

Lab 5: Monitoring the Switch's Queue using Standard Metadata

Jorge Crichigno

College of Engineering and Computing, University of South Carolina

A Hands-on Tutorial on P4 Programmable Data Planes

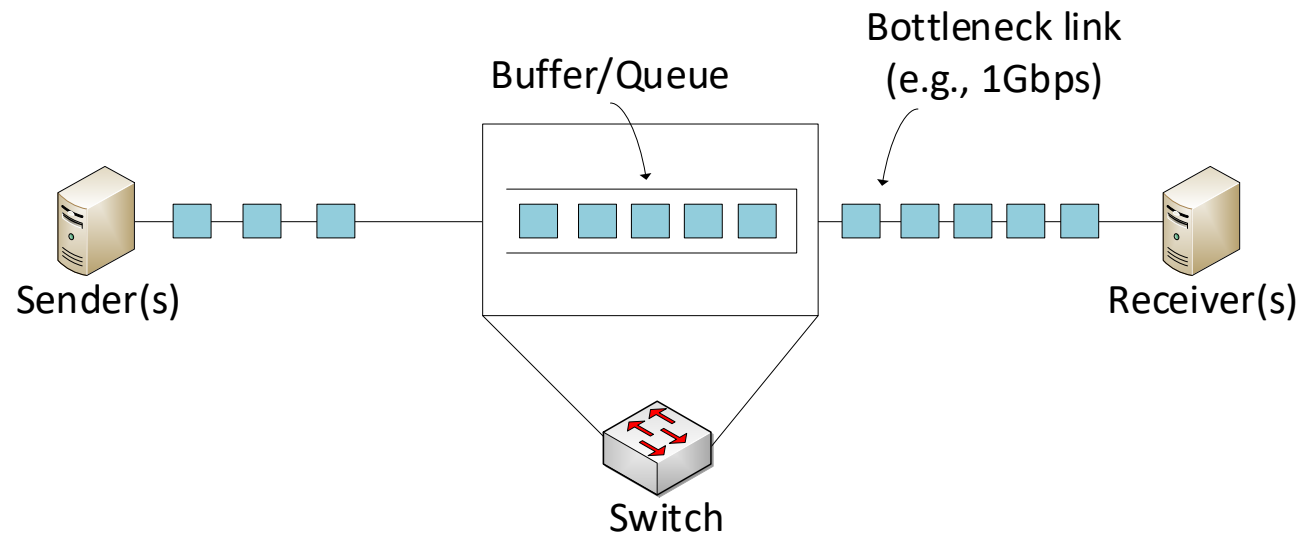
Wednesday March 8, 2023

Monitoring the Switch's Queue using Standard Metadata

Lab activities are described in Lab 5, P4 Programmable Data Planes: Applications, Stateful Elements, and Custom Packet Processing lab series

