

The IPv6 deployment metrics set and the measurement method

on behalf of IPv6 metric WG in IAjapan

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- **Goals of project**
 - About the background and purpose our project
- **IPv6 deployment metrics set**
 - About the 4 categories of measurement
 - About the measurement item in each category
- **Measurement example**
 - About the measurement method and the result
- **Conclusion**
 - Summary and future plan

Goals of project

- Measure the degree of IPv6 deployment
 - It is important to measurement IPv6 specific since the beginning of IPv6 deployment
 - This work is useful for the market strategy and operation of IPv6
- Contents of process
 1. Define the IPv6 metrics set as the measure the IPv6 readiness
 2. Establish the method of analyzing data using continuous measurement
 3. Share the methods and our tools
 4. Do measurement in each country (ex. in AP region)
 5. Compile and publish the result of the measurement
 - make a graph and update web site automatically
- Handling of the measurement data
 - We should be careful to deal with the compiled data
 - It might be sensitive

IPv6 deployment metrics set

- We defined the 4 categories of measurement
- Scale of IPv6 Internet
 - How much IPv6 Internet is actually used
- IPv6 deployment ratio
 - How much IPv6 application and network are ready
- Characteristics and tendency of IPv6 traffic
 - How about the state of using IPv6
- Stability and reliability of IPv6 Internet
 - Now in preparation...

Next: explain the detail of each category 

● Address allocation

- The number of IPv6 address blocks which has been allocated for LIRs by RIRs (number of /32 prefixes)
- The number of IPv6 address blocks which has been registered to RIRs whois Databases (number of /48 prefixes)

● Routing Information

- Total number of IPv6 BGP4+ routing entries
- Total number of ASes using IPv6 BGP4+
- The average of AS path length in each IPv6 BGP4+ routing entries

● Traffic

- IPv6 traffic amount of backbone network

- Routing information
 - Ratio of the number of IPv6 prefixes and the number of IPv4 ones in each AS
- Traffic
 - Ratio of IPv6 traffic amount and IPv4 one on dual-stack IX
- DNS deployment rate
 - Statistics of DNS on .JP domain
 - Target applications: DNS, Mail, Web
- Analysis of access to application
 - Ratio of IPv6 http accesses and IPv4 ones
- IPv6 enabled products
 - The number of the products which has been approved by “IPv6 Ready Logo Program”

