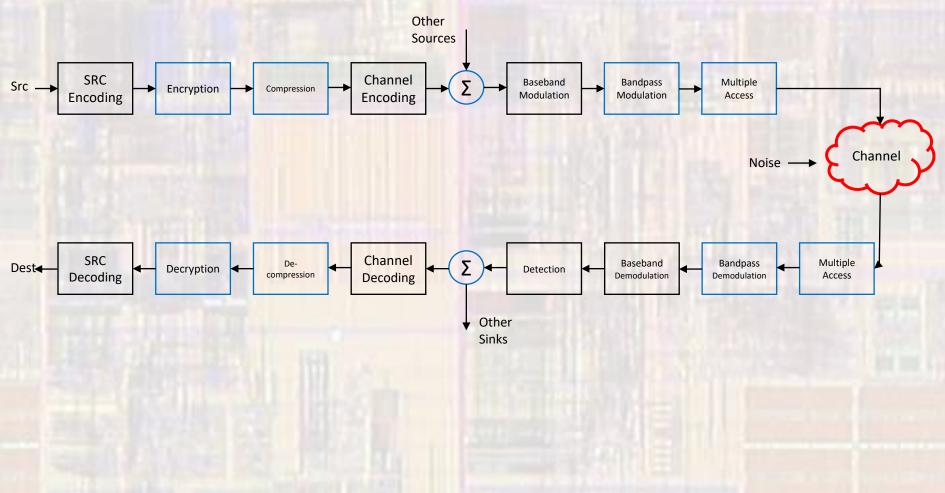
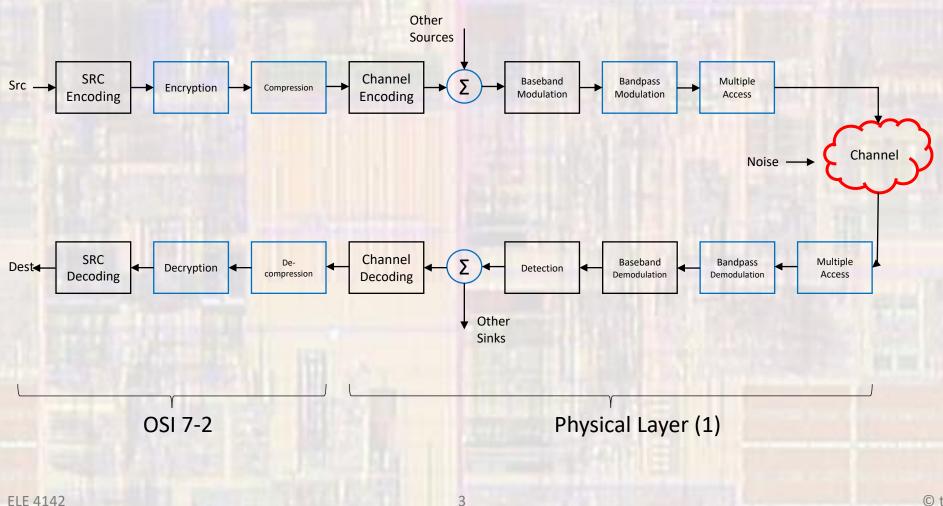
Last updated 4/11/24

Generalized Digital Communications System



Generalized Digital Communications System



Dat		IEEE 802.3 Ethernet Frame Format												
Da			Ethernet	Header (14 b	yte)		,							
• Op	7 byte	l byte	6 byte	6 byte	2 byte	46 to 1500 byte	4 byte							
-	Preamble	Start Frame Delimiter	Destination Address	Source Address	Length	Data	Frame Check Sequence (CRC)							

	в	8	8		8
Version	Header Length	Type of Service or DiffServ		Total Leng	th
	Ident	ifier	Flags	Fragm	ent Offset
Time	to Live	Protocol)	Header Check	ksum
		Source	Address		
		Destinatio	on Address		
		Options			Padding

