NVIDIA CUMULUS LINUX

THE WORLD'S MOST FLEXIBLE NETWORK OPERATING SYSTEM

NVIDIA is building modern data center networks for applications of the future. We provide networking software that is built for automation and is simple, open, resilient, agile, scalable and operationally efficient.

BUILD A BETTER NETWORK WITH NVIDIA CUMULUS LINUX

NVIDIA® Cumulus® Linux® is a powerful open network operating system that enables you to automate, customize and scale using web-scale principles like the world's largest data centers.

Cumulus Linux provides:

ECONOMICAL SCALABILITY

With open hardware and a standardized Linux stack, our customers have increased operational efficiency by reducing time-to-production by up to 95%, reduced CapEx by up to one third and reduced OpEx by up to 74%.

BUILT FOR THE AUTOMATION AGE

Cumulus Linux is a powerful, networking-focused, Linux distribution based on Debian that offers a completely open architecture and is designed for easy automation.

STANDARDIZED TOOLSETS

Existing open source and commercial Linux applications run natively. That means you can use your existing tools, like for automation and others, to improve efficiency and multiply the number of switches per operator.

CHOICE AND FLEXIBILITY

The new era of accelerated computing offers unparalleled choice and flexibility including NVIDIA Mellanox® open network ethernet switches. NVIDIA Mellanox offers the industries best performing ASIC available, NVIDIA Mellanox Spectrum®, as well as choice of best-in-class, modern network operating systems including NVIDIA Cumulus Linux and Sonic.

Build your network based on your needs and your budget, and pivot easily as the industry changes.

UNPRECEDENTED NETWORK VISIBILITY

NVIDIA Cumullus NetQ is a highly-scalable, modern, network operations tool set that delivers actionable insights and operational intelligence about the health of your data center. NetQ is the leading network operations tool that utilizes telemetry for deep troubleshooting, visibility and automated workflows from a single GUI interface, reducing maintenance and network downtimes.

With the addition of full lifecycle management functionality, NetQ now combines the ability to easily upgrade, configure and deploy network elements with a full suite of operations capabilities.

THE IDEAL SOLUTION TO YOUR NETWORK CHALLENGES

Cumulus Linux enables modern data center architectures while providing a transition path for traditional data center architectures, with support for layer 2, layer 3 and overlay architectures. This open architectural approach enables a wide range of solutions:

Web-scale networking is a modern architectural approach to open networking that provides scalability and agility in data center networks while also lowering total cost of ownership.

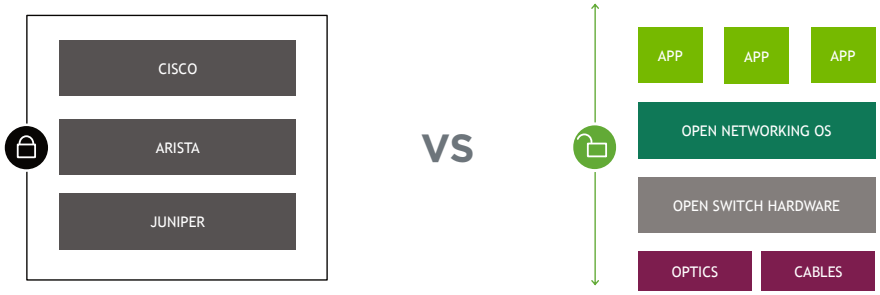
DEPLOYMENT MODELS

USE CASES

CHOOSE THE HARDWARE THAT SUITS YOUR NEEDS

The same Cumulus Linux distribution accelerates networking constructs on a broad range of industry standard switches from different vendors including NVIDIA Mellanox Spectrum based switches. Select the vendor of your choice, and choose from a wide range of platforms with various port densities, form factors and capabilities. Cumulus Networks certifies Cumulus Linux operations for all products on the Hardware Compatibility List (HCL). Look for the HCL table and platform-specific information at **cumulusnetworks.com/hcl**.

Industry-standard hardware comes pre-installed with the Open Network Install Environment (ONIE). ONIE is the key component to decoupling networking hardware from its operating system. It is the enabler for choice of operating system and is a prerequisite for loading Cumulus Linux on industry-standard switches. The installer environment provides for zero touch installation of the network operating system of choice to enable a seamless OS installation experience. You can find more information at **onie.org/**.



