



Cisco: Leading the Transition

For the last 10 years as the world's networking leader, Cisco has been promoting a forward-looking, thoughtful, and network-tested pursuit of the development and integration of IPv6, along with the coexistence of IPv4 and IPv6. Cisco has achieved this movement through its thought leadership in the IETF while standardizing the IPv6 protocol specifications, the phased integration of IPv6 into its product set, best practices and training, and network architecture planning and support—which make a thoughtful, secure, and business-driven integration to IPv6 a reality. Sample Cisco IPv6 contributions include:

- Cisco® IOS® prototype Software with IPv6 deployed in the 6Bone network in 1996
- Founding member of the IPv6 Forum in 1999
- Cisco engineers function as co-chairs in multiple IETF working groups

Many existing Cisco products support IPv6, including all routers and switches. To enable customers and partners to transition securely to IPv6, Cisco has received many product certifications and has developed a phased IPv6 architecture integration plan that moves both our products and our customers' networks forward into the IPv6 future.

Cisco Operating Systems: Extensive and Proven IPv6 Support

In 2001, Cisco released its first commercial versions of Cisco IOS Software with IPv6 support. Today, Cisco operating system software families enable production deployment of IPv6 across the following Cisco devices:

Cisco IOS Software	IPv6 Application
Cisco IOS-XR	<ul style="list-style-type: none"> • Cisco CRS/1 • Cisco 12000 Series
Cisco IOS-XE	<ul style="list-style-type: none"> • Cisco ASR 1000 Series
Cisco IOS Release 12.4M	<ul style="list-style-type: none"> • General Production
Cisco IOS Release 12.4T	<ul style="list-style-type: none"> • Technology Development
Cisco IOS Release 12.2Sx	<ul style="list-style-type: none"> • Cisco Catalyst® switches • Cisco 7x00 and 10000 Series
Cisco NX-OS	<ul style="list-style-type: none"> • Nexus 7000
Cisco SAN-OS	<ul style="list-style-type: none"> • MDS 9500

Cisco Hardware Platforms: Embedded IPv6 Support

As with IPv4, interface speeds and port density determine the need for IPv6 hardware acceleration within Cisco routing and switching systems. The following Cisco platforms benefit from IPv6 hardware forwarding:

System	IPv6 Hardware Forwarding
Routers	<ul style="list-style-type: none"> • Cisco CRS/1 • Cisco 12000 • Cisco 10000 • Cisco 10720 • Cisco ASR 1000 • Cisco 7600
Switches	<ul style="list-style-type: none"> • Catalyst 6500 • Catalyst 4500 • Catalyst 3750/3750-E • Catalyst 3560/3560-E • Nexus 7000 • MDS 9500

Cisco Security/Management: IPv6 Oversight and Optimization

As networking infrastructures evolve to accommodate IPv6, security and management services are two primary components for a successful integration and deployment. The following are sample security and management systems or services that can be deployed today in Cisco IPv6 networks:

Service Set	Sample IPv6 Services
Security	<ul style="list-style-type: none"> • Firewall (Cisco IOS firewall, Adaptive Security Appliance [ASA], Catalyst 6500 Series FWSM) • Packet filtering (std, extended, reflexive, including IPv6 specifics) • IPSec (OSPFv3, site-to-site tunnels, etc.) • IPv6 IPSec HW Encryption devices on ISR and 7200
Management	<ul style="list-style-type: none"> • Instrumentation—Unified IP MIBs, Netflow for IPv6 records, IPv6 SLA, etc. • Applications running over an IPv6 network layer—SNMP, Syslog, Telnet, HTTP, TCL, SOAP, SSH, etc. • Network management applications for IPv6—Cisco LMS, Cisco Network Registrar (CNR), Netflow Collector, Network Analysis Module (NAM), etc.

The Driving Forces Behind IPv6 Adoption

Continuous growth of the Internet requires the overall architecture to evolve. It must accumulate new technologies that support the growing numbers of users, applications, appliances, and services. IPv6 is designed to meet these requirements to enable a global environment where network layer is again transparent to the applications.

What Does IPv6 Deliver to Tomorrow's Networks?

IPv6 quadruples the number of network address bits from 32 bits (in IPv4) to 128 bits or approximately 3.4×10^{38} addressable nodes. This not only allows for ready network expansion, but also meets the requirements of emerging networked applications, including:

- Internet-enabled wireless devices
- Home and industrial appliances
- Internet-connected transportations
- Integrated telephony services
- Sensor networks such as RFID and IEEE 802.15.4 (6LoWPAN)
- Distributed computing or gaming

The use of globally unique IPv6 addresses simplifies the mechanisms used for reachability and end-to-end security for network devices. The functionality is crucial to the applications and services that are driving the demand for the addresses.

The lifetime of IPv4 has been extended using techniques such as address re-use with translation and temporary-use allocations. With the IPv4 address space exhaustion coming quickly, translation mechanisms will be enhanced to meet carrier-class requirements. Although these techniques appear to increase the address space and satisfy the traditional client/server setup, they fail to meet the requirements of on-rushing, innovative applications, and environments.



