### **SnapRoute Update**

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OCP Networking Engineering Workshop – 29 August 2017



### Running the network is too difficult

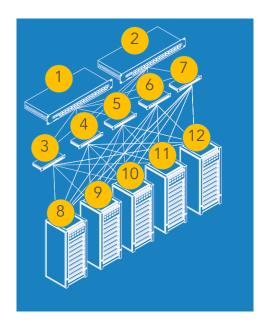
### Old-School Command Line Tools

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Mod					
1 3 4	4.2(1)SU1(4) 4.2(1)SU1(4) 4.2(1)SU1(4) 4.2(1)SU1(4)	0.0 UMMare ESXi 4.1.0 Rel UMMare ESX 4.1.0 Rele			
Mod	MAC-Address(es)		Serial-Num		
1 3 4	02-00-0c-00-03-00	8 to 00-19-07-6c-62-a8 8 to 02-00-0c-00-03-80 8 to 02-00-0c-00-04-80	NA NA NA		
Mod	Server-IP	Server-UUID		Server-Name	
1 3 4 Mo	192.168.1.55	NA 564d9811-0c2c-1938-808 564df9e4-278c-4fc6-f8a			



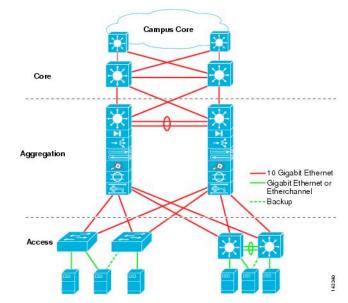
### Error-prone, manual configuration and change control

