Computación en Internet I

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Agenda

1. **Addresses**
   - Introducing IP Addresses
   - Subnetting
   - Network Address Translation
2. **Workshop**

Agenda del día

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- IP addresses operate at the network layer of the TCP/IP protocol stack.
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- They are 32-bit binary numbers (IPv4).

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What is most of the complexity of working with IP addresses?

- Figuring out which part of the complete 32-bit IP address is the network ID and which part is the host ID.

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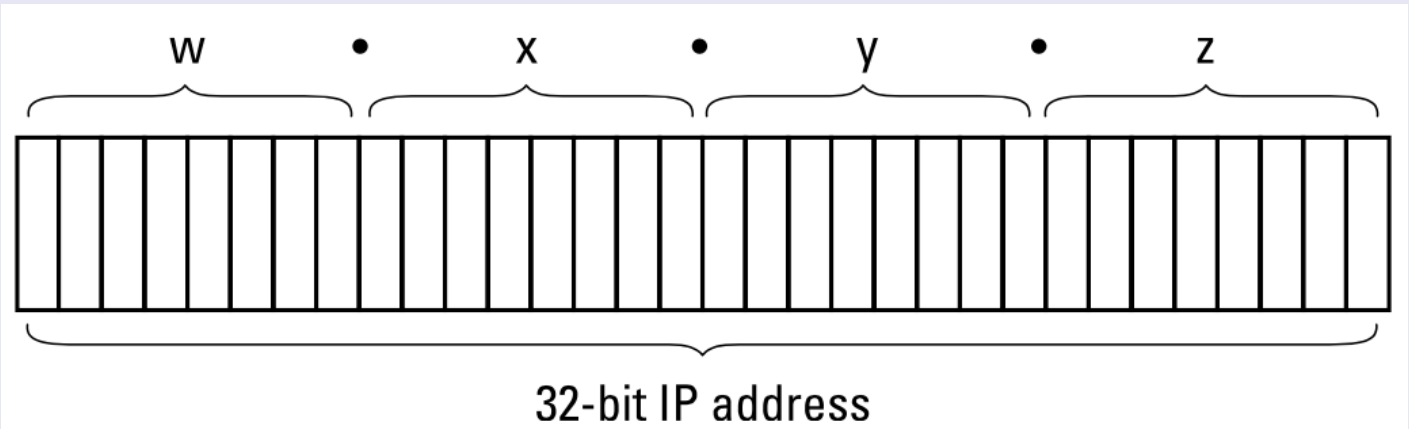

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- Class E is an experimental address class that isn't used.

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- Class E: The first four bits are all one.

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Class	Address Number Range	Starting Bits	Length of Network ID	Number of Networks	Hosts
A	1–126.*x.y.z*	0	8	126	16,777,214
B	128–191.*x.y.z*	10	16	16,384	65,534
C	192–223.*x.y.z*	110	24	2,097,152	254

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- Only about 40 Class A addresses are actually assigned to companies or organizations.
- The rest are either reserved for use by the Internet Assigned Numbers Authority (IANA) or are assigned to organizations that manage IP assignments for geographic regions such as Europe, Asia, and Latin America.

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- Very few networks have tens of thousands of hosts.
- Careless assignment of Class B addresses can lead to a large percentage of the available host addresses being wasted.

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- Done by creating networks that aren't limited to the scales provided by Class A, B, and C IP addresses.
- Networks with more realistic host limits can be created.

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- An arbitrary number of bits to use for the network ID can be selected.

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- For performance reasons, networks are usually segmented into broadcast domains that are smaller than even Class C addresses provide.

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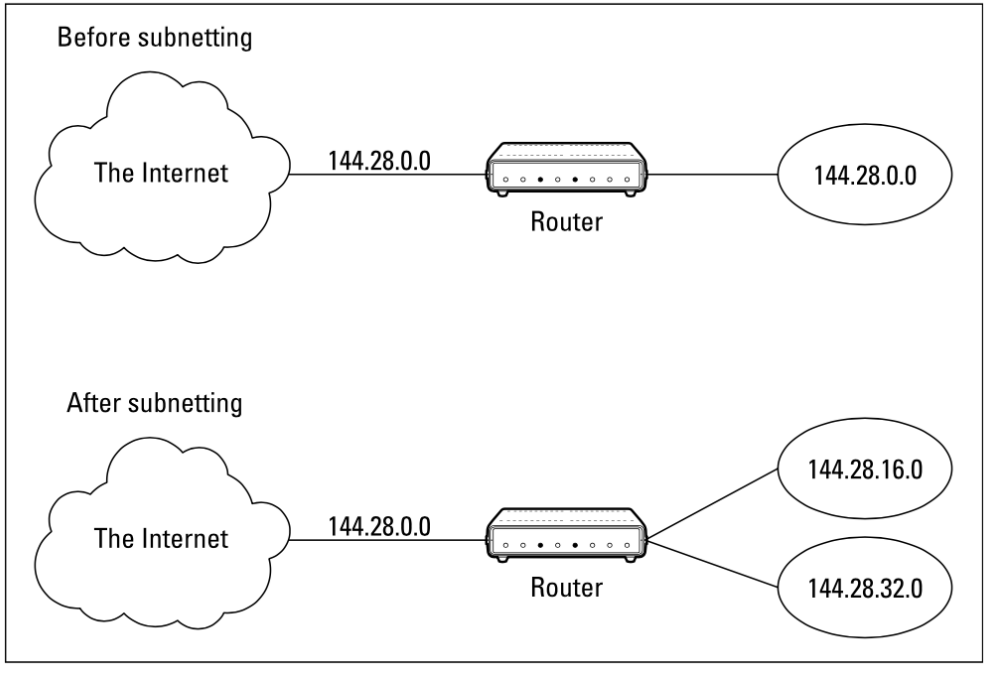

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- The subnet mask itself is usually represented in dotted-decimal notation.
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- It is way of indicating which portion of an IP address should be used to determine the network ID.

