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REPORT FOR GOOGLE

2022 UPDATE: ECONOMIC IMPACT OF GOOGLE'S APAC NETWORK INFRASTRUCTURE

FOCUS ON SINGAPORE

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NOVEMBER 2022

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Contents

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Google's network infrastructure investments in Singapore

Investments in submarine cables

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

Indigo
2019
CABLE LANDING POINTS
Singapore, Australia, Indonesia

MIST
2023
CABLE LANDING POINTS
Singapore, Malaysia, Myanmar, Thailand, India

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

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

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

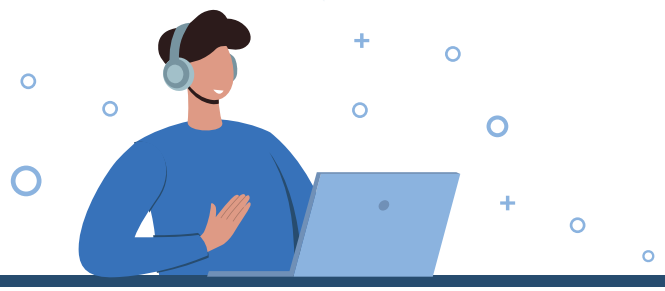
GGC nodes deployed across the country

8 **Peering locations deployed in Singapore**

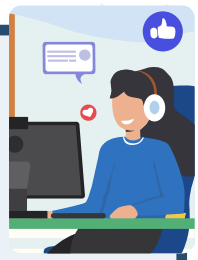
Benefits to digital connectivity

SUPPORT USE-CASES FOR POST-PANDEMIC DIGITAL TRANSFORMATION:

- Cloud services
- e-Commerce
- Video-conferencing



2026 FORECAST



29% **USAGE** OF INTERNET ENABLED

16% **REDUCTION** IN END-USER LATENCY

34% **REDUCTION** IN IP TRANSIT PRICES

23% **INCREASE** IN INTERNET BANDWIDTH

*GGC = Google Global Cache

Economic impact

Forecast to support up to
25 000 jobs
in 2026

Supported up to
11 500 jobs
in 2021

USD13 BILLION
FROM 2010 TO 2021

USD16 BILLION
FROM 2022 TO 2026

2010 2021 2026

GDP

Regulatory and investment regime

Singapore offers best practices for other APAC economies to follow

Deployment and landing of submarine cables

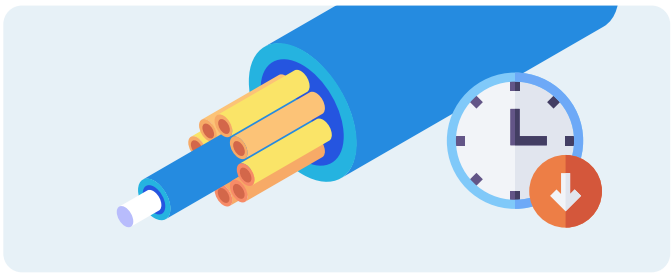
Protection and maintenance of submarine cables

International digital trade agreements encompassing submarine cable terms

Potential areas of progression

Introduce cable protection zones

where feasible to combat risk against damage from high levels of nearby maritime activity



Speed up permitting for vessels

to reduce cable fault repair times by implementing an 'approval in principle' approach for permits

This report is an update of the *Economic impact of Google's APAC network infrastructure – focus on Singapore* 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 Singapore 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.

Singapore is a global leader in telecoms, with almost 100% of broadband subscriptions being full fibre.[3] Internet traffic generated across both fixed and mobile networks has grown strongly at an average of 26% annually from 2010 to 2021, reaching 5.2EB in total in 2021.

Singapore also leads by example in terms of its telecoms regulatory environment, especially in relation to submarine cables and foreign investments. This has led to the economy becoming one of the most successful and attractive digital and economic hubs in the world. As of 2021, 25 international submarine cables were connected to Singapore – the most in APAC.

There are three main telecoms service providers in Singapore, in addition to a mobile operator entrant (Simba, formerly TPG), which has been growing since it entered the market in 2018, and many retail service providers and mobile virtual network operators (MVNOs):

- **Singtel** – the incumbent and largest telecoms operator in Singapore, majority owned by Temasek Holdings
- **StarHub** – the second-largest operator under ST Telemedia
- **M1** – the third-largest fixed and mobile operator, owned by Keppel Corporation.

