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Internet Protocol version 4 vs MAC address

- Cell phone not permanently attached to phone number
- IMEI is permanent part of phone; cannot be changed

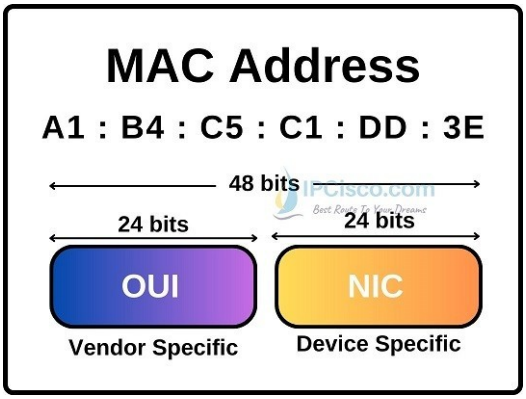
MAC address:

- physical address burned into NIC card
- Similar to IMEI number

- 8 bits:8 bits:8 bits 8 bits:8 bits:8 bits = 48 bits

Created by company that made network card
Eg: Dell
24 bits

Device number
24 bits



All digital is **not** binary.
Can be hexadecimal, octal, or decimal
However,
All binary **IS** digital

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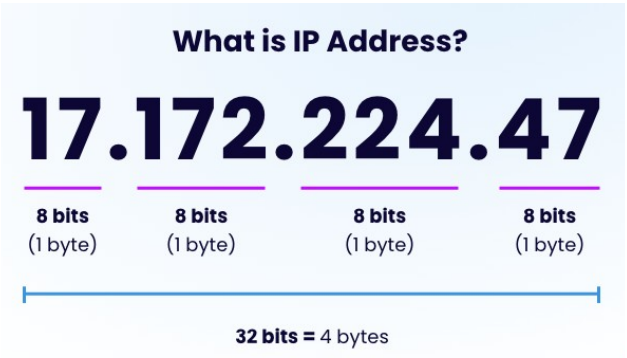
IP Address

- IP addresses are routable
- MAC addresses are NOT routable!
- IP addresses are 32 bits
- Subnet mask determines what portions of IP address at network or node



IP address 10 . 20 . 184 . 63

Subnet mask 0-255 0-255 0-255 0-255

# of bits 8 8 8 8

32 bits

IP address 192.168.1.10 (Subnet address / Node address)

Subnet mask 255.255.255.0

- IP addresses determine if computers are on the same network
- First 3 numbers on IP address determine what network the node is on:
  Eg: 10.20.184.xxx

IP address 10 . 20 . 184 . 63

Network Node

Subnet mask 255 . 255 . 255 . 0

Network Node

255 . 255 . 0 . 0

Network Node

255 . 0 . 0 . 0

Network Node

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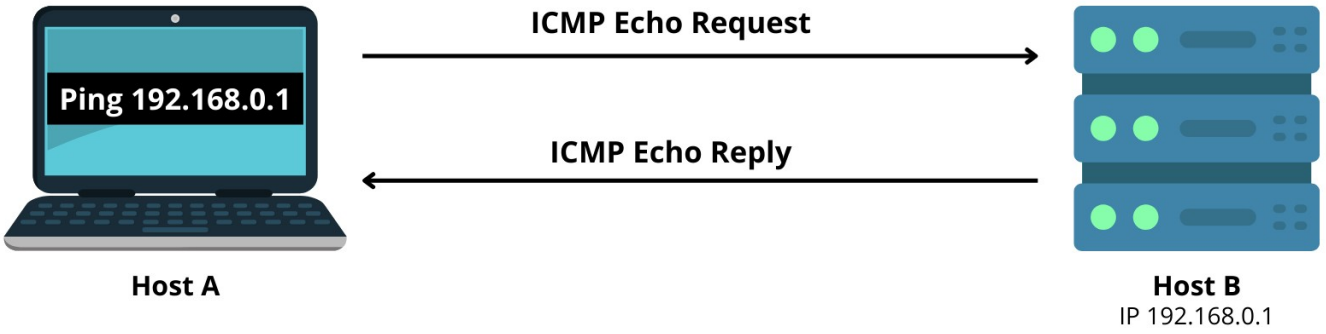
ping command

