Cisco Nexus 5000 Series Switches

Product Overview

The Cisco Nexus™ 5000 Series Switches comprise a family of line-rate, low-latency, lossless 10 Gigabit Ethernet, Cisco® Data Center Ethernet, and Fibre Channel over Ethernet (FCoE) switches for data center applications (Figure 1).

Figure 1. The Cisco Nexus 5000 Series Includes the Cisco Nexus 5010 Switch, Cisco Nexus 5020 Switch that Supports 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE

Today's data centers are increasingly filled with dense rack-mount and blade servers that host powerful multicore processors. The rapid increase of in-rack computing density, along with the increasing use of virtualization software, combine to push the demand for 10 Gigabit Ethernet and consolidated I/O: applications for which the Cisco Nexus 5000 Series is the perfect match. With low latency, front-to-back cooling, and rear-facing ports, the Cisco Nexus 5000 Series is designed for data centers transitioning to 10 Gigabit Ethernet as well as for those ready to deploy a unified fabric that can handle their LAN, SAN, and server clusters, networking over a single link (or dual links for redundancy).

The switch family, using cut-through architecture, supports line-rate 10 Gigabit Ethernet on all ports while maintaining consistent low latency independent of packet size and services enabled. The product family supports Cisco Data Center Ethernet capabilities that increase the reliability, efficiency, and scalability of Ethernet networks. These features allow the switch to support multiple traffic classes over a lossless Ethernet fabric, thus enabling consolidation of LAN, SAN, and cluster environments. Its ability to connect FCoE to native Fibre Channel protects existing storage system investments while dramatically simplifying in-rack cabling. In addition to supporting standard 10 Gigabit Ethernet network interface cards (NICs) on servers, the Cisco Nexus 5000 Series integrates with multifunction adapters called converged network adapters (CNAs) that combine the functions of Ethernet NICs and Fibre Channel host bus adapters (HBAs), making the transition to a single, unified network fabric transparent and consistent with existing practices, management software, and OS drivers. The switch family is compatible with integrated transceivers and Twinax cabling solutions that deliver cost-effective connectivity for 10 Gigabit Ethernet to the servers at the rack level, eliminating expensive optical transceivers.

The Cisco Nexus 5000 Series switch is designed for data center environments with cut-through technology that enables consistent low-latency Ethernet solutions, with front-to-back cooling, and with network ports in the rear, bringing switching into close proximity with servers and making cable runs short and simple. The switch family is highly serviceable, with redundant, hot-pluggable power supplies and fan modules. It uses data center–class Cisco NX-OS Software for high reliability and ease of management.

Cisco Nexus 5020 56-Port Switch

The Cisco Nexus 5020 is a two rack-unit (2RU), 10 Gigabit Ethernet, Cisco Data Center Ethernet, FCoE, and Fibre Channel switch built to provide 1.04 terabits per second (Tbps) throughput with very low latency (Figure 2). It has 40 fixed 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE Small Form Factor Pluggable Plus (SFP+) ports. The first 16 fixed ports support both 10 Gigabit Ethernet and 1 Gigabit Ethernet in hardware, providing a smooth migration path to 10 Gigabit Ethernet. Two expansion module slots can be configured to support up to 12 additional 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE SFP+ ports, up to 16 Fibre Channel switch ports, or a combination of both. The switch has a serial console port and an out-of-band 10/100/1000-Mbps Ethernet management port. The switch is powered by 1+1 redundant, hot-pluggable power supplies and 4+1 redundant, hot-pluggable fan modules to provide highly reliable front-to-back cooling.

Figure 2. The Cisco Nexus 5000 Series Includes the Cisco Nexus 5020, Supporting 40 Fixed Ports of 10 Gigabit Ethernet (Ports 1 to 16 Can Run at 1 Gigabit Ethernet), FCoE, and Cisco Data Center Ethernet as Well as 2 Expansion Module Slots

Cisco Nexus 5010 28-Port Switch

The Cisco Nexus 5010 is a 1RU, 10 Gigabit Ethernet, Cisco Data Center Ethernet, FCoE, and Fibre Channel switch providing more than 520-Gbps throughput with very low latency (Figure 3). It has 20 fixed 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE SFP+ ports. The first 8 fixed ports are dual speed, supporting both 10 Gigabit Ethernet and 1 Gigabit Ethernet in hardware, and providing a smooth migration path to 10 Gigabit Ethernet. One expansion module slot can be configured to support up to 6 additional 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE SFP+ ports, up to 8 Fibre Channel switch ports, or a combination of 4 additional 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE SFP+ ports with 4 additional 4/2/1-Gbps Fibre Channel switch ports. The switch has a serial console port and an out-of-band 10/100/1000-Mbps Ethernet management port. The switch is powered by 1+1 redundant, hot-pluggable power supplies and 1+1 redundant, hot-pluggable fan modules to provide highly reliable front-to-back cooling.

Figure 3. The Cisco Nexus 5000 Series Includes the Cisco Nexus 5010, Supporting 20 Fixed Ports of 10 Gigabit Ethernet (Ports 1 to 16 Can Run at 1 Gigabit Ethernet), FCoE, and Cisco Data Center Ethernet as Well as 1 Expansion Module Slot

Expansion Module Options for the Cisco Nexus 5000 Series

The Cisco Nexus 5000 Series is equipped to support expansion modules that can be used to increase the number of 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE ports or connect to Fibre Channel SANs with 4/2/1-Gbps Fibre Channel switch ports, or both. The Cisco Nexus 5010 supports one expansion module, and the Cisco Nexus 5020 supports any combination of two modules from the following offerings (Figure 4):

- Ethernet module that provides 6 ports of 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE using the SFP+ interface

- Fibre Channel plus Ethernet module that provides 4 ports of 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE using the SFP+ interface, and 4 ports of 4/2/1-Gbps native Fibre Channel connectivity using the SFP interface

- Fibre Channel module that provides 8 ports of 4/2/1-Gbps native Fibre Channel using the SFP interface for transparent connectivity with existing Fibre Channel networks

Figure 4. From Left to Right: 6-Port 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE Module; 4-Port Fibre Channel plus 4-Port 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE Module; and 8-Port Native Fibre Channel Expansion Module

Cisco Nexus 2000 Series Fabric Extenders

The Cisco Nexus 2000 Series Fabric Extenders comprise a category of data center products that provide a universal server-access platform that scales across a multitude of Gigabit Ethernet, 10 Gigabit Ethernet, unified fabric, rack, and blade server environments. The Cisco Nexus 2000 Series Fabric Extenders are designed to simplify data center architecture and operations by meeting the business and application needs of a data center. Working in conjunction with Cisco Nexus switches, the Cisco Nexus 2000 Series Fabric Extenders deliver a cost-effective and efficient way to support today's Gigabit Ethernet environments while allowing easy migration to 10 Gigabit Ethernet, virtual machine–aware Cisco Data Center Ethernet, and unified I/O technologies.

