ROI of Infoblox IPAM (IP Address Management) for DNS and DHCP
3-Year Total Cost of Ownership Evaluation Versus Microsoft DNS and DHCP Services

Executive Summary

Many organizations use the "free" Microsoft DNS and DHCP services that are bundled with Microsoft Windows Server 2008 or previous Windows Server releases. However, without IP address management (IPAM) tools the Microsoft solution can be expensive to manage. Infoblox provides a low impact "overlay" solution for IP address management that lowers the cost of ownership for Microsoft DNS and DHCP servers. Infoblox additionally provides an appliance-based infrastructure to host DNS, DHCP that improves enterprise-wide DNS and DHCP availability and simplifies infrastructure maintenance.

Both of these alternatives enhance the scalability and reliability provided by Microsoft DNS and DHCP and provide a rapid payback on the investment. See Tables 1 and 2.

The Bottom Line

1 Infoblox IPAM for Microsoft DNS and DHCP servers save the organization more than 70% labor costs per year and pays for itself in as little as 3- 6 months

2 Infoblox IPAM automation can eliminate common human errors and deliver 3-year operational cost reduction in enterprises networks of between $60,000 and $500,000

3 Infoblox appliances as the DNS and DHCP servers for critical applications can dramatically improve reliability and scalability – particularly with regard to IPv6 migration and virtualization in the data center

Annual IPAM TCO Labor Savings Projection

	2,000 to 10,000 IPs	10,000 to 20,000 IPs	20, 000 to 35,000 IPs	35,000 to 60,000 IPs	60,000 to 100,000 IPs	More than 100,000 IPs
Microsoft servers being managed (mixed DHCP/DNS servers)	up to 10	up to 15	up to 30	up to 30	up to 50	up to 50
Estimated staff hours/week without Infoblox	8	16	34	44	55	68
Estimated staff hours/week with Infoblox	2.18	4.36	9.26	11.98	14.97	18.51
Annual TCO savings from labor	$22,707	$45,413	$96,504	$124,887	$156,109	$193,007

Hourly labor rate used = $75

IPAM Investment Payback

	IB 550 (single)	IB 550 (pair)	IB 1050 (single)	IB 1050 (pair)	IB 1550 (single)	IB 1550 (pair)
CAPEX of appliance & software*	$7,145	$14,290	$14,845	$29,690	$20,895	$41,790
Annual maintenance	$1,295	$2,590	$2,645	$5,290	$3,745	$7,490
Provisioning (1/2 to 1 full day)	$300	$300	$450	$450	$600	$600
1st Year Investment Cost	$13,967	$28,233	$78,564	$89,457	$130,869	$143,127
1st year TCO savings per month	$1,164	$2,353	$6,547	$7,455	$10,906	$11,927
Payback period in months based on 1st year TCO	6.1	6.1	2.3	4.0	1.9	3.5
3 year TCO reduction	$59,380	$119,060	$271,571	$339,231	$443,087	$529,142

* includes IPAM for Microsoft. All prices USD.

Source: Tolly, March 2011   Table 1

Executive Summary

… Continued

Infoblox provides an easy-to-deploy IP Address Management (IPAM) automation solution for Microsoft DNS and DHCP that does not require replacement or modification of an organization's existing Microsoft server infrastructure. This solution can pay for itself in as little as 3 months for a large enterprise. Maintaining free DNS and DHCP service infrastructure from Microsoft, in an enterprise organization, is actually significantly more expensive in the long run.

Organizations migrating to new technologies such as IPv6 and virtualization can see an elevated risk of application or network outages if they continue to use non-automated DNS/DHCP systems. Human-error alone may cause many problems due to the complexity and frequency of IP address management issues. The Infoblox IPAM solution can mitigate these risks by reducing or removing human error related to complex IPv6 addressing and maintenance of virtual machine address pools.

