



WWW



# CSC 524

Computer Networks  
Dr. Esam A. Alwagait

Lecture 2  
4-5/03/2012

# Agenda

- 1 Introduction
- 2 Network Hardware
- 3 Network Software
- 4 Reference Models
- 5 Example Networks
- 6 Network Standardizations
- 7 Summary & Discussion



# Introduction

## ( let's just talk about Networks)



- We live in the IT Age!
- The world is interconnected → Networks!
- What is a computer network ?
  - Set of computing devices (e.g. computers) that could exchange information (wired, wireless, ..?)
- The Internet .. Not a network!
- WWW .. Not a network !
- Networks vs. Distributed Systems
  - Debatable.. Depends on how you look at it !

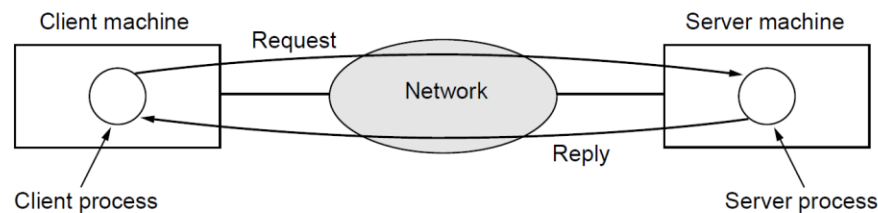




- Networks applications?

- Business

- Share resources: Physical (e.g. printers, servers..)/ logical (Databases, files..)
    - Office only ? No, ATM ! Airplanes! You would be surprised! Think of the movie “Entrapment”
    - Client-Server model
    - E-Commerce .. Did someone say AMAZON ?





- Networks applications?

- Home

- WWW
- Email
- IM
- Peer-to-Peer (P2P)
  - <http://www.youtube.com/watch?v=OuRhu-nZK78>
- Games
- Etc !

Tag	Full name	Example
B2C	Business-to-consumer	Ordering books on-line
B2B	Business-to-business	Car manufacturer ordering tires from supplier
G2C	Government-to-consumer	Government distributing tax forms electronically
C2C	Consumer-to-consumer	Auctioning second-hand products on line
P2P	Peer-to-peer	File sharing



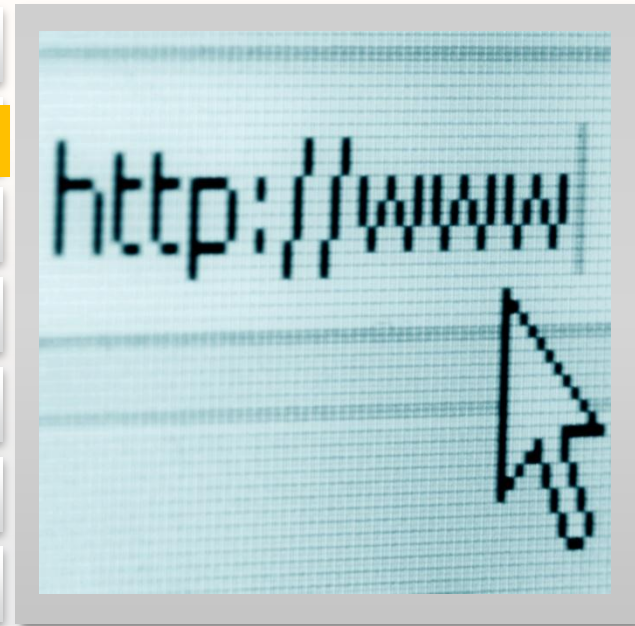


- **Social Issues**
  - Networks are affecting our daily lives
  - Politics ! (Arab Spring)
  - Privacy (Carnivore, Facebook)
  - Freedom of Speech (SOPA)
  - Crime (digital & physical)
  - Social Controversial issues



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- Networks are used to exchange information
  - Broadcasting
    - Multicasting ..
  - Point-to-Point
    - Unicasting
  - Rule of thumb.. Broadcasting used in smaller physical range.. Point-to-Point for further range





# Network Hardware (Cont'd)



Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	
100 m	Building	
1 km	Campus	Local area network
10 km	City	
100 km	Country	Metropolitan area network
1000 km	Continent	
10,000 km	Planet	Wide area network
		The Internet



# Network Hardware (Cont'd)



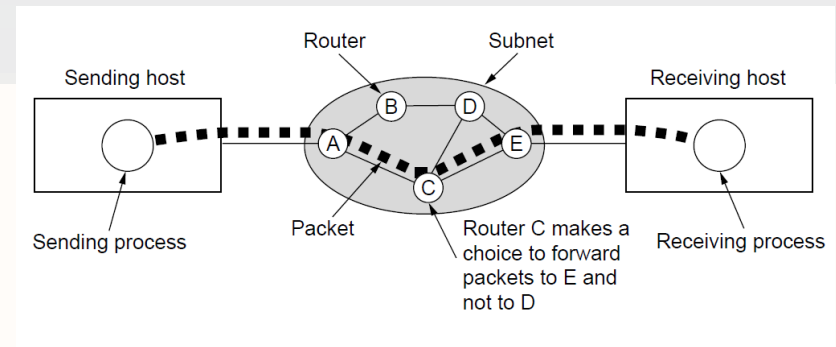
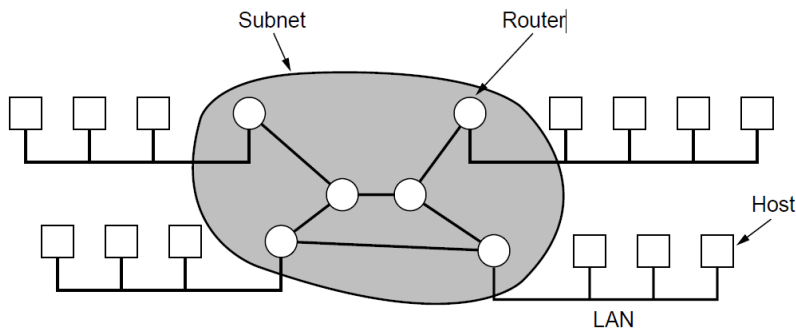
- Local Area Networks (LANs)
  - Size
    - Small, easy to estimate time
  - Transmission technology
    - Cables, 10 Mbps, 100 Mbps, 1Gbps, 10 Gbps..
  - Topology
    - Bus
    - Ring
    - Star
    - Mesh



