



DHCP Configuration Guide for SONiC using GNS3

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Intended Audience

This document is tailored for data center experts, and network engineers who are interested in implementing **DHCP** in SONiC. It is designed for individuals with a solid understanding of networking principles. Whether you are a network engineer, network operator, or vendor, this document aims to provide you with practical, step-by-step guidance, and best practices for deploying, configuring, and conducting behavioral testing of SONiC's L4 features using the GNS3 network simulation tool.

Introduction

This comprehensive document serves as a guide for configuring DHCP using GNS3, a powerful network simulation tool. By leveraging GNS3, users can create virtual instances of SONiC, enabling thorough testing and evaluation of its diverse features. Through practical demonstrations and detailed instructions, the document aims to equip readers with the knowledge and insights required to successfully configure DHCP in their network environments. The step-by-step procedure outlined in this guide provides a comprehensive approach to the deployment and verification of DHCP.

Mode of Allocation

The allocation method of assigning an IP address to the network system can be done in two different ways:

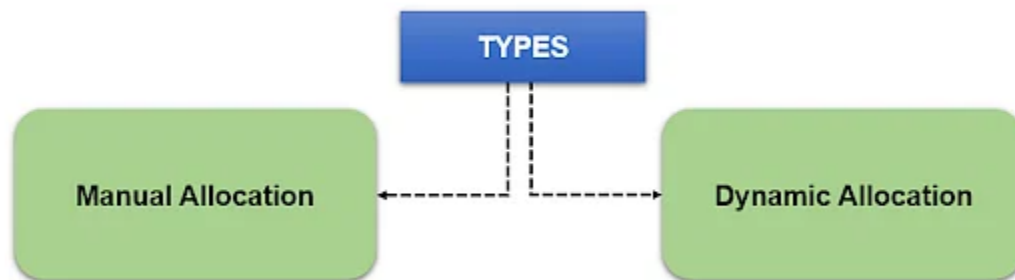


Figure 1 Types of Allocation

1. Manual Allocation: As the name suggests, requires you to manually configure the network settings(IP configurations, gateway configurations, etc) for your device rather than applying any network concept. The manual allocation is done by accessing the network configuration settings

of the device and also requires other related configurations such as subnet mask, default gateway, and preferred DNS server.

This allocation mode is much more time-consuming and is prone to errors because of human intervention.

2. Dynamic Allocation: The dynamic allocation mode involves the DHCP client sending a request message to the DHCP server.

What is DHCP?

Dynamic Host Configuration Protocol (DHCP) is an application layer protocol that allows a server to assign IP addresses dynamically.

DHCP is based on a client-server model and works on the discovery, offer, request, and Acknowledgement. The following ports are used for communication in DHCP:

- Port No. 68 for DHCP server
- Port No. 67 for DHCP Client

DHCP employs UDP services and is a client-server protocol, a pool of addresses is used to assign IP addresses. In DHCP, the client and the server exchange 4 DHCP messages in order to make a connection, also called the DHCP DORA process.

DHCP DORA Process

DORA stands for Discover, Offer, Request, Acknowledge. DHCP uses the Dora Process to provide an IP Address to hosts or client machines. It collects all of the IP addresses from the central server that are accessible and gives them to hosts that want to connect to the network.

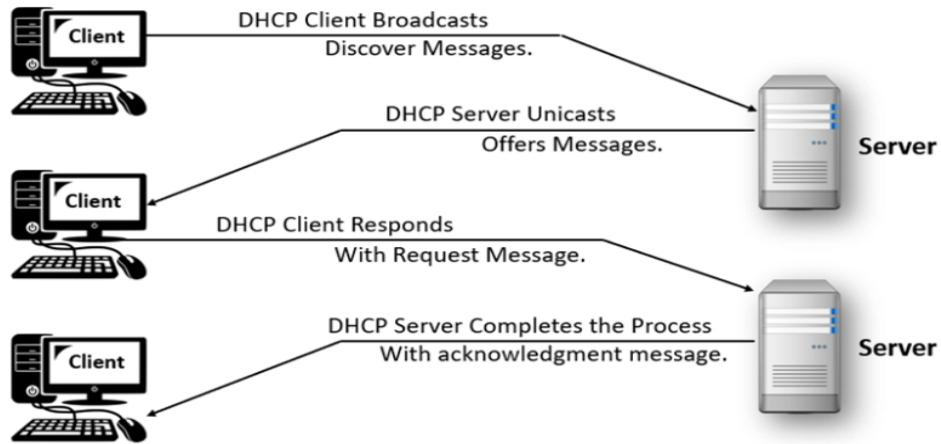


Figure 2 DHCP DORA Process

Discover	Via Client using port no. 67
Offer	Via server using port no. 68
Request	Via Client using port no. 67
Acknowledge	Via server using port no. 68

Important DHCP Terms

- Scope – all the IP Addresses that DHCP provides come under the scope.
- Lease – how long will your DHCP lease the IP to the client?
- Exclusion – to exclude IP Addresses.
- Reservation – to reserve IP Addresses for the machine

DHCP Relay Agent

A DHCP (Dynamic Host Configuration Protocol) relay agent is a network device or service that helps facilitate communication between DHCP clients and DHCP servers across different subnets or networks. When a DHCP client needs to obtain an IP address and additional network configuration settings such as DNS, default gateway, and domain name, for example, it initiates a DHCP request. It sends a DHCP request as a broadcast on its local subnet. However, DHCP broadcasts typically don't traverse across network boundaries.

This is where a DHCP relay agent comes into play. Its primary role is to forward DHCP broadcast messages (like DHCP discovery) from clients to a DHCP server and then relay the server's responses back to the clients. This is crucial in network environments where DHCP servers are located on a different subnet or network segment.

