INTERNATIONAL STANDARD

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Information technology — Open Systems Interconnection — Systems Management: Command sequencer for Systems Management

Technologies de l'information — Interconnexion de systèmes ouverts (OSI) — Gestion-systèmes: Séquenceur de commande pour la gestion-systèmes

Reference number
ISO/IEC 10164-21:1998(E)

Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10164-21 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 33, *Distributed application services*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.753.

ISO/IEC 10164 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Systems Management*:

— *Part 1: Object management function*

— *Part 2: State management function*

— *Part 3: Attributes for representing relationships*

— *Part 4: Alarm reporting function*

— *Part 5: Event report management function*

— *Part 6: Log control function*

— *Part 7: Security alarm reporting function*

— *Part 8: Security audit trail function*

— *Part 9: Objects and attributes for access control*

— *Part 10: Usage metering function for accounting purposes*

— *Part 11: Metric objects and attributes*

— *Part 12: Test management function*

— *Part 13: Summarization function*

— *Part 14: Confidence and diagnostic test categories*

— *Part 15: Scheduling function*

— *Part 16: Management knowledge management function*

— *Part 17: Change over function*

— *Part 18: Software management function*

— *Part 19: Management domain and management policy management functions*

— *Part 20: Time management function*

— *Part 21: Command sequencer for Systems Management*

— *Part 22: Response time monitoring function*

Annexes A, B, D and F to H form an integral part of this part of ISO/IEC 10164. Annexes C and E are for information only.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – SYSTEMS MANAGEMENT: COMMAND SEQUENCER FOR SYSTEMS MANAGEMENT

1 Scope

This Recommendation | International Standard defines a Systems Management Function which may be used by an application process in a centralized or decentralized management environment to interact for the purpose of systems management, as defined by CCITT Rec. X.700 | ISO/IEC 7498-4. This Recommendation | International Standard defines the Command Sequencer which consists of generic definitions, services and functional units. This function is positioned in the application layer of ITU-T Rec. X.200 | ISO/IEC 7498-1 and is defined according to the model provided by ISO 9545. The role of systems management functions is described by ITU Rec. X.701 | ISO/IEC 10040.

This Recommendation | International Standard:

- establishes user requirements for the Command Sequencer;
- establishes models that relate the services provided by the function to user requirements;
- defines the services provided by the function;
- specifies the protocol that is necessary in order to provide the services;
- defines the relationship between the services and SMI operations and notifications;
- defines relationships with other systems management functions;
- specifies conformance requirements;
- defines a scripting language for use in the command sequencer environment.

This Recommendation | International Standard does not:

- define the nature of any implementation intended to provide the Command Sequencer;
- specify the manner in which management is accomplished by the use of the Command Sequencer;
- define the nature of any instructions which result in the use of the Command Sequencer;
- specify the services necessary for the establishment, normal, abnormal release of management associations.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model.*
- ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services*.

- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview*.
- ITU-T Recommendation X.710 (1997) | ISO/IEC 9595:1998, *Information technology – Open Systems Interconnection – Common management information service*.
- ITU-T Recommendation X.711 (1997) | ISO/IEC 9596-1:1998, *Information technology – Open Systems Interconnection – Common management information protocol: Specification*.
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information*.
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects*.
- ITU-T Recommendation X.724 (1996) | ISO/IEC 10165-6:1997, *Information technology – Open Systems Interconnection – Structure of management information: Requirements and guidelines for implementation conformance statement proformas associated with OSI management*.
- ITU-T Recommendation X.725 (1995) | ISO/IEC 10165-7:1996, *Information technology – Open Systems Interconnection – Structure of management information: General relationship model*.
- CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems management: Object management function*.
- CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1992, *Information technology – Open Systems Interconnection – Systems management: State management function*.
- CCITT Recommendation X.733 (1992) | ISO/IEC 10164-4:1992, *Information technology – Open Systems Interconnection – Systems management: Alarm reporting function*.
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems management: Event report management function*.
- CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems management: Log control function*.
- ITU-T Recommendation X.739 (1993) | ISO/IEC 10164-11:1994, *Information technology – Open Systems Interconnection – Systems management: Metric objects and attributes*.
- ITU-T Recommendation X.741 (1995) | ISO/IEC 10164-9:1995, *Information technology – Open Systems Interconnection – Systems management: Objects and attributes for access control*.
- ITU-T Recommendation X.746 (1995) | ISO/IEC 10164-15:1995, *Information technology – Open Systems Interconnection – Systems management: Scheduling function*.

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.209 (1988), *Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)*.

  ISO/IEC 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*.

- ITU-T Recommendation X.291 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Abstract test suite specification*.

  ISO/IEC 9646-2:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 2: Abstract Test Suite specification*.

- ITU-T Recommendation X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Implementation conformance statement*.

  ISO/IEC 9646-7:1995, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements.*.

- CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT Applications.*

  ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework*.

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Basic Reference Model definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1.

a) open system;

b) systems management.

3.2 Service convention definitions

This Recommendation | International Standard makes use of the following term defined in ITU-T Rec. X.210 | ISO/IEC 10731.

– primitive.

3.3 Management framework definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.700 | ISO/IEC 7498-4.

a) management information;

b) managed object.

3.4 Systems management overview definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.701 | ISO/IEC 10040.

a) agent role;

b) management support object;

c) managed object class;

d) manager role;

e) notification;

f) systems management functional unit;

g) system management operation.

3.5 Common management information service definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.710 | ISO/IEC 9595.

a) attribute;

b) common management information services.

3.6 Additional definitions

The following terms are defined in this Recommendation | International Standard.

3.6.1 command sequencer: A management support object representing a resource which functions in a manager role as a notification destination and as an initiator of operations determined by its launch scripts, with the ability to delegate management activities.

3.6.2 launch script: A managed object representing the instructions to be performed by a command sequencer.

3.6.3 thread: A managed object representing the execution of a launch script. The execution results or errors from launch script executions are returned by the thread.

3.6.4 suspendable thread: The suspendable thread is derived from the thread managed object class. These threads are spawned by asynchronous launch pads. They can be suspended by means of suspend action directed at them and resumed by means of a resume action directed at them.

3.6.5 launch pad: A management support object to which a trigger may be directed to initiate the execution of a launch script. A launch pad serves as an Initial Value Managed Object (IVMO) for a thread.

3.6.6 asynchronous launch pad: An asynchronous launch pad is derived from launch pad. It returns a trigger result notification without waiting for results of execution of the launch scripts. Execution results or errors from launch script executions are notified directly from the thread.

3.6.7 synchronous launch pad: A synchronous launch pad is derived from the launch pad. It returns trigger result notification or processing error alarm after it gets all the execution results and errors from threads after the threads complete their execution.

3.6.8 trigger activator: An initiator of script execution by causing a launch pad to spawn one or more threads. It directs a command to a launch pad, in the form of scheduler, operations, notifications or local action.

3.6.9 command: An instruction for a management activity that is performed in the agent system in accordance with contents of a launch script. A command is described with a scripting language. Currently, the system management scripting language is defined in Annex F.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

ASN.1	Abstract Syntax Notation One
CMIS	Common Management Information Service
CS	Command Sequencer
IVMO	Initial Value Managed Object
OSI	Open Systems Interconnection
LP	Launch Pad
SMSL	Systems Management Scripting Language

5 Conventions

This Specification defines services for the command sequencer following the descriptive conventions defined in ITU-T Rec. X.210 | ISO/IEC 10731. In clause 9, the definition of each service includes a table that lists the service parameters. For a given service primitive, the presence of each parameter is described by one of the following values:

M	The parameter is mandatory.
(=)	The value of the parameter is equal to the value of the parameter in the column to the left.
U	The use of the parameter is a Service-user option.
–	The parameter is not present in the interaction described by the primitive concerned.
C	The parameter is conditional. The conditions are defined by the test which describes this parameter.
P	The parameter is subject to the constraints imposed by ITU-T Rec. X.710 | ISO/IEC 9595.

NOTE – The parameters which are marked “P” in service tables of this Specification are mapped directly onto the corresponding parameters of the CMIS service primitive, without changing the semantics or syntax of the parameters.

The font used for GDMO, ASN.1 and GRM in this Recommendation | International Standard is Courier. The BNF for SMSL in F.14.11 is in Courier New. In Annexes F and G, SMSL function parameters have been italicized.

6 Requirements

The requirements to be satisfied are:

- User requirements:
  - Allow the delegation of management activities.
  - Reduce the amount of communication that must occur between manager and agents.

  - Allow delegated manager systems to operate on agent systems even when communications between a manager and the agent systems have been disrupted or are not possible.
  - Provide flexible control of management activities.
  - Provide a scripting language which can describe procedures to perform management operations.
  - Allow delegated systems to execute CMIS operations in sequence.
- Operational requirements:
  - Pre-scheduled or delayed execution of a systems management operation.
  - Capabilities for modifying the request for pre-scheduled or delayed execution.
  - Capabilities for initiating, suspending, resuming and terminating systems management operations based on time management actions or the occurrence of events.
  - Capabilities for reporting and recording the outcome of pre-scheduled or delayed execution.
  - The ability to send notifications when state changes occur.

7 Model

7.1 Model description

The model describes how triggered, pre-scheduled or delayed execution of system management operations can be performed by the command sequencer. It describes the conceptual components, the relationship between these components, a description of the states and possible state transitions.

Figure 1 is a schematic description of the command sequencer capability of a system.

The functionality of a command sequencer is modeled by the launch script, thread, and launch pad objects. It is an OSI abstraction of pre-scheduled or delayed operation execution in open systems. A command sequencer may contain any number of launch pads, for which the command sequencer serves as a service provider. Each launch pad may execute one launch script at a time, or may execute multiple launch scripts at a time. On receiving a trigger from a trigger activator, a launch pad initiates the execution of a launch script. In addition to the trigger id component, the trigger may specify a launch script name (script id) and input arguments to the script as parameters within the execution parameter list component.

There are two types of launch pads, asynchronous launch pad and synchronous launch pad. An asynchronous launch pad returns a trigger result notification without waiting for results of execution of the launch scripts. Execution results or errors from launch script executions are notified directly from the thread. A synchronous launch pad, on the other hand, returns trigger result notification or processing error alarm after it gets all the execution results and errors from threads when the threads complete their execution.

A launch script instance may contain any number of individual instructions. The execution parameter list component of the trigger is a list of scripts (identified by their script ids) to be executed and the corresponding input parameters needed to execute those scripts. A default execution parameter list may be specified for a launch pad to execute in case it receives a trigger in which the trigger parameters are not specified. If the launch pad is not configured to execute a default execution parameter list and the execution parameter list component is not supplied by the trigger and if the launch pad receives a trigger attempting to activate it, a no script error code is returned in the error code field of the trigger result notification. The launch pad has an available script list attribute which can be configured to identify scripts that can be executed by it. If a execution parameter list component is present in the trigger, the launch pad verifies whether each script id from the execution parameter component is present in its available script list attribute. Only those script instances indicated by the script id which are present in the available script list attribute are executed. If none of the script ids are present in the available script list, the launch pad returns a script rejected error code in the trigger result, and script execution does not take place.

Specialized scripting language object classes are derived from the launch script object class. Hence these instructions may be specified as specialized script instances. Multiple sets of launch script instructions may be executed sequentially or in parallel by threads, in accordance with the execution parameter data type. Several nested levels of sub-threading may be necessary in order to execute script instances.

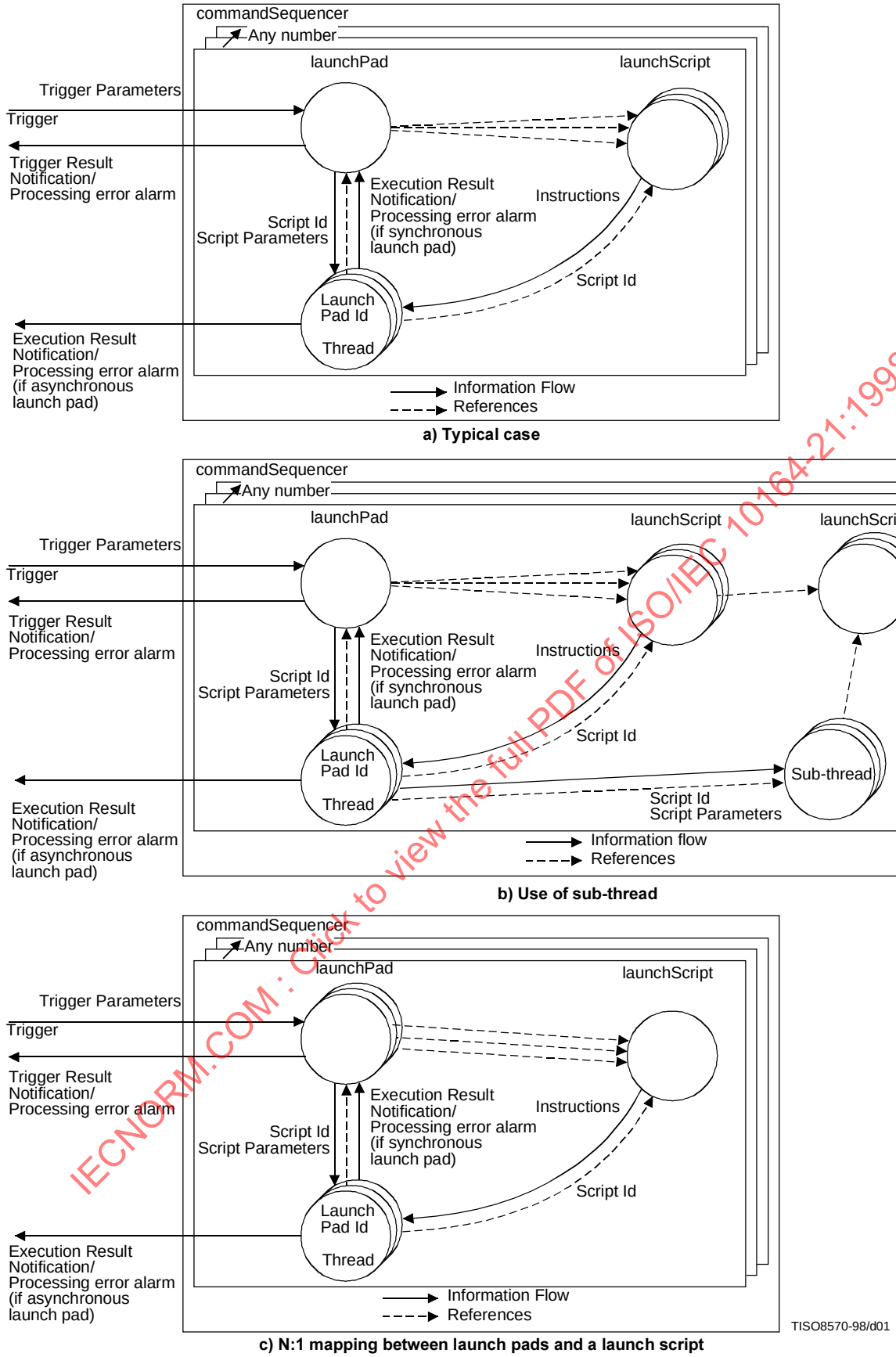


Figure 1 – Command sequencer model

In order to initiate the execution behaviour of launch script instances, a trigger shall be directed at the launch pad object instance. Unparameterized triggers may activate the launch pad in cases where the launch pad has a default execution parameter list.

The launch pad acts as an IVMO for a thread and supplies the execution parameter list to the executing parameters attribute of the thread. The execution parameter list may be a single execution parameter, a sequence of execution parameters or a set of execution parameters. The execution parameter is a sequence of script ids and script parameters. The script id identifies the managed object instance name of the scripting object instance to be executed and the script parameters supply the parameter values which are needed as inputs to the scripting object instance. If a sequence of execution parameters is specified, the launch pad spawns a thread in order to execute the script instances and supplies the script id and the script parameters (if required) from the execution parameters to the thread. On completion of the thread, this is repeated for the rest of the script ids in the list in sequence. If a set of execution parameters is specified, the launch pad supplies the set of script ids and script parameters (if required) to threads and the corresponding scripts instances are executed in parallel. The semantics of parameter passing between the launch pad and threads depend on the parameter passing mechanism supported by the scripting language in which the script is written.

One thread is assigned the execution of one script instance. This thread may spawn other threads if necessary. This may happen when one script instance invokes another script instances. When this happens, the thread executing a calling script spawns a sub-thread, passing the script id and script parameters (if required) of the called script to the sub-thread. The semantics of parameter passing between threads and sub-threads depend on the parameter passing mechanism supported by the scripting language in which the script is written.

Asynchronous launch pads should spawn suspendable threads. A suspendable thread can be suspended and resumed by means of suspend and resume actions respectively. Individual threads spawned by synchronous launch pads may not be suspended and resumed. All threads related to execution of a script may be suspended or resumed in both cases.

A thread is complete after all its sub-threads have completed successfully or reported an error. Once this happens, execution of a launch script is complete; the corresponding launch pad then returns to an inactive (idle) state. A thread is contained by the object which spawned it. A thread may be contained by a launch pad or another thread.

Multiple launch pads may reference a particular launch script. Multiple threads may reference that same launch script. The existence of a script is independent of any references to it by launch pads or threads. Launch scripts are defined in the specialized script classes derived from the launch script object class. The semantics and syntax of these scripts are specified in the definition of the scripting language in which the scripts are written. The scripting language definition also specifies a set of basic scripting functions which are necessary to provide control and processing ability to the launch scripts.

The general string script managed object class should be used for writing scripts which are represented in the form of a general string. The script language name attribute indicates the name of that scripting language and the script content attribute represents the script written in this scripting language in the form of a general string. Annexes F and G define a specialized scripting language, System Management Scripting Language (SMSL), as the scripting language in which scripts represented in the form of a general string should be written. It is possible to define other classes of scripts. Annex D defines, cmisScript, a scripting language, in the form of managed objects which can be used to write scripts in the CMIS environment.

7.2 Triggering process and reporting results

Triggers activators directed at the launch pad may be in various forms such as schedulers, operations, notifications and local action. When a launch pad receives a trigger, it spawns one or more threads in order to execute a script. After all threads related to a trigger are spawned, an asynchronous launch pad emits a trigger result notification which includes sets of thread id and script id. Results of script execution are propagated by threads as execution result notifications directly to the manager in the case of the asynchronous launch pad. After all threads related to a trigger are completed, a synchronous launch pad synchronizes all the execution results or errors from threads and emits a trigger result notification which includes sets of thread id, script id and execution results or errors to the manager.

The execution result type attribute of the script identifies the type of result expected from execution of the script and should correspond to the execution result type attribute of the execution result. The errorCode field of the execution result is set to the no error code when the execution is successful otherwise it is set to the appropriate error code.

An executing thread may terminate spontaneously either upon the completion of its execution or in abnormal conditions. In the latter case, the thread indicates abnormal termination by issuing a processing error alarm notification.

The execution result and processing error alarm notifications are issued by the thread and forwarded to appropriate notification destination(s). In the case of an asynchronous launch pad, these notifications are forwarded to external notification destinations whereas in the case of a synchronous launch pad, these notifications are propagated to the launch pad.

A manager may voluntarily terminate all launching processes by means of a delete operation to the corresponding launch pad. On receiving a delete operation, if the thread-launchPad name binding includes “DELETE DELETES-CONTAINED-OBJECTS” definition, all its threads which cause the execution of the script are terminated and deleted. The launch pad is then deleted.

A manager may voluntarily terminate all executions related to a thread by means of a delete operation to the corresponding thread. On receiving a delete operation, if the thread-thread name binding includes “DELETE DELETES-CONTAINED-OBJECTS” definition, all its sub-threads related to the execution of the script are terminated and deleted. The thread is then deleted.

In order to cause execution of all scripts being currently executed by a synchronous or asynchronous launch pad to be terminated, a terminate action may be directed at the launch pad. All threads related to the execution of scripts are terminated and deleted when a terminate action is received by the launch pad.

Launching of all threads being currently executed by a synchronous or asynchronous launch pad may be suspended by a suspend action directed at the launch pad and subsequently resumed by a resume action.

Execution of scripts by suspendable threads spawned by an asynchronous launch pad, may be suspended by a suspend action directed at the thread and subsequently resumed by a resume action. The thread id, returned in the trigger result notification should be supplied as a parameter to suspend and resume actions.

The launch pad has attributes to monitor a specific attribute of a specific object instance. If the value of the monitored attribute is changed, a trigger is generated to cause execution of a specified script list.

If the monitored attribute is an Event Discrimination Counter (EDC) counter as defined in Annex C, the notifications filtered by the EDC, trigger the launching of scripts by the launch pad.

7.3 Management of command sequencer

The attribute values of the launch pad, thread, launch script, and specialized scripting managed object instances are retrieved and modified through Get and Set operations, respectively.

Tables 1 to 5 map the status attributes of the command sequencer, launch pad, thread and script managed objects to the states defined in CCITT Rec. X.731 | ISO/IEC 10164-2.

NOTE – "–" means any value.

Table 1 – Status table of command sequencer

Status of command sequencer	Administrative state	Operational state
CS not operational	–	disabled
CS is operational	unlocked	enabled
CS is locked	locked	enabled
CS is shutting down	shuttingDown	enabled

When a command sequencer has a disabled operational state it is in a totally inoperable state and its launch pads are not executing scripts. If it is in an enabled state, an event which consists of an operation being performed at the managed object boundary may cause a transition from a locked administrative state to an unlocked state or vice versa. When the command sequencer goes into a locked state, it causes its launch pads to suspend the execution of launch scripts. Alternatively, when it goes into an unlocked administrative state, the launch pads are available to start or resume the execution of launch scripts.

Table 2 – Status table of launch pad

Status of launch pad	Administrative state	Operational state	Control status	Usage state	Availability status
LP is not operational	–	disabled	–	–	
LP is operational	unlocked	enabled	–	Busy	
LP is operational	unlocked	enabled	–	Idle	–
LP is locked	locked	enabled	–	Idle	–
LP is on duty	–	–	–	–	Not Off duty
LP is off duty	–	–	–	–	Off duty
LP is suspended	–	–	Suspended	–	–
LP is resumed	–	–	Empty	–	–

When a launch pad has a disabled operational state, it is in a totally inoperable state and cannot execute scripts. If it is in an enabled state, an event which consists of an operation being performed at the managed object boundary may cause it to transition from a locked administrative state to an unlocked state or vice versa. When the launch pad goes into a locked state, it suspends the execution of launch scripts. Alternatively, when it goes into an unlocked administrative state, the launch pads are available to start or resume the execution of launch scripts. The launch pad is made inactive by an internal control process according to a predetermined time schedule and its availability status value is off duty. A suspend action causes the control status to change to suspended and a resume action changes it back to its default value, empty.

Table 3 – Status table of thread

Status of thread	Operational state
Thread not operational	Disabled
Thread operational	Enabled

The thread is in an enabled state when it is performing a script execution and in a disabled state when it is not.

Table 4 – Status table of suspendable thread

Status of suspendable thread	Operational state	Control status
Suspendable thread not operational	Disabled	–
Suspendable thread operational	Enabled	–
Suspendable thread suspended	–	Suspended
Suspendable thread resumed	–	Empty

A suspend action causes the control status of the suspendable thread to change to suspended and a resume action changes it back to its default value, empty.

Table 5 – Status table of launch script

Status of launch script	Administrative state
LS execution allowed	Unlocked
LS execution not allowed	Locked

An event which consists of an operation being performed at the managed object boundary may cause a script to transition from a locked administrative state to an unlocked state or vice versa. When the launch script goes into a locked state, it cannot be executed by a launch pad other than the ones which are currently executing it. Alternatively, when it goes into an unlocked administrative state, the launch script is available for execution by other launch pads.

7.4 Scheduling of the command sequencer

An external scheduler scheduling package provides the capability of scheduling the activation of a command sequencer's launch pads by triggers. The launch pad's availability status attribute will be changed to "off duty" or "not off duty" in accordance with the scheduling characteristics specified by an external scheduler managed object. The semantics of the external scheduler scheduling package are described in CCITT Rec. X.734 | ISO/IEC 10164-5 and CCITT Rec. X.735 | ISO/IEC 10164-6 .

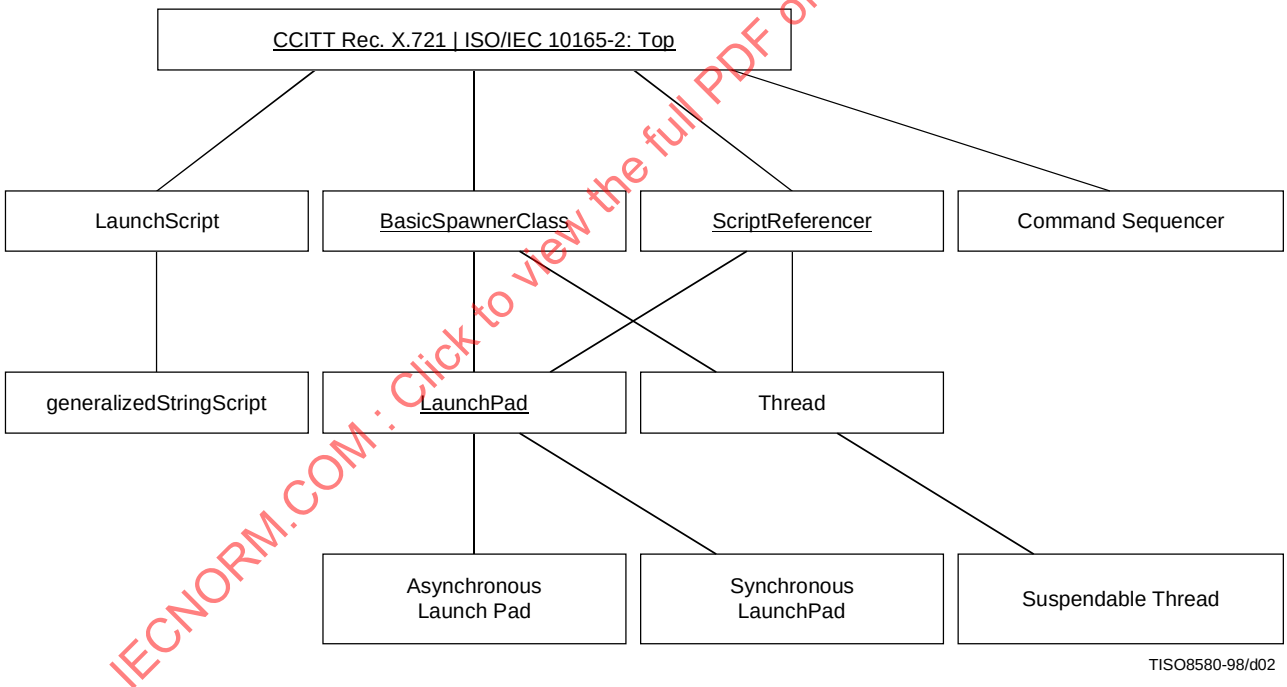
7.5 Access control

The command sequencer should be permitted access to all the managed object instances which are operated on by its threads. Behaviour of the thread when an operation on an instance is denied should be defined in the script. For example, if an operation is denied, an unauthorized access attempt error may be returned by a processing error alarm notification.

8 Generic definitions

8.1 Managed objects

This Specification defines a set of managed object classes. The inheritance structure of these managed object classes is shown in Figure 2.



NOTE – Uninstantiable object classes are underlined.

Figure 2 – Inheritance structure of resources of command sequencer

The containment structure of these managed object classes is shown in Figure 3.

8.1.1 Command sequencer

8.1.1.1 Overview

- A management support object representing a resource which acts in a manager role as an invoker of operations determined by its launch scripts and as a notification destination.
- Acts as service provider for a launch pad.
- Contains one or more launch pads.

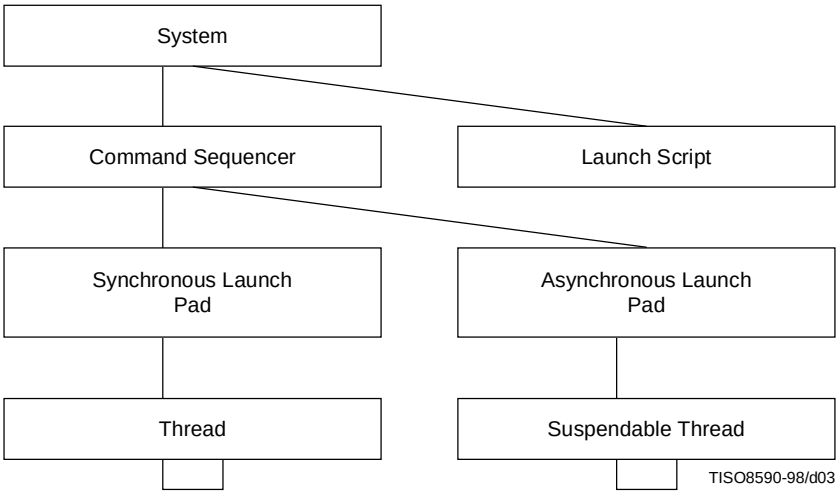


Figure 3 – Containment structure of resources of command sequencer

8.1.1.2 Packages of the command sequencer management support object

The command sequencer management support object has the following mandatory package:

– command sequencer package.

8.1.1.3 Characteristics of the command sequencer

The command sequencer management support object class has the following attributes.

8.1.1.3.1 Command sequencer id

The value of this attribute defines an instance of the command sequencer management support object class.

8.1.1.3.2 Administrative state

This attribute represents the administrative capability of the command sequencer to perform its function. The following administrative states are defined:

a) Unlocked – The launch pads of the command sequencer are permitted to start or resume execution of launch scripts.

b) Locked – The launch pads of the command sequencer are not permitted to start execution of launch scripts. If executions are in progress, they are suspended.

c) Shutting down – The command sequencer is shutting down and its launch pads will not be permitted to perform any script executions.

8.1.1.3.3 Operational state

This attribute represents the operational capability of the command sequencer to perform its functions.

The following operational states are defined:

a) Enabled – The command sequencer is operational and ready for use.

b) Disabled – The command sequencer is not available for use.

