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BC-SIM-TN-005
simEv User Manual
Version 1.0.0

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Index

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1 Introduction

1.1 Scope

In this document, we will describe the software used to extract the Events from the telemetry of the Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem (SIMBIO-SYS). The document will provide documentation also on the output file.

1.2 Reference Document

[RD.1] BC-SIM-TN-003 – Reports and Notes Layout and Flow (DOI: http://dx.doi.org/10.20371/INAF/TechRep/36)

[RD.2] SCOSpy Version 0.2.1 - User Manual (DOI: http://dx.doi.org/10.20371/INAF/TechRep/38)

[RD.3] BC-SIM-GAF-IC-002 - SIMBIO-SYS SOFTWARE INTERFACE CONTROL DOCUMENT - Revision 12

1.3 Acronyms

APID	Application Process Identifier
AKW	Acknowledgement
CSV	Comma Separated Values
FOP	Flight Operation Plan.
FPA	Focal Plane Assembly
HK	Housekeeping
HRIC	High spatial Resolution Imaging Channel
ME	Main Electronics
NECP	Near Earth Commissioning Phase
PDS	Planetary Data System
PDOR	Payload Direct Operation Request
PE	Proximity Electronics
PNG	Portable Network Graphics
PSC	Packet Sequence Control
SCOSS 2000	Satellite Control and Operation System 2000
SIMBIO-SYS	Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem
SSC	Source Sequence Count
STC	STereo imaging Channel
TC	Telecommand
TM	Telemetry
VIHI	VIsible and Hyper-spectral Imaging channel
XML	eXtensible Markup Language

1.4   Document Format and Repository

This document is compliant with the SIMBIO-SYS Report and Note Layout and Flow [RD.1]**Errore. L'origine riferimento non è stata trovata.** and will be archived both on the INAF Open Access repository and the SIMBIO-SYS team Archive.

2   Software description

The simEv software is developed in Python 2.7 for the CenOS 7.0 environment, the SIMBIO-SYS pipeline environment. Some tests demonstrated that it also works correctly in other LINUX distribution (Ubuntu and Fedora) and macOS (10.15.6 and earlier).

The software analyzes the SCOSS 2000 header of the telemetry file, downloaded from the EDDS server, and filters the packets with APID 801 (i.e., TC Verification which includes acceptance, rejection and execution of the TC, AKW) and 807 (i.e., Event Report). The main data of the selected packets are reported in Table 1. The format of the software output, sent to the standard output, is described in section 3.

Type	Description	SubType	Service Reports	APID	PID/PCAT
1	TC Verification	1	TC Acceptance Report – Success	801	50/1
		2	TC Acceptance Report – Failure	801	50/1
		7	TC Execution Report – Success	801	50/1
		8	TC Execution Report – Failure	801	50/1
5	Event Report	1	Normal/Progress Report	807	50/7
		2	Error/Anomaly report – Low Severity	807	50/7
		3	Error/Anomaly report – Medium Severity	807	50/7
		4	Error/Anomaly report – High Severity	807	50/7

Table 1: APID, Type and SubType of the selected packets.

2.1   Version

The current version of the software is 1.0.0 and is included in the SIMBIO-SYS pipeline SimGen starting from the version 1.2.0

2.2   Usage

The standard usage of the software is

```
$./simEv tml.xml
```

where tml.xml is the TLM file write as XML format.
The software can be used with some optional arguments:

    -h, --help
    -o, --output *outFile*
    -c, --color
    -i, --info
    -v, --version
    -k, --kernel *kerFile*
    -d, --debug
    -l, --logFile

That are described in the following subsections.

2.2.1 Help

Print a help message indicating the options and exit.
In this case the file name is ignored.

```
$./simEv -h
usage: simEv [-h] [-o outFile] [-c] [-i] [-v] [-k kerFolder] [-d] [-l fi
leLog] file

SIMBIO-SYS Event and Telecommand parser

positional arguments:
  file                    XML file to process

optional arguments:
  -h, --help              show this help message and exit
  -o outFile, --output outFile
                          The output filename and path
  -c, --color             show colored output
  -i, --info              show packets details
  -v, --version           show program's version number and exit
  -k kerFile, --kernel kerFile
                          Set the metakernel name and location
  -d, --debug             Enable the debug  -l fileLog, --logFile fileLog
                          Name and location of the Log file
  -l fileLog, --logFile fileLog
                          Name and location of the Log file
```

2.2.2 Output

Set the file name and path for the software output (*outFile*). If not provided the output will be printed in the standard device.
The option *color* is ignored, if present.

