



The Internet is for Everyone. Become an ISOC Member.

Where are we one year after World IPv6 Launch ?

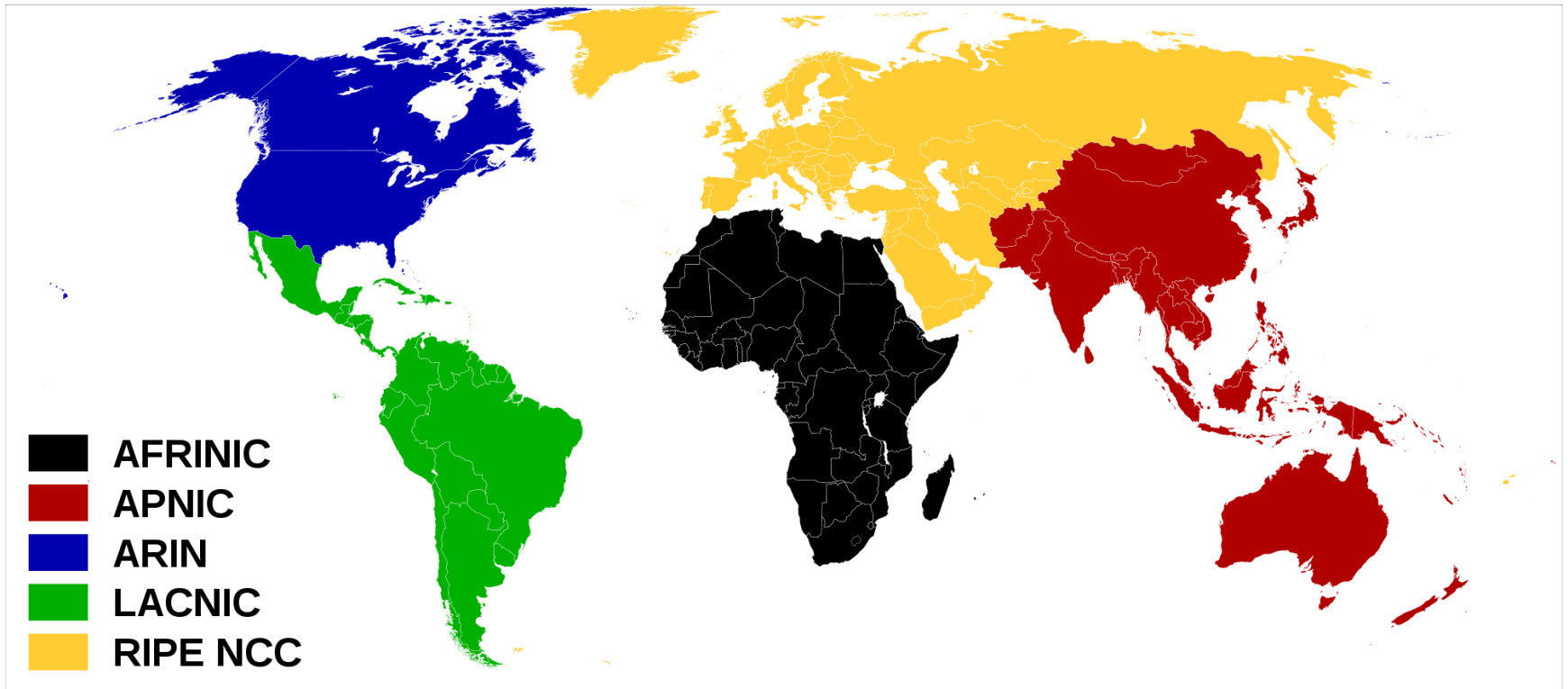
Warren Kwok

Internet Society Hong Kong

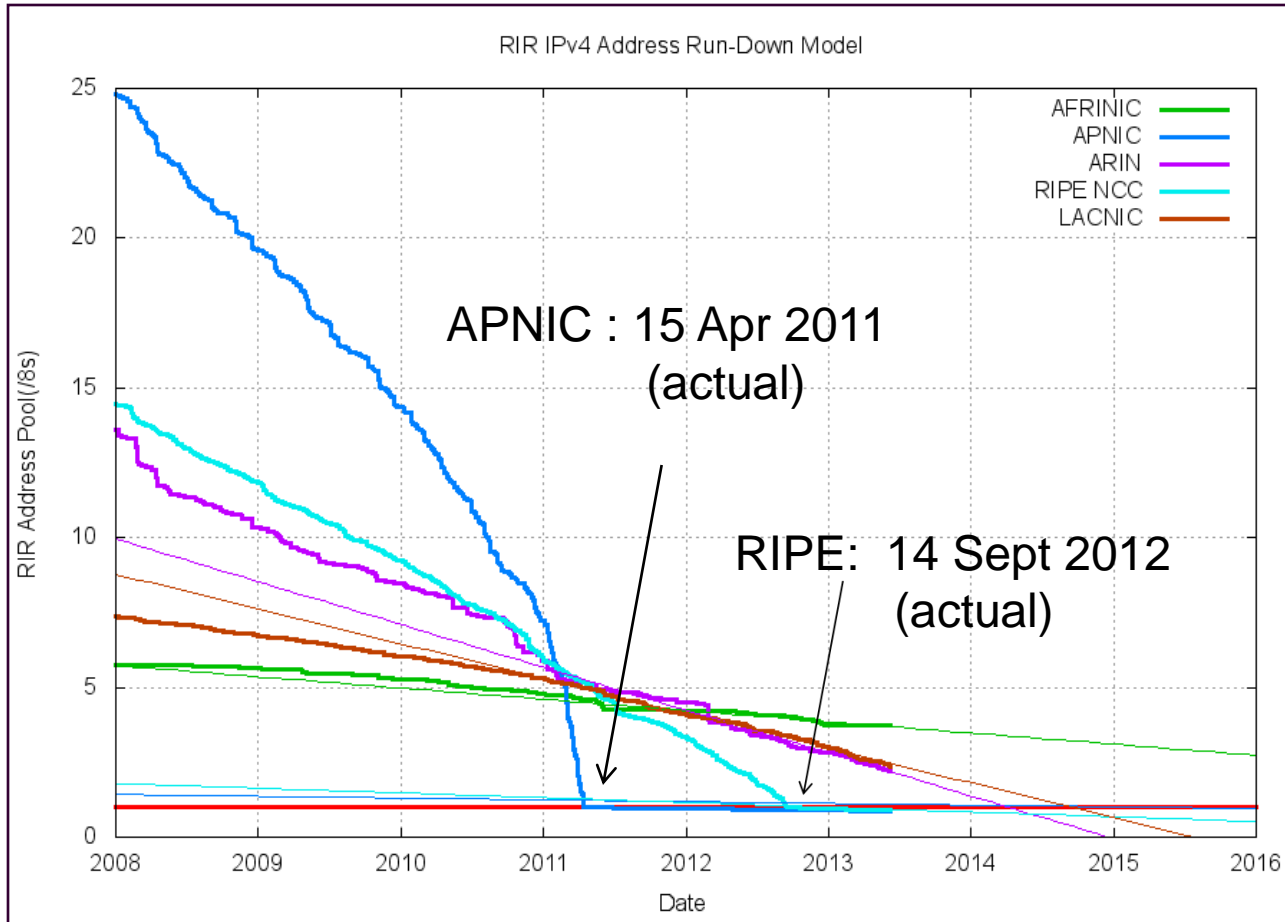
11 July 2013

Allocation of IP addresses

The Internet Corporation for Assigned Names and Numbers (ICANN) delegates IP address allocation to five Regional Internet Registry.



IPv4 Exhaustion in RIRs



Projection

ARIN: 19 April 2014

LACNIC : 9 Aug 2014

AFRNIC: 23 Oct 2020

World IPv6 Day – 8.6.2011

- Internet Society designated 8 June 2011 as World IPv6 Day
- Content providers (Google, Facebook, Yahoo, Bing, Akamai) enabled IPv6 in their main websites for 24 hours test-flight
- Motivate organisations across the industry to prepare IPv6 services
- Examine IPv6 deployment problem, such as IPv6 brokenness in home networks and incomplete IPv6 interconnection
- Over 1000 organisations joint the test flight (including OGCIO, HKIRC and OFCA)
- Gained significant success and confidence in IPv6 deployment



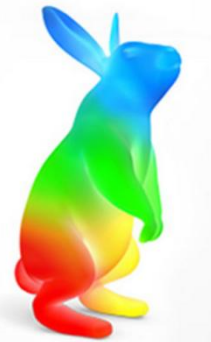
World IPv6 Launch –6.6.2012

- Leading Content Providers
 - Google , Facebook , Yahoo, Bing, Akamai enabled IPv6 permanently
- Broadband Network Operators
 - AT&T, Comcast, Free Telecom, KDDI, Internode, Times Warner Cable boosted 1 % of customers with IPv6 connection
- Equipment vendors
 - Cisco, D-Link, ZyXEL enable IPv6 as factory default in home routers