8.1.1.4 Notifications of the command sequencer

The command sequencer support management object class has the following notifications:

– object creation, as defined in CCITT Rec. X.730 | ISO/IEC 10164-1.

– object deletion, as defined in CCITT Rec. X.730 | ISO/IEC 10164-1.

– state change, as defined in CCITT Rec. X.730 | ISO/IEC 10164-1.

8.1.2 Thread

8.1.2.1 Overview

- A management object that models command execution and performs commands according to a script.
- Subclass of the basic spawner and script referencer managed object classes.
- Each thread is dedicated to a synchronous launch pad.
- This object class has a notification which notifies the result of the execution of the launch script.

8.1.2.2 Packages of the thread managed object class

The thread managed object class has the following mandatory packages:

- thread package;
- execution result package.

8.1.2.3 Characteristics of the thread managed object class

The thread class has the following attributes.

8.1.2.3.1 Thread Id

The value of this attribute identifies an instance of the thread management object class.

8.1.2.3.2 Script Id

This value of this attribute identifies an instance of the launch script managed object class which is being executed.

8.1.2.3.3 Executing parameters

The script parameters component of this attribute is a list of parameter values supplied by a launch pad, which it needs to perform a script execution. The script id component of this attribute indicates the script(s) that should be executed with the corresponding parameters.

8.1.2.3.4 Operational state

This attribute represents the operational capability of the thread to perform its functions. The following operational states are defined:

a) Enabled – The thread is operational and is performing a script execution.

b) Disabled – The thread is not operational.

8.1.2.4 Notifications of the thread managed object class

The thread managed object class has the following notifications, which it forwards to the launch pad managed object class:

- execution result as defined in 8.2.1.
- processing error alarm as defined in CCITT X.733 | ISO/IEC 10164-4.

8.1.3 Suspendable thread

8.1.3.1 Overview

- Subclass of the thread managed object class.
- Spawned by an asynchronous launch pad.
- Can be suspended and resumed by means of suspend and resume actions.

8.1.3.2 Packages of the suspendable thread

The suspendable thread managed object class has the following mandatory package:

- suspend resume accepter.

8.1.3.3 Characteristics of the suspendable thread

The suspendable thread has the following attributes.

8.1.3.3.1 Control status

The control status attribute is defined in CCITT Rec. X.731 | ISO/IEC 10164-2. The default value is empty. If execution is suspended, the control status changes to 'suspended' and if execution is resumed, the value changes to empty.

8.1.3.4 Actions of the suspendable thread managed object class

The following actions can be directed at the suspendable thread managed object class:

- suspend;
- resume.

8.1.4 Launch script

8.1.4.1 Overview

- Management information that represents a series of instructions in specialized scripting languages.
- Each script should be independent.

8.1.4.2 Characteristics of the launch script

The launch script class has the following attributes.

8.1.4.2.1 Script Id

The value of this attribute identifies an instance of the launch script managed object class.

8.1.4.2.2 Execution result type

The value of this attribute identifies the expected type of execution result.

8.1.4.2.3 Administrative state

This is as defined in CCITT Rec. X.731 | ISO/IEC 10164-2.

8.1.4.3 Packages of the launch script object class

The launch script managed object class has the following mandatory package:

- launch script package.

8.1.5 Basic spawner class

8.1.5.1 Overview

- Signifies capability of creation of new contained object instances with automatic name generation for these new instances.
- Superclass of command sequence thread and launch pad object classes.

8.1.5.2 Packages of the basic spawner class

The basic spawner class has the following mandatory package:

- basic spawner package.

8.1.6 Launch pad

8.1.6.1 Overview

- Subclass of the basic spawner and script referencer managed object classes.
- Initiator of launch script execution on receiving a trigger.
- Acts as IVMO for a thread.
- A script is executed by the launch pad by means of one or more threads.

8.1.6.2 Packages of the launch pad managed object class

The mandatory packages of the launch pad managed object class are:

- launch pad package;
- trigger action accepter;
- parameter passer;
- trigger result package;
- trigger event accepter;
- terminate accepter;
- external scheduler;
- suspend resume acceptor.

8.1.6.3 Characteristics of launch pad

The launch pad managed object class has the following attributes.

8.1.6.3.1 Available script list

This is a list of all the scripts which a launch pad is capable of executing. The launch pad executes only those scripts which are present both in the execution parameter list component of trigger parameters of the trigger and in the available script list attribute.

8.1.6.3.2 Default execution parameter list

This is a list of script ids and script parameters which are used for default execution when a launch pad is triggered with no parameters.

8.1.6.3.3 Administrative state

This attribute represents the administrative capability of the launch pad to perform its function. The following administrative states are defined:

a) Unlocked – The launch pad is permitted to start or resume execution of launch scripts.

b) Locked – The launch pad is not permitted to start execution of launch scripts. If executions are in progress, they are suspended.

8.1.6.3.4 Operational state

This attribute represents the operational capability of the launch pad to perform its functions.

The following operational states are defined:

a) Enabled – The launch pad is operational and is available to execute a script.

b) Disabled – The launch pad is not operational and is unavailable for script executions.

8.1.6.3.5 Usage state

This attribute represents the usage status of the launch pad. The following usage states are defined:

a) Busy – The launch pad is being used to execute a launch script.

b) Idle – The launch pad is not being used to execute a script.

8.1.6.3.6 Availability status

This status condition indicates whether the launch pad is available to perform its function. The following states are defined:

a) Off Duty

The launch pad had been made inactive by an internal control process in accordance with a predetermined time schedule.

b) Not Off Duty

The availability status attribute does not have the Off Duty value and hence has been made active.

8.1.6.3.7 Observed object instance

This is defined in ITU-T Rec. X.739 | ISO/IEC 10164-11.

8.1.6.3.8 Observed attribute id

This is defined in ITU-T Rec. X.739 | ISO/IEC 10164-11.

8.1.6.3.9 Control status

This attribute is defined in CCITT Rec. X.731 | ISO/IEC 10164-2. The default value is empty. If execution is suspended, the control status changes to 'suspended' and if execution is resumed, the value changes to empty.

8.1.6.3.10 Launch pad id

This attribute names an instance of the launch pad managed object class.

8.1.6.4 Notifications of the launch pad managed object class

The launch pad managed object class has the following notifications, which can be forwarded to the appropriate notification destination(s):

- trigger result as defined in 8.2.1.
- processing error alarm as defined in CCITT X.733 | ISO/IEC 10164-4.

8.1.7 Asynchronous launch pad

8.1.7.1 Overview

- Subclass of the launch pad managed object class.
- Suspendable threads are spawned by asynchronous launch pad.
- Sends out a trigger result notification as soon as all suspendable threads are spawned.

8.1.7.2 Packages of the asynchronous launch pad

8.1.7.3 Managed object class

The asynchronous launch pad managed object class has the following package:

- triggerAsynchronousResultPackage.

8.1.8 Synchronous launch pad

8.1.8.1 Overview

- Subclass of the launch pad managed object class.
- Threads are spawned by the synchronous launch pad.
- Sends out a trigger result notification after synchronizing results as soon as all threads are complete.

8.1.8.2 Packages of the synchronous launch pad managed object class

The asynchronous launch pad managed object class has the following package:

- trigger synchronous result package.

8.1.9 General string script

8.1.9.1 Overview

- Subclass of the launch script object class.
- Scripts which can be represented in the form of a general string.
- It is possible to add other specialized scripts as subclasses.

8.1.9.2 Characteristics of general string scripting language

The general string scripting language managed object class has the following attributes.

8.1.9.2.1 Scripting language name

This is the name of the language which defines the syntactic and semantic properties of a script which is represented as a general string.

8.1.9.2.2 script content

This point to the script which is represented as a general string.

8.1.9.3 Packages of general string scripting language

The general string scripting language managed object class has the following mandatory package:

- general string script package.

8.1.10 Script referencer

8.1.10.1 Overview

- Superclass for launch pad and thread managed object classes.
- Defines a reference relationship mapping between launch pad and launch script and thread and launch script.

8.1.10.2 Packages of script referencer

The script referencer has the following mandatory package:

- script referencer package.

8.2 Generic notifications

The following notifications are defined in this Specification.

8.2.1 Trigger result

This returns the result of a script execution and with the value of errorCode set to noError if it was successful or an appropriate error code to indicate the nature of failure. The error code which can be returned in the errorCode field of the executionResult notification are:

- no error, if execution was successful;
- no script error, if execution failed because script name was not specified;
- script rejected error, if a script was not in the list of scripts which a launch pad is configured to execute;
- invalid parameter type error, if there is a type mismatch between the parameter type expected by the script and that supplied by the script;
- invalid parameter value error, if the value supplied in the parameter is invalid, e.g. out of range;
- script syntax error, if the script execution failed due to a syntax error in the script;
- script execution failed error, if the script execution failed for reasons other than improper syntax;
- invalid parameter number, if the number of parameters supplied are inconsistent with the number of parameters expected by the script;
- unauthorized access error, if access for one or more object instances to be used by the script, is denied.

8.2.2 Execution result

This returns the result of a script execution and with the value of errorCode set to noError if it was successful or an appropriate error code to indicate the nature of failure. The error code which can be returned in the errorCode field of the executionResult notification are:

- no error, if execution was successful;
- no script error, if execution failed because script name was not specified;
- script rejected error, if a script was not in the list of scripts which a launch pad is configured to execute;
- invalid parameter type error, if there is a type mismatch between the parameter type expected by the script and that supplied by the script;
- invalid parameter value error, if the value supplied parameter is invalid, e.g. out of range;
- script syntax error, if the script execution failed due to a syntax error in the script;

- script execution failed error, if the script execution failed for reasons other than improper syntax;
- invalid parameter number, if the number of parameters supplied are inconsistent with the number of parameters expected by the scrip;
- unauthorized access error, if access for one or more object instances to be used by the script, is denied.

8.3 Generic actions

The following action types are defined within this Specification. These actions have been defined for the launch pad and the suspendable thread managed object classes in this Specification.

8.3.1 Suspend action

The suspend action directed at a managed object causes that object to suspend execution of the script that it is currently executing. The parameters carried by the suspend action are the trigger id to identify this action and either the thread id if the action is directed at a thread or the launch pad id, if this action is directed at a launch pad.

8.3.2 Resume action

The resume action directed at a managed object causes that object to resume execution of the script which has been suspended by a previous suspend action. The parameters carried by the suspend action are the trigger id to identify this action and either the thread id if the action is directed at a thread or the launch pad id, if this action is directed at a launch pad.

8.3.3 Terminate action

The terminate action directed at a managed object causes unconditional termination of any script executions by that object and any objects spawned by this object. The trigger id parameter is used to identify this action.

8.3.4 Trigger action

A trigger action causes initiation of script execution. It supplies the trigger id parameter which identifies this action and its execution parameter list component consists of a sequence of script ids which indicate the scripts which should be executed and script parameters which are needed in order to execute these scripts.

9 Services

9.1 Introduction

The command sequencer provides services to modify the operations of command sequencer and launch scripts. In particular, the operations that can be applied to each instance of a command sequencer and launch scripts are:

- creation of command sequencer, launch pad and launch script instances;
- deletion of launch pad and launch script instances;
- modification of command sequencer, launch pad and launch script attributes;
- retrieval of command sequencer, launch pad and launch script attributes.

In addition to the above services to modify instances, this function provides notification services and action to trigger the command execution.

9.2 Initiation, Termination, Modification and Retrieval Services

The PT-CREATE, PT-DELETE, PT-SET and PT-GET services may be used to create, delete, modify and retrieve attribute values of command sequencer management support object and launch pad and launch script managed object instances.

9.3 Notification services

9.3.1 Execution result service definition

This subclause specifies the executionResultInfo report service which is defined in this Recommendation | International Standard and maps it to the CMIS M-EVENT-REPORT service.

Table 6 – Execution result reporting parameters

Parameter name	Req/Ind	Rsp/Cnf
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C (=)
Event time	P	–
Event information		
trigger id	M	–
script id	M	–
thread id	M	–
error code	U	–
execution result type	U	–
execution result	U	–
Current time	–	P
Event reply	–	P
Errors	–	P

Table 7 – Trigger result reporting parameters

Parameter name	Req/Ind	Rsp/Cnf
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C (=)
Event time	P	–
Event information		
trigger id	M	–
script id	U	–
thread id	–	–
script parameters	U	–
execution type	U	–
error code	U	–
execution result	U	–
Current time	–	P
Event reply	–	P
Errors	–	P

9.4 Action services

This subclause specifies the trigger and terminate action services which are defined in this Recommendation | International Standard and maps them to the CMIS M-EVENT-ACTION service.

Table 8 – Trigger action service parameters

Parameter name	Req/Ind	Rsp/Conf
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	–
Action Information		
trigger id	M	–
Attribute list	U	–
Errors	–	P

Table 9 – Terminate action service parameters

Parameter name	Req/Ind	Rsp/Conf
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	–
Action Information		
trigger id	M	–
Errors	–	P

Table 10 – Suspend action service parameters

Parameter name	Req/Ind	Rsp/Conf
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	–
Action Information		
trigger id	M	–
thread id	U	–
launch pad id	U	–
Errors	–	P

Table 11 – Resume action service parameters

Parameter name	Req/Ind	Rsp/Conf
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	–
Action Information		
trigger id	M	–
thread id	U	–
launch pad id	U	–
Errors	–	P

10 Functional units

Three functional unit are defined in this Recommendation | International Standard for the management of command sequencers:

a) *Execution functional unit*

The execution functional unit requires the services of PT-CREATE, trigger action execution result notification service and processing error alarm reporting service.

b) *Monitoring functional unit*

The monitoring functional unit requires the services of PT-GET.

c) *Control functional unit*

The control functional unit requires the services of terminate action, PT-DELETE.

11 Protocols and abstract syntax

11.1 Abstract syntax

11.1.1 Managed objects

11.1.1.1 Defined managed objects

Table 12 identifies the relationship between the managed objects defined in 8.1 and the managed object class specification in Annex A.

Table 12 – Managed objects and reference labels

Managed object name	Reference label
Basic spawner	basicSpawnerClass
Suspendable thread	suspendableThread
Thread	thread
Asynchronous launch pad	asynchronousLaunchPad
Synchronous launch pad	synchronousLaunchPad
Launch pad	launchPad
Launch script	launchScript
Command sequencer	commandSequencer
General string script	generalStringScript
Script Referencer	scriptReferencer

11.2 Attributes

11.2.1 Attributes imported from the definition of management information

This Specification references the following management attributes, whose abstract syntax are specified in CCITT Rec. X.721 | ISO/IEC 10165-2:

a) administrativeState;

b) usageState;

c) operationalState;

d) controlStatus;

e) availabilityStatus.

It also references the following management attributes, whose abstract syntax are specified in ITU-T Rec. X.739 | ISO/IEC 10164-11:

a) observedObjectInstance;

b) observedAttributeId.

11.2.2 Attributes defined in this Specification

This Specification defines the following management attributes, whose abstract syntax are specified in Annex A:

a) launchPadId;

b) commandSequencerId;

c) threadId;

d) scriptId;

e) triggerId;

f) executionResultType;

g) executingParameters;

h) scriptLanguageName;

i) scriptContent;

j) defaultExecutionParameterList;

k) availableScriptList.

11.2.3 Parameter to Attribute Mapping

Table 13 identifies the relationship between the service parameters defined in 8.1 and 8.2 and the attribute type specifications in Annex A.

Table 13 – Parameters and attribute names

Parameter name	Attribute name
Launch pad id	launchPadId
Command sequencer id	commandSequencerId
Thread id	threadId
Script id	scriptId
Trigger id	triggerId
Execution result type	executionResultType
Executing parameters	executingParameters
Script language name	scriptLanguageName
Script content	scriptContent
Default execution parameter list	defaultExecutionParameterList
Available script list	availableScriptList

11.4 Notifications

11.4.1 Referenced notifications

This Specification references the following events defined in CCITT Rec. X.730 | ISO/IEC 10164-1:

a) object creation notification;

b) object deletion notification;

c) processing error alarm notification.

This Specification also references the following events defined in CCITT Rec. X.731 | ISO/IEC 10164-2:

– state change notification.

11.4.2 Notifications defined in this Specification

Table 14 identifies the relationship between the notifications defined in 9.3 and the notification type specifications in Annex A.

Table 14 – Notifications

Event type	Notification type
Trigger result	triggerResultInfo
Execution result	executionResultInfo

11.5 Actions

11.5.1 Actions defined in this Specification

Table 15 identifies the relationship between the actions defined in 9.4 and the notification type specifications in Annex A.

Table 15 – Actions

Action name	Reference label
terminate	terminate
suspend	suspend
resume	resume
trigger	trigger

11.6 Negotiation of functional units

This Recommendation | International Standard assigns the following object identifier value:

{joint-iso-itu-t ms(9) function(2) part21(21) functionalUnitPackage(1)}

as a value of the ASN.1 type FunctionalUnitPackageId defined in CCITT Rec. X.701 | ISO/IEC 10040 to use for negotiating the following functional units:

0 Execution functional unit

M Monitoring functional unit

2 Control functional unit

where the number identifies the bit positions in the BIT STRING assigned to the functional units, and the names referencing the functional units are defined in clause 10.

Within the Systems management application context, the mechanism for negotiating the functional units is described by CCITT Rec. X.701 | ISO/IEC 10040.

NOTE – The requirement to negotiate functional units is specified by the application context.

12 Relationship with other functions

The command sequencer uses the services defined in CCITT Rec. X.731 | ISO/IEC 10164-2 for the notification of state changes, the services defined in CCITT Rec. X.730 | ISO/IEC 10164-1 for the creation and deletion of managed objects, the retrieval of attributes and notification of attribute value changes.

The command sequencer uses the services defined in ITU-T Rec. X.741 | ISO/IEC 10164-9 to provide access control capabilities to managed object instances which can be operated upon by threads.

13 Conformance

There are two conformance classes: general conformance class and dependent conformance class. A system claiming to implement the elements of procedure for systems management services referenced by this Specification shall comply with the requirements for either the general or the dependent conformance class as defined in the following subclauses. The supplier of the implementation shall state the class to which the conformance is claimed.

13.1 General conformance class requirements

A system claiming general conformance shall support this function for all managed object classes that import the management information defined in this Specification.

NOTE – This is applicable to all subclasses of the management support object classes defined in this Specification.

13.1.1 Static conformance

The system shall:

a) support the role of manager or agent or both, with respect to the control metrics functional unit and the monitor metrics functional unit;

b) support the transfer syntax derived from the encoding rules specified in CCITT Rec. X.209 | ISO/IEC 8825 and named {joint-iso-itu-t asn1(1) basicEncoding(1)}, for the purpose of generating and interpreting the MAPDUs, defined by the abstract data types referenced in 11.4 and 11.5.

c) when acting in the agent role, support one or more instances of at least one of the command sequencer, launch pad, launch script, thread managed object classes or any of their subclasses.

13.1.2 Dynamic conformance

The system shall, in the role(s) for which conformance is claimed:

a) Support the elements of procedure defined in:

- CCITT Rec. X.730 | ISO/IEC 10164-1 for the PT-GET, PT-CREATE, PT-DELETE, PT-SET, object creation reporting, object deletion reporting and attribute change reporting services;
- CCITT Rec. X.731 | ISO/IEC 10164-2 for the state change reporting service.
- CCITT Rec. X.733 | ISO/IEC 10164-4 for the processing error alarm reporting service.

b) Support the elements of procedure defined in this Specification for the following reporting and action services:

- execution result notification;
- trigger action;
- terminate action;
- suspend action;
- resume action.

13.2 Dependent conformance class requirements

13.2.1 Static conformance

The system shall:

a) support the transfer syntax derived from the encoding rules specified in CCITT Rec. X.209 | ISO/IEC 8825 and named {joint-iso-itu-t asn1(1) basicEncoding(1)}, for the purpose of generating and interpreting the MAPDUs, defined by the abstract data types referenced in 11.1, as required by a referencing specification;

b) support one or more instances of one of the command sequencer, launch pad, launch script, thread managed object classes or any of their subclasses, when acting in the agent role.

13.2.2 Dynamic conformance

The system shall support the elements of procedure referenced by this Specification, as required by a referencing specification.

13.3 Conformance to support managed object definitions

The command sequencer objects supported by the open system shall comply with the behaviour specified in clause 8 and the syntax specified in Annex A.

Annex A

Definition of Management Information

(This annex forms an integral part of this Recommendation | International Standard)

A.1 Managed object class definitions

A.1.1 Basic objects

```
basicSpawnerClass   MANAGED OBJECT CLASS
DERIVED FROM "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":top;
CHARACTERIZED BY basicSpawnerPackage ;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx1(1)};

commandSequencer    MANAGED OBJECT CLASS
DERIVED FROM "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":top;
CHARACTERIZED BY
       commandSequencerPackage   PACKAGE
       BEHAVIOUR commandSequencerBehaviour BEHAVIOUR
       DEFINED AS "An instance of this class represents a resource acting in a manager
       role as an invoker of operations determined by its launch scripts.";;
       ATTRIBUTES
              commandSequencerId    GET,
       "CCITT Rec. X.731|ISO/IEC 10164-2:1992": administrativeState GET-REPLACE,
              "CCITT Rec. X.731|ISO/IEC 10164-2:1992":operationalState GET;
       NOTIFICATIONS
              "CCITT Rec. X.730 | ISO/IEC 10164-1": objectCreation,
              "CCITT Rec. X.730 | ISO/IEC 10164-1": objectDeletion,
              "CCITT Rec. X.731 | ISO/IEC 10164-2": stateChange;;;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21)
managedObjectClass(3) xx2(2)};

generalStringScript MANAGED OBJECT CLASS
DERIVED FROM launchScript;
CHARACTERIZED BY generalStringScriptPackage;;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx3(3)};

asynchronousLaunchPad MANAGED OBJECT CLASS
DERIVED FROM launchPad;
CHARACTERIZED BY triggerAsynchronousResultPackage;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx4(4)};

synchronousLaunchPad MANAGED OBJECT CLASS
DERIVED FROM launchPad;
CHARACTERIZED BY triggerSynchronousResultPackage;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx5(5)};
```

```
launchPad    MANAGED OBJECT CLASS
DERIVED FROM basicSpawnerClass, scriptReferencer;
CHARACTERIZED BY
           launchPadPackage,
             triggerActionAccepter,
             parameterPasser,
             triggerResultPackage,
             triggerEventAccepter,
             terminateAccepter,
             "CCITT Rec. 721 | ISO/IEC 10165-2:1992": externalScheduler,
              suspendResumeAccepter;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx6(6)};

launchScript MANAGED OBJECT CLASS
DERIVED FROM "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":top;
CHARACTERIZED BY
       launchScriptPackage PACKAGE
       BEHAVIOUR launchScriptBehaviour BEHAVIOUR
       DEFINED AS "This managed object represents instructions to be carried out by a
       command sequencer.";;
       ATTRIBUTES
             scriptId GET,
             executionResultType GET,
             "CCITT Rec. X.721 | ISO /IEC 10165-2:1992": administrativeState GET-
             REPLACE;;;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx7(7)};


--
-- The following non-instantiable superclass simplifies the description of the
-- relationship between a launch pad and its scripts, along with the description
-- of the relationship between threads and scripts. Both the launch pad and
-- thread classes include it in their inheritance hierarchies.
--
scriptReferencer MANAGED OBJECT CLASS
DERIVED FROM "ITU-T Rec. X.725 | ISO/IEC 10165-7": genericRelationshipObject;
CHARACTERIZED BY scriptReferencerPackage;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx8(8)};

thread MANAGED OBJECT CLASS
       DERIVED FROM basicSpawnerClass, scriptReferencer;
       CHARACTERIZED BY threadPackage, executionResultPackage;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx9(9)};

suspendableThread MANAGED OBJECT CLASS
       DERIVED FROM thread;
       CHARACTERIZED BY suspendResumeAccepter;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx10(10)};
```

A.2 Package definitions

A.2.1 Basic packages

```
basicSpawnerPackage  PACKAGE
        BEHAVIOUR spawnerBehaviour;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx1(1)};

generalStringScriptPackage PACKAGE
        BEHAVIOUR generalStringScriptBehaviour;
        ATTRIBUTES scriptLanguageName GET-REPLACE,
                   scriptContent GET-REPLACE;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx2(2)};

parameterPasser PACKAGE
        BEHAVIOUR
        parameterPasserBehaviour;
        ATTRIBUTES
            "CCITT Rec. X.721 | ISO /IEC 10165-2:1992": administrativeState,
            "CCITT Rec. X.721 | ISO /IEC 10165-2:1992": operationalState,
            "CCITT Rec. X.721 | ISO /IEC 10165-2:1992": usageState,
            "CCITT Rec. X.721 | ISO /IEC 10165-2:1992": availabilityStatus;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx3(3)};

executionResultPackage   PACKAGE
        BEHAVIOUR executionResultBehaviour;;
        NOTIFICATION executionResultInfo;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx4(4)};

launchPadPackage PACKAGE
        BEHAVIOUR launchPadBehaviour;
        ATTRIBUTES launchPadId GET;
        NOTIFICATIONS
        "CCITT Rec. X.721 | ISO/IEC 10165-2:1992": processingErrorAlarm;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx5(5)};

scriptReferencerPackage PACKAGE
        BEHAVIOUR scriptReferencerBehaviour;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx6(6)};

suspendResumeAccepter PACKAGE
        BEHAVIOUR suspendResumeBehaviour;
        ATTRIBUTES "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":controlStatus GET;
        ACTIONS suspend, resume;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx7(7)};
```

```
terminateAccepter PACKAGE
       ACTIONS terminate;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx8(8)};

threadPackage PACKAGE
       BEHAVIOUR threadBehaviour,
                  simpleScriptExecutionBehaviour;
      ATTRIBUTES scriptId GET,
                 threadId GET,
                 executingParameters   GET SET-BY-CREATE,
                      "CCITT Rec. X.731|ISO/IEC 10164-2:1992": operationalState GET;
       NOTIFICATIONS
              "CCITT Rec. X.734|ISO/IEC 10164-5": processingErrorAlarm;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx9(9)};

triggerActionAccepter PACKAGE
       BEHAVIOUR   spawnerBehaviour,
                     triggerActionAccepterBehaviour;;
       ATTRIBUTES defaultExecutionParameterList REPLACE WITH DEFAULT
                  GET-REPLACE
                  SET BY CREATE
                  DEFAULT VALUE CSModule.emptyExecutionParameterList;
             availableScriptList REPLACE WITH DEFAULT
                  ADD-REMOVE
                  GET-REPLACE
                  SET BY CREATE
                  DEFAULT VALUE CSModule.emptyScriptList;
       ACTIONS Trigger;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx10(10)};

triggerEventAccepter PACKAGE
       BEHAVIOUR triggerEventAccepterBehaviour;
       ATTRIBUTES
          "ITU-T Rec. X.739 (1993)|ISO/IEC 10164-11:1994": observedObjectInstance GET-
REPLACE,
          "ITU-T Rec. X.739 (1993)|ISO/IEC 10164-11:1994": observedAttributeId GET-
REPLACE;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx11(11)};

triggerAsynchronousResultPackage PACKAGE
       BEHAVIOUR triggerAsynchronousResultBehaviour;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx12(12)};

triggerSynchronousResultPackage PACKAGE
       BEHAVIOUR triggerSynchronousResultBehaviour;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx13(13)};
```

```
triggerResultPackage PACKAGE

        BEHAVIOUR    triggerResultBehaviour;;

        NOTIFICATION triggerResultInfo;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx14(14)};
```

A.3 Behaviour definitions

```
spawnerBehaviour  BEHAVIOUR

        DEFINED AS !Instances of this class are capable of causing the creation of new
        object instances. The newly created instances will be contained by this instance,
        and their names will be automatically generated. Until all created objects are
        complete, this object's usage status will be "in use". If this object's
        administrative state is "locked" such new objects cannot be created. If, due to
        local resource limitations, this object is incapable of supporting more contained
        objects, its usage status will be "busy".


        When an instance of this class causes the creation of new objects, it serves as an
        IVMO during the creation by supplying values for the new object's attributes based
        on its own defaultExecutionParameterList attribute or any parameters which were
        supplied to it as part of the action or local mechanism which triggered the
        spawning of the new instance.


        An instance of this class may cause the creation of new object instances from a
        single script id, from a set of script ids in any order or from a sequence of
        script ids in the order specified in the list, i.e. after the first has been
        created the second may not be created until after the first is completed, and so
        on. The value of the created object's scriptId attribute gets its value from the
        corresponding element of this object's script_list.!;


executionResultBehaviour BEHAVIOUR

DEFINED AS "Instances of a class supporting this behaviour report intermediate and final
results from execution of a thread.";


triggerAsynchronousResultBehaviour BEHAVIOUR

        DEFINED AS "As soon as all threads that must be launched by one trigger is
        launched, the launch pad issues the triggerResultInfo notification.";


triggerSynchronousResultBehaviour BEHAVIOUR

        DEFINED AS "As soon as all threads that must be launched by one trigger have
        completed, the launch pad issues the triggerResultInfo notification which contains
        execution results or errors.";


triggerResultBehaviour BEHAVIOUR

        DEFINED AS "The launch pad issues the triggerResultInfo notification. ";


scriptReferencerBehaviour BEHAVIOUR

        DEFINED AS "A script referencer is a non-instantiable object class which defines a
        reference relationship mapping from instances of the launch pad and the launch
        script managed object classes and from instances of the thread and the launch
        script managed object classes.";


suspendResumeBehaviour BEHAVIOUR

        DEFINED AS "Execution of a script by a thread may be suspended by a suspend action
        directed at the thread or launch pad and subsequently resumed by a resume action.
        Default value of controlStatus is empty. If the suspend action is performed, the
        value changes to suspended. After the resume action is performed, the value changes
        back to empty.";
```

```
triggerEventAccepterBehaviour BEHAVIOUR
        DEFINED AS "The launch pad has attributes to monitor a specific attribute in a
        specific object instance. If the value of the monitored attribute is changed, a
        trigger to launch the scripts specified by the script ids specified by the default
        execution parameter list attribute is generated. In the case that the monitored
        attribute is a counter of EDC (Event Discrimination Counter) defined in Annex C,
        the notifications through the EDC trigger the launching of script execution by the
        launch pad.";


triggerActionAccepterBehaviour BEHAVIOUR
        DEFINED AS "When an instance of this class which is on duty receives a trigger,
        from a trigger activator, if its scriptId attribute is not empty, a new object is
        created in which the script id and class of the new instance come from the value of
        this instance's scriptId attribute and any of its other attributes and any
        parameters carried by the trigger.";


threadBehaviour BEHAVIOUR
        DEFINED AS "When an instance of an object of this class is created, it begins
        execution of the command sequence specified through its attributes, using its
        parameter list to supply any parameters needed by the script. When execution of
        this sequence is complete, the object is deleted. If execution of the script causes
        the creation of contained threads, this thread is not considered complete until all
        contained threads are complete.";


parameterPasserBehaviour BEHAVIOUR
        DEFINED AS "An instance of an object of this class passes a set of parameters to an
        instance of an object of another class.";


simpleScriptExecutionBehaviour BEHAVIOUR
        DEFINED AS "A script is executed or interpreted by local means. Its execution
        status mirrors the following states:

                –   activated (spontaneous transition to next state: executing);

                –   executing (next state: timed out or completed);

                –   timed out (spontaneous transition to next state: completed);

                –   completed.

         NOTE – Timeout value is implementation dependent.";


generalStringScriptBehaviour BEHAVIOUR
        DEFINED AS "The syntax and semantics of scripting language which can be represented
        as general string. See Annexes F and G for details on one such language, SMSL.";
```

