Stateless Datacenter Load Balancing with Beamer

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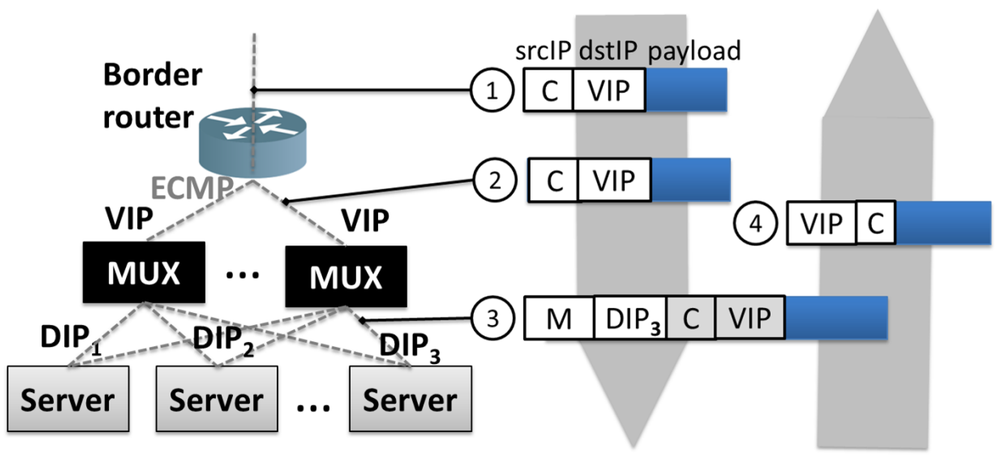
Datacenter load balancing



Common approach

Goal: *connection affinity*
- Packets belonging to a connection must hit the same server

Hashing packets at the mux isn't enough
- Server pool changes break connections

Common approach: stateful muxes
- Hash connection, then remember the result
- Scaling mux pool breaks connections
- SYN flood attacks use up all state memory

Beamer dataplane

Beamer muxes *do not keep per-connection state*; each packet is forwarded independently.

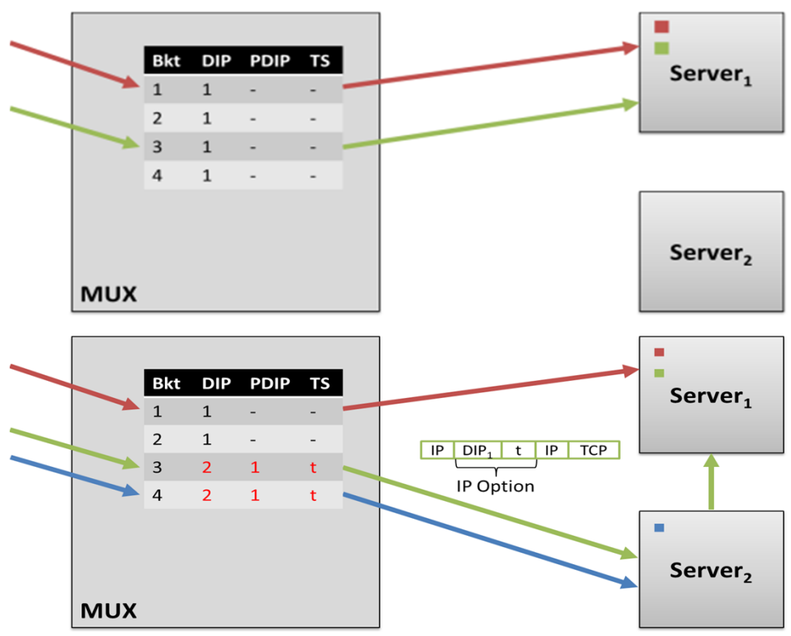
Indirection layer: Hash packets into buckets
- # of buckets depends on max # of servers

Bucket-to-server mappings known by all muxes
- Maintained by a centralized controller

Bkt.	DIP	Prev. DIP	TS
1	10.0.53.146	10.0.3.59	10 min. ago
2	10.0.136.10	10.0.240.166	2 min. ago
3	10.0.141.47	10.0.73.214	5 sec. ago
	...		

