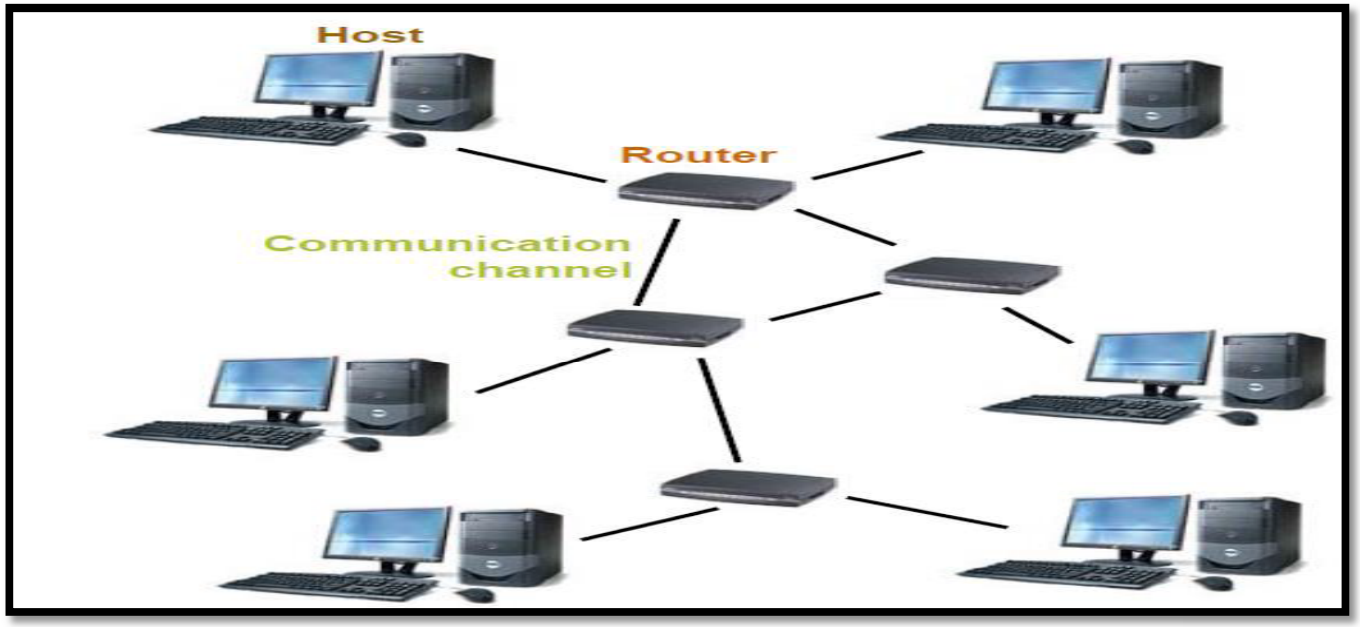
❖Computer Networks:

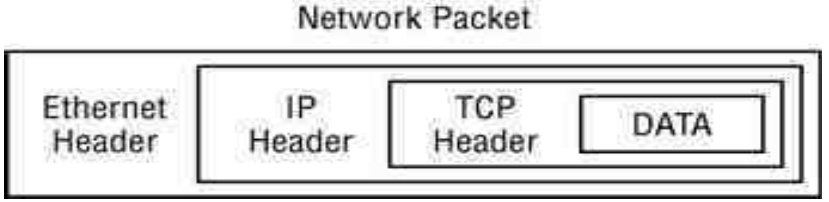
- Consists of **Machines** Interconnected by **communication channels**