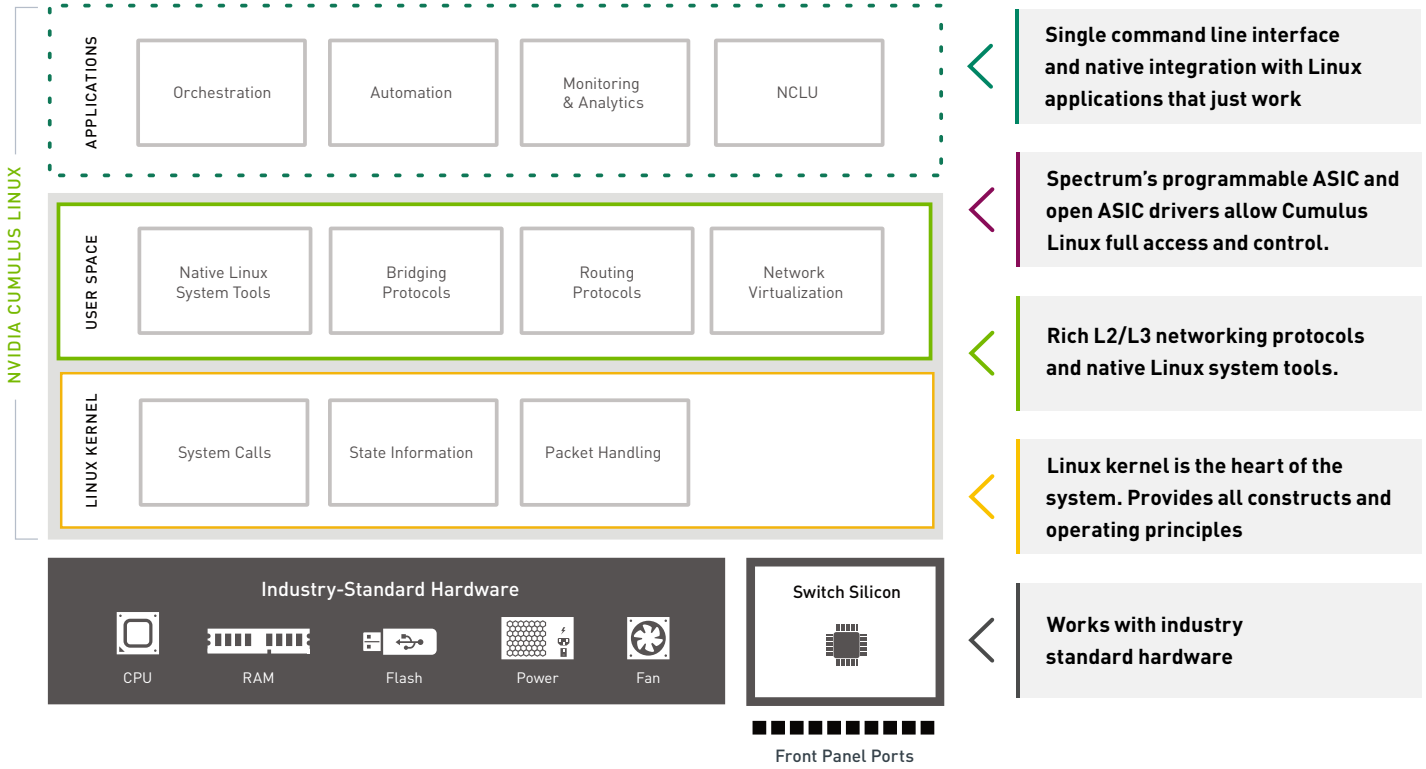
TRADITIONAL
Locked & Proprietary

OPEN
Flexibility & Choice

LEVERAGE ANY APPLICATION FOR A FULLY WEB-SCALE SOLUTION

Cumulus Linux is the foundation for a **rich technology ecosystem**. It can leverage existing applications for automation, monitoring, analytics and more and is the foundation for development and rapid integration of third party applications. Modern data center tools and applications such as Ansible®, Chef® and Puppet® work on Cumulus Linux. It also works with modern data center monitoring tools such as collectd and Ganglia. Leverage scores of applications across compute and network from the more than 40,000 Debian applications available. Customize the platform and build applications for specific business needs to innovate faster.

NVIDIA CUMULUS LINUX ARCHITECTURE



NVIDIA CUMULUS IN PRODUCTION

2000+
CUSTOMERS & COUNTING

34%
OF FORTUNE 50

NVIDIA CUMULUS LINUX TECHNICAL SPECIFICATIONS

DISTRIBUTION

The Cumulus Linux software distribution is based on Debian. It is a networking-focused Linux distribution comprising more than 250 packages. Below is a summary of the packages included in the main distribution.

FUNCTIONALITY	DESCRIPTION
Operating system install & upgrade	> Server-style upgrade/patching across minor releases, server-style process restart/termination > Support for zero touch OS installation using ONIE loaded on industry-standard switches > Standard mechanism for authentication, authorization & accounting with TACACS+
Extensibility	> Cumulus Linux is just Linux — it works with any language supported in Linux today, including scripting with Bash, Perl, Python, Ruby

NVIDIA CUMULUS LINUX TECHNIVAL SPECFICATIONS (CONTINUED)

