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YANG Data Model for Automatic Multicast Tunneling
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Abstract

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

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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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 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 YANG data models for configuring and managing AMT Protocol.

1.1. Terminology

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

o augment

o data model

- data node
- identity
- module

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

AMT: Automatic Multicast Tunneling [RFC7450].

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].

1.4. 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 corresponding YANG module, as shown in Table 1.

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]

Table 1

2. Model Overview

AMT YANG data models are defined in this document.

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

- Parameters of AMT Relay service, such as Relay Discovery Address, Relay Address, service switch, the maximum number of tunnels and secret key timeout.

- Parameters of AMT gateway service, such as Relay Discovery Address, Relay Address, Discovery Timeout, Request Timeout and Maximum Retransmission Count.

- AMT tunnel information, such as endpoint address and UDP port, local address and UDP port.

- DNS resource record used by AMTRELAY.

3. AMT YANG Module

3.1. Tree View

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

This model augments the core routing data model "ietf-routing" specified in [RFC8349]. The AMT model 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-address
          |  |     +--rw local-address      inet:ip-address
          |  +--rw tunnel-limit?            uint32
          |  +--rw secret-key-timeout?      uint32
          |  +--ro amt-tunnels
          |  |  +--ro amt-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 multicastflows
          |  |     |  +--ro multicastflow* [source-address
          |  |     |     |                      group-address]
          |  |     |     +--ro source-address
          |  |     |     |         ip-multicast-source-address
          |  |     |     +--ro group-address
          |  |     |               rt-types:ip-multicast-group-address
          |  |     +--ro multicast-group-num               uint32
          |  |     +--ro request-message-count             uint64
          |  |     +--ro membership-query-message-count    uint64
          |  |     +--ro membership-update-message-count   uint64
          |  +--rw amtrelay-dns-resource-records
          |  |  +--rw amtrelay-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 amtrelay-message-statistics
          |     +--ro amtrelay-received-message-statistics
          |        +--ro relay-discovery        uint64
          |        +--ro request                uint64
          |        +--ro membership-update      uint64
          |        +--ro teardown               uint64
          |     +--ro amtrelay-sent-message-statistics
          |        +--ro relay-advertisement    uint64
          |        +--ro membership-query       uint64
          |     +--ro amtrelay-error-message-statistics
          |        +--ro incomplete-packet      uint64
```

```
          |       +--ro invalid-mac            uint64
          |       +--ro unexpected-type        uint64
          |       +--ro invalid-relay-discovery-address         uint64
          |       +--ro invalid-membership-request-address      uint64
          |       +--ro invalid-membership-update-address       uint64
          |       +--ro incomplete-relay-discovery-messages     uint64
          |       +--ro incomplete-membership-request-messages  uint64
          |       +--ro incomplete-membership-update-messages   uint64
          |       +--ro no-active-gateway                       uint64
          |       +--ro invalid-inner-header-checksum           uint64
          |       +--ro gateways-timed-out                      uint64
          +--rw gateway
             +--rw pseudo-interfaces
             |  +--rw pseudo-interface* [ifIndex]
             |     +--rw ifIndex                   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
             |     +--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       uint64
             |     +--ro relay-advertisement-message-count   uint64
             |     +--ro request-message-count               uint64
             |     +--ro membership-query-message-count      uint64
             |     +--ro membership-update-message-count     uint64
             +--ro amtgateway-message-statistics
                +--ro amtgateway-received-message-statistics
                |  +--ro relay-advertisement       uint64
                |  +--ro membership-query          uint64
                +--ro amtgateway-sent-message-statistics
                   +--ro relay-discovery           uint64
                   +--ro request                   uint64
                   +--ro membership-update         uint64
                   +--ro teardown                  uint64
```

3.2. Yang Module

```
<CODE BEGINS> file "ietf-amt@2022-11-17.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 6991: Common YANG Data Types";
  }

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

  import ietf-interfaces {
    prefix if;
    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 MBONE Working Group";

  contact
    "TBD";

  description
    "This module describes a YANG model for configuring and managing
     AMT Protocol.

