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# COMPUTER NETWORKS AND INTERNET PROTOCOLS

## Introduction

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# Objectives of the Course

- Understand how two computers in the Internet talk to each other
- Go through the basic functionalities of the computer networks
- Learn how to program the network
- Learn the future of the computer network – Do we need any further changes in the design?

**Functionalities**

**Network  
Architecture**

**Protocols**



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# So, What is Network Architecture?

- A way to visualize how two remote computers talk to each other



Network Protocol Stack



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# What is Network Architecture? (contd...)



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# What is Network Architecture? (contd...)



**Requirement:** Convert digital data to analog signal and vice versa

**Physical**

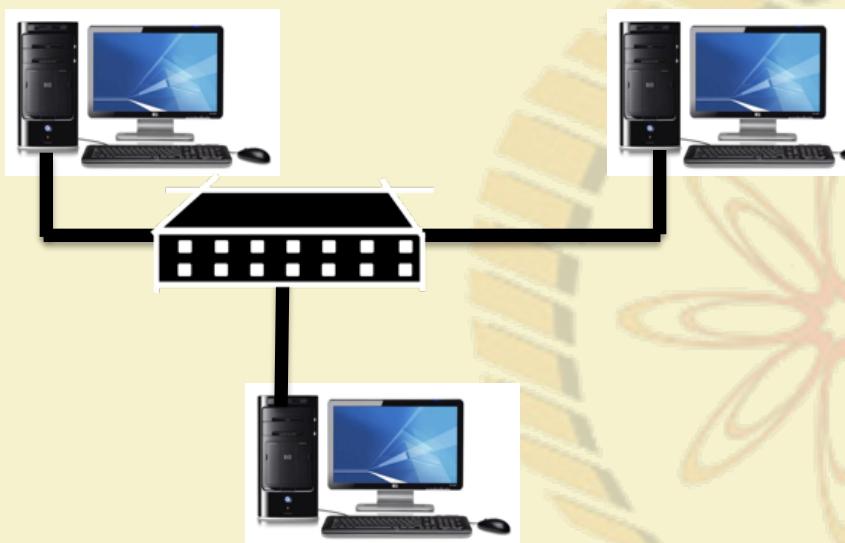


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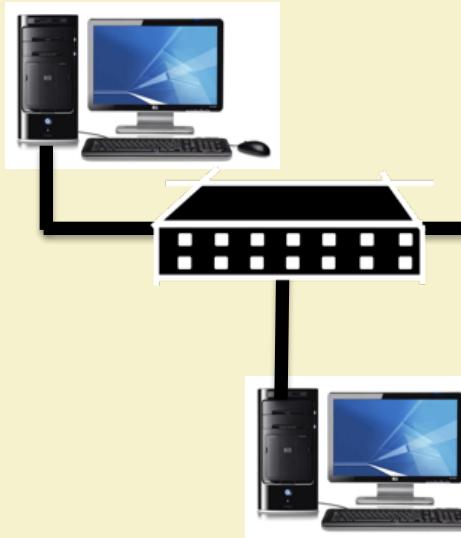


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# What is Network Architecture? (contd...)



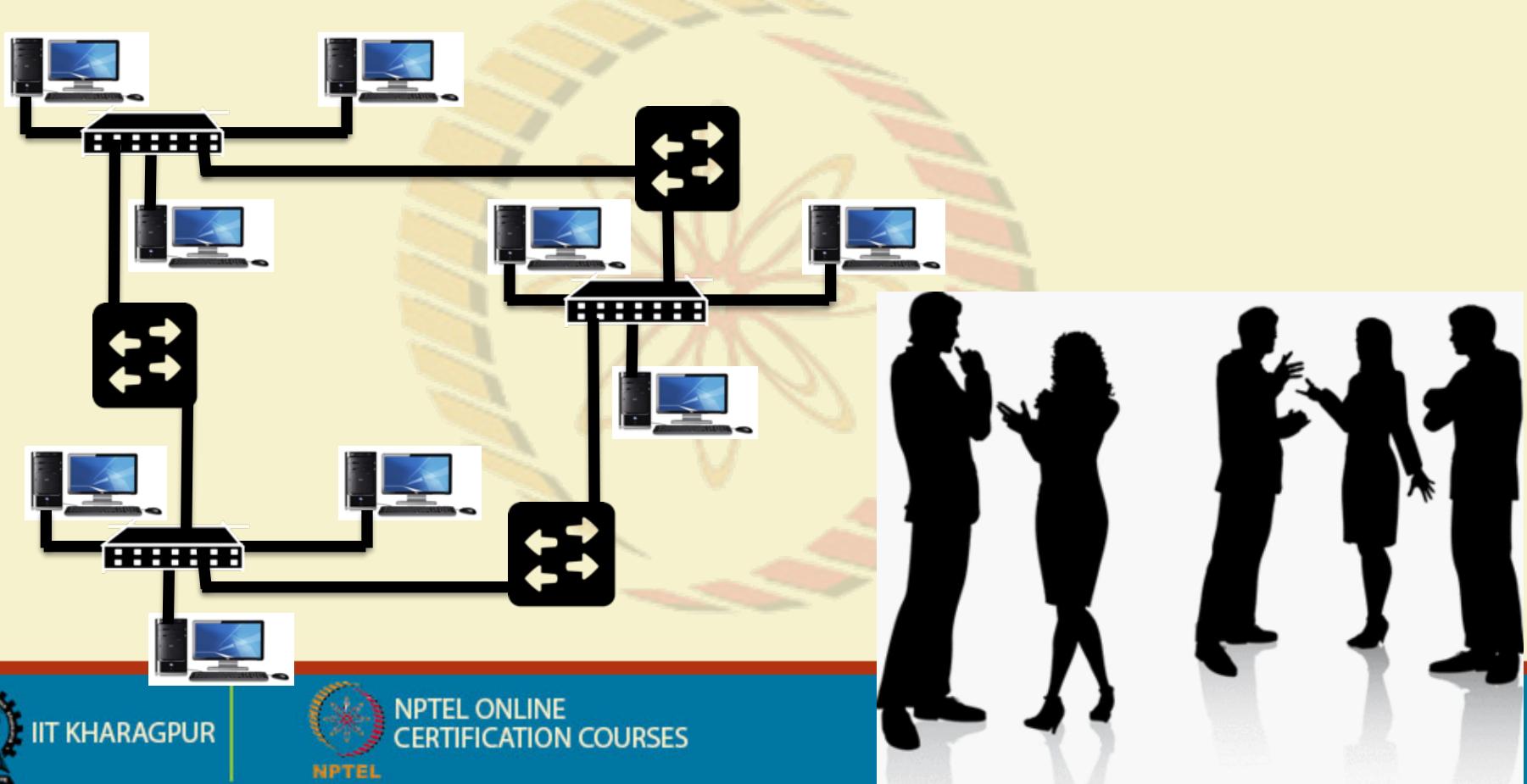
# What is Network Architecture? (contd...)



