

# The Internet

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## **Introductory material.**

An overview lecture that covers Internet related topics, including a definition of the Internet, an overview of its history and growth, and standardization and naming.

# A Definition

- On October 24, 1995, the FNC unanimously passed a resolution defining the term Internet.

•**RESOLUTION:** The Federal Networking Council (FNC) agrees that the following language reflects our definition of the term "Internet".

"Internet" refers to the global information system that --

- (i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons;
- (ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and
- (iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein.

# History of the Internet

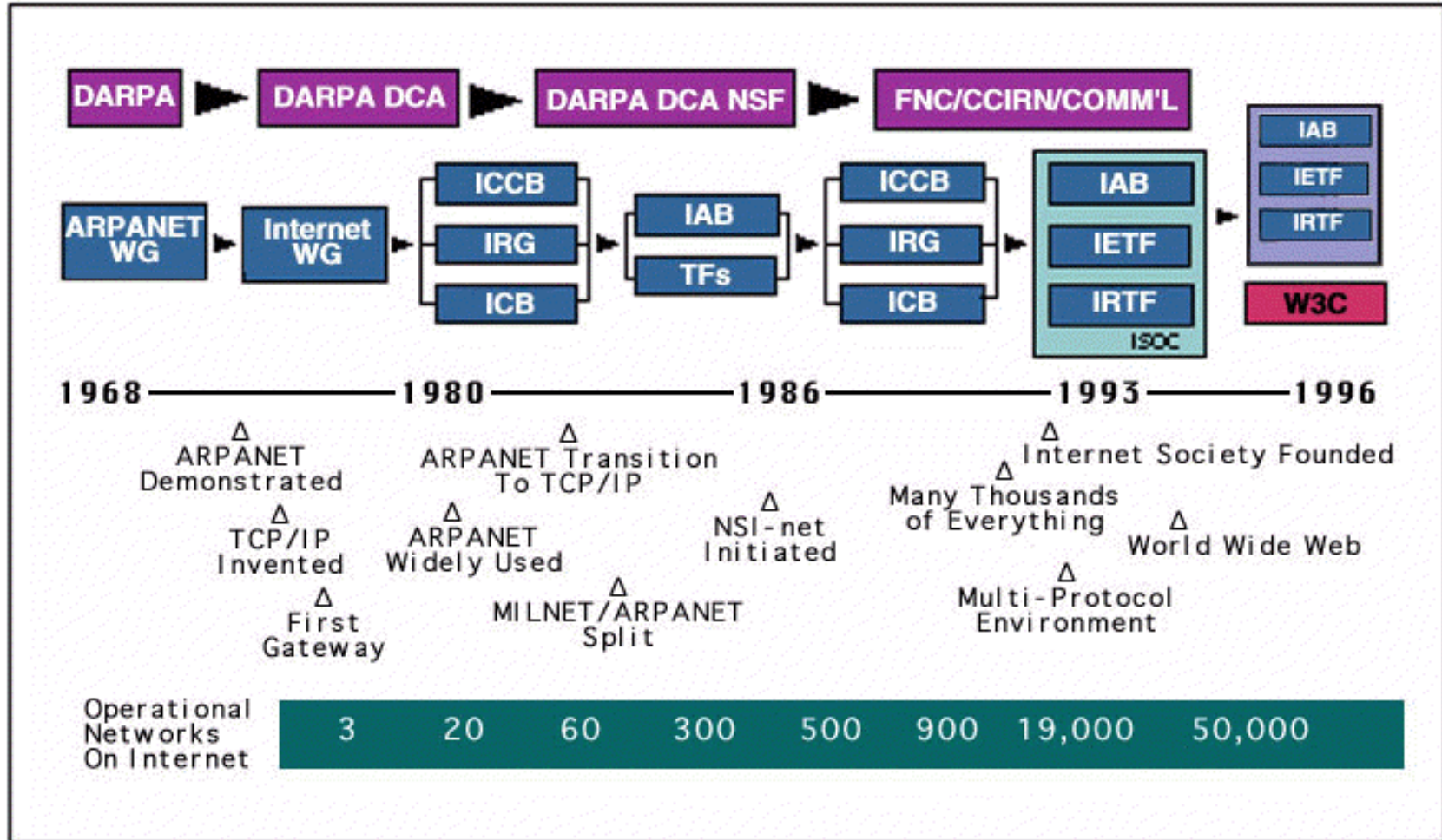
- Mid 1960:** Papers on “Packet Switching” emerge.
- End 1969s:** ARPA sponsors the development of a packet-switching network, called the ARPANET. First four nodes are UCLA, SRI, U. Utah, UCSB.
- 1974:** The TCP/IP protocols and model are being proposed by Cerf/Kahn.
- 1980:** IPv4 is introduced
- 1983:** ARPANET adopts TCP/IP. At this time, the ARPANET has 200 routers.
- 1984:** NSF funds a TCP/IP based backbone network. This backbone grows into the NSFNET, which becomes the successor of the ARPANET.
- 1995:** NSF stops funding of NSFNET. The Internet is completely commercial.

