

# Introduction to the Transport Layer

The primary duties of the transport layer, Layer 4 of the OSI model, are to transport and regulate the flow of information from the source to the destination, reliably and accurately.

End-to-end control and reliability are provided by sliding windows, sequencing numbers, and acknowledgments.

## Reliable transport can accomplish the following:

- Ensure that segments delivered will be acknowledged to the sender
- Provide for retransmission of any segments that are not acknowledged
- Put segments back into their correct sequence at the destination
- Provide congestion avoidance and control

# More on The Transport Layer

The transport layer provides transport services from the source host to the destination host.

It establishes a logical connection between the endpoints of the network.

Transport services include the following basic services: •

Segmentation of upper-layer application data •

Establishment of end-to-end operations •

Transport of segments from one end host to another end host •

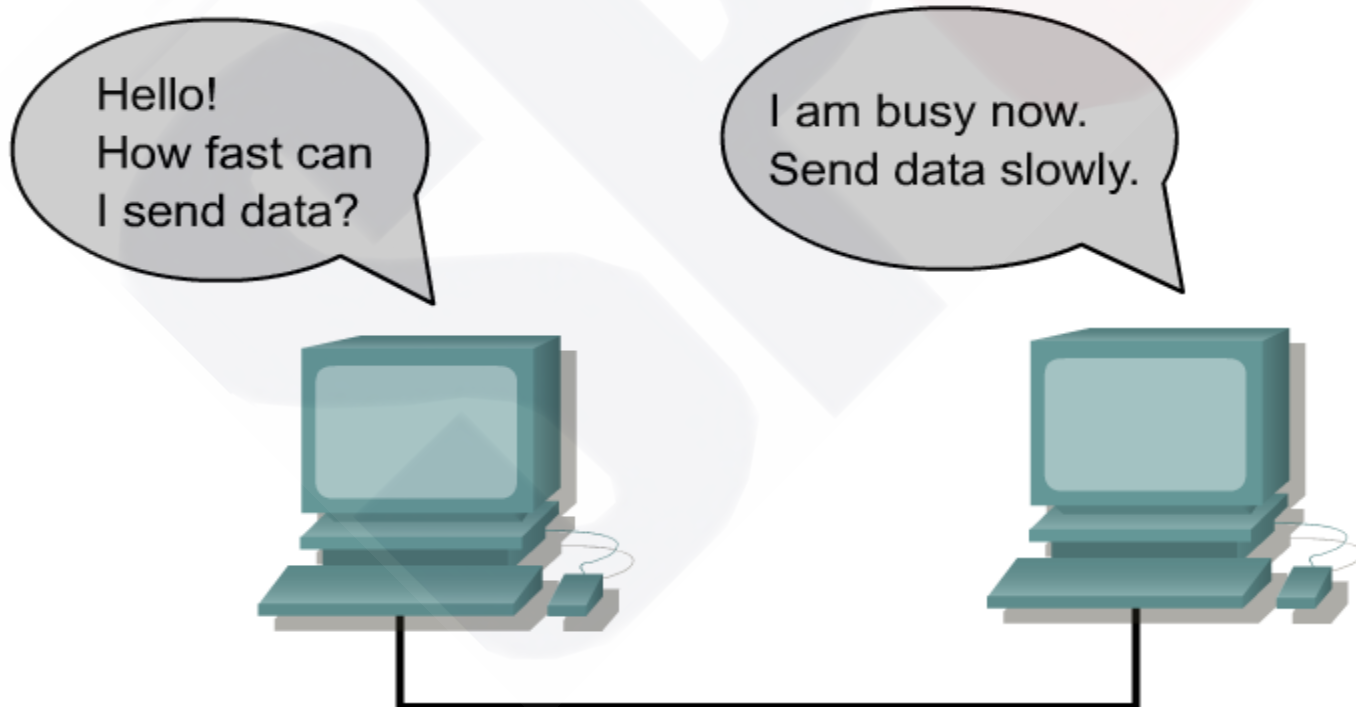
Flow control provided by sliding windows •

