MIS 340 Data Communications & Networking in a Global Environment.

Spring 2011

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Office Hours/Location: After each class, 10:30am until 12:00am Tuesday & Thursday at my office, and other times by appointment. / Office Location A129J

Prerequisites: MIS 295 and either admission to the MIS program or permission of the Director of the MIS program.

Catalog Description: The International standards based technologies which enable the Global Interchange of Information are presented. Data Comm (DC) models, components, terminology, and interaction effects between DC and software applications are evaluated in multiple network architecture configurations supporting transactional knowledge workers, e-business, and e-commerce applications.

Course Overview

This course is an introductory course in information communications. Its primary objective is to introduce students to the basic technology concepts related to creating and deploying distributed applications for Global Business Operations.

- Historical Review of centralized Application development and the business drivers that initiated the evolution to de-centralized applications and the inherent communication technology requirements that were necessary to support this de-centralization.
- An overview of how the International Standards ISO Internet network model which supports the largest Global Network in existence, functions. This will involve an understanding of the concepts of messaging using layers to facilitate distributed application communication.
- Develop a basic understanding of how a Local Area Network (LAN) operates from a hardware and administrative software perspective in both guided media and wireless LAN's
- Introduction to Networking technologies to support LAN, WLAN, Backbone, WAN and the Internet configurations. Discussion of the management implications associated with these technologies in a Global environment.
- Introduction to Network Management and Security issues and the implications to Global Business Data Communications.
- Introduction to Future application decentralization trends such as Virtualization and Cloud computing and a discussion of the potential implications of security and business intellectual property rights.

Course Methods
Our interactions, in and out of the classroom, will be on a professional basis.

All correspondences such as emails and voicemails should be clearly thought out with defined messages. The majority of exams will be written. You will be expected to write in clear business language.

As a professional, your integrity and reputation are your greatest assets. A professional does not lie, cheat, or steal or tolerate those who do. As a professional, you are expected to be on time and participate with substance in class discussions.

It is normal to not have all the answers. The goal of our business to find the answers that can be executed. Through participation and discussions, we will work together to first understand a situation and then logically find appropriate answers.

Our ultimate goal is to become clear thinking problem solvers. We will have the confidence to listen and explain our reasoning.

Class	Date	Subject	Reading
1	Jan 13	Syllabus Review Historical review of centralized application and the evolution to decentralized.	
2	Jan 18	Introduction to the ISO Internet Model and an overview of messaging thru layers	Fitzgerald & Dennis Ch. 1
3	Jan 20	Application Layer – Distributed Application Architectures	Fitzgerald & Dennis Ch. 2
4	Jan 25	Application examples and protocols	Fitzgerald & Dennis Ch. 2
5	Jan 27	Function of the Transport Layer. Overview of TCP	Fitzgerald & Dennis Ch. 5
6	Feb 1	Transport Layer Con't	Fitzgerald & Dennis Ch. 5
7	Feb 3	Function of the Network Layer – addressing, subnet masks, routing	Fitzgerald & Dennis Ch. 5
8	Feb 8	Functions of the Network Layer Con't.	Fitzgerald & Dennis Ch. 5
9	Feb 10	Exam 1	
10	Feb 15	Functions of the Data Link Layer. Media Access Control – controlled	Fitzgerald & Dennis Ch. 4

Class	Date	Subject	Reading
		vs. contention based methods	
11	Feb 17	Error Control – Sources, influence on packet size, Ethernet	Fitzgerald & Dennis Ch. 4
12	Feb 22	The Physical Layer. – Analog vs Digital signaling, cabling terminology	Fitzgerald & Dennis Ch. 3
13	Feb 24	analog to digital conversion, multiplexing	Fitzgerald & Dennis Ch. 3
14	Mar 1	Introduction to Local Area Networks. Overview of hardware, OS functions in a guided media LAN	Fitzgerald & Dennis Ch. 6
15	Mar 3	Introduction to Administrative Software. Active Server Directory, DNS and DHCP.	Fitzgerald & Dennis Ch. 6
16	Mar 8	Introduction to Wireless LAN technology WiFi.	Fitzgerald & Dennis Ch. 7
17	Mar 10	Exam 2	
18	Mar 15/17	Spring Break	
19	Mar 22	Other Wireless technologies – Wimax and Bluetooth.	
20	Mar 24	Improving LAN & WLAN performance	Fitzgerald & Dennis Ch. 7
21	Mar 29	Backbone & WAN's – Private vs Public Networks	Fitzgerald & Dennis Ch. 8&9
22	Mar 31	Introduction to VPN's	Fitzgerald & Dennis Ch. 9
23	Apr 5	Internet Access Technologies	Fitzgerald & Dennis Ch. 10.
24	Apr 7	Internet Governance &Internet 2	Fitzgerald & Dennis Ch. 10
25	Apr 12	Network Security-Risk Assessment	Fitzgerald & Dennis Ch. 11
26	Apr 14	Intrusion Prevention	Fitzgerald & Dennis Ch. 11
27	Apr 19	Encryption – private key vs public key	Fitzgerald & Dennis Ch. 11
28	Apr 21	SSL and Secure Certificates	
29	Apr 26	Exam 3	
30	Apr 28	Final Review	
	May3-May 7	FINAL EXAM WEEK	

