FOREWORD

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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.
DRAFT CCSDS ORGANIZATION AND PROCESSES

At time of publication, the active member and observer agencies of the CCSDS were:

Member Agencies

- Agenzia Spaziale Italiana (ASI)/Italy.
- British National Space Centre (BNSC)/United Kingdom.
- Canadian Space Agency (CSA)/Canada.
- Centre National d’Etudes Spatiales (CNES)/France.
- 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.
- Russian Federal Space Agency (RFSA)/Russian Federation.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSP)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- Centro Tecnico Aeroespacial (CTA)/Brazil.
- 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.
- 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 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.
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1 CCSDS MANAGEMENT PRINCIPLES

1.1 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 WGs.

**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 1-1. Starting at the top of the figure, descriptions of the major organizational functions follow.

Figure 1-1: CCSDS Structure

1.2 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.

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. An extract from the Terms of Reference of the IOAG is attached as Annex D, which provides an interesting insight into the standardization needs of one important future customer.

### 1.3 CCSDS MANAGEMENT COUNCIL (CMC)

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 on a rotating basis.

**NOTE** – In practical terms, the rotation is infrequently activated.

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 customer requirements.

#### 1.3.1 CMC RESPONSIBILITIES

The CMC is specifically responsible for

a) being the final executive decision-making body of the organization;
b) identifying the different CCSDS customer and 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 standardization tracks, including verifying that Standards 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.

1.3.2 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 Standards 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 standardization 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 standardization 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.

d) **Resource Administration:** The CMC coordinates the allocation of the necessary resources to Areas and Working Groups. Before allowing the CESG to form a new Working Group, the CMC must work with the CESG to ensure that a credible funding 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.

### 1.3.3 CMC ADJUNCTS

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

#### 1.3.3.1 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 and scope of TC20/SC13 are attached in Annex E.

#### 1.3.3.2 CCSDS Liaisons

The CMC acts as representative of the interests of the CCSDS in formal liaison relationships with other organizations concerned with standards and other technical and organizational issues relevant to international space mission cross support. 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 a sister subcommittee of ISO TC20/SC13. The other committee, ISO/TC20/SC14, “Space Systems and Operations” has six Working Groups that complement those of CCSDS:

- TC 20/SC 14/WG 1 Design engineering and production
- TC 20/SC 14/WG 2 Interfaces, integration and test
- TC 20/SC 14/WG 3 Operations and ground support
- TC 20/SC 14/WG 4 Space environment (natural and artificial)
- TC 20/SC 14/WG 5 Program management
1.3.3.3 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 new and 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 will be 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.

1.3.3.4 Customer Relations

Whereas the Industrial Relations function described in the previous section is intended to improve relationships with our suppliers, CCSDS also needs to pay significant attention to formalizing its relationships with its various direct customer communities. The IOAG is obviously one important current customers of CCSDS, but the CMC will identify, develop, and nurture customer (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 Customer Relations function acts as a source of advice and guidance to customers concerning architectural, procedural, and (where appropriate) policy matters pertaining to international space-mission cross support and its enabling technologies. It focuses on two-way information exchange, explaining existing CCSDS capabilities to potential customers and sponsors and gathering requirements from them for expanding the suite of CCSDS standards to meet their needs. Customer 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 customer 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 customer, so that customer satisfaction can be both measured and assured.

1.3.3.5 CCSDS Secretariat

The CCSDS Secretariat edits, formats, and publishes CCSDS Recommended Standards (in their various stages of maturity) and provides one definitive repository for all CCSDS documentation. The Secretariat also assists in scheduling and supporting all CCSDS meetings. 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. 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, document manipulation and sharing services, document libraries, electronic balloting facilities, and a system to log and distribute concept papers that are derived early in the development process. 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.

1.3.3.6 Space Assigned Numbers Authority (SANA)

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

1.4 CCSDS ENGINEERING STEERING GROUP (CESG)

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 standardization 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 and the Area Directors (ADs), who are selected by the CMC and are appointed for renewable two-year terms. The chairman also may be an Area Director. Deputies may be appointed for the CESG chairman and the ADs, at the discretion of the CMC.

As a minimum, the CESG must meet face-to-face twice per year to prepare progress reports, proposals, recommendations and other materials prior to the scheduled CMC meetings. Interim CESG meetings may be arranged as necessary at the discretion of the chairman. CESG meetings may be co-located with CMC meetings or may be held in the vicinity of institutions where a significant staff participation in the group exists. Alternative locations are permissible if approved by the CMC.

1.4.1 CESG OPERATING PRINCIPLES

a) **Expert Area Directors.** The ADs for a particular Area are expected to know more about the combined work of their Working Groups 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 on. 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 it entering a standardization 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 Working Groups 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 approving major transitions in the status and designation of most Standards Track documents, they 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 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 Standards comes both from the review that they get in the Working Groups and the review that the WG products get from the ADs.

e) **Anticipation.** The CESG must be able to look ahead and anticipate new standards that customers 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.

### 1.4.2 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 Standards and protocols;

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;
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 “standardization 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 standardization 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; and

m) making recommendations to the CMC concerning when to retire a Standard based on its obsolescence.

1.4.3 CESG CHAIRMAN AND AREA DIRECTORS

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 or Area Director 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 Working Group chair or having served as deputy chair prior to succeeding to chair).

A candidate for selection as an 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 Working Group chair or deputy chair.

1.4.3.1 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 standardization 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.
1.4.3.2  Area Director Responsibilities

An Area Director 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 CESG 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 CESG for the progression of WG documents as they approach key decision gates along the various standardization 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 CESG meetings to the WG and BOF chairs so that they may schedule the completion of their work prior to this time;

h) notifying the WG and BOF 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 and BOFs in a particular Area should be held to maximize opportunities for cross-pollination of ideas);

j) chairing Area meetings, ensuring that every WG or BOF 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 CESG 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 and BOF chairs to prepare detailed reports of overall status, progress and problems for presentation at CESG meetings (as necessary, the AD may request specific WG or BOF chairs to attend CMC meetings to discuss difficult issues);

m) verifying that all Standards 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 CESG 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 and BOF chairs to opportunities to publish results or participate in relevant conferences.

