



**ITI**

# **Introduction to Computer Networks & Cyber Security**

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# Part 1 (TCP/IP Protocol Architecture)



## Transport Layer



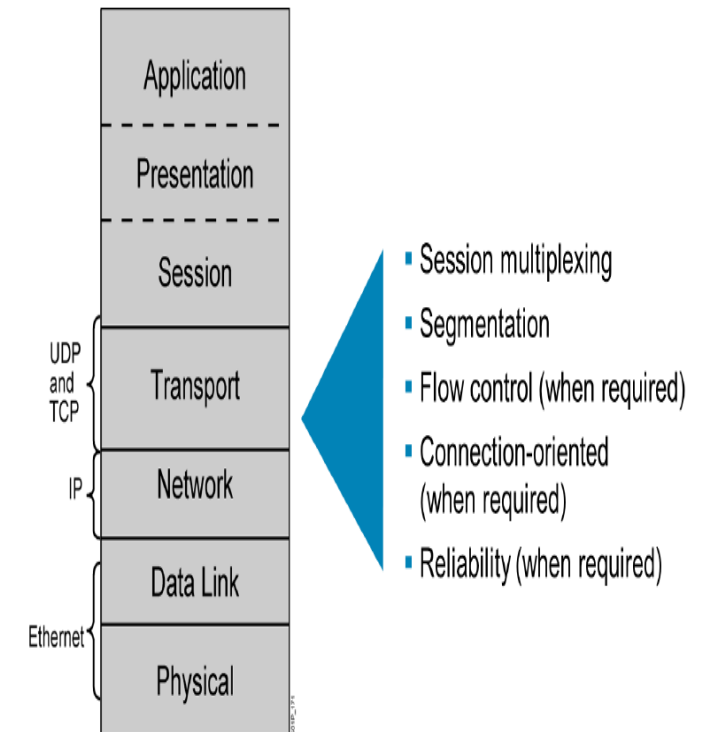
