

Introduction to the Internet: Behind the Web

Objectives

- It is intended to be a basic introduction to WorldCom's Data Products, peppered with some technical tidbits.
 - This module is geared toward those with a basic understanding of data communications. It gives a broad overview of how the internet works, and gives brief descriptions of the internet access products which WorldCom offers. In addition, a brief look at web hosting and firewall.

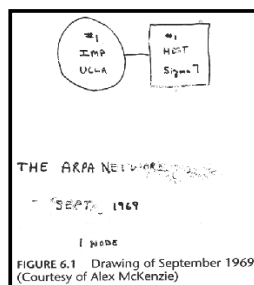
Agenda

- History of "the Net"
- Internet Architecture
- Internet Protocols

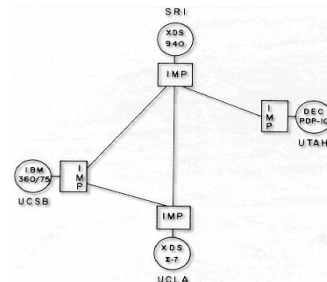
History of "The Net" 1950-1969

- 1957 -Soviet Union launched Sputnik.
- 1969 -Department of Defense Advanced Research Projects Agency was created.
 - (DARPANET/ARPANET)
- First objective - replace the existing point-to-point network with a network that could survive nuclear attack
- Originally linked four universities enabling them to share information and resources
- Pioneering work done by Dr. Leonard Kleinrock at UCLA (and graduate student Mario Gerla)

History of "The Net" (cont.)



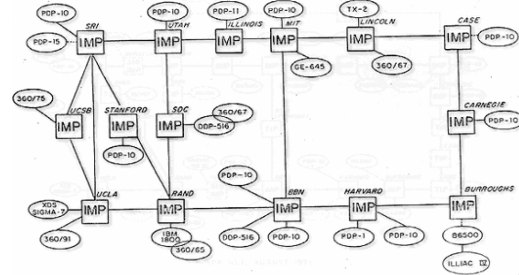
Original 4 Node Network 1971



History of "The Net" 1970's

- 1970 - Xerox Palo Alto Research Center (PARC)
 - Internet Protocol is created
 - Transmission Control Protocol is created
- 1971 - E-mail invented
 - Only 15 nodes on ARPANET
- 1972 - First public demonstration of ARPANET
 - Remote login (TelNet)
- 1973 - File Transfer Protocol (FTP) is specified
 - Ethernet Outlined (DIXinet = DEC, Intel, Xerox)
- 1979 - News Groups Born

Logical map of the ARPANET



April, 1971 = 25 nodes

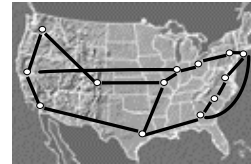
History of "The Net" 1980's

- 1982 - The Department of Defense deploys the TCP/IP suite of protocols on every ARPANET computer.
 - Military and non-military network sites separate creating two networks, ARPANET and MILNET
- 1983 - Name Server is Developed.
- 1984 - Domain Name Server (DNS) is introduced.
 - Number of hosts breaks 1,000

History of "The Net" 1980's cont.

- In 1986, the National Science Foundation (NSF) connects six different supercomputing centers* together with 56K circuits.
 - To expand access, regional networks were allowed to connect to the NSFNet backbone.

* UC-San Diego, UI-Urbana Champaign, Univ. Pittsburgh, Cornell Univ. + 2 Govt. Labs

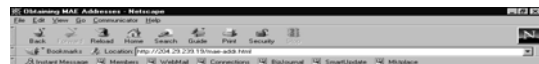


History of "The Net" 1980's cont.

