

# A PRAGMATIC AND COMPREHENSIVE APPROACH TO NEXT-GENERATION NETWORK ADDRESSING

## Challenge

While the Global IANA IPv4 address pool has been allocated, many applications and devices are not IPv6 ready. Furthermore, maintaining IPv4 services is a mandate even though IPv4 and IPv6 are not interoperable “out of the box.”

## Solution

- CGN and related technologies supported across Juniper Networks routing and service gateway portfolios
- Services in hardware that deliver line-rate performance
- Juniper and technology partners’ extensive router applications portfolio

## Benefits

- Low-risk, seamless IPv4/IPv6 coexistence
- Addresses broad business and technical requirements
- In-house expertise, including key IETF Working Group chairs
- Mature technologies proven in production networks

With the depletion of the global Internet Assigned Numbers Authority (IANA) address pool, and the need to maintain IPv4 services for an extended time, IPv4 and IPv6 will have to coexist for the foreseeable future. Coexistence of IPv4 and IPv6 cannot be addressed with a one-size-fits-all approach, but a toolkit of options based on the particular needs and configurations of current networks can provide the right solution.

Juniper Networks has made significant investments in next generation addressing technologies that enable continued growth for enterprises and service providers alike. With our portfolio of high-performance solutions and extensive real-world expertise, Juniper can help customers overcome the challenges associated with IPv4 address exhaustion.

## The Challenge

IPv6 is coming—it is an inevitable change the Internet must make. Still, the vast majority of Internet content is currently accessible via IPv4, and many connected devices in residential networks, such as older PCs, game consoles, consumer electronic devices, and HDTVs, can only use IPv4 addresses. Furthermore, very few network operators have completed their IPv6 rollouts. This leaves the door open to many questions. How do they continue to grow their networks when there are no new IPv4 addresses to give to new users? And even as IPv6 is available to new users, how do they continue to communicate to devices that only support IPv4? How do the end users continue to reach content on the Internet that remains IPv4 only? How do they support legacy IPv4 applications and devices? So, while the move to IPv6 is necessary to accommodate the continuing explosion of Internet space requirements, the current Internet technology profile mandates that access via IPv4 and IPv6 have to coexist for now, and for the foreseeable future.

Regardless of how the transition plays, the depletion of IPv4 addresses is an immediate concern facing service providers and large network operators of all types.

## Next Generation Network Address Product Suite

Juniper recognizes that there will be a long period of transition in which networks will need to support both IPv4 and IPv6. Juniper believes that the future of the Internet is going to certainly include both IPv6 and some form of ‘NATted’ IPv4 with technologies such as Carrier-Grade NAT. Juniper provides a broad set of technologies that enable this transition, as a one-size-fits-all approach is neither effective or practical; these technologies include Dual Stack, NAT44, Dual Stack Lite (DS-Lite), NAT64, 6rd and many more.

## Carrier-Grade NAT: Sharing IPv4 Addresses

In order to maintain IPv4 subscriber growth after IPv4 exhaustion, the remaining IPv4 addresses will have to be shared among end users. This is done with Carrier-Grade NAT (CGN). Rather than assigning public addresses directly to individual users, CGN “pulls back” these addresses to a more centralized Network Address Translation (NAT) point, allowing the sharing of a single public address among a much larger number of end devices.

There are several variations in the deployment architecture of CGN. Dual Stack Lite (DS-Lite) and NAT44(4) are the most important ones for coexistence strategies. They are similar in the way that they enable providers to share a small set of IPv4 addresses among a large number of users. They differ in the way that packets are carried to the CGN. With DS-Lite, they are carried as IPv4 through an IPv6 tunnel; with NAT44(4) they are carried over IPv4.

### NAT44(4)

NAT44(4) is an architecture that uses the NAT44 protocol to extend the life of a customer’s IPv4 address pool by allowing multiple subscribers or end users to share a single public IPv4 address. NAT44(4) requires no change to the service provider’s existing network infrastructure, and can be used in conjunction with 6rd for further benefits.

