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Digital networks – Optical transport networks

Optical transport network (OTN): Protocol-neutral management information model for the network element view

ITU-T Recommendation G.874.1

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ITU-T Recommendation G.874.1

Optical transport network (OTN): Protocol-neutral management information model for the network element view

Summary

This Recommendation provides a protocol-neutral management information model for managing network elements in the optical transport network (OTN). The model contains the managed entities and their properties that are useful to describe the information exchanged across interfaces defined in the M.3010 telecommunications management network (TMN) architecture. The protocol-neutral management information model shall be used as the base for defining protocol-specific management information models, for example, CMISE, CORBA, and SNMP information models. Mapping from the protocol-neutral entities into protocol-specific objects is a decision of the specific protocol modelling design and should be described in the protocol-specific information model Recommendations.

History		
Version	**Date**	**Notes**
1	6 Jan 2002	Initial version

FOREWORD

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

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

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

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

NOTE

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

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

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ITU-T Recommendation G.874.1

Optical transport network (OTN):
Protocol-neutral management information model
for the network element view

1 Scope

This Recommendation provides a protocol-neutral management information model for managing network elements in the optical transport network (OTN) [1]-[3]. It identifies the telecommunications management network (TMN) managed entities required for the management of OTN network elements. These entities are relevant to information exchanged across standardized interfaces defined in the M.3010 TMN architecture [6]. The protocol-neutral management information model should be used as the base for defining protocol-specific management information models, for examples, CMISE information model and CORBA IDL interfaces.

The specific mapping of the protocol-neutral entities into protocol-specific managed object classes is the decision of the protocol-specific modelling design. For example, a TTP entity defined in this Recommendation may be mapped into multiple managed object classes, for instance into TTP Sink and TTP Source in CMISE. On the other hand, all the monitoring entities may be mapped into a single class in a protocol-specific model. Protocol-specific information models and their mapping from the protocol-neutral model will be described in other Recommendations.

This Recommendation applies to OTN network elements and those systems in the TMN that manage OTN network elements. Functional capabilities of OTN equipment are given in ITU-T Rec. G.798 [3], and aspects of the management of OTN equipment are provided in ITU-T Recs. G.7710/Y.1701 [4] and G.874 [5].

The object entities defined in this Recommendation can apply to fault management and configuration management.

There are several different perspectives from which management information may be defined for management purposes. The network element viewpoint is concerned with the information that is required to manage a network element. This refers to information required to manage the network element function and the physical aspects of the network element. This Recommendation addresses only the network element view of OTN management.

2 References

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

[1]   ITU-T Recommendation G.872 (2001), *Architecture of optical transport networks*.

[2]   ITU-T Recommendation G.709/Y.1331 (2001), *Network node interface for the optical transport network*.

[3]   ITU-T Recommendation G.798 (2002), *Characteristics of optical transport network hierarchy equipment functional blocks*.

[4]   ITU-T Recommendation G.7710/Y.1701 (2001), *Common equipment management function requirements*.

[5]   ITU-T Recommendation G.874 (2001), *Management aspects of the optical transport network element*.

[6]   ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network*.

3   Terms and Definitions

3.1   Definitions from ITU-T Rec. M.3100

The following terms are defined in ITU-T Rec. M.3100 and used in this Recommendation.

ASAP   Alarm Severity Assignment Profile

CTP   Connection Termination Point

TP   Termination Point

TTP   Trail Termination Point

3.2   Definitions from ITU-T Rec. G.872

The following terms are defined in ITU-T Rec. G.872 and used in this Recommendation.

OCh   Optical Channel

OMS   Optical Multiplex Section

OTM   Optical Transport Module

OTN   Optical Transport Network

OTS   Optical Transmission Section

OTU   Optical Channel Transport Unit

3.3   Definitions from ITU-T Rec. G.709/Y.1331

The following terms are defined in ITU-T Rec. G.709/Y.1331 and used in this Recommendation.

ODUk   Optical Channel Data Unit-k

ODUkP   Optical Channel Data Unit-k, Path

ODUkT   Optical Channel Data Unit-k, Tandem connection sublayer

OPS   Optical Physical Section

OTUk   Optical Transport Unit-k

3.4   Definitions from ITU-T Rec. G.798

The following terms are defined in ITU-T Rec. G.798 and used in this Recommendation.

A   Adaptation function

GCC   General Communication Channel

MP   Management Point

TT   Trail Termination function

3.5   Definitions from ITU-T Rec. G.7710/Y.1701

The following term is defined in ITU-T Rec.G.7710/Y.1701 and used in this Recommendation.

ARC   Alarm Reporting Control

4 Abbreviations and Acronyms

This Recommendation uses the following abbreviations:

ARC   Alarm Reporting Control

ASAP   Alarm Severity Assignment Profile

CMISE   Common Management Information Service Element

CORBA   Common Object Request Broker Architecture

CTP   Connection Termination Point

GCC   General Communication Channel

IDL   Interface Definition Language

MP   Management Point

NE   Network Element

OCh   Optical Channel

ODUk   Optical Channel Data Unit-k

ODUkP   Optical Channel Data Unit-k, Path

ODUkT   Optical Channel Data Unit-k, Tandem connection sublayer

OMS   Optical Multiplex Section

OPS   Optical Physical Section

OTM   Optical Transport Module

OTN   Optical Transport Network

OTS   Optical Transmission Section

OTU   Optical Channel Transport Unit

SNC   Subnetwork Connection

TMN   Telecommunication Management Network

TP   Termination Point

TT   Trail Termination function

TTP   Trail Termination Point

UML   Unified Modelling Language

5 OTN NE Management Requirements

This Recommendation models the OTN transport functions that are relevant to OTN NE management. These functions are defined in ITU-T Rec. G.798 for the termination, adaptation, and connection functions of the OTN layers, including OTS, OMS, OPS, OCh, OTUk, ODUkP, and ODUkT. In particular, the input and output information exchanged at the Management Point (MP) shall be modelled. The termination, adaptation, and connections functions and input/output information cover the areas of configuration and fault management as described in ITU-T Recs. G.7710/Y.1701 and G.874. Details of the management functions that need to be modelled are provided in ITU-T Recs. G.7710/Y.1701 and G.874.

6 Analysis

In this Recommendation, managed resources and management support resources are modelled as objects in the information model. The management view of a resource is a managed object. This Recommendation specifies the properties of the resources visible for management. Objects with similar properties are be grouped into object classes. An object instance is an instantiation of an object class. The properties of an object include the behaviour, attributes, and operations that can be applied on the object. An object instance is characterized by its object class and may possess multiple attribute types and associated values. In the protocol-neutral model, object classes are represented as Unified Modelling Language (UML) classes.

Object classes, attribute types, and operations are defined for the purpose of communicating network management messages between systems, and need not be related to the structure of data within those systems.

An object class may be a subclass of another class. A subclass inherits properties of its superclass, in addition to possessing its own specific attributes and properties. In this Recommendation, the OTN-specific transport object classes are defined. These object classes are not inherited from any generic transport superclasses. In the future, when defining protocol-specific OTN object classes, the protocol-specific OTN object classes could be mapped from the protocol-neutral OTN object classes and also inherited from the protocol-specific generic transport object classes for additional properties.

In addition to the OTN resource, the model also includes object classes for management support functions such as alarm reporting control and alarm severity assignment.

7 Design of the Protocol-neutral Information Model

7.1 UML Class Diagram

Figure 7-1 provides a generic view of the UML classes of a particular transport layer network and its associated server and client layer networks. In this layer network, the CTP, TTP, SNC, and Subnetwork classes are shown. If connection function is not supported in the layer network, the SNC and Subnetwork classes will not be defined and shown. UML classes of the OTN layers are shown in the 7.2.

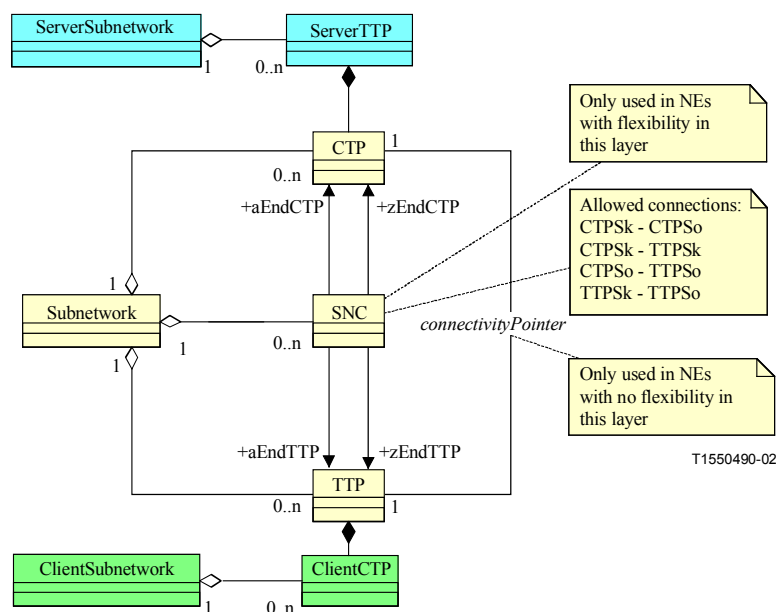**Figure 7-1/G.874.1 – Generic Class Diagram for Transport Layers**

7.1.1 Class Diagram for OTN-Specific Entity
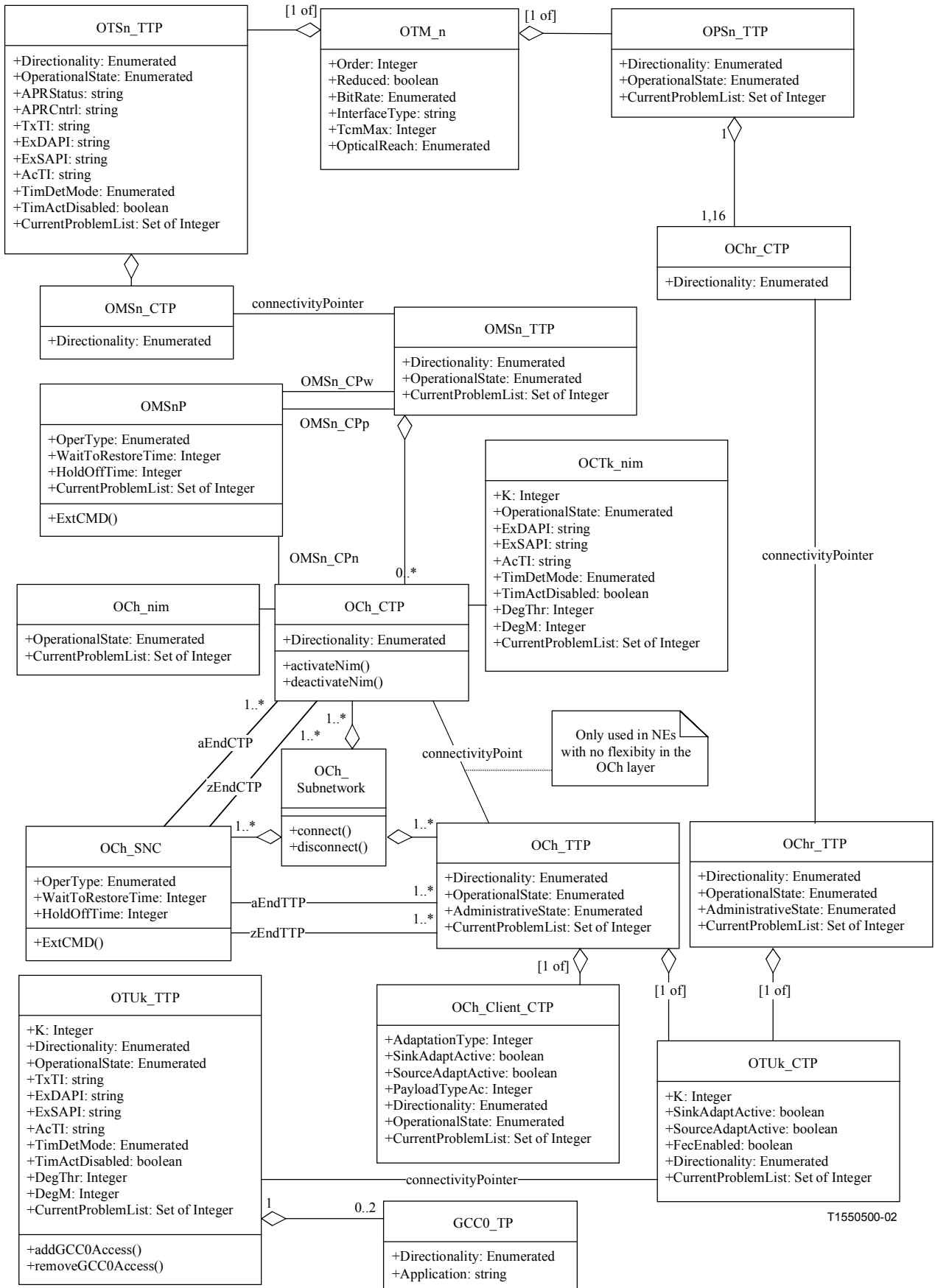
Figure 7-2/G.874.1 – Class Diagram for OTN Entities (Part 1)
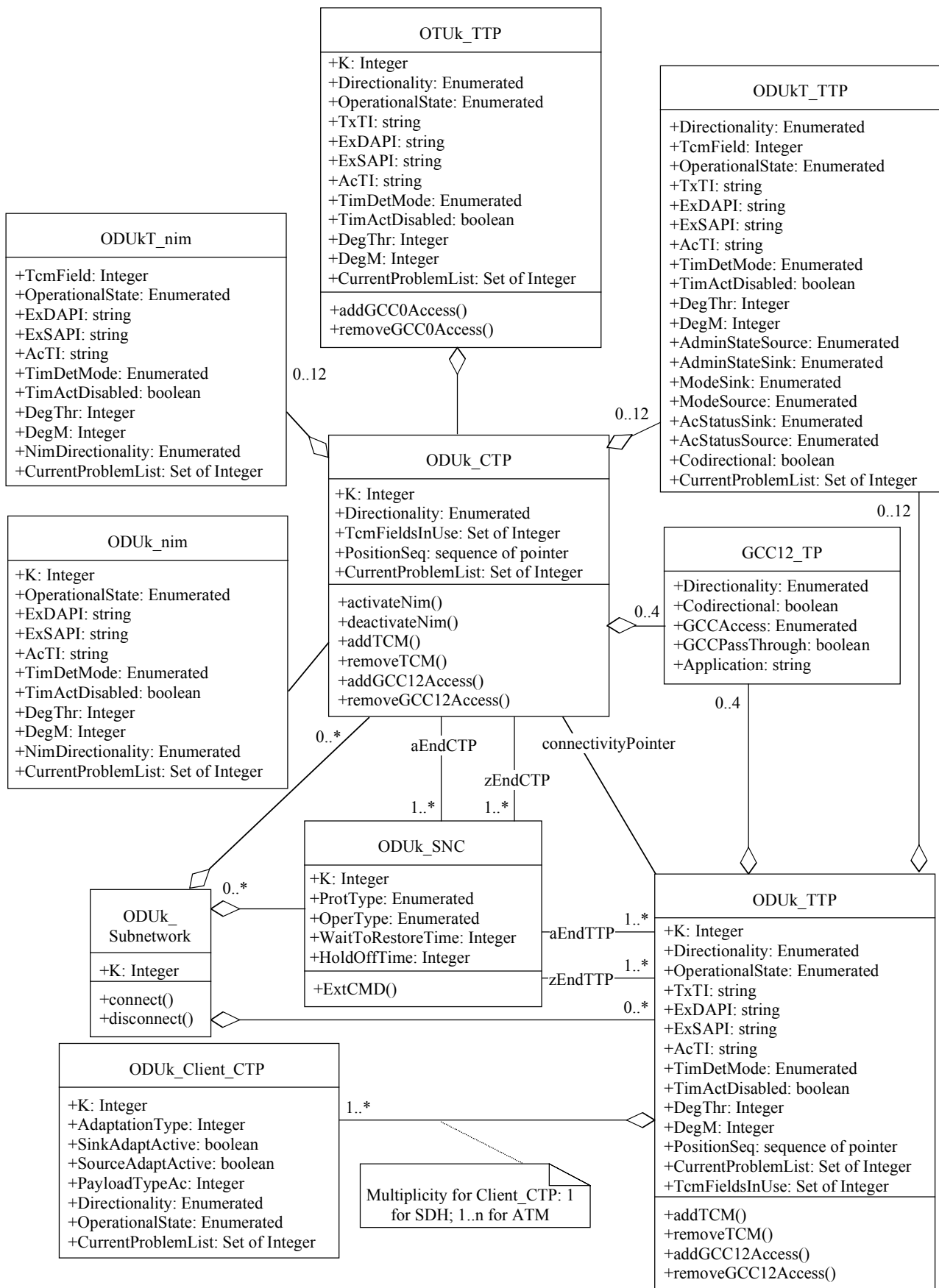
Figure 7-2/G.874.1 – Class Diagram for OTN Entities (Part 2)

