IT 304
Computer Networks
Autumn 2022

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Course Logistics

- Timings
  - Monday 11-11:50 AM
  - Wed   9-9:50 AM
  - Fri   8-8:50 AM

- Philosophy
  - Attend and pay attention
  - No MARKS/GRADE negotiations

- Textbooks:
  - **Computer Networking: A Top-Down Approach 7th edition, Jim Kurose, Keith Ross**
  - Computer Networks: A Systems Approach, 5th Edition, Larry Peterson and Bruce Davie

Experience

Batch taught	Years
MSc IT	2016-2020
BTech	2017, 2021

Component	Percentage
In-Sem I	15
In-Sem II	20
Labs	25
End sem	40

Goal

Teach your Grandparents **WHAT IS INTERNET**
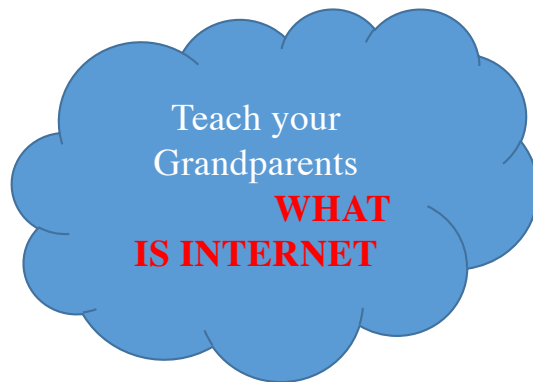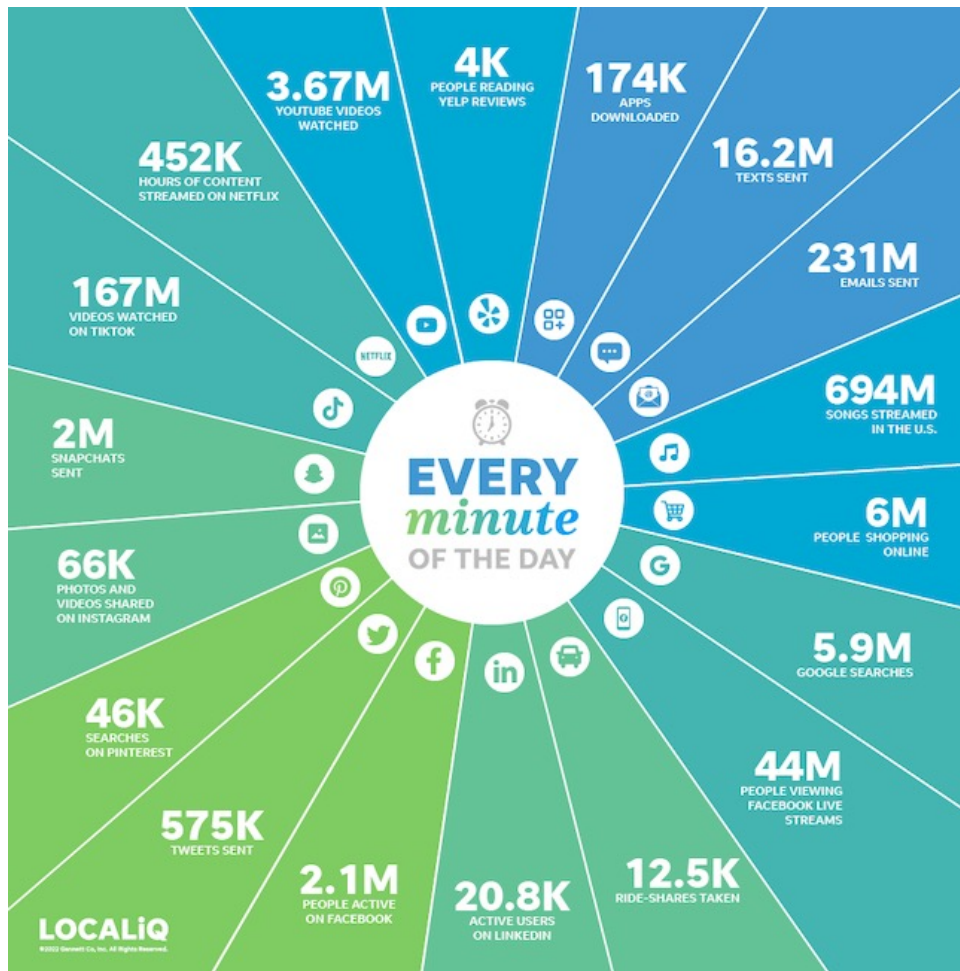
- Learn concepts underlying networks
- How do networks work? What can one do with them?
- Gain a basic understanding of the Internet
- Gain experience writing protocols
- Tools to understand new protocols and applications

