15.561A: Information Systems:
From Technology Infrastructure
to the Networked Corporation

15.566: Information Technology as an
Integrating Force in Manufacturing

Class #13:
THE INTERNET AND
ELECTRONIC COMMERCE #1

Spring 1998
Sloan School of Management
Massachusetts Institute of Technology

Yannis Bakos
E53-329
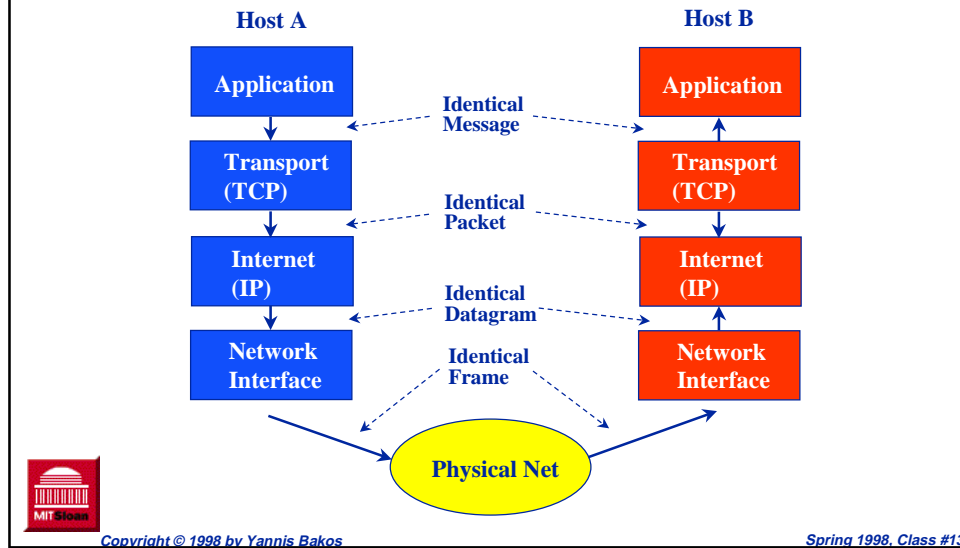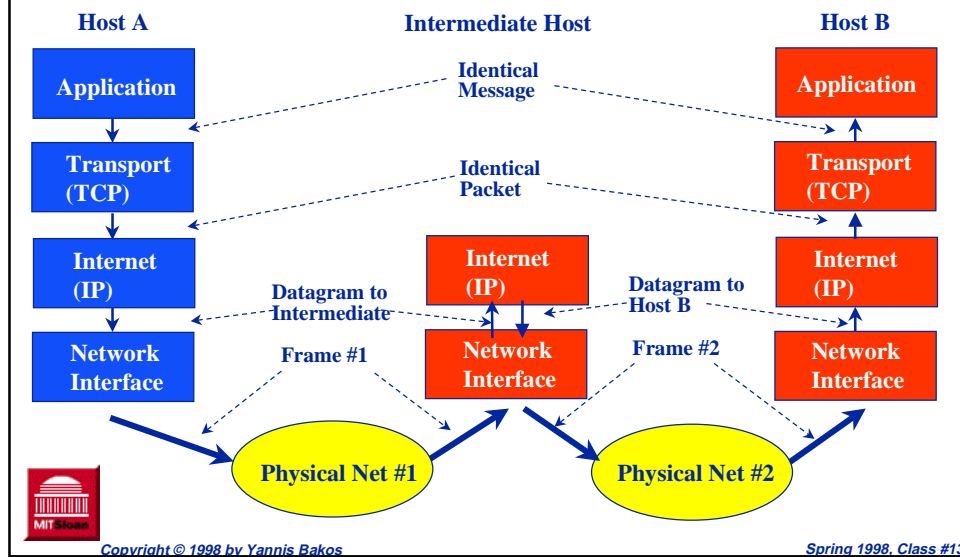Tel. (617) 253-7097; Fax (617) 258-7579
Email: bakos@mit.edu
Web: http://web.mit.edu/bakos

TYPES OF NETWORKS

2

- **Local Area Networks**

- **Metropolitan Area Networks**

- **Wide Area Networks**

1

TRANSPORT CONTROL PROTOCOL/ INTERNET PROTOCOL (TCP/IP)