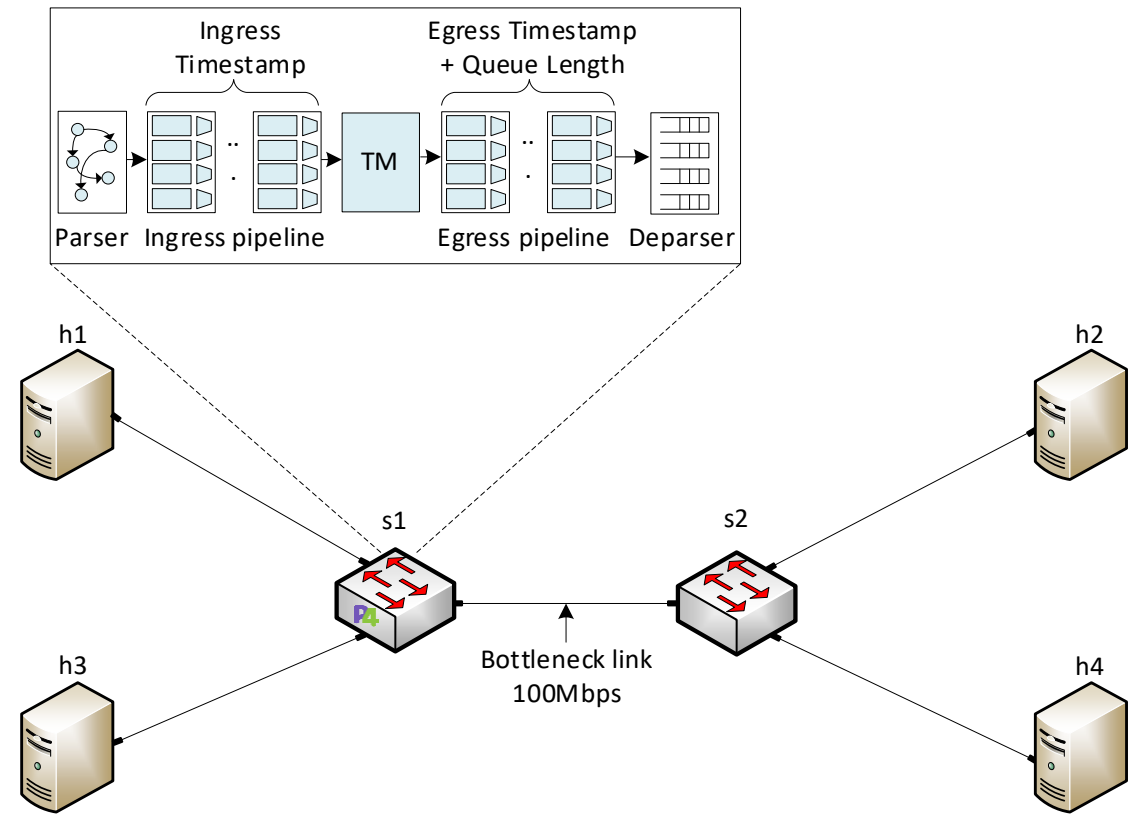
Queueing Delay

- As a packet travels from the sender to the receiver, it experiences several types of delays at each node (router/switch) along the path
- Queueing delay: the time a packet waits for transmission onto the link, in the order of microseconds to milliseconds
- Queue builds up when the output link is fully utilized (i.e., link becomes the bottleneck)



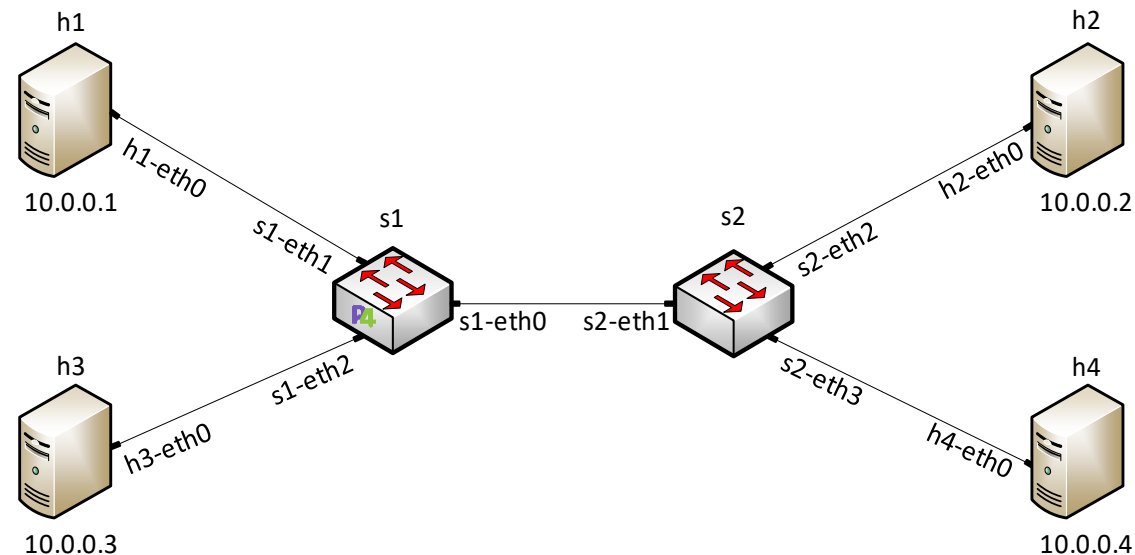
Computing Queueing Delay in P4

- The standard metadata in the switch contains the ingress and egress timestamps
 - The ingress timestamp indicates when a packet arrives in the pipeline
 - The egress timestamp denotes the time when the packet enters the egress pipeline
- The difference between the two timestamps is the time a packet stays in the pipeline
 - This value is dominated by the queueing delay