A.4 Attribute definitions

```
availableScriptList  ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.AvailableScriptList;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        availableScriptListBehaviour BEHAVIOUR
        DEFINED AS "A set of managed object instance names of the script instructions
        which can be executed by a launch pad.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx1(1)};


commandSequencerId  ATTRIBUTE
       WITH ATTRIBUTE SYNTAX CSModule.CommandSequencerId;
       MATCHES FOR EQUALITY;
       BEHAVIOUR
```

```
        commandSequencerIdBehaviour   BEHAVIOUR
        DEFINED AS "The managed object instance name of the command sequencer.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx2(2)};

executionResultType ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.ExecutionResultType;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        executionResultTypeBehaviour BEHAVIOUR
        DEFINED AS "This indicates the type of execution result.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx3(3)};

scriptContent ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.ScriptContent;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        scriptContentBehaviour BEHAVIOUR
        DEFINED AS "The contents of a launch script represented by a general string.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx4(4)};

scriptId   ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.ScriptId;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        scriptIdBehaviour   BEHAVIOUR
        DEFINED AS "The managed object instance name of the script to be executed.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx5(5)};

launchPadId  ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.LaunchPadId;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        launchPadIdBehaviour   BEHAVIOUR
        DEFINED AS "The managed object instance name of the launch pad.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx6(6)};

scriptLanguageName ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.ScriptLanguageName;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        scriptLanguageNameBehaviour BEHAVIOUR
        DEFINED AS "The managed object instance name of a launch script represented by a
        general string.";;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx7(7)};
```

```
defaultExecutionParameterList  ATTRIBUTE

        WITH ATTRIBUTE SYNTAX CSModule.ExecutionParameterList;

        MATCHES FOR EQUALITY;

        BEHAVIOUR

        defaultExecutionParameterListBehaviour BEHAVIOUR

        DEFINED AS "A set of managed object instance names of the script instructions and
        parameter values (if required) as inputs to instances to be executed by
        default.";;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx8(8)};


executingParameters   ATTRIBUTE

        WITH ATTRIBUTE SYNTAX CSModule.ExecutionParameter;

        MATCHES FOR EQUALITY;

        BEHAVIOUR

        executingParametersBehaviour BEHAVIOUR

        DEFINED AS "A set of managed object instance names of the script instructions and
        parameter values (if required) as inputs to script executions.";;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx9(9)};


threadId   ATTRIBUTE

        WITH ATTRIBUTE SYNTAX CSModule.ThreadId;

        MATCHES FOR EQUALITY;

        BEHAVIOUR

        threadIdBehaviour   BEHAVIOUR

        DEFINED AS "The managed object instance name of a thread executing script
        instruction(s).";;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx10(10)};


triggerId ATTRIBUTE

        WITH ATTRIBUTE SYNTAX CSModule.TriggerId;

        MATCHES FOR EQUALITY;

        BEHAVIOUR

        triggerIdBehaviour BEHAVIOUR

        DEFINED AS "The managed object instance name of a trigger initiating the execution
        of a launch script.";;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx11(11)};
```

A.5 Notification definitions

```
executionResultInfo   NOTIFICATION

        WITH INFORMATION SYNTAX CSModule.ExecutionResultInfo;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) notification(10) xx1(1)};


triggerResultInfo NOTIFICATION

        WITH INFORMATION SYNTAX CSModule.TriggerResultInfo;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) notification(10) xx2(2)};
```

A.6 Action definitions

```
resume ACTION
        BEHAVIOUR resumeBehaviour BEHAVIOUR
              DEFINED AS "An action directed at a basicSpawnerClass object, causing
              unconditional resumption of all script executions by the basicSpawnerClass
              object which were initiated by a particular trigger. The value of
              controlStatus becomes empty as the result of a resume action.";;
        WITH INFORMATION SYNTAX CSModule.SpawnerObjectId;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx1(1)};


suspend ACTION
        BEHAVIOUR suspendBehaviour BEHAVIOUR
        DEFINED AS "An action directed at a basicSpawnerClass object, causing
        unconditional suspension of all script executions by the
        basicSpawnerClass object which were initiated by a particular trigger. The value
        of controlStatus becomes 'suspended' as a result of a suspend action.";;
        WITH INFORMATION SYNTAX CSModule.SpawnerObjectId;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx2(2)};


terminate ACTION
        BEHAVIOUR terminateBehaviour BEHAVIOUR
DEFINED AS "An action directed at a launch pad, causing unconditional termination of all
scripts by the launch pad, which was initiated by a particular trigger.";;
        WITH INFORMATION SYNTAX CSModule.TriggerId;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx3(3)};


trigger ACTION
        BEHAVIOUR triggerBehaviour BEHAVIOUR
        DEFINED AS "An initiator of script execution by causing a launch pad to spawn one
        or more threads.";;
        WITH INFORMATION SYNTAX CSModule.TriggerParameters;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx4(4)};
```

A.7 Name binding definitions

```
commandSequencer-system   NAME BINDING
        SUBORDINATE OBJECT CLASS commandSequencer AND SUBCLASSES;
        NAMED BY SUPERIOR OBJECT CLASS system AND SUBCLASSES;
        WITH ATTRIBUTE commandSequencerId;
        BEHAVIOUR csSystemContainmentBehaviour BEHAVIOUR
        DEFINED AS "Superior object class is system and subordinate object
        class is commandSequencer.";;
        CREATE WITH-REFERENCE-OBJECT, WITH-AUTOMATIC-INSTANCE-NAMING;
        DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) nameBinding(6) xx1(1)};


launchPad-commandSequencer NAME BINDING
        SUBORDINATE OBJECT CLASS launchPad AND SUBCLASSES;
        NAMED BY SUPERIOR OBJECT CLASS commandSequencer AND SUBCLASSES;
        WITH ATTRIBUTE launchPadId;
```

```
        BEHAVIOUR lpCsContainmentBehaviour BEHAVIOUR

        DEFINED AS "Naming a command sequence launch pad with respect to a command
        sequencer indicates that the command sequencer is the service provider for the
        launch pad.";;

        CREATE WITH-AUTOMATIC-INSTANCE-NAMING;

        DELETE DELETES-CONTAINED-OBJECTS;

        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) nameBinding(6)
xx2(2)};


thread-synchronousLaunchPad  NAME BINDING

        SUBORDINATE OBJECT CLASS   thread AND SUBCLASSES;

        NAMED BY SUPERIOR OBJECT CLASS synchronousLaunchPad AND SUBCLASSES;

        WITH ATTRIBUTE   threadId;

        BEHAVIOUR threadSyncLpContainmentBehaviour BEHAVIOUR

        DEFINED AS "The superior object class synchronousLaunchPad acts as an IVMO for the
        subordinate object class thread.";;

        DELETE DELETES-CONTAINED-OBJECTS;

        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21)

nameBinding(6) xx3(3)};


suspendableThread-asynchronousLaunchPad   NAME BINDING

        SUBORDINATE OBJECT CLASS   suspendableThread AND SUBCLASSES;

        NAMED BY SUPERIOR OBJECT CLASS asynchronousLaunchPad AND SUBCLASSES;

        WITH ATTRIBUTE   threadId;

        BEHAVIOUR threadAsyncLpContainmentBehaviour BEHAVIOUR

        DEFINED AS "The superior object class asynchronousLaunchPad acts as an IVMO for
        the subordinate object class suspendable thread.";;

        DELETE DELETES-CONTAINED-OBJECTS;

        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21)

nameBinding(6) xx4(4)};


thread-thread   NAME BINDING

        SUBORDINATE OBJECT CLASS   thread AND SUBCLASSES;

        NAMED BY SUPERIOR OBJECT CLASS thread AND SUBCLASSES;

        WITH ATTRIBUTE threadId;

        BEHAVIOUR threadContainmentBehaviour BEHAVIOUR

        DEFINED AS "The superior object class thread acts as a spawner of the subordinate
        object class thread.";;

        DELETE DELETES-CONTAINED-OBJECTS;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) nameBinding(6) xx5(5)};


suspendableThread-suspendableThread   NAME BINDING

        SUBORDINATE OBJECT CLASS   suspendableThread AND SUBCLASSES;

        NAMED BY SUPERIOR OBJECT CLASS suspendableThread AND SUBCLASSES;

        WITH ATTRIBUTE threadId;

        BEHAVIOUR suspendableThreadContainmentBehaviour BEHAVIOUR
```

```
        DEFINED AS "The superior object class suspendable thread acts as a spawner of the
        subordinate object class suspendable thread.";;

        DELETE DELETES-CONTAINED-OBJECTS;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) nameBinding(6) xx6(6)};


launchScript-system NAME BINDING

        SUBORDINATE OBJECT CLASS launchScript AND SUBCLASSES;

        NAMED BY SUPERIOR OBJECT CLASS system AND SUBCLASSES;

        WITH ATTRIBUTE scriptId;

        BEHAVIOUR lsSystemContainmentBehaviour BEHAVIOUR

        DEFINED AS "The superior object class is system and subordinate object
        class is launchScript.";;

        CREATE WITH-REFERENCE-OBJECT, WITH-AUTOMATIC-INSTANCE-NAMING;

        DELETE ONLY-IF-NO-CONTAINED-OBJECTS;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) nameBinding(6) xx7(7)};
```

A.8 ASN.1 definitions

```
CSModule {joint-iso-itu-t ms(9) function(2) part21(21) asn1Module(2) 0}

DEFINITIONS IMPLICIT TAGS ::=

BEGIN


-- EXPORTS everything


IMPORTS

        SimpleNameType

       FROM Attribute-ASN1Module {joint-iso-itu-t ms(9) smi(3) part2(2)
asn1Module(2) 1 }

       ObjectInstance, Attribute, CMISSync, CMISFilter, ModifyOperator, Scope,

       BaseManagedObjectId FROM CMIP-1 {joint-iso-itu-t ms(9) cmip(1) modules(0)
protocol(3)}

       AE-title FROM ACSE-1 {joint-iso-itu-t association-control(2) abstract-syntax(1)
apdus(0) version(1)};


       cmdSeqRelationshipClasses OBJECT IDENTIFIER ::= {joint-iso-itu-t ms(9) function(2)
part21(21) relationshipClass(11) }

       cmdSeqRelationshipMappings OBJECT IDENTIFIER ::= {joint-iso-itu-t ms(9) function(2)
part21(21) relationshipMapping(12)}

        cmdSeqRelationshipRoles OBJECT IDENTIFIER ::= {joint-iso-itu-t ms(9) function(2)
part21(21) relationshipRole(13)}


--

-- Range Constraints used for relationship class definitions

--

RangeFromOneToOne ::= INTEGER (1 .. 1)


RangeFromZeroToMax ::= INTEGER (0 .. MAX)


--
```

```
-- Counter size constraint
--
MaxCounterSize ::= INTEGER{unlimited(0)}-- size in octets

ExecutionResultInfo ::= SEQUENCE {triggerId TriggerId,
                                  scriptId ScriptId,
                                  threadId ThreadId,
                                  errorCode ErrorCode,
                                  executionResultType ExecutionResultType,
                                  executionResult SET OF Attribute}

TriggerResultInfo ::=  SEQUENCE {triggerId TriggerId,
                          CHOICE {singleTriggerResult ResultInfoFromThread,
                                  sequentialTriggerResult SEQUENCE OF
                                                          ResultInfoFromThread,
                                  parallelTriggerResult SET OF ResultInfoFromThread}}

ResultInfoFromThread ::= SEQUENCE{executionType  ExecutionType,
                                  errorCode      ErrorCode,
                                  executionResultType ExecutionResultType,
                                  executionResult SET OF Attribute}

ExecutionType ::= CHOICE {singleExecution ScriptThreadSet,
                          parallelExecution SET OF ScriptThreadSet,
                          sequentialExecution SEQUENCE OF ScriptThreadSet}

ScriptThreadSet ::= SEQUENCE {scriptId  ScriptId,
                              threadId   ThreadId}

SpawnerObjectId ::= SEQUENCE  {triggerId  TriggerId,
                               CHOICE { threadId ThreadId,
                                        launchPadId LaunchPadId}}

ExecutionResultType ::= OBJECT IDENTIFIER
CommandSequencerId ::=  ObjectInstance
ScriptId ::=  ObjectInstance
ThreadId ::=  ObjectInstance
TriggerId ::= ObjectInstance
LaunchPadId ::= ObjectInstance

ScriptList ::= CHOICE {scriptId ScriptId,
                       sequentialScriptList SEQUENCE OF ScriptId,
                       parallelScriptList SET OF ScriptId}
AvailableScriptList ::= SET OF ScriptList
emptyScriptList AvailableScriptList ::= {}
emptyExecutionParameterList ExecutionParameterList ::= sequentialExecutionList:{}

TriggerParameters  ::= SEQUENCE {triggerId TriggerId,
                                 executionParameterList ExecutionParameterList}
```

```
ExecutionParameterList ::= CHOICE {executionParameter ExecutionParameter,
                                   sequentialExecutionList SEQUENCE OF
                                   ExecutionParameter,
                                   parallelExecutionList SET OF
                                   ExecutionParameter}

ExecutionParameter  ::= SEQUENCE  {scriptId ScriptId,
                                   scriptParameters SEQUENCE OF Attribute}

emptyParameterList   ExecutionParameterList  ::= sequentialExecutionList:{ }

ErrorCode ::= SET OF INTEGER {noError(0),
                              noScriptError(1),
                              scriptRejectedError(2),
                              invalidParameterTypeError(3),
                              invalidParameterValueError(4),
                               scriptSyntaxError(5),
                              scriptExecutionFailedError(6),
                              invalidParmeterNumber(7),
                              unauthorizedAccessError(8)}
ScriptLanguageName ::=  OBJECT IDENTIFIER
ScriptContent  ::=  GeneralString
ModificationList ::= SET OF SEQUENCE{modifyOperator  [2] IMPLICIT
                                     ModifyOperator DEFAULT replace,
                                     attributeId AttributeId,
                                     attributeValue ANY DEFINED BY
                                     attributeId  OPTIONAL
                                      -- absent for   setToDefault
                                    }


END
```

Annex B

General Relationship Model

(This annex forms an integral part of this Recommendation | International Standard)

This following is the GRM for the command sequencer.

```
--
-- The following relationship classes support the command sequencer model
--

commandSequencer-launchPadRelationshipClassBehaviour
BEHAVIOUR DEFINED AS

       !

              The relationship class is concerned with the relationship between a command
              sequencer and its launch pads used to initiate the execution of scripts by
              means of threads requiring the support services provided by the command
              sequencer.

       !;


commandSequencer-LaunchPad-bindingBehaviour

BEHAVIOUR DEFINED AS

       !

              This notification occurs upon the binding of a launch pad into the command
              sequencer / launch pad relationship.

       !;


commandSequencer-LaunchPad-unbindingBehaviour

BEHAVIOUR DEFINED AS

       !

              This notification occurs when a launch pad is removed from  the command
              sequencer / launch pad relationship. A launch pad may be removed from the
              relationship only if its administrative state is locked.

       !;


commandSequencer-launchPad-RelationshipClass
RELATIONSHIP CLASS

       BEHAVIOUR commandSequencer-launchPadRelationshipClassBehaviour,

                 commandSequencer-LaunchPad-bindingBehaviour,

                 commandSequencer-LaunchPad-unbindingBehaviour;

       SUPPORTS

              ESTABLISH,

              QUERY,

              TERMINATE,

              NOTIFY commandSequencer-LaunchPad-binding,

              NOTIFY commandSequencer-LaunchPad-unbinding;

       ROLE commandSequencerRole

              COMPATIBLE-WITH     commandSequencer

              PERMITTED-ROLE-CARDINALITY CONSTRAINT CASN1.RangeFromOneToOne

              REQUIRED-ROLE-CARDINALITY-CONSTRAINT CASN1.RangeFromOneToOne
```

```
            PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT

            CASN1.RangeFromOneToOne

            REGISTERED AS  { CSModule.cmdSeqRelationshipRoles 1 }


      ROLE    launchPadRole

            COMPATIBLE-WITH launchPad

            PERMITTED-ROLE-CARDINALITY-CONSTRAINT   CSModule.RangeFromZeroToMax

            REQUIRED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeFromZeroToMax

            BIND-SUPPORT

            UNBIND-SUPPORT

            PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT CSModule.RangeFromOneToOne

      REGISTERED AS { CSModule.cmdSeqRelationshipRoles 2 };

REGISTERED AS { CSModule.cmdSeqRelationshipClasses 1 };


commandSequencer-LaunchPad-RelationshipMapping-Behaviour

BEHAVIOUR DEFINED AS

      !

            This relationship mapping describes how the command sequencer to launch pad
            relationship class may be represented using containment. In this
            relationship mapping, the command sequencer is the superior object for the
            purposes of naming, and launch pads are contained by it. Participation in
            this relationship implies that the launch pad and its spawn may use the
            services provided by the resource represented by the command sequencer.

      !;


commandSequencer-launchPad-RelationshipMapping

RELATIONSHIP MAPPING

      RELATIONSHIP CLASS
      commandSequencer-launchPad-RelationshipClass;

      BEHAVIOUR commandSequencer-launchPad-RelationshipMapping-Behaviour;


      ROLE commandSequencerRole

            RELATED-CLASSES commandSequencer
            REPRESENTED BY NAMING

                  launchPad-commandSequencer-NameBinding
                  USING SUPERIOR,


      ROLE launchPadRole

            RELATED-CLASSES launchPad
            REPRESENTED BY NAMING

                  launchPad-commandSequencer-NameBinding
                  USING SUBORDINATE;


      OPERATIONS  MAPPING

            ESTABLISH     MAPS-TO-OPERATION

                          CREATE commandSequencer OF commandSequencerRole

            TERMINATE     MAPS-TO-OPERATION

                          DELETE commandSequencer OF commandSequencerRole
```

```
                NOTIFY commandSequencer-launchPad-binding
                        MAPS-TO-OPERATION
                        NOTIFICATION "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":
                        objectCreationNotification
                                OF commandSequencerRole
                NOTIFY commandSequencer-launchPad-unbinding
                        MAPS-TO-OPERATION
                        NOTIFICATION "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":
                        objectDeletionNotification
                                OF commandSequencerRole
                BIND    MAPS-TO-OPERATION
                        CREATE launchPad OF launchPadRole
                UNBIND          MAPS-TO-OPERATION
                        DELETE launchPad
                                OF launchPadRole
                QUERY   MAPS-TO-OPERATION
                        GET OF commandSequencerRole
                        GET OF launchPadRole;
REGISTERED AS {CSModule.cmdSeqRelationshipMappings 1}


scriptReferenceRelationshipClassBehaviour
BEHAVIOUR DEFINED AS
        !
                This relationship class describes the relationship existing between scripts
                and an object which references them for the purposes of identifying task(s)
                to be carried out.
        !;


scriptReferencerRelationshipClass
RELATIONSHIP CLASS
        BEHAVIOUR scriptReferencerRelationshipClassBehaviour;
        SUPPORTS
                ESTABLISH,
                TERMINATE,
                QUERY;

        ROLE scriptUserRole
                COMPATIBLE-WITH scriptReferencer
                PERMITTED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeFromOneToOne
                REQUIRED-ROLE-CARDINALITY CONSTRAINT CSModule.RangeFromOneToOne
                PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT
                        CSModule.RangeFromZeroToMax
        REGISTERED AS {CSModule.cmdSeqRelationshipRoles 3}


        ROLE scriptRole
                COMPATIBLE-WITH launchScript
                PERMITTED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeFromOneToOne
                REQUIRED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeFromOneToOne
```

```
            PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT
                  CSModule.RangeFromZeroToMax
      REGISTERED AS {CSModule.cmdSeqRelationshipRoles 4}


REGISTERED AS {CSModule.cmdSeqRelationshipClasses 2}


launchPad-launchScriptRelationshipMappingBehaviour BEHAVIOUR
DEFINED AS
!
      This relationship mapping describes the relationship between the launch pad and the
      launch script. The launch pad initiates execution of the launch script and
      references it for the purposes of execution.
!;


launchPad-LaunchScriptMapping
RELATIONSHIP MAPPING
       RELATIONSHIP CLASS scriptReferenceRelationshipClass;
       BEHAVIOUR launchPad-launchScriptMappingBehaviour;
       ROLE scriptUserRole
           RELATED CLASSES launchPad
           REPRESENTED BY ATTRIBUTE scriptList
       ROLE   scriptRole
           RELATED CLASSES launchScript;
       OPERATIONS MAPPING
           ESTABLISH MAPS-TO-OPERATION
               CREATE launchPad OF scriptUserRole
               -- using SET-BY-CREATE of scriptList --
               REPLACE scriptList of scriptUserRole
               -- which effectively adds a scriptId to scriptList --
               ADD scriptList of scriptUserRole,
           TERMINATE MAPS-TO-OPERATION
               DELETE launchPad OF scriptUserRole
               REPLACE scriptList OF scriptUserRole
               -- which effectively removes a scriptId from scriptList --
               REMOVE scriptList OF scriptUserRole,
           QUERY MAPS-TO-OPERATION
               GET scriptList OF scriptUserRole;
REGISTERED AS {CSModule.cmdSeqRelationshipMappings 2};


thread-launchScriptRelationshipMappingBehaviour BEHAVIOUR
DEFINED AS
!
      This relationship class describes the relationship between a thread and launch
      script. The launch script is referenced by the thread by means of the scriptId
      attribute from the scriptIds in the scriptList.
!;


thread-launchScriptMapping
RELATIONSHIP MAPPING
```

```
        RELATIONSHIP CLASS scriptReferenceRelationshipClass;
        BEHAVIOUR thread-launchScriptRelationshipMappingBehaviour;
        ROLE scriptUserRole
            RELATED CLASSES thread
            REPRESENTED BY ATTRIBUTE scriptId
            QUALIFIED BY scriptList
        ROLE    scriptRole
            RELATED CLASSES launchScript;
        OPERATIONS MAPPING
            ESTABLISH MAPS-TO-OPERATION
                CREATE OF scriptUserRole,
            TERMINATE MAPS-TO-OPERATION
                DELETE OF scriptUserRole,
            QUERY MAPS-TO-OPERATION
                GET scriptId OF scriptUserRole;
REGISTERED AS {CSModule.cmdSeqRelationshipMappings 3};


spawner-progeny-RelationshipClass
RELATIONSHIP CLASS
        BEHAVIOUR spawner-progenyRelationshipClassBehaviour BEHAVIOUR
       DEFINED AS
              !
              When an instance of this class causes the creation of new objects, it serves
              as an IVMO during the creation by supplying values for the new object's
              attributes based on its own defaultExecutionParameterList attribute and any
              parameters which were supplied to it as part of the action or local
              Instances of this class are capable of causing the creation of new object
              instances. The newly created instances will be contained by this instance,
              and their names will be automatically generated. Until all created objects
              are complete, this object's usage status will be "in use". If this object's
              administrative state is "locked" such new objects cannot be created. If, due
              to local resource limitations, this object is incapable of supporting more
              contained objects, its usage status will be "busy".


              An instance of this class may cause the creation of new object instances
              from a single scriptId, from a set of scriptIds in any order or from a
              sequence of scriptIds in the order specified in the list i.e. after the
              first has been created the second may not be created until after the first
              is completed, and so on. The value of the created object's scriptId
              attribute gets its value from the corresponding element of this object's
              scriptList.

            !;
        SUPPORTS
            ESTABLISH
            TERMINATE;


        ROLE spawnerRole COMPATIBLE-WITH basicSpawnerClass
            PERMITTED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeOneToOne
            REQUIRED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeOneToOne
```

```
            PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT

                CSModule.RangeOneToOne

            REGISTERED AS {CSModule.cmdSeqRoles 5}

        ROLE progenyRole COMPATIBLE-WITH thread

            PERMITTED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeZeroToMax

            REQUIRED-ROLE-CARDINALITY-CONSTRAINT CSModule.RangeZeroToMax

            PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT
        CSModule.RangeOneToOne

            REGISTERED AS {CSModule.cmdSeqRoles 6}

REGISTERED AS {CSModule.cmdSeqRelationshipClasses 3};
```

Annex C

Management Information Definitions for Event Discrimination Counting

(This annex does not form an integral part of this Recommendation | International Standard)

The Event Discrimination Counter (EDC) class object counts the number of input events. Before counting up, the EDC tests values of attributes related to the event or an object generating the event and discriminates the event.

C.1 Managed object class

```
eventDiscriminationCounter MANAGED OBJECT CLASS

DERIVED FROM   "DMI":discriminator;

CHARACTERIZED BY

edcPackage PACKAGE

        BEHAVIOUR edcBehaviour BEHAVIOUR

       DEFINED AS

       "If the result of discrimination of a potential event report evaluates to TRUE and
       the event discrimination counter is in the Unlocked and Enabled state and does not
       exhibit the off-duty availability status, then the counter value of the counter
       attribute is incremented.";;

              ATTRIBUTES

                    "CCITT Rec. 721 | ISO/IEC 10165-2:1992":counter GET,

                    maxCounterSize GET;

              NOTIFICATIONS

                    "CCITT Rec. 721 | ISO/IEC10162:1992":processingErrorAlarm;;;

CONDITIONAL PACKAGES

       counterAlarmPackage PRESENT IF "a counter is of finite size and a notification is
       triggered by a capacity alarm threshold.";

REGISTERED AS {joint-iso-itu-t ms(9) ms(9) function(2) part21(21)

managedObjectClass(3) xx11(11)};
```

C.2 Package

```
counterAlarmPackage PACKAGE

        BEHAVIOUR

        counterAlarmBehaviour BEHAVIOUR

        DEFINED AS "When the counter value reaches the capacity alarm threshold(as a
              percentage of maximum counter size), the EDC(Event Discrimination Counter)
              generates an event indicating that a capacity threshold has been reached
              or exceeded. In reporting the capacity threshold event, use is made of the
              alarm report defined in CCITT Rec. X.733 | ISO/IEC 10164-4. Only the
              following parameters of the alarm report shall be used and all parameters
              are mandatory when used for reporting counter capacity threshold alarms.

               Managed Object Class - This parameter shall identify the

               counter class.

               Managed Object Instance - This parameter shall identify the

               instance of the counter that generated the event.

              Alarm Type - This parameter shall indicate that a processing

                         error alarm has occurred.
```

```
Event time - This parameter carries the time at

which the capacity threshold event occurred.

Perceived Severity - This parameter will indicate the severity

assigned to the capacity threshold event. When the 100%

counter full condition is reached, a severity value of critical

shall be assigned to this event.

Monitored Attributes - This parameter shall carry the maximum  counter size
attribute of the EDC.

Probable Cause - This parameter shall carry the value congestion.

Threshold Info - This parameter shall carry the capacity threshold

value (as percentage of total capacity) that was reached or exceeded in
generating this event.";;

ATTRIBUTES

  "CCITT Rec. 721| ISO/IEC 10165-2:1992":capacityAlarmThreshold GET-REPLACE
ADD-REMOVE;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx15(15)};
```

C.3 Attribute

```
maxCounterSize ATTRIBUTE

        WITH ATTRIBUTE SYNTAX CSModule.MaxCounterSize;

        MATCHES FOR EQUALITY, ORDERING;

        BEHAVIOUR

        maxSizeOrderingBehaviour BEHAVIOUR

        DEFINED AS "This Attribute represent the largest value of the counter. The
        ordering in the same as for sequentially increasing positive integers except that
        a value of zero is largest and denotes infinite size.";;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx12(12)};
```

Annex D

cmisScript Management Support Object Class

(This annex forms an integral part of this Recommendation | International Standard)

The following is a script managed object class, CMIS script, which can be defined to handle the invocation of CMIS operations.

D.1 Attributes

D.1.1 Attributes imported from the definition of management information

This Specification references the following management attributes, whose abstract syntax is specified in CCITT Rec. X.721 | ISO/IEC 10165-2:

a) attributeIdentifierList;

b) objectClass;

c) attributeList.

This Specification references the following management attributes, whose abstract syntax is specified in ITU-~~CCIT~~T Rec. X.711 | ISO/IEC 9596-1:

a) synchronization;

b) scope;

c) filter;

d) baseManagedObjectId;

e) modificationList.

D.2 Definitions

D.2.1 **cmisScript:** A management support object, which directs the invocation of a single CMIS operation.

Five types CMIS scripts are specified:

D.2.2 **getCmisScript:** A CMIS script that represents a GET operation.

D.2.3 **set CmisScript:** A CMIS script that represents a SET operation.

D.2.4 **actionCmisScript:** A CMIS script that represents an ACTION operation.

D.2.5 **createCmisScript:** A CMIS script that represents a CREATE operation.

D.2.6 **deleteCmisScript:** A CMIS script that represents a DELETE operation.

