NVIDIA CUMULUS LINUX
THE WORLD'S MOST FLEXIBLE NETWORK OPERATING SYSTEM

NVIDIA is building software defined, hardware accelerated networks for applications of the future. We provide networking software that is built for operational efficiency and integrates seamlessly with your data center automation.

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:

CLOUD SCALE EFFICIENCY

With open hardware and a standardized Linux stack, our customers have increased operational efficiency by reducing time-to-production by up to 95%, spending 36% less IT time keeping the lights on and twice as much time innovating.

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 Ethernet switches. NVIDIA offers the industry's best performing ASIC available, NVIDIA Spectrum®, as well as choice of best-in-class, modern network operating systems including NVIDIA Cumulus Linux and SONiC. For powerful insights via streaming telemetry, leverage NVIDIA What Just Happened (WJH) to gain packet-granular insights into your network.

NETDEVOPS AND NVIDIA AIR

NVIDIA makes it easier than ever to deploy and validate network updates with NVIDIA Air. Build a digital twin of your network and simulate upgrades, automation, and policies. When you are ready to deploy to your physical network, you can deploy with confidence.

UNPRECEDENTED NETWORK VISIBILITY

NVIDIA Cumulus 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, reducing maintenance and network downtimes.

With the addition of full config management functionality, NetQ now combines the ability to easily 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:

DEPLOYMENT MODELS

Clos	L3 network	L2 network	Overlay network	Out-of-band management

USE CASES

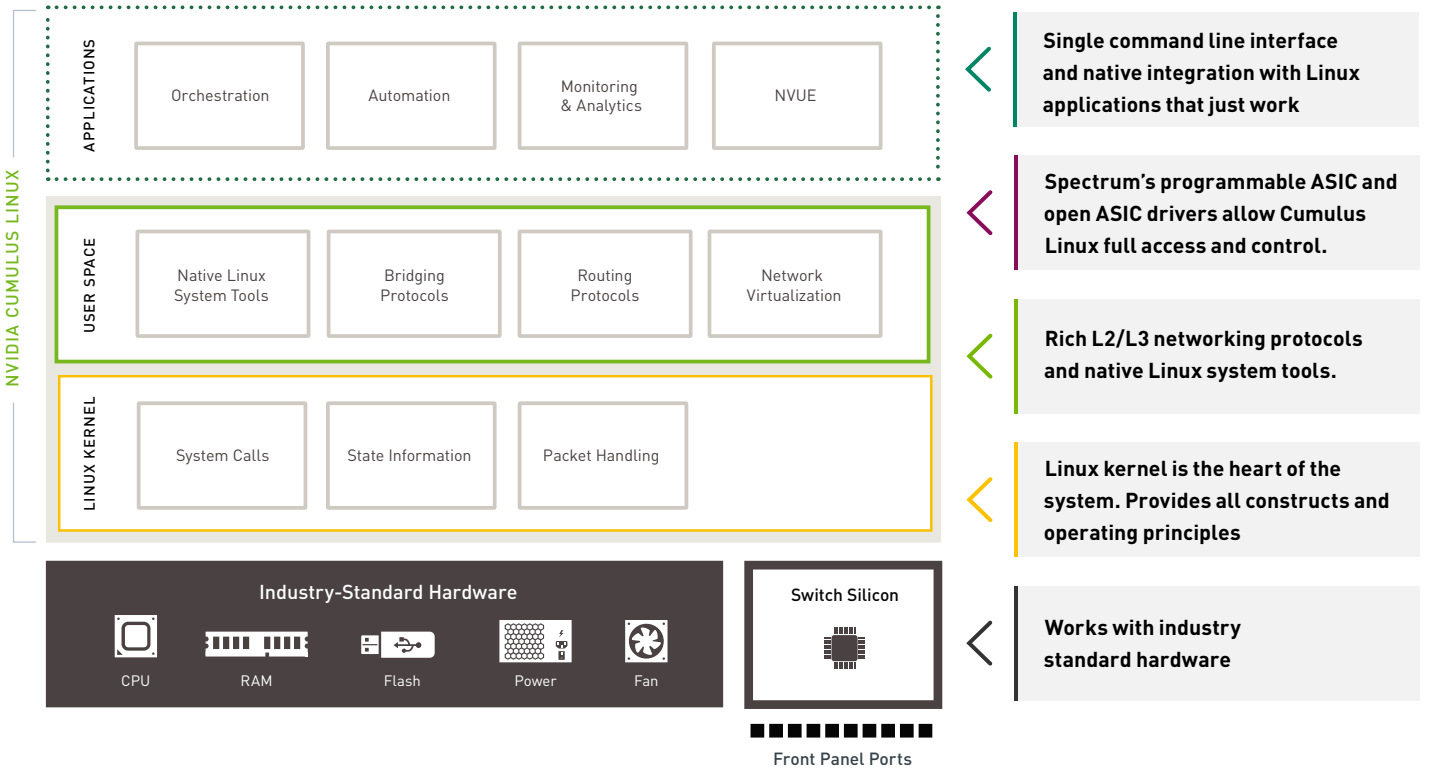| Containers	Big data	Private cloud	Network virtualization	DevOps / automation	Monitoring & analytcs	Hyper-converged infrastructure