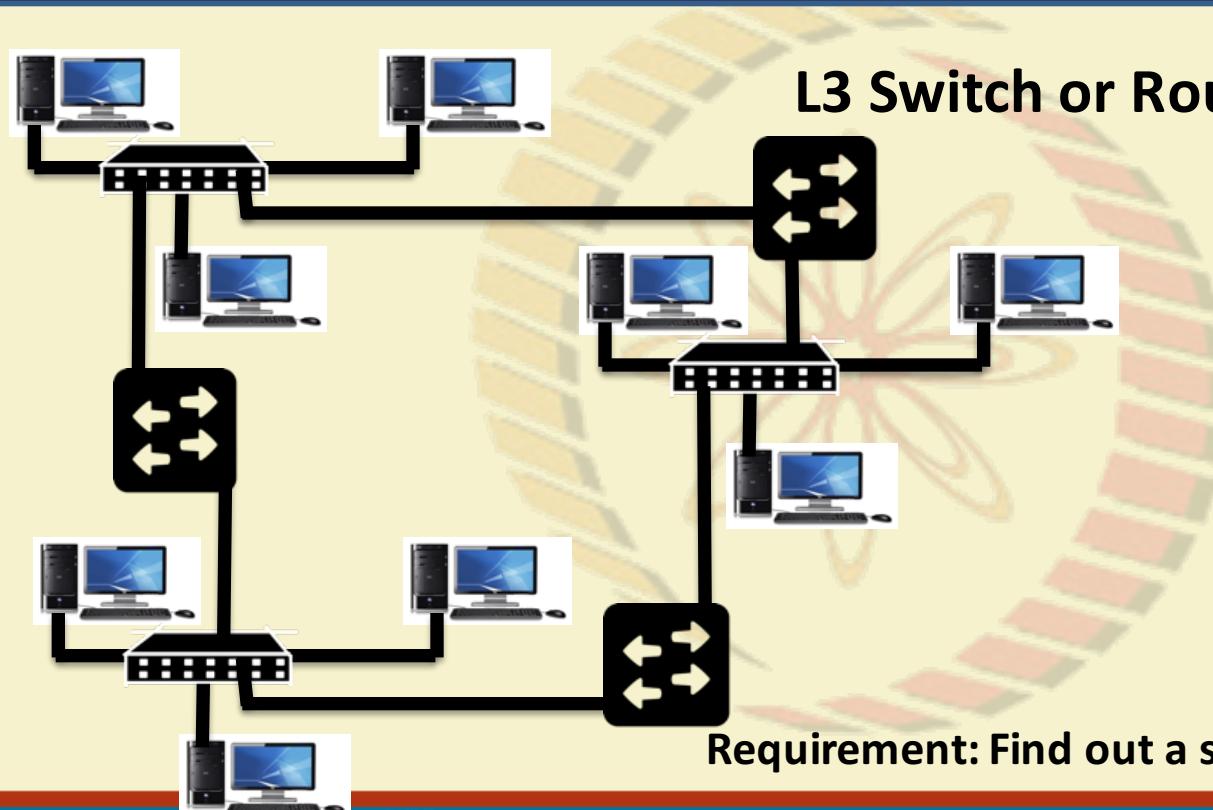
**Requirement:** Ensure proper scheduling in media access