1.5 WORKING GROUPS

The vast majority of the work of CCSDS is done in many Working Groups that are clustered into closely related technical Areas. Each Working Group has a specific published and approved charter and schedule that it is required to follow and a set of associated resources to do the work that must be committed by a sponsor. This is important: No WG will be initiated by CCSDS unless a credible resource plan has been prepared and someone has agreed to provide the necessary support. The charter states the scope of discussion for the Working Group, 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. 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.

1.5.1 WORKING GROUP OPERATING PROCEDURES

Each Working Group'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 must 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 Working Group 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.

1.5.2 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, Working Group 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.

1.5.3 WORKING GROUP CHAIRS

Working Group chairs are nominated by an Area Director and approved by the CESG. 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 Working Group 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 theCESG;

b) publishing the approved work plan, showing the scope of its tasks, their schedule, and the nature and source of the resources 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 standardization tracks and securing the approval of the AD before advancing their designations toward finalization;

h) obtaining specific CMC authorization, via the CESG 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;

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 standardization tracks, and making recommendations to the AD for the progression of documents as they approach key decision gates;
1.6 BIRDS-OF-A-FEATHER GROUPS (BOFS)

To form a Working Group, it is first required to articulate the technical concept, draft a charter, appoint someone who is able to be chair, and demonstrate that resources can be secured to do the work. Birds-of-a-Feather (BOF) groups are formed to get support for establishing an eventual CCSDS WG, not to work the details of a particular technical concept. Many BOFs don't turn into WGs for a variety of reasons, such as not enough people reaching agreement on a focus for the work, a lack of credible sponsorship, or the work is not aligned 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.

1.7 SPECIAL INTEREST GROUPS (SIGS)

Special Interest Groups (SIGs) provide an ad-hoc forum for the discussion and coordination of topics that affect multiple WGs. 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 working groups. If the SIG determines that Standard or Non-Standard Track documentation is needed, then a BOF will be initiated to develop an official charter.

OR

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.
From time to time it may be necessary to form a SIG, typically to address key issues that cross WG or Area boundaries. The purpose of a SIG is to provide a forum where the involved technical experts from different WGs can discuss issues in order to form a consensus on how to resolve them. Unlike a BOF, a SIG is required to first coordinate with the involved ADs and WG chairs. Similar to a BOF, a SIG then is required to articulate the technical concept, appoint someone who is able to be chair, and develop a plan of work. A SIG may result in a position paper, in identification of work items to be handled by existing WGs, or in establishing a new CCSDS WG via the BOF process. SIGs are not expected to produce formal CCSDS Standards, but their results may be documented as CCSDS administrative documents or in other forms.
2 CCSDS TECHNICAL STRUCTURE

The technical work of CCSDS is centered on the CCSDS Engineering Steering Group as shown in figure 2-1.

2.1 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 Working Groups 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.
2.2 SYSTEMS DOMAIN

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

2.2.1 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.

2.3 INFORMATICS DOMAIN

The Informatics Domain contains two Areas:

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

2.3.1 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.
2.3.2 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.

2.4 TELEMATICS DOMAIN

The Telematics Domain contains three Areas:

– Spacecraft Onboard Interface Services
– Space Link Services
– Space Internetworking Services

2.4.1 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.

2.4.2 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.

2.4.3 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.

3 OPERATIONS

3.1 TOOLS OF OPERATION

3.1.1 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.

3.1.2 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.

3.1.3 CMC CCSDS RESOLUTIONS

CCSDS MC Resolutions are the executive decisions of the CMC, CESG, ADs and WGs and shall be concise statements of consensus among their CMC members.

3.1.4 APPROVAL AUTHORITY

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

3.1.5 CCSDS WEB SITE

3.1.5.1 General

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

3.1.5.2 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 or BOF.

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

3.1.5.3 Document Management Tools

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

3.1.5.4 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 email sent to CCSDS email lists to remove SPAM and messages that contain viruses.

3.1.5.5 Meeting Schedules and Registration Tools

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

3.2 MEETINGS

3.2.1 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.
3.2.2 CMC MEETINGS

3.2.2.1 Purpose

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

3.2.2.2 Schedule

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

3.2.2.3 Location

The CMC may rotate its 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.

3.2.2.4 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. 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 CMC members, observers, liaisons, and the CESG. CMC meeting minutes remain in draft status until formally approved by the CMC.

3.2.2.5 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 (and deputy, if one is appointed) 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.

### 3.2.3 CESG MEETINGS

#### 3.2.3.1 Purpose

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

#### 3.2.3.2 Schedule

At a minimum, the CESG must meet face-to-face twice per year in advance of scheduled CMC meetings. The CESG meeting must be completed before the CMC meeting, with sufficient time allocated to formulate the CESG report. Interim CESG meetings may be arranged as necessary at the discretion of the chair.

#### 3.2.3.3 Location

CESG meetings may be co-located with CMC meetings or may be held in the vicinity of institutions where a significant staff participation in the group exists. Alternative locations are permissible if approved by the CMC.

**NOTE** – There is no requirement to co-locate the CESG and CMC meetings.

#### 3.2.3.4 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.

3.2.3.5 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.

3.2.4 AREA MEETINGS

3.2.4.1 Purpose

In general, Area meetings are convened for face-to-face technical discussion aimed at achieving consensus.

3.2.4.2 Schedule

Area meetings are convened at the discretion of the Area Directors. If an AD deems it to be beneficial to hold an Area meeting, the only constraint on the schedule is that it complete its business before the CESG meeting with sufficient time allowed to formulate an Area report.

3.2.4.3 Location

The location of an Area meeting shall be determined by the Area Director. As a general guideline, Area meetings shall be held in the vicinity of institutions where a significant staff participation in the Area exists. 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.
3.2.4.4 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.