# Network Hardware (Cont'd)



- Metropolitan Area Network (MAN)
  - Cable TV
  - WiMAX (IEEE 802.16)
- Wide Area Network (WAN)



# Network Hardware (Cont'd)



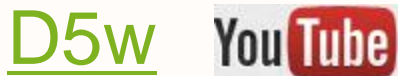
- Wireless Network
  - Interconnection (e.g. Bluetooth)
  - Wireless LANs (A, B, N.. Etc)
  - Wireless WANs (3G )

- Home networks

- DNLA
- Android @home

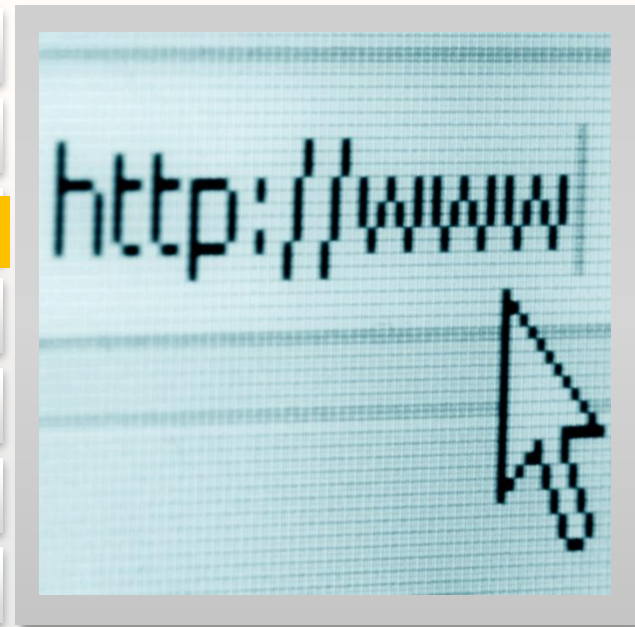


- [http://www.youtube.com/watch?v=zD3Q4kJh](http://www.youtube.com/watch?v=zD3Q4kJhD5w)



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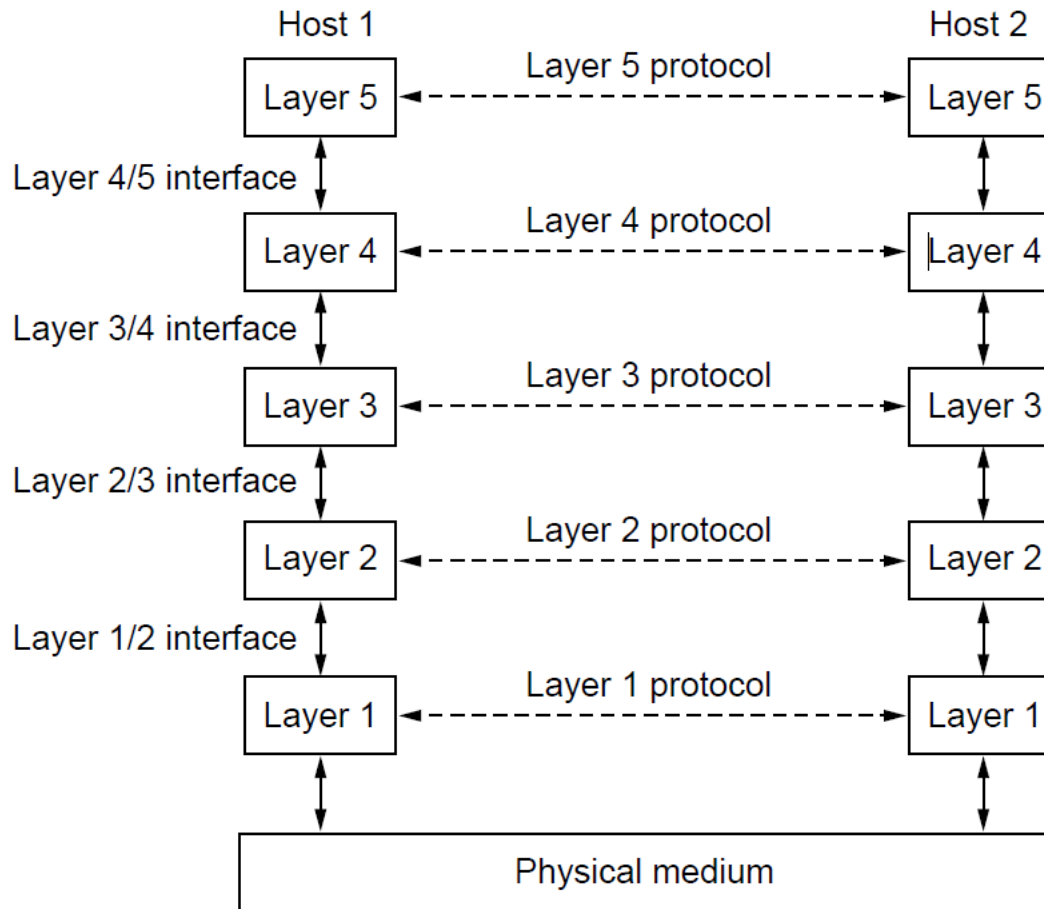




