IPv6 – Global Implementation

Observations and Update

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Company Overview

Our People

- Invented the DNS
- Developed 90% of the world's DNS software
- Architected leading DHCP product

Our Experience

- More than a decade supporting network operators
- Top fixed and mobile operators, enterprise & government customers
- More than 40 patents & patents pending

Our Technology

- World-class DNS/DHCP engines
- Revolutionary N2 Platform
- Open IDEAL ecosystem of application providers

Our mobile customer base includes:

中国电信 CHINA TELECOM · TIM · Telefónica · T · swisscom · vodafone · CHINA MOBILE · movistar · Claro

Our fixed broadband customer base includes:

verizon · comcast · NTT Communications · Virgin media · BT · TELMEX

Business Drivers for IPv6 Migration

Business Benefits of IPv6

1. **Revenue Growth**
   - Accommodates dramatic growth in IP-enabled devices
     - Connected Home, “The Internet of Things” (M2M), etc
   - Support growth into new or expanding markets

2. **Customer Loyalty**
   - Better experience accessing popular connection-intensive content
     - E.g. – Facebook, Google Maps
   - Better peer to peer gaming

3. **Network Efficiency**
   - “Jumbograms” enable high performance applications
     - Moves from 1,536 bytes in IPv4 to 65,536 bytes in IPv6
     - Lower overhead for high performance data transfers for video and cloud access
   - Multi-cast efficiency improvements

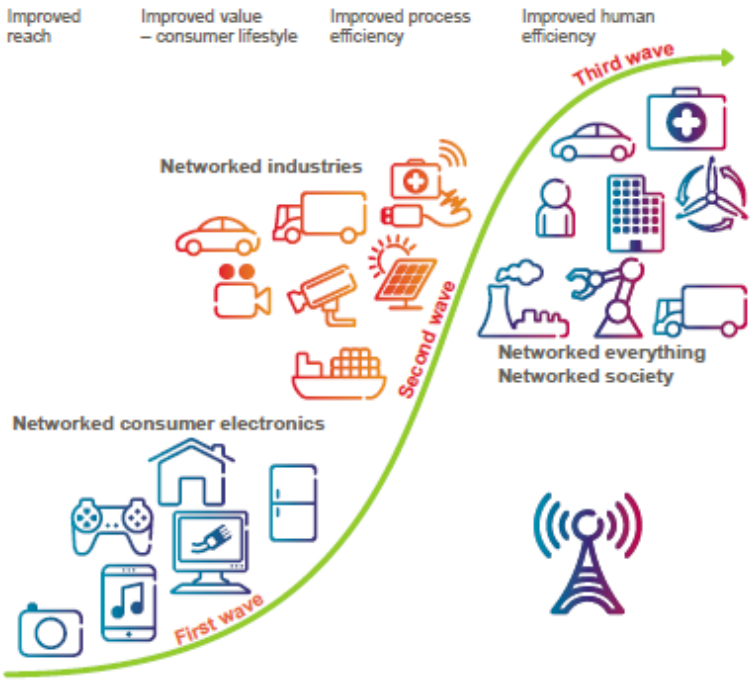
Business Benefits of IPv6 (Continued)

4. **Enterprise agility**
   - Eliminates NAT bottlenecks between corporate divisions
     - IPv6 corporate networks don't require overlapping private address spaces
     - This eliminates need to translate between conflicting private address spaces
     - Reduces cost of supporting conflicting network ranges after M&A
   - Transparent support for connectivity through multiple ISPs

5. **Device-specific analytics and policies**
     - Identifying which devices are infected
     - Applying per-device policies
       - Parental controls
       - Firewall filters

The Demand for Addresses is Exploding

By 2020 estimates of more than **50 billion connected devices** – taking connected devices to mass market and profitability.



- **Home automation**
- **Home security**
- **IPTV**
- **Smart meters**
- **Automobiles**
- **Etc.**

