514-3ICD/0193

Interface Control Document Between the Solar and Heliospheric Observatory (SOHO) Experimenters Operations Facility (EOF) Core System (ECS) and the SOHO Instrumenters

July 1993

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Document History

Issue	Date	CCR Number
Original	July 1993	

ABSTRACT

This document describes the interface between the International Solar-Terrestrial Physics (ISTP) Solar and Heliospheric Observatory (SOHO) Experimenters' Operations Facility (EOF) Core System (ECS) and the SOHO Instrumenters. Section 1 provides an introduction to this document. Section 2 presents an overview of the interface. Section 3 defines the format of the data exchanged over the interface. Section 4 defines the communications protocols and lower level layers of the interface.

Keywords: Experimenters' Operations Facility (EOF)
EOF Core System (ECS)
Solar Heliospheric Observatory (SOHO)
Interface Control Document (ICD)

PREFACE

This is the signature copy of the Interface Control Document (ICD) between the Solar and Heliospheric Observatory (SOHO) Experimenters' Operations Facility (EOF) Core System (ECS) and the SOHO Instrumenters.

The proposed interface for commanding was widely based on a proposal developed by Dr Van Ballegooijen, following an action item from the November 1991 Science Operations Working Group (SOWG) splinter meeting. A preliminary outline of the ICD was presented to the instrumenters during the May 1992 splinter meeting. A preliminary draft version of the document was produced in July 1992 and discussed at the September 1992 SOWG meeting. The final review copy (April 1993) was presented at the June 1993 SOWG meeting and at the ECS Critical Design Review.

This document is under the configuration management of the Mission Operations Division (MOD) Configuration Control Board (CCB). Proposed changes to this document shall be submitted to the MOD CCB, along with supportive material justifying the change. Changes shall be made by document change notice (DCN) or by complete revision.

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SECTION 1. INTRODUCTION

1.1 PURPOSE AND SCOPE

This Interface Control Document (ICD) defines the interface between the Solar and Heliospheric Observatory (SOHO) Instrumenters and the Experimenters' Operations Facility (EOF) Core System (ECS). This interface supports three main data exchanges: instrument commanding data from the instrumenters, telemetry distribution to the instrumenters, and exchange of other mission related data.

The interface between the ECS and the SOHO instrumenters is described within the framework of the Open System Interconnection (OSI) model, a seven-layer reference model developed by the International Organization for Standardization (ISO). Section 2 of this ICD provides an overview of the interface between the ECS and the instrumenters. Section 3 defines the interface at the application layer level. Section 4 defines the lower levels of the OSI model: presentation layer, session layer, transport layer, network layer, data link layer and physical layer.

1.2 BACKGROUND

The SOHO mission is part of the International Solar-Terrestrial Physics (ISTP) program. The SOHO EOF is part of the NASA Goddard Space Flight Center (GSFC) ground system and serves as the focal point for instrument operations, mission planning, and science data analysis related to the operations.

The EOF is comprised of two main elements:

1) The ECS which includes hardware and software to support the three primary ECS functions described above. Two specialized workstations are part of the ECS: the Science Operations Coordinator (SOC) workstation and the Project Scientist workstation.

2) The Instrumenters WorkStations (IWS) which include hardware and software provided by the individual instrument teams and are dedicated to the operation of a given instrument and its science analysis for planning purpose.

The instrumenters may be located as follows:

1) The resident instrumenters are located at the EOF where they have data processing equipment, referred to as the IWSs.

2) The "remote" instrumenters are located outside of the EOF. They may have some support equipment at the EOF, or they may communicate with the ECS via another instrument's IWS or via a dedicated ECS workstation, namely, the SOC workstation. The remote instrumenters may also use the telephone or facsimile to communicate with the Flight Operations Team (FOT) or with an EOF resident team member and request changes in their instrument status.

3) Instrumenters may be located at the Analysis Facility at GSFC. At the present time, instrumenters at the Analysis Facility will have the same privileges as remote

instrumenters. However, the EOF design does not preclude the fact that some of the equipment located at the Analysis Facility could be treated as resident IWSs, provided the following:

- Security requirements are met: this includes having a dedicated line between the two facilities, and ensuring adequate physical security at the Analysis Facility.
- ECS capacity: Telemetry could be distributed in real-time to workstations in the Analysis Facility provided this can be supported by the current ECS hardware/software architecture.

4) Instrumenters may also be located at the European Science Data and Operations Centre (ESDOC). The present document treats these instrumenters as remote instrumenters. If conditions change concerning the availability of a dedicated line and the feasibility of real-time communications (other than FTP), a separate interface document will need to be produced specifically to define the interface between the ECS and ESDOC.

The ECS provides the communications between the instrumenters and other elements of the SOHO ground system as illustrated at a conceptual level in Figure 1.1. The physical configuration of the EOF is defined in section 4. ECS receives and stores telemetry data. ECS makes that telemetry data available to the instrumenters for processing on their own equipment and defining future instrument commands. The instrumenters use their interface with ECS to send these commands to their instruments both in real-time and on a delayed transmission basis. Near-real commanding and reception of real-time telemetry is only available to the EOF resident instrumenters (i.e., IWSs).

1.3 REFERENCES

1. Commanding at the SOHO Experiment Operations Facility, Dr Van Ballegooijen, memorandum, Action Item from SOWG Splinter Meeting, November 1991.

2. SOHO Science Operations Plan, Issue 1.1, June 1993.

3. SOHO Experimenters' Operations Facility (EOF) Core System (ECS) Functional Requirements Document, NASA, April 1992.

4. CCS External Interfaces Specification Document, MATRA, July 1991.

5. Telemetry and Telecommand Handbook, MATRA, March 1991.

6. CCS Protocol Implementation, SS-AN-003-91, March 24, 1992.

7. SOHO Experimenters' Operations Facility (EOF) Core System (ECS) System Requirements Document, NASA 514-4SRD/0492, February 1993.

8. Interface Control Document between the International Solar-Terrestrial Physics (ISTP) SOHO Command Management System (CMS) and the ECS, NASA 514-4ICD/0293, Review Copy, June 1993.

9. Interface Control Document between the Sensor Data Processing Facility (SDPF) and <Mission>, NASA 560-1ICD/0393, Review Copy, July 1993.

10. Interface Control Document between the Information Processing Division Data Distribution Facility (DDF) Phase III and Consumer Systems , NASA, Review Copy, July 1993.

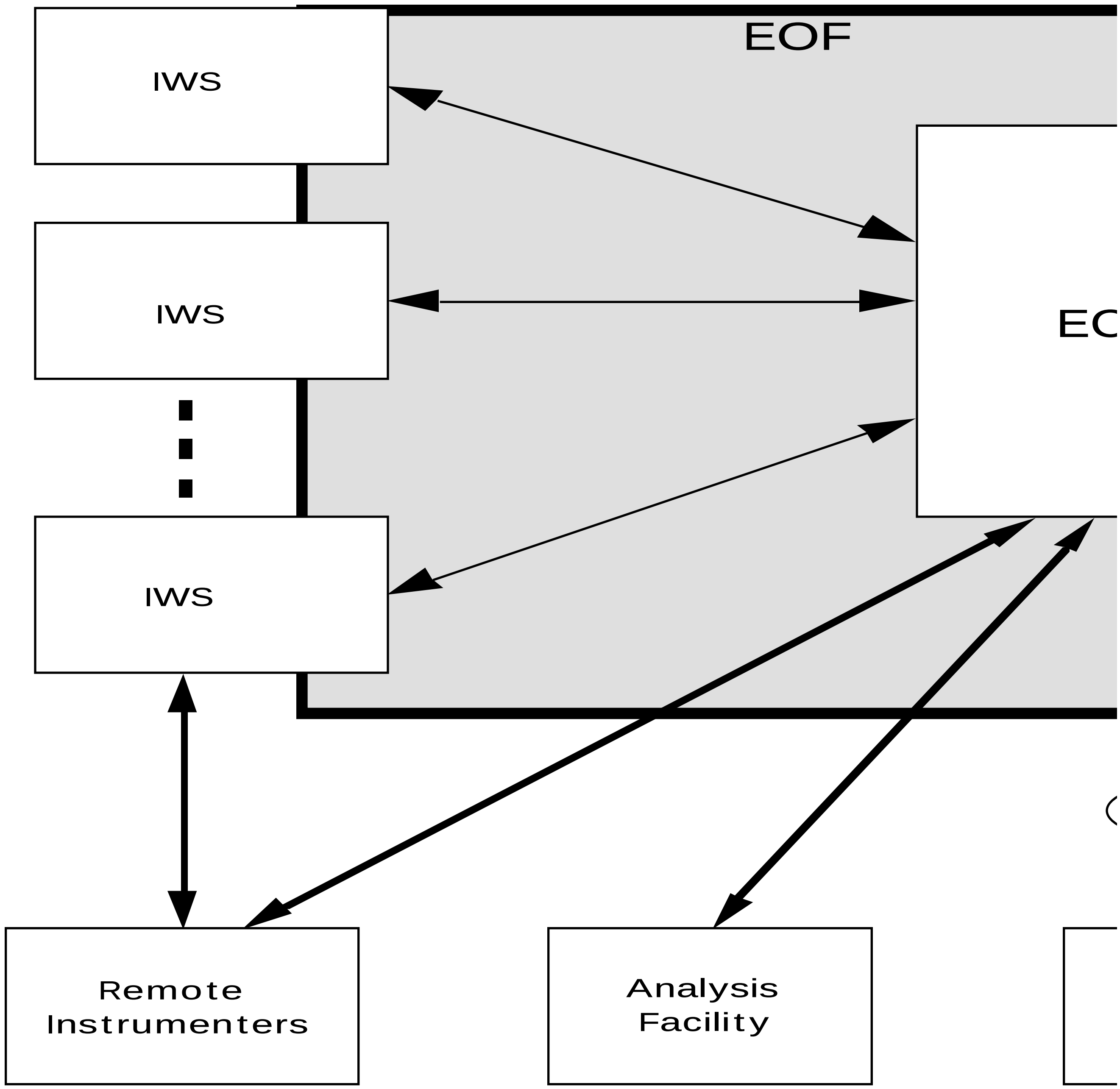


Figure 1.1. ECS/IWSs Context Diagram

11. Memorandum of Understanding between the International Solar-Terrestrial Physics (ISTP) Central Data Handling Facility (CDHF) and the ISTP SOHO Experimenters' Operations Facility (EOF), NASA, Review Copy, June 1993.

12. SOHO Experimenters' Operations Facility (EOF) Core System (ECS) Detailed Design Specification, NASA 514-4DDS/0293, Review Copy, June 1993.

13. SOHO Experimenters' Operations Facility (EOF) Core System (ECS) Software Users' Guide, NASA , Draft, June 1993.

14. Data Format Control Document for the International Solar-Terrestrial Physics (ISTP) SOHO Project Data Base, NASA 511/4DFC/0292, July 1993.

1.4 GLOSSARY

As-Planned Database. Information provided by the instrumenters to the ECS describing the science activities scheduled for a given day or week. This information will be based on the template provided by the ECS Activity Plan (EAP) which shows DSN contact times, FOT-dedicated commanding times, and other related activities. The information provided by the instrumenters will be in the form of ASCII files and it will be electronically transferred to the ECS.

As-Run Database. Information provided by the instrumenters describing the science programs executed. The detailed format and content of the data provided by the instrumenters will be defined separately from this document. The design and implementation of the Database is the responsibility of a designated group of instrumenters. ECS is only responsible for providing the commercial Relational Database Management System package that will be used to support these functions and the hardware on which it will run. Information related to the As-Run data base will be provided to the ECS in an ASCII file format for inclusion into the Summary data files sent to the CDHF, for later distribution to the instrumenters' teams.

Critical Command. A command which is flagged as critical in the Project Database (PDB). Operationally, the uplink of a critical command requires the intervention of a Flight Operations Team (FOT) operator within the Payload Operations Control Center (POCC).

Delayed Commands. A group of commands originating from EOF-resident or remote instrumenters destined to be uplinked by the FOT within a specified time window during the next operational day or later.

Instrument Command. A command addressed to a given instrument. Each instrument has a processor which will act upon that command once it receives it. When an instrument command is received by the spacecraft, it is immediately routed to the instrument. The command may be an actual command to perform a specific function. That function may be executed as soon as received by the instrument processor or it may be stored within the instrument processor memory for execution at a later predefined time (this depends on the capabilities of the instrument processor itself). The command may also be data to be stored in the processor memory. Each Principal Investigator (PI) team is responsible for the management of their instrument processor memory.

Instrumenter WorkStation (IWS). Hardware and software provided by the individual instrument teams, physically located in the EOF. During near-real-time sessions, they are dedicated to either the commanding of a given set of instruments or to their science analysis for planning purposes. The commanding IWSs are the only authorized source of near-real-time commands.

Large Instrument Tables. Instrument command groups which do not need to be uplinked in a time critical manner. This includes large amounts of commanding data which could block the commanding channel for a long period of time. To avoid this, the instrumenters must package the commanding data into "chunks" no larger than 0.5 Kbytes, which corresponds approximately to 10 seconds of uplink time. These "chunks" will be uplinked using the CMS background queue.

Macros. The spacecraft has an on-board macro capability. However, this capability is not available for use by the instrumenters through the EOF.

Near-Real-time (NRT) Commands. A group of commands originating from an IWS that will be routed through the POCC for uplink and arrive at the spacecraft within 60 seconds. Near-real-time commanding is only available to the IWSs during the "throughput mode", that is when there is a contact with the spacecraft and near-real-time commanding is enabled by POCC, CMS and the ECS.

Online/offline Availability. Within the EOF, "online" information may be accessed electronically, without human intervention. "Offline" information is stored on a medium that requires human intervention before access, for example, mounting a tape or disk.

Operational Day and Operational Week. An operational day is the 24-hour period starting at 00:00 GMT. An operational week is the 7-day period starting on a fixed day of the week at 00:00 GMT.

Predefined Command Sequence (PCS). A list of command mnemonics resident in the POCC, identified by a unique name known to both the FOT and the instrumenters. It may contain instrument commands and/or approved spacecraft commands. It contains no time-tags or delay factors. The definition and maintenance of a PCS takes place between the instrumenters and the FOT (possibly via E-mail) and does not involve the ECS.

Project Data Base (PDB). The PDB consists of a series of data sets defining commands, telemetry, page displays, procedures, etc... After the test and integration phase, the PDB is usually delivered to the POCC where the FOT becomes responsible for its maintenance and redistribution. Changes to the PDB require approval by the Change Control Board and are implemented under the control of the FOT.

Quicklook Data. Data created expeditiously by PACOR, post-pass, from the tape recorder dumps. It consists of VC0 and VC1, forward-ordered, organized by APID and by time.

Real-time Telemetry. Telemetry data delivered to ECS by PACOR with minimal delay and immediately distributed to the instrumenters. It includes housekeeping (VC0), science (VC1), and MDI-M (VC2) packets.

