IPv6 and Infranets

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Both service providers and enterprises understand the importance of transforming their approach to networking from opportunistic to strategic and forward-looking. The essential element in this shift is a singular, secure, future-proof IP infrastructure over which all services and applications can be delivered – an approach that Juniper Networks and other technology leaders have defined as "infranets."

Internet Protocol version 6 (IPv6) plays a key role in this transformation. Increasing address size from 32 bits to 128 bits for a total of 3.4×10^{38} addresses IPv6 ensures that infranets can be expanded both logically and geographically. IPv4's current allocation, in contrast, has made it difficult for service providers and large companies, particularly international ones, to obtain efficient address blocks. That has led to a reliance on NAT (Network Address Translation), which often adds complexity and constrains applications.

IPv6 also makes it possible to assign a unique address to virtually any device—mobile phones and PDAs (personal digital assistants) being two recent examples. Thus, IPv6 enables new and advanced applications to be deployed leveraging the same IP infrastructure.

In addition, IPv6 provides a range of operational benefits including: hierarchical addressing for simplifying privacy; stateless auto-configuration for dynamic host address assignment; simplified routing hierarchy for better route summarization; more flexible protocol extensions, and inherent support of IPSec.

While the long-term benefits of IPv6 are widely understood, deployment demands that any IPv6 implementation meet several immediate criteria.

Juniper Networks Infranet-ready IPv6

Juniper Networks delivers the industry's first infranet-ready IPv6 implementation by addressing the greatest IPv6 deployment challenges for service providers and carriers today:

- A comprehensive IPv6 solution which provides end-to-end support for any IPv6 application scenario from enterprise premises to service provider core.

Fig. 1: MINT for IPv6

- Production-quality hardware and software which delivers a rich set of features, a highly available platform, uncompromising performance, and a highly flexible set of transition and operations mechanisms.
- Security for both control and data plane functions.

Recognized by IPv6 technology leaders such as Japan Gigabit Network (JGN) and Internet 2/Abilene, Juniper Networks IPv6 solution delivers on these requirements by executing on its MINT (Model for InfraNet Transformation) framework. Juniper Networks MINT underpins all of its solutions with a comprehensive set of capabilities spanning four essential categories of capabilities: packet transport, resource segmentation, packet processing, and policy and control. Each of these layers provides critical functionality in delivering Juniper Networks' infranet-ready IPv6 solution.

IPv6 from Premises to Core

IPv6 has no natural boundaries and its deployment to date has underscored that fact. IPv6 has been deployed in service provider networks, enterprise networks, research networks, government networks, large networks and small networks. IPv6 also knows no geographical boundaries and has been deployed in every region of the world. As a result, any IPv6 solution must account for this incredible range of deployment scenarios.

Juniper Networks networking and security product portfolios offer a comprehensive IPv6 solution for any IPv6 deployment. Juniper Networks M-series, E-series, and T-series products ensure reliability and performance through a common approach to hardware and software architecture. IPv6 is supported on all E-, M- and T-series interfaces and offers the same configuration and operational simplicity network operators and businesses have come to expect from all Juniper Networks products. Juniper Networks NetScreen security portfolio extends infranet-ready IPv6 from the network core to customer premises with a fully-featured IPv6 protocol stack, a rich set of networking, security and auto configuration features, and a highly flexible set of transition tools. Juniper Networks IPv6 portfolio has also demonstrated extensive interoperability between its own platforms and with other vendor products – delivering the first assured IPv6 solutions from premises to core.

As the Figure 2 (see next page) shows, the Juniper Networks IPv6 solution truly delivers end-to-end support for any deployment scenario.

Production-Quality IPv6

IPv6 today has moved beyond the lab. As a result, an infranet-ready IPv6 solution must deliver production-quality levels of feature richness and availability. In addition, an infranet-ready solution must also provide all necessary tools for the seamless integration and coexistence of IPv6 alongside existing environments.

