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Network Topology data retrieval using ALTO protocol draft-hzx-alto-network-topo-00

Abstract

RFC8345 introduces an abstract YANG data model to represent network topologies. This document uses ALTO protocol to provide access to network Topology data such as L3 topology data , data center network topology data, flexible enough to enable querying of specific and possibly aggregated data.

Status of This Memo

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1. Introduction

This document uses ALTO protocol to provide access to network Topology data such as L3 topology data , Data Center Network Topology data, flexible enough to enable querying of specific and possibly aggregated data. In addition, this document introduces a topology data translation mechanism which allow translation of structure of network topology data modeled in YANG to ALTO data format, which can be seen as a typical example of functional model of reference architecture of Digital Twin Network defined in [I-D.zhou-nmrg-digitaltwin-network-concepts].

The concept of digital twin was proposed by Grieves in [Grieves2014]. It is defined as a virtual representation that serves as the real-time digital counterpart of a physical entity and reflects the whole life-cycle device management. A digital twin network graph is designed by digital twin platform and formulated by applying digital twin techniques to physical networks: it creates a virtual image of a physical network by using network data model technology. The data model defined in [RFC8345] can be seen as basic model defined in [I-D.zhou-nmrg-digitaltwin-network-concepts] and is divided into two parts: The first part of the data model defines a network data model

that enables the definition of network hierarchies, or network stacks (i.e., networks that are layered on top of each other) and maintenance of an inventory of nodes contained in a network. The second part of the data model augments the basic network data model with information to describe topology information. Specifically, it adds the concepts of "links" and "termination points" to describe how nodes in a network are connected to each other. Moreover, the data model introduces vertical layering relationships between networks that can be augmented to cover both network inventories and network/ service topologies. Note that functional model is a derived model from basic models defined in [I-D.zhou-nmrg-digitaltwin-network-concepts] and can be used to provide network analysis, simulation, diagnosis, prediction, assurance, etc.

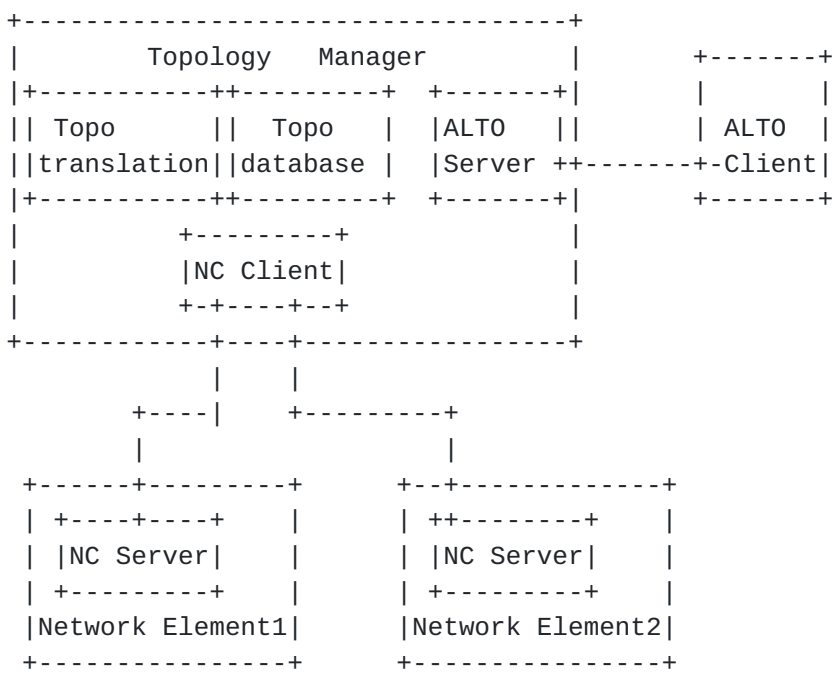
2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119][RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Solution Overview

This document addresses how to retrieve potentially aggregated network topology data from topology manager using ALTO protocol for a certain network,e.g., Data Fabric network, layer 3 network, layer 2 network. These network topology data are collected by NETCONF client using NETCONF protocol [RFC6241] and Layer 3 topology YANG data model [RFC8345], Layer 2 topology YANG data model [RFC8944], data fabric topology YANG data model [RFC8542] and stored in the topo database within the Topolgy manager. The Topology manager is comprised of four components: NETCONF client, Topology database, Topology data translation and ALTO server.

