Contents

Using automatic configuration

Overview

When the device starts up without a valid next-startup configuration file, the device searches the root directory of its default file system for the autocfg.py, autocfg.tcl, and autocfg.cfg files. If any one of the files exists, the device loads the file. If none of the files exists, the device uses the automatic configuration feature to obtain a set of configuration settings. This feature simplifies network configuration and maintenance.

Using server-based automatic configuration

About server-based automatic configuration

Server-based automatic configuration requires a set of servers, including a DHCP server and a file server (HTTP or TFTP server). A DNS server might also be required.

Server-based automatic configuration applies to scenarios that have the following characteristics:

- A number of devices need to be configured.
- The devices to be configured are widely distributed.
- The configuration workload on individual devices is heavy.

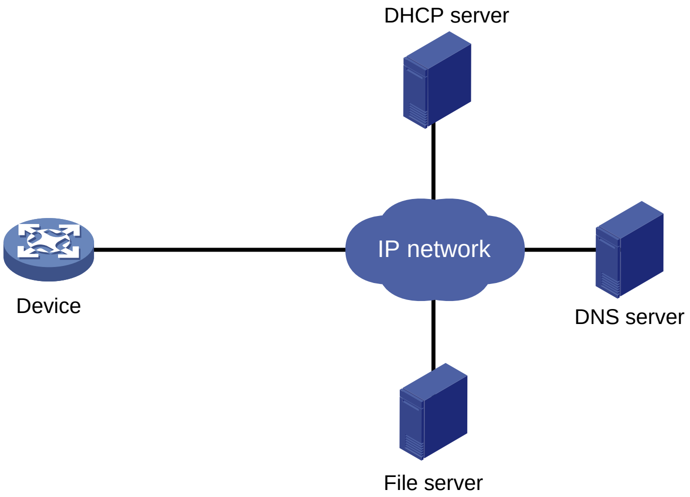
You can deploy server-based automatic configuration on both IPv4 and IPv6 networks by using the same method. This chapter describes the tasks for deploying server-based automatic configuration on an IPv4 network.

Typical server-based automatic configuration network

As shown in Figure 1, a typical server-based automatic configuration network consists of the following servers:

- DHCP server.
- File server (TFTP or HTTP server).
- (Optional.) DNS server.

Figure 1 Server-based automatic configuration network diagram



Server-based automatic configuration task list

Tasks at a glance
(Required.) Configuring the file server
(Required.) Preparing the files for automatic configuration
(Required.) Configuring the DHCP server
(Optional.) Configuring the DNS server
(Optional.) Configuring the gateway
(Required.) Preparing the interface used for automatic configuration
(Required.) Starting and completing automatic configuration

Configuring the file server

For devices to obtain configuration information from a TFTP server, start TFTP service on the file server.

For devices to obtain configuration information from an HTTP server, start HTTP service on the file server.

Preparing the files for automatic configuration

The device can use a script file or configuration file for automatic configuration.

- For devices to use configuration files for automatic configuration, you must create and save the configuration files to the file server as described in "Configuration files." If you do not configure the DHCP server to assign configuration file names, you must also create a host name file on the TFTP server.
- For devices to use script files for automatic configuration, you must create and save the script files to the file server as described in "Script files."

Host name file

The host name file contains host name-IP address mappings and must be named **network.cfg**.

All mapping entries in the host name file must use the **ip host** *host-name ip-address* format. Each mapping entry must reside on a separate line. For example:

```
ip host host1 101.101.101.101
ip host host2 101.101.101.102
ip host client1 101.101.101.103
ip host client2 101.101.101.104
```

Configuration files

To prepare configuration files:

- For devices that require different configurations, perform the following tasks:
  - Determine the name for each device's configuration file.

    The configuration file names must use the extension .cfg. For simple file name identification, use configuration file names that do not contain spaces.
  - Use the file names to save the configuration files for the devices to the file server.
- For devices that share all or some configurations, save the common configurations to a .cfg file on the file server.
- If a TFTP file server is used, you can save a default configuration file named **device.cfg** on the server. This file contains only common configurations that devices use to start up. This file is assigned to a device only when the device does not have other configuration files to use.

During the automatic configuration process, a device first tries to obtain a configuration file dedicated for it. If no dedicated configuration file is found, the device tries to obtain the common configuration file. If no common configuration file is found when a TFTP file server is used, the device obtains and uses the default configuration file.

