Future proofing the digital infrastructure business: A regulatory perspective

edotco Group

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1. Introduction

The tower business is changing. Evolving. While those changes started due to commercial realities and technology change – given the rapid growth of 4G/LTE and now 5G services – external events are now accelerating those trends. The appearance of the coronavirus and the resulting COVID-19 pandemic raises the stakes in all areas of ICT deployment and usage. Commerce, work, and learning have all become more dependent on ICT systems, telecommunications networks and the digital infrastructure provided by towercos. Not only is telecommunications/ICT indispensable to facilitate to the greatest extent possible normal economic and social functioning but it is also critical for the global community’s responses to the virus itself.

The associated economic implications arising from COVID-19 will be broadly adverse. Specifically, Government revenues and costs, mobile network operator (MNO) revenues and costs, restricted foreign investment and trade and consumer incomes, will also have an impact on policy and regulatory settings. It will pose significant risks to market players as well. What may have been left previously to market forces to invest in becomes essential; perhaps with digital infrastructure being treated as a utility with all of the attendant political and regulatory scrutiny, intrusion into commercial decisions and lower rates of return which accompany such classification.

Digital infrastructure which includes towers and associated infrastructure and related services have becoming essential and more critical than ever. It will continue to be stress tested as the demand for services and trends unleashed during this period continue to unfold; more so in some markets compared to others.

While the traditional towerco business was focused on coverage, the prevailing demand for the next decade is for additional capacity and infill. Such demand requires towercos to be nimble, flexible, and well capitalised.

5G is built on both 4G and 5G network infrastructure with a complex multi-radio access technology (RAT), multi-spectrum architectures, among other things, require mobile network operators to have large and diverse number of physical locations and equipment to accommodate full coverage and seamless connectivity, which either being deployed by themselves or outsourced to towercos such as edotco or another vendor/supplier:

- **Outdoor densification** – a larger number of outdoor cell sites, including smaller macrocell ranges in suburban areas, mini/macro cells deployed on poles in cities, and small cells on roofs and street furniture;
- **Indoor densification** – indoor deployment of cellular networks requires new partnerships between MNOs, enterprises, local councils, transport provider, stadium, and property owners to reach the optimum locations within buildings and venues;
- **Massive MIMO** – increasingly large arrays of active antennas will accompany many 5G expansions, especially in mid-band and high frequency spectrum. These units will often require new or upgraded sites;

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1 According to the latest GSA statistics as at April 2021, 436 operators in 133 countries are investing in 5G in the form of tests, trials, pilots, planned and actual deployments including all markets in the edotco footprint. Of those 163 operators in 68 countries/territories have launched mobile or FWA 5G services. More than 238 MNOs now hold licenses issued for 5G bands worldwide. See GSA, *Networks Technology Status update 29 April 2021*; and GSA, *Webinar, End of 2020*, December 2020
2 Rethink Research, *MNOs labor under 5G complexity, tough choices with many partners*, February 2021
- **Multi-haul** – virtualised and disaggregated RANs not only require upgraded backhaul connectivity to support 5G traffic loads, but also fronthaul and mid-haul connectivity between different RAN elements such as radio units, distributed units, and central units. This will require dense deployments of fibre with sufficient quality to enable low latencies of fronthaul; and

- **Edge computing** – as operators start to virtualise their RANs, they will require data centre capacity for virtualised network functions that are deployed on cloud infrastructure. Some of these functions will be located close to the cell site to support low latency response, and these will require sites, housings, and servers near the location of the source data distribution.

The development of towercos has to a large extent been driven firstly, by the need for MNOs to monetise existing passive assets to drive investments into 4G and recently into 5G. Shortening technology cycles mean that there are substantially less opportunities for MNO to reap return on investments (e.g., unlike there was from 2G to 3G etc). Secondly, increasing support for towercos and their role has been driven by the need for cost optimization and focus on core mobile business. With specialised skills, systems, processes, and experience, towercos are in better positioned to improve operational and energy efficiency at scale rather than relying on in-house provisioning of towerco services. Where such factors become more important, and where coverage is less of a differentiator, the emergence of separate business for managing the towers is inevitable.

The desire for domestic control over strategic digital assets and technologies which are essential to digital economies, essential services and to greater parts of the economy as the economy embraces industrial revolution 4.0 (IR4.0) will continue unabated. As shown by current trade debates, these trends are not just reserved to emerging markets but are globally of interest. The lack of detailed international or regional precedents, models, and guidelines in relation to towerco regulation compared with, say the regulation of telecommunications services or interconnection, makes the task more challenging.

Determining the optimal approach to future proofing the digital infrastructure business is challenging. However, the exercise is very worthwhile and important. It is important for countries to devise the best practice frameworks going forward to maximise sector investment and secure country competitive advantage. Regional economic block such has ASEAN has already recognised the needs to harmonise and future proof its digital infrastructure following the adoption of ASEAN Digital Masterplan 2025 (ADM2025) in January 2021 (see Appendix).
2. Overview of key factors impacting the towerco business

This regulatory future proofing paper is structured based on the following four principal key focus areas, namely:
(i) Overview of key factors impacting on the towerco business (see Section 2);
(ii) The evolution of tower companies looking out to the 5G era and beyond (see Section 3);
(iii) Regulatory response towards futureproofing the impact to business (see Section 4); and
(iv) Towerco response to 5G (see Section 5).

2.1 Broader global factors impacting the towerco business

While it is possible to examine many broader global factors impacting the towerco business, the two global factors beyond technological advancement that are likely to have an impact on the towerco business are COVID-19 and climate change.

Impact of COVID-19

The COVID-19 pandemic has had a major impact on health, social interaction, and economic growth around the world. The ASEAN and South Asia regions have not escaped its reach. In particular, the region has suffered from the disease, domestic economic shutdowns, limited international travel/tourism and reverberations from the rest of the world (see Exhibit 1). What was expected to short term challenge from COVID-19, is now likely to have deeper and more ongoing impacts throughout 2021 and into 2022/23.

Exhibit 1: COVID-19 has direct and indirect shocks which governments globally are trying to mitigate

Source: World Bank, From Containment to Recovery, East Asia and Pacific Update October 2020, page 1

As at early 2021, Asian countries are relatively positive compared with the USA or Europe with some qualifications. The pandemic has so far been contained in part of the Asian region, but not in Indonesia, Pakistan, and the Philippines, and still threatens other countries, most recently Myanmar, Malaysia, Sri Lanka, Cambodia, Lao PDR and Thailand. The impacts are uneven depending on success on a country’s ability to tackle the spread of the virus and Government economic response. The next challenge with be enhanced contact tracing and the distribution of COVID-19 vaccines.
While there was a view that shutdowns have been mostly phased out and were to replace by more targeted measures recent restrictions in some Asian countries have upended that view.3

Market players may suffer a reduction in both revenues and profits although this varies as demand for services has risen significantly due to change of user behaviour and shift in traffic patterns, but the ability of end-users to pay for services has fallen as people have lost jobs and businesses have closed. Nevertheless, there are some upside for the industry as firms (and consumers) are increasing their use of digital platforms and digital solutions (see Exhibit 2).

Exhibit 2: Firms are increasing their use of digital platforms and investing in digital solutions

![Bar chart showing the percentage of firms using digital platforms in various countries: Indonesia, Philippines, Vietnam, Cambodia, and Myanmar.]

Source: World Bank, From Containment to Recovery, East Asia and Pacific Update October 2020, page 27

Extensive study by Infrastructure Australia on the impacts of COVID-19 on telecommunications infrastructure in Australia found that demand has shifted from CBD to suburbs and regional areas, adding pressure on broadband infrastructure, accelerating 5G investment and growing demand for cloud services (see Exhibit 2).

Similar trends may also be seen in edotco markets and should therefore be taken into account.4 The Malaysian experience under COVID-19 is detailed in Exhibit 4.

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4 For example, the Malaysia Digital Economy Blueprint, February 2021, has a significant focus on cloud services.
The Infrastructure Australia report found the move to regional Australia by city workers will be semi-permanent, causing network bottlenecks that could constrain resources that would otherwise have been used for network upgrades and maintenance. However, with more people working from home, there is pressure on established networks to upgrade. The report found that compared to other countries, Australia’s infrastructure networks are relatively resilient, service providers are adaptable, and communities are responsive to change.

