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

**Synchronous digital hierarchy (SDH) –
Bidirectional performance monitoring for the
network element view**

ITU-T Recommendation G.774.1

(Formerly CCITT Recommendation)

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ITU-T Recommendation G.774.1

Synchronous digital hierarchy (SDH) – Bidirectional performance monitoring for the network element view

Summary

This Recommendation provides an information model for the Performance Monitoring of Synchronous Digital hierarchy (SDH) Network. This model describes the managed object classes and their properties for the performance monitoring function, as defined in ITU-T G.784 and as related to SDH Network Elements. These objects are useful to describe information exchanged across interfaces defined in ITU-T M.3010 Telecommunications Management Network (TMN) architecture for the management of the performance monitoring function.

Document history	
Issue	Notes
2001	First revision incorporated the changes documented in the G.774.1 Corrigendum 1 (1996). The rsCurrentData, rsCurrentDataTR, rsHistoryData, msAdaptationCurrentData, and msAdaptationHistoryData were moved to ITU-T G.774.6 for unidirectional performance monitoring. The current data and history data object classes for electrical SPI, optical SPI, ms, protection, and path termination TR were removed from the normative part of this Recommendation as the functionality were no longer required.
11/1994	Initial version of the Recommendation.

Source

ITU-T Recommendation G.774.1 was revised by ITU-T Study Group 15 (2001-2004) and approved under the WTSA Resolution 1 procedure on 9 February 2001.

FOREWORD

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NOTE

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ITU-T Recommendation G.774.1

Synchronous digital hierarchy (SDH) – Bidirectional performance monitoring for the network element view

1 Scope

SDH Performance Monitoring Functions are used to monitor specified performance events of specified Termination Points managed objects and to report these performance data, as well as Quality of Service Alarms to its managing system according to a given schedule.

This Recommendation is for bidirectional performance management of SDH path only.

ITU-T M.2120 defines maintenance of transport network, ITU-T G.784 defines the management of SDH based network element. This Recommendation defines the object model based on ITU-T Q.822 according to the requirements described in ITU-T G.784 and ITU-T M.2120. This model uses generic mechanisms defined in ITU-T Q.822.

Structure of this Recommendation

Clause 5.1 provides an overview of the SDH performance monitoring information model. Clauses 6 to 15 describe the information model using the notation mechanisms defined in ITU-T X.722: Guidelines for the Definition of Managed Objects. Clause 15 contains the syntax definitions of the information carried in the protocol using Abstract Syntax Notation One (ASN.1) defined in ITU-T X.680-X.683. Naming and Inheritance are illustrated in informative Appendix I. Diagrams illustrating the Threshold Reset behaviour are provided in informative Appendix II.

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.

- ITU-T G.707/Y.1322 (2000), *Network node interface for the synchronous digital hierarchy (SDH)*.
- ITU-T G.773 (1993), *Protocol suites for Q-interfaces for management of transmission systems*.
- ITU-T G.774 (2001), *Synchronous digital hierarchy (SDH) – Management information model for the network element view*.
- ITU-T G.783 (2000), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks*.
- ITU-T G.784 (1999), *Synchronous digital hierarchy (SDH) management*.
- ITU-T G.803 (2000), *Architecture of transport networks based on the synchronous digital hierarchy (SDH)*.
- ITU-T G.831 (2000), *Management capabilities of transport networks based on the synchronous digital hierarchy (SDH)*.

- ITU-T G.958 (1994), *Digital line systems based on the synchronous digital hierarchy for use on optical fibre cables.*
- ITU-T M.60 (1993), *Maintenance terminology and definitions.*
- ITU-T M.2120 (2000), *PDH path, section and transmission system and SDH path and multiplex section fault detection and localization procedures.*
- ITU-T M.3010 (2000), *Principles for a telecommunication management network.*
- ITU-T M.3013 (2000), *Considerations for a telecommunications management network.*
- ITU-T M.3100 (1995), *Generic network information model.*
- ITU-T Q.811 (1997), *Lower layer protocol profiles for the Q3 and X interfaces.*
- ITU-T Q.812 (1997), *Upper layer protocol profiles for the Q3 and X interfaces.*
- ITU-T Q.822 (1994), *Stage 1, Stage 2 and Stage 3 description for the Q3 interface – Performance management.*
- ITU-T X.680 to X.683 (1997), *Information technology – Abstract Syntax Notation One (ASN.1).*
- ITU-T X.701 (1997), *Information technology – Open Systems Interconnection – Systems management overview.*
- ITU-T X.710 (1997), *Information technology – Open Systems Interconnection – Common management information service.*
- ITU-T X.711 (1997), *Information technology – Open Systems Interconnection – Common management information protocol: Specification.*
- 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).*
- 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).*
- 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).*
- ITU-T X.730 (1992), *Information technology – Open Systems Interconnection – Systems management: Object management function, plus Amd.1 (1995) and Amd.1/Cor.1 (1996).*
- ITU-T X.731 (1992), *Information technology – Open Systems Interconnection – Systems management: State management function, plus Amd.1 (1995), Cor.1 (1995) and Amd/Cor.1 (1996).*
- ITU-T X.733 (1992), *Information technology – Open Systems Interconnection – Systems management: Alarm reporting function, plus Cor.1 (1994), Amd.1 (1995), Amd.1/Cor.1 (1996) and Cor.2 (1999).*
- ITU-T X.734 (1992), *Information technology – Open Systems Interconnection – Systems management: Event report management function, plus Cor.1(1994), Amd.1 (1995), Amd.1/Cor.1 (1996) and Cor.2 (1999).*
- ITU-T X.735 (1992), *Information technology – Open Systems Interconnection – Systems management: Log control function, plus Amd.1 (1995) and Amd.1/Cor.1 (1996).*

- ITU-T X.739 (1993), *Information technology – Open Systems Interconnection – Systems Management: Metric objects and attributes.*

3 Terms and definitions

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

4 Abbreviations

This Recommendation uses the following abbreviations:

AIS	Alarm Indication Signal
BBE	Background Block Error
CSES	Consecutive Severely Errored Second
CTP	Connection Termination Point
EBER	Excessive Bit Error Ratio
ES	Errored Second
FEBBE	Far End Background Block Error
FEEB	Far End Errored Block
FEES	Far End Errored Second
FERF	Far End Receive Failure
FESES	Far End Severely Errored Second
ISO	International Organization for Standardization
ITU	International Telecommunications Union
LB	Laser Bias
LOF	Loss of Frame
LOS	Loss of Signal
LT	Laser Temperature
MS	Multiplex Section
NCSES	Number of Consecutive Severely Errored Second
NE	Network Element
OFS	Out of Frame Second
OOF	Out of Frame
OS	Operations System
OSI	Open Systems Interconnection
OSL	Optical Signal Level
PJC	Pointer Justification Count
PJE	Pointer Justification Event
Pkg	Package
PPI	Plesiochronous Physical Interface

PSC	Protection Switch Count
PSD	Protection Switch Duration
QS	Quality of Service
RAI	Remote Alarm Indication
RDN	Relative Distinguished Name
RS	Regenerator section
SDH	Synchronous Digital Hierarchy
SES	Severely Errored Second
SPI	Synchronous Physical Interface
STM-N	Synchronous Transport Module N
TMN	Telecommunications Management Network
TP	Termination Point
TR	Threshold Reset
TTP	Trail Termination Point
UAS	Unavailable Second

5 Performance management model

5.1 Overview

This clause provides Managed Objects required to support management of performance monitoring in SDH Network Elements.

This model defines subclasses of the generic `currentData` and `historyData` object classes from ITU-T Q.822, for each kind of monitoring point. For each type of monitoring point two subclasses of `currentData` are defined. One is defined for either a 15-minute count or 1-day count period, and provides implicit clearing of threshold crossing alarms at the end of each granularity period. The other subclass is only relevant to 15-minute counting and performs explicit clearing of threshold alarms (Threshold Reset) at the end of a clear 15-minute period (refer to 2.3.4.2/M.2120).

Starting and ending of unavailability period is reported by the instances of these subclasses that hold the 24-hour counts.

History information could either be collected as part of `historyData` instances or one of its subclasses or as an `eventRecord` or one of its subclasses contained in a log. Utilization of a LOG is not mandatory in this Recommendation.

The threshold reset (TR) mechanism used in this Recommendation corresponds to the reset threshold report (RTR) of ITU-T G.784.

