Internetworking and the Internet

One of the world's most rapidly growing and important communications media:

What, How and Why is it happening ?
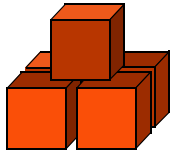
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What is internetworking ?

VALUE ADDED: protocols that "ride on top" of all other transport and network technologies (e.g., clear channel, dialup, X.25, frame relay, Sonet, SMDS, Appletalk, etc...)

Designed to facilitate a "network of networks" these protocols transparently "glue" diverse networks and end systems together. Provide <u>real</u> open systems interconnection.

Technology & market originally fostered by DOD, now commercial - similar scenario as X.25 network progression

Principal applications are: fast easy file sharing, news broadcast, EMail, remote logon, messaging gateways (e.g., SprintMail), network management, directory services, knowledge discovery

In the works: advanced EMail, security features, multimedia
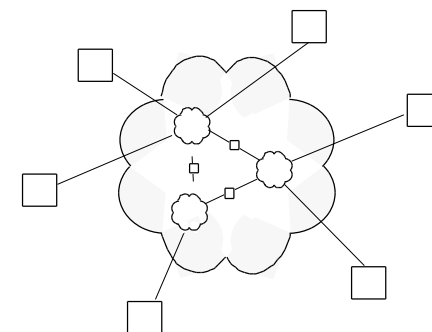
Internet software (TCP/IP + basic applications) now comes bundled with many computer/ workstation operating system platforms and is available for all systems.

Has spawned explosive growth in network equipment (routers), enterprise networks, universal networking

What are <u>i</u>nternets ?

Networks of networks built using internet protocols

> **TCP/IP suite is the most common, but many other protocols also exist.**

General physical architecture

> **wide area transport subnetworks, transmission links, routers, LANs, and hosts (mainframes, minis, workstations, PCs)**
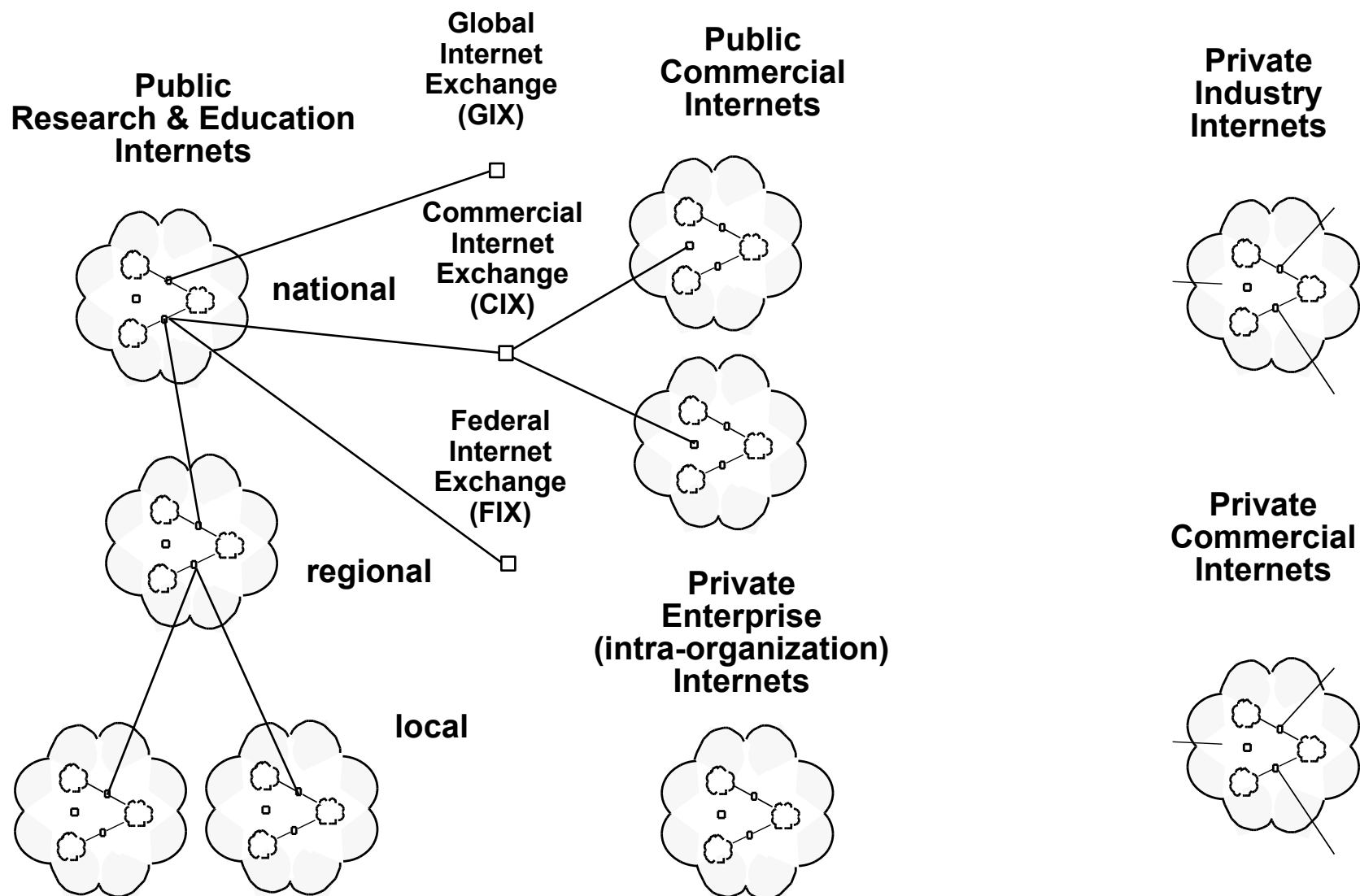
End-to-end transport techniques are connectionless (a/k/a datagram).

