Internetworking and the Internet

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

What, How and Why is it happening ?

A.-M. Rutkowski
Vice-President, Internet Society <amr@nri.reston.va.us>
Director, Technology Assessment, Sprint <amr@sprint.com>

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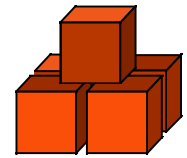
What is internetworking ?



- 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 real 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

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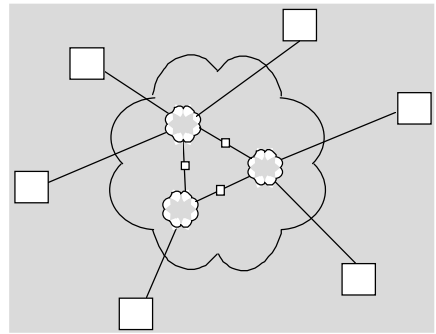
What are internets ?



- 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.

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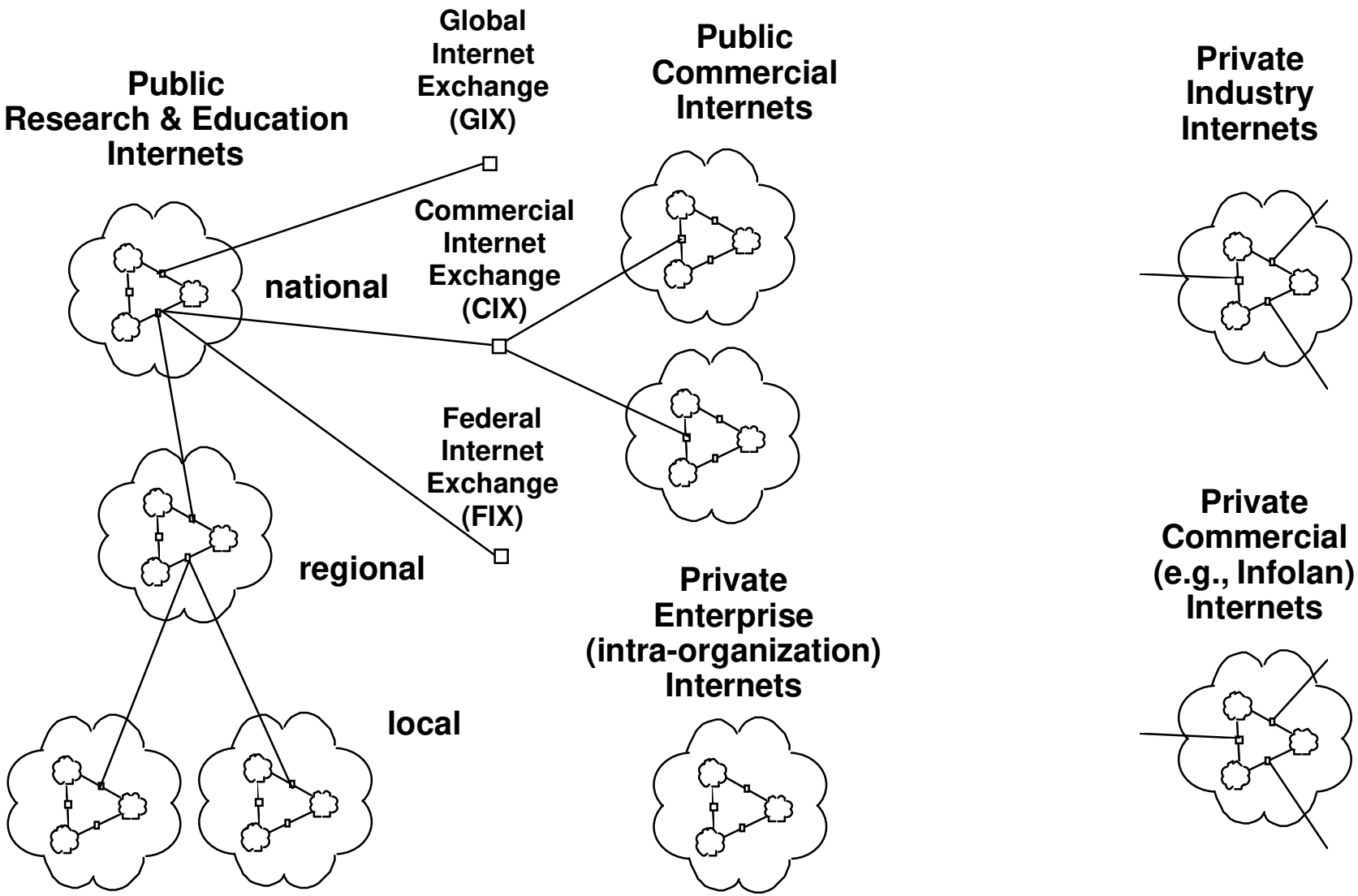
internets: many flavours



