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**GENERAL ASPECTS OF DIGITAL
TRANSMISSION SYSTEMS**

**SYNCHRONOUS DIGITAL HIERARCHY (SDH)
MANAGEMENT OF CONNECTION
SUPERVISION FUNCTIONALITY (HCS/LCS)
FOR THE NETWORK ELEMENT VIEW**

ITU-T Recommendation G.774.05

(Previously "CCITT Recommendation")

FOREWORD

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NOTE

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SUMMARY

This Recommendation provides an information model for the Synchronous Digital Hierarchy (SDH) Network. This model describes the managed object classes and their properties for the management of Connection Supervision Functionality (HCS/LCS), as defined in Recommendation G.783 [2] and as related to SDH network Elements. These objects are useful to describe information exchanged across interfaces defined in M.3010 [5] Telecommunications Management Network (TMN) architecture.

KEYWORDS

Action, ASN.1, Attribute, GDMO, Information Model, Managed Object Class, Notification, Synchronous Digital Hierarchy

**SYNCHRONOUS DIGITAL HIERARCHY (SDH) MANAGEMENT
OF CONNECTION SUPERVISION FUNCTIONALITY (HCS/LCS)
FOR THE NETWORK ELEMENT VIEW**

(Geneva, 1995)

The ITU-T,

considering

- (a) that Recommendations G.707, G.708, and G.709 form a coherent set of specifications for the Synchronous Digital Hierarchy (SDH) and the Network Node Interface (NNI);
- (b) that Recommendations G.781, G.782, G.783, and G.784 form a coherent set of specifications for SDH multiplex equipment functions and management;
- (c) that Recommendation M.3010 defines the principles for a Telecommunications Management Network (TMN);
- (d) that Recommendation G.773 defines the protocol suites for Q-interfaces;
- (e) that Recommendation M.3100 defines a Generic Network Information Model for the exchange of management information;
- (f) that Recommendation G.774 defines an SDH Management Information Model for the Network Element View,

recommends

that the management of Connection Supervision Functionality (HCS/LCS) of SDH equipment be carried out by using the information model defined in accordance with the details contained within this Recommendation.

1 Scope

1.1 Scope of this Recommendation

SDH Connection Supervision Functions are used to configure the supervision of higher and lower order path overhead independent from termination functions.

Configuration is done by modifications of attributes of the relevant managed objects. These attributes are included by subclassing of existing G.774 ([1]) managed object Classes.

1.2 Structure of this Recommendation

Subclause 5.1 provides an overview of the SDH Connection Supervision information model. Clauses 6 to 12 describe the information model using the mechanisms defined in [11]. Clause 15 contains the syntax definitions of the information carried in the protocol using Abstract Syntax Notation One (ASN.1) defined in [7]. Naming and Inheritance are illustrated in informative Appendix I. Clauses 5 to 15 are normative; all other text is informative.

2 References

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

[1] CCITT Recommendation G.774 (1992), *Synchronous Digital Hierarchy SDH management information model for the network element view*.

- [2] ITU-T Recommendation G.783 (1994), *Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks.*
- [3] ITU-T Recommendation G.784 (1994), *Synchronous Digital Hierarchy (SDH) management.*
- [4] ITU-T Recommendation G.803 (1993), *Architecture of transport networks based on the Synchronous Digital Hierarchy (SDH).*
- [5] CCITT Recommendation M.3010 (1992), *Principles for a telecommunications management network.*
- [6] CCITT Recommendation M.3100 (1992), *Generic network information model.*
- [7] CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1).*
- [8] CCITT Recommendation X.701 (1992), *Information technology – Open Systems Interconnection – Systems management overview.*
- [9] CCITT Recommendation X.720 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Management information model.*
- [10] CCITT Recommendation X.721 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information.*
- [11] CCITT Recommendation X.722 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects.*
- [12] CCITT Recommendation X.733 (1992), *Information technology – Open Systems Interconnection Systems Management: Alarm reporting function.*
- [13] ITU-T Recommendation G.774.01 (1994), *Synchronous Digital Hierarchy SDH performance monitoring for the network element view.*
- [14] ITU-T Recommendation G.774.02 (1994), *Synchronous Digital Hierarchy SDH configuration of the payload structure for the network element view.*

3 Definitions

None.

