

***OBOSS System Integration Frame
Contract
Call-Off 1
Technical Budgets***

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1 Introduction

1.1 Purpose

The current document presents the technical budgets for the software developed as part of Call-Off 1 — also known as OBOSS-III — on the 'OBOSS System Integration Frame Contract'¹.

The budgets will be updated at the major milestones in the project.

1.2 Scope

The current version of the document applies at the time of the acceptance review (AR).

¹ ESTEC contract number 16860/02/NL/LvH - Call Off Order 1.



2 References

2.1 Applicable Documents

Reference	Document
[PROP]	<i>OBOSS System Integration Frame Contract – Proposal for Call-Off 1</i> Terma/SPD/OBOSS-III/001, Issue 1.1
[SOW]	<i>Statement of Work – OBOSS System Integration Frame Contract Call-off 1</i> TOS-EMS.SOW/02-101/kh, Issue 1.2
[TAIL]	<i>OBOSS System Integration Frame Contract Call-off 1– Annex A: ECSS-E40 Tailoring</i> Version 1.3

2.2 Reference Documents

Reference	Document
[PUS]	<i>Telemetry & Telecommand Packet Utilization</i> ECSS-E-70-41A, January 2003
[SRD]	<i>OBOSS System Integration Frame Contract — OBOSS-III Software Requirements</i> Terma/SPD/OBOSS-III/003, Issue 2.1
[DEMO]	<i>OBOSS-III Demonstrator Specification</i> Terma/SPD/OBOSS-III/004, Issue 1.B
[SVTS]	<i>OBOSS-III Software Validation Testing Specification</i> Terma/SPD/OBOSS-III/005, Issue 1.A



3 Abbreviations, Terms, and Definitions

3.1 Abbreviations

AR Acceptance Review

CPU Central Processing Unit

3.2 Terms and Definitions

None.

4 Memory Budget

The memory budget — i.e. the amount of utilised memory — is presented below for each of the major milestones in the project. The target memory budget prescribed as part of the technical specification is presented initially.

4.1 Technical Specification

The technical specification defined through the 'OBOSS-III Software Requirements' [SRD] places no resource requirements on the memory utilisation.

4.2 Applied Metrics

Acquisition of the memory budget is based on the *sparc-ork-size* application enclosed as part of the GNAT/ORK compilation system. This takes an object file as input and characterises the memory utilisation for the given object within a number of segments:

- *Text*: The segment where the executable code goes. Sometimes it may also hold read only data. The text segment will normally be placed in EEPROM.
- *Data*: This segment contains initialized global/static variables. The data segment will normally be placed in EEPROM and copied to RAM at application start up.
- *BSS*: This segment contains uninitialized global/static variables. The BSS segment will typically be placed in RAM.
- *Total*: This is the total memory utilisation for the object *excluding* any potential heap usage. It is simply the sum of the Text, Data and BSS segments.

The total memory utilisation is thus the sum of the above segments for all object files making up the application. On top of this comes the memory required for the run-time system as well as any memory dynamically allocated during program execution².

² For the Open Ravenscar Kernel (ORK), all task stacks are allocated from heap during program elaboration. The dynamic memory allocation may thus be a substantial contribution.



4.3 Total Memory Utilisation

The total memory utilisation is summarised in the following table.

Segment	Size (Octets)
Text	2037418
Data	48460
BSS	66113
Total	2151991

The memory utilisation is based on actual benchmarks for existing software as outlined in section 4.2. Detailed segment sizes are presented in Appendix A for all the software components — i.e. object files — making up the Demonstrator application [DEMO]. The application is compiled with all check enabled and without any optimizations. A substantial reduction may thus be achieved through modification of these compiler options.

Once more, it should be noted that dynamically allocated memory — e.g. allocated from the heap — is *not included* in the above totals.

4.4 Software Component Memory Utilisation

The detailed segment sizes presented in Appendix A may be grouped to derive estimated sizes for the various elements making up an OBOSS instantiation:

- *Framework* designating the overall framework elements that have to be there.
- *Application process* assessing the general cost of adding one application process to the set of implemented application processes.
- *PUS service instances* indicating the increase in memory utilisation when adding one instance of a specific service.

It should be noted that it is only possible to give indicative estimates for these elements based on actual benchmarks for the Demonstrator application [DEMO]. These estimates are presented in the following table:

Parameter	Component	Text	Data	BSS	Total
<i>Cost for Framework</i>					
Frm	Framework	605327	10129	64881	680337
<i>Cost per Application Process</i>					
AP	Application Process	30044	636	0	30680



<i>Cost per Service Instance</i>					
Dev_Cmd	Device Commanding	32216	730	4	32950
Ev_Act	Event Action	132894	7250	4	140148
Ev_Rep	Event Reporting	18928	141	0	19069
Fct_Mgt	Function Management	31313	720	24	32057
HK	Housekeeping	185313	4207	0	189520
LDT	Large Data Transfer	172109	5370	0	177479
Mem_Mgt	Memory Management	77883	1976	0	79859
Mon	Monitoring	237927	6428	0	244355
Sched	Onboard Scheduling	168053	863	0	168916
Strg_Reptr	Onboard Storage	60395	849	0	61244
Sci	Science	16635	298	1044	17977

Given a piece of data handling software implemented through adaptation and instantiation of the OBOSS-III baseline, it is thus possible to derive a rough order of magnitude for the total memory utilisation.

The column 'Parameter' in the above table identifies the various contributions. When such a name is used in formulas below, this designates the total memory contribution for this element, i.e. the entry in the 'Total' column.

Estimation of the memory utilisation is based on a number of parameters:

Parameter	Description
#APs	Total number of application processes supported by the data handling software.
Sup_Dev_Cmd	Equals 1, if device commanding is supported, 0 otherwise.
#Ev_Act	Total number of application processes providing the event-action service.
#Fct_Mgt	Total number of application processes providing the function management service.
#HK	Total number of application processes providing the housekeeping & diagnostics service.