- In 1987, the NSF hires a company which collaborates with MCI and IBM to come up with faster networking technologies.
- IN 1988, NSFNet backbone is upgraded to DS-1
- In 1989 the Number of hosts breaks 100,000

History of "The Net" 1990

- 1990 - ARPANET is dissolved. The NSF opens its network to commercial traffic (*world.std.com*)
- 1991 - The World Wide Web protocol is released along with HTTP and HTML (Tim Berners-Lee, CERN)
 - Allowing for easy presentation, organization, and accessibility of information on the Internet.
 - Easy-to-use graphical web browsers such as Netscape and Mosaic are introduced



- The NSFNet backbone is upgraded to DS-3 trunks

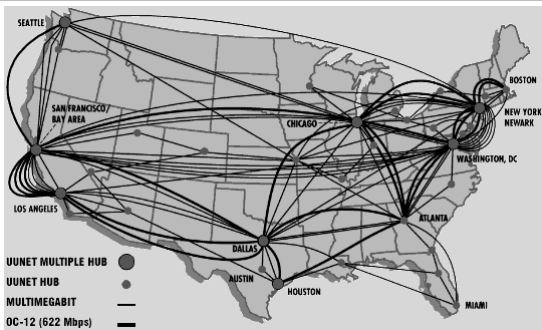
Peering Agreements

- Peering allows ISPs to connect to each other's networks and exchange traffic for their mutual benefit
- Peering agreements are not included in MAE services
- Peering agreements should be reached prior to ordering MAE services
- After peering agreements are negotiated, the NAP will set up VCCs in the ATM switch to direct the desired amount of traffic between peering partners.

