

Note for readers of this English translation

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The Current Status and the Future Outlook for IIJ's Internet Connectivity Services for Enterprises



December 1, 2021

Internet Initiative Japan Inc.
Hajime Shironouchi

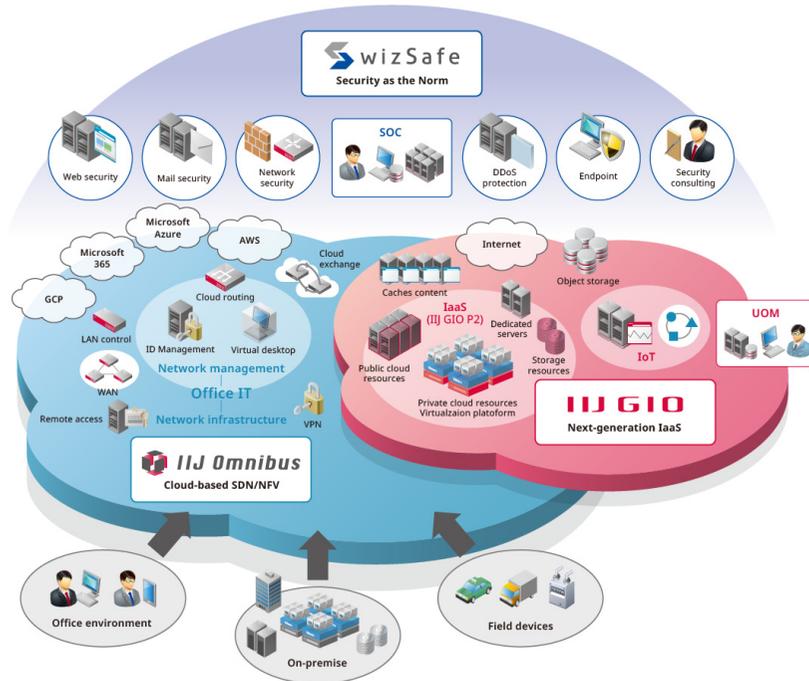
About myself



Hajime Shironouchi **Executive Officer, Division Director for Network**

After working for an independent systems integrator, I joined IIJ in 2002. Started as a solution engineer focusing on network, I became in charge of IP (Internet Protocol) services, from 2009. I have been in charge of various network services such as IP services, mobile, backbone, and Cloud exchanges. I have become an executive officer of IIJ in April 2021.

Overview of IIJ's Enterprise Business



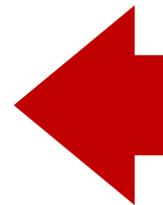
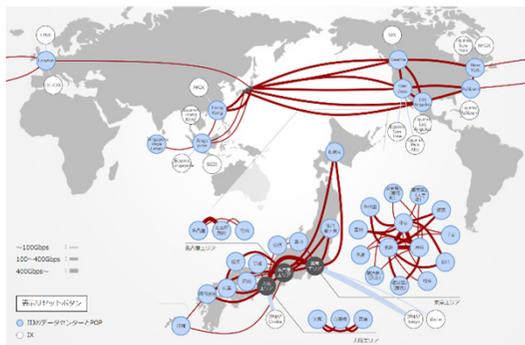
Wide range of network services supporting Japanese enterprises' business operation



Cloud services supporting Japanese enterprises' business operation



Optimal security services for safety



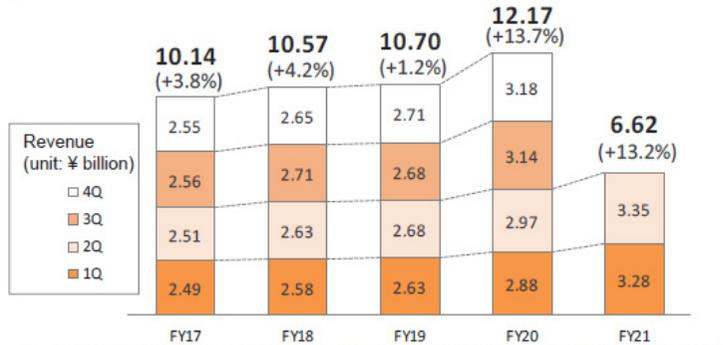
Today's topic:
IP Service and IIJ Backbone

First of all (From presentation material for 1H21 earnings)

III - 3. Service & Business Developments: IP Service

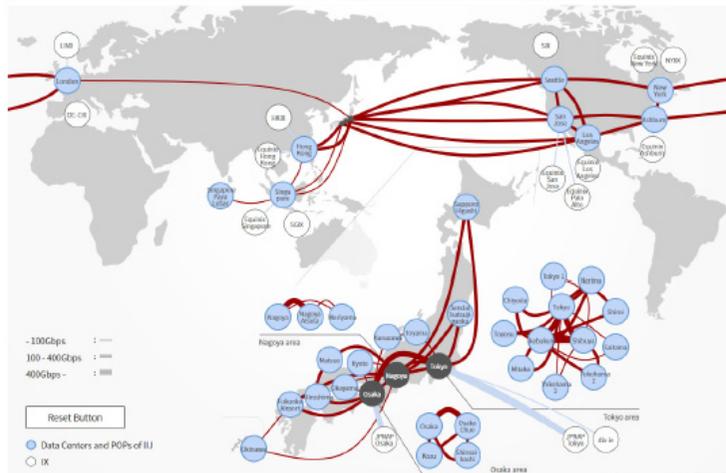
% = Year over year comparison

IP Service (recurring) revenue



- IP (Internet Protocol) service is 100% recognized in Internet connectivity services for enterprise
- ISP is an abbreviation for Internet Service Provider

IIJ's Internet backbone ~ global coverage ~



© Internet Initiative Japan Inc.

IP Service is bandwidth guaranteed and dedicated Internet connectivity service

- Charge based on contracted bandwidth
- Enterprises use the service for their core and main Internet connectivity

Demands have been increasing along with the advancement of IT usages in Japan as seen in increases in virtual meetings, work from home, SaaS usages etc.

- New trend of hybrid work style, expansion of SaaS usages, full-scale adoption of Cloud services, increase in CDN traffic and more

IIJ's competitive advantages

- Japan's first full-scale ISP who has great relationship with Japanese blue-chips companies
 - ✓ Clients are mainly blue-chips companies including BtoBtoC companies, such as consumer ISP, and central government agencies
 - ✓ New entry to the market is difficult as it has already been matured
- Enjoying economy of scale by operating one of the largest Internet backbone networks in Japan
 - ✓ Main costs are for those needed to operate and maintain the entire Internet backbone network such as Internet backbone circuit leasing cost, depreciation for network equipment, data center related and personnel costs. These cost are not directly linked to revenue
 - As an independent and large scale ISP, IIJ has a strong bargaining power when purchasing circuit lines
 - Network equipment performance continues to improve relative to its cost. CAPEX and its related depreciation are in relatively stable trend
 - ✓ Revenue (monthly recurring) is increasing along increase in contracted bandwidth of the current clients
 - Minimum contract period is 1 year. Low churn rate with automatically renewal
- Network is fully redundant configuration: carriers' circuit lines, routes (main and backup) and network equipment (hot and stand by)

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Internet and IIJ

1. Internet, which functions through interconnections among AS holders (ISP, etc.), is compared to an aggregation of communities without any strict rules.
2. As mainly shown by such technologies as the cloud, mobile, video and IoT, the scope of use and application of the internet is always expanding, and required bandwidth and quality are constantly improving.
3. IIJ engages in daily activities with a view toward providing stable connectivity to the internet, a system essential from social infrastructure perspectives, and create internet-related services that serve as good examples.

Diagram of interconnections among AS holders

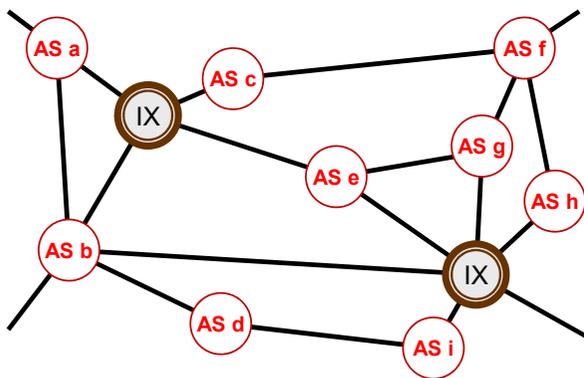
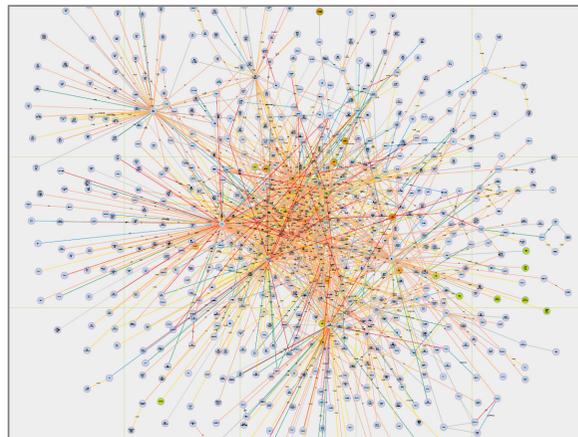
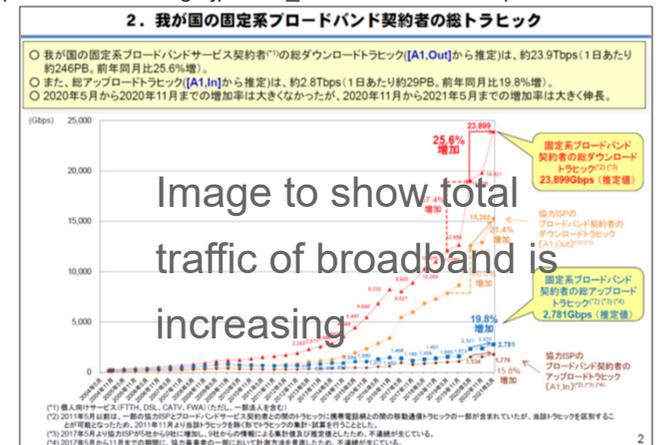