Data Link  
Physical

# What is Network Architecture? (contd...)



# What is Network Architecture? (contd...)



Network

Data Link

Physical

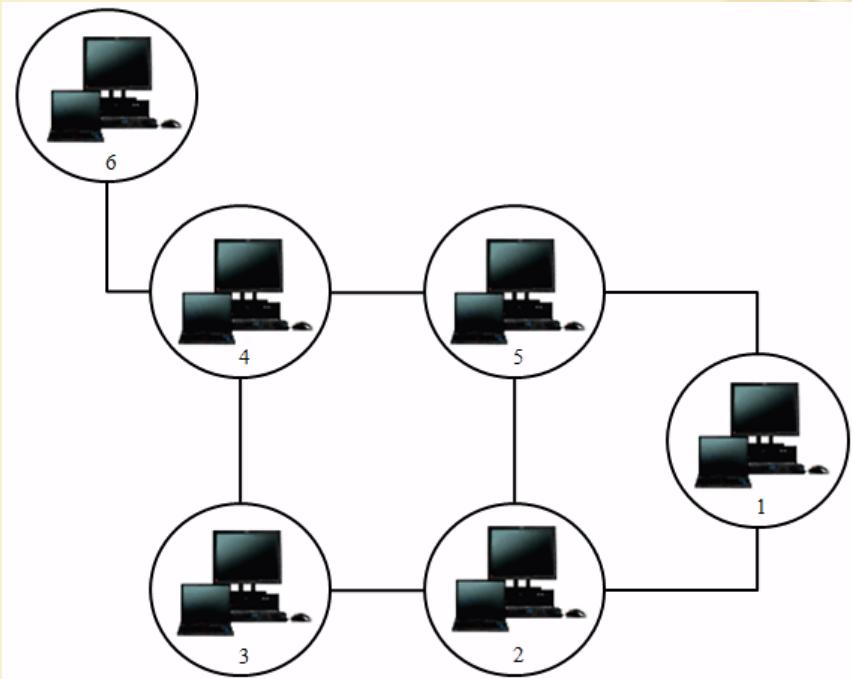


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# What is Network Architecture? (contd...)

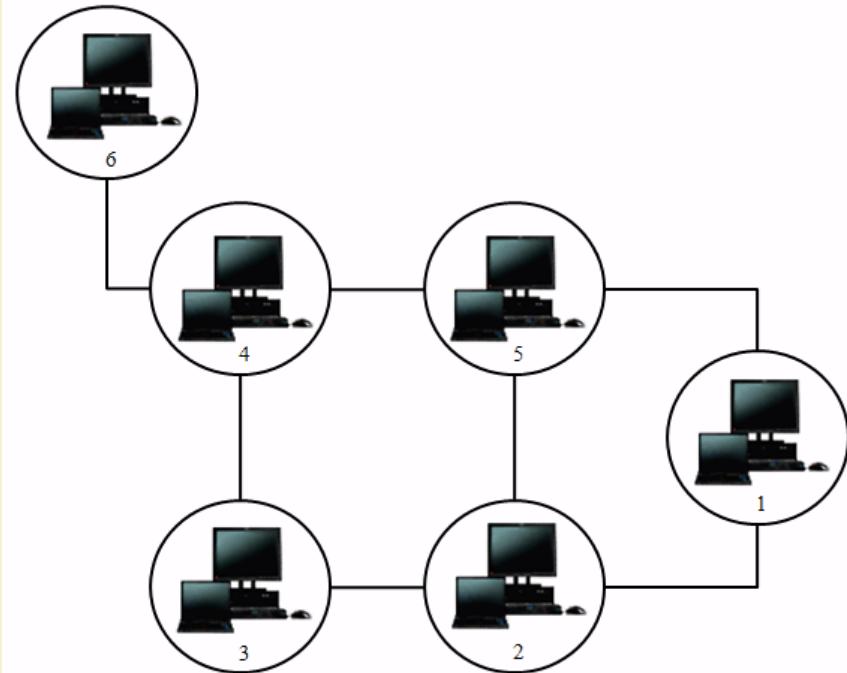


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# What is Network Architecture? (contd...)



**Transport**  
**Network**  
**Data Link**  
**Physical**

**Requirement:** End to end traffic control in the network



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# What is Network Architecture? (contd...)



