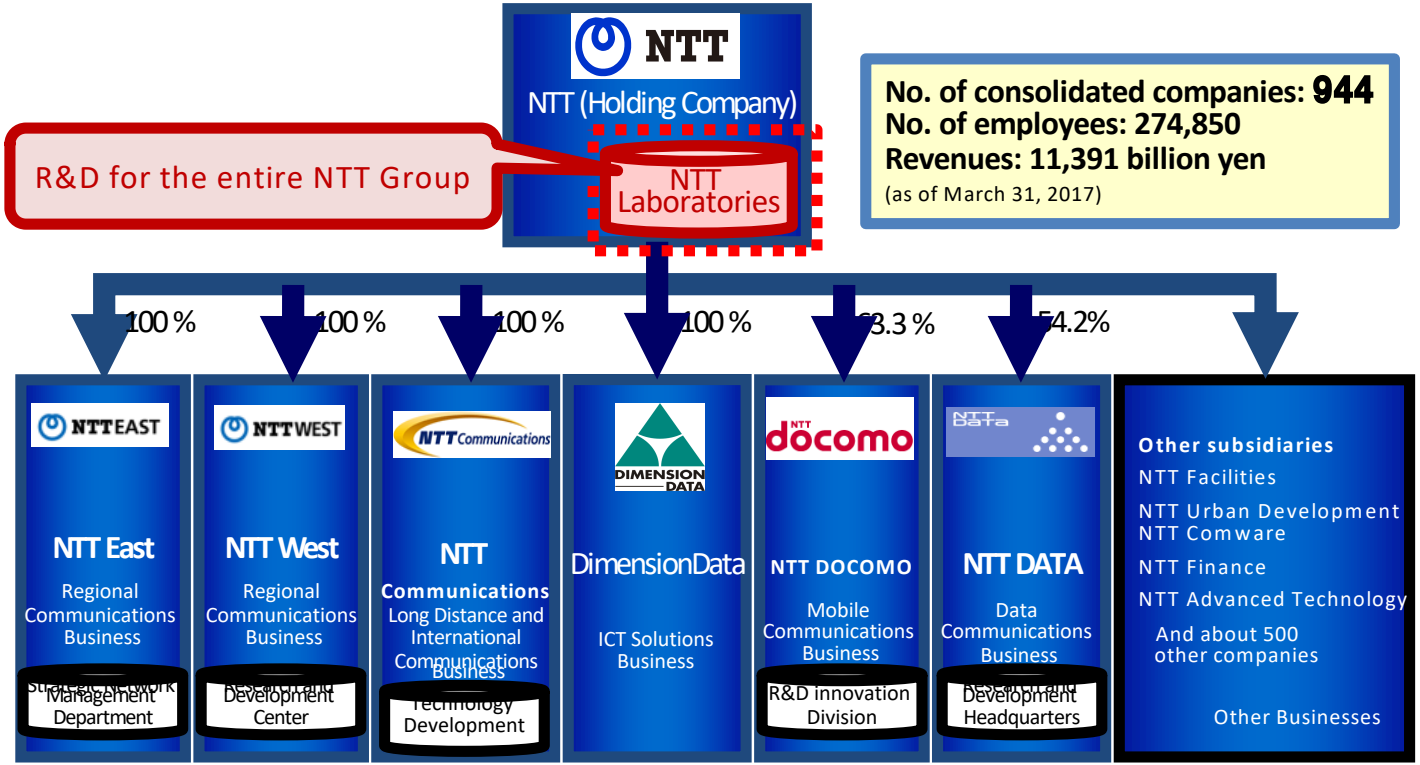
IPv6 deployment experience in NTT and Japan

