Current status and the future direction of IPv6 in Japan

November, 2011

IPv4 Address Exhaustion Task Force, Japan

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IPv6 Day for Japanese networks and contribution by Japanese cases to global IPv6 deployment.

Japanese IPv6 network has to develop IPv6 global service using the NGN(Next Generation Network) access network platform, which is the closed IPv6 transport network provided by NTT group (NTT East and NTT West). In order to come up with this particular network environment, we defined two architectures discussing with MIC(Ministry of Information and Communication) Japan and related stakeholder organizations. One is PPPoE using tunneling technology, and the other is IPoE, in which routing information of roaming providers is advertized into NGN access network and IPv6 network prefix is allocated to every CPN(Customer Premises Network). The IPoE is a kind of roaming service for roaming providers. Due to several technical limitations, the maximum number of roaming providers is three, when we started the IPoE service in 2011.

At the first IPv6 Day in June 8 of 2011, Japanese Internet has not have those solutions in reality, since those solutions had just started the introduction stage. Here, the PPPoE service has been available from June 1 of 2011, and IPoE has been available from July 21 of 2011. Both has been just available by NTT East and NTT West for IPSes and for roaming providers with those date. The practical use of these two services has been progressed in these days. This means that, as November 2011 time-frame, the IPv6 services provided by Japanese ISPes using these solutions (i.e., PPPoE and IPoE over NTT's NGN access network) are just under development phase.

The first IPv6 Day has been carried out with the above environment. Then, the design and operational experiences for the IPv6 Day contributed a lot of knowledge and practices to the IPv6 global service provision over the closed IPv6 transmission network, i.e., NTT's NGN access network. This is provision of both the NGN's native service (e.g., VoIP or IPTV) and the global IPv6 services, simultaneously.

IPv6 includes the multi-home environment for CPN, in order to improve the robustness of CPN connectivity or to avoid ISP lock-on for CPN. End host interface can have multiple IP addresses and CPN can have multiple network prefixes. As discussed and specified in RFC3484 and in RFC5220, end-host and CPN router adequately manage source IP address and destination IP address, according to the network topology/status or to operational policies. Of course, the case, where egress route and ingress route are different are different, is considered. Especially when we have a dominant access provider, we have to yield the environment, where every CPN operator easily design and operate milti-home network environment, in order to yield neutrality for access providers and to avoid the customer lock-on by some particular backbone provider, especially when we have a dominant access provider. This is also true, when we have multiple access providers. RFC3484 and RFC5220 discusses and specified the possible solutions for multi-homing, through we observe that most of end-hosts and CPN routers do not well implement the defined functions.

When we observe the current status of Japanese access networks from the above point of view, we can see that (1) NTT's NGN access network is a dominant access network provider in Japan, and that (2) NTT's NGN network provide very low IPv6 external connectivity, while providing very high IPv6 connectivity for own network. Here, the reason why such a network development has been carried out is so complicated government policies in Japan. As a general understanding, when we design an wide-area dominant access network, even for NTT group, the different design from current network design using NGN's closed IPv6 network will be applied to.

Now, we realize that the practical experience in Japan to provide global IPv6 connectivity over NTT's NGN access network will contribute to establish the practical design, installation and operation of large scale multi-home development and deployment, using the practical and advanced IPv6 network environment.

We briefly summarize what Japanese team did for the first IPv6 Day.

TCP session resetting
The fall-back procedure is carried out, when the destination node is unreachable, though the destination IPv6 address is resolved by DNS. Though RFC3484 defines and specified the necessity of policy table implementation at multi-homing nodes, most of nodes do not have adequate policy table implementation, and each OS (Operating System) has different fall-back behavior. Based on this observation and evaluation in the practical network environment, NTT East and West decided to apply the TCP session resetting on June 6, 2011 for the first IPv6 Day.
Development and delivery of policy management and control software (RFC3484)
The Task Force for IPv4 address exhaustion has collaborated with the WIDE Project for the software development of policy management and control for NTT's NGN multi-homing case. It is based on the RFC3484. And, the software was delivered to some advanced customers.

Based on the experiences and practices during the IPv6 Day and on the discussion and evaluation of IPv6 Day operation, we (Task Force on IPv4 address exhaustion) identify and work on, at least, the following items.

As for the operational issue of fall-back behavior, the essential resolution would be the development and the deployment of multi-homing policy management table and appropriate packet transmission mechanism at every node. For example, we may think the definition and operation against the reception of ICMP destination unreachable message is important.
The multi-home environment by the NTT's NGN access network is not extraordinary case, but is one of wide-area and large scale cases. Actually, the work developed in RFC5220 and RFC5221 is based on this understanding. Japanese team is happy to work on this important issue for IPv6 and for the future Internet.

