



Introduction to Networking

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Chapter 7

7.0 Introduction

7.1 Transport Layer Protocols

7.2 TCP and UDP

7.3 Summary



Chapter 7: Objectives

- Describe the purpose of the transport layer in managing the transportation of data in end-to-end communication.
- Describe characteristics of the TCP and UDP protocols, including port numbers and their uses.
- Explain how TCP session establishment and termination processes facilitate reliable communication.
- Explain how TCP protocol data units are transmitted and acknowledged to guarantee delivery.
- Explain the UDP client processes to establish communication with a server.
- Determine whether high-reliability TCP transmissions, or non guaranteed UDP transmissions, are best suited for common applications.



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Transportation of Data

Role of the Transport Layer

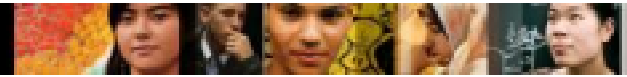
The transport layer is responsible for establishing a temporary communication session between two applications and delivering data between them.

TCP/IP uses two protocols to achieve this:

- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)

Primary Responsibilities of Transport Layer Protocols

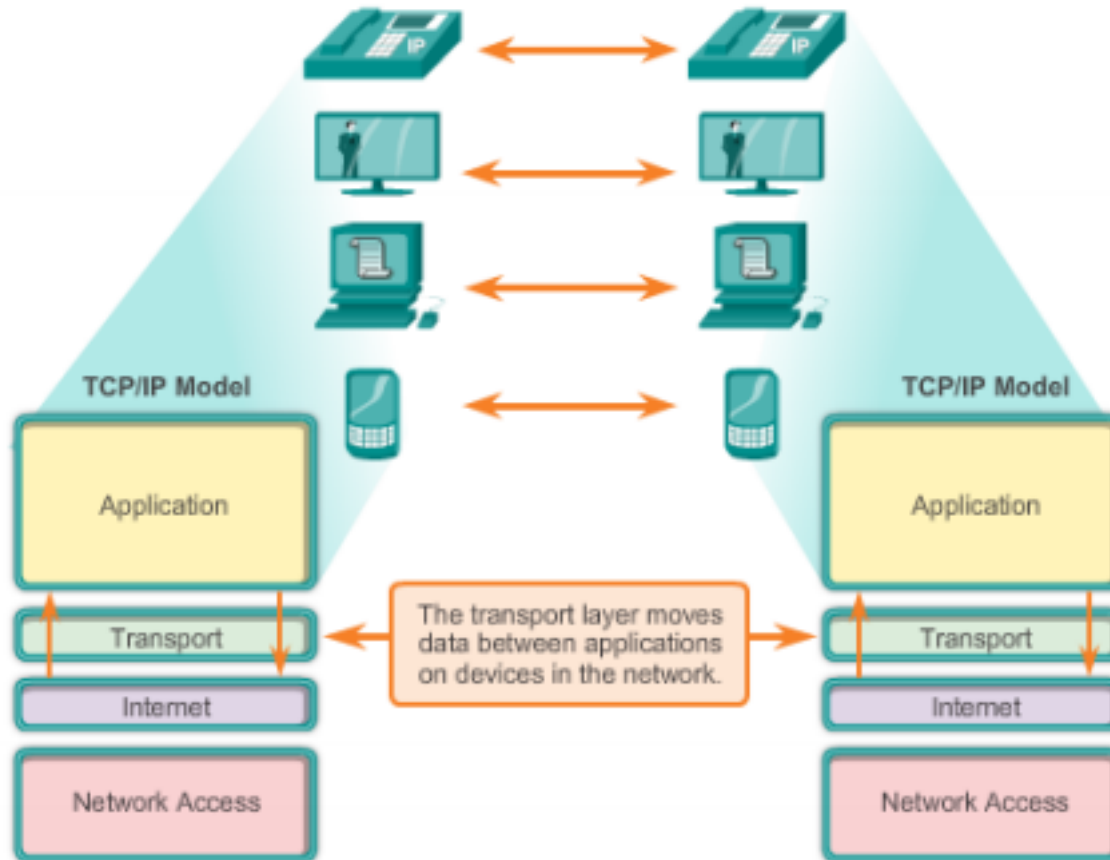
- **Tracking the individual communication** between applications on the source and destination hosts
- **Segmenting data** for manageability and reassembling segmented data into streams of application data at the destination
- **Identifying the proper application** for each communication stream



Transportation of Data

Role of the Transport Layer (Cont.)