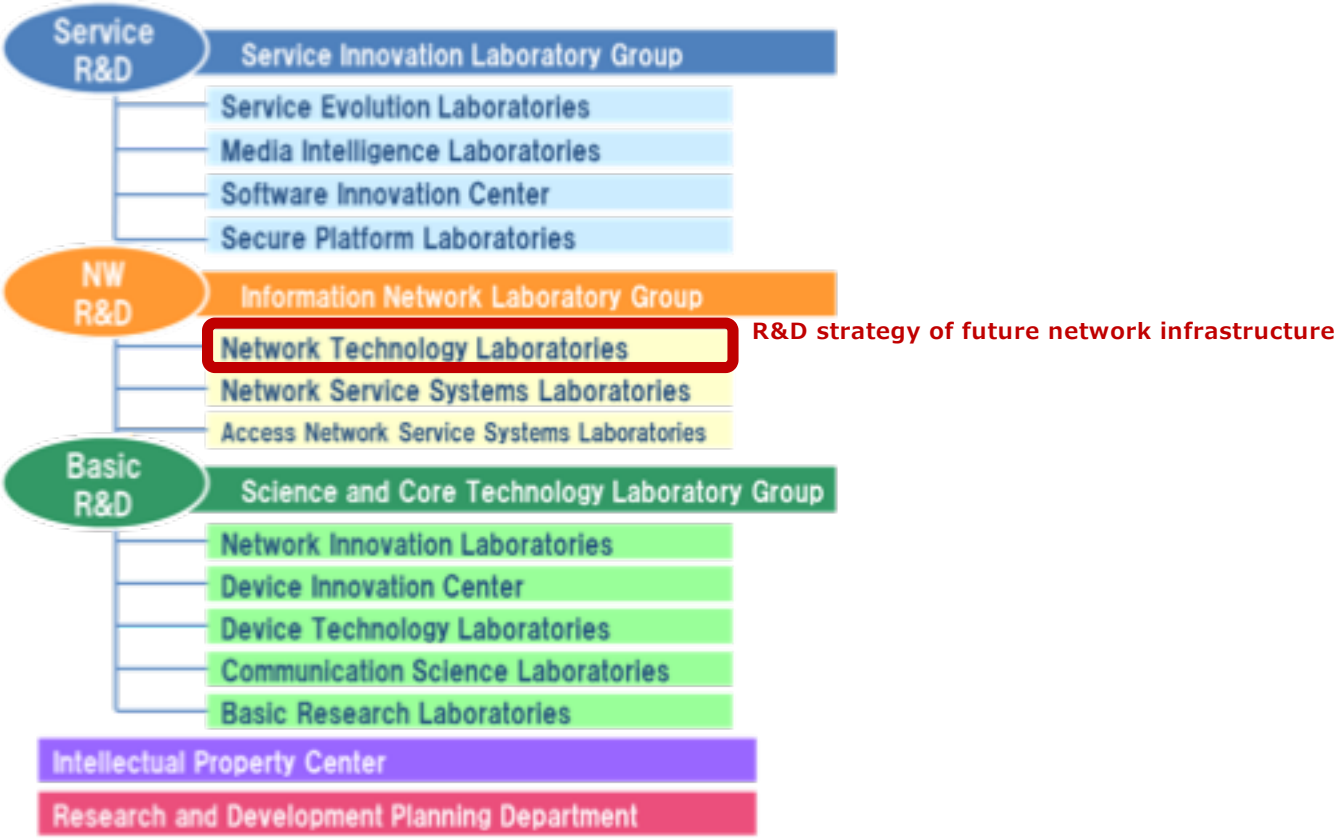
Tomohiro Fujisaki

NTT Network Technology Laboratories

Introduction of NTT Group



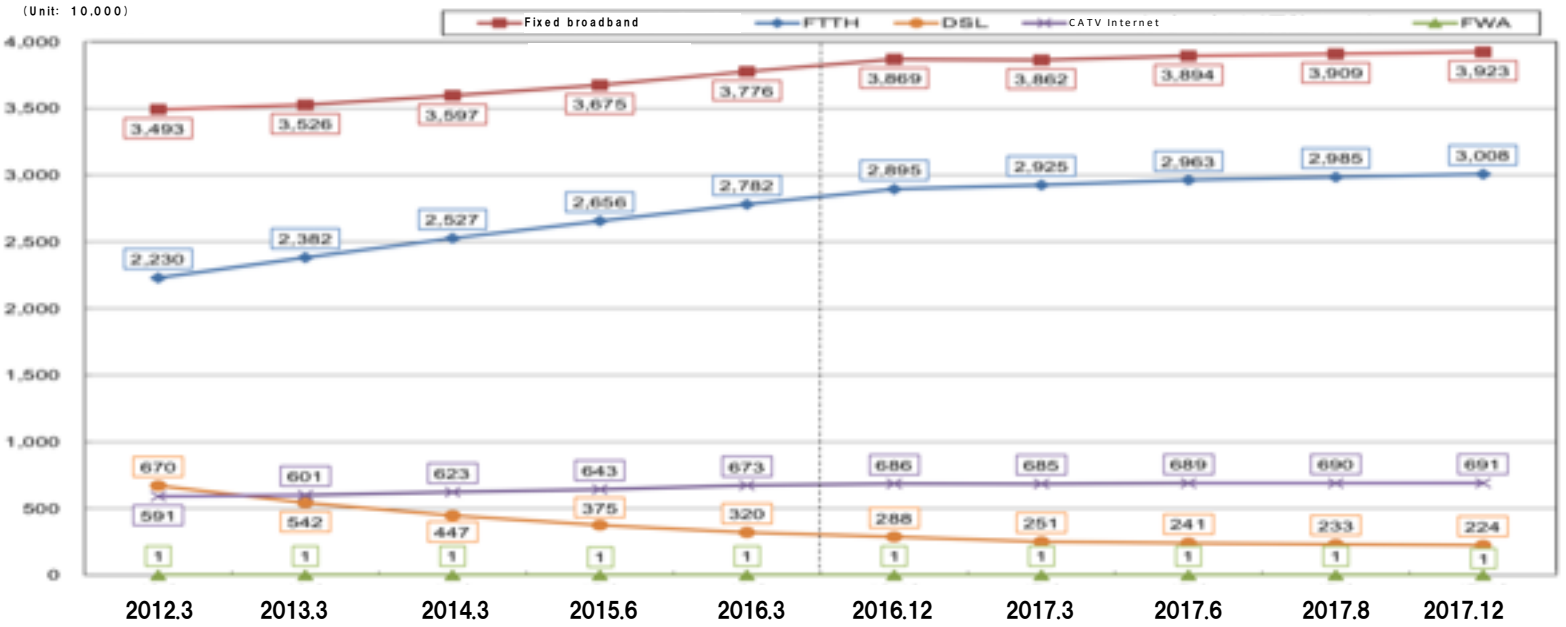
Introduction of NTT Labs



Japan Internet Access Service Market & NTT Group

Japan Market Overview: Fixed line Broadband Internet Access 1/2

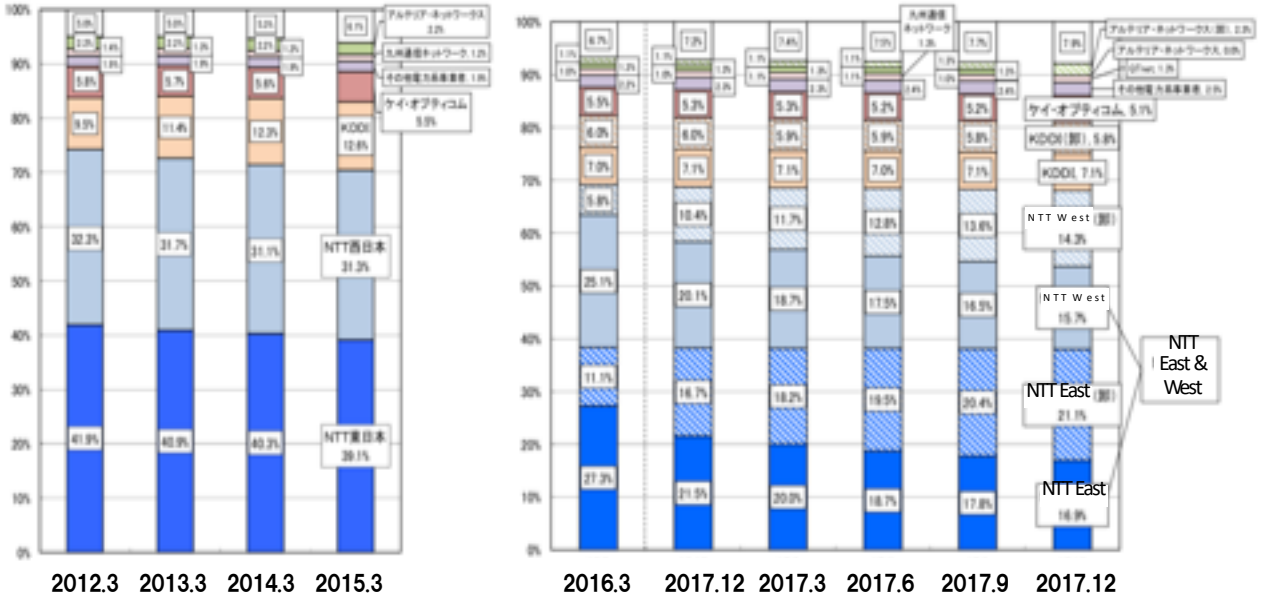
Transition of fixed line broadband service subscribers



http://www.soumu.go.jp/menu_news/s-news/01kiban04_02000131.html

Japan Market Overview: Fixed line Broadband Internet Access 2/2

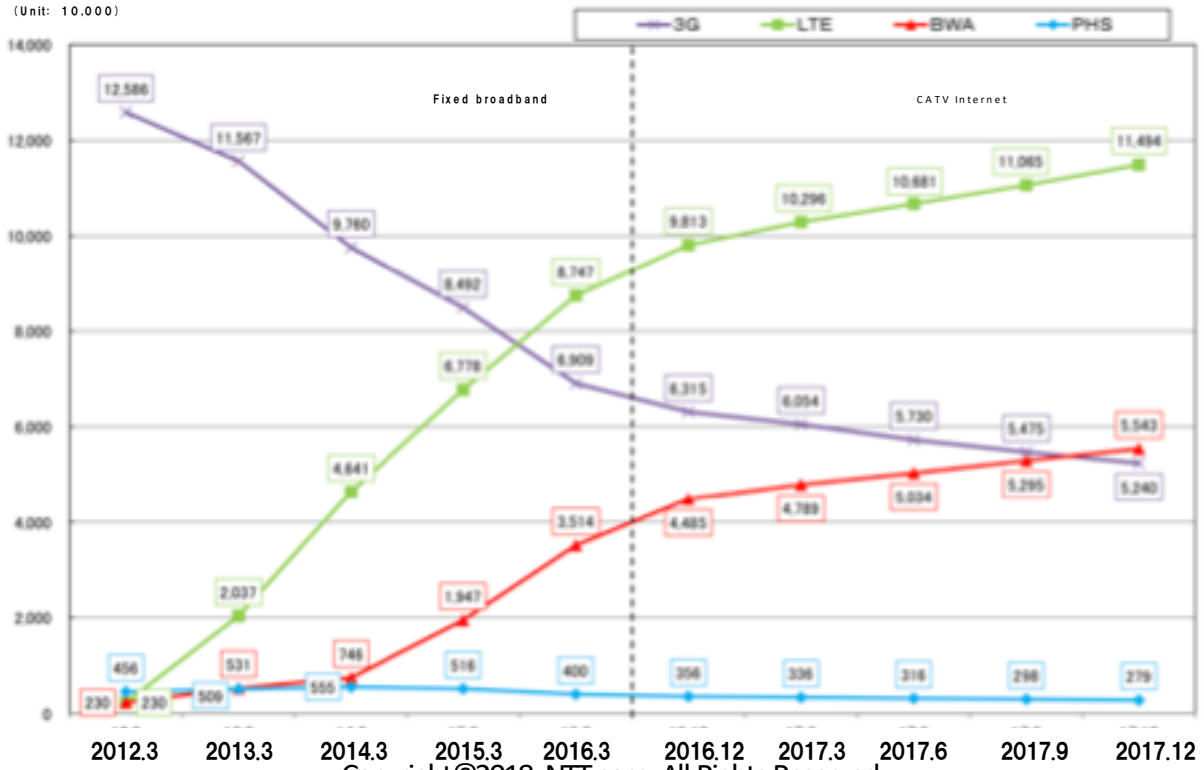
FTTH market share trends in fixed broadband access



http://www.soumu.go.jp/menu_news/s-news/01kiban04_02000131.html

Japan Market Overview: Cellular Broadband Internet Access

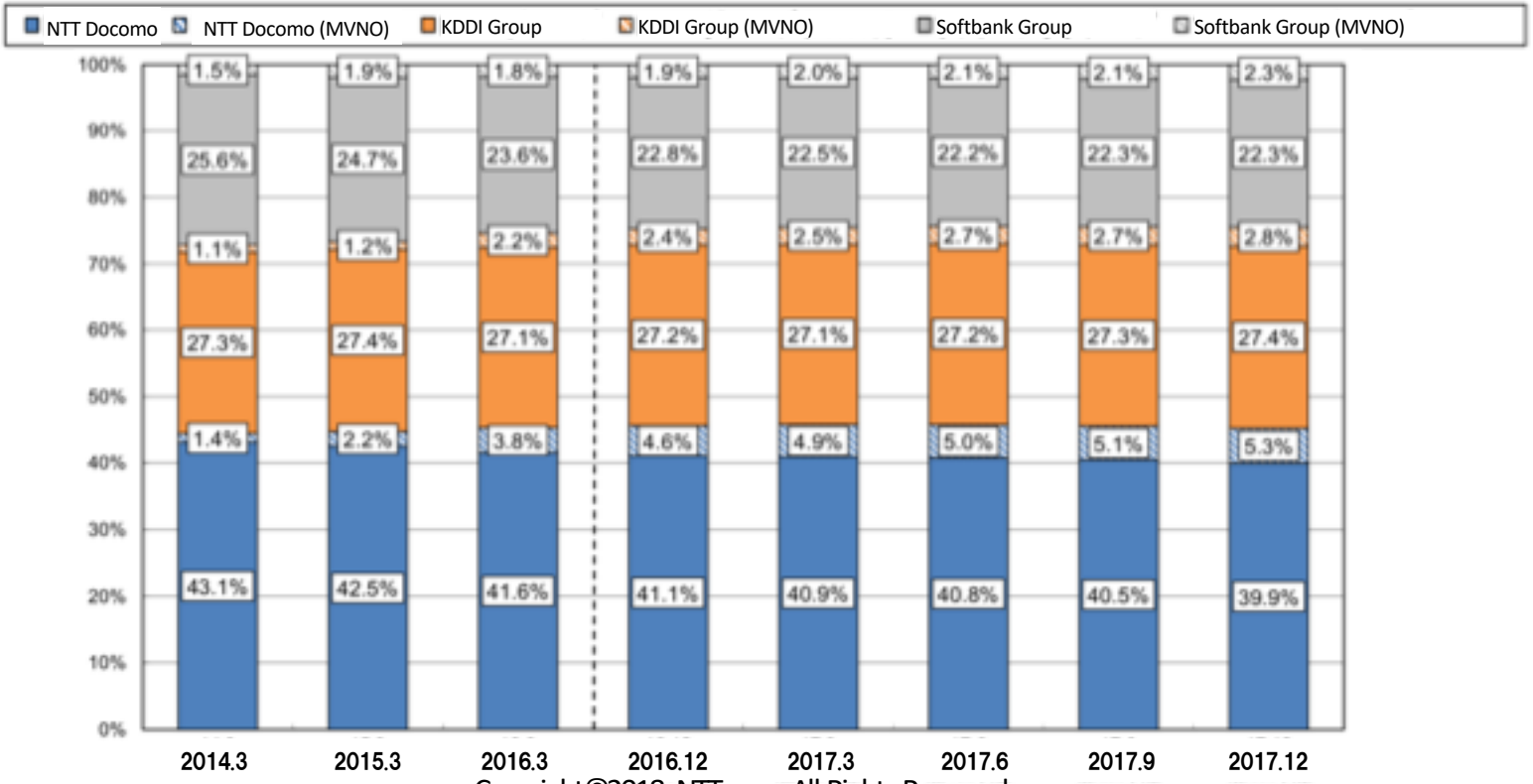
Transition of cellular service subscribers



http://www.soumu.go.jp/menu_news/s-news/01kiban04_02000131.html

Japan Market Overview: Cellular Broadband Internet Access 2/2

Market share trends in cellular service（3G + 4G）



http://www.soumu.go.jp/menu_news/s-news/01kiban04_02000131.html

Internet Exchanges in JP

- BBIX (BroadBand Internet eXchange) [Asia Smart IX (BBIX Asia), Osaka, Tokyo]
- WIDE [DIX-IE (Distributed IX in EDO (former NSPIXP2), NSPIXP3)]
- Equinix [Osaka, Tokyo]
- JPIX (Japan Internet Exchange) [Osaka,Tokyo]
- JPNAP [Osaka, Tokyo, Tokyo 2]
- Echigo-IX (Echigo Internet Exchange)
- RIX (RYUKYUIX) (Ryukyus Internet Exchange)

