# IP-Addresses

28.03.2021

Mostly in use: IPv4 (1971 / 1984)
Very slowly more: IPv6 (1999)

IPv4:(IP-Address-system version No.4)

4 Byte (Octets) = 32 bit

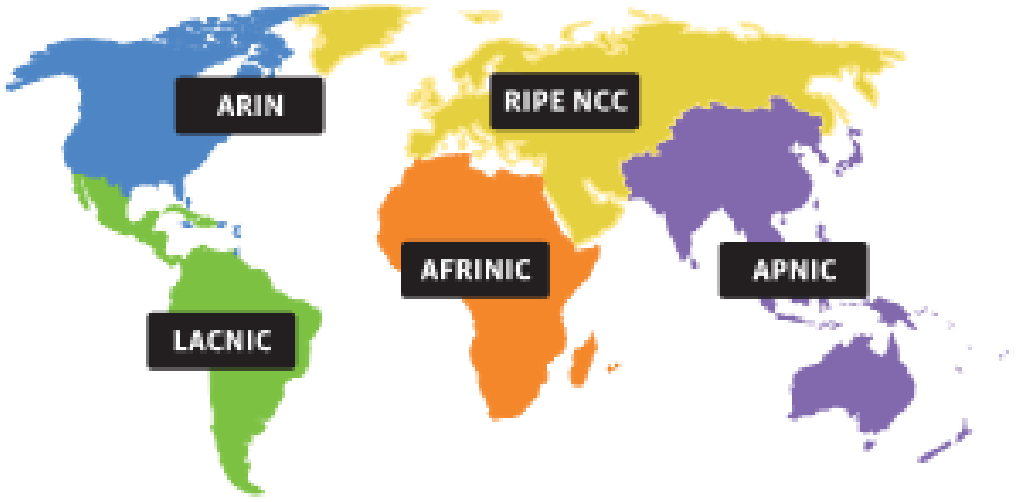
Theoretically $2^{32}$=4.294.967.296 Address.

network-number | host-number
left network-field | host-field right

If Host-Field = 00000… →Network Address
If Host-Field = 11111… →Broadcast Addr.

Two kinds of IP-Addresses:

public addresses (Internet)
These will be administrated by:
http://www.iana.org (Head worldwide)
Internet Assigned Numbers Authority




Only a "site" is member of internet!
(host with a public address)
and
private (internal, nonrouted, Intranet)
these are defined for this purpose (list)

Class A:

0NNNNNNN.HHHHHHHH.HHHHHHHH.HHHHHHHH
00000000.00000000.00000000.00000000
01111111.11111111.11111111.11111111
 0 - 127.   255  .   255  .   255
e.g.: 9.0.0.0 IBM  9.17.223.145
 0.x.y.z              forbidden
10.x.y.z              private
127.x.y.z      localhost - loopback

Class B:

10NNNNNN.NNNNNNNN.HHHHHHHH.HHHHHHHH
10000000.00000000
10111111.11111111
 128.0 - 191.255
e.g.: 176.44.0.0
172.16.H.H - 172.31.H.H private
e.g.: 172.28.0.0     HS-HD-Server

Class C:

110NNNNN.NNNNNNNN.NNNNNNNN.HHHHHHHH
11000000.00000000.00000000
11011111.11111111.11111111
 192.0.0 - 223.255.255
e.g.: 193.197.74.0   HS-HD externally
192.168.x.0          private

class D:                        G=group

1110GGGG.GGGGGGGG.GGGGGGGG.GGGGGGGG
224.0.0.0   to    Multicast
239.255.255.255   M-Bone

class E:

11110……
240.0.0.0 – 247.255.255.255  or
111110……
248.0.0.0 – 255.255.255.254

Example for Host-Numbers and Host-IPs in Class B:

| Host-Number: | | Host-IP in Host-Area: | |
|---|---|---|---|
| Binary | Dec. | Binary | Decimal |
| 1 | 1 | .00000000.00000001 | 0. 1 |
| 11111110 | 254 | .00000000.11111110 | 0.254 |
| 11111111 | 255 | .00000000.11111111 | 0.255 |
| 100000000 | 256 | .00000001.00000000 | 1. 0 |
| 100000001 | 257 | .00000001.00000001 | 1. 1 |

special IPs:

0.x.y.z  special use *.*.*.*
240.0.0.0 ff  „reserved/military“
255.255.255.255  special use

Private:
127.0.0.1 /8  Localhost / loopback
127.x.y.z

10.H.H.H  /8
172.16.H.H to 172.31.H.H  16*/16=/12
192.168.N.H  256*/24=/16

169.254.0.0 /16  APIPA / local loop
AD-HOC-Addresses with DHCP on but no DHCP-Server. Host-part from own MAC.
IANA: 169.254.1.0-169.254.254.255

(Sub-)Netmask

```
 Net-IP |           Host-IP
11111111|00000000.00000000.00000000
 Net-IP |    Subnet-IP     |Host-IP
11111111.11111111.11111111|00000000
```

1111→←0000  1110110000 impossible!

