The Consultative Committee for Space Data Systems

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Consultative Committee for Space Data Systems

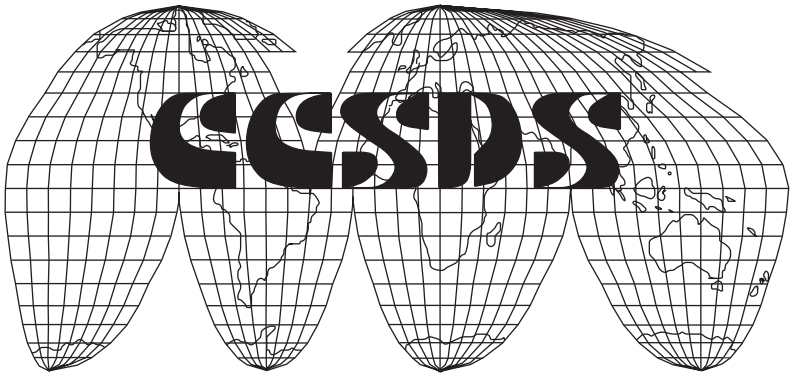
CCSDS MANAGEMENT COUNCIL

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

CCSDS A02.1-Y-2

YELLOW BOOK

April 2004



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This document has been approved for publication by the Management Council of the Consultative Committee for Space Data Systems (CCSDS) and represents the consensus technical agreement of the participating CCSDS Member Agencies. The procedure for review and authorization of CCSDS Recommendations is detailed in the Procedures Manual for the Consultative Committee for Space Data Systems, CCSDS A00.0-Y-9, Yellow Book, Issue 9, November 2003, and the record of Agency participation in the authorization of this document can be obtained from the CCSDS Secretariat at the address below.

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FOREWORD

The Consultative Committee for Space Data Systems (CCSDS) is an international organization supported by 33 space agencies and about 100 companies. It develops the standards that are used to foster interoperability so that spacecraft and their ground support infrastructure can intercommunicate. The current charter of CCSDS is presented in Annex 1.

The original CCSDS organization and its operating procedure were set up in 1982, when the world space community had almost no space standardization. Since then the CCSDS has put in place a fairly robust set of standards that have been adopted by over 270 space missions and their mission support organizations. CCSDS has therefore created a considerable installed base of standardized spacecraft and ground data handling infrastructure that did not exist twenty years ago, and has thus changed its own environment.

In response to calls to update and modernize the CCSDS organization, at its Autumn 2002 meeting the CCSDS Management Council (CMC) appointed a "CCSDS Restructuring Synthesis Group" to study a possible reorganization. The group's recommendations were accepted by the CMC and were published on 14 March 2003 as "CCSDS RECORD A02.1-Y-1, PROPOSAL FOR RESTRUCTURING THE CCSDS ORGANIZATION AND PROCESSES".

This document updates A02.1-Y-1 to remove the rationale that led to the reorganization and to thus streamline the new CCSDS working procedures. Additionally, the results of a "Pink Sheet" review of the Issue 1 document, focusing on clarification of the distinction between "Recommended Standards" and "Recommended Practices" and approved by the CMC in December 2003, have been incorporated herein. The results are summarized in the following three sections of this report:

- Section 1: CCSDS Management Principles

  This section defines the broad management structure and procedures that underlie the new CCSDS organization.

- Section 2: CCSDS Standardization Process

  This section lays out the working procedures for the organization

- Section 3: CCSDS Technical Structure

  This section lays out the new technical organization in top-level detail.

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

Member Agencies

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

Observer Agencies

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

DOCUMENT CONTROL

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CCSDS A02.1-Y-1	Proposal for Restructuring the CCSDS Organization and Processes, Issue 1	March 2003	Superseded.
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CONTENTS

Section Page

1 CCSDS MANAGEMENT PRINCIPLES 1-1

1.1 PURPOSE 1-1
1.2 BACKGROUND 1-2
1.3 CCSDS MANAGEMENT COUNCIL (CMC) 1-3
1.4 CMC ADJUNCTS 1-6
1.5 CCSDS ENGINEERING STEERING GROUP 1-8
1.6 WORKING GROUPS 1-14
1.7 BIRDS-OF-A-FEATHER GROUPS 1-17

