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Amendment 2
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SERIES M: TMN AND NETWORK MAINTENANCE:
INTERNATIONAL TRANSMISSION SYSTEMS,
TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE
AND LEASED CIRCUITS

Telecommunications management network

Generic network information model

Amendment 2

ITU-T Recommendation M.3100 – Amendment 2

(Formerly CCITT Recommendation)

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Generic network information model

AMENDMENT 2

Summary

This amendment provides enhancements to the generic network information model. The model describes managed object classes and their properties that are generic and useful to describe information exchanged across all interfaces defined in M.3010 TMN architecture. These generic managed object classes are intended to be applicable across different technologies, architectures and services. The managed object classes in this amendment may be specialized to support the management of various telecommunications networks.

Source

Amendment 2 to ITU-T Recommendation M.3100 was prepared by ITU-T Study Group 4 (1997-2000) and approved under the WTSC Resolution 1 procedure on 4 February 2000.

Keywords

Actions, ASN.1, attributes, generic network information model, managed object class, notifications.

FOREWORD

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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ITU-T Recommendation M.3100

Generic network information model

AMENDMENT 2

1 Introduction

1.1 Scope

This amendment provides a generic network level information model enhancement to ITU-T Recommendation M.3100. It identifies managed object classes that are common to managed telecommunications networks. This amendment further provides additions to ITU-T Recommendation M.3100 in support of protection switching.

1.2 Related Recommendations

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-T Recommendation G.774.1 (1994), *Synchronous digital hierarchy (SDH) performance monitoring for the network element view*.
- ITU-T Recommendation G.774.3 (1994), *Synchronous digital hierarchy (SDH) management of multiplex-section protection for the network element view*.
- ITU-T Recommendation G.774.9 (1998), *Synchronous digital hierarchy (SDH) configuration of linear multiplex section protection for the network element view*.
- ITU-T Recommendation M.3100 (1995), *Generic network information model*.

1.3 A note on GDMO references

This amendment is an integral part of ITU-T Recommendation M.3100. This implies that all definitions (object classes, packages, attributes, ...) defined in ITU-T Recommendation M.3100 as well as Technical Corrigenda 1 are local and can be referenced without the document identifier.

2 Generic protection fragment

This amendment describes an information model for generic protection switching (PS) of resources such as circuit pack. The object classes defined in this amendment are useful to describe information exchanged across interfaces defined in M.3010 Telecommunications Management Network (TMN) architecture. Two PS object classes are defined in this amendment, namely protectionGroupR2, which is a subclass of the G.774.3 protectionGroupR1 object class, and protectionUnitR1, which is a subclass of the X.721 top object class.

2.1 Protection Group R2

The protectionGroupR2 managed object class is used to represent the various manageable aspects of a protection system within a Network Element (NE). Notifications of protection switch events and management system control of lockouts, forced switches, and manual switches are the primary management functions supported by this entity. This object class is a subclass of the protectionGroupR1 object class defined in G.774.3 Corrigendum 1 (1996).

Instances of this object class may be automatically created in an agent, e.g. immediately following the initialization of the NE resources involved in the protection system, according to the make-up and mode of the NE. Instances of this object class may be automatically deleted in the agent.¹

Multiple instances of the protectionGroupR2 object may exist in an NE (one for each protection system supported by the NE). An instance of the protectionGroupR2 object would contain two or more instances of the protectionUnitR1 object.

This object class inherits the following attributes from its superclass protectionGroupR1:

Protection Group ID: This read-only attribute provides a unique name for the Protection Group instance in the NE.

Operational State: This read-only attribute identifies whether or not the protection mechanism represented by this instance is capable of performing its normal functions.

Protection Group Type: This read-write attribute identifies whether the protection scheme used is 1+1 or M:N.

Revertive: This read-write attribute identifies whether or not the protection scheme used is revertive. The default value for this attribute shall indicate revertive operation, but this attribute should be able to be set to indicate non-revertive operation by a command from the manager.

Wait To Restore Time: This read-write attribute identifies the amount of time, in seconds, that the protection system should wait after a fault clears before switching back to the protected resource. This attribute is only relevant for revertive system operation.

This object class inherits the invokeProtection and releaseProtection actions from its superclass protectionGroupR1.

Invoke Protection: This action is used to request a lockout, a forced switch, or a manual switch on one or more of the resources involved in the protection system. The following input parameters are included in the Invoke Protection action:

- Switch Type (Manual, Forced or Lockout).
- Protection Entity (Optional): ID(s) of the protected and/or protecting Protection Unit entity to which the request applies. If not present, the request is meant to apply to all such entities in the Protection Group.

Release Protection: This action is used to release a lockout, a forced switch, or a manual switch on one or more of the resources involved in the protection system. The following input parameters are included in the Release Protection action:

- Switch Type (Manual, Forced or Lockout).
- Protection Entity (Optional): ID(s) of the protected and/or protecting Protection Unit entity to which the request applies. If not present, the request is meant to apply to all such entities in the Protection Group.

¹ Instances of protectionGroupR2 may also be created or deleted as the result of management operations to the protectionCoordinator object (defined in ITU-T Recommendation G.774.9) of a NE, such as the establishProtection and dismissProtection actions.

This object class also inherits the protectionSwitchReporting, stateChange, objectCreation, objectDeletion, and attributeValueChange notifications from protectionGroupR1.

