

IPV6: Migration and beyond

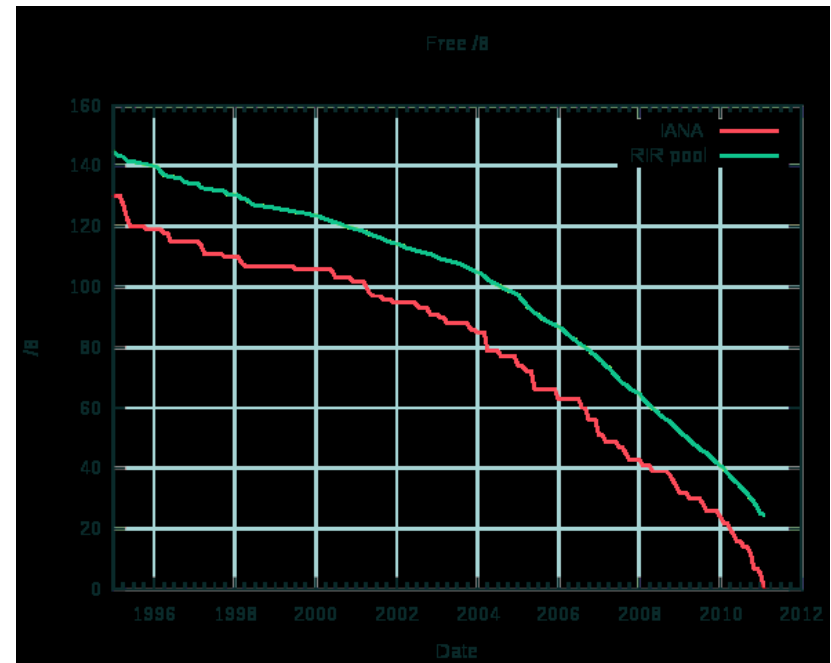
Thomas Hedströmmer

SE +46 733 35 95 91

thedstrommer@infoblox.com

- **IPV6: What is it?**
- **Why Migrate?**
- **Migration Challenges**
- **Infoblox Solutions**

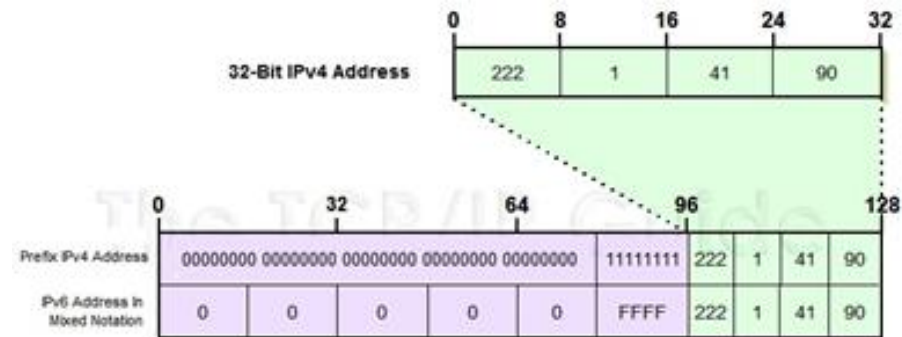
- **IPv4 address consumption**
 - Top level (IANA) is completely gone
 - Regional Registries running out
 - Stop-gap measures are short term
 - Reclaiming unused ranges
 - Microsoft buys Nortel Class-Bs
- **Growing sense of urgency**
 - Must have for ISPs
 - Government mandates
 - Media creating corporate awareness



— = Internet Assigned Numbers Authority (Top Level)
— = Regional Internet Registries

A Few Examples ...

- **Larger address space**
 - IPv4 = 4 Billion
 - IPv6 = 340 undecillion (36 zero)
- **More numerous, larger subnets**
- **Different numbering system**
 - Random IPv4 = 222.1.41.90
 - Random IPv6 = FEDC:BA98:0332:0000:CF8A:000C:2154:7313
- **More DHCP options**
- **Stateless Auto Configuration (SLAAC)**
- **Different DNS record formats**
 - IPv4 = A record
 - IPv6 = AAAA record



Organization type	Recommendation
Broadband Providers	<ul style="list-style-type: none"> Your customers want access to the entire Internet, and this means IPv4 and IPv6 websites. Offering full access requires running IPv4/IPv6 transition services and is a significant engineering project. Multiple transition technologies are available, and each provider needs to make its own architectural decisions.
Internet Service Providers	<ul style="list-style-type: none"> Plan out how to connect businesses via IPv6-only and IPv4/IPv6 in addition to IPv4-only. Businesses are beginning to ask for IPv6 over their existing Internet connections and for their co-located servers. Communicate with your peers and vendors about IPv6, and confirm their timelines for production IPv6 services.
Content providers	<ul style="list-style-type: none"> Content must be reachable to newer Internet customers. Content served only via IPv4 will be accessed by IPv6 customers via transition solutions run by access providers. Plan on serving content via IPv6 in addition to IPv4 as soon as possible.
Enterprise	<ul style="list-style-type: none"> Mail, web, and application servers must be reachable via IPv6 in addition to IPv4. Open a dialogue with your Internet Service Provider about providing IPv6 services. Each organization must decide on timelines, and investment level will vary.
Government	<ul style="list-style-type: none"> Coordinate with industry to support and promote awareness and educational activities. Adopt regulatory and economic incentives to encourage IPv6 adoption. Require IPv6 compatibility in procurement procedures. Officially adopt IPv6 within your government agencies.
Equipment Manufacturers	<ul style="list-style-type: none"> Introduce IPv6 support into your product cycle as soon as possible

IP version	IPv4	IPv6
Deployed	1981	~1999
Address Size	32-bit number	128-bit number
Address Format	Dotted Decimal Notation: 192.0.2.76	Hexadecimal Notation: 2001:0DB8:0234:AB00:0123:4567:8901:ABCD
Number of Addresses	$2^{32} = 4,294,967,296$	$2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456$
Examples of Prefix Notation	192.0.2.0/24 10/8	2001:0DB8:0234::/48 2600:0000::/12
Security	IPSec	IPSec Mandated, works End-to-End
Mobility	Mobile IP	Mobile IP with Direct Routing
Quality of Service	Differentiated/Integrated Service	Differentiated/Integrated Service
IP Multicast	IGMP/PIM/Multicast BGP	MLD/PIM/Multicast, BGP, Scope Identifier

- **Expanded addressing capabilities**
- **Structured hierarchy to manage routing table growth**
- **Server less auto-configuration and reconfiguration**
- **Streamlined header format and flow identification**
- **Improved support for options / extensions**



A wide range of techniques have been identified and implemented

- **Dual-stack** techniques, to allow IPv4 and IPv6 to co-exist in the same devices and networks
- **Tunneling** techniques, to avoid order dependencies when upgrading hosts, routers, or regions
- **Translation** techniques, to allow IPv6-only devices to communicate with IPv4-only devices

Expect all of these to be used, in combination.

