Business and Innovation:
The IPv6 Balancing Act

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Vietnam IPv6 Day Conference

APNIC

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Dissecting IPv6 adoption

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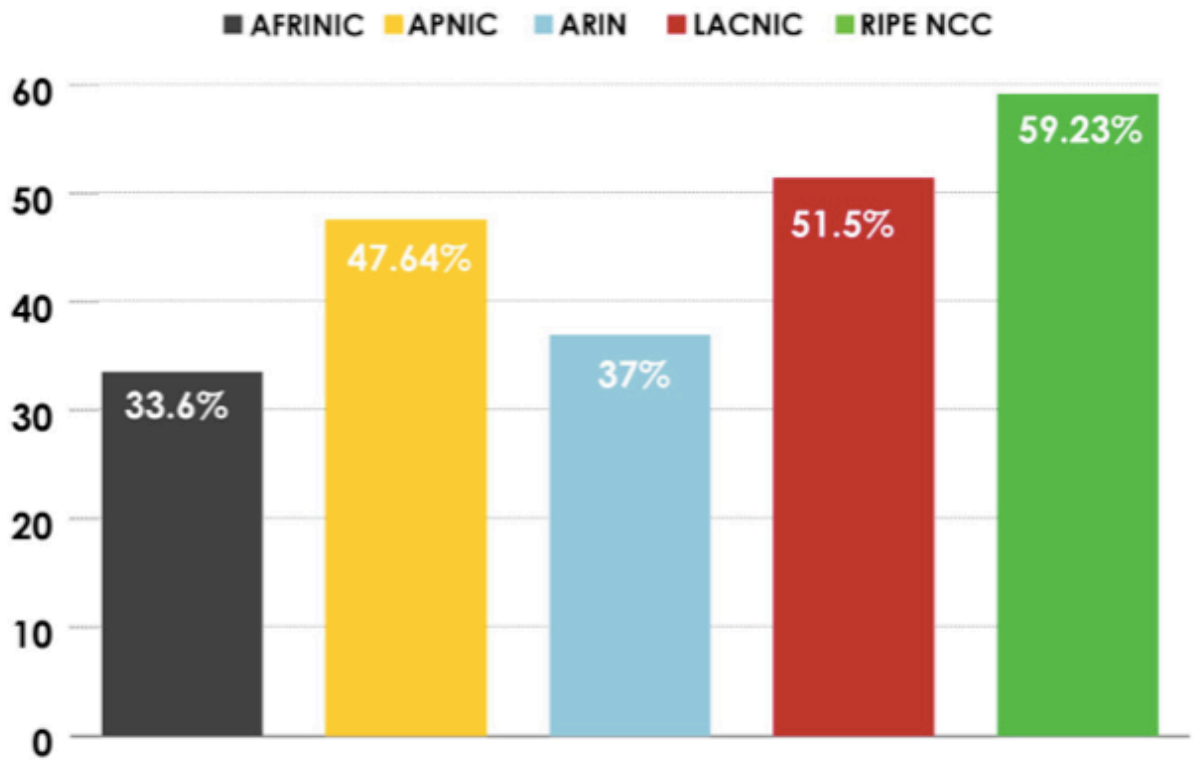
Dissecting IPv6 adoption

- The Internet consists of many stakeholders
  - IPv6 deployment has to go through many phases in different stakeholder realms
  - Need to have multi-dimensional data for a holistic view
- We need to see the density of IPv6 deployment approached logically
  1. IPv6 address allocation by Regional Internet Registries
     - IPv6 address allocation data
  2. IPv6 adoption level in the Internet's core networks (Internet transit providers)
     - BGP, ASN data
  3. Content providers and enterprises to enable their websites with IPv6
     - DNS server and www reachability data
  4. Access networks that allow end users to obtain IPv6 resources
     - End user IPv6 readiness data

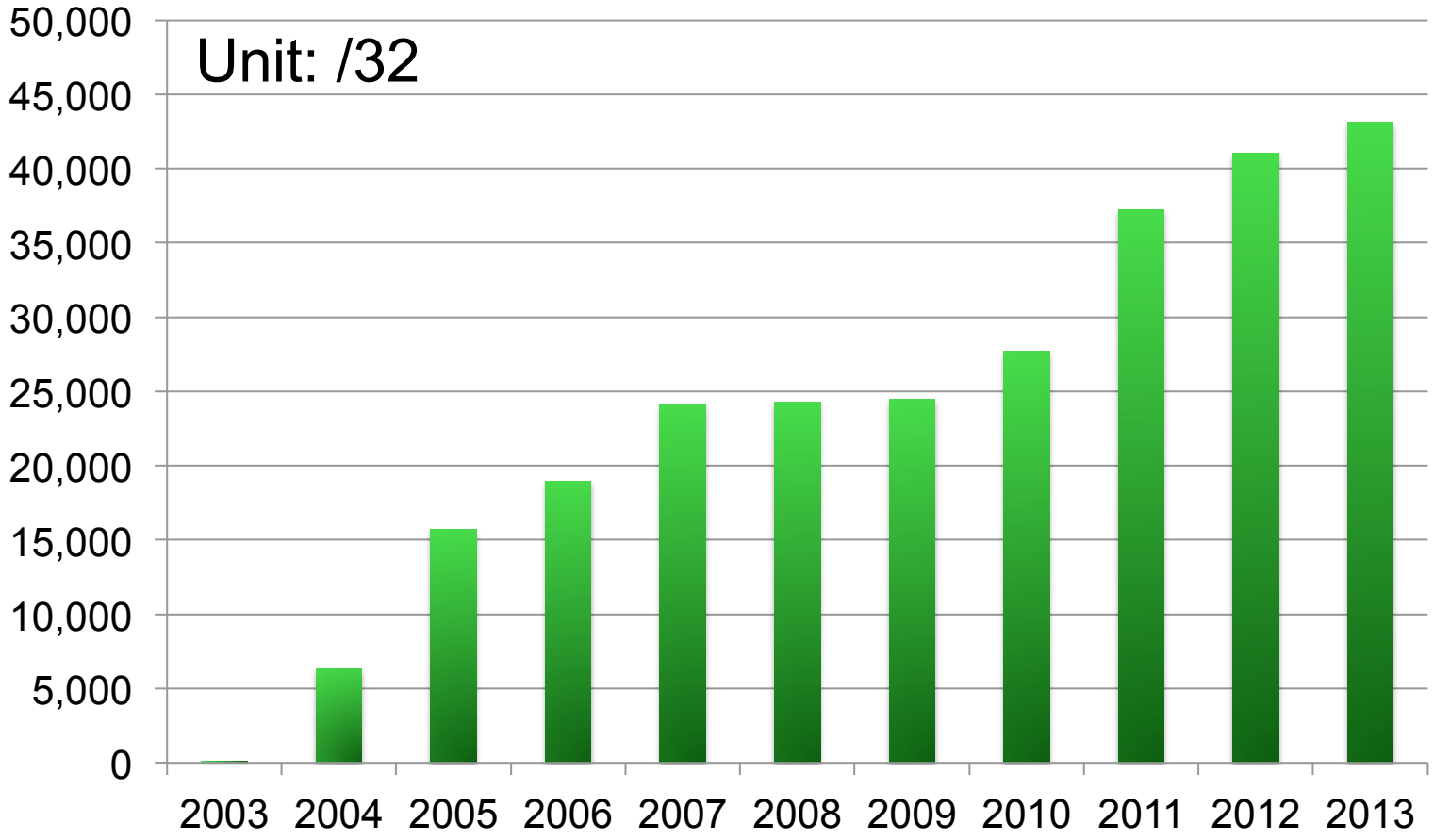
Percentage of members with both IPv4 and IPv6 in each RIR

