IPv4 address

Anatomy of an IPv4 address
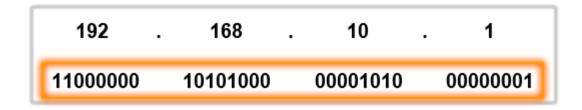
D. Strzęciwilk

IPv4 address

- Explain the **structure IP** addressing

- **IPv4 address** - classify by type

- How addresses are **assigned to networks**

- Determine the **network portion** of the **host address** and the role of the **subnet mask** in dividing networks

What is IPv4?

- **IPv4** addresses have **4 bytes (32 bits)**

192	.	168	.	10	.	1
11000000		10101000		00001010		00000001

- **Binary patterns** representing IPv4 addresses are expressed as **dotted decimals** by separating each byte of the binary pattern, called an **octet**, with a dot

- It is called an octet because each **decimal number** represents **one byte or 8 bits**
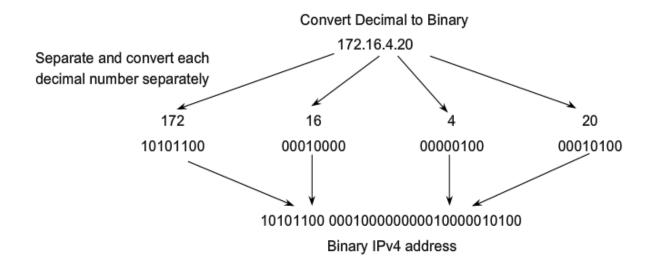
What is IPv4?

- Devices use **binary logic**

- For example, a typical IP address (IPv4) seen by a computer in **binary notation** is:

- **11000000.10101000.00000001.00000001**

- That translates into dotted decimal as:

- **192.168.1.1**

IPv4 address

- Follow the **conversion steps** to see how an **IP address** is converted to binary

Convert Decimal to Binary

172.16.4.20

Separate and convert each decimal number separately

172	16	4	20
10101100	00010000	00000100	00010100

10101100 000100000000010000010100

Binary IPv4 address

Binary To Decimal Conversion
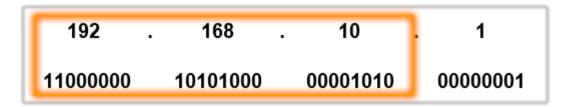
- Example

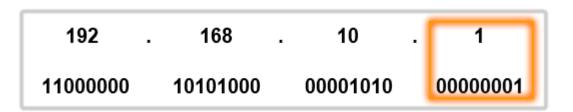| 128	64	32	16	8	4	2	1	Answers	Scratch Area
1	0	0	1	0	0	1	0	*146*	*128 64*
0	1	1	1	0	1	1	1	*119*	*16 32*
1	1	1	1	1	1	1	1		*2 16*
1	1	0	0	0	1	0	1		*146 4*
1	1	1	1	0	1	1	0		*2*
0	0	0	1	0	0	1	1		*1*
1	0	0	0	0	0	0	1		*119*

Network and Host Portions

- For each IPv4 address, some portion of the **high-order** bits represents the **network address**

- We define a network as a **group of hosts** that have **identical bit patterns** in the network address portion of their addresses

192	.	168	.	10	.	1
11000000		10101000		00001010		00000001

Network and Host Portions

- Although all 32 bits define the **IPv4 host address**, we have a variable number of bits that are called the **host portion** of the address

- The **number of bits** used in this host portion determines the **number of hosts** that we can have within the network

192	.	168	.	10	.	1
11000000		10101000		00001010		00000001

IPv4 address

- Within the address range of each IPv4 network, we have three **types of addresses:**

- **Network address -** The address by which we refer to the network

- **Broadcast address -** A special address used to send data to all hosts in the network

- **Host addresses** - The addresses assigned to the end devices in the network

IPv4 address

- Within the address range of each IPv4 network, we have three **types of addresses:**

Network			Host
10	0	0	0
00001010	00000000	00000000	00000000

Network			Host
10	0	0	255
00001010	00000000	00000000	11111111

Network			Host
10	0	0	1
00001010	00000000	00000000	00000001

Subnet Mask

- How do we **calculate** these addresses?

