Cisco Application Centric Infrastructure

Product Overview

Cisco® Application Centric Infrastructure (ACI) is an innovative architecture that radically simplifies, optimizes, and accelerates the entire application deployment lifecycle.

Cisco ACI uses a holistic systems-based approach, with tight integration between physical and virtual elements, an open ecosystem model, and innovation-spanning application-specific integrated circuits (ASICs), hardware, and software. This unique approach uses a common policy-based operating model across a network that supports Cisco ACI along with security elements (and computing and storage in the future), overcoming IT silos and drastically reducing costs and complexity.

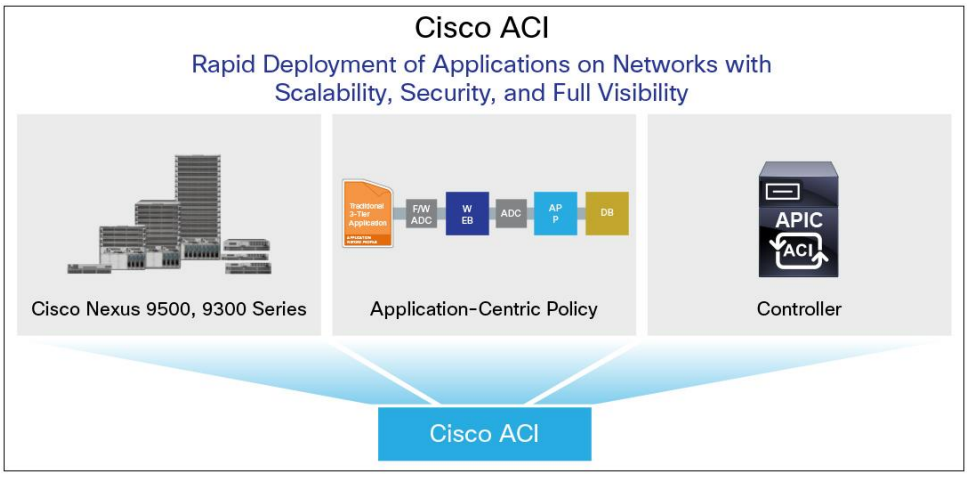
The main benefits of Cisco ACI include:

- Simplified automation with an application-based policy model
- Common platform for managing physical, virtual, and cloud-based environments
- Centralized visibility with real-time application health monitoring
- Operation simplicity, with common policy, management, and operation models across application, network, and security resources (and computing and storage resources in the future)
- Open software flexibility for development and operations (DevOps) teams and ecosystem partner integration
- Scalable performance and secure multitenancy

The Cisco ACI consists of (Figure 1):

- Cisco Application Policy Infrastructure Controller (APIC)
- Cisco Nexus® 9000 Series Switches (Cisco ACI spine and leaf switches)
- Cisco ACI ecosystem

Figure 1. Cisco ACI



Cisco Application Policy Infrastructure Controller

The Cisco Application Policy Infrastructure Controller (APIC) is the main architectural component of the Cisco ACI solution. It is the unified point of automation and management for the Cisco ACI fabric, policy enforcement, and health monitoring. Cisco APIC is a centralized, clustered controller that optimizes performance and unifies operation of physical and virtual environments. The controller manages and operates a scalable multitenant Cisco ACI fabric.

The main features of Cisco APIC include:

- Application-centric network policies
- Data-model-based declarative provisioning
- Application and topology monitoring and troubleshooting
- Third-party integration (Layer 4 through 7 services and VMware vCenter and vShield)
- Image management (spine and leaf)
- Cisco ACI inventory and configuration
- Implementation on a distributed framework across a cluster of appliances
- Health scores for key managed objects (tenants, application profiles, switches, etc.)
- Fault, event, and performance management
- Cisco AVS, which can be used as a virtual leaf for Cisco APIC

The Cisco APIC framework enables broad ecosystem and industry interoperability with Cisco ACI. It enables interoperability between a Cisco ACI environment and management, orchestration, virtualization, and Layer 4 through 7 services from a broad range of vendors.

Cisco APIC Cluster

Cisco APIC is an appliance and is deployed as a cluster. A minimum of three controllers are configured in a cluster to provide control of the scale-out Cisco ACI (Figure 2). The ultimate size of the Cisco APIC cluster is directly proportionate to the Cisco ACI size and is based on the transaction-rate requirements. Any controller in the cluster can service any user for any operation, and a controller can be transparently added to or removed from the Cisco APIC cluster.

