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I2RS Data Flow Requirements
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Abstract

This document covers requests to the netmod and netconf Working Groups for functionality to support the data flows described in the I2RS architecture and the I2RS use cases requirements summary.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on September 15, 2016.

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1. Introduction

The Interface to the Routing System (I2RS) Working Group is chartered with providing architecture and mechanisms to inject into and retrieve information from the routing system. The I2RS Architecture document [I-D.ietf-i2rs-architecture] abstractly documents a number of requirements for implementing the I2RS requirements.

The I2RS Working Group has chosen to use the YANG data modeling language [RFC6020] as the basis to implement its mechanisms.

Additionally, the I2RS Working group has chosen to use the NETCONF [RFC6241] and its similar but lighter-weight relative RESTCONF [I-D.ietf-netconf-restconf] as the protocols for carrying I2RS. NETCONF and RESTCONF are suitable for handling the configuration portion of the I2RS protocol, but need extensions to handle the I2RS use cases described in [I-D.ietf-i2rs-usecase-reqs-summary]. The requirements for these functionalities include:

- ephemeral state - as defined in [I-D.ietf-i2rs-ephemeral-state]
- notifications and events - as defined in [I-D.ietf-i2rs-pub-sub-requirements]
- traceability - as defined in [I-D.ietf-i2rs-traceability]
- protocol security - as defined in [I-D.ietf-i2rs-protocol-security-requirements]
- Generic interfaces to Protocol Local-RIBs or Policy Data bases,
- Large data flows,
- Traffic monitoring data,
- Data flows for Action sequences, and
- data flows during network outages or attacks

This document describes the protocol requirements for these last five types of requirements. The first section summarizes the data flow requirements. Section 2 details how the I2RS use case requirements for Generic interfaces to protocol RIBS or policy data base do not add any requirements to the I2RS protocol. Section 3 describes how the describes

2. Summary of I2RS Data Flow Requirements

Additional requirements from Generic Interface:None

The additional Data flow requirements are:

DF-REQ-01: Pull Publication/subscription mechanism

DF-REQ-02: The support of large data transfers in a data format agnostic format. This the I2RS protocol should support transport of data in any format including: XML, JSON, MTL (ALias/Waveformat, .mtl), protobufs, and ascii text.

DF-REQ-03: Support of any transport,

DF-REQ-04 Support for the ability to send information using IPFIX protocol and IPFIX templates,

DF-REQ-05: Support of traffic statistics for filter-based policies (BGP-FS, I2RS FB-RIB, policy routing), IPPM, SFLOW, and others in yang data model format or IPFIX tempalte formats over XML or JSON.

DF-REQ-06: Ability to carry ALTO protocol objects using ALTO protocol transport (http) with JSON encodings (GET, POST-PUT) for ALTO codes handling ALTO data errors, overload codes, and temporary redirects plus ALTO resource directory requests. ALTO error codes, overload codes, temporary redirets, and diretory requetss should be transformed to I2RS events.

DF-REQ-07: I2RS should be able to support an action which allocates internal resources for the I2RS agent (memory, processing time, interrupts) and outbound data flow bandwidth. It is expected that an action would be included in a data model in an "rpc"-like format in yang.

DF-REQ-08: The I2RS should be able to support an action that interacts with routing OAM functions.

I2RS-DF-09:I2RS Agent must be able signals that it will be using different protocol with different constraints (security, priority of data, or transport) or different constraints on the existing protocol (smaller message sizes, different priorities on data carried, or different security levels).

I2RS-DF-10: I2RS Agent-I2RS Client protocol must allow for a common session level function that supports data flow resilence, "chunking" of data appropriate sizes for congestion, message integrity and replay protection so that during periods of DDoS and bursty congestion due to security attacks. A common "session" function will support an application layer "session" sending data over multiple transports during periods of outage, network attack or congestion.

DF-REQ11: The I2RS protocol must allow for security that exist at the applications’ "session" level that spans multiple transports.

DF-REQ-12: Support of the ability to send/receive IPFIX Templates, and information using IPFIX template formats but use another protocol to transport the data that can handle congestion and DDoS attacks.

