



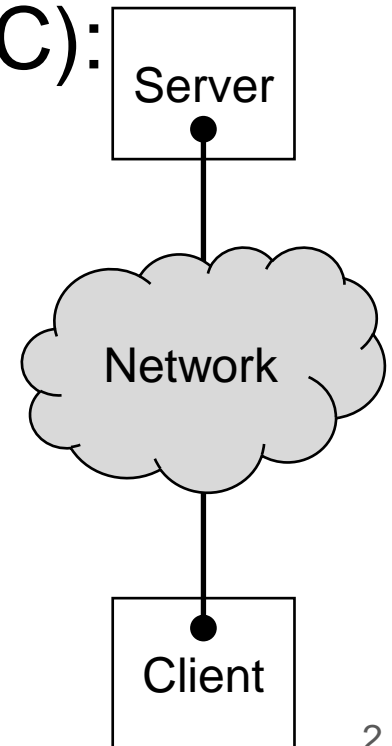
Imre Varga PhD  
University of Debrecen, Faculty of Informatics

# Socket programming

In C language, on Linux OS, over IPv4

# Client & Server

- Server provides a service
- Client requests the service
- Inter-process communication (IPC):
  - Connection-oriented (TCP)
  - Connectionless (UDP)
- Types of sockets:
  - SOCK\_STREAM (TCP)
  - SOCK\_DGRAM (UDP)
- Application layer (API)



# Connectionless time diagram

## Client

- socket
- setsockopt

• sendto

• recvfrom

...

• close

## Server

- socket
- setsockopt
- bind

• recvfrom

• sendto

...

