Final Implementation

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CS/EE 143 Milestone 3

Review

- Tools
- Architecture

Tools

- Python 2.7.1
- SimPy
- Matplotlib
- GitHub

Input

- JSON
- Dictionary format:

```
{ "Hosts" : Number of hosts,
  "Routers" : Number of routers,
  "Links" : [ [Link Rate (Mbps), Link Delay (ms), Link Buffer (KB),
              ['H' or 'R', id], ['H' or 'R', id] ] ],
  "Flows" : [ [Data Amt (MB), Flow start (s), Src host id, Dest host id,
               Congestion Control Algorithm] ] }
```

- Congestion control algorithm can be specified for each flow

Output

- Real time performance curves
    - Simulation run time
    - Data collecting interval
    - Objects to plot
        - link=1,2
        - flow
- Raw data files

Environment

- Periodically pause simulation
- Collect statistics and update plots

Packet

- Data packet (1 KB)
- Acknowledgement packet (64 B)
- Routing update packet (1 KB)
- FIN packet (64 B)
  - two-way handshake termination

Flow

- Sending flow:
    - Send data packets with congestion control
    - Variable start time and data amount
- Receiving flow:
    - Created on-the-fly
    - Acknowledges last data packet in sequence
    - Requests next packet in sequence

Host

- Manage outgoing packets
- Coordinate incoming packets
    - Create receiving flows if necessary

Link

- Half-duplex
    - Packets transmitted in order of arrival
- Accepts packets from connected devices into buffers

Router

- Adjacent hosts
- Records minimum distances to all hosts from all outgoing links
- Immediately forwards data packets

Progress

- Dynamic routing
- Congestion control
- **Pass test cases 1 and 2**

Dynamic Routing - Basics

- Link weight:
  - queuing delay + propagation delay
- Bellman-Ford
- Routing update packets:
  - broadcast to adjacent routers
  - minimum distances to hosts

Dynamic Routing - Router Design

- Distance table for each outgoing link
- Routing table selects link with minimum distance to host H
- Timestamp for each link indicates last arrival time of routing update packet

Dynamic Routing - Routing Update

- Start of simulation
- Perform dynamic routing regularly
- Broadcast when routing table changed

Congestion Control

- Go-back-N
- TCP Tahoe (with fast retransmit)
- FAST TCP

Go-back-N

- Sender:
  - Move window upon receiving ack of packet at the start of current window
  - Send packets in the current window after timeout or receiving the previous batch
- Receiver:
  - Send ack of sequence number of the expected pkt
  - ignore packets coming out of order

Tahoe (with Fast Retransmit)

- Successful ack:
    - slide window;adjust window size
- Failed ack:
    - Only recognize dup ack at least 16ms apart
        - Protect flows from routing changes
    - dup ack count = 3:
        - enter slow start
        - Resend lost packet

FAST

- alpha = 0.75 * buffer size / # flow sharing link
- retransmit timeout = 3 * rtt

FAST_monitor_incoming_pkts()

