DNS & DHCP Guide

Objective: Build a small network using DNS and DHCP

Understanding the Network

There are many components when building a network. To understand how they work together, imagine we are building a small city.

- The Router
    - **Purpose**: Act as traffic directors, connecting multiple devices to the internet and managing data flow between them by routing data packets to their correct destination IP addresses, creating a local network (LAN) for sharing connections, and providing essential features like Wi-Fi and security (firewalls)
    - **City Hall**: Governs the town and the entrances and exits of the city
- The Switch
    - **Purpose**: Connects multiple devices (computers, printers, etc.) in a network, acting as a smart traffic controller that directs data only where it needs to go
    - **Main Street**: All the roads from the houses connect to the main street, allowing them to reach the city hall.
- The PCs
    - **Purpose**: Act as connected endpoints (clients or servers) for sharing resources like files, printers, and internet access, enabling digital communication (email, chat), and running applications together
    - **Houses**: People who live in the city.
- The Cables
    - **Purpose**: Providing wired pathways for data to travel between devices like computers, routers, and servers, enabling communication, file sharing, and internet access by relaying electrical signals or light pulses reliably and often faster/more securely than wireless
    - **Roads**: Used to connect City Hall, Main Street, and the Houses

Why is DHCP Important?

Keeping with the analogy, imagine the Mayor drives to a family's house whenever they move into the city and paints their house number. For the Mayor, it would be time-consuming and worse if they made a mistake and gave out the same address twice. This would cause a conflict with their Amazon packages, as the driver would not know which house to deliver them to. Even worse for the Mayor, if the city grows rapidly, they will have to visit hundreds of homes to register them, but by the time they finish, they realize that going to everyone's house takes too much work.

Now imagine that same scenario, but in a large business's network. The network admin would spend all their time going to every connected device and hand them an IP address. If they were to assign the same IP address to two devices, both devices would be kicked off the network and unable to access the internet. DHCP helps solve this problem in milliseconds.

Why is DNS Important?

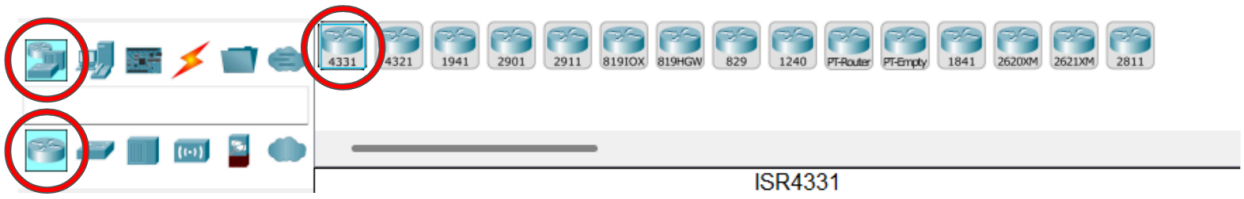
In our created city, everyone is confused about how to get to the nearest McDonald's and pick up their Starbucks. This is because there are no street names or store names. The only way to find the location of a destination or any place is to memorize its GPS coordinates. Then, if McDonald's were to relocate and become a Taco Bell, no one would be able to find them because no one has the new building's coordinates memorized.

This applies to how we access services on the interweb. Instead of going to google.com to ask a question, you now type 8.8.8.8. DNS makes the internet more accessible because it is easier to memorize phrases than a random sequence of numbers.

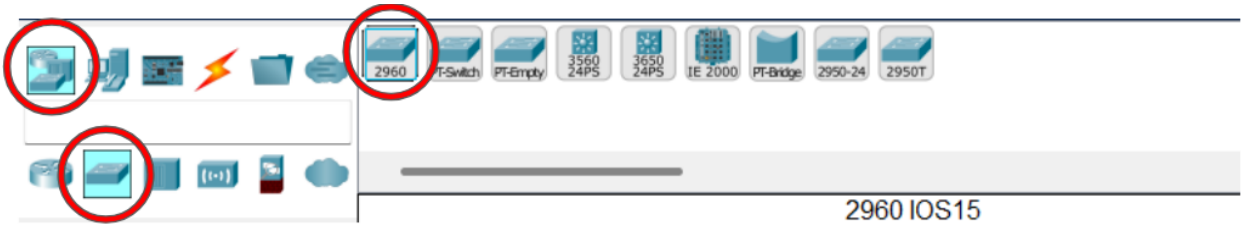
Setting up a Network

Using Packet Tracker, we are going to build our city by placing buildings and paved roads, and using automation.

