Chapter 7

Internet and Intranet Applications

By Pavan Poudel

Overview

1. General Applications: Email, WWW, Gopher, Online Systems
2. Multimedia and Digital video/audio Broadcasting, Video/Audio Conferencing, Internet Relay Chat (IRC)
3. Broadband Communication, Policy, xDSL, and Cable Internet
4. VOIP, FOIP and IP interconnection
5. Datacenters and Data Warehousing, Packet Clearing House
6. Unified Messaging Systems
7. Fundamentals of e-commerce
8. Concept of grid and cloud computing

Gopher

- The Gopher protocol is a TCP/IP application layer protocol designed for distributing, searching and retrieving documents over the internet.
- Strongly oriented towards a menu-document design, the Gopher protocol presented an attractive alternative to the World Wide Web in its early stages, but ultimately failed to achieve popularity.
- The protocol offers some features not natively supported by the Web and imposes a much stronger hierarchy on information stored on it.
- Its text menu interface is easy to use, and well-suited to computing environments that rely heavily on remote text-oriented computer terminals and the simplicity of its protocol facilitated a wide variety of client implementations.

Gopher

- More recent Gopher revisions and graphical clients added support for multimedia.
- Gopher was preferred by many network administrators for using fewer network resources than Web services.
- With its hierarchical structure, Gopher provided a useful platform for the first large-scale electronic library connections.
- Gopher users remember the system as being faster and more efficient and so much more organized than today's Web services.
- Veronica is a search engine system for the Gopher protocol, developed in 1992 by Steven Foster and Fred Barrie at the University of Nevada, Reno.
- Veronica is a constantly updated database of the names of almost every menu item on thousands of Gopher servers. The Veronica database can be searched from most major Gopher menus.

Gopher

- Although largely supplanted by the Web in the years following, the Gopher protocol is still in use by enthusiasts, and a small population of actively-maintained servers remains.
  - A file-like hierarchical arrangement that would be familiar to users.
  - A simple syntax.
  - A system that can be created quickly and inexpensively.
  - Extending the file system metaphor, such as searches

MultiMedia Networking Applications

Classes of MM applications:

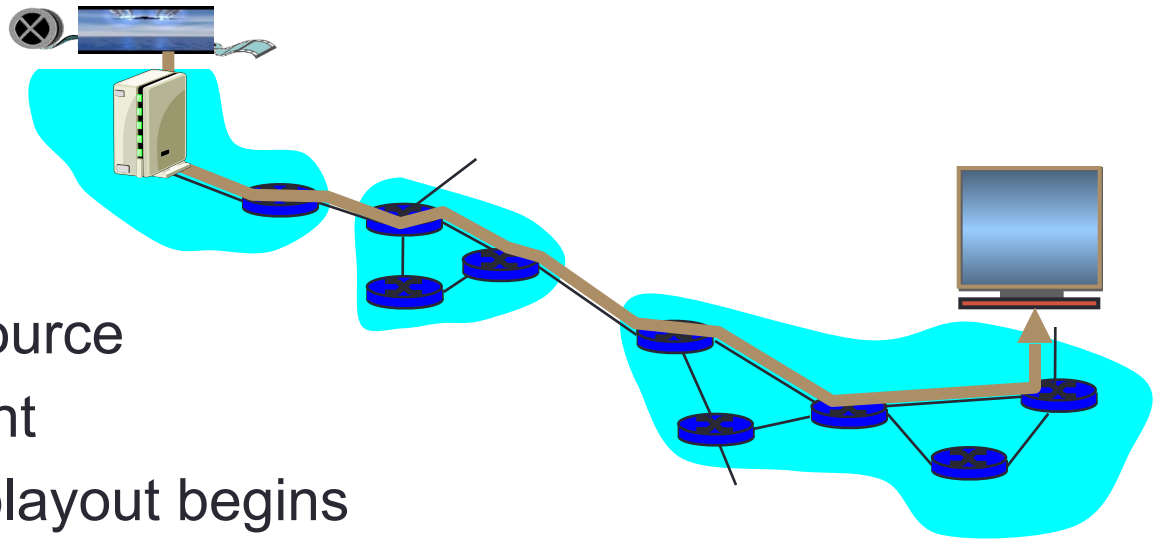
1) stored streaming
2) live streaming
3) interactive, real-time

Fundamental characteristics:

- typically **delay sensitive**
  - end-to-end delay
  - delay jitter
- **loss tolerant**: infrequent losses cause minor glitches
- antithesis of data, which are loss *intolerant* but delay *tolerant*.

Jitter is the variability of packet delays within the same packet stream

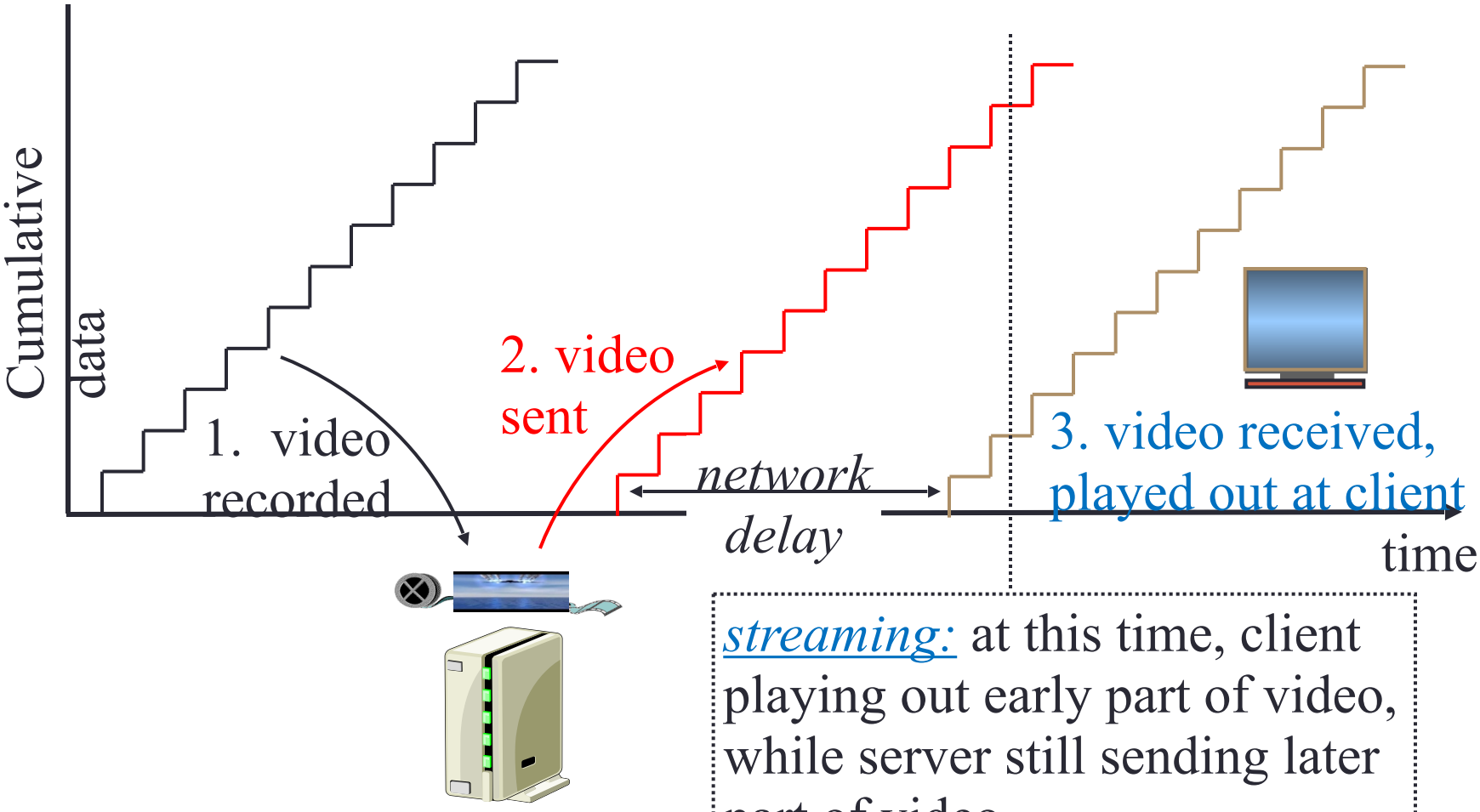
Streaming Stored Multimedia



Stored streaming:

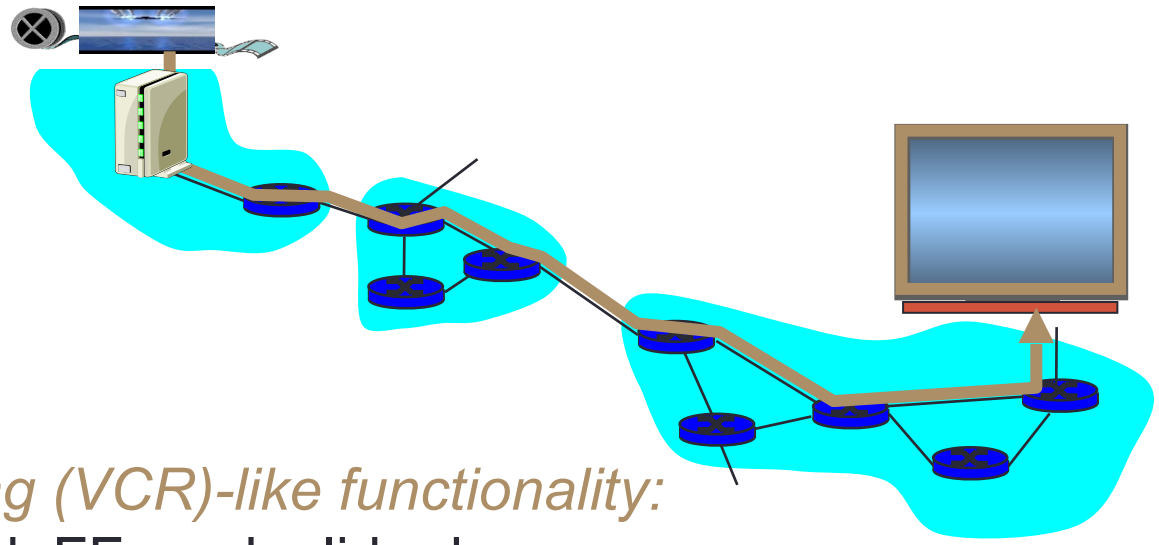
- media stored at source
- transmitted to client
- *streaming:* client playout begins *before* all data has arrived
  - timing constraint for still-to-be transmitted data: in time for playout

Streaming Stored Multimedia: What is it?



streaming: at this time, client playing out early part of video, while server still sending later part of video

Streaming *Stored* Multimedia: Interactivity



- *Video cassette recording (VCR)-like functionality:* client can pause, rewind, FF, push slider bar
  - 10 sec initial delay OK
  - 1-2 sec until command effect OK
- timing constraint for still-to-be transmitted data: in time for playout

Streaming *Live* Multimedia

Examples:

- Internet radio talk show
- live sporting event

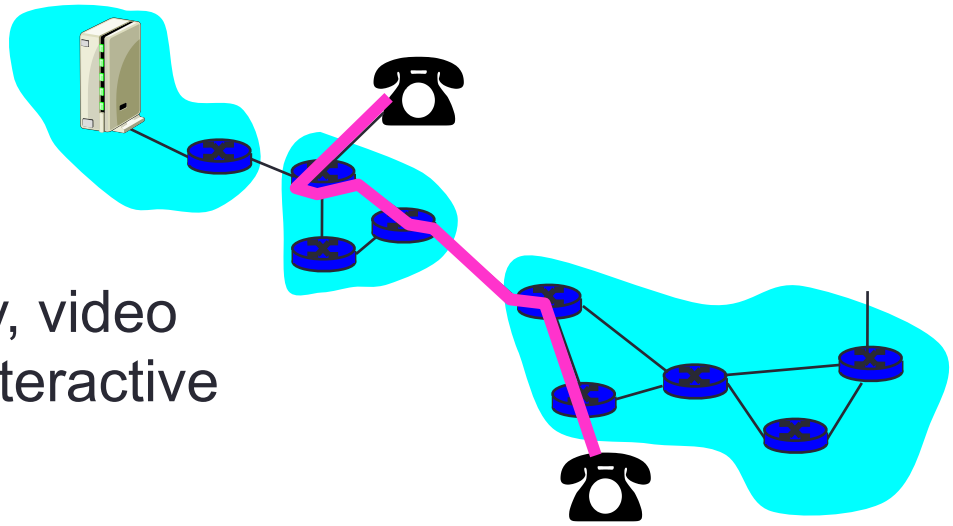
Streaming (as with streaming *stored* multimedia)

- playback buffer
- playback can lag tens of seconds after transmission
- still have timing constraint

Interactivity

- fast forward impossible
- rewind, pause possible!

Real-Time Interactive Multimedia



- applications: IP telephony, video conference, distributed interactive worlds

- end-end delay requirements:
  - audio: < 150 msec good, < 400 msec OK
    - includes application-level (packetization) and network delays
    - higher delays noticeable, impair interactivity

Multimedia Over Today's Internet

TCP/UDP/IP: "best-effort service"

- *no* guarantees on delay, loss

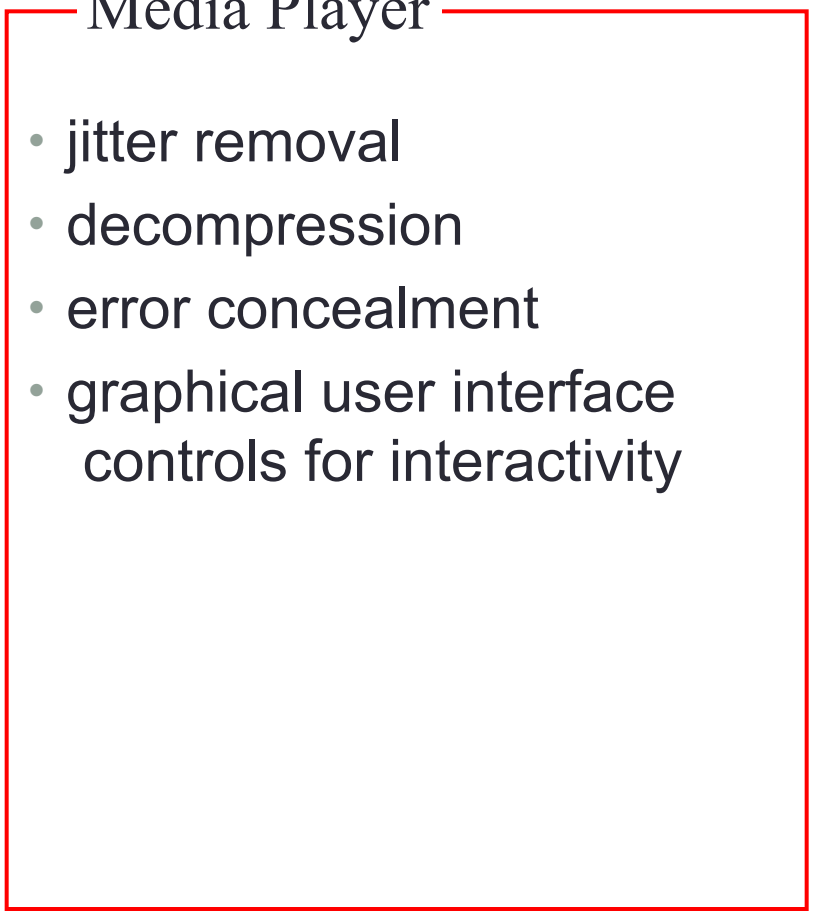
But you said multimedia apps requires QoS and level of performance to be effective!

