INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.774.10

(02/2001)

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital terminal equipments – Operations, administration and maintenance features of transmission equipment

Synchronous Digital Hierarchy (SDH) – Multiplex Section (MS) shared protection ring management for the network element view

ITU-T Recommendation G.774.10

(Formerly CCITT Recommendation)

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TESTING EQUIPMENTS	G.500–G.599
TRANSMISSION MEDIA CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
General	G.700–G.709
Coding of analogue signals by pulse code modulation	G.710–G.719
Coding of analogue signals by methods other than PCM	G.720–G.729
Principal characteristics of primary multiplex equipment	G.730–G.739
Principal characteristics of second order multiplex equipment	G.740–G.749
Principal characteristics of higher order multiplex equipment	G.750–G.759
Principal characteristics of transcoder and digital multiplication equipment	G.760–G.769
Operations, administration and maintenance features of transmission equipment	**G.770–G.779**
Principal characteristics of multiplexing equipment for the synchronous digital hierarchy	G.780–G.789
Other terminal equipment	G.790–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999

For further details, please refer to the list of ITU-T Recommendations.

ITU-T Recommendation G.774.10

Synchronous Digital Hierarchy (SDH) Multiplex Section (MS) shared protection ring management for the network element view

Summary

This Recommendation provides an information model for the Synchronous Digital Hierarchy (SDH) Network. This model describes the managed object classes and their properties for the configuration and post-configuration management of the protection switching function of SDH Multiplex Section (MS) Shared Protection Ring (SPR), as defined in ITU-T G.803 [12], ITU-T G.841 [15] and ITU-T G.842 [16]. These objects are useful to describe information exchanged across interfaces defined in ITU-T M.3010 [3] Telecommunications Management Network (TMN) architecture for the configuration and post-configuration management of the protection function.

History	
Issue	**Notes**
2001	Initial version of the Recommendation.

Source

ITU-T Recommendation G.774.10 was revised by ITU-T Study Group 15 (2001-2004) and approved under the WTSA Resolution 1 procedure on 9 February 2001.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation G.774.10

Synchronous Digital Hierarchy (SDH) – Multiplex Section (MS) shared protection ring management for the network element view

1 Scope

This Recommendation addresses the configuration and post-configuration management of automatic protection switching within the multiplex section (MS) shared protection ring (SPR), high and low order path layers. It covers the protection functions as described in ITU-T G.841 [15] and ITU-T G.842 [16].

It identifies the Telecommunications Management Network (TMN) object classes required for the management of the MS SPR protection function for SDH network elements. These objects are relevant to information exchanged across standardized interfaces defined in ITU-T M.3010 [3] TMN architecture.

Structure of this Recommendation

Clause 5 provides an overview of the SDH MS SPR protection information model. Clauses 6 to 13 describe the information model using the notation mechanisms defined in ITU-T X.722 [7]. Clause 13 contains the syntax definitions of the information carried in the protocol using Abstract Syntax Notation One (ASN.1) defined in ITU-T X.680 [8]. Containment and Inheritance are illustrated in Appendix I.

2 References

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: 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.

[1] ITU-T G.707/Y.1322 (2000), *Network node interface for the synchronous digital hierarchy (SDH).*

[2] ITU-T G.708 (1999), *Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)*.

[3] ITU-T M.3010 (2000), *Principles for a telecommunication management network.*

[4] ITU-T M.3100 (1995), *Generic network information model*.

[5] ITU-T G.783 (2000), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks*.

[6] ITU-T G.784 (1999), *Synchronous digital hierarchy (SDH) management*.

[7] ITU-T X.722 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects, plus* Amd.1 (1995), Amd.2 (1997) and Cor.1 (1996).

[8] ITU-T X.680 (1997), *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

[9] ITU-T X.720 (1992), *Information technology – Open Systems Interconnection – Structure of Management Information: Management information model, plus* Amd.1 (1995) and Cor.1 (1994).

[10] ITU-T G.774 (2001), *Synchronous digital hierarchy (SDH) – Management information model for the network element view*.

[11] ITU-T G.774.1 (2001), *Synchronous digital hierarchy (SDH) – Bidirectional performance monitoring for the network element view*.

[12] ITU-T G.803 (2000), *Architecture of transport networks based on the synchronous digital hierarchy (SDH)*.

[13] ITU-T X.721 (1992), *Information technology – Open Systems Interconnection – Structure of management information – Definition of management information, plus* Cor.1 (1994), Cor.2 (1996), Cor.3 (1998) and Cor.4 (2000).

[14] ITU-T G.774.3 (2001), *Synchronous digital hierarchy (SDH) – Management of multiplex-section protection for the network element view*.

[15] ITU-T G.841 (1998), *Types and characteristics of SDH network protection architectures*.

[16] ITU-T G.842 (1997), *Interworking of SDH network protection architectures*.

[17] ITU-T G.774.4 (2001), *Synchronous digital hierarchy (SDH) – Management of the subnetwork connection protection for the network element view*.

[18] ITU-T G.774.9 (2001), *Synchronous digital hierarchy (SDH) – Configuration of linear multiplex section protection for the network element view*.

3 Terms and Definitions

This Recommendation uses the terms and definitions defined in ITU-T G.774, ITU-T G.784, ITU-T G.841, ITU-T G.842 and ITU-T M.3100.

4 Abbreviations

This Recommendation uses the following abbreviations:

AIS	Alarm Indication Signal
APDU	Application Protocol Data Unit
APS	Automatic Protection Switching
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CTP	Connection Termination Point
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LOF	Loss Of Frame
LOS	Loss Of Signal
MS	Multiplex Section
MSP	Multiplex Section Protection
NE	Network Element

OS	Operations System
OSI	Open Systems Interconnection
Pkg	Package
RDN	Relative Distinguished Name
RRP	Reliable Resource Pointer
SD	Signal Degrade
SDH	Synchronous Digital Hierarchy
SF	Signal Fail
SNCP	Subnetwork Connection Protection
SPR	Shared Protection Ring
STM-N	Synchronous Transport Module N
TMN	Telecommunications Management Network
TP	Termination Point
TTP	Trail Termination Point
URP	Unreliable Resource Pointer
WTR	Wait-to-Restore

5 SDH MS shared protection ring (SPR) protection management

The SDH MS SPR model is based on those generic classes and modeling principles outlined in ITU-T M.3100 and on those common classes from ITU-T G.774.3.

5.1 SDH MS SPR protection management requirements

The management information model of the MS SPR protection shall support the following requirements:

- According to the layer concept described in ITU-T G.805, it shall be possible to add/remove or modify a layer network inside the NE having no effect on the other layers. That is, the MS SPR protection sublayer has to be introduced inside the MS layer from the functional point of view without having any effect on Path layer.
- The establishment and dismiss of MS SPR protection has to be done without affecting traffic.
- The migration from already deployed network to a MS SPR has to be done without traffic cut, including migration from SNCP ring to 2F/4F MS SPR and migration from 2F to 4F ring.
- According to ITU-T G.841, the model should support any kind of path layer traffic, including unidirectional point-to-point, unidirectional point-to-multipoint (broadcast), and bidirectional.
- The existing capabilities of dynamic connection configuration (creation, deletion and modification) have to be maintained; especially in case of modifications that do not affect traffic. (Add/remove leg, add/remove Drop and Continue for dual homing application, RIP table.)
- Configure 2-Fiber or 4-Fiber MS SPR or Transoceanic application.
- The information model shall support bidirectional ring switch.

– The information model shall support 4-Fiber bidirectional span switch.
– The information model shall support forced and manual switch.
– The information model shall support lock out of the protected and protecting facility.
– The information model shall support exercise of protection switch for maintenance activity.
– The information model shall support wait-to-restore time provisioning.
– Modifying the ring topology without impacting existing traffic as long as the node being removed is not involved in the traffic.
– Modifying the G.841 node ID (consequent change to ring map configuration) without causing spurious protection switch. This may happen because until the update are completed in all the nodes, the ring data may not be consistent.
– Changing a channel from NUT type to protected-type should not affect its traffic.
– Changing a channel from protected type to NUT type shall be allowed. If the channel is not in protection, the change shall not affect the traffic.
– Updating squelching information should not cause interruption to traffic.
– Configuration of a NE to support multiple MS SPR and the interconnection among these rings.

5.2 SDH MS SPR information model overview

The model provides a similar way to control and operate the MS SPR protection function as the other protection functions. The model defines two subclasses of the generic G.774.3 protection model:

– **msSPRProtectionGroup**, which represents the association of unreliable resources for the purpose of automatic protection switching and which is the focal point for all management operation related to the MS SPR protection function.
– **msSPRProtectionUnit**, which represents the protected or the protecting unit and which represents the assignment of an unreliable resource to one reliable resource. The **msSPRProtectionUnit** is contained by a **msSPRProtectionGroup**.

The model defines the following additional object classes specific for MS SPR:

– **sdhMSSPRProtectionCoordinator**, which is used specifically to configure SDH MS SPR protection schemes. Only one instance can be created in one NE. When the **establishProtection** action is successfully performed, the following objects are created: one **msSPRProtectionGroup** instance, 4 **msSPRProtectionUnit** instances, one **sPRingManager** instance, and one **squelchTable** instance are created as specified by the action information. Deletion of **msSPR** protection schemes is accomplished via the **dismissProtection** action. When this action is successfully performed the **sPRingManager** and all associated objects are deleted. The **changeSPRConfiguration** action is used to migrate between two fiber and four fiber configurations, or to add or remove NUT or RIP capability, without deleting all the other objects associated with the protection scheme. The result of this action is that the protection group and associated units are deleted and recreated with the appropriate conditional packages present.
– **sPRingManager**, which is used to characterize a single shared protection ring, providing a pointer to the **msSPRProtectionGroup** object, and containing instances of any other objects needed to support the ring (e.g. **nutTable**, **ripTable**, **squelchTable**).
– **nutTable**, which contains information to identify the channels that have been provisioned for Non-preemptible Unprotected Traffic (NUT), and identifies which type of switching (span or ring) is prohibited by the NUT.

– **ripTable**, which represents the RIP (Ring Interconnect on Protection) table in a secondary interconnection node. This table indicates the protection channels that are used to carry secondary circuits in dual-homed interconnection schemes, and the primary node, entry node, and exit node for each of those channels.

– **squelchTable** and **auSquelchTable**, which contain routing information to be used for squelching purposes.

This model also reuses existing object classes from ITU-T G.774.4 for the service selector function of the interconnection nodes in MS SPR, including:

– G.774.4 **sncpFabric**, which supports the interconnect function in MS SPR for the service selector function.

– G.774.4 **connectionProtectionGroupR1**, which is used for ring interconnection to choose between the signal coming in on the low speed side and the signal coming in on the high speed side from the other interconnection node.

– G.774.4 **connectionProtection**, which presents the protection unit (protected or protecting) and the assignment between an unreliable resource (high/low order path termination point) and a reliable resource (high/low order path termination point).