5.2 Requirements

The SDH Performance Monitoring functions shall provide for:

- the ability for a managing system to request the collection of the various Performance events relating to a given monitored entity for a given collection period;
- the ability for a managing system to suspend/resume the performance data collection for a given monitored entity (or set of entities);
- the ability for a managing system to instruct the NE to reset the performance monitoring counters for a given monitored entity (or set of entities);
- the scheduling of performance collection activity within specified time periods, for a given monitored entity (or set of entities);
- the ability for a managing system to request the performance monitoring counters for a given monitored entity (or set of entities);
- the ability for a managed system to send event reports to a managing system to notify the results of the performance data collection, at the end of the collection period;
- the ability for a managing system to instruct the NE to maintain Performance historical data for a specified duration, under specified conditions;
- the ability for a managing system to instruct the NE to remove specific Performance historical data;
- the ability for a managing system to instruct the NE to establish thresholding criteria for a given monitored entity (or set of entities);
- the ability for a managed system to send Quality of Service Alarms upon threshold violation of a performance counter of a monitored entity.

6 Managed Object Classes Definitions

NOTE 1 – See Appendix III for a list of the managed object classes that have been moved to ITU-T G.774.6 for unidirectional performance monitoring.

NOTE 2 – See Appendix IV for the managed object classes that are no longer required.

6.1 SDH Current Data

```
sdhCurrentData  MANAGED OBJECT CLASS
DERIVED FROM  "Recommendation Q.822" : currentData;
CHARACTERIZED BY
"Recommendation Q.822": zeroSuppressionPkg,
"Recommendation Q.822": thresholdPkg,
sdhCurrentDataPackage  PACKAGE
    BEHAVIOUR sdhCurrentDataBehaviour;
    ATTRIBUTES
    "Recommendation M.3100": currentProblemList GET;;;
CONDITIONAL  PACKAGES
historyPackagePRESENT IF
    "an instance does not support flexible assignment of the history length",
unavailableTimeAlarmPackage PRESENT IF
    "starting and ending of unavailable period has to be reported and the
granularity period is 24 hours";
REGISTERED AS {g774-01MObjectClass 1};
```

sdhCurrentDataBehaviour BEHAVIOUR

DEFINED AS

"The sdhCurrentData class is used to define generic characteristic for SDH performance monitoring from which subclasses are defined in order to hold performance event counts for a specific monitoring point. Subclasses of this class are used in order to support performance monitoring of SDH paths at various layers as described in Recommendation G.803. The performance monitoring events ES, SES and BBE which are monitored by some of the subclasses of this subclass are defined in 4.1.1/G.826. The granularityPeriod attribute can only be assigned a value at creation time.

This class can only contain one reference to an instance of the thresholdData object class in the thresholdDataInstance attribute.

The 15' and 24 hours granularity period must be supported fully. If a threshold is reached or crossed then the currentProblemList attribute shall indicate it with the probable cause 'Threshold crossed'. Subclass of this class is used to monitor the near end of the path in case of bidirectional path the far end of the path shall be supported additionally. In case of monitoring of a bidirectional path and Far End unavailability is monitored, an unavailable period starts if either the near end or the far end is in an unavailable condition. In case of monitoring of a unidirectional path only the near end is considered.

An unavailable condition starts when 10 consecutive severely errored seconds have been detected; these 10 seconds belong to the unavailable time. An unavailable condition ends when 10 consecutive seconds with no severely errored second are detected. These 10 seconds belong to the available time. The unavailable period entry/exit criteria are described in Annex A/G.826.

For threshold reset subclasses of this object class the following rules apply:

- No more than one QOS alarm shall be generated until there has been a 15-minute rectangular fixed window with less error count than the low error count threshold and no unavailable period exists.
- To provision the high and low threshold value, the counterThresholdAttributList attribute of the Q.822-ThresholdDataInstance is used.

In this attribute all the thresholds (high and low) for each necessary counter are stored in a list. This means for example, that the high threshold for ES and the low threshold for ES are individually stored in the same list. It is up to the network element to recognize which is the high and which is the low one. If the unavailableTimeAlarmPackage is present and if an unavailable period starts, then a communication alarm shall be sent with a probable cause of 'Unavailable' and the presence of this unavailable condition is indicated by the currentProblemList attribute. If an unavailable period is ending, then a communication alarm shall be sent with a probable cause of 'Unavailable' and a severity of 'Cleared'. An available condition is indicated by the absence of the unavailable condition in the current problem list. The unavailable condition has no effect on the operationalState. Each subclass of this class shall define the performance attributes required to hold the mandatory or optional performance events. These performance event counts are inhibited during unavailable time. Attributes which are defined in a subclass of this class shall be included in history information using the historyData, or one of its subclass, unless it is explicitly specified in the subclass of this class that a particular attribute be not included. Each subclass of this class shall indicate which subclass of the history data is used for history retention. The following conditional packages are not used in this class: filterSuppressionPkg, observedManagedObjectPkg.

Concerning the subclasses of this class the following rule applies:

If a subclass of this class has a granularity period of 15 minutes, it should be either an instance with the threshold reset functionality or an instance without this functionality instantiated (per termination point), but not both.

";

6.2 Regenerator Section Current Data

This managed object class was moved to ITU-T G.774.6.

6.3 Regenerator Section Current Data Threshold Reset

This managed object class was moved to ITU-T G.774.6.

6.4 Path Termination Current Data

```
pathTerminationCurrentData  MANAGED OBJECT CLASS
DERIVED FROM sdhCurrentData;
CHARACTERIZED BY
pathTerminationCurrentDataPackage  PACKAGE
    BEHAVIOUR pathTerminationCurrentDataBehaviour;
ATTRIBUTES
    "Recommendation X.739": granularityPeriod REQUIRED VALUES
    SDHPMASN1.SDHGranularityPeriod,
```

-- According to ITU-G.784 (1999), only the 24 h (one day) granularity period has to be supported.

```
    bBE REPLACE-WITH-DEFAULT    GET,
    eS  REPLACE-WITH-DEFAULT    GET,
    sES REPLACE-WITH-DEFAULT    GET;;;
```

CONDITIONAL PACKAGES

```
cSESCurrentDataPackage PRESENT IF
    "an instance supports it",
farEndCSESCurrentDataPackage PRESENT IF
    "an instance supports it" ,
uASCCurrentDataPackage PRESENT IF
    "an instance supports it",
farEndCurrentDataPackage PRESENT IF
    "monitoring of the far end is supported and the monitored point is
Bidirectional";
REGISTERED AS {g774-01MObjectClass 9};
```

```
pathTerminationCurrentDataBehaviour  BEHAVIOUR
DEFINED AS
```

"Instances of the pathTerminationCurrentData managed object Class are used to hold the current register counts for a High Order Path and or Low Order Path during a collection period. An instance of this object class, for a monitored managed object instance, holds the current register counts of each performance events (BBE, ES, SES, FEBBE, FEES, FESES, UAS).

This managed object class uses the pathTerminationHistoryData managed object class for history retention.

A QOS alarm shall be sent as soon as a threshold is reached or crossed. At the end of the granularity period the QOS alarm is implicitly cleared and, provided there are no other outstanding threshold crossing QOS alarms, 'Threshold crossing' removed from the currentProblemList (i.e. No Notification is Sent) and a new QOS alarm shall be sent if the threshold is reached or crossed again during the next granularity period. Only one threshold value per performance counter will be supported. ";

6.5 Multiplex Section Adaptation Current Data

This managed object class was moved to ITU-T G.774.6.

6.6 Regenerator Section History Data

This managed object class was moved to ITU-T G.774.6.

6.7 Path Termination History Data

```
pathTerminationHistoryData  MANAGED OBJECT CLASS
DERIVED FROM "Recommendation Q.822": historyData;
CHARACTERIZED BY
pathTerminationHistoryDataPackage  PACKAGE
    BEHAVIOUR pathTerminationHistoryDataBehaviour;
    ATTRIBUTES
        bBE  GET,
        eS   GET,
        sES  GET ;;;
CONDITIONAL PACKAGES
uASHistoryDataPackage PRESENT IF
    "the containing pathTerminationCurrentData or contains the
uASCurrentDataPackage",
farEndHistoryDataPackage PRESENT IF
    "the containing pathTerminationCurrentData or pathTerminationCurrentDataTR
instance contains the farEndCurrentDataPackage";
REGISTERED AS {g774-01MObjectClass 17};

pathTerminationHistoryDataBehaviour  BEHAVIOUR
DEFINED AS
"Instances of this class are used to store the observed events of a
pathTerminationCurrentData or pathTerminationCurrentDataTR object at the end of
an observation interval. An instance of this managed object is contained by a
pathTerminationCurrentData or pathTerminationCurrentDataTR managed object
instance.";
```

6.8 Multiplex Section Adaptation History Data

This managed object class was moved to ITU-T G.774.6.