3.2.4.5 Participation

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

3.2.4.6 Location

Areas may co-locate to provide maximum opportunities for technical interchange across different groups.

3.2.5 WORKING GROUP MEETINGS

3.2.5.1 Purpose

Working Group meetings are convened to enable face-to-face technical discussions leading to consensus.

3.2.5.2 Schedule

In the absence of requirements for an Area meeting, the WG chair shall decide if, when, and where face-to-face WG meetings are to be held.

3.2.5.3 Location

WG meetings shall be held in the vicinity of institutions where a significant staff participation in the group exists. Alternative locations are permissible only if specifically approved by the AD.
WGs and BOFs may co-locate to provide maximum opportunities for technical interchange across different groups.

### 3.2.5.4 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 Area-WG meeting shall be presented to the CESG 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.

### 3.2.5.5 Participation

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

### 3.2.6 BOF MEETING

#### 3.2.6.1 Purpose

BOFs meet as necessary to develop the materials needed to propose formation of a Working Group. 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.

#### 3.2.6.2 Schedule

BOF meetings are scheduled as needed to perform BOF work; there is no requirement that BOFs hold face-to-face meetings if the work can be accomplished by other means.

An initial ad-hoc meeting may be held in conjunction with co-located Area and WG meetings for the purpose of gauging interest in forming a BOF.

The AD to whom the BOF will make its presentation shall determine the schedule for the presentation meeting based on the constraints identified in 3.2.4.2 and 3.2.5.2.
3.2.6.3 Location

The location of BOF meetings convened in the course of BOF work is outside the scope of this procedures manual; however, such meetings may be co-located with WG and Area meetings as appropriate. The AD to whom the BOF will make its presentation shall determine the location for the presentation meeting based on the constraints identified in 3.2.4.3 and 3.2.5.3.

3.2.6.4 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.

3.2.6.5 Participation

Participation in BOF meetings is outside the scope of this procedures manual.

3.2.7 CCSDS PLENARY MEETINGS

3.2.7.1 Purpose

A CCSDS plenary meeting

a) provides an opportunity for all CCSDS participants to exchange information in a "conference" environment;

b) provides an opportunity to chart a long-range course for future work; and

c) provides an opportunity for external liaison with non-affiliated space agencies or other relevant standards bodies.

3.2.7.2 Schedule

CCSDS plenaries are organized at the discretion of the CMC. There is no requirement to hold a plenary on a regular basis.

3.2.7.3 Location

CCSDS plenaries typically are co-located with major international conferences or other significant CCSDS-related events.
3.2.7.4 Meeting Materials

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

Papers presented at CCSDS plenaries shall be delivered to the Secretariat for posting on the CCSDS Web site.

3.2.7.5 Participation

Plenary meetings are open to all interested parties. Representatives of CCSDS members, observers, associates, and liaisons automatically are invited. Tutorials on CCSDS activities may be given to individuals involved in space-flight projects and ground support. Assistance in use of CCSDS products may be offered. On occasion, representatives of space-related industries may sponsor exhibits of their CCSDS-compatible products.

3.3 ONLINE VOTING

3.3.1 PURPOSE

To arrive at consensus among the CCSDS participants, a mechanism for formally voting on issues of interest is needed. 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 on-line polling capability is needed to conduct business in a virtual work environment between semiannual meetings.

3.3.2 SCOPE

The online polling feature is a tool that can be found on the CCSDS Web site and is available to Area Directors as well as to the CMC, CESG, and WG chairs to vote on issues and take surveys on topics of interest.

3.3.3 CONCEPT

The CCSDS on-line polling tool is located in a private area of the CWE at http://www.ccsds.org/polls. The Secretariat defines how access to the polling is controlled.
3.3.4 RESPONSIBILITIES

3.3.4.1 Secretariat

The CCSDS Secretariat shall be responsible for maintaining the polling system as part of the CCSDS Web site and collaborative work-space tools. The Secretariat shall provide training to polling managers on the use of the online polling tool.

3.3.4.2 Polling Managers

Polling managers may be Area Directors or CMC, CESG, WG, or BOF chairs, or their designated representatives. The polling manager is responsible for setting up and managing the poll for his or her respective areas of responsibility. Managing the poll includes initiating notices to mail groups that should be participating in the poll as well as issuing follow-up notices.

3.3.5 PROCESS

The following process represents the current method of establishing and conducting a poll. The process includes annotations for the way in which the polling process should work when fully implemented at the next update of this document. Also included are rules assumed at this time that will be needed at certain steps of the process.

3.3.5.1 ESTABLISHING AN ONLINE POLL

Current:

a) The CESG or CMC chair requests the Systems Administrator (SA) to set up a poll. The requester provides
   – wording for the poll,
   – opening and closing dates for the poll, and
   – information concerning whether the poll is secret or open (future option; all polling capability is currently open):
     • Open polling permits anyone to see results of the poll at any time (all polls are currently open)
     • Secret polling restricts results of the poll during voting to the requester and members who have already voted (not available at this time; this feature cannot be set up until polls are restricted to individual login).

b) The SA establishes a poll using the information provided and then returns the location (URL) of the established poll to the requester.
c) The requester sends e-mail messages using the official mailing lists to the group that should respond to the poll; the e-mail provides
   - URL of the polling location and
   - basic information regarding the poll; i.e., title and opening and closing dates of poll.

Future:
The Poll Manager goes to http://www.ccsds.org/polls/ and selects the appropriate domain (CMC, CESG, Area, WG, or BOF) to which the poll applies. Using the collaborative workspace survey tool, the Poll Manager establishes a new survey in the polling area and adds the wording desired for the poll. The Poll Manager then sends an e-mail message using the official mailing lists to the group or groups that should participate in the poll.

