CS214 Recitation Sec.7

Nov. 28, 2017
Dec. 05, 2017

Topics

1. OSI
2. IPv4 vs IPv6
3. TCP vs UDP
4. Sockets
5. Blocking & Non-blocking

Open Systems Interconnection Model

- A technology standard maintained by the International Standards Organization (ISO)
- An abstract model of how *network protocols* and *equipment* should communicate and work together
- Contains *seven* layers in *two* groups: Host layers & Media layers
- Host layers perform *application-specific functions* such as data formatting, encryption, transmission, and connection management
- Media layers provide more primitive *network-specific functions* such as routing, addressing, and flow control

Open Systems Interconnection Model

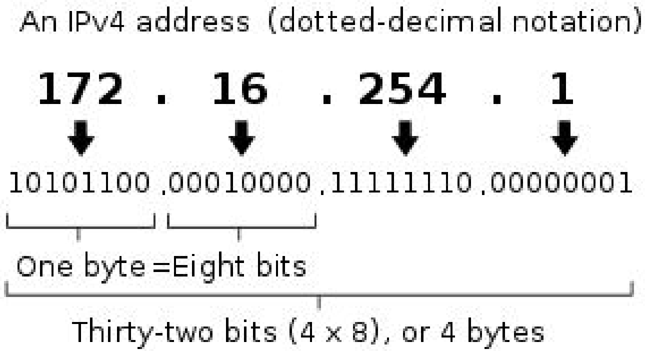
OSI Model				
	Layer	Data unit	Function[3]	Examples
Host layers	7. Application	Data	High-level APIs, including resource sharing, remote file access, directory services and virtual terminals	HTTP, FTP, SMTP
	6. Presentation		Translation of data between a networking service and an application; including character encoding, data compression and encryption/decryption	ASCII, EBCDIC, JPEG
	5. Session		Managing communication sessions, i.e. continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes	RPC, PAP
	4. Transport	Segments	Reliable transmission of data segments between points on a network, including segmentation, acknowledgement and multiplexing	TCP, UDP
Media layers	3. Network	Packet/Datagram	Structuring and managing a multi-node network, including addressing, routing and traffic control	IPv4, IPv6, IPsec, AppleTalk
	2. Data link	Bit/Frame	Reliable transmission of data frames between two nodes connected by a physical layer	PPP, IEEE 802.2, L2TP
	1. Physical	Bit	Transmission and reception of raw bit streams over a physical medium	DSL, USB

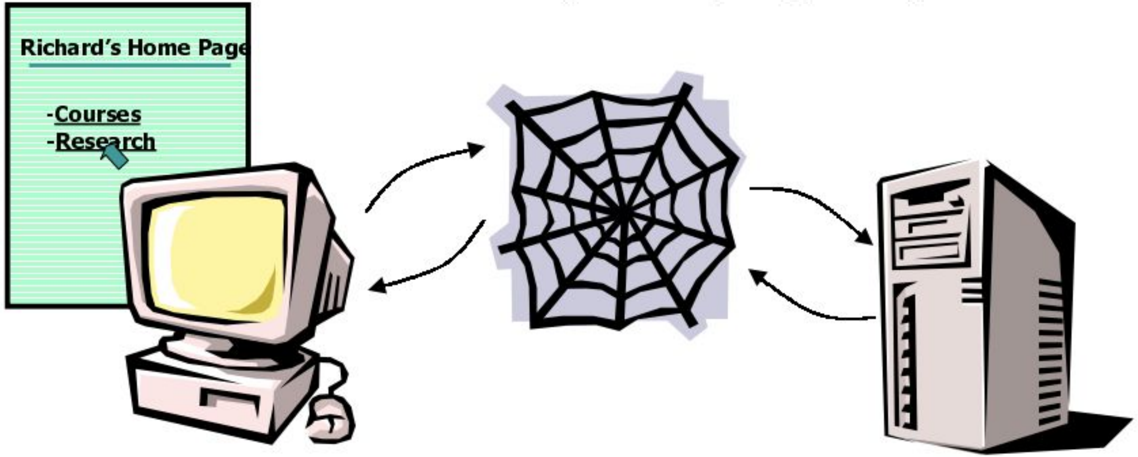
Benefits of OSI

- Simplifies the design of network protocols
- Ensure different types of equipment would all be compatible if built by different manufacturers
- Makes network designs more extensible as new protocols are easier to add to a layered architecture

How do we find the server

- Every computer on the Internet has an Internet address called an **IP** address (Internet Protocol)
- An IP address is four 8-bit numbers separated by dots
- Example: Remote Terminal Server at Rutgers python.cs.rutgers.edu 128.6.13.233





