
Hurricane Electric

Do we need consistent IPv6 addressing at peering points?
Do we need a cleaner IPv6 routing tables?

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Hurricane Electric – Background on two issues

- Hurricane Electric connects to 23 peering points in 15 marketplaces
 - we would like to see some consistency in addressing plans
- Hurricane Electric would like to see various networks (i.e. some R&E IPv6 networks), stop leaking routes all over the place

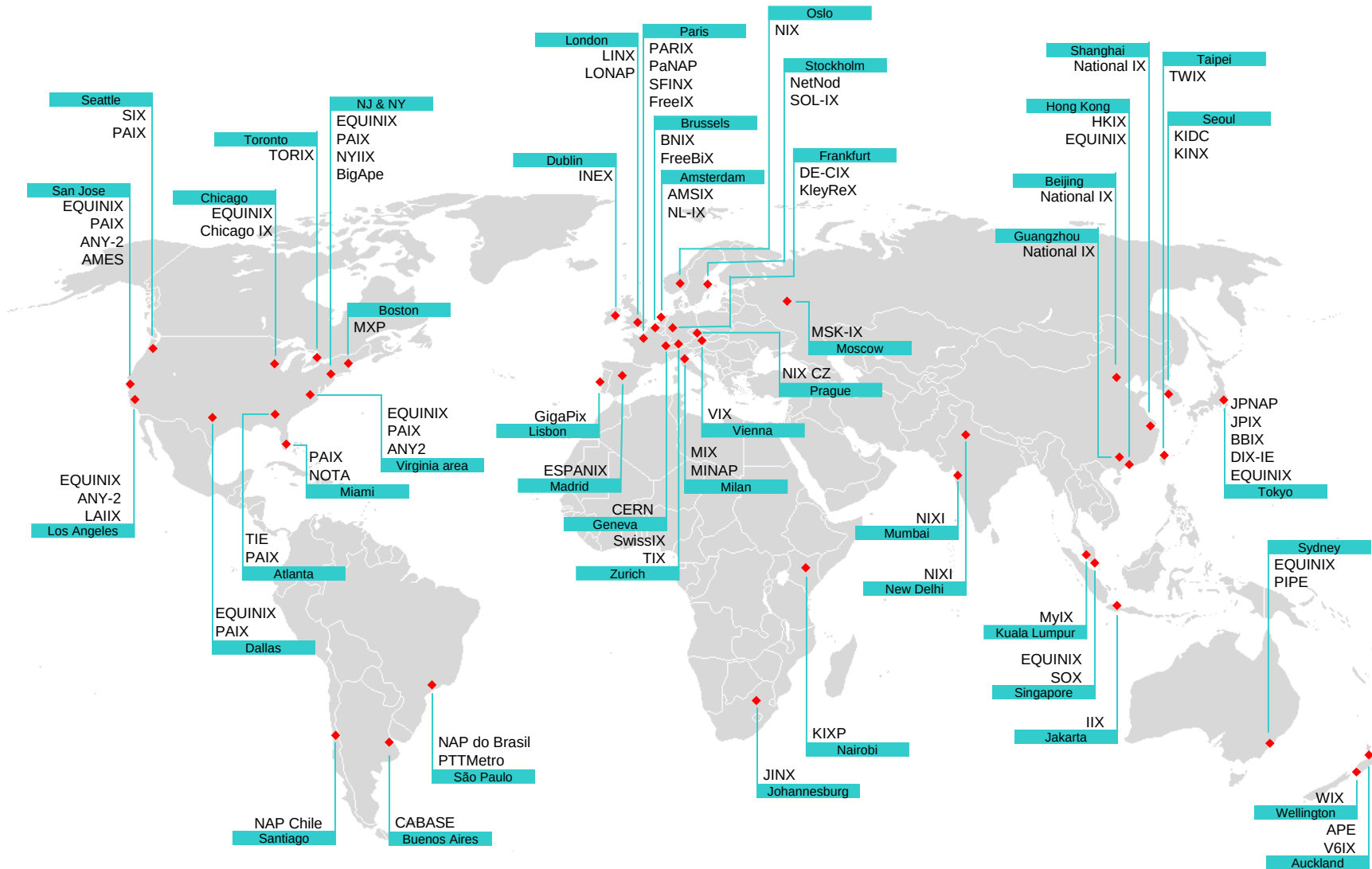


IPv6 Peering

(the good, the bad and the ugly)



The Global IPv6 Peering World – the good



IPv6 Peering Points – addressing schemes

- IPv6 enables “clever” addressing schemes
 - :1, :2, :3, :4, :5, ... (pretty basic)
 - Duplicate last digits of the IPv4 address (decimal to hex)
 - Hex encoding of ASN (i.e. AS6939 == ... ::1B1B: ...)
 - BCD encoding of ASN (i.e. AS6939 == ... ::6939: ...)
 - None of the above (?)

- BCD makes addresses human-readable
 - Will 32bit AS#'s cause an issue?
 - $(2^{32} - 1) == \dots :42:9496:7295: \dots$



IPv6 Peering Points – addressing schemes - bad

 Provider /48 IX AS Number
`2001:504:0:2::6939:1`

 198.32.180.40
2001:478:180::40

* Also NOTA & MXP

 Provider /48 AS Number (HEX)
`2001:7f8:4:0::1B1B:1`

* Also LoNAP & modified more for DE-CIX

Provider /48 IX number

`2001:504:D::10`
`2001:504:F::39`

Provider /120 number

`2001:7FA:0:1::CA28:A19E`

* Will move from /120 to /64 soon

Provider /48 Loc # ASN number

`2001:7f8:30:0:x:y:z:z`
Vienna Internet eXchange

Note that besides HKIX – nearly every exchange uses a /64 for the LAN segment

All examples are Hurricane Electric addresses

IPv6 Peering Points – IPv6 reverse-DNS ugly!