- **Security policies need to be revised**
 - Security issues with IPv4 are well documented; IPv6 remains unexplored
- **Application compatibility needs to be verified**
 - Not all of your existing applications are IPv6 compliant
 - Upgrades may be required
- **V6 compatibility in networking equipment often comes with performance risks**
 - Unlike IPv4 several IPv6 implementations not yet optimized
- **Backend tools are lacking**
 - Current management and troubleshooting tools and methods may not work
- **SPAM tools need to be reinvented.**
 - Heavy reliance on DNS
- **Testing v6 Services for Compatibility**
 - Few reference implementations to test against



The Good News: *The industry has prepared*

- **Most modern OS are ready**
 - Windows 7
 - MacOS X
 - Linux
 - Android and Apple iOS
- **Most modern infrastructure is ready**
 - Routers
 - Switches
 - Firewalls
 - Application Deliver Controllers (SLBs)
 - WAN Optimization
- **IPv6 already routed over Internet**

The Bad News: *Many customers are unprepared*

- **Investigating but no active plan**
- **Some legacy infrastructure doesn't work**
- **Many applications don't support IPv6**
- **Very little IT organizational experience**

Manual change – one by one

- Repetitive tasks for expensive staff
- Hope for no fat fingers or bad copy and paste

Custom scripts (i.e. PERL)

- One expert, hope they never leave
- Always adding more and more over time

We are the experts

- Assume it works, hope for the best
- If it breaks, go fix it

Rely on the change management process

- No one ever makes an undocumented change
- All changes occur within the window and process
- Assume all details are up to date and correct

IPV6 migration will expose these risks

- **Automate**

- Network configuration and change
 - Change management for IPV6 enabled devices
- IP Address Assignments and reclaiming
 - Replace spreadsheets based IP space management
- Subnet calculation and allocation
 - Automated calculation and documentation
- DNS configuration
 - AAAA records are hard to manage manually
 - Reverse DNS zones with IPV6

Leadership

Extend current IPv6 DDI solution with unique features that help customers more easily incorporate IPv6 into their network

Low Risk Adoption

Helps customers plan and execute gradual adoption of IPv6 technology without intrusive architectural change or network disruption

Powerful New Features

- *IPv6 IPAM automation*
- *Dual stack IPv4 and IPv6 services*
- *IPv6 DHCP for dynamic address allocation*
- *DHCP IPv6 prefix delegation option*
- *DNS64 to translate IPv6 DNS lookups on IPv4 resources*

Be a Trusted Advisor

Phase 1

IPv6 at network edge for Internet facing services

- Web
- Email
- Cloud applications
- Time to deploy DNSSEC

Phase 2

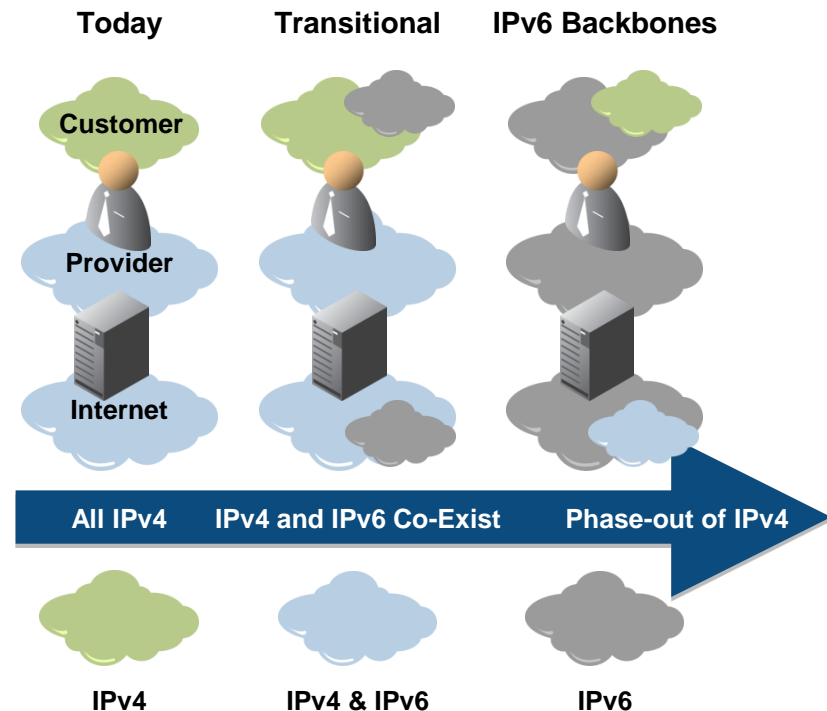
Internal DNS/DHCP with dual stack IPv6 & IPv4

