

Pluribus Netvisor ONE Network Operating System

Linux-based Open Network Operating System with Integrated SDN Automation Powering Open Networking Switches and DPUs for Enterprise and Service Provider Cloud Data Center Deployments

Highlights

- Linux-based, virtualized, modular network OS built for open networking hardware, including ONIE- and OCP-compatible switches and DPUs
- High-performance, scalable, best-in-class, interoperable IPv4 and IPv6 L2/L3 switching and routing
- Integrated SDN providing a rich set of distributed and highly automated overlay services such as distributed policies, distributed VRF routing, anycast gateway, bridge domains with flexible encapsulation (including Q-in-Q) and more
- Microsegmentation to isolate and secure traffic across data center and metro networks
- Extensive QoS, advanced security, policy and control plane protections
- Highly available and resilient network operating system for non-stop operations
- Open REST API enabling programmability and integration with orchestration platforms
- Integration with Ansible, vCenter and OpenStack to automate operational workflows
- Single pane of glass to manage and monitor a geographically distributed fabric

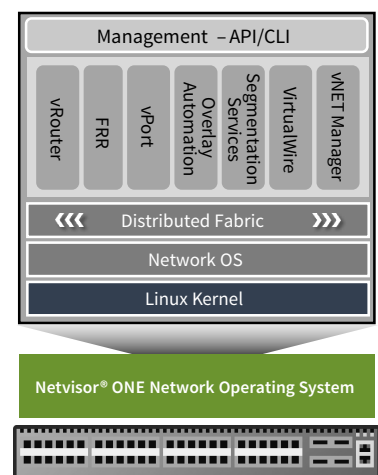
Netvisor® ONE is an open, secure, highly automated and programmable next-generation network OS that is purpose built to optimize the power and performance of disaggregated open networking hardware including switches and data processing units (DPUs). Netvisor ONE is the industry’s only networking OS that is designed to provide a common operating system and common network operations model that can be deployed across switches and DPUs as well as virtual instances in the public cloud. Netvisor simplifies and accelerates the transformation of legacy data center networks into unified cloud networks. Deployment-proven in mission-critical enterprise and service provider networks around the world, Netvisor ONE meets the most stringent performance requirements and delivers the maximum levels of reliability and agility at scale, without compromise.

Built on a Linux foundation, Netvisor ONE is a cloud-native, best-in-class, full-featured network OS that delivers an extensive range of network services, and Layer 2 and 3 switching and routing protocols supporting both IPv4 and IPv6. Netvisor is built using open networking standards to assure interoperability and operational consistency with existing traditional networking infrastructure, enabling simple insertion and a seamless transition to a disaggregated open networking strategy.

The programmable and containerized architecture of Netvisor ONE enables the rapid adoption and deployment of new networking features and advanced networking services as standards evolve and new capabilities become available.

Integrated directly into Netvisor ONE OS is the Unified Cloud Fabric software, a distributed, controllerless SDN control plane that radically automates the deployment and ongoing operations of underlay and overlay cloud data center networks. The Unified Cloud Fabric can elegantly span multiple locations, so they appear as one logical cloud data center with multi-tenant segmentation and microsegmentation to simplify the management and ensure consistency across multiple cloud data center locations.

Exposed APIs support full programmability and provide unrestricted access to the data, control and management planes for true agility to deliver exceptional operational flexibility.



Netvisor OS provides a modular, resilient software design with advanced Layer 2 and 3 networking and services

Built to Power Open Networking Hardware

Netvisor ONE runs on many open networking platforms including switches and DPUs deployed in servers. Netvisor ONE is compatible with many Open Compute Project (OCP) and Open Network Install Environment (ONIE) hardware-compliant switches, including devices from Dell Technologies and Edgecore as well as the Pluribus Freedom™ Series network switches. This flexibility allows organizations the choice of open networking hardware to build scale-out networks with 10, 25, 40, 100 or 400 Gigabit Ethernet interfaces. This means an entire data center can be built with a small set of 1RU disaggregated physical switch models to improve scale, operational consistency, lower costs and simplify sparing strategies. For server-based deployments using DPUs, Netvisor ONE runs on the NVIDIA Bluefield DPU family and is designed to run on other open DPUs in the future.