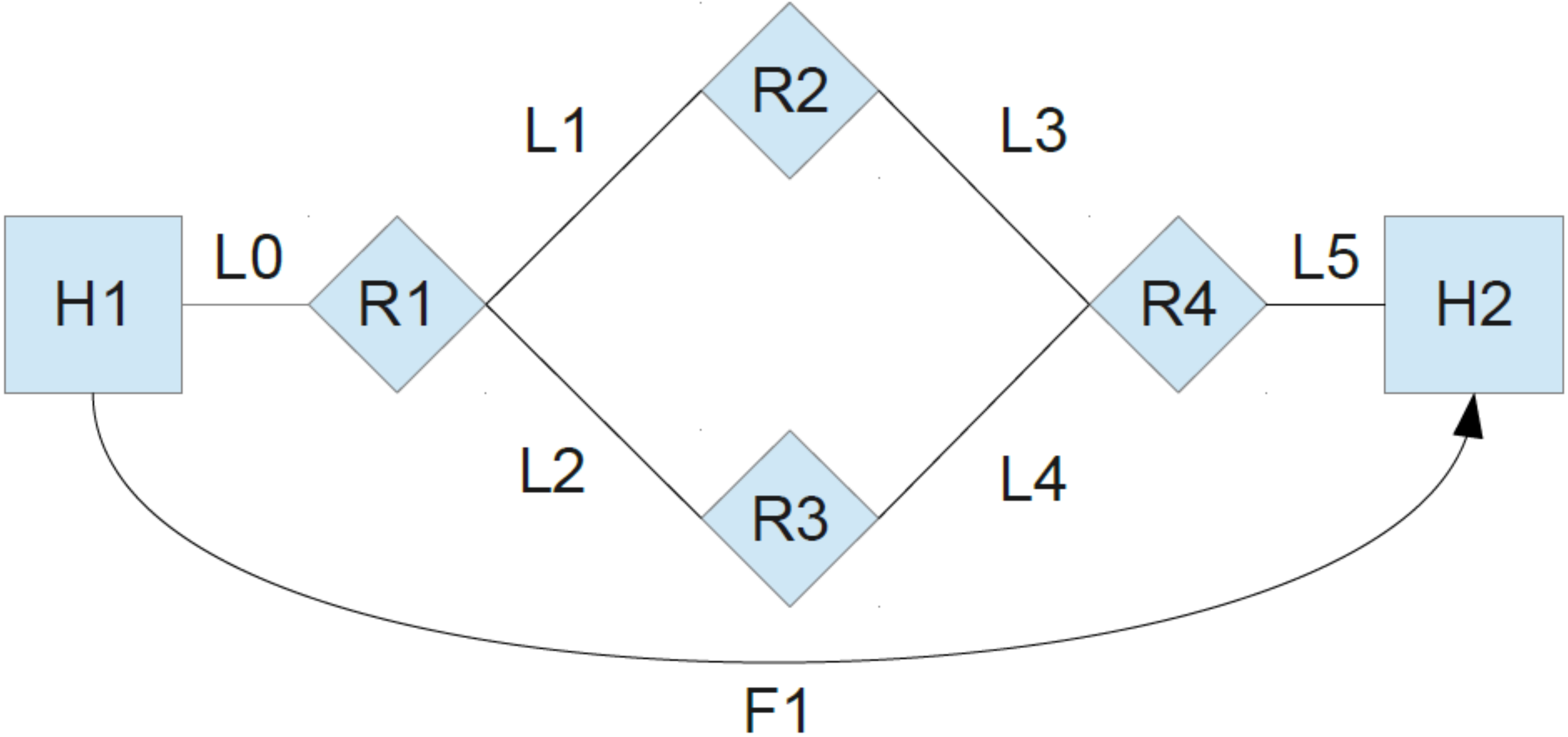
move window upon successful ack, update base rtt, rtt

FAST()

