OVERVIEW

- Finish Introduction to Internet and E-Commerce
- Survey how the Internet works
Electronic Commerce

- B2C or B2B
- Intel on the Web (B2B)
  - From 0 to about $1 billion in orders a month
  - 45,000 faxes/quarter from Taiwan alone
- Started with EDI
- Extranets, Intranets today
- Very large opportunities
EC Pros for Firms

- 24/7
- Global, giant market place, more customers
- Pull technology & inventory management
- Reduces capital costs
- Level playing field for small business?
- Enables niche markets
EC Pros for Society

- Public services better
- Cheaper prices
- More competition
- More mixing of different economies
- New and larger communication media
EC Pros for Customers

- Cheaper products or services?
- More choices, larger market
- 24/7
- Customizable products
- Virtual auctions (distance & size)
- Electronic communities
Problems for EC

- Questionable EC Patents
  - Patents for Business Processes
  - Questionable Business Models
  - “Dot-Coms with patents are worth 10% more”

- Standards for quality, reliability & security

- Bandwidth issues

- Legacy application integration

- Cost

- Taxation

- International Issues
More Problems for EC

- Consumer hesitation
- Brick & mortar still good alternative
- Zealous government regulation
- Money problems lately: market shakeout
- Depends on complex systems
- Disintermediation & displacement
EC Business Models

- Advertising
- Market research/Data Marts
- Merchants
- Transactions, Finance
- Auctions
- Logistic details/services
- Support brick & mortar
Advantages of Ads on the Web

- Interactive & immediate feedback/purchase
- Data mining and other targeting techniques
- Benevolent demographics on the Web
- 24/7 interactive - pull & more one-to-one
- Going to multimedia
- Direct e-mail ads almost Free
- Often the ad runs on consumers machine
- Personalization and customization
E-Marketing

- Interactive Marketing - Instant
- Primary Data on the Web: OLAP & Simulation (http://www.olapreport.com)
- The Web has lots of secondary data
  * Government sites, proprietary data
  * Observe consumer’s movements
- Ask customers what they want: one-to-one
- CRM: Customer Relationship Management
- Market Intelligence & Bots
E-Commerce Infrastructure

- Networks
- Web servers
- Web server support and software
- E-catalogues
- Web Page Design and Construction Software
- Transaction Software (POS)
- Internet Access Components
- Other: Firewalls, email, etc.
How the Internet Works

- Packet switching
- TCP/IP
- IP Addresses
- Ping / tracert
- Client/Server and TCP/IP
- Domain Name Servers
- HTTP, SMTP, POP, IMAP
- OSI
- Ethernet
- Routing
- Quality of Service
- Moore’s Law?
Packet Switching

- We have already had a taste of this from prior lecture
- What does sharing network links do for us?
- Sharing by essentially taking turns, by the packets
- Variable sized packets are possible, though up to some limit
- Universal protocol eases use
Conflicting Network Technologies

- Incompatibility of net technology, even in the same firm
- Router: special computer to route packets
- ISP
  - Interesting pricing issues
  - Interesting connection topology issues
- Leased circuits are expensive
- The Last-Mile Problem
  - DSL and ADSL
  - Cable Modems
- Simulate continuous connectivity
TCP/IP

- Two layered protocol
- TCP controls the assembly and reassembly of packets
- IP is responsible for routing packets and the addressing details for the packets
- Routing Algorithms
- Other protocols: UDP for broadcasting (not peer to peer like TCP)
IP: Internet Protocol

- IP datagrams: packet in the format specified by the IP
- Notion of Virtual Network: IP and routing allows appearance of a completely connected network
TCP provides reliable and error free communication

- Uses ACKs, that is acknowledgments and sequencing in the IP datagram packets
- Can force retransmission
- Automatically adjusts timeout based on network loads, distance, etc.
IP Addresses

