

# INTERNATIONAL STANDARD

ISO  
21080

First edition  
2016-07-01

---

---

## Space data and information transfer systems — Licklider transmission protocol (LTP) for CCSDS

*Données spatiales et systèmes de transfert d'information - Protocol de  
transmission Licklider (LTP) pour CCSDS*

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

[ISO 21080:2016](#)

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>



Reference number  
ISO 21080:2016(E)

© ISO 2016

# iTeh Standards

## (<https://standards.iteh.ai>)

### Document Preview

[ISO 21080:2016](#)

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>



#### COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. [www.iso.org/directives](http://www.iso.org/directives)

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. [www.iso.org/patents](http://www.iso.org/patents)

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

## The Standards Document Preview

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](http://www.iso.org/foreword-supplementary-information)

ISO 21080 was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 734.1-B-1, May 2015) and was adopted (without modifications except those stated in clause 2 of this International Standard) by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 13, *Space data and information transfer systems*.  
<https://www.iso.org/standard/621080.html> 2016-05-fe97dab5616c/iso-21080-2016

## DEDICATION

This book is dedicated to Adrian Hooke, whose end-to-end sensibilities and tireless advocacy for standardization of space data systems directly contributed to the formation of the Consultative Committee for Space Data Systems in 1982. His unique combination of technical skill, management abilities, and vision served CCSDS well for over 30 years. During that time CCSDS solidified the standardization of Physical and Data Link Layer protocols, and developed standards and technologies that had important and wide-ranging impacts in both the space and terrestrial communications industries. In the late 1990s, Adrian envisioned a new era for space communications leveraging a confluence of terrestrial internetworking and space-based data transport technologies. This led to the development of a concept that has come to be known as the Solar System Internetwork (SSI), of which the Licklider Transmission Protocol described here is a part.

Adrian will be missed, by CCSDS for the scope of his technical contributions and his leadership, and by his colleagues and friends for the greatness of his spirit and his wit. But his legacy to the space community remains. CCSDS will continue to provide useful and innovative solutions to space communication challenges so that Adrian's vision of an interoperable, standards-based communication system that reduces mission development time, cost, and risk will eventually be realized.

<https://standards.iteh.ai>

## Document Preview

[ISO 21080:2016](#)

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

## AUTHORITY

Issue:	Recommended Standard, Issue 1
Date:	May 2015
Location:	Washington, DC, USA

This document has been approved for publication by the Management Council of the Consultative Committee for Space Data Systems (CCSDS) and represents the consensus technical agreement of the participating CCSDS Member Agencies. The procedure for review and authorization of CCSDS documents is detailed in *Organization and Processes for the Consultative Committee for Space Data Systems* (CCSDS A02.1-Y-4), and the record of Agency participation in the authorization of this document can be obtained from the CCSDS Secretariat at the e-mail address below.

## iTeh Standards

This document is published and maintained by:

(<https://standards.iteh.ai>)

CCSDS Secretariat  
National Aeronautics and Space Administration  
Washington, DC, USA  
E-mail: [secretariat@mailman.ccsds.org](mailto:secretariat@mailman.ccsds.org)

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

## STATEMENT OF INTENT

The Consultative Committee for Space Data Systems (CCSDS) is an organization officially established by the management of its members. The Committee meets periodically to address data systems problems that are common to all participants, and to formulate sound technical solutions to these problems. Inasmuch as participation in the CCSDS is completely voluntary, the results of Committee actions are termed **Recommended Standards** and are not considered binding on any Agency.

This **Recommended Standard** is issued by, and represents the consensus of, the CCSDS members. Endorsement of this **Recommendation** is entirely voluntary. Endorsement, however, indicates the following understandings:

- o Whenever a member establishes a CCSDS-related **standard**, this **standard** will be in accord with the relevant **Recommended Standard**. Establishing such a **standard** does not preclude other provisions which a member may develop.
- o Whenever a member establishes a CCSDS-related **standard**, that member will provide other CCSDS members with the following information:
  - The **standard** itself.
  - The anticipated date of initial operational capability.
  - The anticipated duration of operational service.
- o Specific service arrangements shall be made via memoranda of agreement. Neither this **Recommended Standard** nor any ensuing **standard** is a substitute for a memorandum of agreement.

No later than five years from its date of issuance, this **Recommended Standard** will be reviewed by the CCSDS to determine whether it should: (1) remain in effect without change; (2) be changed to reflect the impact of new technologies, new requirements, or new directions; or (3) be retired or canceled.

