



**IT Telkom
Surabaya**
Solution for The Nation

INTRODUCTION TO INFORMATION TECHNOLOGY

PROGRAM STUDI S1 TEKNOLOGI INFORMASI
FAKULTAS TEKNOLOGI INFORMASI DAN INDUSTRI
INSTITUT TEKNOLOGI TELKOM SURABAYA

CURRICULUM VITAE

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- ▶ Pendidikan
 - ▶ D4 Teknik Elektronika – Politeknik Elektronika Negeri Surabaya
 - ▶ S2 Teknik Telekomunikasi dan Multimedia – Institut Teknologi Sepuluh Nopember
- ▶ Pengalaman Kerja
 - ▶ Staff Elektronika – Infoglobal Teknologi Semesta

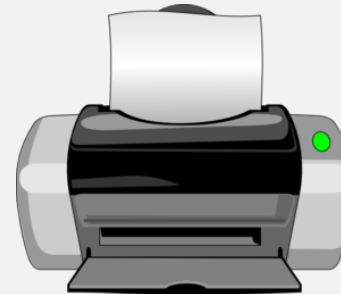


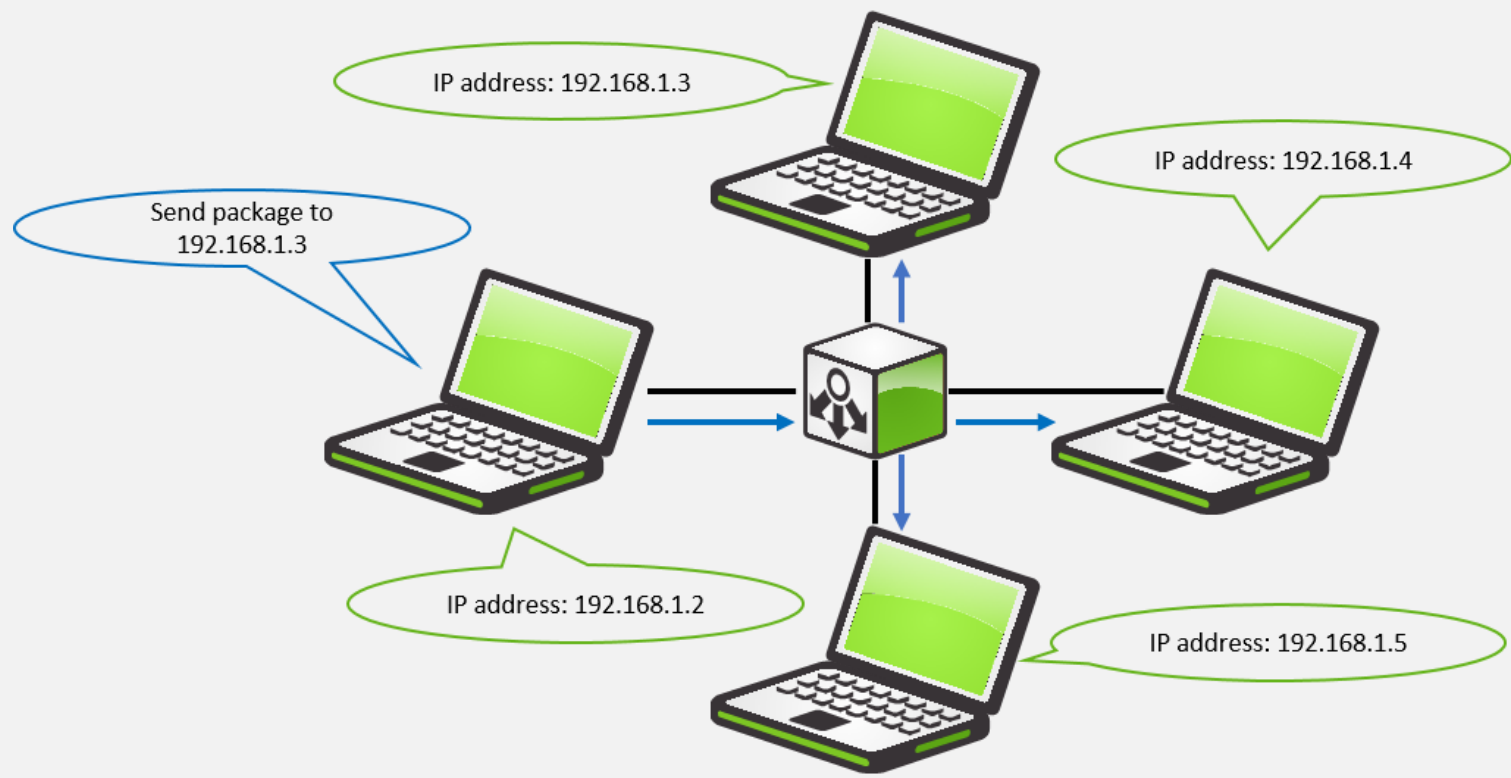
COMPUTER NETWORKS



COMPUTER NETWORKS

- ▶ A computer network is a collection of computers and computer resources connected together to permit communication between resources
- ▶ Resource include:





NETWORK HARDWARE

- ▶ The network itself
 - ▶ Typically some form of cable
 - ▶ Twisted wire – low bandwidth, old, but cheap
 - ▶ Coaxial
 - ▶ Fiber optic – highest bandwidth, data transmitted as light pulses
 - ▶ May also utilize wireless, radio, microwave or signals bounced off of satellites in orbit
- ▶ Broadcast devices
 - ▶ Used to connect resources together to handle message routing
- ▶ MODEM
 - ▶ Modulation/demodulation – devices that permit computers to communicate over an analog medium



COMMUNICATING BY NETWORK

- ▶ Typically, a network consists of multiple nodes
 - ▶ Nodes are different forms of broadcast devices
- ▶ Switching is used for a message (packet) to be moved from one location to another
 - ▶ Circuit switched network – pathway between two devices established at the start of communication (telephone network is circuit switched)
 - ▶ Packet switched network – pathway established as messages is sent from one location to another (most computer networks are packet switched)



