PART XI

USER DATAGRAM PROTOCOL (UDP)

Identifying The Ultimate Destination

- IP address only specifies a computer
- Need a way to specify an application program (process) on a computer
- Unfortunately
  - Application programs can be created and destroyed rapidly
  - Each operating system uses its own identification

Specifying An Application Program

- TCP/IP introduces its own specification
- Abstract destination point known as *protocol port number* (positive integer)
- Each OS determines how to bind protocol port number to specific application program

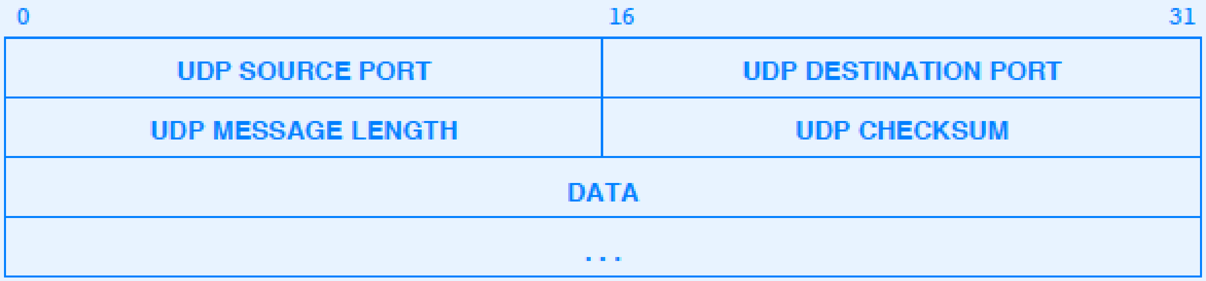
User Datagram Protocol

- Transport-layer protocol (Layer 4)
- Connectionless service: provides application programs with ability to send and receive messages
- Allows multiple, application programs on a single machine to communicate concurrently
- Same best-effort semantics as IP
  - Message can be delayed, lost, or duplicated
  - Messages can arrive out of order
- Application accepts full responsibility for errors

The Added Benefit Of UDP

The User Datagram Protocol (UDP) provides an unreliable connectionless delivery service using IP to transport messages between machines. It uses IP to carry messages, but adds the ability to distinguish among multiple destinations within a given host computer.

UDP Message Format



0	16 31
UDP SOURCE PORT	UDP DESTINATION PORT
UDP MESSAGE LENGTH	UDP CHECKSUM
DATA	
. . .	

- If *UDP CHECKSUM* field contains zeroes, receiver does not verify the checksum

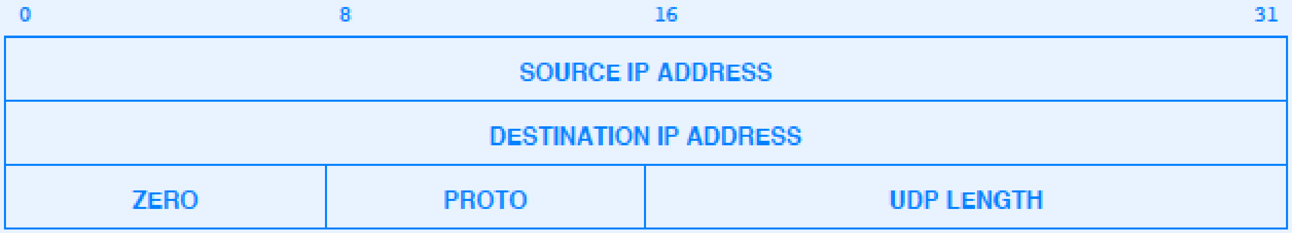
Port Numbers In A UDP Message

- SOURCE PORT identifies application on original source computer
- DESTINATION PORT identifies application on ultimate destination computer
- Note: IP addresses of source and destination do not appear explicitly in header

UDP Pseudo-Header

- Used when computing or verifying a checksum
- Temporarily prepended to UDP message
- Contains items from IP header
- Guarantees that message arrived at correct destination
- Note: pseudo header is *not* sent across Internet

Contents Of UDP Pseudo-Header

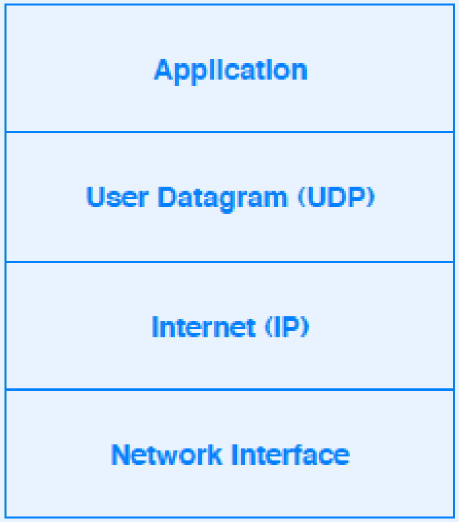


0	8	16	31
SOURCE IP ADDRESS			
DESTINATION IP ADDRESS			
ZERO	PROTO	UDP LENGTH	

- SOURCE ADDRESS and DESTINATION ADDRESS specify IP address of sending and receiving computers
- PROTO contains the Type from the IP datagram header