7 Package definitions

7.1 Consecutive Severely Errored Second Current Data Package

```
cSESCurrentDataPackage  PACKAGE
BEHAVIOUR
    cSESCurrentDataPackageBehaviour;
ATTRIBUTES
    cSESEvent  GET,
    nCSES      PERMITTED VALUES SDHPMASN1.NCSESRange  GET-REPLACE;
REGISTERED AS {g774-01Package 1};
```

```
cSESCurrentDataPackageBehaviour  BEHAVIOUR
DEFINED AS
"This package is used to hold Consecutive Severely Errored Second (CSES) events.
A CSES is detected each time x consecutive SES appear. The number of consecutive
SES that generate a CSES is given by the nCSES attribute, in the range of 2 to 9.
The cSES events are not detected during unavailable time. The CSES events are
recorded in the cSESEvent attribute, this attribute contains the time at which
the consecutive severely errored seconds started and the value of the nCSES
attribute at the time the event has occurred. The cSESEvent attribute shall at
least support recording of 6 CSES events. When the cSESEvent attribute is full, a
wrapping mechanism is used to discard the oldest CSES event. These attributes are
not reset and are not stored in history data objects at the end of the
granularity period. The cSESEvent attribute is initialized as an empty set when
the corresponding object that holds this attribute is created. The CSES event is
described in Recommendation G.784.";
```

7.2 Far End Consecutive Severely Errored Second Current Data Package

```
farEndCSESCurrentDataPackage PACKAGE
  BEHAVIOUR
    farEndCSESCurrentDataPackageBehaviour;
  ATTRIBUTES
    fECSESEvent GET,
    nCSES PERMITTED VALUES SDHPMASN1.NCSESRange GET-REPLACE ;
REGISTERED AS {g774-01Package 2};
```

```
farEndCSESCurrentDataPackageBehaviour BEHAVIOUR
DEFINED AS
```

"This package is used to hold Far End Consecutive Severely Errored Second (fECSES) events. A fECSES is detected each time x consecutive fESES appear. The number of consecutive fESES that generate a fECSES is given by the nCSES attribute, in the range of 2 to 9. The fECSES events are not detected during unavailable time. The fECSES events are recorded in the fECSESEvent attribute, this attribute contains the time at which the far end consecutive severely errored seconds started and the value of the nCSES attribute at the time the event has occurred. The fECSESEvent attribute shall at least support recording of 6 fECSES events. When the fECSESEvent attribute is full, a wrapping mechanism is used to discard the oldest fECSES event. These attributes are not reset and are not stored in history data objects at the end of the granularity period. The fECSESEvent attribute is initialized as an empty set when the corresponding object that holds this attribute is created.";

7.3 Far End Current Data Package

```
farEndCurrentDataPackage PACKAGE
  BEHAVIOUR
    farEndCurrentDataPackageBehaviour;
  ATTRIBUTES
    fEBBE REPLACE-WITH-DEFAULT GET,
    fEES REPLACE-WITH-DEFAULT GET,
    fESES REPLACE-WITH-DEFAULT GET;
REGISTERED AS {g774-01Package 3};
```

```
farEndCurrentDataPackageBehaviour BEHAVIOUR
DEFINED AS
```

"This package is used to record the far end performance event counts.";

7.4 Far End History Data Package

```
farEndHistoryDataPackage PACKAGE
  BEHAVIOUR
    farEndHistoryDataPackageBehaviour;
  ATTRIBUTES
    fEBBE GET,
    fEES GET,
    fESES GET;
REGISTERED AS {g774-01Package 4};
```

```
farEndHistoryDataPackageBehaviour BEHAVIOUR
DEFINED AS
```

"This package is used to record the corresponding current data attribute values at the end of the granularity period.";

7.5 History Package

```
historyPackage PACKAGE
    BEHAVIOUR
        historyPackageBehaviour;
REGISTERED AS {g774-01Package 5};
```

```
historyPackageBehaviour BEHAVIOUR
DEFINED AS
```

"At the end of each performance interval an instance of historyData or one of its subclass shall be created if history retention was not suppressed by other means such as zero suppression. The values of the historyData object or one of its subclass is the copy of the values of the corresponding attributes of the currentData or one of its subclass at the end of each performance interval. Once the new historyData instance is created or one of its subclass this instance shall be retained in the Network Element at least for 16 periods of 15 minutes for 15' performance interval and 1 period of 1 day for 1 day performance interval. The storing of history data is described in 5.3.2/G.784.";

7.6 Threshold Reset Package

```
thresholdResetPackage PACKAGE
    BEHAVIOUR
        thresholdResetPackageBehaviour;
REGISTERED AS {g774-01Package 14};
thresholdResetPackageBehaviour BEHAVIOUR
DEFINED AS
```

"The following rules apply to the thresholds mechanism:

- ES thresholds:

Two thresholds are defined: The upper ES threshold and the low ES threshold - No more than one QOS alarm shall be generated until there has been a 15-minute rectangular fixed window with less ES than the low ES threshold and no unavailable period. At the end of the first 15-minute rectangular period with less ES than the low ES threshold and no unavailable period, if a threshold crossing has been previously generated, then a QOS alarm shall be sent which indicates the clearing of the low ES threshold, and the 'Threshold crossing' removed from the currentProblemList. If the upper ES threshold is reached or crossed, after a 15-minute rectangular fixed window with less ES than the low ES threshold, then a QOS alarm shall be sent.

- SES threshold:

One threshold is defined - No more than one QOS alarm shall be generated until there has been a 15-minute rectangular fixed window with zero SES. At the end of the first 15-minute rectangular period with zero SES, a QOS alarm shall be sent which indicates the clearing of a zero threshold. If after a 15-minute rectangular fixed window with zero SES the SES threshold is reached or crossed then a QOS alarm shall be sent.

- BBE threshold: refer to the ES threshold.

For any of the above thresholds, A QOS clear will not be sent if the Performance Monitoring Data is suspect, as defined by the suspectIntervalFlag attribute. ";

7.7 Unavailable Second Current Data Package

```
uASCurrentDataPackage PACKAGE
    BEHAVIOUR
        uASCurrentDataPackageBehaviour;
    ATTRIBUTES
        uAS REPLACE-WITH-DEFAULT GET;
REGISTERED AS {g774-01Package 15};
```

```
uASCurrentDataPackageBehaviour BEHAVIOUR
DEFINED AS
```

"This package is used to store the counter of one second intervals pertaining to an Unavailable Time.";

7.8 Unavailable Second History Data Package

```
uASHistoryDataPackage PACKAGE
    BEHAVIOUR
        uASHistoryDataPackageBehaviour;
    ATTRIBUTES
        uAS GET;
REGISTERED AS {g774-01Package 16};
```

```
uASHistoryDataPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to record the corresponding current data attribute values
at the end of the granularity period.";
```

7.9 Unavailable Time Alarm Package

```
unavailableTimeAlarmPackage PACKAGE
    BEHAVIOUR
        unavailableTimeAlarmPackageBehaviour;
    NOTIFICATIONS
        "Recommendation X.721 ": communicationsAlarm;
REGISTERED AS {g774-01Package 17};
```

```
unavailableTimeAlarmPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used when a Communication Alarm Notification with the probable
cause. Unavailable is to be emitted to indicate the beginning of an unavailable
time period. The end of an unavailable time period shall be indicated by the
clearing of this alarm.";
```

8 Attributes definitions

8.1 Consecutive Severely Errored Second Event

```
cSESEvent ATTRIBUTE
    WITH ATTRIBUTE SYNTAX SDHPMASN1.CSES;
    BEHAVIOUR
        cSESEventBehaviour BEHAVIOUR
DEFINED AS
"The value of the cSESEvent attribute represents the recording of at least 6 cSES
events. A cSES event is generated each time x consecutive SES appear during the
available time of the monitored resource."
;;
REGISTERED AS {g774-01Attribute 1};
```

