
Computer Networks

Hamidreza Hosseinkhani - 2020

Review: Computer Systems

- System vs Set

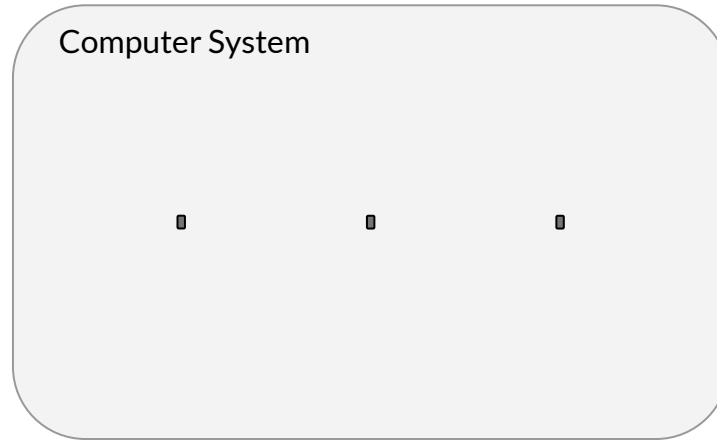
Review: Computer Systems

- System vs Set
 - Computer System
-

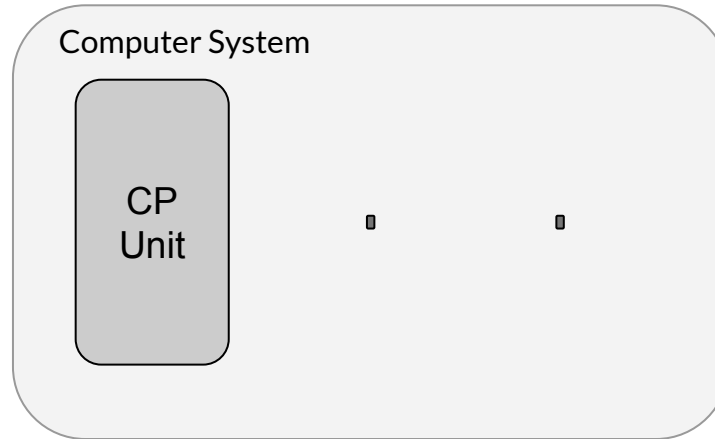
Review: Computer Systems

- System vs Set
- Computer System
 - Stored Program (John Von Neumann)