# Basic Network Elements (Software)



## Transport Layer

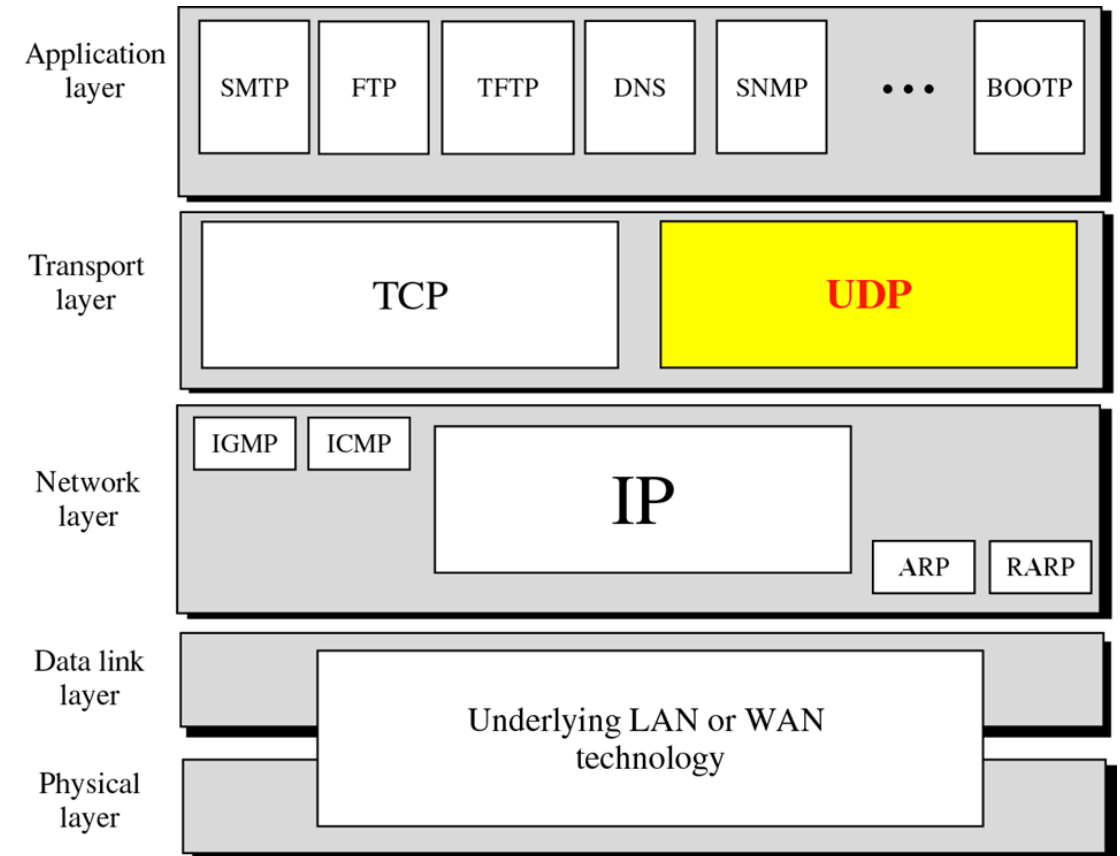
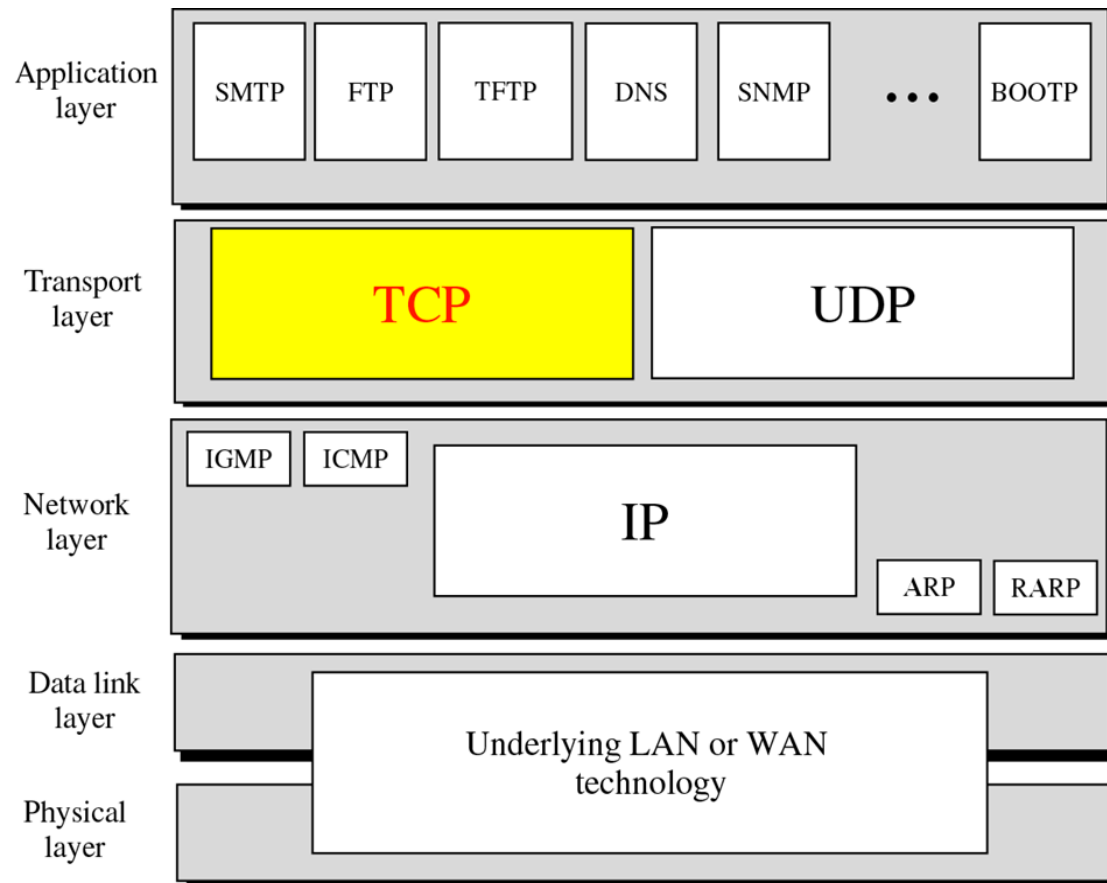
- **Session multiplexing:**
  - open **multiple sessions** using **UDP and TCP**