https://www.peeringdb.com/advanced_search?country_in=JP&reftag=ix

Internet Exchanges in JP

- BBIX (BroadBand Internet eXchange) [Asia Smart IX (BBIX Asia), Osaka, Tokyo] ⇨ Softbank Group
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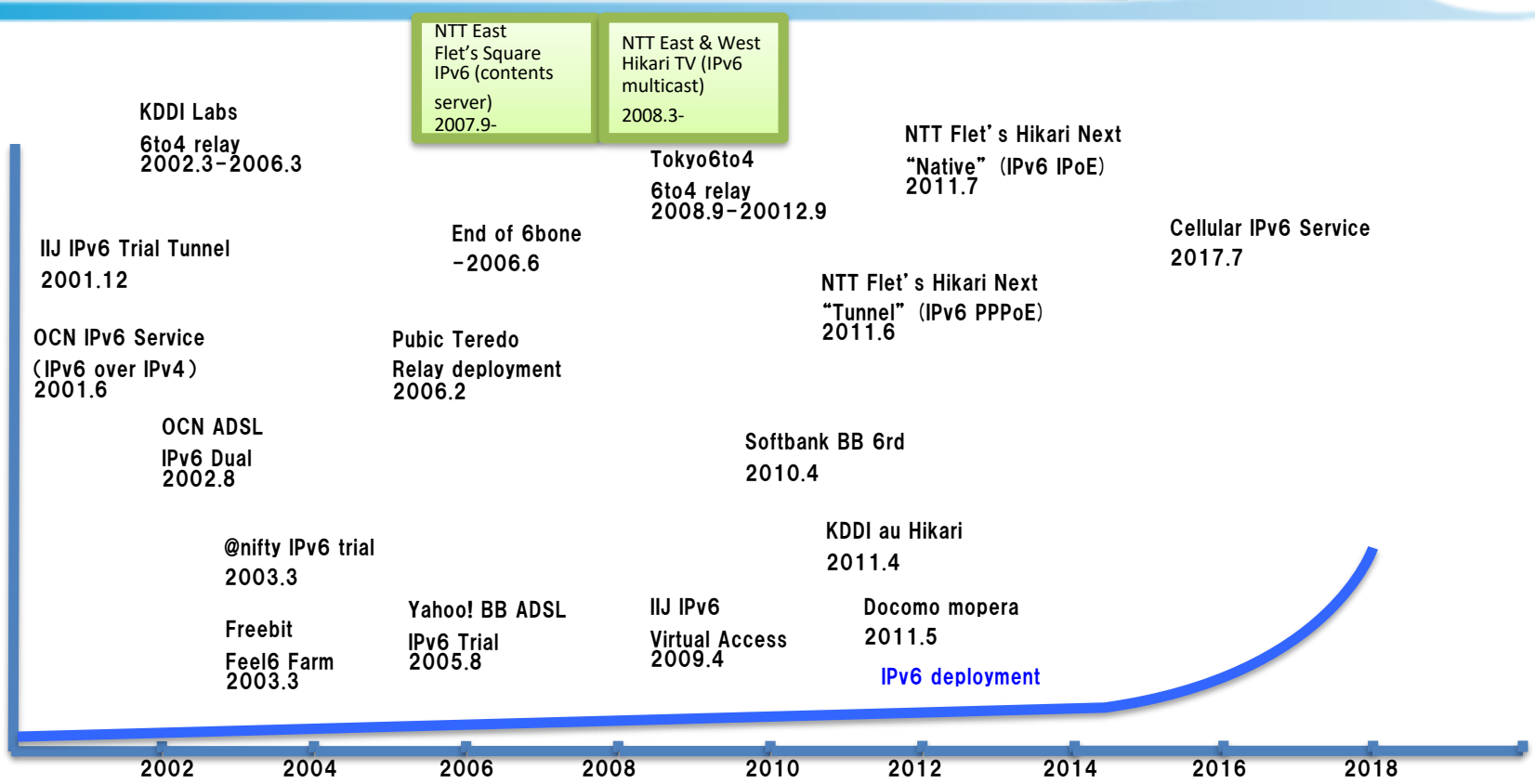
- Equinix [Osaka, Tokyo]
- JPIX (Japan Internet Exchange) [Osaka,Tokyo] ⇨ KDDI Group
- JPNAP [Osaka, Tokyo, Tokyo 2] ⇨ NTT Group
- Echigo-IX (Echigo Internet Exchange)
- RIX (RYUKYUIX) (Ryukyus Internet Exchange)

https://www.peeringdb.com/advanced_search?country_in=JP&reftag=ix

NTT IPv6 Service

History of IPv6 service for (residential) users in Japan

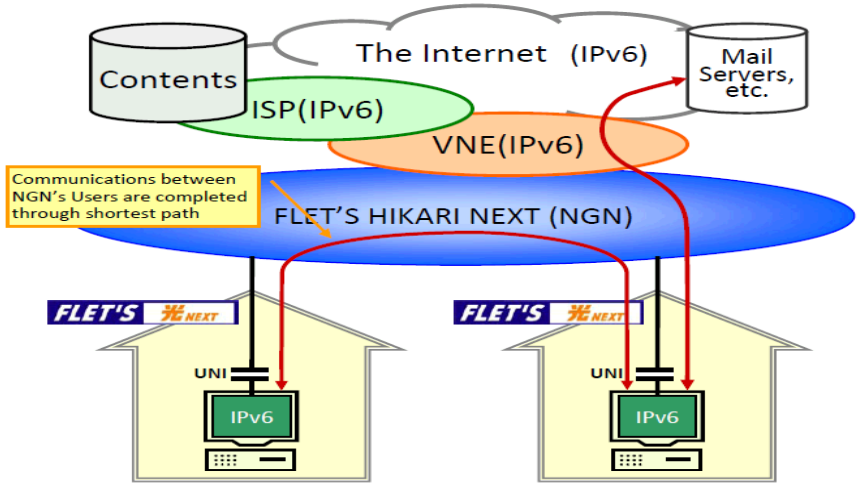


IPv6 Internet Access Platform: IPoE

NTT East and West, NGN's IPv6 IPoE

Outline of IPv6 IPoE

- VNE's prefix will be assigned to UNI when user subscribe to ISP
- Users are required to subscribe to NGN with "FLET'S v6 Option" to make UNI-UNI communications go through shortest path in NGN



Service specifications

Connection method	IPoE(IPv6)
Fee	Included in monthly charge of FLET'S
IPv6 Prefix assign method	RA or DHCPv6-PD (VNE's Prefix)
ISP	BIGLOBE @nifty IIJmio au one NET VECTANT NTT Docomo, OCN And some more ISPs *1
Remark	VNE (Virtual NW Enabler*2) — BBIX, Inc. — Japan Network Enabler, Co. — Internet Multifeed, Co.

*1: http://www.fletes.com/next/ipv6_ipoe/isp.html
*2: A kind of roaming service provider

source: MIC Study Group on Advanced Use of Internet with IPv6 the 3rd interim Report, http://www.soumu.go.jp/main_content/000127670.pdf

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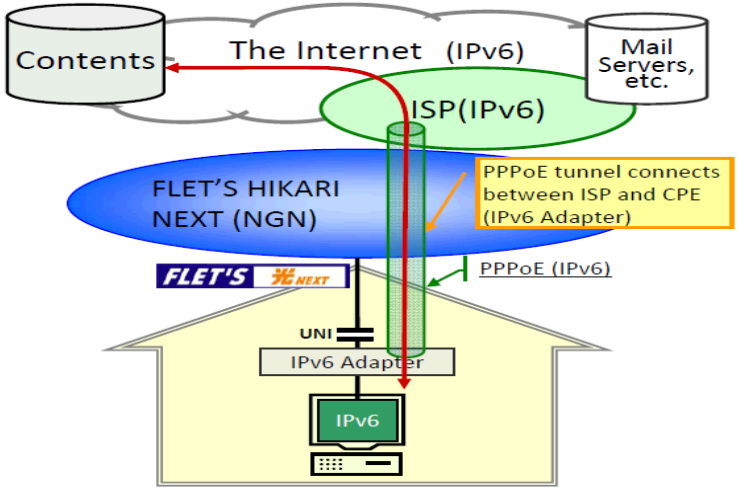
IPv6 Internet Access Platform: PPPoE

NTT East and West, NGN's IPv6 PPPoE

Outline of IPv6 PPPoE

- IPv6 Prefix will be assigned to User via PPPoE by ISP
- new CPE for handling PPPoE(v6CP) and NAT66 is required to access both NGN and the Internet.
- Dedicated ID and password for IPv6 tunnel must be set on IPv6 Adapter



Service specifications

Connection method	PPPoE(IPv6)
Fee	Included in monthly charge of FLET'S
IPv6 Prefix assign method	DHCPv6-PD via PPPoE
ISPs	OCN plala So-net DTI dream.jp and 128 ISPs in total
Remark	IPv6 adapter or similar function to terminate PPPoE(v6CP) and NAT66 is required

source: MIC Study Group on Advanced Use of Internet with IPv6 the 3rd interim Report, http://www.soumu.go.jp/main_content/000127670.pdf

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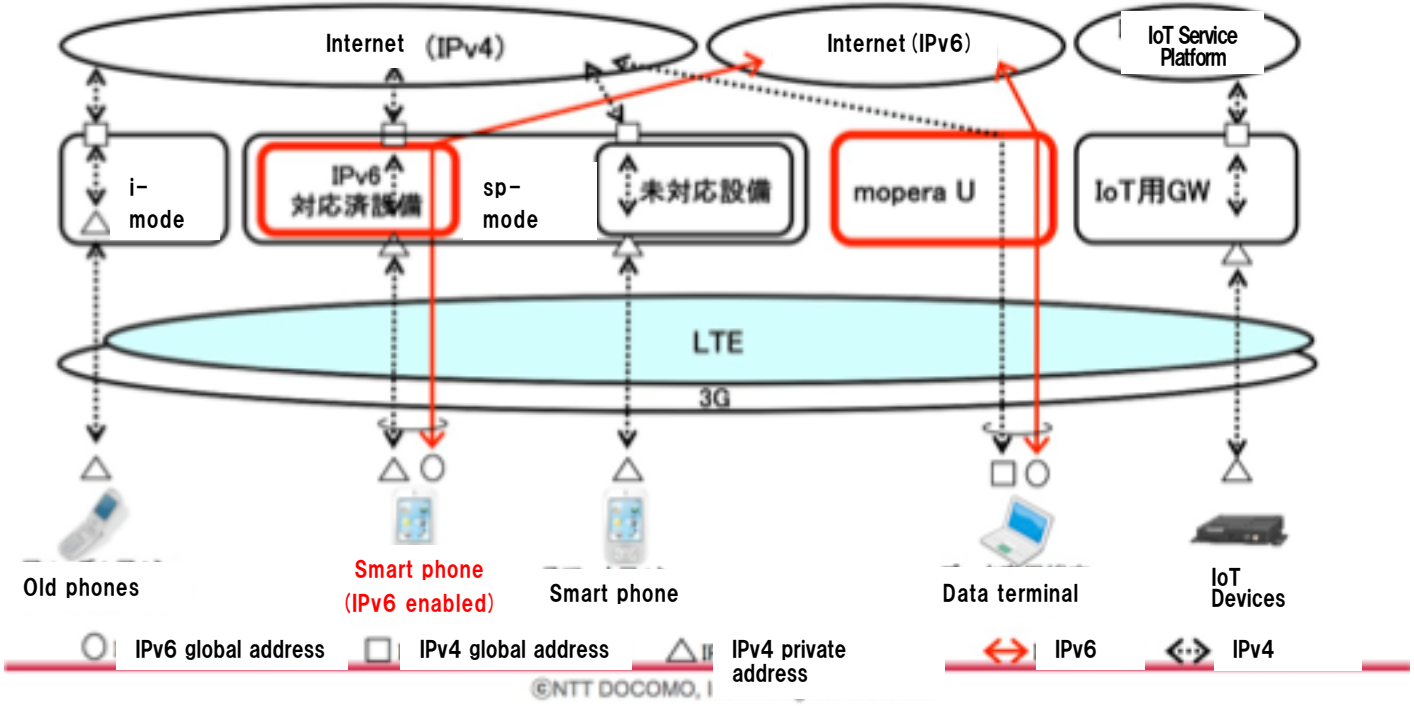
IPv6 Internet Access Service by NTT Docomo



