Zero-Copy Socket Splicing

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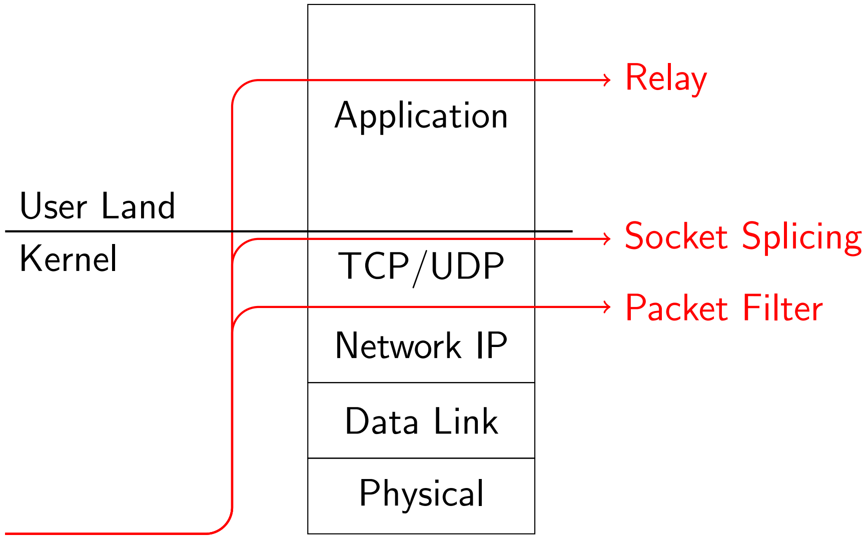
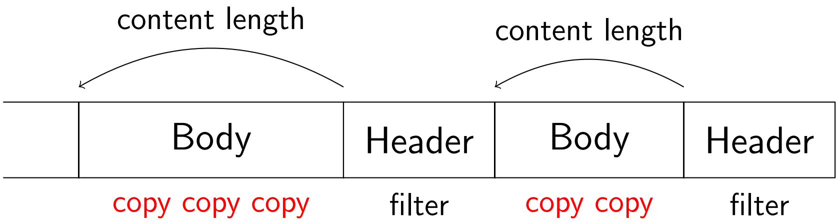
Agenda