6 Managed object class definitions

6.1 auSquelchTable

```
auSquelchTable MANAGED OBJECT CLASS
DERIVED FROM "Recommendation X.721 | ISO/IEC 10165-2":top;
CHARACTERIZED BY
"Recommendation M.3100":attributeValueChangeNotificationPackage,
auSquelchTablePkg PACKAGE
BEHAVIOUR auSquelchTableBeh;
ATTRIBUTES
     auNumber GET,
     auTable GET;;;
REGISTERED AS {g774-10MObjectClass 1};
auSquelchTableBeh BEHAVIOUR
DEFINED AS
     "This object class represents routing information to be used for squelching
purposes. Each instance of this object identifies a single administrative unit
(AU) in the NE for both the east and west sides of the NE.";
```

6.2 msSPRProtectionGroup

```
msSPRProtectionGroup MANAGED OBJECT CLASS
DERIVED FROM "Recommendation G.774-03":protectionGroupR1;
CHARACTERIZED BY
     "Recommendation G.774-03": protectionSwitchExercisePkg,
     msSPRProtectionGroupPkg PACKAGE
     BEHAVIOUR msSPRProtectionGroupBeh;
     ATTRIBUTES
          "Recommendation X.721":administrativeState GET-REPLACE,
          "Recommendation G.774-03":protectionGroupType
               PERMITTED VALUES SDHMSSPRASN1.MSSPRProtectionGroupType,
          "Recommendation G.774-03":revertive
               PERMITTED VALUES SDHMSSPRASN1.True;
     ACTIONS
          "Recommendation G.774-03":invokeProtection mSSPRLockoutTypeParameter,
          "Recommendation G.774-03":releaseProtection msSPRLockoutTypeParameter;
     NOTIFICATIONS
          "Recommendation G.774-03":protectionSwitchReportingR1
```

```
            msSPRProtectionStatusParameter;;;
      CONDITIONAL PACKAGES
           "Recommendation M.3100":tmnCommunicationsAlarmInformationPackage
      PRESENT IF "an instance supports reporting protection protocol failures via
      communicationsAlarms",
           "Recommendation M.3100":alarmSeverityAssignmentPointerPackage
                PRESENT IF "the tmnCommunicationsAlarmInformationPackage is
                present",
           wtrSpanPkg
                PRESENT IF "an instance represents a four fiber MS SPR with a
                single wait to restore time for both high-speed spans and the
                enhancedWtrSpanPkg is not present",
           enhancedWtrSpanPkg
                PRESENT IF "an instance represents a four fiber MS SPR with a
                separate wait to restore time for each high-speed span and the
                wtrSpanPkg is not present";
REGISTERED AS {g774-10MObjectClass 2};
msSPRProtectionGroupBeh BEHAVIOUR
DEFINED AS
"An msSPRProtectionGroup object instance contains four msSPRProtectionUnit
objects to define a MS Shared Protection Ring (SPR) protection switching
relationship for two or four fiber MS SPR architectures. If the ring has a four-
fiber architecture, either the wtrSpanPkg or enhancedWtrSpanPkg must be present.
The administrativeState attribute is used to manage the participation of the
protection group in the APS protocol. This capability can be used to avoid
spurious switches when a ring is being initialized or modified. When the
administrativeState is unlocked, the protection group participates fully in the
APS protocol. When the administrativeState is locked, the protection group does
not respond to incoming switch requests (either via K-bytes or management
request); the outgoing K-bytes shall be defaulted as specified in Recommendation
G.841. When the administrativeState is set to shuttingDown, the protectionGroup
shall transition to the locked administrativeState when all switches at the node
have cleared (i.e. when no protected traffic is using protecting bandwidth).
If the tmnCommunicationsAlarmPkg is present, a communicationsAlarm notification
shall be issued if the protection architecture cannot write or detect and process
the contents of the APS channel appropriately. The probableCause parameter of the
notification shall indicate msSPRApsChannelProcessingFailure.
If the tmnCommunicationsAlarmPkg is present, a communicationsAlarm notification
shall be issued if APS trouble defects are declared in an. APS trouble defects
include Default K Bytes, Inconsistent APS Codes, Node ID Mismatch, and Improper
APS Codes. The probableCause parameter of the notification shall indicate
msSPRDefaultKBytes, msSPRInconsistentApsCodes, msSPRNodeIdMismatch, or
msSPRImproperApsCodes.
The inherited protectionGroupType attribute shall always have the value "colon,"
since a two-fiber MS SPR represents a 1:1 protection scheme, and a four fiber MS
SPR represents a 2:1 protection scheme.
The inherited waitToRestoreTime attribute specifies the Wait To Restore (WTR)
time for ring protection switches, since only ring switches are common to both
two and four fiber MS SPRs. If the MS SPR is four fiber, the
waitToRestoreTimeSpan attribute (in the wtrSpanPkg conditional package) or the
enhancedWaitToRestoreTimeSpan attribute (in the enhancedWtrSpanPkg conditional
package) specifies the WTR time for span switches.
The inherited revertive attribute specifies shall always have the value "True",
since MS SPRs are required to operate in the revertive mode.
The invokeProtection action, which is inherited from the protectionGroupR1 object
class, can be used to request a lockout (i.e., lockout of one or more protection
units in a msSPRProtectionGroup), a forced switch (span or ring), or a manual
switch (span or ring) on one or more msSPRProtectionUnit instances contained in
the msSPRProtectionGroup object. The msSPRProtectionUnit instances involved in
the protection switch must be indicated explicitly in the action argument.
The releaseProtection action inherited from the protectionGroupR1 object class
can be used to release a lockout  (i.e., release lockout of one or more
protection units in a msSPRProtectionGroup), a forced switch (span or ring), or a
manual switch (span or ring) on one or more msSPRProtectionUnit instances
```

contained in the **msSPRProtectionGroup** object. The **msSPRProtectionUnit** instances involved in the protection release must be indicated explicitly in the action argument.
The **invokeExercise** action can be used to initiate an exercise (ring for two fiber, ring or span for four fiber). The **msSPRProtectionUnit** instances involved in the protection exercise must be indicated explicitly in the action argument.
The **protectionSwitchReportingR1** notification is emitted from the **msSPRProtectionGroup** object to report any protection switching events as described in the **msSPRProtectionStatusParameter**, such as a protection switch (forced (span or ring) switch, manual (span or ring) switch, or automatic (span or ring) switch), protection release (release of forced (span or ring) switch, manual (span or ring) switch, or automatic (span or ring) switch), lockout, or release of lockout.
A change in the value of the **administrativeState** or **operationalState** shall cause a **stateChange** notification (inherited) to be emitted.
A change in the value of the following attributes, provided the attribute is present in the managed object, and the **attributeValueChange** notification is supported, shall cause an **attributeValueChange** notification: **waitToRestoreTime** (inherited), **waitToRestoreTimeSpan**, **enhancedWaitToRestoreTimeSpan**.";

6.3 msSPRProtectionUnit

```
msSPRProtectionUnit MANAGED OBJECT CLASS
DERIVED FROM "Recommendation G.774-03":protectionUnit;
CHARACTERIZED BY
     "Recommendation G.774-03":lastAttemptResultPkg,
     msSPRProtectionUnitPkg PACKAGE
     BEHAVIOUR msSPRProtectionUnitBeh;
     ATTRIBUTES
          "Recommendation G.774-03":reliableResourcePointer
               PERMITTED VALUES SDHMSSPRASN1.SDHMSResourcePointer
               GET,
          "Recommendation G.774-03":unreliableResourcePointer
               PERMITTED VALUES SDHMSSPRASN1.SDHMSResourcePointer
               GET,
          msSPRProtectionStatus GET,
          ringPU GET;;;
CONDITIONAL PACKAGES
fourFiberPUPkg
PRESENT IF "an instance supports a four fiber MS SPR",
"Recommendation G.774-03": extraTrafficControlPkg
PRESENT IF "extra traffic may be suspended and resumed";
REGISTERED AS {g774-10MObjectClass 3};
msSPRProtectionUnitBeh BEHAVIOUR
DEFINED AS
"This object class is specific to MS Shared Protection Ring (SPR) protection
systems. Instances of this object class represent a relationship between a
protectedTTP and an unprotectedCTP. If this is a protecting protection unit, the
reliableResourcePointer points to a protectedTTP for extra traffic or NULL if
there is no extra traffic.
When a SPR node enters the pass through state (either full or partial), the
unprotectedCTP upstream and downstream connectivity pointers managed by the two
protecting msSPRProtectionUnit protection units (on either side of the node)
shall be updated to point to each other.
The ringPU attribute points to the msSPRProtectionUnit that would be involved in
a ring switch (or release), or the associated msSPRProtectionUnit on the other
(or opposite) side of the SPR node. This attribute is applicable to both two and
four fiber SPRs.
The spanPU attribute (in the fourFiberPUPkg) points to the msSPRPotectionUnit
that would be involved in a span switch (or release), or the associated
msSPRPotectionUnit on the same side of the SPR node. This attribute is applicable
only to four fiber SPRs.";
```

6.4 nutTable

```
nutTable MANAGED OBJECT CLASS
DERIVED FROM "Recommendation X.721 | ISO/IEC 10165-2":top;
CHARACTERIZED BY
     "Recommendation M.3100":attributeValueChangeNotificationPackage,
     nutTablePkg PACKAGE
          BEHAVIOUR nutTableBeh;
          ATTRIBUTES
               nutTableId GET,
               nutChannelList GET-REPLACE ADD-REMOVE;;;
REGISTERED AS {g774-10MObjectClass 4};
nutTableBeh BEHAVIOUR
DEFINED AS
     "This object class contains information to identify the channels that have
been provisioned for Non-preemptible Unprotected Traffic (NUT), and identifies
which type of switching (span or ring) is prohibited by the NUT. In a 2-fiber
ring, span switches are always unavailable, and the corresponding component of
the syntax shall be absent. A change in the value of the nutChannelList attribute
shall cause an attributeValueChange notification to be emitted.";
```

6.5 ripTable

```
ripTable MANAGED OBJECT CLASS
DERIVED FROM "Recommendation X.721 | ISO/IEC 10165-2":top;
CHARACTERIZED BY
     "Recommendation M.3100":attributeValueChangeNotificationPackage,
     ripTablePkg PACKAGE
          BEHAVIOUR ripTableBeh;
          ATTRIBUTES
               ripTableId GET,
               ripChannelList GET;
          ACTIONS
               updateRipTable;;;
REGISTERED AS {g774-10MObjectClass 5};
ripTableBeh BEHAVIOUR
DEFINED AS
     "This object class represents the RIP table in a secondary interconnection
node. This table indicates the protection channels that are used to carry
secondary circuits in dual-homed interconnection schemes, and the primary node
and terminating node for each of those channels. The table is updated as a result
of the updateRipTable action. A change in the value of the ripChannelList shall
cause an attributeValueChange notification to be emitted.";
```

6.6 sdhMSSPRProtectionCoordinator

```
sdhMSSPRProtectionCoordinator MANAGED OBJECT CLASS
DERIVED FROM "Recommendation G.774-09":protectionCoordinator;
CHARACTERIZED BY
     sdhMSSPRProtectionCoordinatorPkg PACKAGE
     BEHAVIOUR sdhMSSPRProtectionCoordinatorBeh;
     ACTIONS
          "Recommendation G.774-09":establishProtection
                    msSPRProtectionGroupConfigParameter
                    msSPRConfigurationError;;;
CONDITIONAL PACKAGES
     changeSPRConfigurationPkg PRESENT IF "the network element supports
modification of SPR configuration (number of fibers, NUT, RIP, extra traffic)
without traffic disruption";
REGISTERED AS {g774-10MObjectClass 6};
sdhMSSPRProtectionCoordinatorBeh BEHAVIOUR
```

DEFINED AS

"This object class is used specifically to configure SDH MSSPR protection schemes. Only one instance can be created in one NE.
When the **establishProtection** action is successfully performed, the following objects are created: one **msSPRProtectionGroup** instance, 4 **msSPRProtectionUnit** instances, one **sPRingManager** instance, and one **squelchTable** instance are created as specified by the action information. If appropriate, an instance of **nutTable** and/or **ripTable** is also created. The **unreliableResourcePointer** of each **msSPRProtectionUnit** will point to the **unprotectedCTP** indicated by the **unreliableObjects** field of the action information. The **reliableResourcePointer** will point to the **protectedTTP** connected to the **unprotectedCTP**, unless the **protectionUnit** is protecting and extra traffic is not required or not supported (in this case the **reliableResourcePointer** is NULL).
Since the **protectionGroupType** of **msSPRProtectionGroup** is always 'colon', the **protectionGroupType** field of the argument of the **establishProtection** action shall always be 'colon' or not present in the argument. Since the MS-SPR protection scheme is always revertive, the revertive field os the **establishProtection** action shall always be true; the **waitToRestoreTime** field shall specify the wait to restore time for ring switches. The priority field of the argument of the **establishProtection** action shall not be present in the argument. Additional information specific to the MS SPR is conveyed via the parameters attached to the **establishProtection** action.
To avoid spurious protection switches, the **msSPRProtectionGroup** is created with the **administrativeState** set to locked.
UnprotectedCTPs and **protectedTTPs** are always instantiated for multiplex sections that can potentially be included in a protection group irrespective of whether protection is actually present or not. When a section is not part of a protection group, the **crossConnectionObjectPointer** of the **unprotectedCTP** and **protectedTTP** point to the **managedElement**. When protection is established, the **crossConnectionObjectPointer** points to the assocaited **msSPRProtectionUnit**. When it is possible, **unprotectedCTPs** and **protectedTTPs** may be created/deleted as a result of the establish/dismiss actions.
Deletion of **msSPR** protection schemes is accomplished via the **dismissProtection** action. When this action is successfully performed the **sPRingManager** and all associated objects are deleted.
The **changeSPRConfiguration** action is used to migrate between two fiber and four fiber configurations, or to add or remove NUT or RIP capability, without deleting all the other objects associated with the protection scheme. The result of this action is that the protection group and associated units are deleted and recreated with the appropriate conditional packages present.";