Enabling Applications on Devices to Communicate



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Transportation of Data

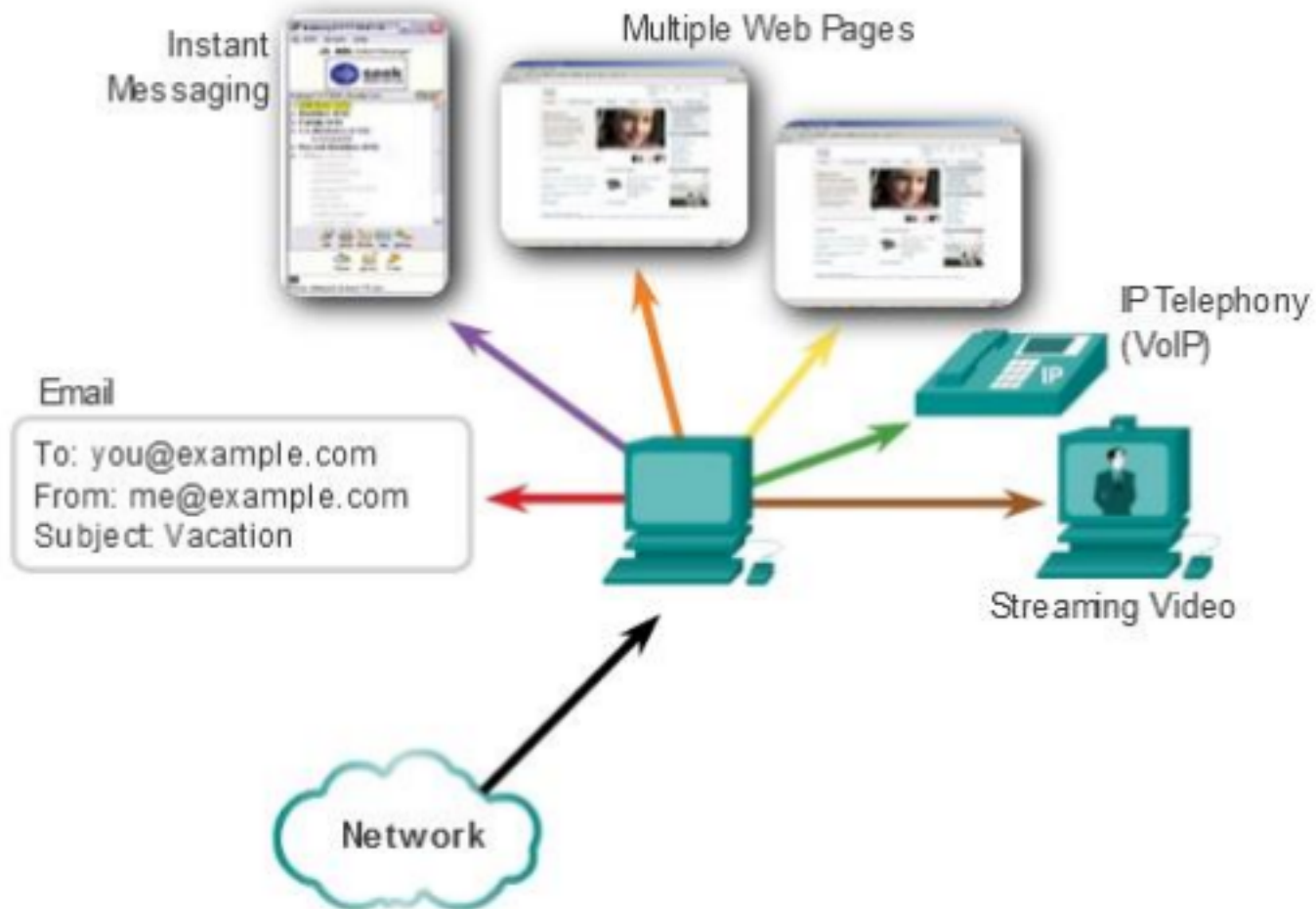
Conversation Multiplexing

Segmenting the Data

- Enables many different communications, from many different users, to be **interleaved (multiplexed)** on the same network, at the same time.
- **Provides the means** to both send and receive data when running multiple applications.
- **Header** added to each segment to identify it.