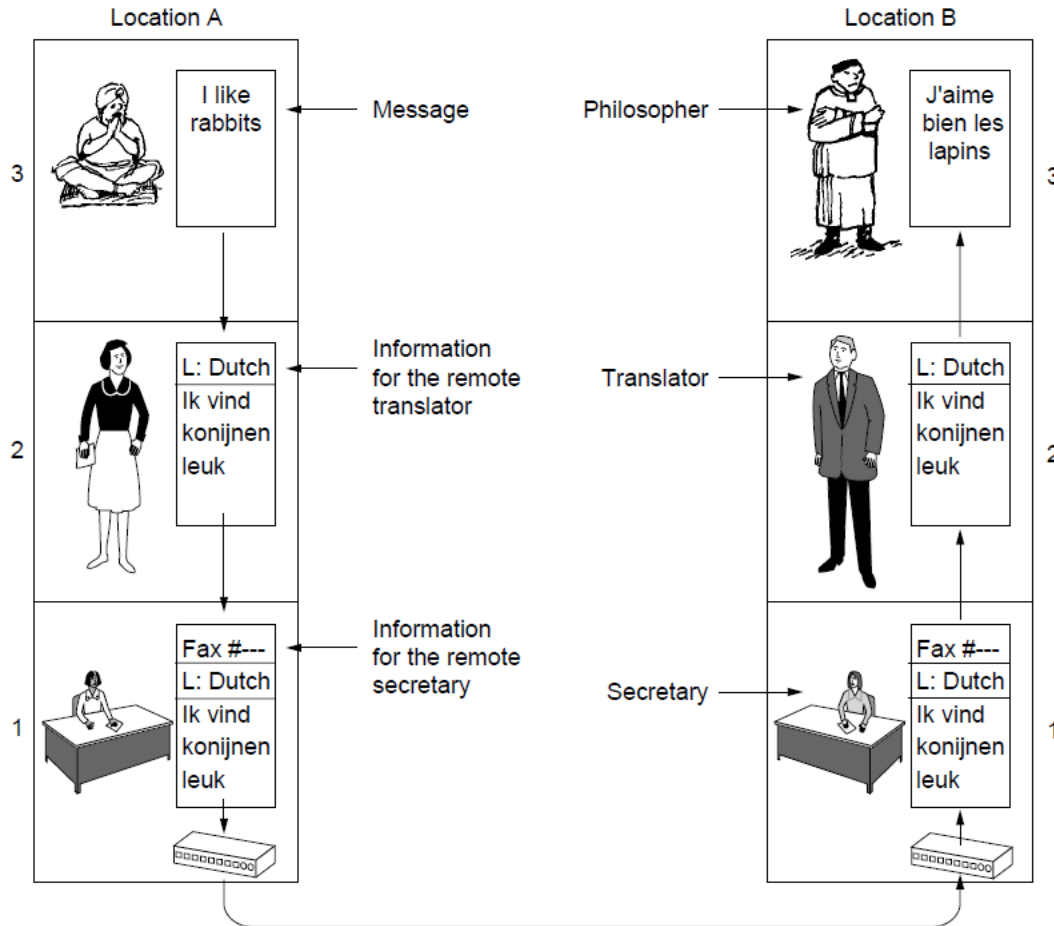
- Protocol Hierarchy
  - Providing layers (layer1, layer2...layerN)
  - Result is a “stack”
  - Number of layers and function of each layer produces a protocol hierarchy
    - OSI vs TCP/IP
  - Each layer has its own protocol
    - Protocol: agreement on comm. Terms