- Needs robust platform
- This may drive platform upgrades

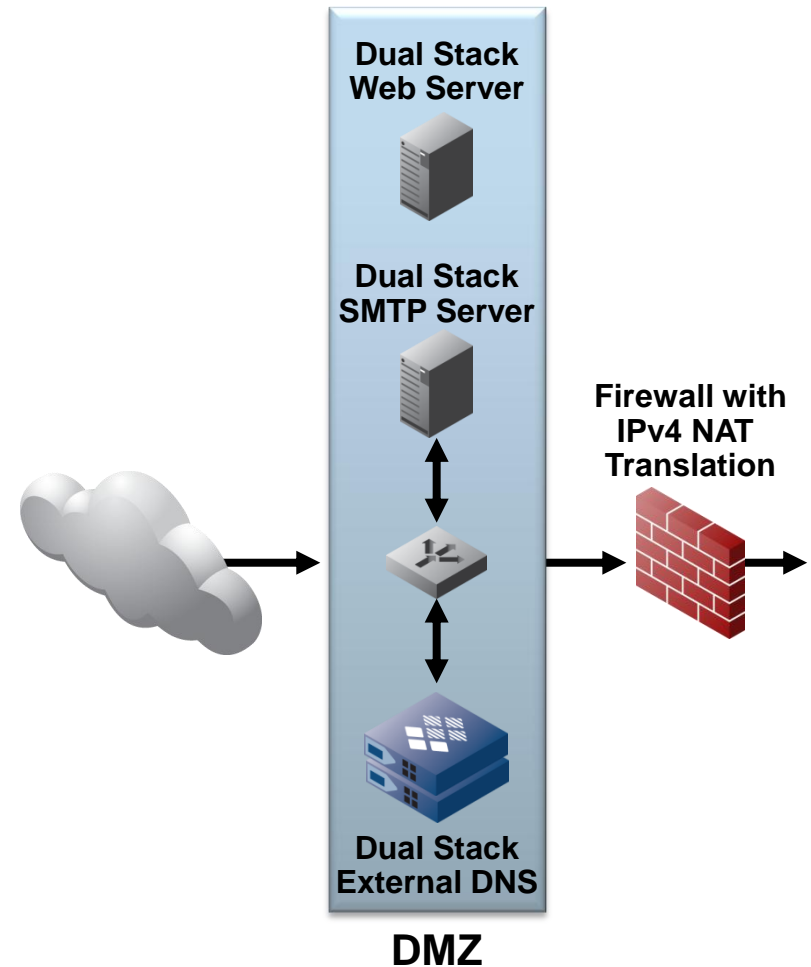
Phase 3

Architectural migration to IPv6 backbone with “legacy islands”

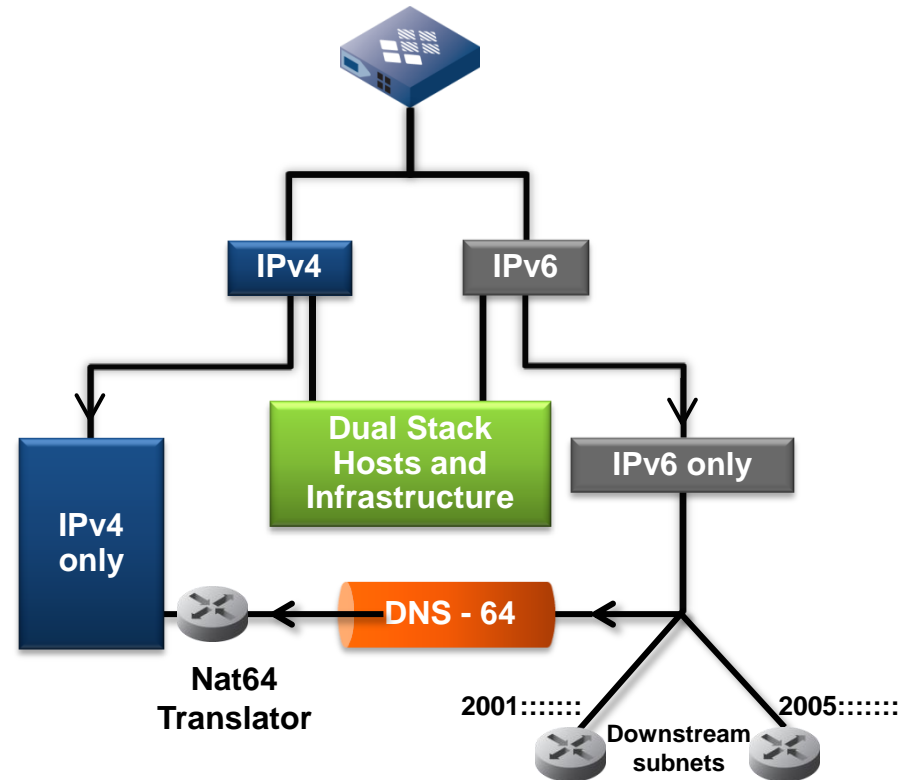
- Translation technologies
- Broad use of tunneling



- **Major domains all signed**
 - .com – announced April 11
 - .gov
 - .mil
 - .net
 - .edu
- **Dual stack servers in DMZ**
 - Respond to either IPv4 or IPv6
 - Must accommodate double data
 - IPv4 DNS A records
 - IPv6 DNS AAAA records
- **Infoblox DNSSEC support**
 - High capacity appliance
 - Also dual protocol
 - Fully automated maintenance

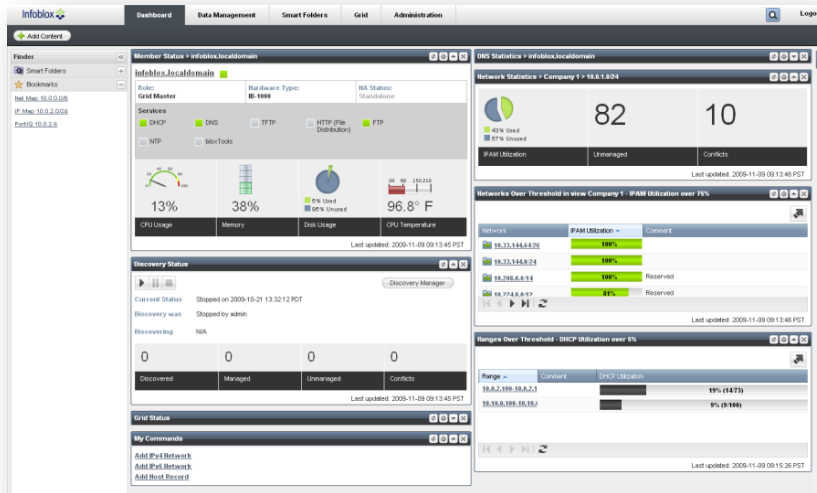


- **IPAM Automation for IPv6**
- **64-bit, dual stack appliances**
- **DHCP for IPv6**
 - Dynamic addresses
 - Delegate ranges “downstream”
- **DNS64 with NAT64 protocol to reach IPv4-only hosts**
 - Legacy internal applications
 - Legacy external web servers
 - Partners (F5, Cisco, Juniper, etc.)