**Network Protocol  
Stack**



**Application**  
**Transport**  
**Network**  
**Data Link**  
**Physical**

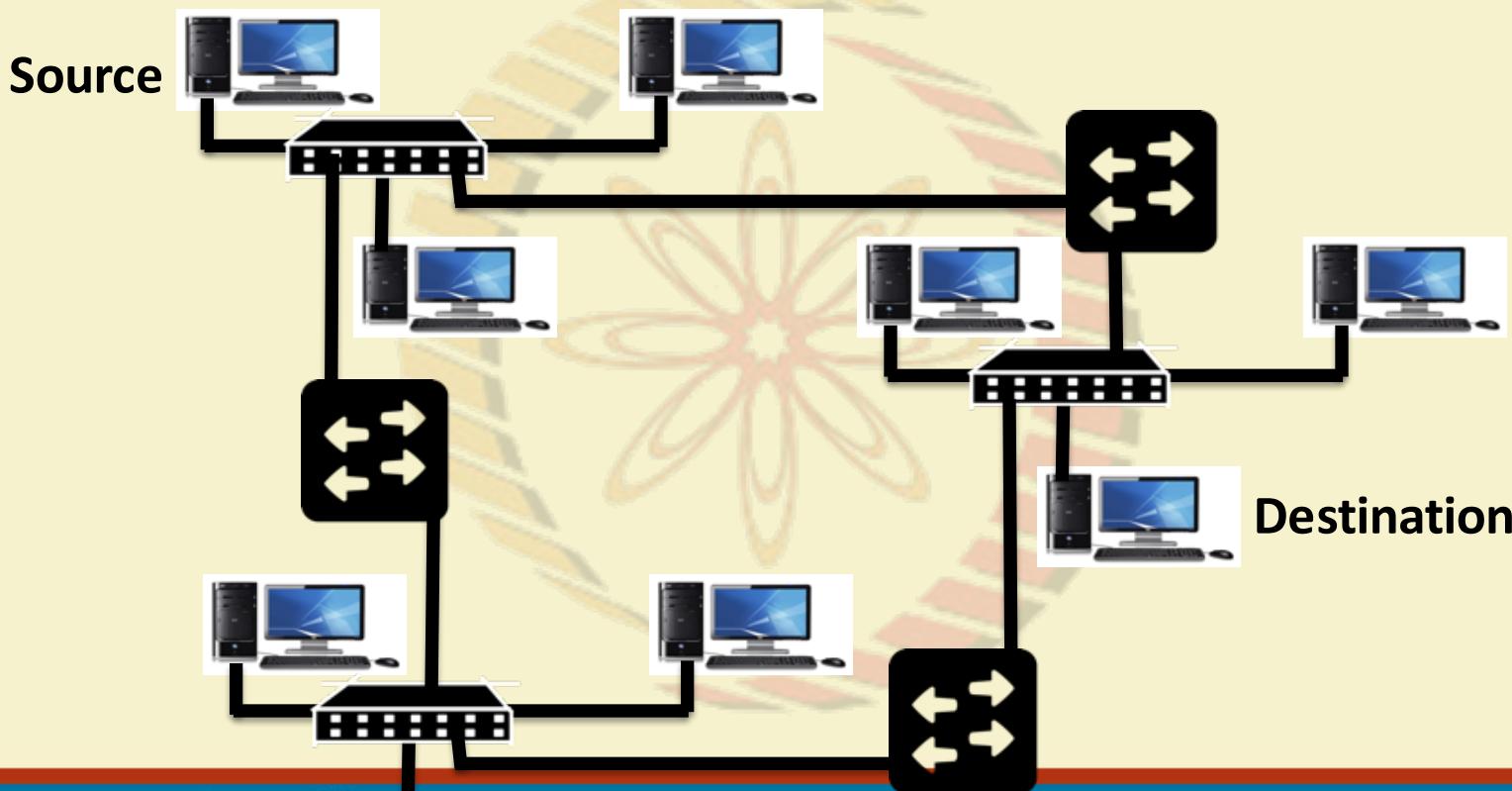


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# Data Transfer between Two Remote Machines



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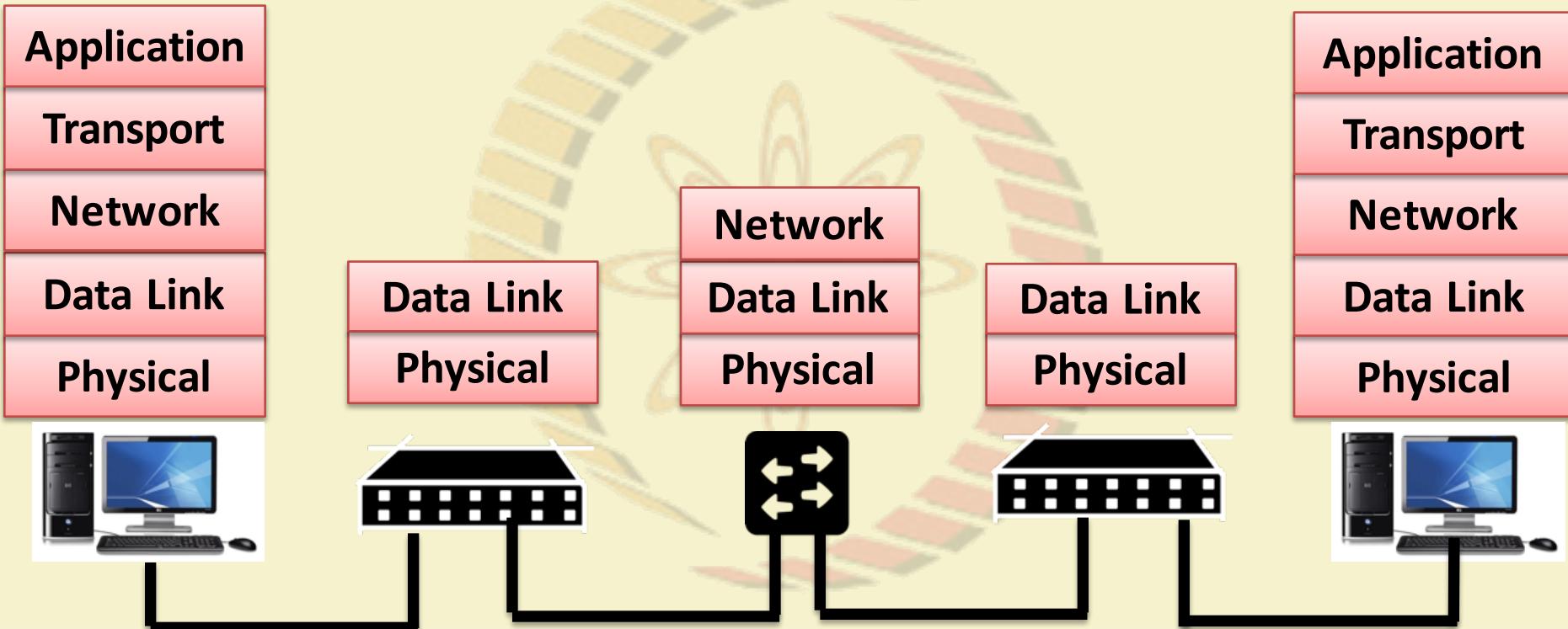