### Managing device-by-device





### Devices and designs are brittle



Architectures are outdated and mandate too many protocols



"High Availability" that isn't

RFC 4607	Source-Specific Multicast for IP	RFC 1195	Use of OSI IS-IS for Routing in TCP/IP and Dual Environments	Table 3. RFC Co	spliance	
RFC 4610	Anycast-RP using PM	RFC 2763	Dynamic Hostname Exchange Mechanism for IS-IS	Standard	Description	<ul> <li>VSANs: VSA is a logically and</li> </ul>
RFC 5132	IP Multicest MIB	RFC 2965	Domainwide Prefix Distribution with Two-Level IS-IS	BGP		This partitioning reconfigurations
ietf-draft	Traceroule Facility for IP Multicest (draft-left-idm-traceroule-ipm-07.bd)	RFC 2973	15-15 Mesh Groups	RFC 1997	BGP Communities Attribute	provided by VSA within the VSAM
farb-thei	Bidirectional Protocol Independent Multiceat (BIDIR-PNM, draft-left-pim- bidir-08.tet)	RFC 3277	15-15 Transient Black Hole Avoidance	RFC 2385	Protection of BGP Sessions with the TCP MD5 Signature Option	infrastructure w
wi-out	Bidractional Forwardina Dataction	RFC 3373	Three-Way Handshake for IS-IS Point-to-Point Adjacencies	RFC 2439	BGP Route Flap Damping	Users For ex
OTV	Burecona rowarding Leaseon	RFC 3567	IS-IS Crystographic Authentication	RFC 2519	Framework for Inter-Domain Route Apgregation	platfor
wi-draft	Overlay Transport Virtualization (draft-hasmil-oh-00)	RFC 3647	Restart Signaling for IS-IS	RFC 2545	Use of BGPv4 Multiprotocol Extensions for IPv6 Inter-Domain Routing	large 5 of a Se
WPLS	(versy introport virtualization (pran-native-out)	ietf-draft	Internet Draft Point-to-Point Operation over LAN in Link-State Routing Protocols (draft-leti-leti-leti-leti-p-p2p-over-lan-05.ht)	RFC 285A	Multienteed Educations for ISCPv4	based Fibre 0
RFC 3031	MPLS Architecture	IP Services		RFC 3065	Autonomous System Confederations for BGP	at a re Cisco I
		RFC 768	User Datagram Protocol (UDP)	RFC 3392	Capabilities Advertisement with BCPv4	(ISLs) allows
RFC 3032	MPLS Label Stack-Encoding	RFC 783	Trial File Transfer Protocol (TFTP)	RFC 4271	8054	Cisco Adapt benefits of the
RFC 3036	LDP Specification	RFC 781	P			providing archit point of manage
RFC 3478	Graceful Restart Mechanism for Label Distribution Protocol			RFC 4273	BGPv4 MB: Definitions of Managed Objects for BGPv4	extension of the
RFC 3812	Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Management Information Base (MIB)	RFC 792	Internet Control Message Protocol (ICMP)	RFC 4456	BGP Route Reflection	interfa adopte
RFC 3813	Multiprotocol Label Switching (MPLS) Label Switching Router (LSR)	RFC 793	TOP	RFC 4486	Subcodes for BGP Cease Notification Message	Sechric With th
APG 3813	Management Information Base (MID)	RFC 826	ARD .	RFC 4724	Graceful Restart Mechanism for BGP	logical
RFC 4382	MPLS/BGP Layer 3 Virtual Private Network (VPN) Management Information Base	RFC 854	Teinet	RFC 4893	BGP Support for Four-Octet as Number Space	of Peri
		RFC 959	FTP	ief-craft	Bestpath Transition Avoidance (draft-ietf-idr-avoid-transition-05.txt)	Product Specif
RFC 3815	Definitions of Managed Objects for Multiprotocol Label Switching (MPLS) and Label Distribution Protocol (LDP)	RFC 1027	Proxy ARP	ief-orat	Peer Table Objects (draft-ietf-idr-bgp4-mib-15.bd)	Bupported Bland Tables 2 and 3
ETF DRAFT	draft-letf-mpie-fasteroute-mit: Multiprotocol Label Switching (MPLS) Traffic Engineering Management Information Base for Fast Reroute	RFC 1305	Network Time Protocol (NTP) Version 3	ief-craft	Dynamic Capability (draft-letf-ldr-dynamic-cap-03.bd)	Table 2. IEEE 4
		RFC 1519	Classiess Interdomain Routing (CIDR)	OSP#		Standard
RFC 5036	LDP Specification (obsoletes RFC3036): Partial Support	RFC 1542	BootP Relay	RFC 2370	OSPF Opeque LSA Option	
RFC 5443	LDP IGP Synchronization	RFC 1591	Domain Name System (DNS) Client	RFC 2328	COPF Version 2	IEEE 802.1D
IETF DRAFT	LDP Capabilities (draft-ietf-mpls-idp-capabilities-04.txt draft)	RFC 1812	IPv4 Routers	RFC 2740	CSPF for IPv6 (CSPFv2)	IEEE 802.1s
IETF DRAFT	LDP Typed Wildcard FEC (draft-leff-right-ldp-typed-wildcard-03.txt)	RFC 2131	DHCP Helper	RFC 3101	CSPF Not So Stubby Area (NSSA) Option	IEEE 802.1w
RFC 2585	Virtual Private Networks Identifier	RFC 2338	Alleb			IEEE 802.1ab
RFC 2858	Multiprotocol Extensions for BGP-4	RFC 2784	GRE	RFC 3137	OSPF Stub Router Advertisement	IEEE 802.1A
RFC 3107	Carrying Label Information in 8GP-4	IP Multicest		RFC 3609	Alternative Implementations of OSPF Area Border Routers	IEEE 802.3xd
RFC 3630	Traffic Engineering (TE) Extensions to OSPF Version 2	RFC 2236	10NPv2	RFC 3623	Graceful OSPF Restart	IEEE 802.3x8
RFC 4364	BGP or MPLS IP VPNs (No InterAS support)	RFC 2710	Multicest Listener Discovery (MLD) for IPv8	RFC 4750	OSPF Version 2 MB	IEEE 802.3z
RFC 4365	Applicability Statement for BGP or MPLS IP VPNs	RFC 3376	IGNP-0	RP		IEEE 802.3ae
RFC 4382	MPLS or BGP Layer 3 VPN MIB	RFC 3445	Anycast Rendezvous Point Mechanism Using PM and MSDP	RFC 1724	RIPv2 MB Extension	IEEE 802.1Q
RFC 4578	Using LSA Options Bit to Prevent Looping in BGP or MPLS IP VPNs	RFC 3569	Overview of 55M	RFC 2082	RIPv2 MD5 Authentication	IEEE 802.1p
	(DN BI)	RFC 3618	MSDP	RFC 2453	RIP Version 2	IEEE 802.1x
RFC 4577	OSPF as the PE or CE Protocol in BGP or MPLS IP VPNs	RFC 3810	MLDPv2 for IPv6	15-15		Fibre Channel
RFC 4559	BGP-MPLS IP VPN Extension for IPv6 VPN (No InterAS support)	RFC 4601	Prstocol independent Multicest - Sparse Mode (PIM-SM) Prstocol	RFC 1142 (05)	CSI 10589 Intermediate System-to-Intermediate System (IS-IS)	700 00 00 0