Network Topology

After importing the image, create a topology in GNS3 using SONiC devices and hosts as shown below.

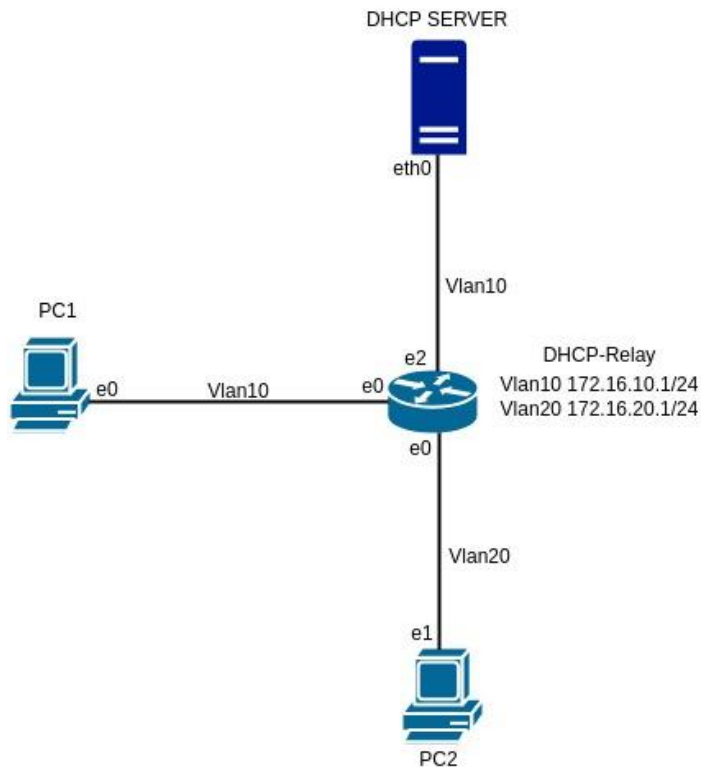


Figure 3 Network topology

In the above topology, the switch is configured as DHCP_Relay, and two hosts (PC1, PC2) are used as DHCP clients. On switch, two vlan's Vlan 10 & 20 are configured and DHCP-Relay service is enabled on Vlan20. PC1 belongs to Vlan10 and PC2 belongs to Vlan20. When the DHCP server is up and running both PC1 and PC2 will get IP addresses from the Vlan10 and Vlan20 pool respectively.

Configurations

The configuration consists of SONiC Native Configurations. All hosts and switches are configured for the above topology.

DHCP Server

As the DHCP server service is not available in SONiC as of today, for this topology setup Ubuntu 22.04 machine is used and ISC-DHCP server is installed on it.

To configure the DHCP server make the following changes to `/etc/default/isc-dhcp-server` file. write the name of the interface on which the DHCP server should serve DHCP Requests—for example Ethernet(ens3).

```
Then add following configurations to /etc/dhcp/dhcpd.conf file
subnet 172.16.10.0 netmask 255.255.255.0 {
    range 172.16.10.10 172.16.10.20;
    option routers 172.16.10.1;
    option domain-name-servers 172.16.10.1, 8.8.8.8;
}
subnet 172.16.20.0 netmask 255.255.255.0 {
    range 172.16.20.10 172.16.20.20;
    option routers 172.16.20.1;
    option domain-name-servers 172.16.20.1, 8.8.8.8;
}
```

- Restart isc-dhcp-server service.

SONiC DHCP-Relay

Step 1. Enable DHCP-Relay service on SONiC Switch.

```
admin@sonic:~$ sudo config feature state dhcp_relay enabled
```

Step 2. Remove IP from interfaces.

```
admin@sonic:~$ sudo config interface ip remove Ethernet0  
10.0.0.0/31  
admin@sonic:~$ sudo config interface ip remove Ethernet4  
10.0.0.2/31  
admin@sonic:~$ sudo config interface ip remove Ethernet8  
10.0.0.4/31
```

Step 3. Add vlans.

```
admin@sonic:~$ sudo config vlan add 10  
admin@sonic:~$ sudo config vlan add 20
```

4- Add Ethernet0 and Ethernet8 as a member of vlan 10.

```
admin@sonic:~$ sudo config vlan member add -u 10 Ethernet0  
admin@sonic:~$ sudo config vlan member add -u 10 Ethernet8
```

5- Add Ethernet0 and Ethernet4 as a member of vlan 20.

```
admin@sonic:~$ sudo config vlan member add -u 20 Ethernet4
```

6- Assign IP Addresses to both vlans.

```
admin@sonic:~$ sudo config interface ip add Vlan10 172.16.10.1/24  
admin@sonic:~$ sudo config interface ip add Vlan20 172.16.20.1/24
```

7- Enable DHCP relay on VLAN20.

```
admin@sonic:~$ sudo config vlan dhcp_relay add 20 172.16.10.2
```


Result

In the DHCP server configuration, IPs are designated for allocation in VLAN segments, specifically Vlan 10 and Vlan 20. During the DORA process initiation, the DHCP server assigns an IP address from the respective VLAN segment to each requesting PC. As a result, PC1, associated with Vlan 10, is allocated an IP from that segment, while PC2, belonging to Vlan 20, is assigned an IP from Vlan20.

PC1

```
PC1> ip dhcp  
DDORA IP 172.16.10.15/24 GW 172.16.10.1
```

PC2

```
PC2> ip dhcp  
DDORA IP 172.16.20.12/24 GW 172.16.20.1
```

References

- <https://www.pynetlabs.com/what-is-dhcp/>
- https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/ipaddr_dhcp/configuration/15-sy/dhcp-15-sy-book/dhcp-relay-agent.html
- <https://support.edge-core.com/hc/en-us/articles/900000198943--Enterprise-SONiC-DHCP-Relay>