Investigating Isolation between Virtual Networks in Case of Congestion for a Pronto 3290 Switch

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Investigating Isolation between Virtual Networks on Pronto 3290 Switch

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Agenda

- Motivation
- Experimental Setup
- Results
- Conclusion and Future Work
Motivation

- Isolation of virtual networks, which share the same physical resources, for individual application or user, is one of key features of Network Virtualization

- Management of virtual network with SDN
  - Configuration of virtual queues on network devices
  - Assignment of flows to specific queues using OpenFlow

- Incoming traffic from several virtual networks and different ingress ports may be forwarded via the same egress port

- To which extent is isolation between virtual networks realized in hardware?
EXPERIMENTAL SETUP
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Experimental Setup

- Traffic Generator: $h_1, h_2$
- Traffic Sink: $h_3$
- Queues limited rates: $\beta_1^l, \beta_2^l$
- Virtual networks rates: $\beta_1, \beta_2$

- Link capacity: $c$
- Total load: $\rho = \frac{\beta_1 + \beta_2}{c}$
- Provisioned bandwidth: $\rho_p = \frac{\beta_1^l + \beta_2^l}{c}$
Course of Experiment

- Traffic generator $h_1$ sends UDP packets with a rate of $\beta_1 = \beta_1^l$

- Traffic generator $h_2$ sends UDP traffic in regular intervals with the rate of $\beta_2 > \beta_2^l$

What is the impact of violation can happen?
RESULTS
Single Experimental Run

- $\beta_1 = \beta_1^l = 640 \text{ Mbps}$, $\beta_2^l = 255 \text{ Mbps}$, $\beta_2 = 465 \text{ Mbps}$, $t_b = 5\text{s}$, $t_\Delta = 3\text{s}$

- Throughput of congested virtual network temporary increased
- Overload scenario, but only a few packets are lost
- Impact of Layer 2 IEEE 802.3x flow control:
  - Notification of overload via a “PAUSE” frame
  - Receiver requests a certain time pause period to cope with overload
Single Experimental Run

- \( \beta_1^l = \beta_1^r = 640 \text{ Mbps}, \beta_2^l = 255 \text{ Mbps}, \beta_2^r = 465 \text{ Mbps}, t_b = 5s, t_\Delta = 3s \)
- Flow control enabled and flow control disabled

- Similar throughput reduction in the not-congested virtual network
- High packet loss if flow control is disabled
- The isolation of virtual networks is violated in both cases
Variation of burst duration, load $\rho$ and provisioned bandwidth $\rho_p$

Flow control on, 10 repetitions, 95% confidence intervals

- Burst duration has no statistically significant impact on the amount of lost packets
- Increasing $\rho$ or $\rho_p$ results in higher number of lost packets
Amount of Lost Packets

- Variation of burst duration, load $\rho$ and provisioned bandwidth $\rho_p$
- Flow control off, 10 repetitions, 95% confidence intervals

- Similar results as for flow control on
- Higher number of lost packets

$t_i > t_b$
Duration of Packet Loss

- Proportional relationship between provisioned bandwidth $\rho_p$ and $t^i$
- The variation of $t^i$ according to $\rho_p$ complies with an exponential family
- Higher total load $\rho$, shorter duration of packet loss $t^i$
Conclusion and Future Work

- Investigation of isolation between virtual networks
  - Experiments conducted in local testbed
  - Used network device: Pronto 3290 Switch

- Isolation may be violated in case of overload in one virtual network
  - Temporary increased throughput for overloaded virtual network, throughput reduction of well behaving virtual network
  - Duration of transient behavior depends on configured throughput for virtual networks ($\rho_p$) and the total load ($\rho$)

- Focus of future investigations
  - Impact of firmware and devices on isolation
  - Investigation of more parameters (delays, realistic traffic patterns,…)
  - Establishment of appropriate models to describe switch behavior
Thank you for your attention!

Q&A