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A YANG Data Model for Automatic Multicast Tunneling (AMT)
draft-ietf-mboned-amt-yang-05

Abstract

This document defines a YANG data model for the ~~configuration and~~ management of Automatic Multicast Tunneling (AMT) protocol operations.

Commenté [MB1]: This is covered by management.

As a reminder C is one of the FCAPS management functions.

Status of this Memo

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1. Introduction

[RFC7450] introduces the protocol definition of the Automatic Multicast Tunneling (AMT) for delivering multicast traffic from sources in a multicast-enabled network to receivers that lack multicast connectivity to the source network. ~~The protocol~~AMT uses UDP encapsulation and unicast replication to provide this functionality.

[RFC8777] updates [RFC7450] by modifying the relay discovery process. It defines DNS Reverse IP AMT Discovery (DRIAD) mechanism for AMT gateways to discover AMT relays that are capable of forwarding multicast traffic from a known source IP address.

This document defines a YANG data models for ~~configuring and managing~~ AMT ~~Protocol~~protocol.

~~The YANG module defined in this document conforms to the Network Management Datastore Architecture (NMDA) [RFC8342].~~

Commenté [MB2]: The new guidance in RFC8704bis is to call out when this is not compliant.

~~1.1-2.~~2. Terminology & Notation Conventions

2.1. Conventions Used in This Document

~~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.~~

2.2 Terminology

The terminology for describing YANG data models is found in [RFC6020] and [RFC7950], including:

- o augment

- o data model
- o data node
- o identity
- o module

~~The following abbreviations are used in this document and the defined model:~~

~~AMT: Automatic Multicast Tunneling [RFC7450],~~

~~XX~~

~~1.2. Conventions Used in This Document~~

~~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.~~

~~1.3. Tree Diagrams~~

Tree diagrams used in this document follow the notation defined in [RFC8340].

2. Data Model Overview

~~AMT YANG data models are defined in this document.~~

~~The ietf-amt.yang data model~~The AMT data model provides the methods for configuring and managing AMT pProtocol. It includes:

- o Parameters of AMT relay service, such as Relay Discovery Address (Section 4.1.5 of [RFC7450]), Relay Address (Section 4.1.5 of [RFC7450]), service switch, the maximum number of tunnels, and secret key timeout.
- o Parameters of AMT gateway service, such as Relay Discovery Address, Relay Address, Discovery Timeout, Request Timeout and Maximum Retransmission Count.
- o AMT tunnel information, such as endpoint IP address and UDP port number, local IP address and UDP port number.
- o DNS Rresource record-Record (RR) used by an AMT relay service.

2.1. Prefixes in Data Node Names

~~In this document, names of data nodes, actions, and other data model objects are often used without a prefix, as long as it is clear from the context in which YANG module each name is defined. Otherwise, names are prefixed using the standard prefix associated with the~~

Commenté [MB3]: This is not needed as this is about one entry. This is already expanded in the intro.

Commenté [MB4]: Please add key AMT terms that are used in the doc: AMT relay/GW/etc.

Commenté [MB5]: I suggest to add a figure to show the various components. This would help readers understand which parts are covered by the module and also the interactions between various components.

Commenté [MB6]: As this is about a YANG file.

Please check the discussion about data model vs module in Section 2.5 of RFC8407bis

Commenté [MB7]: Should be defined in the terminology section

Commenté [MB8]: Add where this parameter is defined.

Commenté [MB9]: Add where this is defined.

Commenté [MB10]: Should be defined in the terminology section

Commenté [MB11]: Consider adding pointers where each of these parameters is defined.

Commenté [MB12]: There is no actions in the doc

corresponding YANG module, as shown in Table 1 summarizes the prefixes used in this document.

Prefix	YANG module	Reference
inet	ietf-inet-types	[RFC6991]
rt-types	ietf-routing-types	[RFC8294]
rt	ietf-routing	[RFC8349]
yang	ietf-yang-types	[RFC6991]
if	ietf-interfaces	[RFC8343]

Commenté [MB13]: Please update as this is obsoleted by RFC9911.