BROADCAST DEVICES

HUB



SWITCH



ROUTER

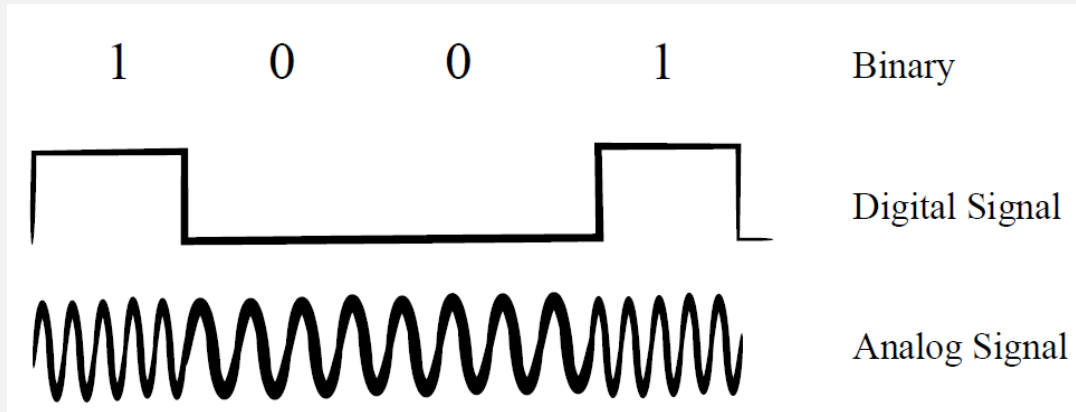


GATEWAY



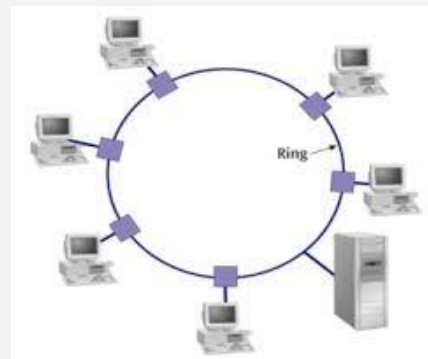
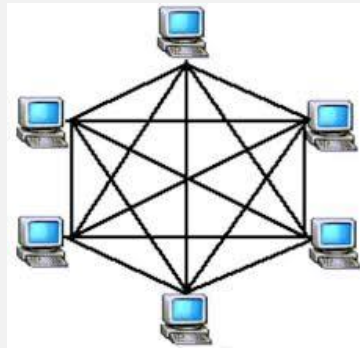
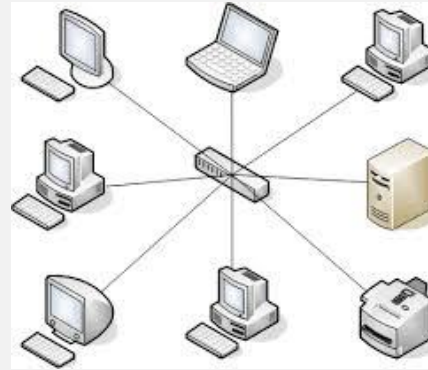
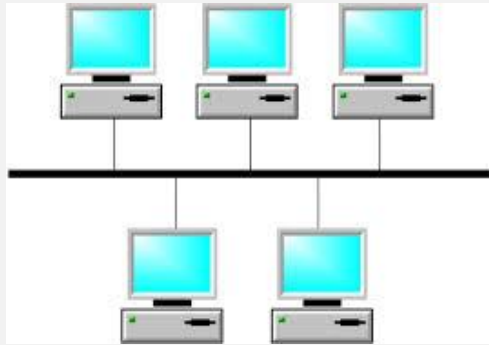
MODEMS AND PHONE LINES

- ▶ Before broadband Internet, most home computer users accessed computer networks via a *MODEM* and their phone lines
 - ▶ *MODEM* translates digital signals into tones (analog signal) to be broadcast over the phone lines



NETWORK TOPOLOGIES

- ▶ Computer Networks can be organized using a variety of layouts
 - ▶ These topologies describe how computers are connected together



CLASSIFYING NETWORKS BY SIZE

- ▶ PAN
 - ▶ Found in many households, connects no more than a few devices together
- ▶ LAN
 - ▶ connects computers together in a room or floor of a building, LANs can be combined to create larger LANs
- ▶ CAN
 - ▶ collection of LANs that make up some organization's site
- ▶ MAN
 - ▶ collection of LANs and other forms of connectivity to provide a network within one metropolitan area
- ▶ WAN
 - ▶ anything larger, the Internet is the largest WAN



OTHER NETWORK CLASSIFICATIONS

- ▶ VPN – Virtual private network
 - ▶ Permitting secure off-site access to LAN
 - ▶ Allows users of network to access network resources remotely
- ▶ Intranet - local area network that uses IP (Internet Protocol) so LAN supports Internet
- ▶ Extranet – extending an intranet to permit remote access
 - ▶ The VPN is a form of extranet that uses encryption technology
