

CIRA's experience in deploying IPv6

Canadian Internet Registration Authority (CIRA)

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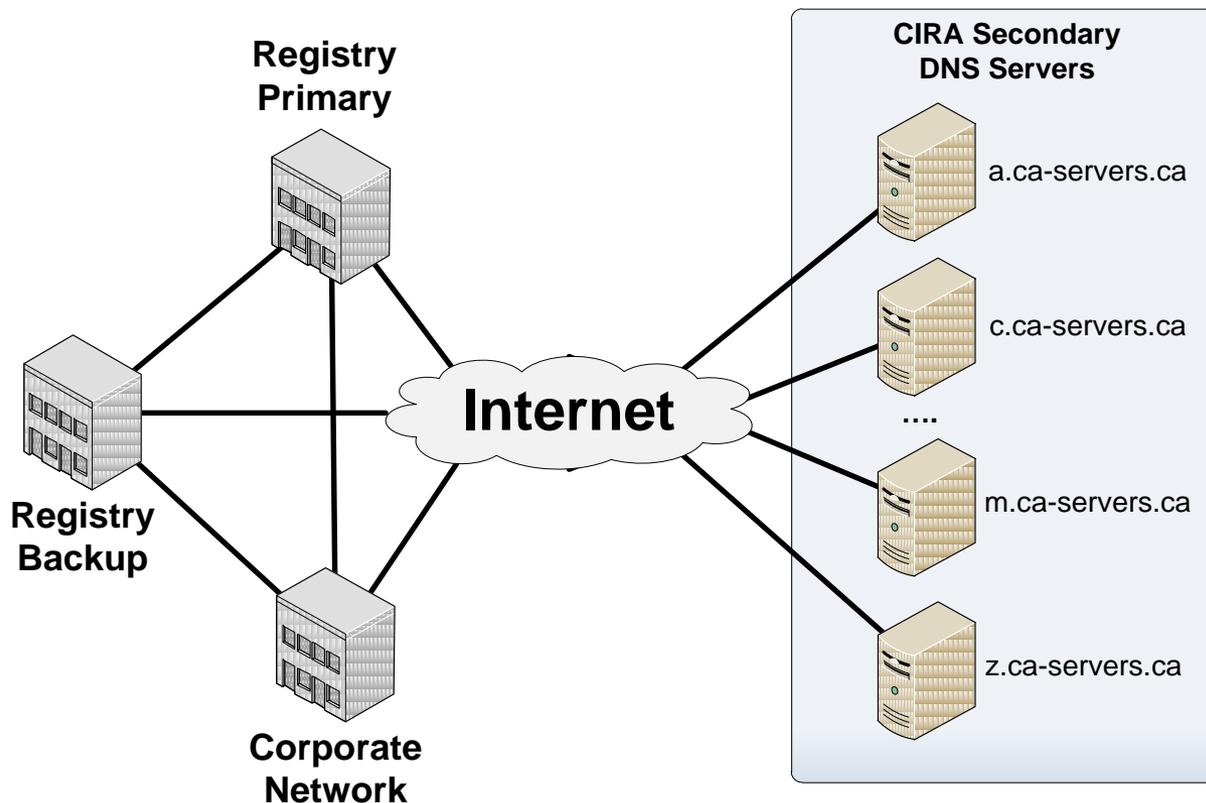
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About CIRA

- The Registry that operates the Country Code Top-Level Domain for Canada
- The “.CA ccTLD”
 - A Thick Registry with over 1.6 million domain names
 - Staff of 50 FTE
 - Has about 150 Certified Registrars
- CIRA processes:
 - 700,000,000 DNS queries per day
 - 5,000 registration requests per day
 - 300 TBR requests per week
 - 250,000 WHOIS queries per day

About CIRA



- We have 2 DNS Secondary IPv6 Enabled (Anycast providers)
- Registry supports IPv6 glue records