Agenda

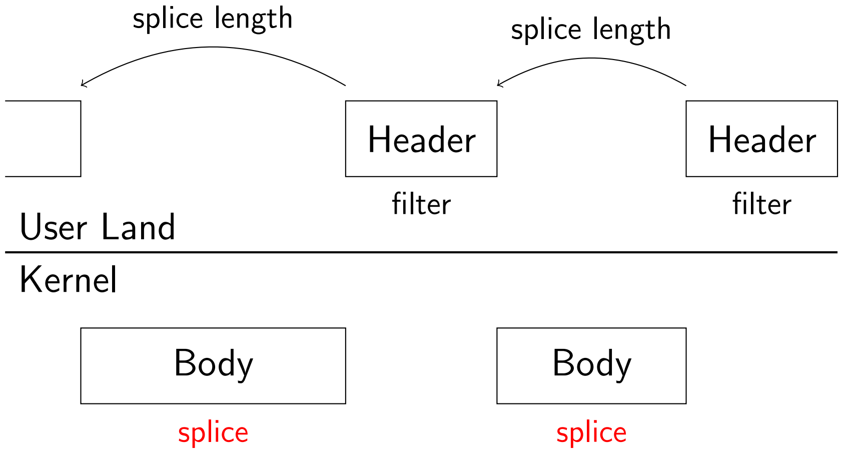
Application Level Gateway



Persistent HTTP Filtering



HTTP Socket Splicing



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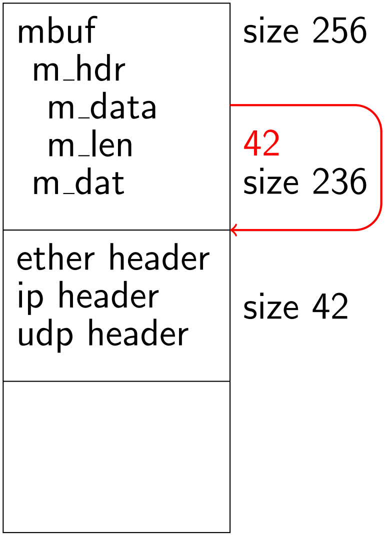
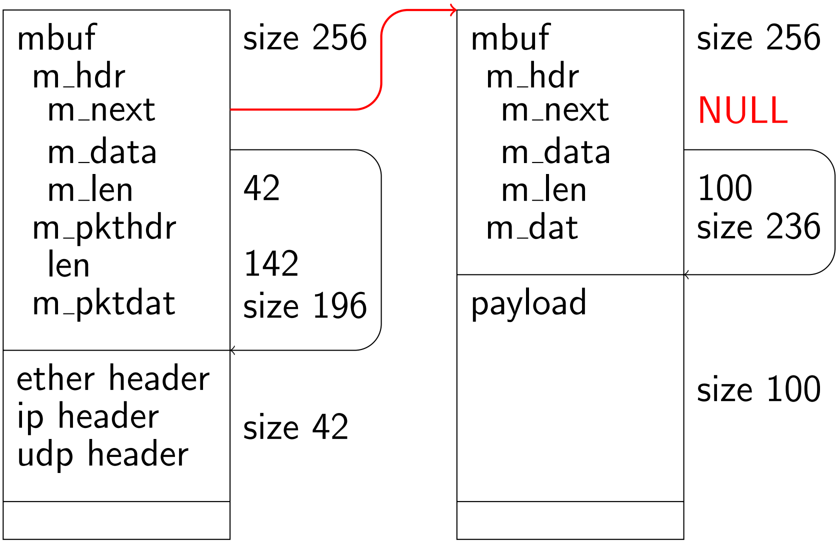
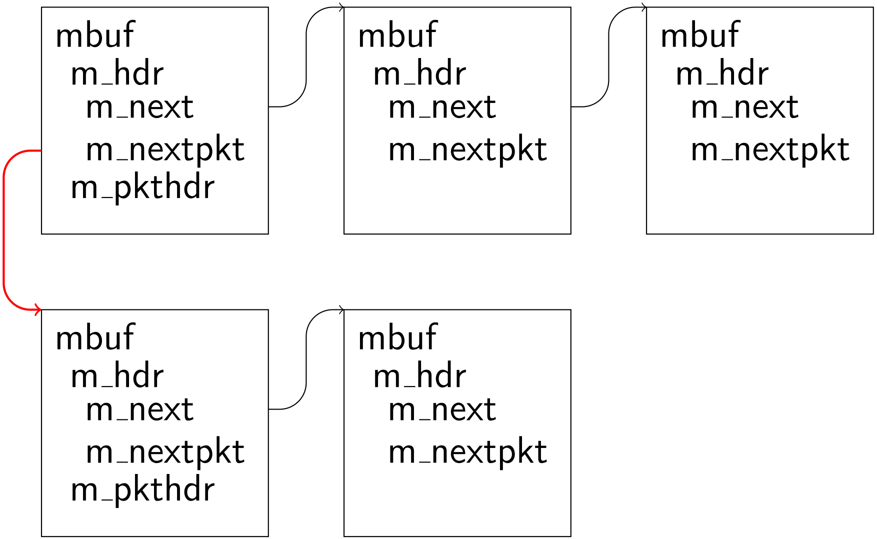
MBuf Data


mbuf
m_hdr
m_data
m_len
m_dat
size 256
42
size 236
ether header
ip header
udp header
size 42

