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Coloured Petri Net Modelling of a Generic Avionics Mission Computer

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ABSTRACT

A Coloured Petri Net has been developed to model real-time task scheduling in avionics mission computers. The model has been applied to a generic avionics mission computer specification, and results are presented for a range of task scheduling protocols. Model input data, output data and complete design are documented to support application of the model to other mission computer hardware and software architectures.

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Executive Summary

Avionics mission computers for military aircraft provide functionality critical to successful mission execution. The large-scale, real-time computer software needed to implement this functionality has led to the utilisation of multi-processor mission computers to accommodate the large software load. Guaranteeing correct real-time performance for large scale, heavily loaded, single processor systems is difficult, and for multi-processor systems is even more so. Long service lifetimes of military aircraft inevitably lead to requirements to change mission software, and the issue of determining correct real-time behaviour has to be addressed.

This report documents a modelling activity performed under DSTO task DST 00/061 "Avionics Enabling Research and Development". A Coloured Petri Net model has been constructed to model real-time mission computer behaviour for a range of mission software and mission computer architectures. Key aspects of the model are discussed to assist with future application of the model to particular mission computer architectures. The Coloured Petri Net model is demonstrated to correctly determine real-time performance for a hypothetical set of software tasks being executed on a single processor mission computer, for a range of task scheduling protocols.

The Coloured Petri Net model is also able to model the real-time behaviour of interacting tasks on multi-processor systems. Application of the Coloured Petri Net model to multi-processor mission computer architectures will offer a means of analysing systems which do not meet the strict assumptions needed for theoretical analysis. The model will permit comparisons between alternative software and mission computer architectures, will determine resource usages that are approaching utilisation limits, and will identify circumstances under which real-time performance requirements are not met.

Contents

1. INTRODUCTION.....	1
2. GENERIC AVIONICS MISSION SYSTEM SPECIFICATION	1
3. COLOURED PETRI NET MODEL	2
3.1 Coloured Petri Net Semantics	2
3.2 Model Overview	4
3.2.1 Task Set Specifications	4
3.2.2 Model Output.....	6
3.2.3 Top Level Abstraction.....	7
3.2.4 Task Resource Sequencing	8
3.2.5 Task Queueing	9
4. MODELLING RESULTS	10
4.1 Non-Preemptive Fixed Priority Scheduling.....	11
4.2 Preemptive Fixed Priority Scheduling.....	12
4.3 Asynchronous Fixed Priority Scheduling	13
4.4 Dynamic Priority Scheduling.....	14
4.5 Static Scheduling	15
4.6 Response Time Summary.....	16
5. CONCLUSIONS.....	18
6. REFERENCES	18
APPENDIX A: COLOURED PETRI NET MODEL PAGES.....	19
A.1. <i>Hierarchy</i> Model Page	19
A.2. <i>Global_Declarations</i> Model Page.....	20
A.3. <i>Initialisation</i> Model Page	21
A.4. <i>Generic_AMS</i> Model Page.....	22
A.5. <i>Task_Initialisation</i> Model Page	23
A.6. <i>Periodic_Task_Arrival</i> Model Page.....	24
A.7. <i>Task_Sequencing</i> Model Page.....	25
A.8. <i>Task_Termination</i> Model Page	26
A.9. <i>Task_Input_Output</i> Model Page.....	27
A.10. <i>IO_Allocation</i> Model Page	28
A.11. <i>IO_Processing</i> Model Page	29
A.12. <i>CPU_Allocation</i> Model Page.....	30
A.13. <i>Task_Enqueueing</i> Model Page	31
A.14. <i>Task_Processing</i> Model Page	32
A.15. <i>Send_Processing</i> Model Page.....	33
A.16. <i>Invoke_Processing</i> Model Page.....	34

A.17. <i>Receive_Processing</i> Model Page.....	35
A.18. <i>Receive_Okay</i> Model Page.....	36
A.19. <i>Receive_Blocked</i> Model Page	37
A.20. <i>Give_Processing</i> Model Page.....	38
A.21. <i>Take_Processing</i> Model Page	39
A.22. <i>Take_Okay</i> Model Page.....	40
A.23. <i>Take_Blocked</i> Model Page	41
A.24. <i>Compute_Processing</i> Model Page	42
 APPENDIX B: SUPPORT FUNCTIONS	 43
 APPENDIX C: TASK AND I/O SPECIFICATIONS	 48
C.1. Non-Preemptive Fixed Priority Task Specifications	48
C.2. Preemptive Fixed Priority Task Specifications	49
C.3. Asynchronous Fixed Priority Task Specifications	51
C.4. Dynamic Priority Task Specifications.....	53
C.5. Static Schedule Task Specifications	54
C.6. I/O Message Specifications	83

1. Introduction

Avionics mission computers are typically highly constrained by size, weight and environmental restrictions, while being required to provide high levels of mission functionality to compensate for the limited number of mission crew that can be accommodated on airborne platforms. The large-scale, real-time software applications needed to implement high levels of mission functionality can heavily load mission computer resources, and have led to the adoption of multi-processor architectures.

Large-scale, real-time software is partitioned into separate tasks, each with timing constraints to be observed for correct real-time performance. Scheduling of task executions such that all timing constraints are satisfied becomes more difficult as processor loadings increase. Schedulability analyses exist to confirm that correct operation is guaranteed for single processor computers with limited forms of interactions between tasks, but multi-processor architectures with complex interactions between tasks are not readily analysed.

Modelling mission computer architectures and software task sets in a Coloured Petri Net provides a means of analysing systems for which schedulability analysis is difficult or impossible. Coloured Petri Net models support simulation and state-space analysis. Simulation reproduces the behaviour of the modelled system, allowing detailed examination of task timings and detection of cases where timing constraints are not met. State-space analysis allows formal proof that a system can not enter an undesired state, such as a timing constraint not being satisfied, but suffers from high computational complexity for large models.

This report documents a Coloured Petri Net model developed to be able to model a wide range of mission software and mission computer architectures. An introduction to Coloured Petri Nets is provided, along with discussion of important aspects of the model, and the complete model design is appended in the form of Coloured Petri Net diagrams. Applicability of the model is demonstrated by determining the schedulability of a set of tasks on a generic avionics mission computer, for a number of task scheduling protocols. Schedulability analyses of the generic task set [1] have verified the correct operation of the model. Input data used to specify task set parameters is appended, to provide documented examples of applying the model to commonly used scheduling protocols.

2. Generic Avionics Mission System Specification

An informal specification for a simple generic avionics mission computer architecture and task set has been developed by Locke et al [2]. The specification is representative of a heavily loaded 16-bit single processor mission computer in a fighter aircraft, with no inter-task interactions and all task input/output (I/O) being performed on a single MIL-STD-1553B data bus.

The generic avionics mission system task and I/O specifications are summarised in Table 1. Aperiodic tasks, for which no period was specified, are treated as periodic tasks with implied periods equal to their deadlines, and some tasks have had their periods rounded down to simplify schedulability analysis. I/O message data word counts are shown in Table 1, within the Coloured Petri Net model I/O activity is modelled as requiring 20 μ s per data word, 40 μ s for command and status words, 12 μ s response time and 50 μ s inter-message gap time. Complete task and I/O specifications used by the model are shown in Appendix C.

Table 1. Generic avionics mission system task and I/O specifications

Task Name	Computation Time (ms)	Period (ms)	Deadline (ms)	Input Message Word Counts	Output Message Word Counts
Weapon release	1	10	5	3, 1	1
Radar tracking	2	40		24, 1	3
Target tracking	4	40		1, 4, 1, 3	6, 3
Target sweetening	2		40	1	
HOTAS bomb button	1		40	4	11
Aircraft flight data	8	50 (55)		5, 12, 1	3, 25, 18, 18
HUD display	6	50 (52)		18, 3, 4	7
MPD tactical display	8	50 (52)		1, 20, 20, 7, 3, 3	5
Steering	6	80		6, 1, 6, 3	3
Weapon trajectory	7	100		17, 3, 1, 1, 1	6
Threat response display	3		100		1, 1
AUTO/CCIP toggle	1		200	4	11
Poll RWR	2	200		20	2
Reinitiate trajectory	6		400	17, 3, 1, 1, 1	6
Periodic BIT	5	1000	400	1, 1, 1, 1, 1, 1	2

3. Coloured Petri Net Model

Coloured Petri Nets enable construction of parameterised models of concurrent systems in terms of states and transitions, with modularisation for large models and support for complex data types and data manipulation. Time is introduced through the use of a global clock, allowing investigation of real-time performance properties of systems. A brief introduction to Coloured Petri Net semantics is provided in §3.1, for a thorough introduction to Coloured Petri Nets see the publication by Jensen [3]. An overview of the Coloured Petri Net model is presented in §3.2.

3.1 Coloured Petri Net Semantics

Coloured Petri Nets are constructed using a simple graphical representation consisting primarily of places, transitions, arcs and tokens. Large or complex Coloured Petri Nets can be modularised into a number of separate graphical pages to assist with their development. Figure 1 shows examples of the graphical notation, along with a key

identifying graphical notation elements. Annotations can be attached to places, transitions and arcs to supply additional information needed to fully describe their properties.

Places are used to store the state of the system, and are diagrammatically represented by ellipses. Each place in a Coloured Petri Net is assigned a colour set, which is a description of the type of data that can reside in the place. Places can be assigned initial data values in the form of tokens, or can default to containing no data tokens.

Transitions describe the changes that happen when the system moves from one state to another, and are drawn as rectangles. A change in state involves a changed data value in one or more places, and arcs connect a transition to the places that are involved when the transition is said to occur and change the state of the system. A transition can only occur when it is enabled, which requires that the input data it consumes be available in all places that have arcs directed into the transition. Transitions may also have a guard expression, shown within square brackets in the Coloured Petri Net diagrams, which is a boolean valued expression that must evaluate to true for the transition to be enabled. When a transition occurs it generates output data to be sent to all places connected by arcs from the transition.

Arcs are directed lines showing the direction of data movement when a transition occurs. Arcs can only connect places to transitions or transitions to places. Annotations called arc expressions are attached to arcs to indicate the data that is required for a transition to be enabled, or the data that is generated when a transition occurs. Arc expressions typically bind data tokens to variable names to permit more elaborate manipulation of token values.

Data values within the model are referred to as tokens. Tokens are typed and belong to a colour set, and can only reside in places having the same colour set. Multiple tokens of the correct type can reside in a single place. The overall distribution of tokens on places is called a marking of a Coloured Petri Net. The initial state of a Coloured Petri Net is specified by assigning initial token values for places, otherwise known as the initial marking.

Substitution transitions provide a means to introduce modular abstraction into a Coloured Petri Net model, to assist with construction of large-scale models. A substitution transition

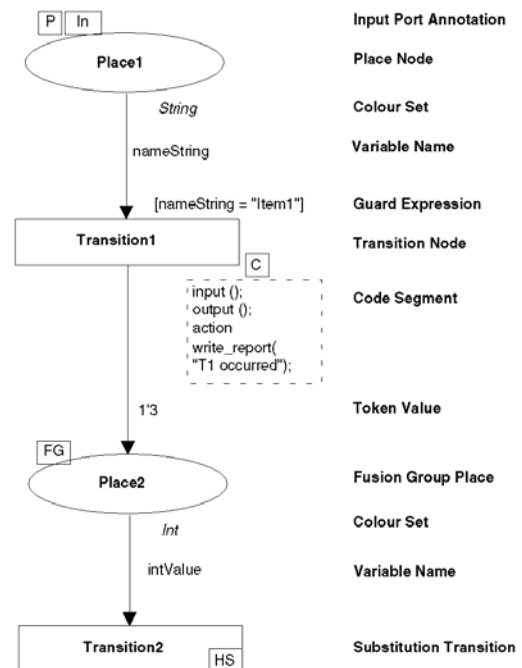


Figure 1. Coloured Petri Net notation

effectively encapsulates transition behaviour, allowing it to be fully developed on a separate diagram page. Multiple levels of substitution transitions can be used.

When a Coloured Petri Net model is executed, the places, transitions, arcs and initial marking determine which transitions are enabled, and the state of the model will change as transitions occur. For models utilising modelled time, model state can be referenced to modelled time to allow modelling of real-time performance.

3.2 Model Overview

The Coloured Petri Net model has been constructed with the aim of modelling as wide a range of mission computing architectures as possible, and uses substitution transition abstractions to partition the model into a number of separate pages. Discussion of key aspects of the model is provided in the following sections, while the complete model is reproduced in Appendix A.

3.2.1 Task Set Specifications

Specifications are required for task parameters, input/output message parameters, message queue definitions and semaphore definitions. The nature of these specifications are discussed in the following paragraphs.

Tasks are specified in terms of the fields in the *TaskRecord* colour set, defined in the *Global_Declarations* page of the model. Ten parameters must be specified for each task, and have interpretations as follows:

- *name* simply provides a descriptive identifier for a task;
- *priority* determines task priority, with lower numbers indicating higher priority. A negative value indicates that dynamic prioritisation is to be used, implemented by the earliest-deadline-first algorithm;
- *preemptable* is a boolean flag indicating whether a task is preemptable;
- *period* specifies the period for periodic tasks, and specifying a period less than or equal to zero signifies that a task is aperiodic;
- *phase* specifies a time delay offset from zero at which periodic scheduling begins;
- *deadline* specifies a time by which a task must be completed to satisfy its real-time constraints, normally set equal to task period for tasks without specific deadline requirements;
- *cpuNumber* identifies the processing resource on which a task is to be executed;
- *activationTime* sets an absolute time at which a task can first be executed, useful for specifying tasks that execute during part of a scenario;
- *deactivationTime* sets an absolute time after which a task can no longer become ready for execution, useful for specifying tasks that cease to execute after a certain stage of a scenario; and

- *computations* specifies a sequential list of operations that a task performs, formatted as a list of strings. This list uses pairings of operators and operands, with the available operator and operand pairings being:
 - *compute, time*. The *compute* operator is used to specify that a task requires *time* units of execution time;
 - *sleep, time*. The *sleep* operator specifies that a task is to enter a sleep state for *time* units of time;
 - *input, message*. The *input* operator specifies that blocking input of a defined *message* is to be performed;
 - *output, message*. The *output* operator specifies that blocking output of a defined *message* is to be performed;
 - *invoke, task*. The *invoke* operator specifies that an aperiodic *task* is to be scheduled for execution;
 - *take, semaphore*. The *take* operator specifies that a *semaphore* is to be taken. If the semaphore cannot be taken, the task must wait on a prioritised queue for the semaphore to become available. If the semaphore was defined to use the priority ceiling protocol, the task may have its priority elevated for the duration that it holds the semaphore;
 - *give, semaphore*. The *give* operator specifies that a *semaphore* is to be given;
 - *send, queue*. The *send* operator specifies that a message is to be sent to the named message *queue*; and
 - *receive, queue*. The *receive* operator specifies that a message is to be read from the named message *queue*. If no message is available to read from the queue, the task must wait on a prioritised queue for a message to arrive.

Input/output is performed over MIL-STD-1553B data busses, and messages are specified in terms of the fields of the *IORecord* colour set, defined in the *Global_Declarations* page of the model. Message parameters and their interpretations are:

- *messageName* provides a descriptive identifier for a message;
- *source* provides a description of the message source;
- *destination* provides a description of the message destination;
- *duration* specifies the total message time, including response time and inter-message gap time; and
- *databusNumber* specifies which MIL-STD-1553B data bus the message is allocated to.

Inter-process messaging is supported through the declaration of named message queues. Message queues are specified in terms of the fields of the *MQRecord* colour set, defined in the *Global_Declarations* page of the model. Message queue parameters and their interpretations are:

- *mqName* specifies a descriptive identifier for a message queue; and
- *mqMsgList* specifies an initial list of messages held in the queue, normally message queues will be specified to have an empty initial message list.

Inter-process synchronisation and mutual exclusion are supported through the declaration of semaphores, which can optionally use the priority ceiling protocol. The priority ceiling protocol is only suited to statically prioritised scheduling, and can not be used with dynamically prioritised scheduling. Semaphores are specified in terms of the fields of the *SemRecord* colour set, defined in the *Global_Declarations* page of the model. Semaphore parameters and their interpretations are:

- *semName* specifies a descriptive identifier for a semaphore;
- *semValue* specifies an initial value for a semaphore; and
- *priorityCeiling*, if greater than or equal to zero, specifies the priority that a task assumes on successfully taking the semaphore. If less than zero, it implies that the priority ceiling protocol is not in use.

3.2.2 Model Output

Execution of the Coloured Petri Net model is logged in a report file containing details of transition occurrences and bindings of values to model variables, which is useful for detailed analysis of model operation. Information of specific interest is added to this report file for post-execution analysis. The mechanism used to write to the report file is the *write_report* function, which can be placed in the *code segment* of a transition and is executed each time the transition occurs. Logging of transition occurrences and bindings can be turned off to produce a report file containing only model generated output.

Model execution assigns a unique identification number to each task arrival, which is used to identify the task in all subsequent model output. Simulated time is also contained in all output records. Model generated output is formatted in a consistent manner, to support automated post-processing of the output. Output records produced by the model take the forms:

- *time time id number arrival task_name;*
- *time time id number input_request;*
- *time time id number input_complete;*
- *time time id number output_request;*
- *time time id number output_complete;*
- *time time id number io_start databus_number;*
- *time time id number io_complete databus_number;*
- *time time id number execution_start cpu_number;*
- *time time id number execution_stop cpu_number;*
- *time time id number response_time time;*
- *time time id number slack_time time;*
- *time time id number termination_status on_time | late;*
- *time time id number semaphore_take sem_name succeeds;*
- *time time id number semaphore_take sem_name blocks;*
- *time time id number semaphore_take sem_name unblocks;*
- *time time id number semaphore_give sem_name;*
- *time time id number message_receive queue_name succeeds;*

- time *time id number* message_receive *queue_name* blocks;
- time *time id number* message_receive *queue_name* unblocks;
- time *time id number* message_send *queue_name*;
- time *time id number* invoke *task_name*;
- time *time id number* sleep_start; and
- time *time id number* sleep_stop.

3.2.3 Top Level Abstraction

The *Generic_AMS* model page is the top level abstraction for the Coloured Petri Net model, and is shown in Figure 2. This page reflects the basic real time computing paradigm where tasks are scheduled to execute periodically, or sporadically in response to some event, and have deadlines that must be met in order to fulfil their real-time performance requirements.

Place *Task_Descriptions* holds a single list of task information read from a data file. Task information is removed from this list by substitution transition *Task_Initialisation*, and tokens containing task control data are put into places *Periodic_Task_Control_Data* and *Aperiodic_Task_Control_Data*.

The *Periodic_Task_Arrival* substitution transition occurs when a periodic task becomes due for execution, replacing the token from the *Periodic_Task_Control_Data* place with a token updated for the next time at which the task becomes due for execution, and placing a task control record token on the *Ready_Tasks* place for subsequent execution. The *Aperiodic_Task_Arrival* transition has void arc expressions and never occurs, but is included to show that sporadic task control record tokens are also put into place *Ready_Tasks* when they become ready for execution.

Task control record tokens in place *Ready_Tasks* are processed by substitution transition *Task_Sequencing*, where they are allocated to processing resources and queued for execution according to priority and preemptability parameters. When task processing is complete, a task control record token is put into place *Executed_Tasks*. Tokens in place *Executed_Tasks* are consumed by the *Task_Termination* substitution transition, which records information about the task and its completion time.

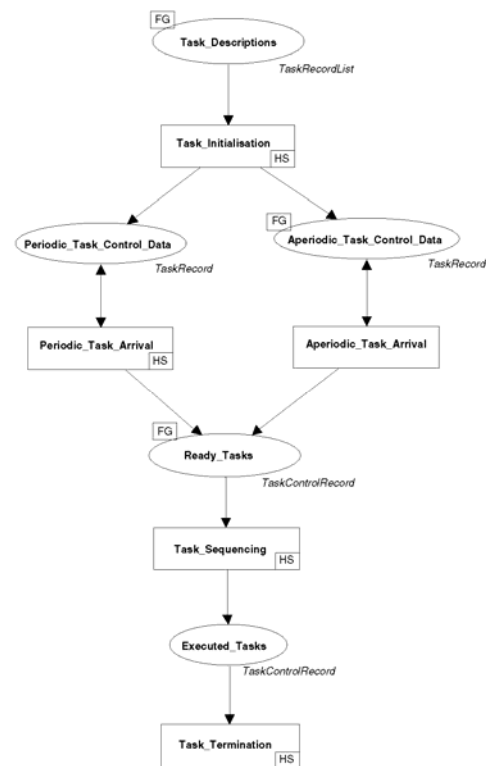


Figure 2. *Generic_AMS* model page

3.2.4 Task Resource Sequencing

The *Task_Sequencing* model page is shown in Figure 3. This page performs high level sequencing of ready tasks, allocating tasks to the type of processing resource needed for the task's next operation. Ready tasks whose next operation is *compute*, *invoke*, *take*, *give*, *send* or *receive* are allocated to a CPU resource by occurrence of the *Compute* transition. This transition places a task control record token into the *Compute_Tasking* place, for processing by the *Task_Compute* substitution transition. On completion of all possible CPU resourced operations, the *Task_Compute* substitution transition will place a task control record token into the *In_Progress_Tasks* place.

Ready tasks with a next operation of *sleep* are a special case not requiring any resources. The *Sleep* transition will occur for these tasks, removing the *sleep* operation from the head of the task's computation list, writing output for post-simulation analysis, and placing a task control record token into the *In_Progress_Tasks* place for further processing after expiration of the *sleep* delay.

Ready tasks with a next operation of *input* or *output* will enable occurrence of the *Input_Output* transition, placing a task control record token into the *IO_Tasking* place. Task control record tokens in the *IO_Tasking* place are allocated to I/O resources for I/O processing by substitution transition *Task_Input_Output*. On completion of all I/O resourced operations, the *Task_Input_Output* substitution transition will place a task control record token into the *In_Progress_Tasks* place.

