TOWERING ABOVE:

BUILDING TOMORROW'S DIGITAL INFRASTRUCTURE IN ASIA

WHITE PAPER

MARCH 2022

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Roland Berger

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EXECUTIVE SUMMARY

The global telecommunications industry is at a crossroads. On one hand, it is a key engine for innovation, inclusivity and digital innovation driven by an explosive demand for data. On the other hand, telecommunications operators are under immense pressure as revenues have stagnated despite ever-growing costs and the need for fresh capital injection. There is an urgent need to adapt traditional business models and network deployment strategies especially with 5G on the horizon. Expectations from 5G are high – promising to be a bigger paradigm shift than the previous generations but this will entail massive requirements in infrastructure expansion and investments.

TowerCos have a pivotal role to play in this evolving ecosystem providing efficiency, scalability, and flexibility. TowerCos have built robust models that specialize in delivering multi-operator connectivity (neutral hosts), reducing the cost of deployment and operations of tower sites. TowerCos are evolving into digital infrastructure providers to better serve the dynamic demands of the sector – expanding from the traditional model of providing passive infrastructure to MNOs, to other activities such as enabling active equipment sharing, building alternate power options and improving operational efficiencies for clients. Overall, it is estimated that TowerCos in emerging Asian countries[1] have the potential to create USD 10 billion of savings for MNOs by 2025, benefit consumers with up to incremental USD 67 billion[2] due to price improvement and GDP growth, as well as reduce 5 – 17 million metric tonnes of carbon footprint by 2025.

Success will heavily depend on a conducive regulatory environment as TowerCos face challenges to realize the full potential. TowerCos require a conducive regulatory environment to play a pivotal role in the ecosystem, especially as they look to venture into new business models driven by the shifting landscape brought on by 5G and technological advancements. Five key regulatory dimensions are critical: 1) strong digital infrastructure mandate, 2) simplified and conducive licensing and ownership, 3) active promotion and guidelines for network sharing, 4) streamlined regulations for infrastructure deployment and 5) enablement of adjacencies. In emerging Asian markets, generally the regulatory environment is still evolving, with efforts underway to put in place more supportive policies and regulations. Overall, there is further room for growth in terms of regulatory and policy support which countries in emerging Asia can adopt compared to global best practices to enable the digital advancement in their respective countries.

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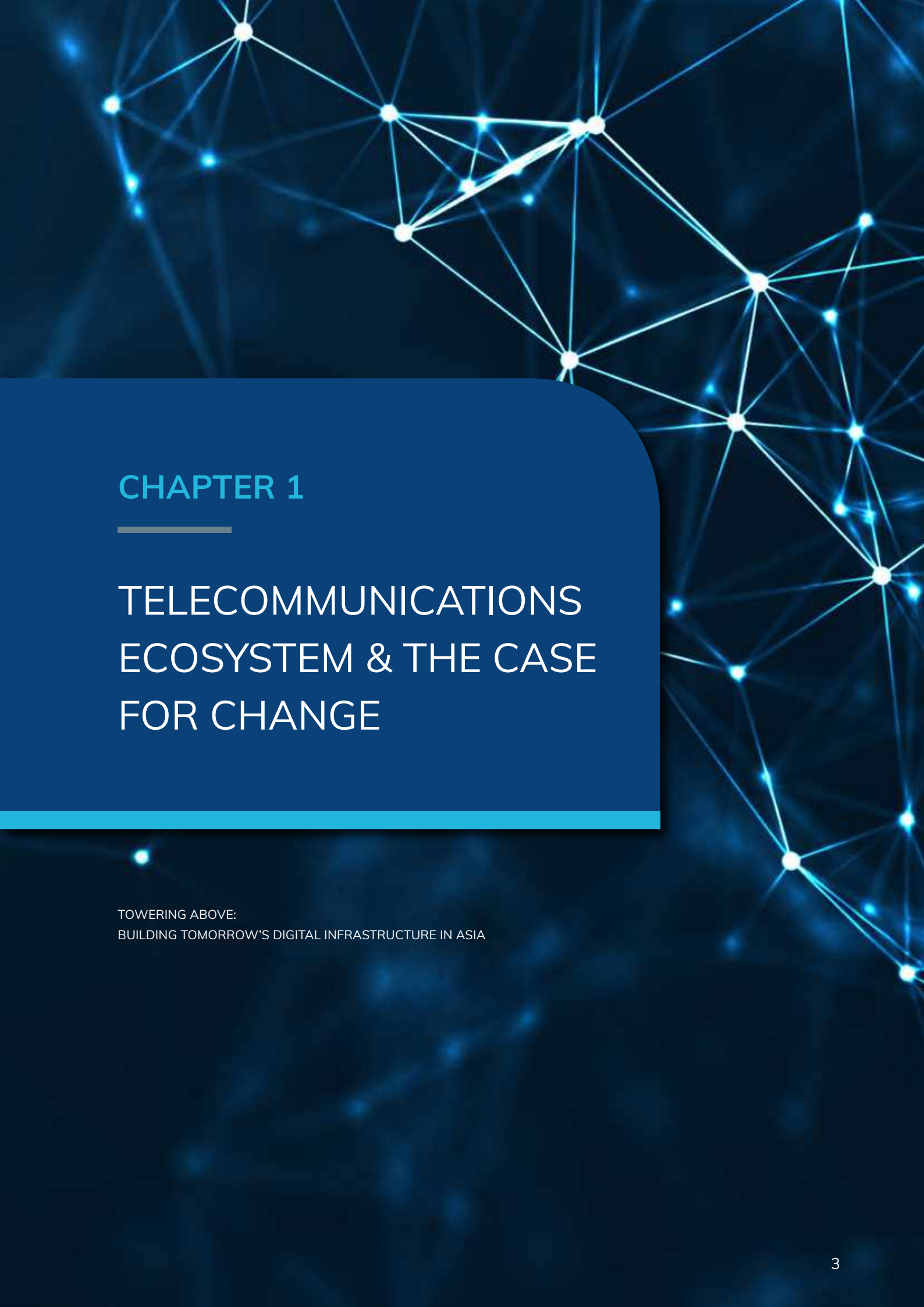
[1] 9 selected emerging Asian countries are Malaysia, Indonesia, Cambodia, Myanmar, Philippines, Sri Lanka, Pakistan, Nepal and Bangladesh

[2] Based on maximum potential benefits which TowerCos can bring



CHAPTER 1

TELECOMMUNICATIONS ECOSYSTEM & THE CASE FOR CHANGE

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TELECOMMUNICATIONS ECOSYSTEM & THE CASE FOR CHANGE

The global telecommunications industry is at a crossroads. On one hand, it is a key engine for innovation, inclusivity and digital innovation driven by an explosive demand for data. On the other hand, telecommunication operators are under immense pressure as revenues have stagnated despite ever-growing customer demand for data while cost pressure has intensified and operators face on-going requirements for fresh capital injection. There is an urgent need to adapt traditional business models and network deployment strategies which has only been further accelerated by the evolution towards 5G. Expectations from 5G are high – with the advent of 5G promising to be a bigger paradigm shift than that of previous generations.

Global deployment of 5G will require investments of more than USD 1 trillion over the next five years – not an easy ask for an industry with stagnating growth. At the same time, 5G coupled with disruptive technologies such as virtualized and Open RAN and edge connectivity offers an opportunity for other players such as infrastructure providers and vendors to play a larger role in the ecosystem and support the transformation of the industry as we know today.

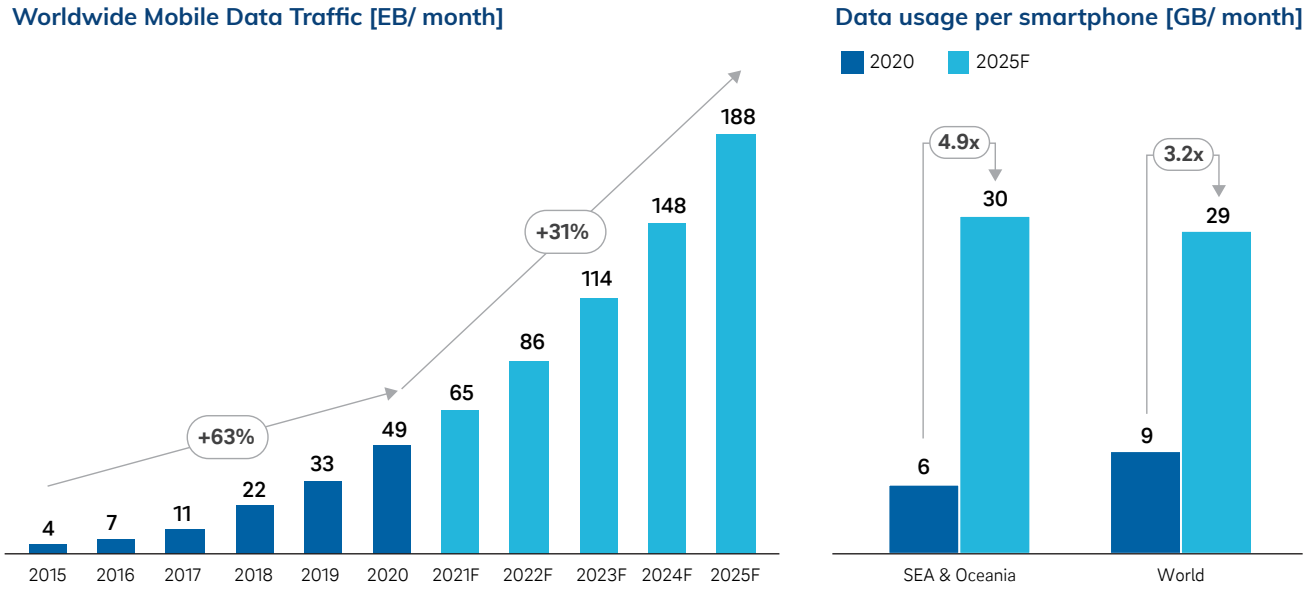
As regions with the fastest growth in data usage, large population pools and emerging economies that are looking to accelerate socio-economic growth by leveraging digital connectivity and infrastructure, South and Southeast Asia represent some of the most dynamic regions for existing and emerging players in the ecosystem.

1.1 The world is seeing explosive growth in data usage

Mobile data has been growing at a breakneck rate of >60% Y-o-Y over the last 5 years reaching usage levels of ~50 EB/ month globally in 2020. This is driven by increasing smartphone penetration, lower data prices and increasing 4G/5G penetration. High data growth rates have continued throughout the COVID-19 pandemic and mobile traffic is expected to reach ~4x of 2020 levels in the next 5 years.