Protection Switch Reporting: This notification is emitted from the Protection Group entity to report any protection switch events. The following parameters are included:

- The ID of the Protection Group entity reporting the notification.
- Time and date the protection switch event was detected.
- The ID of the Protection Unit (within the protection group) involved in the switch event.
- Protection Status (old and new) according to the following rules:
 - If the switch event entails a switch from protected resource to protecting resource (or vice versa) and has been done without preempting an existing switch, the old and new Protection Status parameters in the notification shall match the old and new values of the Protection Status attribute of the protecting Protection Unit.
 - If the switch is performed by preempting an existing one, the old and new Protection Status parameters in the notification shall match the old and new values of the Protection Status attribute of the protecting Protection Unit.
 - If an auto-switch condition exists on a resource but the auto-switch cannot be served due to the unavailability of the resource that otherwise protects it, the old and new Protection Status parameters in the notification shall match the old and new values of the Protection Status attribute of the Protection Unit on which the auto-switch condition arises. The exception is when that resource is already forced or locked out, in which case no notification is sent.
 - If the switch event entails a protected resource being locked out or released from lockout without modifying any existing switch, the old and new Protection Status parameters in the notification shall match the old and new values of the Protection Status attribute of the protected Protection Unit which has been locked out.
 - If the switch event entails a protecting resource being locked out or released from lockout without modifying any existing switch, the old and new Protection Status parameters in the notification shall match the old and new values of the Protection Status attribute of the protecting Protection Unit which has been locked out.

State Change: This notification is used to report changes to the Operational State attribute of this entity. The notification identifies the state attribute that changed, its old value, and its new value.

Object Creation: This notification is used to report the creation of an instance of this entity.

Object Deletion: This notification is used to report the deletion of an instance of this entity.

Attribute Value Change: This notification is used to report a change in a value of a given attribute. The notification identifies the attribute that changed, its old value, and its new value. Supported attributes are: Protection Group Type, Revertive, and Wait To Restore Time.

2.2 Protection Unit R1

The protectionUnitR1 managed object class is used to manage the protected (i.e. working, regular, or preferred) or protecting (i.e. backup or standby) resource in a protection system. It relates the resources (e.g. circuit packs) involved in the protection system and keeps track of the protection switching status of the resources.

Instances of this entity may be automatically created in the agent, e.g. immediately following the initialization of the NE resources (e.g. such as circuit pack) involved in the protection system, according to the make-up and mode of the NE. Instances of this entity may be deleted by the agent,

e.g. upon the deletion of the corresponding resource objects. The agent may also create and delete instances of this object class in order to reflect local modifications in the protection schemes.²

Two or more instances of the protectionUnitR1 object may exist within an instance of the protectionGroupR2 object.

An instance of the protectionUnitR1 object could contain an instance of the protectionCurrentData object (defined in ITU-T Recommendation G.774.1).

A protectionUnitR1 instance is related to instances of resource entities (e.g. Circuit Pack) via the Unreliable Resource Pointer attribute. If the function of the resource entities (e.g. timing function, transport termination point function, etc.) is explicitly modelled as object instances in the NE, then an protectionUnitR1 instance is also related to instances of the modelled function entity via the Reliable Resource Pointer attribute.

This object class has the following attributes:

Protection Unit ID: This read-only attribute provides a unique name for the Protection Unit instance within the containing Protection Group object.

Protecting: This read-only attribute identifies whether or not the protection unit is associated with a resource providing a protecting ("true") or protected ("false") role in the protection system.

Unreliable Resource Pointer: This read-only attribute identifies the unreliable resource (e.g. circuit pack entity) associated with the Protection Unit object (e.g. the actual protected or protecting resource). The syntax of this attribute is set-valued and could point to multiple instances of unreliable resource when a set of resource forms an atomic unit in the protection system.

Reliable Resource Pointer: This read-only attribute identifies the reliable resource (i.e. the functional entity), if there is any, associated with the Protection Unit. The value of this attribute of a protection unit (PU) will change when the PU is involved in a protection switch or release. For a protected PU, when it is not switched, this attribute is pointing to the associated reliable resource (i.e. the functional object) and when it is switched, this attribute points to NULL. For a protecting PU, when it is not switched, this attribute is pointing to NULL, and when it is switched, this attribute is pointing to the associated reliable resource (i.e. the functional object). The syntax of this attribute is set-valued and could point to multiple instances of reliable resource when a set of functional objects form an atomic unit in the protection system. Examples of usage of this attribute are provided in 2.3 below.

Priority: This read-write attribute specifies the priority of the service carried on the resource associated with the protection Unit instance. Valid values for this attribute are integers, where the value 1 indicates the highest priority, and a larger value indicates a lower priority.

This object class is defined with a status attribute.

Protection Status R1: This read-only attribute indicates the status of the protection switch in an Protection Unit object. The following behaviour applies to this attribute:

- This attribute must be capable of indicating pending as well as active switching requests relative to the protection unit. However, only one of the values lockout, forced switch, or manual switch can be present at the same time.
- A protection system may support only a subset of the allowable values of this attribute. The subset of values to be supported by a system is implementation-specific.

² Instances of this object class may also be created or deleted as the result of management operations to the protectionCoordinator object (defined in ITU-T Recommendation G.774.9) of a NE, such as the establishProtection, dismissProtection and modifyProtection actions.

