Layer 4 – The Transport Layer

- The Transport layer provides transparent transfer of data between hosts and is responsible for end-to-end error recovery and flow control.
- Flow control is the process of adjusting the flow of data from the sender to ensure that the receiving host can handle all of it.

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Session Multiplexing

- Session multiplexing is the process by which a host is able to support multiple sessions simultaneously and manage the individual traffic streams over a single link.

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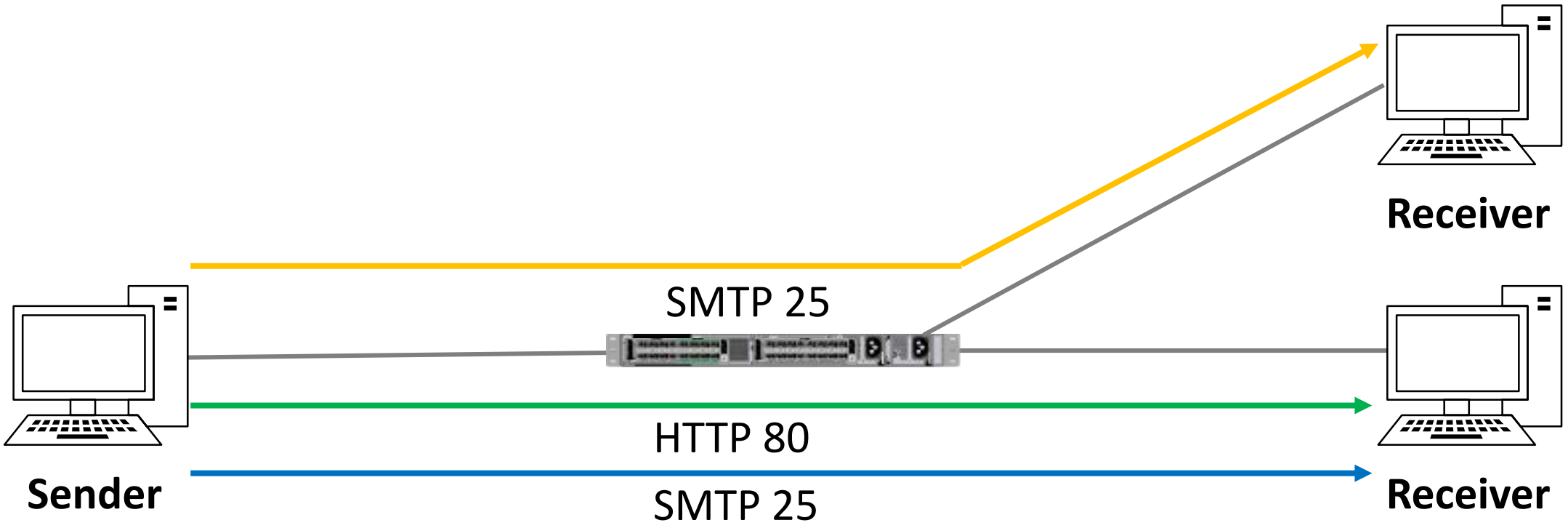
Session Multiplexing



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Layer 4 Port Numbers

- The Layer 4 destination port number is used to identify the upper layer protocol.
- For example, HTTP uses port 80, SMTP email uses port 25.
- The sender also adds a source port number to the Layer 4 header.
- The combination of source and destination port number can be used to track sessions.

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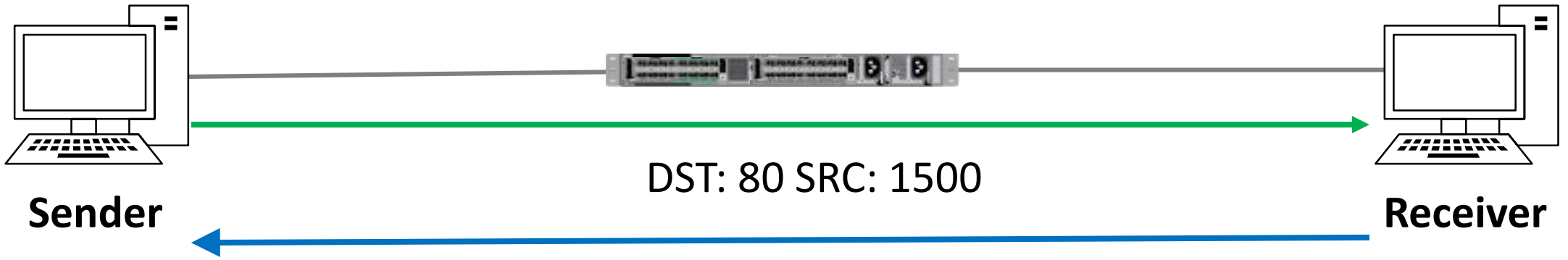
Layer 4 Port Numbers



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TCP

- TCP (Transport Control Protocol) and UDP (the User Datagram Protocol) are the most common Layer 4 protocols.
- TCP is connection oriented – once a connection is established, data can be sent bidirectionally over that connection.
- TCP carries out sequencing to ensure segments are processed in the correct order and none are missing.
- TCP is reliable – the receiving host sends acknowledgments back to the sender. Lost segments are resent.
- TCP performs flow control.