Average mobile data usage in Southeast Asia (SEA) is currently below that of developed markets but over the next 5 years, SEA & Oceania is expected to experience the fastest data growth in the world driven by cheap smartphones, increasing 4G penetration and a largely young population – eventually surpassing global average data usage by 2025 as shown in Figure 1.1

Figure 1.1 Mobile data traffic trend and forecast

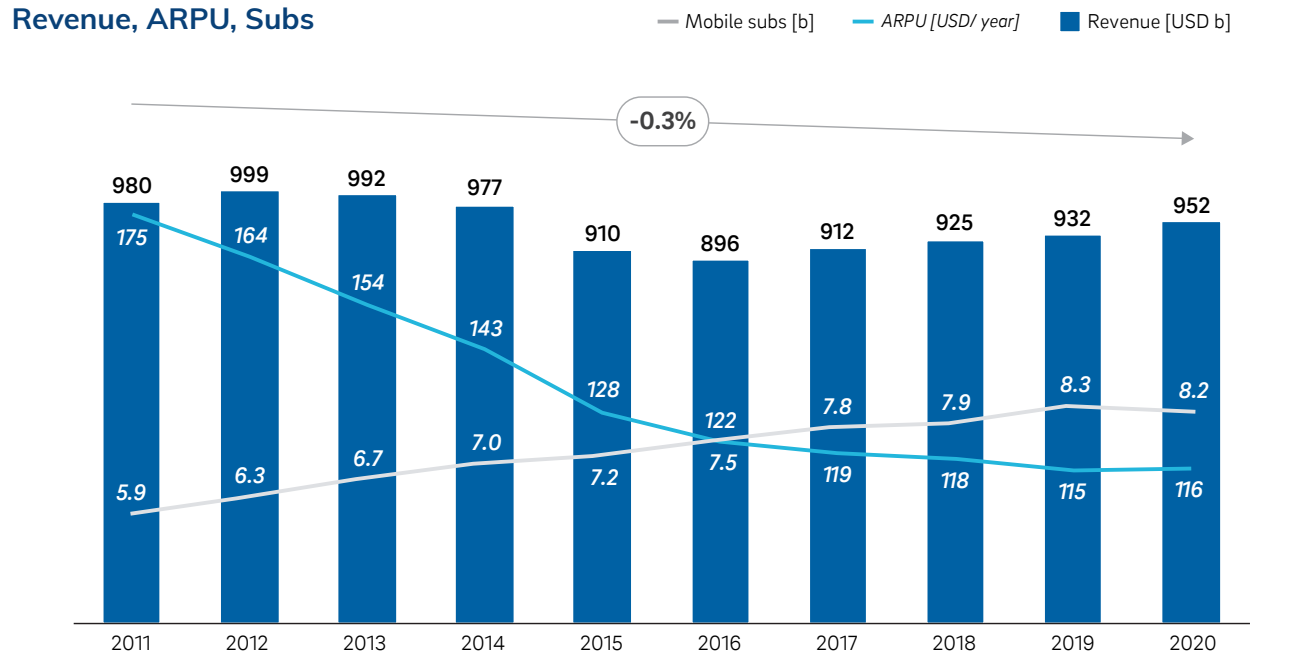


Source: Ericsson

1.2 Mobile operators are under revenue pressure

Despite the dramatic uptick in data usage, MNOs, even in growing regions such as APAC, are not seeing corresponding revenue upside. As shown in Figure 1.2a, mobile revenues have stagnated over the last 10 years. Growth in subscribers has largely come from emerging markets and on the back of lowering prices – overall resulting in an ARPU decline of 36% in the last decade.

Figure 1.2a APAC revenue, ARPU and subscribers for Mobile Operators

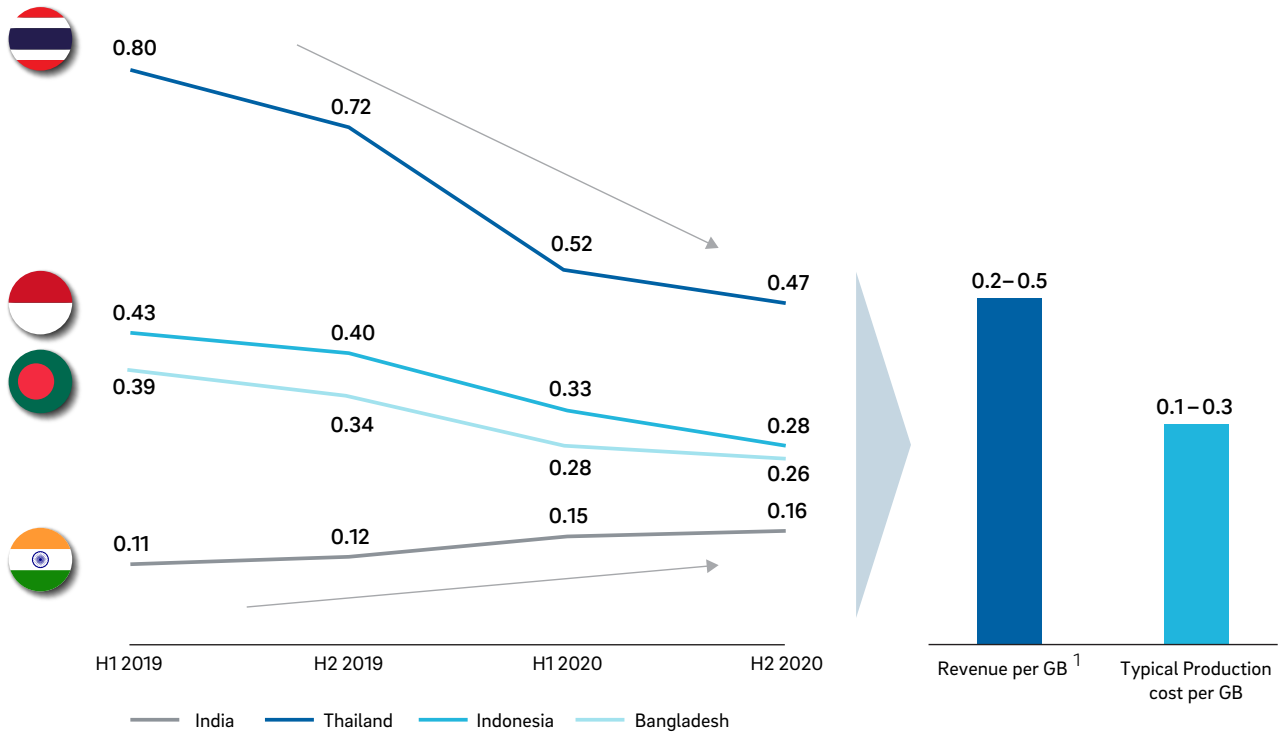


Source: Euromonitor, Roland Berger

The decline in data prices is exemplified in emerging prepaid-heavy markets in South and Southeast Asian markets such as Thailand, Bangladesh and Indonesia. Revenue per GB has declined by ~40% in 2 years (2019-20) with the exception of India. Despite a steady increase in data prices following actions to rationalize the retail pricing post consolidation and reduction of players within the market, data prices in India remain the lowest in the world. On average, data revenue per GB has already come down to USD 0.2 – 0.5 per GB for many markets – which is approaching the average production cost of data of around USD 0.1 – 0.3 per GB with potential for improvement limited under "traditional" operating models.

Figure 1.2b Revenue per GB [USD] in selected Asian markets and comparison with typical cost per GB [USD]

Revenue per GB



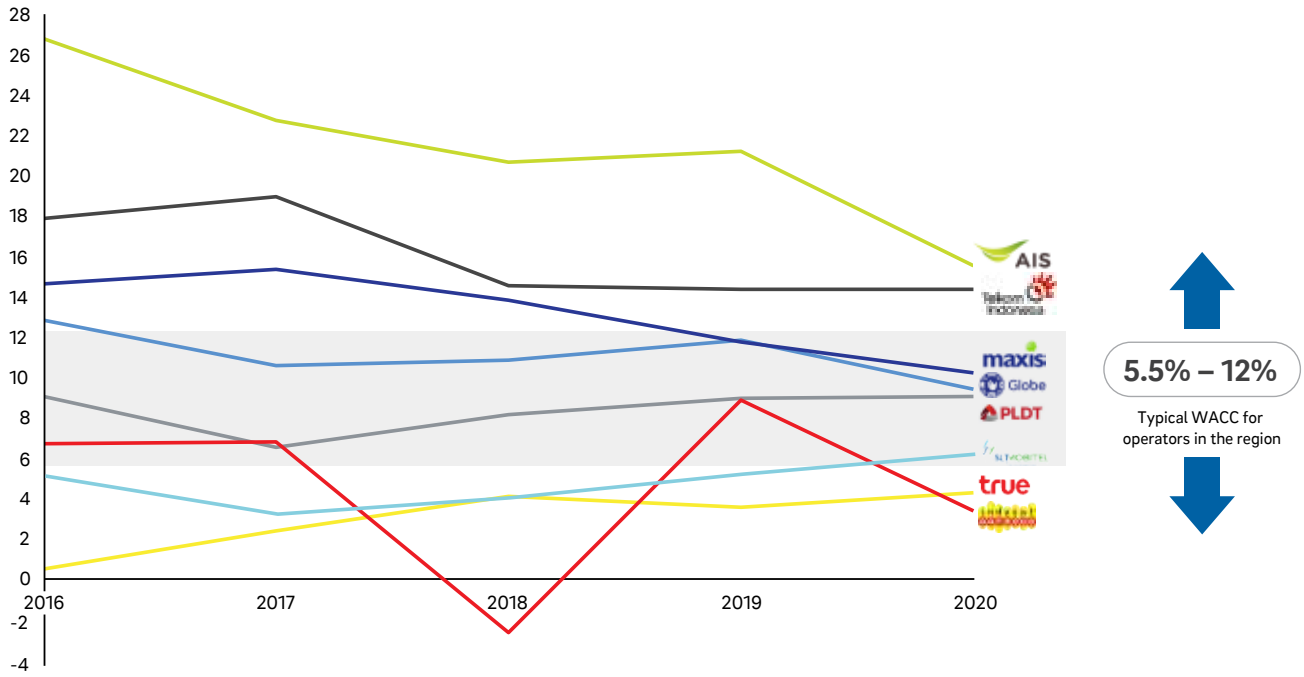
[1] Revenue per GB as of H2 2020

Source: Analyst reports, Operator results, Roland Berger estimates;
Note: Estimated average revenue per GB for some countries based on representative operators

The declining data price and yield is making it increasingly difficult for MNOs to generate returns commensurate to the WACC for investments required for expanding and upgrading their networks to meet the sharp increase in traffic and demand. As shown in Figure 1.2c, ROIC for some operators in the region are already within or below the typical emerging Asian market WACC range.

Figure 1.2c Trend of Return on Invested Capital (ROIC) for selected South and Southeast Asian operators [%]

ROIC and WACC



Source: Morningstar, DBS, Maybank, Operator reports, Roland Berger

This continuous decline is already driving changes in the industry structure and dynamics. There is increasing consolidations and exits within the sector as seen in countries such as India, Indonesia, Malaysia, and Thailand mainly driven by the need to increase scale, improve cost and improve spectrum efficiency. On top of that, there has also been a stronger cry from the industry for regulators to provide higher levels of support and flexibility to ease regulatory and operational burdens. For example, MNOs in India have sought support from the Indian regulator (TRAI) across multiple areas including seeking for a reduction in the reserve price for 5G spectrum given the health and revenue generation ability of India's telecom industry.

Overall, the increasing pressure on revenue and growing demand for data indicates the need for a more aggressive change in business models and operating efficiency.

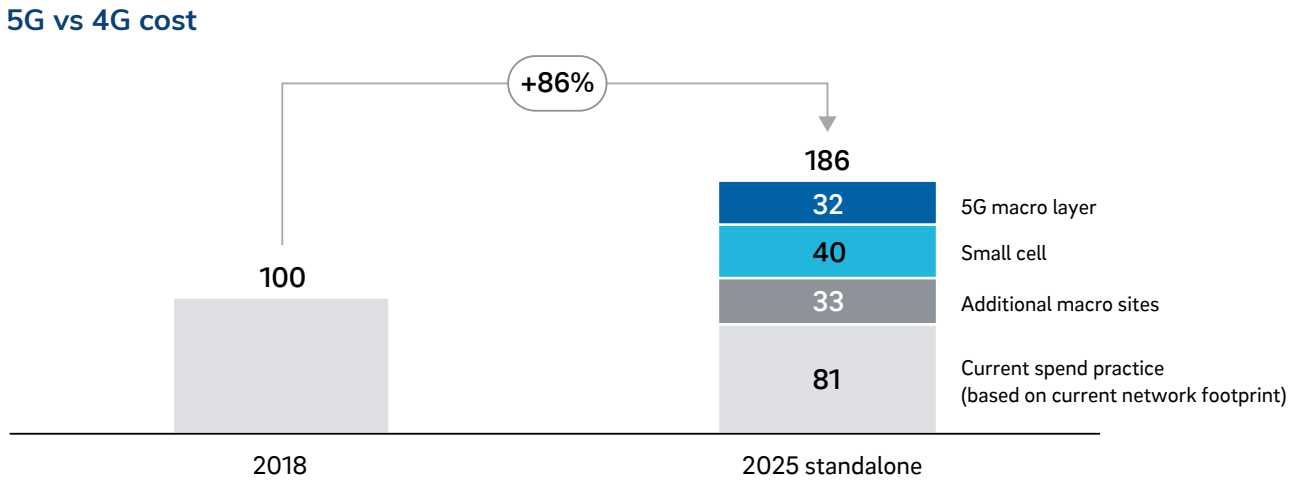
1.3 5G has the potential to revolutionize usage but entails massive requirements for infrastructure expansion and investments

While the industry is facing increased demand and pressure to generate value, the rollout of 5G represents significant disruption potential. A fully-ramped up 5G network is expected to boost traffic capacity and network efficiency that is an order of magnitude higher compared to what 4G can deliver with 3 key underlying benefits – enhanced speeds, ultra-low latency and massive capacity. 5G also promises the emergence of industry verticals such as smart cities, autonomous vehicles, and massive scale industrial IoT. Service providers will be equipped with the ability to slice and customize network experience and parameters to suit different industry use cases.