- The syntax of this attribute includes a sub-field "relatedUnit" which is of ASN.1 CHOICE of "fromProtectionUnitNumber" and "toProtectionUnitNumber". This sub-field is used to indicate on which unit the service is carried.
 - For a protected PU, both the fromProtectionUnitNumber (fromPU#) and the toProtectionUnitNumber (toPU#) hold the ID of the related protecting PU. When switching to the protecting PU (i.e. service will be carried by the protecting PU), the toProtectionUnitNumber choice is used. When switching back to the protected PU (service will be carried by the protected PU), the fromProtectionUnitNumber choice is used.
 - For a protecting PU, both the fromProtectionUnitNumber (fromPU#) and the toProtectionUnitNumber (toPU#) hold the ID of the related protected PU. When switching to the protected PU (i.e. service will be carried by the protected PU), the toProtectionUnitNumber choice is used. When switching to the protecting PU (service will be carried by the protecting PU), the fromProtectionUnitNumber choice is used.
- If a system can support protection switching due to Resource Degrade (RD) besides Resource Fail (RF), protection switching of RD is similar to that in the subsequent description for RF.
- The following allowable Protection Status values are associated with each protected Protection Unit (PU).
 - **No Request:** No switch request is present on the unit. *In this case, service is on the protected PU, status syntax is noRequest. For non-revertive system, the status syntax of the related protecting PU is also noRequest.*
 - **Manual Switch to Protecting Unit Complete:** The unit has completed a Manual Switch. *In this case, service is on the related protectingPU, status syntax of the protected PU is manualSwitch (switchStatus: completed; relatedUnit: toPU#). Status syntax of the related protecting PU is manualSwitch (switchStatus: completed; relatedUnit: fromPU#).*
 - **Release Failed:** A time-out occurs while waiting for a release. *In this case, service is still on the protectingPU, status syntax is releaseFailed plus the previous status, such as manualSwitch (switchStatus: completed; relatedUnit: toPU#). Status syntax of the related protecting PU is still the previous status, such as manualSwitch (switchStatus: completed; relatedUnit: fromPU#).*
 - **Automatic Switch (RF) Pending:** The unit has a Fail condition present and the protecting unit is unavailable. *In this case, service is still on the protectedPU, status syntax is autoSwitch (switchStatus: pending; relatedUnit: toPU#; reason: RF). Status syntax of the related protecting PU is autoSwitch (switchStatus: pending; relatedUnit: fromPU#; reason: RF) plus its previous status.*
 - **Automatic Switch (RF) Complete:** The unit has completed an Automatic Switch to the protecting unit due to an Equipment Fail condition. *In this case, service is on the related protectingPU, status syntax of the protected PU is autoSwitch (switchStatus: completed; relatedUnit: toPU#; reason: RF). Status syntax of the related protecting PU is autoSwitch (switchStatus: completed; relatedUnit: fromPU#; reason: RF).*
 - **Automatic Switch (RF) Present, Operate failed:** An automatic switch (RF) request is in progress and a time-out occurs while waiting for completion. *In this case, service is still on the protectedPU, status syntax is autoSwitch (switchStatus: failed; relatedUnit: toPU#; reason: RF). Status syntax of the related protecting PU is autoSwitch (switchStatus: pending; relatedUnit: fromPU#; reason: RF) plus its previous status.*

- **Force Switch Complete, Automatic Switch (RF) Pending:** The unit has completed a Force Switch. Additionally, the unit has an automatic switch (RF) pending. *In this case, service is on the related protectingPU, status syntax of the protected PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#) plus autoSwitch (switchStatus: pending; relatedUnit: toPU#; reason: RF). Status syntax of the related protecting PU is forceSwitch (switchStatus: completed; relatedUnit: fromPU#) plus autoSwitch (switchStatus: pending; relatedUnit: fromPU#; reason: RF).*
- **Automatic Switch Complete, Wait-To-Restore (revertive only):** The unit has completed an Automatic Switch to the protecting unit. *In this case, service is on the related protectingPU, status syntax of the protected PU is autoSwitch (switchStatus: completed; relatedUnit: toPU#; reason: WTR). Status syntax of the related protecting PU is autoSwitch (switchStatus: completed; relatedUnit: toPU#; reason: WTR).*
- **Force Switch Complete:** The unit has completed a Force Switch to the protecting unit. *In this case, service is on the related protectingPU, status syntax of the protected PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#). Status syntax of the related protecting PU is forceSwitch (switchStatus: completed; relatedUnit: fromPU#).*
- **Protected Unit Lockout Completed:** The unit has been locked out from the protecting unit. *In this case, service is on the protectedPU, status syntax is lockout (switchStatus: completed).*
- **Protected Unit Lockout, Operate failed:** The unit has been locked out from the protecting unit, and, the previously completed switch could not be released within the expected time-out. When the switch is released, the Operate failed status is removed. *In this case, service is still on the related protectingPU, status syntax of the protected PU is lockout (switchStatus: completed) plus releaseFailed. Status syntax of the related protecting PU is still the previous status, such as manualSwitch (switchStatus: completed; relatedUnit: fromPU#).*
- **Locked In:** The unit is in the locked-in condition. This is caused by excessive protection switching events. *In this case, service is on the protectedPU, status syntax is locked-in.*

– A non-revertive protected Protection Unit has the following additional status values:

- **Do Not Revert:** The protected unit has been switched to the protecting unit and the request to do so has been released. The switch to the protecting unit is maintained. *In this case, service is on the related protectingPU, status syntax of the protected PU is doNotRevert. Status syntax of the related protecting PU is doNotRevert.*
- **Manual Switch to Protected Unit Complete:** The unit has completed a Manual Switch from the protecting unit to the protected unit. *In this case, service is on the protectedPU, status syntax is manualSwitch (switchStatus: completed; relatedUnit: fromPU#). Status syntax of the related protecting PU is manualSwitch (switchStatus: completed; relatedUnit: toPU#).*
- **Force Switch to Protected Unit Complete:** The unit has completed a Force Switch from the protecting unit to the protected unit. *In this case, service is on the protectedPU, status syntax is forceSwitch (switchStatus: completed; relatedUnit: fromPU#). Status syntax of the related protecting PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#).*
- **Automatic Switch (RF) to Protected Unit Complete:** The protecting unit has an Equipment Fail condition present and the protected unit is now being utilized. *In this case, service is on the protectedPU, status syntax is autoSwitch (switchStatus: completed; relatedUnit: fromPU#; reason: RF). Status syntax of the related protecting PU is autoSwitch (switchStatus: completed; relatedUnit: toPU#; reason: RF).*