Reliability provided by sequence numbers and acknowledgments •

# Flow Control

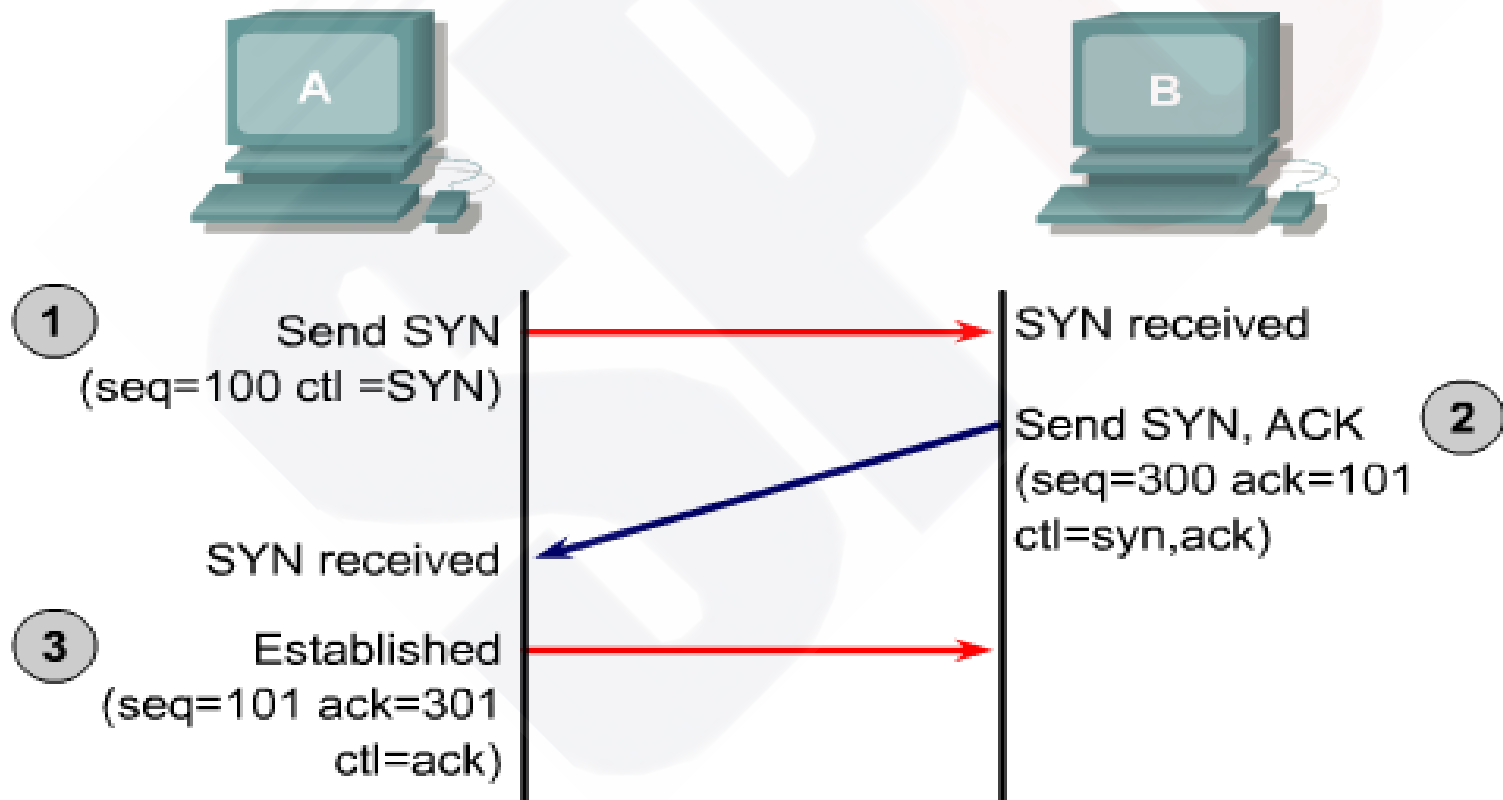
As the transport layer sends data segments, it tries to ensure that data is not lost. A receiving host that is unable to process data as quickly as it arrives could be a cause of data loss.