lity by containing fabric		Ethernet, 10 Gloabil Ethernet, unified fabric, copper and fiber connectivity rack, and blade	pair o
The strict traffic segregation of a given VSAN are confined by, and resilience. VSANs help	Layer 2 Features	server environments. The platform is well suited to support today's traditional Gipabit Ethernet technology while allowing transparent negration to 10 Gipabit Ethernet, virtual machine-aware united fabric technologies. The combination of Class FEX-List and the Class Nexus servert	Spani
rds into a common billy.	Layer 2 switch ports and VLAN trunks	switch enables data centers to scale the number of Gigabit Ethemet access ports, reducing cable runs and the number of management points in the network. • Protocol effects: To reduce the load on the control clares of the device in a Cisco FEX-Link.	Cis     support
d in scope to certain VSANs. allow configuration of all up to allow configuration and	IEEE 802.1Q VLAN encapsulation	design, Cisco NX-OS provides the capability to official link-level protocol processing to the fabric extender CPU. The following protocols are supported:	using
improves the manageability of an errors by isolating the effect e membership can be isolated	Support for up to 4000 VLANs	0 VLAN enclopediation expediation (Section 2014) and Section 2014 (Section 2014) and Section 2	an IP-
IANs are supported across rding VSANs to include devices	Support for up to 32 virtual SANs (VSANs) per switch	cip to 3000 VLVM	
king allows Inter-Switch Links ysical link. F-port trunking I. Virtualization (NPV) mode.	Rapid Per-VLAN Spanning Tree Plus (PVRST+) (IEEE 802.1w compatible)	networking device implementing PFC makes an implicit agreement with the other end of the wire: any accepted packet will be delivered to the next hop and never be locally dropped. To	of the
dender extends the current interface cards (NICs), cal interfaces with a single	Multiple Spanning Tree Protocol (MSTP) (IEEE 802.1s): 64 instances	accepted, and that, essentially, is the flow-control function performed by FPG. The benefits are significant for any protocol that assumes reliability at the media level, such as Fibre Channel over Ethemet (FOGE).	
extender is logically an	Spanning Tree PortFast, Root Guard, and Bridge Assurance	<ul> <li>Troublesheating and diagnostics: Cisco NX-OS is built with unique serviceability functions to enable network operators to take early action based on network trends and events, enhancing</li> </ul>	
S	oftware stack	ks have 30N	/

Private VLAN Private VLAN over trunks Private VLANs over vPC and EtherChannel Cisco EabricPa