[References]
RFC 3684 (Feb. 2003)
R. Draves "Default Address Selection for Internet Protocol version 6 (IPv6)"

P.2, 3rd paragraph
The algorithms in this document are specified as a set of rules that define a partial ordering on the set of addresses that are available for use. In the case of source address selection, a node typically has multiple addresses assigned to its interfaces, and the source address ordering rules in section 5 define which address is the "best" one to use. In the case of destination address selection, the DNS may return a set of addresses for a given name, and an application needs to decide which one to use first, and in what order to try others should the first one not be reachable. The destination address ordering rules in section 6, when applied to the set of addresses returned by the DNS, provide such a recommended ordering.
This document also specifies policy hooks to allow administrative override of the default behavior. For example, using these hooks an administrator can specify a preferred source prefix for use with a destination prefix, or prefer destination addresses with one prefix over addresses with another prefix. These hooks give an administrator flexibility in dealing with some multi-homing and transition scenarios, but they are certainly not a panacea.

P.4
2.1. Policy Table
IPv6 implementations SHOULD support configurable address selection via a mechanism at least as powerful as the policy tables defined here. Note that at the time of this writing there is only limited experience with the use of policies that select from a set of possible IPv6 addresses. As more experience is gained, the recommended default policies may change. Consequently it is important that implementations provide a way to change the default policies as more experience is gained. Sections 10.3 and 10.4 provide examples of the kind of changes that might be needed.

P.11
6. Destination Address Selection

Rule 1: Avoid unusable destinations.
If DB is known to be unreachable or if Source(DB) is undefined, then prefer DA. Similarly, if DA is known to be unreachable or if Source(DA) is undefined, then prefer DB.

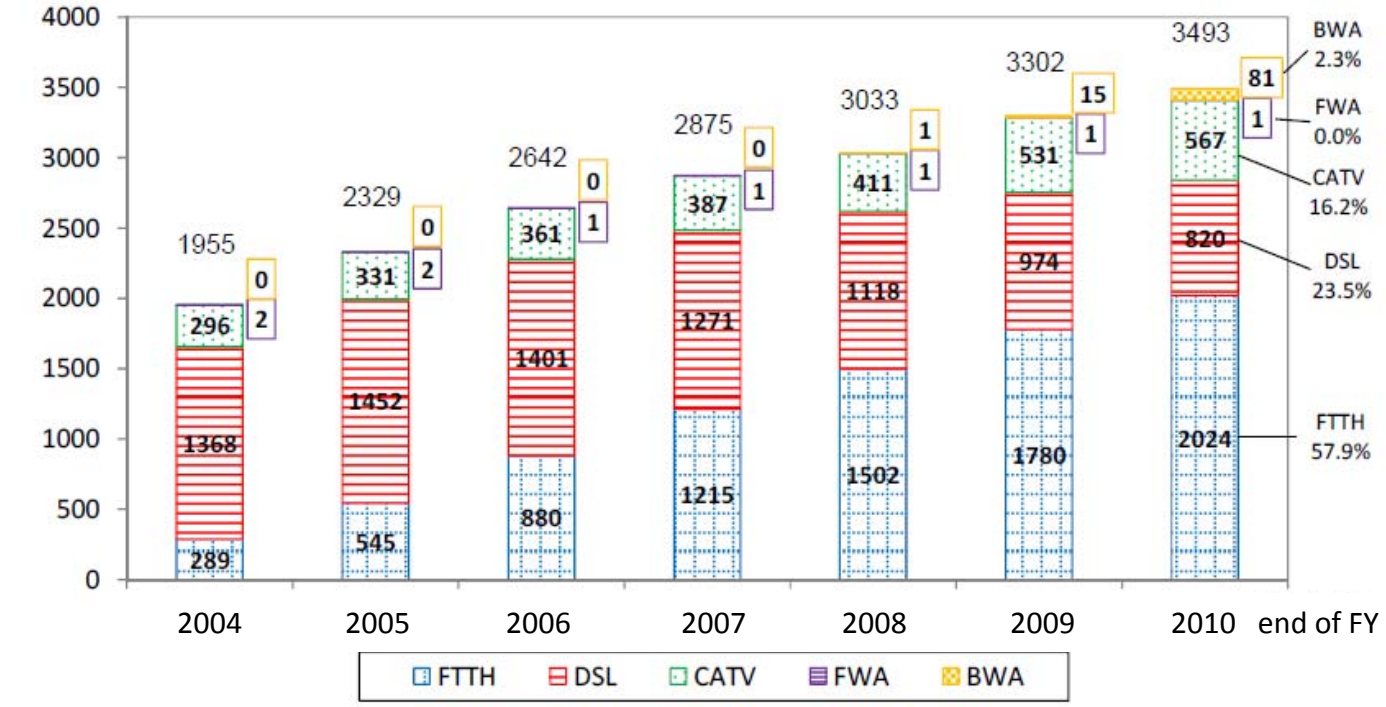
RFC 5220 (July 2008)
A.Matsumoto, T.Fujisaki, R.Hiromi, K.Kanayama,
“Problem Statement for Default Address Selection in Multi-Prefix Environments: Operational Issues of RFC 3484 Default Rules