Position Of UDP In Protocol Stack

Conceptual Layering



Application

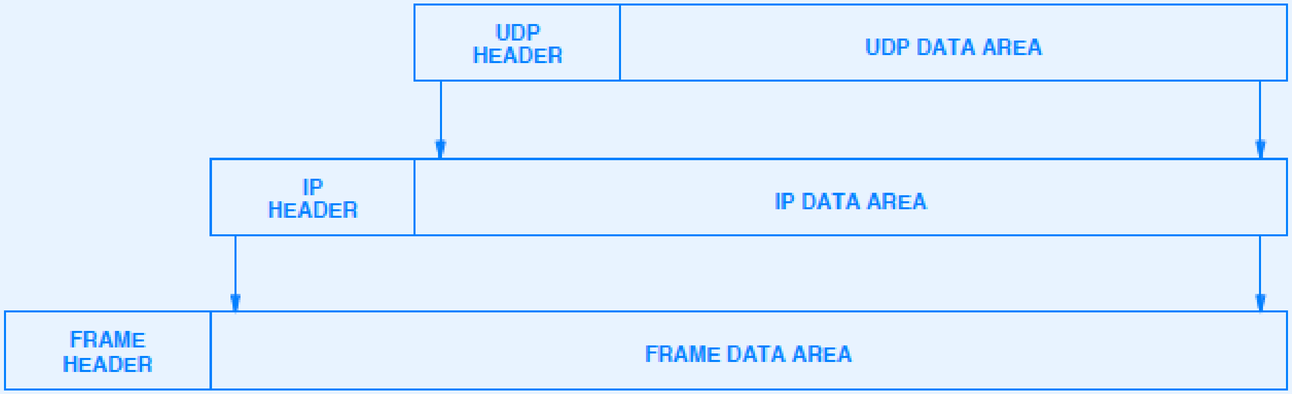
User Datagram (UDP)

Internet (IP)

Network Interface

- UDP lies between applications and IP

Encapsulation

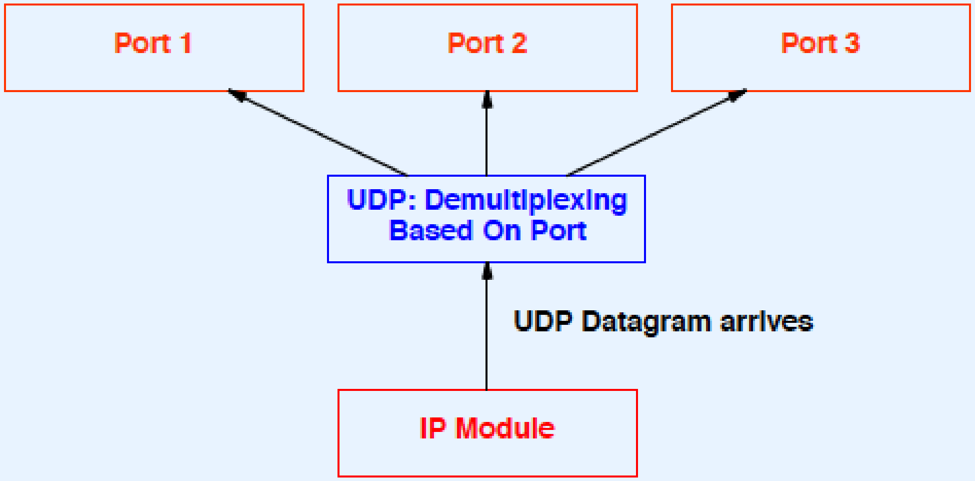


Division Of Duties Between IP and UDP

The IP layer is responsible for transferring data between a pair of hosts on an internet, while the UDP layer is responsible for differentiating among multiple sources or destinations within one host.

- IP header only identifies computer
- UDP header only identifies application programs

Demultiplexing Based On UDP Protocol Port Number



Assignment Of UDP Port Numbers

- Small numbers reserved for specific services
  - Called *well-known ports*
  - Same interpretation throughout the Internet
  - Used by server software
- Large numbers not reserved
  - Available to arbitrary application program
  - Used by client software
- More later in the course

Examples Of Assigned UDP Port Numbers

Decimal	Keyword	UNIX Keyword	Description
0	-	-	Reserved
7	ECHO	echo	Echo
9	DISCARD	discard	Discard
11	USERS	systat	Active Users
13	DAYTIME	daytime	Daytime
15	-	netstat	Network Status Program
17	QUOTE	qotd	Quote of the Day
19	CHARGEN	chargen	Character Generator
37	TIME	time	Time
42	NAMESERVER	name	Host Name Server
43	NICNAME	whois	Who Is
53	DOMAIN	nameserver	Domain Name Server
67	BOOTPS	bootps	BOOTP or DHCP Server
68	BOOTPC	bootpc	BOOTP or DHCP Client
69	TFTP	tftp	Trivial File Transfer
88	KERBEROS	kerberos	Kerberos Security Service
111	SUNRPC	sunrpc	Sun Remote Procedure Call
123	NTP	ntp	Network Time Protocol
161	-	snmp	Simple Network Management Protocol
162	-	snmp-trap	SNMP traps
512	-	biff	UNIX comsat
513	-	who	UNIX rwho Daemon
514	-	syslog	System Log
525	-	timed	Time Daemon

Summary

- User Datagram Protocol (UDP) provides connectionless, best-effort message service
- UDP message encapsulated in IP datagram for delivery
- IP identifies destination computer; UDP identifies application on the destination computer
- UDP uses abstraction known as *protocol port numbers*