Tracking the conversation



The transport layer tracks each individual conversation flowing between a source application and a destination application separately.



Segmentation



The transport layer divides the data into segments that are easier to manage and transport

Identifying the Application



The transport layer ensures that even with multiple applications running on a device, all applications receive the correct data

Transport Layer Services

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Transport Layer Reliability

Different applications have different transport reliability requirements.

TCP/IP provides two transport layer protocols, **TCP and UDP**. **TCP**

- Provides reliable delivery ensuring that all of the data arrives at the destination.
- Uses acknowledged delivery and other processes to ensure delivery

Makes larger demands on the network – more overhead.

UDP

- Provides just the basic functions for delivery – no reliability.

Less overhead.

TCP or UDP

- There is a trade-off between the value of reliability and the burden it places on the network.
- Application developers choose the transport protocol based on the requirements of their applications.

Introducing TCP and UDP

Introducing TCP

- Defined in RFC 793
- Connection-oriented –
Creates a session
between
the source and
destination
- Reliable delivery –
Retransmits lost or
corrupt
data
- Ordered data
reconstruction –
Reconstructs
numbering
and sequencing of
segments



- Flow control – Regulates the amount of data transmitted
- Stateful protocol – Tracks the session

Animation in Section 7.1.1.5

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Introducing TCP and UDP

Introducing UDP

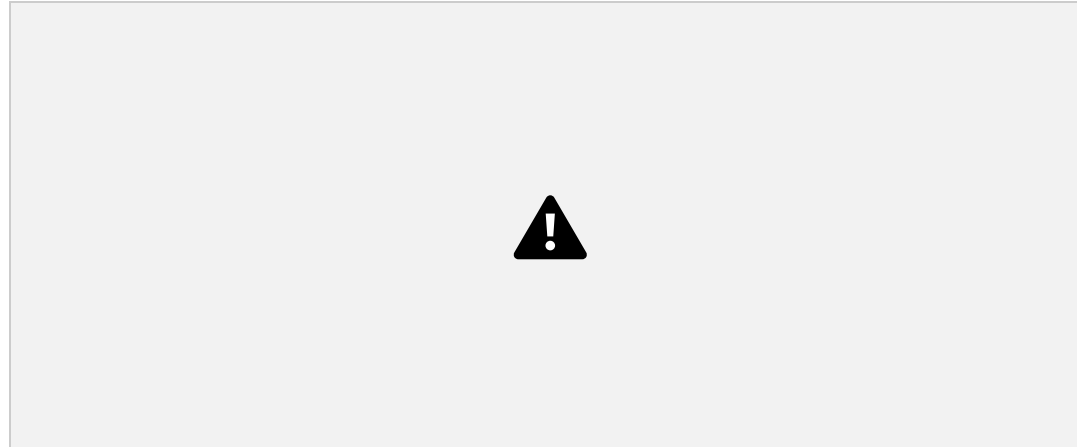
- RFC 768
- Connectionless
- Unreliable delivery
- No ordered data reconstruction
- No flow control



- Stateless protocol

Applications that use
UDP:

- Domain Name System (DNS)
- Video Streaming
- VoIP



Animation in Section 7.1.1.6

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Introducing TCP and UDP

Separating Multiple Communications TCP

and UDP use port numbers to differentiate between applications. .



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Introducing TCP and UDP

TCP and UDP Port Addressing



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Introducing TCP and UDP

TCP and UDP Port Addressing

(Cont.)



TCP and UDP Port Addressing (Cont.)



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Introducing TCP and UDP

TCP and UDP Port Addressing

(Cont.)

Netstat is used to examine TCP connections that are open and running on a networked host.



