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ECONOMIC IMPACT OF GOOGLE'S APAC NETWORK INFRASTRUCTURE

FOCUS ON INDONESIA

David Abecassis, Dion Teo, Goh Wei Jian, Dr. Michael Kende, Prof. Neil Gandal

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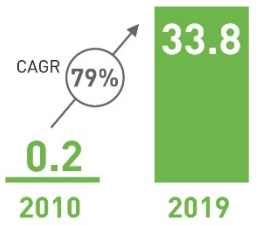
Economic impact of Google's network infrastructure in Indonesia

DATA TRAFFIC IN INDONESIA IS GROWING STRONGLY, DRIVEN IN PART BY THE POPULARITY OF GOOGLE'S SERVICES

Indonesia data traffic growth 2010–2019 (EB)



12% Google services' share of APAC internet traffic

GOOGLE INVESTED OVER USD2 BILLION IN NETWORK INFRASTRUCTURE ACROSS APAC, WHICH SUPPORTS THE INTERNET IN INDONESIA

>$2bn

Google's APAC network infrastructure investment

Indonesia investments

- **1** Indigo submarine cable
- **3** private facilities and **2** IXPs with Google PoPs
- **~35%** of bandwidth purchased from telcos
- **34** cities where GGC nodes are deployed

GOOGLE'S INFRASTRUCTURE INVESTMENT HELPS INDONESIA REALISE STRONG ECONOMIC BENEFITS FROM INCREASED INTERNET USAGE

Last 10 years (2010-2019)	Next 5 years (2020-2024)
160 000 Jobs	**623 000** Jobs
$20bn in GDP	**$48bn** in GDP

1 All currency in USD, in real 2019 terms

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THESE INVESTMENTS IMPROVE THE CONNECTIVITY ECOSYSTEM WHICH BENEFITS CONSUMERS AND BUSINESSES

2024

4.6 million internet users

59 Exabytes internet traffic

36Tbit/s in additional capacity

11ms reduction in end-user latency

Future improvement of download speeds (currently high in APAC)

Future reduction of IP transit prices (currently high in APAC)

3 new use cases supported

- Video Conference
- Commerce and Transactions
- Cloud Services

INDONESIA CLOUD SPEND IS EXPECTED TO GROW STRONGLY DRIVING ADDITIONAL ECONOMIC BENEFITS

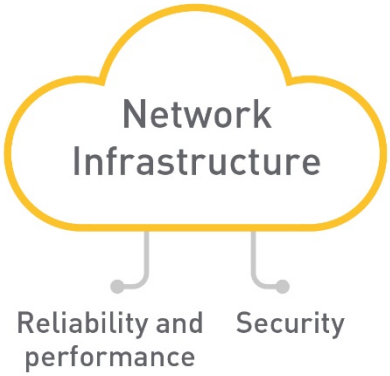
Indonesia cloud spend (USD bn) 2018–2023

Benefits of cloud adoption

- Supports digital transformation agenda
- Additional economic impact from 2019-2023

