Simulation Results On 802.1p and Pacing Approaches

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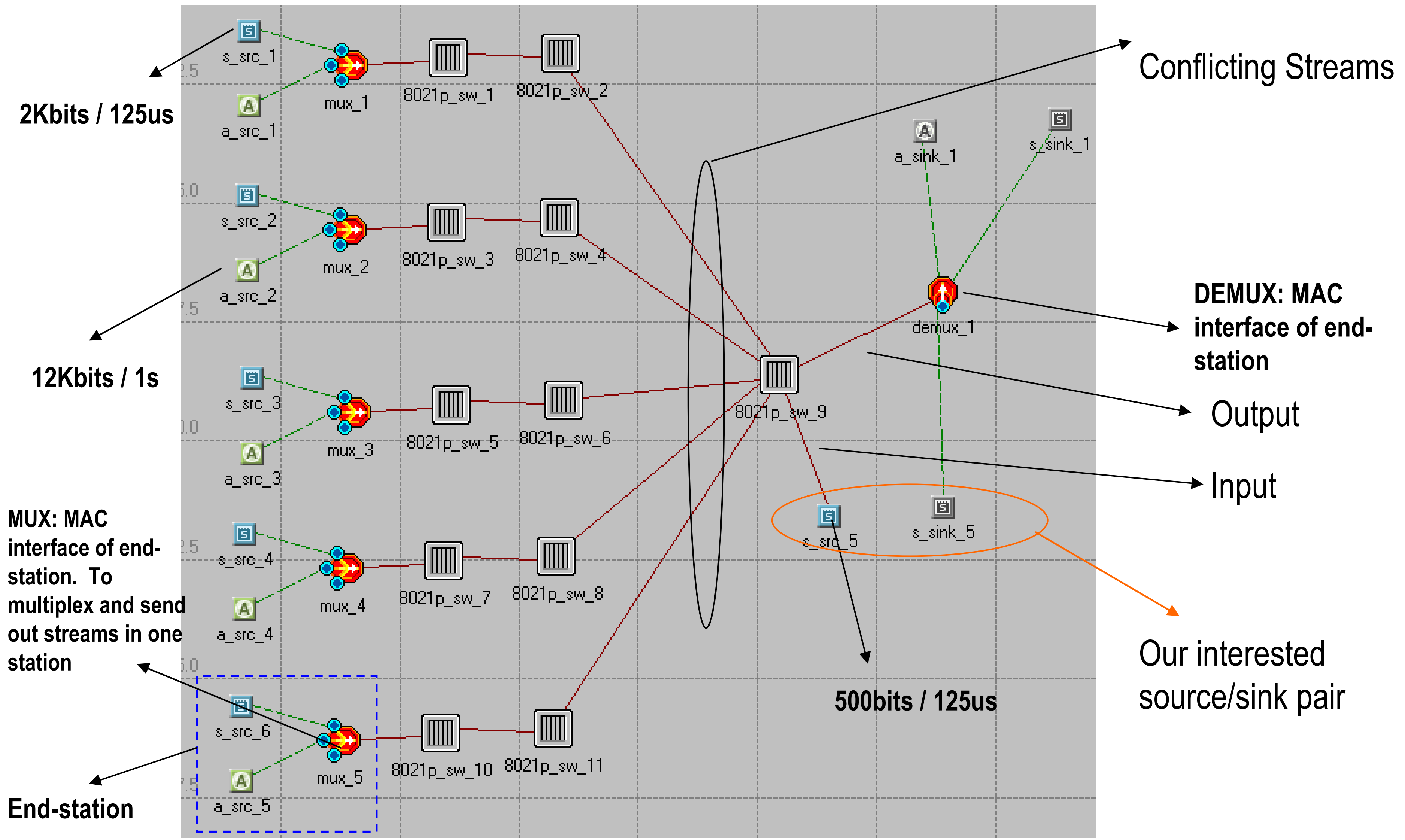
