

NETMOD
Internet-Draft
Intended status: Standards Track
Expires: April 29, 2018

D. Ding
F. Zheng
Huawei
October 26, 2017

YANG Data Model for ARP
draft-ding-netmod-arp-yang-model-00

Abstract

This document defines a YANG data model to describe Address Resolution Protocol (ARP) configurations. It is intended this model be used by service providers who manipulate devices from different vendors in a standard way.

Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on April 29, 2018.

Copyright Notice

Copyright (c) 2017 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction	2
1.1. Terminology	2
1.2. Tree Diagrams	3
2. Problem Statement	3
3. Design of the Data Model	3
4. YANG Module	5
5. Data Model Examples	13
5.1. Static ARP entries	13
5.2. ARP interfaces	14
6. Security Considerations	14
7. Conclusions	15
8. References	15
8.1. Normative References	15
8.2. Informative References	15
Authors' Addresses	16

1. Introduction

This document defines a YANG [RFC6020] data model for Address Resolution Protocol [RFC826] implementation and identification of some common properties within a device containing a Network Configuration Protocol (NETCONF) server. Devices that are managed by NETCONF and perhaps other mechanisms have common properties that need to be configured and monitored in a standard way.

The data model covers configuration of system parameters of ARP, such as static ARP entries, timeout for dynamic ARP entries, interface ARP, proxy ARP, and so on. It also provides information about running state of ARP implementations.

1.1. Terminology

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].

The following terms are defined in [RFC6241] and are not redefined here:

- o client
- o configuration data
- o server

- o state data

1.2. Tree Diagrams

A simplified graphical representation of the data model is presented in Section 3.

- o Brackets "[" and "]" enclose list keys.
- o Abbreviations before data node names: "rw" means configuration (read-write) and "ro" state data (read-only).
- o Symbols after data node names: "?" means an optional node, "!" means a presence container, and "*" denotes a list and leaf-list.
- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").
- o Ellipsis ("...") stands for contents of subtrees that are not shown.

2. Problem Statement

This document defines a YANG [RFC7950] configuration data model that may be used to configure the ARP feature running on a system. YANG models can be used with network management protocols such as NETCONF [RFC6241] to install, manipulate, and delete the configuration of network devices.

The data model makes use of the YANG "feature" construct which allows implementations to support only those ARP features that lie within their capabilities. It is intended this model be used by service providers who manipulate devices from different vendors in a standard way.

This module can be used to configure the ARP applications for discovering the link layer address associated with a given Internet layer address.

3. Design of the Data Model

This data model intends to describe the processing that a protocol finds the hardware address, also known as Media Access Control (MAC) address, of a host from its known IP address. These tasks include, but are not limited to, adding a static entry in the ARP cache, configuring ARP cache entry timeout, and clearing dynamic entries from the ARP cache.

This data model has one top level container, ARP, which consists of several second level containers. Each of these second level containers describes a particular category of ARP handling, such as defining static mapping between an IP address (32-bit address) and a Media Access Control (MAC) address (48-bit address).

```

module: ietf-arp
  +--rw arp
    +--rw arp-static-tables
      +--rw arp-static-table* [vrf-name ip-address]
        +--rw vrf-name          arp:routing-instance-ref
        +--rw ip-address        inet:ipv4-address-no-zone
        +--rw mac-address       yang:mac-address
        +--rw if-name?          leafref
    +--rw arp-interfaces
      +--rw arp-interface* [if-name]
        +--rw if-name              leafref
        +--rw expire-time?         uint32
        +--rw arp-learn-disable?   boolean
        +--rw proxy-enable?        boolean
        +--rw probe-interval?      uint8
        +--rw probe-times?         uint8
        +--rw probe-unicast?       boolean
        +--rw arp-gratuitous?       boolean
        +--rw arp-gratuitous-interval? uint32
        +--rw arp-gratuitous-drop? boolean
        +--rw arp-if-limits
          +--rw arp-if-limit* [vlan-id]
            +--rw vlan-id          uint16
            +--rw limit-number     uint32
            +--rw threshold-value? uint32
    +--ro arp-tables
      +--ro arp-table* [vrf-name ip-address]
        +--ro vrf-name          arp:routing-instance-ref
        +--ro ip-address        inet:ipv4-address-no-zone
        +--ro mac-address?      yang:mac-address
        +--ro expire-time?      uint32
        +--ro if-name?          leafref
    +--ro arp-statistics
      +--ro global-statistics*
        +--ro requests-received? uint32
        +--ro replies-received?  uint32
        +--ro gratuitous-received? uint32
        +--ro requests-sent?      uint32
        +--ro replies-sent?       uint32
        +--ro gratuitous-sent?    uint32
        +--ro drops-received?     uint32

