Project 1 Discussion

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Bug – Part1 Step C2

- If you receive 16 bytes as the payload_len, it's a mistake in our implementation so you can disregard that as it doesn't affect any of the later stages anyway. However don't make the same mistake in your part 2 stage c2.

Key Data Structure → <netinet/in.h>

- **Generic socket address structure**

```
struct sockaddr {
   unsigned short    sa_family;    // address family, AF_XXX
   char              sa_data[14];  // 14 bytes of protocol address
};
```

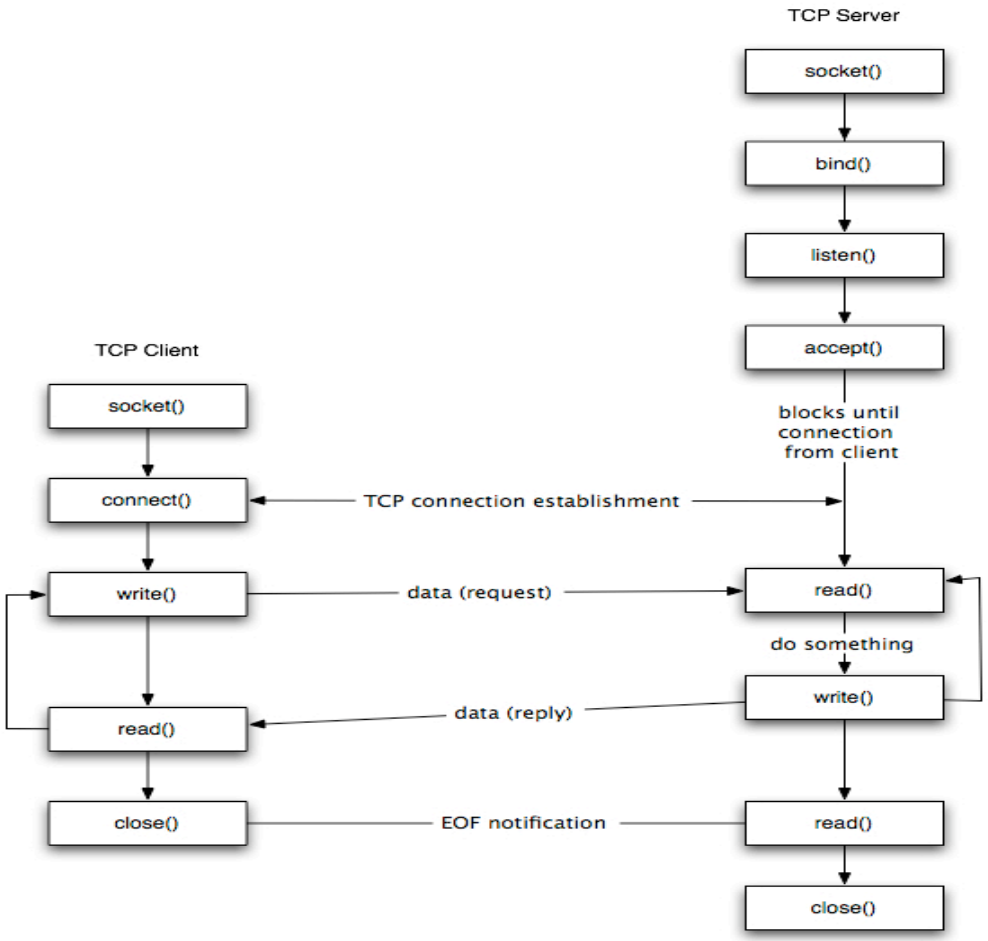
- **IPv4 socket address structure**

```
struct in_addr{
in_addr_t s_addr;                 /*32 bit IPv4 network byte ordered address*/
};
struct sockaddr_in {
  uint8_t sin_len;                /* length of structure (16)*/
  sa_family_t sin_family;         /* AF_INET*/
  in_port_t sin_port;             /* 16 bit TCP or UDP port number  */
  struct in_addr sin_addr;        /* 32 bit IPv4 address*/
  char sin_zero[8];               /* not used but always set to zero */
};
```

