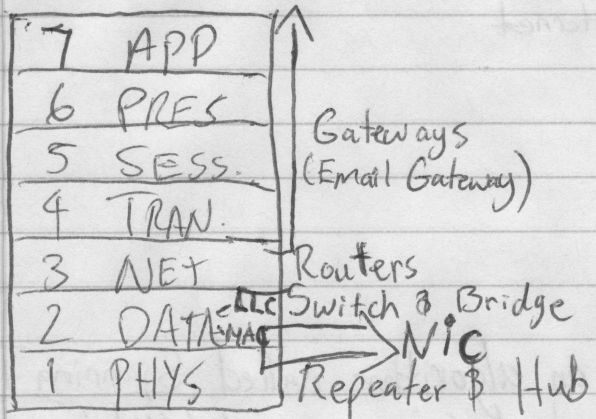
ITM 301 Lecture 7

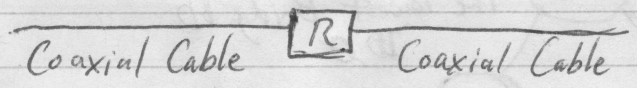
Network Hardware (Switches & Routers) Chap 6

OSI & HW



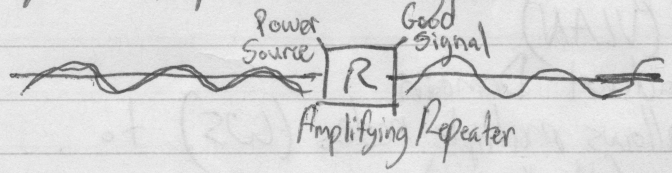
(1) Repeaters & Hub

- A repeater is used to extend cable



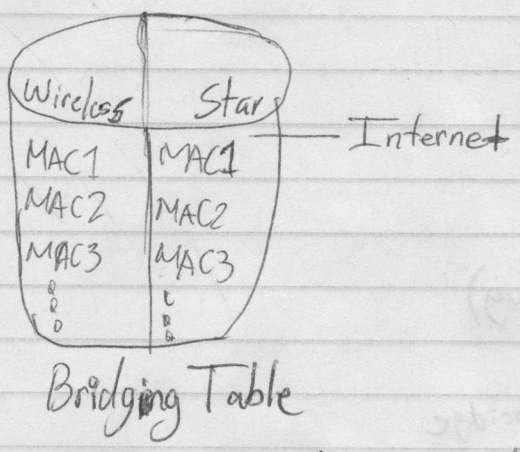
- A Hub has the same function as a repeater, but is used with star topology (CAT5)

- NOTE: We have 2 types of repeaters
  1) Passive Repeater (Requires no power source)
  2) Active Repeater (Amplifying Repeater, need power source)
     ↳ Active Repeaters not only extend cable, but also amplify signal



(2) Bridge is a layer 2 device used for connecting 2 diff. net top

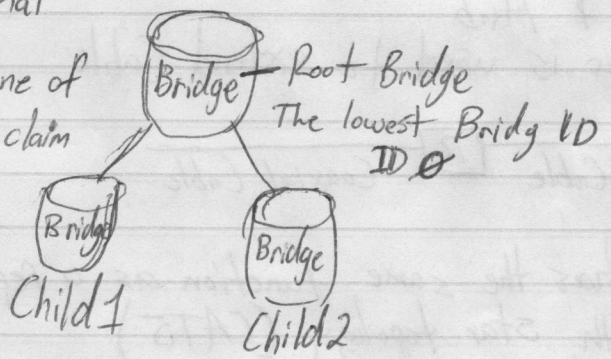
- A bridge contains a "database" of all MAC addresses detected



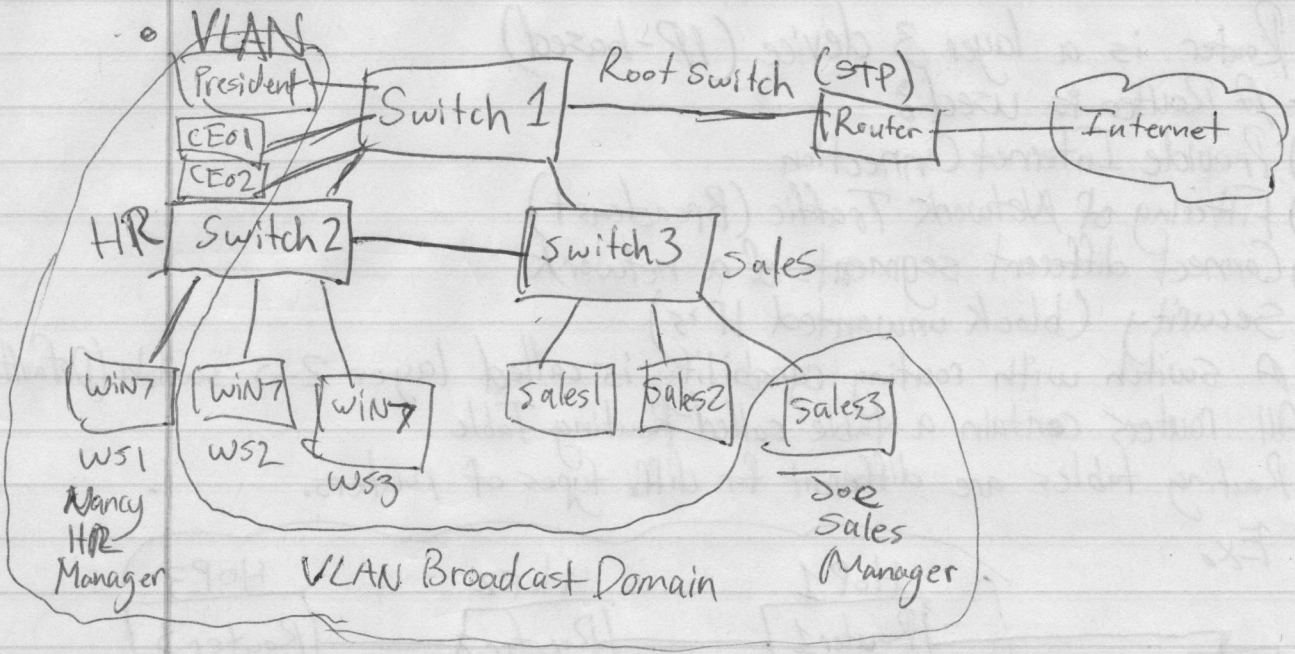
Bridging Table

- A bridge operates based on an algorithm called Spanning Tree Protocol
- STP is used to arrange multiple bridges in a parent/child relationship format

