TERMA
SPACE DIVISION

OBOSS System Integration Frame Contract

OBOSS-III
Demonstrator Specification

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1 B	08.12.2003	Updated after CDR. Document renamed from “Demonstrator Test Case Specification” to “Demonstrator Specification”. Reference document lists in Chapter 2 updated. References to R-SVF documentation and test case descriptions included in Chapter 1. Number of expected values per parameter monitored by the On-Board Monitoring service updated from one to two in Section 5.2.5. Underscores included in Store ID’s in Section 5.4.4.

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1 Introduction

1.1 Purpose

The purpose of this document is to define the demonstrator that will be used for demonstration of the functionality and performance of the On-board Operations Support Software version 3 (OBOSS-III).

The demonstrator will be an instantiation of OBOSS-III that implements all supported PUS services simulating a small data handling system. The data handling system will run on an ERC32 instruction simulator. The test will be supported by the Reference SVF (R-SVF) tool described in [RD1].

1.2 Scope

This document covers the system engineering aspects of the test demonstrator. Applications are identified. Parameter types and numbers are defined. Environmental simulations required in order to demonstrate all the functionality in OBOSS-III are also described.

The test cases that shall be executed using the demonstrator are described in the “Software Validation Testing Specification” [AD4].

2 References

2.1 Applicable Documents

The documents, which are applicable for this document, are:

[AD1] "OBOSS System Integration Frame Contract – Proposal for Call-Off 1", Terma A/S, doc. no. Terma/SPD/OBOSS-III/001, issue 1.1, February 2003.

[AD2] "OBOSS System Integration Frame Contract – OBOSS-III Software Requirements", Terma A/S, doc. no. Terma/SPD/OBOSS-III/003, issue 2.1, November 2003.

[AD3] "Space Engineering: Ground Systems and Operations – Telemetry and Telecommand Packet Utilization", European Cooperation for Space Standardization, doc. no. ECSS-E-70-41A, 30 January 2003.

[AD4] "OBOSS System Integration Frame Contract – OBOSS-III Software Validation Testing Specification"", Terma A/S, doc. no. Terma/SPD/OBOSS-III/005, issue 2, January 2004.

2.2 Reference Documents

The documents, except for the applicable documents, which are referenced in this document, are:

[RD1] "Reference Software Validation Facility, Packet Tools, Software User Manual", Terma A/S, doc. no. TERMA/SPACE/RSVF/PT/SUM, issue 3.3, November 2001.

3 Abbreviations, Terms and Definitions

3.1 Abbreviations

Abbreviations used in this document:

CCSDS	Consultative Committee for Space Data Systems
CUC	CCSDS Unsegmented Code
ID	Identifier
ISO	International Organization for Standardization
MB	Mega Bytes
MHz	Mega Hertz
N/A	Not Applicable
OBOSS	On-Board Operations Support Software
PDR	Preliminary Design Review
PFC	Parameter Format Code
PTC	Parameter Type Code
PUS	Packet Utilisation Standard
RID	Report ID
R-SVF	Reference Software Validation Facility
TBC	To be Confirmed
TBD	To be Defined
SID	Structure ID
TC	Telecommand
TM	Telemetry

3.2 Terms and Definitions

Terms and definitions specific for this document:

None

4 Overview

4.1 Demonstrator Test Set-Up

The demonstration of the OBOSS-III capabilities is based on a small set of application processes that simulates a small data handling system. This instantiation of the OBOSS-III software package will run on an ERC32 instruction simulator. The data handling system will use telecommands and telemetry for communication with a simulated ground control system. The Reference SVF facility will act as the ground segment simulator.

The simulated ERC32 environment will have the following limitations:

- Memory size (code and data): 4 MB
- Clock frequency: 25 MHz (TBC)

The interface between the ERC32 simulator and the R-SVF will have the following limitations:

- TM bandwidth: 4000 bytes/s
- TC bandwidth: 500 bytes/s

4.2 Application Process Population

Figure 4.2-1 shows the application processes that will be implemented in the demonstrator test case.

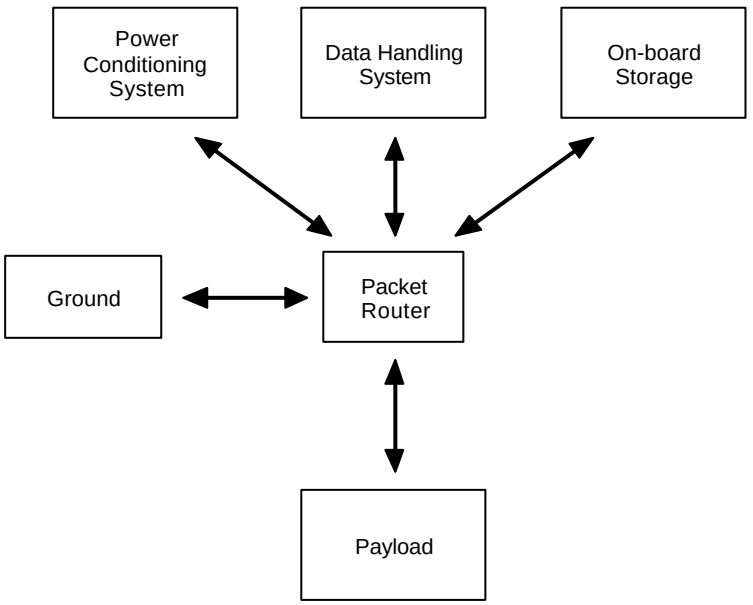

Figure 4.2-1: Application Process Population

Power Conditioning System is a platform application process that controls and monitors the on-board power supply. The Power Conditioning System provides the following PUS services.