2 CCSDS STANDARDIZATION PROCESS 2-1

2.1 OVERVIEW OF CCSDS DOCUMENT FLOW 2-2
2.2 CCSDS CONCEPT PAPER 2-3
2.3 CCSDS STANDARDS TRACK 2-4
2.4 CCSDS NON-STANDARDS TRACK 2-9
2.5 CCSDS ADMINISTRATIVE TRACK 2-11

3 CCSDS TECHNICAL STRUCTURE AND ORGANIZATION OF THE CESG ... 3-1

ANNEX A CCSDS CHARTER A-1
ANNEX B INTERAGENCY OPERATIONS ADVISORY GROUP (IOAG): TERMS OF REFERENCE, SEPTEMBER 2000 ..... B-1
ANNEX C ISO TC20/SC13 SPACE DATA AND INFORMATION TRANSFER SYSTEMS C-1

Figure

1-1 CCSDS Structure 1-2
2-1 CCSDS Document Taxonomy 2-1
3-1 CESG Structure 3-1

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 is concerned primarily with the semantic interpretation of information rather than how it is physically moved 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 domain that encompasses 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, four concrete organizational constructs exist:

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 charted 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.

A 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.

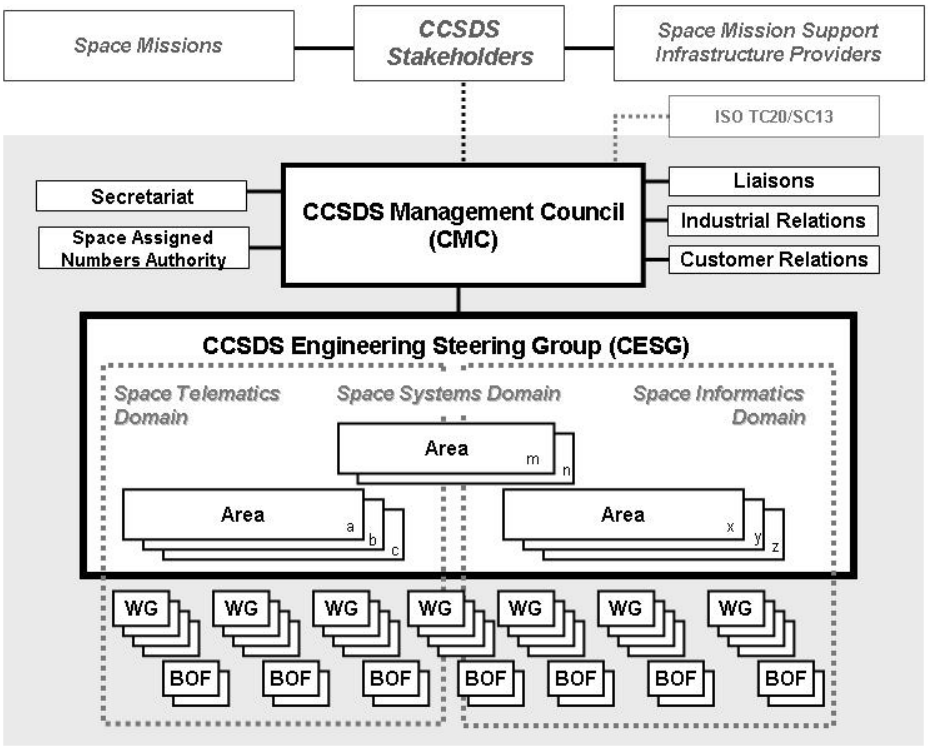

Figure 1-1: CCSDS Structure

1.2 CCSDS STAKEHOLDERS

While the terrestrial Internet has exploded in twenty years from a research activity to an indispensable component of world commerce, by and large "space" still leans towards 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;"

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 towards open and unclassified standardization by needs for interoperability and lowered costs. All of these organizations represent future sources of sponsorship, so a primary challenge for the restructured 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 Inter-agency 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 in Annex 2, 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 Members (one per agency). 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 that customer requirements are satisfied in a timely manner.

1.3.1 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;

g) Providing the overall administration of the organization, including the very important function of the Secretariat.