The instructor reserves the right to make changes in this syllabus at any time during the semester.

Text: The supporting text will be Business Data Communications & Networking, Fitzgerald/Dennis. 10th Edition. ISBN 978-0-470-05575-5

Sharepoint: The MIS 340 SharePoint page will be used to post all lecture notes, exams and other pertinent information regarding MIS 340. Verify, that you can access the 340 page. If you cannot, notify and resolve your issue with Labmx.

Quizzes: Unannounced quizzes may be given weekly at the Instructor's discretion. These will be typically one question tests on lecture material covered in the previous two lectures.

AIME's meetings. It is the expectation that all MIS 340 students will attend the Tuesday night AIME's meeting. They will be held in Austin 30 starting at 6:30. Class will generally be let out 5-10 minutes early so that there is sufficient time to get to Austin Hall.

Grading: 3 Exams plus the final for a total of 70%; The Final Exam is 1.5 times the weighting of the Semester Exams and will be comprehensive. Quizzes 10%; Participation/Assignments 20% . Outside Activities such a technical research topics may be assigned. No late assignments will be accepted.

Attendance is required. Attendance will be taken and excessive absences will impact the final grade. If you cannot attend a class, you must notify the instructor by e-mail 24 hours prior to the class meeting time stating the reason for the absence. Failure to do so will result in an unexcused absence.

Academic Misconduct will not be tolerated. All acts of dishonesty in any work constitute academic misconduct. The Academic Misconduct Disciplinary Policy will be followed in the event of academic misconduct.

Disabilities: If you need to request the accommodation of a disability, you must contact the Office of Disability Services at 348-4285 as soon as possible. You may then contact the instructor to schedule an appointment to discuss your request.

Severe Weather is always a possibility. In the event of an emergency, we will adhere to the following actions in accordance with University policies.

FIRE/FIRE ALARM: Evacuate the building and stay out of the building at a safe distance until authorized to return.

TORNADO WARNING: Move to the Lower Level, inside classrooms, offices or corridors. Remain until the warning has expired. Classes are cancelled until the warning expires.

MIS 340

1/13/2011

- all info on MIS 340 sharepoint site
- join ACM

- main driver for Application Development
  - to engage in commerce

- Character-based systems i.e. DOS
- COBOL was heavily used early-on

- Networked Systems
  - distributed user terminals
  - & " hardware systems & data synchronization
  - solutions were done by developers
  - for remote terminals, used phone
  - batch processing for data sync
  - Visical - spreadsheet application

- e-mail had a significant impact
- email was initially ran on a mainframe, but was too intensive and caused problems

- current versions of Windows have about 94 million lines of code
- only use 2 chars (years) due to programming with punch cards

1/18/2010

- Moore's Law
  - Gordon Moore, one of the co-founders of Intel
  - # of transistors on a chip would double every 18 months
  - in 1965 = 60 transistors; 2008 = 1.7 billion
- capex = capital expenditures
- application programming is keyed on problem solving
- CSE tools - Computer Software Engineering
- internet started in the 1970s but didn't catch on until the 1990s

- web pages were not dynamic; all static
- dial-up was the only way to connect to the internet

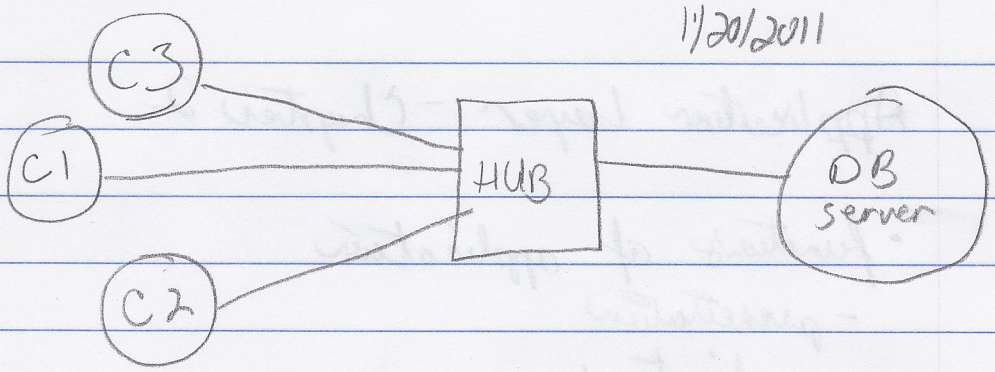
- terminology is inconsistent between the technically precise and marketers