1. Introduction

In IPv6, a single physical link can have multiple prefixes assigned to it. In such cases, an end host may have multiple IP addresses assigned to an interface on that link. In the IPv4-IPv6 dual-stack environment or in a site connected to both a Unique Local Address (ULA) [RFC4193] and globally routable networks, an end host typically has multiple IP addresses. These are examples of the networks that we focus on in this document. In such an environment, an end host may encounter some communication troubles.
Inappropriate source address selection at the end host causes unexpected asymmetric routing, filtering by a router, or discarding of packets because there is no route to the host.

Market Overview

in 10,000



Transition of Broadband subscribers (MIC)

IPv6 available Major Services

FTTH	KDDI	Announced IPv6 adoption for all current au hikari subscribers in April, 2011 and expand to all Kanto area by the end of July, 2011 and expand to nationwide after 2012	7.2million
	NTT East/West	Started provision of IPv6 Internet access function to ISPs by tunneling protocol in June, 2011 and by native protocol in July, 2011 on Flets hikari Next (NGN)	
	K-Opticom	Launched IPv6 Internet access service in July, 2011	
ADSL	Softbank BB	Planning to provide IPv6 Internet access service by 6rd	-
CATV	Jupiter Telecom	Planning to launch IPv6 access service in 2012	-
mobile	NTT Docomo	Launched IPv6 Internet Access for LTE in June 2011	0.2million

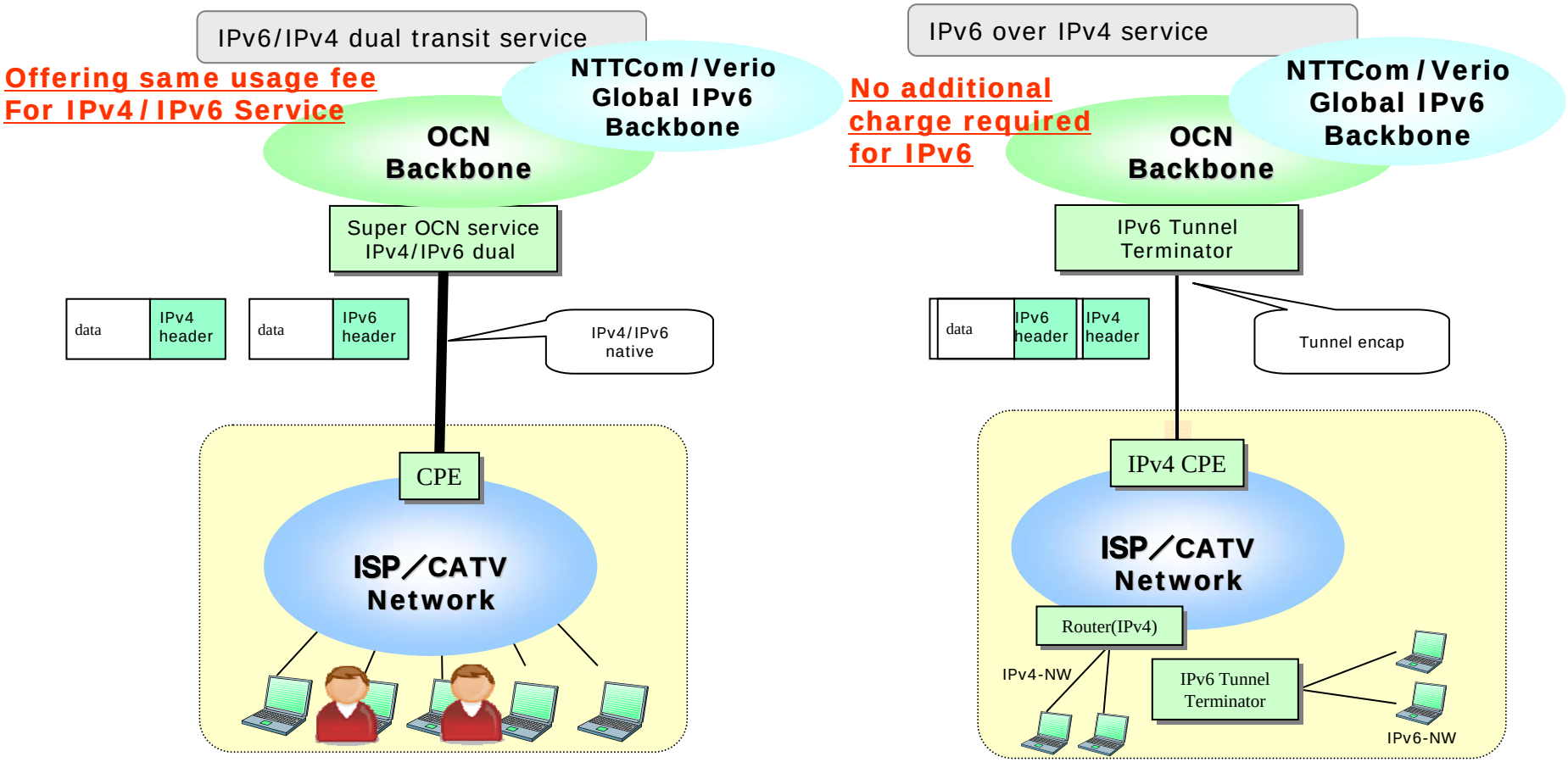
source: MIC Study Group on Advanced Use of Internet with IPv6 the 3rd Interim Report, http://www.soumu.go.jp/main_content/000127670.pdf

