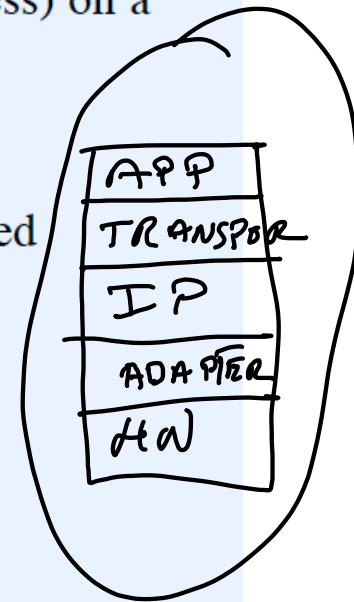
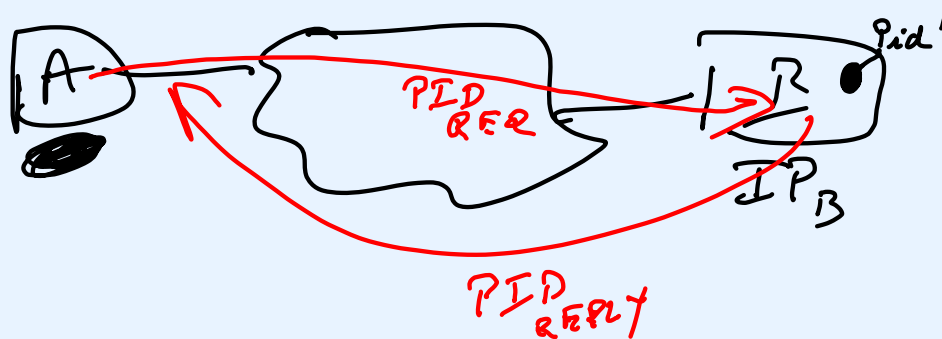


PART XI

USER DATAGRAM PROTOCOL
(UDP)

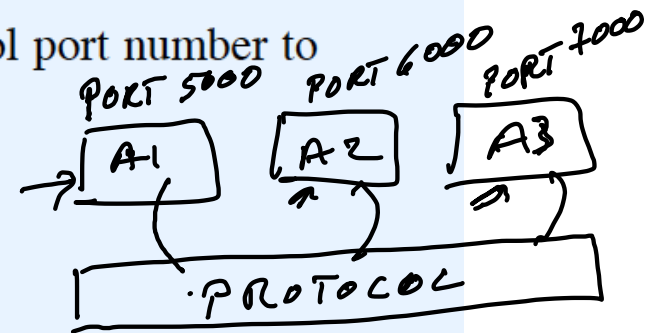
Identifying The Ultimate Destination

- 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



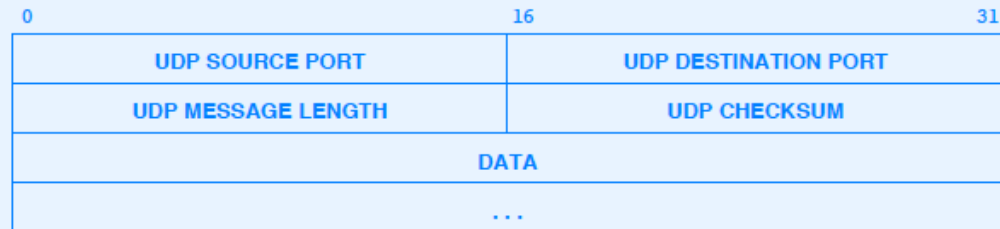
User Datagram Protocol (UDP)

- 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



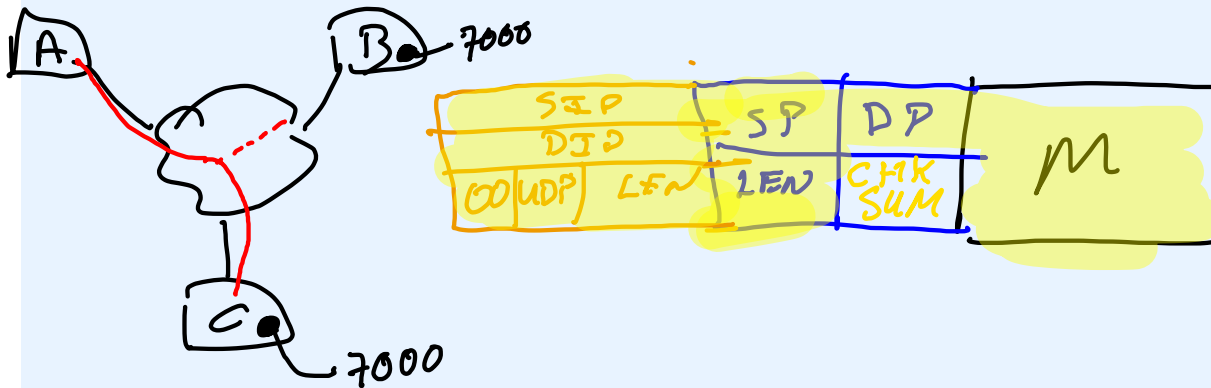
- If *UDP CHECKSUM* field contains zeroes, receiver does not verify the checksum

