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	← you need for 4 subnets = 2^2 = 2 Bits
1111 1111	1111 1111	1111 1111	11**11** 0000	255.255.255.240	/28	
1111 1111	1111 1111	1111 1111	11**00** 0000	255.255.255.240	/28	
1111 1111	1111 1111	1111 1111	11**01** 0000	255.255.255.240	/28	
1111 1111	1111 1111	1111 1111	11**10** 0000	255.255.255.240	/28	
1111 1111	1111 1111	1111 1111	11**11** 0000	255.255.255.240	/28	

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	00**00** 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	00**01** 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	00**10** 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	00**11** 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	0**1**00 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 →	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		
for 30 hosts + $1_{Broadcast}$ + 1_{NetID} IP = 32 IP 32 IP = 2^5 = 5 Bit →	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	111**0 0000**	255.255.255.248	/27		
next possible Bit = NetID of next subnet ←	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		

Supernetting IPv4

you got 4 subnets and need to combine these

1111 1111	1111 1111	1111 1111	11**00** 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	11**01** 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	11**10** 0000	255.255.255.240	/28
1111 1111	1111 1111	1111 1111	11**11** 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

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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

network prefix
never greater than 64 Bit

interface identifier
does not have an broadcast

2^{128} =
340.282.366.920.938.463.463.374.607.431.768.211.456 IP addresses

IPv6 vs IPv4

IPv6...

- has much more addresses
- supports unicast and multicast, not broadcast because "We don't want any device to to be able to broadcast across the entire internet"
- 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

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

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

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

								c5	:69	:61	:de	:f3	:32		
								c5	:69	:61	:ff	:fe	:de	:f3	:32
cd	**3b**	**:d2**	**2b**	**:e3**	**ae**	**:5f**	**18**	:00	00	:00	00	:00	00	:00	00
								c5	:69	:61	:ff	:fe	:de	:f3	:32
cd	3b	:d2	2b	:e3	ae	:5f	18	c5	69	:61	ff	:fe	de	:f3	32
cd	3b	:d2	2b	:e3	ae	:5f	18	c5	69	:61	ff	:fe	de	:f3	32
								1100 0101	0110 1001						
								1100 0101	0100 1001						
cd	3b	:d2	2b	:e3	ae	:5f	18	c5	49	:61	ff	:fe	de	:f3	32

1. **Step** put ff:fe in the middle of MAC, this is the EUI-64 addressformat from IEEE for MACs
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

cd	3b	:d2	2b	:e3	ae	:40		00	:00	00	:00	00	:00	00	:00	00	→ network id
ff	ff	:ff	ff	:ff	ff	:c0		00									→ network prefix
						11**00**	0000										→ **subnet Bits**
cd	3b	:d2	2b	:e3	ae	:40		00	:00	00	:00	00	:00	00	:00	00	
						01**00**	0000										→ **subnet Bit with network id**
cd	3b	:d2	2b	:e3	ae	:**4**0		00	:00	00	:00	00	:00	00	:00	00	→ first subnet
						01**01**	0000										
cd	3b	:d2	2b	:e3	ae	:**5**0		00	:00	00	:00	00	:00	00	:00	00	second subnet
						01**10**	0000										
cd	3b	:d2	2b	:e3	ae	:**6**0		00	:00	00	:00	00	:00	00	:00	00	third subnet
						01**11**	0000										
cd	3b	:d2	2b	:e3	ae	:**7**0		00	:00	00	:00	00	:00	00	:00	00	fourth subnet

binary counting