Consultative Committee for Space Data Systems
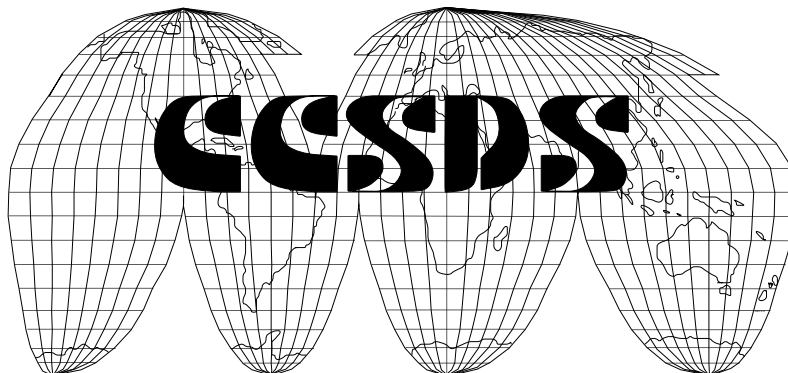
REPORT CONCERNING SPACE
DATA SYSTEM STANDARDS

STANDARD FORMATTED DATA UNITS—CONTROL AUTHORITY PROCEDURES TUTORIAL

CCSDS 631.0-G-2

GREEN BOOK

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FOREWORD

This Report is a companion book to the Control Authority (CA) Procedures Recommendation (reference [2]) and the Control Authority Data Structures (CADS) Recommendation (reference [3]) and contains rationale and explanatory material for the recommendations in both.

Through the process of normal evolution, it is expected that expansion, deletion, or modification to this document may occur. This Recommendation is therefore subject to CCSDS document management and change control procedures which are defined in reference [1].

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

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- National Oceanic & Atmospheric Administration (NOAA)/USA.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

Document	Title	Date	Status/ Remarks
CCSDS 631.0-G-1	Report Concerning Space Data Systems Standards: Standard Formatted Data Units—Control Authority Procedures Tutorial	June 1993	Original Issue
CCSDS 631.0-G-2	Report Concerning Space Data Systems Standards: Standard Formatted Data Units—Control Authority Procedures Tutorial	November 1994	Addition of CADS tutorial material, clarification of text and grammar corrections in several other locations.

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this document is to describe the Control Authority (CA) organization from both an implementor's and user's perspective. This document serves as a companion document to the Control Authority Procedures Recommendation (reference [2]) and the Control Authority Data Structures (CADS) Recommendation (reference [3]), and as su ch is intended to provide:

– a tutorial for the procedures and services identified in the Control Authority Procedures Recommendation, and the data description packaging in the Control Authority Data Structures (CADS) Recommendation;

– background to assist in the effective implementation of the Control Authority Procedures Recommendation and the Control Authority Data Structures (CADS) Recommendation;

– rationale and requirements for the Control Authority organization and for CADS.

1.2 INTENDED AUDIENCE

The intended audience of this document is both those individuals within an Agency who will be implementing a Member Agency Control Authority Office (MACAO), as well as those who will be using the services provided by the Control Authority organization, or creating or using CADS.

1.3 DOCUMENT ORGANIZATION

The Control Authority Procedures Tutorial is organized as follows:

– section 2 introduces the basic concept and rationale of the Control Authority organization;

– section 3 addresses the procedures and services identified in the Control Authority Procedures Recommendation (reference [2]) in a tutorial fashion;

– section 4 contains a tutorial on data description packaging specified in the Control Authority Data Structures (CADS) Recommendation (reference [3]);

– section 5 presents the requirements and their rationales for the establishment of the Control Authority organization and for the structure of CADS;

– annex A contains the acronyms and abbreviations that are used in this document;

– annex B provides the glossary of terms used in this document;

   – annex C provides contact information for the Member Agency Control Authority Offices (MACAOs) existing at the time this document is produced;

   NOTE – This information will be provided in the CA Annual Report.

   – annex D provides a sample forms view for registration of data descriptions;

   – annex E provides scenarios that explain the concept of revisability of data descriptions.

1.4   REFERENCES

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

[1]   *Procedures Manual for the Consultative Committee for Space Data Systems.* CCSDS A00.0-Y-6. Yellow Book. Issue 6. Washington, D.C.: CCSDS, May 1994.

[2]   *Standard Formatted Data Units—Control Authority Procedures*. Recommendation for Space Data Systems Standards, CCSDS 630.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, June 1993.

[3]   *Standard Formatted Data Units—Control Authority Data Structures*. Recommendation for Space Data Systems Standards, CCSDS 632.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, November 1994.

[4]   *Space Data Systems Operations with Standard Formatted Data Units: System and Implementation Aspects.* Report Concerning Space Data Systems Standards, CCSDS 610.0-G-5. Green Book. Issue 5. Washington, D.C.: CCSDS, February 1987.

[5]   *Standard Formatted Data Units—Structure and Construction Rules*. Recommendation for Space Data Systems Standards, CCSDS 620.0-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, May 1992.

[6]   *Parameter Value Language—A Tutorial.* Report Concerning Space Data Systems Standards, CCSDS 641.0-G-1. Green Book. Issue 1. Washington, D.C.: CCSDS, May 1992.

[7]   *Parameter Value Language Specification (CCSD0006).* Recommendation for Space Data Systems Standards, CCSDS 641.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, May 1992.

2   OVERVIEW OF THE CONTROL AUTHORITY CONCEPT

2.1   RATIONALE

Current and future space data systems applications are and will be producing data used over long periods of time by geographically distributed users. A primary objective of these space data systems applications is to have those data available and usable by a number of users. All too often, it is difficult for users to know what data are available or how to locate adequate descriptions of the data. Even after the data and adequate definitions are located, it is often too costly for users to develop software to interpret the data and to prepare them for further analysis. The Standard Formatted Data Unit concept, described in the System and Implementation Aspects Report (reference [4]), the SFDU Structure and Construction Rules Recommendation (reference [5]), and the Parameter Value Language (PVL) Tutorial (reference [6]), is designed to address these situations.

The Control Authority organization is the mechanism within the SFDU concept for ensuring that the descriptions of data will always exist and that the location of the data description and software to interpret the data can readily be found from information contained in the data set.

As described in more detail in 2.3, each data description within the Control Authority organization is given a unique identifier. This unique identifier is part of the standardized label included with the application data and identifies both a particular Member Agency Control Authority Office (MACAO) as well as a particular data description within that MACAO. In this way, any user acquiring the application data is able to identify the particular MACAO where the data description is registered and obtain the data description.

2.2   CONTROL AUTHORITY ORGANIZATION STRUCTURE

Figure 2-1 presents the Control Authority organization. The Control Authority organization is made up of:

– the CCSDS Secretariat, supported by the Control Authority (CA) Agent;

– a number of Member Agency Control Authority Offices (MACAOs).

The CCSDS Secretariat, established by the CCSDS, is the Control Authority Office to which all MACAOs ultimately report; the CA Agent supports the CCSDS Secretariat in all of its Control Authority responsibilities. Both Member and Observer Agencies of the CCSDS may participate in the Control Authority organization and are referred to as Participating Agencies. Each Agency that participates in the Control Authority organization is free to determine its Control Authority organization as it wishes, including sponsoring other organizations to participate within the Control Authority organization. Those organizations might include other Agencies from the same country, private businesses, or universities. All offices within a Participating Agency are referred to as Member Agency Control Authority Offices (MACAOs) regardless of their membership status in the CCSDS. A Participating Agency must, however, establish a Primary MACAO,

which is the official Agency contact with the CCSDS Secretariat. The Primary MACAO has responsibilities in addition to the ones all other MACAOs have.

Figure 2-1 shows some alternative MACAO organizational structures. The organizational structure for Participating Agencies "1" and "n" each consist of only one MACAO, which must be a Primary MACAO. If a hierarchy is established within a given Agency, the relationships of Ascendant MACAO and Descendant MACAOs are used to describe the relative positions of two MACAOs. It is left up to each Agency to determine how it wishes to implement inter-MACAO responsibilities within the Agency. For example, Agency "i" might choose to have all MACAOs other than the Primary MACAO report (per 3.2) directly to the Primary MACAO, or it may decide to have each MACAO report information strictly along its organizational lines.
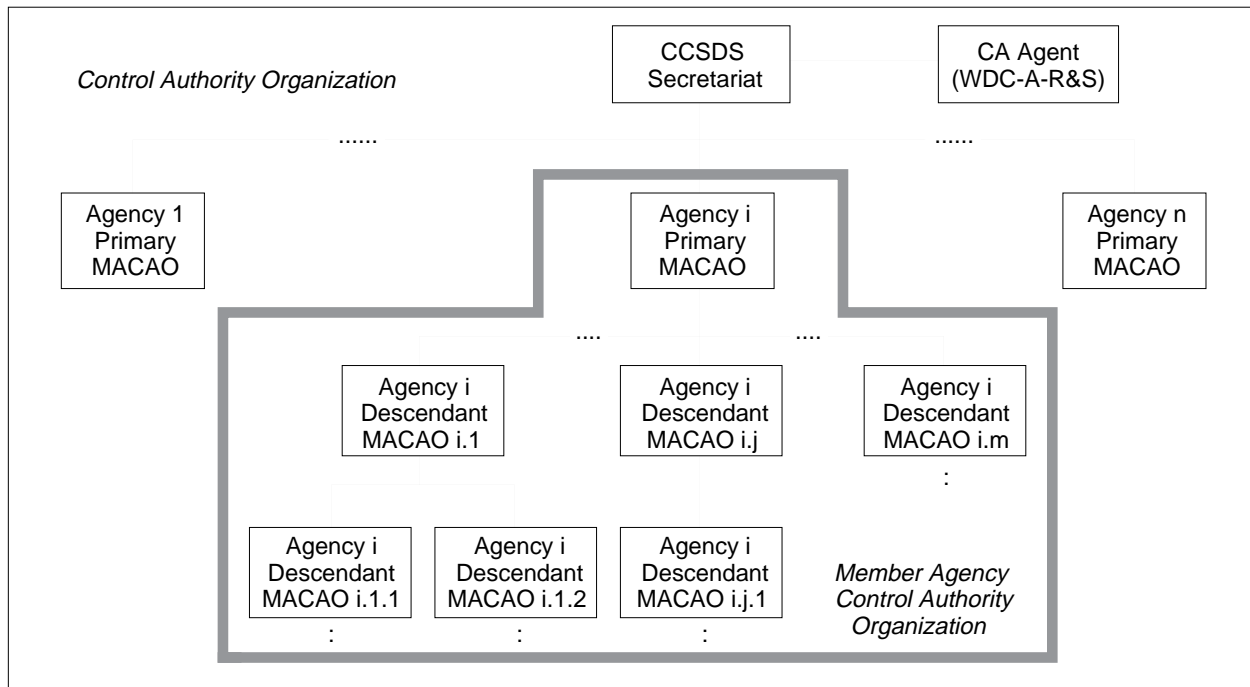
Figure 2-1: Control Authority Organizational Structure

As mentioned earlier, the Primary MACAOs are distinguished from all other MACAOs as they are the focal point to the CCSDS Secretariat and the CA Agent, and they have some additional responsibilities in that role. With that exception, all MACAOs are "equivalent" with respect to one another within the overall Control Authority organization.

A Participating Agency's Control Authority organization might include organizations from other agencies, businesses, or universities. If at some time a descendant MACAO in one of these categories wished to establish its own Control Authority organization, it could do so as long as it has obtained Member or Observer Agency status within the CCSDS.

The CA Agent's role is currently filled by the World Data Center A for Rockets and Satellites (WDC-A-R&S). It performs the CCSDS Secretariat's functions that relate to the Control Authority organization. These include:

–   overall coordination of the Control Authority organization; and

–   provision of all CCSDS data descriptions.

The MACAO's role is to:

–   manage all data descriptions registered with it; and

–   provide necessary information to the CA Agent.

2.3   IDENTIFICATION OF DATA DESCRIPTIONS

All data descriptions registered with the Control Authority organization are uniquely identified by an Authority and Description Identifier (ADID), where:

$$ADID \quad = \quad CAID + DDID$$

where   CAID =   the Control Authority Identifier, which uniquely identifies the MACAO; and

DDID =   the Data Description Identifier, which uniquely identifies the data description within a given MACAO.

Data descriptions are available from both the CA Agent and MACAOs. Those data descriptions which are available from the CA Agent have been assigned a CCSDS ADID. The CCSDS ADID is formulated as follows:

$$CCSDS \ ADID \quad = \quad CCSDzzzz$$

where   CCSD =   the CAID for the CA Agent; and

zzzz =   the DDID, composed of four Restricted ASCII characters (i.e., 0-9, A-Z) which, combined with the CAID, make the CCSDS ADID unique in the CCSDS domain.

