



Hewlett Packard
Enterprise

Current Trends in SDN

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“Think of it as a general language or an instruction set that lets me write a control program for the network rather than having to rewrite all of code on each individual router,” - *Scott Shenker, a Berkley.*”

Legacy networks are holding back the full-potential

“My network is complex and it takes months to deploy applications.”

Too Complex

“Network is too static to respond to my applications .”

Too static

“ I have to manually configure each and every switch for this new application .”

Too Manual

SDN vision and strategy to enable agility & alignment

Agility

Alignment

SDN: Creating programmable networks that rapidly align to business applications

**Data center, campus
& branch automation**

**Open Standards
ecosystem**

**Reignite
innovation**

**Easily accessible
marketplace**

Coexist with brownfield

Platform for innovation

Use-case led

Automation and simplicity

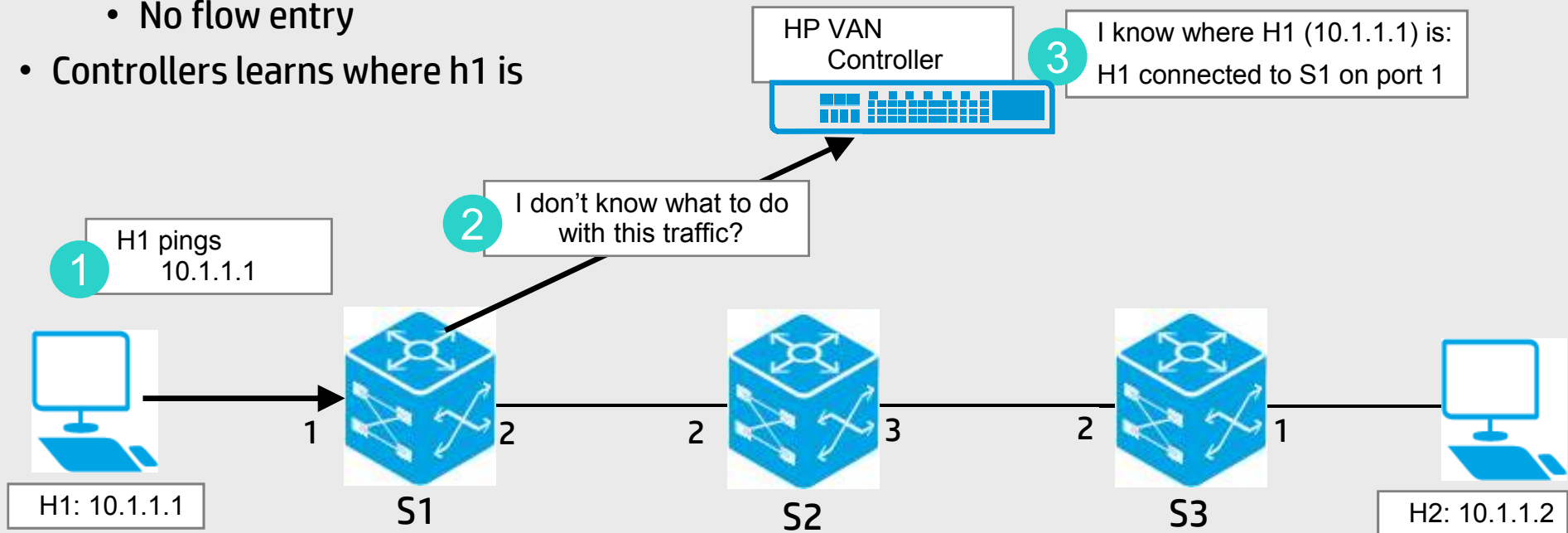


SDN Enterprise

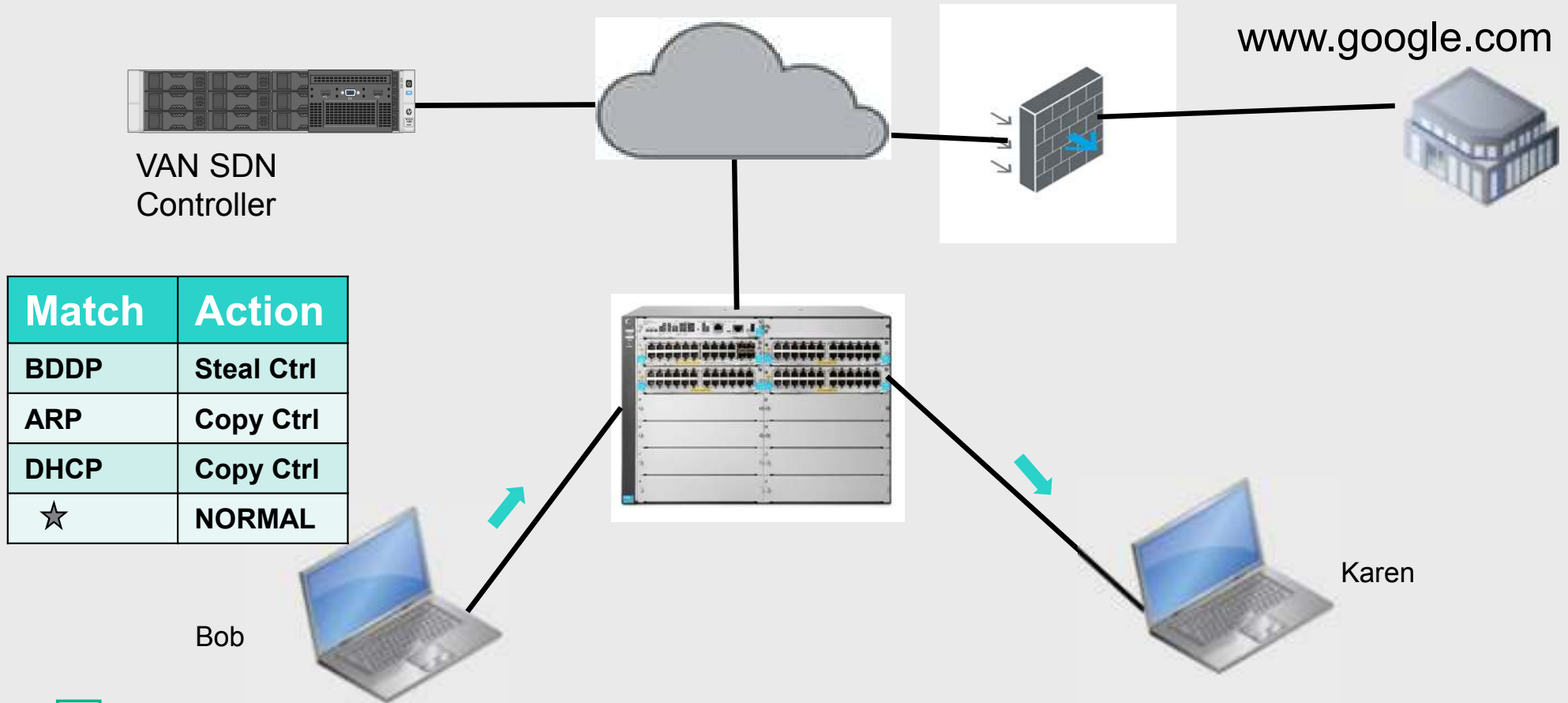
Pure OpenFlow

H1 pings H2

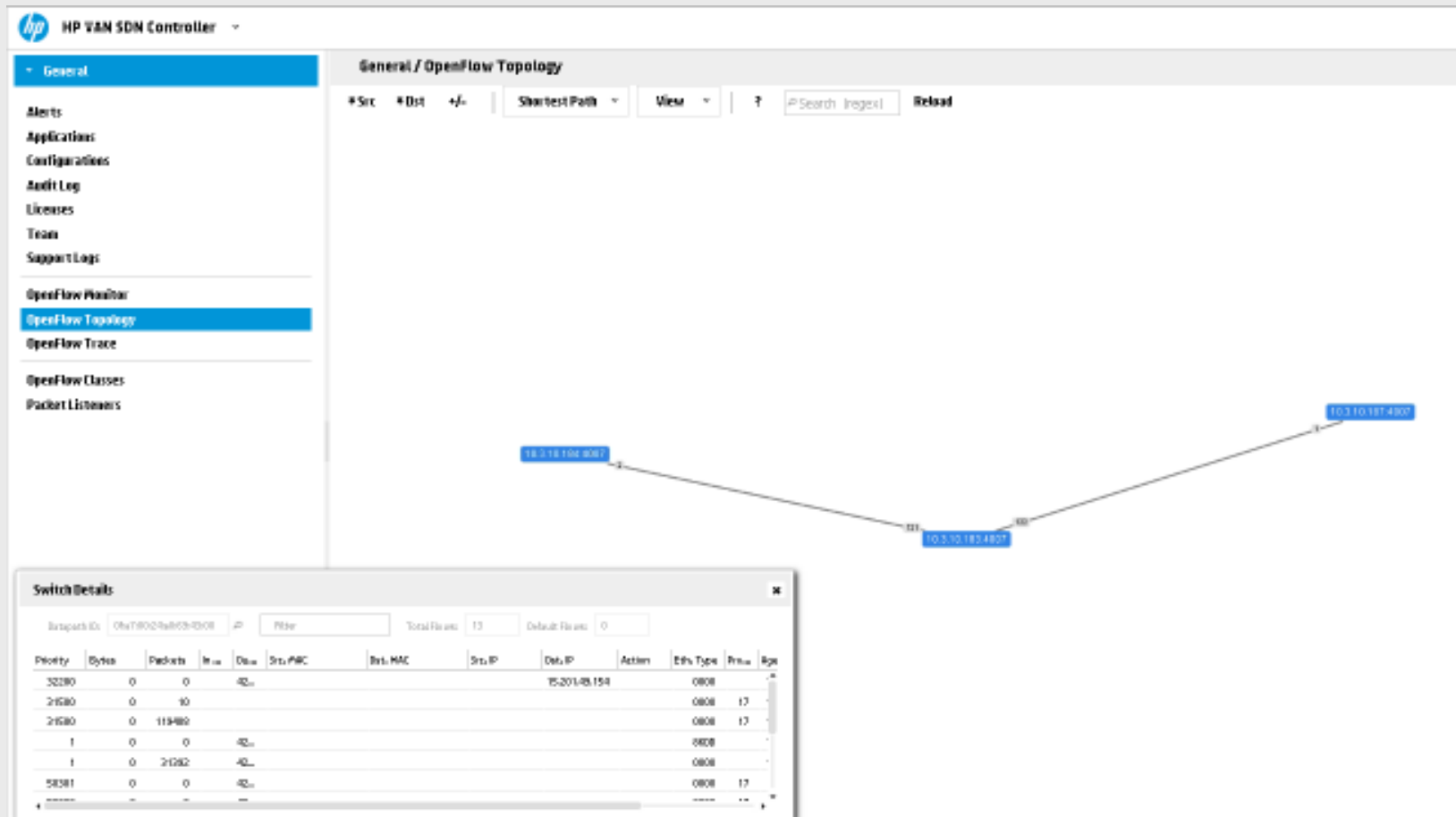
- Traffic sent to switch
- Switch forwards frame to controller
 - No flow entry
- Controller learns where h1 is



Hybrid Services – Add value today



Topology



Open Flow Monitor Continued

HP VAN SDN Controller

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sdn

General

Alerts

Applications

Configurations

Audit Log

Licenses

Team

Support Logs

OpenFlow Monitor

OpenFlow Topology

OpenFlow Trace

OpenFlow Classes

Packet Listeners

Flows for Data Path ID: 0f:a7:00:24:a8:56:0c:00

Summary

Ports

Flows

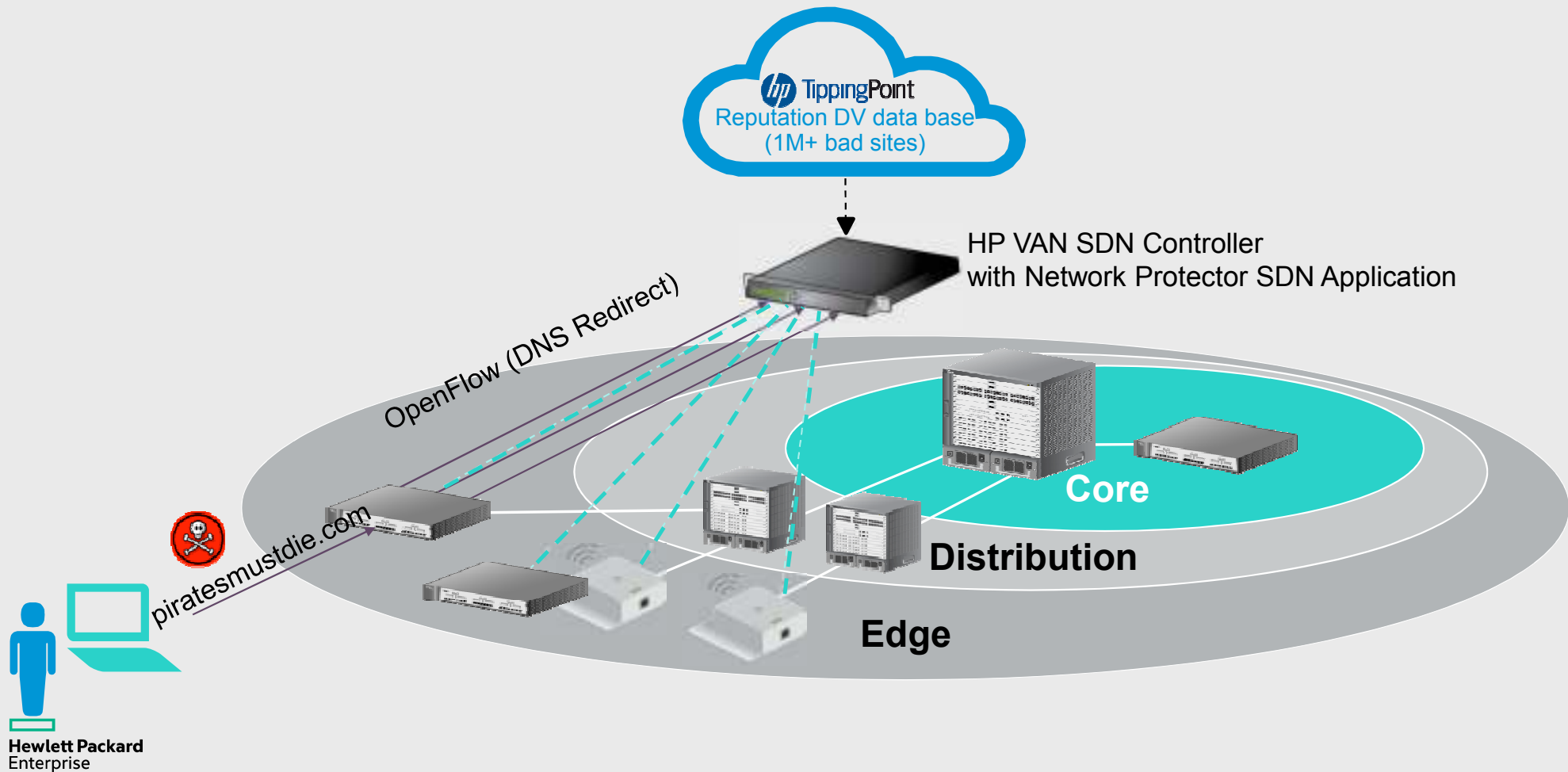
Groups