In NAT44(4), the subscribers have their own private IPv4 (RFC1918) address space behind their customer premises equipment (CPE). The service provider translates the subscriber’s address to another IPv4 address in the access network to allow better utilization of the existing public IPv4 address space by aggregating subscribers in a public IPv4 pool on the carrier-grade NAT (CGN) router.

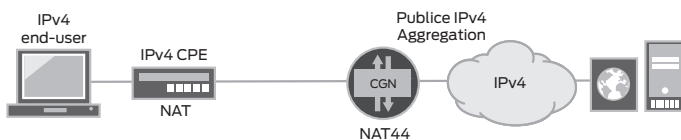


Figure 1. NAT44(4) example

### Dual Stack Lite (DS-Lite)

DS-Lite uses tunneling and NAT44 to mitigate IPv4 address depletion while incrementally adopting IPv6. When a device in the customer network sends an IPv4 packet to any destination, the IPv4 packet is encapsulated in an IPv6 packet for transport into the provider network. The Address Family Transition Router (AFTR) decapsulates the packet back to IPv4, and uses NAT44 to translate the private IPv4 address to a public IPv4 address and delivers the packet to the Internet.

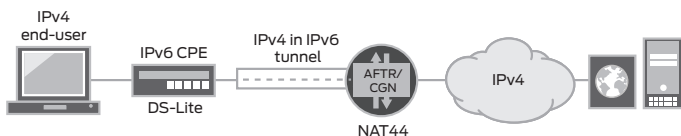


Figure 2. Dual Stack Lite (DS-Lite)

## Additional Juniper supported IPv4/IPv6 Technologies

- **NAT64**—provides IPv6 to IPv4 translation allowing IPv6-only hosts to access IPv4-only hosts.
- **6to4**—connects IPv6 hosts or networks across an IPv4 infrastructure or Internet.
- **6rd**—provides rapid deployment of IPv6 service to end users over an existing IPv4 infrastructure.
- **IPv4/IPv6 Dual Stack**—Juniper Networks® Junos® operating system supports IPv4/IPv6 dual stack, allowing concurrent independent operation of both protocols on a single router.

## Juniper Networks Solution Components

- Carrier Grade NAT (CGN) application
- M Series Multiservice Edge Routers
- MX Series 3D Universal Edge Routers
- T Series Core Routers
- SRX Series Services Gateways
- Junos operating system
- Extensive router applications portfolio from Juniper and its technology partners

## Additional Router Applications Portfolio Overview

**Advanced load balancing with Application Delivery Control (ADC)**—ADC software with advanced traffic load balancing and monitoring features that ensure optimum service scale, performance, and resiliency.

**Increase efficiency with Compressed Real-Time Transport Protocol (CRTP) support**—CRTP compresses the 40-byte IP/UDP/RTP header down to two bytes, significantly reducing the overhead for small packets and allowing service providers to offer VoIP services over low speed links.

**Manage resources with Dynamic Application Awareness**—Advanced packet inspection technology enables the stateful detection, identification, and analysis of traffic on a per application basis, which helps service providers create differentiated services based on application criteria.

**Customize services with Dynamic Subscriber Awareness**—Advanced packet inspection technology and a subscriber database enable the stateful detection, identification, and analysis of traffic on a per subscriber basis. This lets service providers create differentiated services based on subscriber policy, ensure adherence to service-level agreements (SLAs), and maintain subscriber/application fairness.

**Improve security with IPsec**—Our IPsec encryption uses Advanced Encryption Standard (AES), Data Encryption Standard (DES), and triple Data Encryption Standard (3DES) to enable secure network communications. IPsec enhances end user security and increases security for traffic over third-party access links, Layer 3 VPNs, and wholesale networks.

**Protect the network with intrusion prevention system (IPS)**—IPS provides comprehensive identification and mitigation of threats from worms, trojans, spyware, and keyloggers, increasing network security and ensuring continuous availability of applications and services.

**Improve operations environment with J-Flow**—J-Flow collects flow statistics which can be exported in standard cflowd v5, v8, and v9 flow record formats that are compatible with industry standard flow collectors and applications. J-Flow can monitor traffic at the flow, department, or application level for billing purposes, and can provide usage statistics for operational tasks.