Script files

Script files can be used for automatic software upgrade and automatic configuration. The device supports Python scripts (.py files) and Tcl scripts (.tcl files). For more information about Python and Tcl scripts, see "Using Python" and "Using Tcl."

To prepare script files:

- For devices that share all or some configurations, create a script file that contains the common configurations.
- For the other devices, create a separate script file for each of them.

Configuring the DHCP server

The DHCP server assigns the following items to devices that need to be automatically configured:

- IP addresses.
- Paths of the configuration files or scripts.

Configuration guidelines

When you configure the DHCP server, follow these guidelines:

- For devices for which you have prepared different configuration files, perform the following tasks for each of the devices on the DHCP server:
  - Create a DHCP address pool.
  - Configure a static address binding.
  - Specify a configuration file or script file.

Because an address pool can use only one configuration file, you can specify only one static address binding for an address pool.

- For devices for which you have prepared the same configuration file, use either of the following methods:
  - Method 1:
    - Create a DHCP address pool for the devices.
    - Configure a static address binding for each of the devices in the address pool.
    - Specify the configuration file for the devices.
  - Method 2:
    - Create a DHCP address pool for the devices.
    - Specify the subnet for dynamic allocation.
    - Specify the TFTP server.
    - Specify the configuration file for the devices.
- If all devices on a subnet share the same configuration file or script file, perform the following tasks on the DHCP server:
  - Configure dynamic address allocation.
  - Specify the configuration file or script file for the devices.

  The configuration file can contain only the common settings for the devices. You can provide a method for the device administrators to change the configurations after their devices start up.

Configuring the DHCP server when an HTTP file server is used

Step	Command	Remarks
1. Enter system view.	**system-view**	N/A
2. Enable DHCP.	**dhcp enable**	By default, DHCP is disabled.
3. Create a DHCP address pool and enter its view.	**dhcp server ip-pool** *pool-name*	By default, no DHCP address pool is created.
4. Configure the address pool.	• (Method 1.) Specify the primary subnet for the address pool: **network** *network-address* [*mask-length* | **mask** *mask*] • (Method 2.) Configure a static binding: **static-bind ip-address** *ip-address* [*mask-length* | **mask** *mask*] { **client-identifier** *client-identifier* | **hardware-address** *hardware-address* [**ethernet** | **token-ring**] }	Use either or both methods. By default, no primary subnet or static binding is configured. You can add multiple static bindings. One IP address can be bound to only one client. To change the binding for a DHCP client, you must remove the binding and reconfigure a binding.
5. Specify the URL of the configuration file or script file.	**bootfile-name** *url*	By default, no configuration file URL is specified.

Configuring the DHCP server when a TFTP file server is used

Step	Command	Remarks
1. Enter system view.	**system-view**	N/A

Step	Command	Remarks
2. Enable DHCP.	**dhcp enable**	By default, DHCP is disabled.
3. Create a DHCP address pool and enter its view.	**dhcp server ip-pool** *pool-name*	By default, no DHCP address pool is created.
4. Configure the address pool.	• (Method 1.) Specify the primary subnet for the address pool: **network** *network-address* [*mask-length* | **mask** *mask*] • (Method 2.) Configure a static binding: **static-bind ip-address** *ip-address* [*mask-length* | **mask** *mask*] { **client-identifier** *client-identifier* | **hardware-address** *hardware-address* [**ethernet** | **token-ring**] }	Use either or both methods. By default, no primary subnet or static binding is configured. You can add multiple static bindings. One IP address can be bound to only one client. To change the binding for a DHCP client, you must remove the binding and reconfigure a binding.
5. Specify a TFTP server.	• (Method 1.) Specify the IP address of the TFTP server: **tftp-server ip-address** *ip-address* • (Method 2.) Specify the name of the TFTP server: **tftp-server domain-name** *domain-name*	Use either or both methods. By default, no TFTP server is specified. If you specify a TFTP server by its name, a DNS server is required on the network.
6. Specify the name of the configuration file or script file.	**bootfile-name** *bootfile-name*	By default, no configuration or script file name is specified.

