The Consultative Committee for Space Data Systems

CCSDS Historical Document

This document's Historical status indicates that it is no longer current. It has either been replaced by a newer issue or withdrawn because it was deemed obsolete. Current CCSDS publications are maintained at the following location:

http://public.ccsds.org/publications/

Consultative
Committee for
Space Data Systems

SPACE LINK EXTENSION SERVICES—EXECUTIVE SUMMARY

CCSDS 910.0-Y-1

YELLOW BOOK

April 2002

FOREWORD

This Administrative Report provides an overview of Space Link Extension (SLE) Services. It is designed to assist readers with their review of existing and future SLE documentation.

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This Administrative Report is therefore subject to CCSDS document management and change control procedures which are defined in reference [10]. Current versions of CCSDS documents are maintained at the CCSDS Web site:

http://www.ccsds.org

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

Member Agencies

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

Observer Agencies

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

DOCUMENT CONTROL

Document	Title	Date	Status/ Remarks
CCSDS 910.0-Y-1	Space Link Extension Services—Executive Summary	April 2002	Original Issue

CONTENTS

1 BACKGROUND TO SLE SERVICES

1.1 WHAT ARE SLE SERVICES?

The Space Link Extension (SLE) Services extend the forward Telecommand (TC) and return Telemetry (TM) services defined by the Consultative Committee for Space Data Systems (CCSDS) (see figure 1-1.). The forward TC and return TM services are used by many space missions on the space link between ground stations and spacecraft.

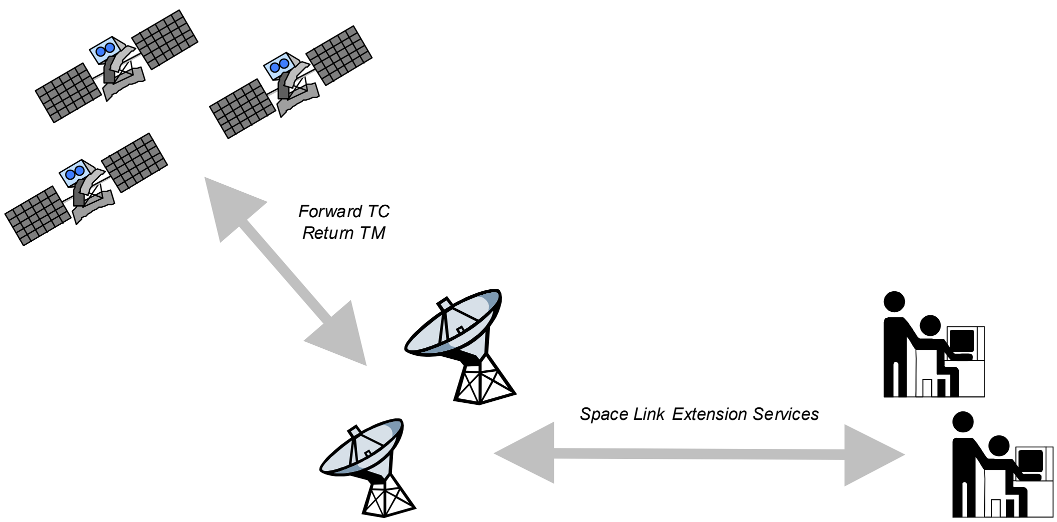

Figure 1-1: Ground Stations Provide SLE Services to Users

The SLE Services include two major elements:

- transfer services that move space link data units between ground stations, control centers and end-user facilities;
- management services that control the scheduling and provisioning of the transfer services.

The SLE Services operate in two phases:

- the definition phase, when most of the management activities take place;
- the utilization phase, when the data transfer takes place (this can be either in real-time or delayed with respect to the contact time with the spacecraft).

The SLE Services will carry all types of space data including, for example, spacecraft commands in the forward direction and science data in the return direction. In addition, the service will convey information such as TM data reception times and ground station configuration information.

1.2 WHY DO WE NEED SLE SERVICES?

The need for SLE Services arises from the desire of spacecraft operations organizations to standardize the interfaces for the transport and management of space data on the ground so that the technical, management and operational costs of providing cross support between the organizations can be greatly reduced.

1.3 WHAT ARE THE BENEFITS OF SLE SERVICES?

SLE Services enable the ground segment assets of space agencies, ground station operators and space data users to interoperate without the need for ad hoc and complicated gateways specifically designed for each new mission.

By developing SLE Services, standard interfaces will be created that allow one mission to use the ground segment elements of another, thereby avoiding duplicate development.

Since the SLE protocols run over existing communications infrastructure, they help integrate space data systems into the global communications network.

The advantages of SLE Services are as follows:

- space organizations will be able to provide cross support to one another more efficiently;
- ground station owners will be able to provide standard services to operators of CCSDS-compliant spacecraft;
- users of spacecraft data will be able to command their payloads and access their data through a familiar interface, using widely available underlying telecommunications technology such as the Internet or an Integrated Services Digital Network (ISDN) line;
- the standardization of ground station, control center and end user interfaces will permit re-use of systems for successive missions and eliminate the costs and risks associated with mission-specific implementations;
- a truly global market for standard Telemetry, Tracking and Command (TT&C) Commercial Off The Shelf (COTS) products will be created, driving down the cost of these systems;
- SLE Services are scalable, so that only the actual services required by a service user or a service provider need to be implemented.