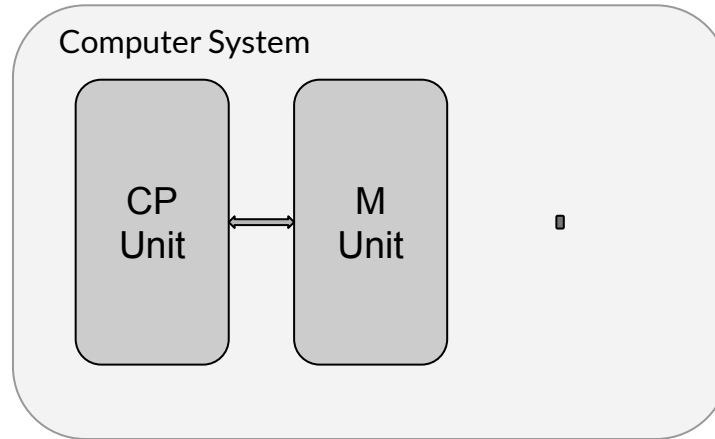
Stored Program Architecture



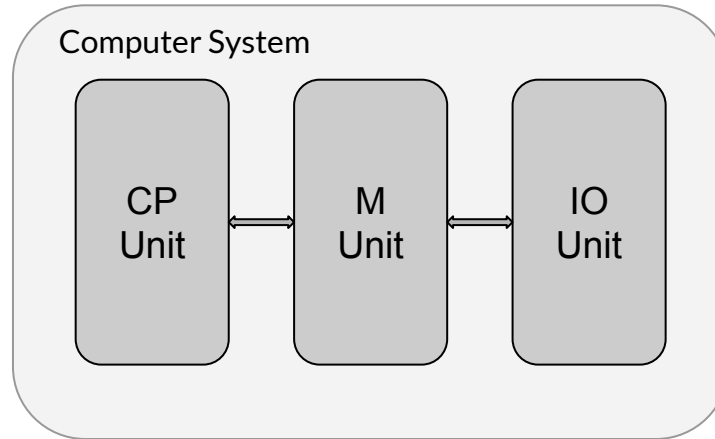
Stored Program Architecture



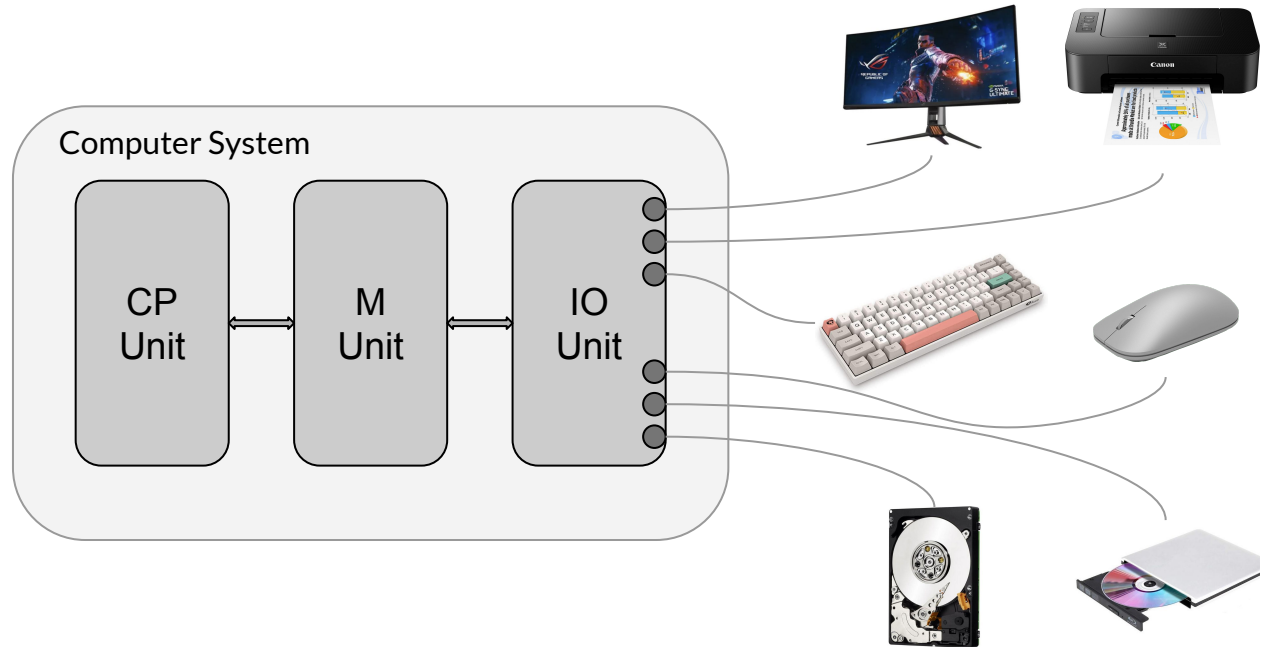
Stored Program Architecture



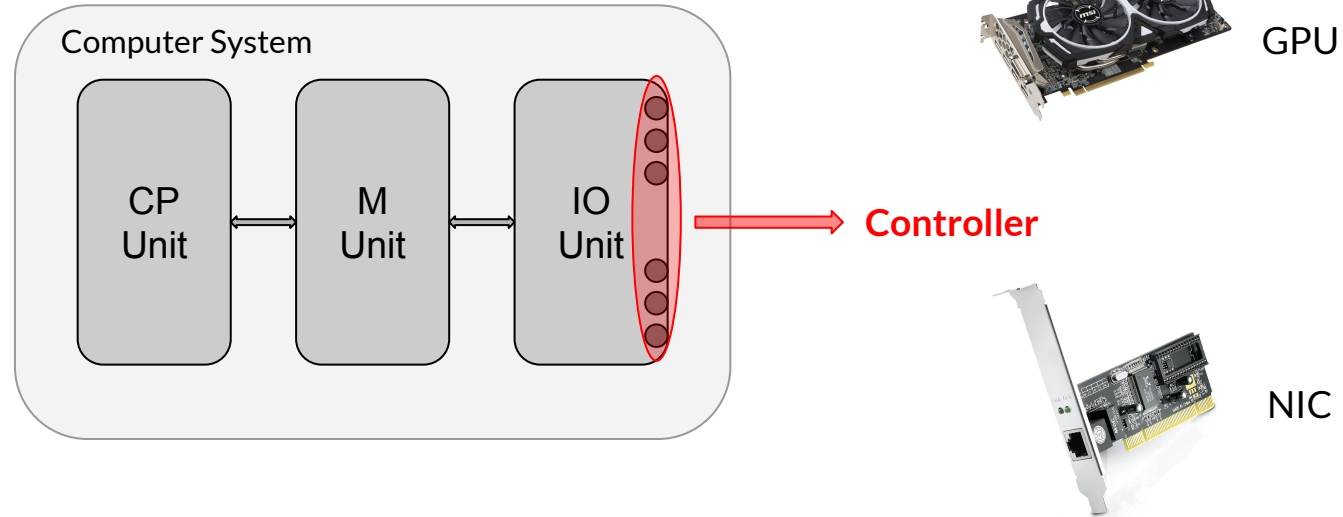
Stored Program Architecture



Stored Program Architecture



Stored Program Architecture



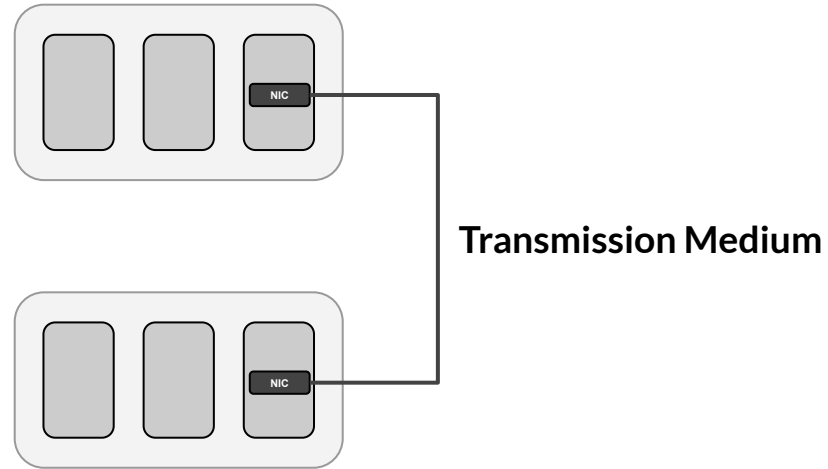
Resources

- Hardware Resources
 - Software Resources
-

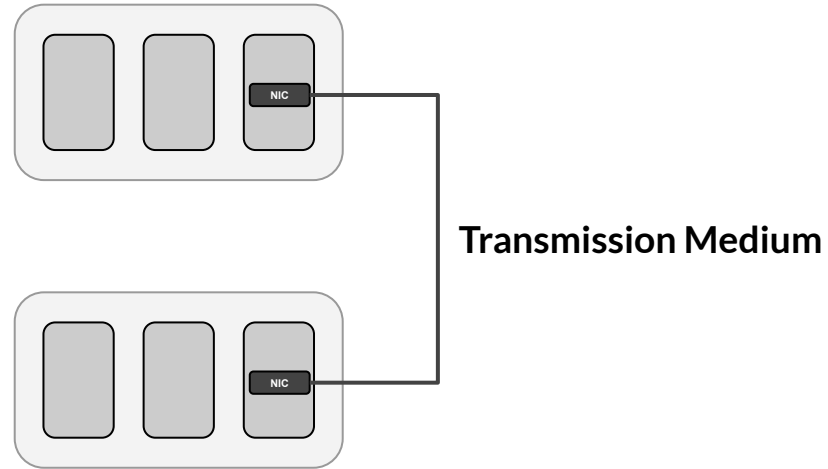
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**How can a computer
system share its
resources with other
computer systems?!**

Computer Network

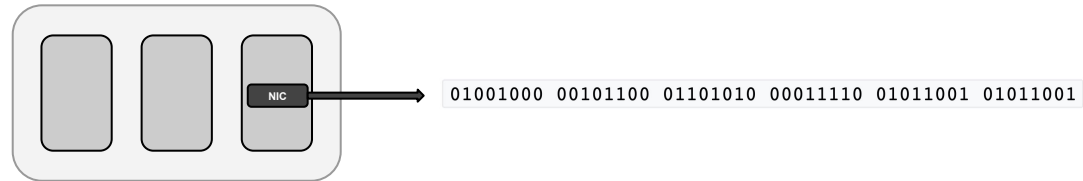
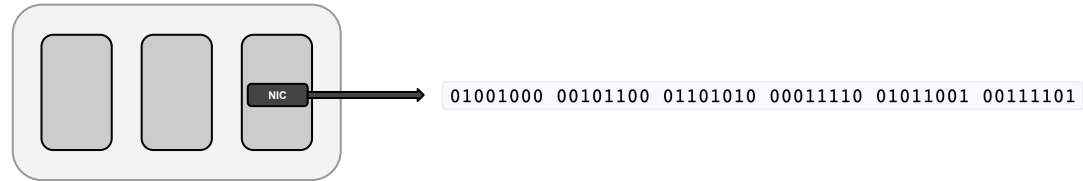


Computer Network

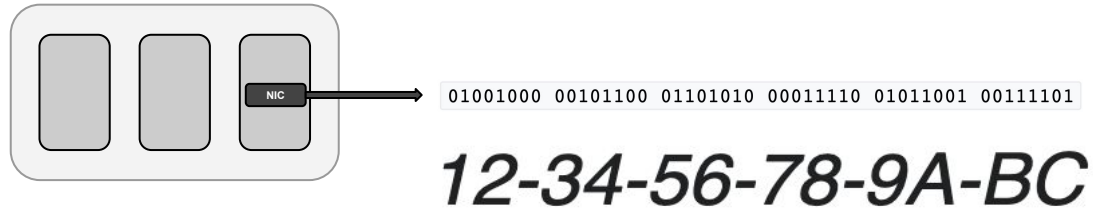


Bandwidth
(bit/s)

Physical Address (MAC Address)



Physical Address (MAC Address)



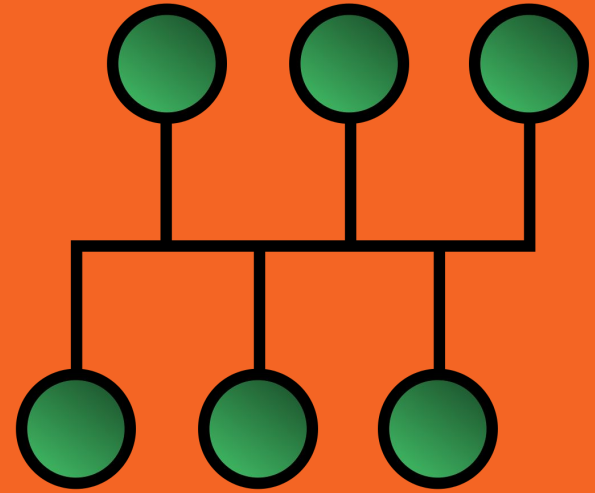
Network Topology

pint-to-point

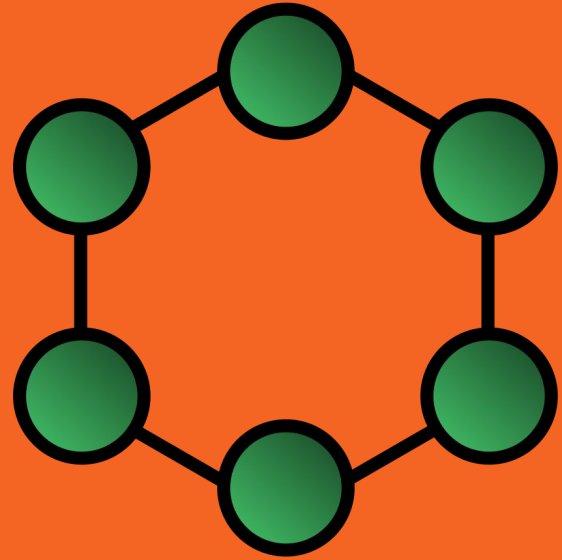


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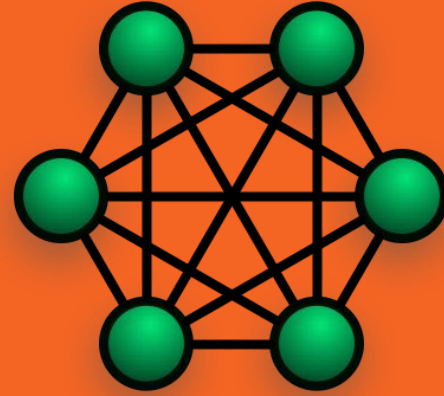
Bus



