Internet Technology
Chapter 7: Internet and Intranet Applications

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7.1 General Applications: Email, WWW, Gopher, Online Systems

Email, WWW…
- Gopher
  - A distributed document search & retrieval protocol (RFC 1436)
  - Designed for distributing, searching, & retrieving documents over the Internet
  - An alternative to the WWW in its early stages, but ultimately failed
  - Follows a client-server model
  - Assumes a reliable TCP data stream
  - Documents reside on many autonomous servers on the Internet
  - Users run client s/w, connecting to a server & sending the server a selector (a line of text) via a TCP connection at port 70
  - Server responds with a block of text terminated by a period on a line by itself & closes the connection
  - Client s/w presents users with a hierarchy of items & directories much like a file system
  - No state is retained by server
  - Not natively supported by modern browsers
  - Veronica is a system that queries titles in Gopher servers on the Internet

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7.1 General Applications: Email, WWW, Gopher, Online Systems

Online Systems

- Provides on-line services giving access to information, entertainment, communications, and/or transaction services via telecommunications

- Includes e-finance or e-banking site, e-health site, e-government site, online shopping site,…

- Many are both on-line service vendors & content providers

- Key distinction betn. on-line services & the Internet is that on-line services companies either provide content or have a close association with a content provider, while the Internet relies on distributed, usually nonaffiliated content providers, including individual corporate entities

- AOL, Prodigy were among pioneers online service providers

- Common services - message boards, chat services, electronic mail, file archives, current news and weather, online encyclopedias, airline reservations, and online games

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7.2 Multimedia and Digital Video/Audio Broadcasting: Video/Audio Conferencing, Internet Relay Chat (IRC)

Video conferencing

- Multimedia environment for live meetings, collaboration and presentations

- Digital compression of audio & video streams in real time

- Uncompressed audio & video consumes a great amount of storage & bandwidth; removing the inherent redundancies in digitized audio & video signals can reduce by orders of magnitude the amount the data that needs to be stored and transmitted

- Codec (coder/decoder)- h/w or s/w performs compression

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7.2 Multimedia and Digital Video/Audio Broadcasting: Video/Audio Conferencing, Internet Relay Chat (IRC)

The International Telecommunications Union (ITU) standards for videoconferencing:

1. ITU H.320 - standard for PSTN or videoconferencing over ISDN

2. ITU H.264 Scalable Video Coding
   - compression standard that enables videoconferencing systems to achieve error resilient IP video transmissions over the Internet without QoS enhanced lines

3. ITU V.80: videoconferencing is generally compatible with H.324 standard point-to-point video telephony over regular POTS phone lines

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7.2 Multimedia and Digital Video/Audio Broadcasting: Video/Audio Conferencing, Internet Relay Chat (IRC)

IRC
•Protocol for real-time Internet text messaging (chat) or synchronous conferencing

•Designed for group communication in discussion forums, called *channels*, but also allows one-to-one communication via private message as well as chat & data transfer, including file sharing
•Users access IRC Server or networks by connecting a client to a server.
•client implementations - mIRC, Xchat, irssi
•server implementations - the original IRCd

•Most IRC servers do not require users to register an account but a user will have to set a nickname before being connected
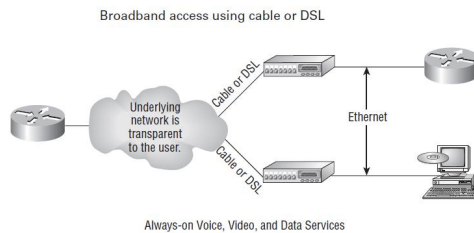
•Microsoft extension for IRC – IRCX, but later stopped supporting IRCX, instead developing MSN .NET Messenger Service

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7.3 Broadband Communications, Policy, xDSL and Cable Internet

Broadband defining as a cluster of concepts
•Always-on
• High-capacity
• Combined provision of voice, video and data at the same time

Broadband access using cable or DSL

Cable or DSL

Underlying network is transparent to the user.

Ethernet

Cable or DSL

Always-on Voice, Video, and Data Services

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7.3 Broadband Communications, Policy, xDSL and Cable Internet

Cable network and terms

HFC

Coaxial cable serving area

Fiber

Node

Headend

DOCSIS standard
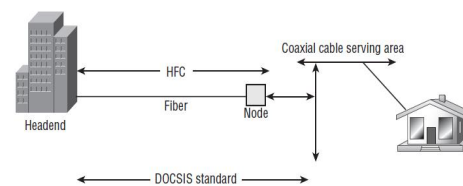
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7.3 Broadband Communications, Policy, xDSL and Cable Internet

Headend
 -where cable signals are received, processed, and formatted
-Signals are transmitted over the distribution network

Distribution network
-Service areas comprising hundreds to thousand customers
-Hybrid fiber-coaxial architecture

-Data Over Cable Service Interface Specification (DOCSIS) v3.1

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7.3 Broadband Communications, Policy, xDSL and Cable Internet

Digital Subscriber Line (DSL)

•requires a phone line, a DSL modem, either an Ethernet card or a router and service provider