lines of code bloat

ort Virtualization (OTV): OTV is a "M&C address in li

IETF DRAM

IETE DRAFT

LISP for Multicast 8

MPLS Support of Differentiated 3 ICIC.TO

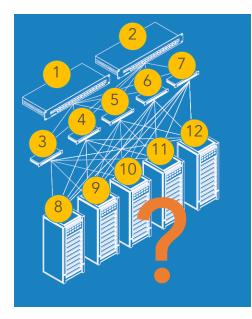
of a Restart Mechanism for RCR with MRI

RSVP v1 Functional Specification

	IP Multicast: Cisco N NX-OS implementation portfolio of multicast-enu
Interface: Based on the NETCONF industry standard, the Cisco NX-OS a consistent API for devices, enabling rapid development and creation of	NX-OS includes state-of functions:
etwork,	- Protocol Inde
anagement Protocol (SNMP): Cisco NX-OS complies with SNMPv1, v2c.	- Source-Spec
n of MIBs is supported.	- PIM Scene 7
feation and nellback: With Cisco NX-OS, the system operator can verify inflouration and the availability of necessary hardware resources prior to	- Bidrectional
ration. A device can thus be preconfigured and the verified configuration	- Anytast Ren
	- Multicest ND
ration as needed.	- RP-Discovery
shreekastion: Configuration synchronization (config-eync) mode allows profiles to synchronize local and seer switches. Config-eync allows	- Internet Grou
configuration changes on one switch and have the system automatically	- IGMPv2 host
is peers. This feature eliminates user errors and reduces the	- IGMP snoopi
d of having to configure both members of a vPC simultaneously.	- Multicest List
profiles enable customers to define a policy once and then apply it many d physical ports, significantly increasing both efficiency and fexibility in	- Multicent Sou
ters.	- IGMP cache
control (RBAC): With RBAC, Cisco NX-OS enables administrators to	- Policies for m
operations by assigning roles to users. Administrators can customize	(group)
o the users who require it. Claco NK-OS also provides a mechanism for ration of RBAC roles across devices running Claco NK-OS, for simplified	- IGMP group-
and a rest interest second second second care of the second	<ul> <li>Debug filters</li> </ul>
ses: Cisco NK-OS incorporates many management features that facilitate	Data Center Bridging     increase network scalab
of growing storage environments with existing resources. Cisco fabric	flows, and optimize perfi
provisioning by automatically distributing configuration information to all wherek. Distributed device alias services provide fabricwide alias names	provided by the Etherne
HBAs), storage devices, and switch ports, eliminating the need to reenter	create an even more ea
an moved.	protocol that simplifies n
legy: Cisco NK-OS supports industry-standard N-port ID virtualization	autonegotiation of DCB - Cisco TrustSec8 ser
nultiple N-port fabric logins concurrently on a single physical Fibre at support NPW can help improve SAN security by enabling configuration	provides outstanding da
urity independently for each virtual machine (OS partition) on a host. In	link-layer cryptography v
I for server connections, NPtV is beneficial for connectivity between core	Link-layer cryptography
<ol> <li>a complementary feature that reduces the number of Fibre Channel</li> </ol>	security service devices
a complementary feature that reduces the number of Fibre Channel core-edge SANs. It is used by edge switches in the NPV mode to log in	a new model in network addresses, enabling imp
d devices that share a link to the core switch.	to their topology indepen
or network security configuration: The autoieam feature allows the	In addition to O
smatically learn about devices and switches that connect to it. The this feature to configure and activate network security features such as	features:
this reasure to compute and activitie network security reasures such as aving to manually configure the security for each port.	- Data path inte
gement processor (CMP) support: Cisco NX-OS supports the use of a	- Control-plane
role management of the platform. The CMP aids operations by providing	- Message-dig
channel to the Cisco NX-OS console. IPv6 support for the CMP interface ing ping6 and traceroute6.	- Cisco integra
and Fibre Channel traceroute: Cisco NX-OS brings to storage	(ARP) Insp
as Fibre Channel ping and Fibre Channel traceroute, which are essential	<ul> <li>Authenticatio</li> </ul>
hooting. With Fibre Channel ping, administrators can check the	- Secure Shell
ort and determine its round-trip latency, and with Fibre Channel traceroute, ick the reachability of a switch by tracing the path followed by frames and	- Simple Netwo
p latency.	<ul> <li>Port security</li> <li>IEEE 802.1x</li> </ul>
	- Lever 2 Ciso
is virtual machine portability and converges multiple services, platforms,	- Policies base
fy and reduce infrastructure sprawl and total cost of ownership (TCO).	- Policies base named AC
axts (VDCs): Cisco NX-OS offers the capability to segment OS and	router-base
to virtual contexts that emulate virtual devices. Each VDC has its own edicated hardware resources (physical interfaces, VLANs, routino table	- Switch and host aut
tt.), and independent management environment. VDCs are instrumental	Cisco NX-OS provide se
separate networks onto a common infrastructure, maintaining the	fabrics. Diffe-Heilman C perform authentication la
ry separation and fault isolation characteristics of physically separate ng many of the operating cost benefits of a single infrastructure. Each	a switch or host cannot j
without affecting the control, data, and management planes of other VDCs	· Port security and fail
	switch port. The entities
il Switching (MPLS): Claco NX-OS supports a comprehensive set of ing label switching, Laver 3 VPNs, MPLS Traffic Engineering with Fast	Names (WWNs). This lo
ing label switching, Layer 3 VPNs, MPLS Traffic Engineering with Past aut VPNs for IPv4, and IP v6 provider edge (6PE) and IPv6 VPN provider	the switch port do not di only between specified s
satures interoperate with Cisco XXS Software. These features provide the	Efficiency
consolidation and centralization of services and policy control for a	Cieco NX-OS repúdea o

