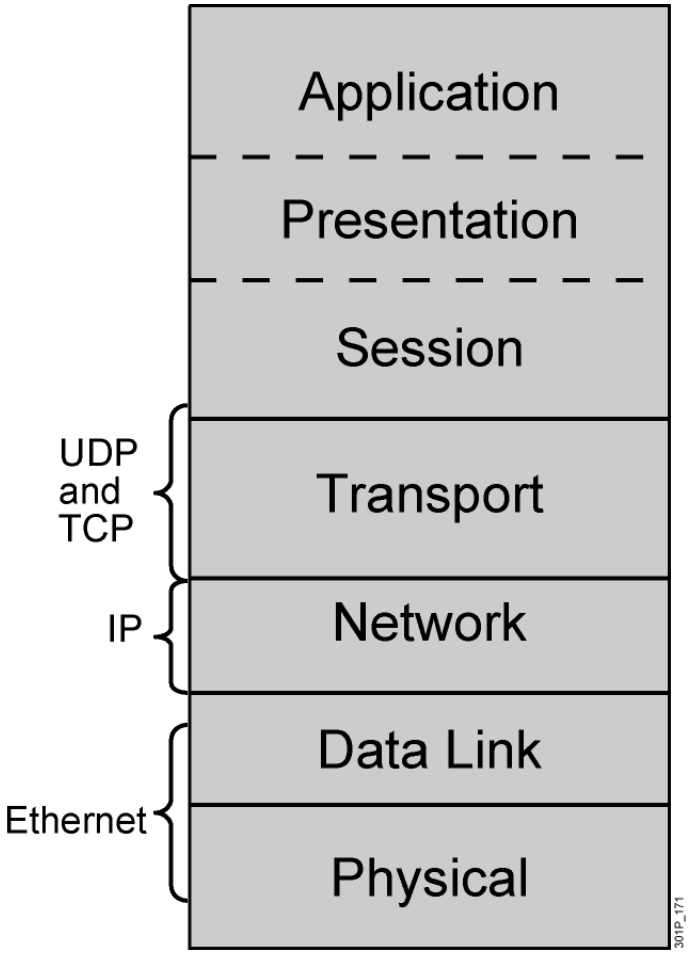
Understanding the TCP/IP Transport Layer

Building a Simple Network

Transport Layer



- Session multiplexing
- Segmentation
- Flow control (when required)
- Connection-oriented (when required)
- Reliability (when required)

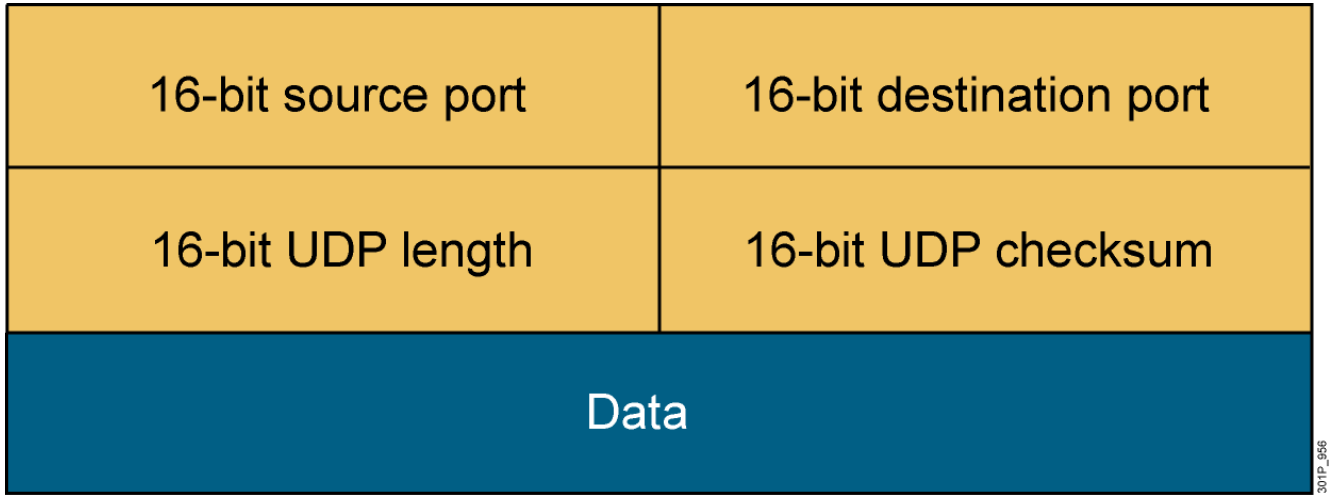
Reliable vs. Best-Effort Comparison

	Reliable	Best-Effort
Connection Type	Connection-oriented	Connectionless
Protocol	TCP	UDP
Sequencing	Yes	No
Uses	▪ E-mail ▪ File sharing ▪ Downloading	▪ Voice streaming ▪ Video streaming

UDP Characteristics

- Operates at transport layer of OSI and TCP/IP models
- Provides applications with access to the network layer without the overhead of reliability mechanisms
- Is a connectionless protocol
- Provides limited error checking
- Provides best-effort delivery
- Has no data-recovery features