Example : open **cisco.com** & open **facebook.com** you are the source using **port 49001** and another **port 49002** on the same machine (session multiplexing).
- **Segmentation:**
  - divided the data up to **multiple segments** to be easier in handling (the maximum performance 1518 byte)
- **Connection Oriented:**
  - To maintain the session with **acknowledgements** that the data are sent to the receiver then terminate the session
- **Reliability:**
  - **Data corrections** and **avoid** the **duplicate data** out of order and data arrangement.



# Part 1 (TCP/IP Protocol Architecture)

## TCP/IP Protocol Architecture



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## TCP Characteristics

- Transmission Control Protocol
- Transport layer protocol
- Use port numbers
- Reliable (Acknowledgement of receipt)
- **Connection oriented**(synchronization)
- **Full duplex**
- Error control(Error checking(checksum )
- **Flow control**
  - Data-recovery features
  - Sequencing of data packets



No internet

## TCP Header

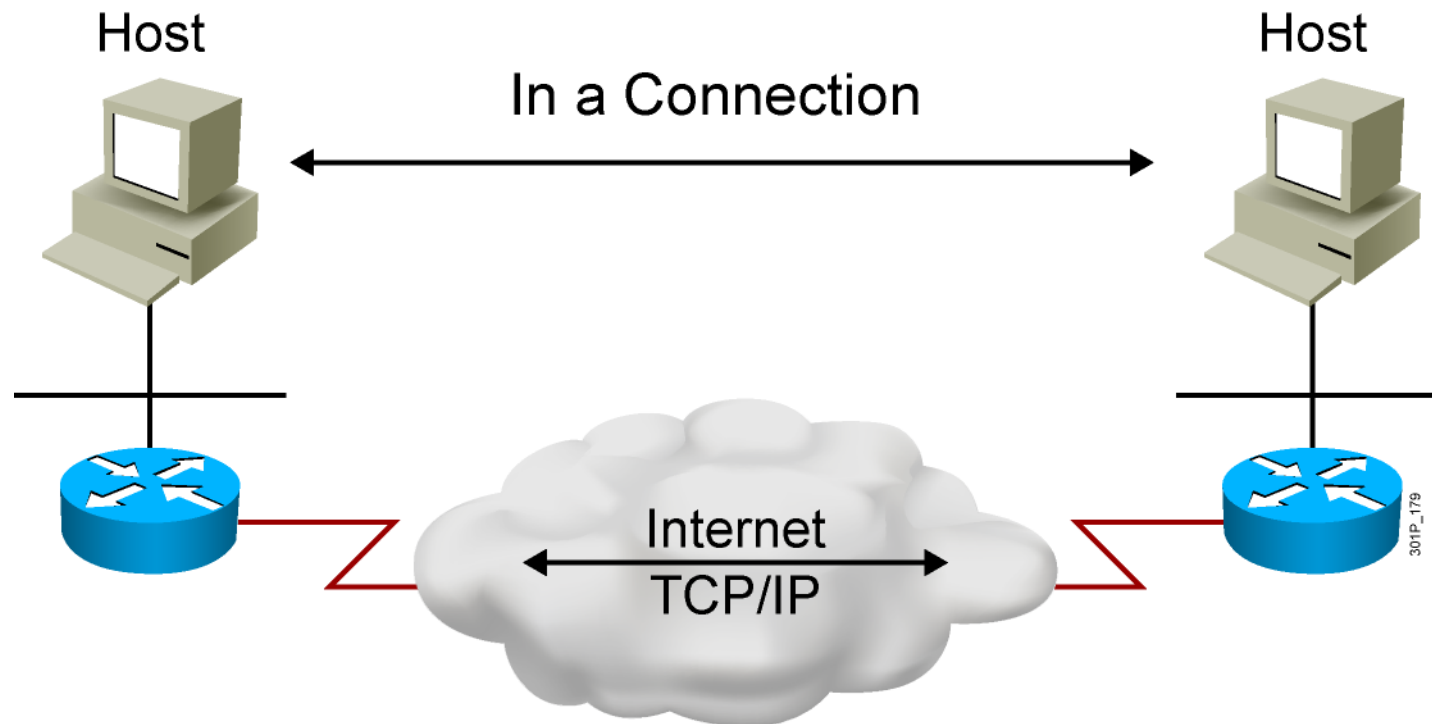
16-Bit source port										16-Bit destination port																			
32-Bit sequence number																													
32-Bit acknowledgment number																													
4-Bit header length		resv		n s		c w		e r		u c		a p		r s		s y		f i		16-Bit window size									
16-bit TCP checksum										16-Bit urgent pointer																			
Options																													
Data																													

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# Part 1 (TCP/IP Protocol Architecture)