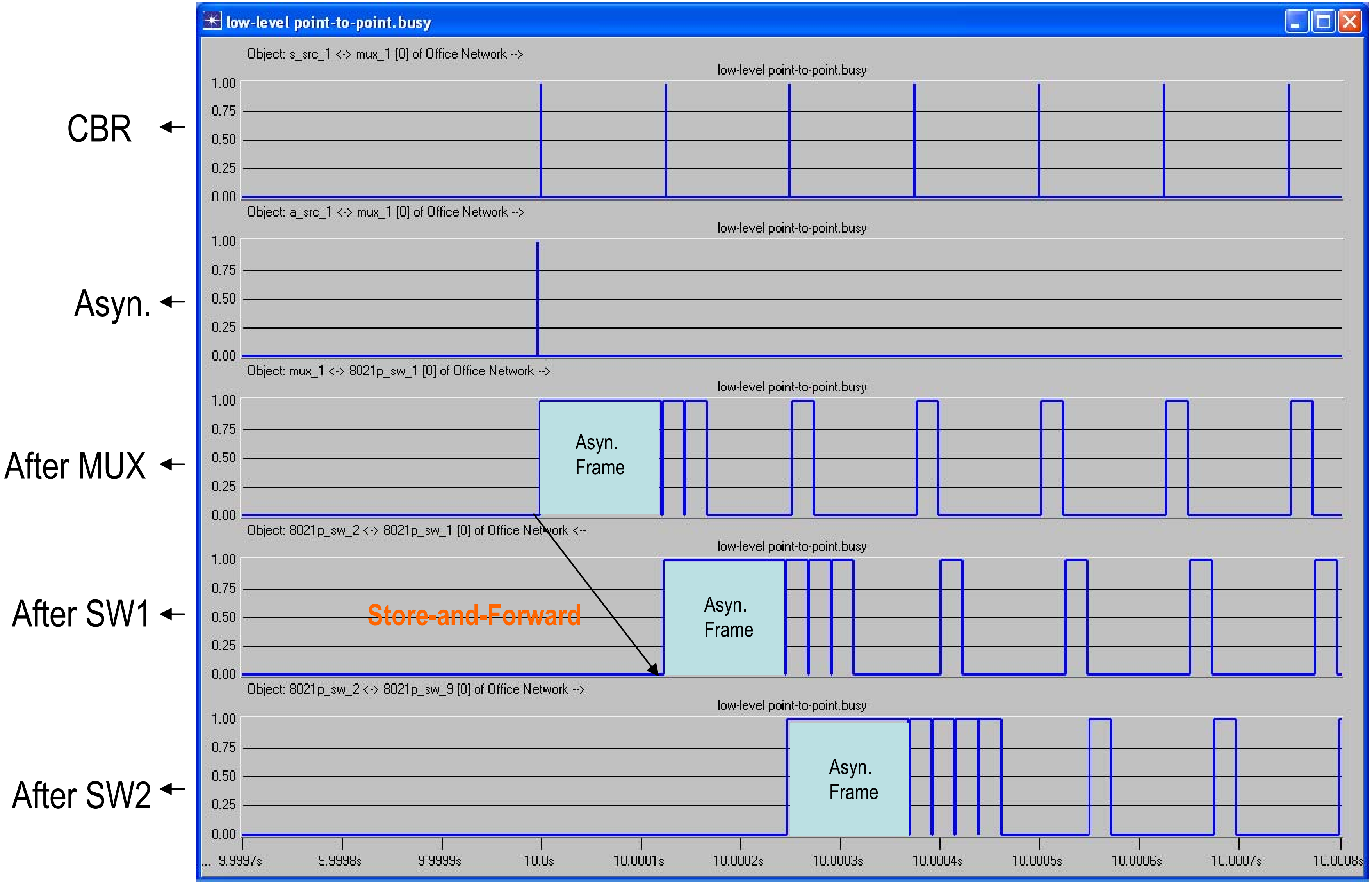
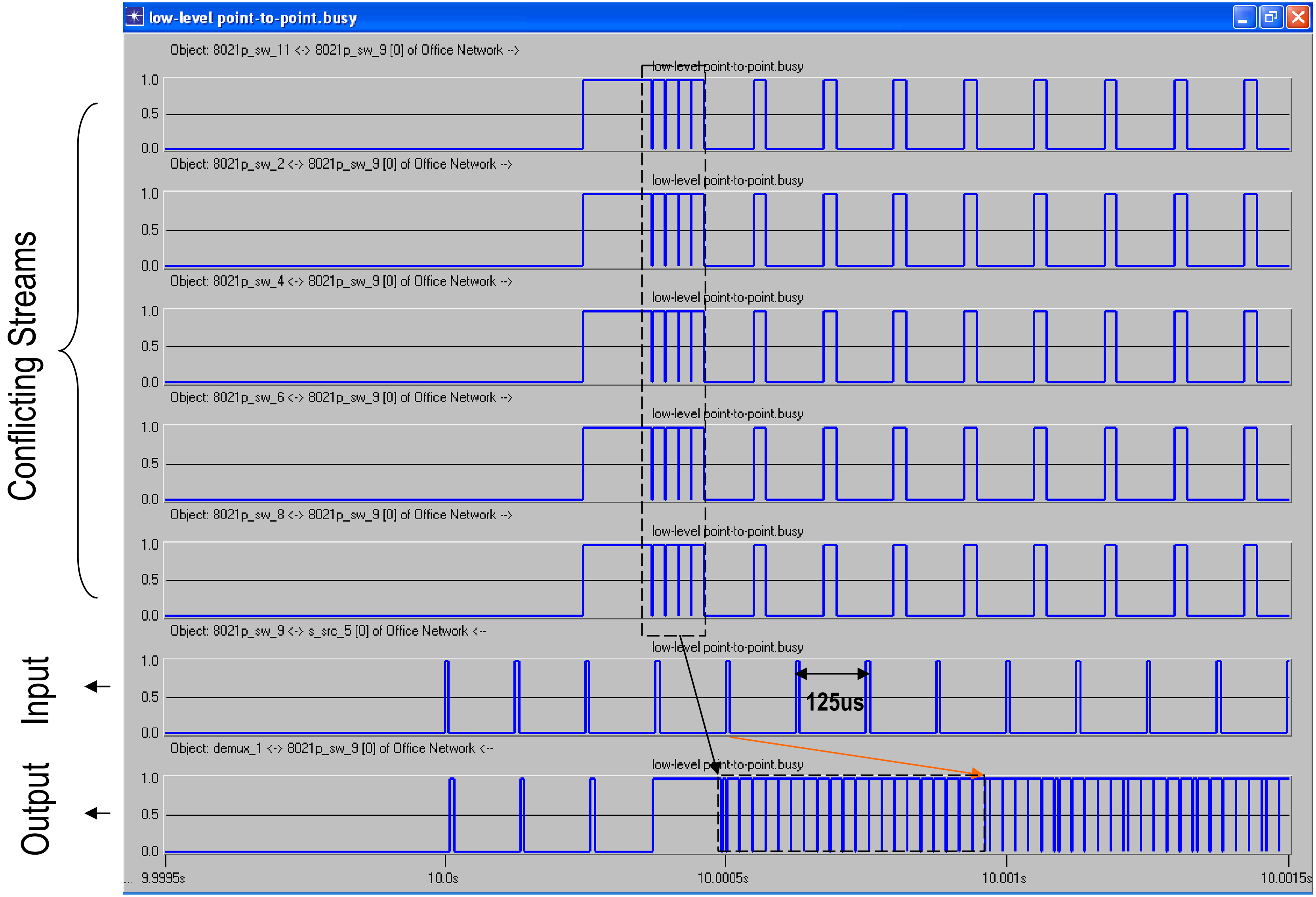
Scenario 1: Using 802.1p switches



