Computer Networking: The Past, Present and Future

Chidera Anichebe
Computer Society Chair, FUTO SB
dera@ieee.org

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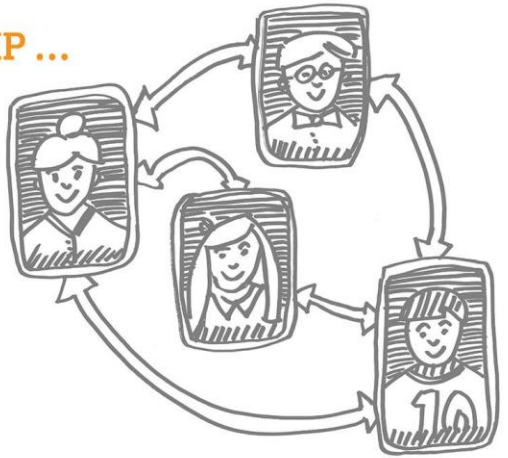

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What is Computer Networking?

Computer networking refers to connected computing devices (such as laptops, desktops, servers, smartphones, and tablets) and an ever-expanding array of IoT devices (such as cameras, door locks, doorbells, refrigerators, audio/visual systems, thermostats, and various sensors) that communicate with one another in other to share information and resources

Features of a Computer Network

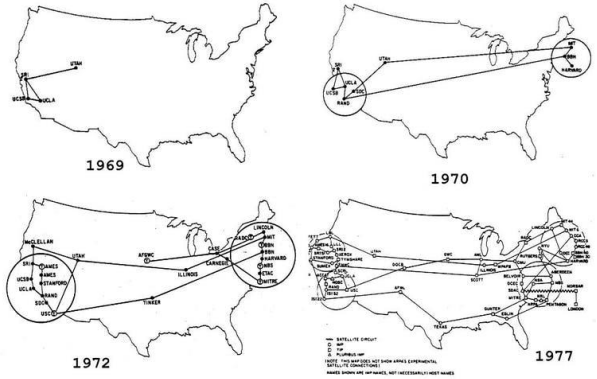
What characteristics should a computer network have?

- Communication speed
- File sharing
- Easy back up and roll back
- Software and Hardware sharing
- Security
- Scalability
- Reliability

Computer Networking: The past

The birth of the first computer network

- The history of modern computer networking dates back to 1969, when ARPANET (Advanced Research Projects Agency Network) became the first connected computer network. It implemented the TCP/IP protocol suite, which later became the Internet. ARPANET was developed by the Advanced Research Projects Agency (ARPA), a subset of the United States Department of Defense
- Its initial purpose was to link computers at Pentagon-funded research institutions over telephone lines
- At the height of the Cold War, it was used to keep lines of communication open if the USA and USSR decided to exchange nuclear devices



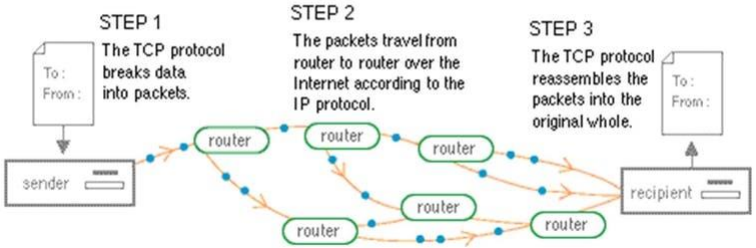
Initial nodes of the ARPANET

- University of California, Los Angeles (UCLA)
- Stanford Research Institute (SRI)
- University of California-Santa Barbara (UCSB)
- University of Utah

What is Packet Switching?

Hot-potato routing: a packet of data

- The ARPANET arose from a desire to share information over great distances without the need for dedicated phone connections between each computer on a network. As it turned out, fulfilling this desire would require "packet switching."
- **Packet Switching** transmits data across digital networks by breaking it down into blocks or packets for more efficient transfer using various network devices. Each time one device sends a file to another, it breaks the file down into packets so that it can determine the most efficient route for sending the data across the network at that time. The network devices can then route the packets to the destination where the receiving device reassembles them for use.



