
ECE 697J – Advanced Topics in Computer Networks

Packet Processing Algorithms and Data Structures
9/16/03

Packet Processing

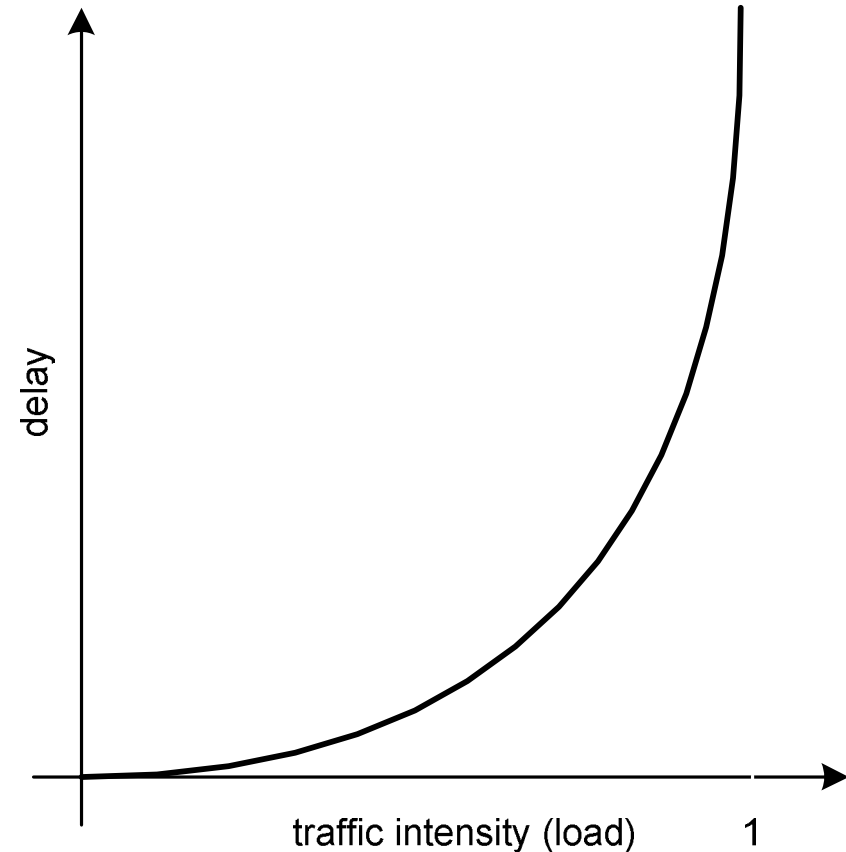
- Software processing of packets
- Issues:
 - System goals
 - Buffer management
 - Network byte order
 - Bridge algorithm
 - Table lookups and hashing
 - IP fragmentation and reassembly
 - IP forwarding
 - TCP connection recognition
 - TCP splicing

System Goals

- *“To allow it to run arbitrarily long, a network system must be designed with limits on all resources and the limits must be fixed independent of arriving traffic; designs that violate this principle will not be considered”*
- Examples?
- Related statement: “Network systems should be designed to handle worst case traffic.”
- How is this different from a general workstation?

