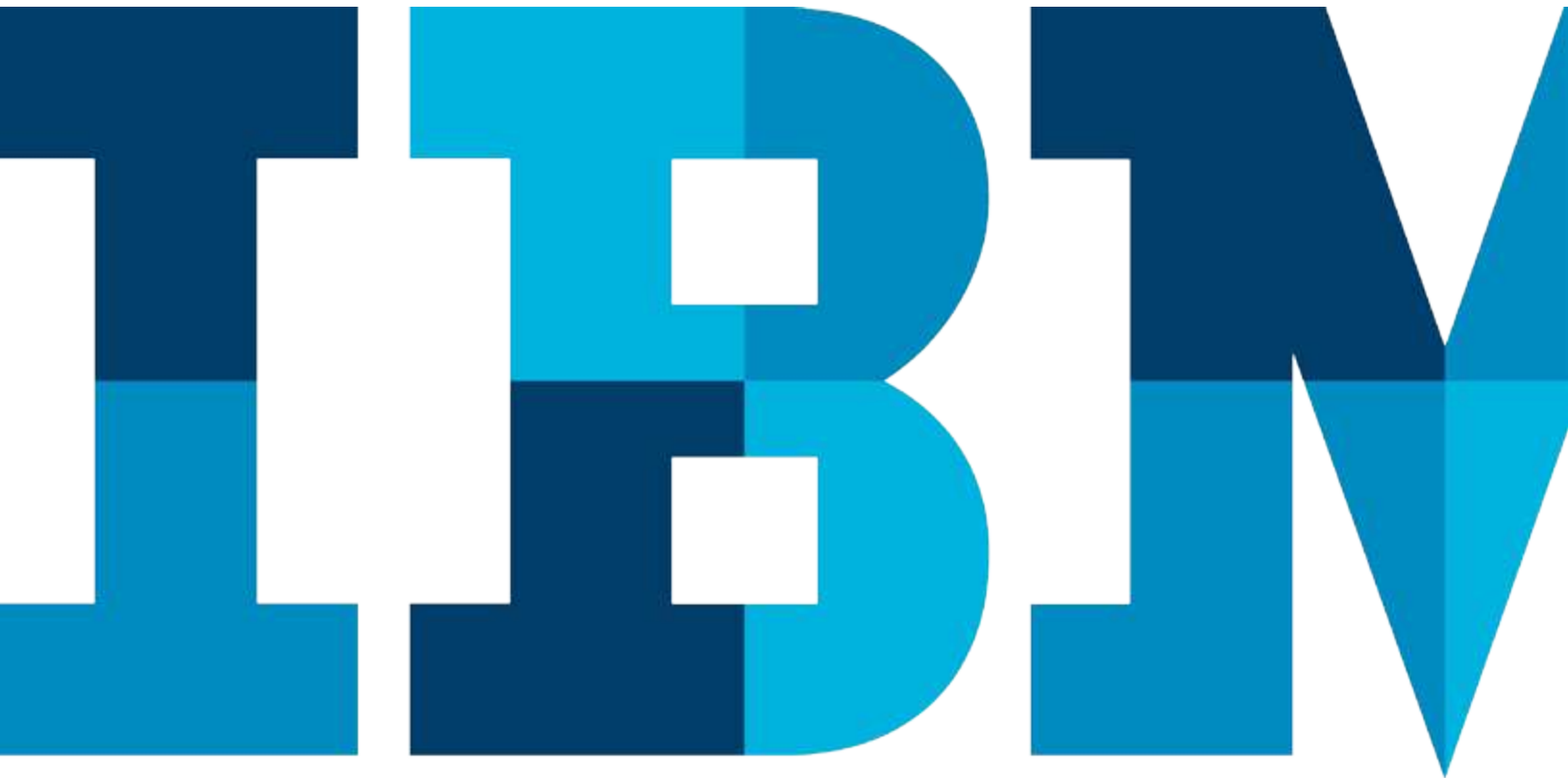# Building a smarter network with IPAM

Build smarter virtual data centers and clouds and transition to IPv6 with IP Address Management (IPAM)

IBM

Contents

Executive overview

To build a smarter planet, organizations need smarter networks that are more reliable, cost-effective and easier to manage. With the explosive growth of IP networks, virtualization and IP-dependent devices including smart phones and tablets, many organizations struggle to manage and control their ever-expanding IP infrastructure. Traditional methods of managing IP addresses with spreadsheets and homegrown database solutions cannot keep pace with current demands, much less scale to accommodate new requirements like virtualization, cloud and IPv6.

Virtualization, cloud computing and IPv6 are deeply interrelated technologies. The dynamics of virtual environments – the constant demand for new networks, virtual machines, virtual desktops and vApps, together with the speed and ease with which these new workloads can be rolled out – has put additional strain on an already disappearing IPv4 address pool. With organizations chewing through IP addresses at a faster rate than ever before, virtualization is driving the adoption of IPv6. Similarly, cloud computing shows tremendous promise, but its development and widespread adoption has been slowed by several factors, including a lack of available IP address space under the current IPv4 protocol. IPv6 will provide the massive IP address space and infrastructure needed for tomorrow's cloud applications.

There is a growing awareness that IPv6, virtualization and the cloud should not be viewed in isolation but as part of a broader IT strategy. Recognizing the need for a big picture view of data center and cloud networks, BlueCat Networks, IBM and Juniper Networks have joined forces to make it easier for organizations to deploy smarter virtual data centers and clouds and transition to IPv6.
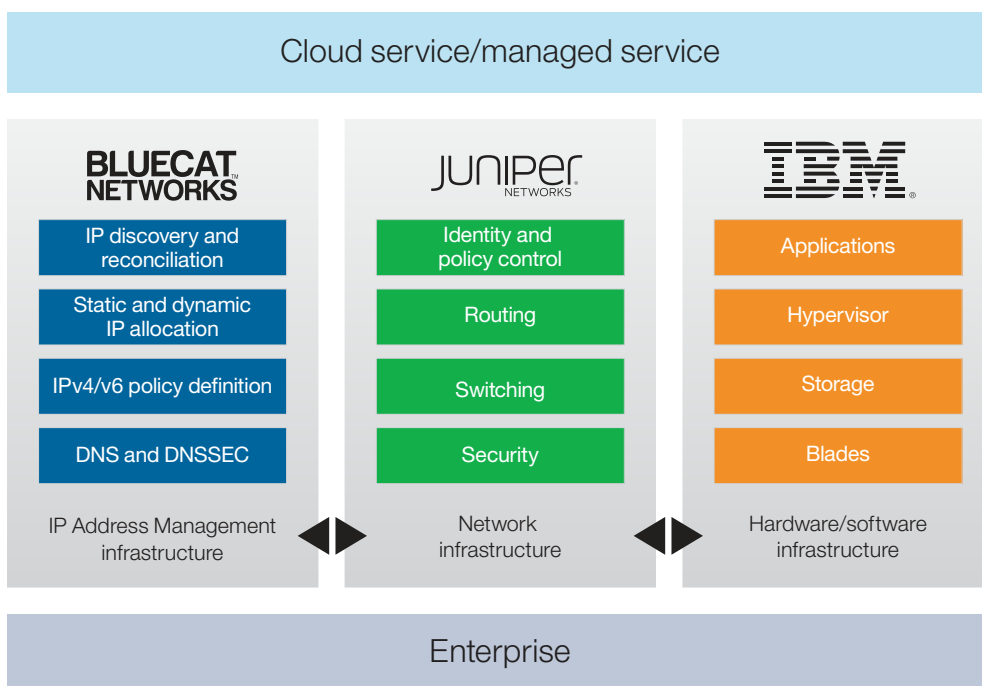
BlueCat Networks, IBM and Juniper Networks are working together to deliver services and solutions based on proven technology, standards and expertise in three key areas:

IP Address Management infrastructure – IP Address Management (IPAM) provides centralized management and visibility into "everything IP" on the network including IP address space and DNS/DHCP core network services. IPAM provides broad capabilities for managing and automating IP networks including IP discovery and reconciliation, IP address allocation, IPv4/IPv6 policy definition and integrated management of DNS and DNSSEC. By providing a central control point in the network, IPAM enables organizations to build a solid foundation for successful virtualization, cloud and IPv6 initiatives.

"The network has become an intrinsic and essential component of the IT infrastructure. Almost all enterprise applications and, thus, business processes are supported by the enterprise network."

Gartner Inc., "Key Issues for Communications Enterprise Strategies," Bjarne Munch and David A. Willis, 3 March 2011

The Big Picture – BlueCat Networks, IBM and Juniper Networks are collaborating on an integrated, pragmatic approach to virtualization, cloud and IPv6 enablement.

Cloud service/managed service

BLUECAT NETWORKS

| IP discovery and reconciliation |
| Static and dynamic IP allocation |
| IPv4/v6 policy definition |
| DNS and DNSSEC |

IP Address Management infrastructure

JUNIPER NETWORKS

| Identity and policy control |
| Routing |
| Switching |
| Security |

Network infrastructure

IBM

| Applications |
| Hypervisor |
| Storage |
| Blades |

Hardware/software infrastructure

Enterprise

"Over the next four years, almost half of all CIOs expect to operate the majority of their applications and infrastructures via cloud technologies."

Gartner Inc., "Reimagining IT: The 2011 CIO Agenda," Mark P. McDonald and Dave Aron, 1 January 2011

Gartner predicts that, "By 2015, 17% of global Internet users will be IPv6, with 28% of new Internet connections running the protocol."

Gartner 2011 MarketScope for DNS, DHCP and IP Address Management

"As cloud computing, virtualization, mobility, unified communications and video drive more application traffic to the network, traditional network design practices will become increasingly significant constraints on the functioning of the business."

Gartner Inc., "The Enterprise Network of the Future Will Be Hyperconverged," Bjarne Munch and David A. Willis, 18 November 2010

Network infrastructure – Because networks are the foundation of a cloud-ready data center, organizations need a solid and secure network infrastructure to build and benefit from virtualization and the cloud. Network infrastructure comprises multi-layered security, switching, routing and identity and policy control. Network infrastructure also encompasses Network Address Translation (NAT) which allows organizations to optimize their IPv4 address space to support virtualization and cloud initiatives, while preparing for a gradual, controlled and cost-effective transition to IPv6.

Hardware/software infrastructure – While cloud computing delivers services to users from an abstracted set of resources, the cloud at its core is still comprised of a series of redundant servers located in a data center somewhere – whether within the organization or offsite at a service provider. This underlying hardware and software infrastructure that powers the cloud must be reliable, scalable, secure and agile. A cloud-ready hardware/software infrastructure includes applications, hypervisors, storage and blade servers that are optimized for virtualization and the cloud. Rapid provisioning, management and scale are key requirements.

BlueCat Networks, IBM and Juniper Networks share a common goal: To provide organizations with all of the layers – IP Address Management infrastructure, network infrastructure and hardware/software infrastructure – required to achieve the benefits of virtualization and get to the cloud faster and smarter. The three companies are collaborating on an integrated, pragmatic approach to virtualization, the cloud and IPv6 enablement.

This white paper focuses primarily on the role of IP Address Management infrastructure in addressing the key IP challenges associated with virtualization, cloud and IPv6. Whether your organization is deploying virtualization for data center consolidation or as part of a broader cloud strategy, IPAM can deliver tangible benefits through the ability to discover, inventory, reorganize and manage IPv4 and IPv6 networks. The paper also outlines the value a joint BlueCat Networks, IBM and Juniper Networks solution offers to organizations looking to accelerate and expand their deployment of virtualization and cloud computing.

The IP issue

Virtualization and cloud promise more agility and flexibility, but an organization's virtual environment is only as agile as the IP infrastructure that supports it. With virtualization, it is possible to stand up a new virtual server in minutes, but this is of little benefit if IT staff still need to perform a manual spreadsheet lookup to find an IP address to give to that server, update the DHCP server, create a new DNS record, and then remember to update the IP spreadsheet or homegrown database. Ineffective automation and manual IP address management can impede performance and add to the cost of every workload.

IP address space has become a valuable financial asset that must be effectively managed. Microsoft recently paid Nortel US$7.5M for 667 thousand IPv4 addresses – that's US$11.25 per IPv4 address (*Network World*, March 2011). Despite the strategic and financial value of IPv4 addresses, many organizations continue to manage their IP space manually with spreadsheets or outdated homegrown database tools. These legacy methods lack the automation, integration and agility needed to effectively manage today's increasingly dynamic and complex data center and cloud networks.

According to Gartner, "the most urgent step that enterprises need to take is to manage their inventory of IPv4 addresses. Public IPv4 address space will become a financial asset, and enterprises will be obliged to account for these assets and their utilization….Centralizing IP address management will help enterprises efficiently use these increasingly scarce resources and prepare for IPv6 deployment."

Gartner Inc., "Internet Protocol Version 6: It's Time for [Limited] Action," Neil Rickard, 8 December 2010

Common IP management pains:

- High-profile service outages caused by IP network configuration errors
- Manual processes consume IT resources and time and effort better spent on more strategic initiatives
- Inability to effectively delegate network configuration workflow to staff or the helpdesk
- Lack of visibility into IP usage, DNS and DHCP increases security and compliance risks
- Lack of integration with self-service portals creates an IT bottleneck in provisioning virtual machines
- Lack of automation and agility hampers virtualization and cloud initiatives and erodes ROI
- An incomplete or fragmented view of IPv4 networks increases IPv6 migration risks

IPv6 throws the IP issue into sharp relief. The exhaustion of IPv4 address space and the need for organizations to begin moving to IPv6 only compounds existing IP challenges and reinforces the need for smarter IP Address Management to better manage IPv4 and IPv6 networks and the DNS/DHCP core services that enable the Internet and IP-based networks to operate.