Tolly engineers validated Infoblox's support for enterprise-class reliability and high availability features for DHCP and DNS infrastructure – such as DHCP protocol layer failover, VRRP-based hardware failover, DNS Anycast support, and Zero Downtime Updating - which satisfy critical enterprise infrastructure requirements for reducing application downtime or potential network outages.

Microsoft DNS/DHCP would require significantly more software and hardware investment to cluster servers and maintain an automated patch management system, yet would still not achieve the same availability metrics because some Microsoft mechanisms such as DHCP split scopes

actually degrade the available address space. Infoblox appliances provide a more robust DNS/DHCP infrastructure that can easily pay for itself over a 3 year lifecycle if customers migrate mission critical Microsoft DNS/DHCP services to Infoblox appliances.

The TCO/ROI test results were calculated for an IPv4 networking environment. An IPv6 environment running Microsoft DNS and DHCP services will likely experience significantly higher costs without IPAM automation, because the complexity of IPv6 addressing can push manual management procedures to their limits and produce high human error rates. Infoblox IPAM for Microsoft DNS and DHCP will help reduce those IPv6 related errors and deliver even more TCO/ROI benefits in an IPv6 environment as compared to free Microsoft services.

Background

In this study, Tolly engineers evaluated the Infoblox IPAM solution in two scenarios:

- "overlay" solution for IPAM on top of Microsoft DNS and DHCP servers.
- appliance-based solution to host DNS, DHCP services.

In both these scenarios, Tolly engineers calculated the time taken to perform common maintenance and administration tasks involved in IP address management. The same tasks were then executed using the free DNS and DHCP management tools bundled with Microsoft Windows Server 2008.

Finally, the time measurements obtained from the above tests were then used to calculate the total cost of ownership over a 3-year lifecycle. The observations from the IPAM administrative tasks are detailed in the following sections.

Effort Comparison: IPAM Administration Tasks

Move, Add Or Change DNS Records

This test group compares the effort and time required to make moves adds or changes for DNS server records using the Microsoft DNS Manager tool in the Microsoft Management Console (MMC) vs. the graphical IPAM tools of Infoblox.

There were 3 processes included in this measurement:

- Change the standard attributes of a DNS Records such as its name, IP address or MAC address.
- Move a record to a different DNS Zone.
- Add or change device meta data used for classifying and tracking other information about the device (such as device type, the device user, device location, department, etc.)

The operations for changing individual DNS record data are relatively high frequency due to users getting new devices, people being transferred to different departments, new employees being hired, employees leaving the organization, and other actions. In a typical enterprise they could also be triggered by some of the following occurrences:

- Adding or modifying attributes of a fixed IP address device such as a printer or VoIP phone on the network.
- Moving a fixed IP address device such as a printer or server to another DNS Zone on the network.
- Adding or changing IPAM meta data to DNS records (Infoblox only) to assist IP

address management by associated detailed user or device information with a DNS record. In a Microsoft-only DNS/DHCP environment this meta data must be tracked through some kind of external data management tool – which is often a spreadsheet.

- Adding an IPv6 AAAA record for a IPv4 server on a dual-stack IPv4/IPv6 DNS server.

The IPAM automation tools from Infoblox will simplify DNS Record moves, adds and changes and help network administrators perform maintenance tasks more efficiently. The head to head difference between the

