

# Space Link Services Area

## Resolution SLS-R-2018-12-002

### Start of CWE Project for CCSDS Experimental Specification (Orange Book) “SCCC extension”

**6<sup>th</sup> December 2018**

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**The Space Link services Area,**

**CONSIDERING** that

- ESA produced a Concept Paper identifying resources and milestones for the production of an Orange Book on “SCCC with High Order Modulations” to be titled “SCCC Extension”
- the Coding & Synchronization Working Group and the RF & Modulation Working Group have consensus on ESA producing this CCSDS Experimental Specification

**RECOGNISING** that required resources have been identified

# Space Link Services Area

## **RESOLVES**

to request CMC to approve starting the CWE Project for  
“SCCC Extension” CCSDS Experimental Specification  
(Orange Book) as per attached Concept Paper

[NOTE: The draft CWE Project is available at

<https://cwe.ccsds.org/fm/Lists/Projects/DispFormDraft.aspx?ID=670> ]

**RECOMMENDS** that the CMC approves this resolution and,  
finally

**REQUESTS** that a CMC poll be conducted to accomplish this.

# Concept Paper for an Orange Book of SCCC with High Order Modulations

## 1. Purpose

The purpose of the proposed work is to issue an experimental recommendation (Orange Book) that extends the existing Blue Book, CCSDS 131.2-B-1 “Flexible Advanced Coding and Modulation Scheme for High Rate Telemetry Applications”, in order to add new modulation and coding options (MODCODs), i.e., increasing the range of operating conditions to higher signal-to-noise ratios.

Namely, the work will consist in:

- Validating the additional MODCODs employing computer based software simulations.
- Validating the additional MODCODs employing by means of hardware (e.g., FPGA) prototyping.
- Performing measurements of an end-to-end system pairing the modulator prototype with a corresponding demodulator implement either in software or in hardware.
- Editing, reviewing and releasing a new Orange Book.

## 2. Key Technical Features

The new Orange Book, with respect to the Blue Book, will include:

- An option for ten (10) new MODCOD options in the high spectral efficiency range, by introducing 128- and 256-APSK modulations and accompanying low complexity coding options, on top of the ones already in the standard covering up to 64-APSK. These new MODCODs will be referred to as ACM#28 to ACM#37.

It is noted that the 27 MODCOD included in CCSDS 131.2-B-1 (ACM#1 to ACM#27) will remain unchanged.

Even if not required for an Orange Book, ESA will develop 2 independent prototypes, implementing the specifications contained in the Orange Book.

## 3. Benefits

Despite the wide range of MODCODs in the existing Blue Book CCSDS 131.2-B-1 (up to 64APSK 9/10), recent studies performed by ESA demonstrated that, depending on the ground station location, the available set of MODCODs already saturates above a certain elevation angle, beyond which a growing gap with respect to achievable capacity is witnessed. The more favourable the geometrical visibility and the propagation impairments are for the ground station location (e.g. polar regions), the lower this elevation leading to spectral efficiency saturation. Furthermore, future GEO-to-ground EESS systems consider the use of large reflectors in space (e.g. in the order of five meter using Unfurlable Mesh Reflector Antennas) along with large size ground stations antennas, leading to extremely favourable link budgets. To fully exploit the K-band (26 GHz) advantages, there is a need for future direct LEO-to-ground and GEO-to-ground EESS systems to further increase their offered spectral efficiency.

Making use of these new MODCODs, the bandwidth available for Earth Observation missions (both X- and K-band) can be fully exploited in the high elevation regime without saturating the data rate, while still respecting realistic constraints, e.g. limited available power and hardware resources.

#### **4. Requirements of prospective missions**

Both LEO-to-ground and GEO-to-ground EESS missions will benefit from higher spectral efficiencies as this feature is related to better data timeliness, higher volumes of data return and an overall reduction of cost. Technology preparation activities are required well in advance to allow future missions to take advantage of these features. Standardization of the proposed techniques will provide the manufactures with the confidence necessary to initiate the relative investments.

## ANNEX 1 – Proposed Charter Modifications

- Issue a new CCSDS Orange Book with new modulation and channel coding options for the high rate telemetry link, extending the SCCC standard (CCSDS 131.2-B).

## ANNEX 2 – Proposed CWE Projects

**Title:** SCCC extension

**Document Number:** To be assigned by the CCSDS Editor

**Document Type:** Orange Book

**Description of Document:** New modulation and coding options (MODCODs) on top of the one in CCSDS 131.2-B.

**Applicable Patents:** Same as for the current CCSDS 131.2-B-1

**Patents Comments:** No new patents are associated with the newly proposed ModCods

**Book Editor (estimated resources + Agency Volunteering):** Total resources 3 mm in ESA. Book editor ESA

**Expected Contributing Agencies:** ESA

**Expected Monitoring Agencies:** CNES, DLR, NASA

## Schedule

**December 2017 – August 2019**

**Total time to complete: 20 months**

Schedule Milestones	Forecast	Comments
Project Approved	15 December 2018	
Internal WG Review		
First draft circulated to WG	30 April 2019	Before Spring 19 Meeting
First draft comments due	30 May 2019	At Spring 19 Meeting
Second draft circulated to WG	30 September 2019	After Spring 19 Meeting
Second draft comments due	30 October 2019	

Final WB Submitted to AD for further processing	30 November 2019	After Fall 19 Meeting
Secretariat Document Processing	30 March 2020	
CMC Approval	30 May 2020	Approved by CMC Poll