NRO data: Mar 2013



http://www.nro.net/wp-content/uploads/NRO_Q1_2013-1.pptx

IPv6 address allocation (cumulative) APNIC

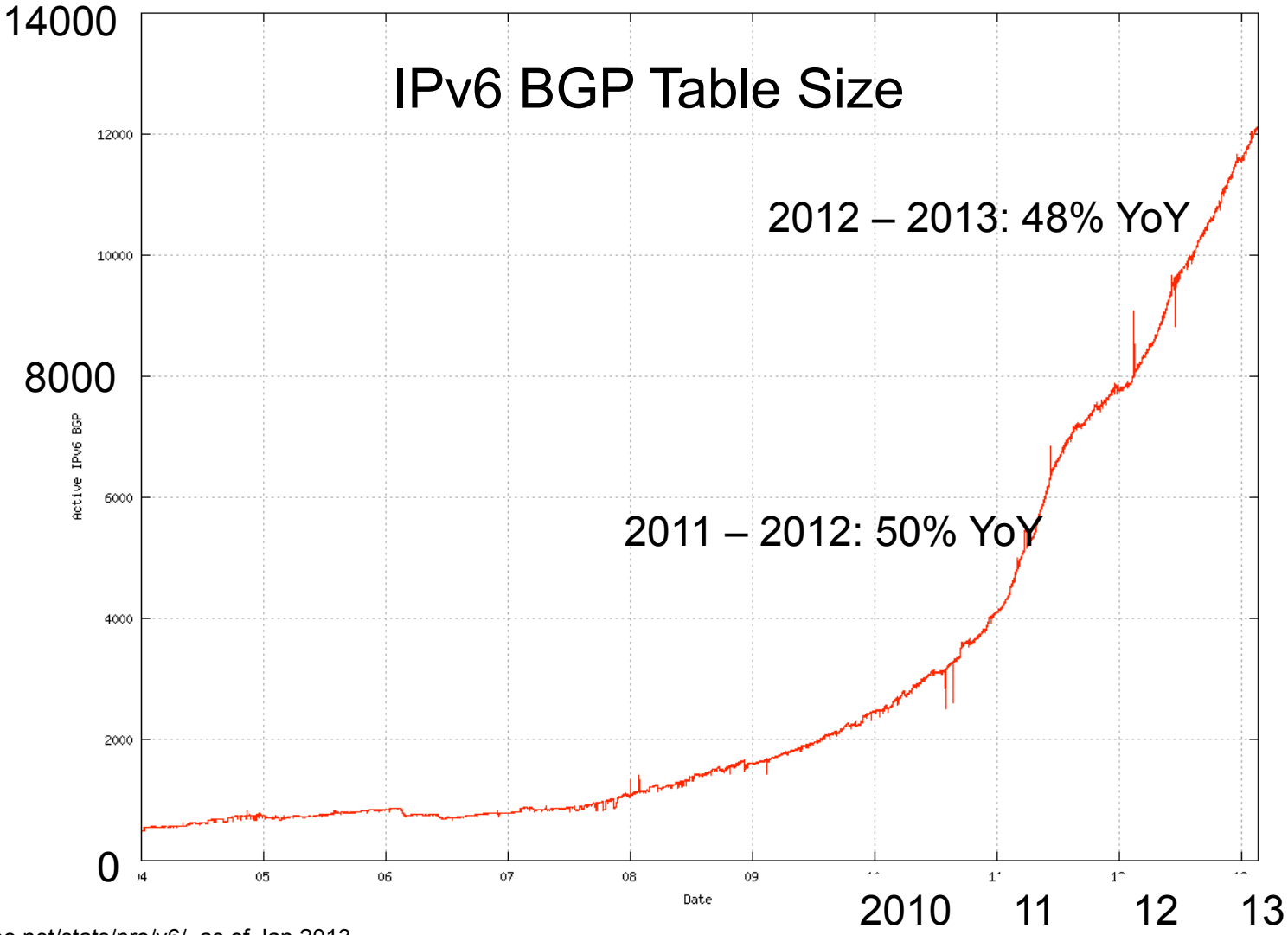


http://stats.apnic.net/o3portal/index.jsp as of 7/3/2013

Sum up 1:
IPv6 address allocation

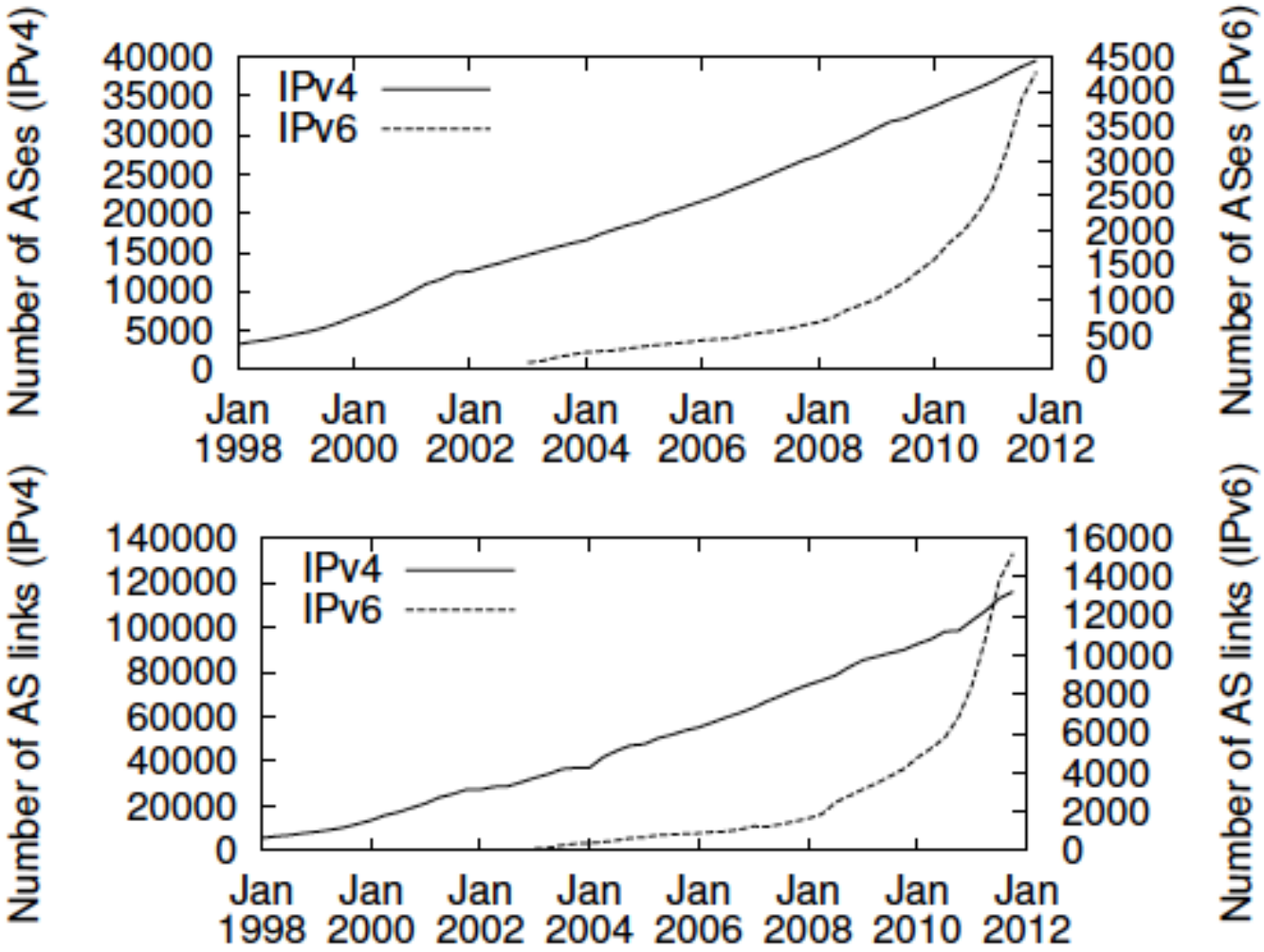
- Mature IPv6 address allocation policies exist