periodically adjust window size by delay

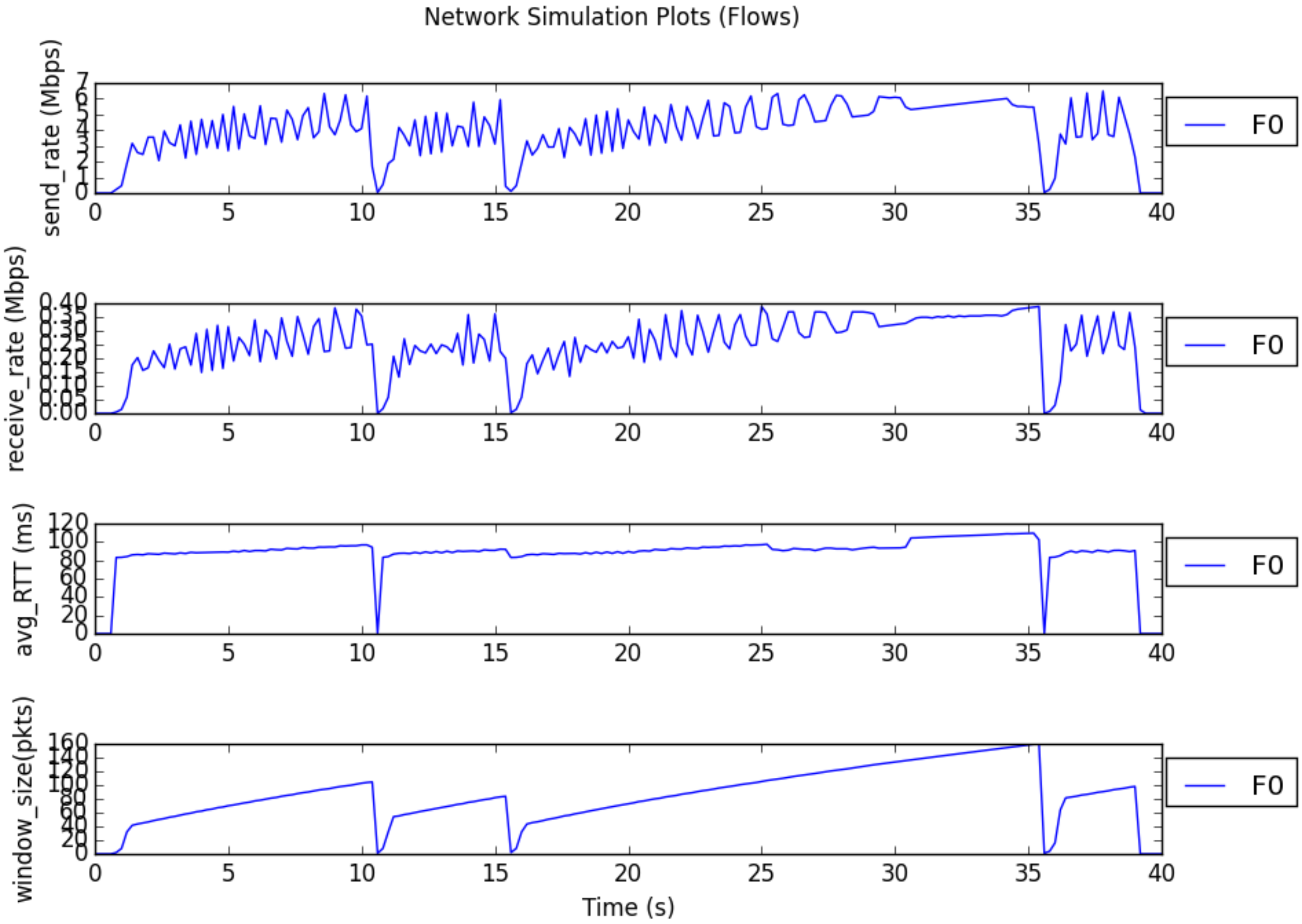
rtt = lastest rtt, base_rtt = smallest rtt seen so far