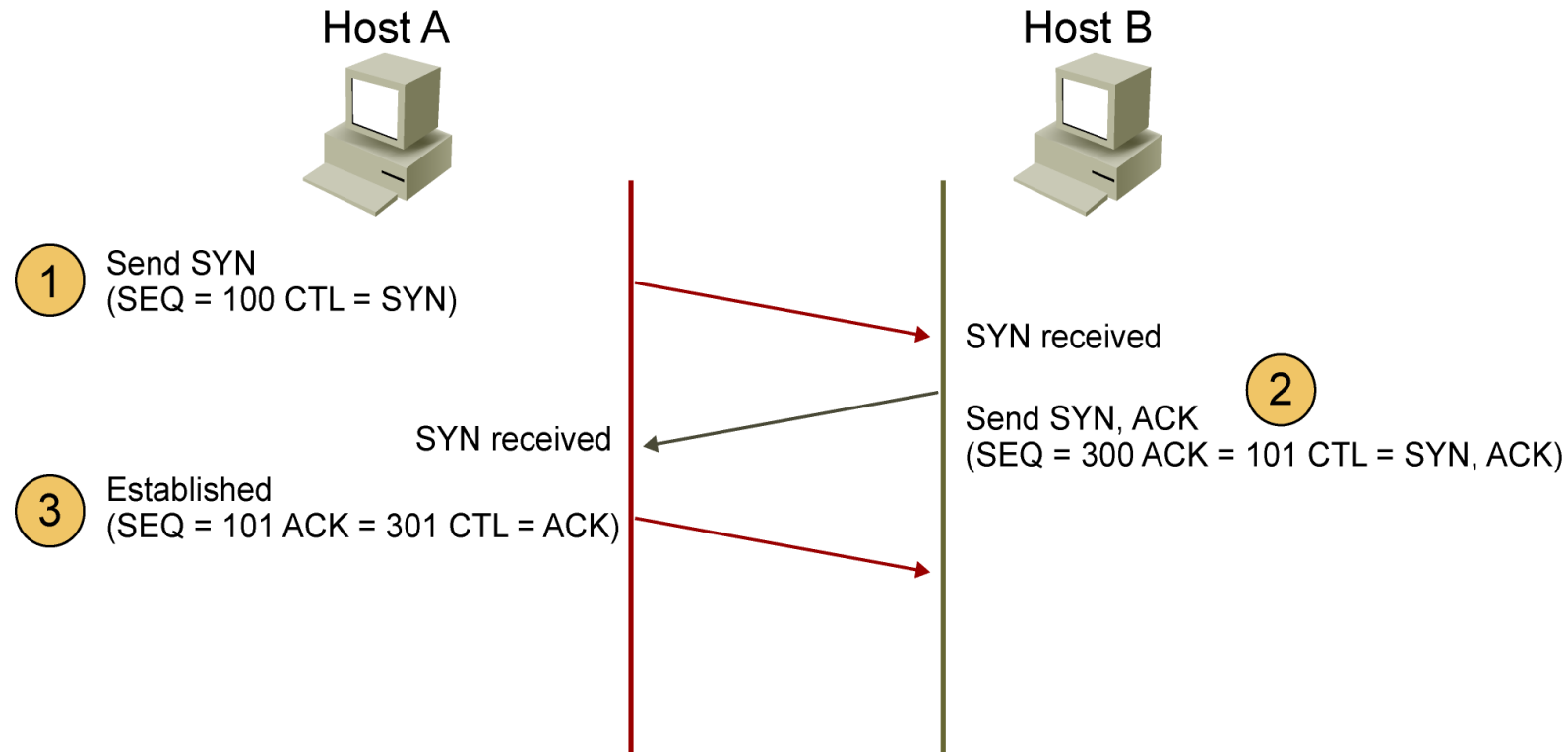
## ESTABLISHING A CONNECTION



# Part 1 (TCP/IP Protocol Architecture)



## THREE-WAY HANDSHAKE

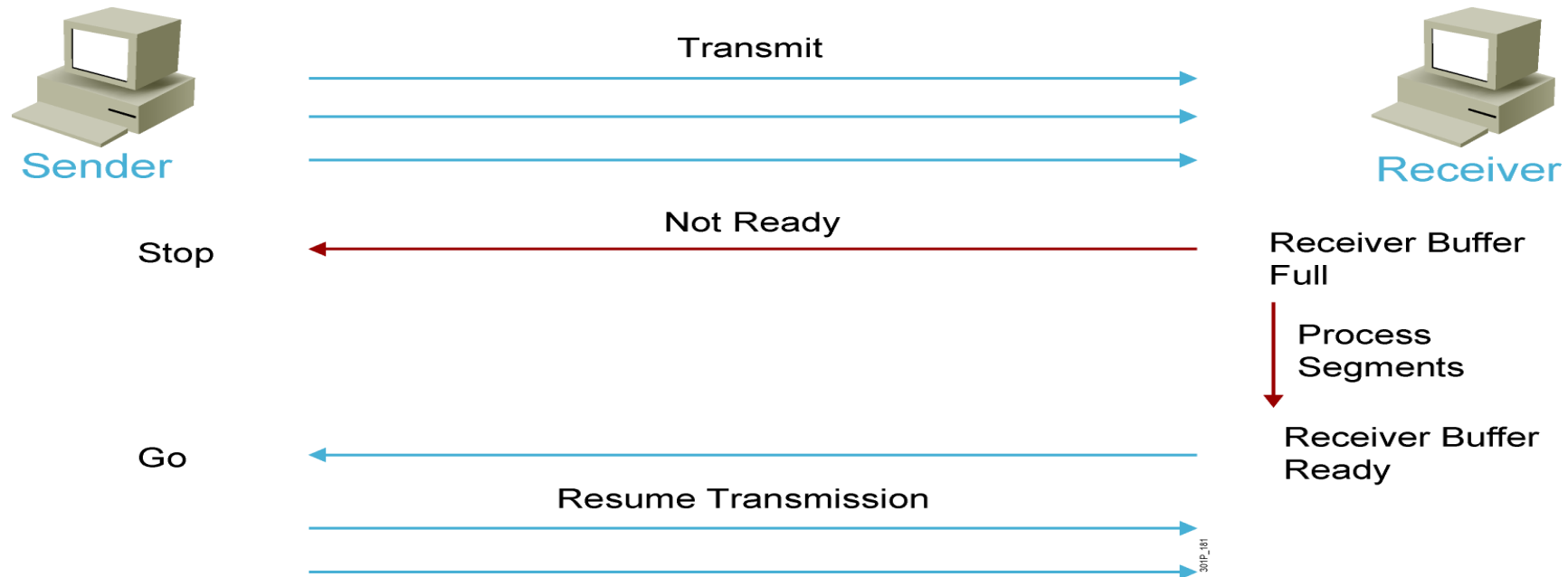


CTL = Which control bits in the TCP header are set to 1



# Part 1 (TCP/IP Protocol Architecture)

## Flow