UNIÓN INTERNACIONAL DE TELECOMUNICACIONES

UIT-T G.774.10

SECTOR DE NORMALIZACIÓN
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SERIE G: SISTEMAS Y MEDIOS DE TRANSMISIÓN,
SISTEMAS Y REDES DIGITALES

Equipos terminales digitales – Características de
operación, administración y mantenimiento de los equipos
de transmisión

Jerarquía digital síncrona − Gestión del anillo de protección compartida de la sección múltiplex desde el punto de vista de los elementos de red

Recomendación UIT-T G.774.10

RECOMENDACIONES UIT-T DE LA SERIE G

SISTEMAS Y MEDIOS DE TRANSMISIÓN, SISTEMAS Y REDES DIGITALES

Para más información, véase la Lista de Recomendaciones del UIT-T.

Recomendación UIT-T G.774.10

Jerarquía digital síncrona – Gestión del anillo de protección compartida de la sección múltiplex desde el punto de vista de los elementos de red

Resumen

Esta Recomendación proporciona un modelo de información para la red de la jerarquía digital síncrona (SDH). El modelo describe las clases de objetos gestionados y sus propiedades para la gestión de la configuración y la posconfiguración de la función conmutación de protección del anillo de protección compartida (SPR) de la sección múltiplex (MS) de la jerarquía digital síncrona, tal como están definidos en UIT-T G.803 [12], UIT-T G.841 [15] y UIT-T G.842 [16]. Estos objetos son de utilidad para describir la información intercambiada a través de las interfaces definidas en la arquitectura de la red de gestión de las telecomunicaciones (RGT) de UIT-T M.3010 [3] para la gestión de la configuración y posconfiguración de la función de protección.

Historial	
Versión	**Notas**
2001	Versión inicial de la Recomendación.

PREFACIO

La UIT (Unión Internacional de Telecomunicaciones) es el organismo especializado de las Naciones Unidas en el campo de las telecomunicaciones. El UIT-T (Sector de Normalización de las Telecomunicaciones de la UIT) es un órgano permanente de la UIT. Este órgano estudia los aspectos técnicos, de explotación y tarifarios y publica Recomendaciones sobre los mismos, con miras a la normalización de las telecomunicaciones en el plano mundial.

La Asamblea Mundial de Normalización de las Telecomunicaciones (AMNT), que se celebra cada cuatro años, establece los temas que han de estudiar las Comisiones de Estudio del UIT-T, que a su vez producen Recomendaciones sobre dichos temas.

La aprobación de Recomendaciones por los Miembros del UIT-T es el objeto del procedimiento establecido en la Resolución 1 de la AMNT.

En ciertos sectores de la tecnología de la información que corresponden a la esfera de competencia del UIT-T, se preparan las normas necesarias en colaboración con la ISO y la CEI.

NOTA

En esta Recomendación, la expresión "Administración" se utiliza para designar, en forma abreviada, tanto una administración de telecomunicaciones como una empresa de explotación reconocida de telecomunicaciones.

PROPIEDAD INTELECTUAL

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Recomendación UIT-T G.774.10

Jerarquía digital síncrona – Gestión del anillo de protección compartida de la sección múltiplex desde el punto de vista de los elementos de red

1   Alcance

Esta Recomendación trata la gestión de la configuración y posconfiguración de la conmutación de protección automática dentro del anillo de protección compartida (SPR, *shared protection ring*) de la sección múltiplex (MS, *multiplex section*), y las capas de trayectos de alto y de bajo orden. Abarca las funciones de protección descritas en UIT-T G.841 [15] y UIT-T G.842 [16].

La presente Recomendación identifica las clases de objetos de la red de gestión de las telecomunicaciones (RGT) requeridos para la gestión de la función de protección MS SPR de los elementos de red de la jerarquía digital síncrona. Estos objetos son de interés para el intercambio de información a través de las interfaces normalizadas definidas en la arquitectura de la red de gestión de las telecomunicaciones de UIT-T M.3010 [3].

Estructura de esta Recomendación

La cláusula 5 presenta una sinopsis del modelo de información de protección SDH SN SPR. Las cláusulas 6 a 13 describen el modelo de información utilizando el mecanismo de notación definido en UIT-T X.722 [7]. La cláusula 13 contiene las definiciones sintácticas de la información transportada en el protocolo mediante el empleo de la notación de sintaxis abstracta uno (ASN.1, *abstract syntax notation one*) definida en UIT-T X.680 [8]. Los aspectos de contenencia y herencia se ilustran en el apéndice I.

2   Referencias

Las siguientes Recomendaciones del UIT-T y otras referencias contienen disposiciones que, mediante su referencia en este texto, constituyen disposiciones de la presente Recomendación. Al efectuar esta publicación, estaban en vigor las ediciones indicadas. Todas las Recomendaciones y otras referencias son objeto de revisiones por lo que se preconiza que los usuarios de esta Recomendación investiguen la posibilidad de aplicar las ediciones más recientes de las Recomendaciones y otras referencias citadas a continuación. Se publica periódicamente una lista de las Recomendaciones UIT-T actualmente vigentes.

[1]   UIT-T G.707/Y.1322 (2000), *Interfaz de nodo de red para la jerarquía digital síncrona*.