Table ID	Priority	Packets	Bytes	Match	Actions/Instructions	Flow Class ID
* 100	32200	0	0	eth_type: ipv4 ipv4_dst: 15.201.49.154	apply_actions: output: NORMAL	
* 100	31500	10	0	eth_type: ipv4 ip_proto: udp udp_src: 67 udp_dst: 68	goto_table: 200	com.hp.sdn.dhcp.copy
* 100	31500	36744	0	eth_type: ipv4 ip_proto: udp udp_src: 68 udp_dst: 67	goto_table: 200	com.hp.sdn.dhcp.copy
* 100	1	0	0	eth_type: ipv6	apply_actions: output: NORMAL	com.hp.sdn.normal
* 100	1	12423	0	eth_type: ipv4	apply_actions: output: NORMAL	com.hp.sdn.normal
* 100	50301	0	0	eth_type: ipv4 ip_proto: udp udp_dst: 53	apply_actions: output: CONTROLLER	
* 100	50300	0	0	eth_type: ipv4 ip_proto: udp udp_dst: 53	apply_actions: output: CONTROLLER	
* 100	0	26929	0		goto_table: 200	com.hp.sdn.normal
* 200	31500	10	5940	eth_type: ipv4 ip_proto: udp udp_src: 67	apply_actions: output: CONTROLLER output: NORMAL	com.hp.sdn.dhcp.copy




Enterprise SDN Apps

HP Network Protector SDN Application



Under the hood

 HP VAN SDN Controller

6 sdn

General

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Network Visualizer

Flows for Data Path ID: 01:90:00:9c:02:d5:c6:c0

					Summary	Ports	Flows	Groups
Table ID	Priority	Packets	Bytes	Match	Actions/Instructions	Flow Class ID		
0	0	0	0		goto_table: 100	com.hp.sdn.ip.normal		
100	60000	4	0	eth_type: bddp	apply_actions: output: CONTROLLER	com.hp.sdn.bddp.steal		
100	31000	4694	0	eth_type: arp	goto_table: 200	com.hp.sdn.arp.copy		
100	31500	0	0	eth_type: ipv4 ip_proto: udp udp_src: 67 udp_dst: 68	goto_table: 200	com.hp.sdn.dhcp.copy		
100	31500	0	0	eth_type: ipv4 ip_proto: udp udp_src: 68 udp_dst: 67	goto_table: 200	com.hp.sdn.dhcp.copy		
100	50300	1551	0	eth_type: ipv4 ip_proto: udp udp_dst: 53	apply_actions: output: 100664155			

