A Small Scale Software-Defined Network Using OpenFlow Protocol with Explicit Load Balancing

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Introduction

Network flow scheduling is a major concern in designing data center network. For many existing data centers, they schedule flows using ordinary Equal-cost Multipath (ECMP) strategy in a symmetric network topology. But this scheduling strategy is not efficient in data center network because there are flows with relatively large size and ECMP could not perform the scheduling well because of hash collision. Bandwidth available in the network cannot be fully utilized.

Project Overview

Software-Defined Networking (SDN)

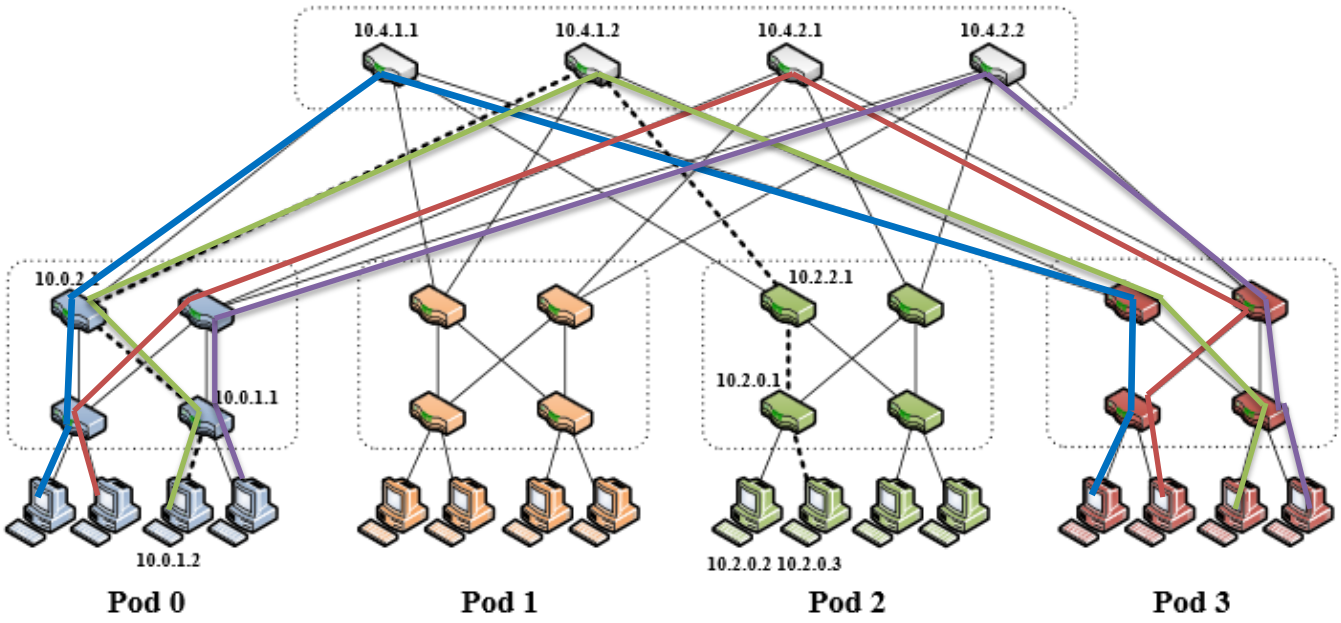
SDN is an approach to computer network that allows network administrators to manage network services through abstraction of lower-level functionality. It separates the network control plane and data plane. SDN requires some method for the control plane to communicate with the data plane which is OpenFlow.