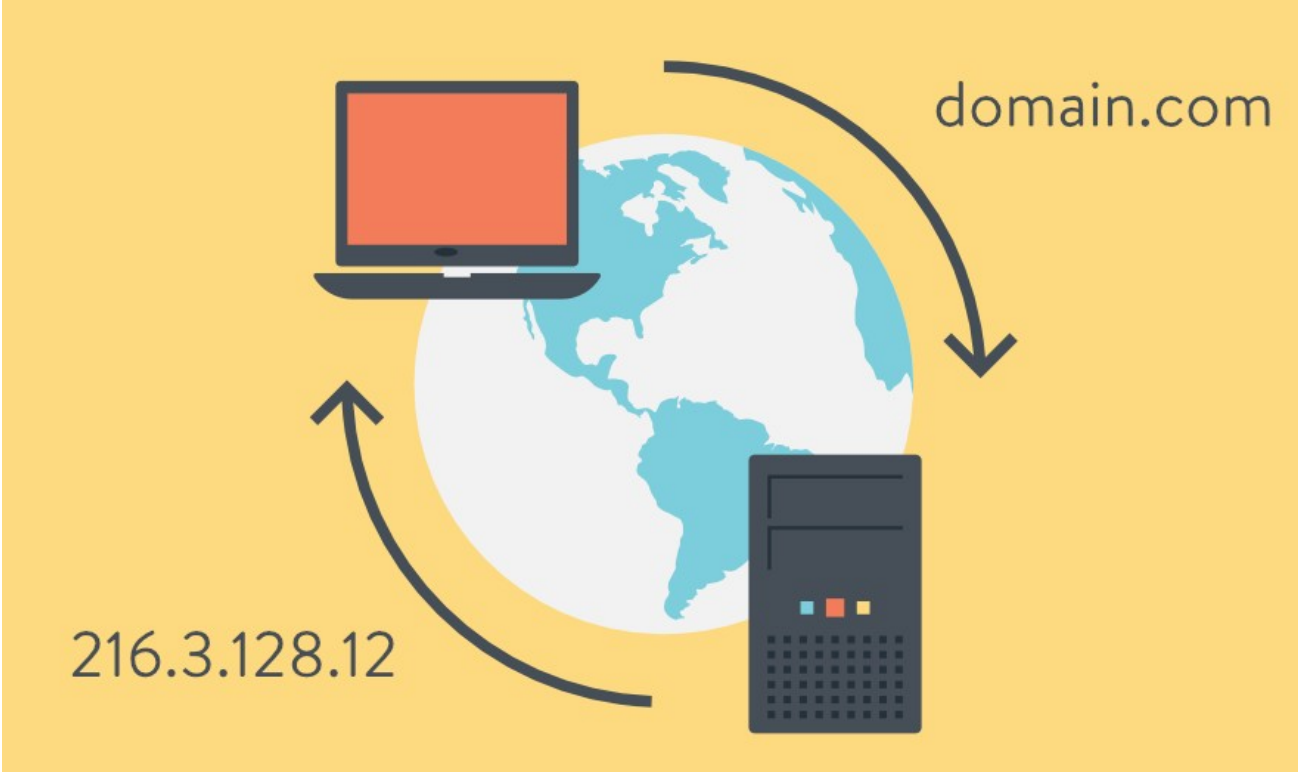
- Sends test packets to website and waits for return
- Can turn off ping response so there is no return packets

Ping command



Domain Name Service [DNS]

- Converts domain name to IP address
- Fully Qualified Domain Name [FQDN] converted to IP address