Singapore has taken the next step to further elevate its mature regulatory environment by promoting international digital trade and digitalisation of the economy, signing Digital Economy Agreements with Chile and New Zealand (DEPA – June 2020[4]), Australia (SADEA – August 2020[5]) and the UK (UKSDEA – December 2021[6]). The SADEA and UKSDEA agreements specifically include regulatory guidelines for submarine cables, which comprise improved terms relating to submarine cable installation, maintenance, licensing, permitting, charting and protection.

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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 TeleGeography, Analysys Mason Research

4 Singapore Ministry of Trade and Industry, see: https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/The-Digital-Economy-Partnership-Agreement

5 Singapore Ministry of Trade and Industry, see: https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/The-Singapore-Australia-Digital-Economy-Agreement

6 Singapore Ministry of Trade and Industry, see: https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/UKSDEA

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

Google's edge network and submarine cable investments in Singapore boost traffic by improving the performance and reliability of Google services and content, as well as 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 two currently deployed cables (SJC and Indigo-West) and announced investment in a further four cables (MIST, Echo, IAX and Apricot):

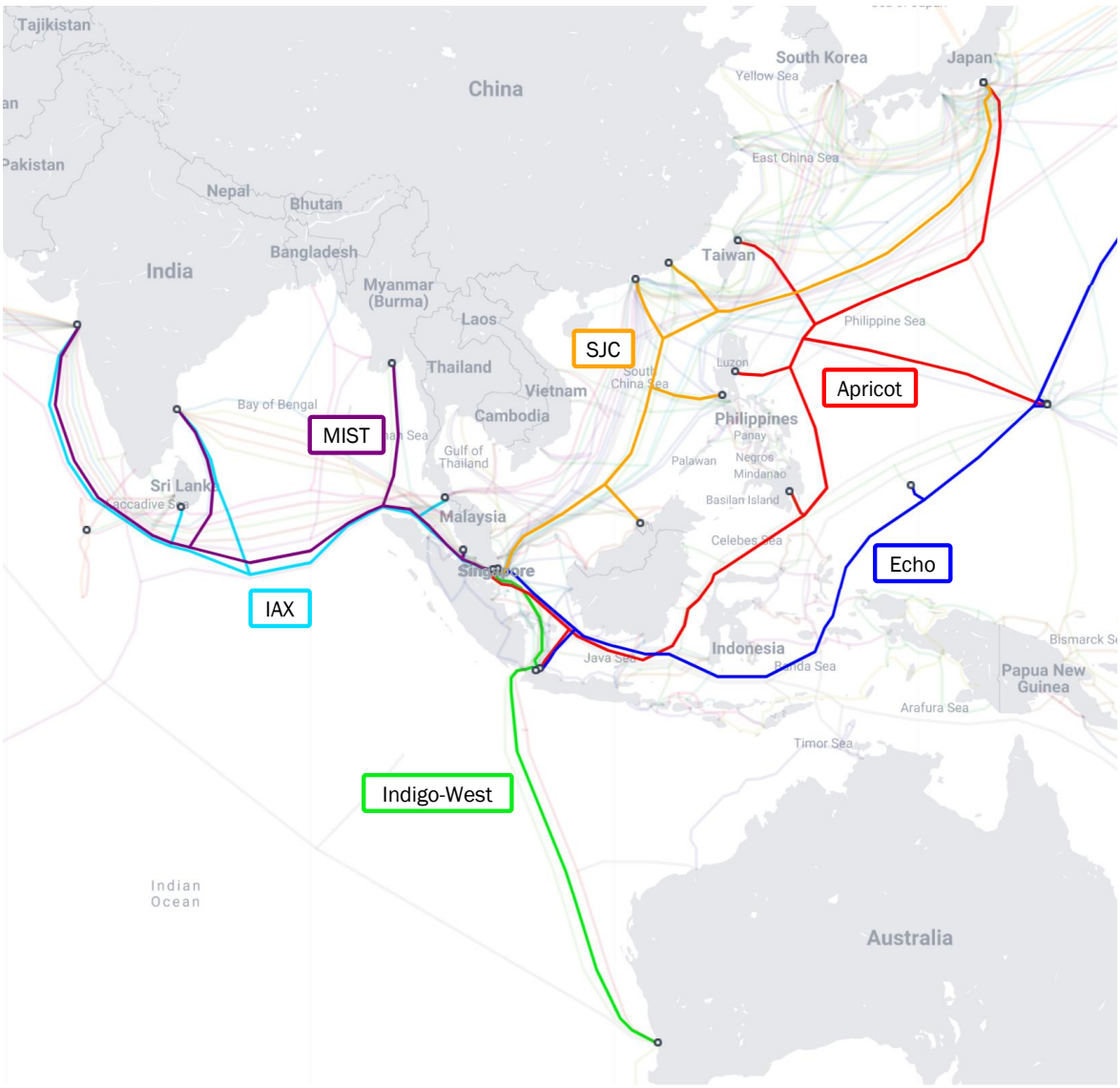
- **SJC (2013) –** Pan-Asian cable system connecting Singapore, Japan, Hong Kong, China, the Philippines, Brunei and Thailand
- **Indigo-West (2019) –** open cable system connecting Singapore, Indonesia and Australia
- **MIST (2023) –** direct cable connection between India, Singapore and other South-East Asian countries[7]
- **Echo (2023) –** first direct connection between Singapore and the USA, also connecting via Indonesia
- **IAX (2023) –** large cable system connecting Singapore, Thailand, Malaysia, the Maldives and India, as a complement to and connecting with the IEX cable system that will connect Europe to the Middle East[8]
- **Apricot (2024) –** Pan-Asian cable system connecting Singapore, Japan, the Philippines, Indonesia and Taiwan.