Today's Internet multimedia applications use application-level techniques to mitigate (as best possible) effects of delay, loss

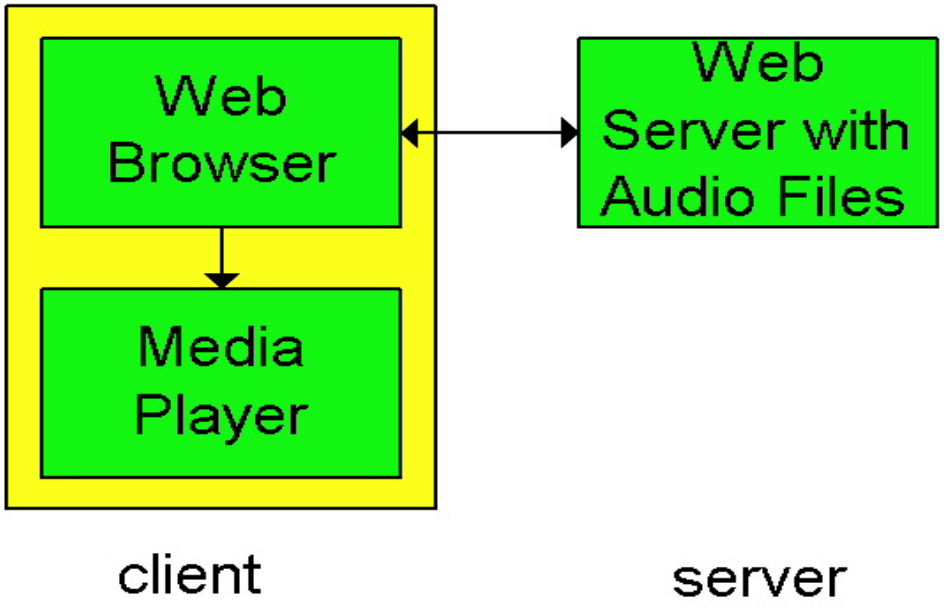
Streaming Stored Multimedia

application-level streaming techniques for making the best out of best effort service:

- client-side buffering
- use of UDP versus TCP
- multiple encodings of multimedia



Internet multimedia: simplest approach

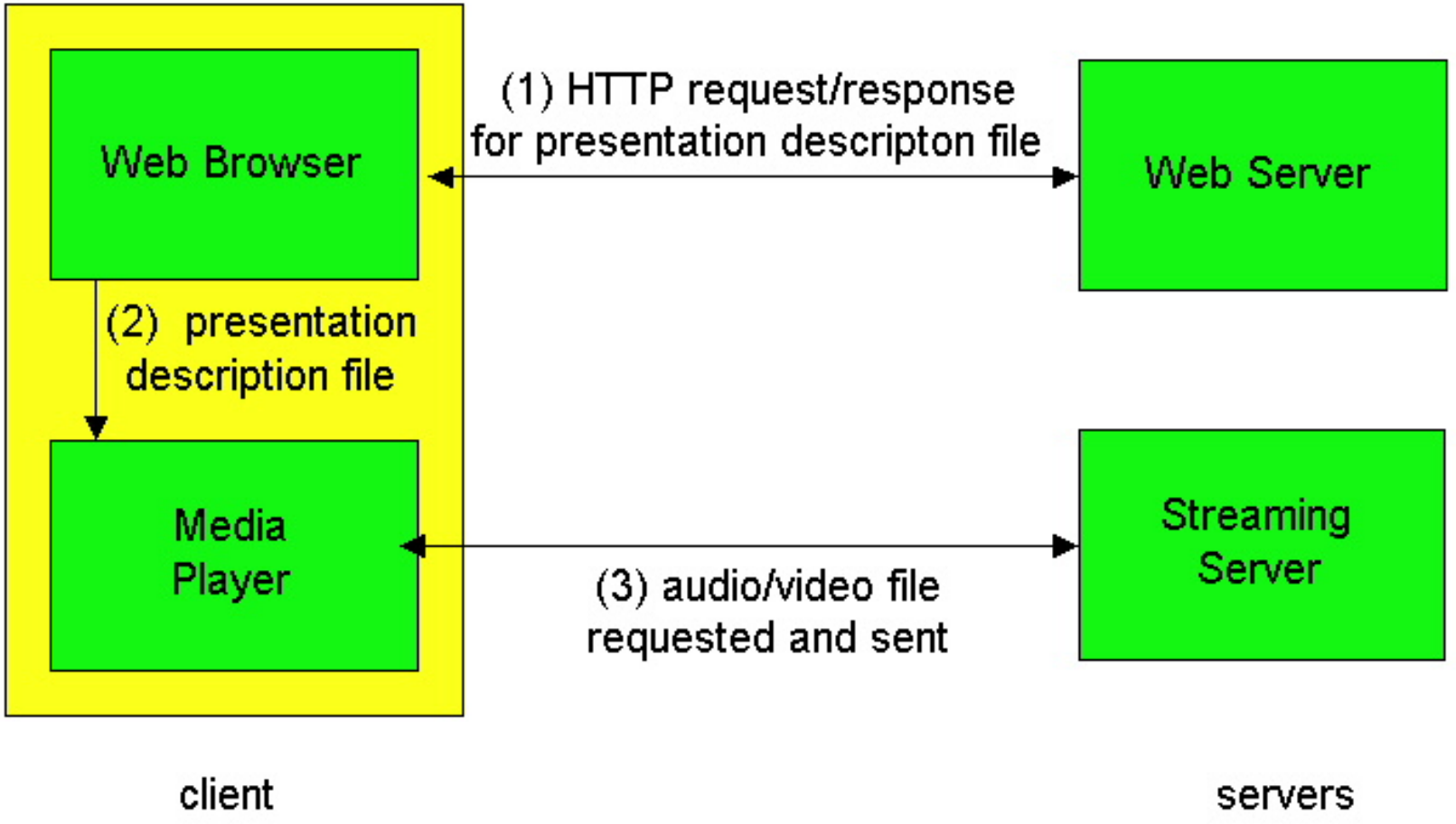


- audio or video stored in file
- files transferred as HTTP object
  - received in entirety at client
  - then passed to player

audio, video not streamed:

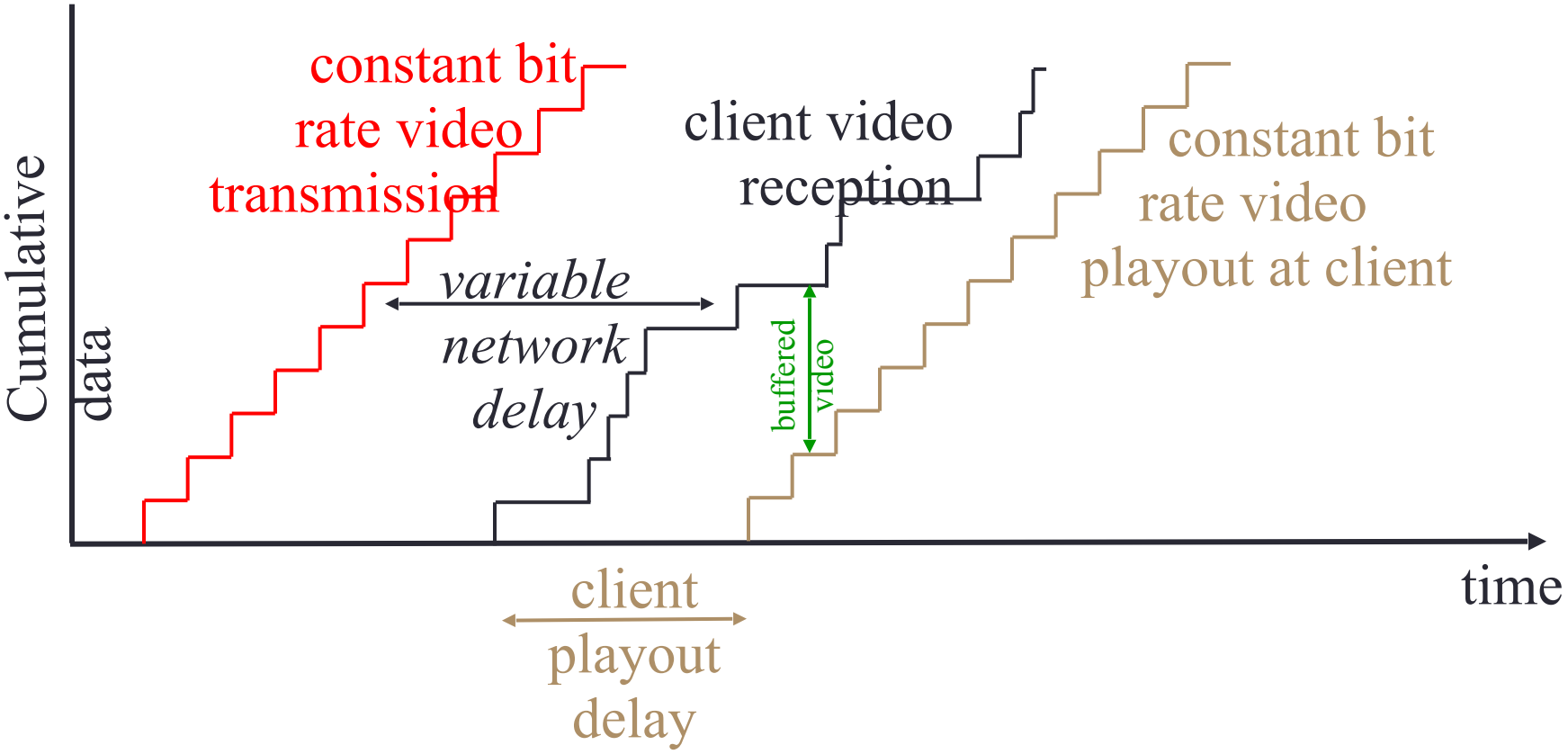
- no, “pipelining,” long delays until playout!

Streaming from a streaming server



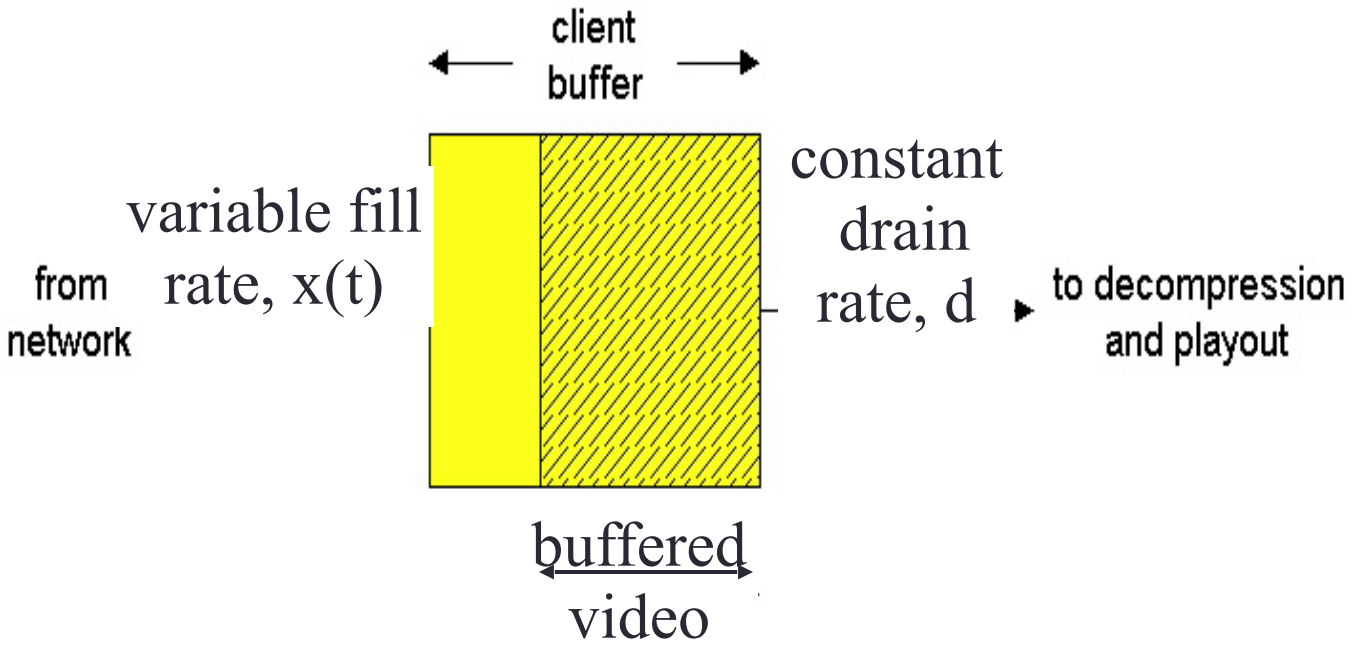
- allows for non-HTTP protocol between server, media player
- UDP or TCP for step (3), more shortly

Streaming Multimedia: Client Buffering



- client-side buffering, playout delay compensate for network-added delay, delay jitter

Streaming Multimedia: Client Buffering



- client-side buffering, playout delay compensate for network-added delay, delay jitter

Streaming Multimedia: UDP or TCP?

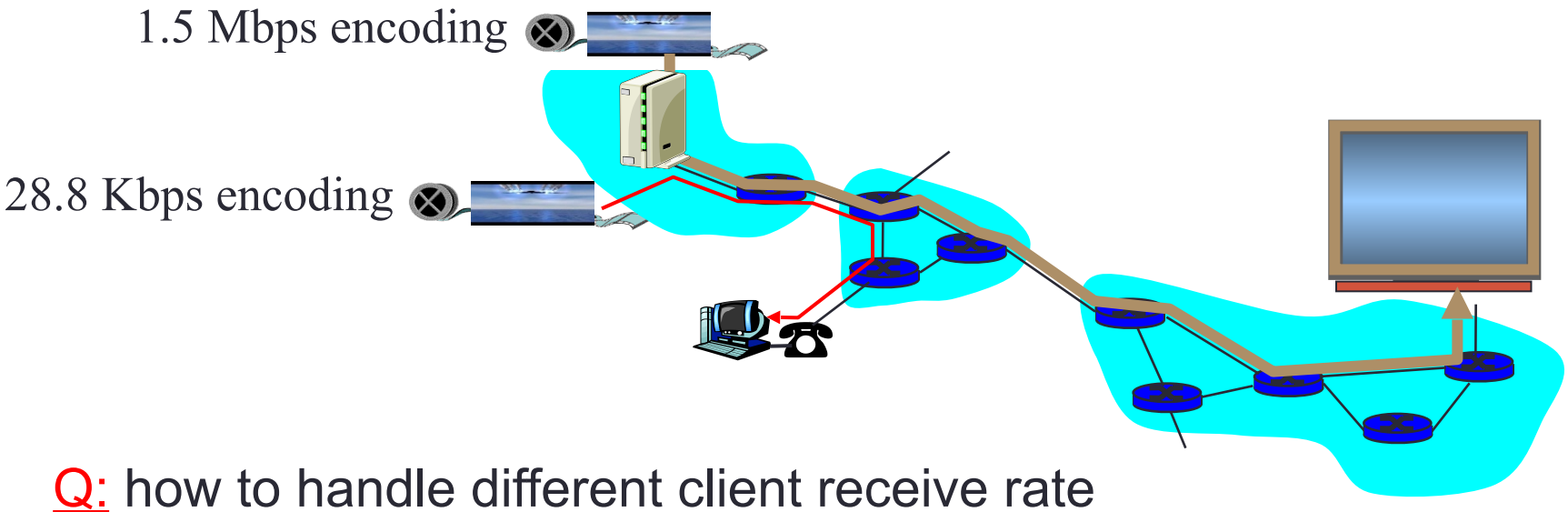
UDP

- server sends at rate appropriate for client (oblivious to network congestion!)
  - often send rate = encoding rate = constant rate
- short playout delay (2-5 seconds) to remove network jitter
- error recover: time permitting

TCP

- send at maximum possible rate under TCP
- larger playout delay: smooth TCP delivery rate
- HTTP/TCP passes more easily through firewalls

Streaming Multimedia: client rate(s)



Q: how to handle different client receive rate capabilities?

- 28.8 Kbps dialup
- 100 Mbps Ethernet

A: server stores, transmits multiple copies of video, encoded at different rates

User Control of Streaming Media: RTSP

HTTP

- does not target multimedia content
- no commands for fast forward, etc.

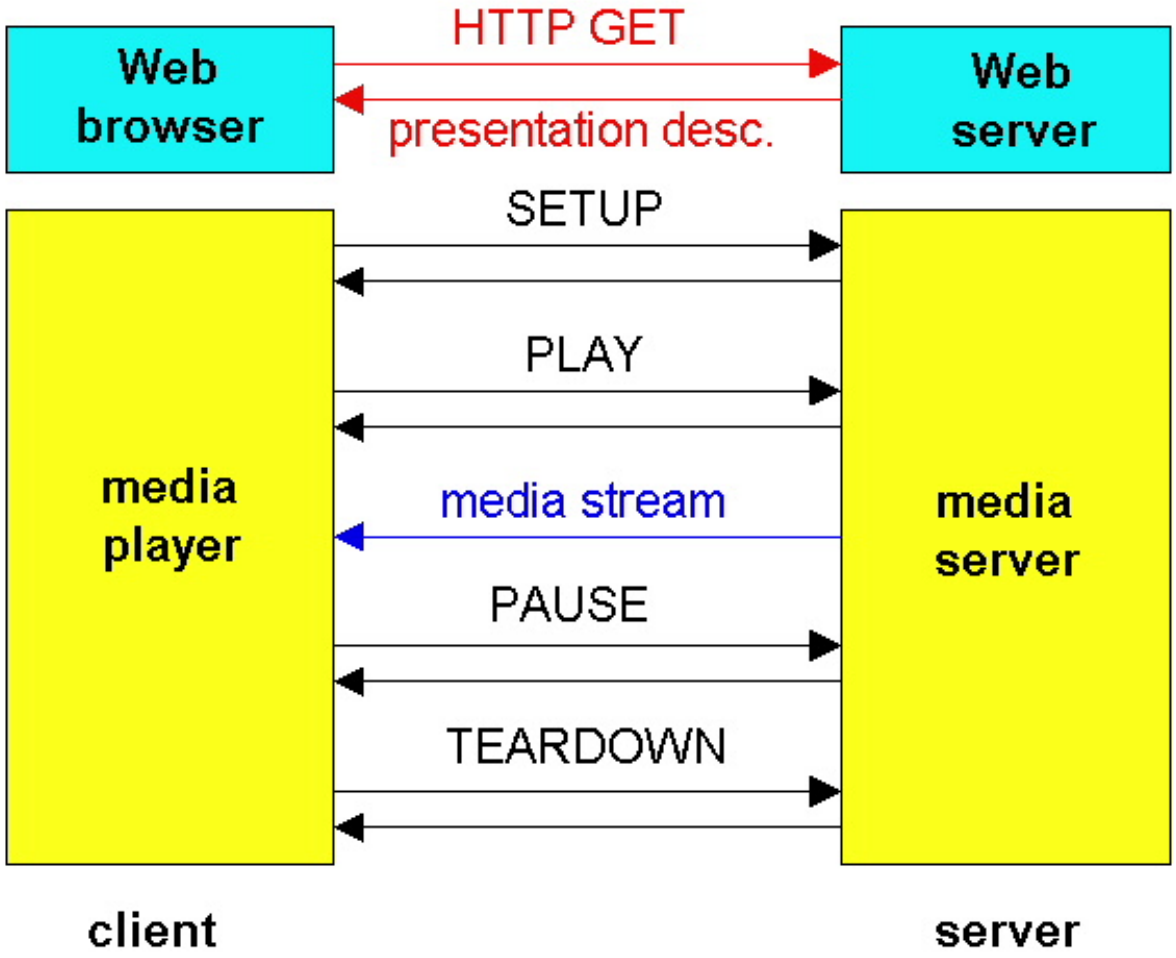
RTSP: RFC 2326

- client-server application layer protocol
- user control: rewind, fast forward, pause, resume, repositioning, etc…

What it doesn't do:

- doesn't define how audio/ video is encapsulated for streaming over network
- doesn't restrict how streamed media is transported (UDP or TCP possible)
- doesn't specify how media player buffers audio/video

RTSP Operation



Real-time interactive applications

- PC-2-PC phone
  - Skype
- PC-2-phone
  - Dialpad
  - Net2phone
  - Skype
- videoconference with webcams
  - Skype
  - Polycom

Videoconferencing – What Is It?

