Network function virtualization

Ankit Singla

ETH Zürich Spring 2017

News from SIGCOMM 2017

- 36 papers (out of 250 submissions)
- On every topic we covered / will cover
- 2 papers from ETH!

An update …

ACM SIGCOMM, 2017

~~Under submission~~

Beyond fat-trees without antennae, mirrors, and disco-balls

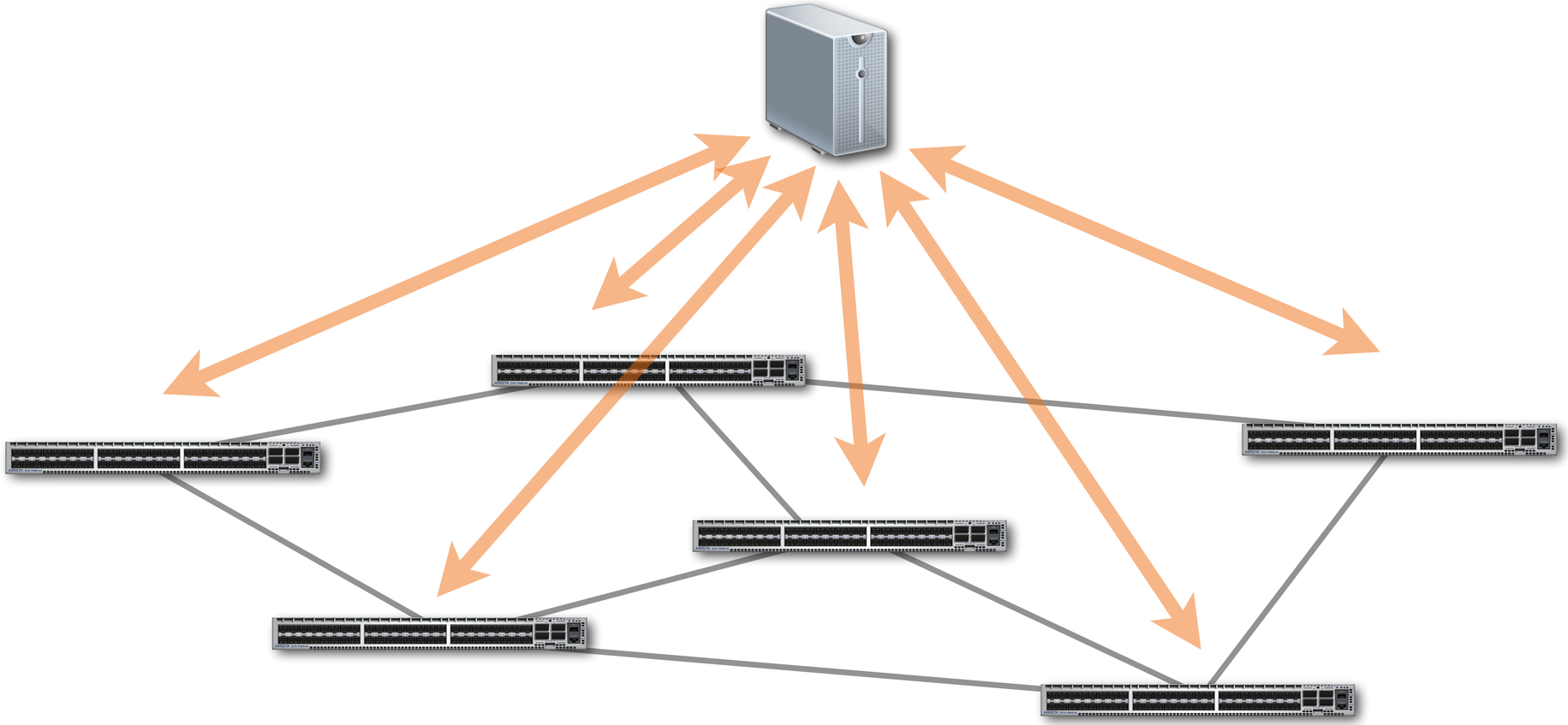
Simon Kassing (**MSc,**

This lecture …

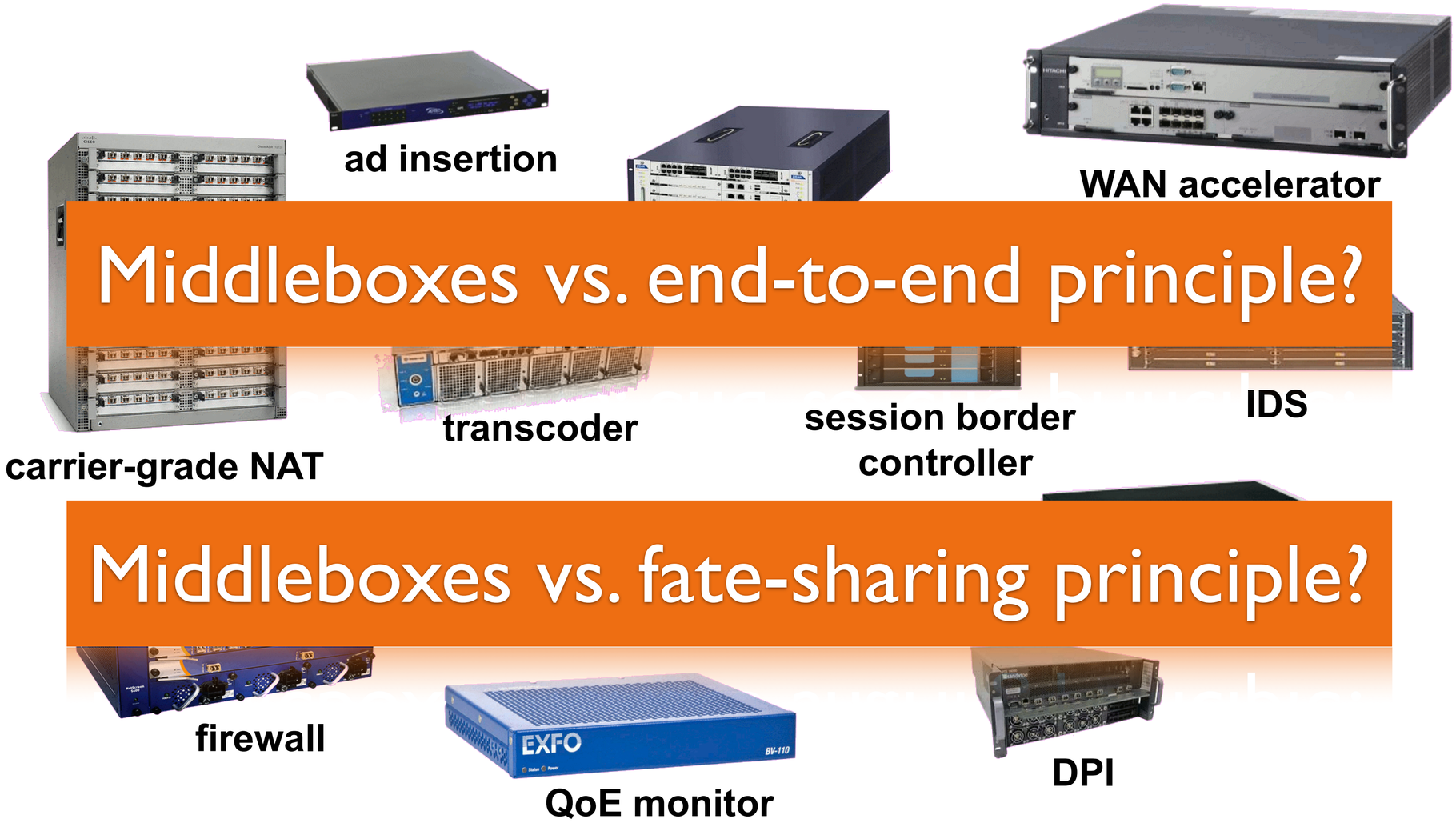
- What are network functions?
- Why / how might we want to virtualize them?