Beyond addressing, there are also many other advantages of using IPv6:

IP Service	IPv4 Solution	IPv6 Solution
Addressing range	32-bit Network Address Translation	128-bit, multiple scopes
Autconfiguration	DHCP	Serverless, reconfiguration, DHCP
Routing	RIP, OSPFv2, IS-IS, EIGRP, MP, -BGP	RIPng, OSPFv3, IS-IS, EIGRP, MP -BGP
IP layer security	IPSec	IPSec mandated works end-to-end
Mobility	Mobile IP	Mobile IP with direct routing
Quality of service	Differentiated and Integrated Service	Differentiated and Integrated service
IP Multicast	IGMP/PIM/Multicast BGP	MLD/PIM/Multicast BGP, scope identifier

Did You Know?

- The Organisation for Economic Co-Operation and Development (OECD) 2007 report, "Economic Considerations in the Management of IPv4 and in the Deployment of IPv6," recommends all state members to adopt IPv6.
- In March 2008, according to Internet World Statistics, there were 1,407,724,920 Internet users and 1 billion connections to the Internet. In 2012, forecasts call for 2.5 billion Internet users and over 5 billion connections.
- In 2008, the forecast for the IPv4 address space exhaustion is CY11 as reported by <http://www.potaroo.net/tools/ipv4/>. In 2007, all regional Internet registries (RIRs) warned that the IPv4 resource pool had been reduced to a point where it now advises the "migration to IPv6 is necessary."

Transitioning to IPv6: Selecting the Right Route to Success

The industry is in the early stages of large-scale IPv6 production deployment. A critical part of the IPv6 design is its capability to integrate into and coexist with current IPv4 networks. The development of transition strategies, tools, and mechanisms has been part of the basic IPv6 design from the start.

Cisco recommends that customers and partners take a proactive, well-informed, and deliberate approach to IPv6 integration. Cisco is actively publishing recommended IPv6 network and security integration architectures and adoption best practices, which it will continue to refine as IPv6 solutions and networks evolve.

The following three principal IPv6 deployment strategies are available:

- **Tunneling**—a simple and inexpensive way to start using IPv6, but not a long-term strategy:
 - o Encapsulates IPv6 traffic within IPv4 packets, so they can be sent over an IPv4 backbone—allowing IPv6 end systems and routers to communicate without the need to upgrade the IPv4 infrastructure that exists between them
- **Dual-Stack**—the best strategy for successful integration over the next 5 to 10 years. It allows for the greatest flexibility when supporting applications that run over IPv4 and/or IPv6:
 - o Routes both IPv4 and IPv6 packets across the network, which requires all routers in the network be upgraded to operate both IPv4 and IPv6 protocol stacks and use each stack's specific routing protocols
 - o Intercommunication between IPv4 and IPv6 requires some level of translation between the two protocols; this happens on the host or router with an application-level view as to which protocol to use
- **Translation**—applied as a simple tool when front-ending a web server or as a very complex option when driving large-scale, carrier-class translation between IPv6-only devices (e.g., mobile handsets) and IPv4-only Internet resources (e.g., Yahoo, MSN, and Google)
 - o Intercommunication between IPv4 and IPv6 requires some level of translation between the two protocols; this happens on the host or router with an application-level view as to which protocol to use

Selection of a deployment strategy or strategies depends upon the current network environment, forecasted amount of IPv6 traffic, and the availability of IPv6 applications on end systems/appliances.

Cisco Professional Services: Advanced IPv6 Support

The migration from IPv4 networks to IPv6 networks and the coexistence of both IPv4 and IPv6 in many networks will require careful and thoughtful planning to prevent disruption of network services. Cisco's long-term involvement in large-scale IPv6 deployments qualifies Cisco Professional Services as a highly experienced IPv6 consultancy. Cisco's IPv6 Assessment and Migration Services form a comprehensive support structure. This structure ranges from up-front network evaluations and design to deployment, to post-transition IPv6 optimization and planning.

Regardless of the support services provided or deployment strategy selected, Cisco adheres to the following objectives in any IPv6 transition:

- Transition is scheduled when and where needed
- New or updated applications must be protocol-independent
- Deployment is incremental, minimizing impact in the existing network
- Operating costs and support requirements are minimized
- Understand your vendor's IPv6 integration strategy through collaboration

Cisco strongly believes that IPv6 will enable continued growth in global communications. We are committed to driving IPv6 standards, incorporating IPv6 into our products, and sharing best practices to help ensure IPv6 success.

For More Information

Refer to the following links for more information and guidance on supporting your organization's transition to IPv6:

IPv6

[Cisco: The IPv6 Transition White Paper](#)

[The IPv6 Forum: Driving IPv6 development](#)

[go6: The IPv6 Portal](#)

Books for Purchase

[Deploying IPv6 Networks](#)
[Global IPv6 strategies](#)