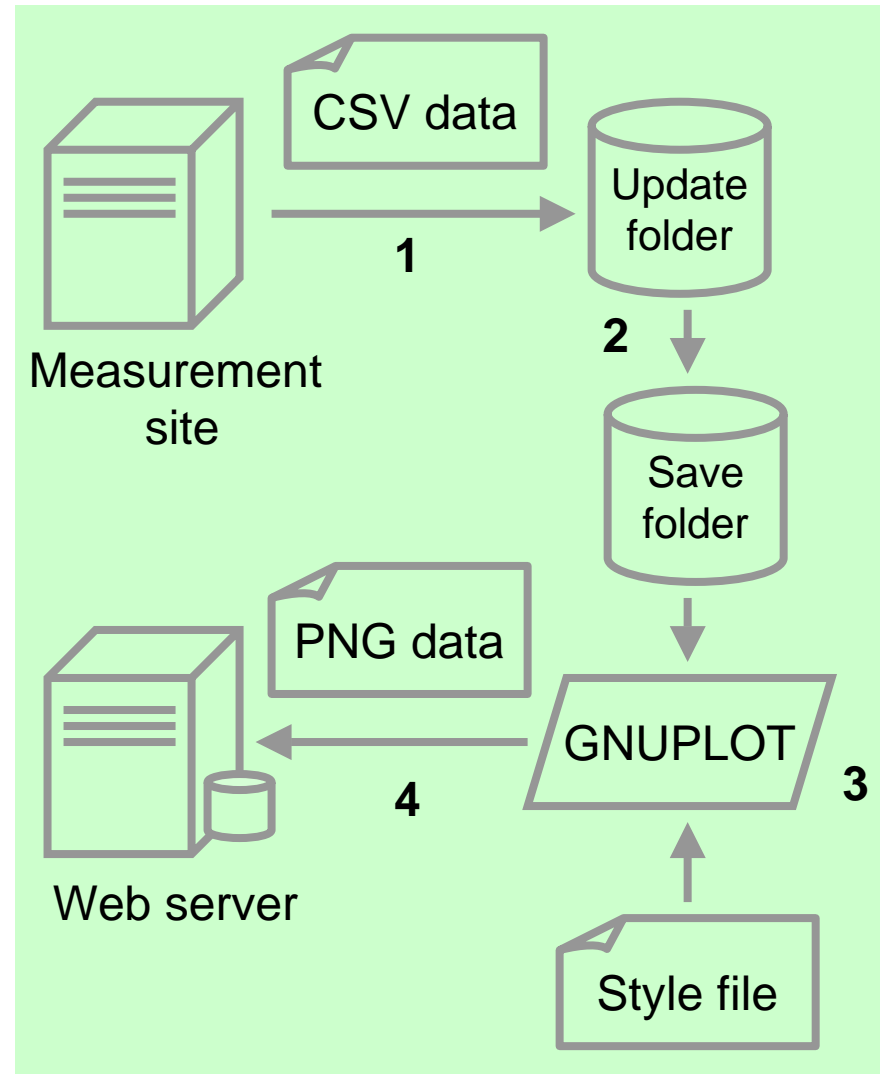
● Traffic

- Analysis of the contents of IPv6 traffic on ISP
- Target protocols: TCP, UDP (source port and destination port)
ICMPv6

Next: introduce our web publishing server 

Web publishing server

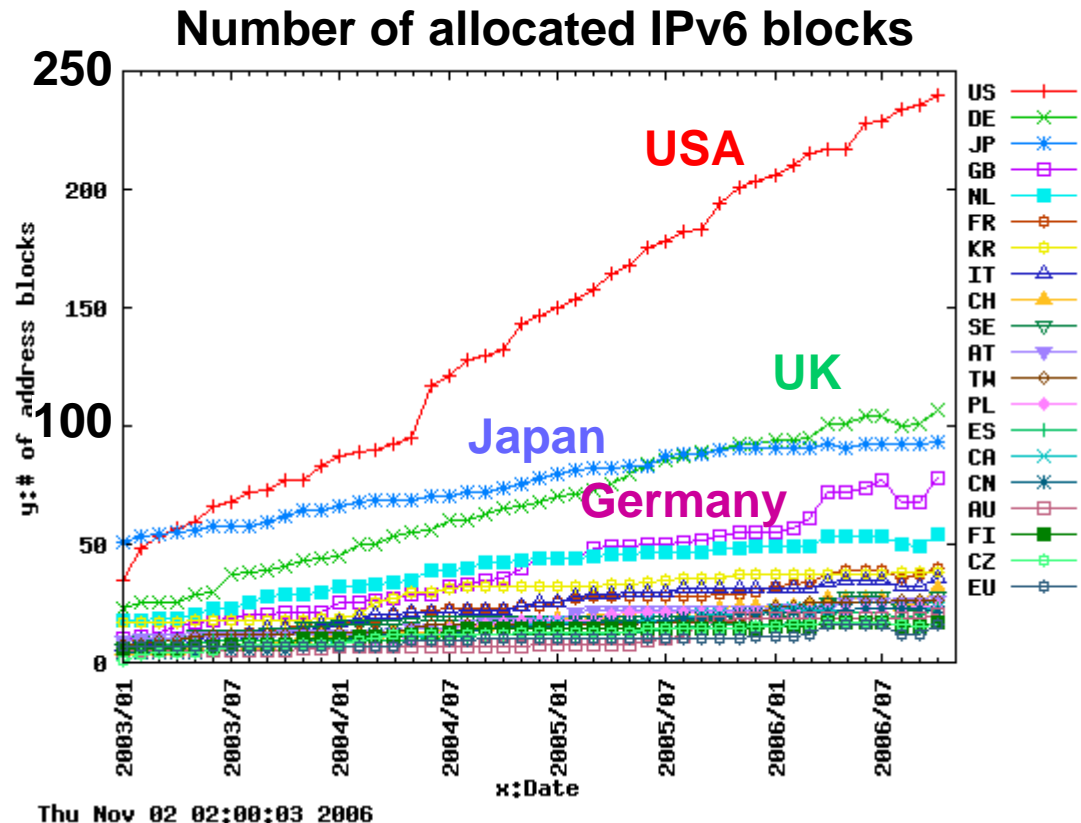
- Constructed publishing server
 - Makes the graph automatically
 - System procedure
 1. Update measurement data
Contribute the CSV format data to folder using SCP protocol
 2. Check the data file format
When the data format is wrong system sends e-mail to data origin
 3. Generate a statistical graph
Define the GNUPLOT's parameter with style file
 4. Update web pages
Move the graphic data to web server and display the updates information
- The update process is executed every day



