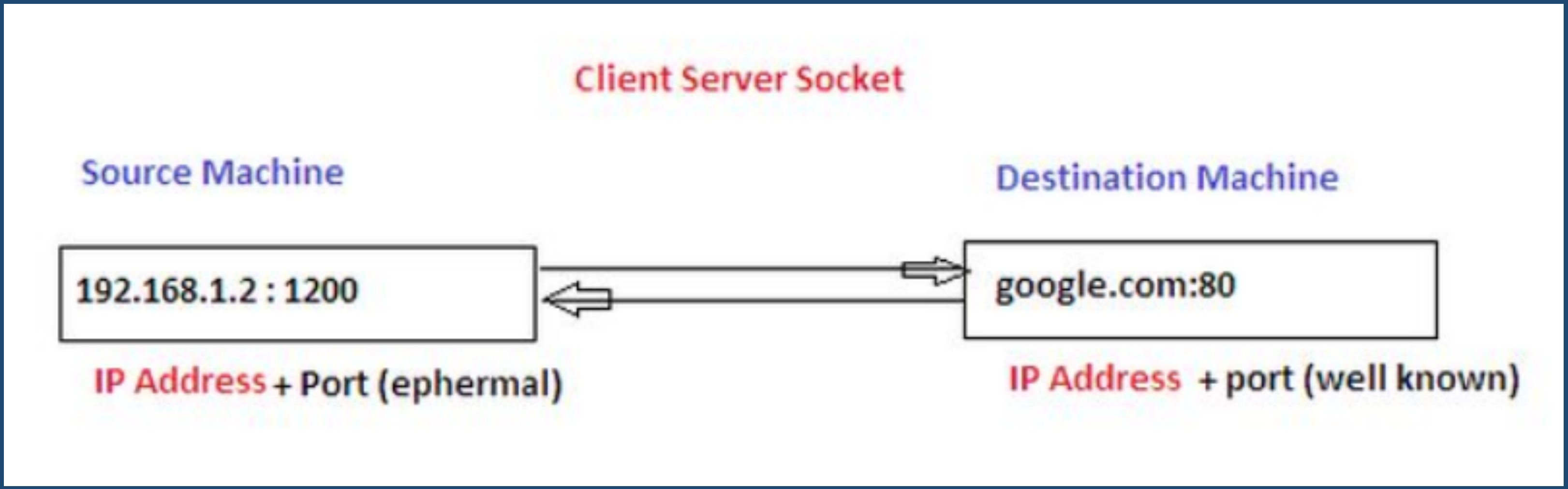


Socket Programming

EECS3214

Winter 2018

Socket programming

Goal: learn how to build client/server application that communicate using sockets

Socket API

- introduced in BSD4.1 UNIX, 1981
- explicitly created, used, released by apps
- client/server paradigm
- two types of transport service via socket API:
  - unreliable datagram
  - reliable, byte stream-oriented

