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1 Configuring CWMP

1.1 Introduction

1.1.1 Overview

The CPE WAN Management Protocol (CWMP), also known as TR-069 protocol, is a management protocol initiated and developed by Digital Subscriber's Line (DSL) forum and numbered TR-069. CWMP provides a general framework of unified device management, related message specifications, management methods, and data models. It solves difficulties in unified management and maintenance of dispersed customer premises equipment (CPEs), improves troubleshooting efficiency, and saves O&M costs.

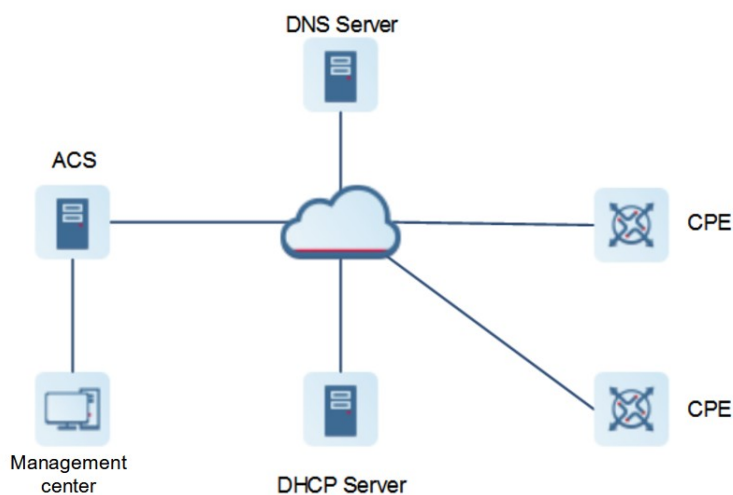
1.1.2 Principles

1. Basic Concepts

[Figure 1-1](#) shows the network structure of CWMP, mainly including:

- ACS: The auto-configuration server (ACS) is the managing device in a network.
- CPE: The customer premises equipment (CPE) is the managed device in a network.
- DHCP server: The Dynamic Host Configuration Protocol (DHCP) server obtains the Uniform Resource Locator (URL) of the ACS dynamically.
- DNS server: The dynamic network server (DNS) parses domain names of the ACS or CPE.

Figure 1-1 Network Structure of CWMP



2. Network Structure of CWMP

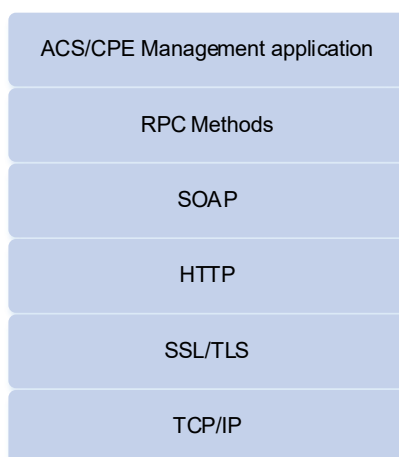
As shown in [Figure 1-1](#), CWMP work is composed of six layers:

- ACS/CPE management application: This layer is not a part of CWMP. It is the development performed by

functional modules of the CPE/ACS to support CWMP. As with the Simple Network Management Protocol (SNMP), CWMP does not cover the management information base (MIB) management of functional modules.