The MACAO ADID is formulated as follows:

$$MACAO \ ADID \ = \ xyyyzzzz$$

where   xyyy =   the CAID for that MACAO; and

zzzz   =   the DDID, composed of four Restricted ASCII characters which, combined with the CAID, make the MACAO ADID unique in the CCSDS domain.

Annex C contains the list of current CAIDs.

NOTE – This list will appear in the CA Annual Report when it is published.

There is one restriction on the first character of the CAID: it cannot be the character "Z" if Control Authority services are desired. No CAID starting with the character "Z" will be assigned to a Participating Agency. That character is reserved for assignment to data descriptions that a user wishes to put in SFDU format but does not intend to register with the Control Authority organization. The Control Authority organization provides no support for such usage. Use of a "Z ADID" would be for temporary use of the data and data description, perhaps for a period of local testing that requires the presence of an SFDU label. Therefore, in open data system interchange, the use of a "Z ADID" requires that the data description and the data be packaged together, and care should be taken to ensure no duplicate "Z ADIDs" exist within the package.

3   TUTORIAL FOR THE CONTROL AUTHORITY PROCEDURES

This section of the document provides a discussion on each feature of the Control Authority organization presented in the Control Authority Procedures Recommendation (reference [2]). The features are divided into the categories of user services provided by the Control Authority organization and internal administration procedures. User services provided by the Control Authority organization are those functions provided to individuals and organizations that relate primarily to the registration, revision, and dissemination of data descriptions. Internal administration procedures relate to those functions necessary for creation and maintenance of the Control Authority organization infrastructure in a globally coordinated manner.

3.1   USER SERVICES PROVIDED BY THE CA ORGANIZATION

The Control Authority organization provides standardized services to users for the registration, revision, and dissemination of data descriptions. The services are described in the following subsections; they describe the interaction between a user and the Control Authority organization. These services are the mechanism by which all users, including a MACAO requesting support from another MACAO, have a common expectation of what is required of them and with what they will be provided. This subsection of the document is a tutorial for both the users and implementers of these services. Table 3-1 summarizes these services and identifies the part(s) of the Control Authority organization responsible for them.

Table 3-1: Summary of User Services Provided by the Control Authority Organization

Service	Responsible Office	Subsection
Request Processing	CA Agent, MACAO	3.1.1
Dissemination of CCSDS Data Descriptions	CA Agent	3.1.2
Registration of Data Descriptions	MACAO	3.1.3
Dissemination of Data Descriptions	MACAO	3.1.4
Revision of Data Descriptions	MACAO	3.1.5
CA Annual Report Dissemination	CA Agent, MACAO	3.1.6

3.1.1 REQUEST PROCESSING

"Request processing" is the phrase used to describe the interaction between a user and an office within the CA organization. The service that all users can expect is that:

–   An acknowledgement of the request will be provided.

–   A response will be provided in no more than five days, minimally confirming receipt of the request and including a promised date when the requested information will be provided. In the event that a promised deadline cannot be met, a subsequent message with a new promised date will be sent by the MACAO to the requester.

–   An explanation will be provided in the case that a request cannot be fulfilled.

The scope of requests covered by this service is those services described in the Control Authority Procedures Recommendation (reference [2]), which involve the registration, revision, and dissemination of data descriptions, and access to information in the CA Annual Report. Data descriptions are categorized as either MACAO data descriptions or CCSDS data descriptions. A MACAO data description is one created by a data producer and registered with a MACAO (see 3.1.3). CCSDS data descriptions are developed within the CCSDS organization and are subject to the CCSDS standardization approval process documented in the CCSDS Procedures Manual (reference [1]). The CCSDS ADID is assigned as part of this standardization process.

Although requests for and about data descriptions can be made of any office in the Control Authority organization, the CA organization suggests that the requester directly contact the office that is responsible for the data description. For instance, requests for CCSDS data descriptions would best be made of the CA Agent, who is responsible for the CCSDS data descriptions. On the other hand, data descriptions that had been registered at a specific MACAO (identifiable by the CAID within the label of the SFDU containing the application data) would be more appropriately requested from the MACAO where the description was registered. A MACAO may respond to a request for a data description not held at that MACAO simply by returning contact information for the correct MACAO.

The above types of requests are the minimum kinds of requests for which the Control Authority provides guaranteed services. Other services that the local MACAO could choose to provide include:

–   general guidance on the interactions with the CA Agent;

–   general guidance on the interactions with other MACAOs;

–   support in producing SFDUs; and

–   support in locating and using software.

The extent of such services will be determined by the local agency.

In order for a MACAO to be able to accept a request, it must be in a format that is supported by that MACAO. The user and MACAO must reach agreement about the medium and the protocol that will be used to communicate the request and the requested information. For instance, in the case of registration of a data description, the MACAO will have preferred media with which it wishes the user to communicate. The user will need to tell the MACAO how to extract the data description from the agreed upon medium (e.g., a filename for disk, the order of the file on a tape, an electronic mail message). The mechanism for this negotiation is entirely up to the local MACAO. It may be verbal, written, or electronic. Figure D-1 (in annex D) provides an example of a form used to obtain the information that a MACAO may require from the user prior to accepting a Registration Package (RP) from a user. The example form is intended to be representational, not all inclusive or required. As another example, in the case of requesting the Annual Report, the user will need to negotiate with the MACAO to determine the medium (e.g., hard copy, a PostScript file, or an ASCII file on PC disk) in which the CA Annual Report will be provided.

3.1.2 DISSEMINATION OF CCSDS DATA DESCRIPTIONS

CCSDS data descriptions are developed within the CCSDS organization and are subject to the CCSDS standardization approval process documented in CCSDS Procedures Manual (reference [1]). The CCSDS ADID is assigned as part of this standardization process. Although CCSDS data descriptions are available in documents called CCSDS Recommendations, a user can request the data description from the CA Agent by supplying the ADID by which the data description is known. In return, the user would receive the CCSDS Recommendation containing the data description. A complete list of the CCSDS ADIDs will be contained in the CA Annual Report.

3.1.3 REGISTRATION OF DATA DESCRIPTIONS

This service, which is provided only by MACAOs and not the CA Agent, allows producers of data to make the data descriptions (format and semantics) of data products available for all who require them. This ensures that the producer of a data product does not have to provide the data description separately to each user utilizing the data product. It provides continual availability of the data description and an unambiguous way to relate a data product to its data description(s).

The MACAO requires certain information from the user in order to perform the registration service. The information the user provides to the MACAO is information about the Originator of the data description, about any Permitted Revisors, about the data description, and the data description itself. This information is provided to the MACAO in a Registration Package (RP). Just as with the request processing service discussed above, each MACAO will establish a user interface to supply this information. For example, the user interface may be a screen form, an interactive screen dialogue, or a hard copy template. Example input forms for RP and RRP submission are shown in figures D-2 and D-3 in annex D. The standard interchange format of this information, specified in the CADS Recommendation (reference [3]), is discussed in detail in section 4 of this document.

3.1.3.1 Registration Package

The following points describe the information that all MACAOs require from a user to register a data description:

a) Submission date of RP to MACAO. The date that the data description is provided to the MACAO.

b) Title, in English, identifying the data description. Words that will succinctly identify the data description.

c) Description, in English, of the purpose and scope of the data description.

d) Identification of the Originator. Information that identifies the individual or organization submitting the data description.

   1) Name. The name of the individual and/or position. The name provided should ensure a degree of permanence (e.g., it should not be the name of a summer student).
   2) Affiliation. The company, Agency branch/code, or project for the person/position submitting the data description.
   3) Postal Address. The address of the person/position submitting the data description.
   4) Telephone number(s). The number(s) that allow voice contact with the Originator.
   5) Electronic mail address(es). The various ways to contact the Originator electronically, including Telemail, Internet, and other systems. If there is no electronic mail address, this must be indicated ("Not Available" may be indicated for this item).
   6) Facsimile number(s). The number(s) that allow facsimile contact with the Originator. If the Originator has no facsimile, this must be indicated ("Not Available" may be indicated for this item).

e) Permitted Revisers. Information that would be provided for each individual or organization designated as a reviser of the data description. The information required for each Permitted Reviser is the same as for the Originator (point d 1-6 above). This list must be provided each time the RP is submitted (i.e., the current Permitted Revisers list is not carried forth with a new revision.) Furthermore, the Originator is not automatically a Permitted Reviser; his/her name and/or position must be explicitly entered as a Permitted Reviser if it is to be included. If there are no Permitted Revisers (i.e., the intention is that the data description not be revisable), there must be no names in this list and the revisability status must indicate "non-revisable."

f) Revisability Status. This indicates whether the data description can be revised. This status must be consistent with the contents of the Permitted Revisers list (i.e., if this indicates the data description is not revisable, there will be no names in the list of Permitted Revisers).

g) Revision Comment, in English. This indicates the nature of the revision. In the case that this is for the initial submission of the RP, it indicates that this is the original submission.

It may be used to provide only a description of this version, or (as it is revised per 3.1.5), to provide a revision history for the data description.

h) Release Status. This indicates whether the data description can be disseminated to the public (i.e., it is releasable) or whether it can only be disseminated to the Originator or Permitted Revisers (i.e., it is non-releasable). See discussion in 3.1.4.

i) The data description. It is possible that the data description could be provided in hard copy only, although electronic form is preferred, and individual MACAO procedures may require submission in electronic form. Ultimately, there must be a data description for the Registration Package to be complete enough to release. It is up to the local MACAO to determine the level of verification of the contents of this item.

3.1.3.2 Additional Information

In addition to the information required by the Control Authority Procedures Recommendation (reference [2]), a local MACAO may wish to have additional information provided by the user. However, this additional information would not be part of the standard data structures. The local MACAO will, of necessity, establish local conventions for checking the RP submitted. These checks could include:

– Is the information provided adequate? (E.g., is the Originator appropriate as a long-term contact?)

– Is the information provided accurate? (E.g., are the telephone numbers, facsimile numbers, etc. correct?)

– Is the RP redundant? (E.g., has a similar data description been registered at the local MACAO or elsewhere within the CA organization?)

– Is there accountability for this data description? (E.g., is the Originator involved in a supported project; has the project overspent its computer resources?)

It should be noted that the MACAO, typically a project-independent infrastructure element, is in an ideal position to monitor the formats defined by different projects and to provide support in identifying suitable formats for reuse.

3.1.4 DISSEMINATION OF DATA DESCRIPTIONS

Dissemination of data descriptions is the service by which a user would receive a requested data description. A user would initiate this service by submitting a request (which would be handled as described in 3.1.1) containing an ADID (plus the information needed to return the information) to a MACAO. The associated data description will be disseminated in the form of a Data Description Package (DDP).

Except for the date of submission, all information included in the RP or the most recent RRP for this data description will be disseminated to requesters. As a result of the RP or RRP request, the DDP is sent to the Originator so that he or she will have an exact copy of what requesters receive. In addition to what the Originator provided, the DDP includes the following items:

a) The ADID of the data description. If the DDP is being disseminated in response to a user request or returned in response to an RRP, then this is the same ADID submitted in the user's request. If the DDP is in response to the registration of a data description, then this is the ADID as assigned by the MACAO.

b) Registration Date of the data description. This is the date that this version of the data description was registered (which is distinct from the date the RP or RRP was submitted). The Submission Date is not included in the DDP.

c) Revision Number of the data description. Unless a specific revision number (version) had been requested, this will be the revision number of the most recent releasable revision. If the requester is the Originator or one of the Permitted Revisers of the non-releasable version of the data description, he or she may also request and receive the non-releasable version if it exists.

Before a data description can be released to anyone other than the Originator or a Permitted Reviser, its status must be releasable. Experience has indicated that RPs may initially be submitted to a MACAO with some of the required fields not having very meaningful data (e.g., "unknown at this time"), or even without the actual data description, and still have an ADID assigned as long as a clear description of how the data description is to be used is included (see annex E). This would provide the Originator with a period of time for testing (other than by using the "Z ADID"). If a MACAO adopts this kind of approach to registration, it might also have a local procedure that would keep the status of this RP as non-releasable until the RP included all required information including a complete data description. Even if the Originator indicated the RP was to be releasable, the MACAO would keep it in a non-releasable status until all required information is provided.. MACAOs may even establish further local procedures for ensuring the quality of the data description is good enough to disseminate to the general user community before allowing the status to be releasable. Conversely to the situation described above, the MACAO may consider the data description releasable in terms of completeness, but the Originator may not because of the possible instability of the data description. Once a data description's status is made releasable, that version of the data description cannot revert to a non-releasable status.