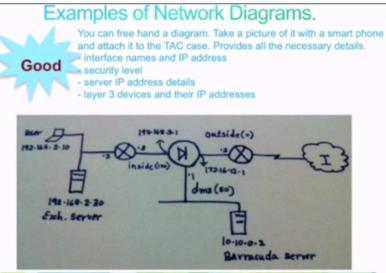


### Troubleshooting is too time consuming



Status codes: s su	ppressed, d damped	d, h histor	, * val	lid, > 1	best, :	i -
internal, r RIB-fa	ilure, S Stale					
Origin codes: i -	IGP, e - EGP, ? -	incomplete				
Network	Next Hop	Metric	LocPrf	Weight	Path	
*> 10.1.0.0/24	0.0.0.0	0		32768	i	
* i	10.1.0.2	0	100	0	i	
*> 10.1.1.0/24	0.0.0.0	0		32768	i	
*>i10.1.2.0/24	10.1.0.2	0	100	0	i	
*> 10.97.97.0/24	172.31.1.3			0	64998	64997
•	172.31.11.4			0	64999	64997
* i	172.31.11.4	0	100	0	64999	64997
*> 10.254.0.0/24	172.31.1.3	0		0	64998	i
•	172.31.11.4			0	64999	64998
* i	172.31.1.3	0	100	0	64998	i
r> 172.31.1.0/24	172.31.1.3	0		0	64998	i
r	172.31.11.4			0	64999	64998
r i	172.31.1.3	0	100	0	64998	i
*> 172.31.2.0/24	172.31.1.3	0		0	64998	i

Expert to Expert: Dos and Don'ts when sending data to your TAC engineer.



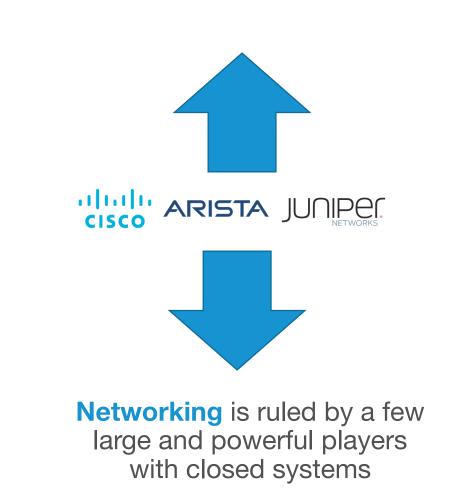
What and where is the problem?

Cannot reliably parse dozens of CLIs in a complex and changing network. Cannot see what matters. Explaining to support. Going through escalations. Waiting on bug fixes.



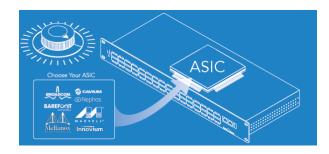
### ...and it's all too proprietary

ORACLE Software BYO cloudera splunk Windows Server OS solaris DELLEMC Hardware SUPERMICR Hewlett Packard Enterprise lenovo Compute has an open and vibrant ecosystem

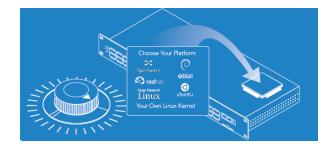




## How hyperscalers solved these problems



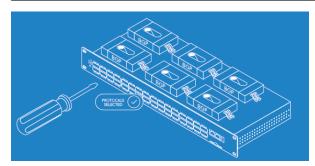
Created a broad ecosystem of merchant silicon & white-box hardware Choice & Flexibility



Used standard Operating Systems **Proven, Open & Secure** 



All highly automated and instrumented



Ran simplified protocol stacks tailor-fit to specific purposes
Reliable & Fast to Fix