DNS/DHCP/IPAM Automation

- DNS/DNSSEC configuration automation
- IP address management automation



IPV6 Enabled Network Configuration Automation

- Network change automation
- Configuration management
- Compliance, policy enforcement and auditing



IPv6 Capable External Presence	<ul style="list-style-type: none">- DNS for IPv6- Dual Stack DNS Appliance- DNS64
Internal IPv6 Migration Planning	<ul style="list-style-type: none">- Current Network Equipment Inventory (with OS version running)- Current Network Topology and Connectivity- Current Subnet Inventory
Internal IPv6	<ul style="list-style-type: none">- IPv6 IP Address Allocation, Tracking and Reclaiming- DHCP for IPv6- IPv6 Subnet Allocation and Tracking- Dual Stack Devices Tracking (Smart Folders)- Reduced Complexity of Dual Stack Environment and IP Address Explosion
IPv6 Network Infrastructure Management	<ul style="list-style-type: none">- Automated Network Change and Configuration for IPv6- Compliance, Policy Enforcement and Auditing

IPv6 Networking

- Members can have an IPv6 address (HA supported)
- Members will respond to DNS queries from/to IPv6 addresses
- Members will respond to zone transfers from/to IPv6 addresses

DNS and DHCP

- AAAA records in the forward zone
- ip6.arpa reverse zone
- ACLs for IPv6 addresses and networks
- DNS64
- DHCP for IPv6 with prefix delegation

IPv6 IPAM

- IPv6 subnets
- IPv6 address assignment
- Split/Join IPv6 networks
- Host objects with IPv6 IP address

Automated network change automation and configuration management for IPv6

- Understand Cause & Effect
- Management view to health, policy and compliance
- Collect & analyze network infrastructure configurations
- Identify violations of best practice rules
- Identify security policy violations
- See the affect of change on health and policy
- Identify, verify and remediate issues proactively

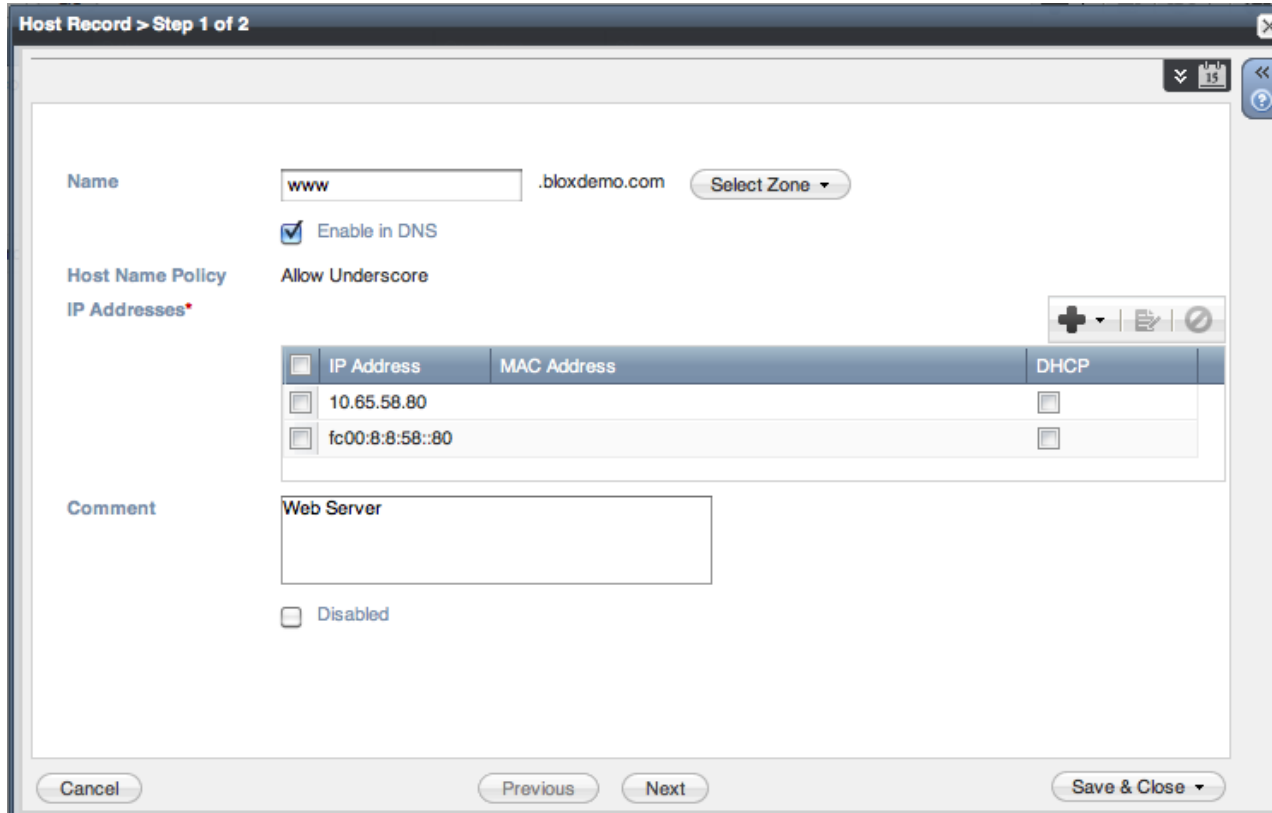
Compliance, policy enforcement and auditing for IPv6

- Hundreds of packaged analysis rules
- Built-in remediation and compliance reports
- Proactive alerts for policy violations
- Live and historical status, trends and reports
- Wizard for encoding complex rule logic