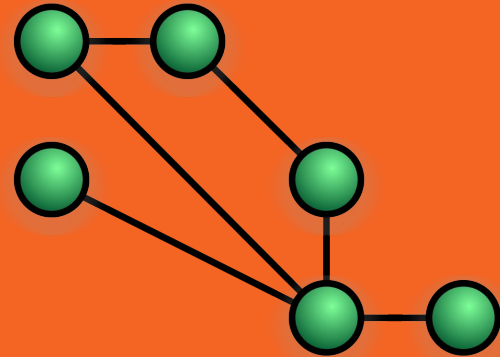
Ring



Mesh

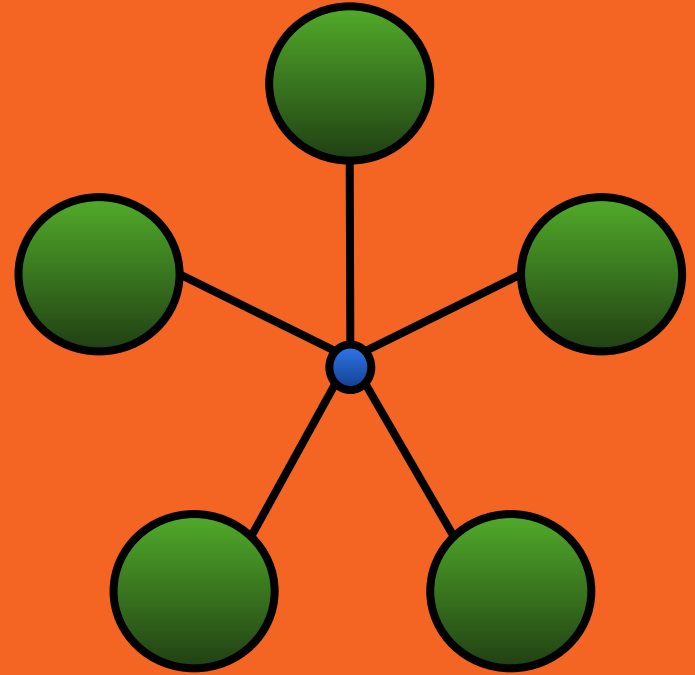


Fully-connected Mesh

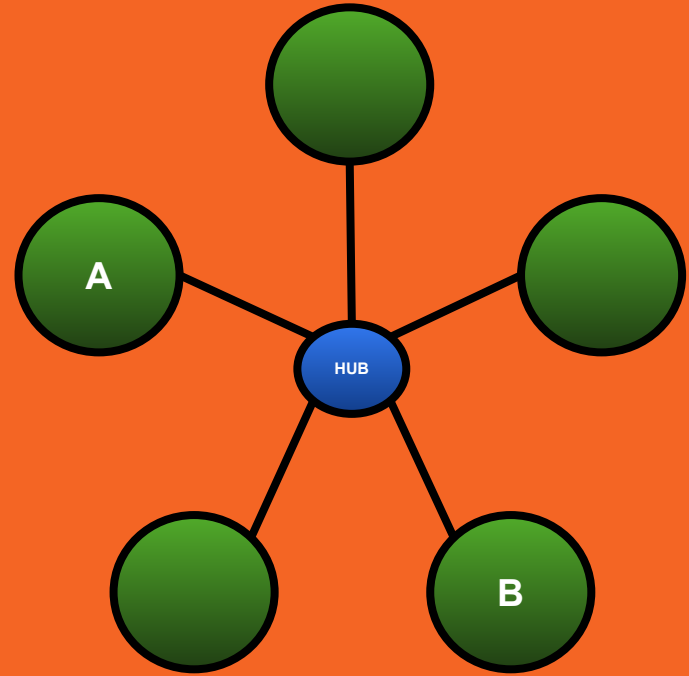


Partially-connected Mesh

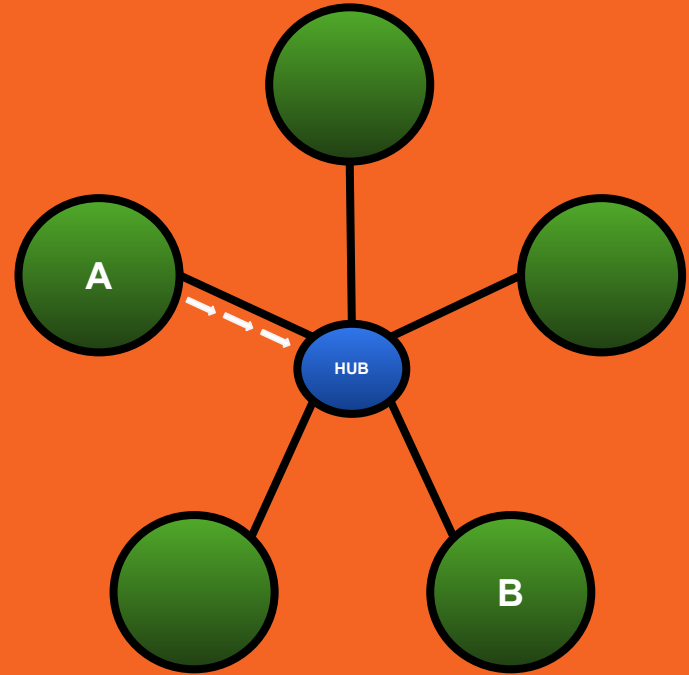
Star



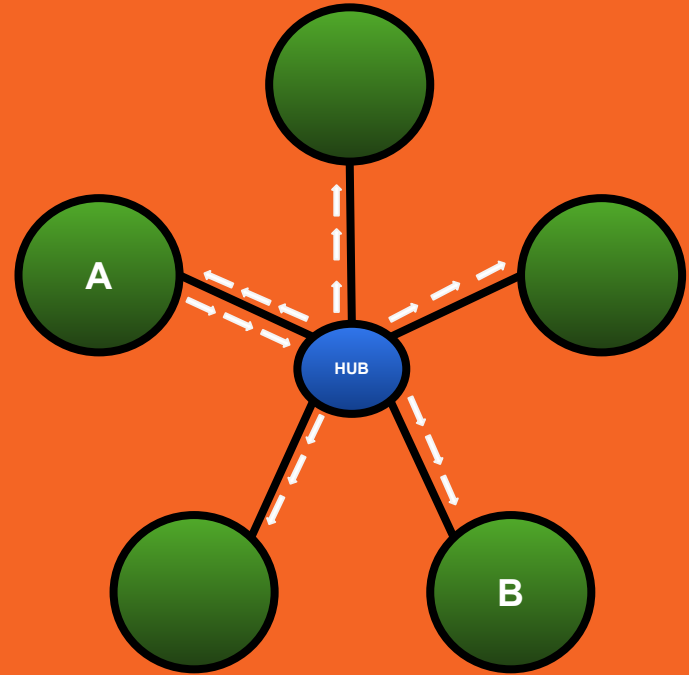
Star



Star



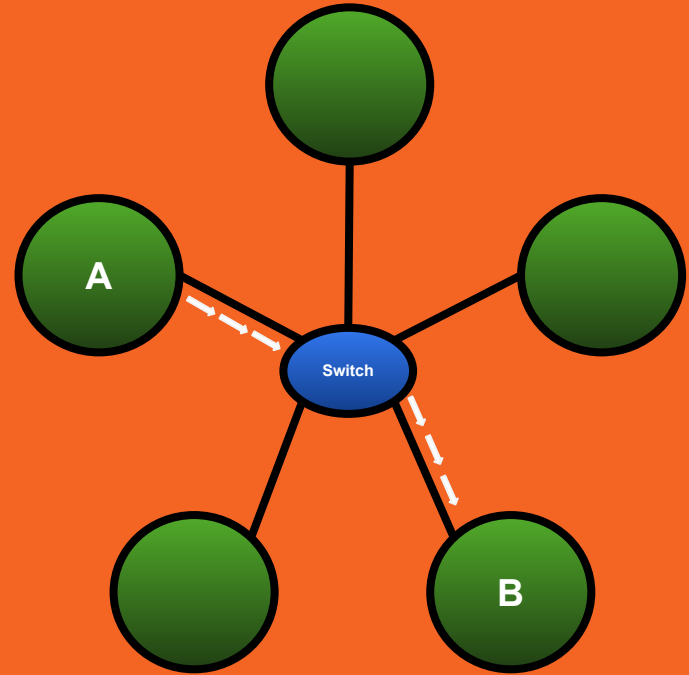
Star



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Broadcast

Star



Unicast

Network Protocol

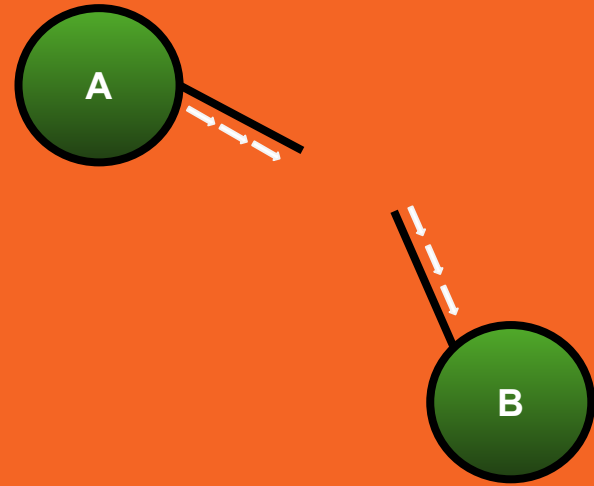
Network Protocol

HTTP, FTP, DNS, SSH

TCP, UDP

IP, ICMP

MAC



Protocols layers

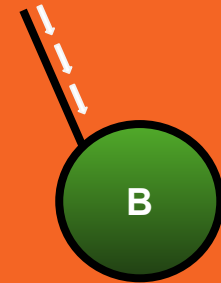
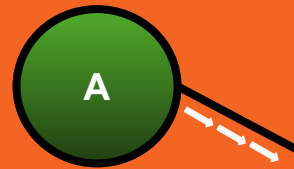
TCP/IP model	Protocols and services	OSI model
Application	HTTP, FTP, Telnet, NTP, DHCP, PING	Application
Transport		Presentation
Network		Session
Network Interface	TCP, UDP	Transport
	IP, ARP, ICMP, IGMP	Network
		Data Link
		Physical

IP Address

1st Octet	2nd Octet	3rd Octet	4th Octet
01101000	11110100	00101010	10000001
104	244	42	129

icanhazip.com

192.168.1.1



192.168.1.2

IP Address

V4 (32 bit)

1st Octet 2nd Octet 3rd Octet 4th Octet
01101000.11110100.00101010.10000001
104 . 244 . 42 . 129

V6 (128 bit)