NOTE: If Root Bridge down, one of the child bridges can claim the role of the root



(3) Switch has the functionality of a bridge & a hub.
- In contrast to hubs, switches allocate net. bandwithd dynamically.
- In addition to bridging function, a switch can be used to implement Virtual LAN (VLAN)
- A VLAN Defines broadcast Domain
- A Broadcast Domain allows multiple nodes (WS) to communicate securely (Hw sec.)



VLAN Group: President + CEO1 + CEO2 + Nancy + Joe Workstations

NOTE: Only Registered Members of a VLAN can participate in a 2-way Communi

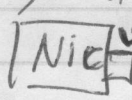
⟹ None Members 'Can Not' access VLAN Data Communication

④ NIC contains 2 types of HW components.

A) MAC 12 Hexadecimal # (Manufacturer ID, Device ID)

- MAC addresses are globally unique numbers

B) Physical Interface



- Types of NIC:
  - PCI (Motherboard 32-bit / 64-bit Connection slot)
  - Wireless (Embedded into Laptops, Cell Phones...)
  - USB

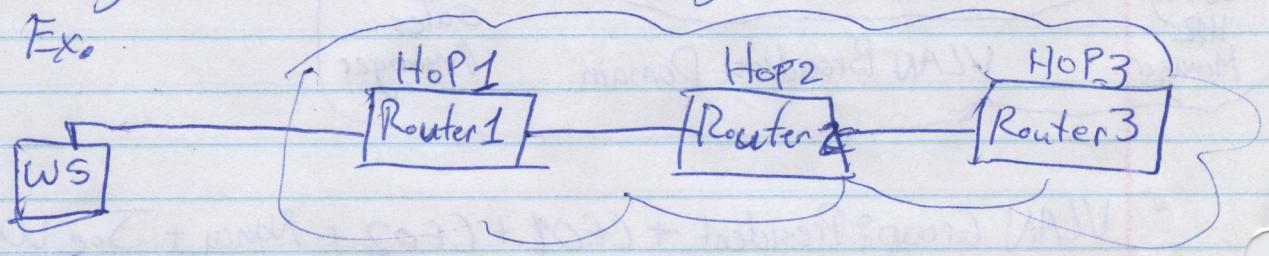
(5) Router is a layer 3 device (IP-based)

- A Router is used:
  a) Provide Internet Connection
  b) Filtering of Network Traffic (Broadcast)
  c) Connect different segments of a network
  d) Security (block unwanted IP's)

NOTE: A switch with routing capability is called layer 2-3 switch (Default

- All routers contain a table called Routing Table
- Routing tables are different for diff. types of routers.

Ex.



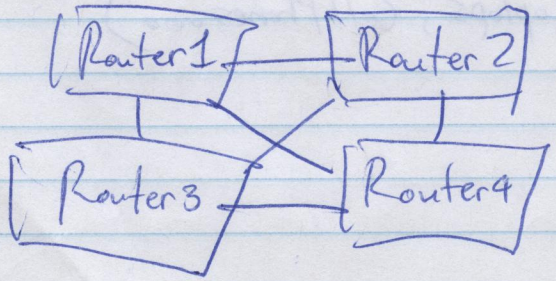
Routing Table:

- Each router has a complete info about its neighbouring Routers, saved in a flash card called Routing table.

64.11.12.100	Router1
82.19.1.30	Router2
100.100.2.3	Router3
⋮	

* Routing tables are constantly updated.

- To provide fault tolerance & load balancing function a mesh topology of routers should be setup.



# of links = $\frac{N(N-1)}{2}$

E.g $\frac{4 \times 3}{2} = 6$

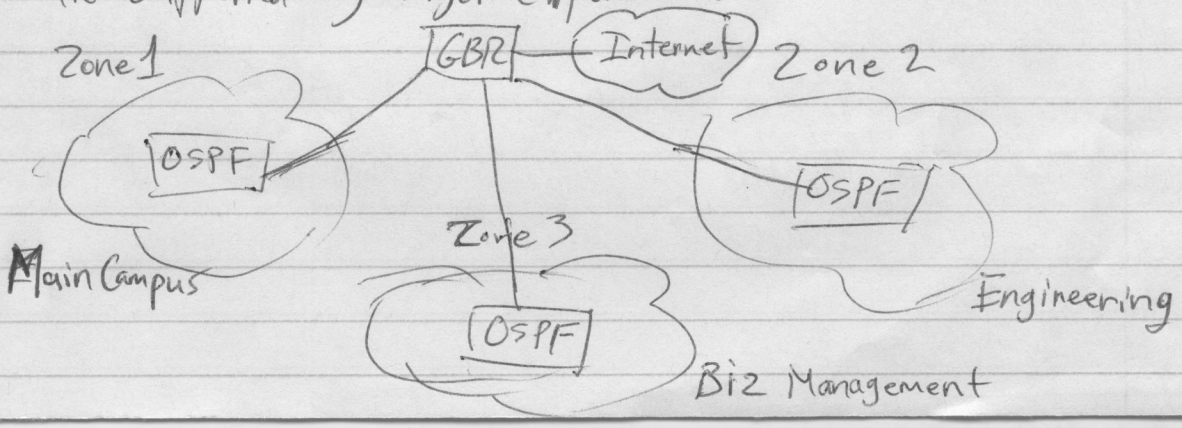
Types (categories) of Routers

a) Distant Routers
Vector Routers
- RIP: Routing information Protocol Routers
- RIPV2
- Very Popular
- Easy to setup
- Define hop as a means of blocking packet loop.