3.3.5.2 Responding to an Online Poll

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

a) Click on the URL located in the notification e-mail and log in with username and password.

b) Enter personal information and cast vote to approve, disapprove, approve with comment, or disapprove with comment:
   - Rule: if “Approve with Comment” or “Disapprove with Comment” is selected, an entry must be made in the comments box to cast the vote.
   - Rule: if “Disapprove with Comment” is selected, sufficient technical feedback must be provided to enable the WG to respond.
   - Rule: Valid name of group member must be entered to successfully cast a vote.
   - Rule: Name is automatically populated from login information (this will occur when roles and permissions are established for the new CCSDS Web site).

c) Click on “Save and Close” to submit vote:
   - Rule: Polling system updates response information and poll summary.

3.3.5.3 Disposition of Poll Comments

The Secretariat will compile any provisional comments on Poll Item Disposition (PID) forms. The PIDs will be submitted to the appropriate WG chair or AD for a response. Responses are provided to the comment originator for concurrence.
3.3.5.4 Distribution of Poll Results

The Secretariat will distribute poll results to the CMC and all WG chairs.

3.3.6 DECISION CRITERIA

Electronic balloting is a method for determining consensus on issues put to a vote. The online polling tool provides for four responses when voting on issues: Approve, Disapprove, Approve with Comment, and Disapprove with Comment. The results of the online poll reflect only the positions of those responding to the vote and provide the statistics, i.e., percent approving, disapproving, etc. It is the responsibility of the Area Directors and CMC, CESG, WG, and BOF chairs to use the information gathered by the poll to determine whether consensus has been reached or whether additional collaboration is required to reach consensus.

3.4 ACTION ITEM TRACKING AND DISPOSITION

3.4.1 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.

3.4.2 SCOPE

The scope is for CMC action items and resolutions.

3.4.3 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.

3.4.4 ACTION ITEM ASSIGNMENT

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

The taxonomy for numbering CCSDS resolutions and action items is designed to maintain a unique number for each item while permitting each item to be tracked all the way through its WG-Area-CESG-CMC life-cycle. Area items forwarded to the CESG and on to the CMC shall adhere to this taxonomy for action items and resolutions. CESG and CMC action items and resolutions shall follow the same taxonomy. It is recommended that WG-level use this taxonomy to maintain traceability of actions or resolutions elevated to the CESG and higher. At the WG level of assignment, an item receives a unique number based on specified format indicating the WG, resolution or action item designation, the meeting by year and month, and a sequential number in that group for that meeting. The assigned number will have the following format:

[WG-R/A-YYMM-nnn].

For example, “SMC-R-0411-003” indicates SM&C Working Group Resolution#3 in a November 2004 meeting. This taxonomy allows for meetings at times other than the scheduled spring and fall meetings and permits easy sorting by a computer.

The Area Director shall ensure action items or resolutions forwarded to the CESG have the correct taxonomy. An Area forwarding a WG item to the CESG would amend the forwarded item by adding the Area designation to the item [AREA-WG-R/A-YYMM-nnn]. If the Area meeting generates the item, the WG designation would not be present in the tracking number [AREA-R/A-YYMM-nnn]. Using the example already given, the MOIMS Area would forward the SM&C resolution using the tracking number [MOIMS-SMC-R-0411-003].

Actions or resolutions assigned at the WG level or Area level may be encapsulated at the CESG level with the following taxonomy:

[CESG-R/A-YYMM-nnn][ AREA-WG-R/A-YYMM-nnn]

or

[CESG-R/A-YYMM-nnn][ AREA-R/A-YYMM-nnn].

Using the example from the MOIMS Area, the following example shows how a resolution or action forwarded to the CESG may be represented. The MOIMS resolution could be encapsulated in a CESG resolution as [CESG-R-0411-001][MOIMS-SMC-R-0411-003], which would represent a CESG Fall (November) 2004 Resolution 1 encapsulating MOIMS Fall (November) 2004 SM&C Working Group Resolution#3. An SLS action item could be encapsulated in a CESG resolution as [CESG-R-0411-006][SLS-SLP-A-0411-004], representing CESG Fall (November) 2004 Resolution 6 encapsulating the SLS Fall (November) 2004 Space Link Protocols Working Group Action#4. The year-month meeting designation needs to be maintained in both the Area and CESG representations in case the action or resolution spans meetings when addressed from one group to the other.
Further encapsulation of actions or resolutions may be captured as they are elevated to the CMC level by continuing the pattern as follows:

[CMC-R/A-YYMM-nnn][CESG-R/A-YYMM-nnn][AREA-WG-R/A-YYMM-nnn].

Using the previous MOIMS example, the MOIMS resolution would be encapsulated at the CMC level with the representation [CMC-R-0412-003][CESG-R-0411-005][MOIMS-SMC-R-0411-003] indicating a CMC Fall (December) 2004 Resolution 3 encapsulating the CESG Fall (November) 2004 Resolution 5 encapsulating the MOIMS SM&C Working Group Fall (November) 2004 Resolution#3.

3.4.6 TRACKING

Tracking shall be performed in an automated tool on the CCSDS collaborative work space for managing action items. The system shall allow for the entering of up-to-date action item status indicating whether the action is in polling, for example, and when the polling is due for completion.

3.4.7 FOLLOW-UP

Follow-up to resolutions and action items shall be performed automatically by alerting the actionee upon assignment of the action and at a frequency of every two weeks until the due date. If the due date passes without completion, the actionee shall be alerted to the overdue status on a daily basis until the action is complete.

3.4.8 NOTIFICATION

Upon completion of an action item, all parties involved in the action shall be notified of the completion or other disposition of the action item via e-mail. The disposition of the action item also shall be documented in the action item record for historical purposes. Closed action items shall be posted on the CCSDS portal in a manner that can be freely accessed by the public as well as the members.