- communication programs had to be written; couldn't be used on other equipment

- use standards; ~~allows~~ allows focusing on other tasks
- OSI model came after Internet model
  - ~~Internet~~ model proved to be superior
- Internet Model
  - layers: Physical, Data Link, Network, Transport, Application
    "Please Do Not Touch Alligators"
  - each layer only has one purpose and does one thing
  - each layer only sees the adjacent layers

- 99% of data transmission on a LAN is done via ethernet

1/20/2011



- where to and from address
- how it is being delivered? packaged
- translate number from base-10 (dec) to base-2 (binary)
- error correction
- delivery confirmation

- package, address (URL) lookup, check if database is ready to receive (connect to server), capabilities, send msg if message has gotten there

socket is ip address and port number

- error correction
- resend packets

Application Layer - Chapter 2

- functions of application
  - presentation
  - application
  - data access
  - data storage

Application architecture

- architecture - total system
  - key structures, external properties, and the relationships

System Structures

- software elements
  - data "
- external hardware elements

- Software Patterns
  - architectural styles
  - design patterns
  - language idioms

Client - Server Style

- response - request protocol
- 2 - tier example
- Fat Client - most functionality on client side

1/25/2011

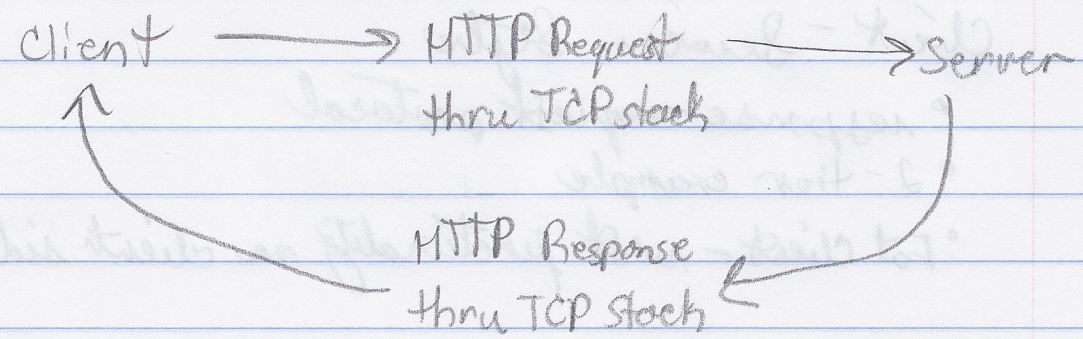
Client - Server

- request - response technology
  - mostly internet - based applications
- Fat Client - MS Outlook

- Thin Client - web browser
- Tiered Architecture
  - usually do three - tier apps
  - much more scalable
  - most complex code goes in 2nd tier; can be expanded if needed
  - more complex to test

- Web Browser
  - http - protocol for distributed app
  - started with hypertext and Uniform Resource Locators (URL)

HTTP – main Web communications protocol



- HTTP Request Msg
  - request line (cmd, URL, HTTP version number) req
  - " header(s) (host, date, referring page) only host req
  - " body (sent to the server) optional

- Request Commands Examples
  - head, get, post, put, delete, trace, options, connect, patch

- Response Msg
  - Response status (version, status code, reason
  - header (date, info on server, URL, format) date is req
  - body

- Success 2XX
  OK 200, Created 201
- Redirection 3XX
  Moved 301
- Error 4XX, 5XX
  - Bad request 400, Unauthorized 401, Not Found 404
    Internal Error 500

Email Standards

- SMTP –
  - Main Standard

- usually two - five

- Post office Protocol (POP) and Internet Mail Access Protocal (IMAP)

- TCP: the reliable protocol

1/27/2014

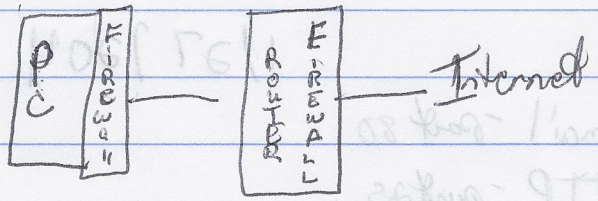
WWW	Email - port 80
HTTP	HTTP - port 25
	SMTP
	POP
	IMAP
	MIME

