

transport-layer protocols, 50, 91  
 end systems implementation, 186  
 IP datagrams, 334  
 living in end systems, 188  
 logical communication between processes, 186, 188–189  
 reliable data transfer, 91  
 reliable delivery, 436  
 security, 93, 705  
 TCP (Transmission Control Protocol), 189  
 throughput, 92  
 timing, 92–93  
 UDP (User Datagram Protocol), 189  
 Transport Layer Security. *See* TLS  
 transport-layer segments, 54–55, 186  
 datagrams, 242  
 delivering data to correct socket, 191–198  
 fields, 191  
 unreliability, 242  
 transport mode, 721  
 transport protocols  
   Internet applications, 96  
   services, 189  
   SSL (Secure Sockets Layer), 712  
   TCP, 51  
   UDP, 51  
 transport services  
   available to applications, 91–93  
   connection-oriented service, 94  
   provided by Internet, 93–96  
   reliable data transfer, 91  
   security, 93  
   TCP services, 94–95  
   throughput, 92  
   timing, 92–93  
   UDP, 95  
 trap messages, 773  
 tree-join messages, 404–405  
 triangle routing problem, 563  
 triple-DES, 710  
 truncation attack, 717  
 TTL (time-to-live) field, 139–140, 334  
 tunneling, 360–361, 561

tunnel mode, 721–722  
 twisted-pair copper wire, 19–20, 475  
 Twitter, 65, 83, 86  
 two-dimensional parity scheme, 441–442  
 2G cellular networks architecture, 548–550  
 Type, Length, Value approach. *See* TLV approach  
 type of service bits. *See* TOS bits

**U**

UDP checksum, 202–204  
 UDPClient.py client program, 158–161  
 UDP header, 202  
 UDP packet, 258, 346, 595  
 UDP ports, 258  
 UDP segments, 202–204, 495–497, 613  
 UDPServer.py server program, 158, 161, 194  
 UDP sockets  
   communicating to processes, 158  
   creation, 161  
   identifying, 194  
   port numbers, 193–194  
 UDP streaming, 593, 595–596  
 UDP (User Datagram Protocol), 51, 93, 189, 387  
 checksum, 208, 334  
 client-server application, 157  
 congestion control, 201, 282  
 connection establishment, 200  
 connectionless transport, 95, 198–204  
 connection state, 200  
 datagrams, 189  
 delays, 200  
 destination port number, 199  
 development, 62  
 directly talking with IP, 199  
 discarding damaged segment, 204  
 DNS and, 199–200  
 end-to-end principle, 203  
 end-to-end throughput, 95  
 error checking, 199  
 error detection, 202–204  
 extending IP’s delivery service, 190