Telemetry Archive Data. The telemetry data archived by ECS. It consists of all VC0, VC1 and VC2 packets received as real-time telemetry, tape recorder dumps quicklook data (VC4), or retransmission from PACOR of real-time telemetry in the case of a failure in the real-time transmission. The telemetry archive data is stored by ECS on-line for 7 days and off-line for 21 days. It can be retrieved by the instrumenters via file transfer.

Remote Command Request (RCR). Electronic request originated by an instrumenter and destined to the POCC. It is used to transmit a PCS which is already approved and stored in the POCC under the control of the FOT. RCRs are primarily intended to allow the instrumenters to make use of spacecraft commands needed by the instrumenters.

Remote Instrumenter. Hardware and software provided by individual instrument teams, physically located outside of the EOF. They will interact with the EOF via file transfer over the NASA Science Internet (NSI). They are not allowed to perform near-real-time commanding from their remote sites and they cannot receive real-time telemetry.

Remote Procedure Request (RPR). Electronic request originated by an instrumenter and destined to the POCC. It is used to request that the FOT operator execute a Systems Test and Operations Language (STOL) procedure which is already approved and stored in the POCC under the control of the FOT. STOL is the high level interactive command language that will be used in the POCC. RPRs are primarily intended to allow the instrumenters to make use of spacecraft commands as well as critical commands.

Spacecraft Command. A command addressed to a spacecraft subsystem, not including the payload instruments. As a general rule, the FOT is responsible for all spacecraft commands and the instrumenters are not allowed to generate these commands. However, some spacecraft commands may affect an instrument operation or invoke functions in which associated instrument commands need to be sent. The following is a list of such spacecraft commands, the execution of which will need to be coordinated with the FOT (see the RPR and RCR definitions):

Pulse commands,
On-Board Time (OBT) update commands,
Instrument power on / off,
Select primary / redundant electronics,
Non-operational heaters on / off,
Select mode of inter-instrument data exchange,
Program inter-instrument data exchange,
Select telemetry sub-mode, etc...

1.5 ACRONYMS

AIV	Assembly, Integration and Validation
APID	Application Process Identification
CCS	Central Checkout System
CDF	Common Data Format
CDHF	Central Data Handling Facility
CDS	Coronal Diagnostic Spectrometer
CELIAS	Charge, Element and Isotope Analysis System
CEPAC	COSTEP-ERNE Particle Analysis Collaboration
CMS	Command Management System
COSTEP	Comprehensive SupraThermal and Energetic Particle Analyzer
DDF	Data Distribution Facility
DFCD	Data Format Control Document
DSN	Deep Space Network
EAP	ECS Activity Plan
ECS	EOF Core System
EGSE	Experiment Ground Support Equipment
EIT	Extreme-ultraviolet Imaging Telescope
EOF	Experimenter Operations Facility
ERNE	Energetic and Relativistic Nuclei and Electron experiment
ESA	European Space Agency
ESDOC	European Science Data and Operations Centre
FDDI	Fiber Distributed Data Interface
FITS	Flexible Image Transport System
FOT	Flight Operations Team

FTP	File Transfer Protocol
GMT	Greenwich Mean Time (see UTC)
GSFC	Goddard Space Flight Center
GOLF	Global Oscillations at Low Frequencies
HK	Housekeeping
IAP	Instrumenter Input to the Activity Plan
ICD	Interface Control Document
IDL	Interactive Data Language
IP	Internet Protocol
IPD	Information Processing Division
ISO	International Organization for Standardization
ISTP	International Solar-Terrestrial Physics
IWS	Instrumenter WorkStation
LASCO	Large Angle Spectrometric Coronagraph
LOBT	Local On-Board Time
MDI-H	Michelson Doppler Imager-Helioseismology
MDI-M	Michelson Doppler Imager-Magnetogram
MO&DSD	Mission Operations and Data Systems Directorate
MODNET	MO&DSD Operational Development Network
NASA	National Aeronautics and Space Administration
NRT	Near-Real-Time
NSI	NASA Science Internet
NTP	Network Time Protocol
OBDH	On-Board Data Handling
OBT	On-Board Time
ODB	Operational Data Base
OSI	Open System Interconnection
PACOR	Packet Processor
PCS	Predefined Command Sequence
PI	Principal Investigator
PDB	Project Data Base
POCC	Payload Operations Control Center
Q&A	Quality and Accounting
RCR	Remote Command Request
RDBMS	Relational DataBase Management System
RFC	Request for Comment
RPR	Remote Procedure Request
R-S	Reed-Solomon
S/C	Spacecraft
SDB	System Data Base
SFDU	Standard Formatted Data Unit
SMOCC	SOHO Mission Operations Control Center
SMTP	Simple Mail Transfer Protocol
SOC	Science Operations Coordinator
SOHO	Solar and Heliospheric Observatory
SOWG	Science Operations Working Group
STOL	Systems Test and Operations Language
SUMER	Solar Ultraviolet Measurements of Emitted Radiation
SWAN	Solar Wind Anisotropies
TBC	To Be Confirmed
TBD	To Be Determined
TBS	To Be Supplied
TCP	Transmission Control Protocol
TELNET	Remote Login over TCP/IP Network

TM	Telemetry
TPOCC	Transportable Payload Operations Control Center
UDP	User Datagram Protocol
UTC	Coordinated Universal Time (see GMT)
UVCS	Ultraviolet Coronagraph Spectrometer
VC	Virtual Channel
VIRGO	Variability of Solar Radiance and Gravity Oscillations

SECTION 2. INTERFACE OVERVIEW

2.1 DATA EXCHANGED

The subsections below provide a description of the various data items exchanged over the interface between the ECS and the instrumenters. Several modes of data transfer will be used:

1) Data stream: transfer data in real-time over sockets.
2) File transfer: transfer large and less time-sensitive data sets using File Transfer Protocol (FTP).
3) Remote login: character-based access to interactive ECS processes (TELNET).
4) Remote graphic displays: graphical interface to interactive ECS processes via X.11.
5) Mail services: address text messages to a specific user to be read later using Simple Mail Transfer Protocol (SMTP).

Table 2.1 provides a list of the main types of data exchanged between the ECS and the instrumenters and, for each type, it identifies the mode of data transfer used.

Table 2.1. Data exchanged over the ECS/instrumenters interface

DATA TRANSFERRED:	DIRECTION	TRANSFER MODE
Session Control messages	Bidirectional ECS/IWSs	Data stream
Near-real-time commanding data	IWSs to ECS	Data stream
Commanding status messages	ECS to IWSs	Data stream
Informational messages	Bidirectional ECS/IWSs	Data stream
Commanding and telemetry status windows	ECS to IWSs	X.11 remote graphic display
Delayed commanding data	Instrumenters to ECS	File transfer
Background-queue commanding data	Instrumenters to ECS	File transfer
Delayed and Background commands validation reports	ECS to Instrumenters	File transfer
Real-time telemetry data	ECS to IWSs	Data stream
Real-time TLM distribution control messages	ECS to IWSs	Data stream
Quicklook / Archived TLM data	ECS to Instrumenters	File transfer
Activity plan	ECS to Instrumenters	File transfer
Instrumenter input to activity plan	Instrumenters to ECS	File transfer
Summary data	ECS to Instrumenters	File transfer
Instrumenters input to the Summary Data	Instrumenters to ECS	File transfer
Orbit and attitude data	ECS to Instrumenters	File transfer

Command history data	ECS to Instrumenters	File transfer
Time correlation log	ECS to Instrumenters	File transfer
SOHO Daily Report	ECS to Instrumenters	File transfer
As-Run Database	Instrumenters to ECS	File transfer
Synoptic data	ECS to Instrumenters	File transfer
Project data base	ECS to Instrumenters	File transfer
Project data base update requests	Instrumenters to ECS	Mail services
Time services	ECS to Instrumenters	Data stream

2.2 COMMANDING PROCESS OVERVIEW

There are two primary commanding modes differentiated by the delay between the time the commands are generated by the instrumenters and the time they are uplinked: the near-real-time commanding mode and the delayed commanding mode. In both modes, all instrument commands are routed to the instruments as soon as they are received by the spacecraft, since the instrumenters may not use the spacecraft time-tagged buffer. The actual execution of a command once it is received by an instrument processor is not relevant to this classification.

A third commanding mode is defined to accommodate the case where instrumenters need to utilize spacecraft commands or critical commands: the FOT-coordinated commanding mode. The instrumenters must coordinate the issuance of these commands with the FOT operator who will send the commands requested by the instrumenters. This commanding mode may also be utilized in case of contingency.

The commands are submitted either in binary or in mnemonic format by the instrumenters who have the basic responsibility of command validation. The role of the ECS is limited to verifying that the commands originate from an authorized source, and does not include a check against the command definitions in the PDB. This check is done by the CMS. However, commands that will be submitted in the binary format will not be checked against the PDB. In particular, critical commands cannot be flagged. The instrumenters have the choice of disallowing commanding in binary format and they may do so by contacting the SOC. From then on and until the request is revoked by the originating instrumenter, ECS will reject commands in binary format for that instrument.

2.2.1 NEAR-REAL-TIME COMMANDING

The near-real-time commanding data is submitted by the IWS to the ECS as a series of "messages", the functional protocol being, as much as possible, similar to the protocol used with the Central Checkout System (CCS) in the Assembly, Integration and Validation (AIV) environment. Modifications have been necessary to support the operational environment.

2.2.1.1 Throughput Mode

The overall ground system requirement for this mode is that commands generated by an instrumenter in the EOF will be received by the spacecraft within 60 seconds. More specifically, ECS shall make a single near-real-time command available for transmission to the SMOCC within 10 seconds of reception from an IWS. This mode is only available to the instrumenters who are resident in the EOF. Its primary goal is science monitoring and control of experiments as dictated by changes in solar activities. Thus, full processor reloads would normally not be done in this mode, although the uplink of large loads might be negotiated among the experiment teams resident at the EOF.

The throughput mode may be interrupted or ended in three different ways:

1) Pause: In order to allow POCC or FOT activities to take place, the throughput mode is temporarily interrupted. At that time, ECS stops accepting near-real-time commands from the instrumenters but all near-real-time command queues in ECS and in the SMOCC are maintained. When the throughput mode resumes, near-real-time commanding resumes without any data loss.

2) Stop gracefully. This is the normal ending for the throughput mode. SMOCC sends a warning that the throughput mode will be ended shortly. All the near-real-time commanding data in the

ECS and in the SMOCC queues are processed, uplinked and acknowledged before the throughput mode is ended.

3) Stop immediate. In cases of emergency, SMOCC will terminate the throughput mode without a warning. In this case, all the near-real-time commanding queues in the SMOCC and in the ECS will be flushed.

If an error is detected in a near-real-time command group, both the ECS and SMOCC will reject all near-real-time command groups addressed to the same instrument following the group where the error was found. The originating IWS must submit an Instrument Reset message. Commanding will resume after proper reception by ECS and SMOCC of the Instrument Reset message. All near-real-time command groups for the same instrument between the group in error and the reset message will be discarded by ECS and the CMS. The operation of the throughput mode for the other instruments is not affected by this process.

2.2.1.2 Reserved-time Commanding

This mode allows one or more instrumenter teams to have exclusive use of the throughput mode during a reserved period of time. At least one operational day in advance, an instrumenter requests a reserved time slot, and indicates the command volume expected. The request is included in the planning process, it is negotiated among the EOF instrument teams, and if no conflicts exist, the requested time window is reserved for that instrumenter. The SOC will manually control the start and end of a reserved-time session. This mode can be used when an instrument requires a larger amount of commands or when the command uplink needs to be timed in a very precise manner.

2.2.2 DELAYED COMMANDING

In this mode, the commanding data will be uplinked to the spacecraft by the FOT within a time window specified by the instrumenter. The delayed commanding mode applies to individual command groups which need to be uplinked during a rather precise time window. It is available to all instrumenters, EOF resident or not.

A command group is submitted in a file, the header of which specifies the desired uplink window. The request to uplink this command group must be formulated and incorporated into the approved schedule at least one operational day in advance of the desired uplink time: this is accomplished by transmitting the command group itself, which contains the appropriate information in its header. When received by ECS, the command group is submitted to the CMS for validation. CMS will return a command validation report which will be transmitted back to the originating instrumenter. If the group is valid and the requested uplink time does not create any scheduling conflict, it will be uplinked by the FOT during the specified window.

The width of the requested uplink window should be at least on the order of one hour. This would avoid scheduling conflicts and too frequent pauses of the throughput mode since the uplink of delayed commands necessitates pausing the throughput mode for near-real-time commands. Also CMS cannot ensure the ordering of individual command groups that would have the same or overlapping uplink windows. In order to avoid sequencing problems, the following is suggested. For a given instrument, all delayed command groups should have non-overlapping uplink windows. Since no limit has been imposed on the length of a delayed command group, a single larger group should be used instead of several smaller groups with the same requested uplink window.

2.2.3 BACKGROUND-QUEUE COMMANDING

This mode is primarily intended to deal with large command groups which do not need to be uplinked in a time-critical manner. In particular, this mode will be used for large amounts of commanding data (e.g., large table loads) which could block the commanding link for a long period of time. To avoid this, the instrumenters must package the commanding data into "chunks" no larger than 0.5 Kbytes, which corresponds to approximately 10 seconds of uplink time.

Just like for delayed commanding, ECS submits the command groups to the CMS that returns a command validation report that will be transmitted back to the originating instrumenter. If no errors were found, the command groups are put in the SMOCC "background queue". The individual groups are uplinked in the order submitted by the instrumenter, by interleaving them into the real-time command stream as soon as some space becomes available. However, ECS and SMOCC understand that there is no need to uplink the individual chunks in any specific order. Background-queue commands have the lowest priority among all commanding data. The originating instrumenter may optionally specify an uplink window. If not specified, the chunks are uplinked whenever possible without a time limit. If specified, CMS would reject all the chunks that could not be uplinked during the requested uplink window. Note that the width of the requested uplink window should be on the order of one operational day.

2.2.4 FOT-COORDINATED COMMANDING MODE

This mode allows the instrumenters to request the execution of spacecraft commands or critical commands. This is implemented using either a Remote Command Request (RCR) or a Remote Procedure Request (RPR). When originating from an IWS, these requests are received by the ECS and forwarded to the FOT via the SMOCC in a format similar to the NRT command messages. These requests identify the originating instrumenter and contain the name of a Predefined Command Sequence (PCS) in the case of an RCR, or the name of a STOL procedure in the case of an RPR. The PCSs and STOL procedures are defined directly between the instrumenters and the FOT. The FOT maintains a list of PCSs and STOL procedures that have been approved and can be invoked in RCRs or RPRs respectively. If an instrumenter's RCR is valid, the PCS will be automatically executed in the POCC and incorporated into the uplink transmission. If an instrumenters' RPR is valid, the FOT operator will initiate its execution. The throughput mode will have to be paused during the execution of either an RCR or an RPR. ECS will always acknowledge the receipt of an RCR or RPR via a NRT response message. When the request is executed, the originating IWS will receive an informational message containing text defined in conjunction with the FOT.

This mode of commanding may only be used by EOF-resident instrumenters. For remote instrumenters, it will require the intervention of the SOC or the FOT operator.

