



**SAN JOSÉ STATE
UNIVERSITY**

IPv6 money trails

From IPv6 Day
to IPv6 every day

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IP Services



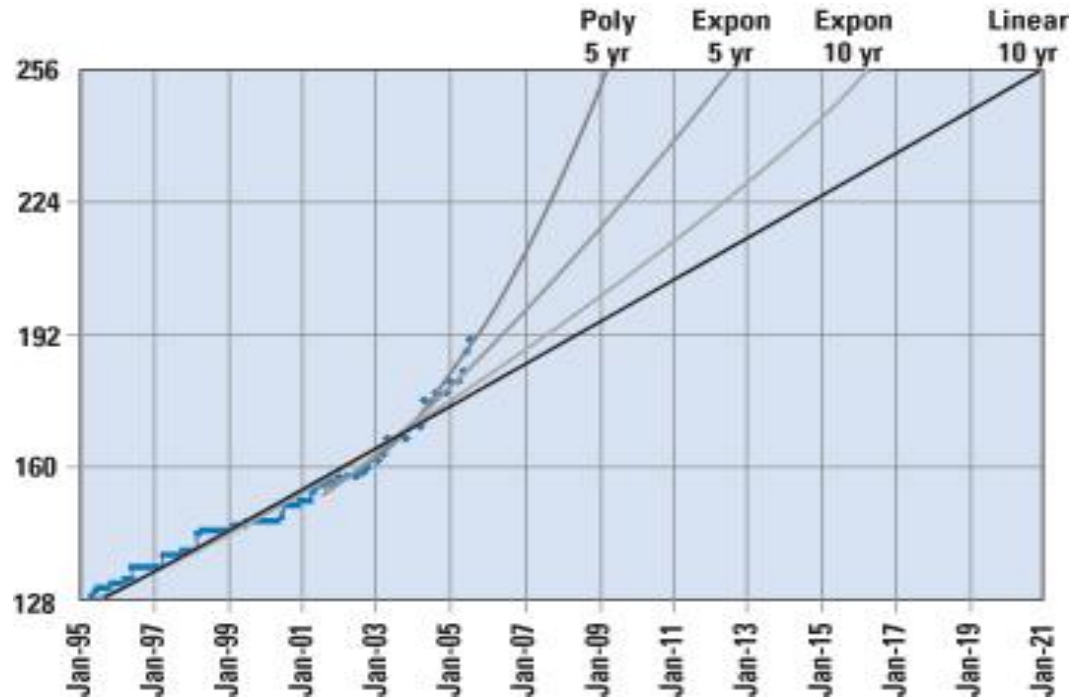
The Tata Group

- 140-year old largest private sector group
- \$70.5 billion in revenues, 61% of business from outside of India
- 350,000 employees
- 3% of India's Gross Domestic Product (GDP)
- Conglomerate comprising 93 operating companies
- Tata Communications: consolidation of VSNL, Tyco cables, Teleglobe Canada and Neotel.
- TATA Steel acquired Corus for \$23 billion
- TATA Motors acquired Jaguar – Land Rover
- Tata Consultancy Services (TCS)
 - Asia's largest software & systems integration services company; present in 33 countries



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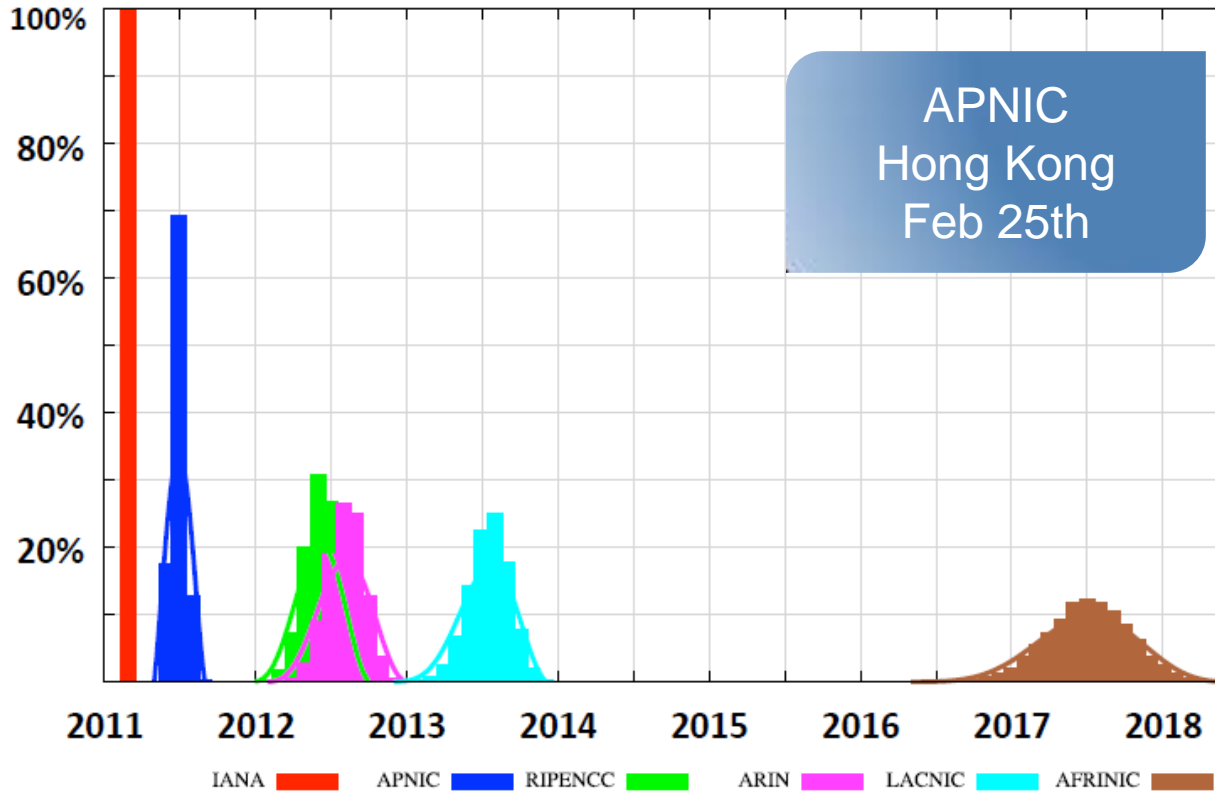
The dark science (art?) of predictions



When will we run out of IPv4 addresses? Mid 2005 extrapolations ranged from 2008 (Tony Hain) to 2020 (Geoff Huston), not surprising that wait and see remained prevalent. On January 31st 2011 it finally happened: IANA allocated its last two freely available 'slash eights'. A wake-up call for many.