8.2 Errored Second

```
eS ATTRIBUTE
    DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
    BEHAVIOUR
        eSBeh BEHAVIOUR
DEFINED AS
"The value of the eS attribute represents the count of seconds with one or more
errored blocks during the available time of the monitored resource during the
corresponding granularity period. The ES performance event is described
in 3.1.1/G.826."
;;
REGISTERED AS {g774-01Attribute 2};
```

8.3 Far End Errored Second

```
fEES ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    ffEESBeh BEHAVIOUR
DEFINED AS
"The value of the fEES attribute represents the count of seconds with one or
more far end errored blocks detected at the remote terminal during the available
time of the monitored resource during the corresponding granularity period."
;;
REGISTERED AS {g774-01Attribute 3};
```

8.4 Far End Background Block Error

```
fEBBE ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    fEBBEBeh BEHAVIOUR
DEFINED AS
"The value of the fEBBE attribute represents the count of errored blocks
(Estimate Errored Block on Bip-n violation) not occurring as part of an fESES."
;;
REGISTERED AS {g774-01Attribute 4};
```

8.5 Far End Consecutive Severely Errored Second Event

```
fECSESEvent ATTRIBUTE
  WITH ATTRIBUTE SYNTAX SDHPMASN1.CSES;
  BEHAVIOUR
    fECSESEventBehaviour BEHAVIOUR
DEFINED AS
"The value of the fECSESEvent attribute represents the recording of at least 6
fECSES events. A fECSES event is generated each time x consecutive fESES appear
during the available time of the monitored resource during the corresponding
granularity period."
;;
REGISTERED AS {g774-01Attribute 5};
```

8.6 Number of Consecutive Severely Errored Second

```
nCSES ATTRIBUTE
  WITH ATTRIBUTE SYNTAX SDHPMASN1.NCSESRange;
  BEHAVIOUR
    nCSESBeh BEHAVIOUR
DEFINED AS
"The value of the nCSES attribute represents the number of consecutive (near or
far end) SES which will lead to the generation of a (near or far end) cSES event.
The nCSES is in the range 2 to 9."
;;
REGISTERED AS {g774-01Attribute 12};
```

8.7 Background Block Error

```
bBE ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    bBEBeh BEHAVIOUR
DEFINED AS
"The value of the bBE attribute represents the count of errored blocks (Estimate
Errored Block on Bip-n violation) not occurring as part of an SES. The bBE
performance event is described in 3.1.1/G.826."
;;
REGISTERED AS {g774-01Attribute 13};
```

8.8 Severely Errored Seconds

```
SES ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    sESBeh BEHAVIOUR
DEFINED AS
"The value of the SES attribute represents the count of one second periods
containing greater than or equal to 30% of errored blocks, or at least one
Severely Disturbed Period (SDP) that is one second containing one or more defects
during the available time of the monitored resource during the corresponding
granularity period. An SES is also counted as an ES. The SES performance event is
described in Recommendation G.826."
;;
REGISTERED AS {g774-01Attribute 17};
```

8.9 Far End Severely Errored Seconds

```
fESSES ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    fESSESBeh BEHAVIOUR
DEFINED AS
"The value of the fESSES attribute represents the count of one second periods
containing greater than or equal to 30% of far end errored blocks as detected at
the remote terminal (fEBC), or at least one Far End Severely Disturbed
Period (SDP) that is one second containing one or more far end defects as
detected at the remote terminal (FERF) during the available time of the monitored
resource during the corresponding granularity period. An fESSES is also counted as
an fEES."
;;
REGISTERED AS {g774-01Attribute 18};
```

8.10 Unavailable Seconds

```
uAS ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    uASBeh BEHAVIOUR
DEFINED AS
"The value of the uAS attribute represents the count of one second intervals
pertaining to an UnavailableTime. A period of unavailable time begins when the
SES continues for a period of ten consecutive seconds. These seconds are
considered to be unavailable time. A new period of available time begins with the
first second of ten consecutive non-SES. The unavailable time entry/exit criteria
is described in Annex A/G.826."
;;
REGISTERED AS {g774-01Attribute 22};
```

9 Actions

None.

10 Notifications

None.

11 Parameters

None.

12 Name binding definitions

12.1 History Data – SDH Current Data

```
historyData-sdhCurrentData NAME BINDING
  SUBORDINATE OBJECT CLASS "Recommendation Q.822": historyData AND
SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS sdhCurrentData AND SUBCLASSES;
    WITH ATTRIBUTE "Recommendation Q.822": historyDataId;
  BEHAVIOUR
    historyData-sdhCurrentDataBehaviour BEHAVIOUR
DEFINED AS
"Instance of the historyData object class or one of its subclass is created at
the end of the granularity period of an instance of the sdhCurrentData object or
one of its subclass and is directly contained by that instance."
;;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 1};
```

12.2 Path Termination Current Data – VC4 TTP SinkR1

```
pathTerminationCurrentData-vc4TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentData AND SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS "Recommendation G.774": vc4TTPSinkR1 AND
SUBCLASSES;
    WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
    WITH-REFERENCE-OBJECT,
    WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
    DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 23};
```

12.3 Path Termination Current Data – VC3 TTP SinkR1

```
pathTerminationCurrentData-vc3TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentData AND SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS "Recommendation G.774": vc3TTPSinkR1 AND
SUBCLASSES;
    WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
    WITH-REFERENCE-OBJECT,
    WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
    DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 24};
```

12.4 Path Termination Current Data – VC2 TTP SinkR1

```
pathTerminationCurrentData-vc2TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentData AND SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS "Recommendation G.774": vc2TTPSinkR1 AND
SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 25};
```

12.5 Path Termination Current Data – VC12 TTP SinkR1

```
pathTerminationCurrentData-vc12TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentData AND SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS "Recommendation G.774": vc12TTPSinkR1 AND
SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 26};
```

12.6 Path Termination Current Data – VC11 TTP SinkR1

```
pathTerminationCurrentData-vc11TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentData AND SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS "Recommendation G.774": vc11TTPSinkR1 AND
SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 27};
```

13 Subordination rules

None.

14 Pointer constraints

None.

15 Supporting ASN.1 productions

```
SDHPMASN1 { itu-t(0) recommendation(0) g(7) g774(774) hyphen(127) pm(01)
informationModel(0)
asn1Module(2) sdhpm (0) }
DEFINITIONS IMPLICIT TAGS ::=
BEGIN
-- EXPORTS everything

IMPORTS
ProbableCause FROM Attribute-ASN1Module { joint-iso-itu-t ms(9) smi(3) part2(2)
asn1Module(2) 1}
TimePeriod FROM MetricModule {joint-iso-itu-t ms(9) function(2) part11(11)
asn1Module(2) 0};

sdhPM OBJECT IDENTIFIER ::= {itu-t(0) recommendation(0) g(7) g774(774)
hyphen(127) pm(01) informationModel(0) }
g774-01MOBJECTCLASS OBJECT IDENTIFIER ::= {sdhPM managedObjectClass(3)}
g774-01ATTRIBUTE OBJECT IDENTIFIER ::= {sdhPM attribute(7)}
g774-01NAMEBINDING OBJECT IDENTIFIER ::= {sdhPM nameBinding(6)}
g774-01PACKAGE OBJECT IDENTIFIER ::= {sdhPM package(4)}

Integer ::= INTEGER
CSES ::= SET OF SEQUENCE {
    eventTime GeneralizedTime,
    nCSES      NCSESRange
}
NCSESRange ::= Integer(2 .. 9)
SDHGranularityPeriod ::= TimePeriod (WITH COMPONENTS {minutes (15), days(1)})
SDHPVGranularityPeriod ::= TimePeriod (WITH COMPONENTS {minutes (15)})

END -- end of SDHPMASN1
```

APPENDIX I

Inheritance and naming diagram

See Figures I.1 and I.2.