> **Ability to globally address individual machines and processes - even on LANs - is very valuable**

Technology widely used for internal company networks known as *Enterprise Networks*.

> **Sets the stage for widespread connectivity and the market for interoperation with other internets.**

Internet Society

internets: many flavours

**Global
Internet
Exchange
(GIX)**

**Public
Commercial
Internets**

**Private
Industry
Internets**

**Public
Research & Education
Internets**

**Commercial
Internet
Exchange
(CIX)**

national

**Federal
Internet
Exchange
(FIX)**

regional

local

**Private
Enterprise
(intra-organization)
Internets**

**Private
Commercial
Internets**

Internet: what is it?

A global open internet metanetwork (a network of networks)

Began in late 70s as DARPA testbed to meet DOD research needs and for developing internetworking technology. (Many of same people and scenarios as packet switching evolution.)

Divested in 1986 to other agencies in USA (NSF, DOE, NASA) and around the world for educational & research purposes with intent to commercialize

Initial three-tier national architectures: regionals, mid-levels, and national backbones

First commercial carriers appear in 1990 in U.S. and Europe

Connected hosts became predominantly industrial in mid-1991 as commercial demand for Internet connectivity increases

Internet Society

Internet: what is happening ?

Massive, Unprecedented, Consistent Growth
- **networks**
- **hosts**
- **users - using and reachable**
- **traffic**
- **information**

Commercialization

Creating *Flat Information Space*

Institutionalization - the Internet Society

Profound Effects
- **Infrastructure**
- **Organizations**
- **Professions**
- **People**

Internetworking: why is it happening?