6.7 sPRingManager

```
sPRingManager MANAGED OBJECT CLASS
DERIVED FROM "Recommendation X.721 | ISO/IEC 10165-2":top;
CHARACTERIZED BY
     "Recommendation M.3100":attributeValueChangeNotificationPackage,
     "Recommendation M.3100":createDeleteNotificationsPackage,
     sPRingManagerPkg PACKAGE
          BEHAVIOUR sPRingManagerBeh;
          ATTRIBUTES
               sPRingManagerId GET,
               directionTable GET,
               nodeNumber GET,
               protectionGroupPointer GET,
               ringId GET-REPLACE,
               ringMap GET,
               sPRingApplication GET;;;
CONDITIONAL PACKAGES
     manualSPRConfigurationPkg
          PRESENT IF "the direction table, node number, and ring map can be
modified by a manager",
     restoreExtraTrafficPkg PRESENT IF "configuration of extra traffic
restoration is supported";
```

REGISTERED AS {g774-10MObjectClass 7};
sPRingManagerBeh BEHAVIOUR
DEFINED AS
"This object class is used to characterize a single shared protection ring, providing a pointer to the **msSPRProtectionGroup** object, and containing instances of any other objects needed to support the ring (e.g. **nutTable**, **ripTable**, **squelchTable**).
The **directionTable** attribute identifies the TTPs on the east and west sides of the node over the relevant ring. This table is used to assist in populating the **squelchTable**.
The **nodeNumber** attribute indicates the node number within the ring for this node. The **ringMap** attribute indicates the sequence of nodes around the ring. The **ringId** provides an identifier that should be provisioned with the same value in each node on the ring.
The **sPRingApplication** attribute indicates whether the ring operates in classic mode or transoceanic mode.
A change in the value of the following attributes shall cause an **attributeValueChange** notification to be emitted: **directionTable**, **nodeNumber**, **ringId**, **ringMap**.";

6.8 squelchTable

```
squelchTable MANAGED OBJECT CLASS
DERIVED FROM "Recommendation X.721 | ISO/IEC 10165-2":top;
CHARACTERIZED BY
     "Recommendation M.3100":attributeValueChangeNotificationPackage,
     "Recommendation M.3100":createDeleteNotificationsPackage,
     squelchTablePkg PACKAGE
          BEHAVIOUR squelchTableBeh;
          ATTRIBUTES
               squelchTableId GET,
               currentSquelchingList GET;
          ACTIONS
               updateSquelchTable;;;
REGISTERED AS {g774-10MObjectClass 8};
squelchTableBeh BEHAVIOUR
DEFINED AS
```
"This object class serves as the head of the naming tree for each entry in the squelch table. Entries are managed as separate objects; the contents of these objects can be modified using the **updateSquelchTable** action.
The **currentSquelchingList** holds information regarding which channels are currently being squelched. A change in the value of the **currentSquelchingList** attribute shall case an **attributeValueChange** notification to be emitted.";

7 Packages

7.1 changeSPRConfigurationPkg

```
changeSPRConfigurationPkg PACKAGE
BEHAVIOUR changeSPRConfigurationPkgBeh;
ACTIONS changeSPRConfiguration;
REGISTERED AS {g774-10Package 1};
changeSPRConfigurationPkgBeh BEHAVIOUR
DEFINED AS
```
"This package provides an action that allows the manager to make changes to the SPR functions without disruption of existing service (provided that the requested changes are compatible with the existing service). The allowable changes are: migration from two-fiber to four-fiber operation and vice versa; enabling and disabling non-user preemptible traffic; enabling and disabling ring interworking on protection; and enabling and disabling extra traffic.";

7.2 enhancedWtrSpanPkg

```
enhancedWtrSpanPkg PACKAGE
BEHAVIOUR enhancedWtrSpanPkgBeh;
ATTRIBUTES
     enhancedWaitToRestoreTimeSpan GET-REPLACE;
REGISTERED AS {g774-10Package 2};
enhancedWtrSpanPkgBeh BEHAVIOUR
DEFINED AS
"This package provides additional information necessary to support four fiber MS
SPR protection architectures with separate wait to restore times for each span.
The enhancedWaitToRestoreTimeSpan attribute specifies the wait to restore time
for a span switch for each span. A change in the value of the
enhancedWaitToRestoreTimeSpan attribute shall cause an attributeValueChange
notification to be emitted.";
```

7.3 fourFiberPUPkg

```
fourFiberPUPkg PACKAGE
BEHAVIOUR fourFiberPUPkgBeh;
ATTRIBUTES
spanPU GET;
REGISTERED AS {g774-10Package 3};
fourFiberPUPkgBeh BEHAVIOUR
DEFINED AS
"This package provides additional information necessary to support four fiber MS
SPR protection architectures. The spanPU attribute in this package indicates
which corresponding protection unit in the protection group will be involved in a
span switch or span switch release. ";
```

7.4 manualSPRConfigurationPkg

```
manualSPRConfigurationPkg PACKAGE
     BEHAVIOUR manualSPRConfigurationPkgBeh;
     ATTRIBUTES
     directionTable GET-REPLACE,
     nodeNumber GET-REPLACE,
     ringMap GET-REPLACE;
REGISTERED AS {g774-10Package 4};
manualSPRConfigurationPkgBeh BEHAVIOUR
DEFINED AS
     "This package provides the ability to configure the values of the
directionTable, nodeNumber, and ringMap attributes. It is used when autodiscovery
of this information is not supported.";
```

7.5 restoreExtraTrafficPkg

```
restoreExtraTrafficPkg PACKAGE
     BEHAVIOUR restoreExtraTrafficPkgBeh;
     ATTRIBUTES
          restoreExtraTraffic
               DEFAULT VALUE SDHMSSPRASN1.booleanTrueDefault
               GET-REPLACE;
REGISTERED AS {g774-10Package 5};
restoreExtraTrafficPkgBeh BEHAVIOUR
DEFINED AS
     "The restoreExtraTraffic attribute indicates whether extra traffic is to be
automatically re-established after the completion of a normal protection
switching session (i.e. after traffic is restored on the protected facility). The
value TRUE indicates that the automatic restoration should occur.";
```

7.6 wtrSpanPkg

wtrSpanPkg PACKAGE
BEHAVIOUR wtrSpanPkgBeh;
ATTRIBUTES
waitToRestoreTimeSpan GET-REPLACE;
REGISTERED AS {g774-10Package 6};
wtrSpanPkgBeh BEHAVIOUR
DEFINED AS
"This package provides additional information necessary to support four fiber MS SPR protection architectures with a single wait to restore time for both high-speed spans. The **waitToRestoreTimeSpan** attribute specifies the wait to restore time for a span switch. A change in the value of the **waitToRestoreSpan** attribute shall cause an **attributeValueChange** notification to be emitted.";

8 Attributes

8.1 auTable

auTable ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.SquelchTableEntry;
MATCHES FOR EQUALITY;
BEHAVIOUR auTableBeh;
REGISTERED AS {g774-10Attribute 1};
auTableBeh BEHAVIOUR
DEFINED AS
"This attribute specifies the current squelch table for an individual AU. The value of this attribute is updated automatically as a result of the **updateSquelchTable** action. The table is divided into East and West, which can be determined by referencing the **directionTable** attribute of the **sPRingManager** object.
The **aNode** and **zNode** fields indicate the source and destination of the circuit, respectively (or NULL if no circuit using the channel in that direction).
If an AU is part of a contiguously concatenated signal, but is not the first AU in that concatenated signal, it shall still be represented in the AU Squelch Table. The information for all of the concatenated channels shall be the same, with the exception of the "concatenated" field; the first channel shall indicate the number of concatenated AU channels, while all others simply indicate that they are concatenated to a previous channel.";

8.2 auNumber

auNumber ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NameType;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR auNumberBeh;
REGISTERED AS {g774-10Attribute 2};
auNumberBeh BEHAVIOUR
DEFINED AS
"The **auNumber** attribute is an attribute type whose distinguished value can be used as an RDN when naming an instance of the **auSquelchTable** managed object class. This attribute identifies the AU number of the working AU in an STM-N system. The value shall be the integer that represents the position of the AU in temporal order. The first AU shall be numbered one. If M working AUs are available, the range of possible values for this shall attribute be 1 through M.";

8.3 currentSquelchingList

```
currentSquelchingList ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.CurrentSquelchingList;
MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR currentSquelchingListBeh;
REGISTERED AS {g774-10Attribute 3};
currentSquelchingListBeh BEHAVIOUR
DEFINED AS
"This attribute contains a list of termination points and their associated cross-
connection objects that are currently being squelched. If the AU is not cross-
connected (i.e. hardwired), the cross-connection object choice is not used. ";
```

8.4 directionTable

```
directionTable ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.DirectionTable;
MATCHES FOR EQUALITY;
BEHAVIOUR directionTableBeh;
REGISTERED AS {g774-10Attribute 4};
directionTableBeh BEHAVIOUR
DEFINED AS
"This attribute specifies the direction table. It specifies msTTP object
instances for both the East and West high speed sides of the sdhNE. East implies
the side of the network element that is associated with the direction of the
(n+1)th node in the ring indicated in the sequence of the ring map; West implies
the side of the network element that is associated with the direction of the
(n-1)th node in the ring indicated in the sequence of the ring map, where the nth
node is the node in which the table resides. Note that n-1 and n+1 indicate the
element in the sequence, not the actual number of the node. The last node in the
sequence is the (n-1)th node of the first node in the sequence. Likewise, the
first node in the sequence is the (n+1)th node to the last node in the sequence.
";
```

8.5 enhancedWaitToRestoreTimeSpan

```
enhancedWaitToRestoreTimeSpan ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.EnhancedWaitToRestoreSpan;
MATCHES FOR EQUALITY;
BEHAVIOUR enhancedWaitToRestoreTimeSpanBeh;
REGISTERED AS {g774-10Attribute 5};
enhancedWaitToRestoreTimeSpanBeh BEHAVIOUR
DEFINED AS
"This attribute indicates the wait to restore time, in seconds, for a span
switch. The value is specified separately for the east and west spans.";
```

8.6 msSPRProtectionStatus

```
msSPRProtectionStatus ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.MSSPRProtectionStatus;
MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR msSPRProtectionStatusBeh;
REGISTERED AS {g774-10Attribute 6};
msSPRProtectionStatusBeh BEHAVIOUR
DEFINED AS
"This attribute is used to indicate the status of the MS SPR protection switch in
a msSPRProtectionUnit object instance.
This attribute is set-valued because some requests are allowed to be pending. The
following rule shall be followed: only one of the values lockout, forcedSwitch
(span or ring), or manualSwitch (span or ring) can be present at the same time,
either local or remote. It is also possible to have two or more pending automatic
switch (span or ring) requests. The msSPRProtectionStatus attribute of a
```

msSPRProtectionUnit that provides protection is used to hold the protection request that is actually performed on that **msSPRProtectionUnit**.
The following is a list of all the possible status values of the **msSPRProtectionStatus** attribute for a protected **msSPRProtectionUnit** object instance:

