Internet and Intranet

Lecture by:

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August 2015

Chapter 7: Internet and Intranet Applications

Topics :

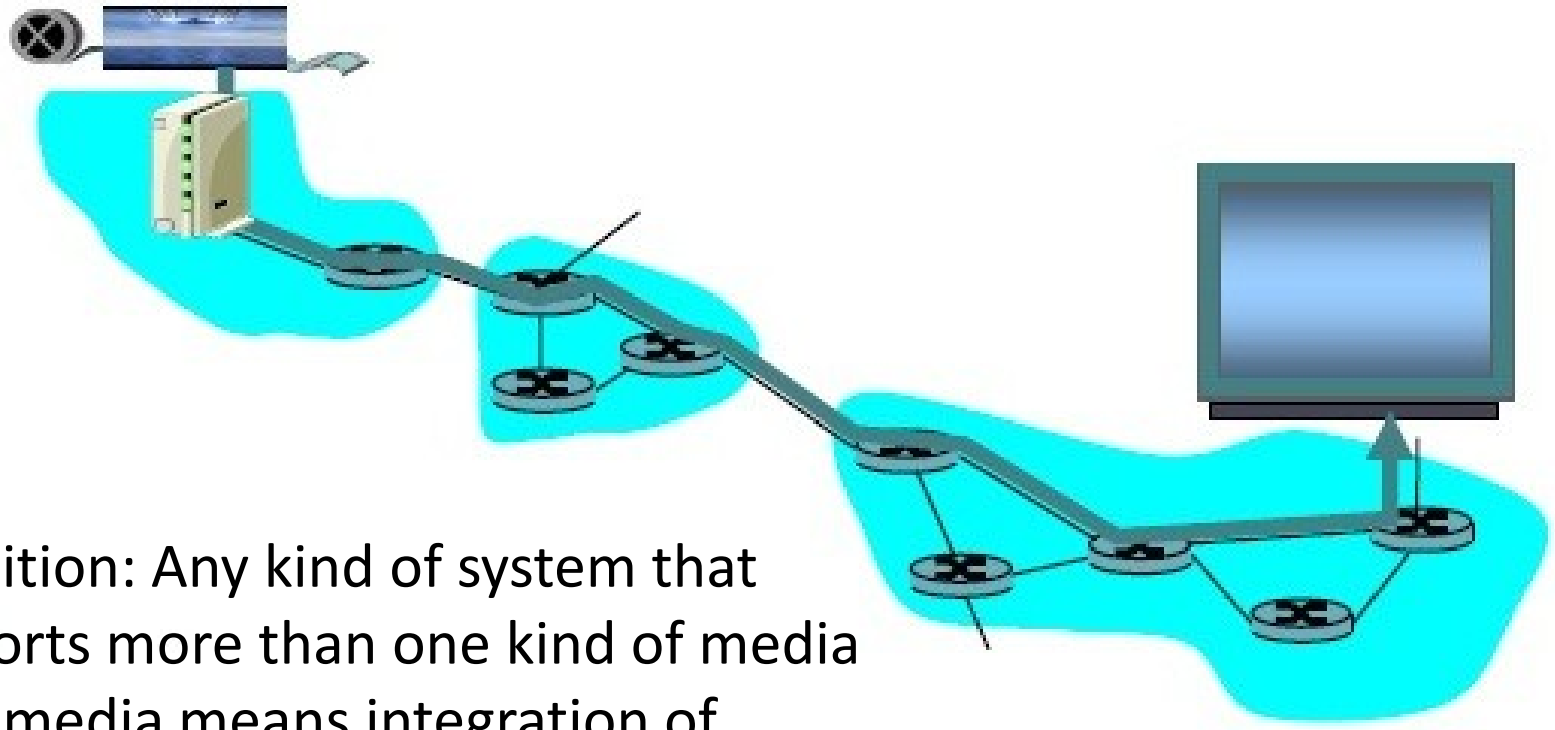
- General Applications: Email, WWW, Gopher, Online Systems
- Multimedia and Digital Video/Audio Broadcasting: Video/Audio Conferencing, Internet Relay Chat (IRC)
- Broadband Communications, Policy, xDSL and Cable Internet
- VoIP, FoIP and IP Interconnection
- Data Centers and Data Warehousing, Packet Clearing House
- Unified Messaging Systems
- Fundamental e-commerce
- 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.
- 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.
- Example:
  - 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.

Multimedia Networking



Definition: Any kind of system that supports more than one kind of media
Multimedia means integration of continuous media (e.g. audio, video) and discrete media (e.g. text graphics , images) through which digital information can be conveyed to the user in appropriate way.

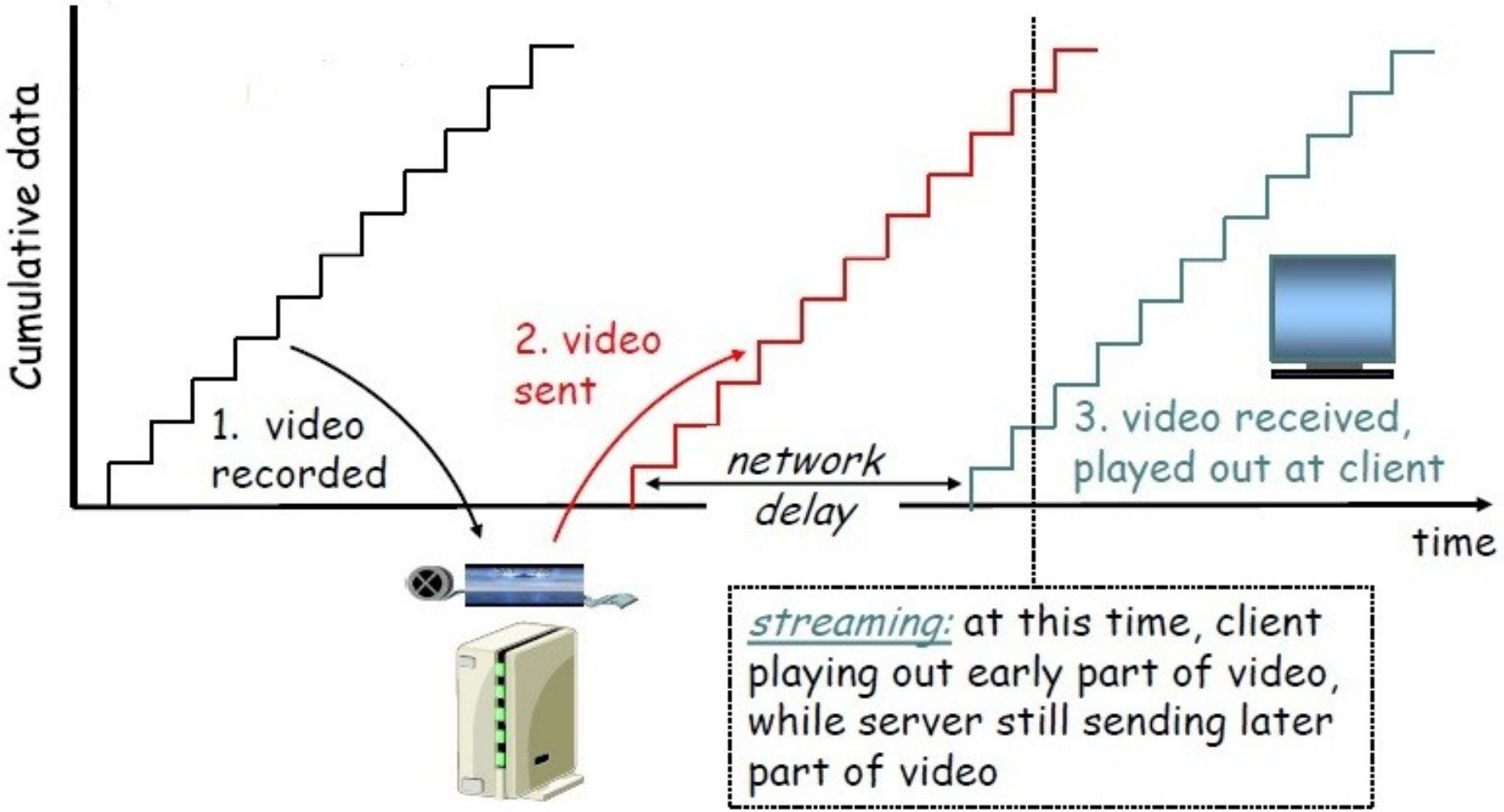
MM Networking Applications

- Classes of MM applications:
  - stored streaming
  - live streaming
  - 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.*

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
- Interactivity
  - 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 Stored Multimedia: What is it?

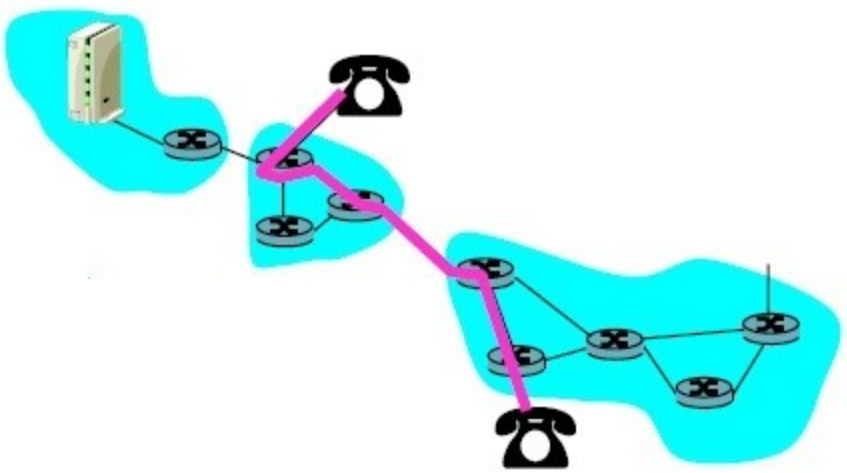


Streaming *Live Multimedia*

- 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

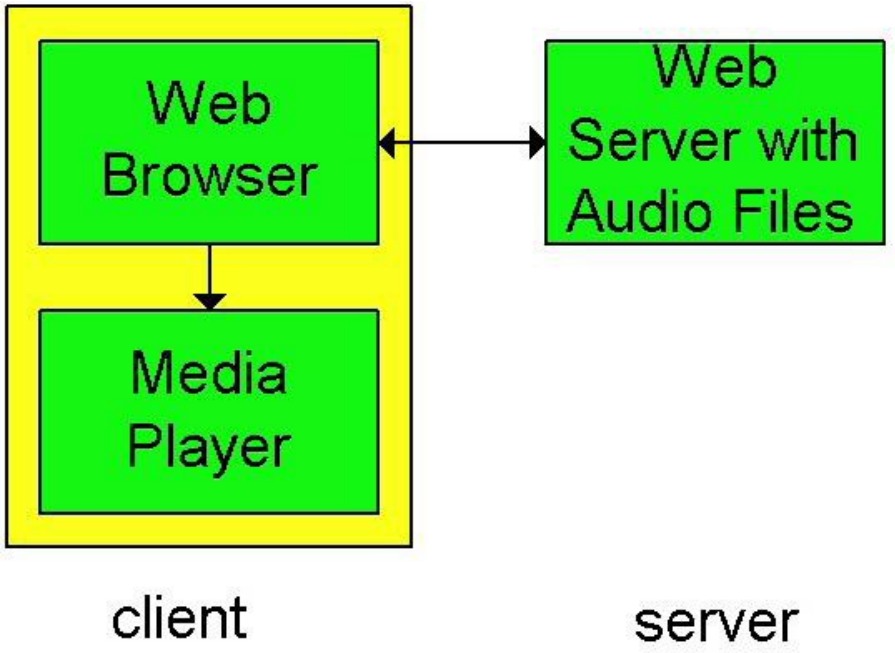
- applications: IP telephony, video conference, distributed interactive worlds
- end-end delay requirements:
  - audio: < 150 msec good, < 400 msec OK
    - includes application-level (packetization) and network delays
    - higher delays noticeable, impair interactivity
- session initialization