"Video conferencing in its most basic form is the transmission of image (video) and speech (audio) back and forth between two or more physically separate locations."

Videoconferencing Components:

- Cameras (to capture and send video from your local endpoint)
- Video displays (to display video received from remote endpoints)
- Microphones (to capture and send audio from your local endpoint)
- Speakers (to play audio received from remote endpoints)

In Addition, Two Additional Requirements:

- Codec - "compressor/de-compressor“ - makes the audio/video data "small enough" to be practical for sending over expensive network connections.
- A codec takes analog signals, compresses and digitizes them, and transmits the signals over digital phone lines.
- The Supporting System and the Network Connection

H.323 – It's Not a Disease

- Standard for interoperability in audio, video and data transmissions as well as Internet phone and voice-over-IP (VoIP)
- Enables videoconferencing without usage fees
- But does not have QOS (quality of service)

Polycom

- Polycom is the market leader in endpoint voice and video communications. And based on
  - Large conference room units:
  - Medium conference room units:
  - Personal units:
    - Via Video




Point-to-point Conferences

- Point-to-point – A videoconference that connects two locations.
- Each site sees and hears the other sites at all times

Multipoint Conferences

- Point-to-multipoint – A videoconference that connects to more than two sites through the use of a multi-point control unit, or MCU.
- Participants at all sites can hear one another at all times and see the site that is currently speaking.
  - Voice activated switching
- Multi-point conferencing can be effective although the scheduling, technical, and logistical dimensions of MCU conferences can be imposing.

Various Uses:

- Presentations
- Virtual meetings
- Videoconference-based learning
- JIT (just in time) events
- Recruitment/search committees
- General meetings

Additional Uses:

- Project coordination
- Informal work sessions
- Alumni relations
- Question and answer sessions

Videoconferencing

- Traditional videoconferencing was about audio-video communications to facilitate meetings without the burden of travel.
- Visual collaboration is much more; it is the combination of audio and video and data in both real-time and store-and-forward applications.
- It’s not just about meetings anymore.

Visual Collaboration

Meetings	→ Meetings, presentations, training
Work alone	→ Teaming, local and remote
On-site training	→ Distance learning, online training
Save Money	→ Be more productive
Reliable connections	→ Managed network services
Videoconferencing	→ Visual collaboration

Benefits of Videoconferencing

- Can improve work quality
- Increase productivity
- Reduce costs
- Improves communication
- Groups can meet more frequently
- Critical meetings can be convened in less time
- More faculty and staff can be involved

Benefits of Video-conf-based Learning

- Closely resembles traditional classroom-based education; permits learners to be active participants in the process
- Faculty and staff needs can be met more quickly through just-in-time training
- More faculty and staff can be trained faster without increasing training resources
- Guest lecturers can be easily integrated into the course

Benefits of Video-conf-based Learning

- Enables any site to be the provider of the learning activities.
- Videoconferencing is cost-effective, when you consider the traveling costs for traditional training.
- Videoconference-based learning exploits the already acquired videoconferencing technologies and network infrastructure.
- H.323 standards provide for learners in any H.323 compliant site to be active participants.

Limitations of Videoconferencing

- The initial cost of the equipment and leasing the lines to transmit conferences may be prohibitive.
- Unless a strong effort is made by the instructor, students not located with the instructor may remain uninvolved in the course.
- If visuals, like handwritten or copied materials, are not properly prepared, students may have a difficult time reading them.
- If the “pipe” that carries the transmission among sites is not large enough, the students may observe “ghost images” when rapid movement occurs in “real time”.
- If the system is not properly configured, class members may observe an audio “echo” effect. The result is audio interference that detracts from the learning environment.

Video Conferencing manners

- Testing, testing, 1, 2, 3,…
  - Connect and test PRIOR to the scheduled time
  - Utilize the picture-in-picture to get a sense of what the remote sites are seeing
- Leaving well enough alone…
  - If the videoconference is satisfactory make as few adjustments as possible
  - Unnecessary "play" of audio or video can have very distracting results.

Video Conferencing manners

- Are you still with me?
  - Videoconferencing is much more like an in person exchange than a telephone call — body language and facial expression count!
  - Avoid "multi-tasking" with other work, looking at other applications on the computer screen, talking to other local participants.

- Talking out of turn…
  - Stray noises and side conversations within a video conference distract from the primary conversation.
  - Side conversations at remote sites seem to spring up more readily than they would if everyone were in the same actual room, which causes problems to voice-activated switching.

Internet Relay Chat (IRC)

- **IRC - Internet Relay Chat** is a method to broadcast and receive live, synchronous, messages.
- There are hundreds of IRC channels (discussion areas) around the world, hosted on servers, on which people type their messages to others on the same channel interested in the same subject.
- There are client IRC programs which provide graphical interfaces which make it easier for people log on and access active channels and send and receive the messages.
- IRC chat, at present, is not limited to two people, unlike earlier versions.
- You need a software program to access the IRC channels.
- The server acts as a router, making sure that all messages are sent to the discussion participants.

IRC

- **Internet Relay Chat** (**IRC**) is a system that facilitates transfer of messages in the form of text.
- The chat process works on a client/server model of networking. IRC clients are computer programs that a user can install on their system.
- These clients are able to communicate with chat servers to transfer messages to other clients.
- It is mainly designed for group communication in discussion forums, called channels, but also allows one-to-one communication via private message as well as chat and data transfer, including file sharing.
- freenode, IRCnet, QuakeNet, undernet, Efnet, rizon etc are examples of IRC.
- MSN Messanger, Yahoo Messanger, WeChat, Google Talk etc. are also using IRC.

xDSL Access Technologies

DSL(Digital Subscriber Line)

- DSL technology provides high-speed, broadband network connections to homes and small businesses.
- DSL utilizes the same cabling used for normal telephones, but it can offer higher data rates through use of the digital modem technology.
- DSL modems comprise the heart of this technology and the lines themselves are actually just plain telephone lines.
- It's possible for DSL subscribers to share the same line for their digital and analog traffic → play web + receive a call.

DSL(Digital Subscriber Line)

- DSL works on the unused (high) frequencies of the telephone line.
- DSL modems contain an internal signal splitter that carries voice signals on the usual low frequencies (from 0 up to 4kHz) and data signals above that.
- This splitter, consequently, allows simultaneous access to the line by the telephone and the computer.

DSL Technology

- **Speed**
  - DSL offers more than 100 times the network performance of a traditional analog modem.
  - The precise speed of a connection depends on the variety of xDSL deployed.
  - DSL is a distance-sensitive technology.
- **Access**
  - DSL service remains "on" all of the time.
  - People should be aware that long-lived connections like DSL can have security issues firewall.
- **Availability**
  - The technology used to implement DSL only works over a limited physical distance.
  - At the maximum, DSL runs about 18,000 feet (3.5 miles or 5.5 kilometers) from a *telephone exchange*.

DSL Technology

- Availability (cont.)
  - To be eligible for DSL service, the phone line involved must be "qualified."
  - The home or business must lie within the distance limitations of DSL (18,000 feet).
  - This phone line must also possess sufficient electrical quality characteristics.

DSL availability of bandwidth

- The actual network bandwidth a customer will receive from DSL in the home depends on the span of their telephone wiring.
- The longer the line, the less bandwidth DSL can support.
- Likewise, its thickness (wire gauge) can affect performance.

Cable length (feet)	**Bandwidth availability** (kbps)
18,000	1,544
16,000	2,048
12,000	6,312
9,000	8,448

xDSL family tree

- The xDSL "family tree" includes two main branches
  - Symmetric DSL
    - services provide identical data rates upstream and downstream.
  - Asymmetric DSL
    - provides relatively lower rates upstream but higher rates downstream.

Access Technologies

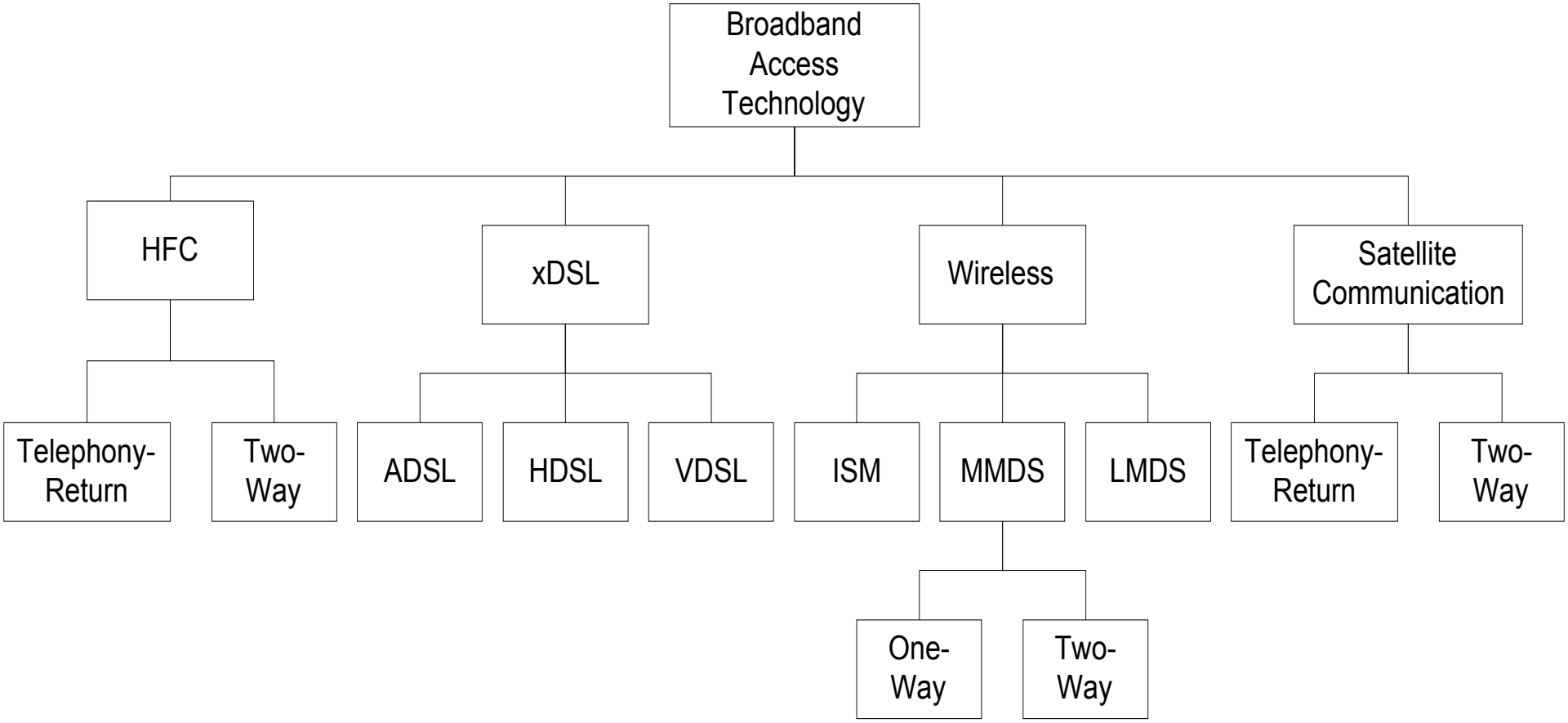


Figure 10.2 Broadband Access Technologies

xDSL family tree

DSL Type	Download	Upload	Distance (feet)
ADSL (Asymmetrical)	1.5 - 8 Mbps	16 kbps to 640 kbps	9K to 18K
UDSL(a.k.a. G.lite, DSL Lite)	1.5 Mbps	384 kbps	12K to 18K
RADSL (Rate Adaptive)	Variable to 7 Mbps	Variable to 640 kbps	18K to 25K
VDSL (Very High Bit Rate)	26 Mbps to 52 Mbps	3 Mbps to 6 Mbps	1K to 3K
IDSL (ISDN over DSL)	144 kbps	144 kbps	18K (more w/ repeater)
SDSL (Symmetrical)	144 kbps to 2 Mbps	144 kbps to 2 Mbps	11.5K to 22K
HDSL (High Bit Rate)	1.544 Mbps	1.544 Mbps	12K on 2 pairs
HDSL (High Bit Rate)	2.048 Mbps	2.048 Mbps	12K on 3 pairs
HDSL2	1.544 Mbps	1.544 Mbps	12K on 1 pair
SHDSL (Single-pair HDSL)	192 kbps to 2.312 Mbps	3 Mbps to 6 Mbps	1K to 3K

Hybrid fibre-coaxial(HFC) Technology

- Broadband LAN
- Asymmetric bandwidth allocation for 2-way communication
- RF spread-spectrum that carries multiple signals over HFC
- RF spectrum allocation to carry multimedia services - voice, video and data

Cable Modem

- HFC uses tree topology
- Downstream in broadcast mode
- Upstream transmission by cable modem coordinated by head end
- Data over cable service specifications (DOCSIS) for cable modem ensures interoperability

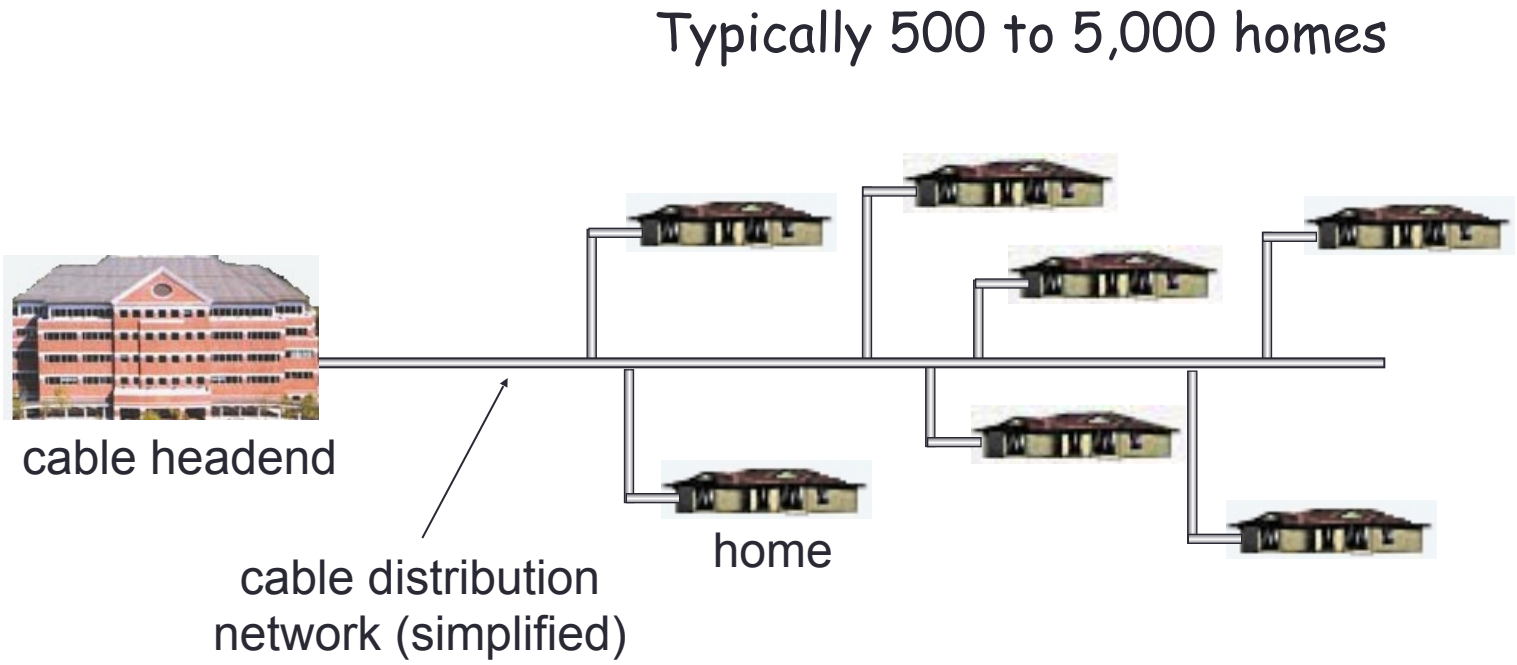
Functions of Cable Modem Termination System

- Equipment at the head end
- All cable modems terminated on the head end Gateway to the external network
- Multiplexes and demultiplexes signals
- Frequency converts upstream to downstream signals
- Can be designed either as a bridge or router