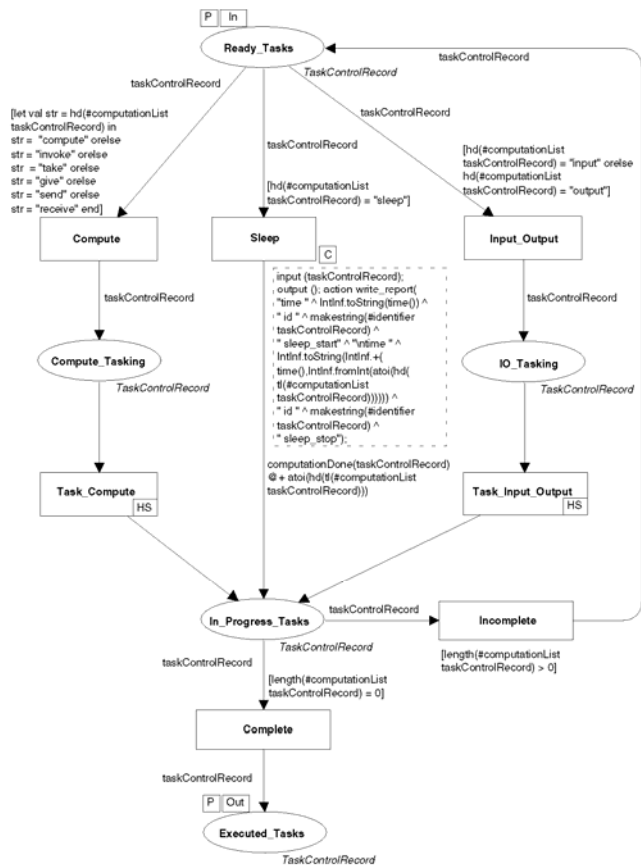


Figure 3. *Task_Sequencing* model page

Task control record tokens in the *In_Progress_Tasks* place will enable one of the complementary transitions *Complete* and *Incomplete*. Transition *Complete* will occur for tasks with no further operations to perform, resulting in a task control record token being placed into place *Executed_Tasks*. Transition *Incomplete* will occur for tasks with further operations pending, and places a task control record token back into place *Ready_Tasks* for allocation to a resource.

3.2.5 Task Queuing

Prioritised queuing of tasks is performed in the *Task_Enqueueing* model page, shown in Figure 4. A list of task control records is maintained within a single token, with task control records being inserted into the list in priority order.

Task control record tokens in place *Ready_Tasks* enable transition *Enqueue* if the task control record list token is in place *Ready_Queue*. Occurrence of transition *Enqueue* copies the task control record in place *Ready_Tasks* into the task control record prioritised list in place *Ready_Queue*.

Once the task control record list token in place *Ready_Queue* contains one or more task control records, the *Start* transition can occur and the task control record list token will be placed into the *Processing_Queue* place. The *Processing_Queue* place holds the prioritised list of tasks for processing by the *Task_Processing* substitution transition, which processes the head of the prioritised list.

Arrival of a task control record token on place *Ready_Tasks* when the task control record list token is on place *Processing_Queue* can interrupt the processing of the head of the task control record list. If the head task of the task control record list is preemptable or may not have started execution yet, transition *Interrupt* occurs and the task control record list token is placed into place *Interrupted*.

Once the task control record list token is in place *Interrupted*, one of the complementary transitions *Reschedule* or *Resume* will then be enabled. If the head task is preemptable or had not yet started execution, transition *Reschedule* will occur, the task control record will be inserted into the task control record list in priority order, and the task control record list token will be placed into place *Ready_Queue*. If the head task is not preemptable and had

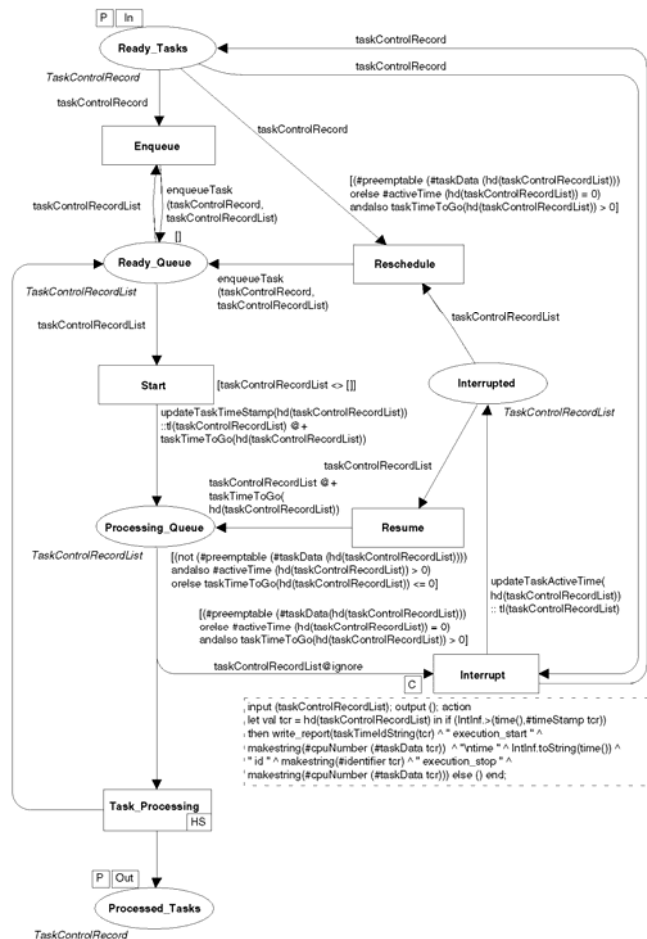


Figure 4. *Task_Enqueueing* model page

already started executing, transition *Resume* will occur, placing the task control record list token into place *Processing_Queue* to complete execution of the head task.

Occurrence of substitution transition *Task_Processing* performs the actions needed to process the head task of the task control record list. If the head task has no further operations to perform or requires a resource other than a CPU resource, it is removed from the task control record list and a copy of the task control record is placed into place *Processed_Tasks*. If the head task has more CPU resourced operations to perform it remains at the head of the task control record list token, which is placed back into the *Ready_Queue* place. Task control record tokens in place *Ready_Tasks* can then be inserted into the task control record list token by transition *Enqueue*, and if the task control record list token is not empty the *Start* transition can occur to place the task control record list token into place *Processing_Queue* to allow processing of the head task.

4. Modelling Results

The Coloured Petri Net model has been used to investigate schedulability of the generic avionics mission system tasks for a number of scheduling protocols. Task scheduling by statically assigned priorities is widely used in real-time applications, and has been modelled for a simple implementation not using preemption as well as a preemptive implementation. Asynchronous fixed priority scheduling, dynamic earliest-deadline-first scheduling and a statically designed schedule have also been modelled.

I/O messaging using the MIL-STD-1553B databus is included in the model. Except for the case of using a statically determined schedule, input I/O databus messages are requested at task arrival, and output I/O databus messages are requested after completion of task processing. Input and output messaging operations block task execution until I/O completes, and I/O service times are included in overall task response times. Servicing of I/O databus requests is performed in order of requesting task priority for statically prioritised protocols, and in order of requesting task deadlines for earliest-deadline-first dynamically prioritised scheduling.

For the statically determined tasking schedule, a statically determined I/O databus schedule is also used. Unevenly spaced frames, of between 8 ms and 13 ms, are used to schedule the consecutive execution of small numbers of tasks, chosen to limit task completion time jitter while satisfying task deadlines. Task input messages are scheduled to occur in the frame preceding task execution, and task output messages are scheduled to occur in the frame following task execution. I/O service times are not included in task response time measurements for this schedule.

Timing diagrams are used in §4.1 to §4.5 to illustrate modelled scheduling behaviour on the single processor, single data bus system. Task execution and I/O databus activity are plotted for each of the generic avionics mission system tasks, for a period of 400 ms, which

is sufficient to illustrate task scheduling behaviour. Task names are appended with the suffix *_cpu1* to signify execution on the single processor, and suffix *_io1* to signify activity on the single data bus. Task arrival times are marked with a delta, and task completion times are marked with a circle, to permit identification of tasks that are not completed before becoming due for execution again. Pseudo tasks *idle_cpu1* and *idle_io1* provide an indication of when the processor and data bus enter idle states. Scheduling behaviour for the five scheduling protocols is summarised in §4.6 in terms of worst-case response times.

4.1 Non-Preemptive Fixed Priority Scheduling

Task scheduling according to statically assigned priorities, and without the use of preemption, is not able to successfully schedule the generic avionics mission system tasks. This is trivially provable due to the existence of tasks of longer duration than the deadline of the *Weapon release* task, which can delay the execution of the *Weapon release* task past its deadline.

Modelling a non-preemptive fixed priority scheduling of the generic avionics mission system tasks confirms that the *Weapon release* task can fail to complete before its 5 ms deadline. Task execution and I\O databus activity are shown in Figure 5, where time is expressed in microseconds. Task *Weapon release* can be seen not to complete execution by its 5 ms deadline on many occasions, but all other tasks are successfully completed before their deadlines.

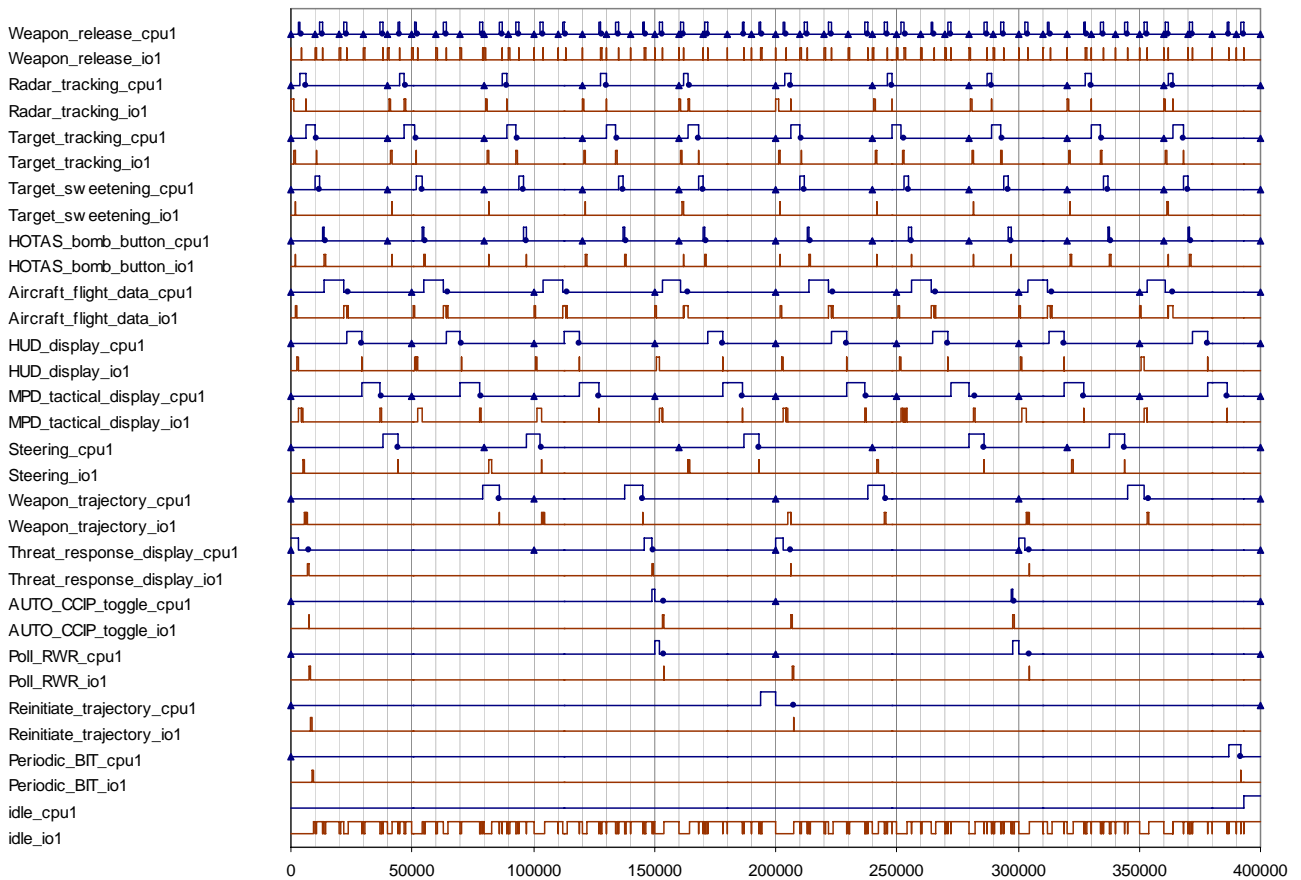


Figure 5. Non-preemptive fixed priority task scheduling

4.2 Preemptive Fixed Priority Scheduling

Statically prioritised preemptive scheduling is a widely used real-time scheduling protocol, but is not suited to applications with high processor utilisation. The generic avionics mission system tasks impose a very high 97.5% processor utilisation, and can not be scheduled by this scheduling protocol [1].

Figure 6 shows that the nine highest priority tasks always complete execution before their deadlines. The highest priority tasks exhibit low levels of completion-time jitter, but jitter becomes more pronounced for tasks of lower priorities. Lower priority tasks have their execution delayed by higher priority tasks, and the *Weapon trajectory* and *Threat response display* tasks can both be seen to not complete their first executions before the arrival times for their second executions.

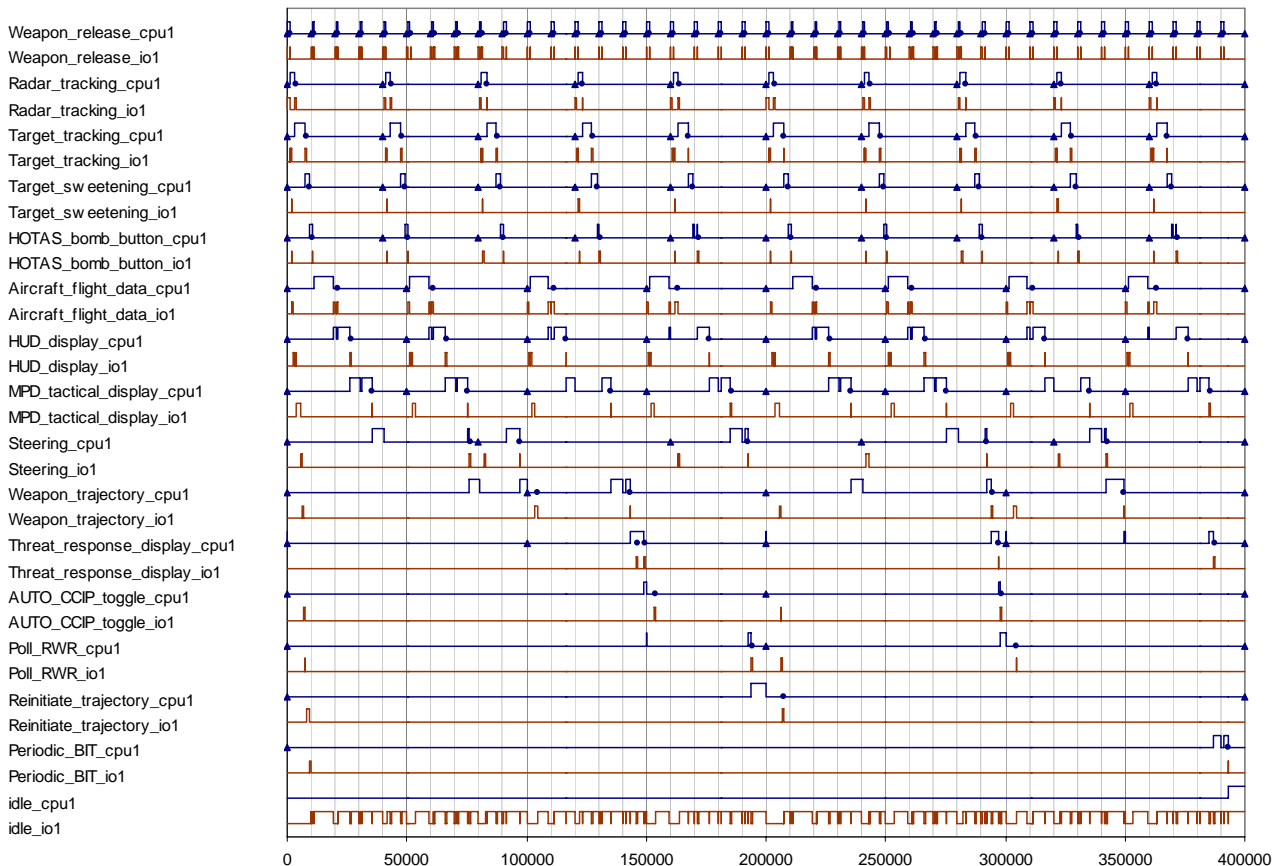


Figure 6. *Preemptive fixed priority task scheduling*

4.3 Asynchronous Fixed Priority Scheduling

Statically prioritised preemptive scheduling places no restrictions on the relative phasing of task executions, allowing simultaneous arrivals of all tasks to occur as the limiting case that bounds usable processor utilisation levels. Asynchronous fixed priority scheduling introduces fixed phase offsets for tasks, and can avoid simultaneous arrivals of tasks scheduled at harmonically related frequencies, allowing higher processor utilisations to be achieved without modification of the run-time scheduler.

Figure 7 shows that the introduction of fixed phase relationships allows successful statically prioritised scheduling with all tasks meeting their deadlines. Completion-time jitter is also improved for lower priority tasks, due to the reduced incidence of multiple high priority task arrivals that cumulatively delay lower priority task execution.

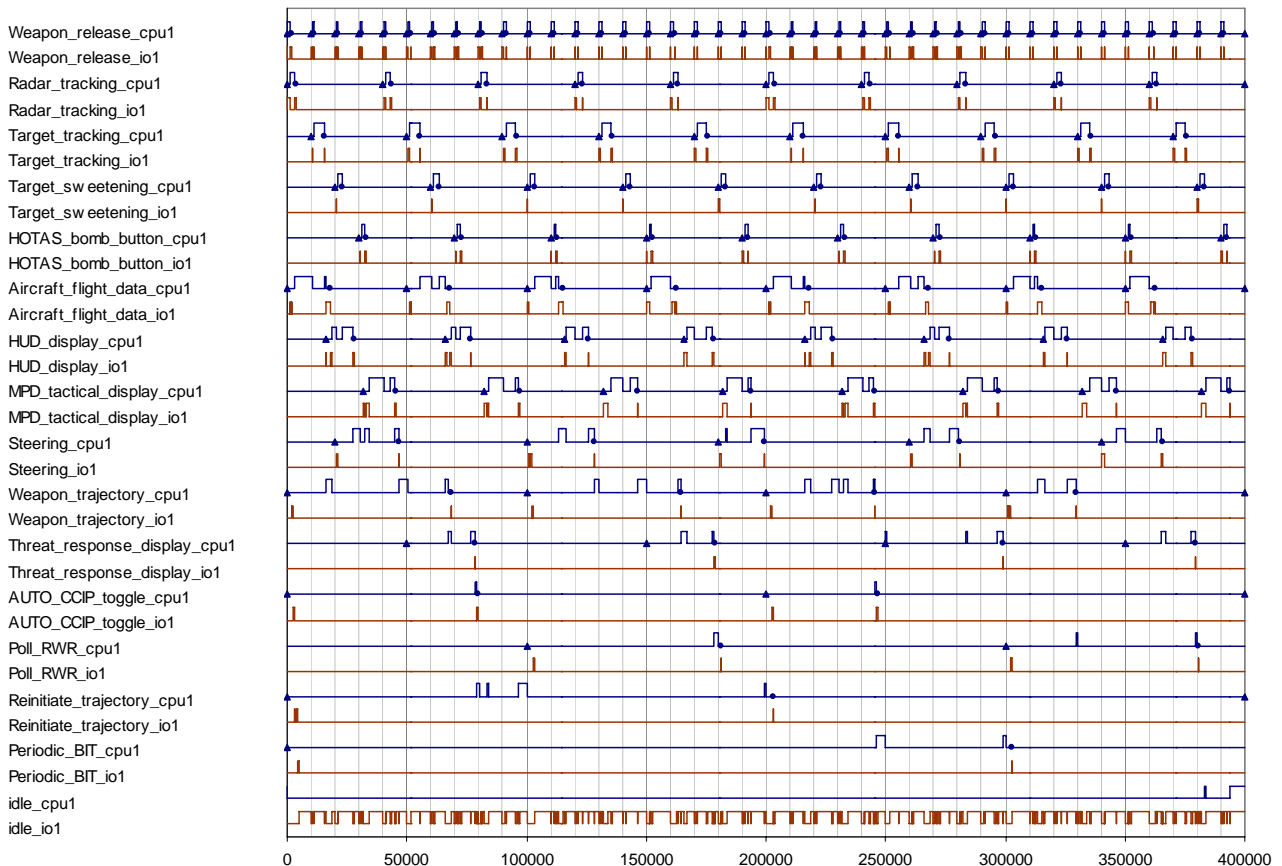


Figure 7. Asynchronous fixed priority task scheduling

4.4 Dynamic Priority Scheduling

Dynamically prioritised preemptive scheduling is optimal in that it is able to fully utilise the processor before any task will miss its deadline. However, it does increase the complexity of the run-time scheduler and introduces additional overheads associated with dynamically assigning task priorities.

Figure 8 shows how the earliest-deadline-first dynamically prioritised scheduling protocol successfully schedules the generic avionics mission system task set. Completion-time jitter is more pronounced in some shorter period tasks, such as the *Radar tracking* task, due to the need to sometimes service longer period tasks that are approaching their deadlines.