4 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

AIS	Alarm Indication Signal
CTP	Connection Termination Point
EBER	Excessive Bit Error Ratio
FERF	Far End Receive Failure
HCS	Higher Order Connection Supervision
HPA	Higher Order Path Adaptation
LCS	Lower Order Connection Supervision
NE	Network Element
MSA	Multiplex Section Adaptation
OS	Operation System
SDH	Synchronous Digital Hierarchy
TMN	Telecommunication Management Network
TTP	Trail Termination Point
VC	Virtual Container

5 Connection supervision information model

5.1 Overview

5.1.1 HCS and LCS may be provided in the case of an open HPC respective LPC (unused connection). This case is modelled by connected AU3/4CTP respective TUxCTP. Therefore:

- the HCS is modelled by “supervisedAU3/4CTP”. These classes are subclasses of AU3/4CTP of G.774 which currently model only the MSA function;
- the LCS is modelled by “supervisedTU3/2/12/11CTP”. These classes are subclasses of TU3/2/12/11CTP of G.774 which currently model only the HPA function.

5.1.2 If an instance of an AU3/4CTP or TUxCTP has to be created (only possible as a consequence of the creation of a superior TTP or as a side effect of payload configuration – see Recommendation G.774.02) and the equipment is able to provide HCS/LCS functionality (see R3.), instead of (Recommendation G.774) CTPs, the supervised CTPs should be created automatically.

5.1.3 The (de-)activation of HCS/LCS is modelled using the attribute generatorEnabled for the unequipped generator subfunction and the attribute monitorActive for the path overhead monitor subfunction. These attributes allow the independent management of both subfunctions (requirement R4.).

5.1.4 The (de-)activation of HCS/LCS in the supervised CTP objects does not influence the behaviour derived from Recommendation G.774 (MSA, HPA). A SET-operation of generatorEnabled or of monitorActive to TRUE may be rejected depending upon the dynamic situation of the specific network element if it supports the connection supervision function with less than 100%. This results from requirement R5.

5.1.5 Performance measurement of the connection supervision functionality of supervised CTPs (Sink or Bidirectional) can be done using a subclass of currentData which is applicable for path termination (see Recommendation G.774.01). This subclass provides the parameters background block errors, errored seconds, severely errored seconds and unavailable seconds (some are optional and are also provided for the far end). If the attribute monitorActive of a CTP has the value FALSE during a part of a PM period the performance data is not reliable. This should be indicated by the attribute suspectIntervalFlag in the currentData object.

5.2 Requirements

The features of HCS/LCS (defined in Recommendation G.783 [2]) which influence the modelling approach are summarized below:

- R1 The connection supervision function includes the monitoring of parts of HO/LO-POH to get alarms and performance information about the path segment [sub function H/L-POM (Path Overhead Monitor)].
- R2 The connection supervision function includes the generation of supervisory unequipped HO/LO-POH with a Path Trace [sub function H/L-UG (Unequipped Generator)].
- R3 The connection supervision function may be optional.
- R4 The connection supervision function shall be able to be set into the INACTIVE state and the ACTIVE state (independent for HPOM and HUG respective LPOM and LUG).
- R5 The connection supervision function may be supported for a specific equipment at the same time in the range of 0% to 100%.

7 Packages

7.1 Virtual Container 11-2 Supervision Bidirectional Package

vc11-2SupervisionBidirectionalPackage PACKAGE

BEHAVIOUR vc11-2SupervisionBidirectionalPackageBehaviour;
REGISTERED AS {g774.05Package 1};

vc11-2SupervisionBidirectionalPackageBehaviour BEHAVIOUR
DEFINED AS

*A communicationAlarm notification shall be issued if a far end receive failure (V5 Byte) is detected. The probableCause parameter of the notification shall indicate FERF (Far End Receive Failure).

If monitoring is suspended due to monitorActive an existing far end receive failure is cleared and removed from the current problem list.