Deployment Flexibility

Netvisor ONE can be deployed as a single OS software image to support any mix of multiple vendor open networking switches in all cloud deployment topologies, including the data center leaf and spine, metro rings, hub and spoke, campus core and aggregation and more. Build a network with multi-vendor hardware to flexibly support evolving physical interface requirements unified by a common and consistent OS to reduce operational complexity, improve efficiency and lower TCO.

Standards-Based for Multi-Vendor Interoperability

The Netvisor ONE OS supports rich and reliable standards-based networking capabilities and can be seamlessly inserted into any existing network, enabling full interoperability with standards-based networking equipment, protocols or network topology. This enables graceful migration to next-generation, disaggregated open networking cloud architectures while preserving existing technology investments and operational models. Integration of open source FRRouting brings in a rich IP routing protocol suite (OSPF, OSPFv3, BGP, MP-BGP, static routes etc.).

High Availability and Resiliency

To meet the stringent continuous availability requirements for mission-critical enterprise and service provider operations, Netvisor ONE provides a comprehensive array of standards-based redundancy protocols and services. The fully distributed control plane architecture enables a highly available Layer 2/3 underlay and overlay infrastructure. Key high-availability capabilities include switch clustering, multi-chassis LAG (vLAG) VRRP, BFD, ECMP, redundant VTEPs and distributed anycast gateway. Netvisor ONE is built for ultra-fast convergence and sub-second failover to enable reliable deployment as either an underlay or overlay network. When deployed in the Unified Cloud Fabric distributed architecture, the unique peering architecture enables highly available, resilient operations across the fabric regardless of the physical location of devices.

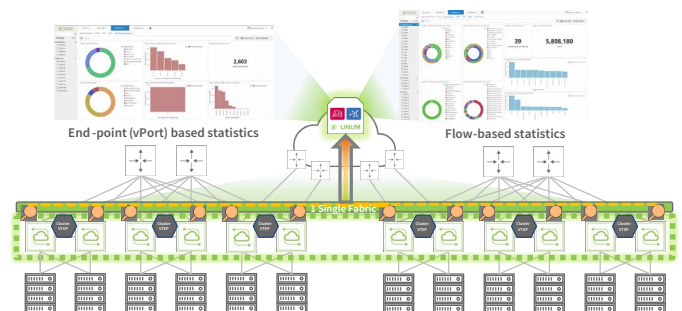
Control Plane Traffic Protection

Netvisor ONE delivers exceptional high availability with its Control Plane Traffic Protection (CPTP) architecture. CPTP protects the CPU from excessive traffic volumes and provides fine-grained control and QoS over different types of control plane classes using 44 independent queues. The auto-quarantine host-hog prevention mechanism identifies and automatically quarantines offending host traffic in hardware. The offending host activity is monitored and traffic is resumed automatically when the offending flow ceases.

Unified Cloud Fabric Architecture

The Unified Cloud Fabric is a simple and secure next-generation software-defined peer-to-peer distributed network cloud architecture that radically simplifies network operations, speeds service delivery and virtually eliminates human error. The fabric abstracts the complexities of the underlying physical network and brings a public-cloud operational model to any cloud or data center network. The fabric's automation eliminates 90+% of the configuration steps associated with managing an overlay fabric across distributed switches and DPUs and its automated roll back ensures 100% configuration consistency across all devices in the fabric.

The Unified Cloud Fabric operates without a controller, dramatically reducing the cost of SDN automation and delivering significant operational advantage over controller-based SDN architectures. This distributed, controllerless architecture enables it to seamlessly interoperate with existing networks, providing a non-disruptive, graceful migration to an automated cloud data center.