- Intro: "Generalizing congestion control"
  - *TCP ex Machina: Computer-Generated Congestion Control*

Our view of networks so far …



Network functions / middleboxes

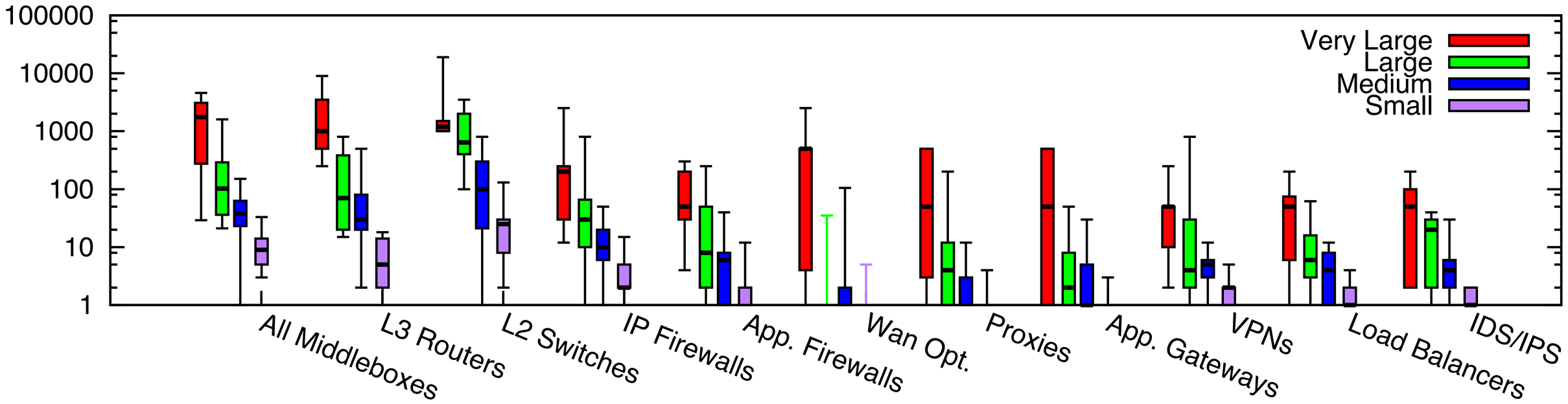


Middleboxes vs. end-to-end principle?

Middleboxes vs. fate-sharing principle?

ClickOS and the Art of Network Function Virtualization, Usenix NSDI'14
Joao Martins, Mohamed Ahmed, Costin Raiciu, Roberto Bifulco, Vladimir Olteanu, Michio Honda, Felipe Huici

Middleboxes are ubiquitous



As many middleboxes as routers or switches!

Making Middleboxes Someone Else's Problem: Network Processing as a Cloud Service, ACM SIGCOMM'12
Justine Sherry, Shaddi Hasan, Colin Scott, Arvind Krishnamurthy, Sylvia Ratnasamy, Vyas Sekar

Middleboxes are complex

	Misconfig.	Overload	Physical/Electric
Firewalls	67.3%	16.3%	16.3%
Proxies	63.2%	15.7%	21.1%
IDS	54.5%	11.4%	34%

1-5 hours per week dealing with middlebox failures

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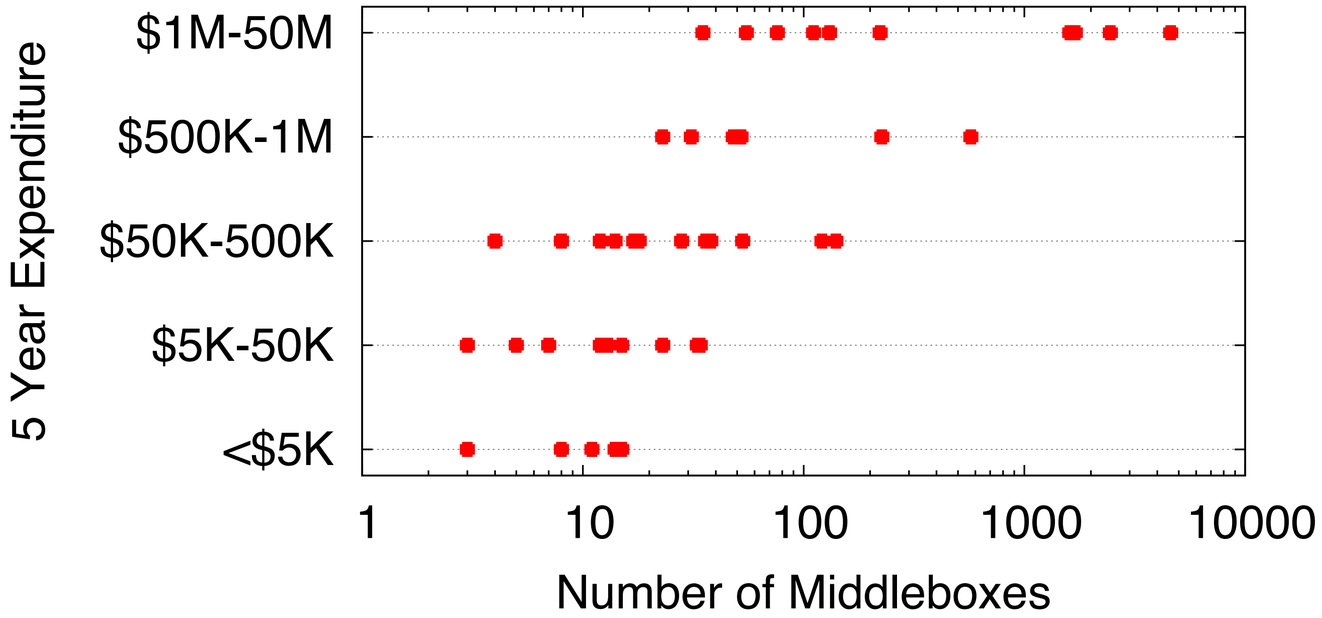
Middleboxes are expensive