Distortion of CBR traffics

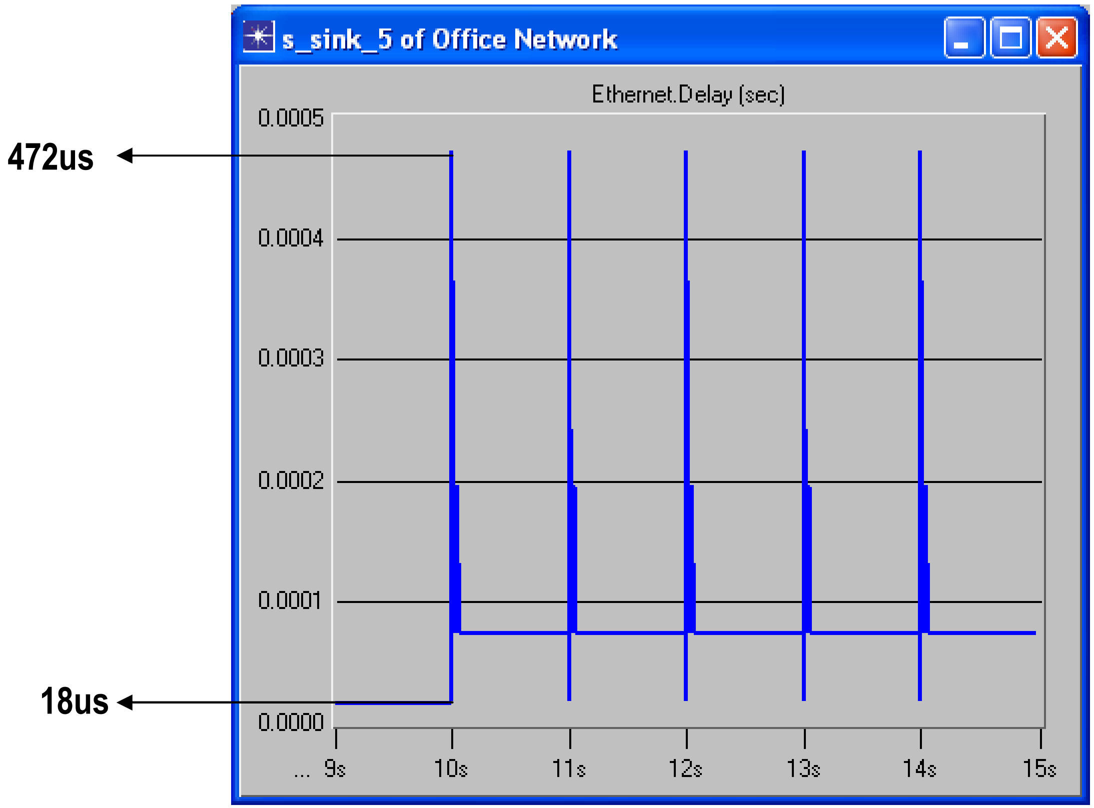


Contention

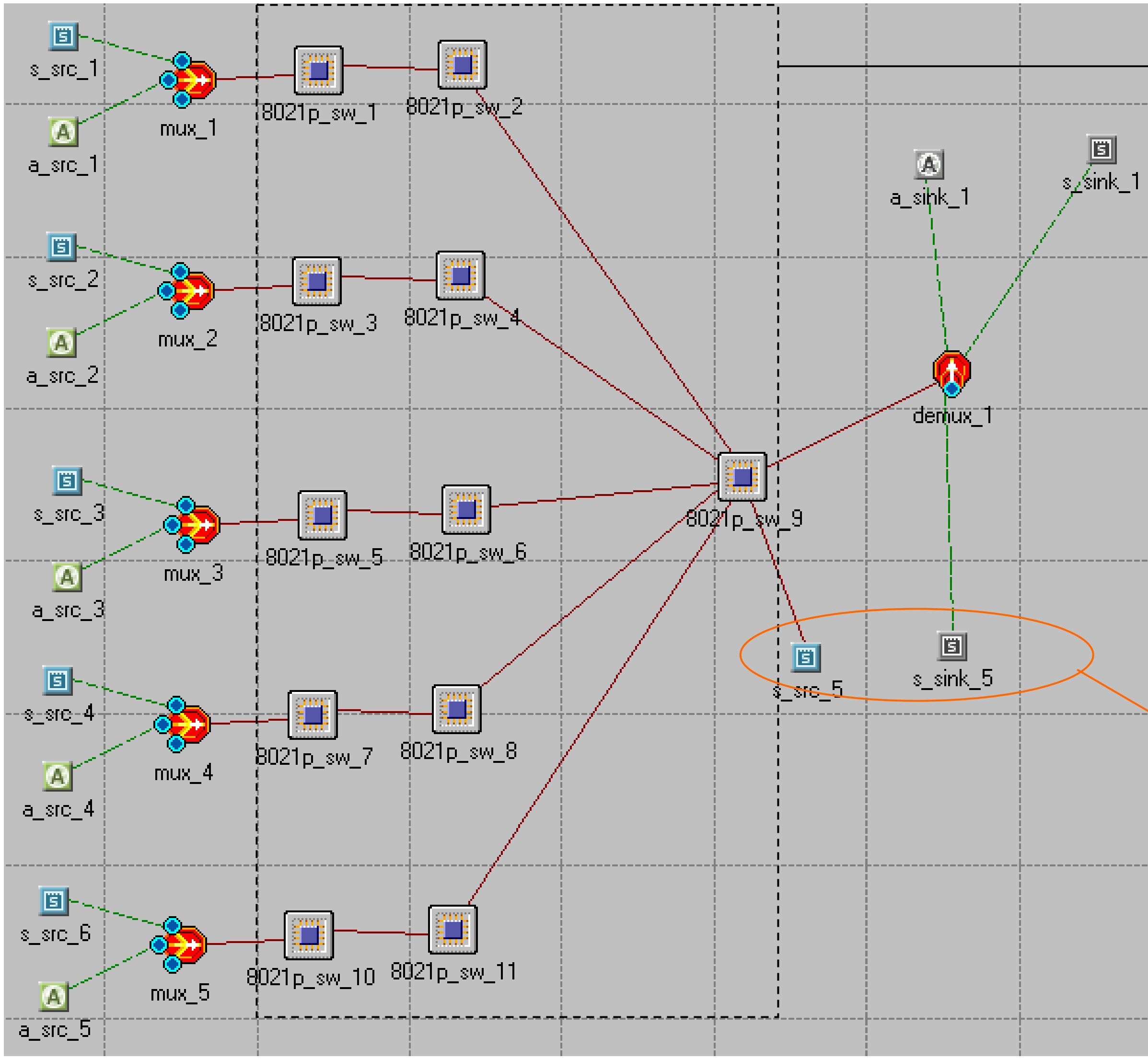


low-level point-to-point.busy
Object: 8021p_sw_11 <-> 8021p_sw_9 [0] of Office Network -->
Object: 8021p_sw_2 <-> 8021p_sw_9 [0] of Office Network -->
Object: 8021p_sw_4 <-> 8021p_sw_9 [0] of Office Network -->
Object: 8021p_sw_6 <-> 8021p_sw_9 [0] of Office Network -->
Object: 8021p_sw_8 <-> 8021p_sw_9 [0] of Office Network -->
Object: 8021p_sw_9 <-> s_src_5 [0] of Office Network <--
Object: demux_1 <-> 8021p_sw_9 [0] of Office Network <--
1.0
0.5
0.0
125us
9.9995s
10.0s
10.0005s
10.001s
10.0015s
Conflicting Streams
Input
Output

Delay Results



Scenario 2: Using Pacing-based Switches



Pacing switches [1]