Peering Agreements

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UUNet Internet Network

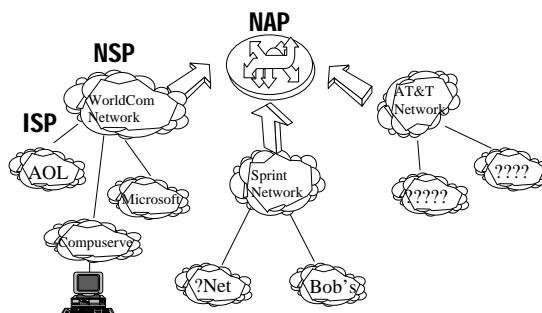


ISP

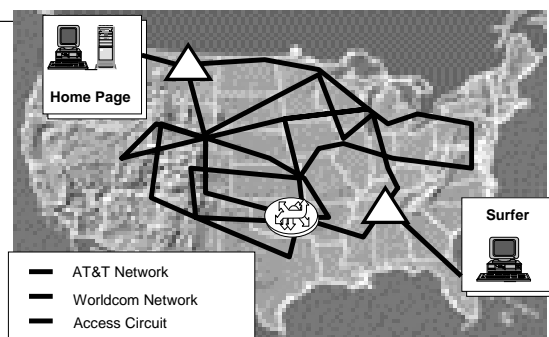
Internet Service Providers

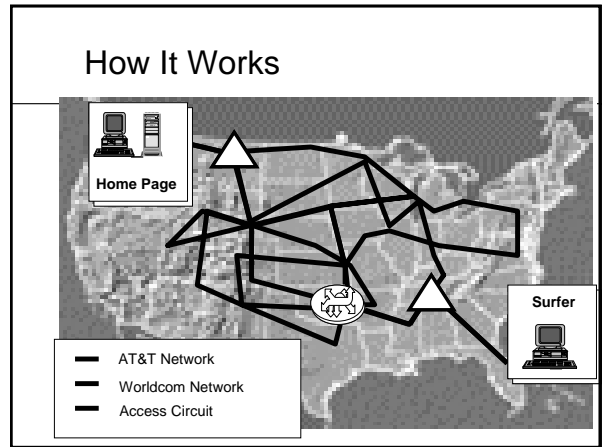
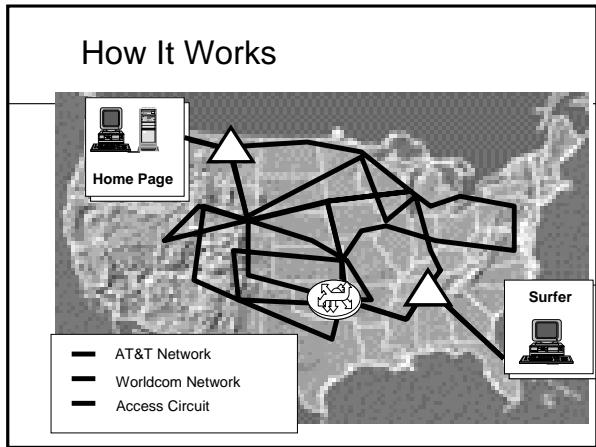
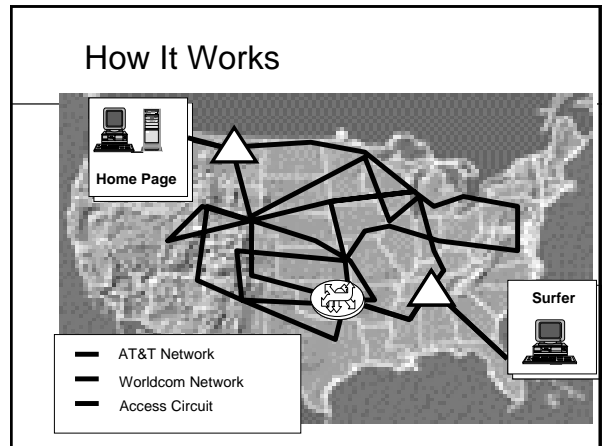
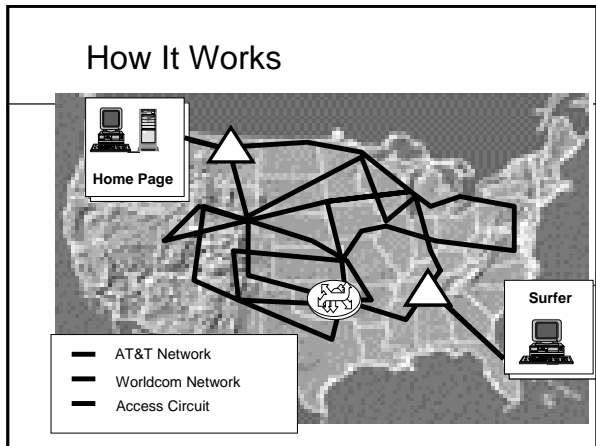
- Build the local access networks that connect directly to the Internet end users.
- Can extend their reach by "backhauling" traffic into their POPs from other regions using LEC or IXC facilities.
- Can also be classified as NSPs if they own their own long haul network to transmit traffic to the NAP

ISP - NSP - NAP



How It Works





Internet Protocols

- ### Features and Functions
- What is a protocol?
 - A pre-determined format for transmitting data.
 - The rules that describe how clients and servers communicate across a network.
 - IP Addresses
 - Domain Names and Domain Name Service (DNS)
 - E-Mail Accounts

TCP/IP
Transmission Control Protocol over Internet Protocol

- This protocol suite is the core of the internet. Everything that happens on the internet is a function of TCP/IP. This protocol is known for being robust and stable across many platforms.
 - Windows, UNIX and Mac

HTTP
Hypertext Transfer Protocol

- This protocol is the most used on the Internet.
- Every time that a web page gets viewed or requested it is transmitted via HTTP.
 - <http://www.wcom.com>

FTP
File Transfer Protocol

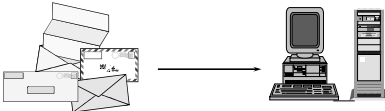
- The means by which large amounts of data are transferred between hosts.
- Protocol used to retrieve e-mail from a mail server.
 - Used to transfer large amounts of data between computers
 - Protocol used to retrieve e-mail from a mail server
 - <ftp://ftp.paxton.com>

SMTP
Simple Mail Transfer Protocol

- This is a protocol for sending e-mail messages between servers.
 - Most e-mail systems that send mail over the Internet use SMTP to send messages from one server to another, the messages can then be retrieved with an e-mail Client using either POP or IMAP.

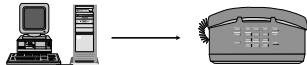
POP
Post Office Protocol

- Protocol used to retrieve e-mail from a mail server.
 - Customer does not need to operate and maintain an e-mail server.
 - Customer must direct e-mail client to the appropriate server to download incoming messages and upload outgoing messages.