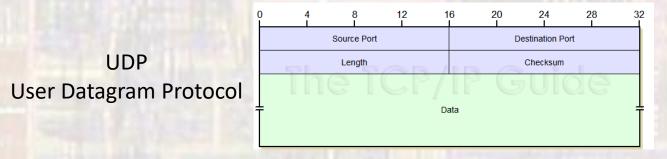
Port					De	stin	ation port
	Sequer	ice r	num	ber			
R	ecogni	tion	nun	iber			
	U	Α	P	R	s	F	
N/A							Reception window
	G	K	н	Т	N	N	size
Checksu	m						Pointer to urgent da
	0	otior	15				
	R N/A	Recogni N/A R G Checksum	Recognition U A R Checksum	Recognition num N/A U A P R C S G K H	N/A U A P R C S S G K H T	Sequence number Recognition number N/A U A V A C S S V G K H T N Checksum	Sequence number Recognition number N/A U A P R S F N/A G K H T N N Checksum Checksum <t< td=""></t<>

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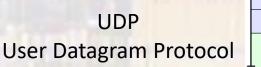
4

- Ethernet Example Application Layer
 - Send an email via a web based app
 - Type in your message and hit send
 - Outlook, Gmail, ... converts your message to HTTP format
 - Other examples might use FTP, SMTP, ...
 - Your message is associated with a specific sending and receiving process (port) in the program/OS

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- Ethernet Example
 - Presentation Layer
 - Encryption is performed if desired
 - Session Layer
 - Involved in managing the transaction
 - No changes to the data





- Ethernet Example Transport Layer
 - The data is encapsulated into the TCP (Transmission Control Protocol)
 - The data is broken into pieces as necessary
 - Additional fields are added to track which piece is being sent, what pieces have already been received, ...

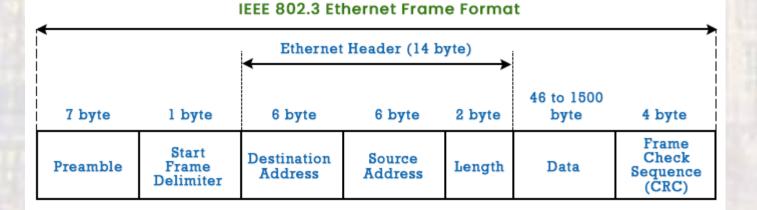
	TCP Segment 32 bits												
	Source Po		equer	lice r	num	ber	De	stin	ation port				
		Re	cogni	tion	nun	nber							
Head Lengt		N/A	U R G	A C K				I	Reception window size				
		Checksun					1		Pointer to urgent data		8 Source Port Length	CP/	Destination Checksu
1			Ō	ptior	ns				1				
1				Data	3								

- Ethernet Example Network Layer
 - The TCP is encapsulated into the IP (Internet Protocol)
 - Internet source and destination information is added
 - Additional information about the packet is added

1	В	8	8	8
Version	Header Length	Type of Service or DiffServ		Total Length
	Ident	ifier	Flags	Fragment Offset
Time	to Live	Protocol	,	Header Checksum
		Source	Address	
		Destinatio	on Address	
		Options		Padding

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- Ethernet Example Data Link Layer
 - The IP packet is encapsulated into the Ethernet Frame
 - MAC addresses are added (physical device)
 - Frame detection and clock recovery data is included



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- Ethernet Example Data Link Layer
 - Preamble
 - Used for clock synchronization
 - 7 bytes of 10101010
 - Start Frame
 - 10101011
 - Physical Address Structure (MAC)
 - NOT the IP address
 - 24 bits assigned to the manufacturer
 - Organizationally Unique Identifier (OUI)
 - 24 bits assigned by manufacturer to the specific device
 - 00-20-C3-C0-B3-EA
 - OUI | Unique

		IEEE 802.3 Et	hernet Fram	e Forma	t	
			,			
7 byte	l byte	6 byte	6 byte	2 byte	46 to 1500 byte	4 byte
Preamble	Start Frame Delimiter	Destination Address	Source Address	Length	Data	Frame Check Sequence (CRC)

• MAC (Media Access)

