Computer Networks QUIZ

Private IPs:

- a private IP address it's an IP address that is reserved for internal use behind a router or NAT device, apart from the public
- 127.0.0.1 is the loopback address, and it points to the local machine. It is commonly used for testing network connections on the local host
- 10.x.x.x (2^24 IPs => max /8)
- 172.16.0.0 -> 172.31.255.255 (2^20 IPs => max /12)
- 192.168.0.0 -> 192.168.255.255 (2^16 IPs => max /16)

Netmasks:

/4 => 240.0.0.0
/5 => 248.0.0.0
/6 => 252.0.0.0
/7 => 254.0.0.0

Class A Networks => 2^24 = 16777216 addresses
/8 => 255.0.0.0
/9 => 255.128.0.0
/10 => 255.192.0.0
/11 => 255.224.0.0
/12 => 255.240.0.0
/13 => 255.248.0.0
/14 => 255.252.0.0
/15 => 255.254.0.0

Class B Networks => 2^16 = 65536 addresses
/16 => 255.255.0.0
/17 => 255.255.128.0
/18 => 255.255.192.0
/19 => 255.255.224.0
/20 => 255.255.240.0

/21 => 255.255.248.0
/22 => 255.255.252.0
/23 => 255.255.254.0

Class C Networks => 2^8 = 256 addresses
/24 => 255.255.255.0
/25 => 255.255.255.128
/26 => 255.255.255.192
/27 => 255.255.255.224
/28 => 255.255.255.240
/29 => 255.255.255.248
/30 => 255.255.255.252

/31 => 255.255.255.254 => point to point links only => useless as always first and last are reserved

/32 => 255.255.255.255 => single IP address => universal broadcast address

- hosts = 2^(32-n), where /n number of bits
- usuable hosts = hosts - 2 (first and last which are reserved)
- class D is multicast

Names:

- DHCP = Dynamic Host Configuration Protocol
- TLD = Top Level Domain
- ROTLD = Romanian Top Level Domain
- NAT = Network Address Translation
- DNS = Domain Name System
- TTL = Time To Live
- ISP = Internet Service Provider
- FTP = File Transfer Protocol
- LAN = Local Area Network
- MAC = Media Access Control
- ARP = Address Resolution Protocol
- UDP = User Datagram Protocol

- TCP = Transmision Control Protocol
- HTTP = HyperText Transfer Protocol
- DSL = Digital Subscriber Line
- SSH = Secure Shell

UDP:

- AF_INET & SOCK_DGRAM
- header:
  - 8 bytes
  - identifies the destination port and a reply port
- not connection-oriented
- UDP datagram payload length = IP length – IP header’s length - UDP header length
- DNS and DHCP use UDP protocol

Server:

- sendto() sends data
- accept() not required

Client:

- connect() is not mandatory
- bind() can be used
  !!! The recvfrom() call reads data from the UDP client.

TCP:

- SOCK_STREAM
- header:
  - 20 bytes
  - Source Port, Destination Port, Sequence Number, Acknowledgment Number, Flags, Data Offset, Checksum, Urgent Pointer

- bytes not read from the stream stay avaliable for the next read
- waits for the confirmation that the packets were received
- HTTP, FTP and STMP use TCP protocol

Server:

- accept() can be used (is mandatory)

Client:

- socket()
- listen()
- connect() can be used
- bind() is not mandatory

Commands:

- arp /a => check if DataLink layer works.
- ipconfig /all => find your network adapter's mac address if you are on Windows
- ping => test if a device on the network is reachable; uses ICMP

LAYERS:

1. Application Layer: DNS, SSH, FTP, HTTP, SMPT
2. Presentation Layer
3. Session Layer
4. Transport Layer: UDP, TCP, HTTPS
5. Network Layer: IP
6. Data Link Layer: MAC
7. Physical Layer

MAC:

- MAC address has 48 bits (12 hexadigits, arranged in 6 bytes)

- Unique, because MAC addresses are burned into the ROM of the network adapter
- Broadcast MAC = a logical address which is used to identify all the computers within a network
- MAC addresses are not routable
- FF:FF:FF:FF:FF:FF is the broadcast MAC address
- MAC addresses can be changed
- is understood by the Switch but not by the Hub
- has to be identical for all computers located in the same local network

ARP:

- is used to determine the MAC address when we know the IP address
- is a protocol for mapping an INTERNET PROTOCOL ADDRESS(IP) to a PHYSICAL MACHINE ADDRESS that is recognized in the local network.

