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**Discovery Of Restconf Metadata for Source-specific multicast
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Abstract

This document defines DORMS (Discovery Of Restconf Metadata for Source-specific multicast), a method to discover and retrieve extensible metadata about source-specific multicast channels using RESTCONF. The reverse IP DNS zone for a multicast sender's IP address is configured to use SRV resource records to advertise the hostname of a RESTCONF server that publishes metadata according to a new YANG module with support for extensions. A new service name and the new YANG module are defined.

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1. Introduction

This document defines DORMS (Discovery Of Restconf Metadata for Source-specific multicast).

A DORMS service is a RESTCONF [[RFC8040](#)] service that provides read access to data in the "ietf-dorms" YANG [[RFC7950](#)] model defined in [Section 4](#). This model, along with optional extensions defined in other documents, provide an extensible set of information about multicast data streams.

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This document defines the "dorms" service name for use with the SRV DNS Resource Record (RR) type [[RFC2782](#)]. A sender offering a DORMS service to publish metadata SHOULD configure at least one SRV RR for the "_dorms._tcp" subdomain in the reverse IP DNS zone for the source IP of its multicast channel to advertise a hostname for a DORMS server that can provide metadata for the sender's source-specific multicast traffic. Doing so enables receivers and middleboxes to discover and query a DORMS server as described in [Section 2](#).

The goal is to provide an extensible framework for attaching information necessary for the correct processing of multicast data channels, both for middle boxes forwarding the traffic, and for receivers subscribing to traffic (hereafter called "clients").

1.1. Background

The reader is assumed to be familiar with the basic DNS concepts described in [[RFC1034](#)], [[RFC1035](#)], and the subsequent documents that update them, as well as the use of the SRV Resource Record type as described in [[RFC2782](#)].

The reader is also assumed to be familiar with the concepts and terminology regarding source-specific multicast as described in [[RFC4607](#)] and the use of IGMPv3 [[RFC3376](#)] and MLDv2 [[RFC3810](#)] for group management of source-specific multicast channels, as described in [[RFC4604](#)].

The reader is also assumed to be familiar with the concepts and terminology for RESTCONF [[RFC8040](#)] and YANG [[RFC7950](#)].

1.2. Terminology

Term	Definition
(S,G)	A source-specific multicast channel, as described in [RFC4607]. A pair of IP addresses with a source host IP and destination group IP.
RR	A DNS Resource Record, as described in [RFC1034]
RRTYPE	A DNS Resource Record Type, as described in [RFC1034]
SSM	Source-specific multicast, as described in [RFC4607]

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 [RFC2119] and [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. Discovery and Metadata Retrieval

A client that needs metadata about a (S,G) MAY attempt to discover metadata for the (S,G) using the mechanisms defined here, and MAY use the metadata received to manage the forwarding or processing of the packets in the channel.

2.1. DNS Bootstrap

The DNS Bootstrap step is how a client discovers an appropriate RESTCONF server, given the source address of an (S,G). Use of the DNS Bootstrap is OPTIONAL for clients with an alternate method of obtaining a RESTCONF hostname for a DORMS server with metadata for an (S,G).

This mechanism only works for source-specific multicast (SSM) channels. The source address of the (S,G) is reversed and used as an index into one of the reverse mapping trees (in-addr.arpa for IPv4, as described in [Section 3.5 of \[RFC1035\]](#), or ip6.arpa for IPv6, as described in [Section 2.5 of \[RFC3596\]](#)).

When a receiver or middle box needs metadata for an (S,G), for example when handling a new join for that (S,G) and looking up authentication methods available, a receiver or middlebox can issue a DNS query for a SRV RR using the "dorms" service name with the domain from the reverse mapping tree, combining them as described in [\[RFC2782\]](#).

For example, while handling a join for (203.0.113.15, 232.1.1.1), a receiver would perform a DNS query for the SRV RRTYPE for the domain:

```
_dorms._tcp.15.113.0.203.in-addr.arpa.
```

The DNS response for this domain might return a record such as:

```
SRV 0 1 443 dorms-restconf.example.com.
```

This response informs the receiver that a DORMS server SHOULD be reachable at dorms-restconf.example.com on port 443. Multiple SRV records are handled as described by [\[RFC2782\]](#).

A sender providing DORMS discovery SHOULD publish at least one SRV record in the reverse DNS zone for each source address of the multicast channels it is sending, in order to advertise the hostname

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of the DORMS server to receivers and middle boxes. The DORMS servers advertised SHOULD be configured with metadata for all the groups sent from the same source IP address that have metadata published with DORMS.