Control



### Flow Control:

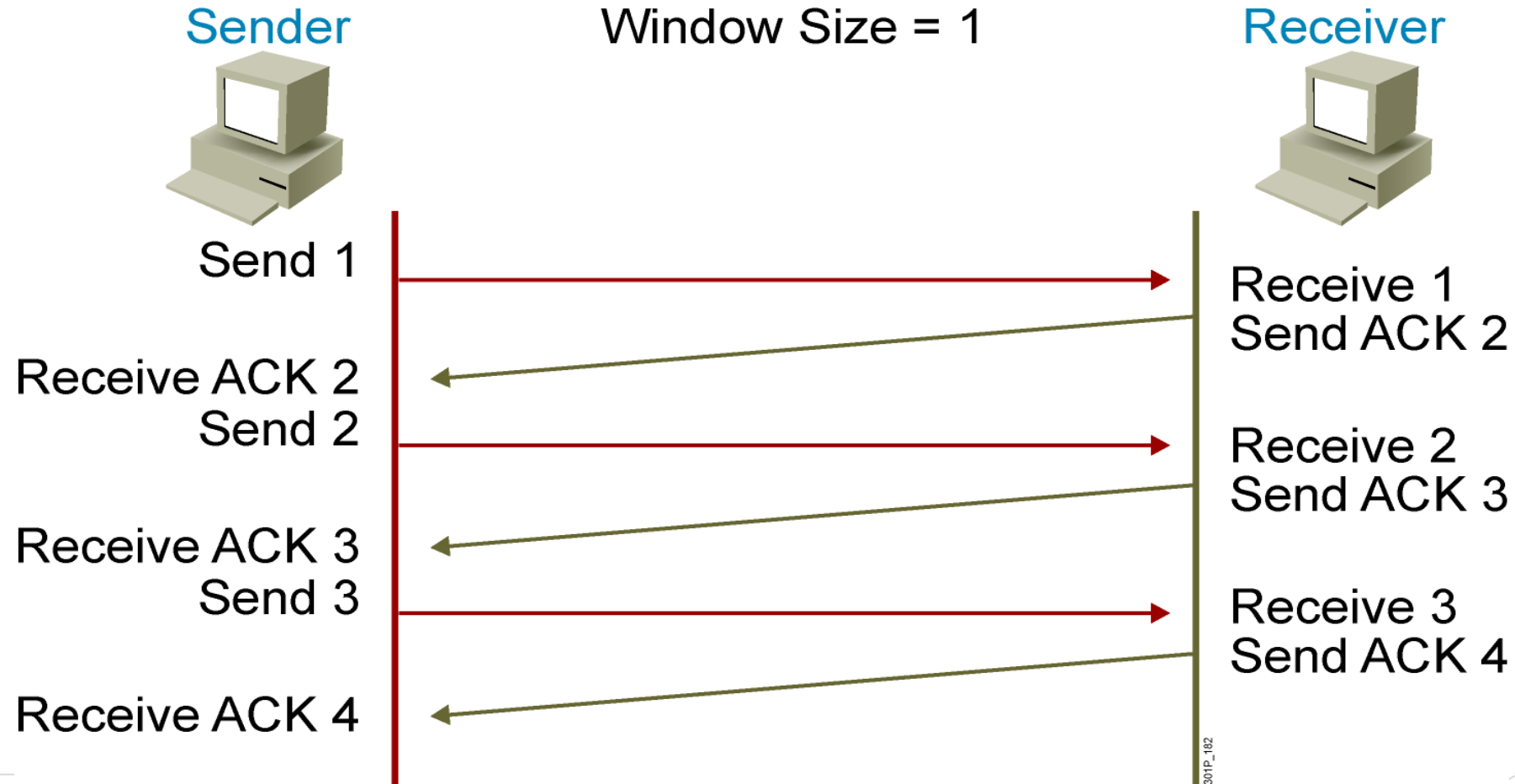
If the transmitter is sending data faster than the receiver so the receiver will drop the data and the retransmitting will waste time and network resources. The Round trip time will be very slow so we used **TCP windowing**