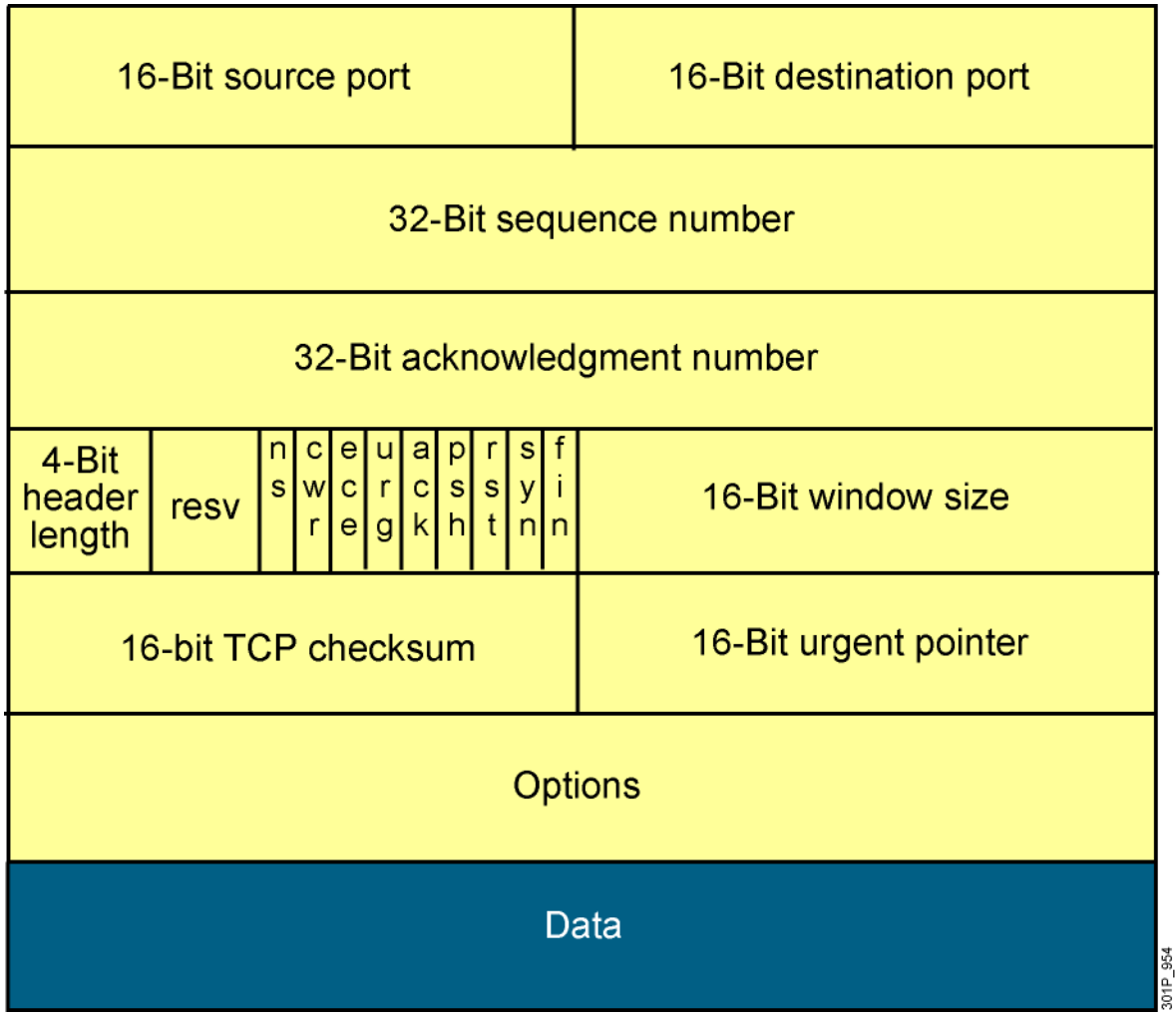
UDP Header



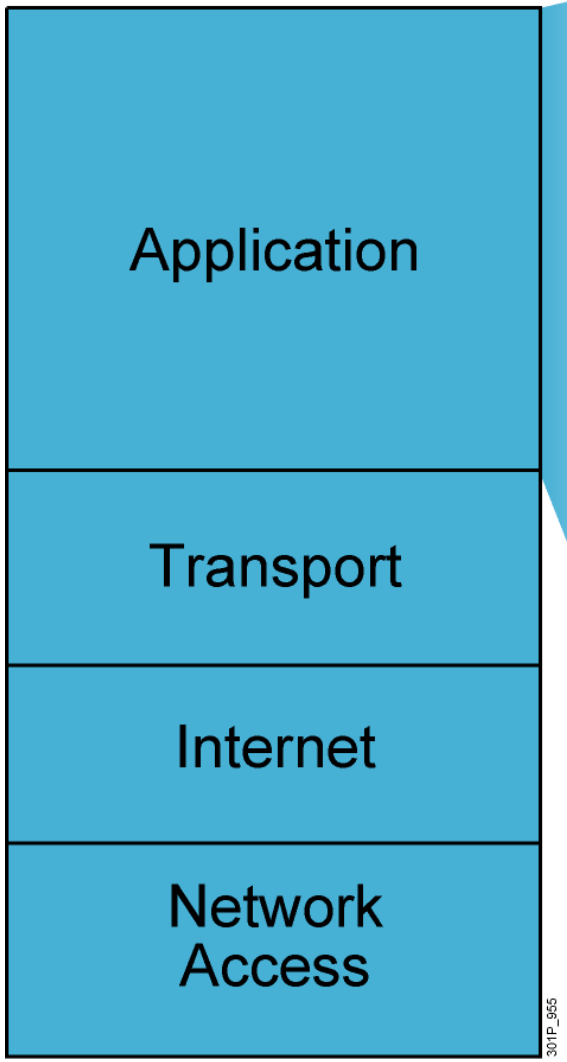
TCP Characteristics

- Transport layer of the TCP/IP stack
- Access to the network layer for applications
- Connection-oriented protocol
- Full-duplex mode operation
- Error checking
- Sequencing of data packets
- Acknowledgement of receipt
- Data-recovery features