Additional expense on specialist engineers to manage them

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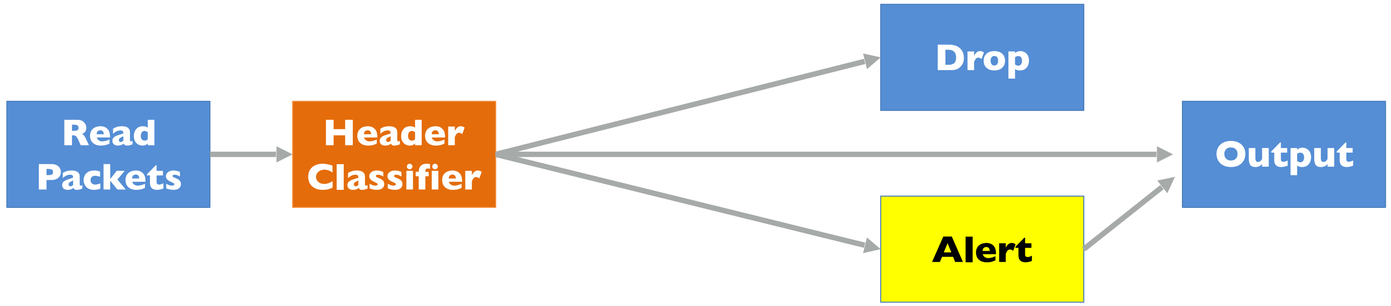
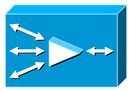
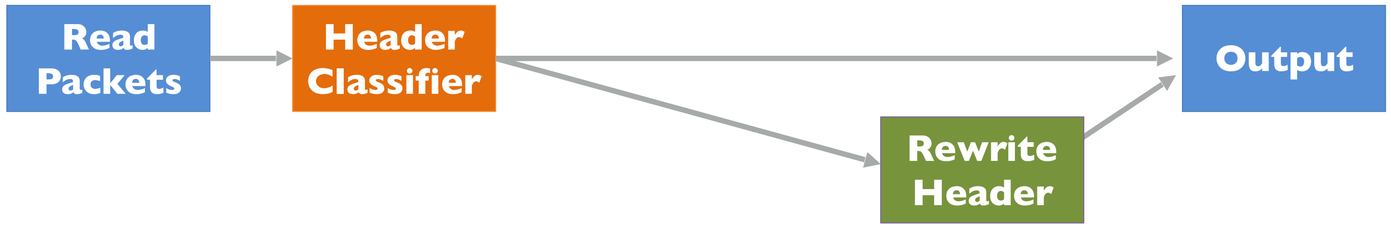
Wasteful replication of functionality

Firewall:

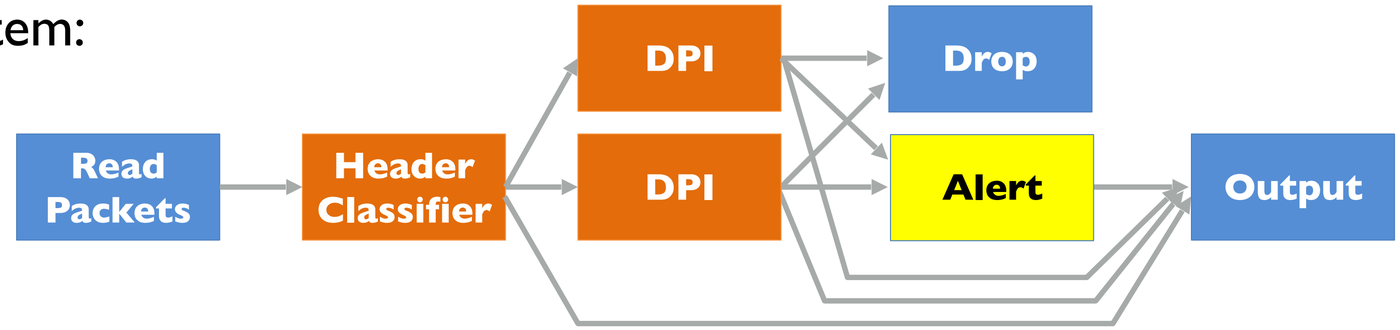




Load balancer:

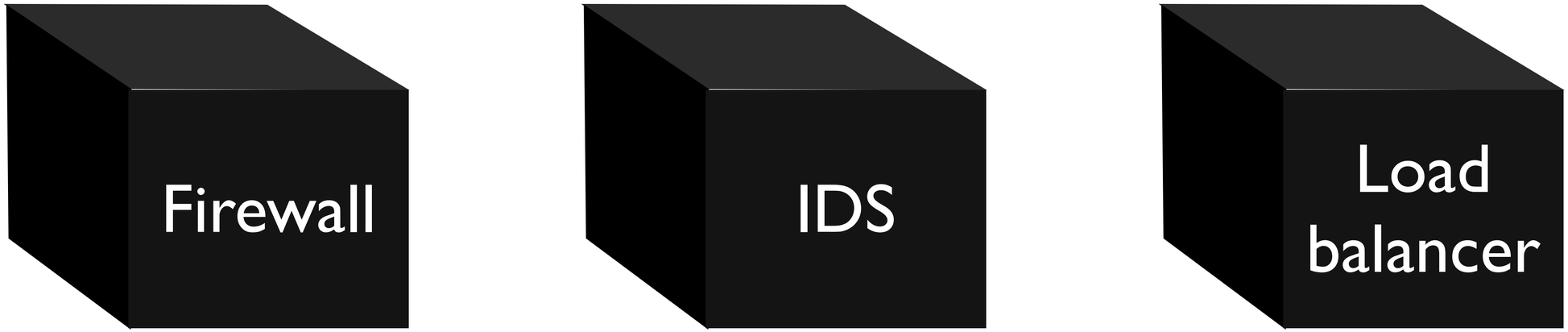


Intrusion prevention system:



OpenBox: A Software-Defined Framework for Developing, Deploying, and Managing Network Functions, ACM SIGCOMM'16
Bremlar-Barr, Harchol, Hay

Middleboxes are black-boxes



- Monolithic ⇒ hard to understand, debug, upgrade, provision …
- Long deployment timelines
- No standards, vendor lock-in, slow innovation

As always: problems = opportunities!