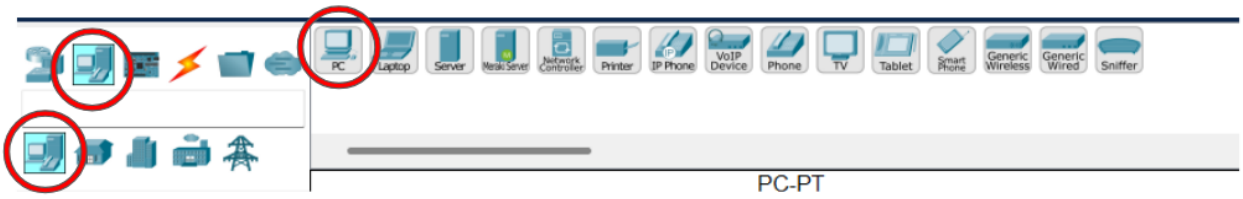
Open an empty file. First place down a router. This is found at the bottom left. Hover over *Network Devices*, then *Routers*. Select the *4331* or the *ISR4331*, then drag it into the space.



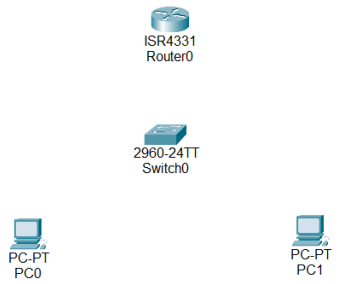
Now pick out the switch. Go to *Network Devices* and then *Switches*. Select the *2960* and place it slightly below the router.



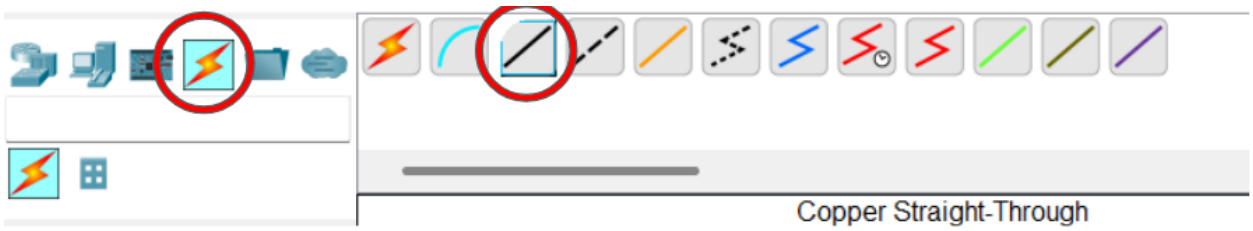
To add PCs, go to *End Devices* and then drag two *PCs* to the bottom.



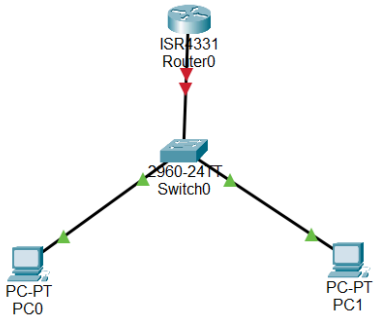
The environment should look like this:



Now, to connect everything, use *Copper Straight-Through cables*. These are found by clicking *Connections, which* should look like a lightning bolt. The cables will look like a solid black line.



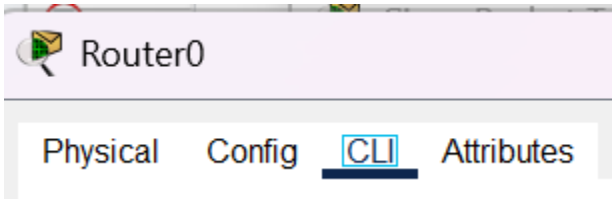
Connect the Router to *GigabitEthernet0/0/0*, then connect the Router to the Switch at *FastEthernet0/1*. From the Switch, connect to FastEthernet0/2 to PC0 FastEthernet0, and repeat for PC1; Switch connects to *FastEthernet0/3* to PC1 *FastEthernet0*.



Setting up DHCP

Here, we are going to help out the Mayor and auto-assign house numbers. We are going to set up the Router to hire a city planner who will instantly assign available house numbers.

Click the *Router*, then go to the *CLI* (Command Line Interface) tab.



In the terminal, add the following **BOLD** Commands.