At the same time, building, deploying and operating a nationwide 5G network will come at a significant cost, both in terms of upfront CAPEX and ongoing OPEX. MNOs, TowerCos and regulators will have to consider multiple factors such as the need for additional macro/micro/IBS sites, associated active equipment for those sites and the build out of a robust backhaul to cater to the new traffic - all requiring sizable capital outlay. Additionally, with majority of the 5G upsides linked to new categories of enterprise use cases, there is uncertainty on the viability and ability of traditional MNOs to capture the value from these emerging use cases.

Rollout of 5G networks is expected to be more expensive than existing 3G/4G deployments with average Total Cost Ownership (TCO) expected to be 86% higher (on a non-shared basis) as shown in Figure 1.3a, with the increase largely driven by requirements for small cells and additional macro sites.

Figure 1.3a Access network TCO evolution [indexed to 100%]



Based on assumption of 35% annual traffic growth

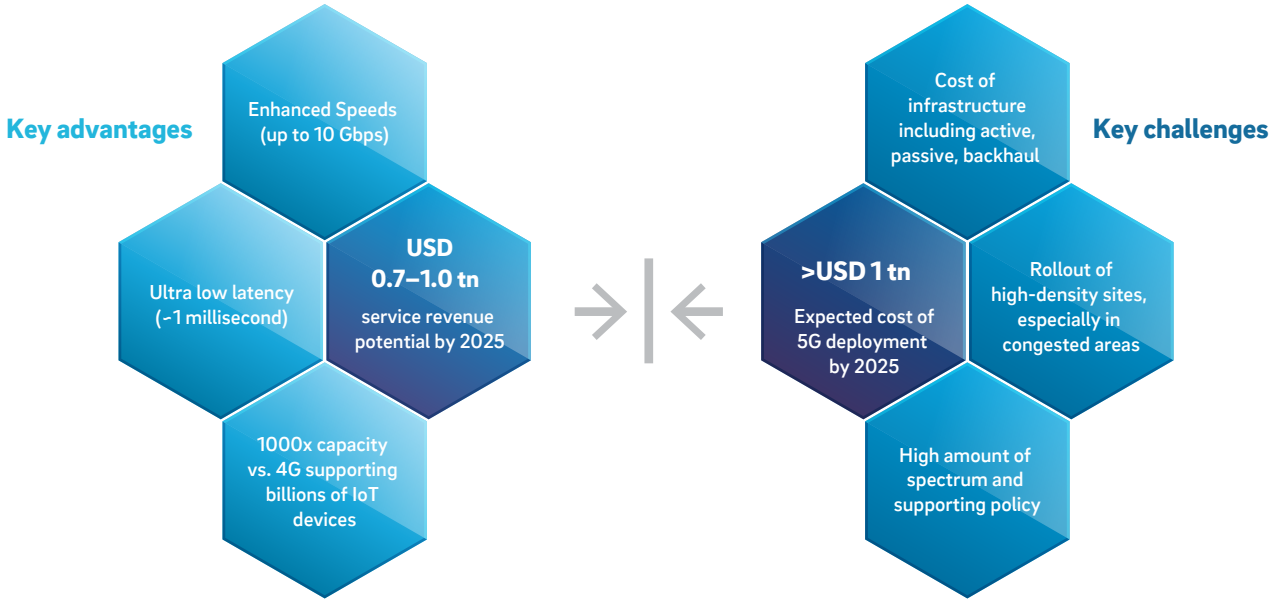
Source: Desk Research, Roland Berger

Globally, the cost of 5G deployment over the next 5 years is estimated by various sources to be more than USD 1 trillion. However, 5G also promises significant upsides with global revenue potential nearing USD 0.7 - 1 trillion by 2025. Delaying 5G can result in a setback in achieving economic and sustainability goals for the telecommunications industry as 5G operations are expected to be more carbon efficient in the long run. For example, reports[3] have estimated the negative impact of delaying 5G by 3 years in the UK to be USD 3 - 24 billion. Figure 1.3b summarizes the key advantages and challenges of 5G.

[3] Based on estimates from Assembly research and UK government in 2020.

Figure 1.3b Key advantages and challenges for 5G

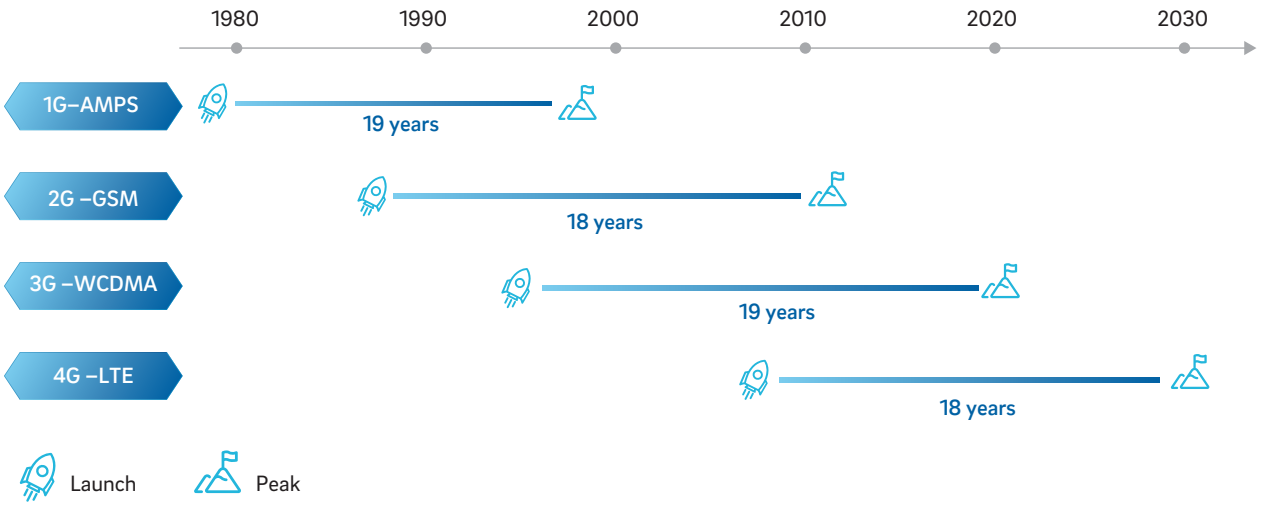
5G challenges and potential



Source: Ericsson, Juniper Research, Roland Berger

At the same time, operators face the challenge that the investments made into existing technologies especially 4G have not yet been fully recovered. As shown in Figure 1.3c below, cellular technologies typically have a ~20-year cycle from launch to peak penetration, with around 10 years between the launch of each new technology. MNOs are still expanding their 4G network while also being faced with the need to build out their 5G network creating the need for investments in both new sites and existing site upgrades – this is a key driver for MNOs to partner with TowerCos to accelerate network expansion.

Figure 1.3c Evolution of mobile technology



Source: GSMA, Roland Berger

1.4 New technologies present the potential to disrupt traditional networks

Several new technologies, often closely linked with 5G, are showing significant promise and have the potential to disrupt traditional approaches of network deployment. Three key innovations which are expected to have a significant impact on telecom networks are:

Virtualized RAN

As the deployment of virtualized Core networks becomes more prevalent, the next step in optimization is Virtualized RAN which aims to substitute certain hardware-based functionalities with software driven infrastructure. This allows operators to share BBUs across a cluster of sites (although a more powerful BBU than a regular site) resulting in both direct cost savings and increased dynamism and control over the access network with the potential to customize network edges for different use cases.

Open RAN

The concept of Open RAN is premised on ensuring interoperability and plug-and-play integrations between different baseband components allowing operators to combine components and software from multiple vendors – thus reducing the cost of individual components, increasing flexibility and reducing the reliance on a select group of integrated RAN hardware vendors. Albeit that Open RAN is in the initial stages of development, there is considerable interest in the concept as evidenced by 35-40 global pilots and deployments currently ongoing. Apart from the direct cost benefits, interest in Open RAN has also been driven by the need from governments and MNOs to promote diversity and to reduce dependencies on a limited number of vendors. There are, however, potential challenges especially in terms of equipment compatibility that raise questions for the adoption of Open RAN technology.

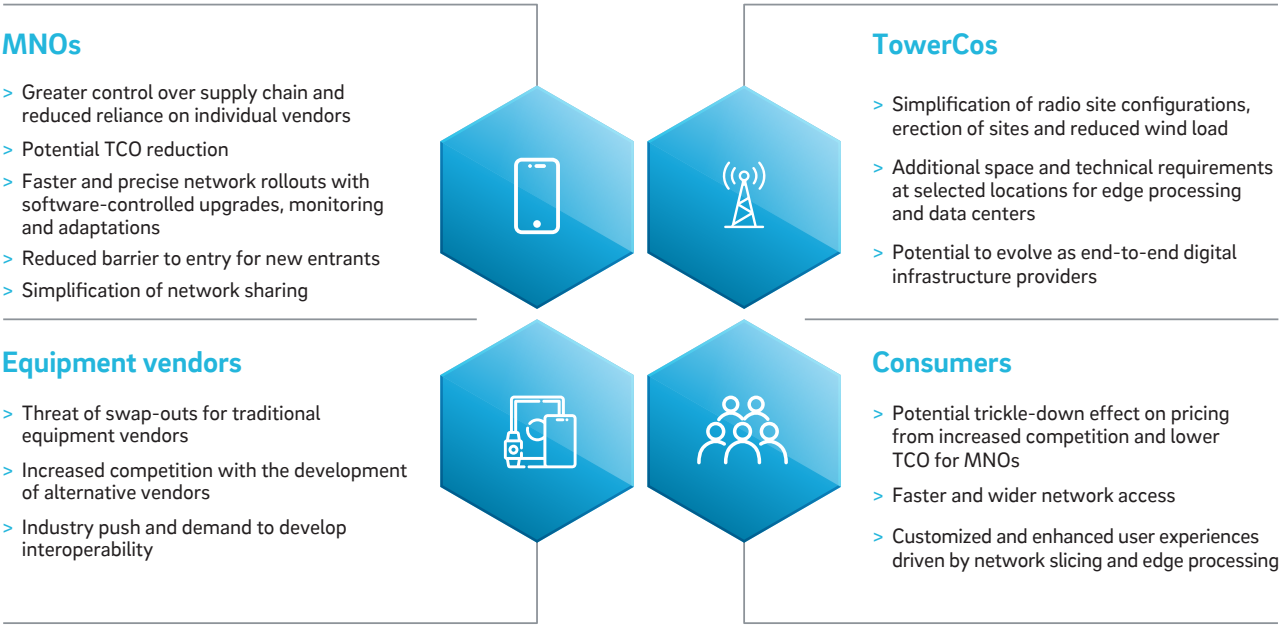
Edge Data Centers / Edge connectivity

Edge data centers are small data centers located at or close to the network edge – these data centers serve the needs for ultra-low latency and edge processing necessary to support various 5G and virtualized RAN models. These often modular, miniature facilities allow data processing close to end users and can enable use cases which rely on low latency such as autonomous vehicles and immersive media / gaming. Mobile telecom towers represent synergetic locations for deployment of edge data centers given the proximity to the end user. Already, there has been considerable interest from TowerCos such as American Towers to venture into the edge data center ecosystem. The opportunity in edge computing is sizeable, with the total market size for edge computing projected to grow at a CAGR of 16% to reach USD 75 billion by 2024 in APAC region driven by the adoption of IoT, industrial IoT, machine learning and AI.