b) Link state Routers
- A more advanced router compared to RIP.
- Define many different metrics to find the best route for packet delivery
  - Ex. Open Shortest Path First (OSPF)
- Faster than RIP
- More difficult to setup & Configure
- Each OSPF Router is responsible for its own Zone.

c) Hybrid Routers
- is a mix of Vector & Link State Technology
  - Ex. IS-IS Routers (Intemediate System-to-Intermediate System)
  - Ex. EIGRP (Enhanced Interior Gateway Routing Protocol)

NOTE: ↳ GRP Routers are dedicated Internet Routers.
NOTE: ↳ GBR (Gateway Border Router) is a more popular internet router supported by larger Corporations



NOTE: All Routers are IP-Based (Layer 3) Devices.

⑥ Gateway is based on layer 3 and up
- Gateway is a router that understands more than one protocol
- Ex: Email Gateway IP, SMTP, POP3, IMAP4

Nov 7th, 2011

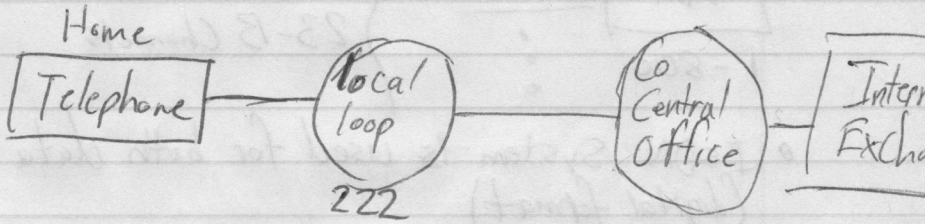
ITM 301 Chapter 7

- Wide Area Network (WAN)
  - ↳ Data link layer + Network layer

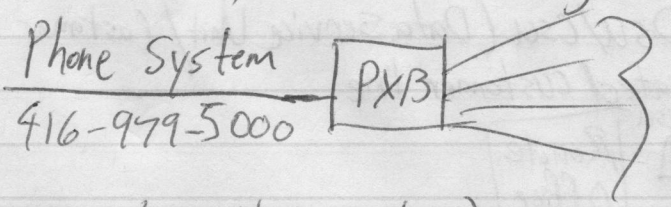
1- PSTN (Public Switched Tel. Net)
PON (Passive Optical Net)

- PSTN is designed for voice transmission
- is used with modem for data trans.
- Older PSTN had a max of 56Kbps speed.
- PSTN defines:
  - ↳ RJ11
  - ↳ Central Office
  - ↳ PXB
  - ↳ local Loop

+1 416 - 222 - 1111
International / local / Phone ID



- Analog System
- A Digital local loop uses passive fiber Optic called (PON)
- PXB: (extension) Private eXchange Branch

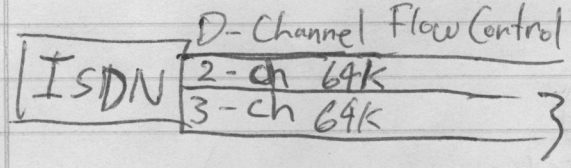


2- ISDN (Digital System)

- ↳ RJ13
- ↳ 2 types of digital connection provided by ISDN: Basic & Pr
- ISDN: Defines a digital line as 64K/S Data channel
  - ↳ DS0 Digital Subscriber Line level 0

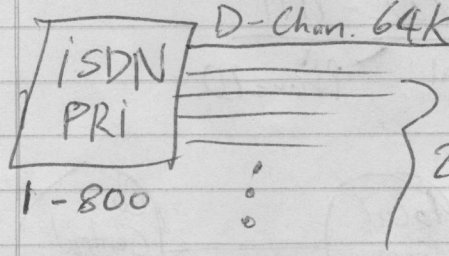
a) BRI (Basic Rate ISDN)

- Has 2 64k Data Channel called B-channel
  - ⇒ 128 Kb/s
- Has 1 D-channel 16K/s



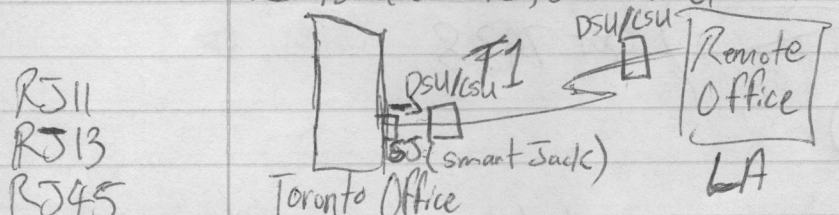
Note: D-Channel can NOT be used for data transmission, the channel is used for flow control of error handling

B) PRi (Primary Rate Interface ISDN)
↳ Provides max speed of 1.544 Mbps
↳ It has 23-B channel (64k each)
↳ It has one D-Channel (64k)



- ISDN System is used for both data & voice transmission. (digital format)

3- Digital Lines T1, T3 (Dedicated Line)
↳ T1: speed 1.544 Mbps
↳ T1 modem is called DSU/CSU (Data Service Unit/ Customer Service Unit)
↳ T1 is a secure, dedicated customer line



SJ (T1/T3) → T1 defines smart jack
Note: The speed of T3 is 45 Mbps
Note: PSTN, ISDN, T1/T3 Carriers are based on layer 2 OSI

4- XDSL (Digital subscriber Line)

