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YANG Models Required for Managing Customer Premises Equipment (CPE) Devices
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Abstract

This document collects together the YANG models necessary for managing a NETCONF-enabled Customer Premises Equipment (CPE) device.

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1. Introduction

NETCONF is used for the monitoring and configuration of networked devices. Implementing NETCONF on CPE devices, along with the relevant YANG models, provides a flexible and exensible management interface for operators.

This document describes the YANG models necessary for managing NETCONF-enabled CPE devices. It defines the requirements for managing a CPE through NETCONF/YANG.

Many of the YANG models which are referenced here are at early stages in the development process and in some cases there is currently no existing work. The aim of this document is to defined which models are necessary and ror each required YANG model, provide information about the current status of the existing work. It is intended as a 'living document', which will be updated as the required / referenced YANG models change. Once finalised, the goal of the document is to serve as a CPE YANG 'Device profile' to be used as a reference for implementors who are adding YANG management capabilities to their devices.

2. Terminology

CPE	Customer Premises Equipment, which provides access for devices connected to a Local Area Network (LAN), typically at the customer's site/home, to the Internet Service Provider's (ISP's) network. The CPE device described in this document supports NETCONF/YANG.
Existing RFCs	Lists of published RFCs at the time of writing the document.
Work In Progress	Lists of currently active Internet Drafts, or relevant standards documents being produced by organisations other than the IETF.
To Be Defined	The models that are necessary for a CPE, but

are not defined by the time of writing the document.

3. Management Requirements

3.1. Interfaces

A CPE has a number of network interfaces, usually including some of the following interface types: Ethernet LAN, Ethernet WAN, Ethernet 802.1q, Ethernet 802.1ag, and WLAN (802.11a/b/n/g/ac). The IETF has published a YANG model for general interface management, which identifies the previously listed interface types. However,

standardisation for Ethernet is done by the IEEE, so it is probable that the YANG models for managing these interfaces would be developed.

NB - The list of interface types necessary for a complete, general HGW model clearly needs to include xDSL (BBF) and DOCSIS (ITU) interfaces. A future version of this document needs to be extended to include these.

3.1.1. Requirements

A YANG-enabled CPE must implement the YANG model for general Interface Management [RFC7223] and support Interface type model defined in [RFC7224].

Specific YANG model(s) for Ethernet LAN, Ethernet WAN, Ethernet 802.1q, Ethernet 802.1ag, and WLAN (802.11a/b/n/g/ac) interfaces.

Needs to include support for optical parameter configuration in the Ethernet WAN interface YANG model.

Support for Connectivity Fault Management (IEEE 802.1ag) in the Ethernet WAN interface YANG model.

3.1.2. Development Status of Relevent YANG Models

Existing RFCs:

- YANG Data Model for Interface Management [RFC7223].

- IANA Interface Type YANG Module [RFC7224].

Work In Progress:

- IEEE Ethernet YANG Model [IEEE-ETH-YANG]

To Be Defined:

- Ethernet WAN
- Ethernet 802.1q
- Ethernet 802.1ag
- Ethernet LAN
- WLAN (802.11a/b/n/g/ac)

3.2. IP Management

3.2.1. Requirements

The CPE implementation requires the YANG models for managing IPv4 and IPv6.

3.2.2. Development of Relevent YANG Models

Existing RFCs:

- YANG Data Model for IP Management [RFC7277].

Work In Progress:

- [To be specified]

To Be Defined:

- [To be specified]

3.3. Routing Management

3.3.1. Requirements

A CPE requires support for the configuration and management of traditional IPv4/IPv6 routing protocols, as well as static route configuration.

YANG models for the management of the IS-IS routing protocol are necessary for CPEs participating in home network IS-IS routing.

Management of Protocol Independent Multicast (PIM) is required.

Management of static multicast routes is required.

3.3.2. Development of Relevent YANG Models

Existing RFCs:

- None

Work In Progress:

- YANG Data Model for Routing Management: [I-D.ietf-netmod-routing-cfg].
- YANG model for static IPv4/IPv6 route: Appendix B in [I-D.ietf-netmod-routing-cfg].
- YANG Data Model for ISIS protocol: [I-D.ietf-isis-yang-isis-cfg].
- YANG model for PIM: [I-D.liu-pim-yang].

- YANG model for IGMP and MLD: [I-D.liu-pim-igmp-mld-yang].

To Be Defined:

- Static Multicast Route

3.4. NETCONF Server Management

3.4.1. Requirements

A NETCONF/YANG enabled CPE requires support for management and configuration of its local NETCONF server using the NETCONF protocol.

A CPE requires support for the base notification function to allow a NETCONF client to retrieve notifications for common system events.

A CPE retrieves NETCONF server configuration automatically during the bootstrap process (ZeroTouch).

