Yang Data Model for OAM of ALTO protocol

draft-zhang-alto-oam-yang

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Main Goal

Defines a YANG data model for the operations and management of ALTO Protocol.

References: RFC7285 (Sec 16), RFC7971.

Latest version: https://datatracker.ietf.org/doc/html/draft-zhang-alto-oam-yang

Editor's copy:
https://openalto.github.io/draft-alto-oam-yang/draft-zhang-alto-oam-yang.html

Requirements

A table of basic requirements considered in current version

Requirement	Reference
Support configuration for ALTO server setup	Sec 16.1 of RFC7285
Define management information model	Sec 16.2.2 of RFC7285
Support configuration for data sources	Sec 16.2.4 of RFC7285
Support configuration for information resource generation algorithms	Sec 16.2.4 of RFC7285
Support configuration for access control at information resource level	Sec 16.2.4 of RFC7285
Support performance monitoring for ALTO-specific metrics	Sec 16.2.5 of RFC7285
Support configuration for security policy management	Sec 16.2.6 of RFC7285

Scope of ALTO OAM Data Model

- What is in the scope?
  - Data model for ALTO client/server operation and management
  - Data model for functionality/capability configuration for ALTO services
  - Data model for performance monitoring for operation purpose
- What is not in the scope?
  - Not define any data model related to specific implementation, including:
    - Data structures for how to store/deliver ALTO information resources (e.g., network map, cost map, property map)
    - Specific algorithms for ALTO information resource generation
    - Data structures for how to store information collected from data sources

Objectives

- The data model should support configuration for ALTO server setup (e.g., caching policy at information resource level, metadata for server discovery).
- The data model should provide configurable data model for administrators to create, update and remove ALTO information resources.
  - The data model should support different types of data source provisioning.
  - The data model should allow developers to augment new APIs for ALTO information resource generation algorithms.
  - The data model should be extensible for new ALTO information resources.
- The data model should collect statistics information of the requests/responses for each ALTO information resource.
- The data model should support security policy configuration at the information resource level.

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Current Progress

ALTO Information Resource Creation

```
module: ietf-alto
  +--rw alto-server
    ...
    +--rw resource* [resource-id]
      +--rw resource-id      resource-id
      +--rw resource-type    identityref
      +--rw description?     string
      +--rw accepted-group* [user-group]
      +--rw dependency*      resource-id
      +--rw auth
      |   +--rw (auth-type-selection)
      |       +--:(auth-key-chain)
      |       +--:(auth-key)
      |       +--:(auth-tls)
      |   ...
      +--rw (resource-params)
        +--:(ird)
        |   +--rw alto-ird-params
        |       +--rw delegation              inet:uri
        +--:(networkmap)
        |   +--rw alto-networkmap-params
        |       +--rw is-default?         boolean
        |       +--rw filtered?           boolean
        |       +--rw (algorithm)
```

Common Parameter

Resource-Specific Parameter

Creation Algorithm

```
augment /alto:alto-server/alto:resource/alto:resource-params
            /alto:networkmap/alto:alto-networkmap-params
            /alto:algorithm:
  +--rw l3-unicast-cluster-algorithm
      +--rw l3-unicast-topo
      |       -> /alto:alto-server/data-source/source-id
      +--rw depth?     uint32
```

```
module: ietf-alto
  +--rw alto-server
    ...
    +--rw data-source* [source-id]
      +--rw source-id    string
      +--rw source-type identityref
      +--rw (update-policy)
      |   +--:(reactive)
      |   |   +--rw reactive        boolean
      |   +--:(proactive)
      |       +--rw poll-interval   uint32
      +--rw (source-params)
        +--:(yang-datastore)
        |   +--rw yang-datastore-source-params
        |       +--rw source-path   yang:xpath1.0
        +--:(prometheus)
            +--rw prometheus-source-params
                +--rw source-uri    inet:uri
                +--rw query-data?   string
```
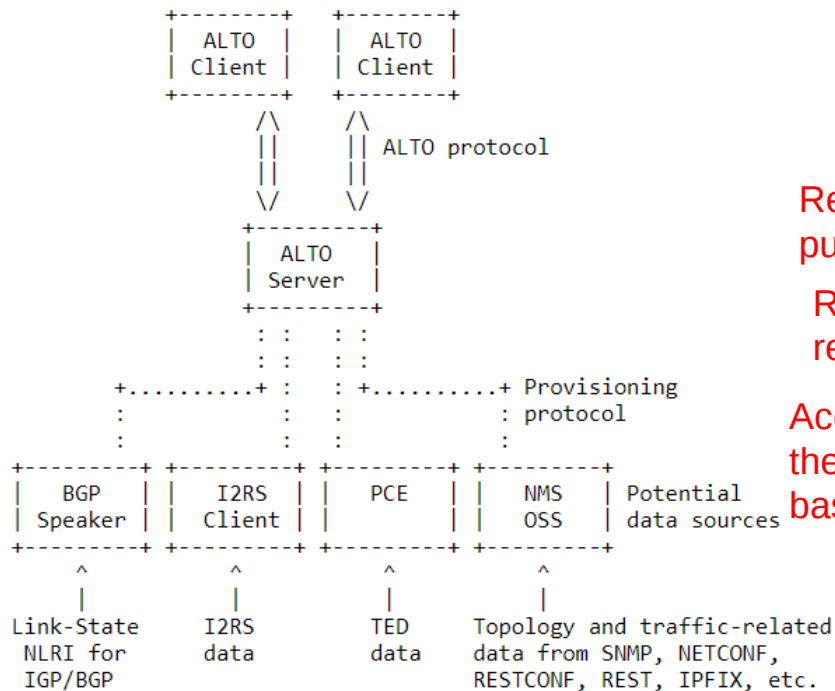
Data Source