Automating policy for enterprise networks

HP Network Optimizer SDN application



- Enhanced user experience
- Simplified policy deployment
- Dynamic traffic prioritization based on user/device
- Application integration ready



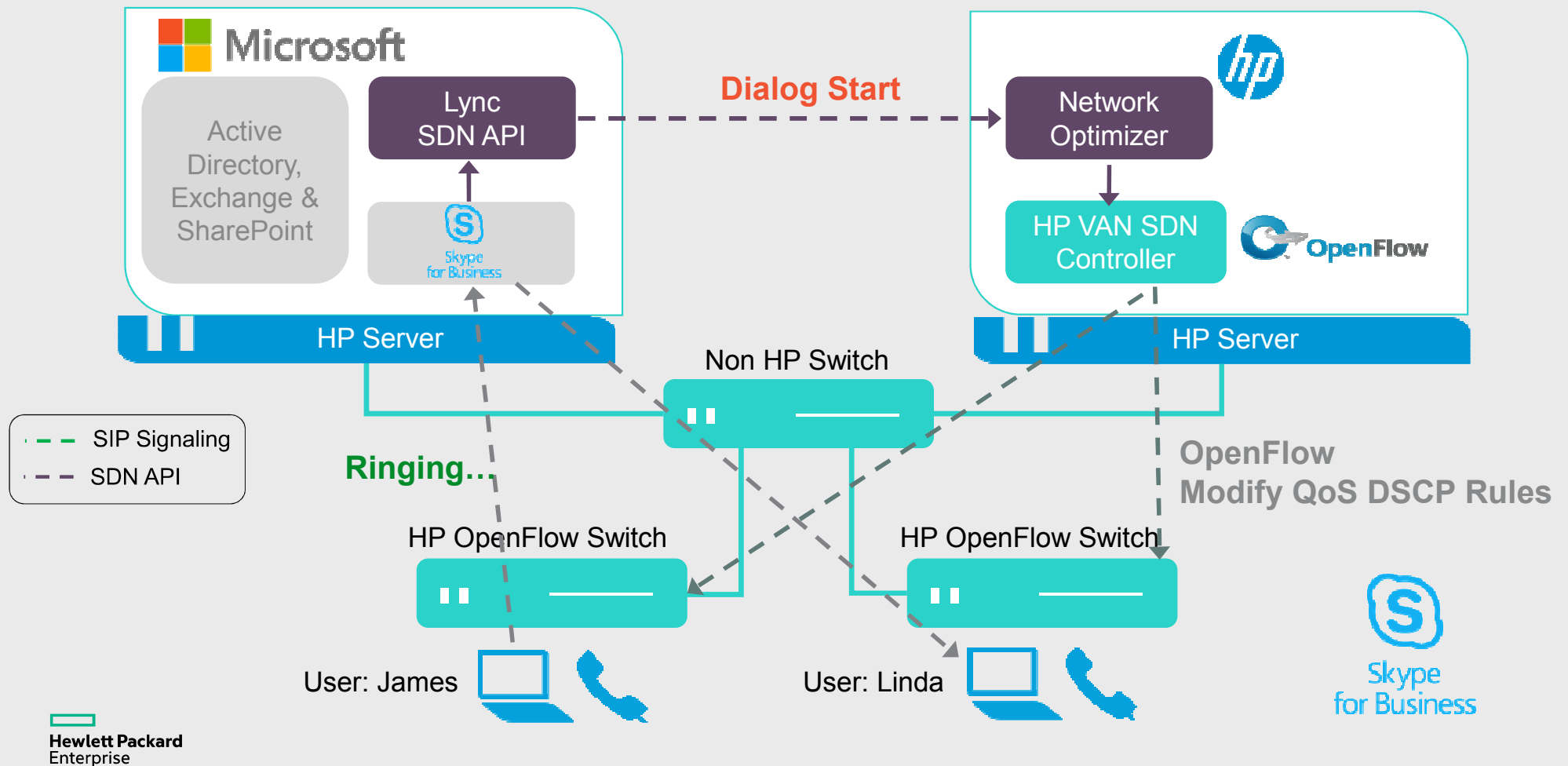
80% reduction
in complexity¹

270%
improvement
in call quality¹

40%
improvement in
S4B quality²

1. Internal calculations
2. Dellipon college case study
Hewlett-Packard
Enterprise

HP Network Optimizer SDN App– S4B



Instant troubleshooting

HP Network Visualizer SDN application

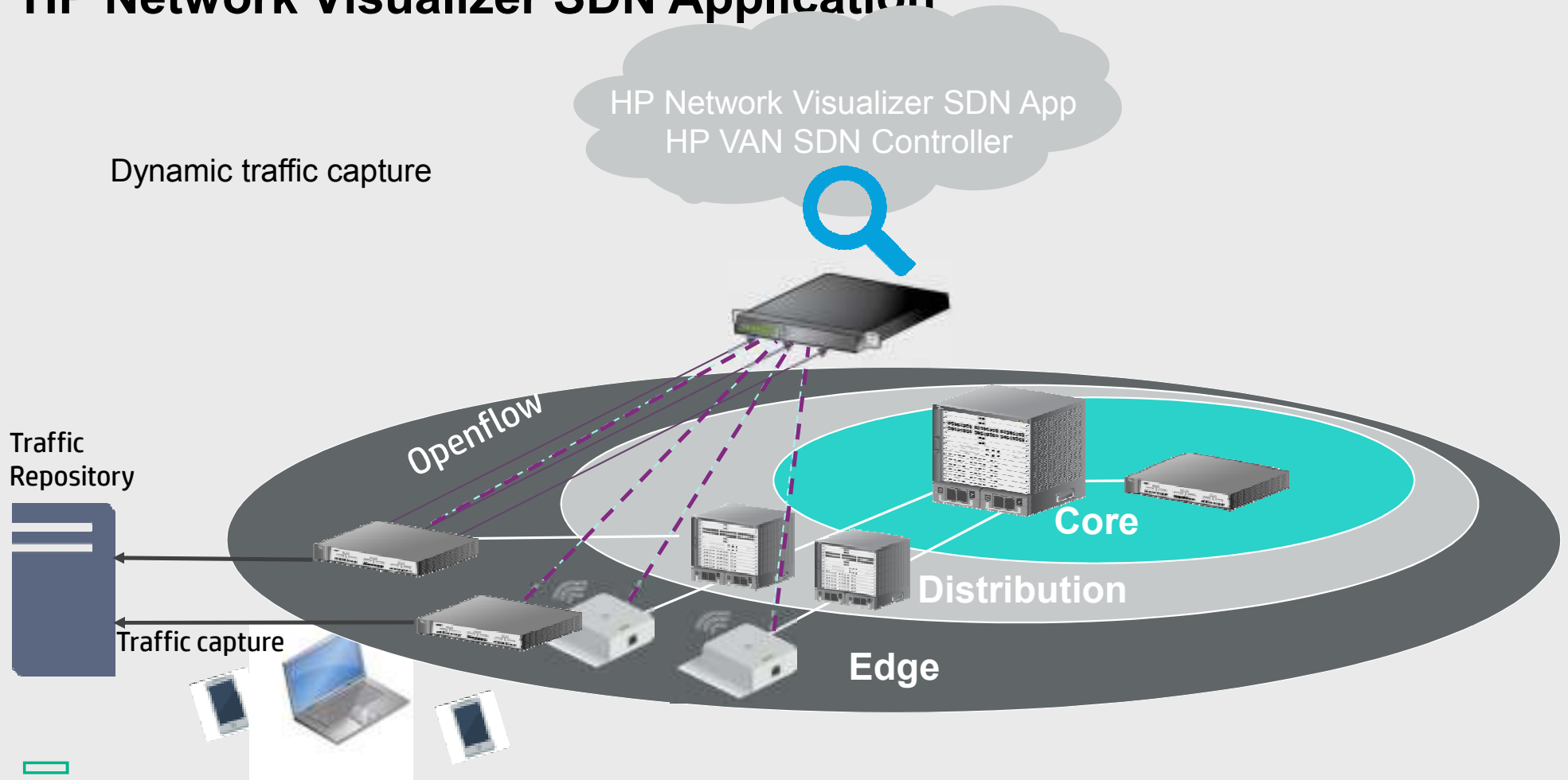


- Solve help desk issues in a matter of seconds vs minutes
- Real-time visibility and diagnosis
- Simple & automated troubleshooting requiring low level network detail
- Proactively monitor the network to reduce the number of help desk issues