In those instances when a new version of a **Recommended Standard** is issued, existing CCSDS-related member standards and implementations are not negated or deemed to be non-CCSDS compatible. It is the responsibility of each member to determine when such standards or implementations are to be modified. Each member is, however, strongly encouraged to direct planning for its new standards and implementations towards the later version of the Recommended Standard.

## FOREWORD

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CCSDS has processes for identifying patent issues and for securing from the patent holder agreement that all licensing policies are reasonable and non-discriminatory. However, CCSDS does not have a patent law staff, and CCSDS shall not be held responsible for identifying any or all such patent rights.

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This Recommended Standard is therefore subject to CCSDS document management and change control procedures, which are defined in *Organization and Processes for the Consultative Committee for Space Data Systems* (CCSDS A02.1-Y-4). Current versions of CCSDS documents are maintained at the CCSDS Web site:

<http://www.ccsds.org/>

Questions relating to the contents or status of this document should be sent to the CCSDS Secretariat at the e-mail address indicated on page i.

**CCSDS  
(<https://standards.iteh.ai>)  
Document Preview**

ISO 21080:2016

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

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

#### Member Agencies

- Agenzia Spaziale Italiana (ASI)/Italy.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- China National Space Administration (CNSA)/People's Republic of China.
- Deutsches Zentrum für Luft- und Raumfahrt (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Federal Space Agency (FSA)/Russian Federation.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.
- UK Space Agency/United Kingdom.

#### Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- China Satellite Launch and Tracking Control General, Beijing Institute of Tracking and Telecommunications Technology (CLTC/BITTT)/China.
- Chinese Academy of Sciences (CAS)/China.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- Danish National Space Center (DNSC)/Denmark.
- Departamento de Ciência e Tecnologia Aeroespacial (DCTA)/Brazil.
- Electronics and Telecommunications Research Institute (ETRI)/Korea.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Geo-Informatics and Space Technology Development Agency (GISTDA)/Thailand.
- Hellenic National Space Committee (HNSC)/Greece.
- Indian Space Research Organization (ISRO)/India.
- Institute of Space Research (IKI)/Russian Federation.
- KFKI Research Institute for Particle & Nuclear Physics (KFKI)/Hungary.
- Korea Aerospace Research Institute (KARI)/Korea.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic and Atmospheric Administration (NOAA)/USA.
- National Space Agency of the Republic of Kazakhstan (NSARK)/Kazakhstan.
- National Space Organization (NSPO)/Chinese Taipei.
- Naval Center for Space Technology (NCST)/USA.
- Scientific and Technological Research Council of Turkey (TUBITAK)/Turkey.
- South African National Space Agency (SANSA)/Republic of South Africa.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- Swiss Space Office (SSO)/Switzerland.
- United States Geological Survey (USGS)/USA.

**DOCUMENT CONTROL**

<b>Document</b>	<b>Title</b>	<b>Date</b>	<b>Status</b>
CCSDS 734.1-B-1	Licklider Transmission Protocol (LTP) for CCSDS, Recommended Standard, Issue 1	May 2015	Original issue

**iTeh Standards**  
**(<https://standards.iteh.ai>)**  
**Document Preview**

[ISO 21080:2016](#)

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

## CONTENTS

<u>Section</u>	<u>Page</u>
<b>1 INTRODUCTION.....</b>	<b>1-1</b>
1.1 PURPOSE.....	1-1
1.2 SCOPE.....	1-1
1.3 ORGANIZATION OF THE DOCUMENT.....	1-1
1.4 CONVENTIONS AND DEFINITIONS.....	1-2
1.5 NOMENCLATURE .....	1-5
1.6 REFERENCES .....	1-6
<b>2 OVERVIEW.....</b>	<b>2-1</b>
2.1 GENERAL.....	2-1
2.2 ARCHITECTURAL ELEMENTS .....	2-2
2.3 SERVICE PROVIDED BY LTP .....	2-2
<b>3 CCSDS PROFILE OF RFC 5326.....</b>	<b>3-1</b>
3.1 BASE SPECIFICATIONS .....	3-1
3.2 AMBIGUITY RESOLUTION.....	3-1
3.3 LTP OVER UDP .....	3-1
3.4 LTP FOR CCSDS .....	3-1
3.5 LIMITS ON THE RANGES OF LTP FIELD VALUES .....	3-2
3.6 AGENCY USE OF LTP ENGINE IDS.....	3-4
3.7 GREEN-PART DATA .....	3-4
3.8 LTP EXTENSIONS.....	3-4
3.9 LTP SECURITY.....	3-4
<b>4 LTP SERVICE SPECIFICATION .....</b>	<b>4-1</b>
4.1 SERVICES AT THE USER INTERFACE .....	4-1
4.2 SUMMARY OF PRIMITIVES .....	4-1
4.3 SUMMARY OF PARAMETERS .....	4-2
4.4 LTP SERVICE PRIMITIVES .....	4-4
<b>5 SERVICES LTP REQUIRES OF THE SYSTEM.....</b>	<b>5-1</b>
5.1 RELIABLE STORAGE SERVICE.....	5-1
5.2 UNDERLYING COMMUNICATION SERVICE REQUIREMENTS .....	5-1