A CPE, as a NETCONF server, requires the Call Home function so that a secure connection to a NETCONF client can be initiated.

3.4.2. Development of Relevent YANG Models

Existing RFCs:

- YANG Module for NETCONF Monitoring: [RFC6022].
- NETCONF Base Notifications: [RFC6470].

Work In Progress:

- ZeroTouch: [I-D.ietf-netconf-zerotouch].
- NETCONF Call Home: [I-D.ietf-netconf-call-home].
- NETCONF Server Configuration Models: [I-D.ietf-netconf-server-model].

To Be Defined:

- [To be specified]

3.5. DHCP/SLAAC/ND Management

3.5.1. Requirements

A CPE requires support for the management of its DHCPv4 server, which typically runs at the IPv4 LAN side.

A CPE requires support for the management of its DHCPv6 server, which can run at the IPv6 LAN side.

A CPE requires support for the management of its DHCPv6 client, which typically runs at the IPv6 WAN side.

A CPE requires support for the management of its DHCPv6 Prefix Delegation configuration (as a requesting router).

A CPE requires support for the management of SLAAC for stateless IPv6 configuration.

A CPE requires support the for management of Neighbour Discovery Protocol configuration, including Router Advertisements on its LAN interface(s).

3.5.2. Development of Relevent YANG Models

Existing RFCs:

- [To be specified]

Work In Progress:

- YANG models for DHCPv4: [I-D.liu-dhc-dhcp-yang-model].
- YANG Data Model for DHCPv6 Configuration: [I-D.cui-dhc-dhcpv6-yang].

To Be Defined:

- YANG for SLAAC (Router Advertisement)
- YANG for Neighbour Discovery Protocol (NDP)
- YANG for DHCPv6 Prefix Delegation (requesting router)

3.6. NAT Management

3.6.1. Requirements

A CPE requires support for the management for NAT44/NAPT44 configuration.

3.6.2. Development of Relevent YANG Models

Existing RFCs:

- [To be specified]

Work In Progress:

- [To be specified]: A possible way to do this is to start from the

NAT MIB document [I-D.perrault-behave-natv2-mib].

To Be Defined:

- YANG model for NAT Management: there is suggestion to produce such a model in the BEHAVE WG.
- Additional YANG models for specific protocol Application Layer Gateways may also be needed.

3.7. IPv6 Transition Mechanisms Management

3.7.1. Requirements

A CPE intended for IPv6 transition, should be able to manage the supported IPv6 transition mechanism(s) through NETCONF/YANG.

3.7.2. Development of Relevent YANG Models

Existing RFCs:

- [To be specified]

Work In Progress:

- YANG model for IPv4-in-IPv6 Softwire: [I-D.sun-softwire-yang].

To Be Defined:

- DHCP 4o6 client: May be combined in DHCPv6 YANG model as a feature.
- DNS64

3.8. Management of Specific Services

3.8.1. Requirements

Some specific services may be needed for a CPE, such as SIP, Web, NTP and SSH services. A CPE may support the management of those services through NETCONF/YANG.

3.8.2. Development of Relevent YANG Models

Existing RFCs:

- NTP Client: [RFC7317]

Work In Progress:

- [To be specified]

To Be Defined:

- SIP Client
- Web server: This is used for configuring the CPE device.
- NTP server
- SSH server: Temporary for operator's need of management. Will be retired.

3.9. Management of Security Components

3.9.1. Requirements

A CPE requires support for the management of Firewall (v4/v6) and ACL functions.

3.9.2. Development of Relevent YANG Models

Existing RFCs:

- [To be specified]

Work In Progress:

- IPv4 Firewall configuration: [I-D.ietf-netmod-acl-model]
- IPv6 Firewall configuration: [I-D.ietf-netmod-acl-model]
- Access Control List (ACL): [I-D.ietf-netmod-acl-model]

To Be Defined:

- IPv4/v6 Firewall (possible)

3.10. CPE Software Upgrade Management

3.10.1. Requirements

During the operational life of the CPE, the firmware and software packages will need to be upgraded to fix bugs, enable new features and resolve security issues, etc. A CPE requires RPCs for file transfer to retrieve up-to-date files from an operator-managed date centre.

3.10.2. Development of Relevent YANG Models

Existing RFCs:

o [To be specified]

Work In Progress:

o File transfer: [I-D.sf-netmod-file-transfer-yang]

To Be Defined:

o YANG model for firmware upgrade

4. Security Considerations

A NETCONF/YANG managed CPE should follow the Section 3.9 for enabling and managing IPv4/IPv6 firewalls. Security considerations from the related documents should be followed.

5. IANA Considerations

There are no IANA considerations for this document.

6. Acknowledgements

The authors would like to thank xxx for their contributions to this work.

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