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# Introduction

The LSF-SDD-\* series of documents are ment to describe the communication format between the various subsystems aboard a cubesat. The various functions supported and executed by the cubesat are implemented in the form of software services as recommented from ECSS, The European Cooperation for Space Standardization and these standards and recommentations has been followed where possible and extended to mission specific areas, also followed practices from other cubesat missions has been taken into account.

# 1 Scope

This documents describes the minimal services that every subsystem across a cubesat should be able to generate a service report following a service request (services are used in accordance with their specification on reference document [i])

# 2 References

1. ECSS-E-70-41A (30Jan2003)

# 3 Terms, conditions and abbreviated terms

# 4 Subsystems common services

## 4.1 Introduction

The following commands are to be implemented from every subsystem on board the gr02UPSat. The packet structure (headers and data fields) for every command is displayed in this paragraph.

### 4.1.1 Telecommand packet structure

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Packet Header (48 bits) | | | | | | | Packet Data Field (Variable bits) | | | |
| Packet ID | | | | Packet Sequence Control | | Packet Length | Data Field Header (Optional see Note1) | Application Data | Spare | Packet Error Control (see Note 2) |
| Version Number (=0) | Type (=1) | Data Field Header Flag | Appliation Process ID |  |  |  |  |  |  |  |
| 3 | 1 | 1 | 11 | 2 | 14 |  |  |  |  |  |
| 16 | | | | 16 | | 16 | Variable | Variable | Variable | 16 |

Figure 1: Telecommand packet fields

* NOTE 1, see note 1 on reference [i], page 42.
* NOTE 2, see note 1 on reference [i], page 43.

For more information regarding the individual segments of the frame see reference [i], page 42.

### 4.1.2 Telemerty source packet structure

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Packet Header (48 bits) | | | | | | | Packet Data Field (Variable bits) | | | |
| Packet ID | | | | Packet Sequence Control | | Packet Length | Data Field Header (Optional see Note1) | Source Data | Spare (Optional) | Packet Error Control (Optional) |
| Version Number (=0) | Type (=0) | Data Field Header Flag | Appliation Process ID | Grouping Flags | Source Sequence Control |  |  |  |  |  |
| 3 | 1 | 1 | 11 | 2 | 14 |  |  |  |  |  |
| 16 | | | | 16 | | 16 | Variable | Variable | Variable | (see Note 2) |

Figure 2: Telemetry packet fields

* NOTE 1, see note 1 on reference [i], page 46.
* NOTE 2, see note 1 on reference [i], page 46.

### 4.1.3 Service data units

A service request or report contains the SourceData field, which is composed from the actual data called 'Service data units' that is relevant to the specific service function. The general format of a service data unit is presented next:

|  |  |  |
| --- | --- | --- |
| Parameter1 | Parameter2 | Parameter3 |
| <type> | <type> | <type> |

* supported types are presented on reference [i], page 42.

## 4.3 Telecommand Event Log Request Service

### 4.3.1 Scope / Service concept

This service request instructs the receiving subsystem to generate a service report with data payload containing the Event log that the subsystem is retains on memory. Every subsystem without individual storage should keep important events on memory and be able to pass them on a requesting service (eg. for OBC to save them on the SDCard)

The service data unit format is the following:

|  |
| --- |
| Parameter1 |
|  |

### 4.3.2 Service Requests and reports

Requests:

|  |
| --- |
|  |
| 0 |

Reports:

|  |
| --- |
|  |
|  |

### 4.3.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

## 4.4 Telecommand Set Time Service

### 4.4.1 Scope / Service concept

This service request instructs the receiving subsystem to update his subsystem time. All times on cubesat subsytems are epoch from 2000.

The service data unit format is the following:

|  |
| --- |
| TimeSet |
| time in seconds |

### 4.4.2 Service Requests and reports

Requests:

|  |
| --- |
| TimeSet |
| time in seconds |

* TimeSet:
  + Type of: unsigned long int.
  + Description: the epoch from year 2000 in seconds.

