
UTM

UNIVERSITI TEKNOLOGI MALAYSIA

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**Project Task 5**

**SECR1213 - NETWORK COMMUNICATION**

**Semester 3, 2024/2025**

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**Section 01**

**Group : Mozilla**

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**DATE: 18 JANUARY 2025**

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**1.0 Network Address**

| Group/Section | Network Address |
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| 1 | 192.16.0.0/8 |
| 2 | 192.17.0.0/8 |
| 3 | 192.18.0.0/8 |
| 4 | 192.19.0.0/8 |
| 5 | 192.20.0.0/8 |
| 6 | 192.21.0.0/8 |
| 7 | 192.22.0.0/8 |
| 8 | 192.23.0.0/8 |
| 9 | 192.24.0.0/8 |
| 10 | 192.25.0.0/8 |

The IP address 192.16.0.0 serves as the base address for a network. This address specifically identifies the network itself, establishing the foundation for all communications within it. The notation "/8" refers to the subnet mask, which in this case is 255.0.0.0. This subnet mask dictates how much of the 32-bit IP address is dedicated to the network portion, and how much is allocated for individual host addresses. In this case, the "/8" mask means that the first 8 bits (the first octet) are used to identify the network, leaving the remaining 24 bits (or three octets) to be used for the host portion of the address. This configuration allows for a large number of hosts within the network, as it enables a range of IP addresses for each individual device connected to the network. The "/8" subnet mask indicates that this address belongs to a Class A network. Class A networks are typically characterized by their capacity to support a vast number of hosts, as the network portion only occupies the first 8 bits of the 32-bit IP address. The Class A range in IPv4 addressing spans from 1.0.0.0 to 127.255.255.255, with the first octet used to define the network and the remaining three octets used to assign unique addresses to devices within that network. In the case of the address 192.16.0.0, the first octet (192) is designated for the network portion, while the next two octets (16.0) specify a more particular subnet within the broader network. The final portion (0.0) can be used for further subnetting, or it can represent the addresses assigned to individual hosts within that specific subnet. This flexibility allows network administrators to allocate IP addresses efficiently, ensuring sufficient addresses are available for all devices, while also maintaining room for expansion as the network grows.

## 2.0 Subnetting

### 2.1 Subnet Mask

A subnet mask is a 32-bit number that helps divide an IP address into two segments which is the network portion and the host portion. In the subnet mask, the bits assigned to the network are set to 1s, while the bits assigned to the host are set to 0s. The primary role of the subnet mask is to determine the network an IP address belongs to and to distinguish between the network and host parts of the address. Subnet masks are frequently used in IPv4 networking, especially when subnetting, which involves splitting a large network into smaller, more manageable sub-networks. For example, with the network address 192.16.0.0/8, the /8 indicates that the first 8 bits of the IP address are dedicated to the network portion, while the remaining 24 bits are available for host addresses. This configuration enables a wide range of possible host addresses within the network. Below is a detailed breakdown of the 192.16.0.0 IP address, showing it in both decimal and binary formats.

| | | | | |
|---|---|---|---|---|
| IP address (Decimal) | 192. | 16. | 0. | 0 |
| IP address (Binary) | 1100 0000 | 0001 0000 | 0000 0000 | 0000 0000 |
| Subnet Mask (Decimal) | 255. | 0. | 0. | 0 |
| Subnet Mask (Binary) | 1111 1111. | 0000 0000. | 0000 0000. | 0000 0000 |

**Subnet Mask: 255.0.0.0**

By converting each octet of the IP address 192.16.0.0 to binary, we get the result “1100 0000. 0001 0000. 0000 0000. 0000 0000” as shown above. Additionally, the "/8" in CIDR notation signifies that the first 8 bits of the IP address are allocated for the network portion, while the remaining 24 bits (32 bits - 8 bits = 24 bits) are available for host addresses. In binary, this corresponds to the subnet mask “11111111.00000000.00000000.00000000”, which represents the subnet mask in binary format. When we convert this binary representation back into dotted-decimal notation, we obtain the subnet mask “255.0.0.0”. This subnet mask allows for a large number of host addresses within the network, making it ideal for a broad range of devices.

**2.2 Subnet Address**

Subnet addressing is a versatile and scalable technique used to design and manage IP networks efficiently. It works by dividing a network into smaller, more manageable subnets. In the case of the IP address 192.16.0.0/8, we are working with 24 host bits, which results in a total of $2^{24}$ = 16,777,216 possible host addresses. These addresses range from 192.16.0.1 to 192.16.255.254. The first address, 192.16.0.0, is reserved as the network address, which represents the network itself and cannot be assigned to individual devices. Similarly, the last address, 192.16.255.255, serves as the broadcast address, used for sending data to all devices in the subnet, and is also unavailable for assignment to hosts. To determine the subnet address, we perform a bitwise AND operation between the given IP address 192.16.0.0 and the subnet mask /8 (which is 255.0.0.0). Converting both the IP address and subnet mask into binary, the IP address becomes 11000000 00010000 00000000 00000000, and the subnet mask becomes 11111111 00000000 00000000 00000000. By applying the AND operation to the corresponding bits, we obtain the subnet address in binary: 11000000 00000000 00000000 00000000, which converts back to decimal as 192.0.0.0. Thus, the subnet address for 192.16.0.0/8 is 192.0.0.0.