**Demand has shifted from CBD to suburbs and regional areas**

Around 30% of employees have been working from home during the pandemic, resulting in greater internet/broadband strain on the network. The impact of large-scale remote working led to a surge in usage with demand being redistributed from the CBD to suburban and regional areas. Regionalisation is expected to lead to increased pressure on broadband networks if the trend persists. A survey conducted by the Regional Australia Institute indicated that the number of Australian’s working from home in a regional setting had doubled following COVID-19 restrictions from March 2020 to August 2020. Increased demand in areas which were not set up to manage business grade interest usage has resulted in higher congestion. Telecommunications providers have handled surges in demand in residential areas through optimising network settings and NBN allocated extra capacity.

**Pressure on broadband infrastructure**

The COVID-19 lockdown saw acute bandwidth congestion, which was addressed by NBN increasing capacity for internet service providers. On average it appears Australian’s have not been significantly impacted with regards to their internet speeds and congestion, however the surge in usage as individuals transitioned to remote working and learning has revealed some bottlenecks in the network. The report found Canberra, Adelaide, Melbourne and the Sunshine Coast experienced a decline in internet quality, while the best place to work from home was Perth. Going forward, one solution is greater infrastructure investment in these areas. Additionally, putting standards in place for how providers should respond in future situations may also ease congestion caused by demand surges.

**5G investment acceleration**

Telecommunications companies have brought forward 5G investments, in part due to the pandemic. Construction of 5G infrastructure is capital intensive relative to 4G, yet it is recognised that 5G roll out could increase profitability of providers and potentially draw away from NBN demand. The report importantly noted that 5G investments are being made despite downward revenue pressure in the mobile businesses of these proponents – with the reduction in travellers and tourists adding to pressure on mobile roaming and pre-paid revenue.

**Cloud services demand**

The demand for Cloud services from Australian companies accelerated as they moved to new models of working, even as the market approaches maturity. Despite the uptake of Cloud, data centre investment declined in 2020 due to restricted cash flow as a result of COVID-19 but is expected to rebound in 2021. Higher levels of remote working and Cloud usage also catalysed an increase in cyber security services investment during COVID-19 lockdowns.

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Exhibit 4: Malaysian experience during COVID-19

In Malaysia, recent analysis from Opensignal of the performance of Malaysia’s MNOs has found that they provided resilient services to their mobile users during the COVID pandemic. That said, the Malaysian Government has launched several initiatives including the Jalinan Digital Negara Plan (JENDELA) to improve coverage and quality of service and set the foundation for 5G, to improve network coverage and ensure the high quality of the country’s telecommunications services. Concurrently, Malaysian MNOs have continued to invest in increasing capacity and upgrading their networks, under the ongoing National Fibreisation and Connectivity Plan (NFCP). Plans were in place to improve the coverage and quality of broadband and digital service, however, measures placed under COVID-19 was a stress test to the nation’s digital infrastructure.

Source: National Digital Infrastructure Lab Report, 3 September 2020

Malaysian MNOs also took pre-emptive measures or managed data traffic differently to reduce the risk of outages. Some operators such as Digi restricted their free internet offers to productivity and information related apps/services and websites (i.e., not video entertainment). Furthermore, with students and employees working from home, and shifts in user behaviour during the lockdown, average speeds could have diminished during the non-peak hours, bringing down overall speeds in Malaysia.

Additionally, many Malaysians working in cities moved out to their kampungs in the suburbs or rural areas to avoid being quarantined in the city. This change in mobile usage location means users were spending more time in locations where the network infrastructure was not have been designed to support such a large number of users and their increased mobile data usage.

Opensignal data shows that mobile data consumption in Malaysia has increased significantly during the COVID-19 pandemic. While it declined from the peak observed back in late March to mid-May 2020, it is likely to keep growing in the future. Interestingly churn has increased in the Malaysian market from small MNOs to Maxis and Celcom who have provided a better customer experience (i.e., greater connectivity and more time on 4G etc).

Climate Change

Climate change is one of the greatest threats to humanity and the telecommunications industry has a big part to play in fighting this global crisis. Asian region is highly vulnerable with many countries are now being exposed to the risk of more frequent and intense flooding, rising seas, landslides, and heat waves. Some 7 of the top 10 countries affected by extreme weather events in the past decade are in the edotco footprint, as shown in Exhibit 5.

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Responding to the threat, leading industry players are taking collaborative action by being fully transparent about their own climate emissions by disclosing climate action roadmap beyond the realm of Corporate Social Responsibility, to achieve net-zero greenhouse gas (GHG) emissions target. Forming an integral part of climate governance framework, notable initiatives generally include rolling out energy-efficient initiatives, sourcing renewable energies, carbon offsetting, expanding the use of smart solutions as well as accelerating digitisation in various parts of business. Towercos such as Vertical Bridge, amongst others are already making voluntary net zero emissions commitment.

More broadly, in limiting the global temperature rise to only 1.5°C, GSMA has also set an ambitious milestone to transform the mobile industry to reach net zero carbon emission by 2050, at the latest. On the regional front, there is already an attempt by ASEAN to take a more concerted approach in dealing with the threat of climate change, with ADM2025 urging its member states to centrally collate various operational data i.e., electricity consumption, proportion from renewable energy, amount of data traffic, from their respective key service providers on yearly basis for monitoring, insights, and more meaningful policy intervention purposes in future.

It is crucial to note that the transitioning to a net-zero economy is not without challenges, more so in the developing regions. As user base and network of towers and other infrastructures expand, the energy needed to power the sites will likely increase manifold. Even when 5G is still nascent, towercos who responsible for managing energy on behalf of their MNO customers, have already experiencing a Year-on-Year energy consumption growth, albeit with a higher productivity and energy intensity. Towercos in the developing markets will also have to be contented with the type of fuel used to power national grids in their markets. Coal remains the primary source of power plants in this region, and renewable energy feed into the national grid is still low. Even with a more advanced developing countries such as Malaysia, the renewable energy will only account for 30% of its total energy produced in 2030.

Given the above limitations, while there is an increasing interest is pushing for a more sustainable business practice, any attempt to mandate the use of specific percentage of renewable energy on towercos or MNOs as part of a license condition or regulatory requirement needs to be carefully justified against the consumer surplus that they generated as infrastructure investment are being expanded into the sub-urban and rural areas.
Exhibit 5: Countries most effected by extreme weather events (1999-2018)\(^{12}\)

Exhibit 6: Mobile subscriptions by technology (billion)

2.2 Industry factors impacting the towerco business

Ericsson Mobility Report projects that by the end of 2026, 5G will attract 3.5 billion subscriptions, generating 45% of the world’s total mobile traffic data (see Exhibit 6).\(^{13}\) In contrast, by 2025, the GSMA expects 5G connections to reach 1.2 billion, and 5G networks are expected to cover one-third of the world’s population.\(^ {14}\)

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\(^{14}\) [www.gsma.com/futurenetworks/ip_services/understanding-5g/5g-innovation/](http://www.gsma.com/futurenetworks/ip_services/understanding-5g/5g-innovation/)
Early 2021, Rethink Research published a detailed study on 5G infrastructure deployment and ownership which covered a wide section of MNO as well as towercos and other infrastructure providers. Exhibit 7 summarizes the challenges and opportunities for towercos.

**Exhibit 7: Summary of Rethink Research study on 5G infrastructure deployment and ownership**

A study undertaken by Rethink Research in 2020, has proven that the 5G infrastructure deployment, its network requirement, ownership models and the network economics are highly complex since it is still evolving.

The Report identified first half of the 2020s as a decade of intensive 4G expansion and/or 5G build-out for many mobile operators round the world. These processes entail far more dramatic changes than previous migrations because:

- there are radical new architectures such as virtualized, disaggregated RAN and core;
- the new networks span a dizzying array of different combinations of spectrum bands and radio access technologies (RATs);
- the 5G networks will need to enable a wide diversity of services and user experiences.
- increased sharing of infrastructure deployment and usage with other operators – including competitors, but also new entrants such as enterprise network operators;
- increased use of wholesale and neutral host providers of sites, fiber, data centres, edge cloud nodes and even active equipment – the later particularly in the emerging small cell-as-a-service (SCaaS) segment); and
- Share or outsource cell towers, high rooftop sites and some backhaul connectivity is already well-established, but will intensify in the 5G era, and extend to other types of infrastructure. This will have a dramatic effect on site numbers and the whole ecosystem.