Mailing Lists Listserv

- Listserv processer } parts of listserv
- listserv mailer
- permit any member to post messages
- to discuss a special topic

FTP - port 21

- sending files over the internet
- commonly used for uploaded web pages
- closed sites: require account name and password
- anonymous sites account name: anonymous
  password: email address



- FTP can pick-up where it left off on a file

Telnet

- allows one computer to another computer
- requires username and password
- " application program on the client computer and Telnet server program on server

- SSH replaced Telnet

- Instant Messaging (IM)
  - client and server on IM software package
  - two step process
    - telling IM server you're online
    - chatting

- Videoconferencing
  - video and audio transmission done in real-time in more than location
  - has standards

- Webcasting
  - uni-directional videoconferencing
  - need plug-in on client end
  - content created by developer
  - no standards exist

- Implications for Management
  - can provide a worry-free environment for applications
  - might change the organization

- increase number of and type of applications

Cost for 200 people

- PC → $500/seat
- Software → $500/seat
- Network → $200/seat
- printers → $50/seat
- support → $2500/seat

$3750/seat

Transport Layer

- App layer
- transport layer
- network layer
- data link layer

- with IPv4, transport and network layer was one part

- TCP/IP is used in a variety of formats

- multiplexing and demultiplexing - combining or splitting a layer of protocol
- segmentation - breaking a large package into a smaller package (source) and then reassembled (receiving end)
- ~~packaging~~ packaging - wrapping in TCP
  - source, destination, segment #

- establishes, manages and terminates

2/11/2010

- test on a week from Thursday

- hard to talk about the transport layer without the network layer

- SNMP - monitors the status of a network; whether it is online or not

- most applications use TCP
- administrative programs use UDP

- multiple layered paths coming out of one path

- transport layer knows what protocol is being used; packets are broken into segments, each has a number
- applications that sent it, segment number, and receiving port number

- if memory is full, then packets are lost; no acknowledge is received and is resent
- every packet that is sent must get acknowledged in TCP/IP; otherwise it must be retransmitted
- flow control prevents a lot of packets being lost; i.e. if one computer (sends) is faster than the receiving computer
- port numbers are managed by IANA
- servers always use standard port numbers; clients do not

TCP
- connection-oriented
- bidirectional
- multiply-connected
- reliable
- acknowledged

- stream-oriented
- data-unstructured - doesn't care what's being sent
- data flow-managed

- SYN Protocol - contains packet size, flow rate, etc
- DHCP - internet white pages
- UDP

- Streaming video, video conferencing use UDP, ~~can~~ unable to be done with TCP
- TCP "Preamble" is 24 bytes (192 bits)
- Source port, destination port, and sequence number are the most important in TCP Message header
- QoS Routing (Quality of Service)
  - give priority to an application
  - used RTP
  - special connection based on priorities

2/8/2011

- primary network layer functions
  - unique address
  - routing (quickest way from point A to B)

- most people use IPv4
- IPV6 has come about due to growth of the Internet
  - IPV4 has 32 bit addresses
  - 1444 bytes available for data message

- 3 critical ~~fields~~ fields of the IP header

- MAC address = Media Access Control address

- DNS server is a directory of websites
- if not found on an DNS server, then it moves up to the next level

- ICANN ~~is managed by~~ manages Internet addresses and IP addresses for websites

- dynamic address - only gives an address when client is connected to network
  - no permanent addresses to clients
  - makes efficient use of IP address space
  - DHCP server applies/assigns addresses

- bootp (Bootstrap Protocol) sends out need IP address message

- must get IP address and subnet mask together

- Host ID is address to client

- Classfull Addressing
  - more host IDs with Class A (Myer-FSD)
  - Class C has the fewest Host IDs
  - under IPv4 has over 3 million IP addresses

- Slash Notation - number after slash are allocated to Network ID's

- NAT Proxy Server can also acts as a firewall

Subnetting

- mostly about sharing to limit resources
- breaks a large network into a smaller network

- quicker to communicate local net
having to go through a ~~router~~ router

2/10/2011

- subnet mask tells the network ID of the IP address

- sharing of info and resources are the reasons for a network

- MAC uses address Resolution Protocol (ARP)

- routing - process identifying what path to have a packet take through a network from sender to receiver
  - uses routing tables

- computers can have a routing table
- each node on a network has its own routing table

- centralized routing
  - decisions made by a central computer
  - mostly on mainframe networks
- de-centralized routing
  - decision made independently
  - static routing
    - skill used; pre-defined
  - dynamic routing or adaptive routing
    - builds its own routing table based on conditions

Dynamic Routing Algorithms
- distance vector
- link state
- RIP - broadcasts routing tables every 30 secs to other routers

- OSPF is an algorithm

- autonomous system — the part of the system that you manage (of a larger network)
- ICMP — error (diagnostic) message protocol, if package is not handled by device being sent to; also used for pinging
- BGP — border gateway protocol — operates between networks

- Study from slides, then books, then online

1/13/2011

Data Communications for a Global Environment

This is MIS 340 – Data Communications & Networking i Environment.