The history of the ARPANET

…paving the way for a digital world

- **October 29, 1969**
  ARPANET, the forerunner of the modern internet, goes live.
- **1972**
  The first email program, written by Ray Tomlinson, becomes a killer app on the fledgling ARPANET, which by the end of the years had expanded to connect 24 sites.
- **1973**
  Satellite links to Hawaii, the University College of London in England, and the Royal Radar Establishment in Norway established. ARPANET goes international across 37 sites.
- **1974**
  Vint Cerf and Bob Kahn publish a paper, A Protocol for Packet Network Intercommunication (PDF), that outlines the design for a Transmission Control Program (TCP).
- **1980**
  ARPANET suffers its first outage on grinds October 27. The problem is traced to an accidentally propagated status-message virus.
- **1983**
  Switch over from the host-to-host Network Control Protocol (NCP) to TCP/IP, as the underpinning network technology. The ARPANET is split with the creation of a military-only (MILNET) and civilian sections.
- **1986**
  NSFNET established with a backbone speed of 56 Kbps.
- **1990**
  ARPANET is retired with most university systems moved onto NSFNET.

*Timeline adapted from Hobbes' Internet Timeline

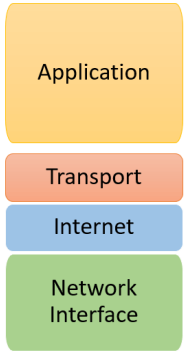
The rise of the Internet

ARPANET, the precursor to the modern internet

- January 1, 1983 is considered the official birthday of the Internet. Prior to this, the various computer networks did not have a standard way to communicate with each other. A new communications protocol was established called Transmission Control Protocol/Internet Protocol (TCP/IP).
- This allowed different kinds of computers on different networks to "talk" to each other. ARPANET and the Defense Data Network officially changed to the TCP/IP standard on January 1, 1983, hence the birth of the Internet. All networks could now be connected by a universal language.

The TCP/IP stack

- TCP/IP short for “Transmission Control Protocol/Internet Protocol” is a model designed and developed by the United States Department of Defense in the 1960s
- The TCP/IP stack is a concise form of the OSI model. It contains four layers, unlike the seven layers of the OSI model. These layers are:
  - Application layer
  - Transport layer
  - Internet layer
  - Network Interface layer



Some common TCP/IP protocols include: TCP, IP, HTTP, SMTP, DNS, Telnet

Modern Networking Devices

the key links for modern computing

Hardware devices that are used to connect computers, printers, fax machines and other electronic devices to a network are called **network devices**.

These devices transfer data in a fast, secure and accurate manner over same or different networks. Network devices may be inter-network or intra-network. Some devices are installed on the device, like NIC card or RJ45 connector, whereas some are part of the network, like router, switch, etc.

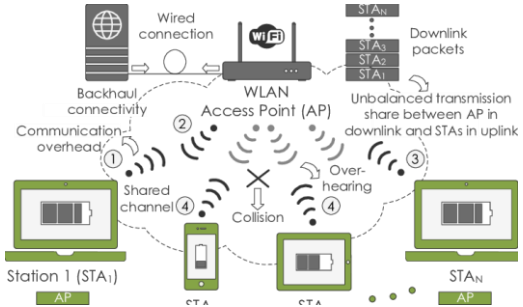





IEEE 802.11 WiFi

Wireless Local Area Networks (WLAN)

- Wi-Fi is the wireless technology used to connect computers, tablets, smartphones and other devices to the internet.
- It is the radio signal sent from a wireless router to a nearby device, which translates the signal into data you can see and use. The device transmits a radio signal back to the router, which connects to the internet by wire or cable.



IEEE 802.15.1 Bluetooth

Wireless Personal Area Networks (WPAN)

- **Bluetooth** is a short-range wireless technology standard that is used for exchanging data between fixed and mobile devices over short distances using UHF radio waves in the ISM bands, from 2.402 GHz to 2.48 GHz, and building personal area networks (PANs)

PAN

The future of Computer Networking

What does the future hold?

- Internet connectivity from space
- Semi and fully autonomous systems
- Growth of connected devices and people
- Cloud infrastructure
- Software defined networking

Thank you!

dera@ieee.org