Reports:

|  |
| --- |
|  |
|  |

### 4.4.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

## 4.5 Telecommand Subsystem Reset Service

### 4.5.1 Scope / Service concept

This service request instructs the receiving subsystem to perform a reset on its self.

After successfull reboot a service report should be generated from the subsystem?

The service data unit format is the following:

|  |
| --- |
| Reset |
| 0 |

### 4.5.2 Service Requests and reports

Requests:

|  |
| --- |
| Reset |
| 0 |

* Reset:
  + Type of: bit.
  + Description: the zero bit, instructing to perform a reset.

Reports:

|  |
| --- |
| Reset |
| 1 |

* Reset:
  + Type of bit.
  + Description: the 1 bit, reporting that the a reset has been executed.

### 4.5.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

# 5 Electrical Power Subsystem services

## 5.1 Health Report service

### 5.1.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report containing various parameters about its state.

The service data unit format is the following:

|  |  |  |  |
| --- | --- | --- | --- |
| HealthExtReport | PanelStats | Battery TempSensorState | StateReport |
| 7 bits per solar panel | ? bits | 1 bit | 1 octet |

### 5.1.2 Service Requests and reports

Requests:

|  |
| --- |
| GenerateReport |
| 0 |

* GenerateReport:
  + Type of: bit.
  + Description: the zero bit, instructing to generate the report.

Reports:

|  |  |  |  |
| --- | --- | --- | --- |
| HealthExtReport | PanelStats | Battery TempSensorState | StateReport |
| 7 bits per solar panel | ? bits | 1 bit | 1 octet |

* HealthExtReport:
  + Type of: bit.
  + Description: 7 bits per solar panel giving status about it?.
* PanelStatus:
  + Type of: bit
  + Description: ? bits, one per panel for working state, where 0 is normal working state.

### 5.1.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

## 5.2 Burn Antenna service

### 5.2.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report after completing the specified system antennas fillament burn.

The service data unit format is the following:

|  |  |
| --- | --- |
| IntervalToExecuteCommand | Subsystem |
| time in seconds | enumerated |

### 5.2.2 Service Requests and reports

Requests:

|  |  |
| --- | --- |
| IntervalToExecuteCommand | Subsystem |
| integer | bit |

* IntervalToExecuteCommand:
  + Type of: uint8.
  + Description: allows interval up to 256 seconds.
* Subsystem:
  + Type of: bit
  + Description: 0 for Communication subsystem antennas, 1 for Science unit antennas.

Reports:

* As standard service type 1

### 5.2.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

## 5.3 **Subsystem power control service**

### 5.3.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report after completing the specified command related to powering on/off specific subsystems of the cubesat.

The service data unit format is the following:

|  |  |
| --- | --- |
| Subsystem | Action |
| enumerated | enumerated |

### 5.3.2 Service Requests and reports

Requests:

|  |  |
| --- | --- |
| Subsystem | Action |
| 3 bits | 1 bit |

* Subsystem:
  + Type of: bit.
  + Description: 00 for total shutdown, 01 for OBC, 10 for SU, 11 for COMMS.
* Action:
  + Type of: bit
  + Description: 0 to power up, 1 to power off.

Reports:

* As standard service type 1

### 5.3.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

# 6 Attitude Determination and Control Subsystem services

## 6.1 Health Report service

### 6.1.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report containing various parameters about its state.

The service data unit format is the following:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SpinTorquer | IMU | Coils | Magneto | Temperature | Vpp | PosFix |
|  |  |  |  |  |  |  |

### 6.1.2 Service Requests and reports

Requests:

|  |
| --- |
| GenerateReport |
| 0 |

* GenerateReport:
  + Type of: bit.
  + Description: the zero bit, instructing to generate the report.