345 000 Jobs **$36bn** in GDP

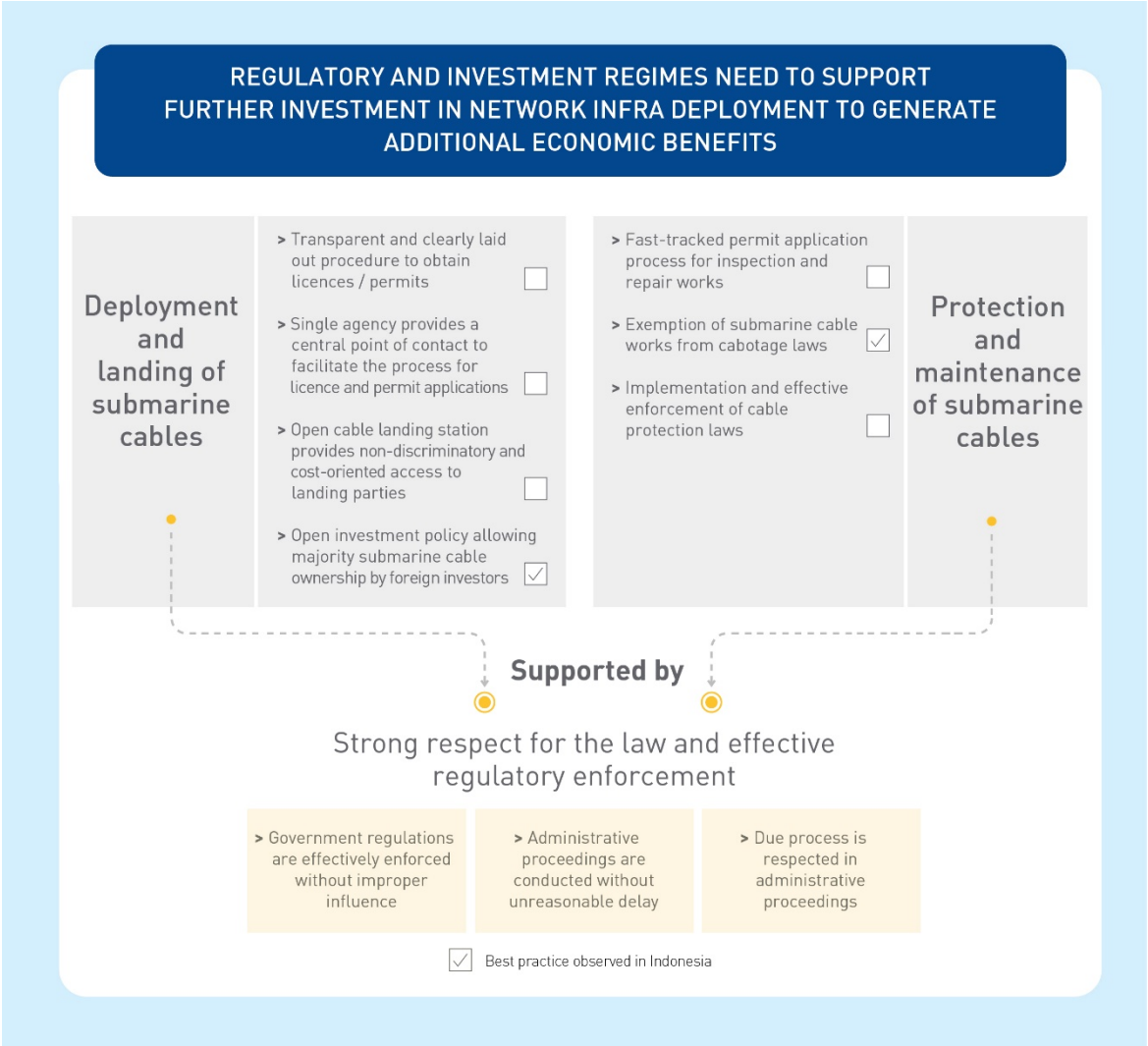
NETWORK INFRASTRUCTURE IS IMPORTANT FOR CLOUD – IT IMPROVES:



Case Study: Traveloka

Traveloka deployed Google Cloud solutions to support its rapid business expansion, continuously supporting more than 40 million monthly active monthly users and an average of 500 000 daily booking transactions across seven countries.

"[GCP] provides low end-to-end latency, fully managed infrastructure with 99.9% system availability, along with auto-scaling of storage and compute"


REGULATORY AND INVESTMENT REGIMES NEED TO SUPPORT FURTHER INVESTMENT IN NETWORK INFRA DEPLOYMENT TO GENERATE ADDITIONAL ECONOMIC BENEFITS
Deployment and landing of submarine cables
> Transparent and clearly laid out procedure to obtain licences / permits
> Single agency provides a central point of contact to facilitate the process for licence and permit applications
> Open cable landing station provides non-discriminatory and cost-oriented access to landing parties
> Open investment policy allowing majority submarine cable ownership by foreign investors
> Fast-tracked permit application process for inspection and repair works
> Exemption of submarine cable works from cabotage laws
> Implementation and effective enforcement of cable protection laws
Protection and maintenance of submarine cables
Supported by
Strong respect for the law and effective regulatory enforcement
> Government regulations are effectively enforced without improper influence
> Administrative proceedings are conducted without unreasonable delay
> Due process is respected in administrative proceedings
Best practice observed in Indonesia

Indonesia is one of the fastest growing economies in ASEAN with between half and two-third of Indonesians connected to the internet in 2019.[2] Internet traffic generated across both fixed and mobile networks has been growing strongly at around 79% annually from 2010 to 2019, reaching 34EB in total in 2019.