Diagram of interconnections among AS holders



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Cited from the collected results of traffics via the internet in Japan (May 2021) compiled by the Ministry of Internal Affairs and Communications https://www.soumu.go.jp/main_content/000761096.pdf



IIJ Backbone

**Number of Dedicated
connectivity services contracts**
(Including Cloud-type)



Excluding Broad band connectivity and mobile connectivity

Network



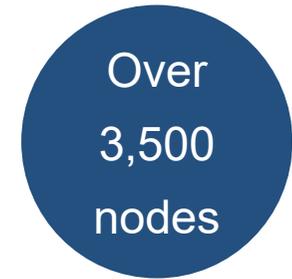
Sum of Japan and overseas

**Number of external
connection points**



Sum of Japan and overseas
Excluding private interconnectivity

**Number of network
facilities**



Sum of Japan and overseas

**Number of External
AS connections**



Sum of Japanese and overseas
venders

**Total Outward
Operating Bandwidth**



Traffic volume which is
exchanged through IIJ backbone
outward connectivity
(excluding inbound traffic)

Number of Routes



Number of prefix owned by IIJ
backbone routers

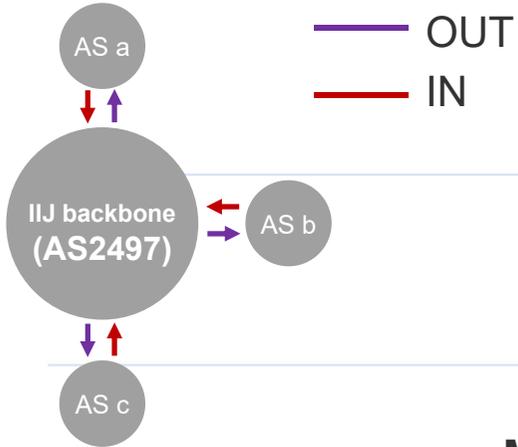
**Average rate of
operation**



Calculated by temporary troubles
(shorter than 30 seconds per year stop)
which includes unstable connectivity
such as connectivity line and equipment.
Please note it is not overall rate.

Changes in IIJ Backbone Traffic

10times in 10 years



Jan. 2010
Illegalizing download
(Revised Copyright law)

Sep. 2009
The Lehman Shock

July 2008
iPhone first offered in Japan (3G)

Mar. 2011
Great Earthquake of
East Japan

Aug. 2012
The London Olympics

All Japan High School
Baseball Tournament

Apr. 2016
Kumamoto
earthquake

Aug. 2016
The Rio
Olympics

Early 2020
COVID-19

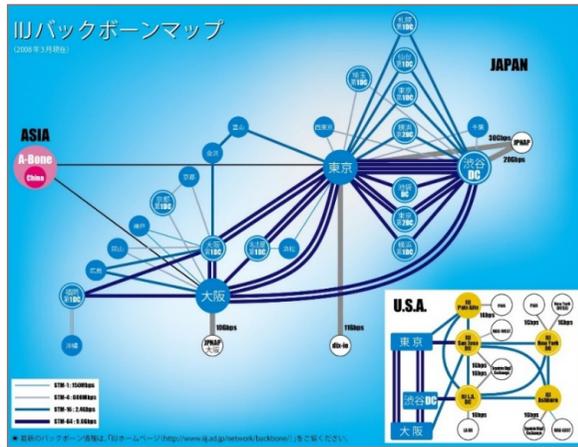
July 2021
TOKYO 2020



Change in IIJ Backbone

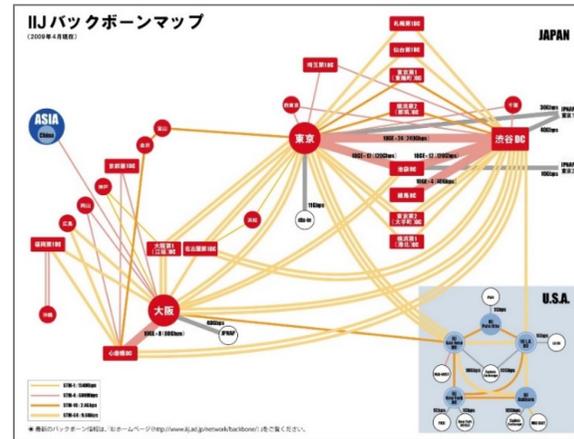
Year 2008

Connecting Tokyo and Osaka through 30G
Connecting Japan and the U.S. through 30G



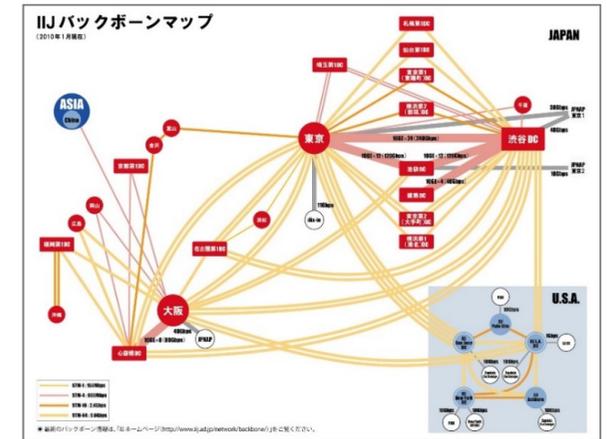
Year 2009

Connecting Tokyo and Osaka through 100G
Connecting Japan and the U.S. through 50G



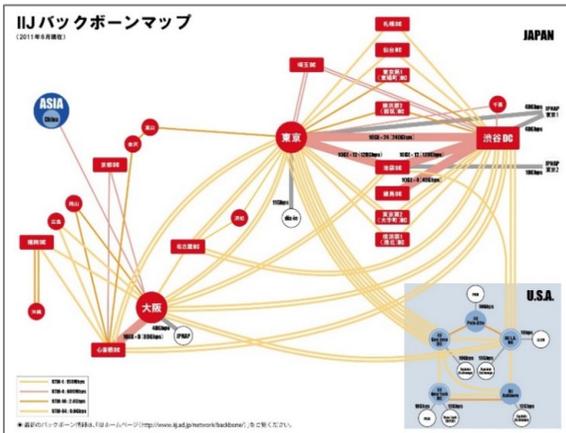
Year 2010

Connecting Tokyo and Osaka through 100G
Connecting Japan and the U.S. through 80G



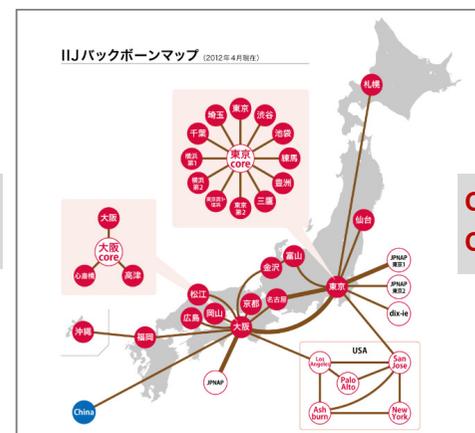
Year 2011

Connecting Tokyo and Osaka through 100G
Connecting Japan and the U.S. through 110G

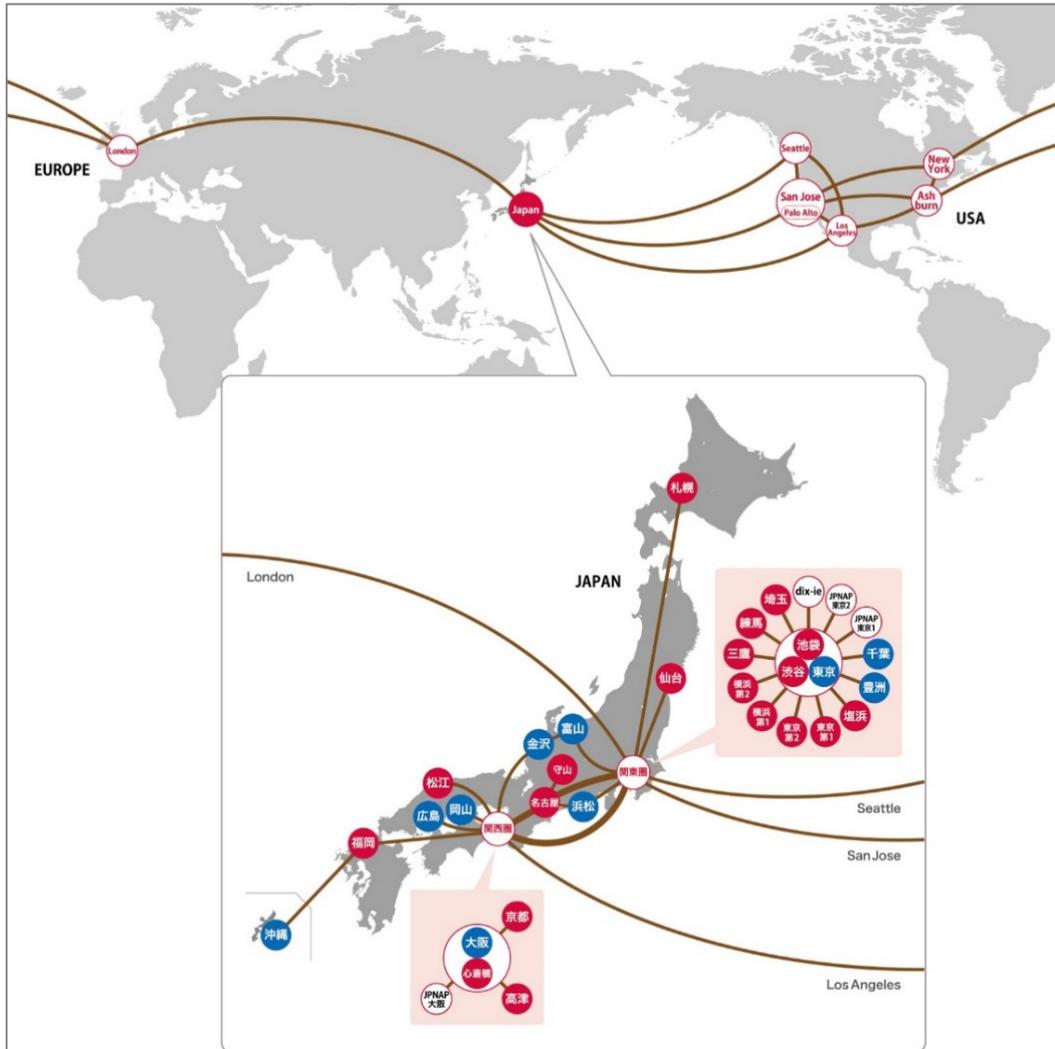


Year 2012

Connecting Tokyo and Osaka through 100G
Connecting Japan and the U.S. through 120G