Best Practice IPAM Operations Workflow (measured in minutes)			
	Repetitions	Microsoft	Infoblox
Move, add or change DNS record for client device or other host (printer, server, VoIP phone, etc.)			
- Change device attributes in A or AAAA record (device name, IP mapping.)	2	1.92	0.42
- Move to new DNS zone (client device, printer, server, virtual machine)	2	2.02	0.53
- Add new DNS record and/or record meta data *	4	1.92	0.33
Subtotal based on repetitions (in minutes)		15.53	3.23
Troubleshoot and remediate user, device or host IP address allocation problems			
- On-demand IPAM data analysis and problem identification**	1	14.00	3.00
- Fixed IP or DHCP lease problem resolution (e.g. resolve IP address conflict, reclaim lease, etc.)	1	1.10	1.75
- Track IP via attribute (e.g. MAC address) to resolve technical, policy, security or compliance issue	2	4.67	3.18
Subtotal based on repetitions (in minutes)		24.43	11.12
Data management, auditing and reporting operations			
- Management summary of all changes in the last week (across all servers)**	1	14.00	0.75
- Full IP address inventory showing device type, managed vs. unmanaged, etc.**	1	14.00	3.00
- IP inventory filtered by various meta data (list of servers, printers, VoIP phones, etc)**	4	5.03	1.13
Subtotal based on repetitions (in minutes)		48.13	8.28
Planned network maintenance and/or modification			
- On-demand report of current DHCP configuration**	1	14.00	3.00
- Modify existing scope (redefine, resize, etc.)	1	2.58	2.37
- Modify allocation within scope (reserve 1st 100 for fixed addresses)	1	1.00	0.57
- Add new DHCP scope and error-check for issues such as overlap	1	4.77	1.50
Subtotal based on repetitions (in minutes)		22.35	7.43
Total Time (in minutes)		110.45	30.07
Time Saved by Infoblox (in minutes)			80.38
% time saved by Infoblox			72.78%

Note:
- The repetitions in the workflow represent a relative weighting for the frequency with which most users perform these procedures
- Actual user results will proportionally increase or decrease based on actual network architecture and server count
- * Microsoft time includes data export/import of CSV files but not searching or formatting by spreadsheet or other data management tools
- ** The data for this measurement was assembled across 4 Microsoft DHCP servers as shown in the network diagrams attached to this report

Source: Tolly, March 2011   Table 2

Microsoft tool and the Infoblox GUI may not be large for an individual change but in a large company these kinds of changes are performed frequently and the aggregate time for all changes adds up quickly.

The primary tool used on a Microsoft server for this is the DNS Manager of the Microsoft Management Console. The Microsoft tool provides a limited amount of information in IPv4 DNS A Records and/or IPv6 AAAA records – specifically device type, name, IP Address and MAC address. Any other information that an organization wishes to associate with users or devices for those records must be kept in an external database or document (the spreadsheet tracking system is extraordinarily common).

The Infoblox IPAM tools provides an integrated database that allows both IPv4 A Records and IPv6 AAAA Records to maintain additional meta data information called "Extensible Attributes" with each DNS record. By associating Extensible Attributes with DNS records an organization gains significantly more ability to sort, search and classify DNS records in multiple ways. This makes it easier to find a record you may want to change or filter for a group of records. As will be discussed in another test profile the Extensible Attributes also make it easier to perform audits, produce organized reports and to generally manage a large volume of DNS records and information.

The database underlying the Infoblox DNS management GUI is the same database underlying the Infoblox DHCP server so that any GUI change made to DNS data will immediately update correlated lease information in DHCP services – even Microsoft DHCP services that are distributed across multiple servers.

The Infoblox management approach allows an administrator to perform the operations in less time with fewer errors and in addition

create a richer data set within its tools for IPAM record searching, tracking and filtering.

Real-time Troubleshooting And Remediating Procedures For IP Address Allocation Issues

This test group compared the effort and time required to find, diagnose and resolve IP network address allocation issues on a network in real time using the built-in Microsoft Management Console Tools for DHCP management vs. the graphical IPAM tools from Infoblox.

There were 3 processes used in this measurement:

- Use the available management tools to find and diagnose the issue on demand when a problem is reported.
- Resolve an issue related to an IP address conflict - the root cause of which is usually a human error.
- Use the available tools to discover meta data about a specific IP or MAC address that was identified as a problem so that the device or user can be located.