[2]   UIT-T G.708 (1999), *Interfaz de nodo de red sub STM-0 para la jerarquía digital síncrona*

[3]   UIT-T M.3010 (2000), *Principios para una red de gestión de las telecomunicaciones*.

[4]   UIT-T M.3100 (1995), *Modelo genérico de información de red*.

[5]   UIT-T G.783 (2000), *Características de los bloques funcionales del equipo de la jerarquía digital síncrona*.

[6]   UIT-T G.784 (1999), *Gestión de la jerarquía digital síncrona*.

[7]   UIT-T X.722 (1992), *Tecnología de la información – Interconexión de sistemas abiertos – Estructura de la información de gestión: Directrices para la definición de objetos gestionados, plus* Enm.1 (1995), Enm.2 (1997) y Corr.1 (1996).

[8]   UIT-T X.680 (1997), *Tecnología de la información – Notación de sintaxis abstracta uno: Especificación de la notación básica*.

[9]   UIT-T X.720 (1992), *Tecnología de la información – Interconexión de sistemas abiertos – Estructura de la información de gestión: Modelo de información de gestión, plus Enm.1 (1995) y Corr.1 (1994).*

[10]   UIT-T G.774 (2001), *Jerarquía digital síncrona – Modelo de información de gestión desde el punto de vista de los elementos de red.*

[11]   UIT-T G.774.1 (2001), *Jerarquía digital síncrona – Supervisión de la calidad de funcionamiento desde el punto de vista de los elementos de red.*

[12]   UIT-T G.803 (2000), *Arquitectura de redes de transporte basadas en la jerarquía digital síncrona.*

[13]   UIT-T X.721 (1992), *Tecnología de la información – Interconexión de sistemas abiertos – Estructura de la información de gestión: Definición de la información de gestión, plus Corr.1 (1994), Corr.2 (1996), Corr.3 (1998) y Corr.4 (2000).*

[14]   UIT-T G.774.3 (2001), *Jerarquía digital síncrona – Gestión de la protección de secciones de multiplexación desde el punto de vista de los elementos de red.*

[15]   UIT-T G.841 (1998), *Tipos y características de las arquitecturas de protección para redes de la jerarquía digital síncrona.*

[16]   UIT-T G.842 (1997), *Interfuncionamiento de las arquitecturas de protección para redes de la jerarquía digital síncrona.*

[17]   UIT-T G.774.4 (2001), *Jerarquía digital síncrona – Gestión de la protección de conexión de subred desde el punto de vista de los elementos de red.*

[18]   UIT-T G.774.9 (2001), *Jerarquía digital síncrona – Configuración de la protección de secciones múltiplex lineal desde el punto de vista de los elementos de red.*

3   Términos y definiciones

En esta Recomendación se utilizan los términos definidos y las definiciones formuladas en UIT-T G.774, UIT-T G.784, UIT-T G.841, UIT-T G.842 y UIT-T M.3100.

4   Abreviaturas

En esta Recomendación se utilizan las siguientes siglas.

AIS   Señal de indicación de alarma (*alarm indication signal*)

APDU   Unidad de datos de protocolo de aplicación (*application protocol data unit*)

APS   Conmutación automática de protección (*automatic protection switching*)

CMIP   Protocolo común de información de gestión (*common management information protocol*)

CMIS   Servicio común de información de gestión (*common management information service*)

CTP   Punto de terminación de conexión (*connection termination point*)

ISO   Organización Internacional de Normalización (*International Organization for Standardization*)

LOF   Pérdida de alineación de trama (*loss of frame*)

LOS   Pérdida de la señal (*loss of signal*)

MS   Sección múltiplex (*multiplex section*)

MSP	Protección de sección múltiplex (*multiplex section protection*)
NE	Elemento de red (*network element*)
OS	Sistema de operaciones (*operations system*)
OSI	Interconexión de sistemas abiertos (*open systems interconnection*)
Pkg	Lote (*package*)
RDN	Nombre distinguido relativo (*relative distinguished name*)
RGT	Red de gestión de las telecomunicaciones
RRP	Puntero de recurso fiable (*reliable resource pointer*)
SD	Degradación de señal (*signal degrade*)
SDH	Jerarquía digital síncrona (*synchronous digital hierarchy*)
SF	Fallo de señal (*signal fail*)
SNCP	Protección de la conexión de subred (*subnetwork connection protection*)
SPR	Anillo de protección compartida (*shared protection ring*)
STM-N	Módulo de transporte síncrono N (*synchronous transport module N*)
TP	Punto de terminación (*termination point*)
TTP	Punto de terminación de camino (*trail termination point*)
UIT-T	Unión Internacional de Telecomunicaciones − Sector de Normalización de las Telecomunicaciones
URP	Puntero de recurso no fiable (*unreliable resource pointer*)
WTR	Espera al restablecimiento (*wait-to-restore*)

5   Gestión de protección de anillo de protección compartida (SPR) SDH MS

El modelo SDH MS SPR se basa en las clases genéricas y los principios de modelación descritos en UIT-T M.3100, así como en las clases comunes de UIT-T G.774.3.

