

# IPv6 deployment status: Where are we now and way forward

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# Dissecting IPv6 adoption

# Dissecting IPv6 adoption

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

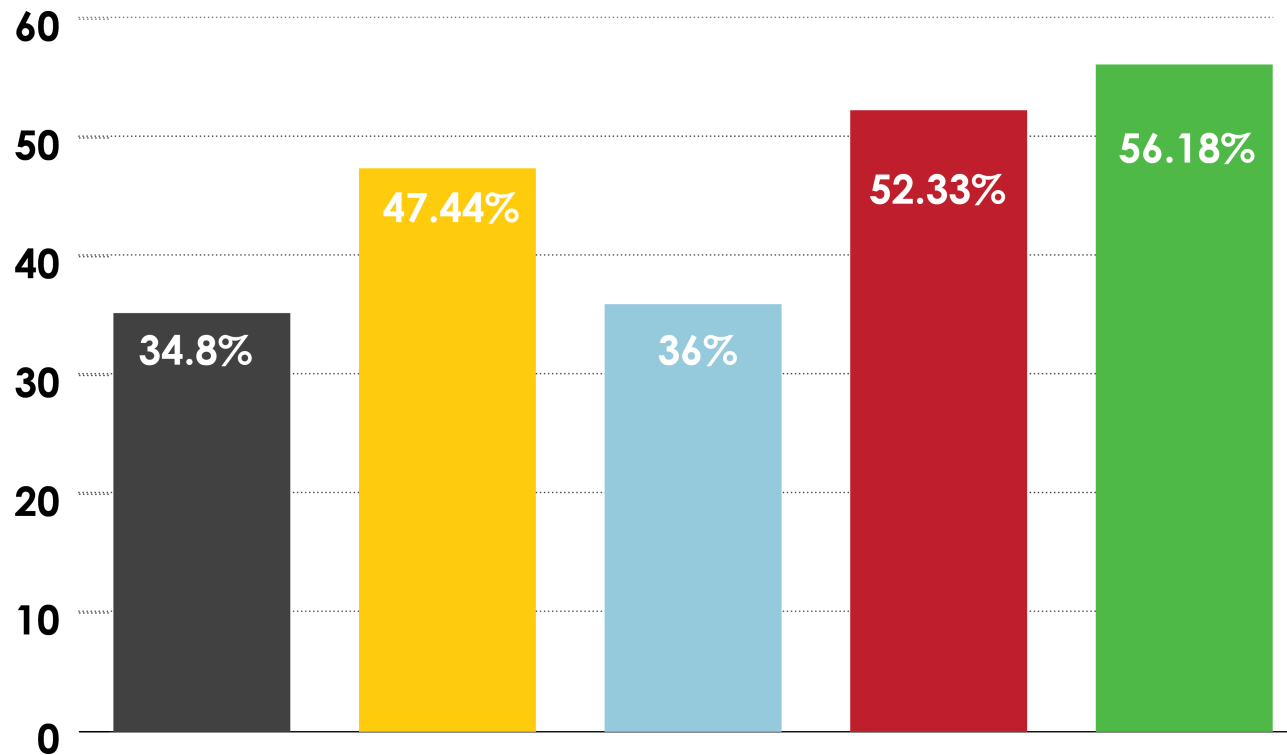
# Percentage of members with both IPv4 and IPv6 in each RIR



