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ECONOMIC IMPACT OF GOOGLE'S APAC NETWORK INFRASTRUCTURE

2022 UPDATE - FOCUS ON JAPAN

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Contents

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Google's network infrastructure investments in Japan

Investments in submarine cables

Unity
2010
CABLE LANDING POINTS
Japan, USA

Indigo
2019
CABLE LANDING POINTS
Singapore, Australia, Indonesia

MIST
2022
CABLE LANDING POINTS
Singapore, Malaysia, Myanmar, Thailand, India

IAX
2023
CABLE LANDING POINTS
Singapore, Malaysia, Thailand, India

SJC
2013
CABLE LANDING POINTS
Singapore, Hong Kong, Japan, China, the Philippines, Brunei, Thailand

PLCN
2020
CABLE LANDING POINTS
Taiwan, USA, the Philippines

Topaz
2022
CABLE LANDING POINTS
Japan, Canada

Apricot
2024
CABLE LANDING POINTS
Singapore, Japan, Indonesia, the Philippines, Taiwan, Guam

FASTER
2016
CABLE LANDING POINTS
Japan, Taiwan, USA

JGA-S
2020
CABLE LANDING POINTS
Australia, Guam

Echo
2023
CABLE LANDING POINTS
Singapore, Indonesia, USA, Guam

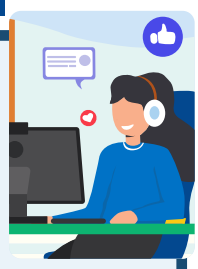
31 cities with GGC nodes

20 Peering locations in 3 cities

Benefits to digital connectivity

SUPPORT USE-CASES FOR POST-PANDEMIC DIGITAL TRANSFORMATION:

- Cloud services
- e-Commerce
- Video-conferencing



2026 FORECAST

33% USAGE OF INTERNET ENABLED

7ms REDUCTION IN END-USER LATENCY

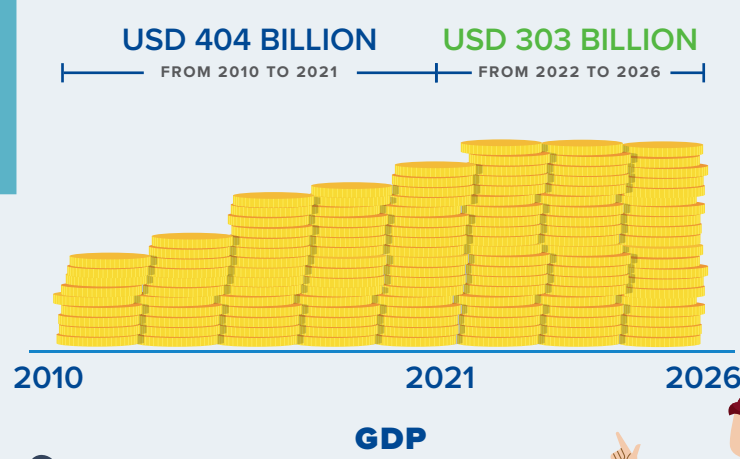
35% REDUCTION IN IP TRANSIT PRICES

30% INCREASE IN INTERNET BANDWIDTH

Economic impact

Forecast to support up to
739 000 additional jobs
in 2026

Supported up to
401 000 additional jobs
in 2021



Regulatory and investment regime

Japan offers best practices for other APAC economies to follow

Deployment and landing
of submarine cables

Protection and maintenance
of submarine cables

Potential areas of progression

Government facilitated discussions between the fishery industry and submarine cable owners – an area that has been historically difficult

Enable early deployment of shore-end cables terminating at the beach manhole without having to go through new applications

New regulations such as the National Economic Security bill should aim to continue to encourage network infrastructure investments

This report is an update of the *Economic impact of Google's APAC network infrastructure – focus on Japan* report, released in 2020.[1] We have further refined our methodology first used in 2020.[2] Since 2020, digital connectivity and the economic landscape of Japan have seen significant development, largely due to the impact of the Covid-19 pandemic. This report will refresh our quantitative impact estimates in line with these developments and our improved methodology.

