Analysis of Transport North Bound Interface Use Case 1
draft-tnbidt-ccamp-transport-nbi-analysis-uc1-00

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Abstract

This document analyses how YANG models being defined by IETF (TEAS
and CCAMP WG in particular) can be used to support Use Case 1
(single-domain with single-layer) scenarios as referenced later in
this document.

Table of Contents

1. Introduction

This document analyses how YANG models being developed by IETF (TEAS
and CCAMP WG) can be used to support Use Case 1 (single-domain with
single-layer) scenarios as described in [TNBI- UseCases].

1.1. Assumptions

   This document is analyzing how existing models developed by the IETF
   can be used at the MPI between the Transport PNC and the MDSC to
   support the use case 1 scenarios as defined in section 3 of [TNBI-
   UseCases].

   This document assumes the applicability of the YANG models to the
   ACTN interfaces as defined in [ACTN-YANG] and therefore considers the
   TE Topology YANG model defined in [TE-TOPO], with the OTN Topology
   augmentation defined in [OTN-TOPO] and the TE Tunnel YANG model
   defined in [TE-TUNNEL], with the OTN Tunnel augmentation defined in
   [OTN-TUNNEL].

   The analysis of how to use the attributes in the I2RS Topology YANG
   model, defined in [I2RS-TOPO], is for further study.

   Moreover this document is making the following assumptions, still to
   be validated with TEAS WG:

   1. The MDSC can request, at the MPI, the Transport PNC to setup a
      Transit Tunnel Segment using the TE Tunnel YANG model: in this
      case, since the endpoints of the E2E Tunnel are outside the domain
      controlled by the Transport PNC, the MDSC would not specify any
      source or destination TTP (i.e., it would leave the source,
      destination, src-tp-id and dst-tp-id attributes empty) and it
      would use the explicit-route-object list to specify the ingress
      and egress links of the Transit Tunnel Segment.

   2. The Transport PNC provides to the MDSC, at the MPI, the list of
      available timeslots on the access links using the TE Topology YANG
      model and OTN Topology augmentation. The TE Topology YANG model in
      [TE-TOPO] is being updated to report the label set information.

1.2. Feedbacks provided to the IETF Working Groups

   The analysis done in this version of this document has triggered the
   following feedbacks to TEAS WG:

   o On-going discussion about how to use the TE Tunnel YANG model in
      [TE-TUNNEL] to support tunnel segments.

   o Need to change TE Tunnel YANG model in [TE-TUNNEL] to clarify that
      the router-id and interface-id attributes in the unnumbered
      explicit-route-object corresponds to the te-node-id and te-tp-id
      attributes identifying an LTP in the TE Topology YANG model.

o Need to add information about the label set (e.g., list of
   available timeslots) in the TE Topology and TE Tunnel YANG models.

o Some detailed fixes to the TE Tunnel YANG model in [TE-TUNNEL]
   have also been identified during the validation of the JSON
   examples against the TE Tunnel YANG model.

2. Conventions used in this document

This document provides some detailed JSON code examples to describe
how the YANG models being developed by IETF (TEAS and CCAMP WG in
particular) can be used.

The examples are provided using JSON because JSON code is easier for
humans to read and write.

Different objects need to have an identifier. The convention used to
create mnemonic identifiers is to use the object name (e.g., S3 for
node S3), followed by its type (e.g., NODE), separated by an "-",
followed by "-ID". For example the mnemonic identifier for node S3
would be S3-NODE-ID.

JSON language does not support the insertion of comments that have
been instead found to be useful when writing the examples. This
document inserts comments into the JSON code as JSON name/value pair
with the JSON name string starting with the "//" characters. For
example, when describing the example of a TE Topology instance
representing the ODU Abstract Topology exposed by the Transport PNC,
the following comment has been added to the JSON code:

```
"// comment": "ODU Abstract Topology @ MPI",
```

The JSON code examples provided in this document have been validated
against the YANG models following the validation process described in
Appendix A, which would not consider the comments.