- **Force Switch from Protecting Unit Complete, Automatic Switch (RF) Pending:** The unit has completed a Force Switch from the protecting unit to the protected unit. Additionally, the protected unit has an automatic switch (RF) condition present. *In this case, service is on the protectedPU, status syntax is forceSwitch (switchStatus: completed; relatedUnit: fromPU#) plus autoSwitch (switchStatus: pending; relatedUnit: toPU#; reason: RF). Status syntax of the related protecting PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#) plus autoSwitch (switchStatus: pending; relatedUnit: fromPU#; reason: RF).*
- The following allowable Protection Status values are associated with each protecting Protection Unit:
- **No Request:** No switch request is present on the protecting unit. *In this case, service is not on the protecting PU, status syntax is noRequest. For non-revertive system, the status syntax of the related protected PU is noRequest.*
 - **Manual Switch to Protecting Unit Complete:** A protected unit has completed a Manual Switch. *In this case, service is on the protectingPU, status syntax is manualSwitch (switchStatus: completed; relatedUnit: fromPU#). Status syntax of the related protected PU is manualSwitch (switchStatus: completed; relatedUnit: toPU#).*
 - **Automatic Switch (RF) Pending:** A protected unit has an Equipment Fail condition present and the protecting unit is unavailable for this request. *In this case, service is still on the protectedPU. Status syntax of the protecting PU is autoSwitch (switchStatus: pending; relatedUnit: fromPU#; reason: RF) plus its previous status, which causes its unavailability. Status syntax of the related protected PU is autoSwitch (switchStatus: pending; relatedUnit: toPU#; reason: RF).*
 - **Automatic Switch Complete (RF) to Protecting Unit:** A protected unit has completed an automatic switch (RF) to the protecting unit. *In this case, service is on the protectingPU, status syntax is autoSwitch (switchStatus: completed; relatedUnit: fromPU#; reason: RF). Status syntax of the related protected PU is autoSwitch (switchStatus: completed; relatedUnit: toPU#; reason: RF).*
 - **Automatic Switch (RF) to Protecting Complete, Wait-To-Restore (revertive only):** The unit has completed an Automatic Switch from the protected unit. *In this case, service is on the protectingPU, status syntax is autoSwitch (switchStatus: completed; relatedUnit: fromPU#; reason: WTR). Status syntax of the related protected PU is autoSwitch (switchStatus: completed; relatedUnit: fromPU#; reason: WTR).*
 - **Protecting Unit RF Present:** The protecting unit has an Equipment Fail condition present. *Status syntax of the protecting PU is resourceFailed.*
 - **Force Switch Complete to Protecting Unit:** The unit has completed a Force Switch from a protected unit to the protecting unit. *In this case, service is on the protectingPU, status syntax is forceSwitch (switchStatus: completed; relatedUnit: fromPU#). Status syntax of the related protected PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#).*
 - **Protecting Unit Locked Out:** The protecting unit has been locked out. *In this case, service is not on the protectingPU, status syntax is lockout (switchStatus: completed).*
 - **Protecting Unit Release Lock Out Failed:** A release of a lockout is in progress and a time-out occurs waiting for the lockout condition to clear. *In this case, service is not on the protectingPU, status syntax is lockout (releaseFailed).*

- A non-revertive protecting Protection Unit has the following additional status values:
 - **Do Not Revert:** A protected unit has been switched to the protecting unit and the request to do so has been released. The switch to the protecting unit is maintained. *In this case, service is on the protectingPU, status syntax is doNotRevert. Status syntax of the related protected PU is doNotRevert.*
 - **Manual Switch to Protected Unit Complete:** The unit has completed a Manual Switch from the protecting unit to the protected unit. *In this case, service is on the protectedPU. Status syntax of the protecting PU is manualSwitch (switchStatus: completed; relatedUnit: toPU#). Status syntax of the related protected PU is manualSwitch (switchStatus: completed; relatedUnit: fromPU#).*
 - **Force Switch to Protected Unit Complete:** The protecting unit has completed a forced switch to the protected unit. *In this case, service is on the protectedPU. Status syntax of the protecting PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#). Status syntax of the related protected PU is forceSwitch (switchStatus: completed; relatedUnit: fromPU#).*
 - **Force Switch to Protected Unit Complete, Protecting Unit Equipment Failed:** The protecting unit has completed a forced switch to the protected unit. Additionally, there is an Equipment Fail condition on the protecting unit. *In this case, service is on the protectedPU. Status syntax of the protecting PU is forceSwitch (switchStatus: completed; relatedUnit: toPU#) plus equipmentFailed. Status syntax of the related protected PU is forceSwitch (switchStatus: completed; relatedUnit: fromPU#).*
 - **Automatic Switch (RF) to Protected Unit Complete:** The protecting unit has an Equipment Fail condition present and the protected unit is now being utilized. *In this case, service is on the protectedPU. Status syntax of the protecting PU is autoSwitch (switchStatus: completed; relatedUnit: toPU#; reason: RF). Status syntax of the related protected PU is autoSwitch (switchStatus: completed; relatedUnit: fromPU#; reason: RF).*

The following table provides a mapping of the protection status of a protection unit to the syntax of the attribute. In the table, the following abbreviate notations are used:

- AS = Auto Switch.
- MS = Manual Switch.
- FS = Forced Switch.
- RF = Resource Failed.
- WTR = Wait To Restore.
- SwitchStatus: completed, pending, failed.
- FromAndToPU: toPU#, fromPU#.
- AutoSwitchReason: waitToRestore, resourceDegrade, resourceFail.