NRO

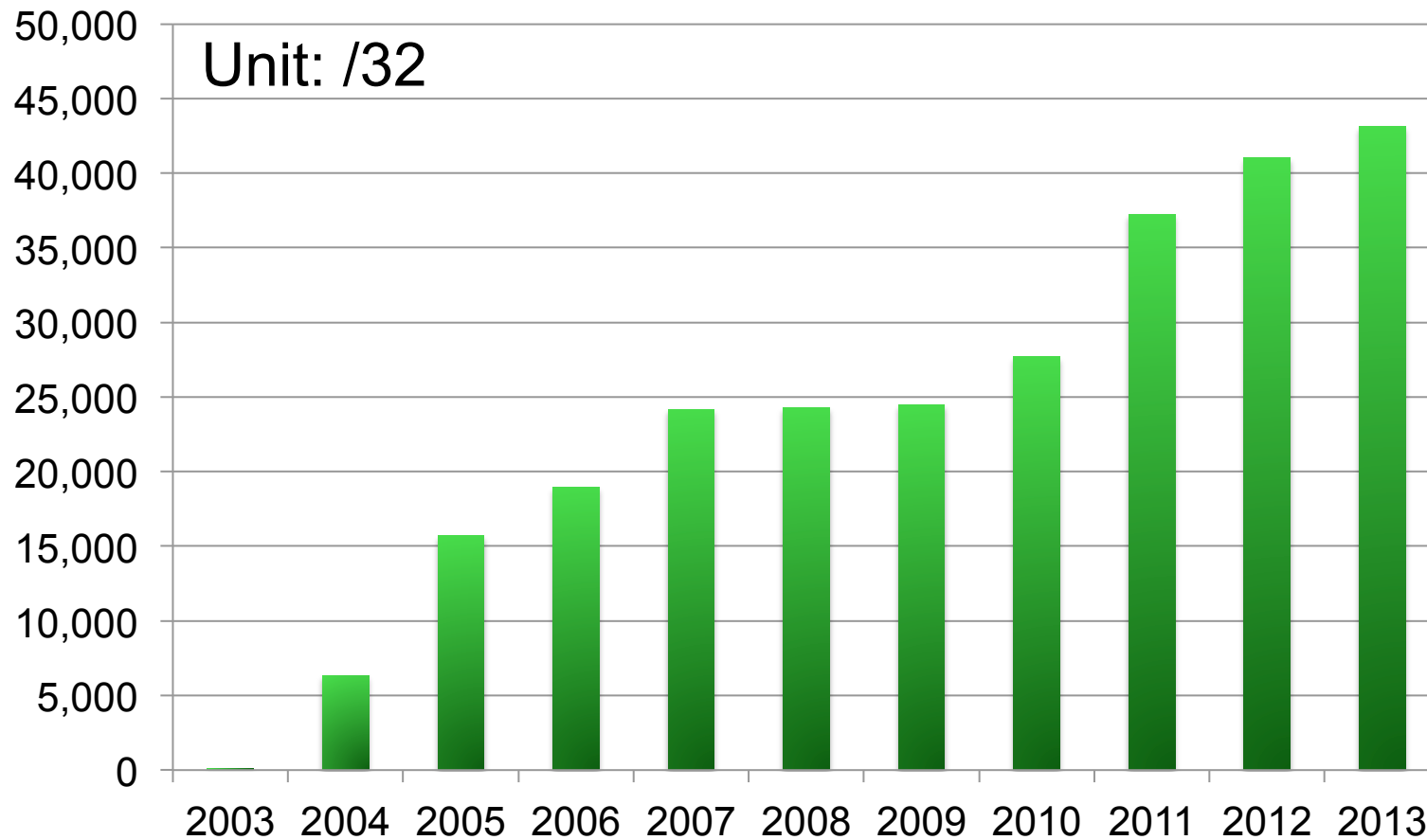
NRO data: Dec 2012

■ AfriNIC ■ APNIC ■ ARIN ■ LACNIC ■ RIPE NCC



[http://www.nro.net/wp-content/uploads/NRO\\_Q4\\_2012.final\\_.pptx](http://www.nro.net/wp-content/uploads/NRO_Q4_2012.final_.pptx)