The topology data translation component is used to translate structure of Topology data modeled in YANG into ALTO data object format. ALTO server provides a query interface for topology data retrieval. NETCONF client retrieves the network topology related data or network element related data from each Network Elements using NETCONF protocols or via other telemetry interface. And the Topology database is fed by the NETCONF client with its retrieved data, as shown in below figure.



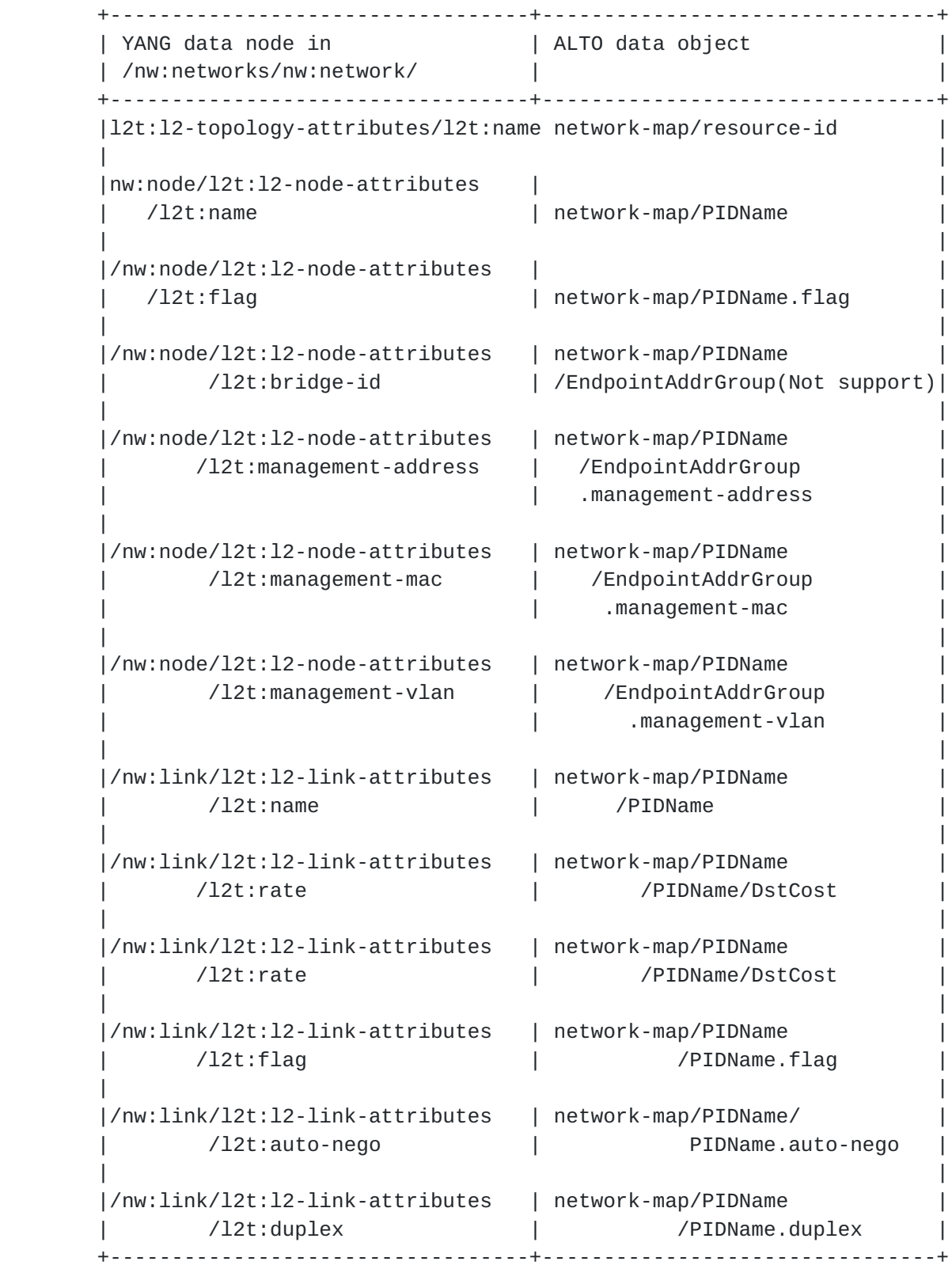
4. Translation of Structure of L3 Topo data to ALTO data format

The following table lists the ALTO data objects with corresponding objects in the L3 Topo YANG data model [RFC8345]. Note that the network topology data described in L3 Topo YANG data model represents aggregated topology information,i.e., overlay network topology information.

