



# Computer Fundamentals

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Lecture 14



# Outline

- Network hardware
- Protocols



# Network Hardware

- Network interface cards
  - ❑ Network adapter
  - ❑ Connects node to the media
  - ❑ Unique Machine Access Code (MAC)



Source: <https://ryanscomputers.com/tp-link-tg-3468-gigabit-pci-express-lan-card.html>

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# Network Hardware (cont.)

- Network linking devices
  - ❑ Connect nodes in the network
  - ❑ Cable runs from node to device
  - ❑ Crossover cable connects two computers



# Network Hardware (cont.)

## ➤ Hubs

- ❑ Center of a star network
- ❑ All nodes receive transmitted packets
- ❑ Slow and insecure



## ➤ Switches

- ❑ Replacement for hubs
- ❑ Only intended node receives transmission
- ❑ Fast and secure



**Source:** <https://www.quora.com/What-is-hub-in-computer-network>

<https://www.ruckuswireless.com/products/campus-network-switches/ruckus-icx-family-switches/ruckus-icx-7150>



# Network Hardware (cont.)

## ➤ Bridge

- ❑ Connects two or more LANs together
- ❑ Packets sent to remote LAN cross
  - Other packets do not cross
- ❑ Segments the network on MAC addresses



## ➤ Router

- ❑ Connects two or more LANs together
- ❑ Packets sent to remote LAN cross
  - Other packets do not cross
  - Also determines best route for packet
- ❑ Network is segmented by IP address
- ❑ Connects internal networks to the Internet
- ❑ Needs to be configured before installation



## ➤ Gateway

- ❑ Connects two dissimilar networks
  - E.g. connects coaxial to twisted pair
- ❑ Most gateways contained in other devices



Source: <https://techbuzzersworld.wordpress.com/2011/08/10/types-of-networks-and-networking-devices>  
<http://www.mercadoit.com/en/6-cisco-router>  
<https://www.globalsign.com/en/blog/what-is-an-iot-gateway-device>



# Network Hardware (cont.)

- Wireless access point
  - ❑ Allows wireless device to connect to wired network
  - ❑ Connected to a router
    - Either with a wire or itself as integral component of router



Source: <http://www.tradebrio.com/product/auteq-autelan.html>



# Network Cabling

- Cabling specifications
  - ❑ Bandwidth measures cable speed
    - Typically measured in Mbps
  - ❑ Maximum cable length
  - ❑ Connector describes type of plug





# Network Cabling (cont.)

## ➤ Ethernet

- ❑ Very popular cabling technology
- ❑ 10 Base-T, 10Base-2, 10Base-5
- ❑ Maximum bandwidth 10 Mbps
- ❑ Maximum distances 100 to 500 meters

## ➤ Fast Ethernet

- ❑ Newer version of Ethernet
- ❑ Bandwidth is 100 Mbps
- ❑ Uses Cat5 or greater cable
  - Sometimes called 100Base T

## ➤ Gigabit Ethernet

- ❑ High bandwidth version of Ethernet
- ❑ 1 to 10 Gbps
  - 1000 Base-T gives 1 Gbps
- ❑ Cat 6 or fiber optic cable
- ❑ Video applications





