



**This appendix covers the following exam topics:**

Describe the Cisco Nexus Product Family

Describe FEX Products

## Cisco Nexus Product Family

The Cisco Nexus product family offers a broad portfolio of LAN and SAN switching products spanning software switches that integrate with multiple types of hypervisors to hardware data center core switches and campus core switches. Cisco Nexus products provide the performance, scalability, and availability to accommodate diverse data center needs, including different types of data center protocols, such as FCoE, FC, iSCSI, and so on.

This appendix focuses on the Cisco Nexus product family. You learn the different specifications of each product, which includes Nexus 9000, Nexus 7000, Nexus 6000, Nexus 5000, Nexus 3000, and Nexus 2000.

### “Do I Know This Already?” Quiz

The “Do I Know This Already?” quiz enables you to assess whether you should read this entire appendix thoroughly or jump to the “Exam Preparation Tasks” section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire appendix. Table B2-1 lists the major headings in this appendix and their corresponding “Do I Know This Already?” quiz questions. You can find the answers in Appendix A, “Answers to the ‘Do I Know This Already?’ Quizzes.”

**Table B2-1** “Do I Know This Already?” Section-to-Question Mapping

Foundation Topics Section	Questions
Describe the Cisco Nexus Product Family	1–11
Describe FEX Products	12, 13

**CAUTION** The goal of self-assessment is to gauge your mastery of the topics in this appendix. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which of the following Nexus 9000 hardware models can work as a spine in a Spine-Leaf topology? (Choose three.)
  - a. Nexus 9508
  - b. Nexus 9516
  - c. Nexus 9396PX
  - d. Nexus 93128TX
  - e. Nexus 9336PQ
2. True or false? The Nexus N9K-X9736PQ can be used in standalone mode when the Nexus 9000 modular switches use NX-OS.
  - a. True
  - b. False
3. How many strands do the 40F BiDi optics use?
  - a. 8
  - b. 2
  - c. 12
  - d. 16
4. What is the current bandwidth per slot for the Nexus 7700?
  - a. 550 Gbps
  - b. 220 Gbps
  - c. 1.3 Tbps
  - d. 2.6 Tbps
5. True or false? The F3 modules can be interchanged between the Nexus 7000 and Nexus 7700.
  - a. True
  - b. False
6. How many VDCs can a SUP2 have?
  - a. 2+1
  - b. 16+1
  - c. 8+1
  - d. 4+1
7. True or false? By upgrading SUP1 to the latest software and using the correct license, you can use FCoE with F2 cards.
  - a. True
  - b. False

8. How many unified ports does the Nexus 6004 currently support?
  - a. 20
  - b. 24
  - c. 48
  - d. 64
9. True or false? The 40-Gbps ports on the Nexus 6000 can be used as 10 Gbps.
  - a. True
  - b. False
10. Which of the following statements are correct? (Choose two.)
  - a. The Nexus 5548P has 48 fixed ports and Nexus 5548UP has 32 fixed ports and 16 unified ports.
  - b. The Nexus 5548P has 32 fixed ports, which are Ethernet ports only, and the Nexus 5548UP has 32 fixed unified ports.
  - c. The Nexus 5548P has 32 fixed ports and can have 16 unified ports, whereas the Nexus 5548UP has all ports unified.
  - d. The Nexus 5548P has 32 fixed ports, which are Ethernet only, and Nexus 5548UP has 32 fixed FCoE only.
11. How many unified ports does the Nexus 5672 have?
  - a. 12
  - b. 16
  - c. 8
  - d. 24
12. Which vendors support the B22 FEX?
  - a. HP
  - b. IBM
  - c. Dell
  - c. Fujitsu
  - e. All the above
13. Which models from the following list of switches support FCoE ? (Choose two.)
  - a. Nexus 2232PP
  - b. Nexus 2248PQ
  - c. Nexus 2232TM
  - d. Nexus 2248TP-E

## Foundation Topics

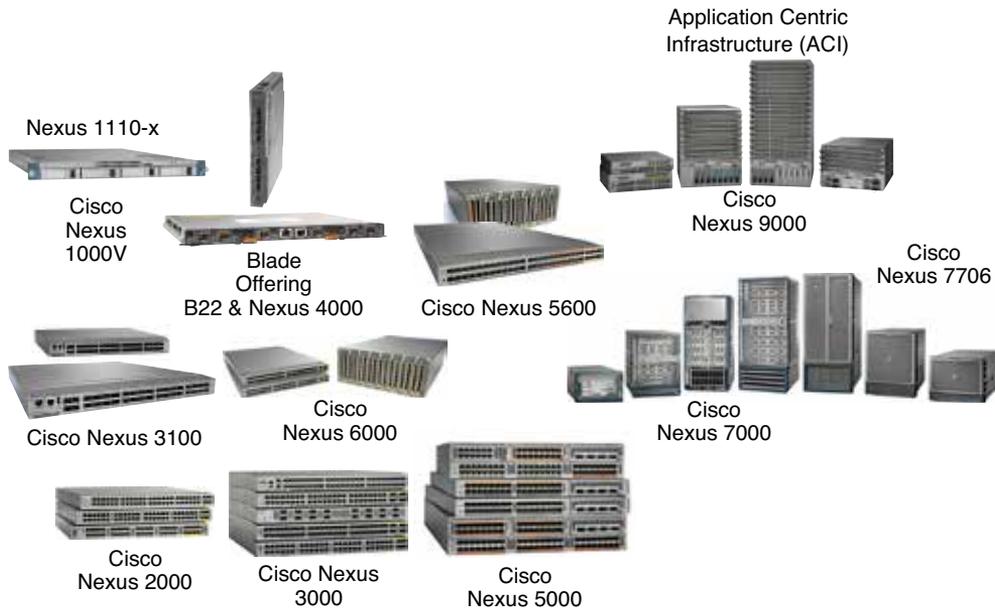
### Describe the Cisco Nexus Product Family

The Cisco Nexus product family is a key component of Cisco unified data center architecture, which is the Unified Fabric. The objective of the Unified Fabric is to build highly available, highly secure network fabrics. Using the Cisco Nexus products, you can build end-to-end data center designs based on three-tier architecture or based on Spine-Leaf architecture. It offers high-density 10 G, 40 G, and 100 G ports as well.

Modern data center designs need the following properties:

- Effective use of available bandwidth in designs where multiple links exist between the source and destination and one path is active and the other is blocked by spanning tree, or the design is limiting us to use Active/Standby NIC teaming. This is addressed today using Layer 2 multipathing technologies such as FabricPath and virtual port channels (vPC).
- Computing resources must be optimized, which happens by building a computing fabric and dealing with CPU and memory as resources that are utilized when needed. Doing capacity planning for all the workloads and identifying candidates to be virtualized help reduce the number of compute nodes in the data center.
- Using the concept of a service profile and booting from SAN in the Cisco Unified Computing system will reduce the time to instantiate new servers. That will make it easy to build and tear down test and development environments.
- Power and cooling are key problems in the data center today. Ways to address this problem include using Unified Fabric (converged SAN and LAN), using Cisco virtual interface cards, and using technologies such as VM-FEX and Adapter-FEX. Rather than using, for example,  $8 \times 10$  G links, you can use  $2 \times 40$  G links and so on. Reducing cabling creates efficient airflow, which in turn reduces cooling requirements.
- The concept of hybrid clouds can benefit your organization. Hybrid clouds extend your existing data center to public clouds as needed, with consistent network and security policies. Cisco is helping customers utilize this concept using Intercloud Fabric.
- Improved reliability during software updates, configuration changes, or adding components to the data center environment, that should happen with minimum disruption.
- Hosts, especially virtual hosts, must move without the need to change the topology or require an address change.

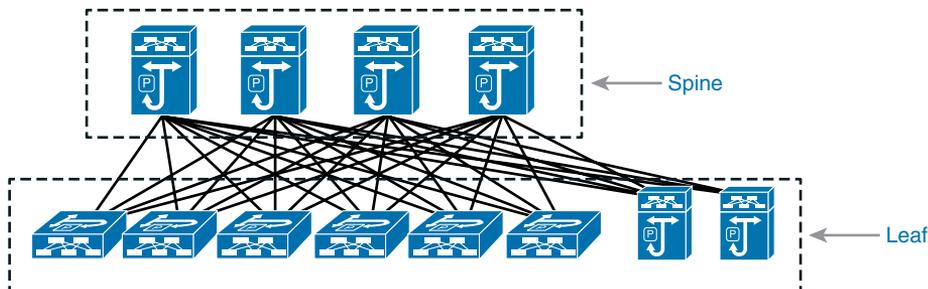
In this appendix you will understand the Cisco Nexus product family. Figure B2-1 shows the different product types available at the time this appendix was written. These products are explained and discussed in the following sections.



**Figure B2-1** *Cisco Nexus Product Family*

## Cisco Nexus 9000 Family

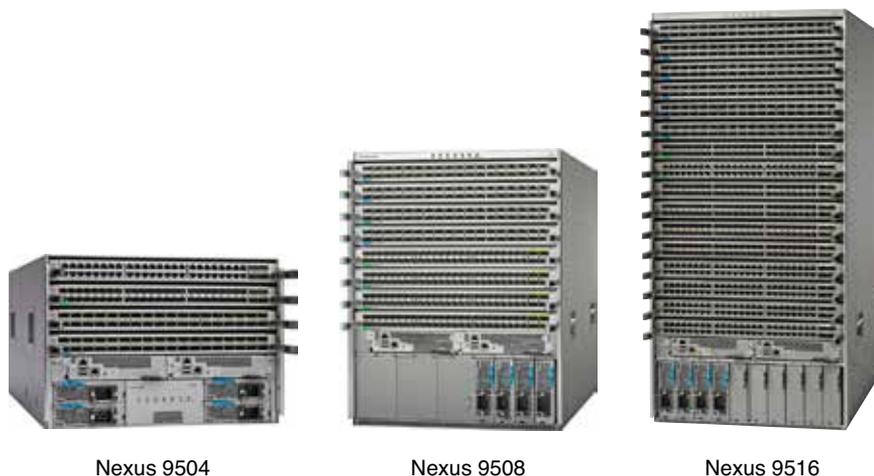
There are two types of switches in the Nexus 9000 Series: the Nexus 9500 modular switches and the Nexus 9300 fixed configuration switches. They can run in two modes. When they run in ACI mode and in combination with Cisco Application Policy Infrastructure Controller (APIC), they provide an application-centric infrastructure. In this case, the design follows the Spine-Leaf architecture shown in Figure B2-2. When they run in NX-OS mode and use the enhanced NX-OS software, they function as a classical Nexus switch. Therefore, the design follows the standard three-tier architecture.



**Figure B2-2** *Nexus 9000 Spine-Leaf Architecture*

## Cisco Nexus 9500 Family

The Nexus 9500 family consists of three types of modular chassis, as shown in Figure B2-3: the 4-slot Nexus 9504, the 8-slot Nexus 9508, and the 16-slot Nexus 9516.



**Figure B2-3** *Nexus 9500 Chassis Options*

The Cisco Nexus 9500 Series switches have a modular architecture that consists of the following:

- Switch chassis
- Supervisor engine
- System controllers
- Fabric modules
- Line cards
- Power supplies
- Fan trays
- Optics

Among these parts, supervisors, system controllers, line cards, and power supplies are common components that can be shared among the entire Nexus 9500 product family. Table B2-2 shows the comparison between the different models of the Nexus 9500 switches.

**Table B2-2** Nexus 9500 Modular Platform Comparison

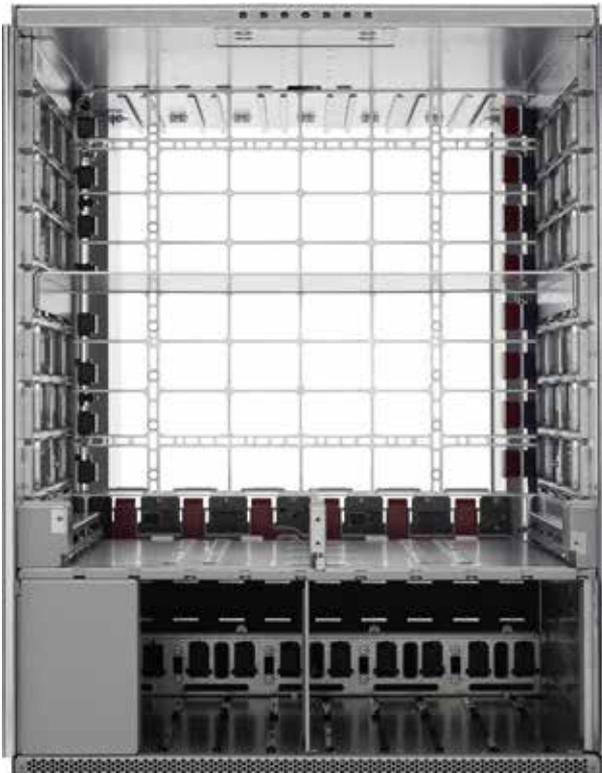
	NEXUS 9504 4-Slot	NEXUS 9508 8-Slot	NEXUS 9516 16-Slot
Height	7RU	13 RU	20 RU
Supervisor Slots	2	2	2
Fabric Module Slots	6	6	6
I/O Module Slots	4	8	16
Max BW per Slot (Tbps)	3.84 Tbps	3.84 Tbps	3.84 Tbps
Max BW per System (Tbps)	15 Tbps	30 Tbps	60 Tbps

	NEXUS 9504 4-Slot	NEXUS 9508 8-Slot	NEXUS 9516 16-Slot
Max 1/10/40 Ports	192/576/144	384/1152/288	768/2304/576
Air Flow	Front-to-back	Front-to-back	Front-to-back
Power Supplies	4 × 3KW AC PSUs	6 × 3KW PSUs	10 × 3KW PSUs
Fan Trays	3	3	3
Application	EoR or Core	EoR or Core	EoR or Core



### Chassis

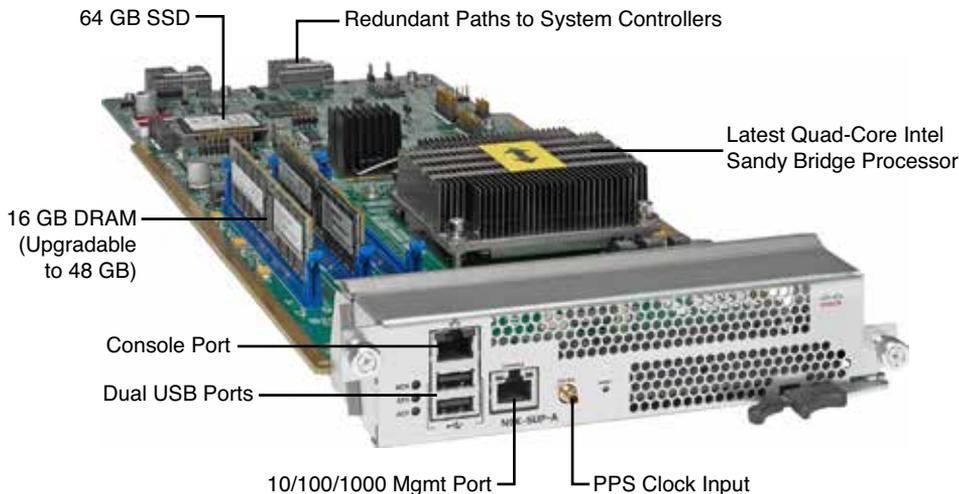
The Nexus 9500 chassis doesn't have a midplane, as shown in Figure B2-4. Midplanes tend to block airflow, which results in reduced cooling efficiency. Because there is no midplane with a precise alignment mechanism, fabric cards and line cards align together.



**Figure B2-4** *Nexus 9500 Chassis*

## Supervisor Engine

The Nexus 9500 modular switch supports two redundant half-width supervisor engines, as shown in Figure B2-5. The supervisor engine is responsible for the control plane function. The supervisor modules manage all switch operations. Each supervisor module consists of a Romely 1.8 GHz CPU, 4 core, and 16 GB RAM, upgradable to 48 GB RAM and 64 GB SSD storage. The supervisor has an external clock source; that is, pulse per second (PPS). There are multiple ports for management, including two USB ports, an RS-232 Serial Port (RJ-45), and a 10/100/1000-Mbps network port (RJ-45).

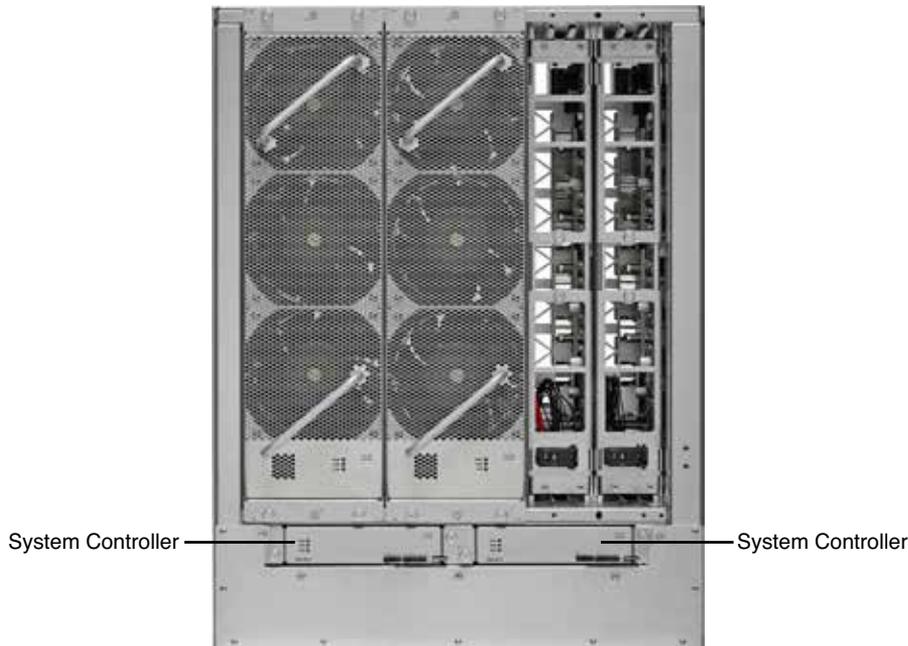


**Figure B2-5** *Nexus 9500 Supervisor Engine*



## System Controller

There is a pair of redundant system controllers at the back of the Nexus 9500 chassis, as shown in Figure B2-6. They offload chassis management functions from the supervisor modules. The system controller is responsible for managing power supplies and fan trays. They host two main control and management paths—the Ethernet Out-of-Band Channel (EOBC) and Ethernet Protocol Channel (EPC)—between supervisor engines, line cards, and fabric modules. The EOBC provides the intrasystem management communication across modules, and the EPC channel handles the intrasystem data plane protocol communication.