From http://www.iajapan.org/ipv6/2017/0419_ws/pdf/20170419_mobile.pdf

NTT Plala's "Hikari TV" IPTV Service

Retransmission of Terrestrial Digital Broadcasting (HD)
'Hikari-TV' is the first RTDB provider

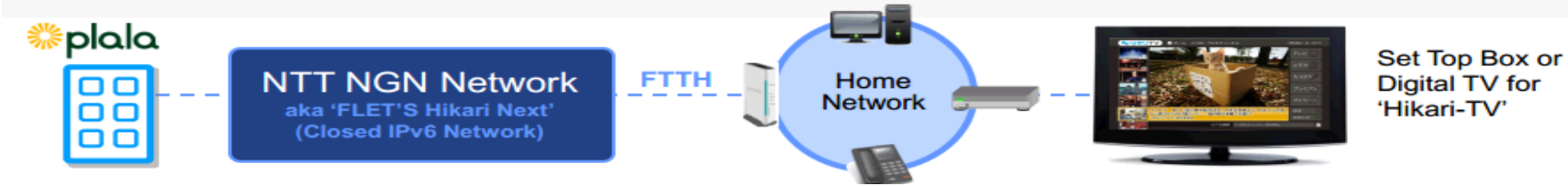
Channel service
76 channels (including HD channels)

VOD service
Over 10,000 titles

Karaoke service
Over 13,000 titles

ひかりTV

'Hikari-TV' Content Delivery Network



Current IPv6 implementation in JPNAP

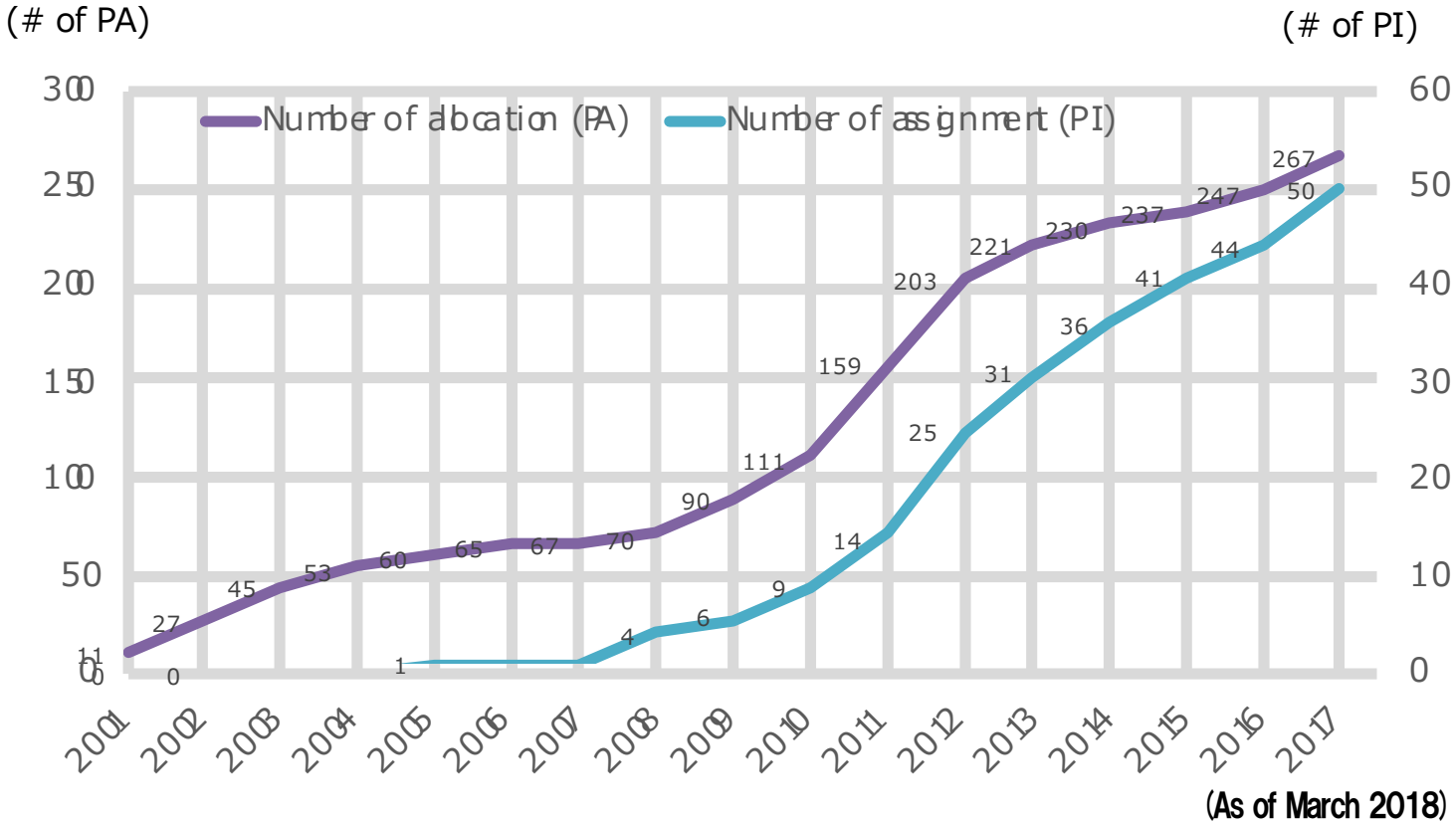
- Dual stack VLAN
  - IPv4 and IPv6 on the same VLAN
  - No multicast available
- Addressing scheme:
  - ASN in decimal number is embedded into interface ID.
- MP-BGP (RFC2545 and RFC4760) for exchanging routes
- Prohibited packets:
  - ICMPv6 Router Advertisement

- Multi-lateral Peering provided by route servers.

Provided by Katsuyasu Toyama, vice president of Internet Multifeed co.