The new guessing game:

When will the RIR's run out of IPv4?

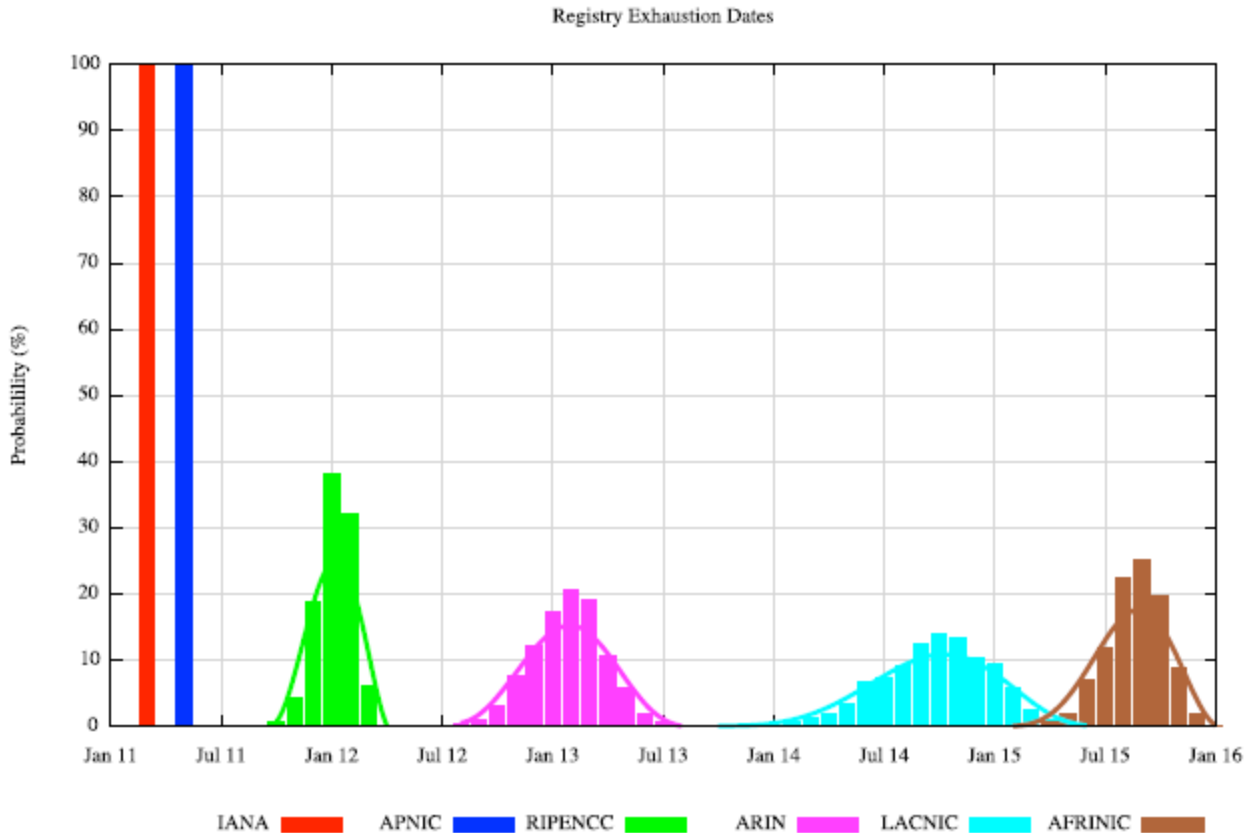


Source: Geoff Huston presentation

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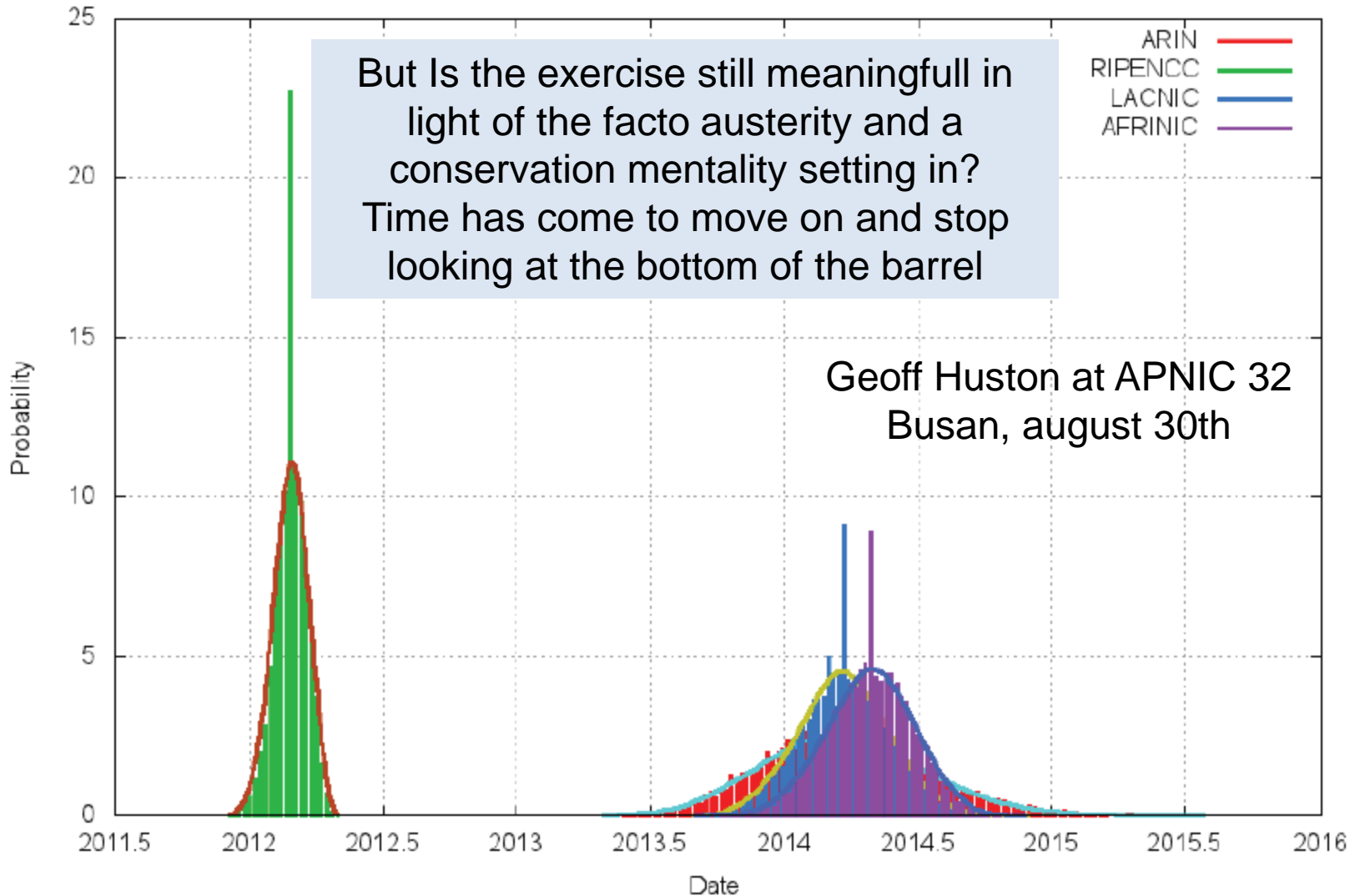
May 6th view of floating histograms