- No Request: No switch request is present on the unit.
- Manual Ring Switch to Protecting Complete: The unit has completed a manual ring switch.
- Manual Span Switch to Protecting Complete: The unit has completed a manual span switch (Four-Fiber Rings only).
- Release failed: A switch has been released or pre-empted and a time-out occurs while waiting for a release of associated bridges, or the near-end switch.
- Automatic Ring Switch (SF) Pending: The unit has a Signal Fail condition present and the protecting unit for a ring switch is unavailable.
- Automatic Ring Switch (SD) Pending: The unit has a Signal Degrade condition present and the protecting unit for a ring switch is unavailable.
- Automatic Ring Switch (SF) Complete: The unit has completed an automatic ring switch to the protecting unit due to a Signal Fail condition.
- Automatic Span Switch (SF) Complete: The unit has completed an automatic span switch to the protecting unit due to a Signal Fail condition.
- Automatic Ring Switch (SD) Complete: The unit has completed an automatic ring switch to the protecting unit due to a Signal Degrade condition.
- Automatic Span Switch (SD) Complete: The unit has completed an automatic span switch to the protecting unit due to a Signal Degrade condition.
- Automatic Ring Switch (SF) Present, Operate Failed: An automatic ring switch (due to a Signal Fail condition) request is in progress and a time-out occurs while waiting for completion.
- Automatic Span Switch (SF) Present, Operate Failed: An automatic span switch (due to a Signal Fail condition) request is in progress and a time-out occurs while waiting for completion (Four-Fiber Ring only).
- Automatic Ring Switch (SD) Present, Operate Failed: An automatic ring switch (due to a Signal Degrade condition) request is in progress and a time-out occurs while waiting for completion.
- Automatic Span Switch (SD) Present, Operate Failed: An automatic span switch (due to a Signal Degrade condition) request is in progress and a time-out occurs while waiting for completion (Four-Fiber Ring only).
- Force Ring Switch Complete, Automatic Ring Switch (SF) Pending: The unit has completed a Force ring switch. Additionally, the unit has an automatic ring switch (SF) pending.
- Force Ring Switch Complete, Automatic Span Switch (SF) Pending: The unit has completed a Force ring switch. Additionally, the unit has an automatic span switch (SF) pending (Four-Fiber Ring only).
- Force Span Switch Complete, Automatic Ring Switch (SF) Pending: The unit has completed a Force span switch. Additionally, the unit has an automatic ring switch (SF) pending (Four- Fiber Ring only).
- Force Span Switch Complete, Automatic Span Switch (SF) Pending: The unit has completed a Force span switch. Additionally, the unit has an automatic span switch (SF) pending (Four-Fiber Ring only).
- Force Ring Switch Complete, Automatic Ring Switch (SD) Pending: The unit has completed a Force ring switch. Additionally, the unit has an automatic ring switch (SD) pending.
- Force Ring Switch Complete, Automatic Span Switch (SD) Pending: The unit has completed a Force ring switch. Additionally, the unit has an automatic span switch (SD) pending (Four-Fiber Ring only).
- Force Span Switch Complete, Automatic Ring Switch (SD) Pending: The unit has completed a Force span switch. Additionally, the unit has an automatic ring switch (SD) pending (Four-Fiber Ring only).
- Force Span Switch Complete, Automatic Span Switch (SD) Pending: The unit has completed a Force span switch. Additionally, the unit has an automatic span switch (SD) pending (Four-Fiber Ring only).
- Automatic Ring Switch Complete, Wait-to-Restore: The unit has completed an automatic ring switch to the protecting unit, and has entered the wait to restore state.

- Automatic Span Switch Complete, Wait-to-Restore: The unit has completed an automatic span switch to the protecting unit (Four-Fiber Ring only), and has entered the wait to restore state.
- Force Ring Switch complete: The unit has completed a Force ring switch to the protecting unit.
- Force Span Switch complete: The unit has completed a Force span switch to the protecting unit (Four-Fiber Ring only).
- Protected Unit Lockout Completed: The unit has been locked out from the protecting unit.
- Protected Unit Lockout Complete, 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.

The following allowable **msSPRProtectionStatus** values are associated with each protecting unit:

- No Request: No switch request is present on the unit.
- Manual Ring Switch to Protecting Complete: The protected unit has completed a manual ring switch.
- Manual Span Switch to Protecting Complete: The protected unit has completed a manual span switch (Four-Fiber Rings only).
- Automatic Ring Switch (SF) Complete to Protecting Unit: The protected unit has completed an automatic ring switch to the protecting unit due to a Signal Fail condition.
- Automatic Span Switch (SF) Complete to Protecting Unit: The protected unit has completed an automatic span switch to the protecting unit due to a Signal Fail condition (Four-Fiber Ring only).
- Automatic Ring Switch (SD) Complete to Protecting Unit: The protected unit has completed an automatic ring switch to the protecting unit due to a Signal Degrade condition.
- Automatic Span Switch (SD) Complete to Protecting Unit: The protected unit has completed an automatic span switch to the protecting unit due to a Signal Degrade condition (Four-Fiber Ring only).
- Automatic Ring Switch Complete (SF) to Protecting Unit, Protecting Unit Signal Degraded: The protected unit has completed an automatic ring switch to the protecting unit. Additionally, the protecting unit has a Signal Degrade condition present.
- Automatic Span Switch Complete (SF) to Protecting Unit, Protecting Unit Signal Degraded: The protected unit has completed an automatic span switch to the protecting unit. Additionally, the protecting unit has a Signal Degrade condition present (Four-Fiber Ring only).
- Automatic Ring Switch Complete (SD) to Protecting Unit, Protecting Unit Signal Degraded: The protected unit has completed an automatic ring switch to the protecting unit. Additionally, the protecting unit has a Signal Degrade condition present.
- Automatic Span Switch Complete (SD) to Protecting Unit, Protecting Unit Signal Degraded: The protected unit has completed an automatic span switch to the protecting unit. Additionally, the protecting unit has a Signal Degrade condition present (Four-Fiber Ring only).
- Protecting Unit Full Pass-through: The protecting unit is in full pass-through mode as a result of a ring switch elsewhere in the ring.
- Protecting Unit K-byte Pass-through: The protecting unit is in K-byte pass-through mode as a result of span switches elsewhere in the ring.
- Protecting Unit SD Present: The protecting unit has a Signal Degrade condition present. This state may also be a result improper or inconsistent APS code, default K-Bytes, or node ID mismatch.
- Protecting Unit SF Present: The protecting unit has a Signal Fail condition present. This state may also be a result improper or inconsistent APS code, default K-Bytes, or node ID mismatch.
- Force Ring Switch Complete to Protecting Unit: The protected unit has completed a Force ring switch to the protecting unit.
- Force Span Switch Complete to Protecting Unit: The protected unit has completed a Force span switch to the protecting unit (Four-Fiber Ring only).

- Force Ring Switch Complete to Protecting Unit, SD Present on Protecting Unit: The protected unit has completed a Force ring switch to the protecting unit. Additionally, there is a Signal Degrade present on the protecting unit.
- Force Span Switch Complete to Protecting Unit, SD Present on Protecting Unit: The protected unit has completed a Force span switch to the protecting unit. Additionally, there is a Signal Degrade present on the protecting unit (Four-Fiber Ring only).
- Protecting Unit Locked Out: The protecting unit has been locked out.
- Protecting Unit Locked Out, Release failed: A release of a lockout is in progress and a time-out occurs waiting for the lockout condition to clear.

";

8.7 nodeNumber

```
nodeNumber ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NodeNumber;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR nodeNumberBeh;
REGISTERED AS {g774-10Attribute 7};
nodeNumberBeh BEHAVIOUR
DEFINED AS
"This attribute contains the node identifier. It is an integer with value ranging from 0 to 15. ";
```

8.8 nutChannelList

```
nutChannelList ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NutChannelList;
MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR nutChannelListBeh;
REGISTERED AS {g774-10Attribute 8};
nutChannelListBeh BEHAVIOUR
DEFINED AS
"This attribute identifies the channels that have been provisioned for non-preemptible unprotected traffic. The NUT function can be provisioned separately for ring and span  switches, and can be provisioned for protected channels only, or for both protected and protecting channels.";
```

8.9 nutTableId

```
nutTableId ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NameType;
MATCHES FOR EQUALITY;
BEHAVIOUR nutTableIdBeh;
REGISTERED AS {g774-10Attribute 9};
nutTableIdBeh BEHAVIOUR
DEFINED AS
```

"The **nutTableId** attribute is an attribute type whose distinguished value can be used as an RDN when naming an instance of the **nutTable** managed object class.";

8.10 protectionGroupPointer

```
protectionGroupPointer ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NameType;
MATCHES FOR EQUALITY;
REGISTERED AS {g774-10Attribute 10};
```

8.11 restoreExtraTraffic

```
restoreExtraTraffic ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.BooleanType;
MATCHES FOR EQUALITY;
BEHAVIOUR restoreExtraTrafficBeh;
REGISTERED AS {g774-10Attribute 11};
restoreExtraTrafficBeh BEHAVIOUR
DEFINED AS
     "This attribute indicates whether extra traffic will be restored immediately
when a switch to protection is cleared.";
```

8.12 ringId

```
ringId ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.RingId;
MATCHES FOR EQUALITY;
BEHAVIOUR ringIdBeh;
REGISTERED AS {g774-10Attribute 12};
ringIdBeh BEHAVIOUR
DEFINED AS
"This attribute used for identifying the MS SPR protection ring associated with
the NE.  All NEs of the same protection ring shall have the same ringId value for
the associated ringMap.  ";
```

8.13 ringMap

```
ringMap ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.Map;
MATCHES FOR EQUALITY;
BEHAVIOUR ringMapBeh;
REGISTERED AS {g774-10Attribute 13};
ringMapBeh BEHAVIOUR
DEFINED AS
"This attribute contains ring map information. ";
```

8.14 ringPU

```
ringPU ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.RelativeDistinguishedName;
MATCHES FOR EQUALITY;
BEHAVIOUR ringPUBeh;
REGISTERED AS {g774-10Attribute 14};
ringPUBeh BEHAVIOUR
DEFINED AS
"This attribute identifies which protection unit will be associated with a ring
switch or ring switch release in a MS SPR architecture.  ";
```

8.15 ripChannelList

```
ripChannelList ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.RipChannelList;
MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR ripChannelListBeh;
REGISTERED AS {g774-10Attribute 15};
ripChannelListBeh BEHAVIOUR
DEFINED AS
"The ripChannelList identifies the protection channels that are being used for
RIP circuits. It also identifies the primary interconnection node and terminating
node for each RIP circuit.";
```

8.16 ripTableId

```
ripTableId ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NameType;
MATCHES FOR EQUALITY;
BEHAVIOUR ripTableIdBeh;
REGISTERED AS {g774-10Attribute 16};
ripTableIdBeh BEHAVIOUR
DEFINED AS
     "The ripTableId attribute is an attribute type whose distinguished value can
be used as an RDN when naming an instance of the ripTable managed object class.";
```

8.17 spanPU

```
spanPU ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.RelativeDistinguishedName;
MATCHES FOR EQUALITY;
BEHAVIOUR spanPUBeh;
REGISTERED AS {g774-10Attribute 17};
spanPUBeh BEHAVIOUR
DEFINED AS
"This attribute identifies which protection unit will be associated with a span
switch or span switch release in a MS SPR architecture.";
```

8.18 sPRingApplication

```
sPRingApplication ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.SPRingApplication;
MATCHES FOR EQUALITY;
BEHAVIOUR sPRingApplicationBeh;
REGISTERED AS {g774-10Attribute 18};
sPRingApplicationBeh BEHAVIOUR
DEFINED AS
"This attribute indicates the application of the SPR scheme. This determines how
the ring responds to failures. Possible values are classic or transoceanic.";
```