# IPv6 address allocation (cumulative) APNIC

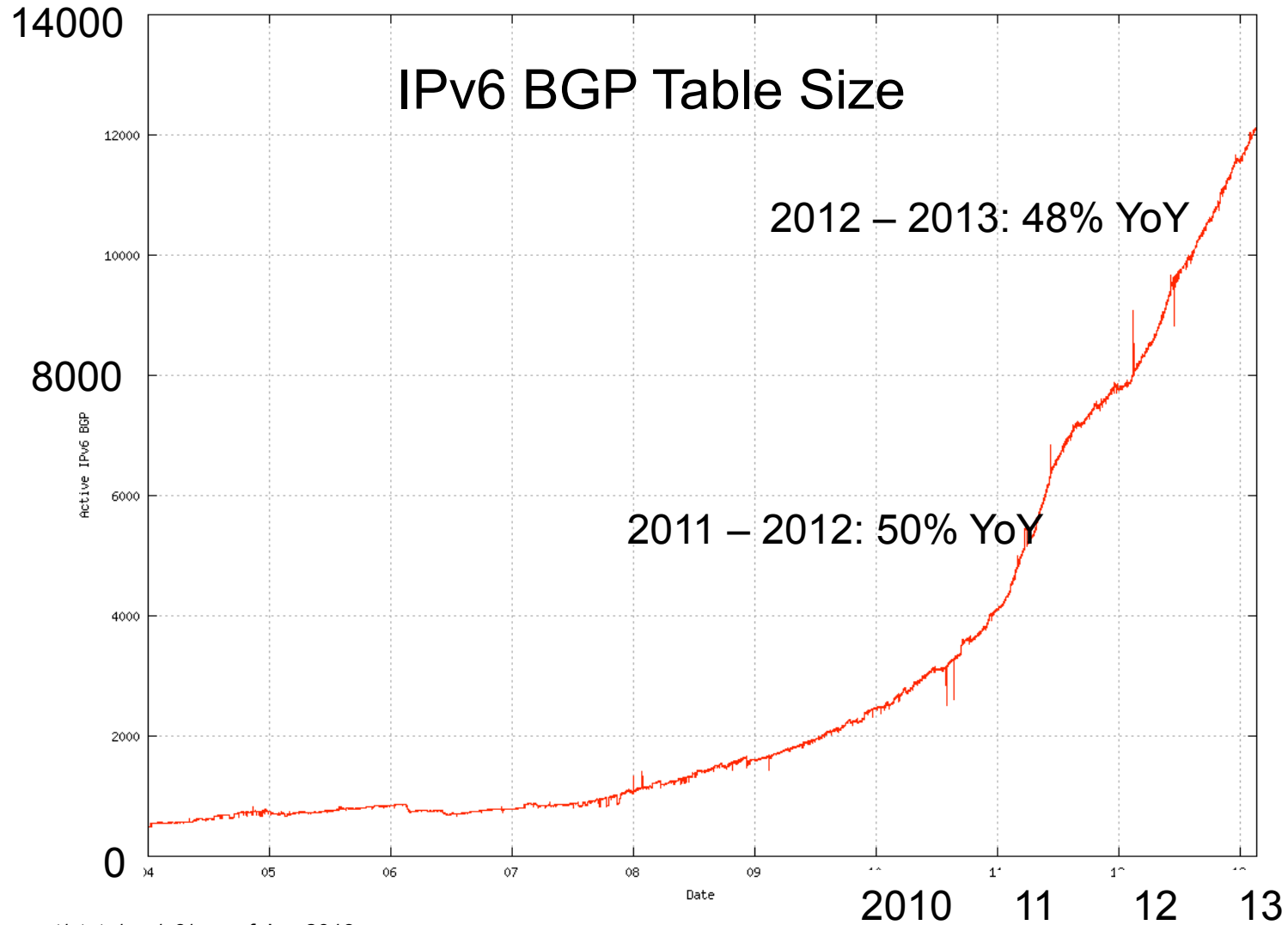


<http://stats.apnic.net/o3portal/index.jsp> as of 7/3/2013

# Sum up 1: IPv6 address allocation

- IPv6 address allocation has happened and is happening very smoothly

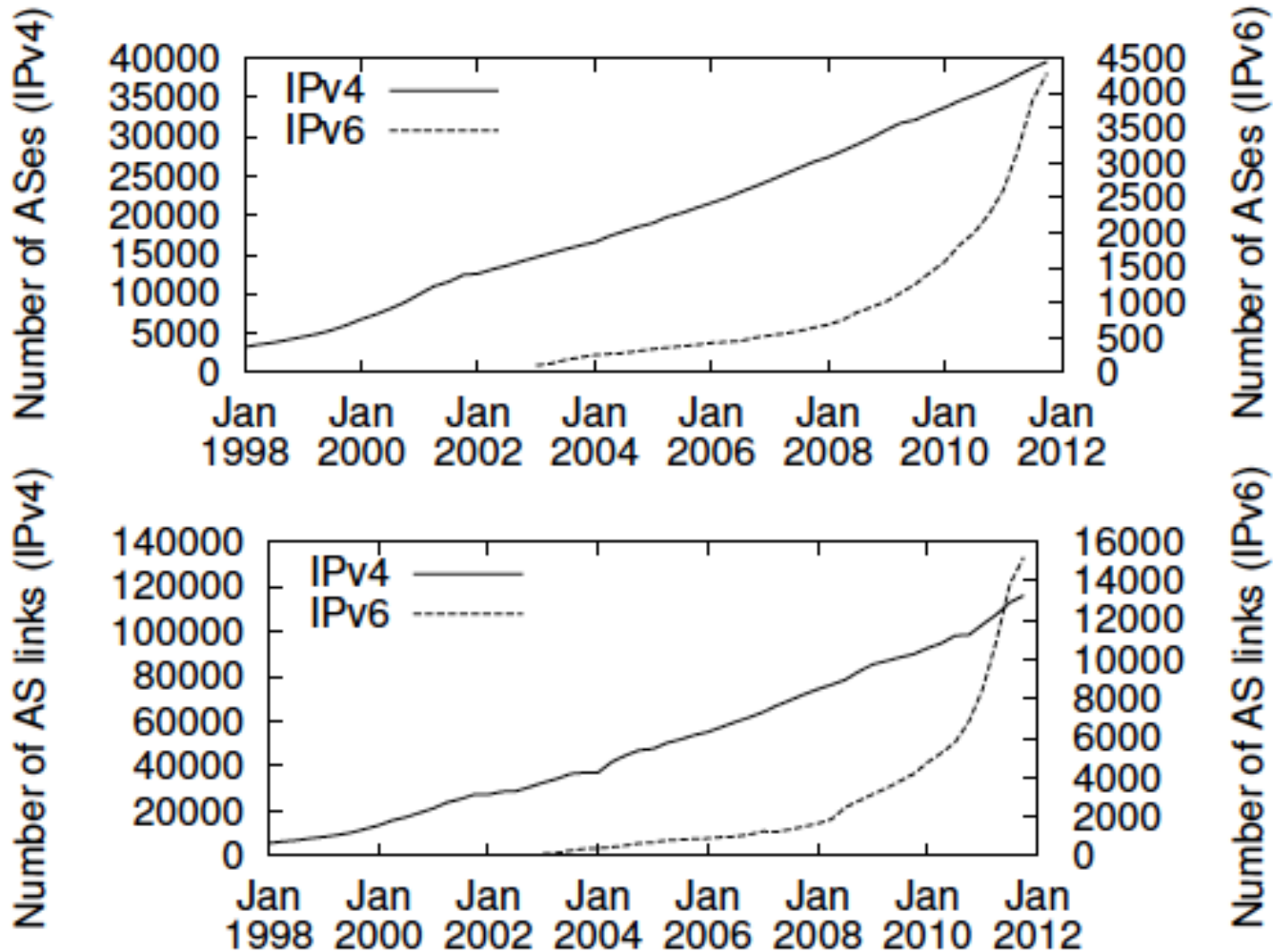