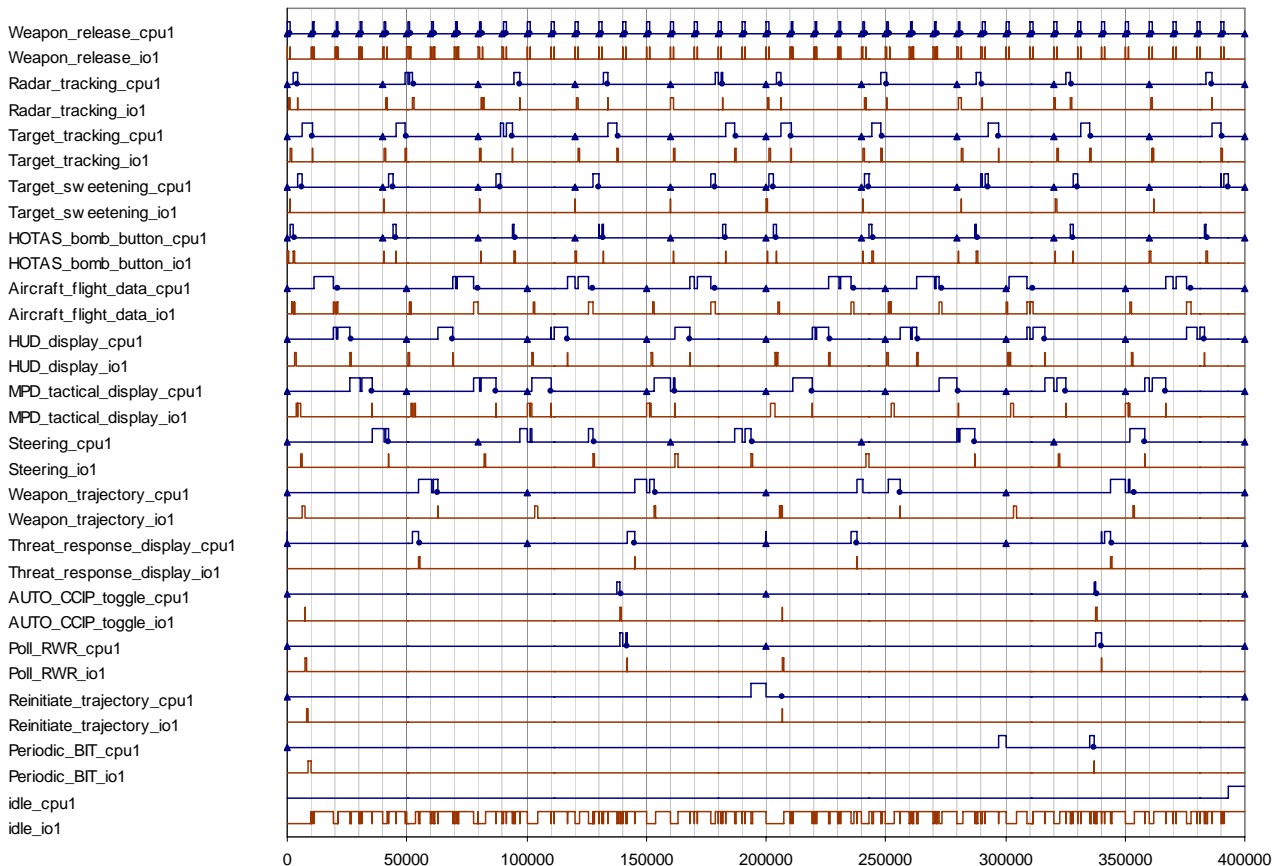


Figure 8. *Dynamic priority task scheduling*

4.5 Static Scheduling

Statically determined schedules have been employed in avionics mission computer applications where processor capabilities were limited or where deterministic operation was required. Avoiding the need for an operating system to algorithmically determine the sequence of task executions, and the need to be able to preempt executing tasks, removes run-time overheads and simplifies run-time executive design. However, additional design effort is required to develop the static schedule, and redesign of the schedule is needed if task execution times change.

Figure 9 shows a statically designed non-preemptive schedule that successfully schedules the generic avionics mission computer tasks. Completion-time jitter is more prevalent due to the unavailability of preemption, most seriously affecting the shortest period *Weapon release* task.

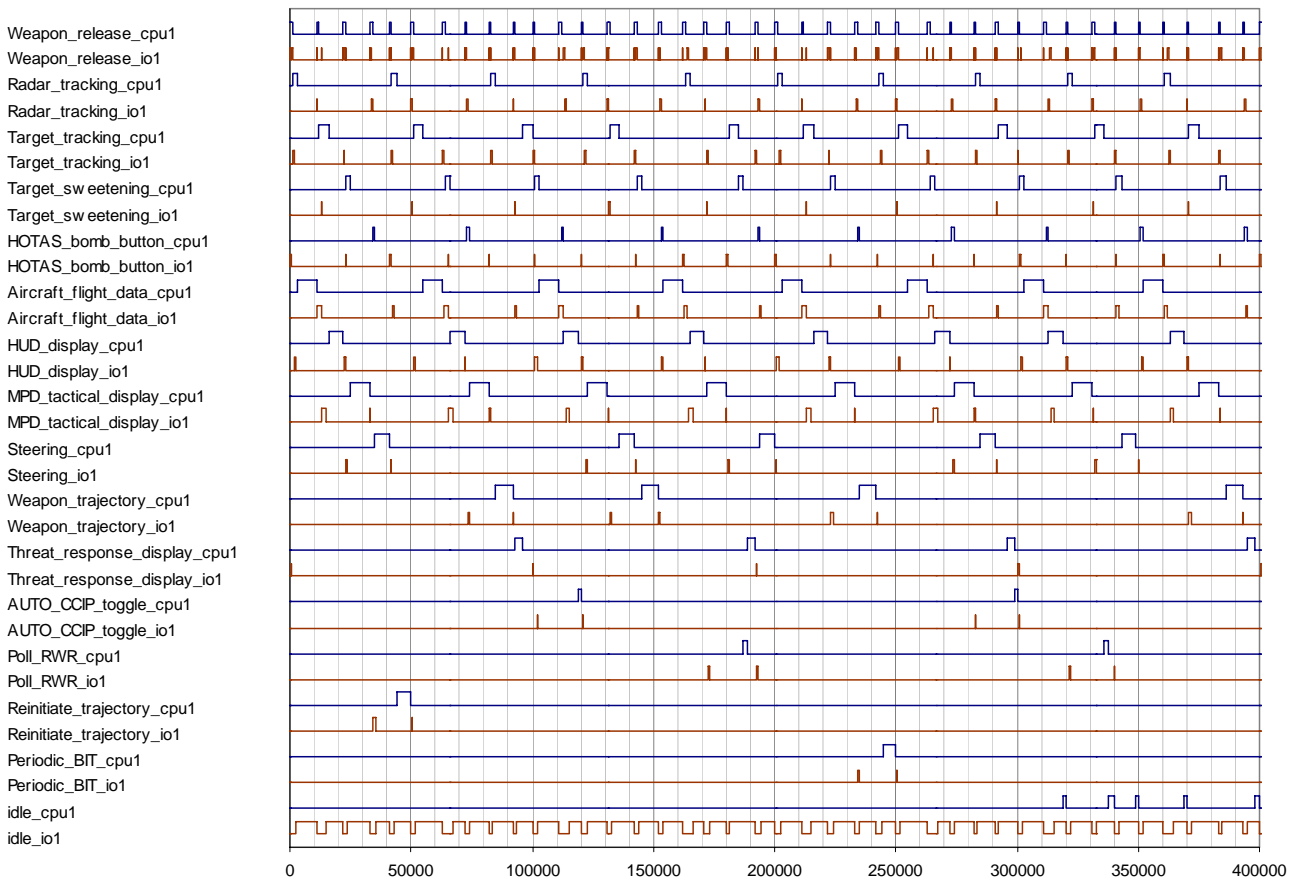


Figure 9. Static task scheduling

4.6 Response Time Summary

Task response times can be used to determine whether a scheduling protocol will operate successfully, by testing that worst-case task response times do not exceed task deadlines. The worst-case response times determined by the Coloured Petri Net model, for each scheduling protocol, are summarised in Table 2. Task worst-case response times exceed task deadlines in three cases, and these appear in bold type within Table 2.

Table 2. Generic avionics mission system worst-case response times

Task Name	Computation Time (ms)	Period (ms)	Deadline (ms)	Phase Offset (ms) (Asynchronous Schedule Only)	Non-Preemptive Fixed Priority Response Time (ms)	Preemptive Fixed Priority Response Time (ms)	Asynchronous Fixed Priority Response Time (ms)	Dynamic Priority Response Time (ms)	Static Schedule Response Time (ms)
Weapon release	1	10	5	0	9.122	1.856	1.874	1.880	4.000
Radar tracking	2	40		0	10.446	3.702	3.556	27.162	5.000
Target tracking	4	40		10	14.384	8.094	5.668	30.668	25.000
Target sweetening	2		40	20	17.000	9.332	3.284	33.000	27.000
HOTAS bomb button	1		40	30	18.322	11.728	2.946	25.322	35.000
Aircraft flight data	8	50 (55)		0	23.810	21.256	18.150	38.688	13.000
HUD display	6	50 (52)		16	29.242	26.526	12.048	33.242	22.000
MPD tactical display	8	50 (52)		32	37.202	35.486	15.056	37.202	33.000
Steering	6	80		20	46.162	76.446	28.446	48.162	62.000
Weapon trajectory	7	100		0	86.222	104.762	68.716	63.222	93.000
Threat response display	3		100	50	49.244	146.244	49.244	55.244	99.000
AUTO/CCIP toggle	1		200	0	153.892	153.892	79.606	142.322	120.000
Poll RWR	2	200		100	154.034	194.142	81.276	142.142	189.000
Reinitiate trajectory	6		400	0	207.448	207.204	203.150	207.024	50.000
Periodic BIT	5	1000	400	0	392.142	393.142	302.808	337.142	250.000

Synchronous fixed priority scheduling has been found to be unable to successfully schedule the generic avionics mission system tasks. Using non-preemptive fixed priority scheduling, the *Weapon release* task worst-case response time of 9.122 ms exceeds the deadline of 5 ms. For preemptive fixed priority scheduling, two tasks have worst-case response times greater than their deadlines. The *Weapon trajectory* and *Threat response display* tasks both have 100 ms deadlines, but the *Weapon trajectory* task has a worst-case response time of 104.762 ms and the *Threat response display* task has a worst-case response time of 146.244 ms.

For the three remaining scheduling protocols of asynchronous fixed priority scheduling, dynamic priority earliest-deadline-first scheduling and a statically designed schedule, no tasks were determined to have worst-case response times that exceeded task deadlines. These three scheduling protocols were all able to successfully schedule the generic avionics mission system tasks.

5. Conclusions

A Coloured Petri Net model has been developed with the capability to model run-time task scheduling and MIL-STD-1553B data bus scheduling for avionics mission computers employing multiple processors and data busses. Key model features have been discussed to support future application of the model to alternative avionics mission computer and mission software architectures.

Operation of the Coloured Petri Net model has been demonstrated by application to a single processor, single data bus, avionics mission computer. Five different scheduling protocols have been modelled for a generic avionics mission computer task set imposing a very high processor load. Model outputs have been presented for each scheduling protocol to illustrate successful model operation.

The design of the Coloured Petri Net model allows for arbitrarily complex task set specifications. Tasks are specified in terms of task attributes and run-time behaviours. Task attributes allow for specification of task priority, preemptability, periodicity, phasing, execution deadline and CPU allocation. Run-time behaviours are specified in terms of constructs for execution times, input/output operations, mutual exclusions, task synchronisations and inter-task messaging.

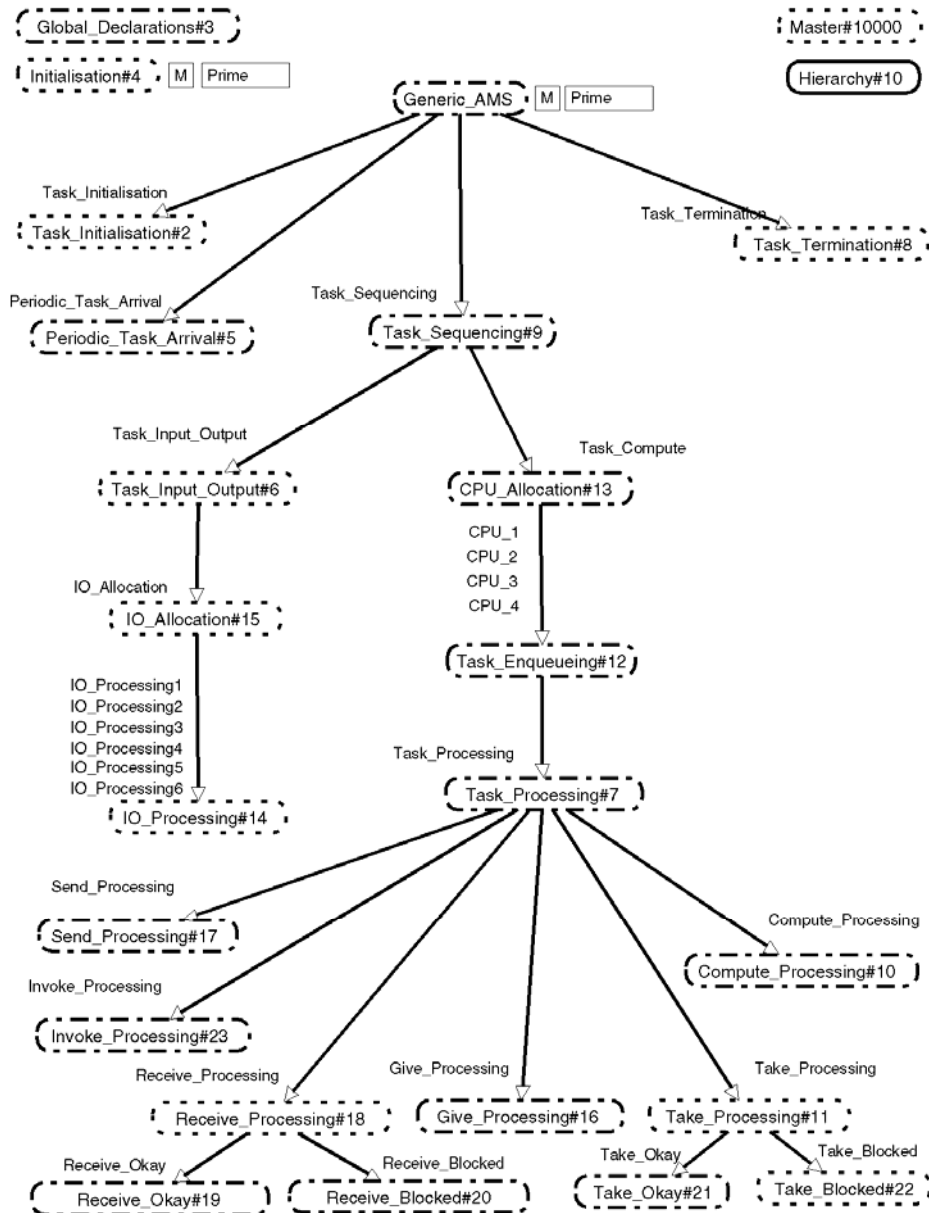
Model design is structured to accommodate extension, readily supporting any number of system processing or data bus resources. Modelling additional mission computer hardware or software features is possible by augmenting the model to encompass the functionality of the additional features. Support for alternative data bus architectures and inter-task communications mechanisms are possible candidates for augmentation of the model.

6. References

- [1] R. B. Dodd, *An Analysis of Task Scheduling for a Generic Avionics Mission Computer*, DSTO Technical Note DSTO-TN-0691, 2006.
- [2] Douglass C. Locke, David R. Vogel, Lee Lucas and John B. Goodenough, *Generic Avionics Software Specification*, Technical report CMU/SEI-90-TR-8-ESD-TR-90-209, Software Engineering Institute, Carnegie Mellon University, December 1990.
- [3] Kurt Jensen, *Coloured Petri Nets, Volume 1: Basic Concepts*, second edition, Springer-Verlag, 1996.

Appendix A: Coloured Petri Net Model Pages

A.1. Hierarchy Model Page



A.2. *Global_Declarations* Model Page

```

(* global declarations *)
val modelID = "Generic_AMS_Model_2_1_03";
val projectPath = "/home/rbd/erd02/CPNmodel_v2_1/";

color Int = int;
color Bool = bool;
color StringList = list String;

color TaskRecord = record
  name : String *
  priority : Int * (* -ve means dynamic priority *)
  preemptable : Bool *
  period : Int * (* <= 0 means aperiodic *)
  phase : Int * (* ignored for aperiodics *)
  deadline : Int * (* <= 0 means none *)
  cpuNumber : Int *
  activationTime : Int *
  deactivationTime : Int * (* -ve means never *)
  computations : StringList timed;

color IORecord = record
  messageName : String *
  destination : String *
  databusNumber : Int timed;
  source : String *
  duration : Int *

color SemRecord = record
  semName : String *
  semValue : Int *
  priorityCeiling : Int; (* -ve means no priority ceiling protocol *)

color MQRecord = record
  mqName : String *
  mqMsgList : StringList;

color TaskControlRecord = record
  identifier : Int *
  taskData : TaskRecord *
  timeStamp : Time *
  arrivalTime : Time *
  computationList : StringList;
  priority : Int *
  unblocking : Bool *
  activeTime : Int *
  deadlineTime : Time *

color IORecordList = list IORecord;

color IOControlRecord = record
  identifier : Int *
  ioList : StringList *
  activeTime : Int *
  deadlineTime : Time;
  priority : Int *
  ioData : IORecordList *
  timeStamp : Time *

color TaskRecordList = list TaskRecord;
color SemRecordList = list SemRecord;
color MQRecordList = list MQRecord;
color TaskControlRecordList = list TaskControlRecord;
color IOControlRecordList = list IOControlRecord;

color SemQueue = record
  semName : String *
  taskQueue : TaskControlRecordList;

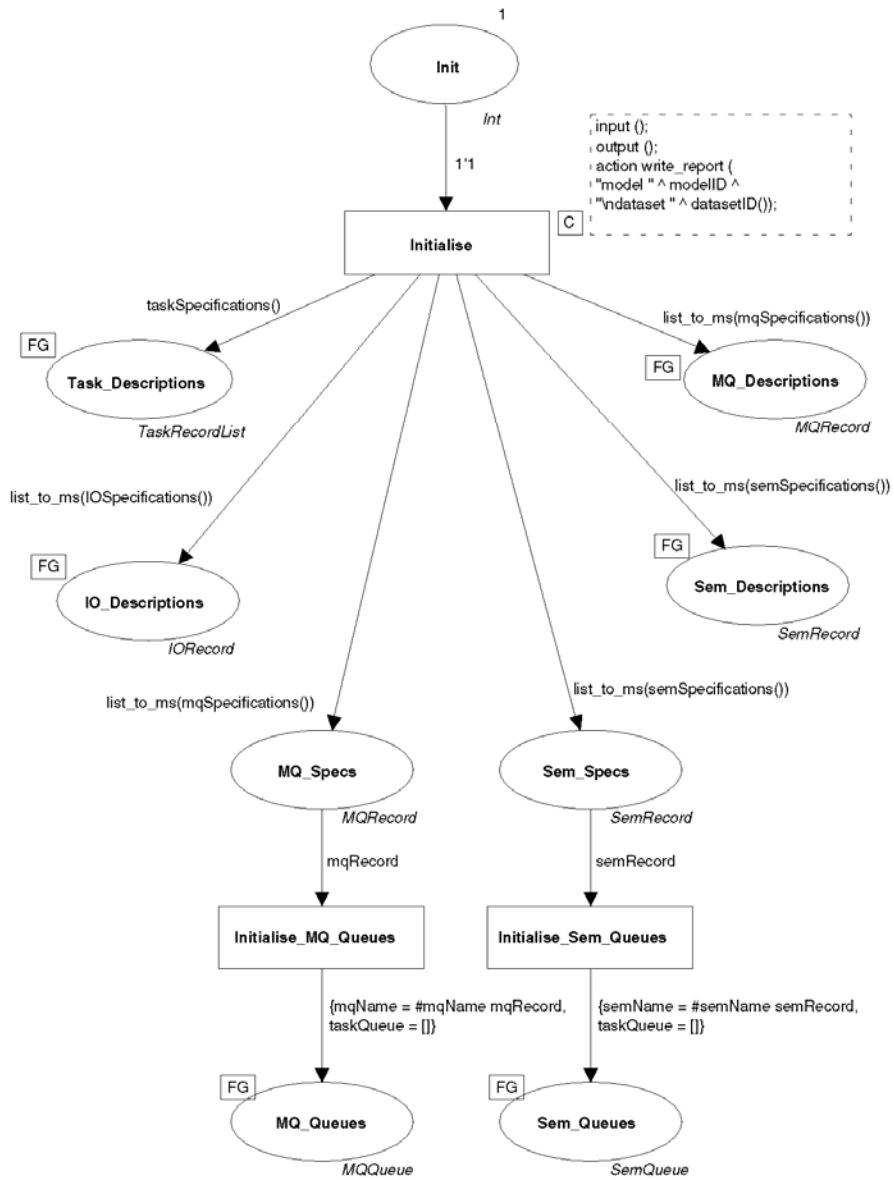
color MQQueue = record
  mqName : String *
  taskQueue : TaskControlRecordList;

var idNumber : Int;
var deactivationRecord : TaskRecord;
var taskControlRecord : TaskControlRecord;
var ioControlRecord : IOControlRecord;
var semQueue : SemQueue;
var mqQueue : MQQueue;
var taskControlRecordList : TaskControlRecordList;
var ioControlRecordList : IOControlRecordList;
var taskRecord : TaskRecord;
var taskRecordList : TaskRecordList;
var ioRecord : IORecord;
var semRecord : SemRecord;
var mqRecord : MQRecord;

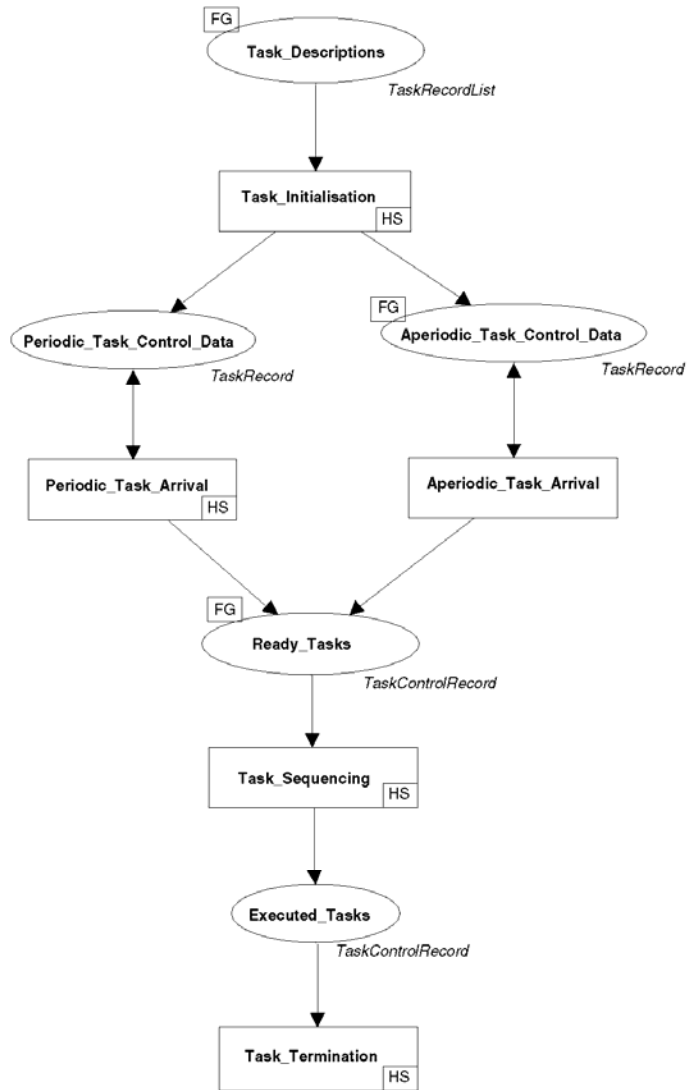
use (projectPath^"model2_1_tasks.sml");
use (projectPath^"model2_1_functions.sml");

