Cloud Networking
Network Virtualization
Case Study : NVP

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Case Study: NVP

Network Virtualization in Multi-tenant Datacenters

Teemu Koponen, Keith Amidon, Peter Balland, Martín Casado, Anupam Chanda, Bryan Fulton, Igor Ganichev, Jesse Gross, Natasha Gude, Paul Ingram, Ethan Jackson, Andrew Lambeth, Romain Lenglet, Shih-Hao Li, Amar Padmanabhan, Justin Pettit, Ben Pfaff, and Rajiv Ramanathan, *VMware;* Scott Shenker, *International Computer Science Institute and the University of California, Berkeley;* Alan Shieh, Jeremy Stribling, Pankaj Thakkar, Dan Wendlandt, Alexander Yip, and Ronghua Zhang, *VMware*

https://www.usenix.org/conference/nsdi14/technical-sessions/presentation/koponen

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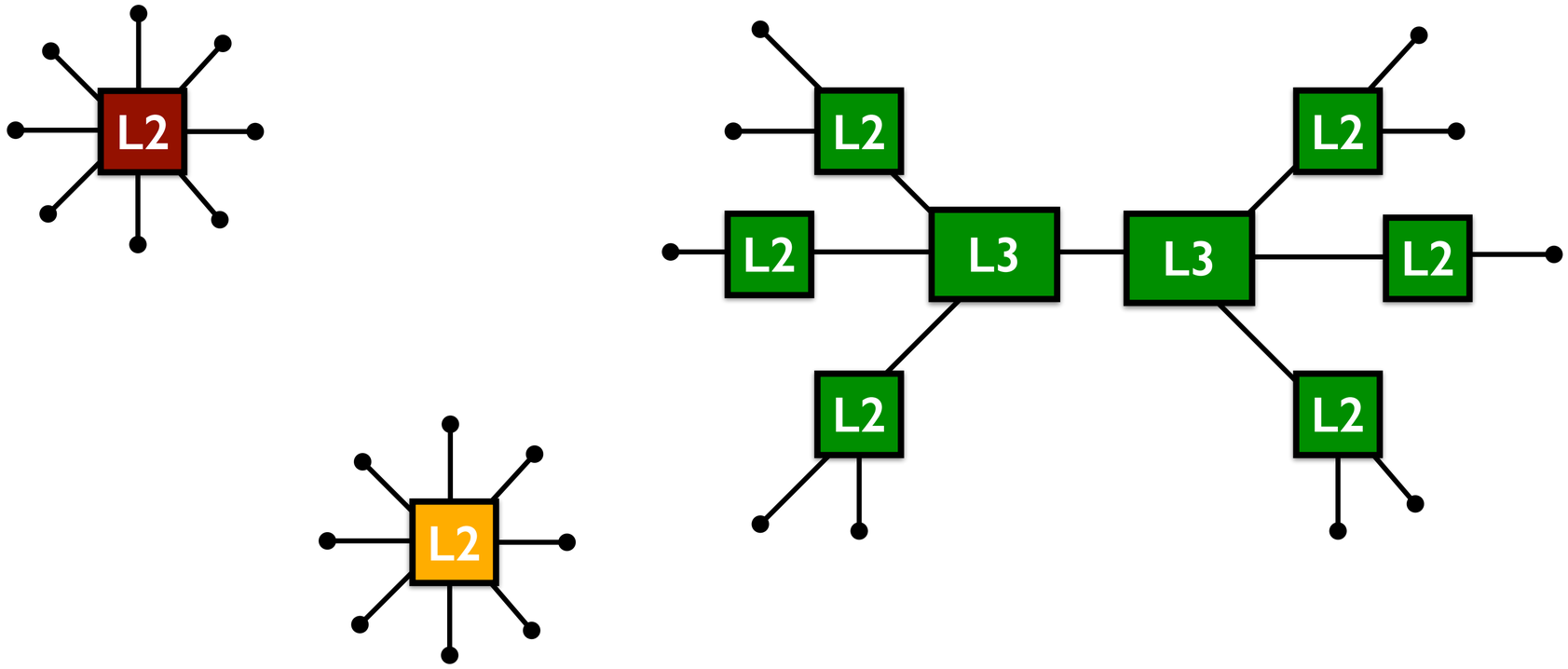
NVP Approach to Virtualization