These operations, depending on the network complexity and goals of an organization, are medium to high frequency events. In a typical enterprise they could be triggered by some of the following:

- A network server having a network performance problem because it was assigned an address already in use. Inaccurate data from a manual tracking system whose IP inventory data was not updated properly is a common cause of this issue.
- Duplicate IP addresses are issued by 2 different MS DHCP servers that are mistakenly allocating the same address space due to overlapping scopes.
- Over-utilization of a DHCP scope which must be resolved by discovering and reclaiming allocated but currently

unused IP leases in the scope's address pool.
- Identifying and locating unmanaged devices in a network scope by discovering their IP lease information and associating it with other information such as the user's department or the switch port on which they are attached.

The visual automation tools from Infoblox will simplify network problem analysis, troubleshooting and problem resolution for network administrators so they can perform all such troubleshooting operations more easily, more quickly and more efficiently. See Figure 1 for a sample management screen.

The capabilities for trouble shooting and problem resolution in the Microsoft DHCP Manager of the Microsoft Management Console are very limited. Network administrators must often search through DHCP configuration data in different scopes on different servers to pinpoint a problem.

In contrast, the Infoblox IPAM product provides automated network discovery capabilities and graphical displays that make it easy to identify address allocation or management problems in a single integrated process. For example, the Infoblox tools can perform periodically scheduled ping sweeps of a network and graphically represent the full address space on a graphical map. The map displays a complete list of devices connected within the scope that is color coded. The map shows issues such as address conflicts and allows a network administrator to resolve the problems by pointing and clicking. The map will also identify unmanaged devices (devices that are found by the ping sweep but for which there is no DNS record in the IPAM database).

Infoblox automated IPAM tools, such as the network map, enable an administrator to be more responsive to their end user

communities and saves time when resolving problems.

Data Management, Auditing And Reporting Procedures

This test group compared the effort and time required to perform periodic audit and discovery operations and produce reports of the data for the purposes of management oversight, compliance, security or other business requirements.

There were three processes used in this measurement:

- A management audit summary of all changes made in the system during the last week.
- A full network IP inventory report and analysis.
- Filtered inventory reports that summarize IPAM data by associated metadata.

These operations are typically medium frequency events, generally performed on a weekly basis, but are nonetheless an essential part of IPAM Best Practices. In a typical enterprise these operations could consist of any of the following:

- A pro-active management procedure which regularly produces an inventory report of the network and it's scopes, allocation schema and other information in order to discover problems before they impact end users.
- A Compliance Report listing what IPAM management operations may have been made regarding any of the organizations systems that contain data covered by compliance regulations such as PCI, HIPAA or others.
- A Management Change Audit for security purposes listing all moves, adds, changes and other operations performed on the DNS and/or DHCP servers, who made them, and when the changes were made.