- 32-bit numbers being phased into 128-bit numbers (IPv6)
- Packet contains source and destination address
- Dotted quads: 255.255.255.255
- Uniquely identifies each computer on the internet
- Name servers and domain names as syntactic sugar for the dotted quad numbers (URLs, etc.)
- Generally, computers on the same “subnet” or LAN have the same prefixes
Ping

- Answers: “Tell me how fast ‘very important’ packets take to get from my computer and back?”
- General network connectivity
- Also, tracks the order the packets are received in
- Internet Control Message Protocol (ICMP) Echo Request Packets sent by ping
- ICMP: what IP uses to communicate network information: “send fewer packets”, “send your packets over there”, etc.
Ping

- TTL: time to live
- TTL packet field set to 255
- TTL decremented by 1 for each router traveled through
- Normal message packets usually have TTL field set to 60
- Time field: round-trip time in milliseconds
- Watch the variance of the round trip time
**traceroute**

- Answers: “What path do my packets take to get to your computer?”
- Which router hops, how many and the time between the hops
- Uses TTL tricks to discern paths
  - First packets TTL = 1, when first router discards the packets (since TTL = 0), it sends back an ICMP message saying “discarded packet since TTL = 0” from router X
- Interesting asymmetric issues
Ping and traceroute

- Important Network diagnostics
- Carefully applied: eat lots of resources
- ping www.rutgers.edu or ping www.andromeda.rutgers.edu
- tracert www.rutgers.edu
- tracert www.google.com
- VisualRoute
Client/Server Model and TCP/IP

- Master/Slave or Resource Sharing
- Allows or Encourages Specialization
- Important model in Enterprise Computing
- Money Saver:
  - Shared resources
  - Virtual Network
- Common protocol, good and easy to interconnect with everyone
Client/Server Model and TCP/IP

- Peer to peer
- Today’s classic: http and web browser
  - Which is the client? Which is the server?
- TCP/IP allows easy communication
- Use of TCP/IP can be programmed into large distributed programs!
- Pipes and sockets
- TCP/IP allows one part of a program to wait for information from another computer without negative ramifications
- Real distributed computing - the power of parallelism
Client Server/Business Aspects

- Redundancy
- Cost
- Well understood paradigm
- Often based on well understood protocols (TCP/IP)
- Easy to plug into
- Can handle giant loads and jobs
Domain Name Servers (DNS)

- Like directory assistance
- Translates name (like www.rutgers.edu) into IP number (128.6.4.5)
- Essentially allows easy-to-use names for Client/Server paradigm to work
- Each computer on the Internet knows its DNS
- What if your DNS is not secure?
HTTP

- http: hypertext transfer protocol
  - Protocol responsible for transferring and displaying web pages
  - 1991 Tim Berners-Lee, at the time in CERN
- The transport part runs “on top of” TCP/IP
  - Movies, sound, graphics, etc. the http client automatically requests these from the http server
- HTML is the major display part that is used to display things in particular ways
Mail servers
So far, email is one of the biggest “killer apps”
SMTP: simple mail transfer protocol
  * Specifics and standards for email servers
POP: post office protocol
  * Gets email from SMTP mail server
  * MIME: Multipurpose Internet Mail Extensions, that is attachments
IMAP: Internet Message Access Protocol: more flexible and advanced than POP
Old Friends

- ftp, telnet and finger
- All can be used also for network debugging
- ftp and telnet for network movements
ISO/OSI Reference Layer Model

- www.it.kth.se/edu/gru/Telesys/95P2_Telesystem/HTML/Module4/ISO-1.html
- Based on Frank Reichert’s notes
- Describe Computer Communication Services and Protocols without making assumptions of
  - Programming languages bindings
  - Operating systems bindings
  - Application and User interface issues
- Models organize knowledge for discussion and dissemination
Define Communication Layers

- Where we must clearly define interfaces for development
- To group related functions together
- Use layering to insulate different places where changes occur
- Layers to expose and standardize important services
- Isolate the changes and the effects of changes as things evolve
- Documentation of existing services in a clear and independent manner
Famous Seven Layers

1. Physical Layer, electric, optical, or acoustic, etc.
2. Link Layer: reliable transfer across link layer, framing of data blocks, error detection, link control flow
3. Network Layer: data transmission, switching technology, topology of the network and paths for data
4. Transport Layer: reliable transparent data transfer between points, error recovery
Famous Seven Layers cont.