- Service Type 1, Telecommand Verification. Supporting service for the other services.
- Service Type 3, Housekeeping and Diagnostic Data Reporting. Collection of currents, voltages etc.
- Service Type 5, Event Reporting. Reporting of errors, over-voltage, under-voltage etc.
- Service Type 8, Function Management. Activation and deactivation of power switches.
- Service Type 12, On-board Monitoring. Monitoring of voltages, currents, and temperatures.
- Service Type 15, On-board Storage and Retrieval, Packet Selection sub-service. Supporting service to the On-board Storage application.

Data Handling System is the application process responsible for the overall control of the on-board data handling. The following PUS services are provided:

- Service Type 1, Telecommand Verification. Supporting service for the other services.
- Service Type 2, Device Command Distribution. Low-level control of power switches and system parameters.
- Service Type 5, Event Reporting. Reporting of errors etc.
- Service Type 6, Memory Management. Load, dump, and check of the on-board data handling computer software.
- Service Type 11, On-board Operations Scheduling. Scheduling of telecommands.
- Service Type 13, Large Data Transfer. Transfer of large (> 2 Kbytes) memory load telecommand packets from ground (receiving sub-service) and transfer of large (> 2 Kbytes) memory dump telemetry packets to ground (sending sub-service).
- Service Type 15, On-board Storage and Retrieval, Packet Selection sub-service. Supporting service to the On-board Storage application.
- Service Type 19, Event-Action. Response to observed anomalies.

On-board Storage is the application process controlling the storage of telemetry for later downlink. The following PUS services are provided:

- Service Type 1, Telecommand Verification. Supporting service for the other services.
- Service Type 5, Event Reporting. Reporting of errors etc.

- Service Type 13, Large Data Transfer. Transfer of large (> 2 Kbytes) telemetry packets to ground (sending sub-service).

- Service Type 15, On-board Storage and Retrieval. Control of the on-board data storage.

Payload is an application process that controls the generation of scientific data. For example from a telescope. The following PUS services are provided:

- Service Type 1, Telecommand Verification. Supporting service for the other services.

- Service Type 3, Housekeeping and Diagnostic Data Reporting. Collection of instrument health information, temperatures, etc.

- Service Type 5, Event Reporting. Reporting of errors etc.

- Service Type 8, Function Management. Change of operational modes.

- Service Type 15, On-board Storage and Retrieval, Packet Selection sub-service. Supporting service to the On-board Storage application.

- Service Type 128, Science Data. Mission specific PUS service providing the actual science data collection.

The packet router is responsible for the traffic management. It does not provide any PUS services.

Ground represents the ground segment. The ground segment is simulated by the R-SVF.

Table 4.2-1 summarizes which PUS services that are supported by the different application processes.

	Telecommand Verification	Device Command Distribution	HK and Diagnostic Data Reporting	Event Reporting	Memory Management	Function Management	On-board Operations Scheduling	On-board Monitoring	Large Data Transfer	On-board Storage (Packet Selection)	On-board Storage and Retrieval	Event-Action	Science
Power Conditioning System	✓		✓	✓		✓		✓		✓			
Data Handling System	✓	✓		✓	✓		✓		✓	✓		✓	
Onboard Storage	✓			✓					✓		✓		
Payload	✓		✓	✓		✓				✓			✓

Table 4.2-1: PUS Service Support

5 Applications

5.1 General

5.1.1 Telecommands

Telecommands shall use the parameter types listed in Table 5.1-1 for Packet Header, Data Field Header, and Packet Error Control fields.

Parameter	Type (PTC,PFC)
Version Number	Enumerated (2,3)
Type	Enumerated (2,1)
Data Field Header Flag	Enumerated (2,1)
Application Process ID	Unsigned Integer (2,11)
Sequence Flags	Enumerated (2,1)
Sequence Count	Unsigned Integer (3,10)
Packet Length	Unsigned Integer (3,12)
CCSDS Secondary Header Flag	Boolean (1,0)
TC Packet PUS Version Number	Enumerated (2,3)
Ack	Enumerated (2,4)
Service Type	Enumerated (2,8)
Service Subtype	Enumerated (2,8)
Source ID	Enumerated (2,12)
Spare	Bit-String (6,4)
Packet Error Control	Unsigned Integer (3,12)

Table 5.1-1: Telecommand Parameters

The distribution of Application ID's can be seen in Table 5.1-2.

Application Process	Application ID
Power Conditioning System	8
Data Handling System	2
On-board Storage	4
Payload	12

Table 5.1-2: Application ID's

The distribution of Source ID's can be seen in Table 5.1-3.