1.4 OVERVIEW OF RETURN SLE SERVICES

The return SLE Services associated with conventional TM include:

- Return All Frames (R-AF), which provides a complete set of TM frames from a single space link symbol stream to spacecraft operators and other users who might need all the frames;
- Return Channel Frames (R-CF), which provides Master Channel (MC) or specific Virtual Channels (VC) extracted from a particular R-AF channel, as specified by each R-CF service user;
- Return Frame Secondary Header (R-FSH), which provides MC or VC Frame Secondary Headers (FSH) extracted from an R-AF channel, as specified by each R-FSH service user;
- Return Operational Control Field (R-OCF), which provides MC or VC Operational Control Fields (OCF) extracted from an R-AF channel, as specified by each R-OCF service user;
- Return Space Packet (R-SP), which enables single users to receive packets with selected Application Process Identifiers (APID) from one spacecraft VC.

Figure 1-2 shows the data transfer interfaces for these services.

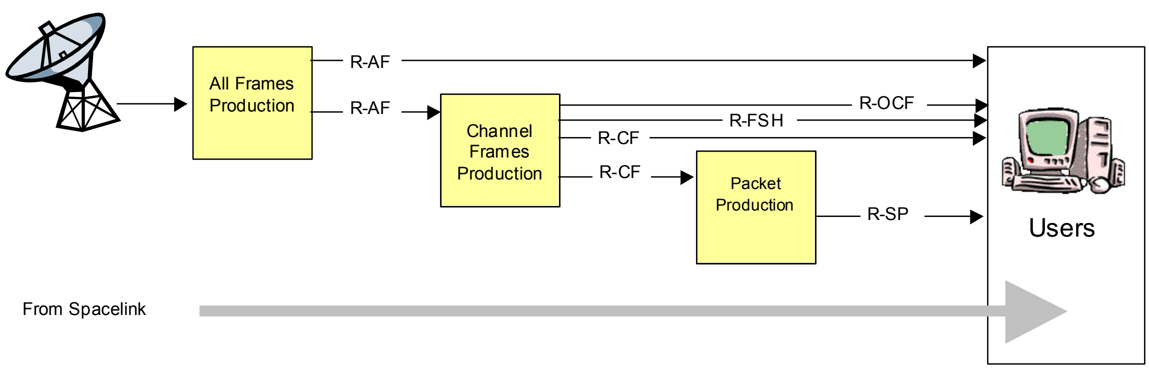

Figure 1-2: Conventional Return SLE Services are Produced in Three Stages

1.5 OVERVIEW OF FORWARD SLE SERVICES

The forward SLE Services associated with conventional TC include:

- Forward Space Packets (F-SP), which enables single users to provide packets for uplink to a spacecraft without needing to coordinate with other users of the spacecraft;
- Forward Telecommand Virtual Channel Access (F-TCVCA), which enables users to provide complete VCs for uplink;
- Forward Telecommand Frames (F-TCF), which enables users to supply TC frames to be transformed to Command Link Transmission Units (CLTU) ready for uplink;

- Forward Command Link Transmission Unit (F-CLTU), which enables users to provide CLTUs for uplink to spacecraft.

Figure 1-3 shows the data transfer interfaces for these services.

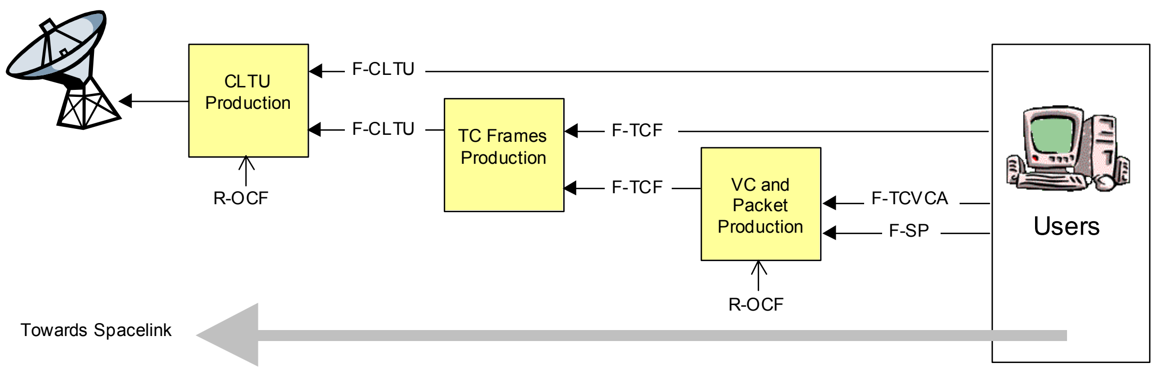

Figure 1-3: Three Stage Approach to Conventional Forward SLE Services

Figure 1-3 shows the R-OCF service as an input to the CLTU Service Provider and the VC and Packet Service Provider. The R-OCF service provides the Command Link Control Word (CLCW), which is required by the CLTU Service Provider to determine the availability of the physical space link channel. The CLCW is also required by the VC and Packet Service Provider to determine if TC frames need to be retransmitted when the Command Operation Procedure 1 (COP-1) is in effect.

1.6 REFERENCES

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

[1] *Standard Terminology, Conventions, and Methodology (TCM) for Defining Data Services*. Report Concerning Space Data Systems Standards, CCSDS 910.2-G-1. Green Book. Issue 1. Washington, D.C.: CCSDS, November 1994.