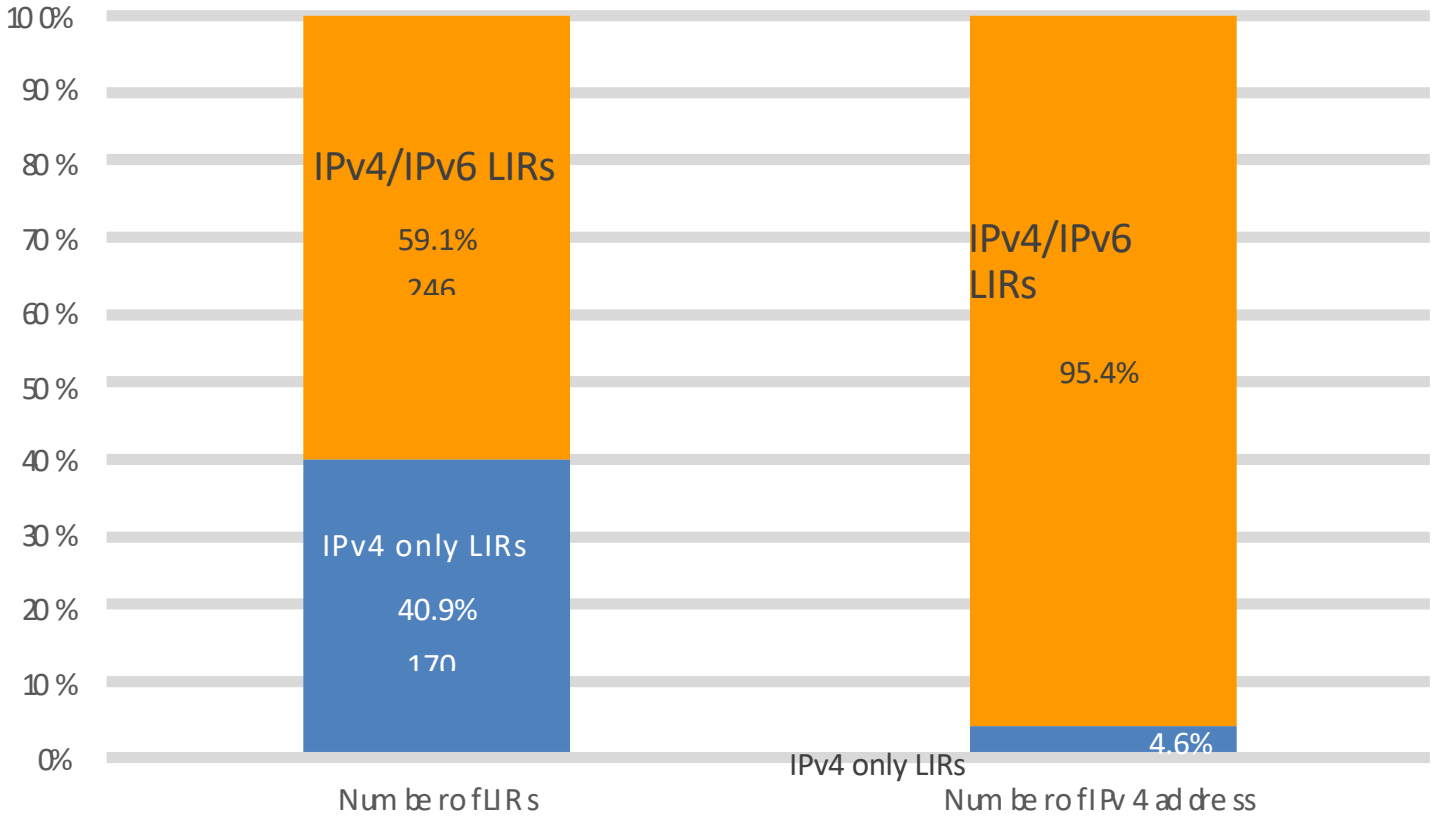
Japan IPv6 Statistics

JPNIC address distribution trends

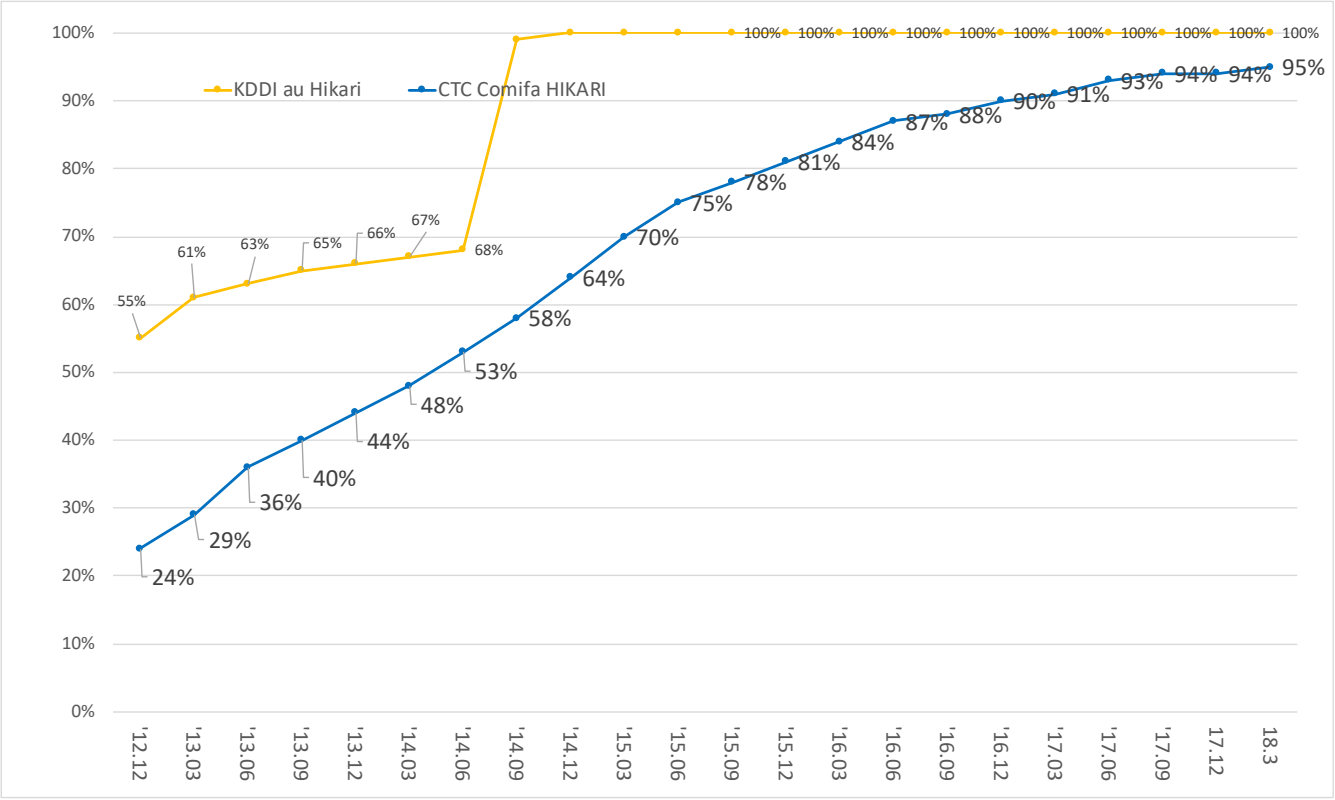


(As of March 2018)

IPv6 Address distribution status in JPNIC

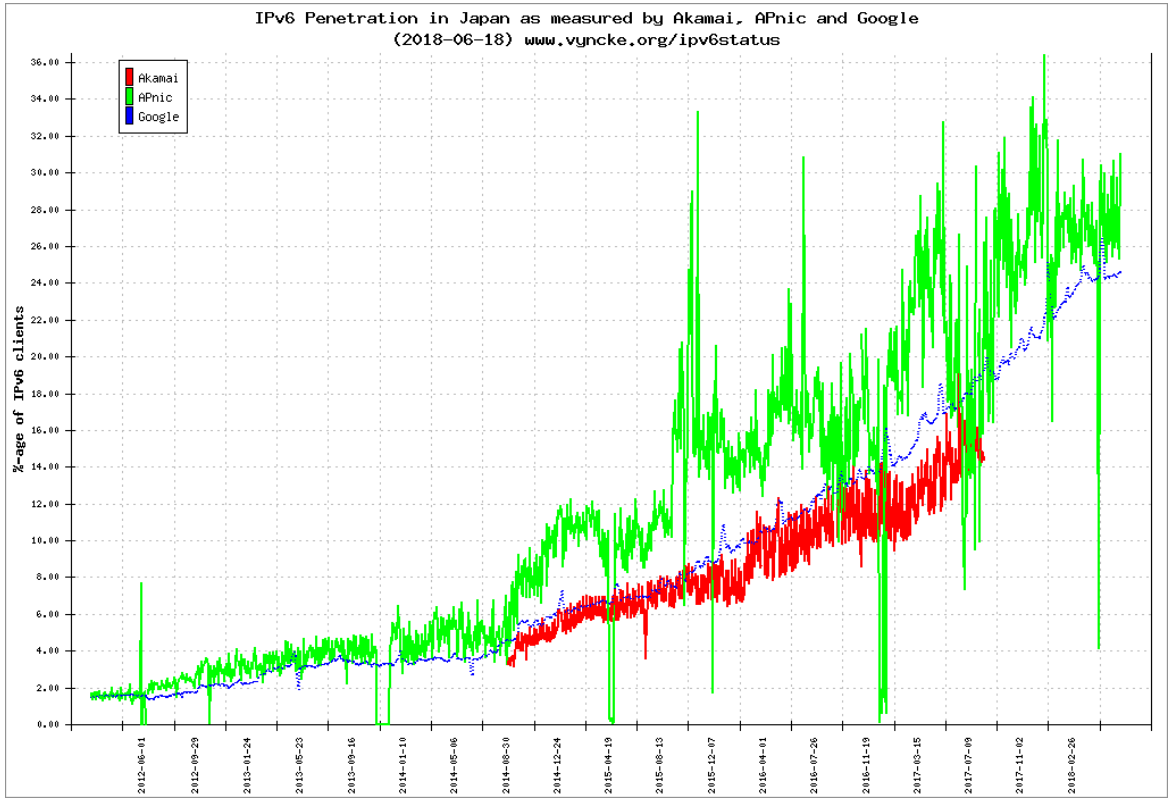


IPv6 consumer service penetration rate in Japan
-KDDI and CTC-



Produced from: http://v6pc.jp/jp/spread/ipv6spread_03.phtml

IPv6 Users penetration measured by Akamai, APNIC and Google

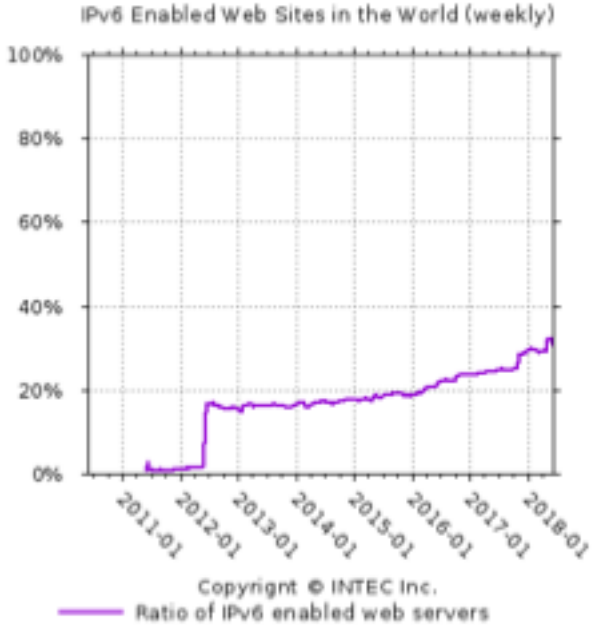


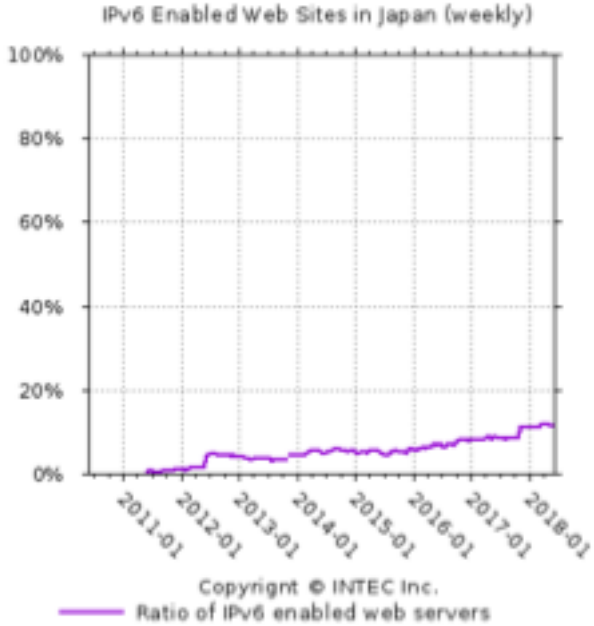
As of 18 June 2018

https://www.vyncke.org/ipv6status/plotpenetration.php?country=jp

IPv6 penetration rate : web servers

The number of IPv6 enabled site in the top 500 web sites which is published by Alexa Internet, Inc (as of 18 June 2018).





http://www.inetcore.com/project/metrics/index.html.en

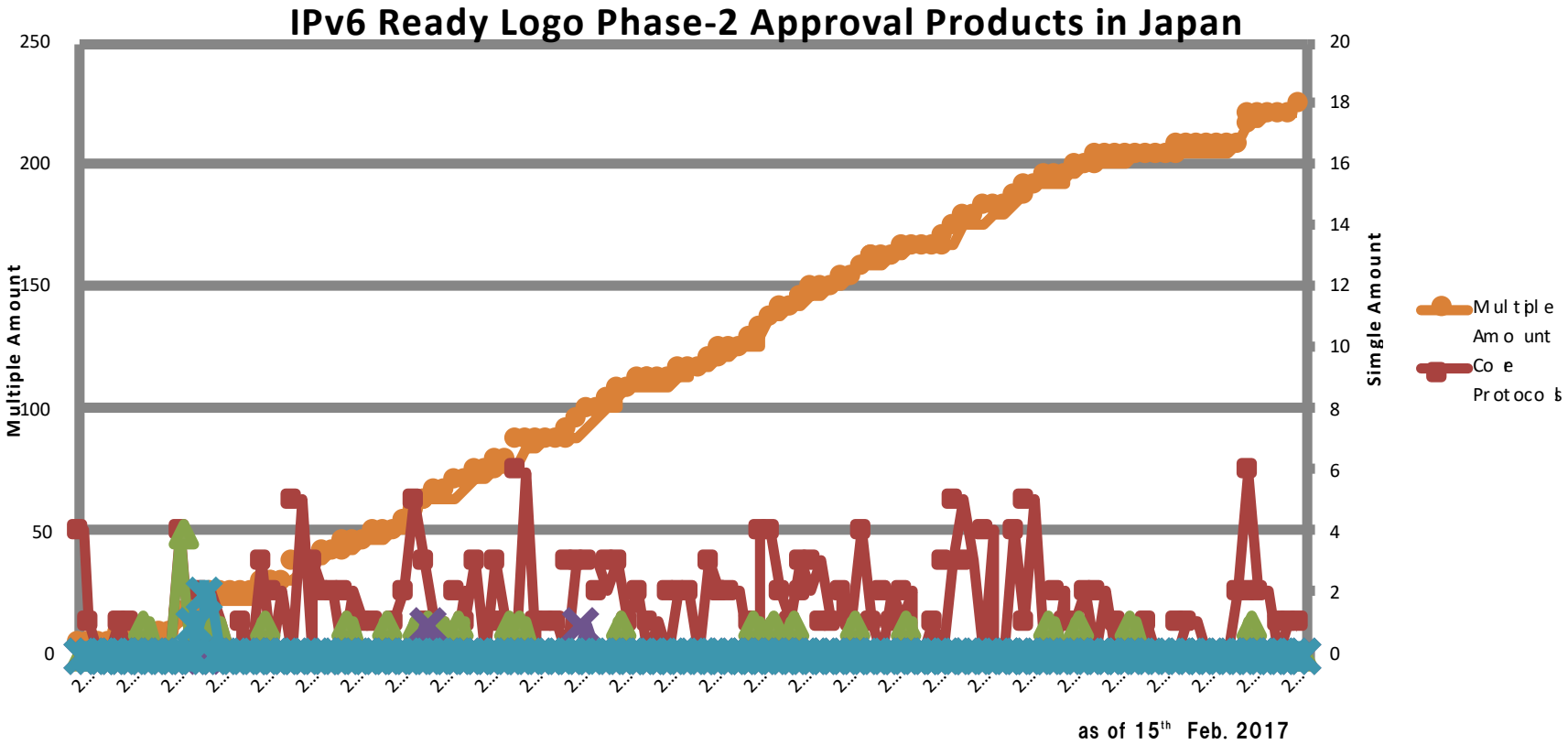
IPv6 services in Governments

Japanese governments' service has been implementing IPv6.