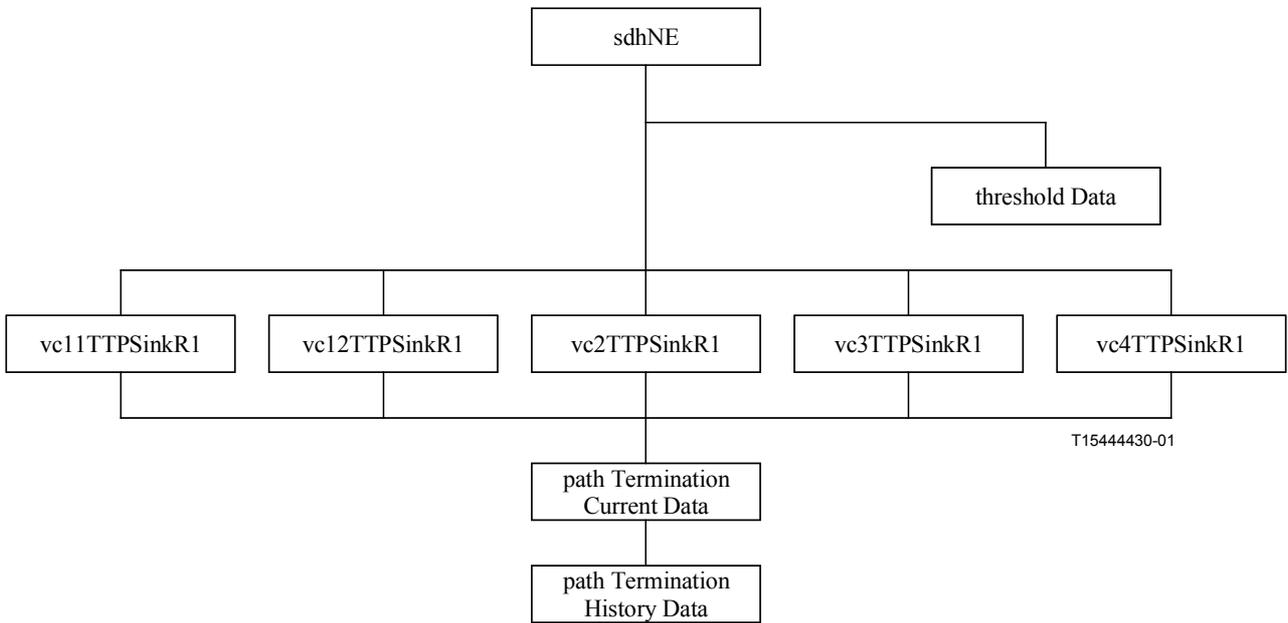


Figure I.1/G.774.1 – Object name binding for bidirectional performance management fragment

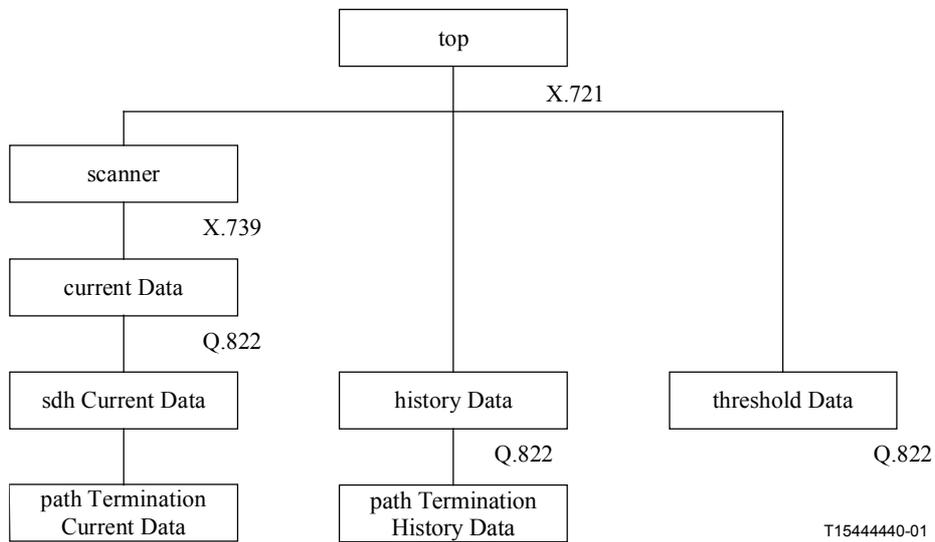


Figure I.2/G.774.1 – Inheritance tree for bidirectional performance management fragment

APPENDIX II

Threshold Reset (TR) Behaviour

Figure II.1 illustrates the Threshold Reset (TR) behaviour for three possible scenarios.

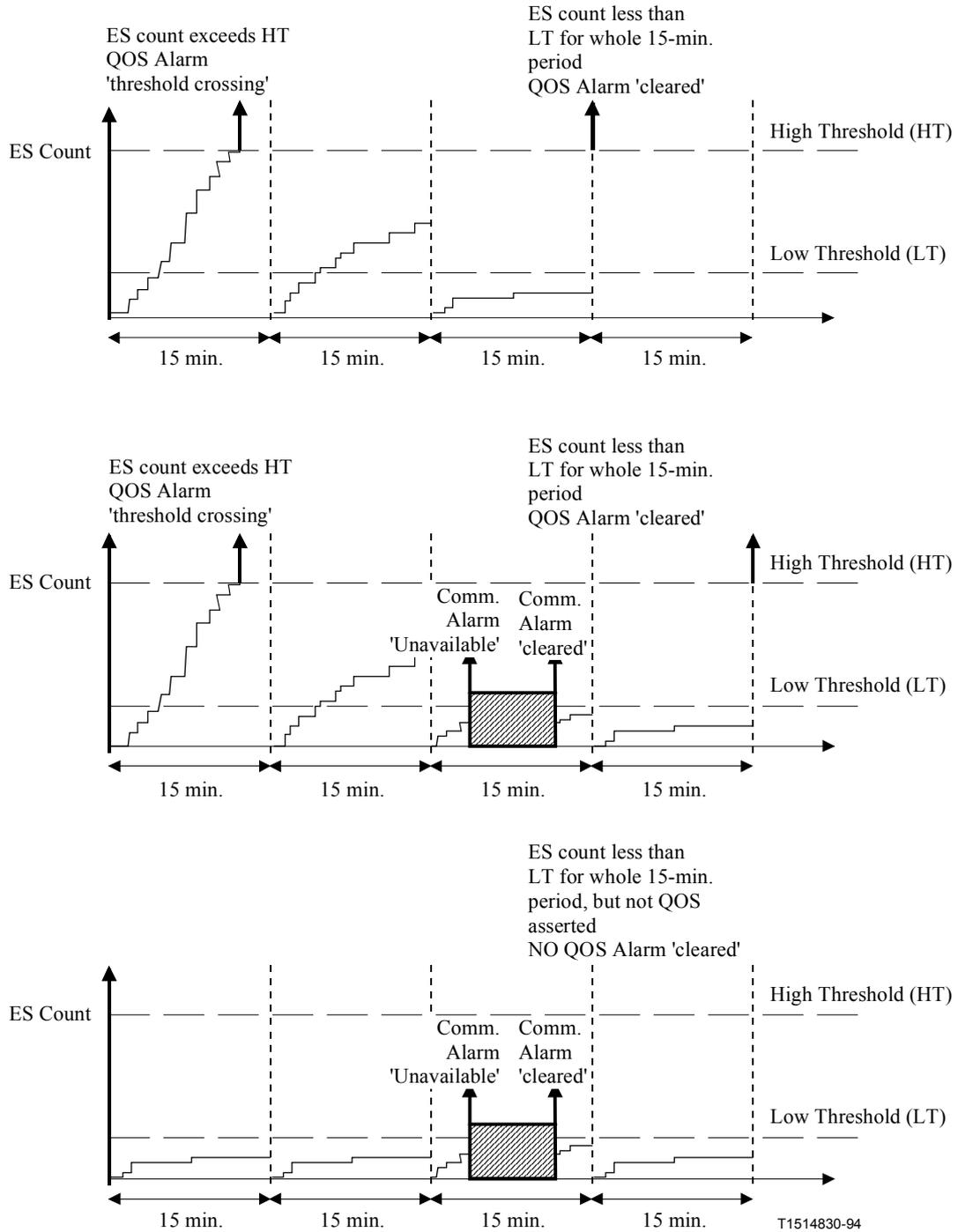


Figure II.1/G.774.1 – Threshold Reset (TR) behaviour

APPENDIX III

Managed object classes moved to ITU-T G.774.6

The following managed object classes have been moved to ITU-T G.774.6 for unidirectional performance monitoring.

