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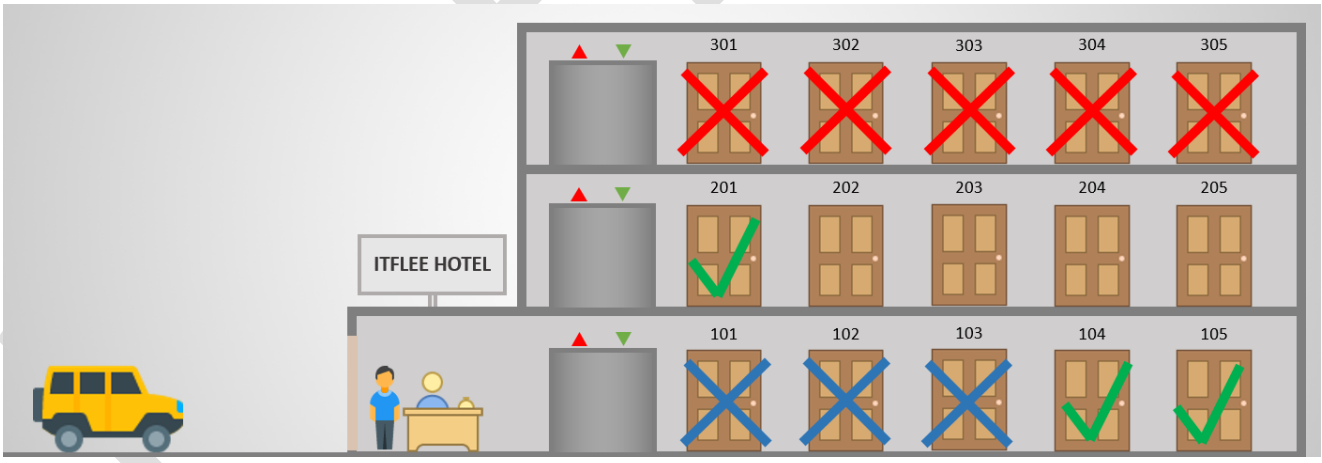
The goal of this lecture is to help you understand what DHCP is and how it works. But before you can understand DHCP you need to understand static IP addresses. A static IP address is manually assigned by an administrator and as the name suggests, it does not change unless it is manually changed. In order to configure a static IP address you must know the basic TCP/IP settings for your network. Things like available IP addresses, what subnet mask to use, what gateway to use and optionally what DNS server to point your computer to. If you enter an invalid setting, your computer will not have network connectivity until you fix the configuration issue.

Dynamic Host Configuration Protocol (or DHCP) is a networking protocol that allows a particular server to assign TCP/IP configurations automatically to client computers on the same network. In the Windows world, you need to install the DHCP server role on a Windows Server in order to have this functionality on your network.

A DHCP server will automatically configure the IP address, Subnet Mask, DNS Server address, and Gateway of a client computer which is any computer on the network that is attempting to use DHCP as its network configuration. The configuration that DHCP assigns is not permanently given to the client computer but is leased to the client for a certain amount of time. Once a DHCP lease has expired, the client computer must reach back to the DHCP server and renew its existing lease for the existing configuration, or an obtain an entire new configuration and lease.

Before DHCP was used System Administrators needed to go to each computer and manually configure the TCP/IP settings. This was bad for several reasons. The first being that it takes a lot of time – what if you have thousands of new computers? Secondly, there is large room for user error – what if an administrator assigned the same IP address to two computers? It would be the equivalent of someone in your neighborhood having the same home address which is obviously a terrible problem.

We are going to look at how a Hotel operates to help you understand how DHCP works:



Jonny is taking a trip and has arrived at his hotel. He walks inside the hotel and asks the clerk for a room. The desk clerk then looks in his registry to see which rooms are available and finds that all of the rooms on the top floor are closed because they are being repainted. This would be an example of a DHCP exclusion, the range of rooms 301 – 305 cannot be handed out to clients because they are excluded from the list of available rooms.