Table 1: Prefixes and Corresponding YANG Modules

Commenté [MB14]: Move this to be under the YANG module as prefixes are used there.

3. AMT YANG Module

3.1. Tree View

The complete tree of the "ietf-amt-yang" data-model YANG module is represented as following in Figure X. See [RFC8340] for an explanation of the symbols used.

Commenté [MB15]: Already mentionned in the terminology section

The AMT YANG module augments the core routing data-model YANG module "ietf-routing" specified in [RFC8349]. Specifically, The the AMT model YANG module augments "/rt:routing/rt:control-plane-protocols".

```
module: ietf-amt
  augment /rt:routing/rt:control-plane-protocols:
    +--rw amt!
      +--rw relay
        +--rw relay-addresses
          | | +--rw relay-address* [family]
          | |   +--rw family identityref
          | |   +--rw anycast-prefix inet:ip-prefix
          | |   +--rw local-address inet:ip-address
          | +--rw tunnel-limit? uint32
          | +--rw secret-key-timeout? uint32
          +--ro tunnels
            | | +--ro tunnel* [gateway-address gateway-port]
            | |   +--ro gateway-address inet:ip-address
            | |   +--ro gateway-port inet:port-number
            | |   +--ro local-address inet:ip-address
            | |   +--ro local-port inet:port-number
            | |   +--ro state enumeration
            | |   +--ro multicast-flows
            | |     +--ro multicast-flow* [source-address group-address]
            | |       | | +--ro source-address
            | |       | |   ip-multicast-source-address
            | |       +--ro group-address
```

Commenté [MB16]: Relay and GW may not supported by the same device. No?
I would define two features: relay and gw to conditionnally trim part of the model that applies to each components

Commenté [MB17]: Do we need to say something about private key provisioning?

```

| | | rt-types:ip-multicast-group-address
| | +--ro multicast-group-num yang:gauge32
| | +--ro request-message-count
| | | yang:zero-based-counter64
| | +--ro membership-query-message-count
| | | yang:zero-based-counter64
| | +--ro membership-update-message-count
| | | yang:zero-based-counter64
| +--rw relay-dns-resource-records
| | +--rw relay-dns-resource-record* [source-address]
| | | +--rw source-address inet:ip-address
| | | +--rw precedence? uint32
| | | +--rw d-flag? boolean
| | | +--rw relay-type? enumeration
| | | +--rw discovery-address? inet:ip-address
| | | +--rw domain-name? inet:domain-name
| +--ro relay-message-statistics
| | +--ro received
| | | +--ro relay-discovery yang:zero-based-counter64
| | | +--ro request yang:zero-based-counter64
| | | +--ro membership-update yang:zero-based-counter64
| | | +--ro teardown yang:zero-based-counter64
| | +--ro sent
| | | +--ro relay-advertisement yang:zero-based-counter64
| | | +--ro membership-query yang:zero-based-counter64
| | +--ro error
| | | +--ro incomplete-packet yang:zero-based-counter64
| | | +--ro invalid-mac yang:zero-based-counter64
| | | +--ro unexpected-type yang:zero-based-counter64
| | | +--ro invalid-relay-discovery-address
| | | | yang:zero-based-counter64
| | | +--ro invalid-membership-request-address
| | | | yang:zero-based-counter64
| | | +--ro invalid-membership-update-address
| | | | yang:zero-based-counter64
| | | +--ro incomplete-relay-discovery-messages
| | | | yang:zero-based-counter64
| | | +--ro incomplete-membership-request-messages
| | | | yang:zero-based-counter64
| | | +--ro incomplete-membership-update-messages
| | | | yang:zero-based-counter64
| | | +--ro no-active-gateway yang:zero-based-counter64
| | | +--ro invalid-inner-header-checksum
| | | | yang:zero-based-counter64
| | | +--ro gateways-timed-out yang:gauge64
+--rw gateway
| +--rw pseudo-interfaces
| | +--rw pseudo-interface* [interface]
| | | +--rw interface if:interface-ref
| | | +--rw discovery-method enumeration
| | | +--rw relay-discovery-address? inet:ip-address
| | | +--rw relay-address? inet:ip-address
| | | +--rw upstream-interface? if:interface-ref
| | | +--rw discovery-timeout? uint32
| | | +--rw discovery-retrans-count? uint32
| | | +--rw request-timeout? uint32
| | | +--rw request-retrans-count? uint32
| | | +--rw dest-unreach-retry-count? uint32

```

Commenté [MB18]: I would position this one before tunnels.