When you open the terminal, it says Would you like to enter the initial configuration dialog? Reply no:
Would you like to enter the initial configuration dialog? [yes/no]: **no**

>**enable**
#configure terminal
(config)**# interface GigabitEthernet0/0/0**
(config-if)**# ip address 172.16.1.1 255.255.255.0**
(config-if)**# no shutdown**
(config-if)**# exit**

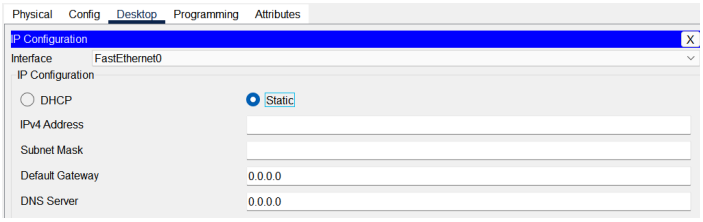
(config)**# service dhcp**
(config)**# ip dhcp excluded-address 172.16.1.1**

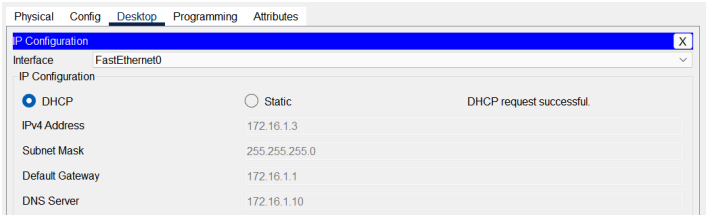
(config)**# ip dhcp pool pool1**
(dhcp-config)**# network 172.16.1.0 255.255.255.0**
(dhcp-config)**# default-router 172.16.1.1**
(dhcp-config)**# exit**

By executing these commands:

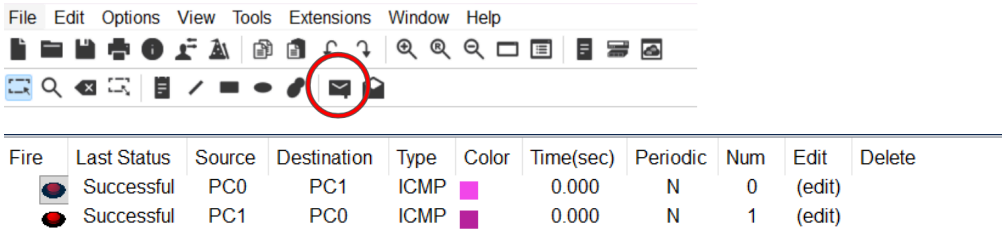
1. The first section enters configuration mode, configures the GigabitEthernet0/0/0 interface by assigning it the IP address 172.16.1.1 with a subnet mask of 255.255.255.0, and then activates the interface with the no shutdown command.
2. The second section enables the DHCP service and uses ip dhcp exclude to ensure the gateway IP of 172.16.1.1 is never assigned to a client.
3. Finally, it creates a DHCP pool named pool1 that defines the range of addresses for the 172.16.1.0 network and sets 172.16.1.1 as the default router (gateway) for all clients.

After that, for each PC, change it to DHCP mode**:** Click on PC0, Go to the Desktop tab, Click IP Configuration, Switch the radio button from Static to DHCP, and repeat this for PC1. If the setup was correct, you should see the PC get assigned an IP Address, Subnet Mask, and Default Gateway. This should happen for both PC0 and PC1.





To check if this is working, check if the PCs can talk to each other. Click the closed envelope in the top-right corner. Then press PC0, then PC1; there should now be an indication of whether it failed or succeeded.

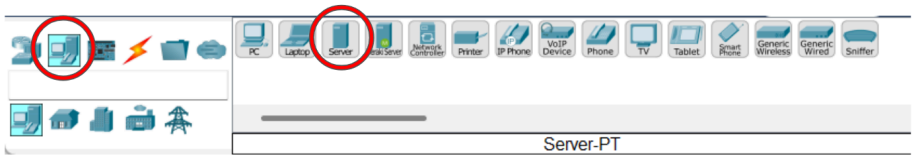


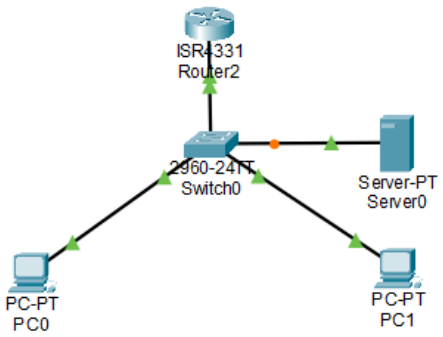
Setting up DNS

Imagine you just moved in and want to order some Domino's stuffed-crust pizza. However, when you search up dominos.com, your computer gives you an error. This is because the computer does not know what “Dominos” is. Computers can only understand numbers.

