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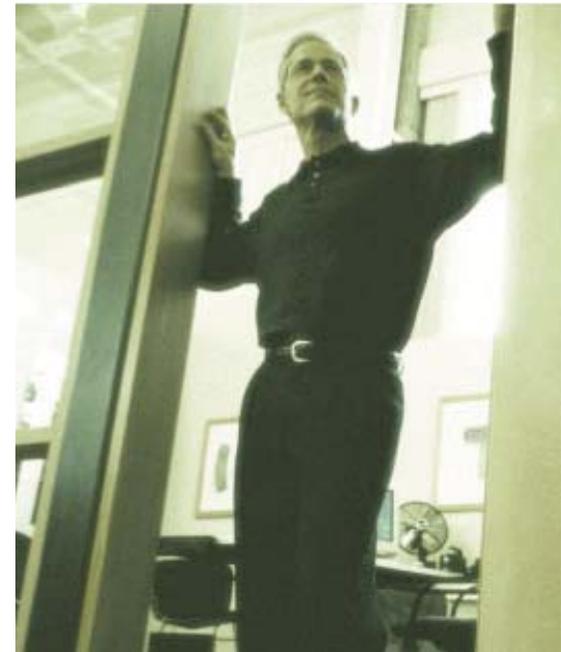
Google IPv6 Conference:

IPv6 Deployment & Commercial Applications

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Agenda

- About NTT
- **NTT - A global IPv6 deployment case study**
 - **Adoption considerations**
 - An Adoption how-to
- IPv6 beyond the transition
 - Hikari-TV
 - Earthquake warning service



Backbone Upgrade Considerations

- All backbone equipment needs to be audited and upgraded if necessary:
 - Chassis, cards, memory, etc.
 - Operating systems
- What features will be offered and can the network support these features.
- How will deployment take place:
 - Core first then the aggregation routers
 - Both at the same time
 - Set up an entire separate (parallel) network
 - Use tunnels
- A test environment needs to be set up. (everything needs to be tested)

Support Infrastructure

- Router configuration tools.
- Route Registry.
- Address allocation database and procedures.
- DNS support. (records and access method)
- Customer interfaces. (looking glass, control panels, etc.)
- Access feature support:
 - Access methods (TDM, Ethernet, Frame, etc.)
 - Features (shadow, managed router, etc.)
 - Consulting services
- Billing system support.

Monitoring and Support

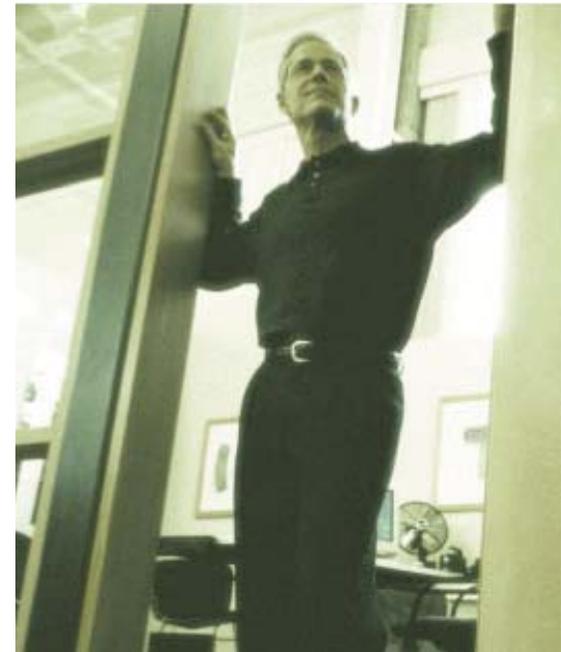
- Network Monitoring.
- Troubleshooting tools.
- Training for NOC and IPeng personnel.
- SLA monitoring and display tools.
- Any other support and monitoring tools will need to be upgraded.

Non-technical Issues

- Collateral needs to be developed.
- Decide which verticals to target.
- PIQs need to be revamped for IPv6.
- Business partnerships (if needed) to support the product.