[2] *Cross Support Concept—Part 1: Space Link Extension Services*. Report Concerning Space Data System Standards, CCSDS 910.3-G-2. Green Book. Issue 2. Washington, D.C.: CCSDS, April 2002.

[3] *Cross Support Reference Model—Part 1: Space Link Extension Services*. Recommendation for Space Data System Standards, CCSDS 910.4-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, May 1996.

[4] *Space Link Extension—Return All Frames Service Specification.* Recommendation for Space Data System Standards, CCSDS 911.1-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, April 2002.

[5] *Space Link Extension—Forward CLTU Service*. Recommendation for Space Data System Standards, CCSDS 912.1-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, April 2002.

[6] *Space Link Extension—Service Management Specification*. Draft Recommendation for Space Data System Standards, CCSDS 910.5-R-2. Red Book. Issue 2. Washington, D.C.: CCSDS, September 2001.

[7] *Space Link Extension—Service Management—Space Link Physical Layer Managed Object Specification*. Draft Recommendation for Space Data System Standards, CCSDS 910.7-R-1. Red Book. Issue 1. Washington, D.C.: CCSDS, October 2001.

[8] *Space Link Extension—Return Virtual Channel Frames Service Specification*. Draft Recommendation for Space Data System Standards, CCSDS 911.2-R-2. Red Book. Issue 2. Washington, D.C.: CCSDS, July 2001.

[9] *Space Link Extension—Forward Space Packet Service Specification.* Draft Recommendation for Space Data System Standards, CCSDS 912.3-R-2. Red Book. Issue 2. Washington, D.C.: CCSDS, July 2001.

[10] *Procedures Manual for the Consultative Committee for Space Data Systems*. CCSDS A00.0-Y-7.4. Yellow Book. Issue 7.4 (interim update). Washington, D.C.: CCSDS, January 2001.

2 SLE SERVICE OPERATIONS

2.1 SLE DATA TRANSFER

The way in which SLE data transfer is organized is best illustrated by an example. Figure 2-1 shows how the Service Provider modules described in the previous section combine into 'SLE complexes' that together form the 'SLE System'. SLE Complexes are formed from a combination of one or more forward and/or return Service Provider modules. The SLE System interacts with the end-users who are part of a 'Mission Data Operations System (MDOS)'. The figure illustrates the transfer of space packets to the end users.

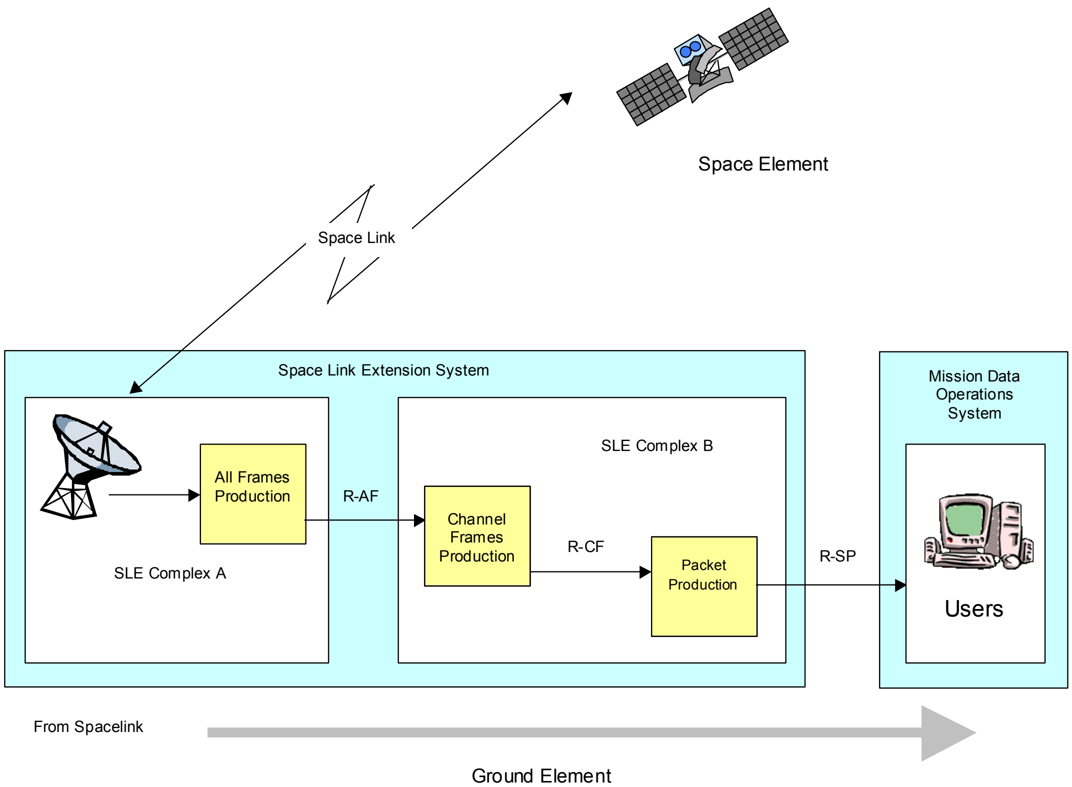

Figure 2-1: Example of SLE Data Transfer

Several features of this example are worth highlighting:

- SLE Complex A represents the installation at a ground station of an R-AF service provider. In a real system, there could be a number of ground stations providing this service from various locations on the Earth.
- SLE Complex B represents the TM processing system of a typical operations center, which acts as a user of the R-AF data service from one or more ground stations and provides a space packet data service for its users.