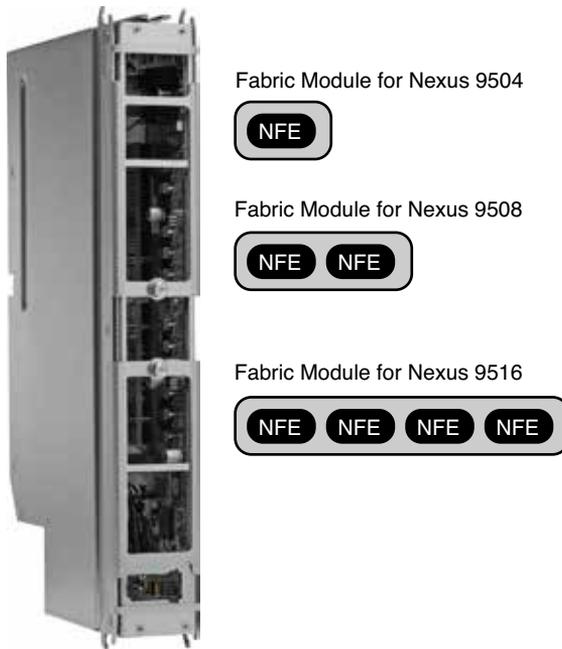


**Figure B2-6** *Nexus 9500 System Controllers*



### Fabric Modules

The platform supports up to six fabric modules. The packet lookup and forwarding functions involve both the line cards and the fabric modules; both contain multiple network forwarding engines (NFE). The NFE is a Broadcom trident two ASIC (T2), and the T2 uses 24 40GE ports to guarantee the line rate. All fabric modules are active; each fabric module consists of multiple NFEs, as shown in Figure B2-7. The Nexus 9504 has one NFE per fabric module, the Nexus 9508 has two, and the Nexus 9516 has four.



**Figure B2-7** *Nexus 9500 Fabric Module*

When you use the 1/10G + 4 40GE line cards, you need a minimum of three fabric modules to achieve line-rate speeds. When you use the 36-port 40GE line cards, you will need six fabric modules to achieve line-rate speeds.

**NOTE** The fabric modules are behind the fan trays, so to install them you must remove the fan trays.

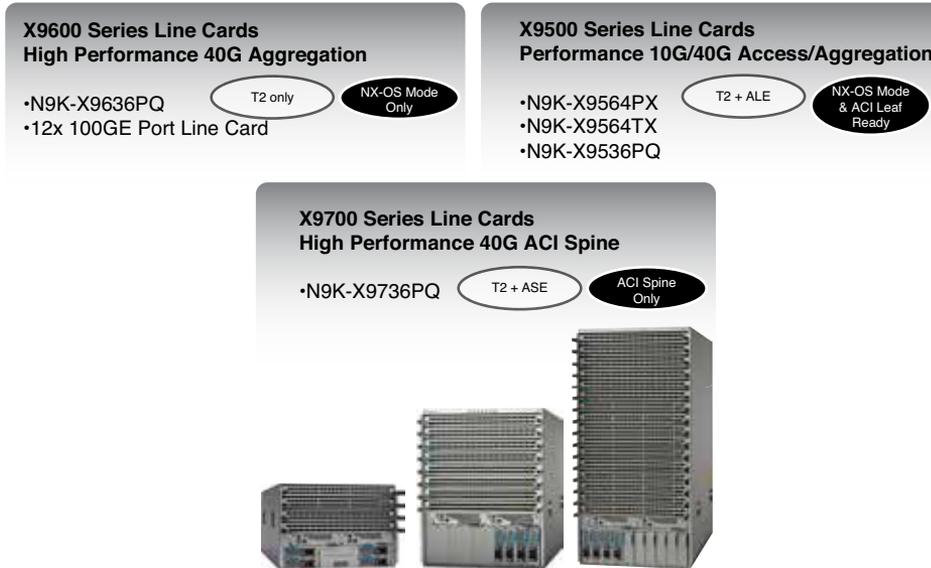
### Key Topic

#### Line Cards

It is important to understand that there are multiple types of Nexus 9500 line cards. There are cards that can be used in standalone mode when used with enhanced NX-OS, in a classical design. There are line cards that can be used in application-centric infrastructure mode (ACI) only. There are also line cards that can be used in both modes: standalone mode using NX-OS and ACI mode.

All line cards have multiple NFEs for packet lookup and forwarding. In addition, the ACI-ready leaf line cards contain an additional ASIC called Application Leaf Engine (ALE). ALE performs the ACI leaf function when the Nexus 9500 is used as a leaf node when deployed in the ACI mode.

The ACI-only line cards contain an additional ASIC called application spine engine (ASE); the ASE performs ACI spine functions when the Nexus 9500 is used as a spine in the ACI mode. Figure B2-8 shows the high-level positioning of the different cards available for the Nexus 9500 Series network switches.



**Figure B2-8** Nexus 9500 Line Cards Positioning

Nexus 9500 line cards are also equipped with dual-core CPUs. This CPU is used to speed up some control functions, such as programming the hardware table resources, collecting and sending line card counters, statistics, and offloading BFD protocol handling from the supervisors. Table B2-3 shows the different types of cards available for the Nexus 9500 Series switches and their specification.

**Key Topic**

**Table B2-3** Nexus 9500 Modular Platform Line Card Comparison

Line Card Part Number	Specification
N9K-X9636PQ 	36 × 40 Gbps QSFP ports Nonblocking Layer 2 and 3 line-rate performance on all ports for all packet sizes Supports 4 × 10 Gbps break-out mode Cannot be upgraded to ACI mode

Line Card Part Number	Specification
<p>N9K-X9564PX</p> 	<p>48-port 1 and 10 Gigabit Ethernet SFP+ with 4-port 40 Gigabit Ethernet QSFP+ line card</p> <p>Designed for use with Cisco Nexus 2000 Series fabric extenders and for mixed 10 and 40 Gigabit Ethernet aggregation</p> <p>Supports both direct-attach 10 Gigabit Ethernet copper cabling and optical transceivers</p> <p>Supports 100 Megabit Ethernet, 1 Gigabit Ethernet, and 10GBASE-T copper cabling connectivity for server access</p> <p>Layer 2 and 3 line-rate performance on all ports for all packet sizes</p> <p>Cisco Enhanced NX-OS and Application Centric Infrastructure (ACI) mode</p>
<p>N9K-X9564TX</p> 	<p>48-port 1 and 10GBASE-T plus 4-port 40 Gigabit Ethernet QSFP+ line card</p> <p>Supports 100 Megabit Ethernet, 1 Gigabit Ethernet, and 10GBASE-T copper cabling connectivity for server access</p> <p>Layer 2 and 3 line-rate performance on all ports for all packet sizes</p> <p>Cisco Enhanced NX-OS and Application Centric Infrastructure (ACI) mode</p>
<p>N9K-X9736PQ</p> 	<p>36-port 40 Gigabit Ethernet QSFP+ line card</p> <p>Nonblocking</p> <p>Designed for use in a spine switch role when used in ACI mode</p> <p>Works only in ACI mode</p>

## Power Supplies

The Nexus 9500 platform supports up to 10 power supplies; they are accessible from the front and are hot swappable. Two 3000W AC power supplies can operate a fully loaded chassis; they support N+1 and N+N (grid redundancy). The 3000W AC power supply shown in Figure B2-9 is 80 Plus platinum rated and provides more than 90% efficiency.

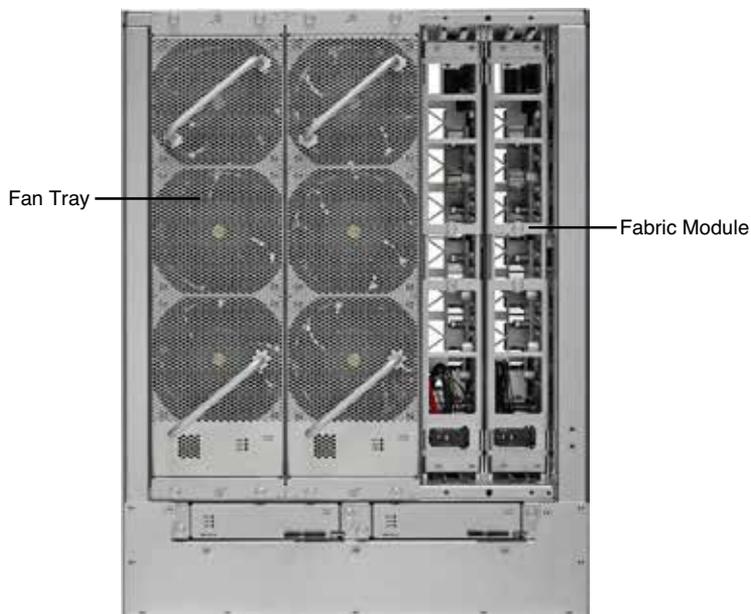
**NOTE** The additional four power supply slots are not needed with existing line cards shown in Table B2-3; however, they offer head room for future port densities, bandwidth, and optics.



**Figure B2-9** *Nexus 9500 AC Power Supply*

### Fan Trays

The Nexus 9500 consists of three fan trays; each tray consists of three fans. Dynamic speed is driven by temperature sensors and front-to-back air flow with N+1 redundancy per tray. Fan trays are installed after the fabric module installation, as shown in Figure B2-10.



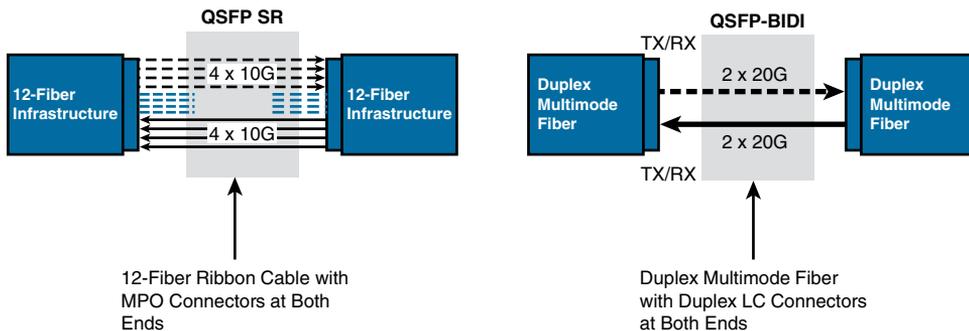
**Figure B2-10** *Nexus 9500 Fan Tray*

**NOTE** To service the fabric modules, the fan tray must be removed first. If one of the fan trays is removed, the other two fan trays will speed up to compensate for the loss of cooling.

### Key Topic

## Cisco QSFP Bi-Di Technology for 40 Gbps Migration

As data center designs evolve from 1 G to 10 G at the access layer, access to aggregation and Spine-Leaf design at the spine layer will move to 40 G. The 40 G adoption is slow today because of multiple barriers; the first is the cost barrier of the 40 G port itself, and second, when you migrate from 10 G to 40 G, you must replace the cabling. 10 G operates on what is referred to as two strands of fiber; however, 40 G operates on eight strands of fiber. Bi-Di optics are standard based, and they enable customers to take the current 10 G cabling plant and use it for 40 G connectivity without replacing the cabling. Figure B2.11 shows the difference between the QSFP SR and the QSFP Bi-Di.



**Figure B2-11** Cisco Bi-Di Optics

## Cisco Nexus 9300 Family

The previous section discussed the Nexus 9500 Series modular switches. This section discusses details of the Cisco Nexus 9300 fixed configuration switches. There are currently four chassis-based models in the Nexus 9300 platform. Table B2-4 summarizes the different specifications of each chassis. The Nexus 9300 is designed for top-of-rack (ToR) and mid-of-row (MoR) deployments.

The 40-Gbps ports for Cisco Nexus 9396PX, 9396TX, and 93128TX are provided on an uplink module that can be serviced and replaced by the user. The uplink module is the same for all switches. If used with the Cisco Nexus 93128TX, 8 out of the 12 × 40 Gbps QSFP+ ports will be available.

As shown in Table B2-4, the Nexus 9396PX, 9396TX, and 93128TX can operate in NX-OS mode and in ACI mode (acting as a leaf node). The Nexus 9336PQ can operate in ACI mode only and act as spine node.

Key  
Topic**Table B2-4** Nexus 9500 Fixed-Platform Comparison

	NEXUS 9396PX 48-Port 1/10GE	NEXUS 9396TX 48-Port 1/10GE	NEXUS 93128TX 96-Port 1/10GE	NEXUS 9336PQ 36-Port 40GE
Height	2 RU	2RU	2RU	RU
I/O Module Slots	1 GEM (12 QSFP)	1 GEM (12 QSFP)	1 GEM (8 QSFP)	Fixed
Max BW /System	480 Gbps (nonblocking)	480 Gbps (nonblocking)	3:1 (oversubscription)	1.44 Tbps (nonblocking)
Max 1/10/40/ ports	48/48/12	48/48/12	96/96/8	0/0/36
Air Flow	Front-to-back Back-to-front	Front-to-back Back-to-front	Front-to-back Back-to-front	Front-to-back
Power Supply Configurations	(1+1) x 650W AC	(1+1) x 650W AC	(1+1) x 650W/1200W AC	1+1) x 1200W AC
Application	ToR	ToR	ToR	EoR
Software Mode	NX-OS or ACI mode (leaf)	NX-OS or ACI mode (leaf)	NX-OS or ACI mode (leaf)	ACI mode only (spine)

Figure B2-12 shows the different models available today from the Nexus 9300 switches.

**Figure B2-12** Cisco Nexus 9300 Switches

## Cisco Nexus 7000 and Nexus 7700 Product Family

The Nexus 7000 Series switches form the core data center networking fabric. There are multiple chassis options from the Nexus 7000 and Nexus 7700 product family, as shown in Table B2-5. The Nexus 7000 and the Nexus 7700 switches offer a comprehensive set of features for the data center network. The modular design of the Nexus 7000 and Nexus 7700 enables them to offer different types of network interfaces—1 G, 10 G, 40 G and 100 G—in a high density, scalable way with a switching capacity beyond 15 Tbps for the Nexus 7000 Series and 83 Tbps for the Nexus 7700 Series. The Nexus 7000 hardware architecture offers redun-

dant supervisor engines, redundant power supplies, and redundant fabric cards for high availability. It is very reliable by supporting in-service software upgrades (ISSU) with zero packet loss. It is easy to manage using the command line or through data center network manager; you can utilize NX-OS APIs to manage it.

The Nexus 7000 and Nexus 7700 product family is modular in design with great focus on the redundancy of all the critical components; this has been applied across the physical, environmental, power, and system software aspects of the chassis.

- **Supervisor module redundancy:** The chassis can have up to two supervisor modules operating in active and standby modes. State and configuration are in sync between the two supervisors, which provide seamless and stateful switchover in the event of a supervisor module failure.

**NOTE** There are dedicated slots for the supervisor engines in all Nexus chassis; the supervisor modules are not interchangeable between the Nexus 7000 and Nexus 7700 chassis.

- **Switch fabric redundancy:** The fabric modules support load sharing. You can have multiple fabric modules; the Nexus 7000 supports up to five fabric modules and Nexus 7700 supports up to six fabric modules. With the current shipping fabric cards and current I/O modules the switches support N+1 redundancy.

**NOTE** The fabric modules between the Nexus 7000 and Nexus 7700 are not interchangeable.

- **Cooling subsystem:** The system has redundant fan trays. There are multiple fans on the fan trays, and any failure of one of the fans will not result in loss of service.
- **Power subsystem availability features:** The system will support the following power redundancy options:
  - Combined mode, where the total power available is the sum of the outputs of all the power supplies installed. (This is not redundant.)
  - PSU redundancy, where the total power available is the sum of all power supplies minus 1, otherwise commonly called N+1 redundancy.
  - Grid redundancy, where the total power available is the sum of the power from only one input on each PSU. Each PSU has two supply inputs, allowing it to be connected to separate isolated A/C supplies. In the event of an A/C supply failure, 50% of power is secure.
  - Full redundancy, which is the combination of PSU redundancy and grid redundancy. In most cases, this will be the same as grid mode but will assure customers that they are protected for either a PSU or a grid failure, but not both at the same time. PSU Redundancy is the default.
- **Modular software upgrades:** The NX-OS software is designed with a modular architecture, which helps to address specific issues and minimize the system overall impact. Each service running is an individual memory protected process, including multiple instances

of a particular service that provide effective fault isolation between services and that make each service individually monitored and managed. Most of the services allow stateful restart, enabling a service experiencing a failure to be restarted and resume operation without affecting other services.

