Australia's AARNet Builds High-IQ Network to Advance International Science, Education, and R&D

Summary

Company:
AARNet Pty Ltd

Industry:
Research and Education

Challenges:
- Network traffic more than doubling every two years
- Need to support customer adoption of cloud services
- Need to increase network agility to facilitate more dynamic big data applications

Selection Criteria:
Retain valuable skills and experience built up over eight successful years of operations with the Junos operating system platform to reduce time to market with next-generation service capabilities.

Network Solution:
- MX Series 3D Universal Edge Routers
- EX Series Ethernet Switches
- Junos operating system
- Junos Space

Results:
- 30-fold increase in network capacity to over one million users
- An SDN-ready network with built-in automation and intelligence
- Big data transfer services optimized for research applications
- Reliable, high-speed, location-agnostic access to data intensive cloud-based services

AARNet Pty Ltd (APL) is a not-for-profit company owned by 38 Australian universities and the Commonwealth Scientific and Industrial Research Organisation, which operates Australia's Academic and Research Network (AARNet).

AARNet provides high-capacity Internet and other advanced communications services for Australia's research and education community, including universities, health and other research organizations, schools, vocational training providers, and cultural institutions. It serves over one million end users who access the network for teaching, learning, and research.

Business Challenges

Since launching its third-generation network in 2005, APL has seen AARNet traffic more than double every two years, driven both by increases in the number of end users on the network and an explosion in the size of data sets generated by advanced research applications.

"AARNet3 was designed as a complex routed IP network, with points-of-presence across the country and overseas, and multiple high-speed links to the Internet and academic research networks in other countries. While it has certainly lived up to its design expectations, from an end-user perspective, AARNet3 was showing its age. High-end science is becoming ever more data-intensive and therefore making it easier to move data is a significant enabler of research productivity," says Chris Hancock, chief executive officer of AARNet Pty Ltd.

As a result, one of APL's principle challenges was to increase network scale—starting with its backbone, where AARNet3 was restricted to 10 Gbps links—with the aim of provisioning more bandwidth at less cost. Above and beyond this, however, the goal for AARNet4 was to "change the ground rules" for network capacity.

"Our new Juniper Networks infrastructure was selected and deployed with the future in mind. It has massive capacity so we can continue to scale bandwidth, add services, and increase our user base over the next few years without a problem."

Chris Hancock, Chief Executive Officer, AARNet Pty Ltd

"It's not just a matter of having fat pipes, but how you use them. Our focus is on navigating the future of networking in Australia and globally so AARNet can drive a layer of more sophisticated value-added services," Hancock says.

In addition to increasing capacity, APL also wanted to expand its domestic footprint, enabling Australia's best and brightest researchers, educators, and students to benefit from greatly expanded network access, and a wide range of value-added network and cloud-based services.

Selection Criteria

Juniper Networks® M Series Multiservice Edge Routers, running on the Junos® network operating system, have provided a robust network core for AARNet since 2005. Their selection was based on AARNet's recognition of Juniper's commitment to a detailed Quality Assurance (QA) process and the M Series' advanced IP service abilities, including concurrent support for IPv6 and multicast traffic as well as unicast IPv4 traffic, without any loss of performance.

Based on eight successful years of experience with Juniper Networks technology, AARNet's favoured option – subject to price/performance evaluation – was to build AARNet4 on its existing operating environment.

"The network is SDN-ready, end-to-end, and we've barely scratched the surface of this capability. In the coming years, however, I'm quite sure standards-based SDN and network functions virtualization will be leveraged to create a wave of service innovation that will be transformational in many ways for Australia's education and research communities."

Chris Hancock, Chief Executive Officer, AARNet Pty Ltd

Business Solution

To lay the foundation for AARNet4, APL initiated a program to expand its fibre optic cable infrastructure across Australia and installed new DWDM optics to support native 100 Gigabit per second links. In November 2013 APL started deploying Juniper Networks MX 3D Universal Edge Routers within the AARNet core, its points-of-presence across Australia and at nine international locations where it peers with other research networks and major Internet service providers.

With its advanced architecture that separates control, management, services, and forwarding planes, and extensive support for virtualized edge network services, the MX Series 3D portfolio is tightly aligned with Juniper Network's software defined networking (SDN) strategy. The MX240, MX480 and MX960 – which differ in system capacity only – were deployed by APL, with the MX960s at the core network nodes and the MX480s and MX240s in points-of-presence.

The upgrade delivers a 30-fold increase in the overall capacity of AARNet, with each MX960 providing up to 10.56 Tbps of system capacity. The MX Series routers were architected from day one to support 100GbE, and can support high-density 100GbE, 40GbE, and 10GbE full-duplex interfaces at wire speed. The upgrade also reduces network latency, bringing responsiveness of data-intensive cloud-based services as close as possible to as those hosted on campus.