- ▶ Peer-to-peer vs client-server is a model of communication
 - ▶ Peer-to-peer – no central server, all devices equal
 - ▶ Client-server – some devices are services, some are clients



NETWORK PROTOCOLS

- ▶ A protocol is a set of rules to govern how people behave and interact
 - ▶ This might be diplomacy, etiquette, means of communication
- ▶ A network protocol is a set of rules that govern how messages can be converted from their application software form to a form that can be transmitted over network
 - ▶ And mapped back from the messages received over network to a message for an application
- ▶ A protocol can include
 - ▶ Forms of addressing
 - ▶ Size of messages (packets)
 - ▶ Error handling mechanisms and encryption



OSI MODEL

- ▶ The Open Systems Interconnection model was generated to provide network developers with a target
 - ▶ OSI is not any particular protocol, but it describes what all network protocols should include
 - ▶ An implementer of a network is free to add mechanisms to the OSI model but should try to fit the model
 - ▶ The OSI model consists of 7 layers
 - ▶ Existing networks have numerous implementations for the 7 layers
- ▶ TCP/IP (which we examine later) is an older model that has some overlap with OSI, but OSI being newer has ideas that are not found in TCP/IP



7 LAYERS AT A GLANCE

- ▶ Layers 7-5 operate at the message level
 - ▶ That is, treating the message as a whole
- ▶ Layer 4 breaks messages into “segments” such as packets
- ▶ Layers 3-1 operate at the network layer
- ▶ Layer 1 involves the physical network