Host A

Host B

Application

Application

Identical Message

Transport (TCP)

Transport (TCP)

Identical Packet

Internet (IP)

Internet (IP)

Identical Datagram

Network Interface

Network Interface

Identical Frame

Physical Net

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INTERNET PROTOCOL CONNECTS DIFFERENT NETWORKS

Host A

Intermediate Host

Host B

Application

Identical Message

Application

Transport (TCP)

Identical Packet

Transport (TCP)

Internet (IP)

Internet (IP)

Internet (IP)

Datagram to Intermediate

Datagram to Host B

Network Interface

Frame #1

Network Interface

Frame #2

Network Interface

Physical Net #1

Physical Net #2

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WHAT IS THE INTERNET?

5

- **A very large collection of computers that "speak" TCP/IP**
- **All connected to each other**
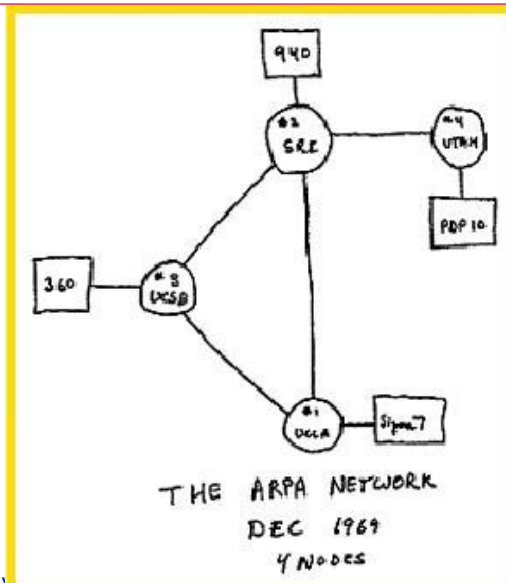- **Information may pass through several other computers**

IT STARTED AS A U.S. GOVERMENT PROJECT

6

THE ARPA NETWORK
DEC 1969
4 NODES

IT STARTED AS A U.S. GOVERMENT PROJECT (Cont'd)

7

The Arpanet - 1971
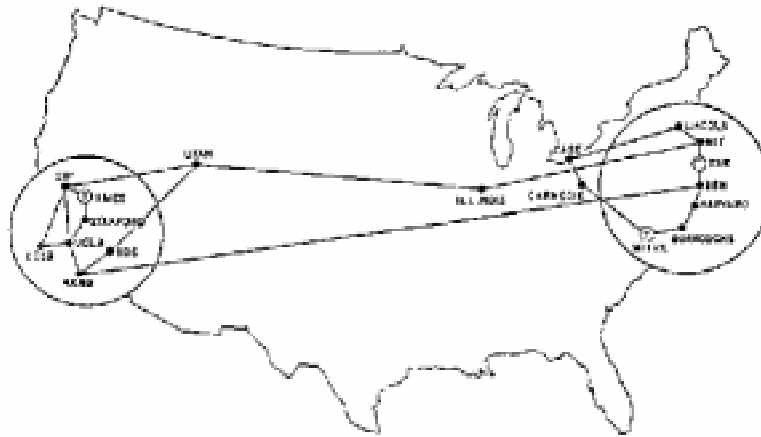
Source: P. Gudonis, BBN Planet