5.1   Requisitos de la gestión de protección SDH MS SPR

El modelo de información de gestión de la protección MS SPR cumplirá los siguientes requisitos:

−   De acuerdo con el concepto de capa descrito en UIT-T G.805, será posible añadir/suprimir o modificar una red de una capa, dentro de elemento de red, sin que esto afecte a otras capas. Es decir, hay que introducir, desde el punto de vista funcional, la subcapa de protección MS SPR en la capa MS sin que esto produzca efecto alguno en la capa de trayecto.

−   El establecimiento y la supresión de la protección MS SPR debe efectuarse sin afectar al tráfico.

−   La migración de una red ya instalada a la MS SPR, incluida la migración de un anillo SNCP a 2F/4F MS SPR y la migración de un anillo 2F a 4F, debe efectuarse sin interrupciones del tráfico.

−   De acuerdo con UIT-T G.841, el modelo deberá soportar todo tipo de tráfico de capa de trayecto, incluido tráfico unidireccional punto a punto, tráfico unidireccional punto a multipunto (difusión), y tráfico bidireccional.

- Las capacidades existentes de configuración dinámica (creación, supresión y modificación) hay que mantenerlas, especialmente en caso de modificaciones que no afecten al tráfico (adición/supresión de tramo, adición/supresión de separación y continuación para aplicaciones con doble punto de partida, tabla RIP).

- Configuración de MS SPR a dos fibras o cuatro fibras, o aplicación transoceánica.

- El modelo de información soportará la conmutación de anillo bidireccional.

- El modelo de información soportará la conmutación de intervalo bidireccional a cuatro fibras.

- El modelo de información soportará la conmutación obligada y la manual.

- El modelo de información soportará el bloqueo del dispositivo protegido y del protector.

- El modelo de información soportará el ejercicio de la conmutación de protección para actividades de mantenimiento.

- El modelo de información permitirá que se prevea un tiempo de espera al restablecimiento.

- Modificación de la topología del anillo sin afectar al tráfico existente, siempre que el nodo que se suprime no intervenga en el tráfico.

- Modificación del identificador de nodo G.841 (cambio consiguiente de la configuración del mapa de anillo) sin que se produzca una conmutación de protección no deseada. Ésta puede producirse porque, antes de que se hayan realizado las actualizaciones en todos los nodos, es posible que los datos del anillo no sean coherentes.

- La conmutación de un canal de tipo tráfico no protegido no preapropiable (NUT) a un canal de tipo protegido no debe afectar a su tráfico.

- La conmutación de un canal de tipo protegido a un canal de tipo NUT deberá estar autorizada. Si el canal no goza protección, el cambio no debe afectar al tráfico.

- La actualización de la información de silenciación no debe provocar interrupciones del tráfico.

- Configuración de un elemento de red para el soporte de múltiples MS SPR y la interconexión entre estos anillos.

5.2   Sinopsis del modelo de información SDH MS SPR

Para el control y la operación de la función de protección MS SPR, el modelo presenta una manera similar a la utilizada para otras funciones de protección. El modelo define dos subclases del modelo de protección G.774.3 genérico:

- **msSPRProtectionGroup**, que representa la asociación de recursos no fiables para fines de conmutación de protección automática y que es el punto focal para todas las operaciones de gestión relacionadas con la función de protección MS SPR.

- **msSPRProtectionUnit**, que representa la unidad protegida o la protectora, y también la asignación de un recurso no fiable a un recurso fiable. La **msSPRProtectionUnit** está contenida en un **msSPRProtectionGroup**.

El modelo define las siguientes clases de objeto adicionales específicas de MS SPR:

- **sdhMSSPRProtectionCoordinator**, que se utiliza concretamente para configurar esquemas de protección SDH MS SPR. En un elemento de red puede crearse un y sólo un ejemplar. Cuando se ejecuta con éxito la acción **establishProtection**, se crean los siguientes ejemplares de objetos: un ejemplar de **msSPRProtectionGroup**, cuatro ejemplares de **msSPRProtectionUnit**, un ejemplar de **sPRingManager**, y un ejemplar de **squelchTable**, como especifica la información de acción. La supresión de esquemas de protección se efectúa mediante la acción **dismissProtection**. Cuando se ejecuta con éxito esta acción, se

suprime el **sPRingManager** y todos los objetos asociados. La acción **changeSPRConfiguration** se utiliza para migrar entre configuraciones a dos fibras y a cuatro fibras, o para añadir o retirar la capacidad NUT o RIP, sin suprimir todos los demás objetos asociados con el esquema de protección. Como resultado de esta acción, el grupo de protección y las unidades asociadas se suprimen y se vuelven a crear con los lotes condicionales apropiados presentes.

– **sPRingManager**, que se utiliza para caracterizar un anillo de protección única compartida, que proporciona un puntero al objeto **msSPRProtectionGroup**, y contiene ejemplares de cualquier otro objeto que se necesite para el soporte del anillo (por ejemplo, **nutTable**, **ripTable**, **squelchTable**).

– **nutTable**, que contiene información para identificar los canales que se han proporcionado para tráfico no protegido no preapropiable (NUT, *non-preemptible unprotected traffic*), e identifica el tipo de conmutación (de intervalo o de anillo) que está prohibido por la NUT.

– **ripTable**, que representa la tabla RIP (*ring interconnect on protection*) en un nodo de interconexión secundario. Esta tabla indica los canales de protección que se utilizan para el transporte de circuitos secundarios en esquemas de interconexión con doble punto de partida, y el nodo primario, nodo de entrada, y nodo de salida para cada uno de esos canales.