# Network Cabling (cont.)

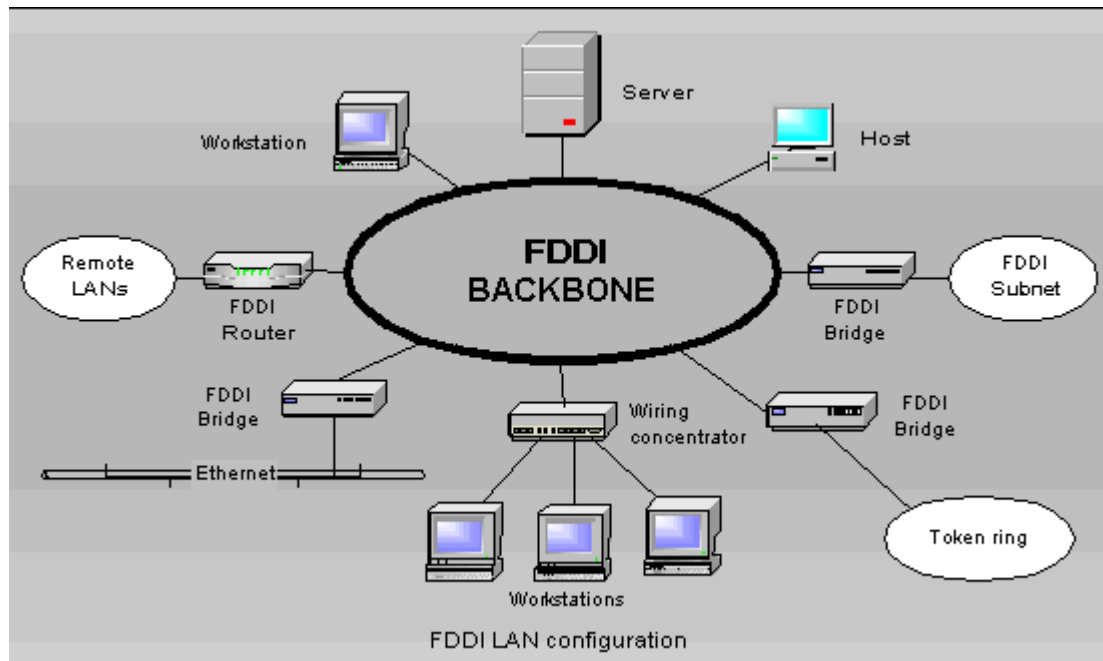
- Token ring
  - ❑ Uses shielded twisted pair cabling
  - ❑ Bandwidth between 4 and 16 Mbps
  - ❑ Uses a multiple access unit (MAU)
  - ❑ Popular in manufacturing and finance





# Fiber Distributed Data Interface

- FDDI, Fiber optic is the cable used
- Token passing is its media accessing method
- 100 Mbps speed
- 100 kms is maximum length of network
- 500 is maximum number of nodes on network





# Network Protocols

- Language of network
  - ☐ Rules of communication
  - ☐ Error resolution
  - ☐ Defines collision and collision recovery
  - ☐ Size of packet
  - ☐ Naming rules for computers



# Network Protocols (cont.)

## ➤ TCP/IP

- ❑ Transmission Control Protocol/Internet Protocol
- ❑ Most popular protocol
  
- ❑ Machines assigned a name of 4 numbers
  - IP address
- ❑ Dynamic Host Configuration Protocol
  - Central management and automation of network configuration of devices
  - Controlled by a DHCP server (often a router)
  - Simplifies assignment of IP addresses
  - In absence of server, device needs to be manually assigned IP address
- ❑ Required for Internet access
  - No access possible without IP address



# Network Protocols (cont.)

- IP addresses fine for computers
  - ❑ But difficult to recognize and remember for humans
- Domain name: meaningful, easy-to-remember 'label' for IP address
- Examples:

121.52.147.74	www.uetpeshawar.edu.pk
221.120.207.34	www.google.com.pk
- Domain Name System (DNS)
  - ❑ Locates and translates domain names into IP addresses
  - ❑ Maintains single, central table of domain name/IP address
    - Billions of DNS-IP translations take place every day
    - The DNS-IP tables get updated continuously