TCP Header

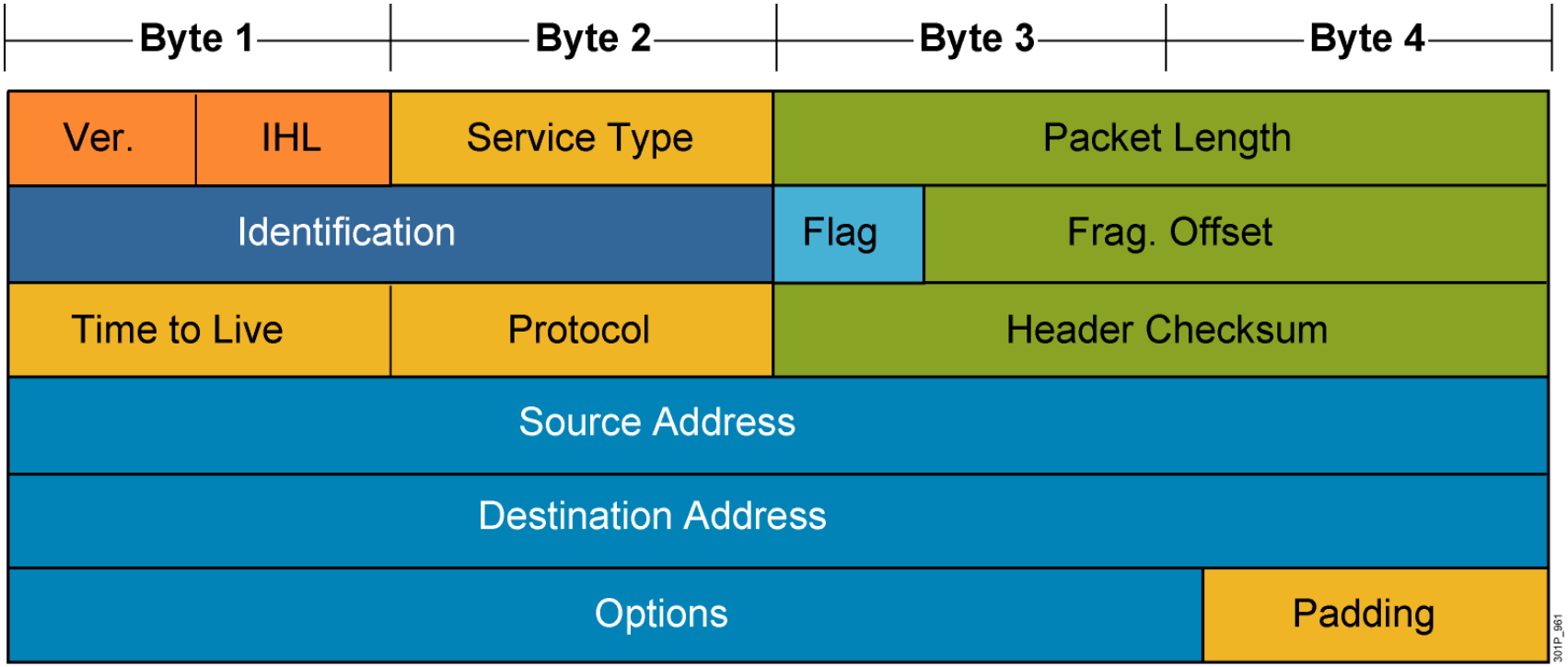


TCP/IP Application Layer Overview

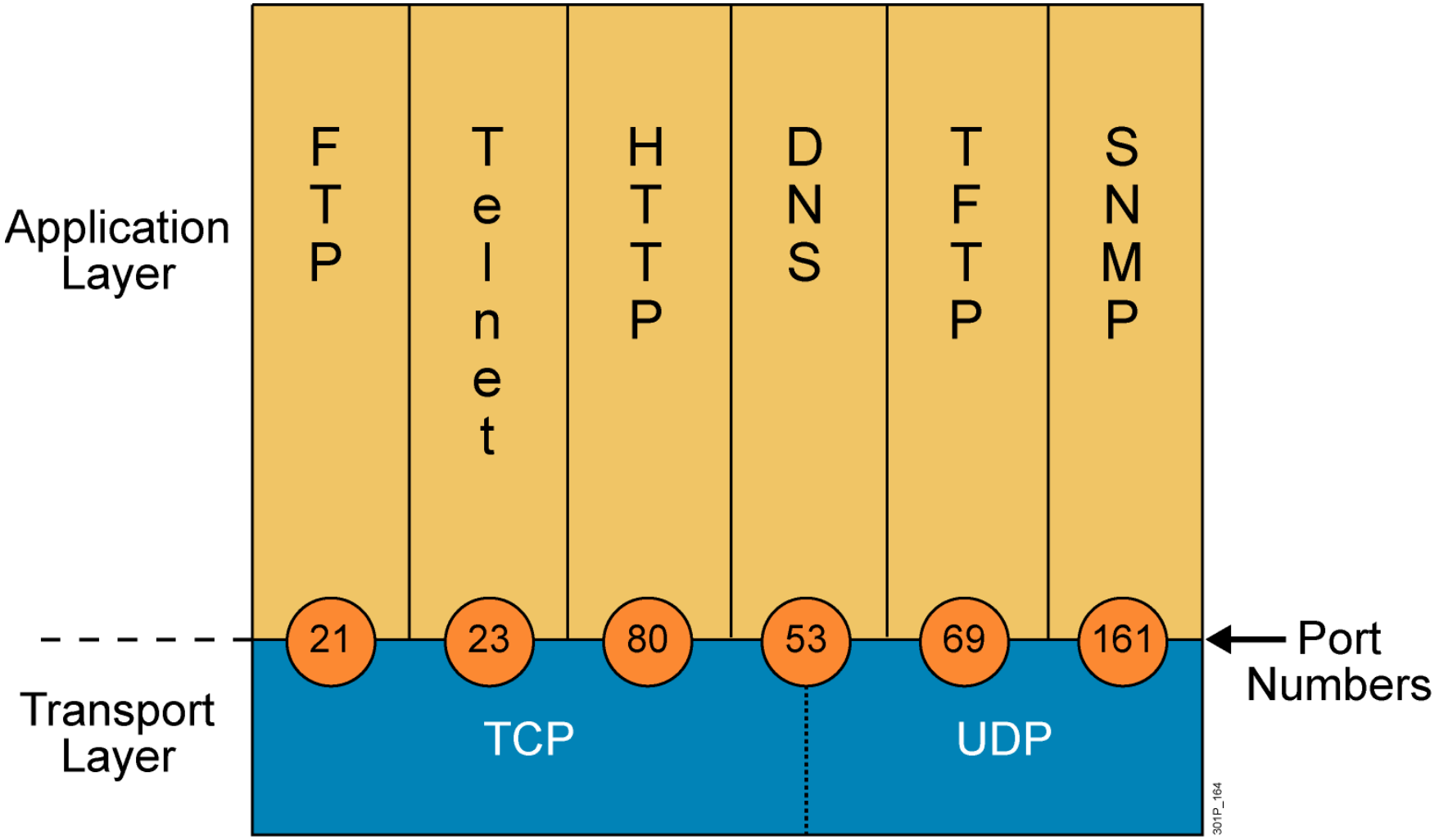


- File transfer
  - FTP
  - TFTP
  - Network File System
- E-mail
  - Simple Mail Transfer Protocol
- Remote login
  - Telnet
  - rlogin
- Network management
  - Simple Network Management Protocol
- Name management
  - Domain Name System

