IP Addressing

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Uretim zamaninin teknolojisi baz alindiginda ortaya cikan en iyi sonuc bu.

Unutmamamiz gereken sey TCPler icinde MAC adreslerini bulundurur.

Routerlar LANlar arasi iletimi sagliyor ve layer 3 te calisiyor.network layer. Switchler layer 2, hublar ise layer 1de.

Her LAN bir network icersisinde o sebepten her birine bir NetID atadik. Ayni LAN icindekiler ayni NETID yi kullanmis olacaklar.

Lakin yine bir ihtiyac var. Network Idler iletimi sagladi fakat bu seferde nereye kime atayacaklarini bilmedikerinden bir HODSTID ihtiyaci dogdu.

IP Terminology

- **Octet** - Same as byte, made up of 8 bits

- **Network Address** - This is the designation used in routing to send packets to a remote network—for example, 10.0.0.0, 172.16.0.0, and 192.168.10.0.

- **Host Address** - A logical address used to define a single host

- **Broadcast Address** - Used by applications and hosts to send information to all hosts on a network. For example 255.255.255.255, which designates all networks and all hosts

Oktet dedigimiz kisim bytelar icin kullaniyoruz ve bir byte 8 bite esittir.
Network adresi o alanin genel adi.
Host adres ise o alanin icindeki her bir hostun ayni network adresine ek olarak numaranlandirmalarin oldugu adres. Host adresi, bir ağdaki her bir cihazın (host) benzersiz kimliğidir. Bu adres, ağ adresine ek olarak belirli bir numaralandırma düzeniyle oluşturulur.
Broadcast adresi ise herkese yapilan duyurunun yapildigi adres. 255.255.255.255 demek butun bitlerin "on" olma durumudur. Yani 11111111.11111111.11111111.11111111. Bunu da kimse kullanamaz.

The Hierarchical IP Addressing Scheme

- IP address consists of **32 bits** or **4 bytes** or **4 octets**

- Represented as:
  - 54.164.151.235 or
  - 00110110.10100100.10010111.11101011 or
  - 66.A4.97.EB

- 32-bit IP address is *structured* (or *hierarchical*) address to make routing possible

- If IP address was *flat* (or *non hierarchical*) routing would be impossible

Biz daha cok bit ya da oktet kullaniyor olacagiz.
16 lik sistemi hic kullanmayacagiz biz.
Bir networkun adresi unik olmak zorunda.

The Hierarchical IP Addressing Scheme

- The **network address** (or **network number**) uniquely identifies each network

- Every machine on the same network shares that network address as part of its IP address

- For example:

IP Address: | 154.101. | 51.235 | → Host address

Network address: Every device in this network starts with these numbers

Bir network icindeki ayni makine ayni network adresini tasir IP adresi icinde.
Mesela 154.101 kismi o network icindeki tum cihazlarin baslangic Ipsi. Heosinde ayni network adresi var ama kalan host adres kismi degisiyor unik olacak sekilde.

The Hierarchical IP Addressing Scheme

Network addresses are divided into 5 classes:

	Octet 1	Octet 2	Octet 3	Octet 4
Class A	0 Network ID		Host ID	
Class B	1 0 Network ID		Host ID	
Class C	1 1 0 Network ID			Host ID
Class D	1 1 1 0 Multicast Address			
Class E	1 1 1 1 Reserved			

Bizim icin A, B ve C onemli.
Bizim asil amacimiz bu sistemi bozmak ama bunun icin oncelikle nasil kurdugumuzu ogrenmemiz gerek.
Ilk oktetler hep soldan baslar.
Ilk oktetin soldaki ilk degeri 0 ise bu class A dir. 1-126 arasindakiler A class. Sadece ilk oktet networke ayrilmis geri kalan 24 bit/3 oktet host icin ayrilmis.
Class B iki oktet netwrork iki oktet ise hosta ayrilmis.
C classta ise 3 oktet network son oktet host.