Parameter	Description
#LDT	Total number of application processes providing the large data transfer service.
#Mem_Mgt	Total number of application processes providing the memory management service.
#Mon	Total number of application processes providing the on-board monitoring service.
#Sched	Total number of application processes providing the on-board scheduling service.
#Strg_Reptr	Total number of application processes providing the onboard storage & retrieval service.
#Sci	Total number of application processes providing the science data collection service ³ .

An estimate for the total memory utilisation may then be derived based on the following formula:

$$Frm + \#AP \times AP + Sup_Dev_Cmd \times Dev_Cmd + \#Ev_Act \times Ev_Act + \#Fct_Mgt \times Fct_Mgt + \#HK \times HK + \#LDT \times LDT + \#Mem_Mgt \times Mem_Mgt + \#Mon \times Mon + \#Sched \times Sched + \#Strg_Reptr \times Strg_Reptr + \#Sci \times Sci$$

Formula for Estimation of Memory Utilisation

³ This service is specific to the OBOSS-III demonstrator instantiation, and should thus only be considered indicative for similar services.

5 Central Processing Unit Utilisation Budget

The utilisation of the central processing unit (CPU Utilisation) — i.e. the relative amount of time that the CPU is in power down mode — is presented below for each of the major milestones in the project. The target CPU utilisation budget prescribed as part of the technical specification is presented initially.

5.1 Technical Specification

The technical specification defined through the 'OBOSS-III Software Requirements' [SRD] places the following resource requirements on the CPU utilisation:

- A typical instantiation of the OBOSS-III software with four application processes, shall be able to run on an 25 MHz ERC32 processor, performing all required operations and fulfilling all specified deadlines.
- Such a typical instantiation shall occupy no more than 75% of the available 25 MHz ERC32 processor resources.

5.2 Applied Operational Scenario

Assessment of the CPU utilisation has to be based on a specific operational scenario. The benchmarks presented in this section is based on the Demonstrator application [DEMO]. The following operational scenario is established:

- Housekeeping collection is started for Power Conditioning System (test case 5.1.1 in [SVTS]).
- Onboard monitoring is started for Power Conditioning System (test case 5.2.2 steps 1 to 3 in [SVTS]).
- Housekeeping collection is started for Payload (test case 5.1.2 steps 1 to 2 in [SVTS]).
- High-speed science collection is started for Payload (test case 5.1.2 step3 in [SVTS]).



5.3 Total CPU Utilisation

The benchmarked total CPU utilisation is 98.43% exceeding the required 75% from the 'OBOSS-III Software Requirements' [SRD].

5.4 Function CPU Utilisation

A more detailed profiling of the individual function invocations have been made using the profiling capabilities of the TSIM ERC32 emulator. The detailed result of this profiling is presented in .

A summary of the specific CPU utilisation contributions is presented below:

<i>Function</i>	<i>Ratio (%)</i>
Transformation and transmission of telemetry on downlink	51.87
High-Speed science data generation at 2.5 Hz	35.55
Housekeeping collection at 0.5 Hz for single application process	2.78
Onboard monitoring at 1 Hz for single application process	0.44

It is possible to derive a rough estimate for the upper limit on the memory utilisation based on the following parameters:

<i>Parameter</i>	<i>Description</i>
<DIAG_MIN_INTERV>	The value of the mission constant <DIAG_MIN_INTERV> as defined in 'Telemetry & Telecommand Packet Utilization' [PUS].
#HK	Total number of application processes providing the housekeeping & diagnostics service.
#Mon	Total number of application processes providing the on-board monitoring service.
#Sci	Total number of application processes providing the science data collection service ⁴ .

A rough estimate for the upper limit on the memory utilization may the n be derived based on the following formula:

$$51.87\% + \#SCI \times 35.55\% + \#HK \times \frac{2.78\% \times 2}{<DIAG_MIN_INTERV>} + \#MON \times \frac{0.44\%}{<DIAG_MIN_INTERV>}$$

⁴ This service is specific to the OBOSS-III demonstrator instantiation, and should thus only be considered indicative for similar services.



Appendix A

Demonstrator Memory Utilisation

**OBOSS System Integration Frame Contract Call-Off 1
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The measured memory utilisation for the object files making up the Demonstrator application software is presented in the table below. All sizes are presented as number of octets.

Filename	Text	Data	BSS	Total
ada_task_configuration.o	0	300	0	300
appl_proc_descr_inits.o	0	0	0	0
appl_proc_descr_manager.o	0	0	0	0
appl_proc_descr_manager_parameters.o	0	8	0	8
application_process_parameters.o	3904	16	0	3920
basic_services_initialiser.o	100	1	0	101
basic_types.o	26015	312	0	26327
b~demonstrator.o	2228	2032	0	4260
cdh_structure_initialiser.o	100	1	0	101
cell_package.o	0	0	0	0
cell_pool.o	24	1	0	25
cell_stream.o	19063	128	0	19191
check_enumeration.o	24	1	0	25
circular_buffer.o	24	1	0	25
cyclic_task.o	24	1	0	25
data_handling_system-dispatcher.o	7697	160	0	7857
data_handling_system-event_action_manager.o	131165	7088	4	138257
data_handling_system-large_data_manager.o	171161	5160	0	176321
data_handling_system-memory_manager.o	65885	1604	0	67489
data_handling_system-parameters.o	892	92	0	984
data_handling_system-router.o	937	0	0	937
data_handling_system-storage_selection_definitions.o	18689	336	0	19025
data_handling_system-tc_interpreter.o	692	1	0	693
data_handling_system-tc_scheduler.o	165513	827	0	166340
data_handling_system.o	160	1	0	161
default_ool_event_handler.o	48	1	0	49
demonstrator.o	320	52	0	372
device_command_distribution_types.o	0	0	0	0
device_command_parser.o	23301	552	4	23857
device_controller.o	0	0	0	0
device_tc_interpreter.o	7873	160	0	8033
dynamic_application_process_descrs_initialiser.o	927	1	6676	7604
event_action-detection_list.o	24	1	0	25
event_action-event_reporter.o	24	1	0	25
event_action-service-interpreter.o	24	1	0	25
event_action-service-pus_handler.o	24	1	0	25
event_action-service-tc_handler.o	24	1	0	25
event_action-service-tc_parser.o	24	1	0	25
event_action-service-tc_verification.o	24	1	0	25
event_action-service-tm_handler.o	24	1	0	25
event_action-service-tm_parser.o	24	1	0	25
event_action-service.o	24	1	0	25
event_action.o	849	100	0	949
event_forwarder.o	2042	20	264	2326