Commenté [MB19]: Does this corresponds to the D-bit?
I would use that name, not flag

Commenté [MB20]: Some | are missing

```

|      +--rw relay-port?          inet:port-number
|      +--ro local-address?       inet:ip-address
|      +--ro local-port?         inet:port-number
|      +--ro tunnel-state        enumeration
|      +--ro relay-discovery-message-count
|      |                          yang:zero-based-counter64
|      +--ro relay-advertisement-message-count
|      |                          yang:zero-based-counter64
|      +--ro request-message-count
|      |                          yang:zero-based-counter64
|      +--ro membership-query-message-count
|      |                          yang:zero-based-counter64
|      +--ro membership-update-message-count
|      |                          yang:zero-based-counter64
+--ro gateway-message-statistics
  +--ro received
  |   +--ro relay-advertisement yang:zero-based-counter64
  |   +--ro membership-query   yang:zero-based-counter64
  +--ro sent
  |   +--ro relay-discovery    yang:zero-based-counter64
  |   +--ro request            yang:zero-based-counter64
  |   +--ro membership-update  yang:zero-based-counter64
  |   +--ro teardown           yang:zero-based-counter64

```

Figure X: AMT Tree Structure

3.2. Yang YANG Module Module

This document imports modules defined in [RFC9961], [RFC8294], [RFC8343], and [RFC8349].

```

<CODE BEGINS> file "ietf-amt@20222026-1102-1726.yang"
module ietf-amt {
  yang-version "1.1";
  namespace "urn:ietf:params:xml:ns:yang:ietf-amt";
  prefix amt;

  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 69919911: Common YANG Data Types, Section 4";
  }

  import ietf-yang-types {
    prefix yang;
    reference
      "RFC 69919911: Common YANG Data Types, Section 3";
  }

  import ietf-routing-types {
    prefix rt-types;
    reference
      "RFC 8294: Common YANG Data Types for the Routing Area";
  }

  import ietf-interfaces {
    prefix if;

```

Commenté [MB21]: You may consider moving the full tree to an appendix, but use snippets to explain the role/meaning of main parts of the hierarchy.

You can refer to <https://www.rfc-editor.org/rfc/rfc9834.html#name-the-attachment-circuit-serv> for an example.

```
reference
  "RFC 8343: A YANG Data Model for Interface Management";
}

import ietf-routing {
  prefix rt;
  reference
    "RFC 8349: A YANG Data Model for Routing Management
      (NMDA Version)";
}

organization
  "IETF Multicast Backbone Deployment (MBONED) Working Group";
```

```
contact
  "WG Web:    <https://datatracker.ietf.org/wg/mboned/>
  WG List:    MBONED <mailto:mboned@ietf.org>

  Editor:     Yisong Liu
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  Editor:     Zheng(Sandy) Zhang
               <mailto:zhang.zheng@zte.com.cn>
  Editor:     Xuesong Geng
               <mailto:gengxuesong@huawei.com>
  Editor:     Vinod Kumar Nagaraj
               <mailto:vinkumar@juniper.net>";
```

```
description
  "This module describes a YANG model for configuring and
  managing the AMT pProtocol.
```

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 YANG model conforms to the Network Management
Datastore Architecture (NMDA) as described in RFC 8342.~~

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All revisions of IETF and IANA published modules can be found at the YANG Parameters registry group (<https://www.iana.org/assignments/yang-parameters>).