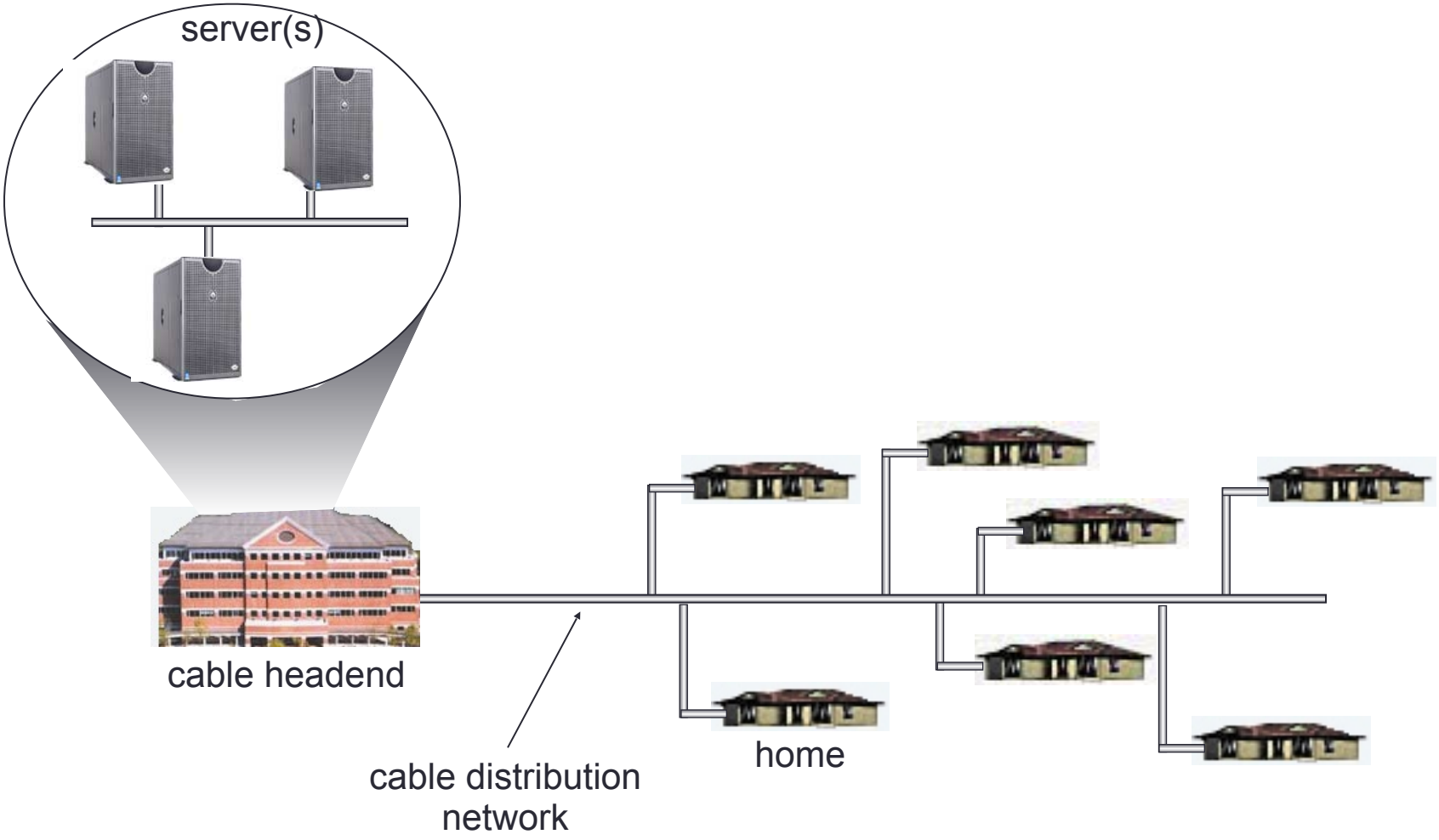
HFC Plant

- Multiple fiber pairs run from head end to fiber node; each pair carries 2 one-way signals
- Head end converts all (telephony, digital video, data, and analog video) signals to optical carrier to transmit on the fiber
- Houses are connected from fiber node via coaxial cables
- Coaxial cable are in tree topology and carries 2-way signal
- Amplifiers on the coaxial cable have 2-way amplifiers that amplify the signals in both directions

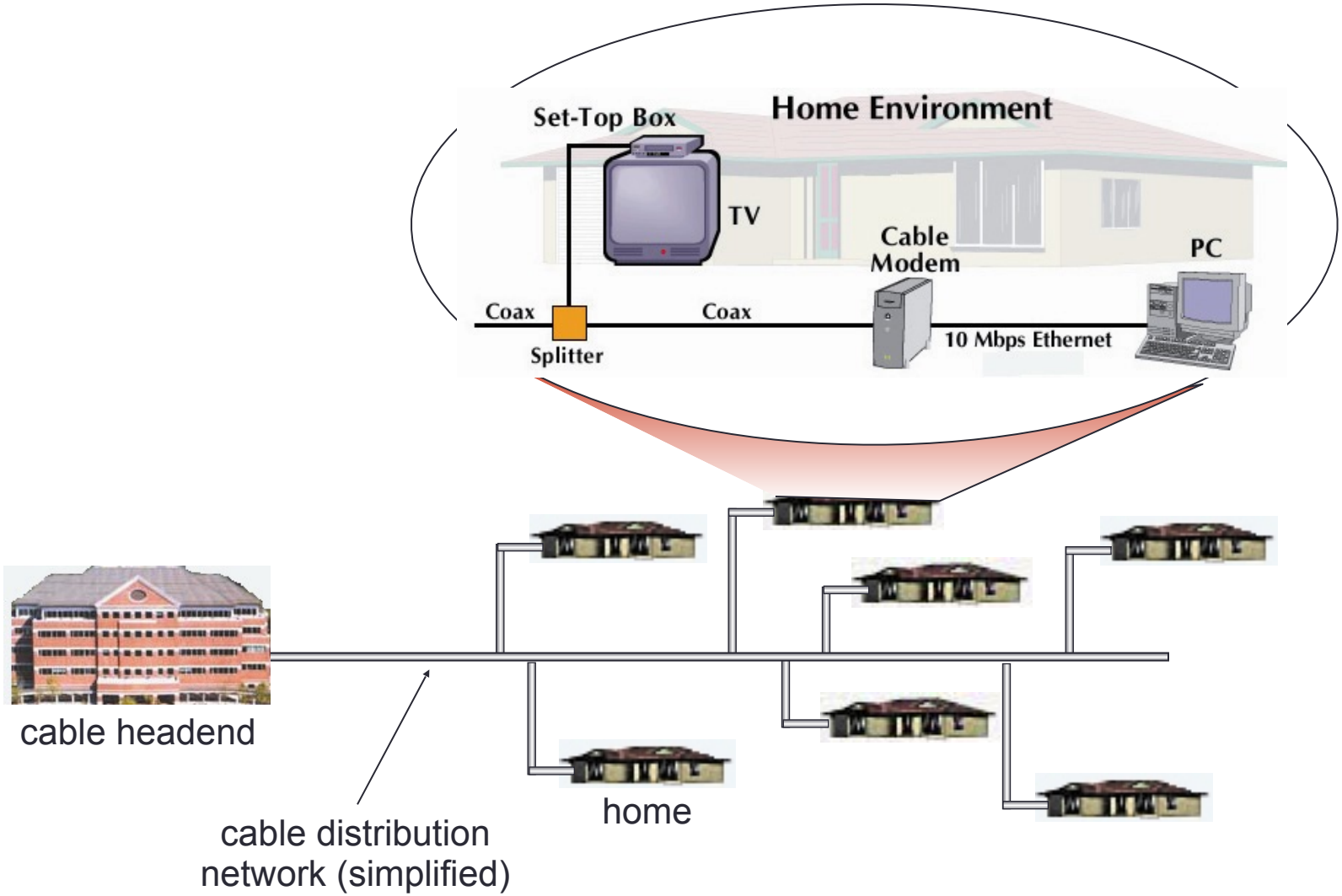
Cable Network Architecture: Overview



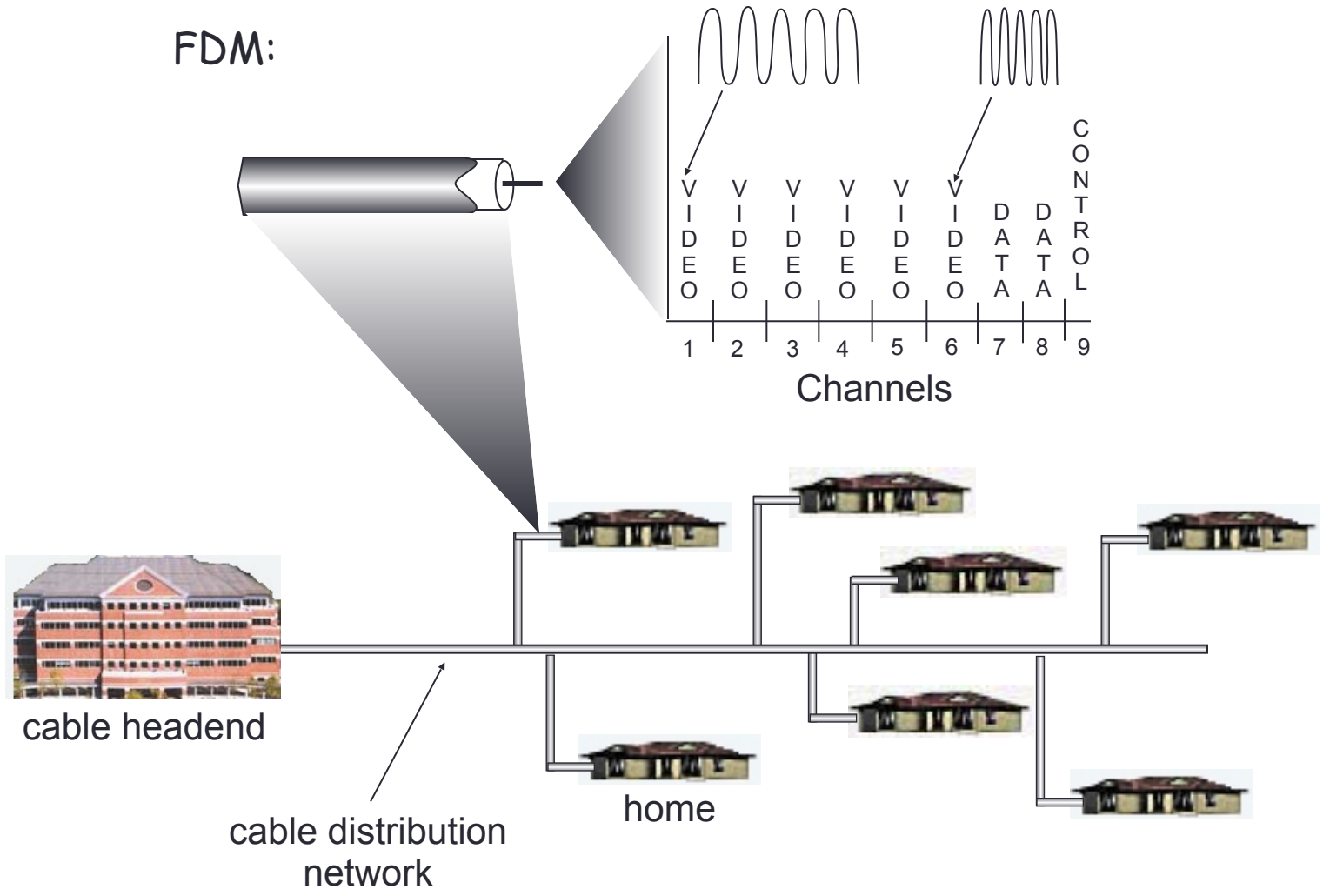
Cable Network Architecture: Overview

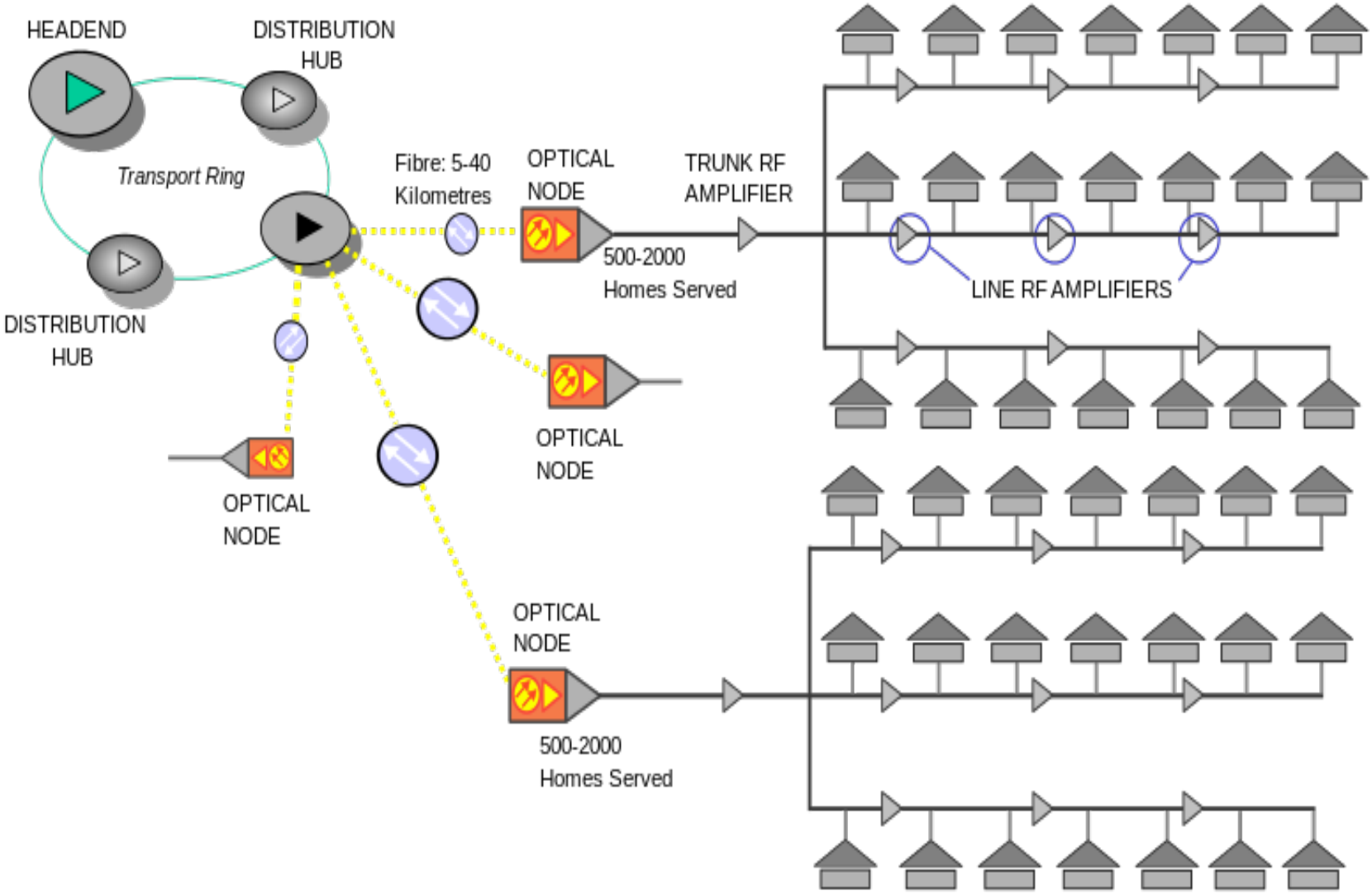


Cable Network Architecture: Overview



Cable Network Architecture: Overview




HEADEND
DISTRIBUTION HUB
Transport Ring
DISTRIBUTION HUB
Fibre: 5-40 Kilometres
OPTICAL NODE
TRUNK RF AMPLIFIER
500-2000 Homes Served
LINE RF AMPLIFIERS
OPTICAL NODE
OPTICAL NODE
OPTICAL NODE
500-2000 Homes Served

DSL & Cable Modem

- Speed
  - Cable modem generally wins the speed battle over DSL.
  - Cable technology can, in theory, achieve networking speeds of approximately 30 Mbps (using a 100 Mbps NIC)
  - Most forms of DSL cannot reach 10 Mbps.
  - cable modem technology delivers *shared bandwidth* within the local neighborhood
  - DSL delivers *dedicated local bandwidth*

ADSL

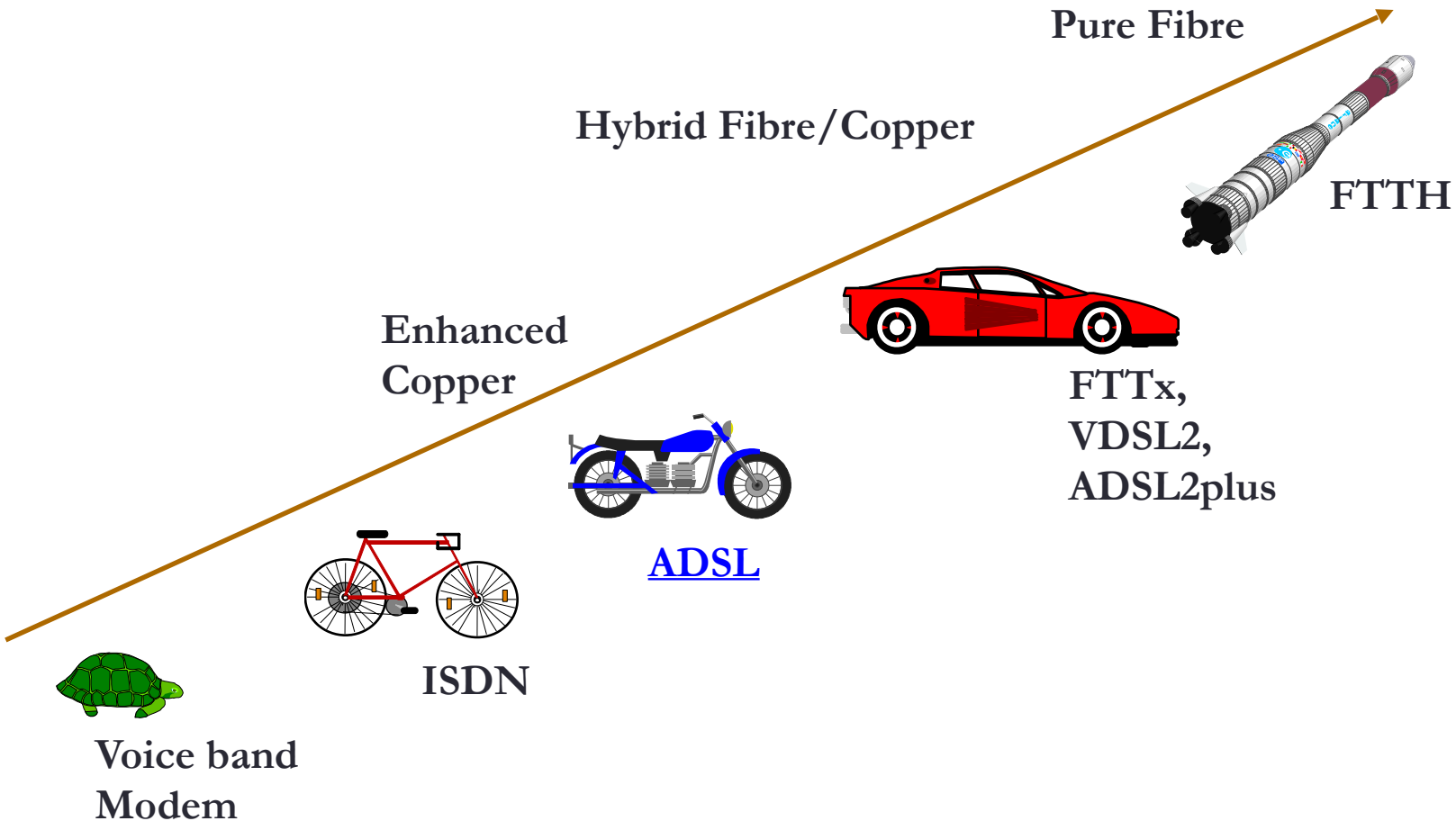
- ***Asymmetric Digital Subscriber Line*** was designed to provide higher downstream data rates at the expense of upstream rates.

