Hawaii IPv6 Deployment Experiences

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Conclusions

• Your best cost mitigation strategy
  – Include IPv6 in your refresh cycle
  – Learn to do it while it's less critical

• Deploying IPv6 in tandem with IPv4 isn't particularly difficult

• The majority of your IPv6 dual-stack deployment effort will be getting it into your staff's consciousness.
  – After they realize it's not hard, they will do it.
UH System Network

• 18 Campuses and learning centers on 6 islands
• ~50 separate research/outreach facilities
• ISP for
  – State Government
  – Bishop Museum
• Internet2 connector for
  – Dept. Of Education
  – NOAA NWS and NMFS
University Of Hawaii Facilities Overview
November 2009

- Green: Instructional Campus
- Red: Agricultural Outreach
- Blue: Research
Mauna Kea Observatories
REN Connectivity
Through TL/PW and U. Hawaii Networks
December 2008
REN Connections
Between U. Hawaii
And The Pacific Rim
November 2009

SX-North Drops 10 GbE on Oahu
SX-South Drops 1 GbE on Big Island
IPv6 is not a “project”

• We don't have an “IPv6 person”, or an “IPv6 team”, or an “IPv6 initiative”.
  • It is our policy to deploy IPv6 where we deploy IPv4

• As upgrades or maintenance or changes are scheduled, IPv6 is on the requirements list.
IPv6 Address Management

• Get an allocation
  – RIR, ISP
  – Allocation policies are in flux

• Addressing plan
  – Set aside v4 starvation mindset
  – Code for: procrastination
    • Limit yourself to 2 meetings and 2 mandays
  – Largely arbitrary
  – We chose not to relate it to our v4 addresses

• privacy addressing a problem
• MIB support for fetching ND tables moving target
U. H. IPv6 History

- Jan. '04: peerings with 3 RENs, demos to Korea/Japan at Techs-In-Paradise 2004
  - Honolulu CC v6 enabled
- Dec '07: Acquired our own addresses
- '08: Turned on State-wide IPv6 routing addressing
Watershed Moments

• Acquired address block 12/2007
• (2008) Long-awaited Cisco IOS Catalyst 6500 and 3750, permitting us to “go native” on most core infrastructure
• In June 2009, we added IPv6 to our TWTC peering, which made “commodity” IPv6 viable
  – Prior paths to commercial sites were circuitous
  – Netflix “Instant” over IPv6 works well
Current UH IPv6 Deployment Status

- DNS Stores and answers forward and reverse IPv6 records
  - Forward currently served in IPv4 packets
  - Reverses currently served in IPv4 and IPv6
- State-wide, 99% of facility gateway routers have IPv6
- 3 campuses have deployed IPv6 in some form
  - Manoa, Honolulu CC and Maui CC
- UH Manoa has native v6 turned on to all user segments
List of Reported Problems: Native IPv6 Deployment To User Networks

- Honest: not a single one.
UH Network Neighborhood

- Dual v6/v4
- V4 only

Diagram showing network connections and relationships between various networks and nodes.
v6 Peerings

• UH
  – TW Telecom
  – Pacific Northwest GigaPoP
  – DREN (Hawaii Intranet Consortium)
  – Hawaii Internet eXchange
  – AARNET (Seattle, Sydney, [LA])

• Lavanet
  – Hurricane Electric
  – Sprint
  – AT&T
  – Verizon Business
  – TowardEX
  – Hawaii Internet eXchange
UH Short Term Goals

• DNS
  – workflow
    • DNS
    • Address management
  – full services in IPv4 packets
  – full services in IPv6 packets

• Dual stack all IP routing
  – Currently @ ~ 99%

• Dual-stack all public-facing services
  – Currently @ ~ 5%
Mail

MX, Spam filtering

SMTP, IMAPS, POPS, Webmail
Cost

• IPv6 is not value-added software (point this out to vendors)
  – The can, however expect to recover costs
  – But v6 is not a “special need”

• Most of our costs are in staff time and training.

• Cost can be controlled if you simply place IPv6 on your requirements list, start requiring it, and don't panic
Graphing v4/v6

• The old MRTG model of graphing interface Octet-counts doesn't do per protocol accounting

• Various non-optimal things can be done
  – ACLs feeding counters, etc
Graphing v4/v6

• The following graphs were by using 8 “bpf” counters fed by individual filter expressions
  – No packet was examined
  – Not a scalable approach

• Data represents 1 day on our TWTC v6/v4 peering
V6 Tunnels and Native Traffic
November 19, 2009

teredo in
teredo out
6to4 in
6to4 out
n6 in
n6 out
Comparing v6/4 paths (UH)

Average Hops from 2504 Hosts
From ping TTL

Average RTT to/from 2504 Hosts
From ping Avg RTT
One Explanation for less hops, higher RTT

- Hops are hidden by tunnels
null
Out-Of-Box V6 Readiness

V6 OOB Clients 2008
Volume of HTTP GETs

- Yes: 35.37%
- No: 64.63%

V6 OOB Clients 2009
Volume of HTTP GETs

- Yes: 52.09%
- No: 47.91%
Every Firewall, ACL, etc

- Web server access controls
- acls
- firewall setups
- PHP code to return restrict content based on IP address
- MaxMind GeoIP
  - is v6 capable
Steps To Dual-stack IPv6/(4) Deployment (NNIO)

• Get connectivity
• Get addresses
• Configure routers
• Configure DNS
• Configure public-facing services (web/mail/etc)
• Configure clients
  – Probably only necessary to the extent that you have Windows XP
Dirty Tricks: OK!

• You can direct the DNS AAAA record for an existing IPv4 services to a separate device
  – Use Apache as a transparent proxy to make it look like the content has a v6 address
  – This is GREATLY simplified if the content has an alternate name
  – Some scenarios/services can simply use a different host
Dirty Tricks: OK!

- Nothing says that the interface or device that offers services via IPv6 is required to be the same as the one that offers those services over IPv4
More

- ipv6hawaii.org
  - 44 minute (YouTube) version of this presentation