Figure 5. The Cisco Nexus 2148T Gigabit Ethernet Fabric Extender Supports 48 Fixed Ports of Gigabit Ethernet (1000BASE-T) Interfaces for Server Connectivity and Up to 4 10 Gigabit Ethernet Uplink Interfaces

The first product in the Cisco Nexus 2000 Series is the Cisco Nexus 2148T Fabric Extender. The Cisco Nexus 2148T provides 48 Gigabit Ethernet (1000BASE-T) server ports and 4 10 Gigabit Ethernet uplink ports in a compact one-rack-unit (1RU) form factor. Designed with architecture to provide the benefits of both top-of-rack and end-of-row configurations, the Cisco Nexus 2148T features front-to-back cooling compatible with data center hot-aisle and cold-aisle designs, all switch ports at the rear of the unit in close proximity to server ports, and all user-serviceable components accessible from the front panel (Figure 5).

Efficient Transceiver and Cabling Options

The Cisco Nexus 5000 Series supports a wide variety of 10 Gigabit Ethernet connectivity options using Cisco 10GBASE SFP+ modules.

In addition, a subset of the ports on the Cisco Nexus 5020 and 5010 support Gigabit Ethernet connectivity options using 1GBASE SFP modules, and 4/2/1-Gbps Fibre Channel SFP interfaces are supported with expansion module options.

Table 1 lists the supported transceiver options.

Table 1. Cisco Nexus 5000 Series Transceiver Support Matrix

Cisco SFP	Description
Cisco SFP-10G-SR	10GBASE-SR SFP+ module (MMF)
Cisco SFP-10G-LR	10GBASE-LR SFP+ module (SMF)
Cisco SFP-H10GB-CU1M	10GBASE-CU SFP+ cable 1m (Twinax cable)
Cisco SFP-H10GB-CU3M	10GBASE-CU SFP+ cable 3m (Twinax cable)
Cisco SFP-H10GB-CU5M	10GBASE-CU SFP+ cable 5m (Twinax cable)
Cisco GLC-T	1000BASE-T SFP
Cisco GLC-SX-MM	GE SFP, LC connector SX transceiver (MMF)
Cisco GLC-LH-SM	GE SFP, LC connector LX/LH transceiver (SMF)
DS-SFP-FC4G-SW(=)	4-Gbps Fibre Channel SW SFP, LC (for Fibre Channel expansion module ports)
DS-SFP-FC4G-LW(=)	4-Gbps Fibre Channel LW SFP, LC (for Fibre Channel expansion module ports)

The high bandwidth of 10 Gigabit Ethernet poses challenges to transmissions that are met by the transceiver and cabling options supported by the Cisco Nexus 5000 Series.

The product family supports an innovative Twinax copper cabling solution that connects to standard SFP+ connectors for in-rack use, and optical cabling for longer cable runs (Table 2).

- For in-rack or adjacent-rack cabling, the Cisco Nexus 5000 Series supports SFP+ direct-attached 10 Gigabit Ethernet copper, an innovative solution that integrates transceivers with Twinax cables into an energy-efficient, low-cost, and low-latency solution. SFP+ direct-attached 10 Gigabit Twinax copper cables uses only 0.1 watt (W) of power per transceiver and introduces only approximately 0.25 microsecond of latency per link.

- For longer cable runs, the Cisco Nexus 5000 Series supports multimode, short-reach optical SFP+ transceivers. These optical transceivers use approximately 1W per transceiver and have a latency of less than 0.1 microsecond.

Both of these options provide lower latency and higher energy efficiency than 10GBASE-T. This standard uses transceivers that consume 4 to 8W per transceiver and contribute a latency of up to 2.5 microseconds per link, making the 10GBASE-T standard a significant contributor to network-level power consumption.

Table 2. The Cisco Nexus 5000 Series Supports SFP+ Direct-Attached 10 Gigabit Copper for In-Rack Cabling, and Optical Solutions for Longer Connections

Connector (Media)	Cable	Distance	Power (Each side)	Transceiver Latency (Link)	Standard
SFP+ CU Copper	Twinax	5m	~0.1W	~0.1 microseconds	SFF 8431
SFP+ USR MMF,and Ultra-Short Reach (Provided as comparison point)	MM OM3	100m	1W	~0 microseconds	IEEE 802.3ae
SFP+ SR MMF and Short Reach	MM OM2 MM OM3	82m 300m	1W	~0 microseconds	IEEE 802.3ae
RJ45 10GBASE-T Copper (Not supported, Provided as comparison point)	Cat6a or 7	30m 100m	~4W ~6W	~1.5 microseconds ~2.5 microseconds	IEEE 802.3an

Features and Benefits

The switch family's rich feature set makes it ideal for top-of-rack, middle-of-row, or end-of-row access-layer applications. It protects investments in data center racks with Cisco Data Center Ethernet, FCoE features, and virtual machine awareness features that allow IT departments to consolidate networks based on their own requirements and timing. The combination of high port density, lossless Ethernet, wire-speed performance, and extremely low latency makes the switch an ideal product to meet the growing demand for 10 Gigabit Ethernet with the capability to support Cisco Data Center Ethernet in enterprise and service provider data centers, protecting enterprises' investments. The switch family has sufficient port density to support single or multiple racks fully populated with blade and rack-mount servers.

- Built for today's data centers, the switches are designed just like the servers they support. Ports and power connections are at the rear, closer to server ports, helping keep cable lengths as short and efficient as possible, delivering benefits traditionally offered on blade servers to rack servers as well. Hot-swappable power and fan modules can be accessed from the front panel, where status lights offer an at-a-glance view of switch operation. Front-to-back cooling is consistent with server designs, supporting efficient data center hot- and cold-aisle designs. Serviceability is enhanced with all customer-replaceable units accessible from the front panel. The use of SFP+ ports offers increased flexibility to use a range of interconnect solutions, including copper Twinax cable for short runs and fiber for long runs.

- Cisco Data Center Ethernet features increase network scalability, support I/O consolidation, ease management of multiple traffic flows, and optimize performance. Although implementing SAN consolidation requires only the lossless fabric provided by the Ethernet pause mechanism, the Cisco Nexus 5000 Series provides additional features that create an even more easily managed, high-performance, unified network fabric. Cisco Data Center Ethernet features supported by the Cisco Nexus 5000 Series are outlined in Table 3.