1. Service: Arbitrary network topology



NVP Approach to Virtualization

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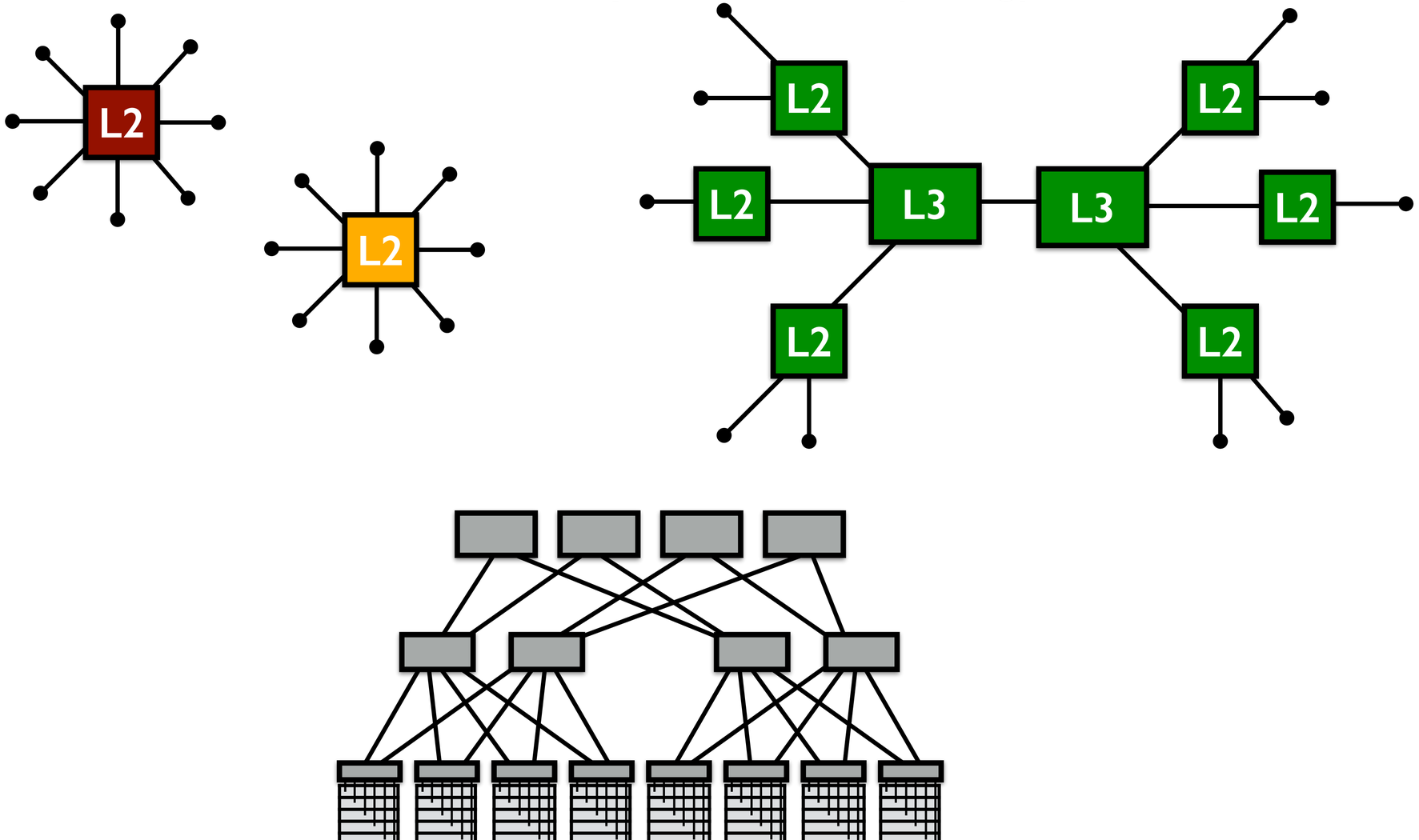
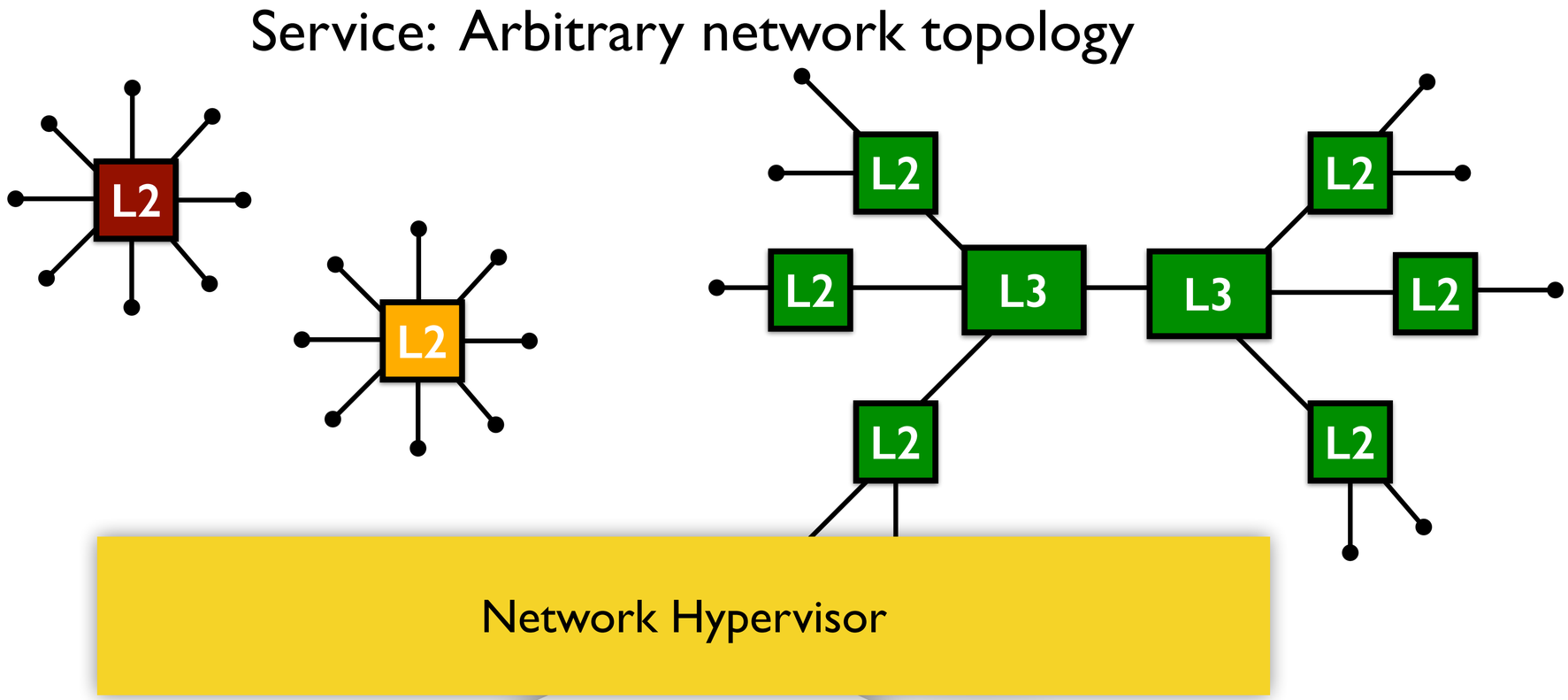