Combined, the adoption of these innovations has wide ranging implications for different players in the telecommunications value chain – as highlighted in Figure 1.4.

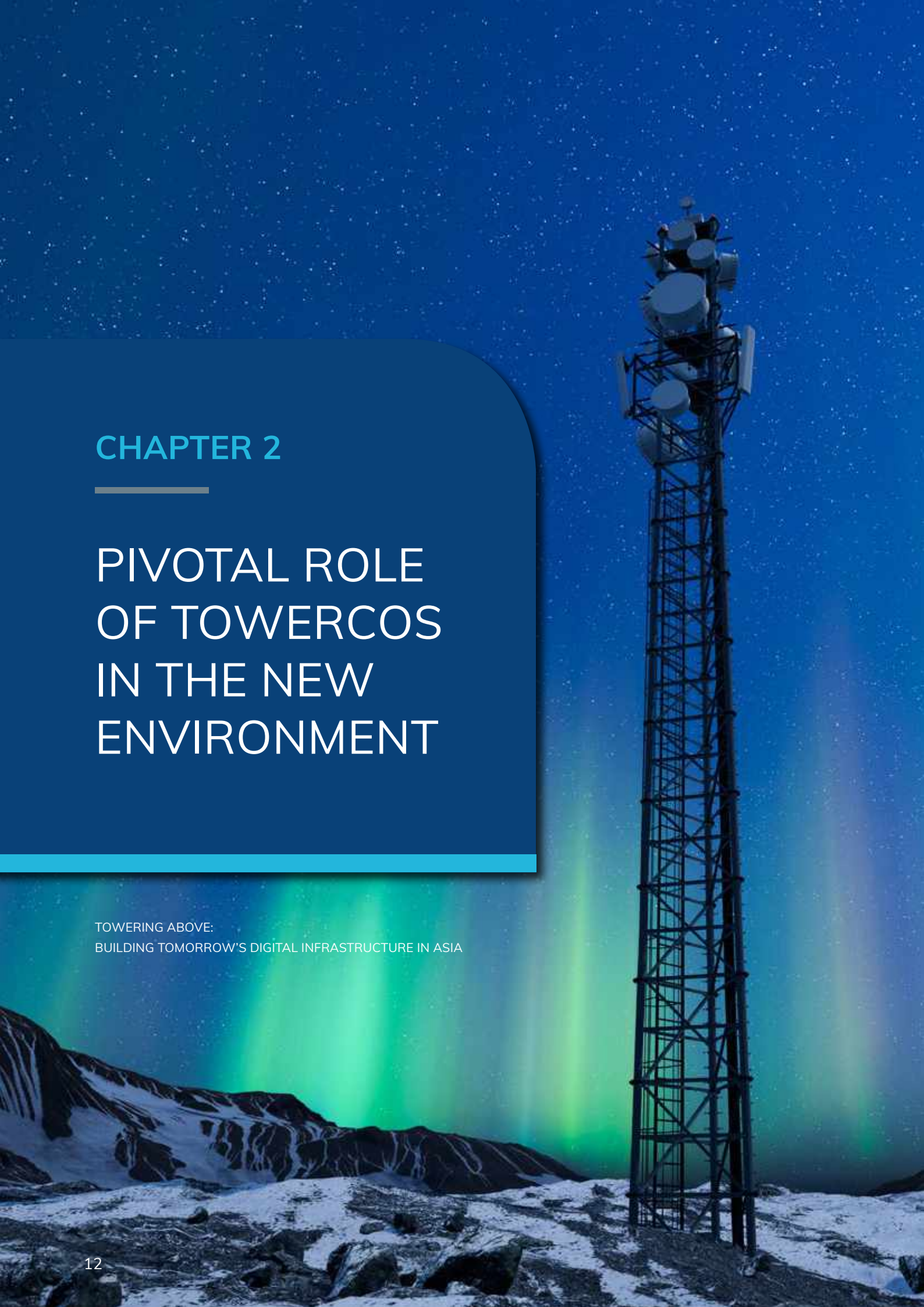
Figure 1.4 Potential benefits of network innovation (Open RAN, Virtualized RAN, Edge connectivity) on stakeholders

OPEN RAN/ New tech implications



Source: Roland Berger

With the telecommunications industry currently looking for innovative approaches and efficient ways of working, InfraCos and TowerCos are poised to play a pivotal role within the entire ecosystem – supporting the next generation of rollouts and advancing up (and beyond) the traditional value chain.



CHAPTER 2

PIVOTAL ROLE OF TOWERCOS IN THE NEW ENVIRONMENT

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2.1 TowerCos provide efficiency, scalability, and flexibility in the evolving ecosystem

The TowerCo business model has proven to be robust, which in turn allows them to play a pivotal role in a constantly evolving ecosystem. Over the past decade, TowerCos have successfully managed the construction, operations and maintenance of telecommunications infrastructure and facilitated varying degrees of network sharing for MNOs. The TowerCo model offers significant benefits across the board from optimization of infrastructure, improved cost, higher efficiencies to better capital efficiency as summarized in Figure 2.1a. Furthermore, TowerCos have also built strong capabilities and competencies in optimizing energy usage by facilitating real-time energy management with a focus towards achieving sustainability goals. Many global leading TowerCos such as American Tower Corporation and edotco have embedded voluntary emissions reduction commitments into their strategies and operations. Overall, sustainability is increasingly becoming a critical theme for the industry as can be seen by the growth in funding and financing by global multi-lateral bodies (such as International Finance Corporation "IFC") and investment funds into sustainable access to connectivity and "green" digital infrastructure.

Figure 2.1a Key benefits of the TowerCo business model [4]

TowerCos will play a significant role in driving long-term modern digital economies with operational and cost efficiencies

Infrastructure optimization & higher co-location

- Tenancy ratios for TowerCo managed towers are much higher than independent MNO towers with average tenancy ratios being almost 2.0 vs less than 1.1 for MNO managed towers worldwide [1]
- Independent TowerCos enable cheaper and easier roll out of new networks including extending access to tycally underserved rural areas
- Increased co-location can drive the reduction in cost per user and fixed costs per tower shared among multiple network operators
- Independent TowerCos enable carbon footprint reduction from operational efficiency and reduction in the number of towers

Cost of capital savings

- Independent TowerCos usually attain cheaper financing compared to MNOs
- TowerCos supply a higher number of MNOs, so returns are less dependent on success of any particular MNOs at retail level; lenders see TowerCos as less of a risk

Opex efficiencies and operational optimization

- Independent TowerCos, given neutral host operating model, are able to host multiple tenants (sharing model) which reduces overall cost for mobile operators, improves coverage and benefit consumers in terms of price
- Telecom network (and also PoP) infrastructure and operations managed by TowerCos in general are significantly more efficient than self-managed infrastructure and operations by an MNO. Higher efficiency is typically driven by co-location, as well as strong focus on OPEX and CAPEX optimization

1) According to Towerxchange in Dec 2019

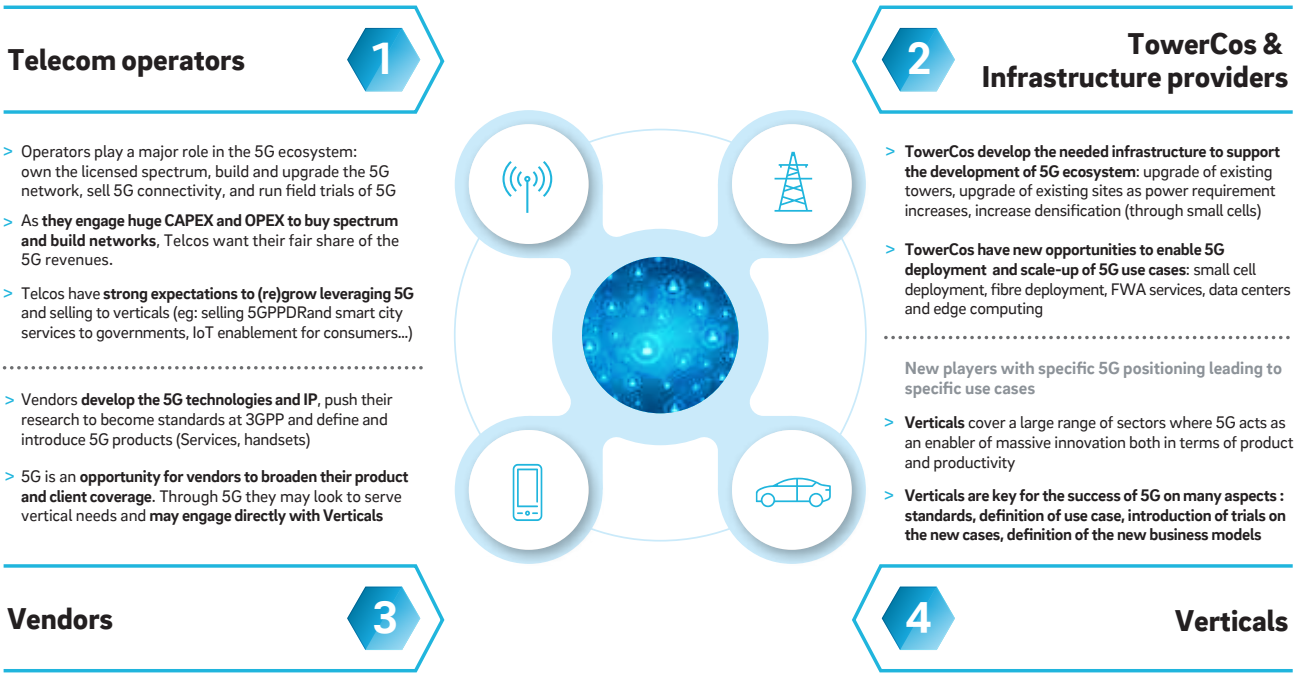
Source: Roland Berger, Desk research, TowerXchange

[4] Tenancy ratios based on Towerxchange Dec 2019 data

TowerCos will gain more prominence with the rollout of 5G as the demand for both macro and small cell sites increases. TowerCos, with their holistic operational expertise in managing infrastructure, are well-positioned to spearhead the increased network sharing that 5G is likely to bring and is poised to capture additional value from new 5G use cases and widespread adoption of the Industrial Internet of Things (IIoT).

5G will entail the emergence of verticals with specific use cases. The new deployment models will require vendors including but not limited to TowerCos, software-defined networking solution providers or even traditional equipment manufacturers to play a larger and more direct role in directly engaging with verticals. Figure 2.1b summarizes the expected roles of selected stakeholders in the new 5G era.