OBOSS System Integration Frame Contract Call-Off 1 Technical Budgets

<i>Filename</i>	<i>Text</i>	<i>Data</i>	<i>BSS</i>	<i>Total</i>
event_forwarder_parameters.o	0	4	0	4
event_queue.o	3386	92	48	3526
event_queue_parameters.o	0	8	0	8
event_reporter.o	24	1	0	25
event_reporting.o	10342	1	0	10343
event_reporting_types.o	2310	60	0	2370
event_scheduler.o	24	1	0	25
event_task.o	24	1	0	25
external_application_process_if.o	24	1	0	25
external_device_command_distribution_types.o	0	16	0	16
external_event_action_types.o	640	52	0	692
external_event_reporting_types.o	6276	80	0	6356
external_function_management_types.o	1670	80	0	1750
external_hk_collector_types.o	2795	84	0	2879
external_large_data_transfer_types.o	0	28	0	28
external_memory_management_types.o	0	0	0	0
external_on_board_clock.o	1036	1	0	1037
external_on_board_scheduling_types.o	0	0	0	0
external_onboard_monitoring_types.o	1310	74	0	1384
external_packet_store_types.o	1756	7	0	1763
external_pus_data_types.o	9091	1296	0	10387
external_pus_initialiser.o	44	1	0	45
external_pus_state.o	52295	1	0	52296
external_telecommand_verification_types.o	0	0	0	0
function_management_types.o	3222	8	0	3230
gen_obs_schedule.o	24	1	0	25
gen_obs_scheduler.o	24	1	0	25
generic_tc_translator-parser.o	24	1	0	25
generic_tc_translator.o	24	1	0	25
globals.o	0	8	0	8
ground_if.o	57812	784	0	58596
hashed_protected_map_type.o	24	1	0	25
high_priority_store.o	12980	40	0	13020
hk_collector.o	24	1	0	25
hk_collector_types.o	1331	28	0	1359
hk_diag_event_manager.o	24	1	0	25
hk_diag_report_generator.o	24	1	0	25
hk_diag_tc_interpreter.o	24	1	0	25
internal_pus_initialiser.o	44	1	0	45
interrupts.o	924	60	0	984
iso_checksum.o	2385	1	0	2386
large_data_transfer-receiver-tc_handler.o	24	1	0	25
large_data_transfer-receiver-tc_parser.o	24	1	0	25
large_data_transfer-receiver.o	24	1	0	25
large_data_transfer-receiver_state.o	24	1	0	25
large_data_transfer-sdu_parts.o	24	1	0	25
large_data_transfer-sender-sdu_sender.o	24	1	0	25
large_data_transfer-sender-tc_handler.o	24	1	0	25

**OBOSS System Integration Frame Contract Call-Off 1
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Filename	Text	Data	BSS	Total
large_data_transfer-sender-tc_parser.o	24	1	0	25
large_data_transfer-sender.o	24	1	0	25
large_data_transfer-sender_state.o	24	1	0	25
large_data_transfer-service.o	24	1	0	25
large_data_transfer.o	24	1	0	25
large_data_transfer_mission_parameters.o	0	0	0	0
large_data_transfer_parser.o	24	1	0	25
large_data_transfer_types.o	612	168	0	780
low_priority_store.o	12980	40	0	13020
map_type.o	24	1	0	25
mass_store.o	24	1	0	25
memory_access.o	24	1	0	25
memory_management.o	24	1	0	25
memory_management_parser.o	24	1	0	25
memory_management_types.o	1780	364	0	2144
memory_manager-code_memory.o	4367	1	0	4368
memory_manager-data_memory.o	5015	1	0	5016
memory_manager-parameters.o	124	2	0	126
memory_manager.o	640	1	0	641
mission_parameters.o	8426	296	0	8722
mission_parameters_initialiser.o	44	1	0	45
mission_verification_values.o	1348	100	0	1448
monitor.o	24	1	0	25
monitor_parser.o	24	1	0	25
monitoring_list.o	24	1	0	25
monitoring_list_exceptions.o	68	140	0	208
on_board_scheduler.o	24	1	0	25
on_board_scheduling_parser.o	24	1	0	25
on_board_scheduling_types.o	2444	32	0	2476
on_off_driver.o	538	1	0	539
onboard_monitoring_types.o	3780	88	0	3868
onboard_storage-dispatcher.o	7605	236	0	7841
onboard_storage-interface_manager.o	1084	1	0	1085
onboard_storage-parameters.o	136	76	0	212
onboard_storage-router.o	937	0	0	937
onboard_storage-storage_and_retrieval_manager.o	20145	412	0	20557
onboard_storage-tc_interpreter.o	436	1	0	437
onboard_storage.o	128	1	0	129
onboard_storage_administrator.o	128	1	0	129
packet_counters_manager.o	4596	1	53420	58017
packet_depositor-sdu_support.o	24	1	0	25
packet_depositor.o	24	1	0	25
packet_router.o	6493	148	0	6641
packet_router_initialiser.o	44	1	0	45
packet_router_parameters.o	0	12	0	12
packet_store.o	24	1	0	25
packet_store_types.o	2032	32	0	2064
param_monitor.o	24	1	0	25



