CCSDS E-mail Lists

The Secretariat shall maintain an e-mail list server and provide moderated announcement and discussion e-mail lists for all CCSDS organizational units, including WGs and BOFs. A Web interface shall be provided for access to list archives.

The e-mail lists maintained by the Secretariat shall be the official CCSDS e-mail lists and shall be used for all official CCSDS correspondence distributed via e-mail to CCSDS organizational units. The Secretariat monitors, filters, and virus-scans all e-mail sent to CCSDS e-mail lists to remove SPAM and messages that contain viruses.

5.1.5.5 Meeting Schedules and Registration Tools

The Secretariat shall maintain a calendar of CCSDS meetings and provide tools for scheduling and online meeting registration.

5.1.6 NUMBERING OF POLLS, RESOLUTIONS, AND ACTION ITEMS

The numbering of CCSDS polls, resolutions, and action items has the following format:

[GROUP-{P|R|A}-YYYY-MM-nnn].

Where

- GROUP identifies the group to which the poll, resolution, or action item, belongs and may be a WG or Area designation, CESG, or CMC;
- {P|R|A} indicates a choice of “P” for a poll, “R” for a resolution, or “A” for an action item;

- YYYY is the four-digit year;
- MM is a two-digit month designation;
- nnn is a three-digit serial number that resets to 001 each month.

For example, “SMC-R-2004-11-003” indicates SM&C WG Resolution #3 issue November 2004; CESG-P-2009-01-001 indicates the first CESG poll conducted in January 2009; CMC-R-2010-007 indicates the seventh resolution issued by the CMC in August 2010.

5.2 MEETINGS

5.2.1 GENERAL

The CMC shall define the requirements for scheduling the overall CCSDS meeting cycle so that work results may be reported in a logical and orderly sequence and management decisions can be made in a timely manner. The following broad rules are established; however, the CMC may at any time issue more restrictive policies that limit the choices.

5.2.2 CMC MEETINGS

5.2.2.1 Purpose

CMC meetings are convened to discuss matters related to the executive management oversight of the CCSDS.

5.2.2.2 Schedule

The CMC will meet twice per year and must publish its proposed meeting schedule at least two years in advance.

5.2.2.3 Location

At least one meeting is collocated with the WG plenary and the CESG meetings, on the week following the plenary meetings. The CMC may rotate its other meetings among the CCSDS members as necessary to satisfy hosting protocol. However, to minimize travel costs for delegates there may be practical constraints on the choice of locations for CMC meetings.

5.2.2.4 Agenda

Two months before each CMC meeting, the Secretariat shall distribute a preliminary agenda and a meeting announcement. The preliminary agenda shall list the new issues to be considered during the discussion of each agenda item together with a list of open action items from previous meetings. Requests for member inputs to this draft agenda shall be made

at this time. Heads of Delegation are required to indicate the status of their individual action items at this time.

One month before each CMC meeting, the Secretariat shall distribute a revised agenda that includes member inputs relative to both agenda suggestions and action item status. Among the materials distributed at this time, the Secretariat shall include a summary of polls and resolutions since the prior meeting. It is the responsibility of those members submitting papers for discussion at an upcoming meeting to make copies of such papers available on the CCSDS Web site one month before that meeting to allow sufficient time for members to review.

The Secretariat shall prepare draft meeting minutes and post them on the CCSDS Web site for review by the CCSDS Members, Observers, Liaisons, and the CESG. CMC meeting minutes remain in draft status until formally approved by the CMC.

5.2.2.5 Participation

The following general guidelines apply to participation in CMC meetings by groups affiliated with CCSDS. Participation is not limited to these groups; the CMC has the discretion to invite others, e.g., industry representatives or technical experts, to attend particular CMC meetings. However, except as noted below, attendance is by invitation only.

- a) **Members.** The principal delegates of the CCSDS members are expected to attend all CMC meetings.
- b) **Observers.** Delegates of CCSDS observers may attend CMC meetings but may not participate in formal polling intended to result in CMC resolutions.
- c) **Liaisons.** Delegates of liaison organizations may attend CMC meetings at the invitation of the CMC.
- d) **Associates.** Delegates of associate organizations may attend CMC meetings at the invitation of the CMC.
- e) **CESG.** The CESG chair or deputy CESG chair shall attend the CMC meetings to report technical progress and make recommendations about the program of work. The CESG chair may be supported by key Area Directors as he or she feels necessary.

5.2.3 CESG MEETINGS

5.2.3.1 Purpose

The CESG meets to prepare progress reports, proposals, recommendations, and other materials before the scheduled CMC meetings.

5.2.3.2 Schedule

The CESG must meet face-to-face at least twice per year to prepare progress reports, proposals, recommendations, and other materials prior to the scheduled CMC meetings. The CESG meeting must be completed before the CMC meeting, with sufficient time allocated to formulate the CESG report.

5.2.3.3 Location

One CESG meeting per year is co-located with CMC meeting on the week following the plenary WG meetings. Alternative locations are permissible if approved by the CMC. Interim CESG meetings may be arranged as necessary at the discretion of the chairman and must be held in the vicinity of institutions where a significant staff participation in the group exists.

5.2.3.4 Meeting Materials

At least six weeks before a meeting, the CESG chair shall distribute a meeting announcement that includes a preliminary agenda and a recommended attendance list.

At least three weeks before a meeting, the CESG chair shall distribute a final agenda, reflecting input resulting from review of the preliminary agenda, along with any meeting materials requiring review in advance of the meeting.

NOTE – Distribution of meeting materials may be accomplished by providing a link to a repository on the CCSDS Web site.

A formal report on each meeting shall be presented to the CMC, and a register of meeting input documents, meeting minutes, and meeting conclusions and recommendations shall be maintained in the CESG work area on the CCSDS Web site.

5.2.3.5 Participation

The CESG chair and Area Directors are expected to attend all CESG meetings. In cases where attendance is not possible, a deputy must attend.

WG and BOF participants, industry representatives, and technical experts may be asked to attend as necessary to deliver reports and participate in technical discussions. The CESG chair shall determine the attendance criteria for individual meetings.

5.2.4 CCSDS PLENARY MEETINGS

5.2.4.1 Purpose

A CCSDS plenary meeting provides an opportunity for

- a) exchanging information among all CCSDS participants in a “conference” environment;
- b) charting a long-range course for future work; and
- c) interacting with non-affiliated space agencies or other relevant standards bodies.

5.2.4.2 Schedule and Location

CCSDS plenary meetings are hosted by CCSDS Member Agencies, in a location that is proposed by the host agency and approved by the CMC. Generally, they will be planned to be held biannually in the Spring and Fall of each year, barring circumstances beyond the control of the CCSDS member agencies. When advantageous, they may be scheduled and co-located in conjunction with major international conferences or other significant CCSDS-related events.

5.2.4.3 Meeting Materials

The Secretariat may prepare informational and promotional materials for distribution to plenary participants.

Papers and presentations presented at CCSDS plenaries shall be posted on the CCSDS website. They can be posted by the Secretariat, the authors, or by WG members who maintain their materials in that WG area of the CCSDS website.

5.2.4.4 Participation

Plenary meeting attendance is generally open to all parties that can contribute to the CCSDS work, but contingent on the approval of a CMC or Secretariat representative. When a prospective attendee from a CMC agency registers, his registration is sent to the CMC delegate from that agency. If no contrary action is taken by that CMC delegate, the attendance is approved. Registrations from attendees outside of the CMC agencies are handled by the Secretariat in consultation with CCSDS management to insure attendees have a valid interest in the work of the committee.

5.2.5 AREA MEETINGS

5.2.5.1 Purpose

In general, Area meetings are convened on the occasion of plenary CCSDS meetings for face-to-face technical discussion aimed at achieving consensus.

5.2.5.2 Schedule and Location

As a general guideline, Area meetings must be held in conjunction with the CCSDS biannual plenary meetings. Additional meetings are at the discretion of the AD, depending on financial and schedule constraints of the agencies of the necessary supporting delegates. The rationale for required meetings at the CCSDS biannual plenary meetings is to support the ability of agencies to allow fewer personnel to support multiple WG meetings. Historically, some agencies have protested when Areas and WGs have met separately from the Plenary meetings because it prevented their participation.

For supplemental meetings, ADs are cautioned that part of their performance evaluation will be based on their ability to persuade their WG and BOF chairs to select meeting locations based on good technical, fiscal, and personnel scheduling considerations, rather than individual preferences. Put plainly, any perception that CCSDS is a “travel club” may result in unwelcome intervention by the CMC.

5.2.5.3 Meeting Materials

At least six weeks before a meeting, the AD shall distribute a meeting announcement that includes a preliminary agenda and a recommended attendance list.

At least three weeks before a meeting, the AD shall distribute a final agenda, reflecting input resulting from review of the preliminary agenda, along with any meeting materials requiring review in advance of the meeting.

NOTE – Distribution of meeting materials may be accomplished by providing a link to a repository on the CCSDS Web site.

A formal report on the Area meeting shall be presented to the CESG, and a register of meeting input documents, meeting minutes, and meeting conclusions and recommendations shall be maintained in the Area’s work area on the CCSDS Web site.

5.2.5.4 Participation

The AD shall determine who participates in Area meetings based on the technical foci of the meeting.

5.2.6 WORKING GROUP MEETINGS

5.2.6.1 Purpose

Working Group meetings are convened on the occasion of plenary CCSDS meetings to enable face-to-face technical discussions leading to consensus.

5.2.6.2 Schedule and Location

As with Area meetings, WG meetings must be held in conjunction with the CCSDS biannual plenary meetings. Additional meetings are at the discretion of the WG, depending on financial and schedule constraints of the agencies of the necessary supporting delegates. The rationale for required meetings at the CCSDS biannual plenary meetings is to support the ability of agencies to allow fewer personnel to support multiple WG meetings. Historically, some agencies have protested when Areas and WGs have met separately from the Plenary meetings because it prevented their participation.

For supplemental meetings, WGs, BOFs, and SIGs may co-locate to provide maximum opportunities for technical interchange across different groups.

5.2.6.3 Meeting Materials

At least six weeks before a meeting, the WG chair shall distribute a meeting announcement and a preliminary agenda.

At least three weeks before a meeting, the WG chair shall distribute a final agenda, reflecting input resulting from review of the preliminary agenda, along with any meeting materials requiring review in advance of the meeting.

NOTE – Distribution of meeting materials may be accomplished by providing a link to a repository on the CCSDS Web site.

A formal report on the WG meeting shall be presented to the AD, and a register of meeting input documents, meeting minutes, and meeting conclusions and recommendations shall be maintained in the WG work area on the CCSDS Web site.

NOTE – Upon dissolution of the WG, these materials will be archived by the Secretariat.

5.2.6.4 Participation

Working Group participation is generally limited to WG members; however, occasional participation by ad-hoc technical experts may take place. Working group members must be affiliated with member or observer agencies, or liaison or associate organizations. Any WG participant who does not meet these criteria must be endorsed by an authorized representative from a member or observer agency.

5.2.7 SPECIAL INTEREST GROUP MEETINGS

5.2.7.1 Purpose

SIG meetings are convened on the occasion of Plenary CCSDS meetings to enable face-to-face technical discussions leading to consensus.

5.2.7.2 Schedule and Location

As with Area meetings, SIG meetings must be held in conjunction with the CCSDS biannual plenary meetings. Additional meetings are at the discretion of the SIG, depending on financial and schedule constraints of the agencies of the necessary supporting delegates. The rationale for requiring meetings in conjunction with the CCSDS biannual plenary meetings is to support the ability of agencies to allow fewer personnel to support multiple WG meetings. Historically, some agencies have protested when Areas and WGs have met separately from the Plenary meetings because it prevented their participation.

For supplemental meetings, WGs, BOFs, and SIGs may co-locate to provide maximum opportunities for technical interchange across different groups.

5.2.7.3 Meeting Materials

At least six weeks before a meeting, the SIG chair shall distribute a meeting announcement and a preliminary agenda.