If the (inherited) attributes monitorActive and generatorEnabled have the value TRUE and the upstreamConnectivityPointer has the value NULL (not connected), the originated supervisory unequipped VC can indicate in the V5 byte a far end receive failure according to the conditions given in the functional specification (Recommendation G.783: signal label mismatch, path trace mismatch, AIS or loss of pointer).

*;

7.2 Virtual Container 11-2 Supervision Sink Package

vc11-2SupervisionSinkPackage PACKAGE

BEHAVIOUR vc11-2SupervisionSinkPackageBehaviour;

ATTRIBUTES

monitorActive	GET-REPLACE,	
"Recommendation G.774: 1992": v5SignalLabelExpected		GET-REPLACE,
"Recommendation G.774: 1992": v5SignalLabelReceive		GET,
j2PathTraceExpected	GET-REPLACE,	
j2PathTraceReceive	GET;	

REGISTERED AS {g774.05Package 2};

vc11-2SupervisionSinkPackageBehaviour BEHAVIOUR
DEFINED AS

*If an SDH-CTP has to be created and the underlying resource is able to provide connection supervision, a supervised CTP should be created.

The attribute monitorActive of supervised CTPs does only influence the behaviour related to connection supervision. A SET-operation of monitorActive to TRUE may be rejected dependent from the dynamic situation of the specific network element. In case of rejection, the "invalidAttributeValue" error should be returned.

If the attribute monitorActive has the value TRUE, then the path overhead is monitored. A communicationAlarm notification shall be issued if the signal label received (V5 Byte) does not match the signal label expected. The probableCause parameter of the notification shall indicate signal label mismatch. A communicationAlarm notification shall be issued if the path trace received (J2 Byte) does not match the path trace expected. The probableCause parameter of the notification shall indicate path trace mismatch.

If monitoring is suspended due to monitorActive, all outstanding alarms related to the connection supervision (see above) are cleared and removed from the current problem list. In this state the attributes v5SignalLabelReceive and j2PathTraceReceive may contain values which do not reflect the received signal and no alarms (see before) are emitted. If the attribute monitorActive has the value FALSE during a part of a PM period, the performance data is not reliable. This should be indicated by the attribute suspectIntervalFlag of a possibly contained currentData object.

If the network element supports LCS with restricted capability, the local initial value of the attribute monitorActive should be FALSE.

*;

7.3 Virtual Container 11-2 Supervision Source Package

vc11-2SupervisionSourcePackage PACKAGE
BEHAVIOUR vc11-2SupervisionSourcePackageBehaviour;
ATTRIBUTES
 generatorEnabled GET-REPLACE,
 j2PathTraceSend GET-REPLACE;
REGISTERED AS {g774.05Package 3};

vc11-2SupervisionSourcePackageBehaviour BEHAVIOUR
DEFINED AS

*If an SDH-CTP has to be created and the underlying resource is able to provide connection supervision, a supervised CTP should be created. The attribute generatorEnabled of supervised CTPs does only influence the behaviour related to connection supervision. A SET-operation of generatorEnabled to TRUE may be rejected dependent from the dynamic situation of the specific network element. In case of rejection, the “invalidAttributeValue” error should be returned.

If the supervised CTP is not connected (the upstreamConnectivityPointer has the value NULL) and the attribute generatorEnabled has the value TRUE, then a supervisory unequipped signal with the current value of j2PathTraceSend is originated.

If the supervised CTP is connected (the upstreamConnectivityPointer does not have the value NULL), this package does not influence the transmitted VC (independent from generatorEnabled).

If the network element supports LCS with restricted capability, the local initial value of the attribute generatorActive should be FALSE.

*;

7.4 Virtual Container 3-4 Supervision Bidirectional Package

vc3-4SupervisionBidirectionalPackage PACKAGE
BEHAVIOUR vc3-4SupervisionBidirectionalPackageBehaviour;
REGISTERED AS {g774.05Package 4};

vc3-4SupervisionBidirectionalPackageBehaviour BEHAVIOUR
DEFINED AS

*A communicationAlarm notification shall be issued if a far end receive failure (G1 Byte) is detected. The probableCause parameter of the notification shall indicate FERF (Far End Receive Failure). If monitoring is suspended due to monitorActive, an existing far end receive failure is cleared and removed from the current problem list.