Test Case 1

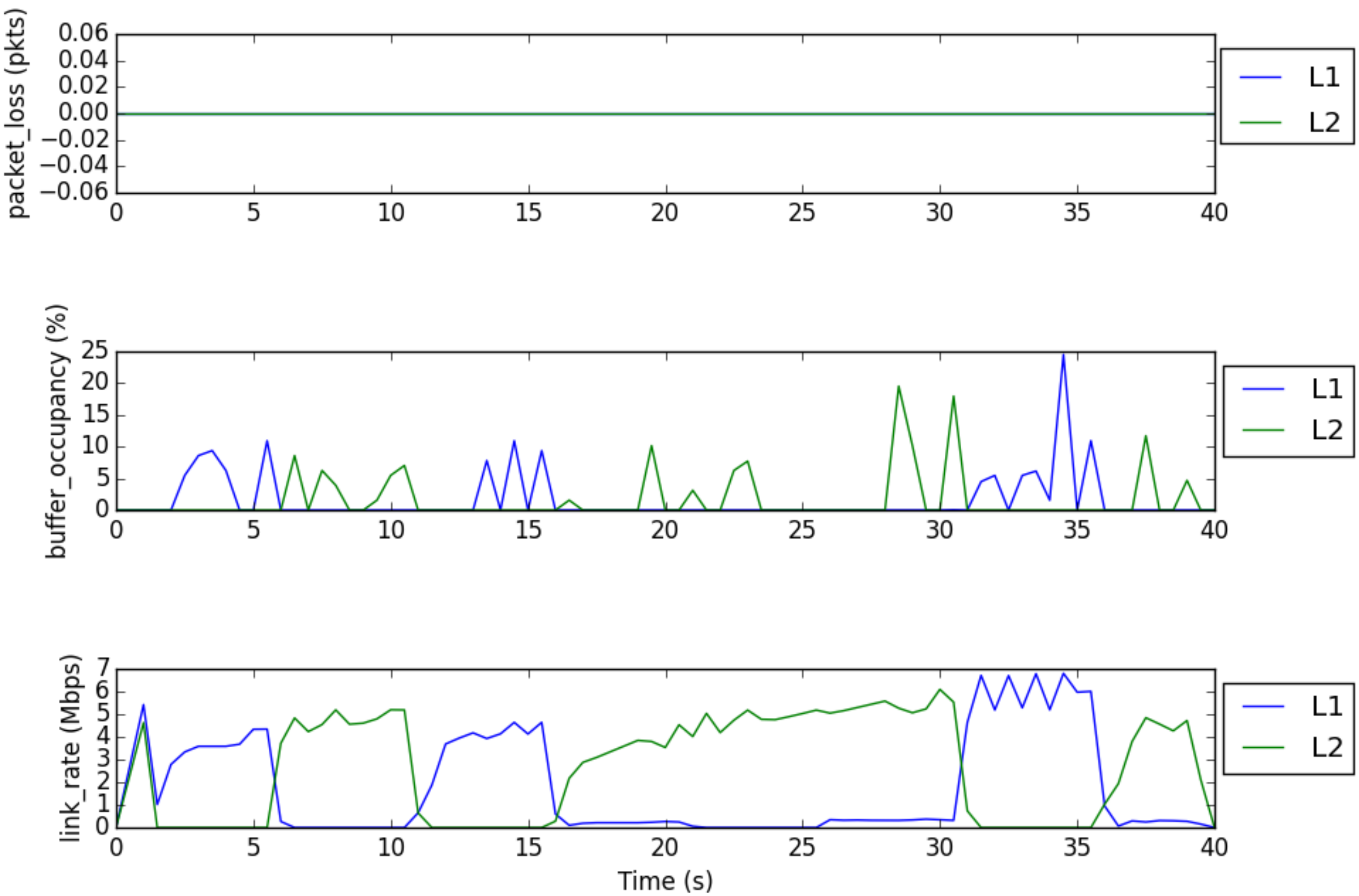


DEMO

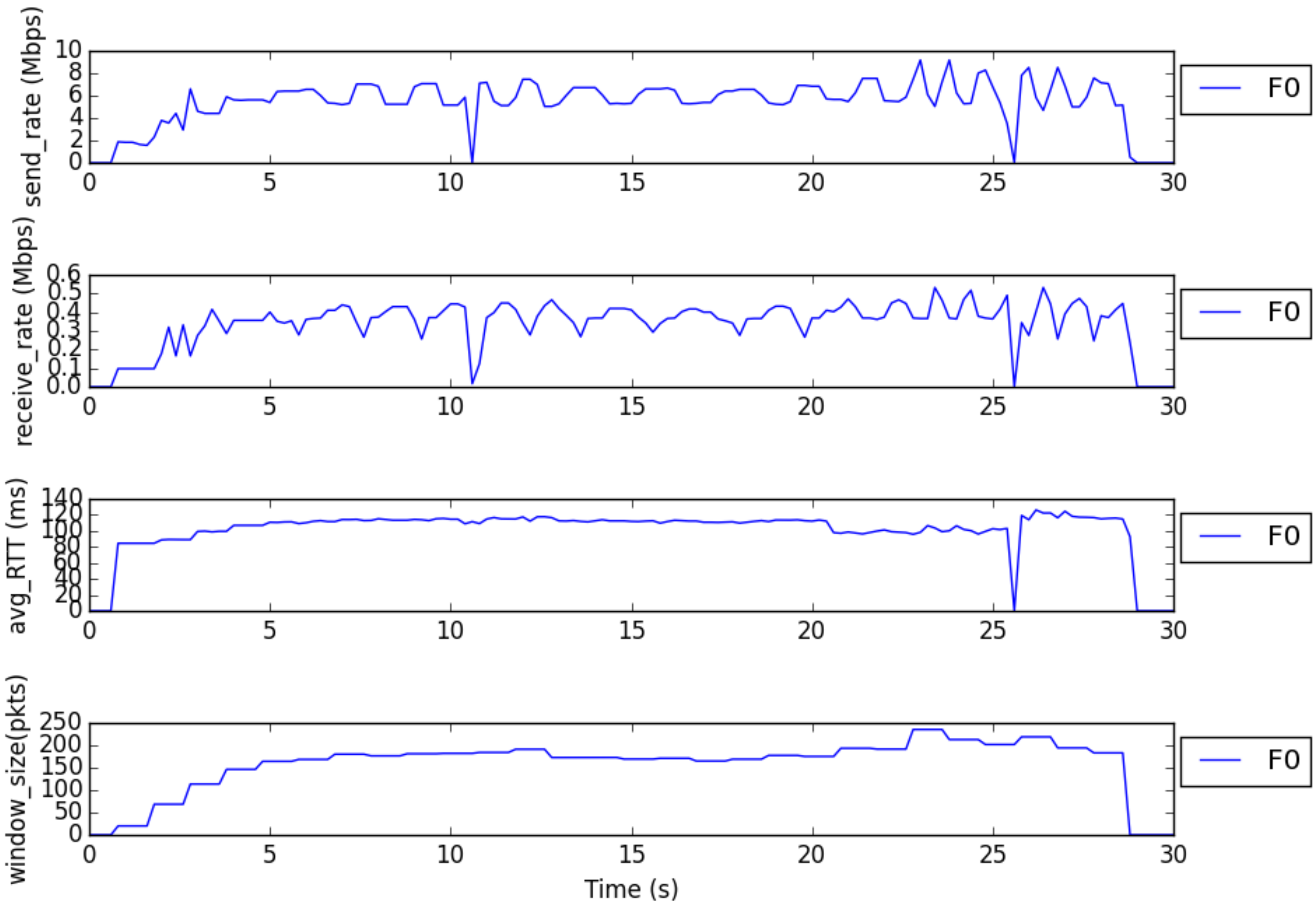
Test Case 1


Network Simulation Plots (Flows)
send_rate (Mbps)
0
1
2
3
4
5
6
7
F0
receive_rate (Mbps)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