At least three weeks before a meeting, the SIG chair shall distribute a final agenda, reflecting input resulting from review of the preliminary agenda, along with any meeting materials requiring review in advance of the meeting.

NOTE – Distribution of meeting materials may be accomplished by providing a link to a repository on the CCSDS Web site.

A formal report on the SIG meeting shall be presented to the AD(s), and a register of meeting input documents, meeting minutes, and meeting conclusions and recommendations shall be maintained in the SIG work area on the CCSDS Web site.

NOTE – Upon dissolution of the SIG, these materials will be archived by the Secretariat.

5.2.7.4 Participation

SIG participation is generally limited to SIG members; however, occasional participation by ad-hoc technical experts may take place.

5.2.8 BOF MEETING

5.2.8.1 Purpose

BOFs meet as necessary to develop the materials needed to propose formation of a WG. At such time as a BOF feels that it has enough agreement to propose formation of a WG, it must schedule a meeting with its authorizing AD to present its case.

5.2.8.2 Schedule and Location

As with Area and WG meetings, BOF meetings, if needed, should be held in conjunction with the CCSDS biannual meetings. This will allow the greatest review and participation by associated WG participants. However, if a BOF can conduct its work without face-to-face meetings, development of the BOF proposals for WG formation can be done by teleconference and other electronic means. The BOF team shall coordinate with the AD to negotiate the presentation of the BOF proposals to that AD.

5.2.8.3 Meeting Materials

All materials developed in the course of BOF work should be maintained in an assigned BOF work area on the CCSDS Web site.

5.2.8.4 Participation

Participation in BOF meetings is expected to consist of domain experts with the capabilities to formulate new work plans in the technology area addressed by the BOF. Participants may be recruited by current CCSDS staff or AD.

5.3 ONLINE VOTING

5.3.1 PURPOSE

To arrive at consensus among the CCSDS participants, a mechanism for formally voting on issues of interest is provided by the Secretariat. Members participate in formal polling intended to result in CMC resolutions. Although the CMC and many of the technical forums are held only twice a year, standards development must continue on a daily basis. The ability to poll CMC members in a world-wide environment on a timely basis is essential to day-to-day operations of the CCSDS. Therefore, an online polling capability is provided to conduct business in a virtual work environment between semiannual meetings.

5.3.2 SCOPE

The online polling feature is a tool that can be found on the CCSDS Web site and is available to the CMC and CESG for voting on issues and taking surveys on topics of interest.

5.3.3 CONCEPT

The CCSDS online polling tool is located in a private area of the Collaborative Work Environment (CWE). The Secretariat defines how access to the polling is controlled.

5.3.4 RESPONSIBILITIES

5.3.4.1 Secretariat

The CCSDS Secretariat shall be responsible for maintaining the polling system as part of the CCSDS Web site and collaborative work-space tools.

5.3.5 PROCESS

5.3.5.1 Establishing an Online Poll

The Secretariat establishes polls to allow the CMC and CESG to vote on proposed resolutions.

The Secretariat announces new polls via e-mail messages to the CMC and CESG e-mail lists. The e-mail announcement

- identifies the poll in which the CMC or CESG is being asked to participate;
- provides a link to the location of the online poll;
- designates the closure date of the poll.

NOTE – Future polling procedures may allow ADs and WG chairs to initiate polls to decide Area and WG issues.

5.3.5.2 Responding to an Online Poll

Upon receiving an e-mail request to participate in an online poll, the participant should do the following:

- a) click on the URL located in the notification e-mail and log in using CWE credentials;
- b) select one of the response options for the poll;
- c) enter comments as needed to explain or qualify the selected option;

- d) click on “Save and Close” to submit vote.

5.3.5.3 Conclusion of Online Poll

5.3.5.3.1 Interpretation of Poll Results

The votes recorded at the closure date of the poll constitute the result of the poll.

Several sets of results are possible for the various kinds of polls conducted, but for most polls, possible results fall into three categories:

- approval;
- conditional approval;
- disapproval (or failure to achieve approval).

In the case of approval, the Secretariat normally undertakes some action implied by the subject of the poll.

In the case of conditional approval, a rapporteur is identified to address the conditions. When the rapporteur has addressed all the conditions to the satisfaction of the voter(s) who raised them, the poll is deemed to be approved.

In the case of disapproval or failure to achieve approval, the causes for the failure of the poll are examined, and if those causes are remediable, a new poll on the same issue may be issued.

A single vote for conditional approval or disapproval is sufficient to produce a poll result of conditional approval or disapproval.

Failure to achieve approval results from lack of quorum. For CMC polls, votes from more than fifty percent of the members are needed to achieve quorum. For CESG polls, votes from more than fifty percent of the Areas are needed to achieve quorum.

In the case of a vote that fails because of lack of quorum, the poll may be reopened with an extended closure date, or the poll may be conducted again at a later date.

5.3.5.3.2 Distribution of Poll Results

The Secretariat distributes poll results to the CMC and CESG-all e-mail lists.

Interpretation of poll results and inferred Secretariat action, when indicated, are provided in the distributed poll results.

5.4 ACTION ITEM TRACKING AND DISPOSITION

5.4.1 PURPOSE

The purpose of this section is to describe action item assignment, tracking, follow-up, notification on closed action items, and disposition. An action item tracking and disposition tool shall be made available to the CCSDS to facilitate management council work.

5.4.2 SCOPE

The scope is for CMC action items and resolutions.

5.4.3 RESPONSIBILITIES

It is the responsibility of the Area Directors and WG, CESG, and CMC chairs to make action item assignments and assign the appropriate numbering for action items and resolutions. The Secretariat support shall follow-up on resolutions and action items resulting from CMC meetings.

5.4.4 ACTION ITEM ASSIGNMENT

Action items shall normally be assigned to a single individual who will be the primary focal point for the action.

NOTE – In some instances a single action may be assigned to multiple individuals, all of whom are expected to respond by the action due date.

All actions shall have due dates and unique tracking numbers upon assignment. Action items and resolutions assigned during meetings shall be captured on an action item form, either in paper form or electronically, during the course of the meeting by the person purposing the resolution or action.

5.5 ONLINE CHARTERING AND PROJECT APPROVAL

The Secretariat staff has developed an online chartering and project approval tool, as part of the online management Framework. When an AD approves the formation of a new WG within his or her Area, the proposed WG lead is responsible for entering the WG information into the chartering tool. The Secretariat then will receive an automatic notification and will set up an approval poll. Should the charter be approved, it will then be confirmed in the system.

Future updates to the charter and associated projects are entered by the WG chair. Again, the Secretariat will receive an automatic notification and a poll will be initiated if necessary. Addition of WG products (standards documents) to a charter in the management Framework requires the entry of a schedule for completion of that document. A CMC poll is required to approve adding a document to or deleting a document from a WG's charter and work plan. Changes to document schedules will be reviewed by the CMC twice yearly in "batch mode" where the CMC has the opportunity to raise issues with document schedules. The WG teams should continue to work to the schedules that they have entered into the system unless directed otherwise by the CMC.

6 CCSDS STANDARDIZATION PROCESS

The general taxonomy of CCSDS documentation is shown in figure 6-1.

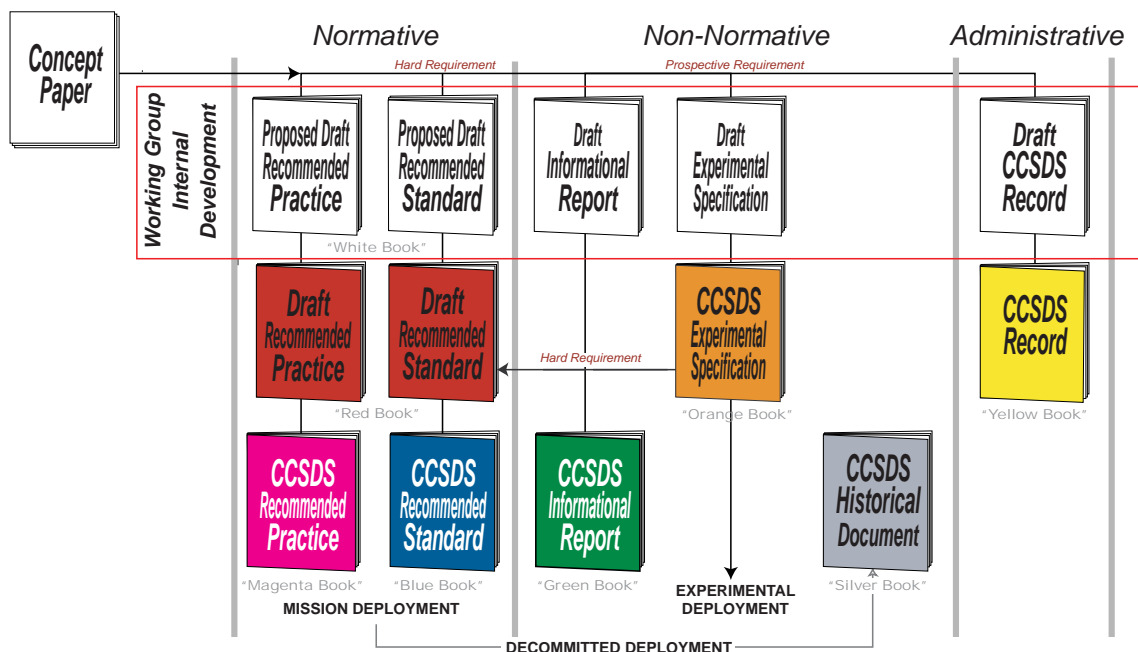


Figure 6-1: CCSDS Document Taxonomy

The CCSDS tracks and designations are summarized as follows:

- CCSDS Concept Paper
- CCSDS Normative Track:
 - CCSDS Proposed Draft Recommended Standard (White Book)
 - CCSDS Draft Recommended Standard (Red Book and Pink Sheets)
 - CCSDS Recommended Standard (Blue Book)
 - CCSDS Proposed Draft Recommended Practice (White Book)
 - CCSDS Draft Recommended Practice (Red Book and Pink Sheets)
 - CCSDS Recommended Practice (Magenta Book)
- Non-Normative Track CCSDS:
 - CCSDS Experimental (Orange Book)
 - CCSDS Informational (Green Book)
 - CCSDS Historical (Silver Book)
- CCSDS Administrative Track:
 - CCSDS Record (Yellow Book)

6.1 OVERVIEW OF CCSDS DOCUMENT FLOW

6.1.1 DOCUMENT FLOW

The flow of developing a CCSDS document is as follows:

Every CCSDS document (or family of related documents) starts out as a CCSDS concept paper.

If a WG is successfully chartered by the CESG to develop a document within CCSDS, the charter must specify a priori which “track” it will follow. The tracks (significance will be defined later) are

- Normative Track;
- Non-Normative Track;
- Administrative Track.

NOTE – Each of the document types described next has an expected content and form. The expected content is described here but the format for each document is addressed in the *CCSDS Publications Manual* (reference [1]). In the following sections general descriptions of the expected content for different document types are provided. In annex C there are some examples showing the sorts of actual document content that appear in typical CCSDS standards of each of the different major types.

The terms “normative” and “prescriptive” are used in the following sections. Socially a “norm” is a relatively specific and precise rule that is established to prescribe appropriate behavior. In this context, norms are specific and precise rules that elaborate the detailed behavioral and structural requirements of a standard. To say that a section of a standard is “normative” is to say that it is both well specified, i.e., a norm, and that it must be adhered to in order for an implementation to be compliant. “Prescriptive” means pertaining to giving directives or rules; a prescriptive standard is concerned with norms of or rules for correct usage. Prescription can refer to both the codification of and the enforcement of rules governing how a standard is to be used.

6.1.2 DEFINITIONS²

(N)-layer: A subdivision of the Open Systems Interconnection (OSI) architecture, constituted by subsystems of the same rank (N).

protocol: A set of rules and formats (semantic and syntactic) which determines the communication behavior of (N)-layer protocol entities in the performance of (N)-layer protocol functions.