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.

With the new NVIDIA User Experience (NVUE) object-oriented management tool, Cumulus Linux customers can go beyond the CLI and unify their network management with the rest of their data center management. NVUE enables any APIs to tie into your NOS management, including REST, gRPC, RestConf, NetConf, and OpenConfig. Additionally, NVUE is Git-based, enabling Diff, revert, apply, branch, and stash behaviors. Additionally, NVUE's configuration is simple: one YAML file ties all Linux configurations together, making it easy to copy configurations from switch to switch.

With Cumulus Linux version 4.4, NVUE and NCLU will both be available for use. After 4.4, NCLU will be deprecated and only NVUE will be usable for Cumulus management. NCLU and NVUE are not interoperable.

NVIDIA CUMULUS LINUX ARCHITECTURE

APPLICATIONS

| Orchestration | Automation | Monitoring & Analytics | NVUE |

Single command line interface and native integration with Linux applications that just work

USER SPACE

| Native Linux System Tools | Bridging Protocols | Routing Protocols | Network Virtualization |

Spectrum's programmable ASIC and open ASIC drivers allow Cumulus Linux full access and control.

Rich L2/L3 networking protocols and native Linux system tools.

LINUX KERNEL

| System Calls | State Information | Packet Handling |

Linux kernel is the heart of the system. Provides all constructs and operating principles

Industry-Standard Hardware

CPU | RAM | Flash | Power | Fan

Switch Silicon

Front Panel Ports

Works with industry standard hardware

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
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

NVIDIA CUMULUS LINUX TECHNIVAL SPECFICATIONS (CONTINUED)

FUNCTIONALITY	DESCRIPTION
Layer 3 Features	> IPv4/v6 routing suite including OSPFv2, OSPFv3, BGPv4/v6 > RDMA over Converged Ethernet (RoCE) support for Layer 2 and Layer 3 (v2) > 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, BGP conditional route advertisement > Protocol-independent multicast (PIM, PIM-SM, PIM-SSM) > Policy-based routing > Generic routing encapsulation (GRE) tunneling > Precision time protocol (PTP) Boundary Clock > VNI scaling: support 6 bridges with up to 1,000 VNIs
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 (cladg daemon) > IGMPv2/v3 snooping, MLDv1/v2 snooping, Optimized Multicast Flooding (OMF) > 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) > Object-oriented API-compatible switch management with NVIDIA User Experience (NVUE) > ISSU: in-service software upgrades > 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 > Snapshot and rollback of the entire system to eliminate risk from system updates
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 Spectrum ASIC commands
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) > Dynamic buffer configuration as default
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 Linux 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, 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 the **NVIDIA support webpage**.

AVAILABILITY

With NVIDIA Cumulus Linux version 4.4, customers no longer require a perpetual license. At power on, all features of the switch are available and do not require any license key.

For previous versions of Cumulus, customers require a license key that gives users the right to use Cumulus Linux for the lifetime of the networking hardware it runs on. Customers who upgrade their Cumulus Linux version to 4.4 no longer need a license key. Customers can purchase software updates and support for 1, 3, and 5 year terms.

Software updates and support includes:

> All software upgrades including major and minor software releases

> All software updates including maintenance and security patches

> Technical support

With Cumulus Linux version 4.4, Broadcom ASICs are no longer supported. Customers running Cumulus Linux on Broadcom ASICs may remain on Cumulus Linux versions prior to 4.4 as long as their OS versions are supported by NVIDIA.

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. Finally, if you'd like to build a digital twin of your network or mock-up a deployment with Cumulus, visit NVIDIA Air at **air.nvidia.com**.

To learn more about NVIDIA Cumulus's ethernet switching solutions
visit **www.nvidia.com/en-us/networking/ethernet-switching/**