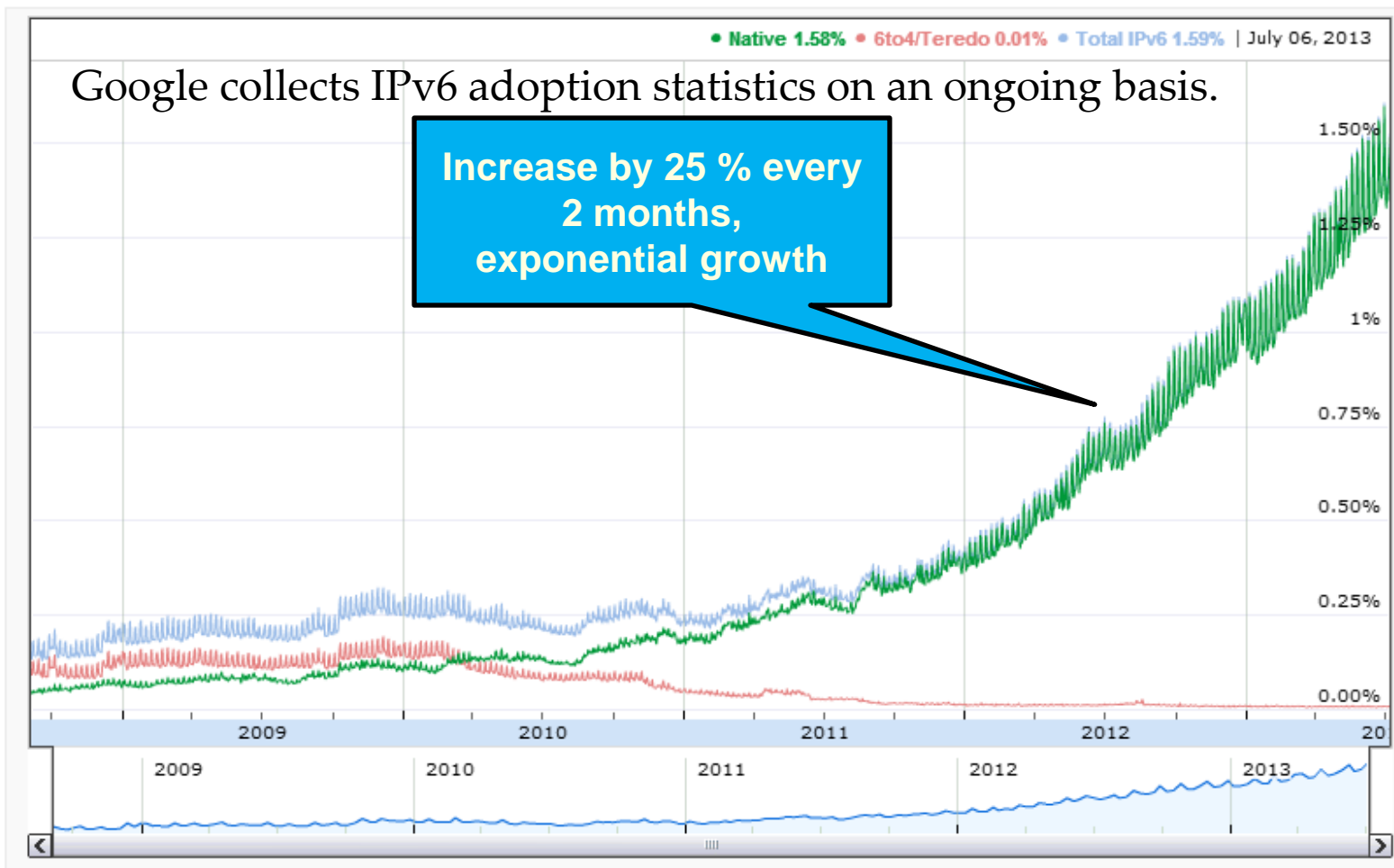


Google's IPv6 services after W6L

- Biggest supporter of IPv6 since 2008
- All Google services on IPv6 after W6L
 - Search Engine
 - Gmail
 - Youtube
 - Google Docs, Map, Plus
 - Google Public DNS resolvers
 - Google Fibre
 - Google Play for Android
 - Blogger



Growth of IPv6 Users



Five Year Growth of IPv6

Period	Percentage	Internet population	IPv6 Users
June 2009	0.23 %	1.67 billion	3.84 million
June 2010	0.25 %	1.97 billion	4.92 million
June 2011	0.34 %	2.11 billion	7.17 million
June 2012	0.6 %	2.43 billion	14.5 million
June 2013	1.53 %	2.79 billion	42.68 million

Top 10 IPv6 countries

Country	% of IPv6 users	Broadband Service Providers
Switzerland	9.6 %	Swisscom (6RD)
France	5.33 %	Free Telecom (6RD)
Luxembourg	5.31 %	EPT Luxembourg
Romania	4.55 %	RCS-RDS
Belgium	3.3 %	VOO
Germany	3.24 %	Deutsche Telekom AG
Japan	3.2 %	NTT, KDDI, Softbank (6RD)
USA	3.05 %	ATT, Verizon Wireless (LTE), T-Mobile Comcast, Time Warner, Google Fibre
Peru	2.5 %	Telefonica del Peru
Singapore	2.3 %	StarHub