**Flow control** avoids the problem of a transmitting host overflowing the buffers in the receiving host.



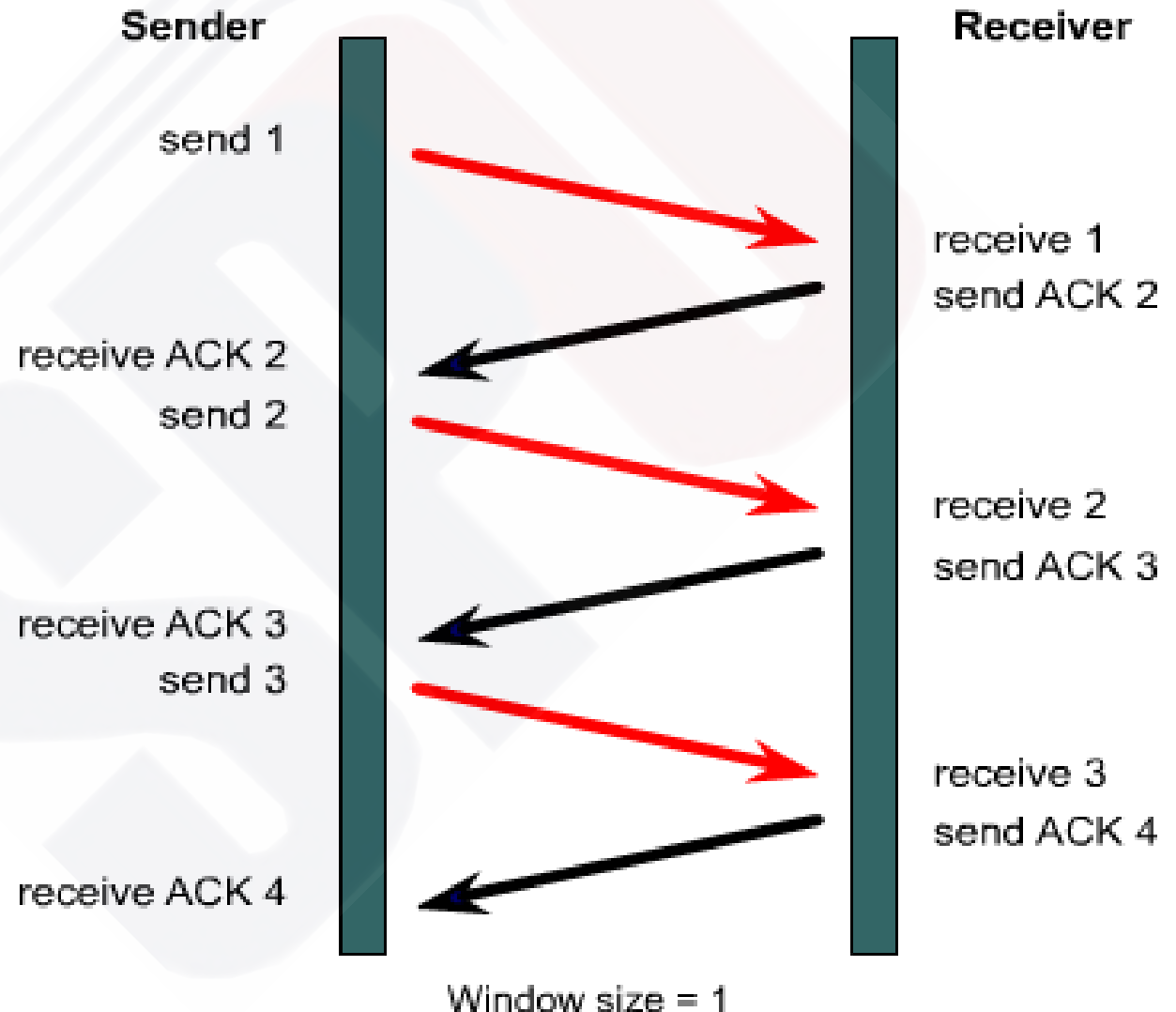
# 3-Way Handshake

TCP requires connection establishment before data transfer begins. For a connection to be established or initialized, the two hosts must synchronize their Initial Sequence Numbers (ISNs).