# Network Software (Cont'd)

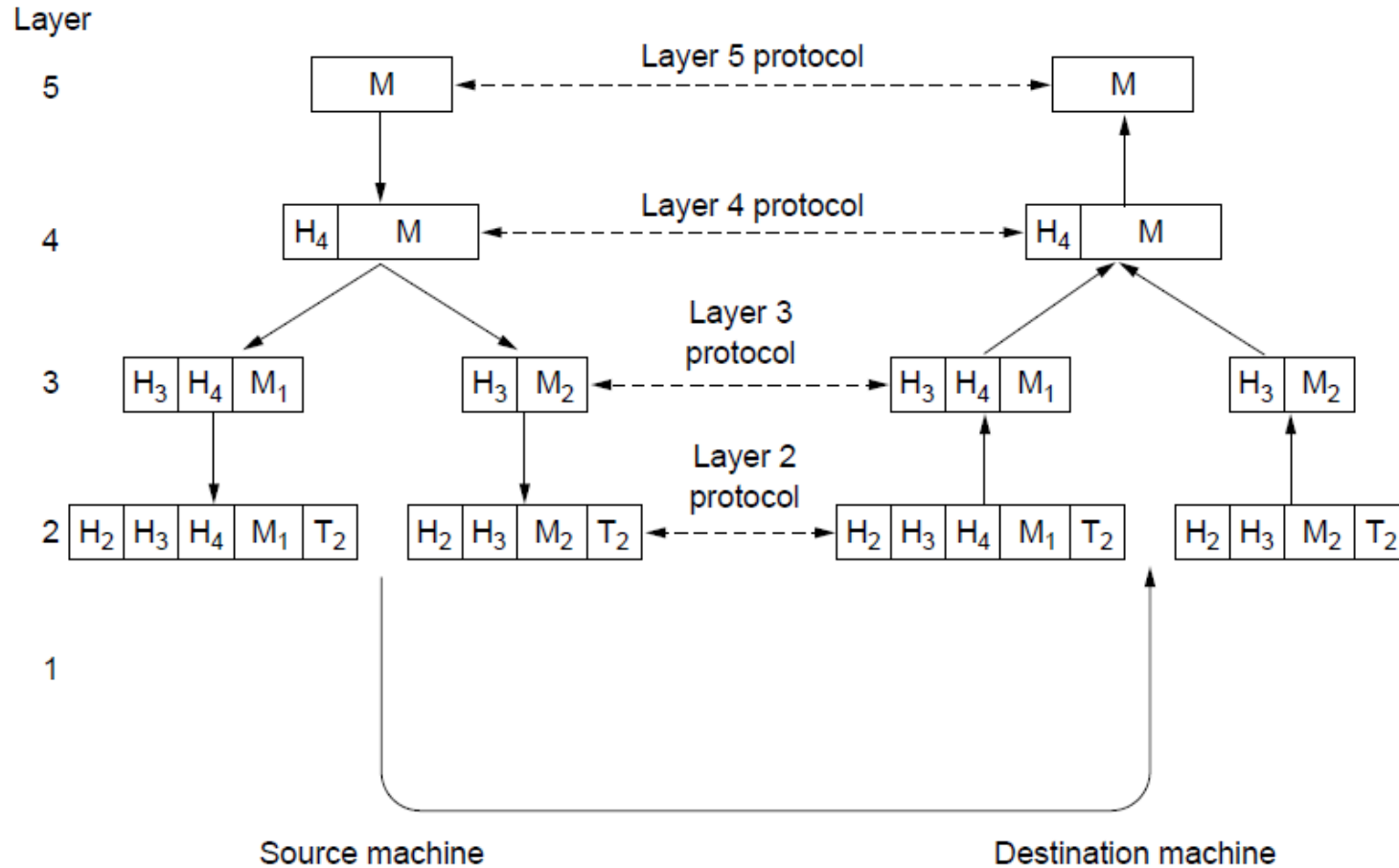


# Network Software (Cont'd)





# Network Software (Cont'd)





- Design Issues
  - Addressing: Identify Sender/Receiver
  - Error Control:
    - Lost messages
    - Messages arriving out of order
  - Flow Control:
    - Slow down !! Too fast





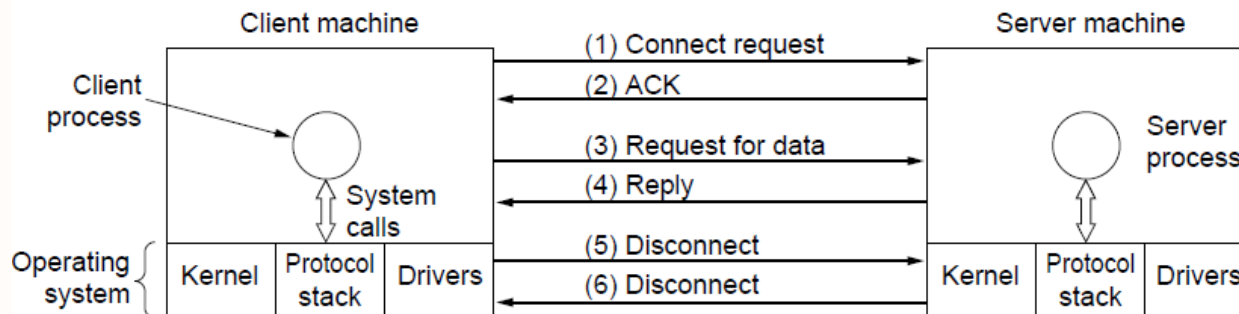
- **Connection-oriented vs. Connectionless**
  - Layers offer different services to layers above them
    - Connection-oriented: open a channel, send, close
    - Connectionless: send right away !
  - QoS ? Reliable or unreliable
    - FTP: must be reliable !!
    - Phone or video conferencing: not a problem





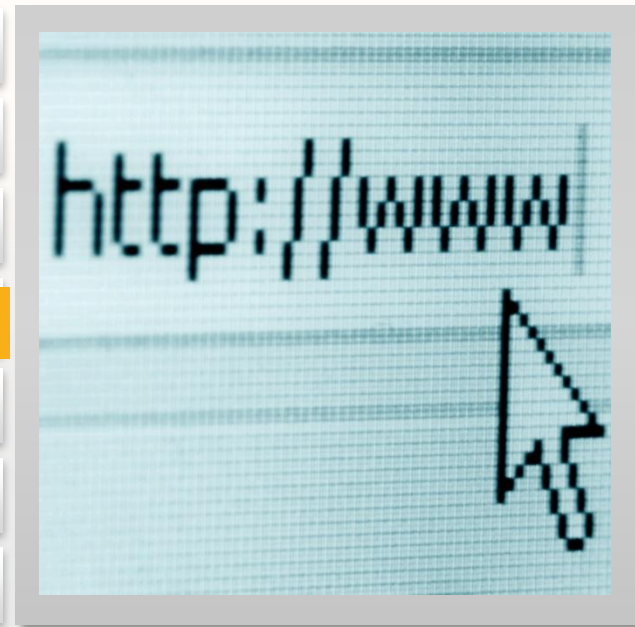
- **Service Primitives**

- Listen: i.e. wait for incoming traffic
- Connect: establish connection
- Receive: Block waiting for incoming
- Send: !! Send
- Disconnect: Terminate a connection