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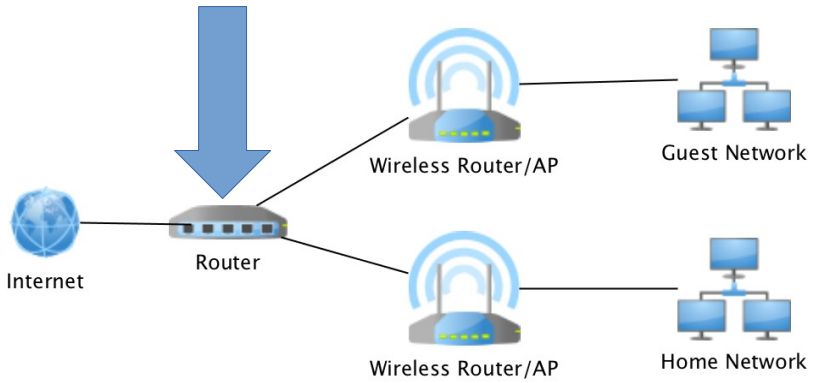
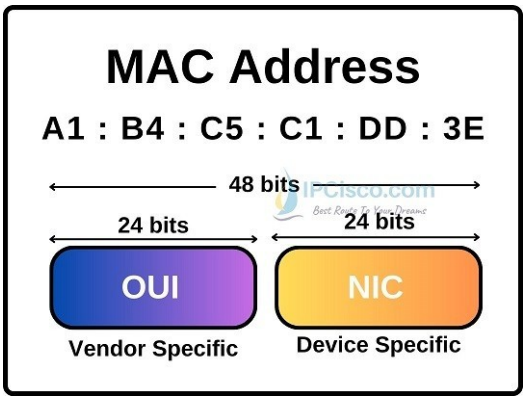
- If the domain is on another network, the traffic is sent to the default gateway
- This is usually a router
- Routers send traffic between networks; internal network to external network