	Scenario	Value of the Protection Status attribute
Cases for the Protected Protection Unit	No Request	noRequest()
	MS to protecting Complete	manualSwitch(completed,toProtectionUnitNumber)
	Release Failed	releaseFailed() and previous status
	AS (RF) Pending	autoSwitch(pending,toProtectionUnitNumber, resourceFail)
	AS (RF) to protecting Complete	autoSwitch(completed,toProtectionUnitNumber, resourceFail)
	AS (RF) Present, Operate failed	autoSwitch(failed,toProtectionUnitNumber, resourceFail)
	FS Complete, AS (RF) Pending	forcedSwitch(completed,toProtectionUnitNumber) and autoSwitch(pending,toProtectionUnitNumber, resourceFail)
	AS to protecting Complete, WTR (revertive only)	autoSwitch(completed,toProtectionUnitNumber, waitToRestore)
	FS to protecting Complete	forcedSwitch(completed,toProtectionUnitNumber)
	Protected Unit Lockout Complete	lockout(completed)
	Protected Unit Lockout Complete Operate failed	lockout(completed) and releaseFailed()
	Locked In	lockedIn ()
Additional Cases for the Non-Revertive Protected Protection Unit	Do Not Revert	doNotRevert()
	MS to Protected Unit Complete	manualSwitch(completed,fromProtectionUnitNumber)
	FS to Protected Unit Complete	forcedSwitch(completed,fromProtectionUnitNumber)
	AS (RF) to Protected Unit Complete	autoSwitch(completed,fromProtectionUnitNumber, resourceFail)
	FS from Protecting Unit Complete, AS (RF) Pending	forcedSwitch(completed,fromProtectionUnitNumber) and autoSwitch(pending,toProtectionUnitNumber, resourceFail)
Cases for the Protecting Protection Unit	No Request	noRequest()
	MS to Protecting Unit Complete	manualSwitch(completed,fromProtectionUnitNumber)
	AS (RF) to Protecting Complete	autoSwitch(completed,fromProtectionUnitNumber, resourceFail)
	AS (RF) to Protecting Pending	autoSwitch(pending,fromProtectionUnitNumber, resourceFail)
	AS Complete (RF) to Protecting, WTR (revertive)	autoSwitch(completed,fromProtectionUnitNumber, waitToRestore)
	Protecting Unit RF Present	resourceFailed()
	FS Complete to Protecting Unit	forcedSwitch(completed,fromProtectionUnitNumber)
	Protecting Unit Locked Out	lockout(completed)
	Protecting Unit Locked Out, Release lockOut Failed	lockout(releaseFailed)

	Scenario	Value of the Protection Status attribute
Additional Cases for the Non-Revertive Protecting Protection Unit	Do Not Revert	doNotRevert()
	MS to Protected Unit Complete	manualSwitch(completed,toProtectionUnitNumber)
	FS to Protected Unit Complete	forcedSwitch(completed,toProtectionUnitNumber)
	FS to Protected Unit Complete, Protecting Unit RF	forcedSwitch(completed,toProtectionUnitNumber) andresourceFailed()
	AS (RF) to Protected Unit Complete	autoSwitch(completed,toProtectionUnitNumber, resourceFail)

NOTE – A protection system may support only a subset of the allowable status values listed in the above table. The subset of values to be supported by a system is implementation-specific.

This object class inherits the following notification from its superclass:

Attribute Value Change: This notification is used to report a change in a value of a given attribute. The notification identifies the attribute that changed, its old value, and its new value. Supported attributes are: Reliable Resource Pointer, Protection Status, and Priority.

2.3 Example Protection Applications

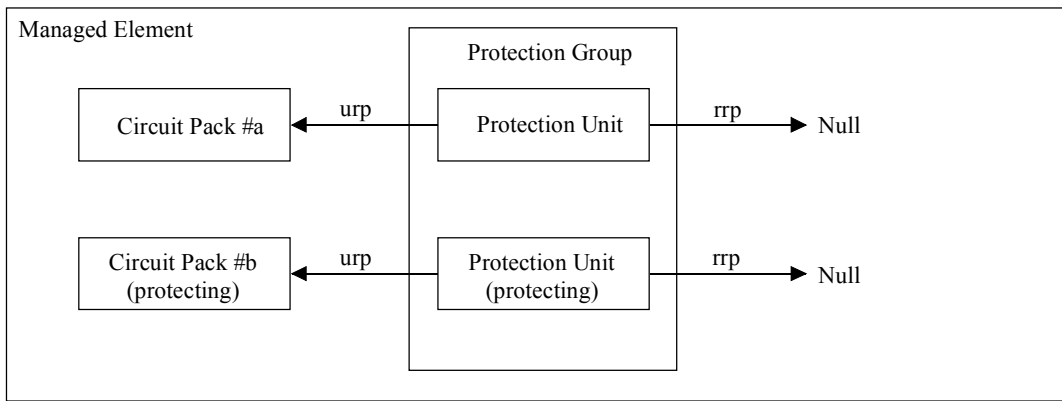
Three protection schemes are illustrated equipment resource (i.e. circuit pack):

- 1+1 Protection without explicitly modelled functions on the circuit packs, e.g. duplicated controllers;
- 1+1 Protection involving explicitly modelled functions on the circuit pack, e.g. Transport packs;
- 1xN Protection, where 1 Protecting pack is available for N normal packs, e.g. in case of a DS3 Port Unit.