As well as the capacity upgrade and the deployment of 100 Gbps backbone links, APL has also leveraged the capabilities of the MX Series and Junos OS to run MPLS over AARNet4. This enables support for new L2 and L3 VPN services, in addition to the publicly routed access to the Internet, with far more granular network traffic control and improved network resiliency.

APL also uses Juniper Networks EX4550 Ethernet Switch as network terminating units to present services at customer premises or at shared data center facilities. The single rack unit EX4550 has 32 wire-speed GbE/10GbE ports, with two expansion slots for optional modules that increase port densities to 48. The switches support L3 dynamic routing protocols such as RIP and OSPF, MPLS services such as L2 and L3 VPNs, Media Access Control Security (MACsec) on all ports, and a comprehensive quality-of-service (QoS) feature set allowing APL to deliver high-bandwidth services in a simple and cost-effective manner, while maintaining network visibility right to the customer's doorstep.

As a comprehensive network management solution, Juniper Networks Junos Space plays a key role in maintaining visibility across AARNet, simplifying the provisioning of customer services and integrating into AARNet's existing network management capabilities. Designed to automate management of Juniper's network devices, Junos Space centralizes configuration, software control, and network application programmability—all essential capabilities in transforming traditional hardware-centric networks into SDN-ready underlay infrastructures.

Technology Results

The phased rollout of AARNet4 has coincided with a number of other education and research initiatives supported by APL, including Research Data Storage Infrastructure (RDSI), a A$50 million federal government funded project providing storage facilities for nationally significant data. AARNet is providing resilient dual 10 Gbps public routed connectivity to each of eight RDSI nodes across Australia, allowing researchers to upload data or access it for analysis. The VPN capability of the AARNet4 backbone allows AARNet to also provide resilient dual 10 Gbps private L3 connectivity between the nodes for high-speed data replication.

The West Australian RDSI node is hosted by iVEC consortium within its new Pawsey supercomputing center. To give researchers friction-free transfer of big data sets into and out of the node at maximum line speed, APL has deployed a pair of Juniper Networks EX4550 Ethernet Switches to create a Science DMZ, which is essentially a very high-speed network on-ramp that bypasses the complicated, performance sapping security measures required to protect business servers and desktop applications.

"The line-rate performance of the Juniper switches, together with their access control list security capabilities, allows researchers to fully utilize the connection services, not hampered by poor network performance," Hancock says.

APL has also developed and deployed a pair of cloud storage solutions: CloudStor, a general purpose file sender application for transferring large files such as gene sequencing data; and CloudStor+, a cloud storage application tuned for high performance aimed at the big data requirements of researchers.

Hundreds of terabytes of storage have been deployed to support these tools across multiple locations nationwide for resilience, and to bring the storage closer to the user for increased performance. Reliably replicating data across a country the size of Australia presents specific challenges of latency and packet loss but private 10 Gbps L2 circuits across the 100 Gbps AARNet4 backbone provide a solution to this problem.

For many years, AARNet has worked in close collaboration with the global astronomy community, whose data flows between telescopes and supercomputers, pushing the traditional boundaries of networking. To support better research interconnection, AARNet in partnership with its international research and education network partners has provisioned a 1 Gbps private L2 circuit from telescopes in New South Wales all the way to a supercomputing facility in the Netherlands. Previously, this circuit was stitched together using SDH and SONET technologies. However, with the extension of MPLS to AARNet's international POPs, the portion traversing AARNet has been migrated to a simple-to-configure L2 VPN circuit with redundancy, thanks to the diverse routed backbone in the new High-IQ Network.

As more Australian schools and universities move their IT systems into the cloud, reliable high-speed connectivity becomes paramount. AARNet's fibre footprint extends to most major data centers across Australia and the new MPLS-based VPN services now enable it to deliver reliable connectivity from customer sites to the data center of their choice, regardless of location. For instance, a university with extensive distance learning offerings can move its web presence to data centers closer to the major international internet transit connection for better responsiveness. Alternatively, a regional university is no longer tied to local data centres, which may charge a premium.

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Next Steps and Lessons Learned

These examples show that, with its new Juniper Networks foundation in place, APL is already delivering on its goals for AARNet4 but—as of mid-2014—it is still early days and the network's full potential has yet to be exploited.

"Our new Juniper Networks infrastructure was selected and deployed with the future in mind. It has massive capacity so we can continue to scale bandwidth, add services, and increase our user base over the next few years without a problem. We're also planning to triple the number of points-of-presence, bringing the total close to 50, making it much easier for education and research organizations to link to AARNet," Hancock says.

"The real difference between AARNet3 and AARNet4, however, is in the level of built-in automation and intelligence. The network is SDN-ready, end-to-end, and we've barely scratched the surface of this capability. In the coming years, however, I'm quite sure standards-based SDN and network functions virtualization will be leveraged to create a wave of service innovation that will be transformational in many ways for Australia's education and research communities."

For More Information

To find out more about Juniper Networks products and solutions, please visit www.juniper.net.

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.

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3520508-001-EN June 2015

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