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# Reference Models



- OSI
- TCP/IP
- Comparison
- Pros/Cons for each



# Reference Models (Cont'd)



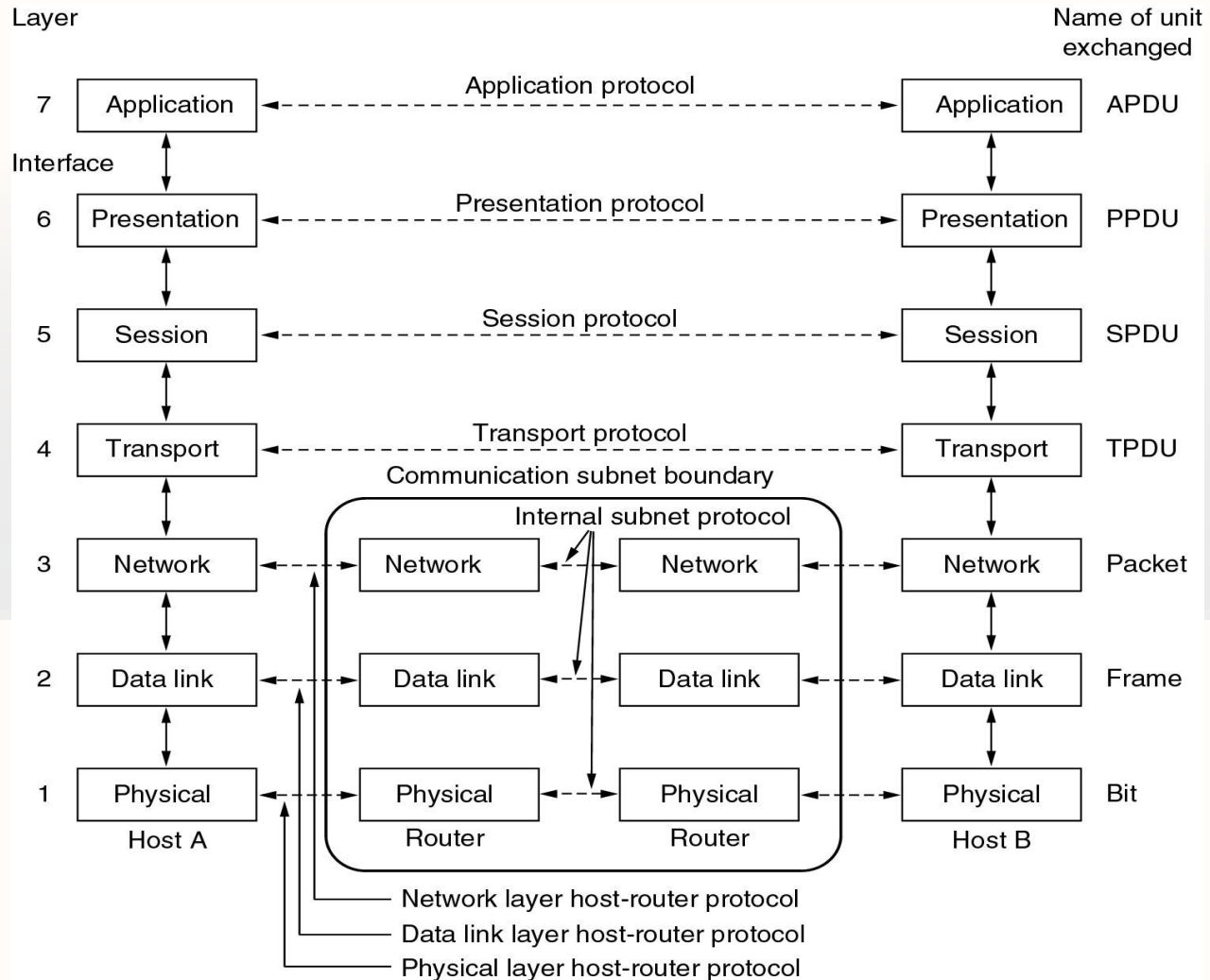
- Open System Interconnection (OSI) proposed by International Standards Organization (ISO)
- 7 Layers...why 7 ? Here is how:
  - A layer should be created where a different abstraction is needed.
  - Each layer should perform a well-defined function.
  - The function of each layer should be chosen with an eye toward defining internationally standardized protocols.
  - The layer boundaries should be chosen to minimize the information flow across the interfaces.
  - The number of layers should be large enough that distinct functions need not be thrown together in the same layer out of necessity and small enough that the architecture does not become unwieldy.