- Software defined middleboxes?
  - Standardized low-level API?
  - Centralized, consolidated control?
- Consolidate middleboxes?
- Virtualized middleboxes?
- Offload middleboxes to the cloud?
  - Peak load ≠ average load

Classical Network Appliance Approach


Message Router


CDN


Session Border Controller


WAN Acceleration


DPI


Firewall


Carrier Grade NAT


Tester/QoE monitor

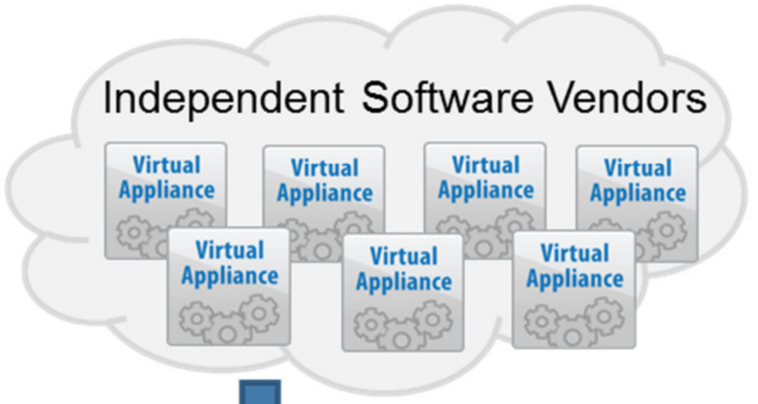

SGSN/GGSN


PE Router


BRAS


Radio/Fixed Access Network Nodes

- Fragmented non-commodity hardware.
- Physical install per appliance per site.
- Hardware development large barrier to entry for new vendors, constraining innovation & competition.




Orchestrated, automatic & remote install.

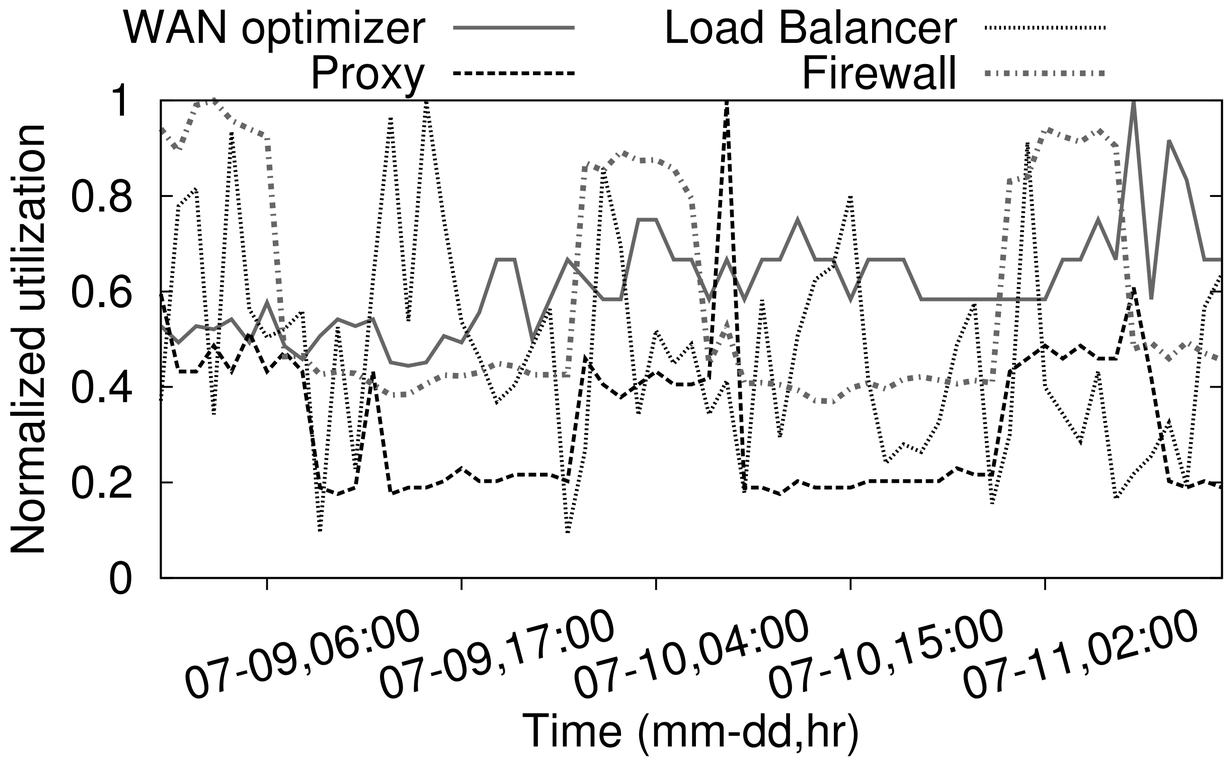

Standard High Volume Servers


Standard High Volume Storage


Standard High Volume Ethernet Switches

Network Functions Virtualisation Approach

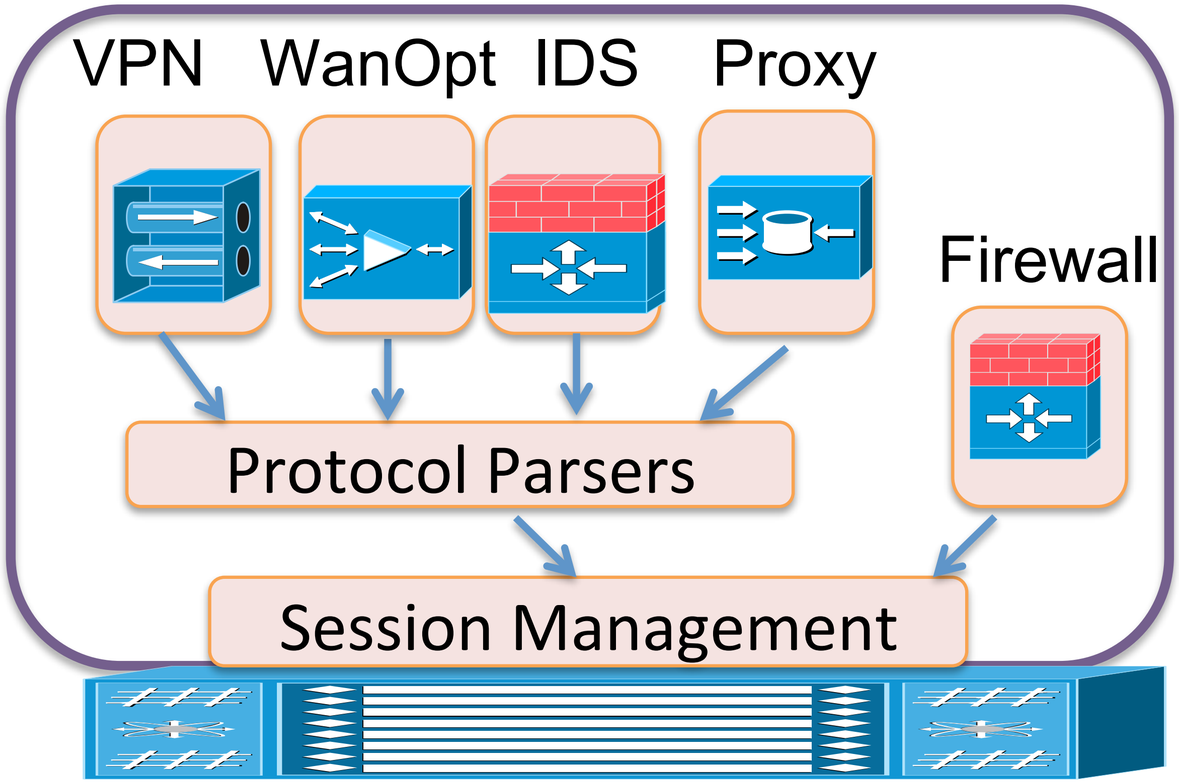
Consolidating middleboxes



Peaks aren't aligned ⇒ multiplexing can yield benefits

Design and Implementation of a Consolidated Middlebox Architecture, Usenix NSDI'12
Vyas Sekar, Norbert Egi, Sylvia Ratnasamy, Michael K. Reiter, Guangyu Shi