# Applications of the Internet

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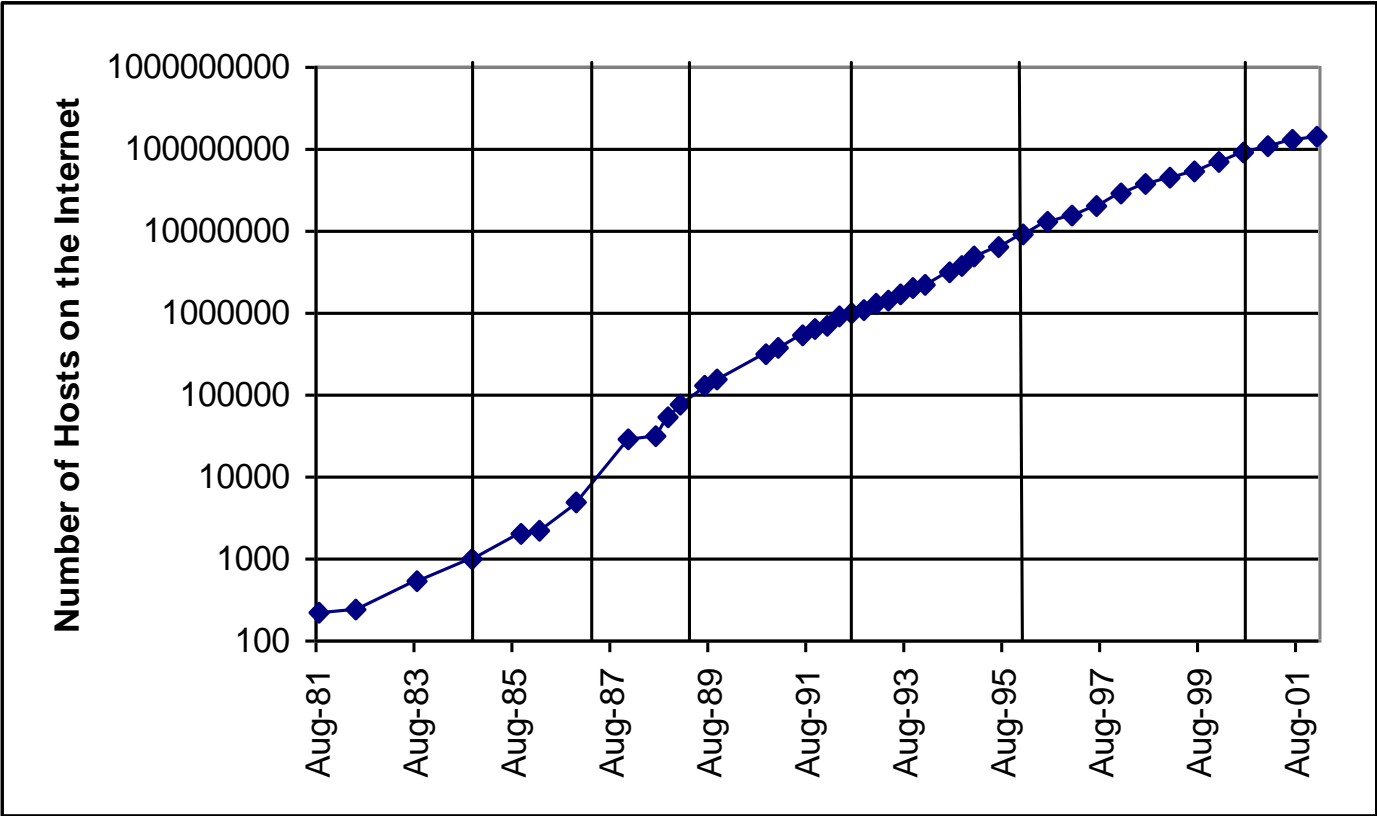
- Traditional core applications:
  - Email
  - News
  - Remote Login
  - File Transfer
- The killer application:
  - World-Wide Web (WWW)
- New applications:
  - Videoconferencing
  - Telephony
  - P2P applications
  - Internet Broadcast