Configuring the DNS server

A DNS server is required in the following situations:

- The TFTP server does not have a host name file. However, devices need to perform the following operations:
  - Use their IP addresses to obtain their host names.
  - Obtain configuration files named in the *host name***.cfg** format from the TFTP server.
- The DHCP server assigns the TFTP server domain name through the DHCP reply message. Devices must use the domain name to obtain the IP address of the TFTP server.

Configuring the gateway

If the devices to be automatically configured and the servers for automatic configuration reside in different network segments, you must perform the following tasks:

- Deploy a gateway and make sure the devices can communicate with the servers.
- Configure the DHCP relay agent feature on the gateway.
- Configure the UDP helper feature on the gateway.

  When a device sends a request through a broadcast packet to the file server, the UDP helper changes the broadcast packet to a unicast packet and forwards the unicast packet to the file server. For more information about UDP helper, see *Layer 3—IP Services Configuration Guide*.

Preparing the interface used for automatic configuration

The device uses the following steps to select the interface for automatic configuration:

1. Identifies the status of the management Ethernet interface at Layer 2. If the status is up, the device uses the management Ethernet interface.
2. Identifies the status of Layer 2 Ethernet interfaces. If one or more Layer 2 Ethernet interfaces are in up state, the device uses the VLAN interface of the default VLAN.
3. Sorts all Layer 3 Ethernet interfaces in up state first in lexicographical order of interface types and then in ascending order of interface numbers. Uses the interface with the smallest interface number among the interfaces of the first interface type.
4. If no Layer 3 Ethernet interfaces are in up state, the device waits 30 seconds and goes to step 1 to try again.

For fast automatic device configuration, connect only the management Ethernet interface on each device to the network.

Starting and completing automatic configuration

1. Power on the devices to be automatically configured.

   If a device does not find a next-start configuration file locally, it starts the automatic configuration process to obtain a configuration file. If one attempt fails, the device waits 30 seconds and then automatically starts the process again. To stop the process, press **Ctrl+C** or **Ctrl+D**.

   After obtaining a configuration file, the device automatically executes the configuration file.
2. Use the **save** command to save the running configuration.

   The device does not save the obtained configuration file locally. If you do not save the running configuration, the device must use the automatic configuration feature again after a reboot.

   For more information about the **save** command, see *Fundamentals Command Reference*.

Server-based automatic configuration examples

Automatic configuration using TFTP server

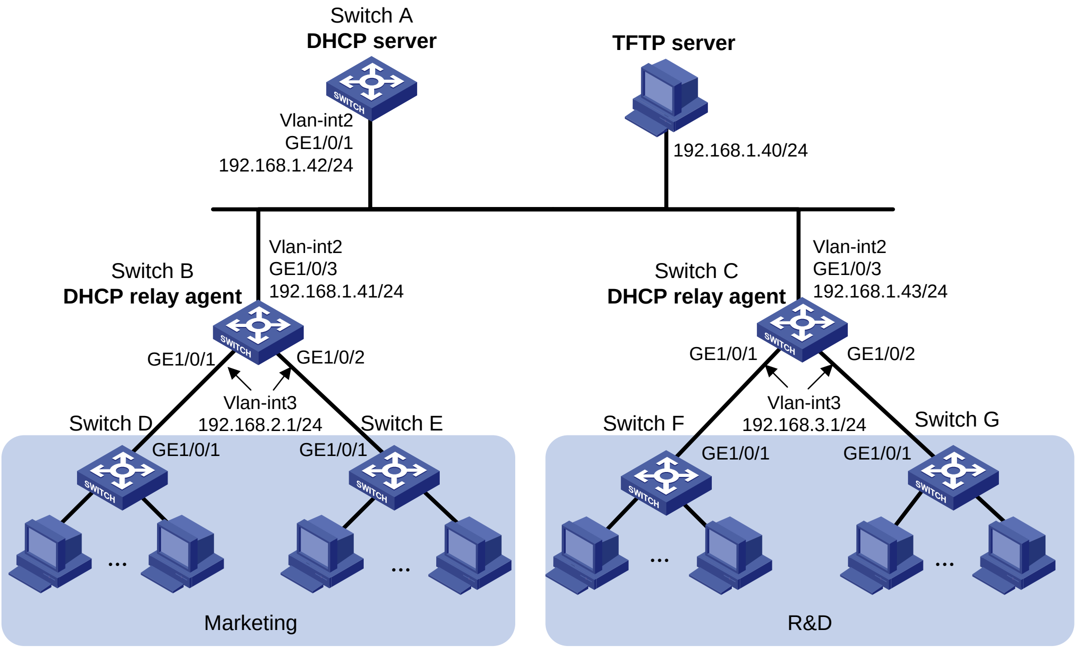
Network requirements

As shown in Figure 2, two departments of a company are connected to the network through gateways (Switch B and Switch C). Access devices Switch D, Switch E, Switch F, and Switch G do not have a configuration file.