APNIC ran out on april 15th with strict rationing of remaining IPv4 addresses now in place. RIPE could run out by the end of the year and ARIN by mid 2012.



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august 30th : the drift continues



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IPv6 is more than a new address format; it is a fundamental game changer

Solves address shortage

Better QoS (flow lables)

Restores p2p communication

Auto configuration

Mobility

- **Much easier roaming**
- **Better spectrum utilization**
- **Better battery life!**

- **Mobile Ad-Hoc networking**
- **Mobile networks**
- **Sensor networks**
- **Plug and Play networks**

Security

- **IPsec mandatory**

Permanent addresses

- **Identity (CLID)**
- **Traceability (RFID)**
- **Addressability!**
- **IP address based billing**

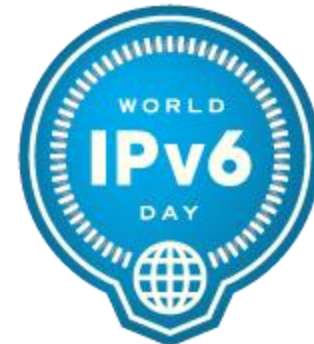
Multicast

IPv6 Day : a fitness test for the internet ecosystem

In preparation peering links were double verified and a specialized helpdesk set up for the day. Traffic monitoring tools were IPv6 enabled at a number of strategic locations.

The Tata Communications website www.tatacommunications.com website was already IPv6 enabled and has been accessible in IPv6 ever since.

June 8th demonstrated the resiliency of the global Network and quite advanced readiness amongst all major backbone providers in anticipation of an eventual major and sudden surge in IPv6 traffic .



specialized helpdesk for IPv6 day

AS 4755

AS 6453

REPORT FROM AS4755

S.no	Date (GMT)	Time (GMT)	URL	IPv6 Address	IPv4 Address	IPv6 RTT Avg	IPv4 RTT Avg	IPv4 Status	IPv6 Status	Traceroute Results
1	7-06-2011	01:16:25	tatacommunications.com	2001:5a0:5000:2::149	121.243.66.50	281	24	↑	↑	Traceroute Result
2	7-06-2011	01:16:25	www.google.co.in	2404:6800:8008::68	74.125.236.48	69	24	↑	↑	Traceroute Result
3	7-06-2011	01:16:25	in.yahoo.com	2a00:1288:f00e:ffe::3001	121.101.152.169	153	26	↑	↑	Traceroute Result
4	7-06-2011	01:16:25	www.youtube.com	2404:6800:8006::5b	209.85.153.136	90	21	↑	↑	Traceroute Result
5	7-06-2011	01:16:25	www.facebook.com	2620:0:1c18:d0:face:b00c:0:2	69.171.224.13	264	309	↑	↑	Traceroute Result
6	7-06-2011	01:16:25	www.bing.com	2600:140e:5:3f96:8359	115.112.224.8	353	24	↑	↑	Traceroute Result
7	7-06-2011	01:16:25	www.xbox.com	2402:6800:720:11:230:48ff:fe8d	203.77.189.7	453	292	↑	↑	Traceroute Result
8	7-06-2011	01:16:25	www.aol.com	2001:4b0:1668:2202:2::1	64.12.245.203	268	Not Reachable	↑	↑	Traceroute Result
9	7-06-2011	01:16:25	www.mapquest.com	2001:4b0:1668:2202:2::3	64.12.99.162	267	Not Reachable	↑	↑	Traceroute Result
10	7-06-2011	01:16:25	www.t-online.de	2003:2:2:40:62:153:159:92	62.153.159.92	Not Reachable	299	↑	↓	Traceroute Result
11	7-06-2011	01:16:25	www.cisco.com	2001:420:80:1c:15c0:d06f00d	60.254.168.170	272	278	↑	↑	Traceroute Result

