Cisco Nexus Smart Switches with DPUs

A window to a transparent secure datacenter network architecture

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Session ID: BRKDCN-2643

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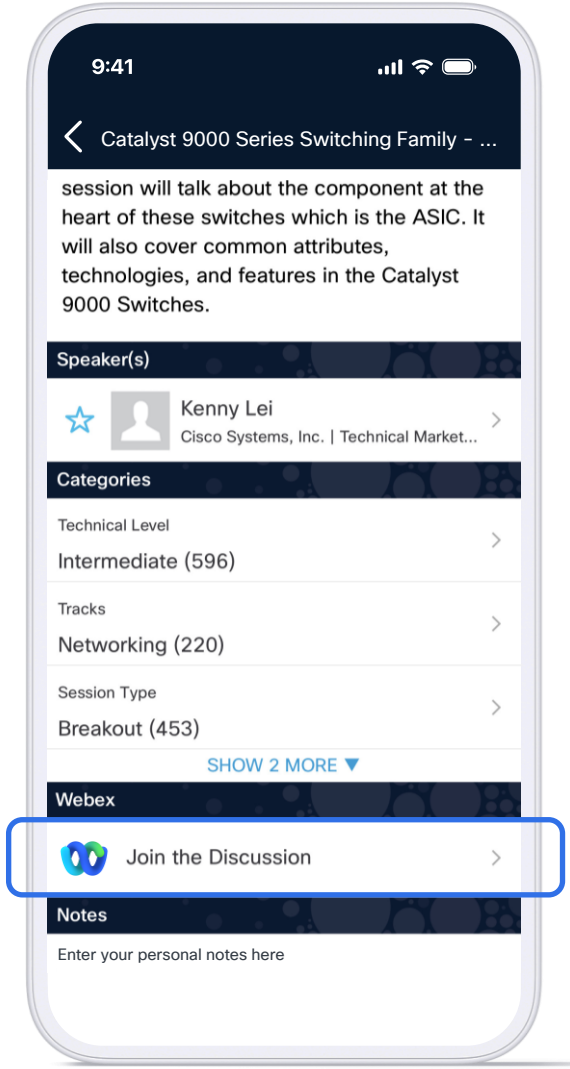

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Agenda

01 Introduction to Smart Switches

02 Security Features

03 Configuration Example

04 Packet Walk

05 Top of The Rack Deployment Examples

06 Target Scale

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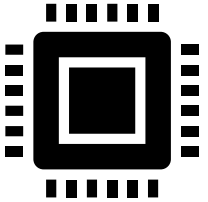
What is a Cisco Nexus N9300 Smart Switch

- A Nexus N9300 Smart Switch is a Silicon One based NXOS switch equipped with a Data Processing Unit (DPU) which is a High-performance, programmable packet processing engine
- DPUs provide a middle ground between software functions running in CPUs and hardware-based forwarding in ASIC
- A DPU consists of a programmable data plane, memory, specialized acceleration engines, and embedded CPUs for control plane/management



- DPU Functions:
  - Distributed stateful firewall
  - Encryption services (e.g., IPsec)
  - Telemetry/flow data collection offload
  - Stateful NAT/PAT

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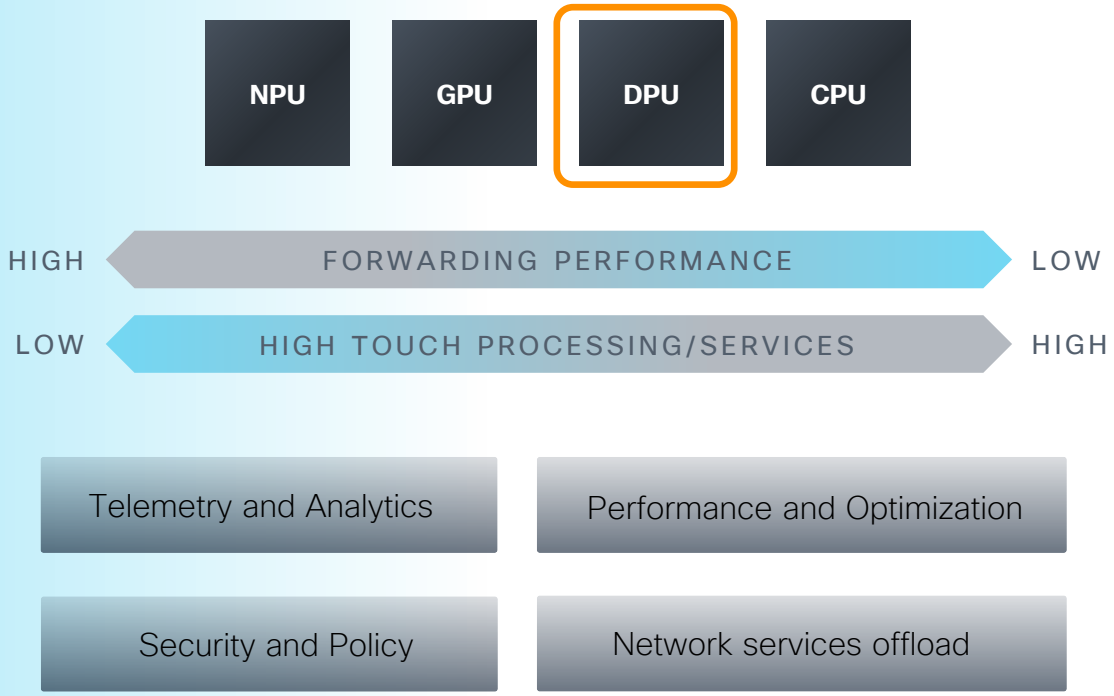
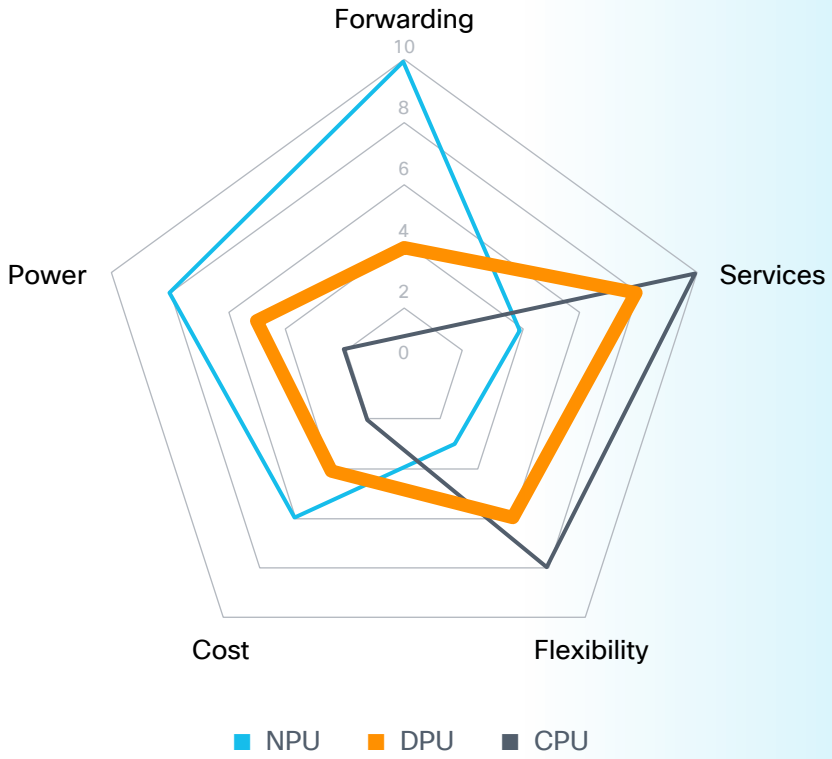
Why a Smart Switch? Benefits of using a DPU





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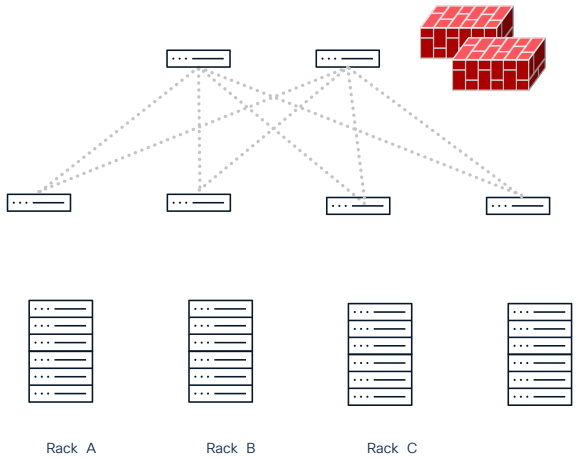
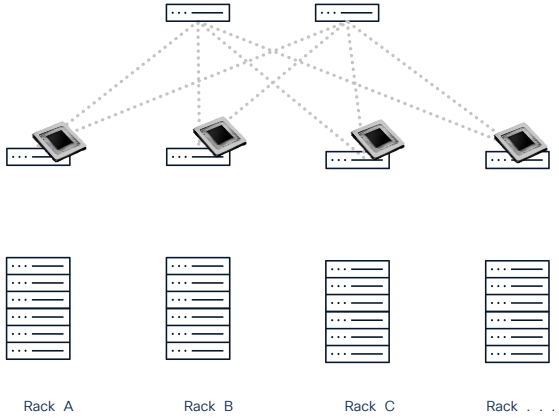
Why a Smart Switch
Benefits of aggregating DPUs in the access layer

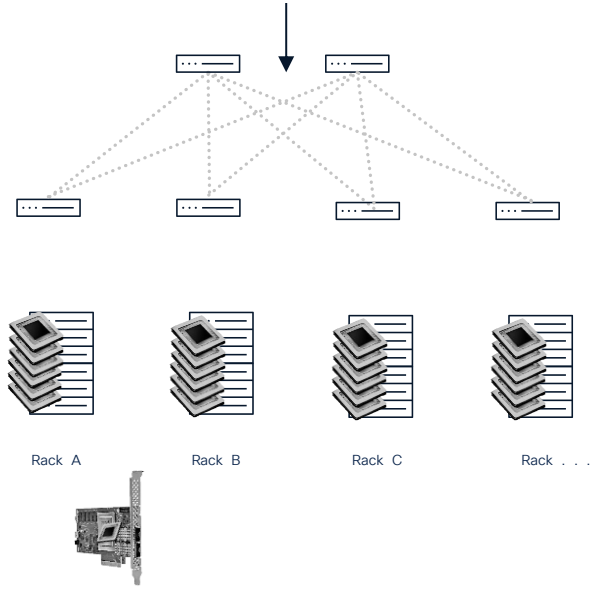
Using Discrete Firewalls
multiple hops away from endpoints
easy to manage



DPU function on the Switch
⇒ close to the endpoints
⇒ easy to manage



DPU Function Accelerator Card / Server:
very close to the endpoint: granular policies
many devices to manage



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Cisco N9324C-SE1U Smart Switch

- 24 x 100G QSFP ports (2.4T)
- Silicon One E100 NPU
- 4 x AMD “Elba” DPUs (800G capacity)
- 16-core 2.5GHz Intel CPU
- 32GB DRAM per DPU (128GB total)

N9324C-SE1U

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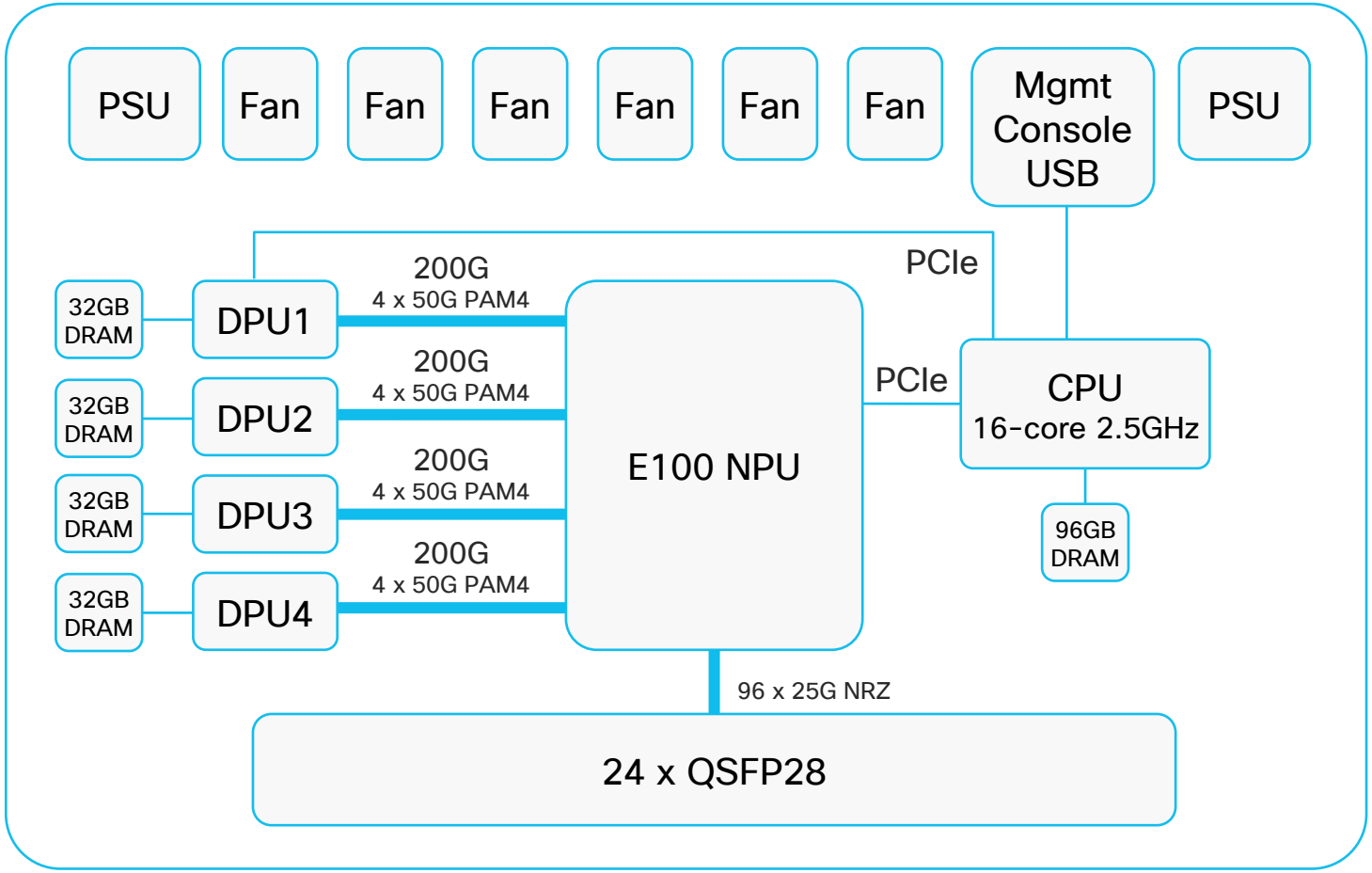
N9324C-SE1U Architecture