Table 3.   Cisco Data Center Ethernet Features and Benefits

Cisco Data Center Ethernet Feature	Business Benefit
Priority flow control (PFC)	• Simplifies management of multiple traffic flows over a single network link • Creates lossless behavior for Ethernet by allowing class-of-service (CoS)–based flow control
Bandwidth management	Enables consistent management of quality-of-service (QoS) at the network level by providing consistent scheduling of different traffic types (IP, storage, etc.)
Data Center Bridging Exchange (DCBX) Protocol	Simplifies network deployment and reduces configuration errors by providing autonegotiation of Cisco Data Center Ethernet features between the NIC and the switch and between switches
Congestion management (backward congestion notification [BCN]) (future)	Pushes congestion to network edges, providing better control over QoS; the Nexus Cisco 5000 Series hardware supports a precursor to IEEE 802.1Qau called BCN, which will be made available based on availability of other system components, such as adapters and core switches and routers
Layer 2 multipathing (hardware capable)	• Allows active-active uplinks from access switch • Increases network performance and Layer 2 domain scale

- FCoE is a standards-based upper-layer protocol that maps Fibre Channel protocol and services onto Layer 2 Ethernet. It is a straightforward encapsulation of Fibre Channel within Ethernet that preserves existing Fibre Channel network management models and tools, helping protect investments in software and staff training.

- Unified I/O consolidates all data center I/O onto Layer 2 Ethernet. Unified I/O reduces capital and operating costs by reducing the number of server adapters, cables, and upstream switches needed. All I/O (LAN, SAN, and cluster) typically is consolidated onto two Ethernet links. Cisco Data Center Ethernet and FCoE enable the incorporation of Fibre Channel frames into unified I/O, facilitating wire-once strategies in which all servers become capable of SAN connection. A standard and uniform approach to I/O enhances server and storage consolidation strategies. The Cisco Nexus 5000 Series also connects to existing native Fibre Channel networks, protecting current investments in storage networks. Additionally, the Cisco Nexus 5000 Series attaches to directly connected FCoE and Fibre Channel storage devices and, as FCoE-enabled switching becomes available across the data center, will support multi-tiered unified network fabric directly over FCoE.

- Energy efficiency achieved through the use of the Cisco Nexus 5000 Series Switches helps data centers operate within their space, power, and cooling parameters while reducing their carbon footprints. Every network link at the rack level requires adapters, switches, and transceivers, all of which consume power. I/O consolidation reduces energy consumption by eliminating the need for separate Fibre Channel adapters, cables, and switches. In many cases, server cluster networks also can be consolidated onto 10 Gigabit Ethernet networks, especially given the low latency of the Cisco Nexus 5000 Series. The switch hardware is also designed for energy efficiency. Variable-speed fans consume only the amount of power necessary to cool the chassis at any point in time. The switch power supplies are sized to support worst-case scenarios, where inefficient SFP+ transceivers increase power draw; however, when low-power cabling solutions are deployed, the switch family's power supplies maintain 90 percent efficiency at only 25 percent utilization, making efficient use of power in best-case scenarios.

- Consistent management for Cisco products is provided through consistency of both Cisco NX-OS Software and Cisco MDS 9000 SAN-OS Software management models and tools. The switch family network features can be managed using the Cisco command-line interface (CLI), and the Fibre Channel and FCoE features can be managed through Cisco

Fabric Manager Suite. In a future release, Cisco Data Center Network Manager (DCNM) will support the Cisco Nexus 5000 Series switch family. The capability to manage Ethernet and FCoE features independently with existing Cisco tools preserves existing management models, best practices, and investments in staff training. In addition, Simple Network Management Protocol (SNMP) MIBs, XML, and the Cisco CLI are made available to customers for switch management through third-party and custom-developed tools. The switch family leverages Cisco NX-OS Software for superior operational efficiency, pervasive security, and continuous operation even through software upgrades.

- Software manageability and serviceability features include Smart Call Home and automated parameter exchange (through DCBX). Security is enhanced through role-based access control (RBAC); support for authentication, authorization, and accounting (AAA), remote TACACS+, and RADIUS servers; and Secure Shell (SSH) access.

Applications

The Cisco Nexus 5000 Series supports a number of application scenarios that use it as an access-layer switch co-located with servers in data center racks or for middle-of-row deployments.

- As an access-layer switch, it can be used purely as a 10 Gigabit Ethernet switch, consolidating 10 Gigabit Ethernet connections into a smaller number of server connections trunked to the aggregation layer.
- In conjunction with the Cisco Nexus 2148T Gigabit Ethernet Fabric Extender, the Cisco Nexus 5000 Series can be a high-density Gigabit Ethernet switching system, consolidating more than 576 Gigabit Ethernet connections within a single management plane.
- As a rack-level I/O consolidation platform, the switch carries Ethernet traffic from servers to the aggregation layer and carries FCoE traffic to existing Fibre Channel SANs.
- As a crucial element in data center I/O consolidation, the switch paves the way with I/O consolidation at the access layer and interoperability with the Cisco Nexus 5000 Series and other standards-based products.

The capability of the Cisco Nexus 5000 Series to function in all these capacities helps protect investment in the data center with a deployment model in which additional features are enabled as they are needed.

Rack-Level 10 Gigabit Ethernet Access-Layer Switch

The Cisco Nexus 5000 Series switch family is designed with the density, performance, front-to-back cooling, and rear port configuration that make it ideal for aggregating a large number of 10 Gigabit Ethernet links from servers into a smaller number of uplinks to aggregation-layer switches. The switch port density allows each switch to support a single rack or neighboring racks using the SFP+ direct-attached 10 Gigabit copper cabling option. The Cisco Nexus 5000 Series Switches can be purchased with only the Ethernet capabilities enabled, allowing IT departments to deploy them in parallel with existing Fibre Channel SANs. Figure 6 shows an active-active pair of Cisco Nexus 5000 Series Switches cross-connected to redundant Ethernet NICs in servers. Instead of using multiple Gigabit Ethernet connections to servers for LAN, virtual machine mobility applications, and Small Computer System Interface over IP (iSCSI) SAN support, customers can combine their traffic over a consolidated, lossless, low-latency 10 Gigabit Ethernet fabric.

Figure 6.   The Cisco Nexus 5000 Series Can Be Deployed as a Top-of-Rack, Access-Layer Switch in Parallel with Existing Fibre Channel SANs
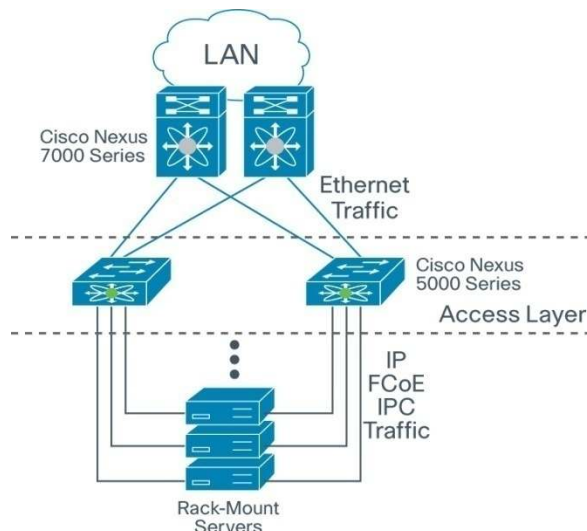
Consolidated Gigabit Ethernet Top-of-Rack Access-Layer System

One deployment scenario involves equipping each data center rack with two Cisco Nexus 2148T Gigabit Ethernet Fabric Extenders connected to two upstream Cisco Nexus 5000 Series Switches (Figure 7). Up to 48 servers can connect to each Fabric Extender. Assuming that these servers are dual-homed, a pair of Nexus 5020s can connect up to 576 servers (12 Fabric Extenders).