# Time Line of the Internet



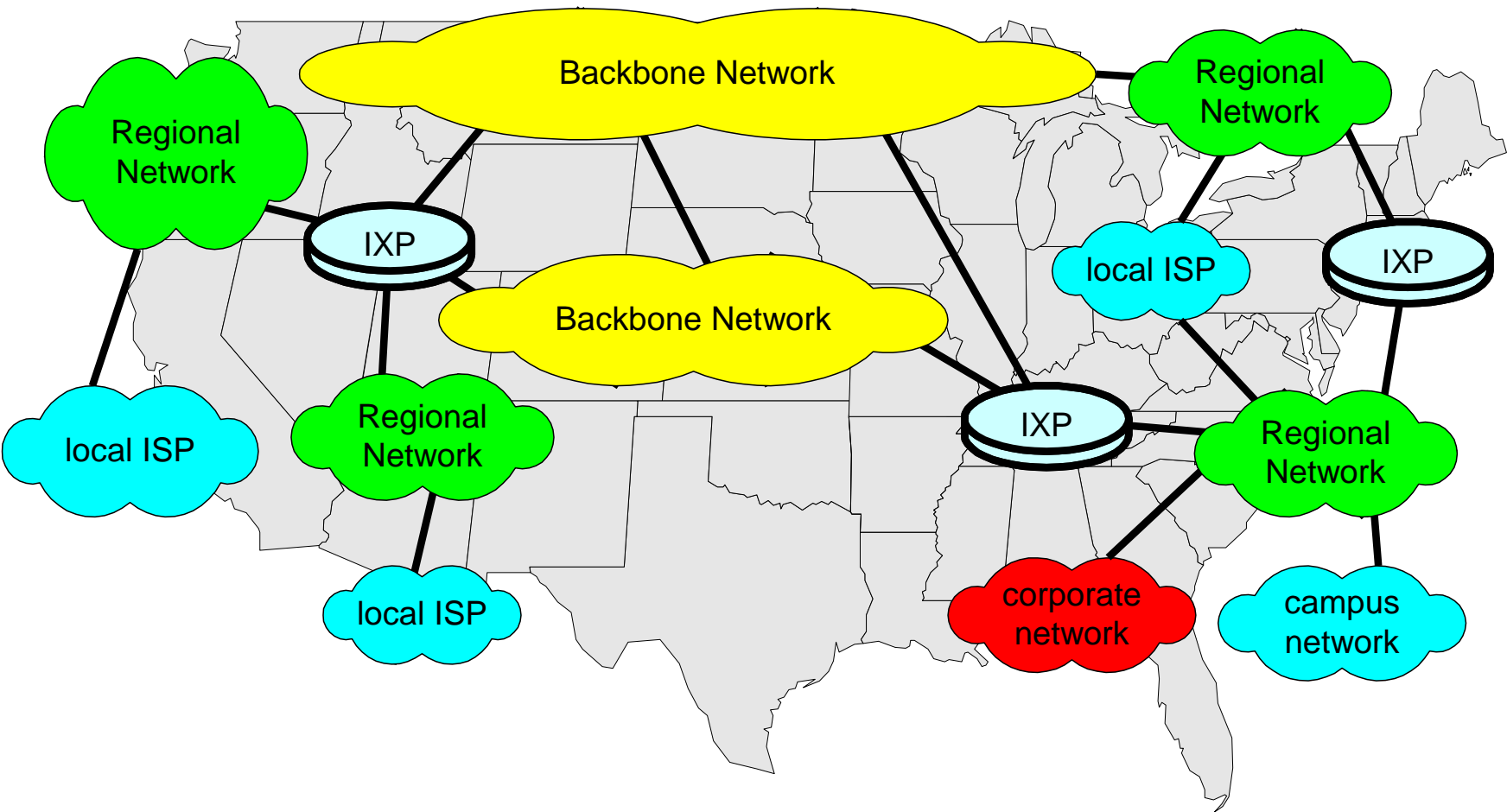
•Source: Internet Society

# Growth of the Internet



Source: Internet Software Consortium

# Internet Infrastructure



# Internet Infrastructure

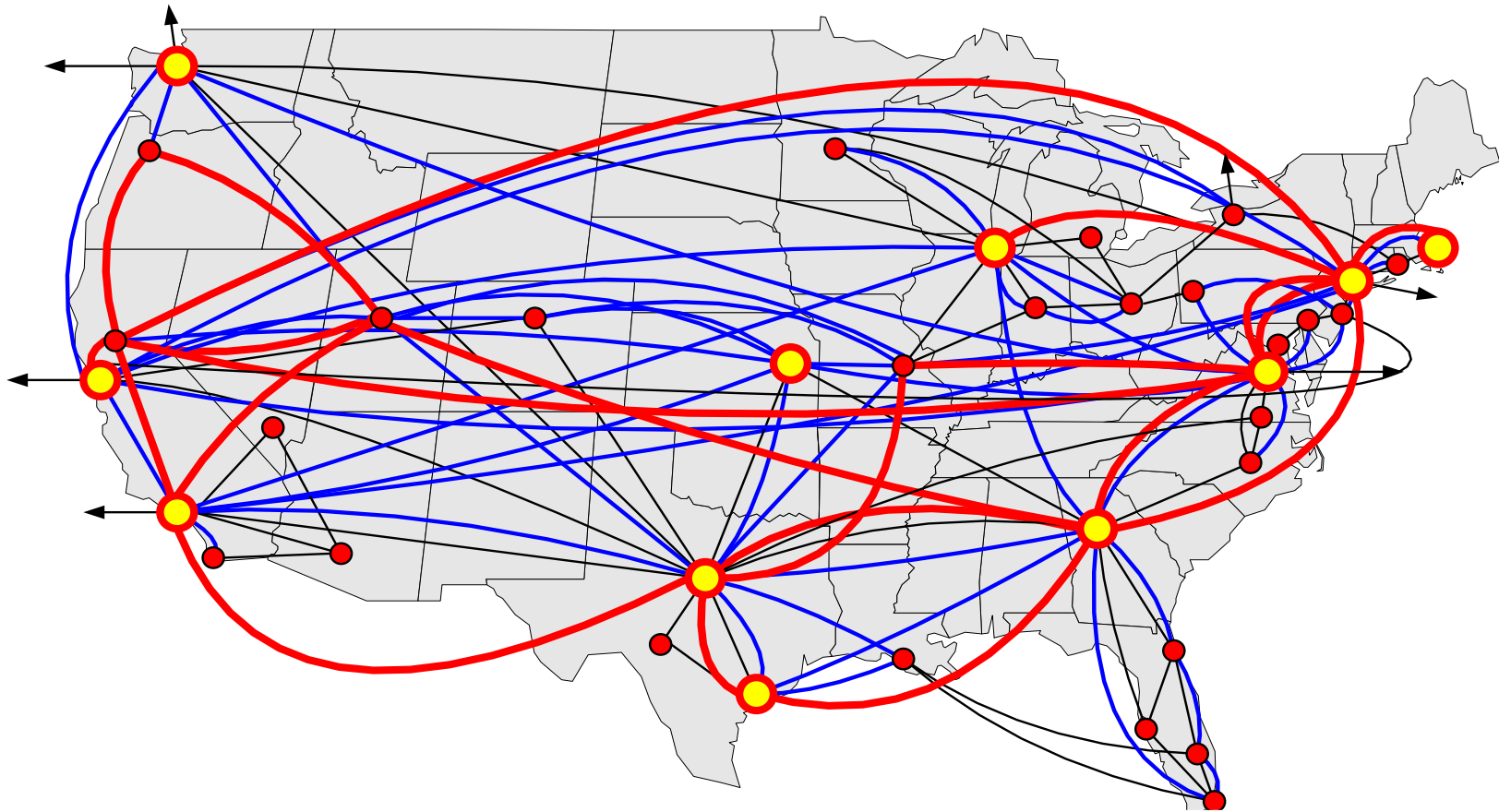
- The infrastructure of the Internet consists of a federation of connected networks that are each independently managed (“**autonomous system**”)
  - Note: Each “autonomous system may consist of multiple IP networks
  - Autonomous systems have a number (**AS number**)
- Hierarchy of network service providers (NSPs)
  - **Tier-1**: nation or worldwide network (US: less than 20)
  - **Tier-2**: regional networks (in US: less than 100)
  - **Tier-3**: local Internet service provider (in US: several thousand)