**Ensure regulatory compliance with Flow Tap and Dynamic Flow Capture (DFC)**—Flow Tap and DFC intercept packets and forward copies to one or more content destinations based on filter criteria in support of lawful intercept applications.

**Boost performance with Link Services**—Link Services offer simultaneous support for enhanced multilink bundling and queuing, and link fragmentation and interleaving (LFI), which facilitate the efficient and cost-effective aggregation and bundling of Frame Relay links. Multilink Point-to-Point Protocol support provides PPP over multiple discrete T1/E1 links.

**Augment security with stateful firewall**—The stateful firewall of Juniper Networks uses a per-flow state table, IPv4/IPv6 packet inspection, and statistical modeling to provide the first line of defense in a layered security architecture, to efficiently offload bulk stateful filtering from external firewalls, or to support a managed security service.

**Video monitoring with StreamScope eRM**—Service providers and cable operators can use StreamScope eRM to identify and isolate video quality issues at the MDI and MPEG layers to reduce troubleshooting time and expensive truck rolls.

**Monitor IP, VPN, and VoIP services with Telchemy ePM (TePM)**—TePM provides comprehensive monitoring capabilities for a wide range of IP, VPN, and VoIP services in support of service planning, troubleshooting, and quality assurance. TePM was developed by Telchemy Inc, a Juniper Technology Alliance partner and a recognized leader in VoIP test and measurement solutions.

**Tunnel services for efficient scale**—Our tunnel services software offers a variety of encapsulation schemes such as IP over IP, Physical Interface Module sparse mode (PIM SM), generic routing encapsulation (GRE), and L2TP network server (LNS). These encapsulation schemes ensure efficient traffic distribution and communications over a range of network architectures and protocols.

## Summary—A Practical and Comprehensive Approach to IPv4/IPv6 Transition

Juniper Networks has made a significant investment in technologies that enable enterprises and service providers to meet mixed IP addressing needs, enabling them to build out IPv6 networks based on market and service requirements.

Coexistence of IPv4 and IPv6 cannot be addressed with a one-size-fits-all approach, rather a toolkit of options is needed to meet each customer's unique business and technical requirements. At Juniper, we are committed to helping our customers make educated, practical design decisions to meet this challenge.

## Next Steps

For more information about how your organization can benefit from Next Generation Network Addressing solutions, visit Juniper Networks on the Web at [www.juniper.net/ipv6](http://www.juniper.net/ipv6) or contact your Juniper representative in your local area. For more information on Router Applications, visit Juniper Networks on the web at [www.juniper.net/products-services/software/router-services](http://www.juniper.net/products-services/software/router-services).

## About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at [www.juniper.net](http://www.juniper.net).

---

### Corporate and Sales Headquarters

Juniper Networks, Inc.  
1194 North Mathilda Avenue  
Sunnyvale, CA 94089 USA  
Phone: 888.JUNIPER (888.586.4737)  
or 408.745.2000  
Fax: 408.745.2100  
[www.juniper.net](http://www.juniper.net)

### APAC Headquarters

Juniper Networks (Hong Kong)  
26/F, Cityplaza One  
1111 King's Road  
Taikoo Shing, Hong Kong  
Phone: 852.2332.3636  
Fax: 852.2574.7803

### EMEA Headquarters

Juniper Networks Ireland  
Airside Business Park  
Swords, County Dublin, Ireland  
Phone: 35.31.8903.600  
EMEA Sales: 00800.4586.4737  
Fax: 35.31.8903.601

To purchase Juniper Networks solutions, please contact your Juniper Networks representative at 1-866-298-6428 or authorized reseller.

Copyright 2011 Juniper Networks, Inc. All rights reserved. Juniper Networks, the Juniper Networks logo, Junos, NetScreen, and ScreenOS are registered trademarks of Juniper Networks, Inc. in the United States and other countries. All other trademarks, service marks, registered marks, or registered service marks are the property of their respective owners. Juniper Networks assumes no responsibility for any inaccuracies in this document. Juniper Networks reserves the right to change, modify, transfer, or otherwise revise this publication without notice.