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Filename	Text	Data	BSS	Total
parameter_monitoring_definitions.o	5276	184	0	5460
parameter_representation.o	250920	4153	0	255073
parameter_representation_constraints.o	0	0	0	0
parameter_structure_descriptions-payload.o	652	60	0	712
parameter_structure_descriptions-power_conditioning_system.o	776	56	0	832
parameter_structure_descriptions.o	2056	88	0	2144
parameter_value_checker.o	24	1	0	25
parser.o	24	1	0	25
passive_controlled_queue.o	24	1	0	25
passive_queue.o	24	1	0	25
payload-dispatcher.o	7521	140	0	7661
payload-driver_if.o	1458	1	0	1459
payload-function_interpreter.o	9132	88	24	9244
payload-function_management.o	17241	542	0	17783
payload-hk_collector.o	179337	4088	0	183425
payload-interfaces-platform_interface.o	112	1	0	113
payload-interfaces-sensor_interface.o	184	1	0	185
payload-interfaces.o	0	0	0	0
payload-parameters.o	40	46	0	86
payload-router.o	937	0	0	937
payload-science_manager-image_representation.o	1608	2	0	1610
payload-science_manager.o	15027	296	1044	16367
payload-storage_selection_defs.o	18657	300	0	18957
payload-tc_acknowledger.o	411	2	0	413
payload-tc_interpreter.o	580	1	0	581
payload.o	144	1	0	145
power_conditioning_system-dispatcher.o	7561	160	0	7721
power_conditioning_system-driver_if.o	2868	1	96	2965
power_conditioning_system-function_interpreter.o	3421	196	16	3633
power_conditioning_system-function_management.o	17449	642	0	18091
power_conditioning_system-hk_collector.o	180705	4744	0	185449
power_conditioning_system-interfaces-pcu_simulator.o	1580	20	16	1616
power_conditioning_system-interfaces-pdu_simulator.o	4087	168	28	4283
power_conditioning_system-interfaces.o	0	0	0	0
power_conditioning_system-monitoring.o	227325	5936	0	233261
power_conditioning_system-parameters.o	40	64	0	104
power_conditioning_system-router.o	937	0	0	937
power_conditioning_system-storage_selection_defs.o	18689	336	0	19025
power_conditioning_system-tc_acknowledger.o	411	2	0	413
power_conditioning_system-tc_interpreter.o	620	1	0	621
power_conditioning_system.o	152	1	0	153
processor_control.o	192	1	36	229
protected_map_type.o	24	1	0	25
pus.o	0	1	0	1
pus_data_types.o	2667	148	0	2815
pus_packet_manager.o	7970	128	544	8642
pus_parser.o	24	1	0	25
pus_state.o	8379	64	2340	10783



<i>Filename</i>	<i>Text</i>	<i>Data</i>	<i>BSS</i>	<i>Total</i>
queue.o	24	1	0	25
register_driver.o	504	1	0	505
resource_manager.o	24	1	0	25
satellite_clock.o	8956	128	17	9101
serial_interface-uart_interface.o	24	1	0	25
serial_interface.o	24	1	0	25
source_data_initialiser.o	69	1	0	70
source_data_manager.o	22656	840	0	23496
source_data_stream.o	24594	136	0	24730
sporadic_task.o	24	1	0	25
standard_thresholds.o	15531	1	0	15532
storage_and_retrieval.o	24	1	0	25
storage_configuration.o	0	0	0	0
storage_selection_defs.o	24	1	0	25
storage_selection_manager.o	29680	1	1532	31213
system_clock.o	72	0	0	72
task_priority_control.o	0	8	0	8
tc_acknowledger.o	4064	64	0	4128
telecommand_verification_generator.o	24	1	0	25
timeout_control.o	24	1	0	25
transition_reporting_list.o	24	1	0	25
universal_parameter_representation-integer.o	2479	79	0	2558
universal_parameter_representation-real.o	2844	76	0	2920
universal_parameter_representation.o	3342	215	4	3561
up_down_link_bus.o	7034	156	0	7190
up_down_link_parameters.o	8556	80	0	8636
verification_types.o	1095	16	0	1111
Total	2037418	48460	66113	2151991



Appendix B

Demonstrator CPU Utilisations



The detailed results of the functional profiling are presented below. The period across which this profiling has been performed is characterised as follows⁵:

<i>Cycles</i>	779369000
<i>Instructions</i>	438123454
<i>Overall CPI</i>	1.75
<i>CPU performance (20.0 MHz)</i>	11.42 MOPS
<i>Simulated time</i>	38.97 s
<i>Processor utilisation</i>	98.43 %

The detailed profiling presented below has been produced using the 'prof' command in the TSIM ERC32 emulator. The entries represents the relative amount of time that has been spent in function calls to the identified functions. Entries are sorted descending according to the ratio.

Function	Ratio (%)
system__task_primitives__operations__init_proc	92.24
kernel__threads__thread_caller	92.23
ground_if__the_ground_if__application_process_dispatcher__the_dispatcher__sporadic__taskTKBXbb	51.87
ground_if__the_ground_if__application_process_dispatcher__convert_and_handle_pus__packetXb	51.84
payload__science_manager__science_collector__cyclic_taskTKBXn	35.55
payload__science_manager__get_current_seed	35.51
source_data_stream__put__2	35.21
payload__science_manager__image_representation__put__2	35.12
payload__science_manager__image_representation__put	35.11
up_down_link_bus__send	28.13
up_down_link_bus__the_uart__write_tx_registerX	27.72
up_down_link_parameters__convert_from_pus_to_ground_external_packet	23.49
external_pus_state__external_tm_packet_to_byte_array	23.38
source_data_stream__make_image_from_stream	19.82
up_down_link_bus__the_uart__uart__write_tx_registerXb	19.81
source_data_stream__get__2	19.80
set_next_running	17.82
kernel__interrupts__wrapper	16.38
system__interrupts__ada_interrupt_wrapper	13.04
up_down_link_bus__uart_handlerPT__handle_ready_interruptP	11.84

⁵ This is the output of a 'perf' command in the TSIM ERC32 emulator.