Successful deployments around the world and precise benchmark testing have demonstrated Juniper Networks excellence in IPv6 and has validated Juniper Networks' ability to deliver operational simplicity and flexibility as well as performance in production environments.
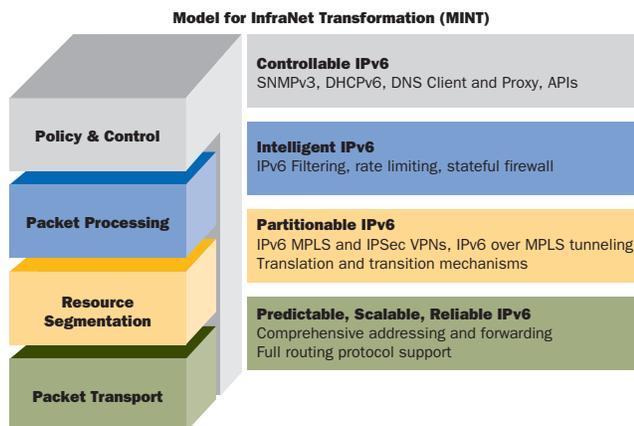
Simplified IPv6 Deployments

Juniper Networks offers a wide range of operational tools to ease IPv6 deployment for a broad set of applications. Infrastructure products, for example, offer both CLI (command-line interface) and the JUNOScript API, enabling IPv6 to be configured and maintained rapidly and efficiently. With the XML-based JUNOScript API in particular, IPv6 is immediately available to existing carrier OSS (operations support system) strategies—minimizing IPv6 time to deployment. Security products offer important operational tools such as DNS client and DNS proxy for IPv6 which enables enterprises to improve security and efficiency by directing IPv4 and IPv6 DNS queries to separate, appropriate DNS instances.

Juniper Networks also offers a complete portfolio of IGP and EGP routing protocols, enabling IPv6 to be deployed in a wide range of network environments. OSPFv3, IS-IS, and RIPng provide flexibility in choosing an internal routing scheme and guarantee that IPv6 is globally deployable. At the same time, Juniper Networks' robust BGP implementation for IPv6 ensures that infranet advantages can be realized across even the largest networks. Static routing also is supported.

Dual Stack

As IPv4 and IPv6 will undoubtedly co-exist in networks for a very long time, the dual-stack method is required to run both IPv4 and IPv6 protocol stacks in parallel. IPv4 applications communicate with IPv4 hosts; IPv6 applications, with IPv6 hosts. Juniper Networks offers high-performance dual stack operation from enterprise premises to service provider core.

Translation & Tunneling

Integration and transition tools and mechanisms play a key role in simplifying operations and minimizing costs when introducing IPv6. Juniper Networks' IPv6 portfolio provides extensive transition mechanisms, such as NAT/NAPT and IPv6 over MPLS that ease the burden of converting from IPv4 to IPv6. Security products, for example, offer "4 to 6" and "6 to 4" tunneling, as well as "4 to 6" and "6 to 4" translation. This dynamic translation capability allows enterprises and service providers to integrate IPv6 without replacing their existing IPv4 network infrastructure.

For sites that regularly exchange traffic, configured tunnels can be used to connect IPv6 hosts or networks over an existing IPv4 infrastructure. With this approach 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-based Tunneling