IPAM starts the network – where IPv6, virtualization and the cloud meet

We live in an increasingly IP-dependent world in which every device that connects to the network needs at least one IP address. Smarter networks start with IP Address Management. IPAM replaces time-consuming, error-prone manual processes for IP, DNS and DHCP provisioning with a scalable, automated solution to help organizations achieve the agility promised by virtualization and the cloud.

Situated at the heart of the network, an IPAM solution acts as a central point of control for "everything IP" including DNS and both statically and dynamically assigned IP addresses. An IPAM solution delivers a range of capabilities that allows organizations to take control of their IP address space and name space. By delivering intelligent automation and single-pane-of-glass visibility, these capabilities simplify management and save time and resources. The diagram below shows some of the capabilities provided by an IPAM platform.

IPAM provides a central control layer for IP, DNS and DHCP deployment, configuration and management.
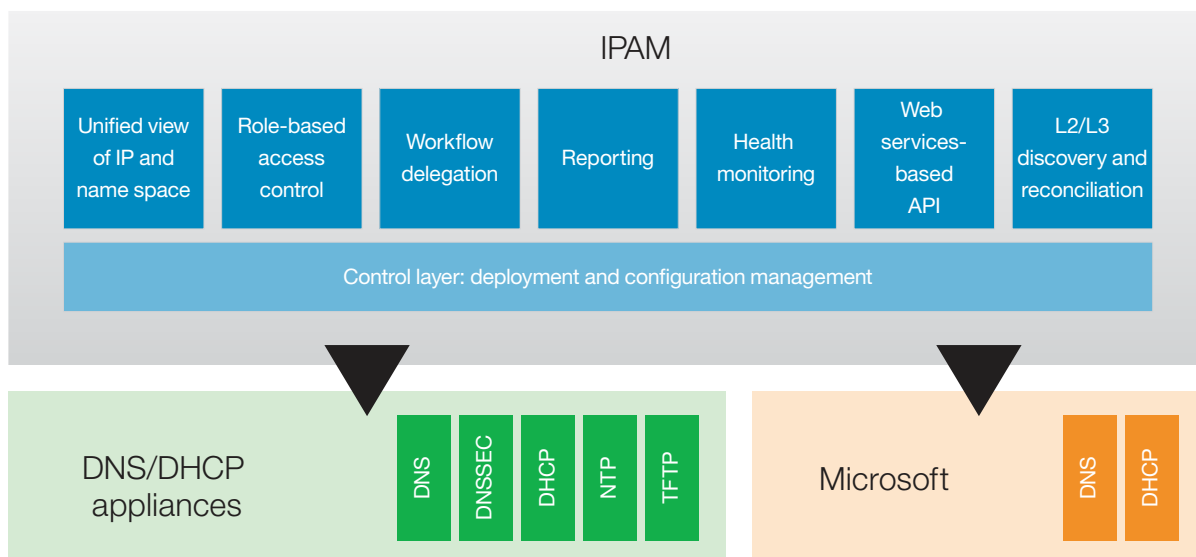
Key IPAM capabilities:

Single pane-of-glass management – IPAM presents a unified, business-centric view of all IP, DNS and DHCP data on the network. Assigning a new IP address within the IPAM solution will also create the DNS host and DHCP reservation, allowing a single action to update multiple services, while ensuring data integrity. All IP-related data is centrally stored and managed, allowing the IPAM solution to act as a central point of control and a single authoritative source for all IP information to ensure corporate governance and regulatory compliance. IPAM provides a view of every device on the network including its MAC address, DHCP lease information and DNS host record.

Role-based access control – Permissions for any number of zones or networks can be defined at a high or low level to assign or restrict access rights to those who need it – regardless of their physical location or logical area of responsibility. Permissions can be quickly and easily assigned via inheritance. Configuration controls can be customized to ensure that administrators and operators have the appropriate level of management rights based on their skills and experience. Concurrent administration allows multiple users to make changes on the network simultaneously, while ensuring that the changes do not cause conflicts.

Workflow delegation – An integrated change control system for managing workflow, network changes and delegation allows administrators to take advantage of a larger pool of personnel that can recommend changes, while ensuring that ownership and accountability for the approval and deployment of these changes remains clear. Less experienced administrators or help desk personnel can create change requests, but those changes are not implemented until they are approved by more senior staff members.

Reporting – Comprehensive reporting and auditing help administrators streamline network operations, identify challenges and report on regulatory policies.

Health monitoring – Administrators can monitor key performance and health indicators across the entire DNS/DHCP infrastructure including the status and availability of business-critical DNS/DHCP servers and services.

Web services API – All IPAM capabilities including DNS, DHCP and IP address move/add/change/delete functions are accessible via a simple, unified web services API. This API makes it simple to integrate IPAM with other systems for trouble ticketing, network automation or asset/configuration tracking.

Network discovery – Network discovery uses SNMP to retrieve key information directly from routers and switches, enabling the IPAM solution to automatically augment its data, such as MAC address, IPv4/IPv6 addresses and DNS records, with network-sourced data including router and switch information, as well as identify changes to IP-enabled devices across geographically-dispersed networks. Administrators can quickly and easily find IP addresses that have been newly added and recently removed from the network.

IP reconciliation – IP reconciliation compares changes to discovered IPv4 and IPv6 data in order to identify unused IP addresses for reclamation and/or unauthorized IP addresses that can create security vulnerabilities. The reconciliation component also identifies conflicts based on DNS hostname and MAC address, allowing administrators to accept or investigate changes in their infrastructure. IP reconciliation policies allow administrators to create acceptance criteria to automate the reconciliation of network discovery data in order to enforce network policies and reclaim unused, but reserved network space.

Multi-platform/multi-hypervisor support – Industry-leading support for virtual infrastructures and multiple hypervisors, as well as for hybrid physical/virtual environments and Microsoft Windows DNS/DHCP, ensures that the IPAM solution provides flexibility to manage "everything IP" across the organization without requiring customers to "lock-in" to a single technology or virtual infrastructure. The IPAM solution can be deployed as physical appliances, virtual appliances and as a cloud-based managed service and deployment options can be mixed and matched as needed.

With these critical IPAM capabilities in place, organizations can, not only better prepare for the migration to a virtual infrastructure and IPv6, but also better manage IPv4/v6 addresses and core network services before, during and after a migration.

Virtualization and IPAM – automating the workload lifecycle

To make the most of virtualization and cloud investments, organizations need to deploy cost-effective virtual DNS and DHCP core services and automate the allocation of an IP address and DNS name to every workload.