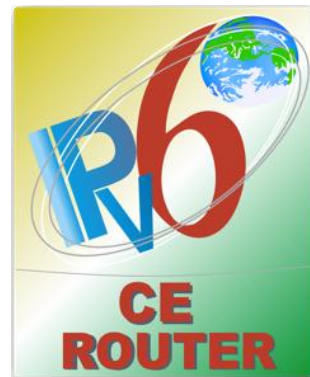
IPv6 Top Level Domains

Type of TLD	IPv6 Readiness	Percentage	Not IPv6 enabled
ccTLD	222 / 249	89 %	.bb, .bd, .bh, .kp .pk, .uz, .vu, .ye, .zw etc.
Generic TLD	21 / 23	91 %	.name, .mil
Internationalized domain name (IDN)	41 / 45	91 %	.ykp, .فلسطين, .مصر, .الجزائ

- ICANN's directive : All new generic Top Level Domains (e.g. ".mtr", ".pccw", ".richardli") must support both IPv4 and IPv6 from Day One of Operation.

IPv6 CE Router Logo (1)

- IPv6 Ready Logo
Baseline for all equipment certifications
covers servers, firewalls, NAS, printers...
- Wait ? What about Customer Edge (CE)
Router for broadband services
- Yes, IPv6 Forum needs a new testing
program and logo for CE Router
- IPv6 CE Router Logo launched in May 2013
- Most important function is Prefix Delegation
over DHCPv6



IPv6 CE Router Logo (2)

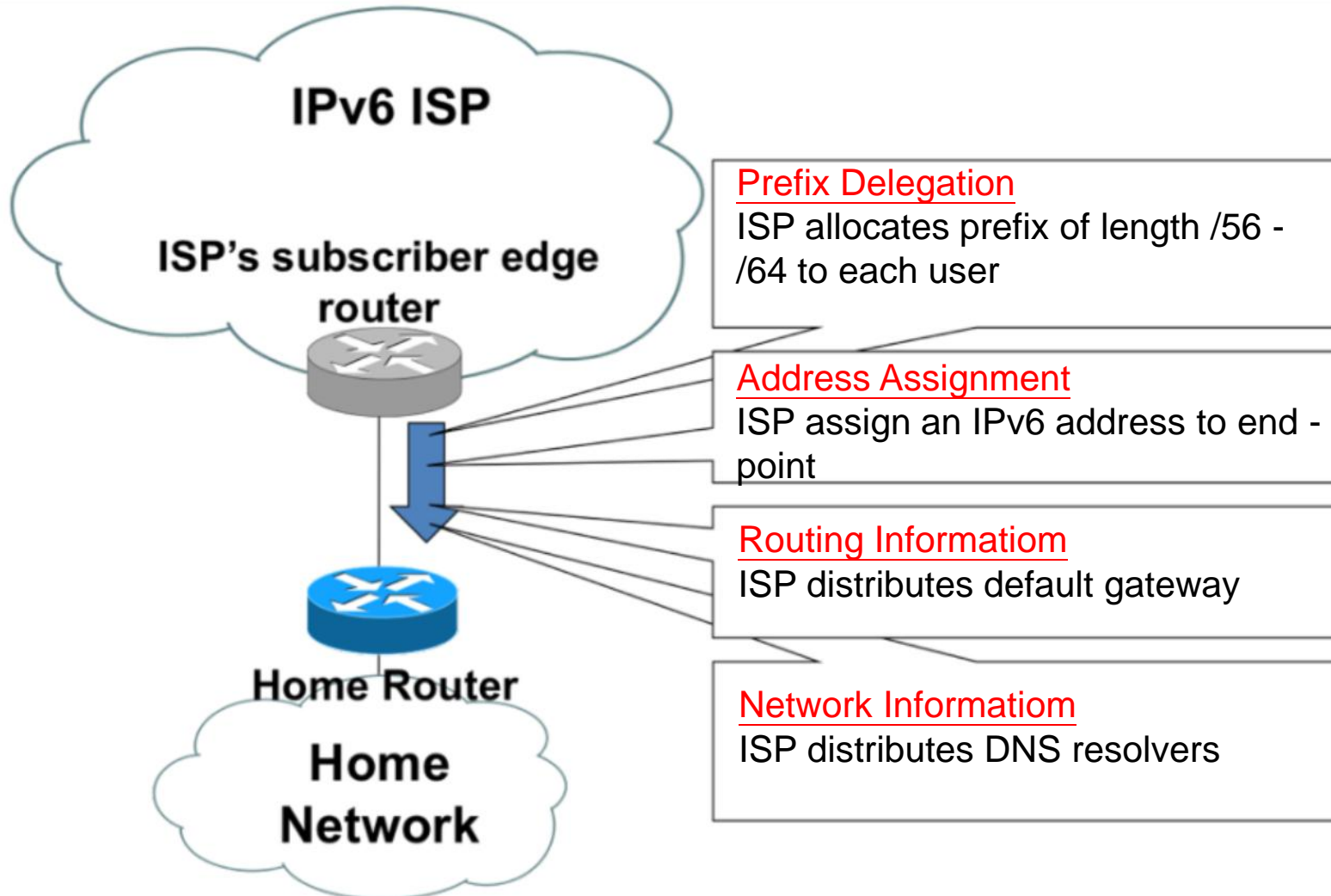
- RFC 6204 - Basic Requirements for IPv6 Customer Edge Routers (Issued Date: 2011/04)