- **Cisco NX-OS In-Service Software Upgrade (ISSU):** With the NX-OS modular architecture you can support ISSU, which enables you to do a complete system upgrade without disrupting the data plane and achieve zero packet loss.
- **Cable management:** The integrated cable management system is designed to support the cabling requirements of a fully configured system to either or both sides of the switch, allowing maximum flexibility.
- **System-level LEDs:** A series of LEDs at the top of the chassis provides a clear summary of the status of the major system components. The LEDs alert operators to the need to conduct further investigation. These LEDs report the power supply, fan, fabric, supervisor, and I/O module status.
- **Cable management:** The cable management cover and optional front module doors provide protection from accidental interference with both the cabling and modules that are installed in the system. The transparent front door allows observation of cabling and module indicator and status lights.

Nexus 7000 and Nexus 7700 have multiple models with different specifications. Figure B2-13 shows these switching models, and Table B2-5 shows their specifications.



**Figure B2-13** Cisco Nexus 7000 and Nexus 7700 Product Family

**Key Topic**

**Table B2-5** Nexus 7000 and Nexus 7700 Modular Platform Comparison

	7004	7009	7010	7018	7706	7710	7718
Supervisor Redundancy	Yes						
I/O Module Slots	2	7	8	16	4	8	16
Bandwidth per Slot	440 Gbps	550 Gbps	550 Gbps	550 Gbps	1.3 Tbps	1.3 Tbps	1.3 Tbps
Switching Capacity (Tbps)	1.92	7.7	8.8	17.6	21	42	83

	7004	7009	7010	7018	7706	7710	7718
1 GE Port Density	96	336	384	768	192	384	768
10 GE Port Density	96	336	384	768	192	384	768
40 GE Port Density	24	84	96	192	96	192	384
100 GE Port Density	4	14	16	32	48	96	192
Rack Space (RU)	7	14	21	25	9	14	26
Airflow	Side-rear	Side-side	Front-back	Side-side	Front-back	Front-back	Front-back

**NOTE** When you go through Table B2-5 you might wonder how the switching capacity was calculated. For example, the Nexus 7010 has 8 line cards slots, so the calculation is [(550 Gbps/slot) × (8 payload slots) = 4400 Gbps, (4400 Gbps) × (2 for full duplex operation) = 8800 Gbps = 8.8 Tbps system bandwidth]. For the Nexus 7700 Series, we'll use the Nexus 7718 as an example. Although the bandwidth/slot shown in the table give us 1.3 Tbps, the Nexus 7700 is capable of more than double its capacity, and that can be achieved by upgrading the fabric cards for the chassis. Therefore, if the bandwidth/slot is 2.6 Tbps, the calculation is [(2.6Tbps/slot) × (16 payload slots) = 41.6 Tbps, (4400Gbps) × (2 for full duplex operation) = 83.2 Tbps system bandwidth].

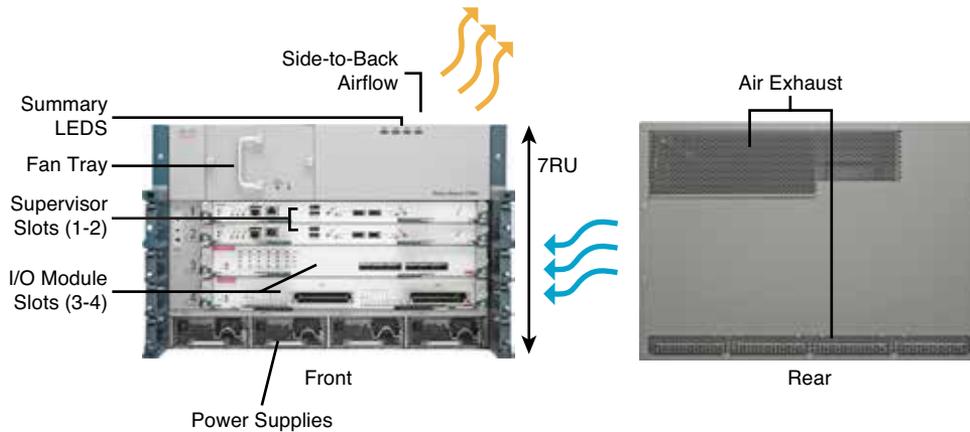
In some bandwidth calculations for the chassis, the supervisor slots are taken into consideration because each supervisor slot has a single channel of connectivity to each fabric card, so that makes a total of 5 crossbar channels.

So, for example, the Cisco Nexus 7010 bandwidth is being calculated like so: [(550 Gbps/slot) × (9 payload slots) = 4950 Gbps, (4950 Gbps) × (2 for full duplex operation) = 9900 Gbps = 9.9 Tbps system bandwidth]. Using this type of calculation, a 9-slot chassis will have 8.8 Tbps, and the 18-slot chassis will have 18.7 Tbps.



### Cisco Nexus 7004 Series Switch Chassis

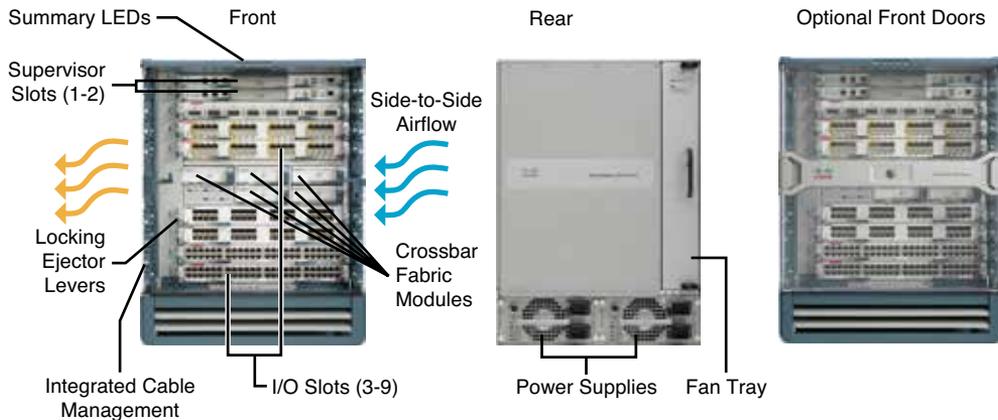
The Cisco Nexus 7004 switch chassis shown in Figure B2-14 has two supervisor module slots and two I/O modules; the complete specification for the Nexus 7004 is shown in Table B2-5. It is worth mentioning that the Nexus 7004 doesn't have any fabric modules; the local I/O module fabrics are connected back-to-back to form a two-stage crossbar that interconnects the I/O modules and the supervisor engines. It has one fan tray and four 3KW power supplies.



**Figure B2-14** Cisco Nexus 7004 Switch

### Cisco Nexus 7009 Series Switch Chassis

The Cisco Nexus 7009 switch chassis shown in Figure B2-15 has two supervisor module slots and seven I/O module slots; the complete specification for the Nexus 7009 is shown in Table B2-5. The Nexus 7009 switch has a single fan tray. The fan redundancy is two parts: individual fans in the fan tray and fan tray controllers. The fan controllers are fully redundant, reducing the probability of a total fan tray failure. The fans in the fan trays are individually wired to isolate any failure and are fully redundant so that other fans in the tray can take over when one or more fans fail. So, there is redundancy within the cooling system due to the number of fans. If an individual fan fails, other fans automatically run at higher speeds, and the system will continue to function, giving you time to get a spare and replace the fan tray.

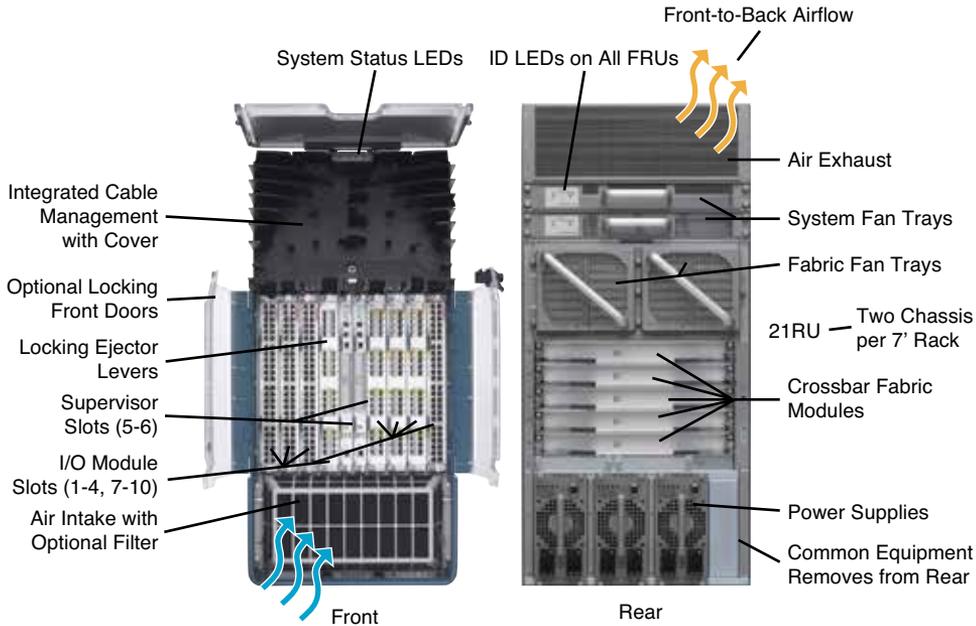


**Figure B2-15** Cisco Nexus 7009 Switch

Although the Nexus 7009 has side-to-side airflow, there is a solution for hot aisle–cold aisle design with the 9-slot chassis.

## Cisco Nexus 7010 Series Switch Chassis

The Cisco Nexus 7010 switch chassis shown in Figure B2-16 has two supervisor engine slots and eight I/O module slots; the complete specification is shown in Table B2-5. There are multiple fans on the 7010 system fan trays. The fans on the trays are N+1 redundant. Any single fan failure will not result in degradation in service; the box does not overheat, and the fan tray will need replacing to restore N+1.



**Figure B2-16** Cisco Nexus 7010 Switch

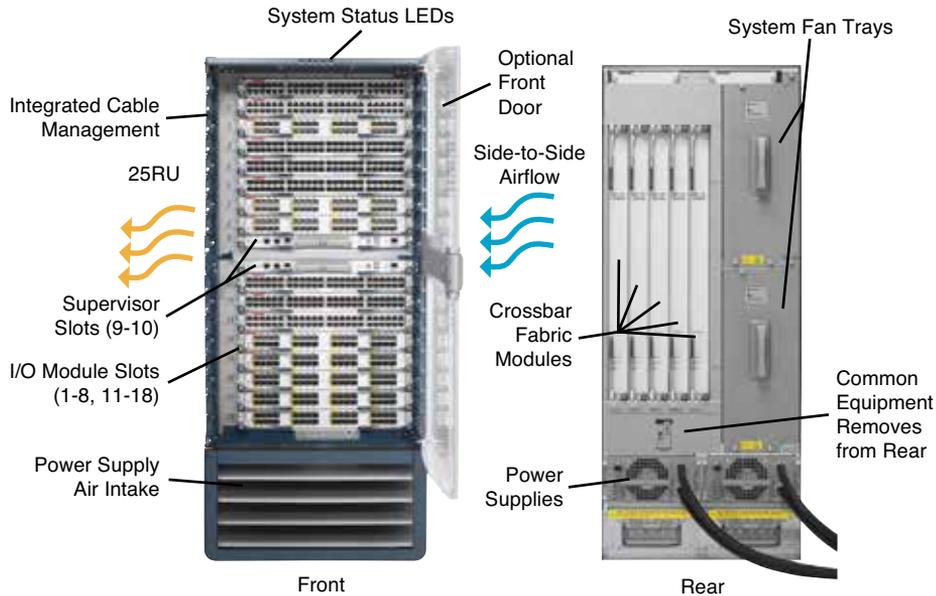
There are two system fan trays in the 7010. If either of the fan trays fails, the system will keep running without overheating as long as the operating environment is within specifications, until the fan tray is replaced. Fan tray replacement restores N+1 redundancy.

There are two fabric fan modules in the 7010; both are required for normal operation. If either fabric fan fails, the remaining fabric fan will continue to cool the fabric modules until the fan is replaced, restoring the N+1 redundancy. The system should not be operated with either the system fan tray or the fabric fan components removed apart from the hot swap period of up to 3 minutes.

## Cisco Nexus 7018 Series Switch Chassis

The Cisco Nexus 7018 switch chassis shown in Figure B2-17 has two supervisor engine slots and 16 I/O module slots; the complete specification is shown in Table B2-5. For the 7018 system there are two system fan trays, one for the upper half and one for the lower half of the system. Both fan trays must be installed at all times (apart from maintenance). Each fan tray contains 12 fans that are in three rows or four. Each row cools three module slots (I/O

and supervisor). The failure of a single fan will result in the other fans increasing speed to compensate, and they will continue to cool the system. The fan tray should be replaced to restore the N+1 fan resilience. Integrated into the system fan tray are the fabric fans. The fabric fans are at the rear of the system fan tray. The two fans are in series so that the air passes through both to leave the switch and cool the fabric modules. Failure of a single fabric fan will not result in a failure; the remaining fan will cool the fabric modules.

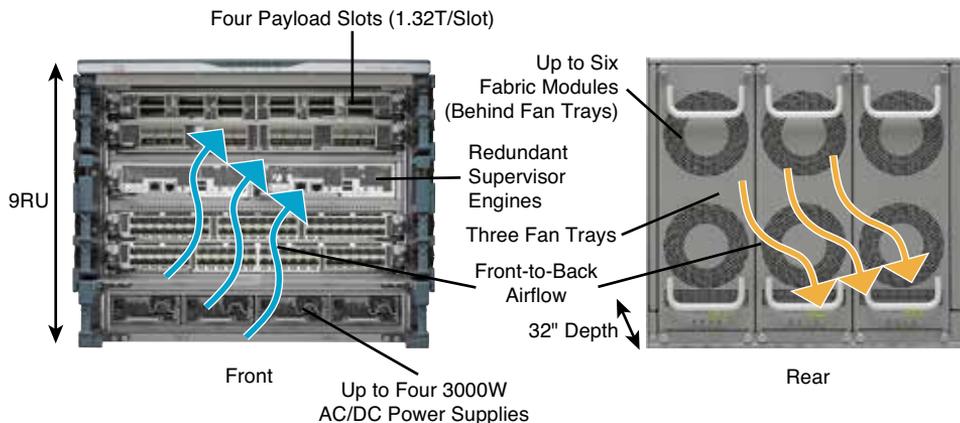


**Figure B2-17** Cisco Nexus 7018 Switch

**NOTE** Although both system fan trays are identical, the fabric fans operate only when installed in the upper fan tray position. Fan trays are fully interchangeable, but when inserted in the lower position the fabric fans are inoperative.

### Cisco Nexus 7706 Series Switch Chassis

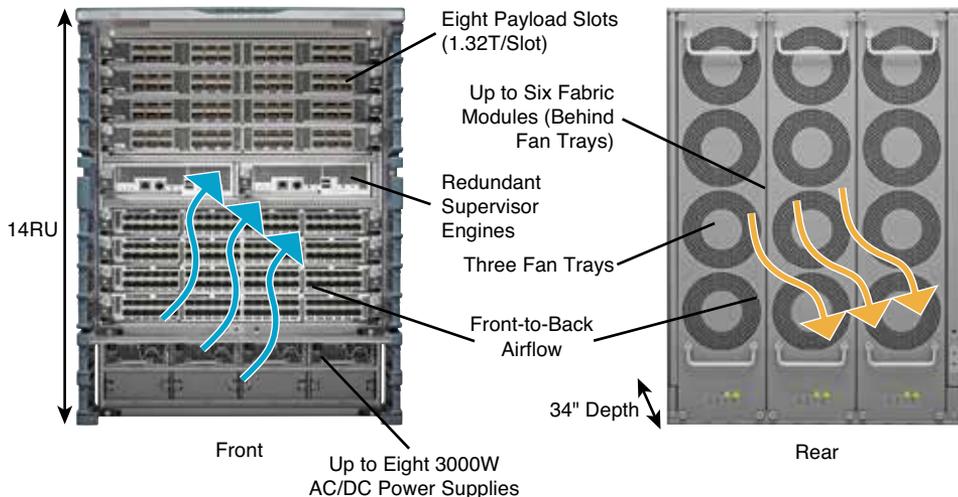
The Cisco Nexus 7706 switch chassis shown in Figure B2-18 has two supervisor module slots and four I/O module slots; the complete specification is shown in Table B2-5. There are 192 10-G ports, 96 40-G ports, 48 100-G ports, true front-to-back airflow, redundant fans, and redundant fabric cards.



