MAC notation

MAC - **M**edia **A**ccess **C**ontrol

dc-a6-32	-52-17-79
manufacturer number	unique ID
Raspberry Pi Trading Ltd	

00-15-5D	-52-17-80
manufacturer number	unique ID
Microsoft Corporation	

68-5D-43	-52-17-81
manufacturer number	unique ID
Intel Corporate	

Rule 1: hexadecimal numbers
Rule 2: hexadecimal letters lowercased
Rule 3: divided by "-" or ":"
Rule 4: 48 Bit length

IPv4 notation

192.168.178.6 /19

CIDR - Classless Inter Domain Routing

octet or Byte

192 .168 .178 .6

1100 0000 1010 1000 1011 0010 0000 0110 → 32 Bit length → 2^{32} possible hosts → 4.294.967.296

255 .255 .254 .0 → Subnet

1111 11111 1111 1111 1110 0000 0000 0000

Rule 1: decimal numbers
Rule 2: divided by "."
Rule 3: 32 Bit length

private address ranges		
Class A	10.0.0.0	10.255.255.255
Class B	172.16.0.0	172.16.255.255
Class C	192.168.0.0	192.168.255.255

Classful adressing definition			
Class A	0...	0.0.0.0 - 127.255.255.255	255.0.0.0
Class B	10...	128.0.0.0 - 191.255.255.255	255.255.0.0
Class C	110...	192.0.0.0 - 223.255.255.255	255.255.255.0
Class D	1110...	224.0.0.0 - 239.255.255.255	reserved for multicast
Class E	1111...	240.0.0.0 - 255.255.255.255	reserved for future

IPv4 loopback

127.0.0.1 - 127.255.255.254

http://127.0.0.1/

IPv4 linklocal

169.254.1.0 - 169.254.254.255

APIPA - **A**utomatic **P**rivate **IP** **A**dressing

IPv4 Subnet notation

1000 0000 0000 0000 0000 0000 0000 0000 128.0.0.0 /1 → biggest subnet

network identifier
interface identifier → 1111 11111 1111 1111 1110 0000 0000 0000 255.255.224.0 /19

added 11 Bit for 2^{11} subnets

reduced possible host
2^2 per subnet - Broadcast - NetId = 2 IP addresses

subnet identifier → 1111 11111 1111 1111 1111 1111 1111 1100 255.255.255.252 /30

network without hosts
2 IP - Broadcast - NetID = 0 IP left → 1111 11111 1111 1111 1111 1111 1111 1110 255.255.255.254 /31 → smallest subnet

Subnetting IPv4 FLSM

take a subnet an divide it to equal subnets

192.168.2.0 / 26 is given, you need 4 subnets

FLSM - **F**ixed **L**ength **S**ubnet **M**ask

1111 1111	**1111 1111**	**1111 1111**	**1100** 0000	255.255.255.192	/26
1111 1111	1111 1111	1111 1111	1111 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1100 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1101 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1110 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1111 0000	255.255.255.240	/28

you need for 4 subnets = 2^2 = 2 Bits

1111 1111	**1111 1111**	**1111 1111**	**1100 0000**	255.255.255.192	/26		
0000 0000	**0000 0000**	**0000 0000**	**0011 1111**	192.168.2.64	/26	192.168.2.0 - 192.168.2.64	2^6 - 2 = 62 IP addresses
0000 0000	0000 0000	0000 0000	0000 0000	192.168.2.0	/28	192.168.2.0 - 192.168.2.31	2^4 - 2 = 14 IP addresses
0000 0000	0000 0000	0000 0000	0001 0000	192.168.2.32	/28	192.168.2.32 - 192.168.2.63	2^4 - 2 = 14 IP addresses
0000 0000	0000 0000	0000 0000	0010 0000	192.168.2.64	/28	192.168.2.64 - 192.168.2.95	2^4 - 2 = 14 IP addresses
0000 0000	0000 0000	0000 0000	0011 0000	192.168.2.96	/28	192.168.2.96 - 192.168.2.127	2^4 - 2 = 14 IP addresses
0000 0000	0000 0000	0000 0000	0100 0000	192.168.2.128			

NetID of next NetID - 1 = Broadcast IP from Subnet Before

Subnetting IPv4 VLSM

take a subnet an divide it into different subnets

192.168.2.0 / 26 is given, you need

1 subnet for 3 hosts

1 subnet for 30 hosts

VLSM - **V**ariable **L**ength **S**ubnet **M**ask

for 3 hosts + $1_{Broadcast}$ + 1_{NetID} IP = 5 IP
5 IP = you need 8 IP = 2^3 = 3 Bit

for 30 hosts + $1_{Broadcast}$ + 1_{NetID} IP = 32 IP
32 IP = 2^5 = 5 Bit

1111 1111	1111 1111	1111 1111	1100 0000	255.255.255.192	/26		
1111 1111	1111 1111	1111 1111	1111 1000	255.255.255.248	/29		
0000 0000	0000 0000	0000 0000	0000 0111	192.168.2.8	/29	192.168.2.0 - 192.168.2.8	2^3 - 2 = 6 IP addresses
1111 1111	1111 1111	1111 1111	1110 0000	255.255.255.248	/27		
0000 0000	0000 0000	0000 0000	0000 1000	192.168.2.9	/27	192.168.2.9 - 192.168.2.32	2^5 - 2 = 30 IP addresses
0000 0000	0000 0000	0000 0000	0001 1111	192.168.2.32	/27		