N9324C-SE1U

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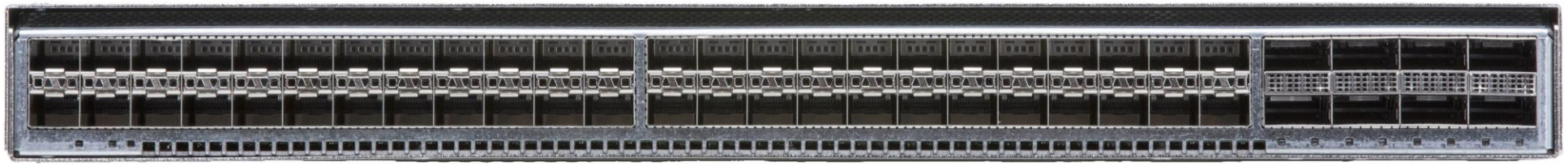
Cisco N9348Y2C6D-SE1U Smart Switch

- 48 x 25G SFP28 ports + 2 x 100G QSFP28 ports + 6 x 400G QSFP-DD ports (3.8T)
- Silicon One E100 NPU
- 2 x AMD “Giglio” DPUs (800G capacity)
- 16-core 2.5GHz Intel CPU
- 96GB system DRAM
- 64GB DRAM per DPU (128GB total)



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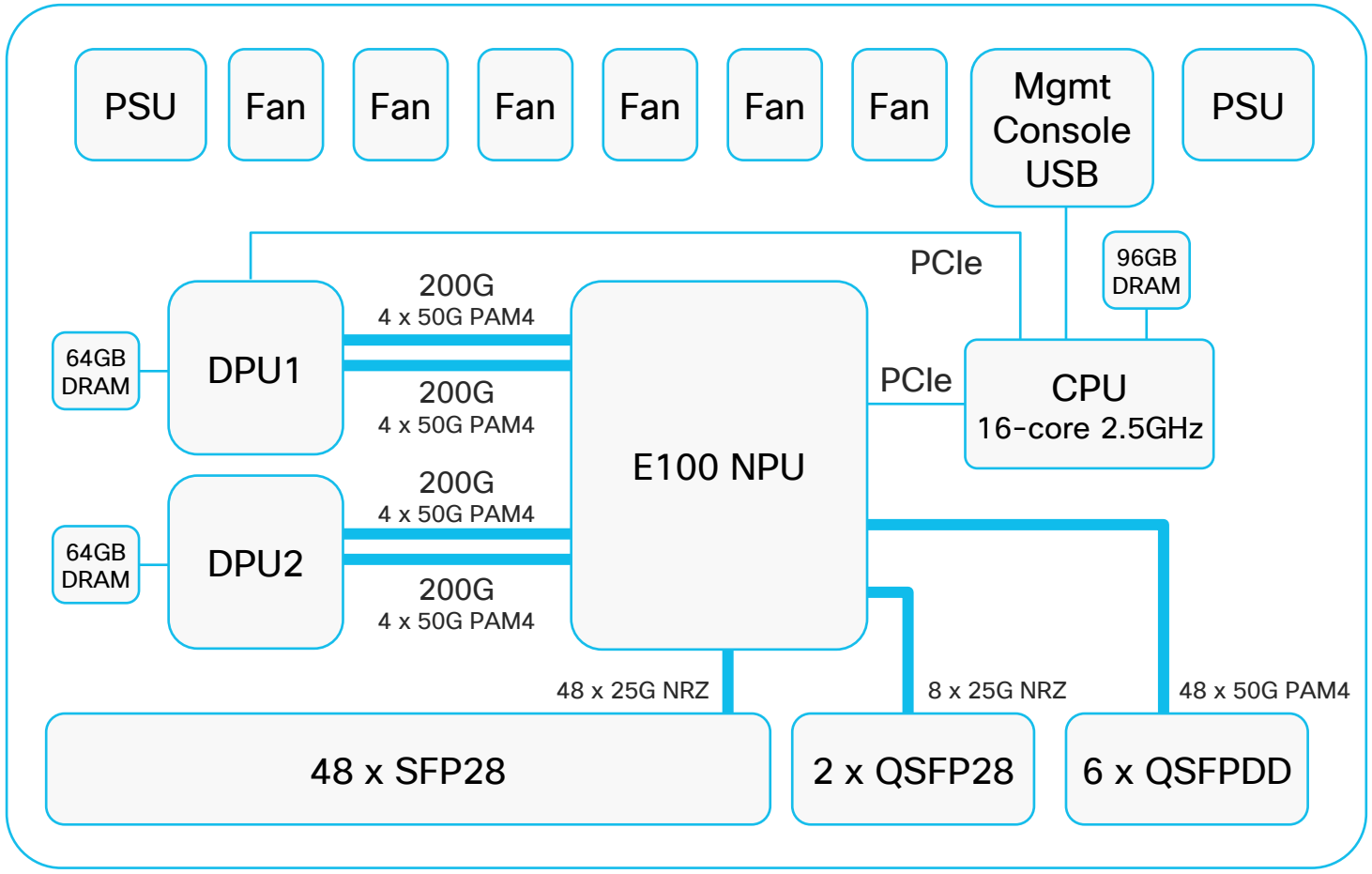
N9348Y2C6D-SE1U Architecture



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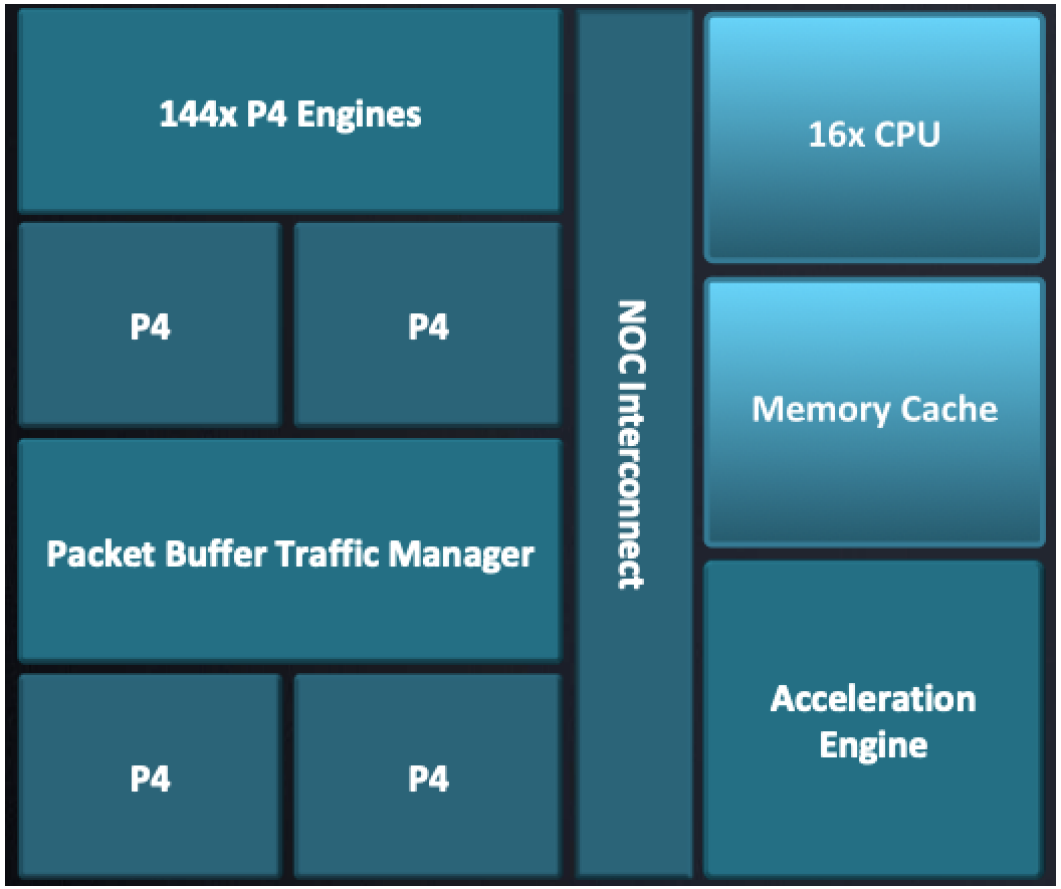
AMD DPU

- Dual 200Gbps connectivity
- 144 P4-programmable pipeline
- 16 ARM cores
- Offloads:
  - IPSEC,
  - compression, decompression
  - deduplication
  - [...]



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Ports Speed and Optics Support
Please refer to the Cisco Datasheet for more information

- Native speeds: 40G and 100G
- Breakout support:
  - 4x25G
  - 4x10G
  - 2x50G (*)
- QSA:
  - 10G QSA – Yes
  - 25G QSA – No
  - 1G QSA – No

- Optics: 100G and 40G Copper Cable support (1,3,5)
- 100G Optics
  - QSFP28-100G-SR4
  - QSFP28-100G-PSM4
  - QSFP28-100G-CWDM4
  - QSFP28-100G-LR4
  - QSFP28 AOC, 1, 3, 5, 7, 10, 15, 30m
  - QSFP28 – 100G DR, 100G FR
- 40G and Optics
  - QSFP-40G-LR4
  - QSFP AOC, 1, 3, 5, 7, 10, 15, 30m
  - QSFP-40G-LR4-S
  - QSFP-40G-SR-BD
  - QSFP-40G-SR4-S
  - QSFP-40G-SR4

(*) 2x50G was tested with third party cables: Mellanox QSFP-100G-PCC.

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N9348Y2C6D-SE1U Port Speed and Optics Support

https://tmgmatrix.cisco.com/?npid=7959

10G optics	10G pre-terminated calbes (AOC/Copper)	10/25G	25G Optics	25G pre-terminated cables (AOC / Copper)	40G optics	40G pre-terminated cables (AOC and copper)	40G breakout 4x10G	100/40G	100G optics	100G pre-terminated cables (AOC and Copper)	100G breakout x25G	400G Optics	400G pre-terminated cables (AOC and copper)	400G breakout
SFP-10G-SR-S	SFP-10G-AOC1M	SFP-10/25G-CSR-S	SFP-25G-SR-S	SFP-25G-AOC1M	QSFP-40G-SR4-S	QSFP-H40G-AOC1M	QSFP-4X10G-AOC1M	QSFP-40/100-SRBD	QSFP-40/100-SRBD	QSFP-100G-AOC1M	QSFP-4SFP25G-CU1M	QDD-400G-SR8-S	QDD-400-AOC1M	QDD-4X100G-FR-S
SFP-10G-LRM	SFP-10G-AOC2M	SFP-10/25G-LR-S	SFP-25G-SL	SFP-25G-AOC2M	QSFP-40G-SR-BD	QSFP-H40G-AOC2M	QSFP-4X10G-AOC3M		QSFP-100G-CWDM4-S	QSFP-100G-AOC2M	QSFP-4SFP25G-CU2M	QDD-400G-DR4-S	QDD-400-AOC2M	QDD-4X100G-LR-S
SFP-10G-LR-S	SFP-10G-AOC3M			SFP-25G-AOC3M	QSFP-40G-LR4-S	QSFP-H40G-AOC3M	QSFP-4X10G-AOC5M		QSFP-100G-PSM4-S	QSFP-100G-AOC3M	QSFP-4SFP25G-CU3M	QDD-400G-FR4-S	QDD-400-AOC3M	QDD-4ZQ100-CU1M
SFP-10G-ER-S	[...]			[...]	QSFP-40G-ER4	[...]	[...]		QSFP-100G-LR4-S	[...]		QDD-400G-LR8-S		QDD-4ZQ100-CU2M
SFP-10G-ZR-S	SFP-H10GB-CU1M			SFP-H25G-CU1M	QSFP-40G-CSR-S	QSFP-H40G-CU5M	QSFP-4SFP10G-CU5M		QSFP-100G-SM-SR	QSFP-100G-AOC10M		QDD-400G-LR4-S	QDD-400-CU1M	QDD-4ZQ100-CU2.5M
	SFP-H10GB-CU2M			SFP-H25G-CU2M	[...]	QSFP-H40G-CU3M	QSFP-4SFP10G-CU3M		QSFP-100G-ER4L-S	QSFP-100G-AOC15M		QDD-400G-SR4.2-BD	QDD-400-CU2M	QDD-4ZQ100-CU3M
	SFP-H10GB-CU3M			SFP-H25G-CU3M		QSFP-H40G-CU1M	QSFP-4SFP10G-CU1M		QSFP-40/100-SRBD	QSFP-100G-AOC20M			QDD-400-CU2.5M	
						[...]	[...]			[...]			[...]	