1.3.2 **CMC** 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 can progress along the various standardization tracks. The CMC does not have to meet in person to grant such approval - electronic balloting mechanisms will be 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.

f) **Meeting Scheduling.** The CMC defines 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:

– there is no requirement for routine fully centralized CCSDS “plenary” meetings, though these may be organized occasionally if a suitable opportunity presents itself (e.g., in association with a major international conference or other CCSDS event);

– the CMC will meet twice per year and must publish its proposed meeting schedule at least two years in advance;

– the CMC may rotate its meetings among the CCSDS Member agencies as necessary to satisfy hosting protocol. However, in order to minimize travel costs for delegates there may be practical constraints on the choice of locations for CMC meetings;

– as a minimum, the CESG chairman shall attend the CMC meetings to report technical progress and make recommendations about the program of work. The CESG chairman may be supported by key Area Directors as he or she feels necessary;

– consequently, the CESG meeting must be completed prior to the CMC meeting, with sufficient time allocated to formulate the CESG report. While not precluded if convenient, there is no requirement to co-locate the CESG and CMC meetings;

– as a further consequence, each Area must complete its business prior to the CESG meeting and with sufficient time allowed to formulate an Area report;

– within the previously stated constraints, each Area Director is free to decide if, when and where to schedule Area meetings where all Working Groups and BOFs will co-locate in order to provide maximum opportunities for technical interchange across different groups. As a general guideline, Area meetings shall be held in the vicinity of institutions where a significant staff participation in the Area exists;

– 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 only if specifically approved by the Area Director;

– Area Directors are cautioned that part of their performance evaluation will be based on their ability to persuade their WG ands 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.

1.4 CMC ADJUNCTS

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

1.4.1 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 recommendations are processed into full ISO standards via this relationship. The charter and scope of TC20/SC13 are attached in Annex-3.

1.4.2 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 exist 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:

a) TC 20/SC 14/WG 1 Design engineering and production;

b) TC 20/SC 14/WG 2 Interfaces, integration and test;

c) TC 20/SC 14/WG 3 Operations and ground support;

d) TC 20/SC 14/WG 4 Space environment (natural and artificial);

e) TC 20/SC 14/WG 5 Program management;

f) TC 20/SC 14/WG 6 Materials and processes.

1.4.3 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 trans-national 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 heard. 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 multi-national 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.

1.4.4 CUSTOMER RELATIONS

While the Industrial Relations function previously described is intended to improve relationships with our suppliers, CCSDS needs to also pay significant attention to formalizing its relationships with its various direct customer communities. The IOAG is obviously one important current customer 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.

1.4.5 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 RIDs) 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.

1.4.6 SPACE ASSIGNED NUMBERS AUTHORITY (SANA)

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

1.5 CCSDS ENGINEERING STEERING GROUP

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 may also 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 in order 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.

1.5.1 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 that the whole the group can agree to. 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 experimental communities to vector research resources into the standardization process.

1.5.2 CESG RESPONSIBILITIES

The CESG is specifically responsible for:

a) 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;

b) 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;

c) making recommendations to the CMC concerning which new WGs should be approved;

d) ensuring that the resource requirements of all WGs are addressed, identified and approved by the CMC prior to initiating new work;

e) hearing appeals from any BOF whose proposal to form a WG was rejected by an AD;

f) deciding and recommending to the CMC to which "standardization track" a particular work item should be assigned, and monitoring its progression through various stages of maturity;

g) 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;

h) periodically reviewing the technical work of each Area to ensure that it is progressing towards 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;

i) identifying "red flag" items where technical work is not progressing satisfactorily, resources are inadequate or significant issues exist, and raising these to the attention of the CMC for corrective action;

j) maintaining records of the status of all CCSDS work items, including completed WG deliverables that have been deployed into operational use;

k) making recommendations to the CMC concerning when to re-convene a WG to refresh a standard that has been finalized and deployed into operational use;

l) making recommendations to the CMC concerning when to retire a standard based on its obsolescence.

1.5.3 CESG CHAIRMAN AND AREA DIRECTORS

Nominations for CESG positions are made by the Principal Delegates from 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.

1.5.3.1 CESG Chair Responsibilities

The CESG is specifically responsible for:

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 that CESG decisions are made in a consensus setting;

d) ensuring that all CCSDS work follows an 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. This 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;

i) Seeking opportunities to advertise and promulgate the work of CCSDS by alerting ADs to opportunities to publish results or participate in relevant conferences.