- **RPC methods:** This layer provides and implements various RPC methods for interactions between the ACS and the CPE. The ACS manages and monitors the CPE with mostly the following RPC methods:
- **Get series methods:** The Get methods enable the ACS to remotely obtain RPC methods, as well as names, values and attributes of the data model parameters supported on the CPE.
- **Set series methods:** The Set methods enable the ACS to remotely set the values and attributes of the data model parameters supported on the CPE.
- **Inform method:** The Inform method enables the CPE to inform the ACS of their device identifiers, parameter information, and events. This is the first method used when sessions are established between the ACS and the CPE.
- **Download method:** The Download method enables the ACS to remotely control and manage file download of the CPE, including main program upgrade, configuration file upgrade, and Web package upgrade.
- **Upload method:** The Upload method enables the ACS to remotely control and manage file upload of the CPE, including configuration file and log file upload.
- **Reboot method:** The Reboot method enables the ACS to remotely control reboot of the CPE.
- **SOAP:** The Simple Object Access Protocol (SOAP) layer uses an XML-based syntax to encode and decode CWMP messages. Thus, CWMP messages must comply with the XML-based syntax of SOAP.
- **HTTP:** The Hypertext Transfer Protocol (HTTP) layer transmits all CWMP messages. Both the ACS and the CPE can behave in the role of HTTP clients and servers. The server is used to monitor reverse connections from the peer.
- **SSL/TLS:** The secure sockets layer (SSL) or transport layer security (TLS) layer guarantees CWMP security, including data integrity, confidentiality, and authentication.
- **TCP/IP:** This layer is the Transmission Control Protocol/Internet Protocol (TCP/IP) stack.

Figure 1-1 CWMP Structure

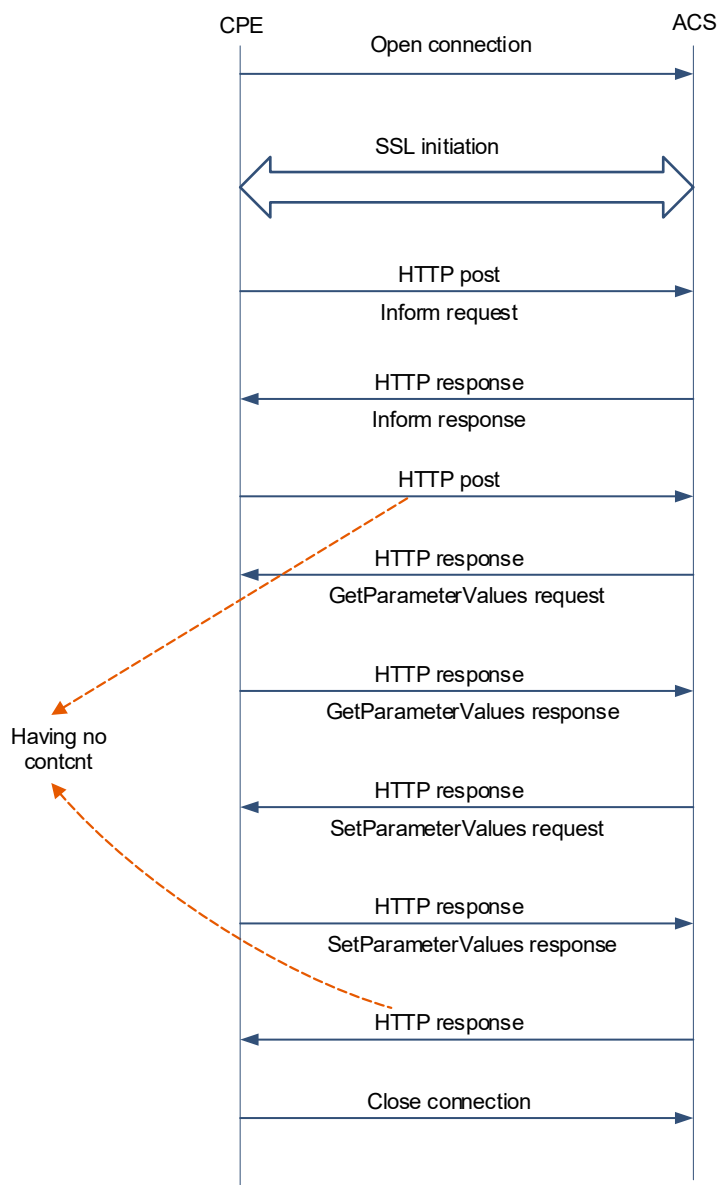


3. Working Process of CWMP

[Figure 1-1](#) shows the working process of CWMP.