Application Process	Source ID
Ground Segment	1
Data Handling System	2

Table 5.1-3: Source ID's

5.1.2 Telemetry

Telemetry shall use the parameter types listed in Table 5.1-4 for Packet Header, Data Field Header, and Packet Error Control.

Parameter	Type (PTC,PFC)
Version Number	Enumerated (2,3)
Type	Enumerated (2,1)
Data Field Header Flag	Enumerated (2,1)
Application Process ID	Unsigned Integer (2,11)
Grouping Flags	Enumerated (2,1)
Source Sequence Count	Unsigned Integer (3,10)
Packet Length	Unsigned Integer (3,12)
Spare	Bit-string (6,1)
TM Source Packet PUS Version Number	Enumerated (2,3)
Spare	Bit-string (6,4)
Service Type	Enumerated (2,8)
Service Subtype	Enumerated (2,8)
Packet Sub-counter	Unsigned Integer (3,4)
Destination ID	Enumerated (2,12)
Time	Absolute Time (9,0) (see Table 5.1-5)
Spare	Bit-String (6,4)
Packet Error Control	Unsigned Integer (3,12)

Table 5.1-4: Telemetry Parameters

Absolute time format shall always contain p-field and Time as shown in Table 5.1-5.

Parameter	Type (PTC,PFC)	Note
p-field	Unsigned Integer (3,4)	Value = 2Fh
Time	Absolute Time (9,18)	

Table 5.1-5: Absolute Time Format

Relative time format shall always contain p-field and Time as shown in Table 5.1-6.

Parameter	Type (PTC,PFC)	Note
p-field	Unsigned Integer (3,4)	Value = 2Fh
Time	Relative Time (10,16)	

Table 5.1-6: Relative Time Format

The distribution of destination ID's can be seen in Table 5.1-7.

Application Process	Destination ID
Ground Segment	1
Data Handling System	2

Table 5.1-7: Destination ID's

5.1.3 Telecommand Verification

All applications supporting the Telecommand Verification service shall use the service specific parameter types shown in Table 5.1-8.

Parameter	Type (PTC,PFC)
Code	Enumerated (2,8)
Step Number	Enumerated (2,8)

Table 5.1-8: Telecommand Verification Parameters

Table 5.1-9 lists the Code values that are applicable for all application processes. Code values 0 to 5 are defined by the standard.

Code	Interpretation
0	Illegal APID
1	Incomplete or invalid packet length
2	Incorrect checksum
3	Illegal packet type (Unknown command code)
4	Illegal packet sub-type
5	Illegal or inconsistent application data (Illegal parameter value)
16	Illegal command
17	Table full
18	Element already in table
19	Element not in table
20	Bus operation failed
21	Command not on schedule
22	No storage selection definition
23	No read access
24	No write access
25	Access outside memory area
26	Unknown memory access error
27	Checksums differ
28	Unsupported activity
29	Buffer full
30	Excessive Memory Data Length
31	Unsupported Checksum Type
32	Report Generation Failure

Table 5.1-9: Code Values Applicable for All Application Processes

5.1.4 Device Command Distribution

Application supporting the Device Command Distribution service shall use the service specific parameter types shown in Table 5.1-10.

Parameter	Type (PTC,PFC)
N	Unsigned Integer (3,4)
Address	Enumerated (2,16)
Register Address	Enumerated (2,16)

Table 5.1-10: Device Command Distribution Parameters

5.1.5 Housekeeping and Diagnostic Data Reporting

Applications supporting the Housekeeping and Diagnostic Data Reporting service shall use the service specific parameter types shown in Table 5.1-11.

Parameter	Type (PTC,PFC)
SID	Enumerated (2,8)
Collection Interval	Unsigned Integer (3,12)
NPAR1	Unsigned Integer (3,12)
Parameter#	Enumerated (2,8)
NFA	Unsigned Integer (3,12)
NREP	Unsigned Integer (3,12)
NPAR2	Unsigned Integer (3,12)
NSID	Unsigned Integer (3,12)
Timeout	Unsigned Integer (3,12)
N	Unsigned Integer (3,12)
Threshold Type	Enumerated (2,1)
Threshold	Unsigned Integer (3,12)
Mode	Enumerated (2,2)

Table 5.1-11: Housekeeping and Diagnostic Data Reporting Parameters

5.1.6 Event Reporting

Applications supporting the Event Reporting service shall use the service specific parameter types shown in Table 5.1-12.

Parameter	Type (PTC,PFC)
RID	Enumerated (2,8)

Table 5.1-12: Event Reporting Parameters

Table 5.1-13 lists the Report ID's that are applicable for all application processes.

RID	Service Sub-type	Parameters	Interpretation
0	1	None	System start up
1	4	Task ID (8,0) (n is Unsigned Integer (3,12)) Exception Name (8,0) (n is Unsigned Integer (3,12)) Exception Message (8,0) (n is Unsigned Integer (3,12)) Exception Information (8,0) (n is Unsigned Integer (3,12))	Task exception report
2	3	None	Packet conversion failure report
4	2	TM Packet Header ID (3,12) TM Packet Sequence Control (3,12)	Unsupported telemetry packet
5	4	None	Uninstantiated sending sub-service
6	2	SDU Unit Type (2,8) SDU Packet Header (3,15)	SDU conversion failure report
7	2	None	Current uplink aborted

Table 5.1-13: Event Reports Applicable for All Application Processes

5.1.7 Memory Management

Applications supporting the Memory Management service shall use the service specific parameter types shown in Table 5.1-14.