```

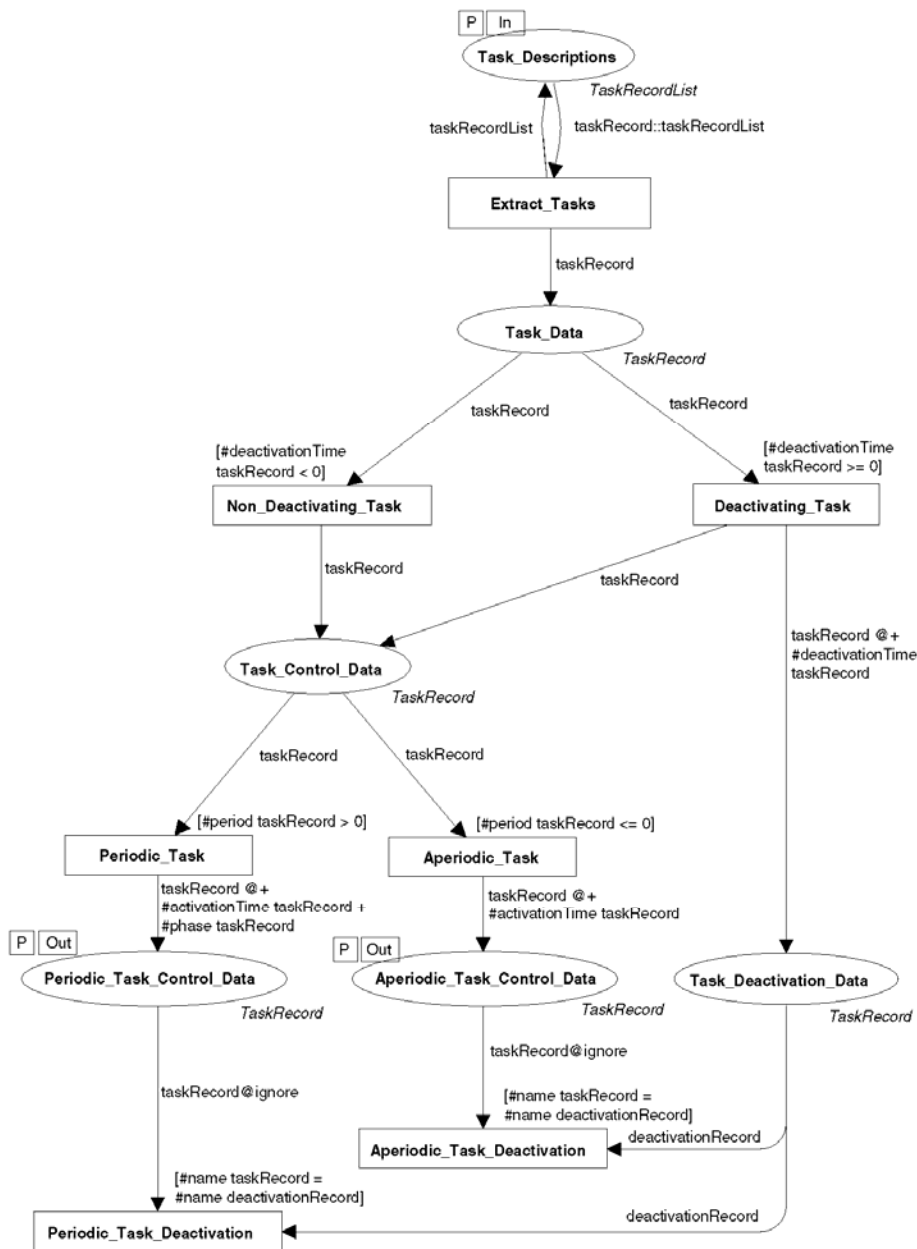
A.3. Initialisation Model Page



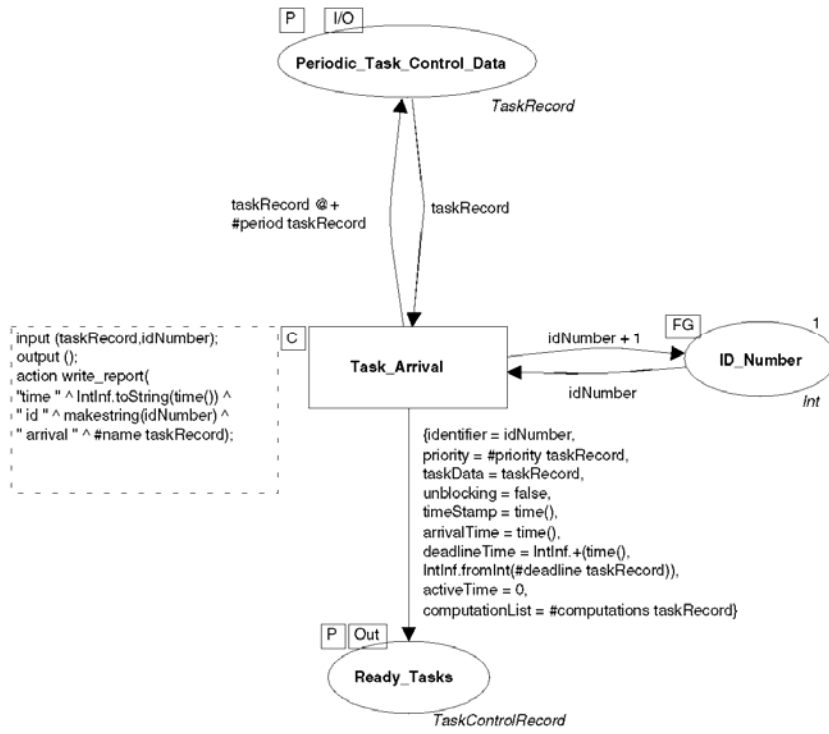
A.4. Generic_AMS Model Page



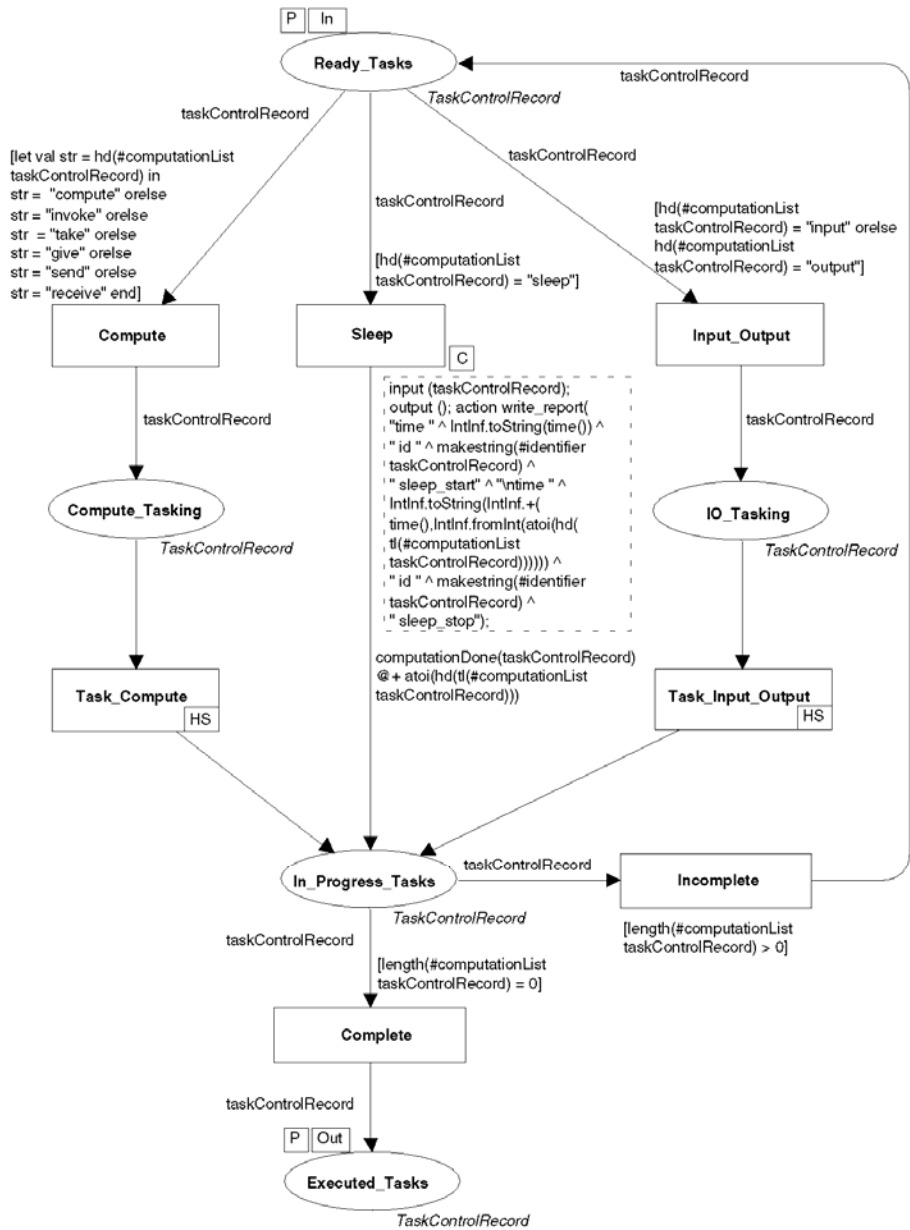
A.5. Task_Initialisation Model Page



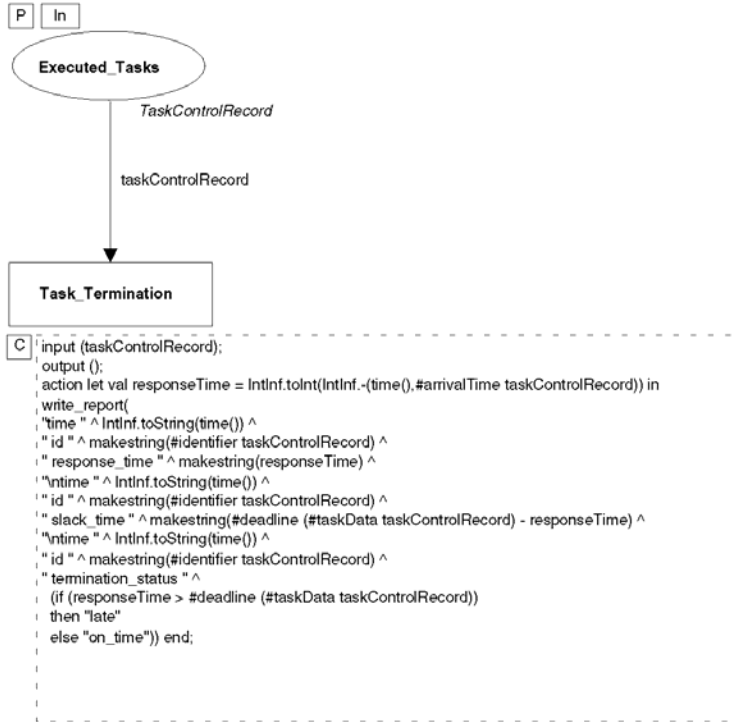
A.6. Periodic_Task_Arrival Model Page



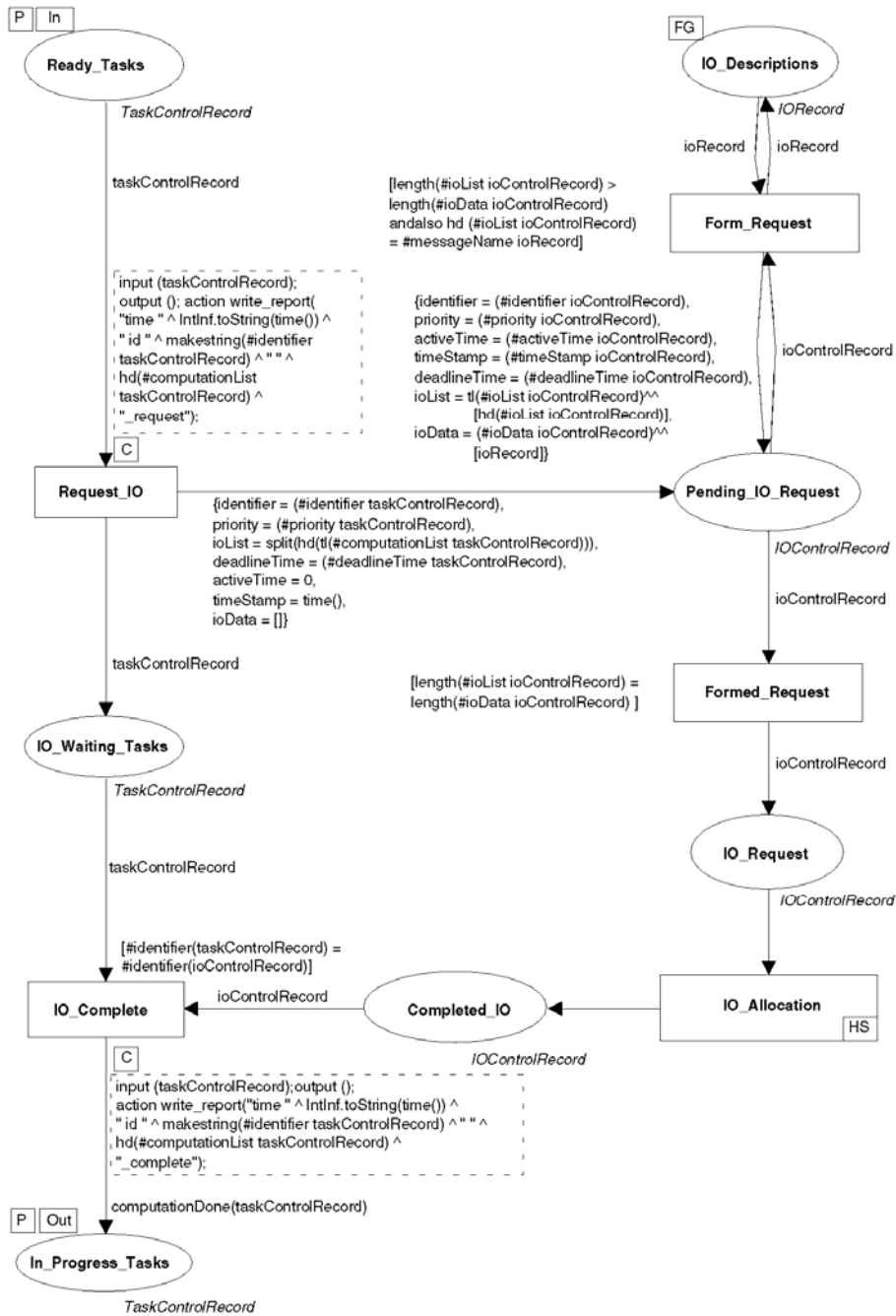
A.7. Task_Sequencing Model Page



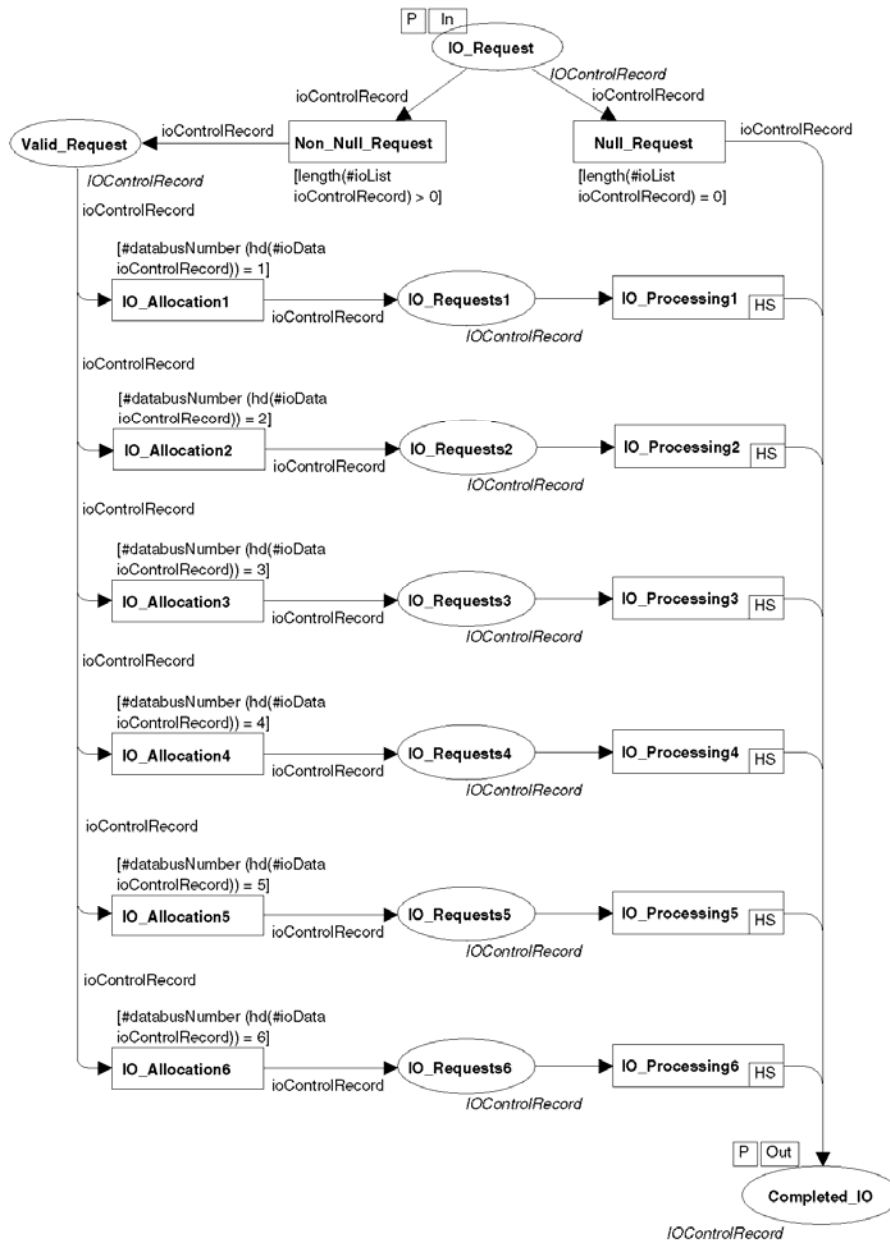
A.8. Task_Termination Model Page



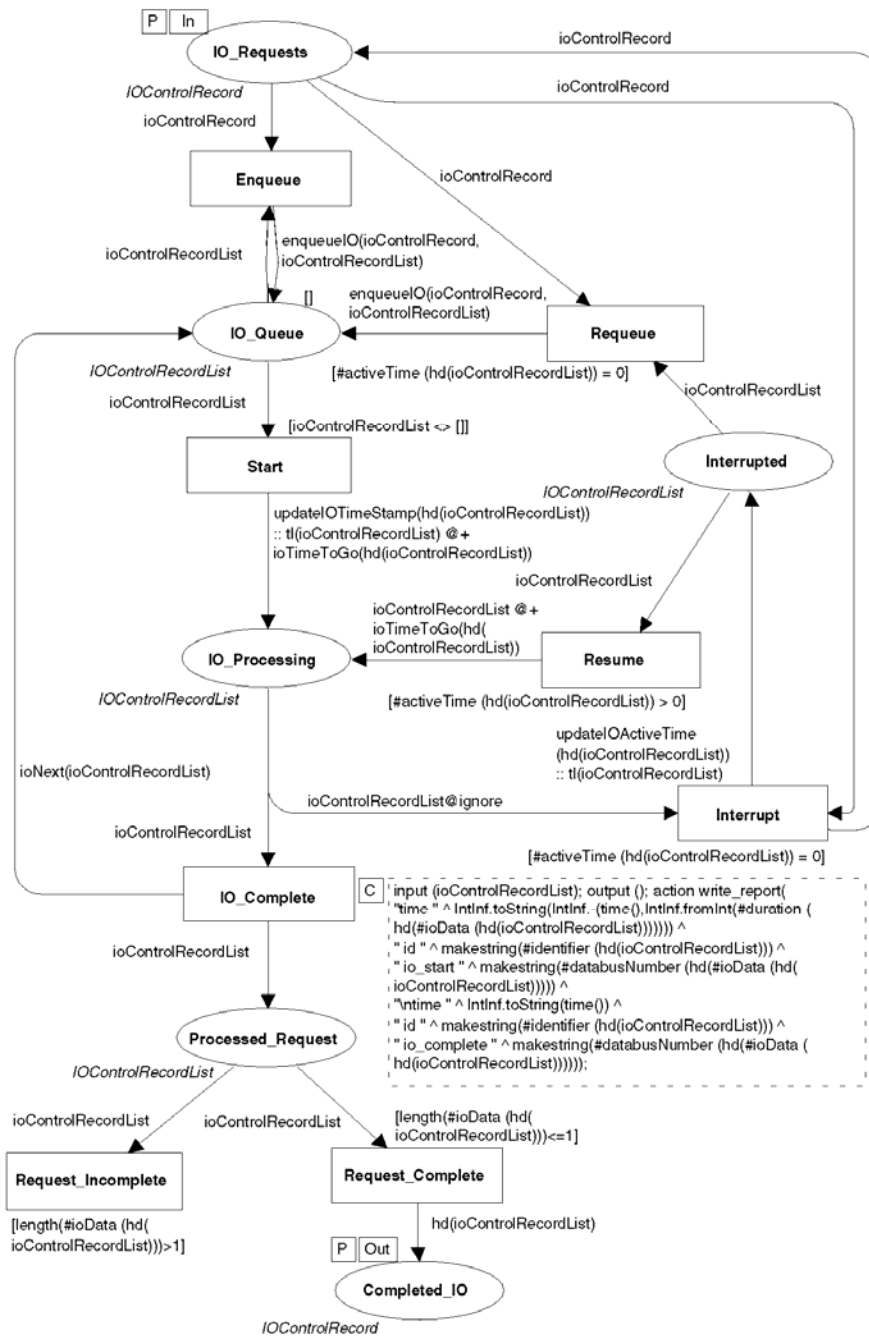
A.9. Task_Input_Output Model Page



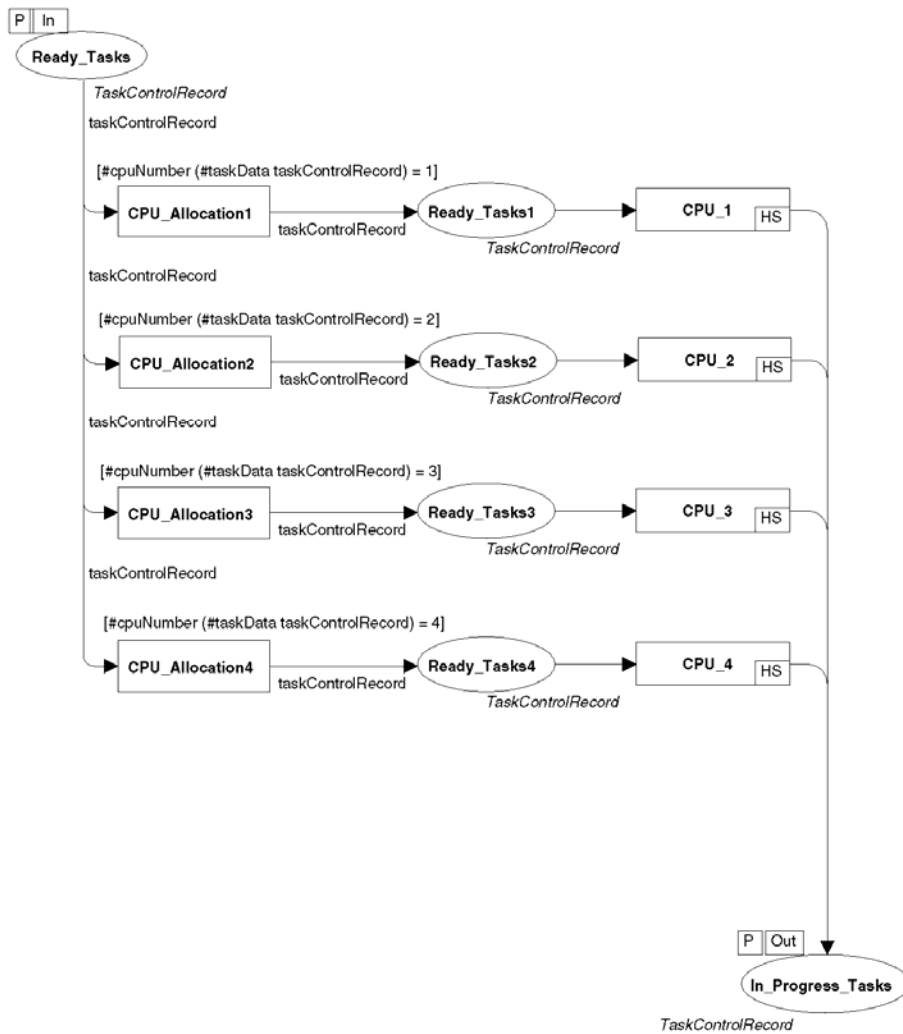
A.10. IO_Allocation Model Page



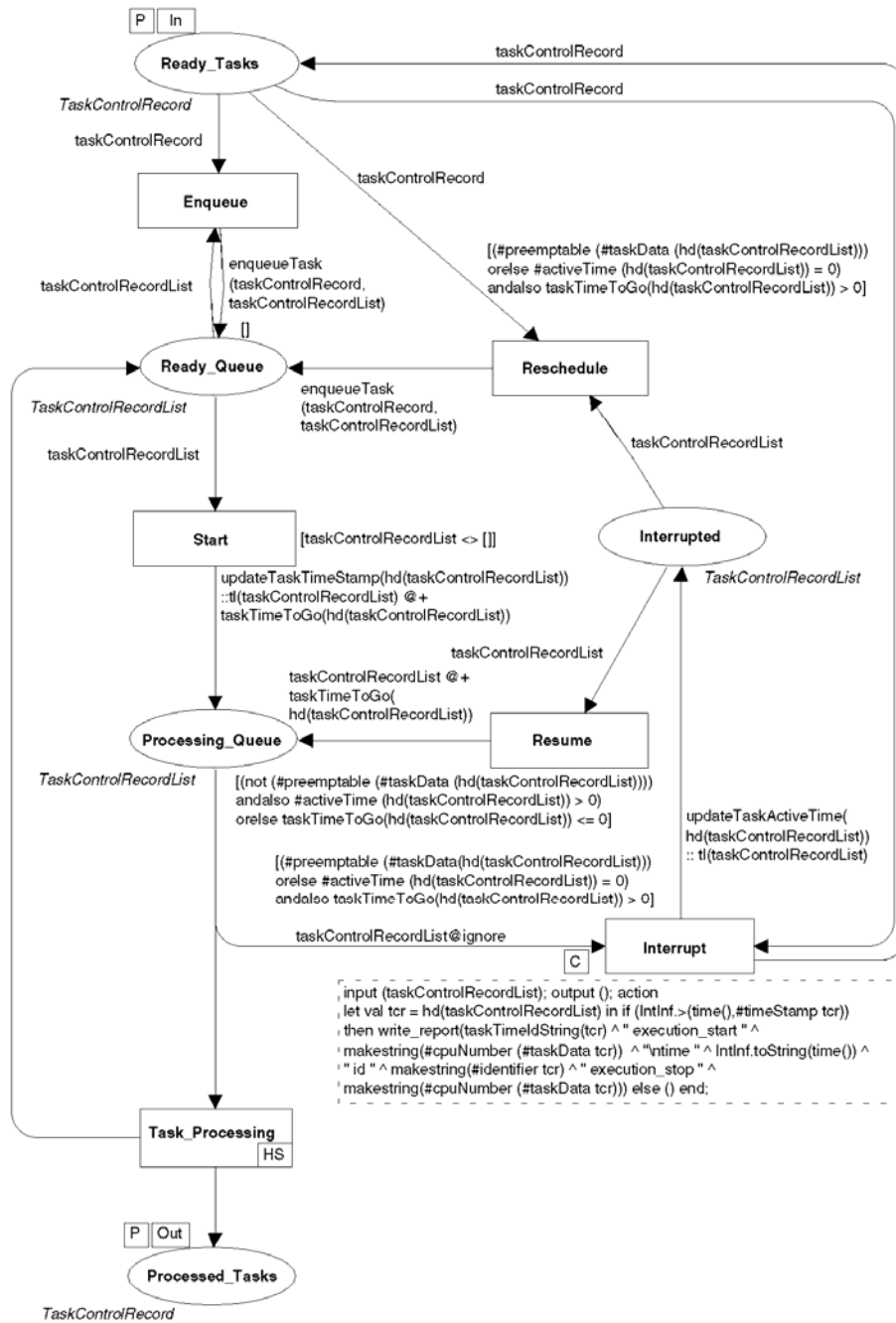
A.11. IO_Processing Model Page



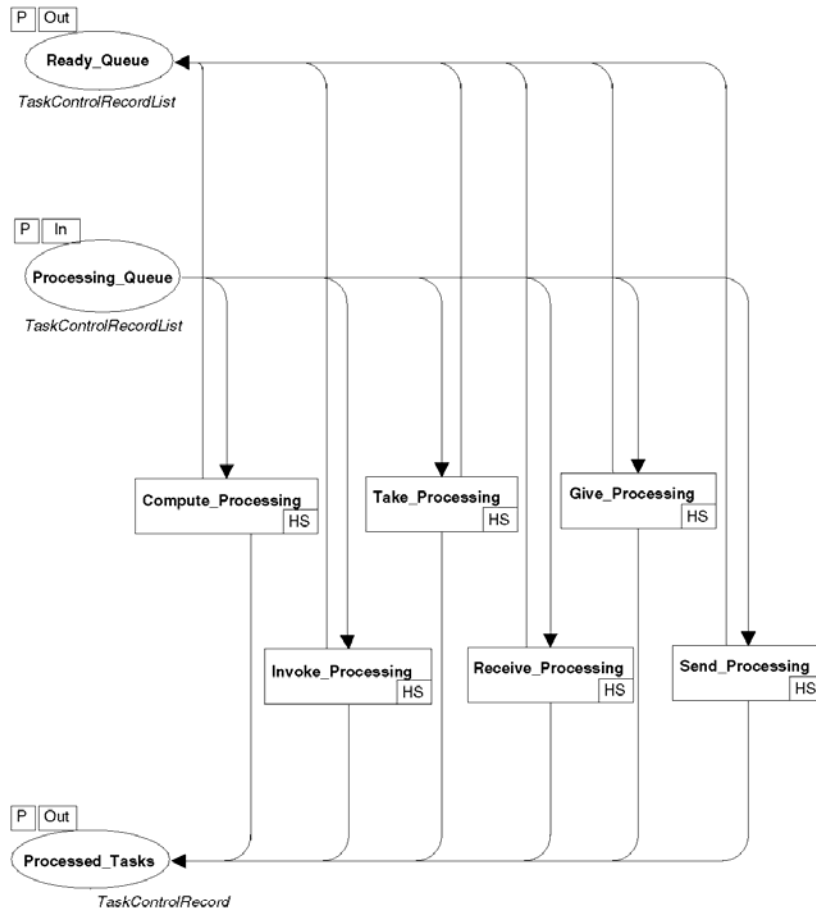
A.12. CPU_Allocation Model Page



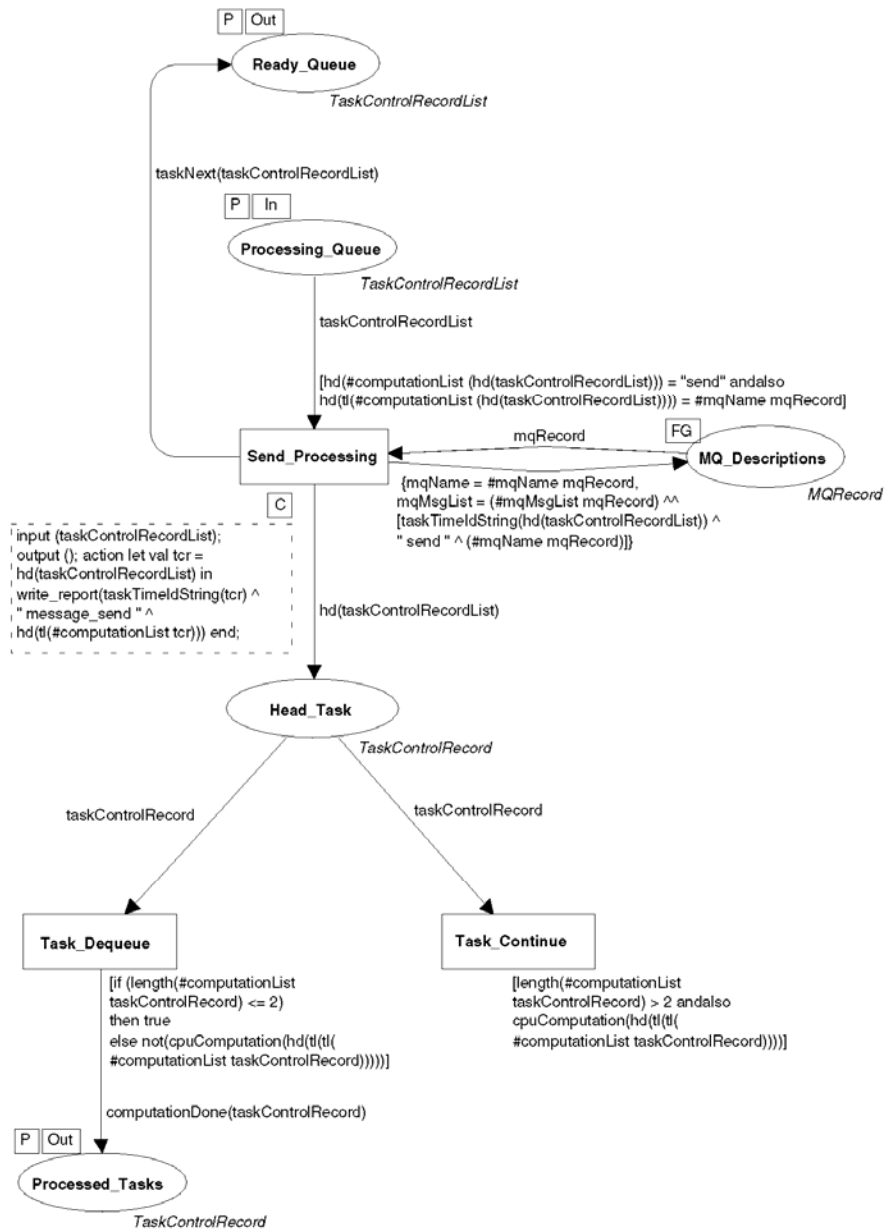
A.13. Task_Enqueueing Model Page



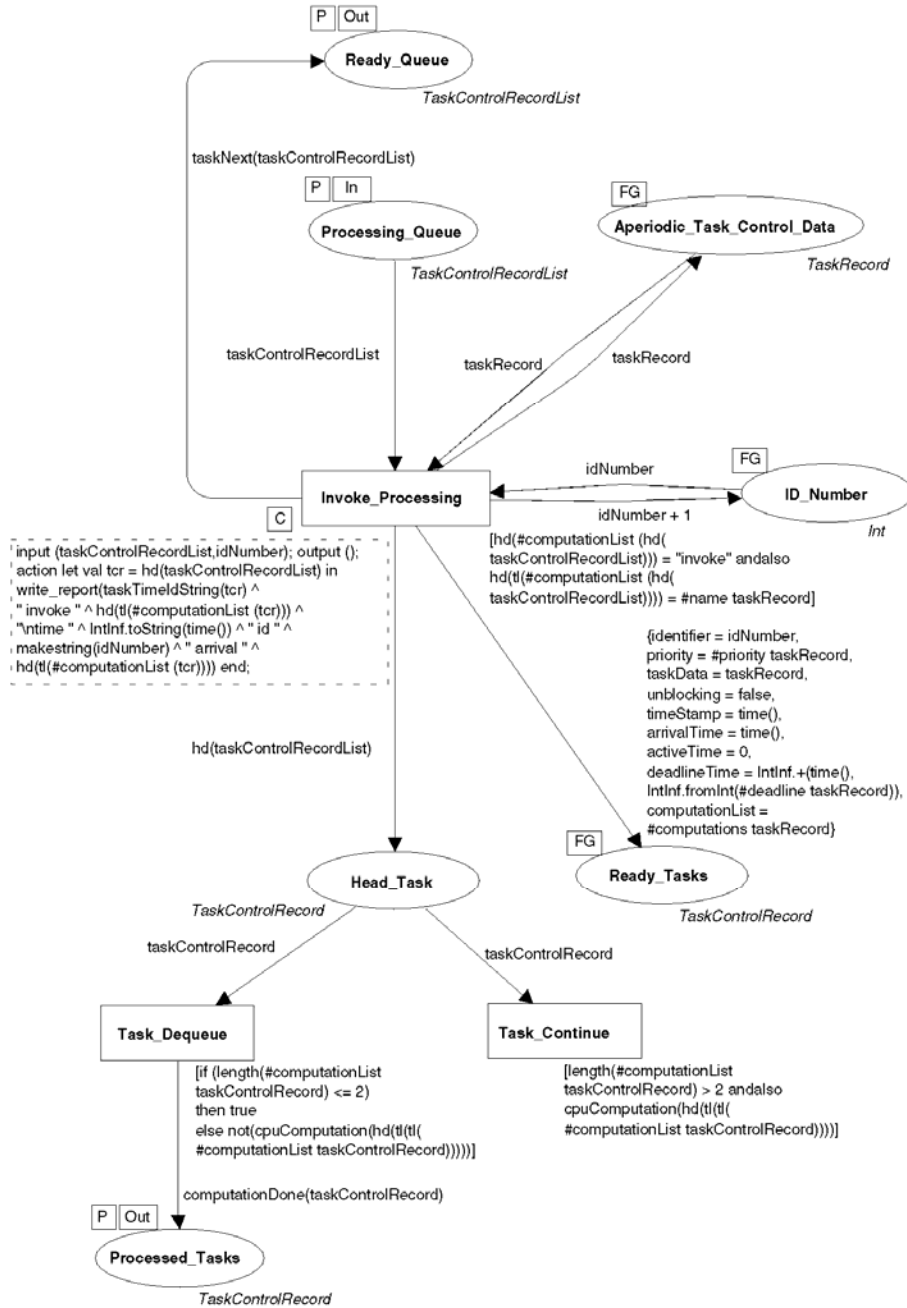
A.14. Task_Processing Model Page



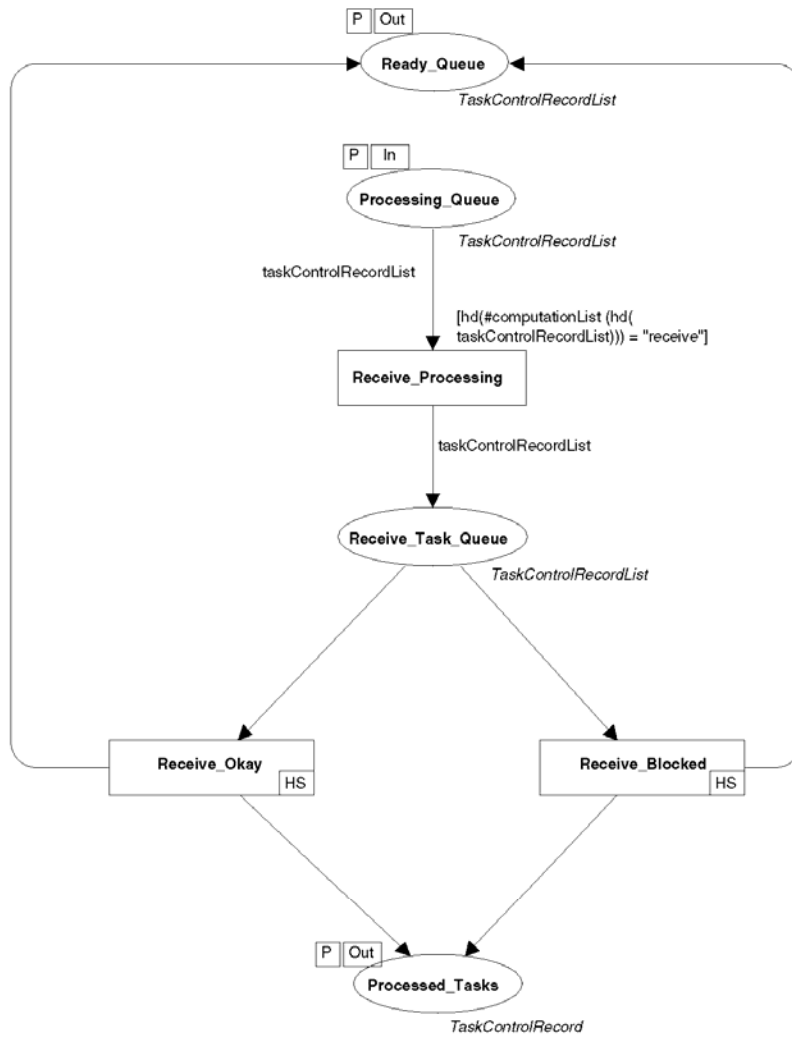
A.15. Send_Processing Model Page



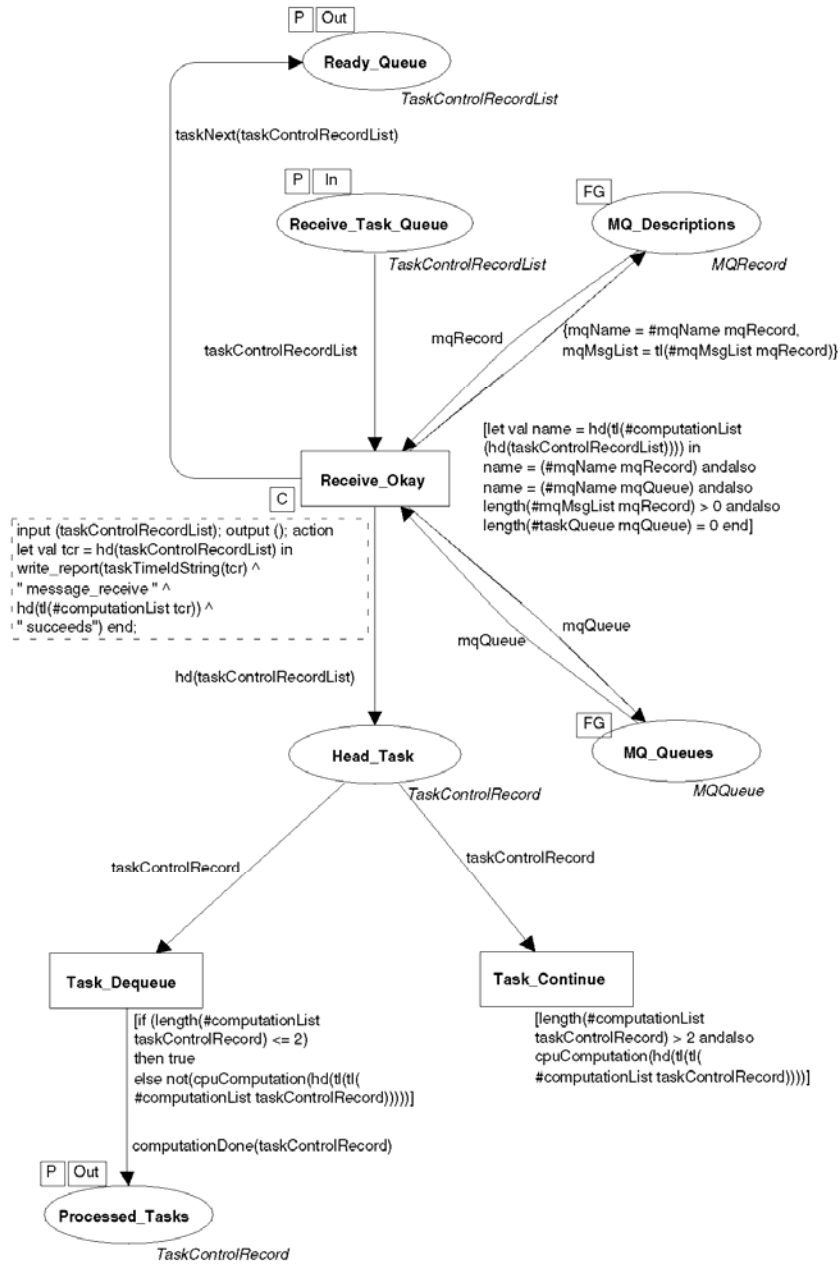
A.16. Invoke_Processing Model Page



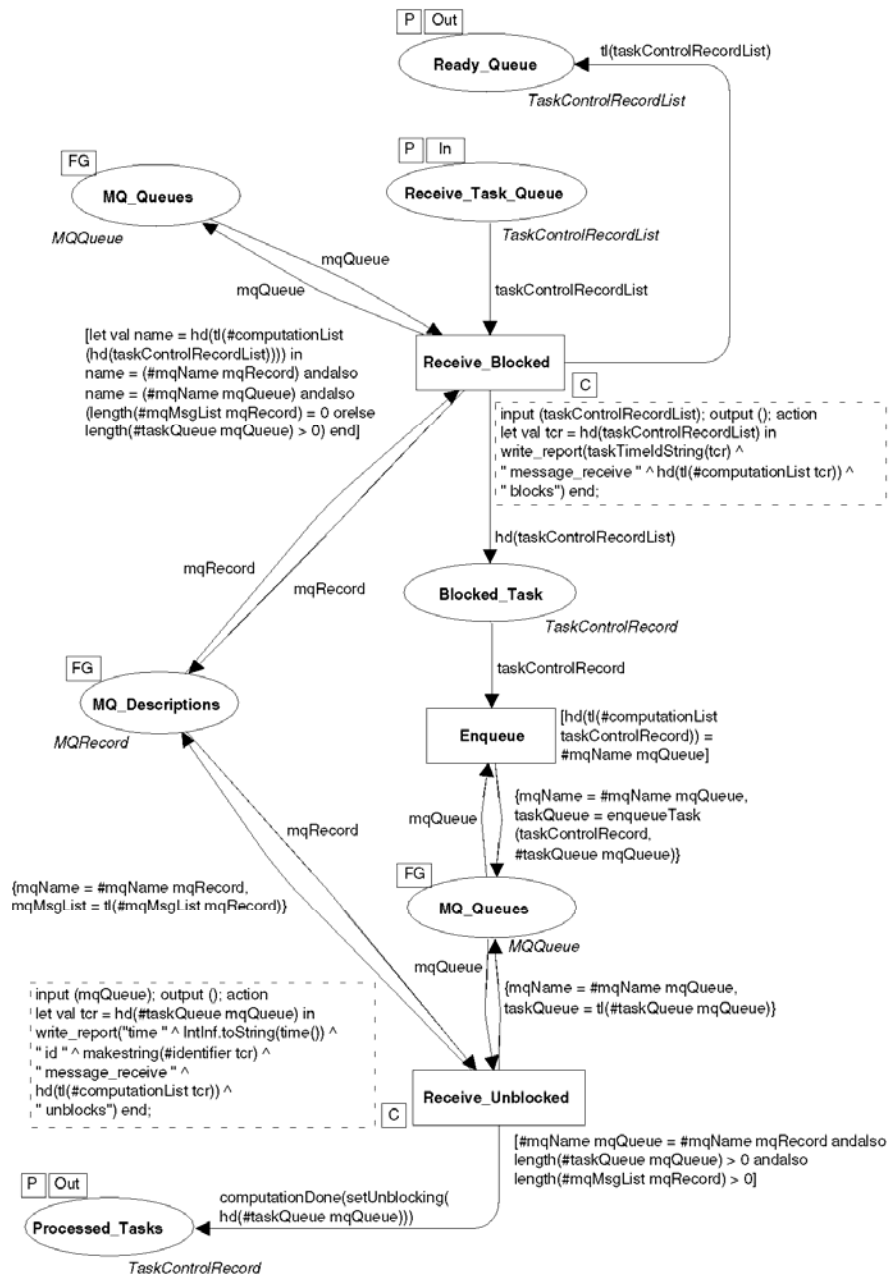
A.17. Receive_Processing Model Page



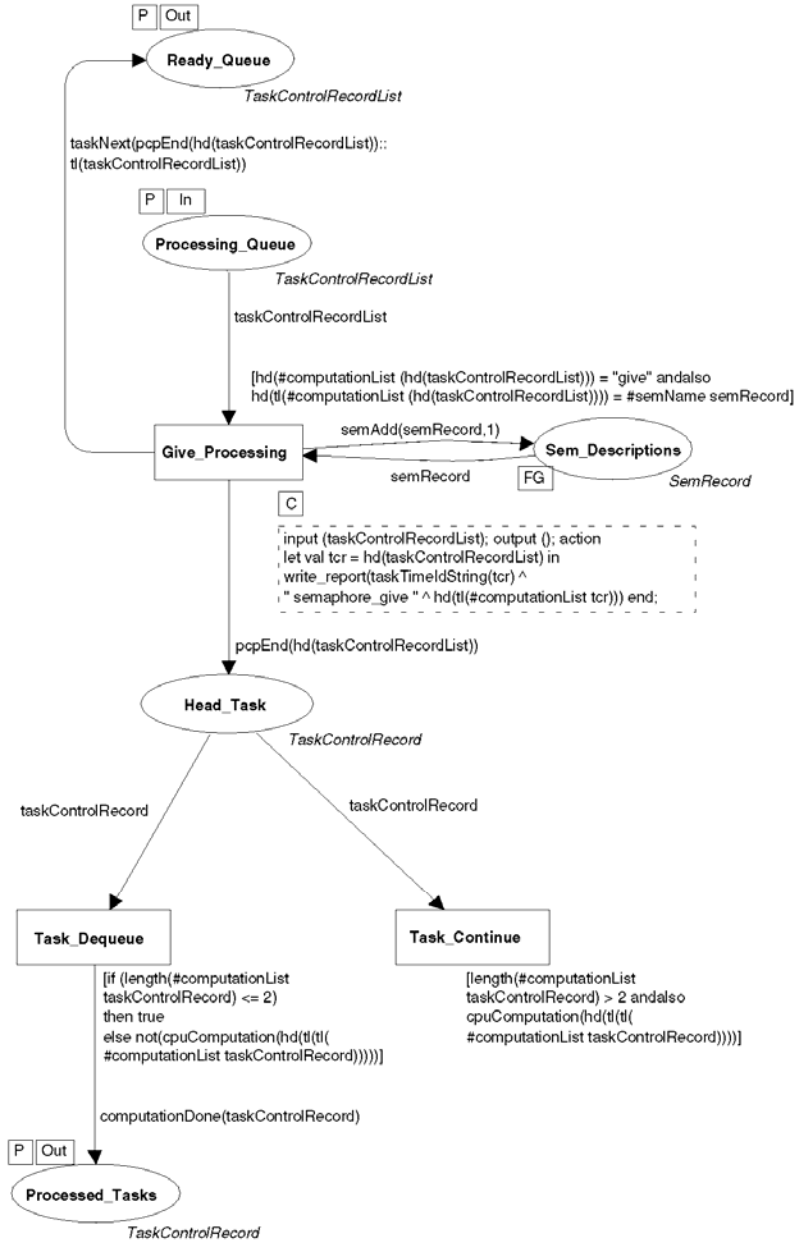
A.18. Receive_Okay Model Page



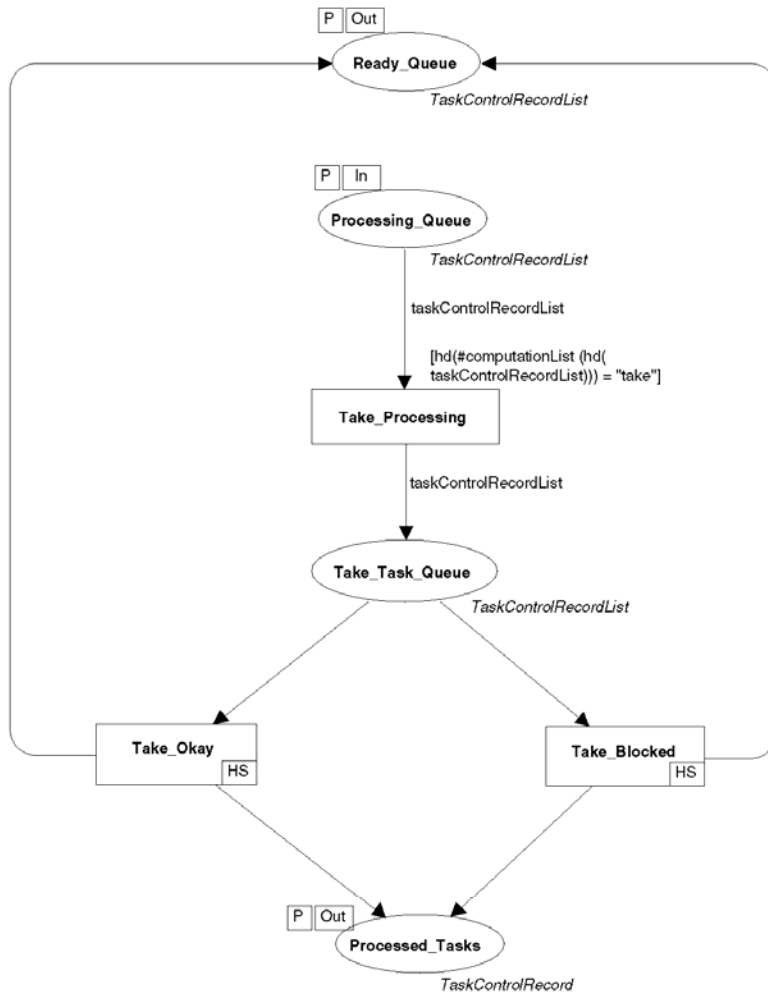
A.19. Receive_Blocked Model Page



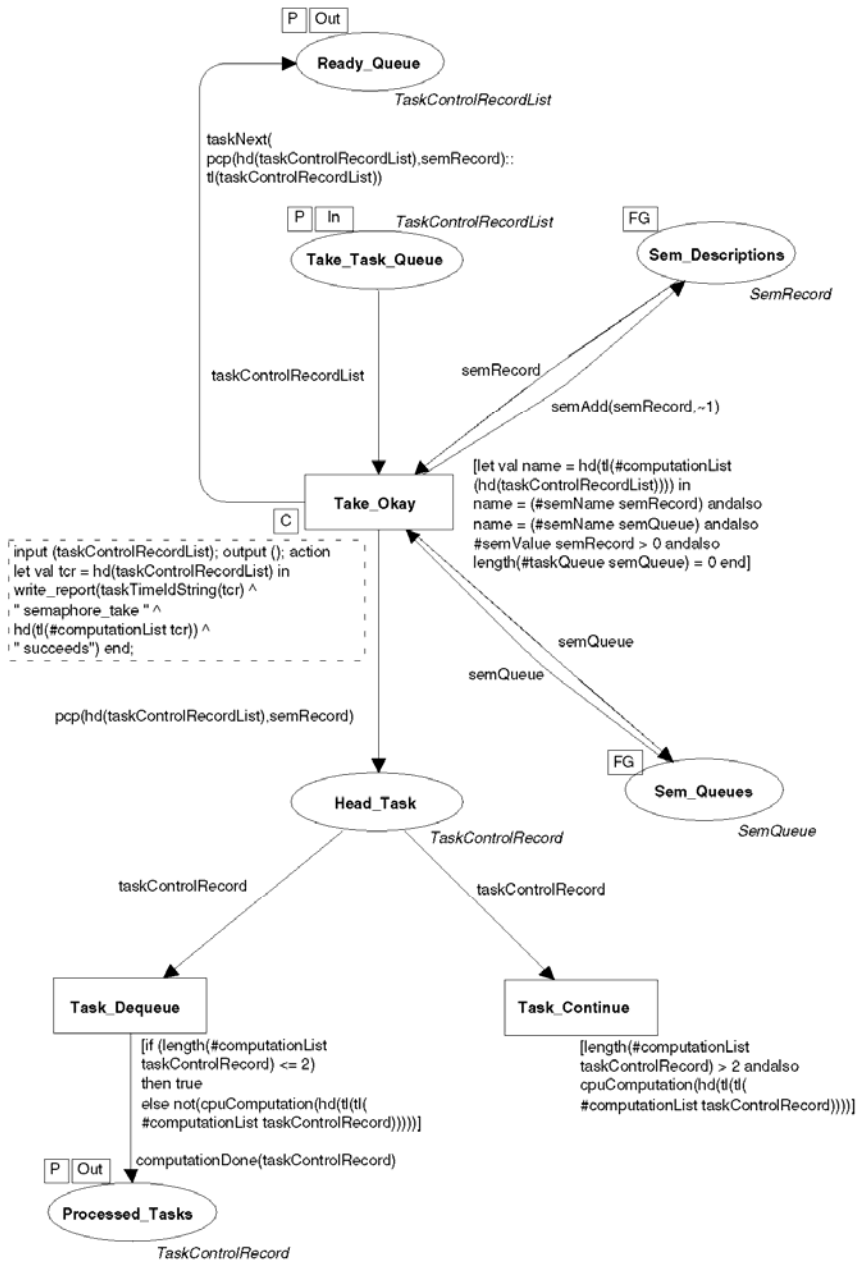
A.20. Give_Processing Model Page



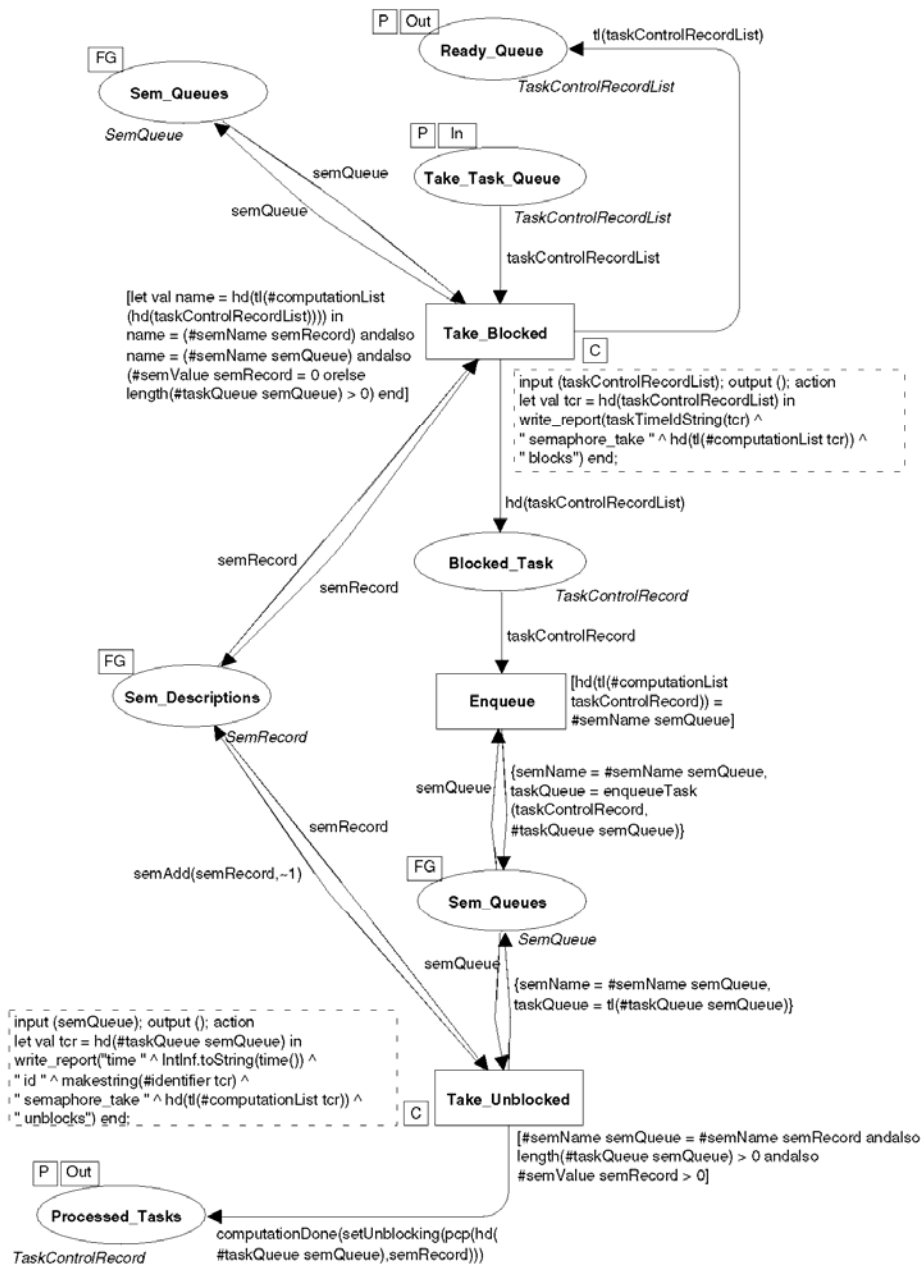
A.21. Take_Processing Model Page



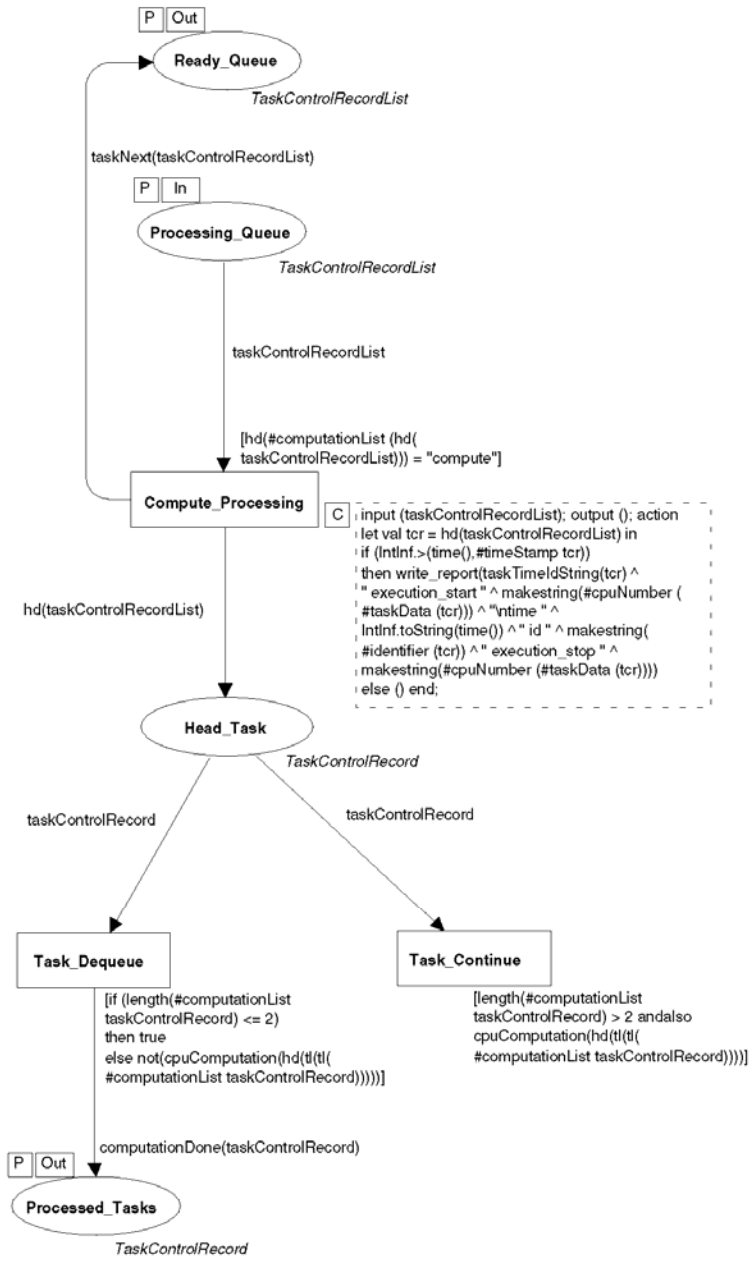
A.22. Take_Okay Model Page



A.23. Take_Blocked Model Page



A.24. Compute_Processing Model Page



Appendix B: Support Functions

A number of support functions have been written in Standard ML, and reside in a separate file. These functions are used by the Coloured Petri Net model pages to implement complex expressions and improve the clarity of the model. A listing of the support functions follows.

```
(*
File: model2_1_functions.sml
*)

(* support function for atoi function *)
fun chtoi (num:Int,[]) = num
  | chtoi (num:Int,chList:StringList) =
    chtoi(num * 10 + ord(hd(chList)) - ord("0"), tl(chList));

(* function for ascii to unsigned integer conversion *)
fun atoi (str:String) = chtoi(0,explode(str));

(* support function for split function *)
fun splitter (strList:StringList,[]) = strList
  | splitter (strList:StringList,chList:StringList) =
    if (hd(chList) = ",")
    then splitter(strList^^[""],tl(chList))
    else splitter(rev((hd(rev(strList))^hd(chList))::tl(rev(strList))),
      tl(chList));

(* function to split a string at commas *)
fun split (str:String) = splitter([""],explode(str));

(* Function to enqueue a task in priority order, after equal priority tasks.
   Uses earliest deadline order if priority < 0. *)
fun standardEnqueueTask (taskRec:TaskControlRecord, []) = [taskRec]
  | standardEnqueueTask (taskRec:TaskControlRecord, taskList:TaskControlRecordList) =
    if (#priority taskRec >= 0)
    then if (#priority taskRec < #priority(hd(taskList)))
         then taskRec::taskList
         else hd(taskList) :: standardEnqueueTask(taskRec, tl(taskList))
    else if (IntInf.<(#deadlineTime taskRec, #deadlineTime(hd(taskList))))
         then taskRec::taskList
         else hd(taskList) :: standardEnqueueTask(taskRec, tl(taskList));

(* Function to enqueue a task in priority order, before equal priority tasks.
   Uses earliest deadline order if priority < 0. *)
fun priorityEnqueueTask (taskRec:TaskControlRecord, []) = [taskRec]
  | priorityEnqueueTask (taskRec:TaskControlRecord, taskList:TaskControlRecordList) =
    if (#priority taskRec >= 0)
    then if (#priority taskRec <= #priority (hd(taskList)))
         then taskRec::taskList
```



```

        else hd(taskList) :: priorityEnqueueTask(taskRec, tl(taskList))
    else if (IntInf.<=#deadlineTime taskRec, #deadlineTime (hd(taskList)))
    then taskRec::taskList
    else hd(taskList) :: priorityEnqueueTask(taskRec, tl(taskList));

(* Function to enqueue a task in priority order, before equal priority tasks if
the unblocking flag is set, after equal priority tasks if the unblocking
flag is not set. Unblocking flag is cleared if it was set. *)

fun enqueueTask (taskRec:TaskControlRecord, []) =
  [{identifier = #identifier taskRec,
   priority = #priority taskRec,
   taskData = #taskData taskRec,
   computationList = #computationList taskRec,
   activeTime = #activeTime taskRec,
   arrivalTime = #arrivalTime taskRec,
   deadlineTime = #deadlineTime taskRec,
   timeStamp = #timeStamp taskRec,
   unblocking = false}]
| enqueueTask (taskRec:TaskControlRecord, taskList:TaskControlRecordList) =
  if (#unblocking taskRec)
  then priorityEnqueueTask(
    {identifier = #identifier taskRec,
     priority = #priority taskRec,
     taskData = #taskData taskRec,
     computationList = #computationList taskRec,
     activeTime = #activeTime taskRec,
     arrivalTime = #arrivalTime taskRec,
     deadlineTime = #deadlineTime taskRec,
     timeStamp = #timeStamp taskRec,
     unblocking = false},taskList)
  else standardEnqueueTask(taskRec,taskList);

(* Function to enqueue an I/O request in priority order. Uses earliest
deadline order if priority < 0. *)

fun enqueueIO (ioRec:IOControlRecord, []) = [ioRec]
| enqueueIO (ioRec:IOControlRecord, ioList:IOControlRecordList) =
  if (#priority ioRec >= 0)
  then if (#priority ioRec < #priority (hd(ioList)))
        then ioRec::ioList
        else hd(ioList) :: enqueueIO(ioRec,tl(ioList))
  else if (IntInf.<=#deadlineTime ioRec, #deadlineTime (hd(ioList)))
  then ioRec::ioList
  else hd(ioList) :: enqueueIO(ioRec,tl(ioList));

(* function to update a task control record timestamp *)

fun updateTaskTimeStamp (taskRec:TaskControlRecord) =
  {identifier = #identifier taskRec,
   priority = #priority taskRec,
   taskData = #taskData taskRec,
   computationList = #computationList taskRec,
   activeTime = #activeTime taskRec,
   arrivalTime = #arrivalTime taskRec,
   deadlineTime = #deadlineTime taskRec,
   unblocking = #unblocking taskRec,
   timeStamp = time()};

(* function to update an I/O control record timestamp *)

fun updateIOTimeStamp (ioRec:IOControlRecord) =
  {identifier = #identifier ioRec,
   priority = #priority ioRec,
   ioList = #ioList ioRec,

```

```

ioData = #ioData ioRec,
activeTime = #activeTime ioRec,
deadlineTime = #deadlineTime ioRec,
timeStamp = time{};

(* function to update a task control record active time and timestamp *)

fun updateTaskActiveTime (taskRec:TaskControlRecord) =
  {identifier = #identifier taskRec,