- (1) Create a TCP connection.
- (1) Create a security mechanism during SSL initialization.
- (2) After the CPE sends an Inform packet, start establishing a CWMP connection. Use the Eventcode field to describe the cause of sending this Inform packet in the Inform packet.
- (3) If the CPE passes the ACS authentication, the ACS returns an Inform response packet to establish the connection.
- (4) If the CPE has no more request, a null packet is sent to meet the rule of HTTP request/response packet interaction. CWMP is based on HTTP, and CWMP packets as data parts of HTTP packets are encapsulated in HTTP packets.
- (5) The ACS queries the value of the ACS URL set on the CPE.
- (6) The CPE returns the obtained ACS URL to the ACS.
- (7) When the ACS discovers that the ACS URL is not the local URL value, the ACS initiates a Set request, requesting the CPE to set its ACL URL to the URL value of the standby ACS.
- (8) After the ACL URL is set, the CPE sends a response packet.
- (9) The ACS sends a null packet to notify the CPE, there are any other requests.
- (10) The CPE closes the session.

Figure 1-1 Work Flowchart of CWMP



- Session management

CWMP sessions are the basis for CWMP. All CWMP interactions between the ACS and the CPE rely on the sessions. The interaction effectiveness of the sessions is ensured by the transmission, management, and maintenance for effective management and monitoring. An ACS-CPE session is a TCP connection, which starts from the Inform negotiation to TCP disconnection. Sessions are classified into those initiated by the CPE and those requested by the ACS according to the session initiator.

- The CPE initiates a connection

The CPE can initiate a connection with the ACS based on the configured ACS address at any time. In the following scenarios, the CPE must establish a connection with the ACS.

When the CPE is powered on, reset or initialized, the CPE establishes a connection with the ACS for the first time.

When the ACS URL changes,

an Inform packet must be sent if a parameter is changed.

When the CPE receives a valid connection request from the ACS,

and the CPE is configured to periodically send Inform packets, it sends connection requests both automatically and periodically.

When the CPE is configured to send Inform packets periodically, the CPE automatically send connection requests at the designated time point.

- o The ACS initiates a connection

The ACS can, at any time, require the CPE to initiate a connection request to the ACS by using the connection request notification mechanism to set up the connection with the CPE.

Note

- The CPE must support the connection request notification mechanism. If the ACS is required to actively initiate a connection request, the ACS must support the connection request notification mechanism.
 - Communication at least once between the ACS and the CPE is the prerequisite for ACS to initiate a connection. If the ACS desires to actively initiate communication, the ACS stores the management IP address of the CPE in the communication. If the management IP address of the CPE changes, the CPE must send an Inform packet to notify the ACS of the new management IP address to timely update the information of the ACS.
-

4. Basic Functions of CWMP

CWMP provides mainly the following functions:

- Auto configuration

After the CPE starts operation, the management center can deliver configuration to the CPE through the ACS server to change the CPE configuration and status and thus manage the CPE. The configuration file is delivered with two methods:

- o Update the configuration file. The configuration file of the CPE is replaced with a specified configuration file so that the new configuration file is run on the CPE after reset.
- o Update running configuration. Specific configuration is directly delivered to the CPE and saved to the running configuration of the CPE. The configuration takes effect immediately upon delivery. The configuration must be saved. Otherwise, the delivered configuration will be lost after CPE reset.

- Status and performance monitoring

The CPE notifies the ACS of the current status and configuration change of the device through the periodic Inform mechanism. The ACS monitors the CPE based on these notifications of the real-time change.

- Fault diagnosis

According to the diagnostic information provided by the CPE, the ACS resolves connection problems and other service problems and executes some predefined diagnostic actions.

- Main program upgrade

Main program upgrade means updating main program of the CPE so as to upgrade software version of the CPE. When the ACS detects any latest version of the main program, the ACS delivers the Download method to the CPE. The CPE downloads the main program from the file server specified in the Download method. After the main program is downloaded and the CPE checks the validity of the main program, the

CPE restart to upgrade the main program. After restart, the CPE notifies the ACS of the completion of main program upgrade.