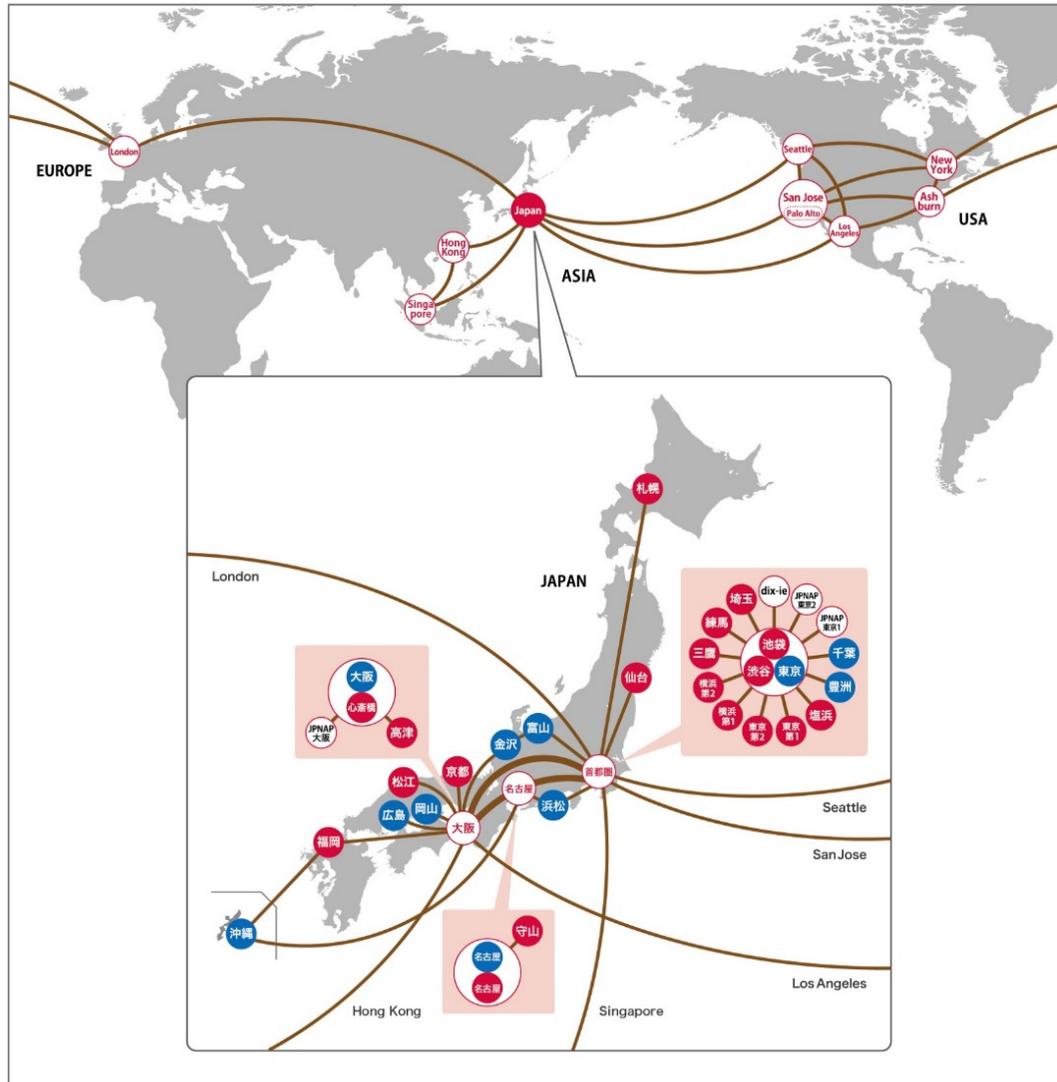
Change in IIJ Backbone: Year 2013



Connecting Tokyo and Osaka through 100G
Connecting Japan and the U.S. through 160G

In 2013, IIJ Backbone became global coverage by connecting to London through Russia

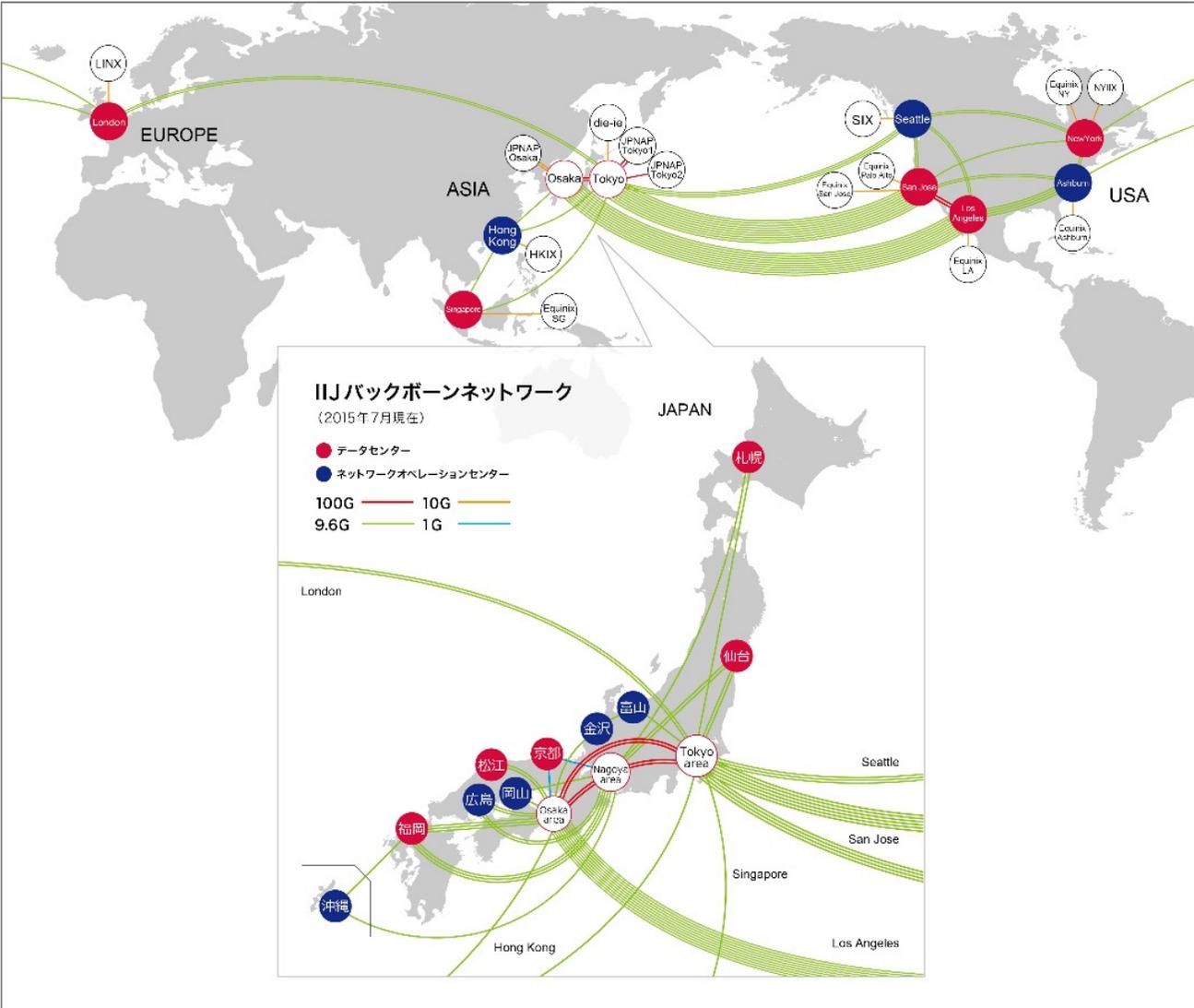
Change in IIJ Backbone: Year 2014



Connecting Tokyo and Osaka through 100G
Connecting Japan and the U.S. through 190G