Bundling. The TCP/IP osi suite was bundled into every workstation and mini sold; and is now invading every PC

Development. It is developed by a highly unique applications development and standards process that promises continued rapid innovation and development

Bottom-up activity. It is just the kind of osi that users want

New paradigms. The network architecture is an ideal match to today's heterogeneous, non-hierarchal technology, provisioning and organizational environment

Corporate synergy. Nearly every enterprise internet uses the TCP/IP osi suite and they now want to plug into the Matrix for <u>inter</u>-organization communication

Education/youth synergy. Every recent college student has been given an Internet address with their student ID

Technological/economic synergy. Connectionless internetworking offers a good cost-performance match for the PC workstation-LAN environment now dominant

Government synergy. Government has encouraged it as critically important infrastructure
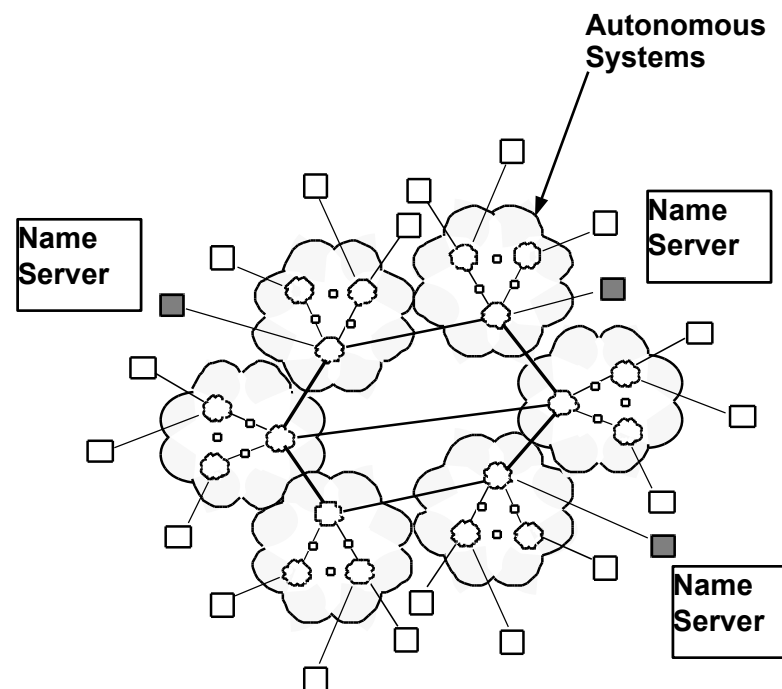
Internet: under the hood

Managed through cooperation among autonomous systems (i.e., internet administrative domains)