# Network with IPv6



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



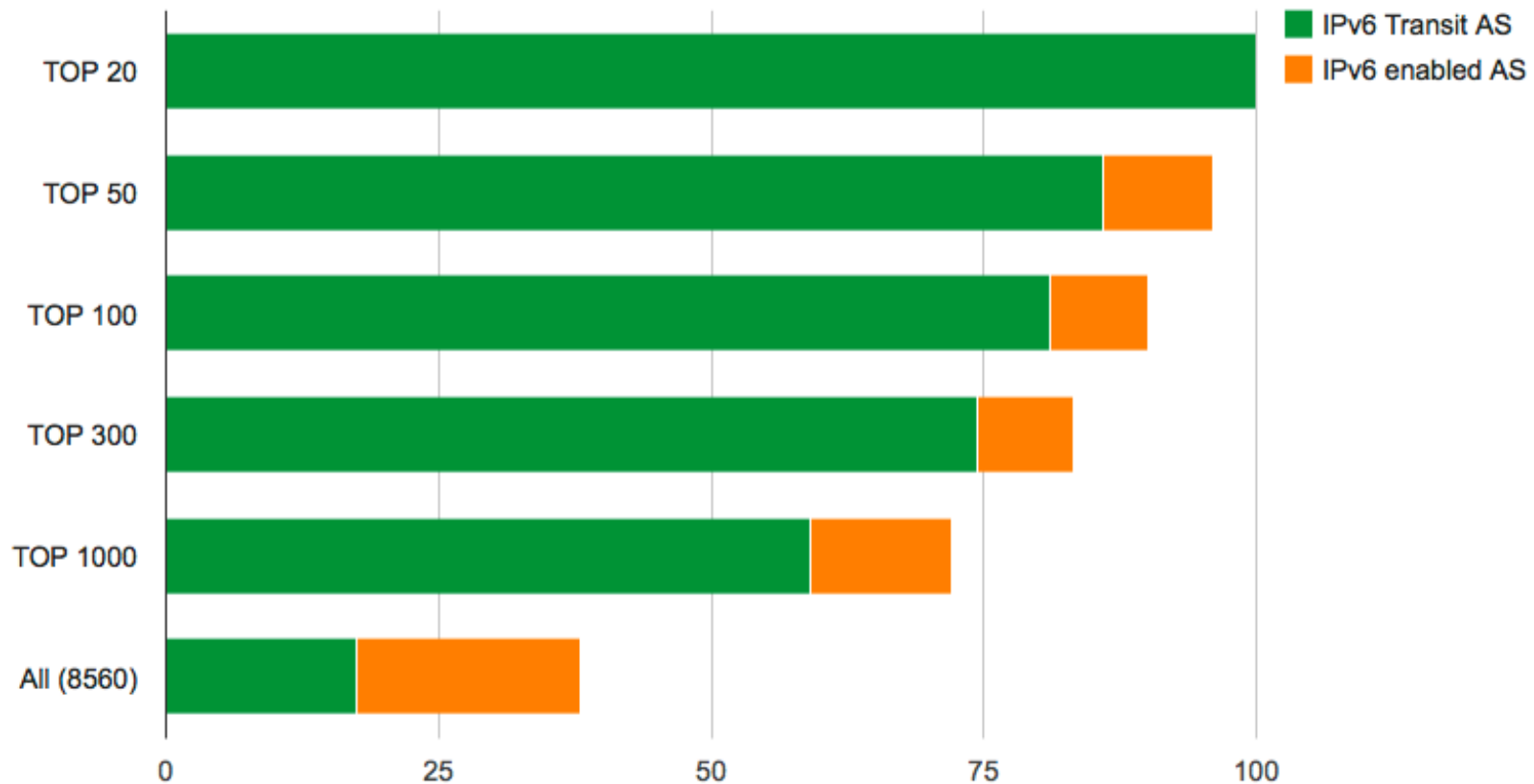
# Growth of AS nodes and links



[http://www.caida.org/publications/papers/2012/measuring\\_deployment\\_ipv6/](http://www.caida.org/publications/papers/2012/measuring_deployment_ipv6/), p2 Sept 2012 paper