– **squelchTable** y **auSquelchTable**, que contienen información de encaminamiento para uso con fines de silenciamiento.

Este modelo también reutiliza clases de objeto existentes, de UIT-T G.774.4, para la función selector de servicio de los nodos de interconexión en MS SPR, incluyendo:

– **sncpFabric**, de la G.774.4, que soporta la función interconexión en MS SPR para la función selector de servicio.

– **connectionProtectionGroupR1**, de la G.774.4, que se utiliza para interconexión de anillo, para elegir entre la señal que llega por el lado de baja velocidad y la señal que llega por el lado de alta velocidad, procedentes del otro nodo de interconexión.

– **connectionProtection**, de la G.774.4, que presenta la unidad de protección (unidad protegida o protectora) y la asignación entre un recurso no fiable (punto de terminación de trayecto de alto/bajo orden) y un recurso fiable (punto de terminación de trayecto de alto/bajo orden).

6   Definiciones de clases de objeto gestionado

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 Lotes (*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   Atributos

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   Acciones

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   Notificaciones

Ninguna.

11   Parámetros

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 Vinculaciones de nombres

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 Reutilización de vinculaciones de nombre existentes

Este modelo, además de utilizar las vinculaciones de nombre definidas en esta Recomendación, reutiliza las siguientes vinculaciones de nombre tomadas de otras normas:

•   UIT-T G.774.3: **protectionGroupR1-managedElement**

Esta vinculación de nombre se reutiliza para la denominación de ejemplares de la clase de objeto **msSPRProtectionGroup** a ejemplares de la clase de objeto **sdhNE**.

•   UIT-T G.774.3: **protectionUnit-protectionGroupR1**

Esta vinculación de nombre se reutiliza para la denominación de ejemplares de la clase de objeto **msSPRProtectionUnit** a ejemplares de la clase de objeto **msSPRProtectionGroup**.

•   UIT-T G.774.9: **protectionCoordinator-managedElement**

Esta vinculación de nombre se reutiliza para la denominación de ejemplares de la clase de objeto **sdhMSSPRProtectionCoodinator** a ejemplares de la clase de objeto.

13   Soporte de producciones ASN.1

```
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 {
    directionTable DirectionTable,
    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
```

APÉNDICE I
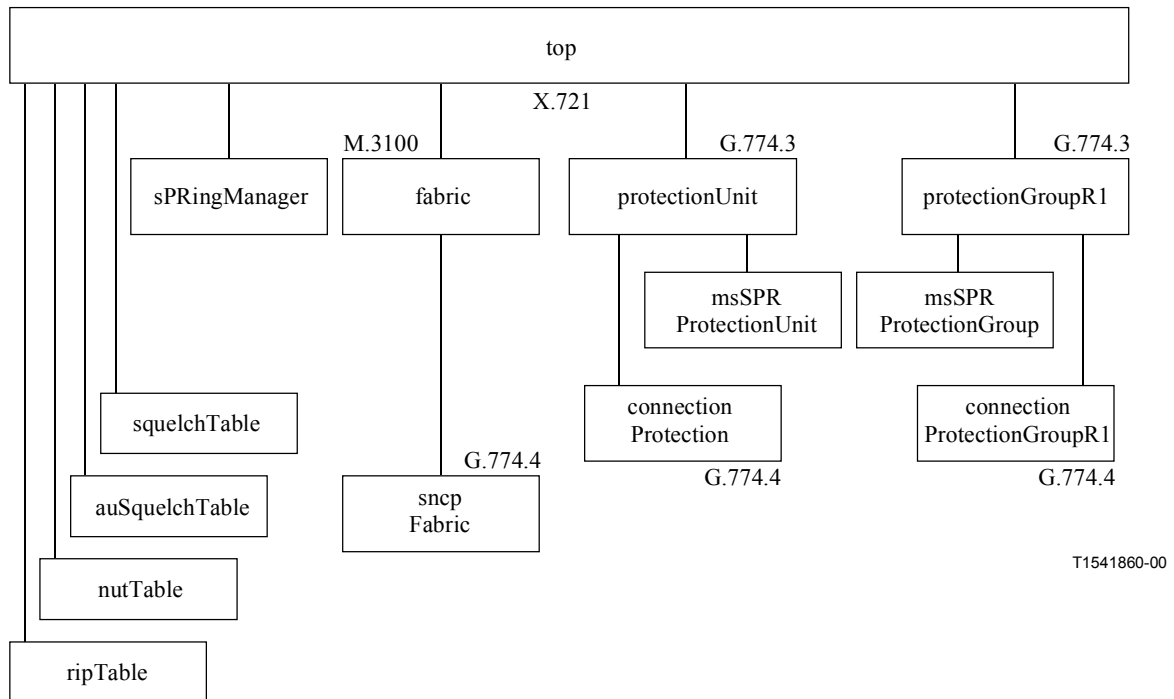
Diagramas de herencia y contenencia