If a user makes a request of a MACAO that is not responsible for the requested data description, the MACAO of whom the request was made has a choice:

a) The MACAO may effectively become a user and request the information from the appropriate MACAO. The second MACAO would then return the information to the first MACAO which would then return it to the user. The first MACAO is responsible for responding to the requester within five days.

b) The MACAO may forward the request to the appropriate MACAO. The first MACAO must send the requester notice that the request has been forwarded.

c) The MACAO may respond to the user saying it cannot satisfy the request and provide the contact information for the appropriate MACAO.

Once the MACAO responsible for the data description receives the request, within five days it will:

a) accommodate the request by providing the requested data description;

b provide an explanation of why the request cannot be fulfilled; or

c) provide an explanation for the delay in accommodating the request along with a promised date for completing the request. In the event that a promised deadline cannot be met, a subsequent message will be sent by the MACAO providing an explanation and a new promised date. Eventually, the MACAO will provide the requested data or an explanation of why the request cannot be fulfilled.

In the case where the requested data description had been registered with a MACAO that has been dissolved (see 3.2.4), the requester would need to determine new contact information for the dissolved MACAO. In this event, the user could contact the Primary MACAO or the CA Agent to determine the new contact information. In the case where the dissolved MACAO is the Primary MACAO, the user would contact the CA Agent to obtain the new contact information.

NOTE – New contact information for dissolved MACAO is included in the CA Annual Report.

3.1.5   REVISION OF DATA DESCRIPTIONS

Registration of revised data descriptions parallels the registration of data descriptions described in 3.1.3. The one additional piece of information required for a revision is the ADID of the data description being revised.

When an RRP is submitted, the person or organization submitting it is called the Originator (of that version). Whereas anyone may submit an RP for the first time, there are restrictions on who may submit a revision for a data description. Only those individuals or organizations indicated in the Permitted Revisers list of the most recent releasable version of the data description can submit a Revision Registration Package (RRP). The Permitted Revisors list is part of the information provided in a Registration Package (RP) or an RRP. If all names were inadvertently omitted from the Permitted Revisors list when the data description was registered, the entire data description would need to be resubmitted and assigned a new ADID. Also, the Originator of a data description is not automatically a Permitted Reviser; his or her name would have to be explicitly supplied as a Permitted Reviser, if applicable. The cycle of Permitted Revisers becoming Originators continues with each subsequent submission.

In all cases, the revision is against the most recent releasable version of the data description. Table 3-2 presents the various scenarios that might occur in revisions of data descriptions. The subscripts "a", "b", and "c" distinguish the data descriptions from one another in a given scenario, and the subscripts "N" and "N+1" indicate the revision number as stored (where "N" is always the most recent releasable version prior to submission of the RRP).

The simplest scenario addresses the situation where a releasable data description revision is submitted, and there are only releasable data descriptions having that ADID in the MACAO's system. The newly submitted version would be assigned a number one greater than the revision number of the previous releasable version of the data description. This is represented by Scenario 1 in table 3-2.

A slightly more complex scenario addresses the situation where a releasable version (data description "a") exists and a data producer has been doing some testing with the data description (data description "b") and submits a new version (data description "c") that he deems releasable. This results in the archiving of both the original releasable data description "a" and the new releasable data description "c". Data description "c" is assigned the revision number of the non-releasable data description "b". Data description "b" is no longer maintained in the archive. This is represented by Scenario 2 in table 3-2.

Table 3-2: Summary of Revision Scenarios

Scenario	Archived Data Description(s) (Before Revision Submitted)	Submitted Revision Data Description	Archived Data Descriptions (After Revision Submitted)
Scenario 1	Releasable$_{a(N)}$	Releasable$_b$	Releasable$_{a(N)}$ Releasable$_{b(N+1)}$
Scenario 2	Releasable$_{a(N)}$ Non-releasable$_{b(N+1)}$	Releasable$_c$	Releasable$_{a(N)}$ Releasable$_{c(N+1)}$
Scenario 3	Releasable$_{a(N)}$	Non-releasable$_b$	Releasable$_{a(N)}$ Non-releasable$_{b(N+1)}$
Scenario 4	Releasable$_{a(N)}$ Non-releasable$_{b(N+1)}$	Non-releasable$_c$	Releasable$_{a(N)}$ Non-releasable$_{c(N+1)}$

Another variation, represented in Scenario 3, shows what happens when a non-releasable data description is submitted and there are only releasable data descriptions having that ADID in the MACAO's system. The non-releasable data description "b" would be assigned a number one greater than the revision number of the most recent releasable data description "a". Both of them would be archived, but only the Originator or Permitted Revisers for the non-releasable data description could request the non-releasable version.

The most complex scenario addresses the situation where a data producer is still testing the data description and does not consider the data description ready for release. The data description may go through several revisions before it is considered releasable by the Originator. But for the external user, all these iterations are irrelevant since the data description is not releasable. Therefore, the revision number of each iteration should not be incremented, as doing so would result in a gap in revision numbers for releasable data descriptions. This is represented in Scenario 4, which shows the same revision number for submissions of non-releasable data descriptions "b" and "c". Each non-releasable version replaces the previous non-releasable version in the archive.

It should be noted that there is no automatic notification required when revisions are registered. Users of revisable data descriptions might check with the MACAO periodically to ensure they have the most recent revision. Alternatively, the Originator or the local MACAO might assume the responsibility of automatic notification to all known users of a data description that has been revised. Scenarios describing some circumstances in which revisions might be made, as well as when it might be more appropriate to have a data description be non-revisable, are provided in annex E.

3.1.6 CA ANNUAL REPORT DISSEMINATION

The Control Authority organization is responsible for producing a report annually that contains an overview of the Control Authority organization, a summary of all the CCSDS data descriptions available within the organization, and a summary of MACAO data description activity for the previous calendar year. Users can request this report from the CA Agent or any MACAO. This may be an opportunity for users to be made aware of data descriptions that could be useful to them.

3.2 INTERNAL ADMINISTRATION PROCEDURES

This subsection of the document is a tutorial directed at implementors of a MACAO. Table 3-3 identifies the various internal administration procedures, which entities within the Control Authority organization are responsible for them, and the subsections of the document in which they are described.

3.2.1 ESTABLISHING A PRIMARY MACAO

Recognition by the CA Agent of an Agency's proposed Primary MACAO is the way that an Agency becomes a part of the Control Authority organization. To establish a Primary MACAO, the Agency must first submit a request to the CA Agent. That request contains the following information:

- Participating Agency name;

- the name of the Participating Agency representative to CCSDS (i.e., the CCSDS Head of Delegation), and their contact information.

Table 3-3: Summary of Internal Administration Procedures

Procedure	Responsible Office	Subsection
Establishing a Primary MACAO	CA Agent	3.2.1
Dissolving a Primary MACAO	CA Agent	3.2.2
Establishing a Descendant MACAO	MACAO, Primary MACAO	3.2.3
Dissolving a Descendant MACAO	MACAO, Primary MACAO	3.2.4
Publishing the CA Annual Report	CA Agent, Primary MACAO	3.2.5

The request also includes the following information about the Primary MACAO:

– the proposed Control Authority Identifier (CAID);

– the name of the MACAO and contact information; and

– principal and secondary contacts and their contact information.

NOTE – This information will be included in the CA Annual Report.

Many Agencies have requested a specific character as an Agency identifier to be the first character of the Control Authority Identifier (CAID) (as noted in annex C) for all MACAOs in their Agency.   Such requests will be considered until name space considerations make this impractical.   Within this restriction, if the proposed CAID is unique, the CA Agent will approve it. If not, the CA Agent will inform the Agency representative; the process will continue until a unique CAID is identified.

This information listed above is also provided to the CA Agent as part of the CA Annual Report submission and is maintained by the CA Agent.

The function of establishing a Primary MACAO is expected to be exercised very infrequently. In fact it will be limited to occurring at most once per Participating Agency.

3.2.2   DISSOLVING A PRIMARY MACAO

If a participating Agency decides to dissolve its Primary MACAO, it needs to inform the CA Agent of its intent. Given that the Control Authority organization is responsible for ensuring continued availability of data descriptions, another Participating Agency needs to be identified to provide archiving, revising, and disseminating support for the data descriptions that had been registered with the dissolving Primary MACAO (and handling interactions with any of its Descendant MACAOs). Therefore, the CA Agent will conduct negotiations to identify the best

replacement for the dissolving Primary MACAO. When the transfer of responsibility has been completed, the CA Agent should be notified so requester can be given correct contact information.

NOTE – This information will be included in the CA Annual Report.

The function of dissolving a Primary MACAO is expected to be exercised very infrequently.

3.2.3 ESTABLISHING A DESCENDANT MACAO

The MACAO that is establishing the new (Descendant) MACAO:

– proposes a CAID for the Descendant MACAO;

– informs the Primary MACAO of the new Descendant MACAO (and the proposed CAID) if it is not the Primary MACAO.

The Primary MACAO provides the CA Agent with all the identifying information for the newly established MACAO, including:

– the Primary MACAO's CAID and contact information;

– the Descendant MACAO's proposed CAID, name, and contact information.

The reason for creating a Descendant MACAO may be to support geographic distribution of facilities (e.g., Agency centers) or users, or may be based on funding. Regardless of the reason, the choice and subsequent management is internal to the Agency.

3.2.4 DISSOLVING A DESCENDANT MACAO

If a choice is made to dissolve a MACAO, another MACAO must be identified to continue the archiving, revising, and disseminating responsibilities for the data descriptions that had been registered (or assumed) by the MACAO that is dissolving. The Primary MACAO must notify the CA Agent of:

– the change to its organizational structure;

– which MACAO has assumed responsibility for the transferred data descriptions.

The MACAO that assumes these responsibilities does not have to be from the same agency; the negotiations for assuming the responsibilities can be with any MACAO. For instance, if there is a multi-agency project, it may be more appropriate for a dissolved MACAO to be assumed by another agency participating in the project than by another MACAO in the same agency.

This function is expected to be exercised infrequently.

3.2.5 CA ANNUAL REPORT PUBLICATION

Once a year, the CA Agent is responsible for publishing a report about its organization. Part of the report addresses the current Control Authority organizational structure, part of it provides a summary of all CCSDS data descriptions, and part of it provides a summary of all the registration and dissemination activity that has occurred in the preceding year.

It is expected that the CA Agent will eventually make this report available via an on-line system.

The Primary MACAOs have the responsibility of providing all the input to the CA Agent that will allow for the publication of the CA Annual Report. At this time, the contents of the report are defined, but they are expected to be refined as the result of experience. The expectation is that, as input from the MACAOs is submitted to the CA Agent, further requirements and refinements for the report will be established.

The entire structure of the Control Authority organization is reported each year. Although a graphical representation of the organization is not required, it is a means of conveying the organizational structure. In the event that a MACAO is dissolved, the newly assigned responsible MACAO and the new contact information will be identified in the report. The ADID of data descriptions that are thus reassigned will not change; therefore, their new source will be officially identifiable through this report.

4   TUTORIAL FOR THE CONTROL AUTHORITY DATA STRUCTURES (CADS)

The interchange of data descriptions with a MACAO can be greatly facilitated by the use of standard data structures which enable both the MACAO and user to consistently process information. These structures are specified in the CADS Recommendation (reference [3]), and they are called Controlled Authority Data Structures (CADS). Three variations of these structures have been defined, one each for the submission of an original Registration Package (RP), the submission of a Revision Registration Package (RRP), and the dissemination of a Data Description Package (DDP).

The CADS are part of the larger context of structures documented in the CCSDS Standard Formatted Data Units (SFDU) Structures and Construction Rules Recommendation (reference [5]). The CADS have been specified as conforming with a Data Description Unit (DDU), which is identified as a Label Value Object (LVO) with Class ID = F and an ADID = CCSD0005.

