

CSE536 Project 3 – Use a logical clock to impose an ordering on messages

Goal:

Project 3 uses project 2 to communicate between machines to implement a logical clock. When sending a message from user i to user j we want to have an ordering to determine among several messages which came first.

Other details:

- Where to store the clock
 - We decided to store it in the .ko
- How to handle multiple apps on the same host
 - We decided to use synchronization to control access from multiple users. Note the need to copy data from the user to the kernel before allowing a tasklet thread to access the data.
- How to make the communication reliable and not duplicated
 - We decided to limit our reliability to waiting for an ack before retransmitting after 5 seconds. If a second timeout occurs discard the event as unobtainable. Keep no state on the receiver ignoring possible duplicates.
- Protocol Number 234
- Transaction format – Store IP numbers in standard format (Big Endian in_aton() at kernel level, inet_aton() at the user level)
 - Ack format
 - 4 Record ID – ack=0 or event =1
 - 4 final clock
 - 4 original clock
 - 4 source IP
 - 4 destination IP
 - 236 string
 - Event format
 - 4 Record ID – ack=0 or event=1
 - 4 final clock
 - 4 original clock
 - 4 source IP
 - 4 destination IP
 - 236 string

Step by step working:

Sender side,

1. We create a data structure of 256 bytes as described in the problem statement.

```
struct packetformat {  
    uint32_t record_id;  
    uint32_t final_clock;  
    uint32_t original_clock;  
    __be32 source_ip;  
    __be32 destination_ip;  
    uint8_t data[236];  
}
```
2. Then we set destination address and monitor IP address.
3. Next we take input from user from our menu W option and assign it to 'data' field of packet.
4. Initialize other members such as record ID =1, final and original clock to 0.
5. In the cse5361 kernel module we assign clock value to original clock and send the event to destination.

At the same time Pass the event to cse536app again and send the copy to CSE536monitor using the udpclient code.

6. When acknowledgement is not received in 5 seconds, resend the message.
7. Increment the clock after each event sent.

On receiver side,

8. Check the record ID, if it is 1 then change it to 0 and assign clock value to final clock value field. Resend the message to sender with rest of the field unchanged.
9. Also, this is the time to update clock. If packet's original clock is greater than local clock then
Clock = received original clock +1;
Final clock = clock;

On sender side again,

10. When acknowledgement is received (record ID is 0) read it in cse536app.
11. If acknowledgement matches with event sent then send the copy to CSE536monitor using the udpclient code.

Screenshots:

1. Sender (IP address = 192.168.0.40)

```

rajesh@rajesh-virtual-machine: ~/cse536
rajesh@rajesh-virtual-machine:~/cse536$ sudo ./cse536app
*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: D
Please input destination IP address (ex. 192.168.0.40):
192.168.0.40
Destination address set to: 192.168.0.40
*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: R
Hello Destination PC
*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: W
Please input string:
Hello Source PC
Message sent to destination PC: Hello Source PC
Event sent to Monitor: Hello Source PC
*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: R
Ack sent to Monitor: Hello Source PC
*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option:

```

2. Kernel Traces on sender side

```

File Edit View Search Terminal Help
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2576.040681] cse536_open: successful
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2576.040684] cse536_ioctl: cmd=21505, arg=140734980511056
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2576.040690] cse536_read: returning 256 bytes
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2576.040880] cse536_release: successful
Dec 1 22:01:51 rajesh-virtual-machine kernel: [ 2583.517992] cse536_open: successful
Dec 1 22:01:51 rajesh-virtual-machine kernel: [ 2583.517990] cse536_ioctl: cmd=21505, arg=140734980511056
Dec 1 22:01:51 rajesh-virtual-machine kernel: [ 2583.518002] cse536_read: returning 256 bytes
Dec 1 22:01:51 rajesh-virtual-machine kernel: [ 2583.518235] cse536_release: successful
Dec 1 22:23:12 rajesh-virtual-machine kernel: [ 3865.330540] cse536_open: successful
Dec 1 22:23:12 rajesh-virtual-machine kernel: [ 3865.330557] cse536_ioctl: cmd=21505, arg=140733990374896
Dec 1 22:23:12 rajesh-virtual-machine kernel: [ 3865.330572] cse536_write - setting address: 192.168.0.41
Dec 1 22:23:12 rajesh-virtual-machine kernel: [ 3865.330573] cse536_ioctl:
Dec 1 22:23:12 rajesh-virtual-machine kernel: [ 3865.330576] cse536_release: successful
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057262] cse536_open: successful
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057271] cse536_ioctl: cmd=21505, arg=140733990374896
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057298] cse536_write - sending message: Hello 192.168.0.41
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057359] cse536_read: clock incremented to 4
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057561] Receive handler called. Received: 18 bytes: Hello 192.168.0.41
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057569] cse536_ioctl:
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057573] cse536_release: successful
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057592] cse536_open: successful
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057600] cse536_ioctl: cmd=21505, arg=140733990374944
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057606] cse536_read: returning 256 bytes
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 4033.057805] cse536_release: successful
Dec 1 22:26:09 rajesh-virtual-machine kernel: [ 4042.547535] cse536_open: successful
Dec 1 22:26:09 rajesh-virtual-machine kernel: [ 4042.547544] cse536_ioctl: cmd=21505, arg=140733990374944
Dec 1 22:26:09 rajesh-virtual-machine kernel: [ 4042.547557] cse536_read: returning 256 bytes
Dec 1 22:26:09 rajesh-virtual-machine kernel: [ 4042.547824] cse536_release: successful
Dec 1 22:28:50 rajesh-virtual-machine kernel: [ 4203.264178] cse536_open: successful
Dec 1 22:28:50 rajesh-virtual-machine kernel: [ 4203.264238] cse536_ioctl: cmd=21505, arg=140736739450048
Dec 1 22:28:50 rajesh-virtual-machine kernel: [ 4203.264276] cse536_write - setting address: 192.168.0.41
Dec 1 22:28:50 rajesh-virtual-machine kernel: [ 4203.264287] cse536_ioctl:
Dec 1 22:28:50 rajesh-virtual-machine kernel: [ 4203.264290] cse536_release: successful
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.279845] cse536_open: successful
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.279853] cse536_ioctl: cmd=21505, arg=140736739450048
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.279868] cse536_write - sending message: Hello Destination PC
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.279906] cse536_read: clock incremented to 5
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280133] Receive handler called. Received: 20 bytes: Hello Destination PC
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280142] cse536_ioctl:
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280145] cse536_release: successful
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280165] cse536_open: successful
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280170] cse536_ioctl: cmd=21505, arg=140736739450096
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280177] cse536_read: returning 256 bytes
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 4226.280413] cse536_release: successful
Dec 1 22:29:17 rajesh-virtual-machine kernel: [ 4229.903390] cse536_open: successful
Dec 1 22:29:17 rajesh-virtual-machine kernel: [ 4229.903399] cse536_ioctl: cmd=21505, arg=140736739450096
Dec 1 22:29:17 rajesh-virtual-machine kernel: [ 4229.903417] cse536_read: returning 256 bytes
Dec 1 22:29:17 rajesh-virtual-machine kernel: [ 4229.903671] cse536_release: successful
Dec 1 22:29:47 rajesh-virtual-machine kernel: [ 4260.640922] Receive handler called. Received: 15 bytes: Hello Source PC
Dec 1 22:29:47 rajesh-virtual-machine kernel: [ 4260.640938] cse536_read: clock incremented to 6
Dec 1 22:29:47 rajesh-virtual-machine kernel: [ 4260.640965] cse536_read: sending ack
Dec 1 22:30:13 rajesh-virtual-machine kernel: [ 4286.685055] cse536_open: successful
Dec 1 22:30:13 rajesh-virtual-machine kernel: [ 4286.685066] cse536_ioctl: cmd=21505, arg=140736739450096
Dec 1 22:30:13 rajesh-virtual-machine kernel: [ 4286.685089] cse536_read: returning 256 bytes
Dec 1 22:30:13 rajesh-virtual-machine kernel: [ 4286.685096] cse536_release: successful

```

3. Receiver (IP address = 192.168.0.41)

```

rajesh@rajesh-virtual-machine: ~/cse536
rajesh@rajesh-virtual-machine:~/cse536$ sudo ./cse536app

*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: d
Please Input destination IP address (ex. 192.168.0.40):
192.168.0.41
Destination address set to: 192.168.0.41

*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: W
Please Input string:
Hello Destination PC
Message sent to destination PC: Hello Destination PC
Event sent to Monitor: Hello Destination PC

*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: R
Ack sent to Monitor: Hello Destination PC

*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option: R
Hello Source PC

*****Main Menu*****
(D) Set destination address
(M) Set monitor address
(W) Write to the device
(R) Read from the device
(Q) Quit
*****
Option:

```

4. Kernel Traces on receiver side

```

rajesh@rajesh-virtual-machine: ~/cse536/linux-3.13.0
rajesh@rajesh-virtual-machine:~/cse536/linux-3.13.0$ clear

rajesh@rajesh-virtual-machine:~/cse536/linux-3.13.0$ tail -f /var/log/kern.log
Dec 1 21:59:31 rajesh-virtual-machine kernel: [ 2008.406796] cse536_read: returning 256 bytes
Dec 1 21:59:31 rajesh-virtual-machine kernel: [ 2008.407126] cse536_release: successful
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2140.948809] Receive handler called. Received: 9 bytes: I an fine
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2140.948825] cse536_read: clock incremented to 3
Dec 1 22:01:44 rajesh-virtual-machine kernel: [ 2140.948855] cse536_read: sending ack
Dec 1 22:22:08 rajesh-virtual-machine kernel: [ 3366.076191] cse536_open: successful
Dec 1 22:22:08 rajesh-virtual-machine kernel: [ 3366.076205] cse536_ioctl: cmd=21505, arg=140735118294272
Dec 1 22:22:08 rajesh-virtual-machine kernel: [ 3366.076226] cse536_write - setting address: 192.168.0.40
Dec 1 22:22:08 rajesh-virtual-machine kernel: [ 3366.076227] cse536_writel:
Dec 1 22:22:08 rajesh-virtual-machine kernel: [ 3366.076230] cse536_release: successful
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 3597.965783] Receive handler called. Received: 18 bytes: Hello 192.168.0.41
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 3597.965797] cse536_read: clock incremented to 4
Dec 1 22:26:00 rajesh-virtual-machine kernel: [ 3597.965826] cse536_read: sending ack
Dec 1 22:26:27 rajesh-virtual-machine kernel: [ 3624.979793] cse536_open: successful
Dec 1 22:26:27 rajesh-virtual-machine kernel: [ 3624.979804] cse536_ioctl: cmd=21505, arg=140735118294320
Dec 1 22:26:27 rajesh-virtual-machine kernel: [ 3624.979820] cse536_read: returning 256 bytes
Dec 1 22:26:27 rajesh-virtual-machine kernel: [ 3624.979831] cse536_release: successful
Dec 1 22:26:33 rajesh-virtual-machine kernel: [ 3630.612140] cse536_open: successful
Dec 1 22:26:33 rajesh-virtual-machine kernel: [ 3630.612148] cse536_ioctl: cmd=21505, arg=140735118294320
Dec 1 22:26:33 rajesh-virtual-machine kernel: [ 3630.612221] cse536_read: returning 256 bytes
Dec 1 22:26:33 rajesh-virtual-machine kernel: [ 3630.612230] cse536_release: successful
Dec 1 22:28:17 rajesh-virtual-machine kernel: [ 3735.129728] cse536_open: successful
Dec 1 22:28:17 rajesh-virtual-machine kernel: [ 3735.129741] cse536_ioctl: cmd=21505, arg=140736068509248
Dec 1 22:28:17 rajesh-virtual-machine kernel: [ 3735.129756] cse536_write - setting address: 192.168.0.40
Dec 1 22:28:17 rajesh-virtual-machine kernel: [ 3735.129759] cse536_writel:
Dec 1 22:28:17 rajesh-virtual-machine kernel: [ 3735.129762] cse536_release: successful
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 3791.188350] Receive handler called. Received: 20 bytes: Hello Destination PC
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 3791.188365] cse536_read: clock incremented to 5
Dec 1 22:29:13 rajesh-virtual-machine kernel: [ 3791.188394] cse536_read: sending ack
Dec 1 22:29:26 rajesh-virtual-machine kernel: [ 3803.593148] cse536_open: successful
Dec 1 22:29:26 rajesh-virtual-machine kernel: [ 3803.593161] cse536_ioctl: cmd=21505, arg=140736068509296
Dec 1 22:29:26 rajesh-virtual-machine kernel: [ 3803.593174] cse536_read: returning 256 bytes
Dec 1 22:29:26 rajesh-virtual-machine kernel: [ 3803.593179] cse536_release: successful
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549131] cse536_open: successful
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549141] cse536_ioctl: cmd=21505, arg=140736068509248
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549155] cse536_write - sending message: Hello Source PC
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549218] cse536_read: clock incremented to 6
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549470] Receive handler called. Received: 15 bytes: Hello Source PC
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549479] cse536_writel:
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549482] cse536_release: successful
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549500] cse536_open: successful
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549504] cse536_ioctl: cmd=21505, arg=140736068509296
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549510] cse536_read: returning 256 bytes
Dec 1 22:29:48 rajesh-virtual-machine kernel: [ 3825.549765] cse536_release: successful
Dec 1 22:29:52 rajesh-virtual-machine kernel: [ 3830.098690] cse536_open: successful
Dec 1 22:29:52 rajesh-virtual-machine kernel: [ 3830.098698] cse536_ioctl: cmd=21505, arg=140736068509296
Dec 1 22:29:52 rajesh-virtual-machine kernel: [ 3830.098711] cse536_read: returning 256 bytes
Dec 1 22:29:52 rajesh-virtual-machine kernel: [ 3830.099192] cse536_release: successful

```

5. Monitor after the events and acknowledgements

The screenshot shows the **cse536monitor** application window. The main window displays a table with the following columns: **ACK=0**, **Final Clock**, **Original Clock**, **Source IP**, **Destination IP**, and **String**. The table contains six rows of data:

ACK=0	Final Clock	Original Clock	Source IP	Destination IP	String
00000	000000000006	00000000000005	192.168.0.41	192.168.0.40	Hello Source PC
00001	000000000000	00000000000005	192.168.0.41	192.168.0.40	Hello Source PC
00000	000000000005	00000000000004	192.168.0.40	192.168.0.41	Hello Destination PC
00001	000000000000	00000000000004	192.168.0.40	192.168.0.41	Hello Destination PC
00000	000000000004	00000000000003	192.168.0.40		
00001	000000000000	00000000000003	192.168.0.40		

An overlay window titled **CSE536 Event Stats** is displayed on the right side of the main window. It contains the following fields and values:

- Server IP:
- List Count:
- Events Received:
- Events Acked:
- Events Failed:
- Highest TS:
- Lowest TS After HTS:

The Windows taskbar at the bottom shows the system clock as 10:32 PM on 12/1/2014.