NAT:

- Address Translation
- a protocol providing a way for multiple computers on a common network to share a single connection to the Internet
- port fowarding
- accessing the web from an internal network. your PC's network will be translated to your public IP (i.e., home network)
- can change ISP only by changing addresses of devices in the local network
- causes loss of end-to-end IP traceability
- After translation: INSIDE GLOBAL HOST
- Before transaltion: OUTSIDE LOCAL HOST

DHCP:

- DHCP is a client/server protocol that automatically provides an Internet Protocol host with its IP addresses, subnet mask & default gateway
- Having more than one DHCP server on the same subnet of a network is possible only if each of them has a different pool of addresses, without sharing any address

Checksum:

- is a 16-bit field used on the header and data to check for errors.
- in the IP header is computed on each router & on each source and destination

RIP:

- RIPv2 supports maximum metric (hop count) value up to 15. Any router further than 15 hops is considered unreachable
- RIPv1 has the same timers as RIPv2
- RIPv1 supports classless routing protocols

IPs

- A network board can have more than one IP address.
- ICMP packets are encapsulated within IP datagrams.
- last IP address = broadcast address
- IP Routing is based on the Destionation IP
- IP and Netmasks have 32 bits (IPv4 format)
    - 1 byte = 8 bits

Switch vs Hub:

- Switch > Hub

- The switch sends a packet specifically to an endpoint or more, the hub broadcasts the message to all the network
- Switch knows MAC addresses, Hub doesn’t
- Both have multiple ports

Congestion Window:

- When the Congestion Window is below Threshold it grows exponentially
- Congestion window is a sender impose window implemented to avoid overrunning some routers in the middle of the network path

Calculate:

- To calculate broadcast: OR between IP and netmask
- To calculate network address: AND between IP and netmask

Other:

- Network Topoligies: Bus & Star
- The BUS topology consists of a single cable which connects in series all the computers from the network.
- There are 4 layers in TCP/IP
- The time-to-live for a packet(TTL) is expressed in the number of routers the packet is allowed to pass
- SMB or SAMBA Protocol is a file transfer protocol
- A router is connected to a computer with a Cross-Over cable
- A computer is connected to a switch through a Straight-Through cable
- Light waves flows through the optical fiber cable
- The bandwidth is the physical property of the transmission medium, while throughput represents the amount of data which we transmit
- Throughput = quantity of data over quantity of time which we send at a given time through a transmission channel

- Datagram = a basic transfer unit used in packet-switched networks, providing a connectionless communication service
- ISP aggregates smaller networks into a larger one in order to reduce the number of entries in the routing table of the router connecting the ISP to the Internet
- DNS can be default gateway
- HTTP transfers encrypted data
- STMP e-mail server
- Routing Table: Interface, netmask, destination address, gateway
- Traceroute shows all IPs of the routers parsed until the current IP
- Broadcasting is when a transmitted packet is received and processed by every machine on the network

PROBLEMS:

1. Write as [network address]/[xx] - in the most compact and ordered way - the addressing space 62.255.254.224...63.64.0.31. (if multiple combinations are needed write them separated by comas without spaces or other characters)

   Answer: 62.255.254.224/27,62.255.255.0/24,63.0.0.0/10,63.64.0.0/27

2. Consider the following network address: 192.0.2.64 . How many net masks can it be used with?

   Answer: 5

3. Write the network mask (only as /x.y.z.t) of the minimum sized network that contain both 80.81.82.83 and 80.83.84.85.

   Answer: 255.252.0.0

4. What is the network address and mask of the smallest subnet that fits these two IP addresses: 180.181.182.183 and 180.186.12.180? (addr/x.y.z.t format)

   Answer: 180.176.0.0/255.240.0.0

5. A company has three departments: Offices, Public and Managers. The offices have 123 computers, Public Relationship has 29 computers and Managers have 5 computers. The company wants to make a network such that: - every computer has access to the internet - have minimum costs - it must be certainly known from which department some webpages are accessed from the HQ in another city Provide a good configuration for these requirements:
   a) 3 subnetworks, 192.168.0.0/24, 192.168.1.0/24, 192.168.2.0/24 for every department and connect every subnet directly to the internet, using NAT, through a different provider
   b) 1 subnetwork for all the company, 192.168.0.0/24, connect computers to internet through a router which translates every address IP to a public IP address with different class depending on department
   c) 3 subnetworks, 192.168.0.0/25, 192.168.0.128/27, 192.168.0.160/29, one router which translates the first network to 30.0.0.1, second to 30.0.0.2, and third to 30.0.0.3
   d) 3 subnetworks, 192.168.0.0/25, 192.168.0.128/27, 192.168.0.160/29 and connect them to a central router which translates all the IPs on 192.168.0.0/24 with the IP 30.0.0.5

   Answer: c)