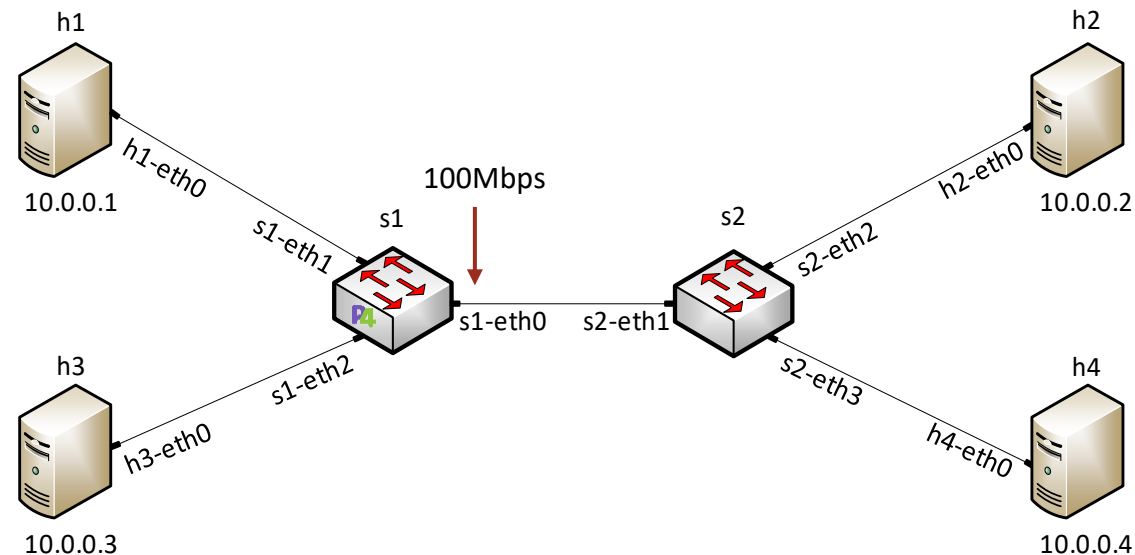
Lab Topology and Objectives

- The topology consists of four hosts: h1, h2, h3, and h4; one P4 switch: s1; and one legacy switch: s2
- The goal is to observe the queue occupancy on the switch s1