Infoblox Management Console: IP Map
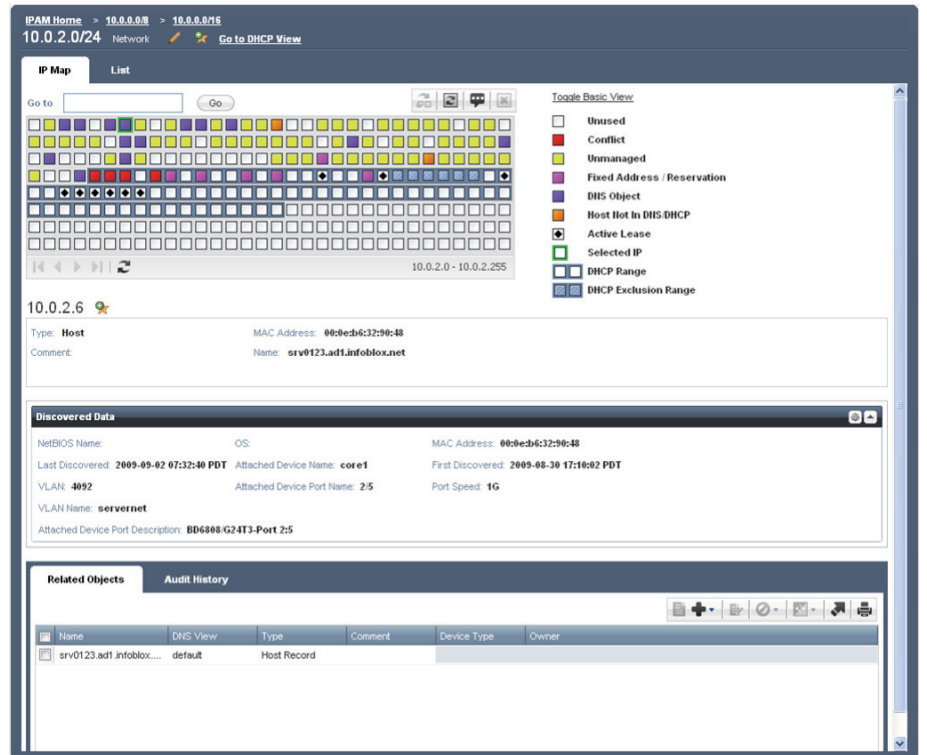
The IP Map provides a quick view of all IPs within a range and access to IPAM functions to manipulate IP addresses. From this view the administrator can manage DNS records, assign fixed addresses, resolve IP address conflicts and review the audit history for any IP address displayed.

Source: Infoblox, March 2011   Figure 1

- A Security Audit which searches for a long term history of any changes that meet a specific profile. For example, you may want to list any changes made by a specific network administrator over a period of time, or you may want to compile a list of any "unmanaged" devices that have active IP addresses or leases.
- An organized and sorted report for IP asset management.

The IPAM automation tools from Infoblox will simplify both regularly produced summary reports and on-demand diagnostic or auditing reports for network administrators so they can perform required

oversight, forensics and maintenance operations more easily, more quickly and more efficiently.

The capabilities in the Microsoft DNS and DHCP Managers of the Microsoft Management Console for searching, auditing and reporting are very limited. Network administrators must often search through DNS and DHCP configuration data in different scopes on different servers to find the required information, then export it to text or CSV files, then use a tool such as a spreadsheet or 3rd party reporting tool to consolidate and organize the data. Since the DNS record data and IP lease information formats in Microsoft DNS and DHCP servers

are limited to the basics such as Device name, IP Address, and MAC address it isn't possible to automate filtering or searching of the data for granular summaries such as a list of all unmanaged devices or a history of all management changes made by a specific network administrator over a specific period of time.

In contrast, the Infoblox IPAM product provide automated network discovery, search, filter and reporting capabilities that make it easy to filter, find, organize and produce any information report in a single integrated process. In addition, because the Infoblox IPAM system makes use of Extensible Attributes for DNS and DHCP, an administrator can search and filter massive amounts of granular data quickly and accurately. For example, the Infoblox GUI can perform a complete management audit of all changes made to DNS records or DHCP IP address scopes by a specific network administer, over a specific period of time, across the entire network, with only a couple of mouse clicks. Similarly, a report of any IP related configuration changes made to any system covered by regulations such as PCI or HIPAA for compliance purposes can just as easily be produced.

Infoblox IPAM automation tools and features such as Extensible Attributes enable an administrator to compile the data for reports, search or filter the information, much more quickly and in much more useful ways than is possible with Microsoft DNS and DHCP management tools.

Planned Network Expansion Or Modification Procedures

This test group compared the effort and time required to make planned adds or changes to an organizations IP network architecture, such as adding or modifying a network or scope, using built in Microsoft DHCP management tools vs. the single graphical network view in the Infoblox IPAM products.

