



ITI

**Introduction to
Computer Networks & Cyber Security
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Part 1 (TCP/IP Protocol Architecture)

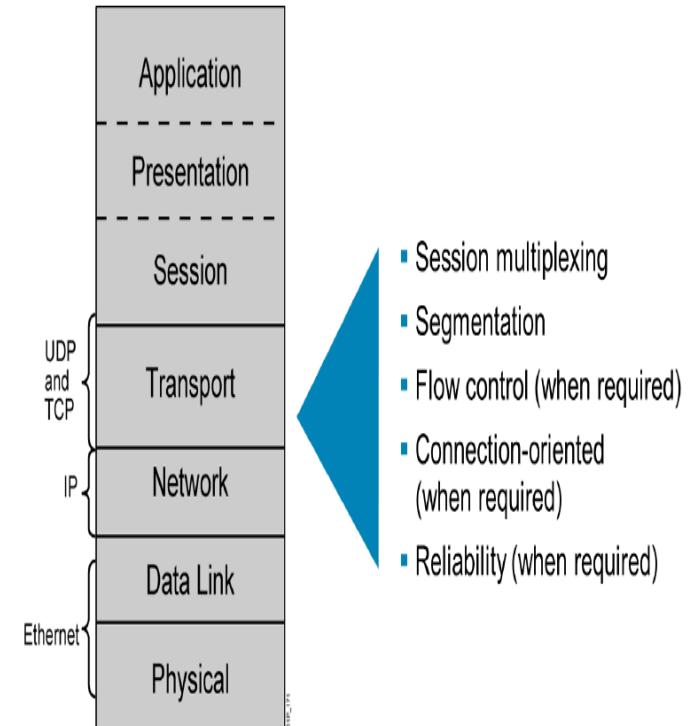
Transport Layer

Basic Network Elements (Software)



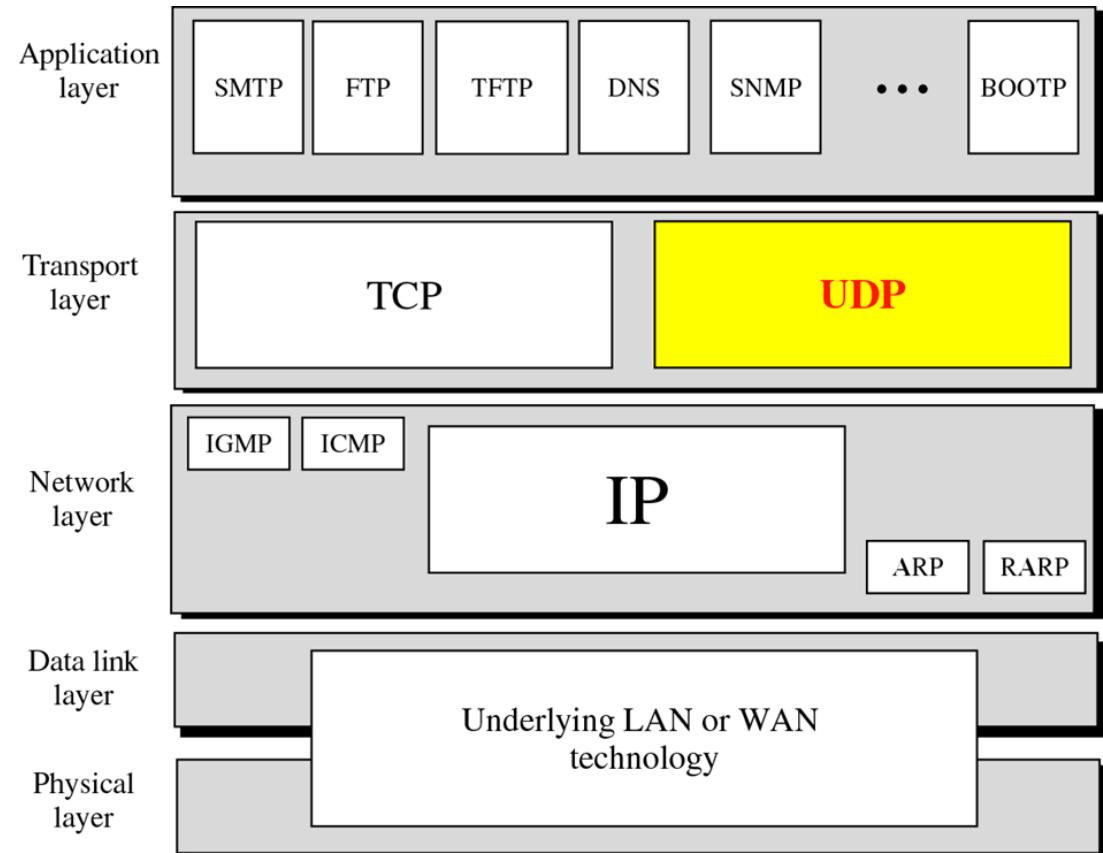
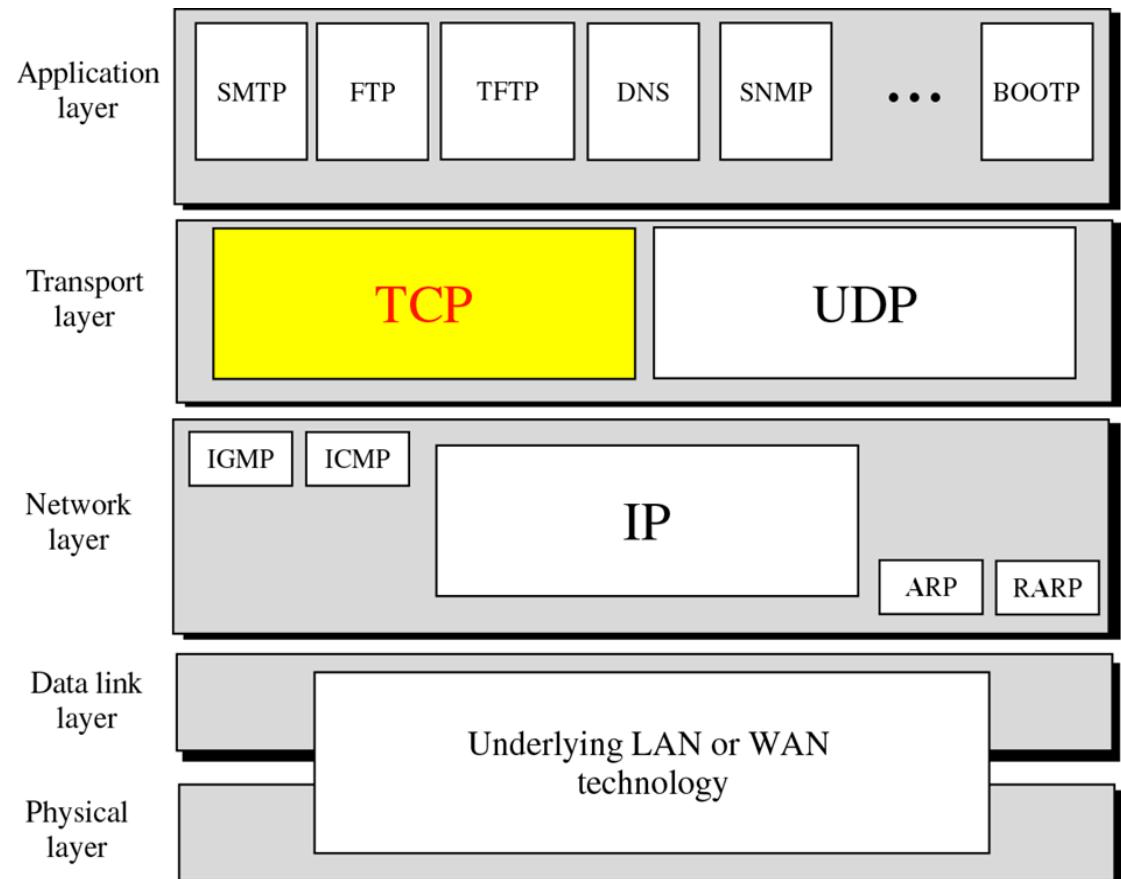
Transport Layer