**Figure B2-18** Cisco Nexus 7706 Switch

### Cisco Nexus 7710 Series Switch Chassis

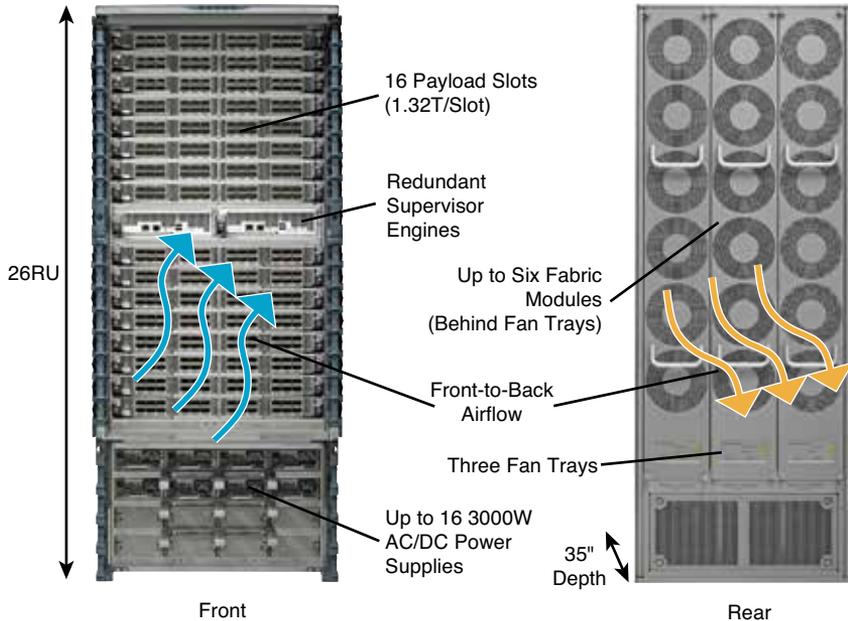
The Cisco Nexus 7710 switch chassis shown in Figure B2-19 has two supervisor engine slots and eight I/O module slots; the complete specification is shown in Table B2-5. There are 384 1-G ports, 192 40-G ports, 96 100-G ports, true front-to-back airflow, redundant fans, and redundant fabric cards.



**Figure B2-19** Cisco Nexus 7710 Switch

### Cisco Nexus 7718 Series Switch Chassis

The Cisco Nexus 7718 switch chassis shown in Figure B2-20 has two supervisor engine slots and 16 I/O module slots; the complete specification is shown in Table B2-5. There are 768 10-G ports, 384 40-G ports, 192 100-G ports, true front-to-back airflow, redundant fans, and redundant fabric cards.



**Figure B2-20** Cisco Nexus 7718 Switch

### Cisco Nexus 7000 and Nexus 7700 Supervisor Module

Nexus 7000 and Nexus 7700 Series switches have two slots that are available for supervisor modules. Redundancy is achieved by having both supervisor slots populated. Table B2-6 describes different options and specifications of the supervisor modules.

**Key Topic**

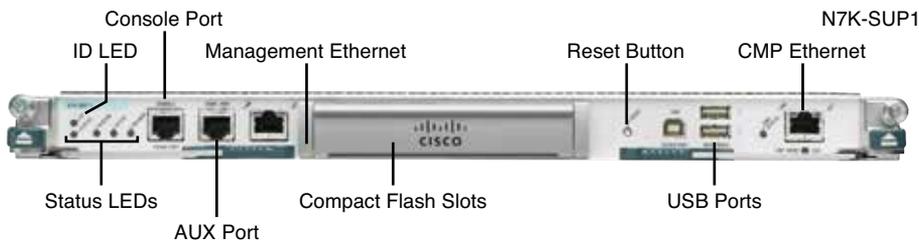
**Table B2-6** Nexus 7000 and Nexus 7700 Supervisor Modules Comparison

	Nexus 7700 Supervisor 2E	Nexus 7000 Supervisor 2E	Nexus 7000 Supervisor 2	Nexus 7000 Supervisor 1
CPU	Dual Quad-Core Xeon	Dual Quad-Core Xeon	Quad-Core Xeon	Dual-Core Xeon
Speed (GHz)	2.13	2.13	2.13	1.66
Memory (GB)	32	32	12	8
Flash memory	USB	USB	USB	Compact Flash
Fiber Channel over Ethernet (FCoE) on F2 module	Yes	Yes	Yes	No
CPU share	Yes	Yes	Yes	No
Virtual Device Contexts (VDC)	8+1 admin VDC	8+1 admin VDC	4+1 admin VDC	4

	Nexus 7700 Supervisor 2E	Nexus 7000 Supervisor 2E	Nexus 7000 Supervisor 2	Nexus 7000 Supervisor 1
Cisco Fabric Extender (FEX) support	64 FEX/3072 ports	64 FEX/3072 ports	32 FEX/1536 ports	32 FEX/1536 ports
Connectivity Management Processor (CMP)	Not supported	Not supported	Not supported	Supported

### Cisco Nexus 7000 Series Supervisor 1 Module

The Cisco Nexus 7000 supervisor module 1 shown in Figure B2-21 is the first-generation supervisor module for the Nexus 7000. As shown in Table B2-6, the operating system runs on a dedicated dual-core Xeon processor; dual supervisor engines run in active-standby mode with stateful switch over (SSO) and configuration synchronization between both supervisors. There is dual redundant Ethernet out-of-band channels (EOBC) to each I/O and fabric modules to provide resiliency for the communication between control and line card processors. An embedded packet analyzer reduces the need for a dedicated packet analyzer to provide faster resolution for control plane problems. The USB ports allow access to USB flash memory devices to software image loading and recovery.



**Figure B2-21** Cisco Nexus 7000 Supervisor Module 1

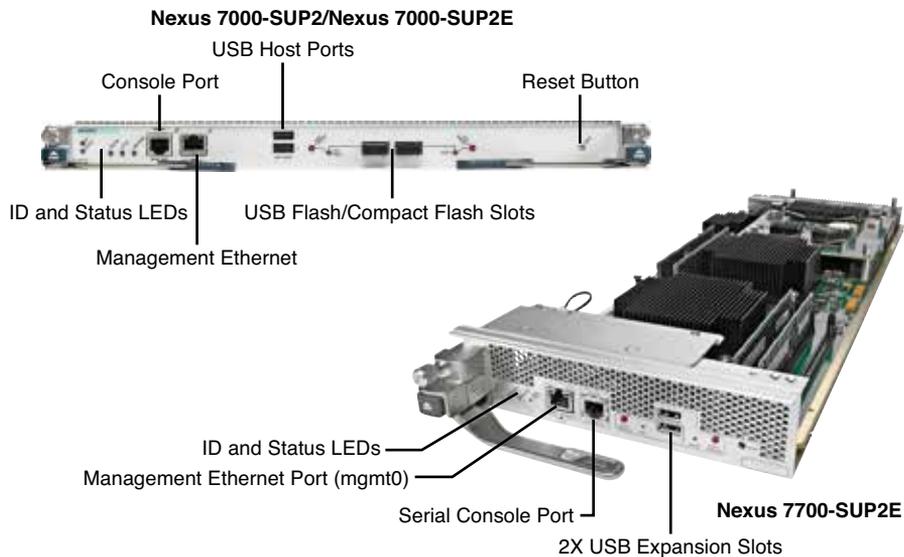
The Connectivity Management Processor (CMP) provides an independent remote system management and monitoring capability. It removes the need for separate terminal server devices for OOB management, and it offers complete visibility during the entire boot process. It has the capability to initiate a complete system restart and shutdown. Administrators must authenticate to get access to the system through CMP, and it also allows access to supervisor logs and full console control on the supervisor engine.

The Cisco Nexus 7000 supervisor module 1 incorporates highly advanced analysis and debugging capabilities. The Power-on Self Test (POST) and Cisco Generic Online Diagnostics (GOLD) provide proactive health monitoring both at startup and during system operation. This is useful in detecting hardware faults. If a fault is detected, corrective action can be taken to mitigate the fault and reduce the risk of a network outage.

### Cisco Nexus 7000 Series Supervisor 2 Module

The Cisco Nexus 7000 supervisor module 2 shown in Figure B2-22 is the next-generation supervisor module. As shown in Table B2-6, it has a quad-core CPU and 12 G of memory

compared to supervisor module 1, which has single-core CPU and 8 G of memory. Supervisor module 2E is the enhanced version of supervisor module 2 with two quad-core CPUs and 32 G of memory.



**Figure B2-22** Cisco Nexus 7000 Supervisor 2 Module

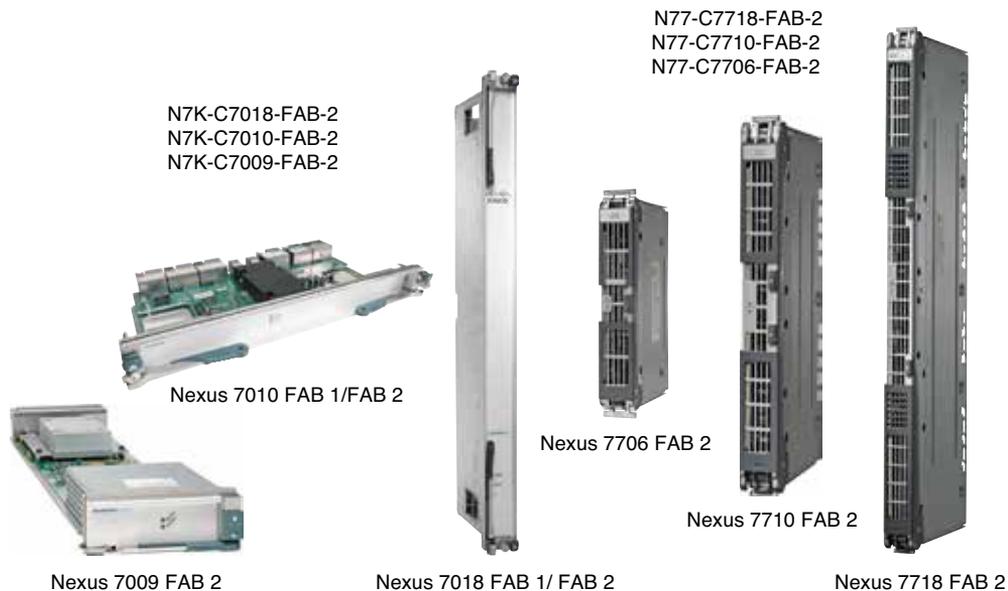
Supervisor module 2 and supervisor module 2E have more powerful CPUs, larger memory, and next-generation ASICs that together will result in improved performance, such as enhanced user experience, faster boot and switchover times, and a higher control plane scale, such as higher VDC and FEX.

Both supervisor module 2 and supervisor module 2E support FCoE; when choosing the proper line card, they support CPU Shares, which will enable you to carve out CPU for higher priority VDCs. Sup2E supports 8+1 VDCs. Sup2 scale is the same as Sup1; it will support 4+1 VDCs.

**NOTE** You cannot mix Sup1 and Sup2 in the same chassis. Note that this will be a disruptive migration requiring removal of supervisor 1. Sup2 and Sup2E can be mixed for migration only. This will be a nondisruptive migration.

## Cisco Nexus 7000 and Nexus 7700 Fabric Modules

The Nexus 7000 and Nexus 7700 fabric modules provide interconnection between line cards and provide fabric channels to the supervisor modules. The Nexus 7000 has five fabric modules, and the Nexus 7700 has six; adding fabric modules increases the available bandwidth per I/O slot because all fabric modules are connected to all slots. Figure B2-23 shows the different fabric modules for the Nexus 7000 and Nexus 7700 products.



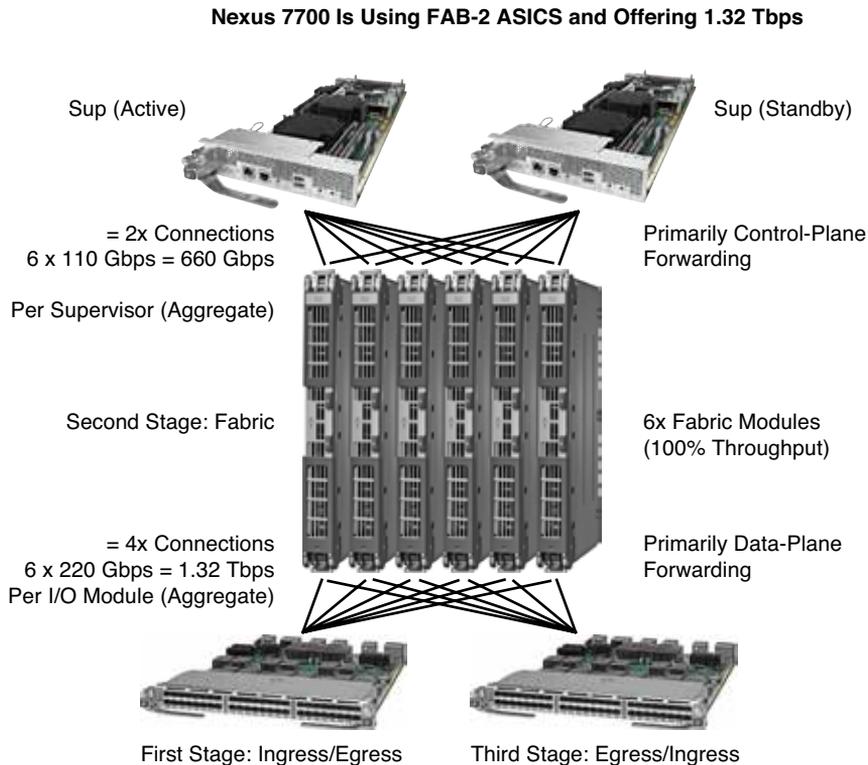
**Figure B2-23** Cisco Nexus 7000 Fabric Module

In the case of Nexus 7000, when using Fabric Module 1, which is 46 Gbps, you can deliver a maximum of 230 Gbps per slot using five fabric modules. When using Fabric Module 2, which is 110 Gbps, you can deliver a maximum of 550 Gbps per slot. In Nexus 7700, by using Fabric Module 2, which is 220 Gbps per slot, you can deliver a maximum of 1.32 Tbps per slot.

All fabric modules support load sharing, and the architecture supports lossless fabric failover. In case of a failure or removal of one of the fabric modules, the remaining fabric modules will load balance the remaining bandwidth to all the remaining line cards.

Nexus 7000 supports virtual output queuing (VOQ) and credit-based arbitration to the crossbar to increase performance. VOQ and credit-based arbitration allow fair sharing of resources when a speed mismatch exists to avoid head-of-line (HOL) blocking.

The Nexus 7000 implements a three-stage crossbar switch. Fabric stage 1 and fabric stage 3 are implemented on the line card module, and stage 2 is implemented on the fabric module. Figure B2-24 shows how these stages are connected to each other. There are four connections from each fabric module to the line cards, and each one of these connections is 55 Gbps. When populating the chassis with six fabric modules, the total number of connections from the fabric cards to each line card is 24. It provides an aggregate bandwidth of 1.32 Tbps per slot.



**Figure B2-24** Cisco Nexus 7700 Crossbar Fabric

There are two connections from each fabric module to the supervisor module. These connections are also 55 Gbps. When all the fabric modules are installed, there are 12 connections from the switch fabric to the supervisor module, providing an aggregate bandwidth of 275 Gbps.

**NOTE** Cisco Nexus 7000 fabric 1 modules provide two 23 Gbps traces to each fabric module, providing 230 Gbps of switching capacity per I/O slot for a fully loaded chassis. Each supervisor module has a single 23 Gbps trace to each fabric module.

## Cisco Nexus 7000 and Nexus 7700 Licensing

Different types of licenses are required for the Nexus 7000 and the Nexus 7700. Table B2-7 describes each license and the features it enables.

It is worth mentioning that Nexus switches have a grace period, which is the amount of time the features in a license package can continue functioning without a license. Enabling a licensed feature that does not have a license key starts a counter on the grace period. You then have 120 days to install the appropriate license keys, disable the use of that feature, or disable the grace period feature. If at the end of the 120-day grace period the device does not have a valid license key for the feature, the Cisco NX-OS software automatically disables

the feature and removes the configuration from the device. There is also an evaluation license, which is a temporary license. Evaluation licenses are time bound (valid for a specified number of days) and are tied to a host ID (device serial number).

**Key  
Topic**
**Table B2-7 Nexus 7000 and Nexus 7700 Software Licensing Features**

Feature License	Features
Enterprise Services Package LAN_ENTERPRISE_SERVICES_PKG	Open Shortest Path First (OSPF) Protocol Border Gateway Protocol (BGP) Intermediate System-to-Intermediate System (IS-IS) Protocol (Layer 3 only) Protocol Independent Multicast (PIM), which includes sparse mode, bidirectional mode, and source-specific mode (SSM) Multicast Source Discovery Protocol (MSDP) Policy-based routing Generic routing encapsulation (GRE) tunnel Enhanced Interior Gateway Routing Protocol (EIGRP)
Advanced Services Package LAN_ADVANCED_SERVICES_PKG	Virtual device contexts (VDCs)
VDC licenses VDC_PKG	Increments four VDC licenses that enable the Cisco Nexus 7000 Series Supervisor 2 Enhanced module to support eight VDCs
Transport Services Package LAN_TRANSPORT_SERVICES_PKG	Overlay Transport Virtualization (OTV) Locator/ID Separation Protocol (LISP)
Scalable Services Package SCALABLE_SERVICES_PKG	A single license per system enables all XL-capable I/O modules to operate in XL mode. The license increases the performance of the following features: <ul style="list-style-type: none"> <li>■ IPv4 routes</li> <li>■ IPv6 routes</li> <li>■ ACL entries</li> </ul>
Enhanced Layer 2 Package ENHANCED_LAYER2_PKG	FabricPath support on the F Series module
MPLS Services Package MPLS_PKG	Multiprotocol Label Switching (MPLS) Layer 3 Virtual Private Network (VPN) Layer 2 Ethernet over MPLS (EoMPLS) Layer 2 Virtual Private LAN Services (VPLS)

Feature License	Features
Storage Enterprise Package STORAGE_ENT	Inter-VSAN routing (IVR) over Fibre Channel and FCoE IVR Network Address Translation (NAT) over Fibre Channel  VSAN-based access control  Fabric binding for open systems
FCoE Services Package (FCOE_PKG)	Fibre Channel over Ethernet (FCoE)  <b>NOTE</b> You do not need the Advanced Services Package to enable the storage VDC required for FCoE.
FCoE F2-Series	Fibre Channel over Ethernet (FCoE) for Cisco Nexus 7000 48-port 10G SFP+ (F2)  FCoE for Cisco Nexus 7700 Enhanced F2e Series 48 Port 10G (SFP+)

**NOTE** To manage the Nexus 7000 two types of licenses are needed: the DCNM LAN and DCNM SAN, each of which is a separate license.

