Exploring the Industry’s Leading Data Center Switching Platform:
The Cisco Nexus 9000 Series Switches
Cisco Nexus 9000 Series Switches

Engineered from the ground up for the automation, performance, and simplicity that your team needs to stay ahead of the ever increasing demands of software developers and applications, the Cisco Nexus® 9000 combines the most programmable network operating systems with the world’s highest performing ASICs so your team can deliver amazing experiences faster than your competition.
Optimize your Architecture

Data center networks around the world are shifting to spine-and-leaf\(^1\,^2\) architecture to simplify scaling bandwidth, deliver consistently lower latency and reduce overall costs.

Unlike traditional 3-tier networks, every leaf (access) switch connects to every spine (aggregation) switch – and every spine switch only connects to the leaf switches. Every connection to the data center network is made through a leaf switch. To increase overall bandwidth, all you need to do is add another spine switch. To add access ports, simply add another leaf switch. Every leaf is only two hops away from every other leaf for consistently low latency. And every link is always active, so your network delivers the maximum bandwidth with the fewest switches.

\(^1\) ACI mode is designed for spine-and-leaf only and requires the Cisco Application Policy Infrastructure Controller (APIC).

\(^2\) While this guide focuses on the spine-and-leaf architecture, the Nexus 9000 and 3000 can be configured for either spine-and-leaf or traditional 2-tier and 3-tier architectures in NX-OS mode.
Hardware innovation

All networking platforms depend upon their network processors and the other microchips on which they run. That’s why we have some of the world’s best Application-Specific Integrated Circuit (ASIC) designers. We are committed to driving the industry forward when we see that customer needs aren’t being met by merchant silicon. A great example of this are the Cloud Scale ASICs.
Three key decisions

Your organization’s data center architecture is unique. When you consider your combination of network administrators, applications, software developers, users, computing, storage, and public cloud usage, no other organization is an exact match for your needs. That's the reason we've built such broad capabilities into the Cisco Nexus 9000 portfolio. As you consider how it could best meet the needs of your organization, there are three key decisions you'll need to make.

Which network operating system is right for you?
Both Cisco ACI1 and NX-OS2 have their benefits. You will need to pick one as your spine-and-leaf operating system.

- **Cisco ACI1**
  - The ACI1 network operating system dramatically simplifies SDN and delivers end-to-end policy automation by taking advantage of Cisco's Cloud Scale ASICs that connect physical and logical networks.

- **NX-OS2**
  - The industry’s most programmable network operating system with open APIs. With over 50,000 customers, NX-OS is the world’s industry-leading network operating system for data centers.

- **Which one is right for you?**
  - It really comes down to your people. ACI1 makes automation dramatically easier. Your people won’t have to learn tools like Ansible, Puppet, or Chef. They’ll have a single-pane of glass for managing physical and virtual networks, and they’ll be able to deploy and maintain applications faster and easier.

Read our Guide to learn more about the different approaches to SDN.

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2 While this guide focuses on the spine-and-leaf architecture, the Nexus 9000 and 3000 can be configured for either spine-and-leaf or traditional 2-tier and 3-tier architectures in NX-OS mode.
Which leaf switches do you need?
You will likely need many different leaf switches to meet your computing, storage, and core networking needs. If you are new to the Cisco Nexus 9000 Series Switches, we recommend that you focus on switches with Cloud Scale ASICs.

<table>
<thead>
<tr>
<th>Cloud Scale ASICs</th>
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<tbody>
<tr>
<td>Built on next-generation process technology (16 nm), our Cloud Scale ASICs deliver significant advantages over merchant silicon: Fundamentally faster due to 16nm processes, Substantially more features in hardware, Higher performing buffers, Line rate encryption and analytics.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Cisco ACI technology</th>
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<tbody>
<tr>
<td>As the industry moves toward Software-Defined Networking (SDN) and infrastructure as code, there is no industry standard for combining physical and virtual networks. We invented Cisco ACI to connect physical and virtual networks for deploying policy-based automation end-to-end.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>FCoE and Fibre Channel</th>
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</thead>
<tbody>
<tr>
<td>While all Cisco Nexus 9000 leaf switches support Fibre Channel-over-Ethernet (FCoE), only the N9K-93180YC-FX can be configured for Fibre Channel ports to connect to your SAN.</td>
</tr>
</tbody>
</table>

What is the best spine switch to standardize on?
Unlike leaf switches, you will want to pick a single spine switch to standardize on. Key considerations include:

<table>
<thead>
<tr>
<th>Total spine bandwidth</th>
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</thead>
<tbody>
<tr>
<td>In most cases, you will start with two spine switches and have the option to expand to up to 6 spines.³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leaf uplinks</th>
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<tbody>
<tr>
<td>You’ll want to make sure your spine is compatible with all your leaves’ uplinks. You’ll need a modular spine if you want to have both QSFP28 and QSFP+ uplinks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating system</th>
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<tr>
<td>You’ll want to make sure your operating system supports all of your spine and leaf switches.</td>
</tr>
</tbody>
</table>

³ ACI mode is designed for spine-and-leaf only and requires the Cisco Application Policy Infrastructure Controller (APIC).