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# Data Transfer between Two Remote Machines



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# Protocols at Different Layers

<b>Application</b>	HTTP, FTP, SMTP
<b>Transport</b>	TCP, UDP, RTP
<b>Network</b>	IPv4, IPv6, MPLS
<b>Data Link</b>	Ethernet, WiFi, Bluetooth, UMTS, LTE
<b>Physical</b>	

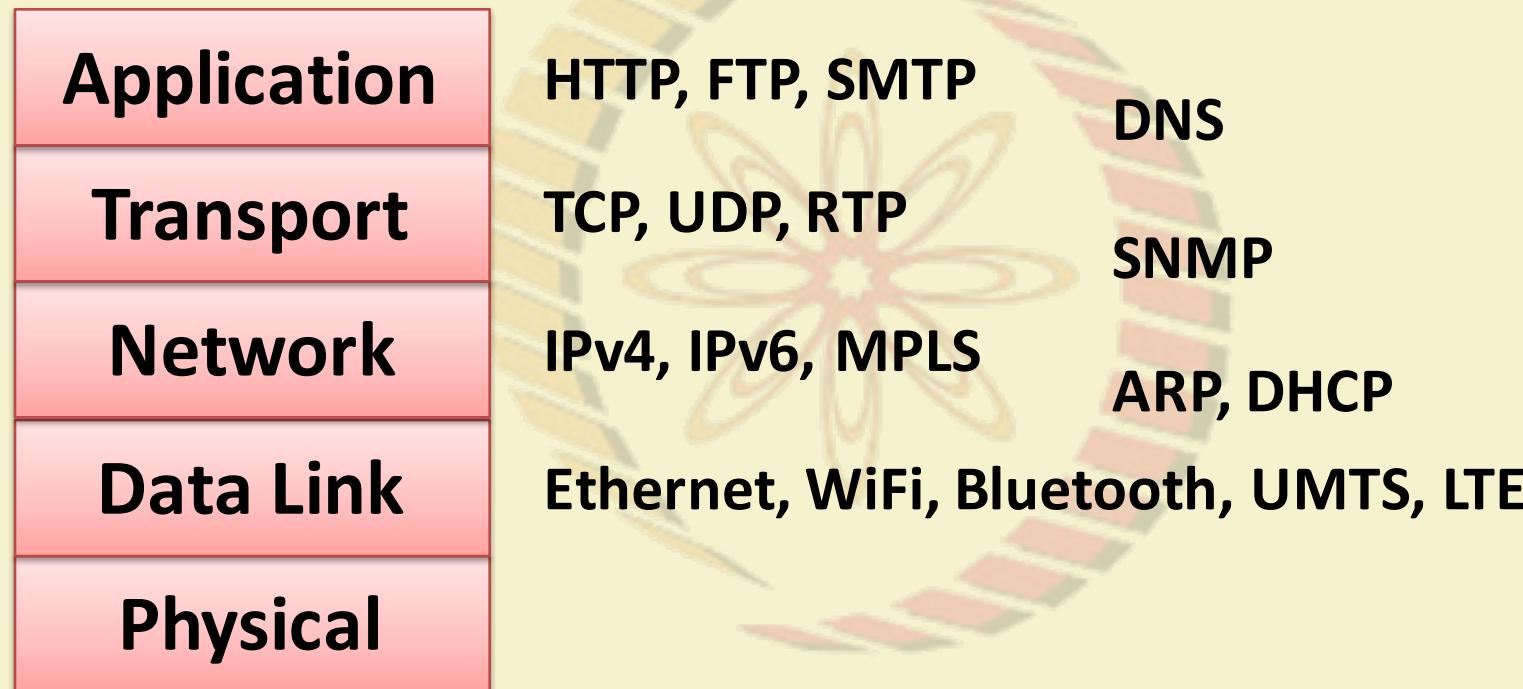


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# Network Management and Control – Cross Layer Protocols