AS 4755

AS 6453

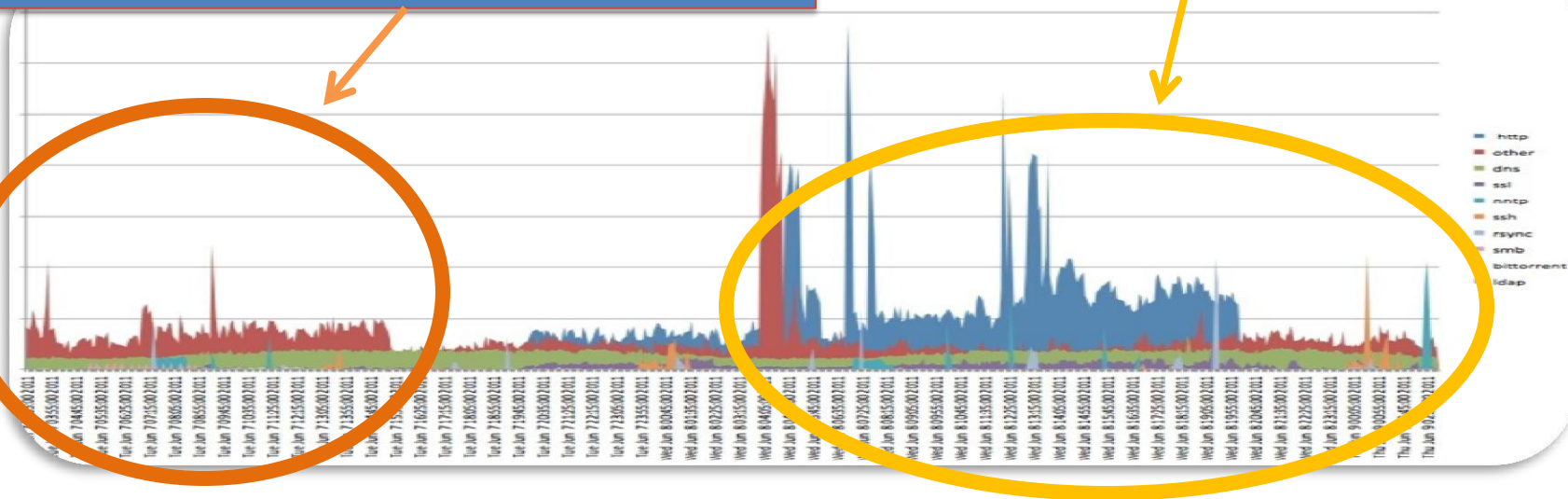
REPORT FROM AS6453

S.no	Date (GMT)	Time (GMT)	URL	IPv6 Address	IPv4 Address	IPv6 RTT Avg	IPv4 RTT Avg	IPv4 Status	IPv6 Status	Traceroute Results
1	7-06-2011	00:50:01	tatacommunications.com	2001:5a0:5000:2::149	121.243.66.50	13	201	↑	↑	Traceroute Result
2	7-06-2011	00:50:01	www.google.co.in	2404:6800:800b::93	74.125.235.51	247	234	↑	↑	Traceroute Result
3	7-06-2011	00:50:01	in.yahoo.com	2001:4998:700b:ffe::3000	67.195.160.76	33	Not Reachable	↑	↑	Traceroute Result
4	7-06-2011	00:50:01	www.youtube.com	2404:6800:800b::be	74.125.235.38	241	240	↑	↑	Traceroute Result
5	7-06-2011	00:50:01	www.facebook.com	2620:0:1c08:4000:face:b00c::	69.171.224.41	71	90	↑	↑	Traceroute Result
6	7-06-2011	00:50:01	www.bing.com	2001:418:2007:1::a88f1169	204.245.162.35	Not Reachable	Not Reachable	↑	↑	Traceroute Result
7	7-06-2011	00:50:01	www.xbox.com	2001:418:2007:1::a88f1128	204.245.162.41	Not Reachable	Not Reachable	↑	↑	Traceroute Result
8	7-06-2011	00:50:01	www.aol.com	2001:4b0:1668:2202:2::1	64.12.245.203	Not Reachable	Not Reachable	↑	↑	Traceroute Result
9	7-06-2011	00:50:01	www.mapquest.com	2001:4b0:1668:2202:2::3	64.12.99.162	Not Reachable	Not Reachable	↑	↑	Traceroute Result
10	7-06-2011	00:50:01	www.t-online.de	2003:2:2:40:62:153:159:92	62.153.159.92	Not Reachable	99	↑	↓	Traceroute Result
11	7-06-2011	00:50:01	www.cisco.com	2001:420:80:1c:15c0:d06f00d	72.246.112.170	78	Not Reachable	↑	↑	Traceroute Result

What did we actually see on World IPv6 Day?

