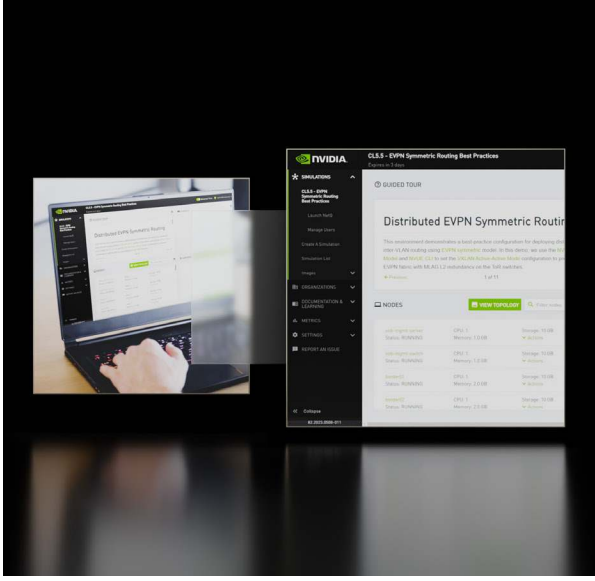
Datasheet

NVIDIA Cumulus Linux

The flagship network operating system for NVIDIA Spectrum Ethernet.



NVIDIA® Cumulus® Linux is a powerful network operating system (NOS) that lets you automate, customize, and scale using web-scale principles needed for the world's largest data centers and AI clouds.

Cumulus Linux, the flagship operating system of the NVIDIA Spectrum™ Ethernet platform, delivers the operational efficiency needed for AI clouds and is a key element of the NVIDIA Spectrum-X Platform stack. In addition to Spectrum-X, Cumulus Linux is the NOS of choice for NVIDIA Ethernet connecting NVIDIA DGX™, NVIDIA HGX™, and NVIDIA OVX™ platforms, as well as AI software such as NVIDIA AI Enterprise.

What Does Cumulus Linux Provide?

Accelerated, High-Performance Ethernet

Cumulus Linux is built for high-speed networking. In addition to supporting zero-touch remote direct-memory access (RDMA) over converged Ethernet (RoCE) acceleration, when combined with **Spectrum-X**, Cumulus Linux supports new and unique adaptive routing and congestion control technology for modern AI clouds. Cumulus Linux delivers the high-performance, differentiated features needed for the Spectrum-X software stack.

Agility and Scalability

Cumulus Linux is built from the ground up for operational efficiency at scale, with comprehensive support for protocols such as border gateway protocol (BGP) and Ethernet VPN-Virtual Extensible LAN (EVPN-VXLAN) with no licensing required. This cloud-scale Internet Protocol (IP) routing stack is based on the open-source Free Range Routing (FRR) project, with NVIDIA as the leading contributor.

Simplified Management

Cumulus Linux supports NVIDIA User Experience (NVUE), a user-friendly interface built as an application programming interface (API)-first object model to simplify automation and management. Combined with the rest of the Spectrum Ethernet software stack, Cumulus Linux makes it easier than ever to manage, deploy, and validate network updates with **NVIDIA Air** and **NVIDIA NetQ**™. In the NVIDIA Air infrastructure simulation platform, you can simulate upgrades, automation, and policies in a data center digital twin before deploying them in the real world. NVIDIA NetQ provides actionable insights and operational intelligence about data center health, utilizing telemetry for validation and reducing maintenance and network downtimes.

Key Features

Ease of Use

- All features enabled by default with no license required
- NVIDIA User Experience (NVUE) API-first operational model
- Turnkey automation
- Native Linux support
- Superior EVPN VXLAN implementation
- Data center digital twins with NVIDIA Air

High-Performance Ethernet

- Spectrum-X support
- RDMA over Converged Ethernet (RoCE)
- RoCE extensions for adaptive routing and congestion control with Spectrum-X
- Link failure robustness
- Histograms for ASIC monitoring
- Telco-grade PTP functionality

Secure Networking

Working in concert with security features built into the Spectrum switch hardware, Cumulus Linux supports state-of-the-art security measures such as role-based access control lists, secure port access, and advanced security protocols.