# IPv6 adoption in Internet core networks

Top Transit AS overview <http://6lab.cisco.com/stats/cible.php?country=world>

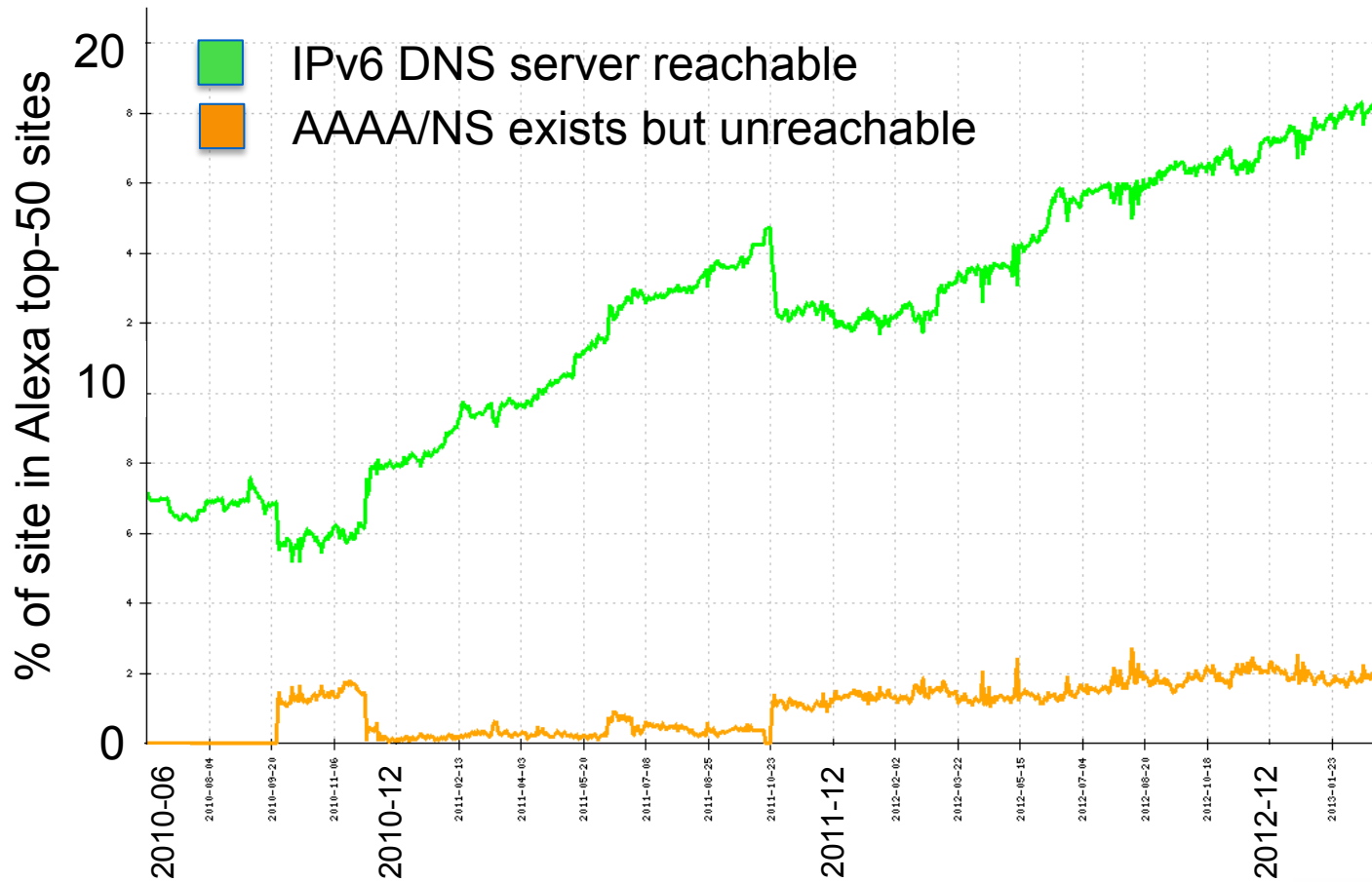


## Sum up 2: IPv6 BGP and ASN

- 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
- So called 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