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Power

- 1+1 1400W PSU
- Nexus 9k power consumption with DPUs off and without transceivers: ~260-300 Watt
- Power consumption of the built-in firewall (DPUs):
  - AMD Pensando: 55-75 Watt per Elba DPU (based on DSC-200) so 4 x Elba = ~300 Watt per Nexus 9300 Smart Switch in addition to the N9300 power consumption with the DPUs off.
- Power consumption of the N9324C with DPUs on and with transceivers:
  - No transceivers: 670W
  - Typical : 794W (all the front ports with optics/transceivers, 50% traffic)
  - Max: 966W (5.5W transceivers used) or 918W (3.5W transceivers used)
  - For the power consumption of 100G transceivers: https://www.cisco.com/c/en/us/products/collateral/interfaces-modules/transceiver-modules/datasheet-c78-736282.html
- Potential Power Savings:
  - No need for external cabling, less optics

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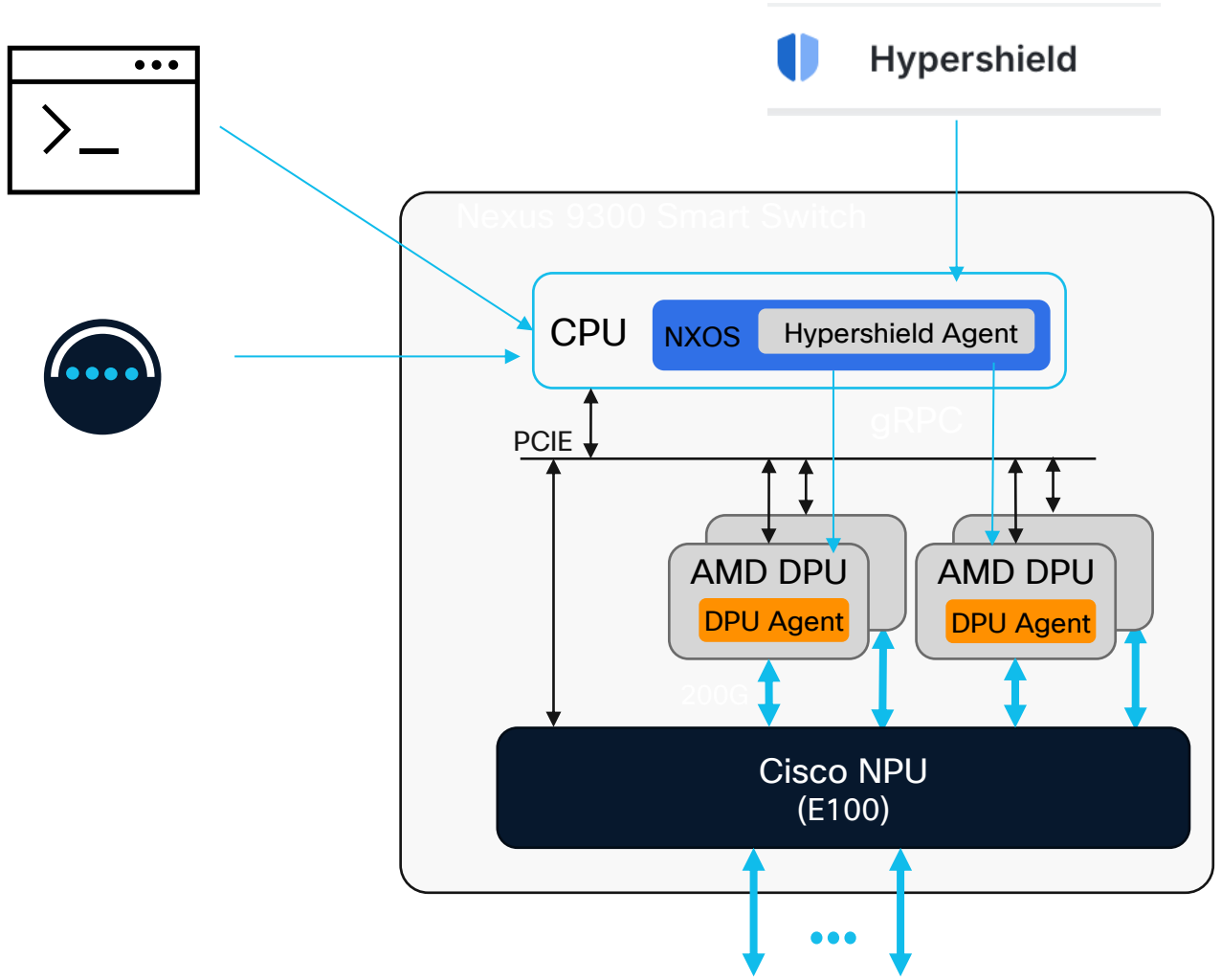
The Nexus 9300 Smart Switch is both a Network Device and a Security Device

- The NPU provides the Nexus 9k routing and switching functions:
  - Managed via CLI and Nexus Dashboard
- The DPU provides the security functions:
  - Managed via Hypershield on premise
- The Nexus9k software image includes both the software for the NPU and the DPU



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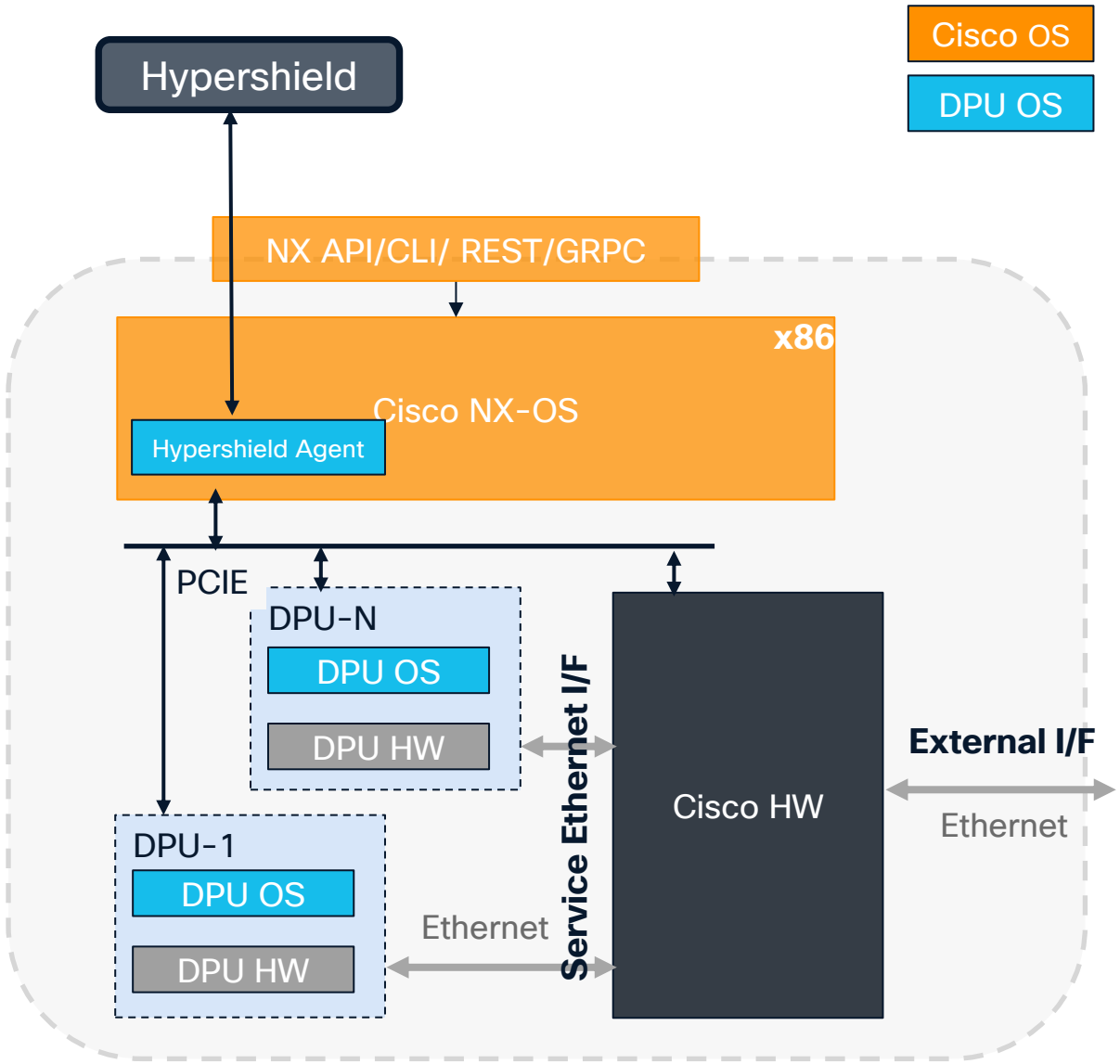
Software Components

- NXOS handles images for both Cisco NXOS and the DPU
- NXOS provides the L3 connectivity for the Hypershield Agent
- The Hypershield agent receives Firewall configurations and policies from Hypershield and pushes them to the DPU complex that in-turn configures firewall rules on DPUs.
- The Hypershield Agent also collects firewall flow information from the DPU complex, construct firewall flow logs and exports them



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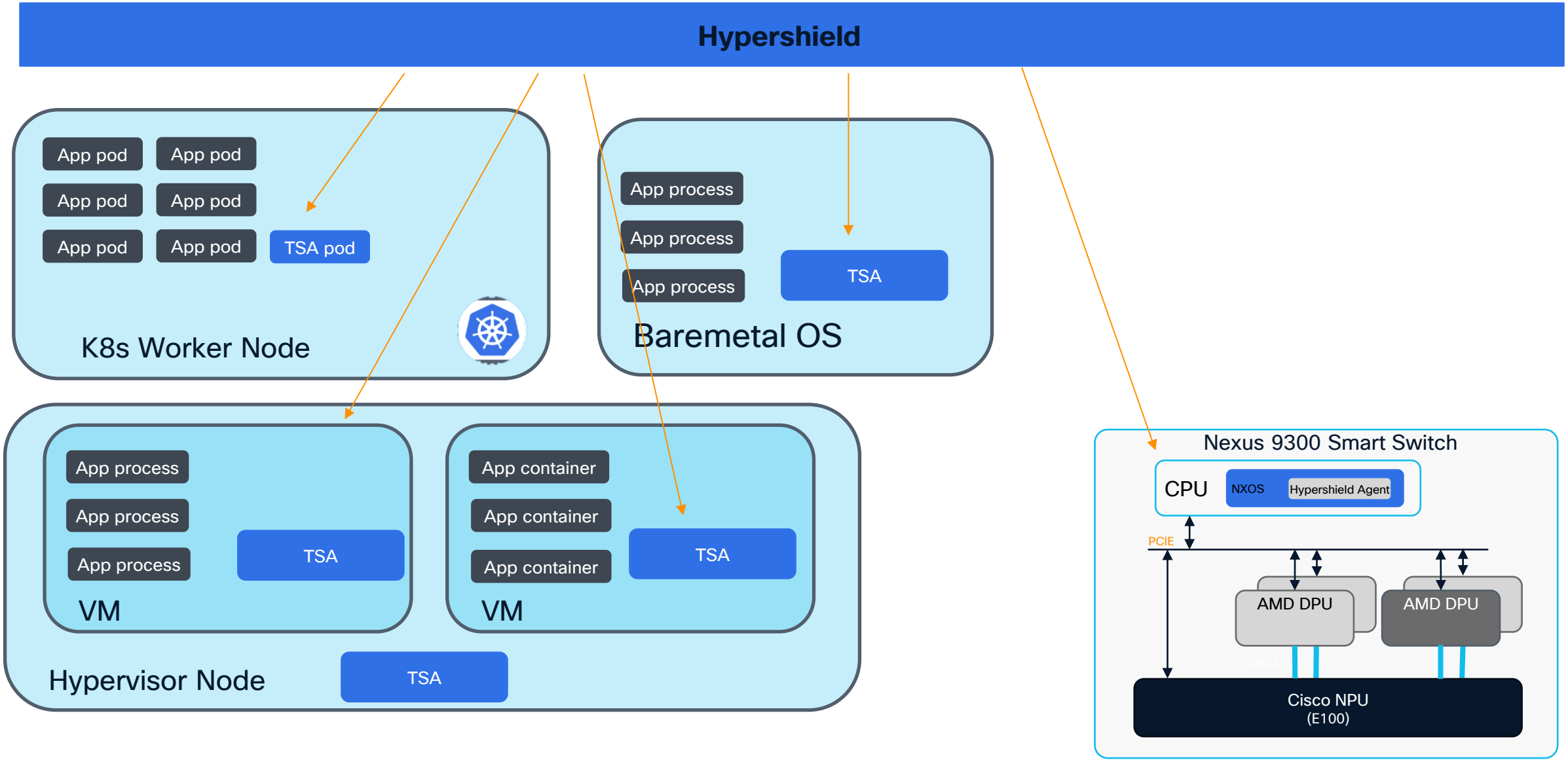
Security Features

Hypershield: Comprehensive Security



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Security functions for Nexus Smart Switch

- Hypershield On-prem Controller
- Traffic redirection to DPUs
- Stateful and stateless filtering
- Policy Sync and HA
- Logging
- VXLAN Integration