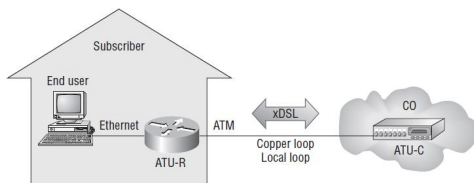•Based upon upstream or downstream speed
  •Symmetrical DSL
  •Asymmetrical DSL – downstream usually faster

•xDSL – ADSL, High-bit-rate DSL (HDSL), Rate Adaptive DSL (RADSL), Synchronous DSL (SDSL), ISDN DSL (IDSL), and very-high-data-rate DSL (VDSL)

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7.3 Broadband Communications, Policy, xDSL and Cable Internet

xDSL connection from home user to central office

All types of DSL are layer 1 technologies.
ATU-R = ADSL Transmission Unit - Remote
ATU-C = ADSL Transmission Unit - Central

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7.3 Broadband Communications, Policy, xDSL and Cable Internet

•ADSL encapsulation

  •PPPoE – encapsulates PPP frames in Ethernet frames & uses PPP features like authentication, encryption ,and compression

  •PPPoA – encapsulation of PPP frames in ATM AAL5

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7.3 Broadband Communications, Policy, xDSL and Cable Internet

PPPoE with ADSL

ISP/Corp router

Aggregation router

ATM   IP

CPE (bridging)   DSLAM

AAA
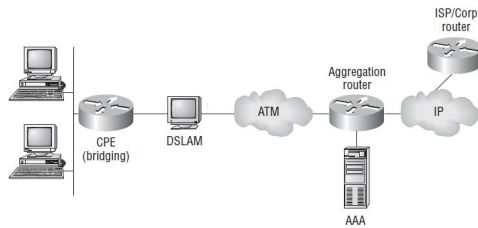
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7.4 VoIP, FoIP and IP Interconnection

Voice over Internet Protocol
Read *Computer Network, Andrew S. Tanenbaum, Chapter 7.4.5 VoIP*

The H323 architectural model for Internet telephony

Zone   Terminal   Gateway

Gatekeeper

Internet   Telephone network
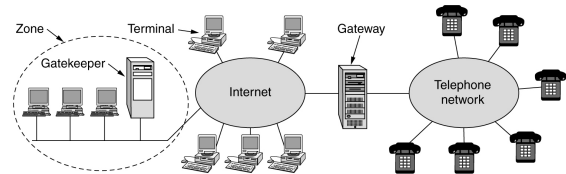
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7.4 VoIP, FoIP and IP Interconnection

Speech	Control			
G.7xx	RTCP	H.225 (RAS)	Q.931 (Call signaling)	H.245 (Call control)
RTP				
UDP			TCP	
IP				
Data link protocol				
Physical layer protocol				

The H323 protocol stack

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7.4 VoIP, FoIP and IP Interconnection

Call signaling channel (Q.931)
Call control channel (H.245)
Forward data channel (RTP)
Reverse data channel (RTP)
Data control channel (RTCP)
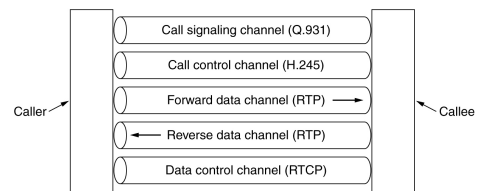
Caller   Callee

Logical channels between the caller and callee during a call

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7.4 VoIP, FoIP and IP Interconnection

Use a proxy and redirection servers with SIP

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7.4 VoIP, FoIP and IP Interconnection

Item	H.323	SIP
Designed by	ITU	IETF
Compatibility with PSTN	Yes	Largely
Compatibility with Internet	No	Yes
Architecture	Monolithic	Modular
Completeness	Full protocol stack	SIP just deals with setup
Parameter negotiation	Yes	Yes
Call signaling	Q.931 over TCP	SIP over TCP or UDP
Message format	Binary	ASCII
Media transport	RTP/RTCP	RTP/RTCP
Multiparty calls	Yes	Yes
Multimedia conferences	Yes	No
Addressing	Host or phone number	URL
Call termination	Explicit or TCP release	Explicit or timeout
Instant messaging	No	Yes
Encryption	Yes	Yes
Size of standards	1400 pages	250 pages
Implementation	Large and complex	Moderate
Status	Widely deployed	Up and coming

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7.5 Datacenters and Data warehousing, packet clearinghouse

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7.6 Unified Messaging Systems

• Integration of different electronic messaging & communications media (e-mail, SMS, Fax, voicemail, video messaging, etc.) technologies into a single interface, accessible from a variety of different devices

• UM solutions integrate communications processes into the existing IT infrastructure, i. e. into CRM, ERP & mail systems

• Handling of voice, fax, and regular text messages as objects in a single mailbox that a user can access either with a regular e-mail client or by telephone

• Cisco Unity Unified Messaging - Access Multiple Message Types from One Inbox

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7.8 Concept of Grid and Cloud Computing

Grid Computing
• Enables aggregation of distributed resources across multiple administrative domains (AD)& transparently access to them

•grids tend to be more loosely coupled, heterogeneous, and geographically dispersed than conventional high performance computing systems such as cluster computing

•Most production grids -TeraGrid and EGEE - seek to share compute & storage resources distributed across AD, focusing on speeding up scientific applications, like climate modeling, drug design, protein analysis,..