- The MDOS represents users of the R-SP service. These could be scientists in universities receiving data from their instruments or operations engineers in spacecraft control centers receiving spacecraft housekeeping data.
- In a cross support scenario, SLE Complex A and SLE Complex B will typically be operated by different organizations. However, once SLE Services are implemented throughout an organization, they are likely to provide a cheaper and more effective way to operate that organization's internal services as well.
- The underlying telecommunications technology between the complexes and between Complex B and the MDOS may be different. For instance, there may be an ISDN link between the complexes to assure a high quality of service, whereas the interface between Complex B and science data users in the MDOS may be the Internet.

Figure 2-1 shows only the return path. In reality, many complexes will handle both forward and return services. For example, it would be normal for Complex A to also provide an F-CLTU service, as shown in figure 2-2.

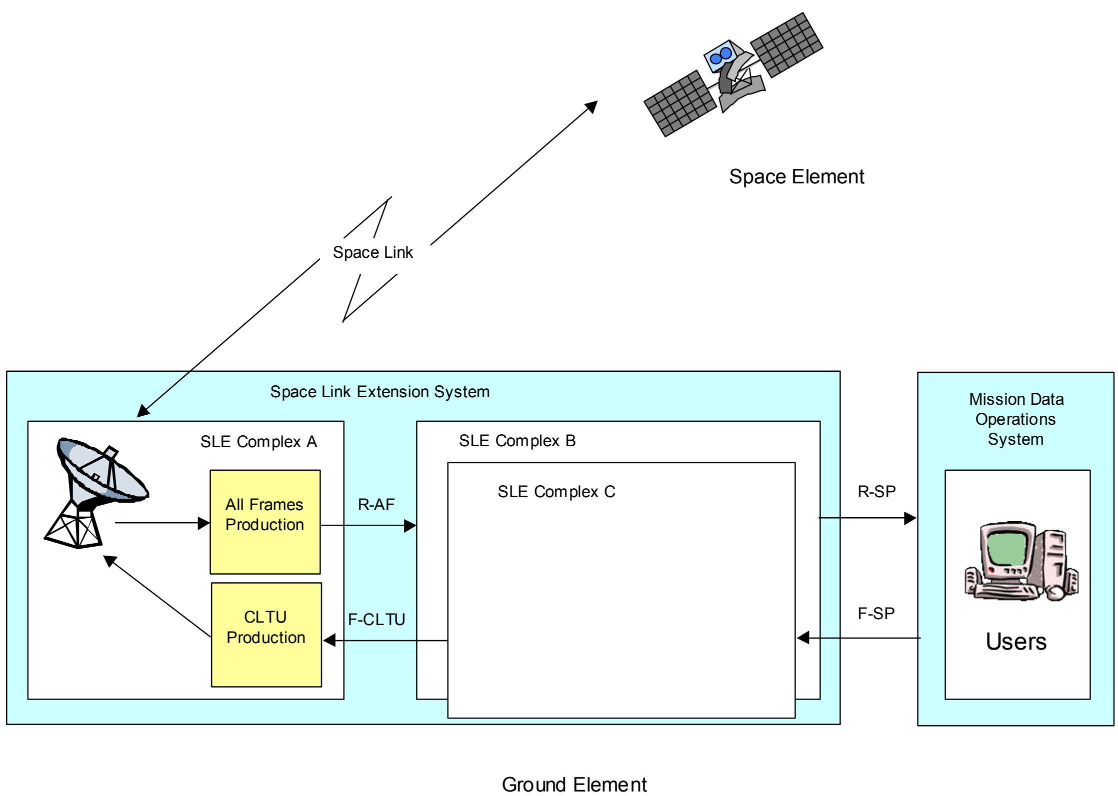

Figure 2-2: An SLE Complex May Provide Both Forward and Return Services

In figure 2-2, the ground station corresponding to SLE Complex A provides both R-AF and F-CLTU services. Sometimes these services may be provided simultaneously from and to a particular spacecraft. Typically several complexes will require the services of Complex A over a period of time.

2.2 SLE SERVICE MANAGEMENT

The purpose of SLE Service Management is to standardize and provide the basis for automating those interactions between users and providers of SLE Services that are required in order to agree upon and schedule the services. In addition, the service management provides the means to monitor and control the resources needed in the provider complex(es) and the MDOS to execute the service. In essence, SLE Service Management is responsible for:

- agreeing upon the values of the parameters involved in an SLE service;
- allocating the complex resources needed for the execution of SLE Services;
- configuring, monitoring and controlling the complex resources during the execution of the service.

The entities involved in SLE Service Management are shown in figure 2-3 and include:

- 'Complex Management' in one or more SLE Complexes;
- 'Utilization Management' in an MDOS.