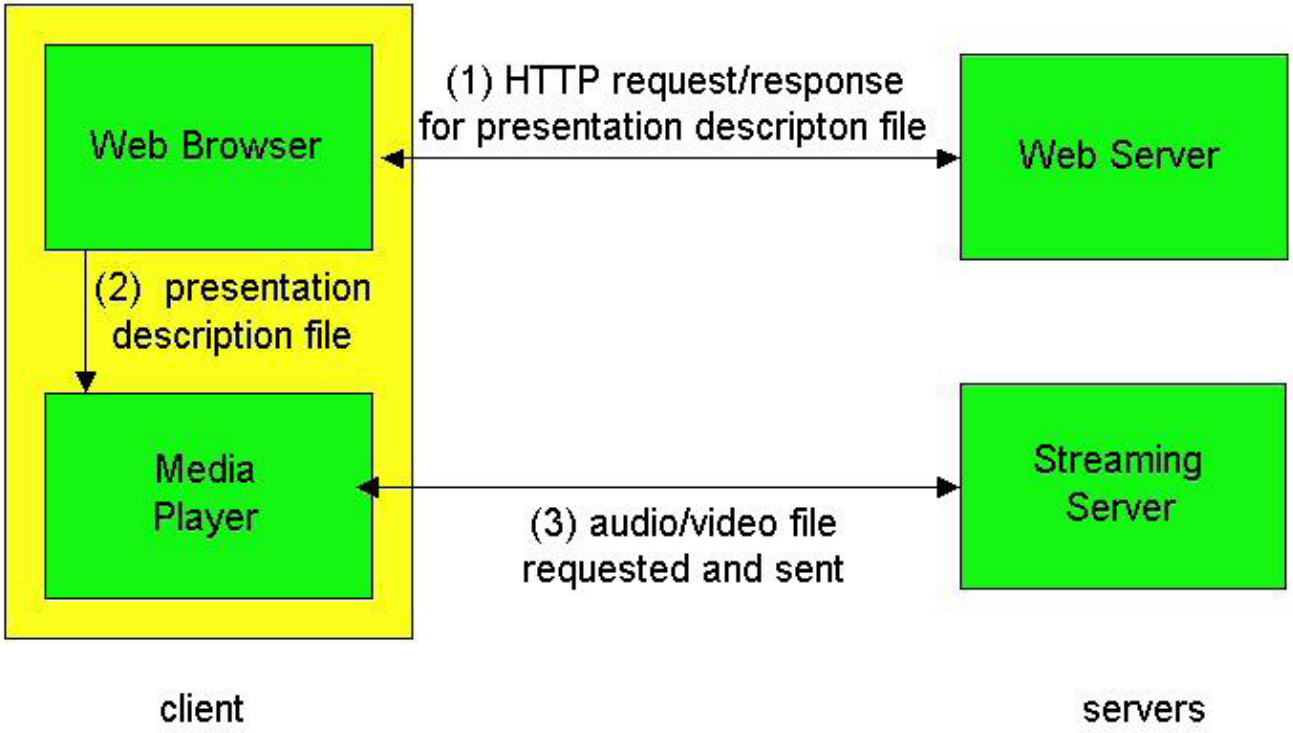
- How should the Internet evolve to better support multimedia?
  - Integrated services philosophy:
    - fundamental changes in Internet so that apps can reserve end-to-end bandwidth
    - requires new, complex software in hosts & routers
  - Laissez-faire
    - no major changes
    - more bandwidth when needed
    - content distribution, application-layer multicast
  - Differentiated services philosophy:
    - fewer changes to Internet infrastructure, yet provide 1st and 2nd class service.

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!

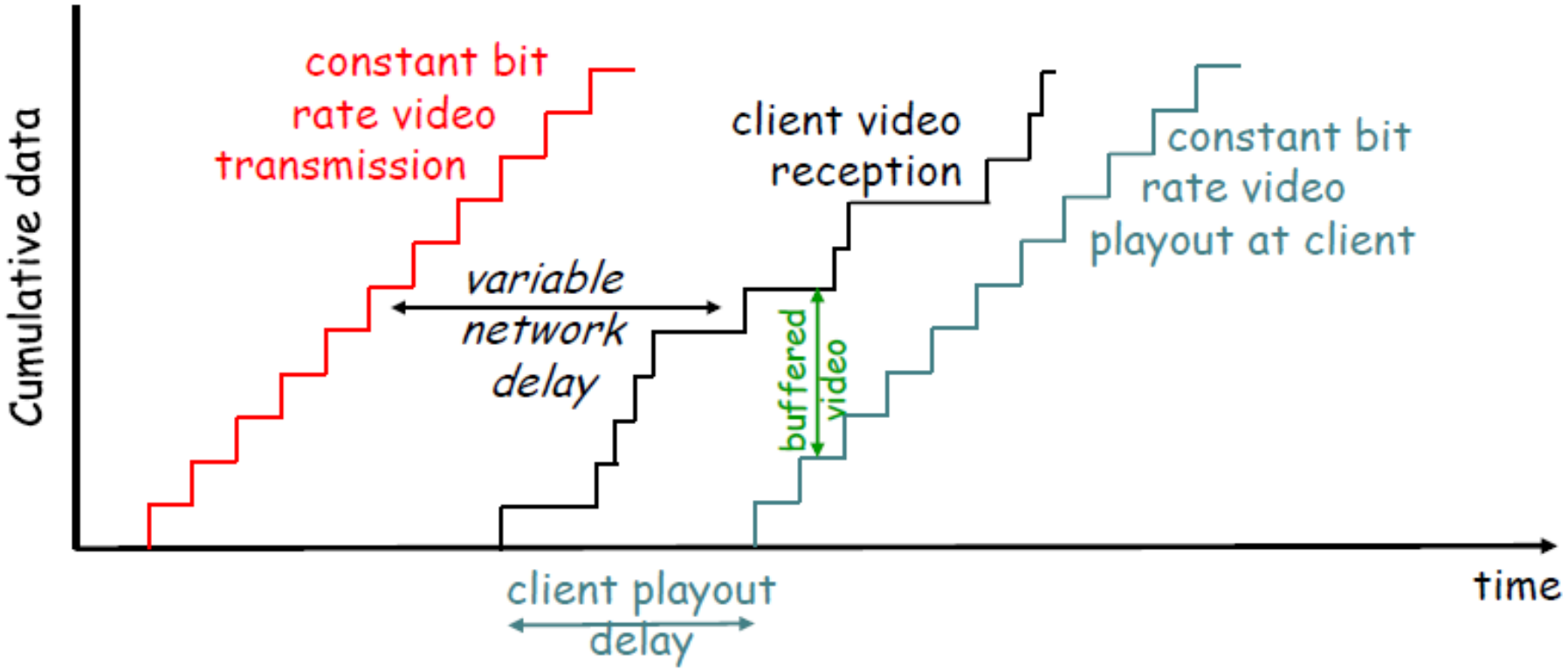


Streaming from a streaming server



- allows for non-HTTP protocol between server, media player.

Streaming Multimedia: Client Buffering



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

Streaming Multimedia: UDP or TCP?

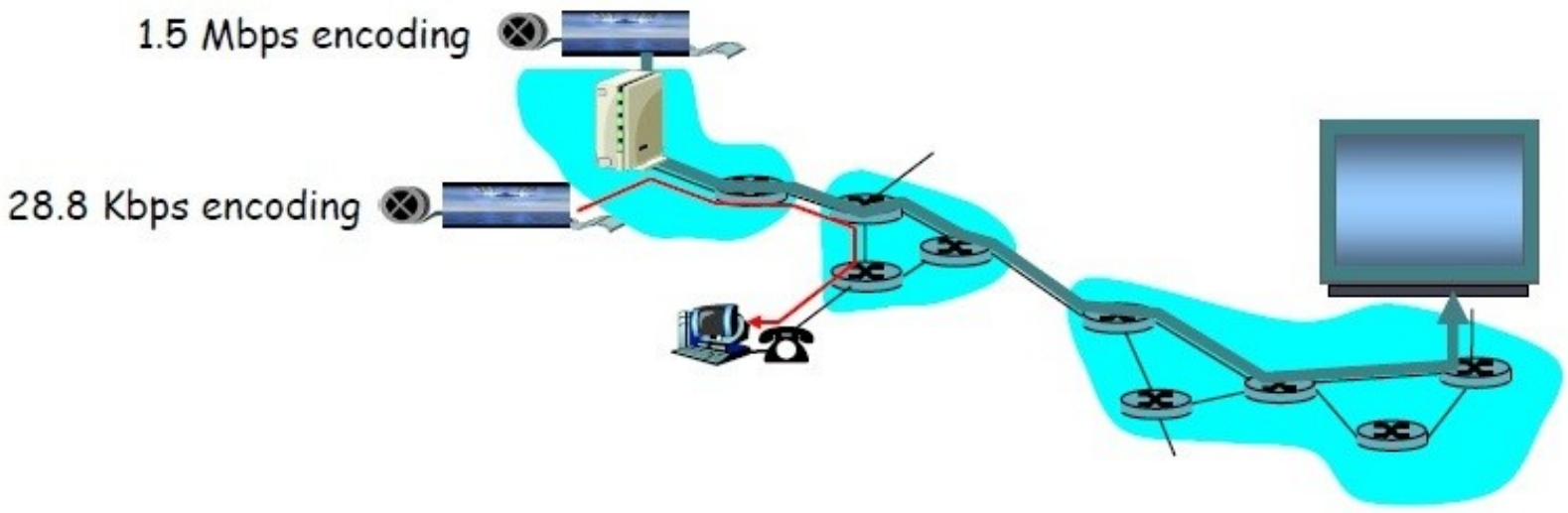
UDP

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

TCP

- send at maximum possible rate under TCP
- fill rate fluctuates due to TCP congestion control
- 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, 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: out of band control

FTP uses an “out-of-band” control channel:

- file transferred over one TCP connection.
- control info (directory changes, file deletion, rename) sent over separate TCP connection
- “out-of-band”, “in-band” channels use different port numbers

RTSP messages also sent out-of-band:

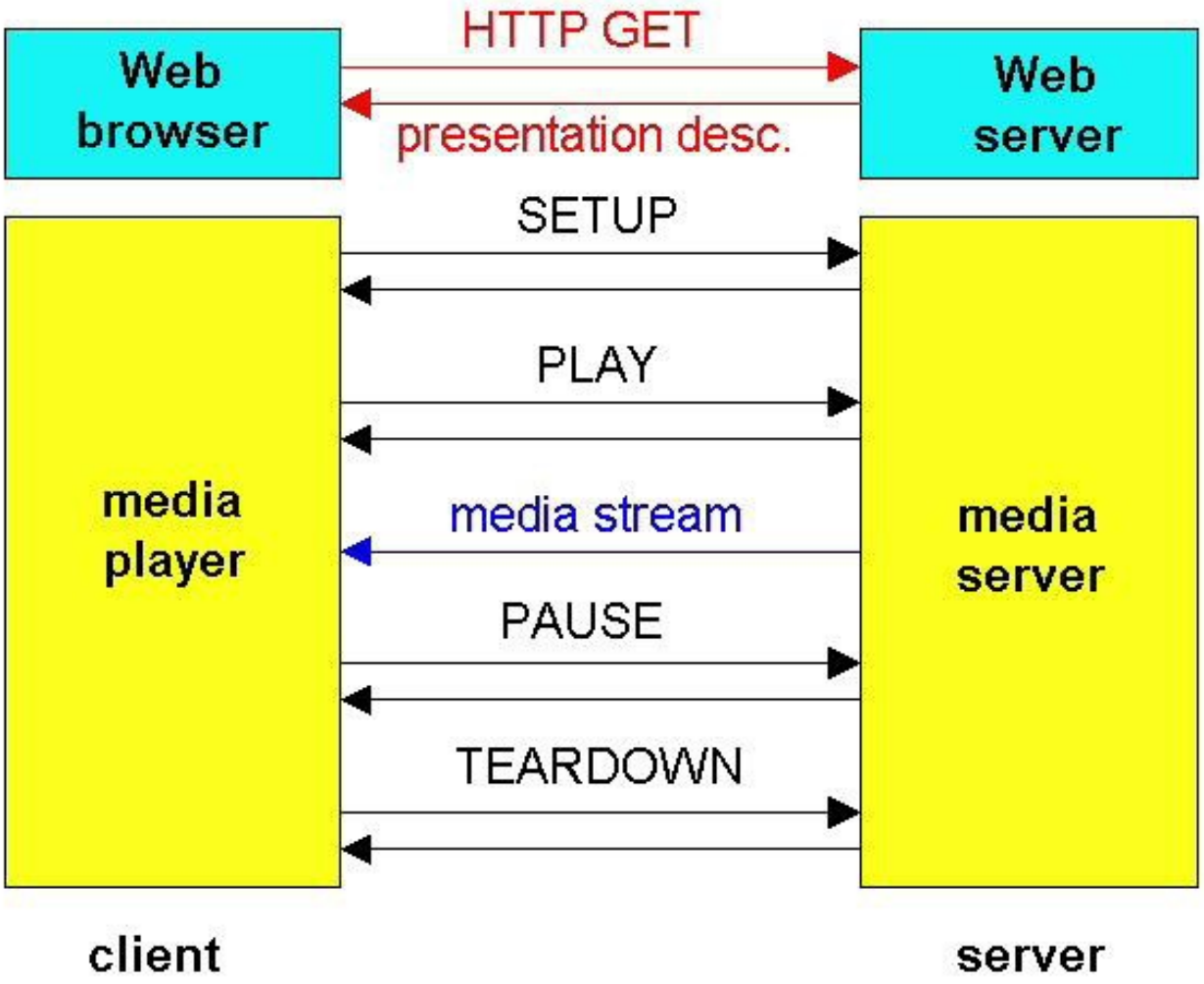
- RTSP control messages use different port numbers than media stream: out-of-band.
- port 554
- media stream is considered “in-band”.

RTSP Example

Scenario:

- metafile communicated to web browser
- browser launches player
- player sets up an RTSP control connection, data connection to streaming server

RTSP Operation



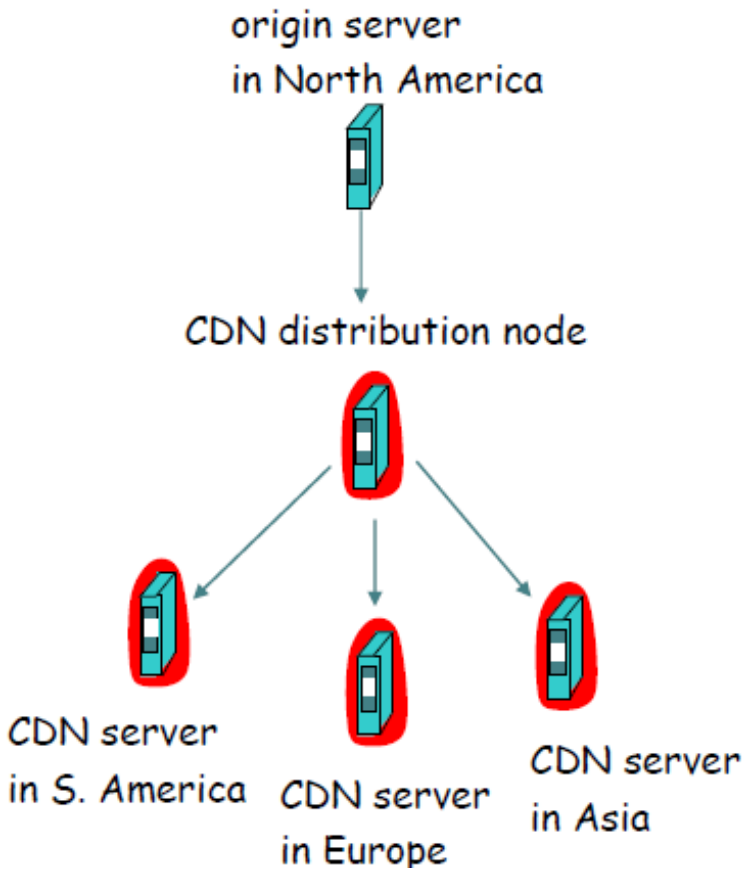
Real-time interactive applications

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

Content distribution networks (CDNs)

Content replication

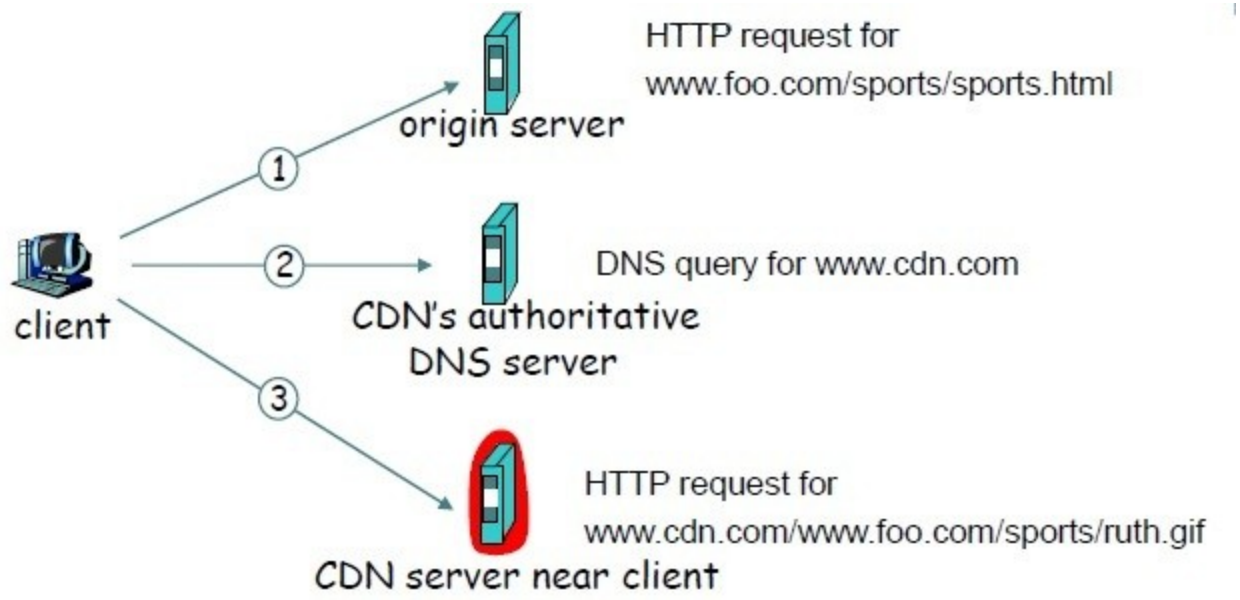
- challenging to stream large files (e.g., video) from single origin server in real time
- *solution: replicate content at hundreds of servers throughout Internet*
  - content downloaded to CDN servers ahead of time
  - *placing content "close" to user avoids impairments (loss, delay) of sending content over long paths*
  - CDN server typically in edge/access network



Content replication

- CDN (e.g., Akamai) customer is the content provider (e.g., CNN)
- CDN replicates customers' content in CDN servers.
- when provider updates content, CDN updates servers

CDN example



origin server (www.foo.com)

- distributes HTML
- replaces:

http://www.foo.com/sports.ruth.gif

With

http://www.cdn.com/www.foo.com/sports/ruth.gif

CDN company (cdn.com)

- distributes gif files
- uses its authoritative DNS server to route redirect requests

Routing requests

- CDN creates a “map”, indicating distances from leaf ISPs and CDN nodes
- when query arrives at authoritative DNS server:
  - server determines ISP from which query originates
  - uses “map” to determine best CDN server
- CDN nodes create application-layer overlay network

Internet Relay Chat

- **Internet Relay Chat** (**IRC**) is an application layer protocol that facilitates the transfer of messages in the form of text.
- The chat process works on a client/server networking model.
- IRC clients are computer programs that a user can install on their system.
- These clients communicate with chat servers to transfer messages to other clients
- IRC is mainly designed for group communication in discussion forums, called channels, but also allows one-on-one communication via private messages as well as chat and data transfer, including file sharing.

- IRC is an open protocol that uses TCP.
- An IRC server can connect to other IRC servers to expand the IRC network.
- Users access IRC networks by connecting a client to a server.
- There are many client implementations,
  - mIRC, HexChat and irssi
- Server implementations,
  - e.g. the original IRCd.
- Microsoft made an extension for IRC in 1998 via the proprietary IRCX.
- They later stopped distributing software supporting IRCX, instead developing the proprietary MSNP

Broadband Communications, Policy, xDSL and Cable Internet

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 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.
- 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.

Access

- DSL service remains "on" all of the time.
- People should be aware that long-lived connections like DSL can have security issues firewall.

xDSL family tree

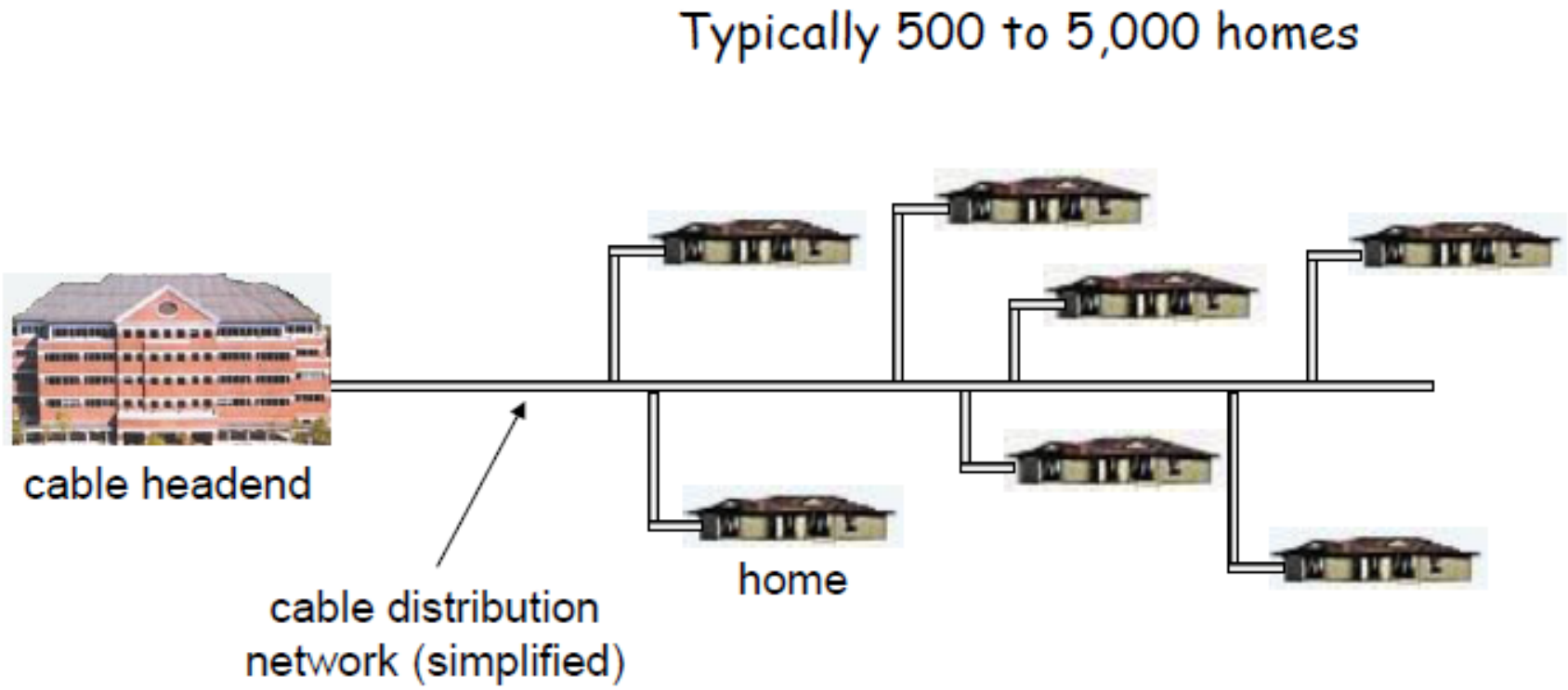
- The xDSL "family tree" includes two main branches
  - Symmetric DSL
    - services provide identical data rates upstream and downstream.
  - Asymmetric DSL
    - provides relatively lower rates upstream but higher rates downstream.