# Reference Models (Cont'd)

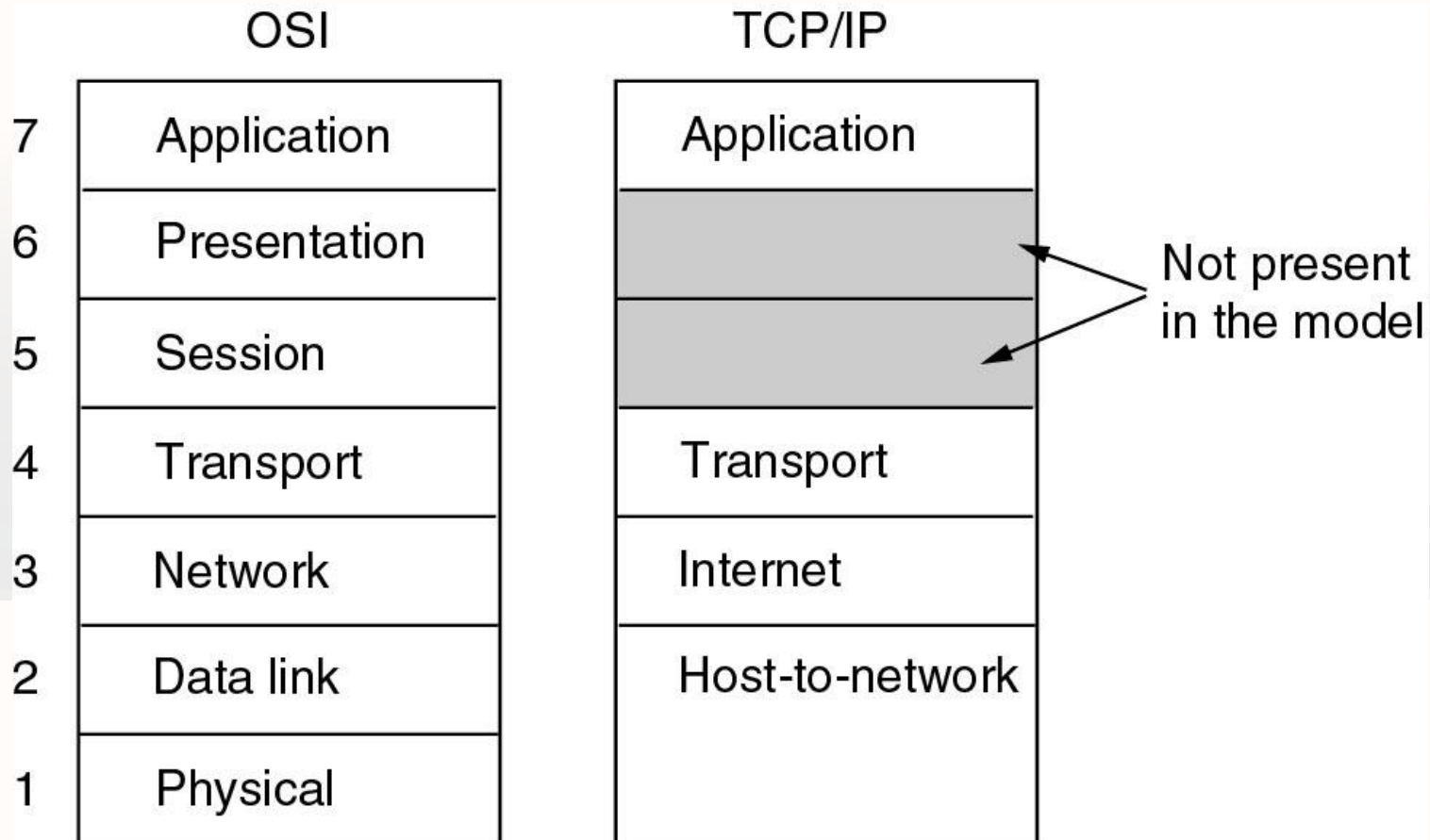


The OSI reference model.

