An SDN-Based WAN Scavenger Service for High-Speed Data Transfers

Presented by:

Sourav Maji

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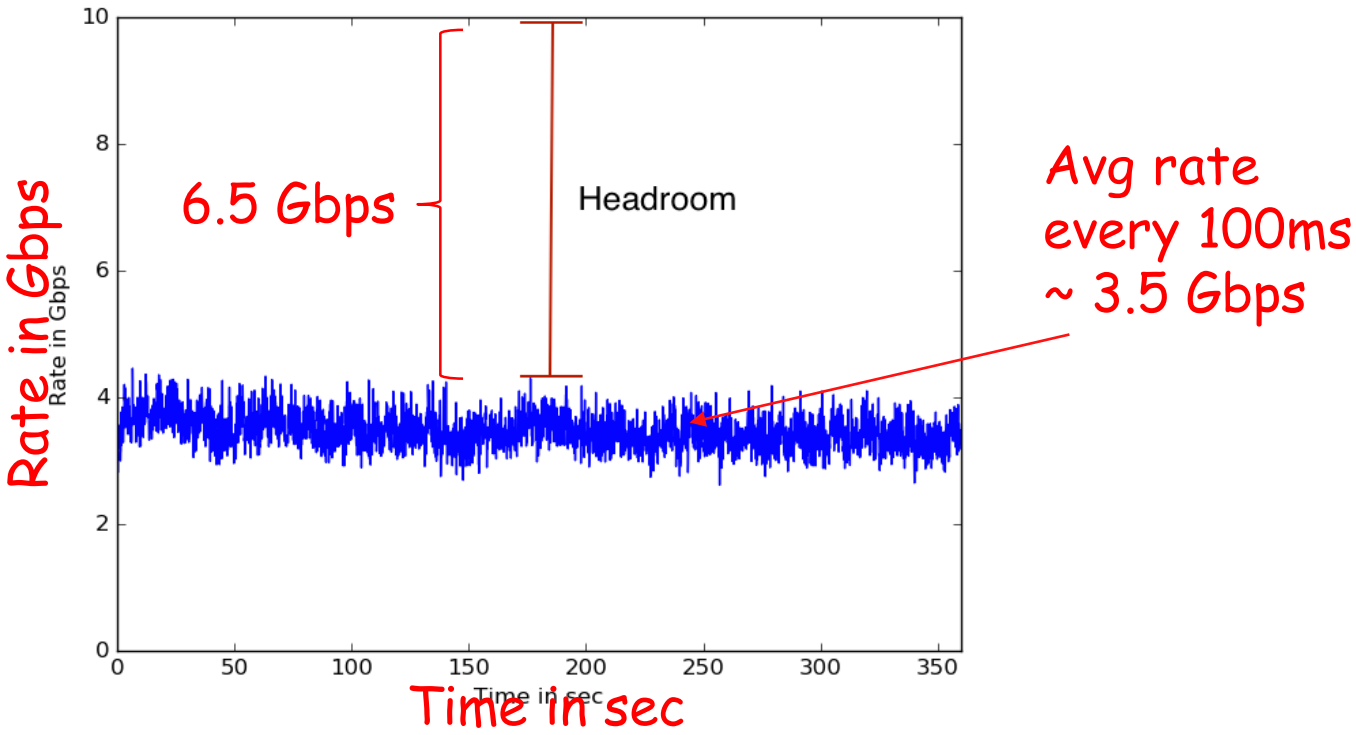
Authors: Fatma Alali, Sourav Maji, Malathi Veeraraghavan, and Naoaki Yamanaka

Outline

- Motivation
- Problem and Solution
- WAN Scavenger Service (SS)
  - Static WAN Scavenger (SWS) Service
  - Dynamic WAN Scavenger (DWS) Service
- Evaluation
  - SWS vs BE
  - Link failure
- Conclusion

Motivation

- Wide-Area Network (WAN) links are under-utilized.
  - accommodate long-term growth in the traffic volume
  - handle extra load created by rerouted traffic due to link failures
  - support elephant (high-rate large-sized) fows



Problem and Solution

- Problem
  - Increase link utilization without service degradations
  - How can a provider attract additional traffic from customers ~ increase in revenue
  - The service must be extended to inter-domain customer-provider needs

- Solution
  - Employ a WAN scavenger service
  - Support inter-domain large data movement
  - An SDN based solution to orchestrate inter-domain functionality