An important single restriction for a DDU, and therefore for CADS, as specified in the CCSDS Standard Formatted Data Units (SFDU) Structures and Construction Rules Recommendation (reference [5]) is that it contain an LVO with Class ID = C and an ADID = CCSD0004. The first parameter of this LVO, ADIDNAME, is required. In the CADS context, the value for this parameter would be the ADID of the data description being registered (or revised or disseminated). The other three optional parameters (DEDID, DDRID, and SUPID) provide the user with the ability to logically include data entity dictionaries, data description records, or supplementary information, respectively, from previously registered data descriptions. If the user provided values for any of these parameters, the corresponding LVOs would be logically included with this description. This is discussed further in 4.1

The CADS Recommendation (reference [3]) further specifies that the LVO with Class ID = C be followed immediately by an LVO with Class ID = K and an ADID = CCSD0007. The contents and rules for the LVO with ADID = CCSD0007 are described in 4.2. This LVO identifies the specific type of CADS package the DDU represents (i.e., RP, RRP, or DDP), and contains information about the data description and the submitter of the data description as required by CA Procedures Recommendation (reference [2]). An individual MACAO may choose to require that additional information be supplied in addition to that specified by CCSD0007. Should that be the case, the additional locally identified information can be defined and included in additional LVOs with Class ID = K and appropriate MACAO ADIDs, i.e. the additional information may not be added to the LVO with Class ID = K and ADID = CCSD0007.

Figure 4-1 provides the structure diagram for the value field of the CADS DDU. There may be zero or more LVOs with Class ID = D, E, S, K, or R following the mandatory LVO with Class ID = K and ADID = CCSD0007. These LVOs supply the content of the data description to be registered, revised, or disseminated. There are several circumstances in which there might be zero LVOs with Class ID = D, E, S, K, or R. One is that the data description might still be in the testing phase, but the submitter requires a MACAO ADID for complete and accurate testing (as opposed to using the "Z ADID"). Another circumstance could occur if the data description

being registered is merely a logical collection of previously registered data descriptions using the optional parameters in the LVO with ADID = CCSD0004. For example, any DEDID parameters would have previously registered Data Entity Dictionaries be logically included, any DDRID parameters would have previously registered Data Description Records be logically included, and any SUPID parameters would have previously registered Supplementary Information be logically included. In this fashion, a data description that is the sum of the pieces is registered without any redundancy of information. The rules addressing the relationship among logically and physically included LVOs with Class ID = E are discussed in the CADS Recommendation (reference [3]).
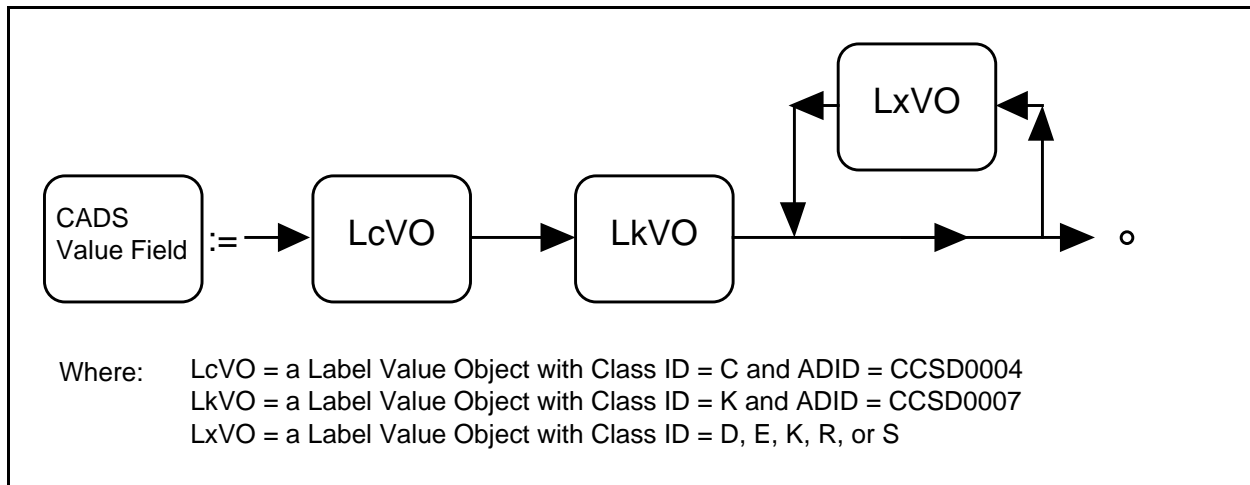
Figure 4-1: Structure Diagram for Value Field of CADS DDU

In accordance with the requirements of the SFDU Structure and Construction Rules Recommendation (reference [5]), the DDU must be contained in an Exchange Data Unit (EDU) when it is actually exchanged between MACAOs and users (i.e., when the user submits an RP or RRP or the MACAO disseminates a DDP).

4.1 VALUE FIELD CONSTRAINTS ON THE LVO WITH CLASS ID = C

The value field for the LVO with Class ID = C consists of one mandatory and three optional PVL statements (of which there can be multiple occurrences). The mandatory statement takes the form:

> ADIDNAME = adidname;
> where adidname = 8 Restricted ASCII (RA) characters

A further restriction is placed on the first character of the ADIDNAME value, which is dependent on the package type identified in the LVO with ADID = CCSD0007. If the CADS package type

is RP, the first character of the ADIDNAME value must be "Z". The first character must not be "Z" if the CADS package type is RRP or DDP. The reason for the restriction is that an ADID is assigned at the time a MACAO registers the data description. The value of the ADID is unknown at the time the RP is submitted for registration. A "Z" in the first position of ADIDNAME value indicates that the ADID has not been assigned by a MACAO. RRPs and DDPs require that the ADIDNAME parameter be set to the ADID assigned by the MACAO. MACAO ADIDs can never begin with a "Z." Therefore, RRPs and DDPs can never contain a "Z" as the first character of ADID.

As discussed in the previous subsection, there are three optional parameters that may appear in the LVO with ADID = CCSD0004 as specified in the CCSDS Standard Formatted Data Units (SFDU) Structures and Construction Rules Recommendation (reference [5]). If any of them appears, the result is the logical inclusion of the identified LVOs as part of the data description being registered, and specific details on their usage is in that reference.

4.2   TUTORIAL FOR THE SPECIFICATION OF ADID = CCSD0007

This subsection presents a tutorial on the construction of LVOs with ADID = CCSD0007. The formal specification of CCSD0007 is contained in the CADS Recommendation (reference [3]) and is not included here; the reader is assumed to have ready access to that document.

The following subsections provide a detailed tutorial for each of the three CADS package types. The three tutorials are organized around real-world examples of the RP, RRP, and DDP, respectively, that are compliant with the CADS Recommendation. The complete structure of each package is provided (i.e, the EDU), including SFDU labels conformant with the CCSDS Standard Formatted Data Units (SFDU) Structures and Construction Rules Recommendation (reference [5]). The conventions used in these figures are: **BOLD** is used for required items, *italics* is used for labels, and all other items are shown in plain text.

4.2.1   THE REGISTRATION PACKAGE (RP)

The Registration Package is the form of CADS that is used to submit a data description to a MACAO for initial registration by the Control Authority organization. The vehicle, e.g. network protocol or physical media, by which a MACAO obtains the RP is not the subject of this document. The MACAO may accept the RP using a variety of communication protocols such as electronic mail, file transfer, etc. The MACAO may also accept RP information using mechanisms in addition to the CADS, although these are not required by this Recommendation.

CCSD3ZS00001marker11CCSD3FS00005marker12CCSD3CS00004marker13

ADIDNAME = ZSSD0000;   /*as provided by the submitter*/
                                             /* to be reassigned by MACAO */
DEDID = NSSD3456;   /*logically includes data entity dictionary from NSSD3456
                              description*/

CCSD$$MARKERmarker13CCSD3KS00007marker14

PACKAGE_TYPE = RP;
SUBMISSION_DATE = 1993-11-22;
TITLE = "Zoro Magnetometer Level 1 Processed Output";
DESCRIPTION = "This data description addresses the ZORO level 1 output object
              obtained from conversion of the instrument incorporates an external Data
              Entity Dictionary (DED) used by the Alpha Project";
RELEASABLE = YES;
REVISABLE = YES;
REVISION_COMMENT = "Initial version";
BEGIN_OBJECT = ORIGINATOR;
  NAME = "Doe, Jane R.";
  POSITION = "ZORO Data Administrator";
  AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
  POSTAL_ADDRESS = ("2317 Lambert Drive", "Rockville, MD 20852", "USA");
  PHONE = "+1 301 225 5089**"**;
  EMAIL = (Internet, "doe@swish.mario.naeda.gov");
  FAX = "+1 301 225 6222**"**;
END_OBJECT = ORIGINATOR;
BEGIN_OBJECT = REVISER;
  NAME = "Doe, Jane R.";
  POSITION = "ZORO Data Administrator";
  AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
  POSTAL_ADDRESS = ("2317 Lambert Drive", "Rockville, MD 20852", "USA");
  PHONE = "+1 301 225 5089**"**;
  EMAIL = (Internet, "doe@swish.mario.naeda.gov");
  FAX = "+1 301 225 6222**"**;
END_OBJECT= REVISER;

CCSD$$MARKERmarker1CCSD3DS00002marker15

  The format of the ZORO level 1 data object is as follows:
  (etc.)

CCSD$$MARKERmarker15CCSD$$MARKERmarker12CCSD$$MARKERmarker11

Figure 4.2.1-1: Example Submission of an RP to a MACAO

As this RP is being submitted to a MACAO, it is enclosed in an EDU as identified by the first 20 byte label with Class ID = Z and ADID = CCSD0001. Note that the SFDU labels have been highlighted with an italic font to make them more visible to the reader. Also note that the marker delimitation technique is being used in all the labels in this example (see the CCSDS Standard Formatted Data Units (SFDU) Structures and Construction Rules Recommendation (reference [5])).

Inside the EDU is a CADS DDU, identified by the second 20 byte label with Class ID = F and ADID = CCSD0005. Inside this DDU is a sequence of three LVOs. The first LVO, required in all DDUs, starts with the third 20 byte label and has a Class ID = C and ADID = CCSD0004. The label is followed by two PVL parameter statements, and the LVO is terminated by its marker (CCSD$$MARKERmarker13). The value field of this LVO has the mandatory ADIDNAME parameter which provides a name to the DDU. In this example, the name is "ZSSD0000". Since it begins with a "Z" this indicates it has not been assigned by the Control Authority organization. This is correct because this is an RP that is being submitted to a MACAO for registration and assignment of a unique ADID.

The second parameter in this example, which is optional, is the DEDID parameter whose value is NSSD3456. It is used to logically include, within this DDU, all the LVOs with Class ID = E (i.e., the Data Entity Dictionaries) that will be found in the previously registered data description whose ADIDNAME = NSSD3456. In other words, the data description previously registered as NSSD3456 is expected to have one or more DEDs and they are also considered to be a part of (i.e., logically include in) this DDU. This allows these DEDs to be registered once but to be part of many other registered data descriptions.

Following the LVO with Class ID = C is an LVO with Class ID = K and ADID = CCSD0007. This is shown by the 20 byte label that follows the LVO with Class ID = C. This LVO carries the registration attributes using PVL as specified in the CADS Recommendation (reference [3]). Each of these attributes is described below.

In this example, the third LVO of the CADS DDU is an LVO with Class ID = D and an ADID = CCSD0002. This LVO would contain the description of the format (Class ID = D) written in English/ASCII (ADID = CCSD0002).

Following is a description of each of the registration attributes included in the second LVO.

PACKAGE_TYPE—The CADS PACKAGE_TYPE identifies the type of package. It is represented as a PVL string and is identified by the statement:

PACKAGE_TYPE = RP;

SUBMISSION_DATE—SUBMISSION_DATE is the date supplied by the Originator indicating when he or she submitted the package to the MACAO. It is represented as a PVL date. According to the PVL Specification (reference [7]), PVL dates may not have quotes around them and they may take a year, month, and day format or a year and day of the year format. For the

year, month, and day format the form is yyyy-mm-dd where yyyy is the four digit year, mm is the two digit month, and dd is the two digit day of the month. For the year and day of the year format, the form is yyyy-ddd where yyyy is the four digit year and ddd is the three digit day of the year. For example, to represent March 12, 1993, either of the following statements could be used:

<div align="center">

SUBMISSION_DATE = 1993-03-12;

or

SUBMISSION_DATE = 1993-071;

</div>

TITLE—A TITLE is given to each data description. This would be a short summary or characterization of what the data description is about/for. Title is represented as a PVL string. The length of the string may not exceed 80 characters. An example of this parameter is:

<div align="center">

TITLE = "Zoro Magnetometer Level 1 Processed Output";

</div>

DESCRIPTION—DESCRIPTION provides an explanation of the nature and expected usage of the data description. It is represented as a PVL string, and may be up to 240 characters in length.