## CONTENTS (continued)

<u>Section</u>	<u>Page</u>
<b>6 CONFORMANCE REQUIREMENTS .....</b>	<b>6-1</b>
6.1 PICS PROFORMA .....	6-1
6.2 LICKLIDER TRANSMISSION PROTOCOL REQUIREMENTS .....	6-1
<b>7 CLIENT OPERATIONS .....</b>	<b>7-1</b>
7.1 OVERVIEW—LTP SERVICE DATA AGGREGATION (SDA).....	7-1
7.2 LTP SDA SPECIFICATION.....	7-1
<b>ANNEX A PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT PROFORMA (NORMATIVE) .....</b>	<b>A-1</b>
<b>ANNEX B USING THE CCSDS SPACE PACKET OR ENCAPSULATION SERVICE AS AN UNDERLYING COMMUNICATION SERVICE FOR LTP (NORMATIVE) .....</b>	<b>B-1</b>
<b>ANNEX C LICKLIDER TRANSMISSION PROTOCOL MANAGEMENT INFORMATION BASE (NORMATIVE) .....</b>	<b>C-1</b>
<b>ANNEX D SECURITY, SANA, AND PATENT CONSIDERATIONS (INFORMATIVE) .....</b>	<b>D-1</b>
<b>ANNEX E INFORMATIVE REFERENCES (INFORMATIVE) .....</b>	<b>E-1</b>
<b>ANNEX F ACRONYMS AND ABBREVIATIONS (INFORMATIVE).....</b>	<b>F-1</b>

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

1-1 LTP's Relationship to Neighboring Protocols.....	1-3
2-1 Protocol Stack View of LTP Architectural Elements.....	2-2
2-2 Communications View of LTP .....	2-3
2-3 Overview of LTP Interactions .....	2-4
2-4 Transmission Using Service Data Aggregation.....	2-4

### Table

A-1 Symbols Used in PICS 'Status' Column .....	A-2
A-2 Symbols to Be Used in PICS 'Support' Column.....	A-2
C-1 Local Engine Configuration Information .....	C-2
C-2 Remote Engine Configuration Information .....	C-3
D-1 Initial CCSDS LTP Engine ID Registry .....	D-5
D-2 Initial CCSDS LTP Client Service ID Number Registry .....	D-6

## 1 INTRODUCTION

### 1.1 PURPOSE

This document defines a Recommended Standard for the CCSDS Licklider Transmission Protocol (LTP) and associated service for application in the space environment. LTP provides optional reliability mechanisms on top of an underlying (usually data link) communication service.

### 1.2 SCOPE

LTP is intended for use over the current and envisaged packet delivery services used in the space environment, including:

- CCSDS conventional packet telecommand;
- CCSDS conventional packet telemetry.

For space data links, LTP will typically be deployed over a CCSDS data link that supports CCSDS Encapsulation Packets so that one LTP segment can be encapsulated in a single Encapsulation Packet. LTP may also operate over a wide variety of ground-network services including those specified by the CCSDS for cross-support purposes.

### 1.3 ORGANIZATION OF THE DOCUMENT

This Recommended Standard is organized as follows:

<https://standards.ieee.org/catalog/standards/iso/d8967/00a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

- a) Section 2 contains a descriptive overview of LTP operation as well as a brief history of the protocol's heritage. Users not already familiar with LTP may want to start with this section.
- b) Section 3 contains a profile of RFC 5326 (reference [3]) for use by CCSDS.
- c) Section 4 contains the abstract service specification for LTP.
- d) Section 5 specifies the services that LTP requires from the underlying system.
- e) Section 6 contains conformance requirements for the CCSDS profile of LTP.
- f) Section 7 defines a client operations service that allows multiple layer-(N+1) SDUs to be aggregated into a single LTP block in order to improve efficiency.
- g) Annex A contains the Protocol Implementation Conformance Statement (PICS) proforma.
- h) Annex B specifies how to layer LTP over the CCSDS Space Packet Service or the CCSDS Encapsulation Service.
- i) Annex C contains the Management Information Base (MIB) for the protocol.