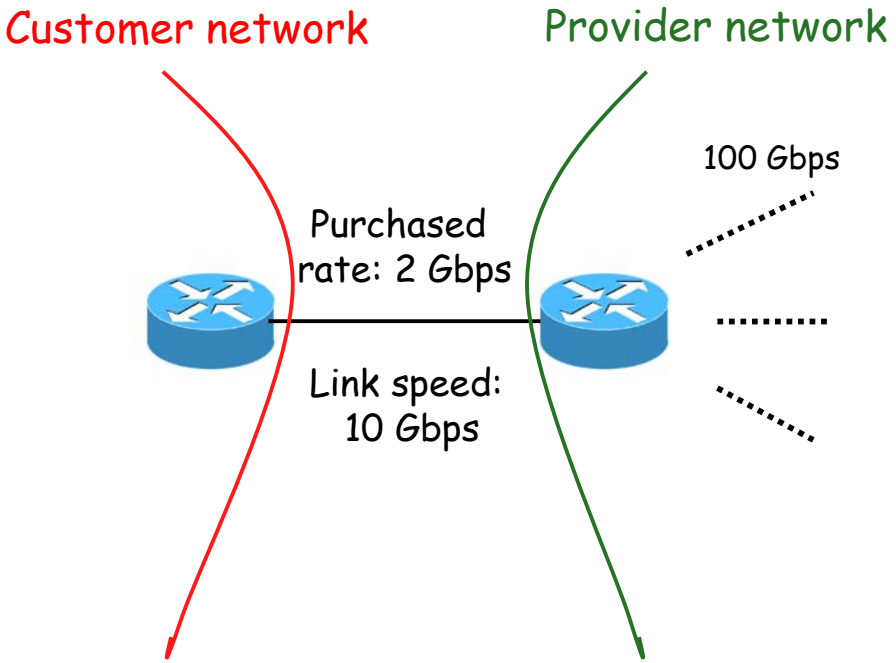
WAN Scavenger Service (SS)

- Customer:

→ send data at a rate higher than purchased rate (SLA) at a lower cost

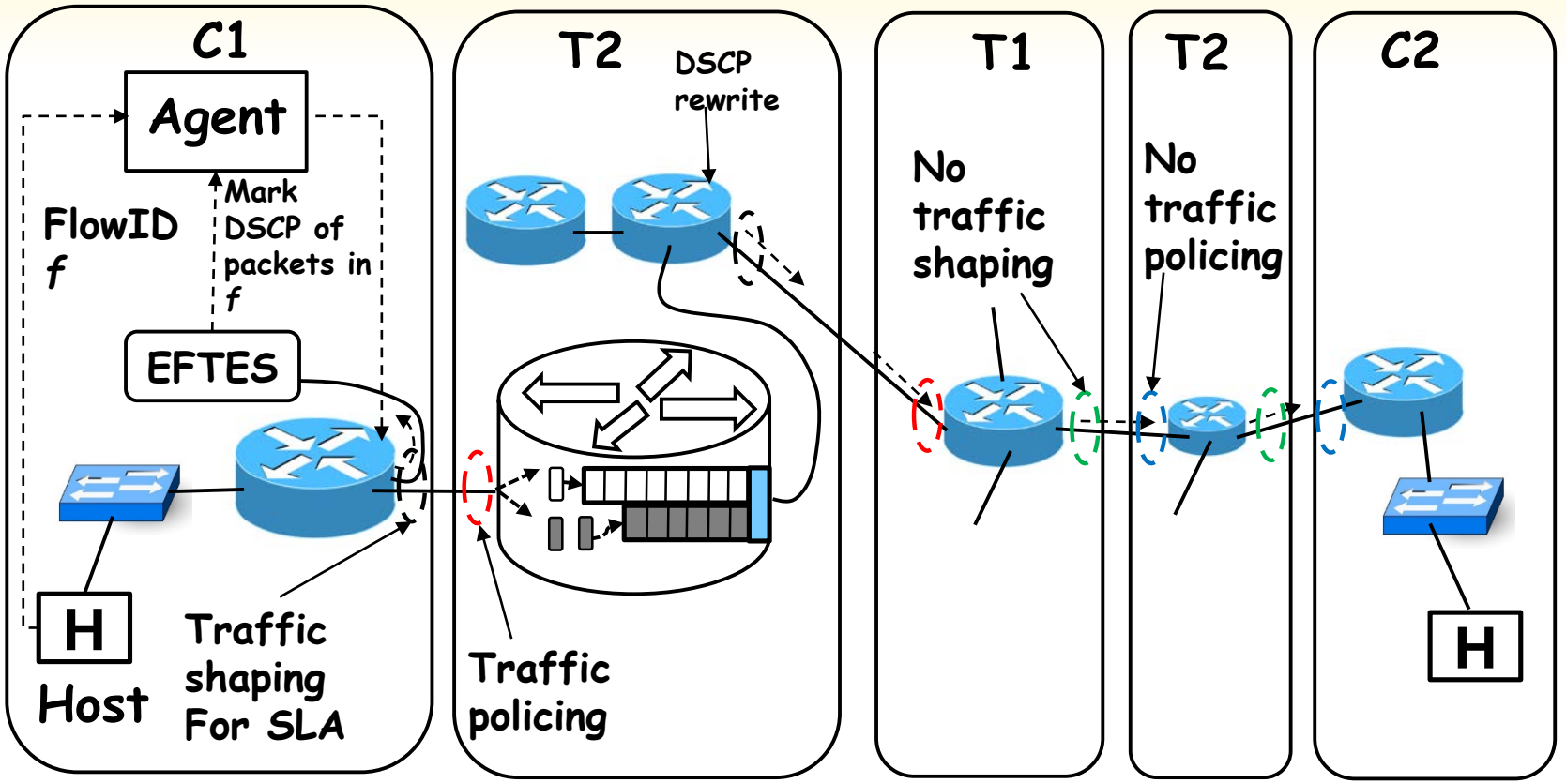
- Provider:

→ utilize links without adversely impacting other general IP traffic

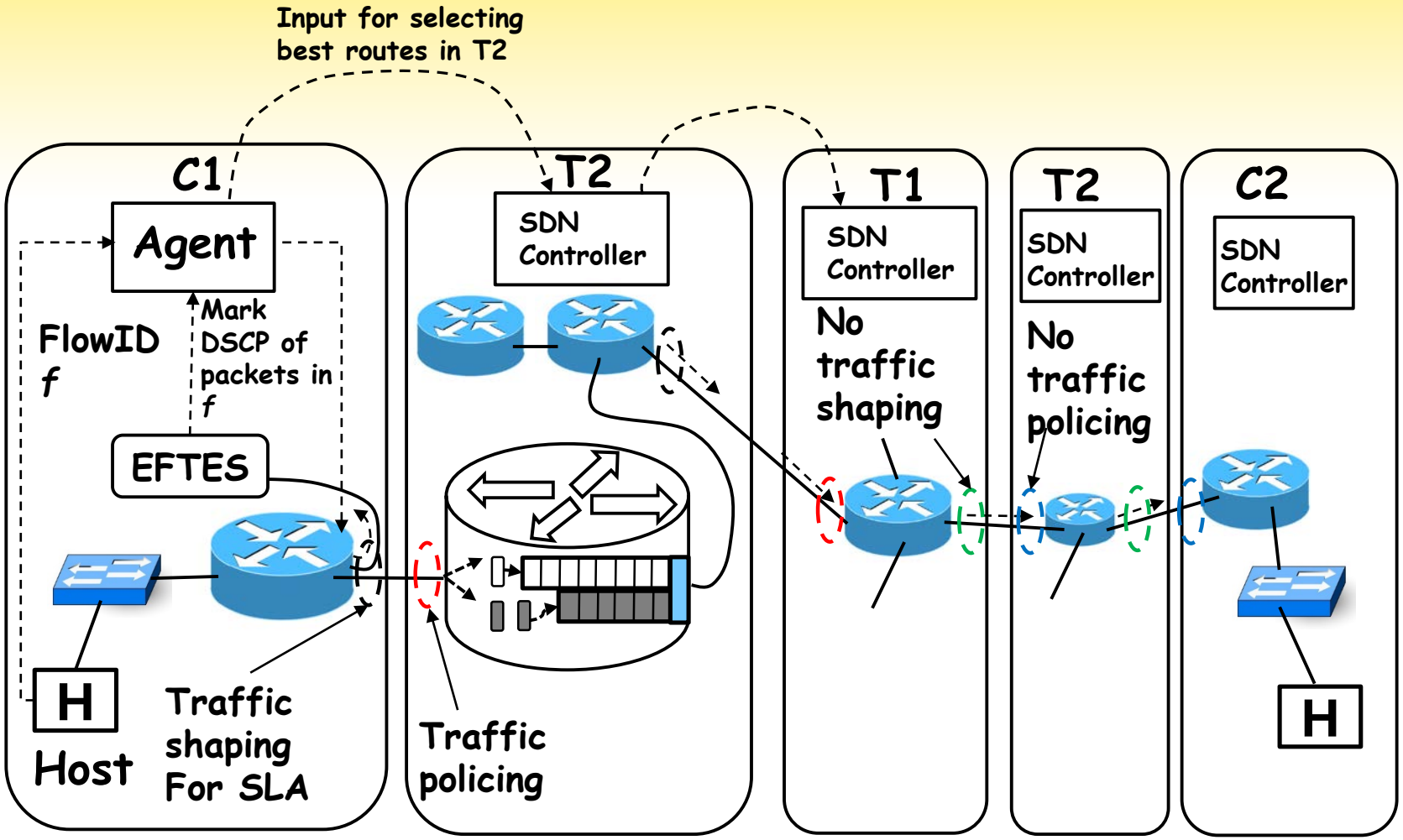


SLA: Service Level Agreement

A deployment of a Static WAN Scavenger Service



A deployment of a Dynamic WAN Scavenger Service



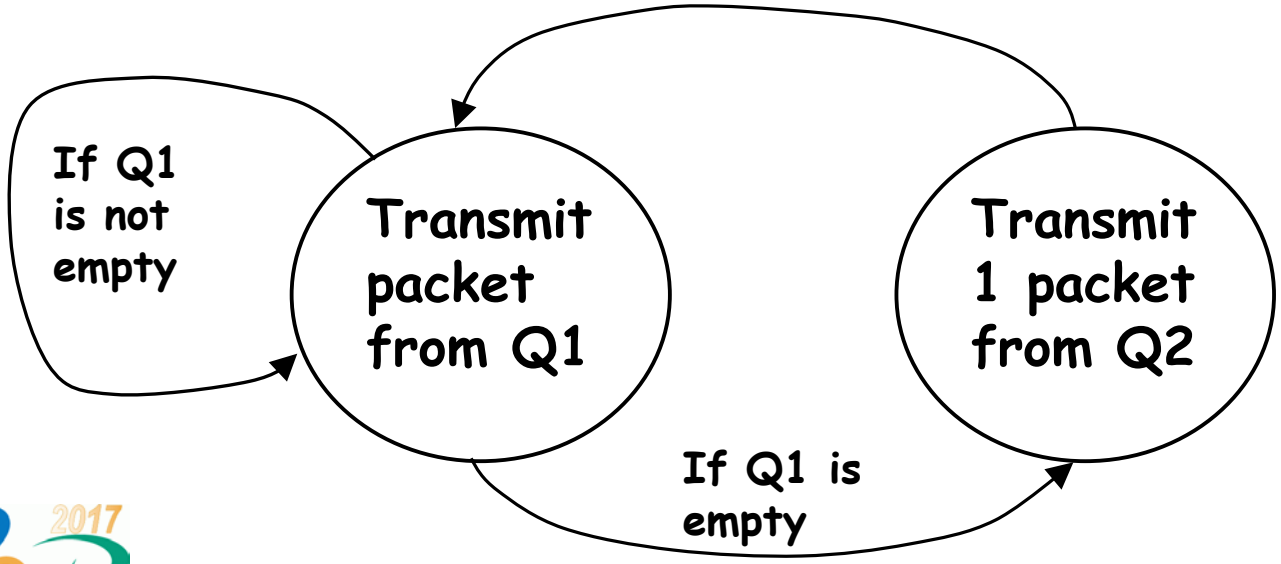
Elements of a Scavenger Service

- Identify large data transfer flows
  - Application notifies flow identifier, e.g. GridFTP can be retooled