This version of this YANG module is part of RFC XXXX; 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."~~

```
revision 20222026-1102-17-26 {
  description
    "Initial Version";
  reference
    "RFC XXXX: A YANG Data Model for Automatic Multicast Tunneling";
}
```

```
identity address-family {
  description
    "Base identity from which identities describing address
    families are derived.";
}
```

```
identity ipv4 {
  base address-family;
  description
    "This identity represents an IPv4 address family.";
}
```

```
identity ipv6 {
  base address-family;
  description
    "This identity represents an IPv6 address family.";
}
```

```
typedef ip-multicast-source-address {
  type union {
    type rt-types:ipv4-multicast-source-address;
    type rt-types:ipv6-multicast-source-address;
  }
  description
    "This type represents a version-neutral IP multicast source
    address. The format of the textual representation implies
    the IP versionaddress family.";
}
```

```
augment "/rt:routing/rt:control-plane-protocols" {
  description
    "AMT augmentation to the routing instance model.";
  container amt {
    description
      "Configuration Management parameters for the AMT protocol.";
    container relay {
      description
        "Parameters of AMT relay service.";
      container relay-addresses {
        description
          "Parameters of AMT relay addresses.";
      }
    }
  }
}
```

```
list relay address {
```

Commenté [MB22]: Why not reusing address-family from RFC 8349 that we already import here.

Commenté [MB23]: Please add reference clauses for each of the parameters.

Commenté [MB24]: As this can be used for retrieval as well

Commenté [MB25]: No need to repeat the parent prefix.


```

    key "family";
    description
        "Each entry contains parameters for an AMT relay
        address identified by the 'family' key. Under normal
        operation, these addresses belong to the same address family indicated by
        the 'family'. Any mismatch is indication of abnormal configurations.";
    leaf family {
        type identityref {
            base address-family;
        }
        mandatory true;
        description
            "Indicates the Address-address family for the entry.";
    }
    leaf anycast-prefix {
        type inet:ip-prefix;
        description
            "The anycast IP prefix of AMT relay discovery
            address which is used when sending discovery
            messages to a relay.";
    }
    leaf local-address {
        type inet:ip-address;
        description
            "The A unicast IP address of the AMT relay address
            which is obtained as a result of the discovery
            process.";
    }
}
}
leaf tunnel-limit {
    type uint32;
    description
        "The total number of endpoints.";
}
leaf secret-key-timeout {
    type uint32;
    description
        "The timeout interval of secret key.";
}
container tunnels {
    config false;
    description
        "The AMT tunnel information on the relay.";
    list tunnel {
        key "gateway-address gateway-port";
        description
            "An entry of AMT tunnelRecords a tunnel entry.";
        leaf gateway-address {
            type inet:ip-address;
            description
                "The IP address of an AMT gateway.";
        }
        leaf gateway-port {
            type inet:port-number;
            description
                "The UDP port number of an AMT gateway.";
        }
    }
}

```

Commenté [MB26]: Hmm, we do say this is a «key». This is redundant.

Commenté [MB27]: This means that we allow only for one and only one address per address family?

Is that really intended?

Commenté [MB28]: What is the typical usage of a list that has only the family key?

I guess this can be used for a GET to query local configuration. If so, please add such intended use in the description.

Commenté [MB29]: Please consider expanding a bit the description to be useful for readers.

```

leaf local-address {
  type inet:ip-address;
  description
    "The local IP address of the AMT relay.";
}
leaf local-port {
  type inet:port-number;
  description
    "The local UDP port of the AMT relay.";
}
leaf state {
  type enumeration {
    enum up {
      description
        "The AMT tunnel has been successfully
        established.";
    }
    enum establishing {
      description
        "The AMT tunnel is being established.";
    }
  }
  description
    "The state of AMT tunnel.";
}

```

Commenté [MB30]: Couldn't we simply reuse the udp-client grouping from draft-ietf-netconf-udp-client-server?

```

container multicast-flows {
  config false;
  description
    "The multicast flow information in the AMT tunnel.";
  list multicast-flow {
    key "source-address group-address";
    description
      "An entry of multicast flow. Records the

```

Commenté [MB31]: Are we confident these are the one possible state?

Wouldn't there be other state to track failed/discarded/etc.

