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SCOSpy

Version 0.2.1
User Manual

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SCOSpy is a python library for the Satellite Control and Operation System 2000 (SCOS-2000) header written as hexadecimal string.

Current version is 0.2.1

The software is distributed under GNU General Public License v3 (GPLv3) license.

The source code is available at https://www.ict.inaf.it/gitlab/romolo.politi/scospy .

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Library Installation

```
$ pip install SCOSpy
```

Usage

```
from SCOS import *

a = SCOS(packet)
```

where *packet* is the hexadecimal string representation of the Telemetry packet.

Limitation

This version of the software works only for ESA BepiColombo Mission Telemetry and Telecommand packets (Packet Types 1 and 2). In the future versions, other missions will be managed.

Data Structure

The SCOS object contains:

- **Common Packet Header Structure (CPH)**

and one of the following sub-object:

- **Telemetry Packet Header (TMPH)**
- **Telecommand Packet Header (TCPH)**
- **Event Packet Header (EPH)**

As last root attribute:

- **Data**

which consists into the "*packet data*", as hexadecimal string.

Usually, in the case of spacecraft telemetry packets, this "*packet data*" is the full unstripped source packet that include the CCSDS/PUS primary header, secondary header (if applicable) and the application data.

Common Packet Header Structure (CHP)

In the CHP are present the following fields.

Field	Description
CTree	Used in earlier version of SCOS-2000 by c-tree to support packets storing in files and be kept for backward compatibility.
AccessF	Storing mode. Allowed values are: **0.** for an inserted packet; **1.** for an update
SimFlag	Simulated packet. Allowed values are: **0.** for a non-simulated packet generated by the spacecraft **1.** for a simulated packet generated by a Simulator or test tool.
FilingTime	In case of TM it is the timestamp. In case of TCs, it is the release time.
CreationTime	in seconds since 1st Jan 1970 00:00:00 It consists into a secondary retrieval key. In case of TM, it is the time at which the SCOS-2000 packet was created, which is also approximately the time that the packet was received by the MCS and stored. In case of TCs, it is its (estimated) execution time
CreateID	Used by the old SCOS-2000 archive for generating a retrieval key and set by the application which generated the packet
SCID	In the case of TM, it is the Spacecraft ID. The SCID is an object, and it is described in the section SCID.
GSID	In the case of TM, it is the ID and the name of the ground station which receives the frame containing this packet. The GSID is an object, and is described in the section GSID.
PSize	Packet Size. Size of the entire SCOS-2000 packet, including all headers and the packet data.
PType	It is a numeric index that describes the type of SCOS-2000 packet. Allowed values are: 1. Telemetry 2. Telecommand 3. Event
Version	The version of this the packet structure.
FilingFlag	Allowed values are: **1** if this packet is to be filed in the MCS archive **0** otherwise.
DistFlag	Allowed values are: **1** if this packet is to be distributed to the MCS applications **0** otherwise.
TSPolicy	It is a numeric flag that determines the timestamp policy for spacecraft TM, i.e. what it will be set in the Filing Time fields above: **0.** packet is time-stamped with the creation time – i.e. SCOS-2000 packet creation **1.** the packet is time-stamped with the time of transmission of the frame it was received in, i.e. Earth Reception Time minus the propagation delay (applicable to spacecraft TM only) **2.** the correlated SCET (for spacecraft TM only)
TQ	It indicates the time quality of the timestamp, used only if the **TsPolicy** is set to 2: Allowed values are: **0.** Good

Field	Description
	1. Inaccurate 2. Bad
StreamID	It is the data stream identifier in the MCS, which for TM maps to VCs. For details see StreamID
SeqCounter	It consists into the Internal MCS counter used for detecting gaps – it is not related to the spacecraft source sequence count value in the PUS header.
SPID	It is the numerical packet ID which identifies the packet structure, and maps to packet definitions in the TM/TC MIB database. **Note:** For TC packets, SPIDs **100** and **200** are used.
MissionID	In case of TM it consists into the MCS mission identifier. For details see MissionID

SCID

The Spacecraft ID is an object with following attributes:

Attribute	Description
Spacecraft	The name of the spacecraft.
Band	Band used for the data transmission.