7.1.2 Class Diagram for Fault Management Support Entity
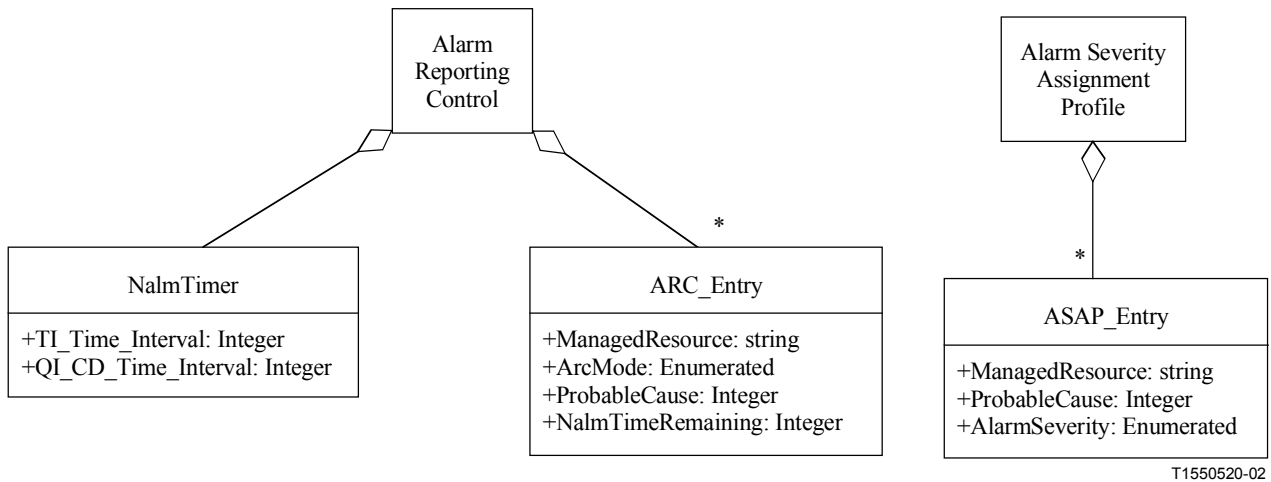
Figure 7-3/G.874.1 – Class Diagram for Alarm Entities

7.2 UML Data Dictionary

7.2.1 Data Dictionary for OTN Specific Entity

This clause provides the data dictionary for the OTN NE UML classes defined in this Recommendation.

7.2.1.1 GCC0_TP

This entity represents the function of terminating and/or originating of the GCC0 channels.

Attributes:

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

    This attribute is read-only.

- `Application`: string

    This attribute indicates the applications transported by the GCC channel. Example applications are ECC, (user data channel). Valid values are string.

    This attribute is read-only.

Operations:

None.

7.2.1.2 GCC12_TP

This entity represents the function of terminating and/or originating of the GCC1 or GCC2 channels.

Attributes:

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source and bidirectional.

    This attribute is read-only.

- `Codirectional`: boolean

  This attribute specifies the directionality of the GCC12_TP with respect to the associated ODUk_CTP. The value of TRUE means that the sink part of the GCC12_TP terminates the same signal direction as the sink part of the ODUk_CTP. The Source part behaves similarly. This attribute is meaningful only on objects instantiated under ODUk_CTP, and at least one among ODUk_CTP and the subordinate object has Directionality equal to Bidirectional.

  This attribute is read-only.

- `GCCAccess`: Enumerated

  This attribute indicates the GCC access represented by this entity. Valid values are:

  1) GCC1;

  2) GCC2;

  3) GCC1 + GCC2.

  This attribute is read-only.

- `GCCPassThrough`: boolean

  This attribute controls the selected GCC overhead whether it is passed through or modified. Valid values are TRUE and FALSE. The value of TRUE means that the GCC overhead shall pass through unmodified from the ODUk CTP input to the ODUk CTP output. Otherwise shall be set to all 0s at the ODUk CTP output after the extraction of the COMMS data. This attribute is not meaningful on objects instantiated under ODUk_TTP, and on objects with Directionality equals to Source.

  This attribute is read only.

- `Application`: string

  This attribute indicates the applications transported by the GCC channel. Example applications are ECC, (user data channel). Valid values are string.

  This attribute is read-only.

Operations:

None.

7.2.1.3 OCh_Client_CTP

This entity represents the OCh to client adaptation function, which performs the adaptation between the OCh layer adapted information and the client layer characteristic information. The OCh layer is the server layer. This entity can be inherited for defining the client layer CTP.

Attributes:

- `AdaptationType`: Integer

  This attribute indicates the type of client signal currently supported by the OCh adaptation function. Valid values are integers:

  1) CBR_2G5;

  2) CBR_10G;

  3) CBR_40G;

  4) RSn.

  This attribute is read-only.

- `SinkAdaptActive`: boolean

  This attribute allows for activation or deactivation the sink adaptation function. The value of TRUE means active.

  This attribute is read-write.

- `SourceAdaptActive`: boolean

  This attribute allows for activion or deactivation the source adaptation function. The value of TRUE means activate.

  This attribute is read-write.

- `PayloadTypeAc`: Integer

  This attribute indicates the actual payload type signal received.

  This attribute is read-only.

- `Directionality`: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

- `OperationalState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;
  2) LOF.

  This attribute is read-only.

Operations:

None.

7.2.1.4   OCh_CTP

This entity represents the functions of terminating and/or originating a link connection in the OCh layer network. The combining of the unidirectional sink and source function forms a bidirectional function.

Attributes:

- `Directionality`: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

Operations:

- `activateNim()`

  This operation activates the non-intrusive monitoring function at the OCh CTP. The input parameter of this operation shall specifies the type of the non-intrusive monitoring to be activated:

  1) OCh non-intrusive monitoring;

  2) Combined OCh and OTUk[V] non-intrusive monitoring.

  If this operation is successfully executed, instance of OCh_nim or OCTk_nim will be created accordingly.

- `deactivateNim()`

  This operation deactivates the previously activated non-intrusive monitoring function at the OCh CTP. If this operation is successfully executed, instance of OCh_nim or OCTk_nim will be deleted accordingly.

7.2.1.5　OCh_nim

This entity represents the OCh non-intrusive monitoring function at the OCh_CTP. This function can be activated and deactivated at the OCh_CTP.

Attributes:

- `OperationalState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  (other values TBD).

  This attribute is read-only.

Operations:

None.

7.2.1.6   OCh_SNC

This entity represents the connection function of the OCh layer network. The OCh connection function may in addition support the subnetwork connection protection function.

Attributes:

*   `OperType`: Enumerated <nullable>

    This attribute indicates the trail protection schemes supported by the entity. Valid value for this attribute is:

    1 + 1 unidirectional.

    This attribute is read-write.

*   `WaitToRestoreTime`: Integer <nullable>

    If the protection system is revertive, this attribute specifies the amount of time, in seconds, to wait after a fault clears before restoring traffic to the protected protectionUnit that initiated the switching. Valid values for this attribute are integers. This attribute is optional.

    This attribute is read-write.

*   `HoldOffTime`: Integer <nullable>

    This attribute indicates the time, in seconds, between declaration of signal degrade or signal fail, and the initialization of the protection switching algorithm. Valid values are integers in units of seconds.

    This attribute is read-write.

Operations:

*   `ExtCMD()`

    This operation represents the external command that instructs the protection system for performing specific protection switching (PS) operations. The input of this operation shall indicate the following:

    −   operation type: exercise, manual switch, forced switch, lockout, release of manual switch, release of forced switch, release of lockout;

    −   targeted entity: the working and/or protecting entity (entities).

    The output of this operation shall indicate the result of the operation.

7.2.1.7   OCh_Subnetwork

This entity represents an OCh subnetwork which is a grouping of OCh_CTP, OCh_TTP, and OCh_SNC entities.

Attributes:

None.

Operations:

*   `connect()`

    This operation performs the function of establishing cross-connections (SNC). The input of the operation shall identify the directionality and the OCh_CTP and/or OCh_TTP entities that will be cross-connected. Allowable connections are:

    −   between CTP Sink and CTP Source;

    −   between TTP Sink and TTP Source;

    −   between CTP Sink and TTP Sink; and

    −   between CTP Source and TTP Source.

Note that Bidirectional has both the Sink and Source functions.

The output of the operation shall indicate the result of the operation.

- `disconnect()`

    This operation performs the function of tearing down cross-connections (SNC). The input of the operation shall identify the cross-connects that should be disconnected. The output of the operation shall indicate the result of the operation.

7.2.1.8   OCh_TTP

This entity represents the OCh trail termination function, which is responsible for the end-to-end supervision of the OCh trail. The combining of the unidirectional sink and source function forms a bidirectional function.

Attributes:

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

    This attribute is read-only.

- `OperationalState`: Enumerated

    This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

    Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

    Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

    Constraints to Provisioning – N/A.

    Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

    This attribute is read-only.

- `AdministrativeState`: Enumerated

    This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for administrativeState in ITU-T Rec. M.3100.

    Possible Values – Unlocked, Locked, and Shutting Down. See ITU-T Recs. X.731 and M.3100.

    Default Value – Unlocked (If there is a need that can be identified for locking this resource, this decision will need to be re-evaluated).

    Constraints to Provisioning – Constrained to Unlocked (If there is a need that can be identified for locking this resource, this decision will need to be re-evaluated).

    Effect of Change in Value – N/A (If there is a need that can be identified for locking this resource, this decision will need to be re-evaluated).