- Some peering points do a good job, some don't
 - A HK base IX has not had IPv6 reverse-DNS ever
 - A California-based IX has entries that don't make sense

```
2001:????:???:70 u[REDACTED]t-3.needs.real.name.  
2001:????:???:82 e[REDACTED]w-6.needs.real.name.  
2001:????:???:c2 t[REDACTED]lay-2.needs.real.name.  
2001:????:???:98 ipv6-[REDACTED]telecom.not-given.
```

- Sometimes the name does not match the owner
- IX's web sites list participants and IP's
 - ...but only the IPv4 ones



IPv6 Peering Points – IPv6 reverse-DNS

■ Recommendations

- ❑ Don't invent yet another scheme
- ❑ Do consider upgrading the scheme to handle 32 ASN's
- ❑ Do consider matching other IX's in your neighborhood (i.e. the way that LINX and LoNAP do)
- ❑ Take reverse-DNS seriously!



IPv6 Routing

(sometimes you can get there from here)



IPv6 routing – time to take it seriously

- Perception:

- Having a full routing tables can be created by letting all “peers” leak routes from anywhere/everywhere

- Reality:

- IPv6 transit routes are available from transit providers



IPv6 Routing – an example of leaking routes

■ Simple example:

Example picked at random

```
* 2001:6E8::/32      ??? 4635 23911 7660 7684 18084 3257 3246 i
* 2001:920::/32      ??? 4635 23911 7660 7684 18084 3257 8220 i
* 2001:AF0::/32      ??? 4635 23911 7660 7684 18084 3257 2819 i
* 2001:B80::/32      ??? 4635 23911 7660 7684 18084 3257 12767 i
* 2001:1430::/32     ??? 4635 23911 7660 7684 18084 3257 3246 29243 i
* 2001:1450::/32     ??? 4635 23911 7660 7684 18084 3257 5602 i
* 2001:15A8::/32     ??? 4635 23911 7660 7684 18084 3257 5602 29449 i
* 2001:15F8::/32     ??? 4635 23911 7660 7684 18084 3257 25384 i
* 2A02:140::/32      ??? 4635 23911 7660 7684 18084 3257 3246 39342 i
* 2A02:790::/32      ??? 4635 23911 7660 7684 18084 3257 24679 i
```

Key:

AS23911	CNGI-BJIX-AS-AP	China Next Generation Internet Beijing IX
AS7660	APAN-JP	Asia Pacific Advanced Network – Japan
AS7684	SAKURA-A	SAKURA Internet Inc.
AS18084	ANC	Asia Netcom Japan Corp.
AS3257	TISCALI-BACKBONE	Tiscali Intl Network BV



IPv6 Routing – an example of leaking routes

■ More complex example:

Example picked at random

```
* 2001:1310::/32    ??? 2516 7660 22388 11537 27750 11340 i
* 2001:1318::/32    ??? 2516 7660 22388 11537 27750 3597 i
* 2001:1348::/32    ??? 2516 7660 22388 11537 27750 i
* 2800:68::/32      ??? 2516 7660 22388 11537 27750 27841 i
* 2800:90::/32      ??? 2516 7660 22388 11537 27750 i
* 2800:110::/32     ??? 2516 7660 22388 11537 27750 3597 4270 i
* 2800:130::/32     ??? 2516 7660 22388 11537 27750 27841 i
* 2800:1A0::/32     ??? 2516 7660 22388 11537 27750 27929 27933 i
```

Key:

AS2516	KDDI	KDDI CORPORATION
AS7660	APAN-JP	Asia Pacific Advanced Network – Japan
AS22388	Indiana University	Indiana University
AS11537	Internet2	Internet2 network
AS27750	UY-CLAR	Cooperación Latino Americana de Redes Avanzadas



IPv6 Routing – What's the problem?

- For commercial IPv6 networks
 - Maybe nothing. They purchase IPv4/v6 transit
 - Access to research networks is on an as-is basis
- For Research & Educational IPv6 networks
 - Internal research traffic works fine
 - External access is on an as-is basis
- The route leaks
 - Commercial networks sometimes see commercial networks via R&E route leaks



IPv6 Routing – The solution (a solution?)

- R&E Network could clean up announcements
 - ❑ Especially where they touch public peering points
 - ❑ Configure IPv6 transit or make sure their routes never hit the public routing tables

- Transit backbones
 - ❑ Obviously: filter, filter, filter!
 - ❑ Reduce cross-leaked IPv6 routes
 - ❑ Set customers expectations



Q&A



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Background slides

(about Hurricane Electric's IPv6 Backbone)



Hurricane Electric – Roots and History

- Founded 14 years ago - ISP & datacenter operator
 - ❑ Roots within the Silicon Valley high-tech community
 - ❑ 1999 – Nationwide IPv4 network
 - ❑ 2001 – IPv6 native and tunnel connectivity
 - ❑ 2005 – European expansion
 - ❑ 2006 – Purchased 206,000 sq ft datacenter building
 - ❑ Q1 2007 – Rolled out dual-stack native IPv6 backbone
 - ❑ Q1 2008 – Ranked #1 IPv6 backbone for BGP adjacencies
 - ❑ Q2 2008 – IPv6 TunnelBroker expanded into nine US & European cities
 - ❑ Q3 2008 – Hong Kong IPv6 POP (no IPv4!)

- ❑ Supports and sponsors global open-software projects



Hurricane Electric – IPv6 Network Reach

All Hurricane Electric POPs are full IPv6 Native routing and peering

