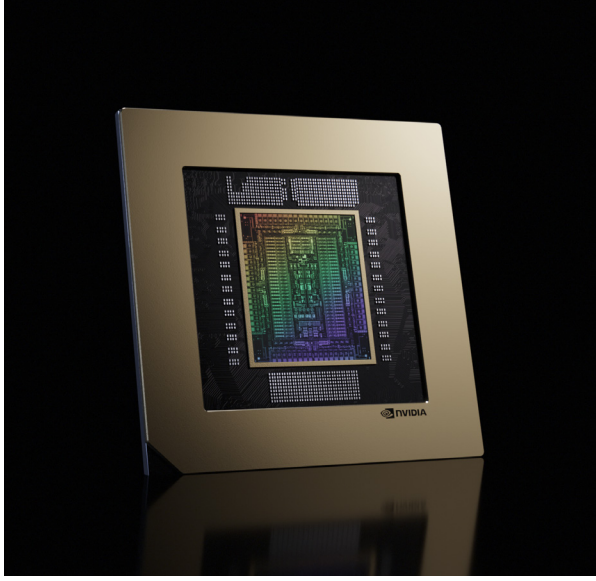
Datasheet

NVIDIA Spectrum-6 Ethernet Switch ASIC

Highest performance Ethernet for AI infrastructure and AI factories.



AI, cloud-native computing, and large-scale simulations are having a dramatic impact on all industries. But because data is their essential driver, they demand the highest performance from networking to be successful. At the same time, multi-tenant, cloud-native applications are becoming increasingly standard, requiring high effective bandwidth and minimal tail latency for communication within data centers. The NVIDIA Spectrum™-6 Ethernet switch application-specific integrated circuit (ASIC) drives best-in-class performance for AI and cloud-native computing workloads, from core to cloud to edge.

NVIDIA Spectrum-6 delivers the highest performance for bandwidth-hungry, accelerated applications based on generative AI, large language models, recommenders, and more. With enhanced remote direct-memory access (RDMA) over Converged Ethernet (RoCE), adaptive routing, and performance isolation, Spectrum-6 is unmatched for workloads running over Ethernet.

NVIDIA Spectrum-X Ethernet Platform

The NVIDIA Spectrum-X™ Ethernet platform was developed specifically for AI. Spectrum-X Ethernet tightly coordinates the Spectrum-6 switch ASIC and NVIDIA Spectrum-X SuperNIC™ to optimize hyperscale generative AI infrastructures using a suite of end-to-end innovations.

Consistency and fair bandwidth sharing are critical for AI superclouds built with NVIDIA HGX™, DGX™, and MGX™ platforms. Accelerated AI applications require a network designed to:

- Support tightly coupled processes
- Handle bursty network capacity with predictive performance and no statistical averaging
- Enable highly efficient RDMA bandwidth
- Prevent jitter and deliver deterministic short tails
- Support non-blocking, rail-optimized fabrics

Specifications

- 102.4 Tb/s switching and routing
- 200 Gb/s PAM4 SerDes
- TSMC 3-nm process
- Fully shared buffer architecture
- Flexible port configurations:
  - 128x 800GbE or 400GbE ports
  - 256x 400GbE or 200GbE ports
  - 512x 200GbE or 100GbE ports

Key Features

Consistent Performance for Generative AI via RoCE Extensions

- Adaptive routing
- Congestion control
- Performance isolation
- RoCE port-to-port (RP2P) auto-path configuration
- Global adaptive routing for fabric resiliency
- Synchronized collectives
- Ultra-low latency

Robust Design

Designed in-house using an NVIDIA 3-nanometer (nm) process and NVIDIA platform innovations, Spectrum-6 features the most robust and stable serializer/deserializer (SerDes) for Ethernet yet.

Spectrum-6 features a fully shared and monolithic packet buffer that's dynamically available to all ports. This provides excellent microburst absorption with low port-to-port latency. This architecture simplifies buffer management and traffic scheduling, while enabling fair resource sharing. The on-chip packet buffer supports high-bandwidth packet reads and writes to deliver consistent, predictable performance. Spectrum-6 also supports flexible pipeline programmability and a packet modifier/parser with no impact to latency or packet rate.

Advanced Network Virtualization and Simulation

NVIDIA Spectrum-6 is designed with a highly flexible, programmable packet pipeline with stateful capability that enables advanced network virtualization. The hybrid packet-forwarding pipeline can be merged into optimized blocks that are streamlined in hardware to deliver the highest performance. Leveraging this capability, Spectrum-6 can deliver industry-leading packet-processing rates at scale, concurrent with programmability and virtualization.

Spectrum-6 also supports single-pass VXLAN routing. In addition to VXLAN, it supports multiple virtualization technologies, such as Segment Routing over IPv6 (SRV6), network address translation (NAT), and custom virtualization.

Actionable Visibility and Telemetry

NVIDIA Spectrum-6 provides packet-granular, network-based visibility data that seamlessly integrates with open APIs at the SDK layer. Referred to as NVIDIA What Just Happened® (WJH), this always-on feature allows network operators to start troubleshooting as soon as an issue arises. WJH can be extended and customized to support both third-party and open-source tools.