- We need **subnet mask**

- **Subnet Mask**: Required to interpret the IP address

- **Subnet Masks:** Used to define which **part of the host address** will be used as the subnet address

- A **32-bit** value that allows the recipient of IP packets to distinguish the **network ID** portion of the IP address from the **host ID portion**

Subnet Mask

- A **Subnet Mask** is also a **32 bit number** that tells the router which bits of the IP address are for the network portion and which bits are the host portion

- Subnet Mask is a **binary number** but is also usually communicated in dotted **decimal format** or **CIDR** format

- Example **Subnet Mask**

  11111111. 11111111. 11111111.00000000

- Example **Subnet Mask** in dotted decimal
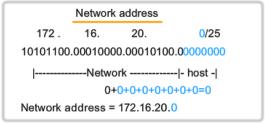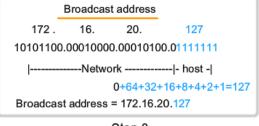
  255.255.255.0

Subnet Mask

- **The Prefix Length**

| Subnet Mask	32-bit Address	Prefix Length
255.0.0.0	11111111.00000000.00000000.00000000	/8
255.255.0.0	11111111.11111111.00000000.00000000	/16
255.255.255.0	11111111.11111111.11111111.00000000	/24
255.255.255.128	11111111.11111111.11111111.10000000	/25
255.255.255.192	11111111.11111111.11111111.11000000	/26
255.255.255.224	11111111.11111111.11111111.11100000	/27
255.255.255.240	11111111.11111111.11111111.11110000	/28
255.255.255.248	11111111.11111111.11111111.11111000	/29
255.255.255.252	11111111.11111111.11111111.11111100	/30

IPv4 address
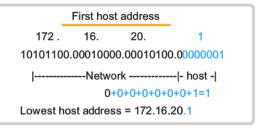
- How do we **calculate** these addresses?

- This calculation process requires us to look at these **addresses in binary**

Network address
172 .   16.   20.   0/25
10101100.00010000.00010100.00000000
|-------------Network -------------|- host -|
0+0+0+0+0+0+0+0=0
Network address = 172.16.20.0

Step 1

First host address
172 .   16.   20.   1
10101100.00010000.00010100.00000001
|-------------Network -------------|- host -|
0+0+0+0+0+0+0+1=1
Lowest host address = 172.16.20.1

Step 2

Broadcast address
172 .   16.   20.   127
10101100.00010000.00010100.01111111
|-------------Network -------------|- host -|
0+64+32+16+8+4+2+1=127
Broadcast address = 172.16.20.127

Step 3

Last host address
172 .   16.   20.   126
10101100.00010000.00010100.01111110
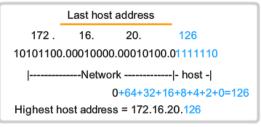|-------------Network -------------|- host -|
0+64+32+16+8+4+2+0=126
Highest host address = 172.16.20.126

Step 4

ANDING

- **ANDING** with default **subnet masks**

- Every IP address must be accompanied by a **subnet mask**

- For computer to determine the network and subnet portion of an IP address it must "**AND**" the **IP address** with the **subnet mask**

- **ANDING Equations**

  - **1 AND 1 = 1**
  - **1 AND 0 = 0**
  - **0 AND 1 = 0**
  - **0 AND 0 = 0**

ANDING

- In order for you computer to get the same information it must **AND** the **IP address** with the **subnet mask** in binary

- Logical **AND comparison**

  11000000. 01100100. 00001010. 00100001   **IP** (**192.168.10.33**)

  11111111. 11111111. 11111111. 00000000   **subnet mask** /24

  11000000. 01100100. 00001010. 00000000   **AND**

- ANDING with the default subnet mask allows to figure out the **network portion** of the **address**.

ANDING

- Logical **AND + NOT**

  11000000. 01100100. 00001010. 00100001   **IP** (**192.168.10.33**)

  11111111. 11111111. 11111111. 00000000   **subnet mask** /24

  11000000. 01100100. 00001010. 11111111   **AND + NOT**

- ANDING with the default subnet mask allows to figure out the **broadcast address**.

IP Range

- **Subnet mask**   **255.255.255.0**

- **Network Address**   **192.168.10.0**

- **Broadcast address**   **192.168.10.255**

- **IP Range**   **192.168.10.1 - 192.168.10.254**

Number of hosts

- Number of valid hosts = **Number of Addresses – 2**

- When you assign an IPv4 address to a computer, the operating system **examines** the address being assigned to determine if this address is a class A, class B, or class C.

- We currently use **classless addressing**. Address blocks appropriate to the number of hosts are assigned to companies or organizations **without regard** to the unicast class.

QA

IPv4 address