Rethink Research concluded that these changes would unfold opportunities for a variety of ecosystem players:

- **Neutral hosts.** Some independent tower operators will expand their business model into small cells, data centres and fibre, while new providers will have a specific focus on one or more of these infrastructure types;

- **Existing data centre and fibre deployers;**

- **Infrastructure services providers.** These range from network services divisions of large base station vendors, to integrators and civil engineering firms;

- **Infrastructure software providers.** These traditionally offered products for site monitoring and service management, but have the opportunity to expand into more modern techniques such as AI-based analytics and digital twin systems; and

- **Core network and orchestration providers, and network-as-a-service (NWaaS) providers.** Network equipment providers and independent software providers will focus on emerging technologies such as network slicing.
Exhibit 8 summarises the key current and future factors impacting towerco business outside normal commercial pressure of financing and operational costs. These key factors are then explored in detail in section 4 below.

**Exhibit 8: Key current and future factors impact on the towerco business**

<table>
<thead>
<tr>
<th><strong>CORE BUSINESS</strong></th>
<th><strong>ANCILLARY BUSINESS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key External Drivers</strong></td>
<td></td>
</tr>
<tr>
<td>• MNO densification</td>
<td>- New Sites</td>
</tr>
<tr>
<td>• MNO ARPU/fixed pressures</td>
<td>- Fibre backhaul</td>
</tr>
<tr>
<td>• 5G deployment</td>
<td>- IRs</td>
</tr>
<tr>
<td>• Legacy 2G/3G switch off</td>
<td>- Small cells</td>
</tr>
<tr>
<td>• MIMO antennas</td>
<td>• Antenna as a service (AaaS)</td>
</tr>
<tr>
<td>• Transition to active infrassharing</td>
<td>• Neutral hosts/Type BAN</td>
</tr>
<tr>
<td>• Accelerating Wi-Fi</td>
<td>• Edge computing</td>
</tr>
<tr>
<td>• 5G</td>
<td>• Public safety broadband networks</td>
</tr>
<tr>
<td>• Gas</td>
<td></td>
</tr>
<tr>
<td>• Industry consolidation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Key Internal Issues</strong></th>
<th><strong>Critical Enablers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Power to sites</td>
<td>- Foreign direct investment rules</td>
</tr>
<tr>
<td>• Tower leasing</td>
<td>- Rights of Way (ROW)</td>
</tr>
<tr>
<td>• Skills for line services/active sharing</td>
<td>- Permitting fees</td>
</tr>
<tr>
<td></td>
<td>- Infrastructure policy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Regulatory Regime Issues</strong></th>
<th><strong>Electronic Magnetic Fields (EMF) Concerns</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensing and fees</td>
<td>Regulatory costs and over regulation</td>
</tr>
<tr>
<td>Active infrastructure sharing</td>
<td>USO schemes and constitution</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** WPC, February 2021.
Exhibit 9: Summary of key external and internal issues and business opportunities for towercos

<table>
<thead>
<tr>
<th>Factors</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KEY EXTERNAL DRIVERS</strong></td>
<td></td>
</tr>
<tr>
<td>MNO capacity increases and extended coverage due to increased demand</td>
<td>As a result of the growth of mobile broadband services (including demand driven by COVID-19) MNO capacity will need to increase as well as coverage will increase to provide services in underserved areas.</td>
</tr>
<tr>
<td>Legacy 2G/3G network switch off</td>
<td>As part of the move to 4G and 5G services, legacy 2G/3G networks will be decommissioned over the next 2 to 10 years depending on the market. One of each MNO’s legacy networks is likely to be switched off by 2023-2025.</td>
</tr>
<tr>
<td>5G deployment</td>
<td>Rapid uptake of 5G services across all emerging markets such as Cambodia, Bangladesh, Pakistan, and Philippines having launched, reviewing or investing in 5G</td>
</tr>
<tr>
<td>New MIMO antennas</td>
<td>Due to additional capacity and move to 5G, massive MIMO antennas are being deployed by MNOs</td>
</tr>
<tr>
<td>Deeper infrastructure sharing</td>
<td>There is an ongoing push for infrastructure sharing – from passive to active sharing and for more sharing of infrastructure in urban/rural areas and for 5G.</td>
</tr>
<tr>
<td>Move to FWA</td>
<td>5G FWA deployment will drive demand for additional wireless services from MNOs and fixed operators including higher frequency and mmWave antennas.</td>
</tr>
<tr>
<td>6G (2030?)</td>
<td>6G services are scheduled to become available in 2030 timeframe impacting network design, towers, etc. Small cells will be a key feature of such new technologies.</td>
</tr>
<tr>
<td><strong>KEY INTERNAL ISSUES</strong></td>
<td></td>
</tr>
<tr>
<td>Power to sites</td>
<td>Power requirements (and backups) are higher in relation to 5G compounded using massive MIMOs antennas.</td>
</tr>
<tr>
<td>Tower loading increases</td>
<td>Antenna weights and loadings due to flat panel design may require legacy tower strengthening and different future designs.</td>
</tr>
<tr>
<td>Skillsets for live services/active sharing</td>
<td>Upskilling resources to manage and operator live, and active sharing services rather than just provide passive infrastructure.</td>
</tr>
<tr>
<td><strong>ANCILLARY BUSINESS – KEY OPPORTUNITIES FOR TOWERCO</strong></td>
<td></td>
</tr>
<tr>
<td>New Sites</td>
<td>Many new sites including for coverage and in-fill for 5G services will be required.</td>
</tr>
<tr>
<td>Fibre backhaul</td>
<td>The design of new 4G/5G systems and capacity demands of end mobile users mean that base stations need to be fiberized to provide high speed broadband. Legacy multiple bonded E1s or MW mini links need to replace.</td>
</tr>
<tr>
<td>Inbuilding systems (IBS)</td>
<td>In-building systems (including services on public transport) will provide high speed connectivity services within a building or other locality/site and can often support multiple MNOs providing an opportunity for towercos</td>
</tr>
<tr>
<td>Small cells deployment</td>
<td>Low-power, short-range wireless transmission systems to provide high speed wireless services. Small cells typically have a coverage range of 50–200 metres. Such deployments – which may include street furniture - will require significant capital and local Government planning approval.</td>
</tr>
<tr>
<td>Antenna as a Service (AaaS)</td>
<td>Effectively the antenna and antenna lines are supplied by towerco allowing MNOs to “plug and play” their radio and network equipment at the macro or small cell site. See Exhibit 11 below</td>
</tr>
<tr>
<td>Neutral hosts/open RAN</td>
<td>Neutral hosts leveraging Open RAN to act as third-party provider to provide a managed service for multiple MNOs</td>
</tr>
<tr>
<td>Edge computing</td>
<td>Bringing computing power closer to customers means partnerships with towercos to co-locate, power, and provide security for edge computing infrastructure.</td>
</tr>
<tr>
<td>Private/Enterprise Networks</td>
<td>Making available of 5G spectrum in many countries including but not limited to mmWave spectrum which make private/enterprise networks attractive to industry verticals for factories, distribution centres, mining etc.</td>
</tr>
<tr>
<td>Public safety networks</td>
<td>Going forward the trend is to public safety broadband networks. While the majority of such networks with be based on a partnership with an MNO, in certain regions (e.g., capital region etc), there is likely to be dedicated network deployment.</td>
</tr>
</tbody>
</table>

Source: WPC Analysis, February 2021
3. The evolution of tower companies in 5G era

The business case for separate tower companies will continue to remain strong. While cost optimisation is important, achieving it through increased tenancy ratios is critical.

The rationale and business case for separate towerco is only expected to increase as mobile operators expand 4G coverage and deploy 5G services. This will however, result in the need for new investment specifically:

- Upgrades to existing towers as equipment load (from massive MIMO antennas) increases;
- Upgrades to existing sites as power requirement increases ~2.4x due to 5G/MIMO antennas (see Exhibit 10 below); and
- Increased densification (but probably more small cells which should be relatively cheaper than macro towers constructed of steel and concrete).

Exhibit 10: Significant increase of power requirements for 5G calls for towercos to managed power for better efficiency and higher Service Level Agreement (SLA) standards.