The Hierarchical IP Addressing Scheme »

Class A Addresses

network	host	host	host

- Class A Network address is 1-byte long, first bit is always **0**
- Maximum 2^7 = 128 Class A networks can be created
- Maximum 2^{24} = 16,777,214 hosts (excluding 2 reserved addresses)
- First bit is always **0** then
  00000000 = 0
  01111111 = 127
- The addresses 00000000 and 01111111 are reserved for default route and troubleshooting respectively
- So Class A network addresses start with 1-126

2 uzeri 7 (cunku ilk oktet 0) tane A networku olusturulabilir.
2 uzeri 24 tane de (cunku kalan 24 oktet host icin ayrilmis) host adresi olusturulabilinir. Ama bunlarin icinden en bastaki ve en sondaki rezerve oldugu icin her zaman dahil etmiyoruz 2 eksi olarak hesapliyoruz.
00000000 ve 11111111 rezerve.
1-126 arasi kullanilabilinir adresler.

Class A Addresses

Address	Function
Network address of all 0s (0.X.X.X)	Means "this network or segment."
Network address of all 1s (127.X.X.X)	Means "all networks."
127.0.0.1	Reserved for loopback tests. Designates the local host and allows that host to send a test packet to itself without generating network traffic.
Host address of all 0s (X.0.0.0)	Means "network address" or any host on the specified network.
Host address of all 1s (X.255.255.255)	Means "all hosts" on the specified network
Entire IP address set to all 0s (0.0.0.0)	Any host on any network
Entire IP address set to all 1s (255.255.255.255)	Broadcast to all hosts on the current network

Flaskte yapilan orneklerde 17.0.0.1 i hatirlamaliyiz.
Bir yazilim yaptigimizda once kendi lokalimizde deneriz. O lokalimiz iste 127.0.0.1 dir.
Diger aklimizda kalmasi gereken ise 0.0.0.0. bu su demek: security gruplarimizda 0.0.0.0 yazmamizin sebebi heryer manasinda yani her networkten her cihaz hepsi bana ulasabilsin.
255.255.255.255 olmasi ise broadcast.

The Hierarchical IP Addressing Scheme »

Class B Addresses

network	network	host	host

- Class B Network Address is 2-byte long, first 2 bits are always **10**
- Maximum 2^{14} = 16,384 Class B networks can be created
- Maximum 2^{16} = 65,534 hosts (excluding 2 reserved addresses)
- First 2 bits are always **10** then
  10000000 = 128
  10111111 = 191
- Class B Network Addresses start with 128-191

2 oktet B classina ayrilmis. 10 ile baslar yani. 16 oktet network icin ayrilmisti.
Bu durumda geriye kalan 2 uzeri 14 kadar b sinifi network adresi olusturabilir
2 uzeri 16 tane de host adresi olusturulur (yine 2 rezerve olani saymiyoruz.)
128-191 arasi adresler

The Hierarchical IP Addressing Scheme

Class C Addresses

network	network	network	host

- Class C Network Address is 3-byte long, first 3 bits are always **110**
- Maximum 2^{21} = 2,097,152 Class C networks can be created
- Maximum 2^8 = 254 hosts (excluding 2 reserved addresses)
- First 3 bits are always 110 then
  11000000 = 192
  11011111 = 223
- Class C Network Addresses start with 192-223

Burada da yine ayni hesap gecerli.
110 net belirlenmis oktetler. 24 oktet ayrilmisti. 3 u kullanildi. 2 uzeri 21 tane network olusturulabilir.
2 uzeri 8 tane de host adresi olusturulabilir.
192 ile 223 arasi adresler.

IP Address Classes:

Address Class	1st Octet Range	1st Octet Bits	Network & Host Parts	# of Possible Networks # of Hosts per Network
A	1-126	00000000 - 01111111	N.H.H.H	128 nets (2^7) 16,777,214 hosts per net (2^{24})-2
B	128-191	10000000 - 10111111	N.N.H.H	16,384 nets (2^{14}) 65,534 hosts per net (2^{16})-2
C	192-223	11000000 - 11011111	N.N.N.H	2,097,150 nets (2^{21}) 254 hosts per net (2^8)-2

The Hierarchical IP Addressing Scheme

Private IP Addresses (RFC 1918)