Instructor: Dr. Bob Hogan
Office: Bevill 1103

Data Communications for a Global Environment

General Information and Rules of Engagement

Everything you need to know concerning this class is on SharePoint.

The very first thing you need to do is verify that you can access the Sharepoint site, Course tab, MIS340, Shared Documents. If you cannot the site, contact Daniel Ryberg and resolve by next class.

AIM's Meetings
You are expected to attend the AIM's meetings on Tuesday at 6:30pm. Feel free to wear suits to class on that day.

Data Communications for a Global Environment

General Information and Rules of Engagement (cont'd)

There will be a Interview prep session Tonight starting at 6:30 in Bevill 10000

The resume review will be held Tuesday, January 18th in AIME. Tuesday, Janu

The signup sheet will be available in the Beville office on the front desk. students sign up as early as possible to get the better slots. Please have your re constructed and in the correct template . You should have received an e-mail fr Ryberg with a link to the resume template. You will need to bring 4 copies of yo

Note: Signing up for a slot and not showing up for the slot will reflect very poorly and may cause you to miss out on opportunities later in the semester (scholarship/internship/etc).

Data Communications for a Global Environment

General Information and Rules of Engagement (cont'd

As a part of resume review, AIMS dues will also be collected. They are $10. cash or check. The checks can be made out to Alabama Information Management Society. This will be collected as you check into resume review Please make sure you bring your Act Card.

Data Communications for a Global Environment

Resources

- MIS 340 SharePoint
  - http://mitcfesvr.eil-server.cba.ua.edu/sites/Courses/MIS_340/default.aspx
- acm.org
  - Student membership
  - $19.00 per year
- Business Data Communications and Networking 8th Edition and later.
  by Jerry FitzGerald, Alan Dennis
  - ISBN-8: 0471348074
  - ISBN-10: 978-0471348078
  - $2.00, used on amazon.com or half.com

Data Communications for a Global Environment

What is the Main Driver for Application Development?

Business Value

Data Communications for a Global Environment

A Brief History of Centralized Software Development and the evolution to Distributed systems

- Prior to 1990, Critical Business Application Software consisted of Character based user interface type Apps that ran on a Central CPU with direct attached storage.
- By today's standards the CPU processing capacity was low, typically < 2 MIPS and very expensive.
- Storage Capacity of Disk Drives were often measured in Kbytes or low Mbytes and had to physically be in close proximity to the CPU.
- Environmentally, the largest CPU's required water cooling
- The cost of a centralized processing system, hardware, OS and software utilities was in the tens of millions of dollars and that was without any Application Software.

Data Communications for a Global Environment

A Brief History of Centralized Software Development and the evolution to Distributed systems

- Centralization of Business applications was not necessarily considered a limitation to Business since many Businesses were also centralized from an Organizational perspective.
- There is no precise moment in time and it varied with Business Segment but certainly by the 1980's, we observe the inexorable expansion of Businesses to serve ever widening geographic areas in order to increase Market Share & Improve production costs.

Data Communications for a Global Environment

A Brief History of Centralized Software Development and the evolution to Distributed systems

This beginning of Networked Systems.

- Distributed user terminals (Remote Terminal Access)
- Distributed hardware systems and Data Synchronization
- Initial Networking solutions were often proprietary and needed to be written by the Application Developer.

What potential technical and business issues can you identify with these approaches?

Data Communications for a Global Environment

A Brief History of Centralized Software Development and the evolution to Distributed systems

Impact of the Personal Computer.

- Around 1984, PC's were starting to appear in volume in larger businesses.
- Initial PC applications were character based but offered personal productivity advantages that could not be matched with existing Mainframe systems
- The "killer" apps (spreadsheet, word processing)
- IT independence.

The "Fox was now in the Hen house"

Data Communications for a Global Environment

A Brief History of Centralized Software Development and the evolution to Distributed systems

Impact of the E-mail

- The fledgling appearance of the Internet masked under names like AOL provided the general population with E-mail capability.
- The demand for E-mail extended into the workplace and initially the Mainframe was used as the E-mail Server. This quickly proved to be to resource intensive but E-mail could not be taken away from the user.