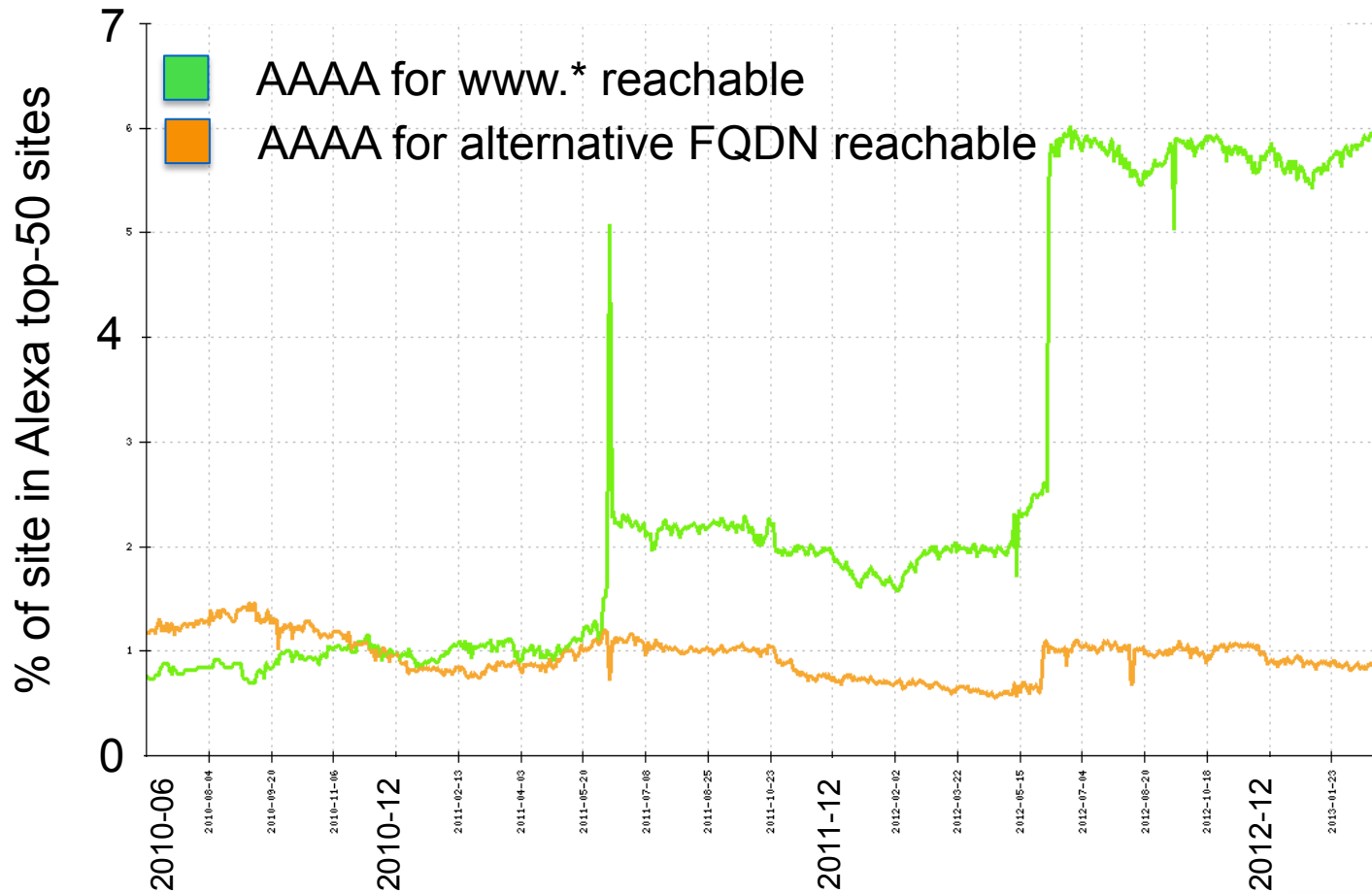
# IPv6 enabled DNS servers

Sites with IPv6 Authoritative DNS Server  
[www.vyncke.org/ipv6status](http://www.vyncke.org/ipv6status)



# IPv6 enabled www sites

[www.vyncke.org/ipv6status](http://www.vyncke.org/ipv6status)