Backbone operation

Idea of offering OCN IPv6 Transit fee for OCN Services

■Current IPv6 Service fee for OCN Service provided to ISP and Corporative Company has revised. IPv6 Service will propel as a standard menu and the fee will offer the same price as IPv4 Service

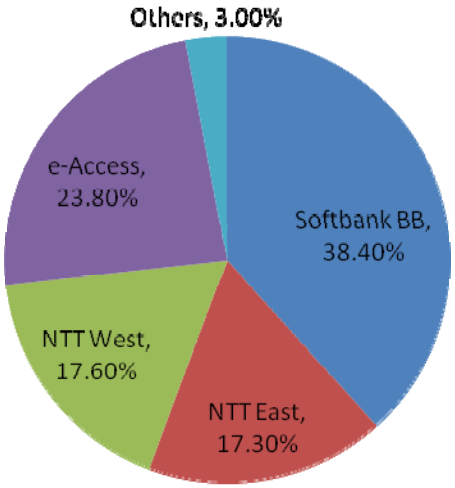
■All functions of IPv4 Service will be applied to IPv6 Service



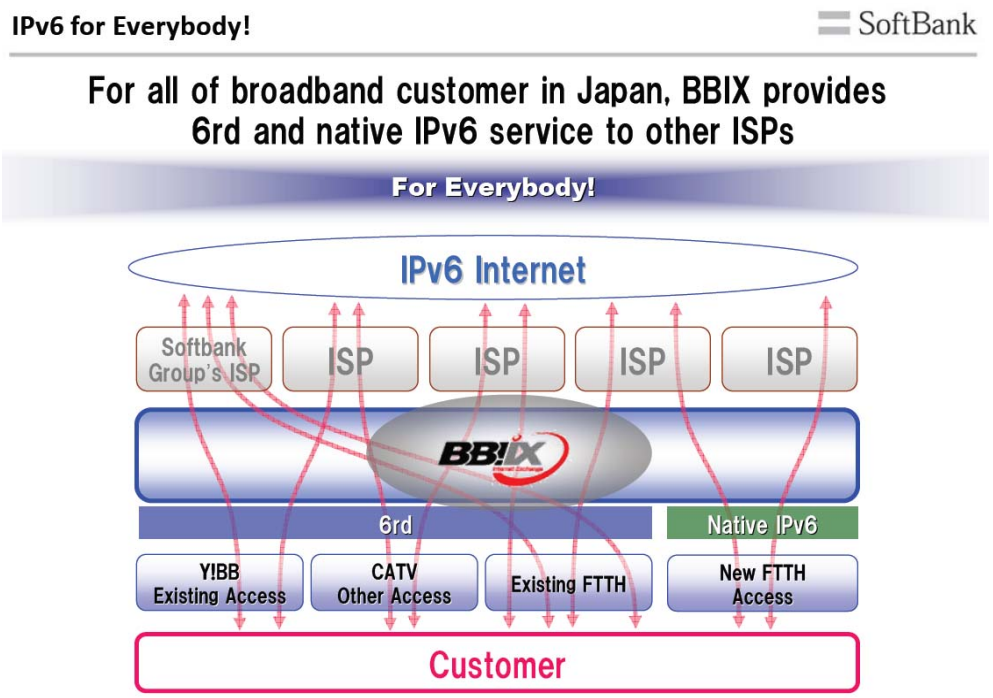
source: MIC Study Group on Advanced Use of Internet with IPv6 the 3rd interim Report, http://www.soumu.go.jp/main_content/000127670.pdf