**Calculation of Subnet Address**

| | | | | |
|---|---|---|---|---|
| IP Address (Decimal) | 192 | 16 | 0 | 0 |
| IP Address (Binary) | 1100 0000 | 0001 0000 | 0000 0000 | 0000 0000 |
| **AND** | | | | |
| Subnet Mask (Decimal) | 255 | 0 | 0 | 0 |
| Subnet Mask (Binary) | 1111 1111 | 0000 0000 | 0000 0000 | 0000 0000 |
| **RESULT** | | | | |

| | | | | |
|---|---|---|---|---|
| Subnet Address (Binary) | 1100 0000 | 0000 0000 | 0000 0000 | 0000 0000 |
| Subnet Address (Decimal) | 192 | 0 | 0 | 0 |

As shown in the table, the process begins by converting both the IP address 192.16.0.0 and the subnet mask 255.0.0.0 into binary. The binary representation of the IP address is 1100 0000.0001 0000.0000 0000.0000 0000, and the subnet mask is 1111 1111.0000 0000.0000 0000.0000 0000. Next, we apply the AND operation bit by bit between the corresponding bits of the IP address and the subnet mask. After performing the AND operation, the resulting binary subnet address is 1100 0000.0000 0000.0000 0000.0000 0000. Finally, we convert this binary result back to decimal, which gives us the subnet address 192.0.0.0. Therefore, the subnet address obtained by applying the AND operation between the IP address 192.16.0.0 and the subnet mask /8 is 192.0.0.0.

**IP address = 192.16.0.0/8**

| **IP Address** | **Network Portion** | **Host Portion** |
|---|---|---|
| 192.16.0.0/8 | 1100 0000 | 0001 0000 0000 0000 0000 0000 |

For the Network portion, there are 8 bits while the Host Portion is 24 bits.

Faculty of Computing which has 8 work areas:

1. Server Room
2. Student Lounge
3. General Purpose Lab 1
4. General Purpose Lab 2
5. Video Conferencing Room
6. Hybrid Classroom

7. Cisco Lab
8. Embedded Lab

Since this faculty has 8 work areas, the network needs to have 8 major subnets.
192.16.0.0/8 to be divided into 8 subnets ($2^3$)

$n = \log_2(8) = 3$

Thus, we need to borrow 3 bits from the host portion

**IP address = 192.16.0.0/11**

| IP Address | Portion |
|---|---|
| 192.16.0.0/11 | 1100 0000.0001 0000.0000 0000.0000 0000 |

No of bits borrowed from the host portion (in red) = 3 bits
Network portion = 11 bits
Host portion = 21 bits

**Subnet Address for each Work Area**

| Subnet | Work Area | Subnet Address (Decimal) | Subnet Address (Binary) |
|---|---|---|---|
| 0 | Server Room | 192.0.0.0/11 | 1100 0000.0000 0000. 0000 0000. 0000 0000 |
| 1 | Student Lounge | 192.32.0.0/11 | 1100 0000.0010 0000. 0000 0000. 0000 0000 |
| 2 | General Purpose Lab 1 | 192.64.0.0/11 | 1100 0000.0100 0000. 0000 0000. 0000 0000 |
| 3 | General Purpose Lab 2 | 192.96.0.0/11 | 1100 0000.0110 0000. 0000 0000. 0000 0000 |

| | | | |
|---|---|---|---|
| 4 | Video Conferencing Room | 192.128.0.0/11 | 1100 0000.1000 0000. 0000 0000. 0000 0000 |
| 5 | Hybrid Classroom | 192.160.0.0/11 | 1100 0000.1010 0000. 0000 0000. 0000 0000 |
| 6 | Cisco Lab | 192.192.0.0/11 | 1100 0000.1100 0000. 0000 0000. 0000 0000 |
| 7 | Embedded Lab | 192.224.0.0/11 | 1100 0000.1110 0000. 0000 0000. 0000 0000 |