TCP and UDP Segmentation

The transport layer divides the data into pieces and adds a header for delivery over the network



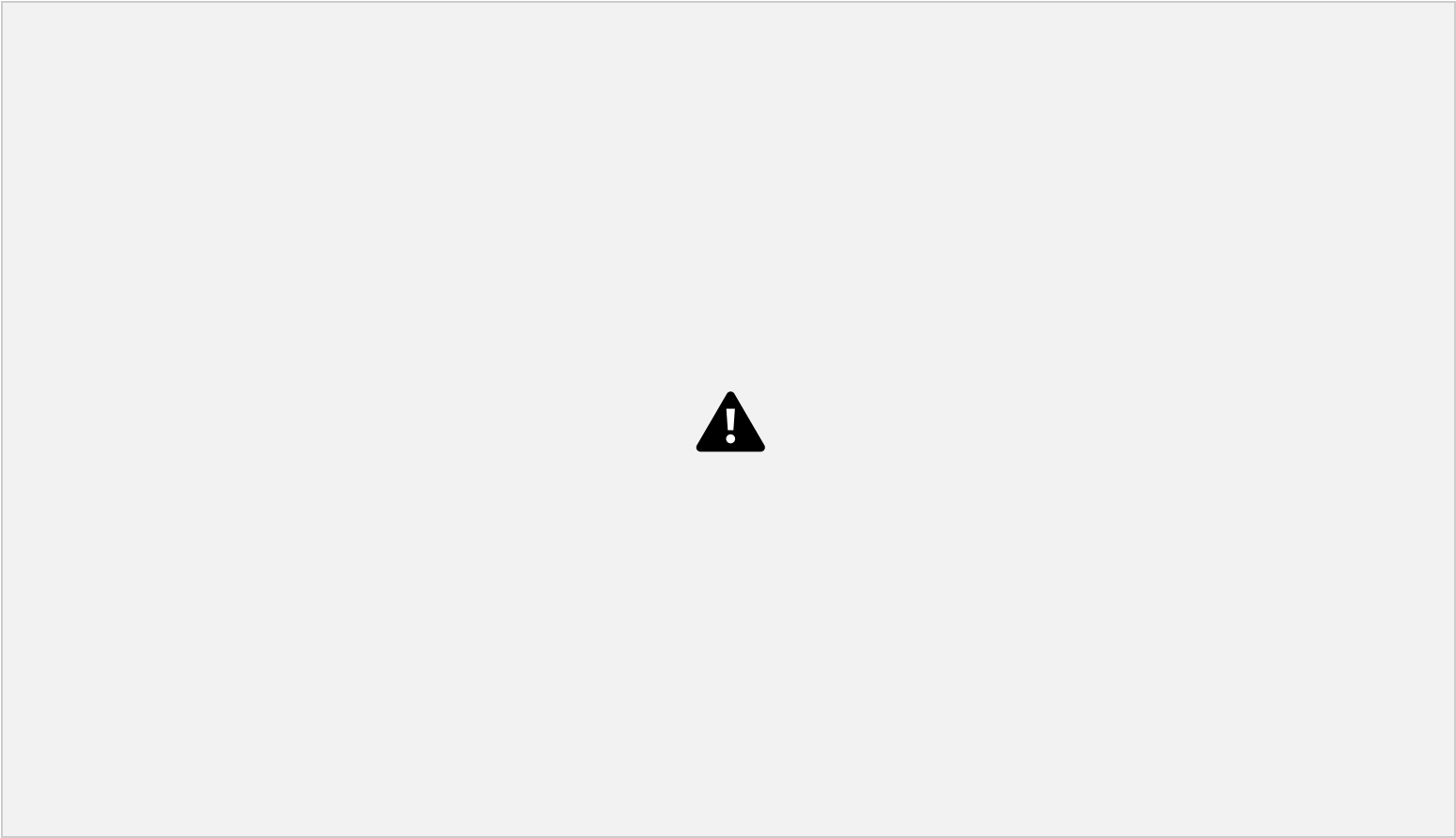
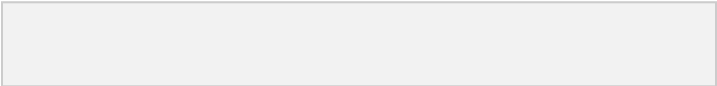




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TCP Communication

TCP Server Processes





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TCP Communication

TCP Server Processes (Cont.)