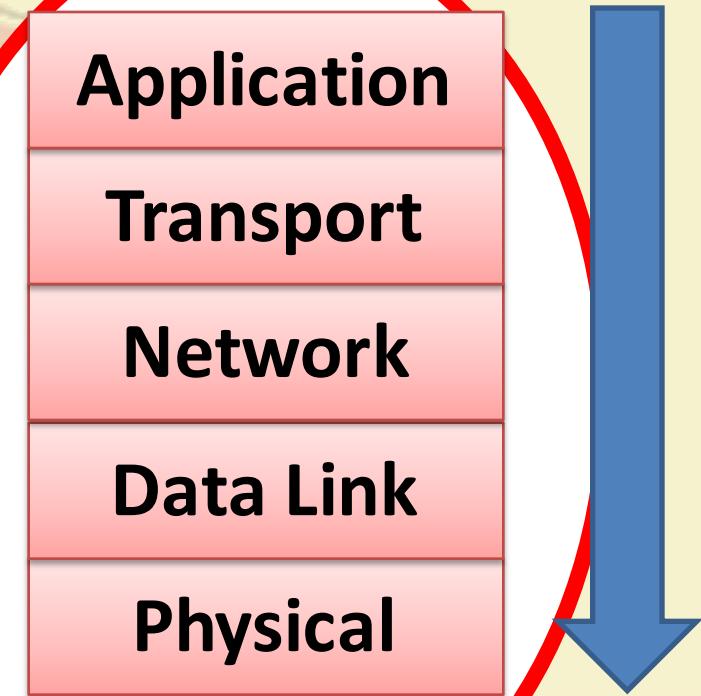
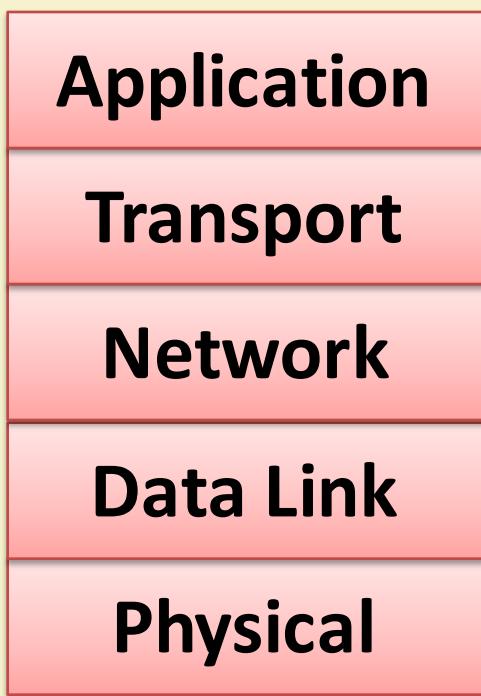


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# Two Ways to Learn Computer Networks



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# History of Computer Networks

- <https://www.youtube.com/watch?v=9hIQjrMHTv4>

The screenshot shows the homepage of the Internet Society's website. At the top, there is a navigation bar with links for 'The Internet', 'What we're doing', 'What you can do', 'Resources', 'About Us', and 'News'. There are also links for 'Member Login', 'EN', a search icon, and a 'Donate' button. Below the navigation bar is a large banner with a cityscape background. The banner features the text 'About the Internet' and 'History of the Internet' in large white letters. A subtext below reads: 'From the early days of ARPANET to today's mobile technologies, here we share some of the different histories of the Internet from various personalities and organizations.' Below the banner is a white navigation bar with links for 'Internet Pioneers', 'World Wide Web', 'Overviews & Collections', 'Regional Histories', 'Timelines', and 'Other Sources'. The main content area has a blue sidebar on the left with the text 'In the words of Internet' and a link to 'A Brief History of the Internet'. The main content area also contains two other links: 'Interesting Historical Background to Internet Governance Issues By One of the Internet Pioneers' and 'Address by John Klensin to the opening of the IGF, Rio de Janeiro, 2007'.

<https://www.internetsociety.org/internet/history-internet>

# History of Internet

Year	Event
1836	Telegraph by Cooke and Wheatstone Revolutionized human (tele)communications. Morse Code a series of dots and dashes used to communicate between humans. This is similar to how computers communicate via (binary 0/1)
1858-1866	Transatlantic cable. Allowed direct instantaneous communication across the Atlantic. Today, cables connect all continents and are still a main hub of telecommunications.
1876	Telephone. Alexander Graham Bell Exhibits. Telephones exchanges provide the backbone of Internet connections today. Modems provide Digital to Audio conversions to allow computers to connect over the telephone network.
1957	The US forms the Advanced Research Projects Agency (ARPA) within the Department of Defense (DoD) to build US skills in computer technology. U.S.S.R. launches Sputnik.
1962	ARPA's contracts from the private sector to universities and laid the foundations for what would become the ARPANET.