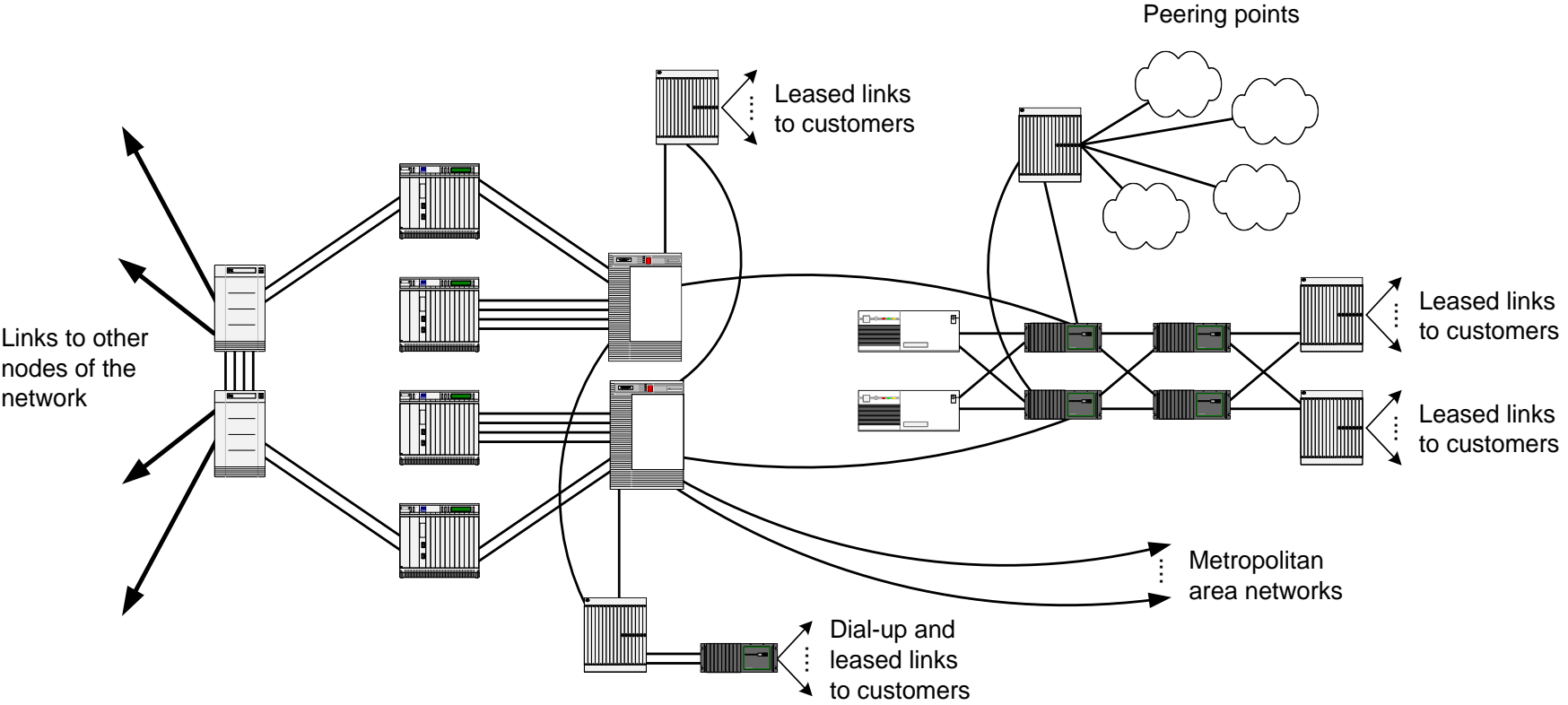
# Internet Infrastructure

- Location where a network (ISP, corporate network, or regional network) gets access to the Internet is called a **Point-of-Presence (POP)**.
- Locations (Tier-1 or Tier-2) networks are connected for the purpose of exchanging traffic are called **peering points**.
  - **Public peering**: Traffic is swapped in a specific location, called Internet exchange points (IXPs)
  - **Private peering**: Two networks establish a direct link to each other.