DNS address

121.52.147.74

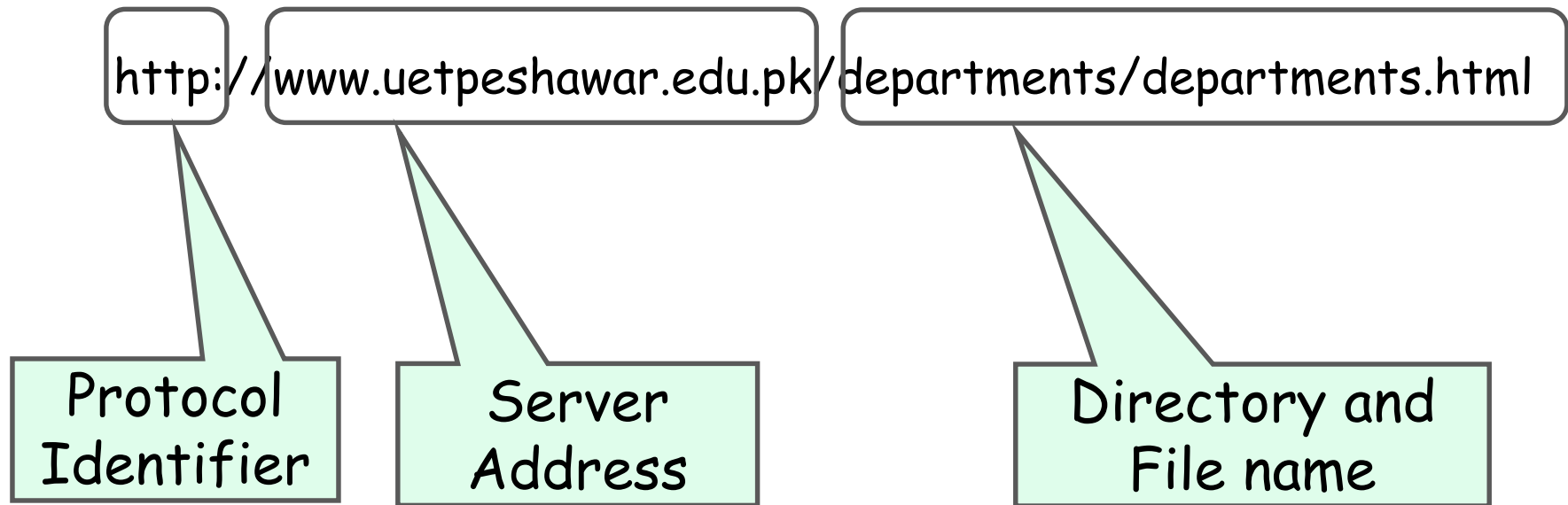
www.uetpeshawar.edu.pk

IP address



# Network Protocols (cont.)

- DNS has three components





# Network Protocols (cont.)

## ➤ IPX/SPX

- ❑ Internet Packet Exchange/Sequenced Packet Exchange
- ❑ Older protocol
- ❑ Associated with Novell Netware
  - A discontinued computer network operating system developed by Novell
- ❑ Replaced by TCP/IP