40X Cost saving for network diagnostics¹

¹ Internal calculations
Hewlett Packard
Enterprise

HP Network Visualizer SDN Application

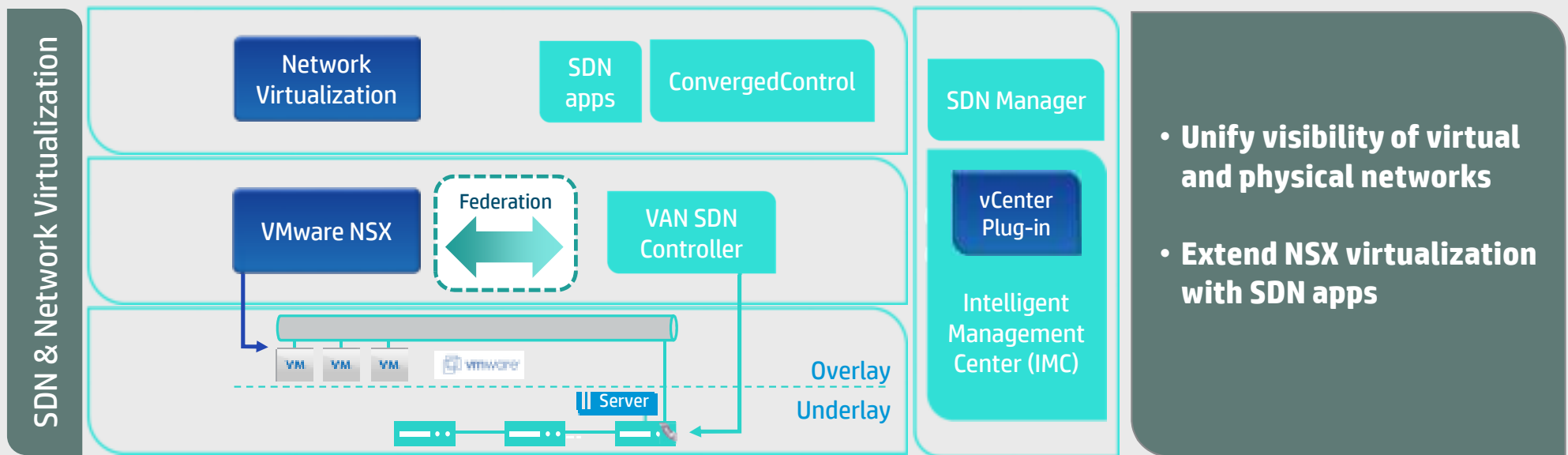




Interesting Projects

Controller Federation

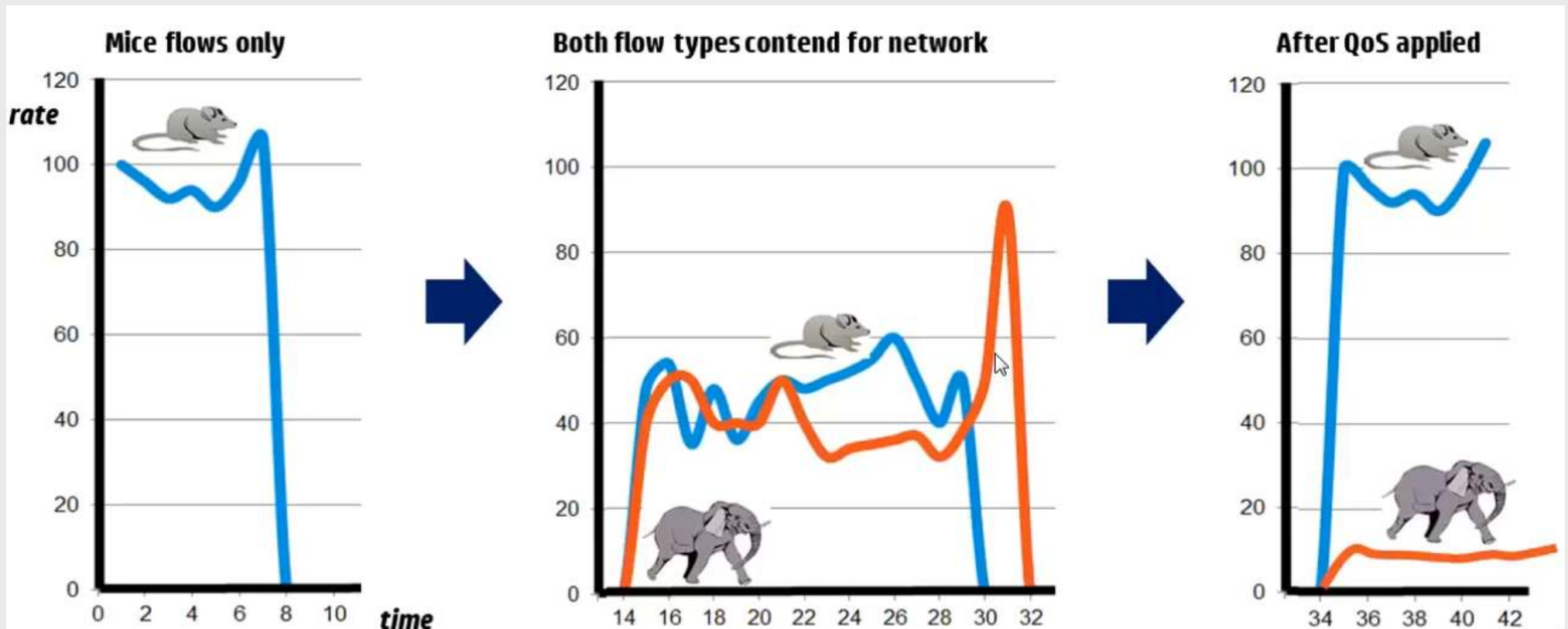
HPE and VMWare -- Open, interoperable solution unifying physical and virtual



https://www.youtube.com/watch?v=NcQq1Og_d9s

Technical Proof Point - Underlay & Overlay Control

– Elephant Flow Quality of Service



Enterprise

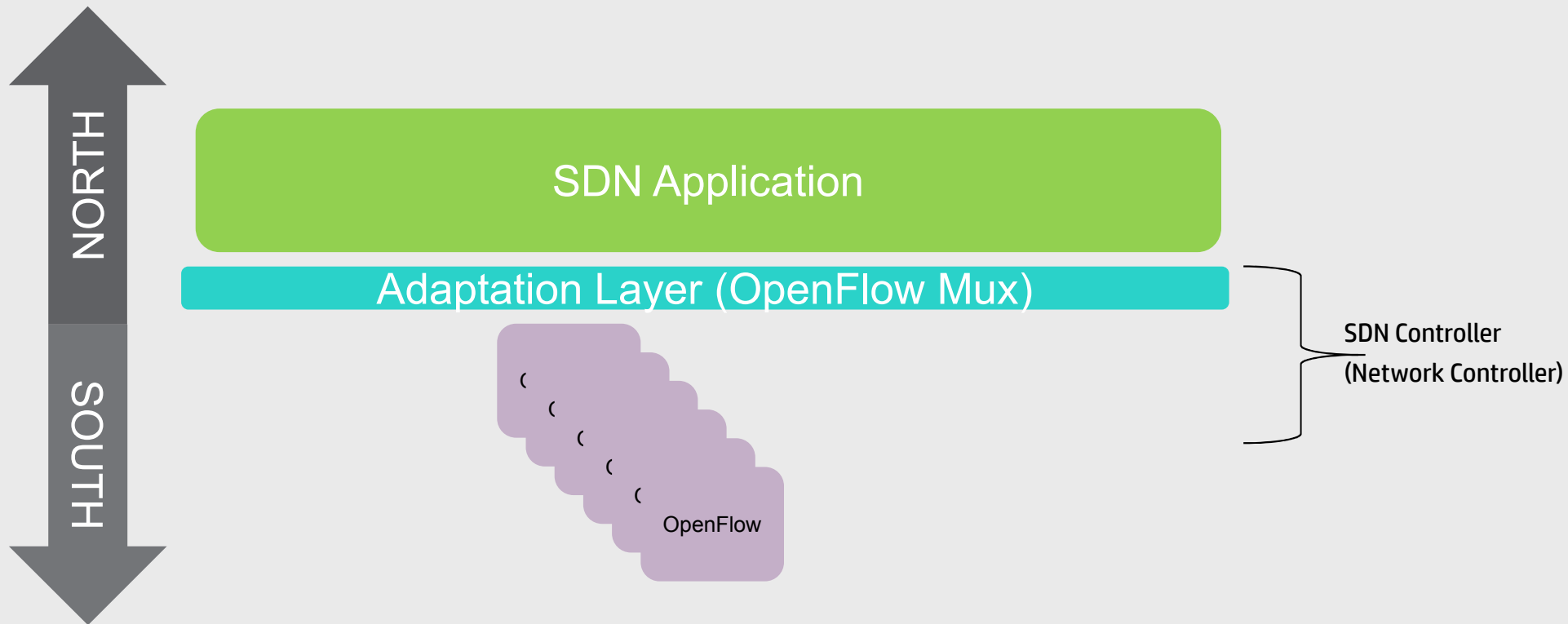
<https://blogs.vmware.com/networkvirtualization/2014/02/elephant-flow-mitigation.html>