If the (inherited) attributes monitorActive and generatorEnabled have the value TRUE and the upstreamConnectivityPointer has the value NULL (not connected), the originated supervisory unequipped VC can indicate in the G1 byte a far end receive failure according to the conditions given in the functional specification (Recommendation G.783: signal label mismatch, path trace mismatch, AIS or loss of pointer).

*;

7.5 Virtual Container 3-4 Supervision Sink Package

vc3-4SupervisionSinkPackage PACKAGE
BEHAVIOUR vc3-4SupervisionSinkPackageBehaviour;
ATTRIBUTES
 monitorActive GET-REPLACE,
 "Recommendation G.774: 1992": c2SignalLabelExpected GET-REPLACE,
 "Recommendation G.774: 1992": c2SignalLabelReceive GET,
 j1PathTraceExpected GET-REPLACE,
 j1PathTraceReceive GET;
REGISTERED AS {g774.05Package 5};

vc3-4SupervisionSinkPackageBehaviour BEHAVIOUR

DEFINED AS

*If an SDH-CTP has to be created and the underlying resource is able to provide connection supervision, a supervised CTP should be created.

The attribute monitorActive of supervised CTPs does only influence the behaviour related to connection supervision. A SET-operation of monitorActive to TRUE may be rejected dependent from the dynamic situation of the specific network element. In case of rejection, the “invalidAttributeValue” error should be returned.

If the attribute monitorActive has the value TRUE, then the path overhead is monitored. A communicationAlarm notification shall be issued if the signal label received (C2 Byte) does not match the signal label expected. The probableCause parameter of the notification shall indicate signal label mismatch. A communicationAlarm notification shall be issued if the path trace received (J1 Byte) does not match the path trace expected. The probableCause parameter of the notification shall indicate path trace mismatch.

If monitoring is suspended due to the attribute monitorActive, all outstanding alarms related to the connection supervision (see above) are cleared and removed from the current problem list. In this state the attributes c2SignalLabelReceive and j1PathTraceReceive may contain values which do not reflect the received signal and no alarms (see before) are emitted. If the attribute monitorActive has the value FALSE during a part of a PM period, the performance data is not reliable. This should be indicated by the attribute suspectIntervalFlag of a possibly contained currentData object.

If the network element supports HCS with restricted capability, the local initial value of the attribute monitorActive should be FALSE.

*;

7.6 Virtual Container 3-4 Supervision Source Package

vc3-4SupervisionSourcePackage PACKAGE

BEHAVIOUR vc3-4SupervisionSourcePackageBehaviour;

ATTRIBUTES

generatorEnabled	GET-REPLACE,
j1PathTraceSend	GET-REPLACE;

REGISTERED AS {g774.05Package 6};

vc3-4SupervisionSourcePackageBehaviour BEHAVIOUR

DEFINED AS

*If an SDH-CTP has to be created and the underlying resource is able to provide connection supervision, a supervised CTP should be created.

The attribute generatorEnabled of supervised CTPs does only influence the behaviour related to connection supervision. A SET-operation of generatorEnabled to TRUE may be rejected dependent from the dynamic situation of the specific network element. In case of rejection, the “invalidAttributeValue” error should be returned.

If the supervised CTP is not connected (the upstreamConnectivityPointer has the value NULL) and the attribute generatorEnabled has the value TRUE, then a supervisory unequipped signal with the current value of j1PathTraceSend is originated.

If the supervised CTP is connected (the upstreamConnectivityPointer does not have the value NULL), this package does not influence the transmitted VC (independent from generatorEnabled).

If the network element supports HCS with restricted capability, the local initial value of the attribute generatorActive should be FALSE.