8.19 sPRingManagerId

```
sPRingManagerId ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NameType;
MATCHES FOR EQUALITY, ORDERING, SUBSTRINGS;
BEHAVIOUR sPRingCoordinatorIdBeh;
REGISTERED AS {g774-10Attribute 19};
sPRingCoordinatorIdBeh BEHAVIOUR
DEFINED AS
"This attribute used for naming instances of the sPRingManager object class. If
the string choice of the syntax is used, then matching on substrings is
permitted. If the number choice of the syntax is used, then matching on ordering
is permitted.";
```

8.20 squelchTableId

```
squelchTableId ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.NameType;
MATCHES FOR EQUALITY, ORDERING, SUBSTRINGS;
BEHAVIOUR squelchTableIdBeh;
REGISTERED AS {g774-10Attribute 20};
squelchTableIdBeh BEHAVIOUR
```

DEFINED AS
"This attribute is used for naming instances of the **squelchTable** object class. If the string choice of the syntax is used, then matching on substrings is permitted. If the number choice of the syntax is used, then matching on ordering is permitted. ";

8.21 waitToRestoreTimeSpan

```
waitToRestoreTimeSpan ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHMSSPRASN1.WaitToRestoreSpan;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR waitToRestoreTimeSpanBeh;
REGISTERED AS {g774-10Attribute 21};
waitToRestoreTimeSpanBeh BEHAVIOUR
DEFINED AS
"This attribute specifies the amount of time, in seconds, to wait after a fault
that caused a span switch in a four fiber MS SPR clears before restoring traffic
to the protected protection unit that initiated the switching.";
```

9 Actions

9.1 changeSPRConfiguration

```
changeSPRConfiguration ACTION
BEHAVIOUR changeSPRConfigurationBeh;
MODE CONFIRMED;
PARAMETERS
     msSPRConfigurationError,
     "Recommendation G.774-09":removeProtectionError;
WITH INFORMATION SYNTAX SDHMSSPRASN1.ChangeSPRConfigInfo;
REGISTERED AS {g774-10Action 1};
changeSPRConfigurationBeh BEHAVIOUR
DEFINED AS
     "This action is used to change the following aspects of the configuration of
a shared protection ring:
Two fiber to four fiber and vice versa. For four fiber configurations, there is
additionally a choice between normal mode (single wait to restore time for both
spans) and enhanced mode (separate wait to restore time for east and west spans).
Enable or disable extra traffic
Enable or disable Non-preemptible Unprotected Traffic (NUT)
Enable or disable Ring Interworking on Protection (RIP)
When the action is successfully performed, and either the number of fibers or the
extra traffic configuration is changed, the existing protection group and
contained protection units are deleted, and then recreated with the appropriate
conditional packages present. No other objects related to the SPR or the traffic
it carries are disturbed by this process.
When the action is successfully performed, and the NUT or RIP configuration is
changed, a nutTable and/or ripTable managed object instance is created or deleted
as appropriate. No other objects related to the SPR or the traffic it carries are
disturbed by this process. This action fails if the requested configuration is
not supported by the network element or is otherwise invalid.";
```

9.2 updateRipTable

```
updateRipTable ACTION
BEHAVIOUR updateRipTableBeh;
MODE CONFIRMED;
WITH INFORMATION SYNTAX SDHMSSPRASN1.UpdateRIPTableInfo;
WITH REPLY SYNTAX SDHMSSPRASN1.UpdateRIPTableReply;
REGISTERED AS {g774-10Action 2};
updateRipTableBeh BEHAVIOUR
```

DEFINED AS
"This action provides the means for updating the contents of the Ring Interworking on Protection (RIP) information in a node. The update fails if the primary or terminating node is not in the **ringMap**, or if the channel is not available for RIP (e.g. because it has already been provisioned for NUT).";

9.3 updateSquelchTable

```
updateSquelchTable ACTION
BEHAVIOUR updateSquelchTableBeh;
MODE CONFIRMED;
WITH INFORMATION SYNTAX SDHMSSPRASN1.UpdateSquelchTableInfo;
WITH REPLY SYNTAX SDHMSSPRASN1.UpdateSquelchTableReply;
REGISTERED AS {g774-10Action 3};
updateSquelchTableBeh BEHAVIOUR
DEFINED AS
```

"This action provides the means for updating the contents of the squelch information in a node. An update fails if the **aNode** or **zNode** is not in the **ringMap**, if the network element does not support the **loAccess** configuration requested, or if the squelching information for the channel cannot be configured as requested because the channel is concatenated to another channel.";

10 Notifications

None.

11 Parameters

11.1 msSPRConfigurationError

```
msSPRConfigurationError PARAMETER
CONTEXT  SPECIFIC-ERROR;
WITH SYNTAX SDHMSSPRASN1.MSSPRConfigurationError;
BEHAVIOUR msSPRConfigurationErrorBeh;
REGISTERED AS {g774-10Parameter 1};
msSPRConfigurationErrorBeh BEHAVIOUR
DEFINED AS
```

"This parameter is included in the error parameter of the CMIP APDU when the **establishProtection** or **changeSPRConfiguration** action fails due to an error that is specific to MS-SPR configuration.";

11.2 msSPRLockoutTypeParameter

```
msSPRLockoutTypeParameter PARAMETER
CONTEXT  ACTION-INFO;
WITH SYNTAX SDHMSSPRASN1.RingOrSpan;
BEHAVIOUR msSPRLockoutTypeBeh;
REGISTERED AS {g774-10Parameter 2};
msSPRLockoutTypeBeh BEHAVIOUR
DEFINED AS
```

"This parameter is used in the management extension field of the **invokeProtection** and **releaseProtection** actions to define whether a lockout applies to ring switching or span switching.";

11.3 msSPRProtectionGroupConfigParameter

msSPRProtectionGroupConfigParameter PARAMETER
CONTEXT ACTION-INFO;
WITH SYNTAX SDHMSSPRASN1.MSSPRProtectionGroupConfigInfo;
BEHAVIOUR msSPRProtectionGroupConfigBeh;
REGISTERED AS {g774-10Parameter 3};

msSPRProtectionGroupConfigBeh BEHAVIOUR
DEFINED AS
"This parameter is used in the **specificPGConfiguration** field of the **establishProtection** action received by the **sdhMSSPRProtectionCoordinator** object when the establishment of a **msSPRProtectionGroup** is requested by the management system.
The information in this parameter is used for provisioning the **msSPRProtectionGroup** and **sPRingManager** objects. The fields of the information syntax are use as follows:
The **directionTable** information is used to initialize the **directionTable** attribute of the **sPRingManager**.
The **directionTable** information is used in conjunction with the **protectionUnits** information in the **establishProtection** action information syntax to determine the value of the **spanPU** and **ringPU** attributes of the subordinate **protectionUnits**.
The **extraTrafficConfig** information, if present, is used to determine which conditional packages are included in the **msSPRProtectionGroup**. If this field is absent, extra traffic is not supported.
The **nutConfig** information, if present, is used to determine if NUT is supported. If the **nutChannelList** is present, an instance of **nutTable** is also created under the **sPRingManager** and populated with the information from this field.
The **nodeNumber** and **ringMap** fields are used to populate the **nodeNumber** and **ringMap** attributes, respectively, of the **sPRingManager**. If the node does not support manual configuration of this data, the **nodeNumber** field shall be NULL and the **ringMap** field shall be absent.
The **ringId** field is used to populate the **ringId** attribute of the **sPRingManager**.
The **ringType** field is used to set the **sPRingApplication** attribute of the **sPRingManager**, and to control instantiation of the **spanSwitchPkg** and **enhancedSpanSwitchPkg** in the **msSPRProtectionGroup**, and the **fourFiberPU** package in the **msSPRProtectionUnit**. This field also provides the initial values for the span wait to restore attributes.
The **ripConfig** field, if present, indicates if RIP is supported. If the **ripChannelList** is present an instance of **ripTable** is also created under the **sPRingManager** and populated with the information from this field.";

11.4 msSPRProtectionStatusParameter

msSPRProtectionStatusParameter PARAMETER
CONTEXT EVENT-INFO;
WITH SYNTAX SDHMSSPRASN1.MSSPRProtectionStatusParameter;
BEHAVIOUR msSPRProtectionStatusParameterBeh;
REGISTERED AS {g774-10Parameter 4};
msSPRProtectionStatusParameterBeh BEHAVIOUR
DEFINED AS
"This parameter is included in the additional information field of the protection switch reporting notification. It includes a set of all changed protection status values and the associated protection units.
This notification is sent by the protection group according to the following rules. There are several cases:
The switch from protected to protecting or protecting to protected has been done without preempting an existing switch. In this case the old and new values of the Protection Status attribute of the protecting protection unit shall be reported in the notification by means of the **oldProtectionStatus** and **newProtectionStatus** parameters respectively.
A switch is performed by preempting an existing one. In this case the old and new values of the Protection Status attribute of the protecting protection unit shall

be reported in the notification by means of the **oldProtectionStatus** and **newProtectionStatus** parameters respectively.
An auto-switch condition exists on a protection unit, but the auto-switch cannot be served due to the unavailability of the protection unit that otherwise protects it. In this case, the **oldProtectionStatus** and **newProtectionStatus** parameters refer to the protection status attribute value of the protection unit on which the auto-switch condition arises. The exception is when the protection unit is already forced or locked out, in which case no notification is sent.
A protected protection unit has been locked out or released from lockout without modifying any existing switch. In this case the **oldProtectionStatus** and **newProtectionStatus** parameters refer to the protection status attribute value of the protected protection unit which has been locked out.
A protecting protection unit has been locked out or released from lockout without modifying the existing switch. In this case the **oldProtectionStatus** and **newProtectionStatus** parameters refer to the protection status attribute value of the protecting protection unit which has been locked out.
A protecting protection unit has move to or from the full passthrough or K-byte passthrough state. In this case the **oldProtectionStatus** and **newProtectionStatus** parameters refer to the protection status attribute value of the protecting protection unit that has changed state.
The **protectionSwitchReportingR1** is not sent when the automatic switch condition is toggling between SD, SF and WTR condition. While in the lockout of forced switch state, no notification is sent except for ending of release failure.";

12 Name Bindings

12.1 auSquelchTable-squelchTable

auSquelchTable-squelchTable NAME BINDING
SUBORDINATE OBJECT CLASS auSquelchTable AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS squelchTable AND SUBCLASSES;
WITH ATTRIBUTE auNumber;
BEHAVIOUR auSquelchTable-squelchTableBeh;
REGISTERED AS {g774-10NameBinding 1};
auSquelchTable-squelchTableBeh BEHAVIOUR
DEFINED AS
"An instance of subordinate object class is automatically instantiated as a result of the initial provisioning of squelching information for an AU channel via the **updateSquelchTable** action. ";

12.2 nutTable-sPRingManager

nutTable-sPRingManager NAME BINDING
SUBORDINATE OBJECT CLASS nutTable AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS sPRingManager AND SUBCLASSES;
WITH ATTRIBUTE nutTableId;
BEHAVIOUR nutTable-sPRingManagerBeh;
REGISTERED AS {g774-10NameBinding 2};
nutTable-sPRingManagerBeh BEHAVIOUR
DEFINED AS
"An instance of the subordinate object class is automatically instantiated when an MS SPR that supports NUT is established, or when the configuration of an existing MS SPR is modified to support NUT. The subordinate object class is deleted when the MS SPR is dismissed, or when the configuration is modified such that the MS SPR no longer supports NUT.";

12.3 ripTable-sPRingManager

```
ripTable-sPRingManager NAME BINDING
     SUBORDINATE OBJECT CLASS ripTable AND SUBCLASSES;
     NAMED BY SUPERIOR OBJECT CLASS sPRingManager AND SUBCLASSES;
     WITH ATTRIBUTE ripTableId;
     BEHAVIOUR ripTable-sPRingManagerBeh;
REGISTERED AS {g774-10NameBinding 3};
ripTable-sPRingManagerBeh BEHAVIOUR
     DEFINED AS
     "An instance of the subordinate object class is automatically instantiated
when an MS SPR that supports RIP is established, or when the configuration of an
existing MS SPR is modified to support RIP. The subordinate object class is
deleted when the MS SPR is dismissed, or when the configuration is modified such
that the MS SPR no longer supports RIP.";
```

