Using 464XLAT in Residential Networks

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Do you know …

• We already run out of IPv4?

• How you keep deploying Internet access to your residential customers?

• Are you using IPv4 to deploy IPv6?
  – such as tunnel broker, 6RD and so?
Once upon a time …

• IETF was considering to solve this problem by more tunneling …

• So we build up softwires, which decided to use L2TP, so we could do
  – IPv6 in IPv4, IPv4 in IPv6
  – (as well IPv4 in IPv4 and IPv6 in IPv6 for multicast in unicast)

• As a result we have, among others:
  – DS-Lite
  – Carrier Grade NAT (AFTR)
  – lw4o6
NAT444

- Public IPv4
- NAT44 Level 2
- NAT44 Level 1

Private IPv4 192.168.1.x

Plain IPv6

ISP network

NAT

IPv4

10.0.0.x/24

IPv6

v4/v6

10.0.0.x/24
lw4o6

Public IPv4

NAT44 Level 1

IPv4-in-IPv6 tunnel

IPv6-only access

“plain” IPv6

Internet IPv4

ISP network

Internet IPv6

CPE (lwB4)

v4

v4/v6

10.0.0.x/24

10.0.0.x/24

CPE (lwB4)

v4

v4

10.0.0.x/24

“plain” IPv6

IPv6

IPv6

IPv4

IPv4

IPv4

IPv4

IPv4
Tunnels per subscribers

- DS-Lite/lw4o6

BGP prefixes: Tens
Tunnels: Millions
IGP prefixes: Hundreds
BNG routes: Thousands
Subscribers: Millions
CGN breaks …

- UPnP-IGD (Universal Plug & Play - Internet Gateway Device protocol)
- NAT-PMP (NAT Port Mapping Protocol)
- Other NAT Traversal mechs
- Security
- AJAX (Asyncronous Javascript And XML)
- FTP (big files)
- BitTorrent/Limewire (seeding – uploading)
- On-line gaming
- Video streaming (Netflix, Hulu, …)
- IP cameras
- Tunnels, VPN, IPsec, ...
- VoIP
- Port forwarding
- …
NAT64

Public IPv4

NAT64

Internet IPv4

ISP network

Internet IPv6

"plain" IPv6

IPv6-only access

CPE

v4

10.0.0.x/24

v4

DNS64

NAT64

v4

10.0.0.x/24

CPE

v4/v6

NAT64

IPv4/v6

NAT64

IPv4
NAT64 breaks ...

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<th>Functionality</th>
<th>Version</th>
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464XLAT

- 464XLAT (RFC6877): RFC6145 + RFC6146
- Very efficient use of scarce IPv4 resources
  - \( N \times 64,000 \) flows per each IPv4 address
  - Network growth not tied to IPv4 availability
- IPv4 basic service to customers over an-IPv6 only infrastructure
  - WORKS with applications that use socket APIs and literal IPv4 addresses (Skype, etc.)
- Allows traffic engineering
  - Without deep packet inspection
- Easy to deploy and available
  - Commercial solutions and open source
How it works 464XLAT?

CLAT: Customer side translator (XLAT)
PLAT: Provider side translator (XLAT)
Possible “app” cases

- **ISP IPv6-only**
  - IPv6-only Internet

- **ISP IPv6-only**
  - IPv4-only Internet

- **ISP IPv6-only**
  - IPv4-only Internet

- **CLAT 4->6**
  - IPv4-only Internet

- **PLAT DNS64/NAT64**
  - IPv4-only Internet

- **PLAT 6->4**
  - IPv4-only Internet
Multiservice Network

464XLAT

Cellular network

PLAT
DNS64/NAT64

Residential network

Corporate network
Example Residential Customer

IPv4 + IPv6
2001:db8::/32
198.51.100.0/24
FE80::1/64

ISP Network

User Network

VM PLAT
(NAT64 + DNS64)

Pool IPv4/NAT64:
198.51.100.11/32
Prefijo IPv6: 64:ff9b::/96

Traffic Legend
Red: IPv6-only
Blue: IPv4-only
Green: Dual-stack

LAN Eth1
192.168.1.1
2001:db8:40::41

CPE (CLAT)
Pool IPv4/NAT46: 100.64.0.1/32
Pool IPv6: 2001:db8:2::/128

2001:db8:1::2
WAN Eth0

Node 1
192.168.1.2/24
2001:db8:40::42/64

Node “n”
192.168.1.x/24
2001:db8:40::xx/64
IPv6 in Cellular/US

*ISOC/World IPv6 Launch data
464XLAT deployment

• NAT64:
  – A10
  – Cisco
  – F5
  – Juniper
  – NEC
  – Huawei
  – Jool, Tayga, Ecdisys, Linux, OpenBSD, …

• CLAT
  – Android
  – Nokia
  – Windows phone
  – NEC
  – OpenWRT

• Commercial deployments:
  – T-Mobile US: +68 Millions of users
  – Orange
  – Telstra
  – SK Telecom
  – …
  – Big trials in several ISPs (thousands of users)
Performance

**US Mobile Performance – Dual Stack Provider iOS**

- iPhone 6 on LTE only
- No Instrumentation of the client
- Examining Client Last Byte Time
  - Time it takes for the device to read the response
  - Read all the data for a newsfeed

**US Mobile Performance – Dual Stack Provider Android**

- Android 4/5
- Galaxy S5 on LTE only
- No Instrumentation of the client
- Examining Client Last Byte Time
  - Time it takes for the device to read the response
  - Read all the data for a newsfeed

**US Mobile Performance – Dual Stack Provider iOS**

- iPhone 6
- Client instrumentation
- No A/B testing
- Mobile Proxygen
- Examining Total Request Time
  - Similar to Client Last Byte Time

*FaceBook data*  
(17/3/2015)
Update of RFC7084

• Basic Requirements for IPv6 Customer Edge Routers
  – Originally include support only for 6RD and DS-LITE
  – Being updated to include support for 464XLAT, MAP T/E, lw4o6, …

Thanks!

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