The Unified Cloud Fabric architecture clusters member switches and DPUs into a symmetrical, unified operating domain

Due to its distributed architecture, the Unified Cloud Fabric can be deployed across a single data center or just as easily stretched across multiple geographically distributed cloud data centers over any existing Layer 2 or Layer 3 core to support highly resilient active-active data center architectures. The VXLAN-based fabric overlay can scale out to support many thousands of ports, with multi-terabit capacity, performance and latency predictability, and support millions of concurrent connections. The Unified Cloud Fabric also supports use of BGP EVPN to enable interconnection of multiple fabrics including multi-vendor interoperability with other fabrics supporting BGP EVPN.

Manageability, Programmability and Automation

The programmability of Netvisor ONE and the Unified Cloud Fabric deliver rapid service provisioning through open programming interfaces enabling both NetOps and DevOps automation to accelerate provisioning, configuration changes and new service rollouts. Policy and services can be provisioned with a single command via RESTful APIs or command line interface (CLI) with complete functional parity. Netvisor ONE supports plug-and-play operations and zero-touch provisioning and configuration.

Additional automation tools, such as Ansible or Pluribus UNUM™ Fabric Manager software, can be leveraged to further streamline the provisioning of an entire deployment. In addition, Netvisor ONE supports a wide array of Linux tools and programming languages for scripting and automation such as Python, as well as traditional NetOps interfaces for SSH, TLS 1.2, SNMP, Syslog and sFlow.

Secure, Role-Based Management Access

The Netvisor OS has extensive security mechanisms to protect access to OS commands through authentication, authorization, and accounting (AAA) access controls. Administrative user authentication is supported through standards-based mechanisms including TACACS+, Secure Shell (SSH) Version 2 and TLS 1.2. Granular permissions can be defined on a per-user, per-role and per-tenant basis, limiting command-level access for all commands performed for all configuration levels.

Advanced Multi-Tenancy

The Netvisor OS offers the ability to create multi-tenancy and application isolation across the fabric through segmentation leveraging VLANs and distributed VRFs. A subset of physical ports or logical interfaces across multiple data center locations can be assigned to a single tenant.

When Netvisor ONE and the Unified Cloud Fabric are deployed in server-based DPUs, they enable additional security capabilities including microsegmentation and distributed firewalls, all without impacting the server CPU.

Additionally, Netvisor offers VNET functionality which enables segmentation across the management plane. With vNETs service providers can completely isolate tenants and even allow tenants to control their own network segment with the automation or orchestration tool of their choice.

The unique network virtualization of Netvisor ONE allows any device in the fabric to instantiate multiple virtual networks that can be dynamically allocated to a single device, or span across multiple physical devices enabling granular network segmentation and multi-tenant services at wire speed.

Network Visibility with No Extra Hardware

Netvisor ONE and the Unified Cloud Fabric provide comprehensive telemetry for every flow that traverses the fabric. FlowTracker supports TCP, UDP, ICMP and infrastructure services flows such as DHCP, DNS and more. This capability is native to Netvisor, and works fabric-wide, enabling network operations teams to avoid the cost of building an overlay network consisting of TAPs, TAP aggregators and packet brokers, saving tremendous capital and operational expense.

The rich meta-data for each flow can be accessed and filtered directly on any switch in the fabric. Alternatively, the meta data for hundreds of millions or even billions of flows can be exported to the UNUM Insight Analytics software, which provides a time machine function, rich graphical dashboards and a powerful search function supporting rapid troubleshooting and fault resolution.

Netvisor ONE also offers KubeTracker™, an advanced feature set that provides NetOps teams visibility into flows between containers inside a Kubernetes cluster as well as the ability to determine where each container is located in the fabric and with which application it is associated. VMTracker provides a similar function for virtual machines that are being managed with VMWare vCenter.