There are four main telecoms service providers in Indonesia:

- **Telkom Indonesia**, the incumbent and largest fixed and mobile operator in Indonesia
- **XL Axiata**, backed by Axiata Group
- **Indosat Ooredoo**, majority-owned by Ooredoo Asia
- **Hutchison 3 Indonesia,** the fourth MNO in Indonesia and is part of the Hutchison Asia Telecom Group.

Fixed broadband networks fall behind mobile networks in terms of coverage, with only roughly 48% of households[3] having access to fibre broadband, while 93% of population are within range of 4G mobile services.[4]

Indonesia is connected to 18 international submarine cable systems that in 2019 offered a total of 324Tbit/s in potential capacity.[5] While it has a relatively large number of submarine cables, they are heavily reliant on the route to Singapore, and greater route diversity will be important.

1 Google's network infrastructure investments have already contributed to higher internet usage in Indonesia, equivalent to 12% of total internet traffic in 2019

Google's investments in network infrastructure not only help to improve service performance and reliability of its content and services, they also improve the overall performance and cost-effectiveness of internet infrastructure in Indonesia. Investments in submarine cables bring new supply, improve the diversity of links and also support the expansion of Google's edge infrastructure in Indonesia. The connectivity improvements include lower latency, faster end-user speeds, lower cost of international connectivity and stimulation of new use cases. These effects translate into more internet traffic generated by both consumers and businesses in Indonesia.

Google is an investor in the Indigo cable, which went live in 2019 and connects Australia, Singapore and Indonesia. The Indigo cable is expected to bring an estimated 36Tbit/s of additional capacity to Indonesia. While Google is an investor in the Indigo cable, it does not have landing points in Indonesia and it needs to purchase capacity provided by telecoms carriers to fulfil their capacity requirements.

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2 The ITU estimated that 40% of Indonesians had used the internet within a three-months period in 2018, whereas the Indonesia Internet Service Providers' Association estimated internet penetration at about 65% in the same year

3 FTTx coverage and capex worldwide: forecasts and analysis 2019–2025, Analysys Mason Research

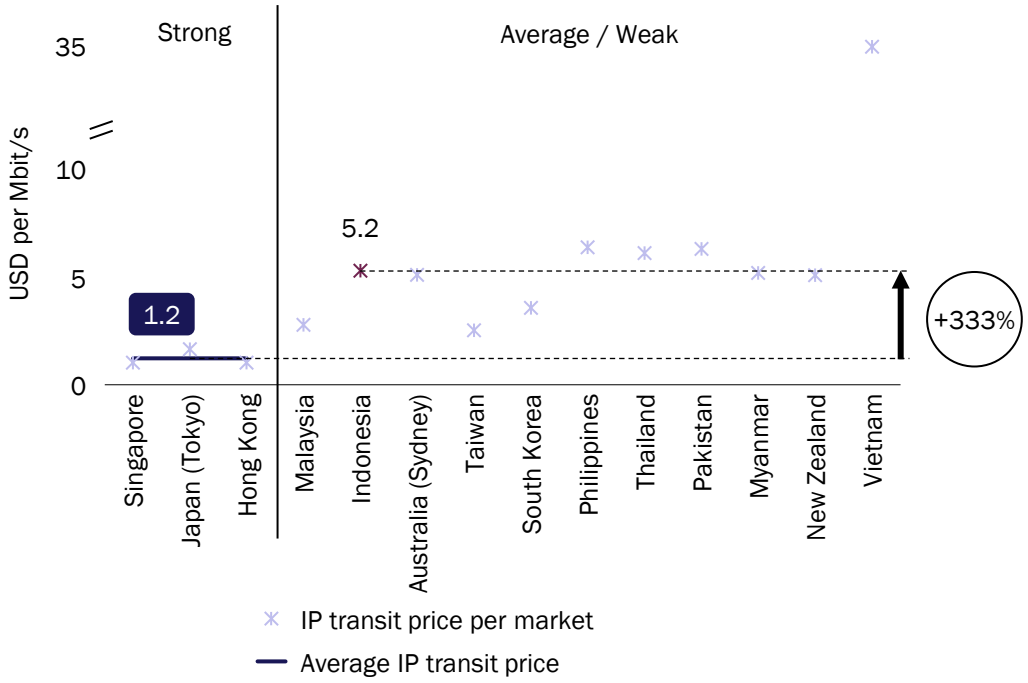
4 Analysys Mason Research

5 Refers to the estimated theoretical maximum capacity that a cable could handle with current technology

Besides bringing additional bandwidth into Indonesia, Google's investment in the Indigo cable also improves route diversity. This could also improve end-user latency: our modelling suggests that Google's investments could correlate with a reduction in end-user latency of about 11m by 2024.