A map of Google's submarine cable investments that connect to Singapore is provided in Figure 1. These cables have significantly increased international capacity and internet performance for Singapore, therefore enabling sustained traffic growth since 2013 and into the future.

7 NEC – OLL and NEC Launch MIST Cable System Construction, see: nec.com/en/press/202008/global_20200821_02.html

8 Subcom – India at the Center of Two New Subsea Cable Systems to Support Exponential Data Growth, see: https://www.subcom.com/documents/2021/Media-Release-JIO-17052021.pdf

Figure 1: Map of Google's submarine cable investments that connect to Singapore [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 two private peering facilities and cross-connected to internet exchange points (IXPs) at six locations as summarised in Figure 2 below. Google also invests in content caches, and Google Global Cache (GGC) nodes are already deployed in Singapore.

Name of facility / fabric	Type	Location
BBIX Singapore	Public	Singapore
DE-CIX Singapore	Public	Singapore
Equinix Singapore	Public	Singapore
MegaIX	Public	Singapore
SGIXPeering LAN	Public	Singapore
SOX	Public	Singapore

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

Equinix (SG3)	Private	Singapore
Global Switch	Private	Singapore

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

End-user latency	End-user latency will reduce by an additional 5 milliseconds (or 16%) by 2026 with Google's investments
IP transit prices	IP transit prices are forecast to be 34% lower by 2026 due to the increased internet supply from SJC, Indigo-West, MIST, Echo, IAX and Apricot
Download speeds	In 2021, the average download speeds in Singapore were over double that of less well-connected economies[9]
Internet traffic	By 2026, we forecast that the impact of Google's investments will have enabled 29% of internet traffic[10]

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

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 Singapore has on internet connectivity. This is expected to have accelerated Singapore's transition to digitalisation both in a work context and outside of it. We estimate that the additional internet usage enabled by Google's network infrastructure investments has driven an additional cumulative USD12.9 billion in GDP (in real terms[11]) in Singapore from 2010 to 2021. As a result of Google's historical and future network infrastructure investments in Singapore, we forecast an additional cumulative USD15.6 billion in GDP enabled by Google's investments between 2022 and 2026 (see Figure 3 below). From 2013 to 2018, many other non-Google cables landed in Singapore,[12] which also contributed towards the historical and forecast internet traffic and GDP growth.