- ADSL is technically capable of up to 8 Mbps (roughly 8000 Kbps), but the service customers actually receive generally performs at 2 Mbps or lower for downloads and 512 Kbps for uploads.

ADSL standards :

Standard name	Common name	Downstream rate	Upstream rate
ITU G.992.1	ADSL (G.DMT)	8 Mbit/s	1.0 Mbit/s
ITU G.992.2	ADSL Lite (G.Lite)	1.5 Mbit/s	0.5 Mbit/s
ITU G.992.3/4	ADSL2	12 Mbit/s	1.0 Mbit/s
ITU G.992.3/4 Annex J	ADSL2	12 Mbit/s	3.5 Mbit/s
ITU G.992.3/4 Annex L	RE-ADSL2	5 Mbit/s	0.8 Mbit/s
ITU G.992.5	ADSL2+	24 Mbit/s	1.0 Mbit/s
ITU G.992.5 Annex L	RE-ADSL2+	24 Mbit/s	1.0 Mbit/s
ITU G.992.5 Annex M	ADSL2+	28 Mbit/s	3.5 Mbit/s

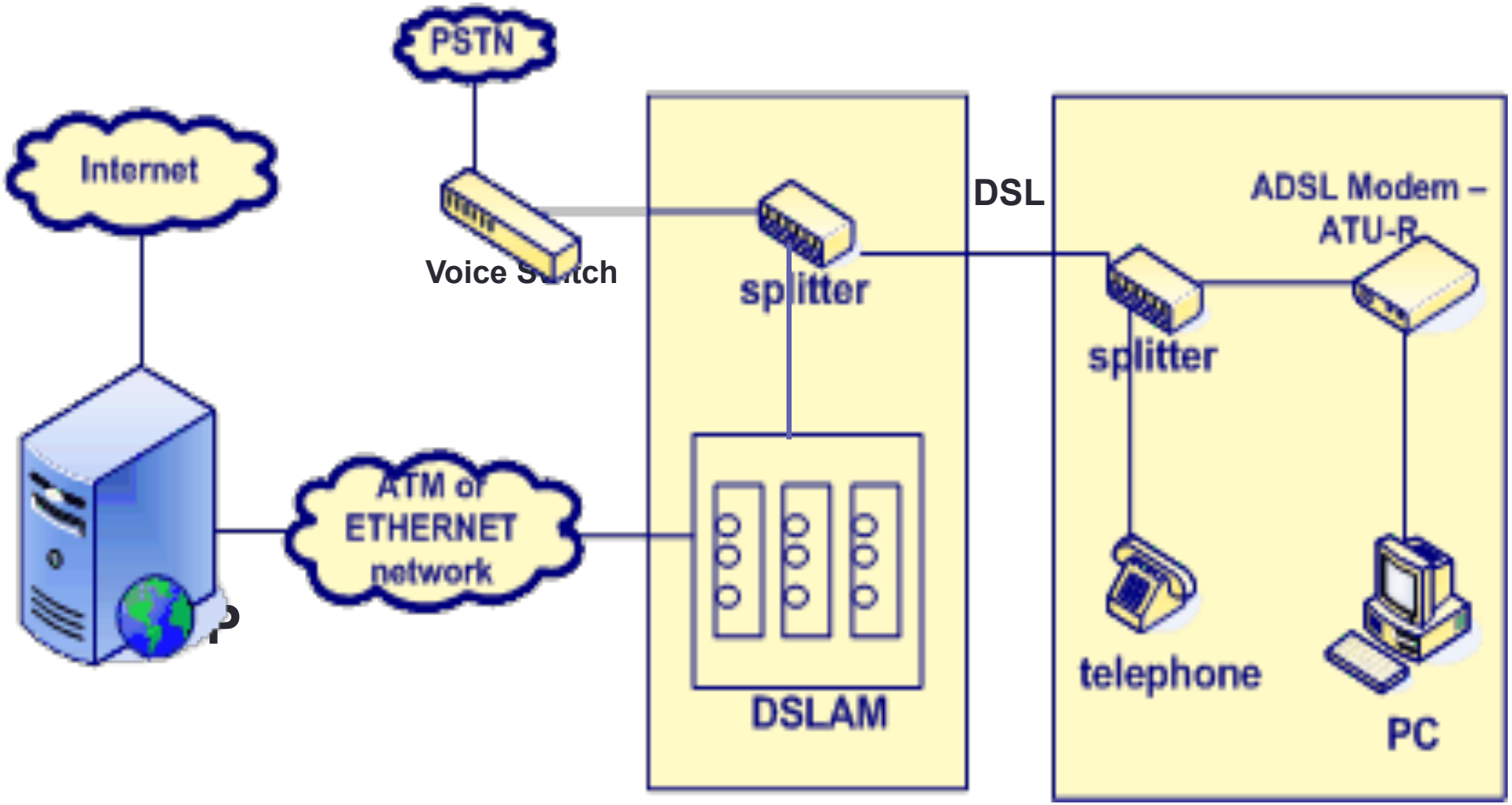
ADSL Speed Comparison



ADSL network components

- The ADSL modem at the customer premises (ATU-R) (ADSL Termination Unit)
- The modem of the central office (ATU-C)
- DSL access multiplexer (DSLAM)
- Broadband Access Server (BAS)
- Splitter - an electronic low pass filter that separates the analogue voice or ISDN signal from ADSL data frequencies DSLAM.

ADSL Loop Architecture



RADSL

- *Rate-Adaptive DSL* (RADSL), is an implementation of ADSL that automatically configures the modem at startup to adjust its rate according to the quality of the phone line.
- RADSL supports a much lower maximum date rate (1,088 kbps) than regular ADSL.

HDSL

- High Bit / Data-Rate DSL (HDSL) offers the same bandwidth both upstream and downstream.
- HDSL requires two phone lines to deliver the basic data rate (1,544 kbps),
- It can deliver a maximum rate of 2,048 kbps using three lines.

SDSL

- Symmetric DSL(SDSL) improves on the older HDSL technology by implementing the same basic data rate (1,544 kbps) while requiring only a single phone line.
- SDSL supports data rates up to 3,088 Kbps.

SHDSL

- Symmetric High-Bit-Rate DSL (SHDSL) attempts to improve on both HDSL and SDSL by only requiring a single line and by integrating low-level services of interest to small businesses.
- SHDSL technology can transport data symmetrically at data rates from 192 Kbps to 2,320 Kbps.

VDSL (BDSL)

- Very High Data-Rate DSL (VDSL) originally named VADSL ('A' for asymmetric) but later was extended to support both symmetric and asymmetric varieties of DSL.
- VDSL relies on fiber optic cabling.
- VDSL needs shorter cable lengths than most other forms of DSL (maximum 4,500 feet as compared to 18,000 feet for regular ADSL), but it also achieves the highest data rate (roughly 51,840 kbps).
- The bandwidth levels supported by VDSL are needed to support certain high-end applications such as High-Definition Television (HDTV) that requires, for example, up to 20,000 kbps.
- The performance of VDSL depends significantly on the physical distance traversed by wiring: Shorter distances mean faster networking.

IDSL

- ISDN DSL (IDSL) implements a hybrid DSL/ISDN solution.
- IDSL offers only limited data rates (128 kbps, although multiple circuits may be bonded).

VOIP (Voice Over IP)

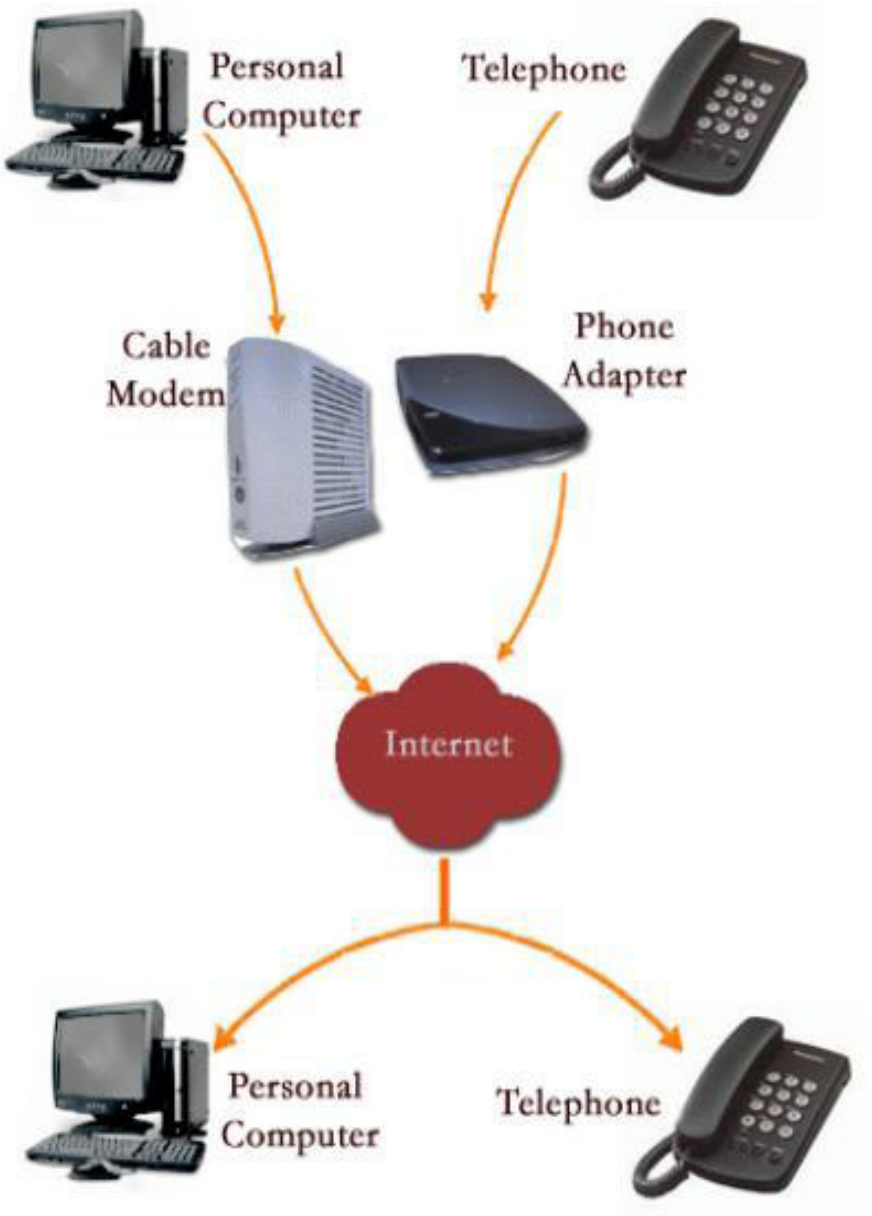
- VoIP is voice over an Internet Protocol (IP) based network
- Voice over Internet Protocol (VoIP) describes the category of hardware and software that enables people to make telephone calls via the Internet.
- Voice signals are converted to packets of data, which are transmitted on shared, public lines, hence avoiding the tolls of the traditional, public-switched telephone network (PSTN).

VOIP (Voice Over IP)

- VoIP uses the Internet Protocol (IP) to transmit voice as packets over an IP network.
- VOIP can be achieved on any data network that uses IP, like the Internet, Intranets and Local Area Networks (LAN).
- The voice signal is digitized, compressed and converted to IP packets and then transmitted over the IP network.
- VoIP services need only a regular phone connection, while others allow you to make telephone calls using an Internet connection instead.

VOIP

- VoIP can allow you to make a call directly from a computer, a special VoIP phone, or a traditional phone using an adapter to another VoIP phone or regular phone.



Transmission of Voice using IP Networks

- Step 1: Because all transmissions must be digital, the caller's voice is digitized.
- Step 2: Next using complex algorithms the digital voice is compressed and then Separated into packets; and using the Internet protocol, the packets are addressed and sends across the network to be reassembled in the proper order at the destination.
- Step 3: During transmission on the Internet, packets may be lost or delayed, or errors may damage the packets. Conventional error correction techniques would request retransmission of unusable or lost packets, but if the transmission is a real-time voice communication that technique obviously would not work, so sophisticated error detection and correction systems are used to create sound to fill in the gaps.
- Step 4: After the packets are transmitted and arrive at the destination, the transmission is assembled and decompressed to restore the data to an approximation of the original form.

Advantages of using VoIP rather PSTN

- Cost reduction - low cost phone calls.
- Convergence of data/voice networks – unification.
- Simplification and consolidation - centralized management.

Fax over Internet Protocol (FoIP)

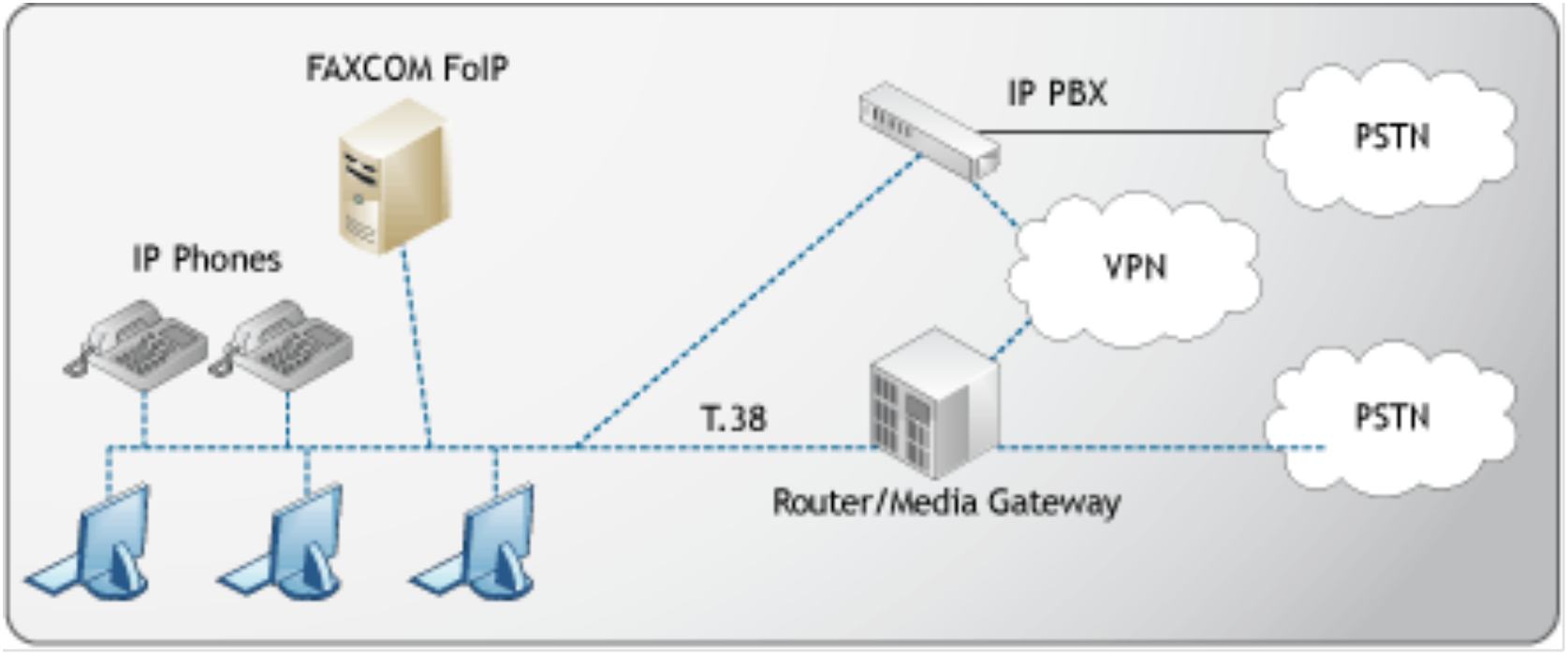
- **FoIP**, also called IP faxing, is a method of sending faxes over the Internet.
- FoIP changes the transmission medium of faxing in much the same way that VoIP (Voice over Internet Protocol) changes the transmission medium of a phone call.
- In both cases, data makes all or most of the trip between sending and receiving devices on a packet-switched network (usually the Internet), avoiding the long-distance phone lines of the circuit-switched telephone.
- This reduces the cost of transmission and can be a more efficient setup for a business that already has access to Internet bandwidth.