2.2.5 COMMANDING PRIORITY SCHEME

The ECS has a requirement to prioritize the commanding data it receives from the instrumenters. To that effect, different levels of priority are implemented at the instrument level.

Near-Real-Time Commanding
Two priority levels apply:

1) **High Priority.** This level is intended for emergency situations. It may only be granted by the SOC for near-real-time commands originating from a given instrument or a given set of

instruments. It may even be a single-user mode where all commanding activities for all other instruments are stopped.

2) Normal Priority. This is the normal level of priority for near-real-time commanding. However, ECS provides several levels within the normal priority (instruments can be prioritized on an individual basis). These levels will be negotiated by the instrumenter teams during the daily planning meeting, but they can be changed at any time by the SOC. This will allow the instrumenters to control, and modify when needed, the allocation of relative priorities regarding near-real-time commanding.

Delayed and Background-Queue Commanding
All delayed commanding data is assigned a lower priority for transmission to the SMOCC. Within the SMOCC, delayed commands are guaranteed an uplink time. Background-queue commands are assigned the lowest priority level and are only transmitted when the uplink channel is free.

2.3 TELEMETRY DISTRIBUTION

ECS receives, archives and distributes to the resident instrumenters real-time telemetry data (house-keeping, science and MDI-M data). ECS receives and archives tape recorder playback data.

2.3.1 REAL-TIME TELEMETRY DISTRIBUTION

The real-time telemetry data is comprised of housekeeping and science data (VC0 and VC1), as well as MDI-M data (VC2). ECS receives that data from the Information Processing Division (IPD) Packet Processor (PACOR) as a stream of packets identified by an Application Process Identifier (APID). ECS distributes these packets in real-time to the IWSs.

The IWSs choose the APIDs they wish to receive during a given real-time pass. These requests should be formulated during the planning process. During the real-time pass, each APID must be requested individually. If during the pass, the requests for telemetry distribution exceed the system capacity, the instrumenters will have to negotiate and determine the distribution scheme. An instrumenter may request more than one APID for simultaneous distribution (for example, housekeeping and science from different sources). A given IWS is not limited to telemetry from the instrument it commands, and it may request telemetry from other instruments. The maximum number of APIDs that may be requested simultaneously depends on the system capacity and will be determined during system integration.

The IWSs receive the telemetry packets they requested in individual messages, one packet per message. PACOR provides Quality and Accounting information associated with each packet. The instrumenters may select to either receive or not receive this information on a session basis. Under normal operations conditions, ECS will stop distributing the telemetry to a given IWS either following an interrupt-packet-transfer message from that IWS, or at the end of the real-time pass.

2.3.2 ARCHIVED TELEMETRY DATA

The telemetry data archived within ECS consists of all VC0, VC1 and VC2 packets received either as real-time telemetry or as quicklook data, including the tape recorder dumps and retransmissions of real-time telemetry in the case of transmission loss. The archived telemetry data are sorted by APID and by time: each file contains approximately 2 hours worth of data for a single APID. The tape recorder dump data are available to the instrumenters at ECS within approximately 4 hours of downlink. The telemetry data are kept on-line for 7 days and off-line for 21 days.

The archived telemetry data are organized among several system directories and specific naming conventions are used. That data may be retrieved by the instrumenters via file transfer. To access the data, the instrumenters utilize the telemetry file naming conventions and search the system directory. They may also submit to the SOC a request to receive the telemetry data for a given set of APIDs and ECS will automatically send the requested data via FTP as soon as the files are available.

2.4 MISSION SUPPORT DATA

2.4.1 SUMMARY DATA

This data provides a synopsis of solar conditions and SOHO science programs. It includes three classes of data: images from the imaging instruments, key parameters from non-imaging instruments, and a list of observation programs which is information extracted from the As-run database. Table 2.2 describes the various components of the summary data.

MDI, EIT, UVCS and LASCO are expected to provide ECS with daily images. SUMER and CDS are also expected to provide images, but possibly not on a daily basis. Key parameters will be calculated for CELIAS and CEPAC by CDHF, and will be kept on-line in that facility. Parameters are expected to be provided to the SOC in the ECS by GOLF, VIRGO, and SWAN. A daily observation program report and an event log will be compiled by the SOC based on input from the instrumenters (see As-run database).

The average size of the instrumenter input to the summary data is 20 Mbytes per day. ECS stores that data (images, instrumenter-generated parameters, event log and observation program report) for on-line access by the instrumenters for 28 days. Input to the summary data is submitted to ECS by the individual instrumenters. Under the control of the SOC, it is merged and stored in the ECS where the instrumenters can access it. Once all the instrumenter input has been received and approved, the SOC transmits the daily summary data to CDHF.

Table 2.2. SOHO Summary Data.

INSTRUMENT	IMAGES	KEY PARAMETERS	OBSERVATION PROGRAM
GOLF		X	X
VIRGO		X	X
MDI	X		X
SUMER	X		X
CDS	X		X
EIT	X		X
UVCS	X		X
LASCO	X		X
SWAN		X	X
CELIAS		X (CDHF)	X
CEPAC		X (CDHF)	X

2.4.2 PREDICTIVE AND DEFINITIVE ORBIT DATA

The orbit data describes the translational motion of the spacecraft relative to an inertial reference system. Definitive orbit refers to the measured past translational motion of the spacecraft; predictive orbit refers to the calculated future translational motion of the spacecraft. That data consists of a series of state vectors describing the position and velocity of the spacecraft at fixed interval of times. The orbital data is generated weekly by FDF and sent electronically to CDHF. The definitive data describes the previous week, and the predicted data refers to the upcoming 5 weeks. ECS stores 5 weeks of predictive and 28 days of definitive orbit data on-line.

2.4.3 DEFINITIVE ATTITUDE DATA

This data describes the rotational motion and pointing stability of the spacecraft relative to an inertial reference system. It refers to the measured past orientations of the spacecraft. The attitude data is generated by CDHF. ECS stores 28 days of definitive attitude data.

2.4.4 COMMAND HISTORY

This data is provided by the SMOCC and contains a time-ordered list of POCC activities and all the command groups uplinked to the spacecraft during a given operational day. This is a fixed-format report, where each entry contains a time field and a description of the activity. Instrument commanding activities are keyed by instrument name and command group ID uniquely identifying each command group. CMS will append to that report activities that are specific to the CMS, such as the background queue processing. ECS may append the information related to near-real-time commanding if not already available in the SMOCC input.

2.4.5 SYNOPTIC DATA

This data is comprised of images and science reports obtained from other missions and other observatories. It is presently estimated that ECS would receive approximately 50 Mbytes per day of solar-related data for planning purpose. It is obtained by the SOC, and stored for 7 days within the ECS, for access by the instrumenters.

2.4.6 TIME CORRELATION LOG

This information describes the on-board clock drift rates and resets. This data is created from information received from the SMOCC in the command history report. It will be kept within the ECS in a data set containing the times and description of procedures run in the POCC affecting the spacecraft clock.

2.4.7 PROJECT DATA BASE

The PDB is maintained by the POCC. ECS will obtain the original version of the PDB from the POCC. Later on, when new versions of the PDB are issued, the POCC distributes the entire updated PDB to the interested entities.

The POCC provides the PDB to the ECS via tape as a series of ASCII files. ECS will make these files available for the instrumenters to retrieve them via file transfer. These files are in the format provided by the POCC, that is the format defined in the Data Format Control Document (DFCD) which is produced by the POCC (reference 14). ECS does not modify or reformat them. An E-mail message will inform the instrumenters of the reception of a new PDB.

The System Data Base (SDB) in its ORACLE format should be available from the FOT. Since a decision has been made to provide ORACLE within the EOF to support the AS-Run data base functions, it may be possible for ECS to make the SDB available to the instrumenters if the PDB format is not acceptable to them. However, this is not an ECS requirement.

2.4.8 PROJECT DATA BASE UPDATE REQUESTS

When instrumenters need to request an update to the existing PDB (for example modification of command or telemetry parameter definitions), they must send an E-mail message to the FOT operator describing the desired change. FOT will approve or reject this request. If accepted, it will be incorporated into the operational data base which is the POCC working copy of the PDB. However, the process of recreating an operational data base is usually cumbersome and is done infrequently. Changes to the PDB require CCB approval and there may be a rather long delay between the time a PDB update is requested by an instrumenter and the time it is actually implemented.

2.4.9 SOHO DAILY REPORT

This report is produced by the FOT, typically within 24 hours of the operational day being reported. It gives a high level status of the spacecraft and each instrument (ON / OFF) for that day. The report provides descriptions and times of anomalies or contingencies in the spacecraft or any instrument. The SOHO Daily Report contains the times of any unrecoverable data gaps. The SOHO Daily Report will be stored in one file per operational day, each file being uniquely named for that calendar day. It will remain available on-line in the EOF for the most recently 30 days. It is also transmitted electronically to CDHF where it is also stored on-line for 30 days for access by remote instrumenters and other interested researchers. The SOHO Daily Report will be included by DDF in the distribution data on hard media.

2.4.10 TIME SERVICES

The ECS will obtain the Coordinated Universal Time (UTC) using the Network Time Protocol (NTP). The ECS system clocks will be synchronized to that time to allow for uniform time tagging. Using the appropriate utilities on their own systems, the instrumenters will be able to access that time service and synchronize their own system clocks.

2.4.11 DISPLAYS

Two main types of displays are made available to the instrumenters:

1) Commanding Status and Telemetry Distribution Monitoring displays. These displays are primarily designed and implemented to support the SOC with ECS monitoring functions. They are made available to the EOF-resident instrument teams that have X.11 capabilities. ECS will make available to the instrumenters ANSI C code to support these displays on their workstations. The format and general content of these displays are provided in Appendix B.

2) POCC Telemetry Displays. Two POCC terminals will be located in the EOF. POCC telemetry pages will be displayed on these terminals for viewing by the instrumenters within the EOF.

2.5 PLANNING PROCESS OVERVIEW

The planning process enables the instrumenters to incorporate their science activities with pre-existing constraints such as DSN contacts or commanding time slots reserved for special spacecraft activities.

Planning can be done on a quarterly, monthly, weekly or daily basis. In all cases, the overall process is basically the same and only differs by its level of detail and precision. The long term planning is mainly based on science programs and campaigns, whereas the shorter term planning incorporates DSN schedules and FOT planned activities.

In order to initially set-up the planning process, a set of activities needs to be defined. The definition of activities also includes specifying associated priorities.

The instrumenters submit their activity requests to ECS who merges them, identifies and resolves conflicts when possible. If conflicts remain, the instrumenters are notified, and they should modify and resubmit their requests. This process is repeated until all conflicts are solved. The final conflict-free plan is referred to as the schedule.

2.5.1 ECS ACTIVITY PLAN

The ECS Activity Plan (EAP) consists of a list of activity requests or notifications. The following is provided to the instrumenters as part of the activity plan:

1) DSN Contacts. This provides DSN contact start and end times, and a confirmation flag indicating if a given contact is only predicted or was confirmed. This information is incorporated into the activity plan as soon as the ECS receives it from the SMOCC. Each transmission covers one week of confirmed schedule and up to 3 weeks of forecast and FDF predicts schedule. Long-term predictions may be incorporated if and when available. This information is transmitted by the SMOCC every week on a fixed day, 3 days before the start of the confirmed week.

2) FOT Reserved Times. This indicates the start and end times of windows reserved by the FOT for special activities such as spacecraft commanding. During these time windows, the throughput mode will not be available.

3) Reserved Times for Activities Coordinated with Other Observatories. This indicates the start and stop times of science programs and special campaign activities.

2.5.2 INSTRUMENTERS INPUT TO THE ACTIVITY PLAN

The Instrumenters Input to the Activity Plan (IAP) consists of a list of statements, each statement defining a specific activity request or notification.

A first set of statements describe science activities: the set of all these statements merged for all the instruments will be referred to as the As-Planned log.

1) Science Program and Campaigns Notifications. These requests describe science programs, their goals and objectives. They identify the instruments involved in the program and the program start and end dates.

2) Notification for Special Activities. This is used to indicate when an instrument will perform an activity that may affect the operation of other instruments, such as a maneuver that may cause vibrations and affect the overall pointing stability of the spacecraft. Specific requests for each type of activity need to be defined by the instrumenters. Each request identifies the activity and defines its start and end times.

3) Instrument Mode Change Notifications. These consist of several specific requests which will be defined in detail during the IWS integration period. Examples of possible requests are:

- Change in telemetry sub-modes
- Change in the inter-instrument flag configuration
- Change in instrument mode of operation (specific to each instrument).

Specific requests need to be defined by the instrumenters for activities which are of interest to or affect the operation of other instruments.

Other requests may need to be provided by the instrumenters, especially to support the daily planning process. Such requests may be:

1) Request for NRT commanding. This request defines the start time and end time of a near-real-time commanding session for a given IWS. It should also specify a predicted command rate during that session. This request is used to estimate and plan the volume of near-real-time commanding and resolve possible conflicts as early as possible: with an uplink bandwidth of only 2 Kbits per second and a maximum on-board processing rate of one OBDH block command per second, it is quite likely that conflicts will occur related to the requested volume of commanding. However, the instrumenters may elect not to use the planning functions for their near-real-time commanding. If this results in an overflow of the uplink capacity, it may cause delays for all the commanding IWSs.

2) Request for Reserved-Time Commanding. This is used by an instrumenter to request a reserved time slot for some special commanding activities. It indicates the instruments involved, the start and end times of the requested window as well as the predicted commanding volume during that time. The planning process will check if this request can be accommodated, and if it can be, the requested time slot will be reserved for that instrument. The activation of the reserved commanding time will remain manually controlled by the SOC.

3) Telemetry Distribution Request. This is used to request the reception of a given type of telemetry by a given IWS. It specifies the receiving IWS, the desired APID and the start and end times of the distribution. An IWS may request more than one type of telemetry for simultaneous distribution (HK and science from different sources). A separate request is needed for each individual APID desired. Due to system capacity constraints, the number of APIDs that can be distributed simultaneously may be limited. The IAP request is used to plan the estimated volume of telemetry and point out conflicts. However, the instrumenters may request telemetry reception during a real-time pass without using the activity plan. The resident instrumenter teams are responsible for the distribution scheme in case of conflicts.

Note that delayed commanding needs to be requested from the SMOCC at least 24 hours in advance. This is done by transmitting the data file itself, its header being used as a request.

2.5.3 AS-RUN DATABASE

This information is provided by the instrumenters to the ECS. It describes the science programs that were actually executed on the previous day. It is electronically transferred to the ECS as ASCII files and the SOC is responsible for incorporating it into the databases. Some of that information is sent as part of the Summary data files to the CDHF, for later distribution to the instrumenters teams. The design and implementation of the As-run database are not the responsibility of the ECS development task. Consequently, further details on the nature and format of that data are not included in this ICD.

SECTION 3 - DATA FORMAT SPECIFICATION

3.1 GENERAL DATA FORMAT SPECIFICATION

3.1.1 ECS MESSAGES

This section describes various messages exchanged between the ECS and the instrumenters as data streams over sockets.