INTERNET STRUCTURE
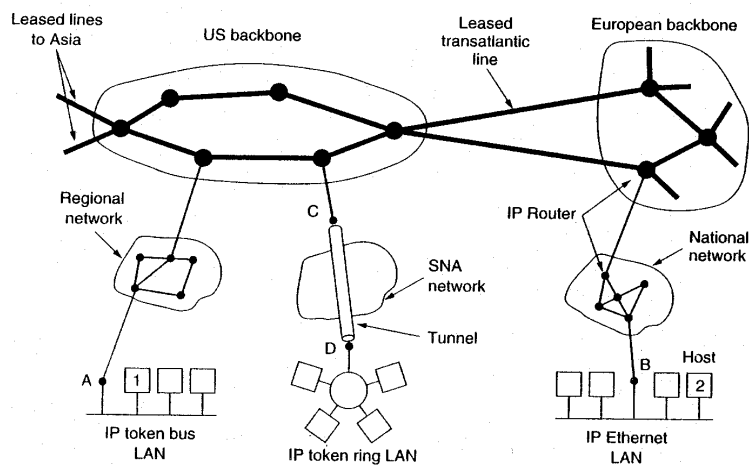
TRACING INTERNET PACKETS

```
MS-DOS Prompt

C:\>tracert www.stanford.edu

Tracing route to www.stanford.edu [171.64.14.251]
over a maximum of 30 hops:

  1    <10 ms    <10 ms    <10 ms   128.122.198.1
  2    <10 ms    <10 ms    <10 ms   NYUGWA-FDDI-2-0.NYU.NET [128.122.253.65]
  3     10 ms     10 ms    <10 ms   ny-nyc-3-H4/0-T3.nysernet.net [169.130.13.17]
  4     10 ms    <10 ms    <10 ms   ny-nyc-9-F1/0.nysernet.net [169.130.10.9]
  5    <10 ms    <10 ms     10 ms   ny-pen-1-H4/1/0-T3.nysernet.net [169.130.1.101]
  6    <10 ms    <10 ms    <10 ms   sl-pen-11-F8/0/0.sprintlink.net [144.228.60.11]
  7    <10 ms     10 ms     10 ms   144.228.180.10
  8     10 ms     20 ms     20 ms   cleveland1-br2.bbnplanet.net [4.0.2.13]
  9     20 ms     30 ms     30 ms   cleveland1-br1.bbnplanet.net [4.0.2.5]
 10     40 ms    220 ms    221 ms   chicago1-br1.bbnplanet.net [4.0.2.9]
 11    150 ms     70 ms     70 ms   paloalto-br1.bbnplanet.net [4.0.1.1]
 12     70 ms     70 ms     70 ms   su-pr1.bbnplanet.net [131.119.0.199]
 13     70 ms     71 ms     70 ms   sunet-gateway.stanford.edu [198.31.10.1]
 14     70 ms     70 ms     70 ms   Core-gateway.Stanford.EDU [171.64.1.33]
 15     70 ms     80 ms     80 ms   www.Stanford.EDU [171.64.14.251]

Trace complete.

C:\>
```
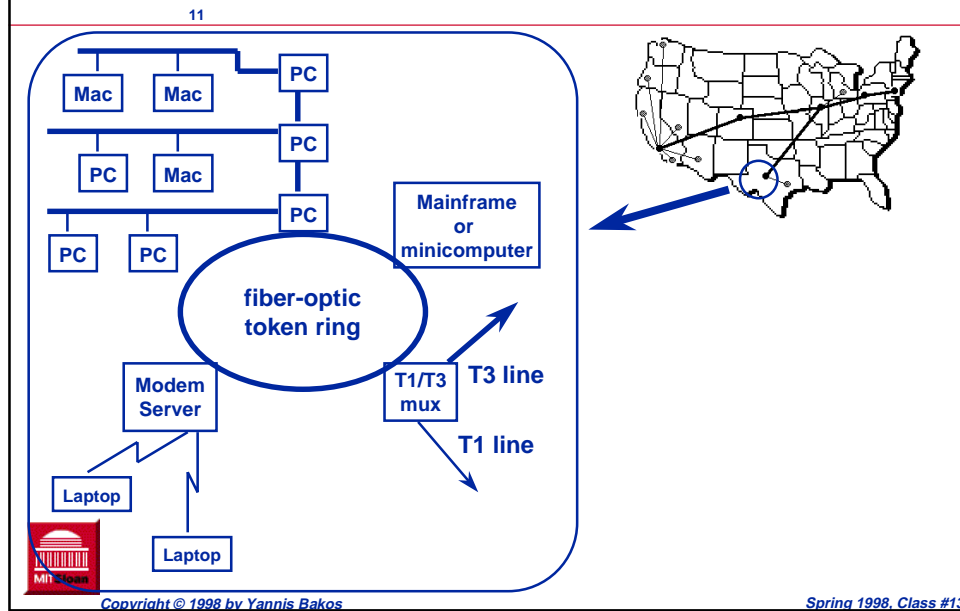
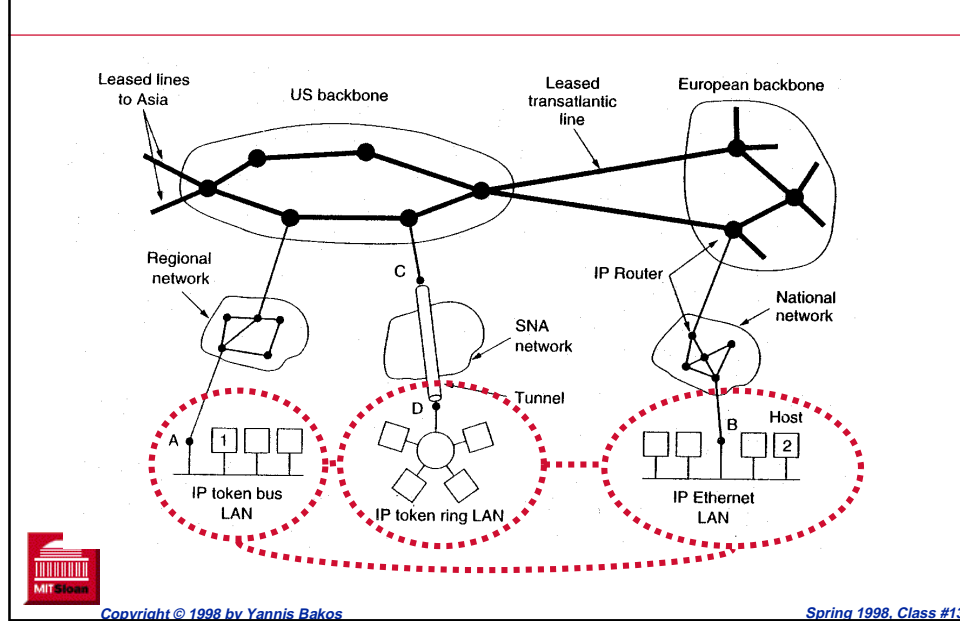## Commercial Internet Exchange Network