- IPv6 address allocation has happened and is happening very smoothly

Network with IPv6



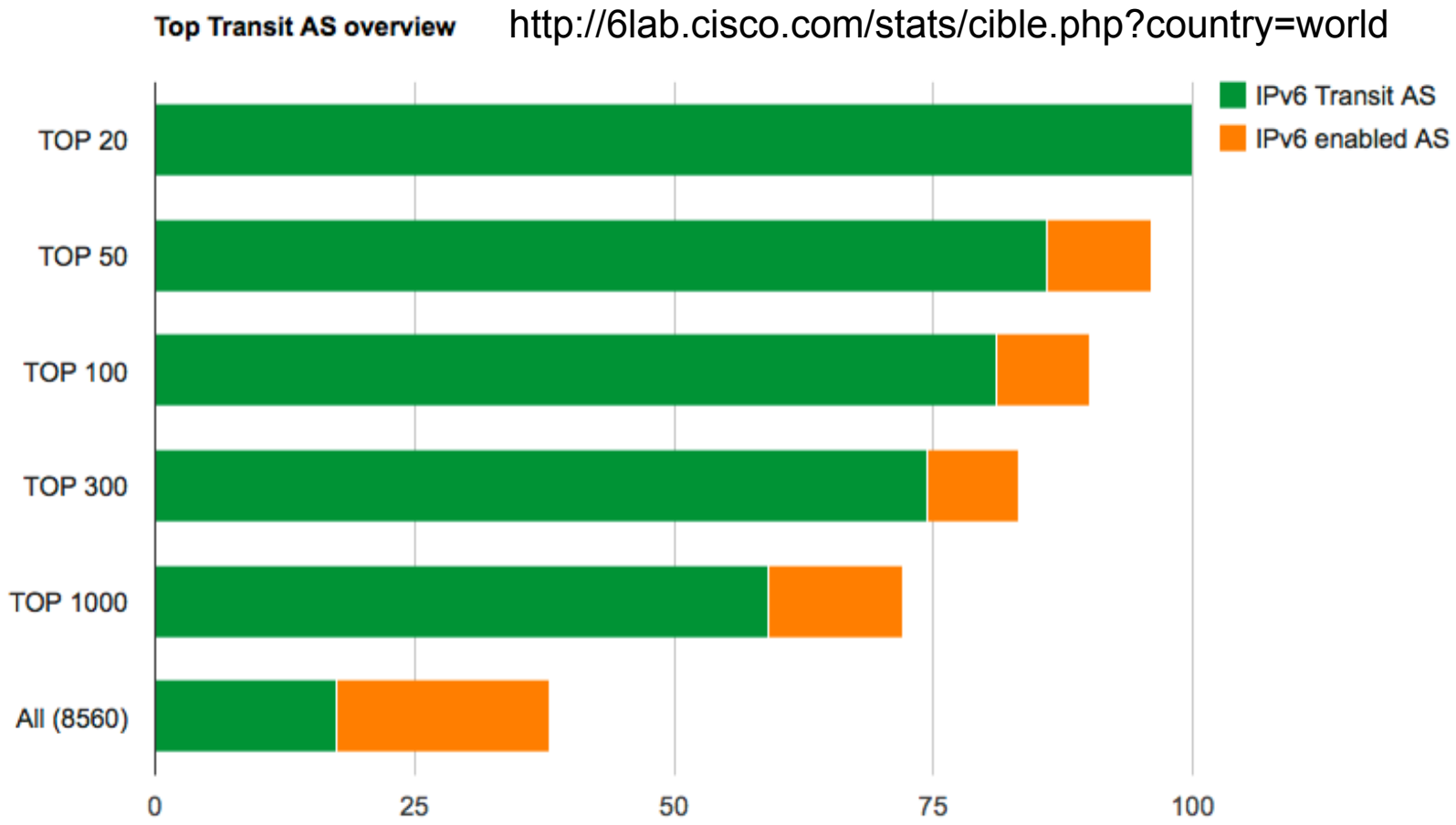
http://bgp.potaroo.net/stats/nro/v6/ as of Jan 2013

Growth of AS nodes and links



http://www.caida.org/publications/papers/2012/measuring_deployment_ipv6/, p2 Sept 2012 paper