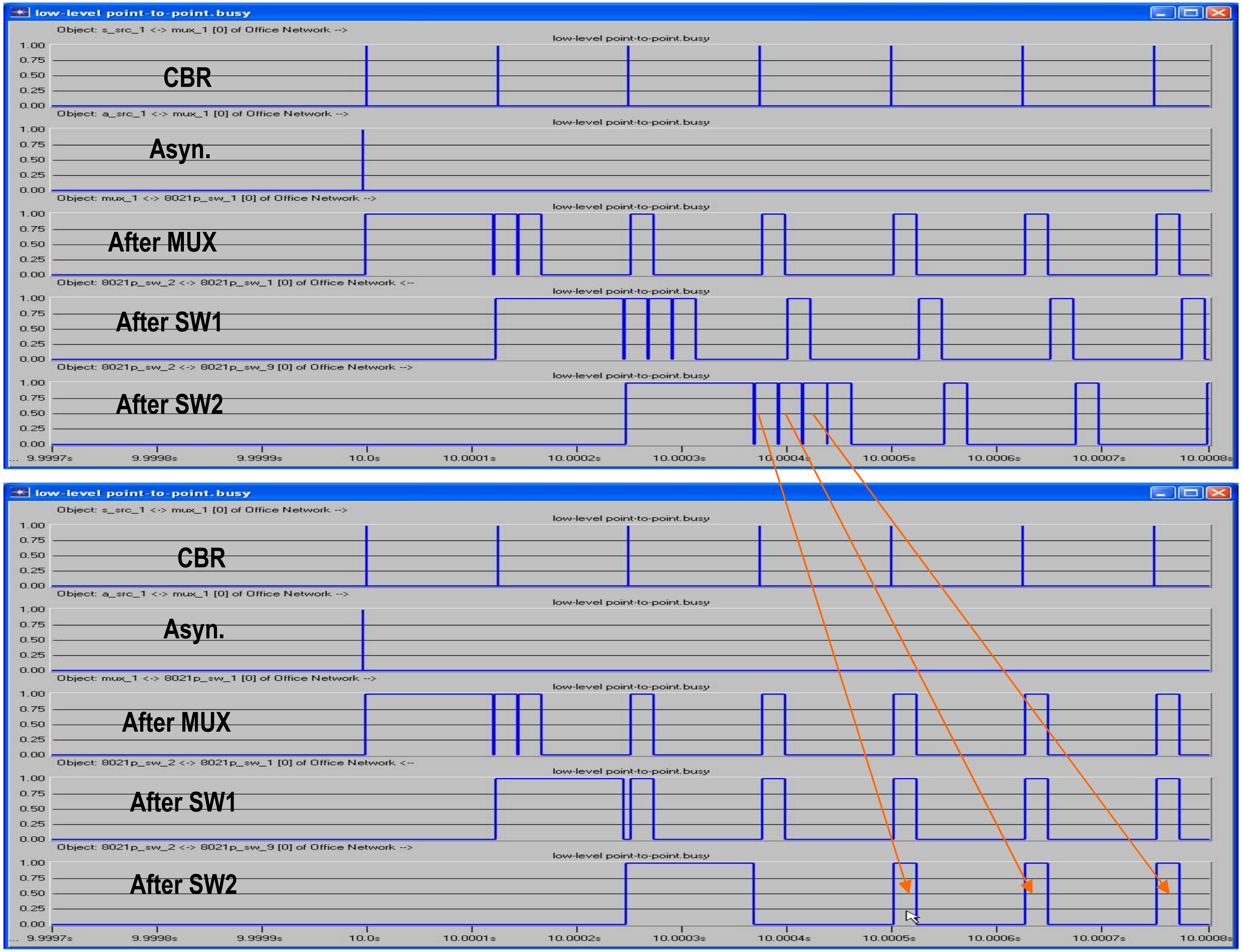
[1] Michael J. Teener, *Residential Ethernet: a status report*