3.4.9 DISPOSITION

An action item may have two forms of settlement. The action item may be “closed,” following successful completion, or an action item may be “canceled,” because it is overcome by events (OBE) or is no longer valid for some reason. The disposition status shall provide for comments indicating the method of disposition (how the item was closed or why it was canceled). For example, comments describing the closure of an item may be similar to the following: “polling period ended Nov 1; four respondents approved the resolution; CMC non-responses taken as agreement to resolution.”
3.5 ONLINE CHARTERING AND PROJECT APPROVAL

The Secretariat staff has developed an online chartering and project approval tool. 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. WG Chairs and ADs are expected to update project timelines on an as-needed basis, but at a minimum all projects must be checked and updated 30 days before the meeting.
4 CCSDS STANDARDIZATION PROCESS

The general taxonomy of CCSDS documentation is shown in figure 4-1.

![Figure 4-1: CCSDS Document Taxonomy](image)

The CCSDS tracks and designations are summarized as follows:

- CCSDS Concept Paper
- CCSDS Standards Track:
  - CCSDS Proposed Standard (White Book)
  - CCSDS Draft Standard (Red Book and Pink Sheets)
  - CCSDS Recommended Standard (Blue Book)
  - CCSDS Proposed Practice (White Book)
  - CCSDS Draft Practice (Red Book and Pink Sheets)
- CCSDS Recommended Practice (Magenta Book)
- Non-Standards Track CCSDS:
DRAFT CCSDS ORGANIZATION AND PROCESSES

- CCSDS Experimental (Orange Book)
- CCSDS Informational (Green Book)
- CCSDS Historical (Silver Book)
  - CCSDS Administrative Track:
    - CCSDS Record (Yellow Book)

4.1 OVERVIEW OF CCSDS DOCUMENT FLOW

4.1.1 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 Working Group 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

- Standards Track
- Non-Standards 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, CCSDS A20.0-Y-2. In the following sections general descriptions of the expected content for different document types are provided. In Annex B 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.

4.1.2 STANDARDS TRACK
The Standards 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)

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 Practices typically do not have prescriptive content. They may be of several types:

a) Specifications that are “foundational” for other specifications, but within themselves do not detail normative content in a way that allows independent development and testing of separate but interoperable systems.

b) Specifications that are “profiles” pointing to other specifications that include normative content.

c) System descriptions that are more general in nature and capture “best” or “state-of-the-art” recommendations for applying standards or standardized processes.

d) Reference architectures and other formal but non-normative specifications.

e) Operational practices that are associated with other CCSDS specifications.

f) Application Programming Interfaces (API), which are useful for portability but are neither normative nor defining of interoperability.

Recommended Practices (Magenta Books) differ from “informational” documents in that they do provide controlling guidance rather than purely descriptive material. Because they provide controlling 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. It simply does not include the level of normative specification that would allow the independent development of separate but interoperable systems.

4.1.2.1 The flow of documents on the Recommended Standard branch is

- CCSDS Proposed Standard (White Book)
- CCSDS Draft 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 Standards Track in order to do the following:

- Advance through each of the various issues of a Draft Standard.
4.1.2.2 The flow of documents on the Recommended Practice branch broadly parallels the Recommended Standard branch; i.e.,

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

However, successful completion of a formal agency review for a Recommended Practice is only required for a document to transition from CCSDS Draft Practice to CCSDS Recommended Practice; often there is only one Red Book and its related agency review phase, but there may be more than one.

4.1.3 NON-STANDARDS TRACK

The Non-Standards 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 Standards Track documents and may provide overview, rationale, analyses, and other descriptive or background materials.

4.1.4 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 manual is a CCSDS Yellow Book and it is a controlling document describing CCSDS procedures.

4.2 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 Practices or Standards.
A CCSDS concept paper is not archived and it only has a lifetime of 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 (CCSDS A20.0-Y-2) 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 Standards Track, to the Non-Standards Track, or to the Administrative Track.

4.3 CCSDS STANDARDS TRACK

Standards 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 Standards 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.

Standards Track specifications normally must not depend on other Standards Track specifications that are at a lower maturity level, or on Non-Standards Track specifications other than referenced specifications from other standards bodies. The CESG makes recommendations concerning which work items should enter the Standards Track when chartering a WG, and the CMC must approve those recommendations prior to the initiation of work.

The Standards 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. 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. Standards must say very clearly, “These are the technical properties of what you must build and how it must behave if you want it to be compliant and interoperable.” Blue Books are also required to include a Protocol Implementation Conformance Statement (PICS) as a normative annex.

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. They may include references to sets of standards selected to perform certain applications, an “application profile” might specify multiple CCSDS Standards that are recommended for use in particular mission-support configurations. 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 you 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 often concerned with the technical specifications for hardware and software components required for computer communication and interoperability across interconnected space-mission support networks, a Recommended Practice typically cannot be directly implemented to develop interoperable system components. However, an application profile may specify a set of standards to be deployed for a specific purpose and this documented “stack” requires will benefit from interoperability testing for validation purposes.

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 Standards 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.

4.3.1 RECOMMENDED STANDARD BRANCH

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

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

A Proposed 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 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 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 Standard state when it is considered to be useful and necessary (and timely) even with known technical omissions. Implementers should treat Proposed 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 Standard. However, such experience is highly desirable and usually will represent a strong argument in favor of granting it a Proposed Standard status.

A Proposed 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 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 Standard status to a specification that materially affects the core CCSDS interoperability protocols or that specifies behavior that may have significant operational impact in the installed base of international mission-support infrastructure.

b) CCSDS Draft Standard (Red Book)

Elevation to Draft 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 Standard to the Draft Standard level. A Draft
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 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 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 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 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 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 fair and non-discriminatory.

In its final stages of issue, a Draft 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 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 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 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 of qualifying implementations and validation testing must include specific statements about its ability to support each of the individual options and features. 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 fair and non-discriminatory.

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 Standard phase: this is known as the familiar CCSDS Pink Sheet process.

A CCSDS Recommended Standard must be reconfirmed or updated every five years, or it shall be retired to CCSDS historical status.