    This attribute is read-write.

- `CurrentProblemList`: Set of Integer

    This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

    1) no defect;

    2) LOS-P (Loss of Signal – Payload);

    3) OCI (Open Connection Indicator);

    4) SSF-P (Server Signal failure – Payload);

    5) SSF-O (Server Signal failure – Overhead);

    6) SSF (Server Signal failure).

    This attribute is read-only.

Operations:

None.

7.2.1.9 OChr_CTP

This entity represents the functions of terminating and/or originating a link connection in the OCh layer network. This entity supports a reduced functionality, i.e. does not support OCh overhead. The combining of the unidirectional sink and source function forms a bidirectional function.

Attributes:

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

    This attribute is read-only.

Operations:

None.

7.2.1.10 OChr_TTP

This entity represents the OChr trail termination function, which is responsible for the end-to-end supervision of the OChr trail. The combining of the unidirectional sink and source function forms a bidirectional function.

Attributes:

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

    This attribute is read-only.

- `OperationalState`: Enumerated

    This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

    Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

    Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

    Constraints to Provisioning – N/A.

Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

This attribute is read-only.

- `AdministrativeState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for administrativeState in ITU-T Rec. M.3100.

  Possible Values – Unlocked, Locked, and Shutting Down. See ITU-T Recs. X.731 and M.3100.

  Default Value – Unlocked (If there is a need that can be identified for locking this resource, this decision will need to be re-evaluated).

  Constraints to Provisioning – Constrained to Unlocked (If there is a need that can be identified for locking this resource, this decision will need to be re-evaluated).

  Effect of Change in Value – N/A (If there is a need that can be identified for locking this resource, this decision will need to be re-evaluated).

  This attribute is read-write.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;
  2) LOS-P (Loss of Signal – Payload);
  3) OCI (Open Connection Indicator);
  4) SSF-P (Server Signal failure – Payload);
  5) SSF-O (Server Signal failure – Overhead);
  6) SSF (Server Signal failure).

  This attribute is read-only.

Operations:

None.

7.2.1.11   OCTk_nim

This entity represents the combined OCh and OTUk [V] non-intrusive monitoring function at the OCh_CTP. This function can be activated and deactivated at the OCh_CTP.

Attributes:

- `K`: Integer[1..3]

  This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2, and 3.

  k = 1 represents an approximate bit rate of 2.5 Gbit/s,

  k = 2 represents an approximate bit rate of 10 Gbit/s,

  k = 3 represents an approximate bit rate of 40 Gbit/s.

  This attribute is read-only.

- `OperationalState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

Default Value − Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

Constraints to Provisioning − N/A.

Effect of Change in Value − See ITU-T Recs. X.731 and M.3100.

This attribute is read-only.

- `ExDAPI`: string[64 bytes]

  The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- `ExSAPI`: string[64 bytes]

  The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- `AcTI`: string[64 bytes]

  The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

  This attribute is read-only.

- `TimDetMode`: Enumerated

  This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

  This attribute is read-write.

- TimActDisabled: boolean

  This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink. The value of TRUE means disabled.

  This attribute is read-write.

- `DegThr`: Integer

  This attribute indicates the threshold level for declaring a performance monitoring (PM) Second to be bad. A PM Second is declared bad if the percentage of detected errored blocks in that second is greater than or equal to the specified threshold level. Valid values are integers in units of percentages.

  This attribute is read-write.

- `DegM`: Integer

  This attribute indicates the threshold level for declaring a Degraded Signal defect (dDEG). A dDEG shall be declared if DegM consecutive bad PM Seconds are detected.

  This attribute is read-write.

- **CurrentProblemList**: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  (other values TBD).

  This attribute is read-only.

Operations:

None.

7.2.1.12 ODUk_Client_CTP

This entity represents the ODUkP to client adaptation function, which performs the adaptation between the ODUkP layer adapted information and the client layer characteristic information. The ODUkP layer is the server layer. This entity can be inherited for defining the client layer CTP.

Attributes:

- **K**: Integer[1..3]

  This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2, and 3.

  k = 1 represents an approximate bit rate of 2.5 Gbit/s;

  k = 2 represents an approximate bit rate of 10 Gbit/s;

  k = 3 represents an approximate bit rate of 40 Gbit/s.

  This attribute is read-only.

- **AdaptationType**: Integer

  This attribute indicates the type of the supported adaptation function at the interface port. Valid values of this attribute are:

  1) CBR;

  2) ATMvp;

  3) GFP;

  4) NULL;

  5) PRBS;

  6) RSn.

  This attribute is read-only.

- **SinkAdaptActive**: boolean

  This attribute allows for activation or deactivation of the sink adaptation function. The value of TRUE means active.

  This attribute is read-write.

- **SourceAdaptActive**: boolean

  This attribute allows for activation or deactivation of the source adaptation function. The value of TRUE means active.

  This attribute is read-write.

- PayloadTypeAc: Integer[0..255]

  This attribute indicates the actual payload type signal received. The Payload Type signal of size of one byte recovered (received) from the OPUk overhead position at the sink of a trail.

  This attribute is read-only.

- Directionality: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

- OperationalState: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

- CurrentProblemList: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;
  2) PLM (Payload mismatch);
  3) LOF (for RSn client);
  4) LSS (Loss of PRBS Lock).

  This attribute is read-only.

Operations:

None.

7.2.1.13 ODUk_CTP

This entity represents the termination and/or origination function of ODUk link connection.

Attributes:

- K: Integer[1..3]

  This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2, and 3.

  k = 1 represents an approximate bit rate of 2.5 Gbit/s;

  k = 2 represents an approximate bit rate of 10 Gbit/s;

  k = 3 represents an approximate bit rate of 40 Gbit/s.

  This attribute is read-only.

- `Directionality`: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

- `TcmFieldsInUse`: Set of Integer[1..6]

  This attribute indicates the used TCM fields of the ODUk OH. Valid values of this attribute are 1, 2, 3, 4, 5 or 6.

  This attribute is read-only.

- `PositionSeq`: sequence of pointer

  This attribute indicates the positions of the TCM and GCC processing functions within the ODUk TP.

  The order of the position in the positionSeq attribute together with the signal flow determine the processing sequence of the TCM and GCC functions within the ODUk TP. Once the positions are determined, the signal processing sequence will follow the signal flow for each direction of the signal.

  Within the ODUk_CTP, the position order is going from adaptation to connection function. Within the ODUk_TTP, the order is going from connection to adaptation function.

  The syntax of the "PositionSeq" attribute will be a SEQUENCE OF pointers, which point to the contained TCM and GCC function.

  The order of TCM and GCC access function in the positionSeq attribute is significant only when there are more than one TCM functions within the ODUk TP and also at least one of them have the TimActDisabled attribute set to FALSE (i.e. AIS is inserted upon TIM).

  If a GCC12_TP is contained in an ODUk_TTP and the GCC12_TP is not listed in the PositionSeq attribute of the ODUk_TTP, then the GCC access is at the AP side of the ODUk TT function.

  This attribute is read-only.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  (other values TBD).

  This attribute is read-only.

Operations:

- `activateNim()`

  This operation activates the non-intrusive monitoring function of the ODUk Trail at the ODUk CTP.

  Successful execution of this operation will creation an instance of ODUk_nim.

- `deactivateNim()`

  This operation deactivates the previously activated non-intrusive ODUk Trail monitoring function at the ODUk_CTP. Successful execution of this operation will delete the ODUk_nim instance.

- addTCM()

    This operation adds a tandem connection monitoring (TCM) TP of a particular field to the ODUk_CTP.

    Parameters provisioned include the TCM field, intrusive or non-intrusive, TxTI, ExDAPI, ExSAPI, TimDetMode, TimActDisabled, DEGThr, DEGM, codirectional, and the position of this TCM TP in the position sequence. Successful execution of this operation will create an instance of ODUkT_TTP (for intrusive monitoring) or ODUkT_nim (for non-intrusive monitoring) of the specified field and the positionSeq attribute will be updated.

- removeTCM()

    This operation removes a previously added tandem connection monitoring (TCM) TP of the ODUk_CTP. The operation shall indicate the TCM TP instance (i.e. the ODUkT_TTP or ODUkT_nim) that is to be deleted. Successful execution of this operation will delete the specified instance and the position sequence attribute will be updated.

- addGCC12Access()

    This operation adds a GCC12_TP to the ODUk_CTP. The input parameters of this operation will provide the values for those attributes defined for the GCC12_TP class, including the directionality, codirectional, GCC access (i.e. GCC1 or GCC2), GCC pass through, application, and the position of this GCC12_TP in the position sequence.

    Successful execution of this operation will create an GCC12_TP instance and the positionSeq attribute will be updated.

- removeGCC12Access()

    This operation removes a previously added GCC12_TP instance from the ODUk_CTP.

    The operation shall specify the GCC12_TP instance to be deleted.

    Successful execution of this operation will delete the GCC12_TP instance and the position sequence attribute will be updated.

7.2.1.14   ODUk_nim

This entity represents the non-intrusive ODUk Path monitoring function, which can be activated or deactivated at the ODUk_CTP. Bidirectional instantiation of this object is not allowed.

Attributes:

- K: Integer[1..3]

    This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2, and 3.

    k = 1 represents an approximate bit rate of 2.5 Gbit/s;

    k = 2 represents an approximate bit rate of 10 Gbit/s;

    k = 3 represents an approximate bit rate of 40 Gbit/s.

    This attribute is read-only.

- OperationalState: Enumerated

    This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

    Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

    Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

Constraints to Provisioning – N/A.

Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

This attribute is read-only.

- `ExDAPI`: string[64 bytes]

  The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- `ExSAPI`: string[64 bytes]

  The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- `AcTI`: string[64 bytes]

  The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

  This attribute is read-only.

- `TimDetMode`: Enumerated

  This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

  This attribute is read-write.

- `TimActDisabled`: boolean

  This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink. The value of TRUE means disabled.

  This attribute is read-write.

- `DegThr`: Integer

  This attribute indicates the threshold level for declaring a performance monitoring (PM) Second to be bad. A PM Second is declared bad if the percentage of detected errored blocks in that second is greater than or equal to the specified threshold level. Valid values are integers in units of percentages.

  This attribute is read-write.

- `DegM`: Integer

  This attribute indicates the threshold level for declaring a Degraded Signal defect (dDEG). A dDEG shall be declared if DegM consecutive bad PM Seconds are detected.

  This attribute is read-write.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;
  2) OCI (Open Connection Indication);
  3) LCK (Locked);
  4) TIM (Trail Trace Identifier Mismatch);

5) DEG (Signal Degraded);

6) BDI (Backward Defect Indication);

7) SSF (Server Signal Fail).

This attribute is read-only.

- `NimDirectionality`: Enumerated

    This attribute indicates the directionality of the ODUk Path non-intrusive monitoring function. Valid values are sink and source. This attribute is significant for ODUk Path unidirectional non-intrusive monitoring when the associated ODUk_CTP is bidirectional.

    This attribute is read-only.

Operations:

None.

7.2.1.15   ODUk_SNC

This entity represents the connection function of the ODUk layer network. The ODUk connection function may in addition support the subnetwork connection protection function.

Attributes:

- `K`: Integer[1..3]

    This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2 and 3.

    k = 1 represents an approximate bit rate of 2.5 Gbit/s;

    k = 2 represents an approximate bit rate of 10 Gbit/s;

    k = 3 represents an approximate bit rate of 40 Gbit/s.

    This attribute is read-only.

- `ProtType`: Enumerated <nullable>

    If subnetwork connection protection is supported, this attribute indicates the protection type of the subnetwork connection protection function. Valid values of this attribute are:

    --TBD--

    This attribute is read-write.

- `OperType`: Enumerated <nullable>

    This attribute indicates the trail protection schemes supported by the entity. Valid value for this attribute is:

    1 + 1 unidirectional.

    This attribute is read-write.

- `WaitToRestoreTime`: Integer <nullable>

    If the protection systems is revertive, this attribute specifies the amount of time, in seconds, to wait after a fault clears before restoring traffic to the protected protectionUnit that initiated the switching. Valid values for this attribute are integers. This attribute is optional.

    This attribute is read-write.

- `HoldOffTime`: Integer <nullable>

  This attribute indicates the time, in seconds, between declaration of signal degrade or signal fail, and the initialization of the protection switching algorithm. Valid values are integers in units of seconds.

  This attribute is read-write.

Operations:

- `ExtCMD()`

  This operation represents the external command that instructs the protection system for performing specific protection switching (PS) operations. The input of this operation shall indicate the following:

  - operation type: exercise, manual switch, forced switch, lockout, release of manual switch, release of forced switch, release of lockout;

  - targeted entity: the working and/or protecting entity (entities).

  The output of this operation shall indicates the result of the operation.

7.2.1.16   ODUk_Subnetwork

This entity represents an ODUk subnetwork which is a grouping of ODUk_CTP, ODUk_TTP, and ODUk_SNC entities.

Attributes:

- `K`: Integer[1..3]

  This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2 and 3.

  k = 1 represents an approximate bit rate of 2.5 Gbit/s;

  k = 2 represents an approximate bit rate of 10 Gbit/s;

  k = 3 represents an approximate bit rate of 40 Gbit/s.

  This attribute is read-only.