Configure the servers and gateways so the access devices can obtain a configuration file to complete the following configuration tasks:

- Enable administrators of access devices to Telnet to and manage their respective access devices.
- Require administrators to enter their respective usernames and passwords at login.

Figure 2 Network diagram



Configuration procedure

1. Configure the DHCP server:

   # Create a VLAN interface and assign an IP address to the interface.

```
<SwitchA> system-view
[SwitchA] vlan 2
[SwitchA-vlan2] port gigabitethernet 1/0/1
[SwitchA-vlan2] quit
[SwitchA] interface vlan-interface 2
[SwitchA-Vlan-interface2] ip address 192.168.1.42 24
[SwitchA-Vlan-interface2] quit
```

   # Enable DHCP.

```
[SwitchA] dhcp enable
```

   # Enable the DHCP server on VLAN-interface 2.

```
[SwitchA] interface vlan-interface 2
[SwitchA-Vlan-interface2] dhcp select server
[SwitchA-Vlan-interface2] quit
```

   # Configure address pool **market** to assign IP addresses on the 192.168.2.0/24 subnet to clients in the Marketing department. Specify the TFTP server, gateway, and configuration file name for the clients.

```
[SwitchA] dhcp server ip-pool market
[SwitchA-dhcp-pool-market] network 192.168.2.0 24
[SwitchA-dhcp-pool-market] tftp-server ip-address 192.168.1.40
[SwitchA-dhcp-pool-market] gateway-list 192.168.2.1
[SwitchA-dhcp-pool-market] bootfile-name market.cfg
[SwitchA-dhcp-pool-market] quit
```

   # Configure address pool **rd** to assign IP addresses on the 192.168.3.0/24 subnet to clients in the R&D department. Specify the TFTP server, gateway, and configuration file name for the clients.

```
[SwitchA] dhcp server ip-pool rd
[SwitchA-dhcp-pool-rd] network 192.168.3.0 24
[SwitchA-dhcp-pool-rd] tftp-server ip-address 192.168.1.40
[SwitchA-dhcp-pool-rd] gateway-list 192.168.3.1
[SwitchA-dhcp-pool-rd] bootfile-name rd.cfg
[SwitchA-dhcp-pool-rd] quit
```

# Configure static routes to the DHCP relay agents.

```
[SwitchA] ip route-static 192.168.2.0 24 192.168.1.41
[SwitchA] ip route-static 192.168.3.0 24 192.168.1.43
[SwitchA] quit
```

2. Configure the gateway Switch B:

# Create VLAN interfaces and assign IP addresses to the interfaces.

```
<SwitchB> system-view
[SwitchB] vlan 2
[SwitchB-vlan2] port gigabitethernet 1/0/3
[SwitchB-vlan2] quit
[SwitchB] interface vlan-interface 2
[SwitchB-Vlan-interface2] ip address 192.168.1.41 24
[SwitchB-Vlan-interface2] quit
[SwitchB] vlan 3
[SwitchB-vlan3] port gigabitethernet 1/0/1
[SwitchB-vlan3] port gigabitethernet 1/0/2
[SwitchB-vlan3] quit
[SwitchB] interface vlan-interface 3
[SwitchB-Vlan-interface3] ip address 192.168.2.1 24
[SwitchB-Vlan-interface3] quit
```

# Enable DHCP.

```
[SwitchB] dhcp enable
```

# Enable the DHCP relay agent on VLAN-interface 3.

```
[SwitchB] interface vlan-interface 3
[SwitchB-Vlan-interface3] dhcp select relay
```