## ➤ NetBEUI

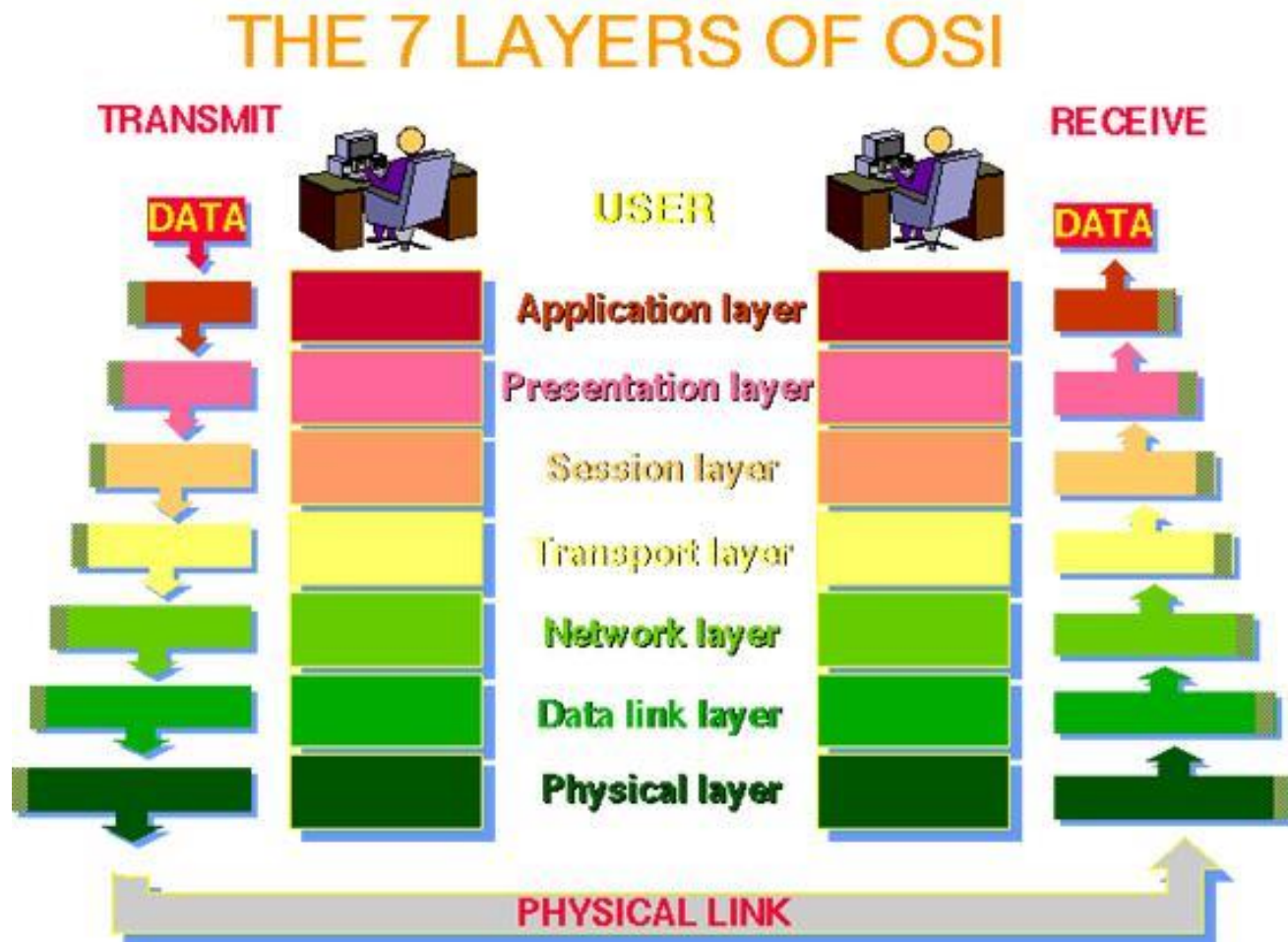
- ❑ Network BIOS Extended User Interface
- ❑ Sends message to every computer that can receive
- ❑ Useful for small networks like offices
- ❑ Used by Windows to name computers in network
  - Name used for communication
  - NetBIOS names can be up to 15 characters