There were four processes used in this measurement:

- Reviewing the current network and scope configurations
- Adding a new DHCP scope to the network
- Modifying the size of an existing scope
- Modifying the fixed vs. dynamic ranges within and existing scope

These operations are medium to low frequency events requiring changes to the organization or layout of the network. In a typical enterprise they could be triggered by some of the following occurrences:

- A general expansion of a network from organic growth within the organization or through some kind of merger or acquisition
- Discovering a mistake in the current IP configuration of the network or a network scope
- Expanding the scope for a user workgroup or set of resources in a data center to accommodate more people, network devices or servers.
- Reconfiguring a Virtual LAN within the user address space or data center address space of a network
- Executing a management policy decision regarding the distribution of fixed vs. dynamic address scopes within a network
- Adding or modifying an IPv6 network and an IPv4 network

The visual automation tools from Infoblox will simplify network moves, adds and changes and help network administrators perform maintenance tasks more efficiently and accurately.

The primary tool used on a Microsoft server for the procedures in this test group is the DHCP Manager of the Microsoft Management Console. With Microsoft DHCP each server on the network will keep its own

log of its DHCP configuration. There is no built-in Microsoft MMC tool that lets an administrator visualize the entire network in a single view. An external product or enterprise management console must be used to discover, track or display all DHCP server configurations across the entire network.

In the event of a major change, such as a merger or acquisition, the new network data for the organization must be manually entered in the appropriate DHCP server. In the Microsoft DHCP architecture no individual DHCP server has knowledge of any other DHCP server or the network and scope configurations on any other server. If split scopes are added or modified it will require input into multiple servers to complete the configuration.

In contrast, the Infoblox IPAM product will provide a single view of the network which displays all current DHCP configurations, all fixed address network ranges, and all unused network ranges in a single graphical view. A color coded legend shows which regions of the network address space are in use and which are unused. The network and it's scopes can be easily modified by pointing and clicking on the map. In situations such as a merger, new network configuration data can be bulk imported into the tool for quick assimilation.

The Infoblox GUI is integrated with the Infoblox database so any GUI made changes will immediately update the database – and populate the map with updated data. Likewise, if any data is imported into the database, the GUI will synchronize with the database and immediately display the new network data.

For many procedures, Infoblox provides error detection and correction features within the Graphical User Interface so that an administrator cannot make a mistake. Error correction and detection is also

embedded within the bulk data import features of the Infoblox tools so that errors such as overlapping network scopes can be detected and excluded.

The Infoblox management approach allows an administrator to perform network architectural changes and planned network maintenance operations in much less time and eliminate the potential of costly human error.

Setting Up Automation Features

This test compared the effort and time required to configure automation feature templates and Smart folders. These templates and Smart Folders can then be used to streamline redundant configuration procedures and to organize data presentation and reporting.

There were 3 procedures used for these measurements:

- Set up network scope template
- Set up Extensible Attributes template
- Set up smart folders for organizational departments and branch offices

A small amount of setup time with Extensible Attribute templates will lead to a lot of labor savings down the road as administrators perform redundant network provisioning and IPAM record management tasks. By using smart folders Infoblox IPAM tools will automatically organize data in an onscreen set of folders and essentially pre-sort and filter data for reporting.

Network templates promote consistency and accuracy as an administrator performs DHCP management tasks such as adding a new scope to the network. The template will present the format that needs to be followed. The template can require mandatory data to be filled out.

Extensible Attributes are meta data that can be associate with basic DNS records. The

Extensible Attributes will provide richer information than just host name, host type and host IP so that administrators can have more information available for analysis and troubleshooting. For example, as done in a similar test in the Test Profile 2 workflow where an IP was located by it's MAC address, any Extensible Attribute could be used to locate a record, as well as to learn other information about the record. The Extensible Attribute data is correlated with DNS records by the Infoblox IPAM database. As with network templates, the Extensible Attribute templates promote consistency and can require mandatory data to be filled out.

Smart folders are essentially an active filter for the graphical user interface (GUI). A smart folder is configured with attributes and then any IPAM database record that matches the smart folder filter are automatically displayed in the smart folder within the GUI. Smart folders help administrators stay organized around their workflow and save them a significant amount of time when searching for data.