## 3.0 IP Assignation

### 3.1 Network and Broadcast Address for Each Subnet

To find the network and broadcast addresses for each subnet, we perform the AND operation between the IP address and the subnet mask. The broadcast address is then determined by setting all the host bits to '1' in the network address. The usable IP address range for hosts within each subnet is from the network address plus one, up to the broadcast address minus one. For instance, in the General Purpose Lab 1 subnet, the range of usable IP addresses spans from 192.0.0.1 to 192.31.255.254. The table below illustrates the network address, broadcast address, and the range of usable IP addresses for each work area, based on the calculations and performance.

| Subnet | Work Area | Network Address | Broadcast Address | Range of usable address |
|---|---|---|---|---|
| 0 | Server Room | 192.0.0.0 | 192.31.255.255 | 192.0.0.1 - 192.31.255.254 |
| | | 1100 0000. 0000 0000. 0000 0000. 0000 0000 | 1100 0000.0001 **1111. 1111 1111. 1111 1111** | 1100 0000. 0000 0000. 0000 0000. 0000 0001 - 1100 0000. 0001 1111. 1111 1111. 1111 1110 |

| | | | | |
|---|---|---|---|---|
| 1 | Student Lounge | 192.32.0.0 | 192. 63.255.255 | 192.32.0.1 - 192.63.255.254 |
| | | 1100 0000.0010 0000. 0000 0000. 0000 0000 | 1100 0000.0011**1111. 1111 1111. 1111 1111** | 1100 0000.0010 0000. 0000 0000. 0000 0001 - 1100 0000.0011 1111. 1111 1111. 1111 1110 |
| 2 | General Purpose Lab1 | 192.64.0.0 | 192.95.255.255 | 192.64.0.1 - 192.95.255.254 |
| | | 1100 0000.0100 0000. 0000 0000.0000 0000 | 1100 0000.0101**1111. 1111 1111. 1111 1111** | 1100 0000.0100 0000. 0000 0000.0000 0001 - 1100 0000.0101 1111. 1111 1111. 1111 1110 |
| 3 | General Purpose Lab2 | 192.96.0.0 | 192.127.255.255 | 192.96.0.1 - 192.127.255.254 |
| | | 1100 0000.0110 0000. 0000 0000.0000 0000 | 1100 0000.0111**1111. 1111 1111. 1111 1111** | 1100 0000.0110 0000. 0000 0000.0000 0001 - 1100 0000.0111 1111. 1111 1111. 1111 1110 |
| 4 | Video Conferencing Room | 192.128.0.0 | 192.159.255.255 | 192.128.0.1 - 192.159.255.254 |
| | | 1100 0000.1000 0000. 0000 0000.0000 0000 | 1100 0000.1001**1111. 1111 1111. 1111 1111** | 1100 0000.1000 0000. 0000 0000.0000 0000 - 1100 0000.1001 1111. 1111 1111. 1111 1110 |
| 5 | Hybrid Classroom | 192.160.0.0 | 192.191.255.255 | 192.160.0.1 - 192.191.255.254 |
| | | 1100 0000.1010 0000. 0000 0000.0000 0000 | 1100 0000.1011**1111. 1111 1111.** | 1100 0000.1010 0000. 0000 0000.0000 0001 - |

| | | | | |
|---|---|---|---|---|
| | | | **1111 1111** | 1100 0000.1011 1111. 1111 1111. 1111 1111 |
| 6 | Cisco Lab | 192.192.0.0 | 192.223.255.255 | 192.192.0.1 - 192.223.255.254 |
| | | 1100 0000.1100 0000. 0000 0000.0000 0000 | 1100 0000.1101 **1111. 1111 1111. 1111 1111** | 1100 0000.1100 0000. 0000 0000.0000 0001 - 1100 0000.1101 1111. 1111 1111. 1111 1110 |
| 7 | Embedded Lab | 192.224.0.0 | 192.255.255.255 | 192.224.0.1 - 192.225.255.254 |
| | | 1100 0000.1110 0000. 0000 0000.0000 0000 | 1100 0000.1111 **1111. 1111 1111. 1111 1111** | 1100 0000.1110 0000. 0000 0000.0000 0001 - 1100 0000.1111 1111. 1111 1111. 1111 1110 |

### 3.2 IP Assignation for Each Work Area

Each area is assigned a specific range of IPs to ensure unique identification, efficient communication, and simplified management. In the Server Room, critical devices like servers, switches, routers, and a wireless access point are assigned IPs within 192.0.0.1 - 192.0.0.10. Similarly, the Student Lounge uses 192.32.0.1 - 192.32.0.24 for its switch, wireless access point, and 20 workstations. The General Purpose Labs are allocated ranges 192.64.0.1 - 192.64.0.34 and 192.96.0.1 - 192.96.0.34, respectively, for 30 workstations, supporting devices, and a server in each lab.