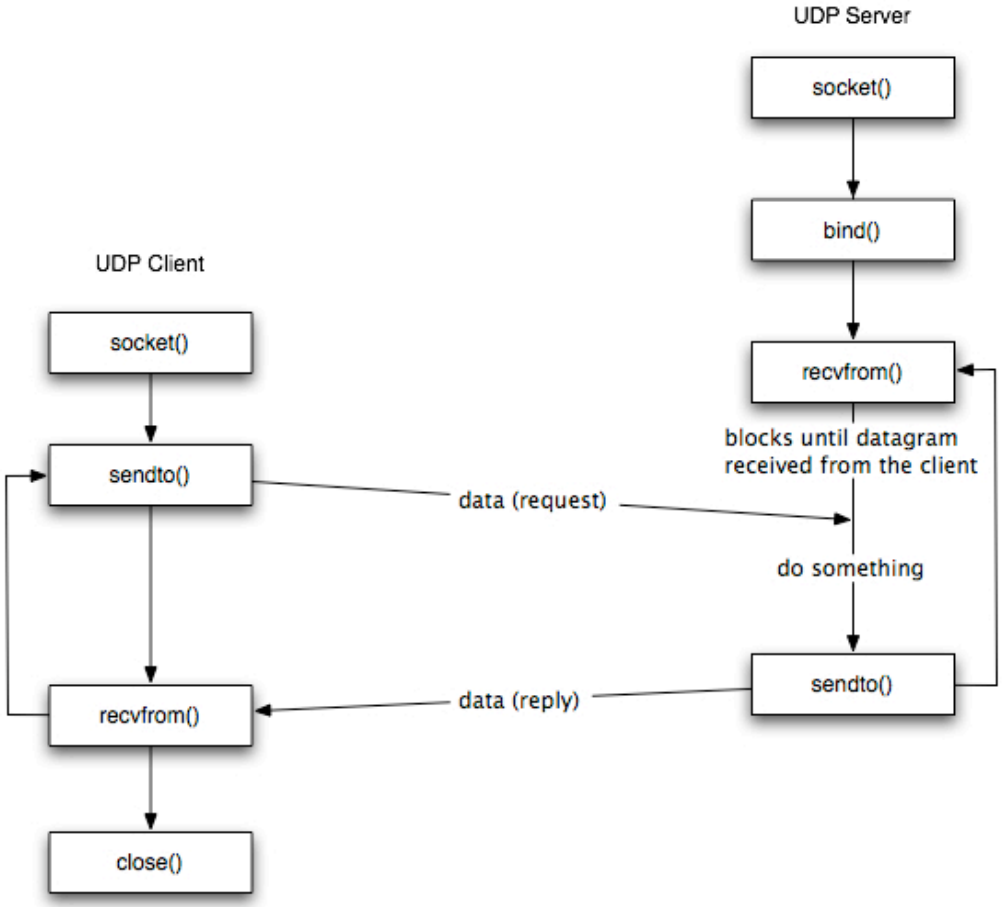
Host Byte Order and Network Byte Order

- Big endian and little endian
  - ✓ Intel, PowerPC
- htons, htonl, ntohs, ntohl

TCP → Connection Oriented Service



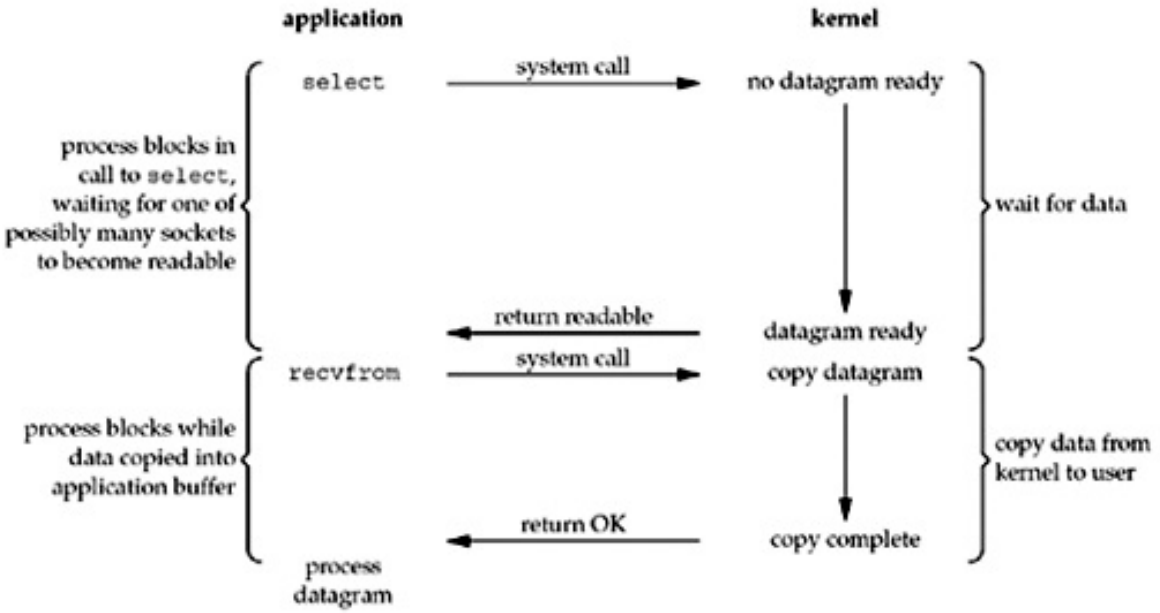
UDP → Connection Less Service



Handle Multiple Clients 1 → Multi-processes

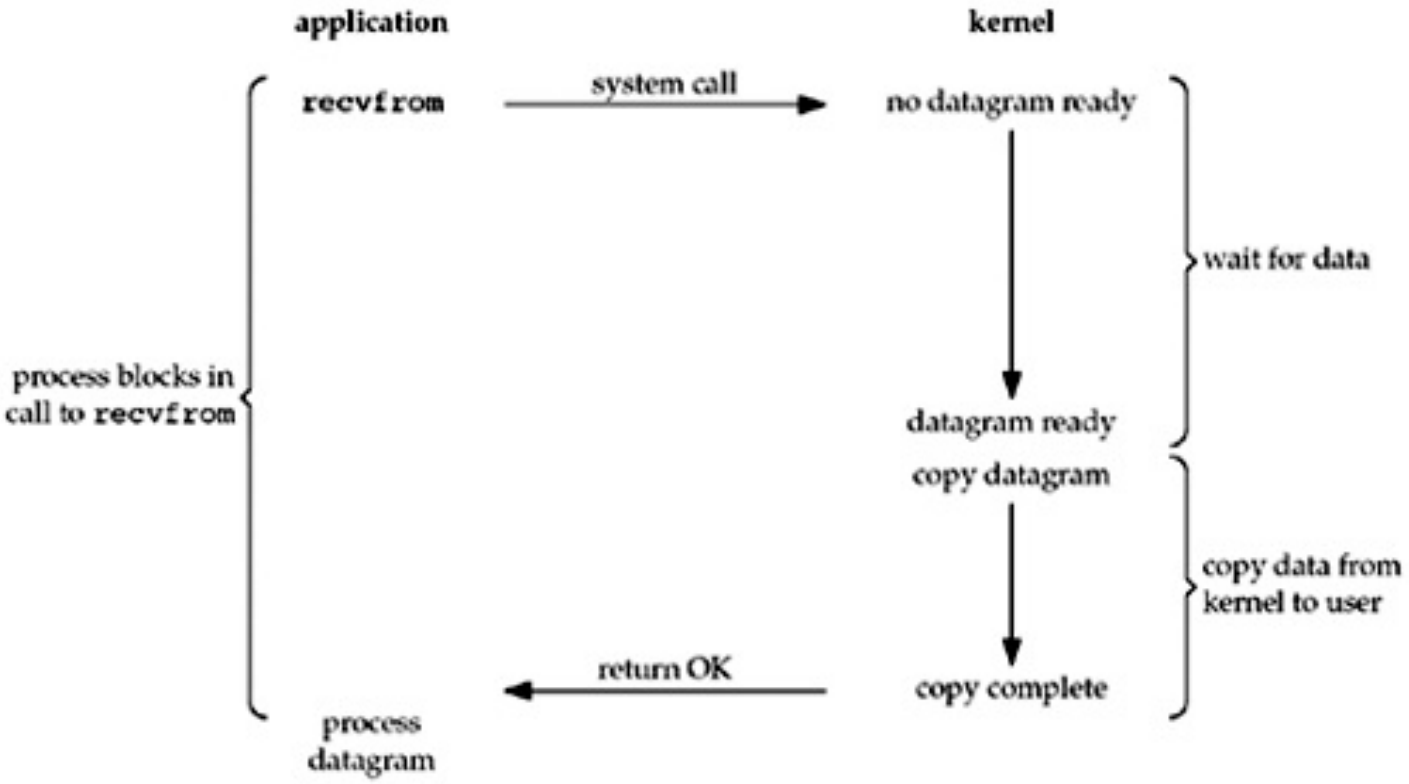
```
pid_t pid;
int listenfd, connfd;
listenfd = socket(...);
bind(listenfd, ...);
listen(listenfd, ...);
for ( ; ; ) {
   connfd = accept(listenfd, ...);          /* blocking call */
   if ( (pid = fork()) == 0 ) {
      close(listenfd);                      /* child closes listening socket */
      /***process the request doing something using connfd ***/
      close(connfd);
      exit(0);                              /* child terminates */
    }
   close(connfd);   /*parent closes connected socket*/
   }
}
```