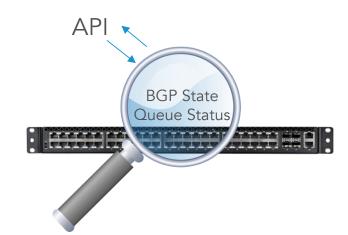




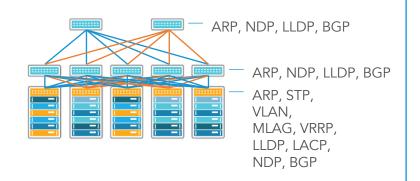
### **A BETTER APPROACH TO NETWORKING**

# FlexSwitch

## **Guiding SnapRoute Principles**



Deep, Programmatic Access Automate & see everything Simplify troubleshooting



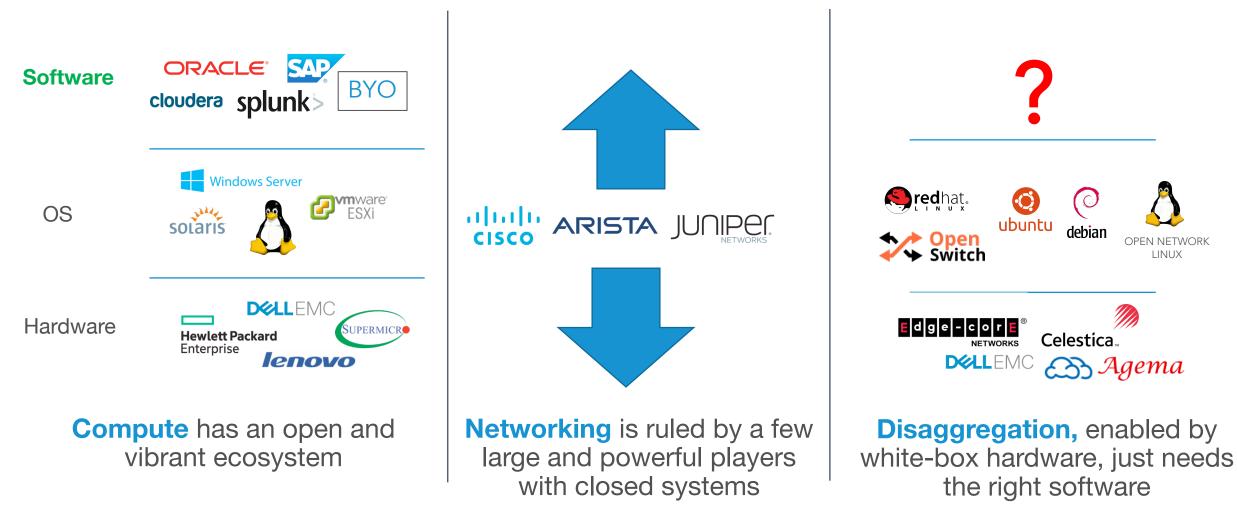
Simplified Architectures Install Only What's Needed Simple, Stable, Reliable