²Adapted from reference [2].

6.1.3 NORMATIVE TRACK

6.1.3.1 The Normative Track has two branches:

- documents that are intended to be Recommended Standards (CCSDS Blue Books);
- documents that are intended to be Recommended Practices (CCSDS Magenta Books).

6.1.3.2 The principal difference between these two branches is that Recommended Standards are precise, prescriptive and/or normative specifications that define interfaces, protocols, or other controlling standards at a sufficient level of technical detail that they can be directly implemented and used for space-mission interoperability and cross support. Recommended Standards may be defined at a single layer in the OSI reference model,³ or they may specify how to utilize a set of related standards from several layers in the OSI reference model or how to adapt other standards for use in space.

6.1.3.3 Recommended Practices are normative and have prescriptive content but are typically not directly implementable for interoperability or cross support. They may be of several types:

- a) specifications that are “foundational” for other specifications, but within themselves do not define content in a way that allows independent development and testing of separate but interoperable systems;
- b) system descriptions that are more general in nature and capture “best” or “state-of-the-art” recommendations for applying standards or defining standardized processes;
- c) reference architectures and other formal but not directly implementable specifications;
- d) operational practices that are associated with other CCSDS specifications.
- e) Application Programming Interfaces (API), which are useful for portability but do not in themselves provide interoperability.

Recommended Practices (Magenta Books) differ from “informational” documents in that they do provide normative, controlling guidance rather than purely descriptive material. Because they provide normative guidance, they are indeed a full-fledged specification at a peer level with Recommended Standards (Blue Books). A Magenta Book is no less of a specification than a Blue Book. However, unlike Recommended Standards, Recommended Practices do not include the level of normative technical, directly implementable, specification that would allow the independent development of separate but interoperable systems.

6.1.3.4 As a result of this difference in prescriptive content between Blue and Magenta books, Blue Books are required to be prototyped before final approval and publication, but Magenta Books are not required to be prototyped.

³ See reference [2].

6.1.3.5 The flow of documents on the Recommended Standard branch is

- CCSDS Proposed Draft Recommended Standard (White Book)
- CCSDS Draft Recommended Standard (Red Book and Pink Sheets)
- CCSDS Recommended Standard (Blue Book)

NOTE – Successful completion of a formal agency review always is required for a document on the Recommended Standard branch of the Normative Track in order to do the following:

- advance through each of the various issues of a Draft Recommended Standard;
- transition from CCSDS Draft Recommended Standard to CCSDS Recommended Standard.

6.1.3.6 The flow of documents on the Recommended Practice branch broadly parallels the Recommended Standard branch; i.e.,

- CCSDS Proposed Draft Recommended Practice (White Book);
- CCSDS Draft Recommended Practice (Red Book);
- CCSDS Recommended Practice (Magenta Book).

6.1.4 NON-NORMATIVE TRACK

The Non-Normative Track includes two specification categories:

- CCSDS Experimental (Orange Book);
- CCSDS Historical (Silver Book).

It also contains a more descriptive category:

- CCSDS Informational (Green Book).

Green Books also can support the Normative Track documents and may provide overview, rationale, analyses, and other descriptive or background materials.

6.1.5 ADMINISTRATIVE TRACK

The Administrative Track consists of the following:

- CCSDS Record (Yellow Book).

Yellow Books may be reports or meeting records, but they are also used for documenting CCSDS internal processes, procedures, and controlling guidelines and for documenting

interoperability test plans and reports. This document is a CCSDS Yellow Book and it is a controlling document describing CCSDS procedures.

An expanded discussion of CCSDS document types is contained in annex B.

6.2 PUBLICATION, DISTRIBUTION, AND MAINTENANCE

6.2.1 CMC APPROVAL

The CMC has sole authority for approving release of CCSDS documents for publication or formal review. Only CMC members may vote to approve publication.

6.2.2 NORMATIVE TRACK DOCUMENT DEVELOPER RESPONSIBILITIES

6.2.2.1 Drafting Requirements

6.2.2.1.1 Document developers shall prepare all documents that are on a track leading to formal agency review and/or publication in accordance with the requirements of the *CCSDS Publications Manual* (reference [1]).

6.2.2.1.2 All document developers are required to attend at least one session of the Technical Editing Boot Camp conducted in conjunction with the semi-annual CCSDS technical meetings.

6.2.2.2 Delivery Requirements

6.2.2.2.1 When WG consensus exists that a Proposed Draft Recommended Standard or Proposed Draft Recommended Practice is technically and editorially mature and ready for review by the CCSDS Agencies, the WG shall deliver the proposed draft to the WG's AD for technical review:

- a) If the AD determines that the document's technical content is not sufficiently mature to warrant CCSDS Agency review, the AD shall return the document to the WG for further development.
- b) If the AD agrees that the proposed draft is sufficiently mature in its technical content for CCSDS Agency review, the AD shall instruct the WG to forward the proposed draft to the CCSDS Chief Technical Editor and supply an Area resolution to the Secretariat requesting that the document be released for Agency review.

6.2.2.2.2 Upon receipt of the proposed draft from the WG, the CCSDS Chief Technical Editor shall verify that the document conforms to *CCSDS Publications Manual* (reference [1]) requirements:

- a) If the document does not conform to *CCSDS Publications Manual* requirements, the CCSDS Chief Technical Editor shall either

- 1) return the document to the WG to be brought into conformance; or
 - 2) edit the document to bring it into conformance.
- b) If the document conforms to *CCSDS Publications Manual* requirements, the CCSDS Chief Technical Editor shall initiate a CESG poll for formal CESG approval.

6.2.2.2.3 The CESG shall review the proposed draft and vote on whether it should be released for Agency review:

- a) If the CESG determines the document requires improvement prior to CCSDS Agency review, the CESG shall return the document to the WG for remediation:
 - 1) if the poll results in rejection, the WG must resubmit the document for a new CESG approval poll after responding to the reasons for rejection;
 - 2) if the poll results in conditional approval, the approval process may continue when the conditions have been satisfied.
- b) If the CESG approves the document for CCSDS Agency review, the Secretariat shall initiate a CMC poll for authorization to release the document for review.

6.2.2.2.4 The CMC shall vote on whether to authorize release of the document for agency review:

- a) if the poll concludes without authorizing release of the document,
 - 1) if the result is rejection, a new poll must be conducted when the reasons for rejection have been addressed;
 - 2) if the result is provisional authorization, the Secretariat shall initiate Agency review when the provisions have been satisfied;
- b) if the poll concludes with authorization for Agency review, the Secretariat shall initiate CCSDS Agency review (see 6.2.5).

NOTE – The procedure defined above is illustrated in figure 6-2.

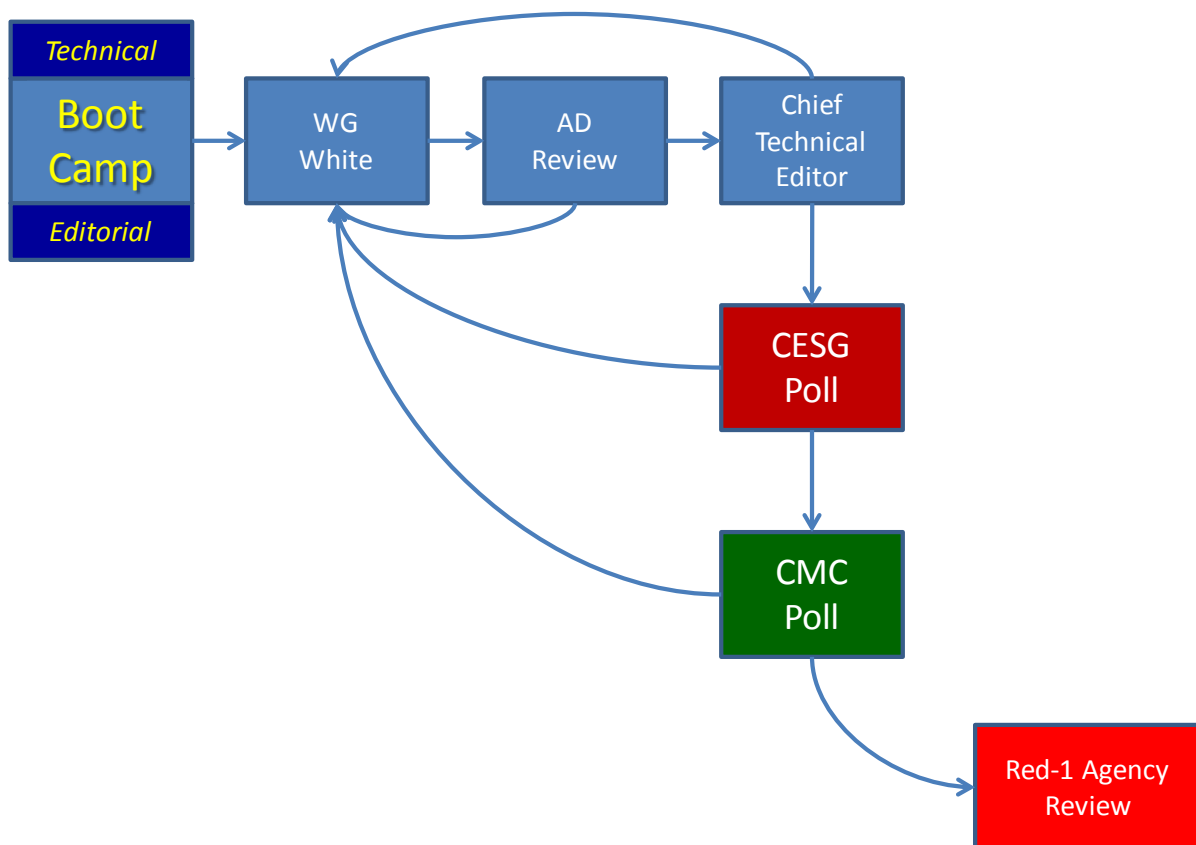


Figure 6-2: Initial Red Book Approval

6.2.3 NON-NORMATIVE TRACK DOCUMENT DEVELOPER RESPONSIBILITIES

6.2.3.1 Developers of non-normative documents intended for final publication shall deliver the WG-approved drafts to the WG's AD for approval.

6.2.3.2 If the AD deems the draft to be suitable for publication, the AD shall instruct the WG to forward the draft to the CCSDS Chief Technical Editor and provide an Area resolution to the Secretariat requesting that the document be published.

6.2.3.3 CCSDS Chief Technical Editor shall:

- a) assure that the document conforms to *CCSDS Publications Manual* requirements;
- b) initiate CESG and CMC polling for approval and authorization to publish the document;
- c) release the document for publication upon successful completion of polling.

6.2.4 SECRETARIAT RESPONSIBILITIES

6.2.4.1 The Secretariat shall be responsible for the publication, distribution, and maintenance of all documents authorized for publication by the CMC.

6.2.4.2 The Secretariat shall be responsible for initiation of all formal reviews and for distribution of review documents and review materials.

6.2.4.3 The Secretariat shall ensure that all documents released for publication or formal review shall conform to the requirements of the *CCSDS Publications Manual*.

6.2.4.4 The Secretariat shall maintain all documents released by the CMC:

- Published documents shall be maintained on the CCSDS Web site and periodically distributed on CD ROM or other mass-storage medium to permanent CCSDS organizational units.
- Documents released for formal agency review shall be maintained on the CCSDS Web site until superseded or withdrawn.

NOTE – Drafts that have completed formal review may undergo transition to historical status on the recommendation of the Area Director.

6.2.5 FORMAL AGENCY REVIEW

6.2.5.1 The schedule for the review shall normally allow 60 days from the time of the review commencement for Agencies to conduct review and return comments to the review coordinator:

- a) the length of the review period may be adjusted according to the size and complexity of the review document;
- b) constraints on the review period identified by the document developer shall be considered when determining the length of a review period, but providing adequate time for Agency review shall be the primary consideration.