Japan's telecoms market is among the most advanced globally across both fixed and mobile services, primarily driven by well-nurtured competition, open foreign investment regulations, and excellent technology availability. Internet traffic generated across both fixed and mobile networks has grown strongly at an average of 27% annually from 2010 to 2021, reaching 152EB in total in 2021. Japan has benefited from its advanced digital connectivity on the business, individual, and governmental level, further enabled by Google's infrastructure investments and software offerings. Education, agriculture, and accessibility are examples of sectors where improved internet connectivity has significantly driven growth in Japan.

The regulatory environment surrounding Japan's submarine cable infrastructure is strong and conducive to foreign investment. This regulatory environment, coupled with Japan's location on the eastern edge of Asia, has made the country one of the main submarine cable hubs in the region. In 2021, Japan was connected to 22 international cable systems, including multiple technologically leading cables invested in by leading Content, application, and service providers (CASPs). Addressing uncertainties relating to negotiations with the fishery industry would further improve the environment and enable more network infrastructure investments.

There are three main telecoms service providers in Japan:

- **NTT –** the incumbent and largest telecoms operator
- **KDDI –** a major mobile and fixed-internet services provider
- **SoftBank –** SoftBank Corp's telecoms subsidiary for mobile and fixed services

Both fixed and mobile networks provide extensive coverage: around 98% of households[3] have access to fibre broadband and over 99% of the population is within range of 4G mobile coverage.[4] Competition in the mobile sector has increased in the past few years with the launch of Rakuten Mobile towards the end of 2019. Japan has also continued investing in its strong telecoms

1 Analysys Mason – Economic impact of Google's APAC network infrastructure, see: analysysmason.com/consulting-redirect/reports/impact-of-google-network-apac-2020/

2 We have updated the list of cables with additional "open-cable" effect to include not just Google cables but that of other CASPs. We have also assessed the impact differently for each Google cable depending on a combination of factors including the number of international submarine cables landing in the country, the number of Google cables landing in the country, the consortium members participating in the cable, and Google's level of contribution to the consortium.

3 Analysys Mason Research – FTTx coverage and capex worldwide: forecasts and analysis 2020–2026

4 Analysys Mason Research

infrastructure, as seen in examples such as the deployment of extensive, free Wi-Fi in advance of the Tokyo Olympics held in 2021.[5]

1 Google's network infrastructure investments generated benefits to the connectivity ecosystem, leading to greater usage of the internet in Japan

Google's edge network and submarine cable investments in Japan boost traffic by improving the performance and reliability of Google services and content, and the overall internet infrastructure of the economy. New submarine cables bring new supply and improve international cable route diversity while directly supporting Google's edge infrastructure. Internet service providers (ISPs) and end users benefit from lower latency, faster speeds and low international connectivity costs, and consequently there is an uptake of new internet use cases and applications.

