Schedulers for Hybrid Data Center Network

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Hybrid DCN = Packet Switching + Circuit Switching



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Schedulers for Hybrid Data Center Network





+ High reliability ✓
+ No setup time ✓

High power consumption
 Not scalable

Circuit Networks

- + High Bandwidth ✓
 + Low Latency ✓
- + Low power, footprint 🗸

Initial setup delayReconfiguration Delay



Hybrid Networks [Best of both world's]

Need Hybrid scheduler to co-ordinate the packet and circuit switched network



64 B packet latency across a Circuit & a packet switch



Optical switch (After Setup, 1st packet)

Latency accumulation across path for electrical and optical switches



Optical Switch (before setup, 100th packet)

--- reactor optical switch (path computation time= 10ms, reconfig time = 20us)

At what flow size does OCS overtake EPS



At what flow size does OCS overtake EPS?



Our Approach: Flow classification at Host





Flow transition





Summary

> Hybrid networks are essential to meet emerging DCN reqirements.

- > Need dynamic schedulers for hybrid networks.
- Ideas for the dynamic hybrid scheduler:
 - Flow classification at host
 - Flow transition
- > Evaluation through simulation and implementation (NetFPGA).

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Backup slides



EPS Vs OCS



Has buffers, TCAM

Arista ToR switch (48x10G and 4x40G) has a power consumption of 400 W.

There is packet processing



No buffers

Glimmerglass OCS with 192x192 optical cross-connect has a power consumption of 85 W.

No packet processing



Case for hybrid switching

• Consider 130,000 node data center using EPS with folded Clos topology.

alone1.3 MW

Core (131072 switch ports) Power consumption = 131072*2 W = 262 KW Aggregation (262144 switch ports) Dever second to the second state of the se

Power consumption = 262144* 2 W = 524 KW

ToR (262144 switch ports) Power consumption = 262144*2 W = 524 KW

Increase maintenance and



Packet Switching & Circuit Switching



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Traditional Fat Tree topology





Hybrid Network





HyNS: Hybrid Network Simulator

- Event-driven, accurate network topology simulator (not a protocol simulator)
- Scaling upto millions of hosts
- Reflects property close to real hardware devices.
- Simulator is not limited to just hybrid networks.

Platform	Sim/Emu	Accuracy	Code Integration complexity	Scalability	Traffic Models
NS 2 (C-through)	Sim	ms	Medium	High	Trace
ReacToR	Sim	us	Low	Low	Fixed packets
OCSEMU	Emu	us	High	Low	Real application traffic
HyNS	Sim	us	Low	High	Fixed packets (WIP*)

* we are working towards developing other traffic stimulus (CDF based, trace driven ..)





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Problem:

Designing scalable and cost effective Data Center Networks (DCN) for future.

Motivation:

- > DCN require more Bandwidth, better energy efficiency.
- > Hybrid DCNs (with dynamic Hybrid schedulers) are needed.



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