4.3.2 RECOMMENDED PRACTICE BRANCH

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

a) CCSDS Proposed Practice (White Book)

The entry-level maturity for a document on the Standards Track that is targeted toward being a Recommended Practice is “Proposed Practice.” An explicit CESG and CMC approval action is required to move a concept paper onto the Standards Track at the Proposed Practice level. Prior to that approval, even though a WG has been
chartered, its documents remain at the concept paper stage. A Proposed 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 Practices as immature guidance.

A Proposed 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 Practice as a Draft 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 Practice and for indicating why it is thought to be ready for advancement.

Application Profiles, in particular, may require prototype implementations and interoperability validation. Whereas these practices do not, in and of themselves, define any new standards, they do define how a set of standards are to be “stacked” in order to provide end-to-end communications services, and this functionality and correct operation must be validated. In these cases a sufficiently detailed test plan must be developed, as would be done for a Blue Book, and interoperability testing must be performed and documented in a Yellow Book test report.

b) CCSDS Draft Practice (Red Book)

Elevation to Draft Practice is a major advance in status, indicating a strong belief that the document is mature and will be useful. A Draft 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 Practice status, and may recommend that the first issue of a Draft Practice be subjected to formal agency review in to gauge its acceptability to the community.

A Draft Practice generally will go through several more issues, during which it will progressively become more mature. Every issue of the Draft Practice must clearly state its status and must indicate the risks associated with using it in its current state. The WG chair determines when each draft issue is published. Although formal agency review is not required to advance to the next issue, the CESG may recommend such a review when judged to be beneficial. At such time as the WG feels that it is ready for finalization, the WG chair must demonstrate that its contents represent the true consensus of the group and must petition the CESG via the Area Director for permission to submit the document for formal agency review prior to its designation as an approved Recommended Practice. To support this advancement, it is desirable to demonstrate its use in some kind of test application or prototype validation in order to gain experience and to validate and clarify the specification.
Application or prototype validation in order to gain experience and to validate and clarify the specification. In its final stages of issue, a Draft Practice is normally considered to be a final specification, and changes are likely to be made only to solve specific problems encountered.

c) CCSDS Recommended Practice (Magenta Book)

Converting a CCSDS Draft Practice to a CCSDS Recommended Practice is always preceded by a successful formal agency review. Generally, only a specification for which significant implementation experience has been obtained may be elevated to the CCSDS Recommended Practice level. The WG chair is responsible for documenting the specific implementations that qualify the specification for advancement. 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 Practice phase. A CCSDS Recommended Practice must be reconfirmed or updated every five years, or it shall be retired to CCSDS historical status.

4.3.3 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 standardization 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.
4.3.4 SECURITY

All Standards 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.

4.4 CCSDS NON-STANDARDS TRACK

Not every specification will be on the Standards 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 Standards 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 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-Standards Track and the CMC must approve those recommendations prior to their initiation. Specifications that are on the Non-Standards 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

4.4.1 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 Standard without being actually on the Standards Track and therefore consuming large amounts of CCSDS resources. Experimental work may be rapidly transferred onto the Standards 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 Standards Track documents) it is not necessary to demonstrate broad support across the CCSDS community before a WG to produce an Experimental Standard is approved; one organization could volunteer to independently perform experimental work, 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 reports, 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 fair and non-discriminatory. Generally, there is no requirement for a formal agency review prior to publishing a CCSDS experimental specification.

4.4.2 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 Standard, or a Recommended Standard. They may therefore contain overview or descriptive material, supporting analysis, test results, scenarios, 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.
4.4.3 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 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.

4.5 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). Only the approval of the organizational unit that produces the document (BOF, WG, AD, CESG, CMC, Secretariat) is required prior to approving its publication. The CCSDS Secretariat will log the item and issue document numbers as necessary.

Yellow Books shall be used to document the test plans and test reports produced in support of CCSDS Blue Book, Orange Book and any required Magenta Book interoperability testing. Yellow Books may be reports, such as test reports or meeting records, but they also may be used to document CCSDS internal processes, procedures, and controlling guidelines. This manual 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.

4.6 PUBLICATION, DISTRIBUTION, AND MAINTENANCE

4.6.1 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.

4.6.2 DOCUMENT DEVELOPER RESPONSIBILITIES

4.6.2.1 Drafting Requirements

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 (see reference [3]).
4.6.2.2 Delivery Requirements

Document developers shall deliver all CMC-approved documents to the Secretariat for processing within 60 days following CMC approval of release. Documents that are not delivered within 60 days of approval shall be deemed not ready for release, and a new request for CMC approval shall be necessary for subsequent release.

4.6.3 SECRETARIAT RESPONSIBILITIES

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

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

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

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 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.

4.7 DOCUMENT IDENTIFICATION

4.7.1 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 9.9B 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 42-1.

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 BG.

Table 4-1: ‘C’ Designations for Document Type

<table>
<thead>
<tr>
<th>Character</th>
<th>Mnemonic</th>
<th>Document Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>White Book</td>
<td>Proposed Standard</td>
</tr>
<tr>
<td>R</td>
<td>Red Book</td>
<td>Draft Standard or Practice</td>
</tr>
<tr>
<td>B</td>
<td>Blue Book</td>
<td>Recommended Standard</td>
</tr>
<tr>
<td>G</td>
<td>Green Book</td>
<td>Informational Report</td>
</tr>
<tr>
<td>Y</td>
<td>Yellow Book</td>
<td>Record (administrative or meeting report)</td>
</tr>
<tr>
<td>P</td>
<td>Pink Sheets or Pink Book</td>
<td>Proposed revised Recommended Standard or Recommended Practice</td>
</tr>
<tr>
<td>M</td>
<td>Magenta Book</td>
<td>Recommended Practice document</td>
</tr>
<tr>
<td>O</td>
<td>Orange Book</td>
<td>Experimental specification</td>
</tr>
<tr>
<td>S</td>
<td>Silver Book</td>
<td>Document having Historic status</td>
</tr>
</tbody>
</table>

4.7.2 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.