Complete Choice & Control Leverage White Box Agility & Economics



### Software was the missing link – so we built it



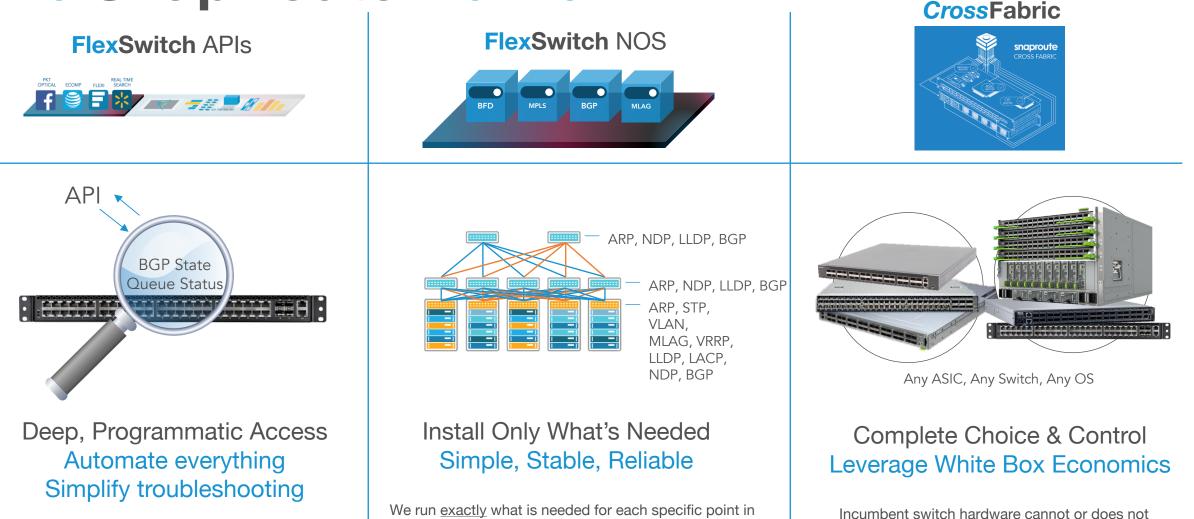


### Modern, modular, microservices architecture

- Reliability & Ease of Troubleshooting: Less code running on the switch. Fewer opportunities for bugs. Easier to diagnose and repair.
- Fault Tolerance: User space daemons do not crash the entire switch
- Rapid Development: API-defined interactions between microservices reduce dependencies and allow for independent module development paths.



## The SnapRoute Network



Configure, Monitor, and Troubleshoot through automation. <u>Manage a network</u>, not multiple individual devices. We run <u>exactly</u> what is needed for each specific point in the network. Nothing more. Increases reliability and simplifies troubleshooting.

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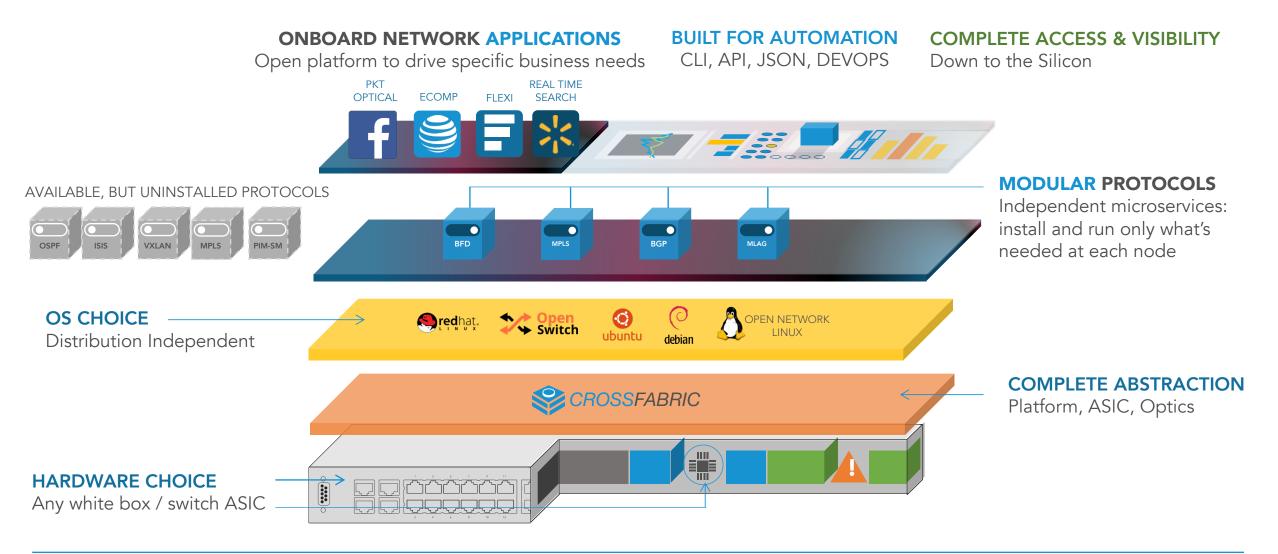
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provide access, control, and visibility mechanisms we

need. So we built on top of white-box.