Broadband access -ADSL

- Softbank BB
- e-Access
- FLET'S ADSL
- Local ADSL



source: MIC Competition Review in the Telecommunications Business Field in FY2010



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

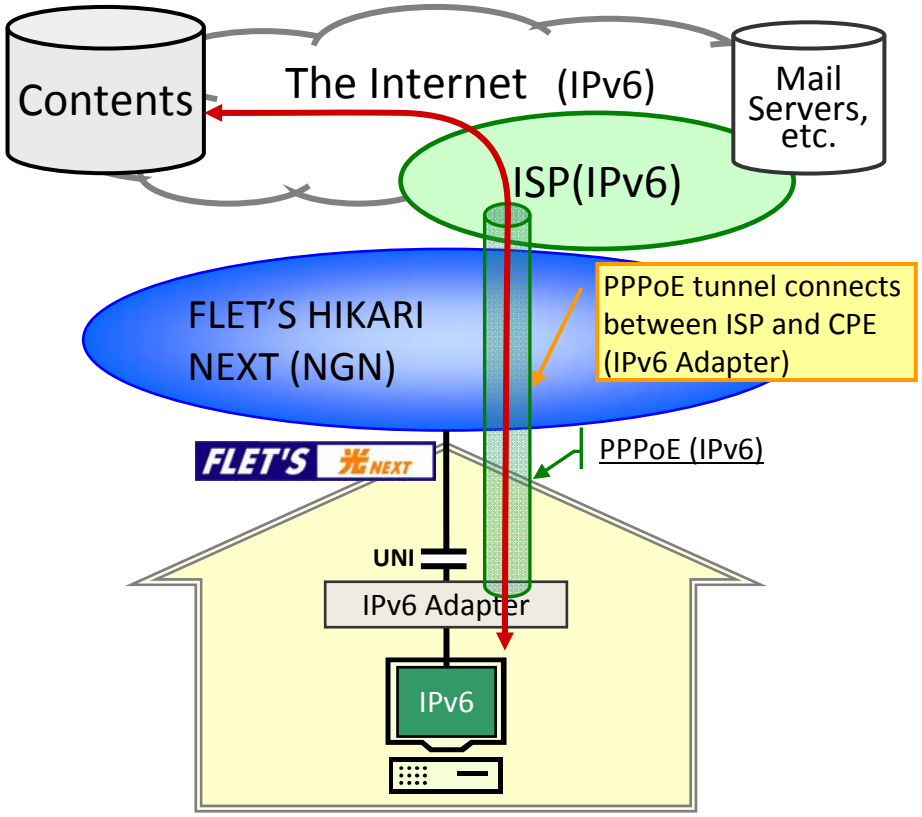
Broadband access -FTTH

- NTT-East and West
  - NGN(FLET'S HIKARI Next)
  - B-Flet's
- KDDI
- eo (K-Opticom)
- Others