Solution Excellence

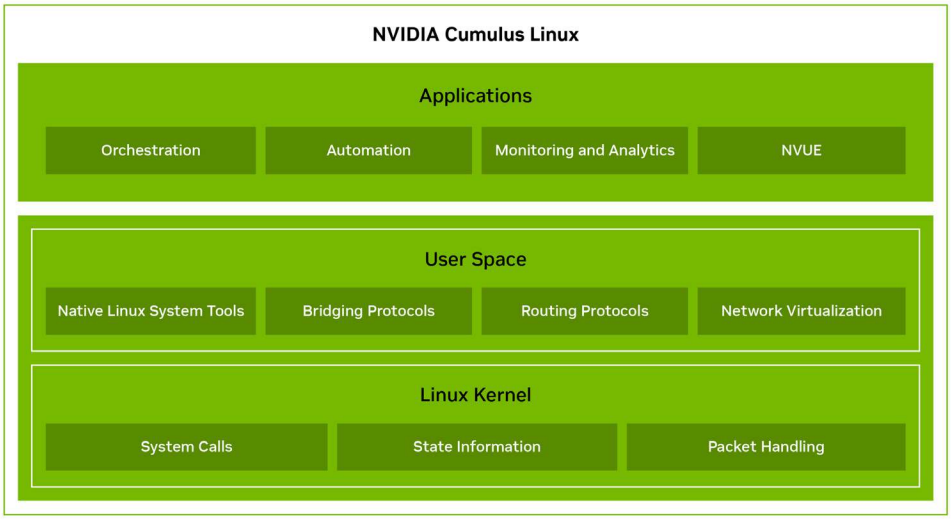
As part of the Spectrum platform, Cumulus Linux is tested and validated with NVIDIA's full portfolio of Ethernet networking technology, including **NVIDIA BlueField®** data processing units (DPUs) and SuperNICs, and **NVIDIA ConnectX®** NICs. This end-to-end switch-to-host solution is critical for powering accelerated workloads and delivers the high-performance and innovative features needed to supercharge cloud-native applications at scale.

Leverage Any Application for Web-Scale Solutions

NVIDIA 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 developing and rapidly integrating third-party applications. Modern data center tools and applications, such as Ansible, Chef, and Puppet, work seamlessly with Cumulus Linux. Cumulus Linux also works with modern data center monitoring tools, such as collectd and Ganglia. You can leverage scores of applications across both compute and networking infrastructure from the more than 40,000 Debian applications available. You can also innovate faster by customizing the platform and building applications for specific business needs.

With the NVUE object-oriented management tool, you can go beyond the command-line interface (CLI) and unify you network management with the rest of your data center management. NVUE lets you tie any APIs into NOS management, including REST, gRPC, RestConf, and NetConf. Additionally, NVUE is Git-based, enabling diff, revert, apply, branch, and stash behaviors. NVUE's configuration is simple: One YAML file ties all Linux configurations together, making it easy to copy configurations from switch to switch.

NVIDIA Cumulus Linux Architecture



Proof Points

- Complete standardization
- Network protection
- Flexible open architecture
- Reduced opex
- Purpose-built for automation
- Faster IT delivery

Architecture Benefits

- Single command-line interface and native, seamless integration with Linux applications
- Full NOS access and control through Spectrum's programmable ASIC and open ASIC drivers
- Rich L2/L3 networking protocols and native Linux system tools
- Linux kernel provides all constructs and operating principles