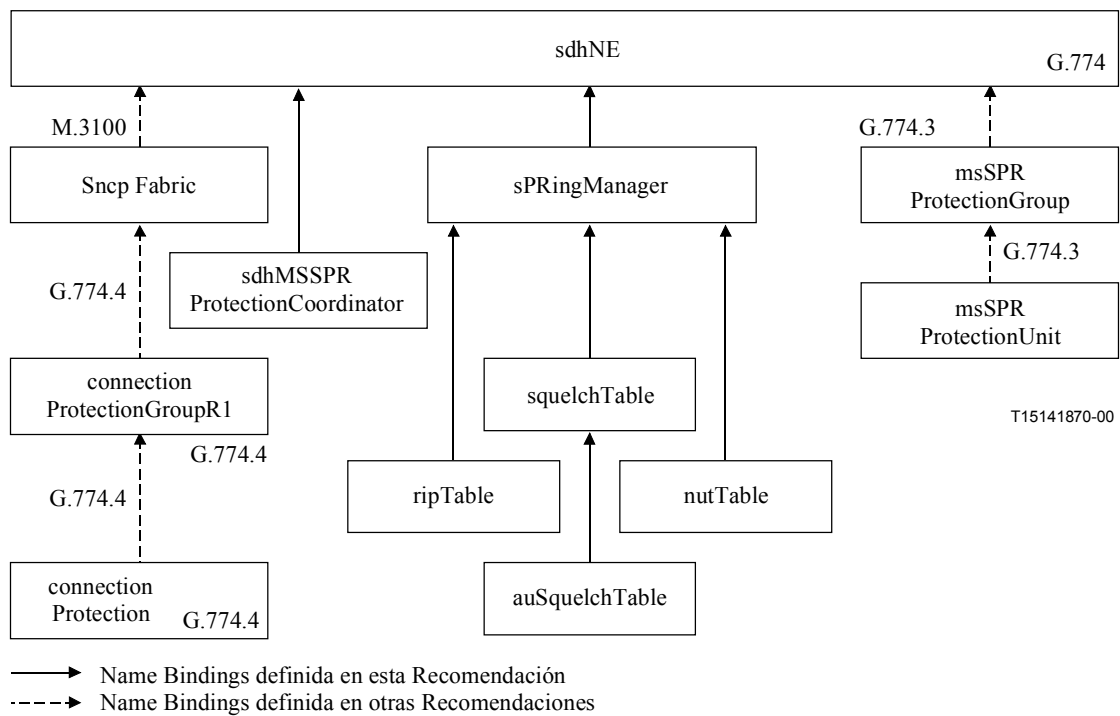**Figura I.1/G.774.10 − Árbol de herencia de un anillo de protección compartida MS**

Figura I.2/G.774.10 − Árbol de contenencia de un anillo de protección compartida MS

Ilustración de la configuración MS SPR

En este apéndice se ilustra el modelo de información MS SPR.

En un elemento de información (NE) MS SPR habrá un ejemplar del objeto **sdhMSSPRProtectionCoordinator**. En la arquitectura MS SPR es posible que un NE participe en múltiples anillos de protección. Para cada anillo MS SPR hay un ejemplar de cada una de las siguientes clases de objeto: **sPRingManager**, **msSPRProtectionGroup**, **squelchTable**, **nutTable**, y **ripTable**. La asociación entre los objetos **sPRingManager** y **msSPRProtectionGroup** se indica por un atributo de puntero **"protectionGroupPointer"** del objeto **sPRingManager**. Los objetos **squelchTable**, **nutTable**, y **ripTable** están contenidos en **sPRingManager**.