2.2. RESTCONF Bootstrap

Once a DORMS host has been chosen (whether via an SRV RR from a DNS response or via some other method), RESTCONF provides all the information necessary to determine the versions and url paths for metadata from the server. A walkthrough is provided here for a sequence of example requests and responses from a receiver connecting to a new DORMS server.

2.2.1. Root Resource Discovery

As described in [Section 3.1 of \[RFC8040\]](#) and [\[RFC6415\]](#), the RESTCONF server provides the link to the RESTCONF api entry point via the `"/.well-known/host-meta"` or `"/.well-known/host-meta.json"` resource.

Example:

The receiver might send:

```
GET /.well-known/host-meta.json HTTP/1.1
Host: dorms-restconf.example.com
Accept: application/json
```

The server might respond as follows:

```
HTTP/1.1 200 OK
Date: Tue, 27 Aug 2019 20:56:00 GMT
Server: example-server
Cache-Control: no-cache
Content-Type: application/json
```

```
{
  "links":[
    {
      "rel":"restconf",
      "href":"/top/restconf"
    }
  ]
}
```


2.2.2. Yang Library Version

As described in [Section 3.3.3 of \[RFC8040\]](#), the yang-library-version leaf is required by RESTCONF, and can be used to determine the schema of the ietf-yang-library module:

Example:

The receiver might send:

```
GET /top/restconf/yang-library-version HTTP/1.1
Host: dorms-restconf.example.com
Accept: application/yang-data+json
```

The server might respond as follows:

```
HTTP/1.1 200 OK
Date: Tue, 27 Aug 2019 20:56:01 GMT
Server: example-server
Cache-Control: no-cache
Content-Type: application/yang-data+json

{
  "ietf-restconf:yang-library-version": "2016-06-21"
}
```

TBD: We might need a method for learning a specific restconf server or resource path that supports a version the client knows how to use, in the case the client is older than the server after a new yang-library version is released... Can this be just retry with a hold-down on specific hostnames, so that you can find a lower priority older server from the SRV records, or is signaling that can find or negotiate an explicit version as part of the lookup going to be necessary? -jake 2019-08-26

2.2.3. Yang Library Contents

After checking that the version of the yang-library module will be understood by the receiver, the client can check that the desired metadata module is available on the DORMS server by fetching the module-state resource from the ietf-yang-library module.

Example:

The receiver might send:

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```
GET /top/restconf/data/ietf-yang-library:modules-state/\
    module=ietf-dorms,2016-08-15
Host: dorms-restconf.example.com
Accept: application/yang-data+json
```

The server might respond as follows:

```
HTTP/1.1 200 OK
Date: Tue, 27 Aug 2019 20:56:02 GMT
Server: example-server
Cache-Control: no-cache
Content-Type: application/yang-data+json
```

```
{
  "ietf-yang-library:module": [
    {
      "conformance-type": "implement",
      "name": "ietf-dorms",
      "namespace": "urn:ietf:params:xml:ns:yang:ietf-dorms",
      "revision": "2019-08-25",
      "schema":
        "https://example.com/yang/ietf-dorms@2019-08-25.yang"
    }
  ]
}
```

Other modules required or desired by the client also can be checked in a similar way, or the full set of available modules can be retrieved by not providing a key for the "module" list.

[2.2.4. Metadata Retrieval](#)

Once the expected DORMS version is confirmed, the client can retrieve the metadata specific to the desired (S,G).

Example:

The receiver might send:

```
GET /top/restconf/data/ietf-dorms:metadata/\
    sender=203.0.113.15/group=232.1.1.1
Host: dorms-restconf.example.com
Accept: application/yang-data+json
```

The server might respond as follows:


```
HTTP/1.1 200 OK
Date: Tue, 27 Aug 2019 20:56:02 GMT
Server: example-server
Cache-Control: no-cache
Content-Type: application/yang-data+json

