NETWORKS CS301 NOTES

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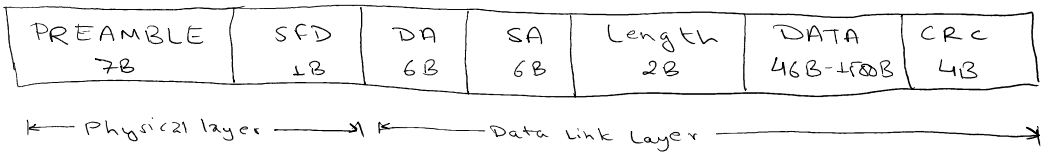
* Ethernet Frame Format (IEEE-802.3) - 1983

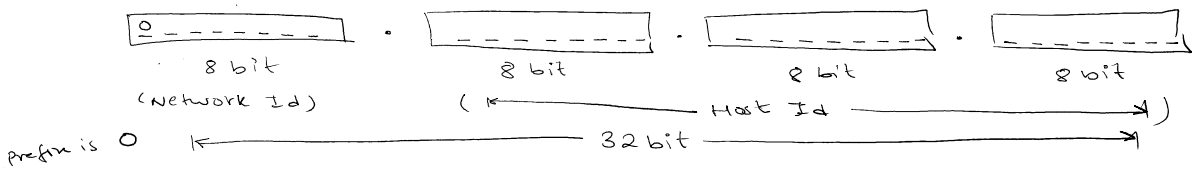


PREAMBLE } Sync / Alert signals
SFD
DA (Destination Address) } MAC Address
SA (Source Address)
length of frame
DATA - pure data. at least 46 bytes
CRC

* Network Layer:

- Host to Host Delivery (Source to Destination Delivery)
- Logical Address - IP Address (Network Id + Host Id)
- Routing
  - RIP
  - OSPF
- Fragmentation
- Congestion Control (Mainly discussed under Transport Layer).

* Class A in IP Addressing.



first bit is always zero. So, Bits for IP Address = 31 bit.
Number of IP Addresses = 2^{31}

Represented in Dotted Decimal : e.g.: 64.0.0.0
64.255.255.255
123.2.8.1

Number of Networks = 00000000 → 01111111 = 2^7 = 128
0 127

No. of usable Network = 128 - 2 = 126 (∵ Not used 0 and 127. Only used address inbetween.)

Number of Host possible = 2^{24}
No. of Usable Host = $2^{24} - 2$

Min Address e.g. 64.0.0.0 is Network representation id.
Max Address e.g. 64.255.255.255 is Directed Broadcast Address
Anything inbetween e.g. 64.0.0.1 is now Host id
64.0.0.2
64.0.2.3 } Host ids.
64.8.1.0

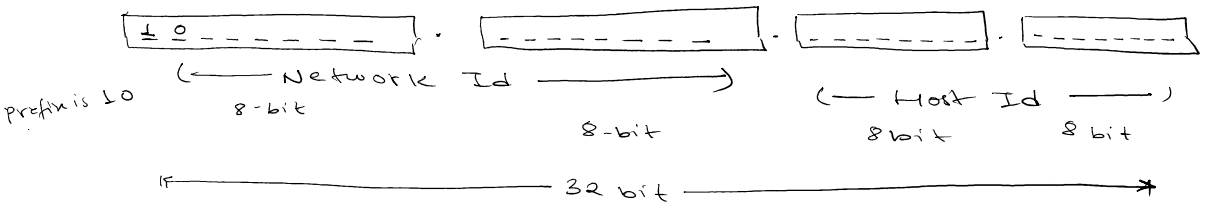
Default mask = 255.0.0.0
= 11111111.00000000.00000000.00000000

Default mask = 255.0.0.0
= 11111111.00000000.00000000.00000000
Example Host = 64.0.0.8
= 01000000.00000000.00000000.00001000

Perform AND Operation : 01000000.00000000.00000000.00000000
= 64.0.0.0 → Network ID.

Class A is used in big universities, large enterprises and orgs. etc.