IPv4 vs IPv6

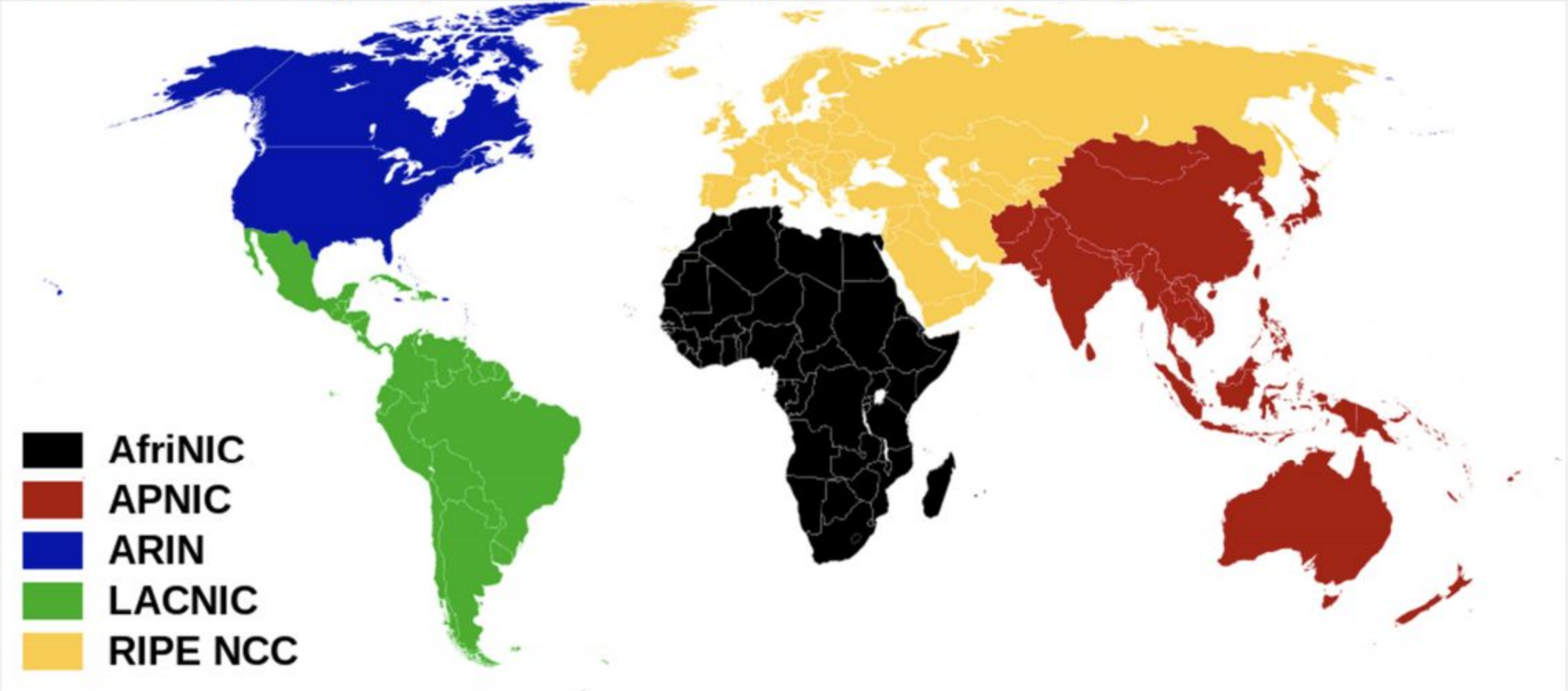
- "**IPv4**" is version 4 of the Internet Protocol how to send packets of information across a network from one machine to another
- Roughly **95%** of all packets on the Internet today are IPv4 packets
- A significant limitation of IPv4 is that source and destination addresses are limited to **32 bits** (8bits * 4)

IPv4 Header Format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Version				IHL				DSCP						ECN		Total Length															
4	32	Identification																Flags			Fragment Offset												
8	64	Time To Live								Protocol								Header Checksum															
12	96	Source IP Address																															
16	128	Destination IP Address																															
20	160	Options (if IHL > 5)																															

IPv4 Depletion

Exhaustion of IPv4 for each of the 5 regional authorities.
ARIN exhausted 24 September 2015
commons.wikimedia.org/wiki/File:Regional_Internet_Registries_world_map.svg



IPv4 Depletion

ARIN ONLINE

Username and password are case sensitive.

username: *new user?*

password: *assistance*

log in

About ARIN Online

IPV4 DEPLETION

IPV4 ADDRESS OPTIONS

Due to depletion of its IPv4 Free Pool, ARIN is no longer able to fulfill requests for IPv4 address space unless you are an organization requesting a small block of IPv4 address space to facilitate the transition to IPv6 (per NRPM 4.10) or micro-allocations for specific purposes such as the operation of exchange points (per NRPM 4.4 and 6.10).

Your options for getting IPv4 address space are:

Find out more…

Check out our blog featuring periodic ARIN IPv4 Depletion status updates

Waiting List for Unmet Requests

Submit an IPv4 request and go on the Waiting List for Unmet Requests - Requests on the waiting list can only be filled when ARIN adds IPv4 address space to its available IPv4 inventory. This usually occurs when a registrant returns IPv4 address; upon revocation by ARIN (typically for non-payment of annual fees); after address space distribution to ARIN by Internet Assigned Numbers Authority (IANA); or when otherwise made available to be re-issued.

Transfers to Specified Recipients

Seek IPv4 address space via a Transfer to Specified Recipients (NRPM 8.3 or NRPM 8.4)

- If you have identified an organization that is interested in transferring an IPv4 address block to you, you can enter directly into the Transfer Process via ARIN Online.
- If you are looking for an organization with IPv4 addresses to transfer, you can get pre-approved for a transfer while you locate available resources. Pre-approvals are valid for 24-months.

Specified Transfer Listing Service

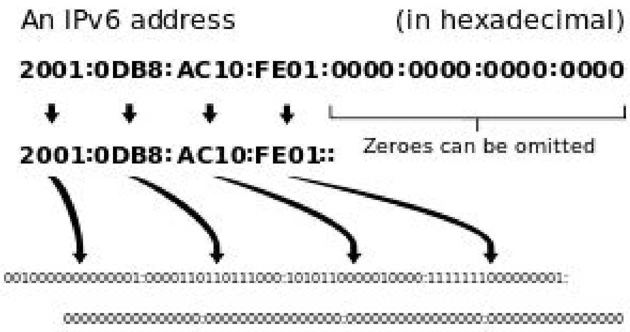
You can register for ARIN's Specified Transfer Listing Service to help find an organization that ARIN has validated as having IPv4 resources eligible for transfer.