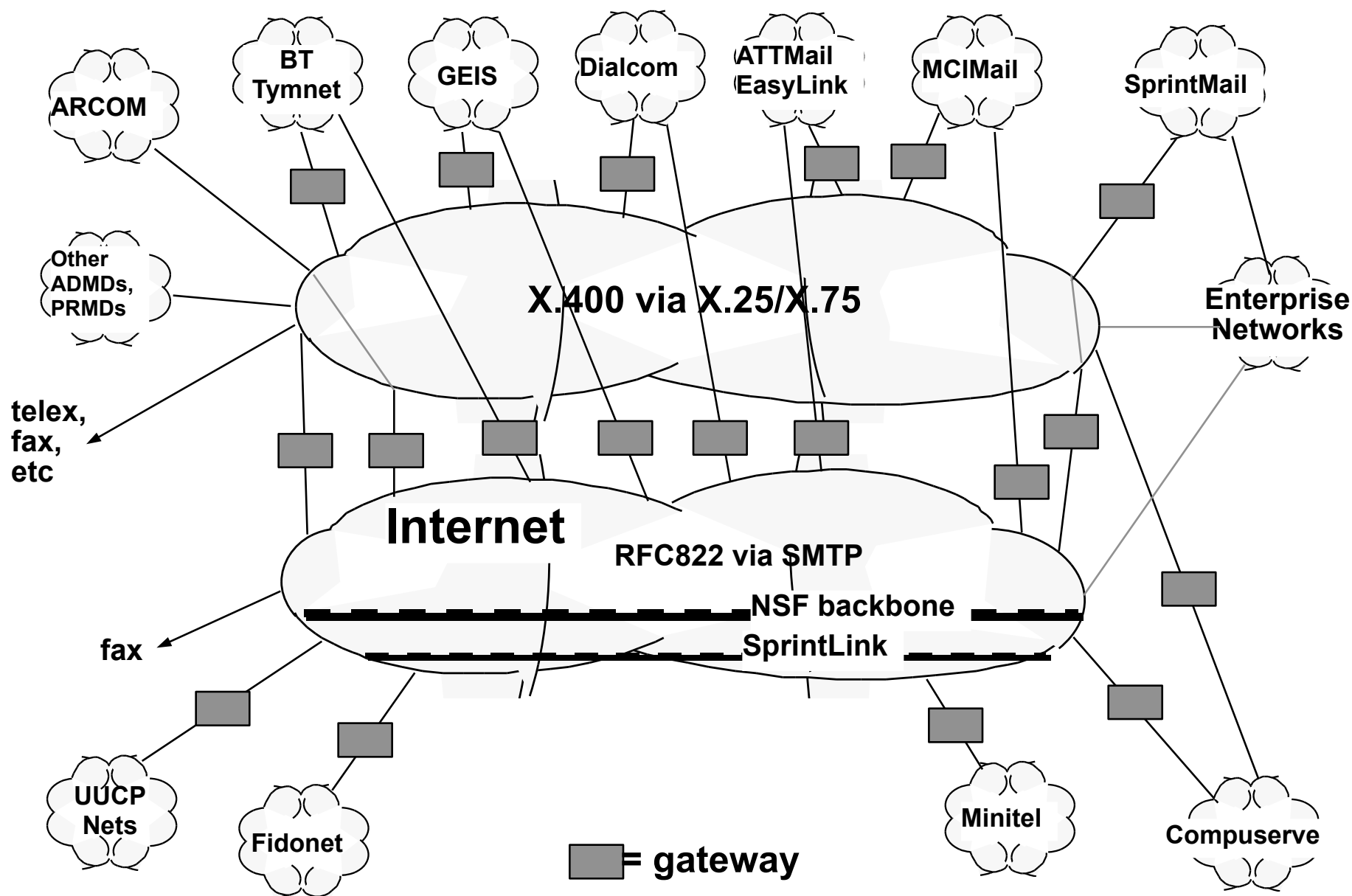**Everyone follows certain addressing and naming practices**