* Class B in IP Addressing:



Range : 10 000000 → 10111111 (128 - 191)
↳ Network Id.
00000000 → 11111111 (0 - 255)
↳ Host Id.

Number of bits = 32
First two bits are fixed as prefix for class B.
So, Number of usuable bits = 30
∴ Number of IP addresses possible = 2^{30}

Number of Networks = $2^{(8+6)} = 2^{14} = 16384$
Number of host in each network = $2^{(8+8)} = 2^{16} = 65536$
No. of usuable host = $2^{16} - 2 = 65536 - 2 = 65534$

(Concept is same as Class A)
Difference in class A and B?
- Network prefix: class A has fixed 0. Class B has fixed 10
- Network bit: class A has 8 bit reserved for Network Id
  class B has 16 bit ressesved for N. Id.
- Host bit: class A has 24 bit reserved for Host Id.
  class B has 16 bit reserved for Host Id.
- Range check to know if IP addr. is class A or class B.

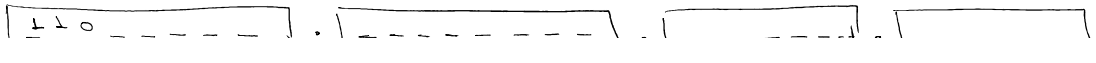
These are small differences. Major concept is similar.
- Calculating Num. of Network Addres
- Calculating Num. of Host Addrs
- Calculating Num of IP Addresses
- Usuable Networks and Host Addres

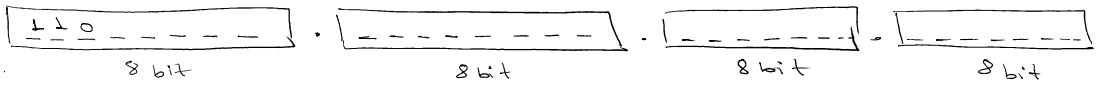
Default Mask = 255.255.0.0
= 11111111.11111111.00000000.00000000
Example IP/Host = 130.2.3.4.
10000010.00000010.00000011.00000100

Perform AND Operation = 10000010.00000010.00000000.00000000
= 130.2.0.0
gives Network Id.

Class B is used in medium scale schools or businesses.

* Class C in IP Addressing:





Prefix is ← Network Id → ← Host Id →

Range : 110 00000 → 110 11111 (192 → 223)

Num. of IP Addresses = $2^{(32-3)} = 2^{29}$

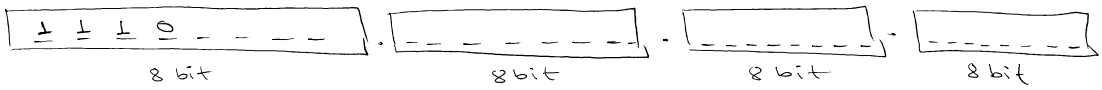
Num of Network Ids = $2^{(24-3)} = 2^{21}$
Num of Usuable Network Ids = $2^{21} - 2$

Num of Hosts in each network = $2^8 = 256$
Num of Usuable Hosts = $2^8 - 2 = 254$

Default Subnet Mask = 255.255.255.0

(class C is the one we use in home networks for IP Addressing (LAN)

* Class D in IP Addressing.



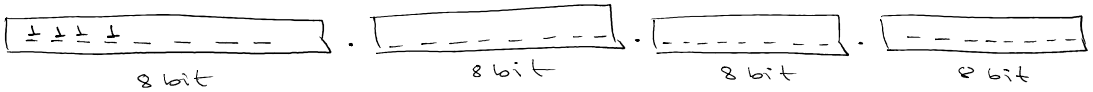
Prefix is 1110

Range: 1110 0000 → 11101111 (224-239)

Number of IP Addresses = $2^{(32-4)} = 2^{28}$

There is no network or host id.
All IP of Class D is used for Multicasting, Group Email / Broadcast

* Class E in IP Addressing.



Prefix is 1111

Range : 11110000 → 11111111 (240-255)

There is no network Id or Host Id.
These IP Addresses of Class D are reserved for Military Purposes.

Number of IP Addresses = $2^{(32-4)} = 2^{28}$

* Conclusion on Classes of IP Addressing.