To get the license file you must obtain the serial number for your device by entering the **show license host-id** command. The host ID is also referred to as the device serial number, as shown in Example B2-1.

**Example B2-1** *NX-OS Command to Obtain the Host ID*

```
switch# show license host-id
License hostid: VDH=FOX064317SQ
```

**TIP** Use the entire ID that appears after the equal sign (=). In this example, the host ID is FOX064317SQ.

After executing the copy licenses command from the default VDC, save your license file to one of four locations—the bootflash: directory, the slot0: device, the usb1: device, or the usb2: device.

Perform the installation by using the **install license** command on the active supervisor module from the device console, as shown in Example B2-2.

**Example B2-2** *Command Used to Install the License File*

```
switch# install license bootflash:license_file.lic
Installing license ..done
```



	N7K- M148GS -11L	N7K- M148GT -11L	N7K- M108X2 -12L	N7K- M132XP -12L	N7K- M224XP -23L	N7K- M206FQ -23L	N7K- M202CF -22L
Locator/ID Separation Protocol (LISP)	No	No	No	Yes	No	No	No
FCoE, FabricPath Support	No						
IEEE 1588 PTP	No	No	No	No	Yes	Yes	Yes
PONG	No	No	No	No	Yes	Yes	Yes

**NOTE** From the table, you see that the M1 32 port I/O module is the only card that supports LISP.

Table B2-9 shows the comparison between F-Series modules.



**Table B2-9** Nexus 7000 and Nexus 7700 F-Series Modules Comparison

	N7K- F248XP -25	N7K- F248XP -25E	N7K- F248XT -25E	N7K- F312FQ -25	N77- F248XP -23E	N77- F348XP -23	N77- F324FQ -25	N77- F312CK -26
Line Card Family	F2	F2e	F2e	F3	F2e	F3	F3	F3
Chassis Supported	Cisco Nexus 7000	Cisco Nexus 7000	Cisco Nexus 7000	Cisco Nexus 7000	Cisco Nexus 7700	Cisco Nexus 7700	Cisco Nexus 7700	Cisco Nexus 7700
Ports (Number and Type)	48 ports, 1 and 10 GE	48 ports, 1 and 10 GE	48 ports, 1 and 10 GE	12-port 40 GE	48-port 1 and 10 GE	48-port 1 and 10 GE	24-port 40 GE	12-port 100 GE
Interface Type	SFP, SFP+	SFP, SFP+	RJ-45	QSFP+, Bidi	SFP, SFP+	SFP, SFP+	QSFP+, Bidi	Cisco CPAK
Fabric Bandwidth (Gbps)	480	480	480	480	480	480	960	1200
Performance (Mpps)	720	720	720	720	720	720	1440	1800
NetFlow	Sampled	Sampled	Sampled	Sampled	Sampled	Sampled	Sampled	Sampled

	N7K- F248XP -25	N7K- F248XP -25E	N7K- F248XT -25E	N7K- F312FQ -25	N77- F248XP -23E	N77- F348XP -23	N77- F324FQ -25	N77- F312CK -26
<b>FEX Support</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>vPC Support</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>FabricPath Support</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Layer 3 Interface</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>FCoE, FabricPath Support</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>OTV, LISP, MPLS</b>	No	No	No	Yes	No	Yes	Yes	Yes
<b>M-Series Interoperability in Same VDC</b>	No	Yes	Yes	Yes	N/A	N/A	N/A	N/A

## Cisco Nexus 7000 and Nexus 7700 Series Power Supply Options

The Nexus 7000 and Nexus 7700 use power supplies with +90% power supply efficiency, reducing power wasted as heat and reducing associated data center cooling requirements. The switches offer different types of redundancy modes. They offer visibility into the actual power consumption of the total system, and modules enabling accurate power consumption monitoring, for the right sizing of power supplies, UPSs, and environmental cooling. Variable-speed fans adjust dynamically to lower power consumption and optimize system cooling for true load.

- **Power Redundancy:** Multiple system-level options for maximum data center availability.
- **Fully Hot Swappable:** Continuous system operations; no downtime in replacing power supplies.
- **Internal fault monitoring:** Detects component defect and shuts down unit.
- **Temperature measurement:** Prevents damage due to overheating (every ASIC on the board has a temperature sensor).
- **Real-time power draw:** Shows real-time power consumption.
- **Variable Fan Speed:** Automatically adjusts to changing thermal characteristics; lower fan speeds use lower power.

### Cisco Nexus 7000 and Nexus 7700 Series 3.0-KW AC Power Supply Module

The 3.0-KW AC power supply shown in Figure B2-25 is designed only for the Nexus 7004 chassis and is used across all the Nexus 7700 Series chassis. It is a single 20 Ampere (A) AC input power supply. When connecting to high line nominal voltage (220 VAC) it will produce a power output of 3000W; connecting to low line nominal voltage (110 VAC) will produce a power output of 1400W.



**Figure B2-25** *Cisco Nexus 7000 3.0-KW AC Power Supply*

**NOTE** Although the Nexus 7700 chassis and the Nexus 7004 use a common power supply architecture, different PIDs are used on each platform. Therefore, if you interchange the power supplies, the system will log an error complaining about the wrong power supply in the system; although technically this might work, it is not officially supported by Cisco.

### Cisco Nexus 7000 and Nexus 7700 Series 3.0-KW DC Power Supply Module

The 3.0-KW DC power supply shown in Figure B2-26 is designed only for the Nexus 7004 chassis and is used across all the Nexus 7700 Series chassis. The Nexus 3.0-kW DC power supply has two isolated input stages, each delivering up to 1500W of output power. Each stage uses a -48V DC connection. The unit will deliver 1551W when only one input is active and 3051W when two inputs are active.



**Figure B2-26** Cisco Nexus 7000 3.0-KW DC Power Supply

### Cisco Nexus 7000 Series 6.0-KW and 75-KW AC Power Supply Module

The 6.0-KW and 75-KW power supplies shown in Figure B2-27 are common across Nexus 7009, 7010, and 7018. They allow mixed-mode AC and DC operation enabling migration without disruption and providing support for dual environments with unreliable AC power, with battery backup capability.



**Figure B2-27** Cisco Nexus 7000 6.0-KW and 7.5-KW Power Supply

Table B2-10 shows the specifications of both power supplies with different numbers of inputs and input types.

**Table B2-10** Nexus 7000 and Nexus 7700 6.0-KW and 7.5-KW Power Supply Specifications

Power Supply Type	Number of Inputs	Input Power	Output
6.0-KW	Single input	220V	3000W
		110V	1200W
	Dual input	220V	6000W
		110V	2400W
	Dual input	110 and 220V	4200W
	7.5-KW	Single input	220V
Dual input		220V	7500W

### Cisco Nexus 7000 Series 6.0-KW DC Power Supply Module

The 6-KW DC power supply shown in Figure B2-28 is common to the 7009, 7010, and 7018 systems. The 6-KW has four isolated input stages, each delivering up to 1500W of power (6000W total on full load) with peak efficiency of 91% (high for a DC power supply). The power supply can be used in combination with AC units or as an all DC setup. It supports the same operational characteristics as the AC units: redundancy modes (N+1 and N+N).

- Real-time power—actual power levels
- Single input mode (3000W)
- Online insertion and removal
- Integrated Lock and On/Off switch (for easy removal)

**Figure B2-28** Cisco Nexus 7000 6.0-KW DC Power Supply

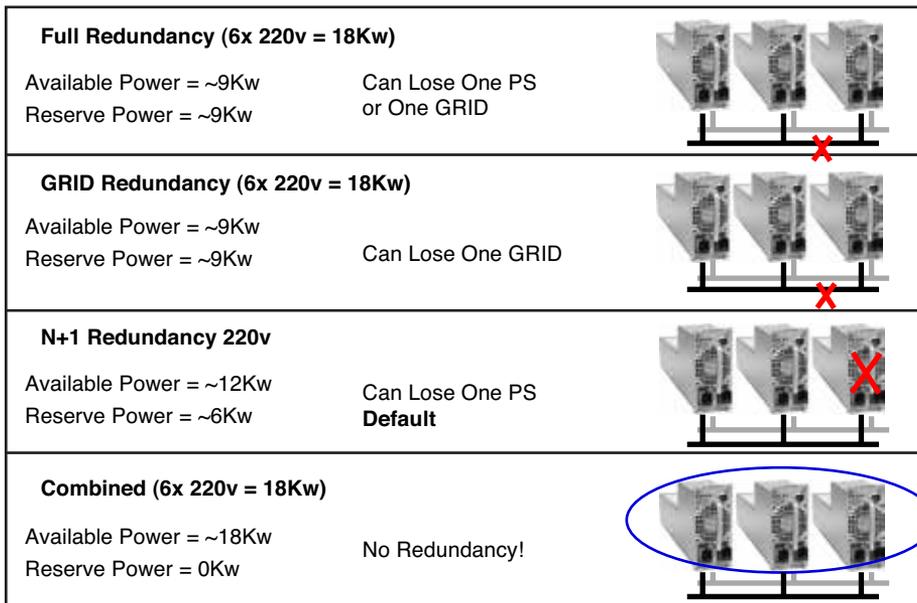


Multiple power redundancy modes can be configured by the user:

- Combined mode, where the total power available is the sum of the outputs of all the power supplies installed. (This is not redundant.)
- PSU redundancy, where the total power available is the sum of all power supplies – 1, otherwise commonly called N+1 redundancy.
- Grid redundancy, where the total power available is the sum of the power from only one input on each PSU. Each PSU has two supply inputs, allowing them to be connected to separate isolated A/C supplies. In the event of an A/C supply failure, 50% of power is secure.
- Full redundancy, which is the combination of PSU redundancy and grid redundancy. You can lose one power supply or one grid; in most cases this will be the same as grid redundancy.

Full redundancy provides the highest level of redundancy, so it is recommended. However, it is always better to choose the mode of power supply operation based on the requirements and needs.

An example of each mode is shown in Figure B2-29.



**Figure B2-29** Nexus 6.0-KW Power Redundancy Modes

To help with planning for the power requirements, Cisco has made a power calculator that can be used as a starting point. It is worth mentioning that the power calculator cannot be taken as a final power recommendation.

The power calculator can be located at <http://www.cisco.com/go/powercalculator>.

## Cisco Nexus 6000 Product Family

The Cisco Nexus 6000 product family is a high-performance, high-density, low-latency 1G/10G/40G/FCoE Ethernet port. When using the unified module on the Nexus 6004 you can get native FC as well. Multiple models are available: Nexus 6001T, Nexus 6001P, Nexus 6004EF, and Nexus 6004X. Table B2-11 describes the difference between the Nexus 6000 models.

**NOTE** At the time this appendix was written, the Nexus 6004X was renamed Nexus 5696Q.

**Table B2-11** Nexus 6000 Product Specification

	Nexus 6001P/Nexus 6001T	Nexus 6004EF/Nexus 6004X
Switch Fabric Throughput	1.28 Tbps	7.68 Tbps
Port-to-Port Latency	~1.0 microseconds for Nexus 6001P ~3.3 microseconds for Nexus 6001T	~ 1.0 microseconds
Layer 3 Capability	Integrated line-rate	Integrated line-rate
Switch Footprint	1RU	4RU
10 Gigabit Ethernet Port Density	64	384
40 Gigabit Ethernet Port Density	4 True 40 G	96 True 40 G
Unified Ports	—	48
1 Gigabit Ethernet FEX Port Scalability	1152	2304
10 Gigabit Ethernet FEX Port Scalability	1152	2304
Packet Buffer	25MB per 3 × 40 G (or 12 × 10 G)	25MB per 3 × 40 G (or 12 × 10 G)

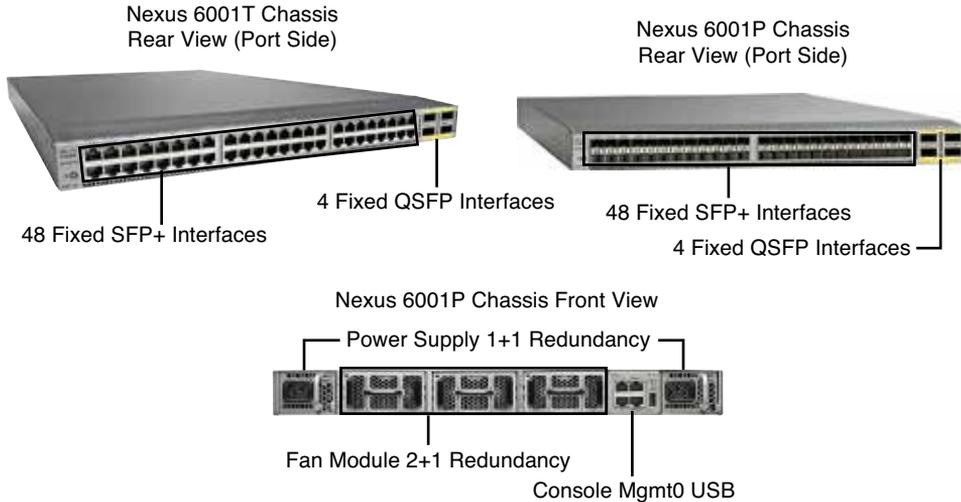
### Cisco Nexus 6001P and Nexus 6001T Switches and Features

The Nexus 6001P is a fixed configuration 1RU Ethernet switch. It provides 48 1G/10G SFP+ ports and four 40-G Ethernet QSFP+ ports. Port-to-port latency is around 1 microsecond. It provides integrated Layer 2 and Layer 3 at wire speed.

It offers two choices of airflow, front-to-back (port side exhaust) and back-to-front (port side intake). Each 40 GE port can be split into 4 × 10 GE ports; this can be done by using a QSFP+ break-out cable (Twinax or Fiber).

The Nexus 6001T is a fixed configuration 1RU Ethernet switch. It provides 48 1G/10G BASE-T ports and four 40 G Ethernet QSFP+ ports; port-to-port latency is around 3.3

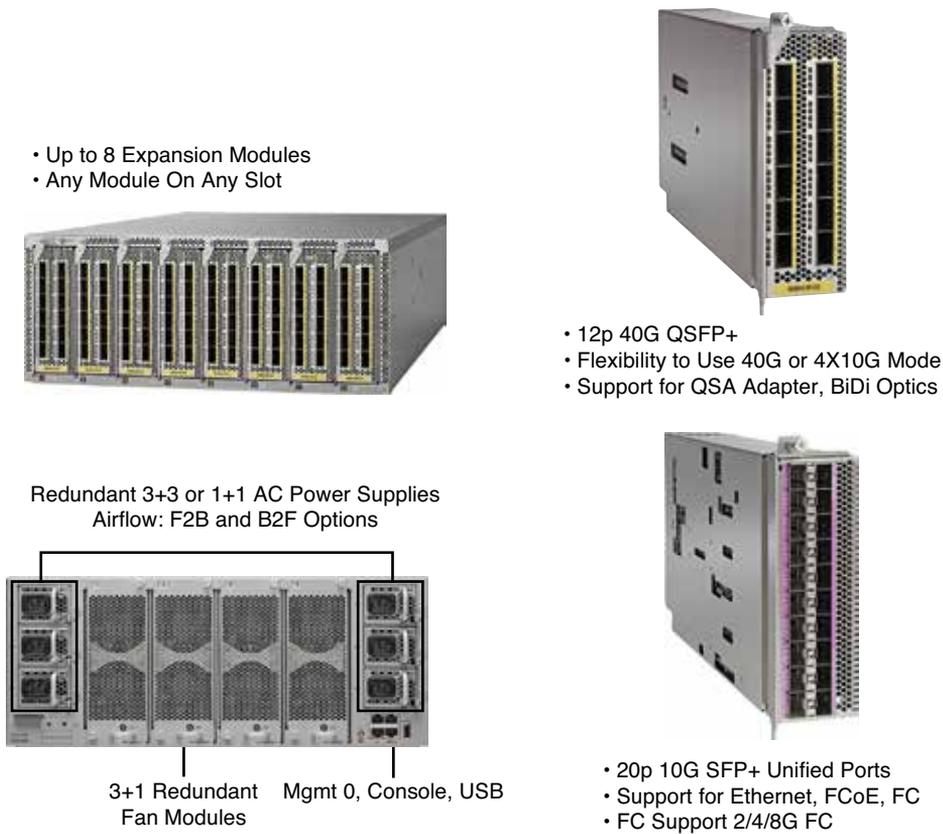
microseconds. It provides integrated Layer 2 and Layer 3 at wire speed. It offers two choices of air flow, front-to-back (port side exhaust) and back-to-front (port side intake). Each 40 GE port can be split into  $4 \times 10\text{GE}$  ports. The split can be done by using a QSFP+ break-out cable (Twinax or Fiber). Nexus 6001T supports FCOE on the RJ-45 ports for up to 30M when CAT 6, 6a, or 7 cables are used. Both switches are shown in Figure B2-30.



**Figure B2-30** Cisco Nexus 6001 Switches

## Cisco Nexus 6004 Switches Features

The Nexus 6004 is shown in Figure B2-31. Currently, there are two models, the Nexus 6004EF and the Nexus 6004X. The main difference is that the Nexus 6004X supports Virtual Extensible LAN (VXLAN). The Nexus 6004 is 4RU 10 G/40 G Ethernet switch; it offers eight line card expansion module (LEM) slots. There are two choices of LEMs: 12-port 10 G/40 G QSFP and 20-port unified ports offering either 1 G/10 G SFP+ or 2/4/8 G FC. The Nexus 6004 offers integrated Layer 2 and Layer 3 at wire rate. Port-to-port latency is approximately 1 microsecond for any packet size. It offers up to 96 40 G QSFP ports and up to 384 10 G SFP+ ports.