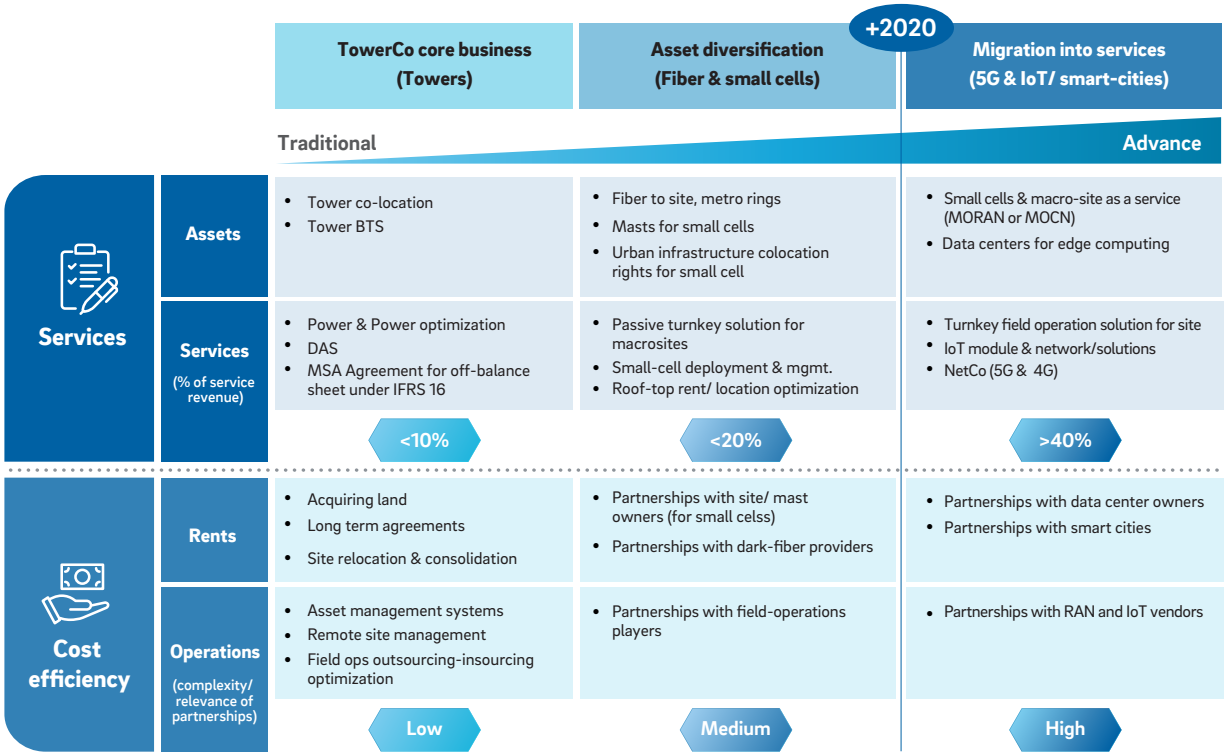
Figure 2.1b The role of selected stakeholders in the new 5G era



Source: Roland Berger

The new 5G paradigm will drive the evolution of TowerCos business as more opportunities are emerging across diversified asset classes such as fiber, small cells and edge computing. Advanced TowerCos are poised to enrich their service portfolios by introducing cost-effective active infrastructure solutions including field operation solutions, IoT network solutions and NetCo solutions to assist MNOs in advancing the provisioning of various emerging 5G, IoT and smart-cities uses cases, as demanded by MNOs' enterprise and retail customers. Such capabilities can be acquired by TowerCos through strong partnerships with various technology and solution partners, as depicted in Figure 2.1c. TowerCos are not just naturally positioned across these emerging opportunities, the pivot by TowerCos towards more innovative business models is also increasingly demanded by industry as a solution to the dire need of MNOs to alleviate their cost burdens given the substantial savings potential as exhibited in Figure 2.1d.

Figure 2.1c TowerCo Business Evolution



Source: Delta Partners "TowerCo Business Model Diversification"

Figure 2.1d Illustrative impact of advanced infrastructure sharing on MNO cost base

		Limited	Tactical	Structural
		Reactivem focused on BAU sharing opportunities, fibre swaps	*Proactive approach, co-build fiber, collaboration in the form of JVs-Build To Suit, colocation*	*TowerCo, multiple tenancies, MOCN type arrangements, fiber co-build, NetCo for5G*
Passive (Towers)	Tenancy Ratio	**1 to 1.4**	**1 to 2.0**	**>2.0**
	Operating Model	BAU	Selective JV	Multiple operator TowerCo
	OPEX Savings [1]	**5 - 10%**	**10 - 15%**	**20 - 30%** [2]
	CAPEX Savings	**5 - 10%**	**10%** [3]	**20 - 30%** [3]
Active	Operating Model	No sharing	MORAN	MOCN
	OPEX Savings	-	**10 - 20%** [4]	**30 - 40%**
	CAPEX Savings	-	**10 - 15%**	**30 - 40%** [5]
Filter	Operating Model	Lease, Swaps	Consolidate capacities	NetCo/ Co-build/ DSO JV
	OPEX Savings [5]	-	**30-50%**	**40 - 60%**
	CAPEX Savings [5]	**5 - 10%**	**30-50%**	**40 - 60%**

Regulatory environment needs to support structural collaboration to drive improved ROIC and enhance industry competitiveness

[1] Largely due to shared rentals, O&M costs
[2] Savings on OPEX, decommissioned sites, New Site Build
[3] Shared new site build
[4] Savings on OPEX largely energy cost, active O&M
[5] Depending on the model and the number of partners

Source: AT Kearney 2019

Crafting a viable 5G business case that is coherent with national policy objectives is extremely challenging for the MNOs in developing markets. MNOs need to reduce their cost per Gb significantly through higher degree of sharing. Despite technical challenges, solutions driven by software-defined network and progressive adoption of new technologies (such as OpenRAN) offer scalability and significant cost advantage over time. Hence, with a deeper network sharing and collaboration going forward, TowerCos – as neutral parties – are well-positioned to play a pivotal role in unlocking these values that provide wider benefits to the industry.

Mohamed Adlan Ahmad Tajudin,
CEO, edotco Group

2.2 TowerCos are evolving to become digital infrastructure providers to better serve the dynamic demand

Historically, TowerCos focused on leasing passive infrastructure and maintaining sites to facilitate cost reductions for MNOs. The traditional independent business model that is driven by tenancy ratio has started to evolve. 5G rollout, new network technologies and regulatory changes are building new market dynamics. In response to the changing environment, TowerCos are adapting their business model as they evolve into digital infrastructure providers to meet increased data usage and prepare themselves for the advent of advanced technologies.

Generally, the majority of sharing agreements, especially those involving TowerCos, have been for passive infrastructure. In recent years though, there is a growing trend towards active sharing including the sharing of radio access network (RAN) consisting of antennas, transceivers, base stations and backhaul. Under these types of active sharing arrangements, TowerCos can own, deploy and operate the equipment associated with active sharing and thus help MNOs to further reduce their costs.

Over the past few years, the need for strong independent shared digital infrastructure providers has been increasing as MNOs are facing higher pressure to reduce cost. Compared to 3G or 4G, a 5G network virtualizes the RAN baseband processing and distributes the core network to run on the network edge. This is expected to drive demand for cloud infrastructure, and sharing of such cloud infrastructure, to support these needs – this in turn will create new opportunities for TowerCos to redefine their product lines to cater to the demand of the market.

Certain global TowerCos are already tapping into these opportunities and have already started converting existing passive ground-based sites into surveillance systems, edge data centers and smart streetlights to prepare for cloud-based sharing. For example, Crown Castle has built itself into a major provider of small cells solutions with over 50,000 small cells supported by its extensive fiber network and has also been an early pioneer into edge infrastructure through its investment in Vapor IO, a company with deep expertise in edge computing applications and devices.

Overall, TowerCos have the opportunity and are already growing into several core and adjacent areas closely related with their core competencies such as:

a. Small Cells as a service / Neutral hosts

Small cell technology creates a huge opportunity for TowerCos to adapt their business model to deploy their own small cells and offer fiberized small cell sites to MNOs, commonly known as Small Cell-as-a-Service (SCasS). A new category of infrastructure providers is emerging with a much larger share of the network value chain. Figure 2.2a summarizes the model of one such player, Dense Air in the UK.

Small cell demand has increased in developed markets and will continue to surge with the deployment of 5G networks. Small Cell Forum reported in its market forecast that demand for small cells will grow with a CAGR of 77% in 2019 to 2026 due to a rising number of industrial applications that require full 5G capabilities [5]. In Asia alone, small cell tower market is expected to witness a CAGR of 25% over a forecast period of 2021 to 2026 [6].

Figure 2.2a Dense Air model and key success factors

The NHN concept created by Dense Air aims to set foundations for 5G, supported by sufficient spectrum access and regulations

Case study: Dense Air Neutral Host Network (NHN)

Model: Neutral host w/ or w/o spectrum

Background:

- 5G deployment and 5G-enabled services require specific network characteristics
- Strong demand for network densification and expansion (white spot filling)
- UK-based Dense Air developed small cells offerings
- Acquired spectrum in several countries through shared spectrum access provided by regulator
- Currently piloted in Dublin (Ireland)

Build blocks

Concept

- Deployment and operation of small-cell based neutral host wholesale network that densifies and extends MNOs' existing networks
- Provision to MNOs of "Small cells as a Service" (SCaaS)
- Whitespots that need to be filled are identified by Artificial Intelligence/ Big Data driven tools
- Scope limited to certain areas (cities, districts, building complexes)

Spectrum

- Preferable: 3.4 – 4.2 GHz
- Potentially 26 & 64 GHz

Infrastructure sharing

- Dense Air to provide service to operators as a neutral wholesaler
- Operators need not acquire/ build on assets but can leverage Dense Air's small cells
- Operators of macro networks access Dense Air's localized sub-networks

Key success factors

Sufficient spectrum

- Licensed and affordable spectrum in high frequency bands (2.6GHz & 3.4 - 4.2GHz)

Regulatory support

- Access to sites, backhaul and power
- Automated equipment approvals

Technology ecosystem

- Framework for vertical industries to participate in Neutral Host Network (NHN) model
- Availability of handsets and IoT devices for high frequencies

Source: Ofcom, Dense Air, desktop research

[5] https://www.eenewseurope.com/news/5g-drives-surging-demand-small-cells
[6] https://www.mordorintelligence.com/industry-reports/asia-pacific-small-cell-tower-market

b. Fiber

Fiberization is critical to further improve network quality and support the surging mobile internet demand. The deployment of 4G and 5G will require strong fiber backhaul. Fiberization of towers, however, still remains low in emerging markets. For example, in India, only about 33% of towers are connected with fiber and the Indian government estimates that the country needs at least 70% to fully leverage opportunities presented by 5G. TowerCos are well-positioned to play a key role in fiberization with their strong expertise in managing infrastructure, power and access to towers.

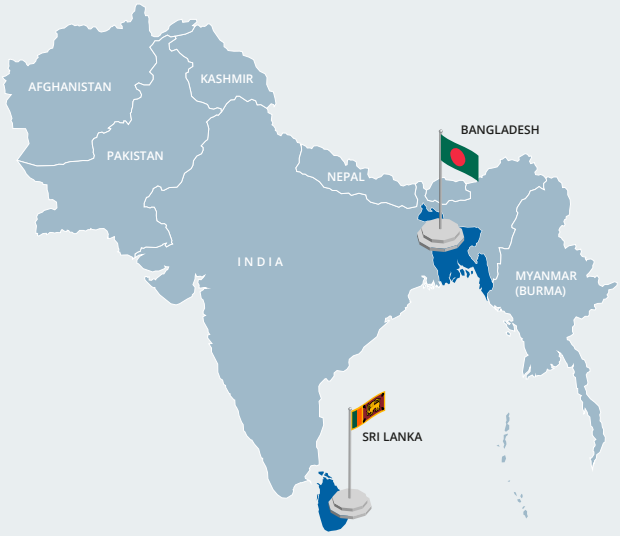
c. Public Wi-Fi

There is a growing demand for reliable and fast Wi-Fi in public areas and enterprises, especially supporting the new Wi-Fi 6 technology. As new devices will be increasingly Wi-Fi 6 enabled, the demand for better performing Wi-Fi is inevitable. TowerCos are already supporting accelerated rollout of internet services in multiple countries. While doing this, they also have an opportunity to support the set-up and operations of public Wi-Fi networks. TowerCos could offer public Wi-Fi network together with the deployment of smart city features (e.g. smart street lights, connected trash bins, smart parking and smart water) if properly supported by regulators especially in terms of allowing unlicensed spectrum usage.

d. Smart Cities

A big opportunity in smart city is deploying a network of wireless connected devices. Digital infrastructure forms the backbone of smart city initiatives and TowerCos have a role to play in developing and maintaining this infrastructure.