Fax over Internet Protocol (FoIP)

- The "IP" in FoIP stands for **Internet Protocol**, which is the series of standards and steps used to transmit data over the Internet to the correct destination address.
- The fax information is transmitted as "IP packets" via the Internet instead of as analog signals via phone lines.
- An **IP packet** is simply a chunk of data organized in a way that lets Internet routers and destination machines understand and decode what's inside it.
- You don't need to buy a new fax machine to use FoIP. FoIP allows traditional (called **3G**) fax machines to transfer data over the Internet using **gateways** between phone lines and the Internet.
- If you want to skip the phone lines altogether, you can use an **IP fax machine** that connects directly to the Internet.
- When you're transmitting a fax between two IP fax machines, the transmission cost is the same as for e-mail, and it's faster because transmission is entirely via broadband channels.

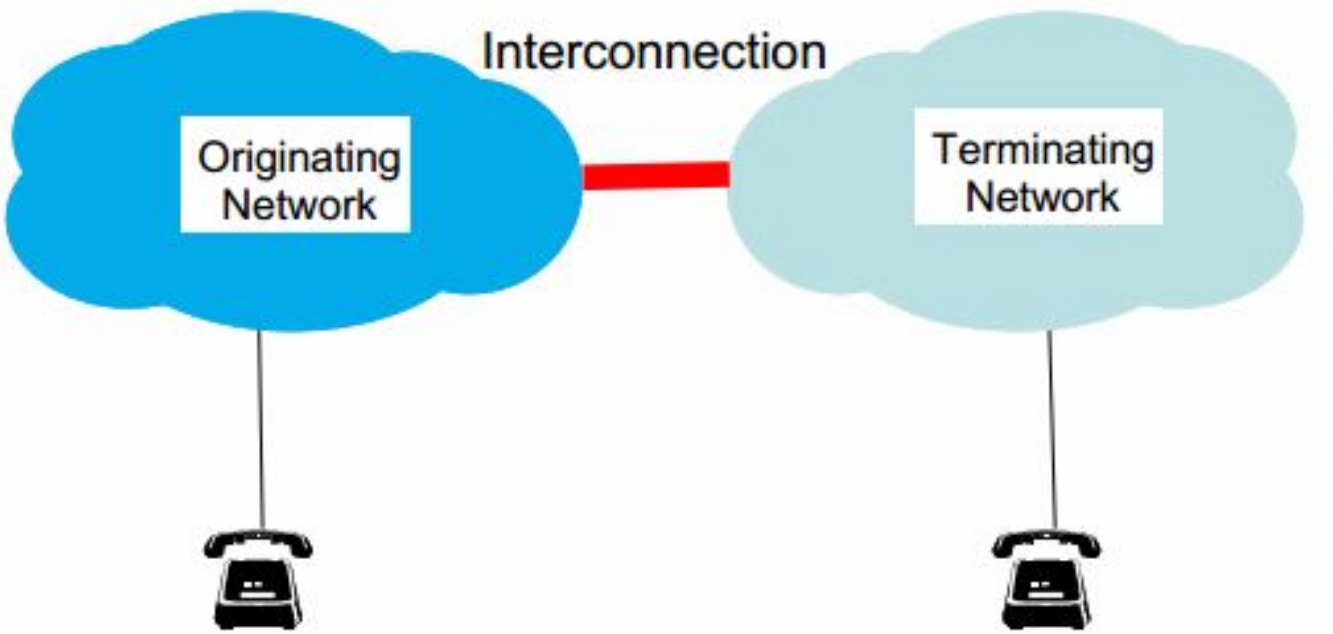
Fax over Internet Protocol (FoIP)

- FoIP works via T.38, where T.38 is a protocol that describes how to send a fax over a computer data network.
- As this diagram shows, T.38 requires a T.38-capable VoIP gateway as well as a T.38-capable fax device.



IP Interconnection

- Interconnection links networks so as to enable the customers of one operator to establish and maintain communications with the customers of another operator.
- Interconnection for Internet traffic over IP networks operates according to a different set of rules from telephony.
- However an increasing proportion of telephone traffic is carried over IP-enabled carrier networks.



IP Interconnection

- There are now many different operators offering network capacity to send, transit and terminate traffic, ranging from traditional telecom carriers to third party vendors, from Internet Access Providers (retail) to Internet Backbone Access (wholesale) carriers, from content distribution networks (CDNs) to utilities with spare capacity to wholesale.
- The commercial terms and ways in which interconnection is offered varies considerable. For example, carriers traditionally interconnect at network Points of Interconnection (POIs) whereas CDNs and cloud computing service companies interconnect in data centres, and Internet Access Providers at Internet Exchanges.
- Nevertheless, despite its origins and the fact that Internet traffic was never subject to the same regulatory regime as telecoms, certain common practices have emerged.

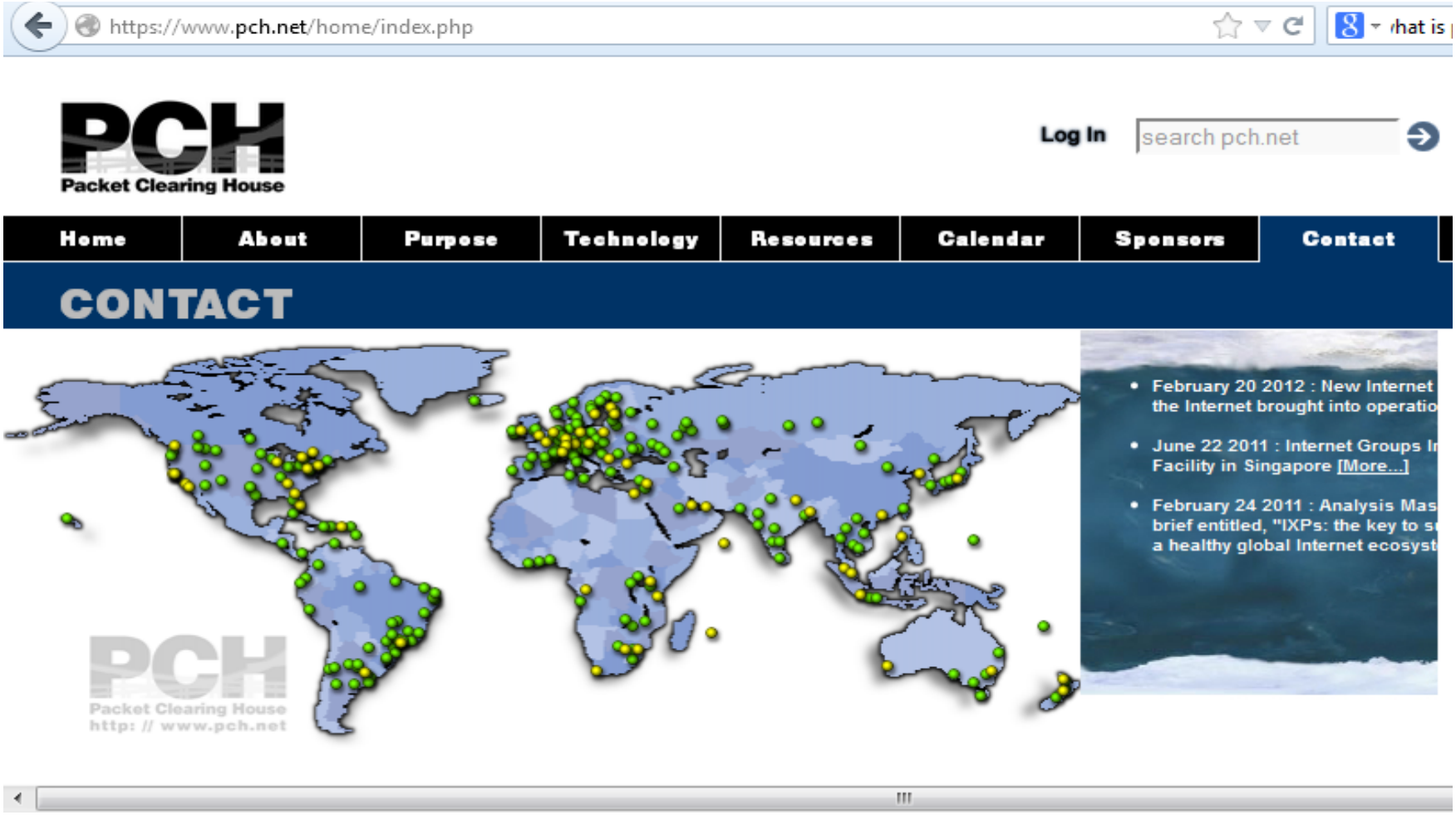
IP Interconnection

- To be cost-effective, interconnection between circuit-switched TDM (Time-Division Multiplexing) telecom networks requires points of interconnection (POI) that minimise route distances.
- For price arbitrage reasons service providers may choose a more round-about routing of traffic, but technically the more direct the routing the more efficient it is and the less latency involved.
- In a packet-switched world of Internet Protocol (IP), a different set of principles operate.
- Because different packets of the same transmission are routed over different networks there is no single POI.

IP Interconnection

- ISPs do not always own their own networks and there is no guarantee of the quality of the networks over which the packets will route.
- So unless the network was ‘managed’ and its quality assured, Internet traffic from its earliest days was only ‘best effort’.
- Investment in broadband in recent years means network quality has generally improved and with more sophisticated routing algorithms ‘best effort’ is now often of very high quality.
- For example, over-the-top (OTT) voice and video services like Skype and Yahoo Messenger, Facebook and Google that are transmitted internationally over broadband networks can be crystal clear with minimal latency.
- In addition, a range of specialist managed Internet networks have arisen such as CDNs that guarantee quality of delivery.

Packet Clearing House (PCH)



What is PCH?

- **Packet Clearing House** is a non-profit research institute that supports operations and analysis in the areas of Internet traffic exchange, routing, economics, and global network development.
- Originally formed in 1994 to provide efficient regional and local network interconnection alternatives for the west coast of the United States, PCH has since grown to become the leading proponent of neutral independent network interconnection and provider of route-servers at major exchange points worldwide.
- PCH also provides equipment, training, data, and operational support to organizations and individual researchers seeking to improve the quality, robustness, and accessibility of the Internet

PCH Activities

- Current and ongoing PCH projects include:
  - construction of Internet Exchanges Points (IXPs) throughout the developing world;
  - operation of the INOC-DBA (Inter-Network Operations Center Dial-By-ASN) global Internet infrastructure protection hotline;
  - support for globally distributed domain name system (DNS) resources;
  - implementation of network research data collection initiatives throughout the world;
  - and the development and presentation of educational materials to foster a better understanding of Internet architectural principles and their policy implications among policy makers, technologists, and the general public.

PCH Operation

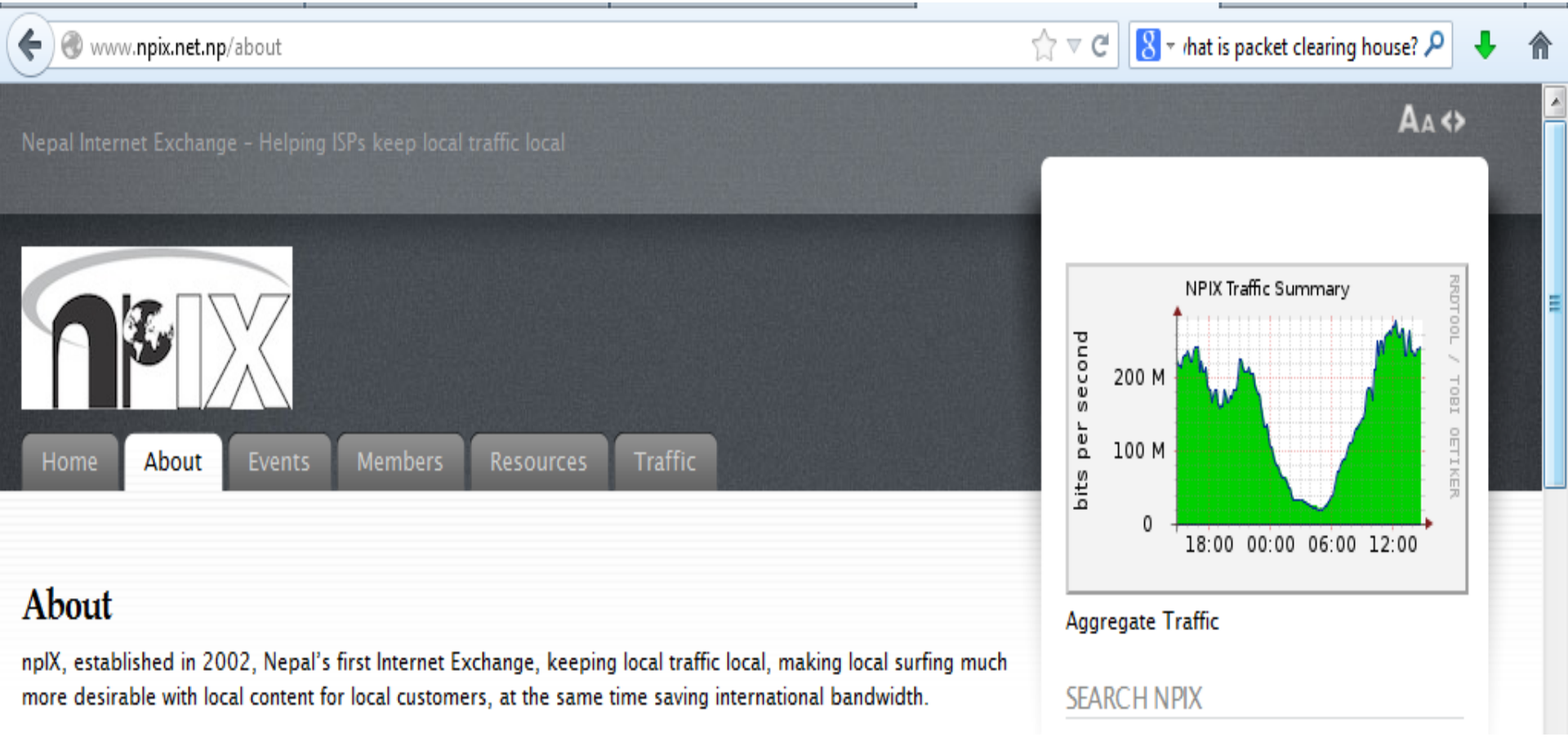
- **INTERNET EXCHANGE SUPPORT**
  - PCH provides support both to Internet exchange facilities in the process of formation and to those that are already up and running.
  - Supply the switching equipment that forms the technological core of exchanges, often to most valuable contribution is in the form of education, technical expertise, and mediation with policy and economic officials of the local government.
  - Works with the exchange, its member-participants, and regulatory authorities to create a new business model that satisfies each of the stakeholders and provides long-term financial stability.
  - PCH also provides Layer-3 route servers to facilitate easier and safer interconnection between participants at the exchange.
  - As new participants join the exchange, they receive the immediate benefit of full use of the exchange as soon as they contact the route server.

PCH Operation

- **INTER-NOC HOTLINE PHONE SYSTEM**
  - Operates the Inter-Network Operations Center Dial-By-ASN (INOC-DBA) hotline phone system.
  - INOC-DBA a global voice telephony network that connects the network operations centers and security incident response teams of critical Internet infrastructure providers.
  - The INOC-DBA is a closed system, ensuring secure and authenticated communications, and uses a combination of highly redundant directory services and direct peer-to-peer communications between stations to create a resilient, high-survivability network.
  - It carries both routine operational traffic and emergency-response traffic.

Packet Clearing House

Nepal internet Exchange : NPIX



Data Centers

Data Centers

- What is a Data Center?
  - A Data center or NOC (network operations center) is a place to consolidate application servers, Web servers, communications equipment, security systems, system administrators, support personnel, and anything or anybody else that provides data services.
  - A data center benefits from centralized management, support, backup control, power management, security, and so on.
  - It may be housed in a single room or fill an entire building.
  - Special equipment is usually installed to protect against power outages, natural disasters, and security breaches.
  - Data Centers are specialized environments that safeguard your company's most valuable equipment and intellectual property.

Data Centers

- Data Centers house the devices that do the following:
  - Process your business transactions
  - Host your website
  - Process and store your intellectual property
  - Maintain your financial records
  - Route your e-mails
- Good design begins with facility concept plan.
- Before you even think about the computers, there are many other “design decisions” to be made:
  - Physical Security needs
  - Cooling issues / Environment Factors
  - Electrical requirements
  - Floor loading restrictions
  - Fire detection/suppression?
  - Growth/floor planning?

Data Centers

- In a world where every IT director and security expert gets his wish, data centers would be constructed with dual electric power feeds, multiple generators, redundant heating, ventilation, air conditioning (HVAC), dual-interlock dry-pipe fire suppression systems, iris scans, laser grids, man traps, face-recognition devices, and a surfeit of other technologically advanced systems and procedures.
- In the real world, operating costs and business strategy intercede, and companies must develop the most practical and effective methods for building and securing their organizations' mission-critical data centers.

What do you need to know?

- Physical design and construction of a Data Center
- How to customize the environment to meet your company's needs
- How to organize and manage your Data Center effectively so downtime is minimized, troubleshooting is easier, and the room's infrastructure is fully used
- So, how much is acceptable to spend on the construction of your Data Center? That depends. To determine the answer, you need to know the value of what your Data Center is protecting.
- Determine needs: Often, a location in a suburban settings is better than a city.
- Common sense factors:
  - Avoid co-location with neighbors involved in any kind of hazmat manufacturing or distribution
  - Avoid locations that may be prone to flooding – even if you seal the building, you have to be able to physically get there!

What do you need to know?

- Security:
  - You can **not** have software security without first having physical security!
  - Can be as simple as a card key, a proximity badge, or a cipher-lock, which is a key pad that requires the user to enter a multi-digit numeric code.
  - At the top of the line are biometric security systems, which can include, but not limited to, handprint recognition, iris scans, and face recognition. Cameras often a good idea.

- Cooling:
  - Computers, packed together, produce a LOT of heat!
  - Problem getting worse – as computers get faster, they're consuming more power. More Power = More heat,
  - Extremely expensive HVAC systems that provide redundant cooling.

