CS4514 Project 2
Help Session
(B07)

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Nov 8, 2007
The goal is to implement a Positive Acknowledgement with Retransmission (PAR) protocol on top of an emulated physical layer.

- The receiver acknowledges only the correctly received segments and the sender uses timeout to detect and send the lost segment.
- Physical layer is emulated by a TCP connection plus an error module.
- Your programs should compile and work on “ccc[1-6].wpi.edu”
Framework

Client

Network Layer

Data Link Layer

Physical Layer

Server

Network Layer

Data Link Layer

Physical Layer

Do NOT attempt to put everything in one big main()
Network Layer

Packet size: 180 bytes
Data Link Layer

Client

Network layer ack

dll_send(pkt)

Data Link Layer

dll_recv(frm)

Network layer ack

Server

Network layer ack

Network layer ack

dll_send(pkt)

Data Link Layer

dll_recv(frm)

_frm

(ack/frm)

(Network Layer ack)

Client link layer does not need to ACK “Network Layer ACK” frame!
Physical Layer

Client

Datalink Layer

ack

phl_send()

Physical Layer

phl_recv()

Server

Datalink Layer

frm

phl_send()

Physical Layer

phl_recv()

TCP Connection
Client: dll_send(pkt, ...)

1. Read a block and split into payloads

2. For each payload
   2.1 Create Frame (frm)
   2.2 Start a Timer
   2.3 phl_send(frm, ...)
   2.4 phl_recv(ack/frm, ...)

   ack/frm?
     yes
     no
     ack

   ack ok?
     yes
     no

3. Waiting for Network Layer ack:
   if (!nwl_ack) phlrecv(frm,...)

phl_send(frm, ...): Force bit error every 7-th Frame

2.2.1 Timeout Handler:
   phl_send(frm, ...)

2.4.1 nwl_ack received

client.log
Create Frame

1. Compute Seq Number, Frame Type and End-Of-Packet (EOP) bytes

2. Error-Detection (ED) bytes (XOR on Seq + FT + EOP + Data)

EOP: End of Packet
FT: Frame Type
ED: Error Detection
Seq: Sequence Num
Server: dll_recv(frm, ...)

1. Compute ED byte
   - ED ok? [yes, no]
     - yes: Return
     - no: Dup? [yes, no]
       - yes: Drop frm
       - no:创 Create ACK Frame (ack)

2. Create ACK Frame (ack)

3. phl_send(ack, ...)

4. Reassemble the packet

5. nwl_recv(pkt, ...)

phl_send(ack, ...): Force bit error every 11-th Frame

server.log

EOP? [yes, no]
Create ACK Frame

1. Compute Seq Number and Frame Type

2. Error-Detection (ED) bytes (ED = Seq)

<table>
<thead>
<tr>
<th>Seq</th>
<th>FT</th>
<th>ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seq</td>
<td>FT</td>
<td>ED</td>
</tr>
</tbody>
</table>

2 Bytes 1 Byte 2 Bytes

EOP: End of Packet
FT: Frame Type
ED: Error Detection
Seq: Sequence Num
Timers

- The client uses a timer to detect a frame loss.
  - The client sets a timer when it transmits a frame.
  - When the timer expires, the client retransmits the frame.

- Two kinds of timer
  - Select : easier to use
  - Signal and Timer : nicer implementation
# include <sys/select.h>
# include <sys/time.h>

int select (int maxfdp1, fd_set *readset, fd_set *writeset,
            fd_set *exceptset, const struct timeval *timeout);

struct timeval {
    long tv_sec;        /* seconds */
    long tv_usec;       /* microseconds */
};
Example: Select

```c
fd_set bvfdRead;
int readyNo;
struct timeval timeout;
int sockfd;

while (1) {
    timeout.tv_sec = 0;
    timeout.tv_usec = 500;
    FD_ZERO(&bvfdRead);
    FD_SET(sockfd, &bvfdRead);
    readyNo = select(sockfd+1, &bvfdRead, 0, 0, &timeout);
    if(readyNo < 0)
        error_handler();
    else if(readyNo == 0)
        timeout_handler();
    else {
        FD_ZERO(&bvfdRead);
        receive_handler();
    }
}
```
Signal and Timer: Soft Interrupt

- Head files
  ```c
  #include <signal.h>
  #include <time.h>
  ```
- Register a function to TIMEOUT signal
  ```c
  signal(SIGALRM, timeout);
  ```
- Create a timer and begin to run
  ```c
  timer_create();
  timer_settime();
  ```
- Compile with option “-lrt” (link runtime library)
Example: Signal and Timer

timer_t timer_id;

void timeout(int signal_number){
    printf("\n SIGNUM: %d\n", signal_number);
    exit(0);
}

void start_timer(){
    struct itimerspec time_val;
    signal (SIGALRM, timeout);
    timer_create(
        CLOCK_REALTIME,
        NULL, &timer_id);
    /* set timeout to 1 second */
    time_val.it_value.tv_sec = 1;
    time_val.it_value.tv_nsec = 0;
    time_val.it_interval.tv_sec = 0;
    time_val.it_interval.tv_nsec = 0;
    timer_settime(timer_id, 0,
        &time_val, NULL);
}

main(){
    start_timer();
    while(1);
}
Open a File

- Open a file for read:
  ```c
  int rfile;
  if ((rfile = open("filename1", O_RDONLY)) < 0)
  {
    perror("Input File Open Error");
    exit(1);
  }
  ```

- Open a file for write (create if not exist):
  ```c
  int ofile;
  if ((ofile = open("filename2", O_WRONLY|O_CREAT|O_TRUNC, S_IRUSR|S_IWUSR|S_IRGRP|S_IWGRP)) < 0)
  {
    perror("Output File Open Error");
    exit(1);
  }
  ```
File Read

- Read from file
  while ((rd_size = read(rfile, buf, 180)) > 0)
    {
      do something with “buf” here
    }
  if (rd_size < 0)
    {
      perror("File Read Error");
      exit(1);
    }
  else
    {
      printf ("Reach the end of the file\n");
    }
File Write/Close

- Write to File
  
  ```c
  if ((wr_size = write(ofile, buf, rd_size)) < 0)
      {
      perror("Write Error:");
      exit(1);
  }
  ```

- Close files
  ```c
  close(rfile);
  close(ofile);
  ```
Display Image in Linux

- Make sure you have “X forwarding” with your ssh client
- And you need have an Xserver (X-Win32 or etc.) running on you windows computer.
- The image display is not required for the Project.
- These code tested on ccc[1–6].wpi.edu

```c
if (fork() == 0) {
    execl("/usr/local/bin/xv", "xv", "image.jpg", NULL);
} else {
    wait(NULL);
    printf("Done display! \n");
}
```
Thanks! and Questions?