BlueCat Networks, IBM and Juniper Networks are collaborating on a best practice approach to IP Address Management and automation for virtual data centers. Taking a holistic approach to virtualization, BlueCat Networks, IBM and Juniper Networks are working to address customers' needs for IPAM and core network services to drive greater automation and agility across the virtual data center's network infrastructure and hardware/software infrastructure.

Virtualization also brings new security challenges associated with increased machine-to-machine interaction. Juniper Networks supports server virtualization with a range of cloud-enabled security services including application identification and monitoring, stateful firewall, intrusion detection and prevention and VPNs – all consolidated on an expandable platform.

IPAM acts as the control point for the virtual data center, enabling organizations to automate IP address and DNS allocation for workload activation and monitor and reclaim unused IP addresses to support future growth. By fully automating the virtual environment from the IP address up, organizations can achieve the agility and on-demand scalability promised by virtualization.

"An IT organization's virtualization project should not be a stand-alone initiative. Instead, IT managers and planners should ensure that virtualization fits in with an organization's overall modernization plan for infrastructure and operations (I&O)."

Gartner Inc., "It's Important to Align Your Virtualization and Modernization Priorities," Philip Dawson, 28 September 2011

In a virtual environment, the lifecycle of any workload begins with someone within the organization making a request for a workload to be created.

Requests for workload activation are typically made through a self-service portal to increase agility and reduce the burden of virtualization on the IT team. The user simply visits the online self-service portal, consults a catalog of available virtual services, selects the type of workload he or she wants and submits the request.

The service request automatically triggers a request to the IPAM solution to reserve an IP address for the workload and create a DNS entry (An A record for IPv4 and/or a AAAA record for IPv6).

The IP address reservation and DNS entry are automatically pushed to the organization's DNS and DHCP servers and to the self-service portal so that administrators and the user who requested the workload know that the Virtual Machine is online, has a valid IP address, is reachable via a qualified domain name and is ready for use. The workload is instantaneously and automatically IP'ed, named and provisioned without any manual intervention from anyone within the IT team.

The same efficiencies can be seen for workload deactivations where the process works in reverse: The user requests that a workload be decommissioned via the self-service portal, the request triggers the IPAM solution to automatically delete the A or AAAA record for DNS and put the decommissioned workload's IP address or addresses back into the available pool for reuse – all without any manual IT intervention.

IPAM increases agility in the virtual data center by providing end-to-end automation of the entire workload lifecycle from activation to retirement.
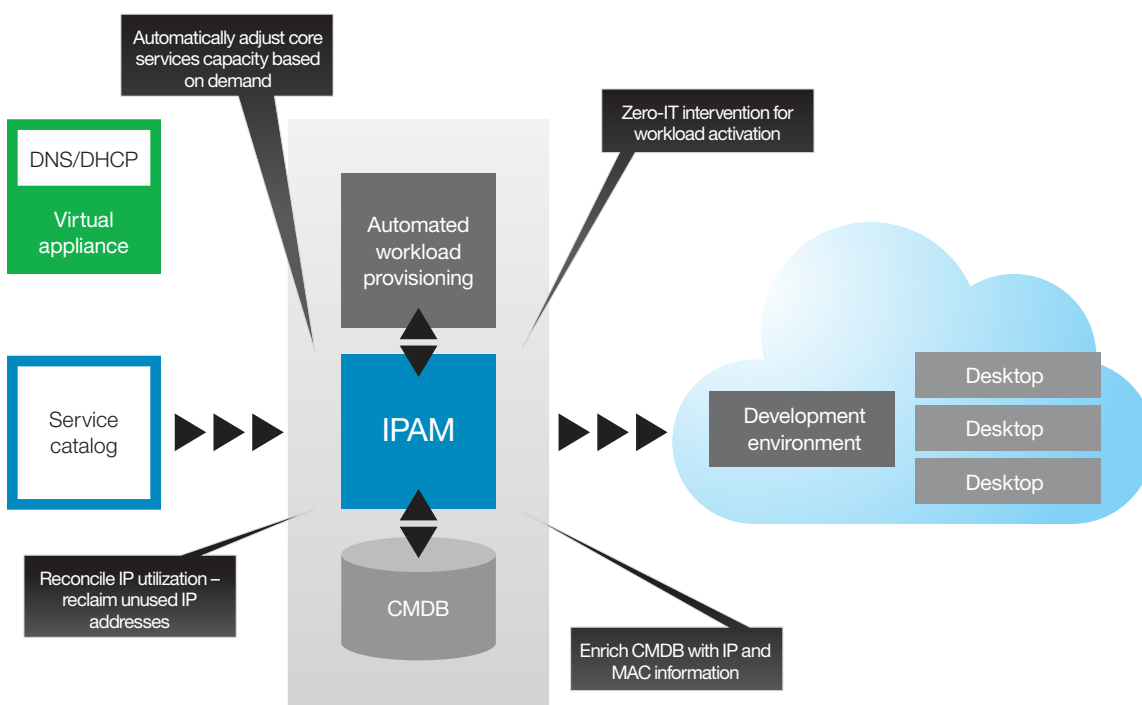
By automating and accelerating the entire workload activation cycle, IPAM makes managing virtual environments more efficient and cost-effective. IPAM eliminates the need for error-prone and time-consuming spreadsheet lookups and manual updates to DNS and DHCP core services. With this level of automation and integration of IPAM into the service request system, organizations can effectively realize the full promise of virtualization: increased agility with zero IT intervention for workload activation and deactivation. Automation at the IP level allows IT staff to increase their efficiency and concentrate on more strategic, high value tasks.

As a central point of control, IPAM also provides an authoritative source for information about the network, DHCP scopes, their utilization, DNS records, zones, subzones, devices and so on. This information can be easily integrated with other systems including the CMDB to enrich existing information and provide a more global view of the network and the relationship between devices, MAC addresses, IP addresses, DNS records, VLANs, switches and switch ports.

"The rise of public cloud computing is changing traffic patterns and security infrastructure requirements. Private cloud computing, which is in market terms a bigger phenomenon, drives a need for more intelligent and dynamic networks. Most organizations will use a hybrid of the two, distributing workloads between public and private as appropriate. In studies of early cloud service adopters, network issues became an inhibiting factor in approximately 30% of cases."

Gartner Inc., "Hype Cycle for Networking and Communications, 2011," David A. Willis, 24 August 2011

The automation of core IP services is critical to accelerate the process by which users can request virtual desktops and servers via a self-service portal. By deploying DNS and DHCP servers as virtual appliances running on blades or purpose-built hardware appliances, alongside a centralized IP Address Management solution, organizations can achieve even greater agility and elasticity in their virtual data center.