- L7 firewalling
- App ID
- IPS
- IDS
- URL filtering
- SSL decryption

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Hypershield Security Policy Example

```
apiVersion: v1alpha1
kind: ACL-Policy
metadata:
  name: "vxlan-segmentation"
  annotations:
    author: "GSX-Admin"
spec:
  logicalNetworkSelector:
    vrf: "red"
  defaultAction: "deny"
  rules:
  - description: "smartswitchRedPolicy"
    hook: "firewall"
    action: "allow"
    source:
    - ipBlock:
        cidr: "10.1.0.1/16"
      ports:
        protocol: "TCP"
    destination:
    - ipBlock:
        cidr: "10.2.0.1/16"
      ports:
        protocol: "TCP"
        ports: [8080]
```

Policy type, name, metadata

Per VRF or VLAN policy

L3 and L4 policy info

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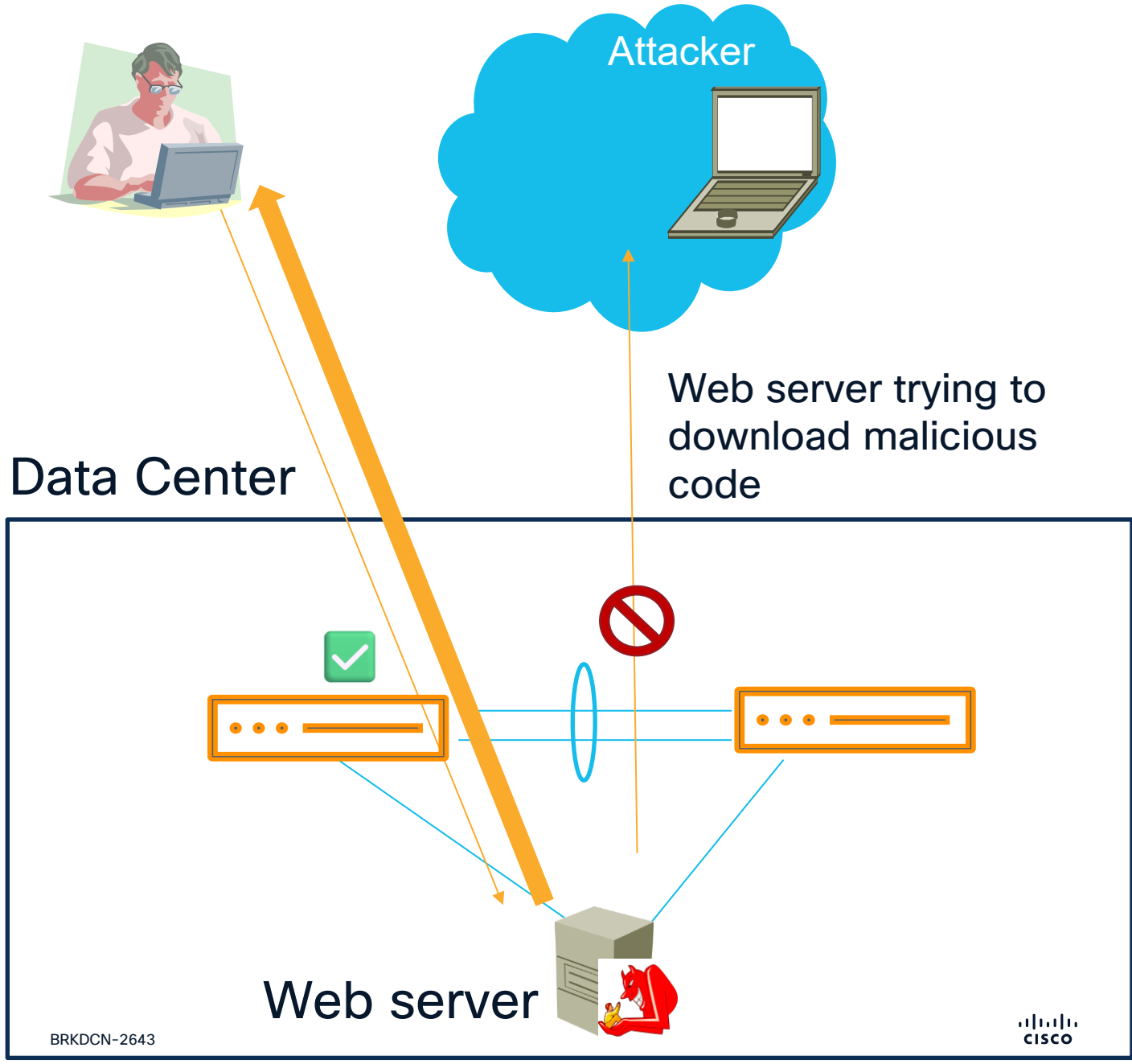
Stateful Filtering

- TCP sequence number checking + Reflexive ACLs
- The server is accessible via an ACL that allows traffic to port 80 in a stateful manner
- After a TCP handshake the ACL will allow only the return traffic to where the request came from
- A compromised server that may initiate connections from port 80 to the outside to download some malicious code will be blocked



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The Cisco Nexus 9300 Smart Switch versus a Firewall

	Nexus 9300 Smart Switch	Firewall
Coordination of policies	Hypershield features	Central Console, L7 functions
Performance/Cost	Higher Performance for less	Less performance
Latency	Lower latency	Higher
Power Consumption	Lower than Firewall+Switch combined	Higher
Stateful Inspection	TCP termination and TCP state tracking	TCP termination and TCP state tracking
MACSEC	MACSEC on Switch ports	NA
Deep Packet Inspection	Few protocols	More features

(*) Latency = ~2.5us (Silicon One) + 3us (DPU) + 2.5us (Silicon One) << FW Latency

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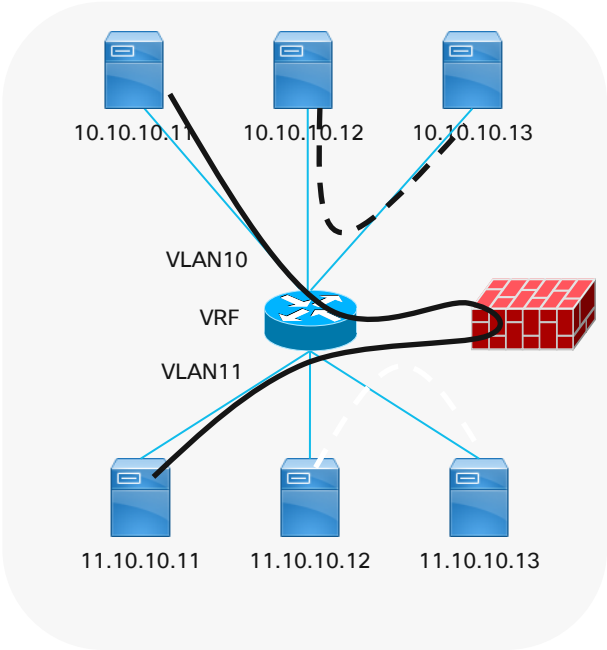
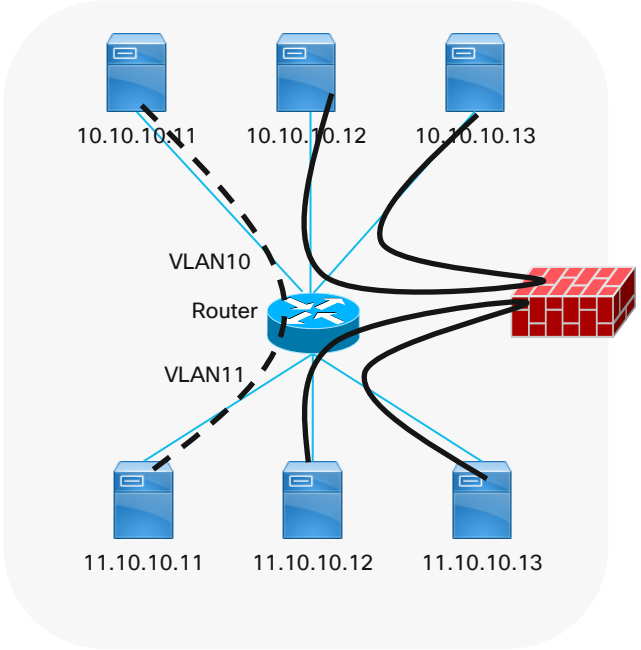
Configuration Examples

How to send traffic to the DPU
VRF Redirect vs VLAN Redirect

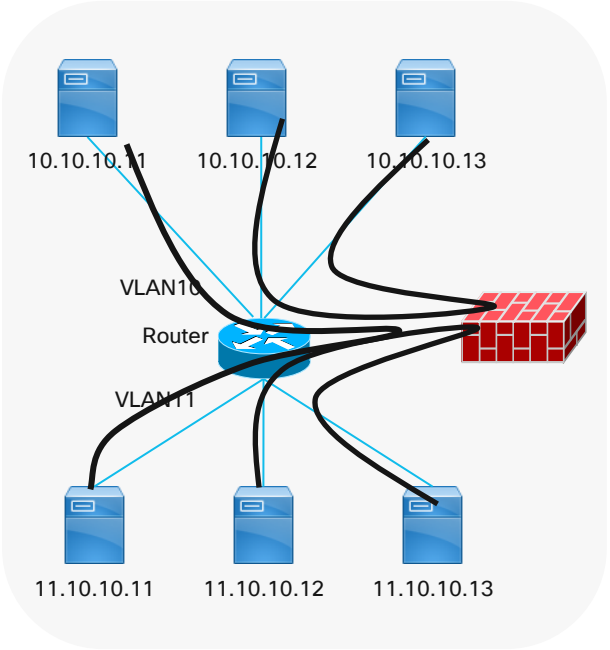
- VRF Redirect
- It applies to routed traffic of a given VRF



- VLAN Redirect
- It applies to bridged traffic of a given VLAN (i.e. traffic within the same subnet)



- VRF+VLAN redirect
- It applies to both routed and bridged traffic of a given VLAN



redirected traffic

non-redirected traffic

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Service Acceleration Configuration for L3 Traffic VRF Redirect

```
feature service-acceleration
service load-balance symmetric-hash
!
service system hypershield
  source-interface loopback100
  service firewall
    vrf red
    vrf green
     in-service

service system hypershield register 34C58A342F...
```

Enable service-acceleration feature – DPUs are powered on

Enable Hypershield service

Loopback to use as source interface

Firewall VRF red and green

Add Hypershield connection token

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Service Acceleration Configuration for L2 Traffic VLAN Redirect

```
feature service-acceleration
service load-balance symmetric-hash
!
service system hypershield
  source-interface loopback100
  service firewall
    vlan 101
    vlan 102
    in-service

service system hypershield register 34C58A342F...
```

Enable service-acceleration feature – DPUs are powered on

Enable Hypershield service

Loopback to use as source interface

Firewall VLAN 101 and 102

Add Hypershield connection token

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Service Acceleration Configuration for L3 Traffic VRF Redirect with pinning

```
feature service-acceleration
no service load-balance symmetric-hash
!
service system hypershield
  https-proxy proxy.example.com port 80
  source-interface loopback100
  service firewall
    vrf red module-affinity dynamic
    vrf green module-affinity 3
    in-service


service system hypershield register 34C58A342F...
```

Enable service-acceleration feature – DPUs are powered on

Enable Hypershield service

Loopback to use as source interface

Specify proxy if necessary

Firewall VRF red, select DPU dynamically based on hash of the VRF number

Enable HS firewall service

Firewall VRF green, use DPU3

Add Hypershield connection token

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Service Acceleration Configuration for L2 Traffic VLAN Redirect with pinning

```
feature service-acceleration
no service load-balance symmetric-hash
!
service system hypershield
 https-proxy proxy.example.com port 80
  source-interface loopback100
service firewall
   vlan 101 bridged-traffic module-affinity dynamic
   vlan 103 bridged-traffic module-affinity 2
   in-service

service system hypershield register 34C58A342F...
```

Enable service-acceleration feature – DPUs are powered on

Enable Hypershield service

Loopback to use as source interface

Specify proxy if necessary

Firewall VLAN 101 select DPU dynamically

Enable HS firewall service

Firewall VLAN 103 use DPU2

Add Hypershield connection token

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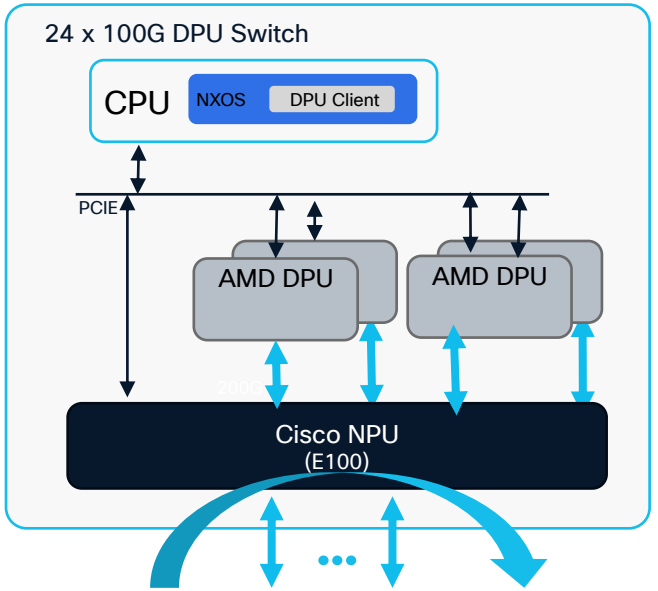
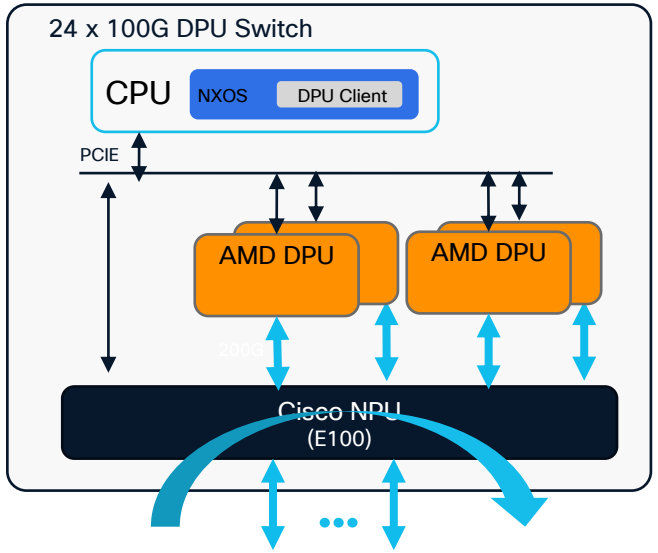
Enable Service Acceleration

- If "feature service-acceleration" is not configured, the DPUs are powered off. The switch functions as a NXOS switch.