An IPv6 address (in hexadecimal)
2001:0DB8:AC10:FE01:0000:0000:0000:0000
↓ ↓ ↓ ↓ ┌──────────┐
2001:0DB8:AC10:FE01:: Zeroes can be omitted
↓ ↓ ↓ ↓
0010000000000001:0000110110111000:1010110000010000:1111111000000001:
0000000000000000:0000000000000000:0000000000000000:0000000000000000

IP Address

V4 (32 bit)

1st Octet 2nd Octet 3rd Octet 4th Octet
01101000.11110100.00101010.10000001
104 . 244 . 42 . 129

$$2^{32} = 4,294,967,296$$

V6 (128 bit)

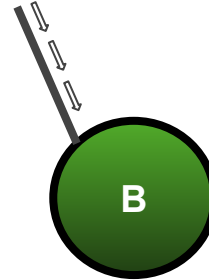
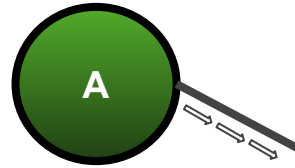
An IPv6 address (in hexadecimal)
2001:0DB8:AC10:FE01:0000:0000:0000:0000
↓ ↓ ↓ ↓ —————
2001:0DB8:AC10:FE01:: Zeroes can be omitted
↓ ↓ ↓ ↓
0010000000000001:0000110110111000:1010110000010000:1111111000000001:
0000000000000000:0000000000000000:0000000000000000:0000000000000000

$$2^{128} = 340282366920938463463374607431768211456$$

Hostname
Domain name

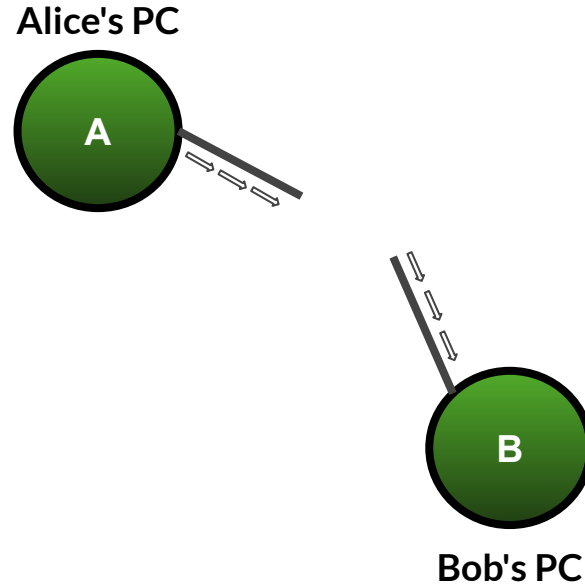
IP addresses are not memorable

192.168.1.1



192.168.1.2

We can use host names

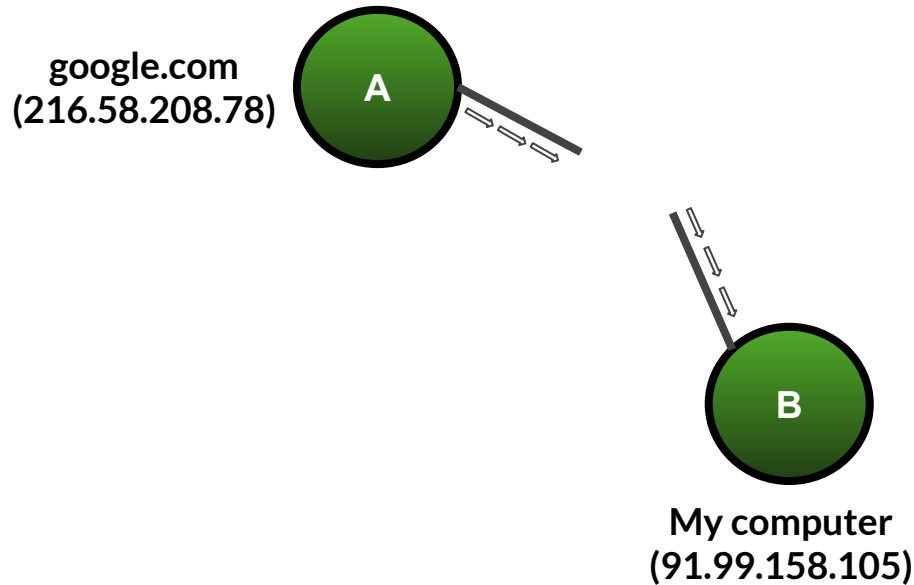


Translate hostnames to IP addresses

Hostname	IP address
Alice's PC	192.168.1.1
Bob's PC	192.168.1.2

Domain Name System
(DNS)