Data Communications for a Global Environment

A Brief History of Centralized Software Development and the evolution to Distributed systems

Impact of the Graphical User Interface

- one could and many did argue that for rapid data entry nothing was faster that a well designed character based entry system.
- the user intuitive capability that the GUI provided the ability to support attachments like files, spreadsheets and pictures eventually overrode any resistance.

Data Communications for a Global Environment

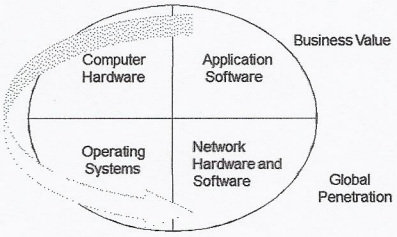
A Brief History of Centralized Software Development and the evolution to Distributed systems

Dealing with the Chaos

- The reemergence of the IT organization
- Year 2000 issue
- The emergence of Application Development methodologies
- Object Oriented Design
- The Internet Explosion

Data Communications for a Global Environment

We are merging 4 environments and we need to know a little about each in order to understand how a system delivers business value.



Data Communications for a Global Environment

The "Manager's Dilemma"

- Technology is necessary for competitiveness
- Cost of technology has decreased ?
- Reliance on technology has increased
- Number of choices have increased
- Choices are both more difficult and more important
- Now that we are Globally connected, Security is a major concern
  and a significant part of the operating cost.

Data Communications for a Global Environment

Most of what we consider to be the modern advances in Information Technology have really occurred within a very narrow window of 30 – 40 years.

Remember Change is mostly evolutionary not revolutionary.

The company who is first with or has the best technology usually doesn't win the prize.

The long term winners in Technology are usually those who are best at determining business or social need and can provide a value based solution.

Lecture 2

Lecture 2:

The ISO Internet Model and Messaging thru Layers

A Brief History of Centralized Software Development and the evolution to Distributed systems

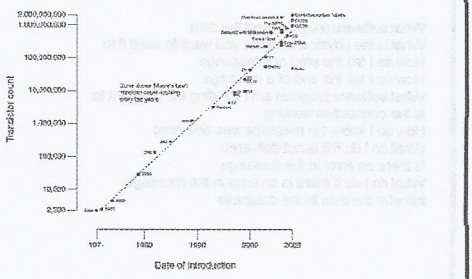
Impact of Moore's Law:

- Gordon Moore observed that the number of transistors on an integrated circuit had doubled every year since the introduction of the IC and that trend would continue into the foreseeable future.
- Actually, it was closer to 18 months and in 1975 Moore modified it again to 24 months. Still despite all the theorists who predicted a quantum limit, the trend has continued for 4 decades.

In 1965, when Moore made his first prediction there were about 60 transistors on a chip. In 2008, Intel has put 1,700,000,000 Transistors on it's Itanium chip.

Moore's Law

CPU Transistor Counts 1971-2008 & Moore's Law



A Brief History of Centralized Software Development and the evolution to Distributed systems

Dealing with the Chaos

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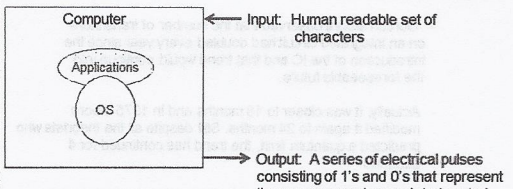
A Brief History of Centralized Software Development and the evolution to Distributed systems

1970	Present
Business more Geographically consolidated	Business Internationally *Diversified*
High Cost, Low CPU capacity Tightly coupled Systems	Low Cost, Distributed CPU capacity. System Components loosely coup
Applications driven by CAPEX considerations a Algorithmic Efficiency.	Applications driven by ROI, Marketing or Busines Advantage considerations
Networks barely existent Providing File Transfer or RTA over private lines	Internet providing a perva World wide communicatio Infrastructure.

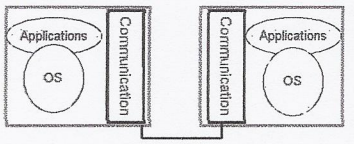
Why does MIS 340 Seem So Confusing?

- Many technologies exist
- No singe underlying Theory exists that explains all the relationships among all the parts
- Multiple organizations have created computer networks standards
- Set of technologies is diverse and changes rapidly.
- Terminology is inconsistent between researcher's trying to be technically precise and Marketers who often invent new terms to distinguish their products.

Let's consider what a networking program would entail.