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

ADSL2+ new technology supports up to 24 Mbps.

Cable Network Architecture: Overview



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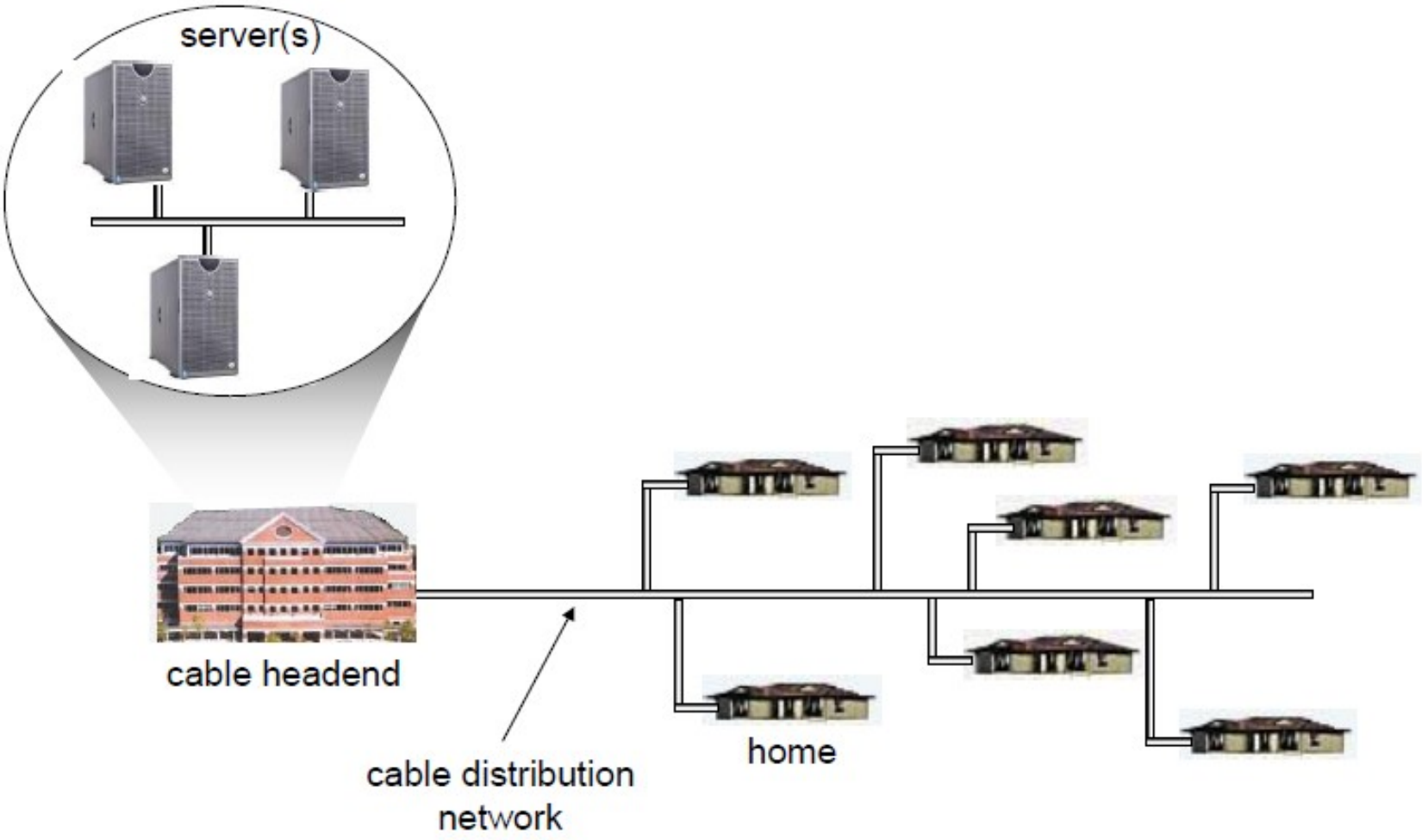

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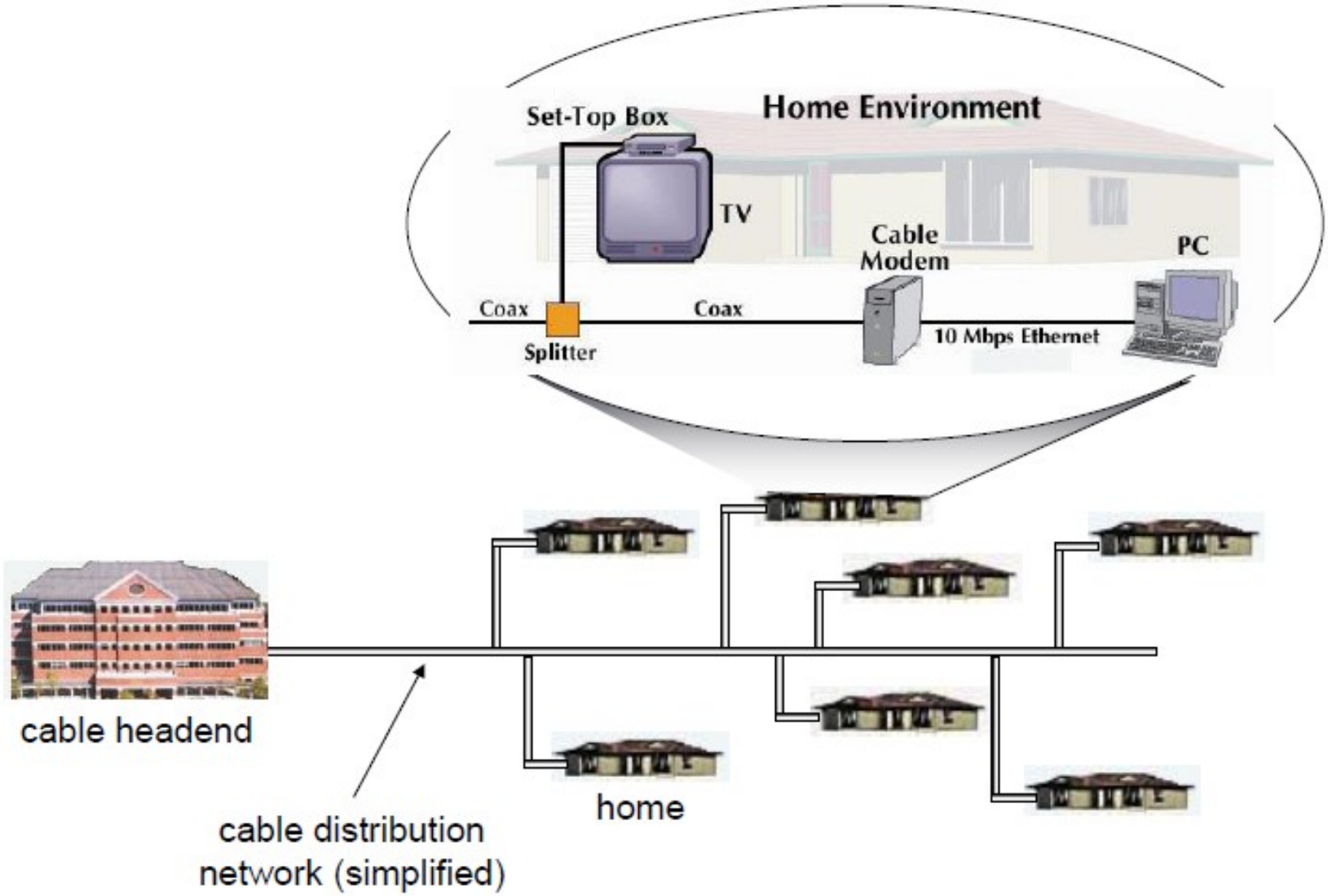

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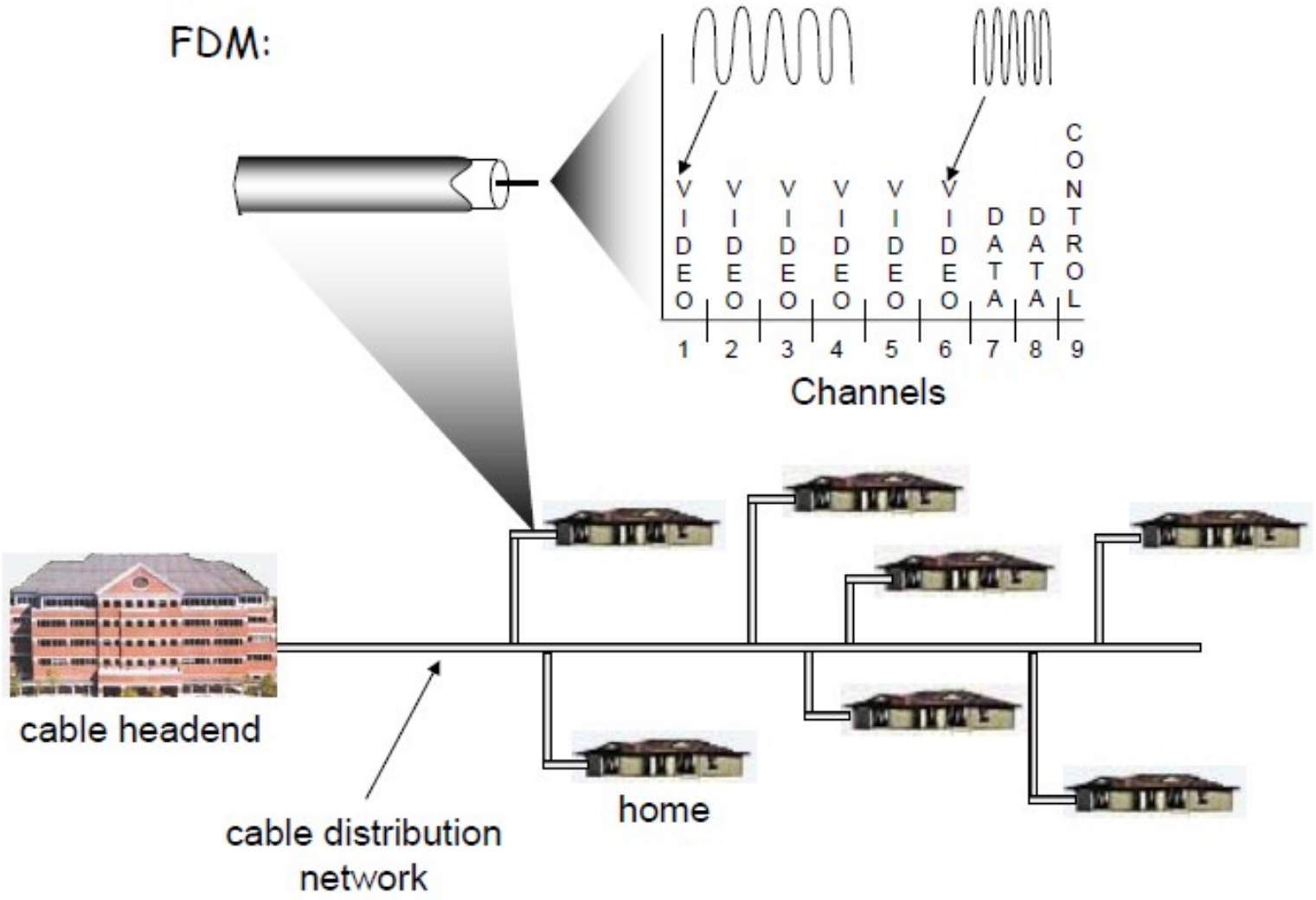


VoIP, FoIP and IP Interconnection

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 network.