	2013/11/29	2015/9/2	2016/2/15	2016/9/27	2017/2/21	2018/6/18
# of servers	34	34	34	34	34	36
Web	32%	50%	59%	59%	61%	61%
Mail	18%	26%	26%	26%	32%	36%
DNS	62%	76%	94%	94%	94%	97%

http://www.attn.jp/ipv6status/jp/go/

Number of products with IPv6 Ready Logo (JP)

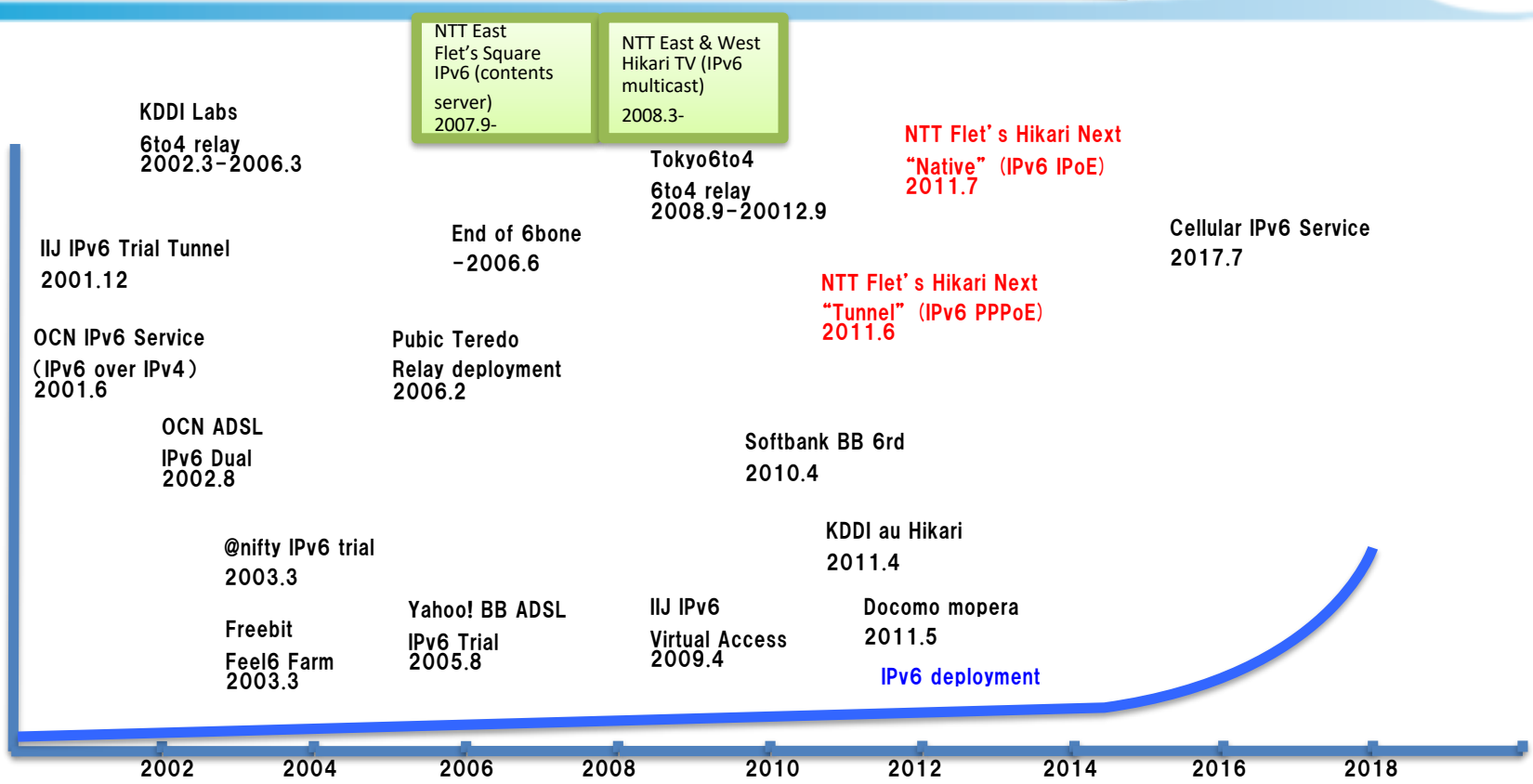


IPv6 deployment experience in NTT

IPv6 deployment: key issues

- Transition of existing IPv4 users
- Applications
- IPv6 on IX

History of IPv6 service for (residential) users in Japan



Transition of existing IPv4 users

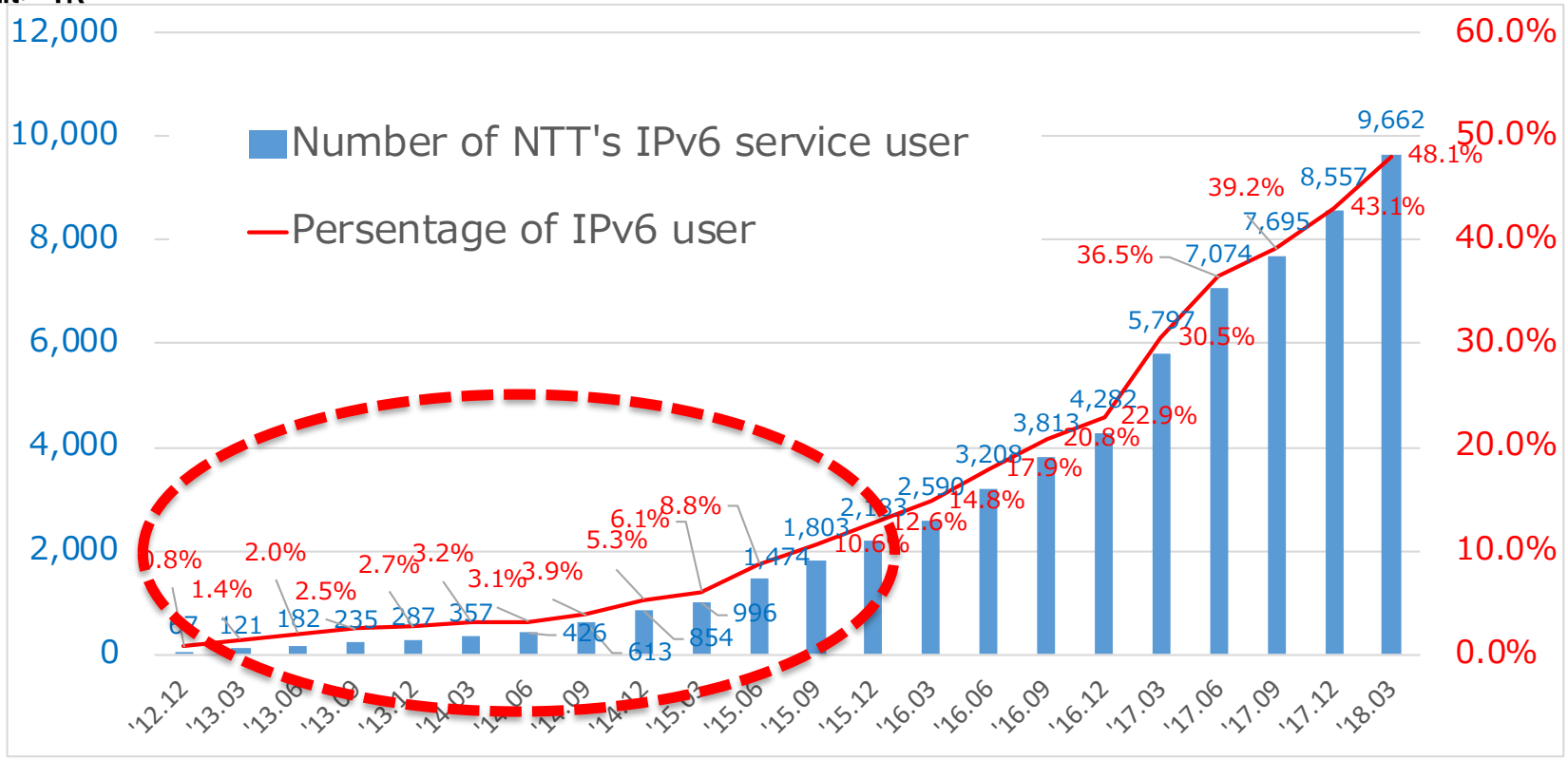
After NTT East & West IPv6 platform implementation in 2011, IPv6 services was available almost every where in Japan.

- At that time, ISPs provide IPv6 service as an ‘optional’ service.
  - Users need to order IPv6 service.
- Then, ISPs started to provide IPv4/IPv6 dual stack service by default to new customers.

Number of IPv6 users did not increase so much.