**Figure B2-31** *Nexus 6004 Switch*

**Key  
Topic**

**NOTE** The Nexus 6004 can support 1 G ports using a QSA converter (QSFP to SFP adapter) on a QSFP interface. This converts each QSFP+ port to one SFP+ port. The SFP+ can support both 10 G and 1 GE transceivers.

## Cisco Nexus 6000 Switches Licensing Options

Different types of licenses are required for the Nexus 6000. Table B2-12 describes each license and the features it enables. It is worth mentioning that Nexus switches have a grace period, which is the amount of time the features in a license package can continue functioning without a license, enabling a licensed feature that does not have a license key to start a counter on the grace period. You then have 120 days to install the appropriate license keys, disable the use of that feature, or disable the grace period feature. If at the end of the 120-day grace period the device does not have a valid license key for the feature, the Cisco NX-OS software automatically disables the feature and removes the configuration from the device.

There is also an evaluation license, which is a temporary license. Evaluation licenses are time bound (valid for a specified number of days) and are tied to a host ID (device serial number).

**Table B2-12** Nexus 6000 Licensing Options

Feature License	Product ID	Features
FabricPath Services Package ENHANCED_LAYER2_PKG	N6001-EL2-SSK9 N6004-EL2-SSK9	FabricPath
FCoE NPV Package FCOE_NPV_PKG	N6K-FNPV-SSK9	FCoE NPV
Layer 3 Base Services Package LAN_BASE_SERVICES_PKG	N6K-BAS1K9	<p>Unlimited static routes and maximum of 256 dynamic routes.</p> <ul style="list-style-type: none"> <li>■ Static routes</li> <li>■ RIPv2</li> <li>■ OSPFv2 and OSPFv3</li> <li>■ EIGRP</li> <li>■ HSRP 2</li> <li>■ VRRP 3</li> <li>■ IGMP v2/v3</li> <li>■ PIMv2 (sparse mode)</li> <li>■ Routed ACL</li> <li>■ uRPF</li> <li>■ MSDP</li> </ul>
Layer 3 Enterprise Services Package LAN_ENTERPRISE_SERVICES_PKG	N6001-LAN1K9 N6004-LAN1K9	<p>N6001-LAN1K9/N6004-LAN1K9 includes the following features in addition to the ones under the N6K-BAS1K9 license:</p> <ul style="list-style-type: none"> <li>■ BGP</li> <li>■ VRF Lite</li> <li>■ PBR</li> <li>■ PIMv2 (all modes)</li> <li>■ L3 IS-IS 6</li> </ul>
Storage Protocols Services Package FC_FEATURES_PKG ENTERPRISE_PKG	N6001-16P-SSK9 N6004-4Q-SSK9 N6004-12Q-SSK9 N6K-16P-SSK97 N6K-20P-SSK98 N6001-64P-SSK9 N6004-96Q-SSK9	<ul style="list-style-type: none"> <li>■ Native Fibre Channel</li> <li>■ FCoE</li> <li>■ FC NPV</li> <li>■ FC Port Security</li> <li>■ Fabric Binding</li> </ul> <p>Fibre Channel Security Protocol (FC-SP) authentication</p>
VM-FEX Package	N6K-VMFEXK9	VM-FEX

**NOTE** To manage the Nexus 6000 two types of licenses are needed: the DCNM LAN and DCNM SAN. Each of them is a separate license.

## Cisco Nexus 5500 and Nexus 5600 Product Family

The Cisco Nexus 5000 product family is a Layer 2 and Layer 3 1G/10G Ethernet with unified ports; it includes Cisco Nexus 5500 and Cisco Nexus 5600 platforms. Table B2-13 shows the comparison between different models.

**Key  
Topic**

**Table B2-13** Nexus 5500 and Nexus 5600 Product Specification

	Cisco Nexus 5548P	Cisco Nexus 5548UP	Cisco Nexus 5596UP	Cisco Nexus 5596T	Cisco Nexus 5672UP	Cisco Nexus 56128P
Rack Unit (RU)	1	1	2	2	1	2
Switching Capacity	960 Gbps	960 Gbps	1.92 Tbps	1.92 Tbps	1.44 Tbps	2.56 Tbps
Expansion Slots	1	1	3	3	None	2
Fixed, Built-in Ports	32	32	48	48	48	48
1/10 GE, 10-Gbps FCoE Port Density	Up to 48	Up to 48	Up to 96	Up to 96	Up to 72	Up to 128
1/10G BASE-T	None	None	None	Up to 68	None	None
40 GE Uplinks	Up to 4 (through expansion module)	Up to 4 (through expansion module)	Up to 4 (through expansion module)	Up to 4 (through expansion module)	6	Up to 8 (through expansion module)
Fibre Channel Port Density (8/4/2/1 Gbps)	Up to 16 (through expansion module)	Up to 48	Up to 96	Up to 64	16	Up to 48 (through expansion modules only)
160-Gbps Layer 3 Routing Engine	Daughter card	Daughter card	Expansion module	Expansion module	Native line rate L3	Native line rate L3
Fabric Extender Support	Yes, up to 24	Yes, up to 24	Yes, up to 24	Yes, up to 24	Yes, up to 24 (L2, L3)	Yes, up to 24 (L2, L3)
Hot-Swappable Power Supplies and Fan Trays	Yes	Yes	Yes	Yes	Yes	Yes

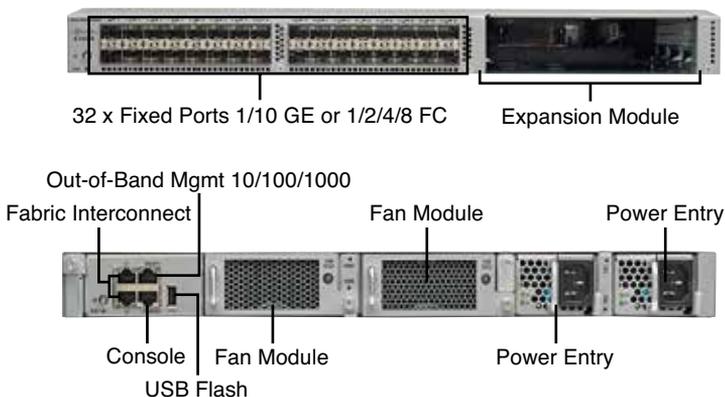
	Cisco Nexus 5548P	Cisco Nexus 5548UP	Cisco Nexus 5596UP	Cisco Nexus 5596T	Cisco Nexus 5672UP	Cisco Nexus 56128P
<b>Air Flow</b>	Front-back (port side exhaust)	Front-back (port side exhaust) and back- front (port side inlet)				
<b>VXLAN</b>	N	N	N	N	Y	Y

**NOTE** The Nexus 5010 and 5020 switches are considered end-of-sale, so they are not covered in this book. Refer to [www.cisco.com](http://www.cisco.com) for more information.

**Key  
Topic**

### Cisco Nexus 5548P and 5548UP Switches Features

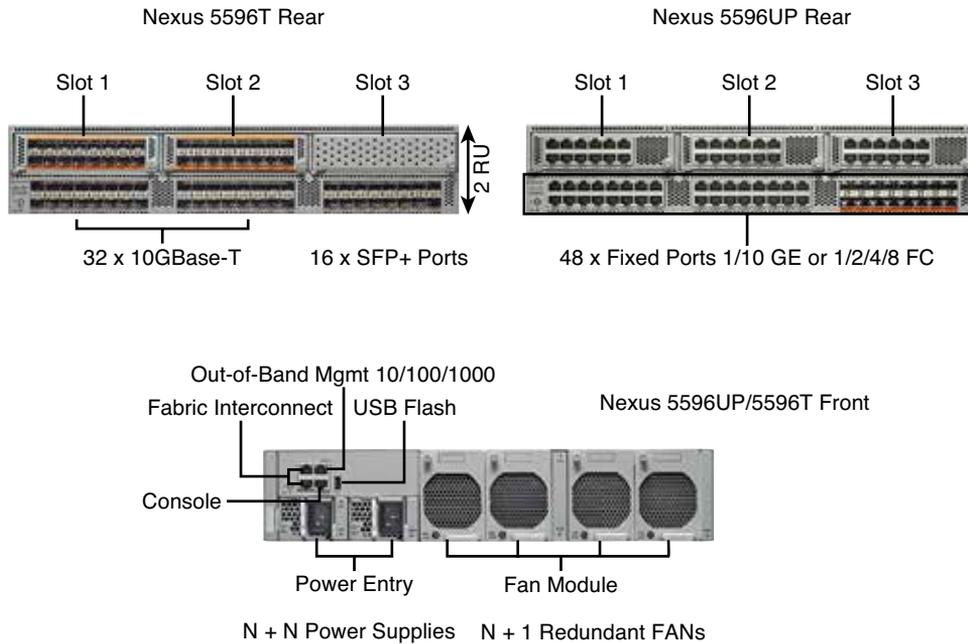
The Nexus 5548P and the Nexus 5548UP are 1/10-Gbps switches with one expansion module. The Nexus 5548P has all the 32 ports 1/10 Gbps Ethernet only. The Nexus 5548UP has the 32 ports unified ports, meaning that the ports can run 1/10 Gbps or they can run 8/4/2/1 Gbps native FC or mix between both. Figure B2-32 shows the layout for them.



**Figure B2-32** *Nexus 5548P and Nexus 5548UP Switches*

### Cisco Nexus 5596UP and 5596T Switches Features

The Nexus 5596T shown in Figure B2-33 is a 2RU 1/10 Gbps Ethernet, native Fibre Channel and FCoE switch. It has 32 fixed ports of 10 G BASE-T and 16 fixed ports of SFP+. The switch has three expansion modules; the switch supports unified ports on all SFP+ ports; the 10 G BASE-T ports support FCoE up to 30m with Category 6a and Category 7 cables.



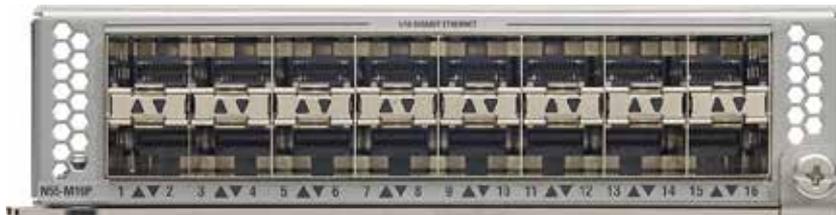
**Figure B2-33** *Nexus 5596UP and Nexus 5596T Switches*



## Cisco Nexus 5500 Products Expansion Modules

You can have additional Ethernet and FCoE ports or native Fibre Channel ports with the Nexus 5500 products by adding expansion modules. The Nexus 5548P/5548UP has one expansion module, and the Nexus 5596UP/5596T has three.

The Cisco N55-M16P module shown in Figure B2-34 has 16 ports 1/10-Gbps Ethernet and FCoE using SFP+ interfaces.



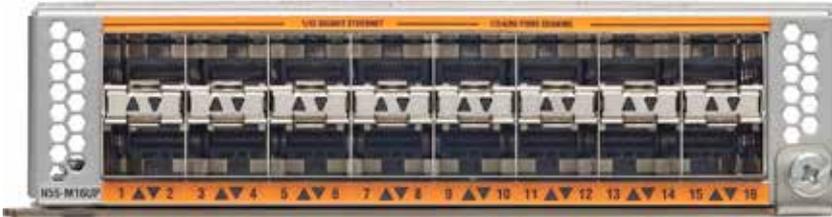
**Figure B2-34** *Cisco N55-M16P Expansion Module*

The Cisco N55-M8P8FP module shown in Figure B2-35 is a 16-port module. It has 8 ports 1/10-Gbps Ethernet and FCoE using SFP+ interfaces, and 8 ports 8/4/2/1-Gbps Native Fibre Channel ports using SFP+ and SFP interfaces.



**Figure B2-35** *Cisco N55-M8P8FP Expansion Module*

The Cisco N55-M16UP shown in Figure B2-36 is a 16 unified ports module. It has 16 ports 1/10-Gbps Ethernet and FCoE using SFP+ interfaces or up to 16 ports 8/4/2/1-Gbps Native Fibre Channel ports using SFP+ and SFP interfaces.



**Figure B2-36** *Cisco N55-M16UP Expansion Module*

The Cisco N55-M4Q shown in Figure B2-37 is a 4-port 40-Gbps Ethernet module. Each QSFP 40-GE port can only work in 4x10G mode and supports DCB and FCoE.



Four Ports QSFP+ GEM

**Figure B2-37** *Cisco N55-M4Q Expansion Module*

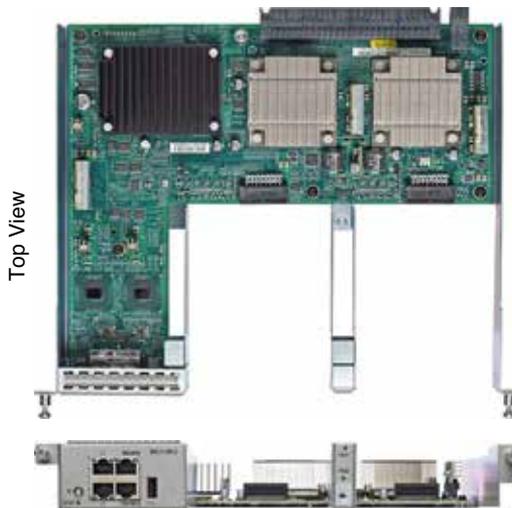
The Cisco N55-M12T shown in Figure B2-38 is a 12-port 10-Gbps BASE-T module; it supports FCoE up to 30m on category 6a and category 7 cables. This module is supported only in the Nexus 5596T.



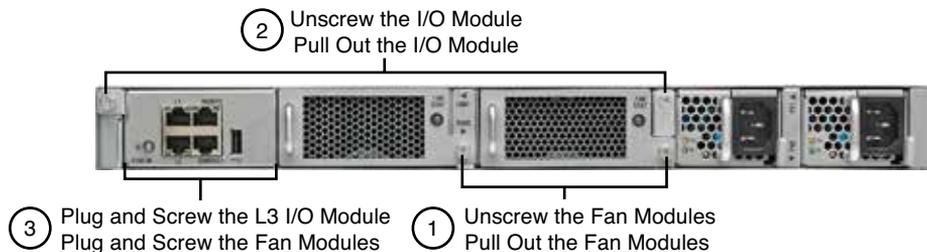
12 x 10GBase-T Ports GEM Module

**Figure B2-38** Cisco N55-M12T Expansion Module

The Cisco 5500 Layer 3 daughter card shown in Figure B2-39 is used to enable Layer 3 on the Nexus 5548P and 5548UP, which can be ordered with the system, or it is field upgradable as a spare. This daughter card provides 160 Gbps of Layer 3 forwarding (240 million packets per second [mpps]), which is shared among all 48 ports.

**Figure B2-39** Cisco Nexus 5548P and 5548UP Layer 3 Daughter Card

To install the Layer 3 module, you must replace the Layer 2 I/O module, power off the switch, and follow the steps as shown in Figure B2-40. There is no need to remove the switch from the rack.



**Figure B2-40** Cisco Nexus 5548P and 5548UP Layer 3 Daughter Card Upgrade Procedure

To enable Layer 3 on the Nexus 5596P and 5596UP, you must have a Layer 3 expansion module, which can be ordered with the system or as a spare. This daughter card provides 160 Gbps of Layer 3 forwarding (240 million packets per second [mpps]), which is shared among all 48 ports. Figure B2-41 shows the Layer 3 expansion module; currently, you can have only one Layer 3 expansion module per Nexus 5596P and 5596UP.



**Figure B2-41** Cisco Nexus 5596P and 5596UP Layer 3 Daughter Card Upgrade Procedure

Enabling Layer 3 affects the scalability limits for the Nexus 5500. For example, the maximum FEXs per Cisco Nexus 5500 Series switches is 24 with Layer 2 only. Enabling Layer 3 makes the supported number per Nexus 5500 to be 16. Verify the scalability limits based on the NX-OS you will be using before creating a design.

## Cisco Nexus 5600 Product Family

The Nexus 5600 is the new generation of the Nexus 5000 switches. The Nexus 5600 has two models, Nexus 5672UP and Nexus 56128P. Both models bring integrated L2 and L3, 1-microsecond port-to-port latency with all frame sizes, true 40-Gbps flow, 40-Gbps FCoE, cut-through switching for 10/40 Gbps, and 25 MB buffer per port ASIC. Table B2-14 shows the summary of the features.

**Key Topic**

**Table B2-14** Nexus 5600 Product Switches Feature

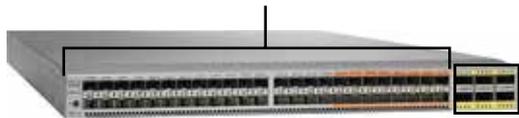
	Nexus 5600-72UP	Nexus 5600-128P
Switch Fabric Throughput	1.44 Tbps	2.56 Tbps
Port-to-Port Latency	~ 1.0 microsecond	~ 1.0 microsecond
Layer 3 Capability	Integrated line-rate	Integrated line-rate
Switch Footprint	1RU	2RU
10 Gigabit Ethernet Port Density	72	128
40 Gigabit Ethernet Port Density	6 True 40G	8 True 40G
Unified Ports	Yes	Yes
1 Gigabit Ethernet FEX Port Scalability	1152	1152
10 Gigabit Ethernet FEX Port Scalability	1152	1152
Packet Buffer	25 MB per 3 × 40 G (or 12 × 10 G)	25 MB per 3 × 40 G (or 12 × 10 G)

### Cisco Nexus 5672UP Switch Features

The Nexus 5672UP shown in Figure B2-42 has 48 fixed 1/10-Gbps SFP+ ports, of which 16 ports are unified, meaning that the ports can run 8/4/2 Gbps Fibre Channel as well as 10 Gigabit Ethernet and FCoE connectivity options. True 40 Gbps ports use QSFP+ for Ethernet/FCOE. The switch has two redundant power supplies and three fan modules. The switch supports both port-side exhaust and port-side intake.

