IPv6

Executive Summary

Today, Internet growth is driven not only by the sheer number of people and organizations that need access, but also by several emerging factors, including:

- Global appeal and scope of the Internet
- Multiservice networks offering voice, video, and data,
- Popularity of wireless and mobile devices, and
- Potential for IP-enabled consumer devices.

IP version 6 (IPv6) is becoming increasingly important to keep pace with the growing demand for IP services. With its greatly expanded addressing and IP services capabilities, IPv6 ensures that the Internet will continue to prosper. Juniper Networks offers a rich portfolio of IPv6 addressing, forwarding, routing, management, and IP services capabilities.

IPv6: Facilitating Internet Globalization

Clearly, address depletion is increasingly a concern. Service providers and enterprises alike, particularly international ones, often have difficulty obtaining useful address blocks and are forced to use gateway methods, such as NAT. IPv6 supports a significantly larger IP address space by increasing the IP address size from 32 bits to 128 bits, which allows for up to 3.4×10^{38} possible addresses. In addition, IPv6 offers other enhancements for facilitating Internet globalization. IPv6:

- Supports more levels of addressing hierarchy and thus a greater number of addressable nodes.
- Simplifies IP address management issues by supporting plug-and-play, stateless autoconfiguration. Hosts and routers can dynamically obtain IP address information.
- Restricts the number of backbone routing entries by advocating route aggregation. This simplified routing hierarchy offers better route summarization.
- Increases flexibility to offer new IP applications, such as mobile Internet services, by offering extensions that provide more tailored IP services.
- Improves security by supporting extensions to authentication, data integrity, and data confidentiality.

Advantages

Juniper Networks IPv6 implementation offers a broad range of IPv6 addressing features that are available across M-series and T-series platforms, with each platform running the same reliable JUNOS Internet software. Feature highlights include:

Features	Benefits
• IPv6 addressing IPv6 forwarding in hardware 128-bit link local, site local, and global addressing	• Ensures uncompromising performance • Increases available addresses by expanding IP address space from 32 bits to 128 bits
• Neighbor discovery	• Enables more aggregation through hierarchical IPv6 addresses
• Path MTU discovery	• Increases configuration flexibility
• Optional extension header	
• Stateless autoconfiguration	• Hosts dynamically configure their own addresses
• Routing BGP IS-IS OSPFv3 RIPng Static	• Increases scalability • Increases configuration flexibility • Provides IPv4 and IPv6 routing • Enables routing protocol interoperability
• Transition mechanisms Dual stack Configured tunnels MPLS transport IPv6 over MPLS	• Enables ability to connect IPv6 networks over IPv4 networks • Enables seamless integration of IPv4 and IPv6 networks • Leverages existing network assets
• ICMPv6	• Enhances error and information reporting
• Operational Efficiency Consistent management CLI JUNOScript API Standards-orientation	• Simplifies configuration and operation

IPv6 Operational Efficiency

Juniper Networks IPv6 implementation ensures operational efficiency by

- delivering exceptional performance with IP services enabled,
- being deployed on all current M-series and T-series platforms,
- offering simplified management tools, and
- easing transition from IPv4 to IPv6.

IPv6 Performance without Compromise

Juniper Networks ASIC-based forwarding and JUNOS software have consistently proven superior performance even under network duress. Successful deployment in worldwide service provider networks and precise benchmark testing have demonstrated Juniper Networks excellence in IP routing. IPv6 is no different. Juniper Networks IPv6 portfolio assures successful deployment of IPv6 in production environments with uncompromising performance. Moreover, IPv4 and IPv6 can run simultaneously while delivering stable, scalable IP services.

Rich IPv6 Feature Portfolio

M-series and T-series platforms ensure reliability and deliver common IP services by sharing the same JUNOS software. This design means full compatibility across IPv6 transport applications and environments: core management, high-speed dedicated access, public and private peering, content and Web hosting, and mobile services. IPv6 is supported on all M-series and T-series interfaces, thus delivering a highly scalable solution and offering the same configuration and operational simplicity service providers have come to expect with all Juniper Networks products.

Simplified IPv6 Deployments

Supported in both the CLI and JUNOScript API, service providers can configure and maintain IPv6 via user-friendly interfaces. With JUNOScript API, in particular, IPv6 is immediately supportable with existing OSS strategies; hence, there is minimal interruption between the time to configure IPv6 and have it running in the production network.