What comes to your mind, when I say …..
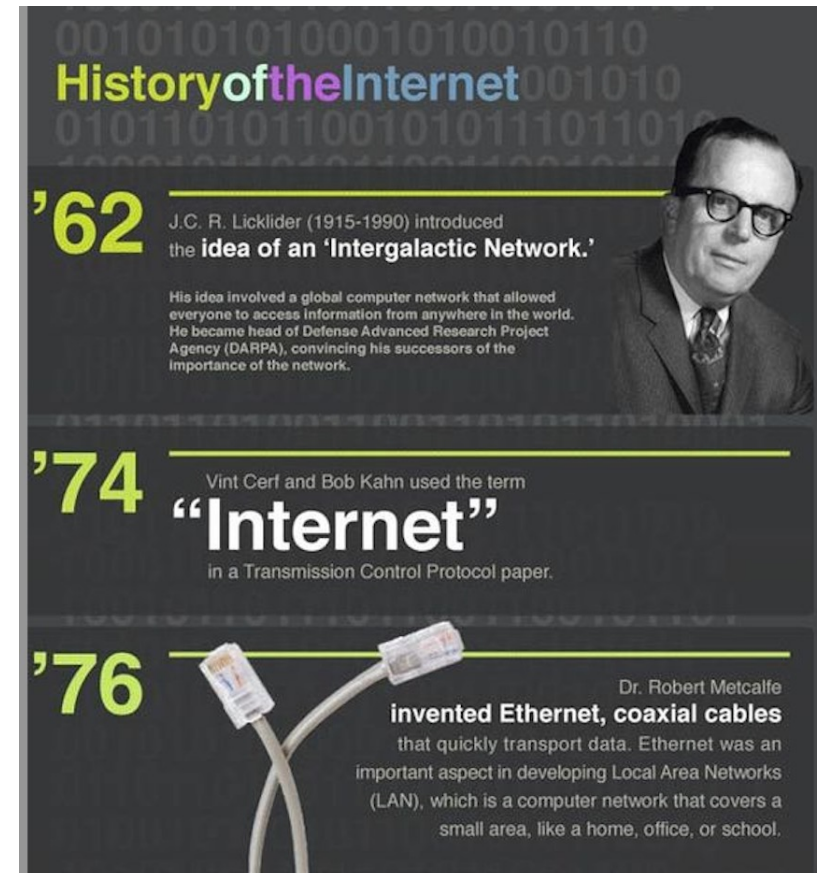
- INTERNET

- World Wide Web

- IT 304

EVERY minute OF THE DAY

- **3.67M** YOUTUBE VIDEOS WATCHED
- **4K** PEOPLE READING YELP REVIEWS
- **174K** APPS DOWNLOADED
- **452K** HOURS OF CONTENT STREAMED ON NETFLIX
- **16.2M** TEXTS SENT
- **167M** VIDEOS WATCHED ON TIKTOK
- **231M** EMAILS SENT
- **2M** SNAPCHATS SENT
- **694M** SONGS STREAMED IN THE U.S.
- **66K** PHOTOS AND VIDEOS SHARED ON INSTAGRAM
- **6M** PEOPLE SHOPPING ONLINE
- **46K** SEARCHES ON PINTEREST
- **5.9M** GOOGLE SEARCHES
- **575K** TWEETS SENT
- **44M** PEOPLE VIEWING FACEBOOK LIVE STREAMS
- **2.1M** PEOPLE ACTIVE ON FACEBOOK
- **20.8K** ACTIVE USERS ON LINKEDIN
- **12.5K** RIDE-SHARES TAKEN

LOCALiQ
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https://localiq.com/blog/what-happens-in-an-internet-minute/

IT 304_2022

Vincent Cerf

Tim Berners Lee

Paul Baran

JCR LickLider

History of the Internet

'62 — J.C. R. Licklider (1915-1990) introduced the **idea of an 'Intergalactic Network.'**

His idea involved a global computer network that allowed everyone to access information from anywhere in the world. He became head of Defense Advanced Research Project Agency (DARPA), convincing his successors of the importance of the network.