<table>
<thead>
<tr>
<th>Site configuration</th>
<th>LTE(RRU)</th>
<th>5G (AAU 1)</th>
<th>5G (AAU 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum</td>
<td>1.8 GHz</td>
<td>3.5 GHz</td>
<td>3.5 GHz</td>
</tr>
<tr>
<td>RRU/AAU Output Power</td>
<td>2*40W</td>
<td>64T64R/200W</td>
<td>32T32R/100W</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>20MHz</td>
<td>100MHz</td>
<td>100MHz</td>
</tr>
<tr>
<td>Cell capacity</td>
<td>150Mbps</td>
<td>10Gbps</td>
<td>5Gbps</td>
</tr>
</tbody>
</table>

Power Consumption

<table>
<thead>
<tr>
<th>Power consumption of RRU/AAU</th>
<th>Typical (50% load)</th>
<th>Maximum (100% load)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>360W</td>
<td>441W</td>
</tr>
<tr>
<td></td>
<td>880W</td>
<td>1040W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power consumption of module/bit</th>
<th>Power consumption of RRU/AAU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical (50% load)</td>
<td>2.4W/Mbps</td>
</tr>
<tr>
<td>Maximum (100% load)</td>
<td>2.94W/Mbps</td>
</tr>
</tbody>
</table>

Source: Huawei, 2020

While towercos traditionally have focused on the construction and maintenance of the physical towers, new business opportunities are emerging as a result of deployment of 4G/5G:

- **Small cell deployment** – cooperation with other utilities to secure in-city locations for small cells (poles, streetlamps, etc.). Regulators in certain EU countries and the United States\(^\text{15}\) are implementing policies and regulations to ease and accelerate the deployment of small cells; reduce federal regulatory impediments for 5G deployment and exemption from local permit requirements for small cells rollout.

- **Fibre deployment** – with the dramatic increase in number of sites and the traffic load – especially related to 4G and 5G services - on each there is an opportunity for tower companies to manage also the backhaul connectivity on behalf on MNO tenants;

\(^\text{15}\) The *Small Cell Order*: The FCC’s September 2018 Small Cell Order was designed to remove various state and local barriers that would prevent 5G providers from accessing existing facilities for installation of small cells - [www.natlawreview.com/article/ninth-circuit-rejects-challenges-to-fcc-s-one-touch-make-ready-small-cell-deployment#:~:text=The%20Small%20Cell%20Order,for%20installation%20of%20small%20cells](www.natlawreview.com/article/ninth-circuit-rejects-challenges-to-fcc-s-one-touch-make-ready-small-cell-deployment#:~:text=The%20Small%20Cell%20Order,for%20installation%20of%20small%20cells)
- **Fixed Wireless Access (FWA) services** being offered by the MNOs or by fixed operators. FWA has recently passed a global take-up of over 100 million customers. This has occurred at a challenging time for operators with COVID-19 driving up the number of bandwidth hungry customers;\(^\text{(16)}\)

- **Indoor site opportunities** such as airports, stadiums, shopping centres and transit hubs for provisioning of inbuilding systems (IBS);

- **Data centres and edge computing** – opportunities to deploy small data centres at tower sites to move data processing and services as close to the end user as possible; and

- **Antenna as a service (AaaS), and open RAN** - Refer Exhibit 11.

Exhibit 11: Antenna as a Service (AaaS)

Source: Huawei, 2020

The consolidation of antennas to mono and simplified version by equipment vendors will significantly reduce the difficulty and cost of site construction while slashing antenna rental costs and site energy consumption and save tower space. Such solution integrates 5G active antenna units (AAUs) and passive antennas for 2G, 3G, and 4G and potentially helps carriers save about 50% on the space required for antennas and improve 5G coverage by increasing the antenna height, having been deployed in China, Switzerland, and other countries.

While the consolidation of antennas is a concept benefitting the mobile network operators, this however would adversely affect towercos cannibalizing its revenue. Thus, towercos should address this trend strategically.

The above key drivers will provide opportunities for a higher degree of infrastructure and network sharing. Furthermore, towercos have an opportunity to play a significant role in the deployment and operation of future 5G ecosystems. These opportunities also imply that tower companies moving from more traditional construction companies into more 'equal' network partners to the MNOs as highlighted by Delta Partners in Exhibit 12 below.

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Towercos have the option to either remain within the traditional segments of infrastructure business or to engage in a forward integration to serve its customers. Some key considerations for such integration by the towercos include the degree of collaboration with third party, reskilling and acquisition of new skill sets, investment into additional support operating system and enhanced processes and Service Level Agreements with customers.

Exhibit 13 and Exhibit 14 below we explore the approaches of six of the global towercos and exemplars.
<table>
<thead>
<tr>
<th>Towerco</th>
<th>Key Markets</th>
<th>Future strategies/offerings</th>
<th>How active services are allowed</th>
</tr>
</thead>
</table>
| **American Tower** | American Tower operates in 20 countries globally, including the USA, France, Nigeria, Colombia, India, Brazil, and Mexico.  
|                 |                                                                              | American Tower’s long-term strategy for the next decade seeks to extend its track record of growth through doing the following:  
|                 |                                                                              | 1. driving operational efficiency;  
|                 |                                                                              | 2. growing portfolio and capabilities;  
|                 |                                                                              | 3. focusing on innovation; and  
|                 |                                                                              | 4. enhancing industry leadership.  
|                 |                                                                              | • USA: unlicensed. Subject to national, state, and local regulatory requirements with respect to the registration, siting, construction, lighting, marking and maintenance of our towers.  
|                 |                                                                              | • France: unlicensed with a general authorization allowing any registered company to engage in TowerCo services (only need license for dark fiber and passive infrastructure services)  
|                 |                                                                              | • Africa: Limited license requirement. Nigeria: six licenses required based on geographical allocation  
|                 |                                                                              | • India: unlimited license requirement.  
|                 |                                                                              | • Latin America: Licensed and regulated as concession and permit holders to provide active telecommunications services.  
| **Cellnex Telecom** | Cellnex Telecom operates in Spain, Italy, France, Netherlands, United Kingdom, Switzerland Ireland, and Portugal.  
|                 |                                                                              | Cellnex Telecom understands its future opportunities as centering on the following:  
|                 |                                                                              | 1. innovation, entrepreneurial culture, and leadership skills;  
|                 |                                                                              | 2. leveraging its status as the first neutral and independent operator in Europe;  
|                 |                                                                              | 3. industrial model and partnership with clients;  
|                 |                                                                              | 4. rigor in investment criteria; and  
|                 |                                                                              | 5. adding value to the 5G ecosystem.  
|                 |                                                                              | • Predominantly unlicensed requirements of either registration or notification to relents regulatory bodies, or for services in UK and France, there is a general authorization allowing any registered company to engage in TowerCo services.  
|                 |                                                                              | Otherwise, subject to obtaining, maintaining, and periodically renewing of several licenses, authorisations, and administrative and regulatory permits in all jurisdictions (EU and domestic levels).  
| **Crown Castle International** | United States                                                                | Crown Castle's long-term strategy differs from its competitors, which primarily focus on towers. Instead, Crown Castle has a small cell strategy that involves:  
|                 |                                                                              | 1. investing in fiber networks to pursue small-  
|                 |                                                                              | • USA: unlicensed. Subject to national, state, and local regulatory requirements with respect to the registration, siting, construction, lighting,  

