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Assignment 1

* Assignment Components
  + OSI Model and TCP/IP Model Overview
    - What organization created each model?
      * OSI model: Developed by the International Organization for Standardization
      * TCP/IP model: Developed by the U.S. department of Defense and further formalized by the Internet Engineering Task Force (IETF)`
    - Make a drawing of each model and list every layer for each model

Network Interface

Internet

Transport

Application

|  |
| --- |
| Application |
| Presentation |
| Session |
| Transport |
| Network |
| Data Link |
| Physical |

* + - Give a brief description (1 to 2 sentences) of each layer for each model
      * Layer 1 (Physical): Deals with the physical connection between devices, including cables, switches, and the electrical signals that transmit data.
      * Layer 2 (Data Link): Provides node-to-node data transfer and error detection/correction. It manages MAC addressing and frames.
      * Layer 3 (Network): Responsible for routing data between devices across different networks using IP addressing.
      * Layer 4 (Transport): Ensures reliable or unreliable delivery of data segments, managing flow control and error correction. Includes TCP and UDP.
      * Layer 5 (Session): Manages sessions or connections between applications, establishing, maintaining, and terminating communication.
      * Layer 6 (Presentation): Translates data formats, handles encryption/decryption, and ensures that data is in a readable format for the application layer.
      * Layer 7 (Application): The interface for end-user applications, providing network services such as email, file transfer, and web browsing.
      * Layer 1 (Network Access): Combines the functions of the OSI Physical and Data Link layers, dealing with how data is physically sent over the network.
      * Layer 2 (Internet): Corresponds to the OSI Network layer, handling packet forwarding, routing, and addressing through IP.
      * Layer 3 (Transport): Responsible for end-to-end communication, ensuring reliable or unreliable delivery of messages (e.g., TCP and UDP).
      * Layer 4 (Application): Encompasses the OSI Application, Presentation, and Session layers, providing protocols for applications to communicate over the network.
    - Give 3 examples of logical/physical entities for each layer (i.e., protocols, services, ports, etc.)
      * Layer 1 (Physical): Ethernet cables, Network Interface Cards (NICs), Hubs
      * Layer 2 (Data Link): MAC addresses, Switches, Ethernet frames
      * Layer 3 (Network): IP addresses, Routers, ICMP (Internet Control Message Protocol)
      * Layer 4 (Transport): TCP segments, UDP datagrams, Port numbers (e.g., 80 for HTTP)
      * Layer 5 (Session): Session IDs, SMB (Server Message Block), NetBIOS
      * Layer 6 (Presentation): SSL (Secure Sockets Layer), Data compression algorithms, Character encoding (e.g., ASCII)
      * Layer 7 (Application): HTTP (HyperText Transfer Protocol), FTP (File Transfer Protocol), DNS (Domain Name System)
  + Layer 1
    - List and describe the 2 major commercial Cabling Standards. Describe the main difference between the 2 standards.
      * EIA-568A and EIA-568B are standard
      * Plenum Cable: Special UTP.STP cable that has a fire-retardant outer insulator
      * Non-plenum Cable: Cannot be used in raised floors, ceilings, or walls.
    - List and describe the 2 fiber optic cabling types. List 2 differences between each type
      * Multimode Fiber: Shorter distances than single-mode fiber and has a core size of 62.5 microns.
      * Single-Mode Fiber: Longer distances than multimode fiber, with a core size of 10 microns.
  + Layer 2
    - What does a MAC Address represent and how many bits/bytes are represented by a MAC address?
      * A MAC address allows computers to uniquely identify themselves on a network at this relatively low level. Physical addressing uses a 48-bit address assigned to a network interface card by the manufacturer. The first 24 bits are vendor code, and the second 24 bits are unique values.
    - What is CSMA/CD and what is it used for? Give a brief description of this process.
      * Carrier Sense Multiple Access/Collision Detect (CSMA/CD) is a network protocol used to manage how devices on an Ethernet network communicate and share the same communication channel. Carrier Sense: A device checks if the network is busy before transmitting. Multiple Access: Any device can transmit, but only one at a time, to avoid conflicts. Collision Detect: A collision corrupts the data if two devices transmit simultaneously. Back off and Retry: After a crash, devices wait randomly and try again to prevent further collisions.
    - What is the standard for Ethernet called? List 3 revisions of this standard over the years.
      * IEEE 802.3 standard
      * 1. IEEE 802.3u (1995)
      * 2. IEEE 802.3z (1998)
      * 3. IEEE 802.3ae (2002)
    - What is a Collision Domain? Describe what it does.
      * A collision domain is defined as a single CSMA/CD network in which a collision will occur if two stations attached to the system transmit at the same time (Ethernet devices transmit based). Devices operate at half-duplex when connected to a hub (Layer 1 device)
  + Layer 3
    - What logical entity represents a Layer 3 construct? Give 2 examples of this logical entity.
      * The logical entity is an IP address, such as IPV4 and IPV6.
    - How many bytes does the IP header take? What sections of the IP header contain 32 bits/4 octets?
      * The IP header takes 20 bytes. The sections of the IP header that contain 32 bits/4 octets are the source IP address.
    - What RFC (Request for Comment) Number is the IP Protocol based on? When year was it created? What government entity was this created for?