- This reduces the cost of transmission and can be a more efficient setup for a business that already has access to Internet bandwidth.
- 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.

- The FoIP setup is a lot like the VoIP setup, and you can even send IP faxes using a VoIP server.
- However, since a fax requires more bandwidth than a voice, a VoIP server doesn't automatically work seamlessly for transmitting faxes.
- It typically requires some modifications, which you can make by installing a piece of software.
- Some companies also make servers that are optimized for both VoIP and FoIP applications.

VoIP

- Communication that allows you to make phone calls over a broadband internet connection.
- Some VoIP services require a computer or a dedicated VoIP phone
- Others allow you to use your landline phone to place VoIP calls through a special adapter.

VoIP configurations

- Dedicated routers
  - These devices allow you to use your traditional phone to place VoIP calls.
  - They are connected to cable/DSL modems (or any high-speed internet source) and allow you to attach an ordinary telephone.
  - Once configured, and with an appropriate VoIP provider and service plan, these devices require no special software or interaction with a computer.

- Adapters (USB)
  - These devices also allow you to use a traditional phone to place VoIP calls.
  - They usually come in the form of USB adapters
  - They feature a standard modular phone jack to which you can attach an ordinary phone line.
  - Once connected, your phone behaves as if it were connected to standard phone service.

- Software-controlled VoIP applications:
  - There are many software applications ("softphones") that allow you to place VoIP phone calls
  - Using an ordinary computer with a headset, microphone, and sound card.
  - Software-based VoIP applications are quite attractive to consumers
    - they often already have most of the components
    - Can start at little to no cost

- Dedicated VoIP phones
  - A VoIP phone looks like an ordinary corded or cordless telephone
  - It connects directly to a computer network rather than a traditional phone line.
  - May consist of a phone and base station that connects to the internet
  - It may also operate on a local wireless network.
  - Like the VoIP adapters mentioned above, dedicated VoIP phones also require a provider and service plan.

Data Centers and Data Warehousing

Data Centers

- A centralized repository, either physical or virtual, for the storage, management, and dissemination of data and information organized around a particular body of knowledge or pertaining to a particular business.
- It is the brain of a company and the place where the most critical processes are run.
- Example:
- The National Climatic Data Center (NCDC) is a public data center that maintains the world's largest archive of weather information.

Decision Support Systems

- Created to facilitate the decision making process
- So much information that it is difficult to extract it all from a traditional database
- Need for a more comprehensive data storage facility
  - Data Warehouse
- Extract Information from data to use as the basis for decision making
- Used at all levels of the Organization
- Interactive and Tailored to specific business areas
- Ad Hoc queries to retrieve and display information
- Combines historical operation data with business activities

4 Components of DSS

- Data Store – The DSS Database
  - Business Data
  - Business Model Data
  - Internal and External Data
- Data Extraction and Filtering
  - Extract and validate data from the operational database and the external data sources
- End-User Query Tool
  - Create Queries that access either the Operational or the DSS database
- End User Presentation Tools
  - Organize and Present the Data

DSS Database Requirements

- DSS Database Scheme
  - Support Complex and Non-Normalized data
    - Summarized and Aggregate data
    - Multiple Relationships
    - Redundant Data

- Data Extraction and Filtering
  - DSS databases are created mainly by extracting data from operational databases combined with data imported from external source
    - Need for advanced data extraction & filtering tools
    - Allow batch / scheduled data extraction
    - Support different types of data sources
    - Check for inconsistent data / data validation rules
    - Support advanced data integration / data formatting conflicts

- End User Analytical Interface
  - Must support advanced data modeling and data presentation tools
  - Data analysis tools
  - Query generation
  - Must Allow the User to Navigate through the DSS
- Size Requirements
  - VERY Large – Terabytes
  - Advanced Hardware (Multiple processors, multiple disk arrays, etc.)

Data Warehouse

- DSS friendly data repository for the DSS is the DATA WAREHOUSE
- Definition: Integrated, Subject-Oriented, Time-Variant, Nonvolatile database that provides support for decision making

Integrated

- The data warehouse is a centralized, consolidated database that integrated data derived from the entire organization
  - Multiple Sources
  - Diverse Sources
  - Diverse Formats

Subject-Oriented

- Data is arranged and optimized to provide answer to questions from diverse functional areas
  - Data is organized and summarized by topic
    - Sales / Marketing / Finance / Distribution / Etc.

Time-Variant

- The Data Warehouse represents the flow of data through time
- Can contain projected data from statistical models
- Data is periodically uploaded then time-dependent data is recomputed

Nonvolatile

- Once data is entered it is NEVER removed
- Represents the company's entire history
  - Near term history is continually added to it
  - Always growing
  - Must support terabyte databases and multiprocessors
- Read-Only database for data analysis and query processing

Data Marts

- Small Data Stores
- More manageable data sets
- Targeted to meet the needs of small groups within the organization
- Small, Single-Subject data warehouse subset that provides decision support to a small group of people

12 Rules of a Data Warehouse

- Data Warehouse and Operational Environments are Separated
- Data is integrated
- Contains historical data over a long period of time
- Data is a snapshot data captured at a given point in time
- Data is subject-oriented
- Mainly read-only with periodic batch updates
- Development Life Cycle has a data driven approach versus the traditional process-driven approach

- Data contains several levels of detail
  - Current, Old, Lightly Summarized, Highly Summarized
- Environment is characterized by Read-only transactions to very large data sets
- System that traces data sources, transformations, and storage
- Metadata is a critical component
  - Source, transformation, integration, storage, relationships, history, etc
- Contains a chargeback mechanism for resource usage that enforces optimal use of data by end users

OLAP

- Online Analytical Processing
- DSS tools that use multidimensional data analysis techniques
  - Support for a DSS data store
  - Data extraction and integration filter
  - Specialized presentation interface
- 4 Main Characteristics
  - Multidimensional data analysis
  - Advanced Database Support
  - Easy-to-use end-user interfaces
  - Support Client/Server architecture

Multidimensional Data Analysis Techniques

- Advanced Data Presentation Functions
  - 3-D graphics, Pivot Tables, Crosstabs, etc.
  - Compatible with Spreadsheets & Statistical packages
  - Advanced data aggregations, consolidation and classification across time dimensions
  - Advanced computational functions
  - Advanced data modeling functions

Advanced Database Support

- Advanced Data Access Features
  - Access to many kinds of DBMS's, flat files, and internal and external data sources
  - Access to aggregated data warehouse data
  - Advanced data navigation (drill-downs and roll-ups)
  - Ability to map end-user requests to the appropriate data source
  - Support for Very Large Databases

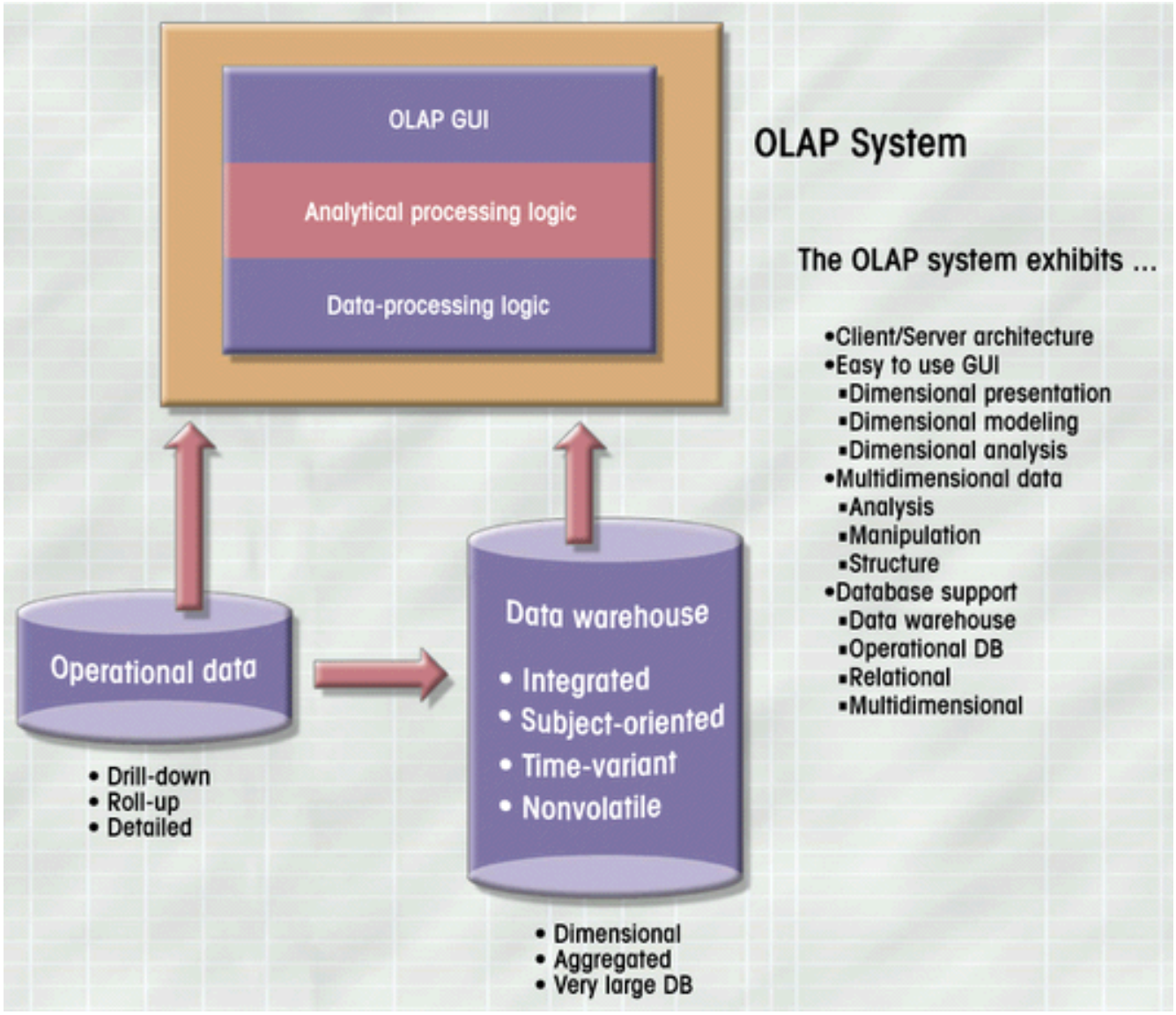
Easy-to-Use End-User Interface

- Graphical User Interfaces
- Much more useful if access is kept simple

Client/Server Architecture

- Framework for the new systems to be designed, developed and implemented
- Divide the OLAP system into several components that define its architecture
  - Same Computer
  - Distributed among several computer

OLAP Client/Server Architecture



Packet Clearing House

- Packet Clearing House or PCH is a non-profit research institute formed in 1994.
- It supports operations and analysis in the areas of Internet traffic exchange, routing economics, and global network development.
- Packet Clearing House was originally formed in 1994 by Chris Alan and Mark Kent to provide efficient regional and local network interconnection alternatives for the west coast of the United States.
- It has since grown to become a leading proponent of neutral independent network interconnection and provider of route-servers at major exchange points worldwide.