Moving to the cloud with IPAM

As organizations expand their use of virtualization, many are beginning to "burst" into the cloud, whether private or public. In the cloud bursting concept, when an organization runs out of compute resources in its internal data center or private cloud, it can "burst" the additional peak workload to an external cloud.

Cloud bursting allows organizations to make more efficient and cost-effective use of their internal infrastructure. Rather than build out their infrastructure to accommodate peak demand, which may only occur a handful of times a year, organizations can scale their environment to support standard operations and burst additional peak workload to an external cloud on an on-demand, pay-per-use basis.

For example, a retailer would likely experience peak workload leading up to Christmas, whereas a public corporation would experience peaks at the end of a fiscal quarter or fiscal year. These organizations could simply burst this workload to the cloud by renting compute power and capacity from a cloud service provider (CSP) such as Virtela. Self-service portals for deploying virtual machines and enterprise connectors enable organizations to cloudburst to cloud services.

If you think of your internal computing resources as a bucket that is filled up with workloads, the cloud can be viewed as a larger bucket readily available to catch any overflow that could occur due to a spike in demand.

Cloud bursting allows organizations to fully utilize their capital assets and maximize investments in existing infrastructure; however it does pose a number of IP challenges. One of the most common reasons private and public cloud environments fail is that the underlying IP infrastructure is unable to accommodate an unforeseen spike in demand.

IP Address Management allows organizations to mitigate the risk of service outages by providing visibility into IP usage. Administrators can obtain a live view of scope utilization and scope rollup to monitor which blocks or networks are approaching peak capacity. Low and high watermarks on scope utilization can be established and the IPAM solution will automatically notify staff when a key threshold is crossed.

The solution also allows organizations to quickly adapt to demand by finding the next available network, applying a pre-configured template to it and deploying it to a DHCP server in a matter of seconds. The IPAM solution provides the ability for one network to easily spill onto another in order to avoid service outages or disruptions caused by a lack of IP addresses. By allowing administrators to quickly and efficiently partition new IP address blocks and deploy them to DHCP servers, IPAM ensures that capacity demands can be proactively met.

With an IPAM solution architected for the cloud, administrators can centrally command and control their organization's entire IP and name space, as well as DNS/DHCP core network services across multiple vSpheres, data centers, remote locations and heterogeneous platforms.

Enterprise network

Private cloud/CSP

Transparent user
connection change
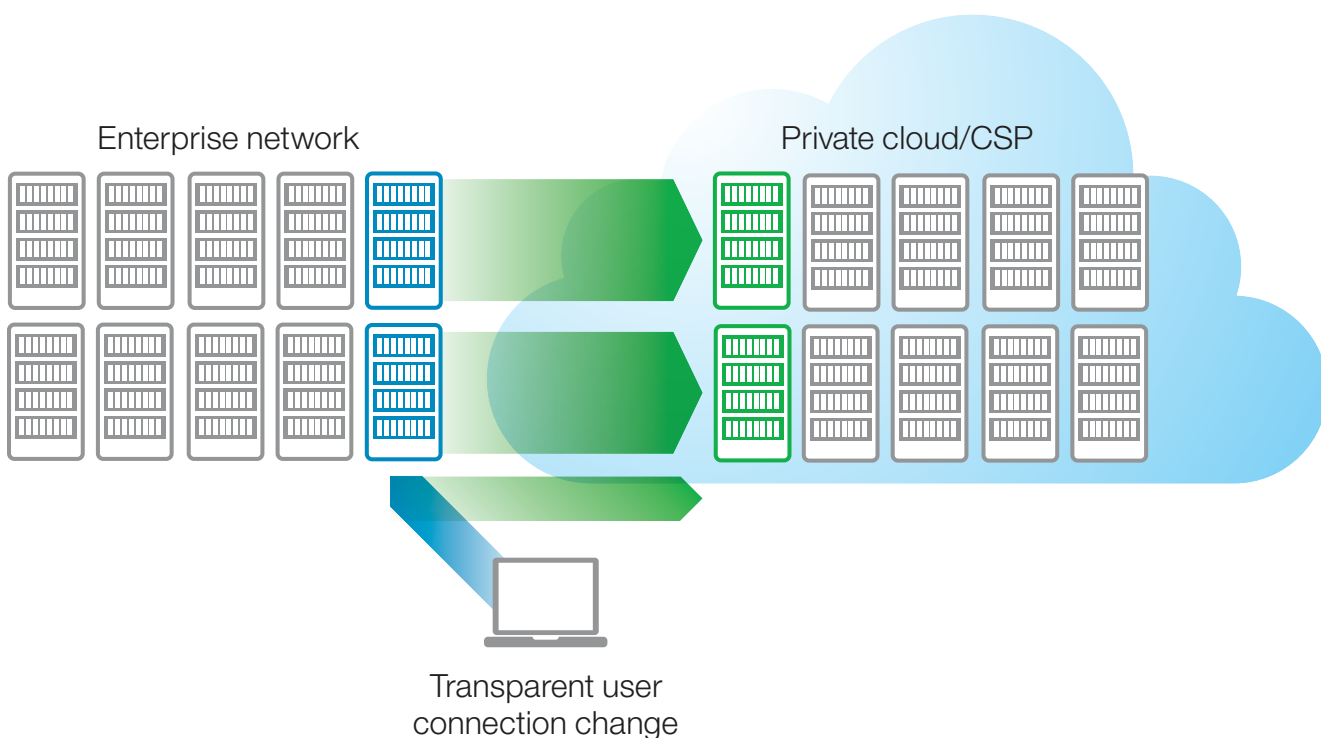
"Cloud computing will hasten the use of tools and automation in IT services as the new paradigm brings with it self-service, automated provisioning and metering, etc., to deliver industrialized services with the potential to transform the industry from a high-touch custom environment to one characterized by automated delivery of IT services."

Gartner, Top Predictions for IT Organizations and Users, 2011 and Beyond: IT's Growing Transparency, November 2010

In addition to on-demand capacity, organizations also need adequate scalability to ensure reliable and successful private and public cloud initiatives. Rated a "Strong Positive" in the Gartner 2011 MarketScope* for DNS, DHCP and IP Address Management, BlueCat Networks' IPAM solution has a uniquely scalable architecture that completely separates management and network services delivery. BlueCat Networks' large live customer deployments have demonstrated that this separation of management and services is critical to cloud scalability.

Key IPAM cloud capabilities

For enterprises deploying private clouds or cloud service providers and managed service providers running on IBM Cloud Service Provider Platform (CSP2), IPAM offers unique capabilities for adopting, managing and automating clouds.

On-demand capacity planning – Automatically adjust core services capacity based on demand by monitoring scope utilization with a live view and making adjustments to DHCP scopes as needed. The solution also allows administrators to create multiple networks and easily and transparently "spill-over" from one network to the next once a network has reached its full capacity.