> DESCRIPTION="This data description addresses the Zoro level 1 output object obtained from conversion of the instrument bit stream. It incorporates an external Data Entity Dictionary (DED) used by the Alpha Project.";

REVISION_COMMENT—The REVISION_COMMENT parameter describes the nature of the change in this version of the data description and is coded as a PVL string. For an RP it must indicate that this is the initial version of the data description. An example is:

<div align="center">

REVISION_COMMENT = "Initial Version";

</div>

RELEASABLE—The value of RELEASABLE indicates whether the Originator says the data description can be made generally available to the user community. The value of this parameter is represented as a PVL string having one of two values, "YES" or "NO". A value of "YES" means that the originator says the data description can be disseminated from the MACAO to anyone requesting it. A value of "NO" means that the data description can only be disseminated from the MACAO to the Originator or a Permitted Reviser. It is suggested that the value of releasable be "NO" until data adhering to the description are publicly available and the data description has been adequately evaluated. However, this would not hold if the description were to be a "standard" to which data carrying the ADID were intended to conform.

REVISABLE—The value of REVISABLE indicates whether the Originator says the data description can be revised. The value of this mandatory parameter is represented as a PVL string having one of two values, "YES" or "NO." A value of "YES" means that those identified as a permitted reviser in any of the REVISER aggregation blocks can subsequently submit a revised data description using the same ADID. A value of "NO" means that the data description cannot be revised. The value of this parameter affects the presence of REVISER aggregation blocks. If the statement

REVISABLE = YES;

is present, then one or more REVISER aggregation blocks (described below) must be present. If the statement

REVISABLE = NO;

is present, then the presence of the REVISER aggregation block is forbidden.

ORIGINATOR/REVISER—The ORIGINATOR and REVISER aggregation blocks are identical in composition and identify the Originator of the Registration Package and any Permitted Reviser(s) of the Registration Package, respectively. CCSD0007 permits the identification of only one Originator and zero or more Permitted Revisers (see REVISABLE above). The aggregation blocks of either type contain the following PVL parameters.

NAME—The value of NAME consists of family name, a comma, an optional title, and then any number of initials or given names for Originator and/or the Permitted Reviser(s). It is expressed as a PVL string and the total string length must not exceed 80 characters. The use of NAME is optional if POSITION is specified (although both may be specified). Examples of the use of the NAME parameter follow:

NAME = "Jones, Jane R.";
NAME = "Jones, Dr. John Whitney";

POSITION—The value of POSITION provides the organizational position or job title of the Originator or Permitted Reviser and is represented as a PVL string whose maximum length is 80 characters. The inclusion of POSITION is optional if NAME is supplied (although both may be specified). For example:

POSITION = "Project Manager";

If several individuals within a group of people are to be designated as Originator or Permitted Revisers, this field, in conjunction with AFFILIATION, can describe that situation. It would not make sense to have a value for NAME in this situation. An example of this would be:

POSITION = "Member";
AFFILIATION = "UARS Science Team";

AFFILIATION—The value of AFFILIATION identifies the institution or organization with which the Originator or Permitted Reviser is associated. This parameter is expressed as a PVL string having a maximum length of 80 characters. AFFILIATION may assume the value of "N/A" if there is no specified affiliation. Examples of AFFILIATION are:

AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
AFFILIATION = "N/A";

POSTAL_ADDRESS—The value of POSTAL_ADDRESS provides the address of the Originator or the Permitted Reviser. The value of this parameter is expressed as a PVL sequence of string values; the lengths of each string forming the sequence may not exceed 80 character. The last string must contain the country. An example follows:

POSTAL_ADDRESS =   ("CODE 632",
                            "NASA Goddard Space Flight Center",
                            "Greenbelt, Maryland",
                            "20771",
                            "USA");

PHONE—The value for PHONE provides the phone number of the Originator or a Permitted Reviser. This parameter is expressed as a PVL string whose maximum length is 30 characters. At least one phone number must be specified for the Originator and each Permitted Reviser. PHONE is specified by concatenating the plus sign (+), the country code, a blank, and the dialing sequence as dialed from outside the country. Only blanks are allowed as separator characters within the PHONE value. Some examples are:

PHONE = "+1 301 286 3575";
PHONE = "+33 61 27 12 34";

EMAIL—The value of EMAIL provides the electronic address of the Originator or Permitted Reviser. This parameter is represented as a PVL string sequence. The string sequence may contain one or two strings. If the sequence consists of a single string, it shall contain "N/A" and not use the set notation; otherwise the sequence shall consist of two string values. The first string value shall contain the network name, (e.g., Internet or NASAMail). The second string value shall contain the network address or the USERID. The EMAIL statement may be repeated as many times as needed. The lengths for each string in the sequence for EMAIL may not exceed 240 characters. Examples follow:

EMAIL = "N/A";

EMAIL = ("Internet","FOO@BAR.COM");

FAX—FAX provides facsimile number of an Originator or Permitted Reviser. This parameter is expressed as a PVL string whose maximum length is 30 characters. One FAX statement is prepared for each phone number. FAX may consist of a single string containing the value "N/A". FAX is specified by concatenating the plus sign (+), the country code, a blank, and the dialing sequence as dialed from outside the country. Only blanks are allowed as separator characters within the FAX value. Some examples are:

FAX = "+49 6151 90 1234";
FAX = "N/A";

4.2.2 THE DATA DESCRIPTION PACKAGE (DDP)

A data description is requested from a MACAO by supplying the registered ADID of the data description and optionally its revision number. If not supplied, the revision number defaults to the most recently registered releasable revision. As described in 3.1.4, the Originator or a Permitted Reviser may request a data description that has not been designated releasable. The MACAO responds to the receipt of the request by preparing a DDP. Figure 4.2.2-1 shows an EDU containing a CADS DDP that could result from the RP example shown in figure 4.2.1-1.

CCSD3ZS00001marker11CCSD3FS00005marker12CCSD3CS00004marker13

ADIDNAME = NSSD3636;   /*as assigned by the MACAO*/
DEDID = NSSD3456;   /*logically includes data entity dictionary from NSSD3456
                              description*/

CCSD$$MARKERmarker13CCSD3KS00007marker14

PACKAGE_TYPE = **DDP**;
REGISTRATION_DATE = 1993-11-26;
TITLE = "Zoro Magnetometer Level 1 Processed Output";
DESCRIPTION = "This data description addresses the ZORO level 1 output object
              obtained from conversion of the instrument incorporates an external Data
              Entity Dictionary (DED) used by the Alpha Project";
RELEASABLE = YES;
REVISABLE = YES;
REVISION_COMMENT = "Initial version";
REVISION_NUMBER = 0;
BEGIN_OBJECT = **ORIGINATOR**;
   NAME = "Doe, Jane R.";
   POSITION = "ZORO Data Administrator";
   AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
   POSTAL_ADDRESS = ("2317 Lambert Drive", "Rockville, MD 20852", "USA");
   PHONE = "+1 301 225 5089";
   EMAIL = (Internet, "doe@swish.mario.naeda.gov");
   FAX = "+1 301 225 6222";
END_OBJECT = **ORIGINATOR**;
BEGIN_OBJECT = **REVISER**;
   NAME = "Doe, Jane R.";
   POSITION = "ZORO Data Administrator";
   AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
   POSTAL_ADDRESS = ("2317 Lambert Drive", "Rockville, MD 20852", "USA");
   PHONE = "+1 301 225 5089";
   EMAIL = (Internet, "doe@swish.mario.naeda.gov");
   FAX = "+1 301 225 6222";
END_OBJECT= **REVISER**;

CCSD$$MARKERmarker1CCSD3DS00002marker15

   The format of the ZORO level 1 data object is as follows:
   (etc.)

CCSD$$MARKERmarker15CCSD$$MARKERmarker12CCSD$$MARKERmarker11

Figure 4.2.2-1: Example Submission of an DDP to a MACAO

The following parameters are noteworthy to discuss for the DDP version of CCSD0007.

ADIDNAME—The value for the ADIDNAME parameter is now a valid MACAO ADID (in this case, NSSD3636) to replace the temporary "Z ADID" in the RP.

PACKAGE_TYPE—The CADS PACKAGE_TYPE now indicates the package is a DDP. It is still represented as a PVL string and is now identified with the mandatory statement:

PACKAGE_TYPE=DDP;

RELEASABLE—The RELEASABLE parameter in a DDP may have the value of "YES" or "NO." It must have a value of "YES" for general distribution of the data descriptions to DDP requesters. If the value is "NO", only the Originator or a Permitted Reviser may receive the DDP. In this case, the value is "YES" and the DDP would be available to all requesters. In a DDP, a value of "YES" indicates both the Originator and MACAO deem the data description suitable for release.

REGISTRATION_DATE—REGISTRATION_DATE is a parameter provided by the MACAO which signifies the date a MACAO assigns an ADID to a data description that has been submitted as a RP, or the date the MACAO increments a Revision Number of a previously registered data description in response to the receipt of a Revision Registration Package (RRP). It is represented as a PVL date.

REVISION_NUMBER—The value for REVISION_NUMBER is provided by the MACAO. This parameter is a number assigned to each revision of a data description. If a data description has not been revised, the value is set to 0. It is represented as a PVL integer.

SUBMISSION_DATE—The SUBMISSION_DATE parameter is not included in the DDP.

4.2.3   THE REVISION REGISTRATION PACKAGE (RRP)

The RRP version of CCSD0007 is constructed with very minor differences from the RP described in 4.2.1. An example EDU for this package is provided in figure 4.2.3-1. Differences from the RP are noted in the paragraphs which follow.

CCSD3ZS00001marker11CCSD3FS00005marker12CCSD3CS00004marker13

ADIDNAME = NSSD3636;   /*as assigned by the MACAO*/
DEDID = NSSD3456;   /*logically includes data entity dictionary from NSSD3456
                    description*/

CCSD$$MARKERmarker13CCSD3KS00007marker14

PACKAGE_TYPE = **RRP**;
SUBMISSION_DATE = 1993-11-26;
TITLE = "Zoro Magnetometer Level 1 Processed Output";
DESCRIPTION = "This data description addresses the ZORO level 1 output object
        obtained from conversion of the instrument incorporates an external Data
        Entity Dictionary (DED) used by the Alpha Project";
RELEASABLE = YES;
REVISABLE = YES;
REVISION_COMMENT = "Updated definitions are provided for Zoro level 1 fields.";
BEGIN_OBJECT = **ORIGINATOR**;
  NAME = "Doe, Jane R.";
  POSITION = "ZORO Data Administrator";
  AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
  POSTAL_ADDRESS = ("2317 Lambert Drive", "Rockville, MD 20852", "USA");
  PHONE = "+1 301 225 5089";
  EMAIL = (Internet, "doe@swish.mario.naeda.gov");
  FAX = "+1 301 225 6222";
END_OBJECT = **ORIGINATOR**;
BEGIN_OBJECT = **REVISER**;
  NAME = "Doe, Jane R.";
  POSITION = "ZORO Data Administrator";
  AFFILIATION = "NAEDA Space Agency, MARIO Field Center";
  POSTAL_ADDRESS = ("2317 Lambert Drive", "Rockville, MD 20852", "USA");
  PHONE = "+1 301 225 5089";
  EMAIL = (Internet, "doe@swish.mario.naeda.gov");
  FAX = "+1 301 225 6222";
END_OBJECT= REVISER;

CCSD$$MARKERmarker1CCSD3DS00002marker15

  The updated description of the format of the ZORO level 1 data object is as follows:
  (etc.)

CCSD$$MARKERmarker15CCSD$$MARKERmarker12CCSD$$MARKERmarker11

Figure 4.2.3-1: Example Submission of an RRP to a MACAO

ADIDNAME—The value for the ADIDNAME parameter is now a valid MACAO ADID (in this case, NSSD3636) to replace the temporary "Z ADID" in the RP.

PACKAGE_TYPE—The CADS PACKAGE_TYPE is represented as a PVL string and is identified by the statement:

PACKAGE_TYPE=RRP;

REVISION_COMMENT—The value of the REVISION_COMMENT parameter contains comments given by the Permitted Reviser (i.e., the new Originator) explaining the nature of the revision. The value field of this parameter is represented as a PVL string which has a maximum length of 8000 characters.

If a running history of revisions is to be maintained for all revisions, the text of the current revision comment may have to be concatenated with the text from previous versions. Conversely, the entire history of revisions could be included in the REVISION_COMMENT field of the current revision. The management of the information for this parameter is a local MACAO function.