Data Unit	Layer Number and Name	Function
Data	7. Application	User interaction with application software
	6. Presentation	Data representation, encryption/decryption
	5. Session	Host-level communication, session management
Segments	4. Transport	Reliability and flow control
Packet/Datagram	3. Network	Logical addressing, routing
Frame	2. Data link	Addressing
Bit	1. Physical	Physical media, signal transmission in binary



LAYERS 7-5

- ▶ Layer 7: Application layer
 - ▶ From the application software, a message is created
 - ▶ telnet, ftp, email, http all operate at this level
- ▶ Layer 6: Presentation layer
 - ▶ Translate message into a common syntax such as stripping out the hierarchical notation of XML or removing special characters such as \0 in C programs
 - ▶ Encryption, if used, is applied here
 - ▶ SSL, TLS, MIME among others implement layer 6
- ▶ Layer 5: Session layer
 - ▶ Maintains session between two devices
 - ▶ NetBIOS, SAP, PPTP, SOCKS



LAYER 4: TRANSPORT LAYER

- ▶ Divide message into segments
- ▶ Implement reliability by error correction
 - ▶ for instance, through a checksum
 - ▶ stamp each segment, for instance, 4 of 7
- ▶ Implement control flow
 - ▶ if two devices communicate at different rates (speeds), handle it here
- ▶ Many implementations including
 - ▶ tcp, udp, sctp



LAYER 3: NETWORK LAYER

- ▶ Addressing takes place here
- ▶ Messages at this level are variable length
 - ▶ add or utilize host and destination addresses here such as IP addresses
 - ▶ messages are further broken into packets
 - ▶ a message might consist of a single packet or hundreds depending upon the length of the message
- ▶ If segments from layer 4 are not already packets, packets are formed here
 - ▶ IP, Appletalk, IPX, ICMP, ARP
- ▶ Routers operate at layer 3



LAYER 2: DATA LINK LAYER

- ▶ Messages on the same network are transmitted at this layer
 - ▶ they do not need to involve layer 3
- ▶ Packets are broken into frames for synchronization (start bits)
- ▶ Two sublayers
 - ▶ logical link control sublayer for multiplexing
 - ▶ media access control sublayer to use MAC addresses
- ▶ Many implementations including
 - ▶ IEEE 802.2, IEEE 802.3, PPP, X-25, ATM
 - ▶ switches operate at this layer