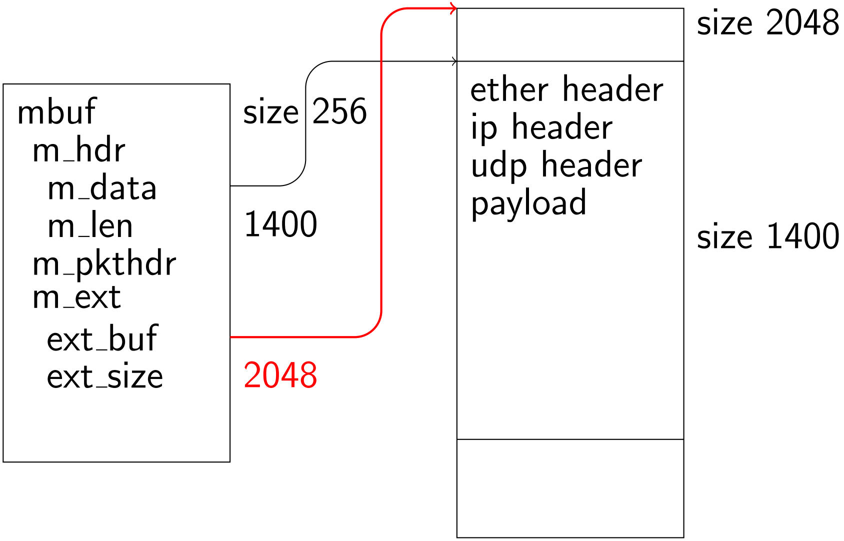
MBuf Data Chaining



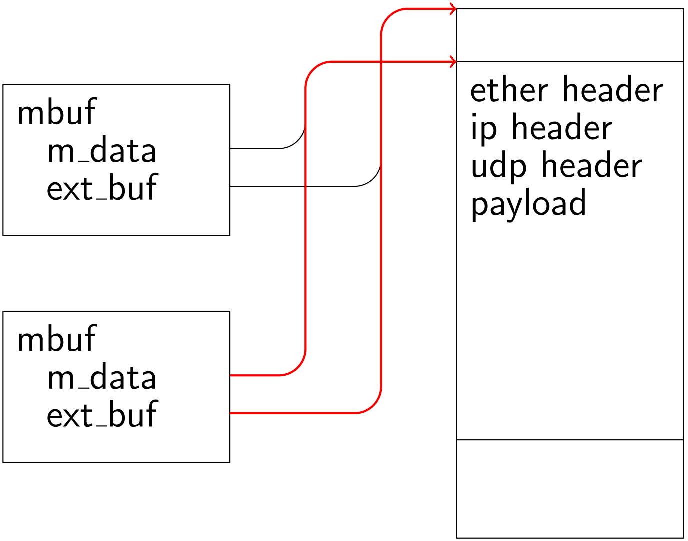
MBuf Packet Chaining



MBuf Cluster



MBuf Cluster Copy



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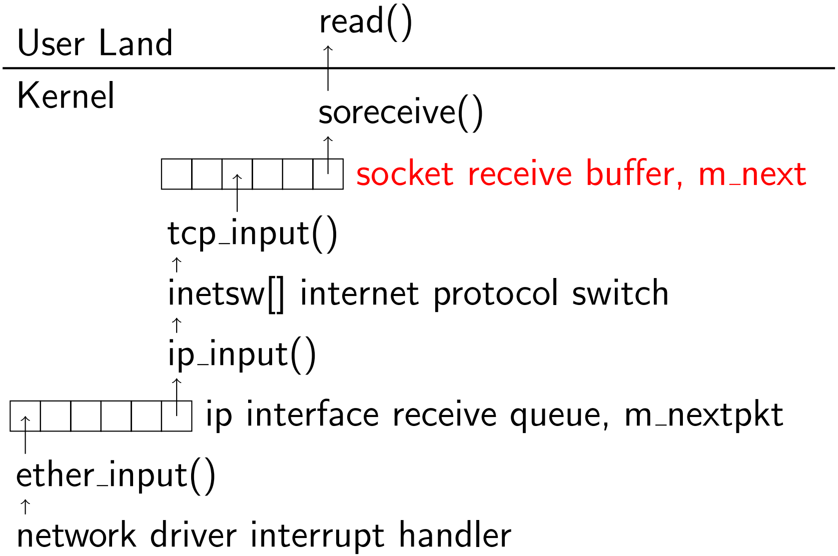
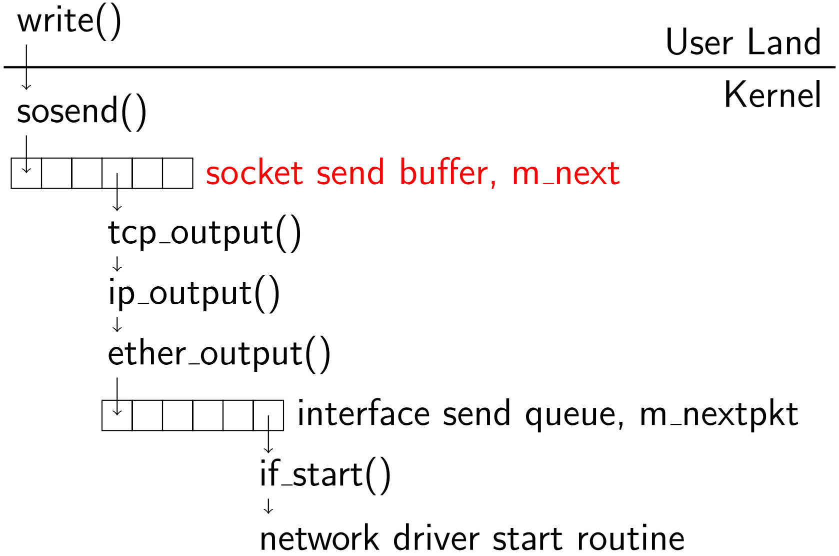