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```
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Subnet mask: 11111111 11111111 11110000 00000000
Network ID: 10010000 00011100 00010000 00000000
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- It provides a way of indicating which portion of an address is the network ID and which is the host ID without relying on standard address classes.
- The IP address 144.28.16.17 with the subnet mask 255.255.240.0 can be represented as 144.28.16.17/20.

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Class	Binary	Dotted-Decimal	Network Prefix
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- If the first two bits are 10, the address is Class B, and 255.255.0.0 is used.

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- If the first bit is 0, the address is Class A, and the subnet mask 255.0.0 is applied.
- If the first two bits are 10, the address is Class B, and 255.255.0.0 is used.
- If the first three bits are 110, the Class C default mask 255.255.255.0 is used.

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- The network ID portion of a subnet mask is always composed of consecutive bits set to 1.
  - Only eight values are possible for each octet of a subnet mask: 0, 128, 192, 224, 248, 252, 254, and 255.

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  - At least two bits for the host ID portion of the address to allow for at least two hosts.
- The network ID portion of a subnet mask is always composed of consecutive bits set to 1.
  - Only eight values are possible for each octet of a subnet mask: 0, 128, 192, 224, 248, 252, 254, and 255.
- A subnet address can't be all zeros or all ones.

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- For example, the CIDR 192.168.1.0/28 represents the following block of 14 IP addresses:

```
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192.168.1.5 192.168.1.6 192.168.1.7 192.168.1.8
192.168.1.9 192.168.1.10 192.168.1.11 192.168.1.12
192.168.1.13 192.168.1.14
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- The first step is to determine the actual network ID.
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  - To determine the first IP address in the block, 1 has to be added the network ID.

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- Take the IP address192.168.1.100 when the subnet mask is 255.255.255.240.

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- Take the IP address192.168.1.100 when the subnet mask is 255.255.255.240.
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- Take the IP address192.168.1.100 when the subnet mask is 255.255.255.240.
- Determine the network ID.
  - 11000000 10101000 00000001 01100100
  - AND
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  - = 11000000 10101000 00000001 01100000
  - = 192.168.1.96

Another example?

- Take the IP address192.168.1.100 when the subnet mask is 255.255.255.240.
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  - 11000000 10101000 00000001 01100100
  - AND
  - 11111111 11111111 11111111 11110000
  - = 11000000 10101000 00000001 01100000
  - = 192.168.1.96
- Subtracting the last octet of the subnet mask from 254, 254 - 240 = 14.

Another example?

- Take the IP address192.168.1.100 when the subnet mask is 255.255.255.240.
- Determine the network ID.
  - 11000000 10101000 00000001 01100100
  - AND
  - 11111111 11111111 11111111 11110000
  - = 11000000 10101000 00000001 01100000
  - = 192.168.1.96
- Subtracting the last octet of the subnet mask from 254, 254 - 240 = 14.
- 192.168.1.97, 192.168.1.98, 192.168.1.99, 192.168.1.100, 192.168.1.101, 192.168.1.102, 192.168.1.103, 192.168.1.104, 192.168.1.105, 192.168.1.106, 192.168.1.107, 192.168.1.108, 192.168.1.109, 192.168.1.110

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- Several blocks of IP addresses are set aside just for this purpose.
- Three such ranges of private addresses exist.

What are these ranges?

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CIDR	Subnet Mask	Address Range
10.0.0.0/8	255.0.0.0	10.0.0.1–10.255.255.254
172.16.0.0/12	255.240.0.0	172.16.1.1–172.31.255.254
192.168.0.0/16	255.255.0.0	192.168.0.1–192.168.255.254

Agenda del día

1. **Addresses**
   - Introducing IP Addresses
   - Subnetting
   - Network Address Translation
2. **Workshop**

Network Address Translation

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What is NAT?

- A technique called network address translation (NAT) used by many firewalls to hide the actual IP address of a host from the outside world.
- The NAT device must use a globally unique IP to represent the host to the Internet.
- Behind the firewall, though, the host can use any IP address it wants.
- When packets cross the firewall, the NAT device translates the private IP address to the public IP address and vice versa.

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Network Address Translation

What is one of the benefits of NAT?

- It helps to slow down the rate at which the IP address space is assigned.
- That's because a NAT device can use a single public IP address for more than one host.
- It does so by keeping track of outgoing packets so that it can match incoming packets with the correct host.

Workshop

Complete workshop for today's class. To be handed in the next class.