Every host on every network should have a routable IP address. But if every host on every network in the world was required to have an unique IP address, we would have run out of IP addresses!
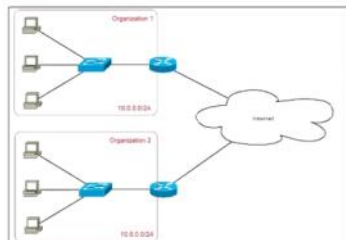
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Private adres public networke cikamayan adrestir.
Bu sistem ilk kuruldugunda hizli bir sekilde internetin yayilmasi uzerine yapilan hatanin farkinin ardindan boyle bir karar verilmis.
Public networke cikamayan yani herhangi bir islev gormeyen adreslere denir. Bu durumda routerlar bunu okuyamiyor ve paket gonderimi yapamiyor.

The Hierarchical IP Addressing Scheme

Private IP Addresses (RFC 1918)

- The IANA reserved the following IP address blocks for use as private IP addresses:
  - Class A: 10.0.0.0 to 10.255.255.255
  - Class B: 172.16.0.0 to 172.31.255.255
  - Class C: 192.168.0.0 to 192.168.255.255
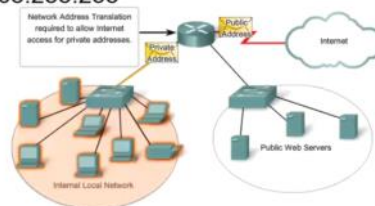
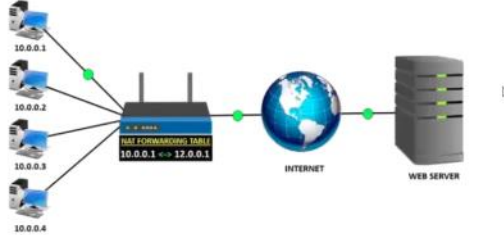CLARUSWAY©

Her classtan bir blok alinmis ve private yapilmis.
Networkler birbirlerine paket gonderirken networklerin isminin mecbur unik olmasi lazim. Bir de bu networkun icindeki host id nin unik olmasi lazim.
belirli bir ağ içinde kullanılan ve internete doğrudan bağlanamayan IP adresidir. Bu adresler, yerel ağlarda (LAN) cihazların birbirleriyle iletişim kurabilmeleri için kullanılır.

Introduction to NAT

- NAT is a process in which one or more local IP addresses are translated into one or more global IP address and vice versa to provide Internet access to the local hosts
- NAT allows multiple devices to access the Internet through a single public address

Private IP adreslerini disari cikartabilmek icin NAT sistemini gelistirmisler.
NAT private Ipleri publice cevirir ve cikisini saglamis olur.
Bir LANin icindeki network Idsi ayni olan tum cihazlar cikis yaparken privatetan public adrese transfer edilir.

Introduction to NAT

- Advantages:
    - Hides internal structure of the network from the outsider and thus increases network security
    - Eliminates address renumbering when a network evolves
    - Allows unlimited private IP address range

- Disadvantages:
    - Changes the IP addresses, thus troubleshooting becomes more complex
    - Translation results in switching path delays
    - Certain applications will not function while NAT is enabled
   - Complicates tunneling protocols such as IPsec

Avantajlarindan en onemlisi guvenlik.
Fakat ote yandan bu ayni zamanda disadvantages. Cunku suc teskil ede bir durum oldugunda bunun takibini yapmak oldukca zor.

Introduction to NAT

Types of NAT:
- **Static NAT (SNAT):**
    - One-to-one mapping (A single private IP with a single global IP)
    - Each device needs a public IP address
    - Generally used for web hosting

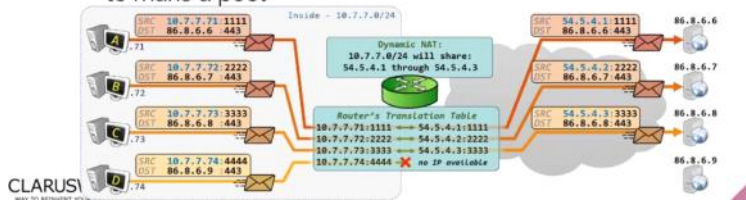Tek bir IP gidiyor ve geri gonderiliyor. Bu statik.
Tek islem
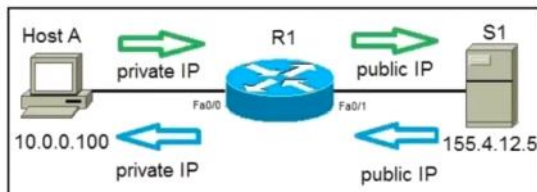
▶ Introduction to NAT