Adoption of IPv6

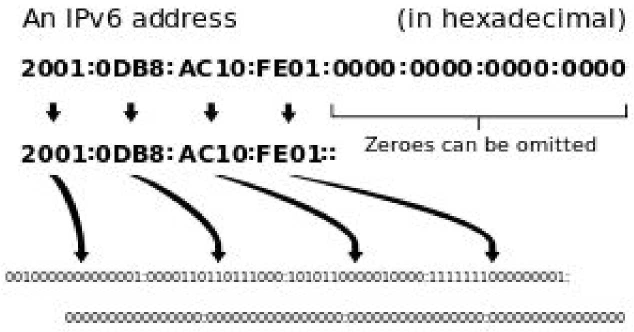
To ensure the growth of your network well into the future, you might also consider requesting IPv6 address space directly from ARIN.

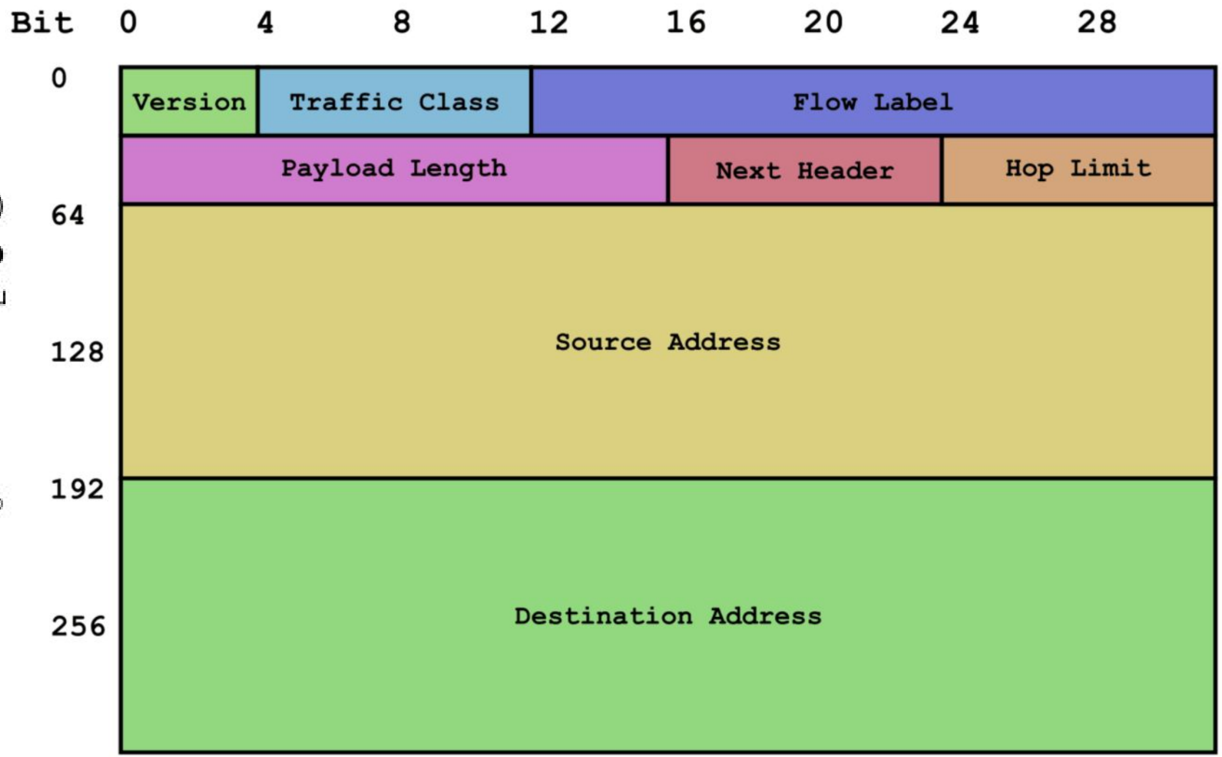
IPv4 vs IPv6

- Each IPv4 packet includes a very small header - typically **20 bytes** (more precisely, "octets"), that includes *a source and destination address*
- Conceptually the source and destination addresses can be split into two: a ***network number*** (the upper bits) and the lower bits represent a ***particular host number*** on that network.
- A newer packet protocol "**IPv6**" solves many of the limitations of IPv4 (e.g. makes routing tables simpler and **128 bit** addresses) however less than 5% of web traffic is IPv6 based. Example:



IPv6 packet header





TCP vs UDP

- UDP is a **connectionless protocol** that is built on top of IPv4 and IPv6
- UDP is very simple to use: 1. Decide the destination address and port and 2. send your data packet
- UDP makes **no guarantee** about whether the packets will arrive
- A typical use case for UDP is when **receiving up to date data is more important** than receiving all of the data

TCP vs UDP

- TCP is a **connection-based protocol** that is built on top of IPv4 and IPv6 (and therefore can be described as "**TCP/IP**" or "TCP over IP")
- TCP creates a ***pipe*** between two machines and under most conditions, bytes sent from one machine will eventually arrive at the other end without duplication or data loss
- TCP will **automatically manage** resending packets, ignoring duplicate packets, re-arranging out-of-order packets and changing the rate at which packets are sent
- To create a pipe between two machines, TCP use a three-way handshake mechanism which is known as ***SYN, SYN-ACK, and ACK***.