In order to have successful validation of the examples, some
numbering scheme has been defined to assign identifiers to the
different entities which would pass the syntax checks. In that case,
to simplify the reading, another JSON name/value pair, formatted as a
comment and using the mnemonic identifiers is also provided. For
example, the identifier of node S3 (S3-NODE-ID) has been assumed to
be "10.0.0.3" and would be shown in the JSON code example using the
two JSON name/value pair:

```
"// te-node-id": "S3-NODE-ID",
```

```
    "te-node-id": "10.0.0.3",
```

The first JSON name/value pair will be automatically removed in the
first step of the validation process while the second JSON name/value
pair will be validate against the YANG model definitions.

3. High-level Overview

Use Case 1 is described in [TNBI-UseCases] as a single-domain with
single layer network scenario supporting different types of services.
This section provides an high-level overview of how IETF YANG models
can be used to support these uses cases at the MPI between the
Transport PNC and the MDSC.

Section 3.1 describes the topology abstraction provided to the MDSC
by the Transport PNC at the MPI.

Section 3.2 describes how the difference services, defined in section
3.3 of [TNBI-UseCases], can be requested to the Transport PNC by the
MDSC at the MPI.

3.1. Topology Abstraction

3.1.1. ODU White Topology Abstraction

In case the Transport PNC exports to the MDSC a white topology, at
the MPI there will be one TE Topology instance for the ODU layer
(called "ODU Topology") containing one TE Node (called "ODU Node")
for each physical node, as shown in Figure 1 below.

```
                 ................................
                 :                              :
                 :    ODU Abstract Topology @ MPI  :
                 :                              :
                 :       +----+        +----+    :
                 :       |    |        |    |    :
                 :       | S1 |--------| S2 |- - - - -(C-R4)
                 :       +----+        +----+    :
                 :        /              |       :
                 :       /               |       :
                 :    +----+   +----+     |       :
                 :    |    |   |    |     |       :
       (C-R1)- - - - -| S3 |---| S4 |     |       :
                 :S3-1+----+   +----+     |       :
                 :       \        \       |       :
                 :        \        \      |       :
                 :       +----+     \     |       :
                 :       |    |      \    |       :
                 :       | S5 |       \   |       :
                 :       +----+        \  |       :
       (C-R2)- - - -     /   \          \ |       :
                 :S6-1 \ /     \          \|       :
                 :    +----+   +----+   +----+    :
                 :    |    |   |    |   |    |    :
                 :    | S6 |---| S7 |---| S8 |- - - - -(C-R5)
                 :    +----+   +----+   +----+    :
                 :      /                         :
       (C-R3)- - - -                              :
                 :S6-2                            :
                 :..............................:
```
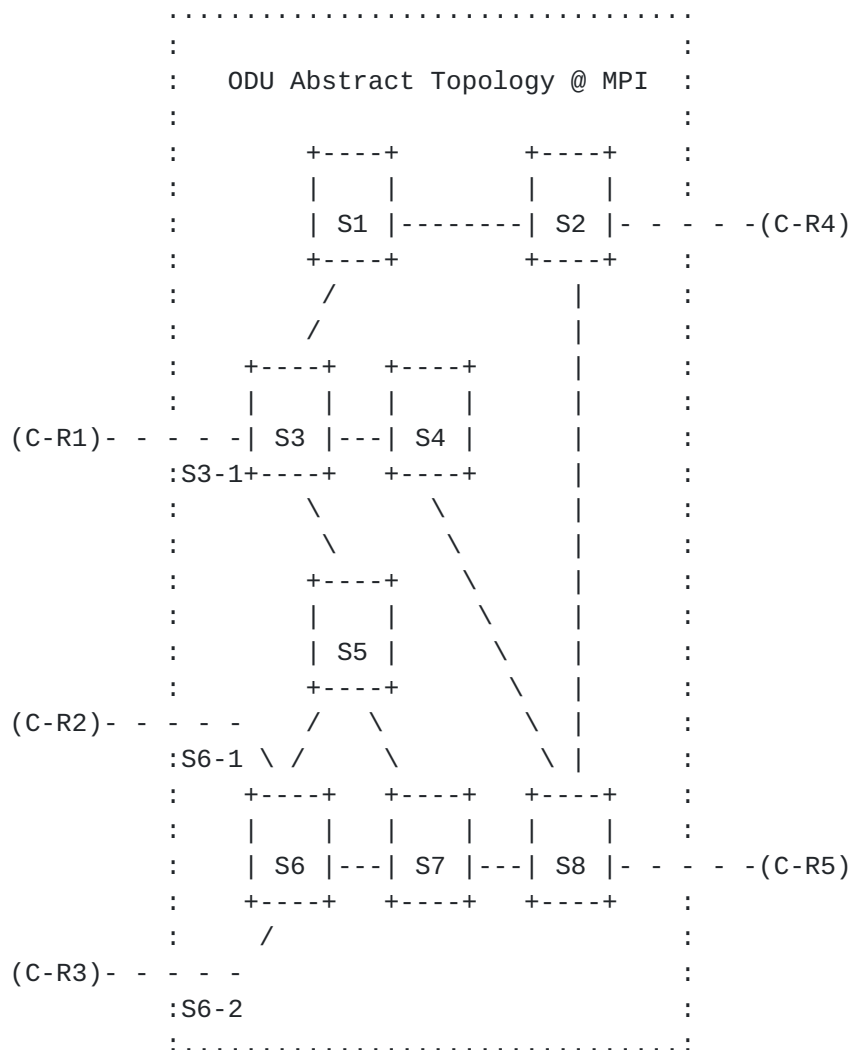
                Figure 1 White Topology Abstraction (ODU Topology)

