

Safeguarding the road to 5G in Malaysia

An economic risk assessment of Malaysia's 5G
plan

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DT Economics

DT Economics LLP is a specialist consulting firm based in London focusing on regulation, competition and expert witness services.

DT Economics has been commissioned by GSMA to produce an independent economic expert report to qualitatively assess the Malaysian proposals for 5G network deployment. All views expressed in this report are those of DT Economics LLP.

This report was completed prior to the release of the MCMC public inquiry paper: “Review of Access List”. As a result, we have not incorporated the regulatory framework elements outlined in the inquiry paper in our analysis. However, we welcome the public inquiry and note that some of the issues raised in our report are included as areas for consultation. We note that time is still very tight to have all the elements of the regulatory framework in place before the launch of 5G services in Malaysia later this year.

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1 Executive summary

- 1.1 Malaysia has made a bold decision to implement a government-owned Single Wholesale Network (SWN). However, national SWNs have a poor track record of successful implementation in other countries¹ (including Mexico's SWN recently filing for bankruptcy protection in July 2021²). Lessons learned elsewhere, including those outlined in our case studies for Australia, UK, South Korea and Mexico, suggest a number of serious risks for the current 5G plan in Malaysia. Without clear mitigation strategies, Malaysia's vision to become a regional leader in the digital economy is under threat.
- 1.2 Our report highlights these risks and offers guidance on how they can be addressed. We note there are a range of unknowns in the Malaysian context (including a lack of clarity on the regulatory framework for the SWN). This adds to the complexity in crafting a mitigation strategy. To address this, we recommend MCMC continue to conduct detailed consultations with all stakeholders (industry, consumers and civil society) to identify concerns and agree workable solutions.

Successful 5G network deployment is key to achieving the Malaysian Government's vision to become a regional leader in the digital economy

- 1.3 5G network deployment is a key 'thrust' in the Government's Digital Economy Blueprint (the Blueprint) published in 2021.³ The central vision of the Blueprint is to transform Malaysia into a
- "...digitally driven, high income nation and a regional leader in digital economy".*
- 1.4 As part of the efforts to accelerate innovation and create an efficient digital ecosystem, the Government has also initiated four key digital infrastructure projects under its MyDigital initiative. One such initiative involves investing RM 15 billion over ten years to construct a national 5G network, through a Special Purpose Vehicle (SPV) called Digital Nasional Berhad (DNB).

Malaysia has a thriving mobile sector: there are major risks associated with the current proposals for 5G

- 1.5 The digital sector in Malaysia has shown steady growth in the last decade. According to the GSMA Intelligence's digital society index,⁴ in 2019 Malaysia was the top performer in the Transition category with 67 points for the Connectivity, just behind Japan, Australia, Singapore and South Korea. By 2021, Malaysia was forecast to have over 95 per cent⁵ of all of its connections being capable of mobile broadband.

¹ See, for example, GSMA (2019) Single Wholesale Networks – Lessons from existing and earlier projects, December (<https://www.gsma.com/spectrum/resources/woan-report/>)

² See <https://www.reuters.com/business/media-telecom/altan-redes-files-bankruptcy-protection-mexico-2021-07-14/>

³ <https://www.epu.gov.my/sites/default/files/2021-03/Malaysia-Digital-Economy-Blueprint.pdf>

⁴ GSMA, Advancing digital societies in Asia Pacific: a whole-of-government approach, (2020). <https://www.gsma.com/asia-pacific/wp-content/uploads/2020/11/201031-DigiSoc.pdf>

⁵ GSMA (calculated), 2021.

- 1.6 Malaysia has already achieved a competitive mobile market. It has four major Mobile Network Operators (**MNOs**), each having a market share of between 18 and 28 per cent, with one additional smaller player (with a market share of less than 5 per cent). Malaysia also has a small, but a well-established, Mobile Virtual Network Operator (**MVNO**) market hosted by the largest four MNOs.⁶
- 1.7 By entrusting the 5G network deployment to the DNB, a competitive wholesale mobile market structure for 5G will be replaced with a nationalised monopoly. While the existing MNOs will be allowed to continue to compete in the provision of 4G (and lower technology) mobile services, they will be entirely reliant on wholesale access to the DNB's network for 5G services.
- 1.8 While this approach presents opportunities, it comes with significant potential risks. The opportunities include lower capital expenditure associated with the roll-out of one national network (instead of multiple 5G networks) and the potential lower cost of financing. We highlight the main risks in Figure 1-1.⁷
- 1.9 It is particularly important to **clarify formally**, such as through a Memorandum of Understanding (**MoU**), **that the DNB is a radio access network (RAN) wholesale only network operator**: this will ensure its main role will be one of building, operating and maintaining the 5G network in Malaysia.
- 1.10 In identifying the key risks associated with the proposals (and formulating ways in which these could be mitigated) we also rely on insights from four country case studies where governments have sought to achieve similar policy objectives with different degrees of success. These case studies also help illustrate some of the important economic principles to be aware of when contemplating infrastructure projects of this size and complexity. These are discussed in detail in the Annex.
- 1.11 We have not been able to identify a clear market failure to justify the proposed intervention in the 5G market. A monopolist with exclusive rights to offer 5G wholesale services (and with no clarity on the framework for how its prices will be regulated) will be, in our view, to the detriment of consumers and enterprises and the broader ambitions of Malaysia to digitise the economy.

⁶ See Section 2 of this report.

⁷ See Section 3 of this report.

Figure 1-1 Key potential risks associated with the introduction of the DNB in Malaysia.

| Key risks | Rationale |
|---|---|
|  Risk 1 Lack of clarity in policy objectives | Clarity on these objectives is a must to ensure the DNB is fit for its purpose, subject to an appropriate regulatory framework and its performance is judged against an appropriate set of indicators. |
|  Risk 2 Adverse impact on economic efficiency | Given one of the Malaysian Government's key considerations is to reduce the deployment costs of the 5G network, there is a risk that productive efficiency (eg lower costs of network deployment) is maximised to the detriment of allocative and dynamic efficiency (eg innovation in the type and quality of 5G services offered over time). As a monopoly network operator, it is vital that the DNB is incentivised to invest and innovate. |
|  Risk 3 Unclear approach to spectrum pricing | When allocating spectrum to the DNB it is important that Government implements an approach (including pricing) which minimises potential competitive distortions (between different mobile services and/or MNOs). |
|  Risk 4 Unclear regulatory approach to wholesale prices | As a monopoly network operator, the DNB would have the incentive and ability to use its position for its own commercial advantage. This would be particularly the case when negotiating wholesale access prices (either in relation to its 5G network or other operators' assets, such as towers and fibre). |
|  Risk 5 Poor Quality of Service (QoS) outcomes | There is a risk that, in the absence of regulation, the level of quality offered on the DNB network does not fulfil the requirements of end-users. This risk is particularly important in the context of the innovative applications that 5G is expected to provide in the enterprise sector, some with critical service delivery requirements. |
|  Risk 6 Unclear approach to network resilience | Clarity is key on how the DNB is planning to secure network resilience (including mitigating against the risks of relying on a single vendor) and whether the cost implications of this have been considered in the funding requirements. |
|  Risk 7 DNB funding and financing risk | The DNB has yet to set out how it proposes to take to minimise key project related execution risks, including financing (to ensure the upfront cash required to build the network) and funding (to ensure the long-term maintenance and operation of the network) requirements. |
|  Risk 8 Lack of clarity of DNB mandate | It is important for the Malaysian Government to clarify the DNB's strategic priorities, including its role and responsibilities. It is also vital to confirm that the DNB is a wholesale only operator. |

It is important to urgently get clarity on DNB's mandate and the regulatory framework under which it will be governed

1.12 There are several ways in which the key risks identified in this report can be mitigated:⁸

- *Clarify the DNB's mandate and regularly monitor its performance against its strategic objectives.* It is important to clarify DNB's strategic objectives, as well as specific role and responsibilities. This is all the more important, given Ericsson have been contracted to design, build and maintain the 5G network.

To ensure the DNB remains fit for purpose, it is important to monitor its performance. For example, and as discussed in this report, it would be preferable to undertake a mandated commercial and regulatory review of the DNB structure, with the ability to reform and

⁸ See Section 4 of this report.

change elements of its governance structure. This review could be undertaken by the MCMC/Government every 2 to 3 years.

- *Introduce a fit for purpose wholesale regulatory regime at the same time as the DNB starts its commercial operations.* This will be key to ensuring regulatory certainty and a level playing field amongst all operators in the retail market. In particular, it is important to clarify the regulatory obligations that the DNB will be required to comply with around the provision of access, new product development, wholesale access prices, quality of service and network resilience.

If the regulatory framework is introduced with a delay and, in the interim, the DNB is allowed to commercially negotiate its wholesale access prices, it is important that these prices are made transparent to the whole industry to minimise competitive distortions. This is crucial, given downstream operators will be entirely reliant on the DNB as the only wholesale 5G network in Malaysia.

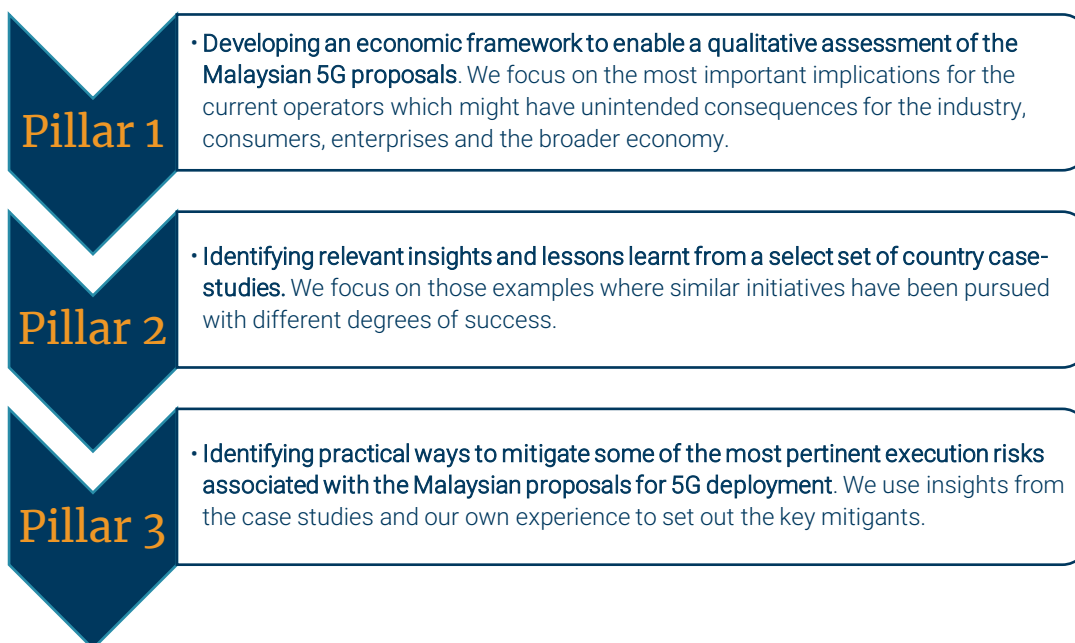
- *Retain flexibility to allow alternative delivery options for 5G networks and services in Malaysia.* In any big infrastructure project, there are always risks of delays and other unexpected developments. There is merit in the Government being open to alternative options for network delivery such as allowing current MNOs to a) use their existing spectrum to provide 5G services, b) deploy 5G networks in certain geographies/sectors of the economy and c) enter into co-investment agreements with the DNB.

Considering alternative delivery options is particularly important for the provision of 5G services to the enterprise sector, where customer requirements are likely to be more specific and stringent. Timely delivery of 5G services to the enterprise sector would also allow the Malaysian economy the opportunity to spring back from the economic and societal challenges of the pandemic.

2 Background and context

Introduction to this report

- 2.1 This is an independent economic expert report prepared by DT Economics to conduct a qualitative economic risk assessment of the Malaysian proposals for 5G network deployment.
- 2.2 Our report is based on three main pillars:



- 2.3 In this first section we briefly set out the background context to our report, including a short discussion of the future benefits of 5G and the latest proposals from the Malaysian Government on how to facilitate its timely deployment.

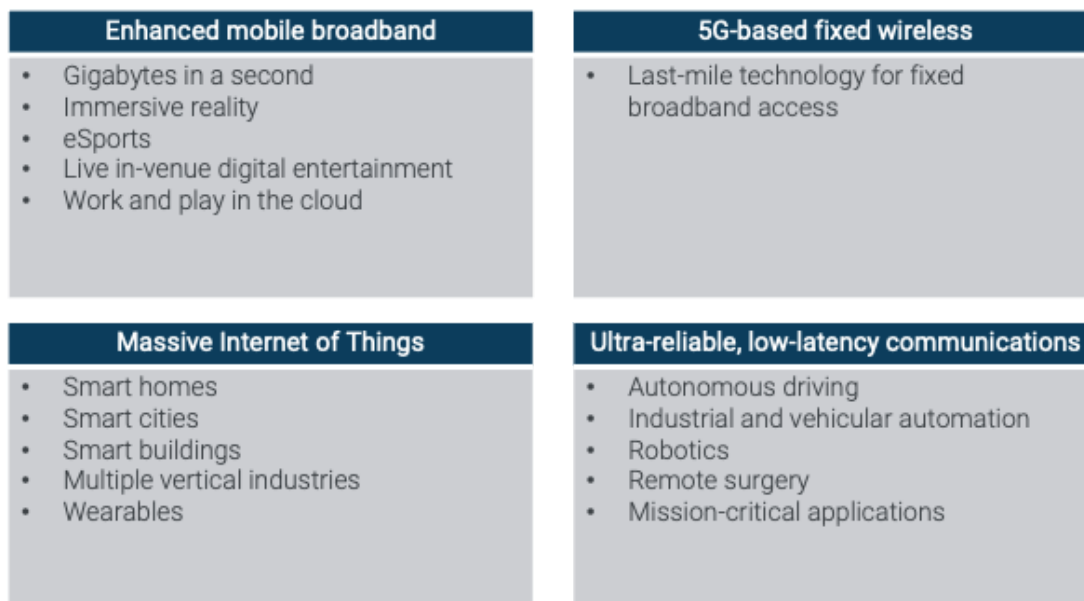
The need to get 5G right

- 2.4 5G, as the next generation in mobile technology, is expected to be transformative creating benefits for consumers, enterprises and society at large. It is expected to be both **evolutionary** and **revolutionary**.
- 2.5 The main advantages of 5G, over 4G, can be briefly summarised as: **greater transmission speeds** (approaching 15 or 20 Gbps), **lower latency** (10 times less), the ability to **connect a greater number of devices** (10-100 times connected devices) and **greater capacity** (1,000 times) providing connectivity adjusted to specific user needs.
- 2.6 As discussed in a recent GSMA study,⁹ to make the most of 5G it is important to adopt a technology neutral approach and to implement a regulatory framework that is flexible, encourages investment and at the same time protects consumers.

⁹ https://www.gsma.com/publicpolicy/wp-content/uploads/2020/03/Realising_5Gs_full_potential_setting_policies_for_success_MARCH20.pdf

2.7 5G is expected to support a wide range of innovative services and applications – some known, many unknown. Figure 2-1 summarises the key expected ‘use-cases’ of 5G services. 5G is forecast to contribute \$2.2 trillion to the global economy over the next 15 years.¹⁰

Figure 2-1 Expected use cases of 5G.¹¹



2.8 Given the novel services that will be provided over it and the associated economic and societal benefits, it is important to ensure the right policy approach is adopted from the outset to facilitate the successful deployment of 5G networks.

The mobile sector in Malaysia

Malaysia has a thriving mobile sector, which is a major contributor to the overall economy

2.9 Over the last decade, the Malaysian telecoms market has seen a steady growth and increasing use of telecoms products with Malaysian society. According to the GSMA Intelligence’s digital society index,¹² in 2019 Malaysia was the top performer in the Transition category with 67 points for Connectivity, just behind Japan, Australia, Singapore and South Korea. By 2021, Malaysia was forecast to have over 95 per cent¹³ of all connections being capable of mobile broadband.

¹⁰ GSMA, The 5G Guide: A reference for operators, April 2019.

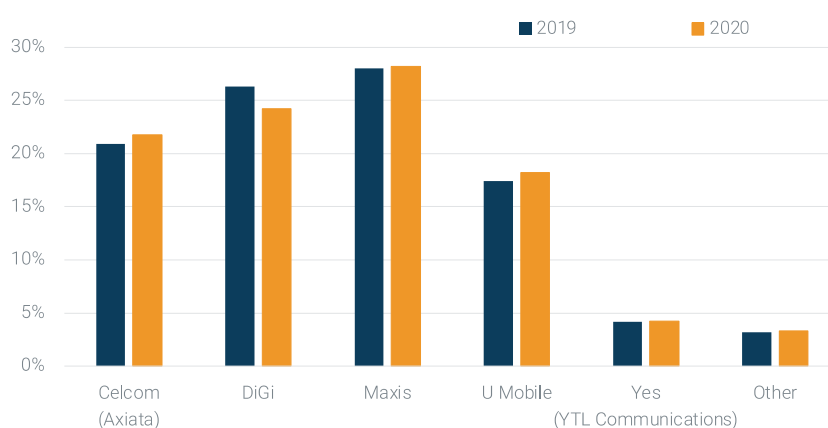
¹¹ GSMA.

¹² GSMA, Advancing digital societies in Asia Pacific: a whole-of-government approach, (2020). <https://www.gsma.com/asia-pacific/wp-content/uploads/2020/11/201031-DigiSoc.pdf>

¹³ GSMA (calculated), 2021.