      * The IP Protocol is based on RFC 791, it was created in 1981, and it was developed for the United States Department of Defense (DoD).
    - What is the standards body that manages and distributes all RFC documents called?
      * The standards body that manages and distributes RFC documents is called the Internet Engineering Task Force (IETF).
    - What is a Broadcast Domain? List 2 differences between a Collision Domain and a Broadcast Domain.
      * Broadcast Domain is a network segment where all devices can receive broadcast messages from any device in the same domain. Collision Domain: Data Collisions can occur when multiple devices try to send data simultaneously. Broadcast Domains don’t deal with collisions. Broadcast Domain: received by all devices in the domain, whereas in a Collision Domain, only one device can communicate without interference.
  + Layer 4
    - Give a brief description (1-2 sentences) of the TCP and UDP Transport Protocols.
      * TCP: A connection-oriented protocol that ensures reliable data transmission by establishing a connection, acknowledging receipt, and retransmitting lost packets.
      * UDP: A connectionless protocol that sends data without establishing a connection or guaranteeing delivery, making it faster but less reliable.
    - List 3 differences between the TCP and UDP Transport protocols
      * TCP: Reliable, Connection-oriented, and Segment Sequencing
      * UDP: Unreliable, Connectionless, and No Sequencing
    - What is the original RFC number that the TCP Protocol is based on? What year was it created? What is the current RFC number for the TCP Protocol? What year was it created?
      * RFC 793 and year 1981
      * Current RFC: 9293 and year 2022
    - What is the original RFC number that the UDP Protocol is based on? When year was it created?
      * RFC 768 and year 1980
  + Layer 5 – 7
    - List 2 logical entities that represent each of these layers.
      * Layer 1: Ethernet Cables, Network Interface Cards
      * Layer 2: MAC address, Ethernet Frame
      * Layer 3: IP Address, Router
      * Layer 4: TCP Segment, UDP Datagram
      * Layer 5: Session ID, Network Session Management
      * Layer 6: Data Encryption, Data Compression
      * Layer 7: HTTP Request/Response, DNS Query
    - List two examples of protocols at Layer 5, Layer 6, and Layer 7.
      * Examples of Layer 5: H.323, NetBIOS
      * Examples of Layer 6: SSH, SSL
      * Examples of Layer 7: HTTP, DNS
  + Encapsulation and Decapsulation
    - Give a brief description of the Encapsulation and Decapsulation processes.
      * Encapsulation: Adding headers to data as it moves down the OSI model from the Application layer to the Physical Layer before transmission.
      * Decapsulation is the reverse process, where the receiving device removes headers and trailers as data moves up the OSI model to be processed by the appropriate layer.
    - What is the main difference between each process?
      * Encapsulation is performed when sending data, while Decapsulation is performed when receiving data.
    - Name 2 types of Headers at the Transport Layer.
      * TCP and UDP Header
    - What is processed at the Physical Layer?
      * The physical layer processes raw bots, converting them into electrical m optical, or radio signals for transmission over the physical medium.
  + Ethernet Standards
    - What is the standards body that manages the 802.x standards?
      * The Institute of Electrical and Electronics Engineers
    - What standard is 802.3ad? What is it used for?
      * It is the standard for Link Aggregation, used to combine multiple network connections into a single logical link to increase bandwidth and provide redundancy.
    - List 2 Power over Ethernet Standards and describe 1 key difference between those standards.
      * 802.3af and 802.3at, 802.3at provides higher power output compared to 802.3af.
    - Give a brief description of a VLAN and what Ethernet standard is it?
      * A VLAN (Virtual Local Area Network) allows logical network segmentation into separate broadcast domains, improving traffic management and security. It is defined in the 802.1Q standard.
    - What is it called when you configure Multiple VLANs to traverse a physical link between network devices?
      * This is called VLAN Trunking, where multiple VLANs are allowed to pass through a single physical link between network devices.
    - What Layer of the OSI model is the Spanning Tree Protocol deployed? What is the main function of Spanning Tree Protocol?
      * Main Function: STP prevents loops in the network by ensuring only one active path between any two network devices in a Layer 2 domain.
  + Network infrastructure Devices
    - Give a brief description of what a Switch does.
      * A switch operates at Layer 2 (Data Link Layer), forwarding data between devices on the same network based on their MAC addresses. It reduces collisions by creating dedicated communication paths between devices.
    - Give a brief description of what a Router does.
      * A Router operates at Layer 3 (Network Layer) and directs data between different networks by analyzing IP addresses and determining the best path for the data.
    - List 3 differences between a Switch and a Router.
      * Layer of Operation: Switches operate at Layer 2 (Data Link Layer), while Routers operate at Layer 3 (Network Layer).
      * Function: Switches forward data within the same network based on MAC addresses, while Routers route data between different networks using IP addresses.
      * Broadcast Handling: Switches forward broadcast traffic within the network, whereas Routers isolate broadcast domains and prevent broadcast traffic from crossing between networks.

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