   The ODU Nodes in Figure 1 are using with the same names as the
   physical nodes to simplify the description of the mapping between the
   ODU Nodes exposed by the Transport PNCs at the MPI and the physical
   nodes in the data plane.

   As described in section 3.2 of [TNBI-UseCases], it is assumed that
   the physical links between the physical nodes are pre-configured up
   to the OTU4 trail using mechanisms which are outside the scope of
   this document. The Transport PNC exports to the MDSC via the MPI, one
   TE Link (called "ODU Link") for each of these physical links.

   Access links in Figure 1 are shown as ODU Links: the modeling of the
   access links for other access technologies is currently an open
   issue.

The "external-domain" container allows the MDSC to glue together the ODU Topology provided by the Transport PNC with the information provided by the IP PNC to know which access link is connected with each link/router in the IP domain (e.g., that C-R1 is connected with the access link terminating on S3-1 LTP in the ODU Topology).

3.2. Service Configuration

3.2.1. ODU Transit Service

In this case, the access links are configured as ODU Link, as described in section 3.1.1 above.

As described in section 3.3.1 of [TNBI-UseCases], the MDSC needs to setup an ODU2 trail, supporting an IP link, between C-R1 and C-R3.

From the topology information described in section 3.1.1 above, the MDSC can know that C-R1 is attached to the access link terminating on S3-1 LTP in the ODU Topology and that C-R3 is attached to the access link terminating on S6-2 LTP in the ODU Topology.

Based on the assumption 1) in section Error! Reference source not found., MDSC would then request Transport PNC to setup an ODU2 (Transit Segment) Tunnel between S3-1 and S6-2 LTPs:

o   Source and Destination TTP are not specified (since it is a Transit Tunnel)

o   Ingress and egress points are indicated in the explicit-route-objects of the primary path:

   o The first element of the explicit-route-objects references the access link terminating on S3-1 LTP

   o Last element of the explicit-route-objects references the access link terminating on S6-2 LTP

The configuration of the timeslots used by the ODU2 connection within the transport network domain (i.e., on the internal links) is a matter of the Transport PNC and its interactions with the physical network elements and therefore is outside the scope of this document.