- 2.10 Over time the mobile sector has become a major contributor to the Malaysian economy, currently directly supporting 54,000 jobs, contributing over \$1.7 billion in tax revenues (direct and indirect) with a total economic impact estimated at over \$24 billion.¹⁴
- 2.11 **The Malaysian mobile market has four major Mobile Network Operators (MNOs)**, with one additional small player (see Figure 2-2). Malaysia also has a small, but a well-established, MVNO market, hosted by the largest four MNOs.
- 2.12 In Q2 2020, the Malaysian wholesale mobile market was considered to be ‘moderately concentrated’¹⁵ – with an Herfindahl–Hirschman Index¹⁶ of 2,240 - with the main four players having a combined market share of 92 per cent.¹⁷

Figure 2-2 Market share of the five MNOs by number of connections (the “Other” category includes several MVNOs).¹⁸



- 2.13 **A different picture emerges when we analyse reliance on the various mobile technologies** – while all MNOs are still using 2G, 3G and 4G technologies, the level of their reliance varies (see Figure 2-3).

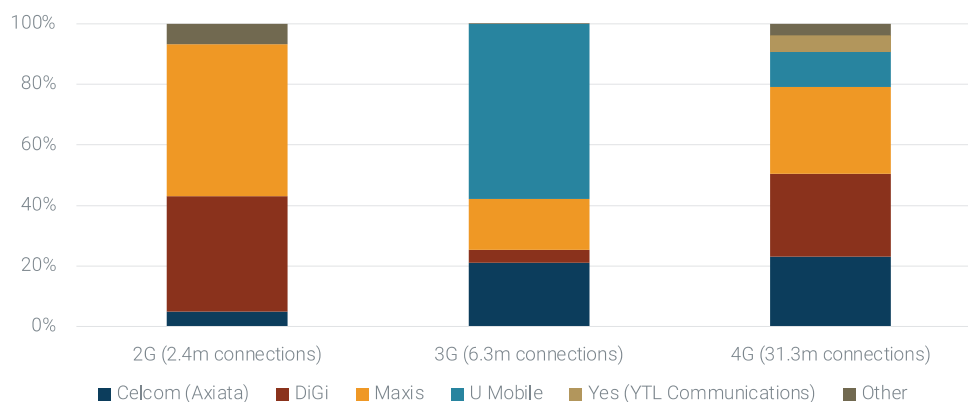
¹⁴ GSMA, Mobile Economic Impact Malaysia, 2019.

¹⁵ A score between 1500 and 2500 is generally considered to be deemed ‘moderately concentrated’. See <https://www.justice.gov/atr/herfindahl-hirschman-index>

¹⁶ This is a measure of the concentration of the market, the higher the number, the more concentrated (less theoretically competitive) said market is. The measure takes the square of the market shares x 100 and adds them together (therefore the larger the players, the higher the number would be due to the effects of powers). For example, if a market only had two players of equal market shares, the HHI would be $(50 \text{ per cent} \times 100)^2 + (50 \text{ per cent} \times 100)^2 = 50^2 + 50^2 = 5,000$.

¹⁷ GSMA (calculated), 2020.

¹⁸ GSMAi, (accessed July 2021)

Figure 2-3 Market shares by mobile technology.¹⁹

- 2.14 Currently, Malaysian MNOs differentiate themselves based on the quality (eg download speeds) and the coverage of their individual networks. They also offer different value propositions to end users - for example, Maxis leads in the post-paid segment,²⁰ while DiGi focusses on affordable packages.²¹
- 2.15 The four major MNOs are also significant contributors to the Malaysian stock market, Bursa.²²
- 2.16 **The mobile market structure is likely to change in the near future.** On 21 June 2021, Axiata Group Berhad and Telenor Asia Pte Ltd have agreed to merge their mobile operations in Malaysia – Celcom Axiata Berhad and Digi.Com Berhad – in a transaction valued at \$15 billion.^{23,24} The rationale for the merger is to establish a “... *commercially stronger and more resilient digital converged service provider*”.

The current regulatory framework supports a competitive mobile sector

- 2.17 The Malaysian Communications and Multimedia Commission (**MCMC**) has instituted a regulatory regime that has fostered the development of a competitive wholesale and retail mobile market in Malaysia.
- 2.18 **Malaysia operates a licensing regime.** MNOs - as network infrastructure providers - are required to hold a Network Facilities Provider (**NFP**) licence, while both MNOs and MVNOs – as service providers – are also required to hold a Network Service Provider (**NSP**) licence.²⁵
- 2.19 **In relation to spectrum assignments,** the MCMC has in the past utilised a combination of administrative assignments and minor auctions. Current spectrum licences for MNOs have been issued for 15- and 16-year periods.²⁶

¹⁹ GSMAi, (accessed July 2021), <https://data.gsmainelligence.com/data/custom-metrics-search>

²⁰ <https://store.maxis.com.my/planlist>

²¹ <https://www.digi.com.my/>

²² <https://www.bursamalaysia.com/#>

²³ <https://www.telenor.com/media/press-release/axiata-telenor-and-digi-sign-transaction-agreements-for-the-proposed-merger-of-celcom-and-digi>

²⁴ <https://www.financierworldwide.com/fw-news/2021/6/22/axiata-and-telenor-agree-15bn-merger-of-mobile-operations-in-malaysia>

²⁵ <https://www.mcmc.gov.my/en/sectors/telco/licensing>

²⁶ <https://www.mcmc.gov.my/en/spectrum/assignment-of-spectrum/spectrum-assignment>

- 2.20 **MCMC also regulates the prices of some wholesale mobile services.** Mobile network origination and mobile network termination services are subject to maximum price caps.²⁷
- 2.21 **Recently the MCMC has raised the Quality of Service (QoS) requirements in the telecoms sector.** The MCMC's public inquiry was focused on several markets, including mobile.²⁸

5G in Malaysia

The government has ambitious 5G objectives for Malaysia

- 2.22 **In February 2021, the Government launched its MyDigital initiative with the publication of the Malaysia Digital Economy Blueprint (the Blueprint):** the vision is to transform Malaysia into a “digitally-driven, high income nation and a regional leader in digital economy”.²⁹ The Blueprint is designed to complement other national policies such as the Twelfth Malaysia Plan (12MP)³⁰ and Wawasan Kemakmuran Bersama 2030 (WKB 2030).³¹
- 2.23 The Blueprint framework comprises six ‘thrusts’ to support the delivery the overall vision. One of the strategic thrusts is the need to “*Build enabling digital infrastructure*” in Malaysia (**Thrust 03**) – such infrastructure includes broadband, data centres and submarine cable landing stations which allow for the generation, flow, exchange, consumption and storage of data.
- 2.24 Furthermore, and as part of the effort to accelerate innovation and create an efficient digital ecosystem, **the Government has also initiated four key digital infrastructure projects under its MyDigital initiative.** These projects will be implemented through public-private-partnership (PPP) where the private partners with suitable financial capacity and technical competency will contribute capital and skills (see Figure 2-4).

²⁷ <https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/MS-Access-Pricing.pdf>

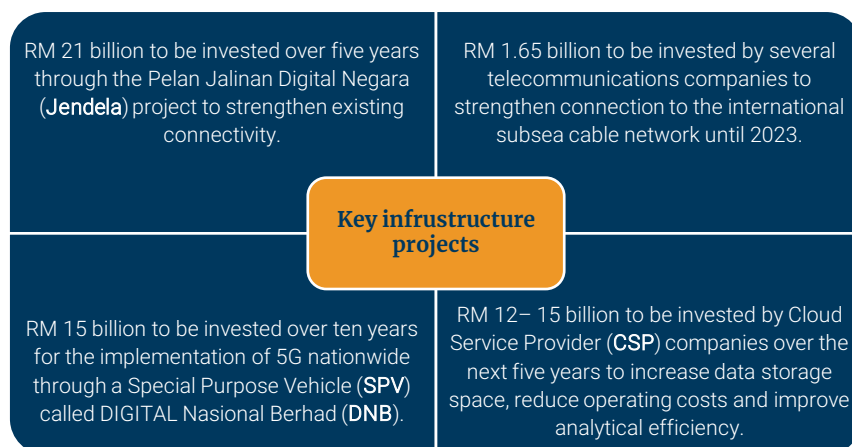
²⁸ <https://www.mcmc.gov.my/en/media/press-clippings/new-mandatory-standards-for-quality-of-service-eff>

²⁹ <https://www.epu.gov.my/sites/default/files/2021-03/Malaysia-Digital-Economy-Blueprint.pdf>

³⁰ <https://policy.asiapacificenergy.org/sites/default/files/Guideline%20Preparation%20for%20the%20Twelfth%20Malaysia%20Plan%2C%202021-2025%20%28MS%29.pdf>

³¹ <https://www.pmo.gov.my/2019/10/shared-prosperity-vision-2030-2/>

Figure 2-4 The four key digital infrastructure projects under MyDigital.



2.25 The connectivity infrastructure project Jendela³² sets out ambitious targets for broadband improvements across fixed and mobile connections by 2025. The Government’s main aspirations are summarised in Table 2-1.

Table 2-1 The Government’s overall digital objectives.³³

| | 12MP Aspirations 2021-2025 | Jendela National Aspirations |
|--------------------|---|--|
| Wireless Broadband | Nationwide 4G coverage 5G roll-out planning | 100 per cent 4G coverage in populated areas 100Mbit/s speeds by adopting 5G |
| Fixed Broadband | Expand fibre to sub-urban and rural areas Alternative technologies to connect premises | Gigabit access to 9 million premises |
| Delivery Ecosystem | Integrating Digital Infrastructure across Government, Business and Rakyat | A readily accessible Digital Infrastructure Plan |

2.26 Jendela is a five-year plan which will be implemented in two phases. In Phase 1, the aim is to optimise existing mobile and fixed infrastructure (2020-2022) by:³⁴

- a) Expanding 4G mobile coverage from 91.8 per cent to 96.9 per cent in populated areas;
- b) Increasing mobile broadband speeds from 25Mbps to 35Mbps;
- c) Enabling up to 7.5 million premises to access gigabit speeds using fixed broadband services;

³² <https://myjendela.my/>

³³ MCMC, National Digital Infrastructure Lab (NDIL), 3 September 2020.

³⁴ Jendela, 2nd Quarterly Report 7 April 2021. https://myjendela.my/Sitejendela/media/Doc/2nd_Quarterly_Report_of_JENDELA.pdf

- d) Retiring 3G networks by the end 2021; and
 - e) 5G planning and implementation for commercialisation which had previously been part of the longer-term Phase 2.
- 2.27 **In Phase 2** (2023 and beyond), the aim is to address the remainder of the digital divide not covered in Phase 1, primarily utilising fixed wireless access (**FWA**) and other fit-for-purpose technologies, as well as ensuring the nation's transition to 5G; which will take place once action plans to build a robust 4G and fibre platform under Phase 1 are achieved.

The Government's latest proposal is for a wholesale only upstream 5G network operator

- 2.28 As part of the Blueprint, **the Government announced the formation of Digital Nasional Berhad (DNB) to be owned by the Ministry of Finance (MoF) and regulated by the MCMC**. DNB is expected to invest R15 billion over the next 10 years and will be given spectrum in the 700MHz, 3.5GHz and 28GHz frequency bands to own, implement and manage all 5G infrastructure in Malaysia.
- 2.29 Based on our discussion with other interested stakeholders, we understand the key reasons cited by Government in favour of the DNB are to:
- a) Reduce capital expenditure;
 - b) Enable communications to work as a utility;
 - c) Enable current MNOs to focus on improving their 4G networks;
 - d) Pass cost savings to consumers and encourage 5G adoption; and
 - e) Allow fair and non-discriminatory access to the 5G network.
- 2.30 We understand the Government's overall proposals include the additional elements summarised in Table 2-2 below.
- 2.31 While the DNB will build, operate and maintain the 5G infrastructure in Malaysia, other MNOs are **expected to continue focusing on the expansion of 4G**, to achieve the Jendela targets. DNB aims to achieve national coverage by 2030 and will aim to cover Kuala Lumpur and other major urban areas first.

Table 2-2: High level overview of the DNB.

| Network Infrastructure | Spectrum | Operating Model |
|--|--|--|
| <p>Standalone (SA) network. DNB will own all 5G assets - no changes in ownership throughout the first 10 years of operation.</p> <p>Multi-operator core network - where possible network assets to be re-used and leased from existing MNOs and fibre operators under a wholesale Mandatory Standard on Access Pricing (MSAP) agreement.</p> | <p>3 spectrum bands to be allocated to DNB (700MHz, 3.5GHz, 28Ghz). DNB expected to pay an Apparatus Assignment Fee. Current MNOs not allowed to use existing allocated spectrum bands for 5G.</p> | <p>Provide wholesale services only (neutral host). New and existing mobile operators will have "open, fair and equal access" to the network and its capacity. Wholesale prices will be based on network build and run costs (including an appropriate rate of return for those financing the build).</p> |
| Governance | Financing | Regulation |
| <p>DNB licensed under the CMA 98 and subject to MCMC's regulatory oversight. MCMC holds full authority to penalise DNB for failure to meet key performance indicators (KPIs).</p> | <p>Private and government backed (to be decided).</p> | <p>MCMC placed high level license conditions on DNB. MCMC to allow DNB to set wholesale prices at the start – no higher than the wholesale price of 4G/Gbit. Full regulatory framework to be developed in due course (within 18 months from launch of DNB).</p> |

- 2.32 On 1 July 2021, it was announced that Ericsson will design and build the 5G network at a total cost of RM11 billion,³⁵ which is lower than the Malaysian Government's estimate of RM15 billion.³⁶

Our report

- 2.33 Our report is structured as follows:
- a) In Section 3 we develop a high-level framework to analyse the economic impact of the Malaysian 5G proposals; and
 - b) In Section 4 we identify several practical ways to mitigate some of the unintended risks of the Malaysian 5G proposals.
- 2.34 In developing our economic framework and mitigants we have also relied on lessons learned from four country case-studies where similar initiatives have been pursued with different degrees of success. We also use these case studies to help illustrate the economic principles described in our report. These case studies are summarised in the Annex.

³⁵ <https://www.reuters.com/business/media-telecom/malaysia-appoints-ericsson-5g-development-partner-2021-07-01/>

³⁶ <https://www.theedgemarkets.com/article/rm15b-5g-infrastructure-cost-be-borne-private-sector-says-mof>

3 The potential economic impact of the latest 5G proposals in Malaysia







Introduction

- 3.1 The Malaysian Government's proposals to build the 5G network are a departure from the current status-quo: rather than relying on the competitive market to deliver a fit-for-purpose network, the Government has decided to create a nationalised upstream monopoly to build, operate and manage the future 5G network in Malaysia.
- 3.2 In this section, we discuss the framework we have developed to analyse the overall implications of the chosen approach. When undertaking our qualitative analysis, we have tried to identify the relevant economic impacts both on operators and their customers.

The economic framework

- 3.3 The key factors considered in our economic framework are summarised in Table 3-1 below
- 3.4 When undertaking our qualitative analysis, we have used the status quo as our counterfactual. We have also prepared four country case studies that provide key lessons learned from other jurisdictions that have followed a similar (or different) approach (see the Annex for a detailed description of each case study).

Table 3-1: Key factors considered in the economic framework.

| Factor | Likely impact of 5G proposals | Rationale for factor |
|---|-------------------------------|--|
| Level of competition in the mobile market | | |
|  Upstream | Monopoly | The structure of a market will determine how effective competition is likely to be in that market – the more sustainable competition is the higher the incentive for firms to provide greater choice, innovation and/or value for money to customers. Without 5G network ownership, MNOs will have less ability to differentiate themselves from their rivals. |
|  Downstream | Possibly decreased | |
| Outcomes | | |
|  Efficiency | Unclear/likely to decrease | Economic efficiency enhances overall consumer welfare. Monopoly provision of 5G network services raises the potential for inefficient supply of services due to the lack of competitive rivalry (eg this could lead to the inefficient ‘gold-plating’ of networks) |
|  Pricing | Unclear | In a competitive environment wholesale access prices would be reflective of an efficient level of costs. |
|  Quality of service | Likely to decrease | The form of competition in the market and the DNB’s ownership structure can influence its incentives for quality of service. |
|  Network resilience | Unclear | The DNB, as a single wholesale network, may be less resilient, unless redundancy is built in. |
| Implementation of DNB | | |
|  Financing and funding | Not secured | The DNB’s success is reliant on having the necessary upfront financing and ongoing funding to operate and maintain its network. |
|  Scope of DNB | Likely execution risk | Clarity on scope and governance of DNB key to its success. |

3.5 We discuss each of the factors outlined in Table 3-1 in more detail below.

3.6 The structure of competition in the Malaysian mobile market is set to change.

A wholesale upstream monopoly is created

3.7 With the creation of the DNB, the Malaysian Government has replaced a competitive wholesale market structure with a nationalised upstream monopoly, which will need to be regulated by the MCMC. As discussed in Section 2, our understanding is that the key reasons behind the Government’s decision to create the DNB are to:

- a) Reduce the level of capital expenditure required to deploy a national 5G network in Malaysia – this, in turn would enable cost savings to be passed onto consumers and encourage 5G adoption;
- b) Enable communications to work as a ‘utility’;
- c) Enable current MNOs to focus on improving their 4G networks; and Annoying

- d) Allow fair and non-discriminatory access to the 5G network.
- 3.8 It is a generally accepted principle that competition in a market is preferable to a monopoly. Simply put when firms compete, consumers get the best possible prices, quantity, and quality of goods and services.
- 3.9 Competition also boosts innovation. Rivalry pushes firms to be the first to the market with a new technology, a new product or a cost innovation. Moreover, firms in a market also react to the commercial actions of their rivals which further fuels these competitive dynamics.
- 3.10 When markets are competitive, (economic) regulation is generally not required and may be even detrimental.
- 3.11 Where regulation is justified to address a market failure, it is important to recognise the associated costs and risks of intervention. For example, a regulatory framework needs to deliver the outcomes of an effectively competitive market where consumer welfare is maximised by considering both static and dynamic considerations. However, this is a challenging task as regulators are a few steps removed from the markets they regulate, increasing the risk of unintended consequences and regulatory failure (in the form of over or under-regulation). There is also the known challenge that regulators may face in attracting staff with the rights skills and expertise.
- 3.12 In our view, a competitive market structure can play a role in delivering on many, if not all, of the Government's objectives as listed above. As discussed above, in a competitive market operators will have an incentive to reduce their costs (and maximise their profits); to improve their network quality (guided by the needs of their users); to adopt various means to encourage adoption of different technologies (including 5G) and to share their networks with other operators (to reduce their costs). No competitive environment is perfect and, if necessary, the regulator can step-in, *ex-ante* and/or *ex-post*, to address any remaining issues.