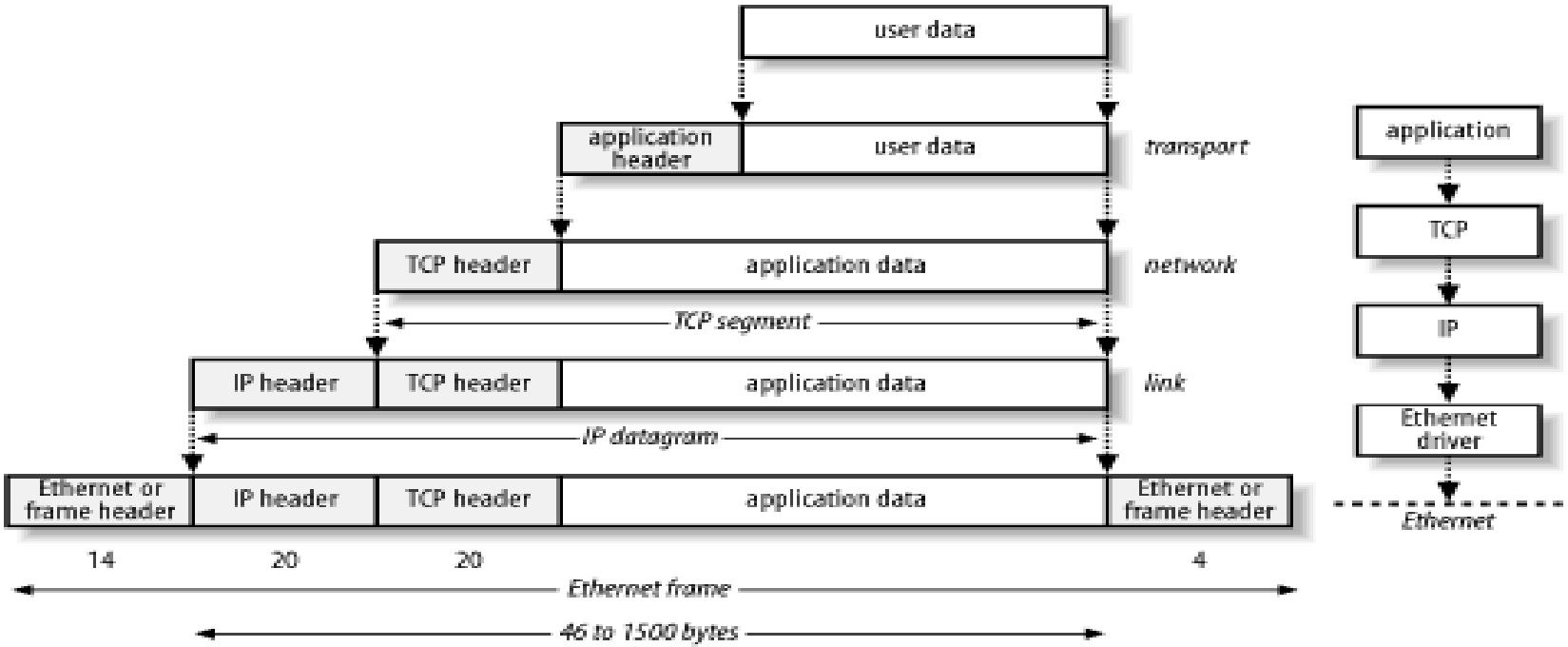


- **Machines** are Hosts and Routers
  - **Hosts** run applications
  - **Routers** forward *information* among communication channels
- **Communication channels** is a means of conveying sequences of bytes from one host to another (Ethernet, dial-up, satellite, etc.)

❖Packets:

- Sequences of **bytes** that are constructed and interpreted by programs
- **A packet contains**
  - Control information:
    - Used by routers to figure out how to forward every packet.
    - e.g. packet destination
  - User data





❖Protocol:

- An agreement about the *packets exchanged* by communicating programs and *what they mean*.
- A protocol tells
  - how packets are structured
    - where the distention information is located in the packet
    - how big it is
- Protocols are designed to solve specific problems
  - TCP/IP is such collection of solutions (protocol suite or family):
    - IP, TCP, UDP, DNS, ARP, HTTP, and many more
- How can we access the services provided by TCP/IP suite?
  - **Sockets API.**

❖Addresses:

- Before one program can communicate with another program, it has to tell the network where to find the other program
- In TCP/IP, it takes two piece of information:
  - Internet Address, used by IP (e.g. Company's main phone number)
  - Port Number, interpreted by TCP & UDP (extension number of an individual in the company)