Figure 7.   An Example Top-of-Rack Deployment Scenario Supports up to 576 servers with Only a Single Pair of Access-Layer Switches and No Oversubscription at the Rack Level.
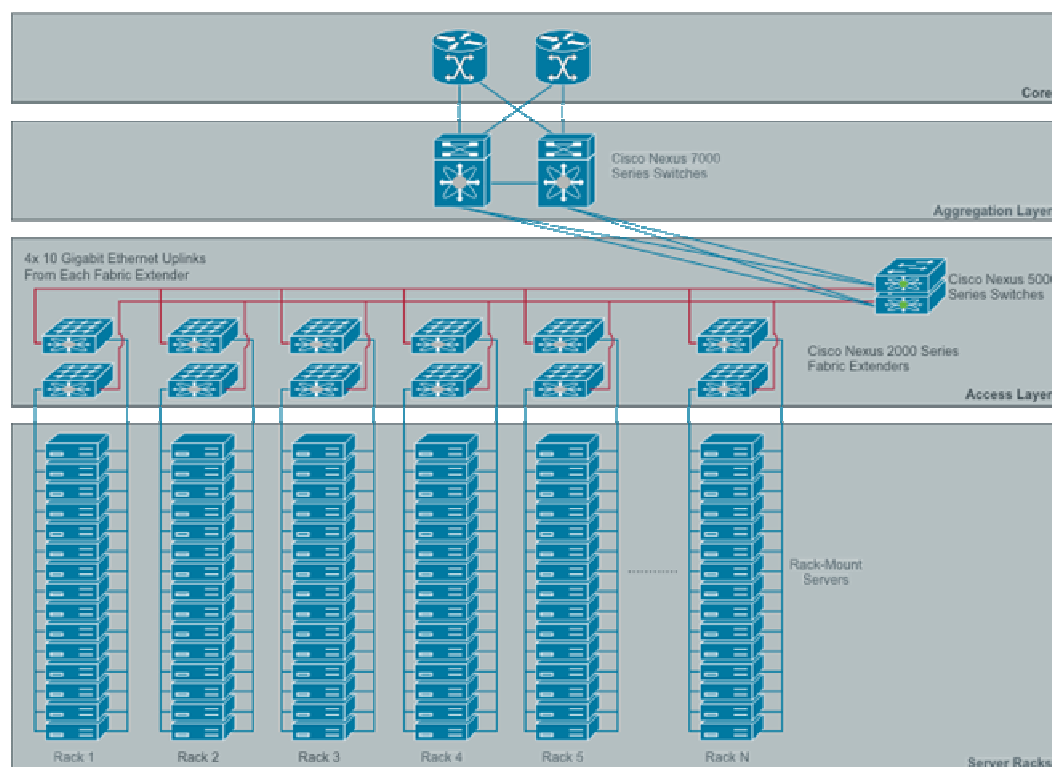
Unified Fabric with FCoE: I/O Consolidation

The Cisco Nexus 5000 Series consolidates multiple networks—LAN, SAN, and server cluster—onto a single unified fabric, saving the capital and operating expenses associated with multiple parallel networks, switching infrastructure, and cabling. The Cisco Nexus 5000 Series Switches are compatible with third-party consolidated I/O adapters (Consolidated Network Adapters or CNAs) that present separate Ethernet NICs and Fibre Channel HBAs to the server operating system. This allows existing drivers and Fibre Channel management software to work transparently with FCoE. Upstream, two different expansion modules support direct connections from the Cisco Nexus 5000 Series to existing native Fibre Channel SANs (Figure 8).

Figure 8. A Pair of Cisco Nexus 5000 Series Switches in an Active-Active Configuration with Native Fibre Channel Connections to Two Storage Networks
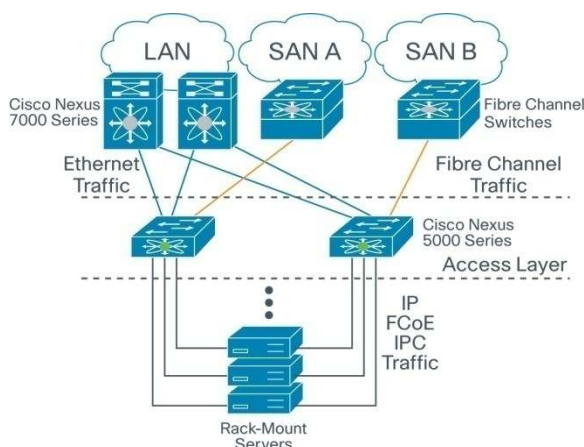
Investment Protection with Unified I/O

The Cisco Nexus 5000 Series supports consolidated I/O using FCoE on downlinks to servers. FCoE is Fibre Channel and, as such, has familiar methods of configuration, operation, and management. On the uplinks to the network, customers can choose between FCoE direct attachment to storage systems and native Fibre Channel connection to existing SANs. FC and FCoE exist simultaneously in the Fibre Channel network, allowing customers to continue to use their existing administration and management tools. Cisco Fabric Manager SAN management software manages both FC and FCoE flows over both FCoE– and FC capable ports.

Product Architecture

The Cisco Nexus 5000 Series is built around two custom components: a unified crossbar fabric and a unified port controller ASIC. Each Cisco Nexus 5000 Series Switch contains a single unified crossbar fabric ASIC and multiple unified port controllers to support fixed ports and expansion modules within the switch.

The unified port controller provides an interface between the unified crossbar fabric ASIC and the network media adapter and makes forwarding decisions for Ethernet, Cisco Data Center Ethernet, Fibre Channel, and FCoE frames. The ASIC supports the overall cut-through design of the switch by transmitting packets to the unified crossbar fabric before the entire payload has been received. The unified crossbar fabric ASIC is a single-stage, nonblocking crossbar fabric capable of meshing all ports at wire speed. The unified crossbar fabric offers superior performance by implementing QoS-aware scheduling for unicast and multicast traffic. Moreover, the tight integration of the

unified crossbar fabric with the unified port controllers helps ensure low-latency lossless fabric for ingress interfaces requesting access to egress interfaces.

Cisco NX-OS Software Overview

Cisco NX-OS Software is a data center–class operating system built with modularity, resiliency, and serviceability at its foundation. Based on the industry-proven Cisco MDS 9000 SAN-OS Software, Cisco NX-OS Software helps ensure continuous availability and sets the standard for mission-critical data center environments. The self-healing and highly modular design of Cisco NX-OS Software makes zero-impact operations a reality and enables exceptional operational flexibility.