Typical day dominated by Peer to Peer and other file transfer

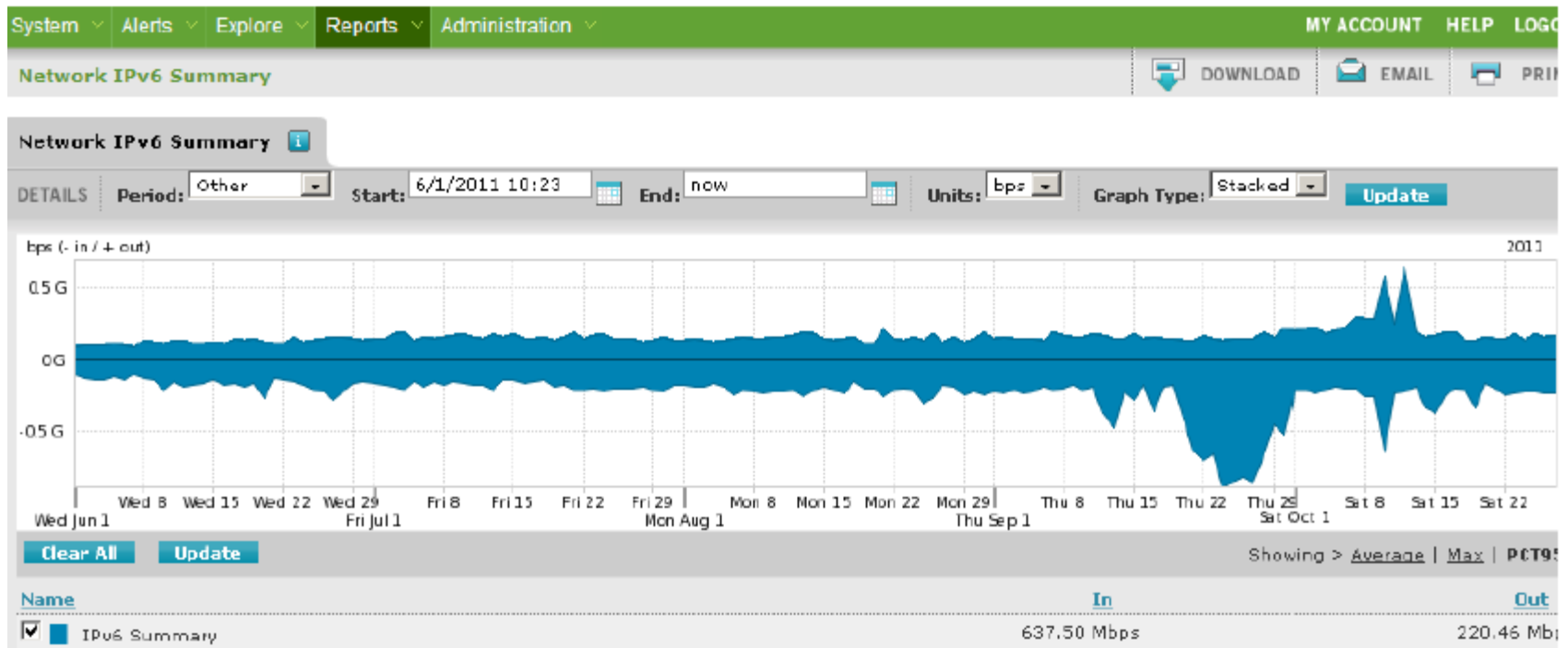
World Day IPv6 day traffic surge



- The experiment on a global scale has enabled content providers and ISP's alike to gain confidence in their IPv6 deployments.
- On June 8th, AS6453 witnessed the sharpest spikes in IPv6 traffic in the US and Europe regions and we reported a 67% day over day traffic increase.

IPv6 since IPv6 day observed by AS6453

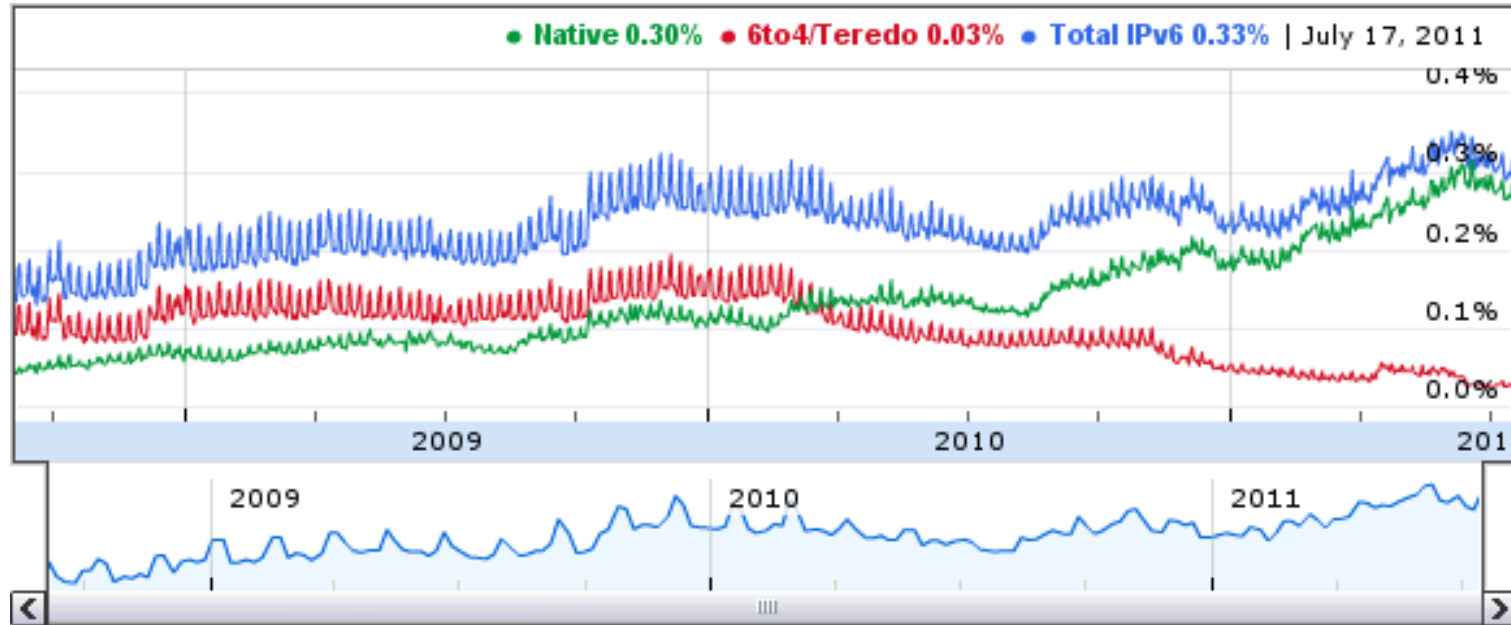
Global IPv6 traffic grows at a slow but steady pace; the June 8th peak is now background noise and some major players are kicking the IPv6 tires



Note that these figures represent only a fraction of the overall Pv4 plus IPv6 traffic of AS6453 derived from probes on a selected number of network points.



IPv6 traffic seen by Google



End July France was the IPv6 traffic champion at 3.6% while Japan clocked in at 1.4% . Without France and Japan world IPv6 traffic share fell to 0.1%

As reported by Lorenzo Colitti at the Quebec IETF meeting on July 25th
<http://www.ietf.org/proceedings/81/slides/plenaryt-9.pdf>

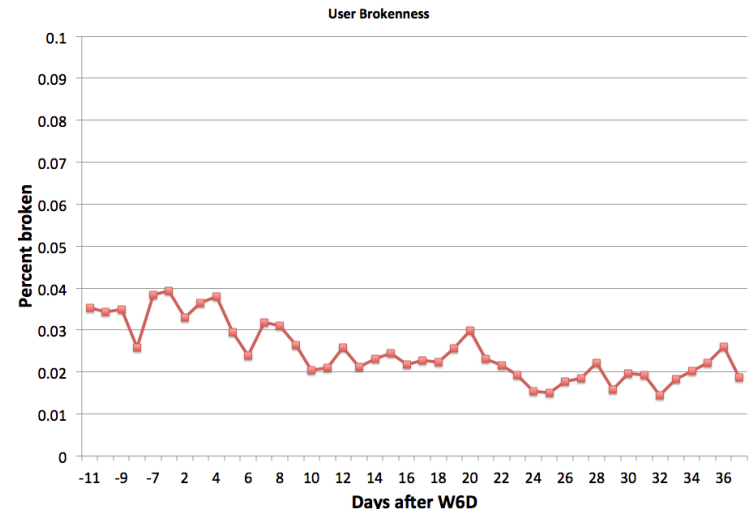
See latest statistics at
<http://www.google.com/intl/en/ipv6/statistics/>