Figure 2. Cisco APIC Cluster

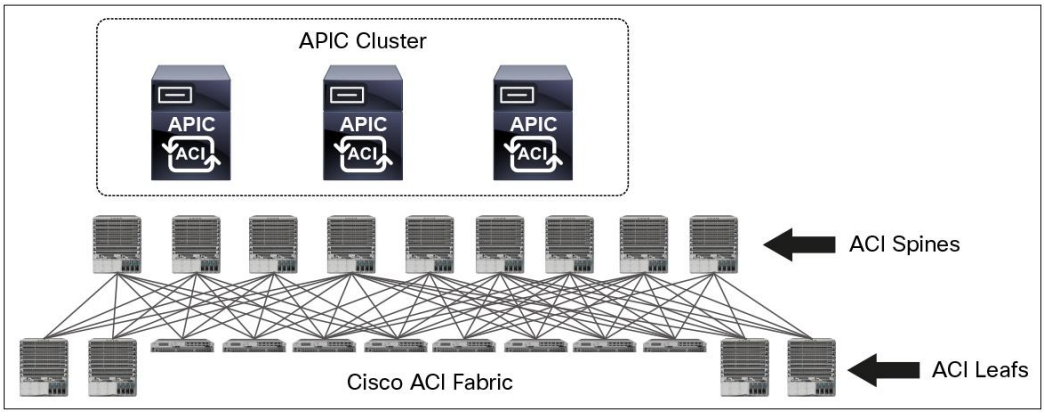


Figure 3 shows the front and back panels views of the Cisco APIC appliance.

Figure 3. Cisco APIC Appliance Front and Back Views

APIC Front Panel	
APIC Back Panel	

Cisco APIC Appliance Product Specifications

The Cisco APIC appliance is available in two form factors (Table 1):

- Medium configuration
- Large configuration

Table 1. Cisco APIC Sizes

Cisco APIC Configuration	Part Number	Description
Medium Cluster	APIC-CLUSTER-M1	Cluster of 3 Cisco APIC controllers with medium CPU, hard drive, and memory configurations (up to 1000 edge ports)
Large Cluster	APIC-CLUSTER-L1	Cluster of 3 Cisco APIC controllers with large CPU, hard drive, and memory configurations (more than 1000 edge ports)
Medium	APIC-M1	Cisco APIC controller with medium CPU, hard drive, and memory configurations (up to 1000 edge ports)
Large	APIC-L1	Cisco APIC controller with large CPU, hard drive, and memory configurations (more than 1000 edge ports)
Medium (SPARE)	APIC-M1=	Cisco APIC controller with medium CPU, hard drive, and memory configurations (up to 1000 edge ports)
Large (SPARE)	APIC-L1=	Cisco APIC controller with large CPU, hard drive, and memory configurations (more than 1000 edge ports)

Table 2 lists the specifications of the Cisco APIC appliance. Note that a minimum of three APIC appliances need to be configured as a cluster.

Table 2. Cisco APIC Appliance Specifications

	Cisco APIC Appliance (Medium Configuration)		Cisco APIC Appliance (Large Configuration)	
	Description	**Default Units**	**Description**	**Default Units**
Processors	2.10-GHz Intel® Xeon® processor E5-2620 v2, 80 watts (W), 6 cores, 15-MB cache, DDR3, 1600 MHz	2	2.60-GHz Intel Xeon processor E5-2630 v2, 80W, 6 cores, 15-MB cache, DDR3, 1600 MHz	2
Memory	16-GB DDR3 1866-MHz RDIMM PC3-14900, dual rank, x4, 1.5V	4	16-GB DDR3 1866-MHz RDIMM PC3-14900, dual rank, x4, 1.5V	8
PCIe Slots	Cisco UCS® Virtual Interface Card (VIC) 1225 dual-port 10-Gbps Enhanced Small Form-Factor Pluggable (SFP+) converged network adapter (CNA) Or Cisco UCS VIC 1225T dual-port 10GBASE-T CNA	1	Cisco UCS VIC 1225 dual-port 10-Gbps SFP+ CNA Or Cisco UCS VIC 1225T dual-port 10GBASE-T CNA	1
Power Supply	650W power supply	1	650W power supply	1

Cisco APIC Medium and Large Configurations	
Physical dimensions (H x W x D)	1 rack unit (1RU): 1.7 x 16.9 x 28.5 in. (4.32 x 43 x 72.4 cm)
Temperature: Operating	32 to 104°F (0 to 40°C) (operating, sea level, no fan fail, no CPU throttling, turbo mode)
Temperature: Nonoperating	-40 to 158°F (-40 to 70°C)
Humidity: Operating	10 to 90% noncondensing
Humidity: Nonoperating	5 to 93% noncondensing
Altitude: Operating	0 to 10,000 ft (0 to 3000m); maximum ambient temperature decreases by 1°C per 300m)
Altitude: Nonoperating	0 to 40,000 ft (12,000m)

Cisco Nexus 9000 Series ACI Spine and Leaf Switches

Cisco Nexus 9000 Series Switches support Cisco ACI, and organizations can use them as spine or leaf switches to take full advantage of an automated, policy-based, systems management approach (Table 3).