IPv6 adoption in Internet core networks



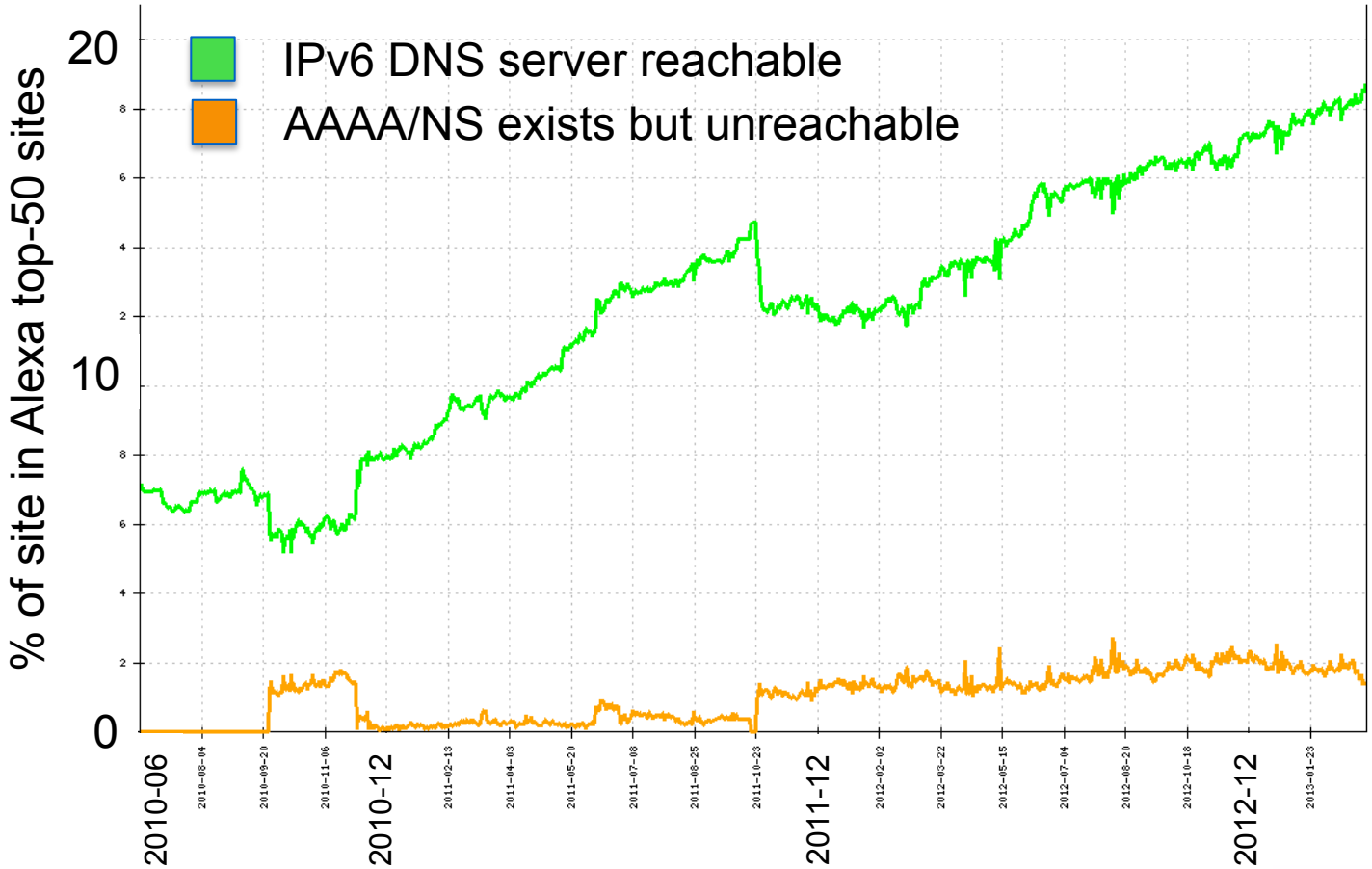
Sum up 2:
IPv6 BGP and ASN

- IPv6 prefix announcement into the global routing table, and ASNs announcing IPv6 prefixes shows healthy growth, especially after two World IPv6 launch events in 2011 and 2012
- Tier1 network operators shows very high level IPv6 readiness: we can safely say the Internet core is ready with IPv6
- However, we need more work in regional and local transit networks

IPv6 enabled DNS servers

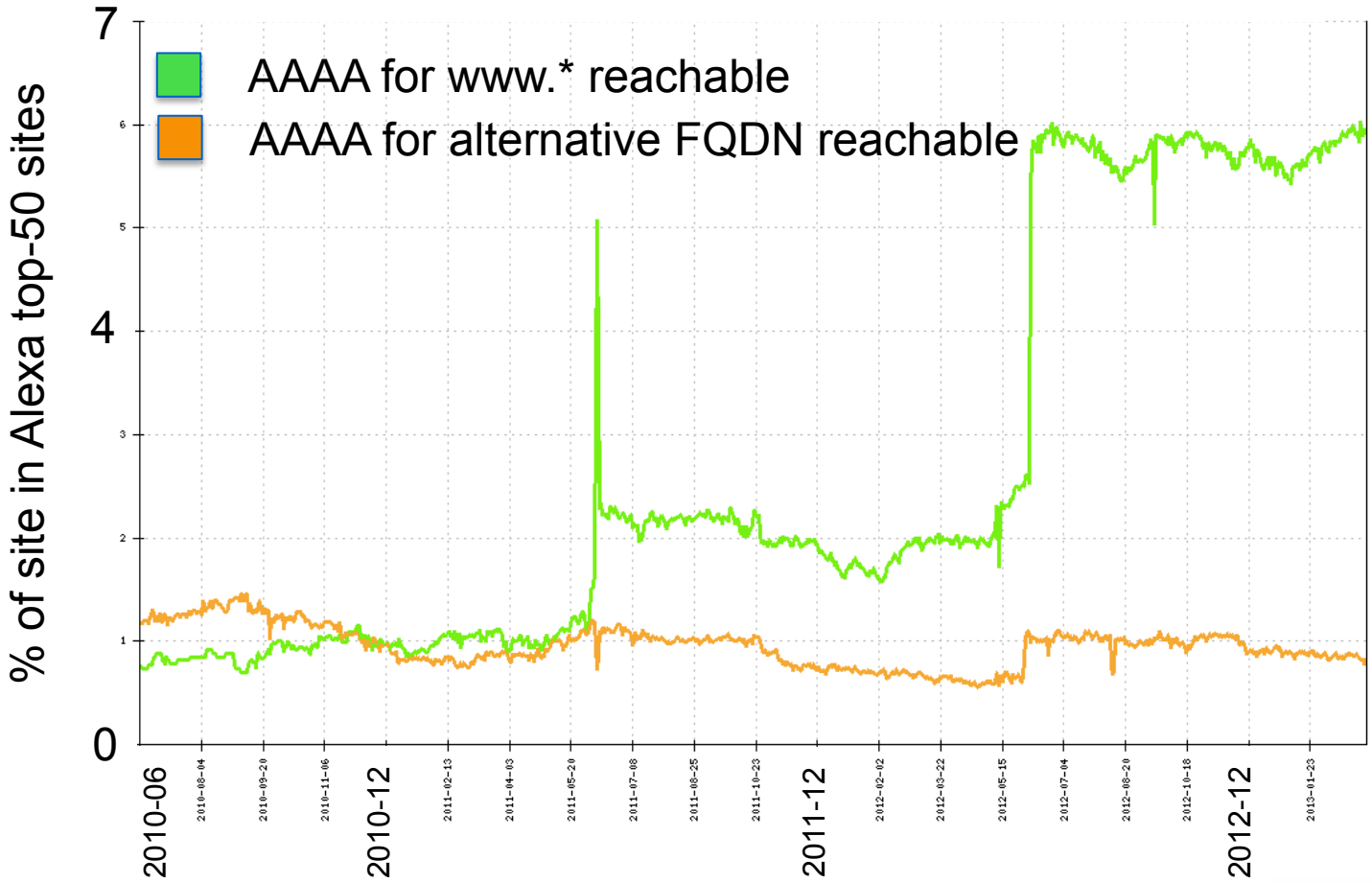
Sites with IPv6 Authoritative DNS Server