- **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



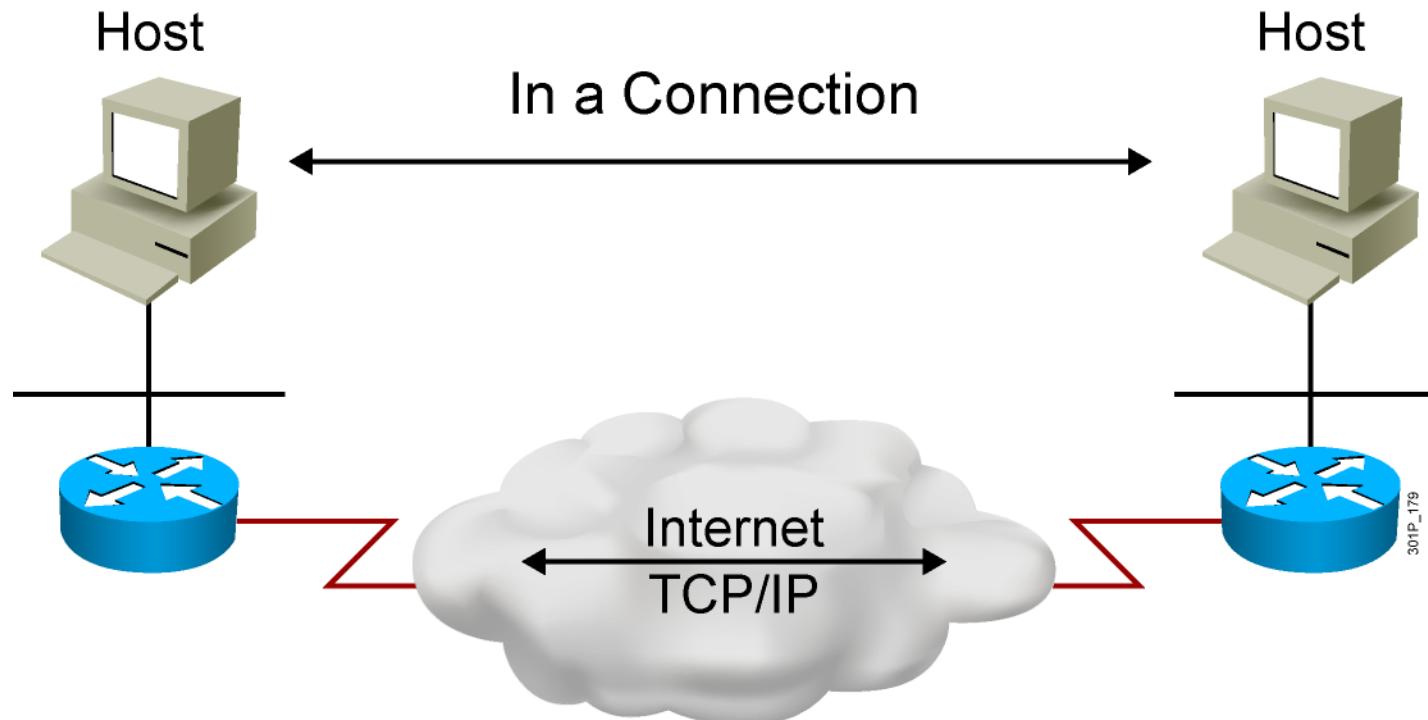
No internet

TCP Header

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

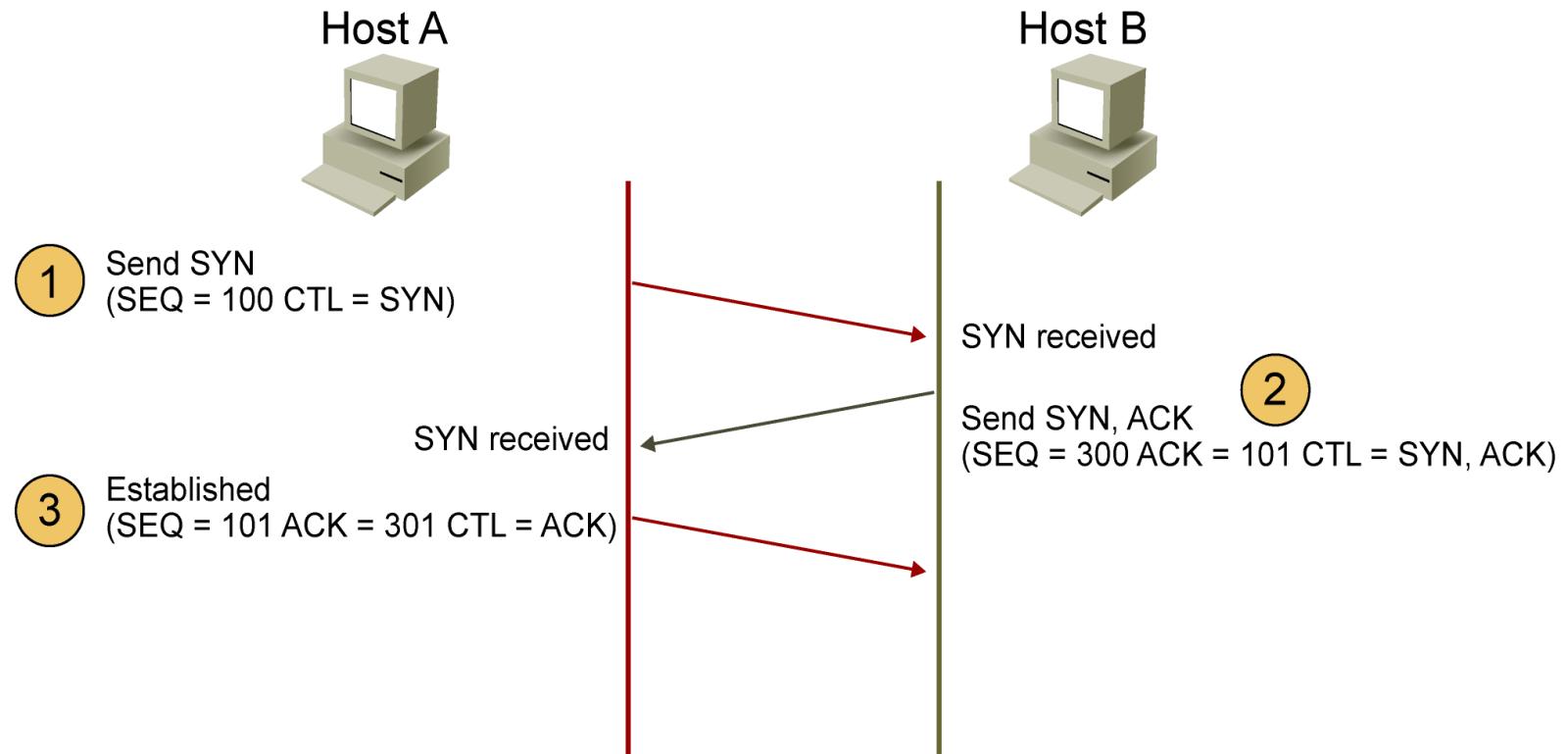
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ESTABLISHING A CONNECTION