*;

8 Attributes

8.1 Generator Enabled

generatorEnabled ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHCSASN1.Boolean;
MATCHES FOR EQUALITY;
REGISTERED AS {g774.05Attribute 1};

8.2 Monitor Active

monitorActive ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHCSASN1.Boolean;
MATCHES FOR EQUALITY;
REGISTERED AS {g774.05Attribute 2};

8.3 J1 Path Trace Receive

j1PathTraceReceive ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHCSASN1.PathTraceRS;
MATCHES FOR EQUALITY;
BEHAVIOUR
j1PathTraceReceiveBehaviour BEHAVIOUR
DEFINED AS

This attribute is used to indicate the value of the incoming J1 VC Path Trace byte message.

;;
REGISTERED AS {g774.05Attribute 3};

8.4 J1 Path Trace Send

j1PathTraceSend ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHCSASN1.PathTraceRS;
MATCHES FOR EQUALITY;
BEHAVIOUR
j1PathTraceSendBehaviour BEHAVIOUR
DEFINED AS

This attribute is used to indicate the value of the outgoing J1 VC Path Trace byte message.

;;
REGISTERED AS {g774.05Attribute 4};

8.5 J2 Path Trace Expected

j2PathTraceExpected ATTRIBUTE
WITH ATTRIBUTE SYNTAX SDHCSASN1.PathTrace;
MATCHES FOR EQUALITY;
BEHAVIOUR
j2PathTraceExpectedBehaviour BEHAVIOUR
DEFINED AS

This attribute is used to specify the value of the expected J2 VC Path Trace byte message. If the value of this attribute is set to NULL then any Received Path Trace shall be considered to match.

;;
REGISTERED AS {g774.05Attribute 5};

8.6 J2 Path Trace Receive

```
j2PathTraceReceive ATTRIBUTE
    WITH ATTRIBUTE SYNTAX    SDHCSASN1.PathTraceRS;
    MATCHES FOR EQUALITY;
    BEHAVIOUR
        j2PathTraceReceiveBehaviour BEHAVIOUR
    DEFINED AS
```

This attribute is used to indicate the value of the incoming J2 VC Path Trace byte message.

::

```
REGISTERED AS {g774.05Attribute 6};
```

8.7 J2 Path Trace Send

```
j2PathTraceSend ATTRIBUTE
    WITH ATTRIBUTE SYNTAX    SDHCSASN1.PathTraceRS;
    MATCHES FOR EQUALITY;
    BEHAVIOUR
        j2PathTraceSendBehaviour BEHAVIOUR
    DEFINED AS
```

This attribute is used to indicate the value of the outgoing J2 VC Path Trace byte message.

::

```
REGISTERED AS {g774.05Attribute 7};
```

9 Actions

None.

10 Notifications

None.

11 Parameters

None.

12 Name bindings

For performance monitoring, name bindings which have supervised CTPs (Sink or Bidirectional) are defined as superior class and the subclass of currentData for path termination as subordinate class (defined in Recommendation G.774.01).

```
pathTerminationCurrentData-au4SupervisedCTPSink    NAME BINDING
    SUBORDINATE OBJECT CLASS "Recommendation G.774.01: 1994 ": pathTerminationCurrentData
    AND
    SUBCLASSES;
    NAMED BY
        SUPERIOR OBJECT CLASS    au4SupervisedTPSink    AND SUBCLASSES;
        WITH ATTRIBUTE            "Recommendation X.739: 1993": scannerId;
    CREATE
        WITH-REFERENCE-OBJECT,
        WITH-AUTOMATIC-INSTANCE-NAMING;
    DELETE
        DELETES-CONTAINED-OBJECTS;
    REGISTERED AS {g774.05NameBinding 1};
```



```

pathTerminationCurrentData-tu11SupervisedCTPSink      NAME BINDING
  SUBORDINATE OBJECT CLASS "Recommendation G.774.01: 1994": pathTerminationCurrentData
  AND
SUBCLASSES;
  NAMED BY
    SUPERIOR OBJECT CLASS      tu11SupervisedCTPSink      AND SUBCLASSES;
    WITH ATTRIBUTE              "Recommendation X.739: 1993": scannerId;
  CREATE
    WITH-REFERENCE-OBJECT,
    WITH-AUTOMATIC-INSTANCE-NAMING;
  DELETE
    DELETES-CONTAINED-OBJECTS;
REGISTERED AS {g774.05NameBinding 6};

```

13 Constraint rules

None.