What's Next

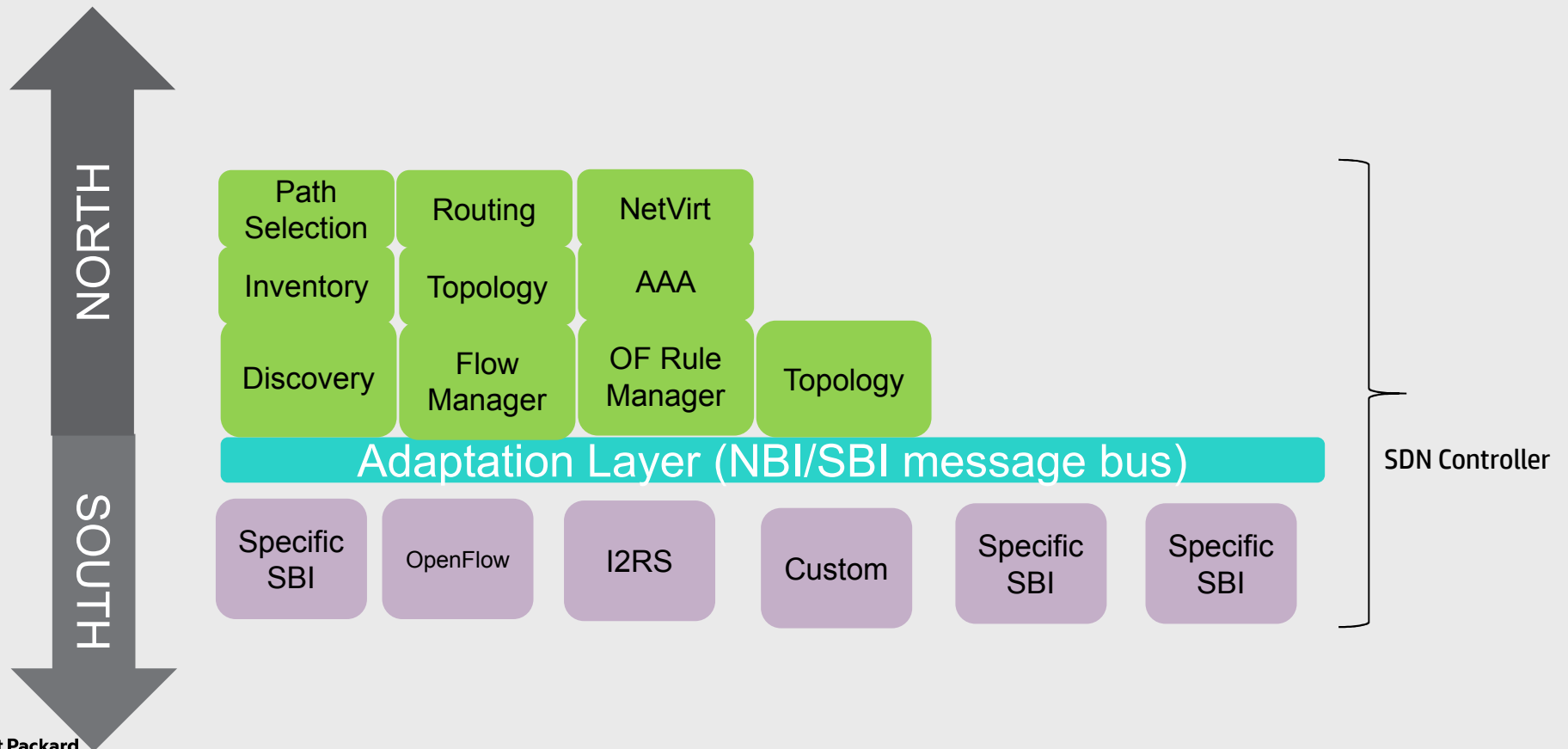
SDN 1.X

OpenFlow == Assembly Language, switch is a flow table.



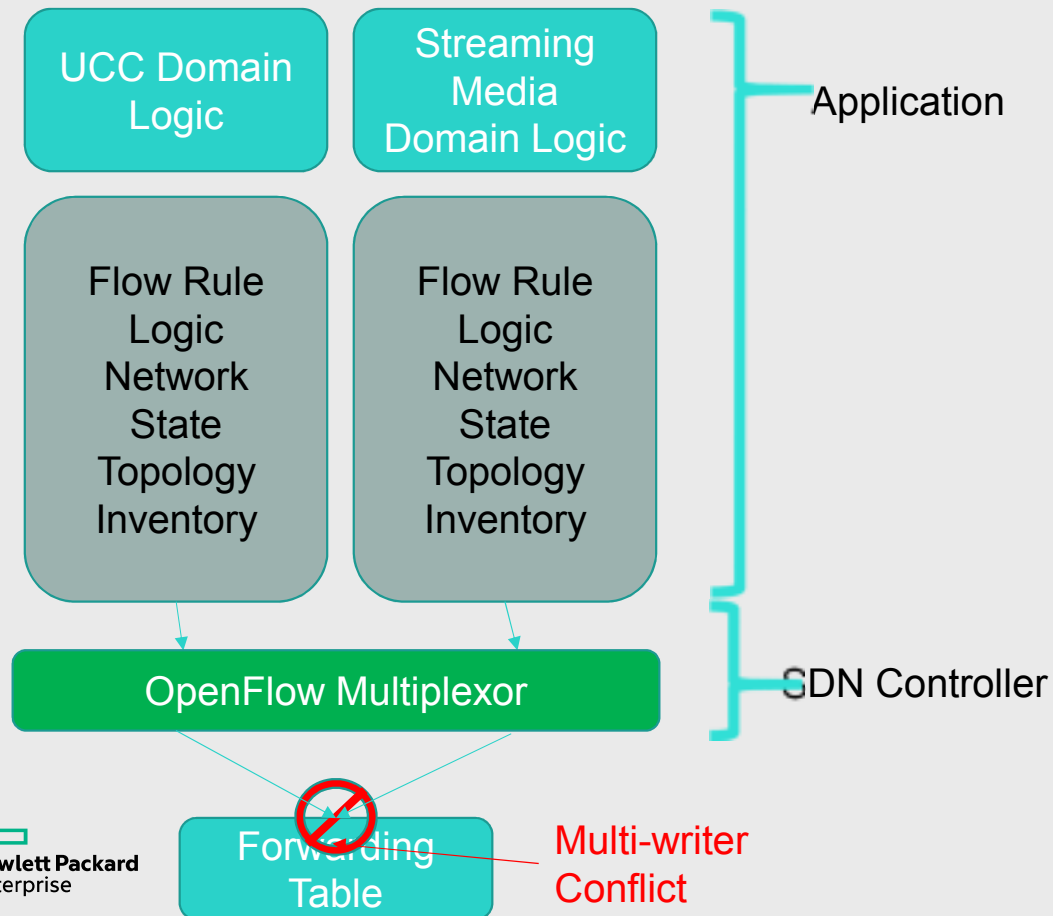
SDN 2.0 - SDK

Allow Software Engineers to program the network, Way too late to try to standardize