4.7.3 IDENTIFICATION OF EXTERNAL STANDARDS

The document identification of any externally developed Standard that has been incorporated into the CCSDS suite of Recommendations shall retain that identification assigned by the originating organization.
4.8 SPECIAL STATUS DESIGNATIONS

4.8.1 MODIFICATION PROHIBITION

Under some circumstances the CMC may explicitly prohibit modification of a document. For example, a draft Recommendation 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 Recommendation, 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.

4.8.2 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.

4.8.3 DENOTATION OF SPECIAL DESIGNATIONS

Procedures for denoting special designations in the documents to which they are applied are defined in the CCSDS Publications Manual (reference [3]).
ANNEX A

CCSDS ARCHITECTURE PRINCIPLES

This annex provides additional explanation of the CCSDS Architecture Principles listed in section 1.5.1. These follow The Open Group Architecture Framework (TOGAF) recommended approach of providing a name, clear statement of intent, rationale and business benefits, and implications.

A1 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.

A2 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).
A3 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.

A4 ADOPT, ADAPT, DEVELOP

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

Rationale: 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 comm) 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.

A5 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 in civilian space 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.

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. Balance against the Adopt, Adapt, Develop Principle.

A6 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.

A7 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.

A8  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.

A9  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 Working Group, 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.
A10 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

DOCUMENT TYPE CONTENT EXAMPLES

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

B1  TYPICAL BLUE BOOK EXAMPLES

Proximity-1 Space Link Protocol—Data Link Layer, CCSDS 211.0-B-4
Layered model protocol architecture, 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
B2  TYPICAL MAGENTA BOOK EXAMPLES

*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

*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

B3  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
DRAFT CCSDS ORGANIZATION AND PROCESSES

ANNEX C

CCSDS CHARTER

(The CCSDS Charter was originally approved in 1982. It was updated in May 1999.)

PREAMBLE

The major space agencies of the world recognize that there are benefits in using standard techniques for handling space data and that, by cooperatively developing these techniques, future data system interoperability will be enhanced. In order to assure that work towards standardization of space-related information technologies provides the maximum benefit for the interested agencies, both individually and collectively, an international Consultative Committee for Space Data Systems (CCSDS) is established as a forum for international cooperation in the development of data handling techniques supporting space research, including space science and applications, for exclusively peaceful purposes.

PURPOSES

The purposes of the CCSDS are as follows:

1. to provide a forum whereby interested agencies may exchange technical information relative to the development or application of standards for space-related information technologies;

2. to identify those common elements of space data systems which, if implemented in a standardized way, will result in significant enhancements in the operation of future cooperative space missions, or in the sharing of mission products;

3. to develop through consensus appropriate Recommendations that will guide the development of agency infrastructure so that interoperability is maximized;

4. to facilitate and promote the use of software and hardware developed under the CCSDS program by all participating agencies;

5. to promote the application of the Recommendations within the space mission community; and;

6. to maintain cognizance of other international standardization activities that may have direct impact on the design or operation of space mission data systems.
PREAMBLE

Budget and workforce constraints have required all space agencies to explore methods for increasing their efficiencies. One approach is to increase cooperative programs wherein two or more international space agencies jointly design, build, launch, and operate a space flight mission. Frequently, one space agency designs, builds, and launches a spacecraft, integrating instruments from both agencies, while another agency provides tracking, data capture, and possibly even operations support. In a multiple-agency model, these functions can be distributed over several separate agencies.

This trend towards increased international cooperation was recognized several years ago and the Inter-Agency Consultative Group (IACG), the Consultative Committee for Space Data Systems (CCSDS), and the Space Frequency Coordination Group (SFCG) were formed to address specific matters arising from increased inter-agency cooperation. These groups have produced many successful cooperative programs and standards, which have reduced the operating costs for all participating organizations.

However, true inter-agency interoperability has yet to be achieved. Interagency interoperability for cross-support is needed to realize the additional economies resulting from an ability to share the large capital investments made by each agency in mission support systems. For that purpose the InterOperability Plenary IOP Meeting (see definition below) was convened in 1999. Seven agencies, listed in the Participation section below, met to agree upon a framework to achieve interoperability. The IOP established an Interagency Operations Advisory Group (IOAG) to resolve issues associated with achieving interagency interoperability.

The IOAG will provide a forum for identifying common needs across multiple agencies for coordinating space communications policy, high level procedures, technical interfaces and other matters related to interoperability and space communications. The IOAG was founded by the IOP to: 1) understand issues related to inter-agency interoperability and other space communications matters, 2) identify solutions complying with IOP policies, and 3) make recommendations to the IOP for specific actions by the IOP. The IOAG shall rely primarily on technical work already completed by other organizations developing standards for space systems such as the CCSDS and SFCG. Provided however, that when a deficiency is discovered, the IOAG may recommend to such standards organizations that they include these missing areas in their plan of work.

a. The IOAG is intended as a forum for issues and needs related to space communications that extends across multiple agencies. Items involving only two agencies are better covered in existing bilateral venues. IOAG member agencies
holding bilateral discussions with other agencies, whether they be IOAG members or not, should report those results to the IOAG.

OBJECTIVES

The IOAG will undertake activities it deems appropriate related to multi-agency space communications. Its relationship to the member space agencies, the IOP, and other organizations is shown in figure D-1.

A specific IOAG goal is the achievement of full interoperability among member space agencies. The following activities support IOAG objectives by identifying cooperative programs and projects proposed by IOAG member agencies and other organizations (e.g., the IACG) in the context of potential candidates for space communications cross-support. Specific objectives are:

1. Identifying the space and ground networks support capabilities needed by potential cooperative programs and projects to achieve their scientific objectives.

2. Promoting the use of internationally recognized standards in the design and implementation of cooperative flight programs including: spacecraft, ground, and space networks.