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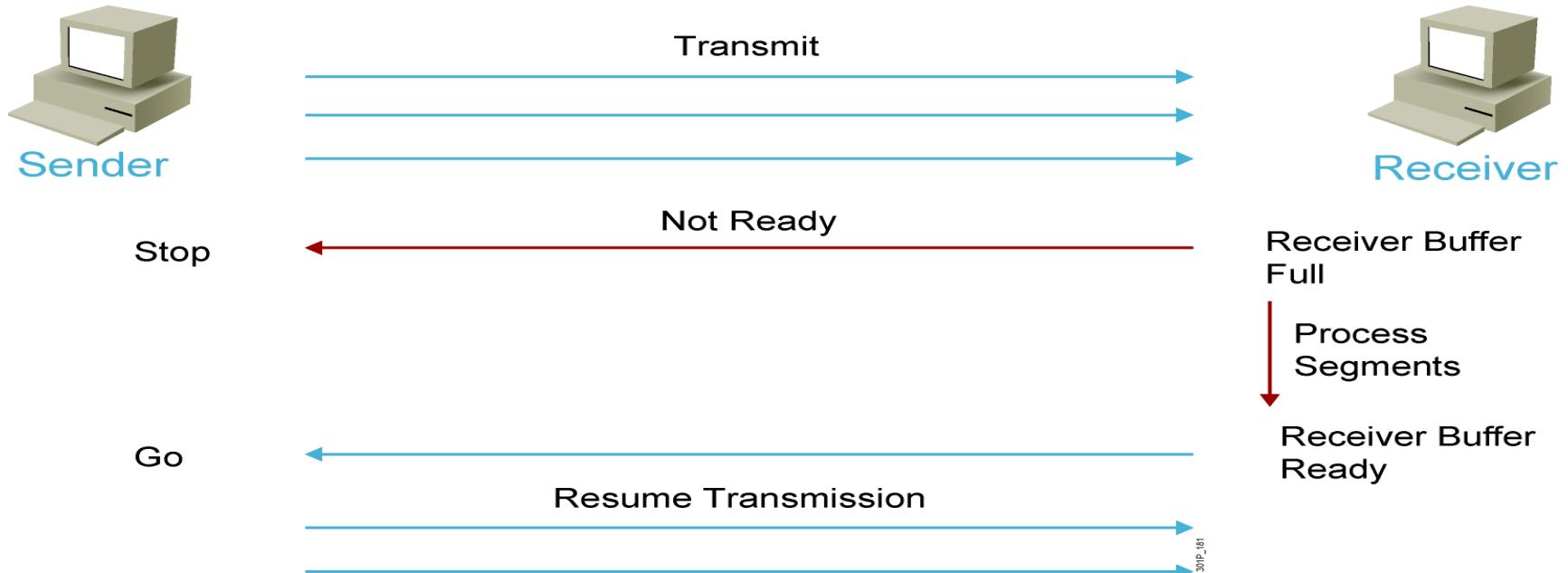
THREE-WAY HANDSHAKE