Reliable virtual DNS and DHCP – With support for multiple hypervisors, virtual DNS/DHCP appliances combine a secure, hardened operating system with extensive disaster recovery and failover capabilities to ensure the reliability of core network services and critical applications.

End-to-end workload lifecycle automation – Automated IP address assignment and DNS for workloads eliminates the management burden of having to manually configure core services and update IP spreadsheets. A web services API enables integration with self-service portals for seamless workload lifecycle automation.

DNSSEC for cloud security – Because cloud computing involves machine-to-machine interaction, DNSSEC is recommended to ensure true end-to-end security. With BlueCat Networks' IPAM, DNS and DHCP solutions, organizations can automate the implementation of DNSSEC through policy definition. Administrators simply apply a user-defined security policy to a zone to immediately enable DNSSEC with automatic key rotation.

Cloud-ready scalability – A single BlueCat Networks IPAM solution is being used by customers today to manage millions of IP addresses, hundreds of thousands of networks and DNS zones and hundreds of data centers and DNS/ DHCP appliances.

Device registration – An integrated MAC registration portal allows administrators to easily register and track all devices connecting to the network or Virtual Desktop Infrastructure (VDI). Available as a virtual machine, the automated solution improves efficiency and reduces IT costs by effectively eliminating IT involvement in device registration. Administrators can discover and remove users and devices from the network and track and audit the relationship between IP address, MAC address and user for accountability and security.

ITIL – Full support for Information Technology Infrastructure Library (ITIL) standards and practices ensures that service definition follows established processes and that the IPAM solution can be integrated into virtual or cloud environments with consistent and predictable results.

CSPs differ from enterprises in that they must balance the loads of many different companies on their shared infrastructure. IP Address Management provides CSPs with an efficient and flexible way to share the cloud with multiple tenants, which involves intelligently carving up IP space, networks and subzones to service an array of customer needs. IPAM also supports IP portability or the ability for cloud customers to easily join and leave the cloud without having to re-IP their workloads. IPAM is a natural extension of IBM's Integrated Service Management for Cloud Service Providers, which provides comprehensive network management, security management, storage management and advanced monitoring and service level management.

Without the right hardware foundation, it can be difficult for enterprises and service providers to realize the full benefits of the cloud. To get cloud computing right, organizations can leverage the infrastructure and expertise of IBM. IBM's own IT organization was an early adopter of cloud computing. IBM brings skills, experience and best practices earned through years of working with clients and operating secure, reliable enterprise data centers and clouds.

IBM provides robust systems and flexible virtualization solutions to build a complete cross-platform cloud computing infrastructure. IBM's approach to cloud computing focuses on open standards such as Java,® JEE, web 2.0, Ajax, Unified Modeling Language and Eclipse, as well as broad support for IBM and non-IBM hardware platforms, operating systems, virtualization platforms and hypervisors. As an extension of its philosophy of an open, vendor-neutral approach to cloud computing, IBM works with an ecosystem of partners which includes BlueCat Networks and Juniper Networks, to extend cloud capabilities.

Juniper Networks complements IBM's robust hardware/ software infrastructure by providing a powerful network application platform designed with the cloud-ready data center in mind. Juniper Networks' network infrastructure solutions and single network operating system help organizations simplify the network architecture, share virtualized resources and secure data flows in the cloud. Juniper Networks' multi-layered security capabilities and identity and policy control address the security concerns that have slowed the adoption of cloud computing.

The American Registry for Internet Numbers (ARIN), the North American Regional Internet Registry, has issued a warning to all organizations that they must support IPv6 traffic externally by January 1, 2012.

The Executive Office of the President (Office of Management and Budget – OMB) has mandated that US government agencies must upgrade public-facing servers and services including web, email, DNS and ISP services with native IPv6 support by the end of fiscal year 2012 (September 30, 2012).

Learn more about IPv6

IBM has been a long time supporter of IPv6. For a list of IBM IPv6-compliant products, visit:
ibm.com/software/info/ipv6/compliance.jsp

To learn more about IBM Networking Strategy and Optimization Services – network infrastructure optimization for IPv6, visit:
ibm.com/services/us/en/it-services/network-infrastructure-optimization-for-ipv6.html

To learn more about Juniper Networks IPv6 coexistence and transition strategies, visit:
juniper.net/us/en/products-services/software/router-services/carrier-grade-nat/

To learn more about BlueCat Network IPv6-Ready IP Address Management (IPAM) solutions, visit:
bluecatnetworks.com/solutions/ipv6

Combined with hardware/software infrastructure and network infrastructure, IPAM is a critical component of a smart, agile cloud or managed service architecture – one that is IPv6-ready. In the next section, we'll look at how IPAM can help both enterprises and service providers simplify the transition to IPv6 from initial planning through to the ongoing management of IPv4 and IPv6 networks.

IPv6 and IPAM – the need for automation

Internet Protocol version 6 (IPv6) is poised to change the way we all communicate and do business. With IPv4 address space almost depleted, the move to IPv6 is necessary to allow the Internet – and the global economy it supports – to continue to grow. The successor to IPv4, IPv6 is a next-generation protocol with new addressing and security features that make it a building block for a smarter planet.

While IPv6-only Internet traffic represents a small amount of all Internet traffic today, innovation will be increasingly centered on IPv6 and new IT initiatives such as virtualization, and the cloud will be built using the new protocol.

The IPv4 protocol uses 32-bit addresses with a finite number of possible unique IPv4 addresses – about 4 billion. At the time IPv4 was developed in the 1970s, no one could have anticipated the explosive growth of IP networks and IP-dependent devices. The enormous growth of IP networks and IP-enabled devices has now all but depleted the limited pool of IPv4 address space.

IPv6 uses 128-bit addresses, which greatly expands the pool of available IP addresses with more than 340 undecillion (undecillion = 10^{36}) unique IPv6 addresses available. That is a very big number – about 50,000 trillion trillion addresses per person on the planet. Unfortunately, IPv6 is not backwards-compatible with IPv4, which will create challenges for organizations as they move gradually to IPv6 over the next few years.

The transition from IPv4 to IPv6 will be a significant network changeover, requiring significant changes to current communication systems and management processes. Not only will IPv6 involve a significant overhaul to the existing infrastructure, it will also require a new approach to how IP address space is managed.

IPv6 addresses and networking concepts differ from IPv4 in significant ways. IPv6 addresses are 128-bits long – four times longer than IPv4 addresses – and are represented in hexadecimal, a format that is not human-friendly and consequently will increase the dependency on DNS to translate meaningful domain names into IPv6 addresses. Unlike IPv4, IPv6 networks are not limited by broadcast. IPv6 multicast allows for the creation of larger, flatter networks that will need to be managed and tracked differently than with IPv4.