# Part 1 (TCP/IP Protocol Architecture)

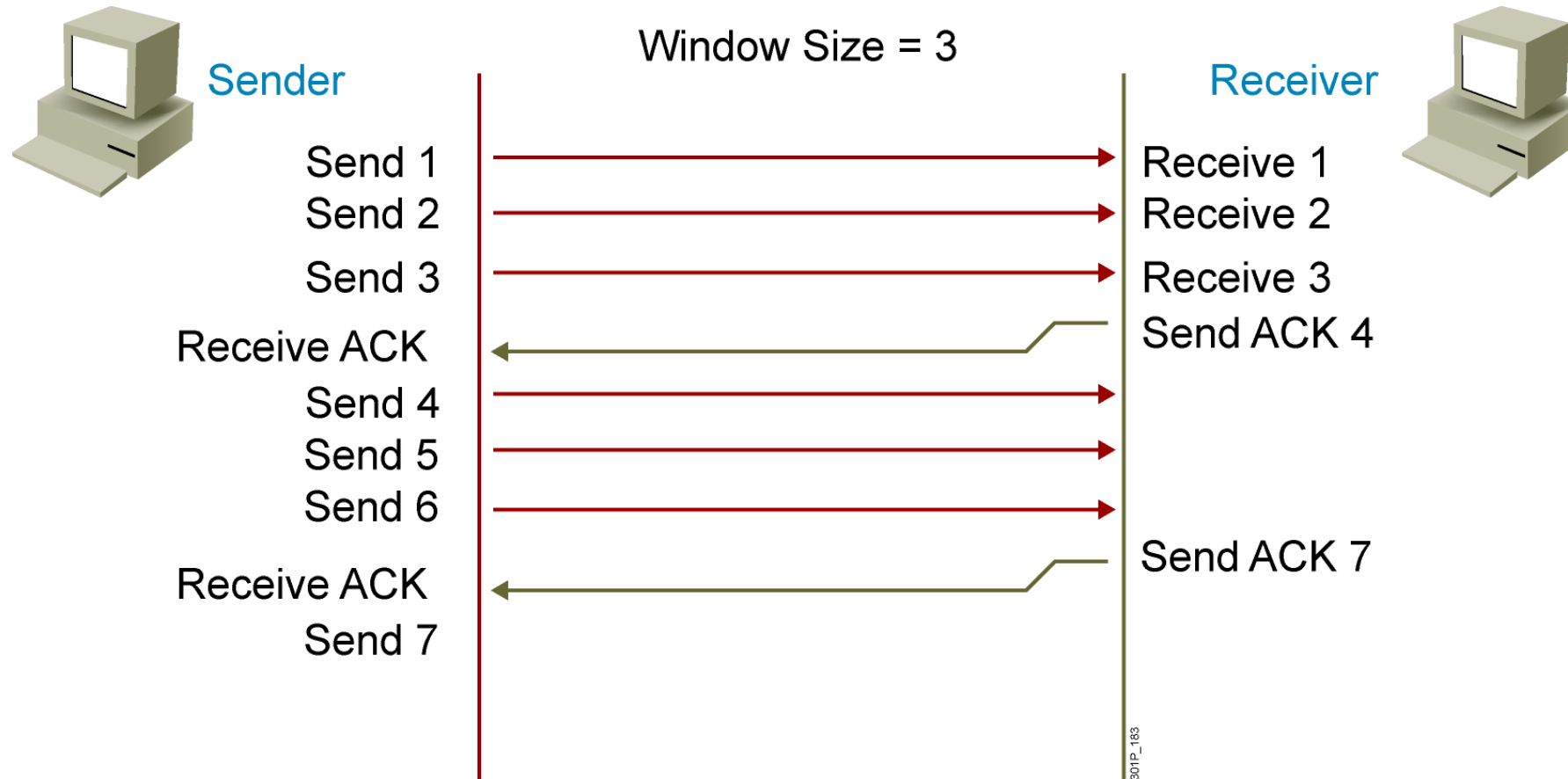


## TCP Acknowledgment



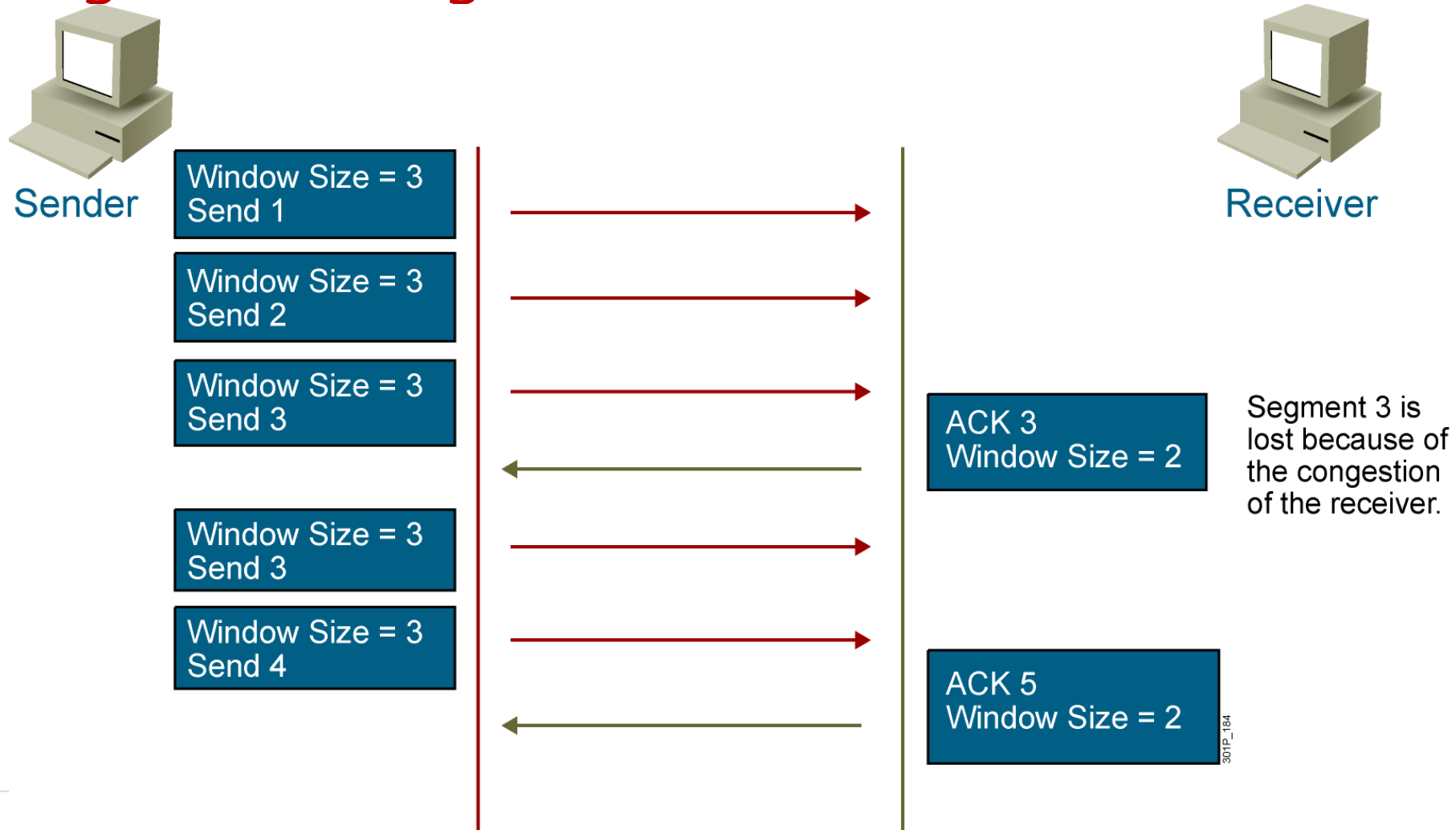
# Part 1 (TCP/IP Protocol Architecture)