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

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Flow Control

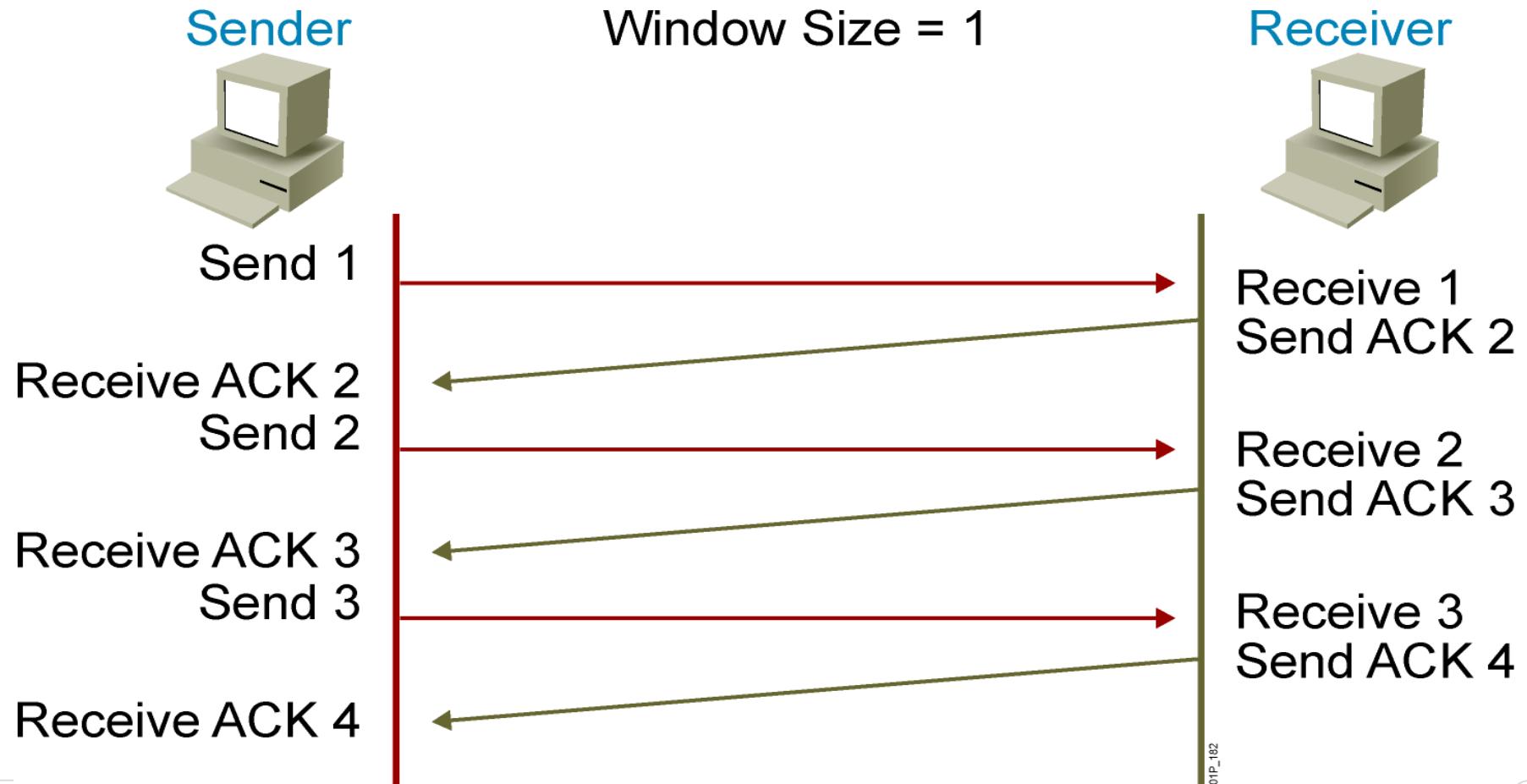


Flow Control:

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**

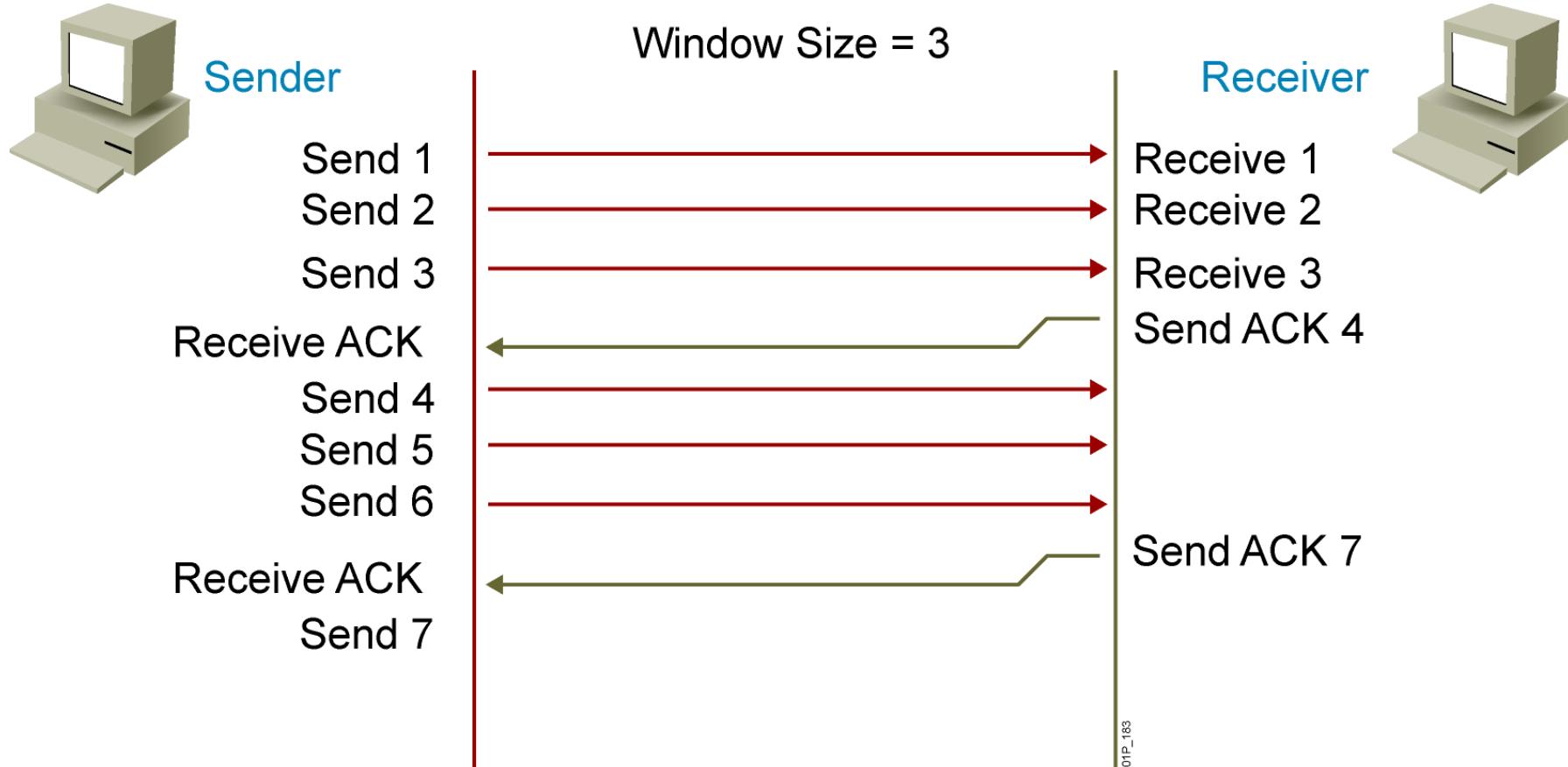
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TCP Acknowledgment



