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Space data and information transfer systems — Delta-DOR Raw Data Exchange Format

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Space data and information transfer systems — Delta-DOR Raw Data Exchange Format

Systèmes de transfert des informations et données spatiales — Format d'échange des données brutes Delta-DOR

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The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

DELTA-DOR RAW DATA EXCHANGE FORMAT

RECOMMENDED STANDARD

CCSDS 506.1-B-1

BLUE BOOK

June 2013

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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*, and the record of Agency participation in the authorization of this document can be obtained from the CCSDS Secretariat at the address below.

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  - The **standard** itself.
  - The anticipated date of initial operational capability.
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No later than three 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.

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FOREWORD

This document is a Recommended Standard for Delta-DOR Raw Data Exchange Format and has been prepared by the Consultative Committee for Space Data Systems (CCSDS). It has been developed via consensus of the Delta-DOR Working Group of the CCSDS Systems Engineering (SEA) area.

The Delta-DOR Raw Data Exchange Format described in this Recommended Standard is the baseline concept for Delta-DOR data interchange applications that are cross-supported between Agencies of the CCSDS.

This Recommended Standard establishes a common framework and provides a common basis for the format of Delta-DOR data exchange between space agencies. It allows implementing organizations within each Agency to proceed coherently with the development of compatible derived standards for ground systems that are within their cognizance.

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1 INTRODUCTION

1.1 PURPOSE

Delta-DOR (Delta Differential One-Way Ranging) is a Very Long Baseline Interferometry (VLBI) technique that can be used in conjunction with Doppler and ranging data to improve spacecraft navigation by more efficiently determining spacecraft angular position in the plane of sky. It involves the use of multiple ground stations, possibly belonging to different agencies, for simultaneous acquisition of either spacecraft or quasar signals (see reference [D2]).

This Delta-DOR Raw Data Exchange Format (RDEF) Recommended Standard specifies a standard format for use in exchanging Delta-DOR raw data among space agencies. Delta-DOR raw data exchange is required every time the data correlation involves at least one participating station not belonging to the agency responsible for the correlation.This document includes specifications on the parameter fields that the data format has been designed to meet. For exchanges where these specifications do not capture the needs of the participating agencies another mechanism may be selected.

1.2 SCOPE AND APPLICABILITY

This Recommended Standard contains the specification for a Delta-DOR RDEF designed for applications involving Delta-DOR raw data interchange among space agencies.

The format here specified can be equally used for collecting and exchanging more general open loop raw data.

This data format is suited to inter-agency exchanges that involve automated interaction. The attributes of the RDEF make it primarily suitable for use in computer-to-computer communication.

The characteristics of the data recording (sampling rate and quantization) are defined within the RDEF. There is no definition of accuracy for raw Delta-DOR data, and hence no assessment of accuracy is provided in the exchange format. An assessment of accuracy for reduced Delta-DOR measurements is outside the scope of this Recommended Standard.
This Recommended Standard defines only the data format and content, but not the means for its transmission. The method of transmitting the data among partners is beyond the scope of this document. Data transmission could be based on a CCSDS data transfer protocol, file-based transfer protocol such as SFTP, stream-oriented media, or other secure transmission mechanism. In general, the transmission mechanism shall not place constraints on the technical data content of an RDEF.

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1.3 CONVENTIONS AND DEFINITIONS

1.3.1 NOMENCLATURE

1.3.1.1 Normative Text

The following conventions apply for the normative specifications in this Recommended Standard:

a) the words 'shall' and 'must' imply a binding and verifiable specification;

b) the word 'should' implies an optional, but desirable, specification;

c) the word 'may' implies an optional specification;

d) the words 'is', 'are', and 'will' imply statements of fact.

NOTE – These conventions do not imply constraints on diction in text that is clearly informative in nature.

1.3.1.2 Informative Text

In the normative sections of this document, informative text is set off from the normative specifications either in notes or under one of the following subsection headings:

– Overview;

– Background;

– Rationale;

– Discussion.

1.3.2 UNIT NOTATION

The following conventions for unit notations apply throughout this Recommended Standard. Insofar as possible, an effort has been made to use units that are part of the International System of Units (SI Units); units are either SI base units, SI derived units, or units outside the SI that are accepted for use with the SI (see reference [2]), e.g.,

Hz: Hertz

s: second

1.3.3 BIT AND BYTE ORDERING

In this document, the following convention is used to identify each bit in an 8-bit byte. The first bit in the byte (i.e., the most right justified when drawing figures and tables) is defined to be 'Bit 1', the following bit is defined to be 'Bit 2', and so on up to 'Bit 8'.

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Byte ordering follows the convention of starting with Byte 1 (i.e., the most right justified when drawing figures and tables) and increasing to the left.

1.4 COMMON DELTA-DOR TERMINOLOGY

Part of the standardization process involves the agreement on common interagency terminology and definitions that apply to interagency Delta-DOR. The following conventions apply throughout this Recommended Standard:

baseline: The vector joining two tracking stations.

channel: A slice of the frequency spectrum containing a spacecraft or quasar signal.

raw data: Time-ordered samples of received radio signal voltage.

sample: Instantaneous measurement of a radio frequency signal voltage.

scan: An observation of a radio source, with typical duration of a few minutes.

session: The time period of the Delta-DOR measurement including several scans.

meteo data: meteorological data (consisting of pressure, temperature, and relative humidity).

1.5 STRUCTURE OF THE DOCUMENT

Section 2 provides a general overview of the Delta-DOR technique and introduces the need of the raw data exchange.

Section 3 describes the basic structure and contents of the CCSDS-recommended RDEF for Delta-DOR.

Section 4 provides a description of the RDEF observation file.

Section 5 provides details on the RDEF product file.

Section 6 describes the RDEF file naming conventions.

Annex A lists the parameters for which conventions need to be specified.

Annex B discusses security aspects for the RDEF.

Annex C is a list of abbreviations and acronyms applicable to the document.

Annex D provides a list of informative references.

Annex E provides an example of a RDEF Observation File.

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1.6 REFERENCES

The following publications contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All publications are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the publications indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS publications.

[1] *Information Technology—8-Bit Single-Byte Coded Graphic Character Sets—Part 1: Latin Alphabet No. 1*. International Standard, ISO/IEC 8859-1:1998. Geneva: ISO, 1998.

[2] "The International System of Units (SI)." Bureau International des Poids et Mesures (BIPM). <http://www.bipm.org/en/si>

[3] *IEEE Standard for Floating-Point Arithmetic*. 2nd ed. IEEE Std. 754-2008. New York: IEEE, 2008.

[4] *Time Code Formats*. Recommendation for Space Data System Standards, CCSDS 301.0-B-4. Blue Book. Issue 4. Washington, D.C.: CCSDS, November 2010.

[5] *Delta-Differential One Way Ranging (Delta-DOR) Operations*. Recommendation for Space Data System Practices, CCSDS 506.0-M-1. Magenta Book. Issue 1. Washington, D.C.: CCSDS, April 2011.

NOTE – Informative references are provided in annex D.

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