Meticulous Measurement of Control Packets in SDN

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Abstract & Introduction

- Data packet statistics sent by OpenFlow compliant switches cumulatively includes statistics about control traffic which is used for network control & management. Ex - MDNS, NDP, MLD, DHCP etc.
- Generated & absorbed at the intermediate switches but included in statistics of sent & received packets to the SDN controller
- Reduces the accuracy of calculation of QoS metrics and thus hampers network monitoring.
- A novel algorithm to accurately measure the fraction of control packets in SDN within 3% error rate.

Impact of control packets in SDN

- Many services run in the SDN controller continuously in the background like topology discovery, network monitoring etc.
- Therefore, more amount of control packets are generated in SDN than traditional networks.
  - Large number of LLDP packets injected by the controller for discovering links. [5]
  - Recommended trade-off b/w resource overhead & measurement accuracy. [3]
  - ⇒load on controller & scalability issues[6]
  - Techniques that will lead to even greater fraction of control traffic. [1] [2]
- 3-9% of the total traffic in experiments

Intuition and Algorithm

- Message exchanges are periodic in nature
- The number of control packets in a subnet being proportional to the number of switches & hosts in the sub-network
- Packets flow via spanning tree

$$N = (A_\tau \times \alpha + B_\tau \times \beta) \times (t/\tau)$$

α: # switches in an interface's subnetwork
β: # hosts in an interface's subnetwork
A_τ: # control packets transferred between two switches in time period τ
B_τ: # control packets transferred between one host and one switch in time period τ

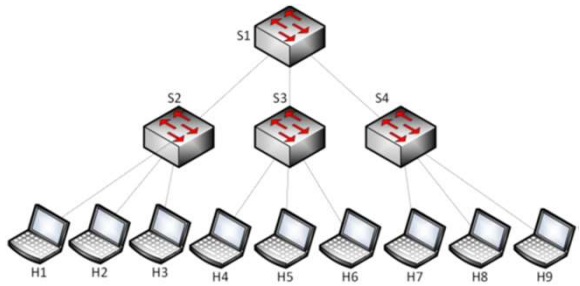
Implementation

- Getting spanning tree information
  - Spanning tree protocol at the controller
  - Control sending/receiving of BPDU packets by MAC learning
  - When connection between each OpenFlow switch & the controller is completed, exchange of BPDU packets starts & root bridge selection, port role setting, & port state change takes place.
- Estimating time period and other constants
  - emulate a network where no traffic, except control traffic is generated.
  - poll the switches every 5 seconds for PortStats for 30 minutes. The time period of the periodic pattern observed.

Emulation and Experiments

Error rates for various topologies

Topology	#Switches	#Links	Degree	Error
Tree	4	12	4	2.948%
Ring	16	32	3	1.8%
Star	5	8	2.4	1.77%
Mesh	4	14	3.5	3.15%



Switch	Switch-1	Switch-2	Switch-3	Switch-4
Port-1	2851	471	477	474
Port-1 est.	2070	460	460	460
Port-1 err.	3.19%	2.34%	3.56%	2.95%
Port-2	2833	470	473	480
Port-2 est.	2070	460	460	460
Port-2 err.	2.57%	2.12%	2.74%	4.16%
Port-3	2826	470	468	476
Port-3 est.	2070	460	460	460
Port-3 err.	2.34%	2.12%	1.71%	3.36%
Port-4	-	7170	7081	7245
Port-4 est.	-	6900	6900	6900
Port-4 err.	-	3.76%	2.55%	4.76%