I suggest we define those as identities so that we have something that we can extend in the future if needed.

Commenté [MB32]: Please expand a bit the description.

```

      characteristics of a multicast flow.";
      leaf source-address {
        type ip-multicast-source-address;
        description
          "The source IP address of a multicast flow.";
      }
      leaf group-address {
        type rt-types:ip-multicast-group-address;
        description
          "The group IP address of a multicast flow.";
      }
    }
  }

```

Commenté [MB33]: Idem as above. Please add an Operational consideration that these are supposed to be from the same address family.

Any mismatch indicates an anomaly.

```

leaf multicast-group-num {
  type yang:gauge32;
  description
    "Number of multicast groups.";
}
leaf request-message-count {
  type yang:zero-based-counter64;
  description
    "Number of AMT request messages received
    in the tunnel.";
}
leaf membership-query-message-count {

```

```

        type yang:zero-based-counter64;
        description
            "Number of AMT membership query messages sent
            in the tunnel.";
    }
    leaf membership-update-message-count {
        type yang:zero-based-counter64;
        description
            "Number of AMT membership update messages received
            in the tunnel.";
    }
}
}
container relay-dns-resource-records {
    description
        "The DNS Rresource records Records (RRs) of the AMT
relay.";
    list relay-dns-resource record {
        key "source-address";
        description
            "An entry of AMT relay resource recordSpecifies an RR
entry.";
        leaf source-address {
            type inet:ip-address;
            description
                "The IP address of multicast sender.";
        }
        leaf precedence {
            type uint32;
            description
                "The precedence of this record.";
        }
        leaf d-flag {
            type boolean;
            default false;
            description
                "If the D-bit is set to true, the gateway MAY
                send an AMT Request message directly to the
                discovered relay address without first
                sending an AMT Discovery message.
                If the D-bit is set to false, the gateway MUST
                receive an AMT relay advertisement message
                for an address before sending an AMT
                Request message to that address.";
        }
    }
    leaf relay-type {
        type enumeration {
            enum empty {
                value 0;
                description
                    "The relay field is empty.";
            }
            enum ipv4-address {
                value 1;
                description
                    "The relay field contains a 4-octet IPv4
                    address.";
            }
        }
    }
}

```

Commenté [MB34]: Should we have a record of discontinuity time?

I think we need one here

Commenté [MB35]: Need more description so that this be useful.

Also, add a reference clause.

Commenté [MB36]: Please add a reference clause

Commenté [MB37]: Can a relay be identified by multiple types?

If so, how this is supposed to work with this structure?

If not, please say so in the description.

```

enum ipv6-address {
    value 2;
    description
        "The relay field contains a 16-octet IPv6
        address.";
}
enum domain-name {
    value 3;
    description
        "The relay field contains a wire-encoded
        domain name.";
}
}
description
    "The type of Relay address.";
}
leaf discovery-address {
    type inet:ip-address;
    description
        "The IP address of AMT relay discovery address.";
}
leaf domain-name {
    type inet:domain-name;
    description
        "The wire-encoded domain name of AMT relay.";
}
}
}
container relay-message-statistics {
    config false;
    description
        "Message statistics of an AMT relay.";
    container received {
        description
            "Received message statistics of AMT relay.";
        leaf relay-discovery {
            type yang:zero-based-counter64;
            description
                "Number of AMT relay discovery messages
                received.";
        }
        leaf request {
            type yang:zero-based-counter64;
            description
                "Number of AMT membership request messages
                received.";
        }
        leaf membership-update {
            type yang:zero-based-counter64;
            description
                "Number of AMT membership update messages
                received.";
        }
        leaf teardown {
            type yang:zero-based-counter64;
            description
                "Number of AMT teardown messages received.";
        }
    }
}

```

Commenté [MB38]: Please indicate how this is supposed to be used.

Commenté [MB39]: Do these depend on the value of relay-type?

Commenté [MB40]: Idem as above, should a discontinuity time be provided?