  - An online Elephant Flow Traffic Engineering System (EFTES)

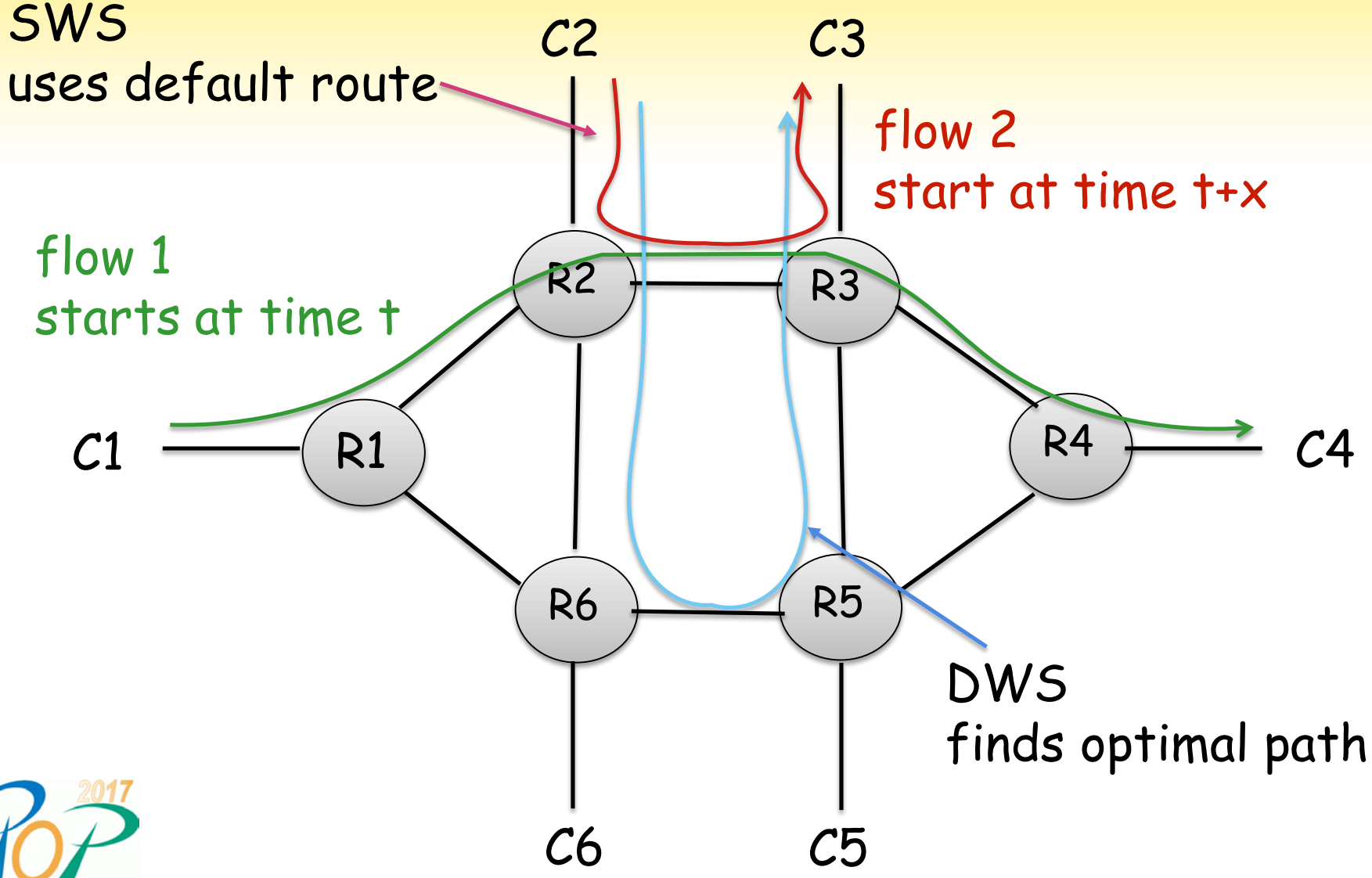
- DSCP and DSCP rewrite
  - 6-bit Differentiated Services Code Point (**DSCP**) in IP header
  - A specific DSCP value represents priority of packets
  - Inter-domain can use the same DSCP value for low priority scavenger traffic
  - Rewrite DSCP field for inter-domain operation

Elements of a Scavenger Service (Contd.)