Types of NAT:

- **Dynamic NAT (DNAT):**
  - ○ Public IP is picked from a pool of IP addresses
  - ○ If no IP is left, data packet is dropped by the NAT
  - ○ Very costly as many global IP addresses have to be bought to make a pool

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Bu da dinamik olan kismi.

▶ Introduction to NAT

Types of NAT:

- **Overloading or Port Address Translation (PAT):**
  - ○ Most popular type of NAT
  - ○ Port numbers are used to distinguish the traffic
  - ○ Cost-effective as lots of users can be connected by using only one public IP address

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En populer olani.
Network icindeki hangi cihazdan iletinin saglnadigi veya donut aldiginda hangi cihazin bu iletiyi almasi gerektigini anlmamiz icin PAT kullanilir.
Mesela 10.6.1.2 bir paket gonderecek. Default olarak ona bir numara atar(mesela 10.6.1.2:2031). Bunu bizim kernelimiz, operatin sistemimiz ayarliyor. Boylece gelecek olan cevabin kime gelecegi netlesmis oluyor.
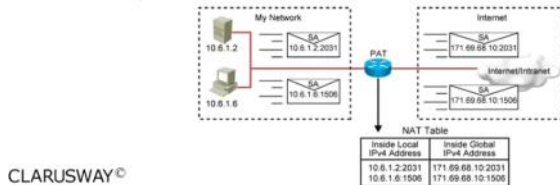
▶ The Hierarchical IP Addressing Scheme

APIPA

- In a network, Dynamic Host Configuration Protocol (DHCP) server assigns IP addresses to all the hosts connected to the network

- If DHCP server isn't available, Windows provides **Automatic Private IP Addressing (APIPA)** service to configure the IP addresses for the hosts

- 169.254.0.1 - 169.254.255.254 reserved for **APIPA**

DHCP server olmadiginda APIPA otomatik bir IP atar host icin.
Bunu da APIPA yapar.

3 ▶ IPv4 Address Types

Layer 2 Broadcasts

- Layer 2 broadcast traffic stays within a local area network (LAN) boundary; known as the **broadcast domain**

- A MAC address of FF:FF:FF:FF:FF:FF is used for broadcast

Broadcast icin ayrilan FF:FF:FF:FF.

Layer 3 Broadcasts

- Layer 3 broadcast traffic is sent to all devices in a network

- A network address of X.255.255.255 is used for broadcast

- **Address Resolution Protocol (ARP)** uses broadcasting to map MAC addresses to IP addresses

- **Dynamic Host Configuration Protocol (DHCP)** uses broadcasting to dynamically assign IP addresses to hosts

Host icin ayrilan bitlerin tamaminin on olmasina broadcast diyorduk.
Bu bilgi subnettingde cok isimize yarayacak.

IPv4 Address Types

Unicast Address

- Identifies a unique node on a network

- Packets addressed to a unicast address are delivered to the node identified by the address

- Unicast address has the MAC address of the destination device

1 mesaj karsiliginda 1 alici ise unicast.
1 mesaja bir cok alici ise multicast.

Multicast Address

- Represent a group of devices in a LAN

- Multicast frames have a value of 1 in the least-significant bit of the first octet of the destination address

- Multicast addresses range from 224.0.0.0 to 239.255.255.255 (Class D)

Internet Protocol Version 6 (IPv6)

Why do we need IPv6?

IPv4 Address Space Consumption

Bu kismi sadece genel bir bilgi olarak bilmek bizim icin yeterli.
Internet kullaniminin hizli yayilmasiyla bir suru cihaz networke baglandi ve unik olmasi gerekn adresler yeterli olmamaya basladi.
Bunu cozmek icin private kullandilar ama yetersiz geldi. Subnetting yaptilar ama o da yeterli olmadi. Sonra v6 cikarttilar.

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