Next: explain about each measurement

Address allocation (1)

- The number of operator allocated IPv6 address by RIRs
 - Count the records of IPv6 allocations made by RIRs
- The first rank is USA today
 - twice the number of the second rank UK
 - Japan was the former leader acquiring IPv6 address block

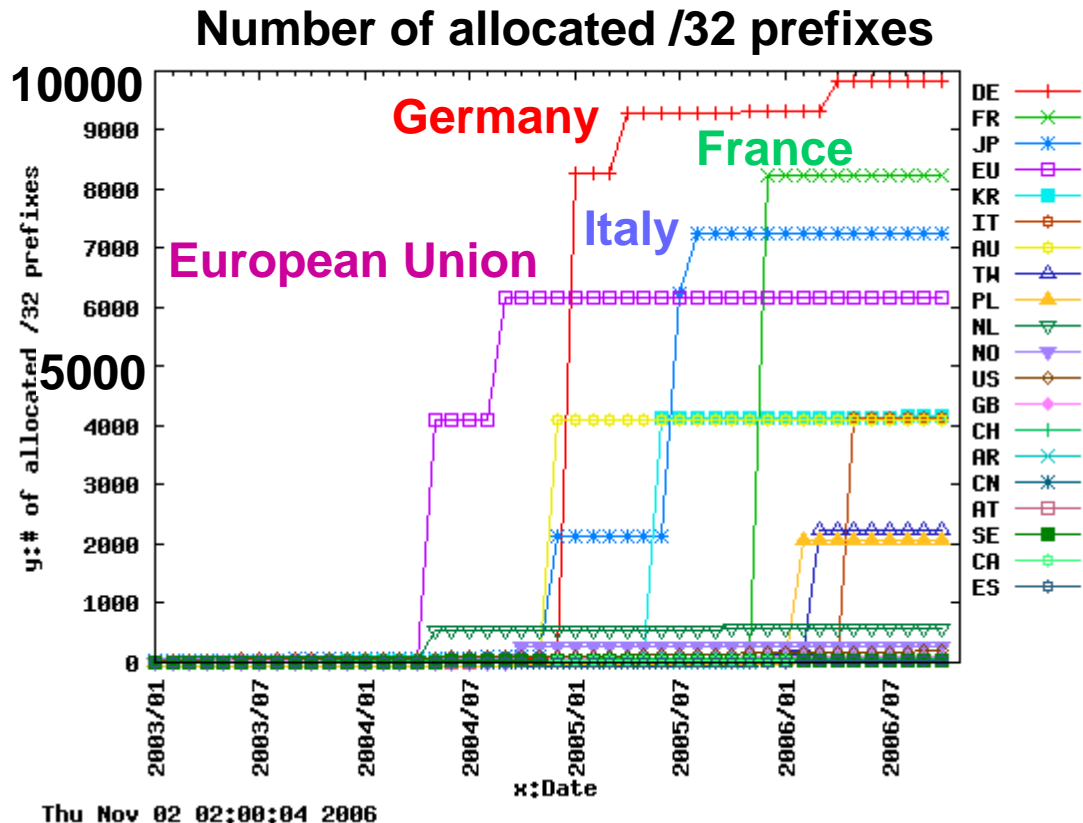


Address allocation (2)

- The number of prospective end-user estimated by operator
 - Converts each /32 allocated address block into a unit
 - Show the space of the allocated IPv6 address
- European countries have large space
 - Germany, France and Italy has been assigned /19 address block

calculation expression

ex) /35 prefix
 $2^{(32-35)} = 2^{-3} = 0.125$



Address allocation (3)