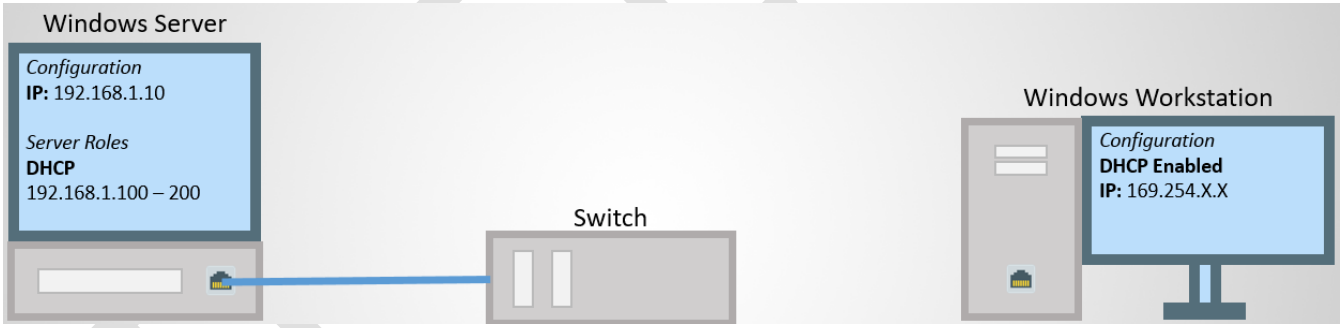
He finds that the first three bottom rooms have been reserved so he cannot give those rooms to Jonny. He also notices that rooms 104, 105 and 201 are occupied so he cannot give him any of those rooms either. Finally, he sees that he can give Jonny room 202 for one week. Jonny accepts the room and goes inside. The clerk updates his registry to note that there is now a person in room 202. At the end of the week, Jonny either has to be back to the clerk and ask for another week on his room or leave. When Jonny finally leaves room 202, it will again become available for the next visitor.

This is very similar to how DHCP works. Administrators may specify the range or scope of IP address that are to be supplied by DHCP as well as excluding or prohibiting certain IP address from being assigned to clients, just like our hotel clerk did for the repainting of the rooms on the top floor.

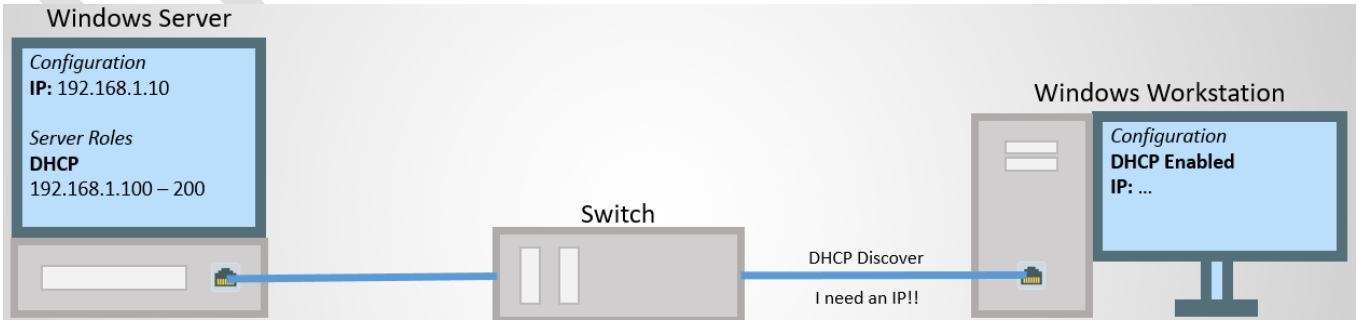
You may also set reservation for specific computers. You could reserve the IP address 192.168.1.10 for the MAC address the server ITFDC01. Only this server will be able to get that IP address from DHCP. This is different from manually configuring the IP address because we are configuring the IP address from the DHCP server and not from the client computer.

If you have a computer that is configured to use DHCP but it has a IP address starting with 169.254, this is referred to as a private IP address. It means that the computer was unable to find a DHCP server on the network so it assigned itself this IP address.

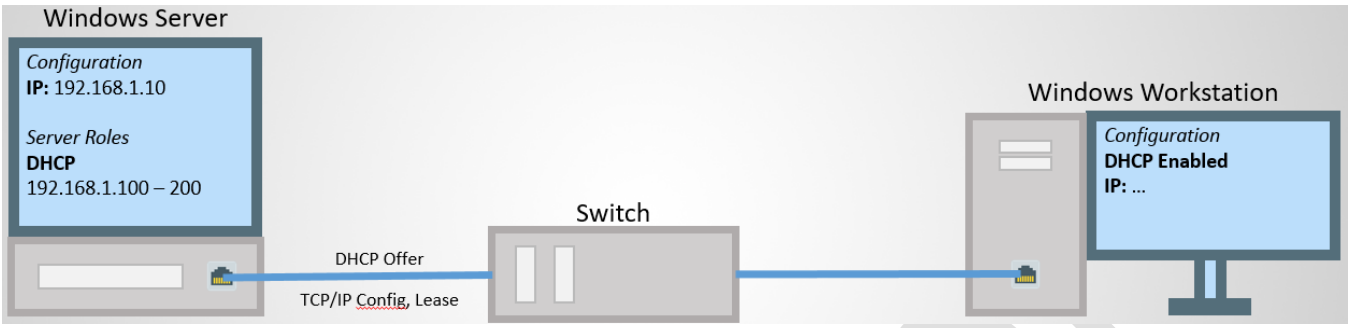
Now let's take a look at the technical explanation of how DHCP works. In this example we are only showing two computers and a switch. Right now the Windows Workstation is not plugged in to the switch. Since it could not find a DHCP server, it has assigned itself a private IP address.