CMIS scripts are single-instruction scripts which give operational details to threads. For example, the script languages may refer to appropriate command records in order to make a CMIS requests to an agent.

D.3 getCmisScript

D.3.1 Characteristics of getCmisScript

The following attributes are defined in the getCmisScript:

– baseManagedObjectId;

– synchronization;

– scope;

– filter;

– attributeIdentifierList.

D.3.2 Packages of getCmisScript

getCmisScript has the following mandatory package:

- getCmisScriptPackage.

D.4 setCmisScript

D.4.1 Characteristics of setCmisScript

setCmisScript has the following attributes definitions:

- baseManagedObjectId;
- synchronization;
- scope;
- filter;
- modificationList.

D.4.2 Packages of setCmisScript

The setCmisScript has the following mandatory package:

- setCmisScriptPackage.

D.5 actionCmisScript

D.5.1 Characteristics of actionCmisScript

The actionCmisScript has the following attribute definitions:

- baseManagedObjectId;
- synchronization;
- scope;
- filter.

D.5.2 Packages of the actionCmisScript

The action command record class has the following mandatory package:

- actionCmisScriptPackage.

D.6 createCmisScript

D.6.1 Characteristics of createCmisScript

The action command record has the following attribute definitions:

- objectClass;
- attributeList.

D.6.2 Packages of createCmisScript

The create command record class has the following mandatory package:

- createCmisScriptPackage.

It has the following conditional packages:

- managedObjectInstancePackage;
- superiorObjectInstancePackage;
- referenceObjectInstancePackage.

D.7 deleteCmisScript

D.7.1 Characteristics of the deleteCmisScript

The deleteCmisScript has the following attribute definitions:

- baseManagedObjectId;
- synchronization;
- scope;
- filter.

D.7.2 Packages of the deleteCmisScript

The deleteCmisScript has the following mandatory package:

- deleteCmisScriptPackage.

D.8 Services

D.8.1 Get reporting service definition

This clause specifies the get reporting service, and maps it onto the CMIS M-EVENT-REPORT services.

D.8.2 Set reporting service definition

This clause specifies the set reporting service, and maps it onto the CMIS M-EVENT-REPORT services.

D.8.3 Action reporting service definition

This clause specifies the action reporting service, and maps it onto the CMIS M-EVENT-REPORT services.

D.8.4 Creation reporting service definition

This service allows an MIS-user, in agent role, to report the creation of a managed object. It is defined as both a confirmed and as a non-confirmed service and mapped onto the CMIS M-EVENT-REPORT services. This service is defined in CCITT Rec. X.730 | ISO/IEC 10164-1.

D.8.5 Deletion report service definition

This service allows an MIS-user, in agent role, to report the deletion of a managed object. It is defined as both a confirmed and as a non-confirmed service and mapped onto the CMIS M-EVENT-REPORT services. This service is defined in CCITT Rec. X.730 | ISO/IEC 10164-1.

D.9 GDMO template

D.9.1 Managed object definitions

```
cmisScript MANAGED OBJECT CLASS
       DERIVED FROM launchScript;
CHARACTERIZED BY cmisScriptPackage PACKAGE
       BEHAVIOUR
              cmisScriptBehaviour BEHAVIOUR
       DEFINED AS
       !
              An instance of this managed object class models information necessary to
              execute a single CMIS operation.
       !;;;;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx12(12)};
getCmisScript MANAGED OBJECT CLASS
       DERIVED FROM cmisScript;
CHARACTERIZED BY getCmisScriptPackage PACKAGE
       BEHAVIOUR
```

```
        getCmisScriptBehaviour   BEHAVIOUR

        DEFINED AS

        !

                An instance of this managed object class models information

                necessary to execute a single CMIS GET operation.

        !;;

        ATTRIBUTES

                baseManagedObjectId GET,

                synchronization GET-REPLACE,

                scopeGET-REPLACE,

                filter GET-REPLACE,

                "CCITT Rec. X.721 | ISO/IEC 10165-2:1992":attributeIdentifierList

                 GET-REPLACE ADD-REMOVE;;;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx13(13)};


setCmisScript MANAGED OBJECT CLASS

        DERIVED FROM cmisScript;

CHARACTERIZED BY setCmisScriptPackage PACKAGE

         BEHAVIOUR

        setCmisScriptBehaviour BEHAVIOUR

        DEFINED AS

        !

                An instance of this managed object class models information necessary to
                execute a single CMIS SET operation.

        !;;

        ATTRIBUTES

                baseManagedObjectId GET,

                synchronization      GET-REPLACE,

                scope                GET-REPLACE,

                filter               GET-REPLACE,

                modificationList     GET-REPLACE ADD-REMOVE;;;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx14(14)};


actionCmisScript MANAGED OBJECT CLASS

        DERIVED FROM cmisScript;

        CHARACTERIZED BY

actionCmisScriptPackage PACKAGE BEHAVIOUR

                actionCmisScriptBehaviour BEHAVIOUR

                DEFINED AS

                !

                An instance of this managed object class models information necessary to
                execute a single CMIS ACTION operation.

                !;;
```

```
            ATTRIBUTES

                  baseManagedObjectId GET,

                  synchronization     GET-REPLACE,

                  scope               GET-REPLACE,

                  filter              GET-REPLACE;;;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx15(15)};


createCmisScript  MANAGED OBJECT CLASS
DERIVED FROM cmisScript;
CHARACTERIZED BY

      createCmisScriptPackage PACKAGE

      BEHAVIOUR

            createCmisScriptBehaviour BEHAVIOUR

            DEFINED AS

            !

                  An instance of this managed object class models information necessary
                  to execute a single CMIS CREATE operation.

            !;;

      ATTRIBUTES

            "CCITT Rec. 721 | ISO/IEC 10165-2:1992": objectClass  GET,

            "CCITT Rec. 721 | ISO/IEC 10165-2:1992": attributeList GET-REPLACE ADD-
            REMOVE;;;

      CONDITIONAL PACKAGES

            managedObjectInstancePackage

                  PRESENT IF "the superiorObjectInstancePackage is not present.",

            superiorObjectInstancePackage

                  PRESENT IF "the managedObjectInstance Package is not present.",

            referenceObjectInstancePackage

                  PRESENT IF "the manager has the specified value.";

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx16(16)};


deleteCmisScript  MANAGED OBJECT CLASS
DERIVED FROM  cmisScript;
CHARACTERIZED BY

      deleteCmisScriptPackage PACKAGE

      BEHAVIOUR

      deleteCmisScriptBehaviour BEHAVIOUR
      DEFINED AS

      !

            An instance of this managed object class models information  necessary to
            execute a single CMIS DELETE operation.

      !;;

      ATTRIBUTES

            baseManagedObjectId GET,
            synchronization     GET-REPLACE,
            scope         GET-REPLACE,
            filter              GET-REPLACE;;;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx17(17)};
```

D.9.2 Package definitions

```
managedObjectInstancePackage    PACKAGE
 ATTRIBUTES
        managedObjectInstance    GET-REPLACE;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx16(16)};

superiorObjectInstancePackage    PACKAGE
        ATTRIBUTES
        superiorObjectInstance    GET-REPLACE;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx17(17)};

       referenceObjectInstancePackage  PACKAGE
        ATTRIBUTES
        referenceObjectInstance  GET-REPLACE;
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx18(18)};
```

D.9.3 Attribute definitions

```
baseManagedObjectId    ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.BaseManagedObjectId;
        MATCHES FOR EQUALITY;
        BEHAVIOUR baseManagedObjectIdBehaviour
        BEHAVIOUR
        DEFINED AS
       !
            This is the identifier for the information on the CMIS
              operation to be executed.
        !;;
        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx13(13)
};

scope ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.Scope;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        scopeBehaviour      BEHAVIOUR
        DEFINED AS
        !
              This is the first phase in the selection of managed object(s) to   which the
              CMIS script operations should be directed. It indicates the managed
              object(s) to which a filter should be applied.
        !;;
         REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7)
xx14(14)};

filter ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.CMISFilter;
        MATCHES FOR EQUALITY;
```

```
        BEHAVIOUR
        filterBehaviour     BEHAVIOUR
        DEFINED AS
        !
              This is the second phase in the selection of managed object(s) to   which
              the CMIS script operations should be directed. A set of tests is applied to
              each of the previously scoped managed objects to extract a subset.
        !;;
        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx15(15)
};


synchronization ATTRIBUTE
       WITH ATTRIBUTE SYNTAX CSModule.CMISSync;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        synchronizationBehaviour BEHAVIOUR
        DEFINED AS
        !
              This indicates the manner in which operations are to be synchronized across
              managed object instances when multiple managed objects have been selected by
              the scoping and filtering mechanisms.
        !;;
        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx16(16)
};


modificationList ATTRIBUTE
       WITH ATTRIBUTE SYNTAX CSModule.ModificationList;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        modificationListBehaviour BEHAVIOUR
        DEFINED AS
        !
              This represents the list of attributes to be modified by the CMISSet script
              and contains the values to which these attributes should be set.";;


        !;;
        REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx17(17)
};


superiorObjectInstance ATTRIBUTE
        WITH ATTRIBUTE SYNTAX CSModule.ObjectInstance;
        MATCHES FOR EQUALITY;
        BEHAVIOUR
        superiorObjectInstanceBehaviour BEHAVIOUR
        DEFINED AS
        !
            This attribute identifies the existing managed object instance
            which is supplied, the managedObjectInstance attribute shall not
            be supplied.
        !;;
```

```
REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx18(18)};


referenceObjectInstance ATTRIBUTE

        WITH ATTRIBUTE SYNTAX CSModule.ObjectInstance;

        MATCHES FOR EQUALITY;

        BEHAVIOUR

        referenceObjectInstanceBehaviour BEHAVIOUR

        DEFINED AS

        !

            The managed object instance name of the same class as the managed object to be
            created. Attribute values associated with the reference object instance become
            default values for those not specified by the attribute list attribute.



        !;;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx19(19)};
```

Annex E

CMIP_CS managed object class

(This annex does not form an integral part of this Recommendation | International Standard)

The following is an example of how additional subclasses may be defined in order to contain attributes such as AE title.

E.1 cmipCS

E.1.1 Overview

- Subclass of cmip protocol machine and command sequencer.
- Defines the calling AE title for the command sequencer.

E.1.2 Characteristics of the cmipCS managed object class

- aetitle.

E.1.3 Packages of cmipCS

The cmipCS managed object class has the following mandatory package:

- aetitle package.

E.1.4 GDMO definitions

```
cmipCS MANAGED OBJECT CLASS

DERIVED FROM commandSequencer;

CHARACTERIZED BY aeTitlePackage;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3)
xx18(18)};


aeTitlePackage PACKAGE

ATTRIBUTES

          aetitle GET;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) package(4) xx19(19)};
```

E.1.5 Attribute definitions

```
aetitle ATTRIBUTE

       WITH ATTRIBUTE SYNTAX CSModule.AE-title;

       MATCHES FOR EQUALITY;

       BEHAVIOUR

       aeTitleBehaviour BEHAVIOUR

      DEFINED AS "An instance of this managed object class defines the

      calling AE title for the command sequencer";;

REGISTERED AS {joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx20(20)};
```

Annex F

Systems Management Scripting Language (SMSL)

(This annex forms an integral part of this Recommendation | International Standard)

This annex defines a general string scripting language, SMSL, for writing procedures for execution in a command sequencer environment.

SMSL has been provided with functions needed for this environment. To accomplish this, SMSL sacrifices some of the completeness of languages such as C, csh, Perl, or awk while implementing some of the statements and functions that make those languages so powerful and popular.

F.1 Mapping GDMO onto SMSL

SMSL has a virtual machine which is capable of interpreting GDMO as described in ISO/IEC 10165-Series and 10164-Series, which has been mapped into the SMSL data types in accordance with the SMSL object model as described in F.14.11. Scripts written in SMSL are interpreted and executed by the SMSL virtual machine. In the command sequencer environment, the SMSL virtual machine acts in the manager role for systems management purposes. The SMSL virtual machine should be able to interpret all the SMSL data types which are used by SMSL scripts, i.e. all the types used in the script without the definitions of these types are known implicitly by the virtual machine, from the viewpoint of the script writer. The SMSL virtual machine should be able to interpret all the SMSL instances which have already been instantiated, i.e. all the references to previously instantiated objects are known to the virtual machine, from the viewpoint of the script writer.

F.2 SMSL Built-in functions

SMSL includes a number of built-in functions for creating and manipulating objects and general-purpose functions such as mathematical, logical, and I/O functions. Following is a summary of the SMSL built-in functions. The functions are individually described below.

F.2.1 Functions for concurrency control

SMSL includes two built-in functions for enforcing concurrency control: lock() and unlock(). These functions are typically used to linearize accesses to shared data structures and resources.

All SMSL processes attempting to linearize accesses to a resource must cooperate by requesting locks of a given lock name. All resource accesses, including the set() and get() functions, are denied shared resource access without a lock. It is the responsibility of each SMSL process to access a resource only when it holds the required lock.

F.3 Set functions for SMSL lists

SMSL includes the following functions for performing set operations on SMSL lists;

- difference() to return the list of different elements between lists;
- intersection() to return a list of elements common between lists;
- sort() to return a list in ascending or descending element order;
- subset() to verify that one list is contained within another;
- union() to return a list that is a combination of lists;
- unique() to return a list of elements that appear in only one list.

These functions process SMSL lists as sets of elements. Each member of a list is text string that ends with a space character.

The NULL set [""] is the equivalent of the null or empty set (Ø) in set theory. The NULL set is treated by the SMSL set functions as a proper set that contains no elements. The NULL string [ ] is a SMSL list element with no characters. The SMSL set functions allow lists to contain NULL strings.

The SMSL concept of a set is not the unique list of ascending or descending elements familiar to set theory. In many cases, the SMSL lists contain duplicate elements arranged in no particular order. A SMSL list can be transformed into an ordered set using the unique() function to remove duplicates and the sort() function to arrange the elements in ascending or descending order.

F.4 SMSL mathematical functions

SMSL supports a basic subset of mathematical functions. These functions are all similar to C-mathematical functions.

The SMSL mathematical functions include some run-time error checking for range and domain. Both conditions result in a run-time error message that sets the SMSL errno variable to an appropriate value.

Additionally, any nonnumeric values produced by printing the result of the function call, such as Nan or -Inf are converted to 0.0 to prevent the return value from being interpreted by SMSL as a non-numeric character string. The SMSL function also returns a run-time error message when it performs the conversion.

F.5 SMSL process synchronization

SMSL provides process synchronization within SMSL processes of a single command sequencer through condition variable primitives used with SMSL locks. These primitives are similar to constructs provided for multithreaded programming in the C-programming language on many non-threading operating systems.

F.6 SMSL shared global channels

SMSL supports the use of shared global channels for communication between a process and another process or file.

The SMSL allows one SMSL process to open a channel to an external process in a explicitly shared mode, which allows any number of other SMSL processes to send data to, and receive data from, the channel.

The ability to share channels requires that SMSL also provide a mechanism for concurrent programming techniques. SMSL provides these in the form of external synchronization primitives.

The primitives are preferable to building concurrency into the channel opening, reading, writing, and closing functions. For example, having each SMSL process lock a shared channel explicitly prevents concurrent reading by one process and writing by another. In addition, having the synchronization primitives separate from channels allows them to be used to synchronize the use of any shared resource such as the agent's internal symbol table or an external file.

The read(), readln() and write() functions for shared channels will fail immediately (without blocking) if another SMSL process is already blocked on the channel.

F.6.1 The effect of SMSL shared global channel mechanisms

The SMSL functions ensure that all operations on a channel are serialized, with all SMSL function calls appearing to be atomic. The SMSL programmer can be assured that file channel reads and writes in different processes will take place atomically. The locks provided in SMSL prevent unpredictable interleaving of sequences of SMSL read and write calls to the channel.

The single exception to serialization on channels created using the popen() function is the allowance for a concurrent read and write operation. A read can occur when a write is pending on the channel, and a write can occur when a read is blocked or pending on the channel – thus, both a reader and a writer SMSL process can be blocked on a shared channel.

File channels opened using the fopen() function can never cause a SMSL read() or write() function to block. To enforce serialization, the second reader process cannot be blocked, nor can the second writer process be blocked; hence, the second SMSL read(), readln() and write() function on a file channel will fail.

F.7 SMSL data types and objects

SMSL has four basic data types: integer, float, string, and list. The values of all four types simple types may be manipulated as though they were character strings. Complex data types can be built up using struct and array constructs. All ASN.1 syntax types are supported by SMSL.

F.7.1 Conversion between GDMO and ASN.1 type and SMSL script-oriented type

Table F.1 shows the relationship between a GDMO and ASN.1 type and the corresponding SMSL type.

Table F.1 – Value conversion between ASN.1 and script-oriented type

Value type group	GDMO and ASN.1 type	script-oriented type
Integer group	INTEGER, BOOLEAN	integer
Float group	REAL	float
String	General string	string
Set group	SEQUENCE, SET	object type
Array expression	SEQUENCE OF, SET OF	list

Variables and values are interpreted as either strings or numbers, whichever is appropriate to the context.

A scalar (integer or float) is interpreted as true in the Boolean sense if it is not the null string or 0. Booleans returned by operators are 1 for true and 0 or "" (the null string) for false.

F.7.2 Numeric constants

Although the internal representation of an integer or floating-point constant is a string, these constants need not appear inside quotation marks in SMSL scripts. Some examples of SMSL integer and floating point constants are:

x = 3; pi = 3.14159;

Table F.2 – Examples of SMSL data types

Data type	Example representation	SMSL representation
integer	3	"3"
float	4.5	"4.5"
string	"abc"	"abc"
list	[1,3,5]	"1\n3\n5"
NOTE – "\n" is the new-line character.		

F.7.3 Complex data types

A struct is a collection of data types which can be grouped together for the purpose of representing complex ASN.1 structures such as ASN.1 SETs and SEQUENCEs can be constructed using struct. Individual struct elements may be accessed using the "." operator.

Array expressions can be expressed using the list type in SMSL. The name binding is mapped to the value of the object name.

F.8 SMSL variables

Variables of any type can be used as lvalues – that is, they can be assigned to. As all data types are treated as strings internally, they all share a common name space. Therefore, you cannot use the same name for a scalar variable, a string variable, and a list variable.

Case is significant. "FOO", "Foo", and "foo" are all different names. Names must start with a letter or an underscore but can contain digits and underscores ("_").

Some identifiers have predefined meanings. Reserved keywords – such as if and foreach – cannot be used as identifiers. Keywords are recognized as either all lowercase or all uppercase letters. In addition, predefined constants cannot be used as identifiers.

F.8.1 Default initialization of SMSL variables

SMSL does not make use of the concept of "declarations" for variables. The first appearance of an identifier serves to add it to the list of global variables for a SMSL script. All variables are initialized with a null string value each time a SMSL script is executed. This value does not change until the variable's value is defined by some explicit operation, such as assignment.

This default initialization to the empty string allows a variable to be treated as an initially empty list/string or as a numeric variable with a 0 value (since arithmetic operators treat the null string as equivalent to 0). However, reliance on this initial value causes a SMSL run-time warning message at its first use (if run-time warnings are enabled). It is considered better style to initially assign a value of "" or 0 to a list/string variable or numeric variable, respectively.

F.9 SMSL predefined constants

A number of identifiers are predefined as constants so that they can be used without needing declaration. These constants are read-only and should not be assigned to.

Table F.3 – SMSL predefined constants

Constant	Definition
ALARM	ALARM object state
OK	OK object state
OFFLINE	OFFLINE object state
VOID	VOID object state
EOF	End-of-file condition constant
true/TRUE/True yes/YES/Yes	Boolean true value (1)
false/FALSE/False no/NO/No	Boolean false value (0)

F.10 SMSL string literals

String literals are delimited by double quotation marks. String literals can be multiline, causing the new-line characters to become part of the string.

The backslash rules apply for escaping characters (such as the backslash or the quotation mark) and for making characters such as new-line or tab. These are the only string literals currently supported in SMSL.

Table F.4 – SMSL string literals

Constant	Definition
\t	tab
\n	new-line
\r	return
\b	backspace
\A . . . \Z	Ctrl-A . . . Ctrl-Z

Control characters can be embedded in SMSL string constants using \A through to \Z to represent Ctrl-A through to Ctrl-Z. A capitalized letter must always be used; lowercase letters other than those already defined (that is, t, n, r, or b) are not valid as escapes and will generate a SMSL compilation warning.

F.11 SMSL lists

List values are denoted by separating individual values with commas and by enclosing the list in square brackets:

[1, 3, 5]

The list is interpolated into a double-quoted string whose elements are separated by spaces. The list is represented internally as:

"1 3 5"

F.12 SMSL simple statements

The most common simple statement is an expression evaluated for its side effects, which is called an expression statement. The most common expression statement is an assignment operation or a function call. Every expression statement must be terminated with a semicolon:

```
y = x + 10;          # assignment
set("value",50);     # function call
s = trim(s,"\t");    # both assignment and function call
```

F.13 SMSL operators

F.13.1 Arithmetic operators

For arithmetic operators, an operand is considered a number if its first character is a digit or a minus sign (–). Otherwise, it is considered a string and converted to 0 for an empty string or 1 for a non-empty string.

The use of a non-number in an arithmetic context may result in a run-time warning.

Table F.5 – SMSL arithmetic operators

Operator	Definition
+	addition
–	subtraction
/	division
*	multiplication
%	modulus

F.13.2 Assignment operators

Following are the assignment operators for SMSL.

For example, a+=b is equivalent to a=a+b.

Table F.6 – SMSL assignment operators

Operator	Definition
=	assignment
.=	self-concatenation for strings
+=	self-addition
–=	self-subtraction
/=	self-division
*=	self-multiplication
%=	self-modulus

Bitwise assignment:

&=	self-bitwise AND
|=	self-bitwise OR
^=	exclusive OR bitwise assignment

Shift assignment:

<<=	shift left assignment
>>=	shift right assignment

Increment/Decrement operators

For example, a++ is equivalent to a=a+1.

Table F.7 – SMSL increment/decrement operators

Operator	Definition
++	increment
--	decrement

F.13.3 Bitwise operators

Following are the bitwise operators defined for SMSL.

For example, a&=b is equivalent to a=a&b.

Table F.8 – SMSL bitwise operators

Operator	Definition
&	bitwise AND
|	bitwise OR
&=	self-bitwise AND
|=	self-bitwise OR
^	exclusive OR bitwise
^=	exclusive OR bitwise assignment

F.13.4 Logical operators

The SMSL logical operators assume for their operands that true is represented by 1 or a non-empty string. False is represented by 0 or an empty string. However, when they return results, they always use 1 for true and 0 for false.

Table F.9 – SMSL logical operators

Operator	Definition
&&	logical AND
||	logical OR
!	logical NOT

F.13.5 Relational operators

The relational operators perform numeric comparisons if both operands are numbers. Otherwise they perform string comparisons (that is, lexical, dictionary ordering). A string is considered a number if it consists of only digits, the minus sign, or a period. No white space is allowed. SMSL relational operators do not consider constants in exponential notation (such as 2.3e+27) to be numbers.

F.13.6 Shift operators

The shift operators perform bit shifting within bytes.

Table F.10 – SMSL relational operators

Operator	Definition
==	equal to
!=	not equal to
<	less than
>	greater than
<=	less than or equal to
>=	greater than or equal to

Table F.11 – SMSL shift operators

Operator	Definition
<<	shift left
<<=	shift left assignment
>>	shift right
>>=	shift right assignment

F.13.7 String operators

SMSL has several operators for string and list manipulation.

[s1, s2, ...]

The list operator builds a list by joining all elements in a comma-separated list in a double-quoted string of items delimited by a space, which is SMSL's representation for lists/arrays.

=~ (equal tilde)

The =~ operator is used in the expression string =~ pattern and returns:

- 1 if the regular expression pattern is contained in string;
- 0 if the regular expression pattern is not contained in string.

If pattern is invalid, SMSL returns a run-time error message and the =~ operation returns 0 (pattern not contained).

!~ (tilde)

The !~ operator is used in the expression string !~ pattern and returns:

- 1 if the regular expression pattern is not contained in string;
- 0 if the regular expression pattern is contained in string.

If pattern is invalid, SMSL returns a run-time error message and the !~ operation returns 0 (pattern contained).

F.13.8 SMSL operator precedence and associativity

The precedence and associativity of SMSL operators is almost identical to that of C and Perl. In addition to the standard operators, there are new string operators – "." and [x,y,...] – with their associated precedences.

In Table F.12, the operators are listed in ascending order of precedence:

Table F.12 – SMSL operator precedence and associativity

Operator precedence	Associativity
=	lowest right
+=, –=, <<=, >>=, ^=	right
*=, /=, %=	right
|=, &=	right
||	left
&&	left
|	left
^	left
&	left
!=, ==, =~, !~	left
<, <=, >, >=	left
<<, >>	left
+, – (binary)	left
*, /, %	left
. (string concat)	left
!, –, ++, --	right
()	left
[] highest	left

F.14 The SMSL core scripting language

A SMSL script consists of a sequence of commands. All uninitialized user-created objects are assumed to start with a NULL or 0 value until they are defined by some explicit operation such as assignment.

SMSL is, for the most part, a free-form language. That is, lines don't have to start or end at or before a particular column; they can just continue on the next line. White space is ignored except for the separation of tokens. Comments are indicated by the # character and extend to the end of the line. For example, here is a comment about an assignment statement:

```
x = y;          # Assign the value of y to the variable x
```

F.14.1 SMSL compound statements

SMSL compound statements include loop statements and if statements. In SMSL, a sequence of statements can be treated as one statement by enclosing it in braces {}. We will call this a statement block and denote it in the statement descriptions as {BLOCK}

F.14.1.1 Exit

Format

```
exit
```

Description

The exit statement causes the SMSL program to immediately end and return control to the process that called it. The exit statement must be terminated with a semicolon when used in a SMSL program.

F.14.1.2 Export

Format

export variable

export function function

Parameters

Description

The export statement makes a variable or function in a SMSL library available for export to another SMSL library or program using the requires statement. Each export statement can specify a single variable or function.

Global variables and functions need not be declared before the export statement. The export statement does not require that a variable be explicitly defined within a library, but it does require that it appear in a SMSL statement to create an implicit definition.

Placement of the export statement

The export function function statement can appear before or after the actual function definition. The export variable statement can appear before or after the first appearance of a global variable.

An export statement can appear inside a function definition without any special significance.

Parameter definition

variable name of a SMSL variable that is available for export to another SMSL program

function name of a SMSL function that is available for export to another SMSL program

Errors involving the export statement

The export statement can generate compiler errors in the following instances:

- variable or function is not defined or used in the library;
- variable or function is a SMSL built-in function;
- variable is a local variable of a user-defined function in the library;
- variable or function is duplicated in another export statement;
- variable or function has been imported using the requires statement.

F.14.1.3 Foreach

Format

foreach [list] {BLOCK}

foreach unit variable [list] {BLOCK}

Description

The foreach loop iterates over list and sets variable to be each element of list, performing BLOCK for each element of list in turn.

Parameter definition

list: A list that contains one or more elements that can be equated to variable.

BLOCK: One or more statements that are executed when variable has been equated to an element from list.

unit controls how list is split into individual elements.

Valid Range:

- word assumes that the array elements are separated by white space (spaces, tabs, or \n);
- line assumes that array elements are separated by \n.

default if not specified: line

variable the name of the element that is equated to each element in list.

Examples

The following examples highlight the usage of the foreach statement.

Sum the Elements in an Array

```
sum = 0;

foreach elem ("1\n2\n3\n4\n5")

{

        sum += elem;

}
```

List the Login ID of Each Account on the System

```
foreach user (cat ("/etc/passwd"))

{

        printf(ntharg (item, 1, ":"), "\n");

}
```

NOTE – cat() and ntharg() are built-in SMSL functions.

Count the Number of Words in a String

```
words = 0;

foreach word w ("The cat sat on the mat.")

{

        words++;

}
```

F.14.1.4 Function

Format

```
function name(argument_list) {BLOCK}
```

Description

The function statement provides user-defined functions within SMSL programs similar to those available in the C-programming language. The function keyword is required in a user function definition. Two additional keywords, local and return, are optional:

- local declares variables that will be used only within the function;
- return identifies function output that is returned to the caller.

Functions must be defined before their first use, and the correct argument_list must be passed in a function call. A function call always returns a character string representing a character string or numeric value. (All data types are represented within SMSL as character strings.)

Parameter definition

name: Character label that is used to identify and call the function from within the SMSL program; name cannot be identical to either of the following:

- a SMSL built-in function;
- a SMSL variable.

argument_list: Zero or more SMSL variables that are passed to the function as parameters when it is called for execution. argument_list can be a NULL entry if no variables are passed to the function, a single argument, or several arguments separated by commas.

BLOCK: One or more SMSL statements that define the action the function performs.

Arguments are passed-by-value to parameters (that is, local copies are created of the arguments' data passed in), and thus changing a parameter will not affect the value of the argument. Function parameters are local to a function and can have names the same as global variables (or the same as parameters of other functions).

If a function definition appears in the middle of executable statements and control flow reaches that definition from above, the definition is skipped as if it were a comment. The only way to enter the body of a function is to explicitly call it. The function definitions serve merely to define a function and are not invoked until called. Hence, it is possible to place executable code above, below, and between function definitions.

F.14.1.5 The return statement

There are three ways to exit a user-defined function:

- return with a return value;
- return without a return value (return value = NULL string);
- fall through to the bottom right brace (return omitted, no return value).

SMSL does not interpret falling through the bottom of a function as an error condition.

SMSL produces a compilation warning similar to that produced by C compilers when it encounters return statements within a function some of which have return values and while others do not. Having multiple exit points in a function that exit in different ways may indicate confusion over whether the function was defined to be perform an action or return a value.

F.14.2 Defining local variables

User-defined function local variables are declared using the local keyword inside the body of the function. The local keyword declares one or more variables specified in a comma-separated list that is terminated by a semicolon. These names become local variables to the function. Following is an example of local variable definitions:

```
function f()
{
        local x;
        local a,b;
        # ... Statements for the function execution.
}
```

Local variables cannot have the same name as a function parameter or another local variable in the same function. Local variable names in one function do not affect those in another function. Local variables can have the same name as a global variable and can "hide" a global name this way.