F0
avg_RTT (ms)
0
20
40
60
80
100
120
F0
window_size(pkts)
0
20
40
60
80
100
120
140
160
F0
0
5
10
15
20
25
30
35
40
Time (s)

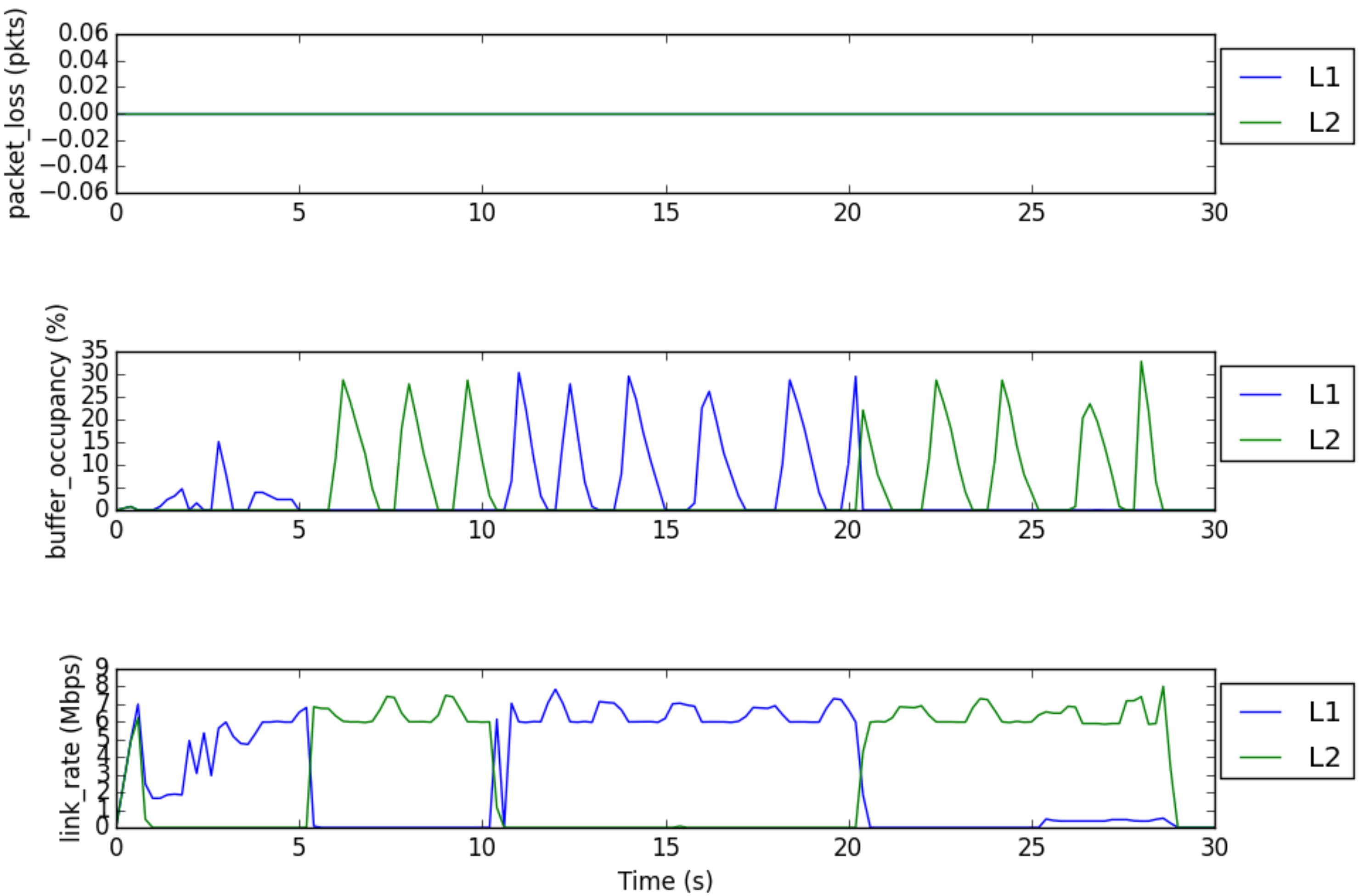
Network Simulation Plots (Links)