DF-REQ-13: Yang MUST have a way to indicate in a data model has actions which allow: different transports, different resource constraints, or different security.

DF-REQ-14: Yang MUST have a way to indicate a data model has different levels of checking where: lowest level is message form only, medium level checks message format plus data syntax, and highest level uses the message format, data syntax and referential check netconf configuration does. The default level for I2RS is message format plus data syntax.

3. Generic Interfaces to Routing Functions

The I2RS use case requirement suggests that a generic interface be created to protocol local RIBs and a generic interface be available to configure policies.

3.1. I2RS-Generic Interface to Local-RIB

The I2RS requirements ([I-D.ietf-i2rs-usecase-reqs-summary]) require that a generic interface be defined to the local-RIB in protocols. This type of data flow does not require a new type of data flow, but the definition of a new data model that creates a generic local RIB and has operations to funnel this generic Local-RIB to a specific protocol.

3.2. I2RS-Generic interfaces to Policies

The I2RS requirements suggest that I2RS have a generic interface to routing policies for protocols, routing distribution, or routing protocols. This generic interface is currently being implemented as common definitions for data models. At this time, This generic interface does not need additional protocol requirements.

3.3. I2RS Data Flow Requirements

These generic interfaces do not have any additional protocol requirements.

4. Large Data Flow Requirements

This section decribes the data flow requirements for large data flows, traffic flows measurements, CDNI traffic flows, OAM and Action rqeuests, data flows during outages or network attacks (DDoS (Distributed Denial of Service) or other network attacks), and non-secure data flows. These data flows are data flows which are not configuration based data flows.

4.1. Large Data Flow Use Case Requirements

The I2RS use case for Large Data Collection systems [I-D.ietf-i2rs-usecase-reqs-summary] requires the I2RS protocol and data models:

- be able to be done at a high frequency and resolution with minimal impact to devices memory or CPU (L-Data-REQ-01) ,
- use a data model which allows definition of the form as part of the data model (L-Data-REQ-02) ,
- support a publication/subscription mechanism with push/pull mechanism (L-Data-REQ-03),
- (supports capability negotiation for level of transport, security, and error handling as a general configurations, per I2RS client-agent protocol for all interfaces and all time instance, or per I2RS interface client-agent protocol per specific interface or per time instances. (L-Data-REQ-04,L-Data-REQ-06, L-Data-REQ-07, L-Data-REQ-08, and L-Data-REQ-09),
- dynamic subscription model set-up via IPFIX (L-REQ-12c),
- support of subscriber and consumer I2RS-Agent pairs (L-REQ-12d),
- remapping of Node’s databases,
- data format agnostic (L-Data-REQ-05),
- data models and I2RS protocol additions that support of query, introspection using data-base model that support a set of capabilities, data filters, and error handling (stale data, repeated transport failures, and other errors.) Introspection supports data verification, inclusion of legacy data, and merging of data flows based on meta-data. (L-Data-REQ-11, L-Data-REQ-13),
- Support of push of data synchronously or asyncronously via registered subscriptions (L-Data-REQ-12a).
- Pull of data in one-shot or multiple sequences (L-Data-REQ-12b), and
- dynamic subscription model set-up via IPFIX (L-REQ-12c)

4.1.1. Data Requirements Supported in pub-sub Requirements

All use case requirements for the publication/subscription service for the push service from large data requirements 01-04 and 6-12 is found in [I-D.ietf-i2rs-pub-sub-requirements], and an example protocol addition to netconf is include in [I-D.ietf-netconf-yang-push].

The requirements for the publication/subscription service for the pull model are not specified in the [I-D.ietf-i2rs-pub-sub-requirements], but a majority of the pub-sub requirements and mechanisms can be reused. In a pull, the publisher prepares the data that is pulled by a few receivers who then distribute it to the receivers. The pull mechanism would have a different "pull latency" versus the push latencey, and a set of parameters which indicate the amount of data stored if receivers did not pull the data within a certain time.

At this time, the pull-model of the publication/subscription model is not being requested by vendors or operators.

4.1.2. Data Flow Requirements Outside of Pub/Sub Requirements

The data flow requirements for large data flows also include support for data flows outside of publication/subscription via any transport (L-Dat-REQ-04) and any data format (L-Data-REQ-05). Support for the IPFIX protocol or just the IPFIX data formats is required.