Case study: UK fibre and 5G deployment

The UK has sought to promote competition in fibre services and 5G by implementing a regulatory regime encouraging network investment in competing alternative networks. At the same time, the government has recognised that there are some geographical areas of the country where market-based solutions have been unable to address poor coverage in fixed and mobile markets.

In fixed markets, the UK telecoms regulator (Ofcom) has recently imposed a regulatory framework to encourage as much network infrastructure competition as possible in the deployment of fibre. At the same time, Ofcom expects 30 per cent of the UK (eg Area 3) to have no material rival deployment to the incumbent BT. To address this 'market failure' Ofcom has modified the regulatory framework to ensure BT is incentivised to invest and able to recover its costs. See *Table A1* in the Annex for more details on the approach to fibre regulation in the UK.

5G deployment in the UK will be undertaken by the current four MNOs: Vodafone, EE, O2³⁷ and Three. In parallel, the Government is supporting three initiatives to bring mobile connectivity to rural areas: the Rural Connected Communities, the Emergency Services Network and the Shared Rural Network (SRN). The SRN will address the 'market failure' in mobile markets by bringing 4G coverage to hard-to-reach (rural) areas, eliminate most of the partial not-spots and will be funded by both the MNOs and the Government (around £500m each respectively). See paragraph A1.55 onwards in the Annex for a more detailed discussion of the SRN.

MNOs' current business models may change in perpetuity

- 3.13 A natural consequence of creating a single wholesale network (SWN) is that the current Malaysian MNOs' business models will need to change and adapt to the new market environment. This is likely to present its own challenges.
- 3.14 First, MNOs will be required to transition from a capex heavy business model to a hybrid/opex heavy model. This transition is likely to take some time and likely to be driven by the timelines for end-user 5G take-up. As part of this transition MNOs will need to retire network assets that will no longer be in use, while investing in new assets and skills to support the expansion of their downstream business.
- 3.15 In addition, the change in business models may create incentives on existing MNOs to slow the migration of its customers to 5G. Instead, MNOs may focus on retaining customers on their existing 4G network to help ensure they earn an adequate return on their existing network investment.
- 3.16 Second, MNOs will be transitioning to a new business model with different economics: for example, a virtual network operator will have a fundamentally different cost structure to an operator that owns its own network. Furthermore, some MNOs will be able to lease some of their infrastructure assets (towers and fibre) to the DNB on commercial rates that reflect an efficient level of costs plus an appropriate rate of return.

³⁷ O2 and Virgin Media have decided to merge their UK operations. The merger was cleared by the Competition and Market Authority in May 2021. <https://www.gov.uk/government/news/cma-gives-virgin-and-o2-merger-green-light>

- 3.17 Third, once the MNOs have completed the transition to their new business models it will be very difficult and costly for them to revert.
- 3.18 Clarity on the Government's policy objectives is a must to ensure the DNB is fit for its purpose, subject to an appropriate regulatory framework and its performance is judged against an appropriate set of strategic Key Performance Indicators (KPIs). In developing these objectives, it is important to keep as much competition as possible at all levels of the value chain.

Case study: Australia and fibre deployment

The Australian experience with the creation of the NBN and roll-out of fibre network infrastructure provides lessons to Malaysia about the importance of ensuring there is flexibility in the regime to allow for changes to be made to address issues as they arise.

In 2007, the then Australian Government decided to build a ubiquitous fibre broadband network to be built/maintained/operated by a wholesale only operator, the National Broadband Network (NBN) Co.

However, following a change in government in 2013, the scope of the NBN was significantly reduced. For example, the new NBN was required to deploy a mixture of technologies to increase the speed of roll-out and decrease the outlay of capital.

As a result of changing government priorities, the NBN took longer to build and is not considered to be future proof (the NBN is already considering investing additional capital to upgrade its network). See paragraph A1.49 onwards in the Annex for a more detailed discussion of the lessons learned on fibre deployment in Australia.

The proposals risk leading to mixed outcomes for operators and ultimately consumers

- 3.19 It is generally accepted that the more sustainable and effective competition is in a market the higher the incentive for firms to provide greater choice, innovation and/or value for money to their customers.
- 3.20 Below we discuss some of the potential outcomes for current operators, which in turn might lead to mixed outcomes for their consumers (both residential and enterprise).

Risk that overall level of efficiency is decreased

- 3.21 Economic efficiency is a fundamental objective of competition policy because it enhances overall consumer welfare. There are three main components to efficiency:
- a) **Productive efficiency** where firms seek to produce the goods and services they sell at the lowest cost possible (usually the lowest possible average total cost).
 - b) **Allocative efficiency** where firms seek to produce those goods and services which have the highest value to their consumers (where prices are typically equal to marginal cost because the price that consumers are willing to pay is equivalent to the marginal utility that they get).

- c) **Dynamic efficiency** where firms seek to innovate and produce new goods/services to capitalise on new technology trends and to respond to the changing needs of their consumers.

3.22 The current proposals for 5G in Malaysia, have the potential to slow the uptake of 5G services. This threatens the government objective to be a regional leader in the digital economy. While productive efficiency may be enhanced by creating a monopoly, if that monopoly leads to lower take-up of 5G services overall, the downsides in the form of reduced innovation and competition rivalry are likely to outweigh any upside.

Scope to increase productive efficiency

3.23 There are likely to be significant efficiency gains from building a single national 5G network. A single network removes the additional costs of network duplication that occur when multiple operators roll-out their own networks. This leads to cost savings where the reduced overall network costs can be recovered from the entire 5G customer base (rather than each network operator needing to recover the costs of its own network from its own customer base). For instance, there are potentially fewer sites needed given only one network is being built. Whether this will lead to fewer sites overall is unclear as 5G networks are likely to need many more sites compared to 4G or 3G networks. Also, with the sharing of passive infrastructure such as masts and fibre backhaul, there is likely to be significant cost savings when compared to the building of two or more stand-alone 5G networks. This is likely to reduce the level of fixed costs and increase **productive efficiency**.

3.24 However, the Malaysian proposals are replacing a competitive network provision with a monopoly which may restrict the level of productive efficiencies elsewhere in the value chain. For example, the DNB is likely to lack some of the economies of scope enjoyed by the MNOs which might lead to higher unit costs (at least, during the period when 4G and 5G service provision overlaps). The DNB would also be unable to cross subsidise across a greater choice of services in a pro-competitive way (for example, offer discounted 5G services to build scale without incurring losses).

3.25 4G networks were built with the expectation that they would have been used to provide 5G services. To the extent that this is no longer possible, MNOs – faced with reduced economies of scale and scope – may end up with stranded assets which would no longer be able to earn an economic return and may be required to increase their own retail prices to recoup their investment.

3.26 Overall, although the creation of the DNB could theoretically increase the scope to achieve productive efficiencies, in the absence of a detailed impact analysis it is difficult to be conclusive on this.

Impact on allocative efficiency unclear

3.27 **Allocative efficiency** is maximised when production is aligned with consumer preferences and demand (for example, 5G networks could be built for capacity, speed, latency or a hybrid of these characteristics based on customer needs).

- 3.28 To maximise allocative efficiency the DNB will need to work closely with the operators to better understand the need of their users and reflect these in the products and services it offers. There is value in the DNB (potentially working with MCMC) clearly setting out the process it will follow to resolve opposing end-user requirements (for example, where to deploy network first given the level of demand).

Case study: Mexico

In Mexico, the ability of the SWN to deliver productivity improvements was impacted by, for example, the limitations placed on the spectrum allocation to Red Compartida. The spectrum allocation of solely 700MHz limited its ability to provide attractive 4G services to potential customers. The lesson from Mexico is to carefully review the impact of the SWN proposals before launch to mitigate any risks to service take-up.

The Red Compartida was set-up to sell wholesale 4G services using 700 MHz spectrum. However, this did not meet the requirement of many customers in Mexico who only wanted voice services over 2G or 3G. As a result, 4G penetration has been generally low in Mexico due to lack of consumer demand – a point which Red Compartida failed to reflect in its own offer of products and services. See paragraph A1.26 onwards in the Annex for a more detailed discussion.

Risk of reduced dynamic efficiency

- 3.29 **Dynamic efficiency** is promoted by a consistent and stable regulatory framework over time, which creates favourable conditions for investment and innovation by all players in the market. The current approach in Malaysia could increase uncertainty in the mobile market and impact on operators' investment and innovation incentives in several ways.
- 3.30 First, the approach adopted will turn a competitive wholesale market into a monopoly – it is our understanding that the MCMC will not be in a position to implement the full regulatory framework when the DNB start commercial operations. Although the DNB will be required to publish a Reference Access Offer (**RAO**), to be approved by the MCMC, this is unlikely to fully mitigate its incentive to offer terms for access to its network that are primarily commercially beneficial to itself (eg pricing), curtailing the MNOs'/MVNOs' investment incentives in the retail markets they serve. Typically, public consultations on market changes of this nature and complexity would be detailed and take place over a number of years.
- 3.31 Second, MNOs will have reduced opportunities for creating innovative products as they become *de-facto* 5G MVNOs. Although this might be mitigated to a certain extent by the fact that 5G allows network slicing and therefore the creation of innovative products for the enterprise market, such differentiation will not be possible in the mass market serving residential consumers (as many 5G enabled applications can already be provided over 4G networks). There is also a potential impact on innovation from delinking network ownership from service delivery. For new 5G enabled applications to be successful, it is likely that a close coordination is needed between the 5G network and new 5G devices (such as handsets). In the absence of integrated MNOs this ability to coordinate is reduced. This may lead to delays in the launch of new services as well as a reduction in the level of service innovation more generally.

- 3.32 Third, and more importantly, there is very little clarity on the Government's likely approach to network deployment following the DNB's first 10 years of operation. Given operators typically start investing into the next big wave of technology (6G, 7G etc) well in advance, this lack of clarity is likely to have a negative impact on MNOs' long-term investment plans. As discussed above, if MNOs complete their transition to a hybrid/opex heavy model, it may be difficult to revert back.

Case study: UK fibre deployment

The UK regulator has sought to provide industry with long-term regulatory clarity to promote investment in fibre networks across the UK. The lesson for Malaysia is that there are clear benefits in providing a clear long-term regulatory framework for 5G in order to promote investment in 5G services.

To incentivise the deployment of fibre networks by competing operators Ofcom has recently imposed a new regulatory framework on BT in relation to its fibre deployment. This regulatory framework will remain in place until 2026 and Ofcom, in recognition of the importance of regulatory stability in promoting network investments, has also stated that the regulatory framework is likely to continue until 2031. See paragraph A1.61 onwards in the Annex for a more detailed discussion.

- 3.33 **Given the Malaysian Government's emphasis on reducing the deployment costs of the 5G network with the creation of the DNB there is a risk that productive efficiency is maximised to the detriment of allocative and dynamic efficiency.**

An uncertain impact on (wholesale) prices

- 3.34 For the purposes of this report, we are focussing our observations on two key issues. First, we are discussing the likely impact of the 5G proposals on DNB's wholesale prices, on the assumption that downstream operators will pass these in full onto end customers. Second, we are discussing those factors which might have the biggest impact on the level of wholesale prices and where there is merit in clarifying the regulatory approach to be implemented as soon as possible.

Impact of efficiency savings

- 3.35 The type and level of efficiency savings is likely to impact the level of wholesale prices – however, as discussed above, we are unclear what impact the 5G proposals are likely to have on DNB's efficiency.

Impact of spectrum pricing

- 3.36 Spectrum is a scarce resource. Therefore, it is considered best practice to allocate it to the operator(s) that value the spectrum the highest (because this operator will normally be the one most likely to use the frequencies to deliver the services consumers most want). This is usually achieved through an auction/tender process to distribute the spectrum amongst interested operators (annual license fees, where appropriate, may also be charged). Further additional rules - in the form of coverage obligations or "use it or lose it" requirements – can be implemented to ensure spectrum is used efficiently.

3.37 Our understanding is that the Malaysian Government's proposals envisage assigning the relevant 5G spectrum to the DNB, which would only be expected to pay the apparatus assignment fee. We also understand that other MNO will not be allowed to use their current spectrum holdings to provide 5G services in the future. In our view, this could give rise to two issues:

- a) *The risk of distortion to the prices of 5G and 4G (and lower) mobile services.* Although standard economic theory would consider spectrum auction prices to be sunk costs and therefore irrelevant to operators' pricing and investment decisions, a GSMA study³⁸ advocates that firms are unlikely to treat upfront spectrum fees as sunk costs due to a variety of reasons (for example, empirical evidence suggests that in sectors with naturally constrained competition, firms with high sunk costs are more reluctant to engage in price competition).

There is a risk that if the price paid by the DNB is not reflective of the true market value of the relevant 5G spectrum this could give rise to distortions in the prices of 5G and 4G (and other) services in the future. In practice, if prices are distorted between 4G and 5G, this creates incentives on MNOs to make inefficient investments (unduly favouring services using one technology over the other). Relatively 'higher' underlying costs for 4G services (where MNOs face full spectrum costs) compared to relatively 'lower' costs for 5G services (where different spectrum costs apply) has potential flow-on impacts into the retail prices for these services. This has impacts on the wider economy as mobile services are important input costs into the production of other products and services (eg digital services produced by other Malaysian businesses where 4G/5G connectivity is a key part of the service).

- b) *Inefficient use of MNOs current spectrum holdings.* To the extent that MNOs are unable to re-farm their current spectrum holdings to provide 5G services in the future, this could lead to inefficient use of their spectrum leading to stranded assets.

3.38 **It is important that the approach to spectrum pricing, as implemented by the Government, minimises competitive distortions between different mobile services.**

Risks that the DNB sets wholesale charges that exploit its monopoly position

3.39 Our understanding is that DNB's wholesale prices for accessing its network will not be regulated from the outset, allowing the DNB to strike commercial agreements with downstream operators (including the ability to offer discounts). The same approach will also apply when the DNB is negotiating access to other operators' assets (such as towers and fibre).

3.40 **There are at least two main reasons why this approach might lead to sub-optimal wholesale access prices during the initial stages of the DNB:**

- a) As the only wholesale operator with a 5G network – and while 4G services are still on the market - the DNB will have the incentive and ability to provide significant discounts to the wholesale price of 5G services to encourage their uptake by downstream operators (MNOs and MVNOs). If these discounts, and their basis, are not transparent to the market (by, for example including in an RAO) this is likely to lead to competitive

³⁸ <https://www.gsma.com/spectrum/wp-content/uploads/2018/12/Effective-Spectrum-Pricing-Full-Web.pdf>

distortions in the downstream market. In the short to medium term, this might lead to consumer harm either because some downstream operators would be unable to compete effectively on the retail market and/or consumer prices would need to be significantly readjusted (increased) subsequently to ensure the DNB makes a return on its investment.

- b) For innovative services that would only be available on the 5G network, as a monopoly provider, the DNB will have the incentive and ability to charge excessive wholesale prices. Downstream operators would need to pass these high wholesale prices onto their end-users causing further consumer harm.
- 3.41 Determining the 'right' wholesale price in new and emerging markets is a complex exercise. For example, demand for 5G services will be uncertain in the short to medium term. Similarly, the total costs of building and operating the 5G network are unlikely to be known until construction is nearly finalised. Moreover, when setting regulated wholesale prices, there will be several policy trade-offs to be made. These include the need to trade off the benefits of setting prices that are reflective of an efficient level of costs, against the need to compensate the DNB for the level of risk it faces for undertaking this project by allowing it to earn a 'fair bet'³⁹ on its investment. An additional consideration would be to ensure regulated prices are set a level which encourage efficient and sustainable competition downstream, where the incentive to invest and innovate are also protected.
- 3.42 Given these complexities, there is urgency in the MCMC clarifying the high-level principles and methodology they will rely on when setting regulated prices before the DNB start commercial operations.

Case studies: Mexico, Australia and the UK

Getting the regulatory framework implemented before the launch of new networks was a key focus area of the regulators in each country. In Mexico and Australia, the 'wholesale-only' network operators (Red Compartida and the National Broadband Network Co respectively) published Reference Offers⁴⁰ where they set out the key price and non-price terms for access before starting their commercial operations. See paragraphs A1.19 (Mexico) and A1.47 (Australia) in the Annex for more details.

As part of the wholesale fixed telecoms market review, Ofcom (UK) consulted extensively before setting out its approach to regulating the wholesale access prices to BT's fibre network. To encourage infrastructure competition, Ofcom decided BT's 40 Mbit/s service is subject to an inflation linked price cap, allowing BT to charge more (£1.70 per month extra) for this service if it is delivered over full fibre. Ofcom also clarified the circumstances under which BT would be allowed to offer discounts on its prices. See paragraph A1.61 onwards in the Annex for a more detailed discussion.