IPv6 CE Router Tested List

The following routers have passed IPv6 testing and provide a high level of confidence operating in an IPv6 environment.

Company	Product	Product Version	Test Scenario Version	Date Listed
Actiontec	MI424WR	40.99.2.4	1.0.0.b6	11/9/11
Broadcom	BCM 93380 WVG	5.5.6	1.0.0.b6	11/9/11
Broadcom	BCM 93383 WVG	5.5.7	1.0.0.b9	6/5/12
Cisco Systems	Linksys E4200v2 and EA4500	Firmware 2.0.37	1.0.0.b8	2/2/12
Cisco Systems	Linksys E4200	v1 Firmware 1.0.04	1.0.0.b8	1/12/12
D-Link	DIR 652	v1.00	1.0.0.b6	11/9/11
D-Link	DIR 825	v2.00	1.0.0.b6	11/9/11
D-Link	DIR 835	v1.02	1.0.0.b9	5/25/12
Lantiq	Broadband Router/Gateway/XRX100/XRX200/XRX300	UGW-5.x series Router/Gateway	1.0.0.b6	11/9/11
Motorola Mobility LLC	SGB6580	v6.3.0.0	1.0.0.b9	9/05/12
NDM Systems	ZyXEL Keenetic series	NDM Firmware v2.0	1.0.0.b9	5/17/12
NEC AccessTechnica	Aterm BL190HW	v2.1.12a (*)	1.0.0.b9	5/30/12
Yamaha	Giga Access VPN Router RTX1200	10.01.40 (build 10)	1.0.0.b9	6/4/12
ZyXEL	VMG1213	v1.32	1.0.0.b9	6/4/12

IPv6 Prefix Delegation (DHCP-PD)



DHCP-PD in CE Router Settings

The screenshot shows the IPv6 configuration page of a CE Router. The page is divided into several sections: IPv6, IPv6 CONNECTION TYPE, IPv6 DNS SETTINGS, LAN IPv6 ADDRESS SETTINGS, and ADDRESS AUTOCONFIGURATION SETTINGS. Red arrows point from blue callout boxes on the right to specific settings in the screenshot.

DIR-825	SETUP	ADVANCED	TOOLS	STATUS	SUPPORT
INTERNET	IPv6				
WIRELESS SETTINGS	Use this section to configure your IPv6 Connection type. If you are unsure of your connection method, please contact your Internet Service Provider.				
NETWORK SETTINGS	<input type="button" value="Save Settings"/> <input type="button" value="Don't Save Settings"/>				
USB SETTINGS	IPv6 CONNECTION TYPE				
IPv6	Choose the mode to be used by the router to the IPv6 Internet.				
	My IPv6 Connection is : <input type="text" value="Auto Detection"/>				
	IPv6 DNS SETTINGS				
	Obtain a DNS server address automatically or enter a specific DNS server address.				
	<input checked="" type="radio"/> Obtain IPv6 DNS servers automatically				
	<input type="radio"/> Use the following IPv6 DNS servers				
	Primary IPv6 DNS Server : <input type="text"/>				
	Secondary IPv6 DNS Server : <input type="text"/>				
	LAN IPv6 ADDRESS SETTINGS				
	Use this section to configure the internal network settings of your router. If you change the LAN IPv6 Address here, you may need to adjust your PC network settings to access the network again.				
	Enable DHCP-PD : <input checked="" type="checkbox"/>				
	LAN IPv6 Address : <input type="text" value="2601:9:4800:24:86c9:b2ff:fe68:6651"/> /64				
	LAN IPv6 Link-Local Address : FE80::86C9:B2FF:FE68:6651/64				
	ADDRESS AUTOCONFIGURATION SETTINGS				
	Use this section to setup IPv6 Autoconfiguration to assign IP addresses to the computers on your network.				
	Enable automatic IPv6 address assignment : <input checked="" type="checkbox"/>				
	Enable Automatic DHCP-PD in LAN : <input checked="" type="checkbox"/>				
	Autoconfiguration Type : <input type="text" value="SLAAC + Stateless DHCPv6"/>				
	Router Advertisement Lifetime : <input type="text" value="1440"/> (minutes)				