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

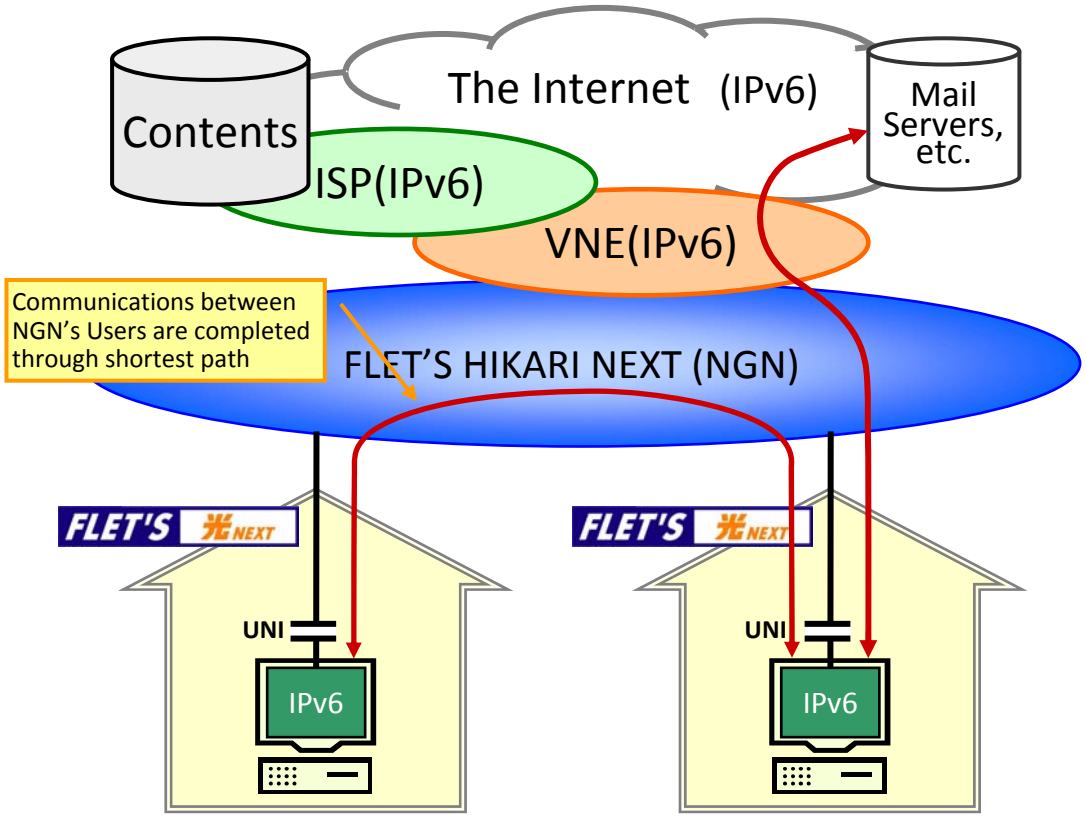
Connection method	PPPoE(IPv6)
Fee	Included in monthly charge of FLET'S
IPv6 Prefix assign method	DHCPv6-PD via PPPoE
ISPs	OCN, plala, So-net, DTI dream.jp and 128 ISPs in total
Remark	IPv6 adapter or similar function to terminate PPPoE(v6CP) and NAT66 is required