YANG data node in /nw:networks/nw:network/	ALTO data object
l3t:l3-topology-attributes/l3t:name	network-map/resource-id
nw:node/l3t:l3-node-attributes /l3t:name	network-map/PIDName
/nw:node/l3t:l3-node-attributes /l3t:flag	network-map/PIDName.flag
/nw:node/l3t:l3-node-attributes /l3t:router-id	network-map/PIDName /EndpointAddrGroup
/nw:node/l3t:l3-node-attributes /l3t:prefix/l3t:prefix	network-map/PIDName /EndpointAddrGroup
/nw:node/l3t:l3-node-attributes /l3t:prefix/l3t:metric	network-map/PIDName /EndpointAddrGroup.metric
/nw:node/l3t:l3-node-attributes /l3t:prefix/l3t:flag	network-map/PIDName /EndpointAddrGroup.flag
/nw:link/l3t:l3-link-attributes /l3t:name	network-map/PIDName /PIDName
/nw:link/l3t:l3-link-attributes /l3t:metric1	network-map/PIDName /PIDName/DstCost
/nw:link/l3t:l3-link-attributes /l3t:metric2	network-map/PIDName /PIDName/DstCost
/nw:link/l3t:l3-link-attributes /l3t:flag	network-map/PIDName /PIDName.flag

5. Translation of Structure of L2 Topo data to ALTO data format

The following table lists the ALTO data objects with corresponding objects in the L2 Topo YANG data model [RFC8944]. Note that the network topology data described in L2 Topo YANG data model represents aggregated topology information,i.e., overlay network topology information.


YANG data node in /nw:networks/nw:network/	ALTO data object
l2t:l2-topology-attributes/l2t:name	network-map/resource-id
nw:node/l2t:l2-node-attributes /l2t:name	network-map/PIDName
/nw:node/l2t:l2-node-attributes /l2t:flag	network-map/PIDName.flag
/nw:node/l2t:l2-node-attributes /l2t:bridge-id	network-map/PIDName /EndpointAddrGroup(Not support)
/nw:node/l2t:l2-node-attributes /l2t:management-address	network-map/PIDName /EndpointAddrGroup .management-address
/nw:node/l2t:l2-node-attributes /l2t:management-mac	network-map/PIDName /EndpointAddrGroup .management-mac
/nw:node/l2t:l2-node-attributes /l2t:management-vlan	network-map/PIDName /EndpointAddrGroup .management-vlan
/nw:link/l2t:l2-link-attributes /l2t:name	network-map/PIDName /PIDName
/nw:link/l2t:l2-link-attributes /l2t:rate	network-map/PIDName /PIDName/DstCost
/nw:link/l2t:l2-link-attributes /l2t:rate	network-map/PIDName /PIDName/DstCost
/nw:link/l2t:l2-link-attributes /l2t:flag	network-map/PIDName /PIDName.flag
/nw:link/l2t:l2-link-attributes /l2t:auto-nego	network-map/PIDName/ PIDName.auto-nego
/nw:link/l2t:l2-link-attributes /l2t:duplex	network-map/PIDName /PIDName.duplex

6. Translation of Structure of Data Fabric Topo data to ALTO data format

The following table lists the ALTO data objects with corresponding objects in the Data Fabric Topo YANG data model [RFC8542]. Note that the network topology data described in Data Fabric Topo YANG data model represents aggregated topology information,i.e., overlay network topology information.