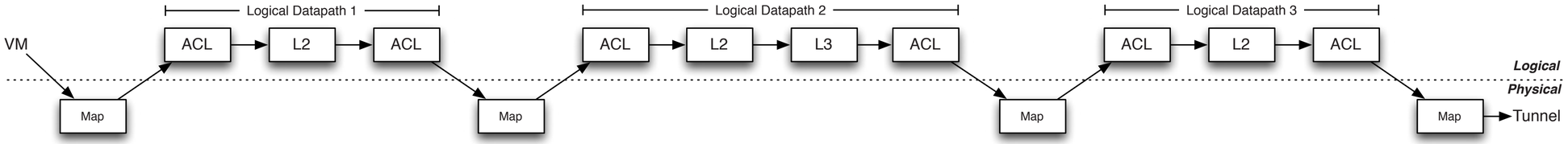
NVP Approach to Virtualization



Virtual network service

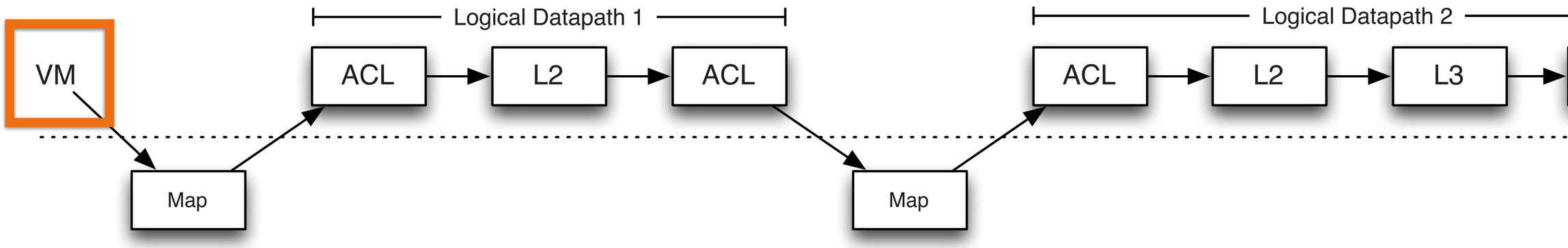
[Figure: Koponen et al.]

Virtual network service



[Figure: Koponen et al.]

Virtual network service



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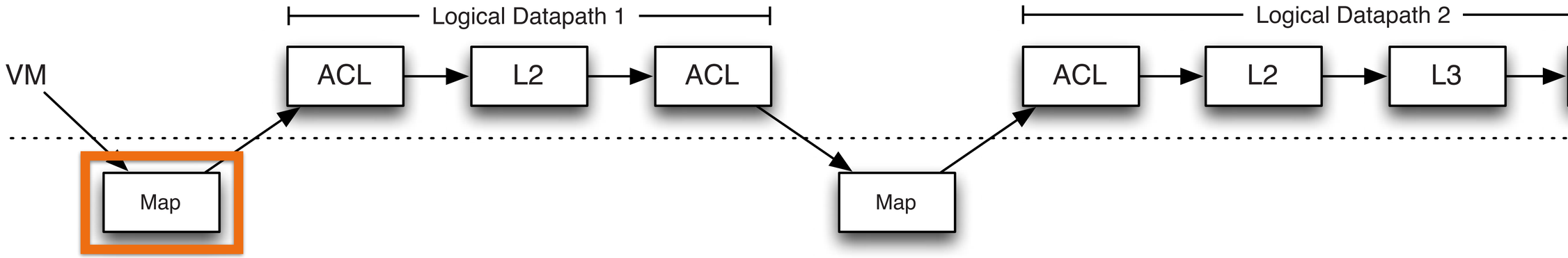

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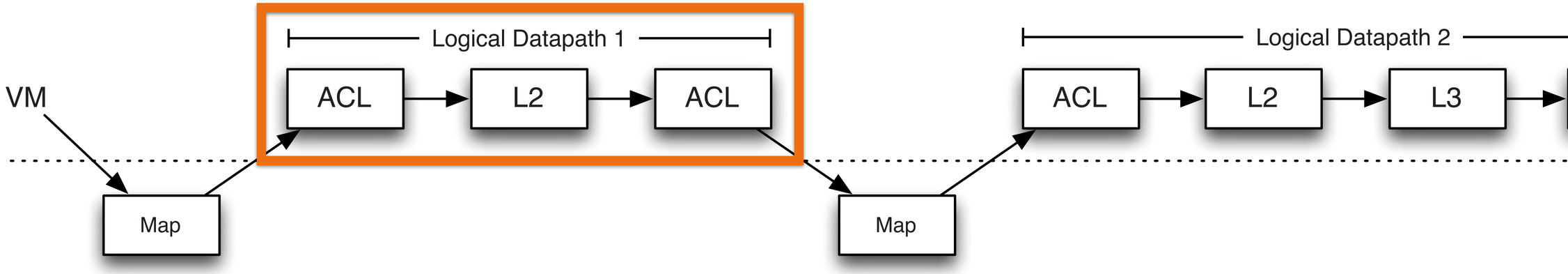