Planned Infrastructure Maintenance DNS And DHCP Server Infrastructure

This test compared the time required for human supervision of hardware maintenance or software upgrade procedures for Microsoft servers compared to Infoblox servers.

For the Microsoft servers we are conservatively estimating updates at once per quarter. This would include security vulnerability patching and other issues. We are estimating a once per year per server maintenance requirement which consists of 1 annual Service Pack level software update and 1 annual incident for some kind of hardware update or problem resolution.

For the Microsoft servers we assume the update or upgrade requires a human operator in all cases for the duration of the

upgrade and the measurement includes the man hours the operator is involved. While there are automated systems available for Microsoft servers to update and upgrade software we did include the use of one of those systems in this test. The cost of one of those systems far exceeds the estimated cost calculated in this test and therefore we believe this test result is a fair and objective estimate of cost.

For the Infoblox appliances the upgrades are automated and can be scheduled for remote appliance upgrades through the Grid Master. Therefore, the estimate is the amount of time required for updating the Grid Master and then setting the schedule. Note that in the Infoblox Grid deployment there is no measurable downtime in the upgrade process, as the entire process is automated and services are not impacted.

Setting Up And Maintaining External DNS Authoritative Forwarding

This test compared the effort and cost required to setup and maintain a secure DNS authoritative forwarder for the Internet so that customers and business partners can find the organizations web site, mail server and other Internet facing services. This test includes the requirement for DNS Security Extensions (DNSSEC) for the Internet facing DNS forwarder so the DNS server is protected from hijacking attacks.

Infoblox notes that, in general, Microsoft DNS servers are rarely used as an external DNS secondary on the Internet, although they could be used in such a manner. Microsoft DNS does support DNSSEC. But one of the key issues inhibiting broad use as an authoritative forwarder are security concerns about malware and other vulnerabilities on such a general purpose operating system as Microsoft server.

Another key issue is that non-automated management of DNSSEC is highly labor intensive. Finally, best practice security around DNSSEC requires frequent turnover and refresh of keys used within DNSSEC for signing DNS zones and the keys which sign the DNS query responses with which a DNSSEC server responds.

The procedures for maintaining a Microsoft DNSSEC server and for refreshing the keys are entirely manual and would probably be prohibitively expensive for most organizations to self-manage. So most organization either outsource their external DNS or use a Bind-based external DNS server. For the Microsoft test, engineers substituted the annual estimated cost of an outsourced DNSSEC server. Also, this cost is only included in the TCO estimates of the larger 1500 user organization, because in the 500 user overlay comparison the assumption is that external DNS is a sunk cost.

Infoblox provides a completely automated solution for external DNSSEC. The automation capabilities include refreshing the Zone Signing Keys and Query Signature Keys which were discussed previously as a DNSSEC Best Practice. The Infoblox DNSSEC management tools enable a schedule to be set to automatically perform all software update and key refresh procedures. Once those are configured there is no more manual labor required for maintenance.

Test Environment

The test environment simulated a corporate network consisting of one headquarters and two branch locations, as shown in Figure 2. The headquarters location used two Infoblox appliances while the branch networks did not. It was assumed that the branch networks utilized the DNS and DHCP services provided by Microsoft servers or dedicated Infoblox IPAM appliances in the headquarters.