## Fixed Windowing



# Part 1 (TCP/IP Protocol Architecture)

## TCP Sliding Windowing



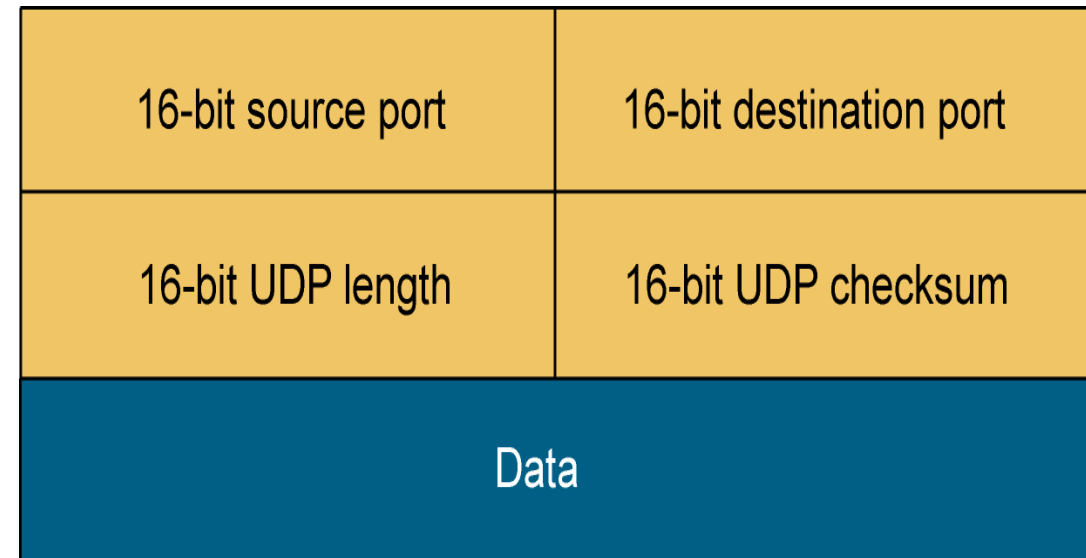
# Part 1 (TCP/IP Protocol Architecture)



## UDP Characteristics

- User Datagram Protocol / Transport layer protocol
- Process to process communication
  - Use port numbers
- **Connectionless** (no notification)
- Unreliable
- **Perform very limited error checking**
- Very simple using a minimum of overhead
- Provides best-effort delivery
  - The data may be dropped due to:
    - Routing Error,
    - Duplicate data due to redundancy
    - Data loss in its way due to TTL.
- **Has no data-recovery features**

## UDP Header



# Part 1 (TCP/IP Protocol Architecture)

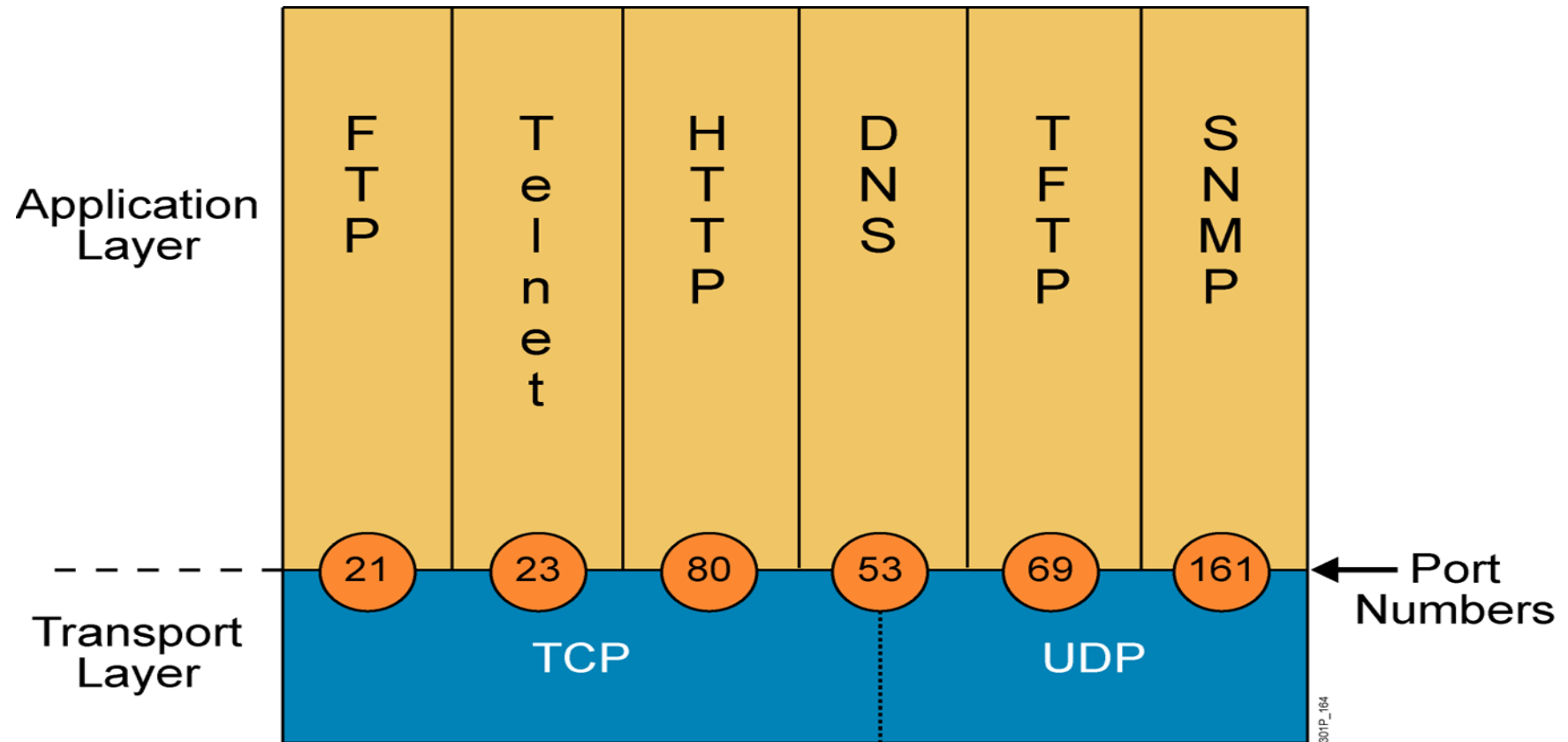


## TCP (Reliable) vs. UDP (Best-Effort Comparison)

	Reliable	Best-Effort
Connection Type	Connection-oriented	Connectionless
Protocol	TCP	UDP
Sequencing	Yes	No
Uses	<ul style="list-style-type: none"><li>■ E-mail</li><li>■ File sharing</li><li>■ Downloading</li></ul>	<ul style="list-style-type: none"><li>■ Voice streaming</li><li>■ Video streaming</li></ul>