YANG data node in /nw:networks/nw:network/	ALTO data object
/nw:node/fabric:fabric-attributes /fabric:name	network-map/PIDName
/nw:node/fabric:fabric-attributes /fabric:type	network-map/PIDName.type
/nw:node/fabric:fabric-attributes /fabric:fabric-id	network-map/PIDName.fabric-id
/nw:node/fabric:fabric-attributes /fabric:description	network-map/PIDName.description
/nw:node/fabric:fabric-attributes /fabric:options/fabric:gateway-mode	network-map/PIDName.options .gateway-mode
/nw:node/fabric:fabric-attributes /fabric:options/fabric: traffic-behavior	network-map/PIDName.options .traffic-behavior
/nw:node/fabric:fabric-attributes /fabric:options/fabric: capability-support	network-map/PIDName.options .capability-support
/nw:node/fabric:fabric-attributes /fabric:device-nodes/fabric: device-ref	network-map/PIDName.device-nodes .device-ref
/nw:node/fabric:fabric-attributes /fabric:device-nodes /fabric:role	network-map/PIDName.device-nodes .role
/nw:node/fabric:fabric-attributes /fabric:device-links /fabric:link-ref	network-map/PIDName.device-links .link-ref

/nw:node/fabric:fabric-attributes /fabric:device-ports /fabric:port-ref	network-map/PIDName.device-ports .port-ref
/nw:node/fabric:fabric-attributes /fabric:device-ports /fabric:port-type	network-map/PIDName.device-ports .port-type
/nw:node/fabric:fabric-attributes /fabric:device-ports /fabric:bandwidth	network-map/PIDName.device-ports .bandwidth

7. Translation of Structure of VPN Performance Monitoring Data to ALTO data format

The following table lists the ALTO data objects with corresponding objects in the VPN performance monitoring YANG data model [I-D.ietf-opsawg-yang-vpn-service-pm]. Note that the network topology data described in VPN performance monitoring model represents aggregated topology information,i.e., overlay network topology information.When VPN performance data gets changed, the translation function defined in this document should be triggered to fetch the updated network topology data and translate them into ALTO map data. This can be realized by using I2RS Pub/Sub Retrieval.

YANG data node in /nw:networks/nw:network/nw:link	ALTO data object
/nvp:link-telemetry/attributes /nvp:loss-statistics /nvp:packet-loss-count	network-map/PIDName /PIDName/DstCost
/nvp:link-telemetry/attributes /nvp:loss-statistics /nvp:packet-reorder-count	network-map/PIDName /PIDName/DstCost
/nvp:link-telemetry/attributes /nvp:loss-statistics /nvp:packet-out-of-seq-count	network-map/PIDName /PIDName/DstCost
/nvp:link-telemetry/attributes /nvp:loss-statistics /nvp:packet-dup-count	network-map/PIDName /PIDName/DstCost
/nvp:link-telemetry/attributes /nvp:loss-statistics	network-map/PIDName /PIDName/DstCost

/nvp:loss-ratio	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:direction	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:unit-value	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:min-delay-value	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:max-delay-value	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:low-delay-percentile	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:middle-delay-percentile	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:delay-statistics	/PIDName/DstCost
/nvp:high-delay-percentile	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:jitter-statistics	/PIDName/DstCost
/nvp:unit-value	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:jitter-statistics	/PIDName/DstCost
/nvp:min-jitter-value	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:jitter-statistics	/PIDName/DstCost
/nvp:max-jitter-value	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:jitter-statistics	/PIDName/DstCost
/nvp:low-jitter-percentile	
/nvp:link-telemetry/attributes	network-map/PIDName
/nvp:jitter-statistics	/PIDName/DstCost

```
|/nvp:middle-jitter-percentile     |                                |
|                                  |                                |
|/nvp:link-telemetry/attributes    | network-map/PIDName            |
|/nvp:jitter-statistics            |      /PIDName/DstCost          |
|/nvp:high-jitter-percentile       |                                |
+----------------------------------+--------------------------------+
```

8. Proposed ALTO protocol extension

ALTO is designed on two abstractions that are useful here. First is the abstraction of the physical network topology into an aggregated but logical topology. The second abstraction that is useful for LMAP (Large Scale Measurement of Broadband Performance) [RFC7594] is the notion of a "cost map".

To support network topology data exposure using ALTO protocol, two ALTO protocol extensions are required:

- Additional address types such as MAC address, VLAN ID need to be defined to represent layer 2 endpoint address.

- Additional entity property type such as termination points needs to be introduced to express how two endpoints or network element are connected to each other.

In addition, path vector needs to be investigated to see how a set of service flows are steered in the different network path.

9. Security Considerations

TBD

10. Acknowledgements

TBD

11. IANA Considerations

TBD

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