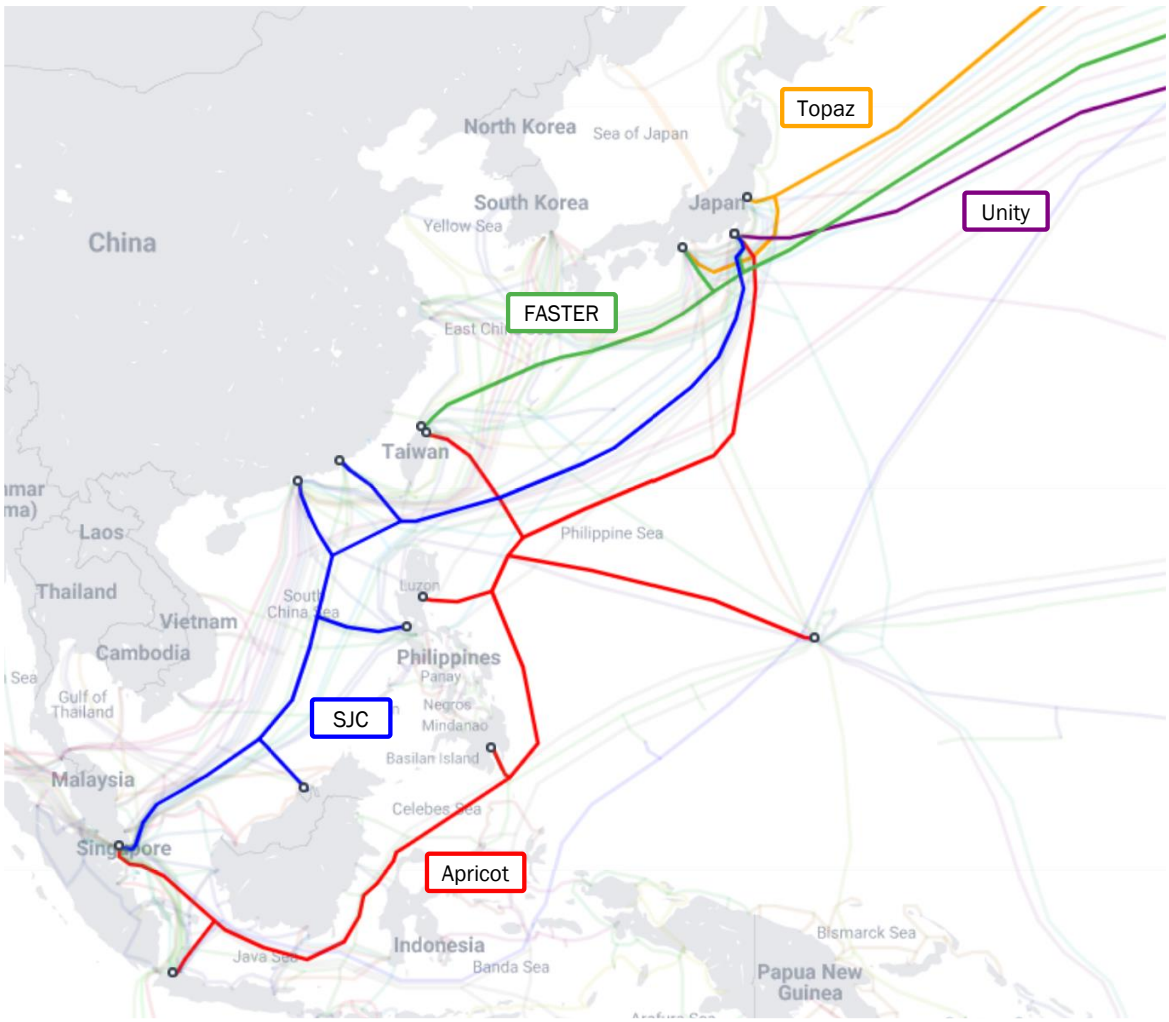
Google has invested in three currently deployed cables (Unity, SJC and FASTER) and announced investment in a further two cables (Topaz and Apricot):

- **Unity (2010) –** Google's first APAC submarine cable investment, connecting Japan to the USA
- **SJC (2013) –** Pan-Asian cable system connecting Japan, Singapore, Hong Kong, China, the Philippines, Brunei and Thailand
- **FASTER (2016) –** Trans-Pacific cable connecting Japan, Taiwan and the USA
- **Topaz (2022) –** cable mainly led by Google with local partners, connecting Japan to Canada
- **Apricot (2024) –** Pan-Asian cable system connecting Japan, Singapore, the Philippines, Indonesia, and Taiwan

Topaz and Apricot are also new generation cables which have much higher fibre pair counts compared to past cables and thus will deliver substantially increased capacity to economies they land in. A map of Google's submarine cable investments that connect to Japan are provided in Figure 1. These cables have significantly increased international capacity and internet performance for Japan, therefore enabling sustained traffic growth since 2010 and into the future.

5 The Japan Times – Hot spot: Is Tokyo finally going wireless?, see: japantimes.co.jp/life/2016/07/09/digital/hot-spot-tokyo-finally-going-wireless/

Figure 1: Map of Google's submarine cable investments that connect to Japan [Source: Submarine Cable Map, 2022]



Apart from investments in international capacity, Google has also continued its investments in edge infrastructure. Google has deployed points of presence (PoPs) in nine private peering facilities and cross-connected to internet exchange points (IXPs) at 11 locations as summarised in Figure 2 below. Google also invests in content caches, and Google Global Cache (GGC) nodes already deployed in 31 cities across Japan.