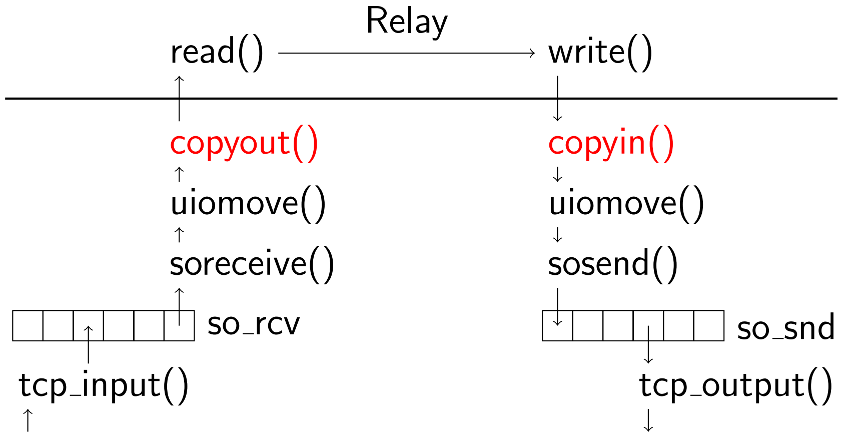
Packet Input


read()
User Land
Kernel
soreceive()
socket receive buffer, m_next
tcp_input()
inetsw[] internet protocol switch
ip_input()
ip interface receive queue, m_nextpkt
ether_input()
network driver interrupt handler