Another management consideration is the number of possible IPv6 addresses per interface. Not counting any multicast addresses, three to four IPv6 addresses may be required per IPv6 interface. And because the transition from IPv4 to IPv6 will be gradual, organizations will need to manage "dual-stacked" IPv6 and IPv4 networks in parallel. A single client may have both an IPv4 and an IPv6 address associated with it, creating additional management challenges.

IPAM will be an indispensible technology for planning, implementing and managing IPv6 and dual-stacked IPv4/IPv6 networks. IT staff and network administrators will need to keep track of thousands or even millions of IPv6 addresses. With such an enormous address pool and complex subnet structure, IPv6 simply cannot be tracked on a spreadsheet – finding a specific address in a seemingly endless list of IPv6 addresses in Excel would be like finding a needle in a haystack. Everyday tasks such as determining the next available network will become anything but trivial. The length and complexity of IPv6 addresses will exacerbate IP address management issues that already existed with IPv4. IPv6 provides an opportunity to simplify many aspects of IP addressing by allowing organizations to map business logic to IPv6 addresses and better structure and break down IPv6 address space. In order to take full advantage of IPv6, organizations need to start with a properly planned IPv6 address space to avoid carrying the errors and inefficiencies of the past forward.

The transition to IPv6 will require IP Address Management (IPAM) solutions that automate common administrative tasks and insulate network administrators from the complexity of defining, allocating and managing IPv6 blocks, networks and addresses. Without IPAM, organizations will be unable to cope with the added complexity of IPv6. An IP Address Management (IPAM) solution offers capabilities for controlling, automating and managing IPv6 address space and name space.

With an IPAM solution in place, organizations can more easily discover existing IPv4/IPv6 space, model new IPv6 networks and track dual-stacked IPv4/IPv6 systems – key success factors for IPv6 adoption.

BlueCat Networks and IBM – the power of blue

As with any large-scale technology initiative, thorough planning and preparation is required to ensure a smooth, seamless and cost-effective transition to IPv6. IBM is committed to assisting organizations to prepare for IPv6 and ensure a smooth, seamless and cost-effective transition. After conducting an extensive review of leading IPAM vendors, IBM has selected BlueCat Networks as a strategic partner in IP Address Management and IPv6 readiness.

IBM is uniquely positioned to help commercial and government customers seeking to transition to IPv6 and take advantage of the expanded functionality in IPv6. IBM is a leading participant in the Internet Engineering Task Force (IETF) and played key roles in the efforts that produced the IPv6 standard. IBM technologists continue to lead in the enhancement of this standard's evolution today. IBM has been

a long time supporter of IPv6. As early as 1997, IBM distributed an IPv6 enabled UNIX system (AIX). IBM is strategically enabling key products with IPv6 capability to meet demands of the next generation Internet, demonstrating its leadership and commitment to IPv6 enablement worldwide.

IBM Networking Strategy and Optimization Services – network infrastructure optimization for IPv6 helps facilitate a more reliable and efficient implementation of IPv6. This service is designed to enable a more cost-effective and efficient deployment of IPv6 in customers' IT environments by assessing and analyzing customers' network infrastructures to support IPv6 enablement. The service can help organizations plan for IPv6 deployment, provide recommendations to optimize network infrastructure to support IPv6 and identify and address potential issues for reduced risk. IBM's skilled experts leverage their vast networking and IT experience, a vendor-independent approach and proven methodologies and tools to provide customers with a methodical, actionable road map for successfully implementing IPv6.

BlueCat Networks' IP Address Management (IPAM) technology is a key component of IBM Networking Strategy and Optimization Services – network infrastructure optimization for IPv6. Provided by IBM Global Technology Services, this IPv6 service is designed to help IBM's global customer base build a road map for successful IPv6 transition and enablement. BlueCat Networks' IPAM solutions and expertise support IPv6 planning and readiness in several key areas:

About BlueCat Networks

BlueCat Networks is a leading provider of smart, simple, scalable IP Address Management (IPAM) solutions. With tightly integrated IP core services, our software solutions give organizations the power to centrally manage "everything IP" in their network from a single pane of glass. The result is a dynamic network that is more resilient, cost-effective and easier to manage.

BlueCat Networks' feature-rich and future-ready solutions have helped Global 2000 companies and government agencies reduce costs and solve today's most critical IT challenges – from accelerating the rollout of new services to data center consolidation, virtualization and the cloud. We also help organizations manage growth and change by easing the transition to new technologies such as IPv6 and DNSSEC.

www.bluecatnetworks.com

Discover – The first step to preparing for IPv6 is to understand the existing IPv4 network. BlueCat Networks' built-in IP discovery and reconciliation tool can be used to get an up-to-date picture of the entire network. With this detailed information, organizations can obtain a clear view of where they stand from an IPv4 perspective and how close they are to exhausting their IPv4 address space.

Inventory – To take control of the IP space in preparation for IPv6, organizations need a detailed inventory of their network resources under IPv4. BlueCat Networks contributes powerful tools to help organizations import all IP data from diverse sources, including existing spreadsheets or homegrown databases, and reconcile the data against network information.

Reorganize – After gaining insight into the existing IP infrastructure, organizations can act on this information to start planning their IPv6 deployment by running what-if scenarios, reorganizing the network and structuring the new IPv6 address block.

BlueCat Networks and IBM are working with Juniper Networks to help customers prepare for IPv6 and enable a cost-effective deployment while optimizing existing investments with a customized roadmap. Customers can rely on IBM, BlueCat Networks and Juniper Networks' skilled experts with proven tools and methods to mitigate risk and enable a smooth and structured transition to IPv6. Looking beyond initial deployment, IPAM simplifies the ongoing management of IPv6 and IPv4 networks, as well as the applications and services that depend on those networks such as virtualization and the cloud.

Juniper Networks – reducing IPv6 transition costs with NAT

While the future of virtualization and the cloud lies with the next generation IPv6 protocol, service providers' IPv6 strategies must be anchored in current economic reality. With over two billion Internet users on IPv4, the transition to IPv6 will necessarily be gradual. IPv4 and IPv6 will coexist for many years and service providers will need to provide reliable access to both current IPv4 and new IPv6 addresses. While IPv4 address space is all but depleted, enterprises and service providers are still under pressure to accommodate an ever-growing volume of IP-dependent devices like smart phones and tablets on their existing IPv4 network infrastructures.

Recognizing that large organizations cannot simply transition their entire infrastructure and all of their end users to IPv6 overnight, BlueCat Networks and IBM are working with Juniper Networks to give organizations more options for extending the life of their existing IPv4 address space to support current needs, while at the same time cost-effectively transitioning new services to IPv6.

About Juniper Networks

Juniper Networks was founded on a simple but incredibly powerful vision for the future of the networks: "Connect everything. Empower everyone." This ideal is the commitment and the mission drive the company…every day and in everything. 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. Additional information can be found at Juniper Networks (www.juniper.net).