Operations:

- `connect()`

  This operation performs the function of establishing cross-connections (SNC). The input of the operation shall identify the directionality and the OCh_CTP and/or OCh_TTP entities that will be cross-connected. Allowable connections are:

  - between CTP Sink and CTP Source;

  - between TTP Sink and TTP Source;

  - between CTP Sink and TTP Sink; and

  - between CTP Source and TTP Source.

  Note that Bidirectional has both the Sink and Source functions. The output of the operation shall indicate the result of the operation.

- `disconnect()`

  This operation performs the function of tearing down cross-connections (SNC). The input of the operation shall identify the cross-connects that should be disconnected. The output of the operation shall indicate the result of the operation.

7.2.1.17 ODUk_TTP

This entity represents the ODUkP_TT termination function, which terminates the Path Monitoring (PM) overhead of the ODUk overhead to determine the status of the ODUk trail.

Attributes:

* K: Integer[1..3]

  This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2 and 3.

  k = 1 represents an approximate bit rate of 2.5 Gbit/s;

  k = 2 represents an approximate bit rate of 10 Gbit/s;

  k = 3 represents an approximate bit rate of 40 Gbit/s.

  This attribute is read-only.

* Directionality: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

* OperationalState: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

* TxTI: string[64 bytes]

  The Trail Trace Identifier (TTI) information, provisioned by the managing system at the termination source, to be placed in the TTI overhead position of the source of a trail for transmission.

  This attribute is read-write.

* ExDAPI: string[64 bytes]

  The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

* ExSAPI: string[64 bytes]

  The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- AcTI: string[64 bytes]

  The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

  This attribute is read-only.

- TimDetMode: Enumerated

  This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

  This attribute is read-write.

- TimActDisabled: boolean

  This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink. The value of TRUE means disabled.

  This attribute is read-write.

- DegThr: Integer

  This attribute indicates the threshold level for declaring a performance monitoring (PM) Second to be bad. A PM Second is declared bad if the percentage of detected errored blocks in that second is greater than or equal to the specified threshold level. Valid values are integers in units of percentages.

  This attribute is read-write.

- DegM: Integer

  This attribute indicates the threshold level for declaring a Degraded Signal defect (dDEG). A dDEG shall be declared if DegM consecutive bad PM Seconds are detected.

  This attribute is read-write.

- PositionSeq: sequence of pointer

  This attribute indicates the positions of the TCM and GCC processing functions within the ODUk TP.

  The order of the position in the positionSeq attribute together with the signal flow determine the processing sequence of the TCM and GCC functions within the ODUk TP. Once the positions are determined, the signal processing sequence will follow the signal flow for each direction of the signal.

  Within the ODUk_CTP, the position order is going from adaptation to connection function. Within the ODUk_TTP, the order is going from connection to adaptation function.

  The syntax of the "PositionSeq" attribute will be a SEQUENCE OF pointers, which point to the contained TCM and GCC function.

  The order of TCM and GCC access function in the positionSeq attribute is significant only when there are more than one TCM functions within the ODUk TP and, also, at least one of them have the TimActDisabled attribute set to FALSE (i.e. AIS is inserted upon TIM).

  If a GCC12_TP is contained in an ODUk_TTP and the GCC12_TP is not listed in the PositionSeq attribute of the ODUk_TTP, then the GCC access is at the AP side of the ODUk TT function.

  This attribute is read-only.

- CurrentProblemList: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;
  2) OCI (Open Connection Indication);
  3) LCK (Locked);
  4) TIM (Trail Trace Identifier Mismatch);
  5) DEG (Signal Degraded);
  6) BDI (Backward Defect Indication);
  7) SSF (Server Signal Fail).

  This attribute is read-only.

- TcmFieldsInUse: Set of Integer[1..6]

  This attribute indicates the used TCM fields of the ODUk OH. Valid values of this attribute are 1, 2, 3, 4, 5 or 6.

  This attribute is read-only.

Operations:

- addTCM()

  This operation adds a tandem connection monitoring (TCM) TP of a particular field to the ODUk_TTP.

  Parameters provisioned include the TCM field, intrusive or non-intrusive, TxTI, ExDAPI, ExSAPI, TimDetMode, TimActDisabled, DEGThr, DEGM, and the position of this TCM TP in the position sequence.

  Successful execution of this operation will create an instance of ODUkT_TTP (for intrusive monitoring) or ODUkT_nim (for non-intrusive monitoring) of the specified field and the positionSeq attribute will be updated.

- removeTCM()

  This operation removes a previously added tandem connection monitoring (TCM) TP from the ODUk_TTP. The operation shall indicate the TCM TP instance (i.e. the ODUkT_TTP or ODUkT_nim) that is to be deleted. Successful execution of this operation will delete the specified instance and the position sequence attribute will be updated.

- addGCC12Access()

  This operation adds a GCC12_TP to the ODUk_TTP. The input parameters of this operation will provide the values for those attributes defined for the GCC12_TP class, including the directionality, codirectionality, GCC access (i.e. GCC1 or GCC2), GCC pass through, application, and the position of this GCC12_TP in the position sequence or the position that includes the trail termination function of the containing ODUk_TTP. Successful execution of this operation will create an GCC12_TP instance and the positionSeq attribute will be updated.

- removeGCC12Access()

  This operation removes a previously added GCC12_TP instance from the ODUk_TTP.

  The operation shall specify the GCC12_TP instance to be deleted.

  Successful execution of this operation will delete the GCC12_TP instance and the position sequence attribute will be updated.

7.2.1.18   ODUkT_nim

This entity represents the ODUk non-intrusive Tandem connection monitoring (niTCM) function, which reports the state of the ODUk TCM. It computes the BIP8, extracts Tandem Connection Monitoring Overhead (TCMOH) – including the TTI, BIP8, BDI and BEI signals – in a selected TCMOH field from the ODUk signal at its ODUk_TCP, detects for AIS, OCI, LCK, TIM, DEG and BDI defects, counts during 1-second period errors (detected via the BIP8) and defects to feed PM. Bidirectional instantiation of this object is not allowed.

Attributes:

*   `TcmField`: Integer

    This attribute indicates the tandem connection monitoring field of the ODUk OH. Valid values are integers from 1 to 6.

    This attribute is read-only.

*   `OperationalState`: Enumerated

    This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

    Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

    Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

    Constraints to Provisioning – N/A.

    Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

    This attribute is read-only.

*   `ExDAPI`: string[64 bytes]

    The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

    This attribute is read-write.

*   `ExSAPI`: string[64 bytes]

    The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

    This attribute is read-write.

*   `AcTI`: string[64 bytes]

    The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

    This attribute is read-only.

*   `TimDetMode`: Enumerated

    This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

    This attribute is read-write.

- TimActDisabled: boolean

  This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink. The value of TRUE means disabled.

  This attribute is read-write.

- DegThr: Integer

  This attribute indicates the threshold level for declaring a performance monitoring (PM) Second to be bad. A PM Second is declared bad if the percentage of detected errored blocks in that second is greater than or equal to the specified threshold level. Valid values are integers in units of percentages.

  This attribute is read-write.

- DegM: Integer

  This attribute indicates the threshold level for declaring a Degraded Signal defect (dDEG). A dDEG shall be declared if DegM consecutive bad PM Seconds are detected.

  This attribute is read-write.

- NimDirectionality: Enumerated

  This attribute indicates the directionality of the ODUk TCM non-intrusive monitoring function. Valid values are sink and source. This attribute is significant for TCM unidirectional non-intrusive monitoring when the containing ODUk_CTP is bidirectional.

  This attribute is read-only.

- CurrentProblemList: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;
  2) OCI (Open Connection Indication);
  3) LCK (Locked);
  4) TIM (Trail Trace Identifier Mismatch);
  5) DEG (Signal Degraded);
  6) BDI (Backward Defect Indication);
  7) SSF (Server Signal Fail).

  This attribute is read-only.

Operations:

None.

7.2.1.19 ODUkT_TTP

This entity represents the ODUkT_TT termination function, which terminates a field of Tandem Connection Monitoring (TCM) overhead of the ODUk to determine the status of the ODUk TCM sublayer trail.

Attributes:

- Directionality: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

- `TcmField`: Integer

  This attribute indicates the tandem connection monitoring field of the ODUk OH. Valid values are integers from 1 to 6.

  This attribute is read-only.

- `OperationalState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

- `TxTI`: string[64 bytes]

  The Trail Trace Identifier (TTI) information, provisioned by the managing system at the termination source, to be placed in the TTI overhead position of the source of a trail for transmission.

  This attribute is read-write.

- `ExDAPI`: string[64 bytes]

  The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- `ExSAPI`: string[64 bytes]

  The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- `AcTI`: string[64 bytes]

  The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

  This attribute is read-only.

- `TimDetMode`: Enumerated

  This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

  This attribute is read-write.

- `TimActDisabled`: boolean

  This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink. The value of TRUE means disabled.

  This attribute is read-write.

- **DegThr**: Integer

  This attribute indicates the threshold level for declaring a performance monitoring (PM) Second to be bad. A PM Second is declared bad if the percentage of detected errored blocks in that second is greater than or equal to the specified threshold level. Valid values are integers in units of percentages.

  This attribute is read-write.

- **DegM**: Integer

  This attribute indicates the threshold level for declaring a Degraded Signal defect (dDEG). A dDEG shall be declared if DegM consecutive bad PM Seconds are detected.

  This attribute is read-write.

- **AdminStateSource**: Enumerated

  This attribute provides the capability to provision the LOCK signal at the source, which is one of the ODUk maintenance signals. Valid values for this attribute are Locked and Normal. When a Tandem Connection endpoint is set to admin state locked, it will insert the ODUk-LCK signal in the source direction.

  This attribute is read-write.

- **AdminStateSink**: Enumerated

  This attribute provides the capability to provision the LOCK signal at the sink, which is one of the ODUk maintenance signals. Valid values for this attribute are Locked and Normal. When a Tandem Connection endpoint is set to admin state locked, it will insert the ODUk-LCK signal in the downstream direction.

  This attribute is read-write.

- **ModeSink**: Enumerated

  This attribute specifies the TCM mode at the entity. Valid values are: Operational, Monitor, and Transparent.

  This attribute is read-write.

- **ModeSource**: Enumerated

  This attribute specifies the TCM mode at the entity. Valid values are: Operational, Transparent.

  This attribute is read-write.

- **AcStatusSink**: Enumerated

  This attribute indicates the status of the accepted TCM. See Table 15-5/G.709/Y.1331 for the allowed values of this attribute.

  This attribute is read-only.

- **AcStatusSource**: Enumerated

  This attribute indicates the status of the accepted TCM. See Table 15-5/G.709/Y.1331 for the allowed values of this attribute.

  This attribute is read-only.

- **Codirectional**: boolean

  This attribute specifies the directionality of the ODUkT TP with respect to the associated ODUk_CTP. The value of TRUE means that the sink part of the ODUkT TP terminates the same signal direction as the sink part of the ODUk_CTP. The Source part behaves similarly. This attribute is meaningful only on objects instantiated under ODUk_CTP, and at least one among ODUk_CTP and the subordinate object has Directionality equal to Bidirectional.

  This attribute is read-only.

- `CurrentProblemList`: Set of Integer
  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:
  1) no defect;
  2) OCI (Open Connection Indication);
  3) LCK (Locked);
  4) TIM (Trail Trace Identifier Mismatch);
  5) DEG (Signal Degraded);
  6) BDI (Backward Defect Indication);
  7) SSF (Server Signal Fail).
  This attribute is read-only.

Operations:

None.

7.2.1.20   OMSn_CTP

This entity represents the functions of terminating and/or orginating a link conncetion in the OMSn layer network.

Attributes:

- `Directionality`: Enumerated
  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.
  This attribute is read-only.

Operations:

None.

7.2.1.21   OMSn_TTP

This entity represents the OMSn trail termination function, which is responsible for the end-to-end supervision of the OMSn trail. The combining of the unidirectional sink and source function forms a bidirectional function.

Attributes:

- `Directionality`: Enumerated
  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.
  This attribute is read-only.

- `OperationalState`: Enumerated
  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.
  This attribute is read-only.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  2) SSF-P (Server Signal Fail – Payload);

  3) SSF-O (Server Signal Fail – Overhead);

  4) SSF (Server Signal Fail);

  5) BDI-P (Backward Defect Indication – Payload);

  6) BDI-O (Backward Defect Indication – Overhead);

  7) BDI (Backward Defect Indication);

  8) LOS-P (Loss of Signal – Payload).

  This attribute is read-only.

Operations:

None.

7.2.1.22 OMSnP

This entity represents the OMS trail protection sublayer function of the OMSn layer network.

Attributes:

- `OperType`: Enumerated

  This attribute indicates the trail protection schemes supported by the entity. Valid value for this attribute is:

  1 + 1 unidirectional.

  This attribute is read-write

- `WaitToRestoreTime`: Integer

  If the protection systems is revertive, this attribute specifies the amount of time, in seconds, to wait after a fault clears before restoring traffic to the protected protectionUnit that initiated the switching. Valid values for this attribute are integers. This attribute is optional.

  This attribute is read-write.

- `HoldOffTime`: Integer

  This attribute indicates the time, in seconds, between declaration of signal degrade or signal fail, and the initialization of the protection switching algorithm. Valid values are integers in units of seconds.