Parameter	Type (PTC,PFC)
Memory ID	Octet-string (7,8)
N	Unsigned Integer (3,4)
Start Address	Unsigned Integer (3,14)
Length/Data	Octet-string (7,0) (n is Unsigned Integer (3,12))
Length	Unsigned Integer (3,14)
Checksum	Bit-string (6,16)

Table 5.1-14: Memory Management Parameters

5.1.8 Function Management

Applications supporting the Function Management service shall use the service specific parameter types shown in Table 5.1-15.

Parameter	Type (PTC,PFC)
Function ID	Character-string (8,20)
N	Unsigned Integer (3,4)
Parameter#	Enumerated (2,8)

Table 5.1-15: Function Management Parameters

5.1.9 On-board Operations Scheduling

Applications supporting the On-board Operations Scheduling service shall use the service specific parameter types listed in Table 5.1-16.

Parameter	Type (PTC,PFC)
N1	Unsigned Integer (3,4)
Sub-schedule ID	Enumerated (2,4)
N2	Unsigned Integer (3,4)
Application Process ID	Enumerated (2,16)
N	Unsigned Integer (3,4)
Scheduling Event	Enumerated (2,8)
Abs/Rel Time Tag	Absolute Time (9,0) (see Table 5.1-5) or Relative Time (10,0) (Table 5.1-6)
Sequence Count	Unsigned Integer (3,12)
Number of Telecommands	Unsigned Integer (3,4)
Range	Enumerated (2,4)
Time Tag 1	Absolute Time (9,0) (see Table 5.1-5)
Time Tag 2	Absolute Time (9,0) (see Table 5.1-5)

Table 5.1-16: On-board Operations Scheduling Parameters

5.1.10 On-board Monitoring

Applications supporting the On-board Monitoring service shall use the service specific parameter types shown in Table 5.1-17.

Parameter	Type (PTC,PFC)
N	Unsigned Integer (3,4)
Parameter#	Enumerated (2,8)
Parameter Monitoring Interval	Unsigned Integer (3,12)
Value #REP	Unsigned Integer (3,4)
Validity Parameter#	Enumerated (2,8)
NOL	Unsigned Integer (3,4)
Check Selection Parameter#	Enumerated (2,8)
RID	Enumerated (2,8)
NOE	Unsigned Integer (3,4)
Check Position	Signed Integer (4,4)
Monitoring Status	Enumerated (2,8)
Maximum Reporting Delay	Unsigned Integer (3,12)
Parameter Monitoring Status	Enumerated (2,8)
Previous Checking Status	Enumerated (2,8)
Current Checking Status	Enumerated (2,8)
Transition Time	Absolute Time (9,0) (see Table 5.1-5)

Table 5.1-17: On-board Monitoring Parameters

5.1.11 Large Data Transfer

Applications supporting the Large Data transfer service shall use the service specific parameter types listed in Table 5.1-18.

Parameter	Type (PTC,PFC)
Unit Type	Enumerated (2,8)
Sequence Number	Unsigned Integer (3,4)
Service Data Unit Part	Octet-String (7,2025)
Reason Code	Enumerated (2,8)
N	Unsigned Integer (3,4)

Table 5.1-18: Large Data Transfer Parameters

Reason Code can take the values listed in Table 5.1-19.

Reason Code	Sending/Receiving	Interpretation
1	Sending	Wrong sequence number in acknowledge
2	Sending	Reception acknowledge timeout
3	Sending	Part stream allocation failed
4	Sending	Part packet allocation failed
5	Sending	Part packet deposit failed
6	Sending	Illegal part from sender state
7	Sending	Sender logic error
8	Receiving	Timeout waiting for part
9	Receiving	Illegal command waiting for part
10	Receiving	Illegal part sequence number
11	Receiving	Repeated part erroneous
12	Receiving	Receiver logic error

Table 5.1-19: Reason Codes

5.1.12 On-board Storage and Retrieval

Applications supporting the On-board Storage and Retrieval service shall use the service specific parameter types listed in Table 5.1-20.

Parameter	Type (PTC,PFC)
N	Unsigned Integer (3,12)
Store ID	Character-String (8,25)
N2	Unsigned Integer (3,12)
Type	Enumerated (2,8)
N3	Unsigned Integer (3,12)
Subtype	Enumerated (2,8)
Packet Set	Enumerated (2,2)
Application Process ID 1	Enumerated (2,16)
Source Sequence Count 1	Unsigned Integer (3,12)
Application Process ID 2	Enumerated (2,16)
Source Sequence Count 2	Unsigned Integer (3,12)
Time Span	Enumerated (2,2)

Parameter	Type (PTC,PFC)
Storage Time 1	Absolute Time (9,0) (see Table 5.1-5)
Storage Time 2	Absolute Time (9,0) (see Table 5.1-5)
Deletion Set	Enumerated (2,1)
Application Process ID	Enumerated (2,16)
Source Sequence Count	Unsigned Integer (3,12)
End Time	Absolute Time (9,0) (see Table 5.1-5)

Table 5.1-20: On-board Storage and Retrieval Parameters

5.1.13 Event-Action

Applications supporting the Event-Action service shall use the service specific parameter types listed in Table 5.1-21.