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17 On 5 November 2020, American Tower announced that it entered into an agreement to acquire InSite Wireless Group for ~US$3.5bn. The portfolio includes more than 1,400 owned towers in the US, over 200 owned towers in Canada and approximately 70 distributed antenna system networks in the U.S. In addition, InSite controls more than 600 land parcels under communications sites as well as ~400 rooftop sites.
<table>
<thead>
<tr>
<th>Towerco</th>
<th>Key Markets</th>
<th>Future strategies/offerings</th>
<th>How active services are allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. increasing small cell node densities associated with 5G networks which it believes has the potential to meaningfully increase long-term shareholder value creation.</td>
<td>marking and maintenance of our towers.</td>
</tr>
<tr>
<td>IHS Towers</td>
<td>Colombia, Nigeria, Cameroon, Côte d'Ivoire Rwanda, Zambia, Kuwait, Brazil, Peru</td>
<td>IHS Towers has six strategic objectives which guide their business strategy and risk management process: 1. long-term strategic relationships with network operators; 2. acquisitions to supplement organic growth; 3. innovative solutions; 4. efficiency and effectiveness in their operating model; 5. adopting an ethical approach; and 6. regulatory compliance.</td>
<td>• Africa: Limited license requirement. Nigeria: six licenses required based on geographical allocation</td>
</tr>
<tr>
<td>Vantage Towers</td>
<td>Ex-Vodafone towers across 10 EU markets</td>
<td>Aim is to be a super host. Key focus areas including 5G DAS to be a neutral host provider, IOT (just done a 10-year deal with Sigfox), and solutions to industry verticals for 5G.</td>
<td>• EU: All European countries are subject to the Implementing Regulation (July 2020) on small-area wireless access points, having regard to the Directive (EU) 2018/1972 of the European Parliament and of the Council of December 2018 (establishing the European Electronic Communications Code). However, the Regulation and Directive are not subject to less restrictive regimes across Europe for the deployment of small-area wireless access points. For instance, France operates unlicensed with a general authorisation allowing any registered company to engage in TowerCo services (a license is required only for dark fibre and passive infrastructure services).</td>
</tr>
</tbody>
</table>

Source: Analysis from shareholder presentations and other sources, February 2021
**Exhibit 14: Exemplar foreign towerco: Digital Colony’s approach, strategies, and plans**

Digital Colony is the world’s largest digital infrastructure investment firm. It focuses its investment efforts in the four key segments of mobile and internet infrastructure – towers, data centres, small cells, and fibre. Digital Colony actively manages 19 portfolio and affiliated companies, comprising more than 350,000 tower sites, and more than 40,000 small cell nodes, more than 95 data centres and a fibre network of more than 140,000 route miles. It has recently entered in the Asian market with an office established in Singapore.

**Digital infrastructure fund**

Digital Colony Management’s inaugural fund, Digital Colony Partners, was the first-ever fund dedicated to digital infrastructure when it was set up in 2019. The fund aimed to raise USD3 billion and exceeded its target by 35%. It received USD4.05 billion in commitments from a broad mix of US and international investors including sovereign wealth funds institutional fund managers and pension funds. In May 2020, it was reported that Digital Colony was seeking at least USD6 billion for its second fund dedicated to communications-infrastructure bets.

**Investments in data centres**

Digital Colony has been behind some high-profile acquisitions in the data centre sector, including funding Vantage Data Centers’ acquisition of Next Generation Data. It also acquired data centres in Brazil from IT company UOL Diveo in 2019. Following this acquisition of assets from UOL Diveo, Digital Colony established Scala Data Centers, a hyperscale data centre platform headquartered in Sao Paulo, Brazil. According to the firm, it sees in the region a digital infrastructure industry and data centres with “multi-billion-dollar opportunities.”

**Investments in fibre**

In March 2020, Digital Colony’s USD8.2 billion acquisition of fibre-network owner Zayo was finalised. In addition, in May 2020, Digital Colony announced a USD181 million strategic recapitalisation of Beanfield Metroconnect, a provider of telecom infrastructure in Canada.

**Investments in small cells**

In November 2018, Digital Colony announced that an affiliate had acquired Open Cell Ltd and plans to combine the newly acquired business with Stratto Ltd, a leading provider of premium DAS and small cell networks for indoor mobile coverage in the UK. In April 2019, it added a UK small cell specialist, iWireless Solutions, to its portfolio.
4. Regulatory response towards futureproofing the business

4.1 Active infrastructure is gaining traction

Infrastructure sharing has become increasingly common through the rollout of 4G and 5G technology and will grow in popularity in the future as both MNOs and regulators see it as beneficial. Infrastructure sharing is favoured by MNOs as it can help to expand coverage, reduce costs, avoid infrastructure duplication, and maximise existing network facilities. For regulators, infrastructure sharing is attractive because it is seen to increase competition since it reduces barriers to entry.

Neutral host models can vary in terms of what assets are included in their parameter of operations (see Exhibit 15). In emerging markets, in most circumstances, these parameters are being shaped by the licensed held by the neutral host operators. Options include real estate, masts/towers, energy (equipment and management), backhaul (for example, fibre), base stations (the hardware and/or the software of baseband units (BBUs) and remote radio units (RRUs)), antennas and spectrum.

Exhibit 15: Overview of the parameter of selected neutral host business models

Source: Analysys Mason, Quarterly, January 2021, page 2

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Implications for towercos

Infrastructure sharing holds both risk and opportunity for a towerco. Passive sharing of mobile infrastructure includes tower sites and its related infrastructure, such as the towers, cables, ducts, shelters and power facilities and cooling systems (but excluding radio equipment). Towercos are crucial to passive infrastructure sharing because MNOs can lease space on a tower rather than having to own the infrastructure. This is attractive to MNOs because it is cost effective and enables the MNO to focus on their core business of expanding coverage and providing services to customers. Passive sharing also has merit from public policy standpoints it is an effective way to minimize the environmental impact of building infrastructure by avoiding unnecessary duplication. Further, it can also reduce the energy demand on a country’s national grid, and therefore is favoured by governments. Passive sharing represents a large potential source of revenue for towercos, because with more tenants comes greater revenue, from largely the same base costs.

Active sharing involves sharing of active electronic network elements, including electronics and antennae. Active sharing is likely to increase with the rollout of 5G. Prior to the rollout of 4G and 5G technology, active sharing was rarely allowed by regulators, because it was feared that the high level of collaboration required between competitors could lead to collusion. However, the high costs of 4G and 5G infrastructure meant that active sharing is by far the most economically viable option for MNOs and is now more commonly accepted.

Going forward, regulators and MNOs are more likely to favour Multi-Operator Radio-Access Network (MORAN) and Multi Operator Core Network (MOCN) agreements, that may exclude legacy technologies in favour of focusing on 4G and 5G. There is an opportunity for towercos to increase tenancy ratios and become integral to MNO operations securing a greater share of sector revenues as shown in Exhibit 16 below.

Exhibit 16: Potential capex and opex saving from sharing for MNOs

<table>
<thead>
<tr>
<th>Tenancy Ratio</th>
<th>Limited</th>
<th>Tactical</th>
<th>Structural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Model</td>
<td>BAU</td>
<td>Selective JV</td>
<td>Multiple operator TowerCo</td>
</tr>
<tr>
<td>OPEX Savings (1)</td>
<td>5 -10%</td>
<td>10 -15%</td>
<td>20 - 30% (2)</td>
</tr>
<tr>
<td>CAPEX Savings</td>
<td>5 - 10%</td>
<td>10% (3)</td>
<td>20% -30% (4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Model</th>
<th>No sharing</th>
<th>MORAN</th>
<th>MOCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEX Savings</td>
<td>-</td>
<td>10 - 20% (5)</td>
<td>30 - 40%</td>
</tr>
<tr>
<td>CAPEX Savings</td>
<td>-</td>
<td>10 - 15%</td>
<td>30 - 40% (6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Model</th>
<th>Lease, Swaps</th>
<th>Consolidate capacities</th>
<th>NetCo/Co-build/DSO JV</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEX Savings</td>
<td>-</td>
<td>30 - 50%</td>
<td>40 - 60%</td>
</tr>
<tr>
<td>CAPEX Savings (7)</td>
<td>5 - 10%</td>
<td>30 - 50%</td>
<td>40 - 60%</td>
</tr>
</tbody>
</table>

Source: AT Kearney, 2019

20 Ibid.
Exhibit 17 shows the advantages and disadvantages of sharing different technologies in an infrastructure sharing agreement in relation to 5G.

Exhibit 17: 5G active network sharing technology options, 2019

Active sharing can remove the need for operators to lease their own space on the tower, as they can share with another MNO. This could drive down potential revenue from towers, as there would be less demand and fewer tenants. Active sharing may also lead to regulatory intervention, where regulators set pricing for leases on towers.

Ultimately, the level of sharing that is appropriate in one context may be ill-suited for another. Different geographies, technologies, and population density may impact upon what sort of sharing is most appropriate for the area.