12.4 sPRingManager-managedElement

```
sPRingManager-managedElement NAME BINDING
     SUBORDINATE OBJECT CLASS sPRingManager AND SUBCLASSES;
     NAMED BY SUPERIOR OBJECT CLASS
          "Recommendation M.3100":managedElement AND SUBCLASSES;
     WITH ATTRIBUTE sPRingManagerId;
     BEHAVIOUR sPRingManager-managedElementBeh;
REGISTERED AS {g774-10NameBinding 4};
sPRingManager-managedElementBeh BEHAVIOUR
DEFINED AS
     "An instance of the subordinate object class is automatically instantiated
when an SPR is set up (e.g., via actions of a protectionCoordinator). The
instance is deleted when the SPR is removed.";
```

12.5 squelchTable-sPRingManager

```
squelchTable-sPRingManager NAME BINDING
SUBORDINATE OBJECT CLASS squelchTable AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS
     sPRingManager AND SUBCLASSES;
WITH ATTRIBUTE squelchTableId;
BEHAVIOUR squelchTable-sPRingManagerBeh;
REGISTERED AS {g774-10NameBinding 5};
squelchTable-sPRingManagerBeh BEHAVIOUR
DEFINED AS
"Instances of the subordinate object class are automatically instantiated an MS-
SPR protection scheme is set up, and deleted when the protection scheme is
deleted.";
```

12.6 Reuse of Existing Name Bindings

In addition to name bindings defined in this Recommendation, this model also reuses the following name bindings from other Recommendation:

- ITU-T G.774.3: **protectionGroupR1-managedElement**

  This name binding is reused for naming instances of the **msSPRProtectionGroup** object class to instances of the **sdhNE** object class.

- ITU-T G.774.3: **protectionUnit-protectionGroupR1**

  This name binding is reused for naming instances of the **msSPRProtectionUnit** object class to instances of the **msSPRProtectionGroup** object class.

- ITU-T G.774.9: **protectionCoordinator-managedElement**

  This name binding is reused for naming instances of the **sdhMSSPRProtectionCoodinator** object class to instances of the **managedElement** object class.

13 Supporting ASN.1 Productions

```
SDHMSSPRASN1 {itu(0) recommendation(0) g(7) g774(774) hyphen(127) msspr(10)
informationModel(0) asn1Module(2) sdhmsspr (0) }
DEFINITIONS IMPLICIT TAGS  ::=
BEGIN
--  EXPORTS everything  --
IMPORTS
RelativeDistinguishedName, RDNSequence
FROM InformationFramework {joint-iso-ccitt ds(5) modules(1)
informationFramework(1)}
ObjectInstance
FROM CMIP-1 { joint-iso-ccitt ms(9) cmip(1) modules(0) protocol(3) }
ManagementExtension, ProbableCause
FROM Attribute-ASN1Module { joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 1
}
NameType, PointerOrNull
FROM ASN1DefinedTypesModule { itu(0) recommendation(0) m(13) gnm(3100)
informationModel(0) asn1Modules(2) asn1DefinedTypesModule(0) }
AutoSwitchReason, booleanTrueDefault, FromAndToProtectionUnit,
ProtectionGroupType, RequestSource, SDHMSResourcePointer, SwitchStatus
FROM SDHProtASN1 { itu(0) recommendation(0) g(7) g774(774) hyphen(127) prot(03)
informationModel(0) asn1Module(2) sdhmsp(0) };
sdhMSSPR OBJECT IDENTIFIER ::= { itu(0) recommendation(0) g(7) g774(774)
hyphen(127) msspr(10) informationModel(0) }
g774-10MObjectClass OBJECT IDENTIFIER ::=  { sdhMSSPR managedObjectClass(3) }
g774-10Attribute OBJECT IDENTIFIER ::=  { sdhMSSPR attribute(7) }
g774-10Action OBJECT IDENTIFIER ::=  { sdhMSSPR action(9) }
g774-10NameBinding OBJECT IDENTIFIER ::=  { sdhMSSPR nameBinding(6) }
g774-10Parameter OBJECT IDENTIFIER ::=  { sdhMSSPR parameter(5) }
g774-10Package OBJECT IDENTIFIER ::=  { sdhMSSPR package(4) }
g774-10StandardSpecificExtension OBJECT IDENTIFIER ::=  { sdhMSSPR
standardSpecificExtension(0)}
--   The following value assignments are for the Protection Criteria in the
     context of SDH.
--   These values shall always be assigned by this Recommendation in the context
     of SDH.
mssprProtectionCriteria  OBJECT IDENTIFIER ::= {g774-10StandardSpecificExtension
0 }
mssprExcessiveErrorCriteria  OBJECT IDENTIFIER ::= { mssprProtectionCriteria 1 }
msSPRProbableCause OBJECT IDENTIFIER ::= {g774-10StandardSpecificExtension 1}
msSPRDefaultKBytes ProbableCause ::= globalValue : { msSPRProbableCause 1}
msSPRInconsistentAPSCodes ProbableCause ::= globalValue : { msSPRProbableCause 2}
msSPRNodeIdMismatch ProbableCause ::= globalValue : { msSPRProbableCause 3}
msSPRImproperAPSCodes ProbableCause ::= globalValue : { msSPRProbableCause 4}
msSPRApsChannelProcessingFailure ProbableCause ::=
globalValue : { msSPRProbableCause 5}
--default/initial value definitions
MSSPRProtectionGroupType ::= ProtectionGroupType (colon)
--supporting productions
BooleanType ::= BOOLEAN
ChangeSPRConfigInfo ::= SET OF CHOICE {
     twoFiberToFourFiber         SEQUENCE {
          eastTPProtecting            ObjectInstance,
          westTPProtecting   ObjectInstance,
          spanSwitchOption   CHOICE {
                    traditional       WaitToRestoreSpan,
                    enhanced          EnhancedWaitToRestoreSpan }},
     fourFiberToTwoFiber     [0] NULL,
     nutConfig                    [1] NutConfig,
     ripConfig                    [2] RipConfig,
     extraTrafficConfig      [3] ExtraTrafficConfig
     }
```

```
CurrentSquelchingList ::= SET OF SEQUENCE {
squelchedTP        ObjectInstance,
associatedXC       CHOICE {
          squelchedXC   RelativeDistinguishedName,
          hardwired     [0] NULL}}

DirectionTable ::= SEQUENCE OF SEQUENCE {
westTP    RDNSequence,
eastTP    RDNSequence }
EnhancedWaitToRestoreSpan ::= SEQUENCE {
     wtrSpanEast   INTEGER,
     wtrSpanWest   INTEGER }
ExtraTrafficConfig ::= ENUMERATED {
     noExtraTraffic     (0),
     extraTraffic       (1),
     extraTrafficWithRestoration (2) }
LinkInfo ::= SEQUENCE {
     localNEId     ObjectInstance,
     localPortId   PointerOrNull,
     remoteNEId    ObjectInstance,
     remotePortId  PointerOrNull }
     -- portId points to the service (preferred) msTTP; Null for Open Ring
Map ::= SEQUENCE OF SEQUENCE {
     nodeIdNumber       INTEGER(0 .. 15),
     linkInfo                LinkInfo OPTIONAL} -- needed for two-node closed
                                                   ring
MSSPRConfigurationError ::= ENUMERATED {
     extraTrafficNotSupported         (0),
     manualProvisioningNotSupported   (1),
     nutNotSupported                  (2),
     ringTypeNotSupported             (3),
     ripNotSupported                  (4),
     duplicatedUnreliable             (5),
     ePdTPNotAvailable                (6), -- east protected TP
     ePgTPNotAvailable                (7), -- east protecting TP
     wPdTPNotAvailable                (8), -- west protected TP
     wPgTPNotAvailable                (9), -- west protecting TP
     invalidWTRTime                   (10) }
MSSPRProtectionGroupConfigInfo ::= SEQUENCE {
     directionTableDirectionTable,
     extraTrafficConfig ExtraTrafficConfig OPTIONAL,
     nodeNumber         NodeOrNull,
     nutConfig          NutConfig OPTIONAL,
     ringId             RingId,
     ringMap            [0] Map OPTIONAL,
     ringType           [1] RingType,
     ripConfig          RipConfig OPTIONAL }

MSSPRProtectionStatus ::= SET OF CHOICE {
noRequest                   [0] NULL,
manualSwitch                [1] SEQUENCE {
     requestSource          [0] RequestSource OPTIONAL,
     switchStatus           [1] SwitchStatus,
     relatedChannel         FromAndToProtectionUnit OPTIONAL,
     switchType             [2] RingOrSpan},
autoSwitch                  [2] SEQUENCE {
     requestSource          [0] RequestSource OPTIONAL,
     switchStatus           [1] SwitchStatus,
     relatedChannel         FromAndToProtectionUnit OPTIONAL,
     autoSwitchReason       [2] AutoSwitchReason,
          switchType        [3] RingOrSpan },
forcedSwitch                [3] SEQUENCE {
     requestSource          [0] RequestSource OPTIONAL,
     switchStatus           [1] SwitchStatus,
```

```
     relatedChannel          FromAndToProtectionUnit OPTIONAL,
     switchType              [2] RingOrSpan},
lockout                      [4] SEQUENCE {
     requestSource           [0] RequestSource OPTIONAL,
     switchStatus            [1] SwitchStatus,
     switchType              [2] RingOrSpan},
releaseFailed                [6] NULL,
protectionFailCond           [7] ENUMERATED {
     inconsistentApsCode     (0),
     nodeIdMismatch          (1),
     improperApsCode         (2),
     defaultKBytes           (3),
     signalDegradeProtect    (4),
     signalFailProtect       (5)},
passThrough                  [8] ENUMERATED {
          full               (0),
          kByte         (1)}}
MSSPRProtectionStatusParameter ::= SET OF SEQUENCE {
protectionUnit                    ObjectInstance,
oldProtectionStatus          MSSPRProtectionStatus,
newProtectionStatus     MSSPRProtectionStatus}
NodeNumber ::= INTEGER(0 .. 15)
NodeOrNull ::= CHOICE {
nodeNumber    NodeNumber,
null          NULL}
NutChannelList ::= SET OF SEQUENCE {
     channel                 INTEGER,
     affectedTraffic         ENUMERATED {
          workingOnly        (0),
          workingAndProtecting    (1) },
     ringSwitchUnavailable        UnavailableSide,
     spanSwitchUnavailable   UnavailableSide OPTIONAL }
NutConfig ::= CHOICE {
     nutOff         NULL,
     nutOn          NutChannelList }
RingId ::= PrintableString
RingOrSpan ::= ENUMERATED {
ring (0),
span (1)}
RingType ::= SEQUENCE {
     application        SPRingApplication,
     fibers             CHOICE {
          twoFiber               NULL,
          fourFiber              WaitToRestoreSpan,
          enhancedFourFiber  EnhancedWaitToRestoreSpan }}
RipChannelList ::= SET OF SEQUENCE {
channel       INTEGER,
ripInformation     RipTableEntry}
RipConfig ::= CHOICE {
     ripOff         NULL,
     ripOn          RipChannelList }
RipInformation ::= SEQUENCE {
primaryNode   NodeOrNull,             -- primary interconnection node
terminatingNode    NodeOrNull }       -- node where the traffic is added/dropped
RipTableEntry ::= SEQUENCE {
     inEast    RipInformation,
     outEast   RipInformation,
     inWest    RipInformation,
     outWest   RipInformation }
SPRingApplication ::= ENUMERATED {
     classic(1),
     transoceanic(2) }
```

```
SquelchTableChannel ::= SEQUENCE {
     aNode              NodeOrNull,    -- entry node of circuit
     zNode              NodeOrNull,    -- exit node of circuit
     loAccess      BOOLEAN,            -- TRUE implies low order access is present
     concatenated  CHOICE {
          firstChannel       INTEGER,       -- number of concatenated channels
          subsequentChannels      NULL } OPTIONAL}
SquelchTableEntry ::= SEQUENCE {
     inEast             SquelchTableChannel,
     outEast            SquelchTableChannel,
     inWest             SquelchTableChannel,
     outWest            SquelchTableChannel,
     additionalInfo     SET OF ManagementExtension OPTIONAL }
True ::= BOOLEAN(TRUE)
UnavailableSide ::= SEQUENCE {
     switchUnavailableEast   BOOLEAN,
     switchUnavailableWest   BOOLEAN }
UpdateRIPFailed ::= CHOICE {
     unknown                      [0] NULL,
     nodeNotInRing                [1] INTEGER(0..15),
     channelNotAvailableForRIP    [2] NULL }
UpdateRIPTableInfo ::= SEQUENCE OF SEQUENCE {
     auChannelNumber    INTEGER,
     ripTableEntry      RipTableEntry }
UpdateRIPTableReply ::= SEQUENCE OF CHOICE {
     failed         UpdateRIPFailed,
     success        SEQUENCE {
          oldRipTable   RipTableEntry,
          newRipTable   RipTableEntry } }
-- the ith entry in the reply corresponds to the ith entry in the information
   syntax
UpdateSquelchFailed ::= CHOICE {
     unknown                 [0] NULL,
     nodeNotInRing           [1] INTEGER(0..15),
     concatenatedChannel     [2] INTEGER,
     loAccessNotSupported    [3] NULL }
UpdateSquelchTableInfo ::= SEQUENCE OF SEQUENCE {
     auChannelNumber INTEGER,
     squelchTableEntry  SquelchTableEntry }
UpdateSquelchTableReply ::= SEQUENCE OF CHOICE {
     failed         UpdateSquelchFailed,
     success             SEQUENCE {
          oldSquelchTableEntry        SquelchTableEntry,
          newSquelchTableEntry        SquelchTableEntry } }
--   the ith entry in the reply corresponds to the ith entry in the information
     syntax
WaitToRestoreSpan ::= INTEGER
END
```