Handle Multiple Clients 2 → I/O multiplexing

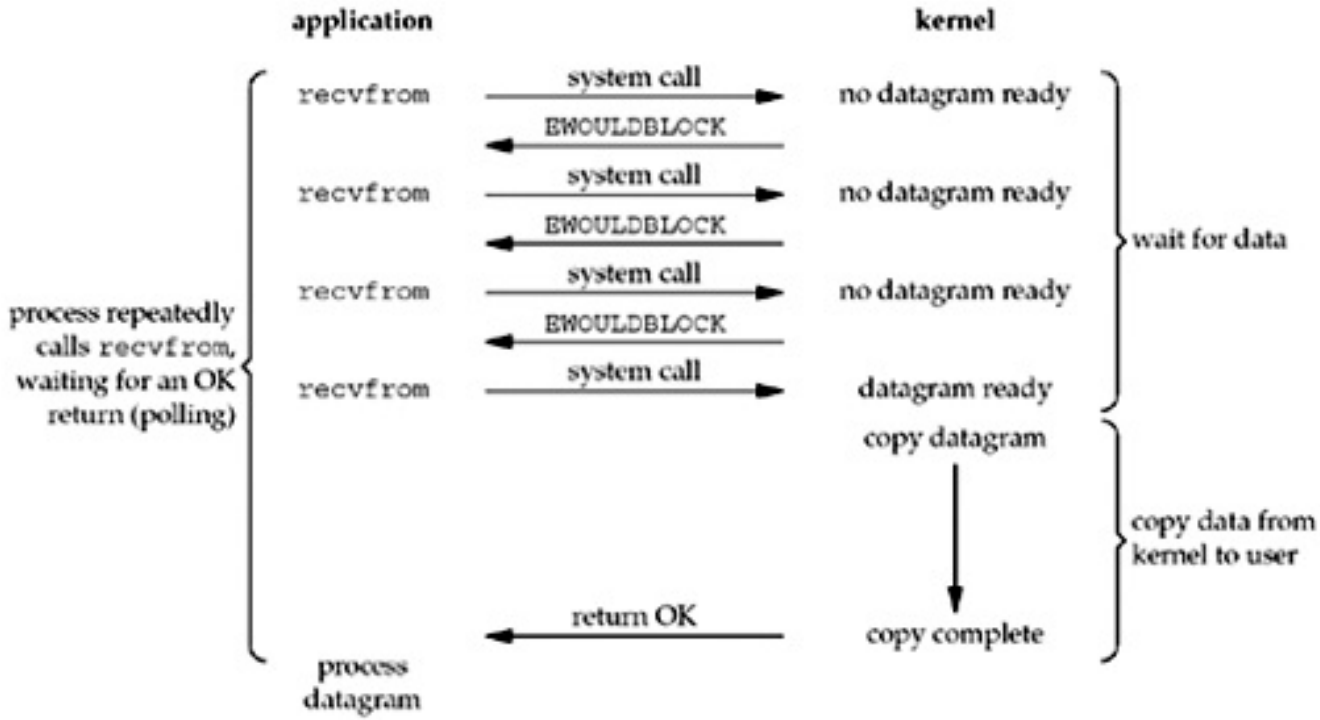


- **Select**
- **poll / epoll**

I/O blocking


application
kernel
recvfrom
system call
no datagram ready
wait for data
process blocks in call to recvfrom
datagram ready
copy datagram
copy data from kernel to user
return OK
copy complete
process datagram

I/O non-blocking



- **fcntl API**

Multithread

- Kernel thread supported
- Pthread --> Threadpool
- Select, Poll, Epoll
- USENIX ATC 1999, Flash: An Efficient and Portable Web Server
- Unix Network Programming Volume 1