Focused on the requirements of the data center, Cisco NX-OS Software provides a robust and rich feature set that fulfills the Ethernet and storage networking requirements of present and future data centers. With an XML interface and a CLI like that of Cisco IOS® Software, Cisco NX-OS Software provides state-of-the-art implementations of relevant networking standards as well as a variety of true data center–class Cisco innovations.

Cisco NX-OS Software Features and Benefits

- **Software compatibility:** Cisco NX-OS Software Release 4.0 interoperates with Cisco products running any variant of the Cisco IOS Software operating system. Cisco NX-OS Software Release 4.0 also interoperates with any networking OS that conforms to the networking standards listed as supported in this data sheet.

- **Common software throughout the data center:** Cisco NX-OS Software simplifies the data center operating environment and provides a unified OS designed to run all areas of the data center network, including the LAN, SAN, and Layer 4 to 7 network services.

- **Modular software design:** Cisco NX-OS Software is designed to support distributed multithreaded processing on symmetric multiprocessors (SMPs), multicore CPUs, and distributed line card processors. Computationally intensive tasks, such as hardware table programming, can be offloaded to dedicated processors distributed across the line cards. Cisco NX-OS Software modular processes are instantiated on demand, each in a separate protected memory space. Thus, processes are started and system resources allocated only when a feature is enabled. The modular processes are governed by a real-time preemptive scheduler that helps ensure the timely processing of critical functions.

- **Quick development of enhancements and problem fixes:** The modularity of Cisco NX-OS Software allows new features, enhancements, and problem fixes to be integrated into the software quickly. Thus, modular fixes can be developed, tested, and delivered in a short time span.

- **Troubleshooting and diagnostics:** Cisco NX-OS Software is built with unique serviceability functions to enable network operators to take early action based on network trends and events, enhancing network planning and improving network operations center (NOC) and vendor response times. Smart Call Home and Cisco Generic Online Diagnostics (GOLD) are some of the features that enhance the serviceability of Cisco NX-OS Software.

  ◦ **Smart Call Home:** The Smart Call Home feature continuously monitors hardware and software components to provide email-based notification of critical system events. A versatile range of message formats is available for optimal compatibility with pager services, standard email, and XML-based automated parsing applications. This feature offers alert grouping capabilities and customizable destination profiles. It can be used, for example, to directly page a network support engineer, send an email message to a NOC,

and employ Cisco Auto-Notify services to directly generate a case with the Cisco Technical Assistance Center (TAC). This feature is a step toward autonomous system operation, enabling networking devices to inform IT when a problem occurs and helping ensure that the problem is acted on quickly, reducing time to resolution and increasing system uptime.

- ◦ **Cisco GOLD:** Cisco GOLD is a suite of diagnostic facilities to verify that hardware and internal data paths are operating as designed. Boot-time diagnostics, continuous monitoring, and on-demand and scheduled tests are part of the Cisco GOLD feature set. This industry-leading diagnostics subsystem allows rapid fault isolation and continuous system monitoring, critical in today's continuously operating environments.

- **Programmatic XML interface:** Based on the NETCONF industry standard, the Cisco NX-OS Software's XML interface provides a consistent API for devices, enabling rapid development and creation of tools to enhance the network.
- **SNMP:** Cisco NX-OS complies with SNMPv1, v2, and v3. A rich collection of MIBs is supported.
- **RBAC:** With RBAC, Cisco NX-OS Software enables administrators to limit access to switch operations by assigning roles to users. Administrators can customize access and restrict it to the users who require it.

Product Specifications

Performance

- Cisco Nexus 5020: Layer 2 hardware forwarding at 1.04 Tbps or 773.8 million packets per second (mpps)
- Cisco Nexus 5010: Layer 2 hardware forwarding at 520 Gbps or 386.9 million packets per second (mpps)
- MAC address table entries: 16,000
- Low latency cut-through design provides predictable, consistent traffic latency regardless of packet size, traffic pattern, or enabled features on 10 Gigabit Ethernet interfaces
- Line rate on all ports

Interfaces

- Cisco Nexus 5020: 40 fixed ports of 10 Gigabit Ethernet (ports 1 to 16 are Gigabit Ethernet and 10 Gigabit Ethernet), FCoE, and Cisco Data Center Ethernet; additional interfaces through two expansion modules
- Cisco Nexus 5010: 20 fixed ports of 10 Gigabit Ethernet (ports 1 to 8 are Gigabit Ethernet and 10 Gigabit Ethernet), FCoE, and Cisco Data Center Ethernet; additional interfaces through one expansion module
- Expansion modules:
  - ◦ 6-port 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE module
  - ◦ 4-port Fibre Channel plus 4-port 10 Gigabit Ethernet, Cisco Data Center Ethernet, and FCoE module
  - ◦ 8-port native 4/2/1-Gbps Fibre Channel expansion module
- Extension through the Cisco Nexus 2000 Series Fabric Extenders (up to 12 fabric extenders per Cisco Nexus 5000 Series Switch)

Layer 2 Features

- Layer 2 switch ports and VLAN trunks
- IEEE 802.1Q VLAN encapsulation
- Support for up to 256 VLANs and 32 virtual SANs (VSANs) per switch
- Rapid Per-VLAN Spanning Tree Plus (PVRST+)
- Multiple Spanning Tree Protocol (MSTP) (IEEE 802.1s): 64 instances
- Spanning Tree PortFast and PortFast Guard
- Spanning Tree UplinkFast and BackboneFast
- Spanning Tree Root Guard
- Spanning Tree Bridge Assurance
- NIC teaming
- Internet Group Management Protocol (IGMP) Versions 1, 2, and 3 snooping
- IGMP snooping querier
- Cisco EtherChannel technology
- Link Aggregation Control Protocol (LACP): IEEE 802.3ad
- Advanced PortChannel hashing based on Layer 2, 3, and 4 information
- Jumbo frames on all ports (up to 9216 bytes)
- Pause frames (IEEE 802.3x)
- Storm control (unicast, multicast, and broadcast)
- Private VLANs
- Private VLAN over trunks

QoS

- Layer 2 IEEE 802.1p (CoS)
- 8 hardware queues per port
- Per-port QoS configuration
- CoS trust
- Port-based CoS assignment
- Modular QoS CLI (MQC) compliance
- Color-aware aggregate policing
- Policed drop
- Per-port virtual output queuing
- CoS-based egress queuing
- Egress strict-priority queuing
- Egress port-based scheduling: Weighted Round-Robin (WRR)
- Ingress policing on physical Ethernet and virtual Ethernet interfaces

Security

- Ingress access control lists (ACLs) (standard and extended) on Ethernet and virtual Ethernet ports
- Standard and extended Layer 2 ACLs: MAC addresses, protocol type, etc.

- Standard and extended Layer 3 to 4 ACLs: IPv4 and v6, Internet Control Message Protocol (ICMP), TCP, User Datagram Protocol (UDP), etc.