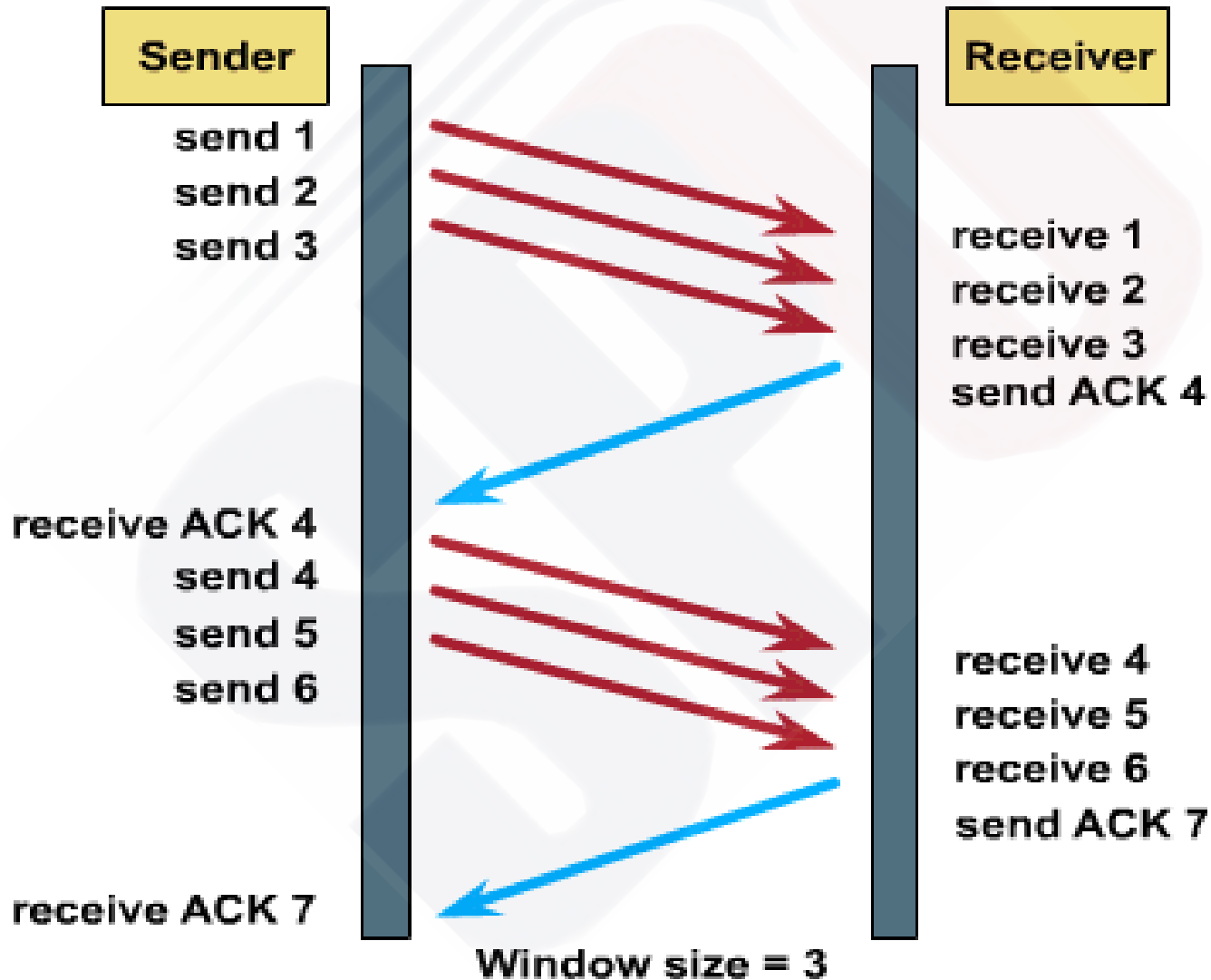


# Basic Windowing

Data packets must be delivered to the recipient in the same order in which they were transmitted to have a reliable, connection-oriented data transfer. The protocol fails if any data packets are lost, damaged, duplicated, or received in a different order. An easy solution is to have a recipient acknowledge the receipt of each packet before the next packet is sent.