Class A: 255. 0 . 0 . 0 /8

```
11111111.00000000.00000000.00000000
NNNNNNNN.HHHHHHHH.HHHHHHHH.HHHHHHHH
```

Class B: 255.255. 0 . 0 /16

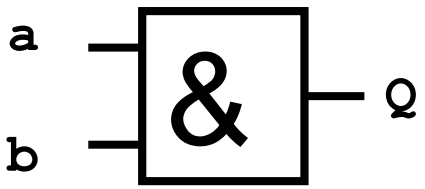
```
11111111.11111111.00000000.00000000
NNNNNNNN.NNNNNNNN.HHHHHHHH.HHHHHHHH
```

Class C: 255.255.255. 0 /24

```
11111111.11111111.11111111.00000000
NNNNNNNN.NNNNNNNN.NNNNNNNN.HHHHHHHH
```

The logical (bool) AND-operation:

| b | a | Q |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |




IP & mask = Network

```
  10101100.00011100.00001011.00010110 a
& 11111111.11111111.00000000.00000000 b
= 10101100.00011100.00000000.00000000
     172   .   28    .   0     .    0
```

**DEST-NETadr. – Own-NETadr. = 0 (equal)?**

**- yes:** Destination is in my Network: find destination MAC-Address, generate Frame and transmit it with included IP-Packet directly to the destination!

**- no:** Dest. is NOT in my Network: find MAC-Address of default-gateway, generate frame and transmit it with included IP-Packet to gateway!

## SUBNETTING

```
NNNNNNNN.NNNNNNNN.SSSSSSSS.HHHHHHHH
   172   .   28    .   17    .   22
10101100.00011100.00010001.00010110
11111111.11111111.11111111.00000000
```

**IP:** 172. 28. 17. 22 CLASS B
**SNM:** 255.255.255. 0 /24 (C)

```
   193   .   197   .   74    .   0
11000001.11000101.01001010.00000000
11111111.11111111.11111111.10000000
NNNNNNNN.NNNNNNNN.NNNNNNNN.SHHHHHHH
MASK:                 /H Subnets  Hosts
255.255.255.0         /24   0       254
255.255.255.128       /25   2       126

Subnetadr.  193.197.74.0   00000000
first Host  193.197.74.1   00000001
Last Host.  193.197.74.126 01111110
Broadcast   193.197.74.127 01111111

Subnetadr.  193.197.74.128 10000000
first Host  193.197.74.129 10000001
Last Host.  193.197.74.254 11111110
Broadcast   193.197.74.255 11111111
```

```
     193   .   197   .   74    .    49
11000001.11000101.01001010.00110001
11111111.11111111.11111111.11000000
NNNNNNNN.NNNNNNNN.NNNNNNNN.SSHHHHHH

                     /H Subnets    Hosts
  255.255.255.0    /24    0        254
  255.255.255.192  /26    4        64-2

0:    SUBNET-Zero                SSHHHHHH
Subnet-A.    193.197.74.0    00000000
First Host   193.197.74.1    00000001
Last Host    193.197.74.62   00111110
Broadcast    193.197.74.63   00111111
1:                           SSHHHHHH
Subnet-A.    193.197.74.64   01000000
First Host   193.197.74.65   01000001
Last Host    193.197.74.126  01111110
Broadcast    193.197.74.127  01111111
2:                           SSHHHHHH
Subnet-A.    193.197.74.128  10000000
First Host   193.197.74.129  10000001
Last Host    193.197.74.190  10111110
Broadcast    193.197.74.191  10111111
3:                           SSHHHHHH
Subnet-A.    193.197.74.192  11000000
First Host   193.197.74.193  11000001
Last Host    193.197.74.254  11111110
Broadcast    193.197.74.255  11111111
```

```
      255.255.255.240 /28  11110000
1:                         SSSSHHHH
Subnet-A.   193.197.74.16  00010000
First Host  193.197.74.17  00010001
Last Host   193.197.74.30  00011110
Broadcast   193.197.74.31  00011111

Subnet-masks Examples for
Class C, B and A:

N.N.N.10000000
…
N.N.N.11111100

N.N.10000000.00000000
…
N.N.11111111.00000000
…
N.N.11111111.11111100

N.10000000.00000000.00000000
…
N.11111111.00000000.00000000
…
N.11111111.11111111.00000000
…
N.11111111.11111111.11111100
```

/30-Network: 255.255.255.252
00 Subnet-Addr.
01 host No. 1
10 host No. 2
11 Broadcast-Addr.

```
    193   .   197   .   74    .     49
11000001.11000101.01001010.00110000 48
11000001.11000101.01001010.00110001 49
11000001.11000101.01001010.00110010 50
11000001.11000101.01001010.00110011 51
11111111.11111111.11111111.11111100 Mask
NNNNNNNN.NNNNNNNN.NNNNNNNN.SSSSSSHH
```

/31 0 Subnet-Addr.  1 Broadcast-Addr.

**Classless IP → "IPv4.5"**
- **Internet: CIDR** (Classless Inter-Domain Routing)
- **Private: VLSM** (Variable Length Subnet-Masking)

**"IP-Block" e.g. 40.123.200.96 /29**
**40.123.200.96 - 40.123.200.103**
**40.123.200.104**

---

**192.168.0.0 255.255.240.0 11110000.000……**
**172.16.0.0 /16 → 16 Networks each 16 bit**
**172.16.0.0 /15 → 8 Networks each 17 bit**
**172.16.0.0 /14 → 4 Networks each 18 bit**
**172.16.0.0 /13 → 2 Networks each 19 bit**
**172.16.0.0 /12 → 1 Network with 20 bit**