In 2014, we added Hong Kong and Singapore

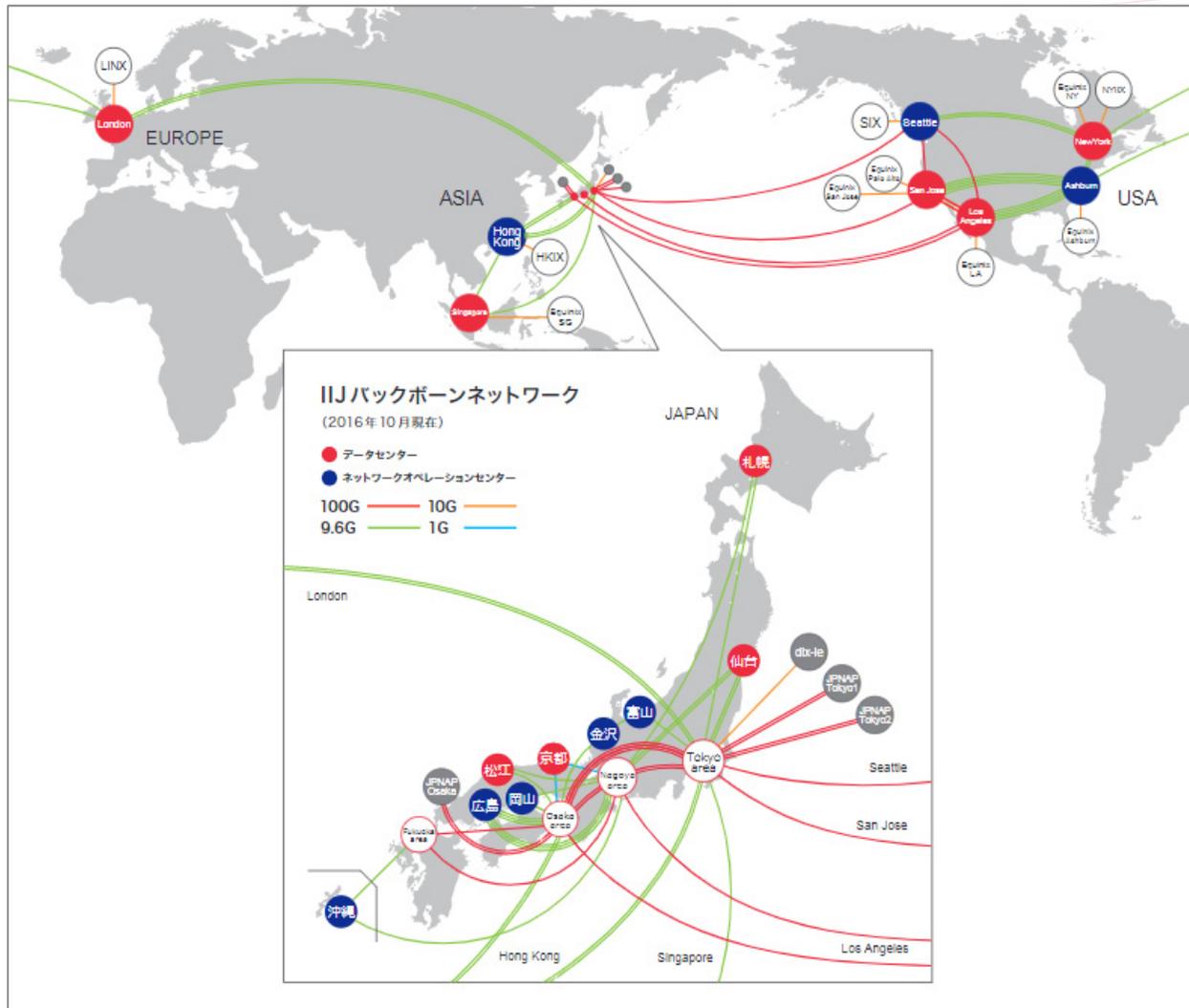
Change in IIJ Backbone: Year 2015



Connecting Tokyo and Osaka through 600G
Connecting Japan and the U.S. through 210G

In 2015, fiber lines not going through Tokyo and Osaka but other major places became 100GE
(not depending on particular places to maintain domestic backbone)

Change in IIJ Backbone: Year 2016

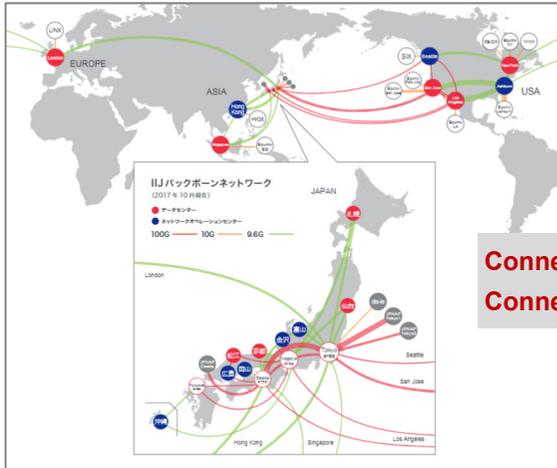


Connecting Tokyo and Osaka through 700G
Connecting Japan and the U.S. through 400G

In 2016, lines to connect Japan and the U.S. were updated to 100GE ones. Also, Nagoya city was added as a new location to connect to overseas

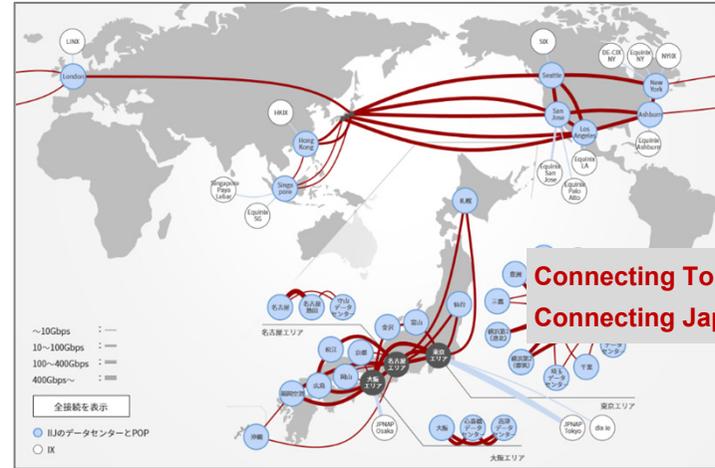
Change in IIJ Backbone

Year 2017



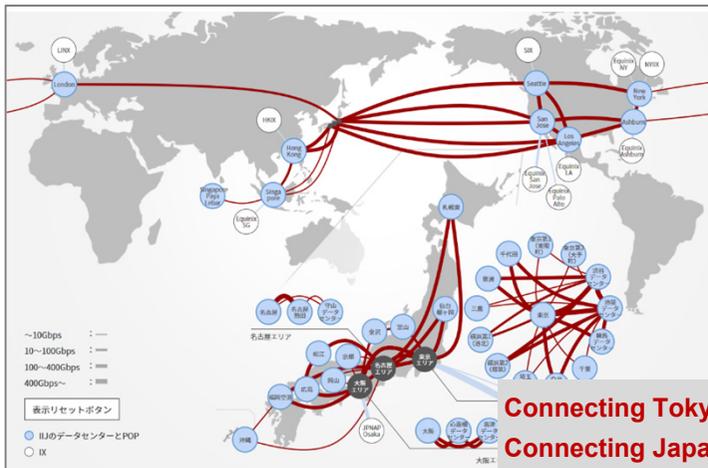
Connecting Tokyo and Osaka through 800G
Connecting Japan and the U.S. through 500G

Year 2018



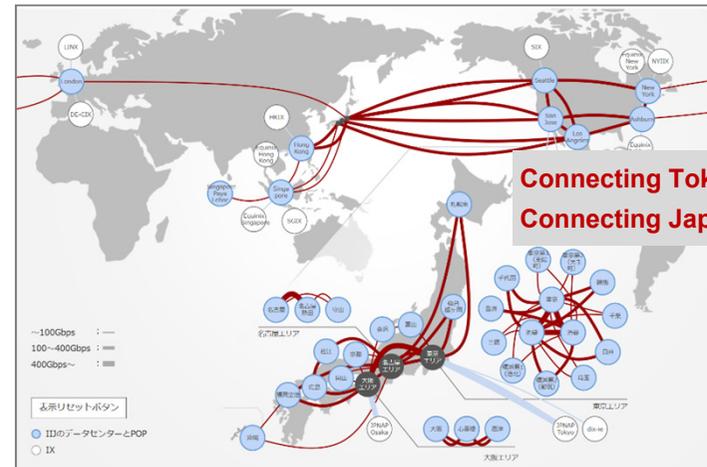
Connecting Tokyo and Osaka through 1300G
Connecting Japan and the U.S. through 600G

Year 2019



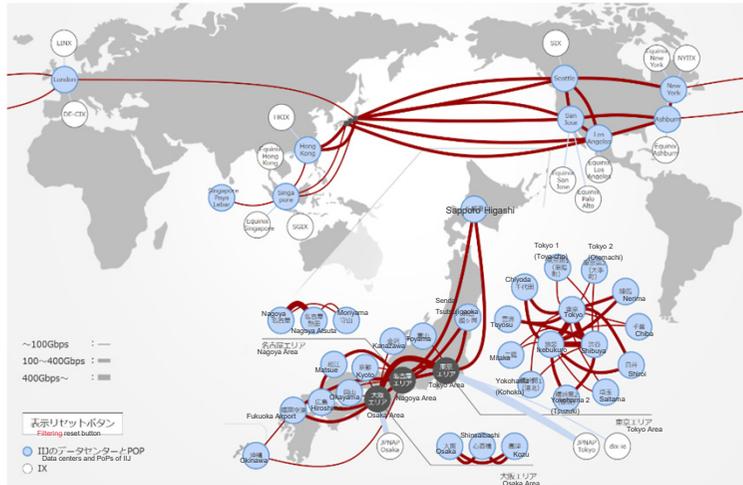
Connecting Tokyo and Osaka through 1300G
Connecting Japan and the U.S. through 600G

Year 2020 Implementation of RPKI



Connecting Tokyo and Osaka through 1300G
Connecting Japan and the U.S. through 600G

Backbone lines of IIJ (including those planned for 2021)



Tokyo/Nagoya/Osaka	1,500G
Japan/United States	600G
United States	
West Coast	600G
Coast to Coast	300G
East Coast	200G
Asia	220G

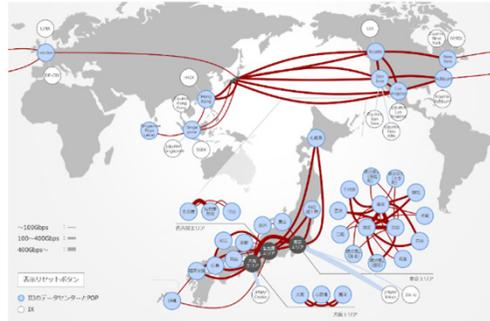
Design policies

- Establish incoming lines to POPs through different routes while also achieving equipment redundancy.
- Leverage lines that are installed in geographically distant areas like those that do not go through Tokyo or Osaka.
- Leverage multiple cable systems for international lines, similarly.
- Establish access points in multiple areas, for example, Nagoya, Osaka, Seattle, San Jose and Los Angeles.
- Lease lines from all telecommunication carriers (multiple carriers) to take advantage of operations without owning lines
- Establish interconnectivity to main ISPs in Japan, the United States, Europe and Asia, to which connectivity is secured through main IX systems.
- Control failures attributable to bugs and other factors by using routers of multiple makers and different types of firmware.