Translate domains to IP addresses

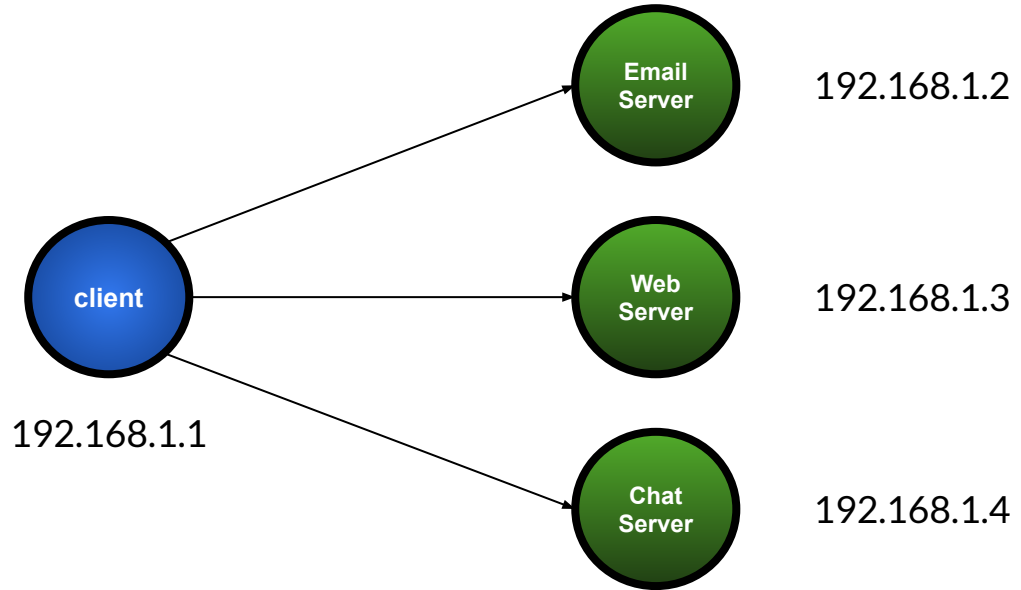


Domain	IP address
google.com	216.58.208.78
sharif.edu	81.31.186.54

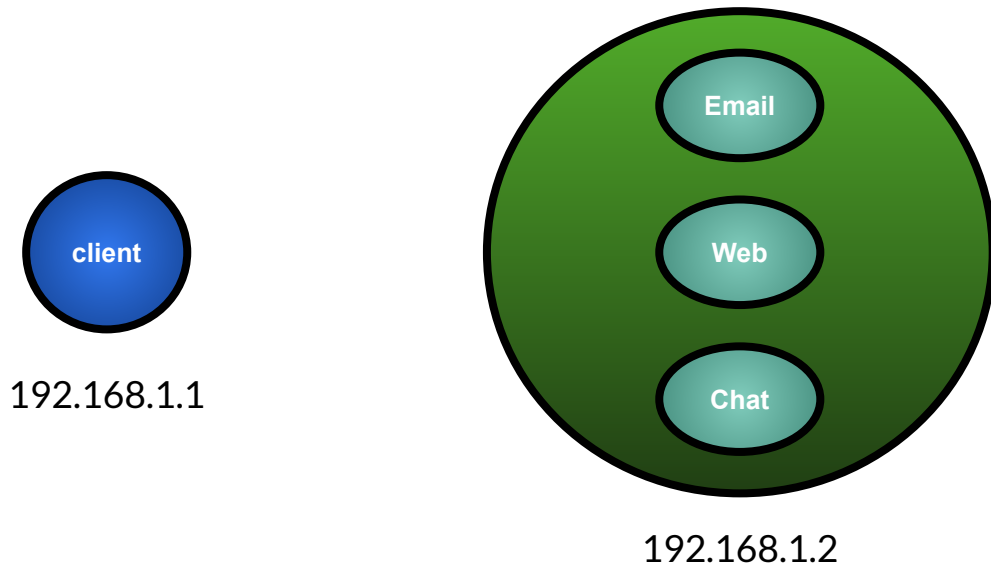
Domain Name System
(DNS)

Server - Client

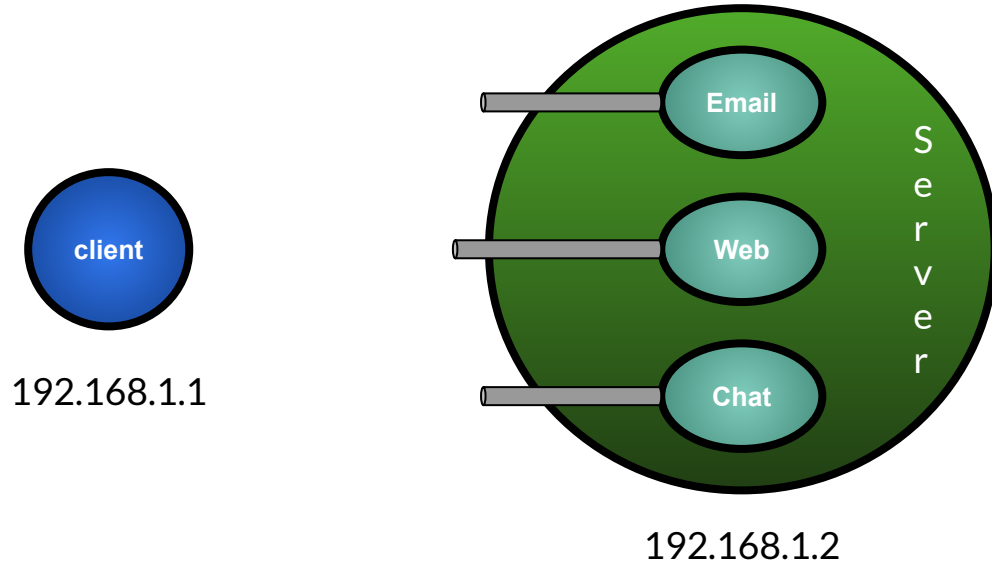
Serve each service on a separate node



Serve all services on a single node

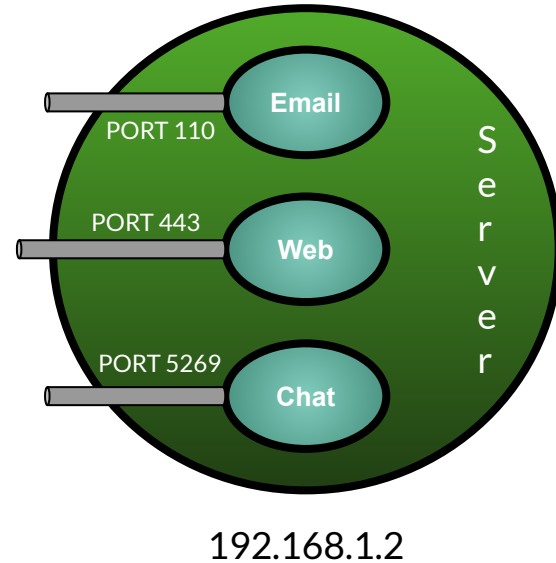


Serve all services on a single node

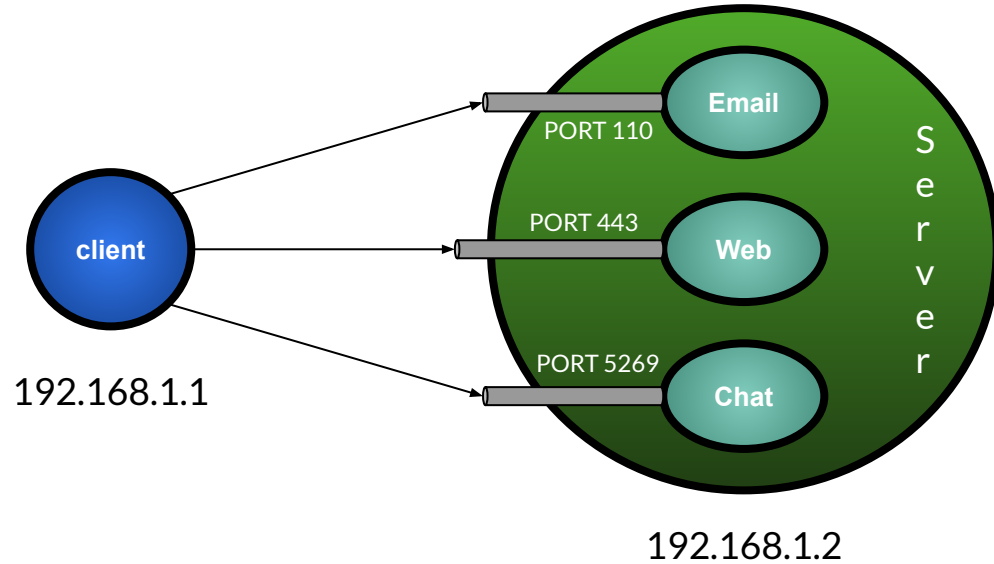


Serve all services on a single node

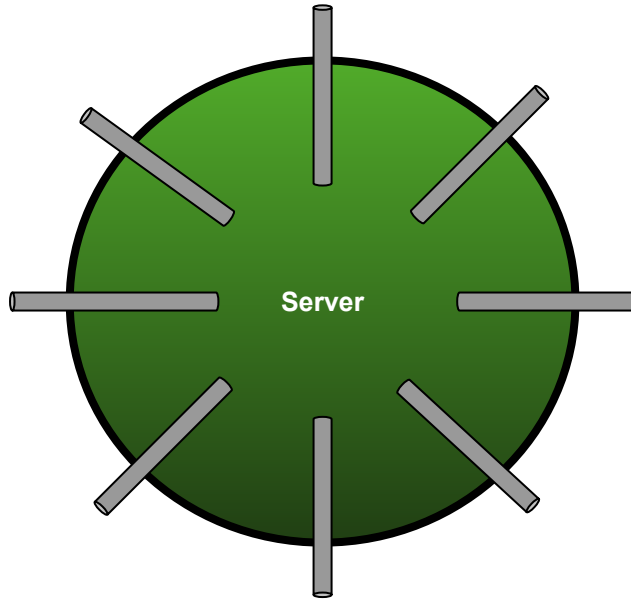
A port is a
16-bit unsigned integer
ranging from 0 to 65535