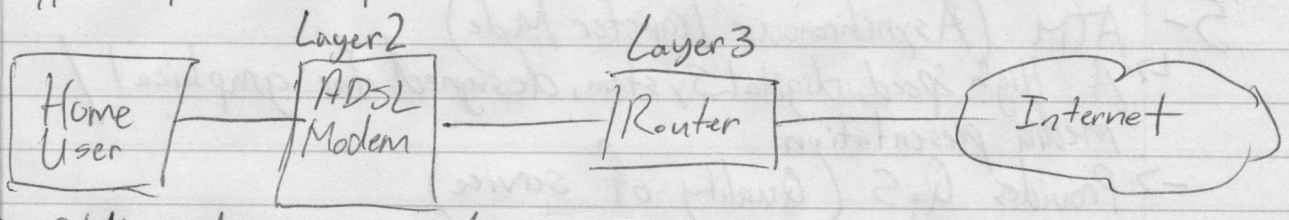
ex. ADSL VDSL

- 2 types of DSL

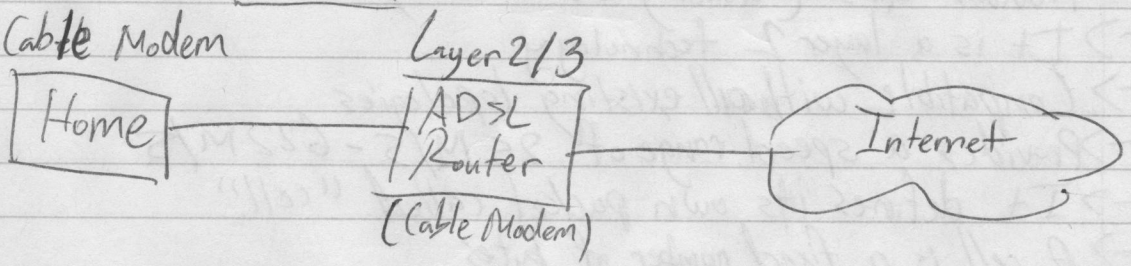
a) => ADSL (Asynchronous DSL) download speed ≠ Upload speed, ex. 2Mbps ~~Best option for internet services~~ Video Conf., Home Users. 512K

b) SDSL (Synch. DSL), download = Upload (Same speed)

- Best option for maintaining a web server.
- Typical speed 6Mbps.



=> Cable Modem

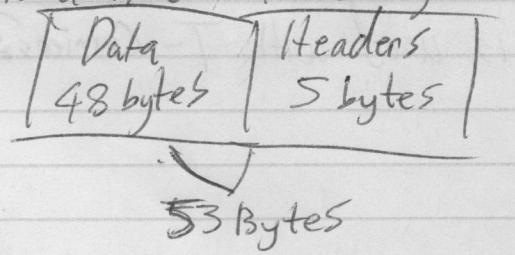


1. Which of the following is used with T-Carriers?
   a) Cable Modem
   b) Router
   c) switch
   X d) CSU/DSU
   e) all of the above

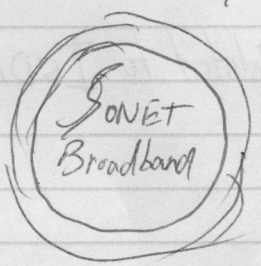
2. What is the ~~Max~~ speed of a D-Channel related to ISDN-BRi?
   a) 16 M/S
   X b) 16 K/S
   c) 64 K/S
   d) 128 K/S
   e) 1.544 M/S

3) What is the max speed of T3?
a) 1.544 M/S
b) 64 K/S
c) 128 K/S
d) 32 M/S
X e) None of the above

5- ATM (Asynchronous Transfer Mode)
↳ A High speed, digital System, designed for graphical / media presentation
-> Provides Q.S (Quality of service)
-> It is a layer 2 technology
-> Compatible with all existing topologies
-> Provides a speed range of 25 M/S - 622 M/S
-> It defines its own packet called "cell"
-> A cell is a fixed number of bytes

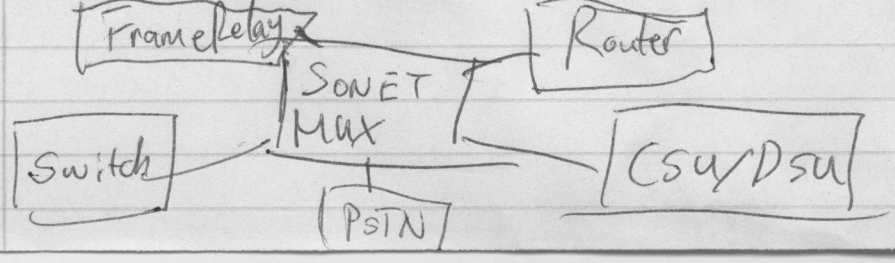


6- SONET (Synch. Optical Net)



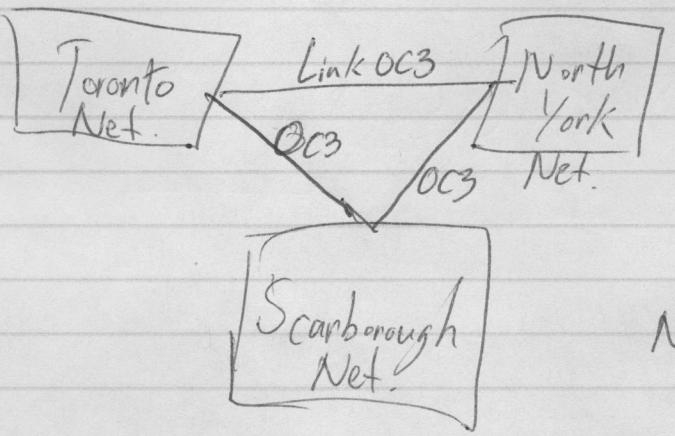
WDM

-> Is the backbone of WAN Connectivities



- SONET Define Optical Carrier OCx.
  - OC1: 51.84 M/s
  - OC3: 155.52 M/s
  - OC96: 5 G/s
  - OC192: 10 G/s