IP transit prices in Indonesia are currently higher than well-connected countries in APAC as shown in Figure 1. As new cables are launched through Google's investments, the cost of international bandwidth will decline and narrow the gap between Indonesia and the best-connected economies in the region.

Figure 1: IP transit prices[6] across APAC [Source: TeleGeography, Analysys Mason, 2019]



6 Refers to USD per Mbit/s of IP transit prices in 2019 based on the committed data rate of 10Gbit/s from TeleGeography; calculation is based on averaging the weighted median prices by cities and quarters (up to Q3 2019) to derive 2019 prices; IP transit price data for 10Gbit/s is referenced, as it provides the highest number of available data points (14 APAC economies with submarine cables)

Apart from investments in international capacity, Google has also invested in edge infrastructure and deployed PoPs in three private peering facilities and cross-connected to four IXPs as shown in Figure 2 below. GGC nodes are also deployed in operator networks across 34 cities in Indonesia.

Name of facility / fabric	Type	Location
DCI Indonesia	Public	Jakarta
IIX-Jakarta	Public	Jakarta
JKT-IX	Public	Jakarta
OpenIXP	Public	Jakarta
Cyber Data Center International	Private	Jakarta Selatan
DCI Indonesia	Private	Kabupaten Bekasi
NTT Com Jakarta	Private	Jakarta

Figure 2: List of Google peering facilities in Indonesia [Source: Google, PeeringDB, 2020]

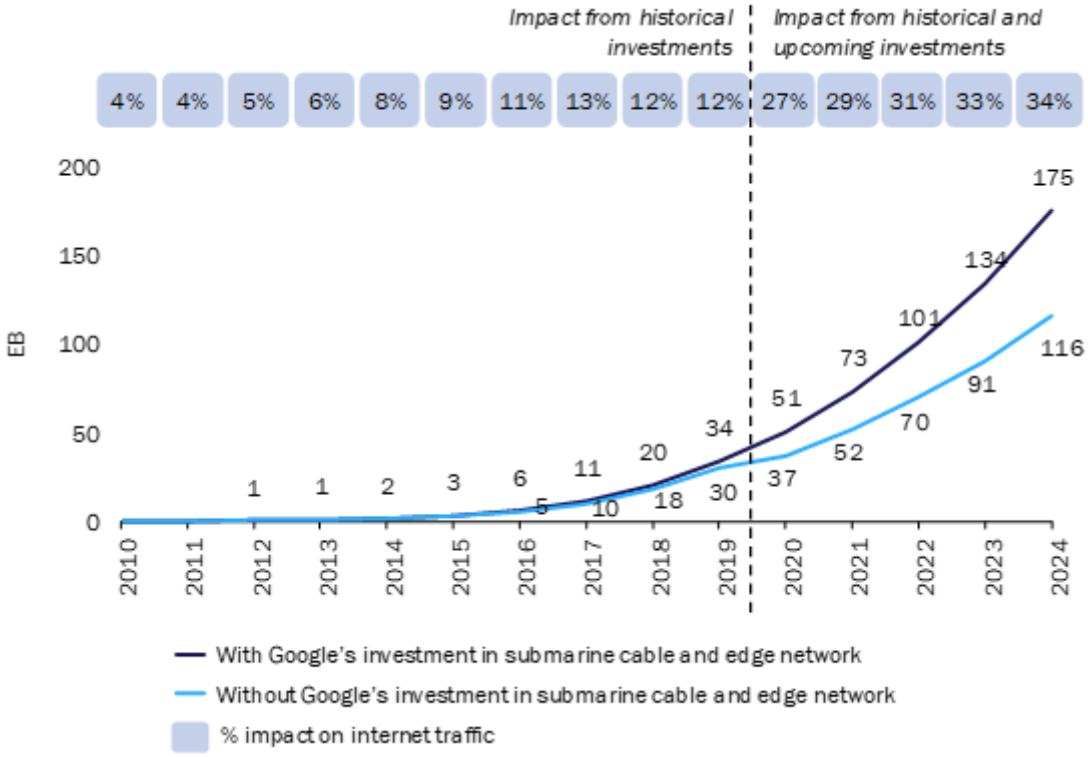
These investments in network infrastructure allow Google to deliver more traffic and at a better quality of service to Google users, and also positively impact the connectivity ecosystem in Indonesia.