- Two queue for packet scheduling
  - A Primary queue and a Scavenger queue
- Strict priority enables true scavenger operation
  - Q1 is the primary queue
  - Q2 is the scavenger queue



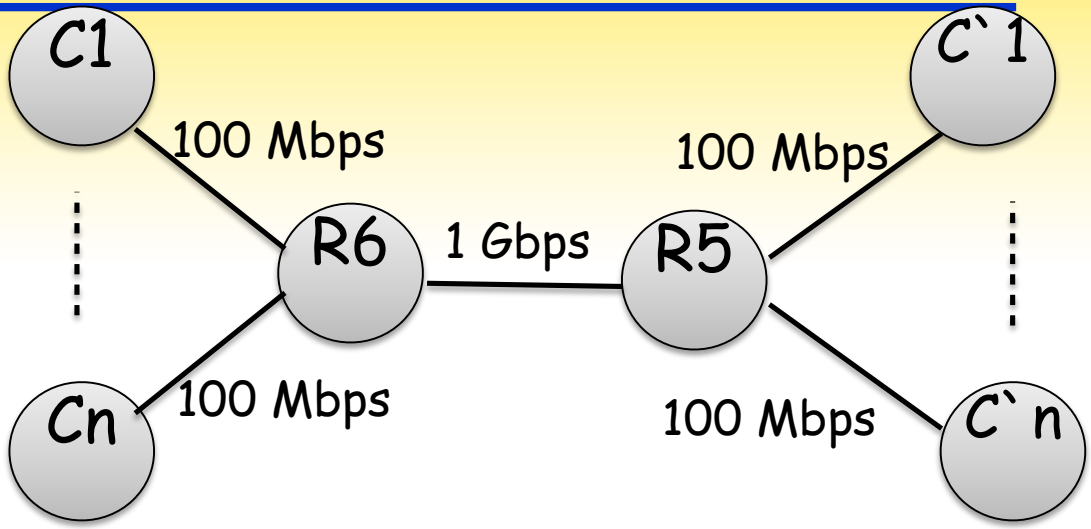
SWS vs DWS


SWS
uses default route
C2
C3
flow 2
start at time t+x
flow 1
starts at time t
R2
R3
C1
R1
R4
C4
R6
R5
DWS
finds optimal path
C6
C5

Evaluation

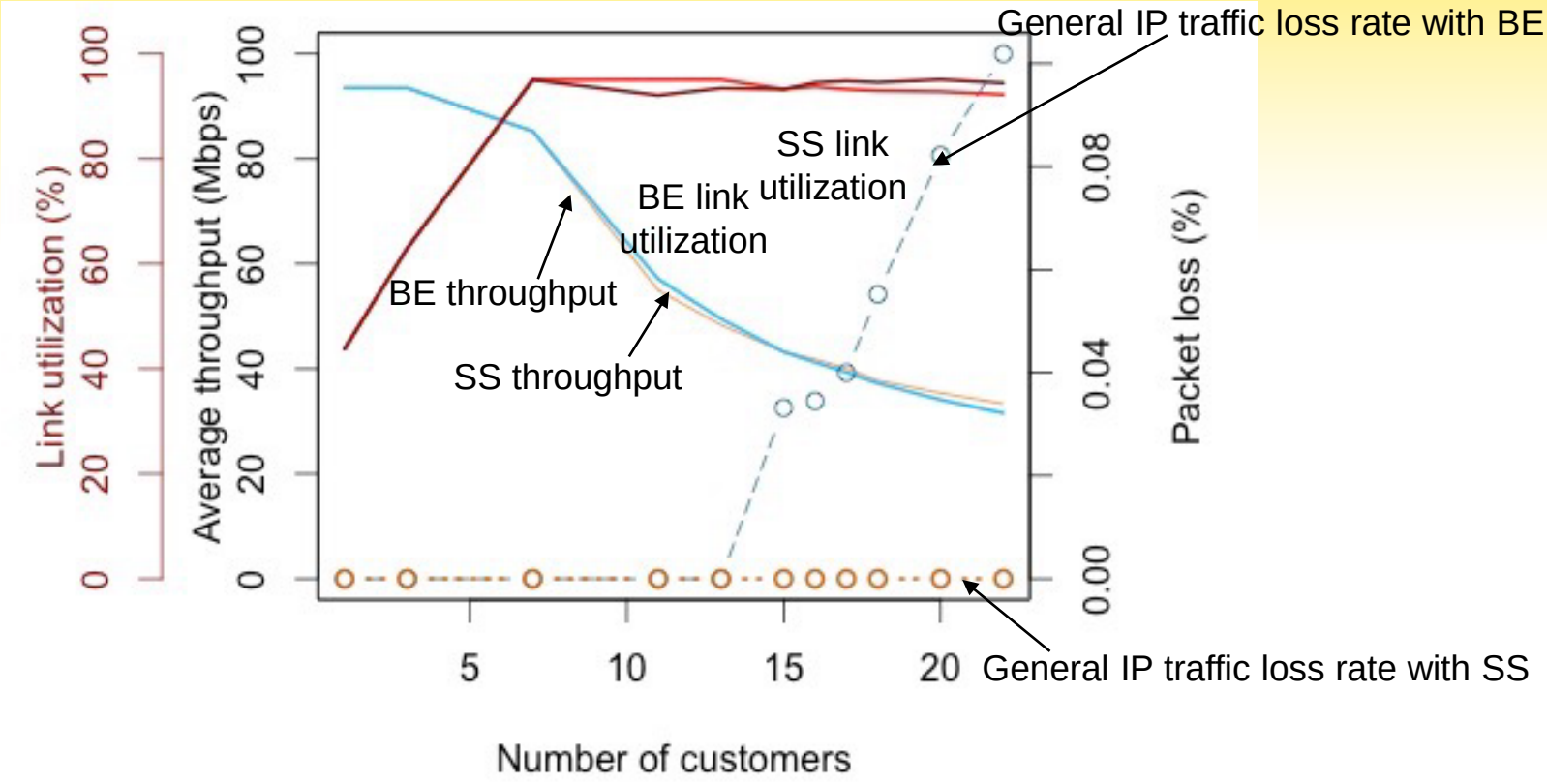
- Simulations:
  - NS3, which is packet based simulator
  - Network packet traces collected at 10 Gbps link used to simulate general IP traffic
    - Center for Applied Internet Data Analysis (CAIDA) traces
    - Developed NS3 model to replay packet traces
  - Two cases:
    - benefit of Scavenger Service (SS) over Best-Effort (BE)
    - link failure