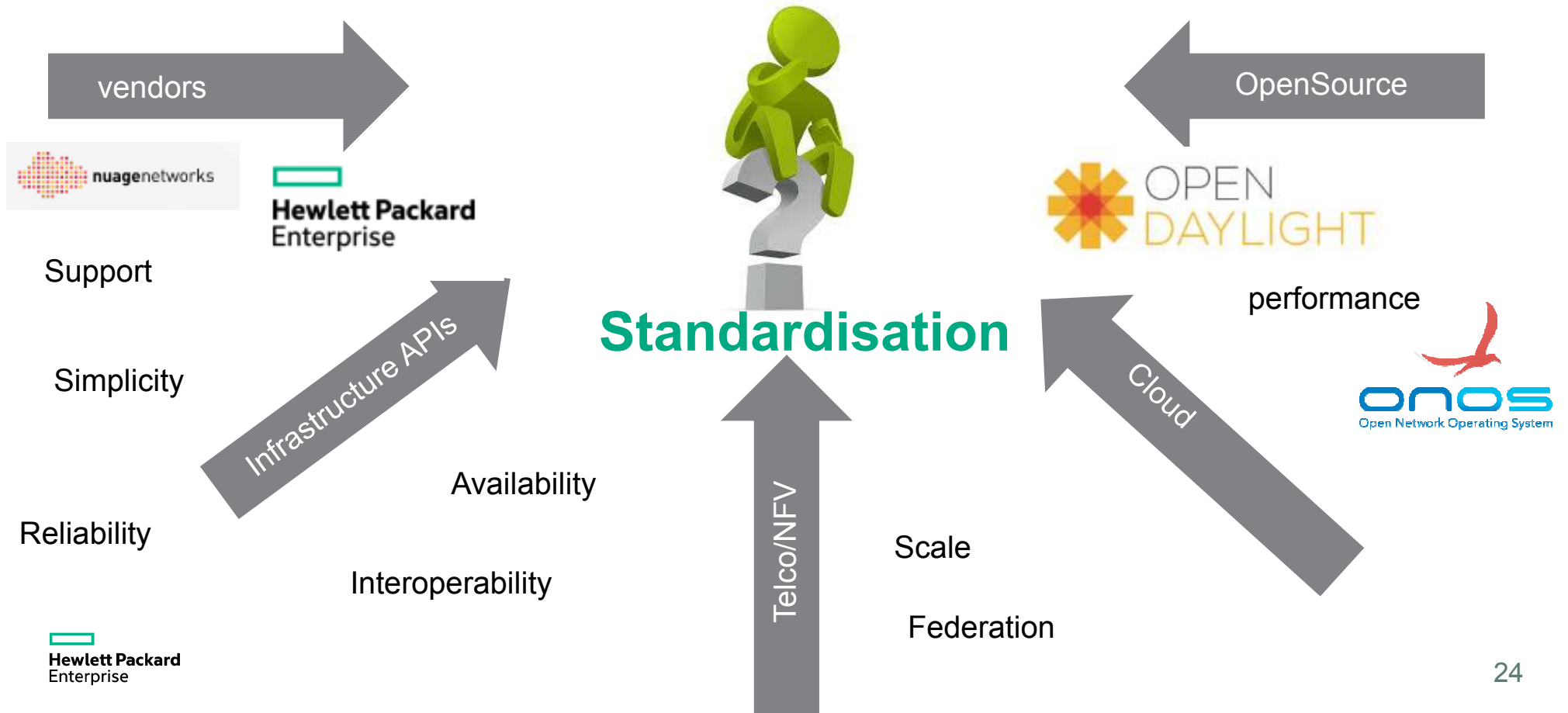
Solving the Multi-Writer Problem

SDN Apps that render openflow



Evolution of SDN

Controller less, Single Controller, Multi controller



Project Boulder - Intent

- Intent-based portability across different controller platform solutions.
- Providing a layer that shields application developers from all of the specifics of controller implementations,
- Encouraging the development of an ecosystem across different domains of the network.
- Boulder can work closely with other open source ecosystem parts include OpenDaylight, ONOS, and OpenStack.
- HP (Dave Lemrow) chairman of the northbound Interface Working Group in the ONF and on the technical steering committees of OpenDaylight and OPNFV
- [opendaylight.org](https://opendaylight.incubator.apache.org/) repository

"Don't tell me what to do. Tell me what you need."

Intent Defined and Positioned

- Intent: “what”, not “how”
- Intent as the “universal language”
- Intent is *dynamic*, but *invariant* in expression
- Intent is *portable*
- Intent is *compose-able*
- Intent is scale-able
- Intent brings *context*
- Intent has a small attack surface.

Over-prescription yields fewer solution choices



Intent versus Prescription

Intent

- What I want, not how to do it
- Portable, independent of protocol, vendor, media, etc.
- “I want my headache to stop”
- “Bob is allowed to access the internet”
- “Please cut my lawn”
- Use only secure transit networks

Prescription

- How to do it (Commands, rules, settings)
- Non-portable, dependent on protocol, vendor, media, etc.
- “Give me two aspirin”
- “Send packets matching this 5-tuple out port 11”
- “Take mower out of truck, fill gas and oil, pull starter cord, push onto lawn, ...”
- Don’t send packets across network X or Y

Further Defining Intent: Intent + Mappings = Recipe

Intent Mappings (Not Portable)

- Devices
- Protocols
- Vendors
- Interfaces
- Addresses
- OSI Layers
- Locations
- 5-tuples
- 12-tuples
- Physical interfaces

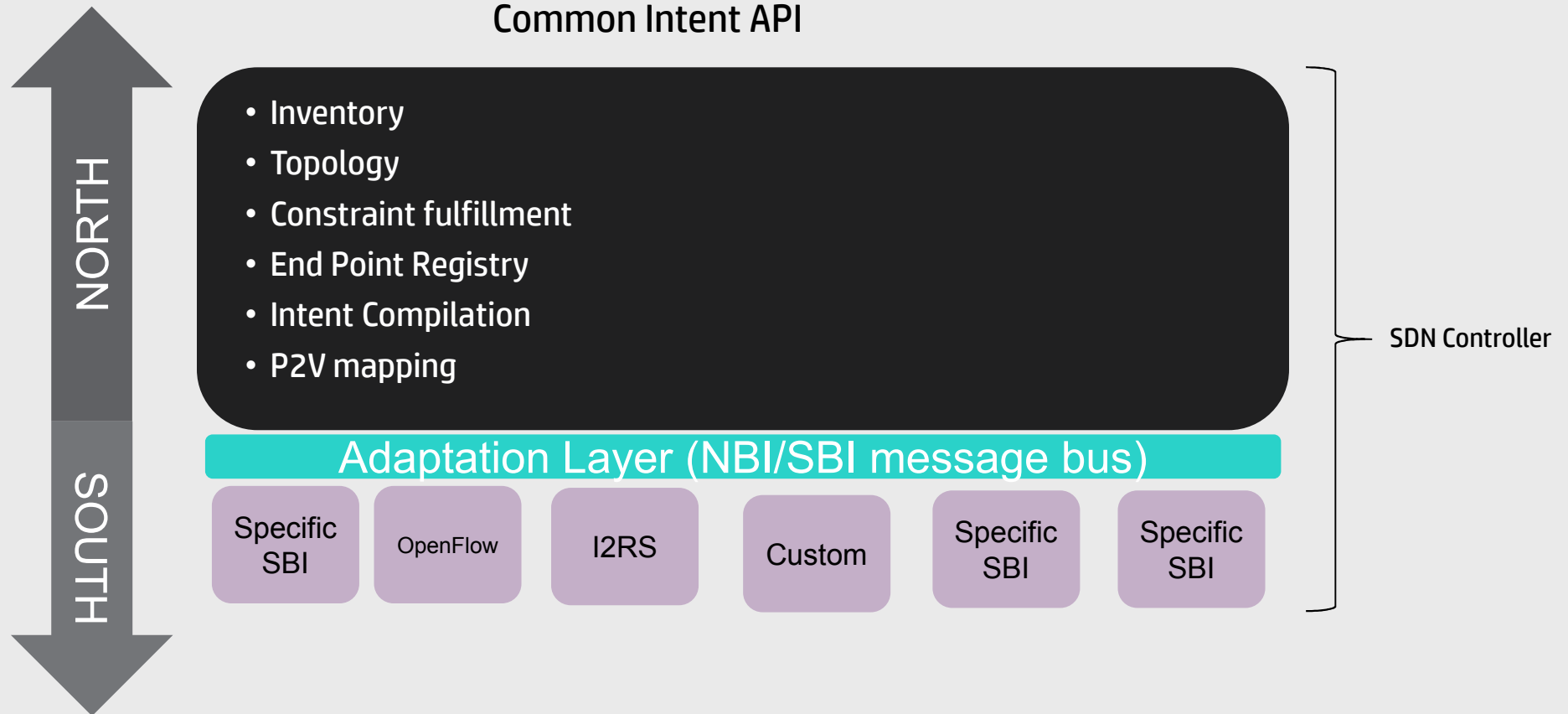
Intent (Portable)

- Relationships between end point groups
- Labels (to lookup in mapping service)
- Intent verbs (allow, redirect, block)
- Intent constraints (QoS, isolation, safe-DNS, DDOS-safe)

SDN 3.0 – Intent API driven Black Box

Greenfield, Allow millions to “program the network”

Common Intent API



Intent is where the battle for 'de facto' API will be fought

Huge interest in vendor and operator communities

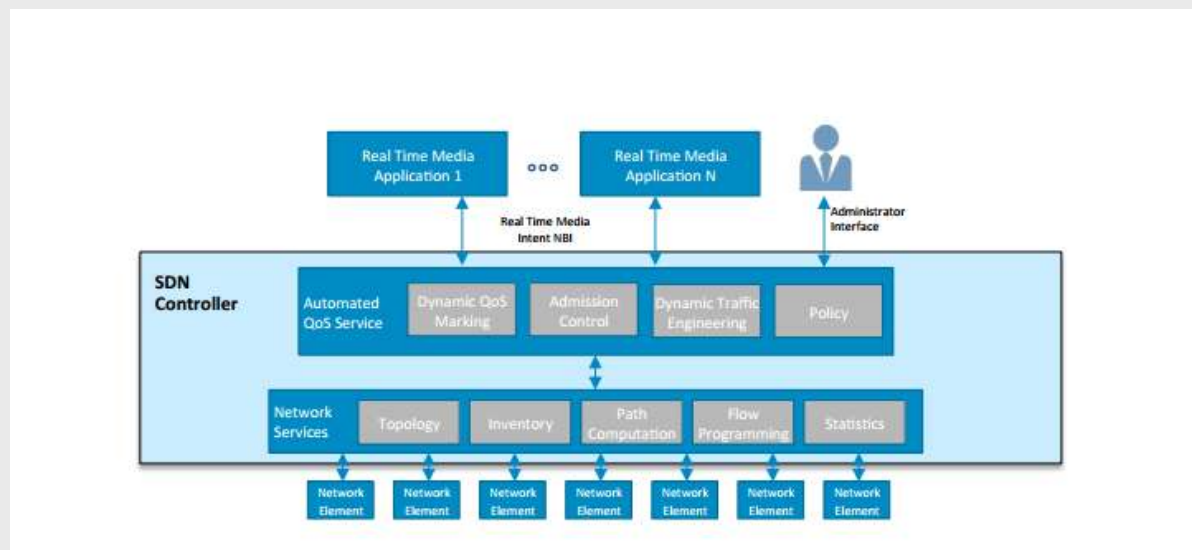
- Intent Value Proposition
 - Ease of Use
 - Portability
 - Composability
 - Scalability
- End of vendor lock era.
- Intent is a greenfield. Other NBI's already diverged.
- Risk of gaming system
 - Lock in a syntax that favors my product design

