**NETWORKING ASSIGNMENT 2**

**COMPUTER SCIENCE 4**

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**An organization with 13 branches scattered across Ghana acquired the IP address 176.184.238.73/16**

1. What class is the IP address?

**Ans: Class B Address**

Since it is in the range of 128.0.0.0 and 191.255.255.255

1. What subnet is the address on?

Ans: 255.255.0.0

**Explanation :**

To get the subnet address convert all the host portion of the address into binary and fill them with binary Zero’s

IP address given decimal notation => 176.184.238.73/16

In binary => 10110000.10111000.11101110.01001001

Since the subnet mask is /16 , it means the first 16 bits represents the network portion and the last 16 bits represent the host portion .

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000. | 11101110.01001001 |

Fill the host portion with binary Zero’s

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000. | 00000000.00000000 |

Subnet Address => 10110000.10111000.00000000.00000000

In Decimal Notation => **176.184.0.0**

1. What is the NetID?

**Ans:** 176.184.0.0

**Explanation :**

Since is a Class B address, the NetID is determined by the first 16 bits.

To get the NetID convert all the host portion of the address into binary and fill them with binary Zero’s

IP address given decimal notation => 176.184.238.73/16

In binary => 10110000.10111000.11101110.1001001

Since the subnet mask is /16 , it means the first 16 bits from your left represents the network portion and the last 16 bits represent the host portion .

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000. | 11101110.01001001 |

Fill the host portion with binary Zero’s

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000. | 00000000.00000000 |

NetID in binary => 10110000.10111000.00000000.00000000

In Decimal Notation => **176.184.0.0**

1. What is the HostID?

Ans: 0.0.238.73

The HostID range is: 176.184.0.1 - 176.184.255.254  
That is minimum host address : 176.184.0.1. The maximum host address is: 176.184.255.254.

**Explanation**

Since is a Class B address with a default mask, the HostId is the last 16 bits of the IP address given.

|  |  |
| --- | --- |
| **Network ID** | **Host ID** |
| 10110000.10111000. | 11101110.01001001 |

Host ID in binary => 00000000.00000000.11101110.01001001

HostID in decimal => 0.0.238.73

1. What is the SubnetID?

**Ans: 176.184.0.0**

1. What is the site address?

**Ans: 176.184.238.73**

1. Give the address in its BITWISE notation.

**Ans: 10110000.10111000.11101110.01001001**

Explanation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Decimal** | **128** | **64** | **32** | **16** | **8** | **4** | **2** | **1** | **Binary** |
| **176** | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 10110000 |
| **184** | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 10111000 |
| **238** | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 11101110 |
| **73** | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 01001001 |

Therefore 176.184.238.73 in binary **=>** 10110000.10111000.11101110.01001001

1. What is the name of the /16 notation

**Ans : Classless Inter - Domain Routing – CIDR**

1. Give the dotted decimal notation of the /16 and also give bitwise notation equivalent.

**Ans: Decimal Notation : 255.255.0.0**

**Bitwise Notation : 11111111.11111111.00000000.00000000**

Explanation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Decimal** | **128** | **64** | **32** | **16** | **8** | **4** | **2** | **1** | **Binary** |
| **255** | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 11111111 |
| **255** | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 11111111 |
| **0** | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 00000000 |
| **0** | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 00000000 |

1. Design a suitable network for the organization ensuring most efficient usage of addresses.

Since the headquarters is assigned an address block of **176.184.0.0**/16 . we will have to subnet to at least 16 subnets to support all the branches. Where the first subnet will be used for the network and the last for broadcast address.

Since we are subnetting based on the number of subnets required, we shall use the formula 2n to find the number of networks, where the n is the number of bits which will be taken from the host side of the address to create a 2n networks.

Step 1

Work out the number of bits required to cover the number of host.

2n = 16

2n = 24

n = 4

Therefore to support 16 subnets we require 4 bits in binary from the host portion to append to the network portion.

Step 2

Convert the host portion of the subnet address into binary.

|  |  |
| --- | --- |
| **Network ID** | **Host ID** |
| 10110000.10111000. | **00000000.00000000** |

Step 3

We counts 4 bits from the left to right in the host portion and allocate it to the network portion.

|  |  |  |
| --- | --- | --- |
| **Network ID** | **Subnet** | **Host ID** |
| 10110000.10111000. | **0000** | 0000.00000000 |

Step 4

Calculate for the network mask

|  |  |
| --- | --- |
| **Network ID** | **Host ID** |
| 10110000.10111000.0000 | **0000.00000000** |