- Data backup

The ACS controls the CPE to upload configuration files to the ACS or file server with the Upload method.

Note

The file server can be ACS or separately deployed.

- Backup and restoration

CPE backup and restoration means that when any remote CPE breaks away from the management center due to an abnormal operation on the ACS, the CPE must be restored to the previous status, so that the ACS can correctly manage and operate the remote device of the CPE once again.

Generally, the CPE breakaway is caused by the delivered incorrect main program or configuration. The CPE must be configured to restore the main program or configuration if any abnormality arises. When the CPE receives any main program upgrade or configuration delivery request, the CPE backs up the current configuration and main program version. After the upgrade or update is completed, the CPE determines whether it is broken away from the ACS. If yes, the CPE restores itself to the previous manageable status.

1.1.3 Protocols and Standards

- TR069: CPE WAN Management Protocol

1.2 Configuration Task Summary

CWMP configuration includes the following tasks:

- (1) [Establishing a Basic CWMP Connection](#)
- (2) (Optional) [Configuring CWMP Attributes](#)

1.3 Configuring CWMP

1.3.1 Establishing a Basic CWMP Connection

1. Overview

A session connection is established between the ACS and the CPE.

2. Restrictions and Guidelines

- Only one ACS username can be configured. If the ACS name is configured repeatedly, the latest username configured takes effect.
- The ACS user password can be in plaintext or cyphertext form. Only one ACS user password can be configured. If the ACS password is configured repeatedly, the latest password configured takes effect.
- Only one ACS URL can be configured. If the ACS URL is configured repeatedly, the latest URL configured takes effect. The ACS URL must be in HTTP format.
- When a CPE password is configured for authentication in the connection with the ACS, the encryption type does not need to be entered. If an encrypted password is copied and pasted, the encryption type must be

entered. A valid password should meet the following format requirements:

- Contain 1 to 26 characters including uppercase letters, lowercase letters, and digits.
- Leading spaces will be ignored, while the trailing and middle spaces are valid.
- Only one CPE URL can be configured for the connection between the CPE and the ACS. If the CPE URL is configured repeatedly, the latest URL configured takes effect. The CPE URL must be in HTTP format instead of domain name format. By default, a CPE URL is automatically selected based on the ACS URL. The CPE URL format must meet the following requirements:
 - Follow the `http://ip [: port]/` format.
 - Contain 256 characters at most.
- Only one CPE username can be configured. If the CPE username is configured repeatedly, the latest user configured takes effect.
- If the ACS URL is not manually configured but a dynamic ACS URL is obtained through DHCP, this dynamic ACS URL is used to initiate a connection to the ACS. The ACS URL must meet the following format requirements:
 - Follow the format of `http://ip[:port]/path`.
 - Contain 256 characters at most.
- The **cpe source** command and the **cpe url** command are not compatible with each other. When the two commands are not configured, the CPE automatically selects URL based on the ACS URL.
 - The interface name of the CPE must be the full name of the interface and can be automatically filled when a CLI command is entered.
 - If no port ID is configured, the default port ID 7547 is used.

3. Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enable the CWMP function.

cwmp

The CWMP function is enabled by default.

- (4) Configure an ACS username for CWMP connection.

acs username *username*

No ACS username is configured for CWMP connection by default.

- (5) Configure an ACS password for CWMP connection

acs password { **0** *encryption-type* | **7** *encrypted-password* | *password* }

No ACS password is configured for CWMP connection by default.

- (6) (Optional) Configure a CPE username for CWMP connection.

cpe username *username*

No CPE username is configured for CWMP connection by default.

- (7) Configure a CPE password for CWMP connection.

cpe password { 0 *encryption-type* | 7 *encrypted-password* | *password* }

No CPE password is configured for CWMP connection by default.

- (8) Configure an ACS URL for CWMP connection.

acs url *url*

No ACS URL is configured for CWMP connection by default.