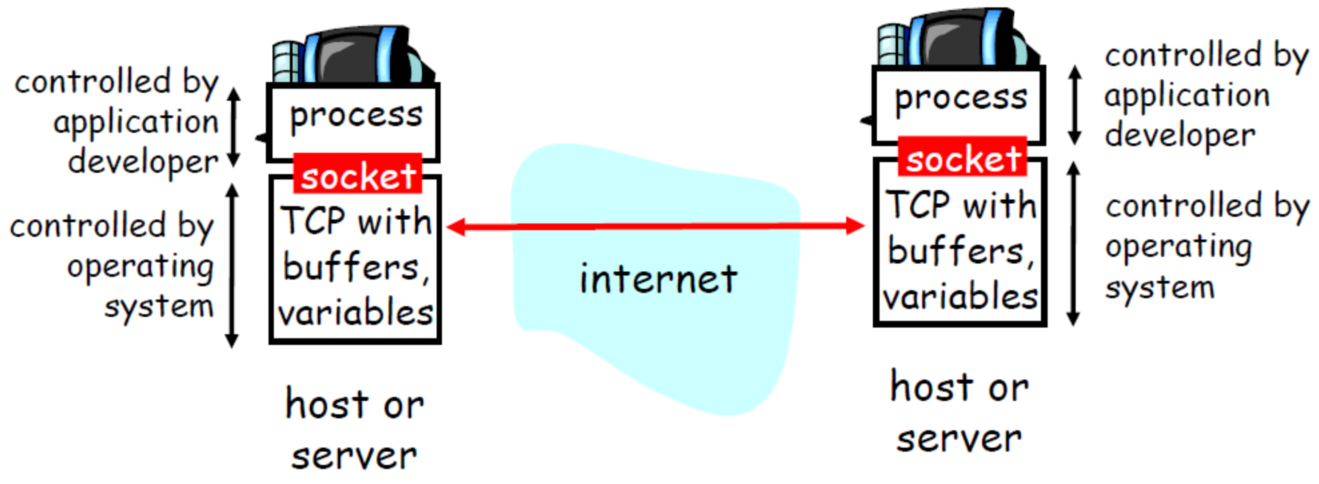
socket

a *host-local*, *application-created*, *OS-controlled* interface (a "door") into which application process can both send and receive messages to/from another application process

Socket-programming using TCP

Socket: a door between application process and end-end-transport protocol (UCP or TCP)

TCP service: reliable transfer of **bytes** from one process to another


controlled by application developer
controlled by operating system
process
socket
TCP with buffers, variables
host or server
internet
process
socket
TCP with buffers, variables
host or server
controlled by application developer
controlled by operating system

Socket programming *with TCP*

Client must contact server

- server process must first be running
- server must have created socket (door) that welcomes client's contact

Client contacts server by:

- creating client-local TCP socket
- specifying IP address, port number of server process
- When client creates socket: client TCP establishes connection to server TCP

- When contacted by client, server TCP creates new socket for server process to communicate with client
  - allows server to talk with multiple clients
  - source port numbers used to distinguish clients (more in Chap 3)

application viewpoint

TCP provides reliable, in-order transfer of bytes ("pipe") between client and server

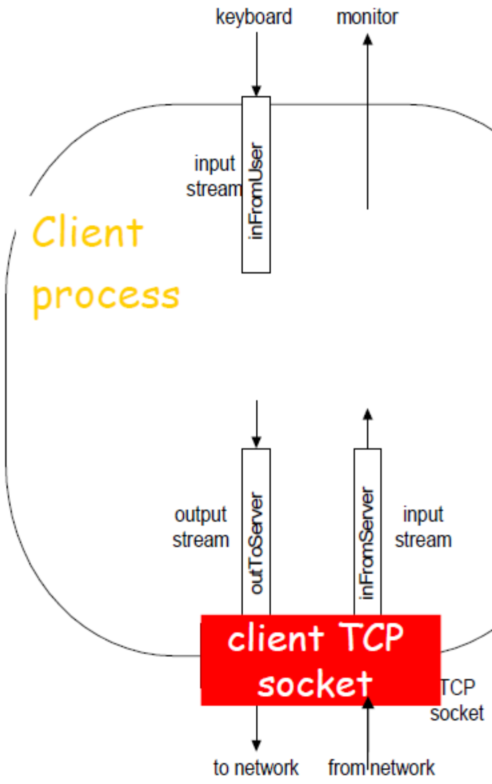
Stream jargon

- A stream is a sequence of characters that flow into or out of a process.
- An input stream is attached to some input source for the process, eg, keyboard or socket.
- An output stream is attached to an output source, eg, monitor or socket.