Our interested source/sink pair

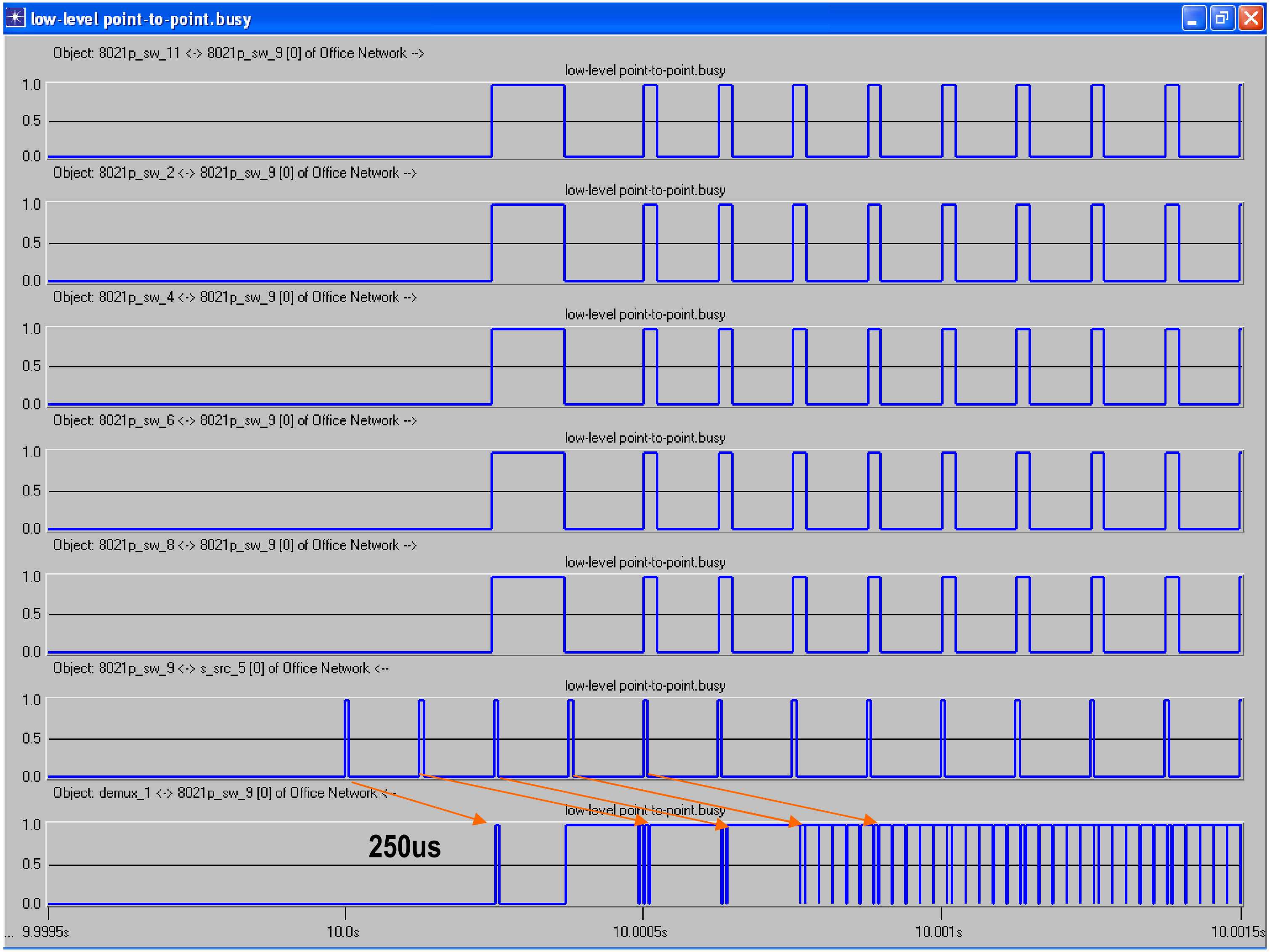
Pacing Avoids the Traffic Distortion

802.1p

Pacing

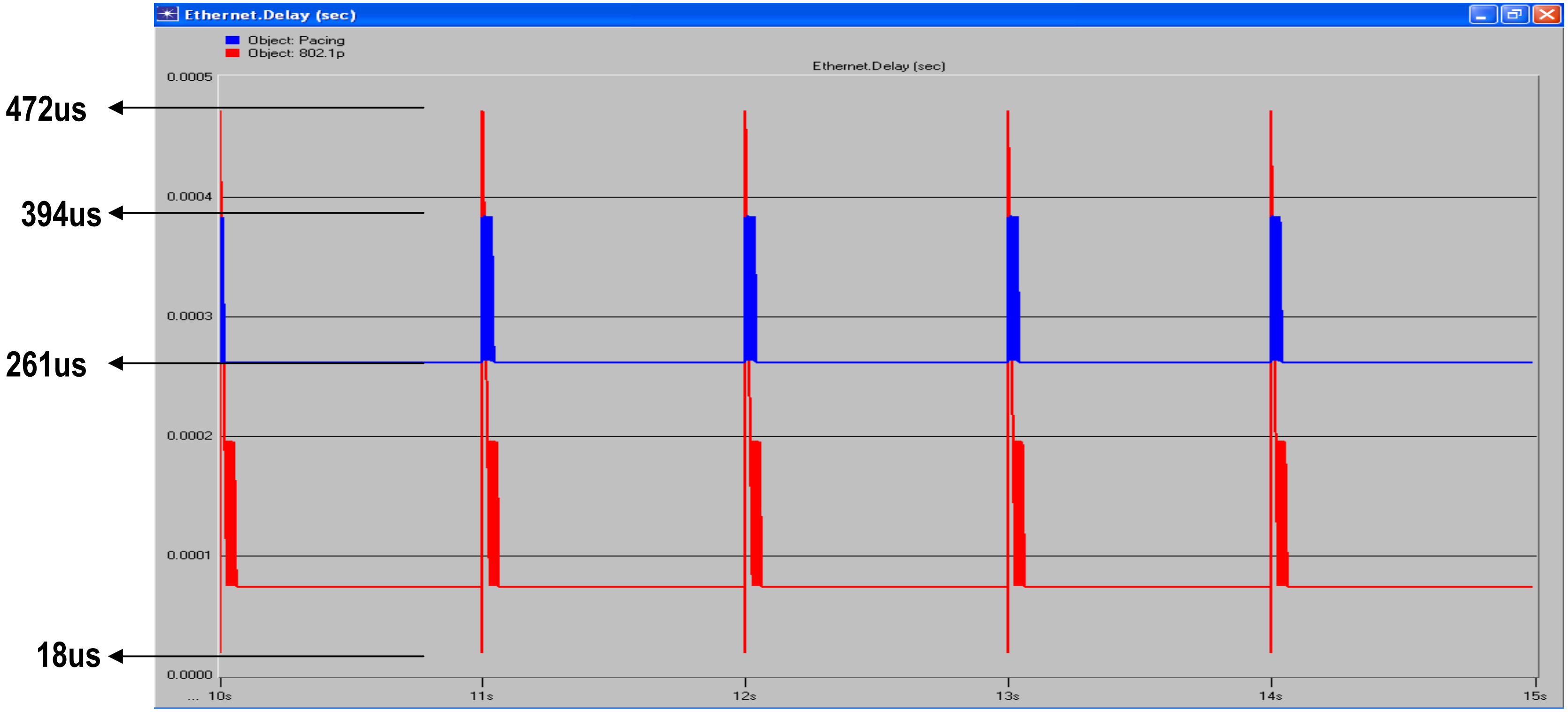


Pacing



low-level point-to-point.busy
Object: 8021p_sw_11 <-> 8021p_sw_9 [0] of Office Network -->
low-level point-to-point.busy
Object: 8021p_sw_2 <-> 8021p_sw_9 [0] of Office Network -->
low-level point-to-point.busy
Object: 8021p_sw_4 <-> 8021p_sw_9 [0] of Office Network -->
low-level point-to-point.busy
Object: 8021p_sw_6 <-> 8021p_sw_9 [0] of Office Network -->
low-level point-to-point.busy
Object: 8021p_sw_8 <-> 8021p_sw_9 [0] of Office Network -->
low-level point-to-point.busy
Object: 8021p_sw_9 <-> s_src_5 [0] of Office Network <--
low-level point-to-point.busy
Object: demux_1 <-> 8021p_sw_9 [0] of Office Network <--
low-level point-to-point.busy
250us
1.0
0.5
0.0
9.9995s
10.0s
10.0005s
10.001s
10.0015s