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

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```

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

      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 2022-11-17 {
    description
      "Initial Version";
    reference
      "RFC XXXX, YANG Data Model for Automatic Multicast Tunneling";
  }

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

  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 version.";
  }

  augment "/rt:routing/rt:control-plane-protocols" {
    description
      "AMT augmentation to the routing instance model.";
    container amt {
      description
        "Configuration 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 {
```

```
            key "family";
            description
              "Each entry contains parameters for a AMT relay
               Address identified by the 'family' key.";
            leaf family {
              type identityref {
                base address-family;
              }
              mandatory true;
              description
                "The Address family.";
            }
            leaf anycast-prefix {
              type inet:ip-address;
              description
                "The anycast IP address of AMT Relay Discovery
                 Address.";
            }
            leaf local-address {
              type inet:ip-address;
              description
                "The unicast IP address of AMT Relay Address.";
            }
          }
        }
        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 amt-tunnels {
          config false;
          description
            "The AMT tunnel information on the relay.";
          list amt-tunnel {
            key "gateway-address gateway-port";
            description
              "An entry of AMT tunnel.";
            leaf gateway-address {
              type inet:ip-address;
              description
                "The IP address of AMT gateway.";
            }
```

```
            leaf gateway-port {
              type inet:port-number;
              description
                "The UDP port of AMT gateway.";
            }
            leaf local-address {
              type inet:ip-address;
              description
                "The local IP address of AMT relay.";
            }
            leaf local-port {
              type inet:port-number;
              description
                "The local UDP port of AMT relay.";
            }
            leaf state {
              type enumeration {
                enum up {
                  description
                    "The AMT tunnel has been successfully
                     established.";
                }
                enum establishing {
                  description
                    "The AMT tunnel is being establishing.";
                }
              }
              description
                "The state of AMT tunnel.";
            }
            container multicastflows {
              config false;
              description
                "The multicast flow information in the AMT tunnel.";
              list multicastflow {
                key "source-address group-address";
                description
                  "An entry of multicast flow.";
                leaf source-address {
                  type ip-multicast-source-address;
                  description
                    "The source IP address of multicast flow.";
                }
                leaf group-address {
                  type rt-types:ip-multicast-group-address;
                  description
                    "The group address of multicast flow.";
                }
```

```
            }
          }
          leaf multicast-group-num {
            type uint32;
            description
              "Number of multicast groups.";
          }
          leaf request-message-count {
            type uint64;
            description
              "Number of AMT request messages received
               in the tunnel.";
          }
          leaf membership-query-message-count {
            type uint64;
            description
              "Number of AMT membership query messages sent
               in the tunnel.";
          }
          leaf membership-update-message-count {
            type uint64;
            description
              "Number of AMT membership update messages received
               in the tunnel.";
          }
        }
      }
      container amtrelay-dns-resource-records {
        description
          "The DNS resource records of AMT relay.";
        list amtrelay-dns-resource-record {
          key "source-address";
          description
            "An entry of AMTRELAY resource record.";
          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.";
                    }
                    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 amtrelay-message-statistics {
        config false;
        description
          "Message statistics of AMT Relay.";
        container amtrelay-received-message-statistics {
          description
            "Received message statistics of AMT Relay.";
          leaf relay-discovery {
            type uint64;
            description
              "Number of AMT relay discovery messages
               received.";
          }
          leaf request {
            type uint64;
            description
              "Number of AMT membership request messages
               received.";
          }
          leaf membership-update {
            type uint64;
            description
              "Number of AMT membership update messages
               received.";
          }
          leaf teardown {
            type uint64;
            description
              "Number of AMT teardown messages received.";
          }
        }
        container amtrelay-sent-message-statistics {
          description
            "Sent message statistics of AMT Relay.";
          leaf relay-advertisement {
            type uint64;
            description
              "Number of AMT relay advertisement messages sent.";
          }
          leaf membership-query {
            type uint64;
            description
              "Number of AMT membership query messages sent.";
          }
        }
        container amtrelay-error-message-statistics {
```

```
                description
                  "Error message statistics of AMT Relay.";
                leaf incomplete-packet {
                  type uint64;
                  description
                    "Number of messages received with length errors
                     so severe that further classification could not
                     occur.";
                }
                leaf invalid-mac {
                  type uint64;
                  description
                    "Number of messages received with an invalid
                     message authentication code (MAC).";
                }
                leaf unexpected-type {
                  type uint64;
                  description
                    "Number of messages received with an unknown
                     message type specified.";
                }
                leaf invalid-relay-discovery-address {
                  type uint64;
                  description
                    "Number of AMT relay discovery messages
                     received with an address other than the
                     configured anycast address.";
                }
                leaf invalid-membership-request-address {
                  type uint64;
                  description
                    "Number of AMT membership request messages
                     received with an address other than the
                     configured AMT local address.";
                }
                leaf invalid-membership-update-address {
                  type uint64;
                  description
                    "Number of AMT membership update messages
                     received with an address other than the
                     configured AMT local address.";
                }
                leaf incomplete-relay-discovery-messages {
                  type uint64;
                  description
                    "Number of AMT relay discovery messages
                     received that are not fully formed.";
                }
```