Network Communication Software



Single layer implementation
-Networking with large components is complex to understand and implement

Exercise Scenario:

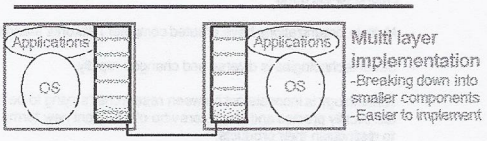
The Application program on system 1 has as its output, a number, which is represented as an 8 bit binary number. You want to store that output on a SQL database residing on system 2. Assume the two computers have a compatible physical connection, There are no other computers on the network, no other application programs are running. You have been asked to write a communication program to transfer the output of system 1 to the database on System 2.

Assignment: Identify all the processes (functions) that have to be considered

If you were writing a communication program what are some of the functions would you need to consider?

What software program sent the data
What is the physical address you want to send it to
How do I tell the start of a message
How do I tell the end of a message
What software program am I sending the program to
Is the connection working
How do I know the message was delivered
What do I do if it is not delivered
Is there an error in the message
What do I do if there is an error in the message
transfer the data to the database

Messaging thru Layers



Multi layer implementation
-Breaking down into smaller components
-Easier to implement

Multi-layer Network Models

- The two most important such network models: OSI and Internet
- Open Systems Interconnection Model
  - Created by International Standards Organization (ISO) as a framework for computer network standards in 1984
  - Based on 7 layers
- Internet Model
  - Created by DARPA originally in early 70's
  - Developed to solve to the problem of internetworking
  - Based on 5 layers (not initially)
  - Based on Transmission Control Protocol/ Internet Protocol (TCP/IP) suite

Internet's 5-Layer Model

Physical	Data Link	Network	Transport	Application

Please Do Not Touch Alligators"

Application Layer
- Now incorporates the functionality of the presentation and Session layers application program

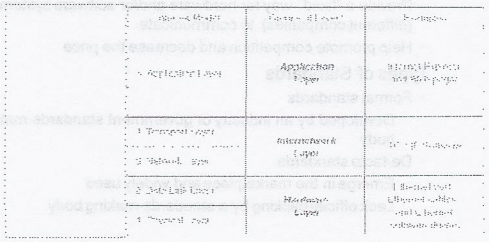
Transport Layer
- responsible for establishing end-to-end connections, translates domain names into numeric addresses and segments messages

Network Layer – provides addressing and routing

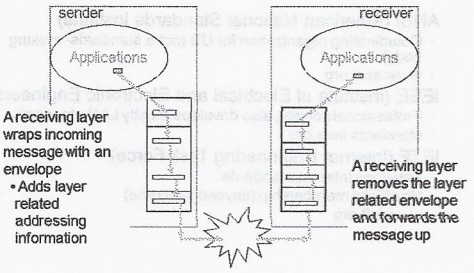
Data Link Layer – provides message delineation, error control and Media Access Control.

Physical Layer - defines how individual bits are formatted to be transmitted through the network

Comparison of Network Models

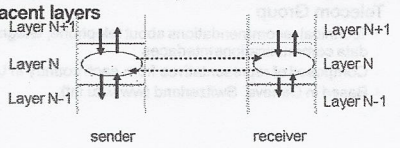


Message Transmission Using Layers

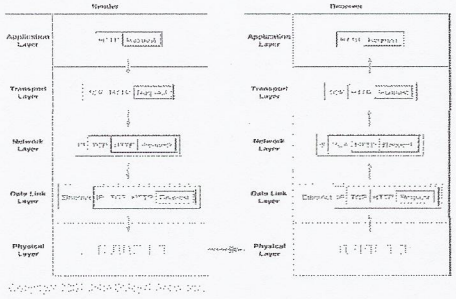


Protocol s

- Used by Network model layers
- Sets of standardized rules to define how to communicate at each layer and how to interface with adjacent layers



message transmission Example



Points about Network Layer Views

- Layers allow simplicity of networking in some ways
  - Easy to develop new software that fits each layer
  - Relatively simple to change the software at any level
- Matching layers communicate between different computers and computer platforms
  - Accomplished by standards that we all agree on
  - e.g., Physical layer at the sending computer must match up with the same layer in the receiving computer
- Somewhat inefficient
  - Involves many software packages and packets
  - Packet overhead (slower transmission, processing time)
  - Interoperability achieved at the expense of perfectly streamlined communication

Standards

Importance

- Provide a "fixed" way for hardware and/or software systems (different companies) to communicate
- Help promote competition and decrease the price

Types of Standards

- Formal standards
  - Developed by an industry or government standards-making body
- De-facto standards
  - Emerge in the marketplace and widely used
  - Lack official backing by a standards-making body

Standardization Processes

- Specification
  - Developing the nomenclature and identifying the problems to be addressed
- *Identification of choices*
  - Identifying solutions to the problems and choose the "optimum" solution
- Acceptance
  - Defining the solution, getting it recognized by industry so that a uniform solution is accepted

Major Standards Bodies

ISO (International Organization for Standardization)

- Technical recommendations for data communication interfaces
- Composed of each country's national standards orgs.
- Based in Geneva, Switzerland (www.iso.ch)

ITU-T (International Telecommunications Union – Telecom Group

- Technical recommendations about telephone, telegraph and data communications interfaces
- Composed of representatives from each country in UN
- Based in Geneva, Switzerland (www.itu.int)

Major Standards Bodies (Cont.)