Comparison of Delay Results



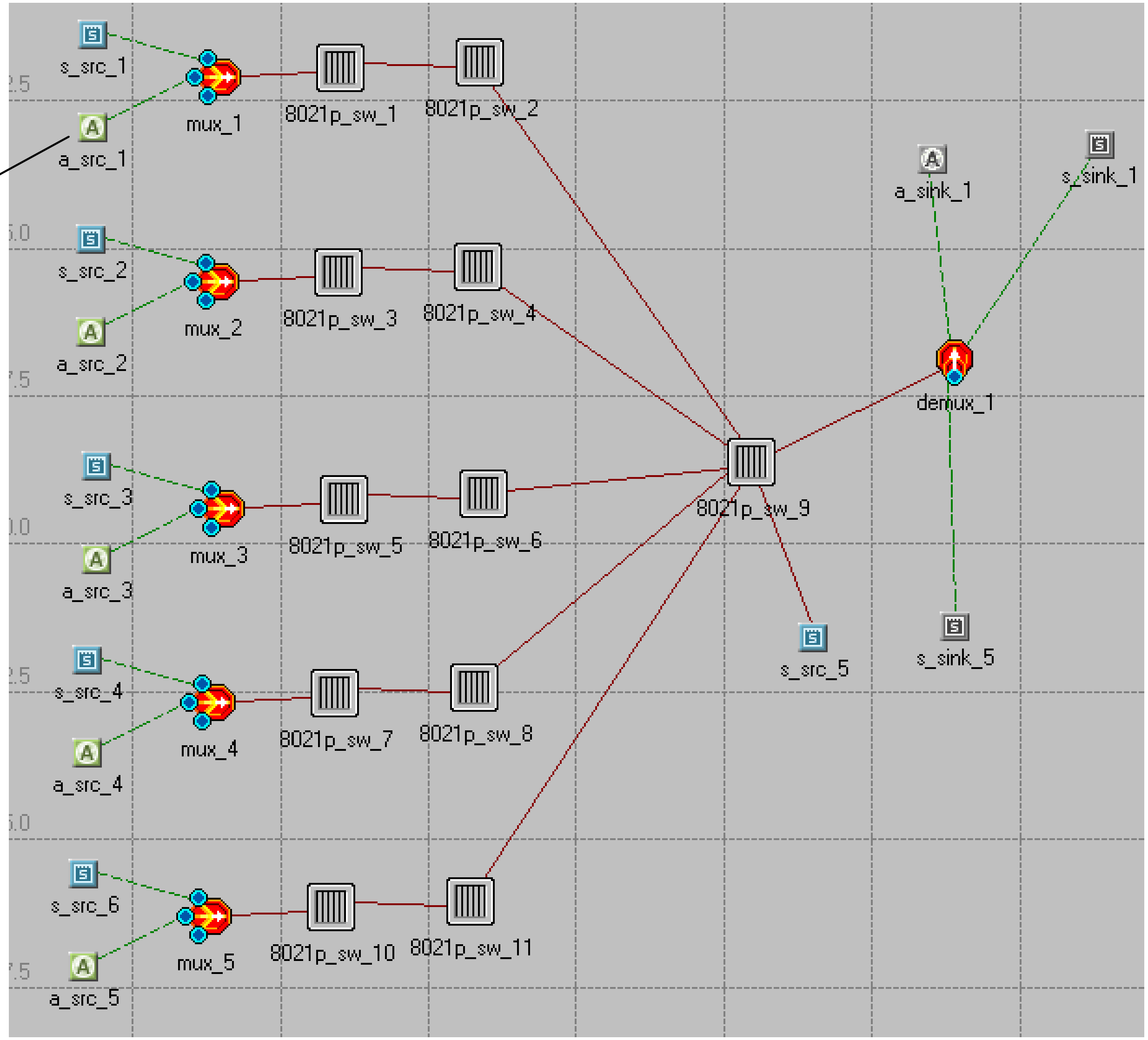
In this case, pacing can decrease both the delay and the delay variation.

However…

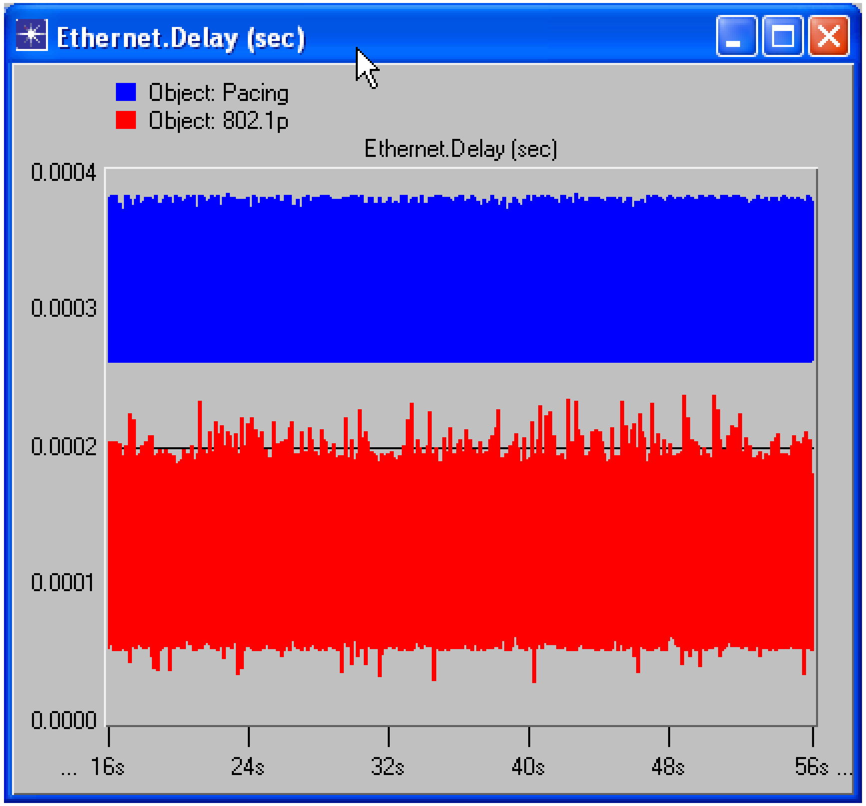
- This scenario is just an artificial case
  - We made all five conflicting CBR streams centralized. So when they come to switch-9, all five streams get bunched bursts and conflict with our interested stream at the same time. We made this case by:
    - Issuing a maximum size conflicting asynchronous packet to each conflicting CBR stream at the same time.
    - The conflicting CBR stream traverses through several store-and-forward switches, which makes the CBR packets bunched together
    - The link is almost fully loaded.
- We would be interested in the performance of each approach in a realistic network environment

Scenario 3: A 'More Realistic' Scenario

Self-similar, H=0.7.
50packets/second.
Packet size = uniform(1K,12K)