- PCH provides equipment, training, data, and operational support to organizations and individual researchers seeking to improve the quality, robustness, and accessibility of the Internet.
- PCH Purpose
  - Education
  - Research and
  - Policy

PCH Projects

- As of 2013, major PCH projects include the construction and support of more than a third of the world's approximately 350 Internet exchange points (IXPs)
- Support for globally anycast Domain Name System (DNS) resources including root name servers and more than one hundred and thirty top-level domains (TLDs)
- Operation of the only Federal Information Processing Standards (FIPS) 140-2 Level 4 global TLD DNSSEC key management and signing infrastructure, with facilities in Singapore, Zurich, and San Jose
- Implementation of network research data collection initiatives in more than three dozen countries
- Development and presentation of educational materials to foster a better understanding of Internet architectural principles and their policy implications

PCH Sponsors

- PCH sponsors include the Soros Open Society Institute, which funded PCH in the development of open-source software tools which assist Internet service providers (ISPs) in optimizing the routing of their traffic, reducing the cost and increasing the performance of Internet service as delivered to the public
- United Nations Development Programme, Cisco Systems, NTT/Verio, the governments of Sweden, Denmark, Canada, Mexico, France, Singapore, Chile, Switzerland, and the United States, and hundreds of Internet service providers and individuals.

PCH offices

- According to its Web site, PCH maintains offices in San Francisco, Berkeley, London, Kathmandu, Buenos Aires, Lima and Port of Spain.

PCH with USTTI

- PCH works closely with the United States Telecommunications Training Institute (USTTI) to offer courses on telecommunications regulation, Internet infrastructure construction and management, domain name system management, and Internet security coordination, three times yearly in Washington D.C., in addition to the eighty to one hundred workshops PCH teaches on-location throughout the world each year.

Unified Messaging Systems

- 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.
- 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.
- Unified Messaging was expected by many in the consumer telecommunications industry to be a popular product, first augmenting and eventually replacing voicemail.

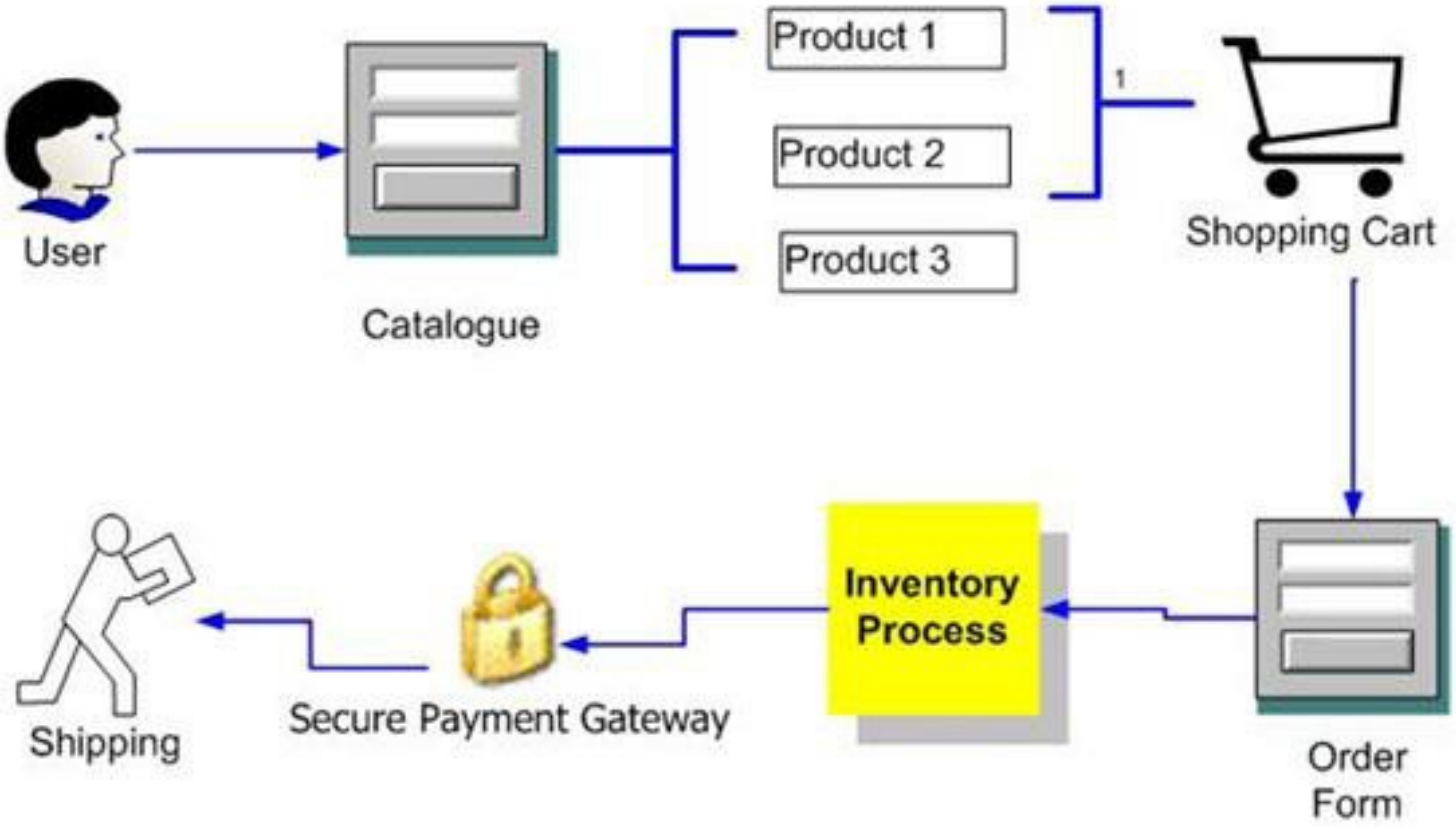
- Today, UM solutions are increasingly accepted in the corporate environment.
- The aim of deploying UM solutions generally is to enhance and improve business productivity while decreasing communication issues.
- UM solutions targeting professional end-user customers integrate communications processes into the existing IT infrastructure, i. e. into CRM, ERP and mail systems (e. g. CallXpress, Phoenixnet PH, Microsoft Exchange, Lotus Notes, SAP, etc.)

Fundamental of E-commerce

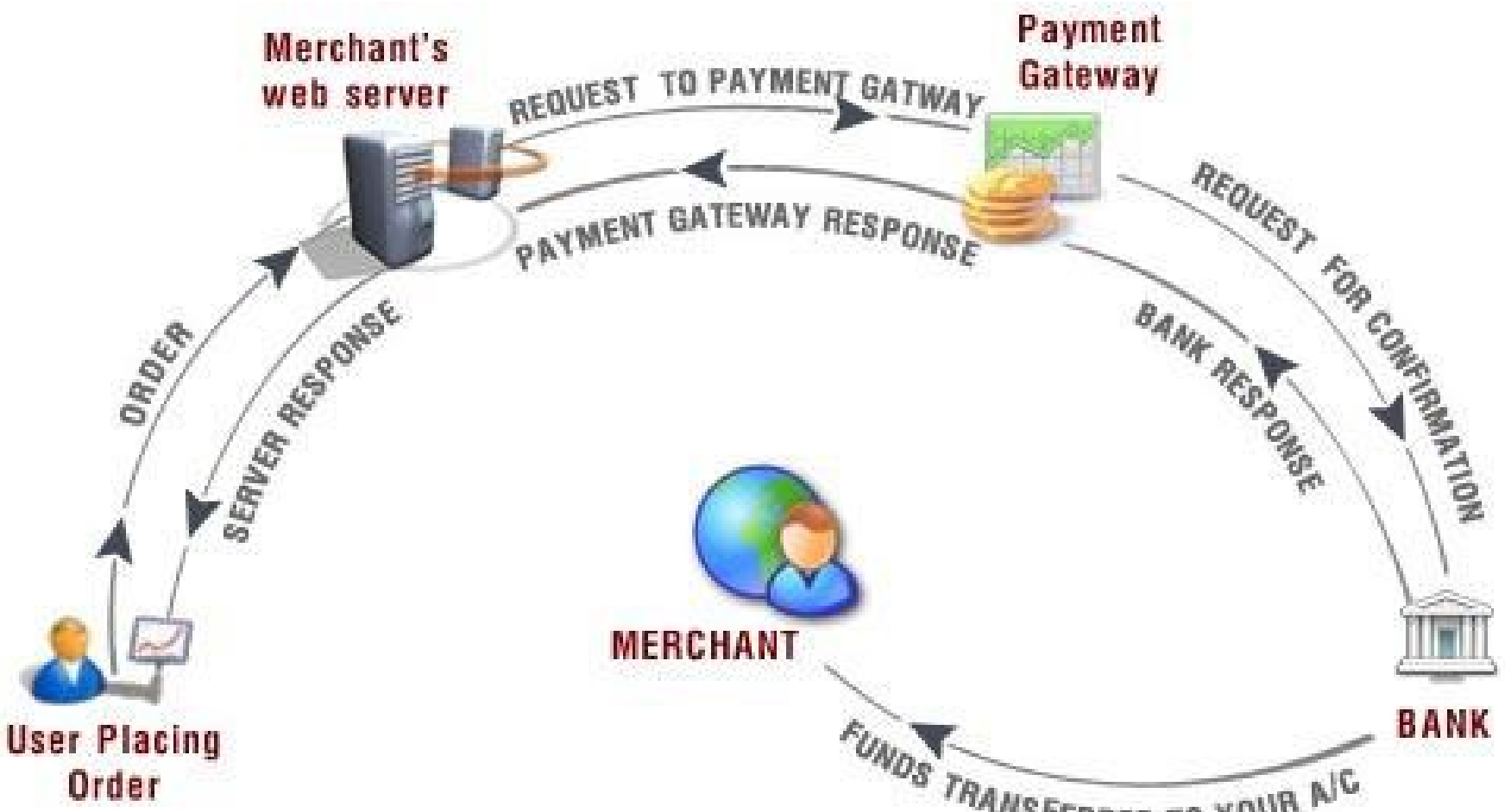
E-Commerce

- 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


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

The building blocks of e-commerce



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.