4.2 Ongoing debate on a "Single Wireless Network" approach

Broadly defined, a single wireless network (SWN) is a network typically owned by a government that compels mobile network operators (MNOs) and other industry stakeholders to rely on the wholesale services provided by the SWN. Often than not, the advent of a SWN set-up is mooted on the premise for better management of spectrum, better operational efficacy, and more cost-efficient network rollout.

On the contrary, many experts such as ITU and GSMA opine that the SWN model is unsustainable and is likely to cause market failure.

This is further substantiated by GSMA global research findings of the SWN model:

(i) No improvement of coverage in rural areas as SWNs often focused on easier to deploy urban areas;
(ii) No reduction in retail prices as the market prices are determined by a single monopoly provider;
(iii) No increase in competition with new MVNO entries in the countries with SWNs; and
(iv) No efficiency of spectrum management.

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Notably, in the context of towercos, a SWN approach is likely to be unfavourable for the following reasons:

(i) **Monopsony of SWN** – other licensees than the SWN would have poor commercial terms with their customers;

(ii) **Low tenancy ratio by other licensees** - A single buyer is unlikely to maximise returns for towerco as it is much harder to increase the tenancy ratio on towers; and

(iii) **Monopoly by SWN** - other licensees than the SWN are restricted to serve markets where SWN has a presence.

Due to the importance and urgency of the 5G networks rollout, some governments sought to centralise the single deployment of infrastructure (via SWN), thinking it is faster and better for the country. This approach may have advantages, such as eliminating redundant infrastructure. However, this is a trade-off between more efficient use of resources and the elimination of duplicate efforts, but a single wholesale network would go too far and undermine the strength of competition to drive ever-better mobile service.

Given the drawbacks outweighing and trading off the benefits of the SWN model, many fellow industry players are not favourable to the SWN model. Albeit some governments continue to adopt the SWN model for quick wins without realising the aftereffect of the SWN implementation in the long run. Few countries adopted the SWN approach, namely Rwanda, Belarus, Mexico, South Africa, and Malaysia23, being the most recent to adopt the SWN model for its 5G network rollout, while a proposal for a SWN model for internet gateway in Cambodia24 is underway.

In essence, the SWN approach is unlikely to be sustainable and that the advantages that it may provide may not be sufficient and may disrupt the industry in the long run due to absence of competition.

A more detailed summary of the GSMA assessment of global SWN can be found in Exhibit 18 below.

**Exhibit 18: Summary of GSMA: Single Wholesale Networks (SWN) Lessons From Existing and Earlier Projects, December 2019**

SWNs are being considered by policymakers in some countries entailing partial network ownership and financing of networks by their respective governments. While variations exist in SWN proposals, they are generally defined as government-initiated network monopolies that compel MNOs and other industry stakeholders to rely on wholesale services provided by the SWN as they serve and compete for retail customers. Customers are promised better coverage, more competition, and as a result, more affordable prices, however, GSMA contends that turning this vision into a working reality is difficult. Lessons from existing and abandoned rollouts mean that SWN’s are perhaps not the solution that is claimed.

Supporters of SWNs argue that they can address some concerns better than the traditional model of network competition including inadequate competition, lack of coverage in rural areas; Inefficient use of radio spectrum; and fears that the private sector may lack incentives to maximise coverage or investment. However, such claim often ignores the fact that to be built, the SWN require significant public subsidies and other forms of support such as cheap/free IMT spectrum.

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23 Digital Nasional Bhd which is a special purpose vehicle under the Malaysian Government has been created. This entity will given the appropriate spectrum to own, implement and manage the 5G infrastructure. All licenced telecommunication companies are supposed to have equal access to this infrastructure, in marketing their 5G services to their customers. The Government stated position is that this infrastructure cost-sharing enables telecommunication companies to generate higher returns and, in turn, provide better and cheaper 5G services to consumers. Digital Nasional Bhd is subject to regulation by the MCMC. Refer to [https://www.thedegemarkets.com/article/muhyiddins-speech-mydigital-malaysia-digital-economy-blueprint-launch-ceremony](https://www.thedegemarkets.com/article/muhyiddins-speech-mydigital-malaysia-digital-economy-blueprint-launch-ceremony) and [www.mcmc.gov.my/en/media/press-releases/mcmc-s-oversight-of-digital-nasional-berhad-the-go](www.mcmc.gov.my/en/media/press-releases/mcmc-s-oversight-of-digital-nasional-berhad-the-go)

24 This may follow recent Cambodian Government decisions to have a national internet gateway. Refer to [www.theregister.com/2021/02/18/cambodia_national_internet_gateway/](www.theregister.com/2021/02/18/cambodia_national_internet_gateway/)

4.3 IMT Spectrum as a driver of customer demand for towers and small cells

The overall quantum of IMT spectrum and the specific spectrum bands released in a market has a significant impact on the MNO demand for sites. Exhibit 19 below detailed the IMT spectrum allocations in key South Asia and South East Asia markets. Likewise, any restrictions placed on the licensed IMT spectrum by the applicable regulatory authority including technology limitations (e.g., 2G, 3G, 4G or 5G), coverage requirements, quality of service (QoS), spectrum pricing and deployment timing will directly impact on demand for towerco space and the need to deploy small cells.

Exhibit 19: Total IMT spectrum allocations in emerging markets


More specifically, the allocation of higher frequency bands including 3.5 GHz and mm Wave (26 & 28 GHz) – both of which will be used for 5G – with their smaller propagation areas directly affects the number of cell sites (and associated infrastructure) that would be required by an MNO to achieve optimum coverage and QoS. In addition, having certainty about the nature and timing of future spectrum releases (e.g., via a spectrum roadmap) provides the required comfort among industry players to invest in future technologies and network expansion.

From edotco perspective, encouraging and facilitating exemplar spectrum management in the markets in which it operates is a recommended approach. Releasing additional spectrum will directly impact the demand for towerco services and is likely to have broader positive economic effects.
4.4 Wi-Fi 6E as a driver of customer demand for small cells

Another technology to highlight which may be of interest in emerging markets is Wi-Fi 6E, although there will be challenges as the 6 GHz band is used in Asia for microwave backhaul links. In April 2020, the US Federal Communications Commission (FCC) voted unanimously to open the 6 GHz band for unlicensed use. With that policy change, significantly more spectrum are open that routers can use to broadcast Wi-Fi signals. The opening of the 6GHz band is the biggest spectrum addition to Wi-Fi since 1989. The inclusion of up to 1.2 GHz of spectrum in the 6 GHz band quadruples the spectrum (14 additional 80MHz channels, and seven additional 160MHz channels) available for routers and smart devices. That means less signal interference. An alternative approach supported by many countries and industry stakeholders including the EU/China/vendors and the GSMA of splitting the 6 GHz band into two parts with half of the band being used for Wi-Fi and the other half being used for IMT services will be on the agenda for ITU World Radio Conference (WRC-23). A range of new companies and MNOs will deploy infrastructure in this band using such technologies. It will be a key technology driver over the next 5 to 10 years.

As of January 2021, countries that have already committed to Wi-Fi 6E are the USA, UK, Europe, Chile, South Korea, and the United Arab Emirates. Countries progressing towards opening 6 GHz for unlicensed operation include Brazil, Canada, Japan, Jordan, Mexico, Peru, Saudi Arabia, and Taiwan.26

4.5 Other future policy considerations

Digital infrastructure is the key to enabling the benefits of the digital economy and society and central to securing the benefits of Industrial revolution 4.0 (IR4.0). Digital infrastructure is the physical hardware and associated software that enables end-to-end information and communications system to operate. Digital infrastructure includes but is not limited to:

- Internet backbone including national and trans-oceanic fibre cables;
- Fixed broadband infrastructure such as analogue coaxial and optic fibre cable networks;
- Mobile communications infrastructure and networks including FWA, transmission towers, radio and optic fiber backhaul networks;
- Broadband communications satellites;
- Data and cloud computing facilities;
- End user equipment;
- Software platforms including computer and mobile device operating systems as well as application programming interfaces; and
- Network edge devices such as sensors, robots, autonomous and semiautonomous vehicles, and other Internet of things facilitating devices and software.

Such digital infrastructure extends to smart cities as detailed in Exhibit 20 below.

A Smart City is (as defined by the UNECE and ITU through a multi-stakeholder approach involving over 300 international experts) an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.

