UNIX Sockets

Outline
  UNIX sockets
Berkeley Sockets

• Networking protocols are implemented as part of the OS
  – The networking API exported by most OS’s is the socket interface
  – Originally provided by BSD 4.1c ~1982.

• The principal abstraction is a socket
  – Point at which an application attaches to the network
  – Defines operations for creating connections, attaching to network, sending/receiving data, closing.
Connection-oriented example (TCP)

Server:
1. Socket()
2. Bind()
3. Listen()
4. Accept()
5. Block until connect
6. Process request
7. Send()
8. Recv()

Client:
1. Socket()
2. Connect()
3. Send()
4. Recv()
Connectionless example (UDP)

**Server**
- Socket()
- Bind()
- `Recvfrom()`

- Block until Data from client
- Process request

**Client**
- Socket()
- Bind()
- `Sendto()`

- Data (request)

- `Sendto()`

- Data (reply)

- `Recvfrom()`
Socket call

- Means by which an application attached to the network
- int socket(int family, int type, int protocol)
- *Family*: address family (protocol family)
  - AF_UNIX, AF_INET, AF_NS, AF_IMPLINK
- *Type*: semantics of communication
  - SOCK_STREAM, SOCK_DGRAM, SOCK_RAW
  - Not all combinations of family and type are valid
- *Protocol*: Usually set to 0 but can be set to specific value.
  - Family and type usually imply the protocol
- Return value is a *handle* for new socket
Bind call

- Binds a newly created socket to the specified address
- int bind(int socket, struct sockaddr *address, int addr_len)
- *Socket*: newly created socket handle
- *Address*: data structure of address of *local* system
  - IP address and port number (demux keys)
  - Same operation for both connection-oriented and connectionless servers
    - Can use well known port or unique port
Listen call

- Used by connection-oriented servers to indicate an application is willing to receive connections
- `Int(int socket, int backlog)`
- `Socket`: handle of newly creates socket
- `Backlog`: number of connection requests that can be queued by the system while waiting for server to execute accept call.
Accept call

- After executing \textit{listen}, the accept call carries out a \textit{passive open} (server prepared to accept connects).
- \texttt{Int accept(int socket, struct sockaddr *address, int addr_len)}
- It blocks until a remote client carries out a connection request.
- When it does return, it returns with a \textit{new} socket that corresponds with new connection and the address contains the clients address
Connect call

- Client executes an *active open* of a connection
- Int connect(int socket, struct sockaddr *address, int addr_len)
- Call does not return until the three-way handshake (TCP) is complete
- Address field contains remote system’s address
- Client OS usually selects random, unused port
Send(to), Recv(from)

- After connection has been made, application uses send/recv to data
- Int send(int socket, char *message, int msg_len, int flags)
  - Send specified message using specified socket
- Int recv(int socket, char *buffer, int buf_len, int flags)
  - Receive message from specified socket into specified buffer
Socket Implementation

- Protocol implementation
  - Process per protocol
    - Use a separate process to implement each protocol
    - Messages are passes between processes
  - Process per message
    - Use one process to handle each message/communication
    - Generally more efficient

- Buffer use
  - Applications use buffers as do protocols
    - Copies are VERY expensive
    - Message abstraction enables pointers to be used and minimal copies
Practical issues – using sockets

• You have to be very careful when using these calls
  – Specific data structures and formats
  – Ports cannot be less than 1024

• You can use other tools to see if things are working
  – Tcpcap
  – /proc
  – netstat

• Client and server can be on same system

• Think about error handling methods

• Check reference text

• Baby steps!!