However, the configuration of the timeslots used by the ODU2 connection at the edge of the transport network domain (i.e., on the access links) needs to take into account not only the timeslots available on the physical nodes at the edge of the transport network domain (e.g., S3 and S6) but also on the devices, outside of the

transport network domain, connected through these access links (e.g., C-R1 and C-R3).

Based on the assumption 2) in section Error! Reference source not found., MDSC, when requesting the Transport PNC to setup the (Transit Segment) ODU2 Tunnel, it would also configure the timeslots to be used on the access links. The MDSC can known the timeslots which are available on the edge OTN Node (e.g., S3 and S6) from the OTN Topology information exposed by the Transport PNC at the MPI as well as the timeslots which are available on the devices, outside of the transport network domain, connected through these access links (e.g., C-R1 and C-R3) by means which are outside the scope of this document.

The Transport PNC performs path computation and sets up the ODU2 cross-connections within the physical nodes S3, S5 and S6, as shown in section 4.3.1 of [TNBI-UseCases].

The Transport PNC reports the status of the created ODU2 (Transit Segment) Tunnel and its path within the ODU Topology as shown in Figure 2 below:

```
              ................................
              :                              :
              :    ODU Abstract Topology @ MPI  :
              :                              :
              :      +----+        +----+    :
              :      |    |        |    |    :
              :      | S1 |--------| S2 |- - - - -(C-R4)
              :      +----+        +----+    :
              :       /               |      :
              :      /                |      :
              :   +----+   +----+     |      :
              :   |    |   |    |     |      :
  (C-R1)- - - - - S3 |---| S4 |     |      :
        :S3-1 <<== +  +----+      |      :
        :        =          \       |      :
        :       = \          \      |      :
        :      == ---+        \     |      :
        :       =    |         \    |      :
        :      = S5 |          \   |      :
        :      == --+           \  |      :
  (C-R2)- - - -      =  \          \ |      :
        :S6-1 \ / =    \           \ |      :
        :   +--- =   +----+    +----+    :
        :   |    =   |    |    |    |    :
        :   | S6 = --| S7 |---| S8 |- - - - -(C-R5)
        :   +--- =   +----+    +----+    :
        :     /    =                    :
  (C-R3)- - - - - <<===                 :
        :S6-2                           :
        :..............................:
```
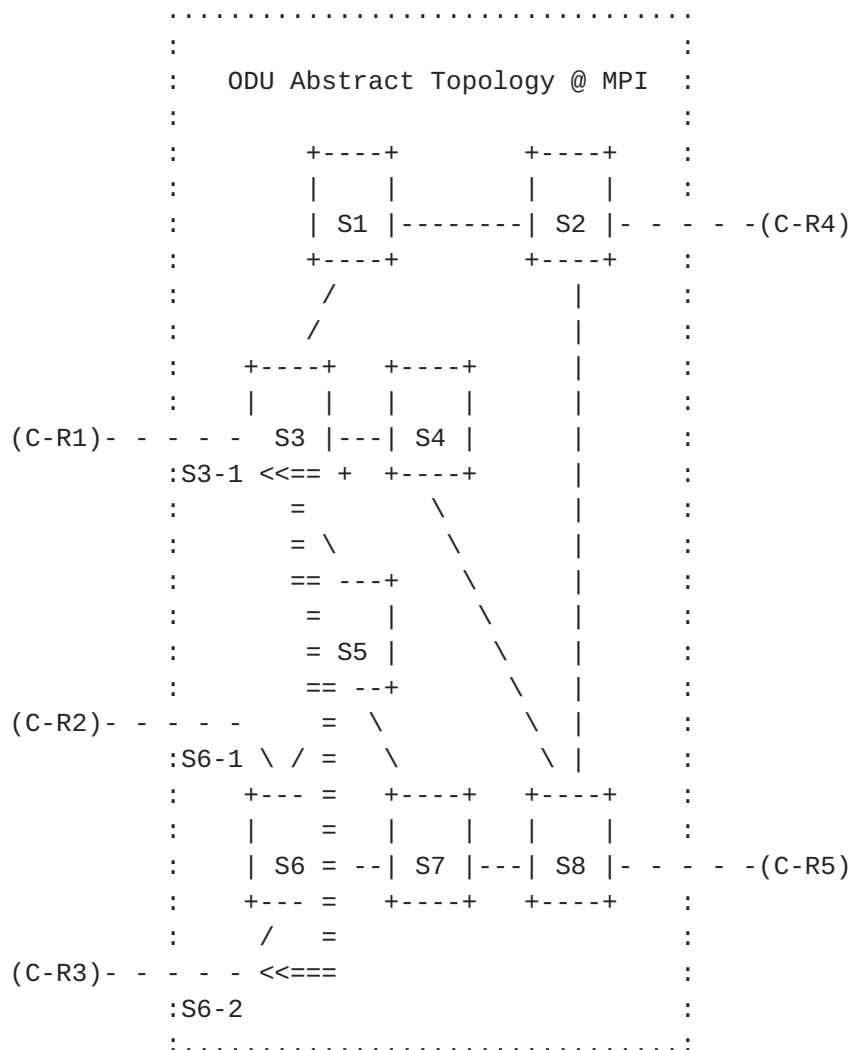
                 Figure 2 ODU2 Transit Tunnel