Local variable declarations are treated as expressions and can appear anywhere within the function that an expression is valid. However, there is no concept of inner scopes in inner blocks and a local variable has scope extending from its point of declaration to the end of the enclosing function (not the enclosing block).

Local variables are initialized to the empty string every time the function is entered. They do not retain their values from a previous call.

The maximum number of local variables and function parameters in user-defined functions (except for the main() function) is implementation specific.

F.14.3 Entry point function

The SMSL entry point function is the main() function. If a SMSL program contains a user-defined function named main, execution begins at the first statement in main(). The SMSL program terminates normally when main() returns. The function you specify as the entry point is permitted to have the same properties as main().

The main() function or the entry point function must be defined in the top-level SMSL program and not in any imported libraries. Functions imported from libraries are ignored when determining whether an entry point function is available.

F.14.3.1 Start of execution without an entry point function

If there is no main() function and no entry point function specified using the SMSL compiler -e option, execution begins at the first executable statement that is not inside a function definition. A program without an entry function will normally have function definitions at the top (they must be defined before their first use) and the main executable statements afterwards. A typical example would be the following:

```
function max(x,y)
{
        if(x > y)
        {
            return x;
        }
        else
        {
            return y;
        }
}
m = max(1,2);              # Execution starts here
printf("maximum is ", m, "\n");
```

As indicated, program execution begins immediately after the function definition.

F.14.3.2 Limitations of user-defined functions

User-defined functions are subject to the following limitations:

- Function Calls are Non-Recursive.
- User-defined functions can make unlimited calls to other functions provided that there is no direct or indirect recursion in the sequence of calls.
- Pass by Value and Pass by Reference Supported.
- SMSL functions support argument passing by reference and argument pass-by value.

Parameter and local variable limits

The parameter and local variable limits for SMSL functions are not defined in this Specification. They are implementation specific.

Function nesting not permitted

SMSL does not permit function nesting – each function definition must be at global scope and cannot be defined inside any other function.

F.14.4 If

Format

```
if (expression) {BLOCK}
if (expression) {BLOCK} else {BLOCK}
if (expression) {BLOCK} elsif (expression) {BLOCK} . . . else{ BLOCK}
```

Description

The if statement is straightforward. Because a statement BLOCK is always bounded by braces, there is no ambiguity about which if, elsif, and else goes with.

Examples

The following examples highlight the usage of if, elsif, and else:

An if statement

if (x > 10)

{

x = 10; # don’t let x get bigger than 10

}

Parameter definition

expression: A SMSL statement whose evaluation returns either TRUE or FALSE.

BLOCK: One or more SMSL statements that are executed once in accordance with the evaluation of the if or elsif expressions.

Description

The if statement is straightforward. Because a statement BLOCK is always bounded by braces, there is no ambiguity about which if, elsif, and else goes with.

Examples

The following examples highlight the usage of if, elsif, and else.

```
An if statement
if (x > 10)
{
       x = 10;     # don’t let x get bigger than 10
}
An if . . . else Statement
if (x == 0)
{
       # do something
}
else
{
       # x != 0
       # do something else
}
An if . . . elsif . . . else Statement
if (x == 0)
{
       # do something
}
elsif (x == 1)
{
```

```
        # do something else
}
else
{
        # x !== 0 &&  x != 1
        # do something else
}
```

F.14.5 Last

Format

last

Description

The last statement causes SMSL execution to exit the innermost execution loop. The last statement must be terminated with a semicolon when used in a SMSL program.

F.14.6 Next

Format

next

Description

The next statement immediately starts the next iteration of the innermost execution loop.

F.14.7 Requires

Format

requires library

Description

The requires statement imports variables and functions identified in export statements from a previously created SMSL library into the SMSL program. Each requires statement can specify a single library name.

SMSL contains no explicit import statement; using the requires statement implies importation. The requires statement searches for the binary containing the library and reads all its export statement information, importing the specified variables and/or functions into the SMSL program.

Any number of requires statements can appear in a SMSL program. All libraries specified in requires statements must be available to the compiler during compilation.

Requires statements in imported libraries

The SMSL compiler will automatically resolve nested dependencies in imported libraries, but it will not automatically load all the other exported functions and variables found in the library that satisfies the nested dependency. You must explicitly import a library in order to guarantee access to all the exported variables and functions within it.

Parameter definition

library: Name of the library whose specified export variables and functions are to be imported into the SMSL program.

A requires statement can appear inside a function definition without special significance.

Variable and function availability among imported libraries

When a SMSL program imports variables and functions from more than one library, the imported variables and functions from one library can set and use the imported variables and functions from the others, regardless of how the libraries are loaded for compilation.

Errors involving the requires statement

The requires statement can generate compiler errors in the following instances:

- A reference to an imported variable or function appears before the requires statement that imports it. You must place a requires statement before the first use of the imported variable or function.
- An imported function has the same name as a function defined within the SMSL program.
- The same variable or function name is imported from two or more libraries.

F.14.8 Switch

Format

```
switch (variable)
{
    case a: {BLOCK}
    case b: {BLOCK}
    . . .
    case p,q,r:{ BLOCK}
    . . .
    case n: {BLOCK}
    default: {BLOCK}
}
```

Parameters

Description

The switch statement evaluates variable and based on its integer value executes a specific SMSL BLOCK. The case labels correspond to the values of variable for which a specific SMSL BLOCK is available.

If the value of variable falls outside the range of the values in the case labels, execution continues with the BLOCK corresponding to the default label. If no default label exists, execution will continue with the first statement following the switch statement.

Parameter definition

variable SMSL: Variable name whose integer value specifies the SMSL statement BLOCK that will be executed.

a,b, . . . p,q,r, . . . n Integer values indicating the value of variable that will cause the corresponding BLOCK to be executed.

BLOCK: One or more statements that are executed when the corresponding case value equals variable.

Description

The switch statement evaluates variable and based on its integer value executes a specific SMSL BLOCK. The case labels correspond to the values of variable for which a specific SMSL BLOCK is available.

If the value of variable falls outside the range of the values in the case labels, execution continues with the BLOCK corresponding to the default label. If no default label exists, execution will continue with the first statement following the switch statement.

The SMSL switch statement behaves the same way as a long sequence of if-then-else-if statements. A case or default clause is effectively a run-time statement that specifies a comparison against the value of variable:

- If the value of variable matches a case, execution moves inside the BLOCK for the case or default clause; and after completing BLOCK, execution continues after the entire switch statement (that is, there is no falling through to the next case clause).
- If the value of variable does not match a case, execution skips to the default clause; and if there is none, execution moves to the statement following the switch statement.

Any statement within the switch statement case block that is not part of a case or default BLOCK executes only if all the case labels above it failed to match variable (that is, it executes as part of the normal sequence of control flow).

The following are the properties of the SMSL switch statement:

- Case expressions can be dynamically evaluated expressions and constant expressions.
- The colon delimiter that separates the case label from the executable BLOCK is optional in SMSL.
- SMSL requires that the default label follow all case labels in the switch statement case block. It returns a compilation error if one or more case labels follow default.
- SMSL does not return a compilation error for duplicate case labels in the switch statement. In SMSL, the second of the duplicate case labels is unreachable.
- SMSL allows multiple cases that execute a common BLOCK to be specified as a comma separated list within a single case label. (Conversely, the stacked labels will not work in SMSL.)
- Execution of a SMSL BLOCK does not “fall through” to the next case label and BLOCK. Upon reaching the closing right brace of a case or default BLOCK, execution moves to the end of the SMSL switch statement.
- The SMSL switch statement uses the last statement to exit from a BLOCK. The last statement exits the innermost switch statement or loop. However, because of the absence of “fall-through” in SMSL, there is little need to use the last statement in the switch statement.
- SMSL generates a compiler error upon detecting two default labels in a single switch statement.
- SMSL permits nested switch statements.

The case BLOCKs are evaluated at run-time in their order of appearance:

- case order for BLOCKs;
- left-to-right for expressions in the comma-separated lists of multiple-case labels.

All expressions within a comma-separated list are evaluated before the case label. This evaluation occurs even if the first expression is a match.

This sequence and method of evaluating the case label can be a dangerous pitfall if any expression in the list modifies either variable for the current switch statement or a variable used in another case expression. Under SMSL, statements within a switch statement that are not part of a BLOCK (free statements) can and will be executed if they are reached by the flow of execution. The condition for control flow to reach these statements is that variable cannot match any of the case labels that precede them within the switch statement. SMSL does not return a warning or error message when two case labels evaluated against variable are nested one inside the other. Two examples of this situation are shown in the following SMSL switch example:

switch(x) { case 1: { f1() # Function f1 Called case 2 : {f2();} # Function f2 Unreachable f3(); # Function f3 Called } default: {case 4: {f4();}} # Function f4 called if x=4 }

Since case and default labels are run-time statements, the effect of one case label nested within another is that variable must match the case value for the case BLOCK to execute. This means that variable must equal two different values! In case 1 of the example, f2 will never be called because x cannot equal both 1 and 2.

In the default case of the example, f4 will be called if variable = 4 because there is no case 4 defined in the switch statement. When variable = 4, the default BLOCK executes, containing the case 4 BLOCK call to function f4.

F.14.9 While

Format

while (expression) {BLOCK}

Parameters

Description

The while loop executes statements as long as expression evaluates to TRUE (non-zero).

Example

The following sample SMSL statements print the integers from 1 to 10.

```
x = 1;

while (x <= 10)

{

        printf (x, " ");

        x++;

}

printf ("\n");
```

Parameter definition

expression A SMSL statement whose evaluation returns either TRUE or FALSE.

BLOCK: One or more SMSL statements that execute repeatedly as long as expression evaluates to TRUE.

Description

The while loop executes statements as long as expression evaluates to TRUE (non-zero).

Example

The following sample SMSL statements print the integers from 1 to 10.

```
x = 1;

while (x <= 10)

{

        printf (x, " ");

        x++;

}

printf("\n");
```


F.14.10 Object model

SMSL is based on a simple object-oriented model which makes it possible to do a mapping from systems management environment described in GDMO (see CCITT Rec. X.733 | ISO/IEC 10164-4). An object is a construct with properties that are variables or other object. Functions associated with an object are the object's methods.

A SMSL user can access the properties of an object with the following notation:

objectName.propertyName

This object can be either GDMO object or some locally defined object.

If this object is GDMO object, the mapping from GDMO properties to SMSL properties is shown in Table F.13.

Table F.13 – Mapping between GDMO and SMSL

GDMO property	SMSL property
class-label	name of object type
instance identifier(INTEGER, etc.)	value of object instance variable
initial values in creating an instance	parameters of “new” operation
managed object instance names	ASN.1 value notation
ASN.1 type of ATTRIBUTES	name of variables
label of ATTRIBUTE GROUPS	name of array variable
label of ACTION	name of method (function)
asynchronous NOTIFICATION handling	onEvent(discriminatorConstruct) handler

A property can be defined by assigning it a value as follows:

objectName.propertyName = value;

A method is a function associated with an object. A function can be associated with an object as follows:

objectName.methodName = functionName

where object is an existing local object, method is the name assigned to the method, and functionName is the name of the function.

Method in the context of the object can be called as follows:

objectName.methodName(parameters);

F.14.10.1 GDMO operation and action parameters

Operation and action parameters are passed to the action method as an object mapped by the rules described in the object model. Return parameter values are returned from the action method (function) as an object mapped by these rules. The description format is as follows:

outputObjectName = ObjectName.actionName(inputObjectName);

outputObjectName = ObjectName.operationName(inputObjectName);

F.14.10.2 “this” object reference

SMSL has a special keyword, “this”, that can be used to refer to the current object.

this[propertyName]

F.14.10.3 Creating and deleting objects

new

An operator that lets you create an instance of a user-defined object type.

Creating an object type requires two steps:

1) Define the object type by writing a function.

2) Create an instance of the object with new.

To define an object type, create a function for the object type that specifies its name, properties and methods. An object can have a property that is itself another object.

Format

objectName = new objectType (param1 [,param2] .... [,paramN])

objectName is the name of the new object instance.

objectType is function that defines an object type.

param1..paramN are the property values for the object. These properties are parameters defined for the objectType function.

An instance of a class can be deleted with “delete” operator.

delete objectName

objectName is the name of the existing object instance.

Moreover local object type can be defined by writing a function. Then a local instance of the object can be created with “new” operator.

Object expression to represent name-binding

If two objects have a name-binding relationship, the following expression of that subordinate object is allowed:

superiorObjectInstance.subordinateObjectInstance

F.14.10.4 WITH

A statement that establishes a default object for a set of statements. Within the set of statements, any property references that do not specify an object are assumed to be for the default object.

Syntax

with (objectName){

statements

}

objectName specifies the default object to use for the *statements*. The parentheses are required around *objectName*. *statements* is any block of statements.

F.14.10.5 Event handler

onEvent

Description

An event handling operator to describe the processing when a specified notification defined by GDMO occurs.

Syntax

onEvent(*DiscriminatorConstructValue*){

statements

}

DiscriminatorConstructValue is DiscriminatorConstruct type value. *statements* is any block of statements.

F.14.10.6 triggerParameterCount

This SMSL virtual machine keeps track of the number of trigger parameters by means of this variable.

F.14.10.7 triggerArgument

Description

The triggerArgument accepts the list of trigger parameters which can be accessed from an SMSL script and returns the identity of the launch pad which then executes the script. The argument list includes the trigger id and script id unless the trigger is not parameterized.

Syntax

triggerArgument(*argument_list*), where *argument_list* can have up to *triggerParameterCount* elements.

Example of SMSL script for management of EFD

This example describes how an EFD can be created and its operational state determined.

The parameters to the script to be triggered are the script id and the notification destination. The SMSL script to get the operational state attribute of the EFD and return it as a notification to the destination is given below.

The trigger is specified with the following parameters:

- *triggerId*, the identifier of this trigger;
- *scriptId*, the identifier of the script to be executed;
- *managerId*, the identifier of the destination to which event reports are to be forwarded.

The SMSL script for this example is given below:

```
#include “CMIP.CMIP-1.h”
#include “DMI.Attribute-ASN1Module.h”

manager1 = triggerArgument(triggerId, scriptId, managerId);

/* Instance creation as CMISFilter type */
CMISFilter counterValue _GT10 = item ( greaterOrEqual ( Attribute-ASN1Module.Count, 10))

/*
* Creating instance of EFD with the following parameters.
* DiscrimnatorConstruct = ( counter > 10 ),
* administrativeState = default value, destination = manager1
*/

efd1 = new eventForwardingDiscriminator( counterValue_GT10, manager1);

triggerResult = efd1.operationalState;                    /* get operational state */

printf(“operational state of event forwarding discriminator %d \n”, triggerResult);
```

The destination manager is supplied as a trigger parameter. The trigger causes the launch pad to spawn threads in order to execute all the script instructions in sequence. The launch pad passes appropriate parameters to threads. When creating efd1, for example, the launch pad passes the script id and the destination manager as parameters to the thread.

F.14.11 BNF for SMSL

(Conventions: "{}" is used for productions which may occur 0 or more times; "[]" is used for optional productions.)

Tokens:

```
T_ELLIPSIS          : "..."
T_EQ                : "=="
T_NE                : "!="
T_REGEXP_EQ         : "=~"
T_REGEXP_NE         : "!~"
T_LEQ               : "<="
T_GEQ               : ">="
T_GT                : ">"
T_LT                : "<"
T_AND               : "&&"
T_OR                : "||"
T_NOT               : "!"
```

```
T_INC                   : "++"
T_DEC                   : "--"
T_PLUSEQ                : "+="
T_MINUSEQ               : "-="
T_MULEQ                 : "*="
T_DIVEQ                 : "/="
T_MODEQ                 : "%="
T_BITANDEQ              : "&="
T_BITOREQ               : "|="
T_LEFT_SHIFT            : "<<"
T_RIGHT_SHIFT           : ">>"
T_RIGHT_SHIFT_ASSIGN    : ">>="
T_LEFT_SHIFT_ASSIGN     : "<<="
T_XOR_ASSIGN            : "^="
```

Keywords:

```
T_IF                    : "if"|"IF"
T_ELSE                  : "else"|"ELSE"
T_ELSIF                 : "elsif"|"ELSEIF"
T_FOREACH               : "foreach"|"FOREACH"
T_FOR                   : "for"|"FOR"
T_WORD                  : "word"|"WORD"
T_LINE                  : "line"|"LINE"
T_NEXT                  : "next"|"NEXT"
T_LAST                  : "last"|"LAST"
T_WHILE                 : "while"|"WHILE"
T_DO                    : "do"|"DO"
T_UNTIL                 : "until"|"UNTIL"
T_EXIT                  : "exit"|"EXIT"
T_TRUE                  :
"true"|"TRUE"|"True"|"yes"|"YES"|"Yes"
T_FALSE                 :
"false"|"FALSE"|"False"|"no"|"NO"|"No"
T_RETURN                : "return"|"RETURN"
T_LOCAL                 : "local"|"LOCAL"
T_FUNCTION              : "function"|"FUNCTION"
T_NATIVE                : "native"|"NATIVE"
T_RPC                   : "rpc"|"RPC"
T_VOID                  : "void"
T_REQUIRES              : "requires"|"REQUIRES"
T_EXPORT                : "export"|"EXPORT"
```

```
T_CASE                  : "case"|"CASE"
T_SWITCH                : "switch"|"SWITCH"
T_DEFAULT               : "default"|"DEFAULT"
```

Rules:

```
program : stmts

stmts : { stmt }

stmt : expr ';'          |
       return    |
       if    |
       foreach    |
       switch     |
       case      |
       default    |
       while     |
       do_until  |
       for_loop  |
       T_LAST ';' |
       T_NEXT ';' |
       T_EXIT ';' |
       function   |
       native_function  |
       rpc       |
       local_var_dec   |
       export    |
       requires

requires : T_REQUIRES requires_name ';'

library_name : T_STRING | T_IDENTIFIER

requires_name : library_name

export : T_EXPORT [ T_FUNCTION ] export_name ';'

export_name : T_IDENTIFIER

part : T_WORD
```

```
foreach : T_FOREACH part simple_id '(' expr ')' '{' stmts '}'

case_exprs : { case_expr ',' } case_expr

case_expr : expr

case : T_CASE case_exprs optional_colon '{' stmts '}'

default : T_DEFAULT optional_colon '{' stmts '}'

optional_colon  :  [ ':' ]

switch : T_SWITCH '(' expr ')' '{' stmts '}'

for_loop : T_FOR '(' optional_expr ';' optional_expr ';' optional_expr ')'
          '{' stmts '}'

do_until : T_DO '{' stmts '}' T_UNTIL '(' expr ')' ';'

while : T_WHILE '(' expr ')' '{' stmts '}'

void : [ T_VOID ]

native_function :
       T_NATIVE void T_FUNCTION function_name '(' func_param_list ')' ';'

rpc : T_RPC void T_FUNCTION function_name '(' func_param_list ')' ';'

function : T_FUNCTION function_name '(' func_param_list ')' '{' stmts '}'

func_param_list : param_list

function_name : T_IDENTIFIER

param_list : [ { one_param ',' }  one_param ]

one_param : T_IDENTIFIER |
           T_ELLIPSIS

local_var_dec : T_LOCAL var_list ';'
```

```
var_list : { one_var ',' }  one_var

one_var : T_IDENTIFIER

return : T_RETURN [ expr ] ';'

if : T_IF '(' expr ')' '{' stmts '}' opt_elsifs opt_else

opt_elsifs : { elsif }

elsif : T_ELSIF '(' expr ')' '{' stmts '}'

opt_else : [ else ]

else : T_ELSE '{' stmts '}'

optional_expr : [ expr ]

expr : unary_expr             |
       expr '+' expr                |
       expr '-' expr                |
       expr '*' expr                |
       expr '/' expr                |
       expr '%' expr                |
       expr T_EQ expr               |
       expr T_NE expr               |
       expr T_REGEXP_NE expr        |
       expr T_REGEXP_EQ expr        |
       expr T_LT expr               |
       expr T_GT expr               |
       expr T_LEQ expr              |
       expr T_GEQ expr              |
       expr T_AND expr              |
       ternary_expr           |
       expr T_OR expr               |
       expr '|' expr                |
       expr '&' expr                |
       expr '^' expr                |
       expr T_LEFT_SHIFT expr       |
       expr T_RIGHT_SHIFT expr            |
       lvalue '=' expr              |
```

```
        lvalue T_PLUSEQ expr          |
        lvalue T_MINUSEQ expr         |
        lvalue T_MULEQ expr           |
        lvalue T_DIVEQ expr           |
        lvalue T_BITANDEQ expr        |
        lvalue T_BITOREQ expr         |
        lvalue T_MODEQ expr           |
        lvalue T_LEFT_SHIFT_ASSIGN expr    |
        lvalue T_XOR_ASSIGN expr           |
        lvalue T_RIGHT_SHIFT_ASSIGN expr   |
        expr '.' expr

simple_id : T_IDENTIFIER

ternary_expr : expr '?' expr ':' expr

lvalue : simple_id

unary_expr : primary          |
           '-' unary_expr     |
           T_NOT unary_expr   |
           T_INC lvalue   |
           T_DEC lvalue

function_call_id : T_IDENTIFIER

primary : simple_id                        |
        T_INT                 |
        T_FLOAT                       |
        T_STRING                      |
        T_TRUE                |
        T_FALSE                       |
        '(' expr ')'                       |
        lvalue T_INC                       |
        lvalue T_DEC                       |
        function_call_id '(' arglist ')'

arglist : [ { expr ',' } expr ]
=======================================================
```

Note that the definition of string should allow embedded \" within strings.

```
T_IDENTIFIER            : [A-Za-z_][A-Za-z_0-9]*
T_STRING                : \"[^"]*\"
T_FLOAT                 : [0-9]*"."[0-9]+
T_INT                   : [0-9]+
```

/ Operator tokens and their precedences */*

```
%right  '='  T_PLUSEQ  T_MINUSEQ  T_MULEQ  T_DIVEQ  T_MODEQ  T_BITANDEQ  T_BITOREQ
T_LEFT_SHIFT_ASSIGN T_RIGHT_SHIFT_ASSIGN T_XOR_ASSIGN
%left '?' ':'
%left T_OR
%left T_AND
%left '|'
%left '^'
%left '&'
%left T_EQ T_NE T_REGEXP_EQ T_REGEXP_NE
%left T_LT T_GT T_LEQ T_GEQ
%left T_LEFT_SHIFT T_RIGHT_SHIFT
%left '+' '-'
%left '*' '/' '%'
%left '.'
%right T_UNARY T_NOT T_INC T_DEC
%left '('
%left '['
```

Annex G

SMSL support functions

(This annex forms an integral part of this Recommendation | International Standard)

acos()

Return the arccosine of the argument.

Format

acos(*cosine*)

Parameter

Parameter	Definition
cosine	cosine argument valid range: –1 <= *cosine* <= 1

Description

The acos() function returns the arccosine of *cosine*; that is, the length in radians of the arc whose cosine is *cosine*.

The output range for the acos() function is 0 ≤ acos() ≤ p. The acos() function return value is accurate to six decimal places.

asctime()

Return the date and time as a character string.

Format

asctime(*clock*,*format*)

Parameters

Parameter	Definition
clock	A reference to the clock or timer whose value should be converted to a character string. *clock* is most commonly time().
format	Optional format specification for the asctime() output string. The following field specifiers are valid: %a abbreviated weekday %A full weekday %b abbreviated month %B full month %c local date and time representation %d decimal day of the month (from 01 to 31) %E combined Emperor/Era name and year %H decimal hour in 24-hour mode (from 00 to 23) %I decimal hour in 12-hour mode (from 01 to 12) %j decimal day of the year (from 001 to 366) %m decimal month (from 01 to 12) %M decimal minute (from 00 to 59) %n new-line character %N Emperor/Era name %o Emperor/Era year %p equivalent of AM/PM

Parameters
(concluded)

Parameter	Definition
format	Optional format specification for the asctime() output string. The following field specifiers are valid: %S decimal second (from 00 to 61) %t tab character %U decimal week of the year: Sunday is the first day of the week; all days preceding the first Sunday of the year are in week 0 (from 00 to 53) %w decimal day of the week: Sunday is the first day of the week (from 00 to 06) %W decimal week of the year: Monday is the first day of the week; all days preceding the first Monday of the year are in week 0 (from 00 to 53) %x local date representation %X local time representation %y decimal year without century (from 00 to 99) %Y decimal year with century %Z time zone name (if time zone name exists) %% % character Field specifiers may be expressed as: [– | 0] *field_specifier*.p where – left-justify the field (right-justification is the default) 0 right-justify the field and pad with zeros on the left .p minimum number of digits to display for decimal fields or the maximum number of characters to display for alphabetic fields. For decimal fields, empty character positions are filled with leading zeros. For character fields, excess characters are truncated on the right. Default if not specified: 24-character string with the format: Sun Sep 16 01:03:52 1973

Description:

The asctime() function returns the date/time of clock as a character string. It is equivalent to the C- library asctime() function.

If format is given, asctime() returns the date/time string in the specified format. The field specifiers used in format are equivalent to those used in the C-library strftime() function.

asin()

Return the arcsine of the argument.

Format

asin(*sine*)

Parameter

Parameter	Definition
sine	Valid range: $-1 \leq sine \leq 1$

Description

The asin() function returns the arcsine of *sine*; that is, the length in radians of the arc whose sine is *sine*. The output range for the asin() function is $-\pi/2 \leq \text{asin}() \leq \pi/2$.

atan()

Return the arctangent of the argument.

Format

atan(*tangent*)

Parameter

Parameter	Definition
tangent	Valid range: $-\infty \leq tangent \leq \infty$

Description

The atan() function returns the arctangent of *tangent*; that is, the length in radians of the arc whose tangent is *tangent*.

The output range for the atan() function is $-\pi/2 \leq \text{atan}() \leq \pi/2$.

cat()

Return the content of a file as a single text string.

Format

cat(*filename*)

Parameters

Parameter	Definition
filename	Name of the file whose contents are to be returned

Description

The cat() function returns the contents of file *filename* as a single string or the NULL string on error. New-lines are preserved so that the foreach statement can be used to process the returned string as a list of the lines in *filename*.

Example

The following SMSL statements list the names of users listed in the UNIX system password file.

```
people = cat("/etc/passwd");
foreach person (people)
{
name = ntharg(person, 1, ":");
printf("name of person is:%s", name, "\n");
}
```

ceil()

Return the smallest integer that is not less than the argument.

Format

ceil(*argument*)

Parameter

Parameter	Definition
argument	Numeric argument whose least integer upper bound is to be determined

Description

The ceil() function returns the smallest integer that is not less than *argument*; that is, the least integer upper bound for *argument*.

The ceil() function and the floor() function together bracket *argument* such that the following are true:

- If *argument* is an integer: ceil(*argument*) = *argument* = floor(*argument*).
- If *argument* is not an integer: floor(*argument*) < *argument* < ceil(*argument*) and ceil(*argument*) = floor(*argument*) + 1.

chan_exists()

Verify that a process or file channel exists.

Format

chan_exists(*channel*)

Parameter

Parameter	Definition
channel	The process or file I/O channel name (shared channels) or number (local channels) that is being verified

Description

The chan_exists() function returns 1 if the local or shared channel exists and 0 if it does not.

The chan_exists() function return value can be used with condition variables for synchronizing one SMSL process to wait until another has opened a channel using either the popen() or fopen() function.

close()

Close a file or process channel.

Format

close(*channel*,*flags*)

Parameters

Parameter	Definition
channel	The process or file I/O channel name (shared channels) or number (local channels) that is to be closed
flags	Optional bit flags used to control close execution. The following bits are used: Bit 1 = 1 indicates that any system process associated with the channel (that is, the SMSL fopen() or popen() function) should be killed while closing the channel. Bit 2 = 1 indicates that the channel should be closed even if another SMSL process is blocked waiting for a read(), readln(), or write() function. Bit 2 applies only to global channels and is ignored by local channels. Default if not specified: Bits 1 and 2 are both zero.

Description

The close() function closes a channel to a process or command previously created by a fopen() or popen() call.

When flags is not specified, the default is zero.

When bit 1 = 0, the close() function does not kill any processes spawned as a result of the fopen() or popen(); and these processes are allowed to continue. This feature of close() allows you to open a channel to a SMSL process, send additional data, and close the channel while allowing the process to complete.

When bit 2 = 1, the close() function will close the channel even if another SMSL process is blocked pending an I/O request on that channel. When blocking occurs, close() causes the blocked function to wake and receive an error return and errno from the process to which the channel was opened.

The close() function returns the NULL string if the closure was successful and –1 with the SMSL variable errno set if the closure was unsuccessful. The close() function fails when bit 2 = 0 and channel is a global channel with at least one blocked SMSL process.

Example

close the channel represented by variable chan

close(chan);

concat()

Concatenate two strings.

Format

concat(*string1*, *string2*)

Description

The concat function causes the concatenation of two strings.

For example, concat("ab","cd") returns "abcd".

cond_signal()

Signal a process that is blocked on a condition wait.

Format

cond_signal(*condition_variable,all*)

Parameters

Parameter	Definition
condition_variable	Name of the variable that will unblock a process blocked by the cond_wait() function
all	Non-NULL value that directs the cond_signal() function to unblock all SMSL processes that are blocked waiting for condition_variable

Description

The cond_signal() function can signal another SMSL process that is currently blocked for a cond_wait() function on *condition_variable*. If *all* is specified and is not the NULL string, the cond_signal() function will wake all SMSL processes that are blocked on condition_variable. If no processes are blocked on condition_variable, the cond_signal() function has no effect. The cond_signal() function can never block and always returns the NULL string.

cond_wait()

Block a process until a condition signal is received.