# Open Systems Interconnection

## ➤ OSI layers





# Open Systems Interconnection (cont.)

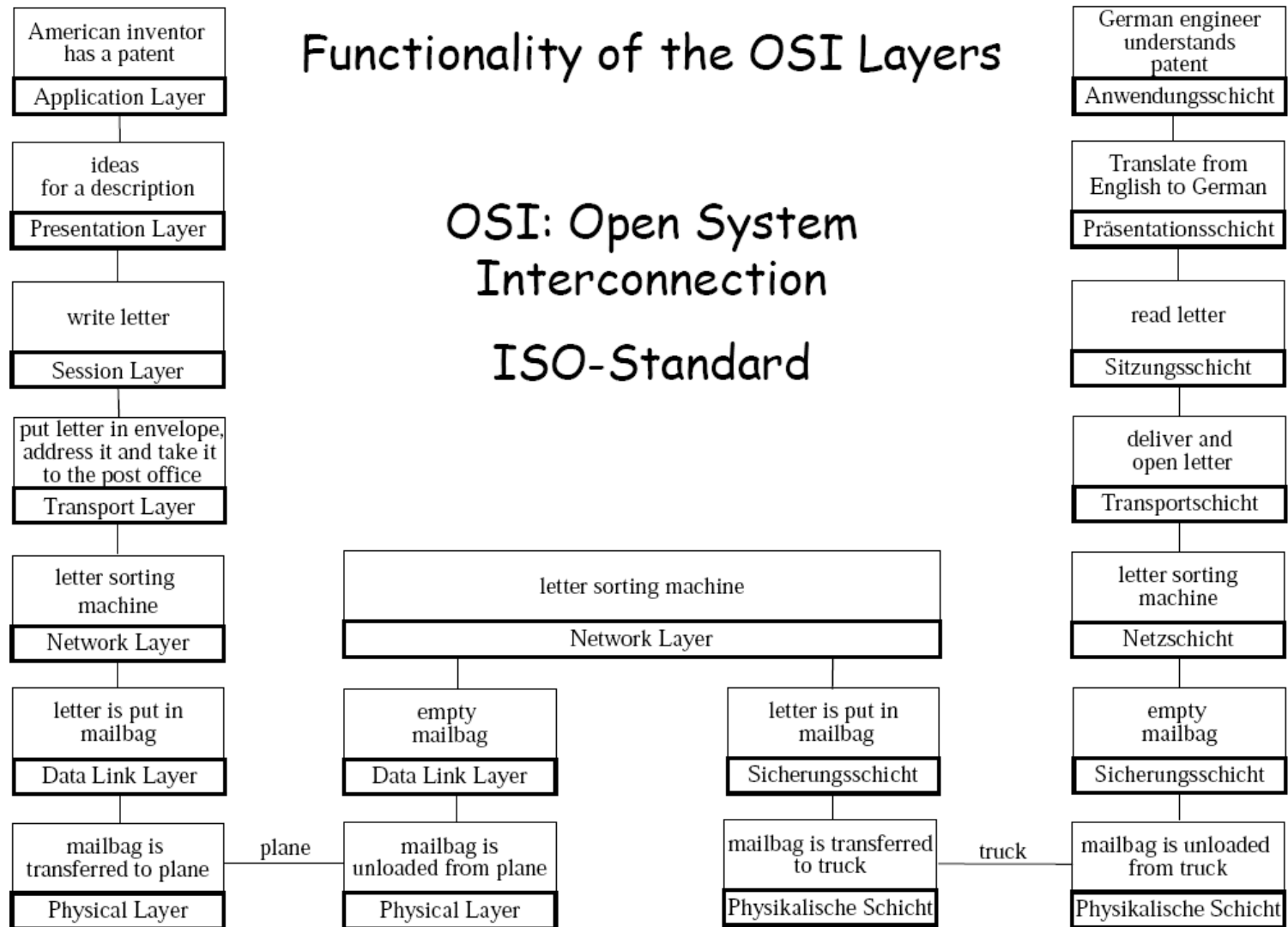
## James Bond meets the 7 layer OSI model

- James Bond meets Number One on the 7th floor of the spy headquarters building. Number One gives Bond a secret message that must get through to the US Embassy across town.
- Bond proceeds to the 6th floor where the message is translated into an intermediary language, encrypted and compressed.
- Bond takes the elevator to the 5th floor where security checks the message to be sure it is all there and puts some checkpoints in the message so his counterpart at the US end can be sure he's got the whole message.
- On the 4th floor the message is analyzed to see if it can be combined with some other small messages that need to go to the US end. Also if the message was very large it might be split into several small packages so other spies can take it and have it reassembled on the other end.
- The 3rd floor personnel check the address on the message and determine who the address is and advising Bond of the fastest route to the Embassy.
- On the 2nd floor the message is put into a special courier pouch (packet). It contains the message, the sender and destination ID. It also warns the recipient if other pieces are still coming.
- Bond proceeds to the 1st floor where Q has prepared the Aston Martin for the trip to the Embassy. Bond departs for the US Embassy with the secret packet in hand.
- On the other end the process is reversed. Bond proceeds from floor to floor where the message is decoded. The US Ambassador is very grateful the message got through safely. "Bond, please tell Number One I'll be glad to meet him for dinner tonight."