Pursuing new urbanisation and the creation of smart cities was one of the key strategic areas in the 13th FYP. In China’s New-type Urbanisation Plan released in 2014 by the State Council, Chapter 18 Section 2 identifies the construction of smart cities as a priority. The critical applications for smart technologies in cities are identified as 1) broadband information networks; 2) informatisation of planning and management, including building public information platforms; 3) intelligent infrastructure in transportation, power, water and sewage, and pipeline networks; 4) convenient public services; 5) industrial development; and 6) social governance.

Currently, China has about 800 smart city pilot programmes under way, which is more than half of the world total. China’s move into 5G is very much geared toward an industrial build to address industrial issues like smart cities and urban planning. China is expediting the construction of its faster 5G networks. More than 10,000 new 5G base stations are being built in China every week.

There has also been development on Smart Cities throughout South East Asia. The AIM2020 undertook some projects in the smart city space and this work is to be progressed further in accordance with ADM2025 under the ASEAN Smart Cities Network (ASCN).

The speed of the development of future networks is very much depends on the industry's ability to adapt to the rapidly changing technologies, the market conditions and consumer demand. Therefore, legal, and regulatory settings need to be light touch to facilitate the evolved business models, investment, efficient competition, and economic returns rather than to regulate (particularly in a post COVID environment). Over-regulation, and/or Government mandated "outcomes" is likely to more stifling for the sector and may delay transition to 4G/5G services.

Further, Government policy for the sector should ideally be focused on value capture for the economy and society in the long term. The telecommunications industry in many emerging markets represents 2 to 6 percent of the GDP and large Telcos are consistently among the largest taxpayers typically facing taxation levels above and beyond those in more developed markets. Governments and Regulators alike need to focus on long term value creation and how a quality telecommunications sector serve as an enabler to other sectors of the economy rather than avenue for short term tax collection. Lastly, as testified by ITU it is crucial to have a resilient telecommunication network to support stronger recovery in the post- COVID-19 environment.27

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4.6 Key approaches for policymakers

While towercos could be the strategic partner to MNO’s by being the arm of infrastructure provider, the regulatory regime must evolve and/or reform accordingly and timely to enable towercos supporting role to MNOs effectively for the transition from 2G/3G to 4G/5G.

Such regulatory regime, *are as follows*:

- **Have a forward-looking licensing regime** that facilitates the co-existence of independent infrastructure providers and allows them to co-operate with traditional MNOs and fixed operators. This means the licences should be expansionary as possible. Taking into account of the towerco evolution, it should be given the flexibility to operate wide range of infrastructure related network services. As a result, generally towercos in Asia will be licensed;

- Acknowledge the *important role of and need for foreign investment* by minimising restrictions (e.g., like Indonesia). Deploying 4G and 5G is capex intensive, and it is unlikely that emerging markets on their own will have the necessary funds and expertise to accelerate the deployment of such wireless broadband in the short term. Rather, Governments and regulators need to acknowledge the need for foreign investment, facilitate for foreign ownership and allow foreign companies – if successful – to make a reasonable return and repatriate dividends to allow reinvestment. This is even more critical post COVID-19;

- **Limit direct regulation on towerco access terms and conditions.** While ensuring access to towers at cost efficient terms and conditions might seem appealing, the focus of the Governments and regulators should be to facilitate efficient competition leaving it to the market to determine the access prices and terms and conditions. Over-regulating access terms and conditions will reduce the willingness to invest and ultimately hamper investment in digital infrastructure. Thus, while having an infrastructure sharing policy is arguably important, the regulator role is best focused, if there is a dispute;

- **Have exemplar active infrastructure sharing arrangements** which facilitate active sharing arrangements between operators and other third parties. Regulators need to acknowledge that to facilitate effective deployment of 4G/5G networks, active sharing arrangements is provided by neutral host to accelerate connectivity aspiration especially in more uneconomic areas of the country. Arguably, such restriction would inhibit tower companies from playing a larger role in shaping the future of the industry; and

- **Have an equitable universal service fund arrangement** focusing on reducing the contribution rate corresponding to the size of business; to include other relevant players such as the data centres and internet exchange; and to allow contributors to claim a reasonable share from the fund. Another aspect that needs to be reviewed is the utilisation of USF which in many markets have been accumulating funds effectively serving as additional taxation rather than meeting its policy objective;

- **Have an effective and speedy site approval and deployment processes.** In many markets site acquisition and deployment and is a lengthy process requiring interaction with and approval from multiple authorities. With 5G the need for additional sites (macro and small cells) will increase and it is essential that MNOs and tower companies can deploy at the speed needed to meet market demand and that access is affordable.

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28 Although given they operate in wholesale rather than retail markets, towercos should not be treated like an MNO from a licence fee and USO contribution perspective.

29 Vietnam is one exception but this could change in the future with tower/network facilities licences being required.
4.7 Key approaches from ITU's perspective for policymakers

The ITU's recommendations on 5G highlight a range of towerco and access issues (see Exhibit 21 below).

### Exhibit 21: ITU's perspective on policy issues needed to facilitate 5G (with key towerco regulatory issues highlighted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ITU recommended approach to &quot;Setting the Scene for 5G: Opportunities &amp; Challenges&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment case</td>
<td>Policymakers may consider undertaking their own independent economic assessment of the commercial viability of deploying 5G networks</td>
</tr>
<tr>
<td>Harmonize spectrum</td>
<td>Regulators should allocate/assign globally harmonized 5G spectrum bands including 3.5 GHz, mm Wave, 2.6 TDD GHz, 2.3 GHz, 700 and 600 MHz</td>
</tr>
<tr>
<td>Spectrum roadmap</td>
<td>Regulators should adopt a spectrum roadmap and a predictable roadmap renewal process</td>
</tr>
<tr>
<td>Spectrum sharing</td>
<td>Regulators may consider allowing sharing to maximize efficient use of available sharing spectrum, particularly to benefit rural areas</td>
</tr>
<tr>
<td>Spectrum pricing</td>
<td>Regulators may consider selecting spectrum award procedures that favour investment (As opposed to auction returns)</td>
</tr>
<tr>
<td>Sub-1 GHz spectrum</td>
<td>Policymakers should consider supporting the use of affordable wireless coverage (e.g., through the 700 &amp; 600 MHz bands) to reduce the digital divide</td>
</tr>
<tr>
<td>Fibre investment incentives</td>
<td>Policymakers, where the market has failed, may consider stimulating fibre investment and passive assets through PPPs, investment funds and the offering of grant funding, etc.</td>
</tr>
<tr>
<td>Fibre tax</td>
<td>Policymakers may consider removing any tax burdens associated with deploying fibre networks to reduce the associated costs</td>
</tr>
<tr>
<td>Copper to fibre</td>
<td>Policymakers may consider adopting policies/financial incentives to encourage migration from copper to fibre &amp; stimulate deployment of fibre</td>
</tr>
<tr>
<td>Wireless backhauls</td>
<td>Wireless Operators may consider a portfolio of wireless technologies for 5G backhaul in addition to fibre, including point-to-multipoint (PMP), microwave and mm Wave radio relays, satellites etc</td>
</tr>
<tr>
<td>Access/sharing of passive infrastructure</td>
<td>Policymakers may consider allowing access to government-owned infrastructure such as utility poles, traffic lights and lampposts to give wireless operators the appropriate rights to deploy electronic small cell apparatus to street furniture. And Regulators may consider continuing to elaborate existing duct access regimes to encompass 5G networks allowing affordable fibre deployments</td>
</tr>
<tr>
<td>Access costs</td>
<td>Policymakers/Regulators may consider ensuring reasonable fees are charged to operators to deploy small-cell radio equipment</td>
</tr>
<tr>
<td>Asset database</td>
<td>Policymakers may consider holding a central database identifying key contacts, showing assets such as utility ducts, fibre networks, CCTV posts, lampposts, etc. This will help operators cost and plan their infrastructure deployment more accurately</td>
</tr>
<tr>
<td>Wayleaves (ROW)</td>
<td>Policymakers may agree upon standardized wayleave agreements to (rights of way) reduce cost and time to deploy fibre &amp; wireless</td>
</tr>
<tr>
<td>5G test beds</td>
<td>Policymakers to encourage 5G pilots and test beds to test 5G technologies, &amp; use cases, and to stimulate market engagement</td>
</tr>
</tbody>
</table>

Source: [www.itu.int/pub/D-PREF-BB.5G_01-2018](http://www.itu.int/pub/D-PREF-BB.5G_01-2018)
5. Towercos response to 5G

5.1 Key operational requirements

Beyond the regulatory ambit, key operational requirements for towercos in light of 5G are as follows:

- Manage the efficient switch-off of legacy 2G and 3G networks by the MNOs;
- Prepare tower structures to cater for both passive and active service for 5G (e.g., increased equipment loads and power requirements);
- Adopt small cell strategies and plans to meet densification demands in urban areas;
- Continuous focus on operational improvements including effective energy solutions and the optimization of maintenance costs with the remote monitoring/digitisation of management; and
- Fiberisation of sites to support surge of traffic.