- MAC addresses are used on the local network



Address Resolution Protocol [ARP]
- IP addresses are saved in the ARP cache
- Command: arp -a

```
Microsoft Windows [Version 10.0.19044.1766]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>arp -a

Interface: 192.168.0.121 --- 0x1b
  Internet Address      Physical Address      Type
  192.168.0.1           d8-07-b6-ec-96-66     dynamic
  192.168.0.101         98-da-c4-1a-37-a2     dynamic
  192.168.0.109         08-d2-3e-80-8d-d8     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.102.18        01-00-5e-7f-66-12     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

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Fully Qualified Domain Name [FQDN] example:
www.yahoo.com

https://bctc.baruch.cuny.edu

Sub-subdomain of college [Department]

Subdomain of university [college]

Domain name of university

TLD: Top Level Domain Educational institution

Reads right to left in terms of DNS resolution

www: means should contact web server on other side of connection

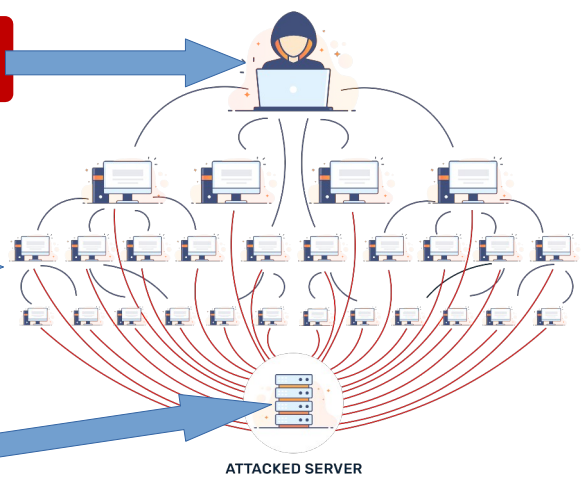
Data:
- Should be confidential
- Integrity secured
- Available to be accessed when requested

2 types web server attacks
- Denial of Service: one person attacks one server
- DDOS: Distributed Denial of Service attack – multiple people/servers attack one target at once, ie; botnet attack

Attacker [cracker]

Botnet [infected computers]

Target server



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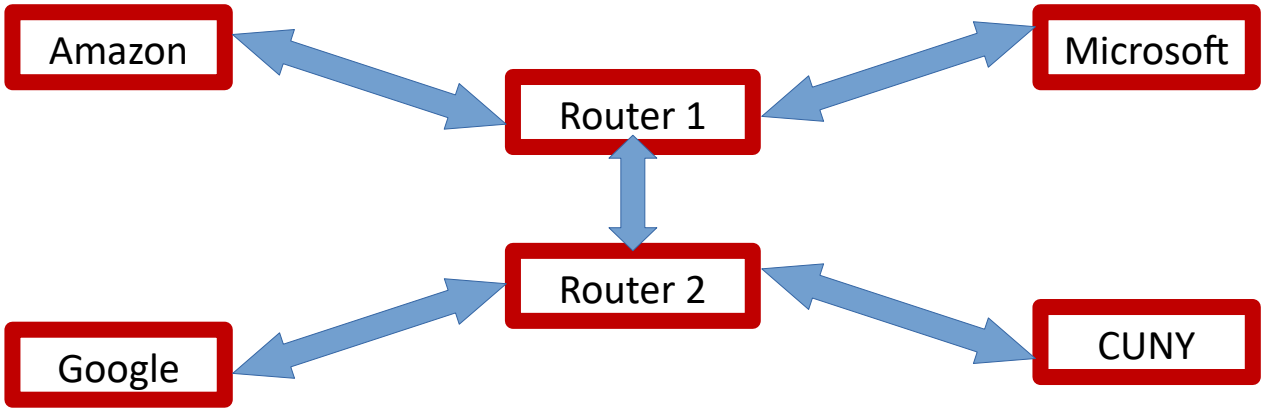
Internet: network of networks connected together



tracert: indicates hops between routers

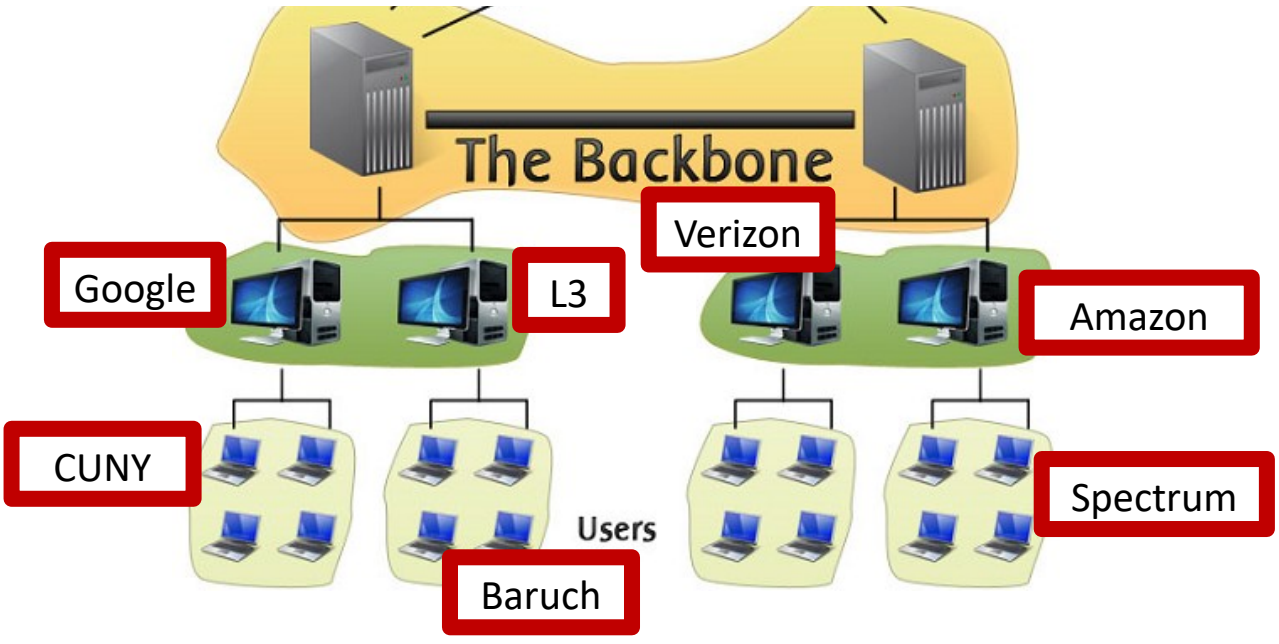
```
C:\Users\Administrator>tracert google.com

Tracing route to google.com [172.217.169.46]
over a maximum of 30 hops:

  1    <1 ms    <1 ms    <1 ms  cs0-cr.ldn.as25369.net [5.226.138.1]
  2     1 ms    <1 ms    <1 ms  195.66.224.125
  3     1 ms     1 ms     1 ms  74.125.242.65
  4     2 ms     2 ms     2 ms  172.253.66.87
  5     1 ms     1 ms     1 ms  lhr48s08-in-f14.1e100.net [172.217.169.46]