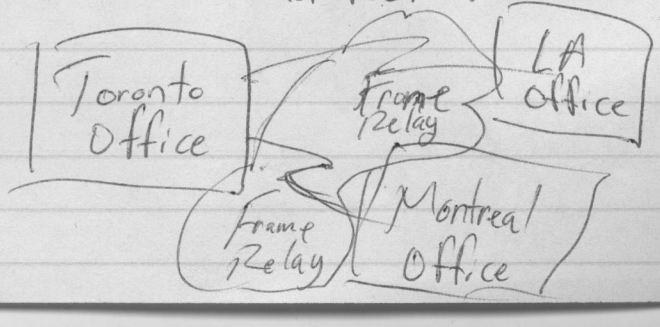
- SONET can network topologies using a MESH Topology
- It also provides the popular Dual-Ring Topology
- MESH Topology: Max # of links



$$\#\text{ of links} = \frac{N(N-1)}{2}$$

N = Number of Nodes

7- Packet Switched Network (WAN)
↳ Is a layer 3 technology
- 2 types of Packet Switch Networks:
a) X.25
↳ Is the oldest Packet Switch Network
↳ It supports 64k/s up.
↳ Originally it was an analog System
b) Frame Relay
↳ Is a digital, High Speed X.25 system
↳ It offers on-demand Net. Bandwidth allocation



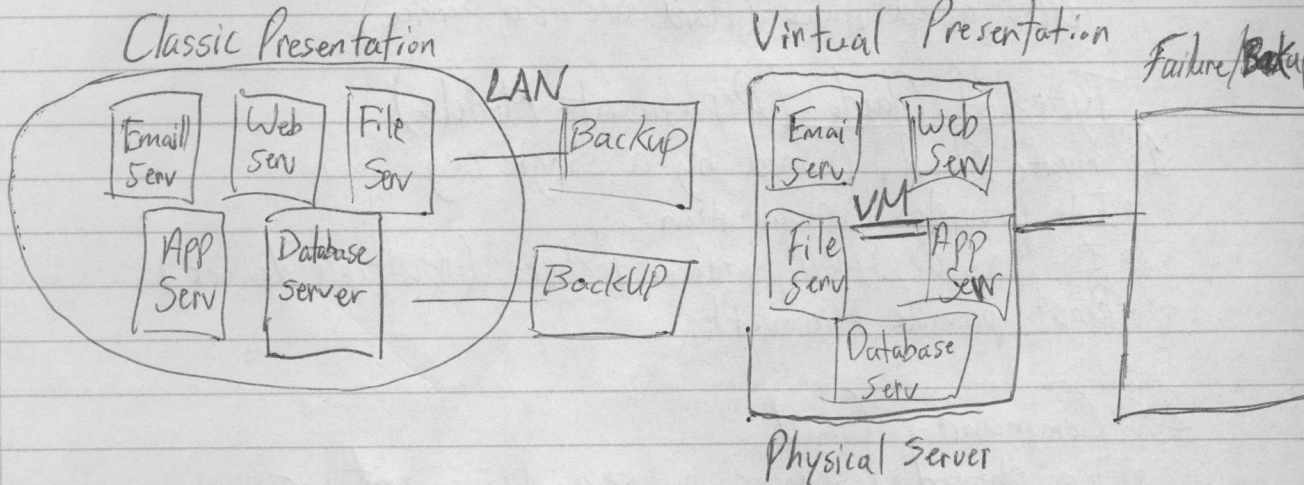
- Typical speed of relay is 45 m/s
- Provides efficient BW allocation by defining SVC & PVC
  - SVC (Switched Virtual Circuit)
    - ↳ Connection is established for transmission, terminated when complete
  - PVC (Permanant Virtual Circuit)
    - ↳ The connection remains alive during & after data transmission.
    - ↳ More expensive than SVC

Note: Fraction Frame Relay is available X64K
ex. 24 x 64K

ITM301 Cloud Computing & Remote Access Chapter 10

1. The heart of a cloud system is a concept called virtualization.
2. Virtualization is a emulation of a computer, OS environment / Applicatio
3. Virtualization provides the following characateristics:
   a) Virtual machine: a map of a physical machine

Note: A physical Machine represents a file called VM.

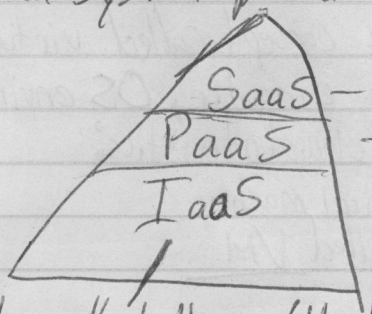


b) Security, instead of monitoring multiple physical servers, we can focus on effective monitoring of a centralized system.
c) Virtualization is an environmental friendly IT- solution (use less Power)
d) Platform independent: an IP-enabled device (laptop, WS, cell phone, IPad) can connect to virtual resources (hardware, software)
e) Multiple organizations can share the cost of Hw & SW
f) Virtual Systems provide loose coupling structure which means providing ellaticity & scalability.

Cloud Computing

- Cloud Computing is a convinient on-demand network access to a shared Pool of resources (network, storage, computer, APP) by providing a high level of abstraction called virtualization.

- A cloud system provides the following service models:



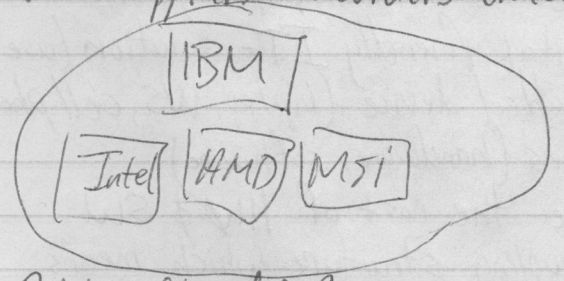
- SaaS – Software as a Service (Client Software)
- PaaS – Platform as a Service (server App development, Not O
- IaaS – Infrastructure as a Service

also called Haas (Hardware as a Service)

Types of Clouds (Deployment Models)