³⁹ Fair bet is a concept used in setting regulated prices in other markets, such as telecoms. For example, it is used by Ofcom in the context of risky investments: "...in order to ensure that an investment is a fair bet, the firm should be allowed to enjoy some of the upside risk when demand turns out to be high (i.e. allow returns higher than the cost of capital) to balance the fact that the firm will earn returns below the cost of capital if demand turns out to be low. This issue is particularly important where there is significant uncertainty around demand".
https://www.ofcom.org.uk/_data/assets/pdf_file/0018/63261/cost_orientation.pdf

⁴⁰ Call 'Special Access Undertakings' (SAU) in Australia.

- 3.43 Similarly, when negotiating access to other network operators' assets (towers and fibre), as a wholesale monopoly 5G operator the DNB would have the incentive and ability to exploit this position for its own commercial advantage by, for example, offering an access price which may not allow operators a fair return on their investment.⁴¹
- 3.44 **Allowing the DNB to set its own wholesale prices risks introducing competitive distortions to the detriment of competition, choice and investment at the retail level. Moreover, given the complexity involved in setting wholesale price caps for new services, there is urgency in clarifying the high-level approach the MCMC are likely to adopt.** In addition, there is a risk that the current plans for 5G reduce the uptake of 5G services as, for example, it may be more profitable for MNOs to favour 4G services provided over their own network to 5G services provided by the DNB. This may have the impact of slowing the transition of customers to 5G services. This further complicates the decisions needed on regulating wholesale prices by the MCMC.

Risk of reduced quality of service

- 3.45 Quality of service (QoS) is an important parameter of competition in telecoms markets.
- 3.46 In a competitive market, MNOs would have an incentive to compete on quality by making the necessary improvements to their networks. For example, they could compete on the level of coverage or capacity they provide.
- 3.47 The DNB, on the other hand, is unlikely to have an incentive to improve QoS to the same extent, given it will not be subject to competitive pressure from rivals. This in turn could curtail the quality of the downstream operators' services, leading to customer dissatisfaction. This risk will be particularly acute for 5G services to be provided to enterprises (such as manufacturing, autonomous cars etc) where QoS requirements are critical.
- 3.48 There is value in getting greater clarity on how the DNB will be regulated regarding a minimum set of QoS requirements (in the way other MNOs in Malaysia are) and whether, and on what basis, the DNB would be subject to punitive financial penalties when these fall below required standards.
- 3.49 Getting a 'fit for purpose' QoS regime in place is a critical component of the regulatory framework needed for the DNB. Without it, there is a risk of adverse impacts on the end-users of 5G services (ie consumers and businesses). For example, if MNOs are unable to get the level of quality required from the DNB (eg latency, a critical element of the use case for some 5G services such as telesurgery and autonomous vehicles⁴²), it may reduce the range of 5G services that can be offered by MNOs to Malaysian businesses.

⁴¹ In this way the DNB would use their potential monopsony power (a market condition where there is only one buyer for, in this case, access to passive infrastructure for 5G) and force access prices below what would typically occur in a competitive market.

⁴² See <https://www.thalesgroup.com/en/markets/digital-identity-and-security/mobile/inspired/5G>

Case study: UK quality of service framework

The UK regulator spent many years developing a regulatory framework for quality of service for services offered by BT's Openreach. Regulating Openreach's QoS was a challenge that Ofcom itself faced. Ofcom believes that network competition is the best means of delivering the QoS that consumers require and that is why it has imposed a regulatory framework to encourage competing full-fibre networks to drive improvements in Openreach's own service performance. However, until such networks have established themselves Ofcom has implemented stringent measures to improve the QoS on the Openreach network by requiring, for example, more services to be installed promptly and repairs completed when consumers expect them.⁴³ It has taken Ofcom several years to produce a regulatory framework for QoS.⁴⁴

- 3.50 **There is a risk that the QoS offered by the DNB network does not fulfil the requirements of end-users. Given the innovative applications which 5G is expected to provide to end users, some with time critical delivery requirements, it is imperative that the DNB is required in contracts with access seekers to adhere to clear QoS rules such as robust Service Level Agreements (SLAs) and Service Level Guarantees (SLGs).**

Risk to network resilience

- 3.51 The DNB will be the only wholesale network operator providing wholesale 5G services. This does raise concerns around network resilience. Key to resilience is not just having sufficient capacity for day-to-day operations, but also being able to offer diverse solutions when faced with an emergency/disaster. The resilience of the 5G network is also key to ensuring the digital resilience and transformation that has been highlighted as a major goal for Malaysian Government's response to the impact of COVID.⁴⁵
- 3.52 Having multiple MNOs providing 5G services would have been one way to offer such resilience. In the absence of this option, there is a real risk that the DNB's network may not be technically resilient enough – this could be problematic, ultimately leading to cost increases and significantly reduced network reliability.
- 3.53 It would be sensible to map out how the DNB plans to mitigate the risks of relying on a single vendor to build the 5G network.
- 3.54 **It is important to get clarity on how the DNB is planning to secure network resilience and whether the cost implications of this have been considered in its financing and funding requirements.**

⁴³ Ofcom, Quality of Service for WLR, MPF and GEA: Statement on quality of service remedies, 28 March 2018. https://www.ofcom.org.uk/__data/assets/pdf_file/0007/112210/statement-qos-wlr-mpf-gea2.pdf

⁴⁴ For a discussion on the impact of Ofcom's regulatory approach to service quality see Ofcom (2020) Improving broadband and landline standards – A review of how Ofcom's service quality rules have affected Openreach's service level performance, May. (https://www.ofcom.org.uk/__data/assets/pdf_file/0033/195099/ex-post-evaluation-openreach-quality-of-service.pdf)

⁴⁵ <https://www.flandersinvestmentandtrade.com/export/nieuws/coronavirus-%E2%80%93-situation-malaysia>

There are several implementation risks

Financing and funding uncertainties might increase execution risk

- 3.55 Our understanding is that the Government expects the total cost to build and operate the 5G network in Malaysia will be around RM15 billion, to be financed by a mixture of investment borne by the private sector and co-investment from the Ministry of Finance (through non-Universal Service Provider (USP) funds). Furthermore, the network will be constructed by private sector operators and contracts are to be awarded through an open-tender process. It is also our understanding that the requisite funding for the network (for example, in the form of an anchor tenant) is yet to be secured.
- 3.56 Greater clarity is needed on the type and level of financing the Government is expecting from the private sector and who the private sector investors might be. This is not an ideal situation, given that on 1 July 2021 the Government announced that the contract to design and build the 5G network was awarded to Ericsson at a total cost of RM11 billion.
- 3.57 It is vital to bring investors on board as soon as possible to ensure they are consulted on key aspects of the project before these are set in stone and key expectations are agreed in advance: for example, the level of investment they are committing to over the course of DNB's operation and the level of return they would expect to get from undertaking such an investment.
- 3.58 Moreover, in the case of big infrastructure investment projects there is always the risk of delays and cost increases, which could have a negative impact not only on the delivery times, but also on the level of efficiencies the Government might be able to ultimately capitalise on (as discussed above). The DNB needs to have the ability to access emergency financing where this is necessary.
- 3.59 Similarly, it would also be important for the DNB to secure the necessary long-term funding for the 5G network to ensure it can pay back its investors and facilitate the long-term maintenance and operation of the 5G network. To achieve this, there will be a need for demand side initiatives which encourage the uptake of 5G services by consumers and enterprises.

Case study: Mexico

The Mexico case study provides lessons on the risks to the funding of the SWN in Malaysia. In Mexico, Altán had, from the onset, clarity on the amount of private investment it required. Through its public-private partnership (PPP) agreement with the Mexican Government, Altán has exclusive access to the 700 MHz spectrum and to the national fibre backbone network (Red Troncal). Altán raised the rest of the funds itself through the private sector which included US\$750 million of equity and US\$1,500 million of loans, including funds from various national and regional banks and through its own technical partners (Huawei and Nokia). However, Altán failed to secure the requisite demand for its network and on 13 July 2021 filed for bankruptcy protection. Despite Altán having clarity on financing at launch, it still failed. See paragraph A1.8 onwards in the Annex for a more detailed discussion.

- 3.60 **There are benefits to clearly setting out the steps the Government and the DNB propose to take to minimise the above-mentioned project execution risks. To ensure timely delivery of the 5G**

network deployment, the Government need to bring on board the requisite private sector investment as soon as possible.

Scope and governance of the DNB

- 3.61 Big capital and infrastructure projects, such as the deployment of the 5G network, are complex and difficult to implement. Successful implementation rests on several key requirements including clarity on DNB's mandate, a clear vision and implementation strategy, a detailed project plan, the right skills at all levels of the organisation, various risk mitigation processes supported by a stable legal, political and regulatory framework.
- 3.62 First, it is important to clarify DNB's scope and strategic objectives from the onset – especially so as Ericsson are tasked with building, operating and maintaining the 5G network. This is vital to ensure the DNB is set up appropriately and with the right skills at the right levels of the organisation.
- 3.63 Given the DNB is a newly formed organisation we have identified several additional risks which would require early mitigation. For example:
- a) The DNB may not have enough time to embed as an organisation which might increase the execution risks around the deployment of the network. In addition, its scope may not have been defined correctly and/or may need to be refined as it matures as an organisation.
 - b) Being fully owned by the MoF, the DNB may be required to respond to changing government priorities for telecoms services, which might distract it from its core mission of deploying the 5G network.
 - c) The DNB may not have the necessary skills and expertise at all levels of the organisation to deliver, operate and maintain the 5G network.
 - d) The lack of clarity between the role and responsibilities of the DNB *vis-à-vis* the vendor could also lead to additional unintended consequences.

Case study: Australia

The Australian case study provides insight on the detailed governance processes implemented by the government prior to the launch of the NBN. Getting this in place as soon as possible should be a priority for the Malaysian government as part of the deployment of a national 5G network through the DNP.

The Australian Government set out NBN's mandate through a Statement of Expectations (SoE) which is supplemented from time to time by policy directives and correspondence. NBN's current objectives are set out in the SoE published on 24 August 2016.

NBN's mandate include several requirements around deployment speeds, deployment areas, funding, transparency and business planning. See *Table A1* in the Annex for a more detailed discussion on the regulatory requirements imposed on NBN.

- 3.64 **It is important for the Malaysian Government to clarify the strategic priorities the DNB is required to deliver and ensure it is empowered to do so.**

Our analysis indicates that there are several risks to successful execution

- 3.65 As discussed above, we have identified the following risks with the creation of the DNB:
- a) **Risk 1 (lack of clarity in policy objectives):** Clarity on the policy objectives for the DNB is a must to ensure the DNB is *fit for its purpose, subject to an appropriate regulatory framework and its performance is judged against an appropriate set of strategic Key Performance Indicators (KPIs)*.
 - b) **Risk 2 (adverse impact on economic efficiency):** Given the Malaysian Government's emphasis on reducing the deployment costs of the 5G network with the creation of the DNB, there is a *risk that productive efficiency is maximised to the detriment of allocative and dynamic efficiency*.
 - c) **Risk 3 (unclear approach to spectrum):** It is important that the approach to spectrum pricing, as implemented by the Government, *minimises competitive distortions between different mobile services*.
 - d) **Risk 4 (unclear regulatory approach to wholesale prices of 5G services):** In the absence of regulation (including transparency), allowing the DNB to set its own wholesale prices risks introducing competitive distortions to the detriment of competition, choice and investment at the retail level. Moreover, *given the complexity involved in setting wholesale price caps for new services, there is urgency in MCMC clarifying the high-level approach are likely to adopt*.
 - e) **Risk 5 (poor QoS outcomes):** There is a risk that, in the absence of regulation, QoS offered by the DNB network does not fulfil the requirements of end-users. Given the innovative applications which 5G is expected to provide to end users, some with time critical delivery requirements, *it is imperative that the DNB is subject to stringent QoS rules*.
 - f) **Risk 6 (unclear approach to network resilience):** The DNB should set out how it plans to secure network resilience and *whether the cost implications of this have been considered in its financing and funding requirements*.
 - g) **Risk 7 (DNB financing and funding risk):** The Government and the DNB should set out how they propose to take to minimise the above-mentioned project execution risks regarding financing and funding. To ensure timely delivery of the 5G network deployment, the Government need to *bring on board the requisite private sector investment as soon as possible*.
 - h) **Risk 8 (lack of clarity on DNB mandate):** It is important for the Malaysian Government to *clarify the strategic priorities the DNB is required to deliver and ensure it is empowered to do so*.
- 3.66 In Section 4 we discuss some practical ways to mitigate the potential risks we have identified above.

4 A proposed risk mitigation strategy












Introduction

4.1 In this section we describe some of the ways in which the risks associated with the 5G deployment proposals in Malaysia (discussed in Section 3) can be mitigated. Our discussion focusses on the most important factors to consider.

Approach to mitigate the potential risks of 5G network proposals in Malaysia

4.2 We have identified three key approaches in which the risks we have identified in Section 3 can be mitigated (as summarised in Table 4-1 below).

Table 4-1: Key mitigations to minimise and/or avoid any unintended risks associated with the 5G proposals in Malaysia.

| Mitigants | Risks addressed | Key proposed mitigants |
|--|--|--|
| The scope and responsibilities of the DNB clarified <i>ex-ante</i> |  Risk 1: lack of clarity in policy objectives  Risk 7: DNB financing and funding risk  Risk 8: lack of clarity of DNB mandate | <p>As the DNB will be fully owned by the Malaysian Government, important to clarify its scope and strategic objectives <i>ex-ante</i> and monitor its performance.</p> <p>Important to measure DNB’s performance regularly; against its strategic KPIs (yearly) and through a mandated regulatory review of its structure (every 2/3 years)</p> |
| Fit-for-purpose wholesale regulatory framework |  Risk 2: adverse impact on economic efficiency  Risk 3: unclear approach to spectrum  Risk 4: unclear regulatory approach to wholesale prices  Risk 5: poor QoS outcomes  Risk 6: unclear approach to network resilience | <p>The DNB will be a wholesale monopoly provider - the MCMC will need to put in place extensive wholesale regulation to minimise the risk of anti-competitive behaviour and protect end-users. At a minimum, the following to be defined <i>ex-ante</i> from the outset:</p> <ul style="list-style-type: none"> • An approach to spectrum pricing that minimises competitive distortions across technologies • Transparency of wholesale prices negotiated commercially (in time, wholesale price regulation) • A fit-for-purpose QoS regime • Approach to ensure network resilience |
| Policy and regulatory flexibility |  Risk 1: lack of clarity in policy objectives  Risk 7: DNB financing and funding risk  Risk 8: lack of clarity on DNB mandate | <p>Need to be flexible and consider additional deployment options, such as:</p> <ul style="list-style-type: none"> • Allowing MNOs to use their current spectrum holdings to provide 5G services • Allowing a consortium of MNOs to deploy 5G networks in certain geographies or sectors of Malaysia. • Allowing co-investments between the DNB and current MNOs. |

- 4.3 When designing possible approaches to mitigate and/or avoid the potential unintended consequences associated with the 5G proposals in Malaysia, we have also relied on key insights from the four country case studies we have prepared (see the Annex).

The scope and responsibilities of the DNB to be clarified *ex-ante*

- 4.4 It is important for the Malaysian Government to clarify which policy objectives it is seeking to maximise through the creation of the DNB. Clarifying these policy objectives will help the Government shape the scope and responsibilities to be entrusted to the DNB. This is even more important, *given the third-party vendor has been entrusted the task of designing, building, operating and maintaining the 5G network*.
- 4.5 As discussed in Section 3, in addition to clarifying that the DNB is a wholesale only network operator, we make the following additional recommendations:

- a) **Provide a clear mandate to the DNB with a high degree of autonomy.** The specific role and responsibilities of the DNB could be set out in a formal way – such as through a Memorandum of Understanding (MoU). As part of the MoU, it would be helpful to clarify under which circumstances the Government could issue the DNB a legally binding direction (for example, in relation to corporate governance matters or social and environmental policies) or guidance. Furthermore, it would be best practice that the Government's role as the sole shareholder is limited to providing a high-level strategic steer on communication policy matters, while day to day management and decision making is entrusted to the DNB Board and executives.

In addition to a clear mandate, it is also imperative that the Government brings on board the requisite private sector financing as soon as possible to ensure the DNB has the financial means to deliver its mandate (including a contingency fund to deal with potential unplanned delays and cost increases in the construction of the 5G network).

- b) **Clarify the lines of accountability for the DNB.** As a regulated monopoly, the DNB will be accountable to the MCMC in relation to its regulatory obligations. As a state-owned company, it is also important to clarify in what ways the DNB will be accountable to the Malaysian Government.
- c) **Regularly monitor the performance of the DNB.** In addition to complying with its regulatory obligations, it is important to regularly monitor the DNB's performance against its overall mandate and strategic objectives.

We would propose the Government *develop and measure the DNB's overall performance against its strategic objectives using a set of specific KPIs* which are also audited by an independent third-party. This review could be undertaken by the MCMC on an annual basis.

As a final step, there may be merit in *undertaking a mandated commercial and regulatory review of the DNB structure* – with the ability to reform/change elements of its governance structure. This review could be undertaken by the MCMC/Government every 2 to 3 years.

To ensure transparency, it would be helpful to publicly disclose the outcomes of these reviews and any remedial actions that will need to be taken.

- d) **Consider imposing financial and non-financial KPIs.** To the extent that the DNB is expected to undertake non-commercial activities (activities which will not be profit generating but may have wider public interest benefits, such as deploying to hard-to-reach rural areas) there is merit in tracking financial and non-financial KPIs to get a broader perspective of the DNB's performance in the round.
- e) **Clarify the potential role of the DNB beyond the first 10 years of operation.** It may be too premature to make any binding decisions in relation to the role of the DNB beyond its first 10 years of its operation – the DNB will need to prove itself as an organisation capable of operating and maintaining the 5G network. At the same time, the lack of any discussion around potential options may reduce operators' own incentives to invest and innovate. Moreover, and as discussed in Section 3, once the MNOs have adapted their business models around the DNB it may be very difficult and costly for them to undertake another major structural shift.