FUNCTIONALITY	DESCRIPTION
Hardware management	> The switch hardware abstraction layer accelerates Linux kernel networking constructs in hardware, including the routing table, ARP table, bridge FDB, IP/EBtables, bonds, VLANs, VXLAN bridges > Hardware management also includes jumbo frames support and environmental management > Forwarding table profiles on the ASIC provide flexible partitioning of resources
Layer 3 features	> IPv4/v6 routing suite including OSPFv2, OSPFv3, BGPv4/v6 > Virtual routing and forwarding (VRF) and VRF route leaking > Equal-cost multi-path (ECMP) and ECMP resilient hashing for IPv4 and IPv6 traffic > Bidirectional forwarding detection (BFD) across all platform & interface types, IPv4 and IPv6, BGP and OSPF, VXLAN > Protocol-independent multicast (PIM, PIM-SM, PIM-SSM) > Policy-based routing > Generic routing encapsulation (GRE) tunneling (on Mellanox switches only) > Precision time protocol (PTP) Boundary Clock (on Mellanox switches only)
Layer 2 features	> Bridge management with STP (IEEE 802.1d), RSTP (IEEE 802.1w), PVRST, PVST, bridge assurance, BPDU guard, BPDU filter > VLANs, VLAN trunks (IEEE 802.1q), LACP (IEEE 802.3ad), LACP bypass, unicast/broadcast storm control, LLDP, CDP, IPv6 neighbor discovery, IPV6 route advertisement > MLAG (clagd daemon) > IGMPv2/v3 snooping, MLDv1/v2 snooping > Virtual router redundancy (VRR - active-active first hop redundancy protocol)
Network virtualization*	> VXLAN support > VXLAN Routing - symmetric and asymmetric > L2 gateway services integration with VMware NSX > VXLAN head end replication > VXLAN active-active bridging with MLAG > Controller-less Network virtualization with EVPN and lightweight network virtualization (LNV)
Management	> Single command line tool to configure and operate the switch (NCLU) > Native Linux management tools such as OpenSSH, SCP, FTPS > Automated install and provisioning: zero touch install and zero touch provisioning > Management VRF > DHCP, v4/v6 DHCP relays > Authentication with LDAP, authorization with sudo NTP > Interface configuration management (ifupdown2) > Advanced management/orchestration through third party add-on packages > Power management for external devices with PoE and PoE+ > Snapshot and rollback of the entire system to eliminate the risk from system upgrades
Monitoring & troubleshooting	> Monitor traffic patterns and preemptive capacity planning with buffer monitoring > Traditional monitoring with SNMPv2 and network-specific MIBs, hardware monitoring via watchdog, analytics with SPAN, ERSPAN, ACL-based counters, DOM optics data, thermal sensors, real time queue-depth and buffer utilization reporting > Troubleshooting with dnsutils, syslog, reachability tools, hardware inventory, log files, server-style filesystem, and merchant silicon-specific commands > Advanced troubleshooting and ease of use with Prescriptive Topology Manager
Security	> Access control lists (ACLs) L2-L4 classification through IP/EPtables, CPU protection through hardware enforced ACL-based rate limiting DoS control > Authenticate and authorize attached devices with 802.1X
QoS	> Link PAUSE > Classification based on Class of Service (CoS) (IEEE 802.1p) or DSCP (queuing, scheduling (DWRR and Strict Priority), buffer allocation)* > Ingress ACL-based classification/policing > Priority flow control and explicit congestion notification (ECN)
Extended support	> Extended support available for Cumulus Linux 2.5 and 3.7
Cumulus VX	> Supported virtual appliance to test and stage production rollouts

*Check the appropriate hardware guide for platform-specific support.

THIRD PARTY PACKAGES

NVIDIA Cumulus supports a vast ecosystem of **technology partners and solutions**. Some of these packages are not core NVIDIA Cumulus Linux functions but are central to modern data center networking. Packages for these solutions are provided in the add-on repository (unless the application is agentless) and are fully supported.

PACKAGES	DESCRIPTION
Orchestration	Ansible, CFEngine, Chef, Puppet
Monitoring	collectd, Ganglia, Graphite, hsflowd, Nagios/Icinga, NetSNMP

SUPPORT

NVIDIA provides world-class support and services to help our customers and partners fully leverage the power of NVIDIA Cumulus Linux. We provide a full range of enterprise support services that include 24/7 access to the NVIDIA Global Support Services (GSS) and online support tools, advanced RMA for our selected hardware manufacturers, and even onsite support for enterprise customers. We are here to ensure our customers and partners can quickly and easily manage and troubleshoot NVIDIA solutions. For more information, refer to **cumulusnetworks.com/support/overview/**.

AVAILABILITY

NVIDIA Cumulus Linux is commercially available through a perpetual licensing model that gives customers the right to use Cumulus Linux for the lifetime of the open networking hardware it runs on. Combined with the license, customers can purchase software updates and support for 1-, 3- and 5-year terms.

Software updates and support includes:

- All software upgrades including major & minor software releases
- All software updates including maintenance & security patches
- Technical support

GET STARTED TODAY

Getting started with Cumulus Linux is easy. In fact, you can explore, test and prototype the technology without spending a dime. Try Cumulus Linux in NVIDIA **Cumulus in the Cloud,** creating a virtual sandbox to test it. Or, download NVIDIA Cumulus VX, our free virtual application at **cumulusnetworks.com/vx**.

Learn more about NVIDIA Cumulus's ethernet switching solutions at **www.cumulusnetworks.com**

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