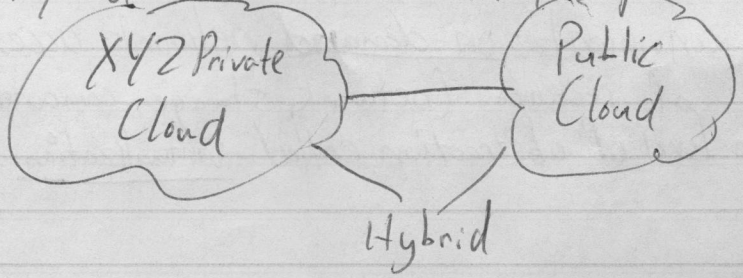
1- Private Cloud: Owned by a single org
- It provides Virtualization
- It provides multiplatform features (multiple devices)
- Best provide Microsoft

2- Community Cloud
- Is shared resources by several organizations
- Common: Security, Policy, Shared Requirements
- Ex. Suppliers + Providers Cloud



3- Public Cloud: Resources are publically available ex. Google VAPP's

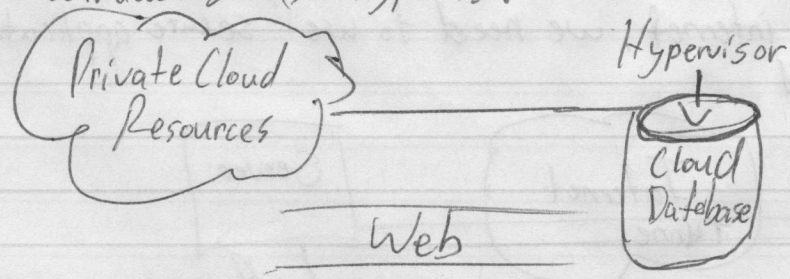
4- Hybrid Cloud: A combination of private & other types of clouds



- Cloud Vendors
  - VMware (initated a real cloud in _____?)
  - Microsoft
  - Xen (Citrix)
  - Amazon.com
  - VKM
- * Open Source Providers

- Hypervisor
  - ↳ Each cloud system need a layer of managing resources & Securi
  - ↳ Hyperrisor is a management layer of cloud
  - ↳ Provides a GUi env. for managing:
    - Nic Card, vNC
    - Hardware (memory, Hardware storage)
    - Network, VPN (Virtual Private Net.)
    - Uses & access permission

Ex. Windows 2008 Hypervisor



Note: A cloud system is based on earlier Tech:

a) Grid Computing
b) Web 2.0 Tech
c) VPN

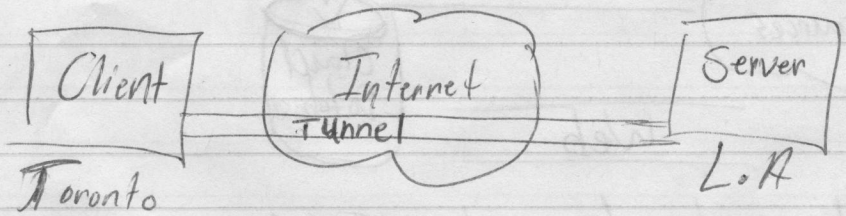
VPN

OSI & VPN

7. Application 6. Presentation 5. Session	RDP (Remote Desktop Protocol)	
4. Transport	TCP	
3. Network	IP	
2. Datalink	PPP, L2TP	PPoE = Point to Point over ethernet
1. Physical Ethernet		PPP = Point to Point Protocol

Note: By default TCP/IP V4 does not provide any security
⟹ Username + Password are sent through a network in plain text format.

- To secure communication over a non-trusted network such as the internet, we need to use secure applications such as VPN



- A VPN establishes a tunnel between Point A & Point B encrypting the entire connection (over-the-internet)
- 2 Main Protocols are

a) PPP → Modem Based Tunneling protocol also called PPTP
b) L2TP → layer 2 Tunneling Protocol

- L2TP is more secured than PPTP, it uses IPsec. protocol to encrypt Not only data but also IP addresses.

=> IPsecurity / L2TP

- L2TP encrypts data using an encryption method called AES. (Advanced Encryp. System).

November 28th

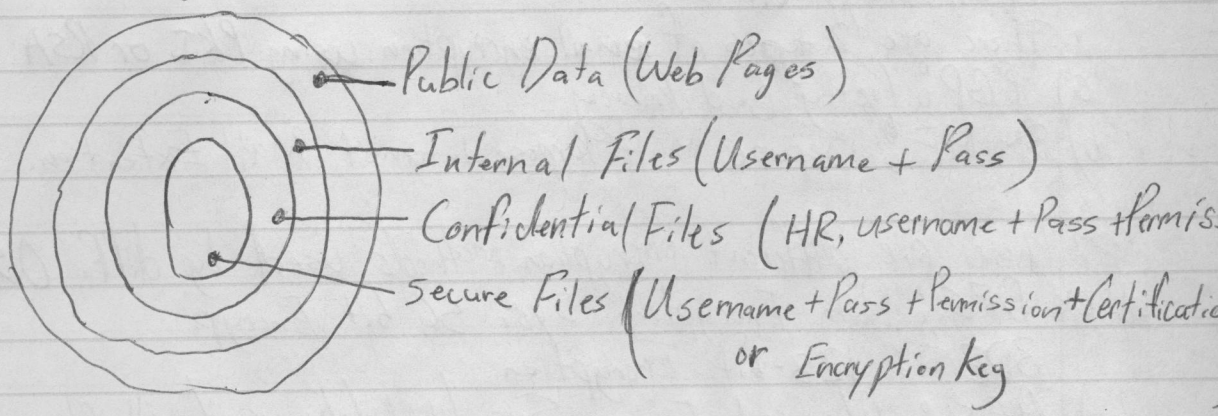
ITM301 Last Lecture

1. Security
2. Review Final Exam

1- File Security
2- Communication Channel Sec.
3- Internet Security
4- Viruses

5- Methods to Secure a Net.