Case study: Australia

Early in the implementation of the NBN in Australia, the government conducted a detailed review to assess the effectiveness of the initiative. As a result of the detailed review, the government decided to change key elements of the approach to address the issues identified. In Malaysia, the DNB is proposed to be in place for 10 years with no formal review of the effectiveness of the structure of the DNB over this period.

In 2013, the Minister for Communications announced an independent panel to conduct a cost-benefit analysis of the broadband policy and review the regulatory arrangements for the NBN.

The panel made recommendations on the most appropriate overall structure and regulatory framework for Australia's future broadband market, including the role of infrastructure-based competition and, particularly, NBN Co's role. The panel also investigated the costs and benefits of alternative options for delivering high-speed broadband.

Following the panel's expert report, the Australian Government published a policy paper setting out a new regulatory framework, including legislative changes. See *Figure A1-3* and paragraph A1.38 onwards in the Annex for a more detailed discussion.

In the absence of competition upstream, wholesale regulation is a must

- 4.6 With the creation of the DNB there will be a single wholesale infrastructure provider of 5G services in Malaysia. As a monopoly operator, the DNB will have both the incentive and the ability to exploit its position by focussing on its own commercial needs to the detriment of downstream operators and therefore will need to be subject to *ex-ante* economic regulation by the MCMC.
- 4.7 In Table 4-2 we discuss the key components of the wholesale regulatory framework we propose the MCMC consult on with all key stakeholders

Table 4-2: Key components of the regulatory framework for the DNB.

| General remedies to be imposed on the DNB | | |
|---|--|---|
|  | Requirement to provide network access and new products | To promote and protect competition in the downstream (retail) market, the DNB to provide network access on reasonable request and do so on fair and reasonable terms and conditions. The DNB should develop and clarify the process they will use to address requests for new forms of network access (eg new products and services) by downstream operators, on a fair and reasonable terms and conditions. |
|  | Requirement not to unduly discriminate | A non-discrimination obligation can be used as a complementary remedy to the network access obligation to prevent the DNB from discriminating between the various downstream operators. The MCMC can provide further <i>ex-ante</i> guidance on how strict the interpretation of this rule will be – for example, a complete prohibition of discrimination with no discretion or one where some flexibility for discriminatory behaviour is allowed (the latter should be transparent and subject to consultation). |
|  | Requirement to publish a Reference Access Offer (RAO) | The DNB to publish an RAO to assist transparency for the monitoring of potential anti-competitive behaviour and to give visibility to the terms and conditions (both price and non-price) on which other downstream operators will purchase wholesale services. This could also include technical information which explains how the DNB network is built and its resilience assured (Risk 6). |
|  | Regulated wholesale access prices and transparency | Wholesale access products to be subject to price regulation, to ensure DNB's prices are at a level which ensure prices are fair, reasonable and non-discriminatory (Risks 2, 3 and 4). All wholesale access prices to be included in the RAO. Regulated wholesale access prices to be set at a level which promote sustainable downstream competition. In the interim, any commercially negotiated wholesale prices between the DNB and other operators to be made transparent to the industry - to ensure a level playing field given the DNB is the only 5G network operator. |
|  | Requirement to notify charges, terms and conditions | To improve transparency for monitoring possible anti-competitive behaviour by the DNB and to ensure downstream operators have sufficient time to plan for changes to price and non-price terms and conditions. |
|  | Requirement to notify technical information | To ensure downstream operators have sufficient time to respond to technical changes that may affect them (Risk 6). |
|  | Requirement for QoS levels – including Service Level Agreements (SLAs) and Service Level Guarantees (SLGs) | To ensure all downstream operators have access to the same types of QoS levels (for example in terms of uplink and downlink speed, latency, and network availability). SLAs to set out the specific QoS terms and SLGs to set out fair and reasonable compensation when QoS levels fall below agreed SLAs (Risk 5). MCMC/DNB to publish annual QoS report. |
|  | Fit for purpose wholesale migration services | Fit for purpose migration service are key to enable efficient downstream competition. |
|  | Requirement for financial reporting | To ensure the DNB have in place a system of rules that support the attribution of revenues and costs to individual markets and services and facilitate transparency. DNB to submit regulatory financial reports to MCMC on an annual basis. Regulatory financial reports to be audited by an independent third party. |

- 4.8 In addition to developing and implementing the appropriate regulatory framework, we recommend that the MCMC should consider implementing the following initiatives:
- a) **Clarify, *ex-ante*, that the DNB is a radio access network (RAN) wholesale-only operator** and is not allowed to provide its own downstream services in competition with the current retail operators – this will ensure the DNB concentrates its efforts on deploying, operating and maintaining the 5G network.
 - b) **Develop and implement the regulatory framework as soon as possible**, and ideally in time for when the DNB starts its commercial operations, to ensure regulatory certainty for all downstream operators and minimise the risk of gaming.

Important that the regulatory framework has the necessary check and balances to ensure *effective* and *sustainable* downstream competition.
 - c) **Develop an appropriate monitoring and compliance process** to ensure the DNB follows its regulatory obligations – given the MCMC will have oversight for an additional monopoly operator it may need to build up its existing skill base itself. MCMC to be empowered to fine the DNB in cases of non-compliance.
- 4.9 There is likely to be more detail underpinning the specific regulatory obligations that will be imposed on the DNB and there may be merit in the MCMC approaching this task in phases. For example, in Phase 1 (to take up to six months) it could develop and implement all regulatory conditions excluding the price control and regulatory financial reporting frameworks, which are typically more complex and likely to require more thought.

Case studies: UK and South Korea

In both the UK and South Korea, there was extensive industry consultation on the regulatory framework to be applied in fixed and mobile markets (and 5G services in particular in South Korea). A similar approach to industry consultation does not appear to have been adopted in Malaysia to date for the DNB and 5G services.

Ofcom published a detailed framework for the regulation of the fixed telecoms markets that underpin broadband, mobile and business connections, for the period from April 2021 to March 2026. This regulatory framework took more than two years to develop (first consultation published in 2018 and decision published in 2020), including extensive consultation with all relevant stakeholders in the market. See paragraph A1.61 onwards in the Annex for a more detailed discussion of the UK approach.

South Korea entered the race to deploy 5G in 2008. Over the next several years, successive governments pursued a strategy of collaboration with numerous domestic and international parties, to reach global agreement on the set of rules and best practices for 5G network development. See paragraph A1.82 onwards in the Annex for a more detailed discussion of the South Korean approach.

Retain flexibility to introduce alternative options for deployment

- 4.10 Given the DNB's performance against its regulatory obligations and its strategic objectives will be regularly reviewed, the Government should remain flexible to introducing alternative options which may be needed to remedy any issues identified. For example, the Government may see merit in:
- a) *Allowing MNOs to use their current spectrum holdings to provide 5G services in certain geographies of Malaysia* – this approach could help the Government roll-out 5G services quicker by focussing on those hard-to-reach areas first.
 - b) *Allowing a consortium of MNOs to deploy 5G networks in certain geographies of Malaysia* – this is similar to the option above, but in addition to 5G services MNOs are also allowed to deploy their own 5G network.
 - c) *Allowing co-investments between the DNB and current MNOs* – this could help the DNB accelerate network roll-out while also reducing its capital outlay.

Case study: Australia

The Australian government had a flexible approach to the network deployment of NBN which allowed key elements to be reviewed and changed early in the network roll-out phase. We contrast this with the situation in Malaysia where the DNB is proposed to be in place for 10 years with no formal review of the effectiveness of the structure over this period.

In 2013, the Minister for Communications announced an independent panel to conduct a cost-benefit analysis of broadband policy and review the regulatory arrangements for the NBN.

As a result of the panel's recommendations, the Government changed the scope of the NBN, including the broadband technology choice to be implemented. See paragraph A1.38 in the Annex for a more detailed discussion.

Conclusions

- 4.11 Malaysia has made a bold decision to implement a government owned SWN. However, as discussed above, national SWNs have a poor track record of successful implementation in other countries (including most recently in Mexico). We have identified a number of serious risks with the current 5G plan in Malaysia. Without clear mitigation strategies, Malaysia's vision to become a regional leader in the digital economy is under threat.
- 4.12 In our view, at a minimum the following are required:
- a) *Clarify the DNB's mandate and regularly monitor its performance against its strategic objectives.* In this regard it is important to undertake a mandated commercial and regulatory review of the DNB structure – with the ability to reform and change elements of its governance structure. This review could be undertaken by the MCMC/Government every 2 to 3 years.
 - b) *Introduce a fit for purpose wholesale regulatory regime at the same time as the DNB starts its commercial operations.* This will be key to ensuring regulatory certainty and a level playing field amongst all operators.

- c) *Remain flexibility to introducing alternative deployment options for 5G networks and services in Malaysia.* In any big infrastructure project, there are always risks of delays and other unexpected developments. There is merit in the Government being open to the idea of allowing current MNOs to use their existing spectrum to provide 5G services, to build 5G networks in certain geographies and/or enter into co-investment agreements with the DNB.

4.13 We note there are a range of unknowns (including on the regulatory framework for the SWN). This adds to the complexity in crafting a mitigation strategy. To address this, we recommend MCMC continue to conduct detailed consultations with all stakeholders - industry, consumers and civil society – in order to identify concerns and agree workable solutions.

A1 Annex: Case studies

A1.1 This annex includes four case studies involving the following countries:



Mexico

- The Government paved the way for the introduction of a wholesale access only operator to deploy a 4G network called Red Compartida.



Australia

- The Government introduced a national wholesale broadband company to facilitate the deployment of fibre.



UK

- The Government is relying on as much network competition as possible to facilitate the deployment of fibre and 5G.



South Korea

- The Government, from the onset, assumed a very consultative approach with key domestic and international stakeholders.

- A1.2 In putting these country case studies together we have relied extensively on our own experience as former regulators and our existing professional relationships with the regulatory authorities and the corporate organisations in each country.
- A1.3 The aim of the case studies is to help illustrate some of the economic principles discussed in the main body of the report as well as provide lessons for Malaysia for its 5G plan.
- A1.4 We summarise each country case study below.

Case study 1: Mexico

Why Mexico?

- A1.5 As part of its reforms to increase access to high-quality telecommunications and broadcasting services to create a vibrant digital economy, **the Mexican Government paved the way for the introduction of a wholesale access only mobile network operator, called the Red Compartida.** The principal objective of Red Compartida was to encourage entry by mobile virtual network operators (MVNOs) to increase competition in the sector and, ultimately, overcome the digital divide between urban and rural areas.

Government's ambitions in relation to digital and 5G

- A1.6 In 2013, the Mexican Government introduced major reforms in the telecoms sector. These reforms were themselves part of a broader cross-party agreement for major reforms - **Pacto por Mexico** - signed in 2012.⁴⁶
- A1.7 The major reforms introduced in the telecommunication sector included, amongst others, the regulation of the incumbent telecoms operator to ensure greater competition and creating an independent telecoms regulator: the Instituto Federal de Telecomunicaciones (IFT).

The major reforms introduced by the Government paved the way for the Red Compartida, a wholesale access only network operator

- A1.8 With the completion of digital switchover in 2015, Mexico was able to prioritise the entry of new digital players in the broadcasting market and to make spectrum available to the Red Compartida, a shared wholesale long-term evolution (4G) wireless network.^{47,48}
- A1.9 The **Red Compartida is regarded as a pioneering development in the Mexican telecoms market**. Its key objective is to expand accessibility in underserved areas (rural and remote areas in Mexico) and to address the inequalities which resulted from decades of deficiencies in policy and regulatory approaches.
- A1.10 In January 2017, Altán Redes (**Altán**) won the tender for the development of the Red Compartida, with the expectation that Red Compartida would start commercial operations before the end of Q1 2018.⁴⁹
- A1.11 Altán was awarded a 20-year concession, renewable for a further 20 years, to design, finance, deploy, and construct a wholesale 4G mobile network. Through its public-private partnership (PPP)⁵⁰ agreement with the Mexican Government, Altán has exclusive access to the 700 MHz spectrum and to the national fibre backbone network (Red Troncal). Altán raised the rest of the funding itself through the private sector which included US\$750 million of equity and US\$1,500 million of loans, including funds from various national and regional banks and through its own technical partners (Huawei and Nokia).
- A1.12 The Red Compartida network is based entirely on 4G-LTE technology, with full virtualization for easy migration to 5G. It is based on an open network architecture, with full interconnection with other networks in Mexico.
- A1.13 Altán has committed to reach at least 92.2 per cent of the Mexican population by 2024.

⁴⁶ <https://www.as-coa.org/articles/explainer-what-pacto-por-mexico>

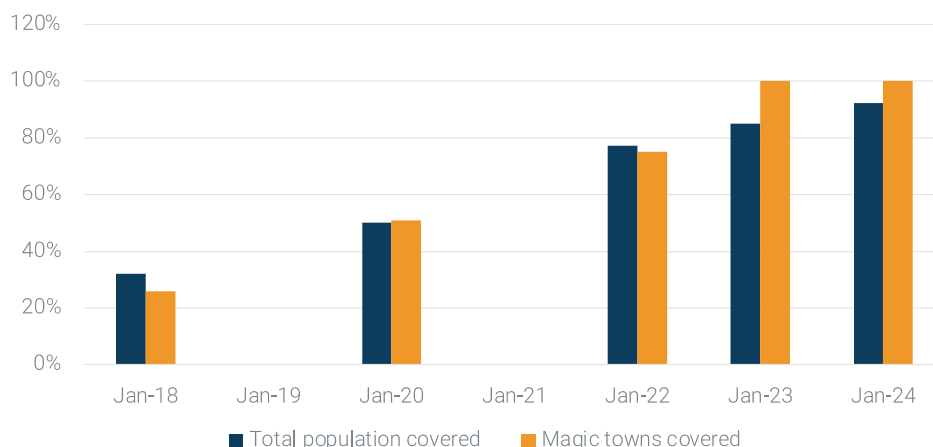
⁴⁷ OECD, Telecommunications and Broadcasting Review of Mexico (2017), page 21. <https://www.oecd-ilibrary.org/docserver/9789264278011-5-en.pdf?expires=1626800098&id=id&accname=guest&checksum=1A766EAAF47CC22A8561E0C1A4632BAB>

⁴⁸ <https://digitalregulation.org/red-compartida-mexico/>

⁴⁹ <http://www.sct.gob.mx/red-compartida/inversionistas-2a-eng-3.html>

⁵⁰ <https://www.altanredes.com/en/who-we-are/how-we-operate/>

Figure A1-1 Coverage for Red Compartida ^{51,52}

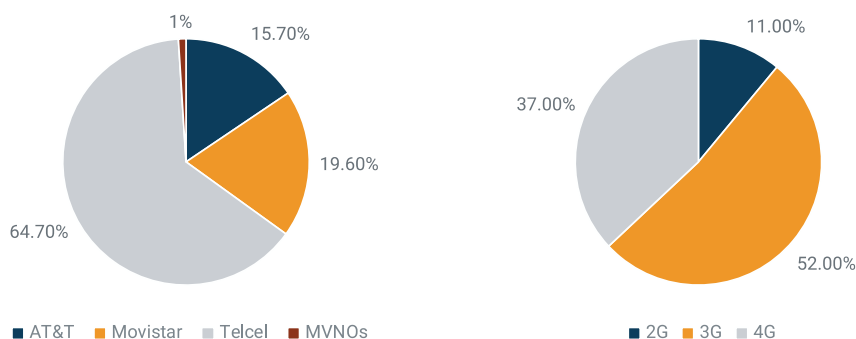


MNOs continue to have high market shares

A1.14 There are three major MNOs in Mexico: Radiomovil Dipsa (Telcel), Telefonica Moviles Mexico (Movistar) and AT&T Mexico. Telcel has retained a market share of between 60 per cent to 70 per cent in the retail mobile market in the past 10 years, while alternative operators (including MVNOs) have struggled to gain market share.

A1.15 The retail market shares of the main players and the main mobile technologies used are shown in the figure below.

Figure A1-2 Market shares of the main MNOs and the main mobile technologies used in Mexico, 2020.⁵³



A1.16 In 2018, the market share of MVNOs was 1.47 per cent, and in the last four years, they have not been able to surpass 2 per cent.⁵⁴ This seems to indicate that Red Compartida has not yet achieved the goal of increasing competition in the retail market by encouraging MVNOs to expand and/or enter.

⁵¹ <https://www.altanredes.com/en/why-the-red-compartida/#1589568438470-2383fb03-c228>

⁵² Magic Towns are re communities of under 20,000 population that have special cultural, natural, or touristic significance, but many of which have not previously had broadband access.

⁵³ GSMAi data, 2020.

⁵⁴ <https://www.bnamericas.com/en/features/mvnos-in-mexico-how-have-they-performed-in-2020>

- A1.17 The current level of deployment of 5G in Mexico is very low to none. To date:⁵⁵
- a) The IFT granted AT&T a private use concession for experimental purposes in the 3.5 GHz band. This allowed AT&T to use the infrastructure based on "Massive MIMO" technology to test 5G technology for six months in Mexico City.
 - b) TV Azteca also gained a private use concession in the 3.5 GHz band in order to conduct technology trials with a 5G-enabled system to transmit audio and video in the TV Azteca's Mexico City studio and in a stadium in Guadalajara.