Parameter	Type (PTC,PFC)
N	Unsigned Integer (3,4)
Application Process ID	Enumerated (2,16)
RID	Enumerated (2,8)
Action Status	Enumerated (2,1)

Table 5.1-21: Event-Action Parameters

5.1.14 Science Data

Science Data is a mission specific PUS service and is therefore equipped with service type 128. The purpose of the Science Data service is to simulate the behaviour of a scientific instrument, producing large amounts of payload data. The service offers the following two service sub-types:

Sub-type 1: Moderate Speed Science

Telemetry source packet, source data:

Octet-string (7,1024).

Sub-type 2: High Speed Science

Telemetry source packet, source data:

Octet-string (7,1024).

5.1.15 Mission Constants

Table 5.1-22 lists the mission constants for the demonstrator.

Constant	Value	Note
<APPL_TIME_CODE>	TM source packet time field is always present Time format is CUC p-field = 2Fh	Applicable to all application processes.
<CPDU_DURATION_UNIT>	N/A	Service type 2 sub-type 3 is not supported.
<CPDU_MAX_INSTR>	N/A	Service type 2 sub-type 3 is not supported.
<DIAG_MIN_INTERV>	1 second	
<MISSION_TIME_CODE>	N/A	Service type 9 is not supported.
<MONLIST_MAX_CHECKS>	2	Applicable to all application processes that is providing on-board monitoring.
<MONLIST_MAX_PARAMS>	50	Applicable to all application processes that is providing on-board monitoring.
<PARAM_ABS_SAMPL_TIME>	1 second	= <DIAG_MIN_INTERV>
<PARAM_REL_SAMPL_TIME>	1 second	= <DIAG_MIN_INTERV>
<PKT_STORAGE_TIME>	N/A	Simulated mission has continuous ground coverage.
<PKTS_NUM_STORED>	2900 packets	
<PSLIST_MAX_PARAMS>	N/A	Service type 4 is not supported.
<SMALLEST_ADDRESSABLE_UNIT>	1 octet	
<TCPKT_MAX_LENGTH>	2048 octets	
<TC_CHECKSUM_TYPE>	ISO Checksum	
<TMPKT_MAX_LENGTH>	2048 octets	
<TM_CHECKSUM_TYPE>	ISO Checksum	

Table 5.1-22: Mission Constants

5.2 Power Conditioning System

Table 5.2-1 lists parameters monitored by the Power Conditioning System application.

Parameter #	Title	Type (PTC,PFC)	Note
100	Switch 1 Status	Boolean (1,0)	0 = off, 1 = on
101	Switch 2 Status	Boolean (1,0)	0 = off, 1 = on
102	Switch 3 Status	Boolean (1,0)	0 = off, 1 = on
103	Switch 4 Status	Boolean (1,0)	0 = off, 1 = on
104	Switch 5 Status	Boolean (1,0)	0 = off, 1 = on
105	Switch 6 Status	Boolean (1,0)	0 = off, 1 = on
106	Switch 7 Status	Boolean (1,0)	0 = off, 1 = on
107	Switch 8 Status	Boolean (1,0)	0 = off, 1 = on
108	Switch 9 Status	Boolean (1,0)	0 = off, 1 = on
109	Switch 10 Status	Boolean (1,0)	0 = off, 1 = on
110	Switch 11 Status	Boolean (1,0)	0 = off, 1 = on
111	Switch 12 Status	Boolean (1,0)	0 = off, 1 = on
112	Voltage 1	Unsigned Integer (3,8)	
113	Voltage 2	Unsigned Integer (3,8)	
114	Voltage 3	Unsigned Integer (3,8)	
115	Voltage 4	Unsigned Integer (3,8)	
116	Voltage 5	Unsigned Integer (3,8)	
117	Voltage 6	Unsigned Integer (3,8)	
118	Voltage 7	Unsigned Integer (3,8)	
119	Voltage 8	Unsigned Integer (3,8)	
120	Voltage 9	Unsigned Integer (3,8)	
121	Voltage 10	Unsigned Integer (3,8)	
122	Voltage 11	Unsigned Integer (3,8)	
123	Voltage 12	Unsigned Integer (3,8)	
124	Current 1	Unsigned Integer (3,8)	
125	Current 2	Unsigned Integer (3,8)	
126	Current 3	Unsigned Integer (3,8)	
127	Current 4	Unsigned Integer (3,8)	
128	Current 5	Unsigned Integer (3,8)	
129	Current 6	Unsigned Integer (3,8)	