Consolidating middleboxes



Re-use underlying machinery: packet I/O, parsing and processing

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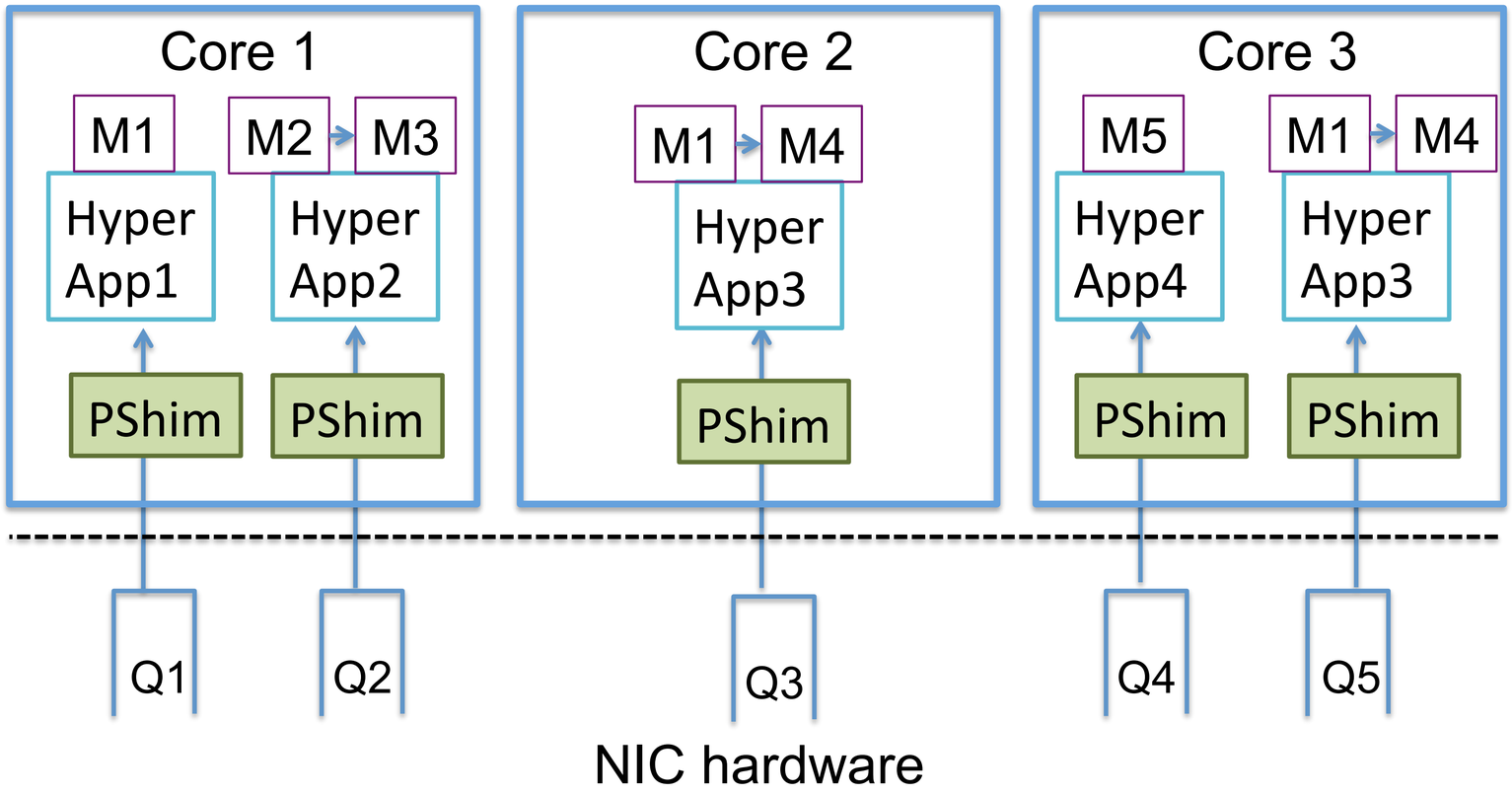

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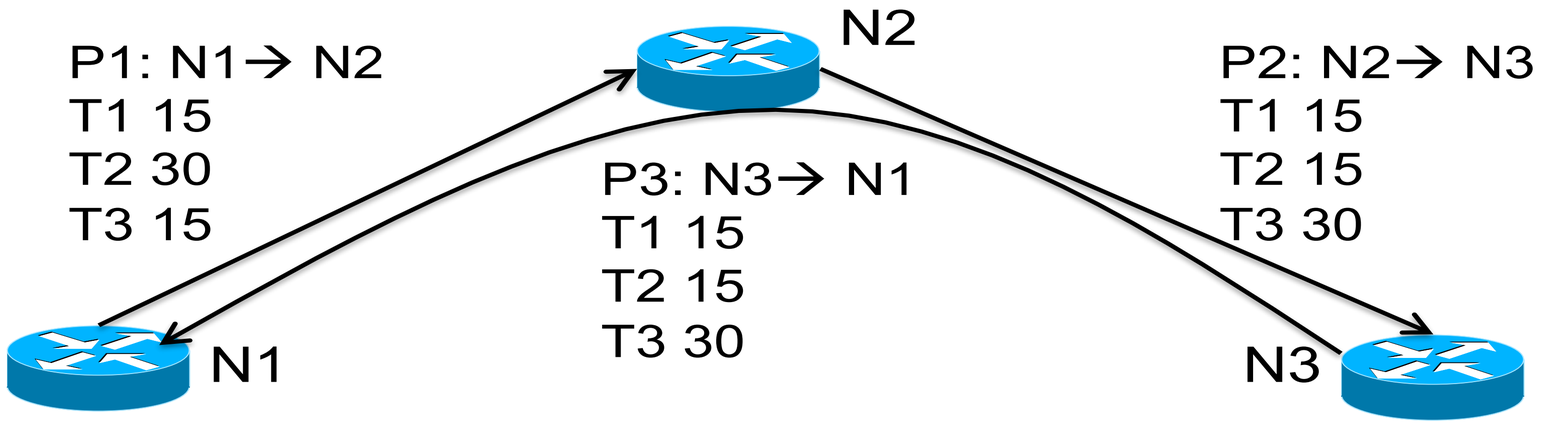
Network-wide coordination