Name of facility / fabric	Type	Location
BBIX Osaka	Public	Osaka
BBIX Tokyo	Public	Tokyo
DIX-IE	Public	Tokyo
Equinix Osaka	Public	Osaka
Equinix Tokyo	Public	Tokyo
JPIX Osaka	Public	Osaka
JPIX Tokyo	Public	Tokyo
JPNAP Osaka	Public	Osaka

Figure 2: List of Google peering facilities in Japan [Source: Google, PeeringDB, 2022]

JPNAP TokyoPeering	Public	Tokyo
KINX (switch at AT Tokyo)	Public	Tokyo
KRIX (Sejong, switch at AT Tokyo)	Public	Tokyo
AT Tokyo	Private	Tokyo
ComSpace	Private	Tokyo
Equinix TY2	Private	Tokyo
Equinix TY4	Private	Tokyo
NTT Com Tokyo	Private	Tokyo
Equinix Osaka (OS1)	Private	Osaka
KDDI Otemachi	Private	Tokyo
NTT Telepark	Private	Osaka
NTT Com OS7	Private	Osaka

These investments in submarine cables, PoPs and GGC nodes in Japan have continued to bring improvements to the connectivity ecosystem, benefiting

End-user latency	End-user latency will reduce by an additional 7 milliseconds beyond latency forecasts without Google's investments by 2026
IP transit prices	IP transit prices are forecast to be 35% lower by 2026 due to the increased internet supply from Unity, SJC, FASTER, Topaz and Apricot
Download speeds	In 2021, the average download speeds in Japan were more than three times that of less well-connected economies
Internet traffic	By 2026, we forecast that the impact of Google's investments will have enabled 33% of internet traffic[6]

2 These investments generate social benefits by supporting new use cases and economic benefits in the form of GDP growth and jobs

From a social impact perspective, consumers benefit from the use of internet applications such as telehealth and online learning, while also seeing more widespread rollouts of other internet-based services. These include job market platforms, digital payments systems, and online savings and investment services which improve employment rates and financial inclusion across Japan.

Businesses benefit from wider customer reach, improved operational efficiency, advanced data analytics, and better advertising efficacy among a multitude of other digitally enabled advancements.

6 We forecast that Google's network infrastructure investments will drive an additional 50% increase in internet traffic beyond forecasts without these investments by 2026.

Enterprises in Japan have also transitioned to online revenue streams in order to mitigate the limited physical reach to customers and embrace global digital transformation trends.

On a governmental level, Japan has recently seen large efforts to digitalise on a national level. The creation of the Digital Agency in 2021 will support modernisation of government services, consolidation of vital databases, and data protection. In healthcare for example, digitalising medical data, adopting new trends in telemedicine and telepharmacy, and promoting medical app use in Japan, are expected to lead to huge gains in the country's healthcare system.

In addition, one of the impacts of the Covid-19 pandemic was a notable increase in remote working and online activity, significantly expanding the economic reliance that Japan has on internet connectivity. Internet use became a substitute for many regular activities such as leisure, entertainment, socialising and out-of-home activities that were limited due to contact-reducing measures.[7] These impacts are expected to have accelerated digitalisation initiatives in Japan.