  priority = #priority taskRec,
  taskData = #taskData taskRec,
  unblocking = #unblocking taskRec,
  computationList = #computationList taskRec,
  arrivalTime = #arrivalTime taskRec,
  deadlineTime = #deadlineTime taskRec,
  activeTime = #activeTime taskRec
  + IntInf.toInt(IntInf.-(time(),#timeStamp taskRec)),
  timeStamp = time{};

(* function to update an I/O control record active time and timestamp *)

fun updateIOActiveTime (ioRec:IOControlRecord) =
  {identifier = #identifier ioRec,
  priority = #priority ioRec,
  ioList = #ioList ioRec,
  ioData = #ioData ioRec,
  deadlineTime = #deadlineTime ioRec,
  activeTime = #activeTime ioRec
  + IntInf.toInt(IntInf.-(time(),#timeStamp ioRec)),
  timeStamp = time{};

(* function to return task time to go *)

fun taskTimeToGo (taskRec:TaskControlRecord) =
  if (hd(#computationList taskRec) = "compute")
  then atoi(hd(tl(#computationList taskRec))) - #activeTime taskRec
  else 0;

(* function to return I/O time to go *)

fun ioTimeToGo (ioRec:IOControlRecord) =
  #duration (hd(#ioData ioRec)) - #activeTime ioRec;

(* function to generate a time and ID string for use in report output *)

fun taskTimeIdString (taskRec:TaskControlRecord) =
  "time " ^ IntInf.toString(#timeStamp taskRec) ^
  " id " ^ makestring(#identifier taskRec);

(* function to discard the head computation from a task control record *)

fun computationDone (taskRec:TaskControlRecord) =
  {identifier = #identifier taskRec,
  priority = #priority taskRec,
  taskData = #taskData taskRec,
  timeStamp = #timeStamp taskRec,
  activeTime = #activeTime taskRec,
  arrivalTime = #arrivalTime taskRec,
  deadlineTime = #deadlineTime taskRec,
  unblocking = #unblocking taskRec,
  computationList = tl(tl(#computationList taskRec))};

```

```

(* function to discard the head of an io control record list *)

fun ioNext (ioRecList:IOControlRecordList) =
  if (length(#ioData (hd(ioRecList))) = 1)
  then tl(ioRecList)
  else {identifier = #identifier (hd(ioRecList)),
        priority = #priority (hd(ioRecList)),
        deadlineTime = #deadlineTime (hd(ioRecList)),
        activeTime = 0,
        timeStamp = time(),
        ioList = tl(#ioList (hd(ioRecList))),
        ioData = tl(#ioData (hd(ioRecList)))} :: tl(ioRecList);

(* function to test a computation string for requiring cpu resourcing *)

fun cpuComputation (computationString:String) =
  computationString = "compute" orelse
  computationString = "invoke" orelse
  computationString = "take" orelse
  computationString = "give" orelse
  computationString = "send" orelse
  computationString = "receive";

(* Function to discard the head computation of a task control record list.
Discards the head task control record if the last computation has been
done or the next computation is not compute, invoke, take, give, send
or receive. *)

fun taskNext (taskRecList:TaskControlRecordList) =
  if (length(#computationList (hd(taskRecList))) <= 2)
  then tl(taskRecList)
  else if (cpuComputation(hd(tl(tl(#computationList (hd(taskRecList)))))))
  then {identifier = #identifier (hd(taskRecList)),
        priority = #priority (hd(taskRecList)),
        taskData = #taskData (hd(taskRecList)),
        unblocking = #unblocking (hd(taskRecList)),
        arrivalTime = #arrivalTime (hd(taskRecList)),
        deadlineTime = #deadlineTime (hd(taskRecList)),
        activeTime = 0,
        timeStamp = time(),
        computationList = tl(tl(#computationList (hd(taskRecList))))}
  :: tl(taskRecList)
  else tl(taskRecList);

(* function to apply priority ceiling protocol if enabled *)

fun pcp (taskRec:TaskControlRecord,semRec:SemRecord) =
  if (#priorityCeiling semRec < 0)
  then taskRec
  else {identifier = #identifier taskRec,
        priority = #priorityCeiling semRec,
        taskData = #taskData taskRec,
        unblocking = #unblocking taskRec,
        arrivalTime = #arrivalTime taskRec,
        deadlineTime = #deadlineTime taskRec,
        activeTime = #activeTime taskRec,
        timeStamp = #timeStamp taskRec,
        computationList = #computationList taskRec};

(* function to end priority ceiling protocol prioritisation *)

fun pcpEnd (taskRec:TaskControlRecord) =
  {identifier = #identifier taskRec,
  priority = #priority (#taskData taskRec),
  taskData = #taskData taskRec,

```

```
unblocking = #unblocking taskRec,  
arrivalTime = #arrivalTime taskRec,  
deadlineTime = #deadlineTime taskRec,  
activeTime = #activeTime taskRec,  
timeStamp = #timeStamp taskRec,  
computationList = #computationList taskRec};  
  
(* function to add to a semaphores value *)  
  
fun semAdd(semRec:SemRecord,num:Int) =  
  {semName = #semName semRec,  
   semValue = #semValue semRec + num,  
   priorityCeiling = #priorityCeiling semRec};  
  
(* function to set the unblocking flag for a task *)  
  
fun setUnblocking (taskRec:TaskControlRecord) =  
  {identifier = #identifier taskRec,  
   priority = #priority taskRec,  
   taskData = #taskData taskRec,  
   unblocking = true,  
   arrivalTime = #arrivalTime taskRec,  
   deadlineTime = #deadlineTime taskRec,  
   activeTime = #activeTime taskRec,  
   timeStamp = #timeStamp taskRec,  
   computationList = #computationList taskRec};
```

Appendix C: Task and I/O Specifications

Task set and I/O specifications are loaded into the model through the use of Standard ML functions *taskSpecifications* and *IOSpecifications*, which return data of types *TaskRecordList* and *IORecordList*. The functions used to specify the task data for each scheduling protocol are shown in appendices C.1 to C.5, and the function used to specify I/O data is shown in Appendix C.6.

C.1. Non-Preemptive Fixed Priority Task Specifications

```

fun taskSpecifications _ =
  [{"name = "Weapon_release",
    priority = 1,
    preemptable = false,
    period = 10000,
    phase = 0,
    deadline = 5000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "AG1,SMS1",
                   "compute", "1000",
                   "output", "SMS2"]},
   {"name = "HOTAS_bomb_button",
    priority = 5,
    preemptable = false,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "DP1",
                   "compute", "1000",
                   "output", "KEYSET1"]},
   {"name = "Radar_tracking",
    priority = 2,
    preemptable = false,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "RADAR1,MPD1",
                   "compute", "2000",
                   "output", "RADAR2"]},
   {"name = "Aircraft_flight_data",
    priority = 6,
    preemptable = false,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "ADC1,INS1,RALT1",