3.2.2. OTN Client Private Line Service

   To be added

3.2.3. EPL over ODU Service

   To be added

4. **Topology Abstraction: detailed JSON examples**

4.1. **ODU White Topology Abstraction**

   Section 3.1.1 describes how the Transport PNC can provide a white
   topology abstraction to the MDSC via the MPI. Figure 1 is an example
   of such ODU Topology.

   This section provides the detailed JSON code describing this ODU
   Topology, using the [TE-TOPO] and [OTN-TOPO] YANG models.

   Note that this example is based on -09 version of [TE-TOPO] and on
   the -00 version of [OTN-TOPO]. Further changes to align with latest
   updates of these YANG models will be provided in the future version
   of this document.

   JSON code "use-case-1-topology-01.json" has been provided at in the
   appendix of this document.

5. **Service Configuration: detailed JSON examples**

5.1. **ODU Transit Service**

   Section 3.2.1 describes how the MDSC can request a Transport PNC, via
   the MPI, to setup an ODU2 transit service over an ODU Topology
   described in section 3.1.1.

   This section provides the detailed JSON code describing this ODU
   Topology, using the [TE-TUNNEL] and [OTN-TUNNEL] YANG models.

   Note that this example is based on -06 version of [TE-TUNNEL] and on
   the -02 version of [OTN-TUNNEL]. Further changes to align with latest
   updates of these YANG models will be provided in the future version
   of this document.

   JSON code "use-case-1-odu2-service-01.json" has been provided at in
   the appendix of this document.

6. **Security Considerations**

   This section is for further study

7. **IANA Considerations**

   This document requires no IANA actions.

8. Conclusions

This section is for further study

9. References

9.1. Normative References

[TNBI-UseCases]   Busi, I., King, D. et al, "Transport Northbound
          Interface Use Cases", draft-tnbidt-ccamp-transport-nbi-use-
          cases, work in progress.

[TE-TOPO] Liu, X. et al., "YANG Data Model for TE Topologies", draft-
          ietf-teas-yang-te-topo, work in progress.

[OTN-TOPO] Zheng, H. et al., "A YANG Data Model for Optical Transport
          Network Topology", draft-ietf-ccamp-otn-topo-yang, work in
          progress.

[TE-TUNNEL] Saad, T. et al., "A YANG Data Model for Traffic
          Engineering Tunnels and Interfaces", draft-ietf-teas-yang-
          te, work in progress.

[OTN-TUNNEL]   Zheng, H. et al., "OTN Tunnel YANG Model", draft-
          sharma-ccamp-otn-tunnel-model, work in progress.

9.2. Informative References

[ACTN-YANG] Zhang, X. et al., "Applicability of YANG models for
          Abstraction and Control of Traffic Engineered Networks",
          draft-zhang-teas-actn-yang, work in progress.