6.2.5.2 Once review of a document has been authorized, that document may be reviewed more than once without additional polling of the CMC:

- a) if technical issues are identified in the course of a review, those issues must be resolved and the review must be repeated before approval can be sought for a change of document status;
- b) increasing draft issue numbers shall be assigned to successive versions of the draft document released in successive iterations of the review (see annex E);
- c) if substantive changes are made to a document that has completed review without technical comment, the Secretariat shall conduct a final review in which Agencies can approve or reject the document but may not suggest additional changes;

- d) the Secretariat shall follow the same procedures for posting review materials and review announcement for each iteration of a review.

6.2.5.3 To prevent a document from languishing in perpetual review, either the CMC or the CESC may terminate review of a document if progress toward satisfactory completion of the review is lacking:

- a) The CESC shall remain cognizant of the status of all documents that have been approved for review and have not completed the review process.
- b) Under normal circumstances, no more than four months should elapse between the end of one review and the beginning on the next.

6.2.5.4 Each CCSDS Agency shall be responsible for establishing local procedures for review of CCSDS documents.

6.2.6 REQUIREMENTS FOR FINALIZING A NORMATIVE TRACK DOCUMENT

The following criteria must be satisfied before a draft Normative Track document can be eligible for approval and release as a CCSDS Recommended Standard or Practice:

- a) the results of formal Agency review must be satisfactorily incorporated, following disposition of review comments to the satisfaction of the comment originators;
- b) for Recommended Standards, either
 - 1) at least two independent and interoperable prototypes or implementations must have been developed and demonstrated in an operationally relevant environment, either real or simulated:
 - the WG Chair is responsible for documenting the specific implementations that qualify the specification for CCSDS Recommended Standard status, along with reports relevant to their testing;
 - if patented or otherwise controlled technology is required for the separate implementations, they each must also have resulted from separate exercise of the licensing process, and it must be demonstrated by the WG Chair that the licensing process and fees are reasonable and non-discriminatory;
 - in cases in which one or more options or features have not been demonstrated in at least two interoperable prototypes or implementations, the specification may advance to the CCSDS Recommended Standard level only if those options or features are removed;
 - each Recommended Standard defining a protocol shall contain, as a normative annex, a Protocol Implementation Conformance Statement (PICS) proforma that provides a statement of what conformance to the specification means or a statement explaining why one is not included;

- the documentation of qualifying implementations must include specific statements about the ability to support each of the individual options and features. The documentation of qualifying protocol implementations may be done by creating a filled out PICS to document which of the mandatory and optional features have been implemented and if there are any deviations or gaps; or
- 2) the WG Chair formally requests and obtains approval of the CESG to have the implementation requirement waived:
 - request for waiver and CESG approval should occur at the time of the WG's formation, or early in the WG development phase, and not at the end of formal Agency review;
 - the request for waiver must provide rationale for waiving the requirement.

When these criteria have been met, the CESG shall ask the CMC to authorize publication of the Draft Recommended Standard as a CCSDS Recommended Standard.

NOTE – Authorization of publication marks the transition in status from Draft Recommended Standard to Recommended Standard.

6.3 DOCUMENT IDENTIFICATION

6.3.1 DOCUMENT NUMBERING SYSTEM

CCSDS documents shall be numbered in accordance with the following system:

CCSDS PXX.V-C-I.r

where

P is a single character identifier designating a specific topic area (see annex E for current P assignments).

XX is a double character identifier designating a related major subtopic.

EXCEPTION – The designation P00 is reserved in every instance for an Overview type Informational Report that describes in some detail the considerations that characterize the topic area.

V is a single character identifier designating a related minor subtopic.

C is a single character corresponding to the type of the document. It must be one of characters listed in table 6-1.

I is an integer designating the issue number of the document.

- r** is a CCSDS-internal control mechanism for tracking document revisions that occur between issue numbers. Here, as applied to the iterative process of finalizing a document under review, the ‘r’ is incremented for successive versions.

An example of this numbering system is shown in annex E.

Table 6-1: ‘C’ Designations for Document Type

| Character | Mnemonic | Document Type |
|-----------|---------------------------------|--|
| W | White Book | Proposed Draft Recommended Standard |
| R | Red Book | Draft Recommended Standard or Practice |
| B | Blue Book | Recommended Standard |
| G | Green Book | Informational Report |
| Y | Yellow Book | Record (administrative or meeting report) |
| P | Pink Sheets <i>or</i> Pink Book | Draft revised Recommended Standard or Recommended Practice |
| M | Magenta Book | Recommended Practice |
| O | Orange Book | Experimental specification |
| S | Silver Book | Document having Historical status |

6.3.2 DOCUMENT NUMBER ASSIGNMENT

The Secretariat maintains a database of all assigned document numbers. To maintain continuity and avoid duplication, Area Directors should request a number assignment from the Secretariat whenever a number is needed for a new document. The request ensures that a unique number is assigned and that the number is recorded in the Secretariat database.

Some Areas may “own” a block of numbers for a given topic and may assign numbers from within that block to new documents according to an Area-internal classification system. In such cases the AD is responsible for ensuring system integrity and for informing the Secretariat of new number assignments.

6.3.3 IDENTIFICATION OF EXTERNAL STANDARDS

The document identification of any externally developed standard that has been incorporated into the CCSDS suite of Recommended Standards shall retain that identification assigned by the originating organization.

6.4 SPECIAL STATUS DESIGNATIONS

6.4.1 MODIFICATION PROHIBITION

Under some circumstances the CMC may explicitly prohibit modification of a document. For example, a Draft Recommended Standard that has successfully completed formal review

may require additional testing before it can be formally approved as a CCSDS Recommended Standard. In such a case, the CMC shall declare the document to be “frozen” in its current state until all testing activities are concluded. The CMC may similarly prohibit further updates to a published Recommended Standard, for example, when a Recommended Standard is expected to be superseded or retired in the future but continues to be valid in the near term.

6.4.2 OTHER SPECIAL DESIGNATIONS

The CMC has the discretion to apply special designations to documents in response to unforeseen circumstances. For example, the CMC may choose to include a dedication in a document after it has completed development.

6.4.3 DENOTATION OF SPECIAL DESIGNATIONS

Procedures for denoting special designations in the documents to which they are applied are defined in the *CCSDS Publications Manual*.

ANNEX A

CCSDS ARCHITECTURE PRINCIPLES

A1 OVERVIEW

This annex provides explanation of the CCSDS Architecture Principles. These follow The Open Group Architecture Framework (TOGAF) recommended approach of providing a name, clear statement of intent, rationale and business benefits, and implications.

A2 DEVELOP LEADING STANDARDS

Statement: Develop Leading Standards to Meet Aggregate Future Multi-Mission Requirements

Rationale: International standards must be focused to solve specific problems, yet must meet a broad range of needs from a variety of different missions. They must be future-looking in order to meet aggregate mission requirements and operational models that may not yet be clearly articulated.

Implications: Standards cannot be based upon requirements from a single mission or even necessarily a set of related missions. Because it takes time to develop standards, due consideration must be given to both near-term (3-5 years) and long-term (5-10 years) planning horizons. Some new missions and operational environments may require new approaches that break with the past (interdependent systems, relaying data, space internetworking) so infusion and evolution of systems must be carefully considered. See related Interoperability Principle.

A3 PROVIDE CROSS SUPPORT

Statement: Provide Cross Support Capabilities Among Different Organizations

Rationale: A primary motivation for standardization is to permit expensive ground and space assets to be shared and re-used among different agencies and different organizations within an agency. This enables cost savings, provides risk reduction, and allows operations of interdependent missions (one agency's ground station communicates with another's spacecraft, one agency's orbiter relays data from another's lander).

Implications: Cross support requires one agency or organization to depend upon assets owned by another. Sometimes this is seen as a riskier approach than having one organization own all the assets it needs. However, there may be significant cost savings from this approach. Defining cross-support interfaces, whether in space or on the ground, requires careful identification of natural interface boundaries (see related Modular Boundary Principle).

A4 MINIMIZE DISRUPTIONS

Statement: Minimize Disruptions to Existing Standards and Installed Systems

Rationale: Standards are typically developed using a layered approach that associates well-defined functionality with each layer or set of elements. Standards developed in a suite are intended to operate together in specific ways, and care must be taken to not disrupt the agreed architecture unless it is essential to do so driven by new requirements. As agencies develop and evolve infrastructure that uses these standards, major investments are made that are typically expected to have lifetimes measured in decades.

Implications: It will usually be the case that it is preferable to build upon the existing, well-tested, and well-documented set of standards rather than adopting some new, potentially disruptive, technology or approach. However, there will also be situations where unforecasted mission requirements or operating modes will mandate consideration of otherwise disruptive approaches. It is essential to balance the benefits against the costs and risks and to seek means to keep disruptions to a minimum.

A5 ADOPT, ADAPT, DEVELOP

Statement: Adopt, Adapt, Develop (i.e., only develop new standards when necessary)

Rationale: First, Adopt whenever possible; Second, Adapt only when it is not possible to Adopt; Third, Develop only when it is not possible to Adopt or Adapt. It is frequently the case that existing terrestrial standards and protocols can be adopted to meet the needs of space data systems, or that they may be adapted by some straightforward means. It is preferable that such approaches should be explored before embarking on the development of a new, space-domain-specific standard. Examples of adoption include XML schema & Reed-Solomon coding, of adaptation include space links (derived from HDLC), space internetworking (adapted from TCP/IP), and examples of development include Proximity-1 (unique characteristics of in-situ communications) and SLE (space agency link level cross support).

Implications: Using adoption or adaptation is a cost and risk reduction technique that has frequently yielded good results. Sometimes this approach requires adaptation to enable smooth integration with the rest of the suite, or to support characteristics essential to space operation. These techniques do require a continuing survey of other technologies and careful analysis for applicability. When it appears necessary to develop new standards they will often be informed by and benefit from this prior study effort.

A6 USE FREELY AVAILABLE TECHNOLOGY

Statement: Define Standards Using Unpatented or Royalty Free, Internationally Available, Free Technology Independent of Specific Agency or Vendor

Rationale: International standards must be able to be implemented by any of the member or observer agencies and their associates. If patented or agency specific technologies are identified as superior approaches they should only be adopted if licenses permitting free and unfettered use can be secured. Commercial or fee-based licensing limits the possibilities of adoption and is counter to good standards practice in an open, consensus based, organization. If it is not possible to secure royalty-free licenses, the technology must as a minimum be Reasonable And Non-Discriminatory (RAND) for all users worldwide.

Implications: There may be instances where commercial technologies have significant technical advantages over what is freely available. In many cases it has been possible to work with the patent holder to permit open use in civilian, non-commercial, space settings. In other cases it may be possible, without infringing upon the patents, to independently develop similar approaches that are better suited for use in space. This has a higher cost to develop the standard, but has the overall effect of reducing the costs to all participants. This must be balanced against the Adopt, Adapt, Develop Principle.

A7 ADOPT NATURAL, MODULAR BOUNDARIES

Statement: Define Interfaces at Natural Boundaries, Adopt Modularity and Loose Coupling, Reduce Integration Complexity

Rationale: This is a general principle in programming that can usefully be promoted to the level of subsystems, systems, and systems of systems. To facilitate re-use, adaptation to specific deployments, and integration careful attention should be paid to the identification of interfaces and layering. This is especially the case where interfaces are being defined for cross support between agencies or interdependent systems.

Implications: The ultimate in efficiency and integration often is in conflict with adoption of high levels of modularity. This is often particularly the case within subsystems, where it is less of a concern and more easily justified. Were such approaches to be used in the identification of standard interfaces and protocols, they would limit the level of possible re-use and make infusion a far more complex process.

A8 INTEROPERABILITY IS ESSENTIAL

Statement: Interoperability is Essential and Must Be Demonstrated, Use Testing for Early Standards Validation and Defect Elimination

Rationale: One of the key capabilities that standards confer is the ability of systems elements developed by one organization to integrate and operate successfully with elements developed by a different organization. This interoperability may occur at many different

levels, from the physical to the logical. It is essential that interoperability be demonstrated by having at least two independently implemented instances of the standard. This is key to ensuring that the standards can be correctly interpreted (see Simplicity and Clarity Principle) and that they operate as expected.