Scavenger Service (SS) vs Best-Effort (BE)



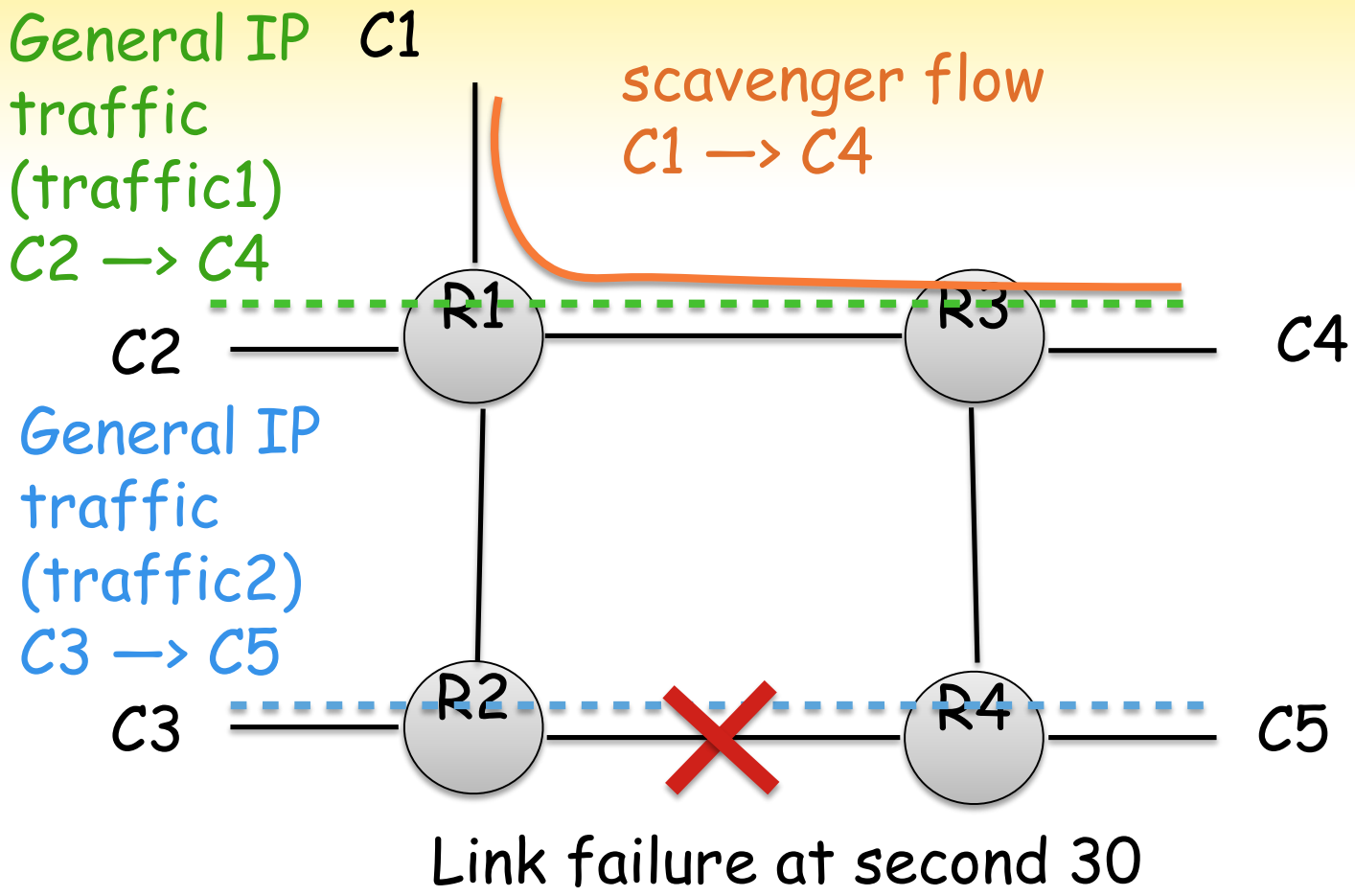
- Number of customers simultaneously using scavenger service increased form 1 to 22 customers
- R6 configured with priority queuing
- Two cases were simulated:
  - All flows go to one queue with out SS
  - Scavenger flows go to scavenger queue