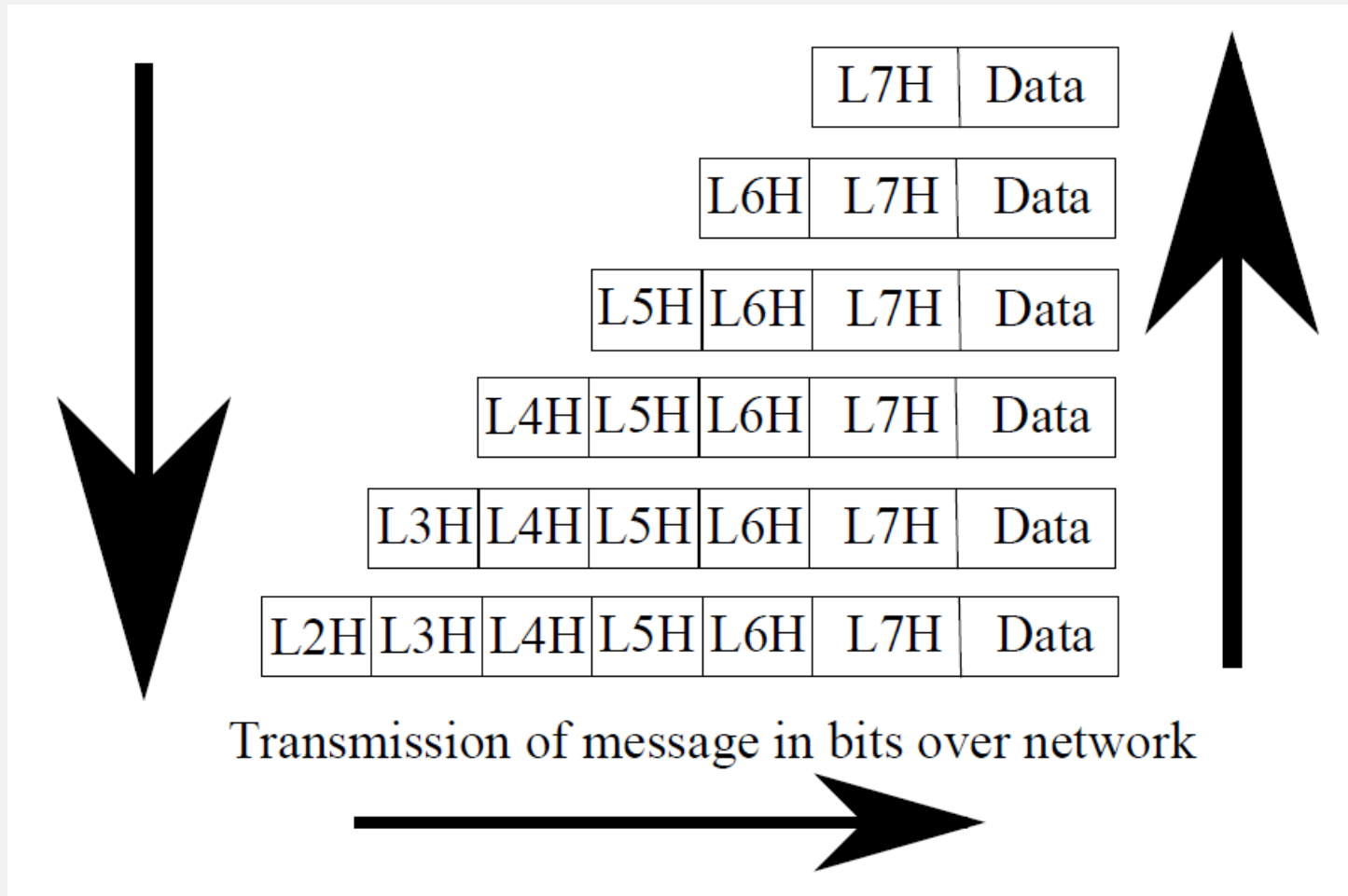


LAYER 1: PHYSICAL LAYER

- ▶ How devices communicate over the media
- ▶ Includes details of voltage, modulation/demodulation
- ▶ How to establish and terminate connections, how to detect message traffic and resolve it
 - ▶ IEE 802.3, IEEE 802.11, Bluetooth, USB, hubs
- ▶ Packets are placed on the media for transmission at this layer (or received from the media)
- ▶ Ethernet is implemented at both layers 1 and 2



OSI MAPPING



TCP/IP

- ▶ TCP/IP is known as a protocol stack
 - ▶ Although TCP and IP are protocols themselves, there are other protocols that can operate in conjunction with them
 - ▶ TCP and IP were developed separately but united to help develop the Internet
 - ▶ TCP handles the higher layers and IP handles the lower layers
- ▶ TCP/IP has 4 layers
 - ▶ These 4 map roughly onto the 7 layers of OSI with some missing components