Additional Advanced Fabric Services

Additional high-value advanced network services enabled by Netvisor ONE include:

- Network packet broker services, which can be provisioned as a stand-alone packet broker fabric or as a virtualized overlay service integrated in a production network fabric
- Layer 1 switching with the VirtualWire license supporting hardware test lab automation
- Metro networking with an advanced metro interconnect architecture that utilizes lower cost data center-class white box switches for high performance metro networking
- Integrations with RedHat OpenStack and VMware vCenter for automated provisioning of network resources

Warranty and Support

Pluribus Networks offers a wide range of advanced services spanning the entire network lifecycle to protect investments and help accelerate success when deploying and optimizing the Netvisor operating system and next-generation network architectures. Multiple extended support options are available, including on-demand global support, on-site support, advanced hardware replacements and professional implementation services. Maintenance options include direct access to a team of expert network engineers with deep networking experience and our self-service online Customer Portal. For more information about Pluribus support options, visit <http://www.pluribusnetworks.com/support> or contact a Pluribus Networks authorized reseller.

License Options					
	Enterprise License	Fabric License	vNET License	VirtualWire Single-switch License	VirtualWire+ License
Layer 2 Networking	●	●			●
Layer 3 Networking	●	●			●
Unified Cloud Fabric Distributed Architecture	● ¹	●			●
VXLAN services	● ¹	●			●
vNET Segmentation and Tenant Services			●		
Monitoring Telemetry	● ¹	●			●
VirtualWire™ and Packet Broker Services				●	●

¹ Enterprise License supports Unified Cloud Fabric features for fabrics up to 6 switches. For larger fabrics, the Fabric License is required.

Features and Specifications

Layer 2

- 802.3z Gigabit Ethernet
- 802.3ab 1000BASE-T
- 802.3ae 10 Gigabit Ethernet
- 802.3ba 40 Gigabit Ethernet
- 802.3ba 100 Gigabit Ethernet
- 802.1D Spanning Tree
- 802.1w Per VLAN Rapid Spanning Tree Protocol (RPVSTP) and RSTP PortFast
- 802.1s Multiple Spanning Tree Protocol (MSTP)
- 802.3ad Link Aggregation (LACP)
- Link Aggregation Group (LAG)
- Multi-Chassis LAG (vLAG)
- STP Cluster Awareness
- Port Fast, BPDU Guard, BPDU Filter, Root Guard
- 802.1q VLANs, VLAN Trunks
- 802.1ab Link Layer Discovery Protocol (LLDP)
- Storm control for Multicast and Broadcast
- IGMP v2/v3 snooping
- MLD snooping v1/v2
- Jumbo frames (9216 Bytes)
- Private VLAN Edge (for Cisco Interop)
- Fabric ARP and IPv6 Neighbor Discovery Optimization
- Fabric Guard

Layer 3

- Routing Protocols: OSPF, OSPFv3, BGP, MP-BGP
- Dynamic Routing for Virtual Routing and Forwarding (VRF)
- Static routes
- Dual-stack IPv4/IPv6
- VRRP for IPv4 and IPv6 with active-active and active-passive forwarding
- Equal-cost multi-path routing (ECMP)
- Bidirectional Forwarding Detection (BFD)
- BGP unnumbered
- BGP Graceful shutdown
- Policy Based Routing (PBR)
- DHCP relay
- Route Maps

Fabric Overlay Network Virtualization

- VXLAN VTEP with high availability
- Automated tunnel management
- Automated VXLAN management
- L2 overlay segmentation services with VLANs and Bridge Domains
- Network Packet Broker
- E-Line, E-LAN, E-Tree services
- VLAN re-use
- VLAN aggregation
- Q-in-Q with Bridge Domains
- No-MAC-learning mode