  This attribute is read-write.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  2) SSF-P (Server Signal Fail – Payload);

  3) SSF-O (Server Signal Fail – Overhead);

  4) SSF (Server Signal Fail).

  This attribute is read-only.

Operations:

- `ExtCMD()`

  This operation represents the external command that instructs the protection system for performing specific protection swtiching (PS) operations.

  The input of this operaton shall indicate the following:

  – operation type: exercise, manual switch, forced switch, lockout, release of manual switch, release of forced switch, release of lockout;

  – targeted entity: the working and/or protecting entity (entities).

  The output of this operation shall inidcates the result of the operation.

7.2.1.23 OPSn_TTP

Attributes:

- `Directionality`: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

- `OperationalState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

- `CurrentProblemList`: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  2) LOS (Loss of Signal).

  This attribute is read-only.

Operations:

None.

7.2.1.24 OTM-n

This entity represents the OTM information structure of an optical interface. See ITU-T Rec. G.709/Y.1331 for detailed definition of OTM-n[r].m.

Attributes:

- `Order`: Integer

  This attribute indicates the order of the OTM, which represents the maximum number of wavelengths that can be supported at the bit rate(s) supported on the interface. See ITU-T Rec. G.709/Y.1331 for details.

  This attribute is read-only.

- **Reduced**: boolean

  This attribute indicates whether a reduced or full functionality is supported at the interface. A value of TRUE means reduced. A value of FALSE means full. See ITU-T Rec. G.709/Y.1331 for details.

  This attribute is read-only.

- **BitRate**: Enumerated

  This attribute is an index used to represent the bit rate or set of bit rates supported on the interface. Valid values are 1, 2, 3, 12, 123 and 23. In the index, each digit k represents an approximate bit rate supported by the interface. $k = 1$ means 2.5 Gbit/s, $k = 2$ means 10 Gbit/s, and $k = 3$ means 40 Gbit/s. Default value of this attribute is system specific.

  This attribute is read-only.

- **InterfaceType**: string

  This attribute identifies the type of interface. The value of this attribute will affect the behaviour of the OTM with respect to presence/absence of OOS processing and TCM activation. For an IrDI interface, there is no OOS processing and TCM activation is limited to n levels as specified by a TCM level threshold.

  Possible Values:

  field 1: enumeration of IrDI or IaDI;

  field 2: 10 character string for additional information.

  Default Value:

  field 1: IaDI;

  field 2: vendor and/or provider specific.

  Constraints to Provisioning – none identified.

  Effect of Change in Value – change in behaviour in accordance with value.

  This attribute is read-only.

- **TcmMax**: Integer[0..6]

  This attribute identifies the maximum number of TCM levels allowed for any Optical Channel contained in this OTM. A new TCM activation will be rejected if the requested level is greater than the threshold. If InterfaceType for the OTM is IaDI, then this attribute is irrelevant.

  Possible Values –integer from 0 to 6. n (IrDI), where $0 < n < 7$.

  Default Value – Value will default to 3.

  Constraints to Provisioning – cannot be modified to new value if new value does not support the number of currently activated TCM levels for any contained Optical Channel.

  Effect of Change in Value – change in behaviour in accordance with value.

  This attribute is read-write.

- **OpticalReach**: Enumerated

  This attribute indicates the length the optical signal may travel before requiring termination or regeneration. Valid values are:

  1) intraOffice;

  2) shortHaul;

  3) longHaul.

  This attribute is read-only.

Operations:

None.

7.2.1.25　OTSn_TTP

This entity represents the OTSn trail termination function, which is responsible for the end-to-end supervision of the OTSn trail. The combining of the unidirectional sink and source function forms a bidirectional function.

Attributes:

- `Directionality`: Enumerated

  This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

  This attribute is read-only.

- `OperationalState`: Enumerated

  This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

  Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

  Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

  Constraints to Provisioning – N/A.

  Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

  This attribute is read-only.

- `APRStatus`: string

  This attribute indicates the status of the Automatic Power Reduction (APR) function of the entity. Valid values are "on" and "off".

  This attribute is read-only.

- `APRCntrl`: string <nullable>

  This attribute provides for the control of the Automatic Power Reduction (APR) function of the entity. The specific APR procedures and trigger criteria of APR is outside the scope of this Recommendation. This attribute is optional.

  This attribute is read-write.

- `TxTI`: string[64 bytes]

  The Trail Trace Identifier (TTI) information, provisioned by the managing system at the termination source, to be placed in the TTI overhead position of the source of a trail for transmission.

  This attribute is read-write.

- `ExDAPI`: string[64 bytes]

  The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

  This attribute is read-write.

- ExSAPI: string[64 bytes]

   The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

   This attribute is read-write.

- AcTI: string[64 bytes]

   The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

   This attribute is read-only.

- TimDetMode: Enumerated

   This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

   This attribute is read-write.

- TimActDisabled: boolean

   This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink. The value of TRUE means disabled.

   This attribute is read-write.

- CurrentProblemList: Set of Integer

   This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

   1) no defect;

   2) BDI-P (Backward Defect Indication – Payload);

   3) BDI-O (Backward Defect Indication – Overhead);

   4) BDI (Backward Defect Indication);

   5) TIM (Trail Trace Identifier Mismatch);

   6) LOS-P (Loss of Signal – Payload);

   7) LOS-O (Loss of Signal – Overhead);

   8) LOS (Loss of Signal).

   This attribute is read-only.

Operations:

None.

7.2.1.26   OTUk_CTP

Attributes:

- K: Integer[1..3]

   This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2 and 3.

   k = 1 represents an approximate bit rate of 2.5 Gbit/s;

   k = 2 represents an approximate bit rate of 10 Gbit/s;

   k = 3 represents an approximate bit rate of 40 Gbit/s.

   This attribute is read-only.

- `SinkAdaptActive`: boolean

    This attribute indicates whether the sink adaptation function is activated or not. Valid values are TRUE and FALSE. TRUE means active.

    This attribute is read-write.

- `SourceAdaptActive`: boolean

    This attribute indicates whether the source adaptation function is activated or not. Valid values are TRUE and FALSE. TRUE means active.

    This attribute is read-write.

- `FecEnabled`: boolean

    If Forward Error Correction (FEC) is supported, this object indicates whether FEC at the OTUk sink adaptation function is enabled or not. This attribute is optional. Valid values are TRUE and FALSE. TRUE means FEC is enabled.

    This attribute is read-write.

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

    This attribute is read-only.

- `CurrentProblemList`: Set of Integer

    This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

    1) no defect;
    2) LOF (Loss of Frame);
    3) AIS (Alarm Indication Signal);
    4) LOM (Loss of MultiFrame).

    This attribute is read-only.

Operations:

None.

7.2.1.27   OTUk_TTP

This entity represents the OTUk trail termination function, which is responsible for the end-to-end supervision of the OTUk trail. The combining of the unidirectional sink and source function forms a bidirectional function.

The source function adds an entity of Section Monitoring Overhead (SMOH) into the OTUk signal (k = 1,2,3) from the OTUk_AP. This SMOH is inserted in the SM overhead location in the OTUk signal. In the other direction of transmission it terminates and processes the SMOH in the SM location in the OTUk overhead to determine the status of the defined connection attributes.

Attributes:

- `Directionality`: Enumerated

    This attribute indicates the directionality of the termination point. Valid values are sink, source, and bidirectional.

    This attribute is read-only.

- `OperationalState`: Enumerated

    This attribute is generally defined in ITU-T Rec. X.731 and the behaviour description for operationalState in ITU-T Rec. M.3100.

Possible Values – Enabled and Disabled. See ITU-T Recs. X.731 and M.3100 for details.

Default Value – Actual state of resource at the time the object is created. If there is a period of time during the initialization process where the operational state is unknown, then the resource will be considered disabled until initialization has completed and the state updated accordingly.

Constraints to Provisioning – N/A.

Effect of Change in Value – See ITU-T Recs. X.731 and M.3100.

This attribute is read-only.

- TxTI: string[64 byte]

The Trail Trace Identifier (TTI) information, provisioned by the managing system at the termination source, to be placed in the TTI overhead position of the source of a trail for transmission.

This attribute is read-write.

- ExDAPI: string[16 byte]

The Expected Destination Access Point Identifier (ExDAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

This attribute is read-write.

- ExSAPI: string[16 byte]

The Expected Source Access Point Identifier (ExSAPI), provisioned by the managing system, to be compared with the TTI accepted at the overhead position of the sink for the purpose of checking the integrity of connectivity.

This attribute is read-write.

- AcTI: string[64 byte]

The Trail Trace Identifier (TTI) information recovered (Accepted) from the TTI overhead position at the sink of a trail.

This attribute is read-only.

- TimDetMode: Enumerated

This attribute indicates the mode of the Trace Identifier Mismatch (TIM) Detection function. Valid values are: off, dapi, sapi, both.

This attribute is read-write.

- TimActDisabled: boolean

This attribute provides the control capability for the managing system to enable or disable the Consequent Action function when detecting Trace Identifier Mismatch (TIM) at the trail termination sink.

The value of TRUE means disabled.

This attribute is read-write.

- DegThr: Integer

This attribute indicates the threshold level for declaring a performance monitoring (PM) Second to be bad. A PM Second is declared bad if the percentage of detected errored blocks in that second is greater than or equal to the specified threshold level. Valid values are integers in units of percentages.

This attribute is read-write.

- **DegM**: Integer

  This attribute indicates the threshold level for declaring a Degraded Signal defect (dDEG). A dDEG shall be declared if DegM consecutive bad PM Seconds are detected.

  This attribute is read-write.

- **CurrentProblemList**: Set of Integer

  This attribute indicates the failure conditions of the entity. Possible values of this attribute include:

  1) no defect;

  2) TIM (Trail Trace Identifier Mismatch);

  3) DEG (Signal Degraded);

  4) BDI (Backward Defect Indication);

  5) SSF (Server Signal Fail).

  This attribute is read-only.

- **K**: Integer[1..3]

  This attribute specifies the index "k" that is used to represent a supported bit rate and the different versions of OPUk, ODUk and OTUk. Valid values for this attribute are integers 1, 2 and 3.

  k = 1 represents an approximate bit rate of 2.5 Gbit/s;

  k = 2 represents an approximate bit rate of 10 Gbit/s; and

  k = 3 represents an approximate bit rate of 40 Gbit/s.

  This attribute is read-only.

Operations:

- **addGCC0Access()**

  This operation adds a GCC0_TP to the OTUk_TTP. The input parameters of this operation will provide the values for those attributes defined for the GCC0_TP class, including the directionality and application. Successful execution of this operation will create an GCC0_TP instance.

- **removeGCC0Access()**

  This operation removes a previously added GCC0_TP instance of the OTUk_TTP. The operation shall specify the GCC0_TP instance to be deleted. Successful execution of this operation will delete the GCC0_TP instance.

7.2.2 Data Dictionary for Fault Management Support Entity

This clause provides the data dictionary for the Fault Management Support entities defined in this Recommendation.

7.2.2.1 Alarm Reporting Control

This entity represents the Alarm Reporting Control (ARC) setting for managed resources in the NE. Each entry in ARC represents the setting of a resource.

See ITU-T Rec. G.7710/Y.1701 for detailed requirements.

Attributes:

None.

Operations:

None.

7.2.2.2   ARC_Entry

This entity represents the Alarm Reporting Control (ARC) setting for a particular resource. It consists of information which identify the resource, the affected possible probable causes, the ARC states (namely ALM, NALM, NALM-TI, NAML-QI, or NALM-QI-CD) and the length of the TI or QI-CD Time Interval to be used, if supported. Note that not all ARC states are necessarily supported by a system.

This entity also contains an attribute indicating the time remaining when the resource is in the TI or CD stage.

Attributes:

- `ManagedResource`: string

  This attribute identifies the managed resource on which the ARC setting will apply.

  The value of this attribute is set at creation and is read-only.

- `ArcMode`: Enumerated

  This attribute indicates the ARC mode (i.e. the Not Alarmed states) of the resource. Valid values are: ALM, NALM, NALM-QI, NALM-TI, and NALM-QI-CD.

  A manager can set the ARC mode to either ALM, NALM, NALM-QI, NALM-TI, and NALM-QI-CD.

  Once the resource enters the ALM, state for the specified alarm type, the corresponding entry will be deleted from the ARC table.

  The value of NALM-QI-CD is a transitional state from NALM-QI to ALM. This value is not allowed to be requested by the managing system. It is optional depending on the type and the implementation of the resource. If it is supported, before the state is transitioned from NALM-QI to ALM, a countdown period is activated for a duration set by the object NALM-QI-CD TimeInterval. When the time is up, the ARC mode is set to ALM.

  The value of this attribute is read-write.

- `ProbableCause`: Integer

  This attribute specifies the possible Probable Cause of the resource that will be affected by the ARC setting. Valid values are integers. Each integer represents a probable cause as defined in ITU-T Rec. M.3100.

  This attribute is read-write.

- `NalmTimeRemaining`: Integer

  This attribute indicates the time remaining in the NALM-TI interval or the NALM-QI-CD interval, in units of seconds.

  At the moment the resource enters the NALM-TI state, this variable will have the initial value equal to the value of arcNalmTITimeInterval and then starts decrementing as time goes by.