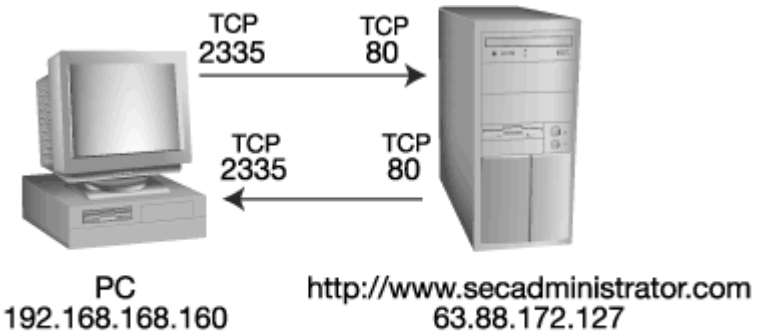
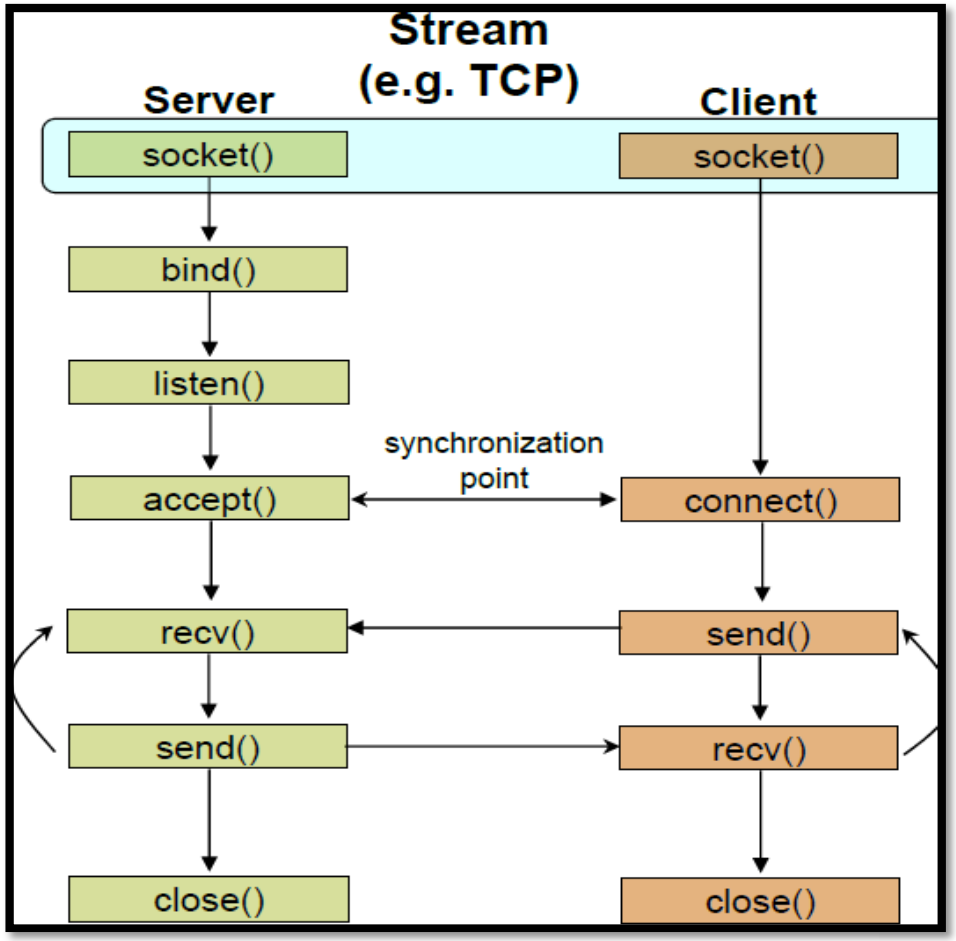


FIGURE 1: Sample TCP session

❖Client and server

- **Server**: *passively* waits for and responds to clients
- **Client**: initiates the communication
  - must know the address and the port of the server



- Socket(): endpoint for communication
- Bind(): assign a unique number
- Listen(): wait for a caller
- Connect(): dial a number
  Accept(): receive a call
- Send() and Receive(): Talk
- Close(): Hang up

- **Server**

1. Create a TCP socket using socket()
2. Assign a port number to the socket with bind()
3. Tell the system to allow connections to be made to that port using listen()
4. Repeatedly do the following:
    - Call accept() to get a new socket for each client connection
    - communicate with the client using send() and recv()
    - Close the client connection using close()

- **Client**

1. Create a TCP socket using socket()
2. Establish a connection to server using connect()
3. communicate using send() and recv()
4. Close connection using close()

❖ Why socket programming?