For large organizations with sizeable investments in IPv4 infrastructure, and whose IPv6 strategy requires a costly upgrade of end-user modems and routers, Juniper Systems, an IBM and BlueCat Networks partner, offers a pragmatic approach based on Network Address Translation (NAT), a mechanism for concealing a set of host addresses on a private network behind a pool of public addresses.

IPv4 depletion has made IPv4 address space a valuable financial asset. NAT allows large enterprises and service providers to use private address space for certain services, while reserving public address space for other public or customer-facing services.

Juniper Networks provides a broad set of technologies that enable IPv4/IPv6 coexistence, while also helping organizations transition to IPv6 in a controlled and cost-effective manner. With broad support for v4/v6 dual stack, NAT44, NAPT44, NAT-PT, NAT64, 6to4-PMT, 6rd and Dual Stack Lite (DS-Lite), the Juniper Networks Junos® operating system (Junos OS) supports NAT on IPv4 and IPv6 networks, and also on traffic transitioning between the two.

Juniper Networks NAT technology, including NAT64, allows enterprises and service providers to bridge IPv4 and IPv6 by transitioning network traffic between the two. NAT is a key technology for optimizing IPv4 address space and enabling IPv4/IPv6 coexistence.
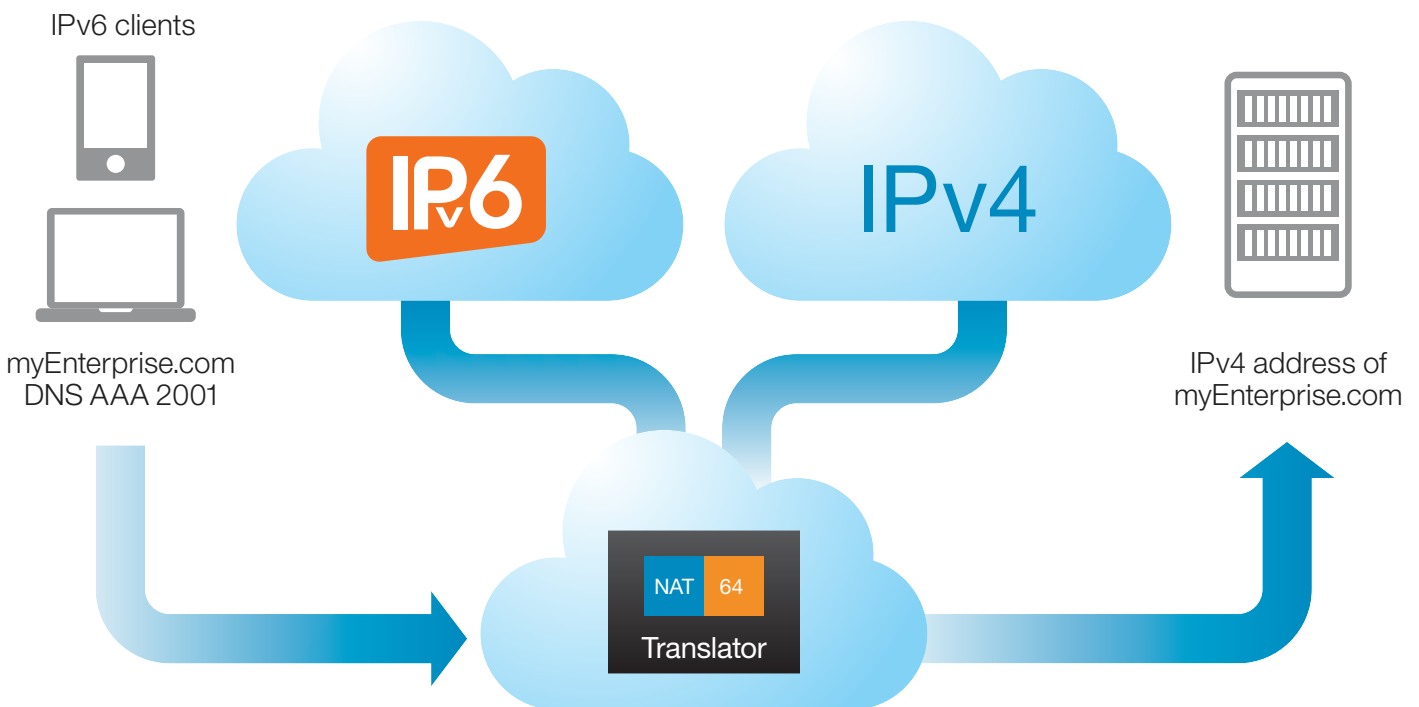
Juniper Networks' NAT technologies ensure that users can access IPv6 networks and content without having to immediately upgrade software and hardware (e.g., modems and routers) at the end point, as the replacement costs involved would be too great. Juniper's flexible NAT-based solutions give enterprises and service providers more cost-effective options for transitioning to IPv6, while optimizing their existing IPv4 address space. This approach effectively buys organizations more time to properly plan their IPv6 transition and helps mitigate the costs and risks associated with IPv6 enablement.

IPAM plays an integral role in helping organizations monitor and track their IPv4 address space and redistribute IP addresses where their value can be maximized. IBM, BlueCat Networks and Juniper Networks are working together to allow enterprises, service providers and telecommunications companies to optimize their networks and accommodate growth on existing infrastructures, while at the same time making the inevitable transition to IPv6 as affordable and painless as possible.

Summing up

Smarter virtualization, cloud and IPv6 transition initiatives start with IP Address Management (IPAM). By deploying IP Address Management at the core of their network, organizations can take control of their IP address and name space and achieve more reliable service delivery and greater efficiencies and cost savings in network operations. Organizations that put IPAM in place today will also be better prepared to successfully plan and implement IPv6 when they are ready.

IBM has selected BlueCat Networks as a strategic partner for IPAM to help organizations build smarter networks. Juniper Networks enhances and extends the value of this strategic relationship by delivering the critical network infrastructure components and expertise needed for successful IP-dependent IT initiatives.

The strategic relationship between BlueCat Networks, IBM and Juniper Networks gives customers the opportunity to leverage the innovations and best practices of three leading technology companies that share a common goal: to provide the robust, scalable and secure IP Address Management infrastructure, network infrastructure and hardware/software infrastructure required for organizations to mitigate risk and realize the benefits of virtualization, the cloud and IPv6.

By taking a big picture view of the infrastructure components needed for successful virtualization, cloud and IPv6 initiatives, and working together on an integrated strategy for delivering these best-of-breed components, BlueCat Networks, IBM and Juniper Networks offer a unique solution that is more than the sum of its parts.

"Through 2020, both the public Internet and the typical corporate/government network will carry both IPv4 and IPv6 traffic."

Gartner Inc., "Hype Cycle for Networking and Communications, 2011," David A. Willis, 24 August 2011