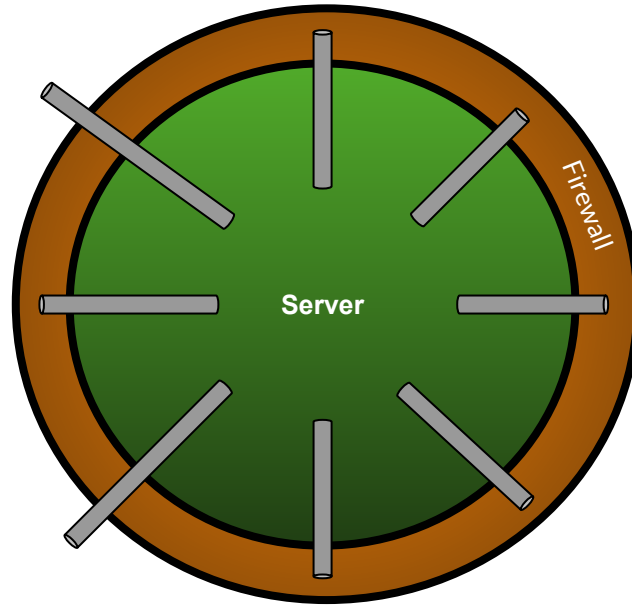
Serve all services on a single node



Open ports!

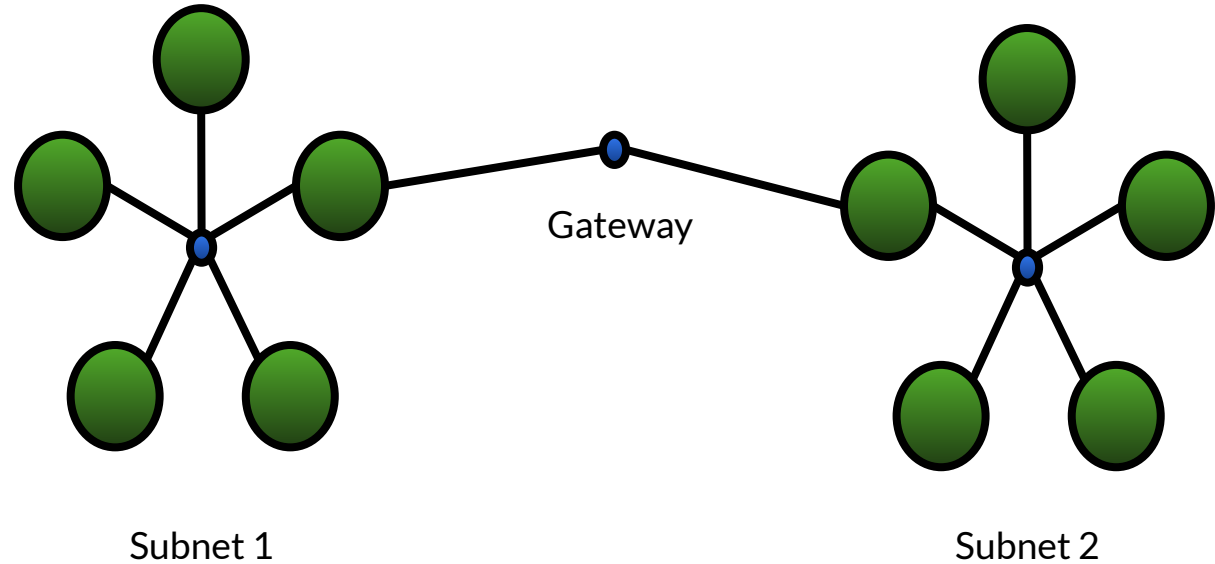


Firewall

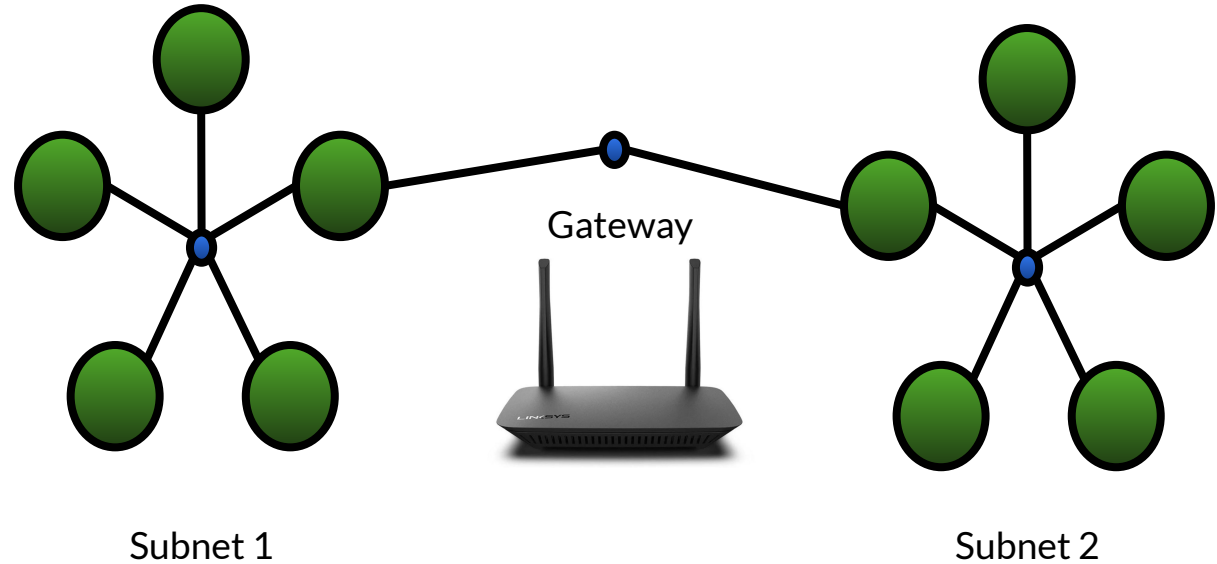


Inter-networking

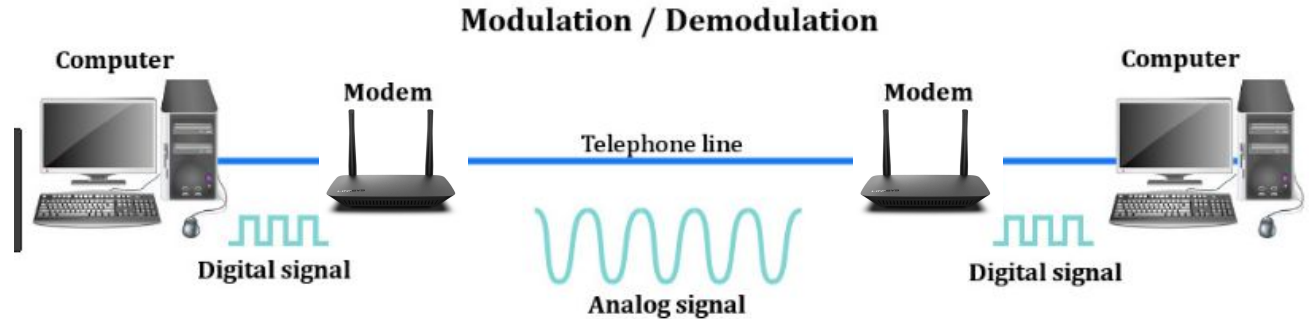
Inter-network (internet)



Inter-network (internet)



Modem (Modulator/Demodulator)