Trace complete.
```

Router can connect to router or network



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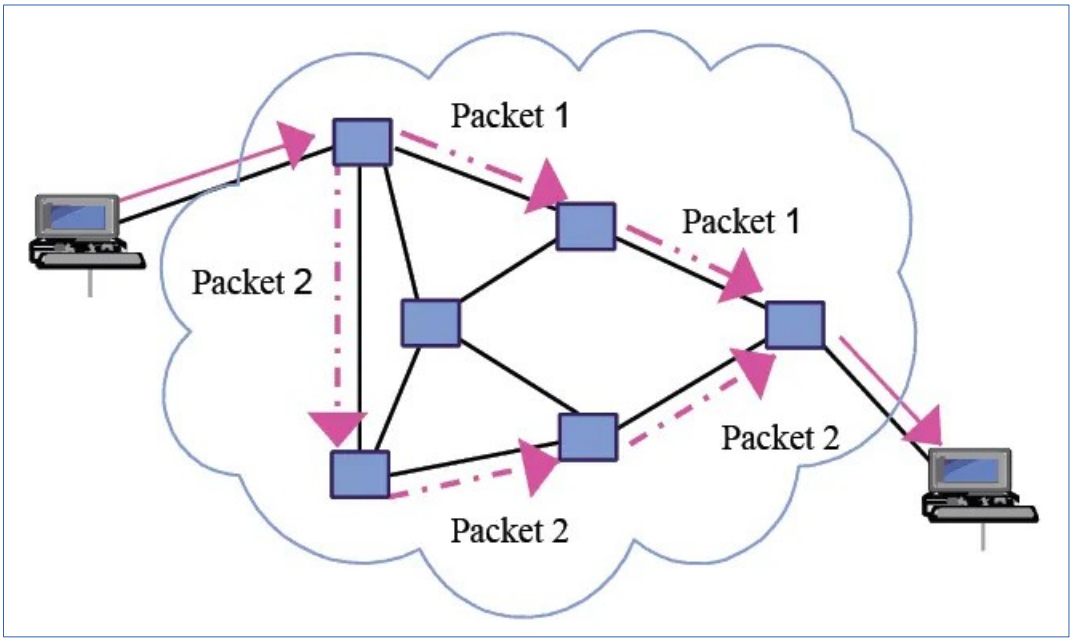
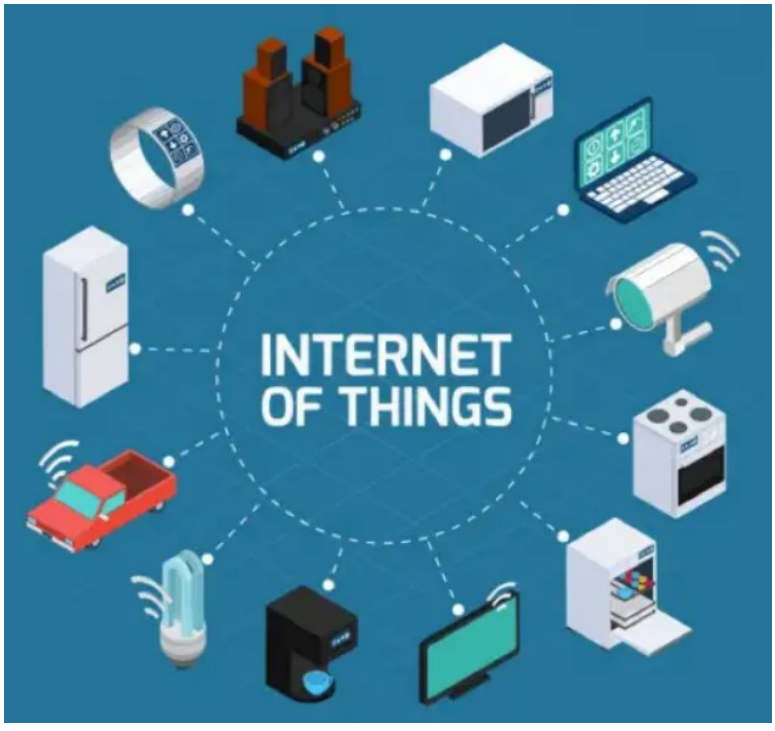
History of Internet
- Government wanted to talk to other agencies and thinktanks
- Continue communication to continue in event of attack
- Packet-switched networks to keep communications going
- TCP/IP is a standardized protocol for networks to talk to each other



Ubiquity – infrastructure is there but don't think about it

IOT – Internet of Things
- Connect sensors, low Input/Output device
- Eg: sensors on cow's earrings, collecting data on cow
- sensor on wolves in the wild
- F1 cars: 40k pieces of data; know which parts going wrong



