What’s New Regarding IPv6 Transition?

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Transition & Coexistence Techniques

- IPv6 has been designed for easing the transition and coexistence with IPv4
- Several strategies have been designed and implemented for coexisting with IPv4 hosts, grouped in three categories:
  - Dual stack: Simultaneous support for both IPv4 and IPv6 stacks
  - Tunnels: IPv6 packets encapsulated in IPv4 ones
    - This has been the commonest choice … till now!
    - Today expect IPv4 packets in IPv6 ones!
  - Translation: Communication of IPv4-only and IPv6-only. Initially discouraged and only “last resort” (imperfect). Today no other choice!
- Expect to use them in combination!
We Are Late!
So, let’s “IPv6-only”!

- We don’t have anymore IPv4 addresses

- We can’t, generally, use IPv6-in-IPv4 tunnels

- We need to use mechanisms that rely on IPv6-only in the access network:
  - 464XLAT
  - DS-Lite
  - Lw4o6
  - MAP-E
  - MAP-T

- 464XLAT is already the winner in terms of number of users
  - Millions of cellular users
  - Also in wired-broadband
How Two “IPv6-only”?

- The ISP runs NAT64 (and DNS64 as an option)
  - NAT64 Deployment Guidelines in Operator and Enterprise Networks
    - draft-palet-v6ops-nat64-deployment

- Routers and/or OSs need to support CLAT
  - Requirements for IPv6 Customer Edge Routers to Support IPv4 Connectivity as-a-Service
    - draft-ietf-v6ops-transition-ipv4aas

- In the DC, support for SIIT-DC
  - Stateless IP/ICMP Translation for IPv6 Data Center Environments
    - RFC7755
464LXAT: How it works?

CLAT: Customer side translator (XLAT)
PLAT: Provider side translator (XLAT)

IPv4 + IPv6

CLAT

ISP + IPv6 Internet

PLAT

IPv4 Internet

IPv6

IPv6-only

IPv4

IPv6

IPv4

IPv6

Private IPv4

Public IPv4

Stateless (4->6) [RFC6145]

Stateful (6->4) [RFC6146]
Possible “app” cases

- **464XLAT**
  - ISP IPv6-only
  - IPv6-only Internet

- **464XLAT**
  - ISP IPv6-only
  - IPv4-only Internet

- **CLAT 4->6**
  - ISP IPv6-only
  - IPv4-only Internet

- **PLAT DNS64/NAT64**
  - ISP IPv6-only

- **PLAT 6->4**
  - ISP IPv6-only
SIIT-DC: Mapping all the IPv4 Internet

- An EAM (Explicit Address Mapping) table is configured in the SIIT-DC BR
  Translation prefix: 2001:db8:46::/96
  IPv4 pool: 192.0.2.0/24

EAM table:
<table>
<thead>
<tr>
<th>IPv4 Internet address</th>
<th>Address in the DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.0.2.1</td>
<td>2001:db8:12:34::1</td>
</tr>
<tr>
<td>192.0.2.2</td>
<td>2001:db8:24:68::80</td>
</tr>
<tr>
<td>192.0.2.3</td>
<td>2001:db8:24:68::25</td>
</tr>
</tbody>
</table>
Availability and Deployment

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

• CLAT
  – Android (since 4.3)
  – Nokia
  – Windows
  – NEC
  – Linux
  – Jool
  – OpenWRT
  – Apple (sort-of, is Bump-in-the-Host [RFC6535] implemented in Happy Eyeballs v2) - IPv6-only since iOS 10.2

• Commercial deployments:
  – T-Mobile US: +90 Millions of users
  – Orange
  – Telstra
  – SK Telecom
  – ...
  – Big trials in several ISPs
IPv6 Point-to-Point Links

• Documenting different alternatives for IPv6 point-to-point links
  – draft-palet-v6ops-p2p-links
  – From a 2006 document and BCOP RIPE-690

• Rationale for /64, /127, /126 and others

• GUA, ULA or unnumbered?

• /64 from prefix customer
  – Example first /64 from a customer /48
Thanks!

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