10

Source : CERFNet

Network Architecture - pre Internet

11

Internet-Based Network Architecture

THE WORLD WIDE WEB

13

A collection of <u>multimedia</u> <u>hypertext</u> documents that is <u>distributed</u>

■ **Links can point to documents on <u>other</u> machines**
  – **URL (uniform resource locator) gives the name of a document on another computer**

■ **Sometimes, linked document can't be accessed**
  – **Computer not operating**
  – **Computer overloaded**
  – **Document does not exist**

MULTIMEDIA AND HYPERTEXT

14

Multimedia documents:

■ **Contain more than text**
  – **images**
  – **drawings**
  – **sounds**
  – **video**

Non-linear text (hypertext):

■ **Links point to <u>other documents</u>**
  – **or other locations in current document**

■ **Sometimes the link invokes a program**

WEB BROWSERS (Clients)

15

- **Software programs on users' computers**
  - Netscape, Internet Explorer,...

- **Can display Web documents**

- **Can follow links**

- **Can execute small but possibly powerful programs ("applets")**

- **Helper applications**
  - e.g. for animation files or "streaming" (real-time) audio or video

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WEB SERVERS

16

- **Computers running server software**

- **Wait for requests to arrive**

- **Typical request is for a document**
  - send the document to requesting machine

- **Request may also include information**
  - e.g., contents of a form a user filled out
  - pass information to another program
  - could then generate a new document to send back to the requesting computer

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INTERNET GROWTH

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Date	Hosts	Domains	Replied To Ping	Network Class A	B	C
Jul 97	19,540,000	1,301,000	4,314,410			
Jan 97	16,146,000	828,000	3,392,000			
Jul 96	12,881,000	488,000	2,569,000	95	5892	128378
Jan 96	9,472,000	240,000	1,682,000	92	5655	87924
Jul 95	6,642,000	120,000	1,149,000	91	5390	56057
Jan 95	4,852,000	71,000	970,000	91	4979	34340
Jul 94	3,212,000	46,000	707,000	89	4493	20628
Jan 94	2,217,000	30,000	576,000	74	4043	16422
Jul 93	1,776,000	26,000	464,000	67	3728	9972
Jan 93	1,313,000	21,000		54	3206	4998

Source: http://www.nw.com/zone

MIT Sloan

nis Bakos

Internet Host Counts 1991-1997

18

07/ 97: 19.5M

Source: http://www.nw.com/zone

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2001: Users = Human Population?