Project Aspen- automation in interactive media communications

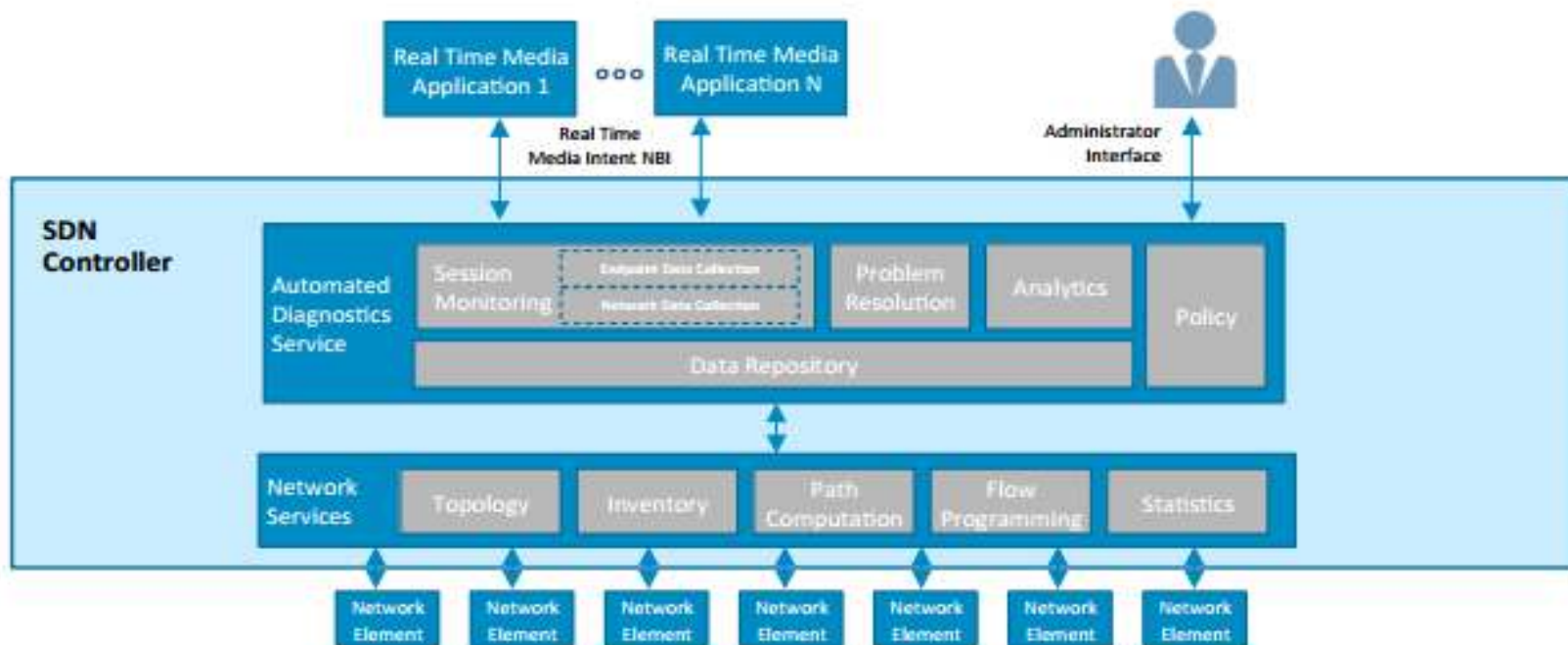
- Real-time media applications, programming the network.
- Leveraging different modules to provide 360 feedback loop
- Align to Boulder framework
- Develop committee to drive innovation