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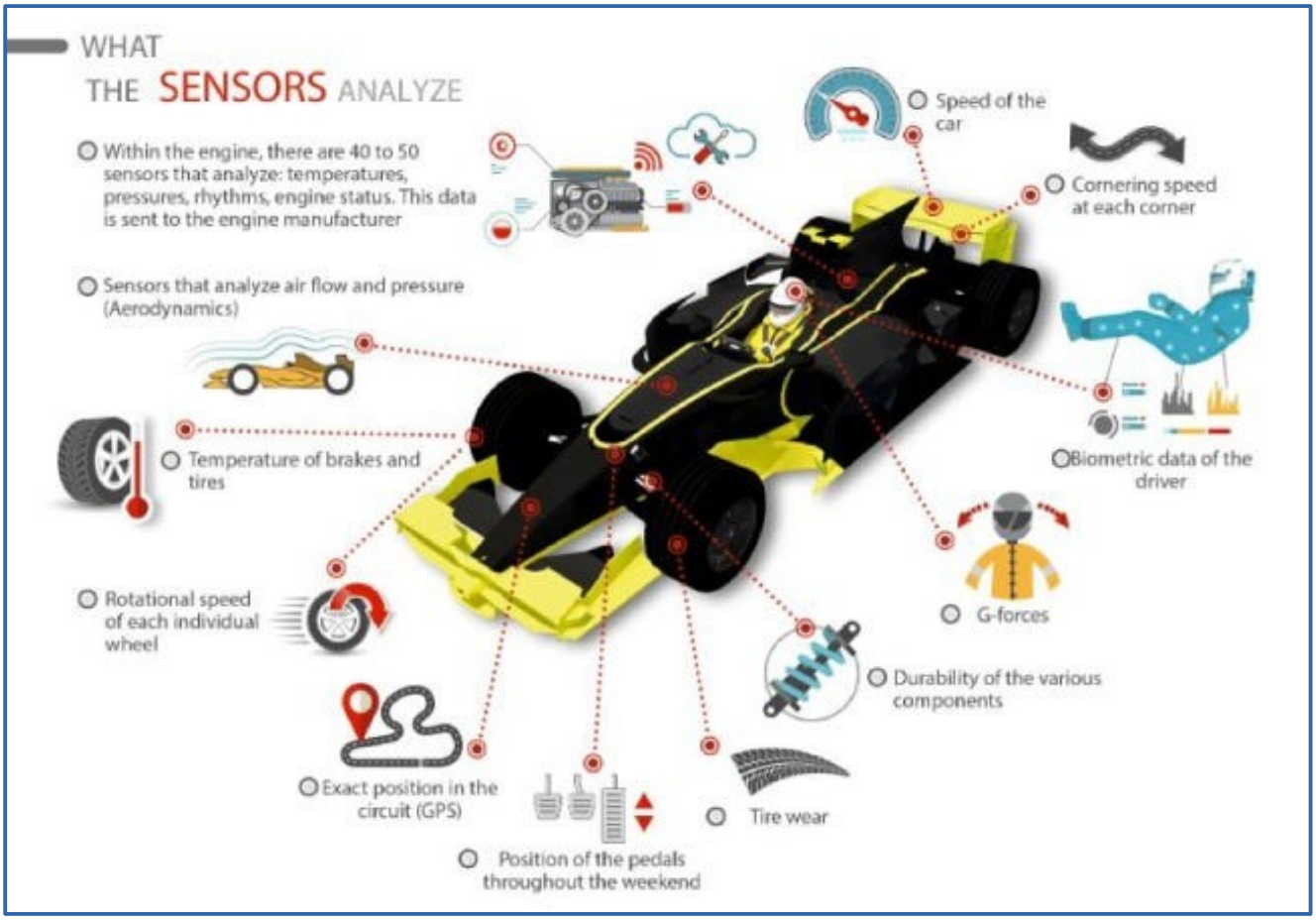
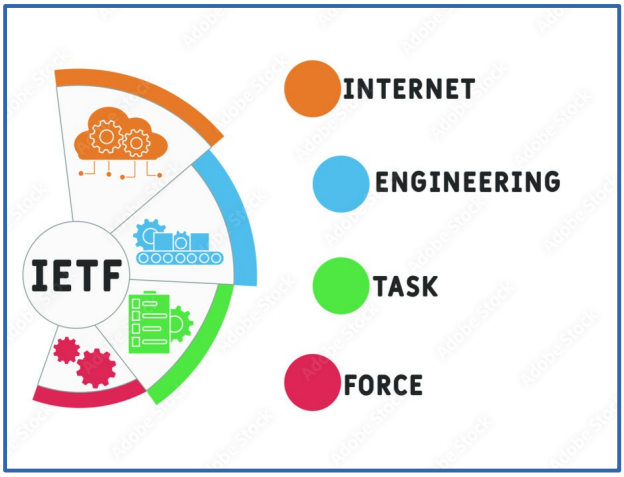
F1 Racing Car Sensors



Managing the Internet
- Internet Engineering Task Force [IETF]: standards making organization
Eg: Lightning standard – proprietary to Apple
USB-C – open standard available to everyone
- USB-C standards include tolerance, settings



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IEEE – Institute of Electrical and Electronic Engineers
Make standards via working groups
ie: 802.11a, 11b, 11n – Wireless Working Group
USB 2, USB 3 – Cabling Working Group
RFC: Request for Comments when considering new standards

IEEE
Advancing Technology for Humanity