- "feature service-acceleration" enablement powers up the DPUs but to complete the configuration you need to define which VRFs traffic should be redirected to the DPU



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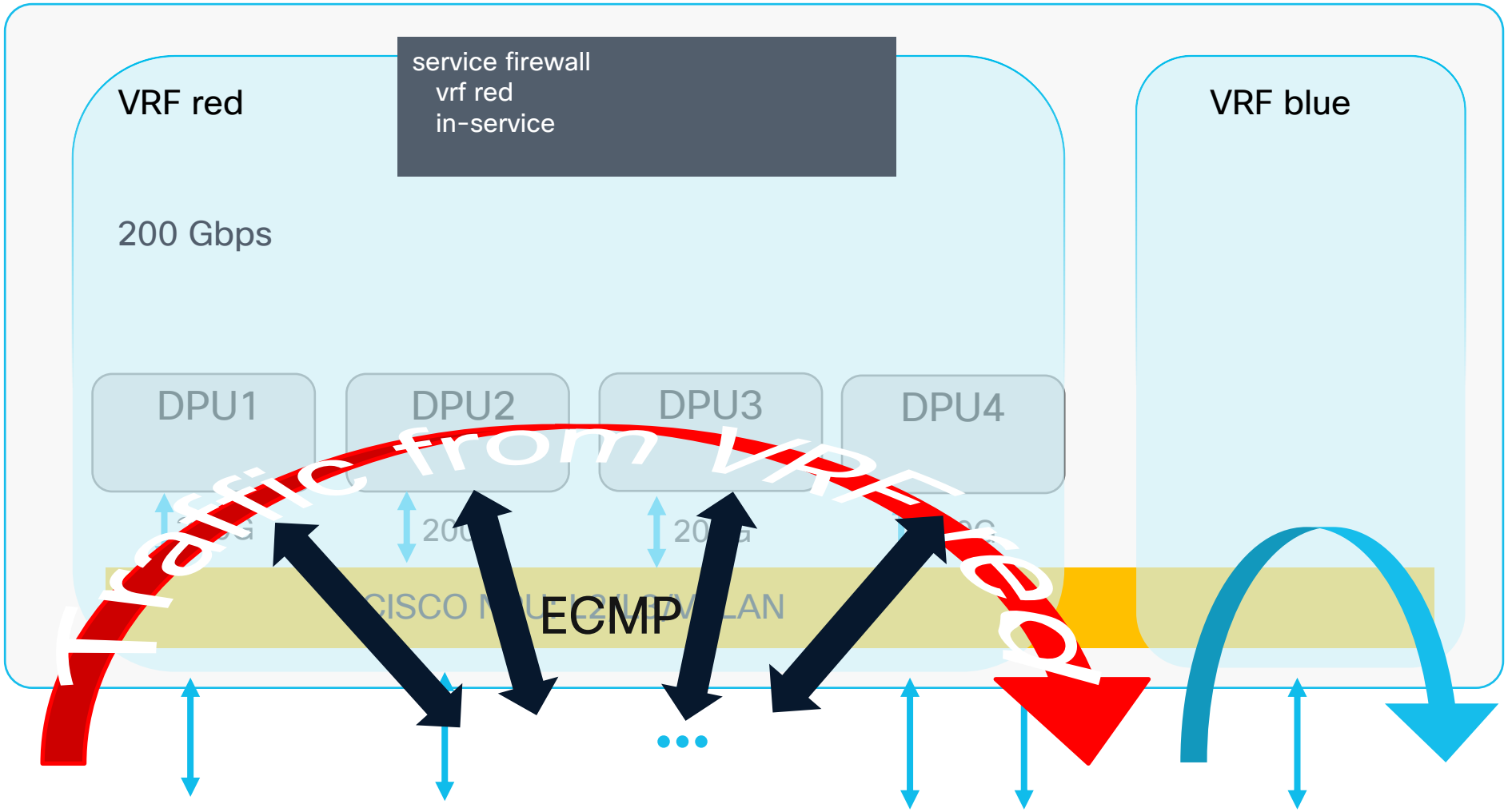
By Default VRF Traffic is sent to all DPUs



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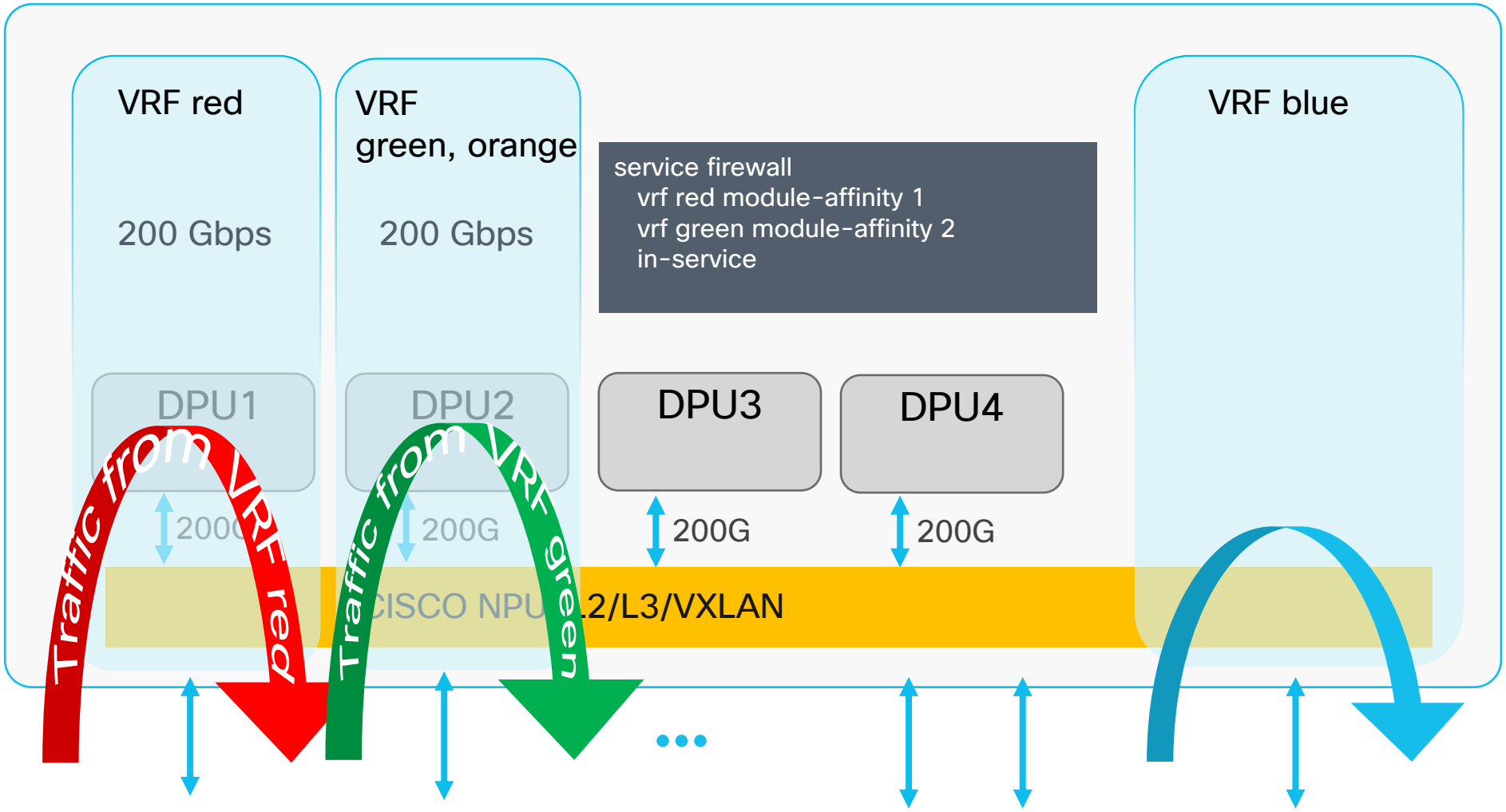
You can also Assign VRF traffic to a specific DPU Configuration for L3 Traffic



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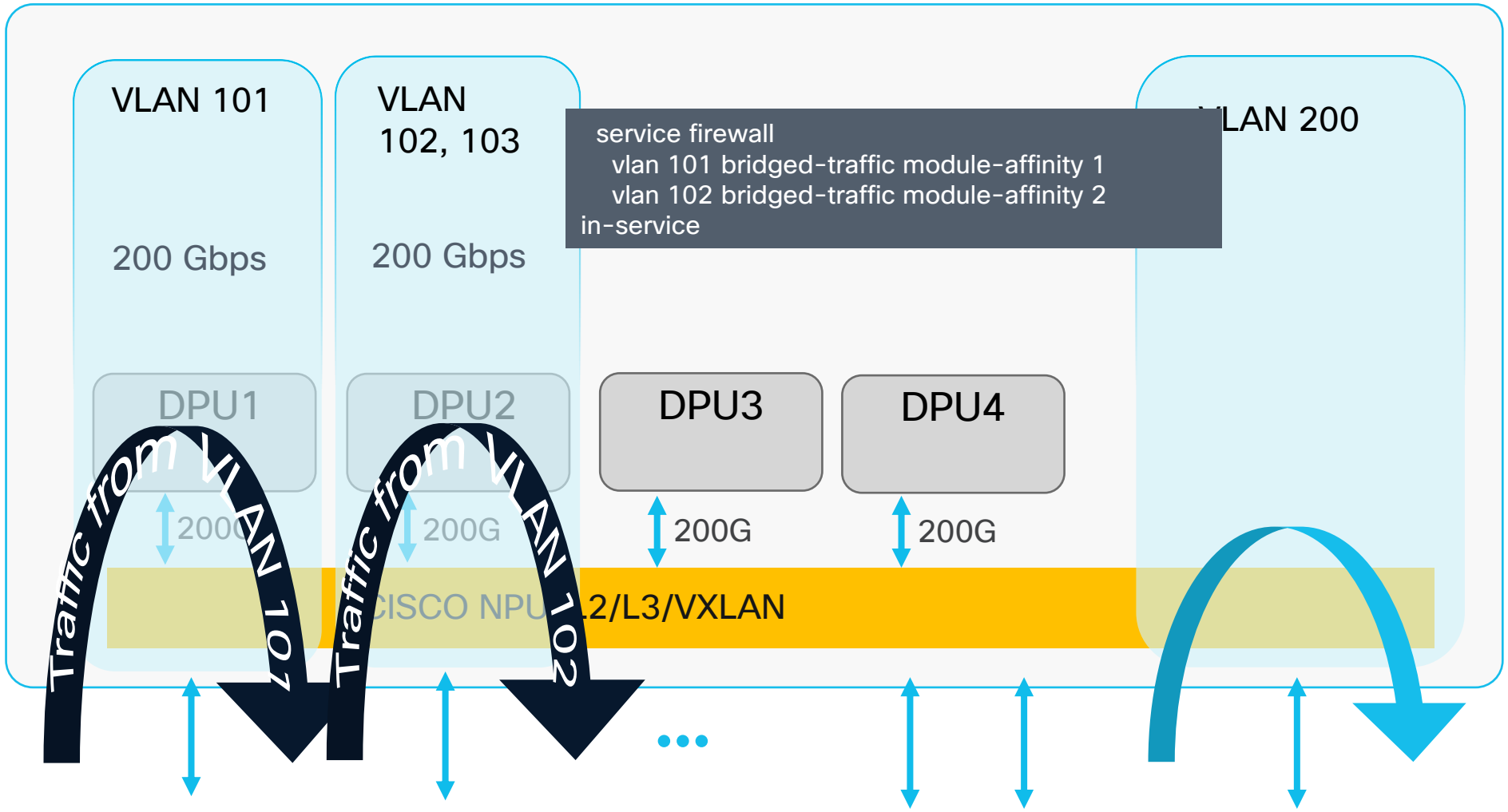
You can also assign VLAN traffic to a specific DPU Configuration for L2 Traffic