- L3 overlay segmentation with distributed VRF with anycast gateway (IPv4, IPv6, Unicast)
- L3 overlay segmentation with distributed multicast VRF (mVRF)
- Virtual Service Group (vSG) for VRF leaking and service insertion
- Single-pass RiOT (Broadcom Trident 3)
- Virtual Private Cloud (VPC) with per-tenant management segmentation (requires vNET license)
- BGP EVPN Gateway on Border Leaf (Broadcom Trident 3 switches)
- BGP EVPN Gateway with symmetric IRB

Security

- IPv4 Ingress/Egress ACL (vFlow)
- IPv6 Ingress/Egress ACL (vFlow)
- ACL statistics (vFlow stats)
- Control Plane Traffic Protection
- AAA authorization and accounting of all commands
- Full AAA switch control (shell, vtysh, CLI)
- Password protected management access, with role-based controls
- TACACS+ AAA
- 802.1X support on management interface
- BGPv4 MD5
- MAC Security
- SNMPv3 SHA (Authentication)
- Management ACL

Features and Specifications (continued)

QoS and Policy

- 802.1p Class of Service (CoS)
- Differentiated Services Code Point (DSCP)
- DSCP to CoS mapping
- Strict priority queueing
- QoS interface trust (CoS/DSCP)
- Egress per port rate limiting
- Per-port, per-CoS minimum egress bandwidth guarantee
- Per-port, per-CoS maximum egress bandwidth limit
- Weighted Round Robin (WRR) Scheduling
- ACL (vFlow) policing/rate limiting

Monitoring and Visibility

- FlowTracker for TCP, UDP, ICMP, DNS, DHCP flows
- KubeTracker to monitor pod-to-pod flows
- VMTracker to monitor VM to VM flows
- Port Mirroring
- RFC 3176 sFlow
- Traceroute
- Monitor logged-in users
- Fabric-wide embedded network and application traffic telemetry

VirtualWire Feature Set

(requires VirtualWire or VirtualWire+ license)

L1 VirtualWire

- One-to-One
- One-to-Many replication
- Many-to-Many aggregation and replication
- Many-to-One aggregation and replication
- Network Packet Broker Fabric filtering services
- Layer 2/3/4 traffic filtering
- VLAN tagging
- MAC re-write
- Jumbo frames pass-through
- Error pass-through (CRC) on Trident 3 switches
- Runt pass-through on Trident 3 switches

Management, Automation and Extensibility

- CLI
- RESTful API (with CLI parity)
- Pluribus UNUM for one-touch management and automation (see Pluribus UNUM datasheet)
- Ansible automation
- Zero-Touch Replacement for nodes in an HA cluster
- Configuration roll-back and roll-forward

- Syslog
- SNMP v1, v2, v3
- IPv6 SNMP
- SHA for SNMP authentication
- SSHv2
- TLS 1.2
- IPv6 for management
- Dual stack IPv4/IPv6 management
- Configuration export via SCP
- Fabric-wide single point of management eve
- Fabric-wide configuration simplification (single, atomic transactions for the entire fabric)
- Transaction Rollback and rollforward
- Fabric software upgrade

Supported RFCs

- RFC 7C8:D26 User Datagram Protocol (UDP)
- RFC 791 IP
- RFC 792 Internet Control Message Protocol (ICMP)
- RFC 793 TCP
- RFC 826 ARP
- RFC 1305 Network Time Protocol (NTP) Version 3
- RFC 1519 Classless Interdomain Routing (CIDR)
- RFC 1591 Domain Name System (DNS) Client
- RFC 1812 IPv4 Routers
- RFC 2236 Internet Group Management Protocol
- RFC 2328 OSPF Version 2
- RFC 7432 BGP MPLS-Based Ethernet VPN
- RFC 2460 Internet Protocol, Version 6 (IPv6) Specification
- RFC 2519 A Framework for Inter-Domain Route Aggregation
- RFC 3101 OSPF Not-So-Stubby-Area (NSSA) Option
- RFC 3137 OSPF Stub Router Advertisement
- RFC 3376 Internet Group Management Protocol
- RFC 3509 Alternative Implementations of OSPF Area Border Routers
- RFC 4271 BGPv4
- RFC 4443 Internet Control Message Protocol (ICMPv6) for IPv6 specification
- RFC 4456 BGP Route Reflection
- RFC 4486 Subcodes for BGP Cease Notification Message
- RFC 4861 Neighbor Discovery for IP Version 6 (IPv6)
- RFC 4893 BGP Support for Four-Octet AS Number Space
- RFC 5549 Advertising IPv4 Network Layer Reachability Information with an IPv6 Next Hop