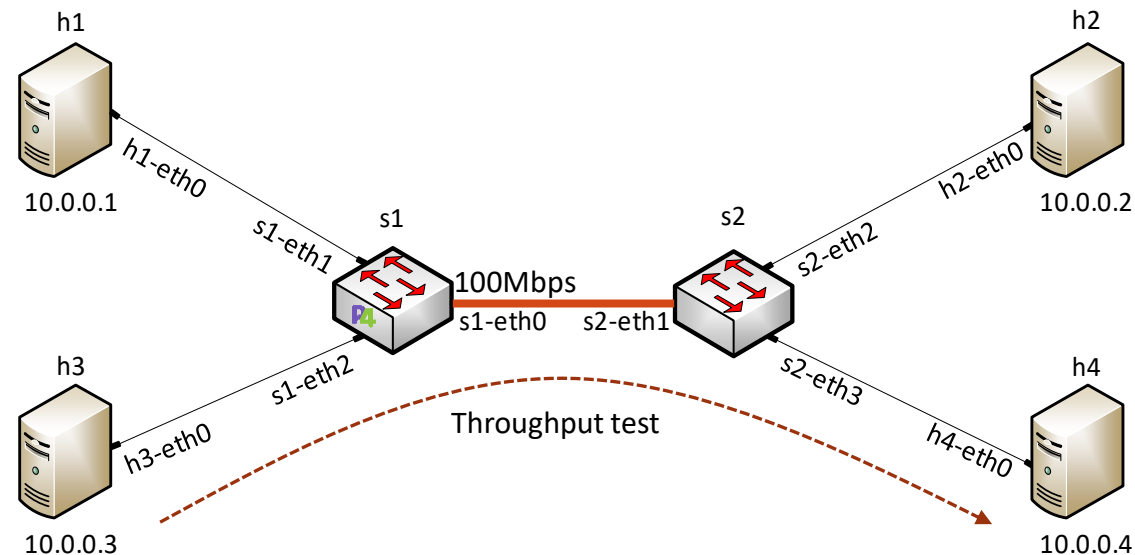
Lab Topology and Objectives

- The topology consists of four hosts: h1, h2, h3, and h4; one P4 switch: s1; and one legacy switch: s2
- The goal is to observe the queue occupancy on the switch s1
- Lab objectives:
 - Limit the rate of the output port of the switch and set the queue size



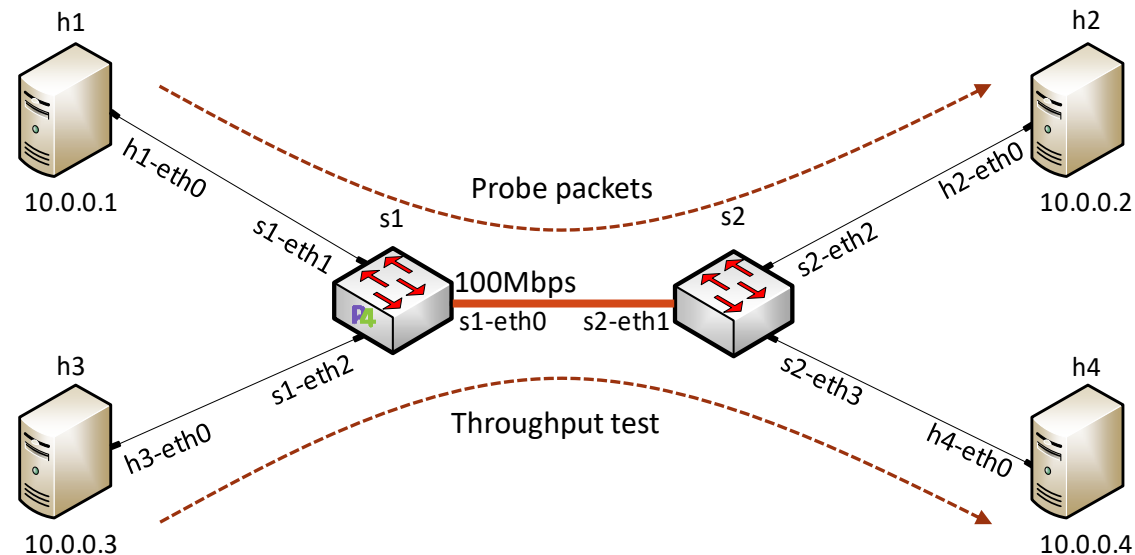
Lab Topology and Objectives

- The topology consists of four hosts: h1, h2, h3, and h4; one P4 switch: s1; and one legacy switch: s2
- The goal is to observe the queue occupancy on the switch s1
- Lab objectives:
 - Limit the rate of the output port of the switch and set the queue size
 - Run a throughput test from h3 to h4 using the iPerf3 tool



Lab Topology and Objectives

- The topology consists of four hosts: h1, h2, h3, and h4; one P4 switch: s1; and one legacy switch: s2
- The goal is to observe the queue occupancy on the switch s1
- Lab objectives:
 - Limit the rate of the output port of the switch and set the queue size
 - Run a throughput test from h3 to h4 using the iPerf3 tool
 - Observe the queue occupancy on h2 by sending probe packets from h1 using a custom protocol



Custom Probing Protocol

- The custom protocol will be added by the sender (the device probing) on top of the IPv4 header
- The fields are initialized to 0
- The P4 switch parses the custom protocol header and overwrites its fields

Field name	Size [bits]	Description
switch_ID	8	Stores the switch identifier
ingress_timestamp	48	Stores the timestamp set when the packet shows up on ingress
egress_timestamp	48	Stores the timestamp set when the packet shows up on egress
time_diff	48	Stores $\text{egress_timestamp} - \text{ingress_timestamp}$
q_depth	24	Stores the current number of packets in the queue