ANSI (American National Standards Institute)

- Coordinating organization for US (not a standards- making body)
- www.ansi.org

IEEE (Institute of Electrical and Electronic Engineers)

- Professional society; also develops mostly LAN standards
- standards.ieee.org

IETF (Internet Engineering Task Force)

- Develops Internet standards
- No official membership (anyone welcome)
- www.ietf.org

Some Data Comm. Standards

Layer	Common Standards
5. Application layer	HTTP, HTML (Web) MPEG, H.323 (audio/video) IMAP, POP (e-mail)
4. Transport layer	TCP (Internet)
3. Network layer	IPv4; IPv6 (Internet)
2. Data link layer	Ethernet (LAN) Frame Relay (WAN)
1. Physical layer	Category 56 twisted pair (LAN) Cable Modem or DSL (BroadBand)

Lecture 3

Data Communications for a Global Environment

Review

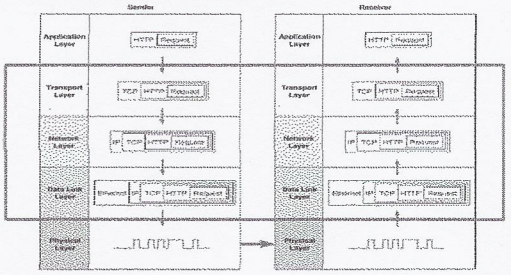
- Increasing Computer capacity and decreasing cost
- Geographic expansion of public network access to Local ISP's
- Business processes becoming more complex and multi-national
- General consumer demand (gamers, e-mail, socialization networks)

↓

Fueling the growth of low cost public networking

Data Communications for a Global Environment

Messaging Thru Layers



Layers
Application
transport
data
network
data link
ethernet (physical)

Data Communications for a Global Environment

Lecture 3:

The Application Layer and Distributed Application Architectures.

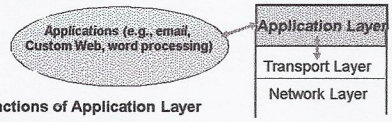
Data Communications for a Global Environment

Chapter 2

Application Layer

Data Communications for a Global Environment

Application Layer - Introduction



- **Functions of Application Layer**
  - **–Presentation logic**
    - **– Presentation of info to user and acceptance of user commands**
  - **–Application logic**
    - **– Business logic such as word processors, spreadsheets**
  - **–Data access logic**
    - **– Processing required to access stored data (e.g., SQL)**
  - **–Data storage**
    - **– Storing of data generated by programs (e.g., files, records)**

P Presentation
A Application
D Data Access
D Data Storage

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Application Architecture

The Architecture of a software-intensive system is the:

- structure or structures of the system, which is comprised of software elements,
- the externally visible properties of those elements,
- and relationships among them.

Rozanski & Woods

Data Communications for a Global Environment

Systems Structures

- Static Structures (design time organization)
- Software Elements: could be Modules, Classes, Stored procedures or any self contained code unit.
- Data Elements: classes, RDB entities/tables, data files
- Internal Hardware Elements:
  - Computers and their constituent parts (CPU, disk)
  - Networking Elements (cables, routers, hubs)

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Software Patterns

- The purpose of a software pattern is to share a proven, widely acceptable solution to a particular design problem in a standard form that allows it to be easily reused.
  - **Architectural Styles:** record solutions for system level organization
  - **Design Patterns:** record solutions to detailed design problems
  - **Language Idioms:** capture useful solution to language specific problems.

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Common Architectural Styles

- Client /Server
- Tiered Computing (.net)
- Peer to Peer
- Layered Implementation
- Publisher Subscriber
- Model-View-Controller (Java)
- Pipes and Filters
- Asynchronous Data Replication
- Distribution Tree
- Integration Hub
- Tuple Space

Examples of Styles we will see in this course.

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Client Server Style

Widely used style comprised of two types of elements

- **Server** that provides one or more services via a well defined interface
- Client that uses those services as part of its operation

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Examples of Client Server Styles

Client Based Computing (Fat Client)(2-Tier)

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Examples of Client Server Styles

Client Based Computing (Thin Client)(2-Tier)