Result: SS vs BE



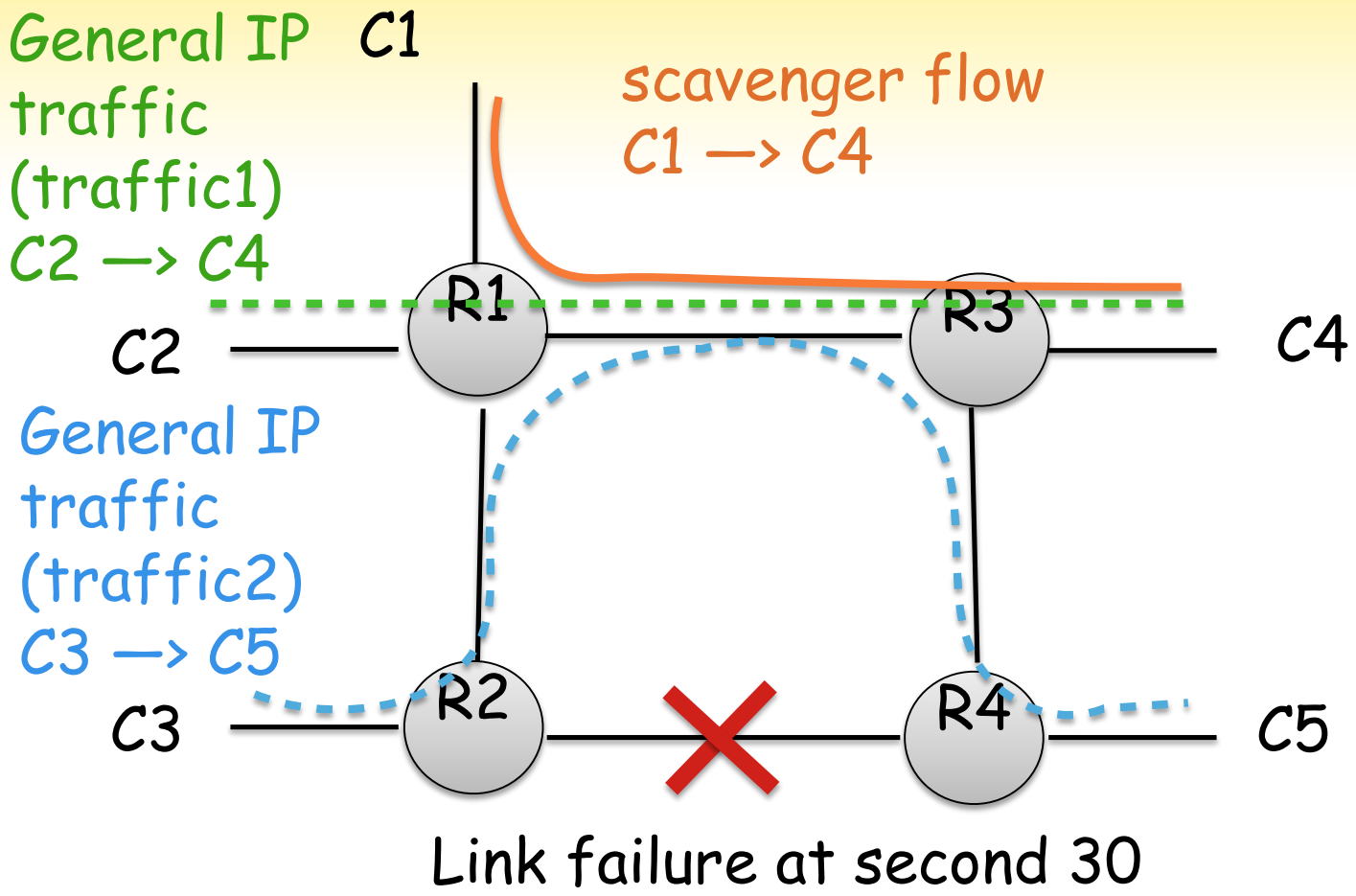
- With few customers
  - The provider will not see the value of SS over BE
  - Both SWS and BE have loss packet rate for background traffic