IPv6 consumer service penetration rate in Japan
- NTT's service platform users-

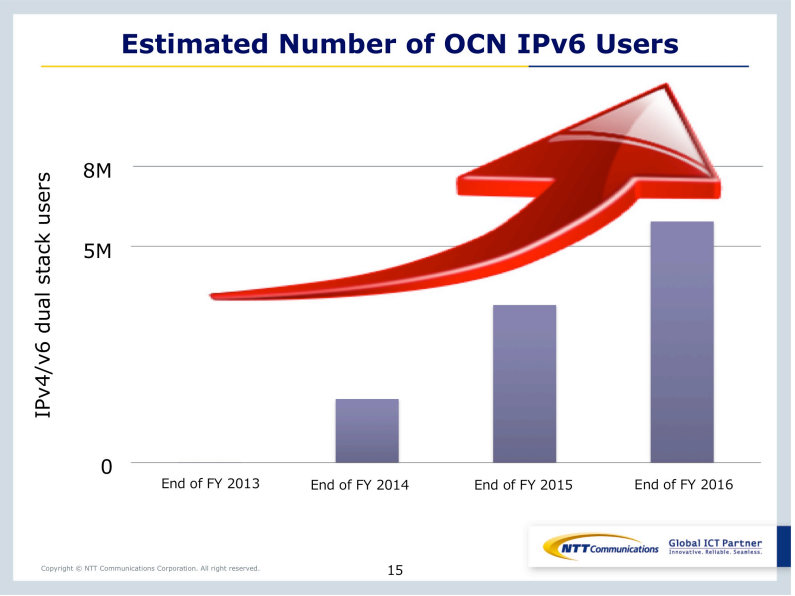
Unit: 1K



Produced from: http://v6pc.jp/jp/spread/ipv6spread_03.phtml

Transition of existing IPv4 users

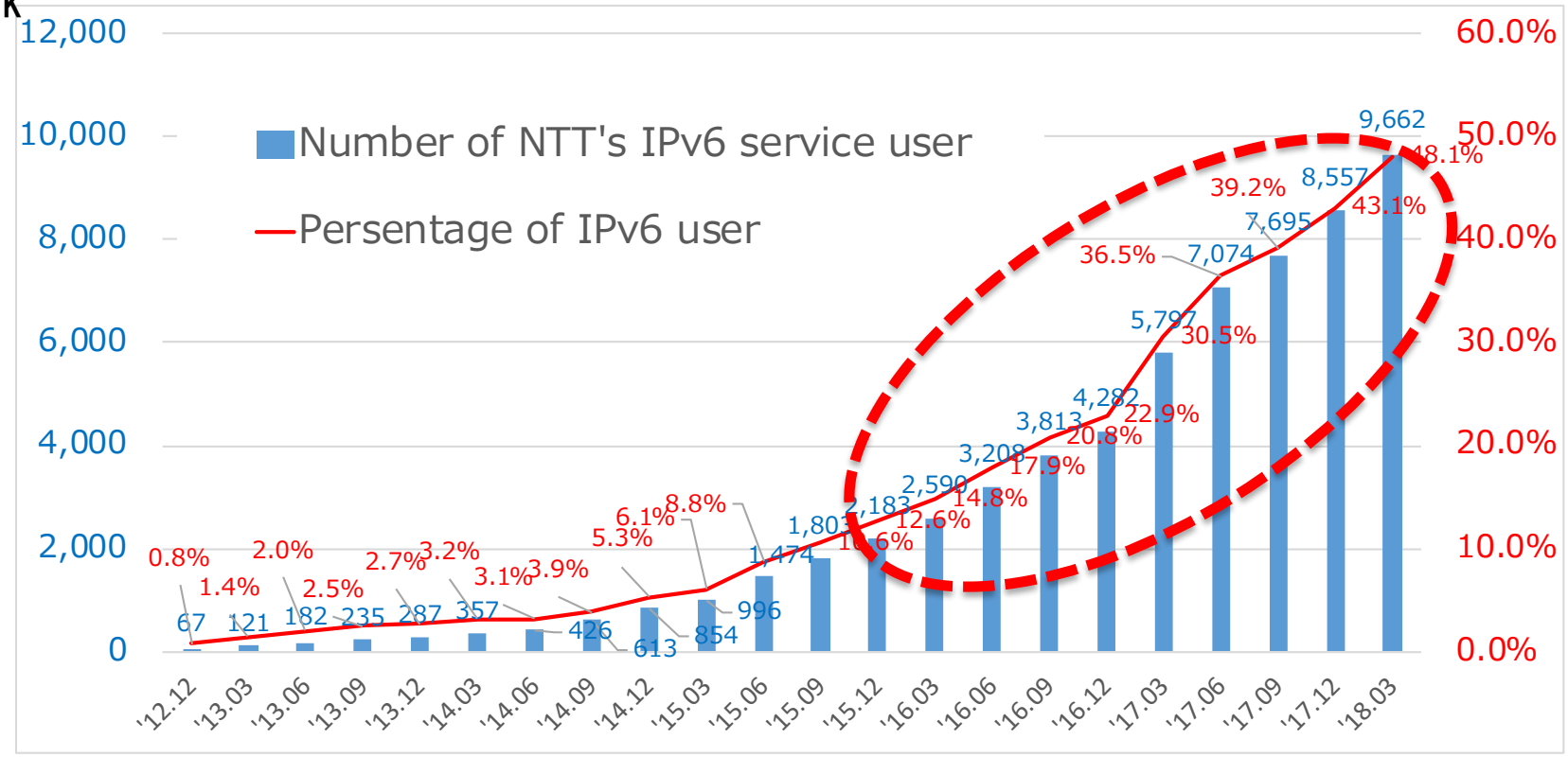
Several ISPs started to transit their existing IPv4 customers to dual stack environment.



Presentation slide in Vietnam IPv6 Day 2014 by NTT Com.

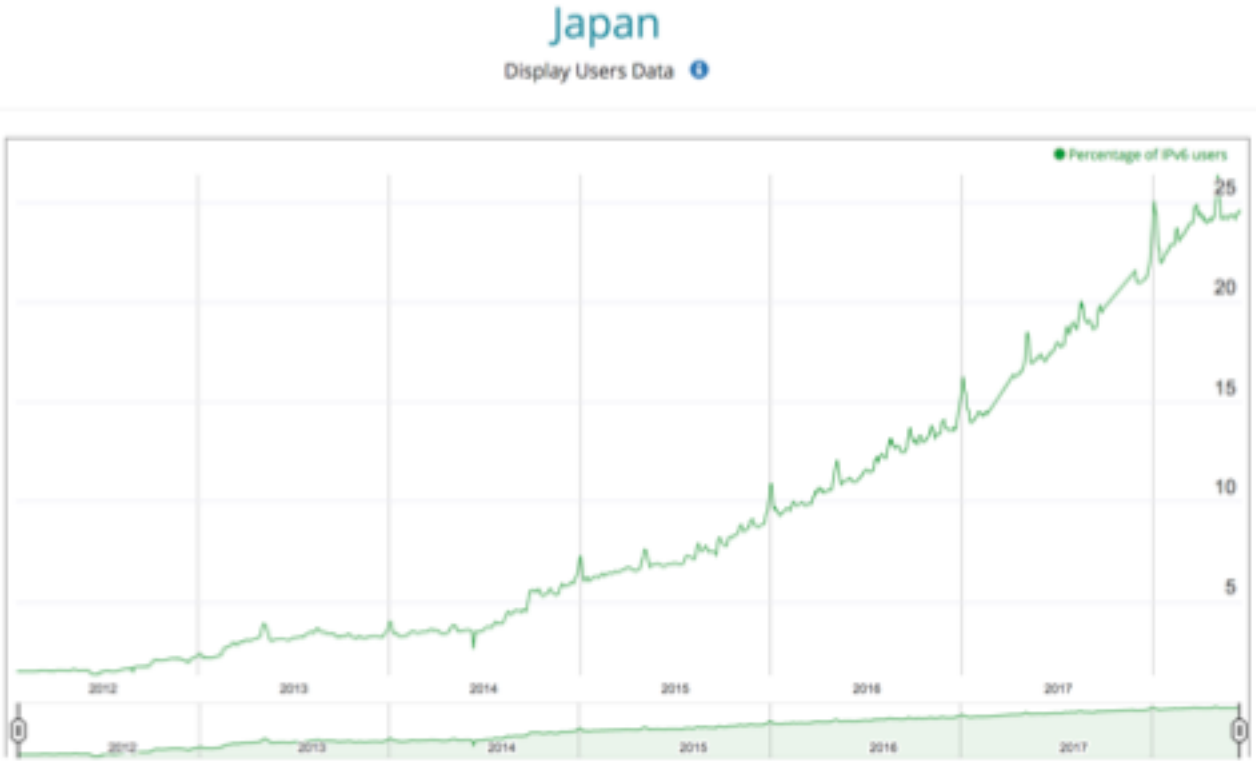
IPv6 consumer service penetration rate in Japan
- NTT's service platform users-

Unit: 1K



Produced from: http://v6pc.jp/jp/spread/ipv6spread_03.phtml

Japan user readiness (by Cisco 6lab)



As of 18 June 2018

From http://6lab.cisco.com/stats/cible.php?country=JP&option=all

IPv6 traffic to Google servers

Rank	Name	ASNs	IPv6 %
1	KDDI	2516	40.98%
2	SoftBank BB	17676	36.02%
3	OCN / plala	4713	29.13%
4	So-net	2527	40.32%
5	BIGLOBE	2518	44.79%
6	NTT docomo	9605	7.05%
7	ctc	18126	51.22%
8	IIJ	2497	17.05%
9	TOKAI	10010	21.83%
10	@nifty	2510	11.31%
11	iTSCOM	9365	14.53%
12	Sony Global Solutions	9619	99.68%
13	star cat	17529	22.08%
14	VECTANT	2519	1.44%
15	K-Opticom	17511	0.53%
16	bit-drive	9600	13.15%
17	SINET	2907	1.59%
18	SuperCSI	2506	43.20%
19	TDNC	9354	1.97%
20	Keio University	38635	31.21%

As of 18 June 2018

- This table shows the amount of IPv6 traffic from the major networks (ASNs) in Japan to Google.
- Absolute number of IPv6 traffic is ranked higher.
- Of the total number of access, right-most column shows the proportion of the IPv6 access.

IPv6 deployment: key issues

- Transition of existing IPv4 users
- Applications
- IPv6 on IX

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'Hikari-TV' Content Delivery Network

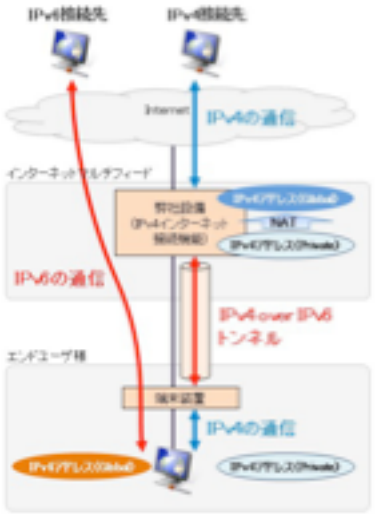
Applications

- IPv6 service : “IPv4”
  - Trend for IPv4 service implementation
    - “IPv4 as a service”
      - Couple of standard protocols are available.
      - Implemented some networks in U.S.