snaproute

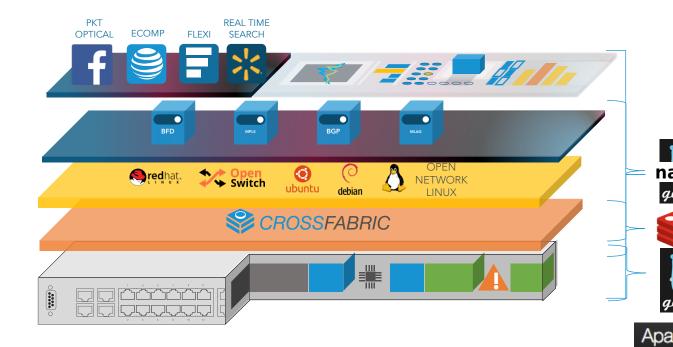
### **The FlexSwitch Stack**





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### **FlexSwitch Foundation**





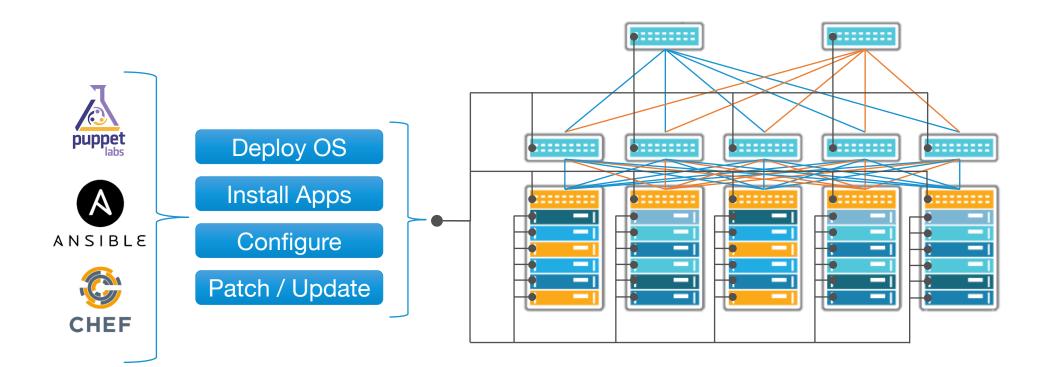
Leverages Proven Technologies

FlexS&itchmonriecationploetoveeln FlexS&itchmonrie



### Leverage modern data center automation

Configure, manage, and monitor at scale, just like servers

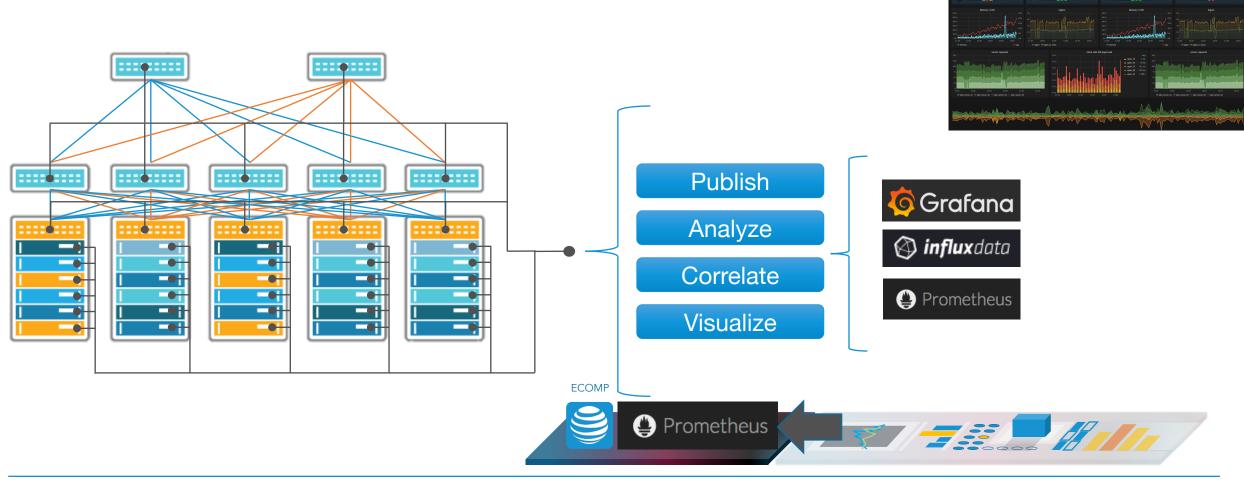




14

### Leverage modern data center automation

Configure, manage, and monitor at scale, just like servers





15

## Thank you.