BACKUP





Host Record > Step 1 of 2

Name: .bloxdemo.com

Enable in DNS

Host Name Policy: Allow Underscore

IP Addresses*

<input type="checkbox"/>	IP Address	MAC Address	DHCP
<input type="checkbox"/>	10.65.58.80		<input type="checkbox"/>
<input type="checkbox"/>	fc00:8:8:58::80		<input type="checkbox"/>

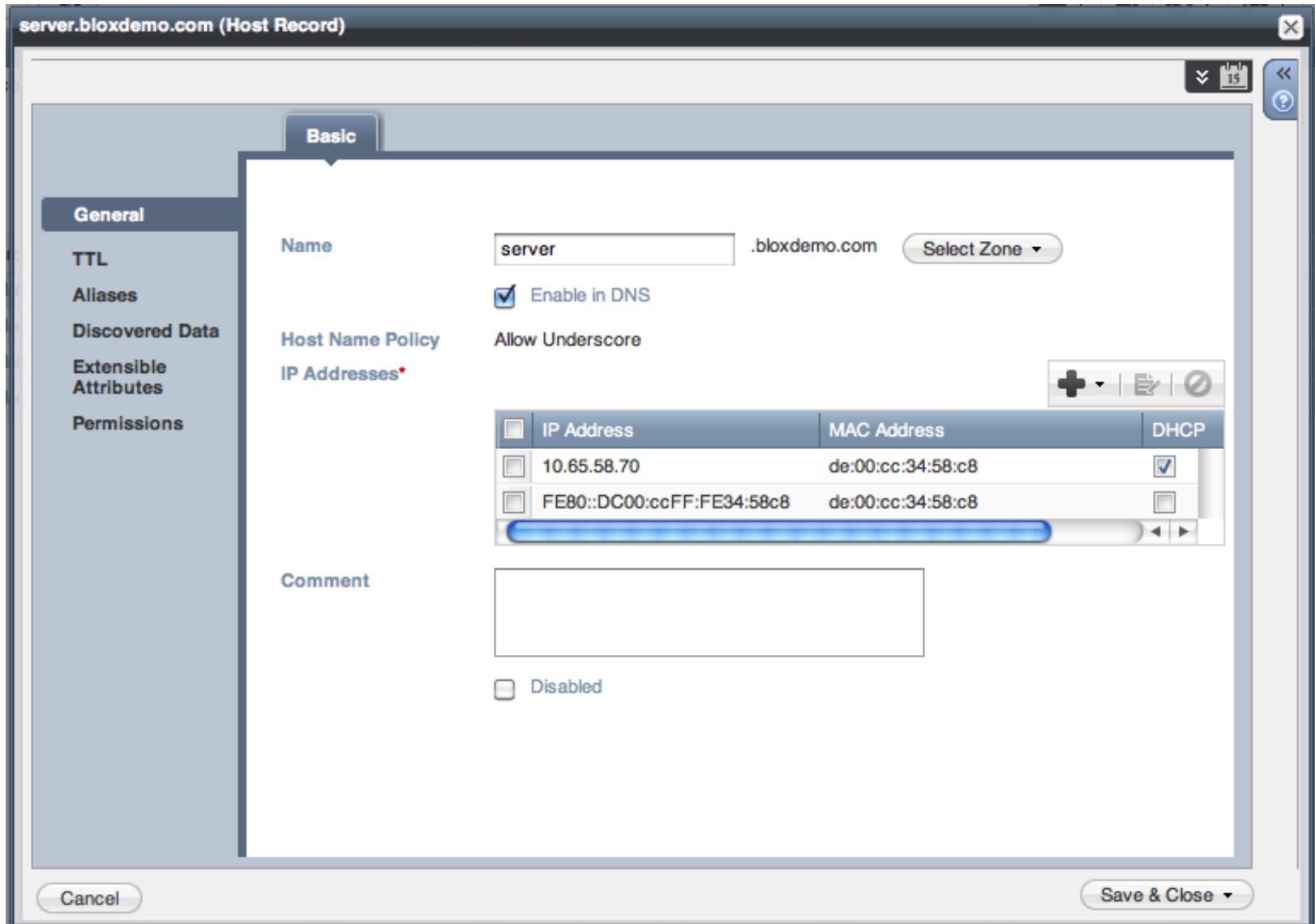
Comment:

Disabled

Buttons: Cancel, Previous, Next, Save & Close

- **Single record for all IPv4 and IPv6 addresses associated with one interface**
- **Ensure DNS name is consistent for both IPv6 and IPv4 addresses**

<input type="checkbox"/>	Network ▲	Comment	IPAM Utilization
<input type="checkbox"/>	 fc00:8:8::/50	EMEA IPv6 Networks	 78%
<input type="checkbox"/>	 fc00:8:8:4000::/50	North American IPv6 Networks	 78%
<input type="checkbox"/>	 fc00:8:8:8000::/50	Latin American IPv6 Networks	 78%
<input type="checkbox"/>	 fc00:8:8:c000::/50	Asia Pacific and Japanese IPv6 Networks	 78%



The screenshot shows the 'Basic' tab of a Host Record configuration window for 'server.bloxdemo.com'. The interface includes a left-hand navigation menu with options like 'General', 'TTL', 'Aliases', 'Discovered Data', 'Extensible Attributes', and 'Permissions'. The main configuration area contains the following fields and controls:

- Name:** 'server' followed by '.bloxdemo.com' and a 'Select Zone' dropdown.
- Enable in DNS:** A checked checkbox.
- Host Name Policy:** 'Allow Underscore'.
- IP Addresses:** A table with columns for IP Address, MAC Address, and DHCP. It contains two entries: one for 10.65.58.70 with MAC de:00:cc:34:58:c8 and DHCP checked, and another for FE80::DC00:ccFF:FE34:58c8 with the same MAC and DHCP unchecked.
- Comment:** An empty text area.
- Disabled:** An unchecked checkbox.