Un ejemplar individual del objeto **msSPRProtectionGroup** (PG) contiene cuatro ejemplares del objeto **msSPRProtectionUnit** (PU), tanto en nodos a dos fibras como en nodos a cuatro fibras. Hay dos unidades de protección (PU) protegidas y dos PU protectoras. Estas unidades de protección están representadas en las figuras II.1 y II.2. La funcionalidad de esta clase de objeto es similar a la de la protección SDH MS (UIT-T G.774.3). En el caso de los nodos a dos fibras, sólo está disponible la conmutación de anillo. Por tanto, una PU protegida se asocia con una PU protectora en el lado opuesto del nodo del anillo (indicado por el atributo **ringPU** de las PU). En caso de los nodos a cuatro fibras, las PU también tienen un atributo **spanPU** que apunta a una PU en el mismo lado del nodo anillo para la conmutación de intervalo que está disponible con MS SPR a cuatro hilos.
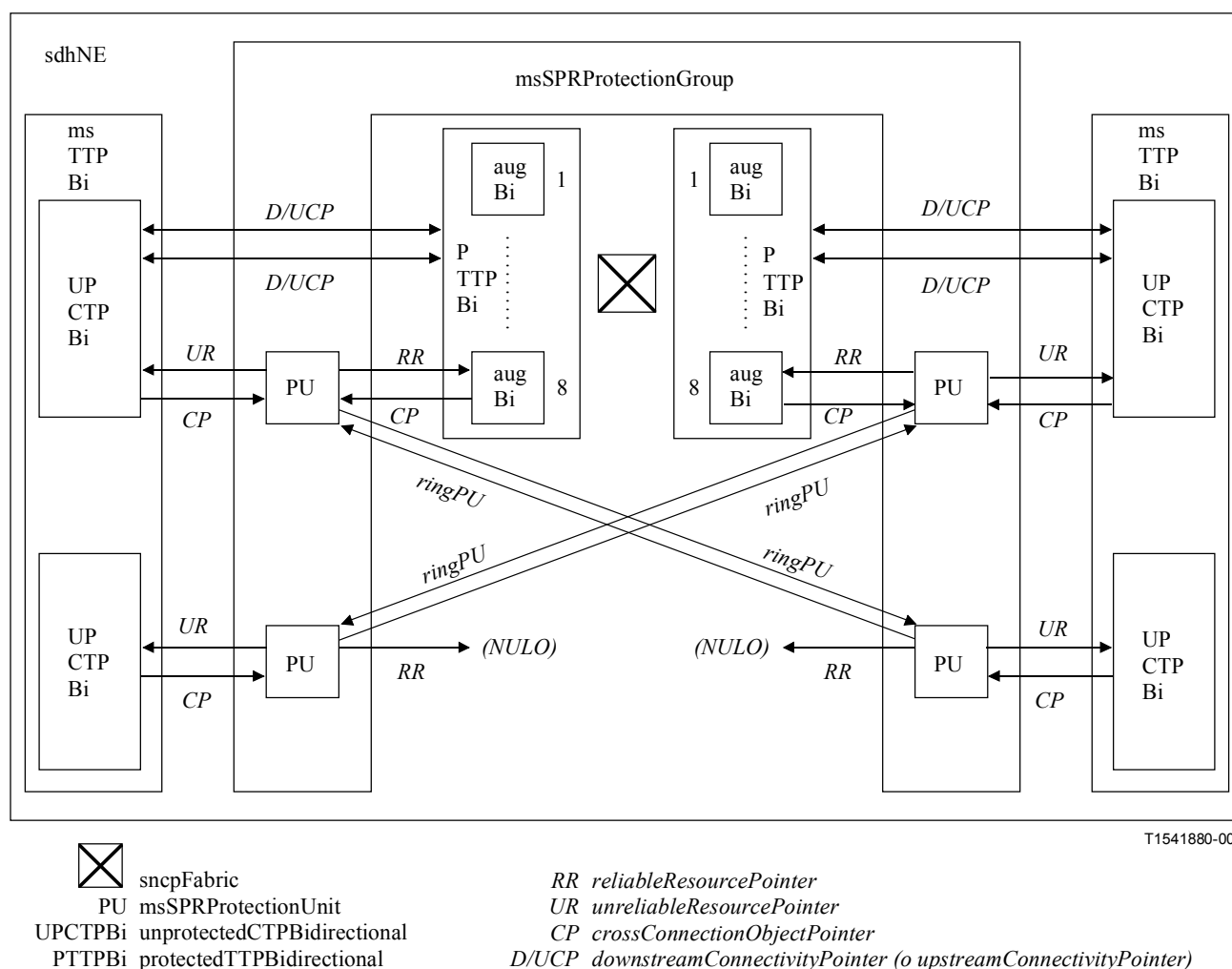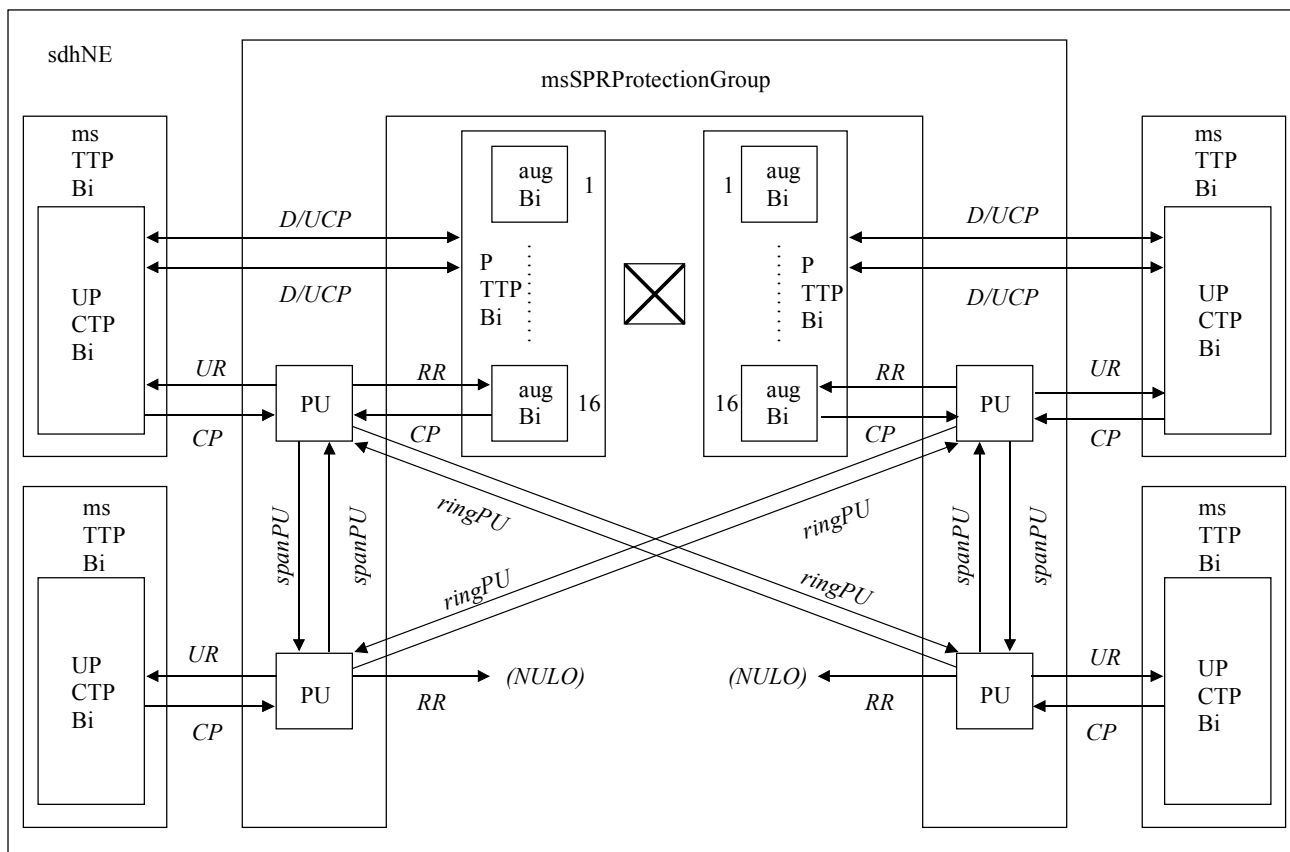