# Specify the DHCP server address.

```
[SwitchB-Vlan-interface3] dhcp relay server-address 192.168.1.42
```

3. Configure the gateway Switch C:

# Create VLAN interfaces and assign IP addresses to the interfaces.

```
<SwitchC> system-view
[SwitchC] vlan 2
[SwitchC-vlan2] port gigabitethernet 1/0/3
[SwitchC-vlan2] quit
[SwitchC] interface vlan-interface 2
[SwitchC-Vlan-interface2] ip address 192.168.1.43 24
[SwitchC-Vlan-interface2] quit
[SwitchC] vlan 3
[SwitchC-vlan3] port gigabitethernet 1/0/1
[SwitchC-vlan3] port gigabitethernet 1/0/2
[SwitchC-vlan3] quit
[SwitchC] interface vlan-interface 3
[SwitchC-Vlan-interface3] ip address 192.168.3.1 24
```

```
[SwitchC-Vlan-interface3] quit
```

# Enable DHCP.

```
[SwitchC] dhcp enable
```

# Enable the DHCP relay agent on VLAN-interface 3.

```
[SwitchC] interface vlan-interface 3
[SwitchC-Vlan-interface3] dhcp select relay
```

# Specify the DHCP server address.

```
[SwitchC-Vlan-interface3] dhcp relay server-address 192.168.1.42
```

4. Configure the TFTP server:

# On the TFTP server, create a configuration file named **market.cfg**.

```
#
 sysname Market
#
 telnet server enable
#
vlan 3
#
local-user market
 password simple market
 service-type telnet
 quit
#
interface Vlan-interface3
 ip address dhcp-alloc
 quit
#
interface gigabitethernet 1/0/1
 port access vlan 3
 quit
#
user-interface vty 0 63
 authentication-mode scheme
 user-role network-admin
#
return
```

# On the TFTP server, create a configuration file named **rd.cfg**.

```
#
 sysname RD
#
 telnet server enable
#
vlan 3
#
local-user rd
 password simple rd
 service-type telnet
 quit
#
```

```
interface Vlan-interface3
 ip address dhcp-alloc
 quit
#
interface gigabitethernet 1/0/1
 port access vlan 3
 quit
#
user-interface vty 0 63
 authentication-mode scheme
 user-role network-admin
#
return
```

# Start TFTP service software, and specify the folder where the two configuration files reside as the working directory. (Details not shown.)

# Verify that the TFTP server and DHCP relay agents can reach each other. (Details not shown.)

Verifying the configuration

1. Power on Switch D, Switch E, Switch F, and Switch G.
2. After the access devices start up, display assigned IP addresses on Switch A.

```
<SwitchA> display dhcp server ip-in-use
IP address       Client-identifier/    Lease expiration      Type
                 Hardware address
192.168.2.2      3030-3066-2e65-3233-  May 6 05:21:25 2013   Auto(C)
                 642e-3561-6633-2d56-
                 6c61-6e2d-696e-7465-
                 7266-6163-6533
192.168.2.3      3030-3066-2e65-3230-  May 6 05:22:50 2013   Auto(C)
                 302e-3232-3033-2d56-
                 6c61-6e2d-696e-7465-
                 7266-6163-6533
192.168.3.2      3030-6530-2e66-6330-  May 6 05:23:15 2013   Auto(C)
                 302e-3335-3131-2d56-
                 6c61-6e2d-696e-7465-
                 7266-6163-6531
192.168.3.3      3030-6530-2e66-6330-  May 6 05:24:10 2013   Auto(C)
                 302e-3335-3135-2d56-
                 6c61-6e2d-696e-7465-
                 7266-6163-6532
```

3. Telnet to 192.168.2.2 from Switch A.

```
<SwitchA> telnet 192.168.2.2
```

4. Enter username **market** and password **market** as prompted. (Details not shown.)

   You are logged in to Switch D or Switch E.

Automatic configuration using HTTP server and Tcl script

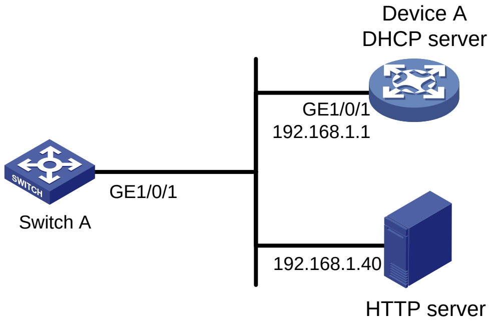
Network requirements

As shown in Figure 3, Switch A does not have a configuration file.