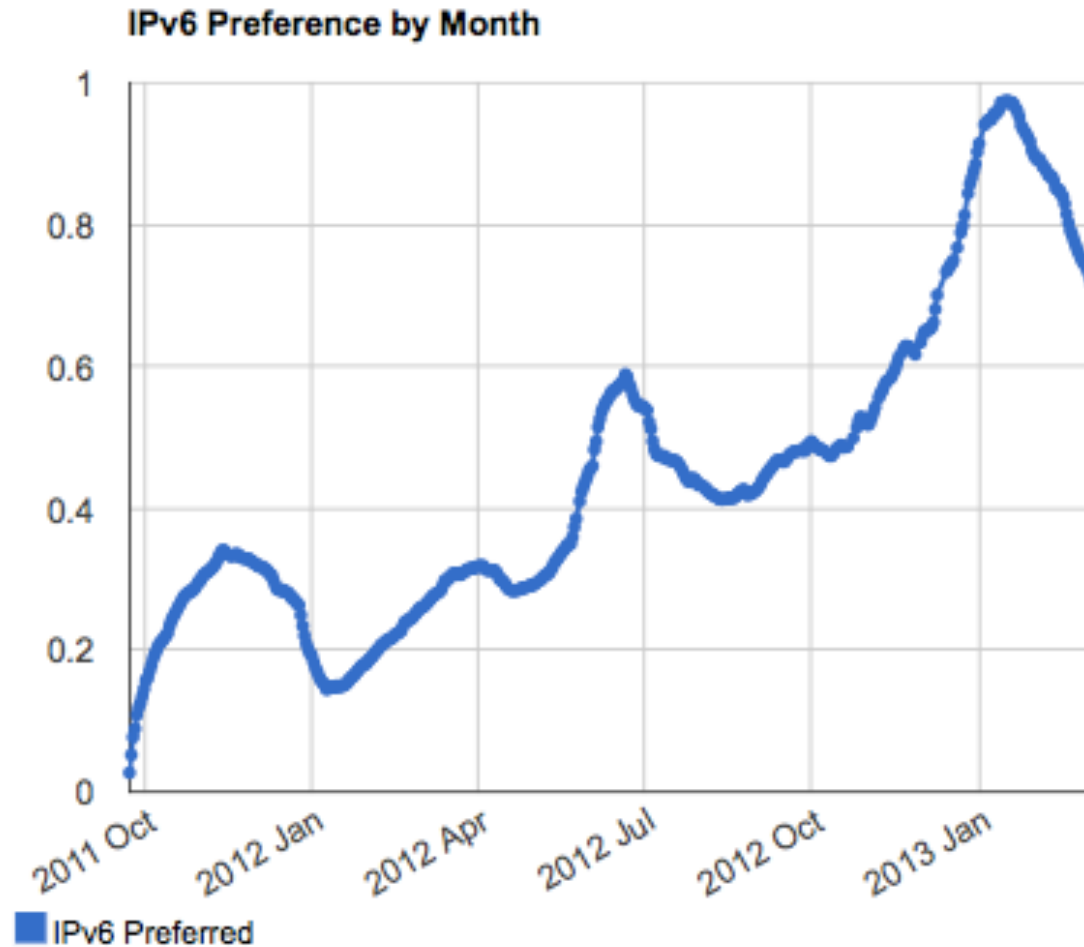
# Sum up 3:

## 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 in their Internet resources

# IPv6 measurement

## End user readiness: World



<http://labs.apnic.net/ipv6-measurement/Regions/001%20World/> as of 07/03/2013

# 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
<a href="#">RO</a>	9.97%	95813
<a href="#">FR</a>	6.40%	54822
<a href="#">LU</a>	4.14%	736
<a href="#">JP</a>	3.24%	245964
<a href="#">CZ</a>	2.18%	41422
<a href="#">US</a>	2.13%	683750
<a href="#">DE</a>	1.63%	37600
<a href="#">NO</a>	1.22%	5941
<a href="#">LT</a>	1.09%	12959
<a href="#">BE</a>	1.08%	28554
<a href="#">CH</a>	0.98%	10022
<a href="#">ZA</a>	0.71%	2276
<a href="#">NL</a>	0.70%	31725
<a href="#">PT</a>	0.68%	16060
<a href="#">SK</a>	0.67%	10943
<a href="#">SI</a>	0.63%	6862
<a href="#">PE</a>	0.62%	85723
<a href="#">BZ</a>	0.42%	246
<a href="#">CN</a>	0.40%	974582
<a href="#">TW</a>	0.36%	81699
<a href="#">GB</a>	0.32%	100704
<a href="#">HU</a>	0.31%	49171
<a href="#">HK</a>	0.30%	27078