Improvements in latency and internet speed increase ISPs' ability to deliver innovative services such as cloud services, video conferencing and gaming. Low latency is also critical for transactional services, including e-commerce.

The end result of these improvements is greater demand for the internet in Indonesia: based on Analysys Mason's modelling, we estimate that internet traffic in Indonesia would have been 12% lower in 2019 had Google not invested in network infrastructure. This impact is expected to increase materially as demand for internet services grows in Indonesia and Google-invested submarine cables start to have a greater impact, to 34% by 2024, as seen below in Figure 3.[7] Our modelling further estimates that the Indigo cable could lead to 4.6 million additional internet users by 2024 in Indonesia.

[7] This takes into account the effect of the entire submarine cable system(s) that Google participates in. As explained in Annex A of the full report, the fact that Google was an investor in these systems appears to have a statistically significant effect on their impact in countries they serve.

Figure 3: Impact of Google's investments in edge network infrastructure on internet traffic served by Google's services in Indonesia [Source: Analysys Mason, 2020]



2 Google's network infrastructure investment benefits the internet ecosystem in Indonesia, supporting 160 000 jobs

The increase in internet use has a positive impact on economic activity across various sectors, leading to benefits for consumers and businesses. We estimate that the increase in internet usage contributed USD20 billion in GDP impact (in real terms[8]) in Indonesia from 2010 to 2019; in 2019, we estimate that GDP would have been 0.17% lower in the scenario where Google had not made investments in network infrastructure.

Google's continued network investments from 2020 onwards are expected to help spur higher internet traffic usage. The historical and continued investments are expected to contribute an additional USD48 billion in GDP impact from 2020 to 2024, of which USD13 billion would be in 2024 alone (see Figure 4 below). This GDP impact represents the mid-range of Analysys Mason's modelling estimates and could range between USD12 billion and USD89 billion from 2020 to 2024 (see Figure 5 below).

8 GDP figures are in constant USD using 2019 as the base year and using a fixed exchange rate to USD in 2019; GDP statistics in USD are sourced from the World Bank and Euromonitor

Figure 4: Increase in real GDP attributable to Google's network infrastructure investments in Indonesia [Source: Analysys Mason, 2020]