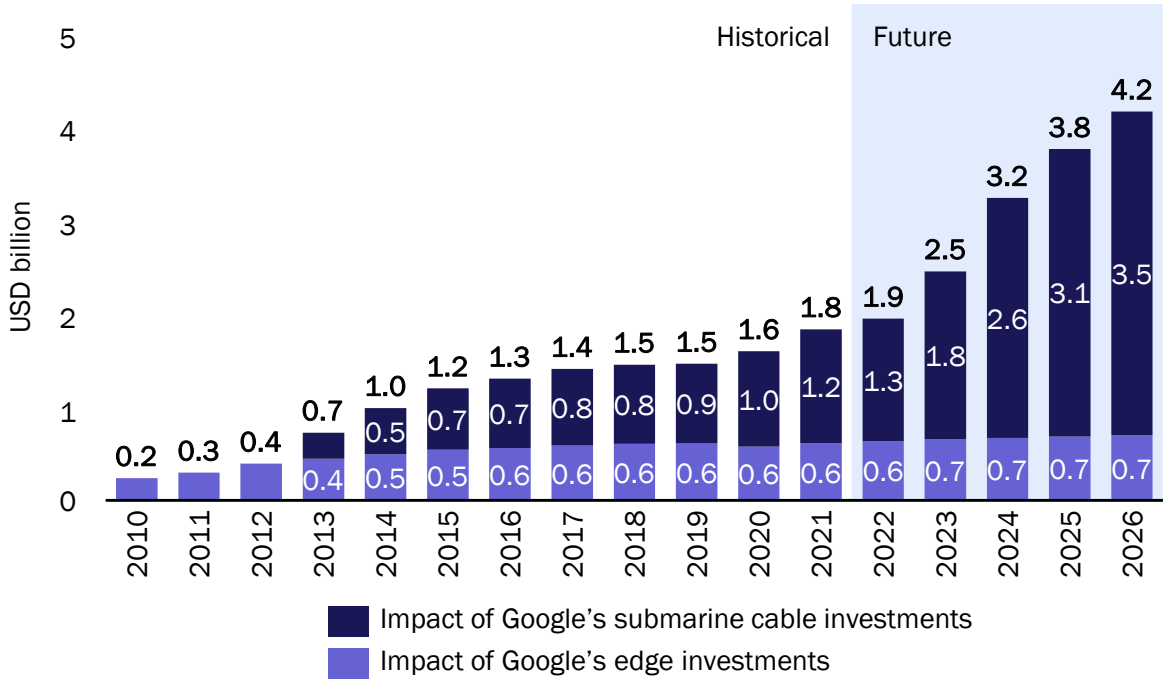
9 Google's investments in edge infrastructure and PoPs bring popular Google content closer to end users in Singapore, which contributes to faster download speeds

10 We forecast that Google's network infrastructure investments will drive an additional 41% increase in internet traffic beyond forecasts without these investments by 2026. This results in 29% of total traffic being attributed to Google's network infrastructure investments in Singapore.

11 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

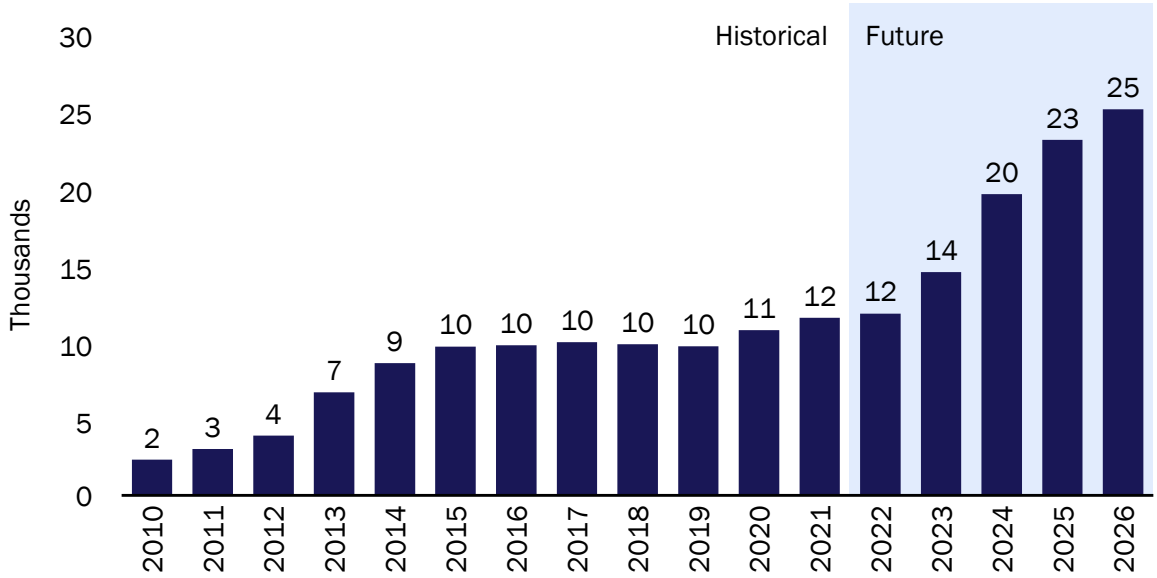
12 B2JS – 2013, Asia Pacific Gateway (APG) – 2016; SeaMeWe-5 – 2016; Australia-Singapore Cable (ASC) – 2018; Indonesia Global Gateway (IGG) – 2018, SEAX-1 – 2018