Registered IP Addresses

- Any network with a connection to the Internet needs a registered Internet Protocol (IP) Address
- Think of an IP address like your “phone number” on the Internet.
 - 165.241.15.2 918-590-1000



IP Addresses

- Computer systems on the Internet are known to each other by their IP number.
- An IP number is a 32 bit address typically displayed as 4 numbers (0-255) separated by dots.
- There are five classes of addresses: A-E

Class A: 116.0.0.0
Class B: 136.212.0.0
Class C: 206.212.78.0

Domain Name Service

- Instead of remembering IP addresses, Internet users have grown accustomed to using domain names (www.paxton.com)
- Computers on the Internet called "domain name servers" translate the DNS to an IP address.



URL

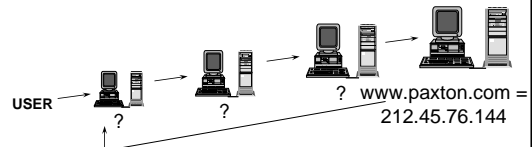
Uniform Resource Locator

- Address that leads you to a file on any computer connected to the Internet
 - 165.241.15.2, www.paxton.com or http://www.paxton.com/index.html
- Common Domain Names
 - gov - USA Government
 - edu - USA Educational Institutions
 - org - Organizations (nonprofit)
 - mil - USA Military
 - net - Network Organization
 - com - Commercial - mainly USA

DNS

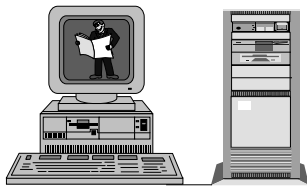
Domain Name Service

- If customers wish, the IXC will help them apply to InterNIC for a domain name.
 - The IXC may also provide primary and secondary DNS on a network server for companies who are not prepared to do it themselves or are too small for it to be practical
 - DNS is hierarchical

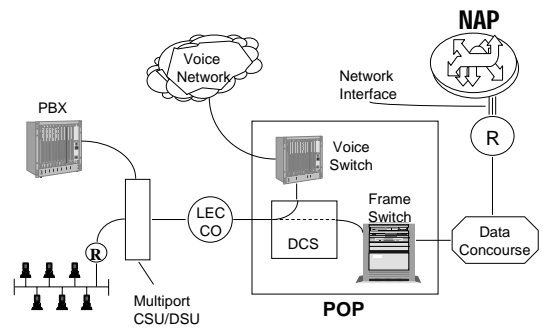


UseNet News Service

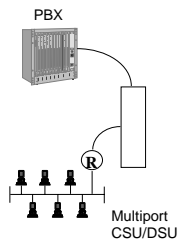
- Customer can receive news reader accounts.
- Allows customer to connect to a IXC news server to download or upload news to any of the 16,000 topic-specific discussion groups.



How It Works



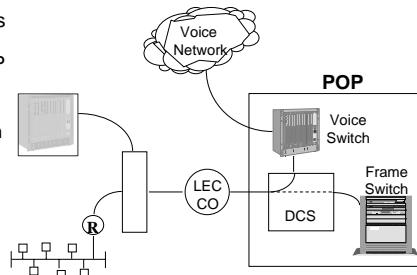
The Customer Premise



- Both voice traffic and LAN traffic are routed through a multiport CSU/DSU
- Depending upon the level of service, an IXC may install, configure, support and maintain the customer router and CSU/DSU.

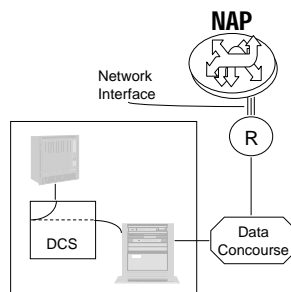
The Local Loop

- Channelized DS-1 loop runs through the CO to the POP
- Channels for voice are routed through DCS to voice switch... Internet channels routed to frame switch



The Data Concourse

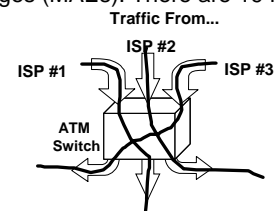
- Internet traffic is passed from the originating frame relay data concourse
- A router in the data concourse connects traffic to a NAP for interconnection to other "internets"



NAP

Network Access Point

- Hub locations where different NSPs connect and exchange IP traffic.
- Sometimes referred to as Metropolitan Area Exchanges (MAEs). There are 19 NAPs.



