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?
  - \((2^{32} - 1) == ... :42:9496:7295: ...\)
IPv6 Peering Points – addressing schemes - bad

- **equinix**
  - Provider /48
  - 2001:504:0:2::6939:1

- **SIX**
  - IX AS Number
  - 198.32.180.40
  - 2001:478:180::40

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

- **HKIX**
  - Provider /120

- **VIX**
  - Provider /48
  - Loc #
  - 2001:7f8:30:0:x:y:z:z

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

* Also NOTA & MXP

* Also LoNAP & modified more for DE-CIX

* Will move from /120 to /64 soon

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###t-3.needs.real.name.
    2001:???::?::82     e###w-6.needs.real.name.
    2001:???::?::c2     t###lay-2.needs.real.name.
    2001:???::?::98     ipv6###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:

```
* 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:

```
* 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
- 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.

IPv6 Peering Locations

IPv6 peering at all major peering points in US and Europe. Private and public peering capacity at 1Gbps & 10Gbps.