The current regulatory framework

- A1.18 According to ITU's model for assessing regulatory evolution, which tracks generations of regulation, Mexico is ranked as a G4 country due to the presence of "*integrated regulation led by socio economic policy*".⁵⁶ According to this metric, Mexico is ranked behind Brazil and the Dominican Republic in 2019.⁵⁷
- A1.19 Under the terms of its PPP with the Government, Altán is not permitted to sell retail services to end users, making its network available to MNOs and MVNOs through a non-discriminatory wholesale reference offer (**RO**) which was approved by the IFT in February 2018 (before Red Compartida started its commercial operations). The RO includes price and non-price terms (such as QoS guarantees, in terms of uplink and downlink speed, latency, and network availability).^{58,59} In relation to access prices MNOs are charged according to their capacity requirements (plus an interconnection fee), while MVNOs are charged a price per user according to a pre-determined traffic profile.
- A1.20 Spectrum is assigned to MNOs through open, transparent bidding processes, with spectrum caps (that may vary in each auction). Licenses are set for a period of 20 years. In addition to the auction price, MNOs are required to pay annual fees for spectrum use which are determined per band and fixed by Congress.⁶⁰
- A1.21 According to a survey undertaken by the IFT, MNOs in Mexico are not in a hurry to deploy 5G networks, as 4G networks are believed to be adequate to address consumer needs into the future.⁶¹ In addition, there are additional regulatory issues which need to be addressed, such as approach to spectrum pricing and improvements to the processes required to get municipal permits to install sites and fibre.

⁵⁵ <https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law/mexico>

⁵⁶ The main regulatory generations as define by the ITU are G1 (command and control), G2 (partly liberalised), G3 (enabling investment, innovation and access), G4 and G5 (collaborative regulation with matrix backed decision making). See <https://digitalregulation.org/wp-content/uploads/D-PREF-TRH.1-2-2020-PDF-E.pdf>

⁵⁷ https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-BB.REG_OUT01-2020-PDF-E.pdf

⁵⁸ <https://digitalregulation.org/red-compartida-mexico/>

⁵⁹ <https://www.altanredes.com/soluciones-a-operadores/oferta-de-referencia/>

⁶⁰ http://www.diputados.gob.mx/LeyesBiblio/pdf_mov/Ley_Federal_de_Derechos.pdf

⁶¹ <http://www.ift.org.mx/estadisticas/expectativas-de-los-servicios-de-telecomunicaciones>

Spectrum for 5G

- A1.22 IFT has published its Annual Spectrum Plan for 2021⁶² and has made several recommendations to the Government in relation to its National Spectrum Plan.⁶³
- A1.23 Currently, spectrum in the 600 MHz and 3.3 GHz bands have been made available for potential use of 5G technology, but there has been no public deployment of the technology.⁶⁴
- A1.24 Furthermore, 150 MHz have been assigned to operators from the 3.4 – 3.6 GHz bands – 100 MHz to Telcel and 50 MHz to AT&T. Telcel will only be able to use 50 MHz for mobile telephony once the physical deployment is ready.⁴¹
- A1.25 To encourage the development of 5G, the Mexican Government has suggested a two-year exemption in the annual licence payments. This would apply to operators looking to build 5G networks in the 600 MHz or 1.5 GHz bands through a commercial concession granted in 2021 and 2022. Operators that purchase frequencies in these bands would make annual licence payments from 1 January 2024 and 1 January 2025, if the spectrum concessions are granted by the IFT prior to 30 November 2021 or after 1 December 2021, depending on the concession terms.⁴¹

Lessons learnt from the deployment of 4G in Mexico

- A1.26 In July 2021, Altán filed for bankruptcy protection.⁶⁵ Discussions with industry stakeholders in Mexico have revealed several contributing factors to this outcome:
- a) **From the onset, there was a lack of demand (at the wholesale level) to use the Red Compartida network.** There is no large anchor tenant on the Red Compartida network. Furthermore, its strategy involved rolling out in urban areas first (followed by rural and regional areas) where MNOs already have their own networks and therefore had little commercial incentives to switch to the Red Compartida network.
 - b) **The lack of interoperability with the existing technical choices of MNOs exacerbated the lack of (wholesale) demand.** Red Compartida has access to only 700MHz spectrum for 4G. Initially, there were also limitations on the number of handsets that could be used on the Red Compartida network which further limited demand from established players: for example, at launch there was no Voice over IP (VoIP) services available.
 - c) **Red Compartida failed to consider end-user demand for services.** Red Compartida focussed on selling a wholesale 4G service using 700 MHz spectrum. However, at the time of launch, many customers in Mexico only wanted voice services over 2G or 3G – as a result 4G penetration has been generally low.
- A1.27 Inappropriate regulation has also led to the following issues:
- a) **Inefficient use of existing 700 MHz spectrum.** Given the lack of demand there is significant unused 700MHz spectrum and there are regulatory and contractual restrictions on Red Compartida that prevent the company from leasing their spectrum to

⁶² <http://www.ift.org.mx/industria/espectro-radioelectrico/programa-anual-de-uso-y-aprovechamiento/programa-anual-2021>

⁶³ http://www.ift.org.mx/sites/default/files/pner_2019-2024.pdf

⁶⁴ <https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law/mexico>

⁶⁵ <https://www.reuters.com/business/media-telecom/altan-redes-files-bankruptcy-protection-mexico-2021-07-14/>

other MNOs. In terms of spectrum efficiency, Altan has a much lower number of subscribers per MHz compared to the industry average.⁶⁶

- b) **Long lead times in establishing a suite of wholesale services.** For example, it took Red Compartida two years to start selling its wholesale access services.
- A1.28 There is also some evidence pointing to the fact that, as a wholesale only organisation, **Red Compartida presented huge organisational complexity**, which was difficult to manage centrally and/or fix through economic regulation. We note, for example, that in the 5 years since its creation, the company had two separate Chairman of the Board and three CEOs.⁶⁷
- A1.29 Finally, despite supply side initiatives from the Government, as discussed above the deployment of 5G networks and services in Mexico are likely to lag other countries given most consumer demand can still be met through 4G.

Case study 2: Australia

Why Australia?

- A1.30 Australia's fixed-line access infrastructure has undergone significant changes in the last decade. Before the establishment of the National Broadband Network (**NBN**), the incumbent (Telstra) controlled the fixed telecommunications and cable television networks given its ownership of the local access infrastructure.
- A1.31 Reforms announced in 2009 led to significant public investment in fixed-line infrastructure and brought significant change in the overall market structure, including the creation of the NBN.
- A1.32 However, the deployment of the NBN was beset by many challenges which provide some helpful lessons learnt in relation to an ambitious national infrastructure project.

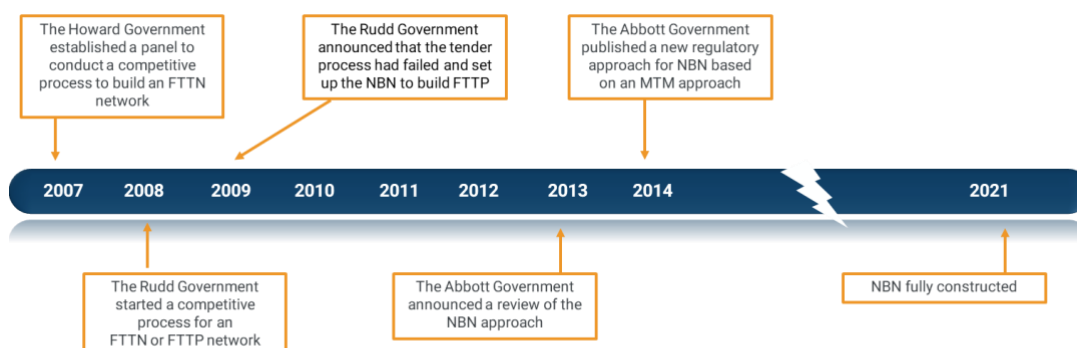
The Government's ambitions for digital and fibre

- A1.33 The Australian Government's ambition the deployment of fibre in Australia changed and evolved over the years.

⁶⁶ Altan has been allocated 90MHz in the 700MHz band and has subscribers of ~3m (<https://www.telegeography.com/products/globalcomms/data/company-profiles/la/altan-redes-red-compartida/company-overview.html>). This compares to an allocation of ~440 MHz of high-band spectrum (PCS, AWS and 2.5G) to the other MNOs. Total mobile subscribers in Mexico are over 122m. ((<https://www.telegeography.com/products/globalcomms/data/country-profiles/la/mexico/wireless.html>). For details on spectrum allocations see OECD (2018) Market Concentration – note by Mexico (IFT), p. 6. ([https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP/WD\(2018\)24&docLanguage=En](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP/WD(2018)24&docLanguage=En)))

⁶⁷ See, for instance, Altán media releases (pre.altanredes.com/en/altan-redes-appoints-bernardo-sepulveda-amor-as-chairman-of-its-board-of-directors, www.altanredes.com/en/salvador-alvare-new-managing/)

Figure A1-3 High level summary of the approach taken to deploy a fibre network in Australia.



A1.34 In 2007, the then Australian Government advocated that Australia needed fibre to the premise (FTTP) to replace the existing copper-based network, dramatically increasing broadband speeds to 98 per cent of Australian households and securing Australia's future productivity, competitiveness and wealth.⁶⁸

A1.35 However, when the previous Government's National Broadband Network (NBN) Request for Proposal (RFP) process concluded unsuccessfully, the newly elected Labour Government put their vision into action in 2009 by creating the NBN Co to design, build and operate Australia's wholesale broadband access network.⁶⁹

A1.36 NBN Co was mainly established as an operational body for investing in infrastructure to improve networks in urban and rural areas. In urban areas, as set out in an Infrastructure Services Agreement signed in 2011,⁷⁰ the approach was based on getting access to the incumbent's (Telstra) ducts to install new cabling and agreeing to decommission its copper-based network. The establishment of NBN meant Telstra lost control of the access infrastructure which was transferred across to NBN.⁷¹

A1.37 Progress was slow in the early years of the NBN and by 2013, and following another change in Government, just over 350,000 premises had been connected to fibre.

A1.38 This slow progress prompted the newly elected Government to reassess the approach to the deployment of the NBN by first engaging an independent panel of experts, chaired by Dr Michael Vertigan (**the Vertigan Panel**). The Vertigan Panel made extensive recommendations (across two main studies), as a result of which the Government introduced a three-stage regulatory reform process:⁷²

⁶⁸ <https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22library%2Fparty%2FE2KM6%22>

⁶⁹ <https://www.anao.gov.au/work/performance-audit/national-broadband-network-request-proposal-process>

⁷⁰ <https://www.nbnco.com.au/content/dam/nbnco/media-releases/2011/nbn-co-and-telstra-sign-binding-definitive-agreements-23-jun-11.pdf>

⁷¹ OECD (2017) Economic Surveys: Australia 2017, p. 90.

⁷² Australian Government, Telecommunications Regulatory and Structural Reform, December 2014, page 8.

- a) **Stage 1** involved a transition period (between 2015 and 2016) where transitional measures were implemented, such as requiring the functional separation of the wholesale and retail arms of network providers owning superfast fixed-line broadband networks.
- b) **Stage 2** involved a new regulatory framework coming into effect from 1 January 2017. Amongst other things, the new rules would require the structural separation between the wholesale and retail arms of new superfast fixed-line broadband networks and create competitively neutral arrangements for funding NBN's non-commercial fixed wireless and satellite services.
- c) **Stage 3** would include the period up to the privatisation of the NBN, once the network was rolled out fully.

A1.39 One of the additional main changes introduced by the Government was to move away from a fibre only network deployment to a strategy involving multi-technology mix (**MtM**)⁷³ to reduce network deployment costs.






A1.40 As of **today**, the NBN network consists of the provision of broadband services over a mix of three technologies: fibre (FTTx), fixed wireless, and next-generation satellite.⁷⁴ Roll-out in many urban areas now comprises the fibre network ending at local nodes with the pre-existing copper or coaxial cable network being used to cover the final connection to dwelling and businesses.

A1.41 Some of the principal objectives and requirements of the Australian Government in setting out the NBN Co are included in a Statement of Expectations (**SoE**) and summarised in Table A1 below.

⁷³ <https://www.nbnco.com.au/learn/network-technology>

⁷⁴ <https://www.nbnco.com.au/learn/network-technology>

Table A1-1 Key requirements imposed on NBN Co.⁷⁵

| | Objectives | Description |
|--|-------------------|---|
|  | Speeds | Peak wholesale download data rates (and proportionate upload rates) of at least 25 Mbit/s to all premises. At least 50 Mbit/s to 90 per cent of fixed line premises as soon as possible. |
|  | Roll-out | Prioritise locations that are poorly served, to the extent commercially and operationally feasible. |
|  | Funding | Taxpayers funded where the Equity Funding Agreement imposed a cap on the maximum amount of equity funding that will be provided by the Government. |
|  | Transparency | NBN required to publish online weekly progress reporting of network deployment and active services, release updated construction plans on a regular basis and deliver quarterly management briefings to the public. Additionally, NBN required to publish information that details how it has addressed the Government's objectives outlined in the SoE, on an annual basis. |
|  | Business planning | NBN required to undertake a rigorous corporate planning process carried out in accordance with its obligations as a Government Business Enterprise, applicable regulatory obligations, and the objectives, directions and guidance given to it by Shareholder Ministers. |

A1.42 On 11 December 2020, the Minister for Communications, Cyber Safety and the Arts, declared that the NBN should be treated as built and fully operational.⁷⁶

The competitive market for fixed broadband services in Australia

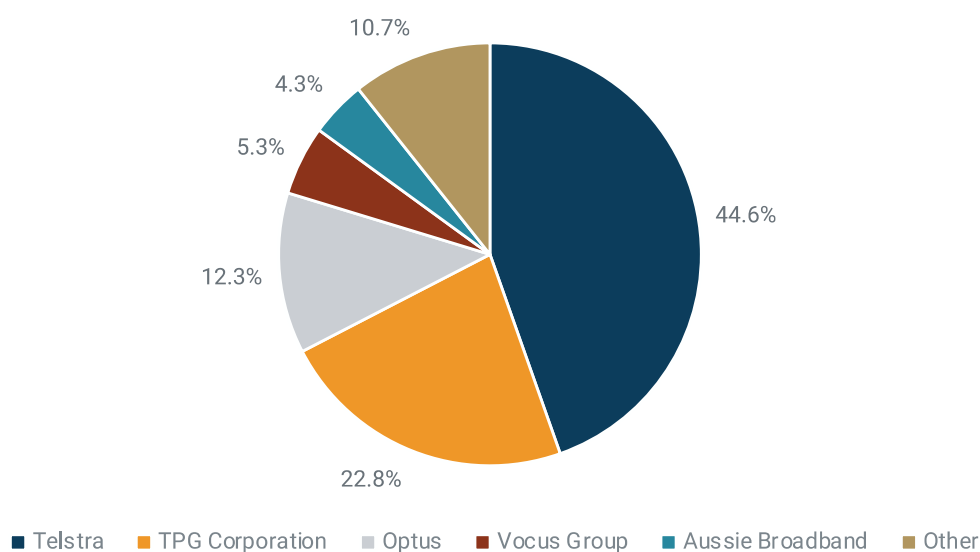
A1.43 NBN is currently the only national provider of wholesale fibre access products to retail providers.

A1.44 Despite the introduction of the NBN, there are only three major providers of fixed broadband at the retail level with around 80 per cent of the market share (Figure A1-4). Telstra (the fixed telecoms incumbent) continues to be the major retail provider.

⁷⁵ NBN Co Ltd, Statement of Expectations, 24 August 2016.

⁷⁶ <https://www.communications.gov.au/what-we-do/internet/national-broadband-network/nbn-legislative-framework>

Figure A1-4 Retail market shares of the major broadband providers in Australia (2020).⁷⁷



The current regulatory framework for broadband in Australia

A1.45 The Department of Infrastructure, Transport, Regional Development and Communications has overall responsibility for setting telecommunications policy in Australia.⁷⁸

A1.46 The **two main regulatory bodies** for the communication industry in Australia are the:⁷⁹

- a) Australian Competition and Consumer Commission (**ACCC**) for competition matters under the Competition and Consumer Act 2010. The ACCC is responsible for the economic regulation of the communications sector (including the NBN) and it is independent of Government.
- b) Australian Communications and Media Authority (**ACMA**) under the Telecommunications Act 1997. ACMA is responsible for regulating telecommunications, broadcasting and radiocommunications in Australia, providing information on consumer issues, standards and compliance, emergency services, numbering, mobile phone matters and other important legislation. It is subject to Ministerial direction.

A1.47 In relation to fixed telecoms, ACCC have oversight of all NBN Co's services and ensure it provides open and fair access to its networks. For example, ACCC:⁸⁰

⁷⁷ <https://www.telegeography.com/products/globalcomms/data/country-profiles/oc/australia/broadband.html>

⁷⁸ <https://www.communications.gov.au/what-we-do>

⁷⁹ <https://www.communications.gov.au/policy/policy-listing/competitive-telecommunications-regime-australia>

⁸⁰ <https://www.accc.gov.au/regulated-infrastructure/communications/accc-role-in-communications>

- a) Assess and enforce terms of access (price and non-price) to the NBN in a Special Access Undertaking (SAU) from NBN Co. It also publishes explanatory material about NBN Co's non-discrimination obligations, and it is involved in determining and reviewing the locations of the NBN points of interconnect.⁸¹
- b) Assess and enforce the incumbent's (Telstra's) Structural Separation Undertaking (SSU) and plan to migrate its customers to the NBN.
- c) Set wholesale prices and wholesale terms of access for declared NBN Co services.
- d) Monitor and report on prices and competition in the communications sector.
- e) Investigate claims of anti-competitive conduct in the communications sector.