- To build network applications.
  - Firefox, google chrome, etc.
  - Apache Http server

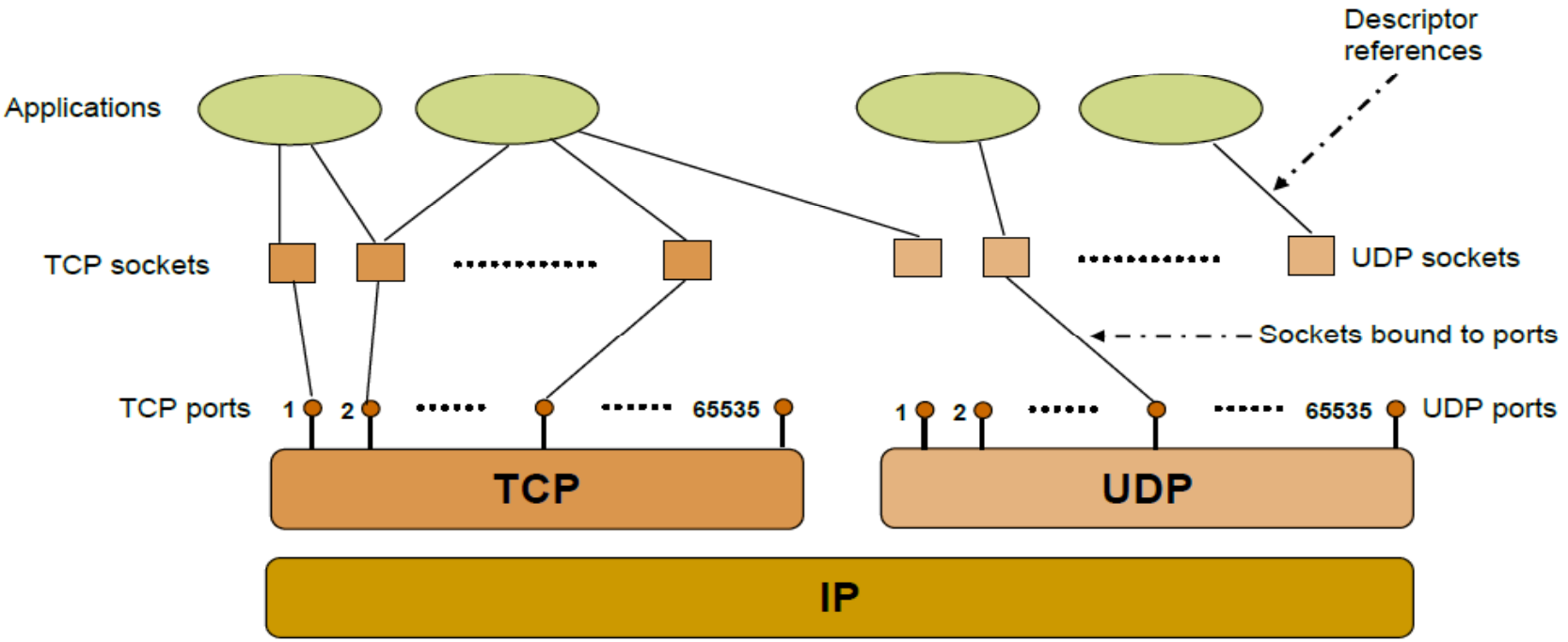
❖ What is a socket?

- It is an abstraction through which an application may send and receive data
- File is an analogy: read (receive) and write (send)

❖ Types of sockets

- Stream sockets (TCP): reliable byte-stream service
- Datagram sockets (UDP): best effort datagram service

- **What is a socket API?**
  - An interface between application and network
  - **Applications** access the services provided by **TCP** and **UDP** through the **sockets API**



❖ Specifying Addresses

- Applications need to be able to specify Internet address and Port number. How?
- Use **Address Structure**
  1. Sockaddr: generic data type
  2. in_addr : internet address
  3. sockaddr_in: another view of Sockaddr

```
struct sockaddr_in{
unsigned short sin_family;    /* Internet protocol (AF_INET) */
unsigned short sin_port;     /* Address port (16 bits) */
struct in_addr sin_addr;    /* Internet address (32 bits) */
char sin_zero[8];            /* Not used */
}
```