The brokenness issue as delaying factor

Concern about brokenness still delays opening the IPv6 floodgates on the content side. Youtube, Yahoo and facebook provided an update on the issue on July 25th in Quebec City at the IETF meeting:

Facebook reports brokenness down to around 0.02%. Google reports brokenness issues largely fixed in Chrome, Firefox 7 follows, Apple's OS X Lion more robust, IE to follow soon.



Chrome versions with fast fallback are 99.995% as reliable as IPv4



How the world changed since IPv6 day

All major tier-1 carriers IP networks are dual stack with adequate peerings to cope with the transition from IPv4 to IPv6 and sudden shifts in relative traffic.

Upgrade to dual stack is still patchy amongst tier 2&3 carriers but improving fast while awareness is growing in certain segments of the enterprise market..

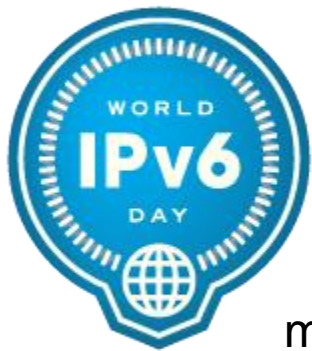
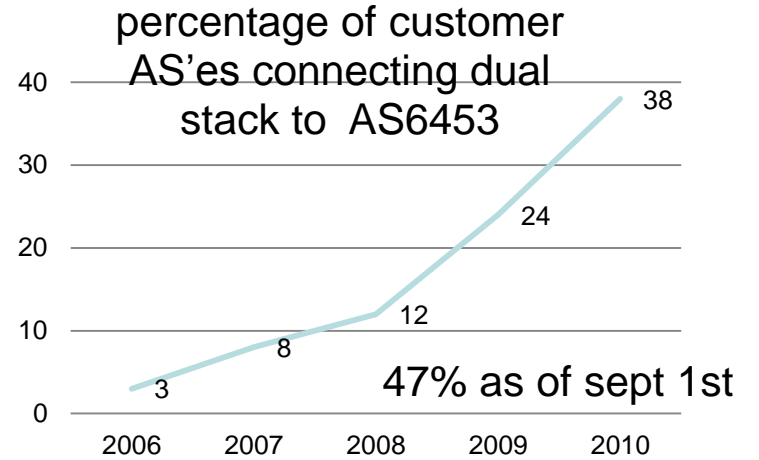
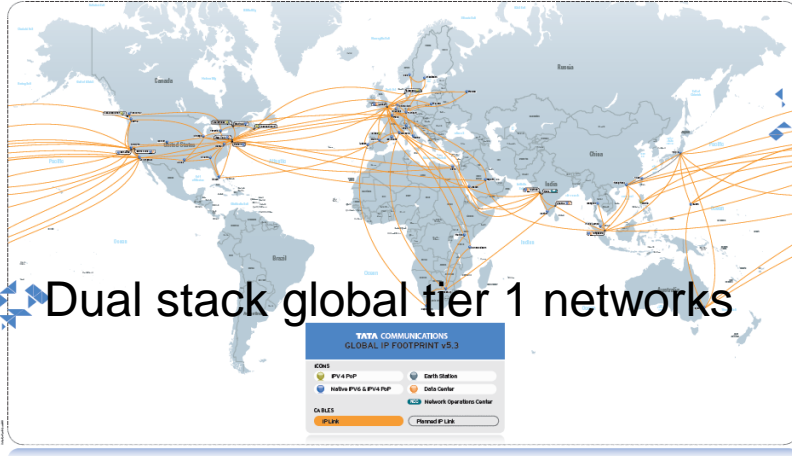
Work-around options such as 6rd or DS-lite are workable and gaining popularity on the local access to avoid the bottleneck of sizeable investments in non easily upgradeable IPv4 only CPE boxes, cable modems and DSL's

Major content providers see the 'brokenness' going down also but still hesitate. The planned IPv6 Week in the first half of 2012 could lead to major content providers leaving IPv6 accessibility on permanently.

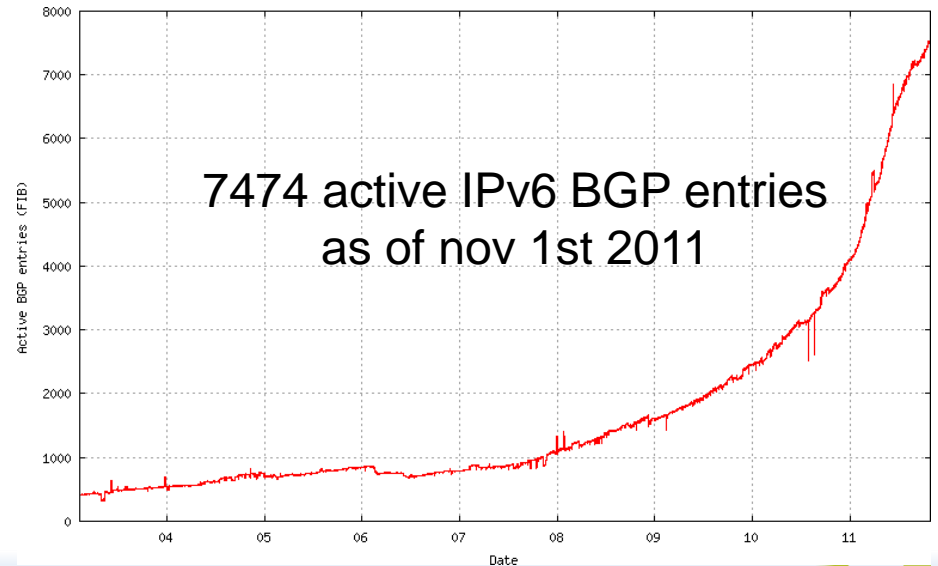
The current levels of robustness testing show full deployment is getting closer



IPv6 : we have lift-off on the network side



June 8th was a major milestone and a success



Is the CPE logjam breaking up? Yes for cable, DSL next? Homerouters?