Backbone lines have been evolving in line with changes in society and traffics.

Internet Connectivity Service (IP Service)

The service that provides direct connectivity to IJ's backbone lines.



■ PoPs for Internet connectivity service (over 26 locations in Japan)

Sapporo Higashi DC, Sendai Tsutsujigaoka, Tokyo (Otemachi), Chiyoda, Shibuya, Ikebukuro, Toyosu, Mitaka, Yokohama 1 (Kohoku), Yokohama 2 (Tsuzuki), Shiroy, Saitama, Nagoya, Nagoya Atsuta, Moriyama, Toyama, Kanazawa, Osaka (Dojima), Shinsaibashi, Koza, Kyoto, Okayama, Hiroshima, Matsue, Fukuoka Airport and Okinawa (Overseas PoPs include those in the United States, London, Hong Kong, Singapore, etc.)

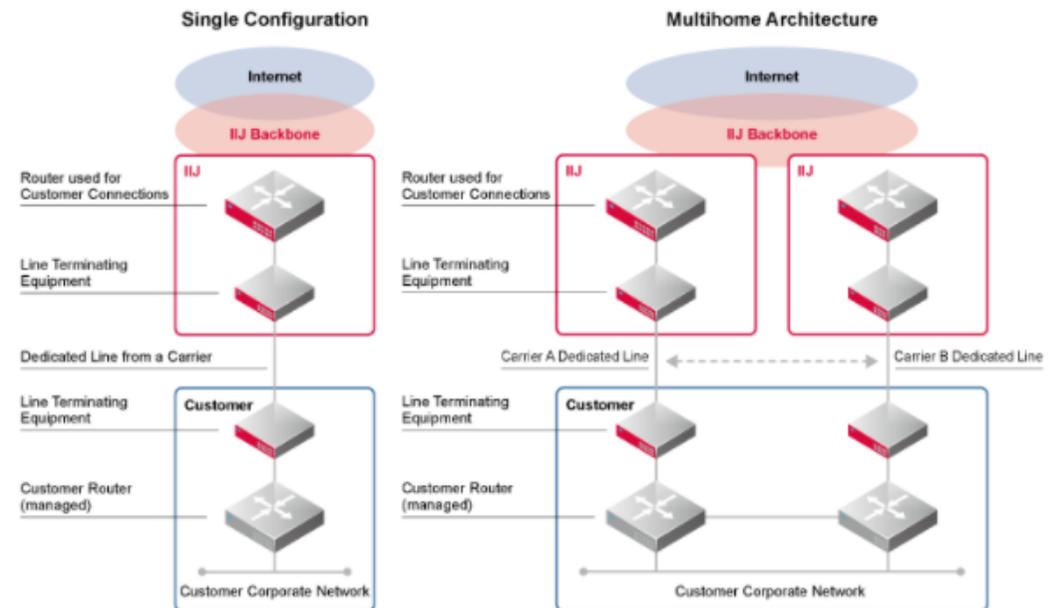
■ Features of the Service

A rich choice of bandwidth ranging from 1Mbps to several hundred Gbps is offered: Customers may select bandwidths and lines that they desire to use to gain access to the internet.

Users may choose IP addresses they use: Customers are provided with as many IPv4/v6 addresses as they need for their networks. They also may continue to use IPv4/v6 addresses that they already have (portable addresses).

Connectivity that supports redundancy is provided to meet customers' requirements: Networks can be made redundant for multiple dedicated lines with the use of dynamic routing (BGP4+) Redundancy is achieved at the line level through the selection of multiple dedicated lines. (Multi-carrier structure)

For customers who use the Managed Router Service, IJ is ready to provide a range of solutions comprehensively including those related to routers installed in customers' premises.



Users of IJ's Internet Connectivity Service: Four types

1

Internet gateways for general enterprises

Point

Reflecting active use of cloud by companies, **demand for broader bandwidth and higher quality in particular has been growing recently**. IJ's Internet access service may be provided together with other services such as firewall (security), remote access, anti-spam measures and WAN.

2

Internet gateway for government/public sector, financial organizations & EC websites

Point

Especially, for use of websites that require high-level availability and security. Sufficient bandwidth should be secured in advance partly because the amount of traffic may increase sharply during busy seasons or due to the holding of events. IJ's internet access service may be provided together with other services such as firewalls and DDoS countermeasures.

3

Internet transit to ISPs & cable TV operators

Point

ISPs and cable TV operators use IJ's Internet connectivity services through which they offer broadband services to their consumer clients. As Internet business operators themselves, ISPs and cable TV operators not only establish interconnectivity with multiple ISPs but they also procure Internet transit to secure reachability. Ultra-wide band-based transmission and superb reachability are required.

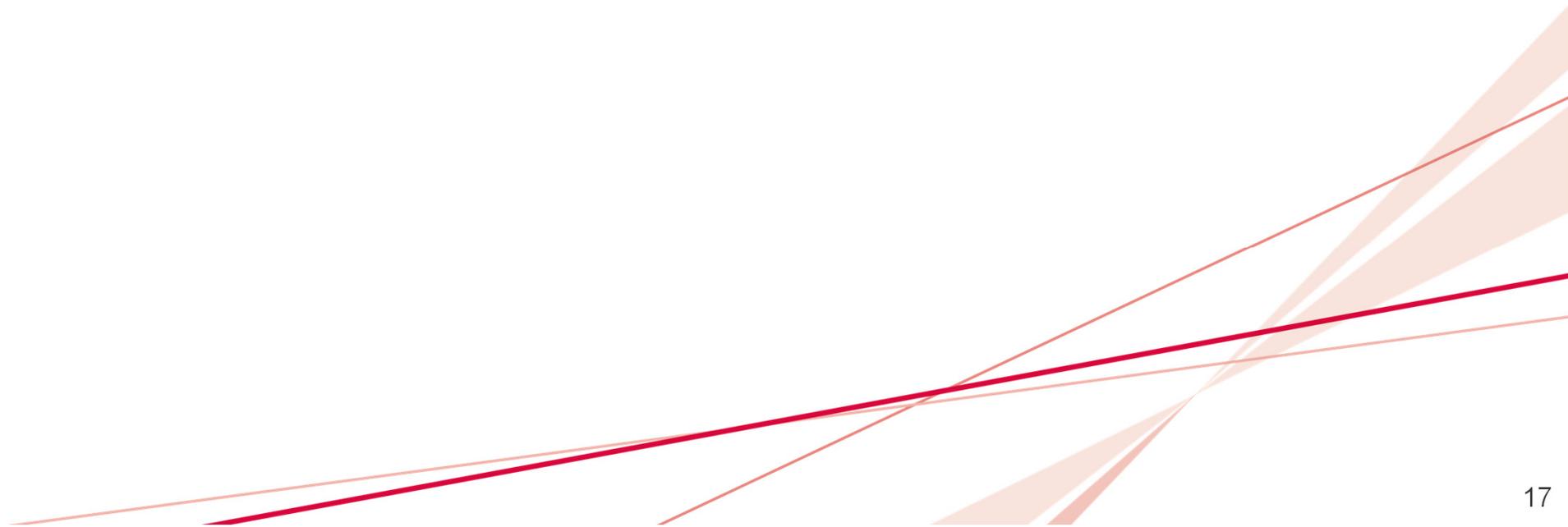
4

Internet transit to game operators, video content operators, CDN operators, etc

Point

Reachability matters because they conduct business as Internet business operators like ISPs and cable TV operators. Sufficient bandwidth should be secured in advance partly because ultra-wide band-based transmission is required and the amount of traffic may increase sharply during busy seasons or due to the holding of events. The service may be provided together with DDoS countermeasures.

