

Standard

Adaptations and Conversions of CCSDS Space Link Extension Forward Communications Link Transmission Unit Transfer Service

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American National Standard

Adaptations and Conversions of CCSDS Space Link Extension Forward Communications Link Transmission Unit Transfer Service

Sponsored by

American Institute of Aeronautics and Astronautics

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Abstract

This document defines adaptations and conversions of the Consultative Committee for Space Data Systems (CCSDS)-standard SLE Forward Communications Link Transmission Unit (FCLTU) command transfer service. The CCSDS SLE transfer services do not support some legacy command and telemetry data flows that must be accommodated by US civil, military, and commercial space element tracking, telemetry, and control networks to allow interoperability in support of US Government space operations. Adaptations of FCLTU by the user and conversions of FCLTU by the provider provide standardized discrete and streaming ternary command services and streaming binary command services which are not otherwise provided by CCSDS SLE transfer services. Discrete and streaming mode ternary command services support space elements which use ternary commanding on the space link. Streaming binary command services support space elements whose commands are not discrete or otherwise do not have discernible command boundaries.

American National Standard

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Foreword

This standard was prepared by the AIAA Satellite Control Network Data Transfer Committee on Standards (CoS). The CoS was formed in 2005 to consider standardization of data transfer services relevant to the interoperation of US civil, military, and commercial telemetry, tracking, and control (TT&C) systems.

This standard is based on an existing space data transfer service standard developed by the international Consultative Committee for Space Data Systems (CCSDS). Specifically, this standard specifies additional functionality that, when used in conjunction with the CCSDS Space Link Extension (SLE) Forward Communications Link Transmission Unit (FCLTU) telecommand transfer service, allows a wider range of command data formats to be transferred than are nominally supported by the CCSDS service. This standard covers aspects of US space element (also known as spacecraft, space vehicle, and satellite) ground systems that were either not considered suitable for international standardization by CCSDS, or that CCSDS had no plans to standardize in the near term. If in the future CCSDS ratifies international standards that provide some or all of the capabilities enabled by this standard, those international standards should supersede the functions of this standard that are redundant.

The CoS was assembled to represent the three main US government TT&C networks (i.e., SA, NOAA, and AFSCN), commercial ground services providers, ground systems hardware vendors, and general interest parties. At the time of approval, the members of the AIAA Satellite Control Network Data Transfer Committee on Standards were:

John Pietras, Chair	Global Science & Technology
Rob Andzik	RTLogic!
Paul Blanchard	L3 Communications
Stephen Boulger	Universal Space Networks
Bill Deng	Aerospace Corporation
Lou Moss	AIAA (Harris Corporation)
Brian Safigan	Avtec Systems
Michael Stoloff	NASA (Jet Propulsion Laboratory)
Capt Robert Thompson	Air Force Satellite Control Network (SMC/SNI)
John Vaccaro	Honeywell DataLynx
Lance Williams, Secretariat	Satellite Control Network Contract (Northrop Grumman)
Ron Wolf	Scitor Corporation

The above consensus body approved this document in February 2007.

The AIAA Standards Executive Council (Mr. Amr ElSawy, Chairman) accepted the document for publication in April 2007.

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Introduction

The CCSDS is an international standards organization which has provided a set of TT&C ground network standards collectively known as Space Link Extension (SLE). The CCSDS SLE standards describe the transport of space element telecommands (hereafter referred to as commands) and telemetry over TCP/IP-based ground networks connecting mission control centers and remote tracking stations. They provide a standard approach to establishing and authenticating service connections, selecting quality of service, and reporting service status.

The SLE Forward Communications Link Transmission Unit (FCLTU) service is formally defined in terms of transferring command frames conforming to CCSDS standards for frame format, synchronization, coding, etc. However, the FCLTU service is capable of carrying data that is not formatted as CCSDS-specified command frames. Examples of other, non-CCSDS command frame data that could be transferred via the FCLTU service include ternary commands represented as dibits and streaming binary commands. Both of these operations are necessary for some US space systems. Whereas the processes for preparing CCSDS-formatted commands for RF uplinks and preparing it for transfer via the FCLTU service are documented in a series of CCSDS recommended specifications, CCSDS has not documented the equivalent processes needed to prepare these other data types for transfer via the FCLTU service.

This Standard defines a set of functions that expand the use of the FCLTU service to support the transfer of other types of data flow from a service user to a service provider. These other data flow types are recognized as potentially useful to a variety of TT&C networks and spaceflight missions, and standardization of their specifications facilitates interoperability among US TT&C networks.

This AIAA standard is one of two which describe the use of SLE to accomplish such ground system operations for which no standards otherwise exist. This volume describes adaptations of SLE FCLTU by the user and conversions by the provider. The companion volume (ANSI/AIAA S-124-2007) describes adaptations and conversions of SLE RAF.

1 Scope

This standard defines a set of functions to be performed by users and providers of the CCSDS FCLTU transfer service to flow types of space element command data that are not implicitly supported by standard implementations of the FCLTU service. These functions

- a) provide a dibit mapping for ternary command symbols,
- b) provide a mechanism to transfer ternary discrete commands over FCLTU,
- c) provide a mechanism to transfer ternary command streams over FCLTU,
- d) provide a mechanism to transfer binary command streams over FCLTU,
- e) provide two ternary idle patterns for the command link, to be used when command data from the user is not available for radiation, and
- f) provide an FCLTU automatic restart function.

The functions specified herein are intended to be implemented in conjunction with other systems with a variety of physical interfaces. Specification of the interfaces between the functions of this standard and these other systems is *not* within the scope of this standard.

2 Tailoring

When viewed from the perspective of a specific program or project context, the requirements defined in this Standard may be tailored to match the actual requirements of the particular program or project. Tailoring of requirements shall be undertaken in consultation with the procuring authority where applicable.

NOTE Tailoring is a process by which individual requirements or specifications, standards, and related documents are evaluated and made applicable to a specific program or project by selection, and in some exceptional cases, modification and addition of requirements in the standards.

3 Applicable Documents

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

CCSDS 912.1-F-2 *Space Link Extension – Forward CLTU Service Specification*

CCSDS 301.0-B-3 *Time Code Formats*

ANSI/AIAA S-124-2007 *Adaptations and Conversions of CCSDS Space Link Extension Return All Frames Transfer Service*

4 Vocabulary

4.1 Acronyms and Abbreviated Terms

AFSCN	Air Force Satellite Control Network
AIAA	American Institute of Aeronautics and Astronautics
ANSI	American National Standards Institute