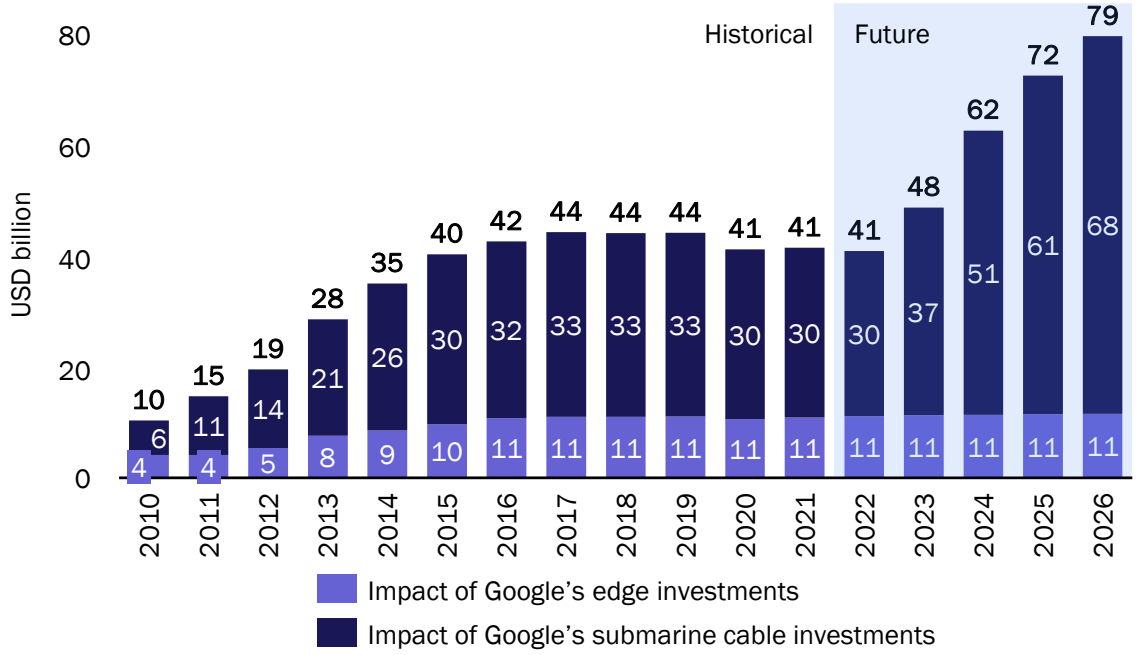
From an economic impact perspective, we estimate that the additional internet usage enabled by Google's network infrastructure investments has driven an additional USD 404 billion in GDP (in real terms[8]) in Japan cumulatively between 2010 and 2021. As a result of Google's historical and future network infrastructure investments in Japan, we forecast USD 303 billion in cumulative additional GDP enabled by Google's investments between 2022 and 2026 cumulatively (see Figure 3 below). From 2018 to 2022, there were many other non-Google cables that landed in Japan[9] which also contributed towards the historical and forecast internet traffic and GDP growth.

7 Naoto Yabe, Tomoya Hanibuchi, Hiroki M. Adachi, Shohei Nagata, Tomoki Nakaya – Relationship between Internet use and out-of-home activities during the first wave of the COVID-19 outbreak in Japan, see: sciencedirect.com/science/article/pii/S2590198221000506

8 GDP figures are in constant USD using 2020 as the base year and using a fixed exchange rate to USD in 2020; GDP statistics in USD are sourced from the World Bank and Euromonitor

