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Using RESTCONF with LMAP Measurement Agents
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Abstract

This document describes how RESTCONF can be used with a YANG data model for Large-Scale Measurement Platforms (LMAP).

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1. Introduction

This document discusses how a controller can use the RESTCONF protocol [I-D.ietf-netconf-restconf] to configure Large-Scale Measurement of Broadband Performance (LMAP) measurement agents (MAs) [I-D.ietf-lmap-framework]. It also discusses how RESTCONF can be used to report measurement results to a collector.

MAs may be deployed as separate hardware devices or as functions embedded in consumer electronic devices and home routers or as pure software solutions that can be installed on off-the-shelf computing equipment. Measurement agents receive instructions from a controller about when and how to conduct what measurements (the measurement schedule) and how and when to report measurement results to a data collector (the report schedule). Further information about the interaction between MAs and controllers and collectors can be found in [I-D.ietf-lmap-framework].

The LMAP information model [I-D.ietf-lmap-information-model] defines the information exchanged between a controller and an MA and the information exchanged between an MA and a collector. An information model is conceptual and protocol-independent. A concrete YANG [RFC6020] data model derived from the conceptual information model is defined in [I-D.schoenw-lmap-yang].

2. Overview of RESTCONF

The RESTCONF protocol [I-D.ietf-netconf-restconf] provides a REST-

like interface to access and manipulate a so-called unified YANG datastore [RFC6020]. The basic idea behind RESTCONF is expose a YANG datastores as a collection of Web resources that can be manipulated using standard HTTP [RFC7230] DELETE, PATCH, POST, and PUT methods.

The resource hierarchy is derived from the nesting structure of the YANG schema tree, leading to a so called data model driven REST API.

RESTCONF is essentially a convention how to use HTTP over TLS to access a datastore that has a structure defined by a YANG data model. The data is exchanged in XML encoding or JSON encoding.

The normal mode of operation is that the RESTCONF client initiates a secure transport to the RESTCONF server. For devices located behind a NAT, a so called 'call-home' mechanism has been defined [I-D.ietf-netconf-call-home] that enables the RESTCONF server to establish a secure transport to a RESTCONF client. Note that call home only changes the TCP connection establishment, the TLS and HTTP client/server roles do not change. The policy used to call home can be configured through a configuration data model [I-D.ietf-netconf-server-model]. This model provides mechanism to configure a list of redundant endpoints and it provides control over call-home policies (e.g, call-home frequency, idle-timers, keep-alive timers).

3. RESTCONF as LMAP Control Protocol

It is straight-forward to user RESTCONF as a control protocol. The YANG data model [I-D.schoenw-lmap-yang] derived from the underlying information model [I-D.ietf-lmap-information-model] translates into a collection of RESTCONF resources that can be manipulated at various levels of granularity using DELETE, PATCH, POST, and PUT methods.

An example exchange showing a REST call to create a schedule object is shown in Appendix B.

4. RESTCONF as LMAP Report Protocol

One way of mapping the information model parts relevant for reports into a YANG data model is the usage of YANG notifications. This is the approach currently used in [I-D.schoenw-lmap-yang]. This mapping

leads to report notifications that push measurement results from the MA to a collector. The RESTCONF protocol uses Server Sent Events as the underlying mechanism to stream notifications.

A direct mapping of the information model leads to relatively verbose exchanges and it is possible to define more space efficient notifications that suppress information that is only changing rarely.

An example exchange of a result notification is shown in Appendix C.

Note that alternative designs are possible. One option is to make the collector a RESTCONF server and to have the MA push results to

the collector by posting to resources on the controller. Another option is to have the results reside on the MA and to export the results as part of the operational state of the MA. The collector(s) will then use GET requests to fetch the result resources from the MA. Note that all three approaches can be implemented using RESTCONF and YANG.

5. Conclusion

This document discusses how RESTCONF can be used as a control protocol and a report protocol for Large-Scale Measurement Platforms (LMAP). The benefit of using RESTCONF is that no new protocol work needs to be done. Additional benefits derive from using YANG and a data model driven approach. Despite the reuse of existing tools, using a data model driven approach allows to easily reuse other data models (e.g., network interfaces [RFC7223], [RFC7277] or general system services [RFC7317]) in order to export additional status information about an MA to a controller.

6. IANA Considerations

This document has no requests for IANA.