³ We strongly recommend you start with at least two spine switches. You will also likely be limited to six spine switches because that is the most common number of uplinks for leaf switches. The range shown here is the total maximum system bandwidth for two to six spine switches.
## Spine Switches

### Modular spine switches

**Total spine bandwidth:** 120–360 Tbps\(^3\) maximum  
**N9K-C9516-FM-E2**  
- 16-slot chassis  
- Cisco ACI\(^1\) and Cisco\(^\circ\) NX-OS\(^2\) modes  
- Up to 576 40/100G or 2,304 10G ports

**Total spine bandwidth:** 60–180 Tbps\(^3\) maximum  
**N9K-C9508-FM-E**  
- 8-slot chassis  
- Cisco ACI\(^1\) and NX-OS\(^2\) modes  
- Up to 288 40/100G or 1,152 10G Ports

### Fixed configuration spine switches

**Total spine bandwidth:** 24–72 Tbps\(^3\) maximum  
**N9K-9364C**  
- Cisco ACI\(^1\) and NX-OS\(^2\) modes  
- 64 ports 40/100G QSPF28 ports  
- 2 fixed 1/10G SFP+ ports  
- 16 ports of MACsec line rate encryption

**Total spine bandwidth:** 14–42 Tbps\(^3\) maximum  
**N9K-9336C-FX2**  
- Cisco ACI\(^1\) and NX-OS\(^2\) modes  
- 36 x 1/10/25/40/100-Gbps QSFP28 ports  
- All ports support MACsec line rate encryption

**Total spine bandwidth:** 6–18 Tbps\(^3\) maximum  
**N9K-9336PQ**  
- Cisco ACI\(^1\) only  
- 36 line-rate 40 GBE QSFP+ ports  
- 16 ports of MACsec line rate encryption

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\(^3\) We strongly recommend you start with at least two spine switches. You will also likely be limited to six spine switches because that is the most common number of uplinks for leaf switches. The range shown here is the total maximum system bandwidth for two to six spine switches.
Leaf Switches

Fixed configuration leaf switches

For NX-OS\textsuperscript{2} fixed copper access, you'll need to use the Cisco ACI enabled leaf switches.

Cisco ACI\textsuperscript{1} and NX-OS\textsuperscript{2} modes with line rate encryption\textsuperscript{4}

Fiber access with MACsec and 100G uplinks

\textbf{N9K-9336C-FX2}
- 36 x 1/10/25/40/100-Gbps QSFP28 ports
- Configure each port for access or uplinks

\textbf{N9K-93240YC-FX2}
- 48 x 1/10/25-Gbps ports
- 12 x 40/100-Gbps QSFP28 uplinks

\textbf{N9K-93180C-FX}
- 48 x 10/25-Gbps or 8/16/32-Gbps Fibre Channel QSFP28 ports
- 6 x 40/100-Gbps QSFP28 uplinks

Copper access with MACsec and 100G uplinks

\textbf{N9K-93108TC-FX}
- 48 x 10GBASE-T ports
- 6 x 40/100-Gbps QSFP28 uplinks

\textbf{N9K-9348GC-FXP}
- 48 x 100M/1G BASE-T ports
- 4 x 1/10/25-Gbps SFP28 uplinks and 2 x 40/100-Gbps QSFP28 uplinks

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\textsuperscript{4} If you are considering using the Nexus 9500 as a leaf switch, the N9K-X9788TC-FX offers line rate encryption in NX-OS mode.
Cisco Nexus 9000 Series Switches

Hardware innovation

Three key decisions

Spine Switches

Leaf Switches

Fixed configuration leaf switches

Modular spine line cards

Modular leaf line cards

Additional information

Learn more

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Cisco ACI\(^1\) and NX-OS\(^2\) modes

**Fiber access with 100G uplinks**

- **N9K-93180LC-EX**
  - 24 x 40/50-Gbps QSFP28 ports
  - 6 x 40/100-Gbps QSFP28 uplinks

- **N9K-93180Y-C-EX**
  - 48 x 10/25-Gbps QSFP28 ports
  - 6 x 40/100-Gbps QSFP28 uplinks

- **N9K-9332PQ**
  - 32 x 40-Gbps QSFP+ ports
  - Configure each port for access or uplinks

- **N9K-9396PX**
  - 48 x 1/10-Gbps SFP+ ports
  - 12 x 40-Gbps QSFP+ uplinks

- **N9K-9372PX-E**
  - 48 x 1/10-Gbps SFP+ ports
  - 6 x 40-Gbps QSFP+ uplinks

- **N9K-9396TX**
  - 48 x 1/10GBASE-T ports
  - 12 x 40-Gbps QSFP+ uplinks

- **N9K-9372TX-E**
  - 48 x 1/10GBASE-T ports
  - 6 x 40-Gbps QSFP+ uplinks

**Fiber access with 40G uplinks**

- **N9K-9332P**
  - 56 x 40-Gbps QSFP+ ports
  - 8 x 100-Gbps QSFP28 uplinks

- **N9K-9236C**
  - 36 x 1/10/25/40/50/100G QSFP28 ports
  - All ports can be configured for access or uplink