The possible values are in the following table:

Spacecraft	Band
BepiColombo	X-Band
	Ka-Band

GSID

The Ground Station ID is an object with following attributes:

Attribute	Description
Code	Absolute identification number
Station	Name of the Ground Station

The possible values are in the following table:

Code	Ground Station Name
21	Kourou
22	Perth
23	New Norcia
24	Cebreros
25	Malargue
30	Maspalomas
97	Usuda
98	Uchinoura

StreamID

The Stream ID is an object with following attributes:

Attribute	Definition
Code	Absolute Identification Number
Description	String with the code description

The possible values of the Stream id are reported in following table:

Code	Description
1000	VC0 Real-Time Non-Science (online)
1001	VC1 Playback Non-Science (online)
1002	VC2 Science (online)
1003	VC3 File-Transfer (online)
2000	VC0 Real-Time Non-Science (offline)
2001	VC1 Playback Non-Science (offline
2002	VC1 Playback Non-Science (offline
2003	VC2 Science (offline
For TCs stream 1 is used	
For EVs stream 1000 and 1001 are used	
65535	is used for internal non spacecraft TM packets, which should be ignored by external users

MissionID

Mission ID is an object with following attributes:

Attribute	Definition
Code	Absolute Identification Number
Description	Name of the mission

The possible values are listed in the following table

Code	Description
816	BepiColombo

Telemetry Packet Header (TMPH)

If the **CHP.PType** is equal to 1, the packet is a telemetry. In this case the TMPH object is present.

The object has the following structure:

Attribute	Description
TPSD	Structure identifier for variable length packets.
RouteID	The LSB of the RouteID field is used by SCOS-2000 to identify the Data Unit Type of Telemetry packet and its qualifier
PUSAPID	The value of the 11-bit Application Process ID, copied from the spacecraft source packet's primary header
PUSSSC	The value of the 14-bit Source Sequence Count, copied from the spacecraft source packet's primary header
PUSST	The value of the 8-bit Service Type, copied from the spacecraft source packet's secondary data field header
PUSSST	The value of the 8-bit Service Sub-type, copied from the spacecraft source packet's secondary data field header

Telecommand Packet Header (TCPH)

If the **CHP.PType** is equal to 2, the packet is a telecommand. In this case the TCPH object is present.

The object has the following structure:

Attribute	Descriprion
UplinkTime	Uplink Time – initially set to the release time (FT), but updated with the timestamp copied from the radiation ground station response message providing the actual time of uplink from the antenna
ExecTime	Execution Time – For time-tagged commands this is the UTC user provided execution time. For immediate commands this is the release time + propagation delay and later updated to be Uplink time + propagation delay
LUTime	Last Update Time, this is the MCS system time at which the TC packet was last updated with a change of status
RequestID	Internal MCS identifier.
ReqElemIdx	Internal MCS sub-identifier.
VarAddSz	Combined size of the fixed and variable parts of the command details data.
PUSAPID	The value of the 11-bit Application Process ID, copied from the spacecraft source packet's primary header
PID	Process ID
PCAT	Packet Category
PUSSSC	The value of the 14-bit Sequence Count, copied from the spacecraft source packet's primary header
PUSST	Service Type - The value of the 8-bit Service Type, copied from the spacecraft source packet's secondary data field header.
PUSSST	Sub-Service Type - The value of the 8-bit Service Sub-type, copied from the spacecraft source packet's secondary data field header
PUSAck	The value of the 4-bit Ack, copied from the spacecraft source packet's secondary data field header **0** No Acknowledge required for acceptance and execution **1** Acknowledge required for acceptance **8** Acknowledge required for execution **9** Acknowledge required for acceptance and execution
UplinkFlag	**1** if the command is to be released (passed PTV) **0** if the command is not to be released (failed PTV)
SourceHost	Numerical ID of the MCS machine running the command source.
SourceType	Enumeration providing the type of the command source
ReqDetFixedSize	Size of the fixed part of the command details data.

Event Packet Header (EPH)

If the *CHP.PType* is equal to 3, the packet is a event. In this case the EPH object is present.

NB: the EPH is not yet implemented.

Change Log

Version 0.2.1
- minor bugs fixed

Version 0.2.0
- Introduced the TCHP
- First version of the README file.