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

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



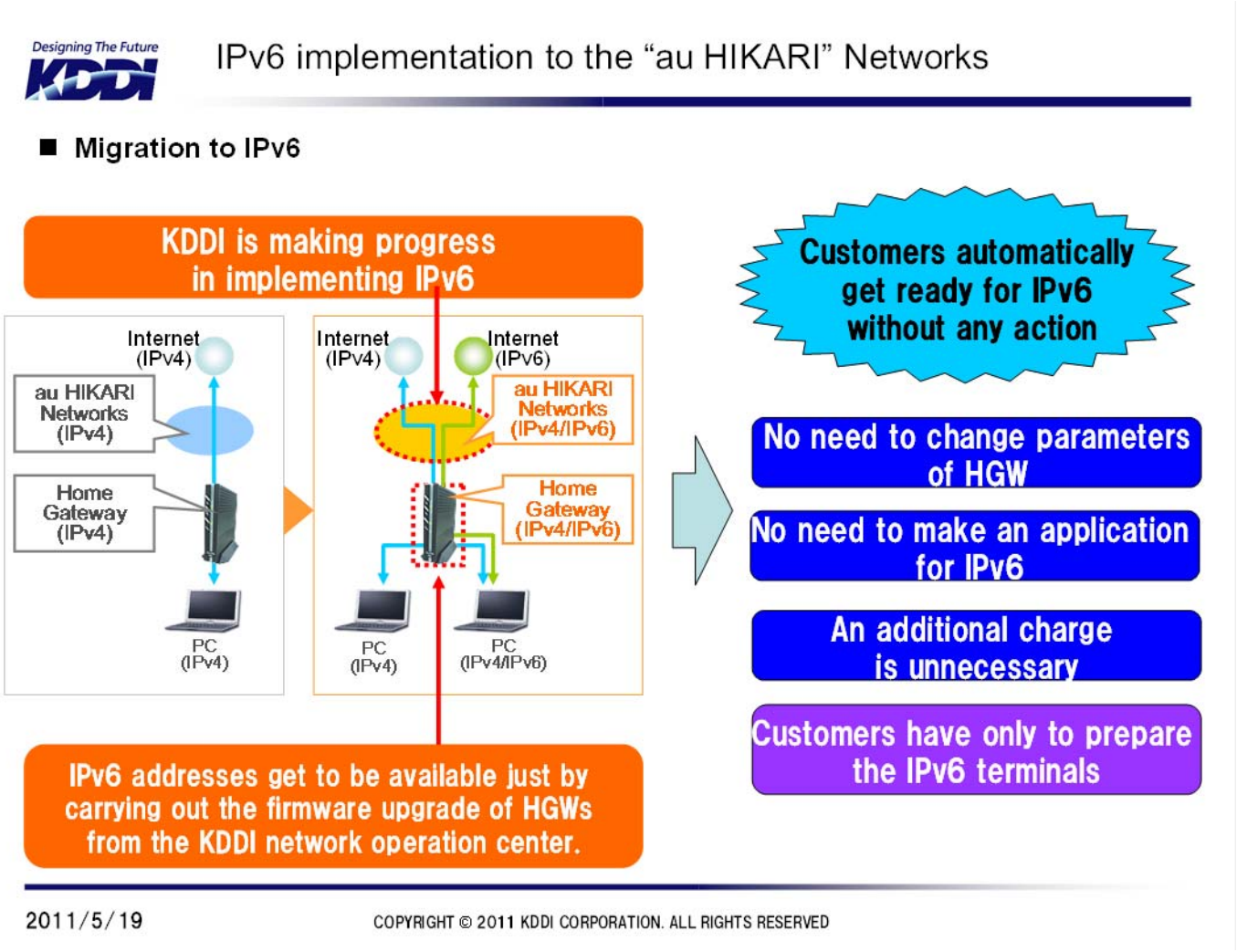
Service specifications

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 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

KDDI (dual stack)

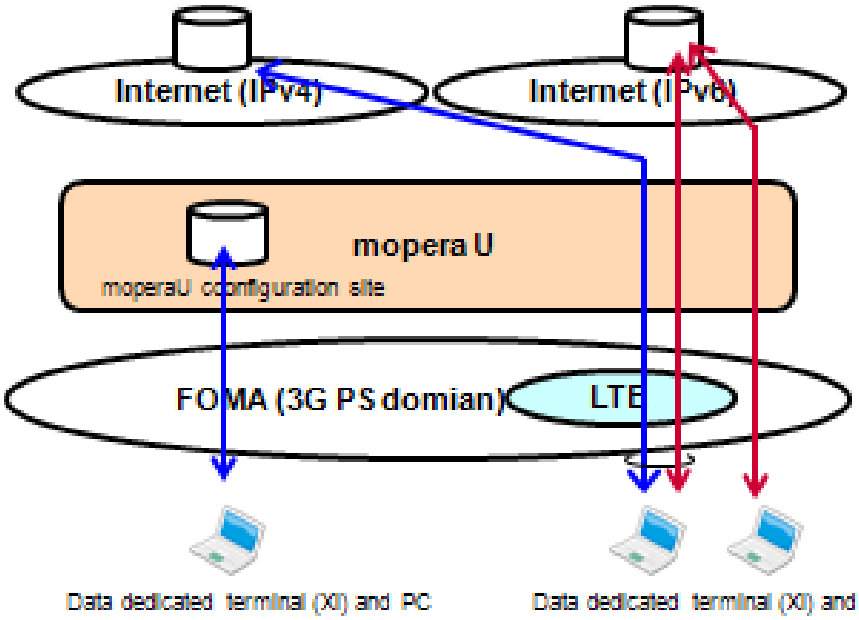


source: MIC Study Group on Advanced Use of Internet with IPv6 the 3rd interim Report, http://www.soumu.go.jp/main_content/000127670.pdf

Wireless Access LTE

mopera-U's IPv6 internet access service

docomo



Change the setting yourself
v4 only -> v4/v6 dual

⇨ v4/v6 dual add(s). to be assigned.

※You can also use v6 connectivity via 3G network

How to use IPv6 service?

- Xi service contract
- mopera-U's ISP contract
- Xi handset
  (L-02C or F-06C by now)
- Change the setting to activate IPv6 using mopera-U's self configuration site.

Note ## In the following cases, you cannot use IPv6 service.

- Access via public wireless LAN nor fixed broadband including FTTH/ADSL, etc. provided by NTT)
- Access in a roaming environment.

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

CATV: Preparing for IPv4 address exhaustion

Action. Preparing for the new internet protocol

• Application services, such as email, web-space, and the access services will be supported.

J:COM will preparing for the IPv6 in two steps

Step 1：IPv6-enabled mail, web-space.
A service can be accessed from the net, such as webmail, and web-space, is made available in advance to IPv6.