- (9) Configure a CPE URL for CWMP connection.

cpe url *url*

No CPE URL is configured for CWMP connection by default.

- (10) Configure the CPE URL based on the IP address of the specified interface.

cpe source interface *interface-type interface-number* [**port** *port-number*]

No CPE URL is configured based on the IP address of the specified interface by default.

1.3.2 Configuring CWMP Attributes

1. Overview

You can configure common functions for CPE, for example, backup and restoration of main program and configuration file, acceptance or not of main program and configuration file delivered by the ACS, management or not of configuration/log files uploaded to the ACS.

2. Restrictions and Guidelines

- Any CPE can be configured with the periodic Inform function.
 - If no Inform start time is configured, the Inform enabling time is used as the Inform start time, and Inform is performed once every default Inform interval. For example, no Inform period or start time is configured, but the Inform function is enabled at 12:00 a.m. Then, periodic Inform will start at 12:00 a.m. next day and be performed once every default Inform interval.
 - If the Inform start time is configured, periodic Inform starts at the specified start time. For example, if the Inform interval is set to 60 seconds and the start time is 12:00 a.m. next day, periodic Inform will start at 12:00 a.m. next day and be performed once every 60 seconds.
- If you do not expect CPE to receive any main program and configuration file from the ACS, you can disable the management Inform function of receiving the main program and configuration file delivered by the ACS. Disabling the function of receiving the main program and configuration file delivered by the ACS does not act on configuration script files. The configuration scripts can still be executed even if this function is disabled.
- If you do not expect CPE to upload configuration file and log file to the ACS, you can disable the management function of uploading any configuration file and log file to the ACS.

3. Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enter the CWMP configuration mode.

cwmp

- (4) (Optional) Configure CWMP attributes. Configure at least one of the following tasks.

- o Enable the periodic Inform function on the CPE.

cpe inform [**interval** *interval*] [**starttime** *hh:mm:ss MM/DD/YY*]

The periodic Inform function of the CPE is disabled by default. The default Inform period is 600 seconds.

- o Enable the management Inform function of receiving any main program and configuration file delivered by the ACS.

no disable download

The management function of receiving any main program and configuration file delivered by the ACS is enabled by default.

- o Enable the management function of uploading any main program and configuration/log file to the ACS from the CPE.

no disable upload

The management function of uploading any main program and configuration/log file upload function to the ACS is enabled by default.

- o Enable the backup and restoration function of the CPE main program or configuration file.

cpe back-up [**delay-time** *time*]

The backup and restoration function of the main program or configuration file is disabled by default.

- o Configure the CPE timeout time in the case of no ACS response.

timer cpe-timeout *timeout*

The default CPE timeout time is 30 seconds in the case of no ACS response.

1.4 Monitoring

Run the **show** command to check the running status of a configured function to verify the configuration effect.

Table 1-1 Monitoring

Command	Purpose
show cwmp configuration	Displays the current configuration of CWMP.
show cwmp status	Displays the current running status of CWMP.

1.5 Configuration Examples

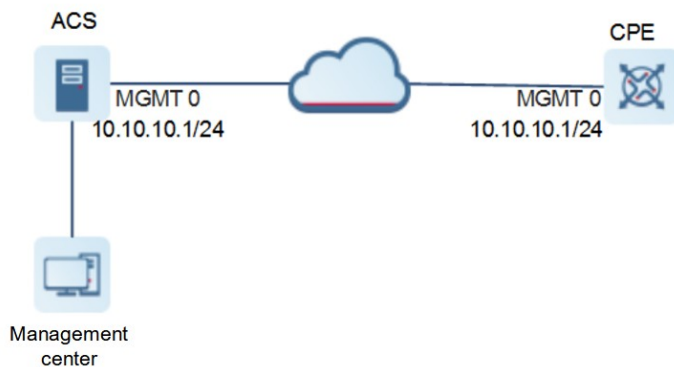
1.5.1 Configuring Basic CWMP Functions

1. Requirements

Many network devices are configured in the corporate network, as shown in [Figure 1-1](#). The network administrator manages and monitors these devices through CWMP to improve O&M efficiency.