```

```
|   +--ro total-received?          uint32
|   +--ro total-sent?              uint32
|   +--ro arp-dynamic-count?       uint32
|   +--ro arp-static-count?        uint32
+--ro arp-if-statistics* [if-name]
    +--ro if-name                  leafref
    +--ro requests-received?       uint32
    +--ro replies-received?        uint32
    +--ro gratuitous-received?     uint32
    +--ro requests-sent?           uint32
    +--ro replies-sent?            uint32
    +--ro gratuitous-sent?         uint32
```

4. YANG Module

This section presents the YANG module for the ARP data model defined in this document.

```
<CODE BEGINS> file "ietf-arp@2017-10-18.yang"
module ietf-arp {
  namespace "urn:ietf:params:xml:ns:yang:ietf-arp";
  prefix arp;

  // import some basic types

  import ietf-inet-types {
    prefix inet;
  }

  import ietf-yang-types {
    prefix yang;
  }

  import ietf-interfaces {
    prefix if;
  }

  import ietf-network-instance {
    prefix ni;
  }
  organization
    "IETF Netmod (Network Modeling) Working Group";
  contact
    "WG Web: <http://tools.ietf.org/wg/netmod/>
    WG List: <mailto:netmod@ietf.org>
```

```
    Editor: Xiaojian Ding
            dingxiaojian1@huawei.com
    Editor: Feng Zheng
            habby.zheng@huawei.com";
description
    "Address Resolution Protocol (ARP) management, which includes
        static ARP configuration, dynamic ARP learning, ARP entry query,
        and packet statistics collection.";

revision 2017-10-18 {
    description
        "Init revision";
    reference
        "RFC XXX: ARP (Address Resolution Protocol) YANG data model.";
}

/*grouping*/

grouping arp-prob-grouping {
    description
        "Common configuration for all ARP probe.";
    leaf probe-interval {
        type uint8 {
            range "1..5";
        }
        units "second";
        description
            "Interval for detecting dynamic ARP entries.";
    }
    leaf probe-times {
        type uint8 {
            range "0..10";
        }
        description
            "Number of aging probe attempts for a dynamic ARP entry. If
            a device does not receive an ARP reply message after the number
            of aging probe attempts reaches a specified number, the
            dynamic ARP entry is deleted.";
    }
    leaf probe-unicast {
        type boolean;
        default "false";
        description
            "Send unicast ARP aging probe messages for a dynamic ARP
            entry.";
    }
}
```

```
grouping arp-gratuitous-grouping {
  description
    "Configure gratuitous ARP.";
  leaf arp-gratuitous {
    type boolean;
    default "false";
    description
      "Enable or disable sending gratuitous-arp packet on
       interface.";
  }
  leaf arp-gratuitous-interval {
    type uint32 {
      range "1..86400";
    }
    units "second";
    description
      "The interval of sending gratuitous-arp packet on the
       interface.";
  }
  leaf arp-gratuitous-drop {
    type boolean;
    default "false";
    description
      "Drop the receipt of gratuitous ARP packets on the interface.";
  }
}

grouping arp-statistics-grouping {
  description "IP ARP statistics information";
  leaf requests-received {
    type uint32;
    description "Total ARP requests received";
  }
  leaf replies-received {
    type uint32;
    description "Total ARP replies received";
  }
  leaf gratuitous-received {
    type uint32;
    description "Total gratuitous ARP received";
  }
  leaf requests-sent {
    type uint32;
    description "Total ARP requests sent";
  }
  leaf replies-sent {
    type uint32;
    description "Total ARP replies sent";
  }
}
```

```
    }
    leaf gratuitous-sent {
        type uint32;
        description "Total gratuitous ARP sent";
    }
}

/* Typedefs */

typedef routing-instance-ref {
    type leafref {
        path "/ni:network-instances/ni:network-instance/ni:name";
    }
    description
        "This type is used for leafs that reference a routing instance
        configuration.";
}

/* Configuration data nodes */

container arp {
    description
        "Address Resolution Protocol (ARP) management, which includes
        static ARP configuration, dynamic ARP learning, ARP entry
        query, and packet statistics collection.";

    container arp-static-tables {
        description
            "List of static ARP configurations.";
        list arp-static-table {
            key "vrf-name ip-address";
            description
                "Static ARP table. By default, the system ARP table is
                empty, and address mappings are implemented by dynamic
                ARP.";
            leaf vrf-name {
                type arp:routing-instance-ref;
                description
                    "Name of a VPN instance. This parameter is used to
                    support the VPN feature. If this parameter is
                    set, it indicates that the ARP entry is in the
                    associated VLAN.";
            }
            leaf ip-address {
                type inet:ipv4-address-no-zone;
                description
                    "IP address, in dotted decimal notation.";
            }
        }
    }
}
```



```
    leaf mac-address {
      type yang:mac-address;
      mandatory true;
      description
        "MAC address in the format of H-H-H, in which H is
         a hexadecimal number of 1 to 4 bits. ";
    }
    leaf if-name {
      type leafref {
        path "/if:interfaces/if:interface/if:name";
      }
      description
        "Name of the ARP outbound interface.";
    }
  }
} //End of arp-static-tables

container arp-interfaces {
  description
    "List of ARP Interface configurations.";
  list arp-interface {
    key "if-name";
    description
      "ARP interface configuration, including the aging time,
       probe interval, number of aging probe attempts, ARP
       learning status, and ARP proxy.";
    leaf if-name {
      type leafref {
        path "/if:interfaces/if:interface/if:name";
      }
      description
        "Name of the interface that has learned dynamic ARP
         entries.";
    }
    leaf expire-time {
      type uint32 {
        range "60..86400";
      }
      units "second";
      description
        "Aging time of a dynamic ARP entry.";
    }
    leaf arp-learn-disable {
      type boolean;
      default "false";
      description
        "Whether dynamic ARP learning is disabled. If the value
         is True, dynamic ARP learning is disabled. If the value
```

```

        is False, dynamic ARP learning is enabled.";
    }
    leaf proxy-enable {
        type boolean;
        default "false";
        description
            "Enable proxy ARP.";
    }
    uses arp-prob-grouping;
    uses arp-gratuitous-grouping;

    container arp-if-limits {
        description
            "Maximum number of dynamic ARP entries that an interface
             can learn.";
        list arp-if-limit {
            key "vlan-id";
            description
                "Maximum number of dynamic ARP entries that an
                 interface can learn. If the number of ARP entries that
                 an interface can learn changes and the number of the
                 learned ARP entries exceeds the changed value, the
                 interface cannot learn additional ARP entries. The
                 system prompts you to delete the excess ARP entries.";
            leaf vlan-id {
                type uint16 {
                    range "0..4094";
                }
                description
                    "ID of the VLAN where ARP learning is restricted.
                     This parameter can be set only on Layer 2 interf
aces
and sub-interfaces. Ethernet, GE, VE, and Eth-Trunk
interfaces can be both Layer 3 and Layer 2
interfaces. When they work in Layer 3 mode, they
cannot have VLANs configured. When they work in
Layer 2 mode, they must have VLANs configured. Etherne
t,
GE, and Eth-Trunk sub-interfaces can be both com
mon
and QinQ sub-interfaces. ";
            }
            leaf limit-number {
                type uint32 {
                    range "1..65536";
                }
                mandatory true;
                description
                    "Maximum number of dynamic ARP entries that an
                     interface can learn.";
            }
        }
    }