Other Environmental Factors

- Relative Humidity – Keep around 45-50%?
- Cabinets often need to protect against Vibration and Shock.

Crisis Management

- Expect the worst, hope for the best
- Have a plan in the event something disastrous happens
- Several companies offer “emergency” services (Sungard)

Purpose of building data center

- Why is your company building this Data Center?
- What needs must it meet?
- What specific functions does it need to perform, and perform well, to be considered a success?
- What level of availability does your business require?

Roles and relationship

- Delineate which departments and people are responsible for what tasks.
- Who designs the Data Center's electrical infrastructure, for example?
  - An IT person who manages the room and knows about the incoming server equipment?
  - A facilities person experienced with electrical systems?
  - An outside architect knowledgeable about regional building codes?

Understanding Client Needs

- Talk to the people who work in the room (your client), and find out the following:
  - What servers they want it to support
  - How much connectivity those devices need
  - What their power requirements are
  - Whether clients see trends among the equipment they are ordering most commonly
- Focus on current needs along with future needs.
- Clients knows well their current needs.
- Clients may do not have any idea about future needs.

Cross-Functional Support

- Responsibility for a company's Data Center is typically shared among multiple departments and personnel.
- Example:
  - Security manager typically governs physical access into the Data Center.
  - IT manager coordinates where servers are physically deployed.
  - Each one has different point of view with regards to security access.
- Solution: Foster communication and seek compromise

Architecting a Productive Data Center

- In order to have well designed data center you need to follow five essential design strategy:
  - Make It Robust
  - Make It Modular
  - Make It Flexible
  - Standardize
  - Promote Good Habits

Data Center Design Criteria

- Availability
- Infrastructure Tiers
- One Room or Several?
- Life Span
- Budget Decisions

Data Center Design Criteria

- **Availability**:
  - The degree to which Data Center devices function continuously is known as the room's availability or its uptime.
  - Availability is represented as a percentage of time. How many days, hours, and minutes is the Data Center's electrical infrastructure operational and supplying power over a given time period.

- **Infrastructure Tiers**
  - The higher the availability you want your Data Center to achieve, the more layers of infrastructure it must have.
  - *N capacity* is the amount of infrastructure required to support all servers or networking devices in the Data Center, assuming that the space is filled to maximum capacity and all devices are functioning.
  - N+1 infrastructure can support the Data Center at full server capacity and includes an additional component

Data Center Design Criteria

- **One Room or Several?**
  - One large Data Center is simpler to manage than several smaller ones.
  - Having only one server environment puts all of your eggs in one basket.

- **Life Span**
  - How long it is expected to support your company's needs without having to be expanded or retrofitted, or otherwise undergo major changes.
  - The most effective strategy is to design a Data Center with a projected life span of a few years.

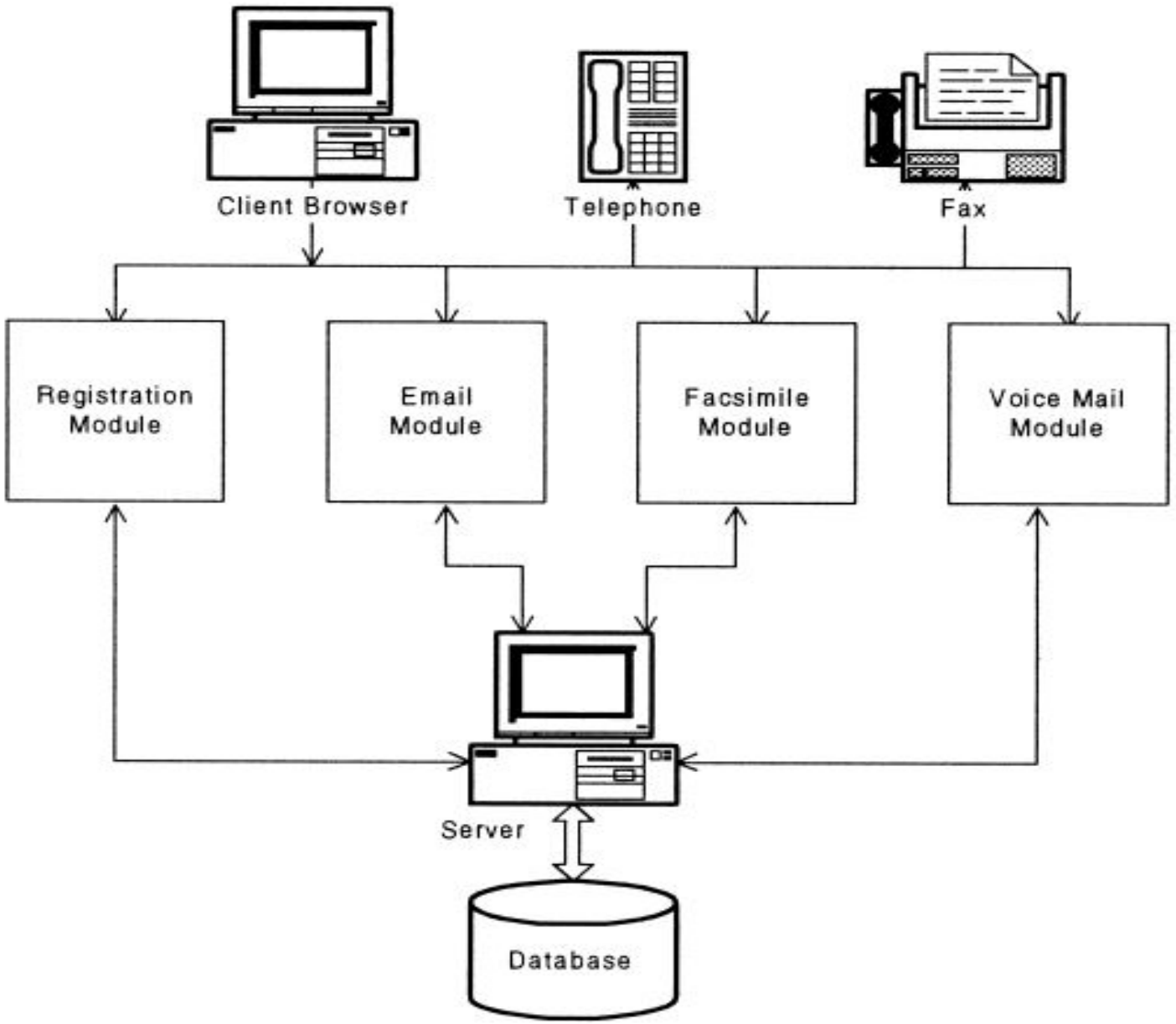
Data Center Design Criteria

- **Budget Decisions**
  - It is not good to spend millions of dollars on a server environment to protect your company's assets if that cost drives your business into bankruptcy.
  - The most obvious costs for a Data Center are labor and materials associated with its initial construction, which, even for a room smaller than 1000 square feet or 100 square meters, normally runs into hundreds of thousands of dollars. This includes:
    - Initial construction
    - Consulting fees
    - Real estate
    - Ongoing operational expenses

Unified Messaging System

- Unified Messaging (or UM) is the integration of different electronic messaging and communications media (e-mail, SMS, Fax, voicemail, video messaging, etc.) technologies into a single interface, accessible from a variety of different devices.
- Broadly speaking, unified messaging can be defined as a system that allows users access to all of their messages, regardless of location, communication device or the type of connection used.
- Unified messaging is a simple, yet extremely powerful concept.
- An individual's communication environment is constantly changing. The amount of information and the respective sources are constantly increasing. Users should be able to listen to voice messages, view documents or faxes on screen, send faxes, create emails and manage information in the manner most appropriate to their communications universe, be it in the office, at home or on the road.

UMS Architecture



Unified Messaging System

- Unified messaging enables users to see, hear, send, store or retrieve all of their messages with whatever tool is more conveniently available.
- These tools include the telephone, desktop, personal computer or laptop.
- It is no surprise that unified messaging saves time and money.
- The fewer devices you need to access to send, retrieve and store messages, the more efficient you can be.
- The power of the Internet is limitless. With the Internet now at our fingertips, unified messaging takes another leap to improve communications. Imagine how much more effective your message becomes when it is heard rather than read.

UMS

- While traditional communications systems delivered messages into several different types of stores such as voicemail systems, e-mail servers, and stand-alone fax machines, with Unified Messaging all types of messages are stored in one system.
- Voicemail messages, for example, can be delivered directly into the user's inbox and played either through a headset or the computer's speaker.
- This simplifies the user's experience (only one place to check for messages) and can offer new options for workflow such as appending notes or documents to forwarded voicemails.

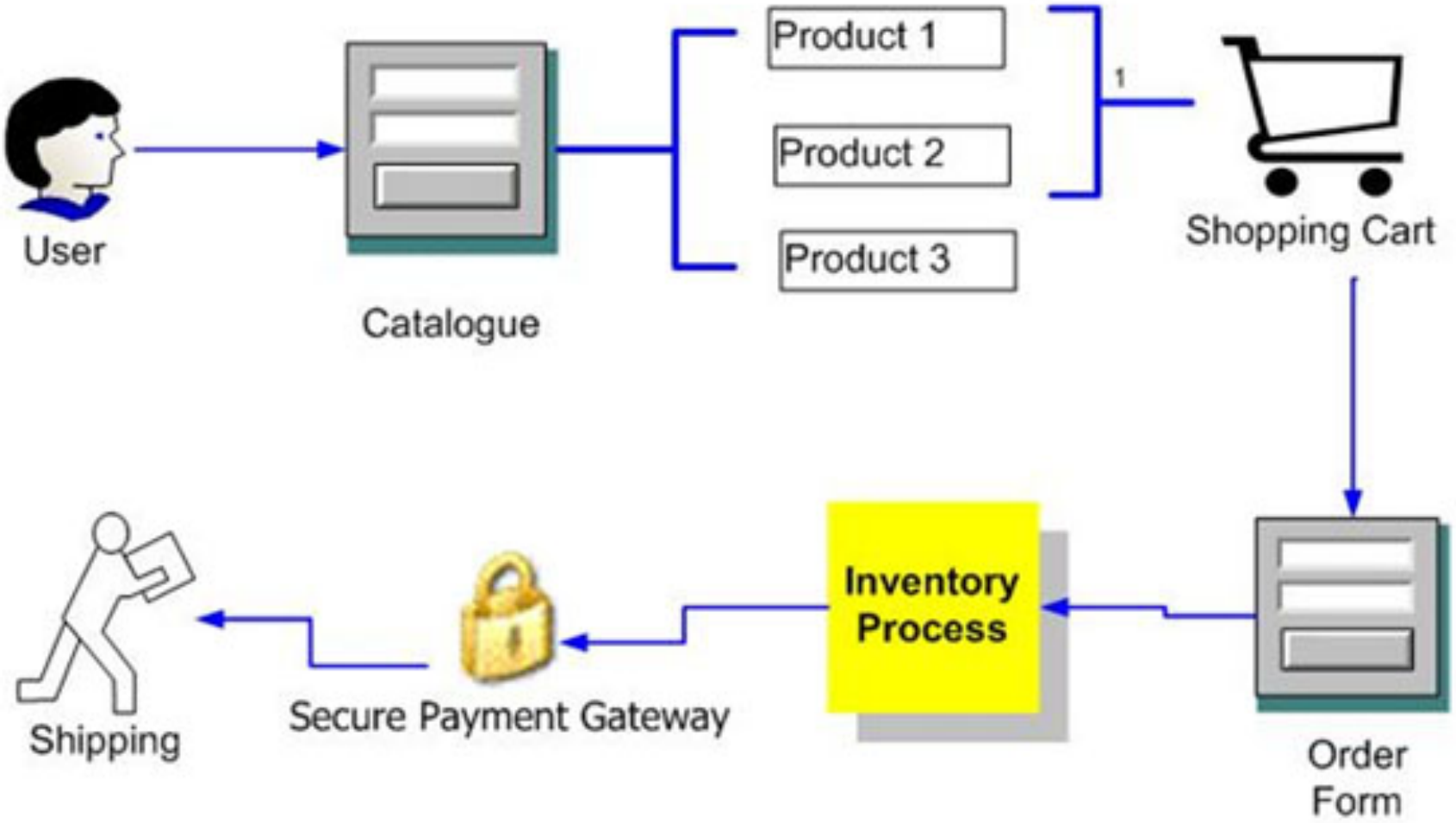
UMS

- Unified Messaging was expected by many in the consumer telecommunications industry to be a popular product, first augmenting and eventually replacing voicemail.
- Today, UM solutions are increasingly accepted in the corporate environment. The aim of deploying UM solutions generally is to enhance and improve business productivity while decreasing communication issues.
- UM solutions targeting professional end-user customers integrate communications processes into the existing IT infrastructure, i. e. into CRM, ERP and mail systems.

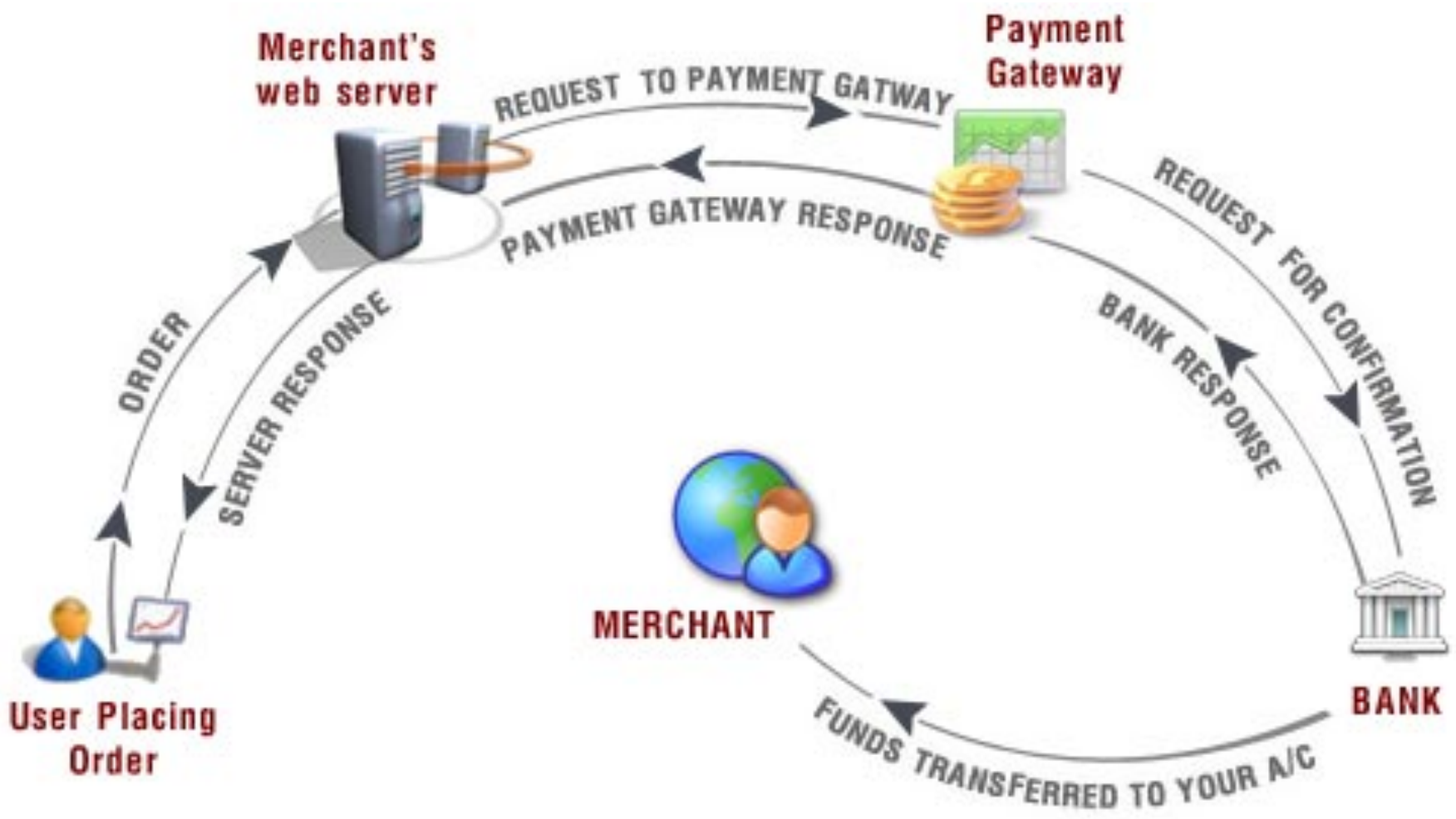
E-Commerce

- E-commerce is the technical term for buying and selling things through the electronic media.
- The concept of ecommerce has come a long way to mean much more than simple buying and selling.
- Ecommerce, in the 21st century means the presence of a complete shop online with advanced functionalities enabling easy shopping.

E-Commerce


User
Catalogue
Product 1
Product 2
Product 3
1
Shopping Cart
Order Form
Inventory Process
Secure Payment Gateway
Shipping

The building blocks of ecommerce



The building blocks of ecommerce

- Web Site
- Shopping Cart Software
- Ecommerce Payment Methods
- Payment Gateway
- Merchant Bank
- SSL

Shopping Cart Software

- This is the most important component that allows shoppers to select products from a list, place an order for them and also make online payment.
- Not long ago vendors used to hire programmers to develop customized shopping cart software for their ecommerce sites, but now it has become all the more easy.
- Ecommerce service provider's offer ready shopping cart software that you can plug and play, making it easy for merchants to launch online business sites.
- Example: Magento, OpenCart, VirtueMart, ZenCart, Shopify etc.

Merchant Bank

- Merchant banks are financial institutions.
- Whenever a person clicks on the checkout page and puts in the credit card payment details, the merchant bank processes and verifies the credit card details and gives instant notification to the customer as well as to the merchant.
- This component is inbuilt within the Payment Gateway.
- Merchants need to open a Merchant Account to avail this service. Thorough knowledge of Merchant Bank and Merchant Account is thus needed to make your ecommerce a success.