Case Study: edotco Group's smart city partnerships in South Asia



1. In 2019, edotco Sri Lanka entered into an agreement with the Board of Investment (BOI) of Sri Lanka to deploy smart city solutions and energy efficient systems over three years. The company announced that it will deploy 1,000 multi-purpose smart poles to serve as sharing infrastructure for MNOs and offer features such as surveillance systems, environmental information sources and natural disaster monitoring systems.
2. edotco has also signed a Public Private Partnership in Bangladesh with the Dhaka North City Corporation to deploy Smart City features. The solution aims at providing free Wi-Fi services and real air quality monitoring.
3. Another agreement has also been signed in Bangladesh with Sylhet City Corporation (SCC) in 2021 to deploy smart poles in the city. The solution will help MNOs to enhance their network coverage and meet the demand of increased data usage while enabling the nation's 5G readiness.

Source: Edotco Group

e. Enterprise solutions

The development of 5G and the Internet of Things (IoT) creates opportunities for TowerCos to develop enterprise solutions. There are a few verticals that TowerCos can address, especially by evolving into private network providers.

1. Autonomous vehicles:

TowerCos can deploy connectivity technologies with different stakeholders in the automotive sector to provide key solutions for the future of mobility in urban environments. Leading global TowerCos have already started deploying the necessary infrastructure and technology that allows the testing of new products in terms of intelligent mobility. For example, American Tower has initiated Paris2Connect (Smart City Project in France) which enables shared digital infrastructures for autonomous vehicles and the deployment of the latest mobililty connectivity solutions.

2. Healthcare

TowerCos can play a role in developing digital solutions in the medical field. Such solutions include facilitating health monitoring, connecting patients with medical professionals through wearable devices, and allowing doctors to perform procedures remotely. For example, Cellnex UK is aiming to build smart hospitals that provide wireless services for users to connect to via their devices, enable tracking of medical equipment and control hospital environments through installed facilities management system.

3. Airport solutions

TowerCos can operate 5G-based backhaul solutions to provide in-airport coverage and enable smart airport use cases. For example, edotco in Malaysia enabled four 5G network smart airport use cases including real-time asset management via smart devices installed on airport trolleys, real-time air quality monitoring, seamless facial recognition for enhanced real-time safety and security as well as significantly increased public WiFi speed.

f. Managed power and field operations (MPFO)

TowerCos have also ventured into providing MPFO offerings – and are evolving towards providing active operations & maintenance services to MNOs. Apart from creating additional revenue streams for TowerCos, this reduces the operating cost for MNOs while also lowering the network carbon footprint as TowerCos can consolidate and streamline maintenance tasks for multiple MNOs.

g. Adjacent non-core services

Apart from near-core adjacencies, TowerCos are also expanding into non-core adjacencies, ranging from power generation, EV recharging, edge data centers, data collection and outdoor advertising depending on their internal capabilities, market demand and regulatory environment in which they operate. Figure 2.2b highlights some examples of TowerCos recently expanding into non-core adjacencies.

Figure 2.2b Selected examples of non-core adjacent ventures from TowerCos

Power generation

- TowerCos are building **energy generation and distribution capabilities at sites** to lower energy consumption costs and add revenue streams.
- For example, **Cellnex** has partnered with Enertika to build **PV self-consumption systems** at some sites - producing **7% more power** than the sites need

EV Recharging

- TowerCos such as **Indus towers**, in India, are building **a network of EV charging units** across sites
- More advanced towercos such as **China Tower** have expanded this opportunity to **exchanging and recycling batteries** for electric two wheelers; offering **power backup** and **emergency charging** services

Edge Data Centers

- From 2020, **American Tower** has begun deploying **a network of small modular data centers** at its tower properties - banking on growing in line with edge computing

Data collection

- **China Tower** offers data collection capabilities with **sensors and cameras** for use cases such as weather monitoring, pollution tracking, agricultural surveys, earthquake monitoring, security surveillance etc.

Outdoor advertising

- **China Tower** can also offer **Out-of-home (OOH) advertising** space at selected sites

Source: China Tower, Indus Towers, American Towers, Enertika, Roland Berger

2.3 TowerCos have created significant value and will continue to do so

The economic value that TowerCos bring to the industry can be categorized into four buckets as illustrated in Figure 2.3a.

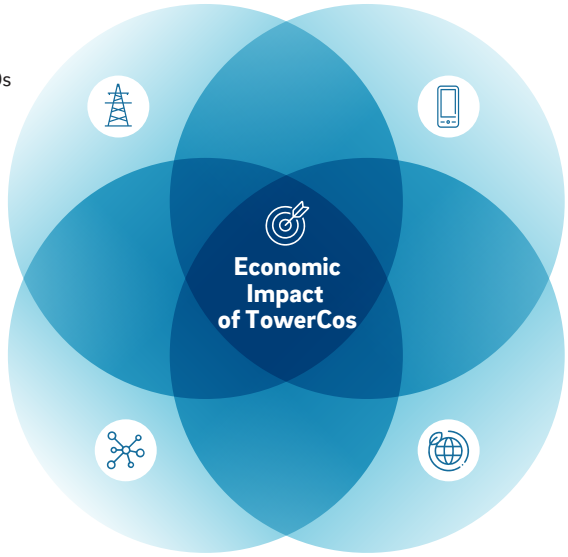
Figure 2.3a Overview of the economic value of TowerCos

1 MNOs

- **CapEx and OpEx savings** for MNOs due to sharing of infrastructure
- More efficient **capital allocation**
- **Faster** network rollouts
- Additional value generated by **carve-outs/ tower sales**

2 Consumers

- Access **higher quality of network** while **enjoying price reduction**
- **Healthy competition** due to lower barriers to entry for MNOs



3 National Digital Agenda

- Higher internet penetration for underserved areas that leads to innovation and **GDP growth**
- **Bridge the digital divide** between urban and rural areas
- **Rural microgrids** and community support initiatives

4 Environment / Sustainability

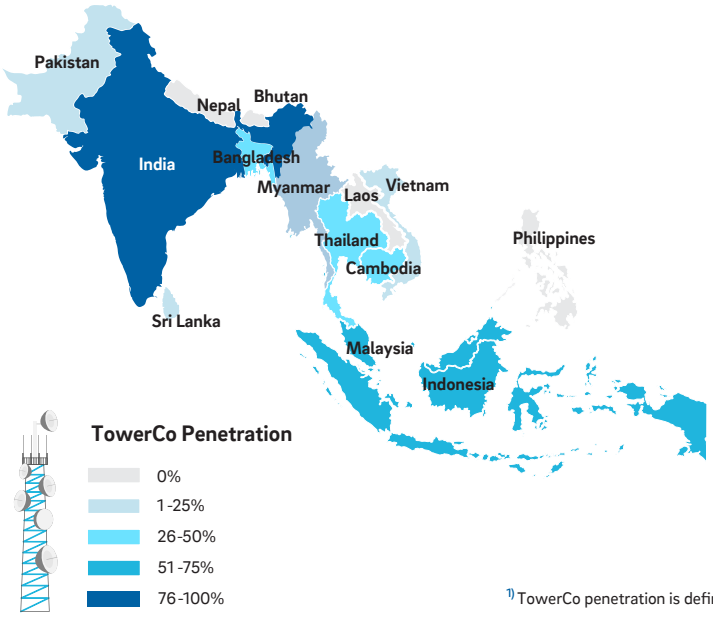
- **Reduce carbon footprint** as a result of shared infrastructure for site operations, optimization of construction and overall reduced number of towers
- **Strong sustainability commitment** from TowerCos

Source: Roland Berger

Other than India, South and Southeast Asia still have significant growth potential for TowerCos. As shown in Figure 2.3b, tower penetration varies vastly within the region – depending on several factors such as regulatory environment, the degree of competition among MNOs, legal barriers to entry, and carrier neutrality. Within the region, TowerCos have already gained significant traction in countries such as India, Indonesia, Malaysia and Myanmar while TowerCo penetration remains below 10% in countries such as Pakistan, Sri Lanka, and Philippines. For the purpose of this study, we explored the realized and potential economic impact of TowerCos in selected Asian countries.

Figure 2.3b TowerCo and tower penetration in emerging Asian countries

Heatmap of TowerCo penetration (2020 Data from Economic Model)



	TowerCo Penetration[1)]	Tower per 100K population
India	84%	38
Indonesia	74%	36
Malaysia	73%	105
Myanmar	57%	43
Cambodia	39%	55
Thailand	31%	75
Bangladesh	26%	24
Vietnam	9%	92
Sri Lanka	2%	37
Pakistan	8%	16
Philippines	0%	16
Laos	0%	103

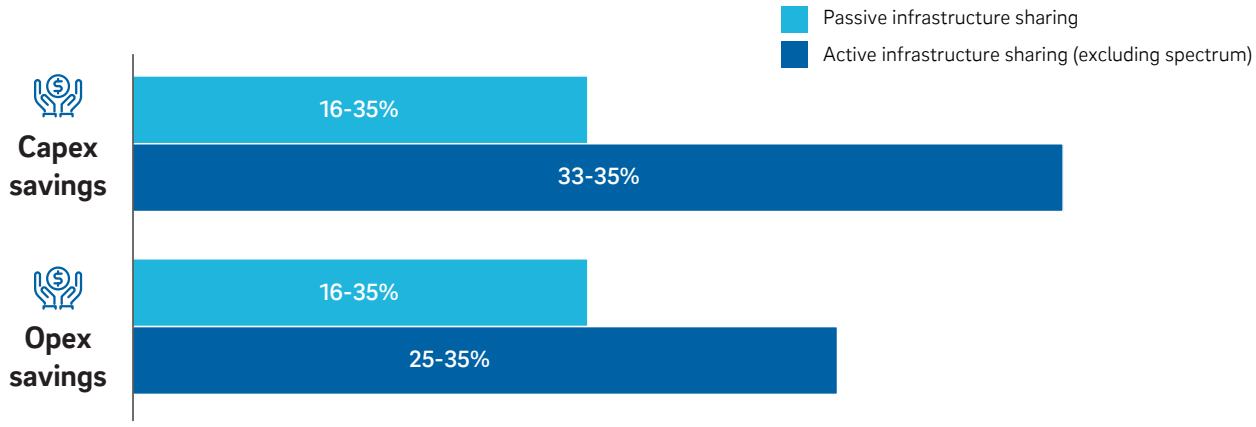
[1)] TowerCo penetration is defined as towers owned or operated by TowerCos as % of total towers in the market

Source: TowerXchange [7], Roland Berger

2.3.1 MNOs

The primary source of value creation for MNOs comes from network CAPEX and OPEX optimization. A BEREC (Body of European Regulators for Electronic Communications) survey identified potential savings of ~16% – 35% for both OPEX and CAPEX stemming from utilization of TowerCos and increased network sharing as compared to pure standalone rollout – as summarized in Figure 2.3.1a.

Figure 2.3.1a Savings potential for network sharing as compared to standalone roll-out



Source: 2018 BEREC Report on Infrastructure Sharing

[7] As of December 2020

While cost may vary according to the size, location and height, an individual tower site can cost between USD 75,000 to USD 100,000. Active equipment may cost around USD 15,000 to USD 40,000 per tower while OPEX further ranges from USD 9,000 to USD 11,000 per year per tower. Thus, overall cost savings for MNOs in selected Asian countries can be summarized in Figure 2.3.1b.