Channel Assignment

- The sum of each 64K channel chosen for Internet traffic = port speed
- Remaining channels can be used for voice traffic (inbound or outbound)
- CIR always equals half of port speed for IIA

Channels	Traffic Type
1-6	Outbound Voice
7-12	Inbound Voice
13-24	Internet

Service Components

- Frame Relay Port
- Frame Relay PVC
- Customer Premise Equipment
- Public, InterNIC-Registered IP Addresses
- Domain Name Service (DNS)
- Domain Name Registration Assistance
- Post Office Protocol (POP) E-Mail Service
- UseNet News Service

Port & PVC

- Port Speeds (maximum information which can be sent to or pulled from the Internet) can be 64K, 128K, 256K, 512K, 768K, 1.544Mbps
- CIR is set at half of port speed
- PVC (Public/Private Virtual Circuit) runs from host site to a gateway router which takes traffic to an Internet exchange point (NAP)

Customer Premise Equipment

- Customer must have a channel bank or drop & insert CSU/DSU with a frame relay interface
- Also requires a frame relay router

T-1 Internet Products

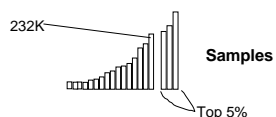
- Flexible T-1
- Double T
 - Single-homed
 - Multi-homed

Flexible T-1

- Full T-1 bandwidth is available all the time, but pricing is based on how much bandwidth a customer uses over 95% of the month.
- Utilizes a Frame Relay connection to the Internet
- Customer Profile
 - Large to mid-size businesses (over 30 users)
 - Host a fairly busy Web site
 - Businesses or organizations wishing to transfer large files on a regular basis (architectural or graphics design firms)

Flexible T-1 Pricing

- Hub switches sample customer traffic every 5 minutes (8640 samples per month)
- Samples are sorted from highest to lowest
- The highest 432 samples are removed (5% of total)
- The next greatest usage sample is used to determine billing rate.



Flexible T-1 Features

- Newsfeeds (Requires customer to have news server)
- E-Mail
- Upgrading Usage Levels
- Usage Statistics
- Registered IP Addresses
- CPE provisioning, install, configuration, & maintenance
- Primary & Secondary DNS

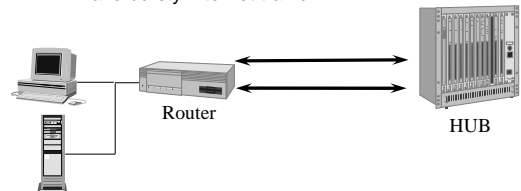
Flexible T-1 Competition

- All major competitors offer a fractional T-1 or full T-1 only option
- DIGEX & BBN offer a flexible product, but each have less extensive networks



Double T

- Customer Profile
 - Internet demands surpass a T-1, but aren't large enough for T-3
 - Require direct connection to the Internet
 - Have bursty Internet traffic



Double T

- Enhancement to Flexible T-1
- "Load balancing" between each T-1
- Does not require additional router, but does require extra CSU/DSU
- Single-homed
 - Both T-1 circuits connect to same hub
- Multi-homed
 - Both T-1s connect to separate hub
 - Provides redundancy

Double T Pricing

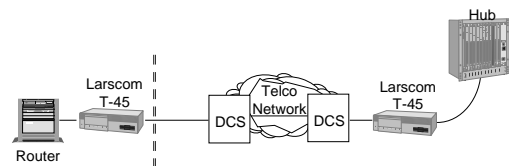
- Flat install fee
- Flat monthly fee
- No sampling - customer has full T-1 bandwidth at all times

Flexible and Tiered T-3

- For companies whose full time Internet requirements demand well over T-1 speeds.
- A Flexible, scalable option
- Flexible T-3
 - Geared toward customers with unpredictable traffic patterns
- Tiered T-3
 - Targeted at customers with predictable bandwidth needs.