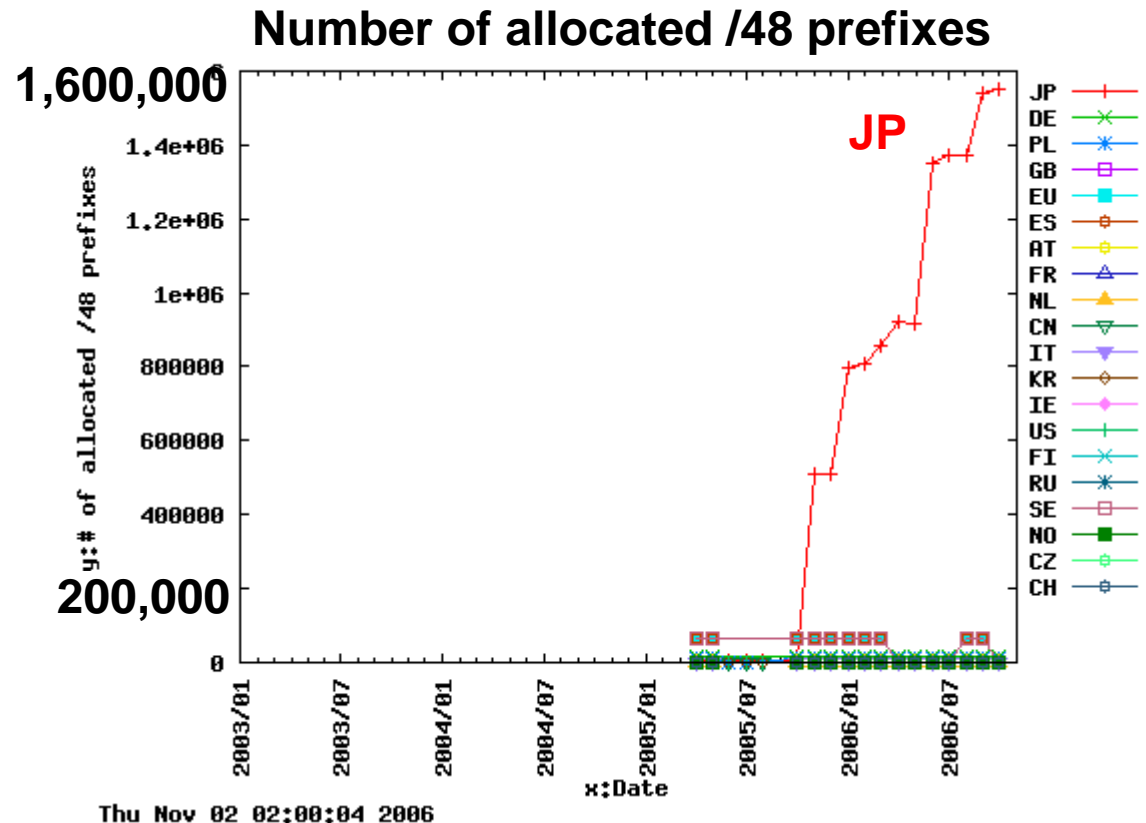
- The number of actual use by operator
 - Uses WHOIS database as hierarchy search by each allocated address block and it is converted each /48 into a unit
 - Show how much assigned IPv6 address to end-user