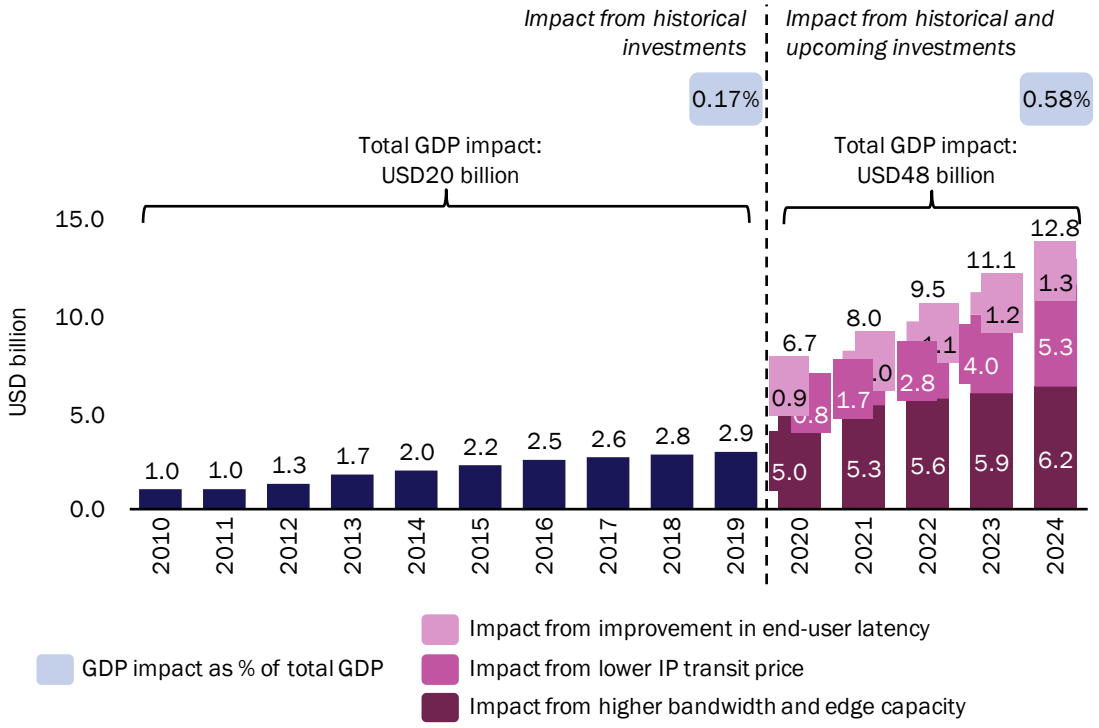


Figure 5: Increase in real GDP from 2020 to 2024 attributable to Google's network infrastructure investments in Indonesia by modelling scenarios and connectivity components [Source: Analysys Mason, 2020]

Drivers of data traffic impacting GDP	Conservative[9]	Base case[10]	Aggressive[11]
Bandwidth and edge impact + IP transit price + Latency impact	27	48	89
Bandwidth and edge impact + IP transit price impact	25	43	79
Bandwidth and edge impact only	12	28	62

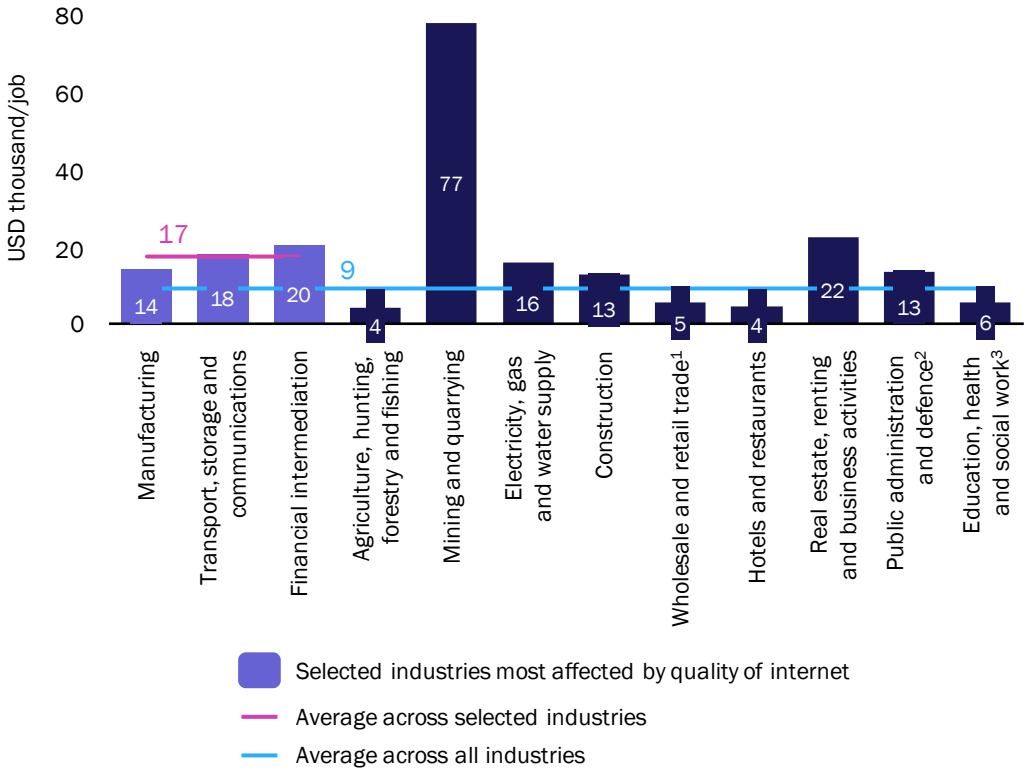
The economic benefits arising from Google's network infrastructure investments translate into jobs: direct jobs in the construction and telecoms sector and indirect jobs driven by the improvement of broadband connectivity across the broader economy, particularly in industries such as IT, financial services and manufacturing. Based on an assessment of gross value added (GVA) across industries in Indonesia, we estimate that, in 2019, the average GVA per job was USD17 000 in industries most affected by the quality of the internet (see Figure 6 below).