TCP Handshake

Host A **sends** a TCP **SYN**chronize packet to Host B

Host B receives A's **SYN**

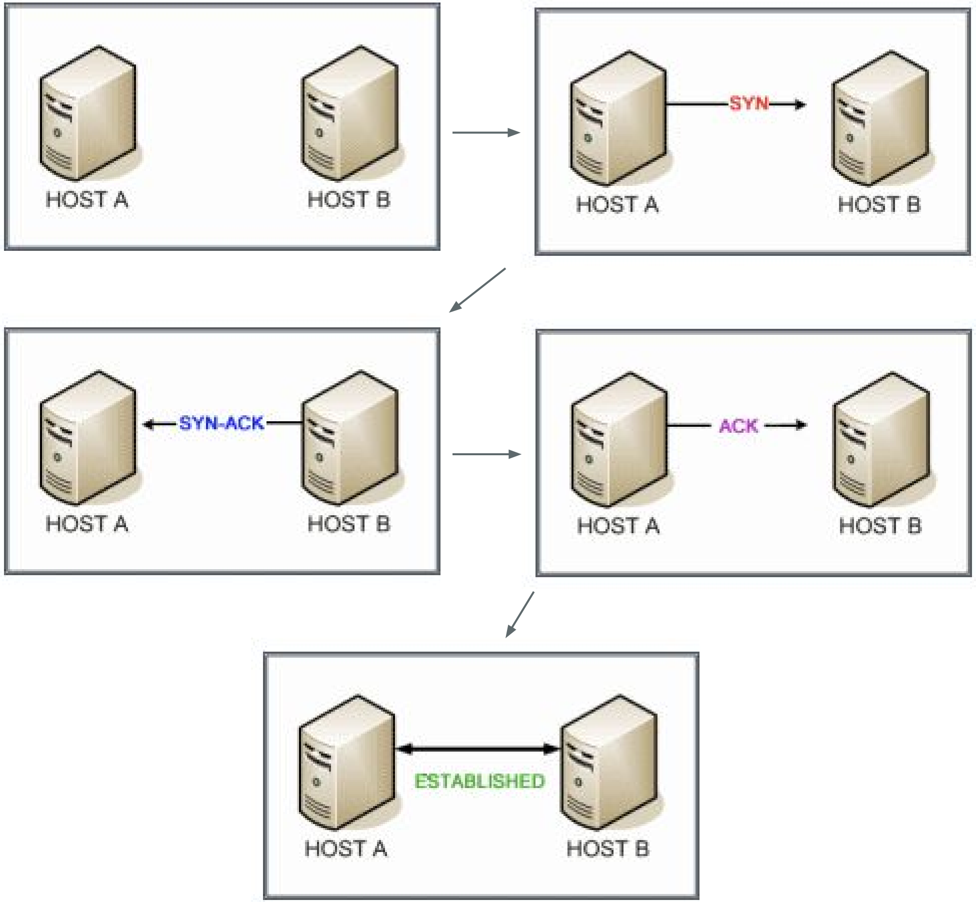
Host B **sends** a **SYN**chronize-**ACK**nowledgement

Host A receives B's **SYN-ACK**

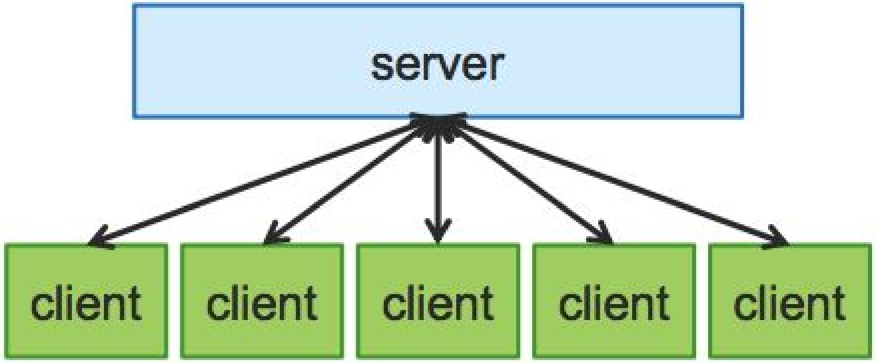
Host A **sends** **ACK**nowledge

Host B receives **ACK**.

TCP socket connection is ESTABLISHED.



Client-Server Model



All communications across a network happen over a **network socket**

- Client:
  - Initiates contact
  - Waits for server's response
- Server:
  - Well-known name
  - Waits for contact
  - Processes requests, sends replies

Socket

- An endpoint for communication between processes
- Bi-directional: sending or receiving data in a computer network
- Connection made via a **socket address**
- **IP address** is the destination of computer
- **Port number** is the destination of process