4.3   PRODUCTION OF AN RP, AN RRP, OR A DDP

The MACAO is responsible for registering and preserving the information content of registered and revised data descriptions. In addition to the changes required to convert an RP or an RRP to a DDP, the MACAO may or may not preserve the original form of the submitted RP or RRP when encapsulating the data description in the DDP in response to a user request. For example, a MACAO may actually store the CADS information received in an RP or an RRP in a database; the MACAO may then generate the CADS information for the DDP from the information stored in the database. Therefore the DDP form of the CADS may differ in the original input, but the information content will remain the same. RP Originators and RRP Originators should avoid attaching special meaning to formatting choices that may be altered by the MACAO since these items are likely to be changed by automated processes in recipient systems.

This subsection identifies those areas where the MACAO may decide to alter the original form of the RP or RRP submission when preparing the DDP. Changes to these areas in no way affect the information content of the data descriptions. This subsection also highlights areas where changes should not be made to ensure that information is preserved in the exchanges of CADS packages.

4.3.1   SFDU LABEL CHANGES

SFDU labels have been designed to explicitly carry information. Originators should not attempt to implicitly include other information in the syntactical form of the SFDU label.

a) The Version of SFDU Labels used may be changed. No special meaning should be attached to which Version of SFDU Labels is used.

A MACAO could receive an RRP with Version 3 Labels. However, the MACAO may wish to switch all the labels to be Version 1 Labels since the MACAO will have to send the DDPs through a particular mission center that was implemented before Version 3 labels were defined. This could allow continued use of previously implemented software that would otherwise be unable to operate in the current environment.

b) The delimitation technique of an LVO may be changed. No special meaning should be attached to which delimitation techniques are used.

A MACAO shall only change an LVO to use a marker pattern delimitation technique (Delimitation ID = S) after examining the structure of the simple or complex LVO to assure that the marker pattern does not occur in the Value field of the LVO where it would be misinterpreted as end of the value field.

4.3.2   LVO ORDERING CHANGES

a) MACAOs should in general preserve the ordering of LVOs within any EDU. This is a re-affirmation of the definition of a compound LVO (of which a CADS DDU is one example) as an LVO whose Value field contains a sequence of LVOs (see *Standard Formatted Data Units—Structure and Construction Rules*, reference [5]). However there are two exceptions to note:

1) LVOs that are referenced by wildcarding associated with R class objects do not have a guaranteed order and therefore the ordering of such LVOs may be altered by MACAOs. The use of wildcarding implies that the order of the referenced LVOs is not significant.

2) R class LVOs may be replaced by the sequence of LVOs formed from external data objects (see *Standard Formatted Data Units—Structure and Construction Rules*, reference [5]). While this will change the syntactic order of LVOs, the sequential order of all LVOs other than R class LVOs is what is significant for information preservation and this will be unaltered.

b) Within C class LVOs, a referenced ADID (e.g., `DDRID = NSSD1234`) shall not be replaced with the actual LVOs referenced as this alters the information content of the data description.

This is because a reference data description always refers to the last registered releasable version of the data description. Physical inclusion of a data description freezes the description at the time the data description is physically included. Thus the physically included data description will not reflect the updates made after the data description was physically included.

4.3.3 PVL CHANGES

Although CADS is not directly affected by PVL Restrictions, the C Class Object and the F Class Object in CADS are based on PVL syntax. The general rules given here have significance due to their application to the CADS LVOs discussed below. General PVL semantics allows for a number of syntactic changes within PVL object without changing the information content. However, specific formats based on PVL may attach additional meaning to some PVL constructs or indicate that other PVL constructs can be handled less rigorously for that object. For examples see the following sections detailing CCSD0004 and CCSD0007 rules. The following items should be considered for a general PVL object.

a) Statement delimiters (e.g., white space, semicolons) may be substituted for each other. The use of a semicolon as the statement delimiter is the form preferred.

```
Example:    ADIDNAME = ZCSD1234
                    could be represented as
            ADIDNAME = ZCSD1234;
```

For example, this change could be made by a MACAO to convert the statement to the preferred form.

b) Comments may be removed.

```
Example:    PHONE = "+1 234 5678 9";
            /* Repeat this field as often as is necessary. */
                could be represented as
            PHONE = "+1 234 5678 9";
```

For example, this change could be made by a MACAO which stored the CADS information in a database (without the comments) and then recreated the CADS from the database. This might also be appropriate if a MACAO distributed templates with a lot of explanatory comments to its users, but did not wish to use space to store those explanatory comments after the users had filled in the templates.

c) White space between PVL statement elements may be altered as to amount and type.

    Example:

```
NAME = "Doe, Jane R.";
AFFILIATION = "NAEDA Space Agency";
PHONE = "+1 301 286 3575";
        could be represented as
NAME =          "Doe, Jane R.";
AFFILIATION =   "NAEDA Space Agency";
PHONE =         "+1 301 286 3575";
```

For example, this change could be made by a MACAO's pretty printer which would present consistently formatted CADS.

d) String delimiters may be added to PVL strings or removed from PVL strings as is consistent with valid PVL and where the meaning of the string is not changed.

    Example:

```
ADIDNAME = "ABCD1234";    /* with double quotes */
        could be represented as
ADIDNAME = ABCD1234;      /* without quotes */
```

For example, this change could be made by a MACAO which stored the PVL string in a database (without the quotes); and then when recreating the PVL object, all PVL strings would be created with the quotes.

e) PVL begin aggregation keywords `OBJECT` and `BEGIN_OBJECT` may be substituted for each other. The use of the `BEGIN_OBJECT` keyword is the preferred form.

    Example:

```
OBJECT = ORIGINATOR;
        could be represented as
BEGIN_OBJECT = ORIGINATOR;
```

For example, this change could be made by a MACAO to convert the statement to the preferred form.

f) PVL end aggregation statements `END_OBJECT = 'block name'` and `END_OBJECT` may be substituted for each other. `END_OBJECT = 'block name'` is the preferred form.

Example: `BEGIN_OBJECT = ORIGINATOR;`

`. . .`
`END_OBJECT;`
       could be represented as
`BEGIN_OBJECT = ORIGINATOR;`
`. . .`
`END_OBJECT = ORIGINATOR;`

For example, this change could be made by a MACAO to convert the statement to the preferred form.

g) PVL begin aggregation keywords `GROUP` and `BEGIN_GROUP` may be substituted for each other. The use of the `BEGIN_GROUP` keyword is the preferred form.

Example: `GROUP = EASE;`
                 could be represented as
`BEGIN_GROUP = EASE;`

For example, this change could be made by a MACAO to convert the statement to the preferred form.

h) PVL end aggregation statements `END_GROUP = 'block name'` and `END_GROUP` may be substituted for each other. `END_GROUP = 'block name'` is the preferred form.

Example: `BEGIN_GROUP = EASE;`

`. . .`
`END_GROUP;`
       could be represented as
`BEGIN_GROUP = EASE;`
`. . .`
`END_GROUP = EASE;`

For example, this change could be made by a MACAO to convert the statement to the preferred form.

i) PVL begin aggregation keywords `GROUP` or `BEGIN_GROUP` may not be substituted for PVL begin aggregation keywords `OBJECT` or `BEGIN_OBJECT`, or vice-versa. However, specific formats built on top of PVL are free to interpret these items as synonyms.

Example: `BEGIN_OBJECT = ORIGINATOR;`
                 could **NOT** be represented as
`BEGIN_GROUP = ORIGINATOR;`

If this change were made in CADS, the result would be an invalid CADS statement.

j) PVL statements may not be reordered. However specific formats built on top of PVL are free to allow statements to be reordered as long as the `BEGIN_OBJECT` and `BEGIN_GROUP` aggregations are correctly preserved.

```
Example:     LABEL = CCSD3SF0000200000001
             REFERENCE = FILE.TXT
             LABEL = CCSD3SF0000600000001
             REFERENCE = FILE.PVL
                   could NOT be represented as
             LABEL = CCSD3SF0000200000001
             REFERENCE = FILE.PVL
             LABEL = CCSD3SF0000600000001
             REFERENCE = FILE.TXT
```

If this change were made in a C Class object, the wrong labels would be applied to the files.

k) Word wrapping is not allowed in PVL strings. However specific formats built on top of PVL are free to allow word wrapping in PVL strings.

Example:

```
TEXT =
"This could be a multiple line description with
some expected formatting.  For example, the comma
in this sentence is located here      ^"
                  could NOT be represented as
TEXT =
"This could be a multiple line description
with some expected formatting.
For example, the comma in this
sentence is located here      ^"
```

This type of change would destroy the alignment of lines that the Originator expected. Preservation of the alignment between lines of the string could be useful to create tables within a PVL string.

4.3.4   CCSD0004 CHANGES

The PVL formatting of CCSD0004 LVOs may be altered by MACAOs. These changes follow directly from the PVL changes discussed in the preceding section. The following changes may take place:

a) Statement delimiters (e.g., white space, semicolons) may be substituted for each other. The use of a semicolon as the statement delimiter is the preferred form.

Example: `ADIDNAME = ZCSD1234`
                         could be represented as
             `ADIDNAME = ZCSD1234;`

For example, this change could be made by a MACAO to convert the statement to the preferred form.

b) Comments found within the CCSD0004 value field may be removed.

Example: `DEDID = NSSD1234;`
             `/* Remember to enter all DEDID in search order.*/`
             `DEDID = NSSD9876;`
                     could be represented as
             `DEDID = NSSD1234;`
             `DEDID = NSSD9876;`

For example, this change could be made by a MACAO which stored the C Class information in a database (without the comments) and then recreated the C Class object from the database. This might also be appropriate if a MACAO distributed templates with a lot of explanatory comments to its users, but did not wish to use space to store those explanatory comments after the users had filled in the templates.

c) White space between PVL statement elements may be altered as to amount and type.

Example: `ADIDNAME = ZCSD0001;`
             `DDRID = CCSD1234;`
             `DEDID =             CCSD9876;`
                 could be represented as
             `ADIDNAME =    ZCSD0001;`
             `DDRID =       CCSD1234;`
             `DEDID =       CCSD9876;`

For example, this change could be made by a MACAO's pretty printer which would present consistently formatted C Class objects.

d) String delimiters may be added to PVL strings or removed from PVL strings as is consistent with valid PVL and where the meaning of the string is not changed.

Example: `ADIDNAME = "ABCD1234";    /* with double quotes */`
                     could be represented as
             `ADIDNAME = ABCD1234;      /* without quotes */`

For example, this change could be made by a MACAO which read the PVL string with the quotes, stored it in a database (without the quotes), and then when recreating the Class C object, all ADID strings would be created without quotes.

4.3.5   CCSD0007 CHANGES

The PVL formatting of CCSD0007 LVOs may be altered by MACAOs. These changes follow directly from the PVL changes discussed in above preceding section. The following changes may take place:

a) Statement delimiters (e.g., white space, semicolons) may be substituted for each other. The use of a semicolon as the statement delimiter is the preferred form.

```
Example:     PHONE = "+1 234 5678 9"
                    could be represented as
             PHONE = "+1 234 5678 9";
```

For example, this change could be made by a MACAO to convert the statement to the preferred form.

b) Comments found within the CCSD0007 value field may be removed.

```
Example:     PHONE = "+1 234 5678 9";
             /* Repeat this field as often as is necessary. */
                    could be represented as
             PHONE = "+1 234 5678 9";
```

For example, this change could be made by a MACAO which stored the CADS information in a database (without the comments) and then recreated the CADS from the database. This might also be appropriate if a MACAO distributed templates with a lot of explanatory comments to its users, but did not wish to use space to store those explanatory comments after the users had filled in the templates.

c) White space between PVL statement elements may be altered as to amount and type.

```
Example:     NAME = "Doe, Jane R.";
             AFFILIATION = "NAEDA Space Agency";
             PHONE = "+1 301 286 3575";
                    could be represented as
             NAME =          "Doe, Jane R.";
             AFFILIATION =   "NAEDA Space Agency";
             PHONE =         "+1 301 286 3575";
```

For example, this change could be made by a MACAO's pretty printer which would present consistently formatted CADS.

d) String delimiters may be added to PVL strings or removed from PVL strings as is consistent with valid PVL and where the meaning of the string is not changed.

Example: `AFFILIATION = NASA;`   `/* without quotes */`
                       could be represented as
             `AFFILIATION = "NASA";`   `/* with double quotes */`

For example, this change could be made by a MACAO which stored the CADS AFFILIATION string in a database (without the quotes); and then when recreating the CADS object, all AFFILIATION strings would be created with the quotes so the program would not have to determine if a quoted string was required base on the characters included in the string.

e) PVL begin aggregation keywords `OBJECT` and `BEGIN_OBJECT` may be substituted for each other. The use of the `BEGIN_OBJECT` keyword is the preferred form.