19

5,076,000,000
2,538,000,000
1,510,912,000
755,456,000
507,904,000
302,080,000
151,040,000
75,520,000
37,760,000
18,880,000
9,440,000
4,720,000
2,360,000
1,180,548
590,274
365,345
234,740
161,434
92,834
63,267
43,799
26,141
9,805
5,089
2,810
1,961
1,024
562
213

Human Population

Projected Internet Users

Projected Human Population

Internet Users

Projected Internet Hosts

Measured Internet Hosts

Source: MIDS, Austin TX, based on historical data

year 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 **2001**
month 6 8 5 8 10 10 11 12 10 7 6 3 1 6 6 6 6 6 6 6

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The Two Laws of Growth

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■ **Moore's Law**

Computers
Producers'
Durable
Equipment

Microprocessors
Memory

■ **Metcalfe's Law**

1   2   3   4   5
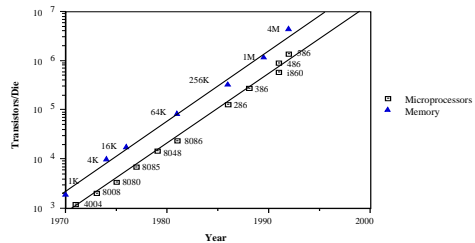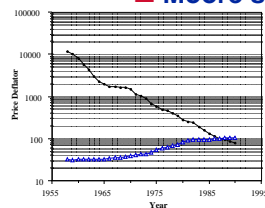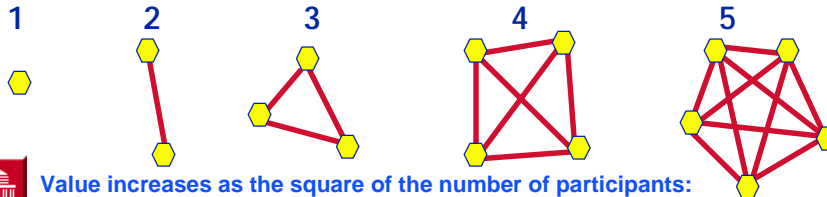
Value increases as the square of the number of participants:
V=$kn(n-1)$=O(n^2)

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21 **The Internet can be charted in terms of content, services and infrastructure**

Nationals

International telcos

Cable cos

Utilities

Independent access providers

Infrastructure

Open Market

Netscape

First Virtual
AOL

Microsoft/VISA

Network Associates

Shopping Malls

Directories

Supporting Services

Publishers

Record Labels

Movie studios

Manufacturers

Retailers

Individuals

Content

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PHYSICAL INFRASTRUCTURE

22

■ **Who owns the Internet?**
  – **75,000+ interconnected, independently owned and managed physical networks**

■ **Who sets the Standards?**
  – **Technical standards set by international non-governmental bodies, like the Internet Engineering Task Force**
  – **Transaction standards are set de facto by private parties or by consortia like CommerceNet**

■ **Openness and decentralization**
  – **Flexibility and constant evolution**
  – **Cooperation among vendors, providers and users**
  – **Much lower cost than private infrastructures**

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WHO ARE THE PLAYERS IN INFRASTRUCTURE

23

- **Hardware**
  - **Servers: Sun, Silicon Graphics, Compaq/DEC**
  - **Switches: Cisco Systems, Bay Networks, 3Com**

- **Software**
  - **Network management: Network Associates, NetManage**
  - **Content management: Oracle, Sybase, Informix**
  - **Programming languages: Sun, Microsoft**

WHO ARE THE PLAYERS IN INFRASTRUCTURE (Cont'd)

24

- **Networks**
  - **Common carriers: AT&T, MCI, Sprint, Stentor (Canadian phone companies), Baby Bells (Ameritech, Bell Atlantic, etc), WorldCom**
  - **Internet Service Providers (ISPs): UUNet (WorldCom), PSINet, BBN Planet (GTE), NYSERNet**
  - **On-line services, e.g., America On-Line and the Microsoft Network (MSN), use ISPs such as UUNet**

- **Internet backbone management**
  - **InterNIC (Network Solutions and AT&T)**
  - **Sprint, BBN Planet**
  - **NORDUNet, EuropaNet, Ebone, EUNet, RusNet**
  - **Commercial Internet Exchange (CIX)**

WHY IS THE INTERNET SO IMPORTANT?