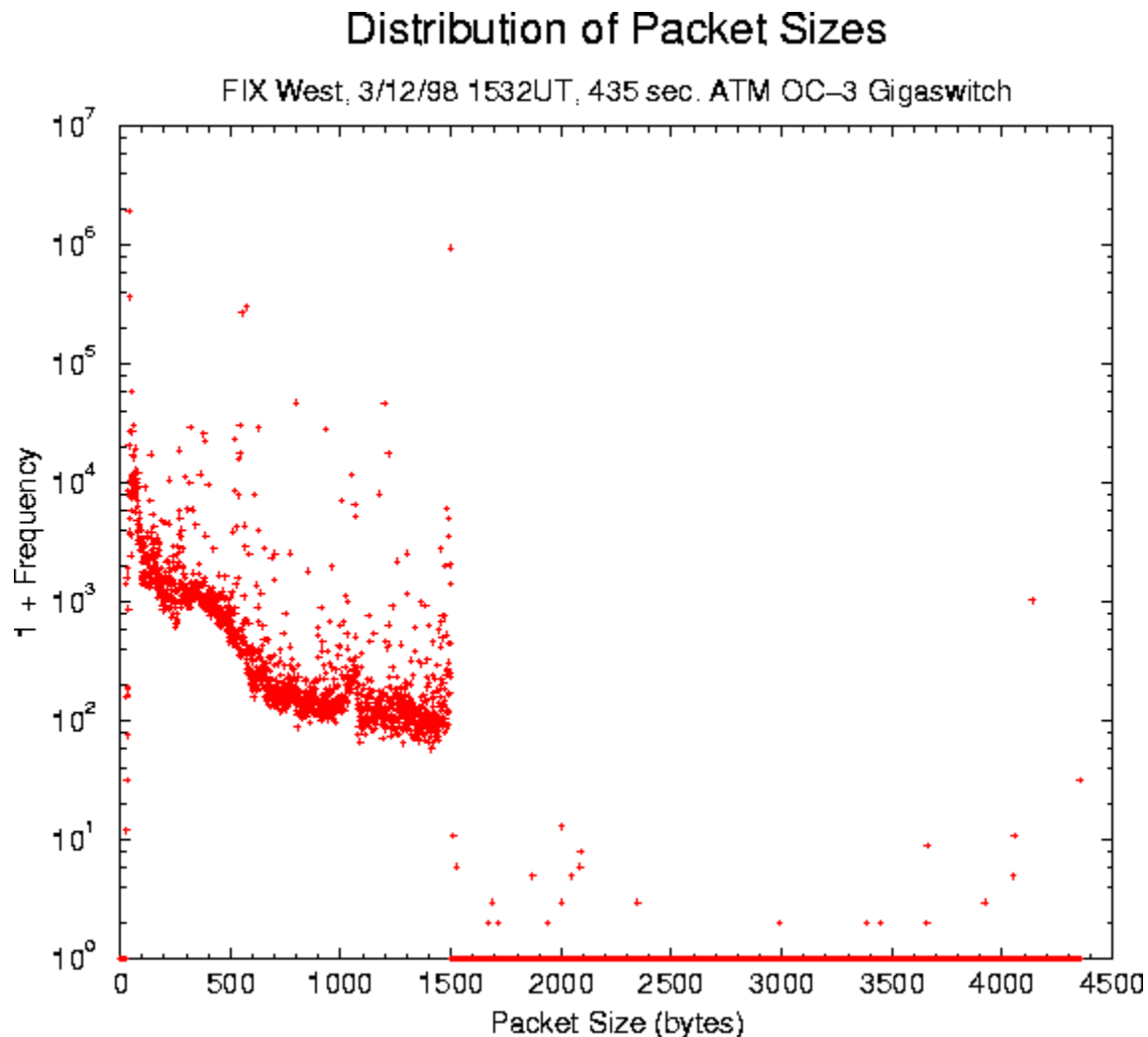
Packet Buffers

- How many packet buffers should be available?
 - Many to avoid loss
 - Few to avoid delay
- Variable-size buffer allocation can lead to fragmentation
 - Example?
- Buffer copying is expensive
 - Why?
 - What can be done to reduce buffer copies?
- What size should buffers be?
 - Max IP packet size is 64kB



