SOCKETS

COMP476
Networked Computer Systems

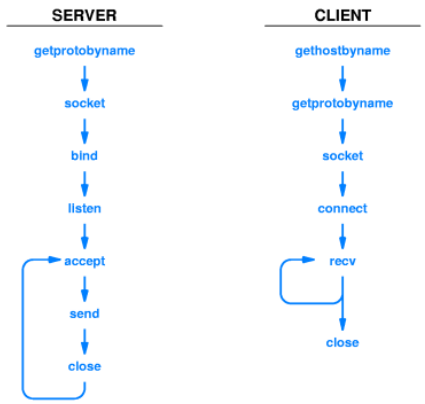
Sockets

Socket functions provide an application programmer interface (API) to send and receive data over a network.

Socket Functions

gethostbyname - get the IP address for an IP name
gethostname - get the name of the local machine
socket - create a new socket
connect - make connection to remote host
send - transmit data through active connection
recv - receive data through active connection
close - terminate use of a socket
bind - attach a network address to a socket
listen - wait for incoming messages
accept - begin using incoming connection

Sequence of Socket Calls



gethostbyname

```
hostent = gethostbyname("IP name")
```

- returns a pointer to a hostent structure.
- provides the IP address for an IP name.

socket

```
descriptor = socket(protofamily,
  type, protocol)
```

- Returns socket descriptor used in subsequent calls
- **`protofamily`** selects protocol family;
  - `AF_INET` - Internet protocols
- **`type`** selects type of communication
  - `SOCK_DGRAM` – connectionless
  - `SOCK_STREAM` - connection-oriented
- **`protocol`** specifies protocol within protocol family:
  - `IPPROTO_TCP` - selects TCP
  - `IPPROTO_UDP` - selects UDP

connect

```
connect(socket,saddress,saddrlen)
```

- Client uses **`connect`** to establish connection to server
- **`socket`** holds descriptor of socket to use
- **`saddress`** is a `struct sockaddr` that identifies server
- **`saddrlen`** gives length of `saddress`

connect *(cont.)*

- Blocks until connection completed (`accept`ed)
- Usually used with connection-oriented transport protocol
- Can be used with connectionless protocol
- Marks local socket with server address
- Implicitly identifies server for subsequent messages

send

```
send(socket, data, length, flags)
```

- Used to send data through a connected socket
- **`socket`** identifies socket
- **`data`** points to data to be sent
- **`length`** gives length of data (in bytes)
- **`flags`** indicate special options
  - zero is a nice flag

sendto

```
sendto(socket, data, length,
       flags, destaddr, addrlen)
```

- Used for *unconnected* sockets by explicitly specifying destination
- **`sendto`** adds additional parameters:
- **`destaddr`** - `struct sockaddr` destination address
- **`addrlen`** - length of `destaddr`

recv

```
recv(socket, buffer, length,flags)
```

- Used to receive incoming data through connected socket
- **`socket`** identifies the socket
- Data copied into **`buffer`**
- At most `length` bytes will be `recv`ed
- **`flags`** give special options
- Returns number of bytes actually `recv`ed
  - `0` implies connection closed
  - `-1` implies error

recvfrom

```
recvfrom(socket, buffer, length,
    flags, sndraddr, addrlen)
```

- Like `recvfrom` (in reverse!)
- Address of source copied into **`sndraddr`**
- Length of address in **`addrlen`**

close

`close(descriptor)`

- Terminates use of socket descriptor
- **`descriptor`** contains descriptor of socket to be closed

gethostname

`gethostname(hostname, buffersize )`

- puts the IP name of the local computer in the **`hostname`** string.

bind

`bind(socket, localaddr, address)`

- Initially, socket has no addresses attached
- **`bind`** selects either local, remote or both addresses
- **`server`** binds local port number for incoming messages
- **`client`** binds remote address and port number to contact server

listen

`listen(socket, queuesize)`

- Server uses **`listen`** to wait for incoming connections
- **`socket`** identifies socket through which connections will arrive (address)
- New connection requests may arrive while server processes previous request
- Operating system can hold requests on queue
- **`queuesize`** sets upper limit on outstanding requests. Usually 2 or 3 will work.

accept

`accept(socket, caddress, caddrlen)`

- Server uses `accept` to accept the next connect request
- `accept` call blocks until connection request arrives
- Returns a *new socket* with server's end of new connection
- *Old socket* remains unchanged and continues to field incoming requests
- `caddress` returns `struct sockaddr` client address;

Socket Address Format

```
struct sockaddr_in {
  u_char  sin_len;      /* total length of address */
  u_char  sin_family;   /* family of the address */
  u_short sin_port;     /* protocol port number */
  struct in_addr sin_addr; /* IP address */
  char sin_zero[8]      /* unused */
  }
```

Host entry structure Format

Host entry structure returned by gethostbyname

```
struct hostent {
  char *h_name;       /* official name of host */
  char **h_aliases;   /* alias list */
  int h_addrtype;     /* host address type */
  int h_length;       /* length of address */
  char **h_addr_list; /* list of addr from DNS */
  };

#define h_addr h_addr_list[0]
                /* address, for backward compatibility */
```

htons Format Conversion

`int = htons( short )`

- Host TO Network Short
- Converts a short int to network standard format.
- Swaps bytes if necessary.

ntohs Format Conversion

```
int = ntohs( short)
```

- Network TO Host Short
- Converts a 16 bit integer in network standard format to a short in the local host format.
- Swaps bytes if necessary.

Microsoft Extensions

```
WSAStartup( version, &wsaData);
```

- Must be called before any other socket function.
- **`WSADATA`** is an structure that will receive information about the socket implementation on this system, such as the implementation version.

```
WSACleanup();
```

- Closes all sockets.
- **`WSAStartup`** must be called to use any socket function again.