BC-SIM-TR-023
Anomalies in the Packet sorting

Romolo Politi[1], Emanuele Simioni[2], Michele Zusi[1]
Fabrizio Capaccioni[1], Maria Teresa Capria[1], Alain Doressoundiram[3], Yves Langevin[4],
Pasquale Palumbo[5], Mathieu Vincendon[4], Gabriele Cremonese[2]

[1]INAF- Istituto Astrofisica e Planetologia Spaziali, Via Fosso del Cavaliere 100, 00133, Rome, Italy
[2]INAF-Osservatorio Astronomico di Padova, Vicolo Osservatorio 5,35122, Padua, Italy
[3]Observatoire de Paris - PSL, Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique (LESIA), 92195 Meudon Cedex, France
[4]Institut d'Astrophysique Spatiale, CNRS / Université Paris Sud, 91405, Orsay, France
[5]Università Parthenope, Centro Direzionale Isola 4, 80133, Naples, Italy

1 Introduction

1.1 Scope

This document describes the issues raised using the EDDS system to retrieve the SIMBIO-SYS raw data that will be used as input for the data reduction pipeline.

1.2 Applicable documents

There are no applicable documents.

1.3 Reference Documents

[RF 1] BC-SIM-TR-001 – EGSE NECP Report
[RF 2] BC-SIM-TR-004 – EGSE ICO#1 Report
[RF 3] BC-SIM-TR-009 – EGSE dNECP Report
[RF 4] BC-SIM-TR-015 – EGSE ICO#2 Report
[RF 5] BC-SIM-TR-003_STC_NECP_Report

1.4 Acronyms

APID	Application Process Identifier.
dNECP	delta Near Earth Commissioning Phase
EDDS	EGOS Data Disposition System.
EGOS	ESA Ground Operation System. Infrastructure SCOS-2000.
ESOC	European Space Operations Centre.
GFTS	Generic File Transfer System.
ICO	Instrument Check-Out.
NECP	Near Earth Commissioning Phase.
SIMBIO-SYS	Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem.
SSC	Source Sequence Counter.
STC	STereo imaging Channel.
TC	Telecommand.
UTC	Universal Time Coordinated.
VIHI	VIsible and Hyper-spectral Imaging channel.
XML	eXtensible Markup Language.

2 Packets Order Issues

2.1 Issue description

The team sends a request based on the *GENERATION_TIME* parameter to download the telemetry from the EDDS server. The *GENERATION_TIME* is the parameter used by the SIMBIO-SYS team for the data sorting.
Considering some rare anomalies in the results of the TEL2RAW pipeline of the EGSE, the team developed, for diagnostic purposes, a software that checks the completeness of the telemetry.

This test is performed by checking each packet's progressive number associated with the SSC.
This number is stored in 14 bits and ranges between 0 and 16383. When the SSC reaches the end of its maximum value, SSC is set to 0 in the following packet, and it starts to increase packet by packet. For this reason, SSC gives only locally the progressive order of the packets and cannot be used as a general index for the data sort.
During all the test sessions performed up now (NECP, dNECP, ICO#1, and ICO#2), the software reported a peculiar sequence of missing packets: x,-(x+1),1 (see [RF 1], [RF 2], [RF 3], [RF 4]) with the result of not-well reconstructed science data as shown for example in [RF 5].

2.2 Issue Analysis

The diagnostic tool revealed the anomalies on the images in some misalignment in the HKs buffer.
Table 2.1 is an example of a case that occurred to STC during ICO#1 in the Performance Test, see [RF 2]. Each line of the table represents a packet and is reported:

- the acquisition time in UTC;
- the line number in the input file;
- the number of packages lost;
- the SSC;
- the XMLid is the id of each packet in the original telemetry file.

The number of packets lost is computed as the difference between the SSCs of the packet considered and the previous one. Thus, nominally this parameter is equal to 1 and greater than 1 when some packet is missing.
The XMLid could not be sequential because the original file was present in all the APIDs, while to produce the input file for the test, we filtered only a single APID, 844 in our case.