- VLAN-based ACLs (VACLs)

- Port-based ACLs (PACLs)

- Named ACLs

- ACL logging and statistics

- Time-based ACLs

- Optimized ACL distribution

High-Availability Features

- Hot-swappable field-replaceable power supplies, fan modules, and expansion modules

- 1:1 power redundancy

- N:1 fan module redundancy

Management

- Switch management using 10/100/1000-Mbps management or console ports

- CLI-based console to provide detailed out-of-band management

- SSHv2

- Telnet

- AAA

- RADIUS

- TACACS+

- Syslog

- Embedded packet analyzer

- SNMP v1, v2, and v3

- Enhanced SNMP MIB support

- XML (NETCONF) support

- Remote monitoring (RMON)

- Advanced Encryption Standard (AES) for management traffic

- Unified username and passwords across CLI and SNMP

- Microsoft Challenge Handshake Authentication Protocol (CHAP)

- Digital certificates for management between switch and RADIUS server

- Cisco Discovery Protocol (CDP) Versions 1 and 2

- RBAC

- Switched Port Analyzer (SPAN) on physical, PortChannel, VLAN, and Fibre Channel interfaces

- Ingress and egress packet counters per interface

- Network Time Protocol (NTP)

- Power-on self-test (POST)

- Cisco GOLD: Ethernet and Fibre Channel

- Comprehensive bootup diagnostic tests

- Call Home
- Smart Call Home
- Cisco Fabric Manager
- CiscoWorks LMS Portal

Cisco Data Center Ethernet

- PFC (per-priority pause frame support)
- DCBX Protocol
- IEEE 802.1Qaz: Bandwidth management

Fibre Channel Features (Requires Storage Services License)

- FCoE
- Any 10 Gigabit Ethernet port configurable as FCoE
- SAN administration separate from LAN administration
- Fibre Channel Protocol (FCP)
- Fibre Channel standard port types: E, F, and NP
- Fibre Channel enhanced port types: TE and VF
- Direct attachment of FCoE and Fibre Channel targets
- Up to 64 buffer credits per port
- VSANs
- Fibre Channel (SAN) PortChannel
- Native Interop Mode 2
- Native Interop Mode 3
- VSAN trunking
- Fabric Device Management Interface (FDMI)
- Fibre Channel ID (FCID) persistence
- Distributed device alias services
- In-order delivery
- Port tracking
- N-port virtualization (NPV)
- N-port identifier virtualization (NPIV)
- Fabric services: Name server, registered state change notification (RSCN), login services, and name-server zoning
- Per-VSAN fabric services
- Cisco Fabric Services
- Diffie-Hellman Challenge Handshake Authentication Protocol (DHCHAP) and Fibre Channel Security Protocol (FC-SP)
- Distributing device alias services
- Host-to-switch and switch-to-switch FC-SP authentication
- Fabric Shortest Path First (FSPF)
- Fabric binding for Fibre Channel

- Standard zoning
- Port security
- Domain and port
- Enhanced zoning
- SAN PortChannels
- Cisco Fabric Analyzer
- Fibre Channel traceroute
- Fibre Channel ping
- Fibre Channel debugging
- Cisco Fabric Manager support

SNMP MIBs

Generic MIBs
- SNMPv2-SMI
- CISCO-SMI
- SNMPv2-TM
- SNMPv2-TC
- IANA-ADDRESS-FAMILY-NUMBERS-MIB
- IANAifType-MIB
- IANAiprouteprotocol-MIB
- HCNUM-TC
- CISCO-TC
- SNMPv2-MIB
- SNMP-COMMUNITY-MIB
- SNMP-FRAMEWORK-MIB
- SNMP-NOTIFICATION-MIB
- SNMP-TARGET-MIB
- SNMP-USER-BASED-SM-MIB
- SNMP-VIEW-BASED-ACM-MIB
- CISCO-SNMP-VACM-EXT-MIB

Fibre Channel MIBs
- CISCO-ST-TC
- CISCO-FC-FE-MIB
- CISCO-FCSP-MIB
- CISCO-PORT-TRACK-MIB
- CISCO-PSM-MIB
- CISCO-FC-SPAN-MIB
- CISCO-PORT-CHANNEL-MIB
- CISCO-RSCN-MIB

- CISCO-NS-MIB
- CISCO-FCS-MIB
- CISCO-DM-MIB
- FIBRE-CHANNEL-FE-MIB
- CISCO-FC-ROUTE-MIB
- CISCO-FSPF-MIB
- CISCO-ZS-MIB
- CISCO-ZS-EXT-MIB
- CISCO-VSAN-MIB
- CISCO-CFS-MIB
- CISCO-FCPING-MIB
- CISCO-FCTRACEROUTE-MIB
- CISCO-FDMI-MIB
- CISCO-FC-DEVICE-ALIAS-MIB
- CISCO-WWNMGR-MIB
- FCMGMT-MIB
- CISCO-VEDM-MIB

Ethernet MIBs

- CISCO-VLAN-MEMBERSHIP-MIB

Configuration MIBs

- ENTITY-MIB
- IF-MIB
- CISCO-ENTITY-EXT-MIB
- CISCO-ENTITY-FRU-CONTROL-MIB
- CISCO-ENTITY-SENSOR-MIB
- CISCO-FLASH-MIB
- CISCO-SYSTEM-MIB
- CISCO-SYSTEM-EXT-MIB
- CISCO-IP-IF-MIB
- CISCO-IF-EXTENSION-MIB
- CISCO-SERVER-INTERFACE-MIB
- CISCO-NTP-MIB
- CISCO-IMAGE-MIB
- CISCO-IMAGE-CHECK-MIB
- CISCO-IMAGE-UPGRADE-MIB
- CISCO-CONFIG-COPY-MIB
- CISCO-ENTITY-VENDORTYPE-OID-MIB

Monitoring MIBs
- DIFFSERV-DSCP-TC
- NOTIFICATION-LOG-MIB
- DIFFSERV-MIB
- CISCO-CALLHOME-MIB
- CISCO-SYSLOG-EXT-MIB
- CISCO-PROCESS-MIB
- RMON-MIB
- CISCO-RMON-CONFIG-MIB
- CISCO-HC-ALARM-MIB

Security MIBs
- CISCO-AAA-SERVER-MIB
- CISCO-AAA-SERVER-EXT-MIB
- CISCO-COMMON-ROLES-MIB
- CISCO-COMMON-MGMT-MIB
- CISCO-RADIUS-MIB
- CISCO-SECURE-SHELL-MIB
- TCP/IP MIBs
- INET-ADDRESS-MIB
- TCP-MIB
- CISCO-TCP-MIB
- UDP-MIB
- IP-MIB
- CISCO-IP-PROTOCOL-FILTER-MIB
- CISCO-DNS-CLIENT-MIB