# Sliding Window



# Sliding Window with Different Window Sizes

Sender Host

send 1  
send 2  
send 3

send 3  
send 4  
send 5

send 5  
send 6

Receiving Host

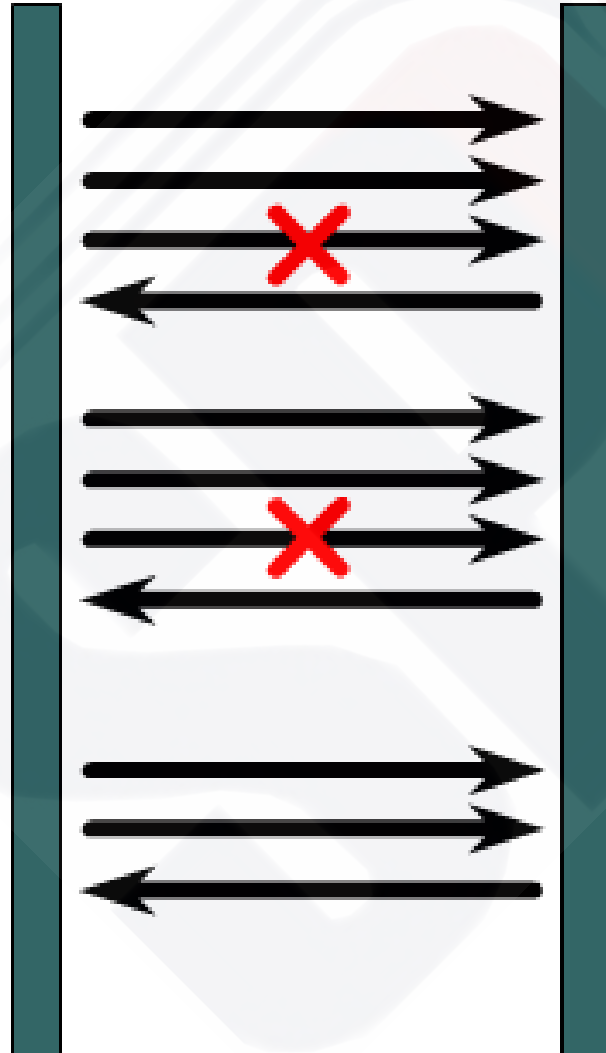
receive 1  
receive 2  
~~receive 3~~  
ACK 3 window size 2

receive 3  
receive 4  
~~receive 5~~  
ACK 5 window size 2

receive 3  
receive 4  
ACK 7 window size 2

Window Size 3

Window Size 2



# TCP Sequence & Acknowledgement

Source Port	Destination Port	Sequence Number	Acknowledgment Numbers	...
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Source	Des.	Seq.	Ack.	...
1028	23	10	1	...



Source	Des.	Seq.	Ack.	...
1028	23	11	2	...



Source	Des.	Seq.	Ack.	...
23	1028	1	11	...



# TCP

Transmission Control Protocol (TCP) is a connection-oriented Layer 4 protocol that provides reliable full-duplex data transmission.