IANA – Internet Assigned Numbering Authority
Manages some domain names, number resources

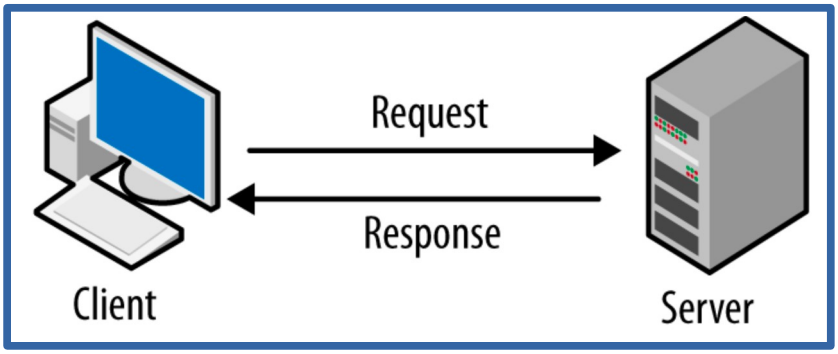
iana
Internet Assigned Numbers Authority

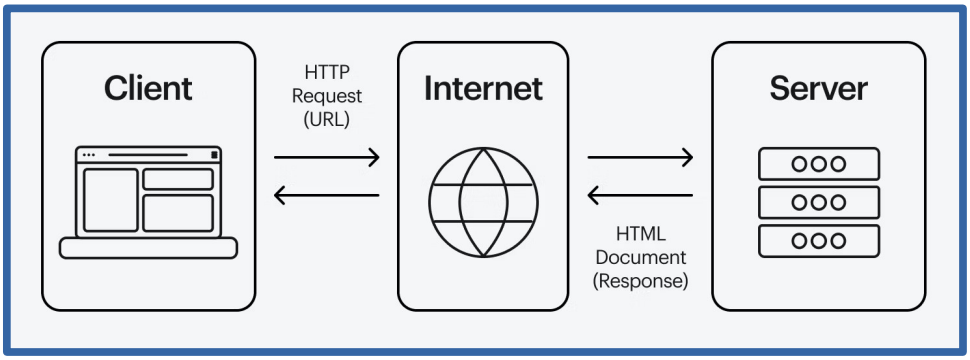
Client-Server Model

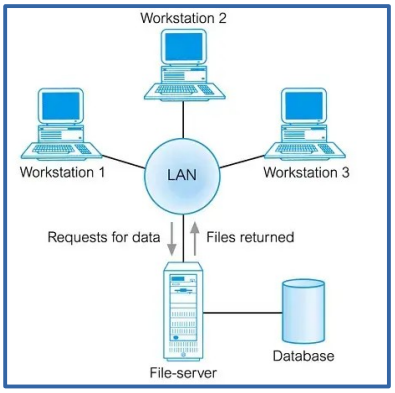
Request resource

Serves resource

*Resources/Services
- Print services
- Web pages, web server
- Data & file servers







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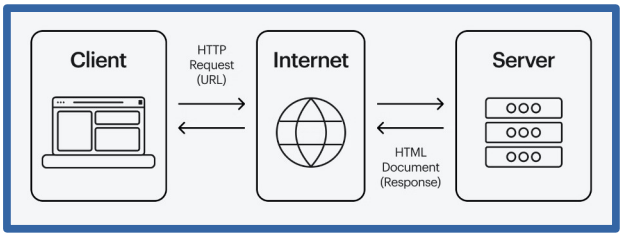
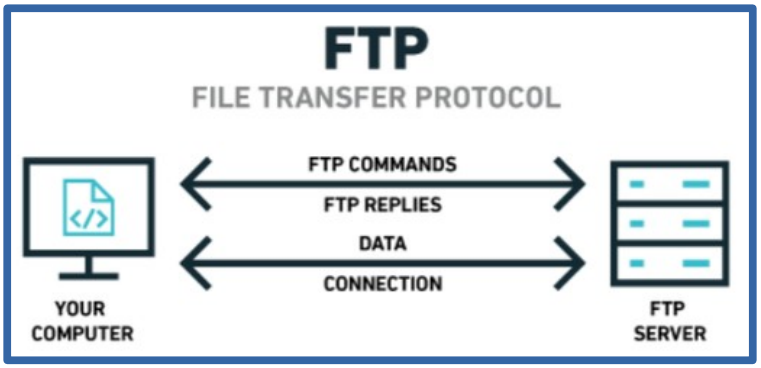




Web Server

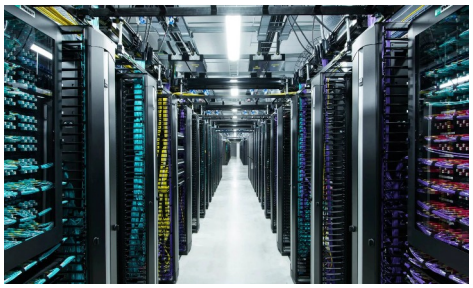
Web browser > requests web page > web server > protocol

Protocols

http: webserver
https: secure webserver
ftp: file transfer protocol server
sftp: secure file transfer server
imap: Internet message access protocol [email]
smtp: simple message transfer protocol [email]
pop: post office protocol [email]
ODBC: Open Database Connectivity

Data Centers

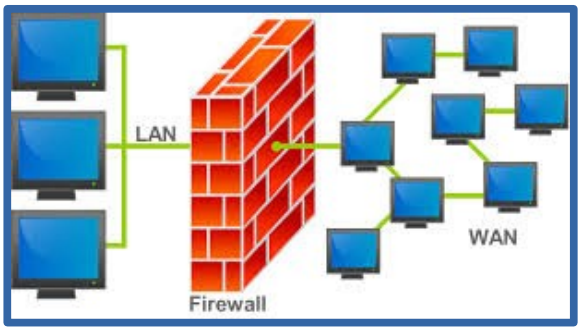
- Rack mounted servers
- Standarized equipment; cost goes down; easier for technical support
- Contain routers, switches, storage devices, firewalls > **computing and communications equipment**



Data center

Router

Storage



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- Data center could be as small as 20 computers

Rackmount cabinet

Rackmount cabinets standard size is 42U or 72 inches [6 feet]

1.75 inches height

19 inches wide

1.75x19 inches

1U – aka “pizza box”