Japan is the country of using IPv6 the most

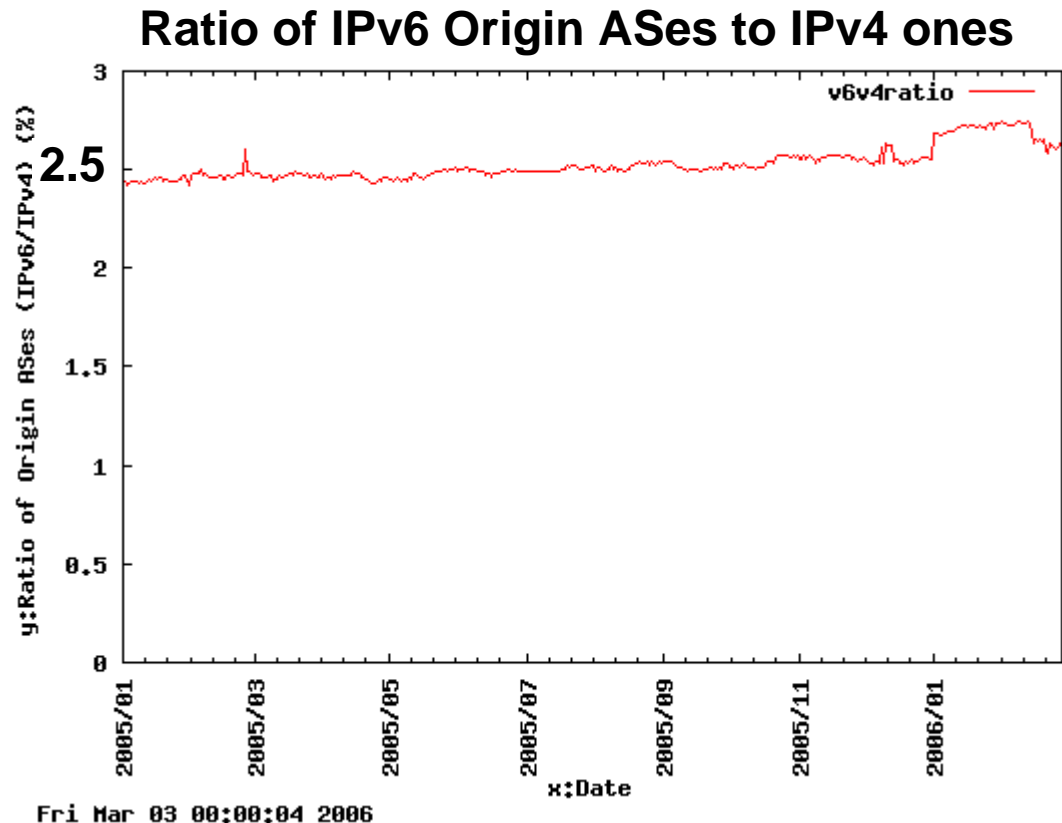
calculation expression

$$\text{ex) /40 prefix} \\ 2^{(48-40)} = 2^8 = 256$$



Number of origin ASes ratio vs. IPv4

- Calculate the data from full routing information
 - Using BGP4+ and BGP
 - The number of IPv6 ready AS is less than 3 percent of IPv4 one
 - ➔ the scale of IPv6 Internet is still small
 - a gradual increasing was observed
 - ➔ IPv6 Internet is expanding surely



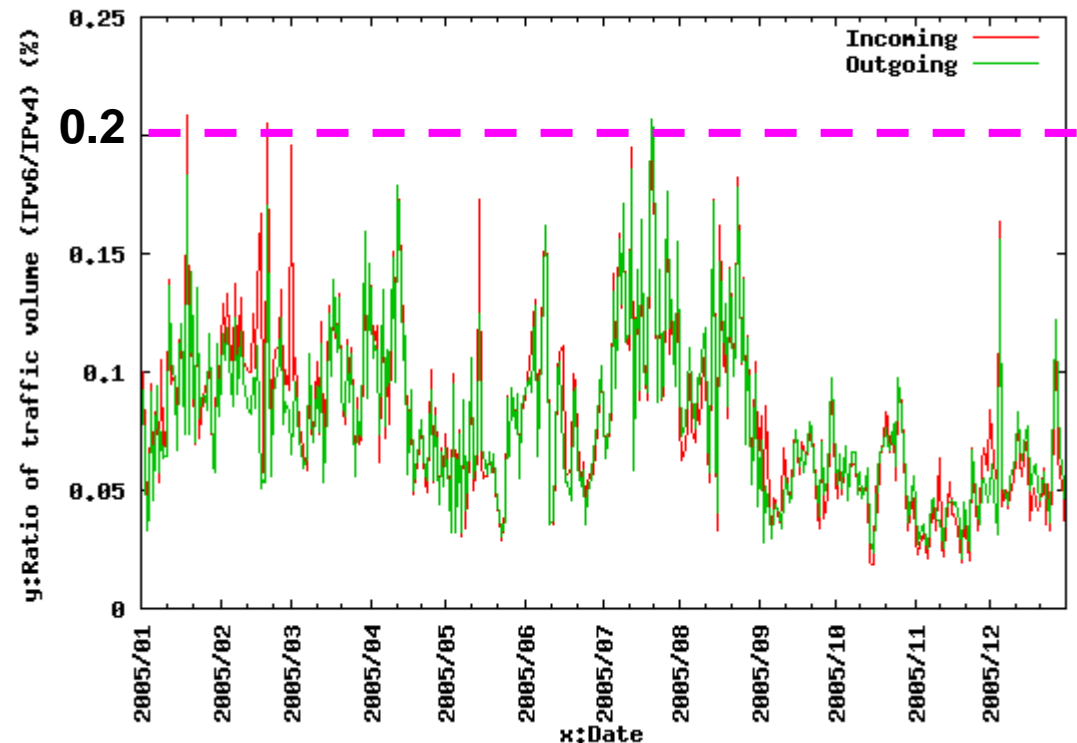
Traffic ratio vs. IPv4

- Use traffic data on a dual-stack IX
 - Measure at port of switching HUB (5 minutes average)
 - IPv4 and IPv6 were completely divided in target IX
 - IPv6 traffic is less than 0.2 percent of IPv4 one