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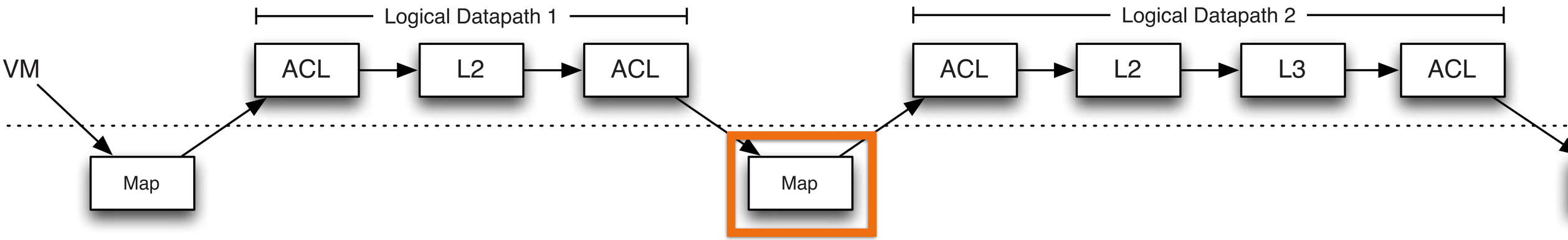

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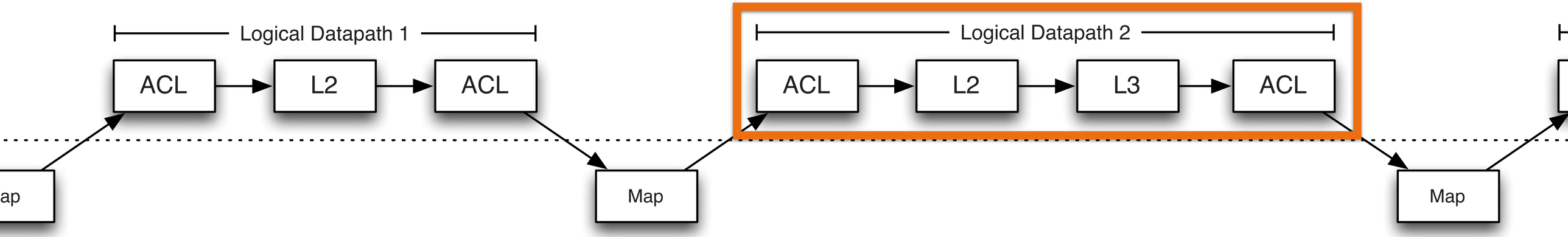

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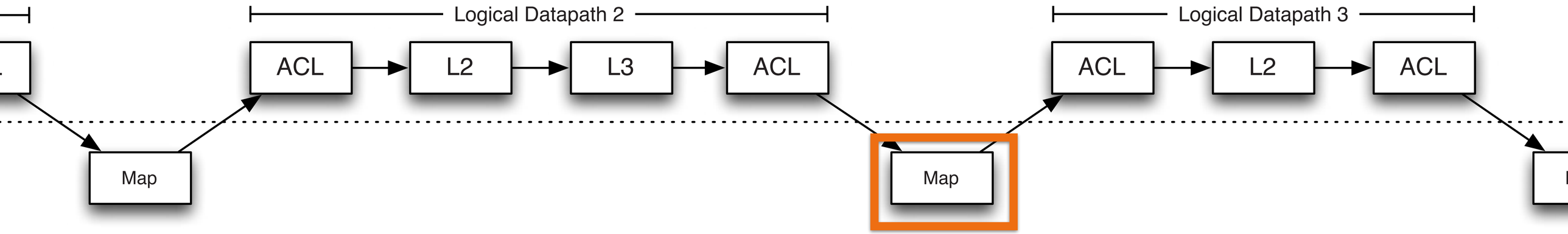