www.vyncke.org/ipv6status



IPv6 enabled www sites

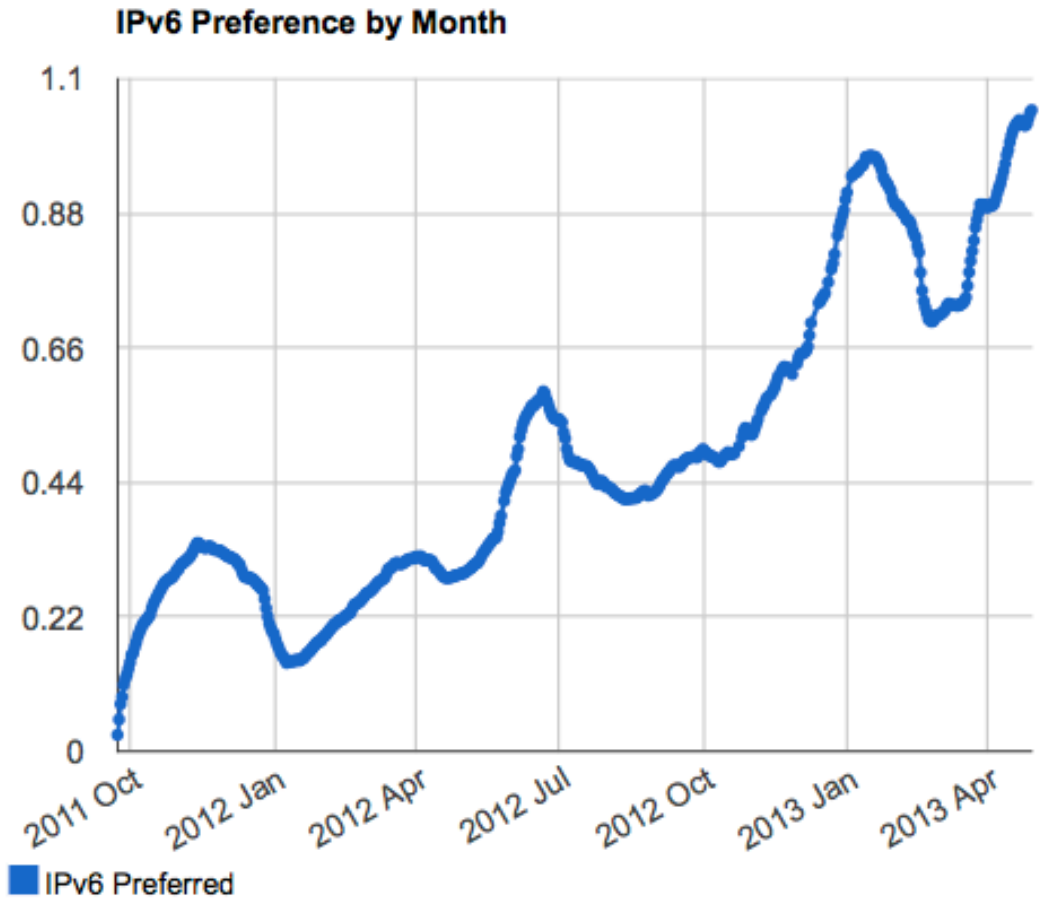
www.vyncke.org/ipv6status



Sum up 3:
Content providers and enterprises

- 20% of DNS servers of Alexa Top50 websites are ready with IPv6 and the IPv6 readiness is growing
- 6% of www servers of Alexa Top50 websites are ready with IPv6
- “No content available on IPv6” is a myth
  - ISPs and network operators need to pay attention to this growth trend of IPv6 ready content while they are preparing their networks for future growth, especially their access networks
  - Do not forget about rapidly increasing Internet access from mobile devices (will talk more in details later)
- Still, content providers (especially local content) and enterprise customers need to keep working on enabling IPv6 access to their online resources

IPv6 measurement
End user readiness: World



http://labs.apnic.net/ipv6-measurement/Regions/001%20World/ as of 01/05/2013

IPv6 measurement
End user readiness: World rankings

IPv6 measurements by Economy.

http://labs.apnic.net/ipv6-measurement/Economies/

World rankings by IPv6 Preference

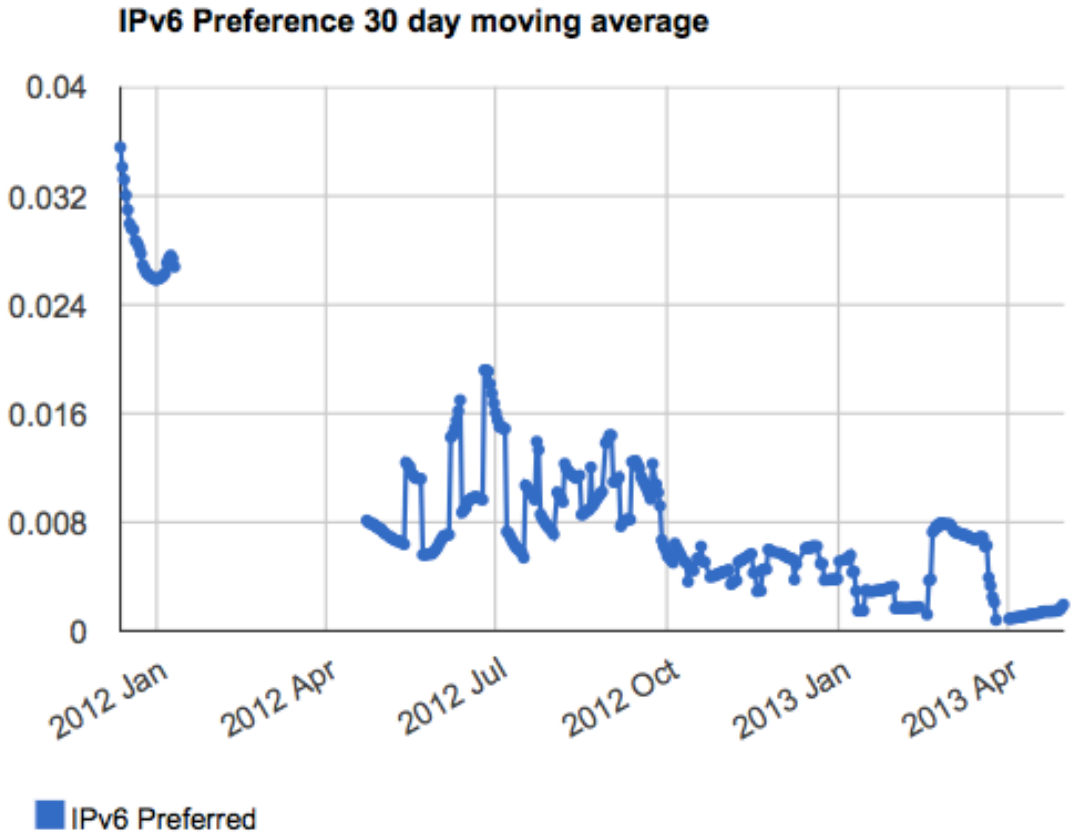
Economy	v6pref	3month avg hits/month
RO	10.07%	284631
EU	10.05%	437
LU	6.06%	1992
FR	5.87%	444598
JP	3.61%	141540
DE	2.68%	77770
US	2.51%	412459
CZ	2.21%	125400
CH	1.86%	11935
PE	1.54%	109424