9 The conservative modelling scenario refers to the use of coefficients (within the 95% confidence interval) in the supply and demand side equations to provide the lowest GDP impact. Specifically, the *highest* coefficient values are used in the supply side equation for latency and both latency and IP transit price variables in the demand side equation for mobile data usage; the *lowest* coefficient values are used in the supply side equation for internet bandwidth and internet bandwidth variable in the demand side equation for mobile data usage

10 The base case modelling scenario refers to the use of mid-point coefficients (within the 95% confidence interval) in the supply side equations (coefficients for submarine cable count and Google submarine cable percentage variables) and demand side equation (coefficients for internet bandwidth); Latency and IP transit price variables in the demand side equation are kept at the highest coefficient values which provides the lowest GDP impact

11 The aggressive modelling scenario refers to the use of coefficients (within the 95% confidence interval) in the supply and demand side equations to provide the highest GDP impact while keeping latency and IP transit variables unadjusted (see above base case modelling scenario). Specifically, the lowest coefficient values are used in the supply side equation for latency; the highest coefficients are used for the supply side equation for internet bandwidth and the internet bandwidth variable in the demand side equation for mobile data usage

Figure 6: 2019 GVA per job by industry in Indonesia [Source: Analysys Mason, national statistics authority via Euromonitor, 2020]



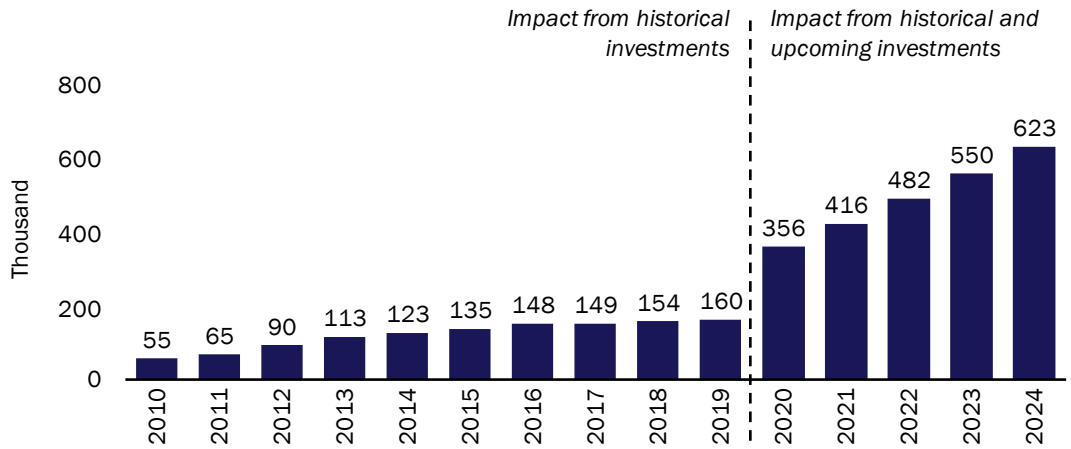
[1] Includes repair of motor vehicles, motorcycles, personal and household goods

[2] Includes compulsory social security

[3] Includes other community, social and personal service activities

The GVA per job estimates for the selected industries will grow in line with expected growth in productivity. Based on this assessment, we estimate that Google's network investments and its impact on GDP translated to around 160 000 jobs by 2019, which will grow to 623 000 jobs by 2024 (see Figure 7 below).

Figure 7: Impact of Google's network investments on job creation in Indonesia [Source: Analysys Mason, 2020]



3 Investments in network infrastructure contribute to the reliability and security of the cloud, driving further positive economic impacts in a segment growing at 25% annually

According to BCG's "Ascent to the Cloud" report, Indonesia's cloud market is still in its formative stages and has one of the fastest growing cloud markets in APAC. The country's public cloud spend is growing at 25% annually, from USD0.2 billion in 2018 to an expected USD0.8 billion in 2023. The increase in cloud expenditure is expected to have a cumulative GDP impact of USD36 billion between 2019 and 2023 and support 345 000 jobs in 2023.[12]

Google is an important player among public cloud service providers in the world. At the end of 2019, GCP had been deployed in seven cloud regions in APAC and it has plans to deploy a new cloud region in Indonesia in 2020.[13] The region will be designed for high availability with three availability zones.