It should be noted that the protection function is independent of the protection function of the explicitly modelled functionality. For instances, if the explicitly modelled functionality is termination point and termination point protection switching is supported (e.g. SDH Multiplex-Section Protection), then in addition to the resource protection model for the resources, the transport protection switching model should be used for the transport objects.

2.3.1 1+1 Equipment Protection, No Explicitly Modelled Functionality

The 1+1 protection schemes of circuit packs are modelled as shown in Figure 1.



urp Unreliable Resource Pointer
 rrp Reliable Resource Pointer

T0412030-99

NOTE 1 – Containment relationship for the Circuit Pack is not shown.

NOTE 2 – If the unit of redundancy is not a single circuit pack but a set of circuit packs, the resource pointers will point to all the circuit packs in the set.

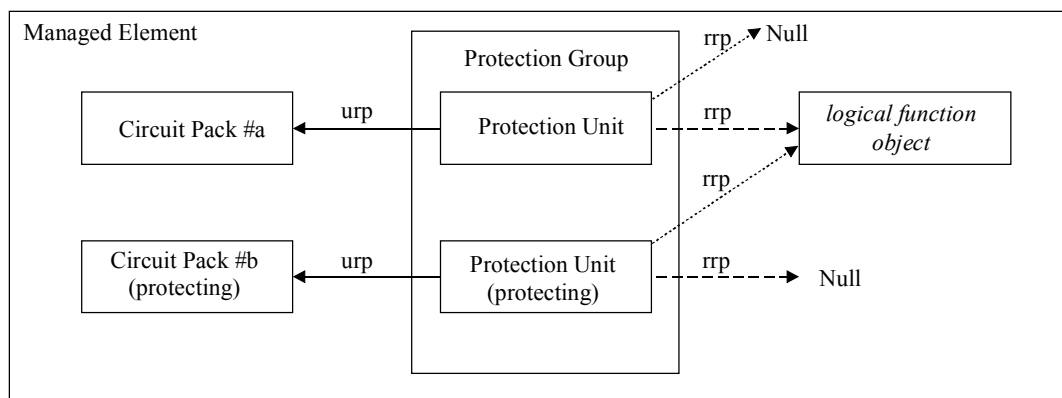
Figure 1/M.3100 – 1+1 Protection, no explicitly modelled functionality

Note that if the unit of redundancy is not a single circuit pack unit but a set of circuit pack, the resource pointers of the Protection Units will point to all the circuit packs in the set. However, the number of Protection Unit is still two.

2.3.2 1+1 Equipment Protection, Explicitly Modelled Functionality

This 1+1 protection schemes apply if circuit packs are associated with explicitly modelled functionality, such as Timing/Synchronization/Termination objects. A similar protection scheme is present as described in 2.3.1; however, the Reliable Resource Pointer is now pointing to the functional objects that are being protected.

See Figure 2.



urp Unreliable Resource Pointer
 rrp Reliable Resource Pointer

T0412040-99

NOTE 1 – Containment relationship for the Circuit Pack is not shown.

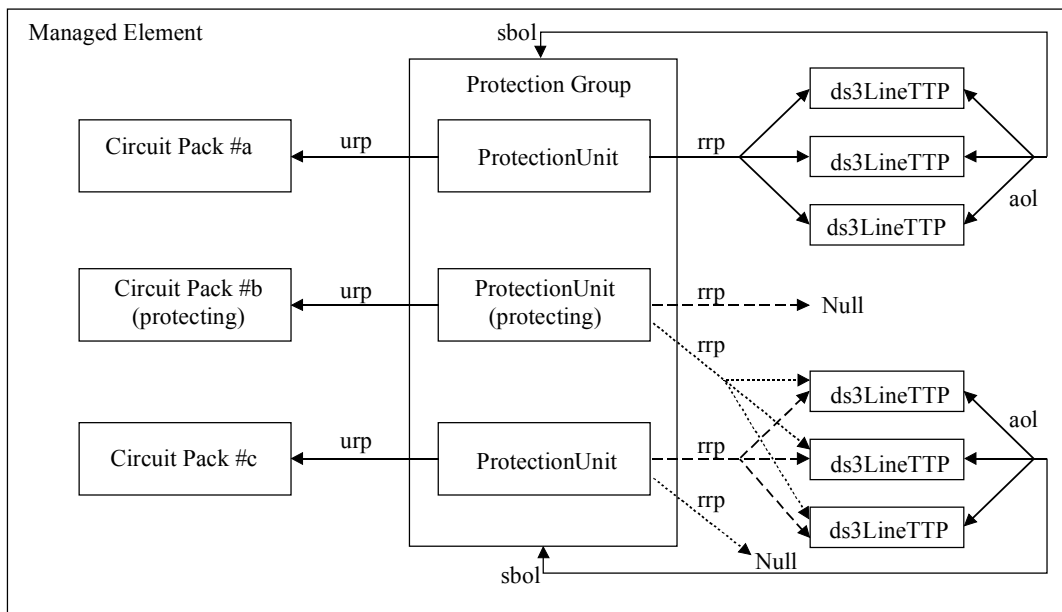
NOTE 2 – On a protection switch from Circuit Pack #a to Circuit Pack #b, all dashed arrows (- - ->) are replaced by the dotted arrows (.....>).

NOTE 3 – If the unit of redundancy is not a single object but a set of objects, the resource pointers will point to all the objects in the set.