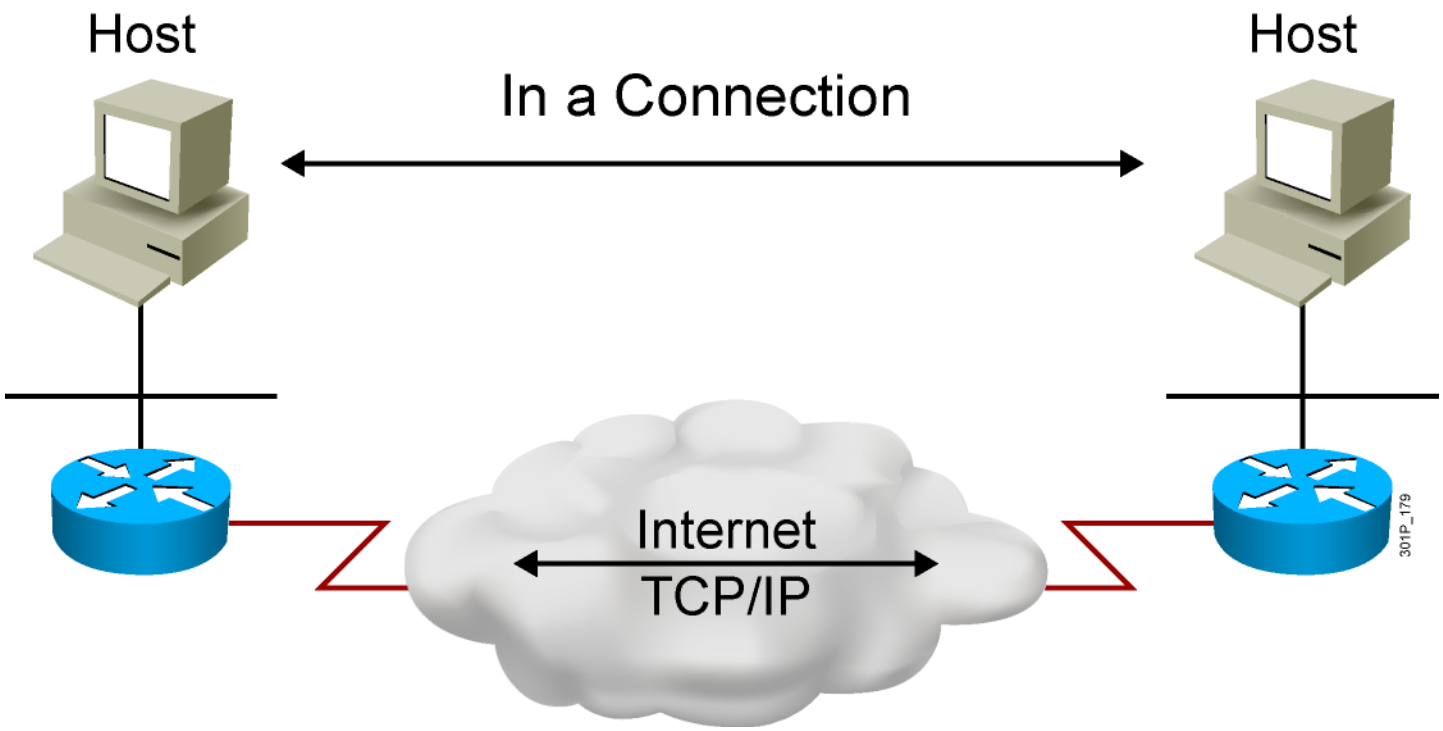
Mapping Layer 3 to Layer 4



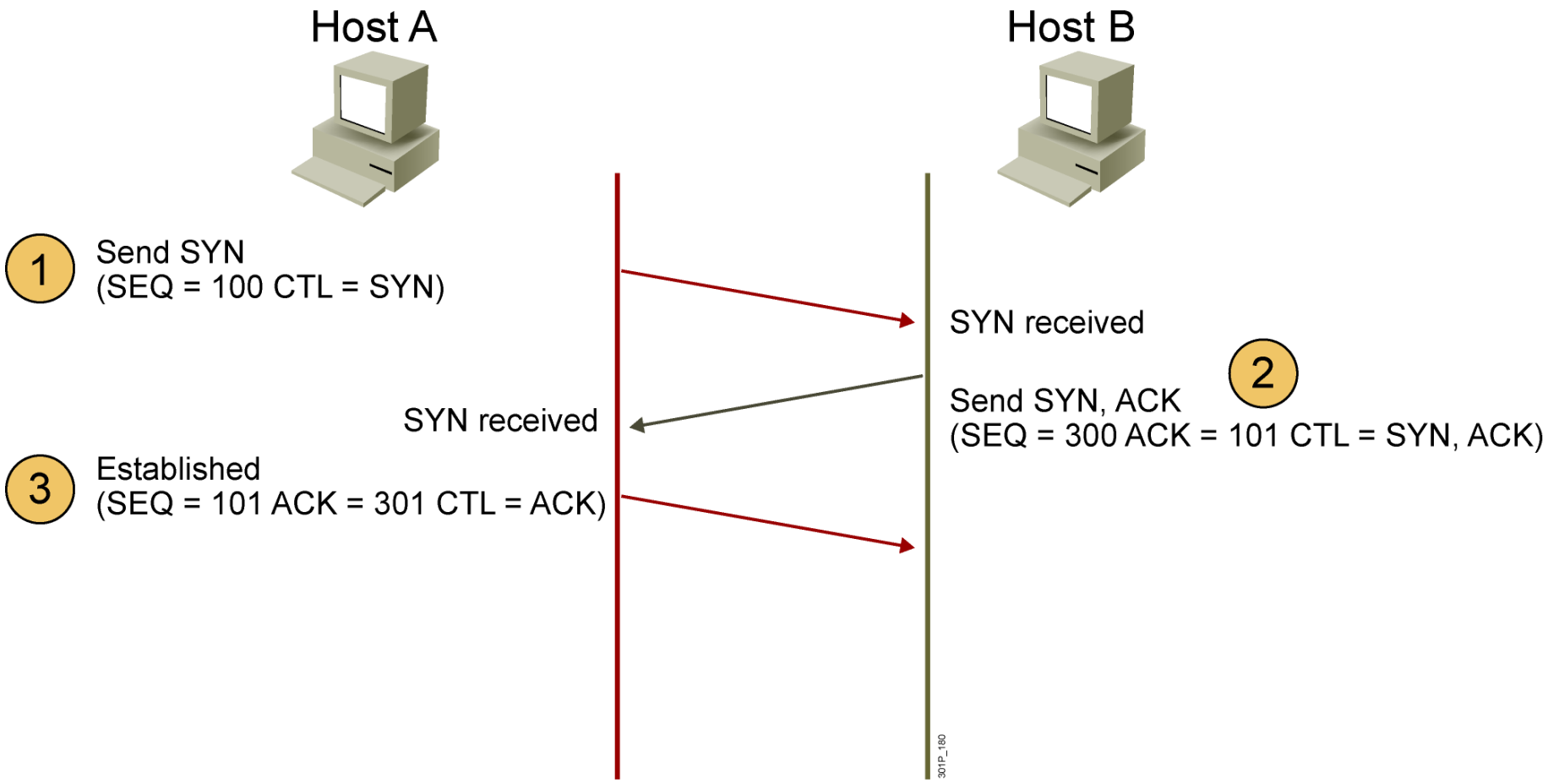
Mapping Layer 4 to Applications



Establishing a Connection

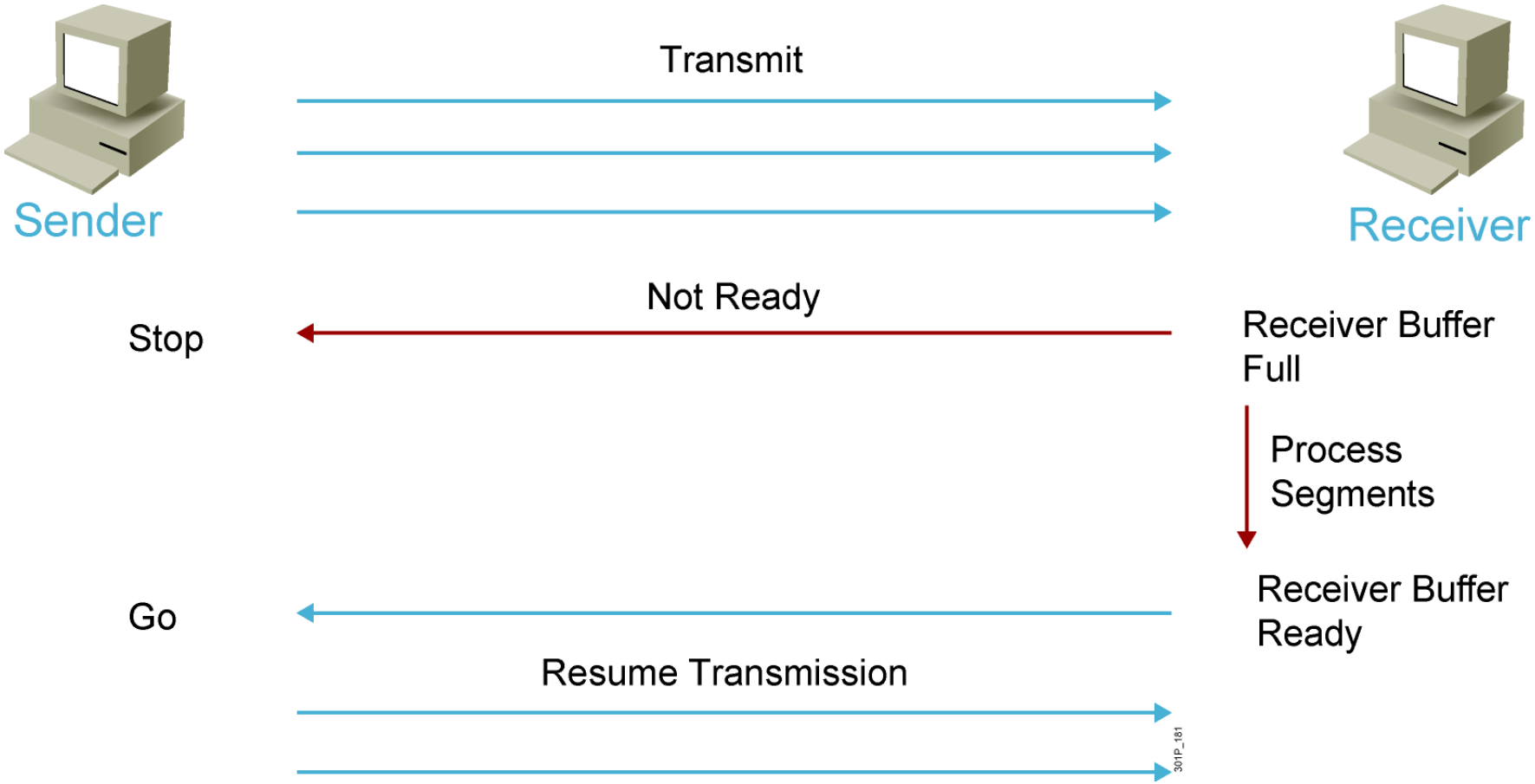


Three-Way Handshake

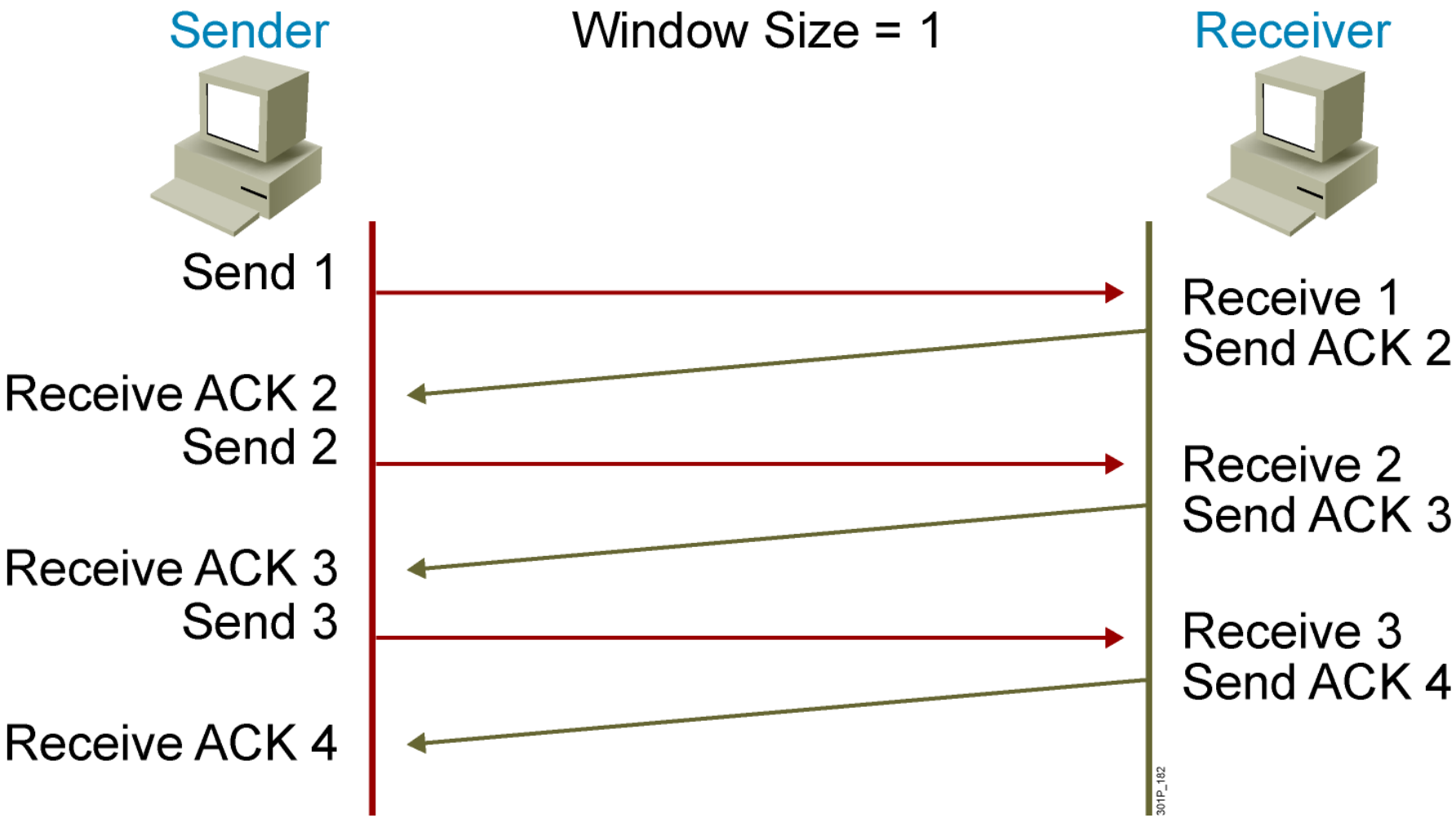


CTL = Which control bits in the TCP header are set to 1

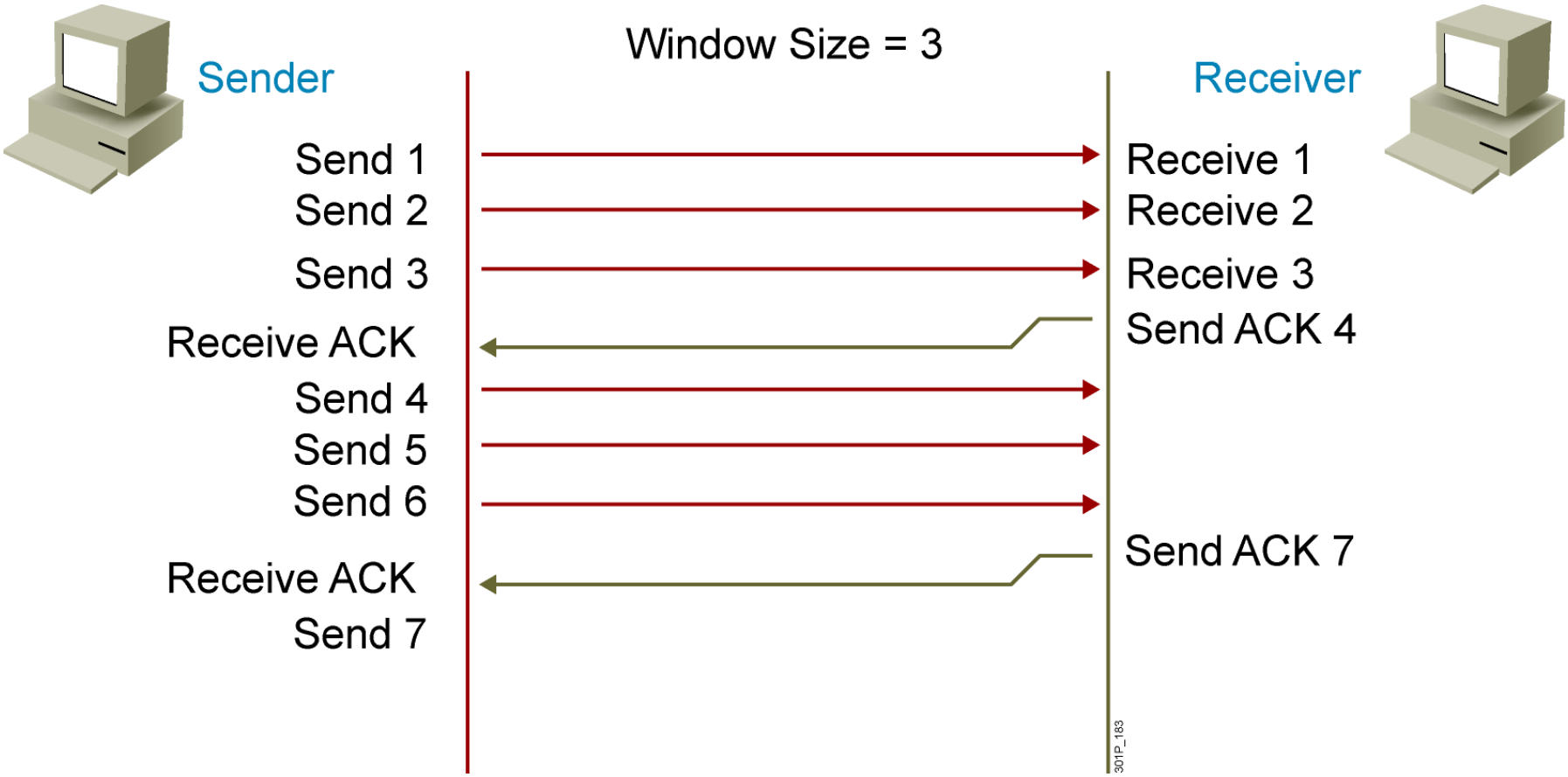
Flow Control



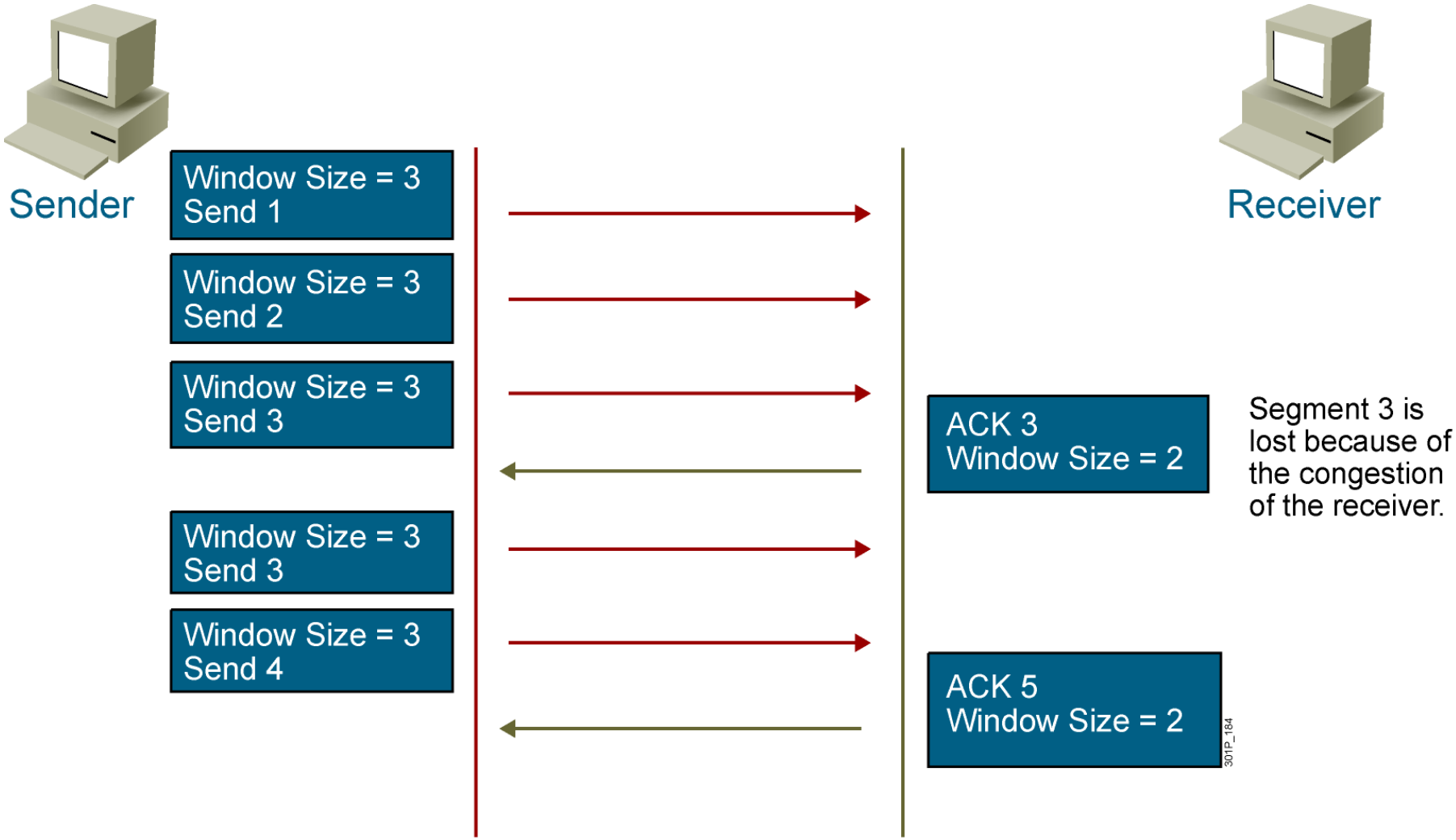
TCP Acknowledgment



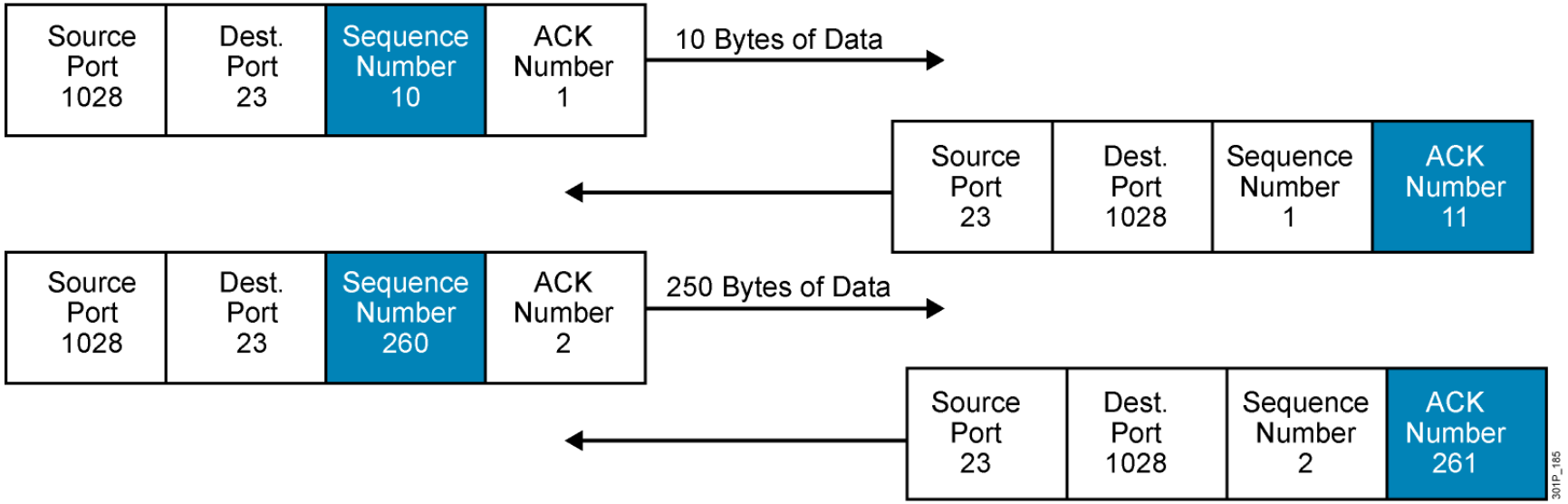
Fixed Windowing