- j) Annex D discusses security, SANA, and patent considerations related to the specification.
- k) Annex E is a list of informative references.
- l) Annex F is a list of abbreviations and acronyms that appear in the document.

## 1.4 CONVENTIONS AND DEFINITIONS

### 1.4.1 TERMS

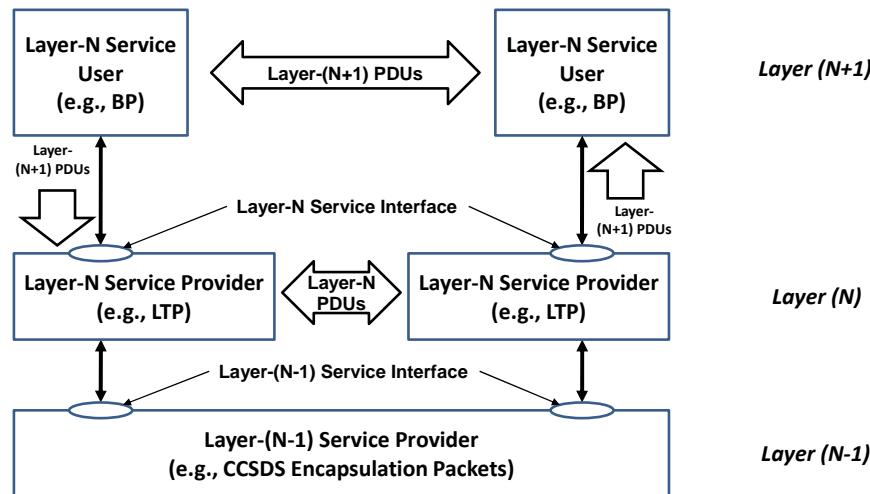
#### 1.4.1.1 Definitions from OSI Basic Reference Model

This Recommended Standard makes use of a number of terms defined in reference [1]. The use of those terms in this Recommended Standard is to be understood in a generic sense, i.e., in the sense that those terms are generally applicable to any of a variety of technologies that provide for the exchange of information between real systems. Those terms are:

- entity;
- Protocol Data Unit (PDU);
- service;
- Service Access Point (SAP);
- Service Data Unit (SDU).

Figure 1-1 illustrates the relationship of the LTP protocol defined in this document and protocols at the layers above and below LTP. From the point of view of protocols above LTP (e.g., Bundle Protocol), the service LTP provides is optionally reliable delivery of layer-(N+1) PDUs across a link. For LTP, the interface to the data link is via either direct encapsulation in CCSDS Space Packets or via the CCSDS Encapsulation Service.

Figure 1-1 illustrates the general service user-service provider relationships among layers. For the specific case of LTP in the CCSDS stack, the LTP service sits between the Data Link Layer and the Network Layer.



**Figure 1-1: LTP's Relationship to Neighboring Protocols**

#### 1.4.1.2 Definitions from Open Systems Interconnection (OSI) Service Definition Conventions

This Recommended Standard makes use of a number of terms defined in reference [2]. The use of those terms in this Recommended Standard is to be understood in a generic sense, i.e., in the sense that those terms are generally applicable to any of a variety of technologies that provide for the exchange of information between real systems. Those terms are:

- indication;
- primitive;
- request;
- response.

[ISO 21080:2016](https://standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/iso/d89b700a-d4b5-42c1-9b05-fe97dab5616c/iso-21080-2016>

#### 1.4.1.3 Definitions from RFC 5326

This Recommended Standard makes use of a number of terms defined in reference [3]. Some of the definitions needed for section 2 of this document are reproduced here for convenience.

**engine ID:** An integer that uniquely identifies a given LTP engine, within some closed set of communicating LTP engines.

**NOTE** – When LTP is operating underneath the Delay-Tolerant Networking (DTN) Bundle Protocol (BP), the convergence layer adapter mediating the two will be responsible for translating between DTN endpoint IDs and LTP engine IDs in an implementation-specific manner.