{
  "ietf-dorms:group": [
    {
      "group-address": "232.1.1.1",
      "udp-stream": [
        {
          "port": "5001"
        }
      ]
    }
  ]
}
```

Note that when other modules are installed on the DORMS server that extend the `ietf-dorms` module, other fields MAY appear inside the response. This is the primary mechanism for providing extensible metadata for an (S,G), so clients SHOULD ignore fields they do not understand.

As mentioned in [Section 3.2](#), most clients SHOULD use data resource identifiers in the request URI as in the above example, in order to retrieve metadata for only the targeted (S,G)s.

2.2.5. Cross Origin Resource Sharing (CORS)

It is RECOMMENDED that DORMS servers use the `Access-Control-Allow-Origin` header field, as specified by [\[W3C.REC-cors-20140116\]](#), and that they respond appropriately to Preflight requests.

Providing '*' for the allowed origins exposes the DORMS-based metadata to all web pages. When access to the metadata is used as a prerequisite to permitting the joining of the multicast flows, this would permit scripts from arbitrary web pages to issue joins for the multicast flows, which could allow e.g. malicious advertisements to participate in overjoining attacks (see [Appendix A](#) of [\[I-D.draft-jholland-cb-assisted-cc-01\]](#)) using multicast flows not controlled by the ad's senders. Therefore the use of '*' for allowed origins is NOT RECOMMENDED. (TBD: this probably deserves a security considerations section.)

3. Scalability Considerations

3.1. Provisioning

In contrast to many common RESTCONF deployments that are intended to provide configuration management for a service to a narrow set of authenticated administrators, DORMS servers often provide read-only metadata for public access, or for a very large set of end receivers, since it provides metadata in support of multicast data streams and multicast can scale to very large audiences.

Operators are advised to provision the DORMS service in a way that will scale appropriately to the size of the expected audience. Specific advice on such scaling is out of scope for this document, but some of the mechanisms outlined in [\[RFC3040\]](#) or other online resources might be useful, depending on the expected number of receivers.

3.2. Data Scoping

In the absence of contextual information, clients SHOULD issue narrowed requests for DORMS resources by following the format from [Section 3.5.3 of \[RFC8040\]](#) to encode data resource identifiers in the request URI. This avoids downloading excessive data, since the DORMS server may provide metadata for many (S,G)s, possibly from many different senders.

However, clients MAY use heuristics or out of band information about the service to issue requests for (S,G) metadata narrowed only by the source-address, or not narrowed at all. Depending on the request patterns and the contents of the data store, this may result in fewer round trips or less overhead, and can therefore be helpful behavior for scaling purposes. Servers MAY restrict or throttle client access based on the client certificate presented (if any), or based on heuristics that take note of client request patterns.

A complete description of the heuristics for clients and servers to meet their scalability goals is out of scope for this document.

4. YANG Model

The primary purpose of the YANG model defined here is to serve as a scaffold for the more useful metadata that will extend it. Currently known use cases include providing authentication information and bit-rate information for use by receivers and middle boxes, but more use cases are anticipated.

4.1. Yang Tree

```
module: ietf-dorms
  +--rw metadata
    +--rw sender* [source-address]
      +--rw source-address  inet:ip-address
    +--rw group* [group-address]
      +--rw group-address  rt-types:ip-multicast-group-address
    +--rw udp-stream* [port]
      +--rw port  inet:port-number
```

DORMS Tree Diagram

4.2. Yang Module

```
<CODE BEGINS> file ietf-dorms@2019-09-26.yang
module ietf-dorms {
  yang-version 1.1;

  namespace "urn:ietf:params:xml:ns:yang:ietf-dorms";
  prefix "dorms";

  import ietf-inet-types {
    prefix "inet";
    reference "RFC 6991 Section 4";
  }

  import ietf-routing-types {
    prefix "rt-types";
    reference "RFC 8294";
  }

  organization "IETF";

  contact
    "Author:  Jake Holland
              <mailto:jholland@akamai.com>
    ";

  description
    "Copyright (c) 2019 IETF Trust and the persons identified as
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```


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(<https://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX

(<https://www.rfc-editor.org/info/rfcXXXX>); see the RFC itself for full legal notices.

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](#) ([RFC 2119](#)) ([RFC 8174](#)) when, and only when, they appear in all capitals, as shown here.

This module contains the definition for the DORMS data type. It provides out of band metadata about SSM channels.";

```
revision 2019-08-25 {
  description "Initial revision.";
  reference
    "";
    // "I-D.draft-jholland-mboned-dorms";
}

container metadata {
  description "Metadata scaffold for source-specific multicast
  channels.";
  list sender {
    key source-address;
    description "Sender for DORMS";

    leaf source-address {
      type inet:ip-address;
      mandatory true;
      description
        "The source IP address of a multicast sender.";
    }

    list group {
      key group-address;
      description "Metadata for a DORMS (S,G).";

      leaf group-address {
        type rt-types:ip-multicast-group-address;
        mandatory true;
        description "The group IP address for an (S,G).";
      }

      list udp-stream {
```