Other new lines of businesses such as data centres and edge computing are unlikely to attract regulatory issues but will revolve around the need for new skills set and competencies which towercos need to address as it moves away from its traditional business. This includes the upskilling and reskilling of human capital and upgrading systems.

5.2 Building strong foundation for 5G network via 4G network – an opportunity for towercos

While the drive for 5G continues and many countries aiming to deploy 5G network expeditiously, 4G networks remain critical and are arguably the key to offering 5G services. This is because of the fact that for a non-standalone (NSA) 5G network, a 4G network must be present to support 5G connectivity. In simple terms, if 4G connection is unavailable, depending on the market current smartphones would not be able to access to 5G services.

In a study carried out by Opensignal in 2019, key finding shows that at least 96% time of mobile users spend on 4G connectivity. In Japan, 4G users’ smartphones spent an incredible 98.5% while South Korea 4G users at 98.4 percent, and U.S. 4G users at 96.1 percent. Further detail illustration by country can be found in Opensignal report\(^{30}\), May 2020.

Furthermore, the critical nature of 4G network has becoming more apparent with COVID-19 became the game-changer of the century, affecting the whole world indiscriminately.

Prior to COVID-19, many countries’ focus and priority was on longer term 5G deployment. Following the COVID-19 pandemic, things have changed dramatically, shifting the focus to accelerating and enhancing 4G delivery (and 5G deployment) from legacy 2G/3G services.\(^{31}\) The immediate industry focus was on improving high speed 4G connectivity and coverage to support working and studying from home (WFH/SFH) and to address the digital divide.\(^{32}\) The ongoing dependency on 4G network (and the need for future 5G services), creates a significant opportunity in the provisioning of backhaul or transmission services for towercos to bridge the gap of insufficient supply of wireless broadband infrastructure. Towercos could provide faster and cheaper such infrastructure than the MNOs.

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\(^{30}\) Refer to \textit{www.opensignal.com/sites/opensignal-com/files/data/reports/pdf-only/data-2020-05/state_of_mobile_experience_may_2020_opensignal_3_0.pdf}  
\(^{31}\) Refer to \textit{www.itu.int/en/myitu/Publications/2021/05/11/08/S2/Pandemic-in-the-Internet-age}  
\(^{32}\) Refer to \textit{www.opensignal.com/2021/05/11/malaysias-mobile-data-consumption-surge-in-2020-dwarfed-that-of-neighbouring-countries}
5.3 Data rights and protection

It should be highlighted that valuable data is created and can be captured in almost every infrastructure deal which typically a towerco does through, such as in IBS contract, where a towerco will know pedestrian traffic in the location which may be valuable in addition to be able to use the data for its own network planning.

Towercos should take the following steps in drafting new infrastructure contracts:\textsuperscript{33}

1. Recognise the diverse data sets associated with design, build, operation, and maintenance of infrastructure assets;
2. Assess the value of that data and determines its fair allocation;
3. To the extent possible, work out which entity should control ("own") that data, and what each other entity handling that data should be contractually required to do to ensure that the ultimate data controller can protect and thereby derive that value; and
4. Work out what practical controls, safeguards, oversight and verification mechanisms, and other good operational data governance should be contractually ensured.

\textsuperscript{33} Refer to Peter Leonard, Getting Smarter about Data in Contracts for Physical Infrastructure, 24 November 2020. Available at www.americanbar.org/groups/business_law/publications/blt/2020/12/physical-infrastructure
6. Conclusions

The evolution of the telecommunication sector has accelerated with the simultaneous birth of 5G technologies and the COVID-19 pandemic. The presence of these two events have called for a more unconventional approach to the telecommunication industry to correspond to the events that has created a dire need for high inclusivity and fast speed of mobile broadband connectivity.

The increasing importance and demand for mobile broadband connectivity has open a new horizon of opportunities to towercos to help MNOs to provide wider coverage and better quality of service (QoS) to mobile users, and at the same time help Governments to achieve their digitalization national aspiration. To realize the new role of towercos to accelerate mobile broadband connectivity, this paper has identified two critical factors that need to take place as an action call for towercos.

Firstly, the towercos need to be internally prepared to serve their customers (MNOs). This includes but not limited to, diversifying their products and services offered i.e. go beyond its core and traditional services of passive towers and infrastructures, upskilling and reskilling its employees to offer the new range of product and services such as fibre that requires specialised skills, etc.

Secondly, the towerco model only existed circa 2009/2010, where many countries still do not have a regulatory framework that addresses the towerco existence and role. This creates uncertainty and makes regulatory and business decisions for towercos more challenging. As a result, towercos products and services are limited to traditional telecommunication towers (Rooftop and Ground Based towers). Furthermore, the transition to 5G network and demand for wider and better coverage and QoS induced the proliferation of 4G network has made towercos role more crucial than ever, making it even pressed for a regulatory framework review/reform.

In essence, the onus to enable rapid 4G/5G evolution is on the towercos to play an active and aggressive role to be internally prepared and externally advocate to the policymakers and the regulators to ensure the regulation enables the evolution to occur though towercos new strategic role to MNOs. In the absence of such towerco role, the evolution will still happen but at a materially slower pace.
Appendix

Appendix: Key relevant ADM2025 Desired Outcomes and Enabling Actions

<table>
<thead>
<tr>
<th>Desired Outcome</th>
<th>Rationale for selecting the desired outcome</th>
<th>Enabling Actions (EA)</th>
<th>EA specific project details if relevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO2: Increase in the quality and coverage of fixed and mobile broadband infrastructure</td>
<td>An excellent telecommunications infrastructure is at the heart of digital transformation. Achieving this outcome ensures that telecommunications infrastructure in ASEAN are upgraded to higher data rates capabilities and resilience in a timely and cost-effective manner and that their coverage is extended into rural areas.</td>
<td>2.1 Encourage inward investment in digital and ICT</td>
<td><strong>EA2.2</strong> ASEAN to commission a project to (1) detail current planning permission processes and access rights in each ASEAN country and best practice from bodies such as ITU (2) determine best practice (3) help countries move towards best practice as best they can.</td>
</tr>
</tbody>
</table>
| DO7: Increased capability for business and people to participate in the digital economy | Providing the ASEAN Community with better digital services to improve their productivity will boost the ASEAN economy. This DO focuses on stimulating innovative local supply and creative capabilities. | 7.4 Progress the work on smart cities begun in AIM 2020 | **EA2.5** It is recommended that is each AMS could require all their main operators to report on:  
- the electricity consumed in running their networks each year;  
- the proportion of this electricity which comes from renewable resources; and the amount of data traffic carried over their network.  
This information can then be collated centrally to compare AMS, to monitor trends, and to identify where there are problems which require action.  
**EA2.9** Establish a centre-of-excellence for best practice rural connectivity, providing insight and knowledge on the range of technologies available such as satellite, fixed wireless and extended-range mobile and the resources to apply this knowledge to cases. This should consider issues such as the availability of sub-1GHz spectrum and the optimal move towards 4G/5G and decommissioning of 2G/3G. Among others to undertake studies to identify post COVID-19 approaches for: (i) suitable international and policy models and practices for smart city development, including in areas such as IoT, machine-to-machine (M2M), and sensor technologies; (ii) adopt optimal standards for smart city developments, such as for IoT, M2M, and sensor technologies, and related policies. |

Source: ASEAN, ASEAN Digital Masterplan 2025, January 2021

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34 There is a specific reference on page 49 of ADM2025 to “Lower the cost of supply by improving tower and backhaul availability in rural areas.”