N1's assignment

	P1	P2	P3	
T1	15	0	5	20
T2	20	0	0	20
T3	15	0	5	20

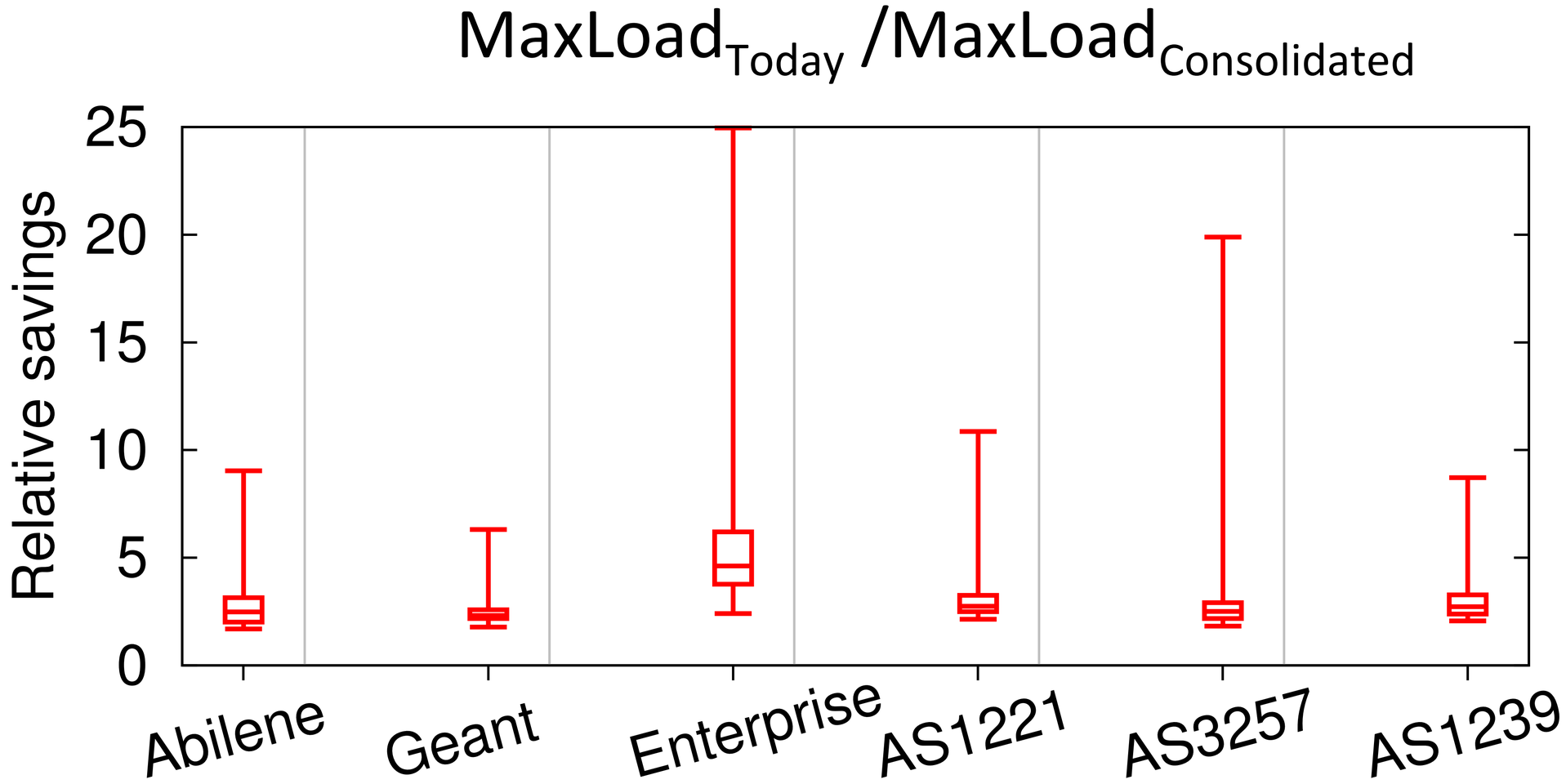
N2's assignment

	P1	P2	P3	
T1	0	15	5	20
T2	10	10	0	20
T3	0	20	0	20

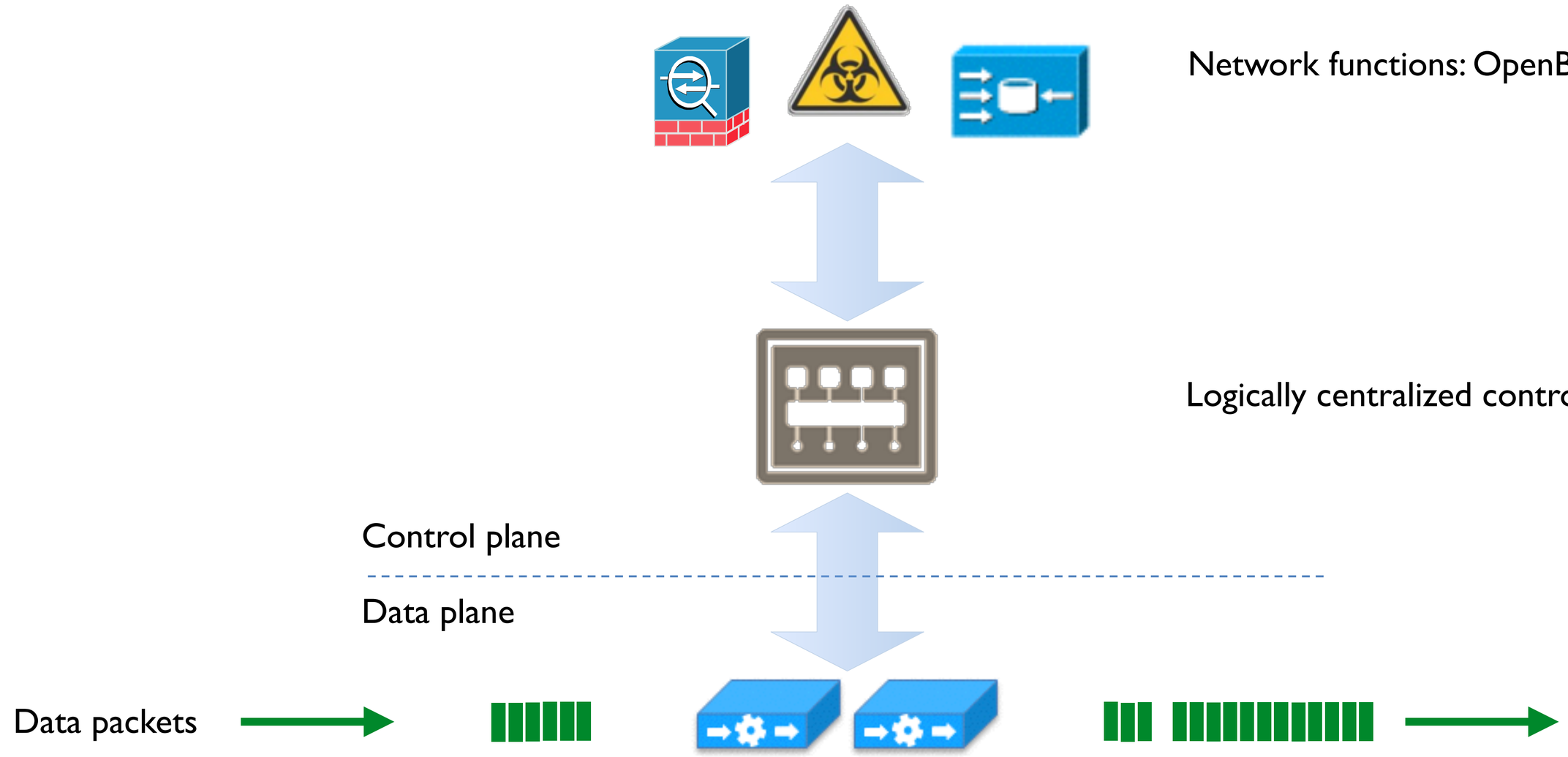
N3's assignment

	P1	P2	P3	