Example: `OBJECT = ORIGINATOR;`
                       could be represented as
             `BEGIN_OBJECT = ORIGINATOR;`

For example, this change could be made by a MACAO to convert the statement to the preferred form.

f) PVL end aggregation statements `END_OBJECT = 'block name'` and `END_OBJECT` may be substituted for each other. `END_OBJECT = 'block name'` is the preferred form.

Example: `BEGIN_OBJECT = ORIGINATOR;`
             `. . .`
             `END_OBJECT;`
                       could be represented as
             `BEGIN_OBJECT = ORIGINATOR;`
             `. . .`
             `END_OBJECT = ORIGINATOR;`

For example, this change could be made by a MACAO to convert the statement to the preferred form.

g) PVL statements may be reordered as long as the `BEGIN_OBJECT` aggregations are correctly preserved.

    Example: REVISABLE = YES;
                     TITLE = "My Format";
                     RELEASABLE = YES;
                            could be represented as
                     TITLE = "My Format";
                     RELEASABLE = YES;
                     REVISABLE = YES;

For example, this change could be made by a MACAO which stored the CADS information in a database and then outputs the parameters in a standard order when the DDP is requested. Note that this is a relaxation of the normal PVL requirement that the order of PVL statements be maintained. However, CADS information is maintained without maintaining the order of the statements and allowing the order to change provides flexibility for MACAOs to provide additional services such as pretty printers displaying CADS objects with a standard ordering of parameters.

5 REQUIREMENTS, RATIONALE, AND TRACEABILITY

The Control Authority organization has been created to accommodate requirements derived from the SFDU concept. Those requirements and the rationale for the requirements, including those for Control Authority Data Structures (CADS), are identified in 5.1 below. The traceability of the requirements to the subsection(s) of the Control Authority Procedures Recommendation (reference [2] and the CADS Recommendation (reference [3]) that address the Control Authority requirements is provided in 5.2.

5.1 REQUIREMENTS AND RATIONALES

5.1.1 CONTROL AUTHORITY REQUIREMENT AND RATIONALES

a) Provide a method for data producers to make a data description available to users of data without disseminating the data description each time a data product is disseminated.

Rationale: Data products using the same format will be produced numerous times, and data descriptions can be quite voluminous. For efficiency reasons, the providers of the data products may not wish to send or the recipients of such products may not want to receive this repetitive information each time.

b) Guarantee availability of data descriptions for an indefinite period of time.

Rationale: The lifetime of space-related data tends to be very long, often longer than the project team is around. The data must still be understood, and therefore the descriptions must be available.

c) Ensure that the user community is aware of the existence of data descriptions.

Rationale: Knowledge of what data descriptions exist will facilitate the interchange of space data among users.

d) Provide a standard way for users to identify the organization from which data descriptions can be acquired.

Rationale: The source of data descriptions needs to be easily and unambiguously identified to support users of data products.

e) Provide a capability to accept standardized methods of requesting data descriptions.

Rationale: It will support the user to have a standardized manner of interacting with the variety of locations where data descriptions are archived.

f) Provide a means of modifying registered data descriptions.

Rationale: Creators of data descriptions may either find that they have incorrectly described a data product, or realize that there is a better way to describe the data product as they gain further understanding.

g) Provide a means of providing the user community with updated data descriptions.

Rationale: Users need to have the most current version of a data description to interpret the data they acquire. Informing them of changes will allow them to use the most current data descriptions.

5.1.2 CADS REQUIREMENTS AND RATIONALES

a) CADS shall present a standardized, machine parsable way of describing the data description identification information.

Rationale: Certain identification information be supplied by the RP or RRP Originator. The MACAO must verify the existence of this information, and for efficiency purposes, the information should be presented in a way that is machine parsable. Also, the provision of the DDP in a machine standardized, machine parsable form will allow recipients to handle descriptions in an automated manner.

b) The RP, RRP, and DDP SFDU objects shall be constructed using a standardized ordering.

Rationale: In order for the semantics of the package to be understood, a standard ordering of contents must be provided. This ordering must specify the primary structural considerations regarding the expression of RPs, RRPs, and DDPs as SFDU objects. This includes the manner in which an encapsulating CCSDS ADID, such as CCSD0005, can be used to create the framework for the CADS packages; the use of the LVO with Class ID = C supporting naming and referencing; the structure of the LVO value field to contain the identification information; and the inclusion of LVOs with Class ID = D, E, S, K, or R which contain the substance of the data description being registered.

c) The RPs, RRPs, and DDPs shall contain within their own structure information sufficient to identify their content as an RP, an RRP, or a DDP.

Rationale: In order for automated support to be provided, the package type must be identifiable. Ideally, to accomplish this, the package would be auto-identifiable.

5.2 TRACEABILITY OF REQUIREMENTS

The following table summarizes the requirements identified in 5.1.1 and indicates where in the Control Authority Procedures Recommendation (reference [2]) each requirement is satisfied.

Table 5-1:   Traceability of Requirements to Subsections in the Control Authority Procedures Recommendation (Reference [2])

Requirement	Requirement Summary	Recommendation Subsection(s)
a	Data description available w/o reproducing / disseminating per data product request	2.2.2(1&2); 3.3.1(1); 3.3.2(1&2)
b	Provide access over time	2.2.1(1); 2.2.2(3,6,&9)
c	Ensure knowledge of data description existence	2.2.1(5); 2.2.2(10); 4.1.3(2&3); 4.2.3
d	Standard way to identify location of data descriptions	2.1; 2.2.1(3&4); 3.3.1(3); 4.1.1; 4.1.3(2a); 4.2.1(1&2)
e	Capability to accept standard requests;	3.1; 3.2.1(1); 3.2.2(1); 3.3.1(1),3.3.2(1); 3.3.3(1)
f	Capability to modify data descriptions	3.3.3
g	Provide notification of updated data descriptions	2.2.1(5); 2.2.2(10); 4.1.3(2c); 4.2.3(3b)

The following table summarizes the CADS requirements identified in 5.1.2 and indicates where in the CADS Recommendation (reference [3]) each requirement is satisfied.

Table 5-2:   Traceability of Requirements to Subsections of the CADS Recommendation (Reference [3])

Requirement	Requirement Summary	Recommendation Subsection(s)
a	CADS has a standardized machine parsable format	3.0; 3.1; 3.2
b	CADS Packages use a standardized ordering	3.0
c	CADS packages may be Identified by their content	3.0; 3.1; 3.2

ANNEX A

ACRONYMS AND ABBREVIATIONS

Purpose:

This annex defines the acronyms and abbreviations used throughout this Report to describe the concepts and elements of the Control Authority procedures and CADS.

Term	Meaning
ADID	Authority and Description Identifier
ASCII	American Standard Code for Information Interchange
CA	Control Authority
CADS	Control Authority Data Structures
CAID	Control Authority Identifier
CCSDS	Consultative Committee for Space Data Systems
DDID	Data Description Identifier
DDP	Data Description Package
DDU	Description Data Unit
EDU	Exchange Data Unit
LVO	Label Value Object
MACAO	Member Agency Control Authority Office
N/A	Not Applicable
PVL	Parameter Value Language
RA	Restricted ASCII
RP	Registration Package
RRP	Revision Registration Package
SFDU	Standard Formatted Data Unit
WDC-A-R&S	World Data Center A for Rockets and Satellites

ANNEX B

GLOSSARY

Purpose:

This annex defines key terms which are used throughout this Report to describe the concepts and elements of the Control Authority procedures and CADS.

Authority and Description Identifier (ADID): The concatenation of the Control Authority Identifier (CAID) and the Data Description Identifier (DDID).

CCSDS ADID: The combination of the Control Authority Identifier (CAID) for the CCSDS Secretariat ("CCSD") and a four character restricted ASCII (RA) string which makes the identifier unique within the CCSDS domain.

Control Authority (CA): An organization under the auspices of CCSDS which supports the transfer and usage of SFDUs by providing operational services of registration, archiving, and dissemination of data descriptions. It comprises:
– The CCSDS Secretariat supported by the Control Authority Agent and
– Member Agency Control Authority Offices (MACAOs).

Control Authority Agent (CA Agent): An organizational entity that has agreed to discharge the Control Authority (CA) responsibilities of the CCSDS Secretariat. The World Data Center A for Rockets and Satellites (WDC-A-R&S) has agreed to act as this agent. Overall Control Authority responsibility rests with the CCSDS Secretariat.

Control Authority Identifier (CAID): A four character restricted ASCII (RA) string that identifies an individual Member Agency Control Authority Office (MACAO) or the CCSDS Secretariat.

Data Description Identifier (DDID): A four character restricted ASCII (RA) string, assigned by a Member Agency Control Authority Office (MACAO) or the CCSDS, to distinguish among descriptions with the same Control Authority Identifier (CAID).

Data Description Package (DDP): The combination of a data description, its Authority and Description Identifier (ADID), and identification information, originating from Member Agency Control Authority Offices (MACAOs) and supplied to users to facilitate understanding of data.

Label Value Object (LVO): The basic SFDU building block comprised of a LABEL field and a VALUE field. This structure is the fundamental structural element used to build SFDUs.

MACAO ADID: The combination of the Control Authority Identifier (CAID) for the Member Agency Control Authority Office (MACAO) and a four character restricted ASCII (RA) string which makes the identifier unique within the CCSDS domain.

Member Agency Control Authority Office (MACAO): An individual CCSDS Participating Agency organization that has accepted the operational responsibilities and constraints specified within CCSDS Recommendations on Control Authority (CA) operations.

Open System Data Interchange: The process of transferring data from one open system to another. An open system is one which uses publicly available formats and protocols, so that anyone can communicate with the open system by following the open system

standards. It should be noted that open system does not imply an uncontrolled or unrestricted access to the data.

Originator: That individual or organization that submits a Registration Package (RP) or a Revision Registration Package (RRP) to a Member Agency Control Authority Office (MACAO) and accepts responsibility for its contents.

Participating Agency: A Member or Observer Agency of the CCSDS.

Permitted Reviser: An individual or organization that has been specified, in a Registration Package (RP) or a Revision Registration Package (RRP), as having the authority to submit a revision of the data description.

Primary Member Agency Control Authority Office (MACAO): The entity in the Control Authority (CA) Organization that has overall responsibility for ensuring CA services for its Agency and any of its Descendant MACAOs are provided.

Registration Date: The date a Member Agency Control Authority Office (MACAO) assigns an Authority and Description Identifier (ADID) or increments a Revision Number of a data description.

Registration Package (RP): A particular data description, with its accompanying identification information, intended for registration by a Member Agency Control Authority Office (MACAO).

Restricted ASCII (RA) Character: A character from the ASCII character set consisting of the numeric characters, 0-9, and the upper case letters, A-Z, of the Roman alphabet.

Revision Registration Package (RRP): A revision of a particular data description, with its accompanying identification information, intended for registration by a Member Agency Control Authority Office (MACAO).

Standard Formatted Data Unit (SFDU): Data that conform to CCSDS SFDU Recommendations for structure, construction rules, and field specification definition.

Submission Date: The date the Registration Package (RP) or the Revision Registration Package (RRP) is submitted to a Member Agency Control Authority (MACAO), as determined by its Originator.

World Data Center A for Rockets and Satellites (WDC-A-R&S): An organization under the World Data Center that is collocated with NASA's National Space Science Data Center. It responds to world-wide requests for information about rockets and satellites and performs related services.

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ANNEX C

CONTACT INFORMATION FOR THE CONTROL AUTHORITY ORGANIZATION

Purpose:

This annex provides the current contact information for the Control Authority organization.