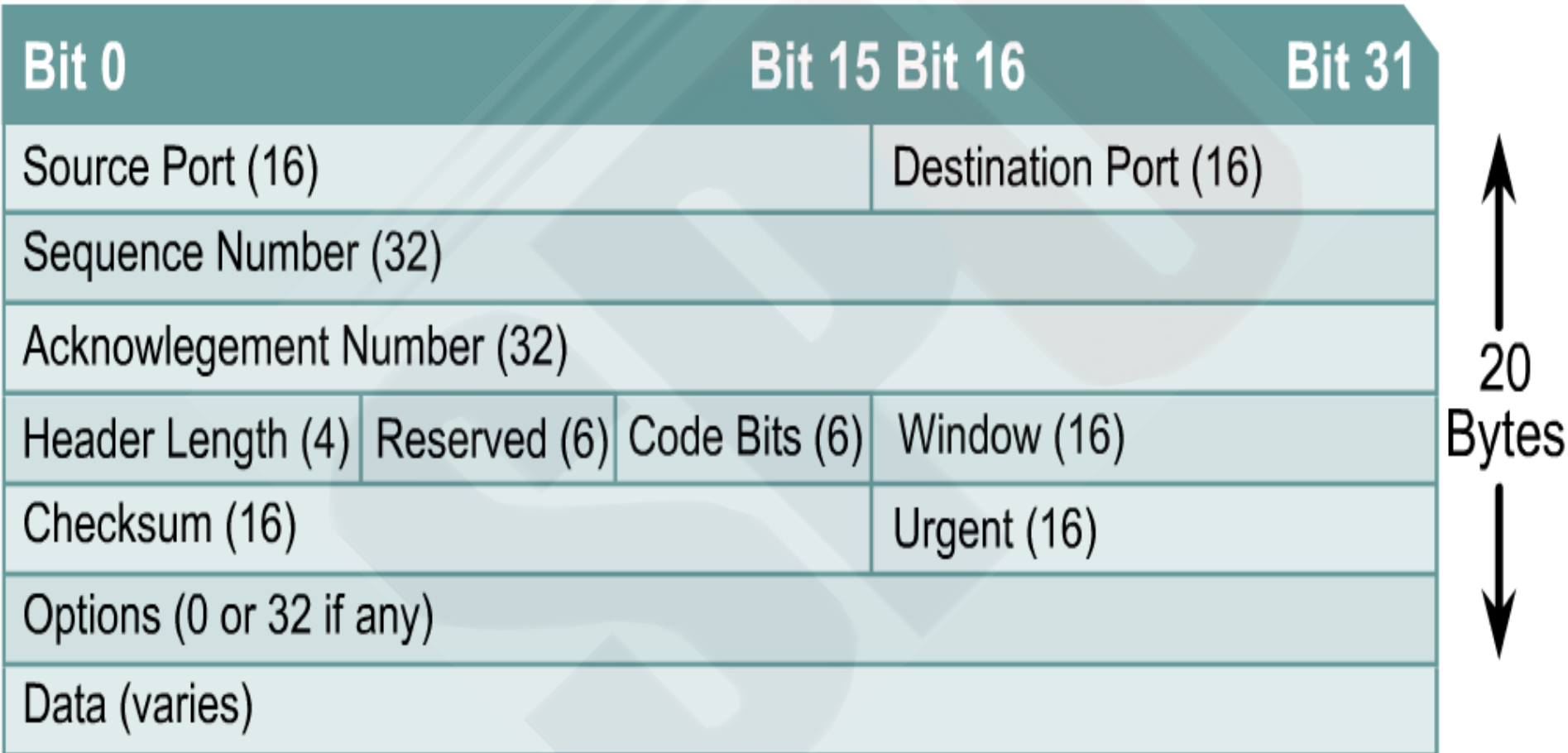
TCP is part of the TCP/IP protocol stack. In a connection-oriented environment, a connection is established between both ends before the transfer of information can begin.

TCP is responsible for breaking messages into segments, reassembling them at the destination station, resending anything that is not received, and reassembling messages from the segments. TCP supplies a virtual circuit between end-user applications.

The protocols that use TCP include:

- FTP (File Transfer Protocol)
- HTTP (Hypertext Transfer Protocol)
- SMTP (Simple Mail Transfer Protocol)
- Telnet

# TCP Segment Format



# UDP

User Datagram Protocol (UDP) is the connectionless transport protocol in the TCP/IP protocol stack.