  Similarly, at the moment the resource enters the NALM-QI-CD state, this variable will have the initial value equal to the value of arcNalmCDTimeInterval and then starts decrementing as time goes by.

  This variable is read-write and thus will allow the manager to extend or shorten the remaining time when the resource is in the NALM-TI or NALM-QI-CD state as needed.

  If this variable is supported and the resource is currently not in the NALM-TI nor NAML-QI-CD state, the value of this variable shall be equal to zero.

Operations:

None.

7.2.2.3 NALM Timer

This entity defines two timers for supporting the ARC feature. The NALM-TI Time Interval timer indicates the time interval used for the NALM-TI state. The NALM-QI-CD Time Interval timer indicates the time interval used for the NALM-QI-CD state.

Attributes:

*   `TI_Time_Interval`: Integer

    This attribute indicates the time interval used for NALM-TI, in units of seconds.

    This attribute is read-write.

*   `QI_CD_Time_Interval`: Integer

    This attribute indicates the time interval used for NALM-QI-CD, in units of seconds.

    This attribute is read-write.

Operations:

None.

7.2.2.4 Alarm Severity Assignment Profile

This entity represents the Alarm Severity Assignment Profile (ASAP), which defines the alarm severity assignment for managed resources in the NE. Each entry in ASAP represents the setting of a resource.

See ITU-T Rec. M.3100 for detailed requirements.

Attributes:

None.

Operations:

None.

7.2.2.5 ASAP_Entry

This entity represents the Alarm Severity Assignment setting for a particular resource. It consists of information which identify the resource, the affected possible probable causes, and the severity assignment.

Attributes:

*   `ManagedResource`: string

    This attribute identifies the managed resource on which the alarm severity assignment setting will apply.

    The value of this attribute is set at creation and is read-only.

*   `ProbableCause`: Integer

    This attribute specifies the possible Probable Cause of the resource that will be affected by the ARC setting. Valid values are integers. Each integer represents a probable cause as defined in ITU-T Rec. M.3100.

    This attribute is read-write.

- `AlarmSeverity`: Enumerated

  This attribute indicates the alarm severity assigned for the specified probable cause of the resource. Valid values are Critical, Major, Minor, and Warning.

  This attribute is read-write.

Operations:

None.

Appendix I

Usage of the Model for TCM and GCC

This appendix provides some examples to illustrate possible positions of TCM and GCC access functions within ODUk TPs and how they will be represented in the information model. This representation is defined via the use of **containment relationships** and the attributes **PositionSeq**, **Codirectional** and **Directionality**.
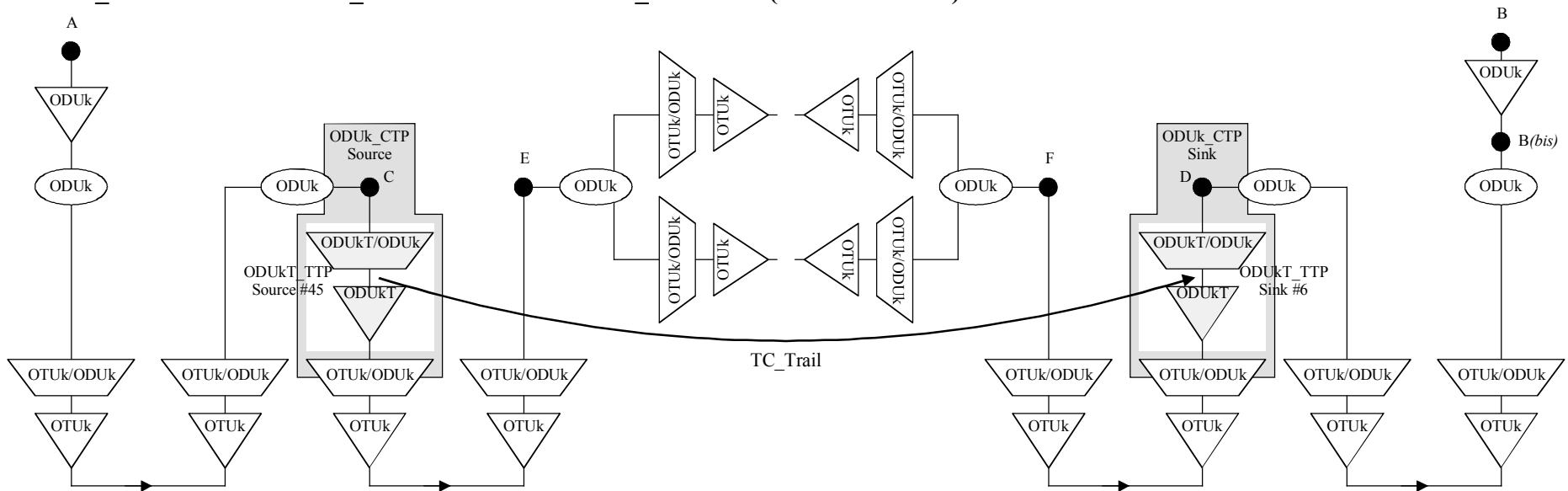
The following ODUk layer network configuration will be used as a basis:
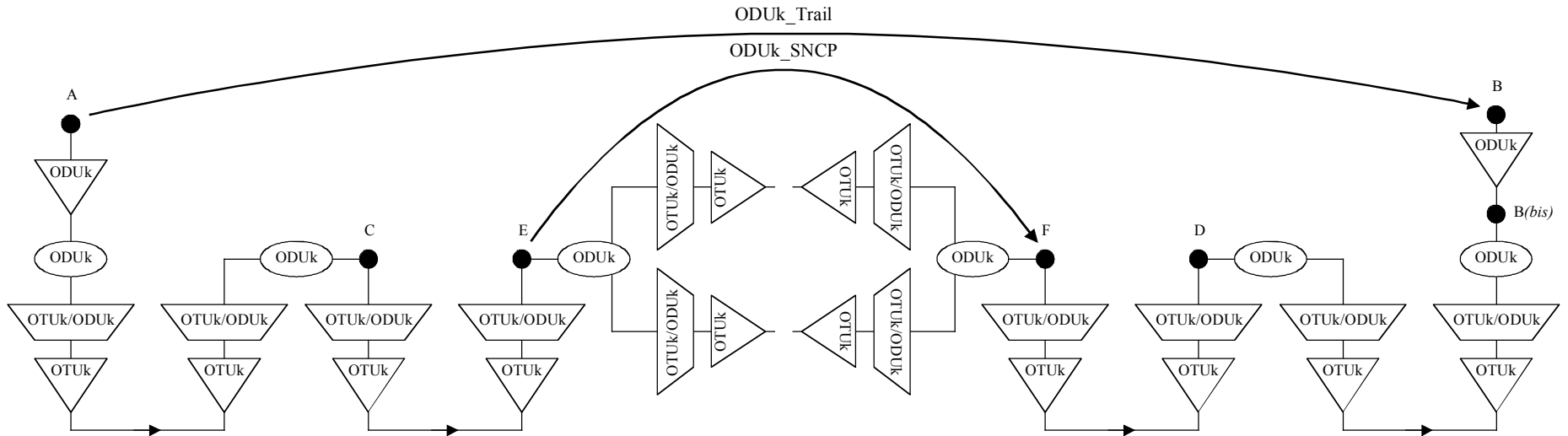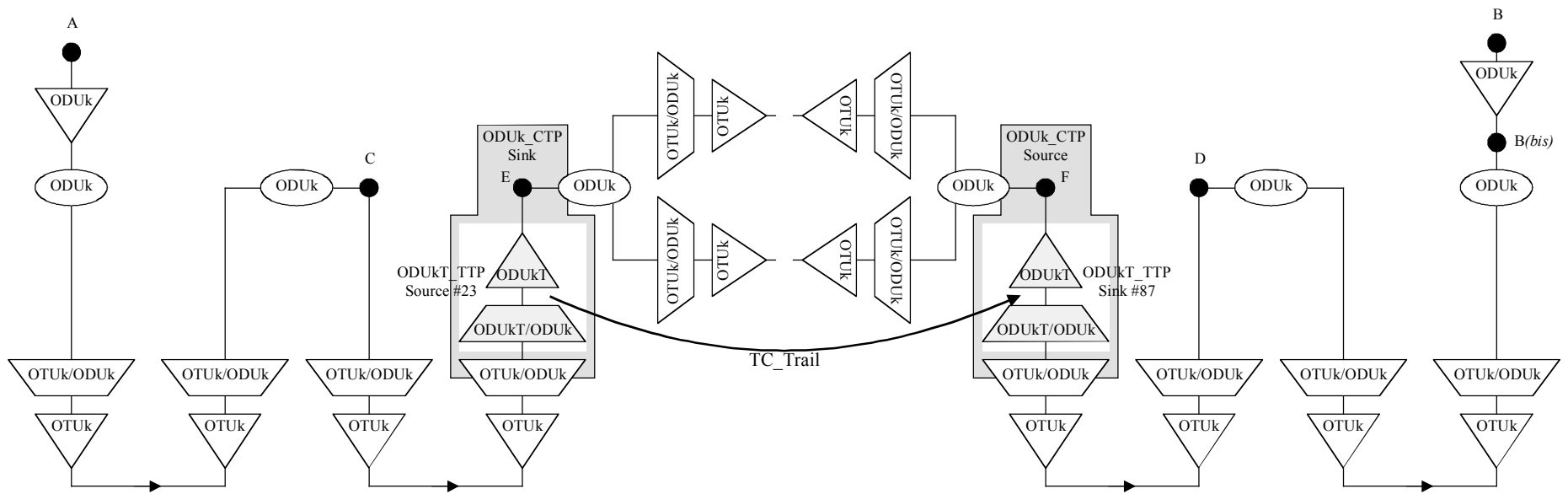
T1550530-02

I.1 TCM locations

I.1.1 TC_Trail between ODUk_CTP Source and ODUk_CTP Sink (Points C and D)

T1550540-02

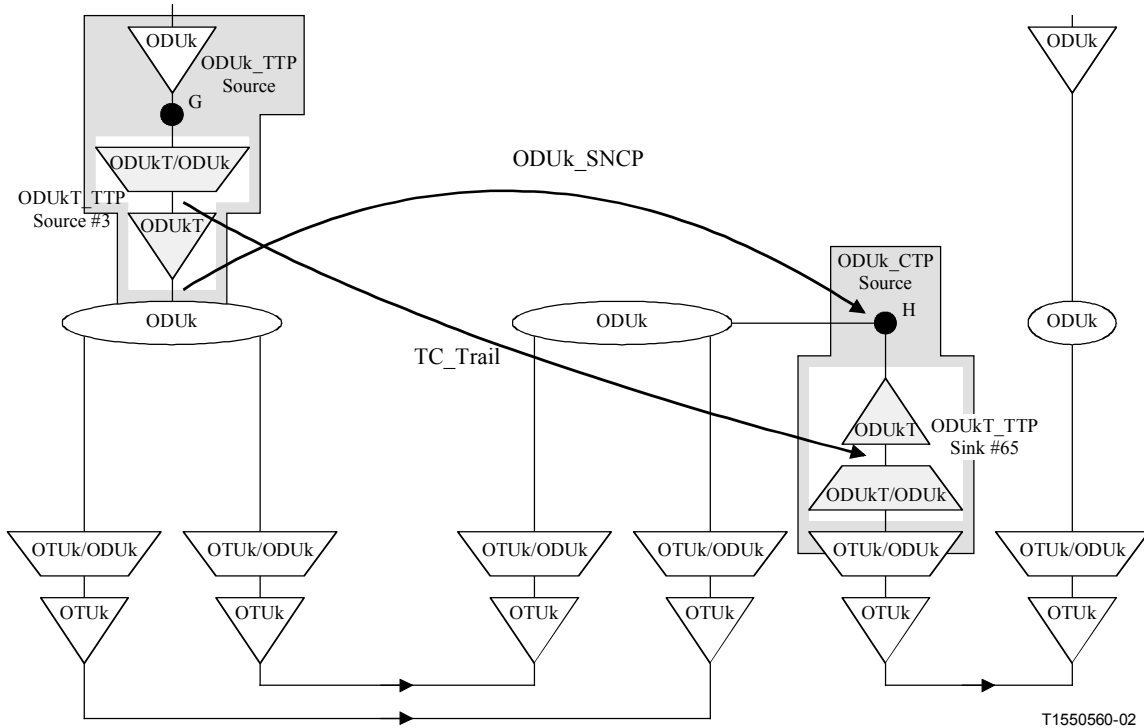| Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_CTP at Point C	ODUkT_TTP #45	ODUkT_TTP #45		source
ODUkT_TTP #45			true	source
ODUk_CTP at Point D	ODUkT_TTP #6	ODUkT_TTP #6		sink
ODUkT_TTP #6			true	sink