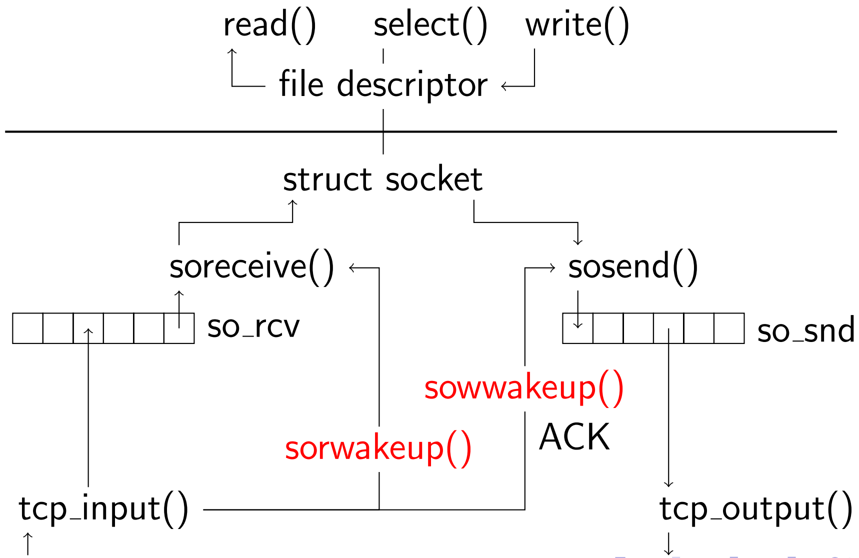
Packet Output


write()
User Land
Kernel
sosend()
socket send buffer, m_next
tcp_output()
ip_output()
ether_output()
interface send queue, m_nextpkt
if_start()
network driver start routine

Data Copy


Relay
read()
write()
copyout()
copyin()
uiomove()
uiomove()
soreceive()
sosend()
so_rcv
so_snd
tcp_input()
tcp_output()

Process Wakeup



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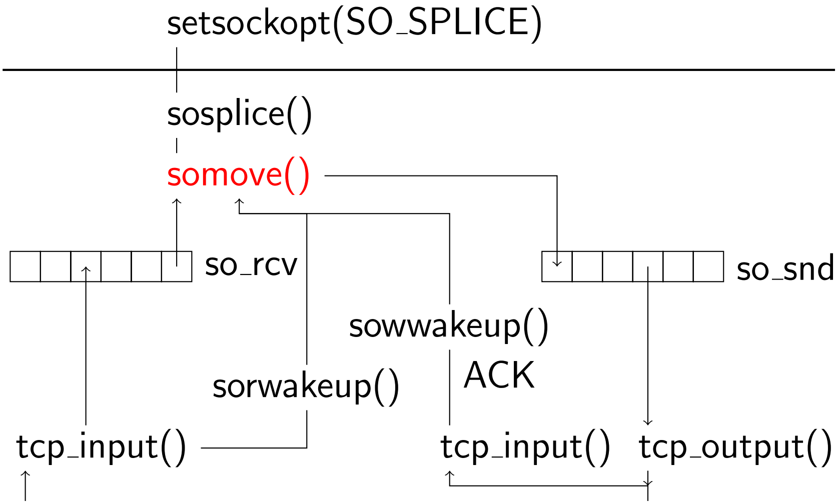
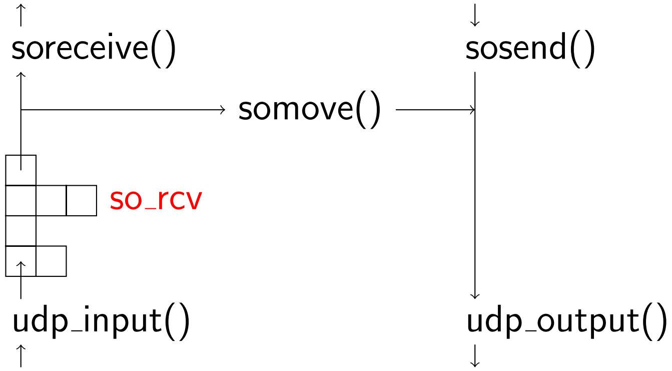
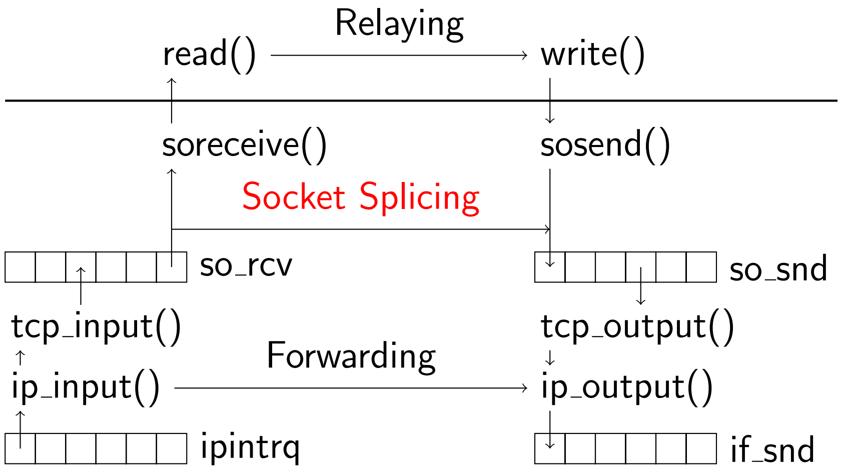
Socket Splicing