Parameter #	Title	Type (PTC,PFC)	Note
130	Current 7	Unsigned Integer (3,8)	
131	Current 8	Unsigned Integer (3,8)	
132	Current 9	Unsigned Integer (3,8)	
133	Current 10	Unsigned Integer (3,8)	
134	Current 11	Unsigned Integer (3,8)	
135	Current 12	Unsigned Integer (3,8)	
136	Temperature 1	Unsigned Integer (3,8)	
137	Temperature 2	Unsigned Integer (3,8)	
138	Temperature 3	Unsigned Integer (3,8)	
139	Temperature 4	Unsigned Integer (3,8)	
140	System 1	Unsigned Integer (3,4)	
141	System 2	Unsigned Integer (3,4)	
142	System 3	Unsigned Integer (3,4)	
143	System 4	Unsigned Integer (3,4)	

Table 5.2-1: Power Conditioning System Parameters

Parameter# 100 to 135 shall initially be 0. When a switch state is changed using either the Device Command Distribution service or the Function Management service the corresponding switch status parameter shall be updated.

When a switch is activated, the voltage and current parameters with the same number shall be set. The voltage value shall be set to 3162. The current value shall be set to 1124. When a switch is deactivated the voltage and current parameters shall be reset to zero.

A special situation shall apply for Parameter# 115, Voltage 4 and Parameter# 131, Current 8.

Parameter# 115, Voltage 4 shall be initialized to 3162 when switch 4 is activated. It shall then be decremented with 1 for every <DIAG_MIN_INTERV> period until it reaches 0 or until switch 4 is deactivated. This shall generate under-voltage situations and initiate out-of-limit events.

Parameter# 131, Current 8 shall be initialized to 1124 when switch 8 is activated. It shall then be incremented with 1 for every <DIAG_MIN_INTERV> period until it reaches 4095 or until switch 8 is deactivated. This shall generate over-current situations and initiate out-of-limit events.

Parameter#136 to 139 shall always have the value 2188.

Parameter# 140 to 143 shall initially be 0. They shall be updated according to the Data Handling System service requests sub-type 2 of the Device Command Distribution service.

5.2.1 Telecommand Verification

The Power Conditioning System application shall provide telecommand verification with no special constraints. No application specific error codes are foreseen.

5.2.2 Housekeeping and Diagnostic Data Reporting

The Power Conditioning System shall support housekeeping and diagnostic data reporting of all the parameters listed in Table 5.2-1.

The Power Conditioning System application process shall be able to store 4 housekeeping report structures (SID's) and 4 diagnostic report structures (SID's).

Power Conditioning System SID's shall be in the range from 0 to 7.

5.2.3 Event Reporting

The Power Conditioning System application shall provide reporting of error events as available in the OBOSS-III baseline.

The Event Reporting service shall also support the On-board Monitoring service generating error reports when out-of-limit events occur. Table 5.2-2 lists the possible event reports.

RID	Service Sub-type	Parameters	Interpretation
128	2	None	Voltage 4 low
129	2	None	Voltage 4 high
130	4	None	Voltage 4 critical low
131	4	None	Voltage 4 critical high
132	3	None	Current 8 low
133	3	None	Current 8 high
134	1	None	Temperature 1 unexpected value
135	1	None	System 1 unexpected value
136	3	None	Temperature 1 low
137	3	None	Temperature 1 high

Table 5.2-2: Event Reports Initiated by Out-of-limit Events

5.2.4 Function Management

The Power Conditioning System application provides Function Management service sub-type 1 Perform Function, with the Function ID listed in Table 5.2-3. The Function ID field shall be padded with

space characters. The service requests can contain the listed parameter numbers with corresponding values. The parameters and their current and voltage values shall be updated accordingly.

Function ID	Possible Parameter#	Possible Values
Assign Switch State	100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111	0: Deactivate switch 1: Activate switch

Table 5.2-3: Power Conditioning System Function ID's

5.2.5 On-board Monitoring

The Power Conditioning System shall provide on-board monitoring of parameter# 112 to 143 (see Table 5.2-1). This is a total of 32 parameters.

Maximum Reporting Delay is fixed to 100 x <DIAG_MIN_INTERV> = 100 s.

It shall be possible to specify two limit pairs and two expected values for each monitored parameter.

5.2.6 On-board Storage and Retrieval (Packet Selection)

The Power Conditioning System application shall provide the Packet Selection part of the On-board Storage and Retrieval service.

Possible Store ID's can be seen in Table 5.4-1.

5.3 Data Handling System

5.3.1 Telecommand Verification

The Data Handling System application shall provide telecommand verification with no special constraints. No application specific error codes are foreseen.

5.3.2 Device Command Distribution

For Device Command Distribution service sub-type 1 Distribute On-Off Commands the Data Handling System application shall accept the addresses listed in Table 5.3-1. The Power Conditioning System parameters shall be updated accordingly.

Address	Function
3001	Switch 1 Off
3002	Switch 2 Off
3003	Switch 3 Off
3004	Switch 4 Off
3005	Switch 5 Off
3006	Switch 6 Off
3007	Switch 7 Off
3008	Switch 8 Off
3009	Switch 9 Off
3010	Switch 10 Off
3011	Switch 11 Off
3012	Switch 12 Off
4001	Switch 1 On
4002	Switch 2 On
4003	Switch 3 On
4004	Switch 4 On
4005	Switch 5 On
4006	Switch 6 On
4007	Switch 7 On
4008	Switch 8 On
4009	Switch 9 On
4010	Switch 10 On
4011	Switch 11 On
4012	Switch 12 On

Table 5.3-1: Distribute On-Off Command Adresses

For Device Command Distribution service sub-type 2 Distribute Register Load Commands, the Data Handling System application shall support the register addresses listed in Table 5.3-2, with the register data types as shown. Power Conditioning System parameters shall be updated accordingly.