I.1.2   TC_Trail between ODUk_CTP Sink and ODUk_CTP Source (Points E and F)
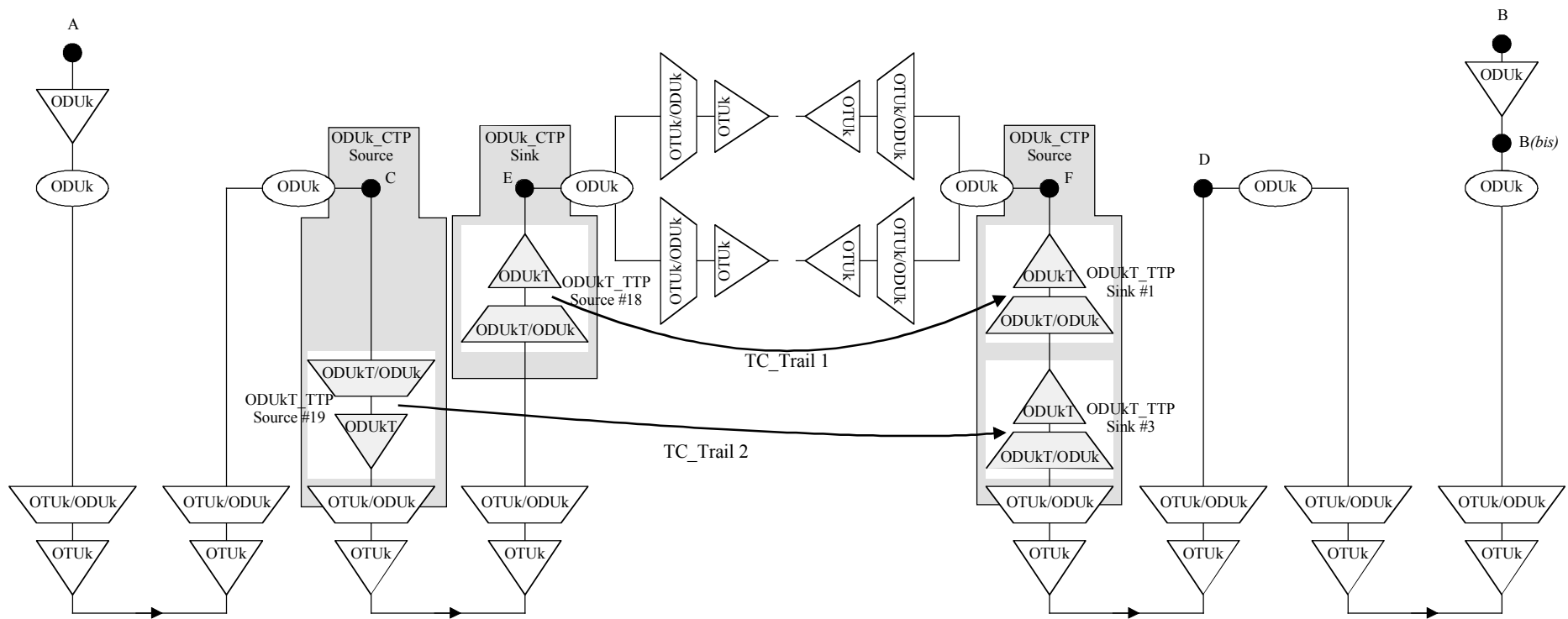

T1550550-02

Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_CTP at Point E	ODUkT_TTP #23	ODUkT_TTP #23		sink
ODUkT_TTP #23			false	source
ODUk_CTP at Point F	ODUkT_TTP #87	ODUkT_TTP #87		source
ODUkT_TTP #87			false	sink

I.1.3   TC_Trail between ODUk_TTP Source and ODUk_CTP Source (Points G and H)

T1550560-02

Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_TTP at Point G	ODUkT_TTP #3	ODUkT_TTP #3		source
ODUkT_TTP #3			meaningless	source
ODUk_CTP at Point H	ODUkT_TTP #65	ODUkT_TTP #65		source
ODUkT_TTP #65			false	sink

I.1.4   Two TC_Trail terminations within one ODUk_CTP

T1550570-02

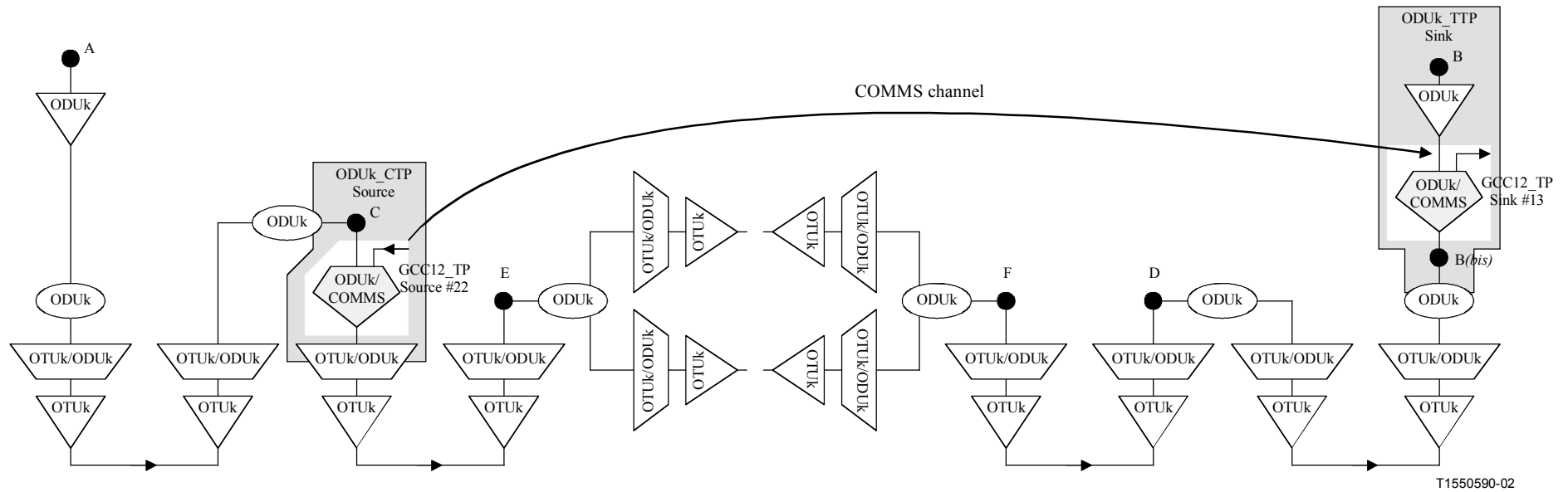| Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_CTP at Point C	ODUkT_TTP #19	ODUkT_TTP #19		source
ODUkT_TTP #19			true	source
ODUk_CTP at Point E	ODUkT_TTP #18	ODUkT_TTP #18		sink
ODUkT_TTP #18			false	source
ODUk_CTP at Point F	ODUkT_TTP #1 ODUkT_TTP #3	ODUkT_TTP #3 ODUkT_TTP #1		source
ODUkT_TTP #1			false	sink
ODUkT_TTP #3			false	sink

I.2 GCC access locations

I.2.1 COMMS channel between two ODUk_TTPs (Points A and B, TT atomic functions are included)
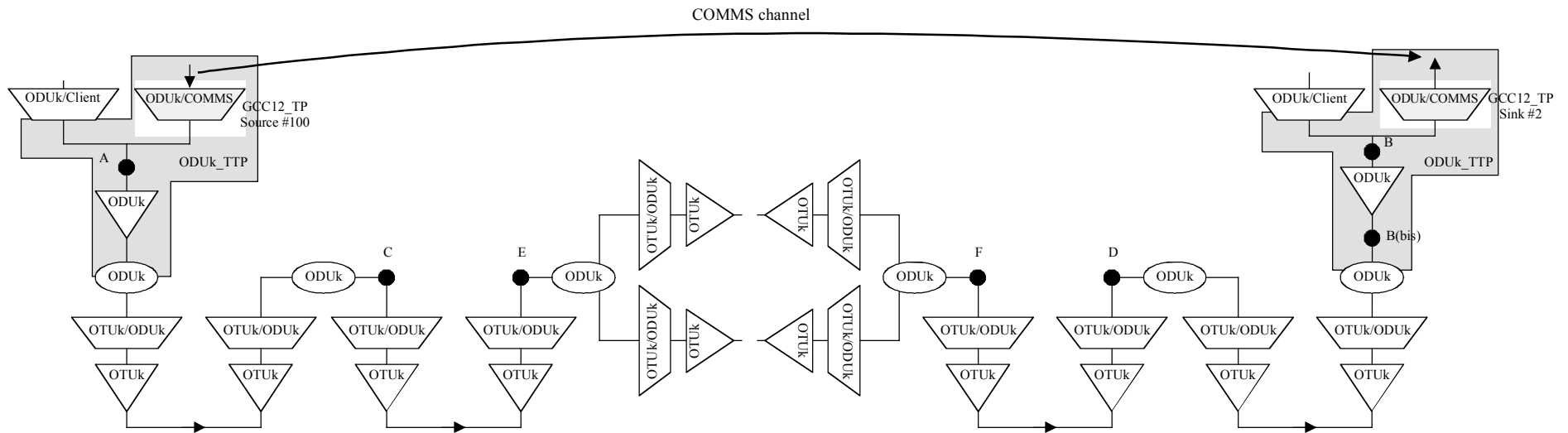
Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_TTP at Point A	GCC12_TP #100	empty		source
GCC12_TP #100			meaningless	source
ODUk_TTP at Point B	GCC12_TP #2	empty		sink
GCC12_TP #2			meaningless	sink

I.2.2 COMMS channel between ODUk_CTP and ODUk_TTP (Points C and B(*bis*) TT atomic function at B(*bis*) is not included)

T1550590-02

Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_CTP at Point C	GCC12_TP #22	GCC12_TP #22		source
GCC12_TP #22			true	source
ODUk_TTP at Point B	GCC12_TP #13	GCC12_TP #13		sink
GCC12_TP #13			meaningless	sink