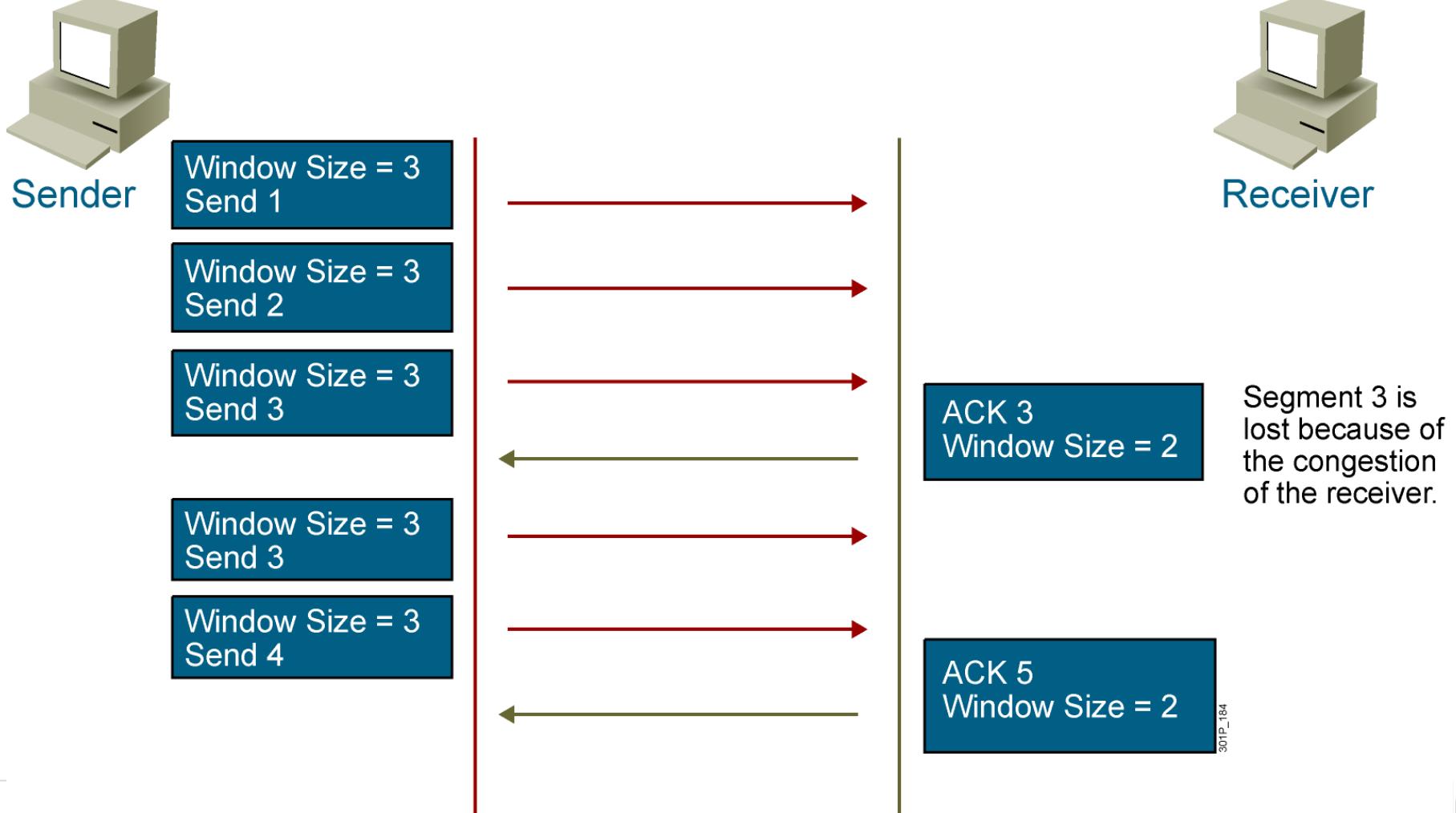
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Fixed Windowing



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TCP Sliding Windowing



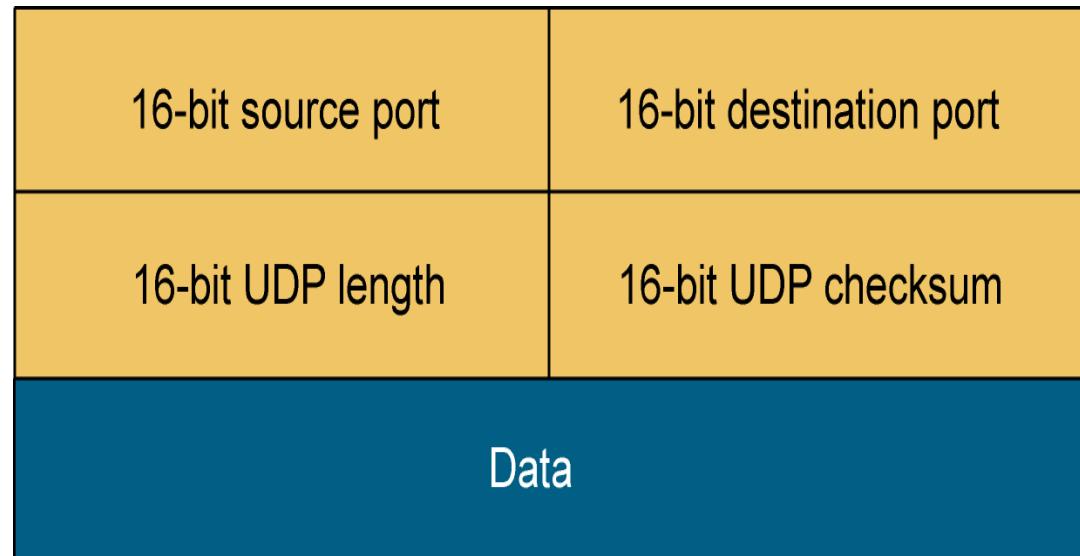
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UDP Characteristics

