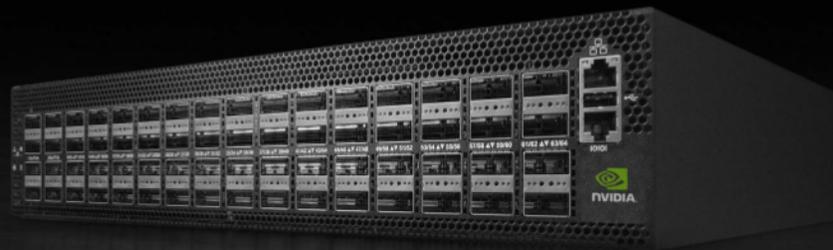**NVIDIA**

# NVIDIA Spectrum SN4000 Series Switches

for accelerated data centers.

## Next-Generation Flexibility and Performance for Data Center Networks

The NVIDIA Spectrum™ SN4000 series of Ethernet switches is the fourth generation of NVIDIA Ethernet switches, purpose-built for leaf, spine, and super-spine data center applications. Allowing maximum flexibility, the SN4000 series provides port speeds spanning from 1 to 400 gigabits per second (Gb/s), with a port density that enables full-rack connectivity to any server at any speed. In addition, the uplink ports allow a variety of blocking ratios to suit any application requirement.

The SN4000 series is ideal for building wire-speed and cloud-scale layer-2 and layer-3 networks. The SN4000 platforms deliver high performance and consistent low latency along with support for advanced software-defined networking features, making it the ideal choice for web-scale IT, cloud, hyperconverged storage, and data analytics applications.

## Network Disaggregation: NVIDIA Open Ethernet

NVIDIA Open Ethernet Spectrum switches break the paradigm of traditional switch systems, eliminating vendor lock-in. Rather than compelling network operators to use vendor-specific software, Open Ethernet allows for the use of a variety of operating systems on top of Ethernet switches. This grants operators greater control over their networks and optimizes utilization, efficiency, and overall return on investment.

Encouraging an ecosystem of open-source, standard network solutions, Open Ethernet adopts the same principles as standard open solutions for servers and storage and applies them to the world of networking infrastructure. These solutions can be easily deployed into the modern data center across network equipment, easing management and ensuring full interoperability.

With a variety of system form factors and a rich software ecosystem, the SN4000 series allows for the selection of the right components for your data center.

## NVIDIA SN4000 Series

The SN4000 series is based on the high-performance Spectrum-3 application-specific integrated circuit (ASIC) with a bidirectional switching capacity of 12.8 terabits per second (Tb/s). SN4000 switches are available in a range of configurations, each delivering high performance and feature-rich layer-2 and layer-3 forwarding, ideally suited for both top-of-rack leaf and fixed-configuration spines. SN4000 switches provide full-wire speed, cut-through-mode latency, on-chip, fully shared 64 megabyte (MB) packet buffering, and flexible port use in addition to advanced capabilities. Combining a wide range of innovations in the areas of programmability, telemetry, and tunneling with industry-leading performance, SN4000 switches address the complex networking requirements of today's data centers.

## Key Features

### Visibility

> NVIDIA What Just Happened?® (WJH) telemetry dramatically reduces mean time to issue resolution by providing answers to When, What, Who, Where, and Why.

> Hardware-accelerated histograms track and summarize queue depths at submicrosecond granularity.

> Inband network telemetry (INT)-ready hardware

> Streaming telemetry

> 512,000 on-chip flow counters

### Performance

> Fully shared packet buffer provides a fair, predictable, and high-bandwidth data path.

> Consistent and low cut-through latency

> Intelligent hardware-accelerated data movement, congestion management, and load balancing for remote direct-memory access (RDMA) over converged Ethernet (RoCE) and machine learning applications that leverage GPUDirect®

### SN4700

The SN4700 spine/super-spine offers 32 ports of 400GbE in a compact 1U form factor. It enables connectivity to endpoints at varying speeds and carries a throughput of 12.8 terabits per second (Tb/s), with a landmark 8.4 billion packets per second (Bpps) processing capacity. As an ideal spine solution, the SN4700 allows maximum flexibility, with port speeds spanning from 1 to 400Gb/s per port.