Figure 2.3.1b CAPEX and OPEX savings in selected Asian countries by 2025

Country	Estimated TowerCo penetration by 2025	Number of towers by 2025 [000]	Cumulative Capex savings 2021-2025 [USD]		Cumulative opexsavings in 2021-2025 [USD]	
			Passive infrastructure sharing	Active infrastructure sharing	Passive infrastructure sharing	Active infrastructure sharing
Indonesia	90%	115.2	0.24–0.85 b	0.49–0.85 b	0.80–2.14b	1.25 –2.14b
Thailand	35%	57.9	0.07 –0.26 b	0.15 –0.26 b	0.40–1.08b	0.63–1.08b
Malaysia	80%	45.6	0.16–0.56 b	0.32 –0.56 b	0.31–0.83b	0.48–0.83 b
Bangladesh	40%	44.2	0.06 –0.23 b	0.13–0.23 b	0.30–0.80 b	0.47–0.80 b
Pakistan	15%	42.3	0.10–0.35 b	0.20–0.35 b	0.28–0.74 b	0.43–0.74 b
Philippines	10%	30.5	0.17–0.62 b	0.35–0.62 b	0.20–0.53 b	0.31–0.53 b
Myanmar	65%	29.0	0.08–0.28 b	0.16–0.28 b	0.20–0.53 b	0.31–0.53 b
Cambodia	40%	11.8	0.04–0.13 b	0.07–0.13 b	0.08–0.22 b	0.13–0.22 b
Sri Lanka	10%	9.3	0.02–0.07 b	0.04–0.07 b	0.06–0.17 b	0.10–0.17 b
Total		**385.6**	**0.93–3.35 b**	**1.92 –3.35b**	**2.63 –7.04 b**	**4.11 –7.04 b**

Source: Roland Berger, TowerXchange, BEREC

Across these nine selected Asian countries, approximately 68 thousand new towers are expected to be constructed between 2021 to 2025, growing the ~320 thousand telecommunications towers in 2020 to over 380 thousand towers. Based on this, MNOs can potentially obtain up to USD 3.3 billion in cumulative CAPEX savings between 2021-2025 through deploying new towers via shared models (including via TowerCos) and up to USD 7.0 billion in cumulative OPEX savings between 2021-2025 assuming 100% of towers are operated on shared basis.

Additionally, infrastructure carve-outs are trending globally. MNOs are increasingly looking at carving out their existing infrastructure business in order to unlock value, optimize operations and save costs, which in turn has also enriched the TowerCo ecosystem by broadening and deepening the pool of potential assets. In Asia, the trend is reflected in recent tower carveouts within the region such as by Indosat and XL in Indonesia and potential carveouts by Bangalink and Robi currently under discussion in Bangladesh or PLDT in the Philippines. One of the drivers for this trend is that the market value as an infrastructure provider is typically viewed more favorably than that of an MNO, with TowerCos typically having higher EBITDA multiples (8-28x) as compared to MNOs (5-8x). Figure 2.3.1c summarizes the value creation due to tower sales for a recent selection of deals.

Figure 2.3.1c Selected Global tower transactions

Year	Country	Seller	Buyer	#Sites	Deal value [EUR m]	EV / Site [EUR k]	EV / EBITDA
2021		SUPR	TOWR	6,410	970	150	10X
2021		Touch Mindscape	edotco Group	1,000	350	350	13X
2021		Airtel Tanzania	SBA	1,400	155	110	10X
2021		Service-Telecom	VEON	15,400	860	56	11X
2021		Bharti	Helios Tower	1,424	95	66	10X
2021		Telstra	Consortium	49% stake of 8200	1,800	448	1
2020		XL Axiata	CMI, Protelindo	2,782	250	90	8X
2020		Indosat	Mitratel, Protelindo	3,100	400	130	8X
2018		Altice	Morgan Stanley, Horizon Equity Partner	75% stake of 2,961 towers	660	297	19
2017		Sunrise (Swiss Towers)	Cellnex	2,339	430	184	12X
2017		Alticom	Cellnex	30	133	-	12X
2017		Bouygues	Cellnex	3,000	845	282	14X
2017		Telxius	KKR	40% stake of 16,000	1,280 (2)	200	11X
2016		Bouygues	Cellnex	230	80	348	16X
2016		Protelindo	Cellnex	261	109	418	14X
2016		Shere Group	Cellnex	1,004	373	372	16X
2016		Media Broadcast Group	Freenet	450	295	656	12X

[8-28]; ∅ = 13x

Source: Roland Berger, Analyst Reports, desk research, CapitalIQ, Mergermarket

Furthermore, carve-outs are transforming beyond pure tower infrastructure and assets – there is a move towards combining both passive and active elements within the carve-out scope as exhibited in Cellnex's acquisition of Polkomtel Infrastruktura. As such, active infrastructure sharing models are increasingly being adopted which could increase the potential benefits to MNOs.

Case Study: Cellnex acquisition of Polkomtel Infrastruktura

Cellnex is an infrastructure operator for wireless telecommunications in Europe. Cellnex's products include telecommunications infrastructure services, DAS and small cells, broadcasting networks, and smart cities, IoT, and securities solutions. Cellnex recently acquired the telecommunications infrastructure of Polkomtel Infrastruktura.

The deal involved the transfer of all passive, active (RAN network) and backhaul assets to a new company (mobile NetCo). Under this model, the MNO retains ownership of spectrum and core network while all remaining elements of the access network (including towers, active equipment and backhaul) are provided by the mobile NetCo. The new mobile NetCo model could allow operators to buy services for individual locations, or even their entire network, based on a modular service catalogue. Passive access could be considered as the standard product while active services and/or backhaul could be added on top.

cellnex

Source: Press releases, desktop research

Besides the optimization of CAPEX and OPEX spend, MNOs are also able to reallocate capital for more efficient use such as investing into innovation or expansion into adjacent businesses that generate higher returns through the reduction in upfront CAPEX and upside value creation from their infrastructure

2.3.2 Consumers

There are two clear and tangible benefits from the consumers' viewpoint that are enabled by TowerCos: 1) mobile services affordability and 2) network quality. TowerCos enable new MNOs to compete with incumbents by ensuring a more efficient wholesale market. Lower mobile market concentration can lead to lower mobile prices and at the same time, support innovation and competition to improve network experience.

Case Study: Iliad's entry lowered data price for consumers in Italy

In Italy, the presence of independent TowerCos in the market has encouraged new MNOs to enter the market. Iliad, a major French telecommunications company, entered Italy in May 2018. As an independent TowerCo providing services on non-discriminatory basis, Cellnex offered Iliad with 10,000 towers to access. As a result, Iliad was able to attract 2.23 million subscribers and capture ~4% market share within just four months. Iliad's provided significant benefits to consumers as the company offered the first 1 million customers with 30 GB of data, unlimited voice minutes and unlimited texts for just €7 per month – about 10 times lower than the offering made by existing players such as Telecommunications Italia.

Source: Iliad S.A.

2.3.3 National Digital Agenda

The business case for cell sites can be challenging in rural areas due to lower population density, lower average incomes, and high cost of network rollout (i.e., logistic and electricity availability). This makes many MNOs reluctant to provide adequate coverage to end-users in rural areas, resulting in a widening socioeconomic gap between rural and urban area. This is one of the key concerns impacting a nation's prosperity and for decades, governments across the world have been providing subsidies and incentives for MNOs to bring broadband to rural areas.

The business model operated by TowerCos helps governments push their agenda to deliver network coverage towards more rural areas. TowerCos facilitate the efficient use of passive infrastructure, thus lowering the threshold at which it becomes profitable to improve service coverage. Together with active sharing models such as MORAN, MOCN, and spectrum sharing, the capital and operating cost of deploying network in rural areas can be reduced while increasing coverage and service offerings to the rural population.

This benefit of lower costs can also be passed on to the economically weaker sections of society, as end-users in rural areas are able to enjoy lower data prices. With more consumers in rural area gaining access to mobile internet, higher value economic activities can improve productivity and efficiency, thus increasing income and GDP per capita.

Coordinated effort between TowerCos, MNOs, and government is key to expanding coverage and delivering connectivity to the rural area. Industry players require financial and regulatory support from the government to push rural telecommunications development.

Case in point: Malaysia's National Digital Plan (JENDELA)

In Malaysia, the government rolled out the JENDELA project, with phase 1 focused on increasing 4G coverage and improving overall internet experience and phase 2 focused on enabling the whole country to gain 100% access to 4G and preparing for 5G technologies.

TowerCos have been supporting the national digital agenda through the construction of infrastructure to support connectivity in rural areas. In 2021, edotco Malaysia announced the construction of 113 new telecommunications sites as part of Phase 1 JENDELA Project – a national plan that was formulated to provide wider coverage for rural areas. The rollout will support rural connectivity across Kedah, Kelantan, Perak, Pahang, Negeri Sembilan, Johor and Sabah. The effort aims to serve as the foundation for Malaysia to transform into a digitally enabled and technology-driven nation.

Source: edotco Group

According to GSMA [8] , an unconventional way to drive rural connectivity is the use of easy-to-build lightweight infrastructure with installed radio equipment specifically designed to serve targeted remote areas. This is one approach that TowerCos can adopt to reduce the overall cost of deployment. Furthermore, governments around the world have been providing support to boost rural mobile coverage.

In 2019, the UK government proposed a scheme worth approximately USD 1.5 billion to support the Shared Rural Network (SRN) program – a project developed by major MNOs in the UK to boost 4G mobile broadband to 95% through shared infrastructure. In 2021, the government announced a USD 685 million support package as it aims to provide all corners of the UK with better mobile connectivity.

In Latin America, Brazil has been exploring innovative ways to expand internet connection to rural schools. For instance, it entered a partnership with SpaceX to provide connectivity through low earth orbit satellites.

TowerCos can play a strong role in driving rural connectivity – including through deploying innovative models and technologies. Vanu serves as an example of how TowerCos can innovate to drive rural connectivity.

[8] From the 2019 GSMA report titled "GSMA Connected Society: How Innovation Can Drive Rural Connectivity"

Case in point: Vanu's rural technology innovation

Vanu is a global provider of mobile communications solutions that allows MNOs to provide connectivity to remote, off-grid markets. It has established presence in key markets such as India, Rwanda and USA, providing geographic proximity of deployments in six continents. The company has developed software technology and designs to lower CAPEX and OPEX associated with base stations and to suit the unique needs of rural markets.

Vanu is able to expand network in rural populations by:

- **Ensuring optimal site power consumption**. Its low-powered solar base stations consume 64 watts of power as compared to 2-4 kilowatts for traditional base stations. As a result, overall OPEX associated with running base stations is lowered.
- **Using patented latency and jitter tolerant backhaul** which can leverage a wide variety of media including microwave, wireless broadband, cable modem and satellite connections. Vanu also leverages software solutions which utilize optimization algorithms to improve overall backhaul efficiency.
- **Leveraging software-enabled remote maintenance processes** which reduce operating costs. This makes the product easy to deploy as there is a reduced need to send technicians to the sites for maintenance.

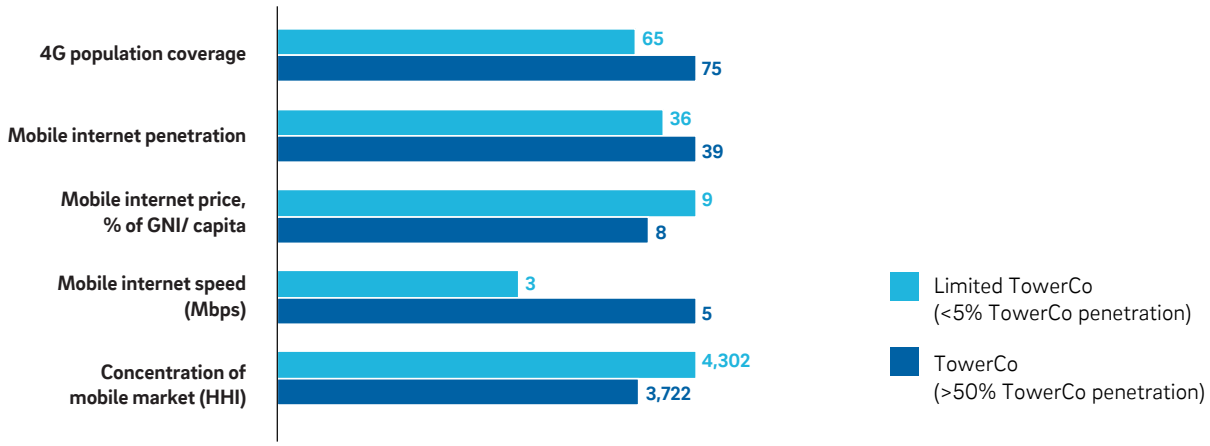
In the future, Vanu's software radio technology can be integrated into hardware processors easily to reduce operating costs, improve efficiency and reduce energy consumption.