- A ***socket address*** is:
  - IP Address
  - Port Number

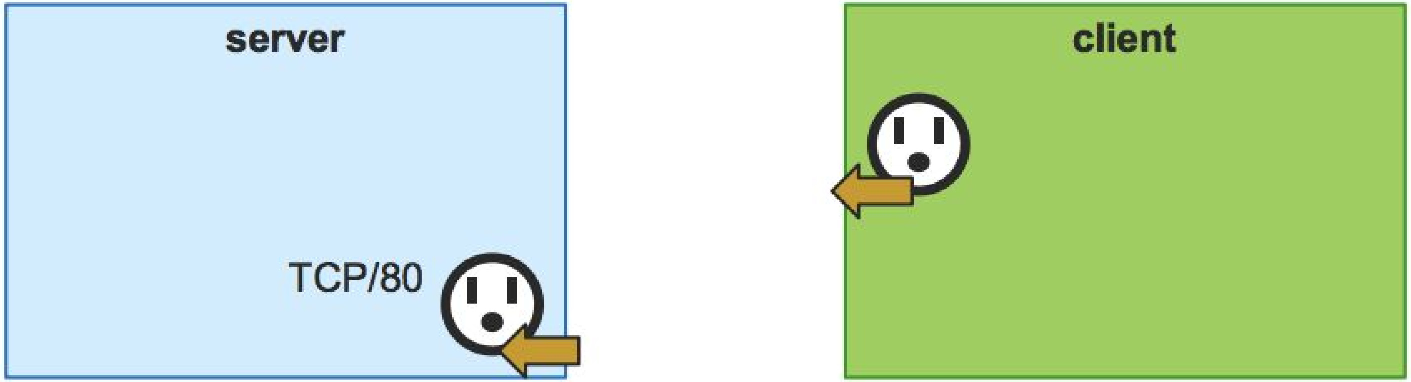
- A socket must also bind to a specific transport-layer protocol.
  - TCP
  - UDP

Socket

- **Port number** is a 16-bit unsigned interger (0 - 65535)
- A *unique resource* shared across the entire system (eg. port 80 can only be utilized by one process)
- Ports below 1024 are *reserved* by operating system
- *Public HTTP servers* always listen for new connections on **port 80**

Initializing a socket

- To listen for an incoming connection, and listen on a specific protocol/port (**Server Socket**)
- To connect to a “server socket” - remote computer (**Client**)



Get socket address with `getaddrinfo`

- The function `getaddrinfo` can convert a human readable domain name (e.g. www.cs.rutgers.edu) into an IPv4 and IPv6 address
- A linked-list of `addrinfo` structs will be returned after calling `getaddrinfo`

```c
struct addrinfo {
    int              ai_flags;
    int              ai_family;
    int              ai_socktype;
    int              ai_protocol;
    socklen_t        ai_addrlen;
    struct sockaddr *ai_addr;
    char            *ai_canonname;
    struct addrinfo *ai_next;
};
```

Get socket address with `getaddrinfo`

```
#include <sys/types.h>
#include <sys/socket.h>
#include <netdb.h>
int getaddrinfo(const char *restrict node,
                const char *restrict service,
                const struct addrinfo *restrict hints,
                struct addrinfo **restrict res);
```

- Parameters
  - `node`: host name or IP address to connect to
  - `service`: a port number (“80“) or the name of a service (found /etc/services: “http”)
  - `hints`: a filled out struct addrinfo

Using `getaddrinfo`

convert *www.cs.rutgers.edu* into an IPv4 address with `getaddrinfo`

output:

```
~/2017F/CS 214/recitation_11_28 » ./addinfo
128.6.68.137
128.6.68.137
```

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netdb.h>

struct addrinfo hints, *infoptr; // So no need to use memset global variables

int main() {

  hints.ai_family = AF_INET; // AF_INET means IPv4 only addresses

  int result = getaddrinfo("www.cs.rutgers.edu", NULL, &hints, &infoptr);
  if (result) {
    fprintf(stderr, "getaddrinfo: %s\n", gai_strerror(result));
    exit(1);
  }

  struct addrinfo *p;
  char host[256];

  for(p = infoptr; p != NULL; p = p->ai_next) {

    getnameinfo(p->ai_addr, p->ai_addrlen, host, sizeof(host), NULL, 0, NI_NUMERICHOST);
    puts(host);
  }

  freeaddrinfo(infoptr);
  return 0;
}
```

Using `getaddrinfo`

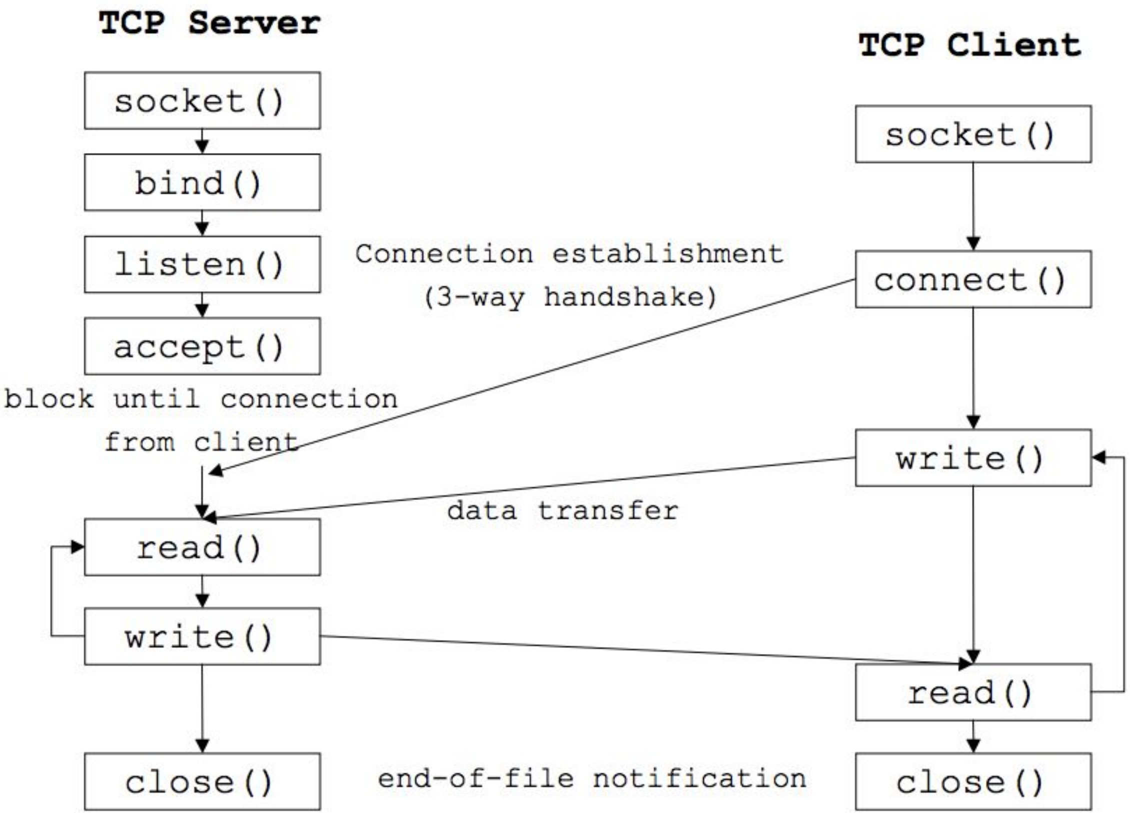
output:

```
~/2017F/CS 214/recitation_11_28 » ./addinfo
getaddrinfo: nodename nor servname provided, or not known
```

convert *www.cs.rutgers.edu* into an IPv6 address with `getaddrinfo`

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netdb.h>

struct addrinfo hints, *infoptr; // So no need to use memset global variables

int main() {

  hints.ai_family = AF_INET6; // Only want IPv6 (use AF_INET for IPv4)
  hints.ai_socktype = SOCK_STREAM; // Only want stream-based connection

  int result = getaddrinfo("www.cs.rutgers.edu", NULL, &hints, &infoptr);
  if (result) {
    fprintf(stderr, "getaddrinfo: %s\n", gai_strerror(result));
    exit(1);
  }

  struct addrinfo *p;
  char host[256];

  for(p = infoptr; p != NULL; p = p->ai_next) {

    getnameinfo(p->ai_addr, p->ai_addrlen, host, sizeof(host), NULL, 0, NI_NUMERICHOST);
    puts(host);
  }

  freeaddrinfo(infoptr);
  return 0;
}
```

TCP Server-Client Model



Creating a “Server Socket”

- **socket()**: Creates a new socket for a specific protocol (eg: TCP)
- **bind()**: Binds the socket to a specific port (eg: 80)
- **listen()**: Moves the socket into a state of listening for incoming connections.
- **accept()**: Accepts an incoming connection.

Creating a “Client Socket”

- **socket()**: Creates a new socket for a specific protocol (eg: TCP)
- **connect()**: Makes a network connection to a specified IP address and port.

socket()

```
int socket (int family, int type, int
    protocol);
```

- Create a socket.
  - Returns file descriptor or -1. Also sets `errno` on failure.
  - `family`: address family (namespace)
    - `AF_INET` for IPv4
    - other possibilities: `AF_INET6` (IPv6), `AF_UNIX` or `AF_LOCAL` (Unix socket), `AF_ROUTE` (routing)
  - `type`: style of communication
    - `SOCK_STREAM` for TCP (with `AF_INET`)
    - `SOCK_DGRAM` for UDP (with `AF_INET`)
  - `protocol`: protocol within family
    - typically 0

bind()

```
int bind (int sockfd, struct sockaddr*
    myaddr, int addrlen);
```

- Bind a socket to a local IP address and port number
  - Returns 0 on success, -1 and sets `errno` on failure
  - `sockfd`: socket file descriptor (returned from `socket`)
  - `myaddr`: includes IP address and port number
    - IP address: set by kernel if value passed is `INADDR_ANY`, else set by caller
    - port number: set by kernel if value passed is 0, else set by caller
  - `addrlen`: length of address structure
    - `= sizeof (struct sockaddr_in)`

listen()

```
int listen (int sockfd, int backlog);
```

- Put socket into passive state (wait for connections rather than initiate a connection)
  - Returns 0 on success, -1 and sets `errno` on failure
  - `sockfd`: socket file descriptor (returned from `socket`)
  - `backlog`: bound on length of unaccepted connection queue (connection backlog); kernel will cap, thus better to set high
  - Example:

```
if (listen(sockfd, BACKLOG) == -1) {
        perror("listen");
        exit(1);
}
```

Establishing a Connection

- Include file `<sys/socket.h>`

```
int connect (int sockfd, struct
    sockaddr* servaddr, int addrlen);
```

  - Connect to another socket.

```
int accept (int sockfd, struct sockaddr*
    cliaddr, int* addrlen);
```

  - Accept a new connection. Returns file descriptor or -1.

connect()

```
int connect (int sockfd, struct
    sockaddr* servaddr, int addrlen);
```

- Connect to another socket.
  - Returns 0 on success, -1 and sets `errno` on failure
  - `sockfd`: socket file descriptor (returned from `socket`)
  - `servaddr`: IP address and port number of server
  - `addrlen`: length of address structure
    - `= sizeof (struct sockaddr_in)`
- Can use with UDP to restrict incoming datagrams and to obtain asynchronous errors

accept()

```
int accept (int sockfd, struct sockaddr* cliaddr,
    int* addrlen);
```

- Block waiting for a new connection
  - Returns file descriptor or -1 and sets `errno` on failure
  - `sockfd`: socket file descriptor (returned from `socket`)
  - `cliaddr`: IP address and port number of client (returned from call)
  - `addrlen`: length of address structure = pointer to `int` set to `sizeof (struct sockaddr_in)`