Google's network infrastructure investments provide route diversity, connecting cloud regions in Indonesia to other regions through different paths and enable low service latency, high levels of availability and increased resilience to cable cuts. These are important to cloud customers as seen from the case study below.

12 The studies underlying the cloud market forecasts were conducted before the onset of the COVID-19 pandemic and thus did not include the effects on the economy arising from COVID-19. We have left these forecasts unchanged, although the forecasts used for the main economic impact assessment in this report reflect updated forecasts as of June 2020. The size of the cloud services market may actually increase faster than anticipated as a result of COVID-19

13 Google Cloud Blog, see: https://cloud.google.com/blog/topics/infrastructure/new-google-cloud-regions-for-2020

Case study: Traveloka deployed GCP solutions to support its rapid business expansion

Traveloka is a technology 'unicorn'[14] in the online travel business and is based in Indonesia. Since its inception in 2012, Traveloka has expanded its operations to cover seven countries in APAC, supporting more than 40 million active monthly users and an average of 500 000 daily booking transactions.[15]

One of the most strategically valuable parts of Traveloka's business is a streaming data processing pipeline that powers multiple business use cases, including fraud detection, ad optimisation and the monitoring of business performance. Since its business was scaling rapidly, Traveloka saw the need to develop its data analytics architecture and outlined the following requirements to support its growth:

- Low end-to-end latency within a guaranteed service-level agreement
- Fully managed infrastructure, providing resilience/99.9% end-to-end system availability and auto-scaling of storage and compute

Traveloka eventually opted for and deployed GCP solutions, namely 'Cloud Pub/Sub', 'Cloud Dataflow' and 'BigQuery' to meet its performance requirements.[16] Supported by Google's network infrastructure, these GCP solutions allowed Traveloka to meet its end-to-end availability requirement and also manage large volumes of data quickly and handle changes in volume and throughput. Empowered by higher speed, greater reliability and enhanced availability through the resilient network infrastructure underpinning GCP, Traveloka is now well positioned for the next phase of its business expansion.

Besides improving the performance of cloud services, Google's network investments also serve as the underlying infrastructure layer delivering cloud traffic. Carrying cloud traffic on Google's own network reduces the security risks, making it less likely that GCP customers' traffic will be attacked, intercepted, or manipulated by malicious actors.

4 Indonesia could consider adoption of regulatory best practices to stimulate more investment in network infrastructure

Indonesia has been making progress in liberalising the telecoms landscape by allowing foreign ownership of telecoms assets including submarine cables landing in Indonesia. Cabotage laws have also been relaxed for submarine cable repair vessels since the announcement from the 2016 ICPC

14 Defined as a start-up company with a value of over USD1 billion

15 Bangkok Post – "Traveloka widens to lifestyle", Nov 2019; see https://www.bangkokpost.com/business/1792399/traveloka-widens-to-lifestyle

16 Traveloka, Google Cloud – "Traveloka's journey to stream analytics on Google Cloud Platform", Apr 2018; see https://medium.com/traveloka-engineering/travelokas-journey-to-stream-analytics-on-google-cloud-platform-3d013d6bf7c9

Plenary.[17] These are helpful steps towards stimulation of further investment of network infrastructure into Indonesia.

However, interviews with submarine cable owners reveal the existence of barriers in Indonesia which could deter future investments. This includes a lengthy process to receive approvals for submarine cable landing and repair works, which favours the involvement of Indonesian parties to navigate regulatory hurdles and handle discussions with local authorities. The removal of informal requirements and procedures to make the permit application process transparent and clear will provide certainty and encourage more investments in the future.

In terms of the protection and maintenance of submarine cables, Indonesia could consider cable protection zones which would reduce the likelihood of cable damage due to human activity and also put in place a clear, transparent and fast-tracked permit application process for submarine cable repairs. Based on data from the ICPC, the average repair commencement time for submarine cables in Indonesia averages around 40 days, with average 'notified to departure' time of around 25 days, signifying a lengthy process to receive permits for conducting cable repairs.[18]

17 See: https://www.businesswire.com/news/home/20160425006234/en/%E2%80%9CVoice-Global-Subsea-Cable-Critical-Infrastructure%E2%80%9D-Resonates

18 A Global Comparison of Repair Commencement Times: Update on the Analysis of Cable Repair Data, ICPC 2020