3.1.1.1 General Format of an ECS Message.

A message exchanged over the ECS/IWS interface consists of a 4-byte standard header followed by a data field of variable length as illustrated in Table 3.1.

Table 3.1. General ECS Message Format.

Field	Bytes	Description
Type/Message ID	2	Standard Header
Length	2	
User data dependent on the message type.	variable	Data field

The standard header is comprised of a 2-byte "type field" followed by a 2-byte length field.

(1) The 2-byte type field is defined as:
first byte is
X'01' for messages to control a communication session
X'02' for messages related to telemetry distribution
X'03' for messages related to telecommanding
second byte identifies the messages within these 3 categories.

(2) The 2-byte length field contains the length in bytes of the message that follows, excluding the 4-byte standard header.

The data field is specific to each type of message and is of variable length.

3.1.1.2 ECS Messages Description.

As much as possible, the ECS/instrumenters functional protocol was kept similar to the protocol implemented between CCS and the Experiment Ground Support Equipment (EGSE) in the AIV environment. Modifications were necessary to apply the AIV protocol to the operational environment, mainly to support the commanding functions. Also, a bi-directional Informational message has been added. Table 3.2. defines the messages used within the EOF.

Table 3.2. ECS Messages.

Message Name	Direction	Standard Header		Data Field	
		Type	Length	Bytes	Description
Session Init	ECS to IWS	X'0101'	X'0004'	Int 4	Endian check block data
Session Init Response	IWS to ECS	X'0102'	X'0015'	ASCII 16 Int 1 Int 4	ORIG_ID Endian check result Endian check block data
Session End	ECS to IWS	X'0103'	X'0001'	Int 1	Reason code
NRT Command	IWS to ECS	X'0301'	var	Int 2 ASCII 6 ASCII var	Request ID Instrument name Command data
Response to NRT Command	ECS to IWS	X'0302'	var	Int 2 ASCII 6 Int 2 Int 2 ASCII var	Request ID Instrument name Response code Reason code Response to command (text)
NRT Command Authority Request	IWS to ECS	X'0303'	X'00A0'	Int 2 ASCII 6 Int 2	Request ID Instrument name Request code
NRT Authority Status	ECS to IWS	X'0304'	var	Int 2 ASCII 6 Int 2 ASCII var	Request ID Instrument name Status code Status description (text)
Remote Command Request	IWS to ECS	X'0305'	var	Int 2 ASCII 6 ASCII 20 ASCII var	Request ID Instrument name PCS name Instructions/Comments
Remote Procedure Request	IWS to ECS	X'0306'	var	Int 2 ASCII 6 ASCII 20 ASCII var ASCII var	Request ID Instrument name STOL Procedure name Parameter specifications Instructions/Comments
TM Packet Distribution Request	IWS to ECS	X'0201'	var: X'0005' or X'0006'	Int 1 Int 2 Int 2 Int 1	Spacecraft ID APID Request ID Optional: Q&A capsule Flag
TM Packet Distribution Response	ECS to IWS	X'0202'	X'0004'	Int 2 Int 1 Int 1	Request ID corresponding to Request Response Code Reason Code
Start of TM Packet Distribution	ECS to IWS	X'0203'	X'0005'	Int 1 Int 2 Int 2	Spacecraft ID APID Request ID
Telemetry Packet	ECS to IWS	X'0204'	var	Int 2 Binary 6 bytes	Request ID TM source packet Q&A capsule

Interrupt TM packet transfer	IWS to ECS	X'0205'	X'0002'	Int 2	Request ID
End of TM Packet Transfer	ECS to IWS	X'0206'	X'0003'	Int 2 Int 1	Request ID Status code
Informational Message	ECS to IWS IWS to ECS	X'0400'	var	ASCII var	Free form text

3.1.2 ECS FILES

Files exchanged between the ECS and the instrumenters have a standard transfer format consisting of a file header followed by a file body. The file header uses keywords to provide information about the file and is in the general format "KEYWORD = value". The file body contains ASCII character data that is specific to each type of data contained in the file.

3.1.2.1 System Directory Organization for Files

The ECS files are organized among various system directories, one directory being provided for each type of file, and sub-directories being provided as needed in each case. For the data that may be retrieved by the instrumenters, the ECS main system directories are as follows:

- Delayed commanding data. There is one directory for all instruments. The instrumenters will transfer their delayed commanding data to that directory.

- Background-queue commanding data. Similarly to delayed commanding, there is one directory where the instrumenters deposit their background-queue commanding data.

- Command validation reports. ECS uses a single directory to store the validation reports generated by CMS for both delayed and background-queue commanding. There is one sub-directory for each instrument.

- Activity plan. One directory contains the ECS activity plan for retrieval by the instrumenters. A second directory with a sub-directory for each instrument is used by the instrumenters to deposit their input to the activity plan.

- Archived telemetry data. There is one directory for each APID.

- Summary data. One directory with one sub-directory per instrument contains the summary data after it has been approved by the SOC. The instrumenters can access that directory to retrieve the copies of the summary data in the format it has been or will be transferred to CDHF. A separate directory with one sub-directory per instrument is used by the instrumenters to deposit their daily input to the summary data.

- Orbit data. A single directory with two subdirectories for predictive and definitive orbit data respectively, can be accessed by the instrumenters for file retrieval.

- Attitude data. A single directory contains the definitive attitude data. It can be accessed by the instrumenters for file retrieval.

- Command history. A single directory can be accessed by the instrumenters for file retrieval.

- Time correlation log. A single directory can be accessed by the instrumenters for file retrieval.

- SOHO Daily Report. A single directory can be accessed by the instrumenters for file retrieval.

- Synoptic data. A single directory with one sub-directory for each type of data (H-a images, radio images, etc...) can be accessed by the instrumenters for file retrieval.

- Project Data Base. A single directory contains all PDB files for access by the instrumenters.

3.1.2.2 File Naming Conventions

Each file is referenced by a unique name consisting of an identifier followed by a file name extension. Several file naming schemes will be necessary in the EOF to better describe the data contained within each file. The specific conventions are described in Appendix A.

3.1.2.3 File Header Format

All file headers described in this document have the same general format: a series of ASCII characters records, each record being of the form "KEYWORD = value", the last character being NL (New Line).

3.1.3 TIME FIELD FORMAT

All time fields, unless specified otherwise in individual cases, will contain both the date and time in a single 19 character long format as follows:

YYYY/MM/DD HH:MM:SS
where:
    YYYY/MM/DD is the date:
        YYYY represents the year (for example 1995)
        MM represents the month (01 for January to 12 for December)
        DD represents the day of the month (01 to 31)
    HH:MM:SS is the time:
        HH represents the hours (00 to 23)
        MM represents the minutes (00 to 59)
        SS represents the seconds (00 to 59)
    The date and time fields are separated by an ASCII blank.

Except for the telemetry packet data, all times mentioned in this ICD are understood to be in reference to GMT.

3.1.4 INSTRUMENT NAME FIELD FORMAT

All fields specifying the Instrument name are 6 ASCII characters in length, and must be one of the following, left-justified and padded with ASCII blanks if necessary:

CDS
CELIAS
CEPAC
EIT
GOLF
LASCO
MDI

SUMER
SWAN
UVCS
VIRGO

3.2 COMMANDING DATA SPECIFICATION

3.2.1 OBDH BLOCK COMMAND

The routing and formatting of the command data from the instrumenters to the spacecraft is illustrated in figure 3.1. The basic unit of command input provided by an instrumenter is an OBDH block command. Each OBDH block command consists of a series of 16-bit words of data as follows:

- one word representing the block header
- up to 30 words of data
- one word containing the checksum of the preceding words (header and data).

The block header is 16 bits long and of the form:
XXYYYYZZZZZLLLLL where:

XX	bits 0 and 1	Reserved
YYYY	bits 2 through 5	Destination address 0100 for CDS — 0101 for CELIAS 0110 for CEPAC — 0111 for EIT 1000 for GOLF — 1001 for LASCO 1010 for MDI — 1011 for SUMER 1100 for SWAN — 1101 for UVCS 1110 for VIRGO
ZZZZZ	bits 6 through 10	Command identifier
LLLLL	bits 11 through 15	Block length (1 to 31): number of 16-bit words in the block, excluding the checksum.

3.2.2 INSTRUMENT COMMAND INPUT

The method and format for submitting instrument commands described in this section are based on the following understanding:

- The instrumenters can only use OBDH block commands when commanding their instruments through the ECS.

- A mnemonic for an instrument command uniquely defines a single OBDH block command

- For each such mnemonic, a PDB file provides the binary equivalent of the OBDH block command header (including destination address, command identifier and number of data words associated with this command).

- For each mnemonic, another PDB file provides the binary equivalent of each 16-bit data word in the OBDH block command. It is our understanding that, if within one word, any bit is not fixed and can be specified by the user, the PDB indicates the entire 16-bit word as user-specified. Hence, each "parameter specification" by the user must correspond to an entire 16-bit word. These parameters specifications can be done using ASCII characters representing the decimal, octal or hexadecimal value of the word.

The content of an OBDH block command may be represented in one of two general formats: binary format and mnemonic format as described in the following sections. This is illustrated in figure 3.2. Note that a procedural language such as STOL or ELISA is not used in the EOF.

Figure 3.1. SOHO Command Formatting.

REPRESENTATION OF AN OBDH BLOCK COMMAND

BINARY FORMAT MNEMONIC FORMAT		OBDH COMMAND BLOCK
4 Hex Characters	------->	Header
4 Hex Characters	------->	Data
4 Hex Characters	------->	Data
.		.
.		.
.		.
.		.
4 Hex Characters	------->	Data
4 Hex Characters	------->	Data
4 Hex Characters	------->	Checksum

<-------- Mnemonic + Representations of words with user-specified values (Variable number as defined in PDB)

COMMAND DEFINITION IN PDB FILES

TC_PARA Table -------> OBDH_B Table

TC_PARA Table	OBDH_B Table			
MNEMO1	MNEMO1	Address	CMD Identifier	Length

Tc_block_obdh_data Table

MNEMO1	Word 1	2401	First word is all fixed bits
MNEMO1	Word 2	xxxx	Second word has variable bits

(Could be up to 30 ...)

EXAMPLE

OBDH Block Command to be uplinked

Header	1203	0001 0010 0000 0011
Data Word 1	2401	0010 0100 0000 0001
Data Word 2	77AF	0111 0111 1010 1111

<--- (Header)

OBDH Block Command Header

Reserved	Destination Address	Command Identifier	Length
2 Bits	4 Bits Represents CDS	5 Bits Command Identifier	5 Bits 3 16-bit words in OBDH block + checksum
00	0100	10000	00011

Checksum	ADB3	1010 1101 1011 0011

Mnemonic representation:

```
MNEMO1,0x77AF;    /* one parameter in hexadecimal */
MNEMO1,123;       /* one parameter in decimal */
MNEMO1,0777;      /* one parameter in octal */
```

Binary representation:

```
BINARY 0x1203,0x2401,0x77AF,0xADB3; /* Only hexadecimal allowed */
```

Figure 3.2. Instrumenters Command Specification.

3.2.2.1 Binary Format

In the binary format, the commanding data consist of a series of ASCII hexadecimal representations of all the 16-bit binary words contained in one OBDH block command including header and checksum:

1) The keyword "BINARY" indicates the start of an OBDH block command.

2) The content of an OBDH block command is represented as a series of up to 32 4-character hexadecimal words:
- The first hexadecimal word represents the 16-bit OBDH block header.
- The following words represent up to 30 16-bit data words.
- The last word represents the 16-bit checksum of the header and data words.

3) Hexadecimal words are separated by a comma.

4) The end of the OBDH block command is indicated by a semicolon.

5) Comments in the form "/* text */" are allowed after the semicolon.

Example: BINARY 0x1203,0x2401,0x77AF,0xADB3; /* optional comment */

3.2.2.2 Mnemonic Format

Each mnemonic specification defines a single OBDH block command. It consists of a mnemonic optionally followed by ASCII representations of the data words which have been defined as user-specified in the PDB.

1) The mnemonic is followed by up to 30 user-specified parameters. The mnemonic must be defined in the telecommand description files of the PDB and the number of user-specified parameters must correspond to the number of user-defined values defined in the PDB.
The user-specified 16-bit words are defined using ASCII character representations:

hexadecimal:	0xhhhh	'0x' followed by hexadecimal digits
octal:	0oooooo	'0' followed by octal digits without leading zeros
decimal:	ddddd	decimal digits without leading zeros

2) The representation of data words are separated by a comma.

3) The end of the command specification (mnemonic and optional data words) is indicated by a semicolon.

4) Comments in the form "/* text */" are allowed after the semicolon.

Examples:

```
CBEFILI,0x77AF;     /* in this command, only one word has user-defined values */
CBEFILI,073657;     /* same command using octal representation */
CBEFILI,30639;      /* same command using decimal representation */
```

Note: The checksum is not provided by the instrumenters in the case of the mnemonic format. It will be calculated by the CMS. However, it is provided by the instrumenters when the binary format is used.

3.2.3. NEAR-REAL-TIME COMMANDING DATA SPECIFICATION

The general format of the messages exchanged over the interface is defined in section 3.1.1. These messages all contain a 4-byte standard header followed by a data field. This section defines the specific functions and the content of the data field for the messages exchanged for near-real-time commanding.

3.2.3.1 Session-Init (ECS to IWS). This message is used to initiate a communication session between the ECS and a given IWS. It is identical to the session-init message used in the CCS environment.

Data field content:

Integer*4	Endian check block data X'01020304' used to insure that the data transmitted by the ECS will correctly be interpreted by the IWS. The ECS uses the big endian format.

3.2.3. 2 Session-Init-Response (IWS to ECS). This message is used to acknowledge a Session-Init message and to identify the entity with which the session is established.

Data field content:

Character*16	IWS Identification padded with ASCII blanks.
Integer*1	Endian check result indicating whether the endian check block included in the session-init message was correctly interpreted by the IWS: X'00': successful X'01': unsuccessful If the check is not successful, ECS will consequently terminate the session.
Integer*4	Endian check block data X'01020304' used to insure that the data transmitted by the IWS is compatible with the endian characteristics of the ECS.

3.2.3.3 Session-End (ECS and IWS). This message is used to terminate a session, either immediately after the reception of a Session-Init-Response if a problem was found or to end an on-going session.

Data field content:

Integer*1	reason Code X'00': normal end X'01': invalid ORIG_ID (IWS identification in Session-Init-Response) X'02': endian check error X'03': unsuccessful session-init-response or no Session-Init-Response received

3.2.3.4 NRT-Command (IWS to ECS). This message is used to transfer the near-real-time command data. It corresponds to the CCS Remote-Command message. The message data field for a near-real-time command message is illustrated in Table 3.3.

Data field content:

Integer*2 — Request ID generated by the IWS to uniquely identify this command message. ECS and SMOCC use the combination "instrument/request ID" to identify all NRT commands groups. ECS uses the Value X'FFFF' for special purposes (see Response-to-NRT-Command and NRT-Authority_Status messages)

Character*6 — Instrument name

Character var — The command data as defined in section 3.2.2.