APPENDIX I

Inheritance and containment diagrams

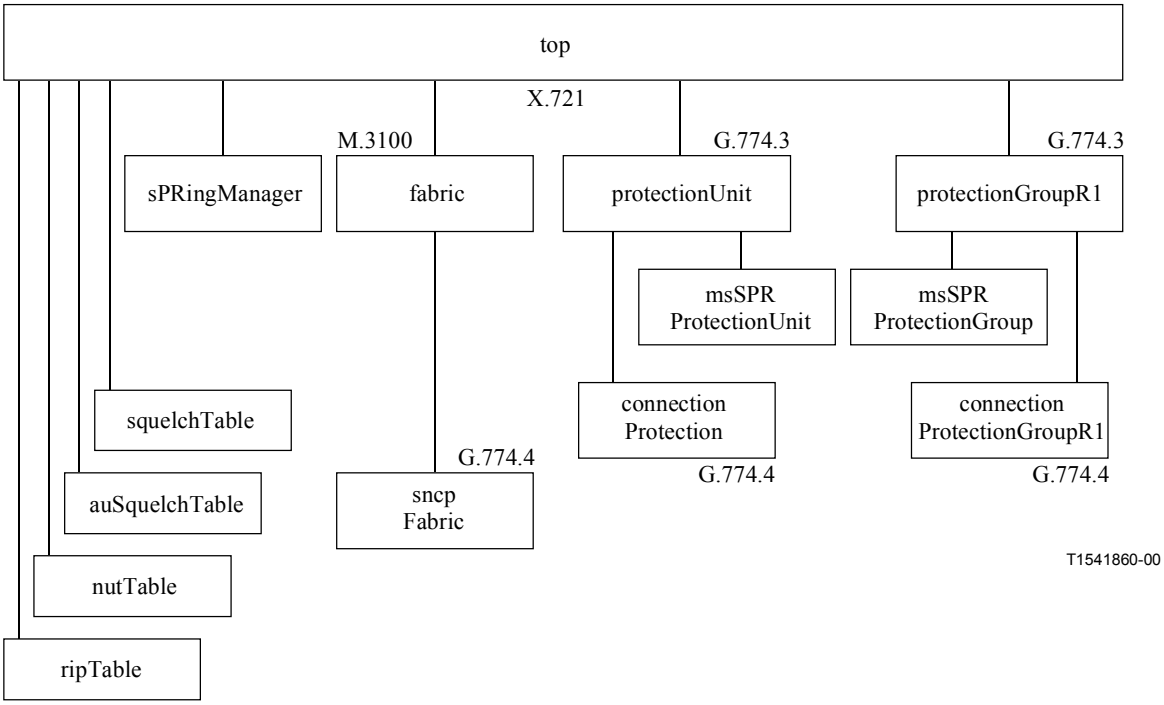


Figure I.1/G.774.10 – Inheritance tree of MS shared protection ring

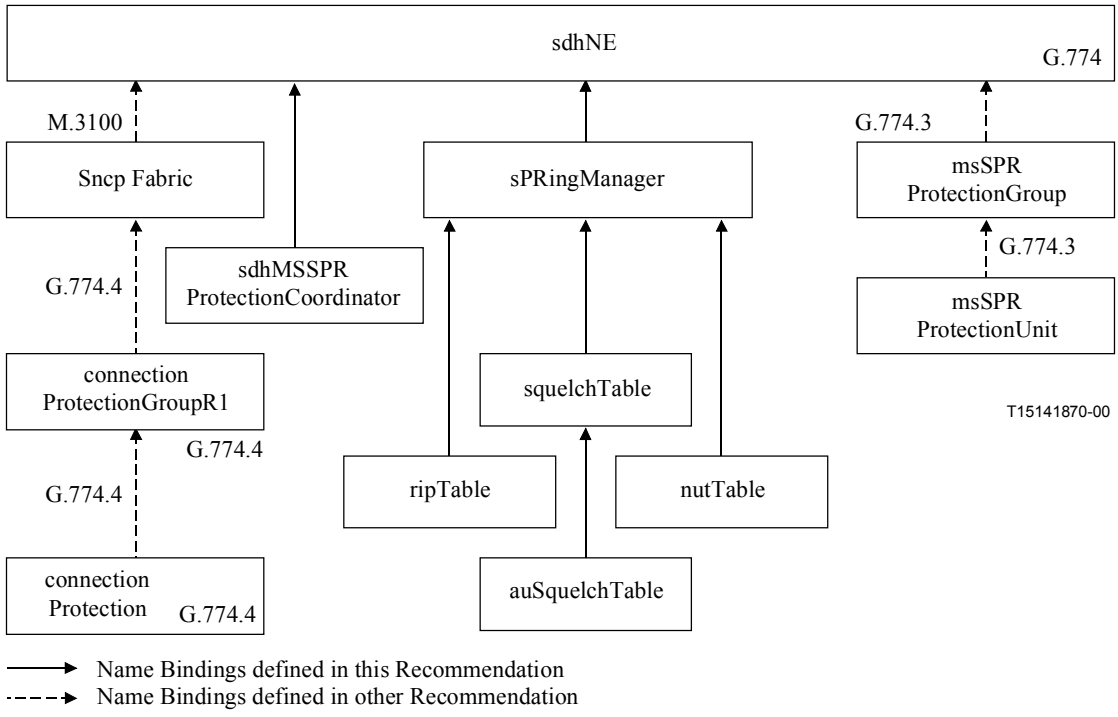


Figure I.2/G.774.10 – Containment tree of MS shared protection ring

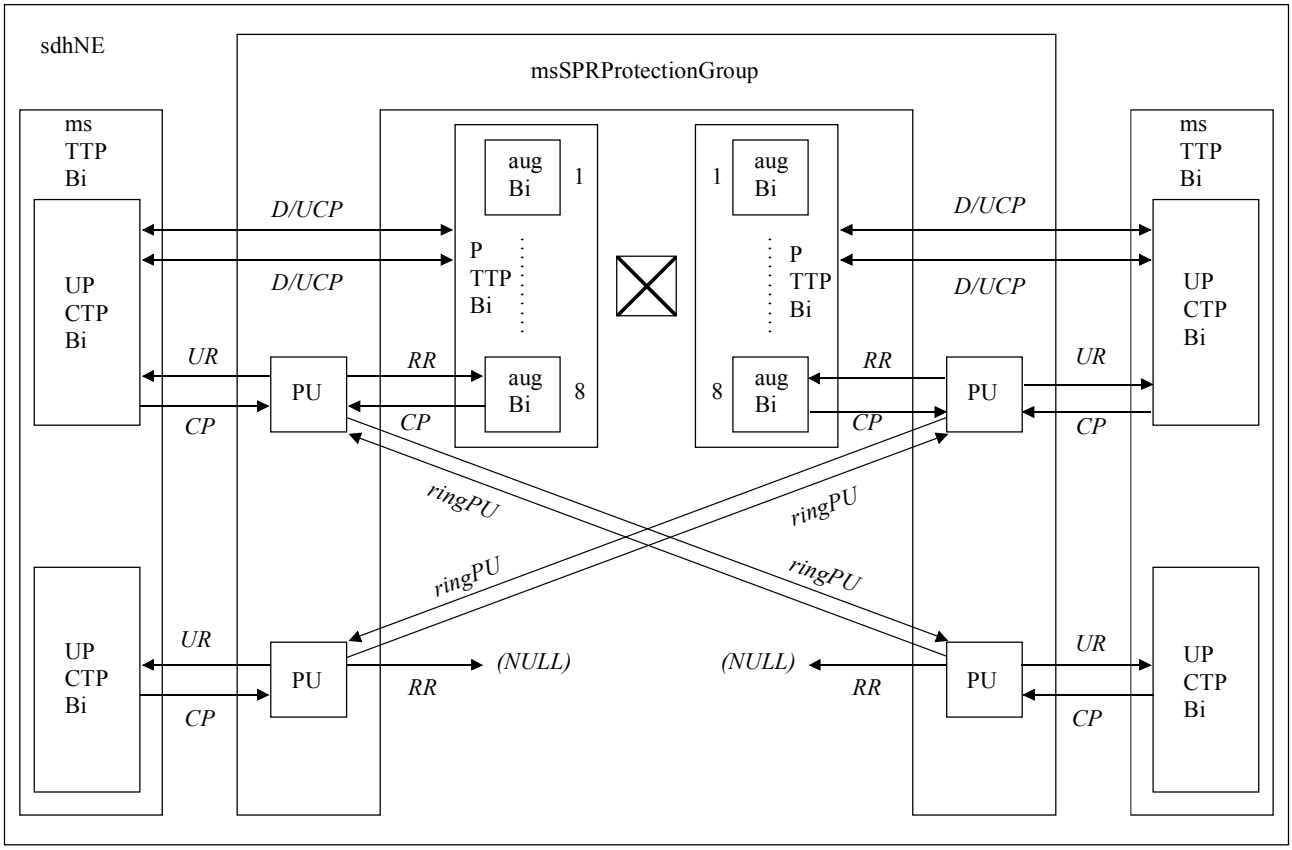
APPENDIX II

Illustrations of MS SPR configuration

This appendix provides informative illustration of the MS SPR information model.

In an MS SPR NE, there will be one instance of the **sdhMSSPRProtectionCoordinator** object. In the MS SPR architecture, it is possible that a NE may participate in multiple protection rings. For each MS SPR ring, there is one instance of each of the following object classes: **sPRingManager**, **msSPRProtectionGroup**, **squelchTable**, **nutTable**, and **ripTable**. The association between the **sPRingManager** and the **msSPRProtectionGroup** objects is indicated by a pointer attribute "**protectionGroupPointer**" in the **sPRingManager** object. The **squelchTable**, **nutTable**, and **ripTable** objects are contained in **sPRingManager**.