- 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



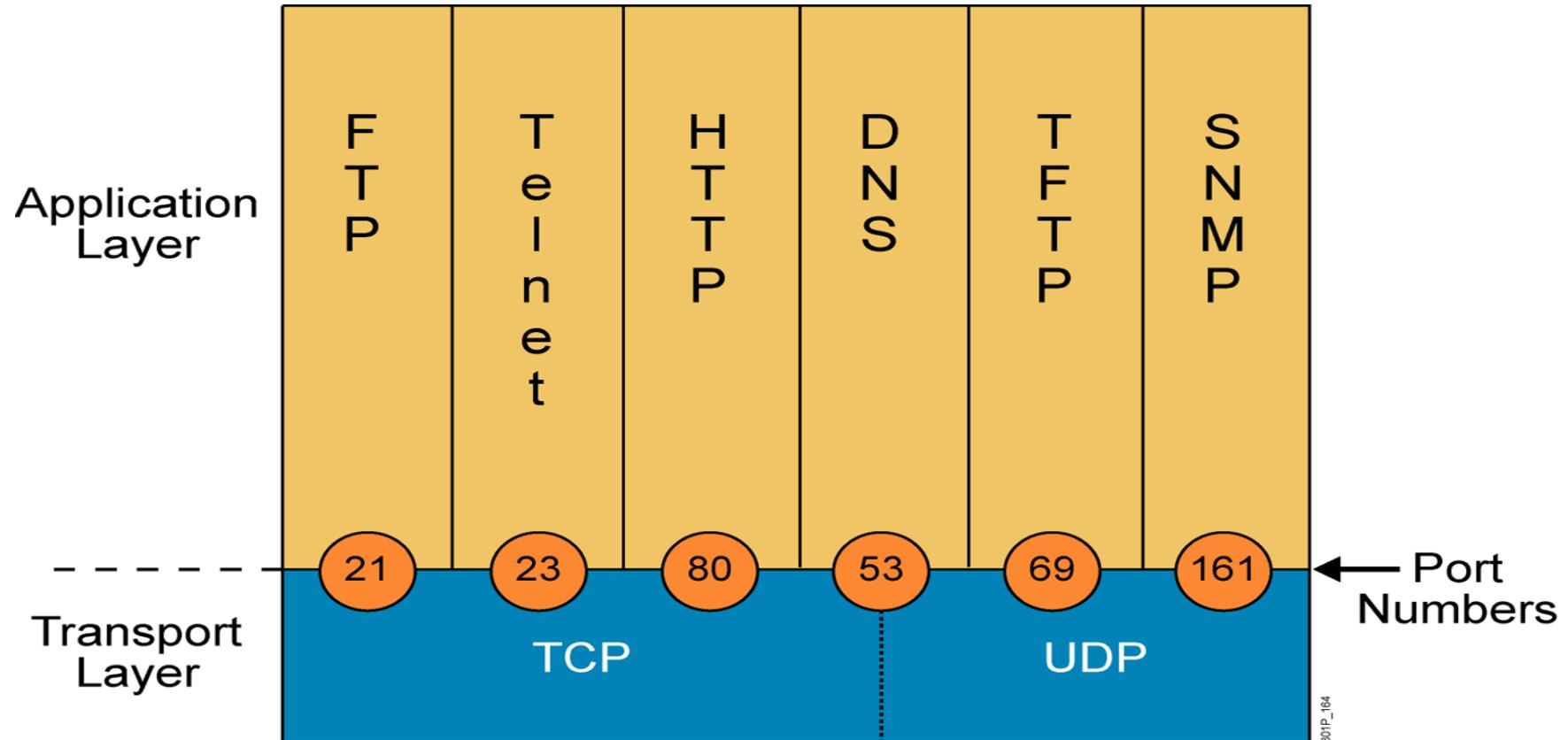
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TCP (Reliable) vs. UDP (Best-Effort Comparison)

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

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Mapping Layer 4 to Applications