Source: Ericsson white paper 284 23-3149 Uen | February 2011

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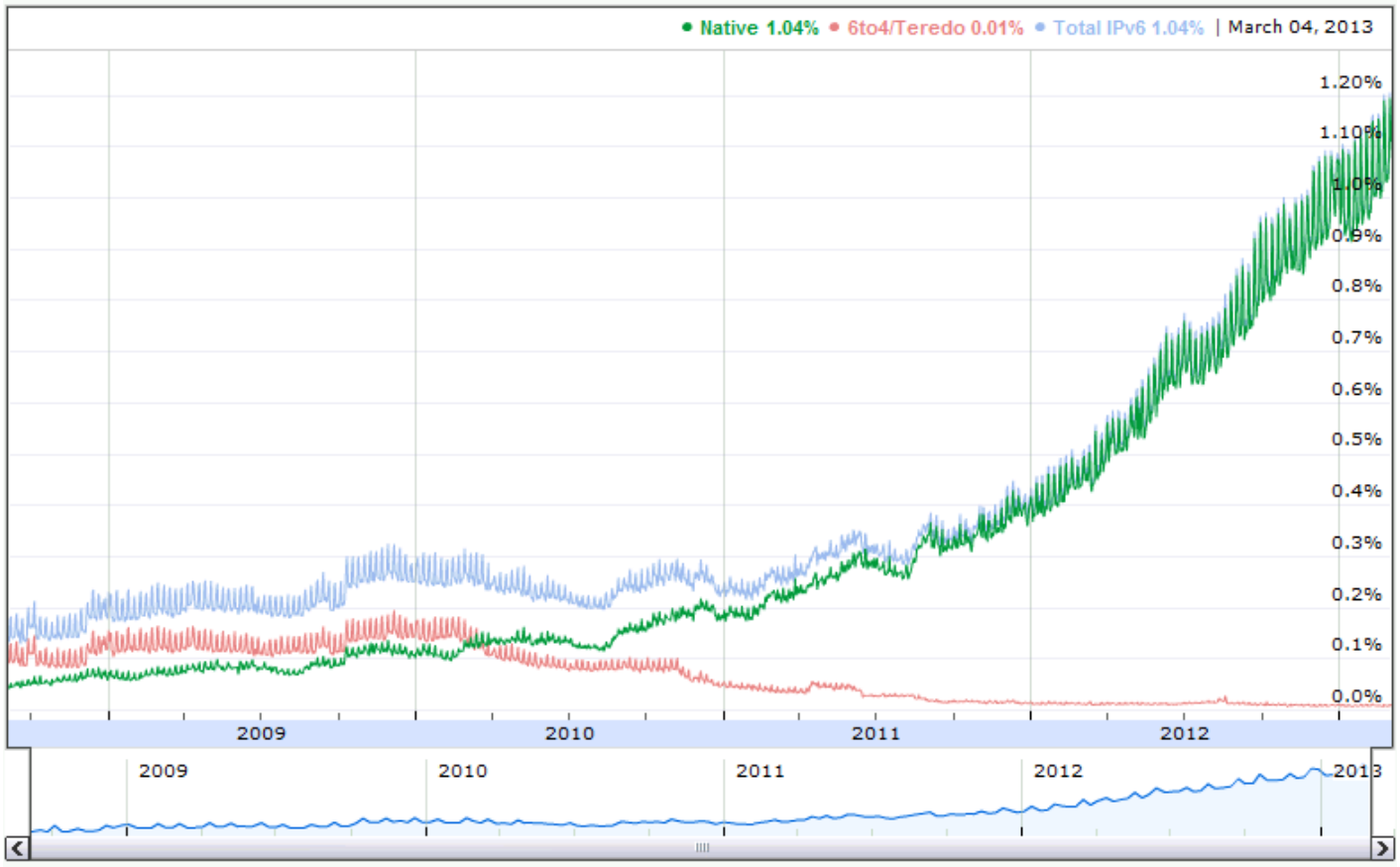
What Moved the Market Movers?

Business	Concern(s)	Advantage(s)
DT Terastream	IPv4 starvation, reducing cost	Network optimization (FTTH)
Bechtel	multi-national globalization	growth emerging markets
Comcast	organic growth	answer for IPv4 exhaust as devices proliferate
T-Mobile USA	device compatibility	thought leader
Google	global reach	Internet growth, better app support, per-device analytics
Akamai	device proliferation	traffic optimization

IPv6 Adoption is Low but Accelerating

% subscribers on IPv6



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Why DNS and DHCP are critical to IPv6

IPv6 Needs Names More than IPv4

- IPv6 addresses are too long to type or remember
  - *E.g. 2001:0db8:85a3:0000:0000:8a2e:0370:7334*
- Devices that need to be easily identified need to have names
- IPv6 makes it possible for the customer to configure devices to be globally accessible
- Devices that need to be globally accessible need to have global names
- mDNS solves the problem of identifying devices on the local network
- mDNS is a local protocol and does not work globally
- So with IPv6, the need to keep the DNS up to date with the address of every node becomes paramount

IPv6 Impact to DNS

- Increased Performance Requirements
  - When customers begin serving both IPv4 and IPv6 client DNS requests, DNS traffic could increase dramatically
    - MacOS issues AAAA queries and then falls back to A queries if no AAAA record
    - Windows Vista & Windows 7 will issue AAAA query if the client is configured with a publicly routable IPv6 address
- Additional Load on DNS Infrastructure
  - IPv6 increases memory use on caching and authoritative DNS servers
  - Makes pre-populating rDNS entries nearly impossible
  - DNS64 will require “synthesizing” responses

IPv6 Impact to Security

- IPv6 has several important security advantages
  - Sparse address space makes scattershot attacks infeasible
  - More modern protocol specs have security built in
  - Compliant IPv6 implementations include Ipsec
  - Cryptographically Generated Addresses (CGA)
- But also introduces several challenges
  - More addresses means attacks can be more agile
  - Blocking based on ranges can cause collateral damage
  - Technologies for pre-fix blocking dont yet exist in IPv6
  - Lack of standards

DHCP: Your View into the Network

- Why do we even need DHCPv6? Doesn't stateless autoconfiguration make it obsolete?
- Stateless address allocation is currently specified for use on local networks, but has limitations
  - How do you identify nodes that need to be externally accessible?
  - What if you want to run a managed network?
  - How do you know what devices are using the network?
- DHCPv6 is needed for prefix delegation
  - Existing cable network IPv6 deployments use prefix delegation—it's not optional

DHCPv6 provides naming and configuration control.

- If DNS is paramount, where do we get the data?
- DHCP provides data as devices connect to the network
- Self-configured addresses (CGA and SLAAC) could be registered using DHCP
- PTR zone delegation is possible with DHCPv6 PD

Summary

1. **IPv6 provides multiple business benefits**
   - New revenue, customer loyalty, network efficiency, business agility and device specific visibility and policies
2. **DNS &DHCP are the logical place to start the transition**
   - Naming and numbering central to the transition
   - Foundation for new revenue-generating service
   - Next generation networks deserve next generation DNS & DHCP
3. **Nominum can help with the transition**
   - Working with standards bodies to address last deployment issues
   - Guidance on deploying DNS & DHCP
   - Software designed to meet needs of demanding network operators
   - Integrated architecture enables efficiency, agility and differentiation