Computer Networks
<//Lecture-03//>

SUBNETTING

Today's agenda

01
WHAT'S SUBNETTING?
A definition and overview
of subnetting

02
WHY SUBNETTING?
The motivations and
benefits for subnetting

03
WHERE IS REQUIRED?
Common scenarios & environments
that use subnetting

04
HOW TO SUBNET?
The process of subnetting
and key calculations.

05
LEARNING ACTIVITIES
Interactive Discussion, Real-World
Case Studies, DEMO Labs, **Quiz#3**,
Assignment#4

06
Q & A Session
Q&A session for students to ask
questions about today's
presentation.

WHAT IS SUBNETTING ?

Definition: Subnetting is the process of dividing a single IP network into two or more smaller, logical networks (subnets). Each subnet acts as a distinct broadcast domain within the larger network.

Key Points:

- **Logical Division:** It partitions the network address into two parts the **Network Portion** (which identifies the Subnets/Networks) and the **Host Portion** (which identifies individual devices).

- **CIDR Notation:** Subnetting is often described using CIDR (Classless Inter-Domain Routing) notation (e.g., 192.168.1.0/24), where the number after the slash represents the number of bits allocated to the network portion.

WHY APPLY SUBNETTING ?

Efficient IP Address Utilization

- **Avoid Wastage:** Organizations can prevent IP address waste by adjusting subnet sizes to the number of hosts needed.
- **Flexibility:** With variable-length subnet masking (VLSM), subnets can be appropriately sized to meet actual requirements.

Improved Network Performance

- **Reduced Broadcast Domains:** Smaller subnets limit the scope of broadcast traffic, which reduces congestion and improves overall network efficiency.
- **Local Traffic Management:** By keeping traffic inside a subnet, additional stress is avoided on other network segments (e.g. in monitoring).

Enhanced Security

- **Traffic Isolation:** Sensitive departments (e.g., finance or HR) can be placed on separate subnets to control and monitor traffic more closely.
- **Access Control:** Firewalls and network policies can be implemented per-subnet, giving precise traffic management.

Simplified Management and Troubleshooting

- **Logical Grouping:** Subnets can be designed to reflect organizational or geographic boundaries, simplifying administration.
- **Efficient Routing:** Routing tables can be made simpler and more efficient by using a technique called **supernetting**, which combines several routes.

</// WHERE IS SUBNETTING USED ? //>

Subnetting is widely used in various network environments, including:

- **Enterprise Networks:** Dividing large corporate networks into departmental or regional subnets.
- **Data Centers:** Segmenting servers and services to enhance security and manage traffic.
- **Service Provider Networks:** Allocating IP blocks to customers while minimizing wasted address space.
- **Small Business & Home Networks:** Even small networks use subnetting (often implicitly) to separate local traffic and manage IP addressing.
- **Cloud Environments**: Virtual networks (VPCs) are often segmented into subnets to isolate workloads and manage security groups.

HOW DOES SUBNETTING WORK?

Understanding IP Addresses

IPv4 Structure: IPv4 are **32-bit numbers** written in 4 dotted-decimal format (e.g., 192.168.1.1). They consist of a network portion and a host portion.

Binary Representation: Understanding how decimal numbers convert to binary is critical for grasping subnet masks.

Understanding Subnet Mask

What Is a Subnet Mask?

A subnet mask is used to define which portion of an IP address is the network portion and which part is the host portion.

It is represented in 4 dotted-decimal notation (e.g., **255.255.255.0**) or in CIDR notation (e.g., **/24**).

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Subnet Masks are typically written in the format of N and H Notation

N: represents the network portion [**i.e. Active Bits**]

H: represents the host portion **[i.e. Inactive Bits]**

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CLASS	FORMAT	SUBNET MASK	HOST PORTION
Class A:	**N.H.H.H**	255.0.0.0 or **/8**	2^{24} -2= 16,777,214 hosts
Class B	**N.N.H.H**	255.255.0.0 or **/16**	2^{16} -2= 65,534 hosts
Class C	**N.N.N.H**	255.255.255.0 or **/24**	2^{8} -2= 254 hosts

<// SUBNETTING TABLE //>

Brock Size (BS)		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
		128	64	32	16	8	4	2	1
Class A	/8	/9	/10	/11	/12	/13	/14	/15	/16
Class B	/16	/17	/18	/19	/20	/21	/22	/23	/24
Class C	/24	/25	/26	/27	/28	/29	/30		
Subnet Mask (SM)		128	192	224	240	248	252	254	255

<// SUBNETTING PRACTICE //>

192.169.1.0/25

Given **/25**, What the subnet Mask, Block size, No Subnets/Networks, and Max of Usable Address ?

SM: 255.255.255.128
BS: 128

No of Subnets/Networks: $2^x=2^1=2$
Max of Usable Hosts: $2^7-2=126$

No	Subnets/Networks	1st Valid IP	Last Valid IP	Broadcast IP
1	192.168.1.0	192.168.1.1	192.168.1.126	192.168.1.127
2	192.168.1.128	192.168.1.129	192.168.1.254	192.168.1.255

<// SUBNETTING PRACTICE //>

11.11.11.11/29

SM: 255.255.255.248
BS: 8

No of Subnets/Networks: $2^x=2^5=32$
Max of Usable Hosts: $2^3-2=6$

No	Subnets/Networks	1st Valid IP	Last Valid IP	Broadcast IP
1	11.11.11.0	11.11.11.1	11.11.11.6	11.11.11.7
2	11.11.11.8	11.11.11.9	11.11.11.14	11.11.11.15
3	11.11.11.16	11.11.11.17	11.11.11.22	11.11.11.23
4	11.11.11.24	11.11.11.25	11.11.11.30	11.11.11.31
5	11.11.11.32	11.11.11.33	11.11.11.38	11.11.11.39
6	11.11.11.40	11.11.11.41	11.11.11.46	11.11.11.47

Dynamic Subnetting for a Hospital

A hospital is assigned the IP address 192.168.0.0/22. They require subnets for various departments: ICU (100 hosts), Pharmacy (30 hosts), and HR (15 hosts). Determine the appropriate subnet mask for each department, calculate the total number of usable addresses for each subnet, and discuss how you would prioritize address allocation based on departmental needs and growth potential.

Optimizing Subnet Allocation for Remote Teams

Your organization has been allocated the IP address block 10.0.0.0/16. You need to create subnets for a remote work team (12 hosts) and a development team (50 hosts). What subnet masks would you use for each team, how many usable hosts will each subnet provide, and what strategies would you implement to ensure efficient future expansion without wasting IP addresses?

BEST PRACTICES

Plan Ahead: Design subnets based on current and anticipated future needs.

Document Thoroughly: Keep a record of your addressing scheme for troubleshooting.

Align with Organizational Structure: Group subnets by department, function, or geography.

Use VLSM for Flexibility: Optimize address space usage with variable subnet sizes.

CONCLUSION

Subnetting is an essential technique for efficient network design and management. By understanding how to divide an IP address space into smaller, manageable subnets and properly applying subnet masks and CIDR notation, network administrators can:

- **Optimize IP Address Utilization**

- **Enhance Network Performance**

- **Improve Security and Troubleshooting**

<//THANK YOU!//>

"For I know the plans I have for you," declares the Lord, "plans to prosper you and not to harm you, plans to give you hope and future."