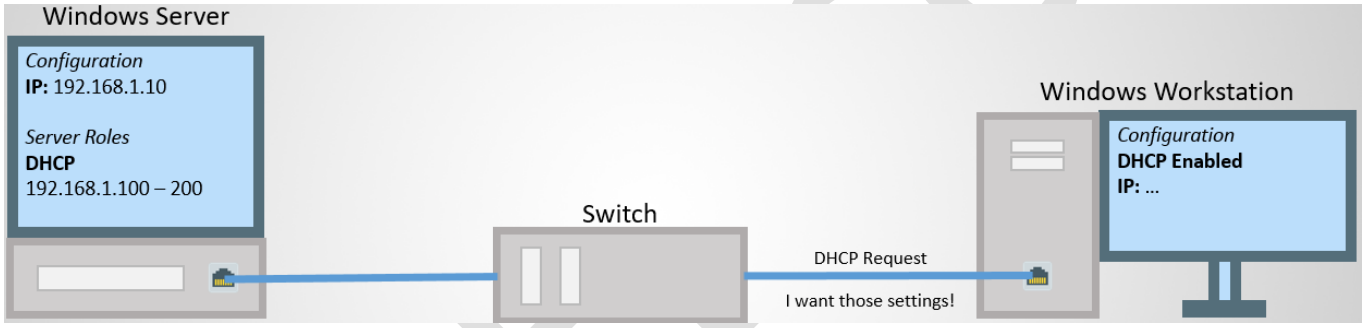
Once we plug the network cable into the switch, the client computer begins broadcasting a DHCP Discover request. The request is sent to the entire network in hopes that the message will reach a DHCP server.



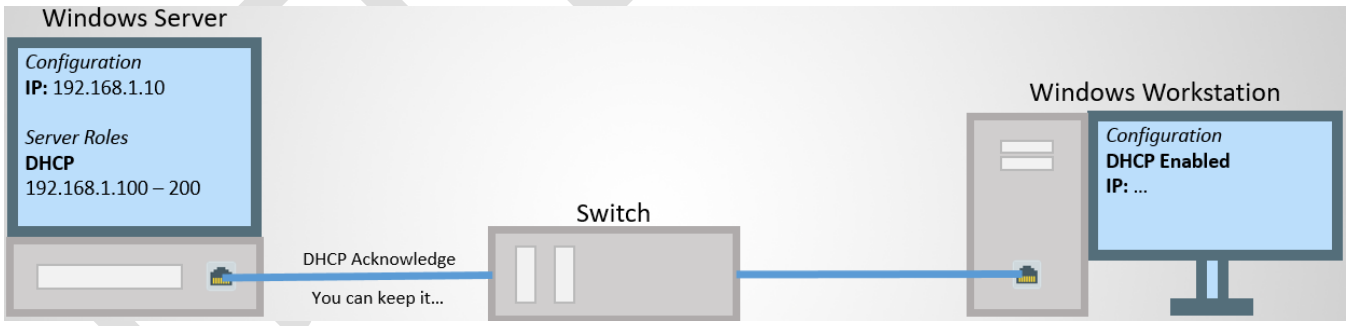
A DHCP server will be listening for this request. Once it receives a DHCP Discover request, it will send back a DHCP Offer. This offer includes all of the TCP/IP configuration (IP address, subnet mask, DNS server, gateway).



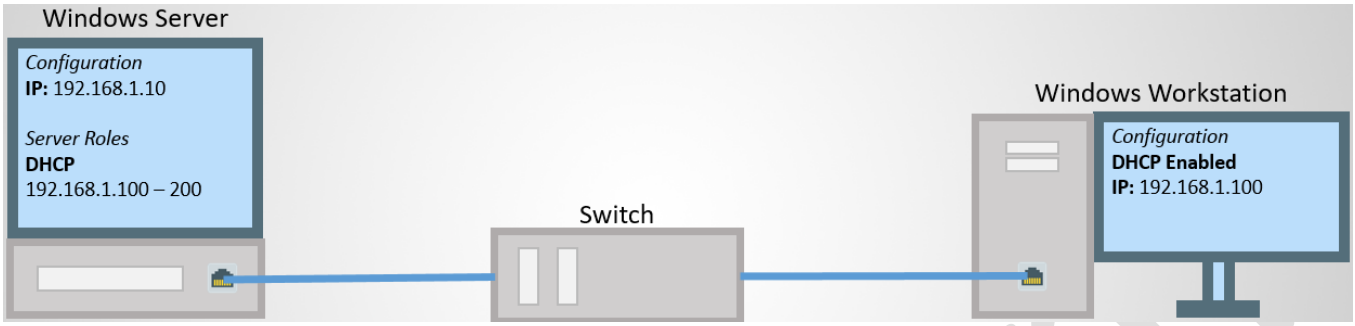
Once the client receives the DHCP offer, it will send back a DHCP Request to the server. This message lets the DHCP server know that it wants to keep the settings that were offered by the DHCP server.



