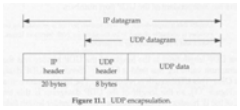
TCP/IP 通訊協定及應用

Spring 2002
中央大學 吳曉光博士
http://wmlab.csie.ncu.edu.tw/course/tcp

Chpater 11: UDP: User Datagram Protocol

Introduction

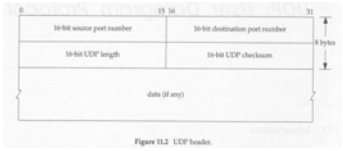
- UDP encapsulation:



  - UDP is a simple, datagram-oriented, transport layer protocol
  - UDP provides no reliability

- UDP Header
  - The port numbers identify the sending process and the receiving process
  - UDP length field is the length of the UDP header and the UDP data in bytes.The minimum value is 8 bytes

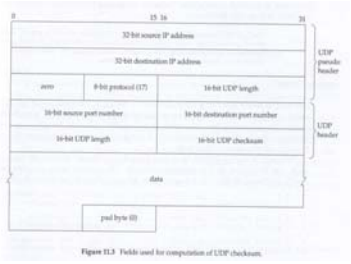
UDP Header



- Compare TCP Checksum and UDP Checksum
  - TCP checksum is mandatory
  - UDP checksum is optional
- Differences between UDP checksum and IP checksum
  - UDP datagram can be an odd number of bytes
  - Both UDP and TCP include a 12-byte pseudo-header purpose to let UDP double-check the data has arrived at the correct destination

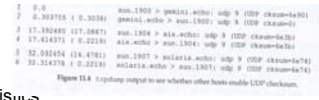
UDP Checksum

- UDP checksum is an end-to-end checksum.If the receiver detects a checksum error, UDP datagram is discarded

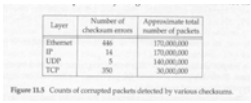


UDP Checksum

- value 0 means the sending host did not calculate the checksum
- The UDP checksums cannot detect an error that swaps to of the 16-bit values



- Some Statistics



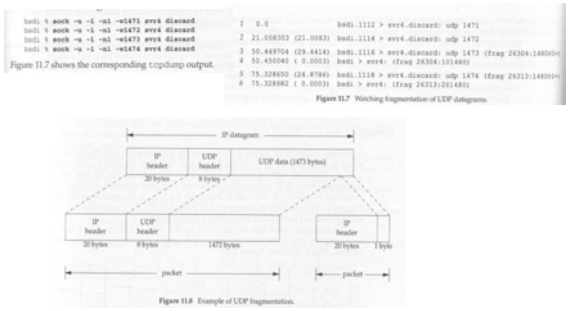
Layer	Number of checksum errors	Approximate total number of packets
Ethernet	446	170,000,000
IP	14	170,000,000
UDP	5	140,000,000
TCP	350	30,000,000

A Simple Example

- There is no communication between the sender and receiver before the first datagram is sent
- There are no acknowledgments by the receiver when the data is received

IP Fragmentation

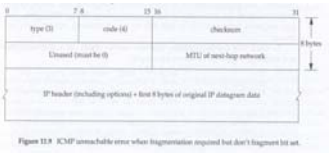
- Example:



ICMP Unreachable Error (Fragmentation Required)

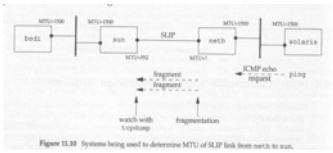
- The port numbers only occurs in the first fragment
- Any transport layer header appears only in the first fragment

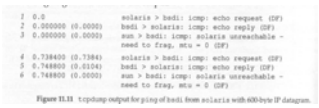
- When occurs the ICMP unreachable error
  - a datagram that requires fragmentation, but the DF flag is turned on



ICMP Unreachable Error (Fragmentation Required)

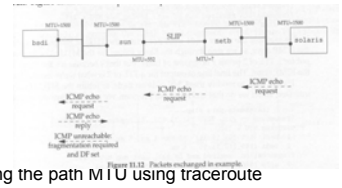
- Example:





ICMP Unreachable Error (Fragmentation Required)