Media State	í
Description Microsoft Wi-Fi Direct Virtual Adapter #2 Physical Address	
Physical Address.	
DHCP Enabled	
reless LAN adapter Wi-Fi: Connection-specific DNS Suffix . : Description Intel(R) Wi-Fi 6 AX201 160MHz Physical Address : C4-75-AB-0E-16-6D DHCP Enabled : Yes Autoconfiguration Enabled : Yes	
Connection-specific DNS Suffix .: Description Intel(R) Wi-Fi 6 AX201 160MHz Physical Address C4-75-AB-0E-16-6D DHCP Enabled Yes Autoconfiguration Enabled : Yes	
Description : Intel(R) Wi-Fi 6 AX201 160MHz Physical Address : C4-75-AB-0E-16-6D DHCP Enabled : Yes Autoconfiguration Enabled : Yes	
Physical Address C4-75-AB-0E-16-6D DHCP Enabled	
DHCP Enabled Yes Autoconfiguration Enabled : Yes	
Autoconfiguration Enabled : Yes	
IPv4 Address	
Subnet Mask	
Lease Obtained Thursday, April 11, 2024 11:37:46 AM	
Lease Expires Friday, April 12, 2024 11:37:48 AM	
Default Gateway	
DHCP Server	
DHCPV6 1A1D	
DNS Servers	
NetBIOS over Tcpip : Enabled	
harnet adapter Blusteath Network Connection.	
hernet adapter Bluetooth Network Connection:	
Media State Media disconnected	

- Ethernet Example Web Page request
 - Application Layer

GET /index.html HTTP/1.1 Host: www.example.com

Transport Layer

Source Port: Destination Port: Sequence Number: Acknowledgment Number: Data Offset: Flags: Window Size: Checksum: Urgent Pointer: 30 39 (12345 in hex) 00 50 (80 in hex) 00 00 00 00 (0 in hex) 00 00 00 00 (0 in hex) 50 (Data offset = 5, multiplied by 4 for header length) 02 (SYN flag set for connection establishment) FF FF (65535 in hex) xx xx (Checksum value, calculated by the protocol) 00 00 (No urgent data)

Encapsulated Presentation Layer Data:

GET /index.html HTTP/1.1\r\nHost: www.example.com\r\n\r\n

Ethernet Example – Web Page request

Network Layer

Version and IHL: Type of Service: Total Length: Identification: Flags and Offset: TTL: Protocol: Header Checksum: Source IP Address: Destination IP Address:

Source Port: Destination Port: Sequence Number: Acknowledgment Number: Data Offset: Flags: Window Size: Checksum: Urgent Pointer:

Encapsulated Presentation Layer Data:

45 (Version = 4, IHL = 5) 00 (No specific priority) 00 28 (40 in hex, 20 bytes IP header + 20 bytes TCP segment) 30 39 (12345 in hex) 00 00 (No fragmentation) 40 (64 in hex) 06 (TCP) xx xx (Calculated checksum) C0 A8 01 02 (192.168.1.2 in hex) 5D B8 D8 22 (93.184.216.34 in hex)

30 39 (12345 in hex) 00 50 (80 in hex) 00 00 00 00 (0 in hex) 00 00 00 00 (0 in hex) 50 (Data offset = 5, multiplied by 4 for header length) 02 (SYN flag set for connection establishment) FF FF (65535 in hex) xx xx (Checksum value, calculated by the protocol) 00 00 (No urgent data)

GET /index.html HTTP/1.1\r\nHost: www.example.com\r\n\r\n

Ethernet Example – Web Page request

Data Link Layer

Destination MAC Address: Source MAC Address: EtherType:

Version and IHL: Type of Service: Total Length: Identification: Flags and Offset: TTL: Protocol: Header Checksum: Source IP Address: Destination IP Address:

Source Port: Destination Port: Sequence Number: Acknowledgment Number: Data Offset: Flags: Window Size: Checksum: Urgent Pointer: 00 1A 2B 3C 4D 5E 11 22 33 44 55 66 08 00 (0x0800, indicates the payload is an IP packet) 45 (Version = 4, IHL = 5) 00 (No specific priority) 00 28 (40 in hex, 20 bytes IP header + 20 bytes TCP segment) 30 39 (12345 in hex) 00 00 (No fragmentation) 40 (64 in hex) 06 (TCP) xx xx (Calculated checksum) C0 A8 01 02 (192.168.1.2 in hex) 5D B8 D8 22 (93.184.216.34 in hex)

30 39 (12345 in hex) 00 50 (80 in hex) 00 00 00 00 (0 in hex) 00 00 00 00 (0 in hex) 50 (Data offset = 5, multiplied by 4 for header length) 02 (SYN flag set for connection establishment) FF FF (65535 in hex) xx xx (Checksum value, calculated by the protocol) 00 00 (No urgent data)

Encapsulated Presentation Layer Data:

GET /index.html HTTP/1.1\r\nHost: www.example.com\r\n\r\n

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- Ethernet Example Web Page request
 - Complete Ethernet Message