next possible Bit = NetID of next subnet

Supernetting IPv4

you got 4 subnets and need to combine these

1111 1111	1111 1111	1111 1111	1100 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1101 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1110 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	1111 0000	255.255.255.240	/28
1111 1111	**1111 1111**	**1111 1111**	**1100** 0000	255.255.255.192	/26

you need for 4 subnets = 2^2 = 2 Bits to change it to one subnet

---

IPv6 notation

2001:db80:ab30:C000:0000:0000:1f37:0210/56

Rule 1: hexadecimal numbers
Rule 2: hexadecimal letters lowercased
Rule 3: divided by ":"
Rule 4: 128 Bit length

ff	ff	:ff	ff	:ff	ff	:ff	ff	:ff	ff	:ff	ff	:ff	ff	:ff	ff
1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
20	01	:db	80	:ab	30	:c0	00	:00	00	:00	00	:1f	37	:02	10
0010 0000	0000 0001	1101 1011	1000 0000	1010 1011	0011 0000	1100 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000	000 1111	0011 0111	0000 0010	0001 0000

2^{128} =
340.282.366.920.938.463.463.374.607.431.768.211.456 IP addresses

network prefix
never greater than 64 Bit

interface identifier
does not have an broadcast

IPv6 vs IPv4

IPv6...

- has much more addresses
- has no broadcast IP
- has less routes, so it's faster for tasported packages
- has IPsec included

IPv6 contraction

2001:db80:ab30:C000:**0000:0000**:1f37:0210/56

Rule 1: string of zeros can be removed once

2001:db80:ab30:C000**::**1f37:**0**210/56

Rule 2: leading zeros or left zeros of sextet can be removed

2001:db80:ab30:C000**::**1f37:**2**10/56

2001:db80:**0000**:C000:**0000:0000**:1f37:**0000**/56

Rule 3: more than one string of 4 zeros can be replaced by 0

2001:db80:**0**:C000**::**1f37:**0**/56

IPv6 loopback

::1 - ffff:ffff:ffff:ffff:ffff:ffff:ffff:ffff

http://[::1]/

IPv6 linklocal

fe80::/10

IPv6 SLAAC

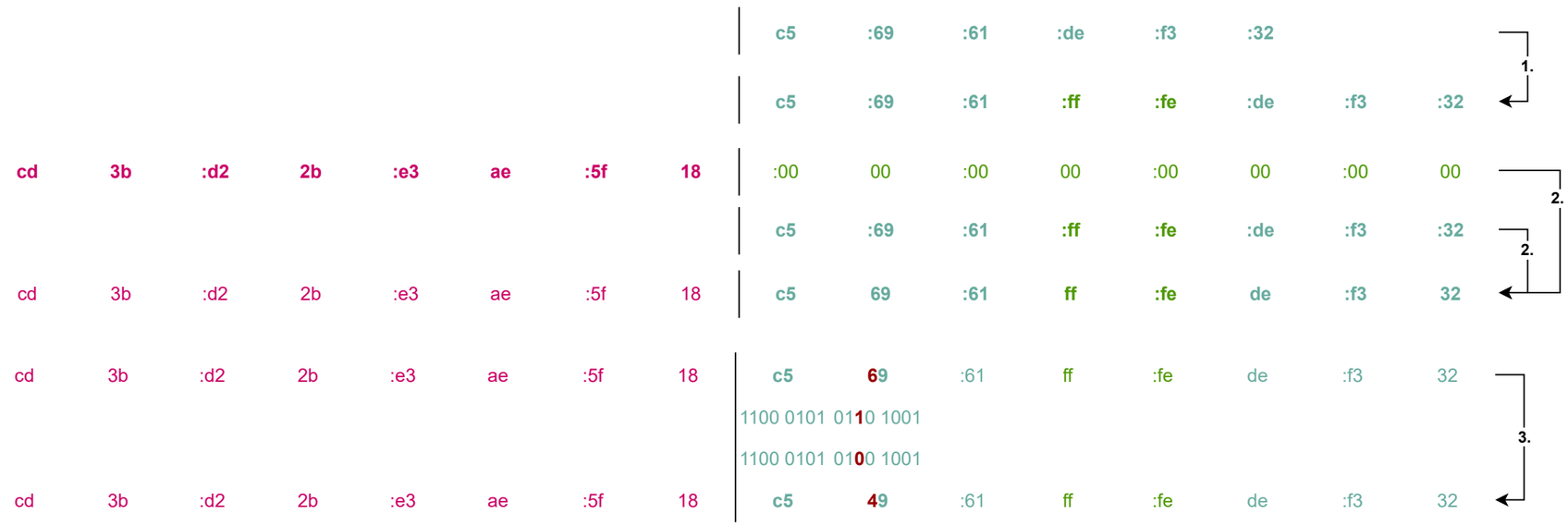
if you get automatically an IPv6 address then by

SLAAC - **S**tateless **A**utomatic **A**ddress **C**onfiguration

your MAC is c5:69:61:de:f3:32

your IPv6 network prefix is cd3b:d22b:e3ae:5f18::/64

SLAAC publishes your MAC address, to prevent this IPv6 Privacy Extension was added e.g. on Windows 10 on default



1. Step put ff:fe in the middle of MAC and extend
2. Step combine network prefix with extended MAC and correct the seperator
3. Step convert the seventh Bit

Subnetting IPv6

take a prefix an divide it to equal subnets

cd3b:d22b:e3ae:4000::/50 is given, you need 4 subnets