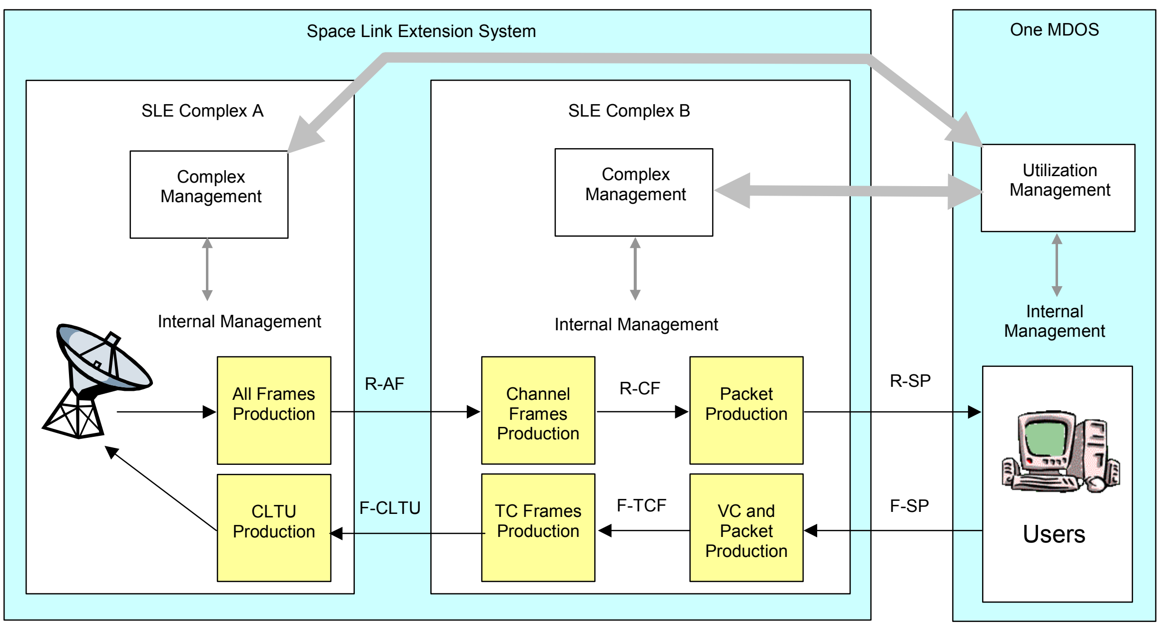

Figure 2-3: Managing SLE Services

It is the responsibility of Utilization Management to request the ground station and mission operations services needed by the mission. The way in which a particular mission coordinates the requirements of scientists, engineers and operations staff is an internal matter for that mission. Utilization Management would typically be the function of a spacecraft's mission manager, supported by the payload manager and operations manager.

Complex Management interacts with Utilization Management through service-oriented operations. Complex Management then translates these operations into the interactions with the real equipment needed to monitor and control the complex resources. The interface between the Complex Management and Utilization Management is defined in the SLE Service Management Recommendations (references [6] and [7]). The internal interfaces are a matter for the SLE Complex. The Complex Management is typically exercised by ground station operators and operations centers.

Figure 2-4 shows the relationship of SLE Service Management to both the resources needed to execute the SLE data transfer and the resources needed to manage the service, using the example of R-AF and F-CLTU services. The interfaces between Complex Management and these resources are a matter for internal design. However, the design must be able to pass parameters that are required by SLE Service Management.

Figure 2-4 also shows that the interactions between the Utilization Management and Complex Management are governed by the agreement and setting up of the set of Service Packages needed to execute the R-AF and F-CLTU services.

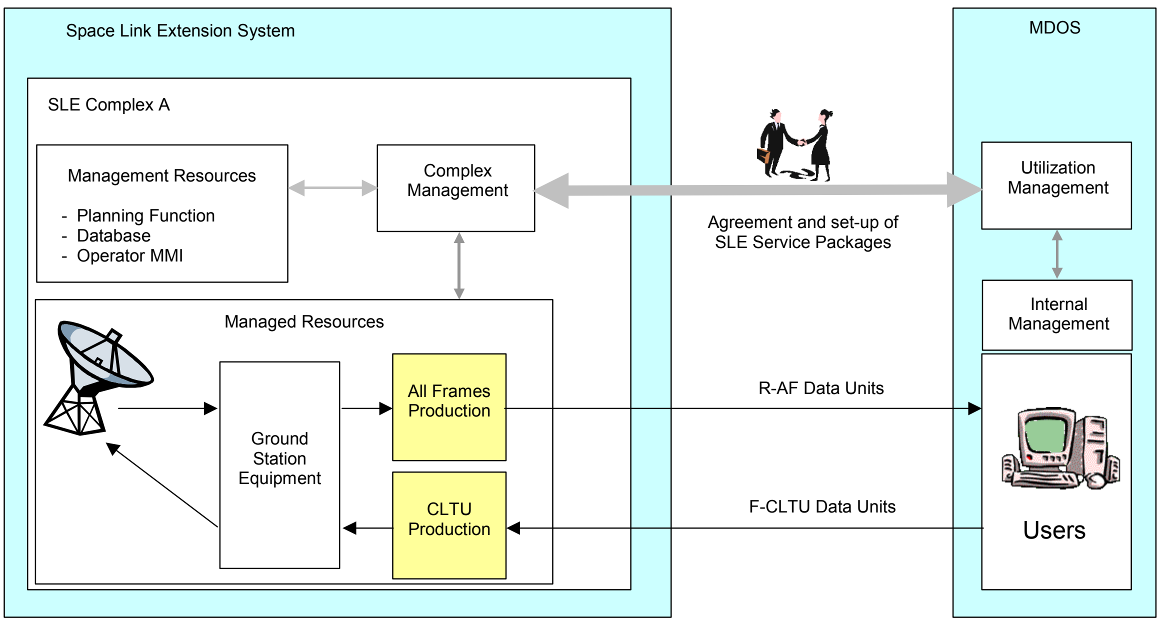

Figure 2-4: Data Transfer and Management Resources

2.3 THE SLE SERVICE LIFECYCLE

The activities involved in planning and utilizing an SLE service are shown in figure 2-5. The four main activities are as follows:

1. Make an Agreement

   A mission will contact ground station providers and/or operation centers requesting an appropriate set of SLE Services. The provider(s) will respond according to the suitability and availability of their resources at the times requested by the user. If the user and provider proceed, the result will be a Service Agreement and a set of provisional Service Packages that contain the information required to execute the services requested by the user.