Total bits = 32

Host bits = 12

Network bits = Total bits – Host bits

= 32 – 12

= 20

Therefore our Network mask = /20 or 255.255.240.0

Step 5

Work outs our new subnets by going through all the various binary combinations for the subnet portion of the address.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Network** | **Network ID** | **Subnet** | **Host ID** | **Subnet Address** |
| 1 | 10110000.10111000. | **0000** | 0000.00000000 | 176.184.0.0/20 |
| 2 | 10110000.10111000. | **0001** | 0000.00000000 | 176.184.16.0/20 |
| 3 | 10110000.10111000. | **0010** | 0000.00000000 | 176.184.32.0/20 |
| 4 | 10110000.10111000. | **0011** | 0000.00000000 | 176.184.48.0/20 |
| 5 | 10110000.10111000. | **0100** | 0000.00000000 | 176.184.64.0/20 |
| 6 | 10110000.10111000. | **0101** | 0000.00000000 | 176.184.80.0/20 |
| 7 | 10110000.10111000. | **0110** | 0000.00000000 | 176.184.96.0/20 |
| 8 | 10110000.10111000. | **0111** | 0000.00000000 | 176.184.112.0/20 |
| 9 | 10110000.10111000. | **1000** | 0000.00000000 | 176.184.128.0/20 |
| 10 | 10110000.10111000. | **1001** | 0000.00000000 | 176.184.144.0/20 |
| 11 | 10110000.10111000. | **1010** | 0000.00000000 | 176.184.160.0/20 |
| 12 | 10110000.10111000. | **1011** | 0000.00000000 | 176.184.176.0/20 |
| 13 | 10110000.10111000. | **1100** | 0000.00000000 | 176.184.192.0/20 |
| 14 | 10110000.10111000. | **1101** | 0000.00000000 | 176.184.208.0/20 |
| 15 | 10110000.10111000. | **1110** | 0000.00000000 | 176.184.224.0/20 |
| 16 | 10110000.10111000. | **1111** | 0000.00000000 | 176.184.240.0/20 |

Number of networks supported = 2n

= 24

= 16

Number of host supported by each subnet = 212

= 4096

Actual host supported excluding the network and broadcast address = 4096 – 2 = 4094

Step 6

To get the host range addresses for each subnet

To get the first host, fill the host portion of an address with binary Zero’s except for the last bit which is set to 1.

Using the first Subnet Address 176.184.0.0/20

|  |  |  |
| --- | --- | --- |
| **Network ID** | **Host ID** | **In decimal** |
| 10110000.10111000.0000 | **0000.00000001** | **176.184.0.1** |

To get the last host, fill the host portion of the address with binary One’s except for the last bit which is set to 0

Using the first Subnet Address 176.184.0.0/20

|  |  |  |
| --- | --- | --- |
| **Network ID** | **Host ID** | **In decimal** |
| 10110000.10111000.0000 | **1111.11111110** | **176.184.15.254** |

Therefore the host range for 176.184.0.0/20 is 176.184**.0.1 to** 176.184.**15.254**

**The rest of the network are reserved for future use or expansion.**

1. List all the subnet addresses

**Ans :**

|  |  |  |
| --- | --- | --- |
| **Network** | **Subnet Address** | **Host Address Range** |
| 1 | 176.184.0.0/20 | 176.184.0.1 - 176.184.15.254 |
| 2 | 176.184.16.0/20 | 176.184.16.1 - 176.184.31.254 |
| 3 | 176.184.32.0/20 | 176.184.32.1 - 176.184.47.254 |
| 4 | 176.184.48.0/20 | 176.184.48.1 - 176.184.63.254 |
| 5 | 176.184.64.0/20 | 176.184.64.1 - 176.184.79.254 |
| 6 | 176.184.80.0/20 | 176.184.80.1 - 176.184.95.254 |
| 7 | 176.184.96.0/20 | 176.184.96.1 - 176.184.111.254 |
| 8 | 176.184.112.0/20 | 176.184.112.1 - 176.184.127.254 |
| 9 | 176.184.128.0/20 | 176.184.128.1 - 176.184.143.254 |
| 10 | 176.184.144.0/20 | 176.184.144.1 - 176.184.159.254 |
| 11 | 176.184.160.0/20 | 176.184.160.1 - 176.184.175.254 |
| 12 | 176.184.176.0/20 | 176.184.176.1 - 176.184.191.254 |
| 13 | 176.184.192.0/20 | 176.184.192.1 - 176.184.207.254 |
| 14 | 176.184.208.0/20 | 176.184.208.1 - 176.184.223.254 |
| 15 | 176.184.224.0/20 | 176.184.224.1 - 176.184.239.254 |
| 16 | 176.184.240.0/20 | 176.184.240.1 - 176.184.255.254 |

l. Give the subnet address that this IP address resides on 176.184.238.73 255.255.240.0

**Ans: Since is in the host range of** 176.184.224.1 - 176.184.239.254 in network 15, its corresponding subnet Address is **176.184.224.0/20**

**Or by Calculation**

Given a subnet mask of 255.255.240.0 in binary 11111111.11111111.11110000.00000000 or /20

To get the subnet address convert all the host portion of the address into binary and fill them with binary Zero’s

IP address given decimal notation => 176.184.238.73/20

In binary => Since the subnet mask is /20 , it means the first 20 bits represents the subnet address.