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```

        key "port";
        description
            "Metadata for UDP traffic on a specific port.";
        leaf port {
            type inet:port-number;
            mandatory true;
            description
                "The UDP port of a data stream in an (S,G).";
        }
    }
}
}
}
}
<CODE ENDS>

```

5. Privacy Considerations

In the typical case, the mechanisms defined in this document provide a standardized way to discover information that is already available in other ways.

However, depending on the metadata provided by the server, observers may be able to more easily associate traffic from an (S,G) with the content contained within the (S,G). At the subscriber edge of a multicast-capable network, where the network operator has the capability to localize a IGMP [RFC3376] or MLD [RFC3810] channel subscription to a specific user or location by MAC address or source IP address, the structured publishing of metadata may make it easier to automate collection of data about the content a receiver is consuming.

RESTCONF communication will expose to the controller of the RESTCONF server information about the consumers of content that is not otherwise available from multicast subscription to a channel, such as the remote IP address and timing information.

6. IANA Considerations

6.1. The YANG Module Names Registry

This document adds one YANG module to the "YANG Module Names" registry maintained at <<https://www.iana.org/assignments/yang-parameters>>. The following registrations are made, per the format in [Section 14 of \[RFC6020\]](#):

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name: ietf-dorms
namespace: urn:ietf:params:xml:ns:yang:ietf-dorms
prefix: dorms
reference: I-D.[draft-jholland-mboned-dorms](#)

6.2. The Service Name and Transport Protocol Port Number Registry

This document adds one service name to the "Service Name and Transport Protocol Port Number Registry" maintained at <https://www.iana.org/assignments/service-names-port-numbers>. The following registrations are made, per the format in [Section 8.1.1 of \[RFC6335\]](#):

Service Name: dorms
Transport Protocol(s): TCP
Assignee: IESG <iesg@ietf.org>
Contact: IETF Chair <chair@ietf.org>
Description: This service name is used to construct the SRV service label "_dorms" for discovering DORMS servers.
Reference: I-D.[draft-jholland-mboned-dorms](#)
Port Number: N/A
Service Code: N/A
Known Unauthorized Uses: N/A
Assignment Notes: This protocol uses HTTPS as a substrate.

7. Security Considerations

7.1. Secure Communications

It is intended that security related metadata about the SSM channels will be delivered over the RESTCONF connection, and that information available from this connection can be used as a trust anchor.

The provisions of [Section 2 of \[RFC8040\]](#) provide secure communication requirements that are already required of DORMS servers, since they are RESTCONF servers. All RESTCONF requirements and security considerations remain in force for DORMS servers.

7.2. Exposure of Metadata

Although some DORMS servers MAY restrict access based on client identity, as described in [Section 2.5 of \[RFC8040\]](#), many DORMS servers will use the ietf-dorms YANG model to publish information without restriction, and even DORMS servers requiring client authentication will inherently, because of the purpose of DORMS, be providing the DORMS metadata to potentially many receivers.

Accordingly, future YANG modules that augment data paths under "ietf-dorms:metadata" MUST NOT include any sensitive data unsuitable for public dissemination in those data paths. Because of the possibility that scalable read-only access might be necessary to fulfill the scalability goals for a DORMS server, data under these paths MAY be cached or replicated by numerous external entities, so owners of such data SHOULD NOT assume it can be kept secret when provided by DORMS servers anywhere under the "ietf-dorms:metadata" path, even if they are authenticating clients.

7.3. DNS Bootstrapping

The DNS bootstrap phase relies on DNS for the reverse IP tree. When using DNS to discover a DORMS server's domain name, there must be a trust relationship between the end consumer of this resource record and the DNS server. This relationship may be end-to-end DNSSEC validation, a TSIG [RFC2845] or SIG(0) [RFC2931] channel to another secure source, a secure local channel on the host, DNS over TLS [RFC7858] or HTTPS [RFC8484], or some other secure mechanism.

If the SRV Resource Record cannot be authenticated, it may be possible for an attacker who can spoof the resource record to perform a denial of service for the receiver by providing wrong or missing authentication metadata. An attacker who can also inject traffic for (S,G)s, would also be able to provide false content in the data stream, so an attacker who can perform both could provide authenticated false content by authenticating with a trust anchor from an attacker-controlled DORMS server.

Clients MAY use other secure methods to explicitly associate an (S,G) with a set of DORMS server hostnames, such as a configured mapping or an alternative trusted lookup service.

8. Acknowledgements

Thanks to Christian Worm Mortensen for some very helpful comments and review.

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