3. Ascertaining inconsistencies in the data transmission, capture, handling, and processing systems used by agencies and drawing such inconsistencies to the attention of relevant standards organizations (such as the CCSDS or SFCG) using Liaison Statements to standards organizations and recommendations to the IOP Delegates inviting them to undertake the development of new international standards.

4. Monitoring the work of relevant standards organizations and assisting in the agreement, adoption and implementation of new standards by space agencies.

5. Agreeing on the guidelines for testing needed to ensure interoperability of space agency facilities.

6. Assessing the resources needed to implement these requirements and inviting IOP Delegates to make these resources available within their agencies.

7. Establishing priorities for the implementation of systems and services needed to achieve full interoperability and enunciating policies furthering interoperability. Such priorities should be passed to relevant organizations using Liaison Statements and recommendations to the IOP Delegates.

8. Maintaining a list of interoperable facilities and services operated by the space agencies.

9. Facilitating the distribution of software to achieve interoperability.

10. Drafting recommended agreements for implementing cross-support between agencies.
Other specific objectives may be added as they are identified.

Figure D-1: IOAG Organizational Relationships
ISO TC20/SC13

Space Data and Information Transfer Systems

In 1990, the CCSDS entered into a cooperative arrangement with the International Organization for Standardization (ISO) concerning its Sub-Committee 13 under Technical Committee 20. Under this arrangement, CCSDS-developed Recommendations are advanced to ISO TC20/SC13 where they are progressed, via the normal ISO procedures of review and voting, into full ISO International Standards. These documents retain the CCSDS format, but are appended with an ISO cover sheet and control number. ISO TC20/SC13 normally meets every six months in conjunction with the CCSDS Management Council meetings.

ISO/TC 20/SC 13:

1. Is an international forum, which addresses the standardization needs of organizations and personnel involved with data and information transfer and exchange standards for civil space applications.

2. Recognizes that technical documents appropriate for international data systems standardization purposes have been developed by other organizations and will utilize these existing documents if they have demonstrated their suitability by wide international acceptance. SC 13 will avoid developing new international standards when adequate standards exist.

3. Promotes international cooperation and progress in civil space applications by encouraging, supporting, and proposing national and international missions; and seeking and initiating new concepts for international cooperative projects and missions. This includes spacecraft missions, ground based radio science, and space and ground tracking networks.

4. Develops both the technical and the institutional framework for international interoperability to facilitate appropriate cross-support opportunities of space data systems.

5. Promotes opportunities for partnership in space applications, including space and ground tracking networks and data sharing, between industrialized countries and the developing countries.

6. Acts as an international information exchange mechanism for data, programs, and plans pertaining to space applications and space/ground tracking networks.
ANNEX F

FORWARDING 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 Standard review request form;
- a Corrigendum form;
- a RID Initiation form.

DRAFT STANDARD FORWARDING FORM

A standard Draft 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

<table>
<thead>
<tr>
<th>Control number:</th>
<th>Distribution:</th>
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<tbody>
<tr>
<td>CtrlNo</td>
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<table>
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<th>Review begins:</th>
<th>Review ends:</th>
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<tbody>
<tr>
<td>RevBegins</td>
<td>RevEnds</td>
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</tbody>
</table>
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
NASA Headquarters, Code M-3
Washington, DC 20546, USA

Fax: +1 202 358 2830
E-mail: ccsds@lists.hq.nasa.gov
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 Recommendation against which the corrigendum is being issued;
- [CorNumber] is an integer indicating the number of the corrigendum;
- [CorIssueDate] is the date when the corrigendum was approved by the CMC;
- [Title of Published Recommendation] is the title of the Recommendation against which the corrigendum is being issued;
- [DocIssueDate] is the original issue date of the Recommendation against which the corrigendum is being issued;
- [Internal Ctrl Number] is an internal distribution control number assigned by the Secretariat.
[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]

Correspondence regarding CCSDS documents should be addressed to

CCSDS Secretariat
NASA Headquarters, Code M-3
Fax: +1 202 358 3520
Internet: ccsds@lists.hq.nasa.gov

CCSDS A02.1-Y-2.1
Page F-6
March 2009
DRAFT CCSDS ORGANIZATION AND PROCESSES

WASHINGTON, DC 20546, USA

REVIEW ITEM DISPOSITION FORM

The standard Review Item Disposition (RID) initiation form for CCSDS Draft Standard and Draft 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 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]

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 Recommendation 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:

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ANNEX G

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 Recommendation:

– Proposed Standard Development:

<table>
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<td>Issue 2</td>
<td>Proposed Standard CCSDS 101.0-W-2</td>
</tr>
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<td>Issue n</td>
<td>Proposed Standard CCSDS 101.0-W-n</td>
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– Draft Standard Iteration:

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<td>Draft Standard  CCSDS 101.0-R-2</td>
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<td>Issue n</td>
<td>Draft Standard  CCSDS 101.0-R-n</td>
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</table>
DRAFT CCSDS ORGANIZATION AND PROCESSES

– Recommended Standard

<table>
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<th>Designation</th>
<th>Number</th>
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<tbody>
<tr>
<td>Issue 1</td>
<td>Recommended Standard CCSDS 101.0-B-1</td>
</tr>
<tr>
<td>Issue 2</td>
<td>Recommended Standard CCSDS 101.0-B-2</td>
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<tr>
<td>Issue n</td>
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For subsequent changes to a Recommended Standard:

– Corrigenda to Recommended Standard

<table>
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<td>Corrigendum 1      CCSDS 101.0-B-1 Cor. 1</td>
</tr>
<tr>
<td>Second corrigendum</td>
<td>Corrigendum 2     CCSDS 101.0-B-1 Cor. 2</td>
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</table>

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

– Draft Revisions to Recommended Standard

<table>
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<td>Second draft issue</td>
<td>Draft Revision Issue 2 CCSDS 101.0-P-1.2</td>
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<td>nth draft issue</td>
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NOTES

1 In the “Draft Revisions to Recommended Standard” 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.