```

```
        leaf threshold-value {
            type uint32 {
                range "60..100";
            }
            must "not(not(..../limit-number))"{
                description
                "Upper boundary must be higher than lower boundary.";
            }
            description
                "Alarm-Threshold for maximum number of ARP entries
                 that an interface can learn.";
        }
    }
} //End of arp-if-limits
}
} // End of arp-interfaces

container arp-tables {
    config false;
    description
        "List of ARP entries that can be queried.";
    list arp-table {
        key "vrf-name ip-address";
        description
            "Query ARP entries, including static, dynamic, and
             interface-based ARP entries.";
        leaf vrf-name {
            type arp:routing-instance-ref;
            description
                "Name of the VPN instance to which an ARP entry
                 belongs.";
        }
        leaf ip-address {
            type inet:ipv4-address-no-zone;
            description
                "IP address, in dotted decimal notation.";
        }
        leaf mac-address {
            type yang:mac-address;
            description
                "MAC address in the format of H-H-H, in which H is a
                 hexadecimal number of 1 to 4 bits. ";
        }
        leaf expire-time {
            type uint32 {
                range "1..1440";
            }
            description
```

```
        "Aging time of a dynamic ARP entry. ";
    }
    leaf if-name {
        type leafref {
            path "/if:interfaces/if:interface/if:name";
        }
        description
            "Type and number of the interface that has learned ARP
            entries.";
    }
}
} //End of arp-tables

container arp-statistics {
    config false;
    description
        "List of ARP packet statistics.";
    list global-statistics {
        description
            "ARP packet statistics.";
        uses arp-statistics-grouping;
        leaf drops-received {
            type uint32 {
                range "0..4294967294";
            }
            description
                "Number of ARP packets discarded.";
        }
        leaf total-received {
            type uint32 {
                range "0..4294967294";
            }
            description
                "Total number of ARP received packets.";
        }
        leaf total-sent {
            type uint32 {
                range "0..4294967294";
            }
            description
                "Total number of ARP sent packets.";
        }
        leaf arp-dynamic-count {
            type uint32 {
                range "0..4294967294";
            }
            description
                "Number of dynamic ARP count.";
```

```
    }
    leaf arp-static-count {
        type uint32 {
            range "0..4294967294";
        }
        description
            "Number of static ARP count.";
    }
}
list arp-if-statistics {
    key "if-name";
    description
        "ARP statistics on interfaces. ARP statistics on all
         interfaces are displayed in sequence.";
    leaf if-name {
        type leafref {
            path "/if:interfaces/if:interface/if:name";
        }
        description
            "Name of an interface where ARP statistics to be
             displayed reside.";
    }
    uses arp-statistics-grouping;
}
} // End of arp-statistics
}
<CODE ENDS>
```