Topics



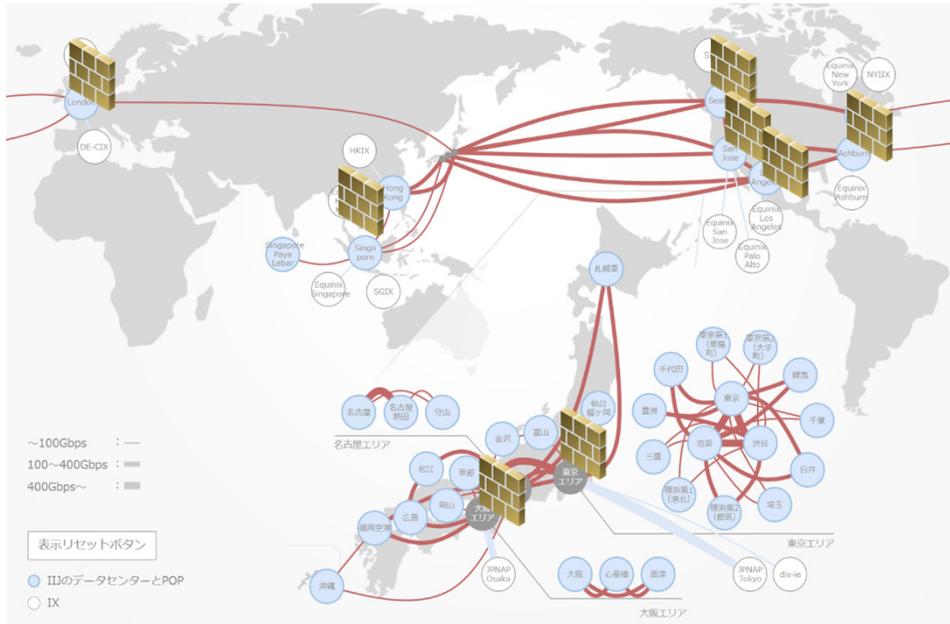
Global Deployment of DDoS Countermeasures

Year 2016

IIJ deployed network equipment at points of external connection (other AS) to respond to DDoS attacks. Countermeasures are implemented against terabit-level DDoS attacks.

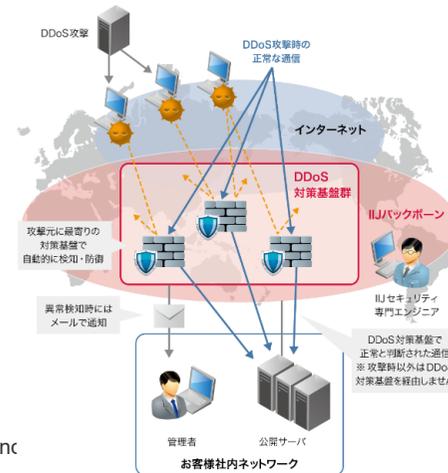
2020 Summary of DDoS Observation Report

<https://www.ijj.ad.jp/dev/report/iir/050/01.html>



月	検出件数 (1日あたりの平均)	パケット数 (万pps)	最も規模の大きな攻撃に関する観測情報		最も長く継続した攻撃に関する観測情報	
			帯域 (Gbps)	主な攻撃手法	継続時間	主な攻撃手法
1	14.45件	約25	2.19	SNMP Amplification	16分	NTP Amplification
2	13.07件	約1114	29.02	SSDP Amplification	1時間50分	SYN Flood
3	16.41件	約999	90.86	DNS及びNTP Amplification	51分	DNS及びNTP, LDAPなどのAmplification
4	24.63件	約184	19.17	DNS Amplification	19分	DNS及びNTP, LDAPなどのAmplification
5	15.06件	約296	32.11	NTP及びLDAP Amplification	22分	NTP Amplification
6	23.33件	約824	21.42	SSDP Amplification	1時間19分	SSDP Amplification
7	11.84件	約93	3.34	NTP Amplification	29分	NTP Amplification
8	11.29件	約743	58.90	DNS及びApple Remote Management Service Amplification	2時間43分	DNS及びApple Remote Management Service Amplification
9	12.73件	約114	11.21	DNS及びLDAP Amplification	23分	LDAP Amplification
10	18.45件	約78	7.54	DNS及びLDAP Amplification	15分	DNS Amplification
11	17.00件	約434	43.23	DNS Amplification	3時間11分	DNS Amplification
12	17.39件	約532	56.56	DNS Amplification	32分	SYN Flood

Started to provide new broadband-based items to respond to terabit-level DDoS attacks in the IIJ DDoS Protection Service.



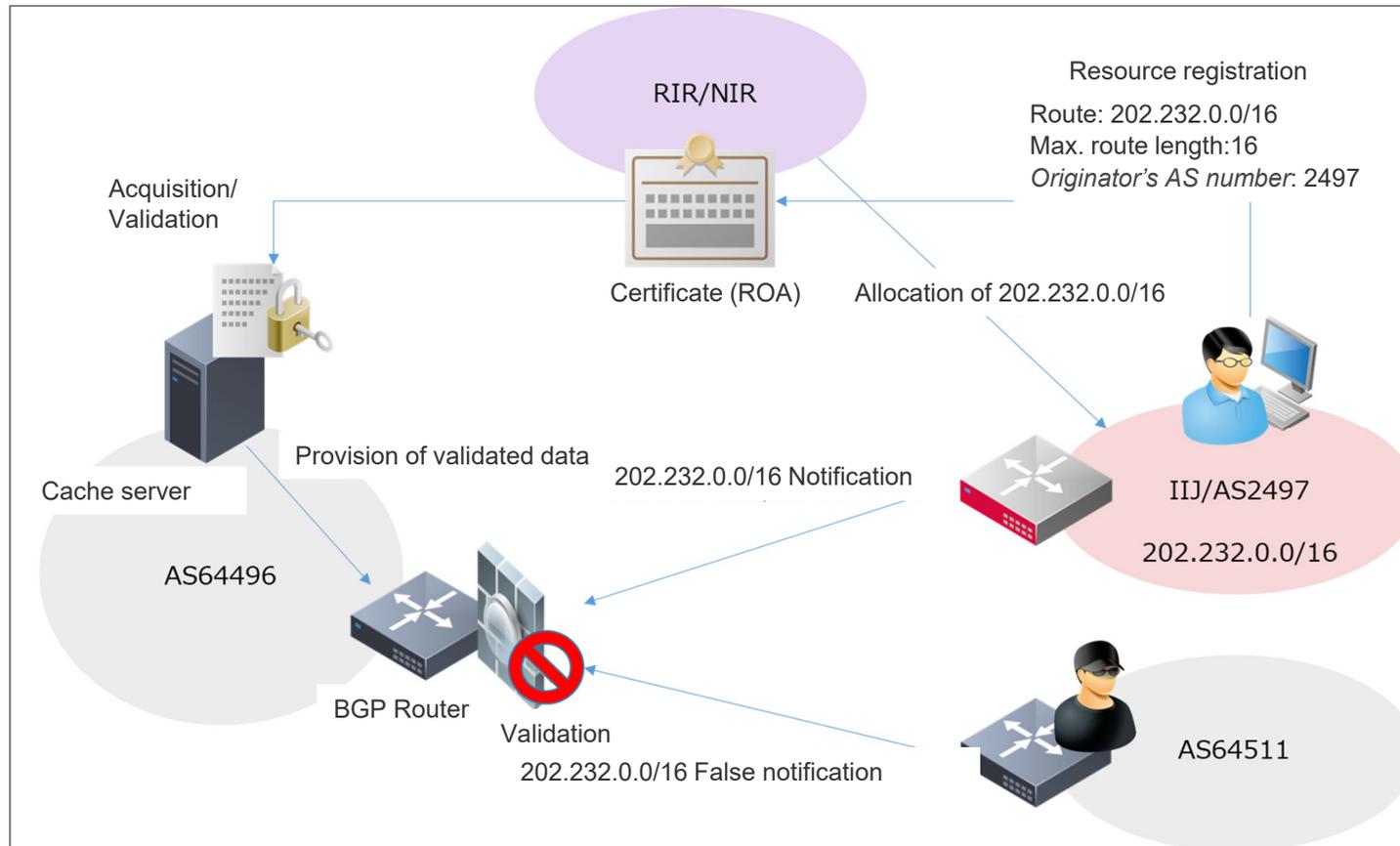
<https://www.ijj.ad.jp/news/pressrelease/2016/1212.html>
(Japanese text only)

Threat of Internet Route Counterfeiting

Year 2021

Prevention of internet route (≡ IP addresses): **RPKI**

* RPKI (Resource Public Key Infrastructure)



Make the internet more robust. We will start to deploy RPKI. (<https://eng-blog.ijj.ad.jp/archives/6861>)

Make the internet more robust. We have started to deploy RPKI. (<https://eng-blog.ijj.ad.jp/archives/9320>)

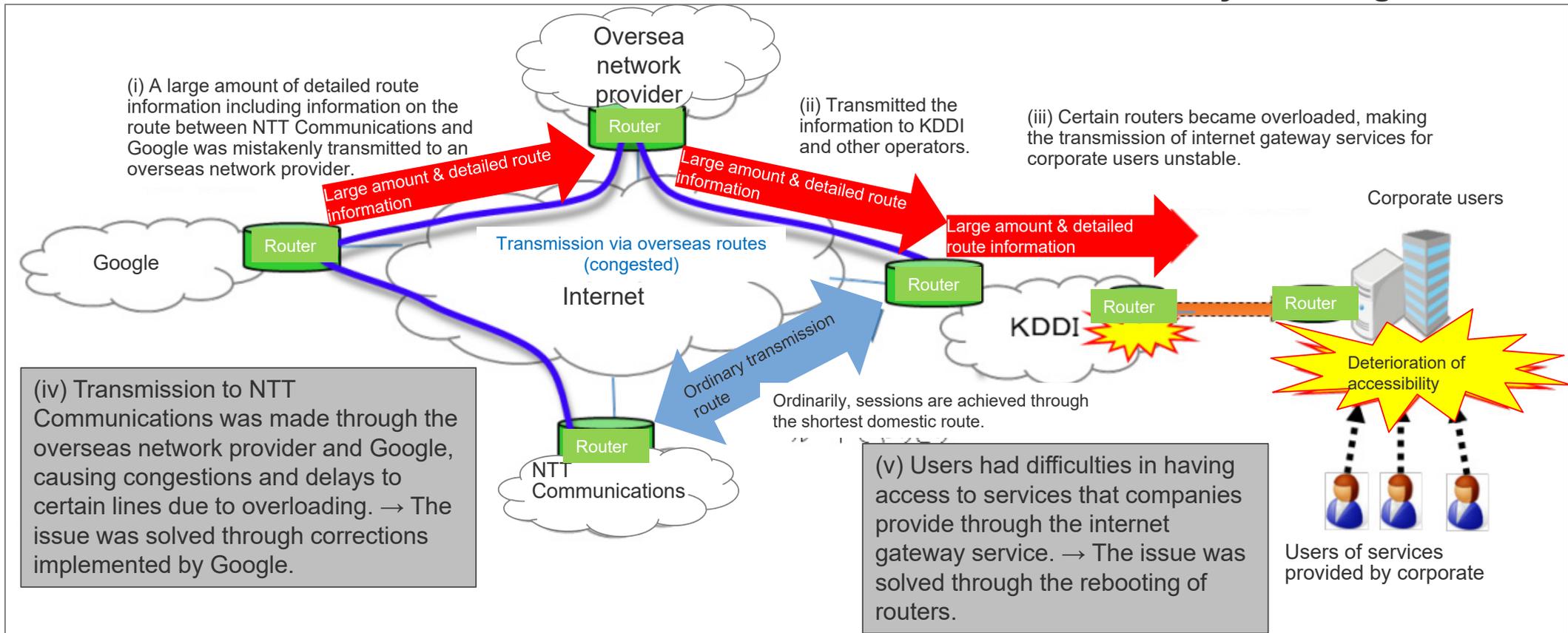
Internet Infrastructure Review (IIR) Vol.50 (<https://www.ijj.ad.jp/dev/report/iir/050/02.html>)