Juniper Networks also offers a complete portfolio of Internet-caliber IGP and EGP routing protocols that simplify IPv6 deployment. OSPFv3, IS-IS and RIPng support provides flexibility in choosing an internal routing scheme and ensures that IPv6 is globally deployable. At the same time, Juniper Networks robust BGP implementation for IPv6 delivers true Internet-class routing for all infrastructure scenarios. Static routing is also supported.

Layering IPv4 and IPv6 Services

Integration and transition tools and mechanisms play a key role in simplifying operations and minimizing costs when introducing IPv6. While numerous transition mechanisms have been proposed, initially Juniper Networks offers those most important for taking the first steps toward smoothly transitioning from IPv4 to IPv6.

Dual Stack

The dual-stack method runs both IPv4 and IPv6 protocol stacks in parallel. IPv4 applications communicate with IPv4 hosts, IPv6 applications communicate with IPv6 hosts, and there is no translation between IPv4 and IPv6. Juniper Networks supports both IPv4 and IPv6 on all interfaces.

Configured Tunnels

For sites that regularly exchange traffic, configured tunnels may be used to connect IPv6 hosts or networks over an existing IPv4 infrastructure. In this method, IPv6 packets are encapsulated in IPv4 headers. The encapsulating router uses the configured tunnel endpoint as the destination address for the IPv4-tunnel packet.

MPLS

Using MPLS Circuit Cross-connect, IPv6 hosts may communicate over an IPv4 network via a point-to-point configured tunnel. IPv6 packets are encapsulated in MPLS headers. Only the ingress router with the tunnel address needs to be configured. MPLS Layer 2 VPNs also simplify MPLS transport by employing BGP for VPN signaling, thus eliminating the need to manually map every circuit to a label-switched path.

IPv6 over MPLS also provides a standards-based, efficient way to transport IPv6 traffic over an existing IPv4/MPLS network. This method provides a cost-effective way for service providers to layer IPv6 services over an IPv4/MPLS network, by enabling IPv6 only on the provider edge (PE) routers. IPv6 over MPLS helps service providers optimize their existing assets by minimizing the number of IPv6-enabled devices required in the infrastructure. It also reduces the amount of operational cost and complexity by limiting the number of devices that must be touched.

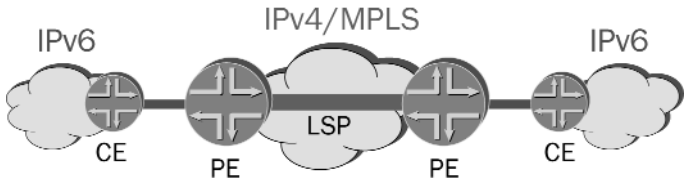

Figure 1: IPv6 over MPLS

Specifications

For a list of supported IPv6 RFCs, see the JUNOS Internet Configuration Guide: IPv6 at http://www.juniper.net/techpubs/software/

Acronyms

API	application programming interface
ASIC	application-specific integrated circuit
BGP	Border Gateway Protocol
CLI	command-line interface
CE	customer edge
DNS	domain name system
EGP	exterior gateway protocol
ICMP	Internet Control Message Protocol
IGP	Interior Gateway Protocol
IP	Internet Protocol
IPv4	IP version 4
IPv6	IP version 6
IS-IS	Intermediate System to Intermediate System
MPLS	Multiprotocol Label Switching
MTU	maximum transmission unit
NAT	Network Address Translation
OSS	operations support systems
PE	provider edge
RFC	Request for Comments
RIPng	Routing Information Protocol next generation
VPN	virtual private network

www.juniper.net

CORPORATE HEADQUARTERS AND SALES HEADQUARTERS FOR NORTH AND SOUTH AMERICA

Juniper Networks, Inc.
1194 N. Mathilda Avenue
Sunnyvale, CA 94089 USA
Phone: 888-JUNIPER (888-586-4737)
or 408-745-2000
Fax: 408-746-2100

EUROPE, MIDDLE EAST, AFRICA REGIONAL SALES HEADQUARTERS

Juniper Networks
Juniper House
Guilford Road
Leatherhead
Surrey, UK
KT22 9JH
Phone +44 (0) 1372385500
Fax +44 (0) 1372 385501

ASIA PACIFIC REGIONAL SALES HEADQUARTERS

Juniper Networks (Hong Kong) Ltd.
Suite 1601-06, Natwest Tower
Times Square, 1 Matheson Street
Causeway Bay, Hong Kong
Phone: 852-2332-3636
Fax: 852-2574-7803

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