IPv6

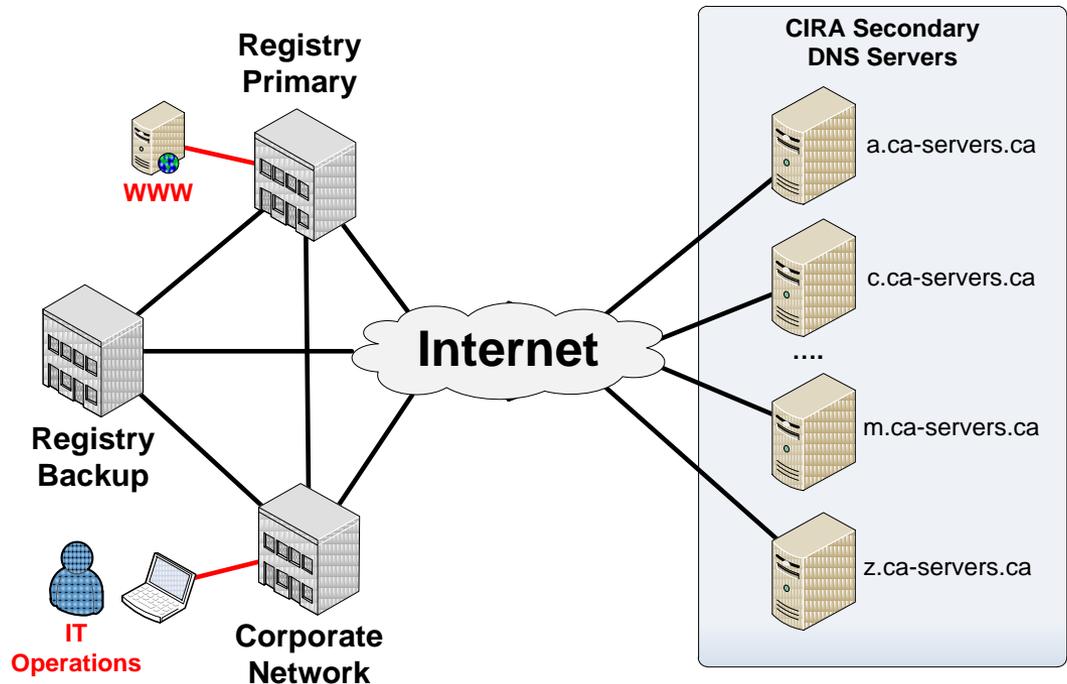
- New protocol (~15 year old)
- Not an extension of IPv4
- Not backward compatible
- New learning curve
- IPv6 **coexists** with IPv4 (Like DECnet, Banyan)
 - Not a transition
 - Not a migration
 - It's a journey!

IPv6 Adoption Strategy

- IPv6 Discovery & Research
- Perform an IPv6 Readiness Assessment
- Define IPv6 Objectives (can't do everything)
- Develop a Project Plan
- Develop a detailed IPv6 Architecture & Design
- Development, testing and pilot mode
- Implement in production

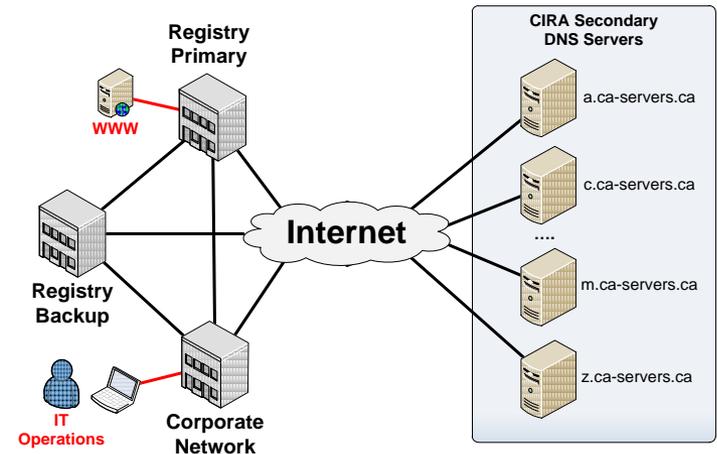
Objectives

- Not everything needs to be IPv6 on day 1
 - World IPv6 Day, June 8, 2011
 - Internet Perimeter & DMZ (www.cira.ca)
 - IT Organization
 - Permanent
 - Presence
 - Support