'74 — Vint Cerf and Bob Kahn used the term **"Internet"** in a Transmission Control Protocol paper.

'76 — Dr. Robert Metcalfe **invented Ethernet, coaxial cables** that quickly transport data. Ethernet was an important aspect in developing Local Area Networks (LAN), which is a computer network that covers a small area, like a home, office, or school.

https://www.history.com/topics/inventions/invention-of-the-internet

https://www.computerhistory.org/timeline/networking-the-web/

Chapter 1: Introduction

our goal:

- get "feel" and terminology

- more depth, detail *later* in course

- approach:
  - use Internet as example

overview:

- History

- What's the Internet?

- What's a protocol?

- Network edge; hosts, access net, physical media

- network core: packet/circuit switching, Internet structure

- performance: loss, delay, throughput

- security

- protocol layers, service models

Chapter 1: roadmap

Internet history

1961-1972: Early packet-switching principles

- 1961: Kleinrock - queueing theory shows effectiveness of packet-switching

- 1964: Baran - packet-switching in military nets

- 1967: ARPAnet conceived by Advanced Research Projects Agency

- 1969: first ARPAnet node operational

- 1972:
  - ARPAnet public demo
  - NCP (Network Control Protocol) first host-host protocol
  - first e-mail program
  - ARPAnet has 15 nodes
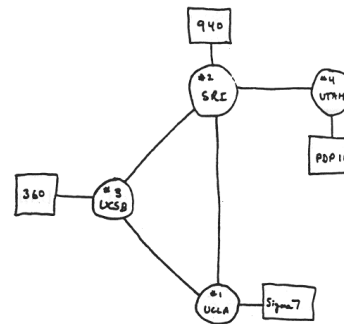
Internet history

1972-1980: Internetworking, new and proprietary nets

- 1970: ALOHAnet satellite network in Hawaii
- 1974: Cerf and Kahn - architecture for interconnecting networks
- 1976: Ethernet at Xerox PARC
- late70's: proprietary architectures: DECnet, SNA, XNA
- late 70's: switching fixed length packets
- 1979: ARPAnet has 200 nodes

Cerf and Kahn's internetworking principles:
- minimalism, autonomy - no internal changes required to interconnect networks
- best effort service model
- stateless routers
- decentralized control

define today's Internet architecture

Internet history

1980-1990: new protocols, a proliferation of networks

- 1983: deployment of TCP/IP

- 1982: smtp e-mail protocol defined

- 1983: DNS defined for name-to-IP-address translation

- 1985: FTP protocol defined

- 1988: TCP congestion control

- new national networks: Csnet, BITnet, NSFnet, Minitel

- 100,000 hosts connected to confederation of networks

Internet history

1990, 2000's: commercialization, the Web, new apps

- early 1990's: ARPAnet decommissioned
- 1991: NSF lifts restrictions on commercial use of NSFnet (decommissioned, 1995)
- early 1990s: Web
  - hypertext [Bush 1945, Nelson 1960's]
  - HTML, HTTP: Berners-Lee
  - 1994: Mosaic, later Netscape
  - late 1990's: commercialization of the Web

late 1990's – 2000's:

- more killer apps: instant messaging, P2P file sharing
- network security to forefront
- est. 50 million host, 100 million+ users
- backbone links running at Gbps

Internet history

2005-present

- ~750 million hosts
  - Smartphones and tablets
- Aggressive deployment of broadband access
- Increasing ubiquity of high-speed wireless access
- Emergence of online social networks:
  - Facebook: soon one billion users
- Service providers (Google, Microsoft) create their own networks
  - Bypass Internet, providing "instantaneous" access to search, emai, etc.
- E-commerce, universities, enterprises running their services in "cloud" (eg, Amazon EC2)

INTERNET

What is a network?

A Network is.....

- **A**ll the components (H/W & S/W) involved in connecting computer across small and large distances

- **Importance of Networks:**
  - ✓Easy access and sharing of information
  - ✓Sharing of expensive devices and network resources
  - ✓Modern Technologies (IP telephony, Video on Demand, ….etc)

What are all part of a network?