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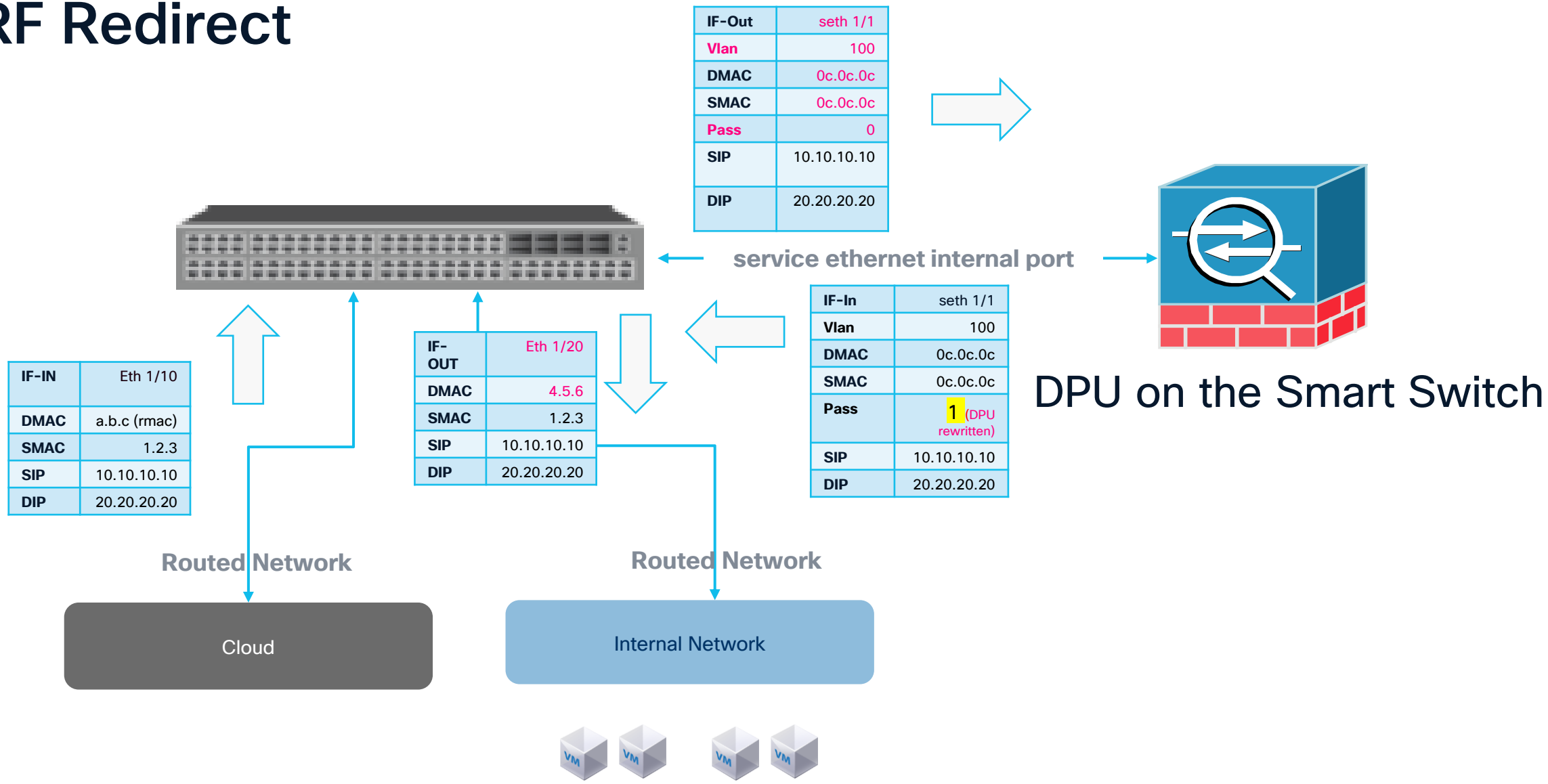
Packet Walk

Smart Switch Represented as a Switch + a Firewall VRF Redirect



DPU on the Smart Switch

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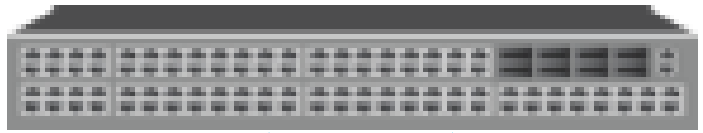
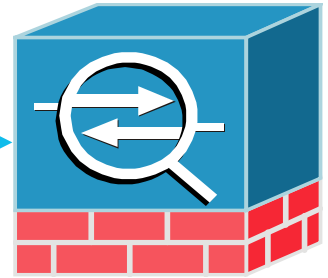
Smart Switch Represented as a Switch + a Firewall
L2 Redirect

IF-Out	seth 1/1
Vlan	10
DMAC	0c.0c.0c
SMAC	0c.0c.0c
Pass	0
SIP	10.10.10.10
DIP	10.10.10.20

VLAN information is preserved



service ethernet internal port



IF-In	seth 1/1
Vlan	10
DMAC	0c.0c.0c
SMAC	0c.0c.0c
Pass	1 (DPU rewritten)
SIP	10.10.10.10
DIP	10.10.10.20

DPU on the Smart Switch

IF-IN	Eth 1/10
VLAN	10
DMAC	4.5.6
SMAC	1.2.3
SIP	10.10.10.10
DIP	10.10.10.20

IF-OUT	Eth 1/20
VLAN	10
DMAC	4.5.6
SMAC	1.2.3
SIP	10.10.10.10
DIP	10.10.10.20

App (Vlan 10)
10.10.10.0/24
(GW: 10.10.10.1)

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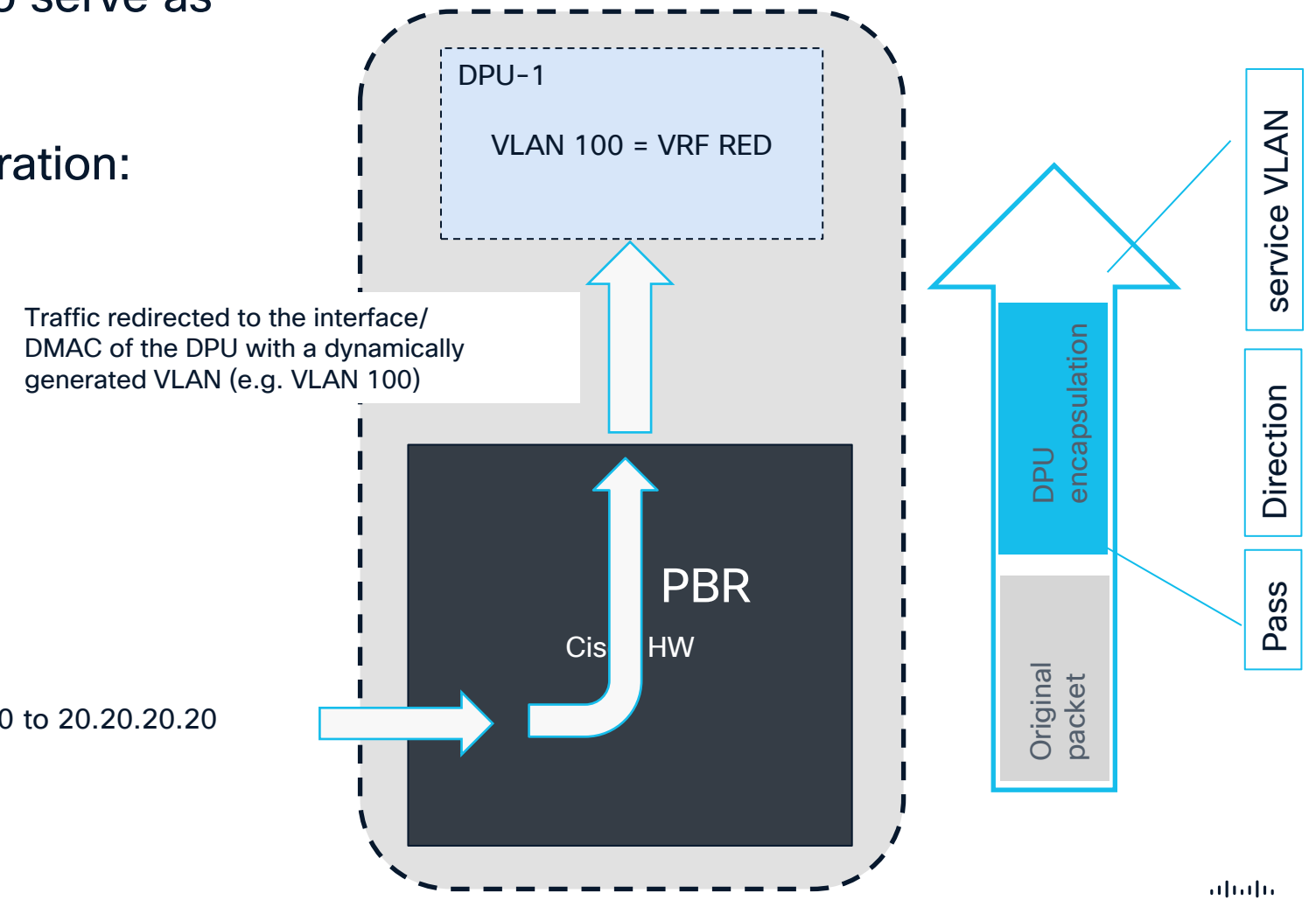
Redirect from NPU to DPU

VRF-Lite Vlan carried as 802.1q tag, to serve as identifier for VRF Context

NXOS Dynamically Generated Configuration:

```
interface seth1/3.100
  vrf member red
  encapsulation dot1q 100

epbr service __red_dpu_redir type dpu
  vrf red
  service-end-point module 1 vlan 100
```



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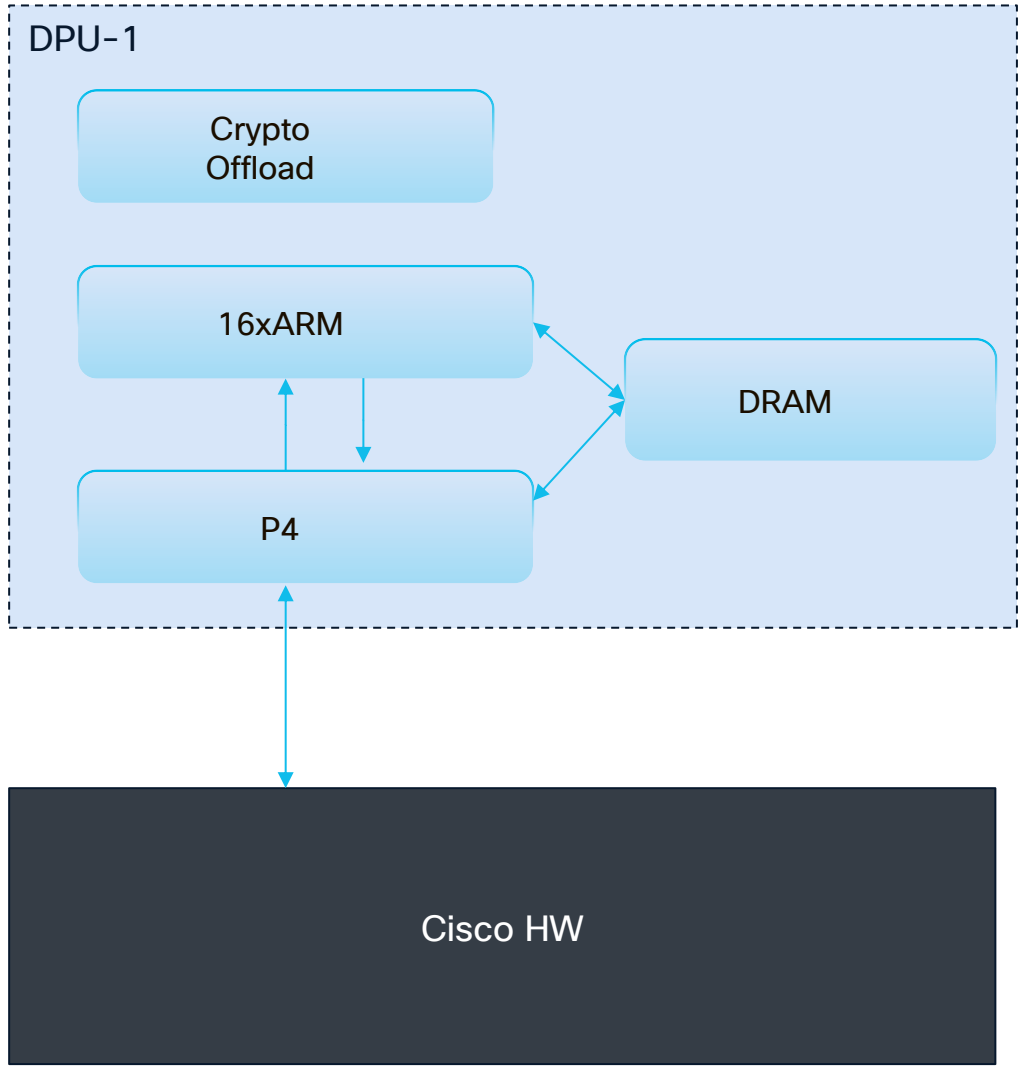
DPU Day in the Life of a Packet

- Packet comes to the DPU P4 pipeline
- If the flow is not found in the flow-table, packets are punted to VPP to setup the flows
- Once the flow is installed, all subsequent packets are forwarded in P4 except:
  - SYN, SYN-ACK, ACK and FIN, FIN-ACK, ACK => VPP
  - These are also synchronized to the peer in case of HA
  - ALG (TFTP/FTP/RPC/RTSP/DNS) – P4 does not support parsing of ALGs, so all the packets are punted to VPP to be parsed.