Format

cond_wait(*condition_variable,lockname,timeout*)

Parameters

Parameter	Definition
condition_variable	Name of the variable that will end the cond_wait() condition. *condition_variable* is issued by the cond_signal() function.
lockname	The name of the lock the cond_wait() function should attempt to acquire when it receives the correct unblocking *condition_variable* in the cond_signal() function. If *lockname* is the NULL string, the cond_wait() function will not attempt to acquire a lock after receiving *condition_variable*.
timeout	Number of seconds to wait for the receipt of *condition_variable* before unblocking and releasing *lockname*. Valid range: *timeout* > 0 specifies the timeout value in seconds; *timeout* < 0 specifies an infinite timeout; only the receipt of *condition_variable* can unblock the process; *timeout* = 0 is not permitted and will result in a SMSL run-time error message. Default if not specified: Infinite timeout.

Description

The cond_wait() function blocks the current SMSL process until either *condition_variable* is received or until timeout expires. If the SMSL process holds *lockname* when the cond_wait() function is issued, the cond_wait() function releases the lock. When the cond_wait() function receives condition_variable, the cond_wait() function immediately attempts to acquire *lockname*.

If the cond_wait() function returns a 1, it will always hold an exclusive lock on *lockname*. If the cond_wait() function fails, it will not hold any form of lock on *lockname* when it returns. If a timeout occurs, the cond_wait() function returns a failure value of "0," sets the SMSL errno to E_SMSL_TIMEOUT and will not hold any lock on *lockname*.

condition_variable

condition_variable is the name of the condition variable that the cond_wait() function waits to have signaled by the cond_signal() function. Condition variable names have global scope analogous to locks and shared channels.

None of these different global scopes interfere with one another. You can use the same name without conflict for a lock, a shared channel, and a condition variable.

lockname

On entry to the cond_wait() function, the process releases the lock *lockname* and blocks waiting to be signalled. *lockname* should usually be an exclusive lock held by this process; otherwise, run-time error messages may occur (although the cond_wait() function will still try to go ahead and wait for a signal anyway). The cond_wait() function will always block waiting for the cond_signal() function or for timeout.

When another SMSL process performs a cond_signal() function that wakes this SMSL process, the cond_wait() function call will attempt to gain an exclusive lock (if a lock is requested; that is, if *lockname* is not the empty string) and either return immediately with the lock or join the queue waiting for an exclusive lock on *lockname*.

It is common style to supply *lockname* since condition variables are almost always shielded by locks. In the cond_wait() function, *lockname* must be supplied as the NULL string rather than omitted to force the SMSL coder to consider whether a lock is needed. The required *lockname* will reduce the number of errors caused by not using a lock when one is needed.

timeout

timeout behaviour is unchanged regardless of whether the cond_wait() function is waiting for a cond_signal() function or waiting to acquire *lockname*. If *condition_variable* or *lockname* is destroyed before the cond_wait() function is complete, the cond_wait() function returns 0 and sets the SMSL errno value but will not hold any lock on *lockname*.

lockname can be the NULL string, in which case *condition_variable* is considered to have no associated lock; and the cond_wait() function will return success immediately upon being signaled without waiting for any lock.

cos()

Return the cosine of the argument.

Format

cos(*radians*)

Parameter

Parameter	Definition
radians	Arc length in radians whose cosine is to be determined Valid range: $-\infty \leq$ radians $\leq \infty$

Description

The cos() function returns the cosine of radians.

The output range for the cos() function is $-1 \leq \cos() \leq 1$.

cosh()

Return the hyperbolic cosine of the argument.

Format

cosh(*argument*)

Parameter

Parameter	Definition
argument	Numeric value whose hyperbolic cosine is to be determined Valid range: $-\infty \leq argument \leq \infty$

Description

The cosh() function returns the hyperbolic cosine of argument. The hyperbolic cosine is defined by the expression:

$$\cosh(x) = (e\ x + e\ –x\ )/2$$

where e is the base for the natural logarithms (e = 2.71828 . . .). The output range for the cosh() function is $1 \leq \cosh() \leq \infty$.

date()

Return the date and time as a 24-character string.

Format

date()

Description

The date() function returns the current date and time as a 24-character string in the format:

Sun Sep 16 01:03:52 1973

The date() function is equivalent to the C-library ctime(3) function. The date() function is also equivalent to the SMSL statement:

asctime(time());

Example

The following examples highlight the usage of the date() function.

Assign the Current Date and Time to a Variable:

today = date();

debugger()

Suspend process pending an attach command from the SMSL debugger.

Format

debugger()

Description

The SMSL debugger() function suspends the current SMSL process waiting for an attach command from the SMSL debugger. The debugger() function complements options within the SMSL debugger that suspend SMSL processes. The debugger() function offers a low-level method of stopping a SMSL process for debugging before it begins.

Although modifying SMSL source code to debug a particular script may not be convenient, the debugger() function provides a general method whereby all SMSL code can be debugged.

The only way to restart a SMSL function suspended through the debugger() function is through the SMSL debugger. If the SMSL process is already being processed by the SMSL debugger, a call to the debugger() function call has no effect. The debugger() function always returns the NULL string.

destroy()

Destroy a SMSL object.

Format

destroy(*object, description*)

Parameters

Parameter	Definition
object	The alphanumeric identifier for the object. *object* is assigned when the object is created.
description	Optional text string that can be used to explain why the object was destroyed. The text string must be enclosed in double quotation marks.

Description

The destroy() function deletes the application instance object. The destroy() function returns TRUE on success, and FALSE on error.

Example

destroy object whose name is in variable <name>

destroy(name);

Default if not specified: NULL string

difference()

Return the list of elements that are unique to a specified SMSL list.

Format

difference(*list1,list2,list3,list4 . . . ,listn*)

Parameters

Parameter	Definition
list1	SMSL list whose elements are being compared against the elements of all other specified lists
list2 . . . listn	One or optionally more lists whose elements are compared against *list1*

Description

The difference() function returns a SMSL list with all elements of *list1* that are not in any of the lists *list2 . . . listn*. If *list1* is the NULL list, the result is the NULL list.

list1 may contain duplicates. Duplicates in list1 appear in the return list in same order and number as they appeared in *list1*, provided that they were not removed by matches with the other lists in the difference() function.

All elements that are returned from *list1* remain in the same order in the return list. If the return list is not the NULL set, the returned set is delimited by new-line characters; that is, all set elements end with a new-line character.

execute()

Execute a command of a specified type.

Format

execute(*type,command,instance*)

Parameters

Parameter	Definition
type	Command processor that should interpret and execute command Valid range: The built-in command types OS or SMSL or a valid user-defined command type.
command	Syntax of the submitted command
instance	The application instance against which command should execute Default if not specified: The application instance that is the nearest ancestor of command.

Description

The execute() function executes a command of any type and returns any output that it produces to stdout or stderr. The status of command is saved in the SMSL variable exit_status.

Example

```
# SQL data is returned into the buffer "data"

data = execute("SQL", "select * from user_objects");
```

exists()

Verify the existence of a SMSL object.

Format

exists(*object,inherit*)

Parameters

Parameter	Definition
object	The alphanumeric identifier for the object whose existence is being verified. *Object* is assigned when the object is created.
inherit	Boolean expression controls whether exists will search the entire inheritance hierarchy to verify the existence of *object*: If *inherit* = TRUE, do not search the inheritance hierarchy. If *inherit* = FALSE and if object is not a reference to an absolute object, search the inheritance hierarchy.

Description

The exists() function returns TRUE if object exists; FALSE otherwise. The exists() function is useful in application discovery procedures that determine whether a discovered instance has previously been discovered and instantiated in the object hierarchy.

Example

```
# Check if we have created the user before
if (exists(name))
{
        printf(“%f”,name);
}
else
{
        printf("User name does not exist");
}
```

exp()

Return the base of the natural logarithms e raised to a power.

Format

exp(*exponent*)

Parameter

Parameter	Definition
exponent	Numeric value to which the natural base e is raised

Description

The exp() function returns the value $e^{exponent}$ where e is the base of the natural logarithms ($e = 2.71828 \ldots$).

fabs()

Return the absolute value of an argument.

Format

fabs(*argument*)

Parameter

Parameter	Definition
argument	Floating point value whose absolute value is to be determined

Description

The fabs() function returns the absolute value of argument; that is:

- *argument if argument* ≥ 0;
- *–argument if argument* < 0.

file()

Return file information.

Format

file(*filename*,*dummy*)

Parameters

Parameter	Definition
filename	Name of the file whose last modification date is to be returned
dummy	Dummy variable that specifies expanded file information in the form: modtime atime ctime mode size numlinks type modtime is the last modification date expressed as the number of seconds since midnight, January 1, 1970. atime is the last access time expressed as the number of seconds since midnight, January 1, 1970. ctime is the last change of status expressed as the number of seconds since midnight, January 1, 1970. mode is the file permissions expressed as an octal integer. size is the length of the file expressed as a number of characters. numlinks the number of links to the file within the file system. type is a character string indicating the file type: FILE ordinary user data file DIR directory SPECIAL character special file BLOCK block special file FIFO pipe or FIFO LINK symbolic link SOCKET socket (not available on all platforms) UNKNOWN unknown file type, possibly a LINK or SOCKET on platforms where the UNIX stat() function cannot determine the type; that is, where S_ISLINK or S_ISSOCK are undefined.

Description

The file() function returns the last modification time of file filename as the number of seconds since midnight, January 1, 1970. If the file does not exist, the file() function returns the NULL string. This function is useful for testing the existence of a file.

NOTE 1 – The file() function return values depend on the operating system and in some cases the file system. Some non-UNIX platforms may not return all return values or may return one or more meaningless return values. For a specific platform, the file() function will generally return the same information as the C-programming language stat() function.

The user does not need permission to read the file but does require search permission on each directory in the path name leading to *filename*. If the user does not have such permission, the file() function fails and returns the NULL string.

The value of *dummy* is ignored, but its presence causes the file() function to return a more detailed string of information.

Examples

The following examples highlight the usage of the file() function.

Print Last Modification Date of the UNIX System Password File

```
printf(“%s”,asctime(file("/etc/passwd")));
# modification time
```

Test for the Existence of a File

```
if (file("some_file"))
{
    printf("File exits!");
}
else
{
    printf("File does not exist.");
}
```

floor()

Return the largest integer that is not larger than the argument.

Format

floor(*argument*)

Parameter

Parameter	Definition
argument	Numeric argument whose greatest integer lower bound is to be determined

Description

The floor() function returns the largest integer that is not greater than *argument*; that is, the greatest integer lower bound for *argument*.

The floor() function and the ceil() function together bracket *argument* such that the following are true:

If *argument* is an integer: ceil(*argument*) = *argument* = floor(*argument*)

If *argument* is not an integer: floor(*argument*) < *argument* < ceil(*argument*) and ceil(*argument*) = floor(*argument*) + 1

fmod()

Return the floating point remainder of a division operation.

Format

fmod(*dividend,divisor*)

Parameters

Parameter	Definition
dividend	The floating point value whose remainder will be returned after being divided by *divisor*
divisor	The floating point value that will divide *dividend*

Description

The fmod() function returns the floating point remainder of the division (*dividend*)/(*divisor*).

fopen()

Open a SMSL channel to a file.

Format

fopen(*filename,mode*)

Parameters

Parameter	Definition
filename	Name of the file to which the SMSL channel should be opened
mode	The file access mode. Valid ranges: r Open for read w Truncate to zero length for write or create file for write a Open for append to end of file or create for write rb Open binary file for read wb Truncate binary file to zero length for write or create binary file for write ab Open binary file for append at end of file or create binary file for write r+ Open for read and write (*update*) w+ Truncate to zero length for read and write or create for read and write a+ Open for read and write at end of file or create file for read and write r+b Open binary file for read and write (*update*) w+b Truncate binary file to zero length for read and write or create binary file for read and write a+b Open binary file for read and write at end of file or create binary file for read and write

Description

The fopen() function opens a channel to filename that provides the access to filename from within a SMSL process. The read(), write(), get_chan_info(), share(), and close() functions apply to channels that have been opened to files.

When supported by the underlying operating system, the fopen() function performs security checks to determine whether the user name of the calling process has permission for the request.

If the fopen() function is successful, it returns the SMSL channel number to filename. A failure to open filename, such as an operating system problem or invalid mode, sets the SMSL errno value and causes the fopen() function returns the NULL string without attempting to open the file.

Support for binary file access

The fopen() function permits binary modes with a b character though there is no way within a SMSL process to write any form of binary data other than character strings.

Flush a file after each SMSL file operation

The SMSL functions ensure that a file is flushed after every operation so that the well-known bug of doing a write-then-read or read-then-write without an intervening fseek rewind or fflush does not occur in SMSL file operations.

fseek()

Set the file position indicator.

Format

fseek(*channel,offset,whence*)

Parameters

Parameter	Definition
channel	The file I/O channel returned when the file was opened by the fopen() function
offset	Number of bytes to be added to whence to obtain the file position
whence	Standard point within a file to which offset is added to obtain the new file position Valid range: One of the following integer values: 0 SEEK_SET, the beginning of the file 1 SEEK_CURR, the current file position 2 SEEK_END, the end of the file

Description

The fseek() function sets the filename position indicator to the whence position plus offset bytes. If whence is invalid, the fseek() function defaults to whence = 0 and raises a run-time error but completes the file seek operation.

NOTE 2 – Issuing the fseek() function against binary files with whence = 2 (SEEK_END) is not meaningfully supported on all platforms.

The fseek() function returns 0 for success and –1 for failure. For an invalid channel, that is, for a pipe channel instead of a file channel, the fseek() function returns –1, raises a run-time error and sets the SMSL errno variable.

fseek and append file mode

Using the fseek() function to change the file position indicator in a file opened in append mode; that is, modes a, ab or a+ will not prevent writes to the end of the file using the write() function.

Example

SMSL contains no equivalent to the C-rewind() function, but the following fseek() function example is the equivalent of the C-function rewind(*channel*):

```
fseek(channel,0,0);
```

ftell()

Return the file position indicator.

Format

ftell(*channel*)

Parameter

Parameter	Definition
channel	The file I/O channel returned when the file was opened by the fopen() function

Description

The ftell() function returns the file position indicator as the integer number of bytes from the beginning of the file. For an invalid channel, that is, a pipe channel instead of a file channel, the ftell() function returns –1, raises a run-time error, and sets the SMSL errno variable.

The typical result of both the C and SMSL versions of the ftell() function is the number of characters written to or read from a file, except on those platforms that perform CR/LF Û new-line conversions on text files. However, the value of the ftell() function after executing an fseek() function to the end of file is usually the total number of characters in the file.

The following SMSL functions change the file position indicator:

- fopen();
- fseek();
- read();
- readln();
- write().

The get_chan_info() function does not change the file position indicator. The close() function makes *channel* invalid.

full_discovery()

Verify that the process is currently in a full discovery cycle.

Format

full_discovery()

Description

The full_discovery() function returns TRUE if the SMSL script containing it is an application discovery script and it is currently in a full discovery cycle. Otherwise, the full_discovery() function returns FALSE.

A full discovery cycle is done after the agent's process cache is refreshed. This flag therefore indicates whether the process cache has been refreshed since the last time the script was executed.

Example

The following example tests whether the SMSL script is in a full discovery cycle and exits the script if it is not.

```
# If we are not in a full discovery cycle
# we can exit immediately
if (!full_discovery())
{
    exit;
}
```

get()

Return the current value of a variable.

Format

get(*variable*)

Parameter

Parameter	Definition
variable	Name of the variable whose current value will be returned

Description

The get() function returns the current value of variable. If *variable* is a relative name and does not exist in the context of the SMSL script, the get() function successively searches each ancestor's context until *variable* is found or until the search fails in the context of the computer.

Example

The following example returns the current status of RDB database Dev.

```
get ("/RDB/Dev/status");
```

get_chan_info()

Return status information from a SMSL file or process channel.

Format

get_chan_info(*channel*,*flags*)

Parameters

Parameter	Definition
channel	Channel name (shared channels) or number (local channels) whose status should be reported or "" indicating all channels should be reported (subject to flags control)
flags	Integer value representing two binary flags that controls the output of global and local channel information as follows: 1 global channels only 2 local channels only 3 both global and local channels Default if not specified: 1

Description

The get_chan_info() function returns channel information a string with the format

name status details type scope read_pid read_name write_pid write_name

Specifying:

get_chan_info("");

causes the get_chan_info() function to return descriptions for all global shared channels. The descriptions are formatted as a new-line separated list, one line per channel.

Field definition

name One of the following:

- scope=SHARED – Channel name.
- scope=LOCAL – Local channel number.
- scope="" – All shared and local channels.

status OPEN or CLOSED

details One of the following:

- fopen() channel – File name that is opened or NONE if no file name is open;
- popen() channel – Process ID of the external operating system process to which the channel is attached; or
- –1 if the process has terminated.

type PIPE or FILE

scope SHARED or LOCAL

read_pid One of the following:

- Process ID of the SMSL process waiting to read from the channel.
- –1 if no process is waiting.

read_name One of the following:

- Name of the process waiting to read from the channel.
- NONE if no process is waiting.
- UNAVAILABLE if there is a process but the name is not available.

write_pid One of the following:

- Process ID of the SMSL process waiting to write to the channel.
- –1 if no process is waiting.

write_name One of the following:

- Name of the process waiting to write to the channel.
- NONE if no process is waiting.
- UNAVAILABLE if there is a process but the name is not available.

Specifying

get_chan_info("",flags);

causes the get_chan_info() function to return all the local or global channels for the current SMSL process as controlled by the value of flags. Note that the following get_chan_info() functions are equivalent, for both return the list of global channels:

get_chan_info("");

get_chan_info("",1);

The get_chan_info() function produces a run-time warning if flags is non-numeric or not greater than zero, but the SMSL variable errno is not set to any value. The SMSL interpreter ignores flags without error if channel is not the empty string.

The get_chan_info() function returns all the fields for each channel even if they do not apply to the particular channel.

The get_chan_info() function returns the NULL string if:

- there are no global shared and/or local channels for the given value of flags;
- it receives a bad channel number or name.

In this case, the get_chan_info() function also sets the SMSL errno variable.

getenv()

Return the string value of a SMSL environment variable.

Format

getenv(*variable*)

Parameter

Parameter	Definition
variable	Name of the object whose value is to be returned

Description

The getenv() function returns the string value of variable in the environment of the SMSL script. The variable value can be returned from any of the following places:

- the parameter's defined environment variables;
- the application's defined environment variables;
- the computer's defined environment;
- the environment of the Agent at the start of its execution.

The getenv() function searches the environment tables in stated order and returns the value of the first matching variable. The getenv() function returns the NULL string if variable is not defined and sets the SMSL errno variable to a non-zero value. If the getenv() function is successful, it returns the value of variable and sets the SMSL errno variable to zero. Hence, you can use errno to distinguish an undefined variable from one that is set to the NULL string.

Example

This SMSL example presents a function that tests whether an environment variable exists.

```
function is_environment_var_defined(name)
{
    getenv(name); # Throw away return value of getenv
    return (errno == 0); # errno is only zero if name is defined
}
```

get_vars()

Return the list of variables for a SMSL object.

Format

get_vars(*object,showchildren*)

Parameters

Parameter	Definition
object	Optional name of the object whose variables are to be listed Default if not specified: Current object
showchildren	Optional flag whose non-zero value indicates get_vars() should also list the subobjects of object. Default if not specified: 0

Description

The get_vars() function returns a list of the variables of object or for the current object if object is omitted. The get_vars() function returns the NULL string if object does not exist.

The list of object variables is sorted in ascending alphabetical order.

grep()

Return the lines from a text block that match a regular expression.

Format

grep(*regular_expression,text,v*)

Parameters

Parameter	Definition
regular_expression	Character sequence that defines the pattern that the grep function searches for in text. *regular_expression* conforms to the regular expressions defined in the UNIX ed(1) command and the UNIX regexp(5) description. Following is a brief summary of several regular expression characters: ^ beginning of line \< beginning of a word $ end of line \> end of a word . match any single character * match zero or more repetitions of the preceding [] match any of the characters contained within [^] match any characters except those contained within.
text	Text to be searched for matches to regular_expression. text can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
v	The character v reverses the output of the grep() function, causing the grep() function to output all lines in text that do not contain a match for regular_expression. This flag is similar to the UNIX grep -v flag.

Description

The grep() function returns a list of the lines in text that match *regular_expression*.

If a character other than v is submitted as the grep() function reverse matching flag, the SMSL interpreter returns a run-time error message.

Example

```
# search for "martin" substring in /etc/passwd
all_lines=cat("/etc/passwd");
# fill a buffer with passwd
matching_lines=grep("martin",all_lines);
```

history()

Return history information from the history database.

Format

history(*parameter,format,number*)

Parameters

Parameter	Definition
parameter	Name of the object whose history should be returned. The expression "" indicates the current parameter. parameter can be: the absolute path, such as "/APP/INST/PARAM" a relative path, such as "." or "../DIFFERENTINST/PARAM". parameter can be "" or "." for the current parameter's history. Default if not specified: Current parameter
format	Optional character string inside double quotation marks that specifies the format of each history() function entry. Valid Values: n return the number of available data points as the first value in the return list t include the time stamp of each entry in the return list v include the value of each history entry in the return list Default if not specified: ntv
number	Optional numeric value that limits the number of entries the history function will return. Default if not specified: 50

Description

The history() function accesses the parameter history database and returns a list containing the number of data points available followed by a number of entries.

The history() function returns the empty string, produces a run-time error, and sets the SMSL errno variable if a bad format character is provided.

Because of the defaults provided in the history() function, the following function specifications are equivalent:

```
history(parameter)
history(parameter,"ntv",50)
```

History output format

The history() function will return any of the following formats, depending on which format flags are set:

- *number_entries*\n if the n flag is set;
- value\n, time\n, or value time\n if the v, t, and vt flags are set.

The history() function separates the values of an entry with spaces and successive entries with new-line characters.

You can use the nthline(list1) function to get the number of points from the head of the list and also to extract the entries. Entries can be split if necessary into time and data values using the ntharg() function. The entries will be single values if either the t or v flag is absent.

index()

Return the starting position of one string within another.

Format

index(*text,string*)

Parameters

Parameter	Definition
text	Text to be searched for the occurrence of string. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
string	One or more characters enclosed in double quotation marks that are to be located within text

Description

The index() function returns the position in text at which string begins, or 0 if string does not occur in text. The first position in text is position 1.

int()

Return the largest integer that is not greater than the argument.

Format

int(*number*)

Parameter

Parameter	Definition
number	Numeric value or numeric variable

Description

The int() function returns the largest integer that is not greater than *number*.

internal()

Process a command internal to the Agent.

Format

internal(*command*)

Parameter

Parameter	Definition
command	Text string that is the command the Agent should process.

Description

The internal() function causes the Agent to process the string command internally and in a platform-specific manner. The internal() function returns the command output if successful. If unsuccessful or if the command is not supported on the specific platform, the internal() function returns the NULL string and sets the SMSL variable errno to E_SMSL_NOT_SUPPORTED.

The internal() function is designed to be used for user and process monitoring and resource inquires that can be handled inside the Agent. In these cases, the internal() function is much more efficient than invoking a separate command that requires a call to the SMSL interpreter or some other command processor.

intersection()

Return a list containing elements that are common to all specified lists.

Format

intersection(*list1,list2,list3list4 . . . listn*)

Parameters

Parameter	Definition
list1 . . . listn	Two or more SMSL lists that are being evaluated for common elements

Description

The intersection() function returns a SMSL list containing the elements that appear in all the lists *list1 . . . listn.*

The returned list is not well-defined and will contain duplicates if duplicates were present in all lists in the same number and order. The elements in the list returned by the intersection function appear in the same order as they were in list1.

If any lists are the NULL list, the return value is the NULL list; otherwise all entries in the returned list are terminated by a new-line character.

isnumber()

Verify that a string is a valid numeric representation.

Format

isnumber(*string*)

Parameter

Parameter	Definition
string	String that is to be evaluated as meeting the criteria for a numeric expression

Description

The isnumber() function returns a Boolean value of 1 if variable is a string that is considered valid as a number or “0” if it is not.

A valid number has only digits, periods, or minus signs for every character in variable. White space or any other invalid character anywhere in the string causes the isnumber() function to return 0. The isnumber() function returns 0 for the NULL string.

is_var()

Verify that a SMSL object variable exists.

Format

is_var(*object*)

Parameter

Parameter	Definition
object	Name of the object that is to be verified as a variable

Description

The is_var() function returns TRUE if object exists and is a variable. The is_var() function returns FALSE if:

- object does not exist;
- object exists but is not a variable (that is, it is an application instance or a parameter).

length()

Return the number of characters in a string.

Format

length(*text*)

Parameter

Parameter	Definition
text	Text to be counted for character length. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.

Description

The length() function returns the length in characters of text, including new lines.

lines()

Return the number of lines in a string.

Format

lines(*text*)

Parameter

Parameter	Definition
text	Text to be counted for number of lines (that is, new-line characters). text can be the name of a text file, a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.

Description

The lines() function returns the number of new-line characters in text. The lines() function is useful for returning the length of a list because the items in a list are delimited by new lines.

lock()

Acquire a SMSL process lock.

Format

lock(*lockname*,*mode*,*timeout*)

Parameters

Parameter	Definition
lockname	Name of the lock that should be acquired
mode	Optional control permitted under the lock. Valid range: s shared r reader w writer x exclusive Default if not specified: x If the first letter of mode is not s, r, w, or x a run-time error occurs and mode defaults to x (exclusive).
timeout	Optional integer value that specifies the number of seconds before the lock request expires. Valid range: timeout > 0 is the integer number of seconds the lock request is valid. timeout = 0 means non-blocking lock request timeout < 0 means infinite timeout period (that is, wait until the lock is released) Default if not specified: Infinite timeout

Description

The lock() function requests a lock with name *lockname*. The mode of the request specifies either shared (*reader*) or exclusive (*writer*) access under the lock. The optional timeout specifies the number of seconds the request is valid.

The default behaviour of lock() function is to request an exclusive lock with an infinite timeout period. The lock() function returns 1 for success and 0 for failure.

Locks and SMSL

Lock names are global to the Agent; thus:

- all SMSL processes share the same table of locks;
- different SMSL processes can share parameter lock names to perform concurrent actions.

There is no way to enforce lock naming scope. It is recommended that lock names in SMSL programs be uniquely encoded using the name of the application. This practice will avoid potential clashes with other SMSL programs.

Shared lock requests

Shared lock requests for a lock that is currently in share mode are granted – unless there is a waiting write request. Giving priority to a waiting write request prevents the lock mechanism from starving write processes.

Requests for locks already held

It is possible to request a lock that you already hold although it is not good style:

- requesting a lock that you already hold is ignored;
- requesting a shared lock on a lock you already hold with exclusive access is also ignored.

Requesting an upgrade to exclusive access of a lock currently held as shared succeeds and upgrades the lock provided you are the only process that is using the shared lock. If you are not the only process using the lock, the lock() function immediately returns 0 in non-blocking mode (regardless of the value of timeout because blocking would cause immediate deadlock by waiting for yourself!).

Rather than using this upgrade feature, it is recommended that you call the unlock() function to release the shared lock before attempting to acquire the new exclusive lock. Lock tracing is possible using the SMSLDebug variable. SMSLDebug can be useful in debugging multiprocess lock interactions.

Failure of the lock function

The lock() function can fail if:

- a non-blocking request fails;
- timeout is exceeded before the lock is granted.

The lock() function can fail for an infinite timeout if:

- a special-case upgrade request is granted;
- the system has performed some external deadlock correction.

loge()

Return the natural logarithm of the argument.

Format

loge(*argument*)

Parameter

Parameter	Definition
argument	Numeric value whose natural logarithm is to be determined. Valid range: argument > 0

Description

The loge() function returns the logarithm of argument with respect to the natural logarithm base e = 2.71828 . . . The output range for the loge() function is $-\infty < \text{loge}() < \infty$.

log10()

Return the logarithm to base 10 of the argument.

Format

log10(*argument*)

Parameter

Parameter	Definition
argument	Numeric value whose base 10 logarithm is to be determined. Valid range: argument > 0

Description

The log10() function returns the logarithm of argument with respect to base 10.

The output range for the log10() function is $-\infty < \log10() < \infty$.

ntharg()

Return a formatted list containing fields from a text string.

Format

ntharg(*text,arguments,delimiters,separator*)

Parameters

Parameter	Definition
text	Text to be separated into fields by the ntharg() function. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
arguments	Integer list specifying the field numbers ntharg() should look for in each line of text. Fields are specified as follows: *x,y* field x and field y x-y all fields from x to y inclusive -x all fields from 1 to x inclusive x- all fields from x to the new-line character inclusive
delimiters	One or more characters that ntharg() should treat as field separators when examining text. Default if not specified: space and \t (*tab*)
separator	Optional character that should be placed between each field of ntharg() output Default if not specified: new-line character ()

Description

The ntharg() function returns the arguments in text.

The ntharg() function normally interprets each line in text as a white space-separated (space or tab) list of fields. If delimiters is given, it specifies the list of characters that ntharg() should treat as field separators. The ntharg() function normally returns selected fields as a new-line delimited list. If separator is given, it specifies the delimiter to be placed between items in the returned list.

NOTE 3 – The difference between the ntharg() function and the nthargf() function is as follows:

- The ntharg() function treats each delimiter that follows a non-delimiter character as the end of a field. The ntharg() function interprets two or more adjacent delimiters as a single delimiter.
- The nthargf() function treats each delimiter as the end of a field. The nthargf() function interprets two or more adjacent delimiters as delimiting one or more NULL strings whose content can be requested and returned.

Example

The following example prints the login name and home directory of each user listed in the UNIX system password file.

```
 foreach user (cat("/etc/passwd"))
{
    printf(ntharg(user,"1,6",":","\t"),"\n");
}
```

nthargf()

Return a formatted string containing fields from a text string.

Format

nthargf(*text,arguments,delimiters,separator*)

Parameters

Parameter	Definition
text	Text to be separated into fields by the nthargf() function. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
arguments	Integer list specifying the field numbers nthargf() should look for in each line of text. Fields are specified as follows: *x,y* field x and field y x-y all fields from x to y inclusive -x all fields from 1 to x inclusive x- all fields from x to the new-line character inclusive
delimiters	One or more characters that nthargf() should treat as field separators when examining text. The nthargf() function treats each occurrence of delimiters as delimiting a field. The nthargf() function interprets two or more adjacent delimiters as delimiting one or more NULL fields. Default if not specified: space and \t (*tab*)
separator	Optional character that should be placed between each field of nthargf() output Default if not specified: new-line character ()

Description

The nthargf() function returns the arguments in text.