The comment applies for similar parts of the module below.

```

}
container sent {
  description
    "Sent message statistics of AMT relay.";
  leaf relay-advertisement {
    type yang:zero-based-counter64;
    description
      "Number of AMT relay advertisement messages sent.";
  }
  leaf membership-query {
    type yang:zero-based-counter64;
    description
      "Number of AMT membership query messages sent.";
  }
}
container error {
  description
    "Error message statistics of AMT relay.";
  leaf incomplete-packet {
    type yang:zero-based-counter64;
    description
      "Number of messages received with length errors
      so severe that further classification could not
      occur.";
  }
  leaf invalid-mac {
    type yang:zero-based-counter64;
    description
      "Number of messages received with an invalid
      message authentication code (MAC).";
  }
  leaf unexpected-type {
    type yang:zero-based-counter64;
    description
      "Number of messages received with an unknown
      message type specified.";
  }
  leaf invalid-relay-discovery-address {
    type yang:zero-based-counter64;
    description
      "Number of AMT relay discovery messages
      received with an address other than the
      configured anycast address.";
  }
  leaf invalid-membership-request-address {
    type yang:zero-based-counter64;
    description
      "Number of AMT membership request messages
      received with an address other than the
      configured AMT local address.";
  }
  leaf invalid-membership-update-address {
    type yang:zero-based-counter64;
    description
      "Number of AMT membership update messages
      received with an address other than the
      configured AMT local address.";
  }
}

```

```

leaf incomplete-relay-discovery-messages {
  type yang:zero-based-counter64;
  description
    "Number of AMT relay discovery messages
    received that are not fully formed.";
}
leaf incomplete-membership-request-messages {
  type yang:zero-based-counter64;
  description
    "Number of AMT membership request messages
    received that are not fully formed.";
}
leaf incomplete-membership-update-messages {
  type yang:zero-based-counter64;
  description
    "Number of AMT membership update messages
    received that are not fully formed.";
}
leaf no-active-gateway {
  type yang:zero-based-counter64;
  description
    "Number of AMT membership update messages
    received for a tunnel that does not exist
    for the gateway that sent the message.";
}
leaf invalid-inner-header-checksum {
  type yang:zero-based-counter64;
  description
    "Number of AMT membership update messages
    received with an invalid IP checksum.";
}
leaf gateways-timed-out {
  type yang:gauge64;
  description
    "Number of gateways that timed out because
    of inactivity.";
}
}
} // relay
container gateway {
  description
    "Parameters of AMT gateway service.";
  container pseudo-interfaces {
    description
      "Parameters of AMT pseudo-interface.";
    list pseudo-interface {
      key "interface";
      description
        "An entry of AMT pseudo-interface.";
      leaf interface {
        type if:interface-ref;
        description
          "Indicates a Pseudo-pseudo interface.";
      }
    }
    leaf discovery-method {
      type enumeration {
        enum by-amt-solicit {

```

Commenté [MB41]: Add to the terminology section.

Commenté [MB42]: Do we expect that other methods to be defined in the future?

If so, please define this as identities.

```

        description
            "Find the relay address by sending an AMT
            Discovery message.";
    }
    enum by-dns-reverse-ip {
        description
            "Find the relay address by DNS reverse IP
            AMT Discovery.";
    }
}
description
    "The method used to discover the relay address.";
}
leaf relay-discovery-address {
    type inet:ip-address;
    description
        "IP address of the AMT relay discovery address.";
}
leaf relay-address {
    type inet:ip-address;
    description
        "IP address of the AMT relay address.";
}
leaf upstream-interface {
    type if:interface-ref;
    description
        "Upstream interface.";
}
leaf discovery-timeout {
    type uint32;
    description
        "Initial time to wait for a response to
        a Relay Discovery message.";
}
leaf discovery-retrans-count {
    type uint32;
    description
        "Maximum number of Relay Discovery retransmissions
        to allow before terminating relay discovery
        and reporting an error.";
}
leaf request-timeout {
    type uint32;
    description
        "Initial time to wait for a response
        to a Request message";
}
leaf request-retrans-count {
    type uint32;
    description
        "Maximum number of Request retransmissions
        to allow before abandoning a relay and restarting
        relay discovery or reporting an error.";
}
leaf dest-unreach-retry-count {
    type uint32;
    description
        "The maximum number of times a gateway should