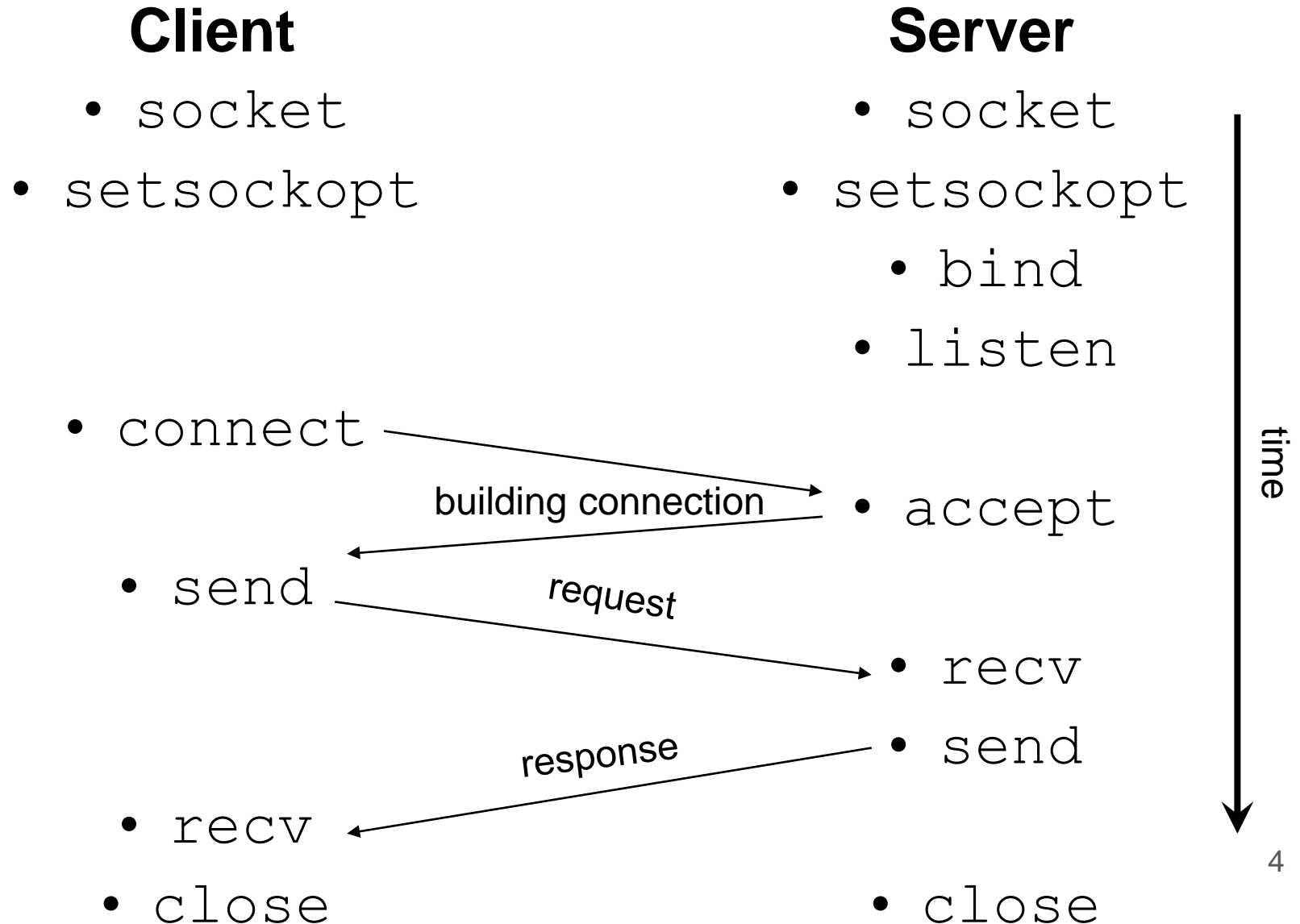
• close

*request*

*response*

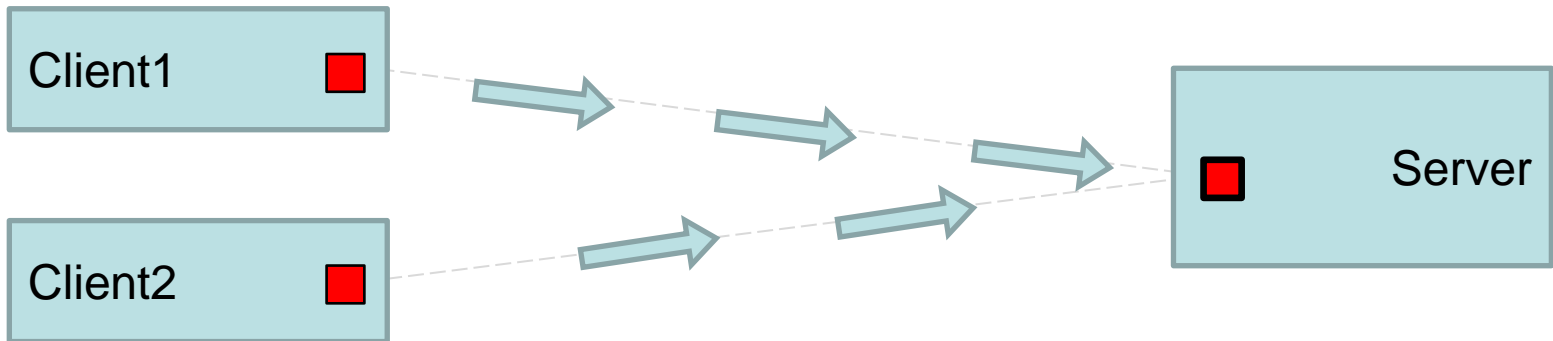
time

# Connection-oriented time diagram

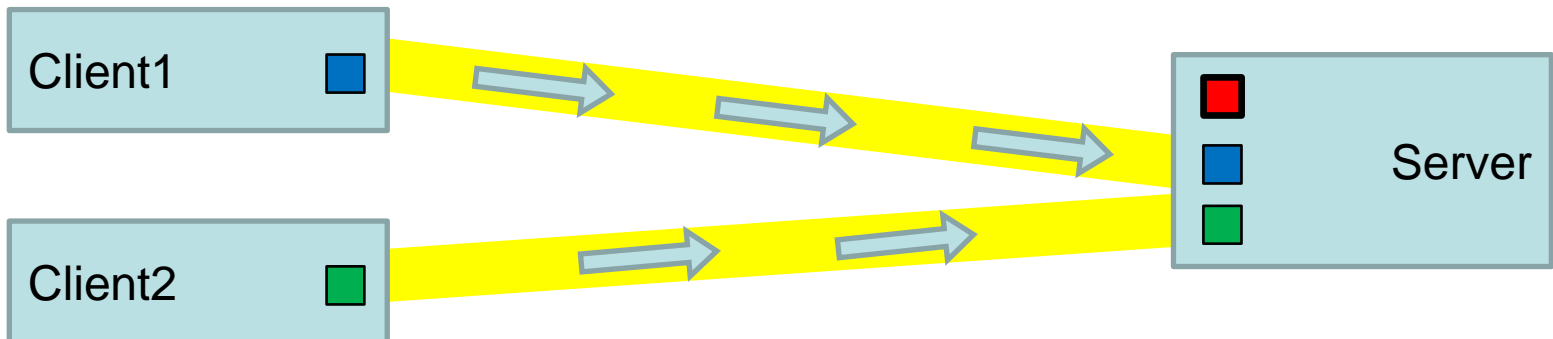


# Communication scheme

## Connectionless



## Connection-oriented



# Header files

- `sys/socket.h`
- `netinet/in.h`
- `arpa/inet.h`
  - `netdb.h`
  - `unistd.h`

# Structures and types

- `in_addr` (`netinet/in.h`)
- `sockaddr_in` (`netinet/in.h`)
- `sockaddr` (`sys/socket.h`)
  - `hostent` (`netdb.h`)
  - `netent` (`netdb.h`)
  - `protoent` (`netdb.h`)
  - `servent` (`netdb.h`)

# Conversion functions

- `inet_addr (...)`
- `inet_aton (...)`
- `inet_ntoa (...)`
- `inet_pton (...)`
- `inet_ntop (...)`
  - `htonl (...)`
  - `htons (...)`
  - `ntohl (...)`
  - `ntohs (...)`



# Socket system calls

- `socket (...)`
- `setsockopt (...)`
- `bind (...)`
- `listen (...)`
- `connect (...)`
- `accept (...)`
- `close (...)`
- `shutdown (...)`
- `select (...)`
- `send (...)`
- `sendto (...)`