- **N9K-92304QC**
  - 56 x 40-Gbps QSFP+ ports
  - 8 x 100-Gbps QSFP28 uplinks

**Copper access with 100G uplinks**

- **N9K-93108TC-EX**
  - 48 x 1/10GBASE-T ports
  - 6 x 40/100-Gbps QSFP28 uplinks

- **N9K-92160YC-X**
  - 96 x 1/10GBASE-T ports
  - 6 x 40-Gbps QSFP+ uplinks

- **N9K-92160YC-X**
  - 48 x 10/25-Gbps SFP+ ports
  - 6 x QSFP28 ports (4 of the QSFP+ ports are 100Gbps capable)

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Modular spine line cards

Cisco ACI\(^1\) and NX-OSI\(^2\) modes

1/10/25/40/ 50/100G QSFP28 uplinks

<table>
<thead>
<tr>
<th>Line rate encryption (+170 byte packets)</th>
<th>Line rate for all packets (no encryption)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplinks N9K-X9736C-FX</td>
<td>N9K-X9732C-EX</td>
</tr>
<tr>
<td>• 36 uplinks</td>
<td>• 32 uplinks</td>
</tr>
<tr>
<td>• 3.6 Tbps</td>
<td>• 3.6 Tbps</td>
</tr>
<tr>
<td>• 160 MB buffer capacity</td>
<td>• 160 MB buffer capacity</td>
</tr>
</tbody>
</table>

NX-OS\(^2\) mode only

Line rate encryption (+170 byte packets)
N9K-X9732C-FX
• 32 uplinks
• 3.6 Tbps
• 160 MB buffer capacity

Line rate for all packets (no encryption)
N9K-X9732C-EX
• 32 uplinks
• 3.6 Tbps
• 160 MB buffer capacity

Line rate for +250 byte packets
N9K-X9432C-S
• 32 uplinks
• 32 MB buffer capacity

Deep buffers
N9K-X9636C-R
• 36 uplinks
• 24 GB buffer capacity

N9K-X9636C-RX
• 36 uplinks
• 16 GB buffer capacity

Modular leaf line cards

Cisco AC and NX-OSI\(^2\) modes
NX-OS\(^2\) mode only

40 GPS QSFP + uplinks

Line rate for all packets
N9K-X9636PQ
• 36 uplinks
• 36 MB buffer capacity
• 4-slot and 8-slot chassis only

Line rate for +200 byte packets
N9K-X9432PQ
• 32 uplinks
• 24 MB buffer capacity

Deep buffers
N9K-X9636Q-R
• 36 uplinks
• 24 GB buffer capacity

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Modular leaf line cards

Modular leaf line cards for the Cisco Nexus 9500

**NX-OS² mode only**

There is also the option to use the Nexus 9500 as a leaf switch. This is usually only needed for data centers with tens of thousands of servers.

**Fiber access, 100G uplinks**

N9K-X97160YC-EX
- 48 x 1/10/25-Gbps SFP+ ports
- 4-port 100-Gbps QSFP28 uplink

**Fiber access, 40G uplinks**

N9K-X9536PQ
- 36 x 40-Gbps QSFP+ ports
- 1.5:1 oversubscription
- All ports can be configured for access or uplinks

N9K-X9564PX
- 48 x 1/10-Gbps SFP+ ports
- 4 x 40 Gigabit Ethernet QSFP+ uplinks

**Copper access, 100G uplinks**

N9K-X9788TC-FX
- 48-port 1 and 10GBASE-T
- 4-port 40/100-Gbps QSFP28 uplinks
- Line rate encryption

**Copper access, 40G uplinks**

N9K-X9564TX
- 48-port 1 and 10GBASE-T
- Line rate for all packets
- 4-port 40-Gbps QSFP+ uplinks

N9K-X9464TX2
- 48-port 1 and 10GBASE-T
- Line rate for +200 byte packets
- 4-port 40-Gbps QSFP+ uplinks

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3. We strongly recommend you start with at least two spine switches. You will also likely be limited to six spine switches because that is the most common number of uplinks for leaf switches. The range shown here is the total maximum system bandwidth for two to six spine switches.

4. If you are considering using the Cisco Nexus 9500 as a leaf switch, the N9K-X9788TC-FX offers line rate encryption in NX-OS mode.

Additional information

- Nexus 9000 guide
- Cisco public
- Three key decisions
- Modular spine line cards
- Modular leaf line cards
- Spine Switches
- Leaf Switches

Learn more
Learn more

Do you need really fast switches?

Switches with a latency of less than 250–750 nanoseconds?

If you do, then the Cisco Nexus 3000 Series Switches are your ideal leaf switches, and, like the Cisco Nexus 9000, they run NX-OS² Learn more.

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