Critical Path

- Training [v] ongoing
- Develop an IPv6 security policy [v] - draft
- Order IPv6 Transit [v] – New circuits...
- IPv6 inside Corporate & DMZ []
- IPv6 on web server []
- IPv6 for IT Operations []



IPv6 Internet Transit

- Architecture guideline:
 - Internet transit providers must support IPv4 & IPv6
- **We need to push ISPs for IPv6 enabled transits**
 - For the enterprise
 - If not, cancel/discontinue IPv4 only Internet transit
 - Order new IPv4/IPv6 Internet transits



Architecture & Design

- Need to define architecture guidelines & security policies for developing & implementing our IPv6 solution
- Address the results from our “Readiness Assessment” report
 - Some of our load balancers do not support IPv6
 - Some of our Internet transits do not support IPv6
 - Need to test our custom/in house application for IPv6 compliance
 - Overall, we’re in good shape to **coexist** with IPv6

Architecture Guidelines

“Rules of engagement”

- **Keep IPv4 as-is**
- **Dual Stack**
 - All systems participating in the IPv6 implementation must support a concurrent IPv4 and IPv6 stack
- **No IPv6 Tunnelling**
 - Usage of IPv6 tunnelling mechanisms such as ISATAP, Teredo, 6to4, 6rd are not permitted
- **Native IPv6 Transit**
 - IPv6 transit must support IPv6 natively without the use of tunnelling (avoid MTU problems)

Architecture Guidelines

- **One host, one IP**
 - All IPv6 hosts/interface will use one Global address
 - Unique Local Addresses (ULA) must not be used
- **No Network Address Translation (NAT)**
 - NAT66, NAT64 & NAT46 technologies not permitted
- **IPv6 Address Assignment - Privacy**
 - The interface identifier (64 bit) part must be randomly/manually generated (Manual, RFC-3041)
 - MAC addresses of internal device must be kept confidential
 - Internet accessible Global Addresses must not use EUI-64 (MAC + FFFE)

Architecture Guidelines

- **IP Addressing Plan**
 - Based on most efficient algorithm (RFC 3531)
 - Leftmost bits (48, 49, 50,...) are assigned to segment the site
 - The rightmost bits (63, 62, 61, 60 ...) are assigned to number the links.
- **Question: IPv6 Address Allocation**
 - DHCPv6 will be used where possible
 - SLAAC enable for non DHCPv6 devices (Mac) with privacy
- **Question: IPv6 Address Lifecycle (Life/Timeout)**
 - Need to assess impact on logging, correlation, & applications of having temporary IP addresses (Windows 7)
 - Address Obfuscation technique

More Guidelines

“Can’t remember all those IPv6 addresses”

- **DNS Address Mapping**

- All static IPv6 address entry must have AAAA and PTR reverse mapping records
- Naming convention required (interface level)

- **Routing**

- Native IPv6 Peering, BGPv4
- Native IPv6 Routing, OSPFv3
- Router redundancy, HSRPv6
- OSPFv3 & BGPv4 secure routing adjacencies using filtering, passwords and hashes.

- **NetFlow data collection**

- Use NetFlow 9 for IPv6 flow exports

Security Guidelines

“because we don’t NAT IPv6”

- **Firewall**
 - Excellent change & configuration management processes
 - “No NAT, check permit ANY/ANY, wide open Internet”
- **Network Perimeter**
 - IPv6 enabled firewalls
 - IPv6 deep packet inspection IDS/IPS
- **Desktop, Hosts & Device Hardening**
 - IPv6 host enabled firewalls
 - IPv6 HIPS (host based IPS)
- **Security Management**
 - SIEM alerts, regular review of logs for all IPv6 enabled devices.
 - Log & monitor all IPv6 traffic Corporate & DMZ

