

Space Link Services Area

Resolution SLS-R-2016-10-001

Start of CWE Project for “Atmospheric Characterization and Forecasting for Optical Link Operations” Magenta Book

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Gian Paolo Calzolari SLS Area Director

Gilles Moury SLS Deputy Area Director

The Space Link services Area,

CONSIDERING that

- The Optical Communications Working Group identified the need for a Magenta Book on “Atmospheric Characterization and Forecasting for Optical Link Operations”
- the WG produced a Concept Paper identifying resources and milestones
- a related draft CWE Project already exist

Space Link Services Area

- At item for a “Blue or Magenta Book(s) for Real-Time Weather and Atmospheric Characterization Data” is already included in the OPT Charter
- the WG has consensus on this

RECOGNISING that required resources have been identified

RESOLVES to request CMC to approve starting the CWE Project for “Atmospheric Characterization and Forecasting for Optical Link Operations” Magenta Book

RECOMMENDS that the CMC approve this resolution and, finally

REQUESTS that a CMC poll be conducted to accomplish this.

CCSDS Optical Communications Working Group (SLS-OPT)

Concept Paper for

Atmospheric Characterization and Forecasting for Optical Link Operations

CCSDS 141.1 Magenta Book

Section 1: Background

Over the last two years the CCSDS Optical Communications Working Group has successfully developed ¹ a Green Book titled, “Atmospheric Characterization for Optical Communication Systems.” This Green Book establishes the physical quantities that are critical to characterizing the line of sight from space to ground and identifies the instruments that are required to measure those quantities. This Green Book identifies clouds, cloud attenuation, optical turbulence, and aerosols as critical parameters to measure or estimate. Example instruments such as the whole sky imager, ceilometer, sun photometer, and differential image motion monitor (DIMM) are identified and described. These instruments and the resulting measured and derived atmospheric parameters are intended to be used to make decisions on the selection of ground sites; develop concepts of operations, including the real-time knowledge of these parameters for link handover decisions; evaluate the long-term characteristics of ground sites; and develop link budgets.

Section 2: Magenta Book

2.1 Purpose of this concept paper

This concept paper proposes to develop a CCSDS Magenta Book titled, “Atmospheric Characterization and Forecasting for Optical Link Operations” as natural follow up to the Green Book described in Section 1 above.

2.2 Key technical features

The Magenta Book will define a set of recommended practices and/or guidelines describing how to use the critical parameters described in the Green Book to characterize the atmospheric channel for mission concept analyses and trade studies, as well as for mission operations (such as the upcoming Laser Communication Relay Demonstration). In particular, this Magenta Book will describe how to use the critical atmospheric inputs for the real-time selection of an optimal ground site from a network of sites. This Magenta Book will also indicate how the space

¹ At the time this concept paper was written, the Green Book was with CCSDS Editor waiting for the relevant CESG/CMC Polls to be issued.

community recommends one should use atmospheric data to plan and carry out operations such as a link handover. Technical issues to be identified and matured may include, but are not limited to, the type of space concept of operations (CONOPS), link handover criteria and decision lead time, and atmospheric forecasting algorithms and technologies.

2.3 Expected benefits

Agencies can use atmospheric data collected from existing sites to evaluate historical performance or link availability, and use that information to plan future missions. This book will make Agencies aware of how to use the atmospheric data collected from existing and future sites to make real-time link handover decisions. Sample algorithms for such link handover decisions will be described and can be utilized by the space agencies.

2.4. Requirements of prospective missions

In an operational scenario consisting of multiple, geographically diverse ground sites, maintaining an optical link from the ground to the spacecraft and vice versa will be critical, given the inevitable occurrence of clouds and other atmospherics. At times, there may be several ground sites to choose from and at other times, there may be only one or none available. A set of guidelines will be required to optimize the selection of a ground site during mission operation.

2.5 Relationship to existing standards

There are no existing CCSDS standards for optical communications.

2.6 Identified deficiencies, flaws, and limitations in existing standards

Since there are no existing CCSDS standards for space to ground optical communications there are currently no deficiencies, flaws and limitations.

2.7 Anticipated agency adoption of any proposed standards and their dependencies

We expect all space agencies within CCSDS that plan to implement optical communications to adopt the recommended practices in this Magenta Book.

2.8 Operational scenarios

This Magenta Book will describe how atmospheric characterization can be used to support typical operational scenarios (see section 2.4) including LEO-to-Earth, as well as deep space-to-Earth scenarios.

SECTION 3: Tentative Work Plan

The following tentative work plan is established.

Schedule Milestones	Expected Completion Date
Project Approved	November 2016 (TBR)
Planned Project Start Date	January 2017
Internal WG Review	Jan 2017- Apr 2018
- First draft circulated to WG	01 July 2018
- First draft comments due	30 Sep 2018
- Second draft circulated to WG	31 Jan 2019
- Second draft comments due	28 Feb 2019
- Final WB submitted to AD for further processing	30 April 2019
Secretariat Document Processing [i.e., start of Agency Review for CCSDS Draft Recommended Practice (Red Book)]	15 June 2019
First Agency Review	15 Sep 2019
RID Resolution	30 Nov 2019
Secretariat Document Processing	31 Jan 2020
Final Agency Review	30 June 2020
RID Resolution [i.e., completion of WG activities and resolution to publish CCSDS Recommend Practice (Magenta Book)]	30 November 2020
CMC Approval (and publication)	30 March 2021

ANNEX A

CCSDS Optical Communications Working Group (SLS-OPT)

Project

Magenta Book for *Atmospheric Characterization and Forecasting for Optical Link Operations*

Title: Atmospheric Characterization and Forecasting for Optical Link Operations

Document Type: Magenta Book

Description of Document: This Magenta Book will define a set of guidelines or best practices for determining how to use in situ atmospheric data for planning and maintaining space to ground optical links.

Contents of the Magenta Book:

- Brief review of Green Book
- System definition of issues to described
 - CONOPS
 - Link handover criteria and decision lead time
 - Atmospheric forecasting technologies

Applicable Patents: None

Patents Comments: None

Book Editor (estimated resources + Agency Volunteering): 12mm + NICT

Prototype 1 (estimated resources + Agency Volunteering): N.A.

Prototype 2 (estimated resources + Agency Volunteering): N.A.

Expected Contributing Agencies: NASA, NICT, ESA

Expected Monitoring Agencies: JAXA, DLR, CNES