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Function	Ratio (%)
kernel_mutex_lock	5.37
kernel_mutex_unlock	5.07
up_down_link_bus_uart_handlerPT_handle_ready_interruptN	5.05
kernel_threads_set_active_priority	4.52
up_down_link_bus_uart_handlerPT_E13s	3.93
_exit	3.63
external_pus_state_make_and_check_tm_packet_header	3.53
basic_types_elabb	3.51
iso_checksum_calculate_checksum	3.49
up_down_link_bus_the_uart_signal_transmission_is_readyX	3.33
ada_synchronous_task_control_suspend_until_true	3.10
up_down_link_bus_the_uart_uart_enable_transmissionXb	3.02
kernel_threads_protection_leave_kernel	3.00
power_conditioning_system_hk_collector_tc_interpreter_event_manager_event_task_cyclic_taskTKBXnbb	2.79
ada_synchronous_task_control_set_true	2.79
power_conditioning_system_hk_collector_tc_interpreter_event_manager_collect_parameters_dueXnb	2.78
_gnat_stack_check	1.98
system_tasking_protected_objects_single_entry_service_entry	1.94
_CLOCK_SPEED	1.90
main	1.90
system_tasking_protected_objects_single_entry_po_service_entry	1.77
system_task_primitives_operations_unlock	1.66
_ada_demonstrator	1.61
processor_control_power_down	1.57
system_tasking_protected_objects_single_entry_unlock_entry	1.55
system_task_primitives_operations_write_lock	1.53
system_soft_links_set_jmpbuf_address_soft	1.52
power_conditioning_system_hk_collector_tc_interpreter_report_generator_measure_parameter_and_generate_report_when_dueXnb	1.49
system_tasking_protected_objects_single_entry_lock_entry	1.43
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_get_events_dueXnbb	1.28
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_critical_regionPT_get_events_duePXnbb	1.27
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_critical_regionPT_get_events_dueNXnbb	1.27
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_get_events_due_on_time_lineXnbb	1.27



Function	Ratio (%)
source_data_stream__put	1.24
cell_stream__put	1.20
kernel__threads__queues__insert_at_tail	1.07
up_down_link_bus__the_uart__read_status_registerX	1.04
power_conditioning_system__hk_collector__tc_interpreter__report_generator__generate_reportXnb	0.95
kernel__threads__protection__enter_kernel	0.90
kernel__threads__queues__extract_from_ready	0.88
kernel__threads__queues__insert_at_head	0.88
system__task_primitives__operations__self	0.87
parameter_representation__put__30	0.83
parameter_representation__put__82	0.82
system__soft_links__get_jmpbuf_address_soft	0.80
text_start	0.64
payload__hk_collector__tc_interpreter__event_manager__event_task__cyclic_taskTKBXnbb	0.63
payload__hk_collector__tc_interpreter__event_manager__collect_parameters_dueXnb	0.62
.div	0.61
enable_interrupts	0.60
disable_interrupts	0.57
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__remove_headXnbb	0.56
kernel__threads__queues__next_running	0.51
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__schedule_eventXnbb	0.50
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__place_event_on_time_lineXnbb	0.50
up_down_link_bus__uart_handlerPT__B14s	0.48
payload__hk_collector__tc_interpreter__report_generator__measure_parameter_and_generate_report_when_dueXnb	0.48
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__the_monitor__cyclic_taskTKBXnbb	0.45
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_parameters_dueXnb	0.44
kernel_condition_signal	0.42
kernel__threads__atcb__thread_self_atcb	0.41
memcpy	0.40
payload__hk_collector__tc_interpreter__report_generator__generate_reportXnb	0.37
adainit	0.29
up_down_link_bus__receiver__event_taskTKBX	0.23



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Function	Ratio (%)
power_conditioning_system_monitoring_the_monitor_parser_the_param_monitor_the_parameter_value_checker_monitor_parameterXnbb	0.22
system_tasking_protected_objects_single_entry_protected_single_entry_call	0.21
packet_router_packet_forwarder_sporadic_taskTKBX	0.19
kernel_threads_protection_dispatch	0.19
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_cyclic_event_intervals_applyXnbbb	0.18
satellite_clock_get_time	0.18
power_conditioning_system_monitoring_the_monitor_parser_the_param_monitor_the_parameter_value_checker_make_checksXnbb	0.17
power_conditioning_system_driver_if_receive	0.17
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_cyclic_event_intervals_map_implementation_find_indexXnbbbb	0.16
power_conditioning_system_monitoring_the_monitor_parser_the_monitoring_list_the_monitoring_list_applyXnb_2	0.16
power_conditioning_system_hk_collector_tc_interpreter_report_generator_sid_map_applyXnbb_2	0.16
power_conditioning_system_monitoring_the_monitor_parser_the_monitoring_list_the_monitoring_list_map_protectorPT_applyPXnb_2	0.16
parameter_representation_put_36	0.15
parameter_representation_put_88	0.15
satellite_clock_elabs	0.15
power_conditioning_system_hk_collector_tc_interpreter_report_generator_sid_map_map_protectorPT_applyPXnbb_2	0.15
up_down_link_bus_the_uart_uart_read_status_registerXb	0.15
power_conditioning_system_driver_if_is_legal_parameter_id	0.14
payload_hk_collector_tc_interpreter_event_manager_the_event_scheduler_get_events_dueXnbb	0.14
system_tasking_protected_objects_unlock	0.13
payload_hk_collector_tc_interpreter_event_manager_the_event_scheduler_critical_regionPT_get_events_duePXnbb	0.13
ground_if_the_ground_if_receiver_the_receiver_sporadic_taskTKBXbb	0.13
payload_hk_collector_tc_interpreter_event_manager_the_event_scheduler_critical_regionPT_get_events_dueNXnbb	0.13
system_task_primitives_operations_set	0.13
ground_if_the_ground_if_receiver_receiveXb	0.13
payload_hk_collector_tc_interpreter_event_manager_the_event_scheduler_get_events_due_on_time_lineXnbb	0.13
system_tasking_protected_objects_lock	0.12
up_down_link_parameters_convert_from_ground_external_to_pus_packet	0.12
storage_selection_manager_get_destination_packet_store_id	0.12
external_pus_state_byte_array_to_external_tc_packet	0.12