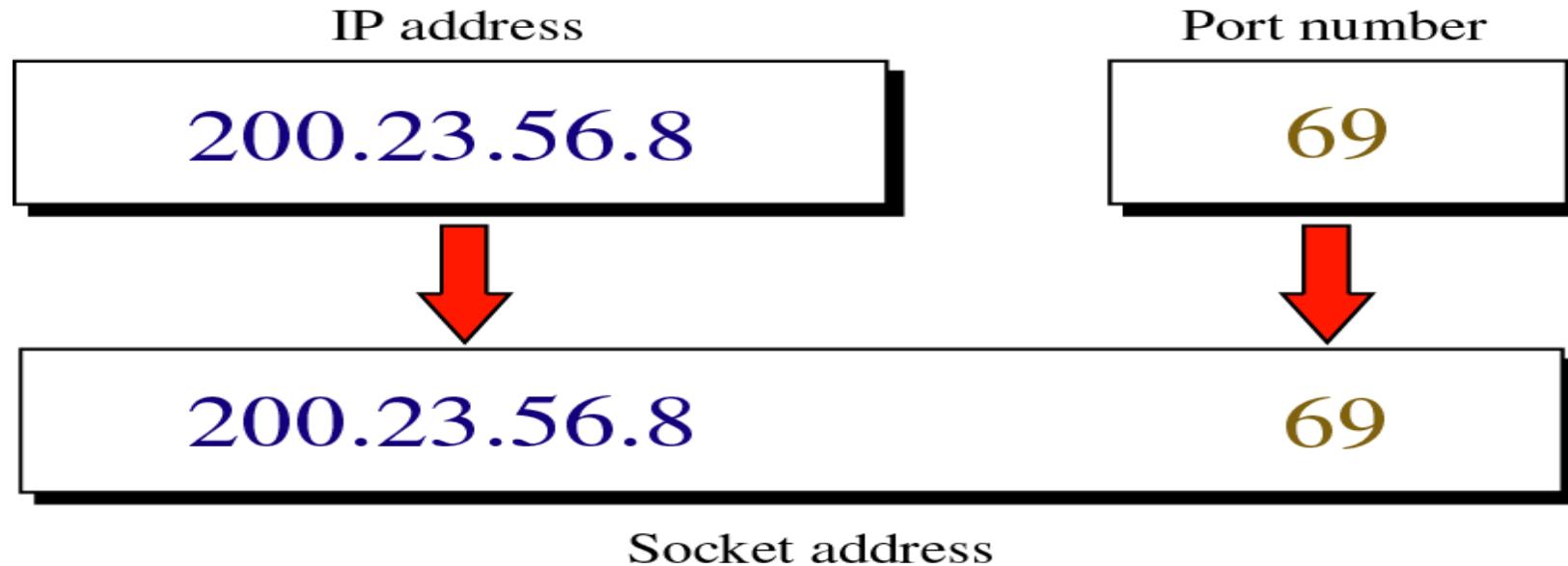


Port Numbers

- **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

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Socket Address



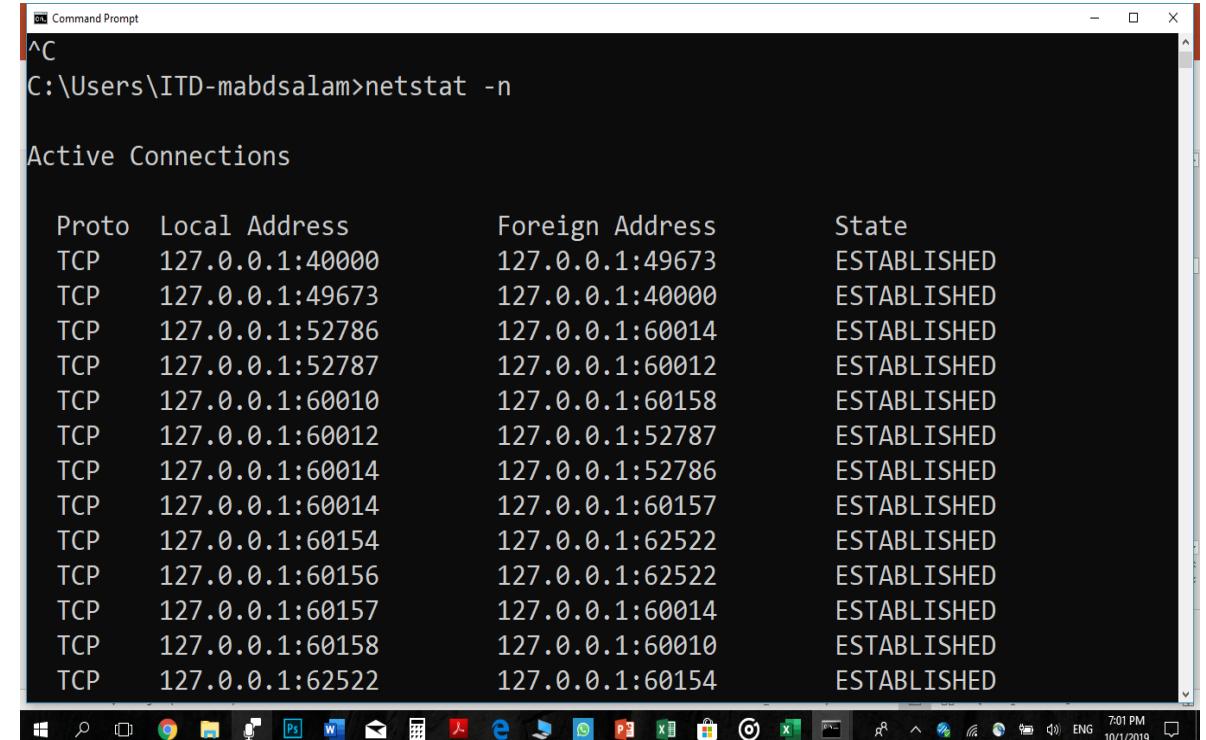
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❖ NETSTATE

netstat -n

netstat -a

To know session and ports on your device



The screenshot shows a Windows Command Prompt window titled 'Command Prompt'. The command 'netstat -n' is entered, followed by the output 'Active Connections' table. The table lists 14 TCP connections on port 127.0.0.1, all in ESTABLISHED state.

| 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