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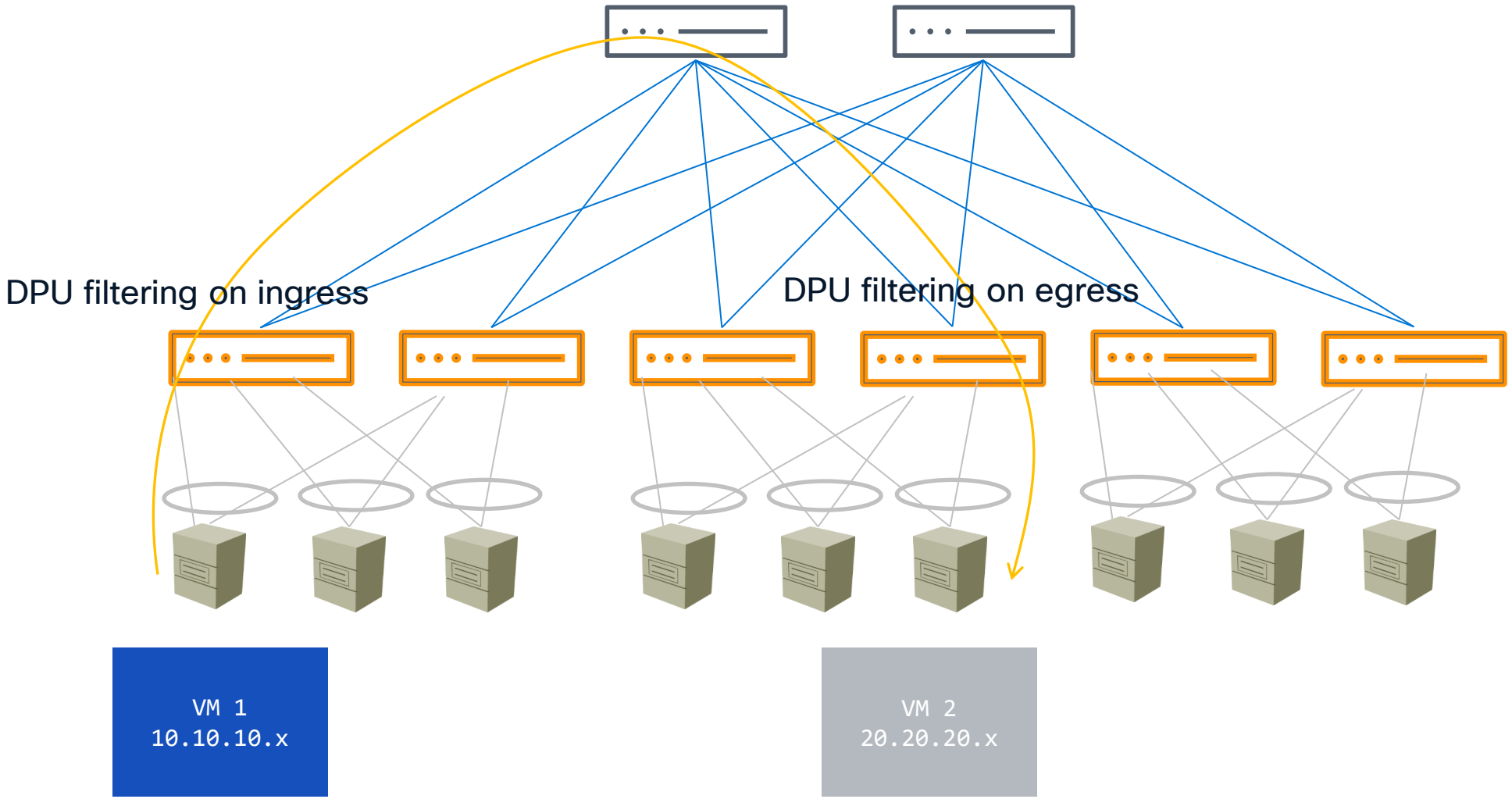
VXLAN Integration



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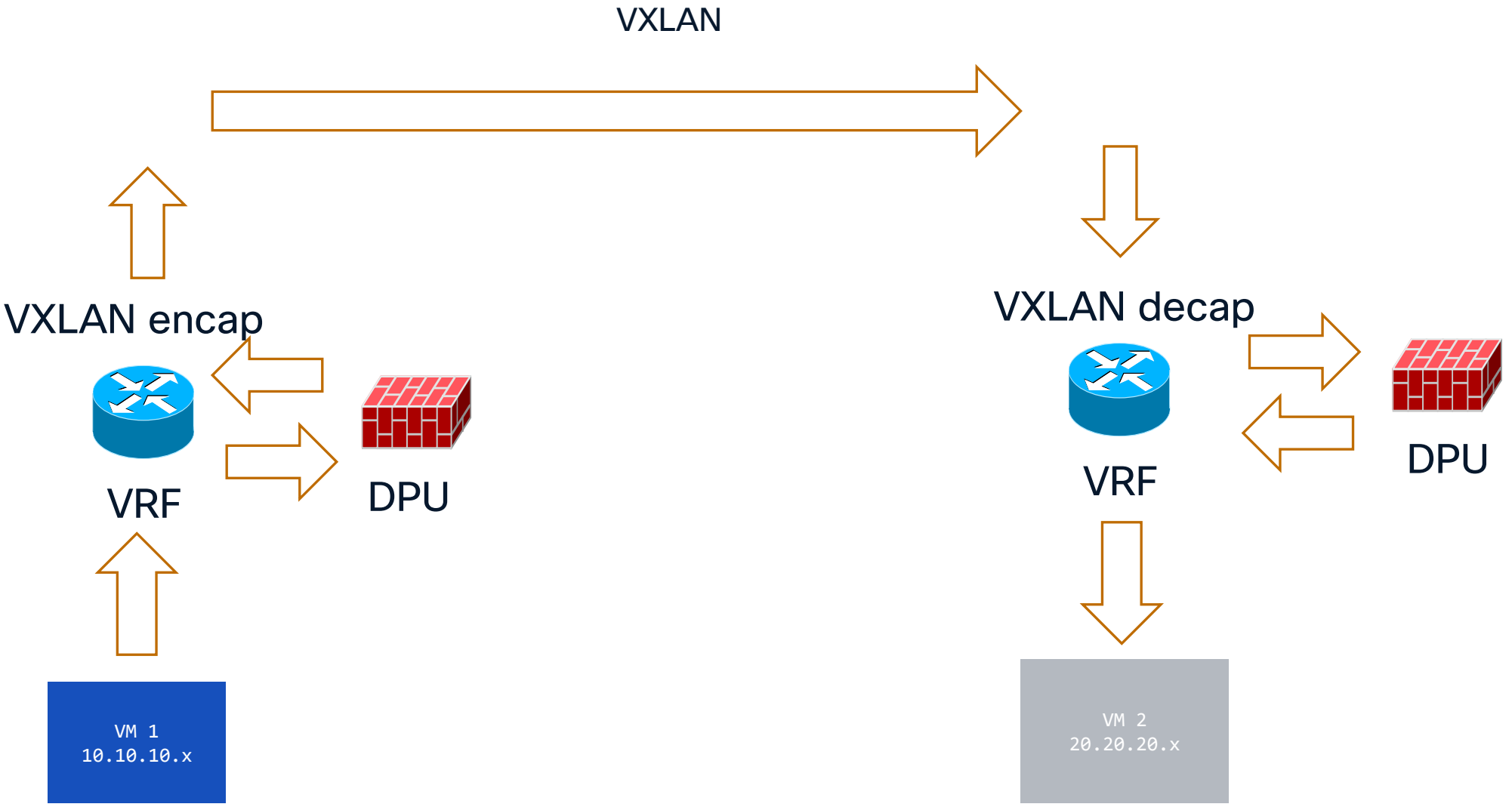
VXLAN Integration

Packet Walk



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Top of the Rack Deployment Examples

Smart Switch “Networking Mode” ToR Use Case

Available Now

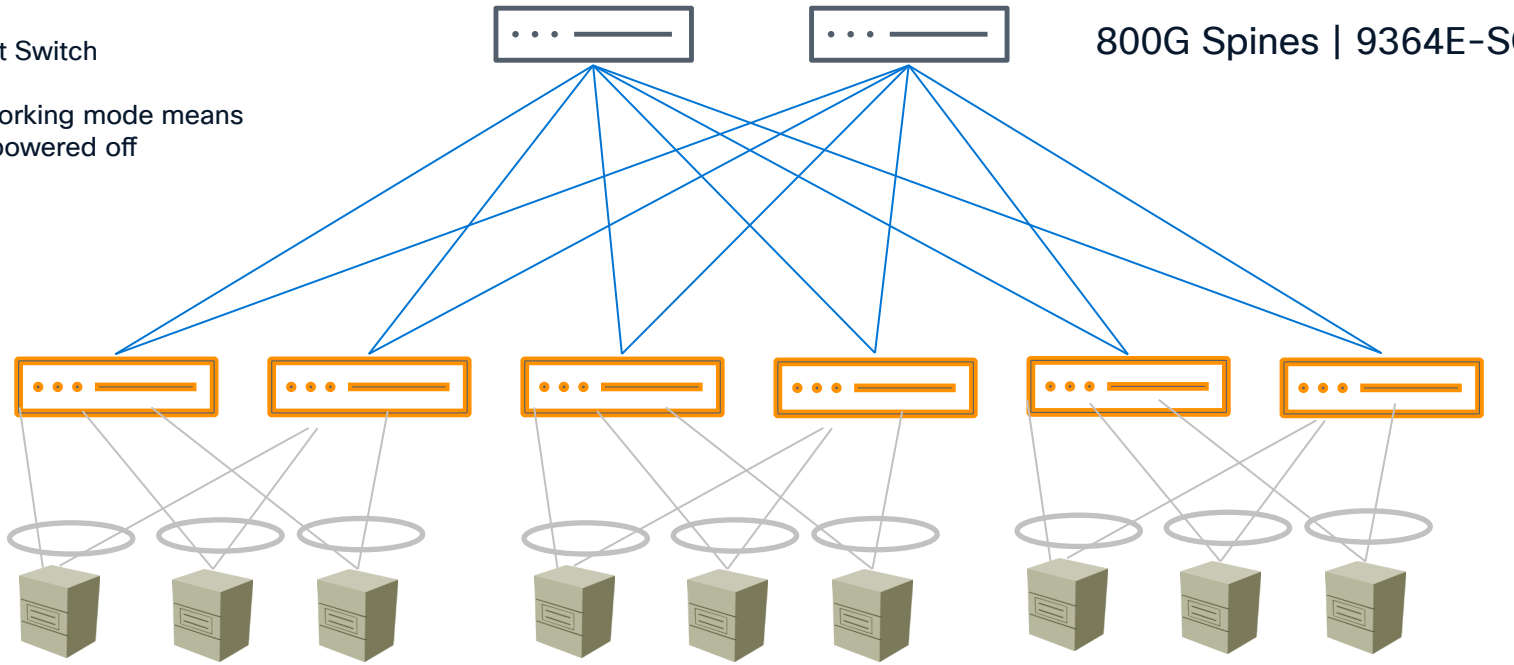
Smart Switch

Networking mode means DPUpowered off

BGP fabric or VXLAN Fabric

400G Spines | GX2A, GX2B, H2R

800G Spines | 9364E-SG2



Cisco N9300 Series Smart Switch
(N9348Y2C6D-SE1U, N9324C-SE1U)

Single Fabric
- VXLAN-EVPN
- BGP

ToR Smart Switch
N9348Y2C6D-SE1U, N9324C-SE1U

Multi-Site
VXLAN-EVPN

ToR Smart Switch
N9348Y2C6D-SE1U, N9324C-SE1U

- ✓ Comprehensive fabric features (L2, L3, QoS, Multicast, VPC, L2 mobility, L2/L3 stretch, etc ...)
- ✓ https://www.cisco.com/c/en/us/td/docs/dcn/nx-os/nexus9000/106x/release-notes/cisco-nexus-9000-nxos-release-notes-1061sF.html

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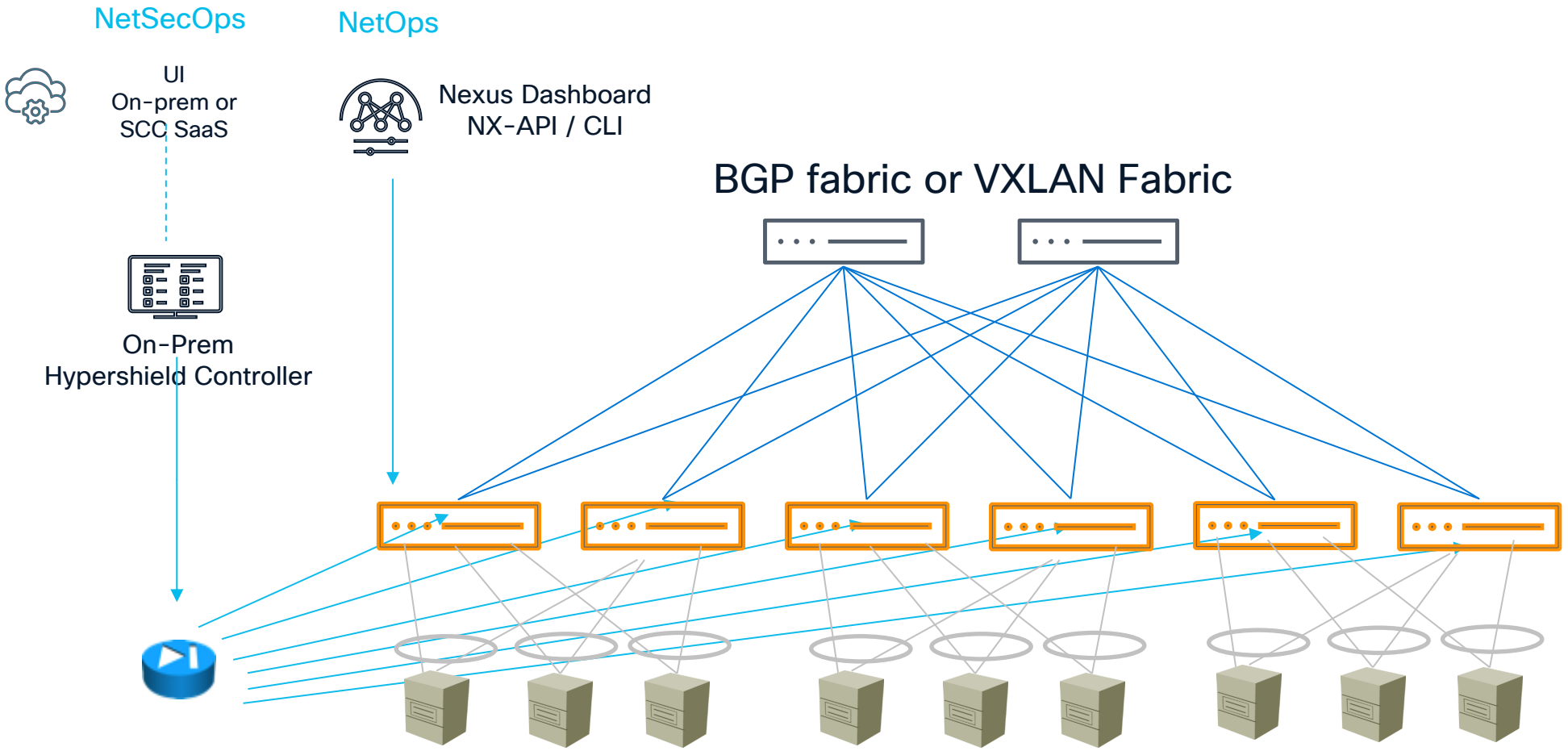
Smart Switch “Networking & Security” Use Case

Top of Rack L4 Segmentation – 10.6(2s)



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High Availability
NXOS 10.6(2)
based on current plans

CISCO Live !