At the bottom of the window are 'Cancel' and 'Save & Close' buttons.

pm-8.pm.Inca.Infoblox.com (Grid Member Properties Editor)

Basic Advanced

Standalone Member
 High Availability Pair

Virtual Router ID Warning: Must be unique on the local network

Required Ports and Addresses

Interface	Address	Subnet Mask	Gateway	Port Settings
LAN	10.65.58.10	255.255.255.0	10.65.58.1	Automatic

Additional Ports and Addresses + | -

<input type="checkbox"/>	Interface	Address	Subnet Mask	Gateway	Port Settings
<input type="checkbox"/>	IPv6	fc00:8:8:58::10	64	automatic	

Cancel Save & Close ▾

IPAM Home > fc00:8:8::/48
fc00:8:8::/50 IPv6NetworkContainer

Go to Go

Off Toggle Filter On | Sho

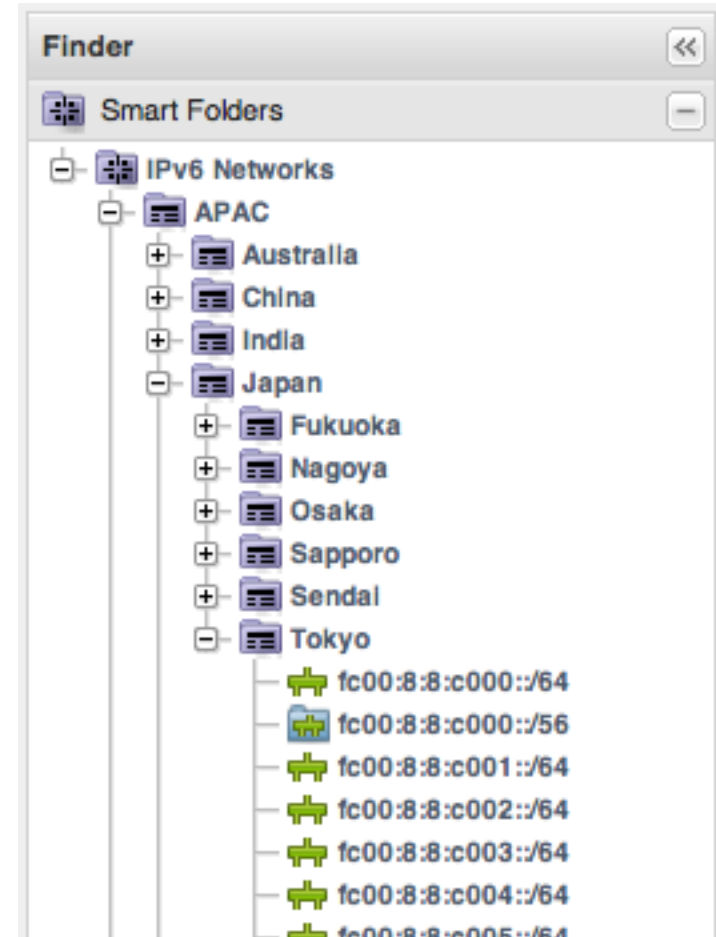
Network	Comment	IPAM Utilization	Country	Region	State	City
<input type="checkbox"/> fc00:8:8::/56	Moscow	<div style="width: 8%;"></div> 8%	Russia	EMEA	Moscow	Moscow
<input type="checkbox"/> fc00:8:8:100::/56	Saint Petersburg	<div style="width: 8%;"></div> 8%	Russia	EMEA	Saint Petersburg	Saint Petersburg
<input type="checkbox"/> fc00:8:8:200::/56	Berlin	<div style="width: 8%;"></div> 8%	Deutschland	EMEA	Berlin	Berlin
<input type="checkbox"/> fc00:8:8:300::/56	Hamburg	<div style="width: 8%;"></div> 8%	Deutschland	EMEA	Hamburg	Hamburg
<input type="checkbox"/> fc00:8:8:400::/56	Munchen	<div style="width: 8%;"></div> 8%	Deutschland	EMEA	Bayern	Munchen
<input type="checkbox"/> fc00:8:8:500::/56	Koln	<div style="width: 8%;"></div> 8%	Deutschland	EMEA	Nordrhein-West...	Koln
<input type="checkbox"/> fc00:8:8:600::/56	Frankfurt am Main	<div style="width: 8%;"></div> 8%	Deutschland	EMEA	Hessen	Frankfurt am Main
<input type="checkbox"/> fc00:8:8:700::/56	Stuttgart	<div style="width: 8%;"></div> 8%	Deutschland	EMEA	Baden-Wurtem...	Stuttgart