● Problem of traffic measurement

- Has not been divided by the SW port
 - ➔ should be used Netflow/sFlow etc.
- Traffic information on IX is very sensitive
 - ➔ should be used amount of traffic information using two of more IXes

Ratio of IPv6 traffic to IPv4 one



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- Using a result of DIG command
 - Takes the updated list of .JP domain from JPRS twice a month
 - There are about 60,000 records on .JP domain now
 - Target applications are DNS, Mail, Web
- DNS service
 - Resolve NS record of target domain and resolve it's AAAA/A record
- Mail service
 - Resolve MX record of target domain and resolve it's AAAA/A record
- Web service
 - Resolve AAAA/A record of www.<domain> and <domain>
 - Can not search all web services, but can calculate the ratio
- Judgment method
 - If AAAA record is exist, the target domain is defined as IPv6 ready

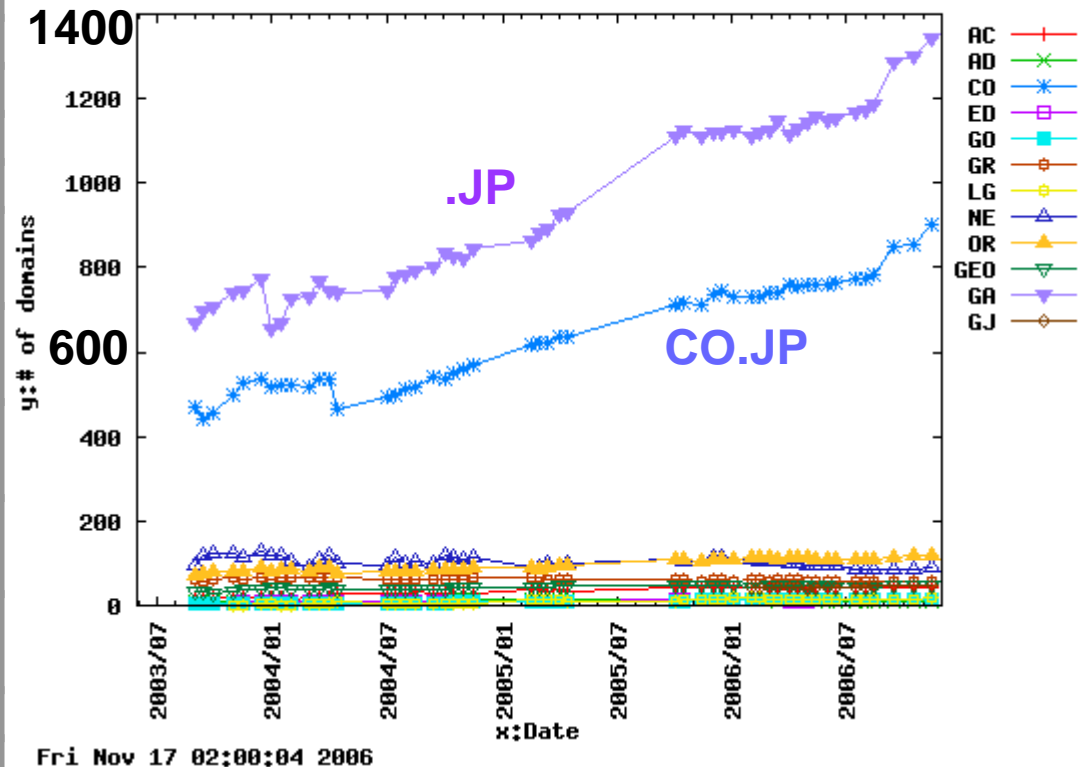
DNS servers readiness (2)

- The IPv6 deployment of name server is well under way
 - The number of DNS server which has AAAA record is increase at GA (General-Use JP) domain and CO (Companies) domain

kind of JP domain name

AC	ac.jp	Universities etc.
AD	ad.jp	JPNIC members
CO	co.jp	Companies
ED	ed.jp	High schools etc.
GO	go.jp	Japanese government
GR	gr.jp	Groups established under the laws of Japan
LG	lg.jp	Japanese local authorities
NE	ne.jp	Network service providers
OR	or.jp	Judicial persons (other than companies)
GEO	ex.) tokyo.jp	Geographic type JP domain
GA	.jp	General-Use JP domain
GJ	日本語.jp	Japanese JP domain

