IPv6-Mostly Networks Deployment and Operations Considerations

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Motivation

Follow-up on "Mission Possible" RIPE87 presentation Documenting successful IPv6-Mostly deployments.

- What
- Why
- How
- What we wish we knew

IPv6-mostly network

A network that provides NAT64 (possibly with DNS64) service as well as IPv4 connectivity and allows the coexistence of IPv6-only, dual-stack, and IPv4-only hosts on the same segment. (RFC8925)



Endpoint:

A device connected to a network and considered a host from the operator's perspective.

IPv6-Only Capable Endpoint:

An endpoint which does not require an IPv4 address and can operate on IPv6-only networks. E.g.

- A device with 464xlat enabled
- A device verified in IPv6-only environment

IPv6-Only Endpoints



Access to IPv4-only Destination: NAT64

Do not use Well-Known Prefix (64:ff9b::/96) if access to RFC1918 destinations is needed. Use Network-Specific Prefix.

Access to IPv4-only Destination: CLAT

CLAT is RECOMMENDED for IPv6-only hosts.

Do not enable Option 108 w/o CLAT....

....unless you have a reason to...

Discovering NAT64 Prefix

RECOMMENDED: include PREF64 into RAs

Faster (CLAT available immediately)

More secure (RA Guard is enabled, right?)

Works with custom resolvers

DNS vs DNS64

DNS64 is needed for:

- 464XLAT prefix discovery (RCF7050)
 - PREF64 in RAs should be used instead
- IPv6-only devices w/o CLAT (or applications which do not use CLAT)
 - Fundamentally insecure
 - Breaks DNSSEC
 - Might not work if hosts/applications use custom resolvers
 - RFC8880 updates RFC7050 but....
 - Some applications do not work anyway

DNS vs DNS64: Recommendations

- PREF64 in RAs is widely supported
- Long-term goal: avoid DNS64
- Is it feasible now? Let's find out!

Try ripemtg WiFi right now!

Benefits Compared to Dual-Stack

- Reduced IPv4 Consumption
- Simplified Operations
- Reduced Dependency on DHCPv4

Benefits Compared to IPv6-Only (+fallback)

- Scalability
- Simplicity
- Optimized IPv4 Consumption
- Problem Visibility
- Incremental Migration

Incremental Rollout Recommendations

- Per-Device and Per-Subnet Incremental Rollout
 - Devices sending 108 unconditionally: per-subnet
 - If option 108 can be turned on/off: per-device
- Rollback speed: controlled by Option 108 value
 - Start with minimal (300 secs), increase later
- Keep a "secret" dual-stack network as a fallback

Address Assignment Policy

• All existing CLAT implementation require SLAAC

Security Policies

- Permit Extension Headers
 - Fragment Header
 - DNS, RADIUS, NTP
 - ESP Header
 - VPN
 - WiFi Calling

"What to Expect"/Typical Issues Section

• Not about implementation bugs!

All IPv6 Issues Become Highly Visible

• Brace yourself!

Devices with Disabled/Dysfunctional IPv6

- Audit and fix managed devices
- Clear message for BYOD

Endpoints Performing Network Extension

- IPv4: NAT44
- IPv6:
 - Delegate prefix per device
 - CLAT on endpoint
 - ND proxy (scalability issues!)

Multiple Addresses per Device

• Ensure APs and switches allows sufficient number of addresses per device

Custom/Manual DNS Config on Endpoints

- Scenarios:
 - Users configure resolvers manually
 - Local recursive resolver on the endpoint
 - Application-specific resolvers
- Advertize PREF64 in RA
- Request RFC8880 support from endpoints



Fragmentation

- Maximize MTU on IPv6-only side
- Configure NAT64 correctly
- If using anycast (RADIUS) and ECMP: use flow labels for balancing

CLAT Not Representing IPv6 Addresses

- ICMPv6 Errors (traceroute, PMTU)
 - how to represent IPv6 addresses?
 - Ignore?
 - Use reserved addresses +TTL
- Proposed solution:
 - If ICMPv6 src is not from NAT64 prefix: add IPv6
 Original Source Extension
 - <u>draft-equinox-intarea-icmpext-xlat-source</u>

0 1	2	3
0 1 2 3 4 5 6 7 8 9 0 1 2 3	3 4 5 6 7 8 9 0 1 2 3 4 5 6 7	78901
+-		
Length = 20	Class TBD1 C-Typ	be=0
+-		
1		1
+		+
original IPv6 source address		
+ 16 octets +		
1		1
+		+
+-		

Next Steps

- Solicit feedback
 - Providing specific recommendations
 - \circ ...while still covering various use cases
- More experience on deploying w/o DNS64
- Publish!