Flexible T-3

- Customers have full T-3 access at all times
- Pricing based on 95% of usage (like Flexible T-1)
 - Cisco 7204 router / Bay Networks BLN
 - Larscom Access T-45



Flexible T-3

Mbps Levels

0 - 6 Mbps	\$12,000	13.51 - 15	\$29,000
6.01 - 7.5	\$14,000	15.01 - 16.5	\$32,000
7.51 - 9	\$17,000	16.51 - 18	\$37,000
9.01 - 10.5	\$19,000	18.01 - 19.5	\$43,000
10.51 - 12	\$22,000	19.51 - 21	\$48,000
12.01 - 13.5	\$26,000	21.01 - 45	\$55,000

* Example Pricing Only

Tiered T-3

- Customers able to burst up to port speed
- Port speeds are available in 3Mbps increments
- Same CPE used as in Flexible T-3

Port Speeds (in Mbps)

3	\$6,000	27	\$26,000
6	\$8,000	30	\$29,000
9	\$10,000	33	\$32,000
12	\$12,000	36	\$37,000
15	\$14,000	39	\$43,000
18	\$17,000	42	\$48,000
21	\$19,000	45	\$54,000
24	\$22,000		

T-3 Product Features

- Newsfeeds (Requires customer to have news server)
- E-Mail
- Upgrading Usage Levels
- Usage Statistics
- Registered IP Addresses
- CPE provisioning, install, configuration, & maintenance
- Primary & Secondary DNS

Reseller T-1 and T-3

- IXC's provide Flexible T-1, Double T, Flexible T-3, and Tiered T-3 to Internet resellers
- T-1 products cost more than commercial
- T-3 products priced the same
- Customers purchase the same equipment, but must interconnect THEIR customers themselves

OC Direct

- For companies who require more than T-3 level full-time bandwidth
- Offers Internet access speeds of up to 155Mbps
- Uses ATM transport and SONET technology
- Primarily intended for wholesalers and ISPs



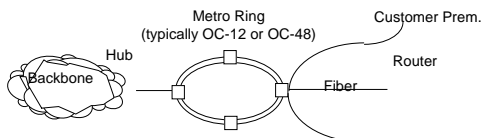
For "hefty-bandwidth" customers!

OC Direct

- OC Direct is only offered as a tiered or "capped" service.
 - At higher speeds it is difficult to offer "bandwidth on demand"
 - At OC-3 speeds, traffic patterns are more predictable.
 - OC-3 customer typically have more traffic management expertise

OC Direct

- Packets travel along the backbone until reaching their destination hub
- Packets are sorted and routed along a local SONET ring or line and brought to customer premise via Single Mode fiber.



OC Direct Features

- Newsfeeds (Requires customer to have news server)
- E-Mail
- Upgrading Usage Levels
- Registered IP Addresses
- CPE provisioning and install

Web Hosting

- In order to have a web site on the Internet, companies must have files stored on a computer that is connected to the Internet.
- Many companies cannot afford an in-house technical staff and/or advanced computer systems, but still want a site on the Internet.
- Web hosting is the answer to their needs.

Web Hosting Benefits

- State-of-the Art Hardware
- Instant scalability
- Latest software and server technologies
- High Speed Connectivity
- Reduced Security Concerns
- Superior reliability
- Traffic Reports
- Development tools and services
- Customer maintains complete control

Web Hosting Savings

- Typically 75% less than just a high speed connection to a web server.
- Cost savings achieved through
 - Direct connection to the backbone
 - Servers connected to 100Mbps FDDI ring
 - FDDI ring connected to fully redundant 45Mbps backbone accessible anywhere in the world
 - No evaluation, installation, or maintenance of web server hardware and software
 - No risk to customer's internal network

Internet Services

- Internet Service Providers (ISPs)
 - Provide customers with either dial-up or broadband services
 - Dial-up services (100's of millions; POTS)
 - Broadband services
 - Cable (CATV) = 18.6 Million subscribers in US (2004)
 - Digital Subscriber Lines (DSL) = 11.4 Million subscribers