Implications: Standards development and validation processes must include adequate time and resources to carry out this part of the task. It is essential to ensuring that the standard can adequately describe the desired functionality and that any new implementations will be able to be validated for correct behavior. In some cases it may be necessary to have two separate implementations made by one organization, but in general there should be two different organizations involved in this process, which may be waived for experimental specifications.

A9 SEEK SCALABILITY AND EXTENSIBILITY

Statement: Seek Scalability and Extensibility Across Different Deployments (single mission / interdependent missions, near Earth / in Situ, Deep Space, low cost / flagship, robotic / manned)

Rationale: Standards must satisfy a broad range of mission operational needs. Designs that are too narrowly focused upon a single mission or operating point may neglect to consider related environments that could well be served by a broader standard. Where possible the standard should include adequate options and configuration parameters to permit its ready adaptation to multiple related mission uses. Standards can also be defined too broadly, or with too much complexity, and not be adopted as a result. Consider this principle in conjunction with the Simplicity and Modularity Principles.

Implications: In many cases it is possible to define a single, well-layered standard that can meet an adequately broad set of deployments while retaining simplicity. In other cases it may be necessary to develop standards that address a particular niche, such as in situ vs. “long haul” standards. Both must deal with disconnection, but the differences in operating environment, signal strength, and communications delays, mandate differing characteristics, often at many layers of the communications stack.

A10 STRIVE FOR SIMPLICITY AND CLARITY

Statement: Strive for Simplicity and Clarity in Design and Documentation

Rationale: This is often stated as “keep it simple,” but Einstein said it best: “Things should be as simple as possible, but no simpler.” Simplicity and clarity are the hallmarks of good design. Especially in the development of standards where the expectation is that any standard specification must be able to be correctly interpreted by a number of different organizations. Consider this in conjunction with the Cross Support, Modularity, and Interoperability Principles.

Implications: It must be expected that standards specifications will take longer to develop, and will undergo more scrutiny, than other technical documents. They must be reviewed by members of the WG, by agency experts, and by external organizations. The agreed process involves a number of different stages and review gates all intended to ensure that this principle (and others) are met. This does, however, have the consequence of requiring more time and resources than a point design might consume, with the benefit of improved functionality, reuse, and reduced risk.

A11 USE COMMON VOCABULARY AND DEFINITIONS

Statement: Develop and Utilize Common Vocabulary and Data Definitions

Rationale: To ensure that complex concepts and specifications are readily understood, it is essential to identify and utilize an agreed set of terms and data definitions. A similar consideration applies to the unambiguous exchange of mission, science, operational data, and even designs. Failure to adequately address this principle can result in faulty communications.

Implications: It will often be apparent that current systems, standards, or practices would be incongruent with the principle upon adoption. The impact to the business and consequences of adopting a principle should be clearly stated. Some of the implications will be identified as potential impacts only, and may be speculative rather than fully analyzed.

ANNEX B

EXPANDED DISCUSSION OF CCSDS DOCUMENT TYPES

B1 CCSDS CONCEPT PAPER

Every final CCSDS Recommended Practice or Recommended Standard starts out as a CCSDS concept paper. Not all CCSDS concept papers, though, end up as CCSDS Recommended Practices or Recommended Standards.

A CCSDS concept paper is not archived and it has a lifetime of only nine months, after which time it has no further significance. Anyone (from any organization and not necessarily already affiliated with CCSDS) can write a CCSDS concept paper at any time, and it is generally used as the “talking paper” to get work started. All that is necessary is to observe some basic formatting rules that are established by the Secretariat in the *CCSDS Publications Manual* (reference [1]) and to submit it to the Secretariat for publication. The Secretariat will then assign the concept paper a reference number and a date of expiration, will place it in an accessible part of the CCSDS Web site, and will announce its availability to an interested mailing list. The announcement will contain a short summary of the concept paper’s subject to solicit interest. This announcement often can be the basis for the subsequent formation of a BOF.

If a CCSDS concept paper has been processed by a BOF as part of its work in developing a WG charter, it must be updated as necessary (so that it has active status), and it must be submitted to the CESG as part of the WG approval process. If accepted as a work item by the CESG, the concept paper becomes the primary initial working document of the WG, and its subsequent development will be assigned by the CESG to the Normative Track, to the Non-Normative Track, or to the Administrative Track.

B2 CCSDS NORMATIVE TRACK

B2.1 GENERAL

Normative Track documents are those that are intended to directly influence and enhance the international installed base of CCSDS-compatible space-mission support infrastructure. Generally, they are developed in response to a direct mission or operational need (a “hard requirement”) that has been identified via the CMC Customer Interface function and approved by a customer group (such as the IOAG). To enter the Normative Track, the WG charter must demonstrate to an Area Director that the work has broad support across the CCSDS community, normally by showing that multiple agencies or other organizations are willing to participate in the development.

Normative Track specifications normally must not depend on other Normative Track specifications that are at a lower maturity level, or on Non-Normative Track specifications other than referenced specifications from other standards bodies. The CESG makes

recommendations concerning which work items should enter the Normative Track when chartering a WG, and the CMC must approve those recommendations prior to the initiation of work.

The Normative Track has two distinct branches:

a) Recommended Standards

CCSDS Recommended Standards (Blue Books) define specific interfaces, technical capabilities, or protocols, or provide prescriptive and/or normative definitions of interfaces, protocols, or other controlling standards such as encoding approaches. Recommended Standards must be complete, unambiguous and at a sufficient level of technical detail that they can be directly implemented and used for space-mission interoperability and cross support. Recommended Standards must say very clearly, “These are the technical properties of what the implementer must build and how it must behave if it is to be compliant and interoperable.” Blue Books may be of three different types:

- 1) CCSDS Recommended Standard (a document that internally contains a native specification developed by CCSDS);
- 2) CCSDS Recommended Standard: Adaptation Profile (a document that adopts/adapts a native specification developed somewhere else, such as by another standards organization);
- 3) CCSDS Recommended Standard: Utilization Profile (a document that specifies how to use one or more existing CCSDS Blue Books or other normative standards to perform a particular function).

Blue Books defining communications protocols must include a Protocol Implementation Conformance Statement (PICS) proforma as a normative annex. (See annex F for details about the structure, content, and an example of the PICS proforma.)

b) Recommended Practices

CCSDS Recommended Practices (Magenta Books) are the consensus results of CCSDS community deliberations and provide a way to capture “best” or “state-of-the-art” approaches for applying or using standards or for documenting reference architectures and other formal specifications. Magenta Books may document guidelines for standardized processes or procedures for accomplishing tasks. They may document reference models or reference architectures to assist in the design, use, description, or selection of one or more standards. Practices say, “Here is how the community recommends that one should carry out or describe this particular kind of operation at present, or how the community recommends that it should be carried out in the future.”

NOTE – While CCSDS Recommended Standards are usually concerned with the technical specifications for hardware and software components required for computer communication, interoperability, and cross support among interconnected space-mission assets, a Recommended Practice typically cannot be directly implemented to develop interoperable system components.

Another use of a Recommended Practice might be to document how the world space-mission infrastructure is composed of networks operated by a great variety of organizations with diverse goals and rules, and that good user service requires that the operators and administrators of these networks follow some common guidelines for policies and operations. While these guidelines are generally different in scope and style from protocol standards, their establishment needs a similar process for consensus building. The Recommended Practice branch of the Normative Track creates a smoothly structured way for these entities to insert proposals into the consensus-building machinery of the CCSDS while gauging the community's view of that issue.

B2.2 RECOMMENDED STANDARD BRANCH

Documents on the Recommended Standard branch of the Normative Track are as follows:

a) CCSDS Proposed Draft Recommended Standard (White Book)

The entry-level maturity for a document on the Normative Track that is targeted toward being a Recommended Standard is “Proposed Draft Recommended Standard.” An explicit CESG approval action is required to move a concept paper onto the Normative Track at the “Proposed Draft Recommended Standard” level. Prior to that approval, even though a WG has been chartered, its documents remain at the concept paper stage.

A Proposed Draft Recommended Standard specification represents a convergence of concepts via a process of WG consensus, has resolved the major design choices, is believed to be pursuing a well-understood sequence of development, has received limited peer review, and appears to enjoy enough community interest to be considered valuable. However, further experience might result in a change or even retraction of the specification before it advances. Because the content of a Proposed Draft Recommended Standard may be changed as it progresses if problems are found or better solutions are identified, deploying implementations of such standards into a disruption-sensitive environment is not recommended.

A Proposed Draft Recommended Standard should have no known technical omissions with respect to the requirements placed upon it. However, this requirement may be waived by the CESG to allow a specification to advance to the Proposed Draft Recommended Standard state when it is considered to be useful and necessary (and timely) even with known technical omissions. Implementers should treat Proposed Draft Recommended Standards as immature specifications, suitable for prototyping but not for operational use.

Usually, neither implementation nor operational experience is required for the initial re-designation of a concept paper as a Proposed Draft Recommended Standard. However, such experience is highly desirable and usually will represent a strong argument in favor of granting it a Proposed Draft Recommended Standard status.

A Proposed Draft Recommended Standard will have a formal CCSDS number assigned that indicates its draft status and will generally go through several versions during which it will progressively become more mature. Every iteration or “issue” must clearly state the status of the specification and must indicate the risks associated with implementing it in its current state. As they progress, it is desirable to prototype Proposed Draft Recommended Standards in some kind of test system to gain experience and to validate and clarify the specification. Such a prototype should exercise critical elements of the specification in an operationally relevant environment, either real or simulated.

NOTE – The CESG may require prototyping and/or operational experience before granting Proposed Draft Recommended Standard status to a specification that materially affects the core CCSDS interoperability protocols or that specifies behavior that may have significant operational impact on the installed base of international mission-support infrastructure.

b) CCSDS Draft Recommended Standard (Red Book)

Elevation to Draft Recommended Standard is a major advance in status, indicating a strong belief that the specification is mature and will be useful. An explicit CESG and CMC approval action is required to move a Proposed Draft Recommended Standard to the Draft Recommended Standard level. A Draft Recommended Standard must be well understood and known to be quite stable, both in its semantics and as a basis for developing an implementation. It will generally go through several issues, during which time it will progressively become more mature. Every time that an issue of a Draft Recommended Standard is published, it automatically triggers a formal agency review and the results of that review must be satisfactorily incorporated before a new issue can be published. Because formal agency reviews consume resources, a review budget must be agreed upon by the CESG and the CMC before publishing the first issue of a Draft Recommended Standard; this budget identifies how many review cycles can be consumed without reauthorization by the CMC. Each separate issue must clearly state the status of the specification and must indicate the risks associated with implementing it in its current state.

At some point in the evolution of a Draft Recommended Standard that is intended to result in a change to mission-support infrastructure, at least one hardware or software prototype (or other implementation) must exist that demonstrates and exercises all of the options and features of the specification in an operationally relevant environment, either real or simulated. This point may be issue-1, or it may be a later issue depending on circumstances, but for most documents the implementation must exist prior to issuing a final Draft Recommended Standard.

The purpose for doing a prototype implementation is two-fold:

- To verify that the specification is sufficiently clear and unambiguous that it can be correctly interpreted and implemented.
- To demonstrate that the specification has all of the features and functionality that are required and that it works correctly in the intended operational environment.

The WG chair is responsible for documenting the specific implementation(s) that qualify the specification, along with detailed, feature-by-feature reports relevant to their testing or for justifying why such implementation is either inappropriate or should otherwise be waived. The documentation of the qualifying implementation must include clear statements, preferably in the form of a filled out PICS proforma (when present), describing the implementation's ability to support each of the individual options and features. If patented or otherwise controlled technology is required for the implementation, it must be demonstrated that the licensing process and fees are reasonable and non-discriminatory. The draft document shall contain, in the Preface, a statement requesting disclosure of any possible patent that might infringe on the standard, as follows:

“Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.”