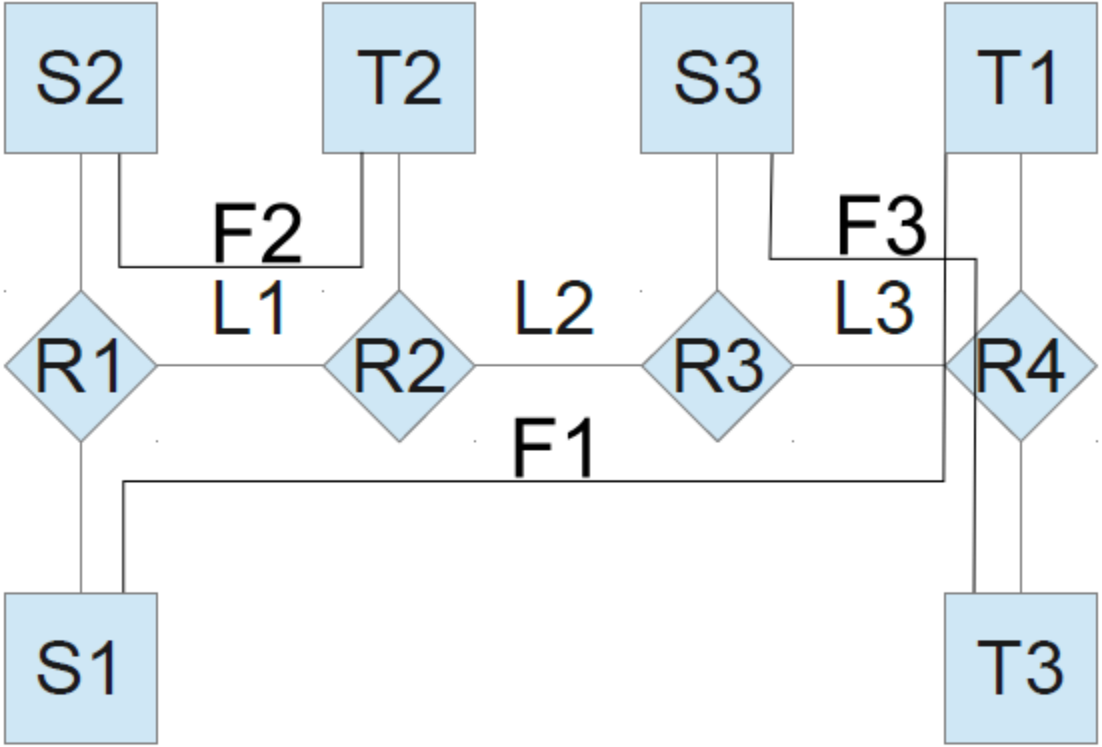
Network Simulation Plots (Flows)



Network Simulation Plots (Links)