T1	0	0	20	20
T2	0	5	15	20
T3	0	10	10	20

Benefits of consolidation & spatial distribution



Software-defined middleboxes



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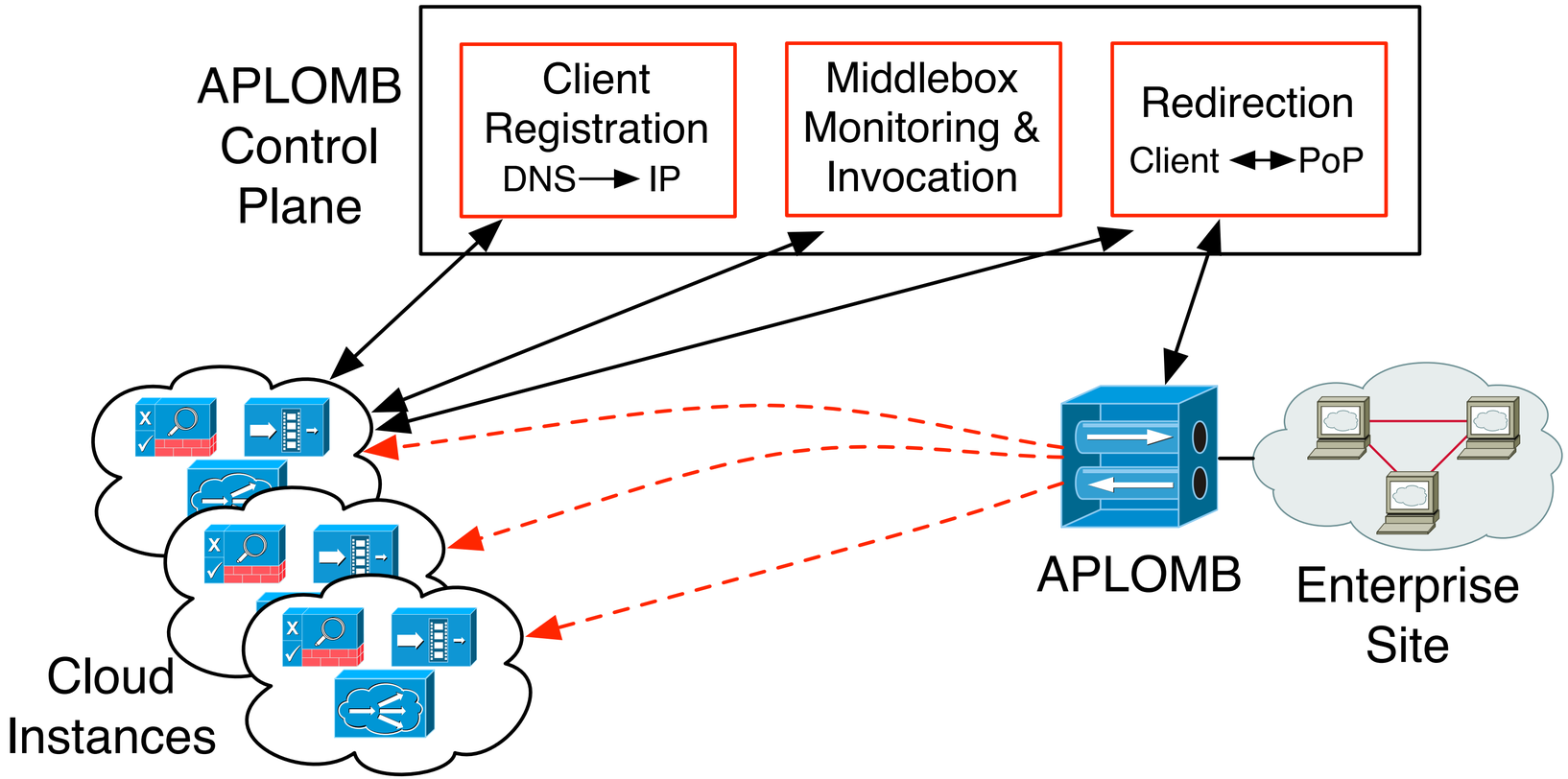
Have “the cloud” take care of it?