Each message will contain one and only one OBDH block command definition, that is one mnemonic definition or one "BINARY" keyword.

Table 3.3. Near-Real-Time Command Message Format

FIELD	Bytes	Description
Standard Header	4	Type (X'0301') and length
Request ID	2	2-Byte integer uniquely identifying this message
Instrument Name	6	Instrument commanded
Command data	var	Command data in mnemonic or binary format. See Section 3.2.2

3.2.3.5 Response-to-NRT-Command (ECS to IWS). This message is used to answer a NRT-Command message. There is one response for each NRT-Command message to indicate its processing status. If an error is detected either by the ECS, the CMS or the POCC, the Response-to-NRT-Command is sent immediately back to the originating IWS with a description of the error. Otherwise, an OK status will be sent once the successful uplink status is received from the POCC. This may represent a few seconds delay between the reception of the NRT-command and the response.

Data field content:

Integer*2 — Request ID identical to the request ID in the corresponding NRT message.

Character*6 — Instrument name

Integer*2 — Response Code
- 00 — NRT command message OK
- 01 — NRT command message was rejected

Integer*2 — Reason Code (see table 3.4)

Character var — Text explaining reason code (see table 3.4)

The Response-to-NRT-Command will also be used to notify an instrumenter that a background-queue group was sent to the POCC for uplink: once received by the POCC background-queue groups are treated as NRT command groups. In that case, the data field will be used as follows:

Integer*2 — Request ID: ECS plans to use a fixed request ID (for instance X'FFFF') reserved to this use and not used by the instrumenters for NRT command messages.

Character*6 — Instrument name

Integer*2 Response Code
- 00 Uplink of background-queue group was successful
- 01 Uplink of background-queue group was failed

Integer*2 Reason Code (see table 3.4)
Character var Text explaining reason code (see table 3.4)

Finally, the Response-to-NRT-Command is also used to notify an instrumenter of the processing status of RCRs and RPRs. This message only indicates that:
- the request was rejected: this could occur if the PCS or procedure was not found on the approved list or if the RCR processing is disabled
- the execution of the requested PCS or procedure has started.

The final status is not systematically made available by the POCC and will not be sent to the instrumenters via this message. For RPRs, an informational message defined between the instrumenters and the FOT may be incorporated into the procedure itself. In the case of RPRs and RCRs, the data field is used as follows:

Integer*2 Request ID: request ID as provided by instrumenter in the RPR or RCR message.
Character*6 Instrument name
Integer*2 Response Code
- 00 RPR/RCR message OK
- 01 RPR/RCR message was rejected

Integer*2 Reason Code (see table 3.4)
Character var Text explaining reason code (see table 3.4)

Table 3.4. Response-to-NRT-Command Format Definition

Response Code	Reason Code	Reason Text
01	1	Rejected- throughput mode is not enabled
01	2	Rejected - syntax error found in this command group
01	3	Rejected - mnemonic not found in PDB
01	4	Rejected - format error found in message received
01	5	Rejected - duplicate request ID for this instrument
01	6	Rejected - binary format disallowed for this instrument
01	7	Rejected- throughput mode disabled for this instrument
01	8	Rejected - message received had invalid message type
01	9	Rejected - invalid instrument for this socket
01	10	Rejected- start-command request not received for this instrument
01	11	Rejected- reset after error expected for that instrument
01	12	Uplink failed BARM verification
01	13	Uplink failed - command transmission failed
01	14	RCR rejected - RCR processing disabled
01	15	RCR rejected - was not on the approved list
01	16	RPR rejected - was not on the approved list
01	17	Background-queue group rejected - was not uplinked within specified time
01	18	Rejected - group was deleted by operator (CMS, POCC or FOT)
00	0	OK - command group successfully uplinked

00	-1	OK - command group uplinked without BARM verification
00	-2	RPR notify - FOT has been notified to start the requested RPR
00	-3	RCR begun - Requested RCR has begun

3.2.3.6 NRT-Command-Authority-Request (IWS to ECS). This message identifies the commanding functions to be performed by a given IWS. It allows the ECS to verify that only one IWS is commanding a given instrument at a given time. This message can be used to request commanding, to stop commanding, or to reset commanding after an error for an instrument.

Data field content:

Integer*2	Request ID generated by the IWS to uniquely identify this message
Character*6	Instrument name
Integer*2	Request code (see table 3.5)

Table 3.5. NRT-Command Authority Request Format Definition

Request Code	Description Text
00	Start commanding the instrument specified
01	Stop commanding the instrument specified
02	Reset after error: commanding for this instrument to restart with the near-real-time command message immediately following.

3.2.3.7 NRT-Authority-Status. (ECS to IWS). This message does not exist in the CCS environment. It is used for a given instrument, to notify an IWS that its near-real-time commanding authority has been granted, or during a commanding session to notify an IWS that its commanding authority was modified. The possible values for the status code transmitted via this message are defined in table 3.6.

Data field content:

Integer*2	Request ID corresponding to ID in NRT-Command-Authority-Request when applicable. When not applicable, ECS will use a fixed value (for instance X'FFFF')
Character*6	Instrument name
Integer*2	Status code (see table 3.6)
Character var	Text explaining status code (see table 3.6)

Table 3.6. NRT-Authority-Status Format Definition

Status Code	Description Text
-1	Start commanding request denied - throughput mode disabled or in shutdown warning state
-2	Start commanding request denied - instrument commanded by another IWS
-3	Start commanding request denied - instrument specified was incorrect
-4	Start commanding request denied - session not properly established (incorrect Session-Init response)
-5	Stop commanding request denied - IWS not currently commanding instrument specified

-6	Reset denied - instrument not in error or IWS not currently commanding instrument specified
1	Start commanding request granted
2	Stop commanding request granted
3	Stop commanding per SOC request (SOC canceled IWS session)
4	Reset accepted
5	Throughput mode status = enabled / RCRs allowed (1)
6	Throughput mode status = enabled / RCRs disallowed (1)
7	Throughput mode status = disabled (1)
8	Throughput mode status = paused (1)
9	Warning: Throughput mode shutdown soon (1)
10	Warning: Throughput mode startup soon (1)
11	Warning: reserved time commanding will begin in 5 minutes (message sent to all IWS's currently commanding) (1)

(1) Request ID is not applicable and will have a fixed value

3.2.3.8 Remote Command Request and Remote Procedure Request. (IWS to ECS)

The message data field identifies the name of a Predefined Command Sequence for RCRs, and the name of a TSTOL procedure for RPRs.

Data field content:

Integer*2	Request ID generated by the IWS to uniquely identify this message.
Character*6	Instrument name
Character*20	The name of the predefined command sequence or the STOL procedure.
Character var	Comments and execution instructions in the form "/* text */".

3.2.3.9 Informationl Message (Bi-directional)

This message is supplied for the exchange of free text between the ECS and the IWSs. For instance, it will be used by ECS to provide execution status for RPRs. The SMOCC passes an informational message to ECS that contains a text defined between the instrumenters and the FOT as part of the definition of the STOL procedures. ECS will forward that message to the originating IWS.

Data field content:

Character var ASCII Free text

3.2.4 DELAYED COMMANDING DATA SPECIFICATION

The delayed commanding data is received by the ECS as files. Each file is comprised of a file header followed by a file body that contains the command data as specified in section 3.2.2. There is no set limit on the number of OBDH block commands that can be included in a single delayed command file. The file header is described in Table 3.7. It specifies the earliest and latest uplink times.

Table 3.7. File Header Format for Delayed Commanding.

KEYWORD	DESCRIPTION
DATATYPE	"DELAYED"
FILENAME	Name of this file: iiiccccccccc.DEL (see Appendix A)
INSTRUME	Instrument being commanded
ORIG_ID	ID of originating entity (IWS ID or remote host)
OBSERVER	Person who generated this file
DATE_CRE	Date file was created YYYY/MM/DD HH:MM:SS (GMT)
NUM_CMDS	Number of commands (OBDH Block commands) in this file.
EARLIEST	Earliest uplink time YYYY/MM/DD HH:MM:SS (GMT)
LATEST	Latest uplink time YYYY/MM/DD HH:MM:SS (GMT)
COMMENT	Free text. May contain special instructions (i.e., contingency, end-item verification by SOC, etc...). This keyword may be repeated to allow several comment lines
END	

3.2.5 BACKGROUND-QUEUE COMMANDING DATA SPECIFICATION

The file header is defined in Table 3.8. It specifies the total number of commands contained in the file and an optional uplink window. The uplink window may be specified when it is critical to uplink the data by a given time. However, SMOCC does not guarantee uplink within that window and would only reject the data that has not yet been uplinked. In most cases the window will not be specified, and the data will be uplinked whenever possible.

The file body contains the commanding data which consists of a series of command specifications either in binary format or mnemonic format as specified in section 3.2.2. The command data, once expanded into the binary form of OBDH block commands, should be less than 0.5 Kbytes in length.

Table 3.8. File Header Format for Background-Queue Commanding.

KEYWORD	DESCRIPTION
DATATYPE	"BACKGROUND"
FILENAME	Name of this file: iiiccccccccc.BCK (see Appendix A)
INSTRUME	Instrument being commanded
ORIG_ID	ID of originating entity (IWS ID or remote host)
OBSERVER	Person who generated this file
DATE_CRE	Date file was created YYYY/MM/DD HH:MM:SS (GMT)
NUM_CMDS	Number of commands (OBDH Block commands) in this file.
EARLIEST	Optional. Earliest uplink time YYYY/MM/DD HH:MM:SS (GMT)
LATEST	Optional. Latest uplink time YYYY/MM/DD HH:MM:SS (GMT)
COMMENT	Free text. May contain special instructions (i.e., contingency, end-item verification by SOC, etc...). This keyword may be repeated to allow several comment lines
END	

3.2.6 COMMAND VALIDATION REPORTS

These reports are generated by the CMS as soon as CMS receives and processes a delayed command group or a background-queue command group. They contain an echo of the original commanding data: list of mnemonics, binary equivalent, and error messages when applicable. There will be one validation report for each group (one uniquely named file) of delayed or background-queue commanding data generated by the instrumenters.

Table 3.9. File Header Format for Command Validation Reports.

KEYWORD	DESCRIPTION
DATATYPE	"COMMAND VALIDATION REPORT"
FILENAME	Name of this file: iiicccccccccc.VRP (see Appendix A)
INSTRUME	Instrument commanded in original delayed or background command group
ORIGFILE	Filename of delayed/background command group this report applies to. iiicccccccccc.DEL or iiicccccccccc.BCK
DATE_CRE	Date this file was created YYYY/MM/DD HH:MM:SS (GMT)
NUM_CMDS	Number of commands (OBDH Block commands) covered in this report
COMMENT	Free text. This keyword may be repeated to allow several comment lines
END	

3.2.7 ACTIVITY PLAN

There are two types of data related to the planning functions: the ECS activity plan and the instrumenters' input to the activity plan.

3.2.7.1 ECS Activity Plan

The file header for the ECS Activity Plan (EAP) is defined in table 3.10.

The file body for the ECS activity plan is an ASCII-text formatted report. Each line corresponds to the description of one activity and contains the following in fixed-length fields:

- Name of the activity
- Start time of the activity
- End time of the activity
- Duration of the activity
- Textual description of the activity.

An example of the proposed format in included in Appendix B.

Table 3.10. File Header for the ECS Activity Plan

KEYWORD	DESCRIPTION
DATATYPE	"ECS ACTIVITY PLAN"
FILENAME	Name of this file: iiicccccccccc.EAP (see Appendix A)
OBSERVER	Person who generated this file
DATE_CRE	Date file was created YYYY/MM/DD HH:MM:SS (GMT)
STARTIME	Start time of period covered YYYY/MM/DD HH:MM:SS (GMT)

ENDTIME	End time of period covered YYYY/MM/DD HH:MM:SS (GMT)
COMMENT	Free text. This keyword may be repeated to allow several comment lines
END	

3.2.7.2 Instrumenters Input to the Activity Plan

One input file will relate to a single instrument and a given period of time. The time span covered (STARTIME/ENDTIME) will typically be one operational day.

The file header for the Instrumenters input to the Activity Plan (IAP) is defined in table 3.11.

Two alternate formats are possible for the IAP. For the first format, the file body contains a list of statements, each statement consisting of a list of data fields of the form KEYWORD = value. The second format is similar to the format used for the ECS Activity Plan (see Appendix B for an example). Each statement defines a specific activity request. The types of requests that may be included were defined in section 2.5.

Notes:
- COMMENT lines may be inserted anywhere
- All time fields are in the standard format YYYY/MM/DD HH:MM:SS.
- The originator ID (ORIG_ID) may be a unique identifier for a given IWS or it may represent other entities such as the SOC or a remote instrumenters' facility or other observatories.

Table 3.11. File Header for the Instrumenter Input to the Activity Plan

KEYWORD	DESCRIPTION
DATATYPE	"INSTRUMENTER INPUT TO THE ACTIVITY PLAN"
FILENAME	Name of this file: iiicccccccccc.IAP (see Appendix A)
INSTRUME	Instrument being commanded
ORIG_ID	ID of originating entity (IWS ID or remote host)
OBSERVER	Person who generated this file
DATE_CRE	Date file was created YYYY/MM/DD HH:MM:SS (GMT)
STARTIME	Start time of period covered YYYY/MM/DD HH:MM:SS (GMT)
ENDTIME	End time of period covered YYYY/MM/DD HH:MM:SS (GMT)
IN_FORM	Format indicator "KEYWORD" for the keyword=value format "FIXED-FIELD" for the fixed-field format
COMMENT	Free text. This keyword may be repeated to allow several comment lines
END	

3.2.7.2.1 Keyword Format for the IAP

The IAP may be submitted in a Keyword=value format if the "KEYWORD" option is selected in the IN_FORM field of the header. In this format, each entry is as follows:

1) Science Program and Campaign Notifications
PROGRAM_xyz
  STARTIME= Start time of the special activity.
  ENDTIME= End time of the special activity.

2) Notification for Special Instrument Activities
ACTIVITY_xyz
  STARTIME= Start time of the special activity.
  ENDTIME= End time of the special activity.

3) Instrument Mode Change Notification.
This request will be broken down into several more specific requests. The overall format of these requests will be as follows:
  MODE=Description of instrument mode.
  STARTIME= Start time of this mode.

4) Request for NRT commanding
NRT_SESSION
  IWS_ID= Identification of the IWS from which the near-real-time commanding activity will be performed.
  CMD_RATE= Expected number of commands during the time indicated above.
  STARTIME= Start time of the requested near-real-time commanding activity.
  ENDTIME= End time of the requested near-real-time commanding activity.

5) Request for Reserved-time Commanding
INST-RESERVED
  CMD_RATE= Expected number of commands during the time indicated above.
  STARTIME= Start time of the reserved-time commanding activity.
  ENDTIME= End time of the reserved-time commanding activity.

6) Telemetry Distribution Request
TLM_REQ
  ORIG_ID= Identification of the IWS that will receive the telemetry.
  AP_ID= Application Process ID.
  STARTIME= Start time of telemetry distribution.
  ENDTIME= End time of telemetry distribution.