Register Address	Register Data Type	Function
6000	Unsigned Integer (3,4)	System parameter 1 update
6001	Unsigned Integer (3,4)	System parameter 2 update
6002	Unsigned Integer (3,4)	System parameter 3 update
6003	Unsigned Integer (3,4)	System parameter 4 update

Table 5.3-2: Distribute Register Load Commands Addresses

5.3.3 Event Reporting

The Data Handling System application shall provide reporting of error events as available in the OBOSS-III baseline.

5.3.4 Memory Management

The Data Handling System application shall support the Memory Management service. It shall be possible to load, dump and check the data memory area and it shall be possible to dump and check the code memory area.

The Memory ID's to be used are shown in Table 5.3-3. The Memory ID field shall be interpreted as ASCII code. Start and end addresses for memory areas are TBD.

Memory ID	Allowed Operations
DATA MEM	Load, Dump, Check
CODE MEM	Dump, Check

Table 5.3-3: Memory Areas

The Memory Management service shall use the supporting Large Data Transfer service. The Memory Management service can therefore expect to receive service requests sub-type 2, Load Memory using Absolute Addresses with a size of up to 65,535 bytes. The Memory Management service is allowed to generate service reports sub-type 6, Memory Dump using Absolute Addresses Report with a size of up to 65,535 bytes.

5.3.5 On-board Operations Scheduling

The Data Handling System application shall provide on-board scheduling with up to 3 sub-schedules. Each sub-schedule shall be able to contain up to 20 telecommands.

Sub-Schedule ID shall have the value 1, 2, or 3.

5.3.6 Large Data Transfer

The Data Handling System shall offer the Large Data Transfer service as a supporting service to the Memory Management service.

Large Data Transfer shall be used for upload of memory (Load Memory using Absolute Addresses) and for download of memory (Memory Dump using Absolute Addresses Report). Both the receiving and sending functionality shall thus be implemented.

5.3.7 On-board Storage and Retrieval (Packet Selection)

The Data Handling System application shall provide the Packet Selection part of the On-board Storage and Retrieval service.

Possible Store ID's can be seen in Table 5.4-1.

5.3.8 Event-Action

The Data Handling System application shall provide an event detection list with up to 20 entries.

5.4 On-board Storage

5.4.1 Telecommand Verification

The On-board Storage application shall provide telecommand verification with no special constraints. No application specific error codes are foreseen.

5.4.2 Event Reporting

The On-board Storage application shall provide reporting of error events as available in the OBOSS-III baseline.

5.4.3 Large Data Transfer

The On-board Storage application shall offer the Large Data Transfer service as a support to the On-board Storage and Retrieval service.

The Large Data Transfer shall be used for the downlink of Packet Store Contents Reports. Only the sending functionality shall thus be implemented.

5.4.4 On-board Storage and Retrieval

The On-board Storage application shall support the entire On-board Storage and Retrieval service. Two stores will be defined. Store ID's, available buffers, and storage strategies are defined in Table 5.4-1. Buffer size is defined in Table 5.4-2.

Store ID	Small Buffers	Medium Buffers	Large Buffers	Storage Strategy
High_Priority_Store	200	100	0	Circular
Low_Priority_Store	100	100	500	Bounded

Table 5.4-1: Store ID's

Buffer Size	# Bytes
Small	32
Medium	512
Large	2048

Table 5.4-2: Buffer Size

The On-board Storage and Retrieval service shall use the Large Data Transfer service for transmission of service reports sub-type 8, Packet Store Content Reports. This will allow the On-Board

Storage and Retrieval service to divide downloads of the on-board storage into packets with a maximum size of 65535 bytes.

5.5 Payload

Table 5.5-1 lists parameters monitored by the Payload application.

Parameter #	Title	Type (PTC,PFC)	Note
200	Payload Mode	Enumerated (2,2)	0 = stand by 1 = moderate speed 2 = high speed
201	Payload Temperature 1	Unsigned Integer (3,14)	
202	Payload Temperature 2	Unsigned Integer (3,14)	
203	Payload Temperature 3	Unsigned Integer (3,14)	
204	Payload Temperature 4	Unsigned Integer (3,14)	
205	Payload Voltage 1	Unsigned Integer (3,8)	
206	Payload Voltage 2	Unsigned Integer (3,8)	
207	Payload Voltage 3	Unsigned Integer (3,8)	
208	Payload Voltage 4	Unsigned Integer (3,8)	
209	Payload Current 1	Unsigned Integer (3,8)	
210	Payload Current 2	Unsigned Integer (3,8)	
211	Payload Current 3	Unsigned Integer (3,8)	
212	Payload Current 4	Unsigned Integer (3,8)	
213	Science Seed Value 1	Unsigned Integer (3,4)	
214	Science Seed Value 2	Unsigned Integer (3,4)	

Table 5.5-1: Payload Parameters

Parameter# 200 shall initially be 0. The value shall then follow the mode selection service requests send to the Function Management service.