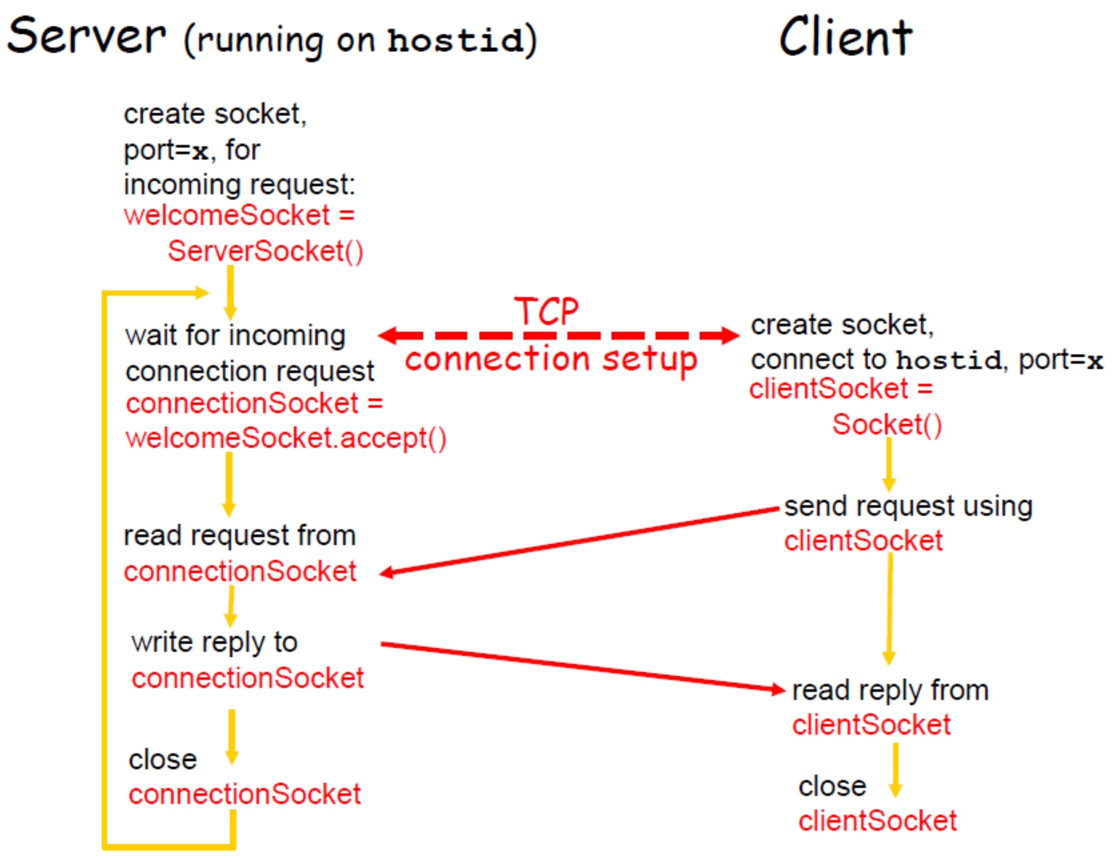
Socket programming with TCP

Example client-server app:

1) client reads line from standard input (**`inFromUser`** stream) , sends to server via socket (**`outToServer`** stream)
2) server reads line from socket
3) server converts line to uppercase, sends back to client
4) client reads, prints modified line from socket (**`inFromServer`** stream)



Client/server socket interaction: TCP



Server (running on hostid)
Client
create socket, port=x, for incoming request:
welcomeSocket = ServerSocket()
wait for incoming connection request
connectionSocket = welcomeSocket.accept()
TCP connection setup
create socket, connect to hostid, port=x
clientSocket = Socket()
send request using clientSocket
read request from connectionSocket
write reply to connectionSocket
read reply from clientSocket
close connectionSocket
close clientSocket

Example: Java client (TCP)

```
import java.io.*;
import java.net.*;
class TCPClient {

    public static void main(String argv[]) throws Exception
    {
        String sentence;
        String modifiedSentence;

        BufferedReader inFromUser =
          new BufferedReader(new InputStreamReader(System.in));

        Socket clientSocket = new Socket("hostname", 6789);

        DataOutputStream outToServer =
          new DataOutputStream(clientSocket.getOutputStream());
```

Create input stream

Create client socket, connect to server

Create output stream attached to socket

Example: Java client (TCP), cont.

Create input stream attached to socket

```
BufferedReader inFromServer =
  new BufferedReader(new
  InputStreamReader(clientSocket.getInputStream()));
```

```
 sentence = inFromUser.readLine();
```

Send line to server

```
 outToServer.writeBytes(sentence + '\n');
```

Read line from server

```
 modifiedSentence = inFromServer.readLine();

 System.out.println("FROM SERVER: " + modifiedSentence);

 clientSocket.close();

}
}
```

Example: Java server (TCP)

```
import java.io.*;
import java.net.*;

class TCPServer {

 public static void main(String argv[]) throws Exception
  {
   String clientSentence;
   String capitalizedSentence;

   ServerSocket welcomeSocket = new ServerSocket(6789);

   while(true) {

      Socket connectionSocket = welcomeSocket.accept();

     BufferedReader inFromClient =
       new BufferedReader(new
       InputStreamReader(connectionSocket.getInputStream()));
```

Create welcoming socket at port 6789

Wait, on welcoming socket for contact by client

Create input stream, attached to socket

Example: Java server (TCP), cont

Create output stream, attached to socket

```
           DataOutputStream  outToClient =
             new DataOutputStream(connectionSocket.getOutputStream());
```

Read in line from socket

```
           clientSentence = inFromClient.readLine();

           capitalizedSentence = clientSentence.toUpperCase() + '\n';
```

Write out line to socket

```
           outToClient.writeBytes(capitalizedSentence);
        }
    }
}
```

End of while loop, loop back and wait for another client connection