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The TCP Three-Way Handshake

Sender **Receiver**

SYN

SYN-ACK

ACK

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OSI Reference Model - Encapsulation

Sender

Receiver

Layer	Name	Includes	Devices
7			
6			
5			
4			
3			
2			
1			

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OSI Reference Model - Encapsulation

Sender **Receiver**

Layer	Name	Includes	Devices
7	Application		
6			
5			
4			
3			
2			
1			

OSI Reference Model - Encapsulation

Sender

Receiver

Layer	Name	Includes	Devices
7	Application		
6	Presentation		
5			
4			
3			
2			
1			

L6 L7

OSI Reference Model - Encapsulation

Sender

Receiver

Layer	Name	Includes	Devices
7	Application		
6	Presentation		
5	Session		
4			
3			
2			
1			

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L5 L6 L7

OSI Reference Model - Encapsulation

Sender

Receiver

Layer	Name	Includes	Devices
7	Application		
6	Presentation		
5	Session		
4	Transport	TCP/UDP, Port	
3			
2			
1			

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L4 L5 L6 L7

OSI Reference Model - Encapsulation

Sender

Receiver

Layer	Name	Includes	Devices
7	Application		
6	Presentation		
5	Session		
4	Transport	TCP/UDP, Port	
3	Network	IP Address	Routers
2			
1			

L3 L4 L5 L6 L7

OSI Reference Model - Encapsulation

Sender **Receiver**

Layer	Name	Includes	Devices
7	Application		
6	Presentation		
5	Session		
4	Transport	TCP/UDP, Port	
3	Network	IP Address	Routers
2	Data-Link	Ethernet MAC Address	Switches
1			