5. Session Layer: establishing a session, management of communications

6. Presentation Layer: Encryption, compression, attachments, etc.

7. Application Layer: Managing communication of applications at a high level.
ISO/OSI Layers

- Where does all the stuff we talk about fit in?
- TCP/IP?
- Business Applications?
- Why is the ISO/OSI model useful?
Daryl’s TCP/IP Primer

- www.ipprimer.windsorcs.com/section.cfm
- Ethernet
- ISO Model
- IP addresses and masks
- Subnetting
- TCP and UDP
- DNS
- Q&A
Ethernet in some Detail

- XEROX PARC in early 1970s
- Simple, High speed, Reliable and one of the most long-lasting network protocols ever
- Most popular forms:
  - 10BaseT, unshielded twisted pair all connect in a star to a single hub
  - 10Base2, single coaxial cable in “bus configuration”
  - 10BaseF, fiber optic cables, often star with central hub
## Ethernet in some Detail

<table>
<thead>
<tr>
<th></th>
<th>Pros</th>
<th>Cons</th>
<th>Typical Use</th>
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<tbody>
<tr>
<td><strong>10baseT</strong></td>
<td>Reliable</td>
<td>Short dist to hub</td>
<td>Small Office or home</td>
</tr>
<tr>
<td><strong>10Base2</strong></td>
<td>No hub, 200m dist.</td>
<td>One break, no network</td>
<td>Small networks</td>
</tr>
<tr>
<td><strong>10BaseF</strong></td>
<td>1km dist.</td>
<td>Costly</td>
<td>Large Scale</td>
</tr>
</tbody>
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Ethernet in some Detail

- Daryl: “A bunch of loud people in an unmediated meeting room”
- Collision detection and random retries:
  - CSMA/CD: Carrier Sense Multiple Access with Collision Detection
- Famous RJ45 connectors: like large phone connectors
- 100BaseTX is used too, likewise Gigabit or 1000Mbps
Bottom of the OSI Model

- Network: IP, AppleTalk, IPX, all use routers
- Datalink: Ethernet, token ring, PPP, SLIP: bridges repeaters and hubs
- Physical: twisted pair, coax, serial cable, fiber: use modems, CSU/DSUs
- Each model cannot see the model below it
IP addresses in Detail

- RFC 1812 the basis of present IP
- Go to www.freesoft.org/CIE/RFC/1812
- Old RFC had class “A”, “B” or “C” IP addresses
- New CIDR (Class Internet Domain Routing)
- This gives a CLASSLESS addressing scheme, allows subnetting more easily
Net Masks

- Binary: AND, OR and XOR
- Allows subnetting, by forcing the packets addressing to pay attention only to part of the IP address
  - Convert IP to binary
  - AND subnet mask: leaves only a part of the IP address
- What is this for?
Net Masks

- Suppose my computer is 129.66.240.15
- I want to send a message to 129.65.15.240
- Are they on the same subnet?
- What is my subnet mask?
Net Masks

- Say it is 255.255.0.0
- I am at
  10000001 01000010 11110000 00001111
- I want to send to
  10000001 01000001 00001111 11110000
- My subnet mask is
  11111111 11111111 00000000 00000000
Net Masks

- Say it is 255.252.0.0
- I am at 10000001 01000010 11110000 00001111
- I want to send to 10000001 01000001 00001111 11110000
- My subnet mask is 11111111 11111100 00000000 00000000