### SN4600

SN4600 is a 2U 64-port 200GbE spine that can also be used as a high-density leaf, fully splittable to up to 128 10/25/50GbE ports when used with splitter cables. SN4600 allows for maximum flexibility, with ports spanning from 1 to 200Gb/s and port density that enables full-rack connectivity to any server at any speed and a variety of blocking ratios.

### SN4600C

SN4600C is a 64-port 100GbE switch system that's ideal for spine/super-spine applications. With a landmark 8.4Bpps processing capacity and 6.4Tb/s throughput in a dense 2U form factor, SN4600C offers diverse Ethernet port speed connectivity in combinations of 10, 25, 40, 50, and 100Gb/s. The SN4600C is well-suited to answer the challenging needs of large virtualized data centers and cloud environments.

## High Availability

The NVIDIA Spectrum SN4000 series is designed with the following features for high availability:

> 1+1 hot-swappable power supplies and N+1 hot-swappable fans

> Color-coded power supply units (PSUs) and fans

> Up to 128 100/50/25/10/1GbE, 64 200GbE, or 32 400GbE ports

> Multi-chassis link aggregation group (LAG) for active/active L2 multipathing

> 128-way equal-cost multi-path (ECMP) routing for load balancing and redundancy

## SN4000 Series: A Rich Software Ecosystem

### NVIDIA Cumulus-Linux

NVIDIA® Cumulus® Linux is a powerful, open network operating system that enables advanced automation, customization, and scalability using web-scale principles hardened in the world's largest data centers. It accelerates networking functions and provides choice from an extensive list of supported switch models, including Spectrum-based switches. Cumulus Linux was built for automation, scalability, and flexibility, allowing you to build data center and campus networks that ideally suit your business needs. Cumulus Linux is the only open network OS that allows you to build affordable and efficient network operations like the world's largest data center operators, unlocking web-scale networking for businesses of all sizes.

### SONiC

SONiC was designed for cloud networking scenarios, where simplicity and managing at scale are the highest priorities. NVIDIA fully supports the pure open-source SONiC from the SONiC community site on all of the SN4000 Ethernet switches. With advanced monitoring and diagnostic capabilities, SONiC is a perfect fit for the NVIDIA SN4000 series. Among other innovations, SONiC on the SN4000 series enables fine-grained failure recovery and in-service upgrades (ISSU), with zero downtime.

### Linux Switch

With Linux Switch, users can natively install and use any standard Linux distribution as the switch operating system. Linux Switch is based on a Linux kernel driver model for Ethernet switches (switchdev).

> Best-in-class Virtual Extensible LAN (VXLAN) scale—10X more tunnels and tunnel endpoints than others

> 512,000 forwarding entries flexibly shared across access control list (ACL), longest prefix match (LPM ) routes, host routes, media access control list (MAC), equal-cost multi-path (ECMP), and tunnel applications

> Up to 1 million IPv4 route entries

**Agility**

> Comprehensive layer-2, layer-3 and RoCE

> Advanced network virtualization with high- performance single-pass VXLAN routing and IPv6 segment routing

> Cloud-scale network address translation (NAT)—100,000 sessions

> Programmable pipeline that can programmatically parse, process, and edit packets

> Deep packet inspection - 512 billion deep


SN4700


SN4600


SN4600C

## NVIDIA Air

The NVIDIA Air infrastructure simulation platform creates digital twins of SN4000 switch systems (as well as the rest of the Spectrum portfolio). The digital twin includes logical instances of every switch and cable, so it can be used to validate security policy compliance, automation processes, monitoring tools, interoperability, and upgrade procedures. The digital twin is key to transforming network operations models, allowing IT architects and infrastructure specialists to deploy and update networks up to 95 percent faster through continuous integration and continuous delivery (CI/CD) integration.

## NVIDIA NetQ

NVIDIA NetQ™ is a highly scalable, modern, network operations toolset that provides visibility, troubleshooting, and lifecycle management of your open networks in real time. NVIDIA NetQ delivers actionable insights and operational intelligence about the health of your data center networks—from the container or host all the way to the switch and port—enabling a NetDevOps approach. NVIDIA 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, NVIDIA NetQ now combines the ability to easily upgrade, configure and deploy network elements with a full suite of operations capabilities, such as visibility, troubleshooting, validation, trace, and comparative look-back functionality.