⊠	sncpFabric
PU	msSPRProtectionUnit
UPCTPBi	unprotectedCTPBidirectional
PTTPBi	protectedTTPBidirectional

RR	*reliableResourcePointer*
UR	*unreliableResourcePointer*
CP	*crossConnectionObjectPointer*
D/UCP	*downstreamConnectivityPointer (o upstreamConnectivityPointer)*

Figura II.1/G.774.10 – Nodo de un anillo MS SPR a dos fibras

sncpFabric
PU   msSPRProtectionUnit
UPCTPBi   unprotectedCTPBidirectional
PTTPBi   protectedTTPBidirectional

RR   reliableResourcePointer
UR   unreliableResourcePointer
CP   crossConnectionObjectPointer
D/UCP   downstreamConnectivityPointer (o upstreamConnectivityPointer)

Figura II.2/G.774.10 – Nodo de un anillo MS SPR a cuatro fibras

En la arquitectura de anillos interconectados, el mecanismo básico de protección MS SPR continúa existiendo en el nodo MS SPR. El modelo de protección de conexión G.774.4 se reutiliza para la función selector de servicio para cada canal que está interconectado con otro anillo, esto es, mediante los objetos **sncpFabric**, **connectionProtectionGroupR1** y **connectionProtection**. Se creará un ejemplar del objeto **connectionProtectionGroupR1** (UIT-T G.774.4, versión 2001) por medio de una acción **protectedConnect** o **protectUnprotect** sobre el objeto **sncpFabric**. El objeto **connectionProtectionGroupR1** (CPG) contendrá dos ejemplares del objeto **connectionProtection** (de UIT-T G.774.4) para modelar una conexión protegida a través del nodo primario de interconexión MS SPR. Esto se representa en la figura II.3 para una conexión au3.
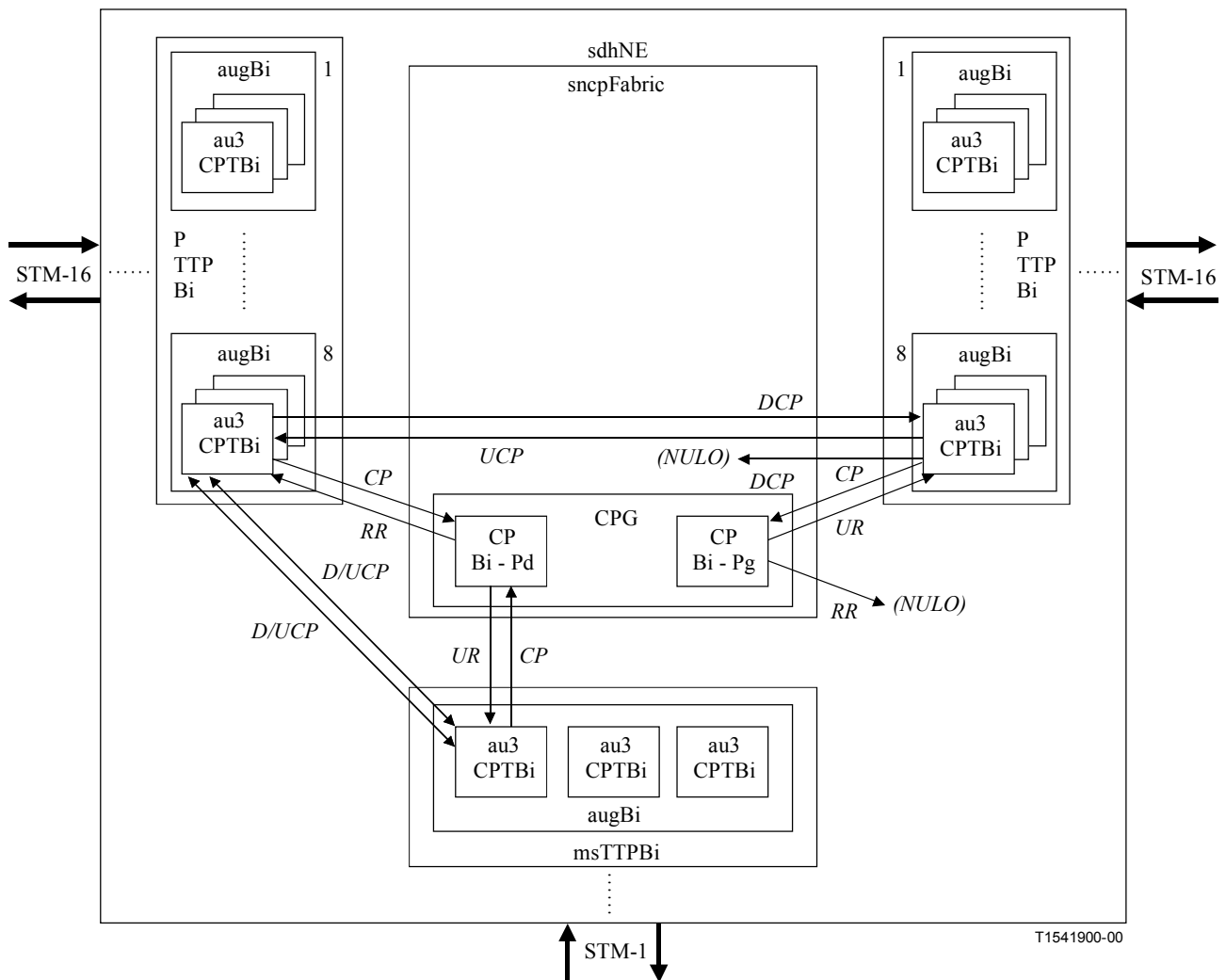
CPG   connectionProtectionGroupR1
CP Bi-Pd connectionProtection (protected)
CP Bi-Pg connectionProtection (protecting)