# Topology of a Tier-1 NSP



# Organization of a single node in a Tier-1 network



# Who is Who on the Internet ?

- **Internet Society (ISOC):** Founded in 1992, an international nonprofit professional organization that provides administrative support for the Internet. Founded in 1992, ISOC is the organizational home for the standardization bodies of the Internet.
- **Internet Engineering Task Force (IETF):** Forum that coordinates the development of new protocols and standards. Organized into working groups that are each devoted to a specific topic or protocol. Working groups document their work in reports, called Request For Comments (RFCs).
- **IRTF (Internet Research Task Force):** The Internet Research Task Force is a composed of a number of focused, long-term and small Research Groups.
- **Internet Architecture Board (IAB):** a technical advisory group of the Internet Society, provides oversight of the architecture for the protocols and the standardization process
- **The Internet Engineering Steering Group (IESG):** The IESG is responsible for technical management of IETF activities and the Internet standards process. Standards. Composed of the Area Directors of the IETF working groups.

# Internet Standardization Process

- Working groups present their work i of the Internet are published as **RFC (Request for Comments)**. RFCs are the basis for Internet standards.
- Not all RFCs become Internet Standards ! (There are >3000 RFCs and less than 70 Internet standards)
- A typical (but not only) way of standardization is:
  - Internet Drafts
  - RFC
  - Proposed Standard
  - Draft Standard (requires 2 working implementation)
  - Internet Standard (declared by IAB)

# Assigning Identifiers for the Internet

- Who gives the university the domain name "virginia.edu"
- Who assigns it the network prefix "128.143.0.0/16"?
- Who assigns port 80 as the default port for web servers?
  
- The functions associated with the assignment of numbers is referred to as **Internet Assigned Number Authority (IANA)**.
  
- IANA used to be managed by Jon Postel at ISI
  
- Since the 1990s, IP addresses and domain name allocation are delegated to independent organizations. Different organizations are responsible for allocating domain names and IP addresses

# The IANA Function

- The functions associated with the assignment of numbers in the Internet is referred to as Internet Assigned Number Authority (IANA).
- IANA serves as a **registry** that keeps records of assigned numbers:
  - IP addresses
  - Protocol numbers
  - Domain names (until 1992)
- There is no charge for allocation.

# Regional Internet Registries (RIRs)

- Registration and management of IP address is done by **Regional Internet Registries (RIRs)**
- Where do RIRs get their addresses from: IANA maintains a high-level registry that distributes large blocks to RIRs
- RIR are administer allocation of:
  - IPv4 address blocks
  - IPv6 address blocks
  - Autonomous system (AS) numbers
- There are currently 4 RIRs worldwide:
  - **APNIC** (Asia/Pacific Region),
  - **ARIN** (North America and Sub-Saharan Africa),
  - **LACNIC** (Latin America and some Caribbean Islands)
  - **RIPE NCC** (Europe, the Middle East, Central Asia, and African countries located north of the equator).
- A fifth regional registry (AfriNIC) is in formation for Africa.



# Transitioning of Domain Name Registration

- **Until 1992:** Domain name registration done as part of IANA
- **1992:** InterNIC was created in a partnership between US government and companies to organize and maintain the growing DNS registry and services. The company Network Solutions ran the administration of InterNIC. Until 1998, Network Solutions had a monopoly for domain names.
- **1995:** InterNIC started charging for domain names (\$100 for 2 years)
- **1997:** President Clinton directs the Secretary of Commerce to privatize the management of the domain name system (DNS) in a manner that increases competition and facilitates international participation in its management.
- **1998:** ICANN was created in response to a policy statement issued by the US Department of Commerce that called for the formation of a private sector not-for-profit Internet stakeholder to administer policy for the Internet name and address system. ICANN operates under a renewable 3-year contract with the US Department of the Commerce.
  - ICANN accredits domain-name registrar for .com, .org., .net (and other domain)

# ICANN

- The Internet Corporation for Assigned Names and Numbers (ICANN) is an internationally organized, non-profit corporation that has responsibility for Internet Protocol (IP) address space allocation, protocol identifier assignment, Top-Level Domain name system management, and root server system management functions.
  - ICANN performs the IANA functions
  - ICANN accredits domain-name registrar for .com, .org., .net (and other domain)
- Since ICANN performs the IANA functions, it is in charge for allocating all numbers. However, the main concern is the allocation of domain names.
- ICANN role is to oversee the domain-name registration system's transition from government hands to private hands and to coordinate its decentralization and the integration into a global community.