(1) File Security: Categories of types of Secure Files



File Security (Encryption)

- Encryption is the process of converting plain text Data into non-plain t

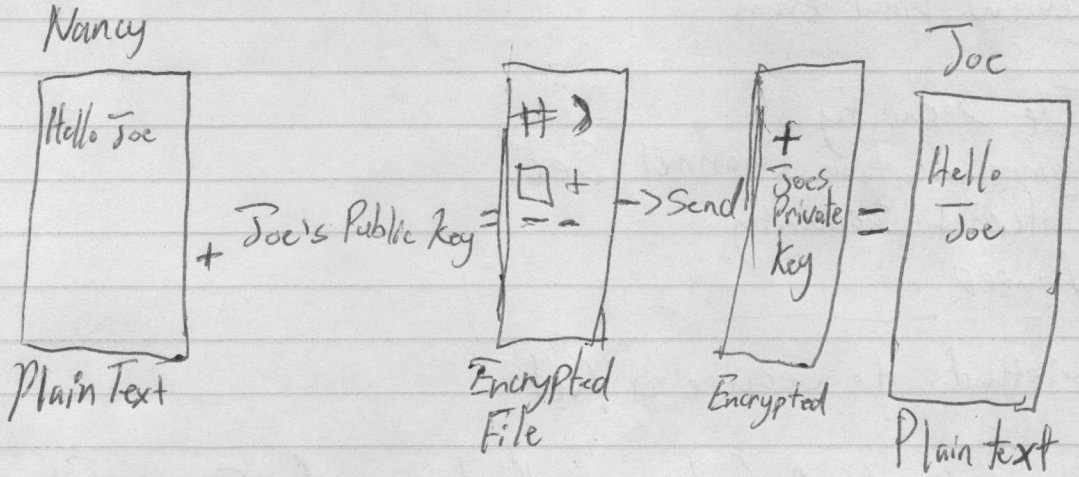
Ex. ABC key=2 Forward = C D E -> send

PKI: Public Key Infrastructure

- Contain 2 keys, one is Public, the other is private
- These 2 keys are hosted together

ex. 123590082351 (Public key) 389567280082 52 (Private key)

The Process of Encryption:



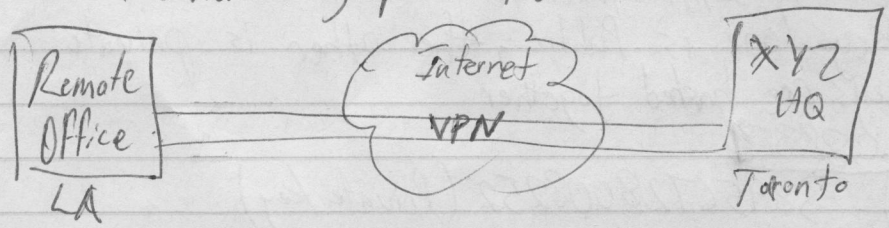
Email Encryption

- There are 2 types of email encryption using PKI or RSA Algorithm
  a) PGP: Pretty Good Privacy
  b) SMIME: Secure Multi Purpose Internet Mail Extention.

- There are different encryption methods used by diff. OS.
  a) ex. DES: Data Encryption Sys. 56 bit Encryp.
  3DES: 128-bit Encryption
  b) AES: Advanced Encryp. Sys. (Widely used with Channel Sec., VPN+IP

(2) Channel Sec.

- By default all communication channels are non-secure (Plain text)
- Virtual Private Net. (VPN) is a method of securing communication channel when using public Net.

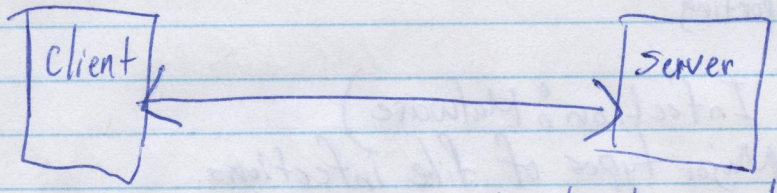


VPN: There are 2 Methods

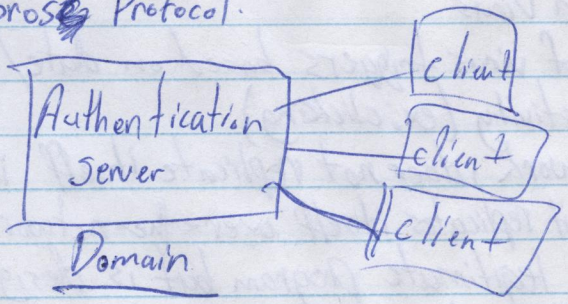
a) PPTP: Point-to-Point tunneling Protocol (modem)
b) IPsec-L2TP: layer 2 Tunneling Protocol.

Note: PPTP encrypts data with 56 bit encryp method.
- L2TP with IPsec. provides a VPN Secure channel by using AES 128-bit