Portability and user-friendliness achieved through use of domain name servers

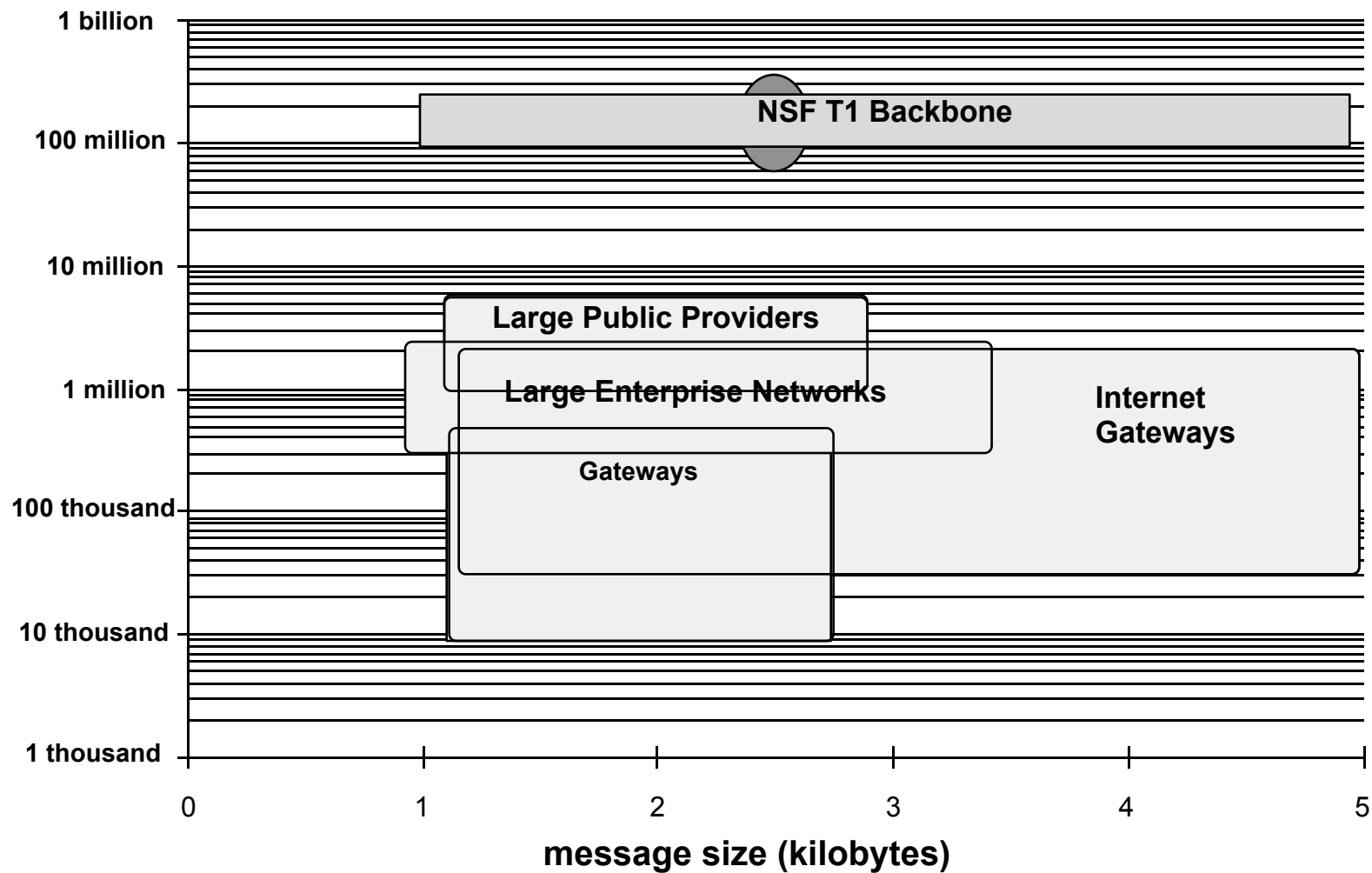**"Sender keeps all" flat rate accounting is universal norm**

Multiprotocol environment

Autonomous
Systems

Name
Server

Name
Server

Name
Server

Internet Society

Today's global messaging internet architecture

ARCOM

BT Tymnet

GEIS

Dialcom

ATTMail EasyLink

MCIMail

SprintMail

Other ADMDs, PRMDs

X.400 via X.25/X.75

Enterprise Networks

telex, fax, etc

Internet

RFC822 via SMTP

NSF backbone

fax

SprintLink

UUCP Nets

Fidonet

Minitel

Compuserve

☐ **= gateway**

Messaging metrics

Where to Learn More

Periodicals	Books and Monographs	Conferences, Meetings & Proceedings
Internet Society News *ConneXions* *Matrix News* *Internet Monthly Report* *Electronic Networking, Journal of* *Computer Communication* *Review (Journal)* *Computer Networks and ISDN* *Systems (Journal)*	Albitz & Liu, *DNS and Bind* Comer, *Internetworking with TCP/IP* Frey & Adams, *!%@:: A Directory of Electronic Mail Addressing & Networks* Hood, *User Services Internet Resource Guide* Hunt, *TCP/IP Network Administration* Kehoe, *Zen and the Art of the Internet* Kroll, *The Whole Earth Internet* Lynch & Rose, *The Internet Systems Handbook* Malamud, *Exploring the Internet* Malamud, *Stacks* Marine, *Internet: Getting Started* Parker, *The Internet Companion* Rose, *The Internet Message* Rose, *The Simple Book* NNSC, *Internet Resource Guide*	International Internetworking Conference Internet Engineering Task Force Sigcomm Conferences Interop Joint European Networking Conference