<u>CA Agent</u>

CAID: CCSD

    Name: Consultative Committee for Space Data Systems

        Postal Address: c/o World Data Center A for Rockets and Satellites

                                    Code 633

                                      Building 26

                                      Goddard Space Flight Center

                                      Greenbelt, Maryland, 20771, USA

        Electronic Mail Addresses:

            Internet =   CAA@NSSDCA.GSFC.NASA.GOV

            NSI DECnet =   NCF::CAA

        Telephone Number: +1 301 441 4169

        Fax Number: +1 301 441 9486

    Primary Contact: John Garrett

        Postal Address: Hughes-STX

                                      7701 Greenbelt Road

                                      Suite 400

                                      Greenbelt, MD 20770   USA

        Electronic Mail Addresses:

            Internet =   John.G.Garrett@gsfc.nasa.gov

            DECNet =   NCF::GARRETT

        Telephone Number: +1 301 441 4169

        Fax Number: +1 301 441 9486

    Secondary Contact: Mr. John Rush

        Postal Address: Program Integration Devision (Code OI)

                                        National Aeronautics and Space Administration

                                      Washington, DC   20546   USA

        Electronic Mail Addresses:

            Internet =   jrush@qmgate.osc.hq.nasa.gov

        Telephone Number: +1 202 358 4819

        Fax Number: +1 202 358 3520

<u>Participating Agencies</u>

British National Space Center (BNSC)/United Kingdom

      Preferred Agency ID: B

Canadian Space Agency (CSA)/Canada

      Preferred Agency ID: D

Centre National d'Etudes Spatiales (CNES)/France
    Preferred Agency ID: F

    Primary MACAO CAID: FCST
        Name: Centre Spatial de Toulouse
            Postal Address: CT/TI/PS/MP
                                  18, Avenue Edouard Belin
                                  31055 Toulouse Cedex
                                  France
            Electronic Mail Addresses:
                Internet =   mazal@cst.cnes.fr
            Telephone Number: +33 61 27 41 64
            Fax Number: +33 61 27 30 84

        Primary Contact: Mr. Patrick Mazal
            Postal Address: Centre National d'Etudes Spatiales (CNES)
                                    Centre Spatial de Toulouse
                                  CT/TI/PS/MP
                                  18, Avenue Edouard Belin
                                  31055 Toulouse Cedex
                                  France
            Electronic Mail Addresses:
                Internet =   mazal@cst.cnes.fr
             Telephone Number: +33 61 27 41 64
            Fax Number: +33 61 27 30 84
    Secondary Contact: Mr. Denis Minguillon
            Postal Address: Centre National d'Etudes Spatiales (CNES)
                                      Centre Spatial de Toulouse
                                  CT/TI/PS/MP
                                  18, Avenue Edouard Belin
                                  31055 Toulouse Cedex
                                  France
            Electronic Mail Addresses:
                Internet =   denis@babbage.cnes.fr
             Telephone Number: +33 61 27 40 93
            Fax Number: +33 61 27 30 84

Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V. (DLR)/Germany
    Preferred Agency ID: G

European Space Agency (ESA)/Europe
    Preferred Agency ID: E

    Primary MACAO CAID: EESA
        Name: European Space Agency Primary Control
             Authority Office
           Postal Address: ESA/ESOC
                          Robert Bosche Strasse 5
                          D-64293 Darmstadt, Germany
           Electronic Mail Addresses:
              Internet =   pmaigne@vmprofs.esoc.esa.de
           Telephone Number: +49 6151 902 875
           Fax Number: +49 6151 903 010

    Primary Contact: Pierre Maigne
           Postal Address: ESA/ESOC
                          Robert Bosche Strasse 5
                          D-64293 Darmstadt, Germany
           Electronic Mail Addresses:
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           Telephone Number: +49 6151 902 875
           Fax Number: +49 6151 903 010

    Secondary Contact: Nestor Peccia
            Postal Address: ESA/ESOC
                          Robert Bosche Strasse 5
                          D-64293 Darmstadt, Germany
           Electronic Mail Addresses:
              Internet =   npeccia@vmprofs.esoc.esa.de
           Telephone Number: +49 6151 902 431
           Fax Number: +49 6151 903 010

    (Note: All ESA Descendant Control Authority Offices have the same contact
        information as the EESA Primary MACAO.)

    Descendant MACAO CAID: ECLU
        Name: ESA Cluster Mission Control Authority Office

    Descendant MACAO CAID: EEUR
        Name: ESA EURECA Mission Control Authority Office

    Descendant MACAO CAID: EHUY
        Name: ESA Huygens Mission Control Authority Office

Instituto de Pesquisas Espaciais (INPE)/Brazil
    Preferred Agency ID: I

National Aeronautics and Space Administration (NASA)/U.S.A.
Preferred Agency ID: N

Primary MACAO CAID: NSSD
     Name: NASA Primary Control Authority Office at the
                            National Space Science Data Center
                            (NSSDC)
          Postal Address: NASA/GSFC
                            NASA/Science Office of Standards and
                            Technology (NOST)
                            SFDU Support Office
                            Code 633.2
                            Greenbelt, MD 20771   USA
          Electronic Mail Addresses:
               Internet =   CAO_NSSD@nssdca.gsfc.nasa.gov
               DECNet =   NCF::CAO_NSSD
          Telephone Number: +1 301 441 4169
          Fax Number: +1 301 441 9486

     Primary Contact: John Garrett
          Postal Address: Hughes-STX
                            7701 Greenbelt Road
                            Suite 400
                            Greenbelt, MD 20770   USA
          Electronic Mail Addresses:
               Internet =   John.G.Garrett@gsfc.nasa.gov
               DECNet =   NCF::GARRETT
          Telephone Number: +1 301 441 4169
          Fax Number: +1 301 441 9486

     Secondary Contact: Donald Sawyer
          Postal Address: NASA/GSFC
                            Code 633.2
                            Greenbelt, MD 20771   USA
          Electronic Mail Addresses:
               Internet =   sawyer@nssdca.gsfc.nasa.gov
               DECNet =   NCF::SAWYER
          Telephone Number: +1 301 286 2748
          Fax Number: +1 301 286 1771

Descendant MACAO CAID: NJPL
    Name: Jet Propulsion Laboratory Control Authority
                  Office
        Postal Address: M/S 301-235
                      4800 Oak Grove Drive
                      Pasadena, CA 91109   USA
        Electronic Mailing Address:
           Internet =   njplca@bongo.jpl.nasa.gov
        Telephone Number: +1 818 354 3890
        Fax Number: +1 818 354 9068
                      (fax registration/revisions not normally accepted)

    Principal Contact: Jim Grimes
        Postal Address: Jet Propulsion Laboratory
                      M/S 301-235
                      4800 Oak Grove Drive
                      Pasadena, CA 91109   USA
        Electronic Mailing Address:
           Internet =   jimg@bongo.jpl.nasa.gov
        Telephone Number: +1 818 354 3890
        Fax Number: +1 818 354 9068

Descendant MACAO CAID: NURS
    Name: UARS Control Authority Office
        Postal Address: Science Systems and Applications, Inc.
                      5900 Princess Garden Parkway
                      Suite 300
                      Lanham, MD 20706 USA
        Electronic Mailing Addresses:
           Internet =   gabbay@cdhf2.gsfc.nasa.gov
           DECnet =   UARS::GABBAY
        Telephone Numbers: +1 301 731 9300
        Fax Number: +1 301 731 1180

    Principal Contact: Altan Gabbay
        Postal Address: Science Systems and Applications, Inc.
                      5900 Princess Garden Parkway
                      Suite 300
                      Lanham, MD 20706 USA
        Electronic Mailing Addresses:
            Internet =   gabbay@cdhf2.gsfc.nasa.gov
           DECnet =   UARS::GABBAY
        Telephone Numbers: +1 301 731 9300
        Fax Number: +1 301 731 1180

Secondary Contact: Stuart Frye
    Postal Address: NASA Goddard Space Flight Center
                          Code 519.6
                          Greenbelt, MD 20771 USA
    Electronic Mailing Addresses:
       Internet =   frye@cdhf2.gsfc.nasa.gov
       DECnet =   UARS::FRYE
    Telephone Numbers: +1 301 286 4279
    Fax Number: +1 301 286 5269

National Space Development Agency of Japan (NASDA)/Japan
    Preferred Agency ID: J

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ANNEX D

SAMPLE FORMS FOR REGISTRATION

Purpose:

This annex provides one example of an interface for the registration of data descriptions.

In order for a user to register data descriptions, he or she must provide the data description to the MACAO in a form that the MACAO can accept. Figure D-1 provides a sample forms view of the information required by a MACAO from a user. If the MACAO only accepts one particular medium, the only information that might change is the title of the data description, and the name or location of the file. The information is not part of the Registration Package, and is provided to assist the MACAO in providing the registration service.

Once the MACAO has agreed to the medium for registering the data description, the user would provide the information that forms the actual Registration Package. This information includes information about the submitter, revisers, and data description (figure D-2), as well as the actual data description itself (figure D-3).

Data Description Block (use as many as needed)

Content Interpretation Language (check one)

___ English ASCII (CCSD0002)
___ PVL (CCSD0006)
___ Other (non-CCSDS) ADID = _____

Type (check one)

___ Catalog Information
___ Data Entity Dictionary (DED)
___ Data Dictionary Record (DDR)
___ Supplementary Information Data

Data Description Block Content

Figure D-1: Example Pre-Submission Form

Data Description Block (use as many as needed)

Content Interpretation Language (check one)	Type (check one)
___ English ASCII (CCSD0002) ___ PVL (CCSD0006) ___ Other (non-CCSDS) ADID = _____	___ Catalog Information ___ Data Entity Dictionary (DED) ___ Data Dictionary Record (DDR) ___ Supplementary Information Data

Data Description Block Content

Figure D-2: Example RP or RRP Input Form (Page 1)

Data Description Block (use as many as needed)

Content Interpretation Language (check one)

___ English ASCII (CCSD0002)
___ PVL (CCSD0006)
___ Other (non-CCSDS) ADID = _____

Type (check one)

___ Catalog Information
___ Data Entity Dictionary (DED)
___ Data Dictionary Record (DDR)
___ Supplementary Information Data

Data Description Block Content

Figure D-3: Example RP or RRP Input Form (Page 2)

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ANNEX E

DATA DESCRIPTION: TO REVISE OR NOT TO REVISE?

Purpose:

This annex provides sample scenarios to explain:

–   The circumstances under which a data description might or might not be revisable

–   The flow of the revision process for a data description that is revisable

Scenario 1: A group of scientists have prepared a data format that they would like adopted as a standard object. One of them decides to register with a MACAO so that it may be readily incorporated by reference into the descriptions of a wide range of data. In this way, future data producers can be sure that this standard format will not change after they have generated labeled data objects and descriptions that may refer to it.

After time, the scientists using the data format have accumulated a set of extensions to be added to the format. However, since the decision was made to ensure that the format would not change, a new data description is created and submitted to the MACAO for registration. It receives a new ADID which is not necessarily related to the old ADID in any visible manner. The scientists advertise the existence of this new format and encourage its use, in place of the older one, for all new data and descriptions. From the point of view of the MACAO, this is just another registered data description with a registration date and brief description that will appear in the annual report. It is up to the community to advertise it as a replacement for new work.

Scenario 2: Investigator A from the GOFORIT project creates a format description to describe the data as it is expected to appear. The ground handling system will actually create the labeled data objects he expects, and requires the registered ADID for insertion into the labels it will add to the data. In addition, Investigator A's local software contractor also wants this ADID to insert into a table that will be used to direct the local data handling and processing software. This software will not use the format description directly, but will incorporate this information into its processing algorithms for efficiency. Investigator A registers his format description with the MACAO and provides the ADID and description both to the ground handling system and the local software contractor. However, the Investigator does not want his description to be publicly available at this time. The investigator wants time to look at the data and verify the correctness of the description before allowing general use. He also advises the MACAO that the format description must be revisable, and supplies his name as a Permitted Reviser.

After a bit of testing, the Investigator informs the MACAO that the data description's status should be releasable. Soon after, he begins to receive labeled data objects from the ground handling system; his local processing software begins to produce garbage. Investigation reveals that there was an error in understanding and documenting how the instrument packed information into a particular 8-bit word. Therefore he has his local software revised and submits a revised description to the MACAO. This data description is labeled Version 1. A brief description of the nature and significance of this update is provided in the revision comment. This error is transparent to the ground handling system, since it does not look at this information to do its processing.

He sends copies of the data to his colleagues and informs them that the MACAO has a revised description. He has included this description in the initial data provided to them. They proceed to fix their software and to make the data available to others locally.

After about 6 months, Investigator A notices a misspelled name for a field in the format description. He wants this correct at the MACAO because he is in the process of preparing additional information that will refer to that name. This results in Revision Number 2. Again,

a brief description of the editorial nature and minor significance of this change is provided in the Revision Comment.

After about 1 year, the instrument suffers a mode failure that results in the periodic occurrence of "all ones" in one of the fields of the format. Fortunately, this is predictable and describable in the following way: For times greater than T0 in word 3, the value of word 5 is fill (all ones) when word 10 indicates mode = 3. This information needs to be added to the format description to improve its correctness for all the labeled data objects carrying the ADID for the format description. He provides the new description to the MACAO, and it becomes Revision 3. At the same time he adds a text description of the instrument operation and the calibration coefficients to use in converting values to physical units. A brief description and the important nature of this revision are noted in the Revision Comment. He notifies his colleagues of this new revision. Because this is a revisable data description, other recipients of the data, who are unknown to him, should periodically check with the MACAO or check the CA Annual Report to see if there are any new revisions.

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