In its final stages of issue, a Draft Recommended Standard normally is considered to be a final specification, and changes are likely to be made only to solve specific problems encountered. In most circumstances, it is fairly safe for users to deploy implementations of the final issue of a Draft Recommended Standard into a disruption sensitive operational environment.

c) CCSDS Recommended Standard (Blue Book)

Generally, only a specification for which significant implementation experience has been obtained may be elevated to the CCSDS Recommended Standard level. A CCSDS Recommended Standard is characterized by a high degree of technical maturity and by a generally held belief that the specified protocol or service provides significant benefit to the international space-mission community.

Converting a CCSDS Draft Recommended Standard to a CCSDS Recommended Standard always is preceded by a successful final, formal agency review. With a few exceptions (for which waivers must be sought), conversion of a Draft Recommended Standard to a Recommended Standard also requires that at least two independent and interoperable prototypes or implementations must have been developed and demonstrated in an operationally relevant environment, either real or simulated. In cases in which one or more options or features have not been demonstrated in at least two independently developed interoperable prototypes or implementations, the specification may advance to the CCSDS Recommended Standard level only if those options or features are removed. The WG chair is responsible for documenting the specific implementations that qualify the specification for CCSDS Recommended

Standard status, along with Yellow Book reports relevant to their testing, or for justifying why such implementation is either inappropriate or should otherwise be waived.

The Yellow Book documenting qualifying implementations and validation testing must include specific statements, preferably in the form of a filled out PICS proforma (when present), about the implementations' ability to support each of the individual options and features. If patented or otherwise controlled technology is required for the implementation, it must be demonstrated that the licensing process and fees are reasonable and non-discriminatory. The published document shall contain one of the two following patent statements, as appropriate:

- A published document for which no patent rights are identified during the preparation thereof, shall contain the following notice in the Foreword:

“Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CCSDS shall not be held responsible for identifying any or all such patent rights.”

- A published document for which patent rights have been identified during the preparation thereof, shall include the following notice in the Introduction:

“The Consultative Committee on Space Data Systems (CCSDS) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning {subject matter} given in {subsection}.

The CCSDS takes no position concerning the evidence, validity, and scope of these patent rights.

The holders of these patent rights have assured the CCSDS that they are willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with CCSDS. Information can be obtained from the CCSDS Secretariat at the address indicated on page i. Contact information for the holders of these patent rights is provided in annex {Security, SANA, and Patent Considerations}.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. The CCSDS shall not be held responsible for identifying any or all such patent rights.”

Based on operational experience, Recommended Standards may themselves go through several issues during their lifetime, as new features or enhanced capabilities are added. Every issue must clearly state the status of the specification and must indicate the risks associated with implementing it in its current state.

The procedure for changing a CCSDS Recommended Standard is that the updates must be circulated back through the CCSDS Draft Recommended Standard phase; this is known as the CCSDS Pink Sheet process.

A CCSDS Recommended Standard must undergo reconfirmation review within the Area three years after issue and every five years subsequently. Reconfirmation review shall result in reconfirmation, revision, or retirement to CCSDS historical status.

d) Draft Recommended Standard Revision (Pink Book or Pink Sheets)

Revisions of Recommended Standards follow a path parallel to the White Book-Red Book process described above. Proposed revisions are iterated as White Books (or White Pages) within a WG until consensus is achieved, at which time they are submitted for approval to be released for agency review as Draft Recommended Standards. Draft revisions are designated “Pink” rather than “Red” (cf. table 6-1).

Pink Books are issued when changes to an existing Blue Book are extensive enough to warrant review of the entire document; Pink Sheets (changed pages only) are issued otherwise. In the case of Pink Sheets, only changes to the current issue of the Blue Book are subject to review.

B2.3 RECOMMENDED PRACTICE BRANCH

Documents on the Recommended Practice branch of the Normative Track are as follows:

a) CCSDS Proposed Draft Recommended Practice (White Book)

The entry-level maturity for a document on the Normative Track that is targeted toward being a Recommended Practice is “Proposed Draft Recommended Practice.” An explicit CESG and CMC approval action is required to move a concept paper onto the Normative Track at the Proposed Draft Recommended Practice level. Prior to that approval, even though a WG has been chartered, its documents remain at the concept paper stage. A Proposed Draft Recommended Practice represents a convergence of concepts via a process of WG consensus, has resolved the major choices, is believed to be pursuing a well-understood sequence of development, has received limited peer review, and appears to enjoy enough community interest to be considered valuable. However, implementers should treat Proposed Draft Recommended Practices as immature guidance.

A Proposed Draft Recommended Practice generally will go through several WG-internal issues, during which it will progressively become more mature, until the WG chair is ready to propose its advancement to the next stage via a request transmitted to the CESG by the Area Director. Usually, neither implementation nor operational experience is required for the initial re-designation of a Proposed Draft Recommended Practice as a Draft Recommended Practice. However, such experience is highly desirable, and will usually represent a strong argument in favor of progressing it forward. The WG chair is responsible for documenting the history of

the Proposed Draft Recommended Practice and for indicating why it is thought to be ready for advancement.

b) CCSDS Draft Recommended Practice (Red Book)

Elevation to Draft Recommended Practice is a major advance in status, indicating a strong belief that the document is mature and will be useful. A Draft Recommended Practice must be well understood and known to be quite stable, both in its semantics and as a basis for guiding an implementation. The CESG will look for evidence of this maturity before granting Draft Recommended Practice status. Draft Recommended Practices must undergo formal CCSDS agency review. Review procedures for Draft Recommended Practices parallel those for Draft Recommended Standards.

c) CCSDS Recommended Practice (Magenta Book)

Converting a CCSDS Draft Recommended Practice to a CCSDS Recommended Practice is always preceded by a successful formal agency review. A CCSDS Recommended Practice is characterized by a high degree of maturity and by a generally held belief that the specified activity provides significant benefit to the international space-mission community.

Based on operational experience, Recommended Practices may themselves go through several issues during their lifetime as new features or enhanced capabilities are added. Every issue must clearly state the status of the specification and must indicate the risks associated with implementing it in its current state. The procedure for changing a CCSDS Recommended Practice is that the updates must be circulated back through the CCSDS Draft Recommended Practice phase; this is known as the CCSDS Pink Sheet process.

A CCSDS Recommended Practice must undergo reconfirmation review within the Area three years after issue and every five years subsequently. Reconfirmation review shall result in reconfirmation, revision, or retirement to CCSDS historical status.

d) Draft Recommended Practice Revision (Pink Book or Pink Sheets)

Revisions of Recommended Practices follow a path parallel to the White Book-Red Book process described above. Proposed revisions are iterated as White Books (or White Pages) within a WG until consensus is achieved, at which time they are submitted for approval to be released for agency review as Draft Recommended Practices. Draft revisions are designated “Pink” rather than “Red” (cf. table 6-1).

Pink Books are issued when changes to an existing Magenta Book are extensive enough to warrant review of the entire document; Pink Sheets (changed pages only) are issued otherwise. In the case of Pink Sheets, only changes to the current issue of the Magenta Book are subject to review.

B2.4 A NOTE ON REFERENCE IMPLEMENTATIONS

The standardization procedures that have been defined greatly increase the significance and value of producing prototypes and implementations as requirements to progress along the document track. It is recognized that implementing a major complicated standard may be a significant piece of work and therefore developing “reference implementations” that can be shared is highly desirable. Making reference implementations available to prospective designers of operational systems can offer them cost- and risk-reduction advantages and can help in the testing of their fielded implementations.

While there is no requirement to do so, WGs and the agencies that support them are strongly encouraged to make available open-source or no-fee licenses of their validated prototype codes, as reference implementations. These may form a basis for other implementations, but at the least will provide a validation suite against which other implementations may be tested. Another approach that has proven useful in some circumstances is to offer a Web site that provides access to a validated implementation of a standard. The CCSDS Secretariat will provide a list of these on the public CCSDS Web site.

B2.5 SECURITY

All Normative Track documents shall include a mandatory section that addresses security issues. The Security Working Group is available for consultation in the development of this section.

B3 CCSDS NON-NORMATIVE TRACK

B3.1 GENERAL

Not every specification will be on the Normative Track. A specification may not be intended to be a CCSDS Recommended Standard or Recommended Practice, or it may be intended for eventual standardization but may not yet be ready to enter the Normative Track because a hard requirement does not currently exist for its use by the mission or mission-support infrastructure communities. Alternatively, an in-use specification may have been superseded by a more recent CCSDS Recommended Standard, or may have otherwise fallen into disuse or disfavor and needs to be retired. The CESG decides which work items should be on the Non-Normative Track and the CMC must approve those recommendations prior to their initiation. Specifications that are on the Non-Normative Track are labeled with one of three “off-track” levels, and documents bearing these labels are not CCSDS standards in any sense:

- Experimental;
- Informational;
- Historical.

B3.2 CCSDS EXPERIMENTAL (ORANGE BOOK)

The “experimental” designation typically denotes a specification that is part of some research or development effort. Its funding and other associated resources are normally independently provided by the organization that initiates the work, and so the CCSDS role is limited to one of periodic review of the work and approval for publication. Experimental work may be based on soft or “prospective” requirements; i.e., it may be looking into the future and may intend to demonstrate technical feasibility in anticipation of a hard requirement that has not yet emerged. This designation therefore allows the work to progress roughly to the equivalent technical status of a Draft Recommended Standard without being actually on the Normative Track and therefore consuming large amounts of CCSDS resources. Experimental work may be rapidly transferred onto the Normative Track if a hard requirement emerges, thus shortening the response time in satisfying the new customer.

Experimental specifications start out as concept papers in BOFs, and a WG must be specifically chartered by the CESG and CMC before it may in any way become part of the CCSDS program of work. However (unlike Normative Track documents) it is not necessary to demonstrate broad support across the CCSDS community before a WG to produce an Experimental Specification is approved; one organization could volunteer to perform experimental work independently, provided that the Area Director is convinced that it is a positive contribution toward the work of CCSDS and that sufficient resources exist to produce a meaningful result. Demonstration of the work being a “positive contribution” is most important; a WG will not be allowed to form unless it has demonstrated that the proposed experimental work is architecturally relevant to CCSDS and will not be disruptive to the installed base if eventually implemented.

An experimental specification will generally go through several draft issues, during which it will progressively become more mature. The WG chair will decide when to publish draft issues. Every draft issue must clearly state the experimental status of the specification and must indicate the risks associated with implementing it in its current state.

At such time as the WG has completed the development, the WG chair may petition the CESG via the Area Director to publish the final document as a CCSDS Experimental Report. As a general rule, prior to publication at least one hardware or software prototype (or other implementation) must exist that demonstrates and exercises all of the options and features of the specification in an operationally relevant environment, either real or simulated. The WG chair is responsible for documenting the specific implementation(s) that qualify the specification for CCSDS experimental status, along with Yellow Book test reports relevant to their testing or for justifying why such implementation is either inappropriate or should otherwise be waived. The documentation of the qualifying implementation must include clear statements about its ability to support each of the individual options and features. If patented or otherwise controlled technology is required for the implementation, it must be demonstrated that the licensing process and fees are reasonable and non-discriminatory.

The published document shall contain one of the two following patent statements, as appropriate:

- A published document for which no patent rights are identified during the preparation thereof, shall contain the following notice in the Foreword:

“Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CCSDS shall not be held responsible for identifying any or all such patent rights.”

- A published document for which patent rights have been identified during the preparation thereof, shall include the following notice in the introduction:

“The Consultative Committee on Space Data Systems (CCSDS) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning {subject matter} given in {subsection}.

The CCSDS takes no position concerning the evidence, validity, and scope of these patent rights.

The holders of these patent rights have assured the CCSDS that they are willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with CCSDS. Information can be obtained from the CCSDS Secretariat at the address indicated on page i. Contact information for the holders of these patent rights is provided in annex {[Security, SANA, and]Patent Considerations}.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. The CCSDS shall not be held responsible for identifying any or all such patent rights.”