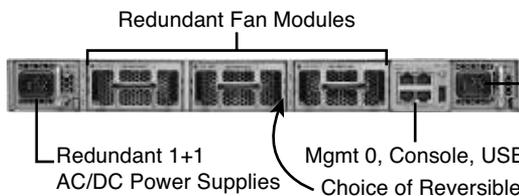
- 48 Fixed 1/10G SFP+ Ports, of Which 16 Ports Are Unified
- 16 Unified Ports Provide 2/4/8G FC, 10G Ethernet/FCoE
- Traditional Ethernet or FCoE or FC

Port Side of Switch



- 6x 40G QSFP+ Ports
- Flexibility to Use 4x10G or 40G

Fan Side of Switch



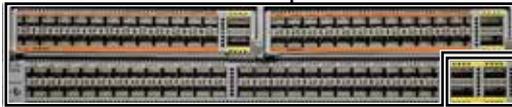
**Figure B2-42** Cisco Nexus 5672UP

## Cisco Nexus 56128P Switch Features

The Cisco Nexus 56128P shown in Figure B2-43 is a 2RU switch. It has 48 fixed 1/10-Gbps Ethernet SFP+ ports and four 40-Gbps QSFP+ ports. The 48 fixed SFP+ ports and four 40 Gbps QSFP+ ports support FCoE as well. The Cisco Nexus 56128P has two expansion modules that support 24 unified ports.

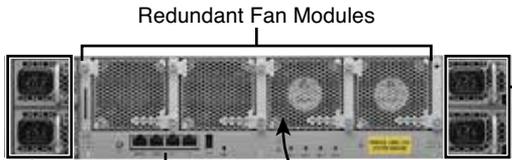
- 48 Fixed 10G SFP+ Ports
- Two Expansion Slots
- Expansion module provides 24 ports 10G Ethernet/FCoE or 2/4/8G FC and 2 ports QSFP+ 40G Ethernet/FCoE.

Port Side of Switch



- Base Chassis
- 4x 40G QSFP+ Ports
  - Flexibility to Use 4x10 or 40G
  - Up to 4 x 40G Ports and 96x 10G Ports

Fan Side of Switch



- Redundant Fan Modules
- Redundant 1+1 AC/DC Power Supplies
- Mgmt 0, Console, USB
- Choice of Reversible Airflow
- Redundant 1+1 AC/DC Power Supplies

**Figure B2-43** Cisco Nexus 56128P

The 24 unified ports provide 8/4/2 Gbps Fibre Channel as well as 10 Gigabit Ethernet and FCoE connectivity options, plus two 40 Gbps ports. It has four N+N redundant, hot-swappable power supplies, four N+1 redundant, hot-swappable independent fans, and a management and console interface on the fan side of the switch.

**Key  
Topic**

## Cisco Nexus 5600 Expansion Modules

Expansion modules enable the Cisco Nexus 5600 switches to support unified ports with native Fibre Channel connectivity. The Nexus 56128P currently supports one expansion module, the N56-M24UP2Q expansion module, as shown in Figure B2-44. That module provides 24 ports 10 G Ethernet/FCoE or 2/4/8 G Fibre Channel and 2 ports 40 Gigabit QSFP+ Ethernet/FCoE ports.



**Figure B2-44** Cisco Nexus 56128P Unified Port Expansion Module

## Cisco Nexus 5500 and Nexus 5600 Licensing Options

Different types of licenses are required for the Nexus 5500 and Nexus 5600. Table B2-15 describes each license and the features it enables. Nexus switches have a grace period, which is the amount of time the features in a license package can continue functioning without a license. Enabling a licensed feature that does not have a license key starts a counter on the grace period. You then have 120 days to install the appropriate license keys, disable the use of that feature, or disable the grace period feature. If at the end of the 120-day grace period the device does not have a valid license key for the feature, the Cisco NX-OS software automatically disables the feature and removes the configuration from the device. There is also an evaluation license, which is a temporary license. Evaluation licenses are time bound (valid for a specified number of days) and are tied to a host ID (device serial number).

**Table B2-15** Nexus 5500 Product Licensing

Feature License	Product ID	Features
FabricPath Services Package ENHANCED_LAYER2_PKG	N5548-EL2-SSK9 N5596-EL2-SSK9 N5672-EL2-SSK9 N56128-EL2-SSK9	FabricPath
FCoE NPV Package FCOE_NPV_PKG	N5548-FNPV--SSK9 N5596-FNPV-SSK9 N56-FNPV-SSK9	FCoE NPV
Layer 3 Base Services Package LAN_BASE_SERVICES_PKG 15	N55-BAS1K9 N56-BAS1K9	Unlimited static routes and maximum of 256 dynamic routes: <ul style="list-style-type: none"> <li>■ Static routes</li> <li>■ RIPv2</li> <li>■ OSPFv2 and OSPFv3</li> <li>■ EIGRP</li> <li>■ HSRP</li> <li>■ VRRP</li> <li>■ IGMP v2/v3</li> <li>■ PIMv2 (sparse mode)</li> <li>■ Routed ACL</li> <li>■ NAT</li> <li>■ MSDP</li> </ul>

Feature License	Product ID	Features
Layer 3 Enterprise Services Package LAN_ENTERPRISE_SERVICES_PKG 1819	N55-LAN1K9 N56-LAN1K9	N55-LAN1K9 includes the following features in addition to the ones under N55-BAS1K9 license: <ul style="list-style-type: none"> <li>■ BGP</li> <li>■ VRF Lite</li> <li>■ PBR</li> <li>■ PIMv2 (all modes)</li> <li>■ L3 IS-IS</li> </ul>
Storage Protocols Services Package FC_FEATURES_PKG ENTERPRISE_PKG	N55-8P-SSK9 N55-48P-SSK9 N56-16p-SSK9 N5672-72P-SSK9 N56128-128P-SSK9	<ul style="list-style-type: none"> <li>■ Native Fibre Channel</li> <li>■ FCoE</li> <li>■ NPV</li> <li>■ FC Port Security</li> <li>■ Fabric Binding</li> <li>■ Fibre Channel Security Protocol (FC-SP) authentication</li> </ul>
VM-FEX Package	N55-VMFEXK9	VM-FEX

**NOTE** To manage the Nexus 5500 and Nexus 5600, two types of licenses are needed: the DCNM LAN and DCNM SAN. Each is a separate license.

## Cisco Nexus 3000 Product Family

The Nexus 3000 switches are part of the Cisco Unified Fabric architecture; they offer high performance and high density at ultra low latency. The Nexus 3000 switches are 1 RU server access switches. This product family consists of multiple switch models: the Nexus 3000 Series, Nexus 3100 Series, and Nexus 3500 switches.

The Nexus 3000 Series consists of five models: Nexus 3064X, Nexus 3064-32T, Nexus 3064T, Nexus 3016Q, and 3048; they are shown in Figure B2-45. All of them offer wire rate Layer 2 and Layer 3 on all ports, and ultra low latency. These are compact 1RU 1/10/40-Gbps Ethernet switches. Table B2-16 gives a comparison and specifications of these different models.



**Nexus 3016**  
10G/40G



**Nexus 3064-X**  
1G/10G/40G



**Nexus 3064-T/Nexus 3064-32T**  
1G/10GT/40G



**Nexus 3048**  
10M/100M/1G

**Figure B2-45** *Cisco Nexus 3000 Switches*

**Table B2-16** Nexus 3000 Product Model Comparison

	Cisco Nexus 3064X	Cisco Nexus 3064-32T	Cisco Nexus 3064T	Cisco Nexus 3016Q	Cisco Nexus 3048
VXLAN Capability	No	No	No	No	No
Openflow Support	Yes	Yes	Yes	Yes	Yes
Cisco OnePK Support	Yes	Yes	Yes	Yes	Yes
Rack Unit (RU)	1	1	1	1	1
Switching Capacity	1.28 Tbps	960 Gbps	1.28 Tbps	1.28 Tbps	176 Gbps
Interface Type	48 SFP+ and 4 QSFP+	32 RJ-45 and 4 QSFP+	48 RJ-45 and 4 QSFP+	16 QSFP+	48 RJ-45 and 4 SFP+
Maximum 1 GE Ports	48	32 enabled (48 maximum)	48	0	Up to 48
Maximum 10 GE Ports	Up to 64 (48 fixed; 16 using 4 QSFP-to-SFP+ cables)	32 10 G BASE-T and 16 using 4 QSFP-to-SFP+ cables are enabled; additional 16 ports with a license	Up to 64 (48 fixed; 16 using 4 QSFP-to-SFP+ cables)	Up to 64 (using 16 QSFP-to-SFP+ cables)	4

	Cisco Nexus 3064X	Cisco Nexus 3064-32T	Cisco Nexus 3064T	Cisco Nexus 3016Q	Cisco Nexus 3048
Maximum 40 GE Ports	Up to 4	4	4	Up to 16	0
Switch Latency	Sub-microsecond	3 to 4 microseconds	3 to 4 microseconds	Sub-microsecond	2.7 to 7.2 microseconds
Line-Rate Traffic Throughput (Both Layer 2 and 3) on All Ports	Yes	Yes	Yes	Yes	Yes
Redundant and Hot-Swappable Power Supply and Fans	Yes	Yes	Yes	Yes	Yes
Air Flow	Front-back and back-front				

The Nexus 3100 switches have four models: Nexus 3132Q, Nexus 3164Q, Nexus 3172Q, and Nexus 3172TQ. Shown in Figure B2-46, all of them offer wire rate Layer 2 and Layer 3 on all ports and ultra low latency. These are compact 1RU 1/10/40-Gbps Ethernet switches. Table B2-17 gives a comparison and specifications of different models.



**Nexus 3132Q**



**Nexus 3172PQ**



**Nexus 3172TQ**



**Nexus 3164Q**

**Figure B2-46** Cisco Nexus 3100 Switches

**Table B2-17** Nexus 3100 Product Model Comparison

	Cisco Nexus 3132Q	Cisco Nexus 3164Q	Cisco Nexus 3172PQ	Cisco Nexus 3172TQ
Virtual Extensible LAN (VXLAN) Capable	Yes	Yes	Yes	Yes
Openflow Support	Yes	Yes	Yes	Yes
OnePK Support	Yes	Yes	Yes	Yes
Rack Unit (RU)	1	2	1	1
Switching Capacity	1280 Gbps	5120 Gbps	720 Gbps	720 Gbps
Interface Type	32 QSFP+	64 QSFP+	48 SFP+ and 6 QSFP+	48 RJ-45 and 6 Quad Small Form-Factor Pluggable Plus (QSFP+)
Maximum 1 Gigabit Ethernet (GE) Ports	4	None	48	48
Maximum 10 GE Ports	104	256 (coming shortly with software release)	72	72
Maximum 40 GE Ports	32	64	6	6
Line-Rate Traffic Throughput (Both Layer 2 and 3) on All Ports	Yes	Yes	Yes	Yes
Redundant and Hot-Swappable Power Supply and Fans	Yes	Yes	Yes	Yes
Air Flow	Port-side intake or port-side exhaust	Port-side intake	Port-side intake or port-side exhaust	Port-side intake or port-side exhaust

The Nexus 3500 switches have two models, Nexus 3524 and Nexus 3548. They are shown in Figure B2-47. Both offer wire rate Layer 2 and Layer 3 on all ports and ultra low latency. These are compact 1RU 1/10-Gbps Ethernet switches. Table B2-18 gives a comparison and specifications of the different models.

**Nexus 3524****Nexus 3548****Figure B2-47** Cisco Nexus 3500 Switches

**Table B2-18** Nexus 3500 Product Model Comparison

	Cisco Nexus 3524	Cisco Nexus 3548
Algo Boost-Capable (NAT, Active Buffer Monitoring)	Yes	Yes
VXLAN Capable	No	No
Openflow Support	No	No
OnePK Support	No	No
Rack Unit (RU)	1	1
Switching Capacity	480 Gbps	960 Gbps
Interface Type	24 SFP+	48 SFP+
Maximum 1 GE ports	24 enabled (48 max)	48
Maximum 10 GE ports	24 10 G SFP+ ports; additional 24 ports via license	48
Maximum 40 GE ports	0	0
Switch Latency	Sub-250 nanosecond	Sub-250 nanosecond
Line-Rate Traffic Throughput (Both Layer 2 and 3) on All Ports	Yes	Yes
Redundant and Hot-Swappable Power Supply and Fans	Yes	Yes
Air Flow	Front-back and back-front	Front-back and back-front

**NOTE** The Nexus 3524 and the Nexus 3548 support a forwarding mode called warp mode, which uses a hardware technology called Algo boost. Algo boost provides ultra-low latency—as low as 190 nanoseconds (ns). They are very well suited for high-performance trading and high-performance computing environments.

### Cisco Nexus 3000 Licensing Options

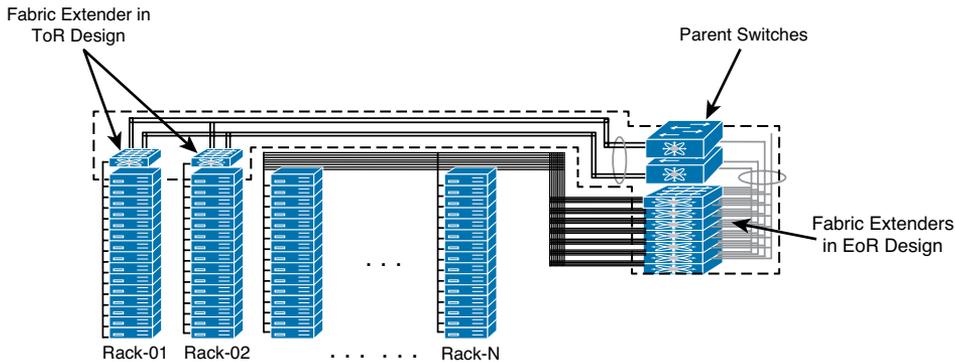
There are different types of licenses for the Nexus 3000. It is worth mentioning that the Nexus 3000 doesn't support the grace period feature. Table B2-19 shows the license options.

**Table B2-19** Nexus 3000 Licensing Options

Feature License	Product ID	Features
Layer 3 Base Services Package LAN_BASE_SERVICES_PKG	N3548-BAS1K9	Static routing RIPv2 EIGRP stub OSPFv2 (limited routes) PIMv2 (sparse mode)
Layer 3 Enterprise Services Package LAN_ENTERPRISE_SERVICES_PKG	N3548-LAN1K9	OSPF (unlimited routes) BGP and VRF-lite (IP-VPN) <b>NOTE</b> Requires Base Services Package.
Cisco Nexus 3500 Algo Boost License ALGO_BOOST_SERVICES_PKG	N3548-ALGK9	Warp Mode Warp SPAN Static NAT
Layer 3 Base Services Package LAN_BASE_SERVICES_PKG	N3K-BAS1K9	Static routing RIPv2 EIGRP stub OSPFv2 (limited routes) PIMv2 (sparse mode) <b>NOTE</b> The Cisco Nexus 3164 switch supports a base-level Layer 3 feature set by default and does not require the Layer 3 Base Services Package license.
Layer 3 Enterprise Services Package LAN_ENTERPRISE_SERVICES_PKG	N3K-LAN1K9	OSPF (unlimited routes) EIGRP (unlimited routes) BGP VXLAN (Cisco Nexus 3164 only) <b>NOTE</b> The Layer 3 Base Services Package license is a prerequisite for the Layer 3 Enterprise Services Package license on all Cisco Nexus 3000 Series switches except the Cisco Nexus 3164 switch.

## Cisco Nexus 2000 Fabric Extenders Product Family

The Cisco Nexus 2000 Fabric Extenders behave as remote line cards. They appear as an extension to the parent switch to which they connect. The parent switch can be Nexus 5000, Nexus 6000, Nexus 7000, and Nexus 9000 Series switches. Using Nexus 2000 gives you great flexibility when it comes to the type of connectivity and physical topology. This type of architecture provides the flexibility and benefit of both architectures: top-of-rack (ToR) and end-of-row (EoR). It also enables highly scalable servers access design without the dependency on spanning tree. All Nexus 2000 Fabric Extenders connected to the same parent switch are managed from a single point. Figure B2-48 shows both types, ToR and EoR.