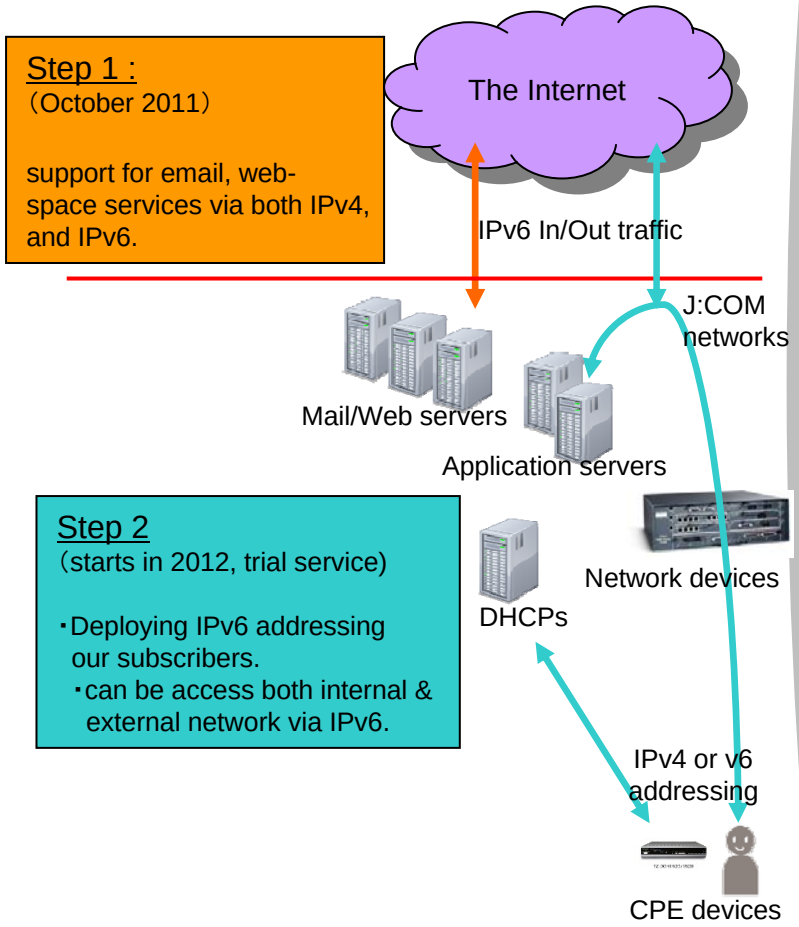
Step 2：Deploying IPv6 address.
Provides IPv6 to our subscribers.

IPv4/IPv6 access-services

- Will not provides only IPv6 service, will provides native “dual-stack” service. (IPv4 and IPv6 coexisting)　Will begin trials of dual-stack service, starts in 2012.
  - will provides IPv6 address before IPv4 address exhaustion.
- Will provide production-grade “dual-stack service”, once trials have successfully completed.

Under consideration

- IPv6 Access-service detail.
- Customer notification.
- Internal IPv6 training, especially call centers, and service engineers.



Figure：IPv4/IPv6 access-services

List of ISPs providing IPv6 service

Company	ISP	IPv6 Service support site (English page with link, Japanese without)
ASAHI Net,Inc.	ASAHI Net	http://asahi-net.jp/en/support/news/101210_3.html
eAccess Ltd.	AOL	http://support.aolservice.jp/info/2010/11/ipv6_101130.html
Internet Initiative Japan Inc.	IIJ	http://www.iij.ad.jp/en/service/IPv6/index.html
NEC BIGLOBE, LTd.	BIGLOBE	http://support.biglobe.ne.jp/ipv6/
NTT Communications Corporation	OCN	http://www.ntt.com/ipv6/
NTT Plala Inc.	Plala	http://www.plala.or.jp/ipv6/
KDDI Corporaiton	au one net	http://www.auone-net.jp/ipv6/
CNCI Group (8 CATV companies)	CATV	http://www.cnci.co.jp/ipv6.html
Sony Business Solutions Corporation	bit-drive	http://www.bit-drive.ne.jp/ipv6/
So-net Entertainment Corporation	So-net	http://www.v6.so-net.ne.jp/common/IPv6/index.html
Softbank Telecom Corp.	ODN/ SpinNet	http://www.odn.ne.jp/odn_info/ipv6/ http://www.spinnet.jp/csc/ipv6/
Softbank BB Corp.	Yahoo! BB	https://ybb.softbank.jp/ipv6/
Densan Co, Ltd	avis	http://www.avis.ne.jp/ipv6/
Dream Train Internet	DTI	http://dream.jp/ipv6/
nifty corporation	@nifty	http://support.nifty.com/support/ipv6/
NSK Internet	@nsk	http://www.nsk.ad.jp/n_information/ipv6.html
UCOM	BROAD-GATE 02	http://www.fttx.co.jp/Home/information/tabid/85/Default.aspx?itemid=27