Generally, there is no requirement for a formal agency review prior to publishing a CCSDS experimental specification.

B3.3 CCSDS INFORMATIONAL (GREEN BOOK)

The “informational” document designation is intended to provide for the timely publication of a very broad range of general information for the CCSDS community. Informational documents are often published in support of an experimental specification, a Draft Recommended Standard, or a Recommended Standard. They may therefore contain overview or descriptive material, supporting analysis, requirements, descriptions of use, scenarios, etc., which are otherwise inappropriate for the contents of a normative technical specification.

An informational document will generally go through several “draft issues,” during which time it will progressively become more mature. The WG chair is responsible for deciding when to publish each of the draft issues. At such time as the WG has completed its development, the WG chair may petition the CESG via the Area Director to publish the final document as a CCSDS Informational Report. Approval normally will be subject to only editorial considerations and to verification that there has been adequate coordination with the

standards process. There is no requirement for a formal agency review prior to publishing a CCSDS informational document.

B3.4 CCSDS HISTORICAL (SILVER BOOK)

The CCSDS “historical” designation is reserved for any approved CCSDS document that has been superseded by a more recent version or is for any other reason considered to be obsolete. More often than not, a CCSDS historical document will be a CCSDS Recommended Standard that has come to the end of its useful operational life and no longer controls a committed deployment of international CCSDS-compatible mission-support infrastructure. However, it can also be used to archive various stages of a CCSDS Draft Recommended Standard or other document if there is a strong need to preserve key information or concepts. An Area Director makes the determination as to which documents transition to CCSDS historical status; the CESG and the CMC must approve this recommendation, but there is no requirement for a formal agency review.

B4 CCSDS ADMINISTRATIVE TRACK

The Administrative Track includes all CCSDS administrative documents such as CCSDS charters, procedures, processes, and meeting minutes. They are given the designation of “CCSDS Record” (Yellow Book).

Yellow Books shall be used to document the test plans and test reports produced in support of CCSDS Blue Book and Orange Book interoperability testing. Yellow Books may also be used to document CCSDS internal processes, procedures, and controlling guidelines. This document is itself a CCSDS Yellow Book, and it is a controlling document describing CCSDS procedures. Any CCSDS Yellow Book that is normative upon CCSDS itself requires CESG review and CMC approval.

ANNEX C

DOCUMENT TYPE CONTENT EXAMPLES

C1 OVERVIEW

This annex provides some examples of typical document content abstracted from existing CCSDS documents. These examples are non-normative, but are provided as guidance.

C2 TYPICAL BLUE BOOK EXAMPLES

Proximity-1 Space Link Protocol—Data Link Layer, CCSDS 211.0-B-4

Layered model protocol architecture, Protocol Data Units (PDUs), data link layer, timing and data services, operations, and I/O sub-layer

Normative PDU data structures, transfer frames, and field definitions, formal control and data transport and behavior specifications, state table specifications of protocol behavior, abstract required service spec for I/O sub-layer

Space Link Extension—Forward CLTU Service Specification, CCSDS 912.1-B-2

Description, architectural model, service operations, protocol, data types, conformance matrix

Structure diagrams, state diagrams, formal operations, parameters, and English and state chart behavioral descriptions, formal ASN.1 PDU, data type, interface and parameter specifications

Space Link Extension—Internet Protocol for Transfer Services, CCSDS 913.1-B-1

Architectural model, authentication, data encoding and transport mapping layers

Concrete bindings using SHA-1, ASN.1 types and encoding rules, TCP socket/port bindings, and defined PDU structures

Transport mapping layer interface primitives and behavior stated in structured English, and UML/EBNF state tables

Orbit Data Messages, CCSDS 502.0-B-1

Normative description of message structure, elements, keywords data types, state vector, segments, metadata

ASCII specification, keyword + value, file formats

IP over CCSDS Space Links, CCSDS 702.1-R-3

Overview, PDU formats, service primitives and protocol layer mappings

Concrete protocol layers (multiple), multiplexing and mappings, formal protocol identifiers, concrete PDU mappings and multi-layer adaptations, abstract provided service specification

C3 TYPICAL MAGENTA BOOK EXAMPLES

Space Link Extension—Application Program Interface for Transfer Services—Core Specification, CCSDS 914.0-M-1

SLE API specification, architecture, requirements, structure, components, and behavior

UML model of architecture, components, interfaces and behavior, structured English mapping to formal SLE specs, state tables in UML and OCL, normative interfaces defined in C++, normative error codes

Space Link Extension—Application Program Interface for Return All Frames Service, CCSDS 915.1-M-1; *Space Link Extension—Application Program Interface for the Forward CLTU Service*, CCSDS 916.1-M-1

SLE API components, bindings to RAF and CLTU operations, interfaces

UML package and structure, normative C++ bindings

Reference Architecture for Space Data Systems, CCSDS 311.0-M-1

Viewpoints, views, stakeholders, concerns, representations, relationships

RM-ODP derived models, RM-ODP and UML derived representations

C4 TYPICAL GREEN BOOK EXAMPLES

Proximity-1 Space Link Protocol—Rationale, Architecture, and Scenarios, CCSDS 210.0-G-1

Overview, abstract architecture, abstract operations and scenarios

Abstract layered architecture, operational behavior, sequence diagrams, and state machines, graphical application scenarios and usage diagrams

Cross Support Concept — Part 1: Space Link Extension Services, CCSDS 910.3-G-3

Background, environment, abstract descriptions of architecture, functional components, operations, data transfer services, service management, applicability

Formal and informal diagrams, deployed systems, interactions, PDUs, state machines, tables of attributes and data types

Navigation Data—Definitions and Conventions, CCSDS 500.0-G-2

Overview, message exchange framework, ancillary data, properties, measurements, applicability

Process, terms, abstract message exchange and data types, English and mathematical descriptions of frames of reference, time scales, properties, maneuvers, and observational techniques

ANNEX D**SECRETARIAT FORMS**

(July 2002)

OVERVIEW

This annex presents various forms used by the Secretariat in the distribution of CCSDS documentation. The forms presented are baseline forms intended to illustrate by example the actual forms used. For a given distribution, the Secretariat may prepare various versions of a particular form, since the Secretariat routinely distributes documents to a variety of recipient categories.

The forms presented in this annex are:

- a Draft Recommended Standard review request form;
- a Corrigendum form;
- a RID Initiation form.

DRAFT RECOMMENDED STANDARD FORWARDING FORM

A standard Draft Recommended Standard forwarding form is shown on the facing page. A variation of this form may be used to distribute other types of review documents, e.g., a draft Record. Variables to be filled in at the time of distribution are as follows:

- [CtrlNo] is an internal distribution control number assigned by the Secretariat;
- [RevBegins] is the beginning date for review of the attached document;
- [RevEnds] is the ending date for the review, by which time all comments should be forwarded to the review coordinator;
- [Citation] is a brief citation for the document, giving title, issue, issue date, and document identifying number;
- [Document Description] is a brief description of the review document in terms of the problem it proposes to solve;
- [Review Coordinator] is the name and contact information for an individual responsible for receiving review comments.



REQUEST FOR REVIEW OF CCSDS DOCUMENT

Control number: [CtrlNo] Distribution: **On Line**
Review begins [RevBegins] Review ends: [RevEnds]

The Management Council of the Consultative Committee for Space Data Systems (CCSDS) has authorized the publication, and requests review, of the following:

[Citation]

Click here to access a Portable Document Format (PDF) version of the review document.
(File:[file name, size]. Requires Acrobat™ 4.0 or later version.)

Notes on printing

DOCUMENT DESCRIPTION: [Document Description]

REVIEW INSTRUCTIONS: Members and Observers are requested to send their sets of review comments to the Review Coordinator with a copy to the CCSDS Secretariat. Each review comment should be submitted on a separate Review Item Disposition (RID) form. Submission of RIDs in electronic form is preferred. The following ASCII RID forms are available (click on form name for access):

Standard RID form for reviewer use.

Member or Observer RID form (includes approval and concurrence fields).

REVIEW COORDINATOR:

[Review Coordinator]

A copy of the set of Agency review comments should be forwarded to the Secretariat at the following address:

CCSDS Secretariat
Space Communications and Navigation Office, 7L70
Space Operations Mission Directorate
NASA Headquarters
Washington, DC 20546-0001, USA

E-mail: secretariat@mailman.ccsds.org

CORRIGENDUM FORM

The standard Corrigendum form is shown on the facing page. Variables to be filled in at the time of distribution are as follows:

- [DocNumber] is the document identifying number of the Recommended Standard against which the corrigendum is being issued;
- [CorNum] is an integer indicating the number of the corrigendum;
- [CorIssueDate] is the date when the corrigendum was approved by the CMC;
- [Title of Published Recommended Standard] is the title of the Recommended Standard against which the corrigendum is being issued;
- [DocIssueDate] is the original issue date of the Recommended Standard against which the corrigendum is being issued;
- [Internal Ctrl Number] is an internal distribution control number assigned by the Secretariat.



**Recommended Standard [DocNumber]
TECHNICAL CORRIGENDUM [CorNum]**

Issue Date: [CorIssueDate]

[Title of Published Recommended Standard]

TECHNICAL CORRIGENDUM [CorNumber]

The Management Council of the Consultative Committee for Space Data Systems (CCSDS) has authorized the publication of corrigendum [CorNumber] to [DocNumber], issued [DocIssueDate].

[Page (Range) Reference]

[Instructions for Making Change]

[Rationale for Change]

Control Number: [Internal Ctrl Number]Corrigendum Identifying Number: [DocNumber] Cor. [CorNumber]

NOTE – Current versions of CCSDS documents are maintained at the CCSDS Web site:

<http://www.ccsds.org/>

Correspondence regarding CCSDS documents should be addressed to

CCSDS Secretariat
Space Communications and Navigation Office, 7L70
Space Operations Mission Directorate
NASA Headquarters
Washington, DC 20546-0001, USA

REVIEW ITEM DISPOSITION FORM

The standard Review Item Disposition (RID) initiation form for CCSDS Draft Recommended Standard and Draft Recommended Practice reviews is shown on the facing page. The variables to be filled in at the time of distribution are the standard citation information for the document being distributed for review.

CCSDS ORGANIZATION AND PROCESSES

CCSDS REVIEW ITEM DISPOSITION (RID): RID INITIATION FORM

AGENCY RID NUMBER:

SUBMITTING ORGANIZATION (Name,unit):

REVIEWER'S NAME:

CODE:

E-MAIL ADDRESS

TELEPHONE:

DOCUMENT NUMBER: [DocNumber] [Color Book], [Issue Number]

DOCUMENT NAME: [Title]

DATE ISSUED: [Issue Date]

PAGE NUMBER:

PARAGRAPH NUMBER:

RID SHORT TITLE:

___ APPROVE (MEMBER) ___ CONCUR (OBSERVER) ___ COMMENTS

DESCRIPTION OF REQUESTED CHANGE: (Use From: '...' To '...' format)

CATEGORY OF REQUESTED CHANGE:

Technical Fact ___ Recommended: ___ Editorial: ___

NOTES:

TECHNICAL FACT: Major technical change of sufficient magnitude as to render the Recommended Standard inaccurate and unacceptable if not corrected. (Supporting analysis/rationale is essential)

RECOMMENDED: Change of a nature that would, if incorporated, produce a marked improvement in document quality and acceptance

EDITORIAL: Typographical or other factual error needing correction. (This type of change will be made without feedback to submitter.)