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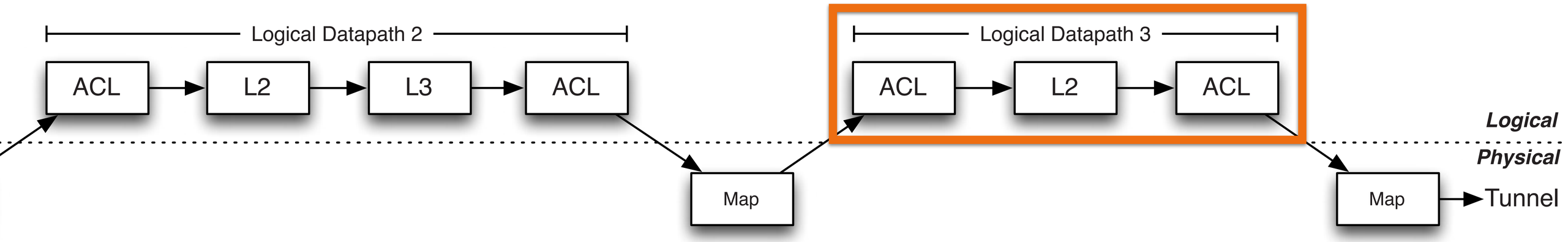

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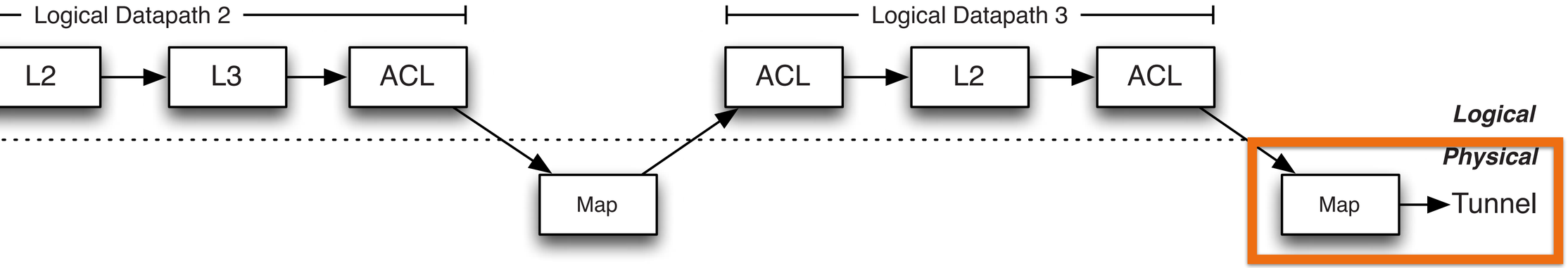
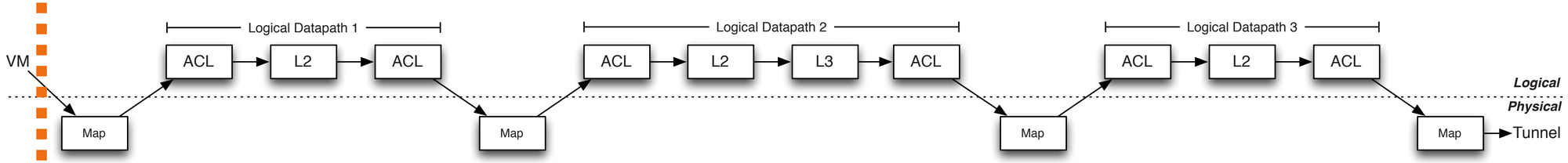