Miscellaneous MIBs
- START-MIB
- CISCO-LICENSE-MGR-MIB
- CISCO-FEATURE-CONTROL-MIB
- CISCO-CDP-MIB
- CISCO-RF-MIB

Standards

Industry Standards
- IEEE 802.1D: Spanning Tree Protocol
- IEEE 802.1p: CoS prioritization
- IEEE 802.1Q: VLAN tagging
- IEEE 802.1s: Multiple VLAN instances of Spanning Tree Protocol
- IEEE 802.1w: Rapid reconfiguration of Spanning Tree Protocol

- IEEE 802.3: Ethernet
- IEEE 802.3ad: LACP
- IEEE 802.3ae: 10 Gigabit Ethernet
- SFP+ support
- RMON

Fibre Channel Standards

- FC-PH, Revision 4.3 (ANSI/INCITS 230-1994)
- FC-PH, Amendment 1 (ANSI/INCITS 230-1994/AM1 1996)
- FC-PH, Amendment 2 (ANSI/INCITS 230-1994/AM2-1999)
- FC-PH-2, Revision 7.4 (ANSI/INCITS 297-1997)
- FC-PH-3, Revision 9.4 (ANSI/INCITS 303-1998)
- FC-PI, Revision 13 (ANSI/INCITS 352-2002)
- FC-PI-2, Revision 10 (ANSI/INCITS 404-2006)
- FC-PI-4, Revision 7.0
- FC-FS, Revision 1.9 (ANSI/INCITS 373-2003)
- FC-FS-2, Revision 0.91
- FC-LS, Revision 1.2
- FC-SW-2, Revision 5.3 (ANSI/INCITS 355-2001)
- FC-SW-3, Revision 6.6 (ANSI/INCITS 384-2004)
- FC-GS-3, Revision 7.01 (ANSI/INCITS 348-2001)
- FC-GS-4, Revision 7.91 (ANSI/INCITS 387-2004)
- FC-BB-5, Revision 1.0 for FCoE
- FCP, Revision 12 (ANSI/INCITS 269-1996)
- FCP-2, Revision 8 (ANSI/INCITS 350-2003)
- FCP-3, Revision 4 (ANSI/INCITS 416-2006)
- FC-MI, Revision 1.92 (INCITS TR-30-2002, except for FL_ports and Class 2)
- FC-MI-2, Revision 2.6 (INCITS TR-39-2005, except for FL_ports and Class 2)
- FC-SP, Revision 1.6
- FC-DA, Revision 3.1 (INCITS TR-36-2004, except for FL_ports, SB_ports and Class 2)
- Class of Service: Class 3, Class F
- Fibre Channel standard port types: E, F
- Fibre Channel enhanced port types: SD, TE

Physical Specifications

SFP+ Optics

Cisco Nexus 5000 Series products support 10 Gigabit Ethernet SFP+ copper Twinax cables for short distances and SFP+ optics (10GBASE-SR and 10GBASE-LR) for longer distances. SFP+ has several advantages compared to other 10 Gigabit Ethernet connectivity options:

- Smallest 10 Gigabit Ethernet form-factor

- Optical interoperability with XENPAK, X2, and XFP interface types

- Lowest power consumption

- Hot-swappable device

SFP Optics

- Cisco Nexus 5000 Series products support Gigabit Ethernet SFP for Gigabit Ethernet connectivity options. The following SFP transceiver modules are supported in ports 1 to 8 of the Cisco Nexus 5010 and ports 1 to 16 of the Cisco Nexus 5020:

    ◦ Cisco 1000BASE-T SFP

    ◦ Cisco 1000BASE-SX SFP

    ◦ Cisco 1000BASE-LX/LR SFP

- Cisco Nexus 5000 Series products support 4-Gbps Fibre Channel–compatible SFPs for native Fibre Channel connectivity options; 4-Gbps Fibre Channel–compatible short-reach and 10-km long-reach SFP transceiver modules operate at 4/2/1 Gbps and are supported in the native Fibre Channel ports on expansion modules.

Power Supply

Table 4 lists the environment properties of the Cisco Nexus 5010 Switch and Cisco Nexus 5020 Switch.

Table 4.   Environment of the Cisco Nexus 5000 Series Switches

AC Power Supply Properties	Cisco Nexus 5010 Switch	Cisco Nexus 5020 Switch
Typical Operating Power	350W	480W
Maximum Power	450W	750W
Input Voltage	100-240VAC	100-240VAC
Frequency	50-60Hz	50-60Hz
Efficiency	88-90%	82-88%
RoHS Compliance	Yes	Yes
Hot swappable	Yes	Yes
Heat Dissipation	1536 BTU/hr	2561 BTU/hr

Cisco Nexus 5000 Switch Environment

Table 5 lists the environment properties of the Cisco Nexus 5010 Switch and Cisco Nexus 5020 Switch

Table 5.   Environment of the Cisco Nexus 5000 Series Switches

Property	Cisco Nexus 5010 Switch	Cisco Nexus 5020 Switch
Physical (height x width x depth)	1.72 x 17.3 x 30.0 in. (4.4 x 43.9 x 76.2 cm)	3.47 x 17.3 x 30.0 in. (8.8 x 43.9 x 76.2 cm)
Operating temperature	32 to 104℉ (0 to 40℃)	32 to 104℉ (0 to 40℃)
Nonoperating (storage) temperature	–40 to 158℉ (–40 to 70℃)	–40 to 158℉ (–40 to 70° C)
Humidity	5 to 95% (noncondensing)	5 to 95% (noncondensing)
Altitude	0 to 10,000 ft (0 to 300m)	0 to 10,000 ft (0 to 300m)

Weight

Table 6 lists the weight of the Cisco Nexus 5010 and Cisco Nexus 5020 Switches.

Table 6.   Weight of the Cisco Nexus 5010 and Cisco Nexus 5020 Switches

Component	Weight
Cisco Nexus 5020 with 2 power supplies, 2 expansion modules and 5 fan modules	50 lb (22.68 kg)
Cisco Nexus 5010 with 2 power supplies, 1 expansion module and 2 fan modules	35 lb (15.88 kg)

Software Requirements

Cisco Nexus 5000 Series Switches are supported by Cisco NX-OS Software Release 4.0 and later. Cisco NX-OS Software interoperates with any networking OS, including Cisco IOS Software, that conforms to the networking standards mentioned in this data sheet.

For the latest software release information and recommendations, please see the product bulletin at http://www.cisco.com/go/nexus5000.

Regulatory Standards Compliance

Table 7 summarizes regulatory standards compliance.