III.1 rsCurrentData

III.2 rsCurrentDataTR

III.3 rsHistoryData

III.4 msAdaptationCurrentData

III.5 msAdaptationHistoryData

APPENDIX IV

Functionality that is no longer required

IV.1 Managed object class definitions

IV.1.1 Electrical Source Synchronous Physical Interface Current Data

```
electricalSourceSPICurrentData  MANAGED OBJECT CLASS
  DERIVED FROM sdhCurrentData;
  CHARACTERIZED BY
    transmitPowerLevelCurrentDataPackage,
    electricalSourceSPICurrentDataPackage  PACKAGE
    BEHAVIOUR electricalSourceSPICurrentDataBehaviour;;;
  CONDITIONAL PACKAGES
    transmitPowerLevelTideMarkPackage PRESENT IF
      "an instance supports it";
REGISTERED AS {g774-01MObjectClass 4};
```

```
electricalSourceSPICurrentDataBehaviour BEHAVIOUR
DEFINED AS
"Instances of the electricalSPICurrentData managed object Class are used to hold
the monitoring of the physical characteristics of the output of an electrical
source (electricalSPITTP). These characteristics are handled by gauge attributes.
The following performance event is defined: transmit Power Level.
When a Tide Mark Package is used ( in conjunction with its associated gauge), the
corresponding Tide Mark attribute shall be reported in the history data at the
end of the granularity period and the values of the tide marks shall be reset to
the current values of the associated gauge at the end of the granularity period.
The unavailableTimeAlarmPackage is not used in this class. This managed object
class uses the electricalSPIHistoryData managed object class for history
retention.";
```

IV.1.2 Optical Source Synchronous Physical Interface Current Data

```
opticalSourceSPICurrentData  MANAGED OBJECT CLASS
  DERIVED FROM sdhCurrentData;
  CHARACTERIZED BY
    opticalSourceSPICurrentDataPackage  PACKAGE
    BEHAVIOUR opticalSourceSPICurrentDataBehaviour;;;
```

```

CONDITIONAL PACKAGES
transmitPowerLevelCurrentDataPackage PRESENT IF
    "an instance supports it",
transmitPowerLevelTideMarkPackage PRESENT IF
    "an instance supports it and transmitPowerLevelCurrentDataPackage is
present",
laserBiasCurrentDataPackage PRESENT IF
    "an instance supports it",
laserBiasTideMarkPackage PRESENT IF
    "an instance supports it and laserBiasCurrentDataPackage is present",
laserTemperatureCurrentDataPackage PRESENT IF
    "an instance supports it",
laserTemperatureTideMarkPackage PRESENT IF
    "an instance supports it and laserTemperatureCurrentDataPackage is present";
REGISTERED AS {g774-01MObjectClass 5};

opticalSourceSPICurrentDataBehaviour BEHAVIOUR
DEFINED AS
"Instances of the opticalSPICurrentData managed object Class are used to hold the
monitoring of the physical characteristics of the output of an optical source
(opticalSPITTP). These characteristics are handled by gauge attributes. The
following performance primitives are observed:
    OSL Optical Signal Level
For the OSL performance primitive, the following performance events are defined:
    transmit Power Level
LB Laser Bias
For the LB performance primitive, the following performance events are defined:
    laser Bias
LT Laser Temperature
For the LT performance primitive, the following performance events are defined:
    laserTemperature
These performance event counts are inhibited under certain failure or unavailable
conditions as specified in the following list:
    Laser Shutdown
When a Tide Mark Package is used (in conjunction with its associated gauge), the
corresponding Tide Mark attribute shall be reported in the history data at the
end of the granularity period and the tide marks shall be reset to the current
values of the associated gauge at the end of the granularity period. The
unavailableTimeAlarmPackage is not used in this class. This managed object class
uses the opticalSPIHistoryData managed object class for history retention.";

```

IV.1.3 Multiplex Section Current Data

```

msCurrentData MANAGED OBJECT CLASS
DERIVED FROM sdhCurrentData;
CHARACTERIZED BY
msCurrentDataPackage PACKAGE
    BEHAVIOUR msCurrentDataBehaviour;
    ATTRIBUTES
    "Recommendation X.739": granularityPeriod REQUIRED VALUES
    SDHPMASN1.SDHGranularityPeriod,
    bBE REPLACE-WITH-DEFAULT GET,
    eS REPLACE-WITH-DEFAULT GET,
    sES REPLACE-WITH-DEFAULT GET;;;
CONDITIONAL PACKAGES
cSESCurrentDataPackage PRESENT IF
    "an instance supports it",
farEndCSESCurrentDataPackage PRESENT IF
    "an instance supports it",
uASCCurrentDataPackage PRESENT IF
    "an instance supports it",
farEndCurrentDataPackage PRESENT IF
    "monitoring of the far end is supported and the monitored point is
bidirectional.";
REGISTERED AS {g774-01MObjectClass 6};

```

msCurrentDataBehaviour BEHAVIOUR
DEFINED AS

*Instances of the msCurrentData managed object Class are used to hold the current register counts for a multiplex section trail termination point during a collection period. The following performance primitives are observed:

EB Errored Block

For the EB performance primitive, the following performance events are defined:

BBE Background Block Error

For the EB performance primitive and the following defect: MS-AIS, Excessive-Error, the following performance events are defined:

ES Errored Second

SES Severely Errored Second

This managed object class uses the msHistoryData managed object class for history retention.

A QOS alarm shall be sent as soon as a threshold is reached or crossed. At the end of the granularity period the QOS alarm is implicitly cleared, providing there are no other outstanding threshold crossing QOS alarms, "Threshold crossing" removed from the currentProblemList (i.e. No Notification is Sent) and a new QOS alarm shall be sent if the threshold is reached or crossed again during the next granularity period. Only one threshold value per performance counter will be supported.*;

IV.1.4 Multiplex Section Current Data Threshold Reset

msCurrentDataTR MANAGED OBJECT CLASS

DERIVED FROM sdhCurrentData;

CHARACTERIZED BY

thresholdReset Package,

msCurrentDataTRPackage PACKAGE

BEHAVIOUR

msCurrentDataTRBehaviour;

ATTRIBUTES

"Recommendation X.739": granularityPeriod PERMITTED VALUES

SDHPMASN1.SDHPVGranularityPeriod,

bBE REPLACE-WITH-DEFAULT GET,

eS REPLACE-WITH-DEFAULT GET,

SES REPLACE-WITH-DEFAULT GET;;;

CONDITIONAL PACKAGES

cSESCurrentDataPackage PRESENT IF

"an instance supports it",

farEndCSESCurrentDataPackage PRESENT IF

"an instance supports it",

uASCURRENTDataPackage PRESENT IF

"an instance supports it",

farEndCurrentDataPackage PRESENT IF

"monitoring of the far end is supported and the monitored point is bidirectional.";

REGISTERED AS {g774-01MObjectClass 7};

msCurrentDataTRBehaviour BEHAVIOUR

DEFINED AS

"Instances of the msCurrentDataTR managed object Class are used to hold the current register counts for a multiplex section trail termination point during a collection period.

The following performance primitives are observed:

EB Errored Block

For the EB performance primitive, the following performance events are defined:

BBE Background Block Error

For the EB performance primitive and the following defect: MS-AIS, Excessive-Error, the following performance events are defined:

ES Errored Second
SES Severely Errored Second

This managed object class uses the msHistoryData managed object class for history retention.";

IV.1.5 Protection Current Data

NOTE – The use of this class is not meaningful for 1 + 1 non-revertive protection.

```
protectionCurrentData  MANAGED OBJECT CLASS
DERIVED FROM sdhCurrentData;
CHARACTERIZED BY
protectionCurrentDataPackage PACKAGE
  BEHAVIOUR
  protectionCurrentDataBehaviour;
  ATTRIBUTES
  "Recommendation X.739": granularityPeriod REQUIRED VALUES
  SDHPMASN1.SDHGranularityPeriod,
  pSC REPLACE-WITH-DEFAULT  GET,
  pSD REPLACE-WITH-DEFAULT  GET;;;
REGISTERED AS {g774-01MObjectClass 8};
```

```
protectionCurrentDataBehaviour BEHAVIOUR
DEFINED AS
"Instances of the protectionCurrentData managed object Class are used to hold the
current register counts for a protection during a collection period. The
following performance primitives are observed:
  PSC Protection Switch Count.
  PSD Protection Switch Duration.
This managed object class uses the protectionHistoryData managed object class for
history retention.";
```

IV.1.6 Path Termination Current Data Threshold Reset

```
pathTerminationCurrentDataTR  MANAGED OBJECT CLASS
DERIVED FROM sdhCurrentData;
CHARACTERIZED BY
thresholdResetPackage,
pathTerminationCurrentDataTRPackage PACKAGE
  BEHAVIOUR pathTerminationCurrentDataTRBehaviour;
  ATTRIBUTES
  "Recommendation X.739": granularityPeriod PERMITTED VALUES
  SDHPMASN1.SDHPVGranularityPeriod,
  bBE REPLACE-WITH-DEFAULT  GET,
  eS  REPLACE-WITH-DEFAULT  GET,
  sES REPLACE-WITH-DEFAULT  GET;;;
CONDITIONAL PACKAGES
cSESCurrentDataPackage PRESENT IF
  "an instance supports it",
farEndCSESCurrentDataPackage PRESENT IF
  "an instance supports it",
uASCURRENTDataPackage PRESENT IF
  "an instance supports it",
farEndCurrentDataPackage PRESENT IF
  "if monitoring of the far end is supported and the monitored point is
Bidirectional";
REGISTERED AS {g774-01MObjectClass 10};
```

pathTerminationCurrentDataTRBehaviour BEHAVIOUR

DEFINED AS

"Instances of the pathTerminationCurrentDataTR managed object Class are used to hold the current register counts for a High Order Path and or Low Order Path during a collection period. An instance of this object class, for a monitored managed object instance, holds the current register counts of each performance events (BBE, ES, SES, FEBBE , FEES, FESES, UAS).