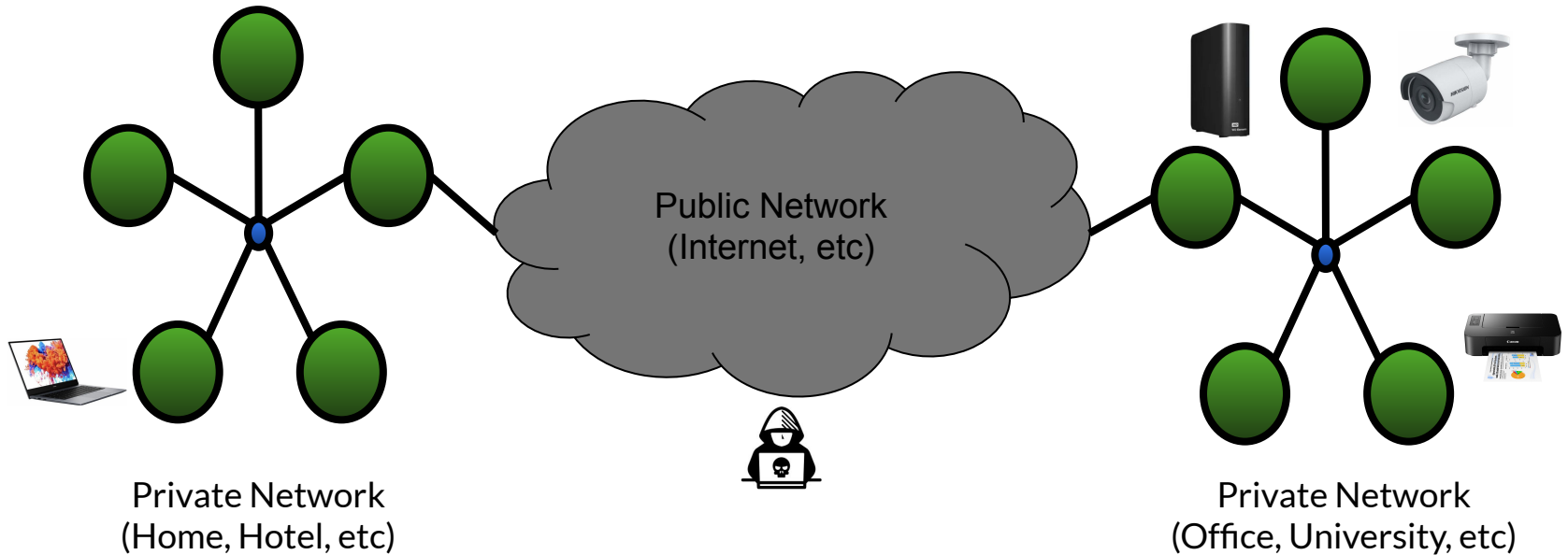


Private Network vs Public Network

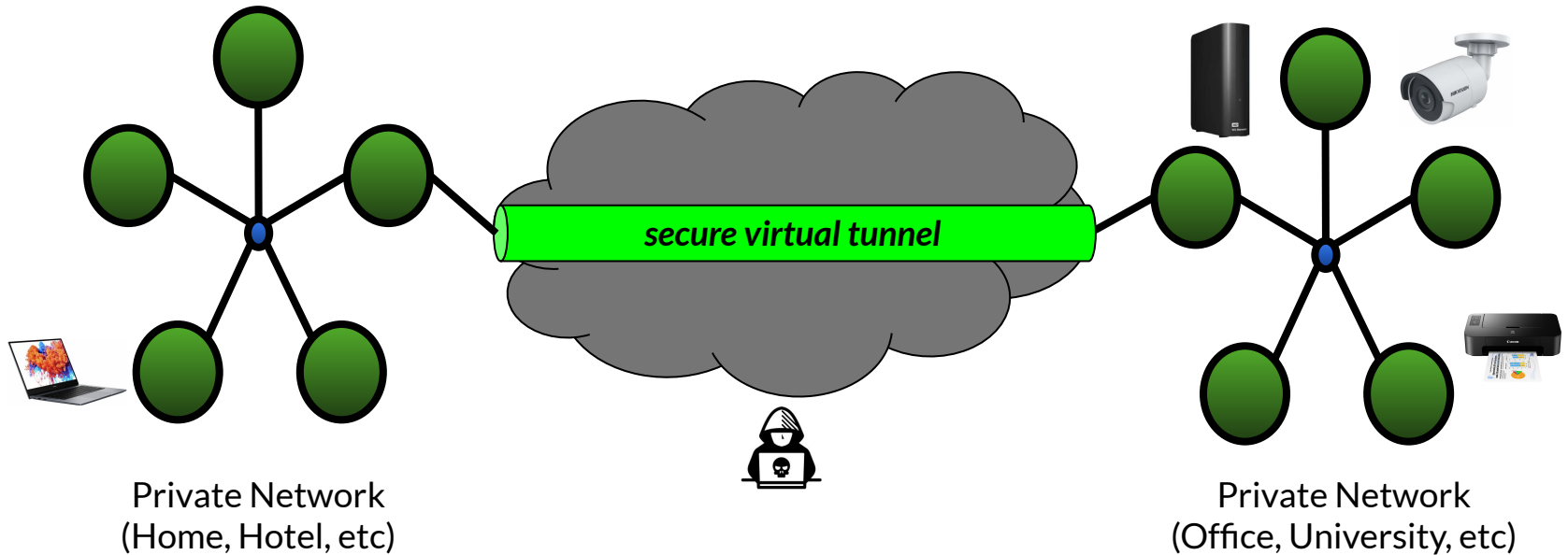
Private/Public IP address

- Private network -> private IP addresses
 - 10.x.x.x
 - 172.16.x.x
 - 192.168.x.x
 - Public network (Internet) -> public IP addresses
-

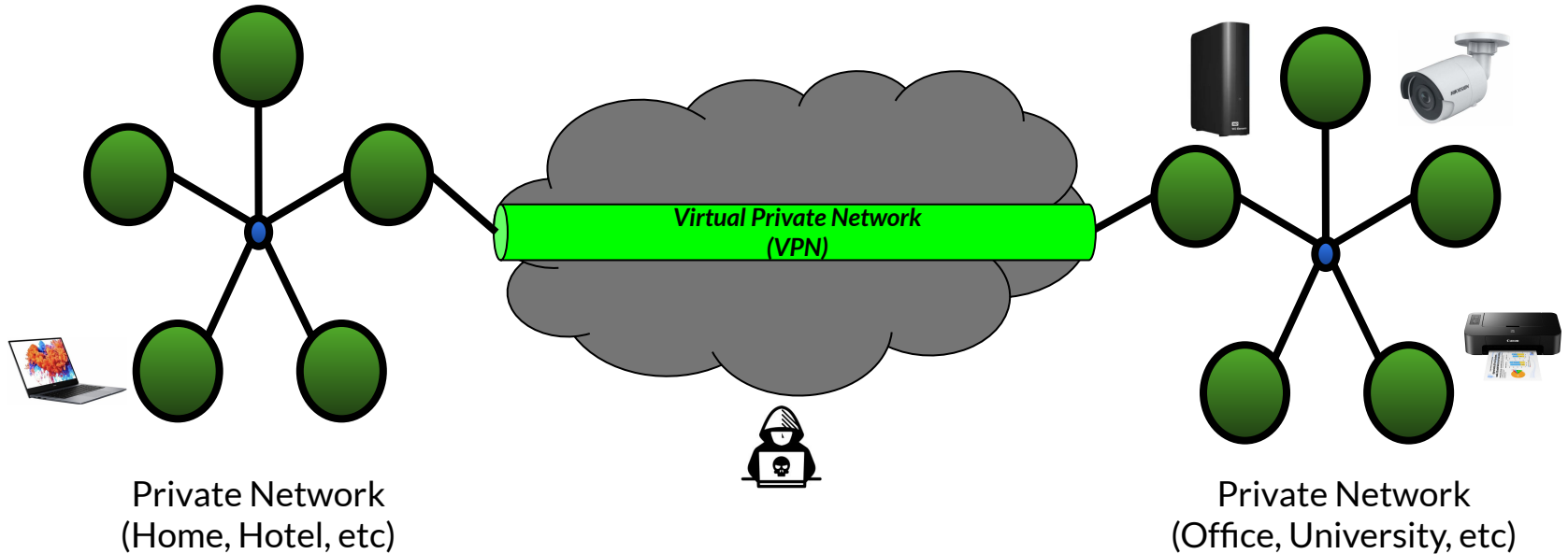
Connect to a private network through a public network