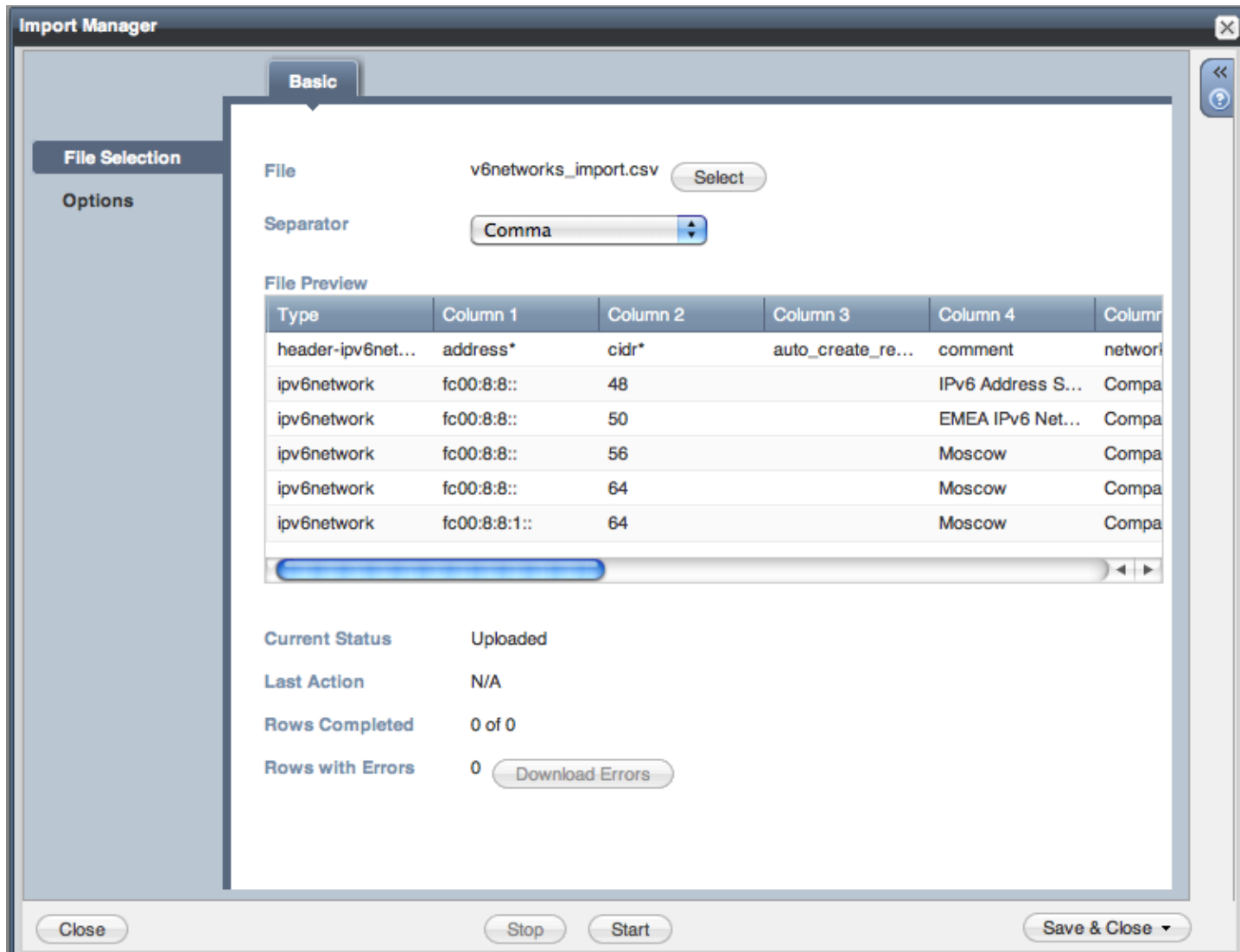
Table View

- Multiple columns with meta data
- Customizable columns

Smart Folders

- Report based on meta data
- Customizable
- Real Time
- Hierarchical





Import Manager

Basic

File Selection

Options

File v6networks_import.csv

Separator Comma

File Preview

Type	Column 1	Column 2	Column 3	Column 4	Column 5
header-ipv6net...	address*	cidr*	auto_create_re...	comment	network
ipv6network	fc00:8:8::	48		IPv6 Address S...	Compa
ipv6network	fc00:8:8::	50		EMEA IPv6 Net...	Compa
ipv6network	fc00:8:8::	56		Moscow	Compa
ipv6network	fc00:8:8::	64		Moscow	Compa
ipv6network	fc00:8:8:1::	64		Moscow	Compa

Current Status Uploaded

Last Action N/A

Rows Completed 0 of 0

Rows with Errors 0

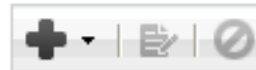
Allow queries from



<input type="checkbox"/>	Permission	Type	Name
▲ <input type="checkbox"/>	Allow	IPv4 Network	10.65.58.0/24
▼ <input type="checkbox"/>	Allow	IPv6 Network	fc00:8:8:58::/64

Allow recursion

Allow recursive queries from



<input type="checkbox"/>	Permission	Type	Name
▲ <input type="checkbox"/>	Allow	IPv4 Network	10.65.58.0/24
▼ <input type="checkbox"/>	Allow	IPv6 Network	fc00:8:8:58::/64

pm-8.Inca.Infoblox.com (Grid Member Properties Editor) Close

Incorrect or missing IPv6 gateway address

Basic **Advanced**

General
Licenses
Network
Anycast
Security
DNS Resolver
Monitoring
Email
Extensible Attributes
Permissions

Required Ports and Addresses

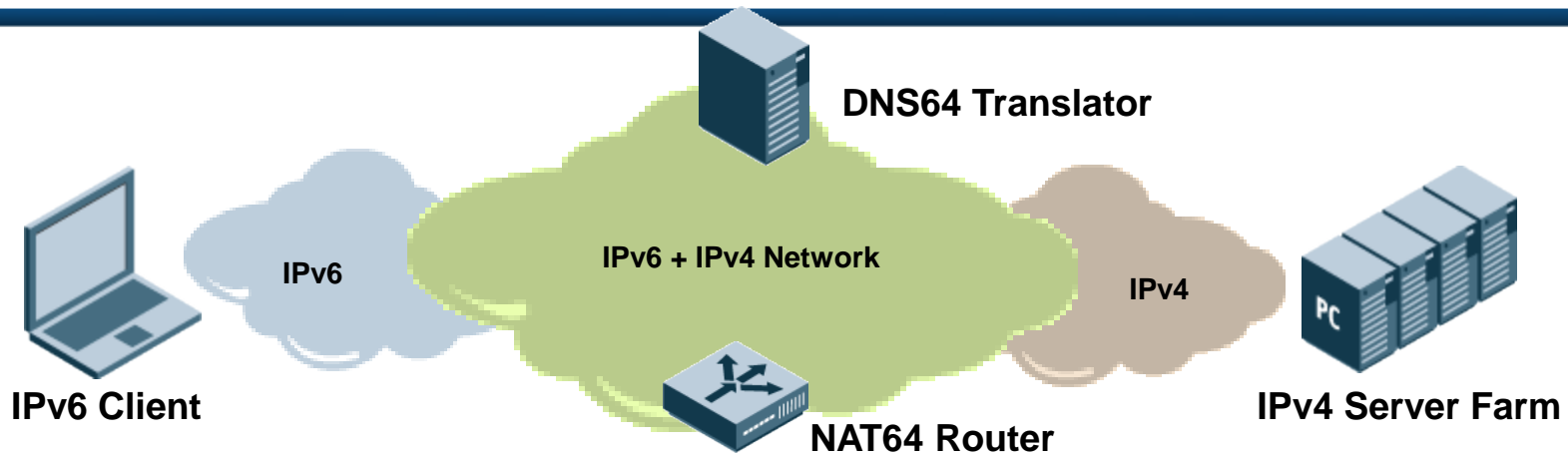
Interface	Address	Subnet Mask	Gateway	Port Settings
LAN	10.65.58.10	255.255.255.0	10.65.58.1	Automatic