Figure 2/M.3100 – 1+1 Protection, explicitly modelled functionality

2.3.3 1xN Equipment Protection, Explicitly Modelled Functionality

The 1xN circuit pack protection schemes of circuit packs that have manageable entities related to them (e.g. DS3 Termination) are modelled as shown in Figure 3.



T0412050-99

urp Unreliable Resource Pointer
 rrp Reliable Resource Pointer
 sbo Supported By Object List
 aol Affected Object List

NOTE 1 – Containment relationship for the Circuit Pack is not shown.

NOTE 2 – On a protection switch from Circuit Pack #c to Circuit Pack #b, all dashed arrows (-->) are replaced by the dotted arrows (.....>).

Figure 3/M.3100 – 1xN Protection, explicitly modelled functionality

3 Model Definitions

3.1 Object Classes

3.1.1 Protection Group R2

protectionGroupR2 MANAGED OBJECT CLASS

DERIVED FROM "Recommendation G.774.3":protectionGroupR1;

CHARACTERIZED BY protectionGroupR2Pkg PACKAGE

BEHAVIOUR protectionGroupR2Beh;

ATTRIBUTES

lockedInCondition GET-REPLACE;

NOTIFICATIONS

"Rec. G.774.3":protectionSwitchReportingR1

protectionStatusParameterR1;;

CONDITIONAL PACKAGES

protectionAlarmPkg PRESENT IF

"the system is capable of reporting failure of protection mechanism or failure of the protecting resource.";

REGISTERED AS {m3100ObjectClass 64};

**protectionGroupR2Beh BEHAVIOUR
DEFINED AS**

"This object class is used for representing a protection system. The invokeProtection action switches always from protected unit to protecting unit. Either all or none of the Protection Unit instances within an Protection Group object shall have the priorityPkg package. It is to be noted that, before the creation of the protectionGroupR2 object, the supported by object list (sbo1) attribute of a reliable resource such as termination point object may point to an unreliable resource object such as circuit pack. But once the protection group object is created, the sbo1 attribute would start pointing at the protection group object";

3.1.2 Equipment Protection Unit

protectionUnitR1 MANAGED OBJECT CLASS

**DERIVED FROM "Recommendation X.721":top;
CHARACTERIZED BY protectionUnitR1Pkg PACKAGE
BEHAVIOUR protectionUnitR1Beh;
ATTRIBUTES**

**"Rec. G.774.3":protectionUnitId GET,
"Rec. G.774.3":protecting GET,
reliableResourcePointerR1 GET,
unreliableResourcePointerR1 GET,
protectionStatusR1 GET;;;**

CONDITIONAL PACKAGES

**"Rec. G.774.3":priorityPkg PRESENT IF
"an instance supports it",**

**"Rec. M.3100":attributeValueChangeNotificationPackage PRESENT IF
"an instance supports it";**

REGISTERED AS {m3100ObjectClass 65};

**protectionUnitR1Beh BEHAVIOUR
DEFINED AS**

"Instances of this object class are used to represent the protected (i.e. working, regular, or preferred) or protecting (i.e. backup or standby) resource in a protection system. Instances of this object class are instantiated by the agent according to the protection schemes adopted by the NE. A Protection Unit instance is deleted when the resource object instance pointed to by the Unreliable Resource Pointer attribute is deleted, and may be created automatically when the associated resource object is created. The agent may also create and delete instances of this object class in order to reflect local modifications in the protection schemes. The attributeValueChange notification is used to notify changes of the Reliable Resource Pointer, Protection Status, and Priority attributes.";

3.2 Packages

3.2.1 Protection Alarm Package

protectionAlarmPkg PACKAGE

ATTRIBUTES

currentProblemList GET;

NOTIFICATIONS

protectionAlarm;

REGISTERED AS {m3100Package 93};

3.3 Attributes

3.3.1 Protection Status R1

protectionStatusR1 ATTRIBUTE

WITH ATTRIBUTE SYNTAX M3100ASN1Module3. ProtectionStatusR1;

MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;

BEHAVIOUR protectionStatusR1Beh;

REGISTERED AS {m3100Attribute 144};

protectionStatusR1Beh BEHAVIOUR

DEFINED AS

" -- See description of this attribute in 2.2.-- "

3.3.2 Locked In Condition

lockedInCondition ATTRIBUTE

WITH ATTRIBUTE SYNTAX M3100ASN1Module3.LockedInCondition;

MATCHES FOR EQUALITY;

BEHAVIOUR

lockedInConditionBeh BEHAVIOUR

DEFINED AS

"This read-write attribute specifies the criteria of the locked-in condition. The criteria includes the automatic protection switching (APS) rate and the associated setting and releasing time windows. If the number of APS of a Protection Unit reaches the value specified in the hitsCount field within a moving time window of specified length, the Protection Unit will enter the locked-in condition. Each switch to protection and its subsequent release is considered as one hit. The length of the time window for entering the locked-in condition is specified in the settingWindowTime field. Once a Protection Unit is in the locked-in condition, future request of APS will be denied until the locked-in condition is released. The release criterion is no APS request within another moving time window. The length of this time window is specified in the releasingWindowTime field. ";

REGISTERED AS { m3100Attribute 145};

3.3.3 Reliable Resource Pointer R1

reliableResourcePointerR1 ATTRIBUTE

WITH ATTRIBUTE SYNTAX M3100ASN1Module3.ResourcePointer;

MATCHES FOR EQUALITY, SET-INTERSECTION, SET-COMPARISON;

BEHAVIOUR reliableResourcePointerR1Beh;