SUPPORTING ANALYSIS:

DISPOSITION:

ANNEX E

CCSDS DOCUMENT NUMBERING SYSTEM

THE CURRENTLY ASSIGNED P-IDENTIFIERS ARE:

- 1 - Telemetry Systems
- 2 - Telecommand Systems
- 3 – Systems Engineering
- 4 - RF and Modulation Systems
- 5 – Navigation, Tracking, and Spacecraft Monitor and Control
- 6 - Information Access and Interchange Systems
- 7 – Space Internetworking Services
- 8 – Spacecraft Onboard Interface Services
- 9 - Cross Support Services

- A - Administrative and Organizational Reports
- B - Meeting Reports and Summaries
- C - Workshop Reports and Summaries
- D - Technical Planning Reports and Summaries

EXAMPLE OF DOCUMENT NUMBERING SYSTEM

For the **initial development** of a Normative Track document:

- Proposed Draft Recommended Standard or Practice Development:

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|------------------|---|-------------------------|
| Issue 1 | Proposed Draft Recommended Standard or Practice | CCSDS 101.0-W-1 |
| Issue 2 | Proposed Draft Recommended Standard or Practice | CCSDS 101.0-W-2 |
| Issue <i>n</i> | Proposed Draft Recommended Standard or Practice | CCSDS 101.0-W- <i>n</i> |

- Draft Recommended Standard or Practice Iteration:

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|------------------|--|-------------------------|
| Issue 1 | Draft Recommended Standard or Practice | CCSDS 101.0-R-1 |
| Issue 2 | Draft Recommended Standard or Practice | CCSDS 101.0-R-2 |
| Issue <i>n</i> | Draft Recommended Standard or Practice | CCSDS 101.0-R- <i>n</i> |

– Recommended Standard

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|------------------|----------------------|-------------------------|
| Issue 1 | Recommended Standard | CCSDS 101.0-B-1 |
| Issue 2 | Recommended Standard | CCSDS 101.0-B-2 |
| Issue <i>n</i> | Recommended Standard | CCSDS 101.0-B- <i>n</i> |

– Recommended Practice

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|------------------|----------------------|-------------------------|
| Issue 1 | Recommended Practice | CCSDS 101.0-M-1 |
| Issue 2 | Recommended Practice | CCSDS 101.0-M-2 |
| Issue <i>n</i> | Recommended Practice | CCSDS 101.0-M- <i>n</i> |

For **subsequent changes** to a Normative Track document:

– Corrigenda to Recommended Standard

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|--------------------|--------------------|------------------------|
| First corrigendum | Corrigendum 1 | CCSDS 101.0-B-1 Cor. 1 |
| Second corrigendum | Corrigendum 2 | CCSDS 101.0-B-1 Cor. 2 |

– Corrigenda to Recommended Practice

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|--------------------|--------------------|------------------------|
| First corrigendum | Corrigendum 1 | CCSDS 311.0-M-1 Cor. 1 |
| Second corrigendum | Corrigendum 2 | CCSDS 311.0-M-1 Cor. 2 |

NOTE – No more than two corrigenda may be issued against a given issue of a Normative Track document; the need for a third corrigendum would result in a revision.

– Draft Revisions to Normative Track document

| <u>Iteration</u> | <u>Designation</u> | <u>Number</u> |
|-------------------------|-------------------------------|---------------------------|
| First draft issue | Draft Revision Issue 1 | CCSDS 101.0-P-1.1 |
| Second draft issue | Draft Revision Issue 2 | CCSDS 101.0-P-1.2 |
| <i>n</i> th draft issue | Draft Revision Issue <i>n</i> | CCSDS 101.0-P-1. <i>n</i> |

NOTES

- 1 In the “Draft Revisions to Normative Track document” example above, the issue being revised is Issue 1, numbered 101.0-B-1; the next approved issue resulting from the revision is Issue 2, numbered 101.0-B-2.
- 2 The Draft Revision numbering system does not distinguish between a set of revised pages or a completely revised book.

ANNEX F

CCSDS PICS PROFORMA

F1 OVERVIEW

This annex provides the rationale, content guidelines, and nominal structure for a CCSDS Protocol Implementation Conformance Statement (PICS) proforma. The PICS proforma is a required normative annex in all CCSDS Blue Books defining communications protocols. Protocol Blue Books may request a waiver from the requirement.

An ICS is not required for other types of CCSDS Blue Books at this time. The decision of requiring an ICS definition for information object standards (i.e., data exchange specs like TDM or XFDU), service specifications, coding or modulation specifications, and compression specifications has been deferred for now.

CCSDS standards are required to clearly document, and in a “terse style” (see reference [1]), just what is required and what is optional in the specification. In doing this they will include specific guidance on how to define all of the technical details of the standard. The specification itself, must define, clearly and unambiguously, just what the specification is, using text, diagrams, tables, state machines, etc. Even in a “terse style” this may consume many pages of specification and detail. As a result it may be difficult to discern, in any compact form, just what is required and what is optional.

The PICS proforma is not intended to recapitulate all of this information. A typical PICS proforma is a succinct statement of just which sections of the specification are required and which are optional. Any given PICS proforma will include an introduction, some fields for documenting compliant implementations, and one or more tables. A simple specification with few options will have a very simple PICS proforma. A complicated specification will have a correspondingly complex PICS proforma, potentially with several sub-sections.

The PICS proforma has two primary purposes:

- a) To succinctly state in one compact form which elements of the specification are mandatory and which are optional;
- b) To provide a template to be filled in by all CCSDS prototype implementers to document which of the features of the standard they have implemented and what the status of their implementation is.

A filled out version of a PICS proforma for a given protocol implementation is called a PICS. The PICS proforma may be used as a template by any implementers of the standard to document which features they have implemented and who the point of contact for the implementation is.

A typical PICS proforma would include one or more tables containing columns for Item

(simple reference ID), Protocol Feature (one or two words), Reference (a reference to the paragraph in the standard), Status (of Item Number, as mandatory, Optional, Conditional, Prohibited, or N/A), and Support (when filled in, the terms yes, no, or N/A). Other columns such as Constraint, Predicate, Sender, Receiver, Initiator, Responder, may also be adopted if they are necessary. There may be more than one table used for different sections of the document, using different columns where required. Normally the subsections of the PICS proforma will align with the subsections in the document itself.

Each of these tables for a protocol specification will have a row for each relevant clause in the specification and may also have rows for PDUs, PDU parameters, Timers, Negotiation Capabilities, Error Handling, Dependencies, and any other required or optional features of the standard.

This guidance captures the salient features of the required PICS proforma for protocols. Each of the required types of rows for any given standard can be directly determined from the Blue Book itself, and the WG members are in the best position, given some simple guidance, to state just what must be included for any given type of Blue Book. The coverage of items in the specification must be complete enough to cover all topics of significance in any specification, to allow users to determine just what is required and what is optional, and to eliminate any ambiguities. The depth of coverage of minute details may be moderated to balance completeness with conciseness.

The document *Space Communications Protocol Specification (SCPS)—Transport Protocol (SCPS-TP)*, CCSDS 714.0-B-2, provides an example of a PICS proforma for a CCSDS protocol. The ISO document *Information Technology—Open Systems Interconnection—Conformance Testing Methodology and Framework—Part 7: Implementation Conformance Statements*, ISO/IEC 9646-7:1995 (reference [3]), provides more extensive guidance on the structure and content of a PICS proforma.

F2 DRAFT PICS PROFORMA

A simple example PICS proforma for the “XYZ Protocol” is provided as a draft template on the following pages. An adapted variation of this draft template should be tailored as needed and included in any final Blue Book as a normative annex. The columns shown are the minimum required. Others may be added as needed for any specific use.

ANNEX X**XYZ PROTOCOL IMPLEMENTATION
CONFORMANCE STATEMENT PROFORMA****(Normative)****X1 INTRODUCTION**

This annex provides the Protocol Implementation Conformance Statement (PICS) Requirements List (PRL) for implementations of the XYZ Protocol, CCSDS nnn.m-B-1, October 2001. The PICS for an implementation is generated by completing the PRL in accordance with the instructions below. An implementation shall satisfy the mandatory conformance requirements of the base standards referenced in the PRL.

The PRL in this annex is blank. An implementation's completed PRL is called the PICS. The PICS states which capabilities and options of the protocol have been implemented. The following can use the PICS:

- the protocol implementer, as a checklist to reduce the risk of failure to conform to the standard through oversight;
- the supplier and acquirer or potential acquirer of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma;
- the user or potential user of the implementation, as a basis for initially checking the possibility of interoperating with another implementation.
- a protocol tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

X2 NOTATION

The following are used in the PRL to indicate the status of features:

Status Symbols

- | | |
|---|------------|
| M | mandatory. |
| O | optional. |

Support Column Symbols

The support of every item as claimed by the implementer is stated by entering the appropriate answer (Y, N, or N/A) in the support column:

| | |
|-----|--|
| Y | Yes, supported by the implementation. |
| N | No, not supported by the implementation. |
| N/A | Not applicable. |

X3 REFERENCED BASE STANDARDS

The base standards referenced in the PRL are:

- XYZ Protocol - this document;
- BFD Protocol – some other document.

X4 GENERAL INFORMATION**IDENTIFICATION OF PICS**

| Ref | Question | |
|-----|--|--|
| 1 | Date of Statement (DD/MM/YYYY) | |
| 2 | PICS serial number | |
| 3 | System Conformance statement cross-reference | |

X.5 IDENTIFICATION OF IMPLEMENTATION UNDER TEST (IUT)

| Ref | Question | Response |
|-----|------------------------|----------|
| 1 | Implementation name | |
| 2 | Implementation version | |
| 3 | Special Configuration | |
| 4 | Other Information | |

X6 IDENTIFICATION

| | |
|---|--|
| Supplier | |
| Contact Point for Queries | |
| Implementation name(s) and Versions | |
| Other Information Necessary for full identification - e.g., name(s) and version(s) for machines and/or operating systems; System Name(s) | |

X7 PROTOCOL SUMMARY

| | |
|--|------------------|
| Protocol Version | |
| Addenda Implemented | |
| Amendments Implemented | |
| Have any exceptions been required? (Note: A YES answer means that the implementation does not conform to the protocol. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.) | Yes_____ No_____ |
| Date of Statement | |

X8 INSTRUCTIONS FOR COMPLETING THE PRL

An implementer shows the extent of compliance to the protocol by completing the PRL; that is, compliance to all mandatory requirements and the options that are not supported are shown. The resulting completed PRL is called a PICS. In the Support column, each response shall be selected either from the indicated set of responses, or it shall comprise one or more parameter values as requested. If a conditional requirement is inapplicable, N/A should be used. If a mandatory requirement is not satisfied, exception information must be supplied by entering a reference Xi, where i, is a unique identifier, to an accompanying rationale for the noncompliance.

X9 GENERAL/MAJOR CAPABILITIES

| Item | Protocol Feature | Reference (Blue Book) | Status | Support |
|---------|--------------------------|--------------------------|----------|---------|
| ITEM-1 | Link | 3.1 | M | |
| ITEM-2 | Link Binding | 3.1.1 | M | |
| ITEM-3 | Link Operation | 3.1.1 | M | |
| ITEM-4 | Link Tear-down | 3.1.1 | M | |
| ITEM-5 | Protocol State Machine | 3.1.2 | M | |
| ITEM-6 | Start State | 3.1.2.1 | M | |
| ITEM-7 | Operating State | 3.1.2.1 | M | |
| ITEM-8 | End State | 3.1.2.1 | M | |
| ITEM-9 | PDU | 3.1.3 | M | |
| ITEM-10 | PDU Structure | 3.1.3.1 | M | |
| ITEM-11 | PDU Field 1 | 3.1.3.1 | M | |
| ITEM-12 | PDU Field 2 | 3.1.3.1 | M | |
| ITEM-13 | PDU Field 3 | 3.1.3.1 | O | |
| ITEM-14 | Optional Features | 3.1.4 | O | |
| ITEM-15 | Feature 1 | 3.1.4.1 | O | |
| ITEM-16 | Feature 2 | 3.1.4.1 | O | |
| ITEM-17 | Constraints | 3.1.5 | M | |
| ITEM-18 | Applicable usage | 3.1.5 | M | |
| ITEM-19 | Limitations on use | 3.1.5 | M | |