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Data Source


```
+--------+   +--------+
| ALTO   |   | ALTO   |
| Client |   | Client |
+--------+   +--------+
    /\          /\
    ||          ||  ALTO protocol
    ||          ||
    \/          \/
  +-----------+
  |   ALTO    |
  |  Server   |
  +-----------+
    : :    : :
    : :    : :
    : :    : :
+.........+ :   : +.........+ Provisioning
:         :   :   :         : protocol
:         :   :   :
:         :   :   :
+---------+ +---------+ +---------+ +---------+
|  BGP    | | I2RS    | |  PCE    | |  NMS    | Potential
| Speaker | | Client  | |         | |  OSS    | data sources
+---------+ +---------+ +---------+ +---------+
     ^           ^          ^           ^
     |           |          |           |
Link-State    I2RS        TED      Topology and traffic-related
NLRI for      data        data     data from SNMP, NETCONF,
IGP/BGP                            RESTCONF, REST, IPFIX, etc.
```

Figure 8: Potential Data Sources for ALTO

```
module: ietf-alto
  +--rw alto-server
     ...
     +--rw data-source* [source-id]
        +--rw source-id    string
        +--rw source-type identityref
        +--rw (update-policy)
        |  +--:(reactive)
        |  |  +--rw reactive          boolean
        |  +--:(proactive)
        |     +--rw poll-interval     uint32
        +--rw (source-params)
           +--:(yang-datastore)
           |  +--rw yang-datastore-source-params
           |     +--rw source-path    yang:xpath1.0
           +--:(prometheus)
              +--rw prometheus-source-params
                 +--rw source-uri    inet:uri
                 +--rw query-data?   string
```

Retrieve data in pub/sub mode

Retrieve data in req/res mode
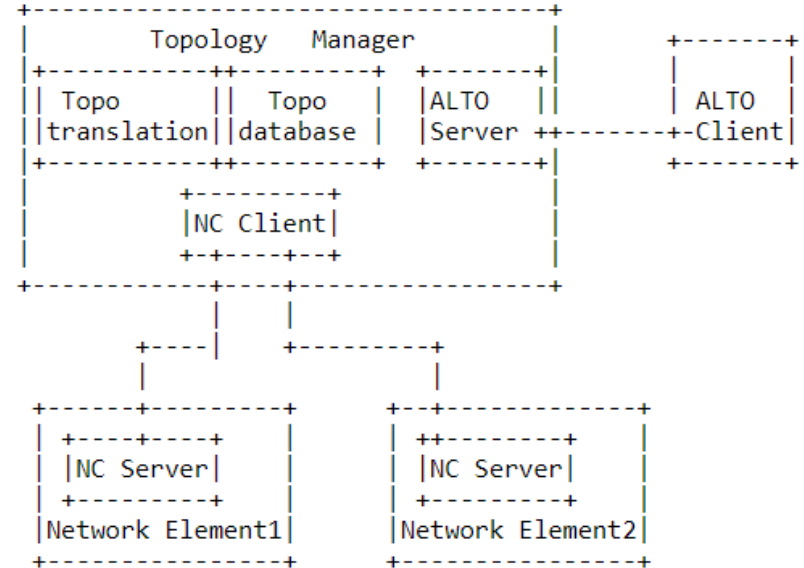
Access data from the same Yang-based DataStore

Access data from a Prometheus server

Reference:
https://datatracker.ietf.org/doc/html/rfc7971#section-3.2.2

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Example of Information Resource Creation Algorithm

Developer implements Network Map creation algorithm.