1.5.3.2 Area Director Responsibilities

An Area Director is specifically responsible for:

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 towards 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) making recommendations to the CESG for the progression of WG documents as they approach key decision gates along the various standardization tracks;

e) demonstrating and certifying that formal review procedures have been properly followed prior to recommending the advancement of a document;

f) 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;

g) notifying the WG and BOF chairs as to how and when their work is to be presented to the AD for review;

h) deciding if Area meetings are to be held. 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 in order to maximize opportunities for cross-pollination of ideas;

i) 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;

j) ensuring that all Area work follows the set of architectural principles agreed by the CESG and is properly synchronized with the smooth evolution of the large installed base of CCSDS-compatible mission support infrastructure;

k) 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;

l) verifying that all Standards Track documents are subject to the proper process of formal Agency review by the WG chair;

m) maintaining the Area master-tracking list of relevant specifications as they progress through the standardization tracks;

n) making recommendations to the CESG to re-convene a WG to refresh a standard that has been finalized and deployed into operational use, and for which the WG is no longer active;

o) making sure that technical cross-pollination occurs among the various WGs. This will be accomplished by seeking frequent opportunities to hold Area meetings;

p) 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.

1.6 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. 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 on 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.

1.6.1 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 towards the milestones in the WG charter - usually publication of one or more CCSDS Recommended Standards. They are not meant to be taskmasters, but are responsible for assuring 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 the CESG;

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) deciding which documents should get published as "official" Working Group drafts, and which should not;

f) managing the progression of documents along the various standardization tracks and securing the approval of the AD before advancing their designations towards finalization;

g) obtaining specific CMC authorization, via the CESG and the AD, for initiating document transitions that require a formal Agency review;

h) 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;

i) reporting status, progress and "red flag" items to the Area Director in a timely manner;

j) working with the Area Director to synchronize WG activities with the CCSDS meeting and reporting cycle established by the CMC;

k) publishing detailed WG meeting agendas, usually a few weeks in advance;

l) chairing WG meetings and making sure that the proceedings follow a process of consensus;

m) appointing document "Rapporteurs" as necessary to be the focal points for making progress on a specification;

n) 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;

o) 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;

p) 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.

1.6.2 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 on-line 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.

WG chairs are free to conduct day to day WG business by whatever media are most effective, including on-line 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 can't attend face-to-face meetings, teleconferences, videoconferences, etc. Mailing Lists may continue on after a WG has been formally closed.

1.6.3 AREA AND WORKING GROUP MEETINGS

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

a) at an Area meeting where all of the WGs and BOFs are co-located, or;

b) via individual face-to-face meetings with each WG, or;

c) via a telecommunicated medium.

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

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

1.7 BIRDS-OF-A-FEATHER GROUPS

In order 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 in order to get support for establishing an eventual CCSDS Working Group, 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 can reach agreement on a focus for the work, a credible source of sponsorship cannot be demonstrated, 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 Area Director 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 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, or 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.

2 CCSDS STANDARDIZATION PROCESS

The general taxonomy of CCSDS documentation is shown in Figure 2-1.