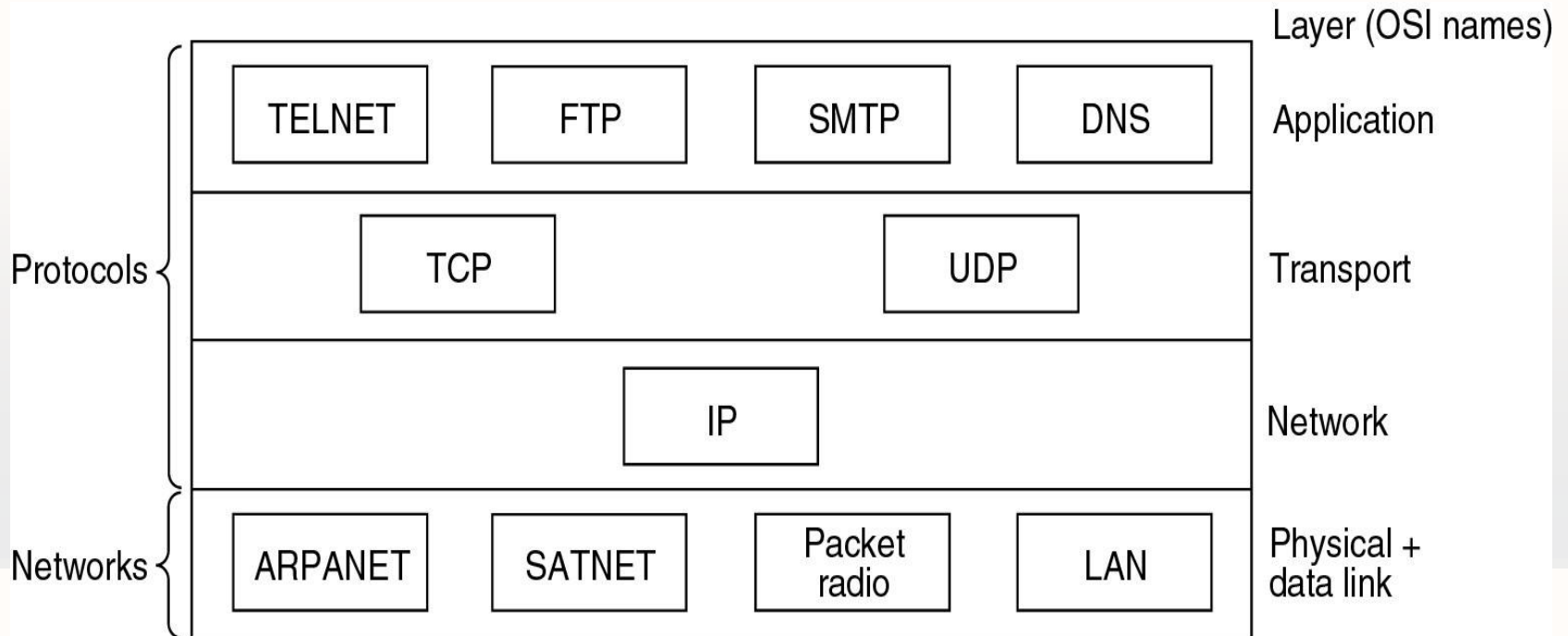




# Reference Models (Cont'd)



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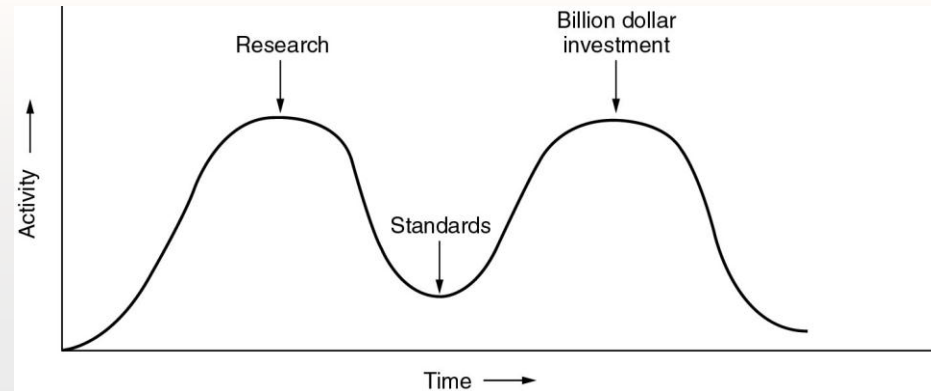
- Comparison
  - Both have a Stack of layers
  - Similar functionality (almost)
  - Differences
    - Unlike TCP/IP OSI defines Services, Interfaces, Protocol
      - Elegant !
    - OSI hides protocols in the layers
    - OSI was created before Protocols were invented
      - General, in theory. In reality, not so much!!
    - TCP/IP came for an existing protocols
    - ddd



# Reference Models (Cont'd)



- Why OSI did not take over the world
  - Bad timing
  - Bad technology
  - Bad implementations
  - Bad politics



# Reference Models (Cont'd)

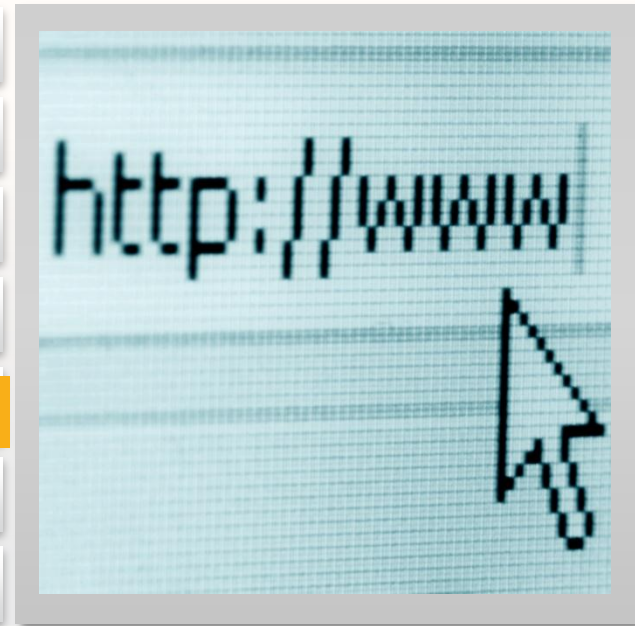


- TCP/IP Problems:
  - Service, interface, and protocol not distinguished
  - Not a general model
  - Host-to-network “layer” not really a layer
  - No mention of physical and data link layers
  - Minor protocols deeply entrenched, hard to replace



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# Example Networks



- The Internet
- ARPA (Advance Research Projects Agency)

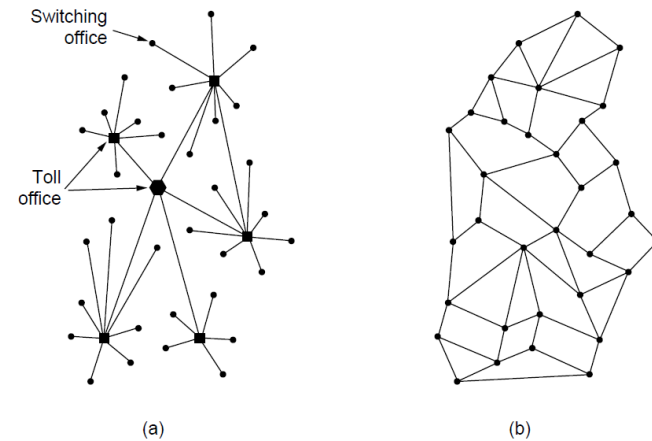


Fig. 1-25. (a) Structure of the telephone system. (b) Baran's proposed distributed switching system.

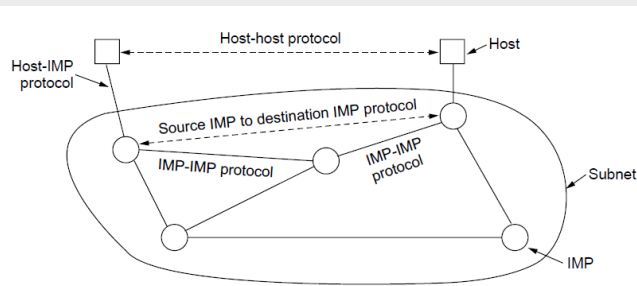


Fig. 1-26. The original ARPANET design.