SNMP MIBs

- RFC 3635 EtherLike-MIB
- RFC 3418 SNMPv2-MIB
- RFC 2863 IF-MIB
- RFC 2096 IP-FORWARD-MIB
- RFC 4363 Q-BRIDGE-MIB
- RFC 4188 BRIDGE-MIB
- RFC 4273 BGP4-MIB
- RFC 4750 OSPF-MIB
- RFC 2787 VRRPV2-MIB
- RFC 4293 IP MIB
- STP MIB

Ordering Information

Software only, requires compatible switch hardware. License does not include maintenance; order desired maintenance separately.

Netvisor ONE Enterprise Edition Perpetual License (licensed per switch device)

- ONVL-10G-ENT-LIC — Pluribus Open Netvisor Linux Enterprise Edition for 10G switch
- ONVL-25G-ENT-LIC — Pluribus Open Netvisor Linux Enterprise Edition for 25G switch
- ONVL-40G-ENT-LIC — Pluribus Open Netvisor Linux Enterprise Edition for 40G switch
- ONVL-100G-ENT-LIC — Pluribus Open Netvisor Linux Enterprise Edition for 32x100G switch
- ONVL-100GXL-ENT-LIC — Pluribus Open Netvisor Linux Enterprise Edition for 64x100G switch
- ONVL-400G-ENT-LIC — Pluribus Open Netvisor Linux Enterprise Edition for 32x400G switch

Netvisor ONE Fabric Edition Perpetual License (licensed per switch device)

- ONVL-10G-PLEX-LIC — Pluribus Open Netvisor Linux Fabric Edition for 10G switch
- ONVL-25G-PLEX-LIC — Pluribus Open Netvisor Linux Fabric Edition for 25G switch
- ONVL-40G-PLEX-LIC — Pluribus Open Netvisor Linux Fabric Edition for 40G switch
- ONVL-100G-PLEX-LIC — Pluribus Open Netvisor Linux Fabric Edition for 32x100G switch
- ONVL-100GXL-PLEX-LIC — Pluribus Open Netvisor Linux Fabric Edition for 64x100G switch
- ONVL-400G-PLEX-LIC — Pluribus Open Netvisor Linux Fabric Edition for 32x400G switch

Netvisor ONE vNET Segmentation License Add-on (licensed per switch device)

- VNV-4-VNET — vNET license for independent per-tenant management of dedicated fabric resources

Netvisor ONE VirtualWire Single-switch License (licensed per switch device)

VirtualWire feature set enables network packet broker and Layer 1 lab automation capabilities. VirtualWire license is for a single switch (not part of a fabric).

- ONVL-10G-VW-LIC — VirtualWire service license for 10G switch
- ONVL-25G-VW-LIC — VirtualWire service license for 25G switch
- ONVL-40G-VW-LIC — VirtualWire service license for 40G switch
- ONVL-100G-VW-LIC — VirtualWire service license for 32x100G switch
- ONVL-100GXL-VW-LIC — VirtualWire service license for 64x100G switch
- ONVL-400G-VW-LIC — VirtualWire service license for 32x400G switch

Netvisor ONE VirtualWire+ License (licensed per switch device)

VirtualWire+ license includes fabric, network packet broker and Layer 1 lab automation capabilities.