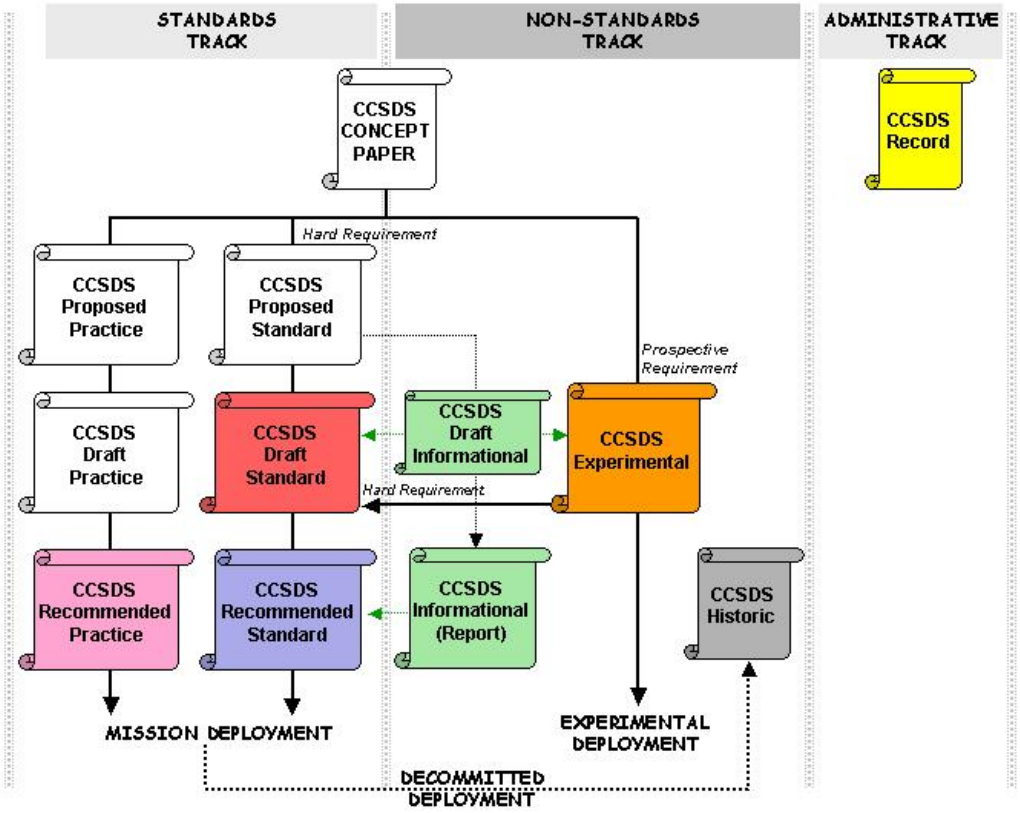

Figure 2-1: CCSDS Document Taxonomy

The CCDSDS Tracks and designations are summarized as:

- 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 (“White Book”);
  - CCSDS Recommended Practice (“Magenta Book”);

- Non-Standards Track CCSDS:
  - CCSDS Experimental (“Orange Book”);
  - CCSDS Informational (“Green Book”);
  - CCSDS Historic (“Silver Book”);
- CCSDS Administrative Track;
  - CCSDS Record (“Yellow Book”).

2.1 OVERVIEW OF CCSDS DOCUMENT FLOW

The flow of developing a CCSDS document is as follows:

1. Every CCSDS document (or family of related documents) starts out as a CCSDS Concept Paper.

2. If a Working Group is successfully chartered by the CESG to develop a document further within CCSDS, the charter must specify which "Track" it will follow. The Tracks (whose significance is defined later) are:
   - Standards Track
   - Non-Standards Track
   - Administrative Track

3. The Standards Track has two branches:
   - documents that are intended to be “*Recommended Standards*” (CCSDS ‘Blue Books’), and;
   - 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* are more general in nature and capture "best" or "state of the art" recommendations for applying standards or standardized processes. They differ from “Informational” documents in that they do provide controlling guidance, rather than purely descriptive material.

   3a 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 that successful completion of a formal Agency review is always required for a document on the “Recommended Standard” branch of the Standards Track in order to:

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

3b 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 (“White 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; there is no “Red Book” phase.

4. The Non-Standards Track includes two specification categories:

   - CCSDS Experimental (“Orange Book”)
   - CCSDS Historic (“Silver Book”)

   It also contains a more descriptive category:

   - CCSDS Informational (“ Green Book”)

   Green Books can also support the Standards Track documents.

5. The Administrative Track consists of:

   - CCSDS Record (“Yellow Book”).

2.2 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 9-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" in order to get work started. All that is necessary is to observe some basic formatting rules that are established by the Secretariat, 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 can often 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 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 either the Standards Track, or to the Non-Standards Track, or to the Administrative Track.

2.3 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). In order to enter the Standards Track, the WG charter must demonstrate to an AD 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 for 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, "this is how you must build something if you want it to be compliant".

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. They may include references to sets of standards selected to perform certain applications, or guidelines for standardized processes or procedures for accomplishing tasks, or other materials (such as reference models) to assist in the design, use or selection of 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 that while CCSDS Recommended *Standards* are often concerned with the technical specifications for hardware and software components required for computer communication across interconnected space mission support networks, a Recommended *Practice* might specify some specific "Application Profiles" of multiple CCSDS Standards that are recommended for use in particular mission support configurations. Another use of a *Practice* might be to recognize that 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.

2.3.1 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 towards being a Recommended Standard is "Proposed Standard". An explicit CESG and CMC 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. Since 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 in order 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.