Table 7.   Regulatory Standards Compliance: Safety and EMC

Specification	Description
Regulatory compliance	Products should comply with CE Markings according to directives 2004/108/EC and 2006/95/EC.
Safety	- UL 60950-1 - CAN/CSA-C22.2 No. 60950-1 - EN 60950-1 - IEC 60950-1 - AS/NZS 60950-1 - GB4943
EMC: Emissions	47CFR Part 15 (CFR 47) Class A - AS/NZS CISPR22 Class A - CISPR22 Class A - EN55022 Class A - ICES003 Class A - VCCI Class A - EN61000-3-2 - EN61000-3-3 - KN22 Class A - CNS13438 Class A
EMC: Immunity	- EN50082-1 - EN61000-6-1 - EN55024 - CISPR24 - EN300386 - KN 61000-4 series
RoHS	The product is RoHS 5 compliant with exceptions for leaded ball grid array (BGA) balls and lead press-fit connectors.

Ordering Information

Table 8 presents ordering information for the Cisco Nexus 5000 Series Switches

Table 8. Cisco Nexus 5000 Ordering Information

Part Number	Description
Chassis	
N5K-C5010P-BF	Cisco Nexus 5000 1RU Chassis no PS, 2 Fan Modules, 20 ports (req SFP+)
N5K-C5020P-BF	Cisco Nexus 5000 2RU Chassis no PS, 5 Fan Modules, 40 ports (req SFP+)
Fan Modules	
N5K-C5010-FAN=	Cisco Nexus 5010 Fan Module, Spare
N5K-C5020-FAN=	Cisco Nexus 5020 Fan Module, Spare
Power Supplies	
N5K-PAC-550W(=)	Cisco Nexus 5010 PSU module, A/C, 100-240V, 550W
N5K-P1-BLNK(=)	Cisco Nexus 5010 PSU module, Blank slot cover
N5K-PAC-1200W(=)	Cisco Nexus 5020 PSU module, A/C, 100-240V, 1200W
N5K-P2-BLNK(=)	Cisco Nexus 5020 PSU module, Blank slot cover
Software	
N5KUK9-401AN2.1(=)	Cisco Nexus 5000 Base OS Software Release 4.0.1a.N2.1
N5KUK9-401AN1.1(=)	Cisco Nexus 5000 Base OS Software Release 4.0.1a.N1.1
Software Licenses	
N5010-SSK9(=)	Nexus 5010 Storage Protocol Services License
N5020-SSK9(=)	Nexus 5020 Storage Protocol Services License
N5000FMS1K9(=)	Nexus 5000 Fabric Manager Server License
Expansion Modules	
N5K-M1600(=)	Cisco Nexus 5000 1000 Series Module 6-port 10 Gigabit Ethernet (req SFP+)
N5K-M1404(=)	Cisco Nexus 5000 1000 Series Module 4x10GE 4xFC 4/2/1 (Requires SFP+, SFP)
N5K-M1008(=)	Cisco Nexus 5000 1000 Series Module 8xFC 4/2/1 (Requires SFP)
N5K-M1-BLNK(=)	Cisco Nexus 5000 1000 Series Expansion Module Blank
Cables and Optics	
SFP-10G-SR(=)	10GBASE-SR SFP+ Module
SFP-10G-LR(=)	10GBASE-LR SFP+ Module
SFP-H10GB-CU1M(=)	10GBASE-CU SFP+ Cable 1 Meter
SFP-H10GB-CU3M(=)	10GBASE-CU SFP+ Cable 3 Meter
SFP-H10GB-CU5M(=)	10GBASE-CU SFP+ Cable 5 Meter
GLC-T(=)	1000BASE-T SFP
GLC-SX-MM(=)	GE SFP, LC connector SX transceiver
GLC-LH-SM(=)	GE SFP, LC connector LX/LH transceiver
DS-SFP-FC4G-SW(=)	4Gbps Fibre Channel-SW SFP, LC
DS-SFP-FC4G-LW(=)	4Gbps Fibre Channel-LW SFP, LC
Power Cords	
CAB-N5K6A-NA(=)	Power Cord, 250V 6A North America, NEMA 6-15
CAB-AC-250V/13A(=)	Power Cord for North America, 250VAC/13A, NEMA L6-20
CAB-C13-C14-JMPR(=)	Cabinet Jumper Power Cord, 250 VAC 10A, C14-C13 Connectors
CAB-C13-CBN(=)	Cabinet Jumper Power Cord, 250 VAC 16A, C14-C13 Connectors
CAB-9K12A-NA(=)	Power Cord, 125VAC 13A NEMA 5-15 Plug, North America
CAB-IND-10A(=)	10A Power cable for India
CAB-9K10A-AU(=)	Power Cord, 250VAC 10A 3112 Plug, Australia
CAB-9K10A-EU(=)	Power Cord, 250VAC 10A CEE 7/7 Plug, EU
CAB-9K10A-IT(=)	Power Cord, 250VAC 10A CEI 23-16/VII Plug, Italy

CAB-9K10A-SW(=)	Power Cord, 250VAC 10A MP232 Plug, SWITZ
CAB-9K10A-UK(=)	Power Cord, 250VAC 13A BS1363 Plug (13 A fuse), UK
SFS-250V-10A-AR(=)	SFS Power Cord - 250V, 10A - Argentina
SFS-250V-10A-CN(=)	SFS Power Cord - 250V, 10A - PRC
SFS-250V-10A-ID(=)	SFS Power Cord - 250V, 10A - India
SFS-250V-10A-IS(=)	SFS Power Cord - 250V, 10A - Israel
Accessory Kit	
N5010-ACC-KIT=	Cisco Nexus 5010 Accessory Kit, Spare
N5020-ACC-KIT=	Cisco Nexus 5020 Accessory Kit, Spare

Cisco Nexus 2000 Series Fabric Extenders can be ordered along with the Cisco Nexus 5000 Series or separately.

Warranty

The Cisco Nexus 5000 Series Switches have a 1-year limited hardware warranty. The warranty includes hardware replacement with a 10-day turnaround from receipt of a return materials authorization (RMA).

Service and Support

Cisco offers a wide range of services to help accelerate your success in deploying and optimizing the Cisco Nexus 5000 Series in your data center. The innovative Cisco services are delivered through a unique combination of people, processes, tools, and partners and are focused on helping you increase operational efficiency and improve your data center network. Cisco Advanced Services uses an architecture-led approach to help you align your data center infrastructure with your business goals and achieve long-term value. Cisco SMARTnet® Service helps you resolve mission-critical problems with direct access any time to Cisco network experts and award-winning resources. With this service, you can take advantage of the Smart Call Home service capability, which offers proactive diagnostics and real-time alerts on your Cisco Nexus 5000 Series Switches. Spanning the entire network lifecycle, Cisco Services help increase investment protection, optimize network operations, support migration operations, and strengthen your IT expertise. For more information about Cisco Nexus services, visit http://www.cisco.com/go/nexusservices.

For More Information

- Cisco Nexus 5000 Series Switches: http://www.cisco.com/go/nexus5000
- Cisco Nexus 2000 Series Fabric Extenders: http://www.cisco.com/go/nexus2000
- Cisco Data Center Ethernet: http://www.cisco.com/go/dce
- Cisco NX-OS Software: http://www.cisco.com/go/nxos