The Internet

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

• 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

#### Internet History

- **1968**: ARPANET Demonstrated
- **1980**: TCP/IP Invented
- **1983**: ARPANET Widely Used
- **1993**: World Wide Web
- **1996**: Internet Society Founded
- **1985**: MILNET/ARPANET Split

#### Operational Networks on Internet

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Hosts</th>
</tr>
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<tbody>
<tr>
<td>Aug-81</td>
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<tr>
<td>Aug-83</td>
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<td>Aug-89</td>
<td>500</td>
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<tr>
<td>Aug-91</td>
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<tr>
<td>Aug-93</td>
<td>19,000</td>
</tr>
<tr>
<td>Aug-95</td>
<td>50,000</td>
</tr>
</tbody>
</table>

*Source: Internet Society*

### Growth of the Internet

#### Number of Hosts on the Internet

![Graph showing exponential growth of Internet hosts](image)

*Source: Internet Software Consortium*
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
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 on 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-Sahara 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**: IANA and NSF jointly created InterNIC, a quasi-governmental body mandated to organize and maintain the growing DNS registry and services.
- **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.