Operator calls corresponding algorithm to translate I2RS topology data source to network map resource.

```
+--------------------------------------+
|           Topology    Manager        |              +--------+
+-----------++---------+   +-------+|   |        |
|| Topo     || Topo    |   |ALTO   ||   |        | ALTO   |
||translation||database |  |Server ++-------+-Client|
|+-----------++---------+   +-------+|   |        +--------+
|           +----------+             |
|           |NC Client|              |
|           +-+----+--+              |
+--------------------------------------+
                |    |
         +----|   +---------+
         |               |
+------------+    +---+------------+
| +---+----+ |    | ++--------+    |
| |NC Server| |   | |NC Server|    |
| +---------+ |   | +---------+    |
|Network Element1| |Network Element2|
+---------------+  +---------------+
```

Reference:
https://datatracker.ietf.org/doc/html/draft-hzx-alto-network-topo-00

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Example of Information Resource Creation Algorithm

Developer implements Property Map creation algorithm.

Operator calls corresponding algorithm to translate multiple data sources (BGP RIB, SNMP/ Prometheus) to property map resource.
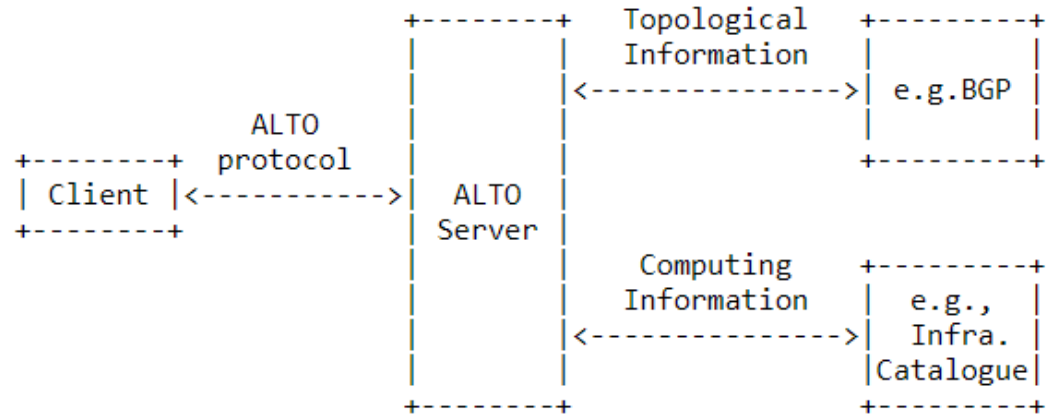

Figure 1: Service Edge Information Exchange

Reference:
https://datatracker.ietf.org/doc/html/draft-contreras-alto-service-edge-03

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Example of Information Resource Creation Algorithm

Developer implements Network Map and Cost Map creation algorithms.

Operator calls algorithms to translate intra-domain topology and TE information collected from BGP-LS sources to network map and cost map resources.
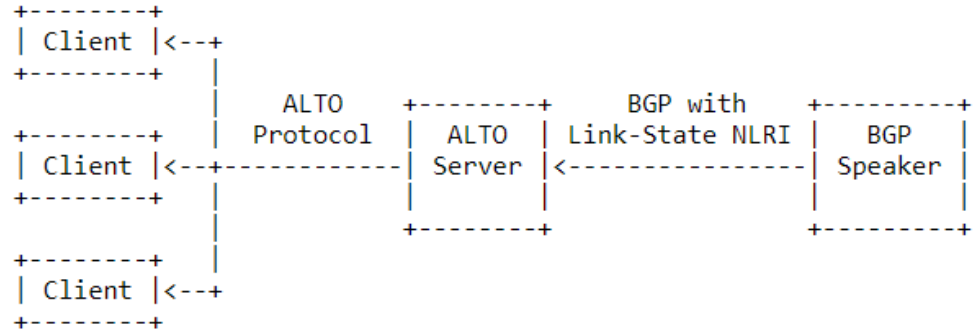
```
+--------+
| Client |<--+
+--------+   |
             |        ALTO      +--------+    BGP with       +---------+
             |       Protocol   | ALTO   | Link-State NLRI   |  BGP    |
+--------+   |                  | Server |<----------------- | Speaker |
| Client |<--+------------------|        |                   |         |
+--------+   |                  |        |                   |         |
             |                  +--------+                   +---------+
+--------+   |
| Client |<--+
+--------+
```

Figure 3: ALTO Server Using Network Topology Information

Standard Reference:
https://datatracker.ietf.org/doc/html/rfc7752#section-2.2

Implementation Experience:
https://datatracker.ietf.org/doc/html/draft-zhang-alto-bgp-ls