14 Subordination rules

None.

15 Supporting ASN.1 productions

```

SDHCSASN1 {ccitt(0) recommendation(0) g(7) g774(774) hyphen(127) sncp(05)
informationModel(0) asn1Module(2) sdhcs(0)}

```

DEFINITIONS IMPLICIT TAGS ::=

BEGIN

-- EXPORTS Everything

IMPORTS

PathTrace

```

FROM SDH {ccitt(0) recommendation(0) g(7) sdhm(774) informationModel(0)
asn1Module(2) sdh(0)};
sdhCS OBJECT IDENTIFIER ::= {ccitt(0) recommendation(0) g(7) g774(774) hyphen(127)
sncp(05) informationModel(0)}

g774.05MObjectClass OBJECT IDENTIFIER ::= {sdhCS managedObjectClass(3)}

g774.05Package OBJECT IDENTIFIER ::= {sdhCS package(4)}

g774.05NameBinding OBJECT IDENTIFIER ::= {sdhCS nameBinding(6)}

g774.05Attribute OBJECT IDENTIFIER ::= {sdhCS attribute(7)}

Boolean ::= BOOLEAN

PathTraceRS ::= GraphicString

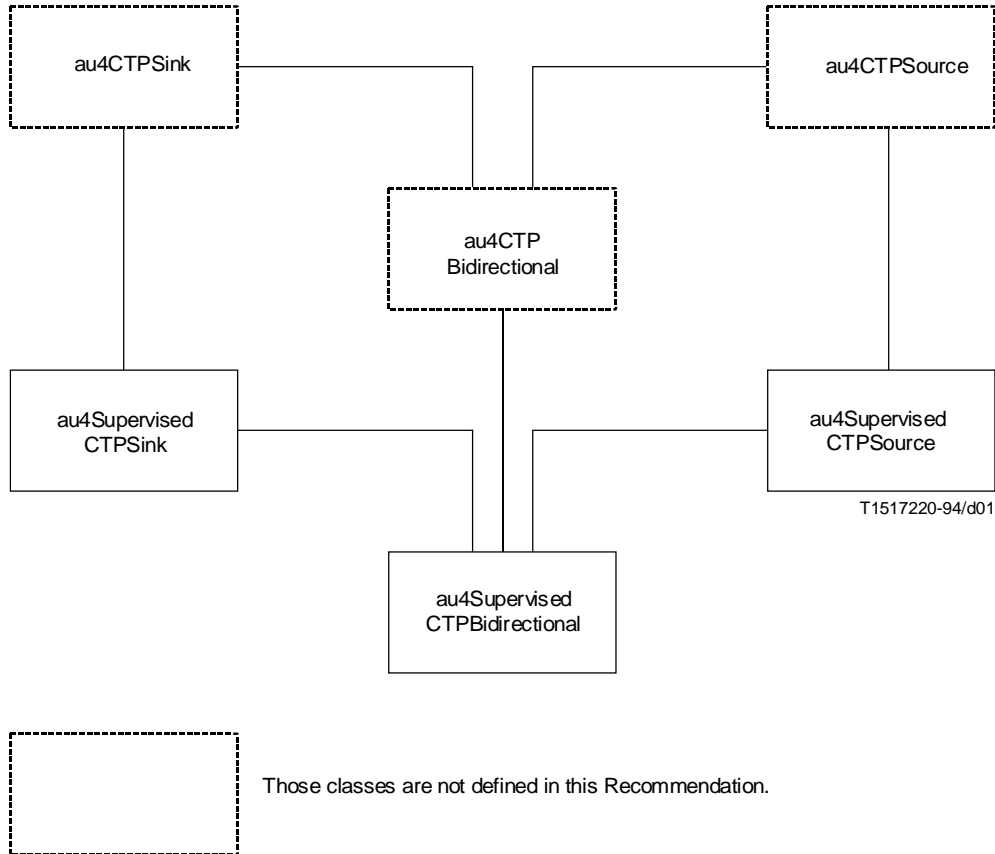
```