OpenFlow

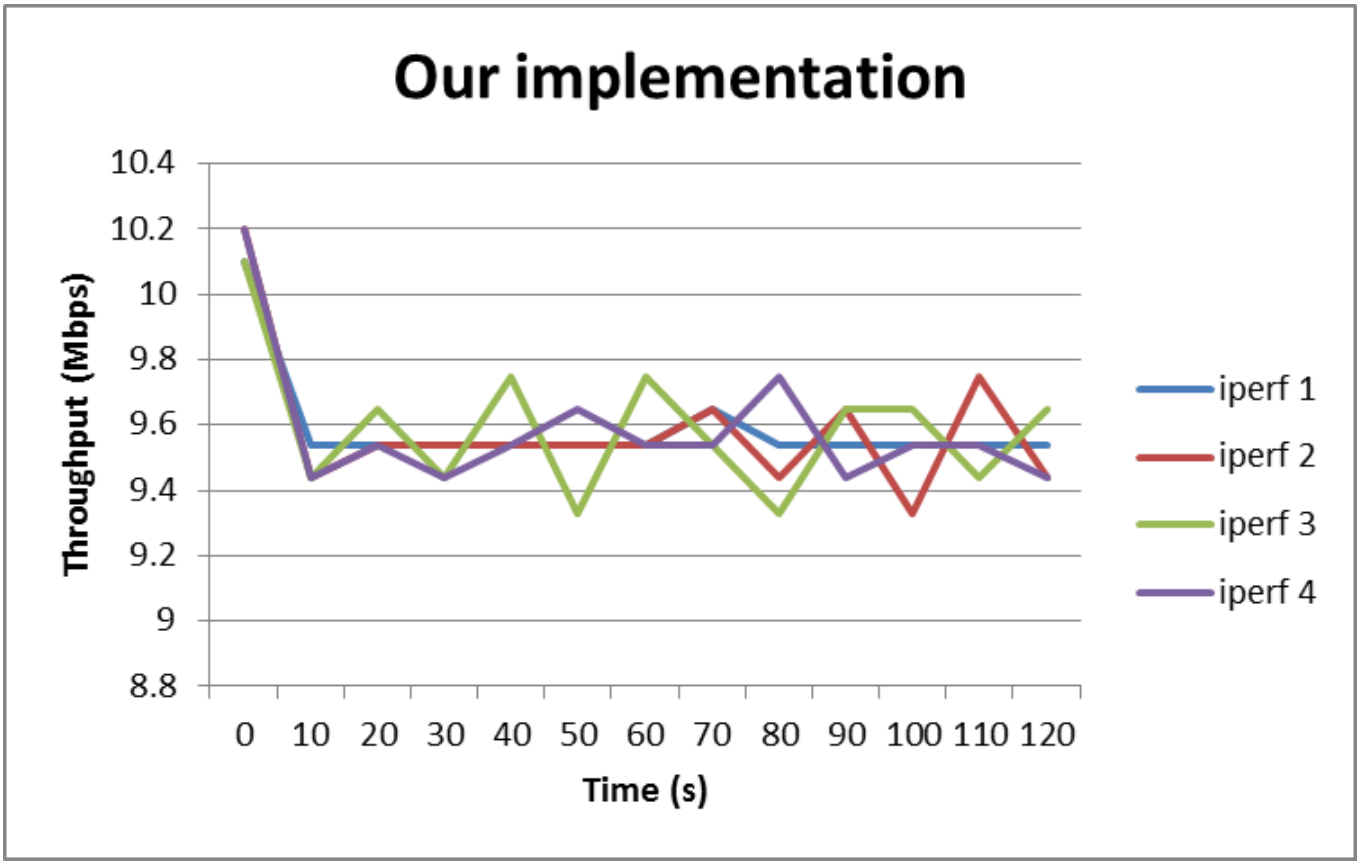
OpenFlow is the standard communications interface defined between the control plane and data plane of SDN architecture.

OpenFlow allows direct access to and manipulation of the data plane of network devices such as switches and routers, both physical and virtual.

Design



Result



Metrics	Our implementation	Normal ECMP (in average)	Improvement (in average)
Aggregate Throughput	38.36 Mbps	27.388 Mbps	40.06% better
Average Flow Completion Time	131.25 s	211.595 s	37.97% better
Tail Latency	0.46 ms	0.5398ms	14.78% better

Conclusion

Using explicit load balancing can utilize symmetrical data center network in a larger extend, which leads to higher throughput and shorter flow completion time for elephant flows (meaning flow size larger than 100KB).

Using explicit load balancing can also improve the tail latency of mice flows (meaning flow size less than 100KB) because there is no flow collisions occurred during the transmission of both elephant and mice flows.