2. Iterate the Details of the Service

   For a new mission, the TT&C parameters will be finalized and the orbit parameters will become more accurate as the launch approaches. The user will be able to iterate the parameters of the Service Packages already agreed upon with the provider(s). The result is a final set of SLE Service Packages.

3. Set Up the Complex

   As the time for the execution of each Service Package approaches, each complex will need to set up the resources needed to execute the Service Package.

4. Execute the Service

   SLE data transfers take place in accordance with the negotiated Service Package(s).

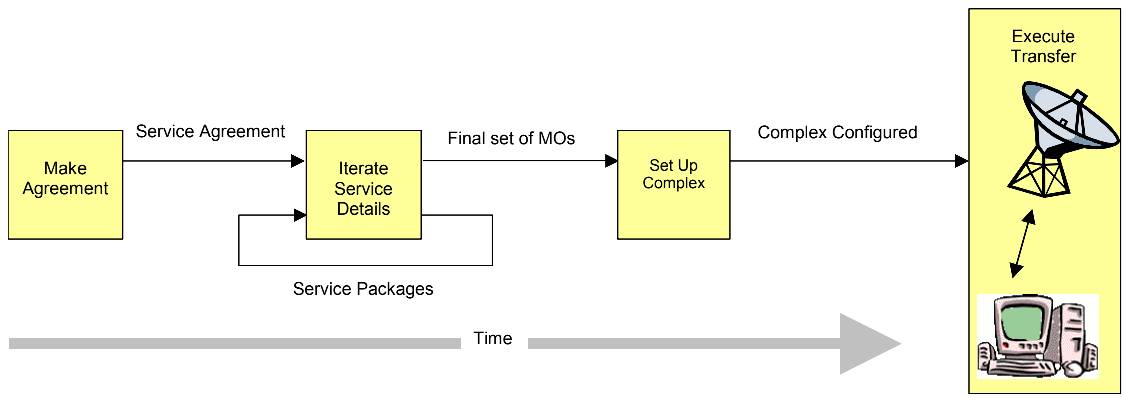

Figure 2-5: The SLE Service Agreement Lifecycle

3 IMPLEMENTING SLE SERVICES

3.1 IMPLEMENTATION OPTIONS

Most organizations have their own implementations of the CCSDS protocols but no standard way of interfacing with other organizations. The SLE Services that provide this standard interface may be implemented in one of the following ways:

1. For users or providers without an existing CCSDS implementation, either:
   – implement the SLE Services from scratch, directly from the SLE service specifications and the SLE Transfer Service Application Program Interface (API) specification, or
   – buy a complete off-the-shelf implementation from a commercial vendor.
2. For users or providers with existing CCSDS implementations, use already-developed software elements such as the SLE Transfer Service API reference implementation to cut down on the amount of new software that needs to be developed.

The SLE Services may be implemented incrementally in existing user and provider ground systems. In the case of option (2), the SLE software can be added to, rather than replace, existing CCSDS ground systems, thereby increasing their capability and enhancing their value. By using standard SLE components such as the SLE Transfer Service API, only the software needed to interface with the standard SLE modules needs to be developed to upgrade legacy systems.

Typical steps in the process are as follows:

1. Implement the data transfer protocols using the SLE Transfer Service API.

   Only the services actually needed by the user or provider need to be implemented. For example, only the F-CLTU, F-SP and R-AF services have been implemented to support the European Space Agency's (ESA) International Gamma-Ray Astrophysics Laboratory (INTEGRAL) mission. However, service management issues are still handled in an ad hoc way at this stage.

2. Implement the service management protocols in order to simplify the setting up and provisioning of the service.

   Only the required transfer services need to be implemented at this stage.

3. Implement the data transfer protocols and service management interfaces for the remaining SLE Services.

   Typically, only a limited number of providers of SLE Services would do this. Users of the SLE Services would tend to focus on a particular service, e.g., control centers might just need to use the F-CLTU and R-AF services, and science users might just need to use the F-SP and R-SP services.

3.2 TECHNOLOGY CONSIDERATIONS

The SLE Service Recommendations are written in a way that is intended to be as independent of the implementation technology as possible. However, the following points should be noted:

- The SLE data transfer protocols are straightforward messaging protocols. They are currently supported by an SLE Transfer Service API that uses Transmission Control Protocol (TCP) and Internet Protocol (IP) as the underlying communications technology. Other APIs could be developed to support other communications protocols.
- The SLE Service Management Recommendations have been written using a managed object approach typical of telecommunications network management. The formal service management specification is written in Guidelines for Definition of Managed Objects (GDMO), Abstract Syntax Notation 1 (ASN.1), Unified Modeling Language (UML) and Common Object Request Broker Architecture (CORBA) Interface Definition Language (IDL).
- Technologies currently being considered for SLE Service Management implementations include:
  - a simple message format;
  - JAVA Remote Method Invocation (RMI);
  - eXtensible Mark-up Language (XML);
  - CORBA.