Connect to a private network through a public network



Connect to a private network through a public network



VPN protocols

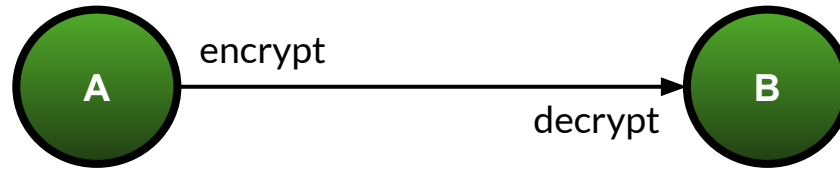
- PPTP 
- L2TP 
- IKEv2/IPSec
- OpenVPN
- WireGuard  

<https://vrgl.ir/wYQfB>

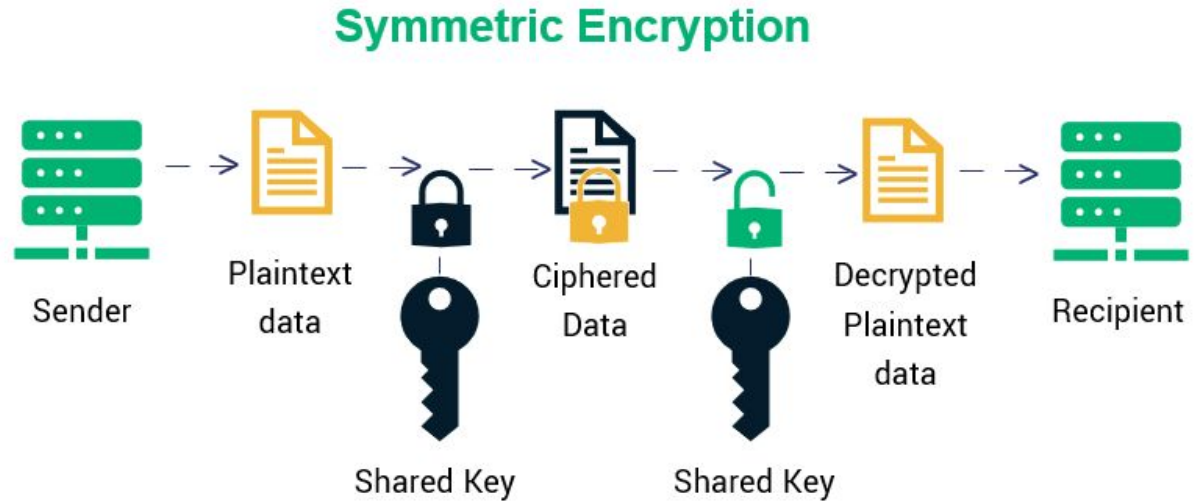
<https://github.com/xei/wireguard-setup-scripts>

Encryption

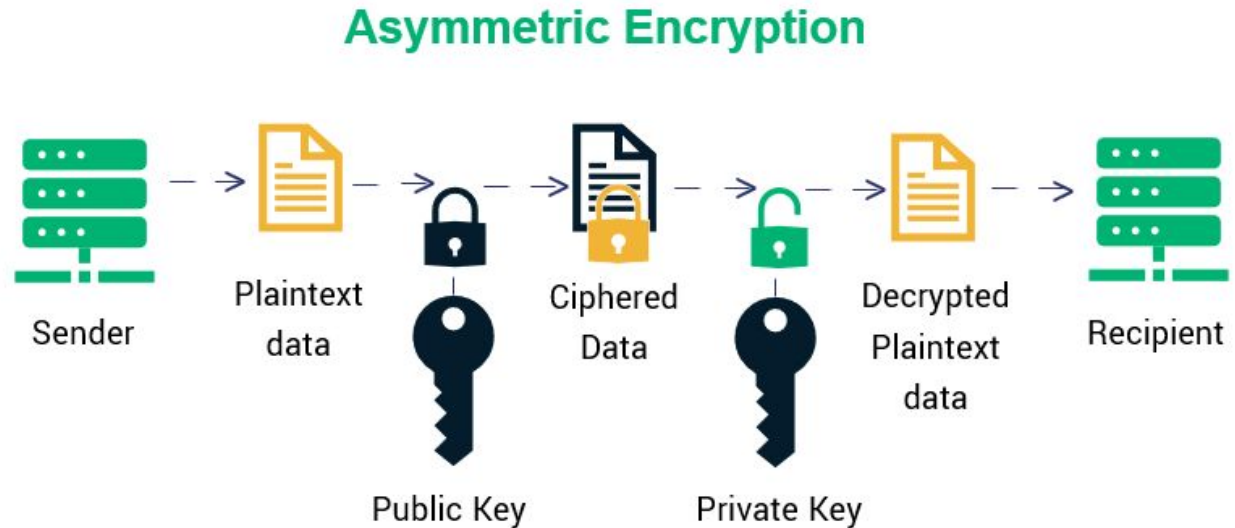
Encryption



Symmetric encryption



Asymmetric encryption

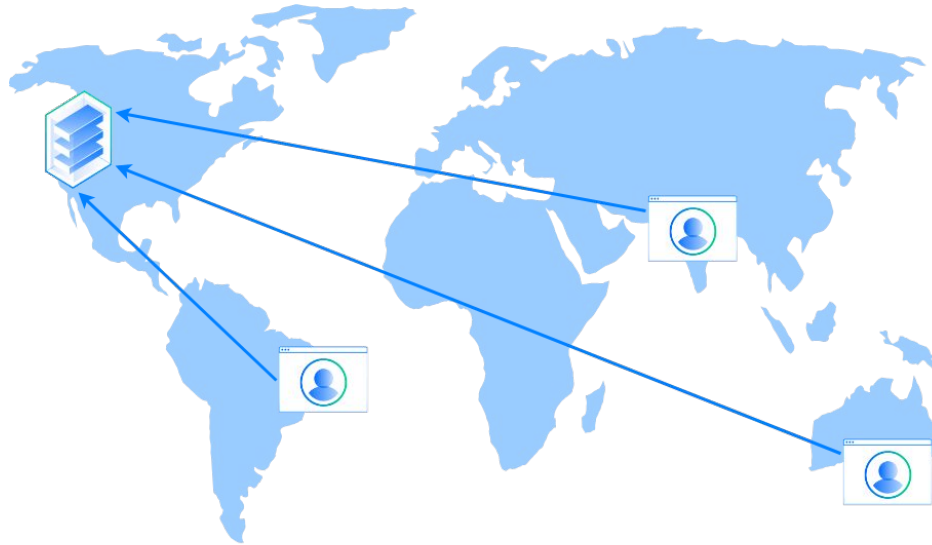


Advanced usages

Advance usages

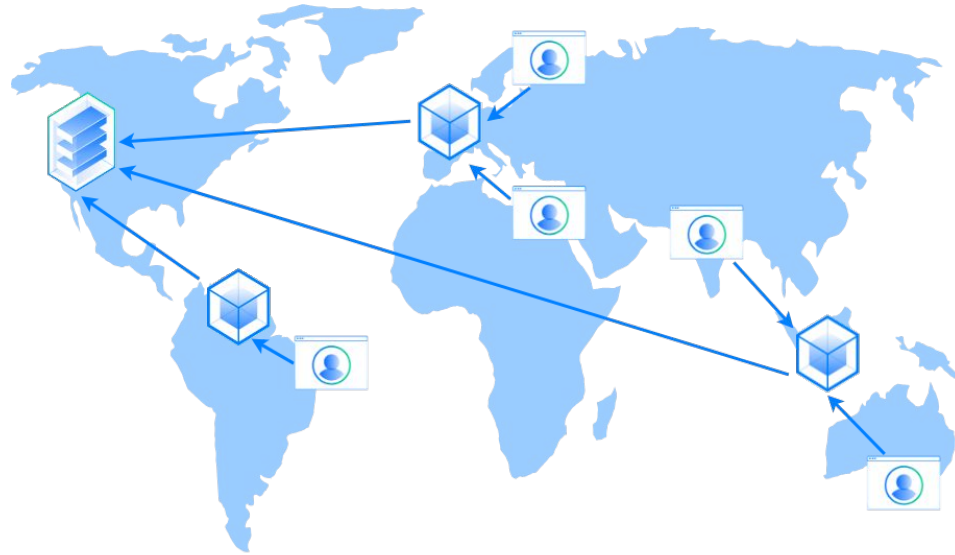
- Content Delivery Network (CDN)
 - <https://www.arvancloud.com/fa/products/cdn/anycast>
 - Cluster computing
 - Cloud Computing
 - BitTorrent
 - Blockchain
-

CDN



Without CDN

CDN



Content Delivery Network (CDN)

Read more!

- <https://www.digitalocean.com/community/tutorials/an-introduction-to-networking-terminology-interfaces-and-protocols>
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Thank you