L2 L3 L4 L5 L6 L7

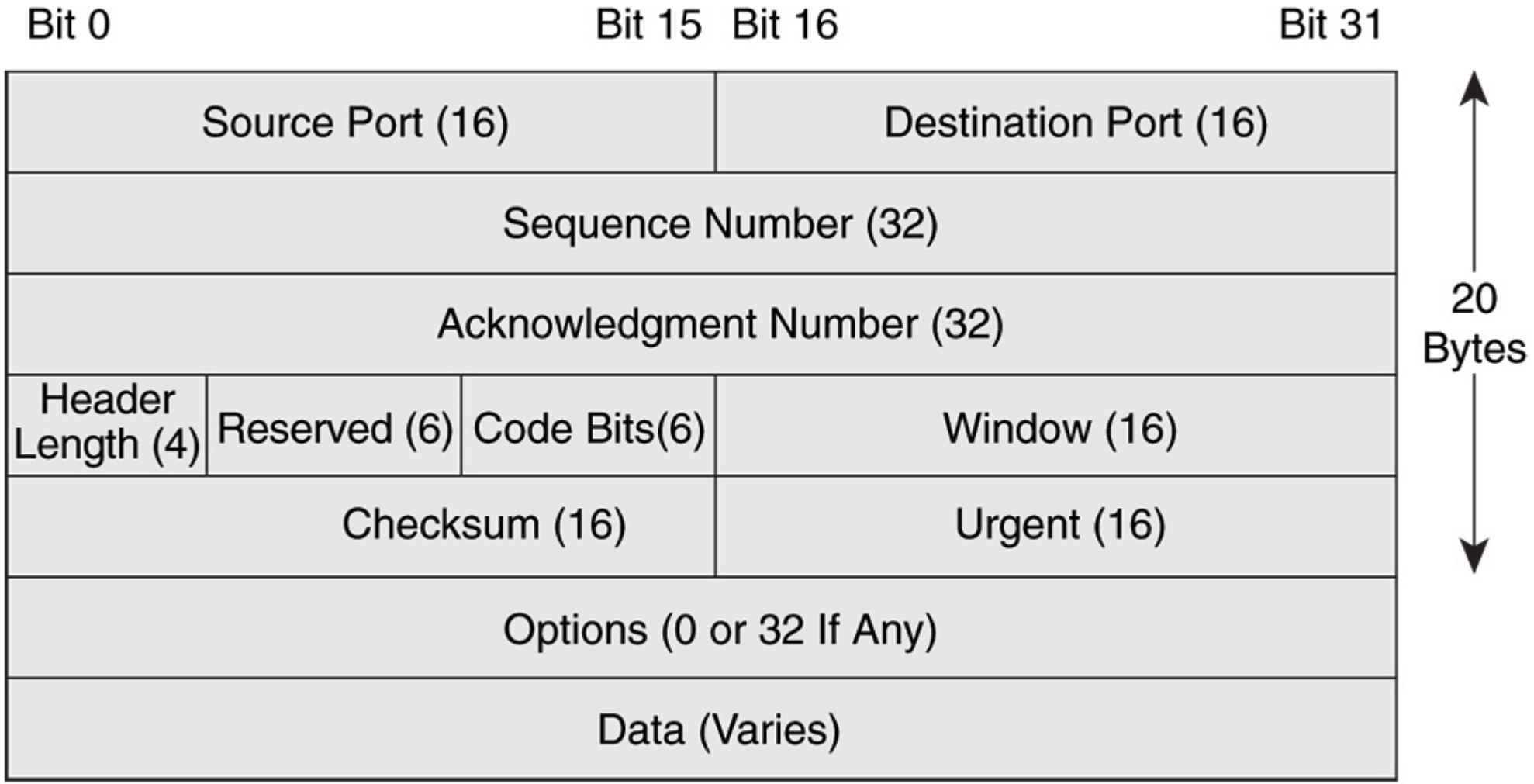
OSI Reference Model - Encapsulation

Sender **Receiver**

Layer	Name	Includes	Devices
7	Application		
6	Presentation		
5	Session		
4	Transport	TCP/UDP, Port	
3	Network	IP Address	Routers
2	Data-Link	Ethernet MAC Address	Switches
1	Physical		Hubs

L2 L3 L4 L5 L6 L7

The TCP Header



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UDP

- The User Datagram Protocol sends traffic best effort.
- UDP is not connection oriented. There is no handshake connection setup between the hosts.
- UDP does not carry out sequencing to ensure segments are processed in the correct order and none are missing.
- UDP is not reliable – the receiving host does not send acknowledgments back to the sender.
- UDP does not perform flow control.
- If error detection and recovery is required it is up to the upper layers to provide it.

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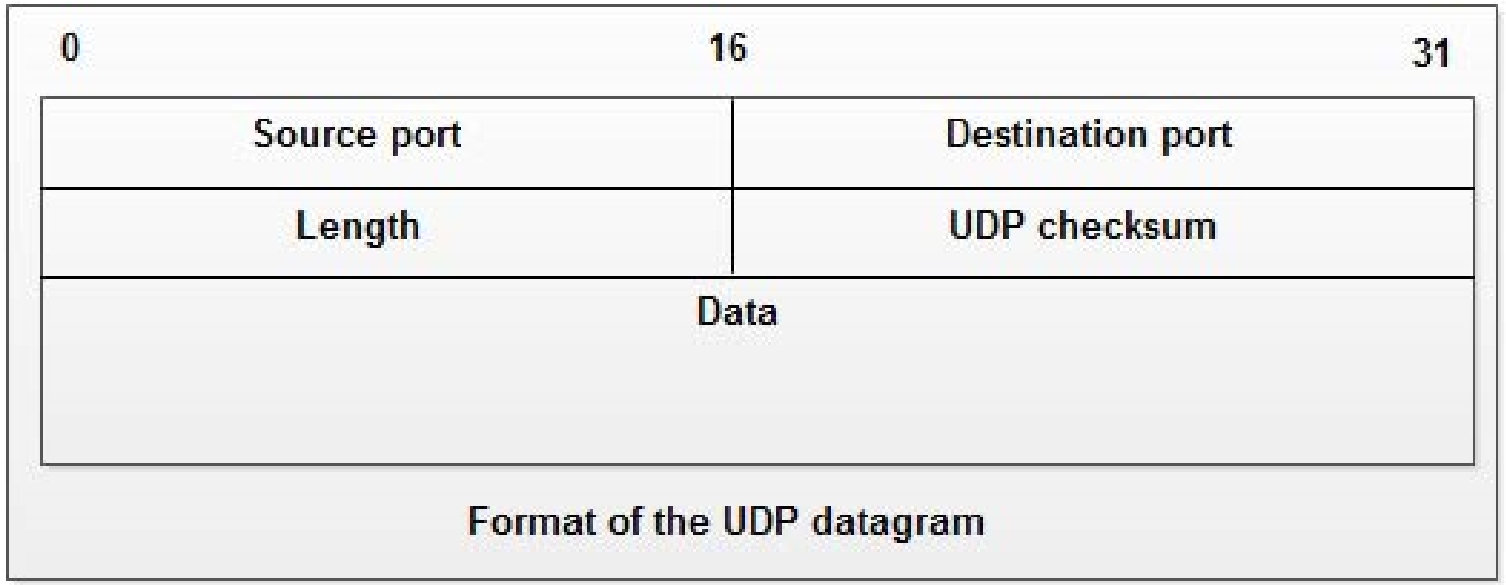
The UDP Header



Format of the UDP datagram

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TCP vs UDP

- Application developers will typically choose to use TCP for traffic which requires reliability.
- Real-time applications such as voice and video can’t afford the extra overhead of TCP so they use UDP.
- Some applications can use both TCP and UDP.

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Common Applications and Their Destination Ports

- TCP
  - FTP (21)
  - SSH (22)
  - Telnet (23)
  - HTTP (80)
  - HTTPS (443)
- UDP
  - TFTP (69)
  - SNMP (161)
- TCP and UDP
  - DNS (53)

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