Test Bed Topology
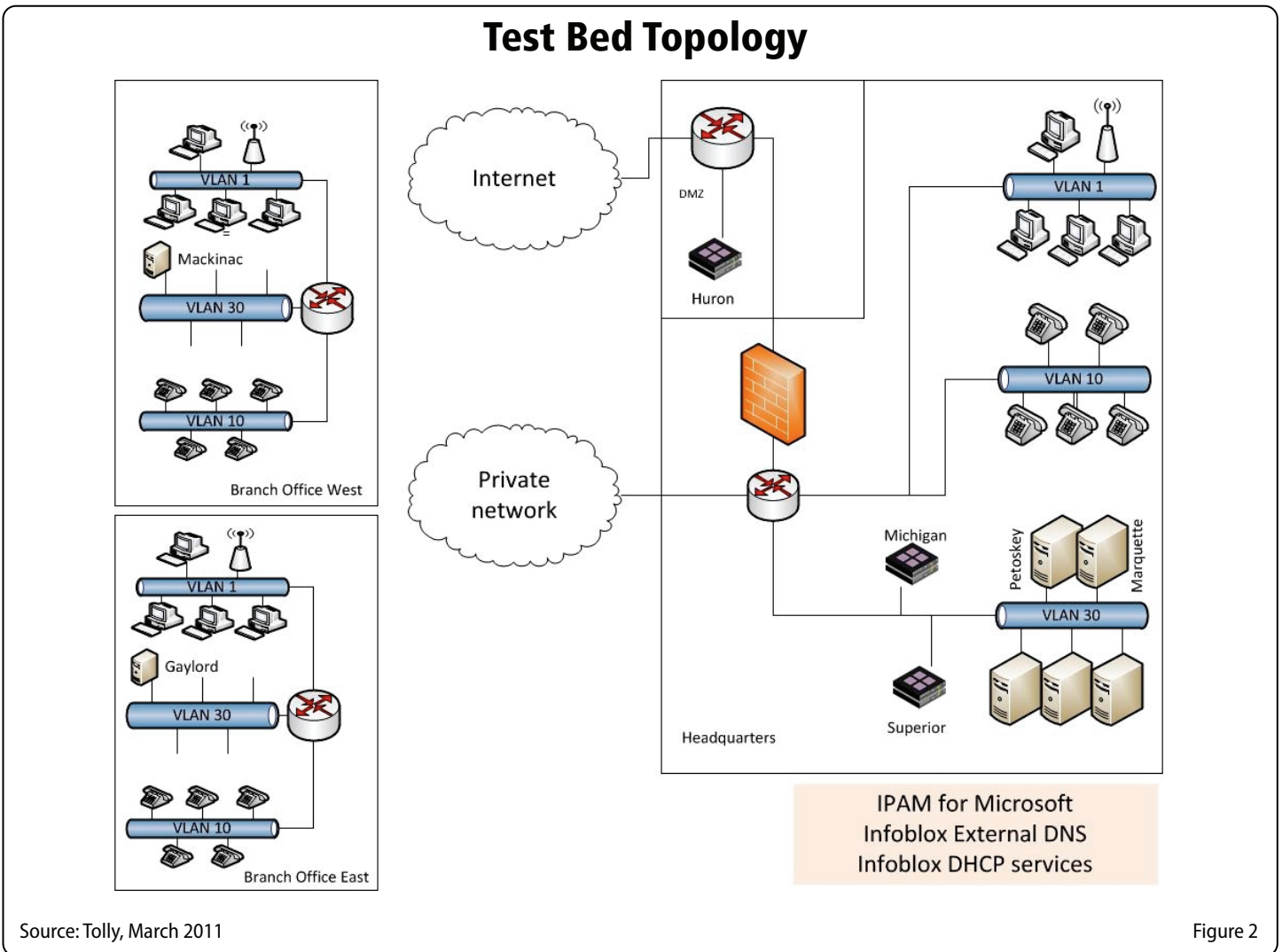
Source: Tolly, March 2011   Figure 2

About Tolly…

The Tolly Group companies have been delivering world-class IT services for 20 years. Tolly is a leading global provider of third-party validation services for vendors of IT products, components and services.

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Interaction with Competitors

In accordance with Tolly's Fair Testing Charter, Tolly personnel invited representatives from Microsoft to review the test plan. Microsoft representatives reviewed the methodology and did not offer any comments.

For more information on the Tolly Fair Testing Charter, visit:
http://www.tolly.com/FTC.aspx

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