UDP Sockets



Layer


Relaying
read()
write()
soreceive()
sosend()
Socket Splicing
so_rcv
so_snd
tcp_input()
tcp_output()
Forwarding
ip_input()
ip_output()
ipintrq
if_snd

Agenda

Simple API

- Begin splicing from source to drain
  setsockopt(source_fd, SO_SPLICE, drain_fd)
- Stop splicing
  setsockopt(source_fd, SO_SPLICE, -1)
- Get spliced data length
  getsockopt(source_fd, SO_SPLICE, &length)

Extended API

```
struct splice {
  int     sp_fd;                 /* drain */
  off_t   sp_max;                /* maximum */
  struct timeval sp_idle;        /* timeout */
};
```

setsockopt(source_fd, SO_SPLICE, &splice)

Properties

- Splicing is unidirectional
- Invoke it twice for bidirectional splicing
- Process can turn it on and off
- Works for TCP and UDP
- Can mix IPv4 and IPv6 sockets

Unsplice

- Dissolve socket splicing manually
- read(2) or select(2) from the source
- EOF source socket shutdown
- EPIPE drain socket error
- EFBIG maximum data length
- ETIMEDOUT idle timeout

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Struct Socket

```
struct socket {
    ...
    struct  socket *so_splice;
    struct  socket *so_spliceback;
    off_t   so_splicelen;
    off_t   so_splicemax;
    struct  timeval so_idletv;
    struct  timeout so_idleto;
    ...
};
```

sosplice(9)

- Protocol must match
- Sockets must be connected
- Double link sockets
- Move existing data

somove(9)

- Check for errors
- Check for space
- Handle maximum
- Handle out of band data
- Move socket buffer data

sounsplice()

- Manual unsplice
- Cannot receive
- Cannot send
- Maximum
- Timeout
- Socket closed

sorwakeup() sowwakeup()

- Called from tcp_input()
- Source calls sorwakeup()
- Drain calls sowwakeup()
- Both invoke somove(9)

Agenda

Relayd

- Plain TCP connections
- HTTP connections
- Filter persistent HTTP
- HTTP Chunking

Tests

- /usr/src/regress/sys/kern/sosplice/
- 15 API tests
- 18 UDP tests
- 76 TCP tests
- perf/relay.c simple example
- BSD::Socket::Splice Perl API
- 28 relayd tests

Performance

- Factor 1 or 2 for TCP
- Factor 6 or 8 for UDP

Documentation

- Manpage setsockopt(2) SO_SPLICE
- Manpage sosplice(9) somove(9)

Questions

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