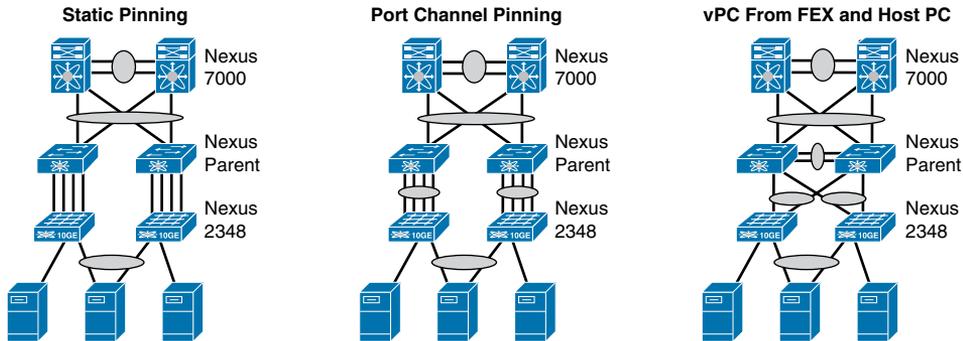


**Figure B2-48** Cisco Nexus 2000 Top-of-Rack and End-of-Row Design

As shown in Figure B2-48, Rack-01 is using dual redundant Cisco Nexus 2000 Series Fabric Extender, which is placed at the top of the rack. The uplink ports on the Cisco Nexus 2000 Series Fabric Extenders can be connected to a Cisco Nexus 5000, Nexus 6000, Cisco Nexus 7000, or Nexus 9000 Series switch that is installed in the EoR position as the parent switch.

This is a ToR design from a cabling point of view, but from an operation point of view this design looks like an EoR design, because all these Nexus 2000 Fabric Extenders will be managed from the parent switch. So no configuration or software maintenance tasks need to be done with the FEXs. The cabling between the servers and the Cisco Nexus 2000 Series Fabric Extenders is contained within the rack, reducing cabling between racks. Only the cables between the Nexus 2000 and the parent switches will run between the racks, which can be 10 Gbps or 40 Gbps.

Multiple connectivity options can be used to connect the FEX to the parent switch, as shown in Figure B2-49, which is explained shortly.



**Figure B2-49** Cisco Nexus 2000 Connectivity Options

- **Straight-through, using static pinning:** To achieve a deterministic relationship between the host port on the FEX to which the server connects and the fabric interfaces that connect to the parent switch, the host port will be statically pinned to one of the uplinks between the FEX and the parent switch. This method is used when the FEX is connected straight through to the parent switch. The server port will always use the same uplink port.

You must use the **pinning max-links** command to create pinned fabric interface connections so that the parent switch can determine a distribution of host interfaces. The host interfaces are divided by the number of the max-links and distributed accordingly. The default value is max-links equals 1.

**NOTE** The Cisco Nexus 2248PQ Fabric Extender does not support the static pinning fabric interface connection.

- **Straight-through, using dynamic pinning (port channel):** You can use this method to load balance between the down link ports connected to the server and the fabric ports connected to the parent switch. This method bundles multiple uplink interfaces to one logical port channel. The traffic is being distributed using a hashing algorithm; for Layer 2 it uses Source MAC and Destination MAC, for Layer 3 it uses Source MAC, Destination MAC, and Source IP Destination IP.
- **Active-active FEX using vPC:** In this scenario, the FEX is dual homed using vPC to different parent switches.

**NOTE** The Cisco Nexus 7000 Series switches currently support only straight-through deployment using dynamic pinning. Static pinning and active-active FEX are currently supported only on the Cisco Nexus 5000 Series switches.

Table B2-20 shows the different models of the 1/10-Gbps fabric extenders.

Key  
Topic**Table B2-20** Nexus 2000 1/10-Gbps Model Comparison

	Cisco Nexus 2232PP	Cisco Nexus 2248PQ	Cisco Nexus 2232TM	Cisco Nexus 2232TM-E	Cisco Nexus 2348UPQ
Fabric Extender Host Interfaces	32	48	32	32	48
Fabric Extender Host Interface Types	1/10 Gigabit Ethernet ports SFP/SFP+	1/10 Gigabit Ethernet ports SFP/SFP+	1/10GBASE-T ports: RJ-45 connectors	1/10GBASE-T ports: RJ-45 connectors	48 Fixed 1/10 G SFP+ Unified Capable Ports, 4x 40G QSFP+(SIF)
Fabric Extender Fabric Interfaces	8	4 QSFP+ (16 x 10 GE)	Uplink module: 8 SFP+ (N2K-M2800P)	8 SFP+	6 x 40G QSFP+
Fabric Speed	80 Gbps in each direction (160 Gbps full duplex)	160 Gbps in each direction (320 Gbps full duplex)	80 Gbps in each direction (160 Gbps full duplex)	80 Gbps in each direction (160 Gbps full duplex)	240 Gbps in each direction (480 Gbps full duplex)
Over-subscription	4:1	3:1	4:1	4:1	2:1
Performance	Hardware forwarding at 560 Gbps or 595 mpps	Hardware forwarding at 960 Gbps or 952 mpps	Hardware forwarding at 560 Gbps or 595 mpps	Hardware forwarding at 560 Gbps or 595 mpps	Hardware forwarding at 1200 Gbps or 952 mpps
Cisco Parent Switch	Cisco Nexus 5000, 6000, 7000, and 9000 Series	Cisco Nexus 5000, 6000, 7000, and 9000 Series	Cisco Nexus 5000, 6000, 7000, and 9000 Series	Cisco Nexus 5000, 6000, and 9000 Series	Cisco Nexus 5000, 6000, 7000, and 9000 Series
FCoE Support	Yes	Yes	No	Yes (supports up to 30 meters)	Yes

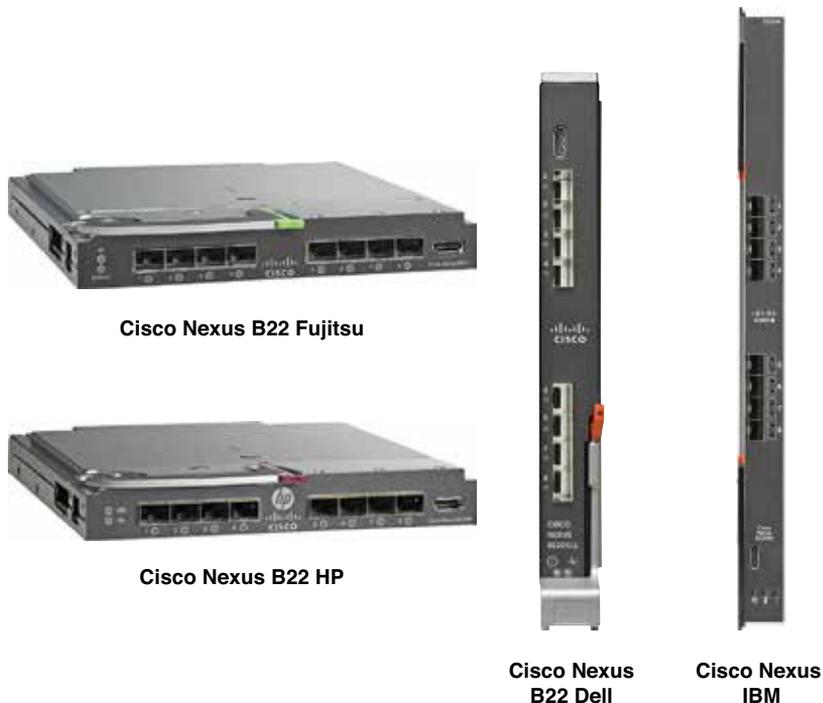
Table B2-21 shows the different models of the 100M and 1 Gbps fabric extenders.

Key  
Topic**Table B2-21** Nexus 2000 100 Mbps/1 Gbps Model Comparison

	Cisco Nexus 2224TP	Cisco Nexus 2248TP	Cisco Nexus 2248TP-E
Fabric Extender Host Interfaces	24	48	48
Fabric Extender Host Interface Types	100BASE-T/1000BASE-T ports: RJ-45 connectors	100BASE-T/1000BASE-T ports: RJ-45 connectors	100BASE-T/1000BASE-T ports: RJ-45 connectors

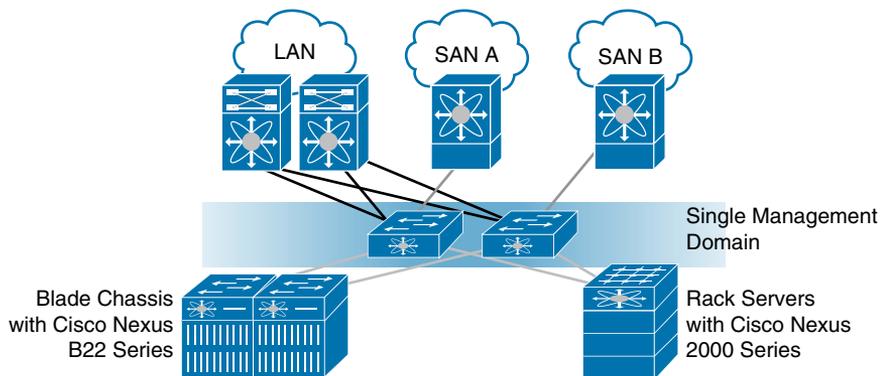
	Cisco Nexus 2224TP	Cisco Nexus 2248TP	Cisco Nexus 2248TP-E
Fabric Extender Fabric Interfaces	2	4	4
Fabric Speed	20 Gbps in each direction (40 Gbps full duplex)	40 Gbps in each direction (80 Gbps full duplex)	40 Gbps in each direction (80 Gbps full duplex)
Oversubscription	1.2:1	1.2:1	1.2:1
Performance	Hardware forwarding at 88 Gbps or 65 mpps	Hardware forwarding at 176 Gbps or 131 mpps	Hardware forwarding at 176 Gbps or 131 mpps
Cisco Parent Switch	Cisco Nexus 5000, 6000, 7000, and 9000 Series	Cisco Nexus 5000, 6000, 7000, and 9000 Series	Cisco Nexus 5000, 6000, 7000, and 9000 Series
FCoE Support	No	No	No

As shown in Figure B2-50, the Cisco Nexus B22 Fabric Extender is part of the fabric extenders family. It extends the FEX to third-party blade centers from HP, Fujitsu, Dell, and IBM. There is a separate hardware model for each vendor. They simplify the operational model by making the blade switch management part of the parent switch and make it appear as a remote line card to the parent switch, similar to the Nexus 2000 fabric extenders.



**Figure B2-50** Cisco Nexus B22 Fabric Extender

The B22 topology shown in Figure B2-51 is creating a highly scalable server access design with no spanning tree running. This architecture gives the benefit of centralized management through the Nexus parent switch. It is similar to the Nexus 2000 Series management architecture. Similar to the Nexus 2000 Series, the B22 consists of two types of ports, host ports for blade server attachments and uplink ports, which are called fabric ports. The uplink ports are visible and are used for the connectivity to the upstream parent switch, as shown in Figure B2-51.



**Figure B2-51** Cisco Nexus B22 Access Topology

The number of host ports and fabric ports for each model is shown in Table B2-22.

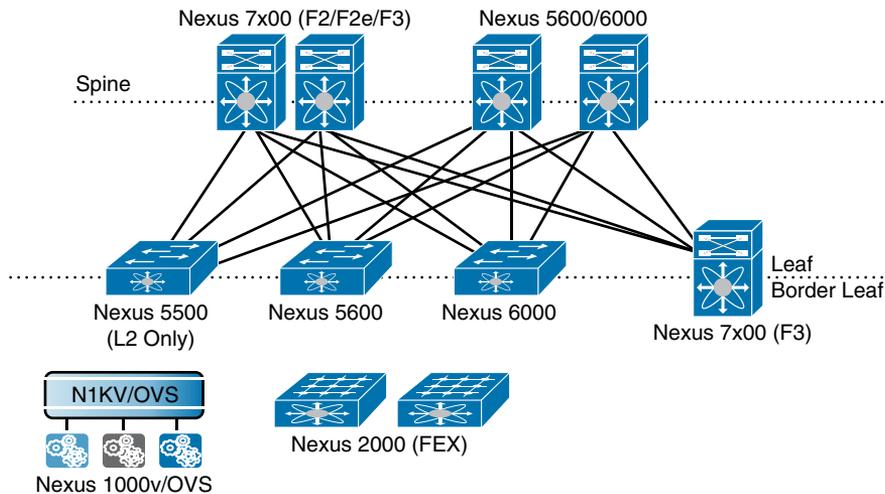
**Key  
Topic**

**Table B2-22** Nexus B22 Specifications

	Cisco Nexus B22HP	Cisco Nexus B22F	Cisco Nexus B22IBM	Cisco Nexus B22DELL
Supported Blade Chassis	HP BladeSystem c3000 enclosure HP BladeSystem c7000 enclosure	Fujitsu PRIMERGY BX400 enclosure Fujitsu PRIMERGY BX900 enclosure	IBM Flex System	Dell PowerEdge M1000e blade enclosure
Fabric Extender Host Interfaces	16	16	14	16
Fabric Extender Host Interface Type	1/10GBASE-KR internal midplane connections	10GBASE-KR internal midplane connections	10GBASE-KR internal midplane connections	1/10GBASE-KR internal midplane connections
Fabric Extender Fabric Interfaces	8	8	8	8

## Cisco Dynamic Fabric Automation

Besides using the Nexus 7000, Nexus 6000, and Nexus 5000 to build standard three-tier data center architectures, you can build a Spine-Leaf architecture called Dynamic Fabric Automation (DFA), as shown in Figure B2-52. The leaf nodes are at the edge, and this is where the host is connected, as well as the L4 to L7 services. The spines are at the core of the network, and nothing connects to the spines except the leaf switches. The DFA architecture includes fabric management using Central Point of Management (CPoM) and the automation of configuration of the fabric components. Using open application programming interfaces (API), you can integrate automation and orchestration tools to provide control for provisioning of the fabric components.



**Figure B2-52** Cisco Nexus B22 Topology

Cisco DFA enables creation of tenant-specific virtual fabrics and allows these virtual fabrics to be extended anywhere within the physical data center fabric. It uses a 24-bit (16 million) segment identifier to support a large-scale virtual fabric that can scale beyond the traditional 4000 VLANs.

## Summary

In this appendix, you learned about the different Cisco Nexus family of switches. The Nexus product family is designed to meet the stringent requirements of the next-generation data center. Following are some points to remember:

- With the Nexus product family you can have an infrastructure that can be scaled cost effectively, and that helps you increase energy, budget, and resource efficiency.
- The Nexus product family offers different types of connectivity options that are needed in the data center, spanning from 100 Mbps per port and going up to 100 Gbps per port.
- The Nexus family provides operational continuity to meet your needs for an environment where system availability is assumed and maintenance windows are rare, if not totally extinct.

- Nexus modular switches are the Nexus 7000, Nexus 7700, and the Nexus 9000 switches.
- The Nexus 7000 can scale up to 550 Gbps per slot; the Nexus 7700 can scale up to 1.32 Tbps per slot; and the Nexus 9000 can scale up to 3.84 Tbps per slot.
- Multiple supervisor modules are available for the Nexus 7000 switches and the Nexus 7700 switches: supervisor module 1, supervisor module 2, and supervisor module 2E.
- Nexus modular switches go from 1 Gbps ports up to 100 Gbps ports. If you want 100 Mbps ports you must use Nexus 2000 fabric extenders.
- The Nexus 5600 Series is the latest addition to the Nexus 5000 family of switches. It supports true 40 Gbps ports with 40 Gbps flows. One of the key features it supports is VXLAN and true 40 Gbps ports.
- The Nexus 6004X is the latest addition to the Nexus 6000 family. It supports unified ports, true 40 Gbps, and is the only switch in the Nexus 6000 family that supports VXLAN.
- Nexus 2000 fabric extenders must have a parent switch connected to them. The Nexus 2000 can be connected to Nexus 7000, Nexus 9000, Nexus 6000, and Nexus 5000 switches. They act as the parent switch for the Nexus 2000.
- Nexus 3000 is part of the unified fabric architecture. It is an ultra-low latency switch that is well suited to the high-performance trading and high-performance computing environments.

## Exam Preparation Tasks

### Review All Key Topics

Review the most important topics in the appendix, noted with the key topic icon in the outer margin of the page. Table B2-23 lists a reference for these key topics and the page numbers on which each is found.



**Table B2-23** Key Topics for Appendix B-2

Key Topic Element	Description	Page
Section	Chassis	621
Section	System Controller	622
Section	Fabric Modules	623
Section	Line Cards	624
Table B2-3	Nexus 9500 Modular Platform Line Card Comparison	625
Section	Cisco QSFP Bi-Di Technology for 40 Gbps Migration	628
Table B2-4	Nexus 9500 Fixed-Platform Comparison	629
Table B2-5	Nexus 7000 and Nexus 7700 Modular Platform Comparison	631
Section	Cisco Nexus 7004 Series Switch Chassis	632
Table B2-6	Nexus 7000 and Nexus 7700 Supervisor Modules Comparison	637
Table B2-7	Nexus 7000 and Nexus 7700 Software Licensing Features	642
Table B2-8	Nexus 7000 and Nexus 7700 M-Series Modules Comparison	644
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List	Redundancy Modes Configurable by Users	650
Note	Nexus 6004 Can Support 1 G Ports	653
Table B2-13	Nexus 5500 and Nexus 5600 Product Specification	655
Section	Cisco Nexus 5548P and 5548UP Switches Features	656
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Table B2-20	Nexus 2000 1/10-Gbps Module Comparison	672
Table B2-21	Nexus 2000 100-Mbps/1-Gbps Module Comparison	672
Table B2-22	Nexus B22 Specifications	674

## Complete Tables and Lists from Memory

Print a copy of Appendix I, “Memory Tables” (found on the disc), or at least the section for this appendix, and complete the tables and lists from memory. Appendix J, “Memory Tables Answer Key,” also on the disc, includes completed tables and lists to check your work.

## Define Key Terms

Define the following key terms from this appendix, and check your answers in the glossary:

Application Centric Infrastructure (ACI), port channel (PC), virtual port channel (vPC), Fabric Extender (FEX), Top of Rack (ToR), End of Row (EoR), Dynamic Fabric Automation (DFA), Virtual Extensible LAN (VXLAN)