3.2.7.2.2 Fixed-field Format for the IAP

The IAP may be submitted in a fixed-field format if the "FIXED-FIELD" option is selected in the IN_FORM field of the header. In this format, each line of the file consists of the following fields:

- Activity type - One of the activity types described above
- Start time - Start time of the activity in the standard time format YYYY/MM/DD HH:MM:SS
- End time - End time of the activity in the standard time format

YYYY/MM/DD HH:MM:SS
- Duration - Duration of the activity in the format HH:MM:SS
- Comment - The remainder of the line can be used for optional comment.

Each field is separated by one or more whitespace characters.

3.3 TELEMETRY DATA SPECIFICATION

3.3.1 REAL-TIME TELEMETRY

The general format of the messages exchanged over the interface was defined in section 3.1.1. They all contain a 4-byte standard header followed by a data field. This section defines the specific functions and the data field content of the messages exchanged for real-time telemetry distribution.

The Session-Init message (ECS to IWS), the Session-Init-Response message (IWS to ECS) and the Session-End messages (ECS and IWS) are identical to the messages used for NRT commanding, defined in section 3.2.3.

3.3.1.1 Telemetry-Packet-Distribution-Request.(IWS to ECS). This message is used by an IWS to indicate what type of telemetry packets (i.e., what APID) it wants to receive. There must be one such message for every APID to be transmitted. The format of this message has been slightly modified from the original CCS format: an optional field has been added to allow an instrumenter to request reception of the Quality and Accounting capsule at the end of each telemetry packet for a given APID. If the flag is not specified (i.e., the message has the same format as the corresponding CCS message), the Quality and Accounting capsule will not be provided at the end of the telemetry packets.

Data Field content:
- Integer*1 Spacecraft ID (X'00'). This is only kept for compatibility with CCS.
- Integer*2 APID to be received.
- Integer*2 Request ID generated by IWS to uniquely identify this telemetry exchange for each IWS. It will be found in all the messages related to this TM distribution request.
- Integer*1 Optional: flag indicating if the Q&A capsule should be included (01) or omitted (00) after each telemetry packet for this APID for this telemetry exchange.

3.3.1.2 Telemetry-Packet-Distribution-Response (ECS to IWS). This message is used to indicate the result of the telemetry-packet-distribution-request:

Data Field content:
- Integer*2 Request ID corresponding to request ID in TM Packet Distribution Request message.
- Integer*1 Request Response Code
  X'00' successful
  X'01' unsuccessful
- Integer*1 Reason Code giving an explanation for success or failure

X'00' Success
X'01' Bad APID
X'02' APID already requested
X'03' Duplicate Request ID
X'04' Request ID in TM-packet-distribution-request is missing
X'05' TM data not available
X'06' ECS system capacity exceeded
X'07' to X'0F' other reasons

3.3.1.3 Start-of-Telemetry-Packet-Distribution (ECS to IWS). This message is used to indicate the start of telemetry transmission.

Data Field content:

Integer*1 Spacecraft ID (X'00'). This is only kept for compatibility with CCS.
Integer*2 APID of telemetry packets included in this distribution
Integer*2 Request ID corresponding to request ID in TM Packet Distribution Request message

3.3.1.4 Interrupt-Telemetry-Packet-Transfer (IWS to ECS). This message is used by an IWS to ask for immediate termination of the current telemetry transfer.

Data Field content:

Integer*2 Request ID corresponding to request ID in TM Packet Distribution Request message

3.3.1.5 End-of-Telemetry-Packet-Transfer (ECS to IWS). This message is sent by ECS to confirm the fact that the telemetry transfer is terminated. This may happen either upon receipt by ECS of an interrupt-telemetry-packet-transfer message, in the case of a system problem, or at the end of the real-time contact period.

Data Field content:

Integer*2 Request ID corresponding to request ID in TM Packet Distribution Request message
Integer*1 Status code
X'00' Canceled by IWS
X'01' Canceled by ECS
X'02' Telemetry transfer interrupted by PACOR
X'03' to X'0F' other reasons.

3.3.1.6 Telemetry-Packet (ECS to IWS). This message is used to transmit the real-time telemetry data, that is one complete telemetry source packet corresponding to the APID requested. Additional data may be included, such as the Quality and Accounting (Q&A) capsule. If requested by the receiving instrumenter in the Telemetry-Packet-Distribution-Request message, a 6-byte Q&A capsule will be appended to the end of each telemetry packet associated with this Request ID.

Data Field content:

Integer*2 Request ID corresponding to request ID in TM-Packet-Distribution-Request.

Binary data Telemetry data packet, including packet header as defined in table 3.12.

Integer*6 (optional, supplied only if requested in Telemetry-Packet-Distribution-Request) Real-time Q&A capsule, as provided by PACOR (see Reference 9) and defined in table 3.13.

Table 3.12. Telemetry Data Packet

PACKET HEADER							PACKET DATA FIELD	
Packet ID				Sequence Control				
Version No.	Packet type	Data field header flag	APID	Segment flags	Source sequence count	Packet length	Data field (OBT or LOBT)	Source data
(2 bytes)				(2 bytes)		(2 bytes)	(6 bytes)	variable

Table 3.13. Real-Time Quality and Accounting Capsule

Field Name	Length	Description
Virtual Channel ID	1 byte	Virtual channel the packet was transmitted on
Data Type Flag	1 byte	PACOR uses each bit is a flag indicating the data type: 00010000 for real-time and 00001000 for test telemetry
Sequence Continuity Flag	1 byte	00 (hexadecimal) no sequence discontinuity 01 (hexadecimal) sequence discontinuity
Reed-Solomon Error Flag	1 byte	00 (hexadecimal) no Reed-Solomon correction 01 (hexadecimal) Reed-Solomon error corrected.
Data Fill Location	2 bytes	Location of the start of fill in the source data unit. A value of 0000 hex indicates there is no fill.

3.3.2 ARCHIVED TELEMETRY DATA

The telemetry data is stored in the ECS for retrieval by the instrumenters. The telemetry archive is sorted by APID and by time. Each file contains approximately 2 hours of telemetry and contains a header followed by the file body. The telemetry data is organized among several system directories, one directory per APID. Under each directory, each file contains packets consecutively received by ECS for the given APID. The instrumenters can obtain the archived telemetry data via file transfer. In order to select the files they want to retrieve, the instrumenters will use the file naming conventions described in Appendix A or will formulate a standing request with the SOC to receive files corresponding to a given APID as soon as these files are available within ECS.

3.3.2.1 Archived Telemetry File Header.

Table 3.14 defines the format of the file header.

Table 3.14. Archived Telemetry File Header

DATATYPE	"ARCHIVED REAL-TIME TELEMETRY" or "ARCHIVED RETRANSMITTED REAL-TIME TELEMETRY" or "ARCHIVED TAPE RECORDER DUMP TELEMETRY"
FILENAME	As defined in Appendix A
APID	APID of the telemetry packet (see Appendix A)
DATE_CRE	Date file was created by ECS YYYY/MM/DD HH:MM:SS (GMT)
NUM_PACK	Number of telemetry packets stored in this file
STARTIME	Start of period covered (Time stamp of first packet) YYYY/MM/DD HH:MM:SS
ENDTIME	End of period covered (Time stamp of last packet) YYYY/MM/DD HH:MM:SS
COMMENT	Free text
END	

3.3.2.2 Archived Telemetry File Body. The file body contains the telemetry packets followed by quality and accounting information as illustrated in table 3.15. The format of the file body was kept identical to the format of the production data as defined in the ICD between the SDPF and <Mission> (Reference 9). However, this document is still in a preliminary form and may be modified. If this would occur, the ECS archived telemetry and the production data would have different formats. The details of the current proposed format are described in Appendix C.

Table 3.15. Archived Telemetry File Body

Source Data Units	Series of telemetry packets: Telemetry packet 1 Telemetry packet 2 . . . Telemetry packet n
Quality and Accounting List Length	Length in bytes of the Quality and Accounting List
Quality and Accounting List	Series of Quality and Accounting Capsules: Quality and Accounting capsule for first packet in error Quality and Accounting capsule for second packet in error . . . Quality and Accounting capsule for m^{th} packet in error
Missing Data Units List Length	Length in bytes of the Missing Data Units List
Missing Data Units List	Series of Missing Data Units Entries: Offset, "From" packet and "To" packet . . .

3.4 MISSION SUPPORT DATA SPECIFICATION

3.4.1 SUMMARY DATA

The summary data received by ECS from the instrumenters is in FITS format. There may be one or more input file for each instrument and each day (some instruments may provide more than one file for the same day, while other instruments may not provide a file for every day). The SOC is responsible for gathering the instrumenters input before sending it to CDHF which requires detached SFDU headers.

The instrumenters submit their input to ECS in FITS format optionally with detached SFDU headers. The file naming convention used for the summary data will comply with the CDHF conventions (see Appendix A).

3.4.2 ORBIT AND ATTITUDE DATA

Orbit and attitude data are received by the ECS from CDHF at a frequency that will be defined within the EOF and operationally agreed upon with CDHF. It is received in files in CDF format with detached SFDU headers.

That data is provided to the instrumenters in CDF format with detached SFDU headers, and the CDHF file naming conventions described in Appendix A are used.

The files will be organized among system directories in the ECS as follows:

- Orbit data directory containing 2 subdirectories for the predictive and definitive data.
- Attitude data directory containing definitive attitude data.

The data files and the corresponding SFDU header files are contained in the same directory or subdirectory.

3.4.3 COMMAND HISTORY

The command history file covers one operational day and is received by ECS as a daily file transmission from the SMOCC. The ECS is required to transmit that data to CDHF and, consequently, must generate SFDU headers.

The command history is available to the instrumenters as ASCII text files with detached SFDU headers.

See Appendix B for an example of the command history file format as proposed by the SMOCC (ASCII text with fixed fields). The command history files will be available from a single ECS system directory.

3.4.4 TIME CORRELATION LOG

The time correlation log is an ASCII text file containing a cumulative log of all SOHO spacecraft clock time offsets since the start of the mission. Once each day that the spacecraft clock is adjusted, ECS updates the time correlation file by appending the new information at the end. ECS extracts the time correlation information from the command history file by recognizing commands that were used to reset the spacecraft clock.

The time correlation log is made available to the instrumenters as an ASCII text file with detached SFDU header.

3.4.5 SYNOPTIC DATA

The format of that data is not defined in this ICD. The synoptic data will be gathered by the SOC and will reside in the ECS. The instrumenters will be able to retrieve it based on a system directory organization and file naming convention. The management of the synoptic data is entirely under the control of the SOC.

3.4.6 PROJECT DATA BASE

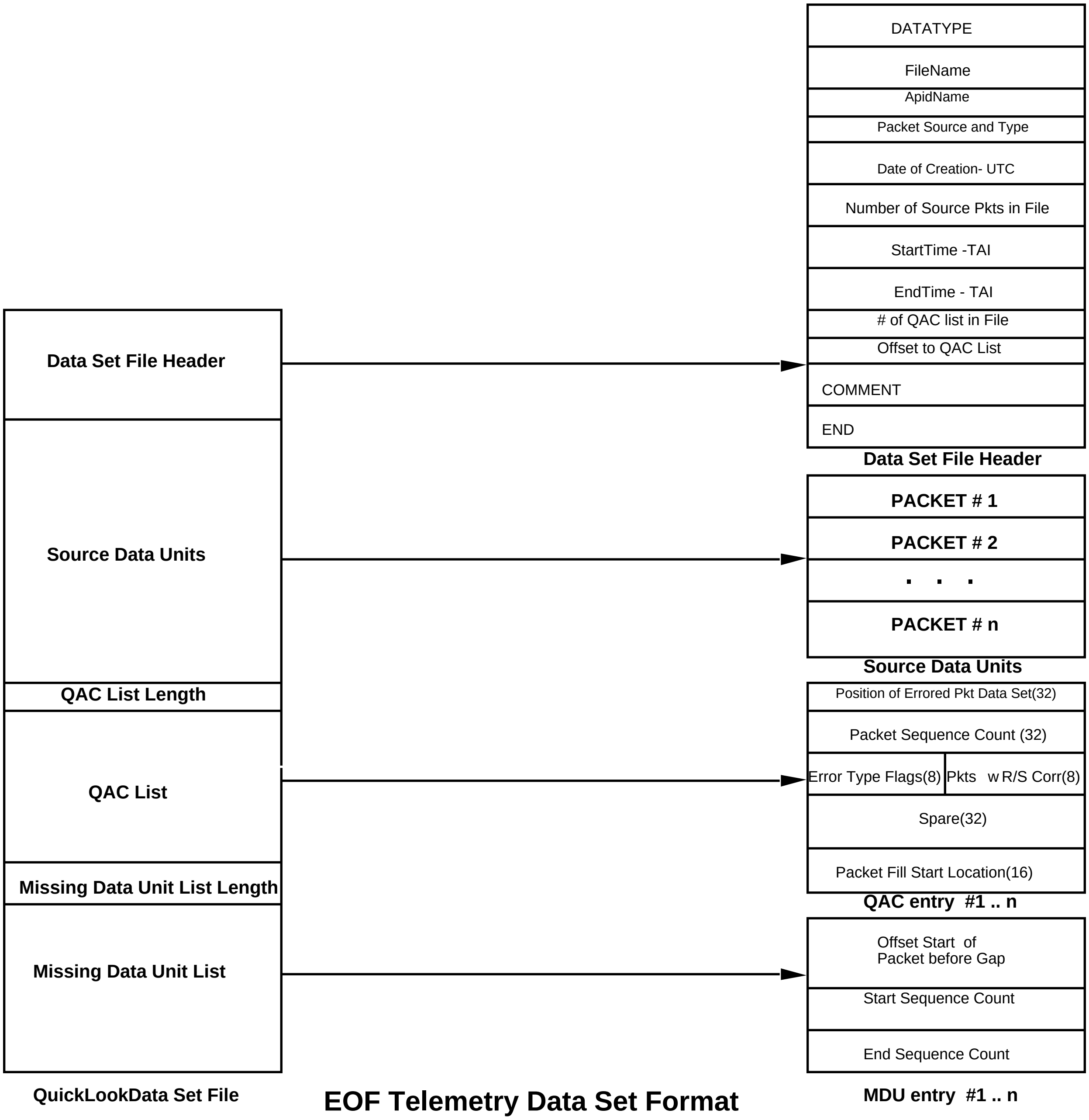
The ECS will make the PDB available to the instrumenters as ASCII files in the Data Format Control Document (DFCD) format as supplied by the POCC.

3.4.7 PROJECT DATA BASE UPDATE REQUEST

The format of this free-form text E-mail message exchanged between the instrumenters and the FOT is not described in this ICD.

3.4.8 SOHO DAILY REPORT

The SOHO Daily Report is an ASCII text file with detached SFDU header. Each file covers one operational day. The files are named according to the CDHF file naming conventions described in Appendix A. The format of the SOHO Daily Report will be defined in the Operations Agreement between the FOT and the Instrumenters.