Security Policy

- **Default deny ANY/ANY of IPv6** addresses and services on perimeter devices such as firewalls, VPN appliances and routers.
 - Log all denied traffic
- **Block 6to4, ISATAP (rfc5214) and TEREDO (rfc4380) and other IPv6 to IPv4 tunneling protocols** on perimeter firewalls, routers and VPN devices as this can bypass security controls.
 - Block TEREDO server UDP port 3544
 - Ingress and egress filtering of IPv4 protocol 41, ISATAP and TEREDO use this IPv4 protocol field
- Filter internal-use IPv6 addresses at border routers and firewalls to prevent the all nodes multicast address (FF01:0:0:0:0:0:0:1, FF02:0:0:0:0:0:0:1) from being exposed to the Internet.
- Filter unneeded IPv6 services at the firewall just like IPv4.
- Filtering inbound and outbound RH0 & RH2 headers on perimeter firewalls routers and VPN appliances.

Based on best practise & RFC Recommendations

Security Policy

- **ICMPv6 messages to allow RFC4890.**
 - Echo request (Type 128) Echo Reply (Type 129)
 - Multicast Listener Messages to allow
 - Listener Query (Type 130) Listener Report (Type 131)
 - Listener Done (Type 132) Listener Report v2 (Type 143)
 - Destination Unreachable (Type 1) – All codes
 - Packet Too Big (Type 2 message)
 - Time Exceeded (Type 3) – Code 0 only
 - Parameter Problem (Type 4 message)
 - SEND Certificate Path Notification messages:
 - Certificate Path Solicitation (Type 148)
 - Certificate Path Advertisement (Type 149)
 - Multicast Router Discovery messages:
 - Multicast Router Advertisement (Type 151)
 - Multicast Router Solicitation (Type 152)
 - Multicast Router Termination (Type 153)

Security Policy available soon at www.cira.ca/knowledge-centre/ipv6

Security Policy

- **Deny IPv6 fragments** destined to an internetworking device.
- Drop all fragments **with less than 1280 octets** (except on the last one)
- Filter ingress packets with IPv6 multicast (**FF05::2 all routers, FF05::1:3 all DHCP**) as the destination address.
- Filter ingress packets with IPv6 multicast (**FF00::/8**) as the source.
- Use IPv6 hop limits to protect network devices to drop hop count greater than 255.
- Configure “**no ipv6 source-route**” and “**no ipv6 unreachable**” on external facing perimeter devices.
- Drop all **Bogon** addresses on perimeter firewalls, routers and VPN appliances.

Learning curve...

Security Policy

- **The following addresses should be blocked as they should not appear on the Internet, based on rfc5156**
 - Unspecified address: **::**
 - Loopback address: **::1**
 - IPv4-compatible addresses: **::/96**
 - IPv4-mapped addresses: **::FFFF:0.0.0.0/96** **::/8**
 - Automatically tunneled packets using compatible addresses : **::0.0.0.0/96**
 - Other compatible addresses:
 - **2002:E000::/20** **2002:7F00::/24** **2002:0000::/24**
 - **2002:FF00::/24** **2002:0A00::/24** **2002:AC10::/28** **2002:C0A8::/32**
 - Deny false 6to4 packets:
 - **2002:E000::/20** **2002:7F00::/24** **2002:0000::/24**
 - **2002:FF00::/24** **2002:0A00::/24** **2002:AC10::/28** **2002:C0A8::/32**
 - Deny link-local addresses: **FE80::/10**
 - Deny site-local addresses: **FEC0::/10**
 - Deny unique-local packets: **FC00::/10**
 - Deny multicast packets (only as a source address): **FF00::/8**
 - Deny documentation address: **2001:DB8::/32**
 - Deny 6Bone addresses: **3FFE::/16**

15 years of legacy?

Testing & Lab

- **Developing an IPv6 lab**
 - Test applications
 - web, cookies, application logging
 - Test load balancers, routers, firewall
 - Log analysis
 - Security - IDS/IPS/SIEM
 - Packet capture
 - Network connectivity, routing protocols

Conclusion

- Dual Stack
- Limited deployment
- Planning
- Technical team trained to support IPv6
- Security policy
- Lab testing
- Pilot project
- Production implementation
- June 8th – Try www.cira.ca on IPv6