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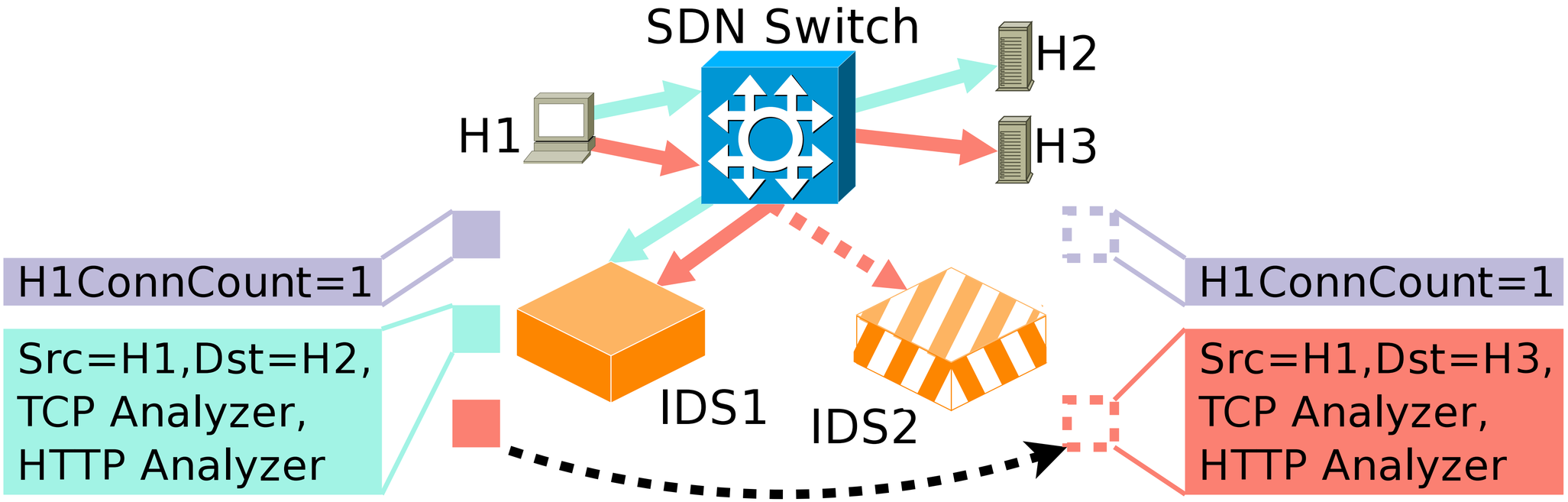
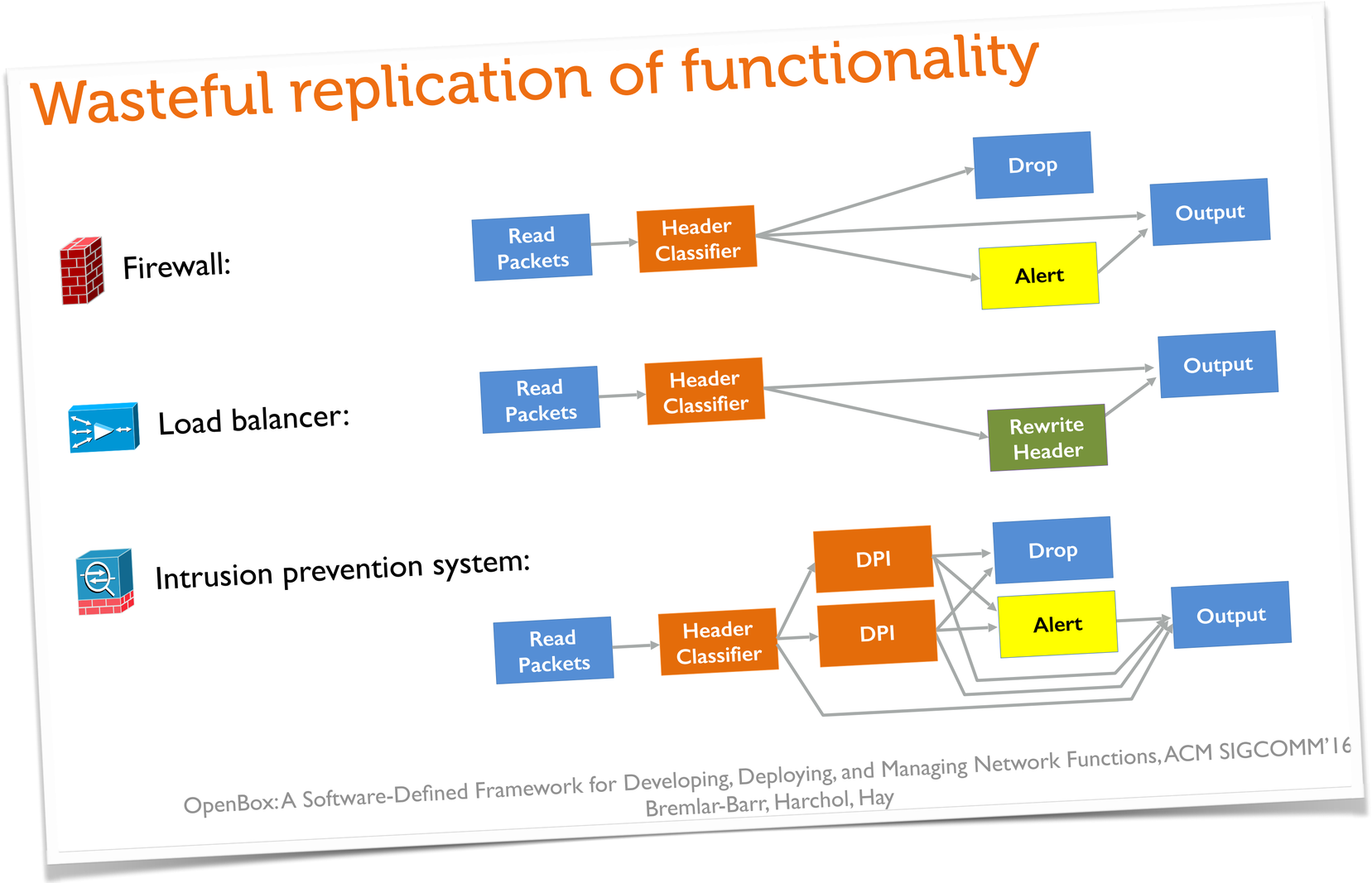
Challenge: managing NF state



Looking to the future …

Wasteful replication of functionality



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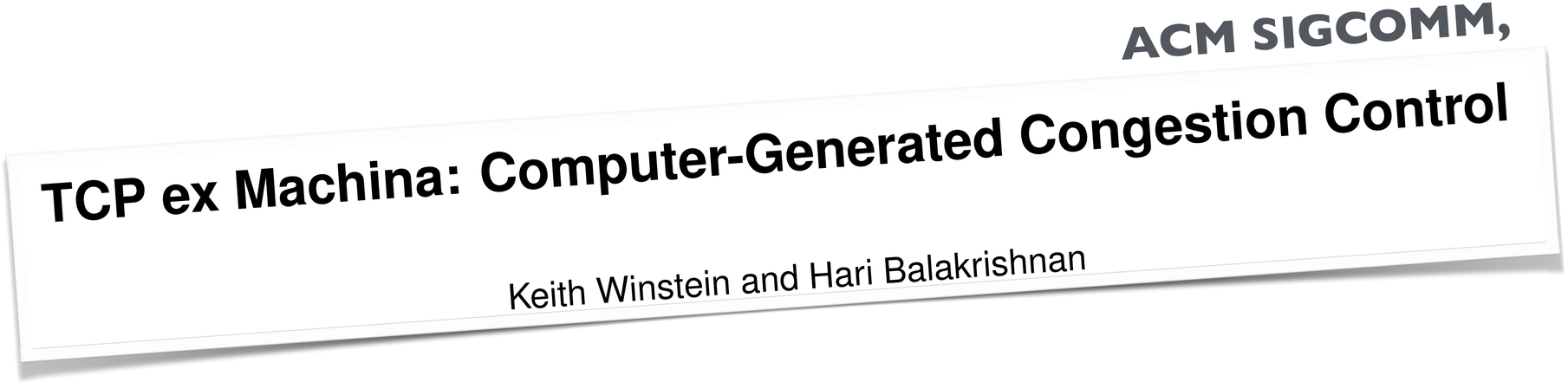
What else shares the common parts of these pipelines?

Weekly reading guide

TCP falls short. Again.



- TCP's brittle rule-action design
- Can machine-generated congestion control work?
- Control / learning approaches to CC?