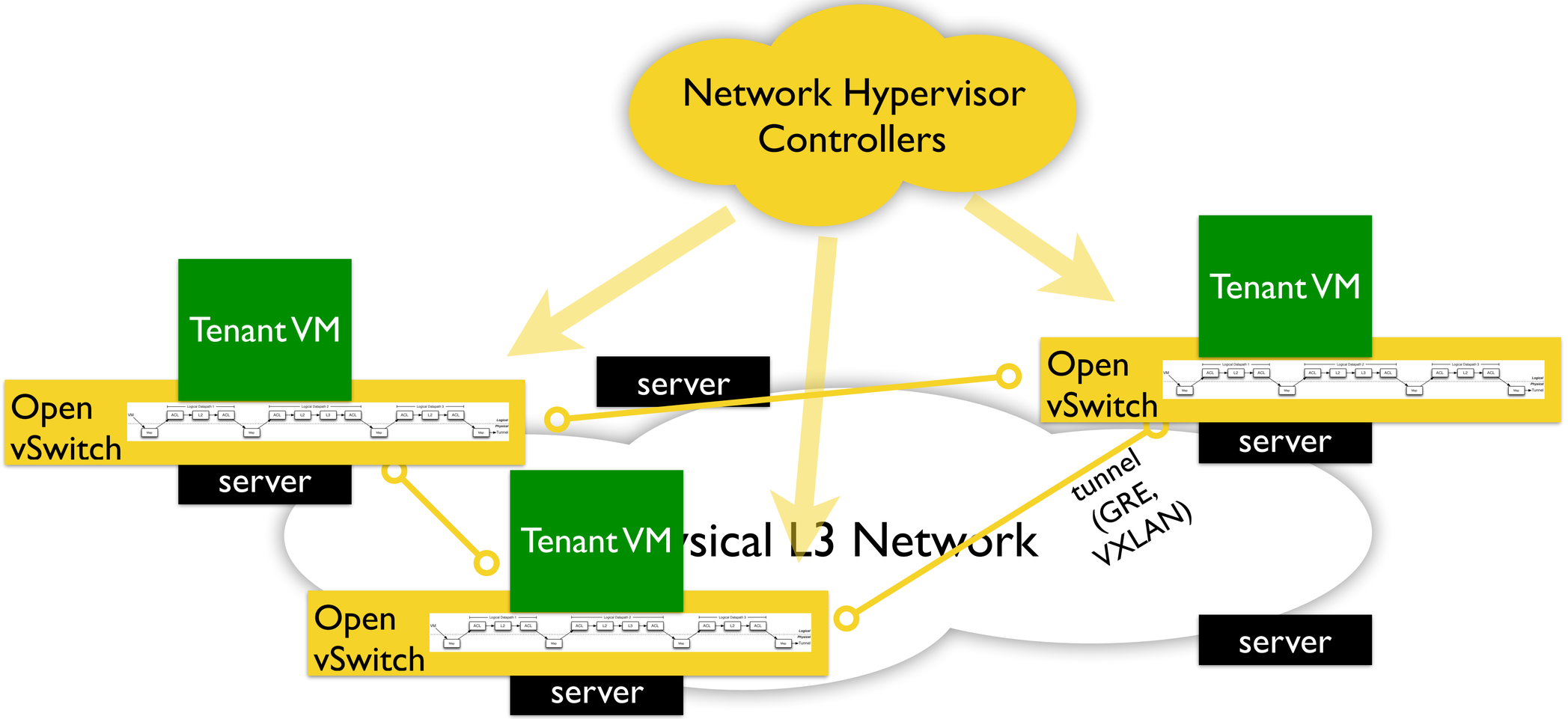
Virtual network service

Control abstraction
(sequence of OpenFlow flow tables)



Packet
abstraction

Tenant control abstraction



Challenge: Performance

Large amount of state to compute

- Full virtual network state at every host with a tenant VM!
- $O(n^2)$ tunnels for tenant with n VMs
- Solution 1: Automated incremental state computation with *nlog* declarative language
- Solution 2: Logical controller computes single set of universal flows for a tenant, translated more locally by "physical controllers"

Challenge: Performance

Pipeline processing in virtual switch can be slow

- Solution: Send first packet of a flow through the full pipeline; thereafter, put an exact-match packet entry in the kernel

Tunneling interferes with TCP Segmentation Offload (TSO)

- NIC can't see TCP outer header
- Solution: STT tunnels adds "fake" outer TCP header

discussion

SDN (my notes, do not publish)

Killer app for SDN because we needed to automate control of a dynamic, virtualized environment, wasn't well suited to past solutions

API to data plane
centralized controller
control abstractions

SDN principles come through strongly, but next week, another killer app for SDN that ends up looking very different – rather than providing arbitrary virtual networks, wide area opt.; rather than prog soft sw., more direct control of hardware. Wide area needs of cloud networking