5. Data Model Examples

This section presents a simple but complete example of configuring static ARP entries and interfaces, based on the YANG module specified in Section 4.

5.1. Static ARP entries

Requirement:

Enable static ARP entry configuration.

```
<config xmlns:xc="urn:ietf:params:xml:ns:netconf:base:1.0">
  <arp xmlns="urn:ietf:params:xml:ns:yang:ietf-arp">
    <arp-static-tables>
      <vrf-name> __public__ </vrf-name>
      <ip-address> 10.2.2.3 </ip-address>
      <mac-address> 00e0-fc01-0000 </mac-address>
      <if-name> GE1/0/1 </if-name>
    </arp-static-tables>
  </arp>
```

5.2. ARP interfaces

Requirement:

Enable static ARP interface configuration.

```
<config xmlns:xc="urn:ietf:params:xml:ns:netconf:base:1.0">
  <arp xmlns="urn:ietf:params:xml:ns:yang:ietf-arp">
    <arp-interfaces>
      <if-name> GE1/0/1 </if-name>
      <expire-time>1200</expire-time>
      <arp-learn-disable>false</arp-learn-disable>
      <proxy-enable>false</proxy-enable>
      <probe-interval>5</probe-interval>
      <probe-times>3</probe-times>
      <probe-unicast>false</probe-unicast>
      <arp-gratuitous>false</arp-gratuitous>
      <arp-gratuitous-interval>60</arp-gratuitous-interval>
      <arp-gratuitous-drop>false</arp-gratuitous-drop>
      <arp-if-limits>
        <vlan-id>3</vlan-id>
        <limit-number>65535</limit-number>
        <threshold-value>80</threshold-value>
      </arp-if-limits>
    </arp-interfaces>
  </arp>
```

6. Security Considerations

The YANG module defined in this document is designed to be accessed via YANG based management protocols, such as NETCONF [RFC6241] and RESTCONF [RFC8040]. Both of these protocols have mandatory-to-implement secure transport layers (e.g., SSH, TLS) with mutual authentication.

The NETCONF access control model (NACM) [RFC6536] provides the means to restrict access for particular users to a pre-configured subset of all available protocol operations and content.

These are the subtrees and data nodes and their sensitivity/vulnerability:

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.

7. Conclusions

TBD.

8. References

8.1. 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>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.
- [RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <<https://www.rfc-editor.org/info/rfc7950>>.

8.2. Informative References

- [RFC0826] Plummer, D., "Ethernet Address Resolution Protocol: Or Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware", STD 37, RFC 826, DOI 10.17487/RFC0826, November 1982, <<https://www.rfc-editor.org/info/rfc826>>.
- [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>>.

[RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.

Authors' Addresses

Xiaojian Ding
Huawei
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012
China

Email: dingxiaojian1@huawei.com

Feng Zheng
Huawei
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012
China

Email: habby.zheng@huawei.com