7. Acknowledgements

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8. Informative References

[I-D.ietf-lmap-framework]
Eardley, P., Morton, A., Bagnulo, M., Burbridge, T., Aitken, P., and A. Akhter, "A framework for Large-Scale Measurement of Broadband Performance (LMAP)", draft-ietf-lmap-framework-12 (work in progress), March 2015.

[I-D.ietf-lmap-information-model]
Burbridge, T., Eardley, P., Bagnulo, M., and J. Schoenwaelder, "Information Model for Large-Scale Measurement Platforms (LMAP)", draft-ietf-lmap-information-model-04 (work in progress), March 2015.

[I-D.ietf-netconf-call-home]
Watsen, K., "NETCONF Call Home and RESTCONF Call Home", draft-ietf-netconf-call-home-04 (work in progress), February 2015.

[I-D.ietf-netconf-restconf]
Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", draft-ietf-netconf-restconf-04 (work in progress), January 2015.

[I-D.ietf-netconf-server-model]
Watsen, K. and J. Schoenwaelder, "NETCONF Server and RESTCONF Server Configuration Models", draft-ietf-netconf-server-model-06 (work in progress), February 2015.

[I-D.schoenw-lmap-yang]
Schoenwaelder, J. and V. Bajpai, "A YANG Data Model for LMAP Measurement Agents", draft-schoenw-lmap-yang-02 (work in progress), January 2015.

[I-D.starkcarey-lmap-protocol-criteria]
Stark, B. and T. Carey, "LMAP Protocol Selection Criteria", draft-starkcarey-lmap-protocol-criteria-01 (work in progress), March 2015.

[RFC6020] Bjorklund, M., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020,

October 2010.

[RFC7223] Bjorklund, M., "A YANG Data Model for Interface Management", RFC 7223, May 2014.

[RFC7230] Fielding, R. and J. Reschke, "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing", RFC 7230, June 2014.

[RFC7277] Bjorklund, M., "A YANG Data Model for IP Management", RFC 7277, June 2014.

[RFC7317] Bierman, A. and M. Bjorklund, "A YANG Data Model for System Management", RFC 7317, August 2014.

Appendix A. Response to Protocol Comparison Criteria

A set of control and report protocol comparison criteria has been defined in [I-D.starkcarey-lmap-protocol-criteria]. This section compares the usage of RESTCONF against the criteria.

CP-MUST-1 yes (RFC6241 RFC6242, RFC5539), [I-D.ietf-netconf-restconf]

CP-MUST-2 yes [I-D.ietf-netconf-call-home]

CP-MUST-3 yes SSH / TLS (NETCONF), TLS (RESTCONF)

CP-MUST-4 yes YANG data models [RFC6020] have a well defined versioning and extension model

CP-DIFF-1 1

CP-DIFF-2 1

CP-DIFF-3 yes

CP-DIFF-4 yes (NETCONF|RESTCONF) call home

CP-DIFF-5 (underspecified - it is JSON or XML over HTTP/TLS)

CP-DIFF-6	(underspecified - it is JSON or XML over HTTP/TLS)
CP-DIFF-7	HTTP and JSON/XML are pretty much everywhere
CP-DIFF-8	YANG tools are out there and the rest will develop, HTTP and TLS are pretty well understood
CP-DIFF-9	yes
CP-DIFF-10	many tools out there to create REST code, YANG tools available
CP-DIFF-11	yes, YANG RFC 6020 data models have a version model
CP-DIFF-12	additional YANG modules can augment the standard data model
CP-DIFF-13	JSON and XML, CBOR in the making
RP-MUST-1	yes [I-D.ietf-netconf-call-home]
RP-MUST-2	SSH / TLS (NETCONF), TLS (RESTCONF)
RP-MUST-3	YANG RFC 6020 data models have a version model
RP-DIFF-1	TCP
RP-DIFF-2	yes
RP-DIFF-3	(underspecified - it is HTTP over TLS)
RP-DIFF-4	yes

RP-DIFF-5	yes
RP-DIFF-6	yes (as part of HTTP encoding negotiations)
RP-DIFF-7	(underspecified - it is JSON or XML over HTTP/TLS)
RP-DIFF-8	HTTP and JSON/XML are pretty much everywhere