Merchant account

- In the simplest of terms, a merchant account is a specialized account provided by a bank or other financial institution to enable real time e-commerce transactions.
- It allows businesses to accept payment online through credit/ debit card and e-check.
- The account is set up under a contractual agreement between business/merchant and the bank. As in such agreements, the rights and responsibilities of both the parties are chalked out.
- Broadly, under this agreement the bank agrees to pay the merchant for all valid online business transactions, including credit card, debit card and e-check and processes the payment made.

Payment Gateway

- Did you ever wonder how you could make online payments so easily, when you go for e-shopping? The answer is simple. Payment Gateway is the connector between the buyers and the financial network.
- It helps to process the online payments and credit card processing made by the customer, with utmost speed and accuracy.
- A third party like Verisign or Paypal often provide this service.
- The correct choice of payment gateway that suits your ecommerce needs is crucial and this is where the role of an authentic ecommerce service provider comes in.

SSL

- Secure Socket Layer provides the security factor in payment transaction.
- With the help of a private key for data encryption, SSL transmits confidential user data, like credit card information, over the Internet.
- Use of SSL in your site assures the customer that their credit card and other personal information are NOT being made public or being misused by the merchant.

Ecommerce – advantages over offline business:

- Saves the cost and time of setting up and maintaining a physical store
- Provides customers the convenience of shopping from anywhere, anytime
- Maintains every business transaction detail, even the smallest one
- Makes the shop accessible to customers from all over the globe
- Many customers can be simultaneously attended to
- Checks fraudulent transaction attempts
- Helps take business beyond the borders of your country or locality, offering you the potential for exponential growth
- Helps the merchant to offer a competitive price to the buyers, by giving discounts and other lucrative offers
- Provides money back guarantee for ensuring customer satisfaction
- By linking to other affiliate sites, helps Customers to find related things of interest

E-Commerce Models

- Business – to – Business (B2B)
- Business – to – Consumer (B2C)
- Consumer – to- Consumer (C2C)
- Consumer – to – Business (C2B)
- Government-to-Government (G2G)
- Government-to-Consumer (G2C)
- Consumer-to-Government (C2G)
- Government-to-Business (G2B)
- Business-to-Government (B2G)

Business-to-Business (B2B) Model

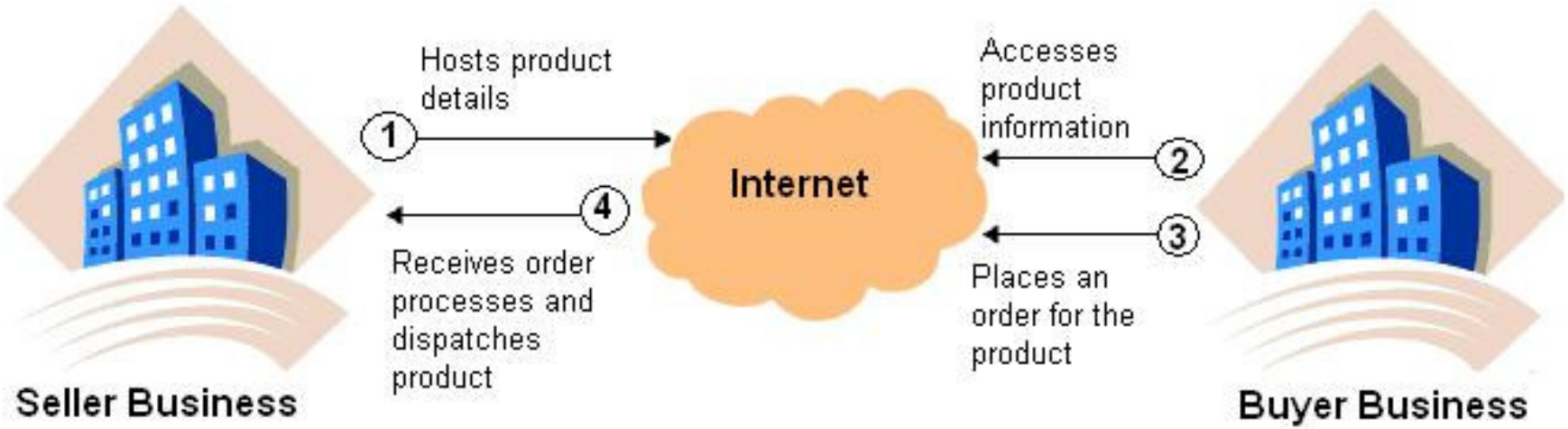
- The B2B model involves electronic transactions for ordering, purchasing, as well as other administrative tasks between houses.
- It includes trading goods, such as business subscriptions, professional services, manufacturing, and wholesale dealings.
- Sometimes in the B2B model, business may exist between virtual companies, neither of which may have any physical existence.
- In such cases, business is conducted only through the Internet.

Business-to-Business (B2B) Model

- As you know, www.amazon.com is an online bookstore that sells books from various publishers including Wrox, O'Reilly, Premier Press, and so on. In this case, the publishers have the option of either developing their own site or displaying their books on the Amazon site (www.amazon.com), or both.
- The publishers mainly choose to display their books on www.amazon.com as it gives them a larger audience. Now, to do this, the publishers need to transact with Amazon, involving business houses on both the ends, is the B2B model.

Business-to-Business (B2B) Model

- B2B

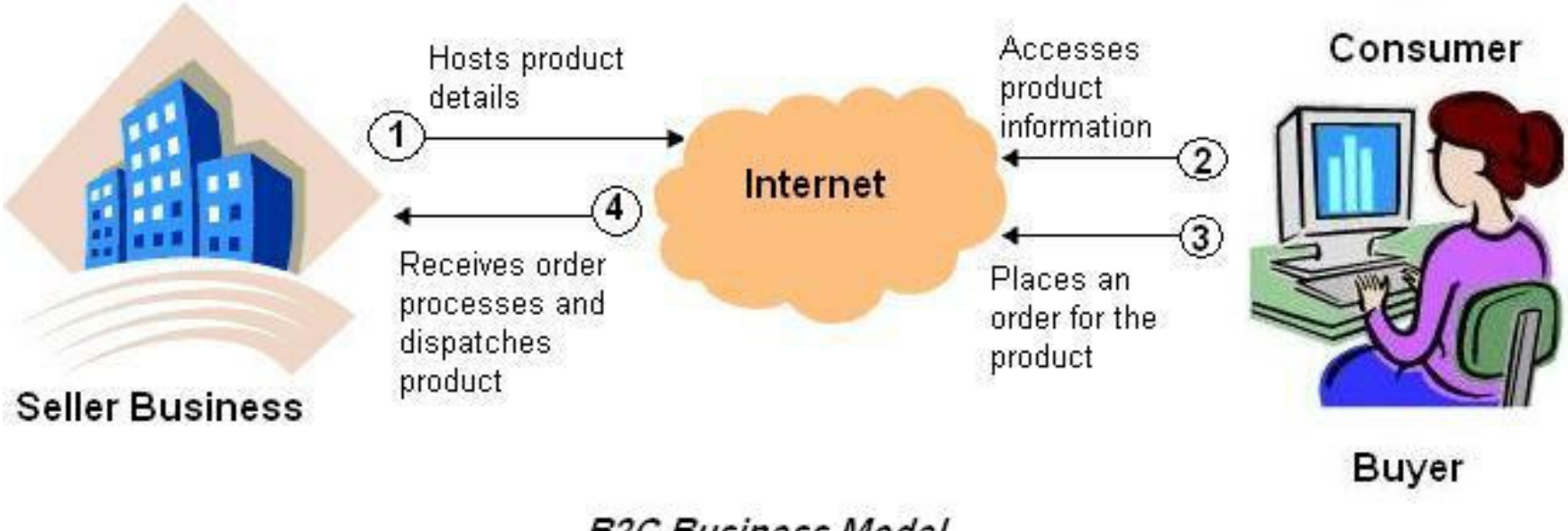


B2B Business Model

Business – to – Consumer (B2C) model

- The B2C model involves transactions between business organizations and consumers.
- It applies to any business organization that sells its products or services to consumers over the Internet.
- These sites display product information in an online catalog and store it in a database.
- The B2C model also includes services online banking, travel services, and health information.
- The example of the www.amazon.com site involves the B2C model in which the consumer searches for a book on their site and places an order, if required

Business – to – Consumer (B2C) model

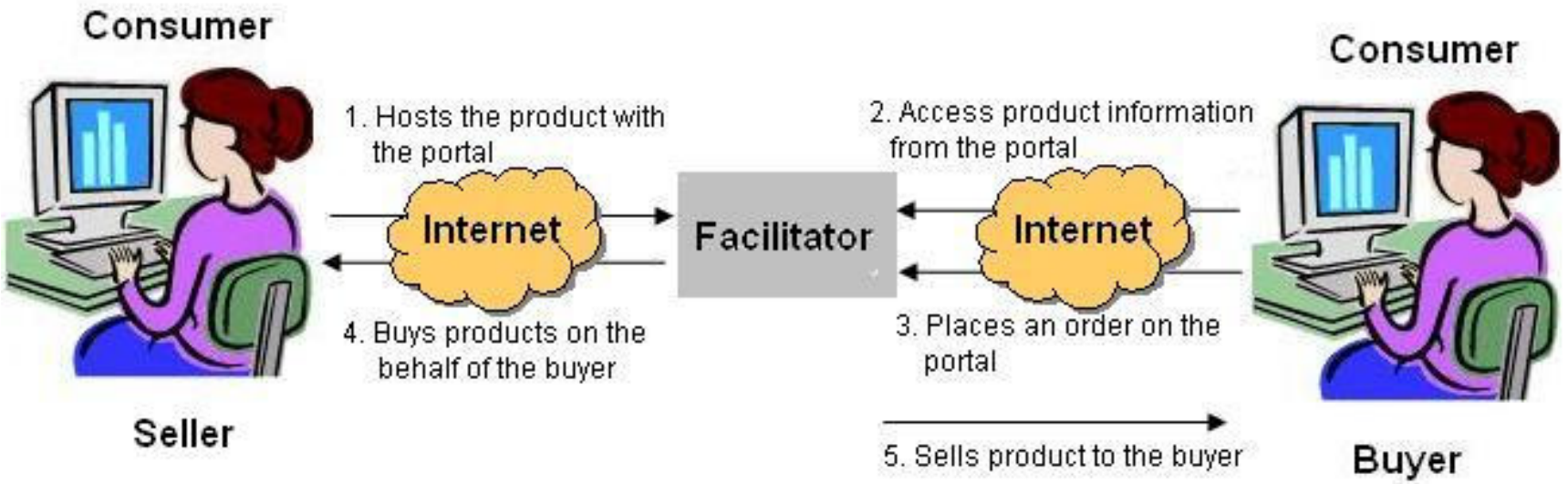


B2C Business Model

Consumer – to- Consumer (C2C) model

- The C2C model involves transaction between consumers.
- Here, a consumer sells directly to another consumer. eBay and www.bazee.com are common examples of online auction Web sites that provide a consumer to advertise and sell their products online to another consumer.
- However, it is essential that both the seller and the buyer must register with the auction site

Consumer – to- Consumer (C2C) model

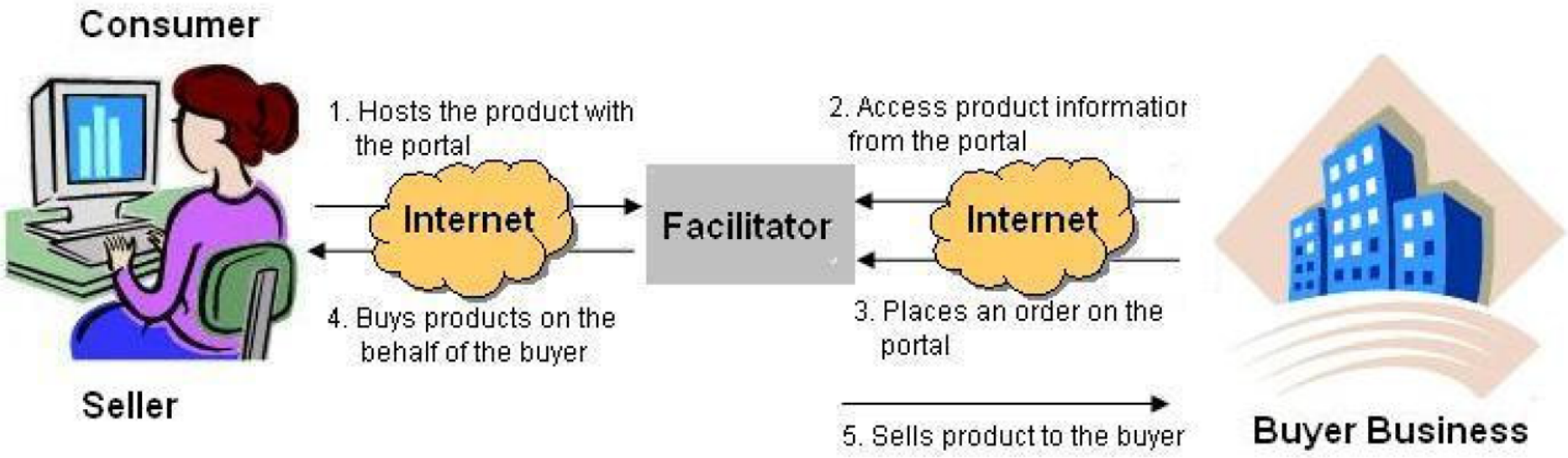


C2C Business Model

Consumer – to – Business (C2B) model

- The C2B model involves a transaction that is conducted between a consumer and a business organization.
- It is similar to the B2C model, however, the difference is that in this case the consumer is the seller and the business organization is the buyer.
- In this kind of a transaction, the consumers decide the price of a particular product rather than the supplier.
- This category includes individuals who sell products and services to organization

Consumer – to – Business (C2B) model



C2C Business Model

Government-to-Government (G2G)

- This model involves transactions between 2 governments.
- For example, if the American government wants to by oil from the Arabian government, the transaction involved are categorized in the G2G model.

Government-to-Consumer (G2C)

- In this model, the government transacts with an individual consumer.
- For example, a government can enforce laws pertaining to tax payments on individual consumers over the Internet by using the G2C model

Consumer-to-Government (C2G)

- In this model, an individual consumer interacts with the government.
- For example, a consumer can pay his income tax or house tax online. The transactions involved in this case are C2G transactions.

Government-to-Business (G2B) model

- This model involves transactions between a government and business organizations.
- For example, the government plans to build a fly over. For this, the government requests for tenders from various contractors. Government can do this over the Internet by using the G2B model

Business-to-Government (B2G)

- In this model, the business houses transact with the government over the Internet.
- For example, similar to an individual consumer, business houses can also pay their taxes on the Internet.

Cloud Computing

- Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
- In October 2007, IBM and Google announced collaboration in cloud computing. The term “cloud computing” become popular from then on.
- Beside the web email, the Amazon Elastic Compute Cloud (EC2), Google App Engine and Sales force’s CRM largely represent a promising conceptual foundation of cloud services.
- The services of cloud computing are broadly divided into three categories:
  - Infrastructure-as-a-Service (IaaS),
  - Platform-as- a-Service (PaaS),
  - Software-as-a-Service (SaaS)

Cloud Computing

- Cloud computing also is divided into five layers including clients, applications, platform, infrastructure and servers.
- The five layers look like more reasonable and clearer than the three categories.
- Mixed machine heterogeneous computing (HC) environments utilize a distributed suite of different machines, interconnected with computer network, to perform different computationally intensive applications that have diverse requirements.
- Miscellaneous resources should be orchestrated to perform a number of tasks in parallel or to solve complex tasks atomized to variety of independent subtasks.

Cloud Computing

- With cloud computing, companies can scale up to massive capacities in an instant without having to invest in new infrastructure, train new personnel, or license new software.
- Cloud computing is of particular benefit to small and medium-sized businesses who wish to completely outsource their data-center infrastructure, or large companies who wish to get peak load capacity without incurring the higher cost of building larger data centers internally. In both instances, service consumers use what they need on the Internet and pay only for what they use.
- The service consumer no longer has to be at a PC, use an application from the PC, or purchase a specific version that's configured for smartphones, PDAs, and other devices.
- The consumer does not own the infrastructure, software, or platform in the cloud. He has lower upfront costs, capital expenses, and operating expenses. He does not care about how servers and networks are maintained in the cloud.
- The consumer can access multiple servers anywhere on the globe without knowing which ones and where they are located.

Grid Computing

- Grid computing is a form of distributed computing that involves coordinating and sharing computing, application, data and storage or network resources across dynamic and geographically dispersed organization.
- The **grid** can be thought of as a distributed system with non-interactive workloads that involve a large number of files.
- Grid technologies promise to change the way organizations tackle complex computational problems.
- The vision of grid computing was to allow access to computer based resources (from CPU cycles to data servers) in the same manner as real world utilities.
- This gave rise to the idea of Virtual Organizations (VOs). Through the creation of VOs, it was possible to access all resources as though all resources were owned by a single organization.

Grid Computing

- Cloud computing evolves from grid computing and provides on-demand resource provisioning.
- Grid computing may or may not be in the cloud depending on what type of users are using it.
- If the users are systems administrators and integrators, they care how things are maintained in the cloud. They upgrade, install, and virtualize servers and applications.
- If the users are consumers, they do not care how things are run in the system.
- Grid computing requires the use of software that can divide and farm out pieces of a program as one large system image to several thousand computers.
- One concern about grid is that if one piece of the software on a node fails, other pieces of the software on other nodes may fail.
- This is alleviated if that component has a failover component on another node, but problems can still arise if components rely on other pieces of software to accomplish one or more grid computing tasks.
- Large system images and associated hardware to operate and maintain them can contribute to large capital and operating expenses.

Thank You !!!