• Realizing web services-based protocols that allow distributed resources to be "discovered, accessed, allocated, monitored, accounted for, and billed for, etc., and in general managed as a single virtual system."

• Open Grid Services Architecture (OGSA) defines a set of core capabilities & behaviors that address key concerns in grid systems

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7.8 Concept of Grid and Cloud Computing

Grid Computing…

• Globus Toolkit - middleware that implements several standard Grid services and over the years has aided the deployment of several service-oriented Grid infrastructures and applications

•The development of standardized protocols for several grid computing activities has contributed to allow delivery of on-demand computing services over the Internet. However, ensuring QoS and guaranteeing execution time ,especially for time-critical applications in grids have been difficult.

•Lack of performance isolation has prevented grids adoption in a variety of scenarios, especially on environments where resources are oversubscribed or users are uncooperative. Activities associated with one user or virtual organization (VO) can influence, in an uncontrollable way, the performance perceived by other users using the same platform.

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7.8 Concept of Grid and Cloud Computing

Grid Computing…

• Another issues when using grids is the availability of resources with diverse s/w configurations, including disparate OS, libraries, compilers, runtime environments,..

• Researches like Globus VirtualWorkspaces aimed at evolving grids to support an additional layer to virtualize computation, storage, and network resources.

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7.8 Concept of Grid and Cloud Computing

•Cloud Computing

•http://www.nytimes.com/2012/08/28/technology/active-in-cloud-amazon-reshapes-computing.html?_r=l&ref=technology

"(1) the illusion of infinite computing resources; (2) the elimination of an up-front commitment by cloud users; and (3) the ability to pay for use . . . as needed . . ."
- A report from the University of California Berkeley

". . . a pay -per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."
- The National Institute of Standards and Technology

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7.8 Concept of Grid and Cloud Computing

•Cloud Computing…

• A Cloud should have:
  • Pay -per-use (no ongoing commitment, utility prices);
  •Elastic capacity and the illusion of infinite resources;
  • Self-service interface; and
  • Resources that are abstracted or virtualized

•Apart form raw computing and storage, service providers provides APIs & Development Tools
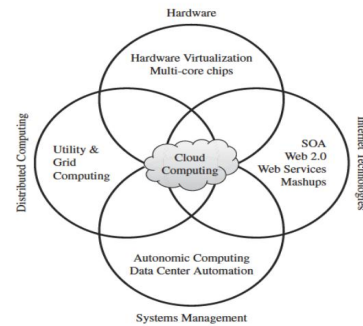

7.8 Concept of Grid and Cloud Computing

Fig. Convergence of various advanced leading to the advent of Cloud Computing
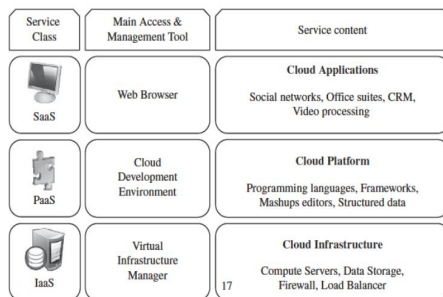

7.8 Concept of Grid and Cloud Computing

Fig. The Cloud Computing Stack

7.8 Concept of Grid and Cloud Computing

Infrastructure as a service (IaaS)

•Virtualized resources (computation, storage & comm.) on demand
•Infrastructure Services lie at the bottom of cloud computing systems
•Eg. Amazon Web Services EC2

7.8 Concept of Grid and Cloud Computing

Platform as a service (PaaS)

- Makes Cloud easily programmable
- Offers scalable environment on which developers create & deploy applications
- Eg. Google AppEngine for developing & hosting Web app.

7.8 Concept of Grid and Cloud Computing

Software as a service (SaaS)

- Online Software Services through Web portals
- Alleviates burden of sw maintenance
- Simplifies development & testing for providers
- Eg. Salesforce.com offering CRM allowing app. customization & access on demand

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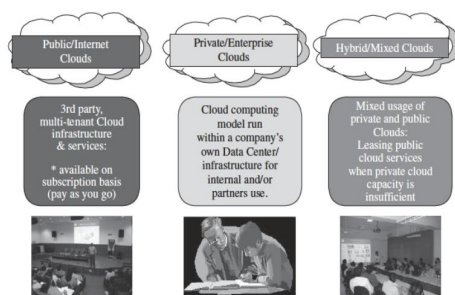### 7.8 Concept of Grid and Cloud Computing

Fig. Types of Clouds based on deployment models

7.8 Concept of Grid and Cloud Computing

- Challenges of Cloud Computing
  - Security, Privacy, and Trust
  - Data Lock-In and Standardization
  - Availability, Fault-Tolerance, and Disaster Recovery
  - Resource Management and Energy-Efficiency

Fig. Types of Clouds based on deployment models