```
            leaf incomplete-membership-request-messages {
              type uint64;
              description
                "Number of AMT membership request messages
                 received that are not fully formed.";
            }
            leaf incomplete-membership-update-messages {
              type uint64;
              description
                "Number of AMT membership update messages
                 received that are not fully formed.";
            }
            leaf no-active-gateway {
              type uint64;
              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 uint64;
              description
                "Number of AMT membership update messages
                 received with an invalid IP checksum.";
            }
            leaf gateways-timed-out {
              type uint64;
              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 ifIndex;
            description
              "An entry of AMT pseudo-interface.";
            leaf ifIndex {
              type if:interface-ref;
              description
                "Index of pseudo interface, which can be ifindex
```

```
                or interface name.";
            }
            leaf discovery-method {
              type enumeration {
                enum by-amt-solicit {
                  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 of discover relay address.";
            }
            leaf relay-discovery-address {
              type inet:ip-address;
              description
                "The IP address of AMT Relay Discovery Address.";
            }
            leaf relay-address {
              type inet:ip-address;
              description
                "The Ip address of AMT relay Address.";
            }
            leaf upstream-interface {
              type if:interface-ref;
              description
                "The index of upstream interface, which can
                 be ifindex or interface name.";
            }
            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 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 of this AMT tunnel.";
      }
      leaf tunnel-state {
        type enumeration {
          enum initial {
            description
              "Initial state.";
          }
          enum discoverying {
            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 uint64;
      config false;
      description
        "Number of AMT relay discovery messages sent
         on the interface.";
    }
    leaf relay-advertisement-message-count {
      type uint64;
      config false;
      description
        "Number of AMT relay advertisement messages received
         on the interface.";
    }
    leaf request-message-count {
      type uint64;
      config false;
      description
        "Number of AMT membership request messages sent
         on the interface.";
    }
    leaf membership-query-message-count {
      type uint64;
      config false;
      description
        "Number of AMT membership query messages received
         on the interface.";
    }
    leaf membership-update-message-count {
      type uint64;
      config false;
      description
        "Number of AMT membership update messages sent
         on the interface.";
```

```
        }
      }
    }
    container amtgateway-message-statistics {
      config false;
      description
        "Message statistics of AMT Gateway.";
      container amtgateway-received-message-statistics {
        description
          "Received message statistics of AMT Gateway.";
        leaf relay-advertisement {
          type uint64;
          description
            "Number of AMT relay advertisement messages
             received.";
        }
        leaf membership-query {
          type uint64;
          description
            "Number of AMT membership query messages
             received.";
        }
      }
      container amtgateway-sent-message-statistics {
        description
          "Sent message statistics of AMT Gateway.";
        leaf relay-discovery {
          type uint64;
          description
            "Number of AMT relay discovery messages sent.";
        }
        leaf request {
          type uint64;
          description
            "Number of AMT membership request messages sent.";
        }
        leaf membership-update {
          type uint64;
          description
            "Number of AMT membership update messages sent.";
        }
        leaf teardown {
          type uint64;
          description
            "Number of AMT teardown messages sent.";
        }
      }
    }
```

```
        } // gateway
      } // amt
    } // augment
  }
  <CODE ENDS>
```

4. Security Considerations

TBD

5. IANA Considerations

TBD

6. References

6.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC6991] Schoenwaelder, J., Ed., "Common YANG Data Types", RFC 6991, DOI 10.17487/RFC6991, July 2013, <https://www.rfc-editor.org/info/rfc6991>.

[RFC8294] Liu, X., Qu, Y., Lindem, A., Hopps, C., and L. Berger, "Common YANG Data Types for the Routing Area", RFC 8294, DOI 10.17487/RFC8294, December 2017, <https://www.rfc-editor.org/info/rfc8294>.

[RFC8349] Lhotka, L., Lindem, A., and Y. Qu, "A YANG Data Model for Routing Management (NMDA Version)", RFC 8349, DOI 10.17487/RFC8349, March 2018, <https://www.rfc-editor.org/info/rfc8349>.

[RFC7450] Bumgardner, G., " Automatic Multicast Tunneling ", RFC 7450, DOI 10.17487/RFC7450, February 2015, <https://www.rfc-editor.org/info/rfc7450>.

[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>.

[RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", BCP 215, RFC 8340, DOI 10.17487/RFC8340, March 2018, <https://www.rfc-editor.org/info/rfc8340>.

6.2. Informative References

TBD

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