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TCP Communication

TCP Connection, Establishment and Termination

Three-Way Handshake

- Establishes that the destination device is present on the network
- Verifies that the destination device has an active service and is accepting requests on the destination port number that the initiating client intends to use for the session
- Informs the destination device that the source client intends to establish a communication session on that port number

Three-Way Handshake



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TCP Session Termination



- Check Activity 7.2.1.9 in CCNA

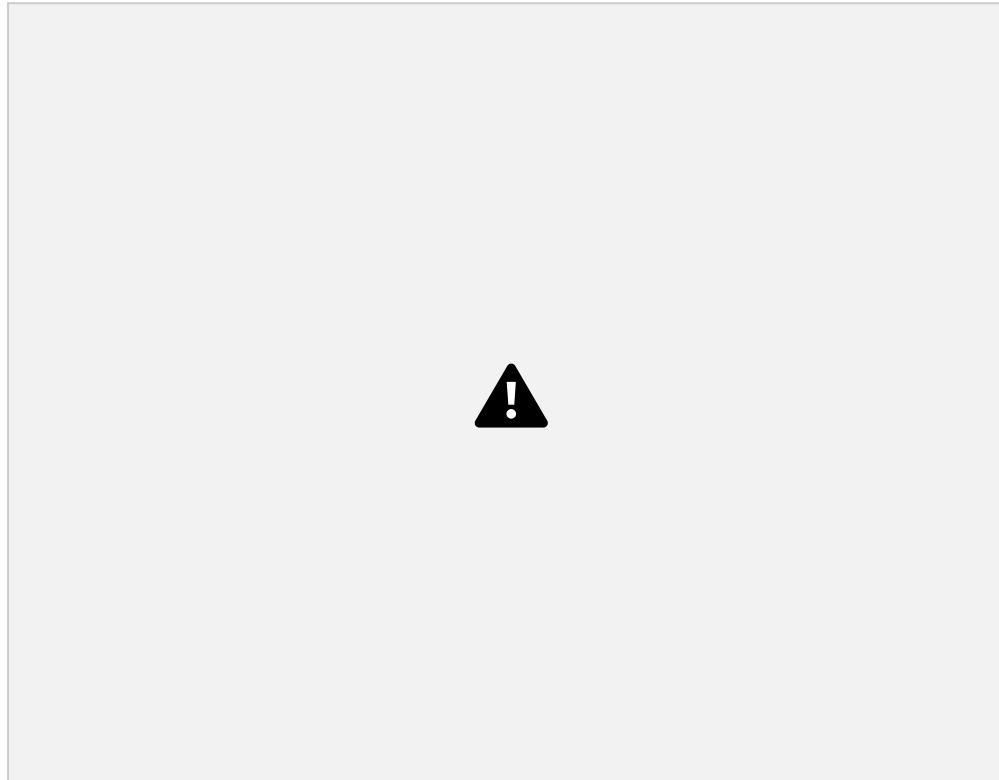
TCP Reliability – Ordered Delivery

Sequence numbers are used to reassemble segments into their original order.



Acknowledgement and Window Size

The sequence number and acknowledgement number are used together to confirm receipt.



The window size is the amount of data that a source can transmit before an acknowledgement must be received.

Reliability and Flow Control

Window Size and

Acknowledgements





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Reliability and Flow Control

TCP Flow Control – Congestion Avoidance



Reliability and Flow Control

TCP Reliability -

Acknowledgements



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UDP Communication

UDP Low Overhead vs. Reliability

UDP

- Simple protocol that provides the basic transport layer function
- Used by applications that can tolerate small loss of data
- Used by applications that cannot tolerate delay

Used by

- DNS
- Simple Network Management Protocol (SNMP)
- Dynamic Host Configuration Protocol (DHCP)
- Trivial File Transfer Protocol (TFTP)
- IP telephony or VoIP
- Online games

Datagram Reassembly



UDP Server and Client Processes

-



UDP-based
server
applications

are assigned
well-known or
registered port
numbers.

- UDP client
process
randomly
selects port
number from
range of
dynamic port
numbers as the
source port.

TCP or UDP

Applications that use TCP



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TCP or UDP

Applications That Use UDP





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Chapter 7: Summary

In this chapter, you learned:

- The role of the transport layer is to provide three main services: multiplexing, segmentation and reassembly, and error checking. It does this by:
 - Dividing data received from an application into segments.
 - Adding a header to identify and manage each segment.
 - Using the header information to reassemble the segments back into application data.
 - Passing the assembled data to the correct application.
- How TCP and UDP operate and which popular applications use each protocol.
- Transport Layer functions are necessary to address issues in QoS and security in networks.
- Ports provide a “tunnel” for data to get from the transport layer to the appropriate application at the destination.