I.2.3 Several COMMS channels

T1550600-02
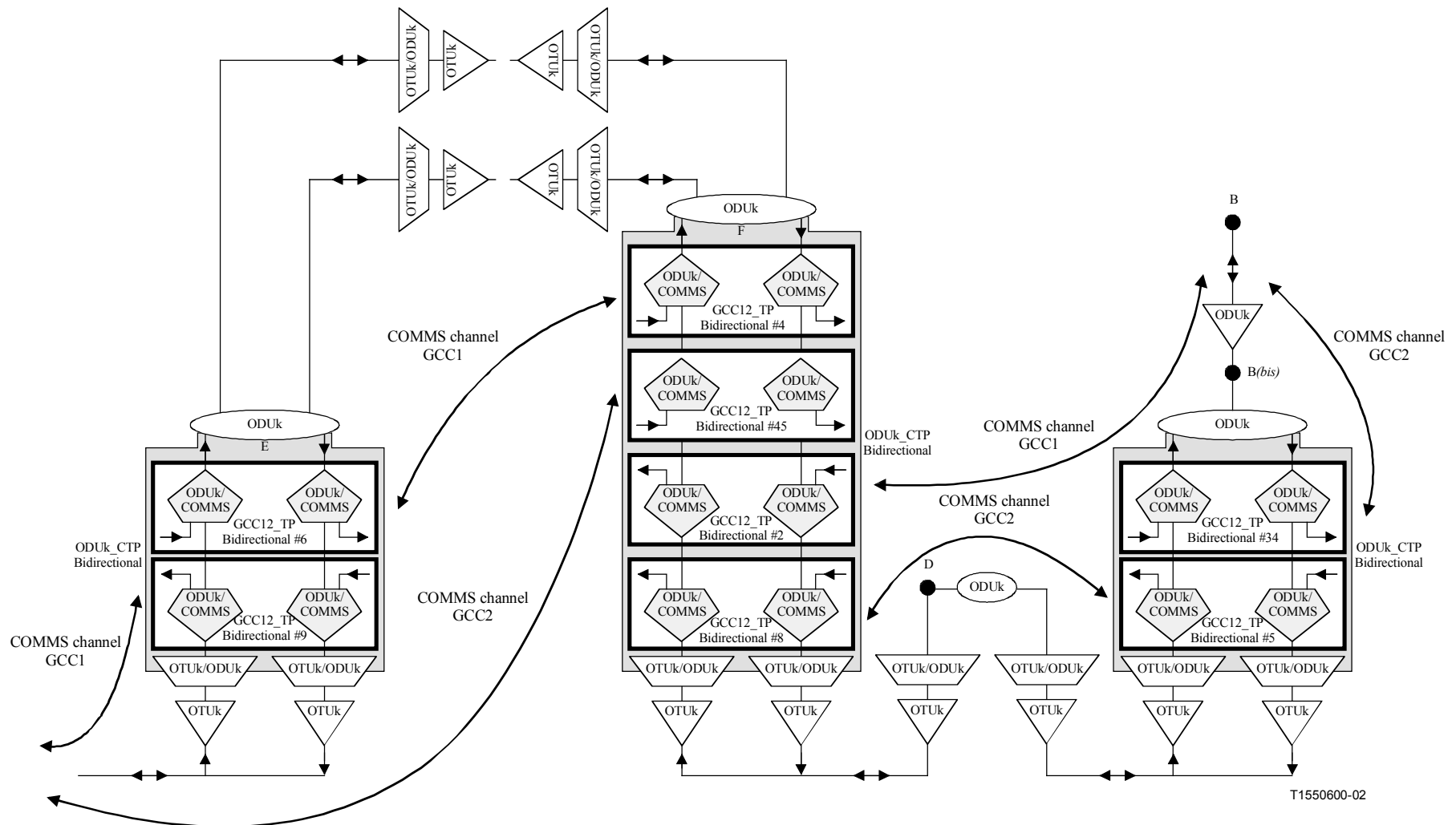
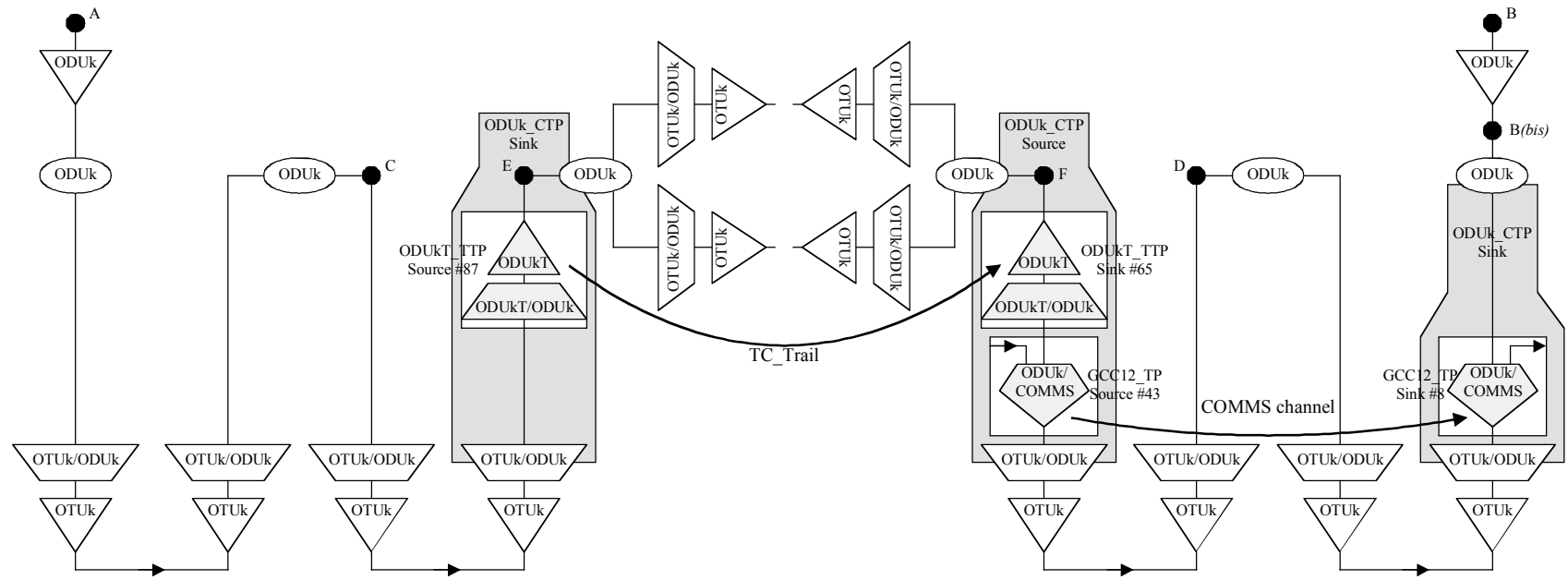| Object	Contains	Position Seq	Codirec-tional	Direc-tionality	GCCAccess
ODUk_CTP at Point E	GCC12_TP #6 GCC12_TP #9	GCC12_TP #9 GCC12_TP #6		bidirectional	
GCC12_TP #6			false	bidirectional	GCC1
GCC12_TP #9			true	bidirectional	GCC1
ODUk_CTP at Point F	GCC12_TP #4 GCC12_TP #45 GCC12_TP #2 GCC12_TP #8	GCC12_TP #8 GCC12_TP #2 GCC12_TP #45 GCC12_TP #4		bidirectional	
GCC12_TP #4			false	bidirectional	GCC1
GCC12_TP #45			false	bidirectional	GCC2
GCC12_TP #2			true	bidirectional	GCC1
GCC12_TP #8			true	bidirectional	GCC2
ODUk_CTP at Point B*(bis)*	GCC12_TP #34 GCC12_TP #5	GCC12_TP #5 GCC12_TP #34		bidirectional	
GCC12_TP #34			false	bidirectional	GCC2
GCC12_TP #5			true	bidirectional	GCC2

I.3 GCC access and TCM locations together

I.3.1 TC_Trail and COMMS channel between ODUk_CTP Source and ODUk_CTP Sink (Points C and D)
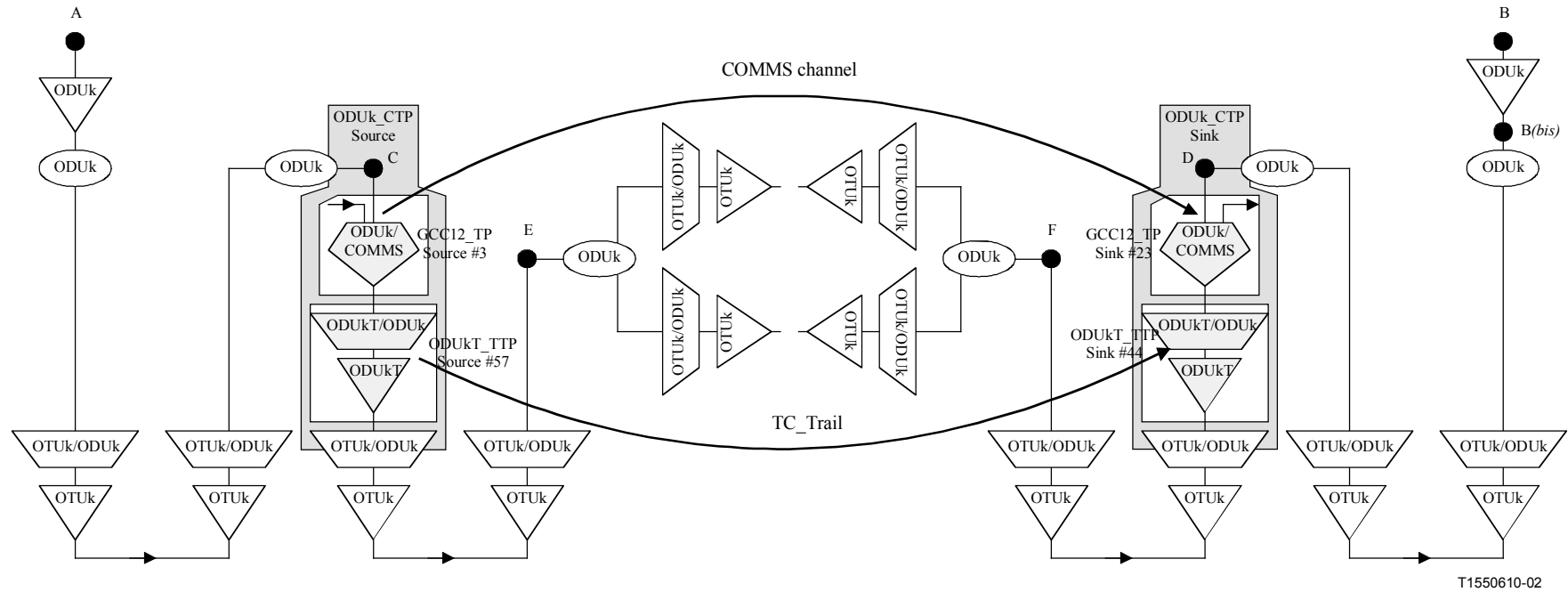
T1550610-02

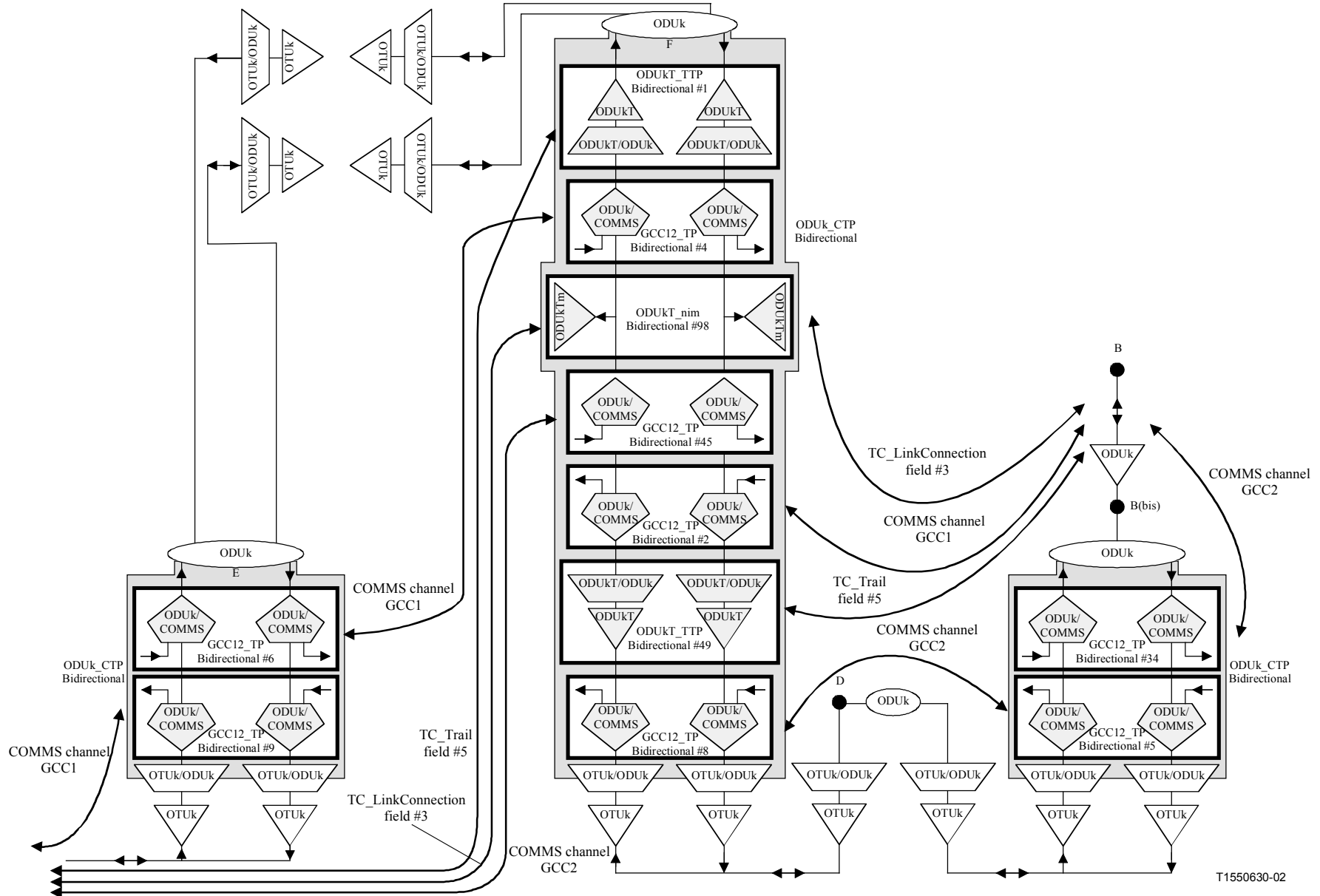| Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_CTP at Point C	GCC12_TP #3 ODUkT_TTP #57	ODUkT_TTP #57 GCC12_TP #3		source
GCC12_TP #3			true	source
ODUkT_TTP #57			true	source
ODUk_CTP at Point D	GCC12_TP #23 ODUkT_TTP #44	ODUkT_TTP #44 GCC12_TP #23		sink
GCC12_TP #23			true	sink
ODUkT_TTP #44			true	sink

I.3.2 Terminating TC_Trail and inserting GCC within one ODUk_CTP

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Object	Contains	PositionSeq	Codirectional	Directionality
ODUk_CTP at Point E	ODUkT_TTP #87	ODUkT_TTP #87		sink
ODUkT_TTP #87			false	source
ODUk_CTP at Point F	ODUkT_TTP #65 GCC12_TP #43	GCC12_TP #43 ODUkT_TTP #65		source
ODUkT_TTP #65			false	sink
GCC12_TP #43			true	source
ODUk_CTP at Point B$_{(bis)}$	GCC12_TP #8	GCC12_TP #8		sink
GCC12_TP #8			true	sink

I.3.3   Bidirectional example with TCM and GCC access

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For increase of readability only the ODUk_CTP at Point F is shown in the table. The other two ODUk_CTPs at E and B(*bis*) are as shown in I.2.3.

Object	Contains	PositionSeq	Codirec-tional	Direc-tionality	GCCAccess/ field
ODUk_CTP at Point F	ODUkT_TTP #1 GCC12_TP #4 ODUkT_nim #98 GCC12_TP #45 GCC12_TP #2 ODUkT_TTP #49 GCC12_TP #8	GCC12_TP #8 ODUkT_TTP #49 GCC12_TP #2 GCC12_TP #45 ODUkT_nim #98 GCC12_TP #4 ODUkT_TTP #1		bidirectional	
ODUkT_TTP #1			false	bidirectional	5
GCC12_TP #4			false	bidirectional	GCC1
ODUkT_nim #98				bidirectional	3
GCC12_TP #45			false	bidirectional	GCC2
GCC12_TP #2			true	bidirectional	GCC1
ODUkT_TTP #49			true	bidirectional	5
GCC12_TP #8			true	bidirectional	GCC2

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