                   "compute", "8000",
                   "output",
                   "INS2,NAV2,NAV3,NAV4"]},
   {"name = "Target_tracking",
    priority = 3,
    preemptable = false,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV1,AG2,AG3,RADAR3",
                   "compute", "4000",
                   "output", "AG4,HUD1"]},
   {"name = "HUD_display",
    priority = 7,
    preemptable = false,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV5,HUD2,AG5",
                   "compute", "6000",
                   "output", "DP2"]},
   {"name = "Target_sweetening",
    priority = 4,
    preemptable = false,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "HOTAS1",
                   "compute", "2000",
                   "output", "SMS2"]},
   {"name = "MPD_tactical_display",
    priority = 8,
    preemptable = false,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV5,HUD2,AG5",
                   "compute", "6000",
                   "output", "DP2"]}]}

```

```

    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
"MPD2,RADAR4,RWR1,NAV6,RADAR5,AG6",
        "compute", "8000",
        "output", "DP3"]},

{name = "Steering",
    priority = 9,
    preemptable = false,
    period = 80000,
    phase = 0,
    deadline = 80000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
"NAV7,MPD3,KEYSET2,AG7",
        "compute", "6000",
        "output", "NAV8"]},

{name = "Weapon_trajectory",
    priority = 10,
    preemptable = false,
    period = 100000,
    phase = 0,
    deadline = 100000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
        "compute", "7000",
        "output", "AG10"]},

{name = "Threat_response_display",
    priority = 11,
    preemptable = false,
    period = 100000,
    phase = 0,
    deadline = 100000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["compute", "3000",
        "output", "MPD5,HUD3"]},

{name = "AUTO_CCIP_toggle",
    priority = 12,
    preemptable = false,

    period = 200000,
    phase = 0,
    deadline = 200000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "DP1",
        "compute", "1000",
        "output", "KEYSET1"]},

{name = "Poll_RWR",
    priority = 13,
    preemptable = false,
    period = 200000,
    phase = 0,
    deadline = 200000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "RWR1",
        "compute", "2000",
        "output", "SMS4"]},

{name = "Reinitiate_trajectory",
    priority = 14,
    preemptable = false,
    period = 400000,
    phase = 0,
    deadline = 400000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
        "compute", "6000",
        "output", "AG10"]},

{name = "Periodic_BIT",
    priority = 15,
    preemptable = false,
    period = 1000000,
    phase = 0,
    deadline = 400000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
"ADC2,INS3,SMS5,RADAR6,RWR2,RALT2",
        "compute", "5000",
        "output", "DP4"]}],

```

C.2. Preemptive Fixed Priority Task Specifications

```

fun taskSpecifications _ =
    [{"name = "Weapon_release",
        priority = 1,
        preemptable = true,
        period = 10000,
        phase = 0,
        deadline = 5000,
        cpuNumber = 1,
        activationTime = 0,
        deactivationTime = ~1,
        computations = ["input", "AG1,SMS1",
"compute", "1000",
"output", "SMS2"]},

{name = "Radar_tracking",
    priority = 2,
    preemptable = true,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,

```

```

deactivationTime = ~1,
computations = ["input", "RADAR1,MPD1",
               "compute", "2000",
               "output", "RADAR2"]},

{name = "Target_tracking",
priority = 3,
preemptable = true,
period = 40000,
phase = 0,
deadline = 40000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV1,AG2,AG3,RADAR3",
               "compute", "4000",
               "output", "AG4,HUD1"]},

{name = "Target_sweetening",
priority = 4,
preemptable = true,
period = 40000,
phase = 0,
deadline = 40000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "HOTAS1",
               "compute", "2000"]},

{name = "HOTAS_bomb_button",
priority = 5,
preemptable = true,
period = 40000,
phase = 0,
deadline = 40000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "DP1",
               "compute", "1000",
               "output", "KEYSET1"]},

{name = "Aircraft_flight_data",
priority = 6,
preemptable = true,
period = 50000,
phase = 0,
deadline = 50000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"ADC1,INS1,RALT1",
               "compute", "8000",
               "output",
"INS2,NAV2,NAV3,NAV4"]},

{name = "HUD_display",
priority = 7,
preemptable = true,
period = 50000,
phase = 0,
deadline = 50000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,

computations = ["input",
"NAV5,HUD2,AG5",
               "compute", "6000",
               "output", "DP2"]},

{name = "MPD_tactical_display",
priority = 8,
preemptable = true,
period = 50000,
phase = 0,
deadline = 50000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"MPD2,RADAR4,RWR1,NAV6,RADAR5,AG6",
               "compute", "8000",
               "output", "DP3"]},

{name = "Steering",
priority = 9,
preemptable = true,
period = 80000,
phase = 0,
deadline = 80000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV7,MPD3,KEYSET2,AG7",
               "compute", "6000",
               "output", "NAV8"]},

{name = "Weapon_trajectory",
priority = 10,
preemptable = true,
period = 100000,
phase = 0,
deadline = 100000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
               "compute", "7000",
               "output", "AG10"]},

{name = "Threat_response_display",
priority = 11,
preemptable = true,
period = 100000,
phase = 0,
deadline = 100000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "3000",
               "output", "MPD5,HUD3"]},

{name = "AUTO_CCIP_toggle",
priority = 12,
preemptable = true,
period = 200000,
phase = 0,
deadline = 200000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "DP1",

```

```

        "compute", "1000",
        "output", "KEYSET1"}},
{name = "Poll_RWR",
  priority = 13,
  preemptable = true,
  period = 200000,
  phase = 0,
  deadline = 200000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input", "RWR1",
                 "compute", "2000",
                 "output", "SMS4"]},
{name = "Reinitiate_trajectory",
  priority = 14,
  preemptable = true,
  period = 400000,
  phase = 0,
  deadline = 400000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input", "AG8,MPD4,AG9,SMS3",
                 "compute", "6000",
                 "output", "AG10"]},
{name = "Periodic_BIT",