The nthargf() function normally interprets each line in text as a white space-separated (space or tab) list of fields. If delimiters is given, it specifies the list of characters that nthargf() should treat as field separators. The nthargf() function normally returns selected fields as a new-line delimited list. If separator is given, it specifies the delimiter to be placed between items in the returned list.

NOTE 4 – The difference between the nthargf() function and the ntharg() function is as follows:

- The nthargf() function treats each delimiter as the end of a field. The nthargf() function interprets two or more adjacent delimiters as delimiting one or more NULL strings whose content can be requested and returned.
- The ntharg() function treats each delimiter that follows a non-delimiter character as the end of a field. The ntharg() function interprets two or more adjacent delimiters as a single delimiter.

nthline()

Return specified lines from a text string.

Format

nthline(*text,lines,separator*)

Parameters

Parameter	Definition
text	Text to be separated into lines by the nthline() function. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
lines	Integer list specifying the line numbers nthline() should look for in text. Lines are specified as follows: *x,y* line x and line y x-y all lines from x to y inclusive -x all lines from 1 to x inclusive x- all lines from x to EOF character inclusive
separator	Optional character that should be placed between each field of nthline() output Default if not specified: new-line character ()

Description

The nthline() function returns the lines of text separated by new-line characters. If you specify a separator, the nthline() function will use separator to separate lines.

NOTE 5 – The difference between the nthlinef() and nthline() functions is as follows:

- The nthlinef() function treats each new-line character as a line.
- The nthline() function treats only a non-empty line (that is, a line with a non-new-line character preceding a new-line character) as a line.

Example

The following SMSL script prints the top five processes executing on a UNIX system.

```
# print the top five processes
printf(“%s”, nthline(system("ps -eaf"),"2-6"));
```

nthlinef()

Return specified lines from a text string.

Format

nthlinef(text,lines,separator)

Parameters

Parameter	Definition
text	Text to be separated into lines by the nthlinef() function. *text* can be a text string enclosed in double quotes, or one or more SMSL commands that produce text as output.
lines	Integer list specifying the line numbers nthlinef() should look for in text. Lines are specified as follows: *x,y* line x and line y, *x-y* all lines from x to y inclusive, *-x* all lines from 1 to x inclusive, *x-* all lines from x to EOF character inclusive
separator	Optional character that should be placed between each field of nthlinef() output Default if not specified: new-line character ()

nthlinef()

Return specified lines from a text string.

Format

nthlinef(text,lines,separator)

Parameters

Parameter	Definition
text	Text to be separated into lines by the nthlinef() function. *text* can be a text string enclosed in double quotes, or one or more SMSL commands that produce text as output.
lines	List specifying the line numbers nthlinef() should look for in text. Lines are specified as follows: *x,y* line x and line y, x-y all lines from x to y inclusive, -x all lines from 1 to x inclusive, x- all lines from x to EOF character inclusive Integer
separator	Optional character that should be placed between each field of nthlinef() output Default if not specified: new-line character ()

Description

The nthlinef() function returns the lines of text separated by new-line characters. If you specify a separator, the nthlinef() function will use separator to separate lines.

NOTE 6 – The difference between the nthlinef() and nthline() functions is as follows:

- The nthlinef() function treats each new-line character as a line.
- The nthline() function treats only a non-empty line (that is, a line with a non-new-line character preceding a new-line character) as a line.

It is recommended that you use nthlinef() function to be consistent with other SMSL functions.

Example

The following SMSL script prints the top five processes executing on a UNIX system.

```
# print the top five processes
printf(“%s”,nthlinef(system("ps -eaf"),"2-6"));
```

popen()

Open a SMSL channel to a process.

Format

popen(*type,command,instance*)

Parameters

Parameter	Definition
type	Command processor that should interpret and execute command Valid range: The built-in command types OS or SMSL, or a valid user-defined command type
command	Syntax of the submitted command
instance	The application instance against which command should execute Default if not specified: The application instance that is the nearest ancestor of command.

Description

The popen() function spawns a process to execute a command of a defined type and returns a channel number which can then be used to read the command’s output or write messages to the command.

The popen() function returns –1 on error.

pow()

Raise a number to a power.

Format

pow(*base,exponent*)

Parameters

Parameter	Definition
base	Numeric value that is to multiplied by itself *exponent* number of times
exponent	Numeric value that indicates the number of times *base* should be multiplied by itself. *exponent* must be positive if *base* ≥0, and *exponent* must be an integer if base < 0.

Description

The pow() function returns the value of base raised to the power exponent, or base exponent.

The output range for the pow() function is $-\infty < pow() < \infty$.

printf()

Print text formatted to the C-library printf() routine specification.

Format

printf(*format*)

Parameter

Parameter	Definition
format	Text, variable names, and control characters that specify the content and format of output to the computer or task output window. format permits the following conversion characters: %d signed decimal (identical to %i) %i signed decimal (identical to %d) %u unsigned decimal %o unsigned octal %x unsigned hexadecimal using abcedf %X unsigned decimal using ABCDEF %c unsigned character %s character string %e double precision form drddde±ddd where each d is a digit and r is the radix character %E double precision form drdddE±ddd where each d is a digit and r is the radix character %f decimal notation form dddrddd where each d is a digit and r is the radix character %g print in the style of %e if the exponent after conversion is less than –4, else print in style %f %G print in the style of %E with the precision specifying the number of significant digits %N Group digits into threes and separate with commas beginning at the right of the string %% print a % character format does not support the standard C-pointer conversion characters %p and %n. format permits the following flags: left-justify and pad on the right with spaces + display plus sign when value is grater than zero 0 pad with zeros if no other padding is specified # alters the meaning of a conversion: appends 0x or 0X to the %x and %X conversions always appends the radix character to the %e, %E, %f, %g, and %G conversions retains trailing zeros in the %g and %G conversions The # flag does not affect the %c, %d, %s, or %i conversions

Description

The printf() function displays output to the computer or task output window using formatting similar to the standard C-printf() function.

A bad format or one that is valid for the C language but not for the printf() function results in a SMSL run-time error that sets the SMSL errno variable.

The printf() function return value is always the null string.

C conventions not supported by the SMSL printf function

The printf() function does not support the C convention of using the asterisk (*) as a field width or precision indicator. The printf() function does not support the %p and %n conversion characters.

The length modifiers h, l (*ell*), and L are not valid and are ignored by the printf function.

The printf() function format conversions are passed directly to the C-library printf() routine on each platform. The output for obscure formatting features may differ across platforms.

Conversion differences between the C printf routine and SMSL printf function

The format conversions have the same meaning between standard C and SMSL, but the concept of variable types differs between the two.

SMSL supports only string types for its variables, and thus string arguments to the printf() function are converted in a manner appropriate for the format conversion:

- Integral formats such as %d convert the string to signed integers.
- Non-integer numeric formats such as %f convert to floating point values.

- %c prints the ASCII equivalent of its integer argument or for non-numeric arguments the first character of its argument. (Applying %c to “65” will print ‘A’ and to “AB” will print ‘A’.)
- %s causes no conversion.
- %% requires no argument.

The %N Format Conversion

The printf() function provides one non-standard C extension – the %N conversion. The %N conversion preprocesses a numeric string so that commas separate each group of three digits beginning at the right side of the string.

For example, the %N conversion causes the following conversions:

$$1234 \Rightarrow 1{,}234 \quad 12345 \Rightarrow 12{,}345 \quad 123456 \Rightarrow 123{,}456$$

The %N conversions ignores initial minus signs and blanks while searching for the first sequence of digits so that %N can be applied to negative values. If no digits are found after the skipped characters, the printed argument is unchanged.

The %N conversion only modifies the first sequence of digits. For example, the %N conversion changes floating point numbers like 1234.1234 to become 1,234.1234 without changing to the digit sequence to the right of the decimal point.

As part of the %N conversion, the printf() function performs a %s conversion using the field width and precision specifiers supplied in format. The printf() function prints the string resulting from the combined %N and %s conversions. Because of the embedded %s conversion, field width and precision under %N conversion have the same effect as with %s.

NOTE 7 – Currently, no localization is supported by %N, and so the formatting achieved by %N does not change in different locales.

proc_exists()

Verify that a process exists.

Format

proc_exists(*pid*)

Parameter

Parameter	Definition
pid	Process identifier number of the process whose existence is being verified

Description

The proc_exists() function returns TRUE if the process with process identifier pid exists; FALSE if it does not.

process()

Return a list of processes from the Agent process cache.

Format

process(*regular_expression*)

Parameter

Parameter	Definition
regular_expression	Character sequence that defines the pattern the process() function searches for in the Agent process cache. *regular_expression* conforms to the regular expressions defined in the UNIX ed(1) command description and the UNIX regexp(5) description. Following is a brief summary of several regular expression characters: ^ beginning of line \< beginning of a word $ end of line \> end of a word . match any single character * match zero or more repetitions of the preceding [] match any of the characters contained within [^] match any characters except those contained within

Description

The process() function returns the list of processes in the Agent's process cache that match the regular expression regular_expression. Each entry in the list is a string formatted as follows:

pid ppid user status size cputime *command_name command_line*

NOTE 8 – Some platforms do not support all the return values. For a specific platform, the process() function generally returns the same information as the ps command. The process() function returns the NULL string if no processes match regular_expression.

Example

The following SMSL commands list all ORACLE database process daemons.

```
# find ORACLE database daemons
ora_procs = process("ora_");
printf ("%d", ora_procs);
```

Parameter

Parameter	Definition
pid	Process identifier number
ppid	Parent process identifier number
user	User name to which the process belongs
status	Process status within the system. Valid range: 0 Non-existent S Sleeping W Waiting R Running I Intermediate Z Terminated T Stopped X Growing
size	Process core image size (in blocks)
cputime	Integer number of CPU seconds consumed by the process
command_name	First word of the command line that started the process
command_line	Complete command line that started the process. Note that the command line may have been modified during process execution.

random()

Return a random number.

Format

random(*maximum*)

Parameter

Parameter	Definition
maximum	Valid range: maximum > 0 Default if not specified: maximum = $2^{32} - 1$ (from the underlying C function)

Description

The random() function is equivalent to the standard C-library random() function.

If maximum is zero or negative, the random() function will return a run-time error message. Optional upper bound for the values returned by random:

$$0 \leq \text{random}() \leq \text{maximum} - 1$$

read()

Read from a SMSL file or process channel.

Format

read(*channel,size*)

Parameters

Parameter	Definition
channel	The process I/O channel number from which the read() function is to read data
size	Integer value controlling the amount of data that the read() function will read from channel. Valid Range: size > 0 instructs the read() function to read at least size bytes and return size = 0 instructs the read() function to return as soon as it has read something from the channel size = –1 instructs the read() function to read all data available from the channel and return Default if not specified: size = 0

Description

The read() function returns the data it reads from channel. The read() function returns the value EOF (that is, the NULL string) on an end-of-file or error condition.

Channels are created by calling the fopen() or popen() function.

NOTE 9 – The read function can block for a process channel created using the popen() function but not for a file channel created using the fopen() function.

To enforce serialization for shared channels, no two reader processes (that is, read() or readln() functions) can be blocked on the same channel. The second reader process that attempts to block on the shared channel will fail, returning the NULL string and setting the SMSL variable errno to E_SMSL_BUSY_CHANNEL.

Another possible shared channel failure can be caused by a close() function being executed against a channel that also has a blocked reader process. The close() function will cause the reader process to return the NULL string and set errno to E_SMSL_UNBLOCKED_BY_CLOSE.

Example

The following SMSL example opens a channel to the UNIX operating system, executes a UNIX ls command, then reads and prints the directory entries returned by the ls command.

```
chan = popen ("OS", "ls");
while ((data = read (chan)) ! = EOF)
{
    printf("%s", data);
}
close (chan);
```

readln()

Read a line of data from a SMSL file or process channel.

Format

readln(*channel*)

Parameter

Parameter	Definition
channel	The process I/O channel number from which the readln function is to read data

Description

The readln() function reads the next line of data from channel and returns it. The readln() function returns the value EOF (NULL) on end-of-file or error.

Channels are created by calling the fopen() or popen() function. Note The readln() function can block for a pipe channel created using the popen() function but not for a file channel created using the fopen() function.

To enforce serialization for shared channels, no two reader processes (that is, read() or readln() functions) can be blocked on the same channel. The second reader process that attempts to block on the shared channel will fail, returning the NULL string and setting the SMSL variable errno to E_SMSL_BUSY_CHANNEL.

Another possible shared channel failure can be caused by a close() function being executed against a channel that also has a blocked reader process. The close() function will cause the reader process to return the NULL string and set errno to E_SMSL_UNBLOCKED_BY_CLOSE.

Limitation

The readln() function has a line limitation of 4K when executed against files opened with the fopen() function. The readln() function may truncate lines longer than 4K. This limitation does not apply to channels opened using the popen() function.

rindex()

Return the last occurrence of one text string within another.

Format

rindex(*text,string*)

Parameter

Parameter	Definition
text	Text to be examined for occurrences of string. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
string	One or more characters whose last occurrence is being identified within text

Description

The rindex() function returns the position of the last occurrence of string in text or 0 if string does not occur in text. Positions in string are numbered starting from one.

set()

Assign a value to a variable.

Format

set(*variable,value*)

Parameters

Parameter	Definition
variable	The name of a variable in the Agent object hierarchy to which value is assigned
value	The numeric or string value that is assigned to variable

Description

The set() function sets the value of variable to be value. If variable is a relative name and does not exist in the context of the SMSL script, the set() function successively searches each ancestor's context until variable is found or until the search fails in the context of the computer.

The set() function returns value if the assignment is successful, the NULL string if it is not.

Example

The following SMSL statement sets the value of RDB database Dev parameter MyParam to 10.

set("/RDB/Dev/MyParam/value",10);

share()

Convert a local channel into a shared global channel.

Format

share(*channel,name*)

Parameters

Parameter	Definition
channel	Process I/O channel number that was returned when the channel was opened using the fopen() or popen() function
name	Character string used to identify the shared channel in the table of global channels It is recommended that you specify a non-numeric name to avoid conflicts with numbers used internally for local channels. Using a number for name does not actually cause the share() function to fail but will raise a SMSL run-time warning. The share() function will dutifully place the specified numeric name in the global table, leading to potential conflicts with local channels in close(), read(), write(), and readln() functions.

Description

The share() function is the main function for using shared channels. The share() function propagates an existing local channel into the table of global channels as name. Channels opened by either the popen() or fopen() functions can be shared.

If the share() function is successful, it returns 0. The local channel is no longer available in the process that opened it and does not require a close() function. In fact, the close() function will return an error since it will not find the local channel.

The share() function will fail, returning –1 and setting the SMSL errno variable if:

- the local channel does not exist;
- the global channel name already exists in the global channel table.

Upon failure, the local channel is unchanged and still available. No global channel is added.

A global channel is referred to by name when passed to the read(), readln(), write(), and close() functions. These functions will first search the local channel table containing only channel numbers and then the global channel table.

sin()

Return the sine of the argument.

Format

sin(*radians*)

Parameter

Parameter	Definition
radians	Arc length in radians whose sine is to be determined Valid range: $-\infty \leq$ radians $\leq \infty$

Description

The sin() function returns the sine of radians. The output range for the sin() function is $-1 \leq \sin() \leq 1$.

sinh()

Return the hyperbolic sine of the argument.

Format

sinh(*argument*)

Parameter

Parameter	Definition
argument	Numeric value whose hyperbolic sine is to be determined Valid range: $-\infty \leq$ argument $\leq \infty$

Description

The sinh() function returns the hyperbolic sine of argument. The hyperbolic sine is defined by the expression:

$$\sinh(x) = (e^{x} - e^{-x})/2$$

where *e* is the base for the natural logarithms (e = 2.71828 . . .). The output range for the sinh() function is $-\infty \leq \sinh() \leq \infty$.

sleep()

Suspend process execution for a number of seconds.

Format

sleep(*seconds*)

Parameter

Parameter	Definition
seconds	Integer specifying the number of seconds the process should be suspended. Valid range: seconds > 0 is the number of seconds the process will sleep seconds ≤ 0 the timer expires immediately

Description

The sleep() function suspends a SMSL process for the specified number of seconds. While suspended, the SMSL process consumes no CPU resources and is not interpreted until awakened by the expiration of the seconds timer.

NOTE 10 – The sleep() function only suspends the process that calls it. All other SMSL processes continue normal execution.

The sleep() function returns a run-time warning if seconds is non-numeric, in which case the timer defaults to zero.

sort()

Sort a list of numeric or alphabetic values.

Format

sort(*list,mode,position*)

Parameters

Parameter	Definition
list	SMSL list whose elements are to be sorted
mode	Optional character string specifying the sort order. Character string must be enclosed in double quotation marks. Valid Range: "n" ascending numeric order; "nr" descending numeric order; "" ascending alphabetic order; "r" descending alphabetic order Default if not specified: “” (ascending alphabetic)
position	Optional integer that specifies the character position within each element of list where sorting is to begin The first character of each list element is character 1. If the length of every element within list is less than position, the effect is the same as if all the elements of list were NULL elements. position does not truncate elements; it only ignores the first (position –1) characters for purposes of comparison. Default if not specified: 1

Description

The sort() function returns a sorted version of list that is ordered according to mode.

The sort() function does not merge duplicate entries in list: the returned list has the same number of members as list. The order in which duplicates are returned is not defined because it is not defined for the C-library qsort() function. This fact is relevant for the following cases:

- numeric sorting of strings with identical numeric prefix values but different non-numeric suffixes;
- any sorting mode in which position is larger than more than one element within list (the sort() function regards all such elements as duplicate NULL elements).

If list is the NULL list, the sort function returns the NULL list. For a non-empty list, the sort() function always returns a well-defined list with the last line properly terminated by a new-line character.

NOTE 11 – List need not be terminated by a new-line character. Numeric sorting is based on floating point values; non-numeric list entries are converted according to the system's standard C-library function atof().

sprintf()

Return the specified format as a character string to a destination.

Format

sprintf(*format*)

Parameter

Parameter	Definition
format	Text, variable names, and control characters that specify the content and format of the character string output to the computer or task output window Format permits the following conversion characters: %d signed decimal (identical to %i) %i signed decimal (identical to %d) %u unsigned decimal %o unsigned octal %x unsigned hexadecimal using abcedf %X unsigned decimal using ABCDEF %c unsigned character %s character string %e double-precision form drddde±ddd where each d is a digit and r is the radix character %E double-precision form drdddE±ddd where each d is a digit and r is the radix character %f decimal notation form dddrddd where each d is a digit and r is the radix character %g print in the style of %e if the exponent after conversion is less than –4, else print in style %f %G print in the style of %E with the precision specifying the number of significant digits %N group digits into threes and separate with commas beginning at the right of the string %% print a % character format does not support the standard C-pointer conversion characters %p and %n. format permits the following flags: – left-justify and pad on the right with spaces + display plus sign when value is greater than zero 0 pad with zeros if no other padding is specified # alters the meaning of a conversion: appends 0x or 0X to the %x and %X conversions always appends the radix character to the %e, %E, %f, %g, and %G conversions retains trailing zeros in the %g and %G conversions The # flag does not affect the %c, %d, %s, or %i conversions.

Description

The sprintf() function is identical to the printf() function except that it returns the created string rather than outputting it. If there is an error in format, sprintf sets the SMSL errno variable and returns the NULL string.

The formats, conversions, and values of errno for the various errors are identical to those described for the printf() function.

C programmers should be careful to use the SMSL style:

destination=sprintf(*format*)

rather than the C style:

sprintf(*destination,format*)

The latter style will often cause a compilation warning about a null-effect statement.

C conventions not supported by the SMSL sprintf function

The sprintf() function does not support the C convention of using the asterisk (*) as a field width or precision indicator. The sprintf() function does not support the %p and %n conversion characters.

The length modifiers h, l (*ell*), and L are not valid and are ignored by the sprintf() function.

The sprintf() function format conversions are passed directly to the C-library sprintf() routine on each platform. The output for obscure formatting features may differ across platforms.

Conversion differences between the C-sprintf routine and SMSL sprintf function

The format conversions have the same meaning between standard C and SMSL, but the concept of variable types differs between the two.

SMSL supports only string types for its variables, and thus string arguments to the sprintf() function are converted in a manner appropriate for the format conversion:

- Integral formats such as %d convert the string to signed integers.
- Non-integer numeric formats such as %f convert to floating point values.
- %c prints the ASCII equivalent of its integer argument, or for non-numeric arguments, the first character of its argument. (Applying %c to "65" will print 'A' and to "AB" will print 'A'.)
- %s causes no conversion.
- %% requires no argument.

sqrt()

Return the square root of the argument.

Format

sqrt(*argument*)

Parameter

Parameter	Definition
argument	Numeric value whose mathematical square root is returned Valid range: $-\infty \leq$ argument $\leq \infty$

Description

The sqrt() function returns the square root of the positive integer or real value argument.

srandom()

Initialize the random number generator with a seed value.

Format

srandom(*seed*)

Parameter

Parameter	Definition
seed	Numeric value used as a starting point for pseudorandom number generation by the random() function

Description

The srandom() function sets the random number seed for the random() function. *seed* is passed directly to the UNIX C srandom() function.

The SMSL srandom() function always returns the NULL string.

subset()

Verify that one SMSL list is a subset of another.

Format

subset(*set,subset*)

Parameters

Parameter	Definition
set	SMSL list, that is the set in the set-subset verification
subset	SMSL list, that is the subset in the set-subset verification

Description

The subset() function returns a Boolean value of 0 or 1 indicating whether subset is a proper or improper subset of set. If subset is the NULL set, the subset() function returns 1 (TRUE). If set is the NULL set and subset is not, the subset() function returns 0 (FALSE).

The subset() function ignores duplicates and returns 1 only if all elements of subset are also present in set.

Example

The subset() function can be used to determine whether a particular element is present in a set and thus provides "is_member" functionality such as the following:

```
if (subset(my_set,"blue"))
{
        # SMSL set "my_set" contains element "blue"
}
```

It is not necessary to place a new line at the end of the "blue" string because it is inserted by the subset() function. The example statements are treated as a subset() function acting on a set with one element.

substr()

Return a specified portion of a string of characters.

Format

substr(*text,start,length*)

Parameters

Parameter	Definition
text	Text from which a substring of characters is to be returned. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
start	The character position within text that is to be the first character of the substring. The first character in text is character position 1.
length	The total number of characters from text to be returned in the substring

Description

The substr() function returns the substring of text of length characters that starts at position *start*.

system()

Submit a command to the computer operating system.

Format

system(*command,instance*)

Parameters

Parameter	Definition
command	Syntax of the submitted operating system command. *command* can contain output redirection, pipes, wild cards, and so on.
instance	Optional application instance against which command should execute Default if not specified: The application instance that is the nearest ancestor of command

Description

The system() function returns any output produced by submitting command to the system-dependent command execution subsystem.

tail()

Return the last lines from a text block.

Format

tail(*text,lines*)

Parameters

Parameter	Definition
text	Text whose last lines are to be returned by tail(). *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
lines	Number of lines of text to be returned, starting from the last line of text

Description

The tail() function returns the last lines number of lines of text.

tan()

Return the tangent of the argument.

Format

tan(*radians*)

Parameter

Parameter	Definition
radians	Arc length in radians whose tangent is to be determined Valid range: $-\infty \leq$ radians $\leq \infty$

Description

The tan() function returns the tangent of radians. The output range for the tan() function is $-\infty <$ tan() $< \infty$. The tan() function is undefined when radians = p(2n+1)/2 where n is an integer.

tanh()

Return the hyperbolic tangent of the argument.

Format

tanh(*argument*)

Parameter

Parameter	Definition
argument	Numeric value whose hyperbolic tangent is to be determined Valid range: $-\infty \leq$ argument $\leq \infty$

Description

The tanh() function returns the hyperbolic tangent of argument. The hyperbolic tangent is defined by the expression:

$$\tanh(x) = (e\ x - e\ -x\ )/(e\ x + e\ -x\ )$$

where e is the base for the natural logarithms (e = 2.71828 . . .). The output range for the tanh() function is $-1 \leq \tanh() \leq 1$.

time()

Return the number of seconds since 00:00:00 GMT January 1, 1970.

Format

time()

Description

The time() function returns the current time as the number of seconds that have elapsed since 00:00:00 GMT, Jan 01, 1970.

tmpnam()

Return a unique name for temporary file creation.

Format

tmpnam()

Description

The tmpnam() function returns a name that is guaranteed to be unique and can be used to pass to the fopen function for creating temporary files.

The semantics of the tmpnam() function are similar to that of the C tmpnam() routine – notably, a restricted number of unique names are returned by the tmpnam() routine as defined by the C-constant TMP_MAX. All SMSL processes on a given Agent share the same set of names, and there can be a danger of mixing names. If the size of TMP_MAX is a concern, add a suffix to the returned file name.

Example

The following example shows how to use the tmpnam() function to generate a temporary file name. The SMSL function adds a suffix to the returned name to further guarantee its uniqueness.

```
name = tmpnam() . ".dave"; fp = fopen(name, "w");
```

tolower()

Convert text to all lowercase characters.

Format

tolower(*text*)

Parameter

Parameter	Definition
text	Text that is to be returned as lowercase letters. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.

Description

The tolower() function returns a copy of text with all uppercase letters converted to lowercase letters.

toupper()

Convert text to all uppercase characters.

Format

toupper(*text*)

Parameter

Parameter	Definition
text	Text that is to be returned as uppercase letters. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.

Description

The toupper() function returns a copy of text with all lowercase letters converted to uppercase letters.

trim()

Remove unwanted characters from text.

Format

trim(*text*,*unwanted*)

Parameters

Parameter	Definition
text	Text to be returned without specified characters. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.
unwanted	One or more characters that are to be removed from the copy of text output by the trim function.

Description

The trim() function returns a copy of text with all occurrences of the characters in unwanted removed.

union()

Return a list that is the union of individual lists.

Format

union(*list1,list2,list3,list4 . . . listn*)

Parameters

Parameter	Definition
listn	SMSL list containing elements that shall be united and returned in a single well-defined list. Only the first two input lists, list1 and list2, are required; all others are optional.

Description

The union() function returns a SMSL list that contains the elements from all listn merged together. Unlike the difference() and intersection() functions, the list returned by the union function is a well-defined set without any duplicates. The union() function adds a new line to the end of every non-empty list that is missing one. If the return value is not the NULL list, the returned set is always terminated by a new line so that all set elements end with a new-line character.

unique()

Remove the duplicate elements from a list.

Format

unique(*list*)

Parameter

Parameter	Definition
list	SMSL list containing elements that shall be returned in a single well-defined (*unique*) list

Description

The unique() function returns a well-defined SMSL list with all duplicates removed. All elements that remain in the return value appear in the same order as they did in list. If list is the NULL list, the unique() function returns the NULL list; otherwise the unique() function returns a list that is terminated by a new-line character so that all list elements in the list end with a new-line character.

unlock()

Release a SMSL process lock.

Format

unlock(*lockname*)

Parameter

Parameter	Definition
lockname	Name of the lock that should be released

Description

The unlock() function releases *lockname* that was granted to this process by a previous call to the lock() function. The unlock() function returns 1 for success and 0 for failure. If no lock is named *lockname* or if it is not currently owned by this process, then the unlock() function reports a run-time error, sets the SMSL errno variable, and returns 0.

NOTE 12 – All locks held by a process are automatically released when the process exits in a manner similar to executing the unlock function. It is recommended that you release locks explicitly using the unlock() function rather than implicitly using the process exit. If this process is the only one holding the lock and processes are queued for it, the first waiting process is awakened and granted use of the lock. If the first process is a shared request, then any other processes that are queued for a shared lock are also granted shared access to the lock (except for processes that are behind a writer request on the queue for this lock).

write()

Write to a SMSL process or file channel.

Format

write(*chan*,*text*)

Parameters

Parameter	Definition
chan	Process I/O channel number to which *text* is written
text	Text to be written to channel *chan*. *text* can be a text string enclosed in double quotation marks, or one or more SMSL commands that produce text as output.

Description

The write() function writes text to channel chan. The write() function returns the number of characters written or –1 on error.

If text cannot be written immediately, the write() function call blocks until it can either write the whole of text or the channel terminates.

NOTE 13 – The write() function can block for a process channel created using the popen() function but not for a file channel created using the fopen() function.

To enforce serialization for shared channels, no two reader processes (that is, the read() or readln() functions) can be blocked on the same channel. The second reader process that attempts to block on the shared channel will fail, returning the NULL string and setting the SMSL variable errno to E_SMSL_BUSY_CHANNEL.

Another possible shared channel failure can be caused by a close() function being executed against a channel that also has a blocked reader process. The close() function will cause the reader process to return the NULL string and set errno to E_SMSL_UNBLOCKED_BY_CLOSE.

Annex H

MOCS proforma

(This annex forms an integral part of this Recommendation | International Standard)

This annex contains MOCS proforma for the subset of object classes defined in [X721] that is used for SDH management.

The following common notations, defined in Recommendation X.724 are used for the status columns:

- m Mandatory
- o Optional
- c Conditional
- x Prohibited
- – Not applicable or out of scope

Note that “c”, “m”, “o” and “x” are prefixed by a “c:” when nested under a conditional or optional item of the same table.

Note that “o” may be suffixed by “n” (where “n” is a unique number) for mutually exclusive or selectable options among a set of status values.

In the status column, the static requirements are stated as follows:

- m For characteristics contained in mandatory packages or in conditional packages if the GDMO condition is always true.
- o For characteristics of conditional packages with GDMO conditions that indicate static optionality, e.g. “if an instance supports it”.
- cn For all other conditions, where “n” is a unique integer and “cn” is a reference to a conditional status expression as defined in ITU-T Rec. X.291 | ISO/IEC 9646-2 and ITU-T Rec. X.296 | ISO/IEC 9646-7. Each condition denoted by “cn” is relative to the containing table.
- x For characteristics explicitly prohibited by the definition.
- – For characteristics that are not mentioned by the definition.