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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

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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

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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 inter-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

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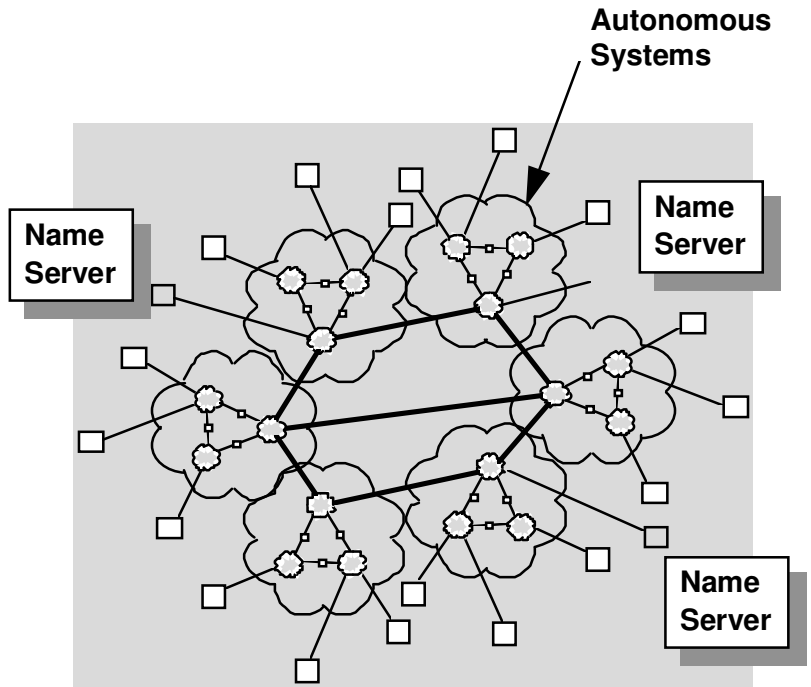
Internet: under the hood

- 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



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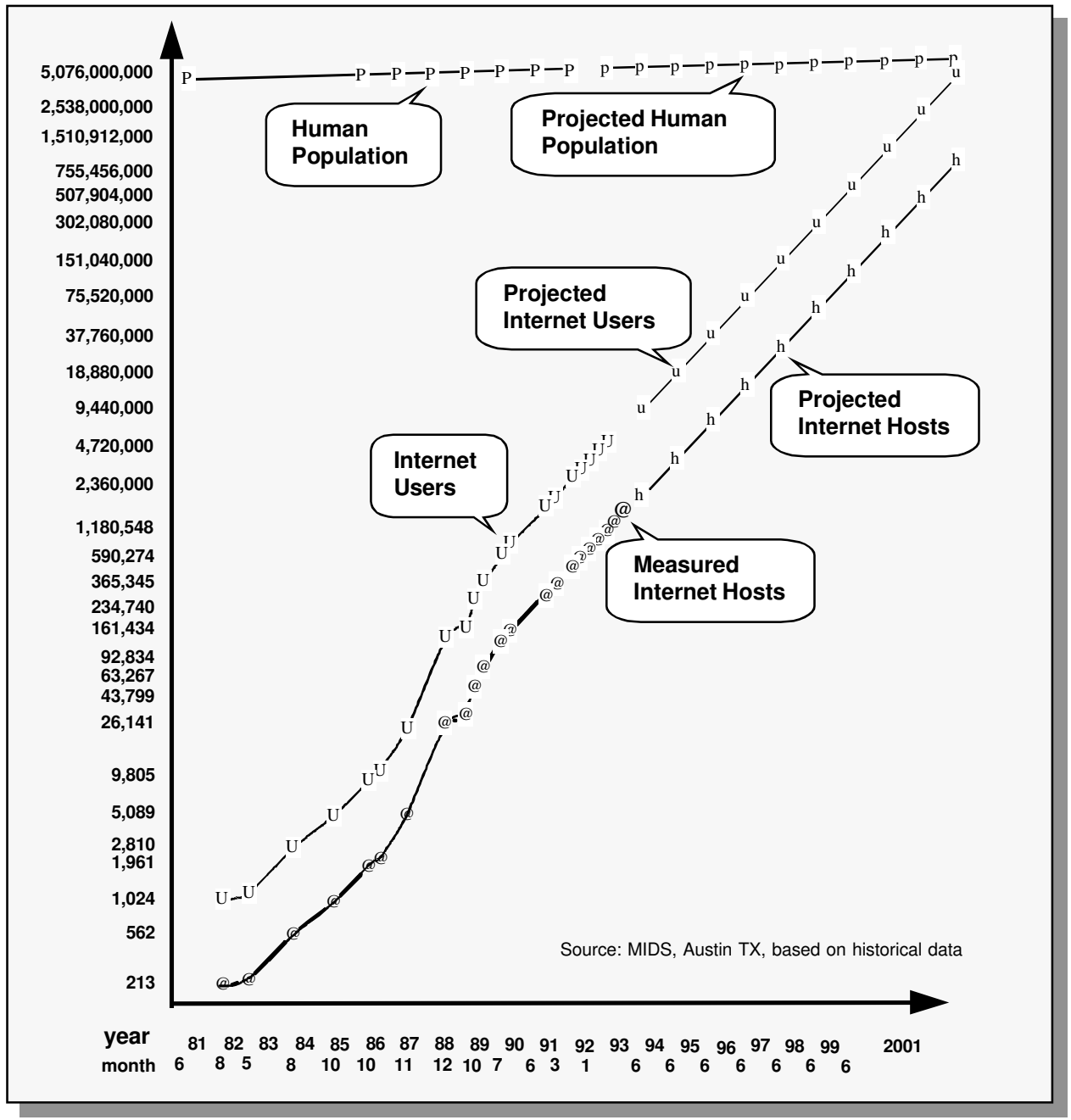
2001: Users = Human Population ?