Near End Monitoring

The following performance primitives are observed:

EB Errored Block

For the EB performance primitive, the following performance events are defined:

BBE Background Block Error

For the EB performance primitive and the following defect: AU-AIS/TU-AIS, Path Trace Mismatch, Signal Label Mismatch, and Loss of TU Multiframe the following performance events are defined:

ES Errored Second

SES Severely Errored Second

Far End Monitoring

The following performance primitive are observed:

FEEB Far End Errored Block

For the FEEB performance primitive, the following performance events are defined:

FEBBE Far End Background Block Error

For the FEEB performance primitive and the following defect: Far End Remote Failure the following performance events are defined:

FEES Far End Errored Second

FESES Far End Severely Errored Second

This managed object class uses the pathTerminationHistoryData managed object class for history retention.";

IV.1.7 Electrical Synchronous Physical Interface History Data

electricalSPIHistoryData MANAGED OBJECT CLASS

DERIVED FROM "Recommendation Q.822": historyData;

CHARACTERIZED BY

transmitPowerLevelCurrentDataPackage,

electricalSPIHistoryDataPackage PACKAGE

BEHAVIOUR opticalSPIHistoryDataBehaviour;;;

CONDITIONAL PACKAGES

transmitPowerLevelTideMarkPackage PRESENT IF

"the containing electricalSPICurrentData instance contains this package";

REGISTERED AS {g774-01MObjectClass 13;

electricalSPIHistoryDataBehaviour BEHAVIOUR

DEFINED AS

"Instances of this class are used to store the observed events of an electricalSourceSPICurrentData object at the end of an observation interval. An instance of this managed object is contained by an electricalSourceSPICurrentData managed object instance.";

IV.1.8 Optical Synchronous Physical Interface History Data

opticalSPIHistoryData MANAGED OBJECT CLASS

DERIVED FROM "Recommendation Q.822": historyData;

CHARACTERIZED BY

opticalSPIHistoryDataPackage PACKAGE

BEHAVIOUR opticalSPIHistoryDataBehaviour;;;

CONDITIONAL PACKAGES

transmitPowerLevelCurrentDataPackage PRESENT IF

"the containing opticalSourceSPICurrentData instance contains this package",

transmitPowerLevelTideMarkPackage PRESENT IF

"the containing opticalSourceSPICurrentData instance contains this package",

laserBiasCurrentDataPackage PRESENT IF

"the containing opticalSourceSPICurrentData instance contains this package",

```

laserBiasTideMarkPackage PRESENT IF
    "the containing opticalSourceSPICurrentData instance contains this package",
laserTemperatureCurrentDataPackage PRESENT IF
    "the containing opticalSourceSPICurrentData instance contains this package",
laserTemperatureTideMarkPackage PRESENT IF
    "the containing opticalSourceSPICurrentData instance contains this package";
REGISTERED AS {g774-01MObjectClass 14};

```

```

opticalSPIHistoryDataBehaviour BEHAVIOUR
DEFINED AS
"Instances of this class are used to store the observed events of an
opticalSourceSPICurrentData object at the end of an observation interval. An
instance of this managed object is contained by an opticalSourceSPICurrentData
managed object instance.";

```

IV.1.9 Multiplex Section History Data

```

msHistoryData MANAGED OBJECT CLASS
DERIVED FROM "Recommendation Q.822": historyData;
CHARACTERIZED BY
msHistoryDataPackage PACKAGE
    BEHAVIOUR
        msHistoryDataBehaviour;
    ATTRIBUTES
        bBE GET,
        eS GET,
        sES GET;;;
CONDITIONAL PACKAGES
uASHistoryDataPackage PRESENT IF
    "the containing msCurrentData contains the uASCurrentDataPackage",
farEndHistoryDataPackage PRESENT IF
    "the containing msCurrentData or msCurrentDataTR instance contains the
farEndCurrentDataPackage";
REGISTERED AS {g774-01MObjectClass 15};

```

```

msHistoryDataBehaviour BEHAVIOUR
DEFINED AS
"Instances of this class are used to store the observed events of an
msCurrentData or msCurrentDataTR object at the end of an observation interval. An
instance of this managed object is contained by an msCurrentData or
msCurrentDataTR managed object instance.";

```

IV.1.10 Protection History Data

```

protectionHistoryData MANAGED OBJECT CLASS
DERIVED FROM "Recommendation Q.822": historyData;
CHARACTERIZED BY
protectionHistoryDataPackage PACKAGE
    BEHAVIOUR protectionHistoryDataBehaviour;
    ATTRIBUTES
        pSC GET,
        pSD GET;;;
REGISTERED AS {g774-01MObjectClass 16};

```

```

protectionHistoryDataBehaviour BEHAVIOUR
DEFINED AS
"Instances of this class are used to store the observed events of a
protectionCurrentData object at the end of an observation interval. An instance
of this managed object is contained by a protectionCurrentData or subclass
managed object instance.";

```

IV.2 Package definitions

IV.2.1 Laser Bias Current Data Package

```
laserBiasCurrentDataPackage PACKAGE
    BEHAVIOUR
        laserBiasCurrentDataPackageBehaviour;
    ATTRIBUTES
        laserBias GET;
REGISTERED AS {g774-01Package 6};
```

```
laserBiasCurrentDataPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to store the gauge of percentage of laser bias of an SDH
optical source.";
```

IV.2.2 Laser Bias Tide Mark Package

```
laserBiasTideMarkPackage PACKAGE
    BEHAVIOUR
        laserBiasTideMarkPackageBehaviour;
    ATTRIBUTES
        laserBiasTideMarkMax GET,
        laserBiasTideMarkMin GET;
REGISTERED AS {g774-01Package 7};
```

```
laserBiasTideMarkPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to store the minimum and maximum values reached by the
laser bias gauge during an observation period.";
```

IV.2.3 Laser Temperature Current Data Package

```
laserTemperatureCurrentDataPackage PACKAGE
    BEHAVIOUR
        laserTemperatureCurrentDataPackageBehaviour;
    ATTRIBUTES
        laserTemperature GET;
REGISTERED AS {g774-01Package 8};
```

```
laserTemperatureCurrentDataPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to store the gauge of laser temperature value of an SDH
optical source.";
```

IV.2.4 Laser Temperature Tide Mark Package

```
laserTemperatureTideMarkPackage PACKAGE
    BEHAVIOUR
        laserTemperatureTideMarkPackageBehaviour;
    ATTRIBUTES
        laserTemperatureTideMarkMax GET,
        laserTemperatureTideMarkMin GET;
REGISTERED AS {g774-01Package 9};
```

```
laserTemperatureTideMarkPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to store the minimum and maximum values reached by the
laser temperature gauge during an observation period.";
```

IV.2.5 Transmit Power Level Current Data Package

```
transmitPowerLevelCurrentDataPackage PACKAGE
  BEHAVIOUR
  transmitPowerLevelCurrentDataPackageBehaviour;
  ATTRIBUTES
  transmitPowerLevel GET;
REGISTERED AS {g774-01Package 12};
```

```
transmitPowerLevelCurrentDataPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to store the gauge of transmit power level value of a
physical source.";
```