2.2.3 Color

Print the output using colors to emphasize the events.
The colors are defined considering the types and subtypes field (see Table 1) and are reported in Table 2.

Type	SubType	Color
1	1	Bright Green
	2	Yellow Background
	7	Bright Green
	8	Red Background
5	1	Standard color
	2	Bright Magenta
	3	Yellow Background

	4		Red Background

Table 2: Text color for each type and subtype

2.2.4 Info

The info option shows all the packets details.
An example is reported below.

```
===============================
| Packet #1 of 59658
===============================
| Mission           : BepiColombo
| Telemetry Packet
===============================
| Common Packet Header
===============================
| Access Flag        : Inserted Packet
| Simulated Flag     : Not Simulated Packet
| Filing Time        : 2020-06-24 20:06:30.082124
| Cration Time       : 2020-06-25 14:08:42.383887
| Cration ID         : 1
| Spacecraft ID      : X-Band
| Ground Station ID  : Malargue
| Packet Size        : 96
| Version            : 8
| Filing             : Packet filed in MSC archive
| Distribution       : Packet is to be distributed to the MSC application
| Timestamp Policy   : Packet timestamped with SCET
| Time Quality       :  Good
| Stream ID          : VC1 Playback Non-Science or Events (online)
| Sequence Counter   : 87
===============================
| TM Packet Header
===============================
| TSPD               : 40900
| Route ID   :
|     Data Unit Type : TM Source Packet
|     Qualifier      : Good
| PUS APID           : 801
| PUS Service Type   : 1
| PUS Service SubType : 1
===============================
| Source Packet Header
===============================
| PacketID           : 2849
|   APID             : 801
|      PID           : 50
|      PCAT          : 1
| Packet Sequence :
|     Grouping       : Stand alone packet
|     Position       : 174
| Packet Length      : 14
===============================
```

Data Field Header

```
====================
Service Type    : 1
Service Sub Type: 1
Destination ID  : 110
SpaceCraft Time : 2020-06-24T20:06:30.083
====================
Telecommand Accepted [APID: 812, Sequence n. 88]
====================
```

2.2.5 Version

Print the software version number and then exit.
In this case the file name is ignored.

2.2.6 Kernel

Set the SPICE metakernel file and location to use for the TM interpretation (*kerFile*).
If no metakernel is provided, the software gets the file in the kernels folder of the pipeline.

2.2.7 Debug

Enable the debug function of the software. More information is shown on screen and in the logfile.

2.2.8 Logfile

Set the file name and the location of the log file. If is not provided the software will use the *simGen-logfile.log* file located in the log folder of the SimGen pipeline.
The software uses the log library implementation of the SimGen pipeline, located in the lib folder.

2.3 Dependencies

The software requires the installation of the following Python libraries:
- alive_progress
- bitstring
- spiceypy
- SCOSpy

The following SimGen library are used:
- logInit.py
- utility.py

3 Output

The output of the software is a string for each selected packet.

The string has the following structure:

```
[{1}] - TM({2},{3}) - [APID {4}] - Event {5} - {6}
```

The numbers in the brackets represent fields that change in each line.

{1} is the time in UTC of the Event or AKW;

{2} is the type of the packet;

{3} is the subtype of the packet;

{4} is the APID of the packet;

{5} is the ID of the Event. If the packet is an AKW the field is set to "N/A";

{6} is the description of the Event or the AKW including, in the last case, APID and SSC of the TC.

The IDs of the Event are reported in Annex A, Table 4, from [RD.3].

The description of an AKW packet could be:

Telecommand Accepted [APID: *XXX*, Sequence n. *YYY*]

Telecommand Rejected [Failure ID: *ZZZ*, APID: *XXX*, Sequence n. *YYY*]

Telecommand Executed [APID: *XXX*, Sequence n. *YYY*]

Telecommand Execution Failure [Failure ID: *ZZZ*, APID: *XXX*, Sequence n. *YYY*]

where:

XXX is the APID of the TC (812 for SIMBIO-SYS)

YYY is the SSC of the TC (is the same reported in the command stack)

ZZZ is the failure code (see Table 3 for details).

In the following, failures identifiers are listed.