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000.**1110** | **1110**.01001001 |

Fill the host portion with binary Zero’s

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000.**1110** | **0000**.00000000 |

Subnet Address => 10110000.10111000.1110**0000.00000000**

In Decimal Notation => **176.184.224.0**

m. What is the site address for the given address in 'l' above

**Ans: 176.184.238.73/20**

n. What is the NetID for the given address in 'l' above

**Ans: 176.184.224.0/20**

o. What is the HostID for the given address in 'l' above

**Ans: 0.0.14.73/20**

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 10110000.10111000.**1110** | **1110**.01001001 |

Fill the network portion with zero’s

|  |  |
| --- | --- |
| **Network Portion** | **Host Portion** |
| 00000000.0000000.0000 | **1110**.01001001 |

Host Address => 00000000.0000000.0000**1110.01001001**

**In Decimal Notation : 0.0.14.73**

p. What is the SubnetID for the given address in 'l' above

**Ans: 176.184.238.73/20**

q. Draw the network diagram that can be used for the implementation of the organisation network

r. Explain the functionality of each if the devices in your network diagram and justify their purpose in your diag.

**Answer:**

* ***Bridge***: A bridge examines each data frame on a LAN, "passing" those known to be within the same LAN segment , and forwarding those known to be on the other interconnected LAN segment. Is used here to join similar LANs together.
* ***Switch***:*A* network device that connects multiple devices together and filters packets based on their destination within the connected devices. It is used as part of the networking diagram to receive incoming data packets and redirects them to their destination on the Local Area Network (LAN).
* ***Router***: A device that receives and analyzes packets and then routes them towards their destination. In some cases, a router will send a packet to another router; in other cases, it will send it directly to its destination. It is used as part of the network diagram to connect the different networks in Local Area Network (LAN) and Wide Area Network (WAN) and also to act as a firewall to to protect one network from the other.
* **Host Devices:** Laptop,Desktop,printer etc to interact with each other.
* **Cables:** Use to connect Networking devices and host devices

s. How will you ensure Internet connectivity for host at each branch.

Answer: by connecting to an ISP at the headquarters to provide wan services.

t. Explain type(s) of connections in your network diagram.

**Answer:**

**LAN: communication between switches and computer(end devices) in diagram is based on LAN**

Local area network (LAN) is a computer network that overlaps with a small area. Usually, a LAN is tied to a single room, building or cluster, but one LAN can be connected to other LANs over any distance via telephone wires and radio waves.The system of LANs connected in this way is called a broadband network (WAN). The difference between LAN and WAN is that the wider area network scans the larger geographically. Usually, a WAN consists of two or more local networks (LANs) and is always connected by public networks.

**WAN: communication between routers to connect two or more networks.**

WAN is a network that uses multiple links - Private Lines, Multiprotocol Label Switching (MPLS), Virtual Private Network (VPN), Wireless (Cellular), Internet - connects small metropolitan and campus networks in one place. The sites they connect to may be a few miles or half across the globe. In an organization, WAN's goals may include linking branch offices or individual remote workers to headquarters or data centers to share corporate offices and communications.

u. Explain the protocols for devices communication in your network diagram

* *TCP* provides *reliable* delivery of data, therefore it supports all the functions described above – segmentation, multiplexing, sequencing and flow control. The disadvantages of using TCP is that, due to its complexity, it can introduce unwanted delays between communicating devices.
* *UDP* provides *rapid* delivery of data, but without reliability. UDP only provides segmenting and multiplexing of data received from the application layer. Data from communication programs using voice and video are typically intolerant of delay and therefore use UDP.

v. Explain protocol for 3 applications communication on your network

* *Simple Mail Transfer Protocol (SMTP)*: used by email programs such as Outlook and Thunderbird when they need to send emails.
* *Post Office Protocol 3 (POP3)*: used by email programs when they need to receive emails.
* *Hyper Text Transfer Protocol (HTTP)*: used by web browsers such as Edge and Firefox to request and transfer webpages from the WWW.
* *File Transfer Protocol (FTP)*: often used by file sharing programs in order to send and receive files between users across the Internet.

HTTP, SMTP, DHCP, FTP, Telnet, SNMP and SMPP.

w. Explain the addressing mechanism in the movement of packets from one branch to the other.

If the destination host is present in different network then the packet is delivered to the default gateway first which in turn delivers the packet to the destination host.

x. Assuming each branch has 58 workstations and a printer, how many collision domains has your network diagram

y. As follow-up question to 'x', how many broadcast domains has your network diagram

z. Write a convincing summary statement to convince management of why they should invest money to deploy your network diagram. Your statement must clearly spell out the advantages of the network that the organisation stands to gain if they implement it.