4.1.3. I2RS Data Flow Requirements

The following requirements are additional data flow requirements for large data flows.

(DF-REQ-01): Support of Subscription/publication service in pull model,

(DF-REQ-02): Support of any data format including: XML, JSON, (MTL (Alias/WaveFormat,.mtl), protobufs, and ascii,

(DF-REQ-03): Support of any transport, and

(DF-REQ-04): support of the ability send information using IPFIX templates as a reporting structure over the IPFIX protocol, or over other data formats.

[I-D.ietf-netconf-yang-push] supports XML and JSON in its first release, and provides an ability to register extra formats, but these

requirements should also support large data flows sent outside of the publication-subscription service.

4.2. Traffic Flow Measurements

The I2RS requirements for the Protocol independent use cases requires the support off interactions with traffic flow and other network management Protocols (requirements PI-REQ-05, PI-REQ06) in [I-D.ietf-i2rs-usecase-reqs-summary]).

The following IETF protocol pass traffic related information:

- BGP Flow Specification (BGP-FS) ([RFC5575]
- IPFIX - IP Flow Information ([RFC7011]) that reports on a wide variety of routing system statistics, and
- IPPM - IP Performance mangement ([RFC2330], [RFC7312]) that reports on one-way or two-way end-to-end network performance statistics,

In addition the SFLOW([RFC3176]) of layer 2 devices is supported by many routers. Other traffic flows may be measured in support of IDS/ IPS, but these will be covered in the section on security flows.

Additional traffic flow models are being defined to configure traffic flow policy and to monitor the statistics on the use of the traffic flow statistics:

- BGP Flow Specification (BGP-FS) yang model [I-D.wu-idr-flowspec-yang-cfg] contains flow filter match statistics.
- I2RS Filter-Based RIB yang model ([I-D.kini-i2rs-fb-rib-info-model], [I-D.hares-i2rs-fb-rib-data-model])- yang model contains ephemeral flow statistics,
- Filter-Based RIB (draft-hares-rtgwg-fb-rib-data-model) contains both flow filter match statistics,

4.2.1. Protocol Requirements based on Traffic Flows

Due to the potentially large data flow these statistics should be handle by push pub-sub model or a pull pub-sub model. Thresholds for data models may be passed by the event portion of the push/pull pub-sub model. The pub-sub model will allow the I2RS client-I2RS Agent to meter the amount of data flow these statistics carry. The push

portion of the pub-sub model is supported by [I-D.ietf-netconf-yang-push], but the pull portion of the pub-sub model is not defined.

Alternatively I2RS can use the the IPFIX protocol ([RFC7011]) as a component protocol. I2RS processes can support an IPFIX exporting process sendinging dta to a node to a node on a collector process. The IPFIX templates can be configured as ephemeral state or configuration state. The IPFIX data flows may run over SCTP, UDP, or TCP utilizing the congestion services at each time. The IPFIX connections assumes that: a) congestion is an temporary anomaly, b) dropping data during a congestion is reported, and c) for some exporiting process it is acceptable to have drop data in a reliable protocol. The I2RS protocol must support the establishment of an IPFIX connection.

Traffic monitoring can occur in a network under DDoS with high levels of congestion and loss the use of these protocols which rely on transport-level retransmission may not be as resilient as needed for network security functions (NSF). These are considered in section 5 on operations during network outages or congestoin.

The Flow Filtering data models with policy rules (BGP Flow Specification, I2RS Filter-Based RIB, and n-tuple policy routing RIB) often track how often these policies are match. These statistics can also be pushed/pulled in a publication/subscription with yang data-model defined format or an IPFIX exporting process format. Similarly IPPM statistics or SFLOW data, be sent via publication/subscription service in yang data model format or in a IPFIX Template or as XML or JSON representation of a yang data model. These additional sources do not change the requirements for the push publication/subscription or expand the

Summary: The pub-sub model push or pull may have to support additional formats (E.g. SFLOW, IPFIX) as well as yang data models.