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Threat of Internet Route Counterfeiting

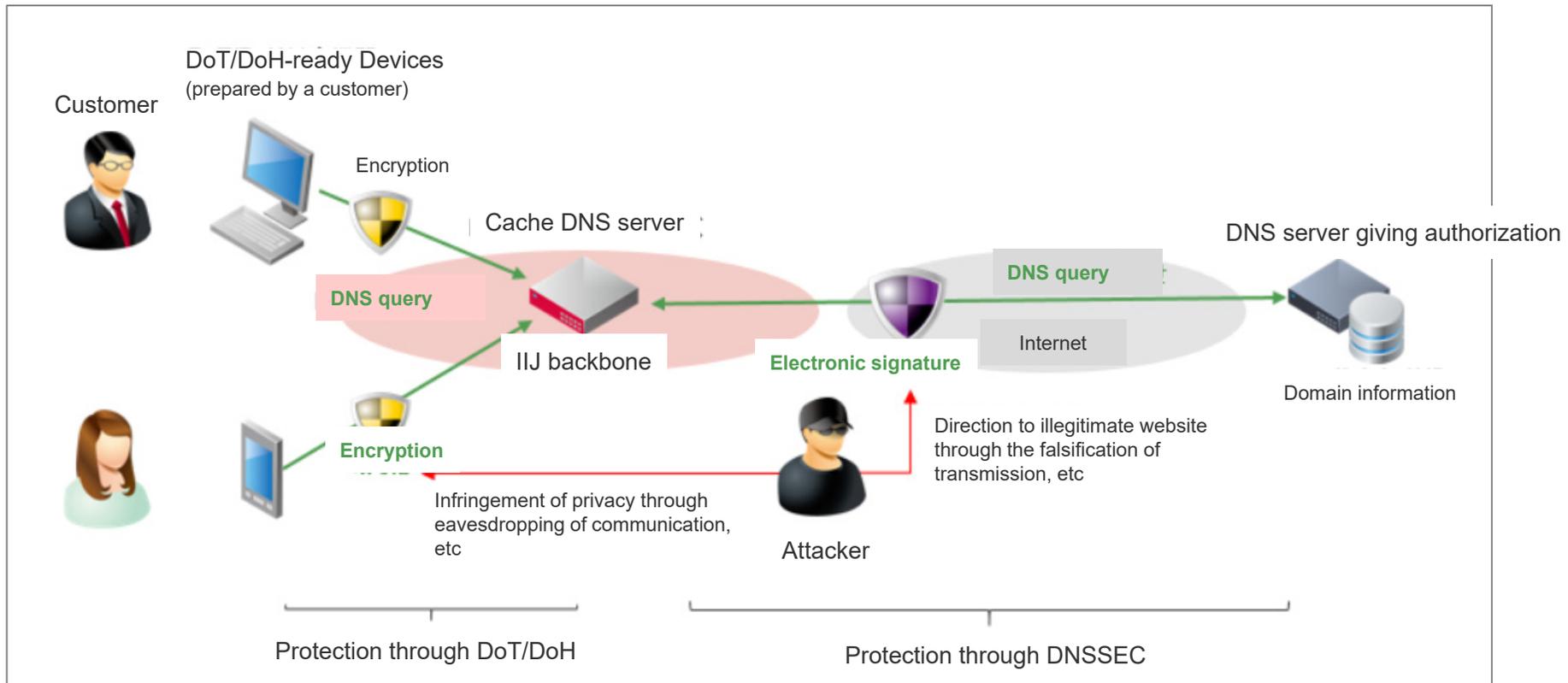
In August 2017, a large-scale route failure took place in Japan.

It made transmission via Internet unstable for several hours on a weekday on a large scale.



Cited from the “December 2017 Telecommunication Accident Validation Meeting – Validation Report Concerning Internet Access Failures” published by the Ministry of Internal Affairs and Communications https://www.soumu.go.jp/main_content/000523153.pdf

Countermeasures for DNS spoofing: **Encryption of DNS** DoT (DNS over TLS), DoH (DNS over HTTPS) and DNSSEC (DNS Security Extensions)

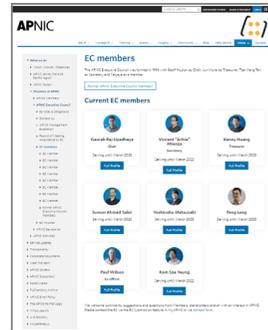
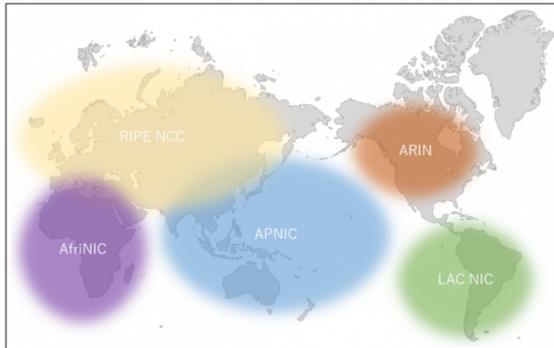


IIJ's initiatives for the encryption of DNS (<https://eng-blog.ij.ad.jp/archives/5298>)

IIJ enhances the security of DNS that it provides for the internet access service (<https://www.ij.ad.jp/news/pressrelease/2020/0116-2.html>)

External activities

■ Director of APNIC is IIJ's employee



■ IIJ was chosen as “Top 3 Beta Contributor” by Juniper Networks



EC Member



Yoshinobu Matsuzaki

Position: Senior Engineer
Organization: Internet Initiative Japan Inc.
Serving until: March 2023

Yoshinobu Matsuzaki, also known as 'maz', began his career working for a commercial ISP in Japan in 1998. He has almost two decades of network operation experience with the backbone network team. He has spoken and presented at APRICOT, bdNOG, btNOG, ENOG, FIRST, HKNOG, IETF, IGF, JANOG, NANOG, npNOG, PacNOG, PhNOG, RIPE, SafNOG, SANOG, and APNIC meetings, as well as other workshops.

He has deep knowledge and expertise on network design, network operation, and network security through his regular participation in various community meetings and workshops as a speaker and an instructor. Through his activities, he has contributed to the stable operation of the Internet in the Asia Pacific region. He has also participated in the policy discussions of APNIC when necessary from his operational perspective.

His activities and performance have been highly recognized throughout the technical community and he is often appointed in key positions such as follows,

- ICT-ISAC Japan BGP-WG Vice Chair (2005-)
- DNSOPS.jp Board (2006-)
- APNIC IPv6 Technical SIG Chair (2007-2011)
- The Asia Pacific OperatorS Forum (APOPS) Co-Chair (2008-)
- JPCERT/CC Technical Advisor (2009-)
- APRICOT Board (2011-)
- JANOG Committee (2012-)
- APRICOT Vice Chair (2013-)
- APRICOT Technical Committee Chair (2015-)
- JPNIC Board of Trustees (2016-)
- ISOC-JP Nomcom (2012,2016,2017)
- RFC6164 (Using 127-Bit IPv6 Prefixes on Inter-Router Links) Co-Author

<https://www.apnic.net/>

<https://eng-blog.iij.ad.jp/archives/9381>

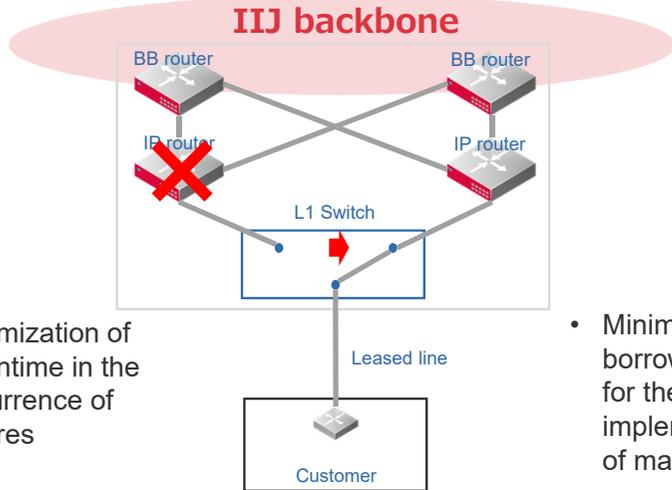
<https://www.juniper.net/jp/ja/company/press-releases/2021/pr-2021-02-01-00-00.html>