The Cumulus Linux software distribution is based on Debian, 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 and Upgrade	> Server-style upgrade and patching across minor releases, server-style process restart and termination > Support for zero-touch OS installation using Open Network Install Environment (ONIE) loaded on industry-standard switches > Standard mechanism for authentication, authorization, and accounting with Terminal Access Controller Access-Control System (TACACS+)
Extensibility	> Cumulus Linux works with any language supported in Linux today, including scripting with Bash, Perl, Python, and Ruby
Hardware Management	> The switch hardware abstraction layer accelerates Linux kernel networking constructs in hardware, including the routing table, ARP table, bridge forwarding database (FDB), IP/EB tables, bonds, VLANs, and VXLAN bridges > Hardware management also includes jumbo frame support and environmental management > Forwarding table profiles on the application-specific integrated circuit (ASIC) provide flexible partitioning of resources
Spectrum-X Features	> Lossless Ethernet > Adaptive routing with RoCE > BGP with weighted ECMP (W-ECMP) > In-band telemetry-enabled congestion control
Layer 3 Features	> IPv4/v6 routing suite, including OSPFv2, OSPFv3, and BGPv4/v6 > RoCE v2 support for Layer 2 and Layer 3 > 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 and interface types, IPv4 and IPv6, Border Gateway Protocol (BGP) and Open Shortest Path First (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 > Virtual network interface (VNI) scaling: supports six bridges with up to 1,000 VNIs > GPRS Tunneling Protocol (GTP) hashing
Layer 2 Features	> Bridge management with Spanning Tree Protocol (STP) (IEEE 802.1d), Rapid Spanning Tree Protocol (RSTP) (1EEE 802.1w), Per-VLAN Rapid Spanning Tree (PVRST), Per-VLAN Spanning Tree (PVST), bridge assurance, Bridge Protocol Data Unit (BPDU) guard and BPDU filter > VLANs, VLAN trunks (IEEE 802.1q), Link Aggregation Control Protocol (LACP) (IEEE 802.3ad), LACP bypass, unicast/broadcast storm control, Link Layer Discovery Protocol (LLDP), Cisco Discovery Protocol (CDP), IPv6 neighbor discovery, and IPv6 route advertisement > Multi-chassis link aggregation group (MLAG) (cladg daemon) > Internet Group Management Protocol (IGMP) v2/v3 snooping, Multicast Listener Discovery (MLD) v1/v2 snooping, Optimized Multicast Flooding (OMF) > Virtual router redundancy (VRR) (active-active first hop redundancy protocol) > LLDP data center bridging (DCB) IEEE type-length-values (TLVs)

Functionality	Description
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
Management	> ingle command-line tool to configure and operate the switch (NCLU; v4 and before) > Object-oriented API-compatible switch management with NVUE v5.x > In-service software upgrades (ISSU) > Warm boot on bonds > Native Linux management tools, such as OpenSSH, Secure Copy (SCP), and File Transfer Protocol Secure (FTPS) > Automated install and provisioning: zero-touch install and zero-touch provisioning > Management VRF > Dynamic Host Configuration Protocol (DHCP) and v4/v6 DHCP relays > Authentication with LDAP and authorization with sudo Network Time Protocol (NTP) > Interface configuration management (ifupdown2) > Advanced management and orchestration through third-party add-on packages > Snapshot and rollback of the entire system to eliminate risk from system updates
Monitoring and Troubleshooting	> Monitor traffic patterns and preemptive capacity planning with buffer monitoring > Traditional monitoring with Simple Network Management Protocol (SNMP) v3 and network-specific management information bases (MIBs), hardware monitoring via watchdog, analytics with Switched Port Analyzer (SPAN), Encapsulated Remote Switched Port Analyzer (ERSPAN), access control list (ACL)-based counters, digital optical monitoring (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 > sFlow monitoring for system statistics and network traffic
Security	> Role-based ACLs L2–L4 classification through IP/EP tables and CPU protection through hardware enforced ACL-based rate limiting denial-of-service (DoS) control > Authenticate and authorize attached devices with 802.1x/AAA > Kernel address space randomization
QoS	> Link pause > Classification based on class of service (CoS) (IEEE 802.1p) or Differentiated Services Code Point (DSCP) > Ingress ACL-based classification and policing > Priority flow control and explicit congestion notification (ECN) > Dynamic buffer configuration as default
Cumulus VX	> Supported virtual appliance to test and stage production rollouts

Third-Party Packages

NVIDIA Cumulus Linux supports a vast ecosystem of technology partners and solutions. Some of these packages are not core 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, Nagios/Icinga, NetSNMP

Support

NVIDIA provides world-class support and services to help you fully leverage the power of Cumulus Linux. Access a full range of enterprise support services that include 24/7 access to the NVIDIA Global Support Services (GSS) and online support tools, advanced return merchandise authorization (RMA), and even onsite support.

Software updates and support can be purchased for one-, three-, and five-year terms.

Software updates and support include:

- Minor and major releases
- Maintenance and security patches
- Technical support

Get Started Today

Getting started with Cumulus Linux is easy. You can explore, test, and prototype the technology without requiring any physical switch infrastructure. To build a data center digital twin or to try a tutorial of Cumulus, visit **NVIDIA Air**. Or download the free **NVIDIA Cumulus VX appliance**.

Ready to Get Started?

To learn more about the NVIDIA Cumulus Linux, visit
www.nvidia.com/cumulus-linux

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