# Sum up: 4

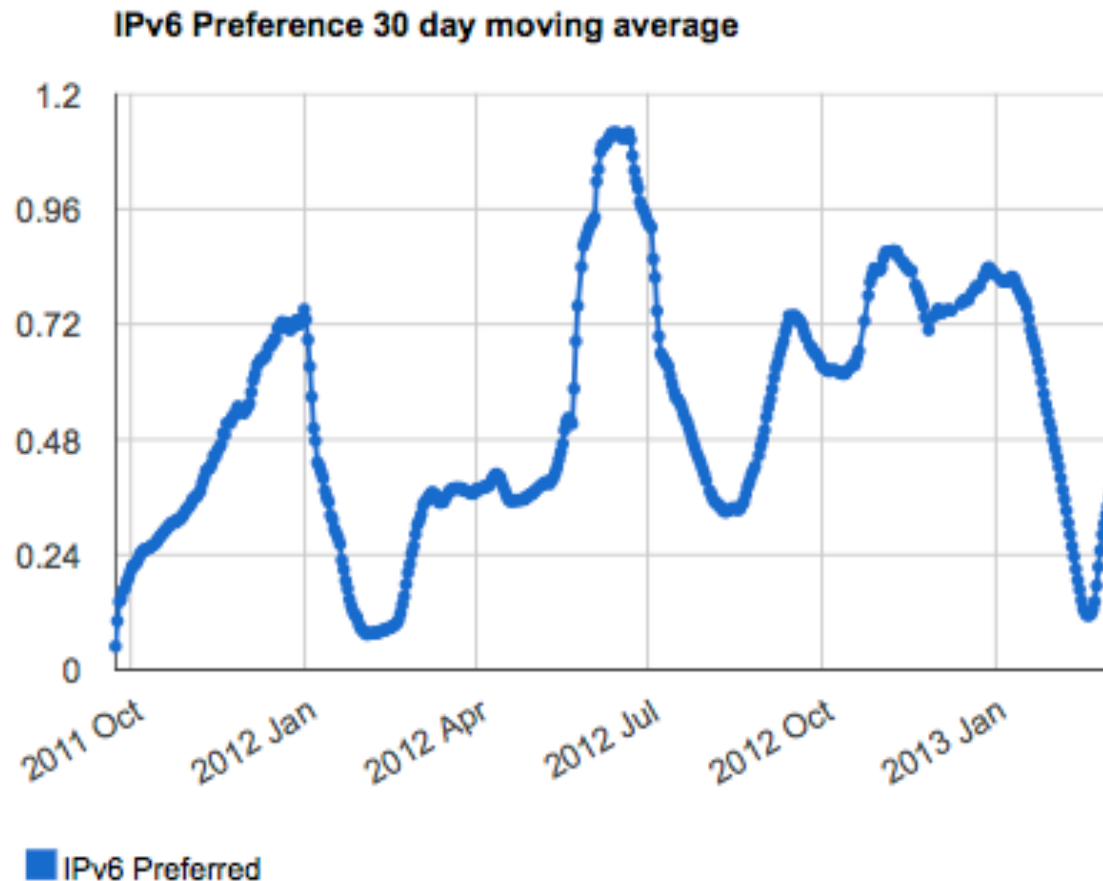
## End user IPv6 readiness

- 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 early 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: China



<http://labs.apnic.net/ipv6-measurement/Economies/CN/> 08/03/2013

# Observations

## IPv6 deployment in China

- Transit networks, providers clearly have IPv6 capability in their core.
- End user deployment was always going to be hard  
CPE upgrade costs, customer-provisioning costs
- Other economies appear to be facing similar problems
  - But some ISPs are also biting the bullet.
  - Comcast (USA), CTC (Japan), Internode (Australia), Free (France).  
RCS (Romania)

# 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
    - Start 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 enterprises 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](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](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-APIIPv6TF-Agarwal-ver2.pdf](http://conference.apnic.net/__data/assets/pdf_file/0006/58533/DOT-PPT-APIIPv6TF-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](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](http://conference.apnic.net/__data/assets/pdf_file/0010/58744/ida-ipv6-transition-programme-2013-apricot_1361845288.pdf)

# 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**

# 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
- 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



2001:dc0:a000:4:54be:e565

via v6

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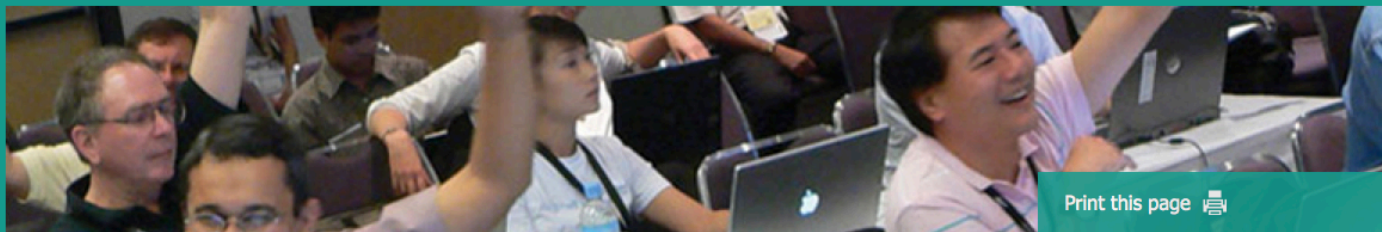
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## IPv6@APNIC



Status: IPv6 Enabled  
Last: 2013-02-18

IPv6 is a top issue for the Asia Pacific Internet community. APNIC engages in activities throughout the region to help facilitate a smooth transition. The greater goal is to support the Asia Pacific in deploying IPv6 to maintain a scalable Internet for everyone.

APNIC reached the last /8 of IPv4 addresses in April 2011, and now delegates IPv4 resources according to the "last /8 policy". The scarcity of IPv4 makes IPv6 deployment critical for all networks and organizations in the Asia Pacific. Here's what APNIC is doing to support the community in achieving real and tangible IPv6 deployment:



Get your IPv6 addresses!

### Distributing IPv6 addresses

Getting an IPv6 block is the first step in your transition, and the process is very simple.

## Related links

- IPv6 news feed

## IPv6 Info

Curated by APNIC



A Cloud Without IPv6

# APNIC





# www.apnic.net/ipv6



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## Community

- Policy development
- Participate
- Working with the community
- About the Internet community

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## IPv6@APNIC

IPv6 is a top issue for the region to help facilitate deploying IPv6 to main

APNIC reached the last according to the "last networks and organization community in achieving

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process is very simple

A Cloud Without IPv6

# APNIC



**Thank you!**