Network components

- **Network has three main components**
  - ✓ **Computers** (servers and hosts)
    - - Source of applications (network aware applications)
    - - ex: HTTP (Hyper Text Transmission Protocol),
            FTP (File Transfer Protocol),
            SNMP (Simple Network Management Protocol)
            Telnet

  - ✓ **Network Devices**
    - - Devices that interconnect different computers together
   - - ex: Repeaters, hub, bridge, switch, router, NIC and modems

  - ✓ **Connectivity**
    - - Media that physically connect the computers and network devices
    - - ex: Wireless and cables

Network Types

- **<u>LAN</u> (Local Area Network):**
  It is a group of network components that work within small area

- **<u>MAN</u> (Metropolitan Area Network):**
  It is a group of LANs that are interconnected within small area

- **<u>WAN</u> (Wide Area Network):**
  It is a group of LANs that are interconnected within large area

What's the Internet: "nuts and bolts" view

user's view

actual connections
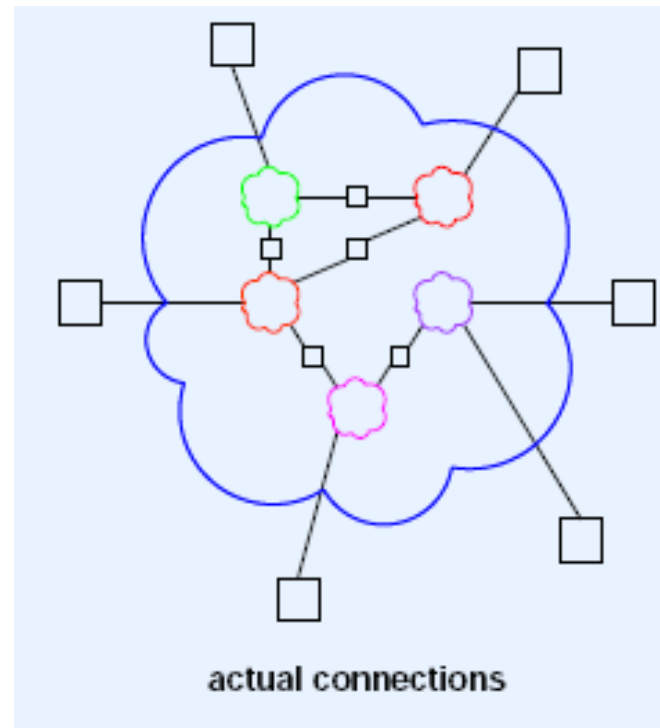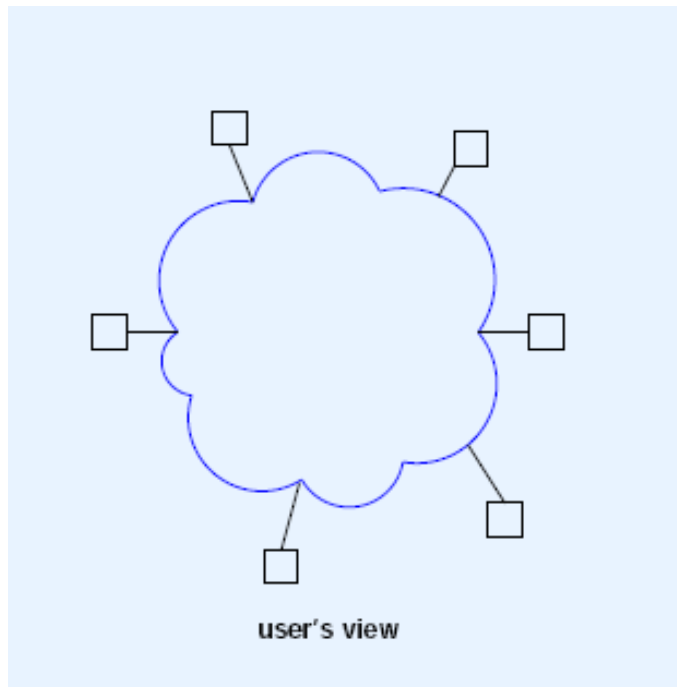
What is the use of Internet?

"We set up a telephone connection between us and the guys at SRI ...", Kleinrock ... said in an interview: "We typed the L and we asked on the phone,

"Do you see the L?"

"Yes, we see the L," came the response.

We typed the O, and we asked, "Do you see the O."

"Yes, we see the O."

Then we typed the G, and the system crashed ...

https://www.youtube.com/watch?v=p5mASvEvDZc