WAN side
Auto-detection

Auto Obtain IPv6
DNS resolvers

CE Router sends
prefix delegation
request

Autoconfig IPv6
address in LAN
side

LAN side can
have multiple /64
networks

US Development

- 3.05 % or 7.5 million IPv6 users
- Verizon Wireless launch the 1st IPv6 LTE service (1 IPv6 address + 1 NAT IPv4 address)
- T-Mobile launch IPv6 only service in 3G network for users of compatible smartphones
 - Samsung Galaxy Note 2, S3, S4, S Relay, SII, HTC One Google Nexus 4
 - use **DNS64 + NAT 64** to bridge to IPv4 network
 - Alert users not to use Skype and Tango
 - successful in **464XLAT** (RFC 6877) for all IPv4 applications
- IPv6 fixed broadband by ATT, Verizon and Google Fibre
- IPv6 cable services by Comcast and Time Warner Cable

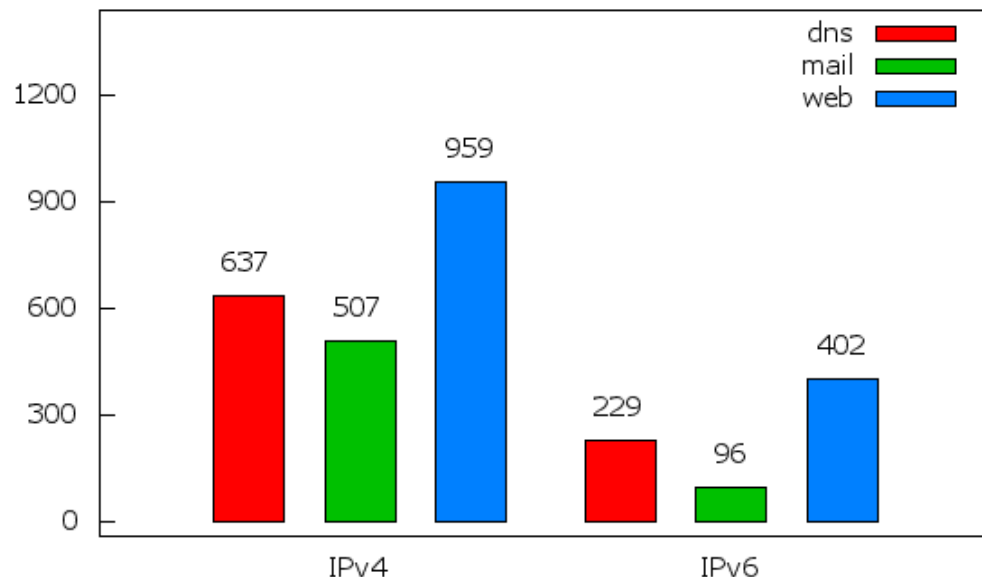
US Government Mandate (1)

- June 2008 – IPv6 in Federal backbone networks – **complied by deadline**
- Oct 2012 - all public facing servers of Federal on native IPv6, no interim tunneling solutions is allowed – **about 35 % passed**
- Oct 2014 - internal systems/clients on IPv6
- Each agency appoints a transition manager to report progress

US Government Mandate (2)

Current Status As Measured by NIST

USG Unique Configured Service Interfaces for 2013.07.01
- 1351 Domains Measured -