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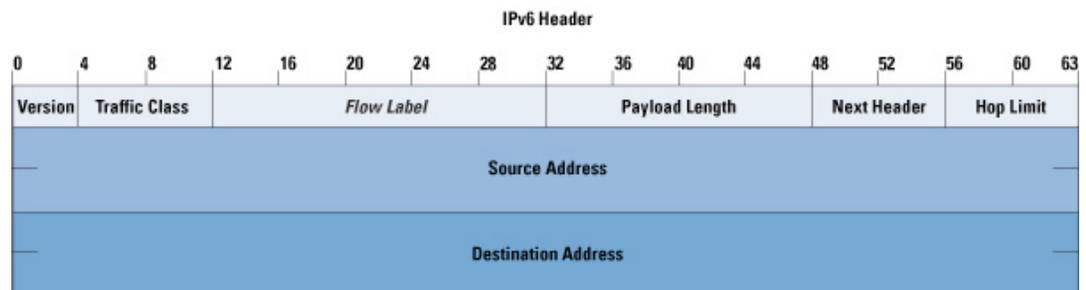
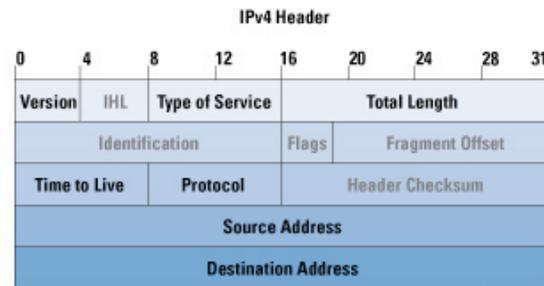


Background - NTT Communications and IPv6

- In 1996 NTT Labs started one of the world's largest global IPv6 research networks.
- Equipment procurement: in 1997 started working with vendors for IPv6 support, and in 1999 started pushing hard for commercial support.
- In 1999 NTT obtained an sTLA from APNIC. (Asia)
- In 2000 an sTLA was obtained from ARIN. (N.A.)
- 6bone was used for testing initially - later a private IPv6 lab in Dallas was used.
- In 2000 IPv6 was officially on NTT Communications' product road map.

Steps For Deploying IPv6

- NTT treated the deployment of IPv6 similar to launching a new product.
 - Set up a core team representing all necessary groups
 - Set up a project plan, document project requirements, design documents, test plans, etc.
 - Deploy IPv6 in a phased approach:
 - (I) Precommercial Phase
 - (II) Commercial
 - (III) Follow up releases



NTT's Pre-commercial IPv6 Service in the US

- In June of 2003, NTT Communications launched pre-commercial IPv6 service in the US.
- Native IPv6 was available in three locations:
 - Bay Area
 - Los Angeles
 - Washington D.C. Area
- Cisco 7206 routers in these three locations running dual stack - tunneling across the backbone. (backbone not dual stack)
- Tunneling (RFC 2893 manually configured IPv6 over IPv4) available in all other POPs. (tunnel built to one of the locations above)

Pre-commercial Service Objectives

- Pre-commercial service was offered from June 2003 to December 2003. (at which time commercial service was launched)
- Pre-commercial objectives:
 - Bring on a small, manageable number of customers
 - Test provisioning and support procedures
 - Train NOC staff
 - Continue JunOS/IOS IPv6 testing
 - Develop internal tools
 - Allowed time to upgrade backbone to dual stack
- Still just a few dual stack routers with tunneling across the backbone everywhere else.

NTT's Commercial IPv6 Service Launch

- In 4Q2003 global backbone was upgraded to dual stack. (Asia, Australia, North America, and Europe)
- In December, 2003, three types of IPv6 service were offered on a commercial basis:
 - Native IPv6 (available at every POP)
 - Manually configured IPv6 over IPv4 tunneling
 - Dual stack IPv4/IPv6
- AS2914 core completely dual stack. (globally)
- 7x24 NOC support and SLAs.
- Still service functionality gaps.

IPv6 Follow Up Releases

- Since the commercial launch in December 2003, follow up releases have been pushed out to fill functionality gaps.
- Added IPv6 support for:
 - Off-net Tunneling
 - Managed Router Service
 - Shadow support for TDM and Ethernet
 - Managed Firewall
 - Dual stack Virtual Private Server
- Our goal and philosophy is to offer all features and services in IPv4 and IPv6. (It doesn't matter which flavor of IP you buy - you can get the same things.)