A single instance of the **msSPRProtectionGroup** (PG) object contains four instances of the **msSPRProtectionUnit** (PU) object in both two-fiber and four-fiber MS SPR nodes. There are two protected PUs and two protecting PUs. These are depicted in Figures II.1 and II.2. The functionality of these object classes is similar to those of SDH MS protection (ITU-T G.774.3). In the two-fiber case, only ring switching is available. Therefore, a protected PU is mated with a protection PU on the opposite side of the ring node (indicated with the **ringPU** attribute of the PUs). In the four-fiber case, the PUs also have a **spanPU** attribute which points to PU on the same side of the ring node for span switching that are available with four-fiber MS SPR.



	sncpFabric	*RR*	*reliableResourcePointer*
PU	msSPRProtectionUnit	*UR*	*unreliableResourcePointer*
UPCTPBi	unprotectedCTPBidirectional	*CP*	*crossConnectionObjectPointer*
PTTPBi	protectedTTPBidirectional	*D/UCP*	*downstreamConnectivityPointer (or upstreamConnectivityPointer)*

Figure II.1/G.774.10 – Two-fiber MS SPR ring node

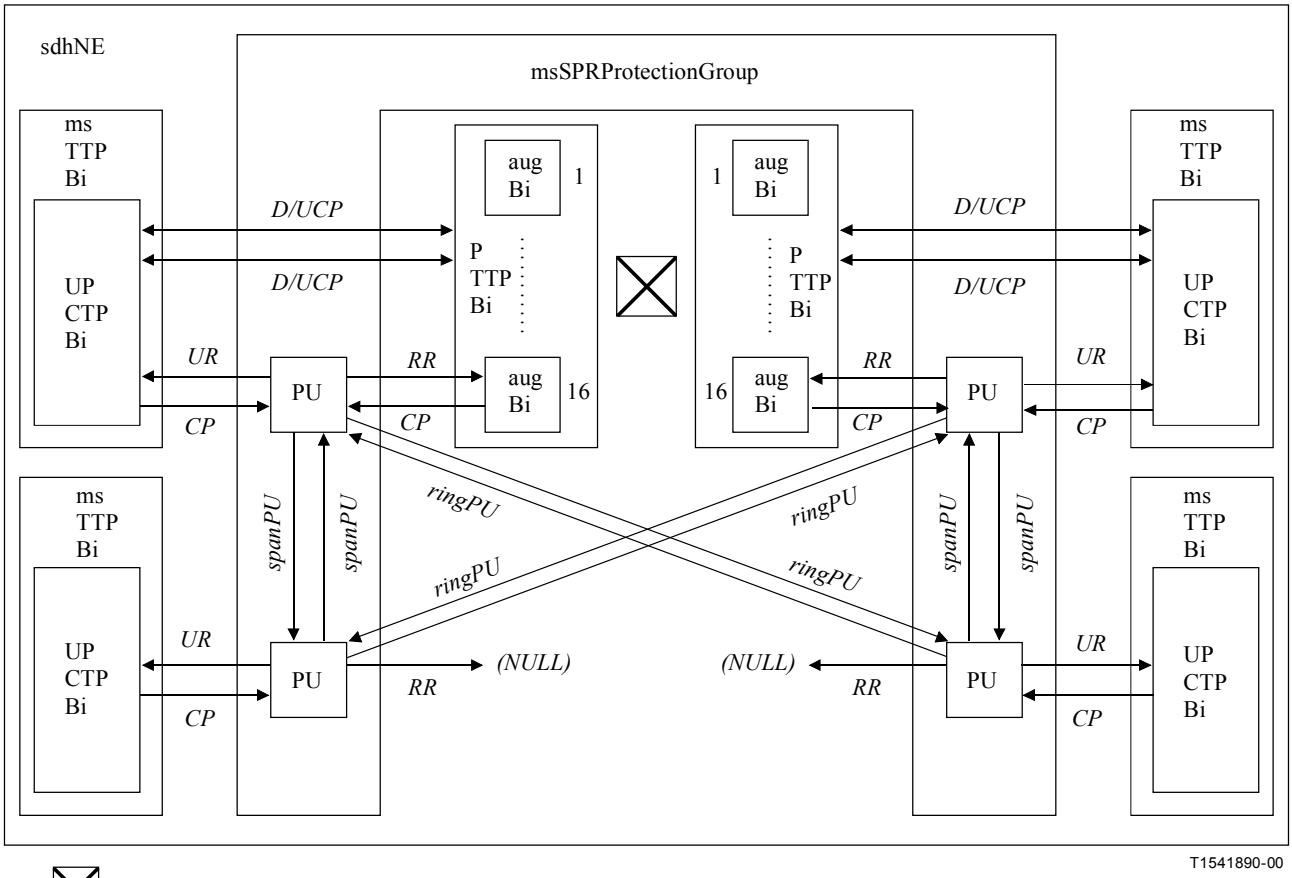
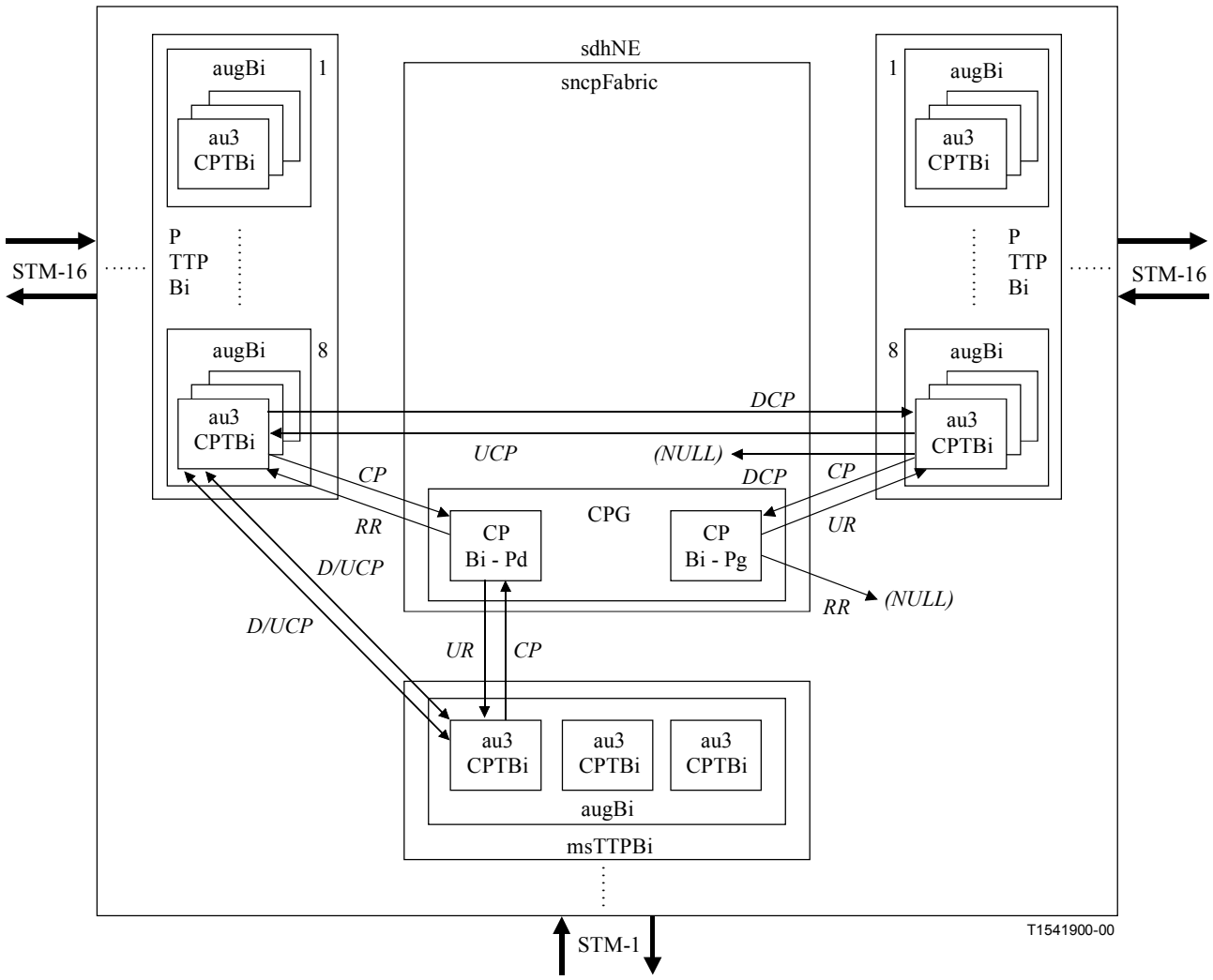


Figure II.2/G.774.10 – Four-fiber MS SPR ring node

For interconnected ring architecture, the basic MS SPR protection mechanisms continue to exist in the MS SPR node. The G.774.4 connection protection model is reused for the service selector function for each ring channel that is interconnected with another ring, i.e. using the **sncpFabric**, **connectionProtectionGroupR1** and **connectionProtection** objects. The **connectionProtectionGroupR1** object (ITU-T G.774.4, 2001 version) will be instantiated via a **protectedConnect** or **protectUnprotect** action on the **sncpFabric** object. The **connectionProtectionGroupR1** (CPG) object will contain two **connectionProtection** object instances (from ITU-T G.774.4) to model a protected connection through the primary MS SPR interconnect node. This is depicted for an au3 connection in Figure II.3.



		RR	*reliableResourcePointer*
CPG	connectionProtectionGroupR1	*UR*	*unreliableResourcePointer*
CP Bi-Pd	connectionProtection (protected)	*CP*	*crossConnectionObjectPointer*
CP Bi-Pg	connectionProtection (protecting)	*D/UCP*	*downstreamConnectivityPointer (or upstreamConnectivityPointer)*

Figure II.3/G.774.10 – AU3 service selector at 2-fiber MS SPR primary node

The **squelchTable**, **auSquelchTable**, and **sPRingManager** object classes represent the ring configuration information that an MS SPR node must maintain in order to communicate with other ring nodes on the APS signalling channel and to properly perform ring (and span) protection switches and squelching. The **sPRingManager** object describes the identity and relative order of the nodes, and the directionality of the TTPs around the ring, which must be common to all nodes on the ring. The **squelchTable** and **auSquelchTable** objects provide squelch-related information for each ring channel (AU) processed by the ring node. Each instance of the **auSquelchTable** object includes the following information for a particular ring channel:

- entrance and exit node identifiers for the channel;
- an indication if the channel is part of a concatenated ring channel;
- an indication if lower-order VC access is provided on that channel in the ring.

The above information is available for each direction of each channel on the east- and west-side of the node. Therefore it is able to reflect various connection configurations, such as

- a bidirectional pass-through;
- an unidirection east to west pass-through, an unidirectional add to east and unidirectional drop from west;
- a bidirectional add/drop on the east side and a bidirectional add/drop on the west side;
- two unidirectional pass-through with different **aNode** and **zNode**.

The **updateSquelchTable** action of the **squelchTable** object is used for updating the contents of the squelch information of a node.

If there are multiple links between two nodes (e.g. in the case of a two-node closed ring), in order to unambiguously discover or provision the ring topology, there is a need to indicate the link termination (i.e. port Id) information in the ring map. The syntax of the **ringMap** attribute provides an optional field for such indication.

The **nutTable** object classes is defined to support non-preemptible channel provisioning. As defined in ITU-T G.841, non-preemptible unprotected traffic (NUT) is unprotected traffic that is carried on channels with the MS SPR automatic protection switching mechanism disabled for certain high order (HO) VC channels (i.e. working channels and their corresponding protection channels). Support of non-preemptible channel provisioning requires that a NUT table be present at each node on the MS SPR.

The **ripTable** object class is defined to support ring interworking on protection. As defined in ITU-T G.842, ring interworking on protection (RIP) is a mechanism to help alleviate bandwidth exhaustion between the primary and secondary interconnection nodes in a dual-homed interconnection scheme by using protection bandwidth for the secondary circuit. Support of ring interworking on protection requires that a RIP table be present at each secondary interconnection node on the MS SPR.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems

Geneva, 2001