Delay Results

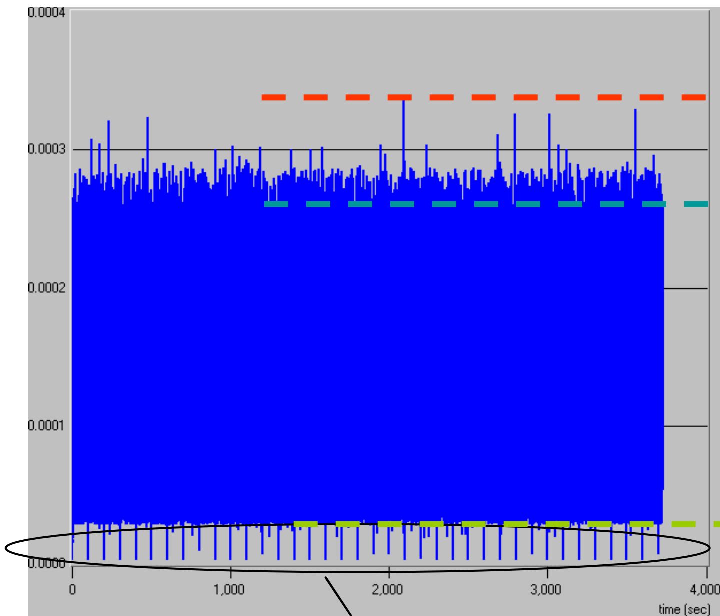


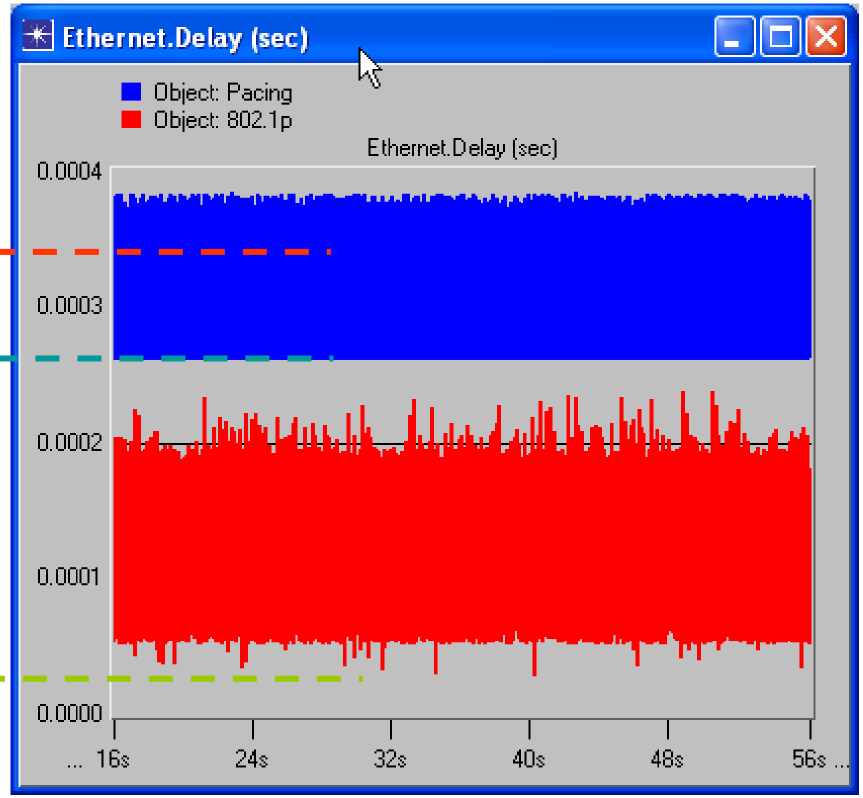
In this scenario, over 60 seconds, we didn't notice the occurrence of the worst case.
Here pacing scheme has larger delay but smaller delay variation.

Additional tests: MTU Packets, Self-Similar Arrival

Self-similar, H=0.7.
50packets/second.
Packet size = 12K
With 802.1p switches

Self-similar, H=0.7.
50packets/second.
Packet size = uniform(1K,12K)



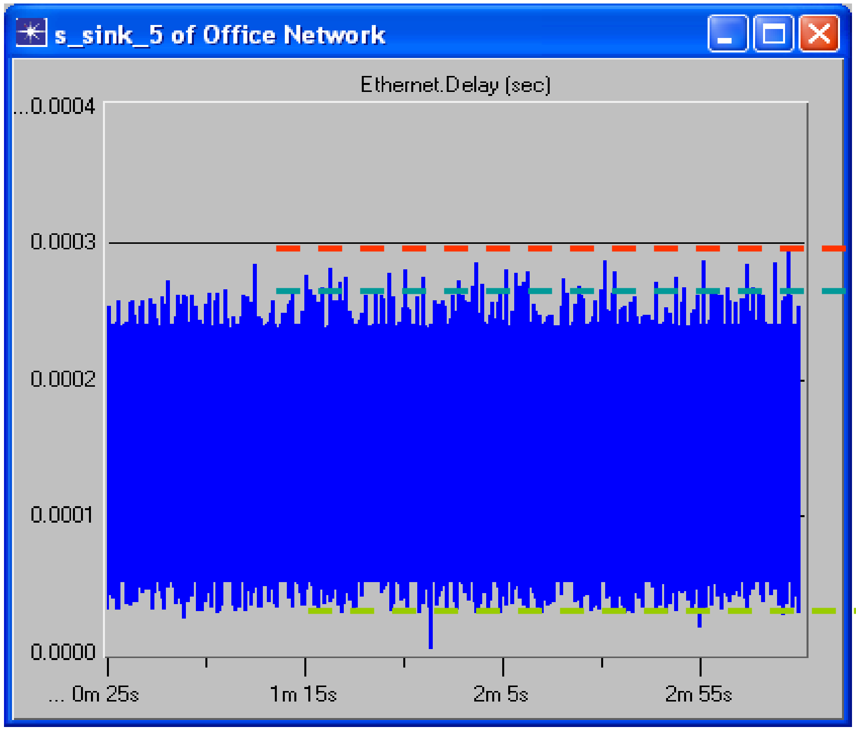


These small delays are because that I make sink nodes broadcast their addresses every 100 seconds.