# Part 1 (TCP/IP Protocol Architecture)

## Mapping Layer 4 to Applications



# Part 1 (TCP/IP Protocol Architecture)



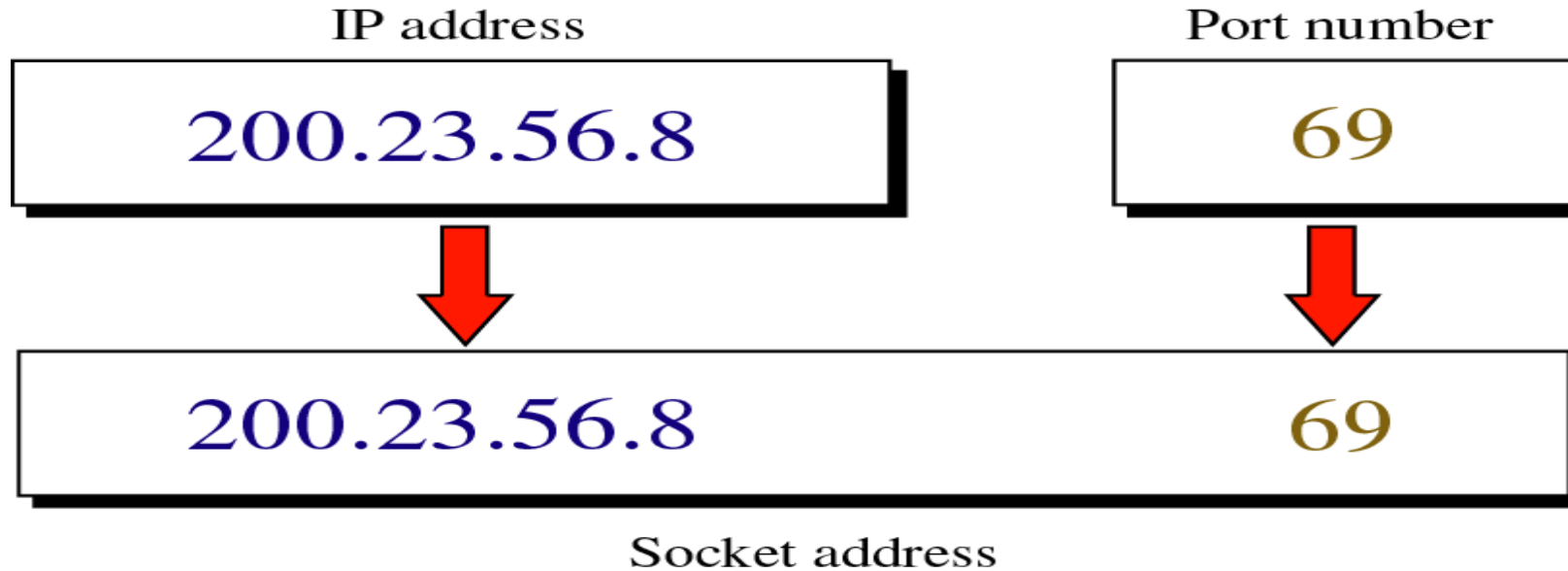
## Port Numbers

- **Well Known ports**
  - Range from 0 to 1,023 are assigned and controlled by ICANN
- **Registered ports**
  - Range from 1,024 to 49,151 not assigned or controlled by ICANN but can be registered at ICANN to avoid duplication
- **Dynamic ports**
  - Range from 49,152 to 65,535 are neither controlled nor registered
- [https://en.wikipedia.org/wiki/List\\_of\\_TCP\\_and\\_UDP\\_port\\_numbers](https://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers)



# Part 1 (TCP/IP Protocol Architecture)

## Socket Address





# Part 1 (TCP/IP Protocol Architecture)- LAB



## ❖ NETSTATE

netstat -n

netstat -a

To know session and ports on your device

```
Command Prompt
^C
C:\Users\ITD-mabdsalam>netstat -n

Active Connections

Proto Local Address          Foreign Address         State
TCP    127.0.0.1:40000         127.0.0.1:49673        ESTABLISHED
TCP    127.0.0.1:49673         127.0.0.1:40000        ESTABLISHED
TCP    127.0.0.1:52786         127.0.0.1:60014        ESTABLISHED
TCP    127.0.0.1:52787         127.0.0.1:60012        ESTABLISHED
TCP    127.0.0.1:60010         127.0.0.1:60158        ESTABLISHED
TCP    127.0.0.1:60012         127.0.0.1:52787        ESTABLISHED
TCP    127.0.0.1:60014         127.0.0.1:52786        ESTABLISHED
TCP    127.0.0.1:60014         127.0.0.1:60157        ESTABLISHED
TCP    127.0.0.1:60154         127.0.0.1:62522        ESTABLISHED
TCP    127.0.0.1:60156         127.0.0.1:62522        ESTABLISHED
TCP    127.0.0.1:60157         127.0.0.1:60014        ESTABLISHED
TCP    127.0.0.1:60158         127.0.0.1:60010        ESTABLISHED
TCP    127.0.0.1:62522         127.0.0.1:60154        ESTABLISHED
```



**Thank You**