REGISTERED AS { m3100Attribute 146};

reliableResourcePointerR1Beh BEHAVIOUR

DEFINED AS

"The value of the reliableResourcePointerR1 attribute points to the reliable resource(s) (e.g. the functional objects) that is/are associated with the Protection Unit instance.";

3.3.4 Unreliable Resource Pointer R1

unreliableResourcePointerR1 ATTRIBUTE

WITH ATTRIBUTE SYNTAX M3100ASN1Module3.ResourcePointer;

MATCHES FOR EQUALITY, SET-INTERSECTION, SET-COMPARISON;

BEHAVIOUR unreliableResourcePointerR1Beh;

REGISTERED AS { m3100Attribute 147};

unreliableResourcePointerR1Beh BEHAVIOUR

DEFINED AS

"The value of the unreliableResourcePointerR1 attribute points to the unreliable resource(s) (e.g. circuit pack) that is/are associated with the Protection Unit instance.";

3.4 Notifications

3.4.1 Protection Alarm

protectionAlarm NOTIFICATION

BEHAVIOUR protectionAlarmBeh;

WITH INFORMATION SYNTAX M3100ASN1Module3.ProtectionAlarmInfo;

AND ATTRIBUTE IDS

probableCause "Rec. X.721 | ISO/IEC 10165-2 : 1992": probableCause,

additionalInfo "Rec. X.721 | ISO/IEC 10165-2 : 1992": additionalInformation;

REGISTERED AS { m3100Notification 1};

**protectionAlarmBeh BEHAVIOUR
DEFINED AS**

"The protectionAlarm notification is emitted from the Protection Group object to report any protection mechanism failure or protecting resource failure.";

3.5 Parameters

3.5.1 Protection Status Parameter R1

**protectionStatusParameterR1 PARAMETER
CONTEXT EVENT-INFO;
WITH SYNTAX M3100ASN1Module3.ProtectionStatusParameterR1;
BEHAVIOUR protectionStatusParameterR1Beh;
REGISTERED AS {m3100Parameter 65};**

**protectionStatusParameterR1Beh BEHAVIOUR
DEFINED AS**

"This parameter is included in the additional info field of the protectionSwitchReporting notification. This parameter is used according to the following rules. – See description in 2.2";

4 Supporting ASN.1

The following ASN.1 productions are added by this amendment to M.3100:

**M3100ASN1Module3 {itu-t recommendation m gnm(3100) informationModel(0) asn1Modules(2) asn1Module3(2)
}**

DEFINITIONS IMPLICIT TAGS ::=

BEGIN

-- EXPORTS everything

IMPORTS

SwitchStatus FROM

**SDHProtASN1 {itu(0) recommendation(0) g(7) g774(774) hyphen(127) prot(3) informationModel(0)
asn1Module(2) sdhmsp(0)};**

**AutoSwitchReason ::= ENUMERATED {
waitToRestore (0),
resourceDegrade (1),
resourceFailed (2) }**

**ProtectionStatusR1 ::= SET OF CHOICE {
noRequest [0] NULL,
doNotRevert [1] NULL,
manualSwitch [2] SEQUENCE {
switchStatus [1] SwitchStatus,
relatedUnit [2] FromAndToProtectionUnit},
autoSwitch [3] SEQUENCE {
switchStatus [1] SwitchStatus,
relatedUnit [2] FromAndToProtectionUnit,
autoSwitchReason [3] AutoSwitchReason},
forcedSwitch [4] SEQUENCE {
switchStatus [1] SwitchStatus,
relatedUnit [2] FromAndToProtectionUnit},
lockout [5] CHOICE {
switchStatus [1] SwitchStatus,
releaseFailed [2] NULL},**

```
releaseFailed      [6] NULL,
resourceFailed     [7] NULL,
lockedIn           [8] NULL}
```

```
ProtectionStatusParameterR1 ::= SEQUENCE {
    oldProtectionStatus      ProtectionStatusR1,
    newProtectionStatus      ProtectionStatusR1}
```

```
FromAndToProtectionUnit ::= CHOICE {
    fromProtectionUnitNumber [0] RelativeDistinguishedName,
    toProtectionUnitNumber  [1] RelativeDistinguishedName }
```

-- For a protected PU, both the fromProtectionUnitNumber and the toProtectionUnitNumber hold the number of the -- related protecting PU. When switching to the protecting PU (service on the protecting PU), the -- toProtectionUnitNumber choice is used. When switching back to the protected PU (service on the protected PU), -- the fromProtectionUnitNumber choice is used.

-- For a protecting PU, both the fromProtectionUnitNumber and the toProtectionUnitNumber hold the number of the -- related protected PU. When switching to the protected PU (service on the protected PU), the toProtectionUnitNumber -- choice is used. When switching back to the protecting PU (service on the protecting PU), the --fromProtectionUnitNumber choice is used.

```
LockedInCondition ::= SEQUENCE {
    settingWindowTime [0] INTEGER, -- number of seconds
    releasingWindowTime [1] INTEGER, -- number of seconds
    hitsCount          [2] INTEGER}
```

```
ResourcePointer ::= CHOICE{
    null           NULL,
    objectInstances SET OF ObjectInstance }
```

```
ProtectionAlarmInfo ::= SEQUENCE {
    probableCause      ProbableCause,
    additionalInfo     AdditionalInformation }
```

END

4.1 Additions to base M.3100 ASN.1 module

Add the following productions to the ASN1DefinedTypesModule:

-- additional Probable Causes as following:

```
protectionMechanismFailure    ProbableCause ::= localValue : 81
protectingResourceFailure      ProbableCause ::= localValue : 82
```

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