- DF flag is set causes sun to generate the ICMP unreachable error back to bsdi (where it's discarded)

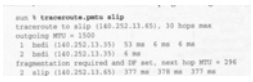


- Determining the path MTU using traceroute
  - Whenever we receive an ICMP "can't fragment" error,we'll reduce the size of the packet

Determining the Path MTU Using Traceroute

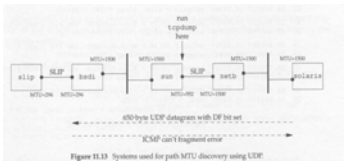
- The router bsdi does not return the MTU

- The ICMP code on bsdi to return the MTU



Path MTU Discovery with UDP

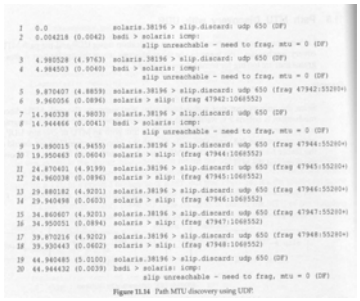
- Example:



- The following command generates ten 650-byte UDP datagrams, with a 5-second pause between each datagram:

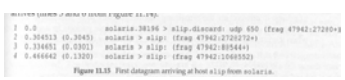
```
solaris % sock -u -i -n10 -w650 -p5 slip discard
```


Path MTU Discovery with UDP

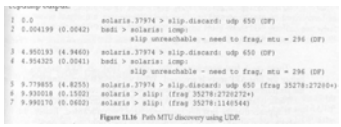


Path MTU Discovery with UDP

- Four fragments generated by the router bsdi



- Three fragments generated by the router bsdi return the next-hop MTU in the ICMP “can’t fragment” error



Interaction Between UDP and ARP

- Example:

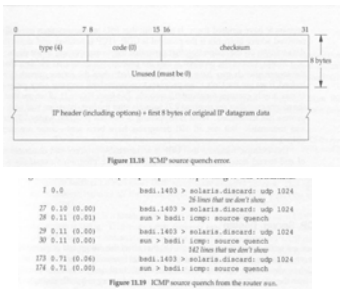
- Six ARP requests are generated before the first ARP reply is returned
- Only the last fragment is sent, first five fragments have been discarded
- Unexplained anomaly in output seven ARP replies, not six

Interaction Between UDP and ARP

- Why we don’t see the ICMP message
  - Most Berkeley derived implementations never generate this error
  - The first fragment which containing the UDP header was never received
- Maximum UDP Datagram Size
  - Just over 8192 bytes for the maximum size of a UDP datagram that can be read or written
  - Limit the size of an IP datagram to less than 65535 bytes
- How to deal with received datagram exceeds the size
  - The traditional Berkeley => discarding any excess data
  - The sockets API under SVR4 => does not truncate the datagram
  - The TLI API => Instead a flag is returned

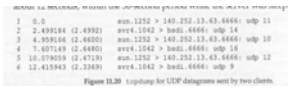
ICMP Source Quench Error

- This is an error that may be generated by a system (router or host) when it receives datagrams at a rate is too fast to be processed



UDP Server Design

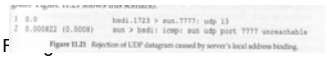
- Client IP Address and Port Number
  - When an application receives a UDP datagram, it must be told by the operating system who sent the message--the source IP address and port number
- Destination IP Address
  - Who the datagram was sent to, that is, the destination IP address
- UDP Input Queue
  - A single server process handles all the client requests on a single UDP port



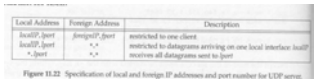
UDP Server Design

- The application is not told when its input queue overflows
- Nothing is sent back to the client to tell it that its datagram was discarded
- UDP input queue is FIFO,ARP input queue was LIFO

- Restricting Local IP Address



- Restricting F
- Multiple Recipients per Port



Summary

- UDP is a simple protocol
- The services it provides to a user process are port numbers and an optional checksum
- Path MTU discovery using Traceroute and UDP
- The ICMP source quench error can be sent by a system that is receiving IP datagrams faster than they can processed