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 will usually represent a strong argument in favor of granting it a Proposed Standard status.

Proposed Standards will generally go through several "Issues" during which they will progressively become more mature. Every 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 in order 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 that the CESG may require prototyping and/or operational experience prior to 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 on 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. A second 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. Since formal Agency reviews consume resources, a "review budget" must be agreed by the CESG and the CMC prior to publishing the first Issue of a Draft Standard; this budget identifies how many review cycles can be consumed without re-authorization 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 which 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 WG Chair is responsible for documenting the specific implementation(s) that qualify the specification, along with 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 is normally 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. (Exceptions include things like prescriptive Reference Models, which are not intended to be directly implemented in hardware or software.) 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 is always 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 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 reports relevant to their testing, or for justifying why such implementation is either inappropriate or should otherwise be waived. The documentation of qualifying implementations 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 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 Historic" status.

2.3.2 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 towards 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 will generally 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 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.

b) CCSDS Draft Practice (White Book)

Even though its “color” does not change, 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 should be subjected to formal Agency review in order to gauge its acceptability to the community.

A Draft Practice will generally go through several more Issues, during which it will progressively become more mature. Every Issue of the Draft 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 AD 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 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 Historic" status.

2.3.3 A NOTE CONCERNING “REFERENCE IMPLEMENTATIONS’

The proposed new standardization procedures defined above greatly increase the significance 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 that developing “reference implementations” that can be shared is highly desirable. Making reference implementations available to prospective designers of operational systems can offer them both cost and risk reduction advantages and can help in the testing of their fielded implementations.

2.4 CCSDS NON-STANDARDS TRACK

Not every specification is on the Standards Track. A specification may not be intended to be a CCSDS Recommended Standard or BCP, 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;
- Historic.

2.4.1 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, so the CCSDS role is limited to one of periodic review and 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 they 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 is approved – one organization could volunteer to independently perform Experimental work, providing that the Area Director is convinced that it is a positive contribution towards 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 AD to publish the final document as “CCSDS Experimental”. As a general rule, prior to publication at least one hardware or software prototype (or other implementation) must exist which 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 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.

2.4.2 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 descriptive material, supporting analysis, test results, scenarios, etc., which are otherwise inappropriate for the contents of a 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 AD to publish the final document as “CCSDS Informational Report”. Approval will normally be subject only to 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.

2.4.3 CCSDS HISTORIC (SILVER BOOK)

The CCSDS Historic 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 Historic 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 Historic status: the CESG and the CMC must approve this recommendation, but there is no requirement for a formal Agency review.

2.5 CCSDS ADMINISTRATIVE TRACK

This Track includes all CCSDS administrative documents such as CCSDS charters, procedures 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) is required prior to approving its publication. The CCSDS Secretariat will log the item and issue document numbers as necessary.

3 CCSDS TECHNICAL STRUCTURE AND ORGANIZATION OF THE CESG

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

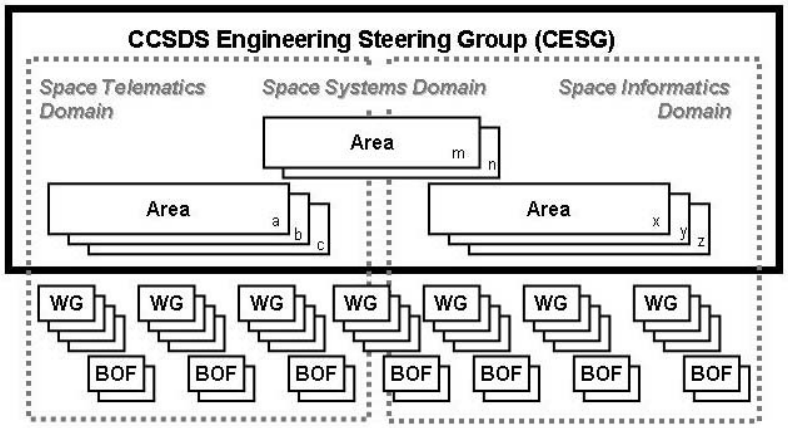

Figure 3-1: CESG Structure

The technical work of the CESG logically cleaves into the three broad "Domains" of "Systems", "Informatics" and "Telematics". Note that 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.