RP-DIFF-9 many tools out there to create REST code, YANG tools available

RP-DIFF-10 yes

RP-DIFF-11 many tools out there to create REST code, YANG tools available

RP-DIFF-12 JSON and XML, CBOR in the making

Appendix B. Example RESTCONF Control Protocol Exchange

Below is a YANG tree diagram of a part of the data model covering schedules. This is taken from [I-D.schoenw-lmap-yang].

```
module: ietf-lmap
   +--rw lmap
      +--rw schedules
         +--rw schedule* [name]
            +--rw name      string
            +--rw action* [name]
            |  +--rw name           string
            |  +--rw task           leafref
            |  +--rw option* [name]
            |  |  +--rw name     string
            |  |  +--rw value?   string
            |  +--rw destination* [name]
            |     +--rw name        string
            |     +--rw output*     uint16
            |     +--rw schedule    leafref
            |     +--rw action      leafref
            +--rw timing    leafref
```

Below is an XML representation of instance data conforming to the YANG data model is shown below. Note that some of the strings are

references to other portions of the instance data not show here.

This is again taken from [I-D.schoenw-lmap-yang].

```
<lmap xmlns="urn:ietf:params:xml:ns:yang:ietf-lmap">
  <schedules>
    <schedule>
      <name>hourly</name>
      <action>
        <name>icmp-latency-hourly</name>
        <task>icmp-latency-measurement</task>
        <destination>
          <name>q-all</name>
          <schedule>daily</schedule>
          <action>report-daily</action>
        </destination>
      </action>
      <timing>hourly</timing>
    </schedule>
  </schedules>
</lmap>
```

Below is an example showing how RESTCONF can be used to create the above schedule. The prefix C: indicates the controller, the prefix M: indicates the measurement agent. This example uses a JSON encoding (and note that much of the white-space can be removed, this is only there to help with readability).

```
C: POST /restconf/data/ietf-lmap:lmap/schedules HTTP/1.1
C: Host: example.com
C: Content-Type: application/yang.data+json
C:
C:   {
C:     "ietf-lmap:schedule": {
C:       "name": "hourly",
C:       "action": [
C:         {
C:           "name": "icmp-latency-hourly",
C:           "task": "icmp-latency-measurement",
C:           "destination": [
C:             {
C:               "name": "q-all",
C:               "schedule": "daily",
C:               "action": "report-daily"
C:             }
C:           ]
C:         }
C:       ],
C:       "timing": "hourly"
C:     }
C:   }

M: HTTP/1.1 201 Created
M: Date: Mon, 23 Apr 2012 17:01:00 GMT
M: Server: example-server
M: Location: https://example.com/restconf/data/ietf-lmap:lmap/schedules/sched
M: Last-Modified: Mon, 23 Apr 2012 17:01:00 GMT
M: ETag: b3a3e673be2
```

Appendix C. Example RESTCONF Report Protocol Exchange

The first step taken by the collector is to lookup the event stream resource.

```
  C: GET /restconf/data/ietf-restconf-monitoring:restconf-state/streams/stream=
  C: Host: example.com
  C: Accept: application/yang.data+xml

  M: HTTP/1.1 200 OK
  M: Content-Type: application/yang.api+xml
  M:
  M: <events
  M:  xmlns="urn:ietf:params:xml:ns:yang:ietf-restconf-monitoring">
  M:  https://example.com/streams/NETCONF
  M: </events>
```

Once the event stream resource is known (information might be cached), the collector subscribes to the event stream resource.

```
C: GET /streams/NETCONF HTTP/1.1
C: Host: example.com
C: Accept: text/event-stream
C: Cache-Control: no-cache
C: Connection: keep-alive

M: data: <notification
M: data:    xmlns="urn:ietf:params:xml:ns:yang:ietf-restconf">
M: data:    <event-time>2013-12-21T00:01:00Z</event-time>
M: data:    <report xmlns="urn:ietf:params:xml:ns:yang:ietf-lmap">
M: data:    </report>
M: data:

M: data: {
M: data:    "ietf-restconf:notification": {
M: data:      "event-time": "2015-02-25T00:01:00Z",
M: data:      "ietf-lmap:report": {
M: data:         "date": "2015-02-25T00:01:00Z",
M: data:         "agent-id": "xxx",
M: data:         "header": {
M: data:           "column": "target",
M: data:           "column": "rtt"
M: data:         }
M: data:         "row": {
M: data:           "start": "2015-02-25T00:01:00Z",
M: data:           "value": "192.0.2.1",
M: data:           "value": 42
M: data:         }
M: data:         "row": {
M: data:           "start": "2015-02-25T00:01:00Z",
M: data:           "value": "192.0.2.2",
M: data:           "value": 24
```

```
M: data:          }
M: data:       }
M: data:    }
M: data: }
```

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