The Cisco Nexus 9000 Series offers modular and fixed 1/10/40 Gigabit Ethernet switch configurations that are designed to operate either in Cisco NX-OS mode for compatibility and consistency with the current Cisco Nexus switches or in Cisco ACI mode to take full advantage of Cisco ACI application-policy-based services and infrastructure automation features. This dual-function capability provides customers with investment protection and ease of migration to Cisco ACI through a software upgrade.

Cisco Nexus 9000 Series Hardware Support for Cisco ACI

Table 3 lists the Cisco Nexus 9000 Series Switches that support Cisco ACI in conjunction with Cisco APIC. Additional hardware and configurations will be supported in the future.

Table 3. Cisco Nexus 9000 Series Support for Cisco ACI

Cisco Nexus 9000 Series Switches	Part Number	Description
Top-of-rack (ToR) leaf switch	N9K-C9396PX	Cisco Nexus 9300 platform: 48-port 1/10 Gigabit Ethernet SFP+ and up to 12-port 40 Gigabit Ethernet Quad SFP (QSFP) switch
Top-of-rack (ToR) leaf switch	N9K-C9396TX	Cisco Nexus 9300 platform: 48-port 1/10BASE-T and up to 12-port 40 Gigabit Ethernet QSFP
ToR leaf switch	N9K-C93128TX	Cisco Nexus 9300 platform: 96-port 1/10BASE-T and up to 8-port 40 Gigabit Ethernet QSFP
Spine switch	N9K-C9508-B2	Cisco Nexus 9508 Switch
Spine switch	N9K-C9504-B2	Cisco Nexus 9504 Switch
Spine switch	N9K-C9336PQ	Cisco Nexus 9336PQ ACI platform: 36 fixed port 40 Gigabit Ethernet QSFP+
ACI Line Cards	N9K-X9736PQ	Nexus 9500 ACI Spine linecard, 36-port 40 Gigabit Ethernet QSFP aggregation module

Cisco Nexus 2000 Series Fabric Extenders Support

Table 4 lists the Cisco Nexus 2000 Series Fabric Extenders supported in the Cisco ACI fabric.

Table 4. Cisco Nexus 2000 Series Fabric Extenders Supported in Cisco ACI

Part Number	Description
N2K-C2248PQ	Cisco Nexus 2248PQ 10GE Fabric Extender
N2K-C2248TP-E	Cisco Nexus 2248TP-E Fabric Extender
N2K-C2248TP-1GE	Cisco Nexus 2248TP GE Fabric Extender
N2K-C2232PP-10GE	Cisco Nexus 2232PP 10GE Fabric Extender
N2K-C2232TM-E	Cisco Nexus 2232TM 10GE Fabric Extender

Cisco Application Virtual Switch

Cisco AVS for VMware vSphere extends the Cisco ACI policy framework to virtual servers. Cisco AVS is supported on servers directly attached to the Cisco Nexus 9000 Series leaf nodes on the Cisco ACI fabric.

Cisco ACI Ecosystem Integration

The Cisco APIC framework enables broad ecosystem and industry interoperability with Cisco ACI. It enables interoperability between a Cisco ACI environment and management, orchestration, virtualization, and Layer 4 through 7 services from a broad range of vendors.

Cisco APIC provides centralized access to Cisco ACI through an object-oriented Representational State Transfer (REST) API framework with XML and JavaScript Object Notation (JSON) binding. It also supports a modernized, user-extensible command-line interface (CLI) and GUI. APIs have full read and write access to Cisco ACI, providing tenant- and application-aware programmability, automation, and system access.

For latest information on integration with ACI ecosystem partners and supported versions, please refer to ACI Compatibility Matrix.

Cisco ACI Features

The Cisco ACI mode fabric software is an optimized version of NX-OS that is a foundational approach to building a programmable network infrastructure. The operating system has been rewritten as a fully object-based switch operating system for Cisco ACI. The object model enables fluid programmability and full access to the underlying components of the infrastructure using REST APIs. This approach provides a framework for network control and programmability with a degree of openness that is not found in other systems.