Failure ID	Description	Failure type	Raised by BSW/ ASW
Standard Failures			
0	Illegal APID: either PID or PCAT is illegal	Acceptance failure	BSW and ASW
1	Incomplete or Invalid length	Acceptance failure	BSW and ASW
2	Incorrect checksum	Acceptance failure	BSW and ASW
3	Illegal Packet type	Acceptance failure	BSW and ASW
4	Illegal Packet subtype	Acceptance failure	BSW and ASW
7	Command cannot be executed at this mode	Execution failure	BSW and ASW
11	Illegal Packet Source Identifier	Acceptance failure	BSW and ASW
SIMBIO-SYS specific failures			
40000	Parameter out of range	Execution failure	ASW
40010	Unknown TC to be executed. This error is raised when the "default" of "switch case" is reached, meaning that this TC is not handled by the SW (SW robustness)	Execution failure	ASW

Failure ID	Description	Failure type	Raised by BSW/ ASW
40011	TC conflicts with arm&fire previous TC	Execution failure	ASW
40012	Channel not available. This error is raised after 10 trial runs for powering on the channel. The TC(171-172-173,1) fails since either the FPGA has not been successfully powered on (in this case also the event EID 41207 is raised), or the SpW has not been successfully powered on (in this case, also the event EID 41209 is raised)	Execution failure	ASW

Table 3 List of SIMBIO-SYS TC failures from Table 3.7.2-6 in [RD.3]

3.1   Example

An example of the output string (coming from NECP phase) is here reported. The strings include 1 Event Report describing the Change Mod of HRIC channel (the first message) and 2 TC Verification describing the acceptance and execution of a SCIENCE TC:

```
[2018-12-10T09:03:36.334] - TM(5,1) - [APID 807] - Event 40400 - Mode change  HRIC [OFF _> Standby]
[2018-12-10T09:04:02.365] - TM(1,1) - [APID 801] - Event N/A - Telecommand Accepted [APID: 812, Sequence n. 9]
[2018-12-10T09:04:02.365] - TM(1,7) - [APID 801] - Event N/A - Telecommand Executed [APID: 812, Sequence n. 9]
```

4   History

1.0.0   Using the SCOSpy package
Setup output color and logging
Introduction of the progress bar
Introduction of the following options:
- Output
- kernel
- Debug
- logfile

0.3.0   Introduction of the SCOSpy library;

0.2.2   Bug fixing;

0.2.1   Bug fixing;

0.2.0   Introduction of the SPICE library

0.1.0   Original version

Annex A

Event ID	Description	Raised by BSW/ASW
Normal/ Progress Report TM(5,1)		
40400	Mode change	BSW and ASW
40406	Application SW CRC check OK This event is raised at reception of TC(170,2) or TC(170,4)	BSW and ASW
40407	PE Science Frame Restart This event is raised after "PE Science frame stop event", at the moment when the problems on SpW ME/ SpaceCraft are solved so that the TM transmission can proceed and the Science buffer can contain new science received from PE. It could be a Burst TM report (burst event means 10000events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW
40408	PE HK Frame Restart. This event is raised after "PE HK frame stop event", at the moment when the problems on SpW ME/ SpaceCraft are solved so that the HK transmission can proceed and the HK buffer can contain new HK received from PE. It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW
40409	Boot SW Report	BSW
Error/ Anomaly Report TM(5,2)		
40800	HK discarded due to SpW error on link from the specified channel It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, StandBy
40801	Science discarded due to SpW error on the specified channel. For VIHI this means that the already binned frames (if any) will be discarded at all It could be a Burst TM report (burst event means 10000events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, Science
40803	HK timeout from PE on the specified channel (Extraction-Blocked) then the CU is full (all CU buffers are unavailable). It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, StandBy
40804	Science timeout from PE on the specified channel. For VIHI this means that the already binned frames (if any) will be discarded at all (Extraction-Blocked) then the CU is full (all CU buffers are unavailable). It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, Science
40805	HK from PE of the specified channel rejected because too short It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, StandBy
40806	Science from PE of the specified channel rejected because too short. For VIHI this means that the already binned frames (if any) will be discarded at all It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, Science
40807	HK from PE of the specified channel rejected because too long It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, StandBy
40808	Science from PE of the specified channel rejected because too long. For VIHI this means that the already binned frames (if any) will be discarded at all	ASW, Science