The current definition of the Technical Areas is contained in the CCSDS Strategic Plan, CCSDS A01.1-Y-2, Issue 2, April 2004.

ANNEX A
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.

ANNEX B
INTERAGENCY OPERATIONS ADVISORY GROUP (IOAG): TERMS OF REFERENCE, SEPTEMBER 2000

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 commutations 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.

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 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; and,

11. other specific objectives may be added as they are identified.

Figure B-1 illustrates CCSDS organizational relationships.

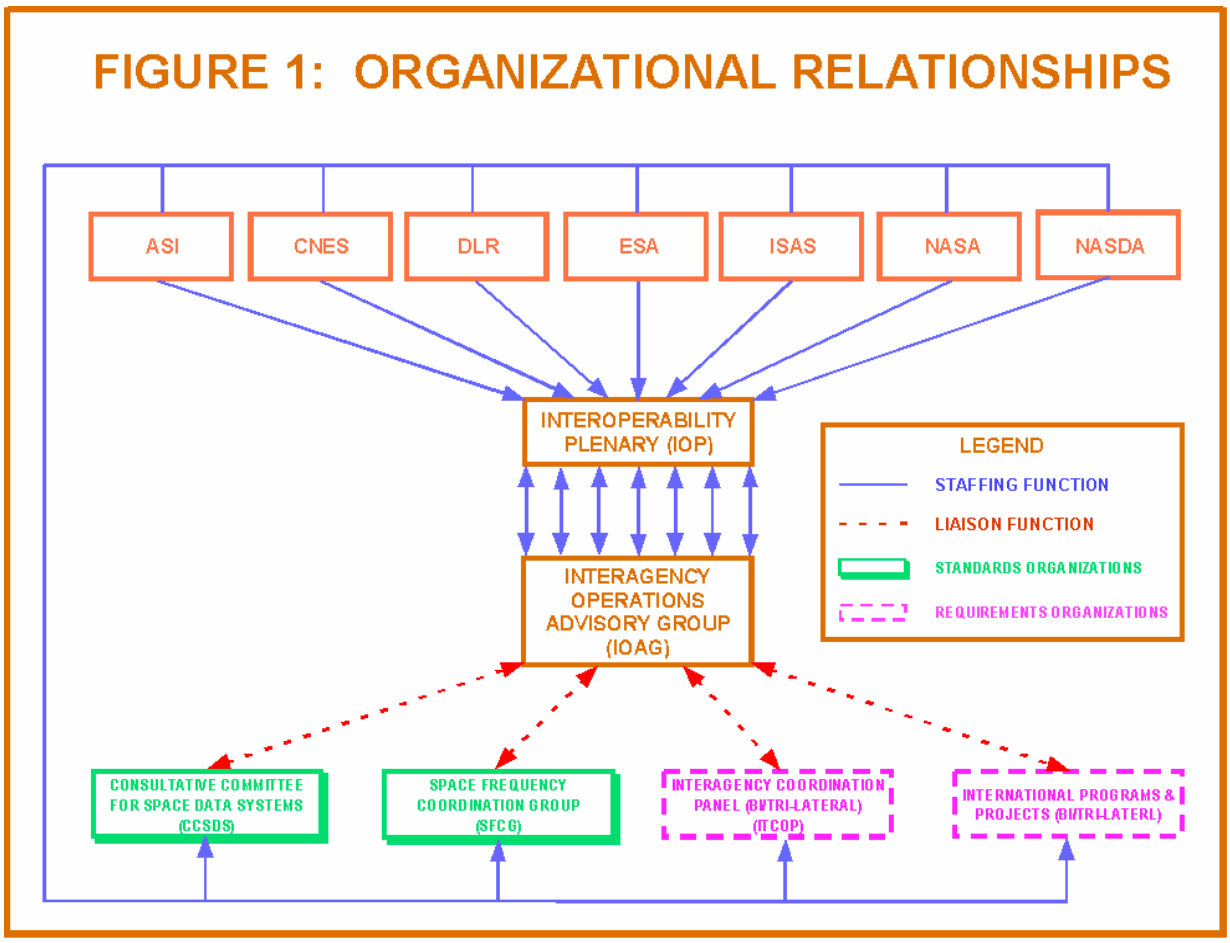

Figure B-1: CCSDS Organizational Relationships

ANNEX C
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.