Function	Ratio (%)
ground_if__receive	0.12
ground_if__the_ground_if__receiveX	0.11
ground_if__the_ground_if__sync_protocol__receiveXb	0.11
source_data_stream__get	0.11
power_conditioning_system__hk_collector__tc_interpreter_task__sporadic_taskTKBXn	0.10
power_conditioning_system__hk_collector__handle_pus_packet	0.10
power_conditioning_system__hk_collector__tc_interpreter__execute_telecommandXn	0.10
dynamic_application_process_descrs_initialiser__elabb	0.10
cell_stream__get	0.10
power_conditioning_system__monitoring__monitor_tc_interpreter__the_tc_interpreter__sporadic_taskTKBXnb	0.10
power_conditioning_system__monitoring__monitor_tc_interpreter__execute_telecommandXn	0.10
source_data_stream__make_stream_from_image	0.10
pus_state__generate_pus__2	0.09
parameter_representation__put__26	0.09
power_conditioning_system__monitoring__the_monitor_parser__the_monitoring_list__the_monitoring_list_map_protectorPT__applyNXnb__2	0.09
parameter_representation__put__78	0.09
system__stack_checking__elabs	0.08
ground_if__the_ground_if__the_circular_buffer__putXb__2	0.08
power_conditioning_system__monitoring__the_monitor_parser__the_monitoring_list__get_monitoring_definitionsXnb	0.08
power_conditioning_system__hk_collector__tc_interpreter__report_generator__sid_map__map_protectorPT__applyNXnbb__2	0.08
tc_acknowledger__make_tc_verification	0.08
__gnat_malloc	0.08
tc_acknowledger__elabs	0.08
kernel_initialize	0.08
kernel_check_no_mutexes	0.07
ground_if__the_ground_if__the_circular_buffer__bufferPT__putPXb__2	0.07
kernel_condition_wait	0.07
power_conditioning_system__monitoring__the_monitor_parser__the_monitoring_list__the_monitoring_list__the_map__applyXnb__2	0.07
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__the_parameter_value_checker__make_checkXnbb	0.07
system__tasking__protected_objects__single_entry__wait_for_completion	0.07
system__task_primitives__operations__sleep	0.07
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__cyclic_event_intervals__map_implementation__find_root_indexXnbbbb	0.07
power_conditioning_system__interfaces__pdu_simulator__read_output_voltage	0.07



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Function	Ratio (%)
system__soft_links__get_gnat_exception	0.07
parameter_representation__put__13	0.06
storage_selection_manager__init_proc__5	0.06
parameter_representation__get__70	0.06
parameter_representation__put__65	0.06
system__tasking__protected_objects__single_entry__po_do_or_queue	0.06
ground_if__the_ground_if__the_circular_buffer__bufferPT__putNXb__2	0.06
kernel_thread_self	0.06
power_conditioning_system__monitoring__the_monitor_parser__the_monitoring_list__the_monitoring_list__the_map__map_implementation__find_indexXnbbnn	0.06
storage_selection_manager__get_routing_destination_apid	0.06
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_scheduler__get_events_dueXnbb	0.06
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_scheduler__critical_regionPT__get_events_duePXnbb	0.05
external_pus_state__pus_packet_to_external_tm_packet	0.05
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_scheduler__critical_regionPT__get_events_dueNXnbb	0.05
payload__hk_collector__tc_interpreter_task__sporadic_taskTKBXn	0.05
payload__hk_collector__handle_pus_packet	0.05
power_conditioning_system__hk_collector__tc_interpreter__report_generator__sid_map__the_map__applyXnbb__2	0.05
payload__hk_collector__tc_interpreter__execute_telecommandXn	0.05
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_scheduler__get_events_due_on_time_lineXnbb	0.05
mission_parameters__rep_to_pos__3	0.05
parameter_structure_descriptions__get	0.05
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__cyclic_event_intervals__map_implementation__descent_right_subtreeXnbbbb	0.05
power_conditioning_system__monitoring__the_monitor_parser__the_monitoring_list__get_value_repetitionsXnb	0.05
power_conditioning_system__hk_collector__tc_interpreter__send_tmXn	0.04
payload__router__deposit	0.04
source_data_manager__dereference	0.04
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__cyclic_event_intervals__map_implementation__descent_left_subtreeXnbbb	0.04
power_conditioning_system__monitoring__the_monitor_parser__parse_tcXn	0.04
power_conditioning_system__monitoring__the_monitor_parser__the_parser__parse_tcXn	0.04