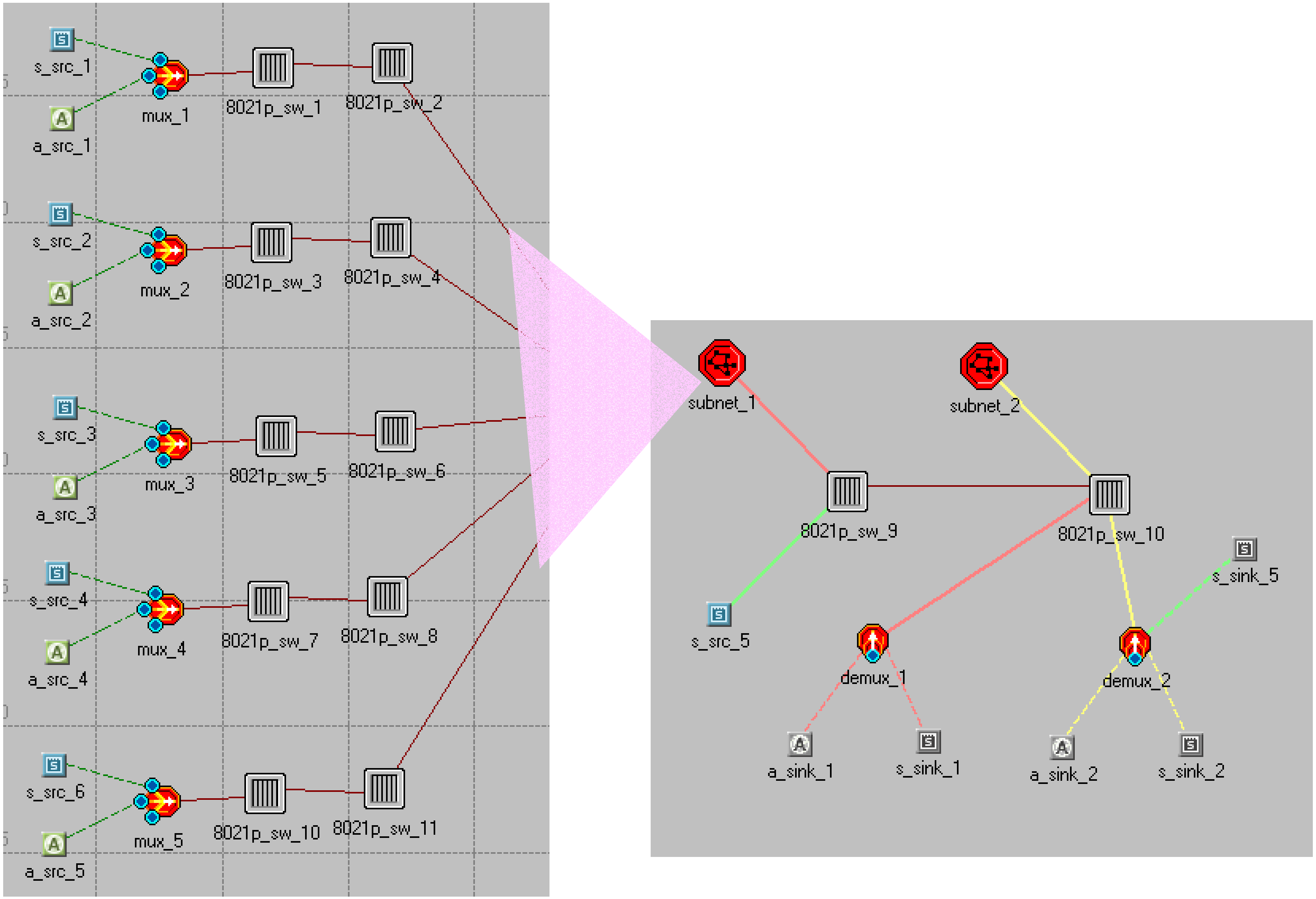
Additional tests: MTU Packets, Poisson Arrival

Poisson arrival,
50packets/second.
Packet size = 12K
With 802.1p switches

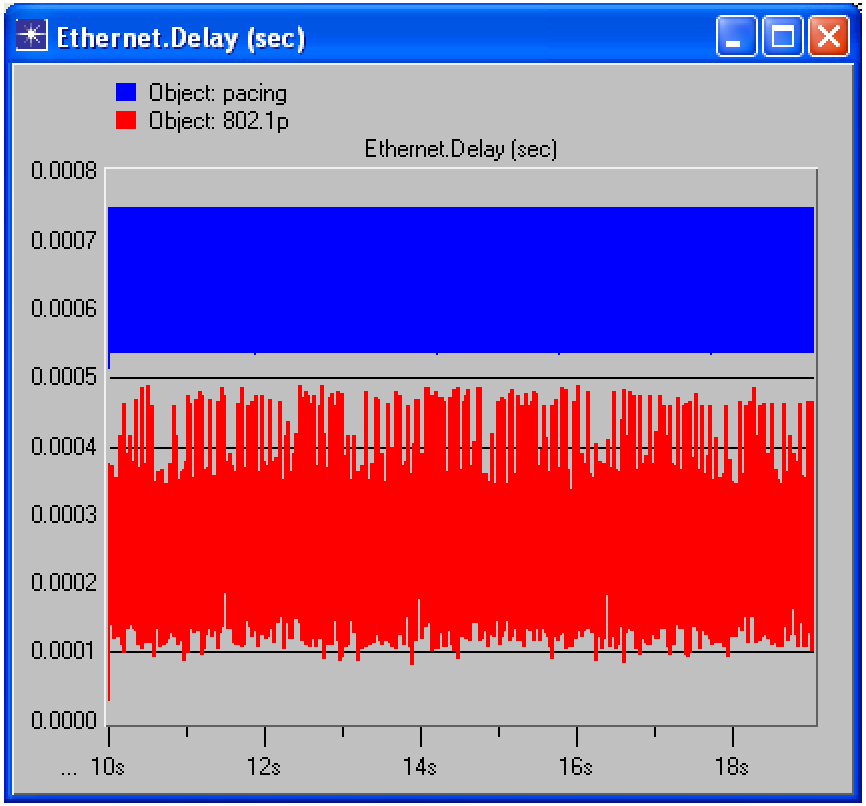
Self-similar, H=0.7.
50packets/second.
Packet size = uniform(1K,12K)



Scenario 4: Multi-hop Scenario



Delay Results



Within the observation period, pacing scheme still has larger delay but smaller delay variation.

- With pacing method, jitter is not accumulated along the multi-hop path.
- With 802.1p method, jitter could be accumulated along the multi-hop path.
- As long as timing synchronization is implemented, this jitter can be removed using buffer.

Summary

- In a worst case, 802.1p has larger delay and delay variation than pacing scheme.
  - The worst case delay of 802.1p is related to the number of incoming conflicting streams, the extent of distortion of those conflicting streams, and the cycle size of CBR traffic
- In a realistic scenario, 802.1p shows a smaller delay, but larger delay variation (jitter).
  - Jitter could be accumulated along the multi-hop path.
  - As long as timing synchronization is implemented, this jitter can be removed using buffer.
  - But as the jitter could be accumulated, it may cause scalability issues.
- In a realistic scenario, pacing shows a larger delay, but smaller delay variation (jitter).
  - Jitter is not accumulated along the multi-hop path.
  - So pacing offers the benefit of evenly distributed buffer requirement on all switches