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.
- 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)

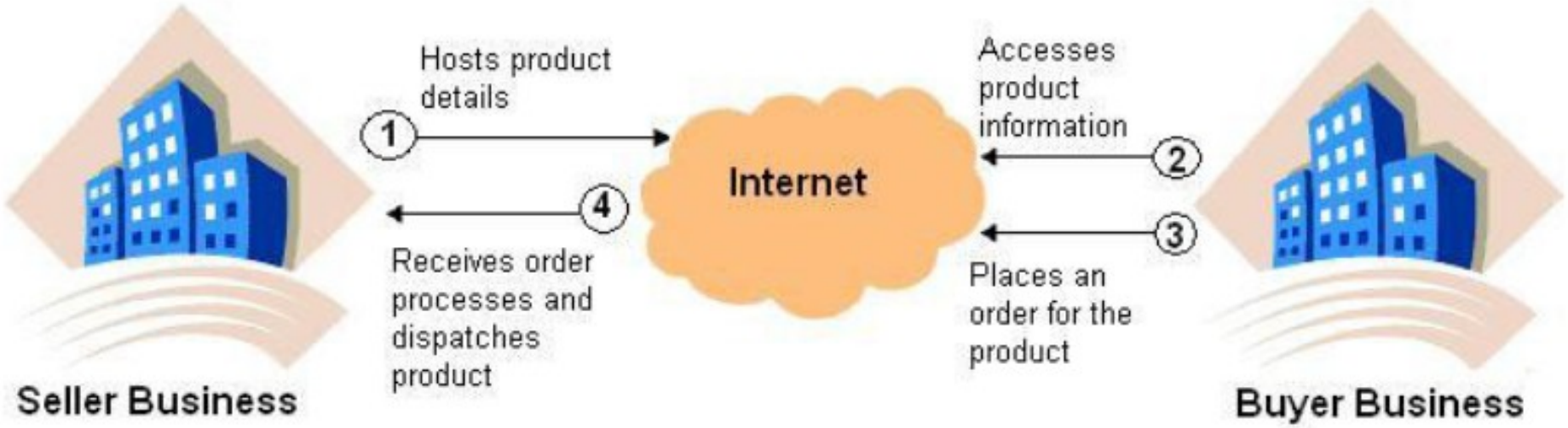
Business-to-Business (B2B) Model

- 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

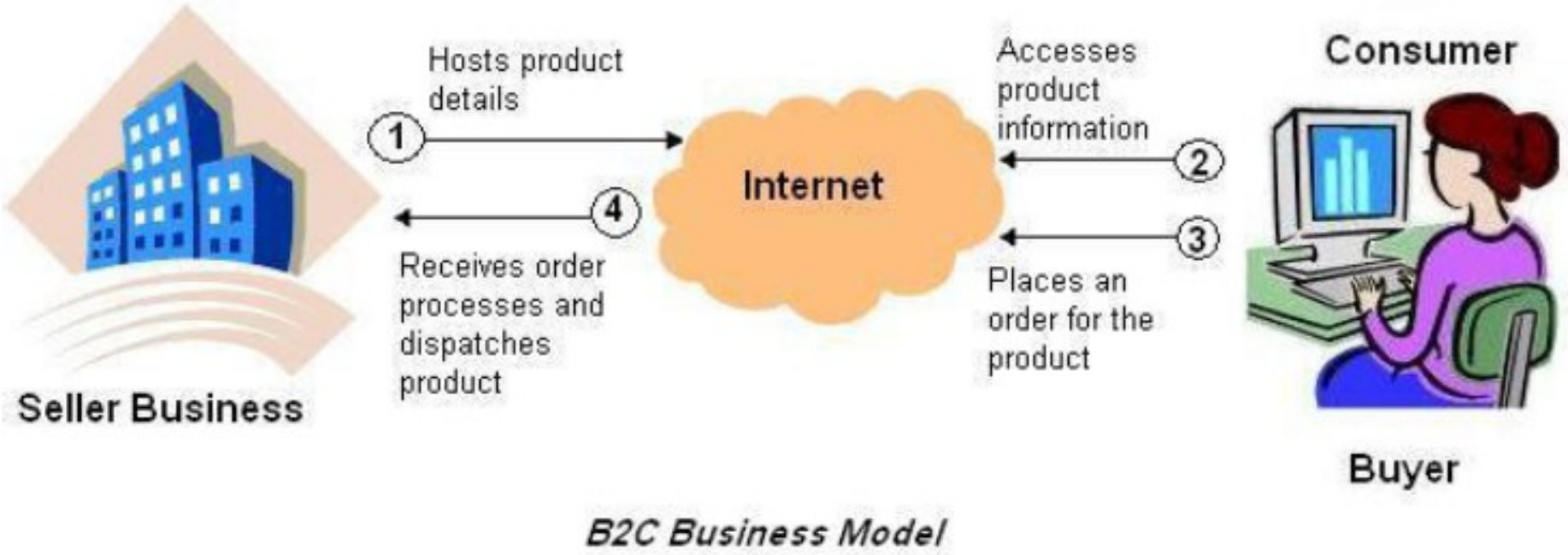


B2B Business Model

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

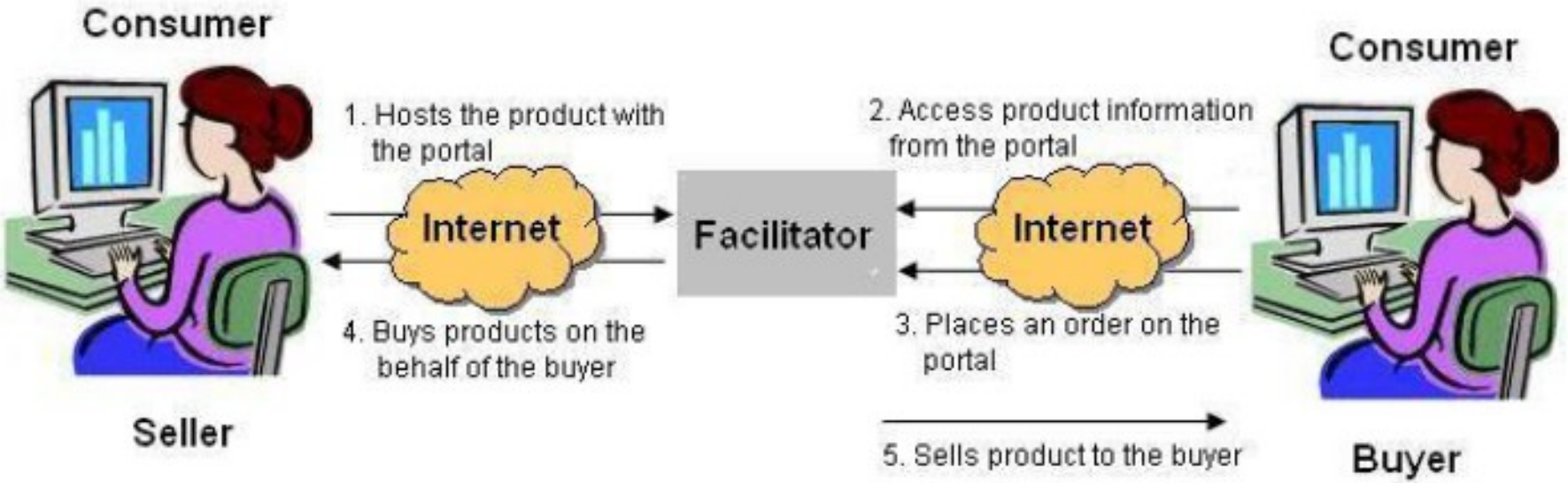


B2C Business Model

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

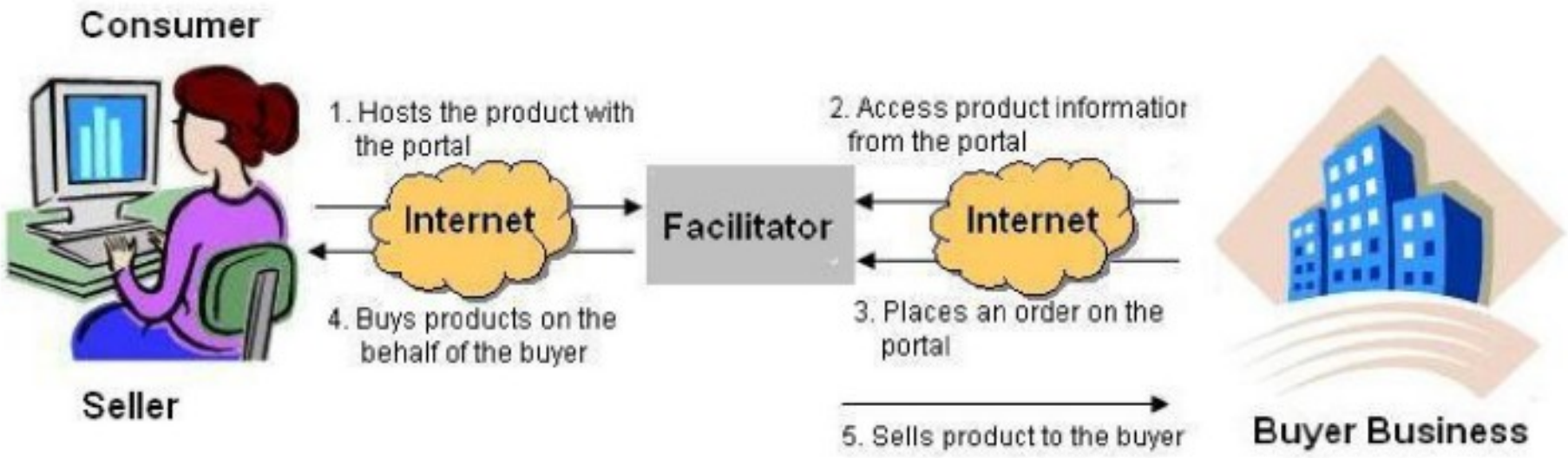


C2C Business Model

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)

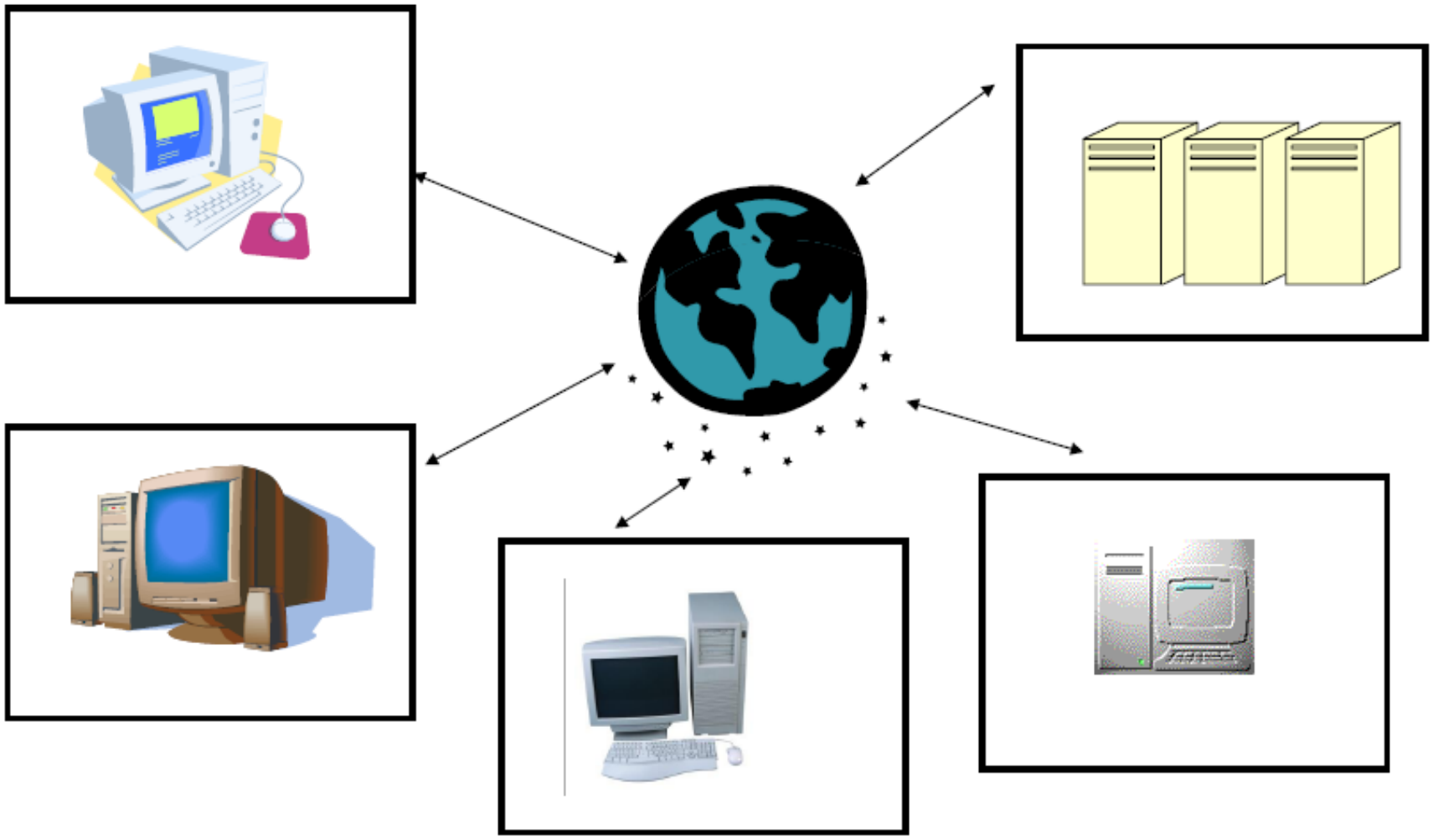
- In this model, the business houses transact with the government over the Internet.
- For example, similar to an individual consumer, business houses can also pay their taxes on the Internet

Concept of Grid and Cloud Computing

What is a Grid?