Configure the servers so Switch A can obtain a Tcl script to complete the following configuration tasks:

- Enable the administrator to Telnet to Switch A to manage Switch A.
- Require the administrator to enter the correct username and password at login.

Figure 3 Network diagram



Configuration procedure

1. Configure the DHCP server:

   # Enable DHCP.

```
<DeviceA> system-view
[DeviceA] dhcp enable
```

   # Configure address pool **1** to assign IP addresses on the 192.168.1.0/24 subnet to clients.

```
[DeviceA] dhcp server ip-pool 1
[DeviceA-dhcp-pool-1] network 192.168.1.0 24
```

   # Specify the URL of the script file for the clients.

```
[DeviceA-dhcp-pool-1] bootfile-name http://192.168.1.40/device.tcl
```

2. Configure the HTTP server:

   # Create a configuration file named **device.tcl** on the HTTP server.

```
return
system-view
telnet server enable
local-user user
password simple abcabc
service-type telnet
quit
user-interface vty 0 63
authentication-mode scheme
user-role network-admin
quit

interface gigabitethernet 1/0/1
port link-mode route
ip address dhcp-alloc
```

```
return
```

# Start HTTP service software and enable HTTP service. (Details not shown.)

Verifying the configuration

1. Power on Switch A.
2. After Switch A starts up, display assigned IP addresses on Device A.

```
<DeviceA> display dhcp server ip-in-use
IP address       Client identifier/    Lease expiration      Type
                 Hardware address
192.168.1.2      0030-3030-632e-3239-  Dec 12 17:41:15 2013  Auto(C)
                 3035-2e36-3736-622d-
                 4574-6830-2f30-2f32
```

3. Telnet to 192.168.1.2 from Device A.

```
<DeviceA> telnet 192.168.1.2
```

4. Enter username **user** and password **abcabc** as prompted. (Details not shown.)

   You are logged in to Switch A.

Automatic configuration using HTTP server and Python script

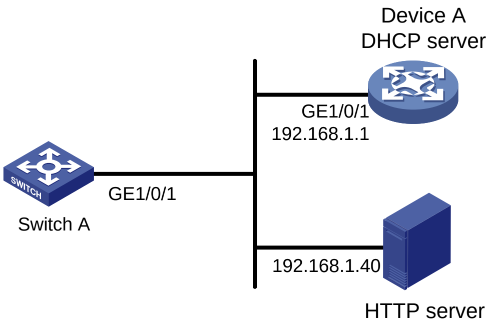
Network requirements

As shown in Figure 4, Switch A does not have a configuration file.

Configure the servers so Switch A can obtain a Python script to complete the following configuration tasks:

- Enable the administrator to Telnet to Switch A to manage Switch A.
- Require the administrator to enter the correct username and password at login.

Figure 4 Network diagram



Configuration procedure

1. Configure the DHCP server:

   # Enable DHCP.

```
<DeviceA> system-view
[DeviceA] dhcp enable
```

# Configure address pool **1** to assign IP addresses on the 192.168.1.0/24 subnet to clients.

```
[DeviceA] dhcp server ip-pool 1
[DeviceA-dhcp-pool-1] network 192.168.1.0 24
```

# Specify the URL of the script file for the clients.

```
[DeviceA-dhcp-pool-1] bootfile-name http://192.168.1.40/device.py
```

2. Configure the HTTP server:

   # Create a configuration file named **device.py** on the HTTP server.

```
#!usr/bin/python

import comware
comware.CLI('system-view ;telnet server enable ;local-user user ;password simple
abcabc ;service-type telnet ;quit ;user-interface vty 0 63 ;authentication-mode
scheme ;user-role network-admin ;quit ;interface gigabitethernet 1/0/1 ;port
link-mode route ;ip address dhcp-alloc ;return')
```

   # Start HTTP service software and enable HTTP service. (Details not shown.)

Verifying the configuration

1. Power on Switch A.
2. After Switch A starts up, display assigned IP addresses on Device A.

```
<DeviceA> display dhcp server ip-in-use
IP address       Client identifier/    Lease expiration      Type
                 Hardware address
192.168.1.2      0030-3030-632e-3239-  Dec 12 17:41:15 2013  Auto(C)
                 3035-2e36-3736-622d-
                 4574-6830-2f30-2f32
```

3. Telnet to 192.168.1.2 from Device A.

```
<DeviceA> telnet 192.168.1.2
```

4. Enter username **user** and password **abcabc** as prompted. (Details not shown.)

   You are logged in to Switch A.