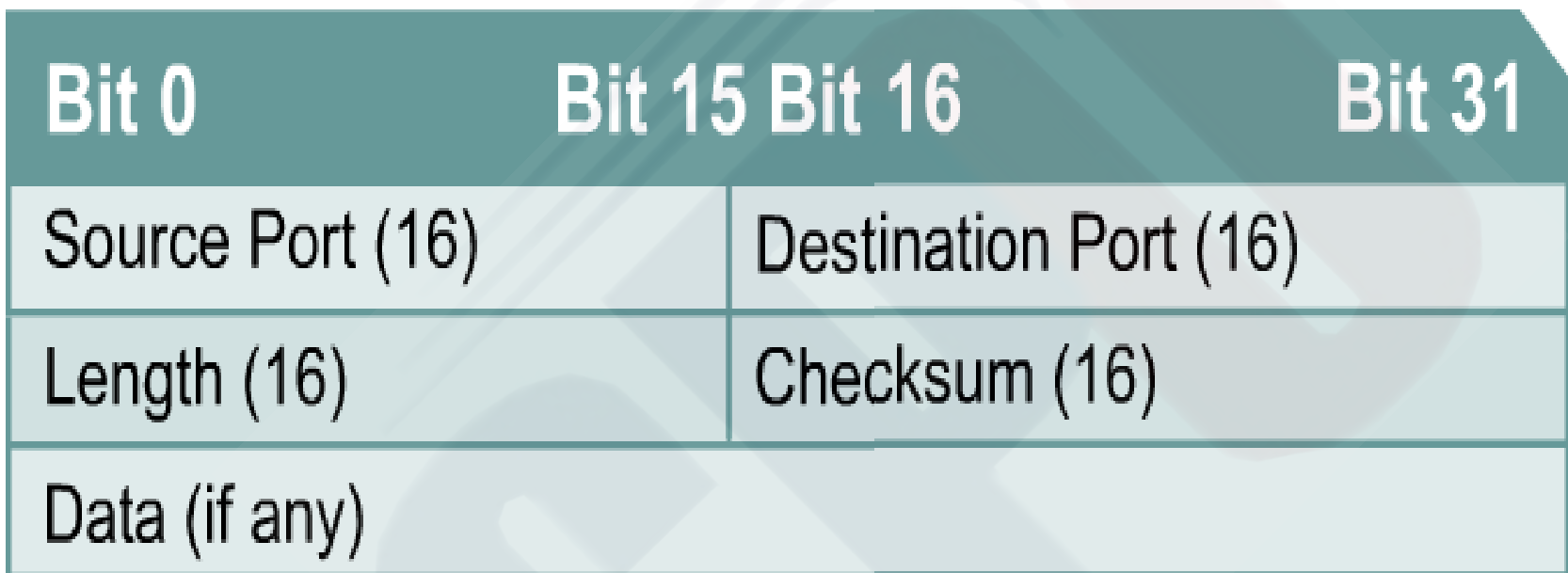
UDP is a simple protocol that exchanges datagrams, without acknowledgments or guaranteed delivery. Error processing and retransmission must be handled by higher layer protocols.

UDP uses no windowing or acknowledgments so reliability, if needed, is provided by application layer protocols. UDP is designed for applications that do not need to put sequences of segments together.

The protocols that use UDP include:

- TFTP (Trivial File Transfer Protocol) •
- SNMP (Simple Network Management Protocol) •
- DHCP (Dynamic Host Control Protocol) •
- DNS (Domain Name System) •

# UDP Segment Format



↑  
8 Bytes  
↓

No sequence or acknowledgement fields

# UDP ( User Datagram Protocol)

- تستخدم هذا البروتوكول الاتصال غير الموثوق لأن المرسل يرسل البيانات بدون أن ينتظر لتلقى إشعار بوصول البيانات
- يعتبر UDP الأكثر استعمالاً للنقل الغير موثوق
- يؤمن UDP الاتصال بين مستخدمين فقط
- ضمن البروتوكول UDP ثلاث أنواع من نقل البيانات وهي
  - Uni-cast : وفيه يتم الارسال لمستخدم واحد
  - Multi-cast : وفيه يتم الارسال إلى مجموعة من المستخدمين في الشبكة دفعة واحدة
  - Broadcast : وفيه يتم الإرسال إلى كل المستخدمين في الشبكة

# FTP (file transfer Protocol)

- FTP هو الذي يسمح بقل الملفات من حاسوب لآخر باستخدام TCP
- يسمح FTP للمستخدم البعيد بالدخول على ملفات الطرف الآخر بعد التعريف عن نفسه وإدخال كلمة السر من خلال الأوامر التالية
- Open .... لإنشاء الاتصال بالحاسوب البعيد
- الأمر LS لاستعراض المجلدات
- الأمر get للحصول على ملف ما
- الأمر bye لإنهاء الاتصال والخروج