3.3 EXISTING SLE IMPLEMENTATIONS

3.3.1 SLE TRANSFER SERVICE API

ESA and the Jet Propulsion Laboratory (JPL), with commercial support, have both implemented versions of the SLE Transfer Service API for use initially in the INTEGRAL mission, in which JPL will supply F-CLTU, R-CF and R-AF services to ESA. The SLE Transfer Service APIs are available in Unix and Windows NT versions for incorporation into the existing CCSDS-compliant systems of TT&C ground segment users and providers.

3.3.2 SLE SERVICE MANAGEMENT

The British National Space Centre (BNSC) is funding a commercial company to prototype an implementation of the F-CLTU and R-AF services in the TT&C ground segment of QinetiQ (formerly the Defence Evaluation and Research Agency [DERA]). This implementation incorporates the ESA SLE Transfer Service API and implements the SLE Service

Management associated with the F-CLTU and R-AF services. Users will interact with the QinetiQ SLE service by means of a Web-based Internet interface.

3.4 FUTURE CROSS SUPPORT SERVICES

3.4.1 OVERVIEW

The SLE Services that have been defined by CCSDS at the time of writing cover ‘conventional’ TM and TC services. These are the services that are used by the majority of missions.

When there is a demand, the SLE Services will be extended to cover other CCSDS-defined services, including:

- off-line conventional TC services;
- forward Advanced Orbiting Systems (AOS) services;
- CCSDS File Delivery Protocol (CFDP) services;
- Space Communications Protocol Standards (SCPS).

The SLE Services will be complimented by Ground Domain Services (GDS) that will provide the additional cross support standards needed for operational implementations, including:

- security;
- tracking and orbit propagation;
- ground station monitoring and control interfaces;
- ground station planning interfaces.

The latter three items are discussed in subsections 3.4.2 through 3.4.4.

3.4.2 TRACKING AND ORBIT PROPAGATION SERVICES

In order to set up a Service Agreement for an SLE service, the mission manager will need to pass the orbit parameters to the provider. The provider then needs to check that the spacecraft will be visible from his ground station so that the service can be provided in principle.

Later, when the user passes the accurate orbit parameters, the provider needs to check that the spacecraft is visible from the ground station at the particular times and for the required durations specified by the user. To carry out this function, the provider will need to use a tracking and orbit propagation tool to validate the information provided by the user.

In addition to the particular SLE service requested, the user may need the support of the ground station to track the satellite. This type of service is yet to be defined, but should be defined in a way that is compatible with existing SLE standards.

3.4.3 GROUND STATION MONITORING AND CONTROL INTERFACES

The provision of the F-CLTU and R-AF services is intimately associated with the status of the ground station involved. It may therefore be efficient to standardize the interfaces between SLE Service Management and the various ground station monitoring and control implementations used by different organizations.

3.4.4 GROUND STATION PLANNING INTERFACES

When a user requests a particular service over a particular period, the provider needs to check the availability of the assets required (in particular, whether a ground station is available to provide the requested service). In order to do this, the provider needs to have a means of planning the use of the ground station.

Most ground station planning is currently carried out manually. In the longer term, a more automated system will be required that can:

- check the long-term availability of the ground station when a user initially requests a service;
- ‘block out’ periods allocated to particular users in the medium-term;
- schedule the detailed operations in the short-term.

A further complication arises when a provider operates several ground stations, each of which can support particular phases of a given mission. In this case, there is an additional layer of planning that needs to allocate certain ground stations to certain users. The planning systems will need to be flexible enough to accommodate changes in allocations at each planning stage.

Space agencies, through CCSDS Panel 3, will need to examine the ground station planning issue and recommend standard ways of interchanging planning information between users and providers. Although ground station operators will then need to comply with a standard interface to be CCSDS-compliant, they will still be free to implement their own planning systems in a way best suited to their normal practices.

4 SLE DOCUMENTATION

4.1 ROADMAP TO SLE DOCUMENTS

The SLE Documentation is organized as shown in figure 4-1.