Function	Ratio (%)
payload__hk_collector__tc_interpreter__event_manager__the_event_scheduler__remove_headXnbb	0.04
system__task_primitives__operations__write_lock__2	0.04
power_conditioning_system__monitoring__the_monitor_parser__parse_source_dataXn	0.04
power_conditioning_system__monitoring__the_monitor_parser__the_monitoring_list__parameter_is_validXnb	0.04
payload__hk_collector__tc_interpreter__event_manager__the_event_scheduler__schedule_eventXnbb	0.04
pus_state__dispose_pus	0.04
system__exp_ft__exp_float	0.04
source_data_stream__deallocate	0.04
payload__hk_collector__tc_interpreter__event_manager__the_event_scheduler__place_event_on_time_lineXnbb	0.04
source_data_manager__deallocate	0.04
storage_selection_manager__init_proc__4	0.03
pus_packet_manager__init_proc__4	0.03
packet_counters_manager__get_next_tm_packet_subcounter	0.03
parameter_representation__make_standard_value__3	0.03
power_conditioning_system__monitoring__the_monitor_parser__parse_add_parameters_to_monitoring_listXn	0.03
ground_if__forward_packet	0.03
ground_if__the_ground_if__forward_packetX	0.03
payload__hk_collector__tc_interpreter__report_generator__sid_map__applyXnbb__2	0.03
power_conditioning_system__hk_collector__tc_interpreter__report_generator__sid_map__the_map__map_implementation__find_indexXnbbbn	0.03
payload__hk_collector__tc_interpreter__report_generator__sid_map__map_protectorPT__applyPXnbb__2	0.03
context_trap	0.03
ground_if__the_ground_if__application_process_dispatcher__forward_packetXb	0.03
ground_if__the_ground_if__application_process_dispatcher__the_dispatcher__startXbb	0.03
ground_if__the_ground_if__application_process_dispatcher__the_dispatcher__event_buffer_depositXbbb	0.03
power_conditioning_system__monitoring__the_monitor_parser__parse_parameter_additionsXn	0.03
packet_router__deposit	0.03
ground_if__the_ground_if__application_process_dispatcher__the_dispatcher__event_buffer_queuePT__depositPXbbb	0.03
power_conditioning_system__monitoring__the_monitor_parser__verify_stageXn	0.03
power_conditioning_system__hk_collector__tc_interpreter__event_manager__enable_reportXnb	0.03
power_conditioning_system__hk_collector__tc_interpreter__event_manager__add_eventsXnb	0.03



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Function	Ratio (%)
source_data_manager__large_cell_pool__dereferenceX	0.03
packet_router__packet_forwarder__startX	0.03
packet_router__packet_forwarder__event_buffer__depositXb	0.03
packet_router__packet_forwarder__event_buffer__queuePT__depositPXb	0.03
source_data_manager__large_cell_pool__store_manager__is_allocatedXb	0.03
payload__hk_collector__tc_interpreter__event_manager__the_event_scheduler__cyclic_event_intervals__applyXnbbb	0.03
parameter_representation__put__69	0.03
external_hk_collector_types__put__12	0.03
payload__function_management__the_tc_interpreter__sporadic_taskTKBXn	0.03
source_data_manager__large_cell_pool__deallocateX	0.02
source_data_manager__large_cell_pool__store_manager__allocatorPT__is_allocatedPXb	0.02
payload__function_management__handle_pus_packet	0.02
system__exception_table__register_exception	0.02
ground_if__the_ground_if__application_process_dispatcher__the_dispatcher__event_buffer__queuePT__depositNXbbb	0.02
system__exception_table__exception_htable__setXn	0.02
source_data_manager__large_cell_pool__store_manager__allocatorPT__deallocatePXb	0.02
source_data_manager__large_cell_pool__store_manager__deallocateXb	0.02
pus_packet_manager__deallocate	0.02
system__exception_table__hash	0.02
parameter_structure_descriptions__power_conditioning_system__get_parameter_code	0.02
data_handling_system__tc_scheduler__obs_scheduler__the_scheduler__cyclic_taskTKBXnb	0.02
storage_selection_manager__init_proc__2	0.02
power_conditioning_system__hk_collector__tc_interpreter__report_generator__sid_map__map_protectorPT__is_inPXnbb	0.02
packet_router__packet_forwarder__event_buffer__queuePT__depositNXb	0.02
power_conditioning_system__interfaces__pdu_simulator__read_output_current	0.02
payload__hk_collector__tc_interpreter__event_manager__the_event_scheduler__cyclic_event_intervals__map_implementation__find_indexXnbbbb	0.02
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__add_cyclic_eventXnbb	0.02
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__critical_regionPT__add_cyclic_eventPXnbb	0.02
system__arith_64__multiply_with_ovflo_check	0.02
ada_tags__external_tag_htable__setXn	0.02
payload__router__update_counters	0.02
ada_tags__register_tag	0.02
kernel__peripherals__priority_of_interrupt	0.02



Function	Ratio (%)
ada_tags_hash	0.02
payload_hk_collector_tc_interpreter_send_tmXn	0.02
kernel_mutex_init	0.02
power_conditioning_system_hk_collector_tc_interpreter_send_verificationXn	0.02
packet_router_packet_forwarder_event_buffer_extractXb	0.02
payload_hk_collector_tc_interpreter_send_verificationXn	0.02
system_finalization_implementation_finalize_list	0.02
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_critical_regionPT_add_cyclic_eventNXnbb	0.02
power_conditioning_system_monitoring_the_monitor_parser_the_monitoring_list_the_monitoring_list_map_protectorPT_is_inPXnb	0.02
power_conditioning_system_monitoring_the_monitor_parser_the_monitoring_list_the_monitoring_list_the_map_map_implementation_find_root_indexXnbbnn	0.02
kernel_delay_until	0.02
power_conditioning_system_interfaces_pdu_simulator_read_switch_state	0.02
data_handling_system_router_optional_deposit	0.02
source_data_stream_allocate	0.02
power_conditioning_system_hk_collector_elabb	0.02
external_on_board_clock_get_current_obt	0.02
ground_if_the_ground_if_application_process_dispatcher_the_dispatcher_event_buffer_extractXbbb	0.02
payload_hk_collector_elabb	0.02
source_data_stream_share	0.02
external_pus_state_dispose_2	0.02
source_data_manager_share	0.02
payload_hk_collector_tc_interpreter_report_generator_sid_map_map_protectorPT_applyNXnbb_2	0.02
ada_real_time_delays_delay_until	0.01
data_handling_system_tc_scheduler_obs_scheduler_schedule_telecommands_dueXn	0.01
power_conditioning_system_hk_collector_tc_interpreter_event_manager_the_event_scheduler_cyclic_event_intervals_map_implementation_make_treeXnbbbbb	0.01
power_conditioning_system_hk_collector_tc_interpreter_report_generator_sid_map_the_map_map_implementation_make_treeXnbbbn	0.01
pus_state_generate_pus	0.01
source_data_manager_allocate	0.01
source_data_manager_large_cell_pool_store_manager_allocatorPT_allocatePXb	0.01
source_data_manager_elabb	0.01
power_conditioning_system_monitoring_the_monitor_parser_parse_limit_specificationsXn	0.01
system_task_primitives_operations_unlock_2	0.01