- Early defs: Foster and Kesselman, 1998
  - "A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational facilities"
- Kleinrock 1969:
  - "We will probably see the spread of 'computer utilities', which, like present electric and telephone utilities, will service individual homes and offices across the country."

Grid Architecture



Autonomous, globally distributed computers/clusters

Why do we need Grids?

- Many large-scale problems cannot be solved by a single computer
- Globally distributed data and resources

Background: Related technologies

- Cluster computing
- Peer-to-peer computing
- Internet computing

Cluster computing

- Idea: put some PCs together and get them to communicate
- Cheaper to build than a mainframe supercomputer
- Different sizes of clusters
- Scalable – can grow a cluster by adding more PCs

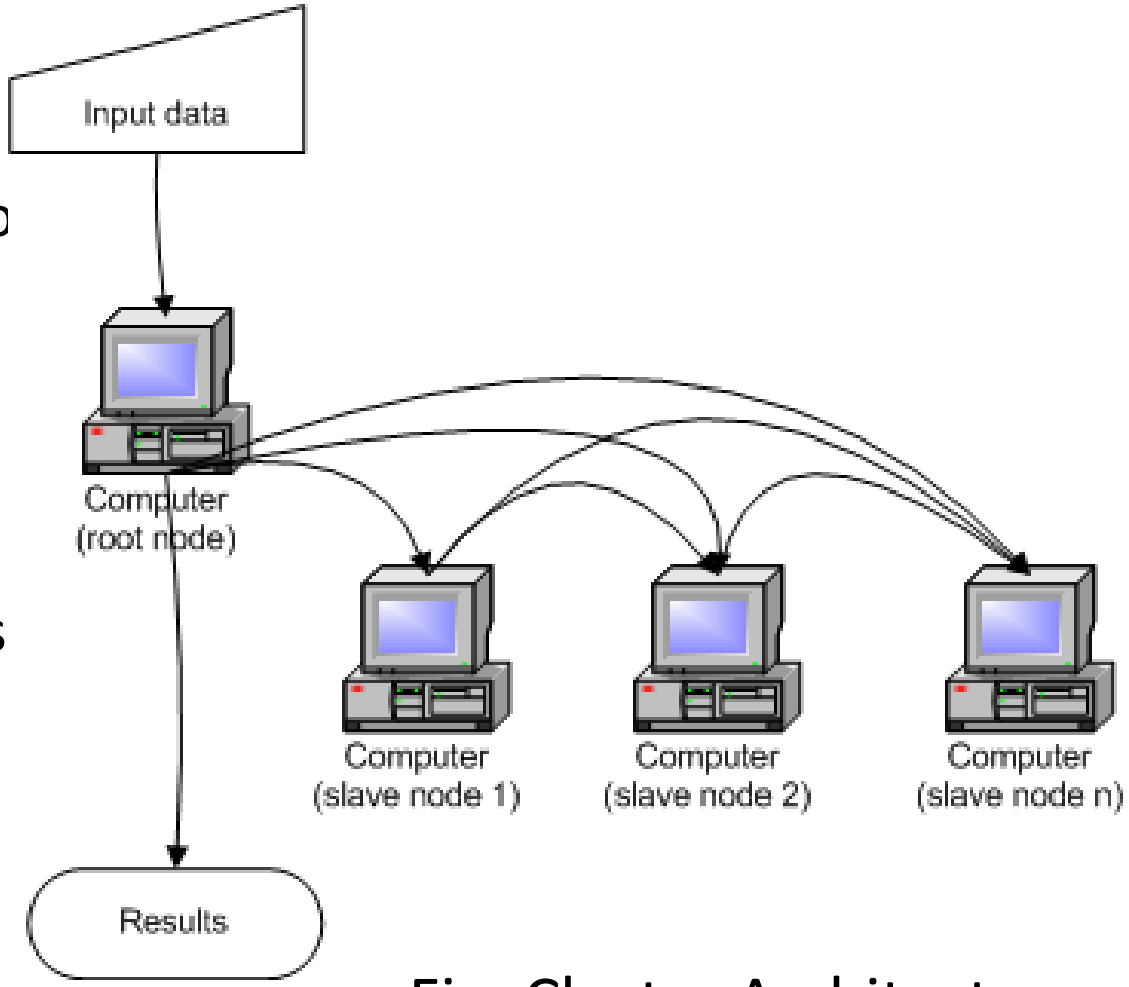


Fig: Cluster Architecture

Peer-to-Peer computing

- Connect to other computers
- Can access files from any computer on the network
- Allows data sharing without going through central server
- Decentralized approach also useful for Grid

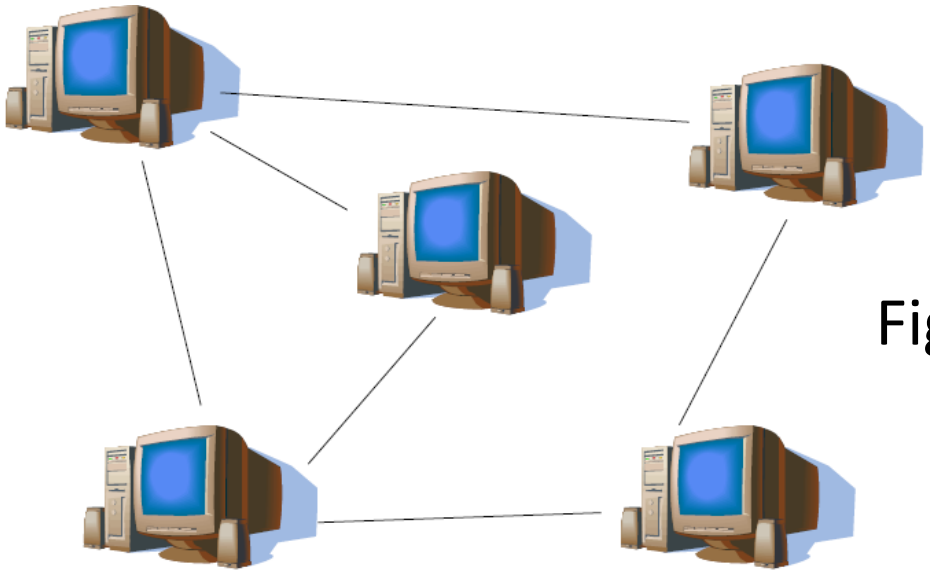


Fig: Peer to Peer Architecture

Internet computing

- Idea: many idle PCs on the Internet
- Can perform other computations while not being used
- “Cycle scavenging” – rely on getting free time on other people’s computers
- Example: SETI@home
- What are advantages/disadvantages of cycle scavenging?

Some Grid Applications

- Distributed supercomputing
- High-throughput computing
- On-demand computing
- Data-intensive computing
- Collaborative computing

Distributed Supercomputing

- Idea: aggregate computational resources to tackle problems that cannot be solved by a single system
- Examples: climate modeling, computational chemistry
- Challenges include:
  - Scheduling scarce and expensive resources
  - Scalability of protocols and algorithms
  - Maintaining high levels of performance across heterogeneous systems

High-throughput computing

- Schedule large numbers of independent tasks
- Goal: exploit unused CPU cycles (e.g., from idle workstations)
- Unlike distributed computing, tasks loosely coupled
- Examples: parameter studies, cryptographic problems

On-demand computing

- Use Grid capabilities to meet short-term requirements for resources that cannot conveniently be located locally
- Unlike distributed computing, driven by cost-performance concerns rather than absolute performance
- Dispatch expensive or specialized computations to remote servers

Data-intensive computing

- Synthesize data in geographically distributed repositories
- Synthesis may be computationally and communication intensive
- Examples:
  - High energy physics generate terabytes of distributed data, need complex queries to detect “interesting” events
  - Distributed analysis of Sloan Digital Sky Survey data

Collaborative computing

- Enable shared use of data archives and simulations
- Examples:
  - Collaborative exploration of large geophysical data sets
- Challenges:
  - Real-time demands of interactive applications
  - Rich variety of interactions

Grid Communities

- Who will use Grids?
- Broad view
  - Benefits of sharing outweigh costs
  - Universal, like a power Grid
- Narrow view
  - Cost of sharing across institutional boundaries is too high
  - Resources only shared when incentive to do so
  - Grid will be specialized to support specific communities with specific goals

Government

- Small number of users
- Couple small numbers of high-end resources
- Goals:
  - Provide “strategic computing reserve” for crisis management
  - Support collaborative investigations of scientific and engineering problems
- Need to integrate diverse resources and balance diversity of competing interests

Health Maintenance Organization

- Share high-end computers, workstations, administrative databases, medical image archives, instruments, etc. across hospitals in a metropolitan area
- Enable new computationally enhanced applications
- *Private grid*
  - Small scale, central management, common purpose
  - Diversity of applications and complexity of integration

Materials Science Collaboratory

- Scientists operating a variety of instruments (electron microscopes, particle accelerators, X-ray sources) for characterization of materials
- Highly distributed and fluid community
- Sharing of instruments, archives, software, computers
- *Virtual Grid*
  - strong focus and narrow goals
  - Dynamic membership, decentralized, sharing resources

Computational Market Economy

- Combine:
  - Consumers with diverse needs and interests
  - Providers of specialized services
  - Providers of compute resources and network providers
- *Public Grid*
  - Need applications that can exploit loosely coupled resources
  - Need contributors of resources

Some Grid challenges

- Data movement
- Data replication
- Resource management
- Job submission

Some Grid-Related Projects

- Globus
- Condor
- Nimrod-G

Cloud Computing

- Future scenario:
  - No computing on local computers
  - Third-party compute and storage facilities
- Cloud Computing:
  - "A large-scale distributed computing paradigm that is driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms, and services are delivered on demand to external customers over the Internet"

Cloud computing characteristics

- Elasticity: Resource allocation can be increased or decreased according to the demand
- Scalability: the cloud scales according to the demand
- Self-service provisioning: Cloud customers accessing cloud services
- Standardized interfaces: Standard APIs
- Billing service: A pay-as-you-go model

Advantages of cloud computing

- Lower computer and software costs
- Enhanced software updates
- Unlimited storage capacity

Disadvantages of cloud computing

- Requires a high-speed internet connection
- Security and confidentiality of data
- Not solved yet the execution of HPC apps in cloud computing
- Interoperability between cloud based systems

Grid Computing vs Cloud Computing

- Business model:
  - Grid computing: project-oriented, in which it is possible to spend an amount of service units, generally CPU hours
    - Example: TeraGrid, proposals for the increment of computational power
  - Cloud computing: customers pay providers on a consumption basis (such as electricity)
    - Example: EC2 from Amazon (instance-hour consumed), S3 from Amazon (GB-Month of storage)

Thank You

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