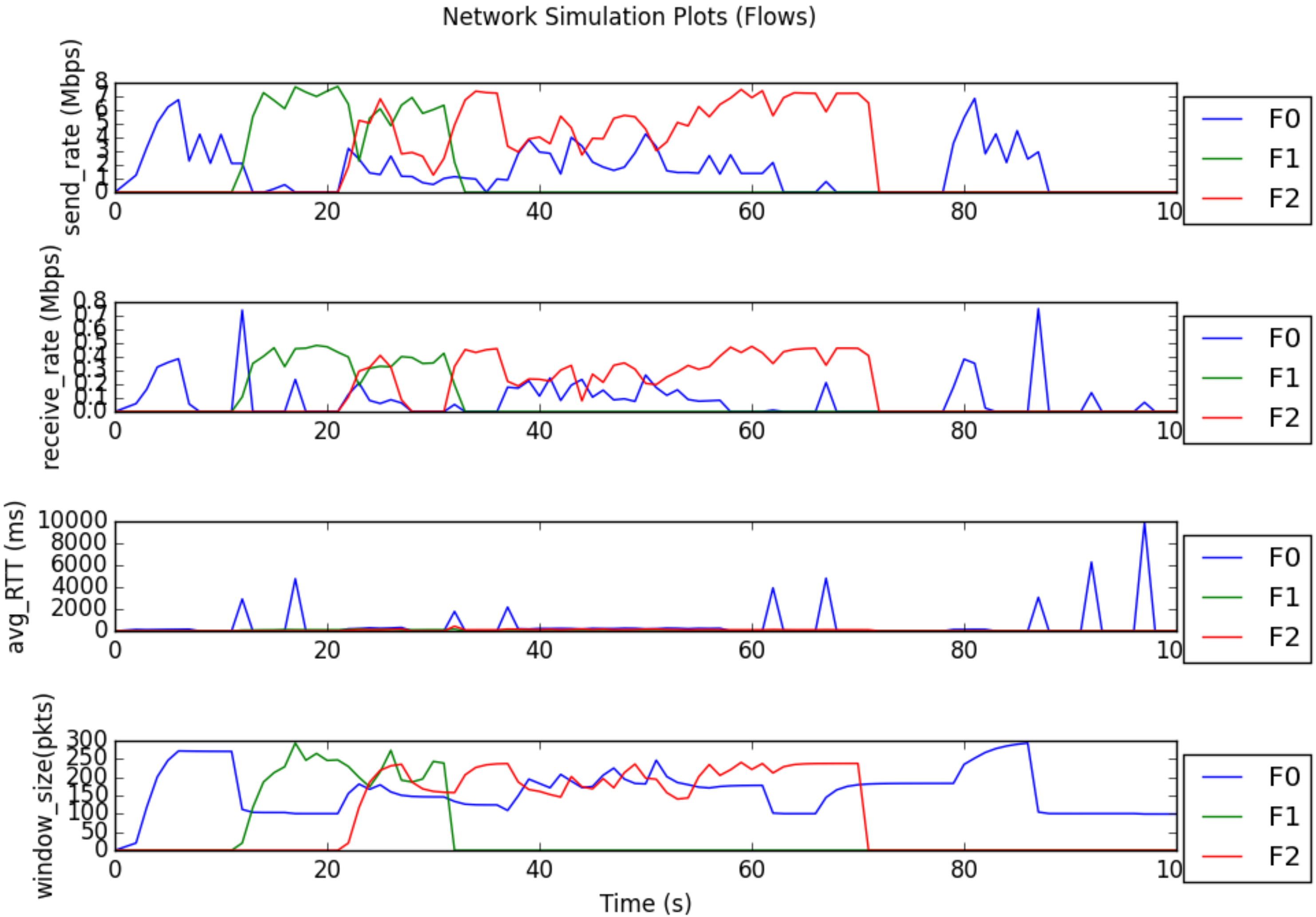


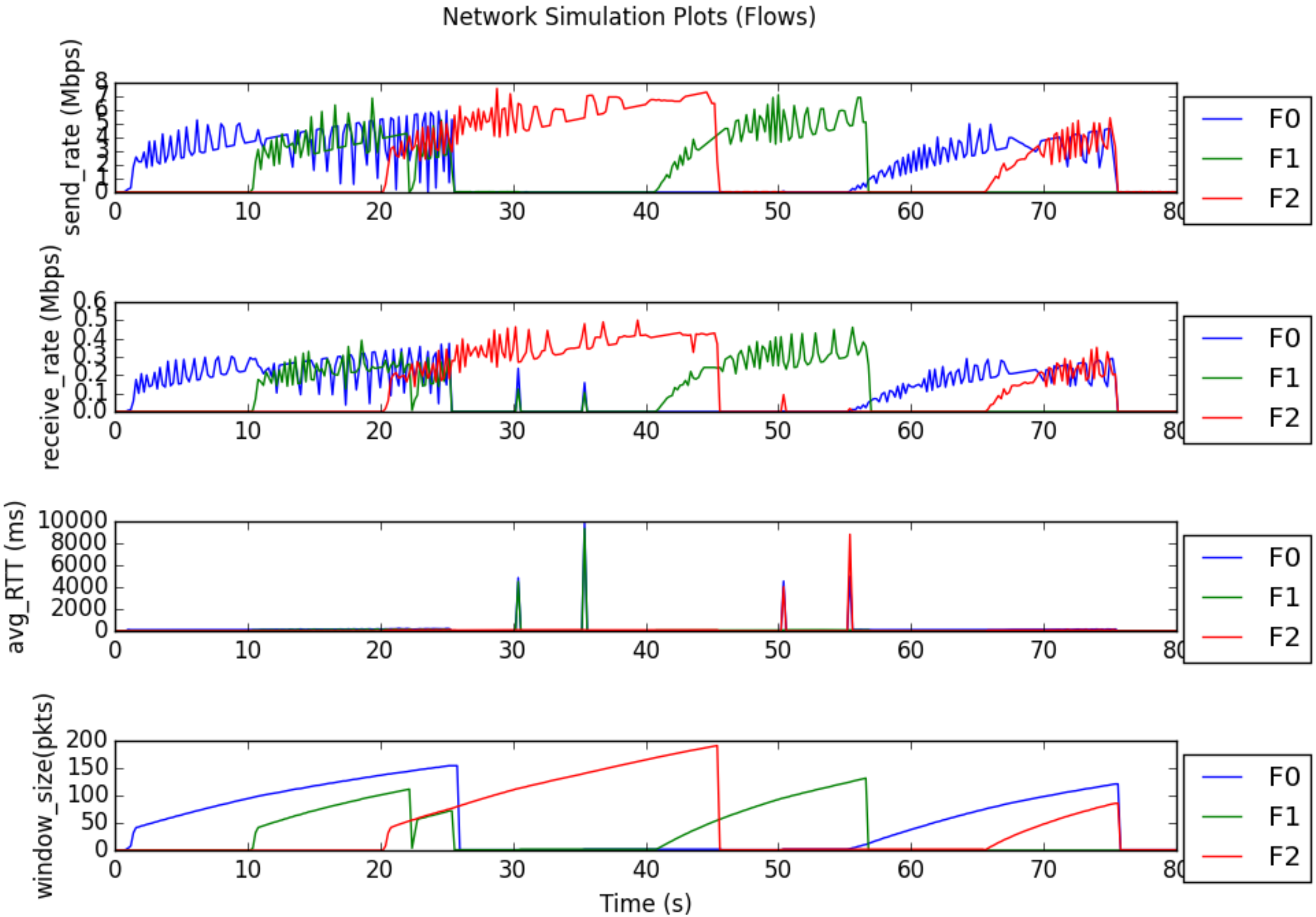
Test Case 2



DEMO

Test Case 2


Network Simulation Plots (Flows)
send_rate (Mbps)
0
1
2
3
4
5
6
7
8
receive_rate (Mbps)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
avg_RTT (ms)
0
2000
4000
6000
8000
10000
window_size(pkts)
0
50
100
150
200
250
300
0
20
40
60
80
10
F0
F1
F2
Time (s)


Network Simulation Plots (Flows)
send_rate (Mbps)
0
1
2
3
4
5
6
7
8
receive_rate (Mbps)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
avg_RTT (ms)
0
2000
4000
6000
8000
10000
window_size(pkts)
0
50
100
150
200
0
10
20
30
40
50
60
70
80
Time (s)
F0
F1
F2

Timeline and Division of Labor

- Week 5 (Kexin):Environment, I/O, packets
- Week 6, 7 (Aman): Host, link, flow, router
- Week 8, 9 (Xander): congestion control, dynamic routing, *additional goals
- Week 10 (Aditya): final presentation, report