4.2.2. I2RS Data Flow Requirements

(DF-REQ-05): Support of traffic statistics for filter-based policies (BGP-FS, I2RS FB-RIB, policy routing), IPPM, SFLOW, and others in yang data model format or IPFIX tempalte formats over XML or JSON.

4.3. CDNI Use case requirements

The CDNI use case has the two requirements for an I2RS interface:

interface that allows redirection of cDNI request via the Alto protocol or query of ALTO information (CDNI-REQ-01s, CNDI-REQ-02,

interface using I2RS Client-Agent that allows I2RS agent to redirect content request message to a downstream agent

CDNI meta data sent with CNDI metadata to determine how CNDI can deliver or reroute CDNI content (CNDI-REQ-1b, CDNI-REQ-03.

4.3.1. CNDI Requirements for data flow

Alto protocol objects which include

* map-object with request resoponse data that includes:
* InfoResourceDirectory,
* InfoResourceNetworkMap,
* InfoResourceCostMap,
* InfoResourceEndpointProperties, and
* InfoResourceEndpointCostMap.

ALTO transport (http) and JSON encodings (GET, POST, PUT) for ALTO codes

Receive ALTO Error data with error codes (Code = application/alto-error+json), or overload (HTTP 503 ("Service Unavailable")), or temporary redirect (HTTP 307 ("Temporary Redirect")) and re-interpret as Events or responses on CDNI interface.

Transfer ALTO Resource directory information to CDNI meta data (Jason encoded data with: "application/alto-directory+json")

4.3.2. I2RS Data Flow Requirements

DF-REQ-06: Support carry ALTO protocol objects using ALTO protocol transport (http) with JSON encodings (GET, POST-PUT) for ALTO codes handling ALTO data errors, overload codes, and temporary redirects plus ALTO resource directory requests. ALTO error codes, overload codes, temporary redirets, and diretory requetss should be transformed to I2RS events.

4.4. Action sequences in Data Models

Several of the I2RS requirements from the use cases require a sequence of events with the following actions:

1. query data in protocol independent model (topology, RIB, Filter-RIB), or protocol),

2. start calculation (or re-calculation) in protocol function,

3. Report results,

4. install topology or RIB calculated,

5. check results,

6. recycle.

The actions included looking for overlapping BGP routes, IGP LFA calculation, ECMP load balancing traffic, optimizing paths via MPLS-TE, CCNE re-optimization, and virtual topology creation.

An alternate pattern within the requirements is if the topology is calculated off-line, and uploaded.

These action patterns may involve an interaction of the I2RS action sequences with existing OAM functions in the routing system.

NETCONF/RESTCONF have the concepts of an "rpc" for a configuration enabled action, but these action sequences should have the abilty to have the following characteristics:

- the ability to request a reservation of resources for this effort so the action sequence does not start unless there is enough calculation or response bandwidth in a node,

- the abilty ability to have validation on off-line calculated data so this critical data does not have errors

- the ability to "prioritize" notification or reports ahead of other I2RS data streams to allow process to work.

4.4.1. I2RS Data Flow Requirement

I2RS-DF-REQ-07: I2RS should be able to support an action which allocates internal resources for the I2RS agent (memory, processing time, interrupts) and outbound data flow bandwidth. It is expected that an action would be included in a data model in an "rpc"-like format in yang.

DF-REQ-08: The I2RS should be able to support an action that interacts with routing OAM functions.

4.5. Operation during network outages or attacks

The router needs dynamic management during periods of outage or periods of security attack.

4.5.1. Periods of Network Outage

During periods of outage, the I2RS protocol must operate when data bandwidth is reduced and network connectivity fluctuates. I2RS agents must be able to adjust operation of event notifications, logging, or data traffic during this period. Data Models and I2RS agent configuration must allow operator-applied policy to prioritize data during this period. The I2RS Agent should be able to signal the I2RS Client that such a time period is occuring.