Finally, the DHCP server will send back an Acknowledgement message stating that it understands the client computer is going to keep the settings it offered.



The computer will accept the TCP/IP configuration.

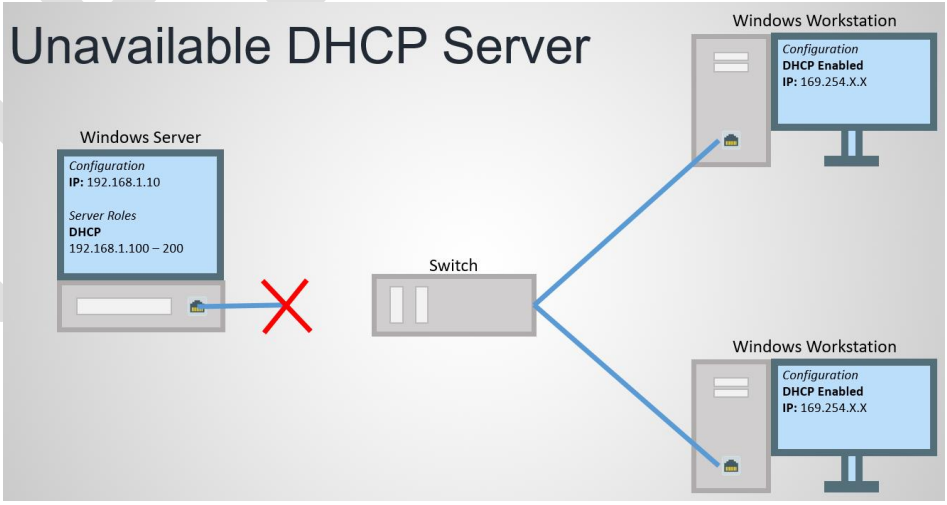


Let's recap exactly what has happened. We can memorize the process for **D**iscover, **O**ffer, **R**equest and **A**cknowledgement with the acronym DORA. The client sends out a DHCP **D**iscover message and the DHCP server responds with a DHCP **O**ffer. The client **R**equests the offered settings and the Server **A**cknowledges the request.

So you might ask why would we ever want to use a static IP address? Well remember that one of the settings that DHCP can automatically configure is the DNS server? This configuration would be specified with by an IP address (e.x. 192.168.1.10). What if the DNS server used DHCP and its IP address changed from week to week? We would need to update the DHCP settings with the new IP address every time it changed – I can't think of a single circumstance where you would want to do this. It is much less complicated to simply assign a static IP address to our DNS server so it never changes.

Another example would be printers or scanners. You would want these devices to use a static IP address so people would be able to consistently print to them and not need to re-enter the IP address every time it obtained a new TCP/IP configuration from DHCP.

Earlier we talked about making reservations where DHCP will assign an IP address to a specific MAC address. You might be wondering why we would take the time to log on to each client computer and manually configure a static IP address when we can simply create DHCP reservations from a single server. While the end result is the same as if you would have manually configured the IP address statically, what if your DHCP server crashed? Once the lease expired for the client computer it would no longer have access to the network and would revert to a private IP address (169.254.X.X).



Let's recap what we have covered in this lecture. First, DHCP is a network protocol that is installed on Windows Server as a role. Admins can specify a single scope (range) of IP addresses for DHCP to assign to clients. The configurations handed out by DHCP are leased and only must be renewed regularly, You can exclude a range of IP addresses, make a IP reservations for individual MAC addresses, the technical process of a client getting its TCP/IP configuration from a DHCP server is DORA (discover, offer, request, acknowledge), static IP address are still relevant for things like servers and printers, if your DHCP server crashes, computers relying on DHCP will stay connected until their TCP/IP lease expires, and finally, if a client computer configured to use DHCP cannot find a DHCP server it will assign itself a private IP address starting with 169.254.x.x.

Great job getting through all of this information, I will see you in the next lecture!