Cisco APIC provides centralized access to your Cisco ACI through an object-oriented RESTful API framework with XML and JSON binding. It also supports a modernized, user-extensible command-line interface (CLI) and GUI. APIs have full read and write access to the Cisco ACI, providing tenant- and application-aware programmability, automation, and system access.

Table 5. Cisco ACI Features: Supported on Cisco APIC and Cisco Nexus 9000 Series Switches

Feature	Description
Integrated overlay over nonblocking 40 Gigabit Ethernet IP fabric	• IPv4 Unicast, IPv4 Multicast Line-rate • Penalty-free application and tenant mobility • Full host mobility • Dynamic load balancing and packet prioritization • Advanced congestion management
External connectivity	• Static routes • Routing Protocols: Open Shortest Path First (OSPF) Not So Stubby Area (NSSA) and internal Border Gateway Protocol (iBGP) • Virtual PortChannel (vPC): Straight-through mode to end hosts and servers
Systemwide application visibility and troubleshooting	• Cisco Switched Port Analyzer (SPAN) and Encapsulated Remote SPAN (ERSPAN) support • Atomic counters • Application and tenant health scores
Application network profiles	• Logical representation of all components of the application and its interdependencies on the application fabric
Policy	• Fabricwide policy enforcement regardless of endpoint location • Policy enforcement between endpoint groups (EPGs)

Feature	Description
Quality of service (QoS)	• EPG policy classification: class of service (CoS) or Differentiated Services Code Point (DSCP) or source EPG, destination EPG, and Layer 4 port • 3 user-configurable classes of service (3 queues) • DSCP marking for IPv4, Priority Queue, Deficit Weighted Round Robin (DWRR), Data Redundancy Elimination (DRE) bits, and flowlet prioritization
Cisco ACI availability	• 3 Cisco APIC node clusters with N+2 redundancy • Cisco APIC cluster software rolling upgrade and downgrade • Less than one second for fabric convergence after node or link failure detection (with spine redundancy and vPC) • N-way spine redundancy • Cisco APIC split-brain detection • Hot-swappable field-replaceable units (FRUs) (except GEM) for ToR
Security	• Permit, deny, and taboo list (blacklist), and application-centric whitelist policy model for securing both physical and virtual applications • EPG policy filtering (source EPG, destination EPG, and Layer 4 ports) • Secure multitenancy at scale built into the Cisco ACI fabric • Built-in distributed Layer 4 security integrated into Cisco ACI fabric to secure east-west traffic • Centralized Layer 4 through 7 security policy lifecycle management with support for broad ecosystem of security devices (physical and virtual firewalls). • Security policies automated to move as workloads are moved in the data center • Automated insertion of Layer 4 through 7 security services (firewall and intrusion prevention system [IPS]) in the application traffic flow for layered security defense on a per-application basis • Accelerated threat detection and incident response • Role-based access control (RBAC), authenticated access based on certificate authentication, Cisco Secure Access Control System (ACS), and local authentication • Auditing of all user access and changes
Centralized fabric management	• Automatic fabric discovery • Single pane across networking, hypervisors, and Layer 4 through 7 services • Intuitive GUI, extensible command-line interface (CLI), and REST APIs
Management upgrades, versioning, and scale-out	• Upgrade of switches and Cisco APIC across the fabric • Multiple-software leaf and spine version support per Cisco APIC domain • Touchless ToR addition to fabric (zero-touch plug and play)
Secure user authentication	• TACACS+, RADIUS, and Lightweight Directory Access Protocol (LDAP) • Local authentication with password and RBAC
Monitoring	Virtual network interface cards (NICs) (VMware only) • Received and transmitted ingress and egress packets • Broadcast, multicast, and dropped packets Cisco NX-OS and APIC processes and system • Per leaf, spine, and Cisco APIC • CPU utilization per process and overall • Memory utilization per process and overall Protocol statistics (available on iShell) • Intermediate System-to-Intermediate System (IS-IS), and iBGP global statistics • Per logical interface and per adjacency for protocol statistics Service insertion • Packets and bytes • VLAN and BD statistics Health scores • 0 to 100 with ±1 granularity • Historical records of health scores Fabric • Spine, leaf, fabric extender (host interfaces [HIFs] and network interfaces [NIFs]), and vPC • Ingress and egress counters • Unicast, multicast, flood, and drop EPG (VLAN and Virtual Extensible LAN [VXLAN]): aggregated • Ingress only, unicast, and multicast