Source: C. Görg, *Communication Networks I*, University of Bremen, 2008



# Open Systems Interconnection (cont.)



Source: C. Görg, *Communication Networks I*, University of Bremen, 2008



# Open Systems Interconnection (cont.)

## ➤ Application layer

- ❑ Services that support applications or softwares
- ❑ E.g. file transfer, email, conversational video etc.

## ➤ Presentation layer

- ❑ Application layer data translated to intermediate format
- ❑ E.g. Encryption, compression etc.

## ➤ Session layer

- ❑ Allows applications on different computers to establish connection
- ❑ Regulates which side transmits, when and how long

## ➤ Transport layer

- ❑ Handles error recognition and recovery
- ❑ Segments long messages
- ❑ Issues acknowledgements for successful message delivery



Source: C. Görg, *Communication Networks I*, University of Bremen, 2008  
<http://vasubirla.blogspot.com/2016/02/part14-of-segment-1-application-layer.html>



# Open Systems Interconnection (cont.)

- Network layer
  - ❑ Addresses messages
  - ❑ Determines route from source to destination
- Data link layer
  - ❑ Checks whether arrived bits are error free or not
- Physical layer
  - ❑ Transmits bits from one computer to another
  - ❑ Defines physical medium e.g. wired or wireless

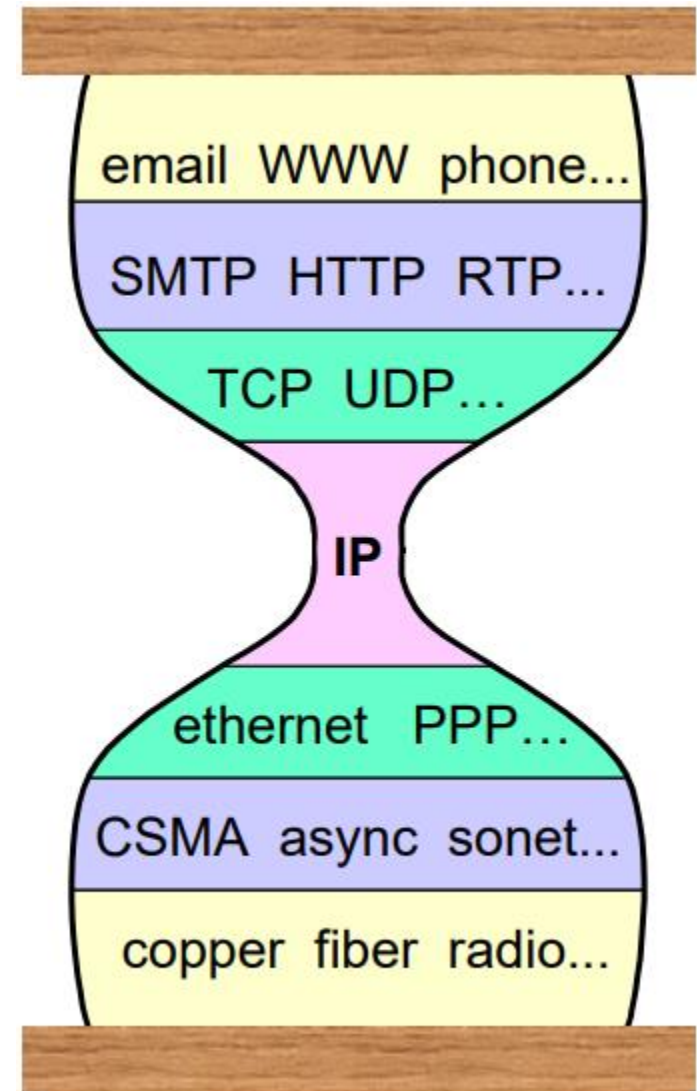
Source: C. Görg, *Communication Networks I*, University of Bremen, 2008



# Network Protocols (cont.)

## ➤ Hourglass

- ❑ Single protocol in network layer
- ❑ Minimize service interface types
- ❑ Maximize interoperability



Source: <https://www.iab.org/wp-content/IAB-uploads/2010/11/hourglass-london-ietf.pdf>