TCP Sliding Windowing



TCP Sequence and Acknowledgment Numbers



Summary

- The purpose of the transport layer is to hide the network requirements from the application layer.
- Connection-oriented transport provides reliable transport; connectionless transport provides best-effort transport.
- UDP is a protocol that operates at the transport layer and provides applications with access to the network layer without the overhead of the reliability mechanisms of TCP. UDP is a connectionless, best-effort delivery protocol.
- TCP is a protocol that operates at the transport layer and provides applications with access to the network layer. TCP is connection-oriented, provides error checking, delivers data reliably, operates in full-duplex mode, and provides some data recovery functions.

Summary (Cont.)

- TCP/IP supports a number of applications, including FTP (supports bidirectional binary and ASCII file transfers), TFTP (transfers configuration files and Cisco IOS images), and Telnet (provides capability to remotely access another computer).
- IP uses a protocol number in the datagram header to identify which protocol to use for a particular datagram.
- Port numbers are used to map Layer 4 to an application.

Summary (Cont.)

- Flow control avoids the problem of a transmitting host overflowing the buffers in the receiving host and slowing network performance.
- TCP provides sequencing of segments with a forward reference acknowledgment. When a single segment is sent, receipt is acknowledged and the next segment is then sent.

Summary (Cont.)

- The TCP window size decreases the transmission rate to a level at which congestion and data loss do not occur. The TCP window size allows a specified number of unacknowledged segments to be sent.
- A fixed window is a window with an unchanging size that can accommodate a specific flow of segments.
- A TCP sliding window is a window that can change size dynamically to accommodate the flow of segments.
- TCP provides the sequencing of segments by providing sequence numbers and acknowledgment numbers in TCP headers.