Feature	Description
	• Flood, VXLAN only drop (bytes), and egress only for VLAN encapsulated traffic • Per ingress EPG • Per flow only (drill-down only) • Endpoints (virtual NIC [vNIC] only and VMware only), drill-down, and on demand
Layer 4 through 7 services integration	• Layer 4 through 7 service policy automation (scripting interface) and data path integration • Service chaining; forwarding based (no policy redirection) • Service policy automation through REST API with JSON and XML format • Automated service node insertion and provisioning • Health score for service and clustering degradation (through scripting interface) • Support for transparent and routed firewall modes (traditional mode)
Virtualization integration	• VMware ESXi, vSphere and vShield • VMware VDS support with automated creation of port group for VLAN and VXLAN mapped to EPG • VMware vMotion between the fabric-connected hosts • Fabricwide maximum transmission unit (MTU) size configuration (configurable per Cisco ESX) • Virtual machine-level monitoring • Cisco AVS for Cisco ACI fabric (VMware)

Cisco ACI Ordering Information

Table 6 presents the ordering information for Cisco ACI components.

Table 6. Ordering Information

Part Number	Product Description
Cisco Application Policy Infrastructure Controller	
APIC-CLUSTER-M1	APIC Cluster - Medium Configurations (Up to 1000 Edge Ports)
APIC-CLUSTER-L1	APIC Cluster - Large Configurations (> 1000 Edge Ports)
APIC-M1	APIC Appliance - Medium Configuration(Up to 1000 Edge Ports)
APIC-L1	APIC Appliance - Large Configurations (> 1000 Edge Ports)
APIC-M1=	APIC Appliance - Medium Configuration(Up to 1000 Edge Ports) (SPARE)
APIC-L1=	APIC Appliance - Large Configurations (> 1000 Edge Ports) (SPARE)
Cisco Nexus 9000 Series Spine Switches (Modular)	
N9K-C9508-B2	Nexus 9508 Bundle 2 for 40G Configurations: includes chassis, 1 Supervisor, 2 System Controllers, 3 Fan Trays, 3 Power Supplies, 6 Fabric Modules
N9K-C9504-B2	Nexus 9504 Bundle 2 for 40G Configurations: includes chassis, 1 Supervisor, 2 System Controllers, 3 Fan Trays, 3 Power Supplies, 6 Fabric Modules
Cisco Nexus 9000 Series ACI Lines Cards for Spine Switches (Modular)	
N9K-X9736PQ	ACI Ready Spine Line Card: 36p QSFP 40G (36p line rate)
Cisco Nexus 9000 Series Spine Switches (Fixed)	
N9K-C9336PQ	ACI Ready Spine: 36p QSFP; incl 2 Power Supplies & 3 Fan Trays
Cisco Nexus 9000 Series Leaf Switches (Fixed)	
N9K-C9396PX	Nexus 9396PX switch, 960G, 48p 10G SFP+ & up to 12p 40G QSFP+
N9K-C9396TX	Nexus 9396TX switch, 960G, 48p 1/10G-T & up to 12p 40G QSFP+
N9K-C93128TX	Nexus 93128TX switch, 1,280G, 96p 1/10G-T & up to 8p 40G QSFP+
Cisco Nexus 9000 Series Leaf Switches: Cisco ACI Software Licenses	
ACI-N9K-48X(=)	ACI SW license for a 48p 1/10G Nexus 9K
ACI-N9K-96X(=)	ACI SW license for a 96p 1/10G Nexus 9K

Part Number	Product Description
Cisco Nexus 2000 Series Fabric Extenders: Cisco ACI Software Licenses	
ACI-F48G=	ACI SW license for a 48p 1G Nexus 2K
ACI-F32X=	ACI SW license for a 32p 1/10G Nexus 2K
ACI-F48X=	ACI SW license for a 48p 1/10G Nexus 2K
Cisco ACI Starter Kits	
ACI-C9336-B1-192PX	2 N9336PQ, 4 N9396PX + 4 ACI SW lic, 1 APIC-CLUSTER-M1, 8 40G AOC
ACI-C9336-B2-384TX	2 N9336PQ, 4 N93128TX + 4 ACI SW lic, 1 APIC-CLUSTER-M1, 8 40G AOC
ACI-C9508-B1-96PX	2 N9508 & 2X9736PQ, 2 N9396PX + 2 ACI SW lic, 1 APIC-CLUSTER-M1, 8 40G AOC
ACI-C9508-B2-192TX	2 N9508 & 2X9736PQ, 2 N93128TX + 2 ACI SW lic, 1 APIC-CLUSTER-M1, 8 40G AOC

Service and Support

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

For More Information

For more information about Cisco ACI, please visit http://www.cisco.com/go/aci.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

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