If first octet of IP Address begins with or contains or is in between following ranges:

Range : 0 - 127 : Class A (Example : 123.0.0.1)
Range : 128 - 191 : Class B (Example : 132.1.8.7)
Range : 192 - 223 : Class C (Example : 192.168.1.1)
Range : 224 - 239 : Class D (Example : 233.255.255.223)

Range : 128 - 191 : Class B (Example : 132.1.8.7)
Range : 192 - 223 : Class C (Example : 192.168.1.1)
Range : 224 - 239 : Class D (Example : 233.255.255.223)
Range : 240 - 255 : Class E (Example : 245.245.128.4)

Example: Given IP Address : 201.20.30.40
Calculate and Find : (i) Class
(ii) Network ID
(iii) 4th Host ID
(iv) Last Host ID
(v) Broadcast Address.

→ 201.20.30.40
first octet

201 falls under the range of 192-223.
Hence, (i) Given IP is of Class C.

for Class C, Default Subnet Mask = 255.255.255.0

(ii) Network ID = 201.20.30.40
AND 255.255.255.0
201.20.30.0

∴ Network ID = 201.20.30.0

TRICK: Performing AND with 255 gives the same number.
Performing AND with 0 gives 0.

How? $(201 \text{ AND } 255)_{10} = ($ 11001001 $)_2$
AND 11111111
$(11001001)_2$
$= (201)_{10}$

and, $(40 \text{ AND } 0)_{10} = ($ 00101000 $)$
AND 00000000
$(00000000)_2$
$= (0)_{10}$

(iii) 4th Host ID = 201.20.30.4

(why not 201.20.30.3 ?)
G :: 201.20.30.0 is network Id. Hence, host counting cannot start from 0 and should begin from 1. So the fourth host is 4).

(iv) Last Host ID = 201.20.30.254.

(why not 201.20.30.255 ?)
G :: 201.20.30.255 is Direct Broadcast Addres Hence, host counting ends befor 255, ie., 254 is the last host.)
This is why we subtract 2 in total number of 'usuable' host address. to begin counting from 1 (instead of 0) and end on 254 (instead of 255).

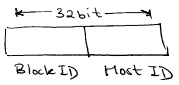
(v) Broadcast Address:
(a) → Limited = 255.255.255.255.
(b) → Direct = 201.20.30.255

(Limited Broadcast Address is same for all class type).
(Direct Broadcast Address is Network Id dot 255.
i.e., place 255 on all the host octaves).

* Problems with classful Addressing.
- Wastage of IP Addresses (along with no flexibility)
- Maintenance is time consuming.
- More prone to errors
- Security challenges.

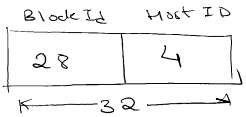
To overcome flexibility issue, we use classless Addressing

* Classless Addressing (CIDR)
- No classes.
- Only blocks



- Notation:
  x.y.z.w/n
  e.g.: 200.10.20.40/28

Here, n is mask or no. of bits represent block/network.
28 n means 28 number of ones. i.e., 11111111.11111111.11111111.11110000
i.e, 255.255.255.240



So, Number of Host in each network = $2^4 = 16$
Number of usable Hosts = $2^4 - 2 = 14$

So, Network Id = 200.10.20.40 AND 255.255.255.240
=> 200.10.20.40 AND 255.255.255.240
= 200.10.20.
00101000 AND 11110000
00100000
= 32.

∴ Network Id = 200.10.20.32/28

Rules for Classless Addressing:
- Addresses should be contiguous
- No. of addresses in a block must be in power of 2.
- First address of every block must be evenly divisible with size of block

e.g.: 200.10.20.40/28
Here size of block = 2^4 = Number of hosts in the address
first address of block = 200.10.20.32 = Network Id.
00100000
2^4 — last four bits is zero.
Then, Yes, divisible

Then, Yes, divisible

* Routing Protocols → Intradomain → Distance Vector (RIP)
  Link State (OSPF)
  Interdomain → Path Vector (BGP)