Figure 3: Increase in real GDP attributable to Google's network infrastructure investments in Singapore [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. We estimate that up to 11 500 direct, indirect and induced jobs were supported through Google's network infrastructure investments in 2021, growing to 25 000 in 2026 (see Figure 4).

Figure 4: Jobs supported by Google's network infrastructure investments in Singapore [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, which means that traffic from Google Cloud customers is shielded from internet exposure, making it less likely to be susceptible to attacks.

At the end of 2021, Google Cloud deployed in 11 cloud regions in APAC, one of which was launched in Singapore in 2017. This was the first Google Cloud region in South-East Asia and now contains three availability zones.

4 Singapore's regulatory regime is a leading example of an attractive and supportive environment for submarine cable investments

Singapore is a global leader in digital connectivity, largely due to its regulatory environment, and is seen as an example that other economies in APAC can follow. The Infocomm Media Development Authority (IMDA) acts as a central point of contact for cable owners – among other things, it provides required information for cable-related processes and facilitates permit applications with other government agencies. Singapore does not have foreign equity limits on investments in network infrastructure, and access to cable landing stations are based on non-discriminatory, cost-based terms. It has also expanded its trade agreements to encompass digital trade with Australia and the UK, promoting the digitalisation and accelerated growth of the digital economy.

Case study: Singapore's digital economy agreements

In Singapore, the Ministry of Trade and Industry (MOTI) signed two digital economy agreements with Australia (SADEA)[13] and the UK (UKSDEA).[14] Both SADEA and UKSDEA encompassed regulatory guidelines for submarine cables, including terms on:

- flexibility to choose suppliers of installation, maintenance or repair services from either country
- licence or permit requirements to be made publicly available with criteria and application processes clearly stated
- timeline for approval of licences or permits to be provided within a reasonable timeframe
- public demarcation of areas where submarine cables are present with specific activities banned within that area to protect the submarine cable
- information sharing on the location of submarine cable to inform mapping and charting

These digital economy agreements reflect Singapore's continuous efforts to elevate its status as the leading digital hub in APAC, supported further by strong regulatory enforcement and a centralised, regulator-based cable application process.

Singapore is also seen as a jurisdiction with highly effective regulatory enforcement principles. It scores well on the Rule of Law index published by the World Justice Project, with a regulatory enforcement factor score of 0.86, which is the highest in APAC and the fourth highest globally.[15] The score is assessed based on five factors provided below:

- Government regulations are effectively enforced
- Government regulations are applied and enforced without improper influence
- Administrative proceedings are conducted without unreasonable delay
- Due process is respected in administrative proceedings
- The government does not expropriate without lawful process and adequate compensation

The strong position achieved by Singapore boosts investors' confidence, particularly in the context of capital-intensive investments such as the deployment of submarine cables.

To further improve Singapore's submarine cable environment, a focus on the protection and maintenance of cables would reduce internet downtime and boost the quality of the internet for the region. Given the significance of Singapore's role in APAC's submarine cable systems, it is important to both protect cables and reduce the repair times of damaged cables. The seas around

13 Singapore Ministry of Trade and Industry, see: mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/The-Singapore-Australia-Digital-Economy-Agreement

14 Singapore Ministry of Trade and Industry, see: www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/UKSDEA

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

Singapore contain high levels of maritime activity, significantly increasing the risk of cable damage. Introducing cable protection zones where feasible, as seen in Australia, would combat this risk. To speed up the permitting process for vessels, in turn reducing overall repair times of cable faults, Singapore could implement an 'approval in principle' approach for permits, as seen in Taiwan. Currently, cable fault repair procedures require notification to the IMDA as well as approval from the Maritime & Port Authority of Singapore (MPA). These two changes would help to support the higher resilience of the internet in the region by reducing the overall downtime of cables.