Number of DNS support IPv6 on JP domain



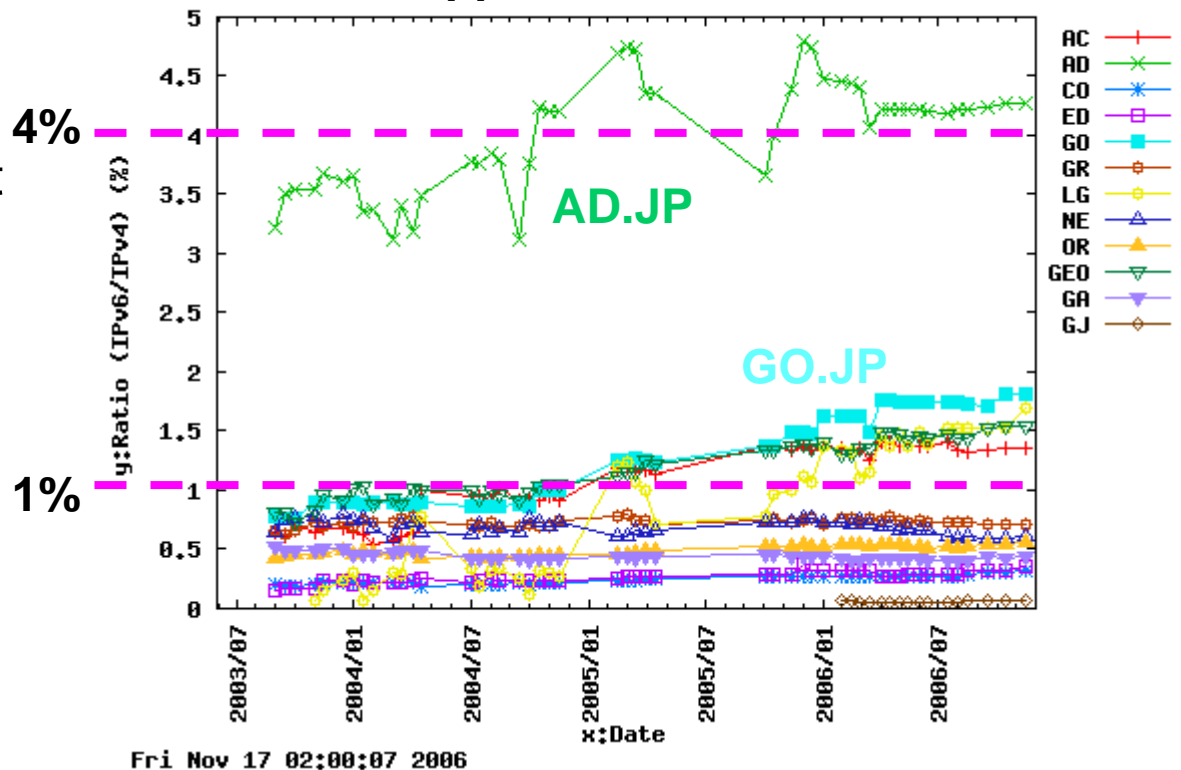
DNS servers readiness (3)

- Compared with the number of IPv4 DNS server
 - The most advanced IPv6 deployment domain is AD (JPNIC members) domain, next one is GO (government) domain
 - Only the AD domain's ratio is over 4 percent



IPv6 deployment in company is not large yet

Ratio of DNS support IPv6 to IPv4 on JP domain



Summary

- We defined the IPv6 metrics set
 - 4 categories and measurement method
- We kept continuously observing it
- We developed the web publishing server which regularly makes the graph automatically using the observational data
- The tendency of IPv6 Internet was observed
 - Address allocation, IPv6 deployment of DNS and AS are increasing securely
 - But it's scale is still smaller than IPv4 ones

Future plan

- Internationalization of our web site
 - construct English pages until end of this year
- Distribute of our measurement and analyzing tools
- Monthly report
 - Publish our examination on every end of month
- The measurement of amount of IPv6 traffic in Japan
 - Add up the result of two or more IXes
- About the stability of IPv6 Internet
 - define the index of the stability
- Develop this work with another country or organization

謝謝

Our project web page:
<http://v6metric.inetcore.com/>