Sample data plane

Daisy chaining



Leverage state held by servers
- Redirect **stray packets** to previous server
- Handle **new connections** locally

Controller

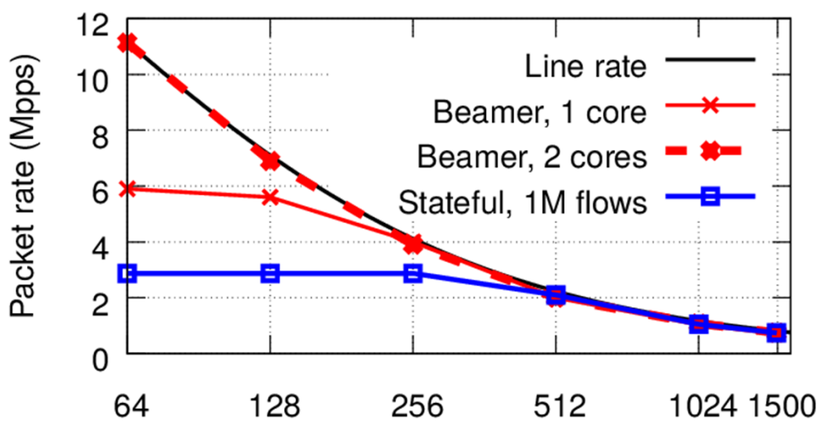
Centralized, fault tolerant controller
- Writes dataplane configuration in ZooKeeper
- Muxes notified automatically
- Muxes download new configuration

Performance when adding 32K servers
- 1-10s to write new configuration
- 0.5-6s for muxes to download it.
- 1GB total traffic

Implementation

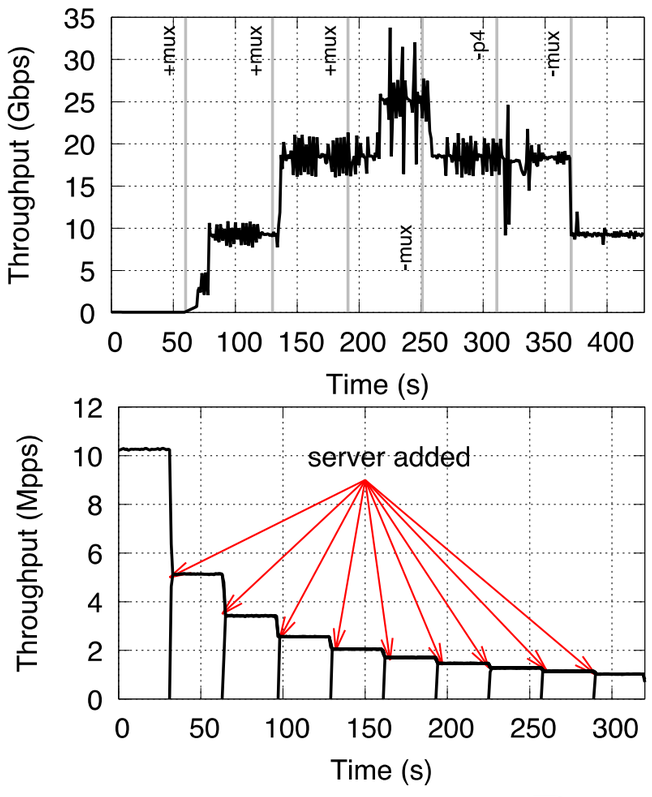
- Software and P4 muxes
- Java implementation for controller
- Linux kernel module + patches

Software mux performance



With realistic HTTP traffic: **36Gbps** on 7 cores
- 540Gbps downstream traffic: one mux can handle 50-500 servers

Seamless scaling



Connection affinity

700 long term connections
Scale-down
- Start with 2 muxes and 8 servers
- Remove some servers
- Then remove one mux after 30s

DIPs removed	0	1	2	4
Stateful	0	54 ± 7	103 ± 14	214 ± 48
Beamer	0	0	0	0

SYN flood
- start with 2 muxes and 8 servers
- SYN flood @ 1Mpps
- Remove some servers

DIPs removed	0	1	2	4
Stateful	0	87 ± 2	184 ± 8	351 ± 21
Beamer	0	0	0	0

Ask us about…

- **MPTCP support**
- **P4 mux implementation**
- **Minimizing # of rules needed in mux**
- **Avoiding reset connections in corner cases**

Beamer is Open Source

https://github.com/Beamer-LB

Thanks to SSICLOPS SUPERFLUIDITY