# Example Networks (Cont'd)

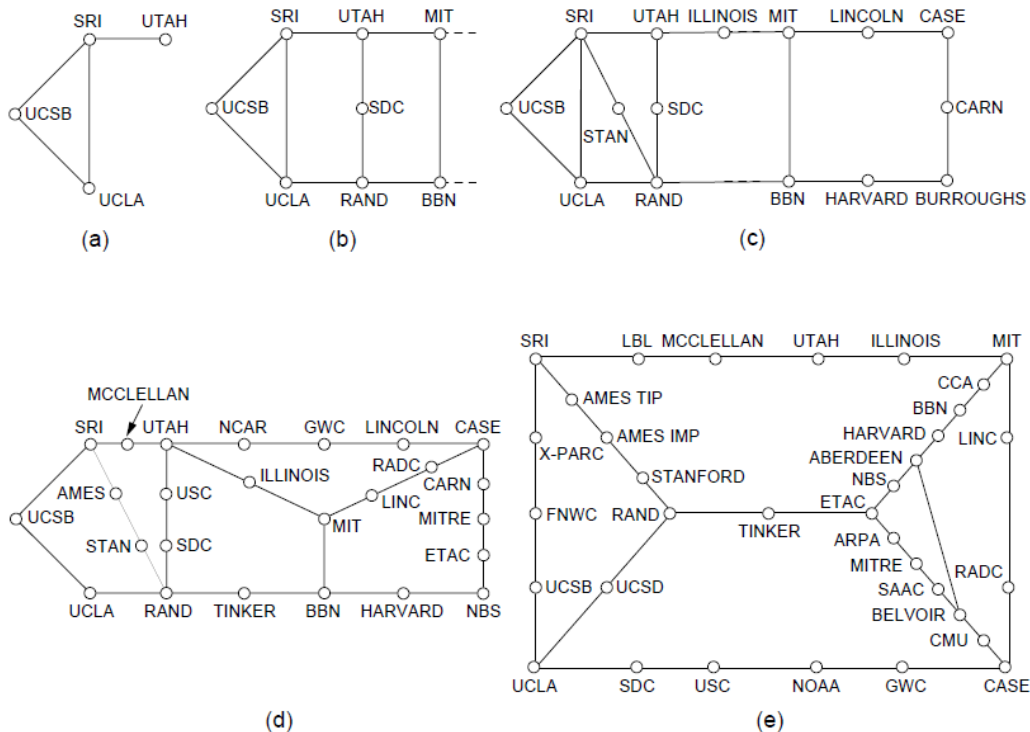


Fig. 1-27. Growth of the ARPANET. (a) December 1969. (b) July 1970. (c) March 1971. (d) April 1972. (e) September 1972.



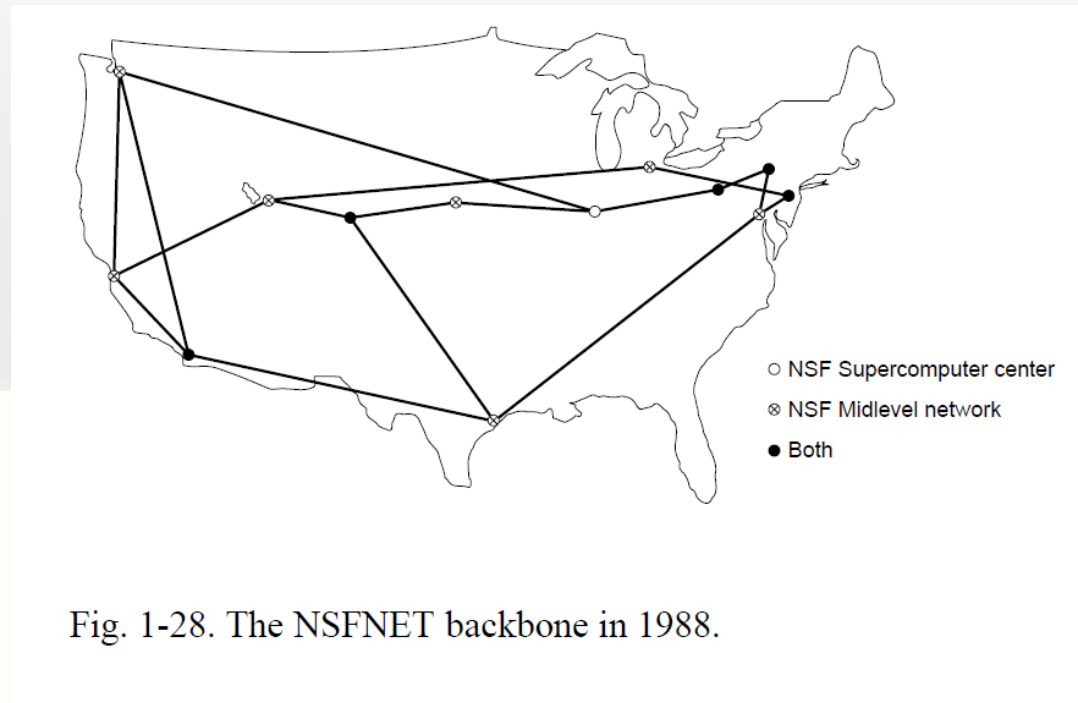


# Example Networks (Cont'd)



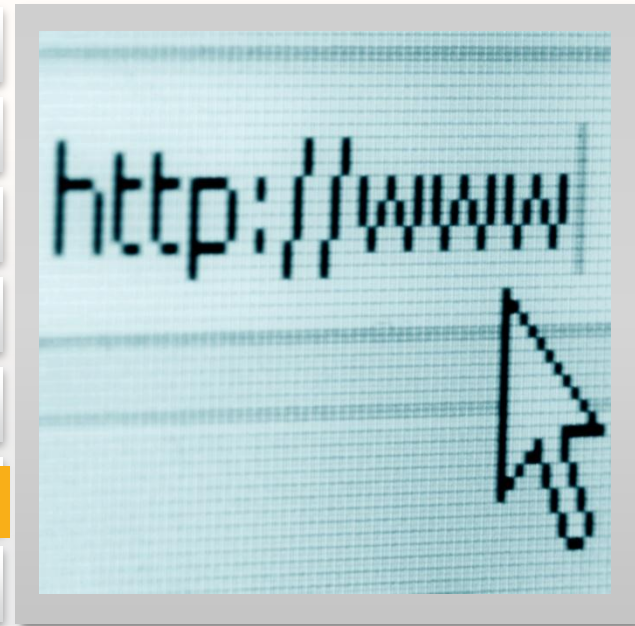
## NSFNET

### National Science Foundation Net



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# Example Networks (Cont'd)



- Read from the book
- Not included in the tests or final



**THANK YOU!**