- `addrlen` is a **value-result** argument
  - the caller passes the size of the address structure, the kernel returns the size of the client's address (the number of bytes written)

Sending and Receiving Data

```
int send(int sockfd, const void * buf,
    size_t nbytes, int flags);
```

- Write data to a stream (TCP) or “connected” datagram (UDP) socket.
  - Returns number of bytes written or -1.

```
int recv(int sockfd, void *buf, size_t
    nbytes, int flags);
```

- Read data from a stream (TCP) or “connected” datagram (UDP) socket.
  - Returns number of bytes read or -1.

send()

```
int send(int sockfd, const void * buf, size_t
    nbytes, int flags);
```

- Send data un a stream (TCP) or “connected” datagram (UDP) socket
  - Returns number of bytes written or -1 and sets `errno` on failure
  - `sockfd`: socket file descriptor (returned from `socket`)
  - `buf`: data buffer
  - `nbytes`: number of bytes to try to write
  - `flags`: control flags
    - MSG_PEEK: get data from the beginning of the receive queue without removing that data from the queue

recv()

```
int recv(int sockfd, void *buf, size_t nbytes,
    int flags);
```

- Read data from a stream (TCP) or "connected" datagram (UDP) socket
  - Returns number of bytes read or -1, sets `errno` on failure
  - Returns 0 if socket closed
  - `sockfd`: socket file descriptor (returned from `socket`)
  - `buf`: data buffer
  - `nbytes`: number of bytes to try to read
  - `flags`: see man page for details; typically use 0

Building a simple TCP Client

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netdb.h>
#include <unistd.h>

int main(int argc, char **argv)
{
    int s;
    int sock_fd = socket(AF_INET, SOCK_STREAM, 0);

    struct addrinfo hints, *result;
    memset(&hints, 0, sizeof(struct addrinfo));
    hints.ai_family = AF_INET; /* IPv4 only */
    hints.ai_socktype = SOCK_STREAM; /* TCP */

    s = getaddrinfo("www.cs.rutgers.edu", "80", &hints, &result);
    if (s != 0) {
            fprintf(stderr, "getaddrinfo: %s\n", gai_strerror(s));
            exit(1);
    }

    if(connect(sock_fd, result->ai_addr, result->ai_addrlen) == -1){
                perror("connect");
                exit(2);
        }

    char *buffer = "GET / HTTP/1.0\r\n\r\n";
    printf("SENDING: %s", buffer);
    printf("===\n");

    write(sock_fd, buffer, strlen(buffer));


    char resp[1000];
    int len = read(sock_fd, resp, 999);
    resp[len] = '\0';
    printf("%s\n", resp);

    return 0;
}
```

Building a simple TCP Client

```
~/2017F/CS 214/recitation_11_28 » ./tcp_client
SENDING: GET / HTTP/1.0

===
HTTP/1.1 301 Moved Permanently
Date: Wed, 29 Nov 2017 17:13:04 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_auth_gssapi/1.3.1 mod_auth
_kerb/5.4 mod_fcgid/2.3.9 mod_nss/2.4.6 NSS/3.19.1 Basic ECC PHP/5.4.16 SVN/1.7.
14 mod_wsgi/3.4 Python/2.7.5
Location: http://www.cs.rutgers.edu/
Content-Length: 234
Connection: close
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>301 Moved Permanently</title>
</head><body>
<h1>Moved Permanently</h1>
<p>The document has moved <a href="http://www.cs.rutgers.edu/">here</a>.</p>
</body></html>
```

Building a simple TCP Server

```c
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netdb.h>
#include <unistd.h>
#include <arpa/inet.h>

int main(int argc, char **argv)
{
    int s;
    int sock_fd = socket(AF_INET, SOCK_STREAM, 0);

    struct addrinfo hints, *result;
    memset(&hints, 0, sizeof(struct addrinfo));
    hints.ai_family = AF_INET;
    hints.ai_socktype = SOCK_STREAM;
    hints.ai_flags = AI_PASSIVE;

    s = getaddrinfo(NULL, "1234", &hints, &result);
    if (s != 0) {
            fprintf(stderr, "getaddrinfo: %s\n", gai_strerror(s));
            exit(1);
    }

    if (bind(sock_fd, result->ai_addr, result->ai_addrlen) != 0) {
        perror("bind()");
        exit(1);
    }

    if (listen(sock_fd, 10) != 0) {
        perror("listen()");
        exit(1);
    }

    struct sockaddr_in *result_addr = (struct sockaddr_in *) result->ai_addr;
    printf("Listening on file descriptor %d, port %d\n", sock_fd, ntohs(result_addr->sin_port));

    printf("Waiting for connection...\n");
    int client_fd = accept(sock_fd, NULL, NULL);
    printf("Connection made: client_fd=%d\n", client_fd);

    char buffer[1000];
    int len = read(client_fd, buffer, sizeof(buffer) - 1);
    buffer[len] = '\0';

    printf("Read %d chars\n", len);
    printf("===\n");
    printf("%s\n", buffer);

    return 0;
}
```

Building a simple TCP Server

```
~/2017F/CS 214/recitation_11_28 » ./tcp_server
Listening on file descriptor 3, port 1234
Waiting for connection...
```

Blocking & Non-blocking

- If using **blocking** mode, when a process executes `read()`, if the data is not available yet, the process is blocked and it will wait until the data is ready before the function returns.
- If using **non-blocking** mode, when a process executes `read()`, if the data is not available yet, the process will return immediately with a different value and continues executing.
- Non-blocking mode is more **efficient** than blocking mode. But may use more CPU resources.

Blocking & Non-blocking

- The default mode is **block** mode. If there are more than one sockets, when we work on one of these sockets, we cannot handle other sockets at the same time.
- Design a **concurrent** program to solve the above problem, and make sure multiple sockets can work together.

Non-blocking

- Three ways to set nonblocking
- 1. To set a file descriptor to be nonblocking