  priority = 15,
  preemptable = true,
  period = 1000000,
  phase = 0,
  deadline = 400000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
                 "ADC2,INS3,SMS5,RADAR6,RWR2,RALT2",
                 "compute", "5000",
                 "output", "DP4"]}]};

```

C.3. Asynchronous Fixed Priority Task Specifications

```

fun taskSpecifications _ =
[
  {name = "Weapon_release",
    priority = 1,
    preemptable = true,
    period = 10000,
    phase = 0,
    deadline = 5000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "AG1,SMS1",
                   "compute", "1000",
                   "output", "SMS2"]},
  {name = "Radar_tracking",
    priority = 2,
    preemptable = true,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "RADAR1,MPD1",
                   "compute", "2000",
                   "output", "RADAR2"]},
  {name = "Target_tracking",
    priority = 3,
    preemptable = true,
    period = 40000,
    phase = 10000,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV1,AG2,AG3,RADAR3",
                   "compute", "4000",
                   "output", "AG4,HUD1"]},
  {name = "Target_sweetening",
    priority = 4,
    preemptable = true,
    period = 40000,
    phase = 20000,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "HOTAS1",
                   "compute", "2000"]},
  {name = "HOTAS_bomb_button",
    priority = 5,
    preemptable = true,
    period = 40000,
    phase = 30000,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "DP1",
                   "compute", "1000",
                   "output", "KEYSET1"]},
  {name = "Aircraft_flight_data",
    priority = 6,
    preemptable = true,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "ADC1,INS1,RALT1",
                   "compute", "8000",

```



```

        "output",
"INS2,NAV2,NAV3,NAV4"}},

{name = "HUD_display",
  priority = 7,
  preemptable = true,
  period = 50000,
  phase = 16000,
  deadline = 50000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
"NAV5,HUD2,AG5",
        "compute", "6000",
        "output", "DP2"]},

{name = "MPD_tactical_display",
  priority = 8,
  preemptable = true,
  period = 50000,
  phase = 32000,
  deadline = 50000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
"MPD2,RADAR4,RWR1,NAV6,RADAR5,AG6",
        "compute", "8000",
        "output", "DP3"]},

{name = "Steering",
  priority = 9,
  preemptable = true,
  period = 80000,
  phase = 20000,
  deadline = 80000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
"NAV7,MPD3,KEYSET2,AG7",
        "compute", "6000",
        "output", "NAV8"]},

{name = "Weapon_trajectory",
  priority = 10,
  preemptable = true,
  period = 100000,
  phase = 0,
  deadline = 100000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
        "compute", "7000",
        "output", "AG10"]},

{name = "Threat_response_display",
  priority = 11,
  preemptable = true,

        period = 100000,
        phase = 50000,
        deadline = 100000,
        cpuNumber = 1,
        activationTime = 0,
        deactivationTime = ~1,
        computations = ["compute", "3000",
        "output", "MPD5,HUD3"]},

{name = "AUTO_CCIP_toggle",
  priority = 12,
  preemptable = true,
  period = 200000,
  phase = 0,
  deadline = 200000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input", "DP1",
        "compute", "1000",
        "output", "KEYSET1"]},

{name = "Poll_RWR",
  priority = 13,
  preemptable = true,
  period = 200000,
  phase = 100000,
  deadline = 200000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input", "RWR1",
        "compute", "2000",
        "output", "SMS4"]},

{name = "Reinitiate_trajectory",
  priority = 14,
  preemptable = true,
  period = 400000,
  phase = 0,
  deadline = 400000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
        "compute", "6000",
        "output", "AG10"]},

{name = "Periodic_BIT",
  priority = 15,
  preemptable = true,
  period = 1000000,
  phase = 0,
  deadline = 400000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input",
"ADC2,INS3,SMS5,RADAR6,RWR2,RALT2",
        "compute", "5000",
        "output", "DP4"]}];

```

C.4. Dynamic Priority Task Specifications

```

fun taskSpecifications _ =
  [{"name = "Weapon_release",
    priority = ~1,
    preemptable = true,
    period = 10000,
    phase = 0,
    deadline = 5000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "AG1,SMS1",
                   "compute", "1000",
                   "output", "SMS2"]},
   {"name = "Radar_tracking",
    priority = ~1,
    preemptable = true,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "RADAR1,MPD1",
                   "compute", "2000",
                   "output", "RADAR2"]},
   {"name = "Target_tracking",
    priority = ~1,
    preemptable = true,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV1,AG2,AG3,RADAR3",
                   "compute", "4000",
                   "output", "AG4,HUD1"]},
   {"name = "Target_sweetening",
    priority = ~1,
    preemptable = true,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "HOTAS1",
                   "compute", "2000"]},
   {"name = "HOTAS_bomb_button",
    priority = ~1,
    preemptable = true,
    period = 40000,
    phase = 0,
    deadline = 40000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input", "DP1",
                   "compute", "1000",
                   "output", "KEYSET1"]},
   {"name = "Aircraft_flight_data",
    priority = ~1,
    preemptable = true,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "ADC1,INS1,RALT1",
                   "compute", "8000",
                   "output",
                   "INS2,NAV2,NAV3,NAV4"]},
   {"name = "HUD_display",
    priority = ~1,
    preemptable = true,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV5,HUD2,AG5",
                   "compute", "6000",
                   "output", "DP2"]},
   {"name = "MPD_tactical_display",
    priority = ~1,
    preemptable = true,
    period = 50000,
    phase = 0,
    deadline = 50000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "MPD2,RADAR4,RWR1,NAV6,RADAR5,AG6",
                   "compute", "8000",
                   "output", "DP3"]},
   {"name = "Steering",
    priority = ~1,
    preemptable = true,
    period = 80000,
    phase = 0,
    deadline = 80000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
                   "NAV7,MPD3,KEYSET2,AG7",
                   "compute", "6000",
                   "output", "NAV8"]},
   {"name = "Weapon_trajectory",
    priority = ~1,
    preemptable = true,
    period = 100000,
    phase = 0,
    }