IPv6/IPv4 Dual Stack Backbone

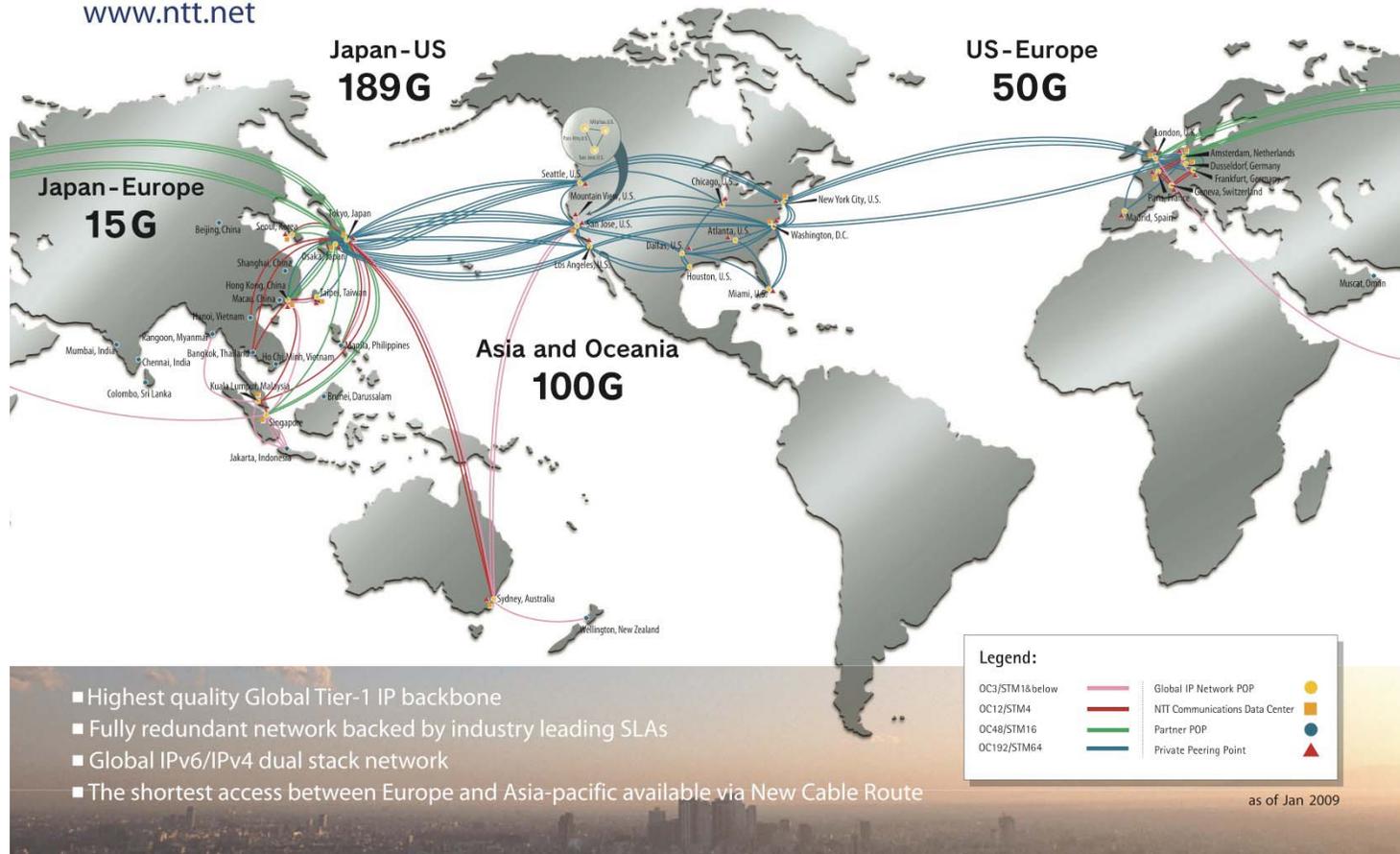
- IPv6/IPv4 Dual Stack Backbone has shown excellent performance with no critical problems so far.
- Core routers / routing protocols have had no problems handing IPv6 traffic. (in addition to the IPv4 traffic/routing)
- But still, we have some operational gaps:
 - Stats tools are still lacking in the IPv6 environment (IPv6 MIB support, SNMP over IPv6 support...)
 - IPv6 jitter measurement system compatible with our IPv4 system.
 - IPv6-enabled irrd/whois have been released, but exhibit poor performance
 - Limited netflow v9 collector support.

Dual Stack IP Backbone - January 2009



NTT Communications Global IP Network

www.ntt.net



- Highest quality Global Tier-1 IP backbone
- Fully redundant network backed by industry leading SLAs
- Global IPv6/IPv4 dual stack network
- The shortest access between Europe and Asia-pacific available via New Cable Route



Summary and Recommendations

- Create a core project team with representation from all pertinent groups in your organizations.
- Plan well in advance and make purchasing decisions based on IPv6 support. (NTT had no capital budget specifically for IPv6 deployment)
- Proper planning reduces cost and pain.
- Select the best backbone migration approach for your network - running IPv4/IPv6 dual stack is recommended if possible.
- Set up a test environment and/or use existing test beds.
- Get training for engineering, provisioning, and support personnel.
- Employ a phased rollout approach
 - Allows to continue testing
 - Get internal resources trained and up to speed
 - Solidify internal processes and tools
 - Can fill in functionality gaps over time
- Make sure your security policy also includes IPv6
- Get outside help if needed.
- IPv6 roll out should be easier today with the increased maturity of IPv6.