# History of Internet

Year	Event
1962-1968	Packet-switching (PS) networks developed The Internet relies on packets to transfer data. Data is split into tiny packets that may take different routes to a destination.
1969	ARPANET commissioned by DoD for research into networking. Four (4) nodes: (i) Univ of California, Los Angeles (UCLA); (ii) Stanford Research Institute (SRI); (iii) Univ of California, Santa Barbara (UCSB); (iv) Univ of Utah
1971	Ray Tomlinson invents Email program to send messages across a distributed network. 15 nodes (23 hosts) on ARPANET
1973	Global Networking becomes a reality. First international connections to the ARPANET: University College of London (England) and Royal Radar Establishment (Norway)
1974	Packets become mode of transfer Transmission Control Program (TCP) specified. Packet network Intercommunication -- the basis of Internet Communication. Telenet, a commercial version of ARPANET, opened -- the first public packet data service.



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# History of Internet

Year	Event
1977	E-mail becomes a reality Hosts: 100+
1979	News Groups formed. USENET established using UUCP - A collection of discussions groups, news groups.
1982	establishes the Transmission Control Protocol (TCP) and Internet Protocol (IP), as the protocol suite, commonly known as TCP/IP, for ARPANET. TCP/IP defines future network communication.
1983	Name server developed.
1984	Domain Name Server (DNS) introduced. Hosts: 1,000+ NSFNET created - NSF establishes 5 super-computing centers to provide high-computing power for all -- This allows an explosion of connections, especially from universities.
1987	Commercialization of Internet. UUNET is founded with Usenix funds to provide commercial UUCP and Usenet access. Hosts: ~30,000.



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# History of Internet

Year	Event
1989	First relays between a commercial electronic mail carrier and the Internet Hosts: 100,000+ WWW concept by Tim Berners-Lee
1990	First search-engine (Archie) 300,000 Hosts. 1,000 News groups ARPANET ceases to exist. First browser/editor program.
1991	User Friendly Interface to Internet established Gopher released by Paul Lindner and Mark P. McCahill from the U of Minnesota. Text based, menu-driven interface to access internet resources.
1992	Multimedia changes the face of the Internet Hosts: 1+ Million. News groups 4,000 The term "Surfing the Internet" is coined by Jean Armour Polly.
1993	The WWW Revolution truly begins Hosts: 2 Million. 600 WWW sites. The Mosaic Web browser is released on the Net



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# Web exploded...

- 1994 – 3,2 million hosts and 3,000 websites
- 1995 – 6,4 million hosts and 25,000 websites
- 1997 – 19,5 million hosts and 1,2 million websites
- January 2001 – 110 million hosts and 30 million websites
- Expansion continues....

# Some Facts

- 1994 – Hotmail starts web based email
- 1994 – World Wide Web Consortium (W3C) was founded
- 1995 – JAVA source code was released
- 1996 – Mirabilis (Israel) starts ICQ
- 1998 – Google is founded



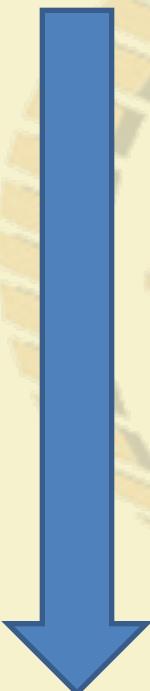
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# Books / Resources to Follow ...