Juniper Networks infrastrastructure portfolio offers a range of MPLS-based options for tunneling IPv6 traffic. Using MPLS Circuit Cross-connect, IPv6 hosts can communicate over an IPv4 network via a point-to-point configured tunnel. IPv6 packets are encapsulated in MPLS (multiprotocol label-switching) headers. Only the ingress router with the tunnel address need be configured. MPLS Layer 2 VPNs (virtual private networks) also simplify MPLS transport by employing BGP for VPN signaling, thus eliminating the need to manually map every circuit to a label-switched path.
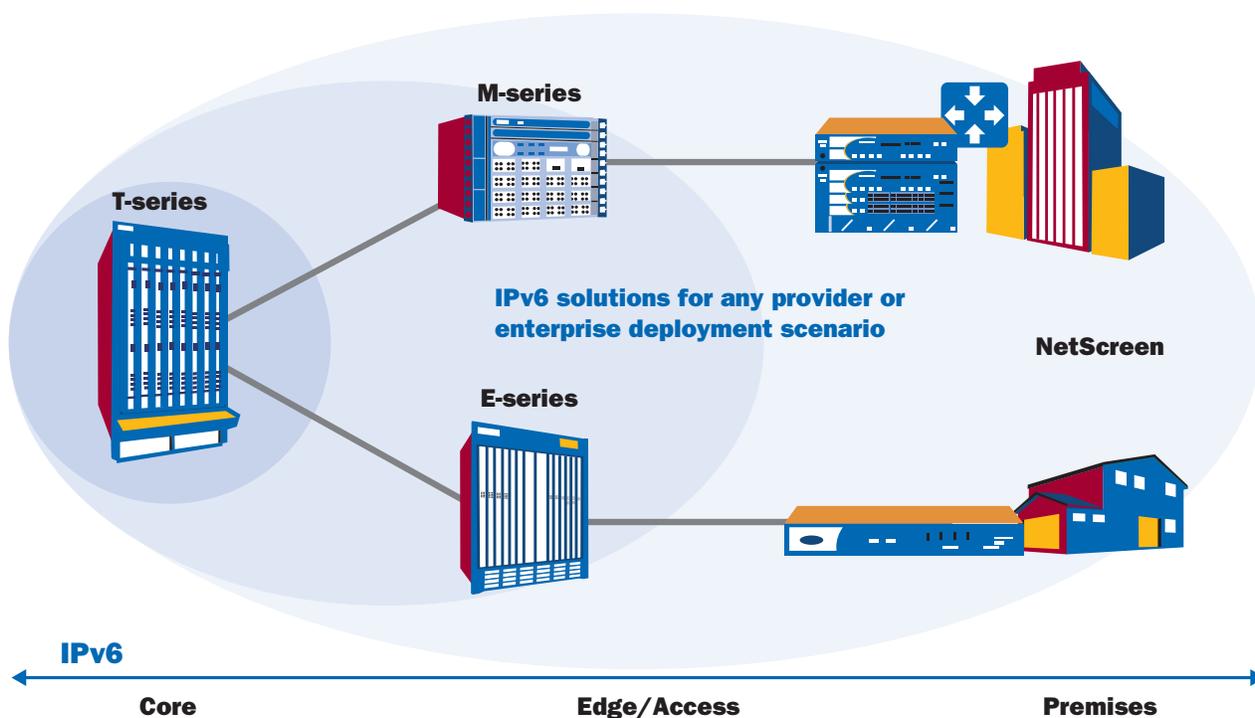

Fig. 2: IPv6 from Premises to Core

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 assets by minimizing the number of IPv6-enabled devices required in the infrastructure; it also reduces the operational cost and complexity by limiting the number of devices that must be touched.

Secure IPv6

Juniper Networks' IPv6 solution also addresses one of the greatest challenges to IPv6 deployment: security. Delivering the industry's first integrated IPv6-enabed stateful firewall and IPSec VPN implementation, Juniper Networks extends its IPv6 security leadership. Juniper Networks' security product portfolio ensures that enterprises can create a trusted IPv6 environment where both their network infrastructure and their data can be secured from threats. Service providers can take advantage of Juniper Networks' infrastructure product portfolio to protect both the control plane of their network and their customers' data through robust IPv6 filtering and rate limiting without compromising performance.

Conclusion

IPv6 has a critical role to play in the deployment of infranets. Through its MINT framework, Juniper Networks delivers significant advantages in IPv6 performance and richness—enabling network operators and businesses around the world to deploy secure, production-quality IPv6 for any application from premises to core. As a recognized leader in IPv6, Juniper Networks is helping customers transform their networks by delivering infranet-ready IPv6.

Specifications

For a list of supported IPv6 RFCs, please visit our technical documentation library 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
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
RFC	Request for Comments
RIPng	Routing Information Protocol next generation
VPN	Virtual private network