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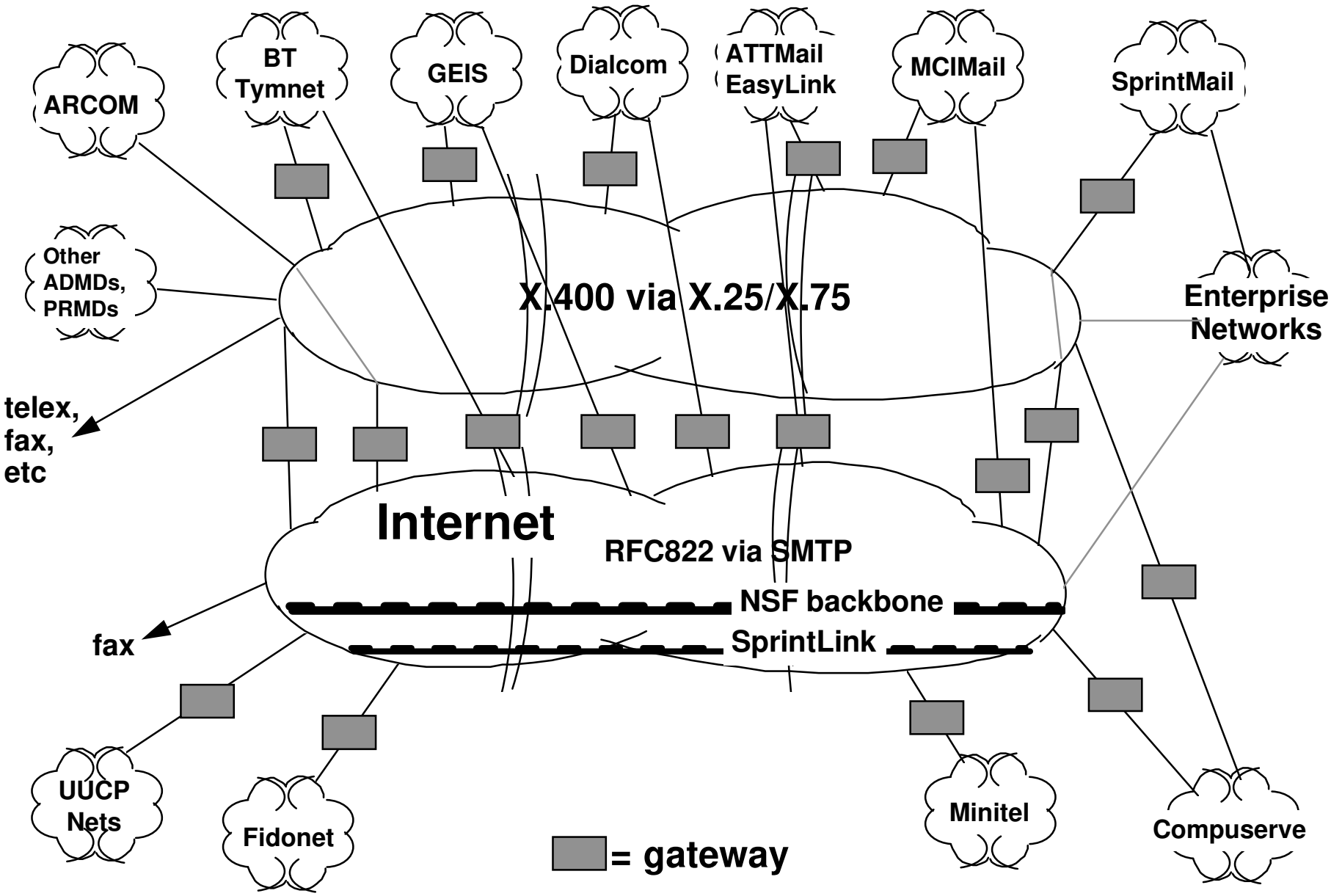
Today's global messaging internet architecture



