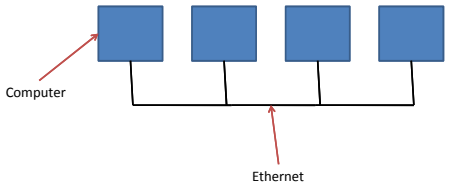
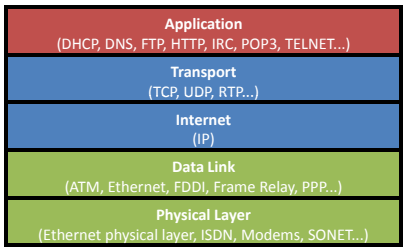
Network Communication

Jonathan Misurda
jmisurda@cs.pitt.edu

Network



Internet Layer Model



Internet Protocol (IP)

- **Protocol** – A standard procedure for regulating data transmission between computers.
- **IP Addresses** – 32-bit (v4) or 128 (v6) number denoting an destination or source
- **Datagram** – (play on telegram) A message with no acknowledgement

Transmission Control Protocol (TCP)

- **Connection-oriented** – Make a circuit with a remote machine
- **Port** – a number representing a particular listener on a machine
- Guarantees data arrives, and in-order

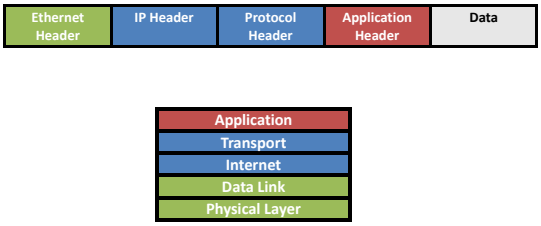
User Datagram Protocol (UDP)

- **Connectionless** – Send and forget
- No guarantee data arrives or is in the order sent

IP Packet

	Bits 0–3	4–7	8–15	16–18	19–31
0	Version	Header length	Type of Service	Total Length	
32	Identification			Flags	Fragment Offset
64	Time to Live		Protocol	Header Checksum	
96	Source Address				
128	Destination Address				
160	Options				
192-	Data				

Packets



BERKELEY SOCKETS

Socket

- UNIX treats everything as a file
  - File Descriptor
  - read()/ write()
- Treat network as a file called a socket
- Berkeley sockets are de facto standard API

socket()

- Creates a Socket Descriptor

```
#include <sys/types.h>
#include <sys/socket.h>

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

Parameter	Values
domain	•PF_INET for IPv4 •PF_INET6 for IPv6
type	•SOCK_STREAM •SOCK_DGRAM •SOCK_SEQPACKET •SOCK_RAW
protocol	IPPROTO_IP (defined as 0)

SERVER STUFF

bind()

- Attach a socket to a port

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

memset(&my_addr, 0, sizeof(struct sockaddr));
my_addr.sin_family = AF_INET;
my_addr.sin_port = htons(PORT);
my_addr.sin_addr.s_addr=inet_addr("127.0.0.1");
```

listen()

- Set up a listening socket

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

backlog – how many pending connections are allowed to wait (OS max usually around 20, set to lower, ~10)

accept()

- Block and wait for connection to occur

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

- Will return information about the client through the structure (can be NULL)

send() and recv()

```
int send(int clientfd, const void *msg, int
  len, unsigned int flags);

int recv(int clientfd, void *buf, int len,
  unsigned int flags);
```

CLIENT STUFF

socket()

- Creates a Socket Descriptor

```
#include <sys/types.h>
#include <sys/socket.h>

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

Parameter	Values
domain	•PF_INET for IPv4 •PF_INET6 for IPv6
type	•SOCK_STREAM •SOCK_DGRAM •SOCK_SEQPACKET •SOCK_RAW
protocol	IPPROTO_IP (defined as 0)

connect()

- Connect to a server located at some address and port

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

memset(&my_addr, 0, sizeof(struct sockaddr));
my_addr.sin_family = AF_INET;
my_addr.sin_port = htons(PORT);
my_addr.sin_addr.s_addr=inet_addr("127.0.0.1");
```

send() and recv()

```
int send(int clientfd, const void *msg, int
  len, unsigned int flags);

int recv(int client, void *buf, int len,
  unsigned int flags);
```

CONNECTIONLESS COMMUNICATION

Datagram Send and Receive

```
int sendto(int sockfd, const void *msg, int
  len, unsigned int flags, const struct
  sockaddr *to, socklen_t tolen);

int recvfrom(int sockfd, void *buf, int len,
  unsigned int flags, struct sockaddr *from,
  int *fromlen);
```

DNS

- Domain Name Server
- Resolve a name to an IP address:

  http://www.cs.pitt.edu -> 130.49.220.23

DNS

```
#include <netdb.h>
struct hostent *gethostbyname(const char *name);

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 addresses */
}
#define h_addr  h_addr_list[0]  /* for backward compatibility */
```