- `sendmsg (...)`
- `write (...)`
- `recv (...)`
- `recvfrom (...)`
- `recvmsg (...)`
- `read (...)`

# Information functions

- `getpeername (...)`
- `gethostname (...)`
- `gethostbyname (...)`
- `gethostbyaddr (...)`
- `getservbyname (...)`
- `getservbyport (...)`
- `getsockname (...)`

# Useful literature

- Socket sample codes  
<https://irh.inf.unideb.hu/~vargai/download/sysprog/Socket.zip>
- Michael J. Donahoo, Kenneth L. Calvert:  
*TCP/IP Sockets in C* (Elsevier, 2009)
- Linux manual pages  
<https://man7.org/linux/man-pages>
- Socket Programming Tutorial In C For Beginners  
<https://www.youtube.com/watch?v=LtXEMwSG5-8>
- Socket Library Functions  
<https://userpages.uni-koblenz.de/~ros/Rechnerorganisation/socketlibfun.pdf>
- University of Crete: Introduction to Sockets Programming in C using TCP/IP  
<https://www.csd.uoc.gr/~hy556/material/tutorials/cs556-3rd-tutorial.pdf>
- Berkeley sockets  
[https://en.wikipedia.org/wiki/Berkeley\\_sockets](https://en.wikipedia.org/wiki/Berkeley_sockets)