Event ID	Description	Raised by BSW/ASW
	It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	
40809	HK from PE of the specified channel rejected because EOP/EOR not received in time (Acquisition-Blocked) It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, StandBy
40810	Science from PE of the specified channel rejected because EOP/EOR not received in time (Acquisition-). For VIHI this means that the already binned frames (if any) will be discarded at all It could be a Burst TM report (burst event means 10000 events/s), but the SW prevent that it is a burst event, as a maximum, 10 times is raised	ASW, Science
40814	Application SW upload failed. This event is raised by BSW during the execution of TC(170,4), since a failure in CRC is detected. So, at failure of TC(170,4), the following TM reports are generated: - TM(1,1) - TM(1,7) - TM(5,2) EID 40814	BSW
40815	Application SW CRC not Ok This event is generated as consequence of TC(170,2), as failure report of the required RAM consistency check. The TM(1,1) and TM(1,7) are in any case generated for the TC(170,2). Note, TM(1,7) is generated since TC(170,2) is successfully executed.	BSW
40816	FIFO HK full. The error is raised when the internal FIFO devoted to store small TM reports (HK, Event, ack) is full. Note, this FIFO is not related to CU or SpW features. The production of this event is inhibited in case of ME- S/C SpW communication error	BSW and ASW
40817	PE Science frame stop. This event is raised when there are problems on SpW ME/ SpaceCraft transmission, or in case of Disable Transfer from User, that cause the interruption of Science TM Report transfer. Such an interruption causes to full the internal CU buffer containing the TM report, so that the science request to PE is "paused": it is delayed by steps of 5 ms until the problems ME/ SpaceCraft communication are solved or the Enable Transfer from User is received. When the problems on SpW ME/ SpaceCraft are solved, the event "PE Science Frame Start" will be raised.	ASW
40818	PE HK Frame stop This event is raised when there are problems on SpW ME/ SpaceCraft transmission or in case of DTU, causing the interruption of TM Report transfer (included HK transfer). Such an interruption causes to full the internal buffer containing the TM report, so that the HK request to PE is "paused": it is delayed by steps of 5 ms until the problems ME/ SpaceCraft communication are solved When the problems on SpW ME/ SpaceCraft are solved, the event "PE HK Frame Start" will be raised.	ASW
40820	SpaceWire ME/ SpaceCraft Error detected (DMA, chunk, EEP)	BSW and ASW

Event ID	Description	Raised by BSW/ASW
	It could be a Burst TM report (burst event means 10000events/s), but the SW prevent that it is a burst event. . Same behaviour of 41600 (stored internally and transmitted after 1minute in case it is detected again)	
40825	S/C TC Fifo Full The error is raised when the internal FIFO devoted to store TC is full. Note, this FIFO is not related to CU or SpW features.	BSW and ASW
Error/ Anomaly report- ground action TM(5,3)		
41200	Stop science acquisition with the specified channel due to persistent ME-PE SpW errors. The "failed" channel stays in its actual mode (and it is powered on)	ASW, Science
41201	Stop HK acquisition with the specified channel due to persistent ME-PE SpW errors. The "failed" channel stays in its actual mode (and it is powered on)..	ASW, StandBy
41202	Stop science acquisition with the specified channel due to persistent ME-PE failure of length/ timeout message checks. The "failed" channel stays in its actual science mode (and it is powered on) without producing aby science report. The user is in charge to send proper commands for exit from this non nominal condition	ASW, Science
41203	Stop HK acquisition with the specified channel due to persistent ME-PE failure of length/ timeout message checks. The "failed" channel stays in its actual mode (and it is powered on). No more HK for that channel is generated	ASW, StandBy
41207	CU (or CPCU) FPGA not powered ON (*power-on failure*). The event is raised: - by BSW, when tries to power on the CPCU FPGA - by ASW, at execution of TC(171-2-3, 1), when FPGA of channel HRIC/ STC/ VIHI are not powered on (specific pattern can not be read) From now on, the channel is definitely declared failed if controlled by the current electronics.	BSW (for the CPCU FPGA) and ASW (for the channel FPGA)
41209	CU channel is not operative The event is raised by ASW, at execution of TC(171-2-3, 1), when FPGA of channel HRIC/ STC/ VIHI are powered on but SpW link can not be started. From now on, the channel is definitely declared failed if controlled by the current electronics. Note: the event is not raised for the SpW link at ME/ SpaceCraft side, since the ME/ SpaceCraft communication is initiated by SpaceCraft, not by CPCU	ASW

Table 4: List of the identification code and description of the instrument events.