```

```

        attempt to send the same Request or Membership
        Update message after receiving an ICMP Destination
        Unreachable message.";
    }
    leaf relay-port {
        type inet:port-number;
        description
            "The UDP port number of AMT relay.";
    }
    leaf local-address {
        type inet:ip-address;
        config false;
        description
            "The local IP address of this AMT tunnel.";
    }
    leaf local-port {
        type inet:port-number;
        config false;
        description
            "The local UDP port number of this AMT tunnel.";
    }
    leaf tunnel-state {
        type enumeration {
            enum initial {
                description
                    "Initial state.";
            }
            enum discovering {
                description
                    "The Relay Discovery message has been sent
                    and is waiting for the Advertisement message.";
            }
            enum requesting {
                description
                    "The Request message has been sent,
                    waiting for the Query message.";
            }
            enum up {
                description
                    "The AMT tunnel is Established.";
            }
        }
        config false;
        description
            "The tunnel's state.";
    }
    leaf relay-discovery-message-count {
        type yang:zero-based-counter64;
        config false;
        description
            "Number of AMT relay discovery messages sent
            on the interface.";
    }
    leaf relay-advertisement-message-count {
        type yang:zero-based-counter64;
        config false;
        description
            "Number of AMT relay advertisement messages received

```

Commenté [MB43]: Same as above


```

        on the interface.";
    }
    leaf request-message-count {
        type yang:zero-based-counter64;
        config false;
        description
            "Number of AMT membership request messages sent
            on the interface.";
    }
    leaf membership-query-message-count {
        type yang:zero-based-counter64;
        config false;
        description
            "Number of AMT membership query messages received
            on the interface.";
    }
    leaf membership-update-message-count {
        type yang:zero-based-counter64;
        config false;
        description
            "Number of AMT membership update messages sent
            on the interface.";
    }
}
}
container gateway-message-statistics {
    config false;
    description
        "Message statistics of AMT Gateway.";
    container received {
        description
            "Received message statistics of AMT Gateway.";
        leaf relay-advertisement {
            type yang:zero-based-counter64;
            description
                "Number of AMT relay advertisement messages
                received.";
        }
        leaf membership-query {
            type yang:zero-based-counter64;
            description
                "Number of AMT membership query messages
                received.";
        }
    }
}
container sent {
    description
        "Sent message statistics of AMT Gateway.";
    leaf relay-discovery {
        type yang:zero-based-counter64;
        description
            "Number of AMT relay discovery messages sent.";
    }
    leaf request {
        type yang:zero-based-counter64;
        description
            "Number of AMT membership request messages sent.";
    }
}

```

```

        leaf membership-update {
            type yang:zero-based-counter64;
            description
                "Number of AMT membership update messages sent.";
        }
        leaf teardown {
            type yang:zero-based-counter64;
            description
                "Number of AMT teardown messages sent.";
        }
    }
} // gateway
} // amt
} // augment
}
<CODE ENDS>

```

4. Data Model Example

This section presents a simple and illustrative example of how to configure AMT.

The example is represented in XML [W3C.REC-xml-20081126].

~~The following is~~ Figure X shows -an example configuration for an AMT relay service.

This example configures the protocol address family (IPv4), secret key timeout (120 minutes), and tunnel limit (10) for AMT relay function. In addition, the AMT anycast prefix is set to 10.10.10.10/32 and the AMT local address is configured to 10.255.112.201.

```

<?xml version="1.0" encoding="UTF-8"?>
<config xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <routing xmlns="urn:ietf:params:xml:ns:yang:ietf-routing">
    <control-plane-protocols>
      <amt xmlns="urn:ietf:params:xml:ns:yang:ietf-amt">
        <relay>
          <relay-addresses>
            <relay-address>
              <family>ipv4</family>
              <anycast-prefix>10.10.10.10/32</anycast-prefix>
              <local-address>10.255.112.201</local-address>
            </relay-address>
          </relay-addresses>
          <tunnel-limit>12</tunnel-limit>
          <secret-key-timeout>120</secret-key-timeout>
        </relay>
      </amt>
    </control-plane-protocols>
  </routing>
</config>

```

Figure X: XXXX

5. Security Considerations

Commenté [MB44]: Please move this to an appendix as this is informative.