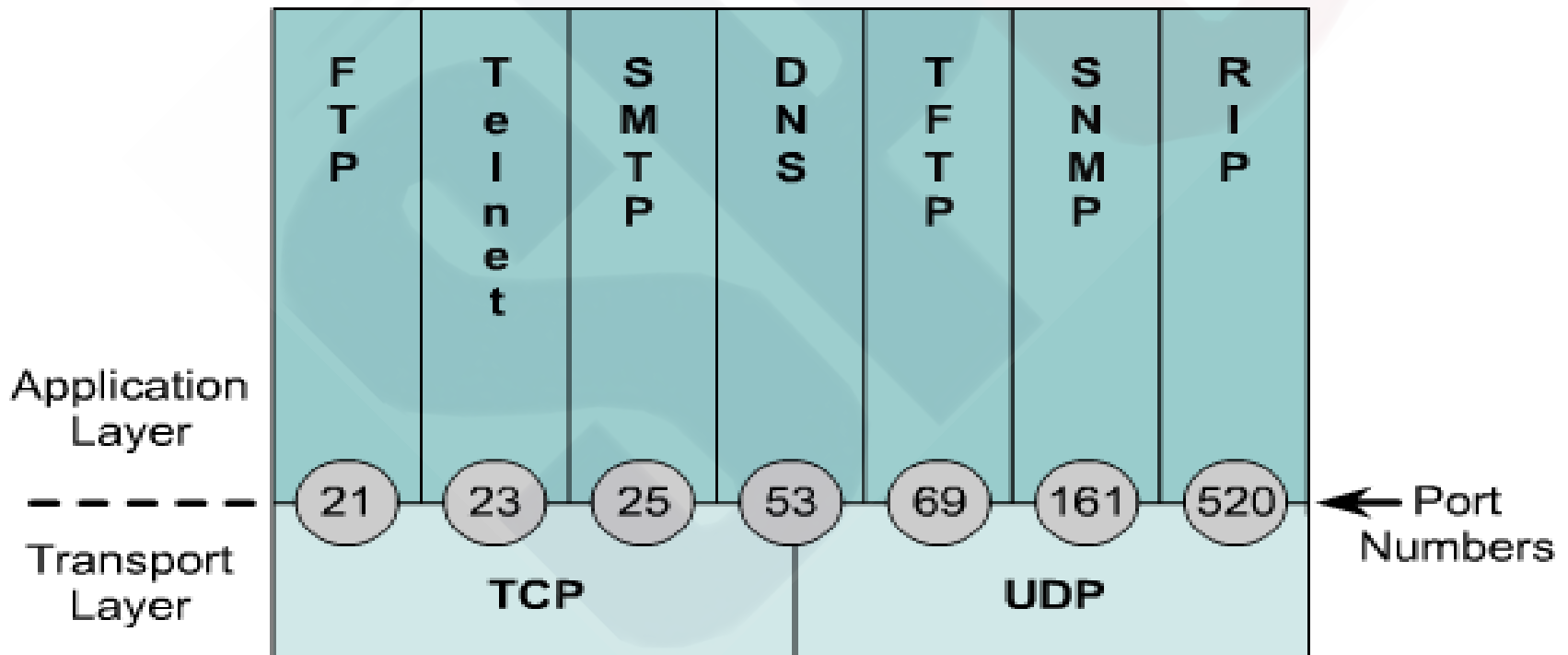
# Well Known Port Numbers

The following port numbers should be memorized:

NOTE:

The curriculum forgot to mention one of the most important port numbers.

**Port 80** is used for **HTTP** or **WWW** protocols. (Essentially access to the internet.)



# URL

http://	www.	cisco.com	/edu/
Identifies to the browser what protocol should be used.	Identifies the hostname or name of a specific machine	Represents the domain entity of the web site.	Identifies the folder where the web page is located on the server. Also since no name is specified, the browser will load the default page identified by the server

Identified here are the parts of a standard URL (Uniform Resource Locator) address.