Sum up: 4
End user IPv6 readiness

- Although the absolute number of end user IPv6 readiness for the world average is still quite small, the growth rate is robust, and there are great disparities across economies
  - We start observing IPv6 adopter economies with high level of IPv6 readiness among end users
- End users' IPv6 readiness depends on IPv6 readiness in last miles – i.e., access networks
  - Local ISPs need to make an informed decision
  - Deploying NAT444 CGN without deploying IPv6 transition technologies does not scale the future growth

IPv6 deployment status in the AP region

IPv6 measurement
End user readiness: Vietnam



http://labs.apnic.net/ipv6-measurement/Economies/VN/ as of 01/05/2013

Observations
IPv6 deployment in Vietnam

- Vietnam has received 227 ASNs from APNIC
  - Networks with unique routing policies will have a unique ASN
  - Looking at the IPv6 readiness of Vietnam's ASNs will give us a reasonable understanding of IPv6 readiness in Vietnam
- Of those 227, 123 (54%) Vietnam's ASNs advertise both IPv4 and IPv6 prefixes into the global routing table
- Of those 123, 91 ASNs (74%) are seen via the APNIC experimental measurement system implemented by labs.apnic.net
- Of those 91, 15 ASNs (16%) have at least one globally routable IPv6 prefix
- Of those 15, 7 ASNs (47%) with active IPv6 BGP appear to have end users active in IPv6

Observations
IPv6 deployment in Vietnam

ASN	NetName	Description	Count	V6 pref %
45896	VNPTGLOBAL-AS-VN	VNPT Global JSC	287	2.43
7643	VNPT-AS-VN	Vietnam Posts and Telecommunications (VNPT)	1357	1.17
18403	FTP-AS-AP	The Corporation for Financing & Promoting Technology	53200	0.67
45903	CMCTI-AS-VN	CMT Telecom Infrastructure Company	3720	0.65
7602	SPT-AS-VN	Saigon Postel Corporation	1903	0.58
45899	VNPT-AS-VN	VNPT Corp	110003	0.37
7552	VIETEL-AS-AP	Vietel Corporation	50535	0.30

Observations
IPv6 deployment in Vietnam

ASN	NetName	Description	Count	V6 Pref %	v6 Capable %
45896	VNPTGLOBAL-AS-VN	VNPT Global JSC	287	2.43	**13.59**
7643	VNPT-AS-VN	Vietnam Posts and Telecommunications (VNPT)	1357	1.17	**8.11**
18403	FTP-AS-AP	The Corporation for Financing & Promoting Technology	53200	0.67	**5.24**
45903	CMCTI-AS-VN	CMT Telecom Infrastructure Company	3720	0.65	**6.02**
7602	SPT-AS-VN	Saigon Postel Corporation	1903	0.58	**6.2**
45899	VNPT-AS-VN	VNPT Corp	110003	0.37	**3.47**
7552	VIETEL-AS-AP	Vietel Corporation	50535	0.30	**2.91**

Observations
IPv6 deployment in Vietnam

- Transit networks, providers clearly have IPv6 capability in their core.
- End user deployment is always going to be challenging
  - Due to CPE upgrade costs, customer-provisioning costs
- Other economies appear to be facing similar problems
  - But some ISPs are also biting the bullet.
  - Free/Internode/RCS/Comcast
- IPv6 capability to be explored
  - More IPv6 implementation in the last mile is required in Vietnam to grow the base of end users that have access to IPv6 enabled Internet resources via IPv6 enabled access and core networks

China

- Great leadership shown by the Chinese State Council
  - IPv6 mandates to the industry in Nov 2011:
    - "China will put Internet Protocol version 6 (IPv6) into small-scale commercial pilot use and form a mature business model by the end of 2013, the State Council recently said at an executive meeting about the main goals and road map for the China Next Generation Internet project" (People's Daily Online, Jan 2012, http://english.people.com.cn/90778/7696495.html)
    - 3 million users for each operators by 2013
    - 25 million users by 2015
  - SPs in China are responding to this mandate
    - We have started observing some increase in IPv6 end users' readiness (labs.apnic.net)

Australia

- The Australian Government Information Management Office initiative to bring IPv6 to all federal Australian government departments:
  - All Departments reporting on their IPv6 readiness
  - 40% deployed in production networks/gateways
  - 16 complete (end 2012) Remaining 32/110 >50%
- Large Australian government agencies have IPv6 adoption in their governance profiles

http://conference.apnic.net/__data/assets/pdf_file/0004/58927/2013-02-27-apipv6tf_au-_update_1v1_1361887087.pdf

Hong Kong

- The HK SAR Government OGCIO sponsored the Internet Society Hong Kong to organise the "IPv6 in Action" project to raise IPv6 awareness among general public and small and Small and Medium Enterprises (SMEs)
  - IPv6 website was launched in March 2012
  - “IPv6 Consumer Guide” published in June 2012
    - To promote IPv6 awareness among end users
    - http://www.ipv6now.hk/en/WhatisIPv6.php
- An interesting approach to reach out end users with IPv6 messages

http://conference.apnic.net/__data/assets/pdf_file/0004/58864/ipv6_hongkong_1361900559.pdf

India

- National IPv6 deployment roadmap (version 2)
  - The original version was issued in June 2010
- Recommendations for Internet multi-stakeholders
  - Enable IPv6 services at all new enterprise customers (connecting to the Internet after Jan 2014)
  - Enable IPv6 services at all new retail wire line customers (connecting to the Internet after July 2014)
  - Enable IPv6 services for LTE customers (connecting to the Internet after June 2013)
  - All content and application providers to adopt iPv6 for new contents and applications by June 2014
  - All new .in domain to be compulsorily on dual stack from Jan 2014
  - All governments complete transition to IPv6 by Dec 2017

http://conference.apnic.net/__data/assets/pdf_file/0006/58533/DOT-PPT-APIPv6TF-Agarwal-ver2.pdf