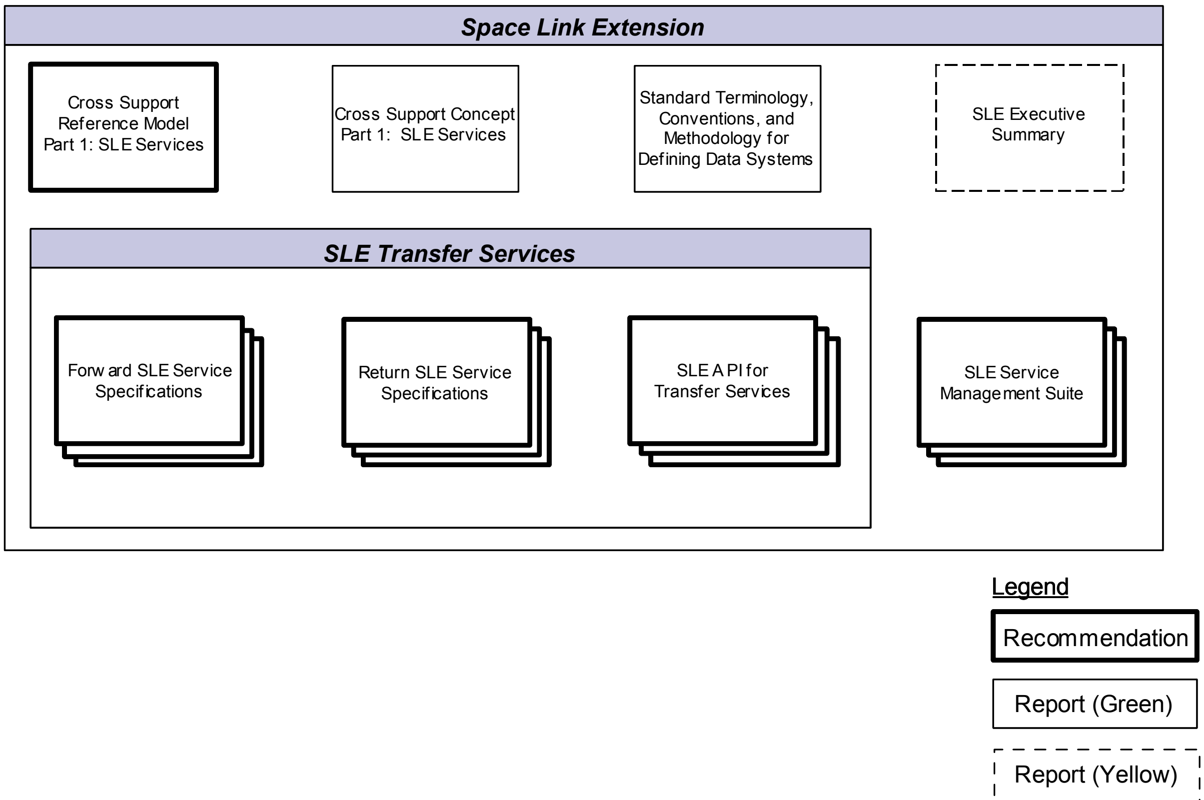

Figure 4-1: Space Link Extension Services Documentation Hierarchy

The SLE documentation includes:

- A CCSDS report that describes the SLE cross support concept (reference [2]);
- A CCSDS report that describes the standard Terminology, Conventions and Methodology (TCM) used in defining the transfer services (reference [1];
- A CCSDS Recommendation that defines the cross support Reference Model used in the transfer and service management specifications (reference [3]);
- A set of CCSDS Recommendations that specify the Forward transfer services (reference [9]);
- A set of CCSDS Recommendations that specify the Return transfer services (reference [8]);

- A set of CCSDS Recommendations that specify the SLE Service Management (references [6] and [7]).

4.2 GUIDE TO FURTHER READING

Readers wishing to have a more complete understanding of the SLE services may like to read one or more of the Reference Documents (RD) listed in subsection 1.6. The following guide indicates which documents are most appropriate in a given situation:

For an introduction to the concepts of cross support and SLE Services, →	read the Concept Document [2]
To understand the model underlying the SLE Recommendations, →	read the Reference Model [3]
To implement only the SLE data transfer service, with ad hoc service management, →	read both of the above, plus the Transfer Service Specifications, [4] and [5]
To implement a complete SLE Service, including Service Management, →	read all the above, plus relevant sections from: - Service Management Specification [6] - Space Link Physical Layer Specification [7]
For background on the international standards used in defining the SLE Services, →	read the TCM Document [1]

Further information on the SLE Services may be found on the CCSDS web site at http://www.ccsds.org.

ANNEX A

ACRONYMS AND ABBREVIATIONS

AOS	Advanced Orbiting Systems
API	Application Program Interface
APID	Application Process Identifier
ASN.1	Abstract Syntax Notation 1
BNSC	British National Space Centre
CCSDS	Consultative Committee for Space Data Systems
CFDP	CCSDS File Delivery Protocol
CLCW	Command Link Control Word
CLTU	Command Link Transmission Unit
COP-1	Command Operation Procedure 1
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off The Shelf
DERA	Defence Evaluation and Research Agency
ESA	European Space Agency
F-CLTU	Forward Command Link Transmission Unit
FSH	Frame Secondary Header
F-SP	Forward Space Packets
F-TCF	Forward Telecommand Frames
F-TCVCA	Telecommand Virtual Channel Access
GDMO	Guidelines for Definition of Managed Objects
GDS	Ground Domain Services
IDL	Interface Definition Language
IP	Internet Protocol

ISDN	Integrated Services Digital Network
JPL	Jet Propulsion Laboratory
MC	Master Channel
MDOS	Mission Data Operations System
MO	Managed Object
OCF	Operational Control Field
R-AF	Return All Frames
R-CF	Return Channel Frames
RD	Reference Document
R-FSH	Return Frame Secondary Header
RMI	Remote Method Invocation
R-OCF	Return Operational Control Field
R-SP	Return Space Packet
SCPS	Space Communications Protocol Standards
SLE	Space Link Extension
TC	Telecommand
TCM	Terminology, Conventions and Methodology
TCP	Transmission Control Protocol
TM	Telemetry
TT&C	Telemetry, Tracking and Command
UML	Unified Modeling Language
VC	Virtual Channel
XML	eXtensible Mark-up Language