Link Failure



All links 10 Gbps

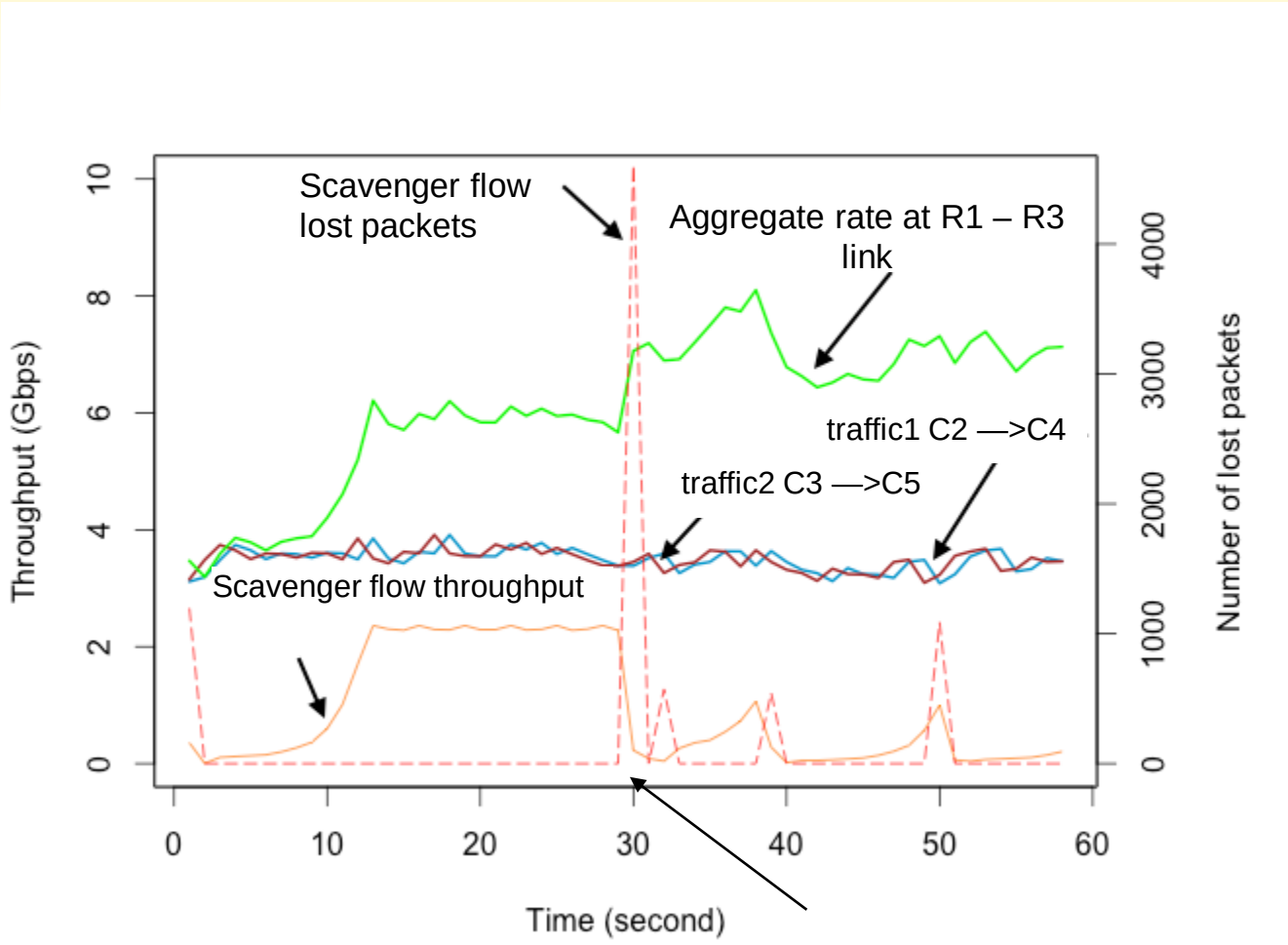
Link Failure



All links10 Gbps

Result: Link Failure

- General IP traffic not impacted after failure and redirection because scavenger flow uses a low priority queue



Conclusions

- Scavenger service offers a solution to increase link utilization
- In order to honor SLA between the customer and provider
  - Scavenger traffic that is above SLA traffic rate should not be shaped ~ benefits customer to offload large traffic
  - Provider should modify traffic policing to allow more traffic from a customer but charge differently for scavenger traffic
- We propose a static scavenger service and dynamic scavenger service for inter-domain operation
- We showed that with SWS the provider will not harm its priority traffic ~ even with link failure
- Next step is to develop control plane protocols for inter-domain SWS and DWS operation

Backup: SWS vs DWS

- SWS
  - o All provider routers are pre-configured with a scavenger queue
  - o Customer performs DSCP rewrite based on the provider scavenger DSCP

  + Easy to deploy
  + No overhead of computing the path
  – Could have lower throughput when the scavenger users increases

- DWS
  - o Has full topology graph
  - o Find an optimal path with the minimum scavenger used rate
  - o Configure routers on the path with scavenger queue

  + Higher throughput for scavenger flow
  + Better utilization for provider links
  - Requires deploying DWS controller
  - Overhead of signaling, calculating and configuring the path