Korea

- IPv6 interconnection agreement among ISPs in Korea
  - Wired network: 3 major ISPS (KT, SKB, LGU+) adopted IPv6 at their backbone and IXs (Dec 2012)
- Mobile network: A joint project of Korea Internet & Security Agency (KISA) and SK Telecom (Number one mobile network operator in Korea) to test IPv6 on LTE mobile network (Dec 2012)
  - Android devices on NAT64 successfully worked
  - http://www.youtube.com/watch?v=wYzN0c7go4M
  - IPv6 traffic monitoring and billing system etc. need to be prepared before commercializing the service

http://conference.apnic.net/__data/assets/pdf_file/0009/58455/ipv6-deployment-update-from-koreakisa_youngsun-la_1361361191.pdf

Singapore

- IPv6 Transition Program lead by Infocomm Development Authority (iDA) of Singapore
  - Applying multi-stakeholder approach in conjunction with “pull” and “push” strategies to support IPv6 adoption
    - Create Initial IPv6 demand by enterprises, government agencies, content and application providers
    - Create IPv6 supply by network providers
    - Drive competency across multi-stakeholders
    - Ensure IPv6 and IPv4 performance equity by hardware and software vendors
    - Raise awareness on IPv6 across multi-stakeholders
    - Managing IPv4 address exhaustion mainly by network providers

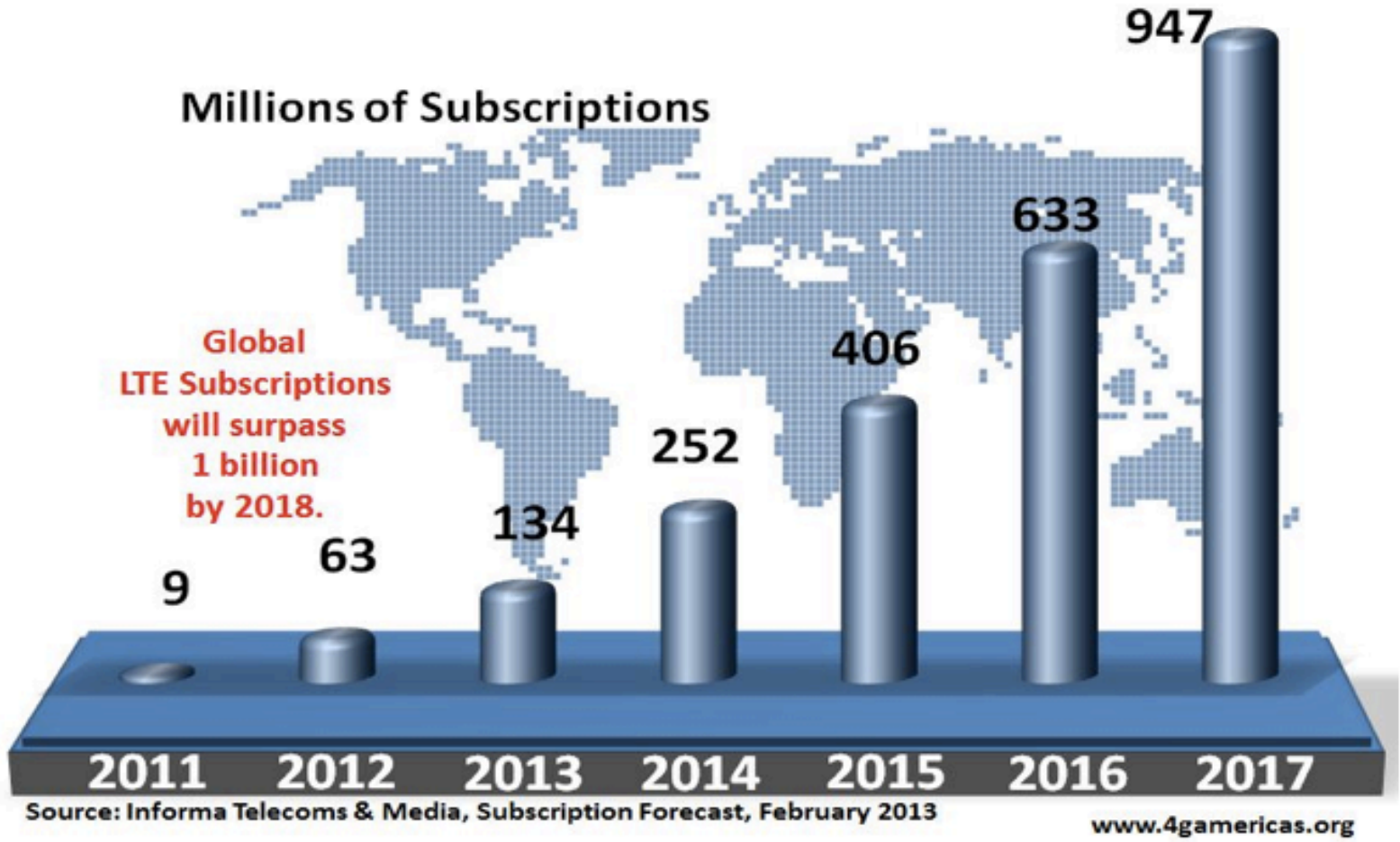
http://conference.apnic.net/__data/assets/pdf_file/0010/58744/ida-ipv6-transition-programme-2013-apricot_1361845288.pdf

Increase of encouraging activities

- Many encouraging activities have been seen in the region
  - Updating government ICT procurement criteria with IPv6
  - Policies to support deploying IPv6 in government networks with clear mandate goals and timeframe
    - Leading the industry by examples in adopting IPv6
  - Partnership between public and private sectors, e.g.,
    - Establishing certification mechanism to recognize “IPv6 ready” products
    - Launching IPv6 project to raise IPv6 awareness among key stakeholders
    - Promoting IPv6 activities through media, events, competitions, awards etc.
  - Human capacity development
    - Supporting IPv6 skill up trainings to the industry
- **Need to keep providing positive support to speed up IPv6 adoption in the region**

Rapidly changing business environment

Global LTE growth focus



www.4gamericas.org/index.cfm?fuseaction=page&pageid=1781

Rapidly increasing mobile devices

- The business competency of mobile network operators is shifting from being a traditional voice and messaging provider to a mobile broadband service provider
  - Services on voice, messaging, and data are converging on IP-based services
- Given the rapid increase in the number of mobile devices, rich media applications and content, investing in techniques just to extend the lifetime of IPv4 is ultimately limited from a business continuity point of view
  - IPv6 will sustain a future business model

IPv6 in mobile networks

- Significant growth in mobile devices accessing the Internet
  - Entry of mobile devices into the Internet is largely impacting the demography of Internet users and their behavior
  - Sustaining end-to-end connectivity will lead to innovative use of these tools
  - We have not seen the largest growth of the Internet yet!
  - And it's coming!!
- For example, Internet of Things, new applications using Machine-2-Machine (M2M) connectivity in areas of:
  - Energy and utilities, financial services and banking, government, healthcare, travel and transportation, etc.