## ONIE

The Open Network Install Environment (ONIE) is an Open Compute Project, an open-source initiative driven by a community to define an open "install environment" for bare-metal network switches, such as the NVIDIA SN4000 series. ONIE enables a bare-metal network switch ecosystem where end users have a choice of different network operating systems.

## Docker Containers

NVIDIA fully supports the running of third-party containerized applications on the switch system itself. The third-party application has complete access to the bare-metal switch via its direct access to the SDK. The switch has tight controls over the amount of memory and CPU cycles each container is allowed to use, along with fine-grained monitoring of those resources.
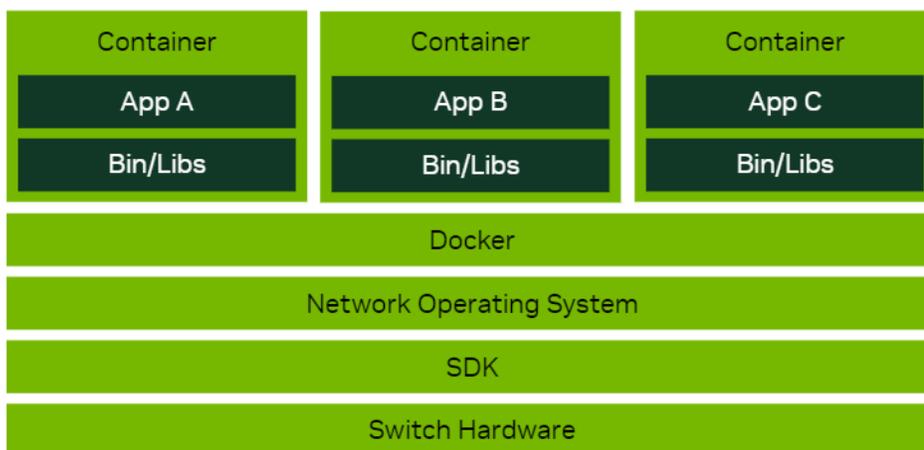


Docker Containers Support

# NVIDIA Spectrum-3: Build your cloud without compromise

## Groundbreaking Performance

Packet buffer architecture has a major impact on overall switch performance. The Spectrum-3 packet buffer is monolithic and fully shared across all ports, supporting cut-through line-rate traffic from all ports, without compromising scale or features. With its fast packet buffer, Spectrum-3 provides a high- performance, fair, and bottleneck-free data path for mission-critical applications.

## Pervasive Visibility

Spectrum-3 provides deep and contextual network visibility, which enables network operators to proactively manage issues and reduce mean time to recovery or innocence. What Just Happened leverages the underlying silicon and software capability to provide granular and event-triggered information about infrastructure issues. In addition, Spectrum-3's rich telemetry information is readily available via open APIs that can be integrated with third-party software tools and workflow engines.

## Unprecedented Agility

For modern data center infrastructure to be software-defined and agile, both its compute and network building blocks need to be agile. Spectrum-3 features

a unique, feature-rich, and efficient packet processing pipeline that offers advanced data center network virtualization without compromising on performance or scale. Spectrum-3 has a programmable pipeline and a deep packet parser and editor that can process payloads up to the first 512 billion. Spectrum-3 supports single-pass VXLAN routing and bridging. Additionally, Spectrum-3 supports advanced virtualization features such as IPv6 segment routing and NAT.

## Massive Scale

The number of endpoints in the data center is increasing exponentially. With the current shift from virtual machine-based architectures to container-

based architectures, the high-scale forwarding tables required by modern data centers and mega clouds increase by up to an order of magnitude or more. To answer these needs for scalability and flexibility, Spectrum-3 uses intelligent algorithms and efficient resource sharing and supports unprecedented forwarding table, counters, and policy scale.

Building on this commitment to adaptability and precision, fine-grained resource allocation is tailored to fit all specific needs, allowing up to 512,000 entries to be dynamically shared across MAC, ARP, IPv4/IPv6 routes, ACLs, ECMP, and tunnels. An innovative algorithmic TCAM is further optimized for data centers and cloud environments, which can scale the number of rules to up to half a million.

## End-to-End Solution

The SN4000 series is part of NVIDIA's complete end-to-end Ethernet networking solution, which provides 1–400Gb/s of interconnectivity within the data center. Other devices in this solution include NVIDIA BlueField data processing units (DPUs), ConnectX®-based network interface cards and LinkX® copper or fiber cabling.