Statistics Data Model

Measurement information suggested by RFC7971:

- Measurement of impact
  - Total amount and distribution of traffic
  - Application performance
- System and service performance
  - Requests and responses for each information resource
  - CPU and memory utilization
  - ALTO map updates
  - Number of PIDs
  - ALTO map sizes

Other useful measurement information for ALTO extensions:

- Number of other ALTO entities
- Statistics for update sessions and events
- Statistics for calendar

```
module: ietf-alto-stats

  augment /alto:alto-server/alto:resource:
    +--ro num-res-upd?      yang:counter32
    +--ro res-mem-size?     yang:counter32
    +--ro res-enc-size?     yang:counter32

  augment /alto:alto-server/alto:resource/alto:resource-params
          /alto:networkmap/alto:alto-networkmap-params:
    +--ro num-map-pid?      yang:counter32

  augment /alto:alto-server/alto:resource/alto:resource-params
          /alto:propmap/alto:alto-propmap-params:
    +--ro num-map-entry?   yang:counter32

  augment /alto:alto-server/alto:resource/alto:resource-params
          /alto:cdni/alto:alto-cdni-params:
    +--ro num-base-obj?     yang:counter32

  augment /alto:alto-server/alto:resource/alto:resource-params
          /alto:update/alto:alto-update-params:
    +--ro num-upd-sess      yang:counter32
    +--ro num-event-total yang:counter32
    +--ro num-event-max?    yang:counter32
    +--ro num-event-min?    yang:counter32
    +--ro num-event-avg?    yang:counter32
```

Planning Items in Future Version

What is missing in current data model?

- Configuration for server discovery
  - It can be useful on multi-domain settings or integrated client-server settings
  - Refer to RFC7286 and RFC8686
- More data source retrieval mechanisms support
  - Tuning for caching and incremental update
- Partial computation support for information resource creation algorithm
- More options for security policy
  - How to integrate server-level security policy with information resource-level security policy
- Lifecycle management
  - RFC8969 suggests a lifecycle management procedure (e.g., service assurance, service diagnosis) for automated services

Online Discussions

- Does this document provide any generic network model like SONiC
  Switch Abstraction Interface (SAI) or MALT [NSDI21]? (from Y. Richard Yang)
  - Providing generic network model is not in the scope of this document. But a common interface for connect ALTO information resources to other ALTO information resources and related data sources can be useful.
- How to understand the intent-based interface for information resource creation? (from Dhruv Dhody)
  - Authors haven't made the decision that the interface should not be intent-based. But the data model can be used to configure the connection between the created ALTO information resources and related data sources. When data sources changed, the ALTO information resources should also be updated.
- When we say internal or external, compare with who, it is internal or external? (from Qin Wu and Dhruv Dhody)
  - The latest version has removed "internal" and "external" data sources. Instead, developers should augment the common data model for data-source to define how to connect to a specific data source.

Mailing List Discussions

- What about server discovery? Do we need to configure the ALTO client/server for server discovery? And what is needed for data model? (from Qin Wu)
  - It is an important item in the future version.
- Do we need to monitor ALTO information resource lifecycle management? What is missing part is performance measurement aspect? (from Qin Wu)
  - Latest version defines some of performance measurement. It can be interesting to integrate generic measurement framework. We need to investigate more references.
  - Integration with generic lifecycle management framework can be also interesting.
- For data source aspect, we should also consider how to collect data (transmission mechanism) and which kind of data we can collect (data source type). (from Qin Wu)
  - It is the limitation of current proposed model. In the next version, we are going to: 1) define some of popular data sources for references; 2) summarize common configuration options and allow third-party data sources to augment the common data model.

Author Discussions

- Is the decision being made that YANG is only useful for ALTO server configuration and there is no need to configure ALTO clients via YANG? (from Dhruv Dhody)
    - Data model for ALTO client configuration is in the scope of this document (in future version). But we should clarify the use cases (e.g., network application integration cases, multi-domain cases)
- Are all kind of TLS protocol versions possible or do we have limitations? (from Roland Schott)
    - RFC7285 requires TLS v1.2
- Should `polling-interval` be such accurate (millisecond level right now)? (from Roland Schott)
    - In most practical cases, "second" level is enough.

Further Feedback

Email to ALTO WG mailing list: alto@ietf.org

Or cc Authors: draft-zhang-alto-oam-yang@ietf.org

Open an issue in GitHub:

https://github.com/openalto/draft-alto-oam-yang/issues/new/choose

We are looking forward to receiving your feedback!