2. Topology

Figure 1-1 Topology of Basic CWMP Functions



3. Notes

- Configure that the CPE and ACS are mutually reachable via routes.
- Enable the CWMP function on the CPE.

4. Procedure

Configure an IP address for the network management interface of the CPE.

```

Hostname> enable
Hostname# configure terminal
Hostname(config)# interface mgmt 0
Hostname(config-if-Mgmt 0)# ip address 10.10.10.10 255.255.255.0
Hostname(config-if-Mgmt 0)# gateway 10.10.10.1
  
```

Configure a URL connection between the ACS and CPE.

```

Hostname# configure terminal
Hostname(config)# cwmp
Hostname(config-cwmp)# acs url http://10.10.10.10:7547/acs
Hostname(config-cwmp)# cpe url http://10.10.10.1:7547/
  
```

Set the periodic Inform interval of the CPE to 60 seconds.

```

Hostname(config-cwmp)# cpe inform interval 60
  
```

Set the backup and restoration delay to 30 seconds.

```

Hostname(config-cwmp)# cpe back-up delay-time 30
  
```

Set the CPE timeout time to 30 seconds in the case of no ACS response.

```
Hostname(config-cwmp)# timer cpe-timeout 100
```

Disable the management function of any main program and configuration file delivered and downloaded by the ACS.

```
Hostname(config-cwmp)# disable download
```

Disable the management function of uploading any main program, configuration file and log file to the ACS.

```
Hostname(config-cwmp)# disable upload
```

Configure the username and password of the ACS.

```
Hostname(config-cwmp)# acs username USERB
```

```
Hostname(config-cwmp)# acs password PASSWORDB
```

Configure the username and password of the CPE.

```
Hostname(config-cwmp)# cpe username USERB
```

```
Hostname(config-cwmp)# cpe password PASSWORDB
```

5. Verification

Run the **ping** command to check whether the CPE and ACS are mutually reachable via L3 routes.

```
Hostname# ping oob 10.10.10.1
Sending 5, 100-byte ICMP Echoes to 10.10.10.1, timeout is 2 seconds:
 < press Ctrl+C to break >
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/3 ms.
Hostname#
```

Run the **show cwmp configuration** command to display the CWMP configuration result on the CPE.

```
Hostname# show cwmp configuration
CWMP status                : enable
ACS URL                     : http://10.10.10.10:7547/acs
ACS username                : USERB
ACS password                : PASSWORDB
CPE source interface name   :
CPE URL                     : http://10.10.10.1:7547/
CPE username                : USERB
CPE password                : PASSWORDB
CPE inform status           : enable
CPE inform interval         : 60s
CPE inform start-time       : 0:0:0 0 0 0
CPE wait timeout            : 100s
CPE download status         : disable
CPE upload status           : disable
CPE back up status          : enable
CPE back up delay time      : 30s
CPE STUN port-adaptive      : enable
CPE STUN probe nat agingtime : enable
CPE STUN port                : 3478
CPE STUN max-period         : 60s
```

```
CPE STUN min-period          : 20s
```

6. Configuration Files

Device A configuration file

```
hostname Hostname
!
cwmp
  acs url http://10.10.10.10:7547/acs
  acs username USERB
  acs password PASSWORDB
  cpe source interface GigabitEthernet 0/1
  cpe username USERB
  cpe password PASSWORDB
  timer cpe-timeout 100
  disable upload
  cpe back-up delay-time 30
!
interface Mgmt 0
  ip address 10.10.10.10 255.255.255.0
  gateway 10.10.10.1
```

7. Common Errors

- The entered password is cyphertext and the password length exceeds 254 or the password is not an even number.
- The entered password is plaintext and longer than 126 characters.
- The entered password is plaintext and contains illegal characters.
- The ACS URL is null.
- The CPE URL is null.