Way forward

IPv6@APNIC

APNIC's IPv6 key messages

- IPv6 deployment has experienced large growth in the last two years
  - Eight times growth in IPv6 enabled end users globally in the last 12 months
  - Given there is no other way to manage IPv4 address exhaustion, IPv6 is an ultimate solution
  - Some large network operators start seeing this fact and taking proactive actions by deploying IPv6
  - **New networks of service providers are a good place to start enabling IPv6: Default IPv6 for new customers**
  - **Upgrade legacy IPv4 customers to IPv6 during a service upgrade occasion**

APNIC's IPv6 key messages

- Large Scale NAT (LSN), Carrier Grade NAT (CGN), or any other type of technologies to provide IPv4-to-IPv4 NAT platforms (AKA NAT444) are **NOT** a transition mechanism to IPv6
  - Their goal is to extend IPv4 address lifetime
  - SPs also need to deploy IPv6 simultaneously to ensure business continuity.
- Selection of transition technology should align with the long term vision of the operator
  - Less iteration to achieve such vision is better
  - Minimize iterations in order to keep lower CAPEX and OPEX
- Choices of transition technologies determines number of iteration of requirement of "transition"
  - Native IPv6 – once
  - Other choices – multiple iterations over long term

IPv6 in mobile networks

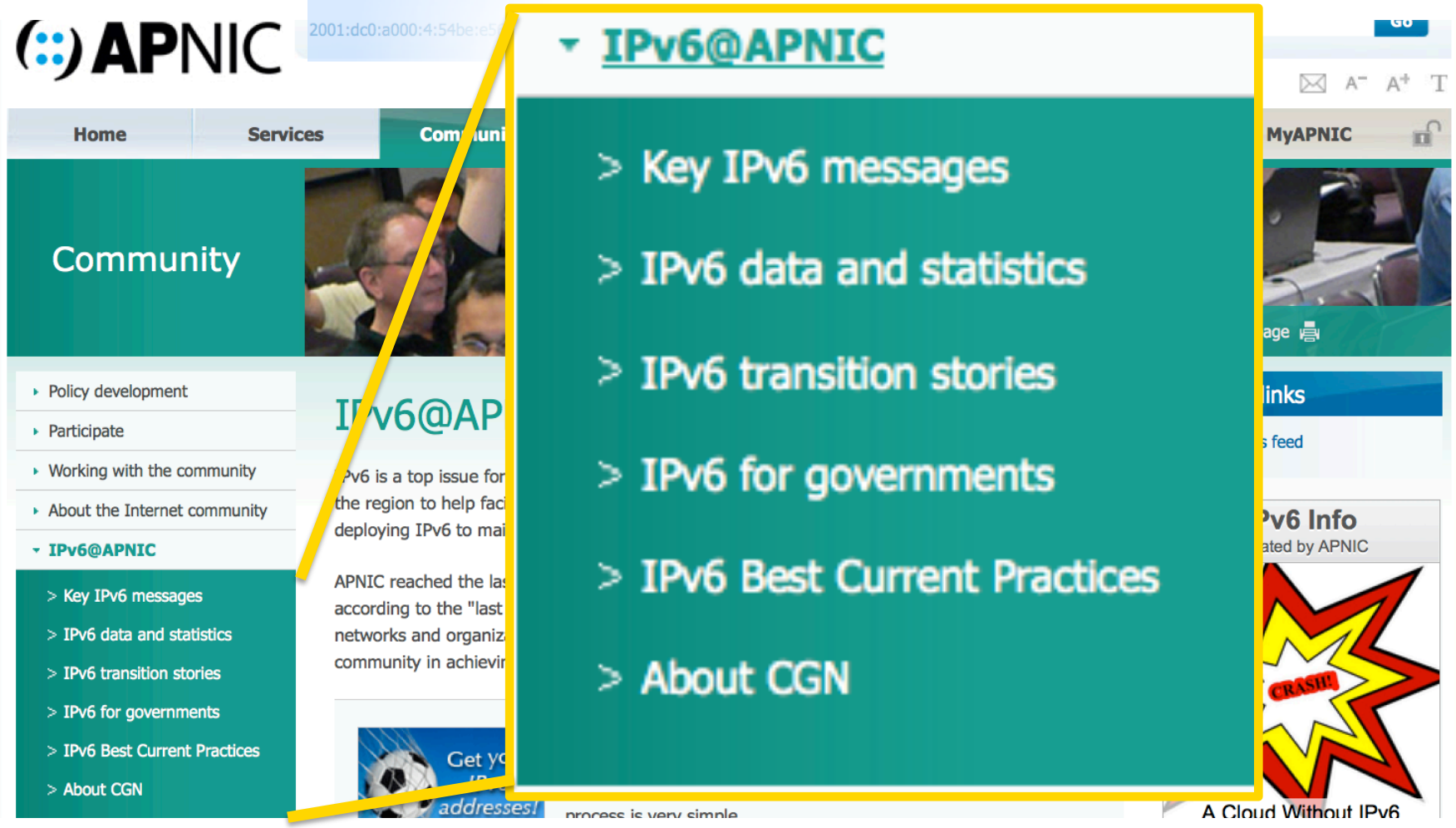
- We must avoid put the largest growth engine, i.e., use of mobile devices in mobile networks, in a small cage
  - Need to avoid mobile networks from being indefinitely bounded to IPv4 addresses (exhausting!) and being caught in fragile NATed networks
  - It's **not a simple growth of number of devices**. These devices keep **holding IP addresses longer** and making **more number of connections**
  - IPv4 does not support today's business needs
- IPv6 is ready to be used in mobile networks, and it will save cost of network operators
  - No need to spend your limited financial resources on NAT, CGN (NAT444) or sourcing IPv4 addresses

IPv6@APNIC

- APNIC Survey 2012 revealed collective input from the AP Internet community
  - "APNIC should step up efforts regarding IPv6 deployment and training"
    - Best current practice information on IPv6 deployment
    - Advice and consultation on IPv6 deployment
    - More practical hands-on trainings on IPv6 deployment
    - Raise awareness among stakeholders on IPv6
    - More facilitation with local Internet communities to help IPv6 uptake
- APNIC is responding to such requests: Plans in 2013
  - More hands-on IPv6 trainings
  - Engineering assistance on IPv6 deployment
  - More community outreach on IPv6

www.apnic.net/ipv6

www.apnic.net/ipv6



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Thank you!

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