**Application**  
**Transport**  
**Network**  
**Data Link**  
**Physical**



**COMPUTER  
NETWORKING** FIFTH EDITION

*A Top-Down Approach*



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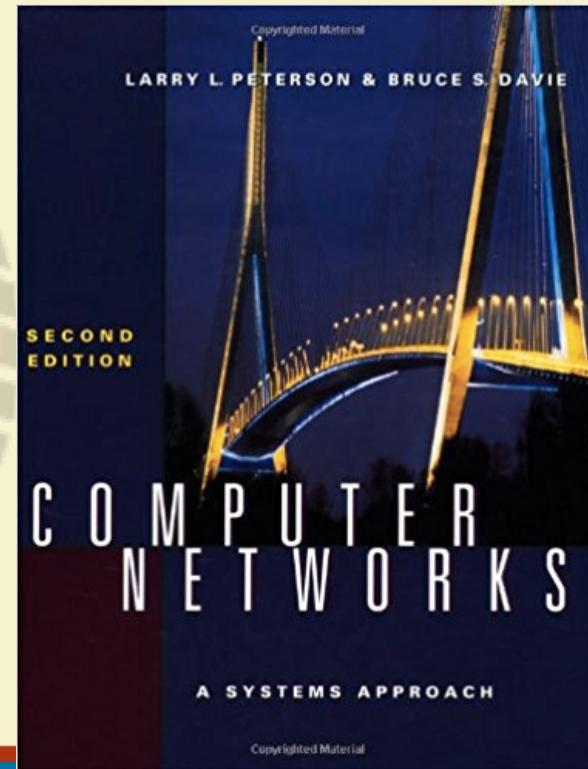
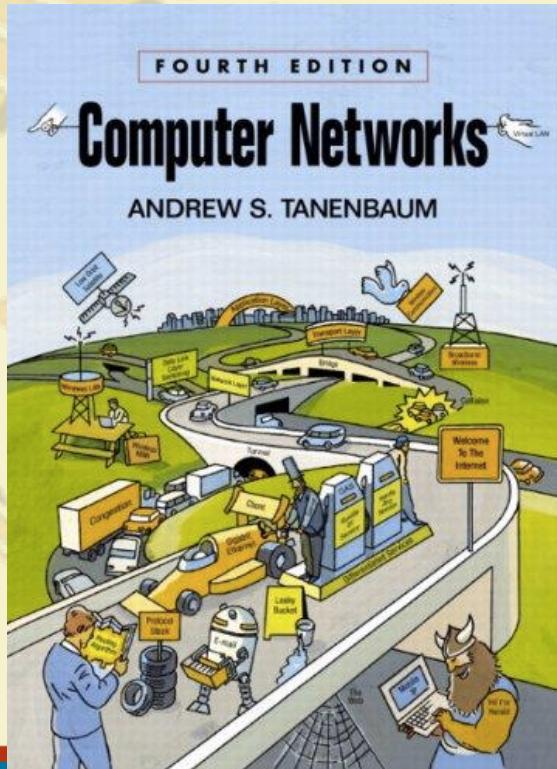
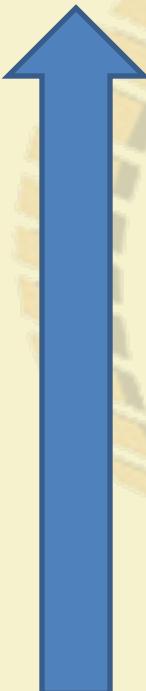


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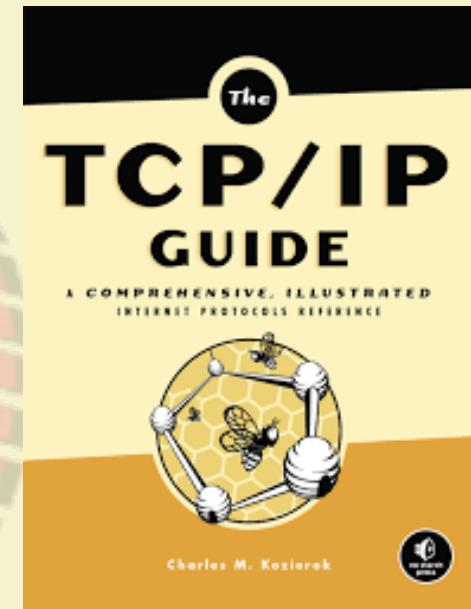
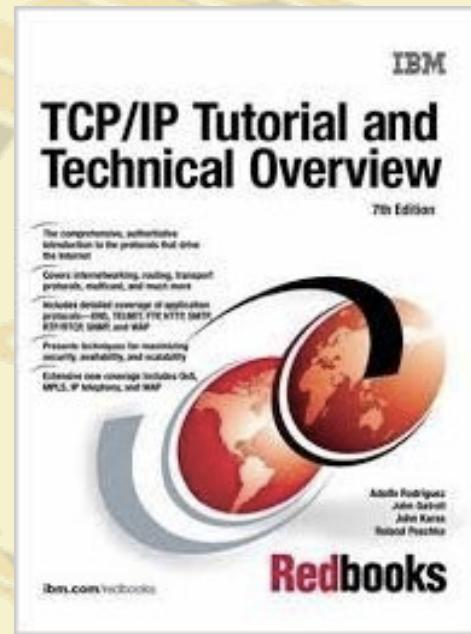
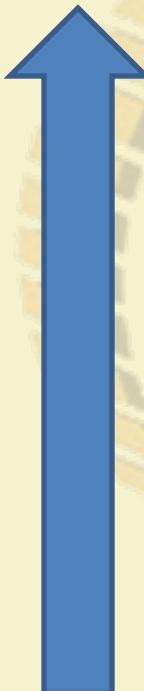
# Books / Resources to Follow ...

Application  
Transport  
Network  
Data Link  
Physical



# Books / Resources to Follow ... (online)

Application  
Transport  
Network  
Data Link  
Physical



<http://www.redbooks.ibm.com/abstracts/gg243376.html>  
<http://www.tcpipguide.com/>



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Memos in the **Requests for Comments (RFC)** document series contain technical and organizational notes about the Internet. They cover many aspects of computer networking, including protocols, procedures, programs, and concepts, as well as meeting notes, opinions, and sometimes humor. Below are links to RFCs, as available from ietf.org and from rfc-editor.org. Note that there is a brief time period when the two sites will be out of sync. When in doubt, the RFC Editor site is the authoritative source page.

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The goal of the IETF is to make the Internet work better.

The mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet. Newcomers to the IETF should [start here](#).

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6778 is now in use:

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ing in, use your datatracker

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thank you!



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