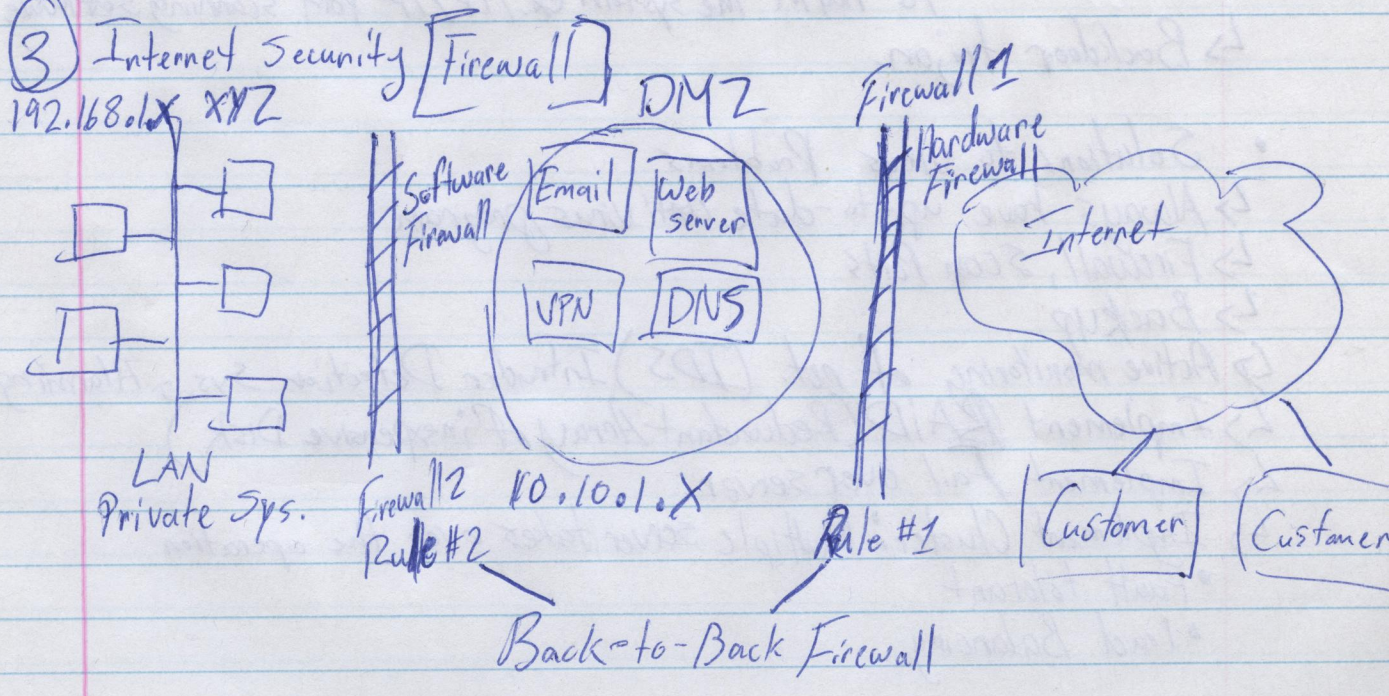
- Microsoft uses MS-CHAP for client/server authentication



- MS-CHAPv2 is a 2-way authentication channel
- CHAP: Challenged Handshake Auth. Protocol.
- Both client & servers must be able to authenticate themselves to each others at any given time.
- Kerbros Protocol.
  - Kerbros is a domain based Authentication



(3) Internet Security Firewall



Firewall does the following tasks (Advanced)

a) Block unwanted web sites
b) Block unwanted IP addresses
c) Block unwanted Applications
d) Block unwanted users
e) Monitoring & Reporting

4) Viruses (File Infection : Malware)

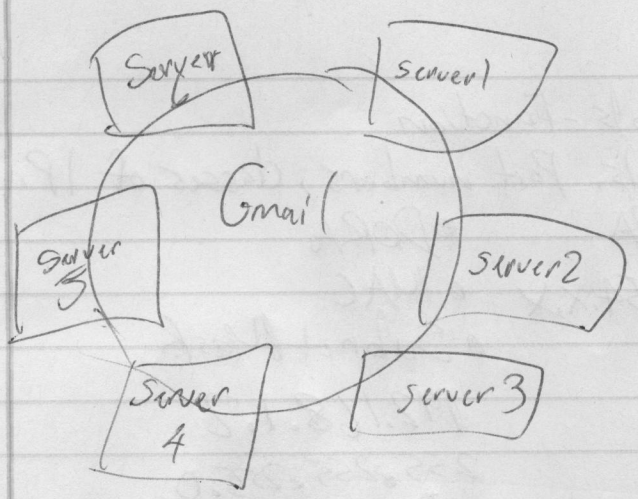
- There are 3 Major types of file infections.

a) Virus : infects a single sys., replicates itself
   - ↳ Boot sector virus : Disables computers boot sys.
   - ↳ Macro-virus : MS Macros (Excel)
   - ↳ Hoax : Is sent through alarming messages
   - ↳ Bot, Robot : Chat room virus
   - ↳ Logic Bomb : is a type of virus triggers based on date/time or users activity (ex. clicking)

b) Worm : Infects entire network, does not replicate itself in a local machine, rather it replicates itself over-the-network. (Red Worm)

c) Trojan Horse : Acts as a legitimate program but is designed to harm the system ex. TCP/IP Port scanning software.
   - ↳ Backdoor trojan.

- Solutions to virus Problems
  - ↳ Always have up-to-date anti virus program
  - ↳ Firewall, Scan Ports
  - ↳ Backup
  - ↳ Active monitoring of net. (IDS) Intruder Detection Sys., Alarming Net
  - ↳ Implement RAID (Redundant Array of inexpensive Disk)
  - ↳ Implement Fail over server
  - ↳ Implement Cluster : Multiple server takes over the operation
    - Fault tolerant
    - Load Balancing



Dec 14th

Review Final

1- Todays lecture

Settings: 75 MC Questions, 2 Hours

Scenarios: 1, 2, 3 + Generic MCQ.

Ex. Scenario 1: You are the net. admin of XYZ inc
You need to modify your net. to fullfil the following/e
a) Implement Internet sec.
b) Implement DMZ
c) Implement network topology 802.5 + 802.8

Answer the following Question:

1) Which of the following topologies is 802.5
a) Star
b) Ethernet
✓ c) Token

2) Which of the following servers is not part of DMZ
a) VPN
b) Web
c) DNS
✓ d) Domain
e) Email

Categories

1- Osi Model - layers - Protocols - function

2- TCP/IP Model, Protocols, Port numbers, classes of IP.

Private IP
10.X.X.X
172.16.X.X
192.168.X.X

APIPA
169.254.X.X

- DORA
- MAC
- Subnet Mask

192.168.1.2
255.255.255.0
H.ID: 12 (X.X.X.12)
Net ID = 192.168.1

3- Topology IEEE
- Wireless, SONET

4- Cables IEEE, 10Base2

5- Remote Access

6- Server Os
- Domain, Kerbos, Domain Objects

7- Carrier, T1, T3, OC1, OC192, ISDN { Primary / Basic 2B Channel 64K / 1D Channel 16K

8- Misc