25

- **Everything the Internet gives you, you could achieve without it**
  - But at a much **higher cost**,
  - Reaching **critical mass** would take much longer,
  - And you would not have an **open, standards-based solution!**

- **The Internet is flexible**

- **The Internet is truly global**

- **The Internet is the Great Equalizer because of low cost of entry**

- **Same technology is used for intranets and extranets**

TECHNOLOGY TRENDS

26

- **Increased bandwidth for communications**
  - will allow true multimedia communications (voice, graphics, video)

- **Rapidly increasing penetration over next five years**
  - virtually all businesses in the U.S. and 40% of the homes will have access to a fast connection (ISDN or faster).
  - Internet connectivity will become embedded, ubiquitous and transparent

TECHNOLOGY TRENDS (Cont'd)

27

- **Intranets increasingly form the core of corporate IT architectures**

- **The Internet/intranet architecture facilitates links with business partners**

- **Open standards have been winning to this point**
  - **but vendors will always try to control them...**

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Business and Competitive Trends

28

- **The Internet is providing the infrastructure for communications both within an organization (intranets) and between organizations (extranets, i.e., secure links between organizations)**

- **Companies are forging links with customers and suppliers**

- **More specialized and price-competitive markets**

- **Strategic advantage will require rapid response**
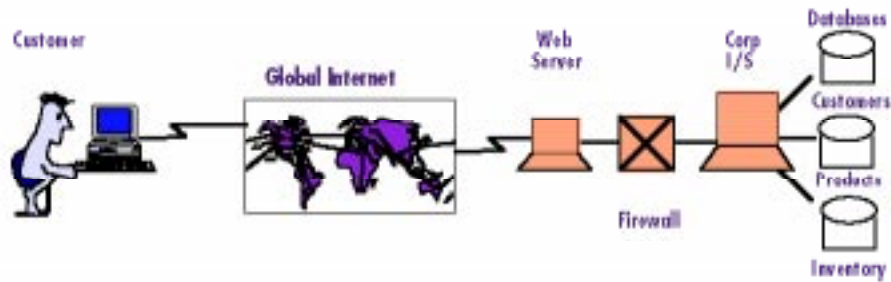 - **rapid evolution**
  - **must learn to live in "web years"**