```
// fd is my file descriptor
int flags = fcntl(fd, F_GETFL, 0);
fcntl(fd, F_SETFL, flags | O_NONBLOCK);
```

- 2. For a socket, create it in nonblocking mode by adding SOCK_NONBLOCK to the second argument

```
fd = socket(AF_INET, SOCK_STREAM | SOCK_NONBLOCK, 0);
```

Non-blocking

- The previous two methods continue looking up sockets, and use many CPU resources
- 3. Multiplexing with select(), it will wait for any of those file descriptors to become 'ready'.
- select() returns the **total number** of file descriptors that are ready. If none of them become ready during the time defined by timeout, it will return 0.

```
#include <sys/time.h>
#include <sys/types.h>
#include <unistd.h>

int select(int numfds, fd_set *readfds, fd_set *writefds,
        fd_set *exceptfds, struct timeval *timeout);
```

Non-blocking

```
#include <sys/time.h>
#include <sys/types.h>
#include <unistd.h>

int select(int numfds, fd_set *readfds, fd_set *writefds,
        fd_set *exceptfds, struct timeval *timeout);
```

```
#ifndef FD_SETSIZE
#define FD_SETSIZE      64
#endif /* FD_SETSIZE */

typedef struct fd_set {
        u_int fd_count;        // how many are SET?
        SOCKET  fd_array[FD_SETSIZE]; // an array of SOCKETs
} fd_set;
```

FD_SET(int fd, fd_set *set); add *fd* to *set*

FD_CLR(int fd, fd_set *set); remove *fd* from *set*

FD_ISSET(int fd, fd_set *set); If *fd* is in *set*, return true

FD_ZERO(fd_set *set); Set the whold *set* to zero

```
struct timeval {
  int tv_sec; // second
  int tv_usec; // microseconds
};
```

Non-blocking

```
fd_set readfds, writefds;
FD_ZERO(&readfds);
FD_ZERO(&writefds);
for (int i=0; i < read_fd_count; i++)
  FD_SET(my_read_fds[i], &readfds);
for (int i=0; i < write_fd_count; i++)
  FD_SET(my_write_fds[i], &writefds);

struct timeval timeout;
timeout.tv_sec = 3;
timeout.tv_usec = 0;

int num_ready = select(FD_SETSIZE, &readfds, &writefds, NULL, &timeout);

if (num_ready < 0) {
  perror("error in select()");
} else if (num_ready == 0) {
  printf("timeout\n");
} else {
  for (int i=0; i < read_fd_count; i++)
    if (FD_ISSET(my_read_fds[i], &readfds))
      printf("fd %d is ready for reading\n", my_read_fds[i]);
  for (int i=0; i < write_fd_count; i++)
    if (FD_ISSET(my_write_fds[i], &writefds))
      printf("fd %d is ready for writing\n", my_write_fds[i]);
}
```

Construct a chat program - Server

```
while(1)
{
    FD_ZERO(&servfd);//clear all fds of server
    FD_ZERO(&recvfd);//clear all fds of client
    FD_SET(sockfd,&servfd);
    //timeout.tv_sec=30;//reduce the check frequency
    switch(select(max_servfd+1,&servfd,NULL,NULL,&timeout))
    {
        case -1:
            perror("select error");
            break;
        case 0:
            break;
        default:
            //printf("has datas to offer accept\n");
            if(FD_ISSET(sockfd,&servfd))//sockfd if have data, means can be accepted
            {
                /*accept a client's request*/
                if((clientfd=accept(sockfd,(struct sockaddr  *)&clientSockaddr, &sinSize))==-1)
                {
                    perror("fail to accept");
                    exit(1);
                }
                printf("Success to accpet a connection request...\n");
                printf(">>>>>> %s:%d join in! ID(fd):%d \n",inet_ntoa(clientSockaddr.sin_addr),ntohs(cl
                //print_time(ch,&now);
                //time(&now);
                struct tm *info;
                time(&now);
                info = localtime(&now);
                printf("Join on:%s\n",asctime(info));

                if((recvSize=recv(clientfd,(char *)&use,sizeof(struct user),0))==-1 || recvSize==0)
                {
                    perror("fail to receive datas");
                }
```

Construct a chat program - Client

```
//send-recv
if((pid=fork())<0)
{
    perror("fork error\n");
}
else if(pid==0)/*child*/
{
    while(1)
    {
        fgets(sendBuf,MAX_BUF,stdin);
        printf("Me:%s\n", sendBuf);
        if(send(sockfd,sendBuf,strlen(sendBuf),0)==-1)
        {
            perror("fail to receive datas.");
        }
        memset(sendBuf,0,sizeof(sendBuf));
    }
}
else
{
    while(1)
    {
        if((recvSize=recv(sockfd,recvBuf,MAX_BUF,0)==-1))
        {
            printf("Server maybe shutdown!");
            break;
        }
        printf("%s\n",recvBuf);
        memset(recvBuf,0,sizeof(recvBuf));
    }
    kill(pid,SIGKILL);
}
```