EOF Telemetry Data Set Format

3.3.2.2.1 DATA SET FILE HEADER

The data set file header ... The size of the header is 12 fields. Each field is in ascii format.

Datatype: "ARCHIVED REAL-TIME TELEMETRY" or "ARCHIVED TAPE RECORDER DUMP TELEMETRY"

FileName: As defined in Appendix A.

ApidName: APID of the telemetry packet (see Appendix A)

Packet Source and Type: Description of the APID indicating source and type (see Appendix A)

Date of Creation: Date of file creation YYYY/MM/DD HH:MM:SS in GMT.

Number of Source Packets In File: Contains the actual number of source data units in the data set contained in the file.

Start Time: Start of period covered (time stamp of first packet) YYYY/MM/DD HH:MM:SS in TAI.

End Time: End of period covered (time stamp of last packet) YYYY/MM/DD HH:MM:SS in TAI.

# of QAC Lists in File: The number of QAC lists in the Data Set File. i.e. Number of QAC Lists = m

Offset to QAC List: Indicates the position of the QAC list counted from the last bit of the Data Set File Header. This field is repeated the number of times indicated by the number of QAC lists in the Data Set File, i.e. 'm' times.

Comment: This field is blank and is maintained to preserve consistentancy with the SFDU format.

End: This keyword is maintained to preserve consistentancy with the SFDU format.

3.3.2.2.2 SOURCE DATA UNITS

TO be supplied.

3.3.2.2.3 QUALITY AND ACCOUNTING INFORMATION

There are two different elements for the quality and accounting information associated with the source data units in the Data Set Files that are stored in the ECS. The first element is a Quality and Accounting Capsule (QAC) which will be appended for each source data unit for which an anomaly was detected. The other element which is optional, is a Missing Data Unit List for the data set, identified by source data unit sequence number. These quality and accounting items are appended to the end of the data set.. The contents of all the generic fields are described in the following paragraphs.

3.3.2.2.3.1 QUALITY AND ACCOUNTING CAPSULES (QACs)

The QA element contains anomaly information about the errored-source data unit(s) in the data set. The first filed in the QAC is the length of the QAC list. The next set of fields are repeated for every source data units for which anomalies were detected, and contains flags indicating the type of errors.

QAC List Length:	Integer*4	The QAC length, in bytes, of the QAC list for the Data Set File.
Position of Errored Packet Data Set:	Integer*4	The relative position of the errored data unit in the data set, for example, n^{th} Data Unit in Data Set counted from the end of the last bit in the data set file header.
Packet Sequence Count:	Integer*2	Indicates the number packets in the Source Data Unit. The segmentation subfield, which occupies the upper two most significant bits within sequence count field, is not maintained.
Error Type Flags:	Integer	Indicates the type of error(s) associated with the data unit. Bit 8: xxx, Bit: yyy
Packets with ReedSolomon Correction:	Integer	Indicates if Reed Solomon correction was applied to the packet.

Spare:	Integer*4	
Packet Fill Start Location:	Integer*2	Indicates the number of bytes from the start of the data unit where the fill data starts. The fill pattern is TBD.

3.3.2.2.3.2 MISSING DATA UNITS ENTRY (MDUE)

This accounting element follows the QAC entries. The first part of the MDUE shown in Figure TBD is the length of the Missing Data Unit List Length (MDULL) followed by the list of the missing data units. The missing Data Units List (MDUL) is optional, however the length of the MDUL will be present and be set to zero when the MDUL is not requested.

Missing Data Unit List Length:	Integer*4	Specifies the length in bytes of the missing data units list.
Offset Start of Packet before Gap:	Integer*4	Indicates the position of the MDUL counted from the last bit of the Data Set File Header.
Start Sequence Count:	Integer*2	Specifies the starting source data unit sequence count number for the first packet missing.
End Sequence Count:	Integer*2	Specifies the ending source data unit sequence count number for the last packet missing.

SECTION 4. COMMUNICATIONS PROTOCOLS

4.1 COMMUNICATIONS OVERVIEW

The workstations for the EOF-resident instrumenters (IWSs) will be connected to ECS and among themselves using Ethernet. Upgrades to provide higher capacity to some instrumenters' teams may be implemented if necessary (for instance, upgrade to CDDI). The communications among the IWSs may use either TCP/IP or DECNET. Additionally, TCP/IP will be routed to Internet and DECNET to SPAN. Communications between the ECS and the IWSs will take place using a subset of TCP/IP services and protocol as illustrated in Figure 4-1. Internet connections from remote instrumenters will be routed through NASA GSFC. All instrumenters, resident or not, may access ECS through FTP and SMTP. The IWSs may additionally use sockets, NTP, X11 and rlogin to access various resources on ECS.

4.1.1 FILE TRANSFER

FTP is used to support file transfers between the ECS and all instrumenters' teams (resident or remote). As described in the following paragraphs, three different methods may be used to exchange files between the ECS and the instrumenters. The method selected depends on the type of data exchanged.

1) Files that ECS needs to send to specific instrumenters' teams (i.e., command validation reports). ECS maintains a list of designated computer addresses where each type of file is to be forwarded, typically two addresses per instrument team. As soon as a file becomes available, ECS initiates an FTP session with the computers designated to receive that type of file for that particular instrument, and writes the file to that computer. ECS must maintain a list of Internet addressees for all the instrumenters' teams. ECS must also have an account on each of these instrumenters' computers and maintain a list of current account names and passwords. In the case where ECS would be unable to connect to any of the receiving computers, the SOC will notify the addressees via E-mail, and ECS will keep the files for a certain period of time for possible manual retransmission by the SOC.

2) Files generated by ECS and retrieved by the instrumenters when needed (i.e., Activity Plan). These files are deposited by ECS on specific system directories. At the present time, it is envisioned that read access will be available to all members of the scientific community with a valid account: ECS will maintain a list these valid Internet addresses. If security requirements allow it, ECS will maintain anonymous FTP accounts.

3) Files generated by the instrumenters (i.e., delayed commands or input to the summary data). The instrumenters initiate an FTP session with ECS and write their files to specified ECS systems directories. ECS must maintain a list of authorized computers and provide accounts for access by each of these computers. ECS must make the account information available (account name and password) to the system administrator of each of these systems.

4.1.2 E-MAIL

SMTP mail utility will be used to exchange non-time-critical information between ECS and the instrumenters. ECS must obtain and maintain a list of Internet addresses and user-names where to send mail. Similarly, ECS must supply the instrumenters with the ECS Internet address, user-name and password.

<table>
<tr><td rowspan="5">Communication
Protocols
and
Application Level
Services</td><td>FTP
RFC-959</td><td>SMTP
RFC-821</td><td>X 11</td><td>SOCKET
I/F</td><td>NTP
RFC-123</td></tr>
<tr><td colspan="4">TCP
RFC-793</td><td>UDP
RFC-768</td></tr>
<tr><td colspan="5">IP/ICMP
RFC-791 RFC-792</td></tr>
<tr><td colspan="5">ETHERNET Link Level
RFC-826 RFC-894</td></tr>
<tr></tr>
<tr><td>Physical Interface</td><td colspan="5">ETHERNET
IEEE 802.3</td></tr>
</table>

Note: The Requests for Comment (RFCs) listed above are the specifications for the various protocols for Internet. The full listing of each RFC is available via anonymous FTP on various Internet computers (i.e., NIC.DN.MIL).

Figure 4.1. SOHO/ECS Communication Architecture

4.1.3 XWINDOWS

X11 will be used by the IWSs (i.e., EOF-resident) to view ECS displays such as the commanding status window or telemetry distribution monitoring display. ECS will make 'C' language software available to the instrumenters to allow the display of these Motif windows.

4.1.4 REMOTE LOGIN

Rlogin will be used by the IWSs to initiate an X11 session. ECS will maintain a list of network addresses and user-names of these IWSs allowed to do remote login.

4.1.5 TIME SERVICES

NTP will be used to supply standard time to the instrumenters. This protocol allows the synchronization of the internal clock of each served computer to a time server computer. No special hardware or software is needed on the instrumenter computers: NTP is part of the suite of software distributed with almost all implementations of TCP/IP. The time server computer provides the Coordinated Universal Time (UTC). Using NTP, the instrumenters can synchronize the system clock of their computers to within 20 milliseconds of UTC. Then, they can obtain UTC by using system utilities to read their system clock. System clocks are generally readable down to milliseconds and sometimes microseconds.

4.1.6 SOCKETS

Sockets are used for the transmission of real-time data streams (primarily, near-real-time commanding and telemetry distribution) between the IWSs and the ECS. The IWSs will serve the necessary sockets and ECS will connect to them when data need to be transferred (for instance, at the beginning of a pass when real-time telemetry is received by ECS or when the NRT throughput mode is enabled). ECS has reserved a group of port numbers for the sockets to be served by the IWSs (see Table 4.1 below).

- For telemetry data, 4 sockets are available to each IWS, one of these being reserved for the transmission of MDI-M data. This could allow a given IWS to receive telemetry simultaneously on up to 3 separate sockets for non-MDI data, and a fourth socket for MDI-M data. It is envisioned that operationally, an IWS will not use more than one or two sockets at one time. However, this is provided to allow separate processes to run and accept different types of telemetry on a single IWS. ECS will maintain a list of 'default IWS-socket pairs' which are the sockets over which telemetry is expected to be distributed during a real-time pass. At the beginning of the pass, ECS will attempt to initiate a session with each of these 'default IWS-socket pairs'. Additional connections may be requested at any time via the SOC.

- For commanding data, 11 sockets are available to each IWS, each socket corresponding to one instrument. Each IWS will use the port socket(s) it needs to command the instrument(s) it intends to command. ECS will maintain a list of 'default IWS-instrument pairs'. When the throughput mode is enabled, ECS attempts to initiate a session with each 'default IWS-instrument pair'. It is expected that an IWS will not serve a socket for an instrument it is not authorized to command or an instrument it will not command during the current NRT session.

Table 4.1 Port number assignments for NRT sockets.

FUNCTION		PORT NUMBER
Telemetry	Connection	
	First	20100
	Second	20101
	Third	20102
	Fourth	20103

Commanding	Instrument	
	CDS	20200
	CELIAS	20201
	CEPAC	20202
	EIF	20203
	GOLF	20204
	LASCO	20205
	MDI	20206
	SUMER	20207
	SWAN	20208
	UVCS	20209
	VIRGO	20210

4.2 ECS HARDWARE CONFIGURATION

The proposed ECS hardware configuration is illustrated in figure 4.2. This is the configuration that was presented as part of the ECS Detailed Design Specifications. It is only included in this document for informational purpose.

The proposed hardware configuration has been in part dictated by security considerations. The description of specific security measures, policies and procedures are not within the scope of this ICD. The following section outlines the main characteristics of the security implementation within the ECS.

1) The filtering capability of the routers will be utilized to limit external access to the EOF. Only packets with specific combinations of source address, destination address and IP port number or DECNET packet type will be allowed to pass.

2) Only specific services (e.g., E-mail, or FTP) on specific ECS hosts will be available to external users. The ECS itself will support only TCP/IP.

3) Host protection measures will remain the primary security measures. They vary from host to host, depending on the capabilities of the various operating systems. Specific host protection capabilities, or lack thereof, will influence filter settings on the routers. Specifically, it is recommended that remote logins not be allowed on a given IWS while this IWS supports an active near-real-time commanding session.

ECS hosts will be RS/6000 workstations running AIX. Only certain hosts within the ECS will have non-ECS accounts. Only specific network services will be supported. The standard UNIX file and directory restrictions, the AIX auditing capabilities and system resource utilization limits will also be employed. Additional measures such as secure-ID cards may be required. The EOF interface to the GSFC MODNET will be two RS/6000 workstations (primary and backup) which function as the telemetry and commanding servers. IP forwarding to these workstations will be disabled to prevent unauthorized or unintended communications between the EOF and MODNET.

Figure 4.2. SOHO/EOF Proposed Hardware Architecture

APPENDIX A. FILE NAMING CONVENTIONS

A.1 "ORIGINATOR/ID" SCHEME iiiccccccccccc.ext

In this scheme, the first 3 characters of the identifier represent the originator of the file. The file name extension is three-characters long and is used to indicate the type of data contained in the file.

A file name is of the general form: **iiiccccccccccc.ext** where:

iii: 3-letter abbreviation of the file originator name (upper-case)

CDS	for CDS	CEL	for CELIAS
CEP	for CEPAC	EIT	for EIT
GOL	for GOLF	LAS	for LASCO
MDI	for MDI	SUM	for SUMER
SWA	for SWAN	UVC	for UVCS
VIR	for VIRGO	ECS	for ECS

ccccccccccc: alphanumeric characters to uniquely identify this file
We suggest for this field is to use 11 characters: YYMMDDHHvvv where: YYMMDDHH represents the year, month, day and hour, and vvv uniquely identifies this file.

.**ext**: defines the data type contained in the file

DEL	for delayed commanding data
BCK	for background-queue commanding data
IAP	for instrumenter input to the activity plan
EAP	for the ECS activity plan
VRP	for command validation report

A.2 "TELEMETRY FILE" SCHEME

This scheme is used for archived telemetry files. It includes a representation of the APID followed by a date representative of the data contained in the file.