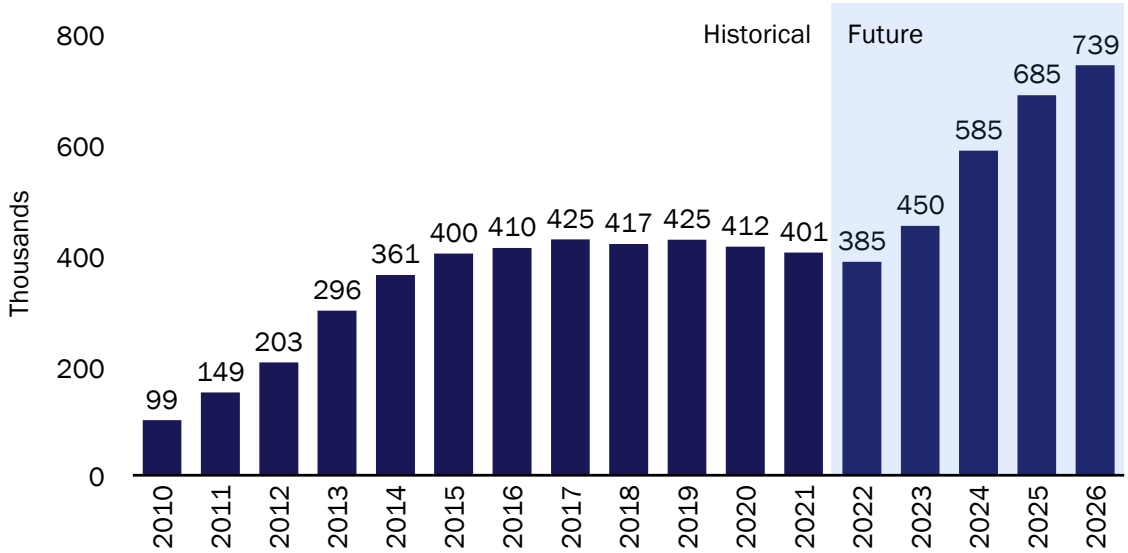
9 New Cross Pacific (NCP) – 2018, JUPITER – 2020; Japan-Guam-Australia North (JGA-N) – 2020; Asia Direct Cable (ADC) – 2022; Southeast Asia-Japan Cable 2 (SJC2) – 2022

Figure 3: Increase in real GDP attributable to Google's network infrastructure investments in Japan [Source: Analysys Mason, 2022]



The economic benefits arising from Google's network infrastructure investments lead to direct job creation in sectors such as telecoms and construction. Indirect job creation is prominent in industries that can benefit most from improved internet connectivity and digitalisation, namely IT, financial and professional services, and manufacturing. Boosts in productivity and further enablement of digital applications have led to the creation of new jobs. We estimate that up to 401 000 direct, indirect and induced jobs were supported through Google's network infrastructure investments in 2021, growing to 739 000 in 2026 (see Figure 4).

Figure 4: Jobs supported by Google's network infrastructure investments in Japan [Source: Analysys Mason, 2022]



3 Investments in network infrastructure continue to drive security, reliability and performance improvements in cloud services, while cloud adoption is booming

As discussed in our original report, Google's network infrastructure investments are beneficial to ISPs and end users in various ways, by providing route diversity, reducing latency, and increasing availability and network resilience. Cloud services, including Google Cloud, can in turn offer improved service quality, security and reliability to their users. Google's infrastructure also delivers cloud traffic directly into Japan, which means that Google Cloud Platform (GCP) customers are better protected from internet attacks.

At the end of 2021, Google Cloud deployed in 11 cloud regions in APAC, two of which are in Tokyo and Osaka, launching in 2016 and 2019 respectively. Both regions contain three availability zones each. Google has also announced plans to build a hyperscale data centre in Inzai, Japan. This will be Google's first data centre in Japan and its third in APAC.

4 Japan continues to have a regulatory environment that is supportive of foreign submarine cable investment

As a leading submarine cable hub in the APAC region, Japan's regulatory regime is highly conducive to digital infrastructure investment. Application processes for landing cables are mature and well established, there are no equity limits on foreign investments of network infrastructure, and landing station owners generally provide access to submarine cable owners. This aligns with Japan's longstanding efforts to foster strong market competition and technological innovation.

Japan is also seen as a jurisdiction with strong regulatory enforcement principles. It scores well on the Rule of Law index, with a regulatory enforcement factor score of 0.79, which is one of the best

scores amongst APAC countries.[10] This boosts investors' confidence, particularly in the context of capital-intensive investments such as the deployment of submarine cables.

However, Japan can further support the submarine cable industry. The government could facilitate discussions between the fishery industry and submarine cable owners – an area that has been historically difficult and introduces substantial uncertainty into cable landings in Japan. Japan could also enable submarine cable owners to deploy spare shore-end cables terminating at the beach manhole without having to go through new applications each time as this would speed up deployment processes for subsequent cables that need to connect to the same cable landing station. Finally, new regulations such as those in the new National Economic Security bill should continue to enable future network infrastructure investments.

10 World Justice Project – Rule of Law Index 2021, see: worldjusticeproject.org/rule-of-law-index/