Reports:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SpinTorquer | IMU | Coils | Magneto | Temperature | Vpp | PosFix | TIme |
|  |  |  |  |  |  |  |  |

* SpinTorquer:
  + Type of:
  + Description:
* IMU:
  + Type of: ?
  + Description: ?
* Coils:
  + Type of: ?
  + Description: ?
* Magneto:
  + Type of: ?
  + Description: ?
* Temperature:
  + Type of: ?
  + Description: ?
* Vpp:
  + Type of: ?
  + Description: ?
* PosFix:
  + Type of: ?
  + Description: ?
* Time:
  + Type of: ?
  + Description: ?

Reports:

* + As standard service type 1

## 6.2 GPSPwrCtrl service

### 6.2.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report after completing the specified command related to powering on/off the GPS.

The service data unit format is the following:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SpinTorquer | IMU | Coils | Magneto | Temperature | Vpp | PosFix |
|  |  |  |  |  |  |  |

### 6.2.2 Service Requests and reports

Requests:

|  |
| --- |
| GPSPWRMODE |
| 0 |

* GPSPWRMODE:
  + Type of: bit.
  + Description: 0 for power up, 1 for power off.

Reports:

* As standard service type 1

### 6.1.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

# 7 Communication subsystem services

## 7.1 Health Report service

### 7.1.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report containing various parameters about its state.

The service data unit format is the following:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Temprature | PowerAmpsOverTemp | RSSI RX | Reset Count | SystemState |
|  |  |  |  |  |

### 7.1.2 Service Requests and reports

Requests:

|  |
| --- |
| GenerateReport |
| 0 |

* GenerateReport:
  + Type of: bit.
  + Description: the zero bit, instructing to generate the report.

Reports:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Temprature | PowerAmpsOverTemp | RSSI RX | Reset Count | SystemState |
|  |  |  |  |  |

* Temprature:
  + Type of:
  + Description:
* PowerAmpsOverTemp:
  + Type of: ?
  + Description: ?
* RSSI RX:
  + Type of: ?
  + Description: ?
* ResetCount:
  + Type of: ?
  + Description: ?
* SystemState:
  + Type of: ?
  + Description: ?

Reports:

* + As standard service type 1

## 7.2 SetRate service

### 7.2.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report after completing the specified command related to setting the TX/RX rate of the communication subsystem.

The service data unit format is the following:

|  |  |
| --- | --- |
| Subsystem | Speed |
| enumerated | enumerated |

### 7.2.2 Service Requests and reports

Requests:

|  |  |
| --- | --- |
| Subsystem | Speed |
| bit | bit |

* Subsystem:
  + Type of: bit.
  + Description: 0 to set tx rate, 1 to set rx rate.
* Speed:
  + Type of: bit
  + Description: to be decided, etc 001 fro 1200bps

Reports:

* As standard service type 1

### 7.1.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

## 7.3 SetTXPower service

### 7.3.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report after completing the specified command related to setting the transmission power of the communication subsystem.

The service data unit format is the following:

|  |
| --- |
| Power |
| integer |

### 7.3.2 Service Requests and reports

Requests:

|  |
| --- |
| Power |
| integer |

* Power:
  + Type of: uint8.
  + Description: the tx power to be set.

Reports:

* As standard service type 1

### 7.3.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |

## 7.4 SetRXTXState service

### 7.4.1 Scope / Service concept

This service request instructs the receiving subsystem generate a service report after completing the specified command related to setting the transmission switch on or off communication subsystem.

The service data unit format is the following:

|  |
| --- |
| State |
| bit |

### 7.4.2 Service Requests and reports

Requests:

|  |
| --- |
| State |
| 2 bits |

* State:
  + Type of: bit
  + Description: the state are as follows:

|  |  |
| --- | --- |
| 00 | TX ON |
| 01 | TX OFF |
| 10 | RX ON |
| 11 | RX OFF |

Reports:

* As standard service type 1

### 7.4.3 Service capability sets

Minimum Capability set:

|  |  |
| --- | --- |
| Subtype | Service request, report or capability |
| 1 |  |
| 2 |  |