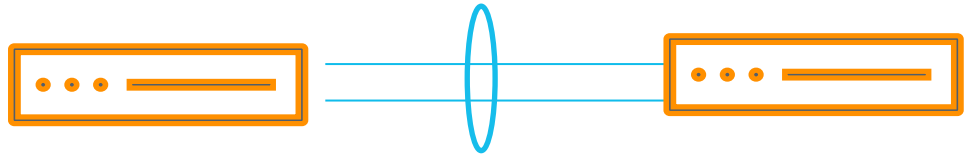
Stateful Filtering + HA => State Synchronisation

- The Smart Switch performs stateful filtering
- TCP connection information is synchronized between two Smart Switches
- As of 10.6(2s), this requires direct connectivity over redundant links
  - The architecture can allow non direct cabling

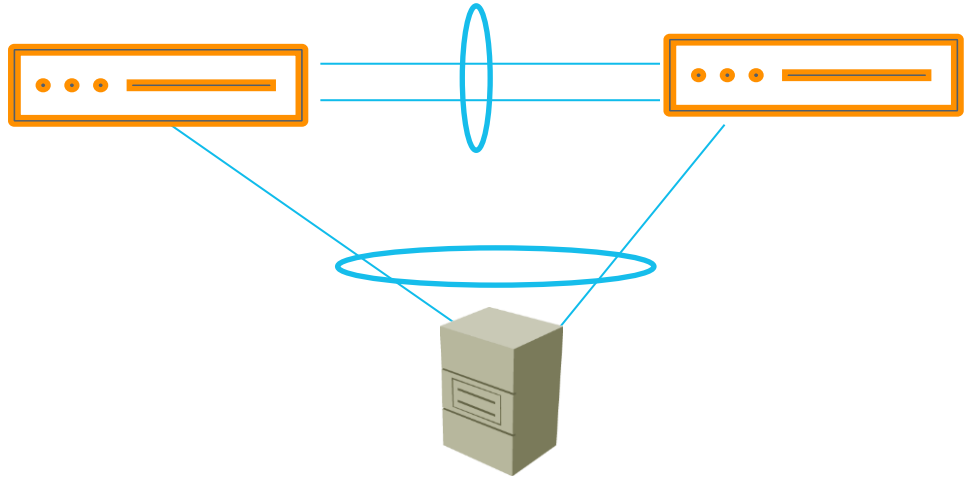
- The minimum requirement is 2 x 25G links
- In the future this link can be "virtual" over the fabric

The connectivity can be over a L3 Interface or an SVI

2x 25G (can also be Breakout ports)



The vPC peer link can also used for state synchronisation



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HA Configuration

- The configuration specifies a Port-channel configured with an IP address
  - A Port-channel instead of just a L3 interface is for redundancy purposes
- Or a VLAN = SVI
- Or a Loopback: not in this first release but in a future release
  - The Loopback is to support non direct connectivity between HA pairs

- `(config) #service system hypershield`
- `(config-svc-sys)#[no] high-availability`
- `(config-svc-sys-ha)#[no] source-interface <Po N/Vlan/Loopback>`
- `(config-svc-sys-ha)#[no] peer <IP addr>`
- `(config-svc-sys-ha)#[no]`

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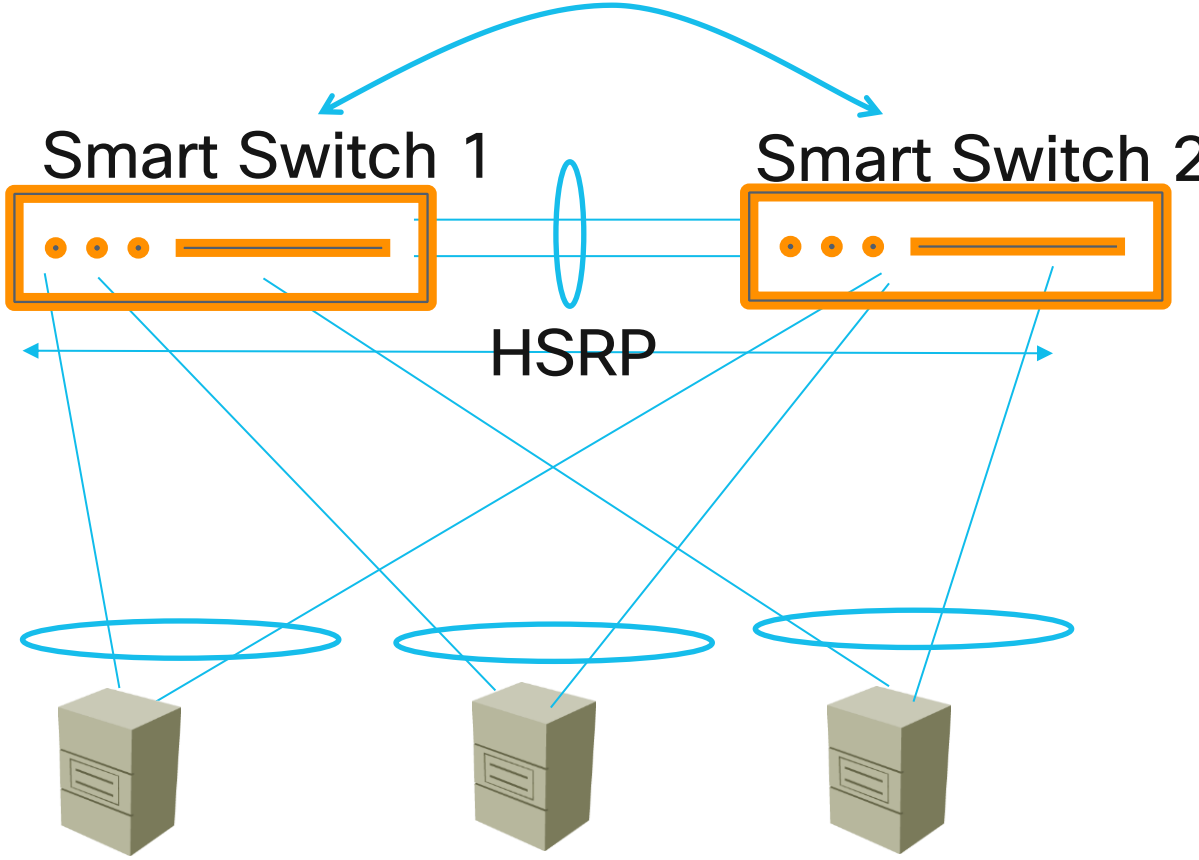
HA deployment with vPC

- In case of a vPC Deployment the HA connectivity is on a VLAN on the same Port-channel used by vPC as the peer link.
- The HSRP MAC is simultaneously active on both Smart Switches
- DPU filtering with VLAN Redirect and/or VRF Redirect works within the same HA-pair



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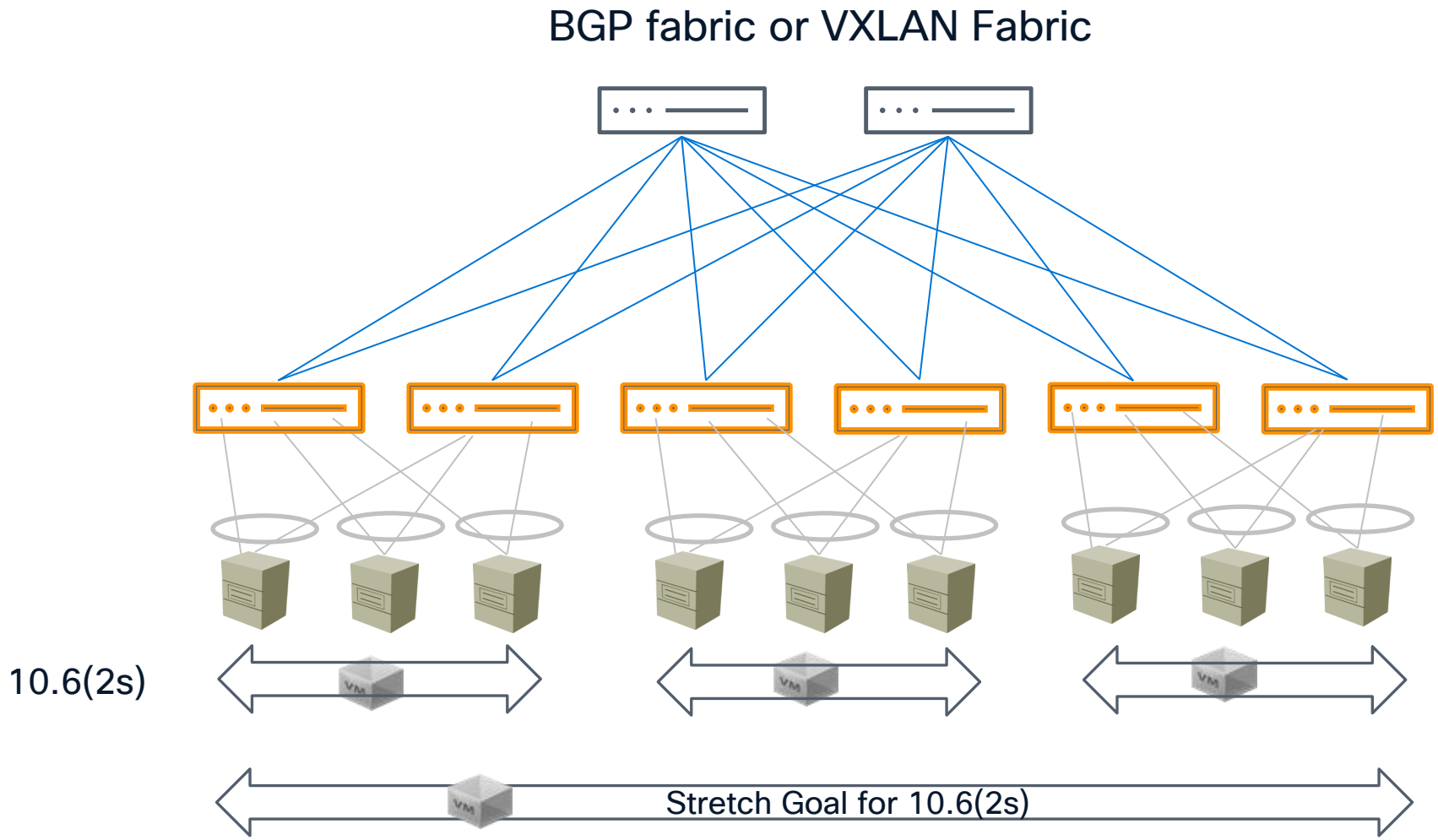
Stateful Filtering and VM Mobility
In 10.6(2s) VM mobility within HA pair



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Features by release

NXOS 10.6(2): Network Features Planned for end of November 2025 (*)

N9324C and N9348Y2C6D-SE1U switch support

Feature set with DPUs enabled:

- Layer 2 features
  - Access, trunk, SVI, L2 port-channel
  - VLANs, spanning-tree (RSTP/MST)
  - VPC
  - LACP
  - RACL on SVI
- HSRP/VRRP for gateway redundancy
- Transport infrastructure for Hypershield HA – VPC peer link or direct L3
- VLAN-based redirection to DPUs
- Inter-VRF and inter-VLAN traffic flow via DPUs (different VRF/VLAN in and out)
- SPAN/ERSPAN, including Service-Ethernet ports
- Nexus Dashboard support for N9324C

(*) This is an indicative roadmap and it may change, pls refer to the official product management presentations for accurate information

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NXOS 10.6(2): Security Features Planned for end of November 2025 (*)

- Stateless filtering
- Stateful filtering (stretch goal)
- VRF or VLAN redirection to the DPU
- 100k policy filtering rules
- 800Gbps of Throughput
- 80k CPS/DPU
- Canary Rollout/Rollback

- Syslog:
  - to syslog server
  - to Controller
  - to Splunk (TBD)

(*) This is an indicative roadmap and it may change, pls refer to the official product management presentations for accurate information

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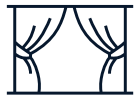

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