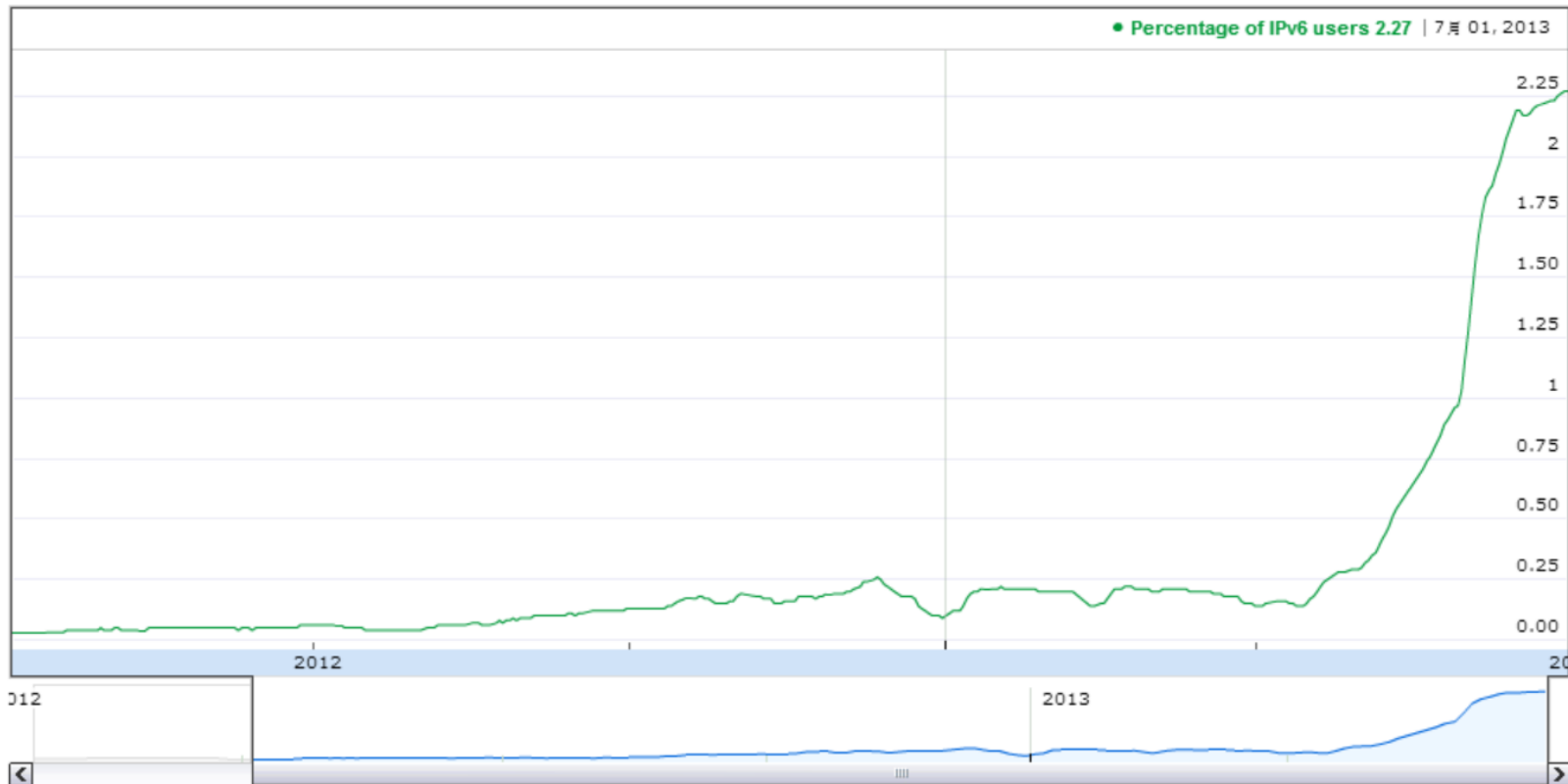


Sample Check

NSA: Web ✓ DNS ✗ Email ✗
CIA: Web ✓ DNS ✗ Email ✗
NASA: Web ✓ DNS ✓ Email ✓

Singapore's recent achievement

- StarHub's IPv6 deployment increased from 0.1% to 8% in one month.
- Singapore goes from 0.25 to 2.25% of Users on IPv6.



Taiwan

- Current deployment - 0.64 % or 112k IPv6 users
- Five ISPs offer free tunnel broker services to broadband customers

單位名稱	說明網站URL
亞太電信	http://www.apol.com.tw/ipv6/ipv6-tb-4.html
遠傳電信	http://ipv6.fetnet.net/how2v6/step.html
台灣大電訊	http://www.twmsolution.com/ipv6/
台灣碩網	http://www.so-net.net.tw/service/ipv6/
中華電信	http://www.ipv6.hinet.net/installGuide.htm

- Adopts gogoCLIENT as tunnel software
Windows – GUI interface
Mac OSX and Linux – command line interface