A file name is of the general form: **apid_yymmdd_hhmmss.ext** where:

apid: up to 6 alphanumeric characters representing an APID. See table A.1.
yymmdd_hhmmss: represents the date/time of the first packet time stamp (year, month, day, hours, minutes and seconds)
.ext: defines the data type contained in the file

.REL	for telemetry data received in real-time from Pacor or real-time telemetry retransmissions.
.QKL	for quicklook telemetry data received from DDF (tape recorder dumps)

Table A.1. SOHO APID Abbreviations

Packet Name	APID	Abbreviation
SVM HK1	8803	SMVHK1
SVMHK2	8805	SMVHK2
SVMHK3	8806	SMVHK3
SVMHK4	8809	SMVHK4
AOCS HK1	8833	AOCHK1
AOCS HK2	8835	AOCHK2
ATTITUDE 1	8836	ATTIT1
ATTITUDE 2	8839	ATTIT2
S/W	880A	SW
OBT	8000	OBT
EXPERM HK	8860	EXPHK
CDS HK	8863	CDSHK
CELIAS HK	8865	CELHK
CEPAC HK	8866	CEPHK
EIT/LASCO HK1	8869	ELAHK1
EIT/LASCO HK2	886A	ELAHK2
EIT/LASCO HK3	886C	ELAHK3
GOLF HK	886F	GOLHK
MDI HK1	8893	MDIHK1
MDI HK2	8895	MDIHK2
SUMER HK	8896	SUMHK
SWAN HK	8899	SWAHK
UVCS HK	889A	UVCHK
VIRGO HK	889C	VIRHK
CDS SC LR	88A3	CDSSCL
CDS SC MR	88A5	CDSSCM
CDS SC HR	88A6	CDSSCH
CELIAS SC	88A9	CELSC
CELIAS SC ???	88AA	CELSC
EIT/LASCO SC LR	88AC	ELASCL
EIT/LASCO SC HR	88AF	ELASCH
GOLF SC	88C3	GOLSC
MDI SC	88C5	MDISC
SUMER SC LR	88C6	SUMSCL
SUMER SC HR	88C9	SUMSCH
SWAN SC	88CA	SWASC
UVCS SC	88CC	UVCSSC
VIRGO SC	88CF	VIRSC
IDLE	87FF	IDLE

A.3 CDHF CONVENTION

This naming convention is used for
- Summary data (images and daily parameters and As-Run Information)
- Orbit and attitude data
- Command history report
- Time correlation log
- Soho daily report

The general file name is:
mission_datatype_descriptor_date_version.extension

The logical file identifier is a concatenation of 5 fields:

mission	identifies the mission or investigation. For example: "SO" for SOHO
datatype	identifies the type of data. For example: OR orbit AT attitude CH command history K0 to K9 Key parameters SU summary data (images) (TBD) SP summary data (parameters) PG summary data (As-Run) AN Ancillary data
descriptor	Further qualifies the type of data. Can be an instrument name as in A.1 above or PRE for predictive data DEF for definitive data TCF for time correlation log SDR for SOHO daily report ...
date	YYYYMMDD
version	Vnn where n = 0 to 9

The file extension may be

.SFDU	for an SFDU file
.DAT	for a generic data file
.CDF	for a CDF file

Examples:

1) Definitive attitude data
   SO_AT_DEF_19950523_V01.SFDU
   SO_AT_DEF_19950523_V01.DAT

2) Predictive orbit data
   SO_OR_PRE_19930523_V00.SFDU
   SO_OR_PRE_19930523_V00.CDF

3) SOHO Daily Report
   SO_AN_SDR_19960523_V00.SFDU
   SO_AN_SDR_19960523_V00.DAT

4) Time Correlation Log

SO_AN_TCF_19960523_V00.SFDU
SO_AN_TCF_19960523_V00.DAT

5) Command History

SO_CH_ALL_19960523_V00.SFDU
SO_CH_ALL_19960523_V00.DAT

6) Summary Data (Images)

SO_SU_MDI_19960523_V00.SFDU
SO_SU_MDI_19960523_V00.DAT

APPENDIX B. EXAMPLES OF ECS DATA SETS AND REPORTS

B.1 NEAR-REAL-TIME COMMAND DATA EXAMPLE

B.1.1 BINARY FORMAT

```
X'03010023'          (4 binary bytes for message type and length)
X'1010'              (Request ID)
CDS                  (6-Char, padded with blanks)
BINARY 0x1203,0x2401,0x77AF,0xADB3; /* OBDH block with header, 2 data
                                       words and checksum */
```

B.1.2 MNEMONIC FORMAT

```
X'03010033'          (4 binary bytes for message type and length)
X'A001'              (Request ID)
LASCO        (6-Char, padded with blanks)
MNEMO1,0x1AB,0x1234;  /*command with 2 variable words in hex format */.
```

B.2 DELAYED COMMAND GROUP

This example contains commands in mnemonic format. The binary format could also have been used. The example also contains errors in the command data to illustrate the validation report format in section B.3.

```
DATATYPE=   DELAYED
FILENAME=   CDS0126001.DEL
INSTRUME=   CDS
ORIG_ID=    CDS_OPS_1
OBSERVER=   Ricky Ricardo
DATE_CRE=   1996/01/25 15:27:30
NUM_CMDS=   3
EARLIEST=   1996/01/26 18:00:00
LATEST=     1996/01/26 18:30:00
COMMENT=    In case of contingency, notify PI team by telephone
COMMENT=    This example contains errors as illustrated in the associated validation
report
END
CDSMNEMO1;  /* first command, no argument */
LASCOMNEMO, 10;  /* 2nd command, argument in decimal */
CDSMNEMO2,01AB,1234;  /* 3rd command, first argument in octal, second in decimal*/
```

B.3 DELAYED COMMAND VALIDATION REPORT

```
DATATYPE=   COMMAND VALIDATION REPORT
FILENAME=   CMS0004321.VRP
INSTRUME=   CDS
ORIGFILE=   CDS0126001.DEL
DATE_CRE=   1996/01/26 15:37:53
NUM_CMDS=   3
COMMENT=    Sorry, errors were found in your input
END

                 Validation Report for Command Group CDS0126001.DEL
                             Commanded Instrument CDS
          Group created at 1996/01/25 15:27:30  by Ricky Ricardo at CDS_OPS_1
                        Earliest Uplink Time: 1996/01/26 18:00:00
                         Latest Uplink Time: 1996/01/26 18:30:00

                              Command group is INVALID

Input commands:
1        CDSMNEMO1;  /* first command */
2   ***  LASCOMNEMO, 10;  /* 2nd command */
           ^
           Invalid mnemonic for this insrument
3   ***  CDSMNEMO2,01AB,1234;  /* 3rd command */
                             ^ Too many parameters
```

NOTE: This is only an ECS proposed format. The final report format will be defined by CMS.

B.4 BACKGROUND-QUEUE COMMAND GROUP

This example contains

```
DATATYPE=   BACKGROUND
FILENAME=   MDITBL0001.BCK
INSTRUME=   MDI
ORIG_ID=    MDI_IWS_2
OBSERVER=   C. Moi
DATE_CRE=   1996/01/25 15:27:30
NUM_CMDS=   8
EARLIEST=
LATEST=
COMMENT=    This will be uplinked by SMOCC as soon as possible.
END
BINARY 0x1000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x2000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x3000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x4000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x5000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x6000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x7000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
BINARY 0x8000,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0xF,
0x0,0x1,0x2,0x3,0x4,0x5,0x6,0x7,0x8,0x9,0xA,0xB,0xC,0xD,0xE,0x1234;
```

B.5 ECS ACTIVITY PLAN REPORT EXAMPLE

DATATYPE= ECS ACTIVITY PLAN
FILENAME= ECS950523.EAP
OBSERVER= Monsieur Truc
DATE_CRE= 1996/05/20 18:20:22
STARTIME= 1996/05/23 00:00:00
ENDTIME= 1996/05/24 00:00:00
COMMENT= For your information, this is my latest schedule
END

Activity	Instru ment	Start Time	End Time	Duration	De:
Synoptic_Study		1996/05/23 00:00:00	1996/05/23 03:00:00	03:00:00	
Spectral_Atlas		1996/05/23 03:00:00	1996/05/23 06:30:00	03:30:00	Quiet sun target
Mode_2_TLM		1996/05/23 06:30:00	1996/05/23 07:00:00	00:30:00	EIT Images. No CDS
EM_Study		1996/05/23 07:00:00	1996/05/23 11:10:00	04:10:00	EM study of the QS
Dyn_Explos_1		1996/05/23 11:10:00	1996/05/23 13:10:00	02:00:00	Dynamic/Explosive
Dyn_Explos_2		1996/05/23 13:10:00	1996/05/23 15:10:00	02:00:00	Dynamic/Explosive
Coronal_Structure		1996/05/23 15:10:00	1996/05/23 17:00:00	01:50:00	Coronal Structure ab
Mass_Eject		1996/05/23 17:00:00	1995/06/23 00:00:00	07:00:00	Mass Ejection Study
DSN_Contact		1996/05/23 01:00:00	1996/05/23 02:40:00	01:40:00	First short DSN con
DSN_Contact		1996/05/23 07:20:00	1996/05/23 09:00:00	01:40:00	Second short DSN cc
DSN_Contact		1996/05/23 11:20:00	1996/05/23 13:00:00	01:40:00	Third short DSN co
DSN_Contact		1996/05/23 13:00:00	1996/05/23 21:00:00	08:00:00	Long DSN contact
FOT_RESERVED		1996/05/23 01:00:00	1996/05/23 01:20:00	00:20:00	Spacecraft command
FOT_RESERVED		1996/05/23 07:20:00	1996/05/23 08:00:00	00:40:00	Spacecraft command
FOT_RESERVED		1996/05/23 11:20:00	1996/05/23 14:00:00	02:40:00	Spacecraft command
NRT_Session	LASCO	1996/05/23 01:20:00	1996/05/23 02:40:00	01:20:00	LASCO does near-re
NRT_Session	LASCO	1996/05/23 08:00:00	1996/05/23 09:00:00	01:00:00	LASCO does near-re
NRT_Reserved	LASCO	1996/05/23 08:30:00	1996/05/23 09:00:00	00:30:00	LASCO has reserved
NRT_Session	LASCO	1996/05/23 14:00:00	1996/05/23 20:00:00	06:00:00	LASCO does near-re
NRT_Session	EIT	1996/05/23 01:20:00	1996/05/23 02:40:00	01:20:00	EIT does near-real-ti
NRT_Session	EIT	1996/05/23 08:00:00	1996/05/23 08:30:00	00:30:00	EIT does near-real-ti
NRT_Session	EIT	1996/05/23 14:00:00	1996/05/23 20:00:00	06:00:00	EIT does near-real-ti
NRT_Session	UVCS	1996/05/23 01:40:00	1996/05/23 02:40:00	01:00:00	UVCS does near-rea
NRT_Session	UVCS	1996/05/23 08:00:00	1996/05/23 08:30:00	00:30:00	UVCS does near-rea
NRT_Session	UVCS	1996/05/23 14:00:00	1996/05/23 20:40:00	06:40:00	UVCS does near-rea

B.6 ECS ACTIVITY PLAN DISPLAY EXAMPLE

```
                              00  01  02  03  04  05  06  07  08  09  10  11  12  13  14  15  16  17  18
                          19  20  21  22  23  00
Synoptic Study                ----------------
Spectral_Atlas                            --------------------
Mode_2_TLM                                                --
EM_Study                                                      -------------------
Dyn_Explos_1                                                                      -------
Dyn_Explos_2                                                                              -------
Coronal_Structure                                                                                 ------
Mass_Eject                                                                                            ---------
-------------------------

DSN_Contacts                      ............                ............
.....................................................................
FOT_Reserved_Time                 ....                       ...        ..................

LASCO_NRT_Session                    -------                  ------                       ----------------------
---------
LASCO_NRT_Reserved                                               --
EIT_NRT_Session                      -------                  ---                          ----------------------
---------
UVCS_NRT_Session                      -----                   ---                          ----------------------
-----------------
```

B.7 <u>COMMAND HISTORY REPORT EXAMPLE</u> *(AS PROVIDED BY SMOCC - FROM WIND)*

***** COMMAND HISTORY REPORT ***** Page No. 1

Mission: ~~WIND~~ SOHO
Command Station: ~~TDW~~
Time Range: (start) 95-133-17-23:39:00

Local GMT: 95-133-19:25:39:00
~~Orbit: 1234~~
(stop): 95-133-17:26:00:00

Current Mode Parameter Values

Commanding Mode: 1 STEP
Command Counter Delay:25000 ms
Automatic Retransmission: DISABLED
Command Spacecraft ID: Normal

Command Counter Verification: DISABLED
Command Metering Rate: 17152 ms
Uplink processor: CAP1
Command Execution Verification: DISABLED

GMT	Crit	EVT Num	Event Message
133:17:23:39.9		1770	Commanding in TWO step mode
133:17:23:49.5		1771	Command counter verification ENABLED
133:17:24:05.7		1772	Memory Load sequence initiated for loadname in <loadfile>
133:17:25.06.5	C	1773	Memory Load uplink complete - block 2

END OF COMMAND SUMMARY REPORT
****

B.6 ECS ACTIVITY PLAN DISPLAY

B.7 COMMAND HISTORY REPORT EXAMPLE
(AS PROVIDED BY SMOCC)

```
          *****        COMMAND HISTORY REPORT        *****           Page No.   1

Mission: SOHO        Local GMT: 1995/11/13 05:39:00
Time Range: (start) 1995/11/12 00:00:00        (stop): 1995/11/12 23:59:59

                              Current Mode Parameter Values
                              ------------------------------------------

Throughput Mode:              DISABLED                 RCR Processing:      DISABLED
CMS Background Queue:         ENABLED


        GMT                   Crit    Event No     Event Message
1995/11/12 07:23:39                      1700          Commanding in Normal Scheduled
Mode
1995/11/12 08:00:00                      1701          Throughput Mode Enabled
1995/11/12 08:00:00                      1702          RCR Processing Enabled
1995/11/12 08:10:00                      1703          VIRGO 12: NRT command group
uplinked
....

                      END OF COMMAND HISTORY REPORT
*************************************************************
*************************************************

          *****        BACKGROUND QUEUE STATUS REPORT        *****     Page No.   1

Mission: SOHO        Local GMT: 1995/11/12 06:20:00
Time Range: (start) 1995/11/12 00:00:00        (stop): 1995/11/12 23:59:59

                              Current Mode Parameter Values
                              ------------------------------------------

Throughput Mode:              ENABLED                  RCR Processing:      DISABLED
CMS Background Queue:         ENABLED

File Name             Time Received         Time to POCC          Status
MDITBL0001.BCK     1995/11/11 17:00:39     1995/11/12 03:10:10     Uplink
Verified
MDITBL0002.BCK     1995/11/11 17:01:00     1995/11/12 03:10:12     Uplink
Verified
MDITBL0003.BCK     1995/11/11 17:02:00     1995/11/12 03:10:14     Uplink
Verified
MDITBL0004.BCK     1995/11/11 17:03:00     1995/11/12 03:10:15     Uplink
Failed - BARM


                      END OF BACKGROUND QUEUE REPORT
*************************************************************
*************************************************
```

B.8 ECS COMMANDING STATUS WINDOW

B.9 DATA ACCOUNTABILITY LOG EXAMPLE

DATE	START TIME	END TIME	COMMENT
1996/05/20	00:00:00	01:40:00	No data loss
1996/05/21	12:13:30	12:16:50	DSN loss of lock during tape recorder dump
1996/05/22	16:05:00	16:05:33	DSN loss of lock during real-time session

APPENDIX C. ARCHIVED TELEMETRY FILE FORMAT

Production Data Format

(As defined in the July 1993 version of the SDPF to <Mission> ICD)

Source Data Units	Telemetry packet 1 Telemetry packet 2 Telemetry packet 3 . . . . Telemetry packet n	
Quality and Accounting List Length	32-bit integer specifying the length in bytes of the Quality and Accounting List	
Quality and Accounting List	Offset of Data Unit	(32-bits): Position of errored packet in this file
	Data Unit sequence number	(16-bits): Sequence number of packet in error
	Error Type Flags	(8-bits): type of errors found Bit 0 Not used Bit 1 R-S header errors Bit 2 Length code wrong Bit 3 R-S frame errors Bit 4 CRC frame errors Bit 5 Sequence count error Bit 6 Detected frame errors Bit 7 Contain fill data
	Count of segments CRC/RS errors	(8-bits): number of segments from frames with errors
	Spare	(32-bits)
	Fill start location	(16-bits); byte location of start of fill. 0000 for no fill
Missing Data Units List Length	32-bit integer specifying the length in bytes of the missing data units list	
Offset to Missing Data Units List	Offset to Missing Data Units List	(32-bit): position of start of data unit immediately preceding the first data unit of the list
	From	Data unit sequence number
	To	Data unit sequence number