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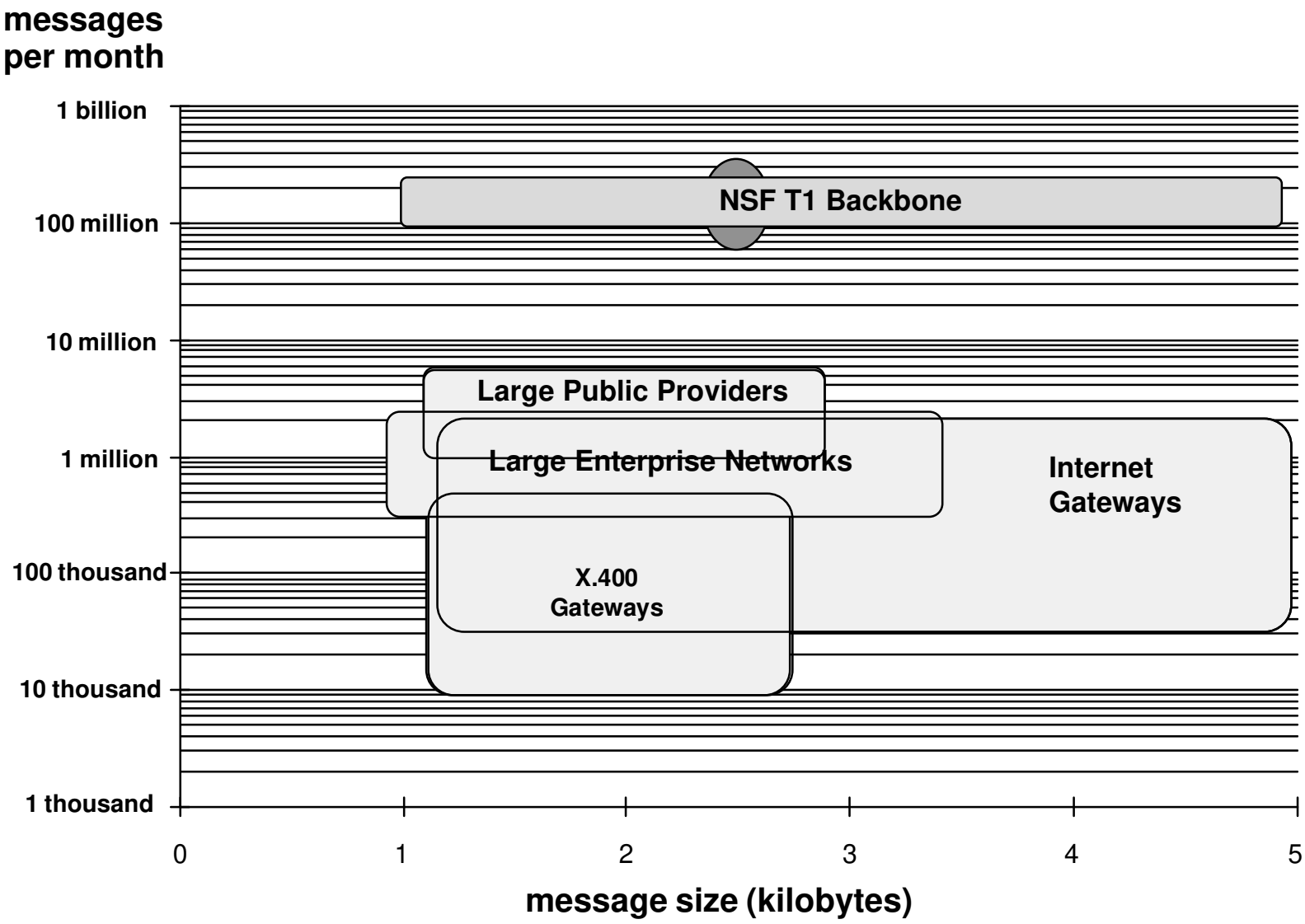
Messaging metrics



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Where to Learn More

Periodicals

- *Internet Society News*
- *ConneXions*
- *Matrix News*
- *Internet Monthly Report*

- *Electronic Networking, Journal of*
- *Computer Communication Review (Journal)*
- *Computer Networks and ISDN Systems (Journal)*

Books and Monographs

- 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*

Conferences, Meetings & Proceedings

- International Internetworking Conference
- Internet Engineering Task Force
- Sigcomm Conferences
- Interop
- Joint European Networking Conference