## Technical Specifications

| Switch Model | SN4700 | SN4600 | SN4600C |
|---|---|---|---|
| Connectors | 32 QSFP-DD 400GbE | 64 QSFP56 200GbE | 64 QSFP28 100GbE |
| Max. 400GbE ports | 32 | - | - |
| Max. 200GbE ports | 64 | 64 | - |
| Max. 100GbE ports | 128 | 128 | 64 |
| Max. 50GbE ports | 128 | 128 | 128 |
| Max. 40GbE ports | 64 | 64 | 64 |
| Max. 25 ports | 128 | 128 | 128 |
| Max. 10GbE ports | 128 | 128 | 128 |
| Max. 1GbE ports | 128 | 128 | 128 |
| Switching capacity (Tb/s) | 12.8Tb/s | 12.8Tb/s | 6.4Tb/s |
| Wire speed switching (Bpps) | 8.4Bpps | 8.4Bpps | 8.48Bpps |
| Lanes per port x max speed per lane | 8x 50G PAM4 | 4x 50G PAM4 | 4x 25G NRZ |
| Latency | 620ns | 580ns | 560ns |
| CPU | Quad-core x86 | Quad-core x86 | Quad-core x86 |
| System memory | 16GB | 16GB | 8GB |
| SSD memory | 64GB | 64GB | 32GB |
| Packet buffer | 64MB | 64MB | 64MB |
| 100/1000Mb/s management ports | 1 | 1 | 1 |
| Serial ports | 1 RJ45 | 1 RJ45 | 1 RJ45 |
| USB ports | 1 | 1 | 1 |
| Hot-swap power supplies | 2 (1+1 redundant) | 2 (1+1 redundant) | 2 (1+1 redundant) |
| Hot-swappable fans | 6 (N+1 redundant) | 3 (N+1 redundant) | 3 (N+1 redundant) |
| Reversible airflow option | Yes | Yes | Yes |
| Power supplies | Frequency: 50–60Hz Input range: 100–264Vac | Frequency: 50–60Hz Input range: 100–264Vac | Frequency: 50–60Hz Input range: 100–264Vac |
| Size (H x W x D) | 1.72" (H) x 16.85" (W) x 22.3" (D) | 3.46" (H) x 16.85" (W) x 22.3" (D) | 3.46" (H) x 16.85" (W) x 22.3" (D) |
| | 44mm (H) x 428mm (W) x 568.5mm (D) | 88mm (H) x 428mm (W) x 568mm (D) | 88mm (H) x 428mm (W) x 568mm (D) |
| Weight | 11.7kg (25.8lb) | 14.8kg (32lb) | 15kg (33lb) |

## Compliance

| Standards Compliance | |
| --- | --- |
| Safety | CB, CE, cTUVus, CU |
| EMC | CE, ICES, FCC, RCM, VCCI |
| Operating conditions | Operating: 0–40ºC; Non-operating: -40–70ºC |
| Relative humidity | 5–85% |
| Operating altitude | 0-3050m |
| RoHS | RoHS compliant |

## Enterprise Support and Services

A minimum of one-year of **Enterprise Business-Standard Support** is required when purchasing NVIDIA Spectrum SN4000 Ethernet switches.

> NVIDIA Enterprise Support provides access to NVIDIA experts, the NVIDIA Enterprise Support Portal, advanced return material authorization (RMA), and more.

> Add-on services—including installation, configuration, technical account manager, four-hour on-site engineer, expedited RMA, media retention, and more—are available.

For details, visit the **NVIDIA Enterprise Support and Services User Guide.**

## Product Specifications

Details of the NVIDIA Spectrum SN4000 series of Ethernet switches are available in the **SN4000 Switch Systems User Manual.**

**Transceivers and Cables**

> For details on NVIDIA cables and transceivers, visit the **Interconnect documentation hub.**

> Some transceivers may require higher than typical power delivery. Please refer to the **SN4000 Switch Systems User Manual** for detailed information on switch ports' power specifications.

## Ready to Get Started?

To learn more about NVIDIA Spectrum SN4000 switches, including product specifications and ordering information, refer to the **SN4000 Switch Systems User Manual.**