The following common notations, defined in ITU-T Rec. X.724 | ISO/IEC 10165-6 and Rec. X.296 | ISO/IEC 9646-7 are used for the support answer columns:

- Y Implemented
- N Not implemented
- – No answer required

The following abbreviations are used:

smi2AttributeID	{ joint-iso-itu-t ms(9) smi(3) part2(2) attribute(7) }
smi2MObjectClass	{ joint-iso-itu-t ms(9) smi(3) part2(2) managedObjectClass(3) }
smi2Notification	{ joint-iso-itu-t ms(9) smi(3) part2(2) notification(10) }

H.1 Statement of conformance to the basicSpawnerClass object class

Table H.1 – MOCS – Managed object class support

Index	Managed object class template label	Value of object identifier for class	Support of all mandatory features	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	basicSpawnerClass	{joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx1(1)}		

If the answer to the actual class question in the managed object class support Table H.1 is no, the supplier of the implementation shall fill in the actual class support in Table H.2.

Table H.2 – MOCS – Actual class support

Index	Actual managed object class template label	Value of object identifier for actual class	Additional information
1			
2			

H.1.1 Packages

The supplier of the implementation shall state whether or not the conditional packages specified by this class are supported by an instance of this class, in the "Support" and "Additional information" columns in Table H.3.

Table H.3 – MOCS – Package support

Index	Package template label	Value of object identifier for package	Constraints and values	Status	Support	Additional information
1	allomorphicPackage	{smi2Package 17}		c1		
2	packagesPackage	{smi2Package 16}		m		
c1: if not (H-1/1b) then m else –						

H.1.2 Attributes

The supplier of the implementation shall state whether or not the attributes specified by all packages instantiated in a managed object of this class are supported, in the "Support" and "Additional information" columns in Table H.4. The supplier of the implementation shall indicate support for each of the operations for each attribute supported.

Table H.4 – MOCS – Attribute support

				Set by create		Get		Replace	
Index	Attribute template label	Value of object identifier for attribute	Constraints and values	Status	Support	Status	Support	Status	Support
1	allomorphs	{smi2AttributeID 50}		x		c1		x	
2	nameBinding	{smi2AttributeID 63}		–		m		x	
3	objectClass	{smi2AttributeID 65}		–		m		x	
4	packages	{smi2AttributeID 66}		–		m		x	

Table H.4 *(concluded)*

	Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Additional information
1	x		x		x		
2	x		x		x		
3	x		x		x		
4	x		x		x		
c1: if not (H-1/1b) then m else –							

H.1.3 Attribute groups

There are no attribute groups defined for the managed object class.

H.1.4 Actions

There are no actions defined for this object class.

H.1.5 Notifications

There are no notifications defined for this object class.

H.1.6 Parameters

There are no parameters defined for this object class.

H.2 Statement of conformance to the commandSequencer object class

Table H.5 – MOCS – Managed object class support

Index	Managed object class template label	Value of object identifier for class	Support of all mandatory features	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	commandSequencer	{joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx2(2)}		

If the answer to the actual class question in the managed object class support Table H.5 is no, the supplier of the implementation shall fill in the actual class support in Table H.6.

Table H.6 – MOCS – Actual class support

Index	Actual managed object class template label	Value of object identifier for actual class	Additional information
1			
2			

H.2.1 Packages

The supplier of the implementation shall state whether or not the conditional packages specified by this class are supported by an instance of this class, in the “Support” and “Additional information” columns in Table H.7.

Table H.7 – MOCS – Package support

Index	Package template label	Value of object identifier for package	Constraints and values	Status	Support	Additional information
1	allomorphicPackage	{smi2Package 17}		c1		
2	packagesPackage	{smi2Package 16}		c2		
c1: if not (H-5/1b) then m else – c2: if H-7/1 then m else –						

H.2.2 Attributes

The supplier of the implementation shall state whether or not the attributes specified by all packages instantiated in a managed object of this class are supported, in the “Support” and “Additional information” columns in Table H.8. The supplier of the implementation shall indicate support for each of the operations for each attribute supported.

Table H.8 – MOCS – Attribute support

				Set by create		Get		Replace	
Index	Attribute template label	Value of object identifier for attribute	Constraints and values	Status	Support	Status	Support	Status	Support
1	administrativeState	{smi2AttributeID 31}		m		m		m	
2	allomorphs	{smi2AttributeID 50}		x		c1		x	
3	commandSequencerId	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx2(2)}		–		m		x	
4	nameBinding	{smi2AttributeID 63}		–		m		x	
5	objectClass	{smi2AttributeID 65}		–		m		x	
6	operationalState	{smi2AttributeID 35}		–		m		x	
7	packages	{smi2AttributeID 66}		–		c2		x	

Table H.8 *(concluded)*

	Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Additional information
1	x		x		x		
2	x		x		x		
3	x		x		x		
4	x		x		x		
5	x		x		x		
6	x		x		x		
7	x		x		x		

c1: if not (H-5/1b) then m else –
c2: if H-7/2 then m else –

H.2.3 Attribute groups

There are no attribute groups defined for the managed object class.

H.2.4 Actions

There are no actions defined for this object class.

H.2.5 Notifications

The supplier of the implementation shall state whether or not the notifications specified by all packages instantiated in a managed object of this class are supported, in the “Support” and “Additional information” columns in Table H.9. The supplier of the implementation shall indicate support in terms of the confirmed and non-confirmed modes.

Table H.9 – MOCS – Notification support

Index	Notification type template label	Value of object identifier for notification type	Constraints and values	Status	Support		Additional information
					Confirmed	Non-confirmed	
1	objectCreation	{smi2Notification 6}		m			
2	objectDeletion	{smi2Notification 7}		m			
3	stateChange	{smi2Notification 14}		m			

Table H.9 *(continued)*

Index	Subindex	Notification field name label	Value of object identifier of attribute type associated with field	Constraints and values	Status	Support	Additional information
1	1.1	additionalInformation	{smi2AttributeID 6}		o		
	1.1.1	identifier	–		c:m		
	1.1.2	significance	–		c:m		
	1.1.3	information	–		c:m		
	1.2	additionalText	{smi2AttributeID 7}		o		
	1.3	attributeList	{smi2AttributeID 9}		o		
	1.3.1	attributeId	–		c:m		
	1.3.1.1	globalForm	–		c:o.1		
	1.3.1.2	localForm	–		c:o.1		
	1.3.2	attributeValue	–		c:m		
	1.4	correlatedNotifications	{smi2AttributeID 12}		o		
	1.4.1	correlatedNotifications	–		c:m		
	1.4.2	sourceObjectInst	–		c:o		
	1.4.2.1	distinguishedName	–		c:o.2		
	1.4.2.1.1	AttributeType	–		c:m		
	1.4.2.1.2	AttributeValue	–		c:m		
	1.4.2.2	nonSpecificForm	–		c:o.2		
	1.4.2.3	localDistinguishedName	–		c:o.2		
	1.4.2.3.1	AttributeType	–		c:m		
	1.4.2.3.2	AttributeValue	–		c:m		
	1.5	notificationIdentifier	{smi2AttributeID 16}		o		
	1.6	sourceIndicator	{smi2AttributeID 26}		o		
2	2.1	additionalInformation	{smi2AttributeID 6}		o		
	2.1.1	identifier	–		c:m		
	2.1.2	significance	–		c:m		
	2.1.3	information	–		c:m		
	2.2	additionalText	{smi2AttributeID 7}		o		
	2.3	attributeList	{smi2AttributeID 9}		o		
	2.3.1	attributeId	–		c:m		
	2.3.1.1	globalForm	–		c:o.3		
	2.3.1.2	localForm	–		c:o.3		
	2.3.2	attributeValue	–		c:m		
	2.4	correlatedNotifications	{smi2AttributeID 12}		o		
	2.4.1	correlatedNotifications	–		c:m		
	2.4.2	sourceObjectInst	–		c:o		
	2.4.2.1	distinguishedName	–		c:o.4		
	2.4.2.1.1	AttributeType	–		c:m		
	2.4.2.1.2	AttributeValue	–		c:m		
	2.4.2.2	nonSpecificForm	–		c:o.4		
	2.4.2.3	localDistinguishedName	–		c:o.4		

Table H.9 *(concluded)*

Index	Subindex	Notification field name label	Value of object identifier of attribute type associated with field	Constraints and values	Status	Support	Additional information
	2.4.2.3.1	AttributeType	–		c:m		
	2.4.2.3.2	AttributeValue	–		c:m		
	2.5	notificationIdentifier	{smi2AttributeID 16}		o		
	2.6	sourceIndicator	{smi2AttributeID 26}		o		
3	3.1	additionalInformation	{smi2AttributeID 6}		o		
	3.1.1	identifier	–		c:m		
	3.1.2	significance	–		c:m		
	3.1.3	information	–		c:m		
	3.2	additionalText	{smi2AttributeID 7}		o		
	3.3	attributeIdentifierList	{smi2AttributeID 8}		o		
	3.3.1	globalForm	–		c:o.5		
	3.3.2	localForm	–		c:o.5		
	3.4	correlatedNotifications	{smi2AttributeID 12}		o		
	3.4.1	correlatedNotifications	–		c:m		
	3.4.2	sourceObjectInst	–		c:o		
	3.4.2.1	distinguishedName	–		c:o.6		
	3.4.2.1.1	AttributeType	–		c:m		
	3.4.2.1.2	AttributeValue	–		c:m		
	3.4.2.2	nonSpecificForm	–		c:o.6		
	3.4.2.3	localDistinguishedName	–		c:o.6		
	3.4.2.3.1	AttributeType	–		c:m		
	3.4.2.3.2	AttributeValue	–		c:m		
	3.5	notificationIdentifier	{smi2AttributeID 16}		o		
	3.6	sourceIndicator	{smi2AttributeID 26}		o		
	3.7	stateChangeDefinition	{smi2AttributeID 28}		m		
	3.7.1	attributeID	–		m		
	3.7.1.1	globalForm	–		c:o.7		
	3.7.1.2	localForm	–		c:o.7		
	3.7.2	oldAttributeValue	–		o		
	3.7.3	newAttributeValue	–		m		

H.2.6 Parameters

There are no parameters defined for this object class.

H.3 Statement of conformance to the generalStringScript object class

Table H.10 – MOCS – Managed object class support

Index	Managed object class template label	Value of object identifier for class	Support of all mandatory features	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	generalStringScript	{joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx3(3)}		

If the answer to the actual class question in the managed object class support Table H.10 is no, the supplier of the implementation shall fill in the actual class support in Table H.11.

Table H.11 – MOCS – Actual class support

Index	Actual managed object class template label	Value of object identifier for actual class	Additional information
1			
2			

H.3.1 Packages

The supplier of the implementation shall state whether or not the conditional packages specified by this class are supported by an instance of this class, in the "Support" and "Additional information" columns in Table H.12.

Table H.12 – MOCS – Package support

Index	Package template label	Value of object identifier for package	Constraints and values	Status	Support	Additional information
1	allomorphicPackage	{smi2Package 17}		c1		
2	packagesPackage	{smi2Package 16}		m		
c1: if not (H-10/1b) then m else –						

H.3.2 Attributes

The supplier of the implementation shall state whether or not the attributes specified by all packages instantiated in a managed object of this class are supported, in the "Support" and "Additional information" columns in Table H.13. The supplier of the implementation shall indicate support for each of the operations for each attribute supported.

Table H.13 – MOCS – Attribute support

				Set by create		Get		Replace	
Index	Attribute template label	Value of object identifier for attribute	Constraints and values	Status	Support	Status	Support	Status	Support
1	administrativeState	{smi2AttributeID 31}		m		m		m	
2	allomorphs	{smi2AttributeID 50}		x		c1		x	
3	executionResultType	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx3(3)}		–		m		x	
4	nameBinding	{smi2AttributeID 63}		–		m		x	
5	objectClass	{smi2AttributeID 65}		–		m		x	
6	packages	{smi2AttributeID 66}		–		m		x	
7	scriptContent	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx4(4)}		m		m		m	
8	scriptId	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx5(5)}		–		m		x	
9	scriptLanguageName	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx7(7)}		m		m		m	

Table H.13 *(concluded)*

	Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Additional information
1	x		x		x		
2	x		x		x		
3	x		x		x		
4	x		x		x		
5	x		x		x		
6	x		x		x		
7	x		x		x		
8	x		x		x		
9	x		x		x		
c1: if not (H-10/1b) then m else –							

H.3.4 Attribute groups

There are no attribute groups defined for the managed object class.

H.3.5 Actions

There are no actions defined for this object class.

H.3.6 Notifications

There are no notifications defined for this object class.

H.3.7 Parameters

There are no parameters defined for this object class.

H.4 Statement of conformance to the launchPad object class

Table H.14 – MOCS – Managed object class support

Index	Managed object class template label	Value of object identifier for class	Support of all mandatory features	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	launchPad	{joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx6(6)}		

If the answer to the actual class question in the managed object class support Table H.14 is no, the supplier of the implementation shall fill in the actual class support in Table H.15.

Table H.15 – MOCS – Actual class support

Index	Actual managed object class template label	Value of object identifier for actual class	Additional information
1			
2			

H.4.1 Packages

The supplier of the implementation shall state whether or not the conditional packages specified by this class are supported by an instance of this class, in the “Support” and “Additional information” columns in Table H.16.

Table H.16 – MOCS – Package support

Index	Package template label	Value of object identifier for package	Constraints and values	Status	Support	Additional information
1	allomorphicPackage	{smi2Package 17}		c1		
2	packagesPackage	{smi2Package 16}		m		
c1: if not (H-14/1b) then m else –						

H.4.2 Attributes

The supplier of the implementation shall state whether or not the attributes specified by all packages instantiated in a managed object of this class are supported, in the “Support” and “Additional information” columns in Table H.17. The supplier of the implementation shall indicate support for each of the operations for each attribute supported.

Table H.17 – MOCS – Attribute support

				Set by create		Get		Replace	
Index	Attribute template label	Value of object identifier for attribute	Constraints and values	Status	Support	Status	Support	Status	Support
1	administrativeState	{smi2AttributeID 31}		–		x		x	
2	allomorphs	{smi2AttributeID 50}		x		c1		x	
3	availabilityStatus	{smi2AttributeID 33}		–		x		x	
4	controlStatus	{smi2AttributeID 34}		–		m		x	
5	launchPadId	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx6(6)}		–		m		x	
6	nameBinding	{smi2AttributeID 63}		–		m		x	
7	objectClass	{smi2AttributeID 65}		–		m		x	
8	observedAttributeId	{joint-iso-itu-t ms(9) function(2) part11(11) attribute(7) xx15(15)}		m		m		m	
9	observedObjectInstance	{joint-iso-itu-t ms(9) function(2) part11(11) attribute(7) xx16(16)}		m		m		m	
10	operationalState	{smi2AttributeID 35}		–		x		x	
11	packages	{smi2AttributeID 66}		–		m		x	
12	schedulerName	{smi2AttributeID 67}		–		m		x	
13	usageState	{smi2AttributeID 39}		–		x		x	

Table H.17 *(concluded)*

	Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Additional information
1	x		x		x		
2	x		x		x		
3	x		x		x		
4	x		x		x		
5	x		x		x		
6	x		x		x		
7	x		x		x		
8	x		x		x		
9	x		x		x		
10	x		x		x		
11	x		x		x		
12	x		x		x		
13	x		x		x		
c1: if not (H-14/1b) then m else –							

H.4.3 Attribute groups

There are no attribute groups defined for the managed object class.

H.4.4 Actions

The supplier of the implementation shall state whether or not the actions specified by all packages instantiated in a managed object of this class are supported, in the "Support" and "Additional information" columns in Table H.18.

Table H.18 – MOCS – Action support

Index	Action type template label	Value of object identifier for action type	Constraints and values	Status	Support	Additional information
1	resume	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx1(1)}		m		
2	suspend	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx2(2)}		m		
3	terminate	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx3(3)}		m		

Table H.19 – MOCS – Action support

Index	Subindex	Action field name label	Constraints and values	Status	Support	Additional information
1	1.1	SpawnerObjectId		m		
	1.1.1	triggerId		m		
	1.1.1.1	distinguishedName		c:o.1		
	1.1.1.1.1	AttributeType		c:m		
	1.1.1.1.2	AttributeValue		c:m		
	1.1.1.2	nonSpecificForm		c:o.1		
	1.1.1.3	localDistinguishedName		c:o.1		
	1.1.1.3.1	AttributeType		c:m		
	1.1.1.3.2	AttributeValue		c:m		
	1.1.2	CHOICE		m		
	1.1.2.1	threadId		c:o.2		
	1.1.2.1.1	distinguishedName		c:o.3		
	1.1.2.1.1.1	AttributeType		c:m		
	1.1.2.1.1.2	AttributeValue		c:m		
	1.1.2.1.2	nonSpecificForm		c:o.3		
	1.1.2.1.3	localDistinguishedName		c:o.3		
	1.1.2.1.3.1	AttributeType		c:m		
	1.1.2.1.3.2	AttributeValue		c:m		
	1.1.2.2	launchPadId		c:o.2		
	1.1.2.2.1	distinguishedName		c:o.4		
	1.1.2.2.1.1	AttributeType		c:m		
	1.1.2.2.1.2	AttributeValue		c:m		
	1.1.2.2.2	nonSpecificForm		c:o.4		
	1.1.2.2.3	localDistinguishedName		c:o.4		
	1.1.2.2.3.1	AttributeType		c:m		
	1.1.2.2.3.2	AttributeValue		c:m		
2	2.1	SpawnerObjectId		m		
	2.1.1	triggerId		m		
	2.1.1.1	distinguishedName		c:o.5		
	2.1.1.1.1	AttributeType		c:m		
	2.1.1.1.2	AttributeValue		c:m		
	2.1.1.2	nonSpecificForm		c:o.5		
	2.1.1.3	localDistinguishedName		c:o.5		
	2.1.1.3.1	AttributeType		c:m		
	2.1.1.3.2	AttributeValue		c:m		
	2.1.2	CHOICE		m		
	2.1.2.1	threadId		c:o.6		
	2.1.2.1.1	distinguishedName		c:o.7		
	2.1.2.1.1.1	AttributeType		c:m		
	2.1.2.1.1.2	AttributeValue		c:m		
	2.1.2.1.2	nonSpecificForm		c:o.7		
	2.1.2.1.3	localDistinguishedName		c:o.7		
	2.1.2.1.3.1	AttributeType		c:m		
	2.1.2.1.3.2	AttributeValue		c:m		
	2.1.2.2	launchPadId		c:o.6		
	2.1.2.2.1	distinguishedName		c:o.8		
	2.1.2.2.1.1	AttributeType		c:m		
	2.1.2.2.1.2	AttributeValue		c:m		
	2.1.2.2.2	nonSpecificForm		c:o.8		
	2.1.2.2.3	localDistinguishedName		c:o.8		
	2.1.2.2.3.1	AttributeType		c:m		
	2.1.2.2.3.2	AttributeValue		c:m		
3	3.1	TriggerId		m		
	3.1.1	distinguishedName		c:o.9		
	3.1.1.1	AttributeType		c:m		
	3.1.1.2	AttributeValue		c:m		
	3.1.2	nonSpecificForm		c:o.9		
	3.1.3	localDistinguishedName		c:o.9		
	3.1.3.1	AttributeType		c:m		
	3.1.3.2	AttributeValue		c:m		

H.4.5 Notifications

There are no notifications defined for this object class.

H.4.6 Parameters

There are no parameters defined for this object class.

H.5 Statement of conformance to the asynchronousLaunchPad object class

Table H.20 – MOCS – Managed object class support

Index	Managed object class template label	Value of object identifier for class	Support of all mandatory features	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	asynchronousLaunchPad	{joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx4(4)}		

If the answer to the actual class question in the managed object class support Table H.20 is no, the supplier of the implementation shall fill in the actual class support in Table H.21.

Table H.21 – MOCS – Actual class support

Index	Actual managed object class template label	Value of object identifier for actual class	Additional information
1			
2			

H.5.1 Packages

The supplier of the implementation shall state whether or not the conditional packages specified by this class are supported by an instance of this class, in the "Support" and "Additional information" columns in Table H.22.

Table H.22 – MOCS – Package support

Index	Package template label	Value of object identifier for package	Constraints and values	Status	Support	Additional information
1	allomorphicPackage	{smi2Package 17}		c1		
2	packagesPackage	{smi2Package 16}		m		
c1: if not (H-20/1b) then m else –						

H.5.2 Attributes

The supplier of the implementation shall state whether or not the attributes specified by all packages instantiated in a managed object of this class are supported, in the "Support" and "Additional information" columns in Table H.23. The supplier of the implementation shall indicate support for each of the operations for each attribute supported.

H.5.3 Attribute groups

There are no attribute groups defined for the managed object class.

Table H.23 – MOCS – Attribute support

				Set by create		Get		Replace	
Index	Attribute template label	Value of object identifier for attribute	Constraints and values	Status	Support	Status	Support	Status	Support
1	administrativeState	{smi2AttributeID 31}		–		x		x	
2	allomorphs	{smi2AttributeID 50}		x		c1		x	
3	availabilityStatus	{smi2AttributeID 33}		–		x		x	
4	controlStatus	{smi2AttributeID 34}		–		m		x	
5	launchPadId	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx6(6)}		–		m		x	
6	nameBinding	{smi2AttributeID 63}		–		m		x	
7	objectClass	{smi2AttributeID 65}		–		m		x	
8	observedAttributeId	{joint-iso-itu-t ms(9) function(2) part11(11) attribute(7) xx15(15)}		m		m		m	
9	observedObjectInstance	{joint-iso-itu-t ms(9) function(2) part11(11) attribute(7) xx16(16)}		m		m		m	
10	operationalState	{smi2AttributeID 35}		–		x		x	
11	packages	{smi2AttributeID 66}		–		m		x	
12	schedulerName	{smi2AttributeID 67}		–		m		x	
13	usageState	{smi2AttributeID 39}		–		x		x	

Table H.23 *(concluded)*

	Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Additional information
1	x		x		x		
2	x		x		x		
3	x		x		x		
4	x		x		x		
5	x		x		x		
6	x		x		x		
7	x		x		x		
8	x		x		x		
9	x		x		x		
10	x		x		x		
11	x		x		x		
12	x		x		x		
13	x		x		x		
c1: if not (H-20/1b) then m else –							

H.5.4 Actions

The supplier of the implementation shall state whether or not the actions specified by all packages instantiated in a managed object of this class are supported, in the "Support" and "Additional information" columns in Table H.24.

Table H.24 – MOCS – Action support

Index	Action type template label	Value of object identifier for action type	Constraints and values	Status	Support	Additional information
1	resume	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx1(1)}		m		
2	suspend	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx2(2)}		m		
3	terminate	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx3(3)}		m		

Table H.25 – MOCS – Action support

Index	Subindex	Action field name label	Constraints and values	Status	Support	Additional information
1	1.1	SpawnerObjectId		m		
	1.1.1	triggerId		m		
	1.1.1.1	distinguishedName		c:o.1		
	1.1.1.1.1	AttributeType		c:m		
	1.1.1.1.2	AttributeValue		c:m		
	1.1.1.2	nonSpecificForm		c:o.1		
	1.1.1.3	localDistinguishedName		c:o.1		
	1.1.1.3.1	AttributeType		c:m		
	1.1.1.3.2	AttributeValue		c:m		
	1.1.2	CHOICE		m		
	1.1.2.1	threadId		c:o.2		
	1.1.2.1.1	distinguishedName		c:o.3		
	1.1.2.1.1.1	AttributeType		c:m		
	1.1.2.1.1.2	AttributeValue		c:m		
	1.1.2.1.2	nonSpecificForm		c:o.3		
	1.1.2.1.3	localDistinguishedName		c:o.3		
	1.1.2.1.3.1	AttributeType		c:m		
	1.1.2.1.3.2	AttributeValue		c:m		
	1.1.2.2	launchPadId		c:o.2		
	1.1.2.2.1	distinguishedName		c:o.4		
	1.1.2.2.1.1	AttributeType		c:m		
	1.1.2.2.1.2	AttributeValue		c:m		
	1.1.2.2.2	nonSpecificForm		c:o.4		
	1.1.2.2.3	localDistinguishedName		c:o.4		
	1.1.2.2.3.1	AttributeType		c:m		
	1.1.2.2.3.2	AttributeValue		c:m		
2	2.1	SpawnerObjectId		m		
	2.1.1	triggerId		m		
	2.1.1.1	distinguishedName		c:o.5		
	2.1.1.1.1	AttributeType		c:m		
	2.1.1.1.2	AttributeValue		c:m		
	2.1.1.2	nonSpecificForm		c:o.5		

Table H.25 *(concluded)*

Index	Subindex	Action field name label	Constraints and values	Status	Support	Additional information
	2.1.1.3	localDistinguishedName		c:o.5		
	2.1.1.3.1	AttributeType		c:m		
	2.1.1.3.2	AttributeValue		c:m		
	2.1.2	CHOICE		m		
	2.1.2.1	threadId		c:o.6		
	2.1.2.1.1	distinguishedName		c:o.7		
	2.1.2.1.1.1	AttributeType		c:m		
	2.1.2.1.1.2	AttributeValue		c:m		
	2.1.2.1.2	nonSpecificForm		c:o.7		
	2.1.2.1.3	localDistinguishedName		c:o.7		
	2.1.2.1.3.1	AttributeType		c:m		
	2.1.2.1.3.2	AttributeValue		c:m		
	2.1.2.2	launchPadId		c:o.6		
	2.1.2.2.1	distinguishedName		c:o.8		
	2.1.2.2.1.1	AttributeType		c:m		
	2.1.2.2.1.2	AttributeValue		c:m		
	2.1.2.2.2	nonSpecificForm		c:o.8		
	2.1.2.2.3	localDistinguishedName		c:o.8		
	2.1.2.2.3.1	AttributeType		c:m		
	2.1.2.2.3.2	AttributeValue		c:m		
3	3.1	TriggerId		m		
	3.1.1	distinguishedName		c:o.9		
	3.1.1.1	AttributeType		c:m		
	3.1.1.2	AttributeValue		c:m		
	3.1.2	nonSpecificForm		c:o.9		
	3.1.3	localDistinguishedName		c:o.9		
	3.1.3.1	AttributeType		c:m		
	3.1.3.2	AttributeValue		c:m		

H.5.6 Notifications

There are no notifications defined for this object class.

H.5.7 Parameters

There are no parameters defined for this object class.

H.6 Statement of conformance to the synchronousLaunchPad object class

Table H.26 – MOCS – Managed object class support

Index	Managed object class template label	Value of object identifier for class	Support of all mandatory features	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	synchronousLaunchPad	{joint-iso-itu-t ms(9) function(2) part21(21) managedObjectClass(3) xx5(5)}		

If the answer to the actual class question in the managed object class support Table H.26 is no, the supplier of the implementation shall fill in the actual class support in Table H.27.

Table H.27 – MOCS – Actual class support

Index	Actual managed object class template label	Value of object identifier for actual class	Additional information
1			
2			

H.6.1 Packages

The supplier of the implementation shall state whether or not the conditional packages specified by this class are supported by an instance of this class, in the "Support" and "Additional information" columns in Table H.28.

Table H.28 – MOCS – Package support

Index	Package template label	Value of object identifier for package	Constraints and values	Status	Support	Additional information
1	allomorphicPackage	{smi2Package 17}		c1		
2	packagesPackage	{smi2Package 16}		m		
c1: if not (H-26/1b) then m else –						

H.6.2 Attributes

The supplier of the implementation shall state whether or not the attributes specified by all packages instantiated in a managed object of this class are supported, in the "Support" and "Additional information" columns in Table H.29. The supplier of the implementation shall indicate support for each of the operations for each attribute supported.

Table H.29 – MOCS – Attribute support

				Set by create		Get		Replace	
Index	Attribute template label	Value of object identifier for attribute	Constraints and values	Status	Support	Status	Support	Status	Support
1	administrativeState	{smi2AttributeID 31}		–		x		x	
2	allomorphs	{smi2AttributeID 50}		x		c1		x	
3	availabilityStatus	{smi2AttributeID 33}		–		x		x	
4	controlStatus	{smi2AttributeID 34}		–		m		x	
5	launchPadId	{joint-iso-itu-t ms(9) function(2) part21(21) attribute(7) xx6(6)}		–		m		x	
6	nameBinding	{smi2AttributeID 63}		–		m		x	
7	objectClass	{smi2AttributeID 65}		–		m		x	
8	observedAttributeId	{joint-iso-itu-t ms(9) function(2) part11(11) attribute(7) xx15(15)}		m		m		m	
9	observedObjectInstance	{joint-iso-itu-t ms(9) function(2) part11(11) attribute(7) xx16(16)}		m		m		m	
10	operationalState	{smi2AttributeID 35}		–		x		x	
11	packages	{smi2AttributeID 66}		–		m		x	
12	schedulerName	{smi2AttributeID 67}		–		m		x	
13	usageState	{smi2AttributeID 39}		–		x		x	

Table H.29 *(concluded)*

	Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Additional information
1	x		x		x		
2	x		x		x		
3	x		x		x		
4	x		x		x		
5	x		x		x		
6	x		x		x		
7	x		x		x		
8	x		x		x		
9	x		x		x		
10	x		x		x		
11	x		x		x		
12	x		x		x		
13	x		x		x		
c1: if not (H-26/1b) then m else –							

H.6.3 Attribute groups

There are no attribute groups defined for the managed object class.

H.6.4 Actions

The supplier of the implementation shall state whether or not the actions specified by all packages instantiated in a managed object of this class are supported, in the “Support” and “Additional information” columns in Table H.30.

Table H.30 – MOCS – Action support

Index	Action type template label	Value of object identifier for action type	Constraints and values	Status	Support	Additional information
1	resume	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx1(1)}		m		
2	suspend	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx2(2)}		m		
3	terminate	{joint-iso-itu-t ms(9) function(2) part21(21) action(9) xx3(3)}		m		