- ONVL-10G-VW+-LIC — VirtualWire+ service license for 10G switch
- ONVL-25G-VW+-LIC — VirtualWire+ service license for 25G switch
- ONVL-40G-VW+-LIC — VirtualWire+ service license for 40G switch
- ONVL-100G-VW+-LIC — VirtualWire+ service license for 32x100G switch
- ONVL-100GXL-VW+-LIC — VirtualWire+ service license for 64x100G switch
- ONVL-400G-VW+-LIC — VirtualWire+ service license for 32x400G switch

The Unified Cloud Fabric capabilities and advanced services of Netvisor ONE are optionally licensed at time of initial deployment, or may be unlocked as an in-place, non-disruptive upgrade for existing devices through a simple license key.

Netvisor ONE OS Scalability

Supported Switching Devices						
Pluribus Freedom	9273-X 9372-T		9572L-V 9532L-C	9432-C 9480-V 9460-X 9460-T	F9664-C	
Dell EMC PowerSwitch		S4148F-ON S4148T-ON S4128F-ON S4128T-ON S4112FF-ON S4112T-ON	Z9100 S5048-ON	S5232F-ON S5248F-ON S5224F-ON	Z9264F-ON	Z9432F-ON
Edge-Core	AS-5812-54X AS-5812-54T		AS-7312-54XS AS-7712-32X Wedge 100-32X	AS7726-32X AS7326-56X AS5835-54X AS5835-54T	AS7816-64X	
MAC Addresses*	200,000	207,000	102,000	229,000	200,000	229,000
IPv4 LPM Routes*	16,000	16,000	16,000	32,000	32,500	32,000
IPv4 host table size*	16,000	32,767	32,767	38,500	48,500	38,500
Rapid per-VLAN Spanning Tree (RPVST) instances	256	256	256	256	510	256
VLANs (with MST)*	4,096	4,096	4,096	4,096	4,096	4,096
VLAN with Bridge Domain	4K per cluster (switch HA pair)	4K per cluster (switch HA pair)	4K per cluster (switch HA pair)	4K per cluster (switch HA pair)	4K per cluster (switch HA pair)	4K per cluster (switch HA pair)
Bridge Domain	4000	4000	4000	4000	4000	4000
MST Instances	20	20	20	20	20	20
Link Aggregation Group (LAG)	40	40	40	40	40	40
Number of links per LAG	16	16	16	16	16	16
Multi-chassis LAG (vLAG)	32	32	32	32	32	32
Member ports per vLAG	16	16	16	16	16	16
IGMP Groups	4,000	8,000	4,000	12,000	8,000	12,000
MLD Groups	4,000	8,000	4,000	12,000	4,700	12,000
Mirroring Sessions	2 bidir/4 unidir	2 bidir/4 unidir	4 unidir	2 bidir/4 unidir	2 bidir/4 unidir	2 bidir/4 unidir
Jumbo Frames	9416B	9416B	9416B	9416B	9416B	9416B
Ingress ACL (vFlow)	8,000	4,096	1,000	3,072	1,024	3,072
L3 Interfaces	64	64	64	64	64	64
Distributed VRFs	1,000	1,000	1,000	1,000	1,000	1,000
VRRP Groups*	256	256	256	256	256	256
BGP Neighbors	64	64	64	64	64	64
OSPF Neighbors	64	64	64	64	64	64
BFD Sessions	64	64	64	64	256	64
ECMP Paths	16	16	16	16	16	16
VXLAN Tunnels	1,000	1,000	1,000	1,000	1,000	1,000
QoS Queues	8	8	8	8	8	8
Telemetry: TCP Connection Track Rate	5,000/sec	5,000/sec	5,000/sec	5,000/sec	5,000/sec	5,000/sec
Number of vRouters	2	2	2	2	2	2

Notes:

- Functionality and scalability varies based upon underlying open networking hardware capabilities
- * = Limited by hardware