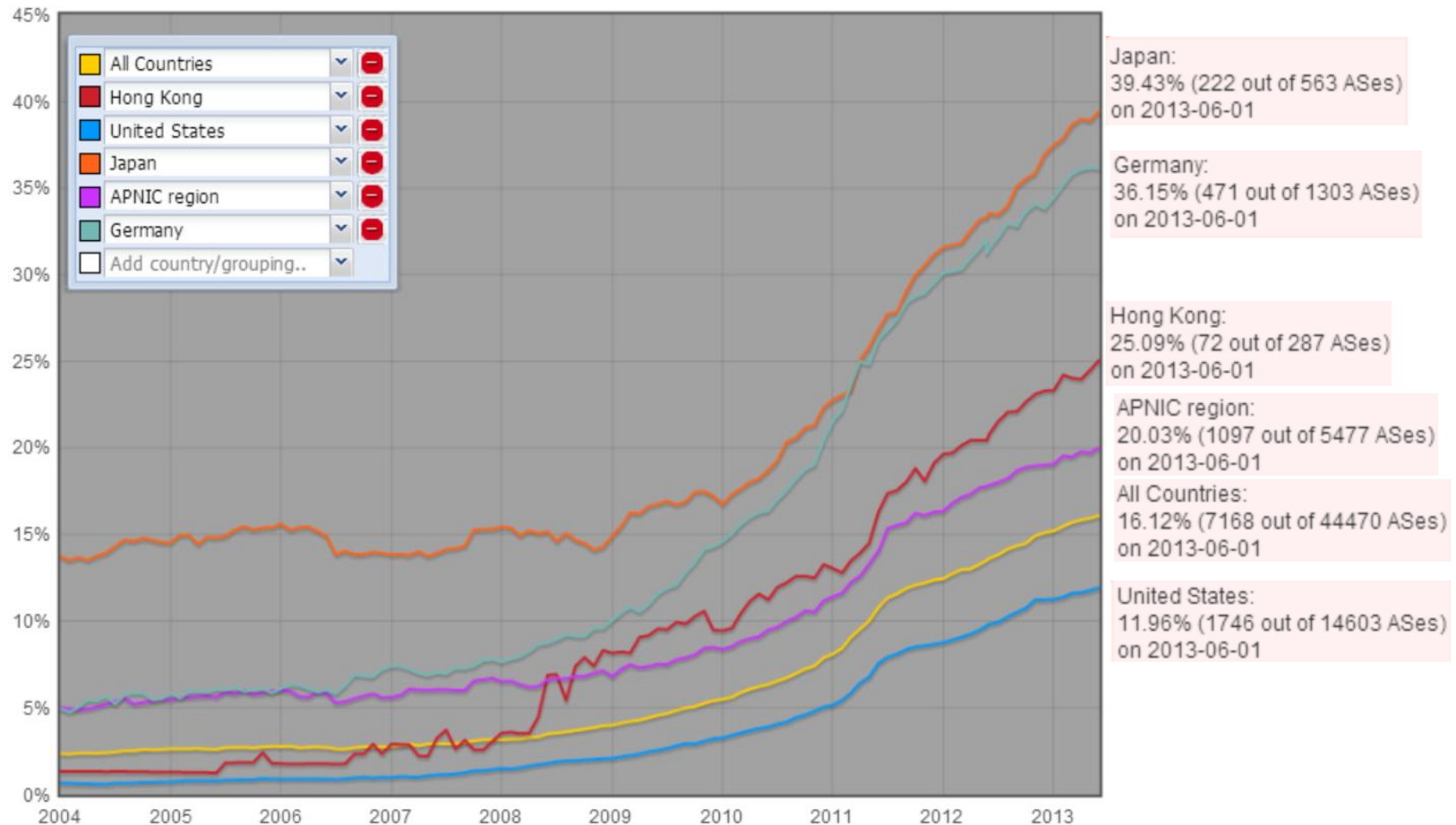
HK's Status after W6L

- 0.13 % IPv6 (about 7,000) users as of July 2013
- Users seen from the following ASNs:
WTT, HGC, PCCW, HKBN, PACNET, CUHK, HKU
- Major fixed operators offer IPv6 services to corporate users over Dedicated Internet Access
- A handful of IPv6 web hosting providers (Udomain, Easylink, Pacswitch)
- WTT and Pacswitch awarded IPv6 ISP Logo
- IPv6 in GovWiFi since Dec 2012
- goIPv6 tunnel service launched in July 2013



HK's IPv6-enabled networks

This graph shows the percentage of networks (ASes) that announce an IPv6 prefix for a specified list of countries or groups of countries



Promoting IPv6 awareness in HK

- Sponsored by OGCIO, ISOC-HK launched IPv6 in Action Project in 2012
- Promote awareness to public and SMEs
- Thematic websites, talks, ICT Expo, Consumer Guide, radio episodes, Roadshow videos, flash games, mobile apps
- Benchmarking surveys in 2012 Q1 and Q4 showed IPv6 awareness increased from 57 – 86 %



Myth about DNSv6

- No such new technology or protocol named as DNSv6
- All authoritative DNS servers can support AAAA record for forward lookup and ip6.arpa for reverse lookup regardless of riding on IPv4 or IPv6 backbone
- RFC 3901 - DNS IPv6 Transport Operational Guidelines
 - All recursive name servers should be IPv4 only or dual stack hosts.
 - All zones should be served by at least one authoritative IPv4 capable host.

Conclusions

- The Internet is IPv4 and IPv6
- Number of IPv6 end users tripled one year after W6L
- Yet, there is still a long way to go
- Home IPv6 CE Router has been available in the market
- 4G LTE is a new momentum to stimulate tremendous IPv6 growth
- Expect to see IPv6 only 4G LTE service in the market
- The age of Internet of Things has come





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Thanks !