draft-hiromi-sunset4-ipv4-termination-00.txt

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Field test of IPv6 only network at NAIST
IPv6 only with DNS64/NAT64

- DNS64/NAT64: Map all IPv4 on Internet into IPv6 RA: Enable Other Config (for DHCP6)
- DHCP6: Distribute DNS64 address
- DHCP4: No DHCP4 running!

Field test of IPv6 only network at NAIST
Assumption

• People run their devices in dual stack mode
  – Some of them fully support DHCP6 features
  – Some of them support only RA
  – Some of them have happy eyeball features

• People, except for geeks, cannot set up IPv6 configuration in manual
  – So, people usually let OSes set up automatic configuration
Tested OSes

- Windows Vista, 7, 8, XP
- MacOS X (Leopard, Snow Leopard, Lion, Mountain Lion)
- Apple iOS 4, 5
- Android 2.3.4, 4.1

- All of them can get IPv6 address through RA
Issues on OS in IPv6 only network

- **Windows Vista, 7, 8**
  - No problem except for waiting time out of DHCP4

- **Windows XP, MacOS X (~Snow Leopard)**
  - Need manual settings of DNS
  - Except for geeks, people cannot set up it

- **MacOS X**
  - Waiting for IPv4 connection timeout for Chrome, Firefox. (Safari has no problem).
  - Many Mac OS users met nightmare!

- **iOS5**
  - In some 3G carrier, network Settings was not completed, and continuously failed due to retry
  - In other 3G carrier, there are no problem

- **Android 2.3.4, 4.1**
  - DNS was not usable (DNS queries employed IPv4 function).
  - No manual configuration was available.
Issues in detail

• DNS is not available (WinXP, MacOS Snow Leopard, Android)
  – DNS information should be got via DHCP6, but these Oses did not have DHCP6 function.
  – Android 2.x cannot be configured to use DNS over IPv6 even in manual configuration.

• Network Settings is not completed in IPv6 only network (iOS5 in Some 3G carrier)
  – “Network Settings” will be completed only if IPv4 address, IPv4 router, and IPv4 DNS can be retrieved via DHCPv4 or manually configured all of these 3.

• Waiting for IPv4 connection timeout (MacOS X)
  – MacOS X implements RFC3927 3.3 (Interaction with Hosts with Routable Addresses), which assumes all IPv4 address are on-link at Link-Local configuration.
  – MacOS X’s implementation of getaddrinfo() prefer IPv4 over IPv6, while Happy-Eyeball is implemented on Objective-C API. So Safari has no timeout problem, but Chrome, Firefox and most other application uses C API faced the problem.
DNS forwarder with “A” filter

• Just convert “AAAA” filter to “A” filter on bind
  – Quick hack patch by Jinmei of ISC
  – This DNS forwarder forwards every queries to DNS64 and filters out A records from replied records
  – We provided this DNS forwarder through DHCP4 and stateless DHCP6 in 3rd exp (September 2012) and in 4th exp (March 2013) of WIDE camp
    • DHCP4 does not tell IPv4 gateway or an IPv4 gateway does not forward any IPv4 packets

• “A” filter DNS forwarder can cease troubles on OS

• This DNS forwarder should be run with DHCP4 that provides only private IPv4 address
  – See Appendix
DNS forwarder with “A” filter

- Example

This DNS forwarder has both IPv4 and IPv6 address

A filter DNS Forwarder

DNS64/NAT64 Subnet IPv6 GW

dual stack bb

Global IPv6 and private IPv4

Note: Both DHCP4 and DHCP6 announce DNS forwarder’s IP(v4 or v6) address

Do not forward any IPv4 packet

RA DHCP6 DHCP4

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

- IPv6 only node

IPv6 only node

A filter DNS Forwarder

DNS64/NAT64 Subnet IPv6 GW

dual stack bb

Get A filter DNS forwarder’ address through DHCP6
DNS forwarder with “A” filter

• IPv6 only node

A filter DNS Forwarder

DNS64/NAT64 Subnet IPv6 GW
dual stack bb

Query [www.example.com](http://www.example.com) by IPv6

IPv6 only node

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

• IPv6 only node

Forward query on www.example.com
DNS forwarder with “A” filter

- IPv6 only node

A filter DNS Forwarder → DNS64/NAT64 Subnet IPv6 GW

dual stack bb

DNS64 may return A and AAAA records on www.example.com
The AAAA record may be NAT64 prefix-mapped IPv4 address