```

```

    deadline = 100000,
    cpuNumber = 1,
    activationTime = 0,
    deactivationTime = ~1,
    computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
                    "compute", "7000",
                    "output", "AG10"}],

{name = "Threat_response_display",
priority = ~1,
preemptable = true,
period = 100000,
phase = 0,
deadline = 100000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "3000",
                "output", "MPD5,HUD3"]},

{name = "AUTO_CCIP_toggle",
priority = ~1,
preemptable = true,
period = 200000,
phase = 0,
deadline = 200000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "DP1",
                "compute", "1000",
                "output", "KEYSET1"]},

{name = "Poll_RWR",
priority = ~1,
preemptable = true,
period = 200000,
phase = 0,
deadline = 200000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "RWR1",
                "compute", "2000",
                "output", "SMS4"]},

{name = "Reinitiate_trajectory",
priority = ~1,
preemptable = true,
period = 400000,
phase = 0,
deadline = 400000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3",
                "compute", "6000",
                "output", "AG10"]},

{name = "Periodic_BIT",
priority = ~1,
preemptable = true,
period = 1000000,
phase = 0,
deadline = 400000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"ADC2,INS3,SMS5,RADAR6,RWR2,RALT2",
                "compute", "5000",
                "output", "DP4"]}],

```

C.5. Static Schedule Task Specifications

```

fun taskSpecifications _ =
[ {name = "Weapon_release_input",
  priority = 2,
  preemptable = false,
  period = 0, (* 10000 *)
  phase = 0,
  deadline = 7000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input", "AG1,SMS1"]},

  {name = "Weapon_release_output",
  priority = 1,
  preemptable = false,
  period = 0, (* 10000 *)
  phase = 0,
  deadline = 7000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["output", "SMS2"]},

  {name = "Weapon_release",
  priority = 1,
  preemptable = false,
  period = 0, (* 10000 *)
  phase = 0,
  deadline = 1000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["compute", "1000"]},

  {name = "Radar_tracking_input",
  priority = 2,
  preemptable = false,
  period = 0, (* 40000 *)
  phase = 0,
  deadline = 7000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["input", "RADAR1,MPD1"]},

  {name = "Radar_tracking_output",
  priority = 1,
  preemptable = false,
  period = 0, (* 40000 *)
  phase = 0,
  deadline = 7000,
  cpuNumber = 1,
  activationTime = 0,
  deactivationTime = ~1,
  computations = ["output", "SMS2"]}
]

```

```

period = 0,          (* 40000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "RADAR2"]},

{name = "Radar_tracking",
priority = 1,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 2000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "2000"]},

{name = "Target_tracking_input",
priority = 2,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV1,AG2,AG3,RADAR3"]},

{name = "Target_tracking_output",
priority = 1,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "AG4,HUD1"]},

{name = "Target_tracking",
priority = 1,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 4000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "4000"]},

{name = "Target_sweetening_input",
priority = 2,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "HOTAS1"]},

{name = "Target_sweetening",
priority = 1,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 2000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "2000"]},

{name = "HOTAS_bomb_button_input",
priority = 2,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "DPI"]},

{name = "HOTAS_bomb_button_output",
priority = 1,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "KEYSET1"]},

{name = "HOTAS_bomb_button",
priority = 1,
preemptable = false,
period = 0,          (* 40000 *)
phase = 0,
deadline = 1000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "1000"]},

{name = "Aircraft_flight_data_input",
priority = 2,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "ADC1,INS1,RALT1"]},

{name = "Aircraft_flight_data_output",
priority = 1,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output",
"INS2,NAV2,NAV3,NAV4"]},

{name = "Aircraft_flight_data",
priority = 1,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 8000,
cpuNumber = 1,

```

```

activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "8000"]},

{name = "HUD_display_input",
priority = 2,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "NAV5,HUD2,AG5"]},

{name = "HUD_display_output",
priority = 1,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "DP2"]},

{name = "HUD_display",
priority = 1,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 6000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "6000"]},

{name = "MPD_tactical_display_input",
priority = 2,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"MPD2,RADAR4,RWR1,NAV6,RADAR5,AG6"]},

{name = "MPD_tactical_display_output",
priority = 1,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "DP3"]},

{name = "MPD_tactical_display",
priority = 1,
preemptable = false,
period = 0,          (* 50000 *)
phase = 0,
deadline = 8000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,

computations = ["compute", "8000"]},

{name = "Steering_input",
priority = 2,
preemptable = false,
period = 0,          (* 80000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV7,MPD3,KEYSET2,AG7"]},

{name = "Steering_output",
priority = 1,
preemptable = false,
period = 0,          (* 80000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "NAV8"]},

{name = "Steering",
priority = 1,
preemptable = false,
period = 0,          (* 80000 *)
phase = 0,
deadline = 6000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "6000"]},

{name = "Weapon_trajectory_input",
priority = 2,
preemptable = false,
period = 0,          (* 100000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3"]},

{name = "Weapon_trajectory_output",
priority = 1,
preemptable = false,
period = 0,          (* 100000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "AG10"]},

{name = "Weapon_trajectory",
priority = 1,
preemptable = false,
period = 0,          (* 100000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "7000"]}

```

```

{name = "Threat_response_display_output",
priority = 1,
preemptable = false,
period = 0,          (* 100000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "MPD5,HUD3"]},

{name = "Threat_response_display",
priority = 1,
preemptable = false,
period = 0,          (* 100000 *)
phase = 0,
deadline = 3000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "3000"]},

{name = "AUTO_CCIP_toggle_input",
priority = 2,
preemptable = false,
period = 0,          (* 200000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "DP1"]},

{name = "AUTO_CCIP_toggle_output",
priority = 1,
preemptable = false,
period = 0,          (* 200000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "KEYSET1"]},

{name = "AUTO_CCIP_toggle",
priority = 1,
preemptable = false,
period = 0,          (* 200000 *)
phase = 0,
deadline = 1000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "1000"]},

{name = "Poll_RWR_input",
priority = 2,
preemptable = false,
period = 0,          (* 200000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input", "RWR1"]},

{name = "Poll_RWR_output",
priority = 1,
preemptable = false,
period = 0,          (* 200000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "SMS4"]},

{name = "Poll_RWR",
priority = 1,
preemptable = false,
period = 0,          (* 200000 *)
phase = 0,
deadline = 2000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "2000"]},

{name = "Reinitiate_trajectory_input",
priority = 2,
preemptable = false,
period = 0,          (* 400000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"NAV9,AG8,MPD4,AG9,SMS3"]},

{name = "Reinitiate_trajectory_output",
priority = 1,
preemptable = false,
period = 0,          (* 400000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "AG10"]},

{name = "Reinitiate_trajectory",
priority = 1,
preemptable = false,
period = 0,          (* 400000 *)
phase = 0,
deadline = 6000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "6000"]},

{name = "Periodic_BIT_input",
priority = 2,
preemptable = false,
period = 0,          (* 1000000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["input",
"ADC2,INS3,SMS5,RADAR6,RWR2,RALT2"]},

{name = "Periodic_BIT_output",
priority = 1,
preemptable = false,

```

```

period = 0,          (* 1000000 *)
phase = 0,
deadline = 7000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["output", "DP4"]},

{name = "Periodic_BIT",
priority = 1,
preemptable = false,
period = 0,          (* 1000000 *)
phase = 0,
deadline = 5000,
cpuNumber = 1,
activationTime = 0,
deactivationTime = ~1,
computations = ["compute", "5000"]},

{name = "Schedule_task",
priority = 1,
preemptable = true,
period = 2000000,
phase = 0,
deadline = 2000000,
cpuNumber = 2,
activationTime = 0,
deactivationTime = ~1,
computations = [

(* t = 0 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 11 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 22 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 33 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 41 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Reinitiate_trajectory",
"sleep", "6000",

(* t = 50 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 63 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 72 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 82 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 92 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "Target_tracking",
"sleep", "4000",

(* t = 100 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 111 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 120 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 131 *)
"invoke", "Weapon_release",

```

```

"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Steering",
"sleep", "6000",

(* t = 142 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 152 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 162 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 171 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 180 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Poll_RWR",
"sleep", "2000",
"invoke", "Threat_response_display",
"sleep", "3000",

(* t = 192 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 200 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 211 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",

"invoke", "HUD_display",
"sleep", "6000",

(* t = 222 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 233 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 242 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Periodic_BIT",
"sleep", "5000",

(* t = 250 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 263 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 272 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 282 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

(* t = 291 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

```



```

(* t = 300 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 311 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 320 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 331 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Poll_RWR",
"sleep", "2000",

"sleep", "2000",

(* t = 340 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

"sleep", "1000",

(* t = 350 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 360 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 370 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",

"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 383 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 393 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",

"sleep", "2000",

(* t = 400 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 411 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 422 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 433 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 441 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Reinitiate_trajectory",
"sleep", "6000",

(* t = 450 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

```

```

(* t = 463 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 472 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 482 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 492 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "Target_tracking",
"sleep", "4000",

(* t = 500 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 511 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 520 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 531 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Steering",
"sleep", "6000",

(* t = 542 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 552 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 562 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 571 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 580 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Poll_RWR",
"sleep", "2000",
"invoke", "Threat_response_display",
"sleep", "3000",

(* t = 592 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 600 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 611 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 622 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",

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```

"sleep", "8000",
(* t = 633 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 642 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",

"sleep", "5000",

(* t = 650 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 663 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 672 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 682 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

(* t = 691 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 700 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 711 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 720 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 731 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Poll_RWR",
"sleep", "2000",

"sleep", "2000",

(* t = 740 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

"sleep", "1000",

(* t = 750 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 760 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 770 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 783 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",

```

```

"sleep", "7000",
(* t = 793 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",
"sleep", "2000",
(* t = 800 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",
(* t = 811 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",
(* t = 822 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",
(* t = 833 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",
(* t = 841 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Reinitiate_trajectory",
"sleep", "6000",
(* t = 850 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",
(* t = 863 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",
(* t = 872 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",
(* t = 882 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",
(* t = 892 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "Target_tracking",
"sleep", "4000",
(* t = 900 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",
(* t = 911 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",
(* t = 920 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",
(* t = 931 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Steering",
"sleep", "6000",
(* t = 942 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",
(* t = 952 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",

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```

"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 962 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 971 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 980 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Poll_RWR",
"sleep", "2000",
"invoke", "Threat_response_display",
"sleep", "3000",

(* t = 992 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1000 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1011 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1022 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1033 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1042 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Periodic_BIT",
"sleep", "5000",

(* t = 1050 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1063 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1072 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1082 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1091 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 1100 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1111 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

```

```

(* t = 1120 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1131 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Poll_RWR",
"sleep", "2000",

"sleep", "2000",

(* t = 1140 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

"sleep", "1000",

(* t = 1150 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1160 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 1170 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1183 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1193 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",

"sleep", "2000",

(* t = 1200 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1211 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1222 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1233 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1241 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Reinitiate_trajectory",
"sleep", "6000",

(* t = 1250 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1263 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1272 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1282 *)
"invoke", "Weapon_release",

```

```

"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1292 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "Target_tracking",
"sleep", "4000",

(* t = 1300 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1311 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 1320 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1331 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1342 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1352 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1362 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",

"invoke", "HUD_display",
"sleep", "6000",

(* t = 1371 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1380 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Poll_RWR",
"sleep", "2000",
"invoke", "Threat_response_display",
"sleep", "3000",

(* t = 1392 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1400 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1411 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1422 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1433 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1442 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",

"sleep", "5000",

```

```

(* t = 1450 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1463 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1472 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1482 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1491 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 1500 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1511 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 1520 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1531 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Poll_RWR",
"sleep", "2000",

"sleep", "2000",

(* t = 1540 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

"sleep", "1000",

(* t = 1550 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1560 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 1570 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1583 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1593 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",

"sleep", "2000",

(* t = 1600 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",

```



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"sleep", "8000",
(* t = 1611 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",
(* t = 1622 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",
(* t = 1633 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",
(* t = 1641 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Reinitiate_trajectory",
"sleep", "6000",
(* t = 1650 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",
(* t = 1663 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",
(* t = 1672 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",
(* t = 1682 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",
(* t = 1692 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "Target_tracking",
"sleep", "4000",
(* t = 1700 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",
(* t = 1711 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",
(* t = 1720 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",
(* t = 1731 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Steering",
"sleep", "6000",
(* t = 1742 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",
(* t = 1752 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",
(* t = 1762 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",
(* t = 1771 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

```

```

(* t = 1780 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Poll_RWR",
"sleep", "2000",
"invoke", "Threat_response_display",
"sleep", "3000",

(* t = 1792 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1800 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1811 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1822 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1833 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1842 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",

"sleep", "5000",

(* t = 1850 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1863 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "HUD_display",
"sleep", "6000",

(* t = 1872 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1882 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

(* t = 1891 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Threat_response_display",
"sleep", "3000",
"invoke", "AUTO_CCIP_toggle",
"sleep", "1000",

(* t = 1900 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1911 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 1920 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1931 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "Poll_RWR",
"sleep", "2000",

"sleep", "2000",

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(* t = 1940 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Steering",
"sleep", "6000",

"sleep", "1000",

(* t = 1950 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Aircraft_flight_data",
"sleep", "8000",

(* t = 1960 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Radar_tracking",
"sleep", "2000",
"invoke", "HUD_display",
"sleep", "6000",

"sleep", "1000",

(* t = 1970 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_tracking",
"sleep", "4000",
"invoke", "MPD_tactical_display",
"sleep", "8000",

(* t = 1983 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "Target_sweetening",
"sleep", "2000",
"invoke", "Weapon_trajectory",
"sleep", "7000",

(* t = 1993 *)
"invoke", "Weapon_release",
"sleep", "1000",
"invoke", "HOTAS_bomb_button",
"sleep", "1000",
"invoke", "Threat_response_display",
"sleep", "3000",

"sleep", "2000"]}],

{name = "Schedule_io",
priority = 1,
preemptable = true,
period = 2000000,
phase = 0,
deadline = 2000000,
cpuNumber = 3,
activationTime = 0,
deactivationTime = ~1,
computations = [

(* t = 0 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Threat_response_display_output",

"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 11 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 22 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 33 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Reinitiate_trajectory_input",
"sleep", "8000",

(* t = 41 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 50 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Reinitiate_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 63 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 72 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Weapon_trajectory_input",
"sleep", "10000",

(* t = 82 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",

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"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"sleep", "10000",

(* t = 92 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 100 *)
"invoke", "Weapon_release_output",
"invoke", "Threat_response_display_output",
"invoke", "Target_tracking_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "11000",

(* t = 111 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 120 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 131 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 142 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 152 *)
"invoke", "Weapon_release_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 162 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 171 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Target_sweetening_input",
"invoke", "Poll_RWR_input",
"sleep", "9000",

(* t = 180 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "12000",

(* t = 192 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 200 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 211 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 222 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 233 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Periodic_BIT_input",
"sleep", "9000",

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(* t = 242 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 250 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Periodic_BIT_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 263 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 272 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Steering_input",
"sleep", "10000",

(* t = 282 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "9000",

(* t = 291 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 300 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Threat_response_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 311 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",

"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 320 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Poll_RWR_input",
"sleep", "11000",

(* t = 331 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Steering_input",
"sleep", "9000",

(* t = 340 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 350 *)
"invoke", "Weapon_release_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 360 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "10000",

(* t = 370 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "13000",

(* t = 383 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"sleep", "10000",

(* t = 393 *)
"invoke", "Weapon_release_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",

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"invoke", "Aircraft_flight_data_input",
"sleep", "7000",

(* t = 400 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 411 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 422 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 433 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Reinitiate_trajectory_input",
"sleep", "8000",

(* t = 441 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 450 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Reinitiate_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 463 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 472 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",

"invoke", "Radar_tracking_input",
"invoke", "Weapon_trajectory_input",
"sleep", "10000",

(* t = 482 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"sleep", "10000",

(* t = 492 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 500 *)
"invoke", "Weapon_release_output",
"invoke", "Threat_response_display_output",
"invoke", "Target_tracking_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "11000",

(* t = 511 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 520 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 531 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 542 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 552 *)
"invoke", "Weapon_release_output",

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"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 562 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 571 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Target_sweetening_input",
"invoke", "Poll_RWR_input",
"sleep", "9000",

(* t = 580 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "12000",

(* t = 592 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 600 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 611 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 622 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 633 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"sleep", "9000",

(* t = 642 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 650 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 663 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 672 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Steering_input",
"sleep", "10000",

(* t = 682 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "9000",

(* t = 691 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 700 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Threat_response_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"sleep", "11000",

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(* t = 711 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 720 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Poll_RWR_input",
"sleep", "11000",

(* t = 731 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Steering_input",
"sleep", "9000",

(* t = 740 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 750 *)
"invoke", "Weapon_release_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 760 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "10000",

(* t = 770 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "13000",

(* t = 783 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"sleep", "10000",

(* t = 793 *)
"invoke", "Weapon_release_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "7000",

(* t = 800 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 811 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 822 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 833 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Reinitiate_trajectory_input",
"sleep", "8000",

(* t = 841 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 850 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Reinitiate_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 863 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

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(* t = 872 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Weapon_trajectory_input",
"sleep", "10000",

(* t = 882 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"sleep", "10000",

(* t = 892 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 900 *)
"invoke", "Weapon_release_output",
"invoke", "Threat_response_display_output",
"invoke", "Target_tracking_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "11000",

(* t = 911 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 920 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 931 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 942 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",

"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 952 *)
"invoke", "Weapon_release_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 962 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 971 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Target_sweetening_input",
"invoke", "Poll_RWR_input",
"sleep", "9000",

(* t = 980 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "12000",

(* t = 992 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 1000 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 1011 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 1022 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",

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"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 1033 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Periodic_BIT_input",
"sleep", "9000",

(* t = 1042 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 1050 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Periodic_BIT_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 1063 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1072 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Steering_input",
"sleep", "10000",

(* t = 1082 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "9000",

(* t = 1091 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 1100 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",

"invoke", "Threat_response_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 1111 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1120 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Poll_RWR_input",
"sleep", "11000",

(* t = 1131 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Steering_input",
"sleep", "9000",

(* t = 1140 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 1150 *)
"invoke", "Weapon_release_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 1160 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "10000",

(* t = 1170 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "13000",

(* t = 1183 *)

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"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"sleep", "10000",

(* t = 1193 *)
"invoke", "Weapon_release_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "7000",

(* t = 1200 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 1211 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 1222 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 1233 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Reinitiate_trajectory_input",
"sleep", "8000",

(* t = 1241 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "9000",

(* t = 1250 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Reinitiate_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 1263 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1272 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Weapon_trajectory_input",
"sleep", "10000",

(* t = 1282 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"sleep", "10000",

(* t = 1292 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 1300 *)
"invoke", "Weapon_release_output",
"invoke", "Threat_response_display_output",
"invoke", "Target_tracking_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "11000",

(* t = 1311 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1320 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Steering_input",
"sleep", "11000",

(* t = 1331 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

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(* t = 1342 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "10000",

(* t = 1352 *)
"invoke", "Weapon_release_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "HUD_display_input",
"sleep", "10000",

(* t = 1362 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1371 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Target_sweetening_input",
"invoke", "Poll_RWR_input",
"sleep", "9000",

(* t = 1380 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Steering_input",
"sleep", "12000",

(* t = 1392 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Threat_response_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 1400 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 1411 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",

"invoke", "MPD_tactical_display_input",
"sleep", "11000",

(* t = 1422 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "Weapon_trajectory_input",
"sleep", "11000",

(* t = 1433 *)
"invoke", "Weapon_release_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"sleep", "9000",

(* t = 1442 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "Weapon_trajectory_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Aircraft_flight_data_input",
"sleep", "8000",

(* t = 1450 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "HUD_display_input",
"sleep", "13000",

(* t = 1463 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1472 *)
"invoke", "Weapon_release_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "Steering_input",
"sleep", "10000",

(* t = 1482 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "AUTO_CCIP_toggle_input",
"sleep", "9000",

(* t = 1491 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "Steering_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Aircraft_flight_data_input",

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"sleep", "9000",
(* t = 1500 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Threat_response_display_output",
"invoke", "AUTO_CCIP_toggle_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
"invoke", "HUD_display_input",
"sleep", "11000",

(* t = 1511 *)
"invoke", "Weapon_release_output",
"invoke", "Aircraft_flight_data_output",
"invoke", "Weapon_release_input",
"invoke", "Radar_tracking_input",
"invoke", "MPD_tactical_display_input",
"sleep", "9000",

(* t = 1520 *)
"invoke", "Weapon_release_output",
"invoke", "HOTAS_bomb_button_output",
"invoke", "HUD_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_tracking_input",
"invoke", "Poll_RWR_input",
"sleep", "11000",

(* t = 1531 *)
"invoke", "Weapon_release_output",
"invoke", "Radar_tracking_output",
"invoke", "MPD_tactical_display_output",
"invoke", "Weapon_release_input",
"invoke", "Target_sweetening_input",
"invoke", "Steering_input",
"sleep", "9000",

(* t = 1540 *)
"invoke", "Weapon_release_output",
"invoke", "Target_tracking_output",
"invoke", "Poll_RWR_output",
"invoke", "Weapon_release_input",
"invoke", "HOTAS_bomb_button_input",
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"invoke", "HUD_display_input",
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"invoke", "Aircraft_flight_data_input",
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"invoke", "AUTO_CCIP_toggle_input",
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(* t = 1811 *)

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(* t = 1911 *)
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C.6. I/O Message Specifications

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18. DSTO Research Library Thesaurus Petri nets, Modelling, Real-time computer programs					
19. ABSTRACT A Coloured Petri Net has been developed to model real-time task scheduling in avionics mission computers. The model has been applied to a generic avionics mission computer specification, and results are presented for a range of task scheduling protocols. Model input data, output data and complete design are documented to support application of the model to other mission computer hardware and software architectures.					