RR   *reliableResourcePointer*
UR   *unreliableResourcePointer*
CP   *crossConnectionObjectPointer*
D/UCP *downstreamConnectivityPointer (o upstreamConnectivityPointer)*

Figura II.3/G.774.10 – Selector de servicio AU3 en un nodo primario MS SPR a dos fibras

Las clases de objeto **squelchTable**, **auSquelchTable**, y **sPRingManager** representan la información de configuración de anillo que un nodo MS SPR debe mantener para comunicar con otros nodos de anillo en el canal de señalización APS y para efectuar debidamente conmutaciones de protección de anillo (y de intervalo) y silenciamiento. El objeto **sPRingManager** describe la identidad y el orden relativo de los nodos, y la direccionalidad de los TTP alrededor del anillo, que deben ser comunes a todos los anillos. Los objetos **squelchTable** y **auSquelchTable** proporcionan información relacionada con el silenciamiento para cada canal de anillo (AU) procesado por el nodo de anillo. Cada ejemplar del objeto **auSquelchTable** incluye la siguiente información para un determinado canal de anillo:

• identificadores del nodo de entrada y del nodo de salida para el canal;

• una indicación, en su caso, de que el canal forma parte de un canal de anillo concatenado;

• una indicación, en su caso, de que se proporciona acceso a VC de orden inferior por ese canal en el anillo.

Esta información está disponible para cada sentido de transmisión de cada canal en los lados este y oeste del nodo, por lo que puede reflejar diversas configuraciones de conexión, tales como:

- un paso a través bidireccional;
- un paso a través unidireccional de este a oeste, una adición unidireccional al este y una separación unidireccional del oeste;
- una adición/separación bidireccional en el lado este y una adición/separación bidireccional en el lado oeste;
- dos pasos a través unidireccionales con **aNode** y **zNode** diferentes.

La acción **updateSquelchTable** del objeto **squelchTable** se utiliza para actualizar el contenido de la información de silenciamiento de un nodo.

Si hay varios enlaces entre dos nodos (por ejemplo, en el caso de un anillo cerrado formado por dos nodos), para descubrir o proporcionar inequívocamente la topología del anillo es necesario dar la información de terminación del enlace (es decir, el identificador de puerto) en el mapa del anillo. La sintaxis del atributo **ringMap** proporciona un campo facultativo para esa indicación.

Por definición, la clase de objeto **nutTable** soporta el aprovisionamiento de canal no preapropiable. Como se define en UIT-T G.841, por tráfico no protegido no preapropiable (NUT) ha de entenderse tráfico no protegido que es transportado por canales con el dispositivo de conmutación de protección automática inhabilitado para ciertos canales VC de alto orden (HO, *high order*) (es decir, canales de trabajo y sus correspondientes canales de protección). Para el soporte del aprovisionamiento de canales no preapropiables es necesario que haya una tabla NUT en cada nodo del MS SPR.

Por definición, la clase de objeto **ripTable** soporta el interfuncionamiento de anillo en protección. Como se define en UIT-T G.842, la interconexión de anillos en protección (RIP, *ring interworking on protection*) es un mecanismo que ayuda a resolver el problema del agotamiento de la anchura de banda en los nodos de interconexión primario y secundario en un esquema de interconexión con doble punto de partida mediante el empleo de una anchura de banda de protección para el circuito secundario. Para el soporte del interfuncionamiento de anillos en protección es necesario haya una tabla RIP en cada nodo de interconexión secundario del MS SPR.

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