IPv6 only node

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

• IPv6 only node

A filter DNS Forwarder

DNS64/NAT64 Subnet IPv6 GW

dual stack bb

DNS forwarder returns only AAAA record of www.example.com

IPv6 only node

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

- IPv6 only node

Communicate www.example.com through IPv6 or NAT64 translation

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

- Dual stack node

Get A filter DNS forwarder’ address through DHCP4

Dual stack node

A filter DNS Forwarder

DNS64/NAT64 Subnet IPv6 GW

dual stack bb

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

- Dual stack node

Query www.example.com by IPv4
DNS forwarder with “A” filter

• Dual stack node

Forward query on www.example.com to DNS64 or other cache servers

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

• Dual stack node

DNS64 may return A and AAAA records on www.example.com
The AAAA record may be NAT64 prefix-mapped IPv4 address
DNS forwarder with “A” filter

- Dual stack node

A filter DNS Forwarder

DNS64/NAT64 Subnet IPv6 GW

dual stack bb

DNS forwarder returns only AAAA records of www.example.com
DNS forwarder with “A” filter

- Dual stack node

Communicate www.example.com through IPv6 or NAT64 translation

Field test of IPv6 only network at NAIST
DNS forwarder with “A” filter

• Benefit
  – Enable dual stack in name resolution, however, force single stack (v6 only) in IP forwarding
  – Most OSes can reach happy IPv6 only life
    • if WiFi network is stable

Field test of IPv6 only network at NAIST
BIND 9.9.2P1 Patch

• See appendix of a WIDE technical report
Issues on apps in IPv6 only networks

- We cannot use IPv4 literals
- We cannot use IPv4 only applications
- Inappropriate DNS mentioned in RFC4074
  - ServFail stops DNS64’s address mapping
Is WG interested in this proposal?

• Is our experience and “A” filter DNS forwarder suited for WG draft on sunset4?
Appendix:
Field test of IPv6 only network at NAIST

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Try work around in campus wi-fi network

- We tried IPv6 only network settings according to draft-hazeyama-widecamp-ipv6-only-experience-02
  - Phase 1
    - Just placed DNS64/NAT64 in our campus wi-fi network
  - Phase 2 (current)
    - Added DHCP4 server
      - Same as experiment 1 setting of draft-hazeyama-02
  - Phase 3 (under construction)
    - DNS forwarder with A filter solution
Configuration of phase 1

- Campus network
- IPv6/v4 dual net
  - NAT64
  - DNS64
  - IPv6 router
- Send RA
- IPv6 only net
- Wi-Fi AP
- IPv6 capable host
- IPv6/v4 capable host

Field test of IPv6 only network at NAIST
Results of phase 1

• IPv6 capable host
  – Works well for almost applications
  – NAT64/DNS64 provide connectivity between IPv6 client and IPv4 server
  – Temporary address issue

• IPv6/v4 capable host
  – Poor experience
  – RFC 3927 capable hosts activate IPv4 link-local address and it brings IPv4 black hole network to realize IPv4/IPv6 fallback issue
Configuration of phase 2

IPv6/v4 dual net

NAT64 DNS64
IPv6 router
DHCPv4 server
Wi-Fi AP

Act as IPv4 default router and respond destination unreachable for any destination

Send RA
Assign private IPv4 address
Global IPv6 Private IPv4

IPv6 capable host
IPv6/v4 capable host

Field test of IPv6 only network at NAIST
Results of phase 2

- IPv6 capable host
  - Works well for almost applications the same as phase 1

- IPv6/v4 capable host
  - Works well for almost applications against phase 1
  - Quickly fallback to IPv6 on ICMP destination unreachable response to any IPv4 destination
Temporary address issue

• RFC 4941 capable hosts generate temporary addresses whenever they connect to the network and receive RA

• The hosts generates many temporary addresses on unstable network connection (e.g. Wi-Fi roaming, note PC suspend/resume)

• Some security gateways reject IPv6 communication because they limit number of IP addresses for each node

• One solution is stateful address auto-configuration by DHCPv6
Key mechanisms

• NAT64 / DNS64
• IPv4 private address assignment by DHCPv4 and destination unreachable response for any IPv4 destination
• stateful address autoconfiguration by DHCPv6