Microsoft SDN API + HP Network Optimizer

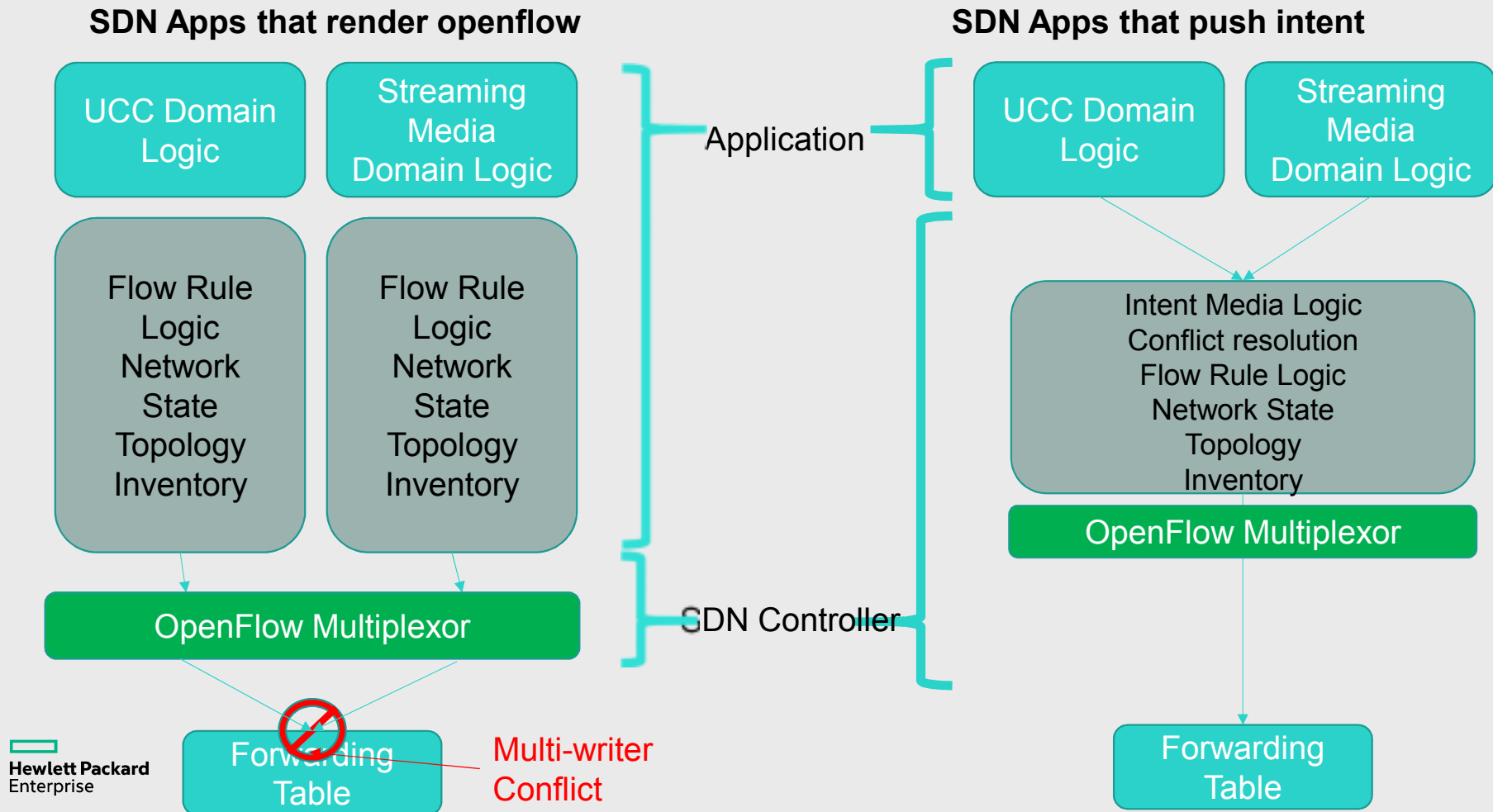
Aspen - QoS



Aspen - Diagnostics



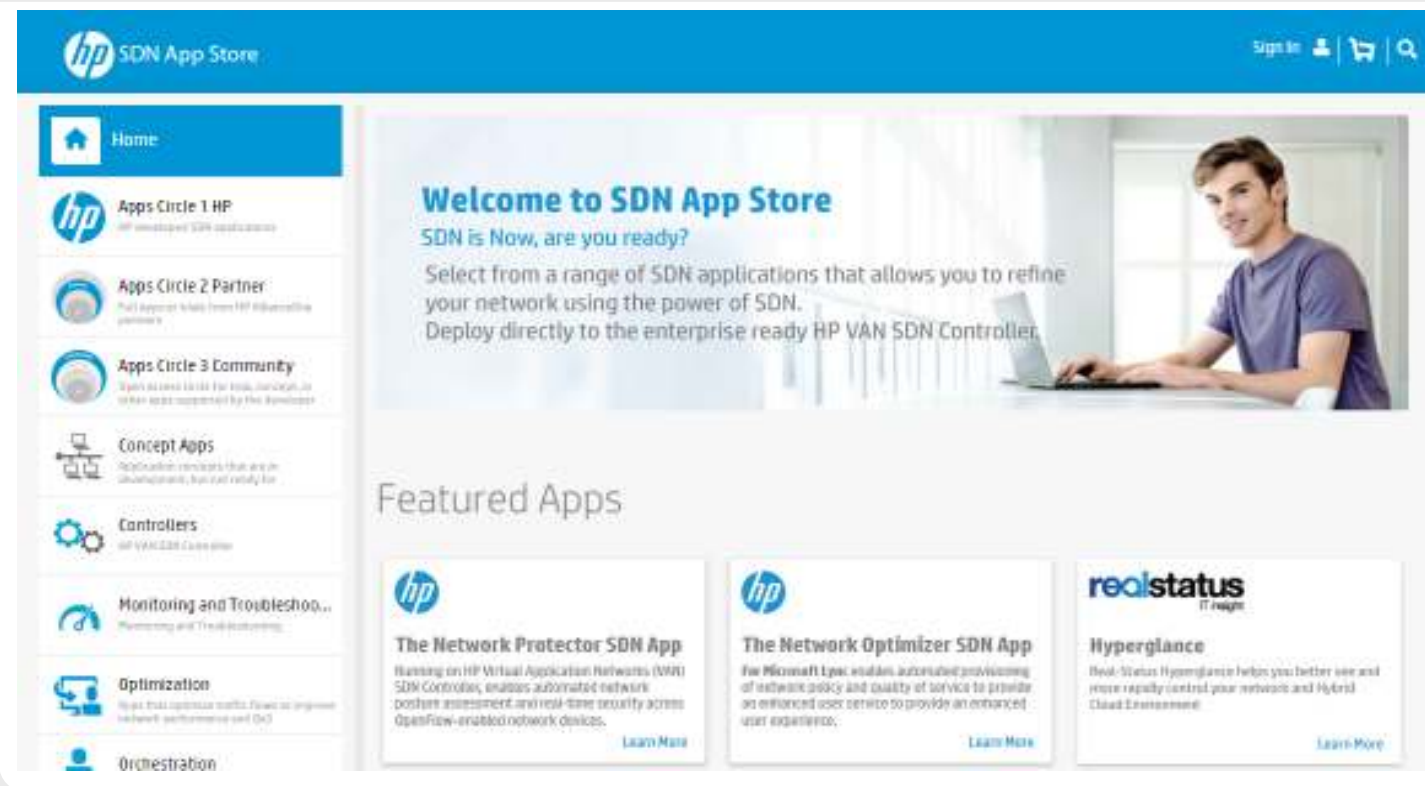
Solving the Multi-Writer Problem





Supporting Application Development

HPE SDN App Store



60%¹

Lower costs



90%¹

Shorter time to Service



100%

Standards-based and open



50

Switches SDN-enabled

Based on Internal Study

Hewlett Packard
Enterprise

... and enterprise ready

<https://hpn.hpwsportal.com/catalog.html#/Home/Show>

The screenshot displays the HP SDN App Store interface. The top navigation bar is blue with the HP logo and 'SDN App Store' text. On the right, there are links for 'Sign In', a shopping cart icon, and a search icon. A left sidebar contains a 'Home' link and several category tiles: 'Apps Circle 1 HP' (HP developed SDN applications), 'Apps Circle 2 Partner' (Full apps or trials from HP Approved partners), 'Apps Circle 3 Community' (Open access circle for trial, concept, or other apps supported by the developer directly or through forum discussions), 'Concept Apps' (Work in progress concepts that are not ready for use), 'Controller' (HP and SDN Controller), 'Data Center' (Data Center), 'ODL Controller and Apps' (OpenDaylight is a multi-vendor open source controller infrastructure built for SDN), 'Optimization' (Apps that optimize SDN, flow management, network performance and QoS), and 'Orchestration and Visualization' (Network Management and Orchestration Apps). The main content area is titled 'Apps Circle 3 Community' and includes a description: 'Open access circle for trial, concept, or other apps supported by the developer directly or through forum discussions.' It also contains text about contacting HP sales professionals or submitting apps to the Community circle. Below this, a grid of application cards is shown, each with a logo, name, description, rating, and price. The applications include: 'Avni Software Defined Cloud - Load Balanc...' (Avni Internal Application, 5 stars, Free), 'BlackList' (Community Developer SDN Internal Application, 5 stars, Free), 'Epoch: OpenFlow Simulator (Linux)' (Northbound Networks Compressed Package, 5 stars, Free), 'Epoch: OpenFlow Simulator (Mac OSX)' (Northbound Networks Compressed Package, 5 stars, Free), 'flotapr2' (Workinware Microsoft Word, 5 stars, Free), 'Flow Maker' (Northbound Networks SDN Internal Application, 5 stars, Free), 'Flow Maker Deluxe' (Northbound Networks SDN Internal Application, 5 stars, \$29.00), 'Glenn: The dpid database' (Workinware SDN External Application, 5 stars, Free), 'SDN Privatizer' (Dik van Deventer SDN Internal Application, 5 stars, Free), and 'Simple SDN Sniffer' (Joo Hinko SDN Internal Application, 5 stars, Free).

We've accelerated our innovation over the last year

Over 30 million SDN-ready ports



HP SDN Controller:
7500+ downloads

Customers and
development partners

Number of available APIs: 100+

JAVA/ REST/ PYTHON

Curated Apps:

3 HP and 19 Partner

BlueCat, F5, Riverbed, ...

Protector, Optimizer, Visualizer



HP SDK Kit:
5000+ downloads

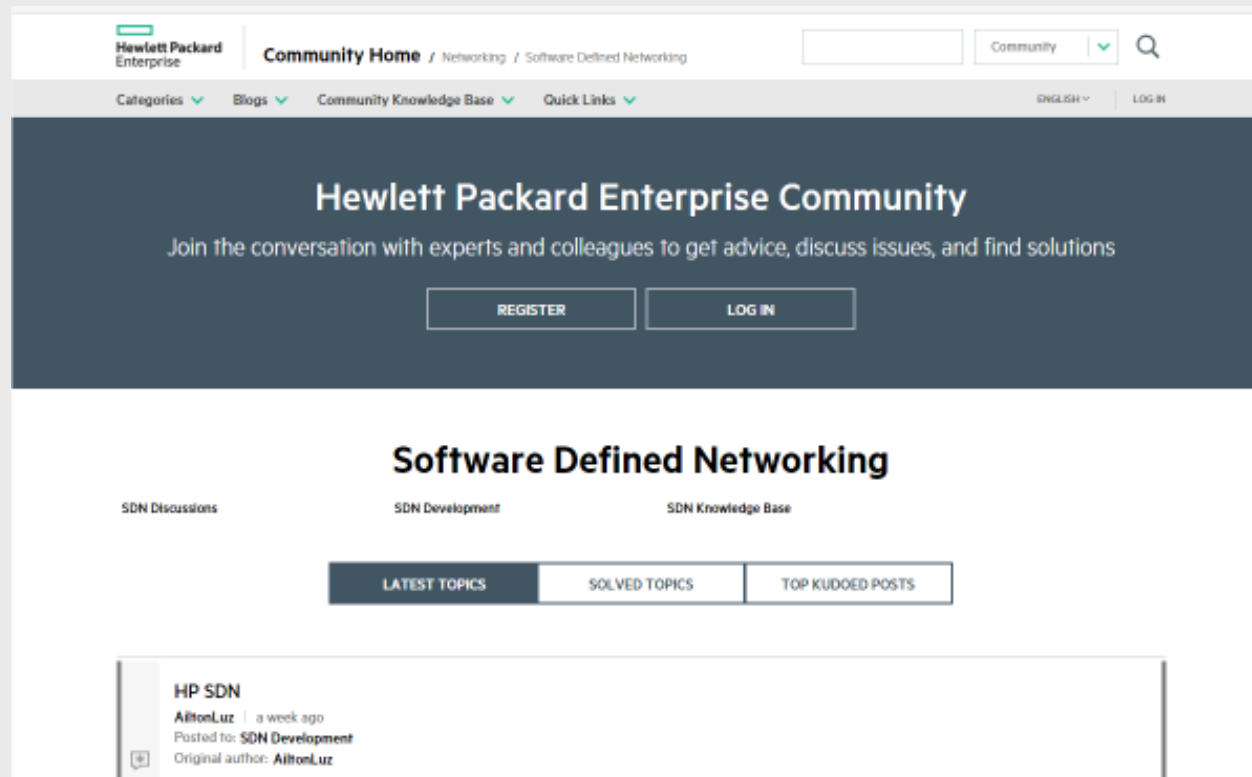
5 Developer events globally



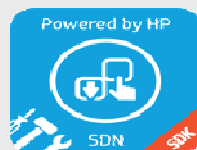
Ecosystem Partners: 30+

... and we're just getting started

SDN Development Community



Accelerate innovation with partners



93 SDN Members



21 SDN Apps



Thank you