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Function	Ratio (%)
payload_interfaces_sensor_interface_readout_image_row	0.01
power_conditioning_system_monitoring_the_monitor_parser_the_param_monitor_monitor_scheduler_cyclic_event_intervals_applyXnbbb	0.01
system_task_primitives_operations_write_lock_3	0.01
power_conditioning_system_router_deposit	0.01
power_conditioning_system_router_optional_deposit	0.01
source_data_manager_large_cell_pool_store_manager_allocatorPT_sharePXb	0.01
payload_driver_if_receive	0.01
__muldi3	0.01
system_task_primitives_operations_timed_delay	0.01
power_conditioning_system_monitoring_the_monitor_parser_the_monitoring_list_the_monitoring_list_the_map_map_implementation_make_treeXnbbnn	0.01
parameter_representation_put_67	0.01
power_conditioning_system_monitoring_the_monitor_parser_parse_parameter_check_specificationXn	0.01
payload_function_management_the_parser_transform_telecommandXn	0.01
.udiv	0.01
iso_checksum_checksum_ok	0.01
power_conditioning_system_monitoring_the_monitor_parser_the_param_monitor_monitor_scheduler_schedule_eventXnbb	0.01
payload_function_management_the_parser_parse_function_idXn	0.01
external_function_management_types_get_3	0.01
parameter_representation_character_get	0.01
parameter_representation_get_114	0.01
power_conditioning_system_monitoring_the_monitor_parser_interpret_tcXn_2	0.01
data_handling_system_tc_scheduler_obs_schedule_get_telecommands_dueXn	0.01
ada_tags_get_ht_link	0.01
power_conditioning_system_monitoring_the_monitor_parser_parse_limit_specificationXn	0.01
power_conditioning_system_monitoring_the_monitor_parser_the_monitoring_list_the_monitoring_list_the_map_map_implementation_descent_right_subtreeXnbbnn	0.01
data_handling_system_tc_scheduler_obs_schedule_critical_regionPT_get_telecommands_duePXn	0.01
ada_synchronous_task_control_current_state	0.01
pus_packet_manager_allocate	0.01
system_secondary_stack_ss_allocate	0.01
cdh_structure_initialiser_initialize	0.01
payload_hk_collector_tc_interpreter_report_generator_sid_map_the_map_applyXnbb_2	0.01
dynamic_application_process_descrs_initialiser_initialize	0.01
malloc	0.01



Function	Ratio (%)
packet_counters_manager__init_appl_proc_descr	0.01
basic_types__make_cuc_representation_conform	0.01
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_scheduler__place_event_on_time_lineXnbb	0.01
power_conditioning_system__monitoring__the_monitor_parser__the_param_monitor__monitor_scheduler__cyclic_event_intervals__map_implementation__find_indexXnbbbb	0.01
source_data_manager__small_cell_pool__store_manager__allocatorPT__deallocatePXb	0.01
source_data_manager__large_cell_pool__shareX	0.01
source_data_manager__dereference_safe	0.01
source_data_manager__small_cell_pool__store_manager__deallocateXb	0.01
packet_counters_manager__get_next_tm_counter	0.01
__malloc_r	0.01
payload__router__optional_deposit	0.01
data_handling_system__large_data_manager__elabb	0.01
source_data_manager__large_cell_pool__allocateX	0.01
external_hk_collector_types__put__13	0.01
power_conditioning_system__hk_collector__tc_interpreter__event_manager__the_event_scheduler__cyclic_event_intervals__map_implementation__is_leafXnbbbb	0.01
parameter_representation__elabs	0.01
storage_selection_manager__init_proc__3	0.01
data_handling_system__event_action_manager__elabs	0.01
pus_packet_manager__elabb	0.01
power_conditioning_system__monitoring__elabb	0.01
data_handling_system__tc_scheduler__obs_schedule__critical_regionPT__get_telecom_mands_dueNXn	0.01
payload__tc_acknowledger__generate_tc_verification	0.01
hk_collector_types__init_proc__3	0.01
source_data_manager__large_cell_pool__store_manager__shareXb	0.01
pus_packet_manager__share	0.01
parameter_representation__get__87	0.01
source_data_manager__large_cell_pool__store_manager__allocateXb	0.01
system__tasking__restricted__stages__create_restricted_task	0.01
data_handling_system__tc_scheduler__obs_schedule__do_get_telecommands_dueXn	0.01
__divdi3	0.01
system__tasking__protected_objects__single_entry__wakeup_entry_caller	0.01
power_conditioning_system__interfaces__pcu_simulator__get_system_parameter	0.01
system__task_primitives__operations__elabb	0.01
parameter_representation__get__79	0.01
power_conditioning_system__interfaces__pcu_simulator__get_temperature_reading	0.01



**OBOSS System Integration Frame Contract Call-Off 1
Technical Budgets**

Function	Ratio (%)
system__tasking__restricted__stages__activate__restricted__tasks	0.01