Commenté [MB45]: Please use documentation addresses in rfc5737

Commenté [MB46]: Please add an example with IPv6

Commenté [MB47]: For readers convenience, I suggest to use JSON?

Commenté [MB48]: Please update to follow the template at <https://datatracker.ietf.org/doc/html/draft-ietf-netmod-rfc8407bis-28#name-security-considerations-sect>

This section is modeled after the template described in Section 3.7 of [I-D.ietf-netmod].

a mis en forme : Anglais (États-Unis)

The "ietf-amt" YANG module defines a data model that is designed to be accessed via YANG-based management protocols, such as NETCONF [RFC6241] and RESTCONF [RFC8040]. These protocols have to use a secure transport layer (e.g., SSH [RFC4252], TLS [RFC8446], and QUIC [RFC9000]) and have to use mutual authentication.

The Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in this YANG module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations. These are the subtrees and data nodes and their sensitivity/vulnerability:

Under /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/:

amt/relay/relay-addresses/relay-address

This subtree specifies the IPv4 or IPv6 address information for an AMT relay. Modifying the configuration may cause the AMT tunnel to be torn down or established.

a mis en forme : Retrait : Gauche : 1,25 cm

Commenté [MB49]: Fix formatting

amt/relay/relay-dns-resource-records/relay-dns-resource-record

This subtree specifies the DNS ~~resource-records~~RR configuration used to discover AMT relays. Modifying this configuration may cause the AMT gateway to discover new AMT relay devices, or fail to discover AMT relay devices.

a mis en forme : Retrait : Gauche : 1,25 cm

amt/gateway/pseudo-interfaces/pseudo-interface

This subtree specifies the parameters of AMT pseudo-interface for an AMT gateway. Modifying this configuration may cause the AMT gateway to establish or tear down tunnels with multiple AMT relays.

a mis en forme : Retrait : Gauche : 1,25 cm

Unauthorized access to any data nodes in these subtrees can adversely affect the AMT subsystem of both the local device and the network. This may lead to network malfunctions, delivery of packets to inappropriate destinations, and other problems.

Some of the readable data nodes in this YANG module may be

considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. These are the subtrees and data nodes and their sensitivity/vulnerability:

Under /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/:

amt/relay

amt/gateway

Unauthorized access to any data nodes in these subtrees can disclose operational state information about the AMT relay or AMT gateway on this device.

a mis en forme : Retrait : Gauche : 1,25 cm

6. IANA Considerations

RFC Ed.: ~~In this section, Please~~ replace all occurrences of 'XXXX' with the actual RFC number (and remove this note).

6.1. IETF XML Registry

The IANA is requested to assign the following URI in the "IETF XML Registry" [RFC3688]:

URI: urn:ietf:params:xml:ns:yang:ietf-amt
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.

6.2. YANG Module Names Registry

This document ~~request IANA to~~ registers the following YANG module in the "YANG Module Names" registry [RFC6020]:

Name: ietf-amt
Maintained by IANA? N
Namespace: urn:ietf:params:xml:ns:yang:ietf-amt
Prefix: amt
Reference: RFC XXXX

7. References

7.1. Normative References

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- [RFC8777] Holland, J., "DNS Reverse IP Automatic Multicast Tunneling (AMT) Discovery", RFC 8210, DOI 10.17487/RFC8777, April 2020, <<https://www.rfc-editor.org/info/rfc8777>>.

7.2. Informative References

- [RFC4252] Ylonen, T. and C. Lonvick, Ed., "The Secure Shell (SSH) Authentication Protocol", RFC 4252, DOI 10.17487/RFC4252, January 2006, <<https://www.rfc-editor.org/info/rfc4252>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
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Commenté [MB50]: To be updated to 9911

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