Parameter# 201 to 204 shall always be 10046.

Parameter # 205 to 208 shall always be 2003.

Parameter# 209 to 212 shall always be 1596.

Parameter# 213 shall initially be 0. Parameter# 214 shall initially be 1. The values shall be updated when the parameters are contained in the Function Management service requests.

5.5.1 Telecommand Verification

The Payload application shall provide telecommand verification with no special constraints. No application specific error codes are foreseen.

5.5.2 Housekeeping and Diagnostic Data Reporting

The Payload application shall support housekeeping and diagnostic data reporting of all the parameters listed in Table 5.5-1.

The Payload application process shall be able to store 4 housekeeping report structures (SID's) and 4 diagnostic report structures (SID's).

Payload SID's shall be in the range from 8 to 15.

5.5.3 Event Reporting

The Payload application shall provide reporting of error events as available in the OBOSS-III baseline.

5.5.4 Function Management

The Payload application shall support the Function ID's shown in Table 5.5-2.

Function ID	Possible Parameter#	Activity
Stand By	None (N = 0)	Stop science data generation.
Moderate Speed	213, 214	Start science data generation at moderate speed using service type 128.
High Speed	213, 214	Start science data generation at high speed using service type 128.

Table 5.5-2: Payload Function ID's

The Function ID field shall be padded with space characters.

The Function ID's shall be accompanied by zero, one, or two parameter# and parameter values. When parameters are included these shall be updated accordingly. Parameter values of 200 and above shall not be allowed. The values shall be checked during execution of the service request. If a parameter value in the service request is 200 or higher, the Telecommand Verification service shall reply with a Telecommand Execution Progress Report – Failure, service sub-type 6. Code shall be set to 128. Step Number shall indicate whether it is the first parameter in the service request that is 200 or above (Step Number = 1) or whether it is the second parameter in the service request that is 200 or above (Step Number = 2).

At the end of execution the service shall check whether the two parameters, parameter# 213 and parameter# 214, have identical values. If the values are identical the Telecommand Verification service shall reply with a Telecommand Execution Completed Report – Failure, service sub-type 8. Code shall be set to 129.

The science data generation mode shall not be changed before parameters included in the service request have been updated and it has been verified that the parameter values are different from each other.

The payload application can move freely between the three modes of operation, as illustrated in the state-diagram on Figure 5.5-1. The payload mode parameter (parameter# 200) shall be updated accordingly.

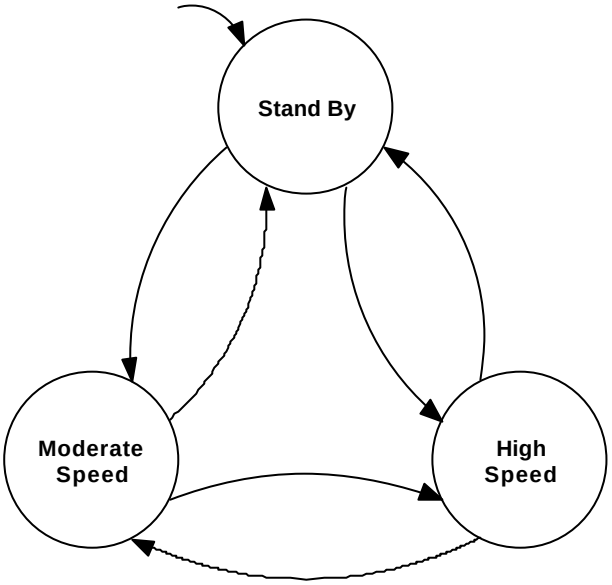

Figure 5.5-1: Payload State-Diagram

5.5.5 On-board Storage and Retrieval (Packet Selection)

The Payload application shall provide the Packet Selection part of the On-board Storage and Retrieval service.

Possible Store ID's can be seen in Table 5.4-1.

5.5.6 Science Data

When the payload is in Stand By mode, which is the initial condition, it shall not generate any science data.

When the payload is in Moderate Speed mode, it shall generate a service report sub-type 1, Moderate Speed Science every 5 seconds. The source data shall consist of 1024 octets simulated science data (i.e. anything).

Whenever a request is received to go from Moderate Speed mode to either Stand By mode or High Speed mode, the Payload application shall generate a service report sub-type 1, Moderate Speed Science, with a size reflecting the duration since the last service report was generated. If for example the last packet was generated 2 seconds before the mode change, the Payload application shall generate a packet with a size of 1024x2/5 = 409 octets.

When the payload is in High Speed mode, it shall generate a service report sub-type 2, High Speed Science every 0.5 seconds. The source data shall be identical to the source data in a Moderate Speed Science Packet (1024 bytes simulated science data).

Whenever a request is received to go from High Speed mode to either Stand By mode or Moderate Speed mode, the Payload application shall generate a service report sub-type 2, High Speed Science, with a size reflecting the duration since the last service report was generated.