A1.48 In May 2020, the Government has introduced further regulatory reforms which were initially envisaged to be part of the Stage 2 regulatory reforms discussed above. These have three main elements:⁸²

- a) **The Statutory Infrastructure Provider (SIP) regime.** The SIP regime will be part of a new Universal Service Guarantee (USG) covering broadband as well as voice. NBN Co is designated as the SIP for areas it has declared ready for service. Other network providers will be the SIPs for new developments where they have a contract to install telecommunications infrastructure, and complete construction after 1 July 2020.
- b) **The Regional Broadband Scheme (RBS).** The Government has established the RBS to cross-subsidise NBN Co's fixed wireless and satellite networks in regional, rural and remote regions in Australia (estimated to incur net losses of \$9.8 billion over 30 years).

This scheme will ensure that, after the RBS commences, around 95 per cent of the cost of funding NBN Co's fixed wireless and satellite networks will continue to be paid for by NBN Co, while the remaining five per cent will be paid for by competing NBN-comparable wholesale networks in commercially viable areas. Under the scheme network providers are required to pay \$7.10 per month for each premise on their network with an active high speed superfast broadband service provided over a local access line.⁸³

- c) **Reforms to carrier separation arrangements.** Amendments to the carrier separation rules were introduced on 25 August 2020. Since 1 January 2011, new high speed broadband networks have been required to be wholesale-only. The Government has amended these rules to make them clearer and more effective and allow network providers to run wholesale and retail businesses on a 'functionally separated' basis. Network providers will need to obtain the approval of the ACCC by submitting a functional separation undertaking.

⁸¹ <https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn>

⁸² <https://www.communications.gov.au/what-we-do/internet/telecommunication-reform-package>

⁸³ <https://www.communications.gov.au/documents/regional-broadband-scheme>. The Scheme also includes a concession period that exempts the first 25,000 residential and small business premises on each carrier's network, or the first 55,000 'recently connected greenfield premises' for carriers operating greenfield networks, for the first five financial years.

Lessons learnt from the deployment of fibre in Australia

- A1.49 There were several major challenges to completing the roll-out of NBN in Australia. We have captured the main lessons learnt below.
- A1.50 **First, the initial network deployment in 2009 was much slower than expected – a point which was expected, but not properly communicated to key stakeholders.** Discussions with experts in Australia have confirmed that this was not due to poor planning or lack of resources at NBN Co, but a reflection of the complexity involved in building an FTTP network from scratch and poor expectation management. For example, there were several regulatory hurdles which took time to address, such as the need to strike agreements with the incumbent (Telstra) to gain access to its ducts and exchange buildings and designing the most appropriate topology for the new network (including the location of the 121 points of interconnection).
- A1.51 On the other hand, relevant price and non-price terms of access were clarified by the NBN Co in its commercial Wholesale Broadband Access (**WBA**) agreements⁸⁴ and the SAU⁸⁵ it offered to the ACCC. In addition, the ACCC had the power to intervene *ex-post* in the event NBN Co behaved anti-competitively.
- A1.52 **Second, and as discussed above, the newly elected Government in 2013 decided to introduce significant changes to the scope of the NBN and the accompanying regulatory framework – five years after roll-out of the FTTP network began.** These changes have themselves introduced additional delays in the network roll-out. Some of the most significant changes the then Government introduced include the following:
- a) **Adopt a multi-technology mix (MTM) to reduce the total capex required to roll-out NBN.** MTM was regarded as being ‘economically future proof’ as it could be upgraded when demand for FTTP crystallised.⁸⁶
 - b) **Introduce as much infrastructure competition as practically possible.** According to the Vertigan Panel,⁸⁷ entrenching an infrastructure monopoly imposed too great a risk on consumers, government and taxpayers and would have been unlikely to meet the objective of timely and cost-effective deployment. This is because NBN Co’s sunk costs and access to public funds would have erected huge barriers to entry for future network operators.^{88,89}
 - c) **Remove the requirement for alternative network providers to be wholesale only.**⁹⁰ To facilitate the entry of alternative network providers the Government decided to introduce legislation to require new networks targeting residential customers and offering high-speed broadband to be structurally separated as a default and offer non-discriminatory

⁸⁴ <https://www.nbnco.com.au/sell-nbn-services/supply-agreements/wba>.

⁸⁵ <https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn/nbn-co-special-access-undertaking-2011>

⁸⁶ Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 10.

⁸⁷ Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 16.

⁸⁸ Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 64.

⁸⁹ Australian Government, Telecommunications Regulatory and Structural Reform, December 2014, page 9.

⁹⁰ Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 79.

access. However, the legislation also allows the ACCC to authorise functional separation arrangements (subject to undertakings from said providers).⁹¹

- d) **Remove the requirement of uniform wholesale prices for NBN products and services.** To encourage competition, the Vertigan Panel proposed capping NBN's wholesale prices accompanied by a gradual move towards cost-based wholesale pricing, including targeted subsidies used to address any concerns regarding user affordability that may result from this change.^{92,93}
- e) **Clarify NBN Co's product development processes to safeguard dynamic efficiency.** The Vertigan Panel were of the view that the combination of vertical separation and upstream monopoly would have increased the risks to dynamic efficiency despite NBN Co's need to recoup the very considerable sunk costs the NBN involves. To this end the Government asked the ACCC publish guidelines in relation to new product development.^{94,95}
- f) **Clarify and specify in legislation NBN Co's social policy obligations.** To help remove any potential conflicts arising between NBN Co's high-level objective to achieve certain policy outcomes and the decisions it would take as a commercial entity, the Vertigan Panel recommended NBN Co's social policy objectives are set in legislation.⁹⁶

A1.53 **Third, following the extensive reviews discussed above and the introduction of a new regulatory framework, there were still ongoing issues.** In addition to the NBN not being technically future proof:

- a) **NBN Co's continued focus on profits was damaging.**⁹⁷ According to OECD (2017), as a monopoly provider, the NBN was setting wholesale prices to maximise revenue while also limiting innovation by offering products to retailers that are quite 'high level' technically.⁹⁸ This is unsurprising as NBN Co, although funded by the Government, was set-up as an investment which was expected to earn a return of up to 7%.⁹⁹
- b) **Introducing network competition at a much later stage comes with its own costs.** Under the RBS scheme discussed above, network providers are required to pay \$7.10 per month to the NBN for each of the premises on their network to subsidise the latter's non-commercial activities.
- c) **The ACCC has potentially intervened too late to set wholesale access prices for NBN.** Although the 2011 SAU was fit for its purpose, it took until 2021 to revise it and fully

⁹¹ Australian Government, Telecommunications Regulatory and Structural Reform, December 2014, page 10.

⁹² Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 19 and 100.

⁹³ Australian Government, Telecommunications Regulatory and Structural Reform, December 2014, page 11.

⁹⁴ Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 122.

⁹⁵ Australian Government, Telecommunications Regulatory and Structural Reform, December 2014, page 12.

⁹⁶ Independent cost-benefit analysis of broadband and review of regulation, Volume I – National Broadband Network Market and Regulatory Report, August 2014, page 113.

⁹⁷ <https://www.news.com.au/technology/online/internet/oecd-questions-cost-of-nbn-and-whether-its-encouraging-innovation/news-story/cd8c023de9b1d8c7a75e3cadaf145960>

⁹⁸ OECD (2017) Economic Surveys: Australia 2017, p. 90.

⁹⁹ NBN Co, Corporate Plan 2012-15, page 9. <https://www.nbnco.com.au/content/dam/nbnco/documents/nbn-co-corporate-plan-6-aug-2012.pdf>

align it to NBN Co's new scope.¹⁰⁰ Moreover, it is only on 4 November 2020, that the ACCC completed an inquiry into NBN's wholesale access prices with a focus on the entry level wholesale product prices and is currently investigating potential changes to the regulatory arrangements for the NBN that could be established under a revised special access undertaking.¹⁰¹

Case study 3: United Kingdom

Why the UK?

A1.54 The UK has a mature telecoms market and a well-established regulatory framework. The main reasons it makes an interesting case study are as follows:

- a) Despite its mature market, fibre roll-out lags other major developed countries. Despite this, both the UK Government and the telecoms regulator (Ofcom) believe fibre deployment is to be encouraged through as much network competition as possible.
- b) Furthermore, both the UK Government and Ofcom regard the deployment of fibre and 5G as intrinsically linked, where fibre connectivity provides the backhaul connectivity that links mobile base stations, such as masts, to the core network.
- c) The UK government (in collaboration with the four UK MNOs) has created a Shared Rural Network (SRN) to address an identified market failure of poor mobile coverage in rural areas of the country

The Government's ambitions for fibre and 5G

A1.55 Digital infrastructure, and in particular gigabit-available broadband, is at the heart of the Government's policy making.

A1.56 The UK Government is working with industry to target a minimum of 85 per cent gigabit capable coverage by 2025, getting this as close to 100 per cent as possible. The Government has started an ambitious work programme to remove barriers to broadband deployment and maximise coverage in the hardest to reach areas of the country, including:¹⁰²

- a) **£5 billion package through the UK Gigabit Programme.** The Government expects the private sector to deliver gigabit-capable broadband to around 80 per cent of UK premises. However, around 20 per cent of UK premises are expected to be uncommercial, which the Government will subsidise to ensure no area is left behind.
- b) **£500 million through the Shared Rural Network (SRN).** The government is investing £500 million, matched by the four MNOs, to deliver high-quality 4G mobile coverage

¹⁰⁰ <https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn>

¹⁰¹ <https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn/inquiry-into-nbn-access-pricing>

¹⁰² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938539/NIS_Report_Web_Accessible.pdf

from at least one operator across 95 per cent of the UK by 2025. Through this initiative each MNO has individually committed to reach 90 per cent of the UK by 2026, and collectively the SRN will provide additional coverage to 280,000 by 2026.

- c) **£50 million in 5G trials.** The government continues to support its 5G Testbeds and Trials Programme, with £50 million in 2021-22.
- d) **5G Supply Chain Diversification Strategy.** In December 2020, the UK Government published its 5G Supply Chain Diversification Strategy to ensure the UK's 5G networks are not over reliant on a single supplier, committing £250 million to this initiative.¹⁰³ As part of this initiative, the Government has also set up the Telecoms Diversification Taskforce to drive forward ongoing work to diversify the UK's telecoms supply chain and reduce reliance on high-risk vendors.¹⁰⁴ The Task Force published its final report in April 2021 which included several recommendations, including the adoption of Open Radio Access Network (**O-RAN**) technology.¹⁰⁵

A1.57 In addition, in April 2021 the UK Government proposed new rules to end so called "not spots" and to eliminate "mobile signal blindspots" in rural locations and on roads.¹⁰⁶

The current state of competition in the UK

A1.58 The UK mobile market has been long established and competitive, with four main MNOs: Three, EE, Virgin Media/O2, and Vodafone. Whilst EE leads the market overall in connection terms,¹⁰⁷ their share is larger in the new generation networks, including 34 per cent of the 4G and 41 per cent of the 5G network.¹⁰⁸

¹⁰³ <https://www.gov.uk/government/publications/5g-supply-chain-diversification-strategy/5g-supply-chain-diversification-strategy>

¹⁰⁴ <https://www.gov.uk/government/news/ex-bt-boss-leads-task-force-to-attract-new-vendors-to-uk-telecoms>

¹⁰⁵ <https://www.gov.uk/government/news/new-laws-to-wipe-out-rural-mobile-not-spots-and-speed-up-rollout-of-next-generation-5g-technology>

¹⁰⁶ <https://www.gov.uk/government/news/new-laws-to-wipe-out-rural-mobile-not-spots-and-speed-up-rollout-of-next-generation-5g-technology>

¹⁰⁷ The annual HHI is never above 2,915 in the last decade.

¹⁰⁸ GSMA (calculated), 2021.

Figure A1-5 Market shares of the four UK MNOs by connections.

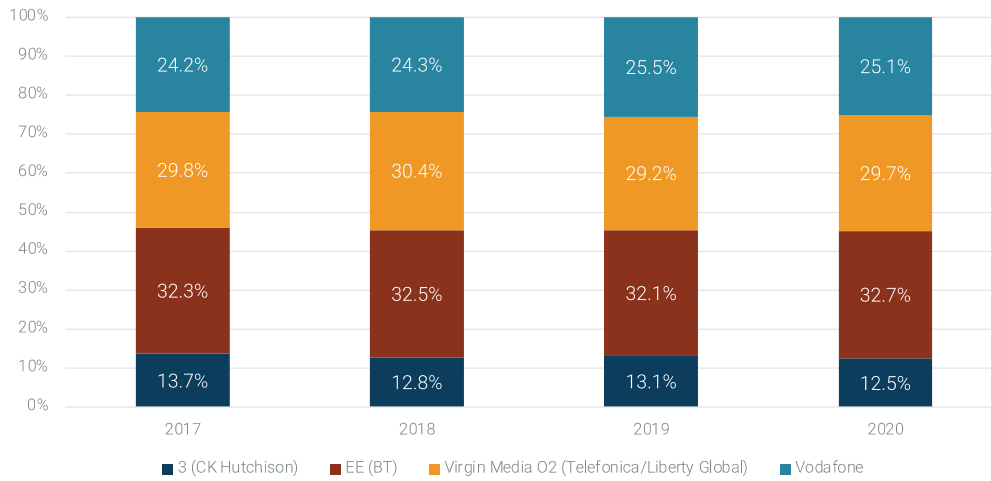
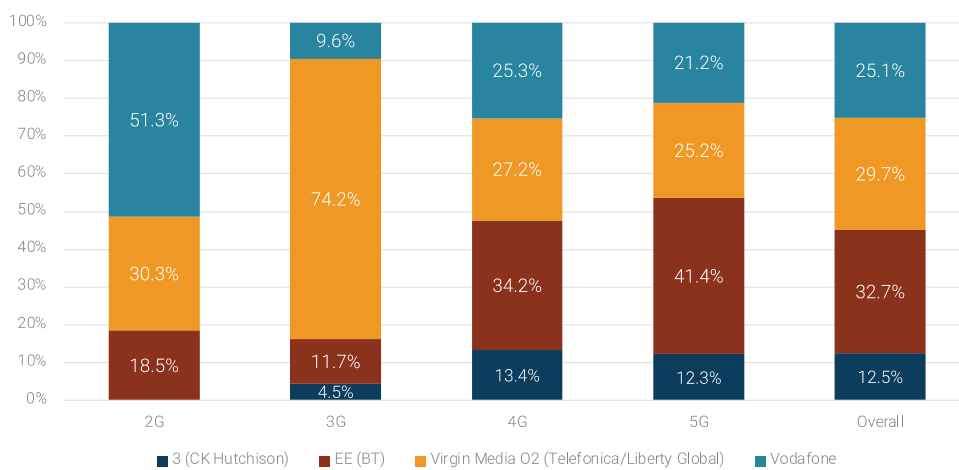


Figure A1-6 Market shares of the four UK MNOs by technology (as of 2020).



A1.59 The UK also holds a large MVNO market, with the majority of the larger companies currently being hosted in isolation by EE.¹⁰⁹

A1.60 In fixed telecoms, BT is the incumbent network provider at the wholesale level (and provides wholesale access to downstream operators through its legally separated network infrastructure company, Openreach). In 50 per cent of the UK (mainly urban areas) Virgin Media is a key network competitor to BT (using its own cable network).

¹⁰⁹ Cable. What is an MVNO? <https://www.cable.co.uk/mobiles/guides/mvno/>. 28th of January 2021

The current regulatory framework in the UK

The case for fibre regulation

- A1.61 As discussed above, successful national deployment of fibre is key to the deployment of 5G in the UK.
- A1.62 Ofcom has recently published its decision in relation to the regulation of fibre networks in the UK.¹¹⁰ In order to encourage as much infrastructure competition as possible Ofcom subdivided the UK into three main areas, adjusting the regulatory framework accordingly.

Table A1-2

| | Description | Key regulatory obligations imposed on Openreach |
|--|---|--|
| Area 1 | Competitive – commercial deployment by at least two rival networks to BT each with established market positions | No regulatory obligations |
| Area 2 70 per cent of UK | Potentially competitive - where there is already (or there will be) one commercial deployment by rival networks to BT | Openreach to provide wholesale access to its network Entry level FTTC products (40/10) subject to an inflation linked price cap Pricing flexibility on all FTTP products Geographic discounts not allowed |
| Area 3 ¹¹¹ 30 per cent of UK | Unlikely to be any material commercial deployment by rival networks to BT | FTTC products subject to an inflation linked price cap Pricing flexibility on all FTTP products Geographic discounts allowed on FTTP products |

- A1.63 To further encourage investment, Ofcom has allowed Openreach to charge more (£1.70 per month extra) for the 40 Mbit/s service if it is delivered over full fibre.
- A1.64 Ofcom is regulating leased lines services in a similar way to residential broadband services discussed above. Moreover, in Area 3, Ofcom is requiring Openreach to provide dark fibre links at cost to support mobile and other network growth.
- A1.65 Ofcom's regulatory framework for fibre will remain in place until March 2026. However, in recognition of the longer payback periods of investments in gigabit-capable networks, Ofcom have tried to increase regulatory certainty further by giving a strong indication that they do not expect to introduce cost-based price controls until at least 2031.

The case for 5G regulation

- A1.66 The wholesale mobile sector in the UK is subject to minimum economic regulation (where only mobile call termination rates are subject to a price control).

¹¹⁰ Ofcom. Promoting competition and investment in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26 - Volume 1: Overview, summary and structure. 18th of March 2021. https://www.ofcom.org.uk/_data/assets/pdf_file/0025/216088/wftmr-statement-volume-4-pricing-remedies.pdf

¹¹¹ Area 3 is further subdivided into commercial and non-commercial areas. Non-commercial parts of Area 3 will benefit from the Government subsidy of £5bn.