UTC	Line Number	Packets lost	SSC	XMLid
2019-06-07 09:34:13.625922	132302	267	1495	133567
2019-06-07 09:34:14.076789	132303	-268	1228	133574
2019-06-07 09:34:14.626639	132570	1	1496	133843

Table 2.1: Output from the completeness analysis of the STC Performance Test in ICO#1

The first line of Table 2.1 shows that at the line of the input file 132302, the SSC increases by 267 units and not 1 as usual. In the second line, starting from the SSC of the first line, we see a decrement of 268 units instead of an increment by one unit.

In Table 2.2 are reported the SSCs for the lines from 132301 to 132303.

Line Number	SSC
132301	1227
132302	1495
132303	1228

Table 2.2: Line sequence vs. SSC.

The third line in Table 2.1 indicates that the packet at line 132569 has SSC 1494.
The analysis has revealed that the packet with SSC 1495 is not in the correct position, as demonstrated from the corrupted images, but the time order is respected. Therefore, the same conclusions are reached in all the cases considered.
If we move the packet with SSC 1495 before the packet with SSC 1496, all the images acquired by STC become correct, and no other anomalies are detected.
The conclusion is that the time associated with the packet with SSC 1495 is not correct.

2.3 Packets Analysis

After deeper analysis, we all the occurrences registered for the issue.
SCET associated with each not correct packet is not valid.
For example, Table 2.3 shows a sequence of consequent packets (order by XMLID) of SCETs and the difference between one SCET and before.

Local ID	SCET	Delta t
1	52.998413000	0.000763000
2	52.999161000	0.000748000
3	**52.000000000**	**-0.999161000**
4	53.000717000	1.000717000
5	53.001480000	0.000763000
6	53.002228000	0.000748000

Table 2.3: SSC timeline example.

The sequence shows how the increasing SCET reaches the limit of the integer round number after the integer part of the SCET is not updated. The same trend is illustrated in Figure 1 where the blue line shows the read values, and the red leads to the expected one.

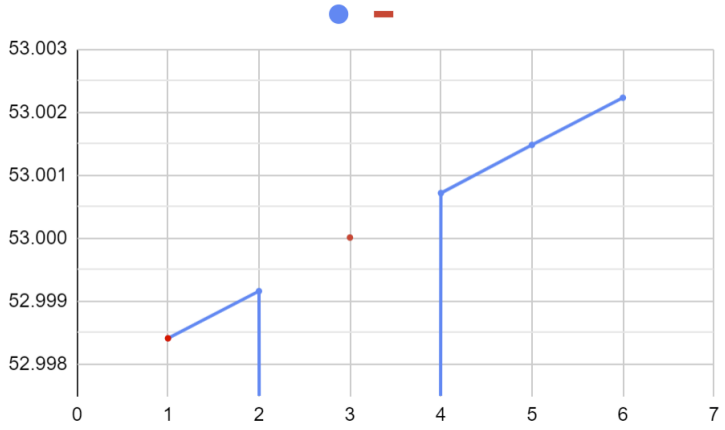

Figure 1Trend of the SCET value about the expected SCET=53.

The issue is linked to the granularity of the register. The last pocket must be distant to the integer value less than the minimum time step representable in the SCET register. The SCET Fine Time is 2 bytes record with a maximum raw value of 65535, 0.999984 s. When the Fine Time is greater than

0.999984 and less than 1, the SCET is incorrectly registered in the CCSDS header. If the packets are sorted by the generation time, the packet will be in the wrong position.

3 Conclusions

The problem is linked to the length of the fine time of the SCET that, sometimes, requires more than the 2 allocated byte. A solution could be increasing the bytes allocated for the Fine Time, but it requires a modify of the Application Software.
As temporary solution could be a creation of a preprocessing software able to discover the packets in the wrong position and resort the telemetry.