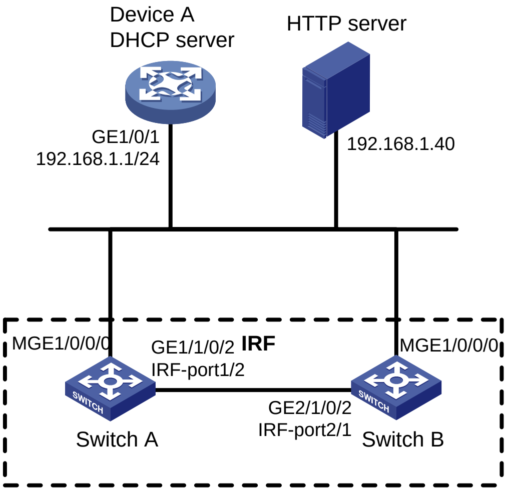
Automatic IRF setup

Network requirements

As shown in Figure 5, Switch A and Switch B do not have a configuration file.

Configure the servers so the switches can obtain a Python script to complete their respective configurations and form an IRF fabric.

Figure 5 Network diagram



Configuration procedure

1. Assign IP addresses to the interfaces. Make sure the devices can reach each other. (Details not shown.)
2. Configure the following files on the HTTP server:

File	Content	Remarks
.cfg configuration file	Commands required for IRF setup.	You can create a configuration file by copying and modifying the configuration file of an existing IRF fabric.
sn.txt	Serial numbers of the member switches.	Each SN uniquely identifies a switch. These SNs will be used for assigning a unique IRF member ID to each member switch.
(Optional.) .ipe or .bin software image file	Software images.	If the member switches are running different software versions, you must prepare the software image file used for software upgrade.
.py Python script file	Python commands that complete the following tasks: **a** (Optional.) Verify that the flash memory has sufficient space for the files to be downloaded. **b** Download the configuration file and **sn.txt**. **c** (Optional.) Download the software image file and specify it as the main startup image file. **d** Resolve **sn.txt** and assign a unique IRF member ID to each SN. **e** Specify the configuration file as the main next-startup configuration file. **f** Reboot the member switches.	For more information about Python script configuration, see "Using Python."

3. Configure Device A as the DHCP server:

   # Enable DHCP.

   ```
   <DeviceA> system-view
   [DeviceA] dhcp enable
   ```

   # Configure address pool **1** to assign IP addresses on the 192.168.1.0/24 subnet to clients.

   ```
   [DeviceA] dhcp server ip-pool 1
   [DeviceA-dhcp-pool-1] network 192.168.1.0 24
   ```

   # Specify the URL of the script file for the clients.

   ```
   [DeviceA-dhcp-pool-1] bootfile-name http://192.168.1.40/device.py
   [DeviceA-dhcp-pool-1] quit
   ```

   # Enable the DHCP server on GigabitEthernet 1/0/1.

   ```
   [DeviceA] interface gigabitethernet 1/0/1
   [DeviceA-GigabitEthernet1/0/1] dhcp select server
   [DeviceA-GigabitEthernet1/0/1] quit
   ```

4. Power on Switch A and Switch B.

Switch A and Switch B will obtain the Python script file from the DHCP server and execute the script. After completing the IRF configuration, Switch A and Switch B reboot.

5. After Switch A and Switch B start up again, use a cable to connect Switch A and Switch B through their IRF physical ports.

Switch A and Switch B will elect a master member. The subordinate member will reboot to join the IRF fabric.

Verifying the configuration

# On Switch A, display IRF member devices. You can also use the **display irf** command on Switch B to display IRF member devices.

```
<Switch A> display irf
MemberID  Slot  Role    Priority  CPU-Mac         Description
   1      1     Standby 1         00e0-fc0f-8c02  ---
 *+2      1     Master  30        00e0-fc0f-8c14  ---
--------------------------------------------------
 * indicates the device is the master.
 + indicates the device through which the user logs in.

 The Bridge MAC of the IRF is: 000c-1000-1111
 Auto upgrade                : yes
 Mac persistent              : always
 Domain ID                   : 0
 Auto merge                  : yes
```

The output shows that the switches have formed an IRF fabric.