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31
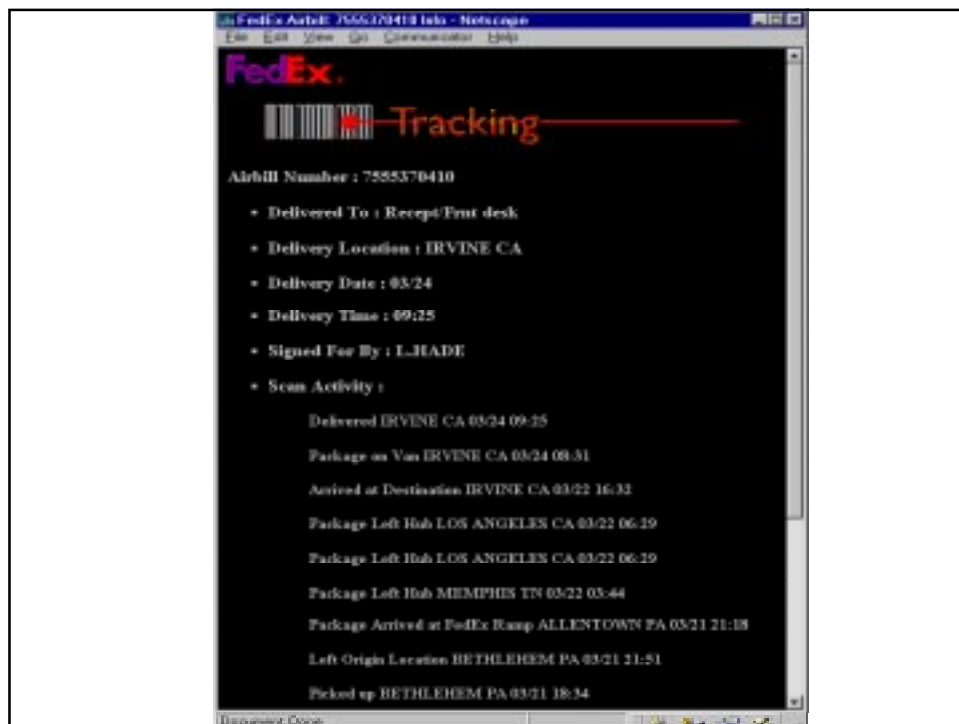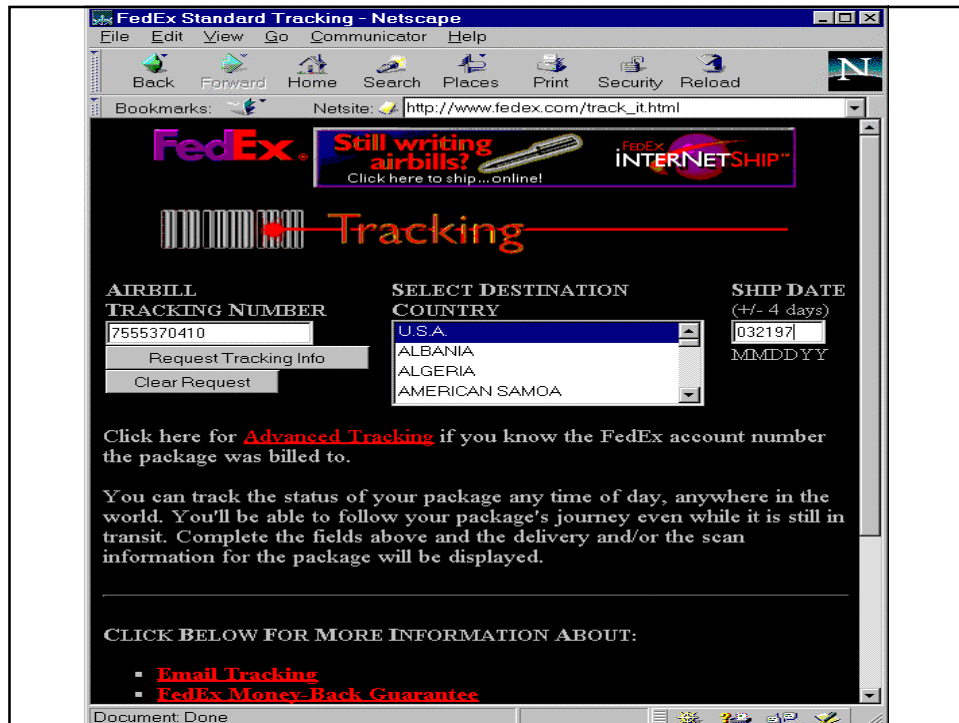
PROVIDE ACCESS TO CORPORATE DATABASES INTERNALLY AND EXTERNALLY

For: Order Status
Transaction Records
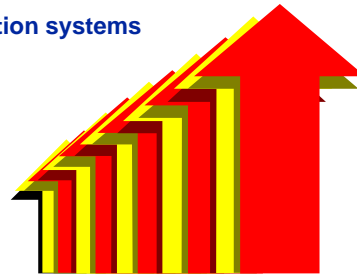Product Information

source: P. Gudonis, BBN Planet

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IMPLICATIONS FOR THE IT INFRASTRUCTURE

- **Network the organization together and to the customer**

- **Renovate and integrate the transaction systems**

- **Provide for data consistency, control and security**

- **Extend the transaction systems out to the suppliers and the customers to promote information exchange**
  - in design, production, delivery and service

- **An extroverted IT architecture, based on Intranets, and taking advantage of the Internet!**

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