Beyond providing hardware-accelerated mechanisms that measure and summarize packet buffer dynamics, Spectrum-6 also supports traditional hardware-based visibility tools, such as sFlow, in-band telemetry, and streaming telemetry. In addition to providing actionable visibility, Spectrum-6 enables state-of-the-art security features, like by-default secure boot via hardware root of trust (HRoT).

Choice of Software

NVIDIA offers a rich set of software development tools and open APIs that allow users and partners to develop fully functional switching solutions on top of the Spectrum-6 ASIC with low TCO and a short time to market. Users have the flexibility to choose the network operating system that's best suited to their needs, including the flagship NVIDIA Cumulus® Linux and Software for Open Networking in the Cloud (SONiC). Combined with the Spectrum SDK and the ability to build on custom operating systems on top of the Switch Abstraction Interface (SAI), Spectrum-6 is purpose-built to support full network customization and programmability.

End-to-End Synergy

As part of the NVIDIA Spectrum platform, the Spectrum-6 Ethernet switch ASIC is pretested and prevalidated with NVIDIA's full portfolio of Ethernet networking technology, including SuperNICs, cables, and transceivers, based on the same 200G SerDes used with Spectrum-6.

Advanced Virtualization and Security

- Single-pass Virtual Extensible LAN (VXLAN) bridging and routing
- Centralized VXLAN routing
- Comprehensive and programmable tunneling technology support
- Hardware acceleration for NAT
- Hardware root of trust for secured switching

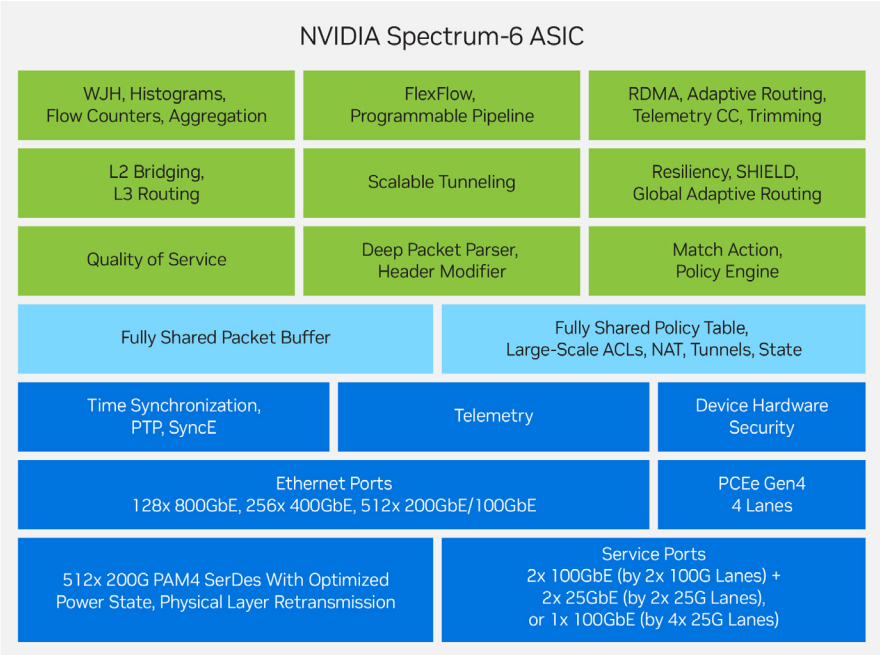
Cloud-Tier Scale

- Programmable network control and policy support for 750,000 entries, shared across routes, media access control (MAC), and access control list (ACL)
- Precision Time Protocol (PTP) time synchronization

Telemetry and Visibility

- Hardware-accelerated, high-frequency telemetry pipeline
- Packet-granular, event-level diagnostics
- Support for NVIDIA switch SDK and SONiC command-line interface (CLI)
- Real-time telemetry via open APIs (OTLP, gNMI, gNOI)

Features



Compatibility

Ethernet	**Switch ports:** 800GbE 400GbE 200GbE 100GbE DCB (PFC, ETS, DCBX)
CPU Options	**Intel x86, AMD x86, Arm®**
AI Solutions	**Optimized for NVIDIA:** Spectrum-X DGX HGX MGX BlueField® ConnectX® NVIDIA Magnum IO™ NVIDIA RAPIDS™ NVMe-oF
IO Specs	**Standards:** SPI flash I2C, SMBus, MDIO IEEE 1149.1, 1588

Ordering Information

OPN / SKU	Description
SP06-B00X22Y-A1	NVIDIA Spectrum-6, 102.4 Tb/s switch IC with 512x200 Gb/s, 512 MAC

Ready to Get Started?

To learn more about NVIDIA Spectrum products, visit: nvidia.com/ethernet-switching

This document describes hardware features and capabilities.
For information on feature availability, refer to the switch software release notes.
Images are for illustration only; actual products may vary.

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