- A1.67 In addition, Ofcom has taken several key steps to help deliver the deployment and use of 5G in the UK, specifically:
- a) **Making spectrum available for 5G and other wireless services.** Ofcom has identified spectrum bands at low, mid and high frequencies which have different characteristics and can be used to deliver different benefits.¹¹² For example, in May 2021, Ofcom has awarded the 700 MHz and 3.6-3.8 GHz frequency bands by auction.¹¹³
 - b) **Working with Government and other decision makers to ensure access to sites is not a barrier to 5G.** For example, planning reforms were introduced in England in 2016 to make it easier to deploy masts to support rural coverage, with Scotland introducing its own reforms in 2017.¹¹⁴ The Government has announced further reforms in 2020 to planning laws in England which will allow mobile network providers to put more equipment than they currently can on phone masts, making it easier to share masts and increase mobile coverage areas.¹¹⁵
 - c) **Ensuring access to backhaul connectivity between 5G base stations and the core network.** Ofcom has recognised that increasing capacity demand from macro cells and the deployment of small cells might require a denser fibre network and a change in the nature of the services provided by network operators, away from managed capacity connections to more flexible links such as those provided by dark fibre. As a result, and as discussed above, Ofcom has required Openreach to provide dark fibre at cost in Area 3 to support mobile and other network growth.

Lessons learnt from 5G deployment in the UK

- A1.68 Both the deployment of fibre and 5G networks in the UK are very much at the beginning of their journey. In particular, the take-up of 5G in the UK is still relatively low with around 800k 5G active devices in 2020 (equivalent to over 1 per cent of all active devices).¹¹⁶
- A1.69 Therefore, more time is required to test whether the Government's work programme and Ofcom's regulatory decisions on fibre/5G will yield the desired outcomes. In a report prepared for the House of Commons (dated December 2020) the following risks were raised:¹¹⁷
- a) **Any technologies used need to be future proof.** The Government's technology-neutral approach to securing a nationwide gigabit capable network is helpful to deliver network roll-out to as many premises as possible as quickly as possible. However, any new networks that are rolled out need to be technically future proof.
 - b) **There needs to be sufficient funding for hard-to-reach areas.** There are concerns that the Government's current proposed subsidy of £5bn may not be enough to bring gigabit connectivity to the hardest to reach premises.

¹¹² https://www.ofcom.org.uk/_data/assets/pdf_file/0021/97023/5G-update-08022017.pdf

¹¹³ <https://www.ofcom.org.uk/spectrum/spectrum-management/spectrum-awards/awards-archive/700-mhz-and-3.6-3.8-ghz-auction>

¹¹⁴ <https://www.gov.scot/publications/permitted-development-rights-class-67-changes/>

¹¹⁵ <https://www.gov.uk/government/news/new-law-changes-to-bring-better-connectivity-to-the-uk>

¹¹⁶ Ofcom. Connected Nations Update. https://www.ofcom.org.uk/_data/assets/pdf_file/0028/218881/Connected-Nations-Spring-Update-2021.pdf. : 12th of May 2021.

¹¹⁷ <https://committees.parliament.uk/publications/4109/documents/40723/default/>

- c) **There is a risk that policy objectives clash with commercial objectives.** There are concerns that 5G will not be enough to deliver gigabit connectivity to rural areas and this might be exacerbated if 5G network deployment is commercially driven as previous generations of mobile technology.
- d) **The Government's efforts to address the most serious barriers to roll-out do not match the scale of its ambition for gigabit connectivity.** For example, despite the challenges of the 2025 target, the Government is adopting a "wait and see" approach to some complex issues - such as third-party access - instead of addressing these proactively.
- e) **There is a risk that there may not be enough engineers to build the relevant networks.**

A1.70 Moreover, according to an article written by the 5G UK Innovation Network,¹¹⁸ the deployment of 5G (especially in the enterprise sector where it is likely to have the biggest impact) faces several challenges, such as **the revenue potential**, which may be outside the direct influence of either the regulator or the UK Government.

Case study 4: South Korea

Why South Korea?

A1.71 South Korea officially entered the race to deploy a 5G network in 2008 and became the first nation in the world to launch a nationwide 5G network in April 2019.¹¹⁹ The 5G network deployment in South Korea is hailed as a real success story, so much so that the Government's plan is for the country to play an ever-increasing role in the global 5G market, capturing a 15 per cent share by 2026.¹¹²

The Government's ambition in 5G

A1.72 **South Korea entered the race to deploy 5G in 2008.** Over the next several years, successive governments pursued a strategy of collaboration with numerous domestic and international parties, to reach global agreement on the set of rules and best practices for 5G network development.¹¹² A requirement for global interoperability was key for the South Korean economy, given its reliance on exports.

A1.73 As a result, **5G development in South Korea involved many stakeholders and there were several parallel initiatives set-up to bring these stakeholders together.** For example, these included the 5G Strategy Promotion Committee (launched in 2015 to discuss updates on network development and private sector concerns) and the 5G Forum (launched in 2013).¹²⁰ These initiatives are still ongoing today.

¹¹⁸ <https://uk5g.org/5g-updates/read-articles/5g-rollout-biggest-challenges/>

¹¹⁹ Korea Economic Institute of America. South Korea's 5g Ambitions. http://www.keia.org/sites/default/files/publications/kei_aps_gillispie_200316.pdf. 23rd March 2020.

¹²⁰ <http://www.5gforum.org/html/sub/company/greeting.php>

- A1.74 The 5G Forum was established as a public-private 5G promotion think tank to create a vision and a 5G mobile communication strategy for South Korea.¹²¹ In addition to the Government, the 5G Forum members included MNOs, global manufacturers, research institutes and universities.
- A1.75 In July 2017, in a meeting co-ordinated by the Ministry of Science and ICT (MSIT), **the country's three MNOs** –SK Telecom, KT Corporation, and LG U+– **agreed to roll-out their 5G services simultaneously** in a move designed to “avoid heated competition” among them.¹²²
- A1.76 In April 2019,^{123,124} the Government announced its **5G+ Strategy**: which is about creating a holistic and safe 5G environment by integrating advanced devices and Internet of Things (IoT) services to the 5G infrastructure. **This strategy focusses on five core services and ten core industries** – with the aim of delivering 180 trillion won in productivity, \$73 billion in export and creating 600,000 quality jobs by 2026. The five core services include digital health care, immersive contents, smart factories, autonomous vehicles and smart cities.
- A1.77 The 5G+ Strategy envisages the continued close cooperation between the public and private sector. It also envisages the investment of over 30 trillion KRW (through cooperation between the government and the private sector) to create the world's first 5G ecosystem by establishing a nationwide 5G network at an early stage (by 2022).
- A1.78 On the back of the pandemic, the Korean Government recently announced the **Korean New Deal** to revive the economy, by facilitating the convergence of new and old industries through enhanced use of digitalisation. The deal has three main objectives: the Digital New Deal, Green New Deal, and strengthening the employment and the social safety nets.¹²⁵ The deal focusses on projects to exploit synergies between the government and the business sector, where establishing 5G network infrastructure early is one of the key objectives.¹²⁶

The current state of competition in South Korea

- A1.79 There are three main MNOs that provide retail services in South Korea. There is also a significant MVNO market with a market share of around 13 per cent as of March 2021.

¹²¹ Communications of the ACM. 5G Commercialization and Trials in Korea. <https://cacm.acm.org/magazines/2020/4/243638-5g-commercialization-and-trials-in-korea/fulltext>. April 2020.

¹²² <https://en.yna.co.kr/view/AEN20180717006200320>

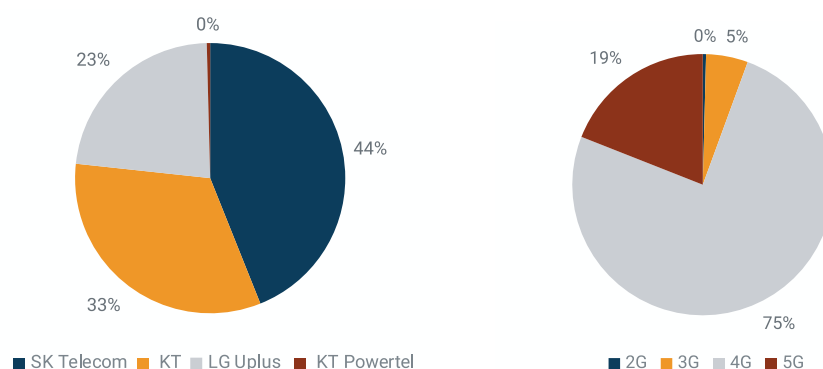
¹²³ <https://www.msit.go.kr/eng/newsLetter/view.do?sCode=&mId=&mPid=&pageIndex=3&newsLetterSeqNo=41&searchOpt=0&searchTxt=>

¹²⁴ The Government of the Republic of Korea: 5G+ Strategy, 2019. <https://english.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=10&mPid=9&pageIndex=&bbsSeqNo=46&nttSeqNo=7&searchOpt=ALL&searchTxt=>

¹²⁵ <https://thediplomat.com/2020/07/south-koreas-new-deal/>

¹²⁶ OECD Economic Survey: Korea, Overview, August 2020, page 36.

Figure A1-7 Market shares and technology split of the MNOs in South Korea.



A1.80 According to the OECD, all three operators are expected to launch SA-5G networks in 2021 with industrial applications.

A1.81 By April 2020, 5G subscriptions in Korea had reached 6.34 million users.¹²⁷

The current regulatory framework for 5G in South Korea

A1.82 Telecoms services in South Korea are regulated by two organisations:

- a) The Ministry of Science and ICT (**MSIT**). The MSIT is an executive ministry and is directed by the Prime Minister.
- b) The Korean Communications Commission (**KCC**), established under the Act on the Establishment and Operation of KCC. The KCC is one of the central administrative agencies and is under the control of the President.

A1.83 The regulatory framework for telecoms is set out in the Telecommunications Business Act (**TBA**) and the Radio Waves Act (**RWA**). While MSIT is the regulatory agency with overall supervisory powers of the communications business (under the TBA, ITNA and Protection of Communications Secrets Act); KCC has responsibility for investigating and fining operator breaches under the TBA, amongst other duties.¹²⁸

A1.84 To facilitate the deployment of 5G networks and commercialisation of 5G several policy initiatives were implemented, including:¹²⁹

- a) Developing a pilot service for the 2018 Pyeongchang Olympics: 5G was indeed key to the Olympic game's opening ceremony;¹³⁰
- b) Developing a process for spectrum bidding and early allocation of frequency bands;

¹²⁷ https://www.oecd-ilibrary.org/sites/bb167041-en/1/3/3/index.html?itemId=/content/publication/bb167041-en&_csp_=509e10cb8ea8559b6f9cc53015e8814d&itemIGO=oecd&itemContentType=book#section-16

¹²⁸ <https://www.lexology.com/library/detail.aspx?g=eb116ab0-8a68-4f08-aaf4-8199183dc491>

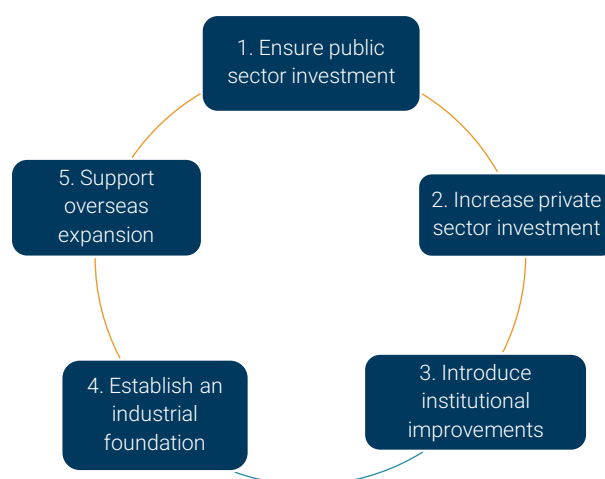
¹²⁹ MSIT, 5G+ Strategy to Realise Innovative growth (2019), page 12.

¹³⁰ <https://www.forbes.com/sites/elaineramirez/2018/02/23/in-the-race-for-5g-south-korea-shows-off-its-tech-prowess-at-the-winter-olympics/>

- c) Introducing institutional improvements for joint construction of 5G infrastructure and equipment;
- d) Adopting policies to enhance backhaul and backbone connectivity; and
- e) Implementing tax deductions specifically for 5G investments.¹³¹

A1.85 In its 5G+ Strategy MSIT is going further by proposing five key tasks (each supported by several objectives) to support the deployment of 5G+ networks and services.

Figure A1-8 Key objectives of the 5G+ Strategy in South Korea.



A1.86 Under objective 3 (Introduce institutional improvements) in the figure above, MSIT aims to improve the regulatory environment further by, for example:

- a) Encouraging the introduction of a **tariff** that does not sharply increase the prices faced by residential consumers, to ensure they enjoy diverse 5G services (April 2019).
- b) **Increasing the supply of 5G frequency** bands by two-fold. This will also require re-farming the frequency bands currently used for 2G, 3G and 4G networks which are due to expire in 2021 to provide 5G convergence services (i.e. autonomous vehicles, smart factories and cities). In addition, at present only three companies have access to the existing 5G spectrum in South Korea: however, from November 2021, additional operators, including non-telecommunications companies will be potentially offered access to the spectrum.¹³²
- c) **Easing the administrative burden** by introducing ‘frequency band licenses’ that combine and streamline processes such as frequency band allocation and establishment of radio stations.

¹³¹ The Government of the Republic of Korea. Infographics of 2020 Annual Report on National Informatization. <https://english.msit.go.kr/SYNAP/skin/doc.html?fn=5b528f8a2ce056dc686fef46eb8671ad&rs=/SYNAP/sn3hcv/result/>.

¹³² Total Telecom. Non-telcos to gain 5G spectrum in South Korea <https://www.totaltele.com/510123/Non-telcos-to-gain-5G-spectrum-in-South-Korea>. 29th of June 2021.

- d) Establishing **the safest environment for use of 5G**. For example, by establishing a comprehensive system for cyber security and designating core 5G facilities as critical information and communications infrastructure.
- e) Encouraging **regulatory innovation for 5G convergence services**. For example, continue to identify 'regulatory sandbox' tasks for 5G convergence technologies and services through private-public communication channels including 5G forums and committees.

A1.87 Also, important to note that coordination of 5G+ strategy is based **on strong cooperation between the Government, the regulator and the private sector**. For example, the 5G+ strategy will be overseen by a joint 5G+ Strategy Committee comprised of relevant ministries and experts from the private sector. Moreover, regular assessments will be conducted on progress through a 5G+ Strategy Review Meeting within MSIT every quarter (including the Second Vice Minister) and every month (including the Deputy Minister of ICT Policy).

Lessons learnt from deployment of 5G in South Korea

A1.88 The relative success of 5G deployment in South Korea has been attributed **to the strong ongoing collaboration between the Government and the private sector, both domestically and internationally**. In addition, progress in 5G development is continuously monitored by the 5G Strategy Promotion Committee.¹³³

A1.89 As discussed above, other important contributing factors to the success of 5G/5G+ in South Korea are as follow:

- a) **There is wide support for its domestic strategy and approach to deploy 5G networks and services**. This support includes all key stakeholders from the Government, the regulator and the private sector. In addition, private sector experts are a key part of the Government's 5G+ Strategy Commitment.
- b) **There is an emphasis on developing both supply and demand side policy initiatives**. The Korean Government continues to improve measures to accelerate 5G adoption through direct and indirect measures.

As set out in its 5G+ strategy, on the supply side policy initiatives aim at increasing investment by the private sector (for example, by increasing tax incentives and providing R&D support to SMEs). On the demand side, there is a big push for the public sector to adopt 5G services (for example, by supporting safe and efficient management of outdated public facilities and creating a 5G device market linked to public demand).

- c) **There was early recognition that creating the right regulatory framework is paramount to ensuring successful roll-out of networks**. The Government prioritised spectrum allocation and implemented effective spectrum management from the onset.¹³⁴ Following several consultations with the 5G Promotion Committee, and a year before the 5G service launch, the Korean Government held the world's first 5G spectrum

¹³³ Samsung. 5G Launches in Korea – Get a Taste of the Future. <https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/5g-launches-in-korea-get-a-taste-of-the-future/5G-Launches-in-Korea-Get-a-taste-of-the-future.pdf>

¹³⁴ <https://blogs.worldbank.org/eastasiapacific/5g-korea-lessons-developing-world>

auction in 2018.¹³⁵ The Government also communicated the spectrum roadmaps and plans for new spectrum releases to boost investor confidence.¹²⁸

As part of its 5G+ strategy the Government is planning to further increase available spectrum for 5G services, including re-farming the frequency bands currently used for 2G, 3G and 4G networks which are due to expire in 2021.

- d) **As well as a clear domestic strategy, South Korea developed many international collaborations to ensure the development and adoption of 5G.** For example, the 5G Forum established bilateral and multilateral collaborations with Chinese IMT-2020 Promotion Group, European 5G-IA (Infrastructure Association), Japanese 5G-MF (Mobile Promotion), 5G Americas, 5G Brazil, UK5G, 5GTurky, Indonesia i5G, Taiwan 5G-Alliance, WWRF, and FuTURE Forum.¹³⁶
- e) **South Korea adopted a forward-looking approach to 5G and is a leading player in many technological developments.** For example, in 2016 the 5G Forum, MSIT and Giga KOREA Foundation set up the six task forces to develop 5G convergence service scenarios that were most likely to be commercialised in Korea by 2030: the Korean Government included the most promising five in its 5G+ strategy.¹³⁷

¹³⁵ <https://www.mobileworldlive.com/featured-content/top-three/south-korea-completes-5g-auction>

¹³⁶ <https://cacm.acm.org/magazines/2020/4/243638-5g-commercialization-and-trials-in-korea/fulltext>

¹³⁷ <https://cacm.acm.org/magazines/2020/4/243638-5g-commercialization-and-trials-in-korea/fulltext>