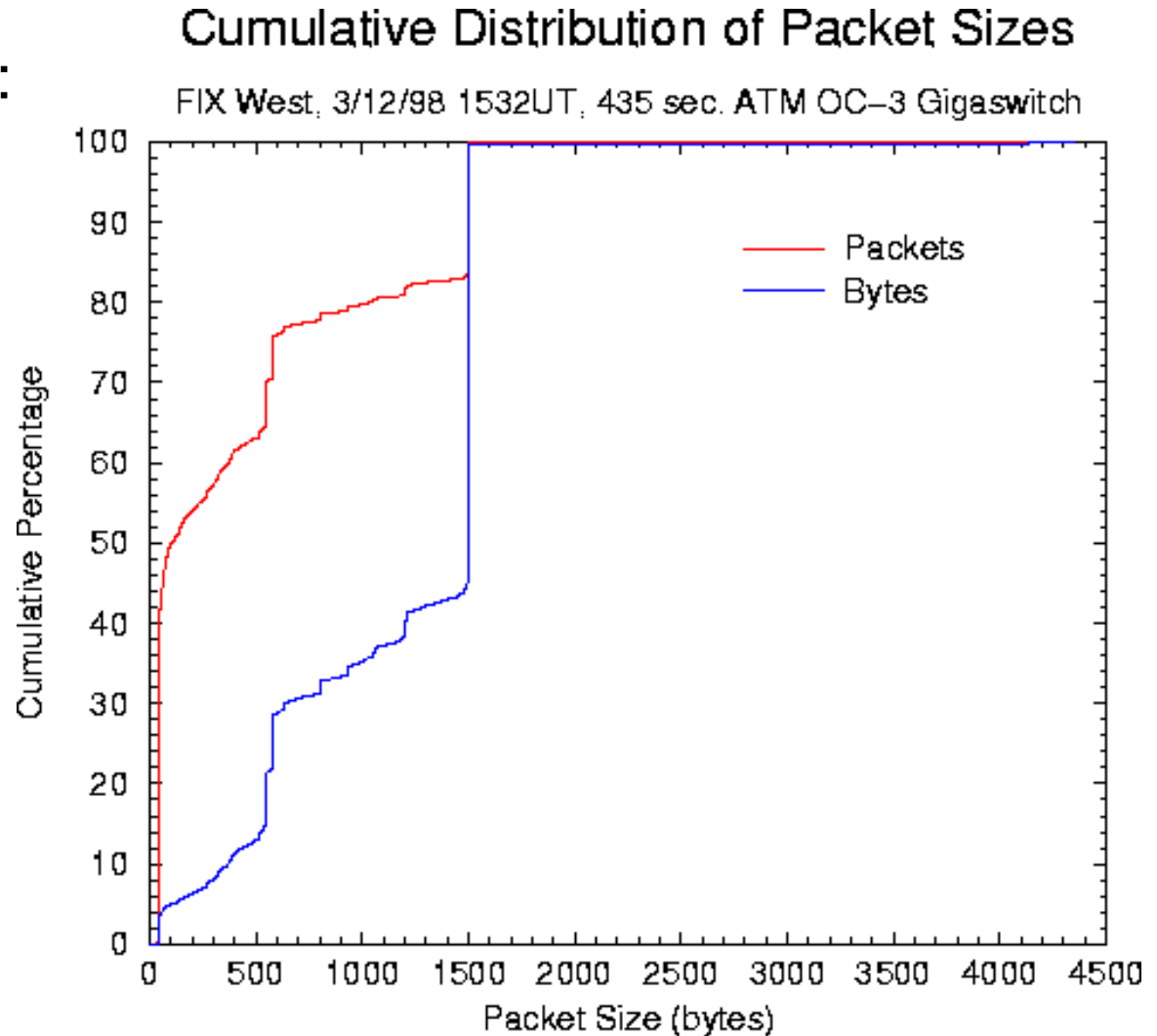
Packet Sizes

- From caida.org:



Packet Sizes

- From caida.org:

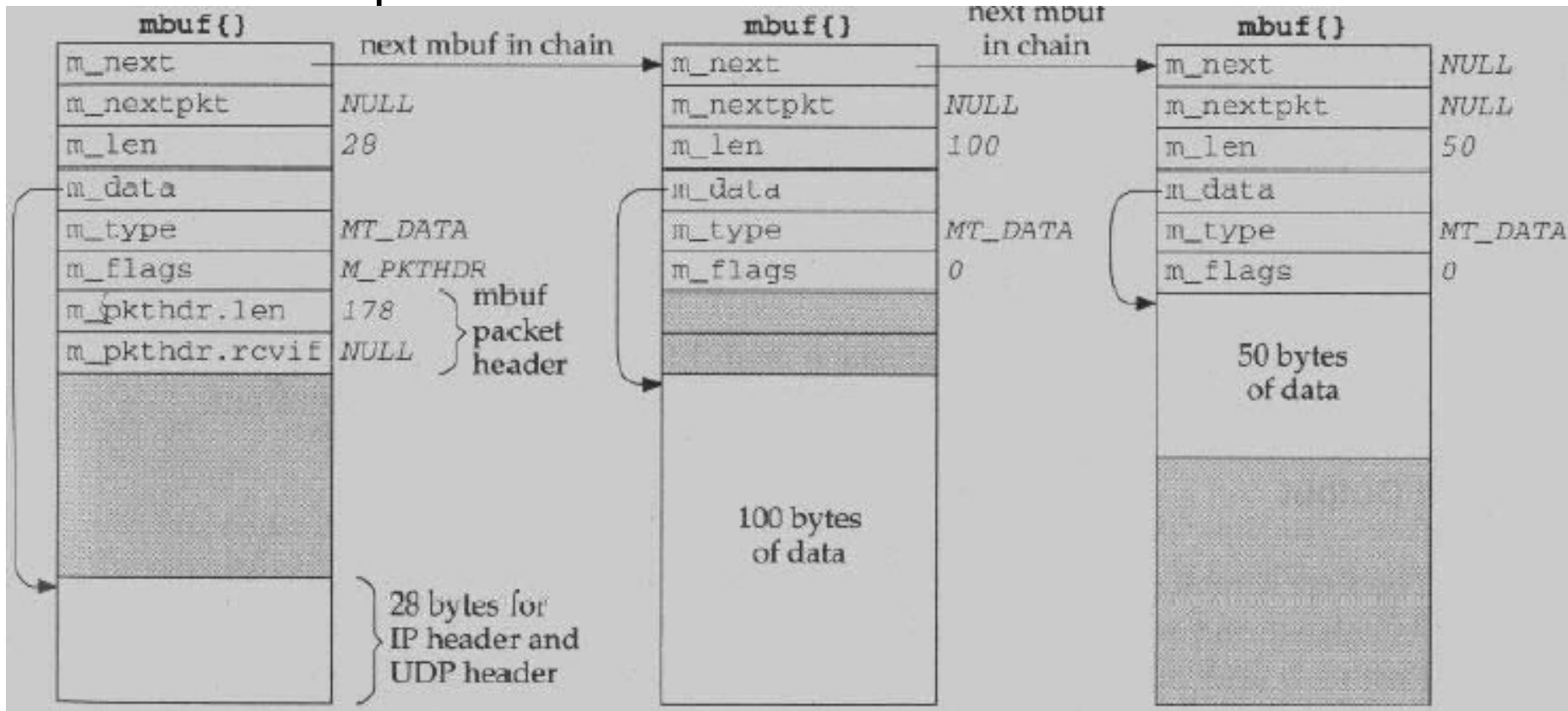


Buffer Sizes

- Many packets are very small
- Almost no packets larger than 1500 bytes
- Buffer allocation schemes:
 - Large buffer
 - Linked list
- What are the pros and cons?
- Example implementation of buffer mechanism:
 - “mbufs” in BSD Unix operating system

mbufs

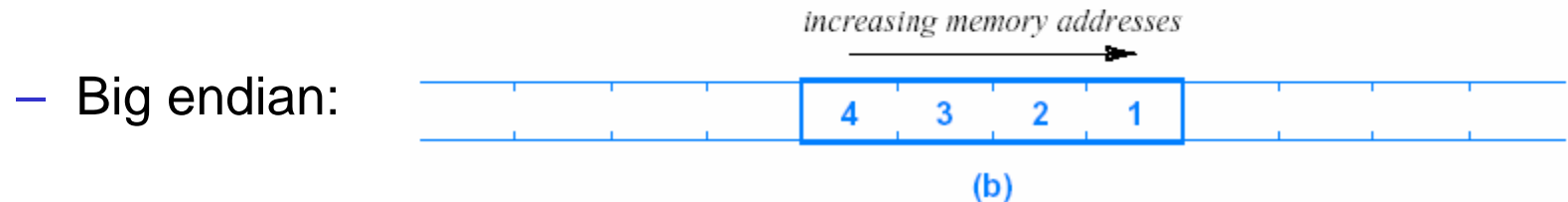
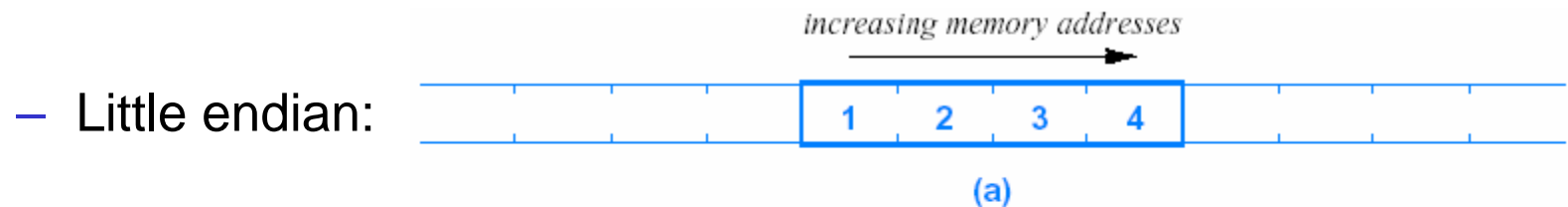
- Unix BSD packet mbufs:



- Also allows for large buffer

Byte Order

- Networks connect to heterogeneous end-systems
- Different end-systems implement things differently
- Byte order: arrangement of bytes that make up word



- Which systems implement what order?
 - Intel architecture: little endian
 - Network byte order: big endian

Byte Order Conversion

- Typical OS functions to adjust byte order:

Function	data size	Translation
<code>ntohs</code>	16 bits	Network byte order to host's byte order
<code>htons</code>	16 bits	Host's byte order to network byte order
<code>ntohl</code>	32 bits	Network byte order to host's byte order
<code>htonl</code>	32 bits	Host's byte order to network byte order

- This is a major source of programming errors!
- Side note: What are other annoying system convention that cause interoperability problems?

Next Class

- Ramu will present:
 - Packet classification
 - Scheduling
 - Read chapters 6 & 9
- Next Tuesday:
 - IP lookup paper (everybody read the paper!)
 - Protocol software on conventional processor (chapter 7)
- Other issue:
 - Presentation evaluation form