Specialized areas like the Video Conferencing Room, Hybrid Classroom, Cisco Lab, and Embedded Lab also follow organized IP ranges. For example, the Cisco Lab uses 192.192.0.1 - 192.192.0.47 for workstations, servers, and networking devices, while the Hybrid Classroom allocates IPs from 192.160.0.1 - 192.160.0.34. This structured assignation ensures seamless device communication, minimizes conflicts, and supports effective network administration, with routers positioned strategically in the Server Room and Cisco Lab for network management at different levels.

| **Work Area** | **Hosts** | **Range IP Address** |
|---|---|---|
| Server Room | 6 server | 192.0.0.1 - 192.0.0.7 |
| | Wireless Access Point | 192.0.0.8 |
| | Switch | 192.0.0.9 |
| | Router | 192.0.0.10 |
| Student Lounge | Switch | 192.32.0.1 |
| | Wireless Access Point | 192.32.0.2 |
| | 20 workstation | 192.32.0.3 - 192.32.0.24 |
| General Purpose Lab 1 | 30 workstations | 192.64.0.1 - 192.64.0.31 |

| | | |
|---|---|---|
| | Switch | 192.64.0.32 |
| | Wireless Access Point | 192.64.0.33 |
| | Server | 192.64.0.34 |
| General Purpose Lab 2 | 30 workstations | 192.96.0.1 - 192.96.0.31 |
| | Switch | 192.96.0.32 |
| | Wireless Access Point | 192.96.0.33 |
| | Server | 192.96.0.34 |
| Video Conferencing Room | 2 workstations | 192.128.0.1 -192.128.0.3 |
| | Switch | 192.128.0.4 |
| | Wireless Access Point | 192.128.0.5 |
| | 2 Smartboard | 192.128.0.6 - 192.128.0.8 |
| Hybrid Classroom | 30 workstations | 192.160.0.1 - 192.160.0.31 |
| | Wireless Access Point | 192.160.0.32 |
| | Switch | 192.160.0.33 |
| | Smartboard | 192.160.0.34 |
| Cisco Lab | 30 workstations | 192.192.0.1 - 192.192.0.31 |
| | 12 server | 192.192.0.32 - 192.192.0.44 |
| | Switch | 192.192.0.45 |
| | Router | 192.192.0.46 |
| | Wireless Access Point | 192.192.0.47 |
| Embedded Lab | 30 workstations | 192.224.0.1 - 192.224.0.31 |

| | | |
|---|---|---|
| | Switch | 192.224.0.32 |
| | Wireless Access Points | 192.224.0.33 |

| **Network Management** | **Host** |
|---|---|
| Level 1 (Server Room) | Router |
| Level 2 (Cisco Lab) | Router |

**4.0 Meeting Minutes**

**MEETING MINUTES**

| | | | |
|---|---|---|---|
| **DATE/TIME** | 13/1/2025 9:30pm | | |
| **LOCATION** | MA6 | | |
| **AGENDA** | Discussion on IP Addressing Scheme and Subnetting for Network Assignment | | |
| **Meeting MC** | Athirah | | |
| **ATTENDANCE** | | | |
| **NAME** | **TIME** | **REASON FOR ABSENCE** | |
| Nazatul | 2130 | - | |
| Raudhah | 2130 | - | |
| Athirah | 2130 | - | |
| Syafina | 2130 | - | |
| **MINUTES** | | | |
| **NO.** | **ITEM DISCUSSED** | **IDEAS/SUGGESTIONS AND PERSON GIVING IT** | **PERSON IN CHARGE & DATE** |
| 1 | Obtaining Network Address from Lecturer | Naza will contact the lecturer to get the network address for the group. | Naza - 13/01 |
| 2 | Dividing the Network Address into Subnets for Labs/Rooms | Raudhah suggested dividing the network based on the number of labs and rooms. Each | Raudhah - 13/01 |

| | | | |
|---|---|---|---|
| | | lab/room should have enough addresses for all devices. | |
| 3 | Understanding IP Requirements for Each Lab/Room | Syafina proposed that a list be created for each lab and room, showing the number of hosts needed (computers, printers, etc.). | Syafina - 13/01 |
| 4 | Subnetting Plan Discussion | Athirah discussed using CIDR notation to create subnets that will efficiently allocate IP addresses based on the required number of hosts. | Athirah - 13/01 |
| 5 | Assigning IP Address Ranges to Each Lab/Room | The team agreed that Naza will handle assigning the specific IP address ranges to each room/lab once subnetting is completed. | Naza - 13/01 |
| 6 | Documentation and Report for Submission | Athirah will document the entire subnetting process and IP address allocation for each room and lab. This documentation will be | Athirah - 13/01 |

| | | | |
|---|---|---|---|
| | | included in the final report. | |
| 4 | Next meeting | 15/01 - finalize the IP addressing and subnetting details. | All - 15/01 |
| 5 | Meeting ended | 0000 | |