END

Appendix I

Inheritance and naming diagrams

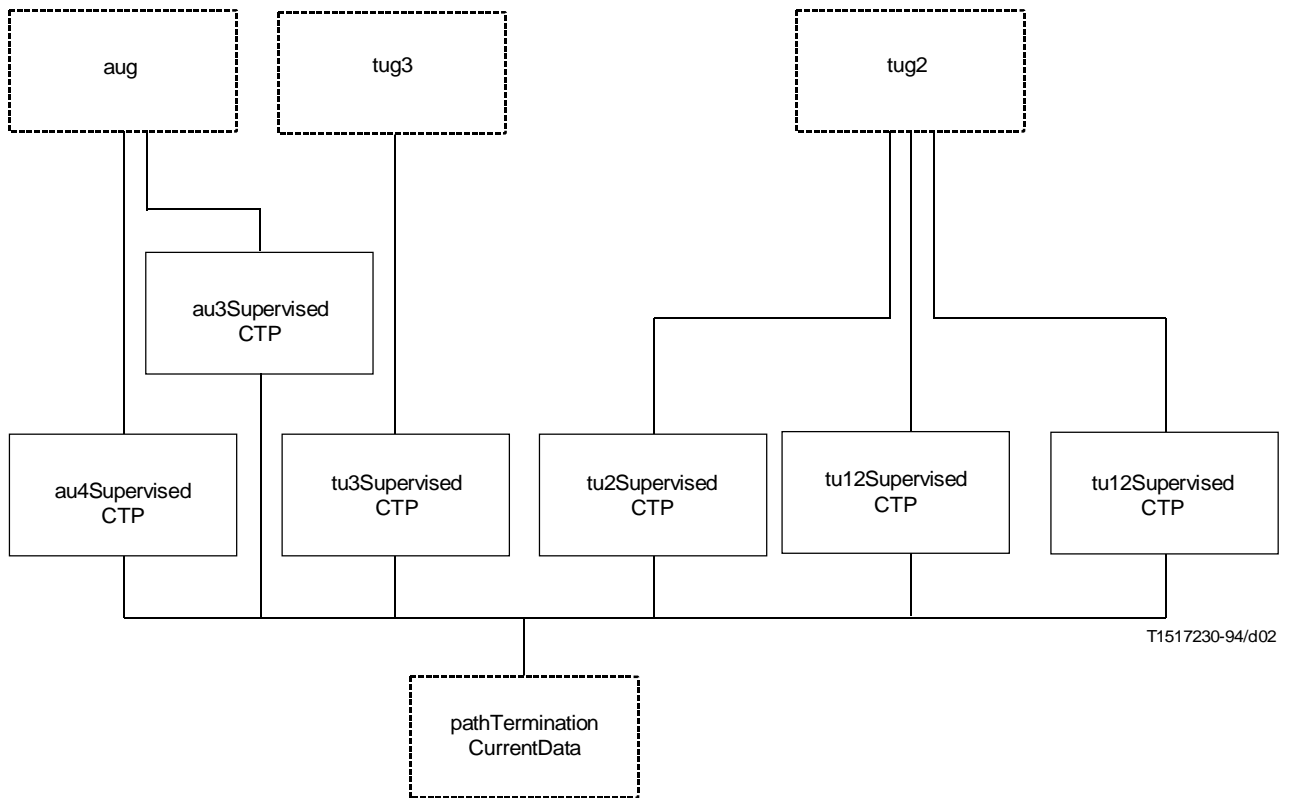
(This appendix does not form an integral part of this Recommendation)



NOTE – The inheritance scheme for supervised au3CTPs and tu3/2/12/11 CTPS is analogous to this figure.

FIGURE I.1/G.774.05

Inheritance relationship for supervised au4CTPs



Those classes are not defined in this Recommendation.

NOTE – Sink/Source and Bidirectional classes are not distinguished in this figure. Instances of Source classes cannot contain pathTermination-CurrentData.

FIGURE I.2/G.774.05
Containment relationship for supervised CTPs