4.5.2. I2RS used for Security functions in routers (I2NSF requirements)

For protection, most network devices have basic firewalls and flow filters. Some network routing devices have more advanced security. An interface to Network Security Function (I2NSF) is a new interface being defined by manage network security devices using the same higher-level protocol concept as I2RS where the I2NSF will be comprised of component protocols (see [I-D.ietf-i2nsf-problem-and-use-cases] for a description of the problem space and use cases for I2NSF), The intent of the I2NSF interface is to utilize the I2RS protocol as a component protocol which interfaces routing and forwarding functions in the security devices or in routing/forwarding devices in the network which include basic security devices (E.g. NAT firewalls or traffic filtesr in routing devices). The I2NSF function supports configuration of security devices as well as providing notification of events, logging of security action, and reporting of statistics and traffic flow measurement. The I2RS data functions described above will support sending information most network conditions except during the high loss and heavy congestion due DDoS or other security incidents. This section provides a short review of these type of streams of data and places to look-up additional input.

The common need for I2RS (and I2NSF) to support these functions via an application layer services with to support data flow resilence, "chunking" of data appropriate sizes for congestion, mesage integrity and replay protection during periods of DDoS and bursty congestion due to security attacks. A common "session" function as an I2RS data flow can provide these functions.

4.5.2.1. DOTS - DDoS Open Threat Signaling

Sending information to signal information about DDoS threats occurs during periods where the DDoS is congesting the network or causing large packet losses. Management systems need to configure network security functions (NSFs) on routers and on security devices to with new filtering policy, pull events and logs from NSF, and receive traffic monitoring data and logs regarding network security incidents.

These features for routing devices are handled by the existing I2RS data flow requirements except it does not support the network resilience in the presence of loss or congestion.

The DOTS requirements for messages from devices with security functions (such as firewalls in routing devices) are specified in: [I-D.ietf-dots-requirements]. The following are DOTS descriptions of the resiliency needed by the data

- Resilence (DOTS-G-003) in the face of severally constrained severely constrained network conditions imposed by the attack traffic. The protocol SHOULD be resilient, that is, continue operating despite message loss and out-of-order or redundant signal delivery.

- Small message sizes (DOTS-G-005) to prevent fragmentation so that all of message goes through in attack,

- Message integrity (G-006) and Message level replay protection (G-007) must exist for data streams even during periods of attack,

- Session-level Health monitoring (aka Heart beats) during attack (DOTS-OP-003)

- Abiilty to request/stop mitigation quickly (DOTS-OP-005)

4.5.2.2. MILE - Managed Incident Lightweight Exchange

The MILE related protocols ([RFC5070] and [I-D.ietf-mile-rfc5070-bis] provide data formats for reporting network security incidents during time periods of network attack. Similar to DOTS, the data passed by these protocols requires resilience, message integrity, message level replay protection, and session-level health monitoring. During attacks, the use of small message sizes is necessary.

4.5.3. I2RS Data Flow Requirements

I2RS-DF-09:I2RS Agent must be able signals that it will be using different protocol with different constraints (security, priority of data, or transport) or different constraints on the existing protocol (smaller message sizes, different priorities on data carried, or different security levels).

I2RS-DF-10: I2RS Agent-I2RS Client protocol must allow for a common session level function that supports data flow resilence, "chunking" of data appropriate sizes for congestion, mesage integrity and replay protection so that during periods of DDoS and bursty congestion due to security attacks. A common "session" function will support an application layer "session" function that serves multiple transports.

DF-REQ10: The I2RS protocol must allow for security that exist at the applications' "session" level that spans multiple transports.

DF-REQ-12: Support of the ability to send/receive IPFIX Templates, and information using IPFIX template formats but use another protocol to transport the data that can handle congestion and DDoS attacks. congestion-friendly

5. changes to YANG

DF-REQ-13: Yang MUST have a way to indicate in a data model has actions which allow: different transports, different resource constraints, or different security.

DF-REQ-14: Yang MUST have a way to indicate a data model has different levels of checking where: lowest level is message form only, medium level checks message format plus data syntax, and highest level uses the message format, data syntax and referential check netconf configuration does. The default level for I2RS is message format plus data syntax.

6. IANA Considerations

There are no IANA requirements for this document.

7. Security Considerations

The security requirements for the I2RS protocol are covered in [I-D.ietf-i2rs-protocol-security-requirements] document.

8. Acknowledgements

The following people have aided in the discuss

- Russ White,and
- Robert Moskowitz.

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