

DEFENSE RESEARCH AND ENGINEERING NETWORK LOOKS TO GAIN THE BENEFITS OF IPV6 AND MEET GOVERNMENT MANDATES

Summary

Industry: Research, Services

Challenge:

- Demonstrate and test the performance, security and capabilities of IPv6 in an operational network as the IPv6 pilot for the Department of Defense
- Support co-existence of dual stack IPv4/IPv6 while maintaining both throughput performance and management
- Handle the bandwidth demands placed on DREN backbone by jumbo-frame traffic
- Maintain service levels for MPLS network while also supporting asynchronous transfer mode (ATM) traffic

Selection Criteria: As a Juniper Networks customer, DREN had firsthand experience with Juniper’s best-in-class, high-performance routers and firewalls, and turned to Juniper for IPv6 support.

Network Solution:

- Juniper Networks M Series Multiservice Edge Routers
- Hardware-based IPsec service modules for the M Series routers using Adaptive Services and Multiservice Physical Interface Cards (PICs)
- Juniper Networks ISG2000 Integrated Security Gateway, SSG550M Secure Services Gateway and NetScreen 5000 Series Security Systems

Results: IPv4/IPv6 dual-stack communications fully supported

Inaugurated in 1992, the Defense Research and Engineering Network (DREN) provides long-haul communication service for the United States Department of Defense’s high-performance computing (HPC) environment. DREN is operated and managed by Verizon Business Network Services, and connects more than 150 sites with WAN links at speeds up to OC-48 (2.5 Gbps) and 10 Gigabit Ethernet LAN drops.

DREN has both classified and unclassified components, each of which supports DoD research and development, testing, evaluation, modeling and simulation. DREN is also used for testing security on high-capacity networks and for early deployment of new and emerging technologies, such as IPv6.

In 2003, DREN was selected as the first IPv6 pilot site for the DoD. The primary goal was to figure out how to deploy IPv6 in a production network to assist the rest of the DoD when it began to transition. Other major goals were to demonstrate end-to-end interoperability using IPv6 and to show that IPv6 provided equivalent security and performance as IPv4.

Challenges

No change to a network architecture as complex as DREN is undertaken without rigorous planning. With a highly differentiated and distributed end-user base, DREN must juggle the demands and requirements of the military, DoD contractors, affiliated research organizations, and Tier-1 ISPs, to name a few. Then there’s the operating system mix used for HPC – Microsoft Windows, Sun Solaris, and Apple Mac OS X – to contend with as well.

As a service provider to the defense research community, DREN needed to support variable size jumbo frames (up to 9Kb) as well as IPv6. Working closely with DREN, Juniper Networks® pioneered the use of jumbo frames in this demanding, security-minded environment so that DREN could go back to its customers with full confidence in its new capabilities.

Fortunately, Juniper Networks routers and the Juniper Networks Junos® software operating system already had built-in IPv6 support, so it was only a matter of turning on IPsec services. “We started out deploying IPv6 on a site-by-site basis until we had more experience with the protocol and how it behaves in a mixed-use environment,” says Ron Broersma, chief architect of DREN. “We made extensive use of the Juniper GUI and command-line interface to keep tabs on the management.”

Many DREN sites are also already equipped with Juniper Networks Firewall/VPNs to provide a secure gateway between the sites and the rest of the DREN network. Like the Juniper backbone and service routers, the DREN firewalls must support features and services, such as IPv6, jumbo frames, and multicast concurrently, while not sacrificing performance.

Selection Criteria

Given the extensive use of Juniper Networks products throughout DREN and Juniper's leading position in high-performance networks with best-in-class security, it was natural for DREN to turn to Juniper for the enhancements and additions it needed where IPv6 was concerned.

Juniper's longstanding experience with gigabit and terabit routing, coupled with the security requirements of classified applications and networks, made Juniper a natural choice for DREN. Unlike other networking vendors that have only recently woken up to the reality of IPv6, Juniper's product portfolio has supported IPv6 since 2001.

Solution

DREN is a real showcase for the power and innovation of HPC environments. DREN's reliance on Juniper routers for the multi-gigabit backbone is testament to their reliability and superiority.

DREN taps into the Verizon Business Network with M Series Multiservice Edge Routers, which serve as the DREN service delivery platform (SDP) for IPv4 unicast and multicast; IPv6 unicast (with IPv6 multicast on the way); and IPsec encryption. DREN uses Adaptive Services (AS) and Multiservice Physical Interface Cards (PICs) to supply hardware acceleration in the M Series routers, including for IPsec.

"We were pleased to find that we experienced no performance degradation with IPv6 when compared to IPv4," Broersma explains. Throughput, jitter, and delay metrics fall within the service level agreement (SLA) struck between Verizon and DREN.

Once its sites were activated and stabilized, DREN also set up peering arrangements with IPv6-enabled service providers and research organizations such as Abilene/Internet2, AARnet and SingREN.

"The ability to concurrently support jumbo frames and multicast in IPv6, coupled with the inherent security of IPsec, has been elemental in our ability to deliver converged services."

Ron Broersma,
Chief Engineer, Defense Research and Engineering Network

The IPv6 migration did not require hardware upgrades in the DREN core, since Juniper routers already supported IPv6. And because DREN already made extensive use of Border Gateway Protocol (BGP), activating IPv6 was a simple configuration change to each node, Broersma explains.

"The fact this migration did not forklift upgrades to the routers in the DREN core saved us headaches and enabled us to meet federal compliance timeframes for IPv6 deployment," Broersma says.

In addition to the M Series, many sites also employ Juniper Networks firewalls and security gateways to provide secure connectivity between the sites and the rest of the DREN network. Due to the continuing innovations of Juniper security products, supporting the new services across the multiple sites could not have been simpler.

The ISG2000 high-performance firewall and intrusion detection/prevention platforms are distributed throughout the DREN network along with NetScreen Series products to support locations that require high-speed multi-gigabit throughput. Both ISG2000 and NetScreen Series firewall/IPsec VPNs support all the necessary services, including IPv6, jumbo frames and multicast. Smaller sites employ Juniper Networks SSG550 integrated security appliances. The high performance of these firewalls ensures that performance does not degrade as new services are added.

Results

In addition to handling unicast IPv4/IPv6 communications, DREN can now support other DoD pilots, demonstrations and test beds as part of the department's transition to IPv6 use. DREN can be tapped to support a variety of HPC applications, such as the MoonV6 interoperability test bed, Global Information Grid, and Joint Rapid Architecture Experimentation (JRAE).

DREN has established some important performance thresholds in IPv6 networking. DREN routers route IPv6 in hardware as fast as IPv4 and typically only need about two times as much memory to support both IPv4 and IPv6. DREN has also clocked coast-to-coast data transfer rates for IPv6 within 0.4 percent of IPv4 across an OC-12c link, and transfer rates within a single site come within 0.3 percent at 10 Gbps.

Next Steps and Lessons Learned

Broersma and his team at DREN are looking to build on their success. They plan to add encryption to IPv6 traffic and will add HPC applications at pilot sites to the IPv4/IPv6 dual stack. They will also transition additional customer sites to IPv6, and enrich the external connectivity through peering with additional IPv6-capable networks and ISPs. DREN also plans to conduct wide-area mobility experiments and extend IPv6 to classified sites.

About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. Additional information can be found at www.juniper.net.

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