<https://eng-blog.iij.ad.jp/archives/9005>

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Other Topics

■ Duplication of IPs: offering from 2008

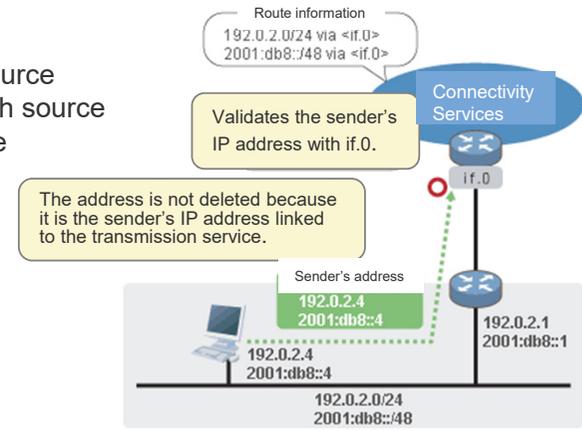


- Minimization of downtime in the occurrence of failures

- Minimization of borrowing time for the implementation of maintenance

■ SAV (Source Address Validation) : offering from 2009

- Implementation of SAV (Source Address Validation) in which source addresses block illegitimate communication

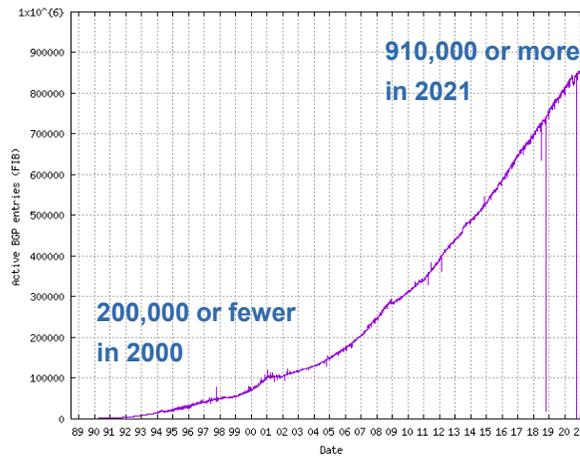


<https://www.ij.ad.jp/dev/tech/activities/sav/>

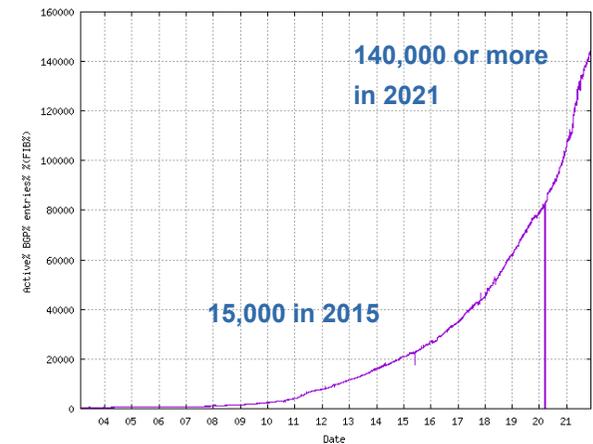
■ One million route issue

- The number of routes in Internet has been rising in line with the development of Internet itself
- IJ was quick to implement countermeasures to all of its network devices with an eye on one million routes (measures to support four million routes).

Number of IPv4 Prefix

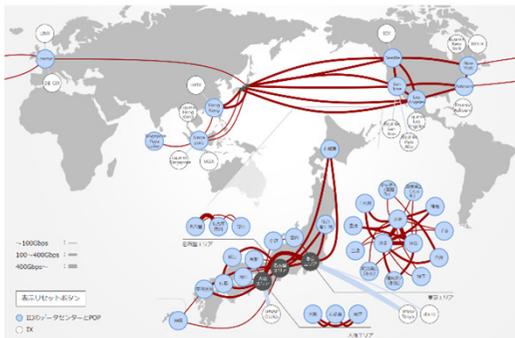


Number of IPv6 Prefix



Future Outlook

1. With Internet is still in the development stage, the scope of use and application of Internet is constantly expanding as mainly shown by such technologies as Cloud, mobile, CDN (Contents Distribution Network) and IoT.
2. Internet shall inevitably continue to play an important role going forward to facilitate DX (digital transformation), Society 5.0, etc.
3. IIJ shall continue to engage in a range of activities with a view toward the stabilization and development of the internet which plays a central role in social infrastructure.

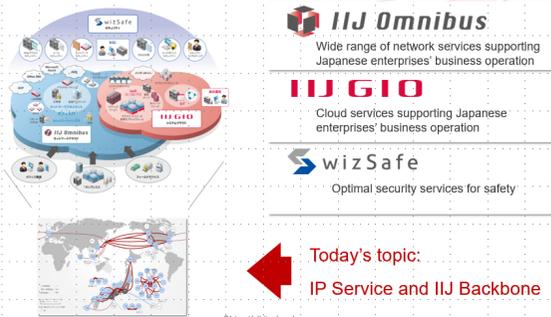


Main affiliated organizations

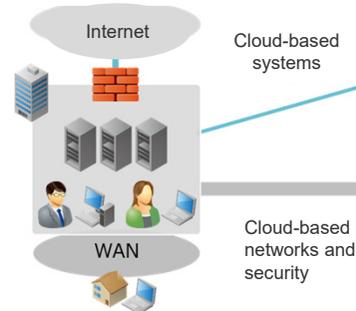


IIJ's Digital Workplace for Corporate Users

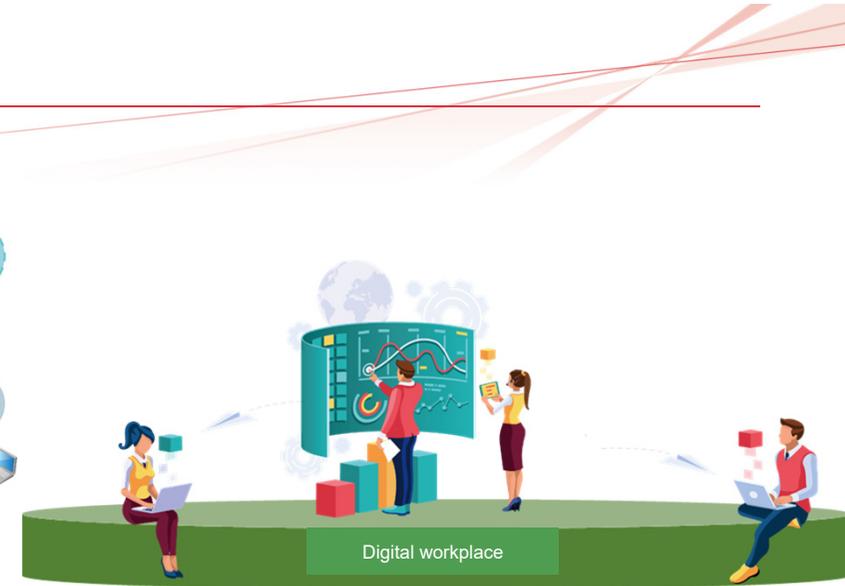
Overview of IIJ's Enterprise Business



Conventional corporate IT infrastructure



Digital workplace



◆ What is a digital workplace?

Goal

Digital workplace

Concept featuring digital-technology-based diverse workstyles without the constraint of places and time

Services to be offered

IIJ Omnibus

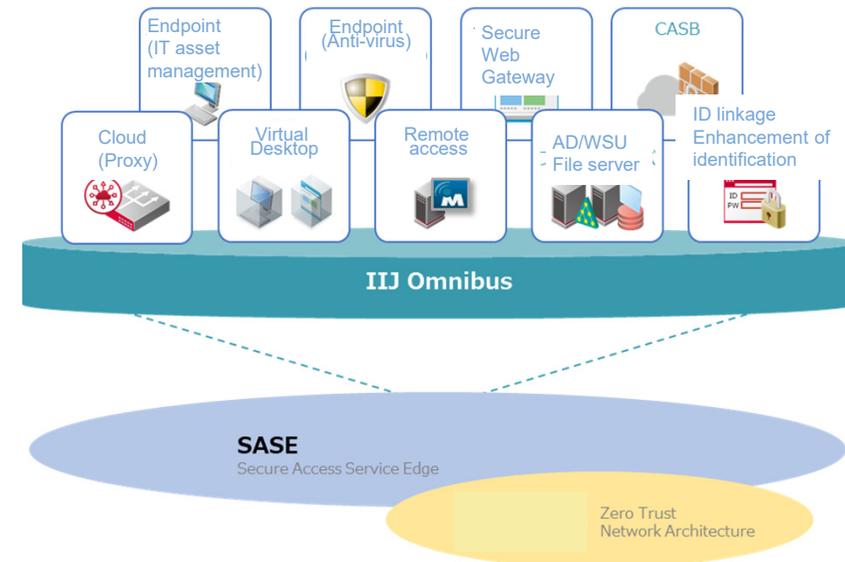
Provides a range of functions necessary for establishing the foundation of a digital workplace as cloud-based services

Underlying conceptual model

SASE and Zero Trust

Network and security services are integrated and consolidated, and provided in the cloud.

Configuration based on the assumption that installing only boundary security is not safe enough and no connection sources or networks are reliable.





The internet started in Japan in 1992, along with IIJ. Since that time, the IIJ Group has been building the infrastructure for a networked society, and with our technical expertise, we have continued to support its development. We have also continued to evolve our vision for the future and innovate to make it a reality. As an internet pioneer, IIJ has blazed the trail so that others could realize the full potential of a networked society, and that will never change. The middle "I" in "IIJ" stands for "initiative," and IIJ always starts with the future.

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