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Declaration: I understand that I am required to submit my assignment under the appropriate module page prior to the specified deadline, in order for it to be considered for marking. I acknowledge that any assignment submitted after the deadline will be deemed as a non-submission and will not be marked, resulting in a score of zero.

Table of Contents

Table of Figures

1. Introduction

The primary objective of this report is to provide detailed information about IP and DHCP, as well as practical insights into their working mechanisms. PowerShell is utilized to execute and demonstrate commands that retrieve essential network details, ensuring a hands-on approach to understanding these concepts.

2. Objective

The main objective of this report is to get detailed information about IP and DHCP.

3. Required Tools

PowerShell is used to get different information as per the need.

4. Research contents

Question No. 1

What is the OSI model? How many layers are there in the OSI model? What is the function of each layer?

The OSI (Open Systems Interconnection) model is a conceptual framework used to understand and implement network communication between different systems (Andrew J. Whitaker, 2008). There are seven layers of OSI model.

1. Physical Layer: Deals with the physical connection between devices, including Hubs, Repeaters, Modems, Cables, and the electrical signals that traverse them.

2. Data Link Layer: Responsible for node-to-node data transfer and error detection/correction. Switches, Bridges are used in this layer.

3. Network Layer: Handles data routing between networks using logical addressing (IP addresses) and determines the best path for data transfer. Devices like Router and Layer 3 switches are used for this layer.

4. Transport Layer: Ensures complete data transfer and error recovery. It provides end-to-end communication and includes protocols like TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

5. Session Layer: Manages sessions between applications or devices. It establishes, maintains, and terminates connections between applications.

6. Presentation Layer: Translates data between the application layer and the network. It handles data encoding, encryption, and compression.

7. Application Layer: Provides network services to end-users, such as email, file transfer, and directory services. It acts as the interface between the user and the network.

Question No. 2

What is an IP address? How many bits does an IP address have (you can limit your answers to IPv4)? What are network bits, host bits, subnet address and subnet mask? Provide an example. What is the default gateway?

An IP address (Internet Protocol address) is a unique numerical identifier assigned to each device connected to a network (N.B., n.d.). It enables devices to communicate by identifying their location in the network.

An IPv4 address is 32 bits long. It allows a total of 2^(32) unique addresses. The 32 bits is divided into network bits and host bits.

Network bits: It is the portion of the IP address that specifies the network. All devices within the same network share the same network bits.

Host Bits: It is the portion of the IP address that identifies specific devices (hosts) within a network.

Subnet Address: It is the first address in an IP range for a specific subnet. It represents the network portion of the address, with all host bits set to 0.

Subnet Mask: A subnet mask is a 32-bit number that divides an IP address into network portion and host portion represented in dotted decimal notation like '255.255.255.0' or in CIDR notation like '/24'.

For example:

IP Address: 192.168.1.10

Subnet Mask: 255.255.255.0 (Taking CIDR: /24)

Binary Conversion of Subnet Mask: 11111111.11111111.11111111.00000000

Network Bits: 24 (First 24 bits are 1).

Host Bits: 8 (Last 8 bits are 0).

Default Gateway: It is the IP address of a router that serves as an access point to other networks.

Question No. 3

How does a computer on a network get the IP address, subnet mask and default gateway?

A dynamic IP address is automatically assigned to a network when a router is set up.

- When a computer or a DHCP client connects to a network, it first sends a DHCP Discover message on the local network to find a DHCP server.
- A DHCP server (usually a router or a dedicated server) listens for DHCP Discover messages and responds with a DHCP Offer message that contains IP Address, Subnet Mask, Default Gateway and Lease Time.
- The client selects an offer and responds with a DHCP Request message indicates that the client has accepted the offer from the DHCP server and will use the provided IP address, subnet mask, and default gateway.

- The DHCP server receives the DHCP Request message and sends a DHCP Acknowledgment (ACK) message to the client that confirms the assigning of IP address, subnet mask, and the default gateway.

Question No. 4

For a packet, you send to google.com, what is the destination IP address and how do you get it? What is the destination MAC address and how do you get it?

When sending a packet to google.com, the destination IP address and destination MAC address are determined by resolving the domain name to an IP address and routing the packet through our local network.

The destination IP address is the public IP address of the google.com server and it is obtained using DNS (Domain Name System), which resolves the human-readable domain name (google.com) to its IP address.

We can use the ping command in the PowerShell to get the IP address as in picture below:

```
PS C:\Users\amank> ping google.com

Pinging google.com [142.250.207.206] with 32 bytes of data:
Reply from 142.250.207.206: bytes=32 time=32ms TTL=55
Request timed out.
Reply from 142.250.207.206: bytes=32 time=78ms TTL=55
Reply from 142.250.207.206: bytes=32 time=404ms TTL=55

Ping statistics for 142.250.207.206:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 32ms, Maximum = 404ms, Average = 171ms
PS C:\Users\amank>
```

Figure 1: Pinging google.com

The destination MAC address is the hardware or the physical address of the next hop device on our local network, usually the router. The MAC address is used for communication within the local network and the MAC address of the next hop is determined using the ARP (Address Resolution Protocol). We can check the destination MAC address by using the command “arp – a” after pinging “google.com”.

If the destination IP is outside the local subnet, the device forwards the packet to our default gateway (router).

```
PS C:\Users\amank> arp -a

Interface: 192.168.36.1 --- 0x4
  Internet Address      Physical Address      Type
  192.168.36.254        00-50-56-fe-61-e8     dynamic
  192.168.36.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 192.168.22.1 --- 0x8
  Internet Address      Physical Address      Type
  192.168.22.254        00-50-56-e2-56-be     dynamic
  192.168.22.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 192.168.18.70 --- 0xf
  Internet Address      Physical Address      Type
  192.168.18.1          64-2c-ac-72-dd-5d     dynamic
  192.168.18.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.102.18        01-00-5e-7f-66-12     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 192.168.56.1 --- 0x18
  Internet Address      Physical Address      Type
  192.168.56.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static

Interface: 172.30.176.1 --- 0x21
  Internet Address      Physical Address      Type
  172.30.191.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
PS C:\Users\amank>
```

Figure 2: Command arp -a

We can find the default gateway by using the command “ipconfig”.

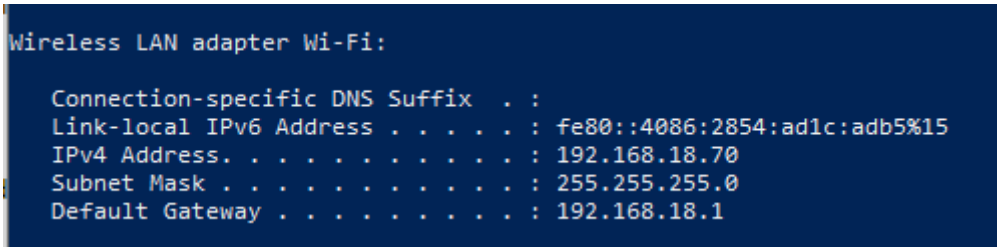

Figure 3: Addresses and Default Gateway of the Wi-Fi used

1. Conclusion

This report provides an in-depth understanding of the IP and DHCP protocols, essential components required for networking. By exploring the OSI model, the report clarifies the roles of various network layers. Detailed explanations of IPv4 address structures, including network bits, host bits, subnetting, and the concept of default gateways, illuminate how devices communicate within and across networks.