An NCTA letter to the FCC dated oct 17th states that cable operators will have deployed DOCSIS 3.0 platforms to 77% of U.S. homes by the end of 2011, up from 60% at the end of 2010.

Benbroadband (Central Oregon) and Masillon Cable (Western Kansas) are the champions with 100%! Congratulations 😊

<http://fjallfoss.fcc.gov/ecfs/document/view?id=7021714823>

DOCSIS 3.0 allows cable operators to offer wideband Internet service of 50 Mbps to more than 100 Mbps, and DOCSIS 3.0 standards specify IPv6 support.

Most emergent technologies of 2011

CIO Insight Research Exclusive october 2011

	investigating, testing currently using	in testing stage
Tablet devices	93%	31%
Unified communications	84%	27%
Private clouds	79%	25%
IPv6	75%	29%
Location-based apps	65%	21%
predictive analytics	63%	20%
4G wide-area services	60%	16%
Crowdsourcing	59%	19%
Context-aware computing	56%	18%
Semantic Web	53%	17%

http://circ.ziffdavisenterprise.com/pdfs/Research_CIOI_11_0910.pdf

Top 10 Strategic Technologies for 2012

According to Gartner Symposium oct 16-20 Orlando

1. **Media Tablets and Beyond**
2. **Mobile-Centric Applications and Interfaces**
3. **Contextual and Social User Experience**
4. **Internet of Things**
5. **App Stores and Marketplaces**
6. **Next-Generation Analytics**
7. **Big Data**
8. **In-Memory Computing**
9. **Extreme Low-Energy Servers**
10. **Cloud Computing**

<http://www.gartner.com/it/page.jsp?id=1826214>



IPv6 money trails: Mobile Broadband and LTE



June 10th 2009 as reported by Networkworld:

According to device requirements Verizon released earlier this year, any device that hooks onto the LTE network"shall support IPv6" and further states that "the device shall be assigned an IPv6 address whenever it attaches to the LTE network." The requirements make support for IPv4 optional and state that any device supporting IPv4 "shall be able to support simultaneous IPv6 and IPv4 sessions."

Nov 2nd 2011 : Verizon has the most LTE subscribers in the world; congratulations Verizon!

Worldwide LTE deployments (oct14th GSA report):

35 commercial networks in 21 countries

185 operator commitments in 66 countries

63 pre-commit trials in 21 more countries

103 anticipated commercial LTE networks by end 2012

IPv6 money trails: smart grids and smart meters

‘By the end of 2015, more than 55 million meters will be installed on 45 percent of U.S. households. In addition, 17 percent of U.S. households will have some form of in-home display for monitoring energy consumption by 2015. And by 2021, nearly 50 percent of households will have an energy management network’

Source: http://www.fiercesmartgrid.com/offer/smart_metering?source=fsgblast



OSGP = Open Smartgrid Protocol
IPv6 specified in the standards

IPv6 money trails: Smart homes

- ‘ **Smart home sensor network chipset shipments, the majority wireless chipset solutions, will approach 100 million worldwide in 2015, enabling nearly \$6 billion in cloud services for energy and home service providers, according to a study by ON World.**

Further, smart home sensor network systems based on IPv6 are a growing trend and, in addition to the migration to ZigBee Smart Energy 2.0, there are several service providers that currently offer IPv6 based smart home systems.

According to a survey by ON World of over 500 consumers, 4 out of 5 are “interested” or “very interested” in applications such as security, safety, lighting and energy management, and 29 percent are willing to spend \$10 or more per month for a smart home cloud service. ‘

Source : m2m worldnews

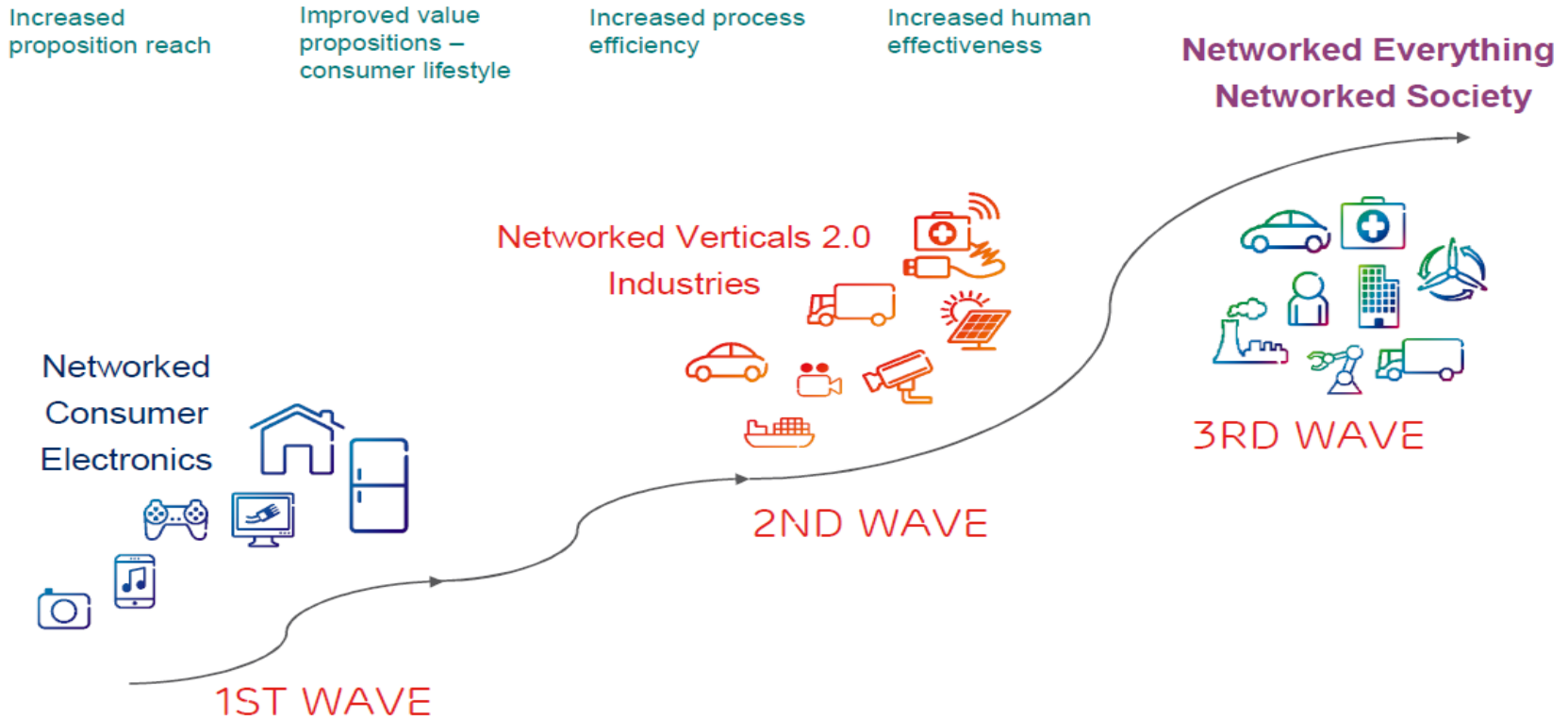
<http://m2mworldnews.com/2011/10/17/30981-smart-home-cloud-services-worth-6-billion-in-2015/>