Port Numbers In A UDP Message

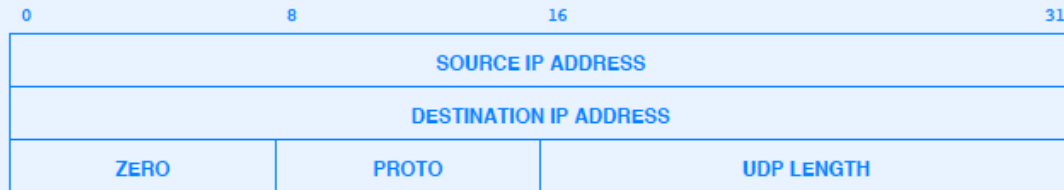
- SOURCE PORT identifies application on original source computer
- DESTINATION PORT identifies application on ultimate destination computer
- Note: IP addresses of source and destination do not appear explicitly in header

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



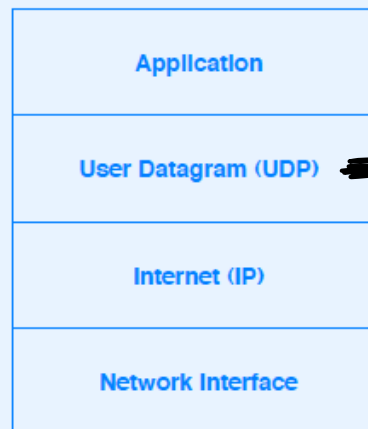
Contents Of UDP Pseudo-Header



- 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

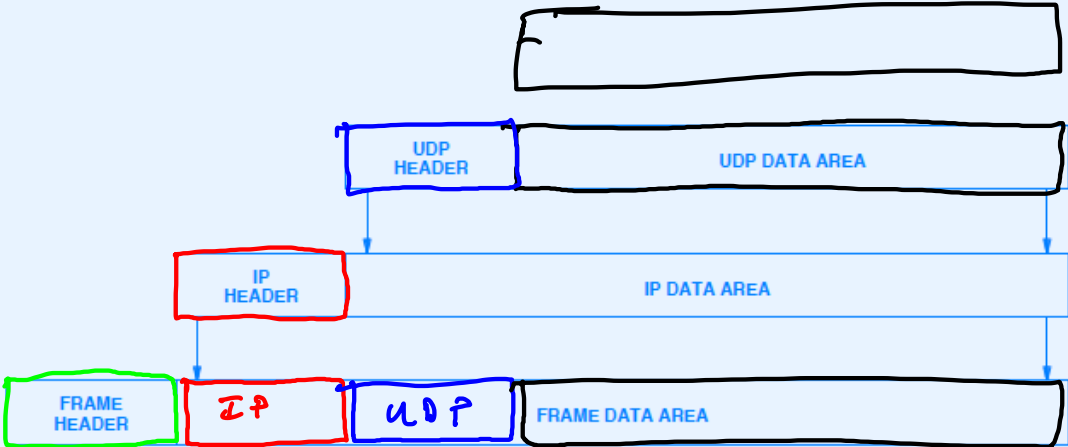
Conceptual Layering



~~PROTOCOL~~

- UDP lies between applications and IP

Encapsulation

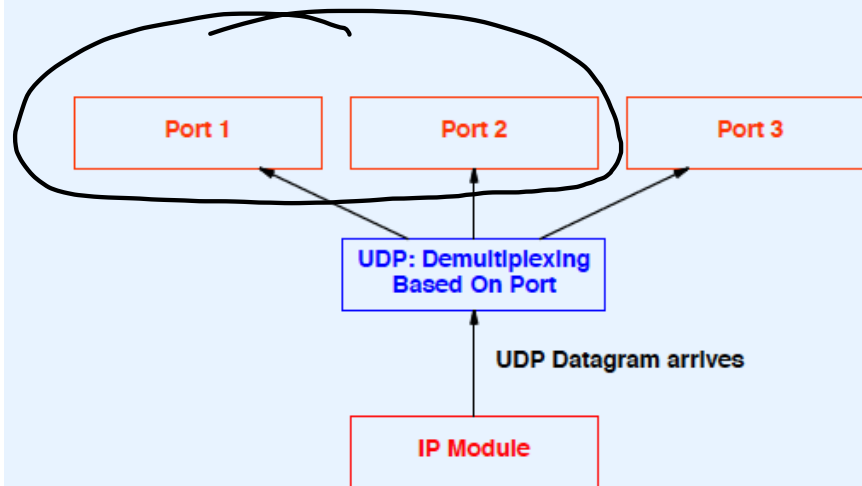


Division Of Duties Between IP and UDP

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

64K

65,535

PORT 80
WEB SERVER

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*