IV.2.6 Transmit Power Level Tide Mark Package

```
transmitPowerLevelTideMarkPackage PACKAGE
  BEHAVIOUR
  transmitPowerLevelTideMarkPackageBehaviour;
  ATTRIBUTES
  transmitPowerLevelTideMarkMax GET,
  transmitPowerLevelTideMarkMin GET;
REGISTERED AS {g774-01Package 13};
```

```
transmitPowerLevelTideMarkPackageBehaviour BEHAVIOUR
DEFINED AS
"This package is used to store the minimum and maximum values reached by the
transmit power level gauge during an observation period.";
```

IV.3 Attributes definitions

IV.3.1 Laser Bias

```
laserBias ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": gauge;
  BEHAVIOUR
  laserBiasBeh BEHAVIOUR
DEFINED AS
"The value of the laserBias attribute represents the percentage of the normalized
value of laser bias current at a SDH optical SPI source or a SDH optical SPI
bidirectional trail termination point."
;;
REGISTERED AS {g774-01Attribute 6};
```

IV.3.2 Laser Bias Tide Mark Maximum

```
laserBiasTideMarkMax ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": tideMark;
  BEHAVIOUR
  laserBiasTideMarkMaxBeh BEHAVIOUR
DEFINED AS
"The laserBias TideMark Maximum attribute stores the maximum value reached by the
laser bias during a granularity period."
;;
REGISTERED AS {g774-01Attribute 7};
```

IV.3.3 Laser Bias Tide Mark Minimum

```
laserBiasTideMarkMin ATTRIBUTE
    DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": tideMark;
    BEHAVIOUR
        laserBiasTideMarkMinBeh BEHAVIOUR
DEFINED AS
"The laserBias TideMark Minimum attribute stores the minimum value reached by the
laser bias during a granularity period."
;;
REGISTERED AS {g774-01Attribute 8};
```

IV.3.4 Laser Temperature

```
laserTemperature ATTRIBUTE
    DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": gauge;
    BEHAVIOUR
        laserTemperatureBeh BEHAVIOUR
DEFINED AS
"The value of the laserTemperature attribute represents the laser temperature of
a physical optical source."
;;
REGISTERED AS {g774-01Attribute 9};
```

IV.3.5 Laser Temperature Tide Mark Maximum

```
laserTemperatureTideMarkMax ATTRIBUTE
    DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": tideMark;
    BEHAVIOUR
        laserTemperatureTideMarkMaxBeh BEHAVIOUR
DEFINED AS
"The laserTemperature TideMark Maximum attribute stores the maximum value reached
by the laser temperature during a granularity period."
;;
REGISTERED AS {g774-01Attribute 10};
```

IV.3.6 Laser Temperature Tide Mark Minimum

```
laserTemperatureTideMarkMin ATTRIBUTE
    DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": tideMark;
    BEHAVIOUR
        laserTemperatureTideMarkMinBeh BEHAVIOUR
DEFINED AS
"The laserTemperature TideMark Minimum attribute stores the minimum value reached
by the laser temperature during a granularity period."
;;
REGISTERED AS {g774-01Attribute 11};
```

IV.3.7 Protection Switch Count

```
pSC ATTRIBUTE
    DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
    BEHAVIOUR
        pSCBeh BEHAVIOUR
DEFINED AS
"In the case of a protected unit, the value of the pSC attribute represents the
count of switches to the protecting unit. In the case of a protecting unit, this
attribute represents the count of switches from any protected unit to that
protecting unit. Editor Note: This behaviour needs clarification in accordance
with protection management."
;;
REGISTERED AS {g774-01Attribute 15};
```

IV.3.8 Protection Switch Duration

```
psd ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": counter;
  BEHAVIOUR
    psDBeh BEHAVIOUR
DEFINED AS
"The value of the psd attribute represents the count of seconds during which the
service was switched from working to protection."
;;
REGISTERED AS {g774-01Attribute 16};
```

IV.3.9 Transmit Power Level

```
transmitPowerLevel ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": gauge;
  BEHAVIOUR
    transmitPowerLevelBeh BEHAVIOUR
DEFINED AS
"The value of the transmitPowerLevel gauge attribute represents the value of the
output signal level emitted by a physical (electrical or optical) source."
;;
REGISTERED AS {g774-01Attribute 19};
```

IV.3.10 Transmit Power Level Tide Mark Maximum

```
transmitPowerLevelTideMarkMax ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": tideMark;
  BEHAVIOUR
    transmitPowerLevelTideMarkMaxBeh BEHAVIOUR
DEFINED AS
"The transmitPowerLevelTideMark Maximum attribute stores the maximum value
reached by the transmit power level during an observation period."
;;
REGISTERED AS {g774-01Attribute 20};
```

IV.3.11 Transmit Power Level Tide Mark Minimum

```
transmitPowerLevelTideMarkMin ATTRIBUTE
  DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2": tideMark;
  BEHAVIOUR
    transmitPowerLevelTideMarkMinBeh BEHAVIOUR
DEFINED AS
"The transmitPowerLevelTideMark Minimum attribute stores the minimum value
reached by the transmit power level during an observation period."
;;
REGISTERED AS {g774-01Attribute 21};
```

IV.4 Name binding definitions

IV.4.1 MS Current Data – MS TTP Sink

```
msCurrentData-msTTPSink NAME BINDING
  SUBORDINATE OBJECT CLASS msCurrentData AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": msTTPSink AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 2};
```

IV.4.2 MS Current Data Threshold Reset – MS TTP Sink

```
msCurrentDataTR-msTTPSink NAME BINDING
  SUBORDINATE OBJECT CLASS msCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": msTTPSink AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 3};
```

IV.4.3 MS Current Data – Protected TTP Sink

```
msCurrentData-protectedTTPSink NAME BINDING
  SUBORDINATE OBJECT CLASS msCurrentData AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774.03": protectedTTPSink AND
SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 4};
```

IV.4.4 MS Current Data Threshold Reset – Protected TTP Sink

```
msCurrentDataTR-protectedTTPSink NAME BINDING
  SUBORDINATE OBJECT CLASS msCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774.03": protectedTTPSink AND
SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 5};
```

IV.4.5 Protection Current Data – Protection Unit

```
protectionCurrentData-protectionUnit NAME BINDING
  SUBORDINATE OBJECT CLASS protectionCurrentData AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774.03": protectionUnit AND
SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 6};
```

IV.4.6 Path Termination Current Data Threshold Reset – VC4 TTP SinkR1

```
pathTerminationCurrentDataTR-vc4TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": vc4TTPSinkR1 AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 28};
```

IV.4.7 Path Termination Current Data Threshold Reset – VC3 TTP SinkR1

```
pathTerminationCurrentDataTR-vc3TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": vc3TTPSinkR1 AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 29};
```

IV.4.8 Path Termination Current Data Threshold Reset – VC2 TTP SinkR1

```
pathTerminationCurrentDataTR-vc2TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": vc2TTPSinkR1 AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 30};
```

IV.4.9 Path Termination Current Data Threshold Reset – VC12 TTP SinkR1

```
pathTerminationCurrentDataTR-vc12TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": vc12TTPSinkR1 AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
  CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 31};
```

IV.4.10 Path Termination Current Data Threshold Reset – VC11 TTP SinkR1

```
pathTerminationCurrentDataTR-vc11TTPSinkR1 NAME BINDING
  SUBORDINATE OBJECT CLASS pathTerminationCurrentDataTR AND SUBCLASSES;
  NAMED BY
  SUPERIOR OBJECT CLASS "Recommendation G.774": vc11TTPSinkR1 AND SUBCLASSES;
  WITH ATTRIBUTE "Recommendation X.739": scannerId;
```

```
CREATE
WITH-REFERENCE-OBJECT,
WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 32};
```

IV.4.11 Electrical Source SPI Current Data – Electrical SPITTP Source

```
electricalSourceSPICurrentData-electricalSPITTPSource NAME BINDING
SUBORDINATE OBJECT CLASS electricalSourceSPICurrentData AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS "Recommendation G.774": electricalSPITTPSource AND
SUBCLASSES;
WITH ATTRIBUTE "Recommendation X.739": scannerId;
CREATE
WITH-REFERENCE-OBJECT,
WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 19};
```

IV.4.12 Optical Source SPI Current Data – Optical SPITTP Source

```
opticalSourceSPICurrentData-opticalSPITTPSource NAME BINDING
SUBORDINATE OBJECT CLASS opticalSourceSPICurrentData AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS "Recommendation G.774": opticalSPITTPSource AND
SUBCLASSES;
WITH ATTRIBUTE "Recommendation X.739": scannerId;
CREATE
WITH-REFERENCE-OBJECT,
WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774-01NameBinding 20};
```

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