IPv6 money trails: the embedded internet

IETF 6lowpan standards are now right, front and center

50 billion connected devices by 2020? Ericsson's vision of three waves



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IPv6 money trails: help the transition

10,000 US Government websites have to be IPv6 ready by september 2012

The Indian Government issued a major call for tender to select consulting firms to assist in their transition to IPv6 by the end of 2012

The banking sector and credit card companies are now visible at IPv6 workshops and conferences, as well as the energy sector and major retailers.

Verizon, AT&T, Orange, IBM, HP, Cisco and others have set up 'IPv6 Centers of Excellence' or 'IPv6 practices' or 'IPv6 Professional services' to cater to what will be market with a peak in maybe two years and a long tail.



IPv6 money trails : clouds and virtualization

Small IPv6 advantages add up:

You can keep your same address every time you access the cloud and cloud resources can easily be recognized with very fine granularity by their IP addresses. Persistent IP addresses lead to symbiosis between user and cloud service.

IPv6 Neighbour discovery allows to put many more hosts in the cloud; no more needless ARP broadcast chatter annoying everybody.

Rise of cloud computing rises demand for off-site storage centers.

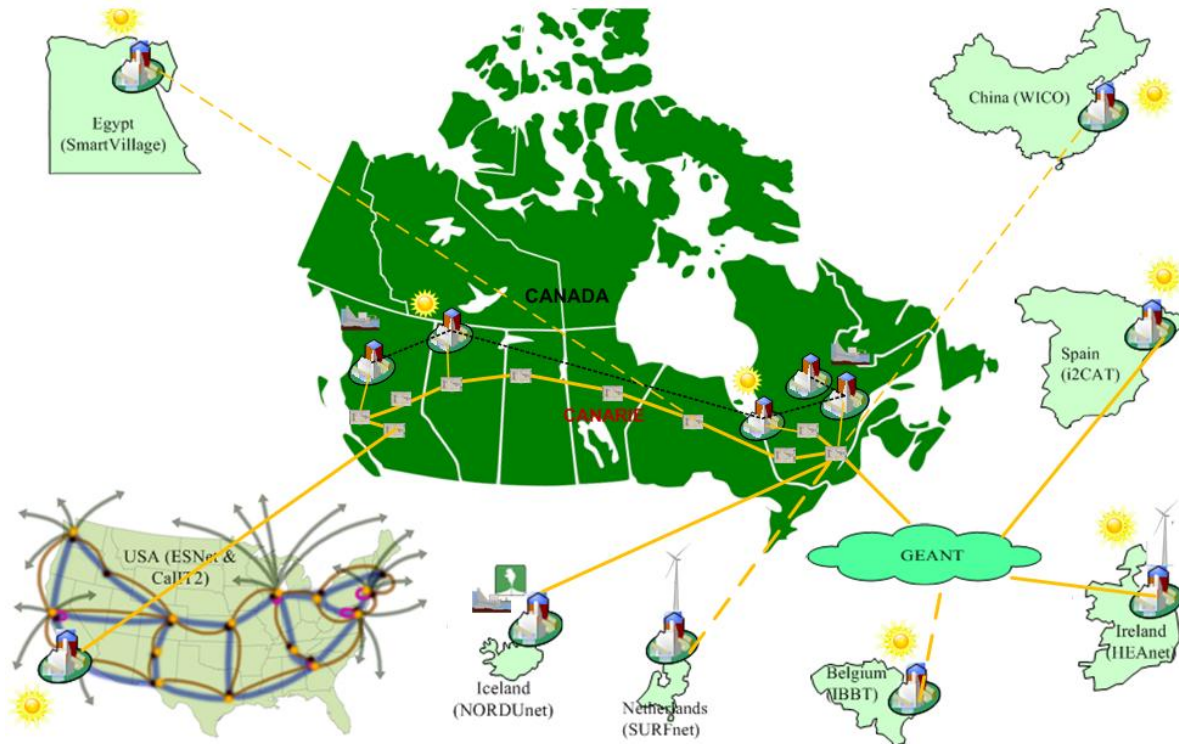
Virtualization of data storage and data processing similarly will benefit from persistent addresses



IPv6 money trails : Green Networks, Green IT

Virtualization of data processing and storage centers moving around the world based on immediate renewable energy supply situation needs persistent addresses to scale.

GreenStar Network – World’s First Zero Carbon Network & Cloud



Greenstar :

Follow the sun, follow the wind

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Just imagine what new possibilities omnipresence opens up with a near infinite supply of persistent addresses and meta-addresses



Thank You

« These days all competitive advantages are fleeting. So the smartest companies are learning to create new ones – again and again and again »

Robert D. Hof , Business Week