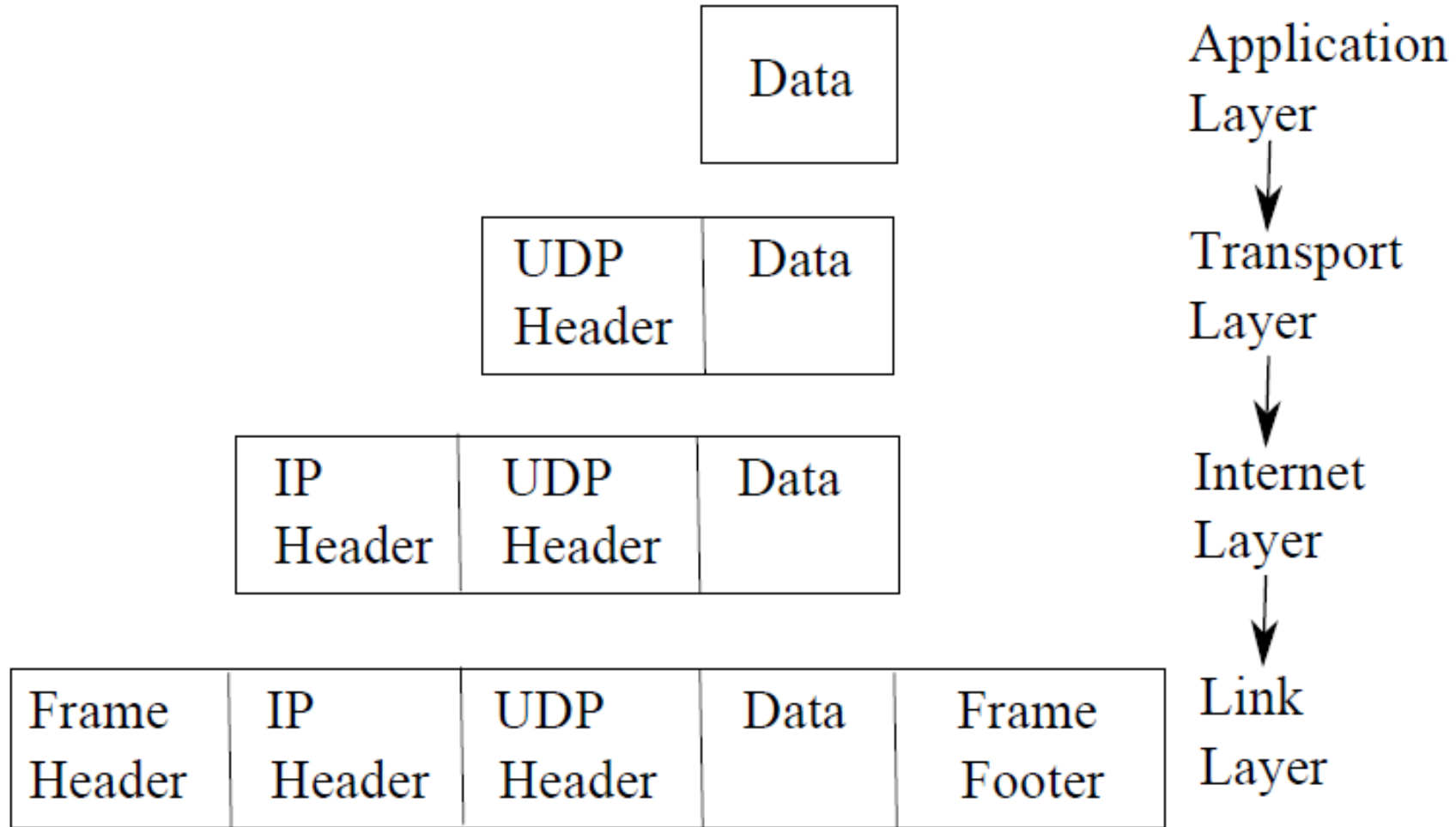
COMPARING THE PACKETS



Source Address		
Destination Address		
Source Port	Destination Port	
Sequence Number		
Acknowledgement Number		
Data Offset/Reserved Bits	Flags	Window
Checksum	Urgent Pointer	
Options (optional)		
Data		

Source Address	
Destination Address	
Source Port	Destination Port
Length	Checksum
Data	

TCP/IP MAPPING



TCP/IP HANDSHAKING

- ▶ A network handshake involves
 - ▶ Source computer requesting communication with destination computer
 - ▶ Destination computer acknowledging
- ▶ In TCP/IP, there is a three-way handshake
 - ▶ Machine 1 sends synchronization packet (SYN)
 - ▶ Machine 2 replies with synchronization and acknowledgement packet (SYN/ACK)
 - ▶ Machine 1 confirms with acknowledgement (ACK)
 - ▶ examine the TCP packet (slide 36), there is an entry for acknowledgement number to support the TCP/IP handshake



TCP/IP PORTS

- ▶ Aside from IP addresses, messages are sent using a port address
 - ▶ The address is used to specify the type of message
 - ▶ This in turn specifies how the message is expected to be handled
 - ▶ in terms of application software or server
- ▶ Most software have officially designated port addresses
 - ▶ This helps with security
 - ▶ ftp (20), ssh (22), telnet (23), smtp (25), http (80, 8080), https (431)



“PRACTICE MAKES PERFECT”