[I2RS-TOPO] Clemm, A. et al., "A Data Model for Network Topologies",
          draft-ietf-i2rs-yang-network-topo, work in progress.

10. Acknowledgments

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Appendix A.   **Validating a JSON fragment against a YANG Model**

   The objective is to have a tool that allows validating whether a
   piece of JSON code is compliant with a YANG model without using a
   client/server.

A.1. **DSDL-based approach**

   The idea is to generate a JSON driver file (JTOX) from YANG, then use
   it to translate JSON to XML and validate it against the DSDL schemas,
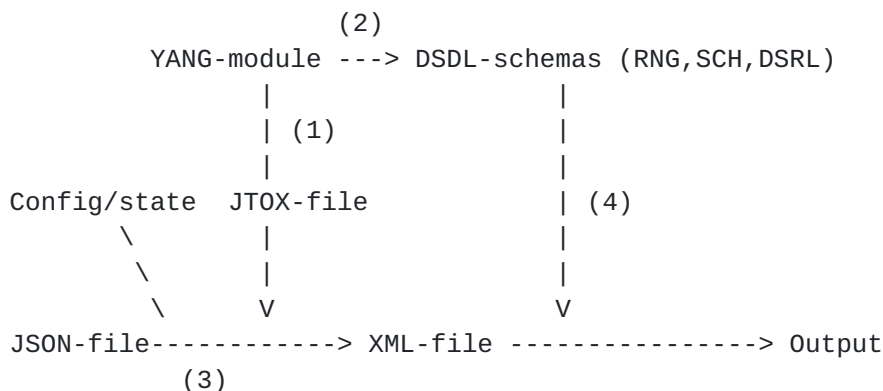   as shown in Figure 3.

   Useful link: https://github.com/mbj4668/pyang/wiki/XmlJson

```
                      (2)
            YANG-module ---> DSDL-schemas (RNG,SCH,DSRL)
                 |                    |
                 | (1)                |
                 |                    |
   Config/state  JTOX-file            | (4)
         \        |                    |
          \       |                    |
           \      V                    V
   JSON-file------------> XML-file ----------------> Output
            (3)
```

         Figure 3 - DSDL-based approach for JSON code validation

   In order to allow the use of comments following the convention
   defined in section 0 without impacting the validation process, these
   comments will be automatically removed from the JSON-file that will
   be validate.

A.2. **Why not using a XSD-based approach**

   This approach has been analyzed and discarded because no longer
   supported by pyang.

   The idea is to convert YANG to XSD, JSON to XML and validate it
   against the XSD, as shown in Figure 4:

```
                (1)
       YANG-module ---> XSD-schema - \       (3)
                                      +--> Validation
       JSON-file------> XML-file ----/
                (2)
```
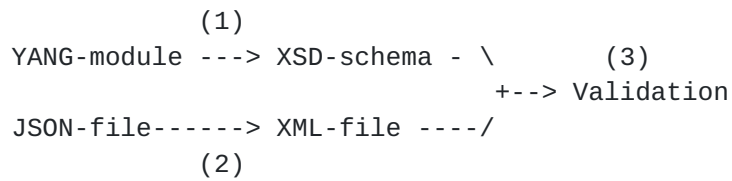
          Figure 4 - XSD-based approach for JSON code validation

   The pyang support for the XSD output format was deprecated in 1.5 and
   removed in 1.7.1. However pyang 1.7.1 is necessary to work with YANG
   1.1 so the process shown in Figure 4 will stop just at step (1).

A.3. JSON Code: use-case-1-topology-01.json

   The JSON code for this use case is currently located on GitHub at:

   https://github.com/danielkinguk/transport-nbi/blob/master/Internet
   -Drafts/Use-Case-1-Analysis/use-case-1-topology-01.json

A.4. JSON Code: use-case-1-odu2-service-01.json

   The JSON code for this use case is currently located on GitHub at:

   https://github.com/danielkinguk/transport-nbi/blob/master/Internet
   -Drafts/Use-Case-1-Analysis/use-case-1-odu2-service-01.json

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