Additional Ports and Addresses + - ⊘

<input type="checkbox"/>	Interface	Address	Subnet Mask	Gateway	Port Settings
<input checked="" type="checkbox"/>	IPv6	fc00:8:8:58::10	64		

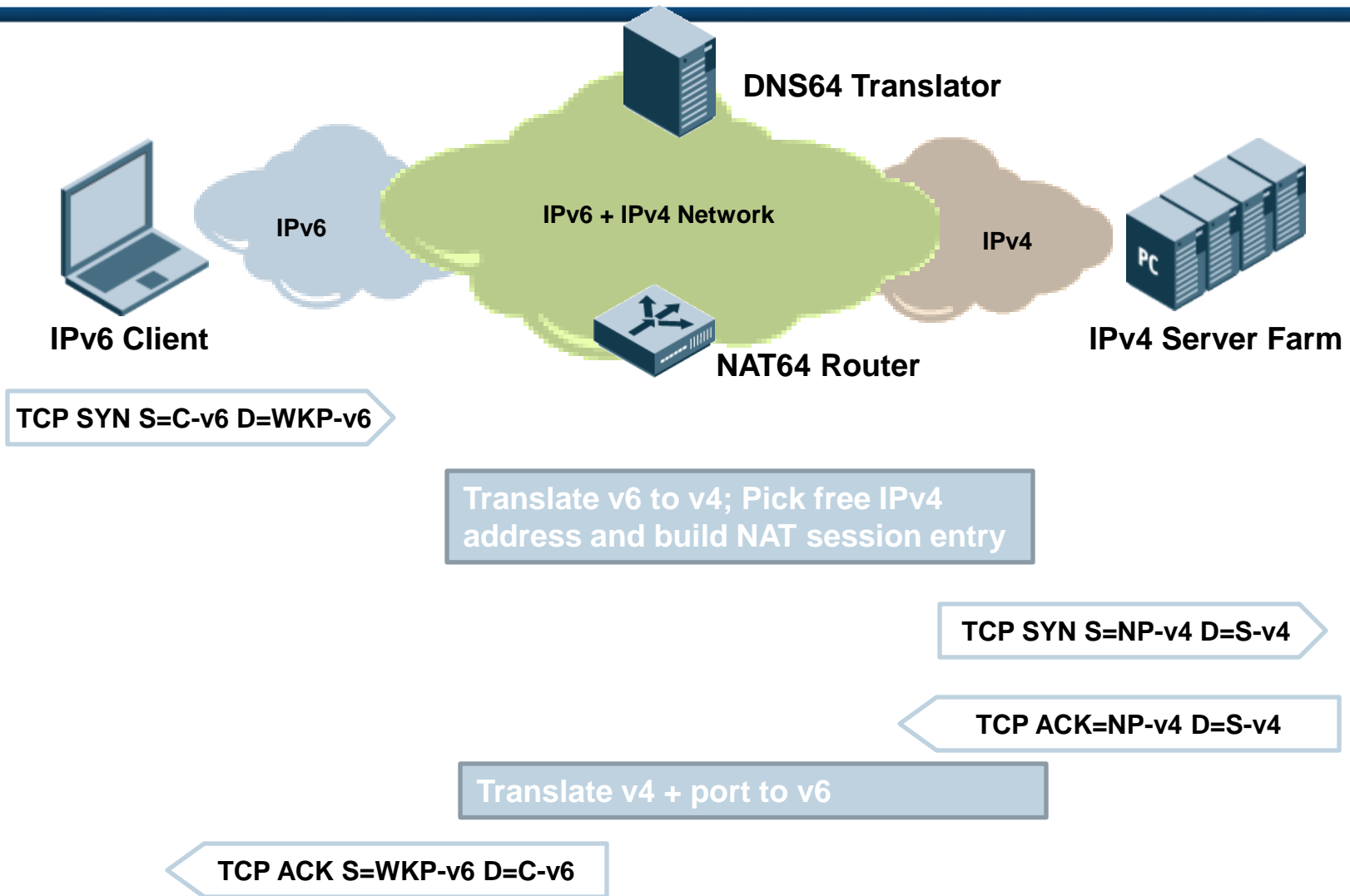
Cancel Save & Close

- **Client sends messages to link-local multicast address**
- **Server unicasts response to client**
- **Information-Request / Reply - provide client configuration information but no addresses**
- **Confirm / Reply - assist in determining whether client moved**
- **Reconfigure - allow servers to initiate a client reconfiguration**
- **Basic client/server authentication capabilities in base standard**
- **DHCP Unique Identifier (DUID) used to identify clients & servers**
- **Identity Association ID (IAID) used to identify a collection of addresses**
- **Relay Agents used when server not on-link**
- **Relay Agents may be chained**



- IPv6 Prefix dedicated to mapped IPv4 addresses
- DNS64 used to convert A records to equivalent AAAA records
- NAT64 router uses prefix to correctly route/attract IPv6 packets for routing to IPv4 network

NAT64: How does it work?



Feature	Infoblox	Notes
JITC IPv6 Certification	✓	
IPAM / Create IPv6 Networks	✓	
IPAM / Split/Join IPv6 Networks	✓	
IPAM / Auto-create ip6.arpa zones	✓	Key feature. Typing in ip6.arpa zones is prone to errors
IPAM / Dual-stack hosts	✓	IP Address management for dual stack devices
IPAM / Create IPv6 address based on MAC	✓	
IPAM / IPv6 Network Utilization Bars	✓	
IPv6 Network Interfaces	✓	Services can be configured to work with IPV4, IPV6 or both
DNS / AAAA records	✓	
DNS / AAAA Shared Records	✓	
DNS / IP6.ARPA Zone	✓	Just like IPv6
DNS / Mixed v4 and v6 ACLs	✓	
Network Configuration and Change Management	✓	NetMRI NCCM solution has full support for IPV6