We are going to set up a Public Library (DNS Server) that will act as a giant phonebook, so when you type dominos.com, it will route you to Dominos.

Go to *End Devices* in the bottom-left corner, then place a *Server* next to the switch and connect them with a *Copper Straight-Through Cable.*





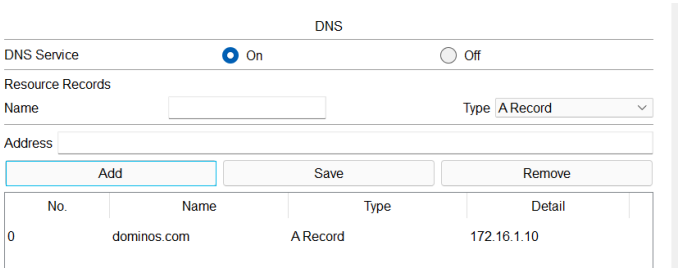
Click on the *Server,* open the *Desktop* tab, and navigate to *IP Configuration*. You see that there's already an IP Address, Subnet Mask, and Default Gateway. This is because of the DHCP we set up earlier. We want to replace this with a Static IP Address. Select Static and fill in the blanks.

IP Address: 172.16.1.10
Subnet Mask: 255.255.255.0
Default Gateway: 172.16.1.1

Open the *Services* tab, then navigate to *DNS*. Make sure that DNS is on

Name: dominos.com
Address: 172.16.1.10

Click Add
Note, this is a test we can use the Server's own IP Address.

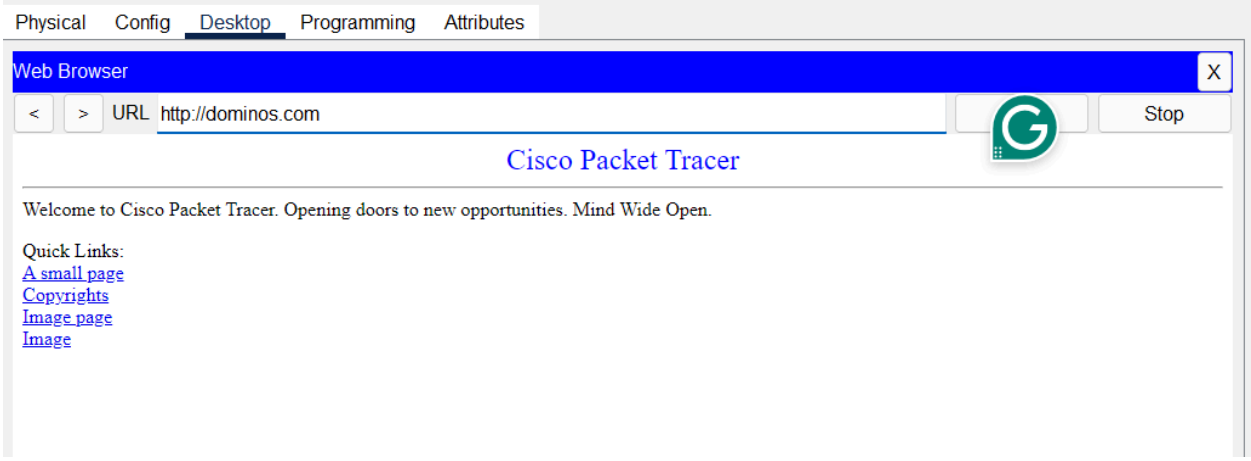


Now open the Router and type these commands:

>enable
#configure terminal
(dhcp-config)**#ip dhcp pool pool1**
(dhcp-config)**#dns-server 172.16.1.10**
(dhcp-config)**#exit**

After everything, you need to cycle your PC's IP configuration by switching to Static, then back to DHCP to pick up the new settings.

To test that everything is working correctly, click one of the PCs, then click Web Browser. Enter the same name as before. If everything is working, this screen should appear.



Now you should be able to order your pizza and relax in your new house.

Conclusion

If everything is working correctly, then you have created a small network in Packet Tracker. By following the steps, you have built a digital community. A Mayor to govern traffic (Router), a city planner to auto-assign new people (DHCP), and a library to help people navigate (DNS).

Real World Application

In your house, you have a router that handles several protocols, including DHCP and DNS. These two services allow new devices to join your Wi-Fi and for you to open websites. Expanding outside the household, businesses rely on enterprise-grade DHCP servers to manage hundreds of thousands of devices, schools use DNS to direct students to campus resources, and data centers depend on accurate DNS records to route internet traffic. Whether running a simple home Wi-Fi or a Fortune 500 company, DNS and DHCP are the invisible engines that keep entire systems running.