IPv4 as a service (IPv4aaS)

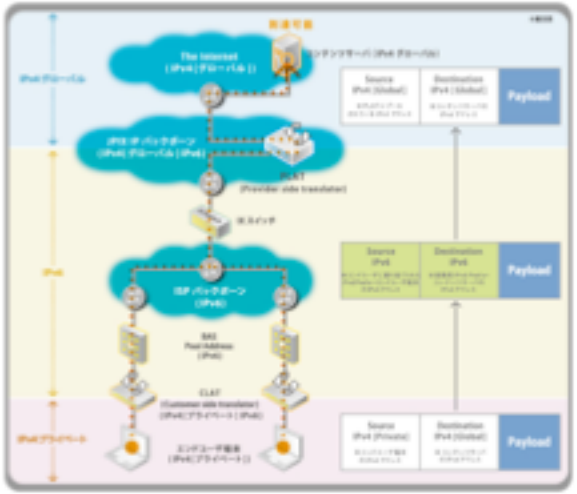
- Some commercial IPv4aaSs in Japan

Transix: DS-Lite by IMF
http://www.mfeed.ad.jp/transix/



Implemented on Flets using NTT's HGW

IPv6v4 Exchange: 464XLAT by JPIX
http://www.jpix.ad.jp/jp/service/ipv6v4.html



v6Plus: MAP-E by JPNE
http://www.jpne.co.jp/service/v6plus/

IPv6 deployment: key issues

- Transition of existing IPv4 users
- Applications
- IPv6 on IX

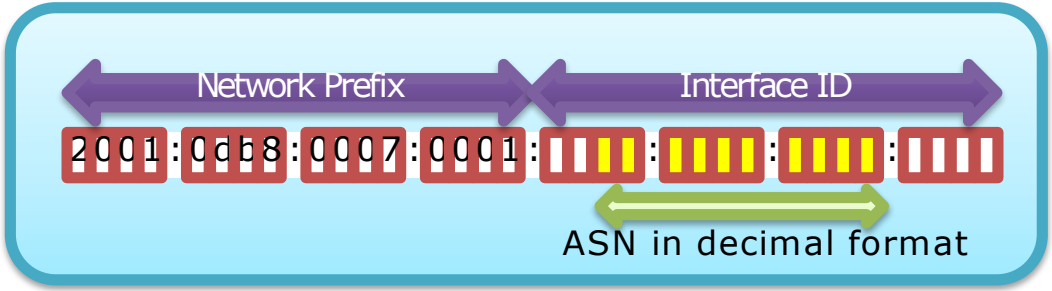
IPv6 Internet Exchange (IX) Service in Japan

- Major IXes has implemented IPv6.
  - L2 IX Service
    - JPNAP (from 2008.4) (JPNAP6 from 2002-2010)
    - JPIX (2008-)
    - BBIX
- IPv6 service on IX (JPNAP)
  - IPv6 peering
    - Provide IPv6 address to peer with other ASes
  - IPv6 Route server
- Other services (JPNAP)
  - IPv6 NTP server
  - 'IPv4 over IPv6' service
    - Transix (DS-lite) (JPANP)
    - V6 Option (MAP-E) (JPNE (KDDI Group))

IPv6 Experience in IX (JPNAP)

- JPNAP IX service is L2.
  - Basically, do not care about L3 protocol (IPv6 or IPv4).
- At the beginning of IPv6 service, used separate IPv6 facilities from IPv4.
  - JPNAP6 (2002-2010)
  - At that time, IPv6 implementation would not be mature.
- The points to ponder :
  1. Addressing
  2. Network management
  3. Services on IX

Address Assignment Scheme

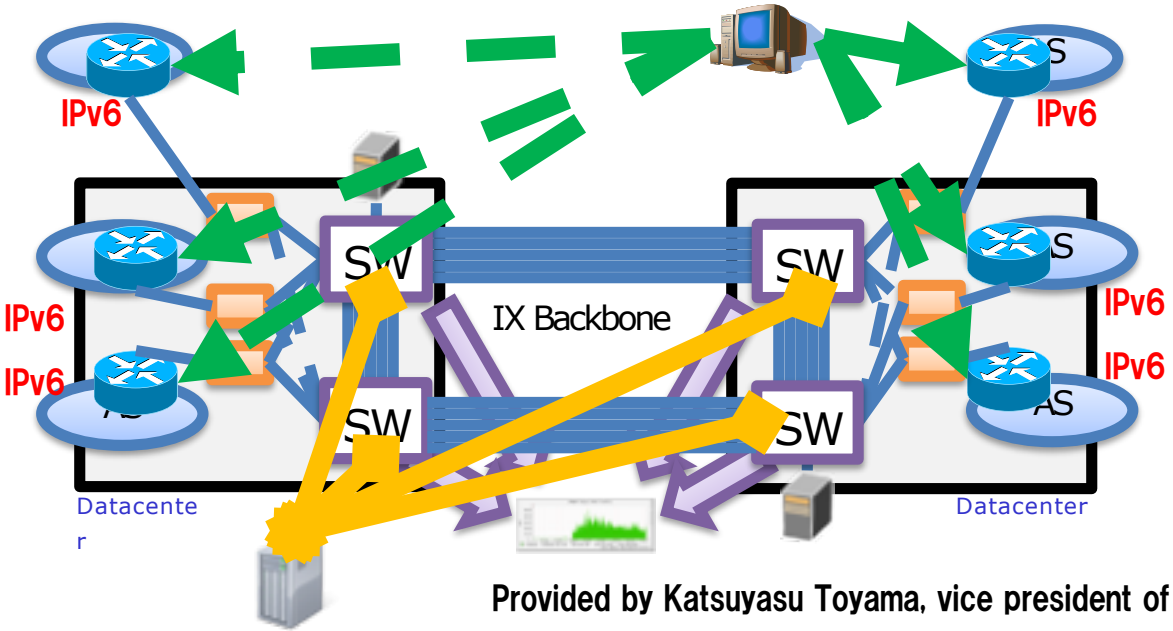


	Tokyo I	Tokyo II	Osaka
IPv6	2001:0db8:0007: 0001::/64	2001:0db8:0007: 0003::/64	2001:0db8:0007: 0002::/64
Scheme	For AS7521 2001:0db8:0007:0001:0000:0000:7521:0001 For AS131079 (AS2.7) 2001:0db8:0007:0001:0000:0013:1079:0001 For AS4294967295 (AS65535.65535) 2001:0db8:0007:0001:0042:9496:7295:0001		
IPv4	2xx.xxx.176.0/24	2xx.xxx.45.0/24	2xx.xxx.178.0/25

Provided by Katsuyasu Toyama, vice president of Internet Multifeed co.

What should be provided for IPv6 in IX?

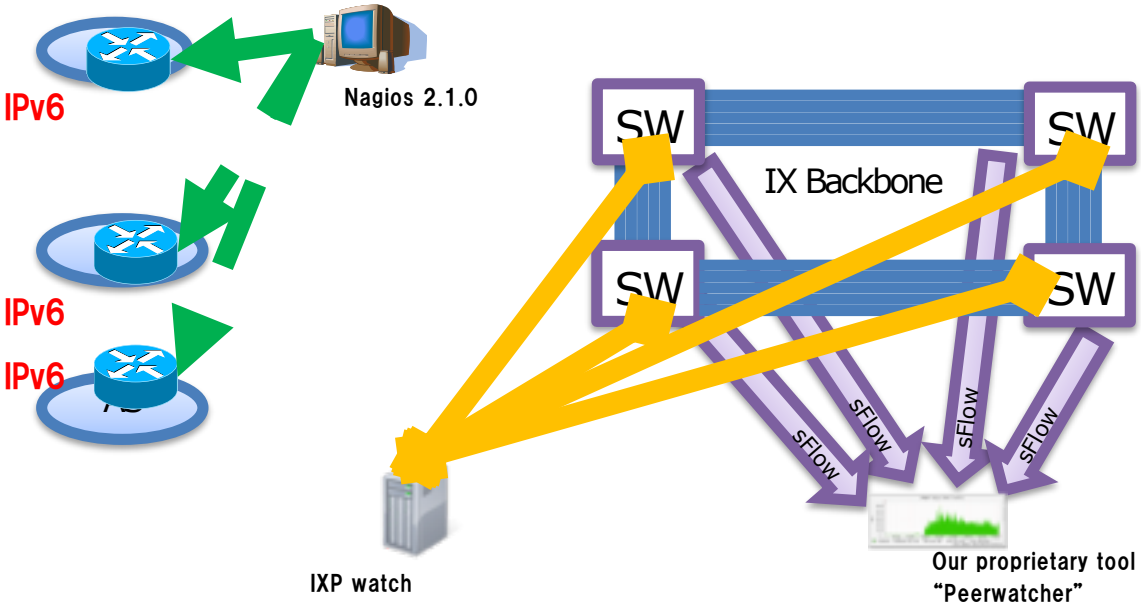
- On main LAN
  - IPv6 address assignment and management
  - Monitoring customer interface (ping6 and bgp+)
  - Monitoring disallowed types of packet (Route Advertisement)
  - Traffic flow of IPv6



Provided by Katsuyasu Toyama, vice president of Internet Multifeed co.

What should be provided for IPv6 in IX?

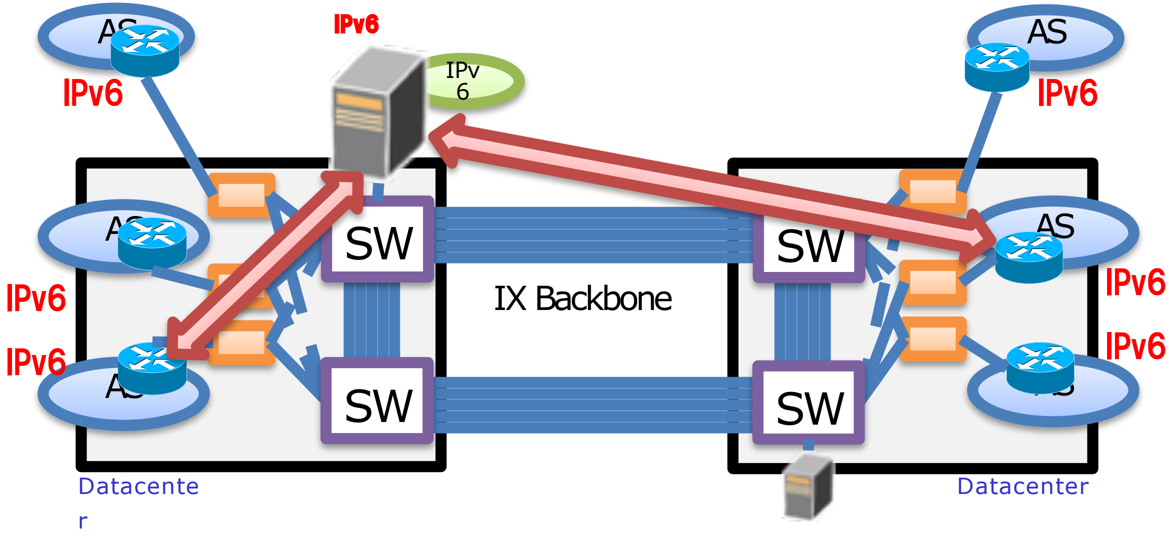
- Tools
  - Monitoring customer interface
  - Monitoring disallowed types of packet
  - Traffic flow of IPv6



Provided by Katsuyasu Toyama, vice president of Internet Multifeed co.

What should be provided for IPv6 in IX?

- On route servers
  - Exchanging IPv6 routes
    - IPv6 NLRI
    - MP-BGP on IPv6 transport



Provided by Katsuyasu Toyama, vice president of Internet Multifeed co.

Summary

- NTT Group has been implementing IPv6 widely.
  - IPv6 is available almost everywhere in Japan.
  - Possible to provide IPv6 service in many countries.
- In Japan, IPv6 become popular
  - Many ISPs are IPv6 ready, and started to migrate their IPv4 only users to dual stack environment.
  - Mobile carriers, NTT Docomo, KDDI and Softbank has started full IPv6 service.


Congratulations !
IPv6 Base Spec Issued as
‘Internet Standard’!!
RFC8200

Global deployment of IPv6!