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# Standard

# Adaptations and Conversions of CCSDS Space Link Extension Return All Frames Transfer Service



Approved American National Standard

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# Adaptations and Conversions of CCSDS Space Link Extension Return All Frames Transfer Service

**Sponsored by**

American Institute of Aeronautics and Astronautics

**Approved 3 May 2007**

American National Standards Institute

**Abstract**

This document defines adaptations and conversions of the Consultative Committee for Space Data Systems (CCSDS) standard Space Link Extension (SLE) Return All Frames (RAF) telemetry data 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 RAF by the user and conversions of RAF by the provider provide standardized time-correlated telemetry and command echo services which are not otherwise provided by CCSDS SLE transfer services. Time-correlated telemetry service supports space elements which use unframed bit streams or bit streams without provider-side frame synchronization. Command echo service supports systems which require an independent check of provider RF equipment.

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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) Return All Frames (RAF) telemetry transfer service, allows a wider range of 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 (NASA, 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:

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|---|---|
| John Pietras, Chair | Global Science & Technology |
| Rob Andzik | RTLogic! |
| Paul Blanchard | L3 Communications |
| Stephen Boulger | Universal Space Networks |
| Bill Deng | Aerospace Corporation |
| Lou Moss | NOAA (Harris Corporation) |
| Brian Safigan | Avtec Systems |
| Michael Stoloff | NASA (Jet Propulsion Laboratory) |
| Capt Robert Thompson | Air Force Satellite Control Network (SMC/SNI) |
| John Vaccarino | Honeywell DataLynx |
| Lance Williams, Secretariat | Satellite Control Network Contract (Northrop Grumman) |
| Ron Woll | 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 organization which has provided a set of TT&C 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 RAF service is formally defined in terms of transferring telemetry frames conforming to CCSDS standards for frame format, synchronization, coding, etc. However, the RAF service is capable of carrying data that is not formatted as CCSDS-specified telemetry frames. Examples of other, non-CCSDS telemetry frame data that could be transferred via the RAF service include telemetry data for which the frame format is unavailable to the receiving ground station and command data echoed back to the sending facility. Both of these operations are necessary for some US space systems. Whereas the processes for extracting CCSDS-formatted telemetry from RF downlinks and preparing it for transfer via the RAF 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 RAF service.

This Standard defines a set of functions that expand the use of the RAF service to support the transfer of other types of data flow from a service provider to a service user. 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 these ground system operations for which no standards otherwise exist. This volume describes adaptations of SLE RAF by the user and conversions by the provider. The companion volume (ANSI/AIAA S-124-2007) describes adaptations and conversions of SLE Forward Communication Link Transmission Unit (FCLTU) service.

# 1 Scope

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

a) convert a bitstream into octet segments for transfer using the CCSDS RAF Transfer Service,

b) regenerate a serial bitstream from octet segments in a manner that is correlated to the time of receipt at the receiving ground antenna,

c) convert an echoed command ternary symbol stream into octet segments containing dibits for transfer using the RAF Transfer Service,

d) regenerate a serial stream of ternary symbols from octet segments containing dibits,

e) convert an echoed command bitstream into octet segments for transfer using the RAF Transfer Service, and

f) regenerate a serial command bitstream from octet segments in a manner that provides a high probability of completeness.

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.

The functions specified herein are intended for use in the transfer of real-time data; that is, data that is transferred without storage and subsequent forwarding (e.g., recording and playback of telemetry). Support for stored-and-forwarded services (termed *offline* services in the CCSDS SLE specifications) is outside the scope of this standard and are subject for further study.

# 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.

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| CCSDS 911.1-B-2 | *Space Link Extension—Return All Frames Service Specification* |
| CCSDS 301.0-B-3 | *Time Code Formats* |
| ANSI/AIAA S-123-2007 | *Adaptations and Conversions of CCSDS Space Link Extension Forward Communication Link Transmission Unit Transfer Service* |