Source: Vanu

Besides providing connectivity to rural areas, TowerCos can drive rural microgrid growth to improve community outreach and power access. Microgrid is an independent energy system disconnected from the traditional grid, allowing it to serve local regions autonomously. Today, about 10% of the world does not have access to electricity [9]. Out of the total population without access to electricity, 20% is in Asia and 77% is in Africa [10]. The presence of network infrastructure in rural areas opens up the opportunity for energy service providers to offer TowerCos with renewable electricity at a competitive price while also providing electricity to the local community through microgrids.

According to IFC, TowerCo penetration is correlated with the development of mobile connectivity with higher TowerCo penetration correlated to more available, affordable and faster internet, and increased telecommunications market competitiveness – as summarized in Figure 2.3.3a. Higher mobile internet penetration in turn is related to higher economic impact due to increased productivity and new innovations, with ITU estimating that every 1% increase in mobile internet penetration results in 0.2% increase in GDP.

Figure 2.3.3a Impact of TowerCos penetration on mobile connectivity



Source: IFC

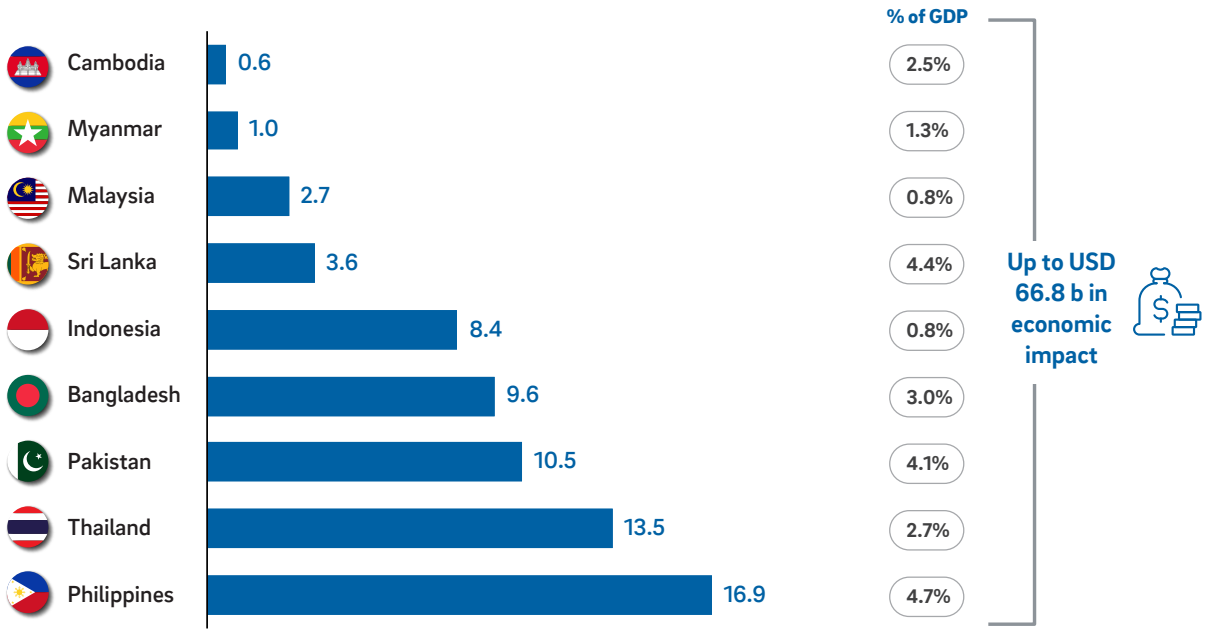
[9] https://www.statista.com/statistics/829803/number-of-people-without-access-to-electricity-by-region/
[10] https://www.statista.com/statistics/829803/number-of-people-without-access-to-electricity-by-region/

According to IFC, TowerCo penetration is correlated with the development of mobile connectivity with higher TowerCo penetration correlated to more available, affordable and faster internet, and increased telecommunications market competitiveness

Based on the potential impact to GDP growth due to higher mobile internet penetration and lower mobile internet prices for consumers, there is significant value that can be created for the 9 selected Asian markets, as estimated in Figure 2.3.3b.

Figure 2.3.3b Economic impact of TowerCos on consumers through passive infrastructure sharing [USD b]

Consumer Impact



Source: Roland Berger

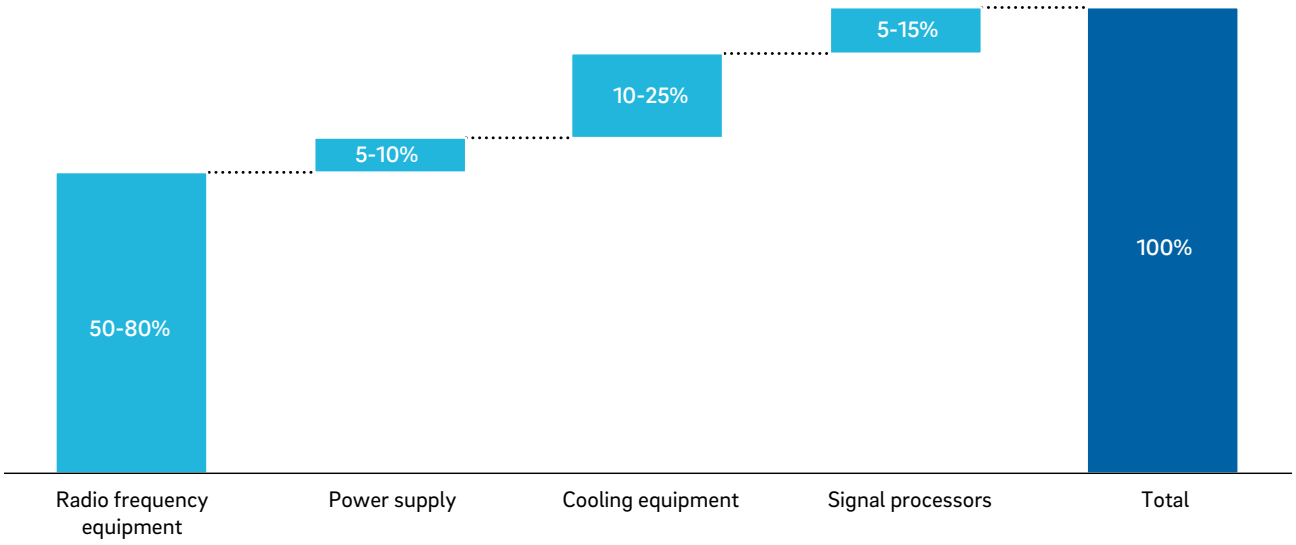
Assuming 100% TowerCo penetration, it is estimated that TowerCos would generate a total of USD 67 billion incremental economic impact for consumers as compared to 2020 base through GDP growth and data price reduction across the 9 selected SA and SEA markets. Across the 9 markets, Philippines and Thailand are estimated to have the highest potential economic impact due to both markets having low TowerCo penetration currently. Active sharing could enable even greater consumer benefits given lower cost and faster rollouts as compared to passive infrastructure sharing.

2.3.4 Environment and Sustainability

The impact of the deployment and operations of mobile telecommunications infrastructure on the environment is significant – directly from the carbon footprint due to the construction of the infrastructure and on-going operations of passive and active elements on site and also indirectly through the activities of third-party vendors and suppliers in the supply chain. An average tower in Asia produces 32 metric tonnes of carbon footprint per year per site from on-going site operations, out of which up to 80% of the carbon footprint is generated by the active elements as shown in Figure 2.3.4a. The construction of towers also emits significant amount of carbon emissions, with carbon footprint per new tower constructed estimated at between 55-85 metric tonnes.

Figure 2.3.4a Breakdown of carbon footprint by component for the operations of 1 telecommunications site

Breakdown of energy consumption at a tower site with an outdoor BTS requiring cooling



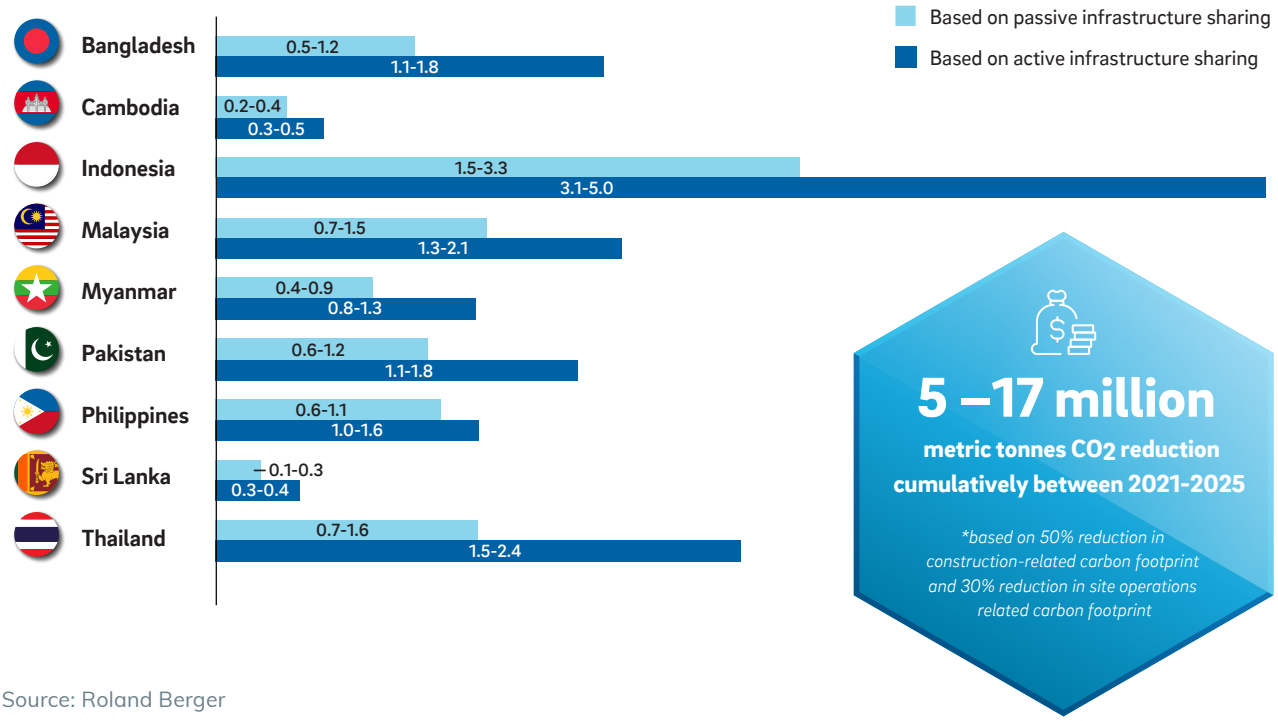
Source: GSMA

TowerCos have significant control and influence over carbon emissions in a number of ways – from optimizing infrastructure footprint through sharing, using greener materials and methods for construction, to improving efficiency of site operations to reduce carbon footprint. As shown in Figure 2.3.4b, TowerCos are expected to reduce 5 – 17 million metric tonnes of carbon footprint (by reducing their construction-related carbon footprint by 50% and by reducing their site operations related carbon footprint by 30%) across the 9 selected Asian markets cumulatively by 2025. Passive infrastructure sharing alone will result in a reduction of carbon footprint up to 11 million metric tonnes by 2025, equivalent to a social cost of around USD 110 million [11] . Indonesia, Thailand and Malaysia will see the highest impact due to the higher number of towers in these markets.

[11] Under the assumption that the social cost each metric tonne of carbon footprint is USD 10

Figure 2.3.4b | Impact of TowerCos on environmental footprint reduction by 2025

Carbon footprint reduction from operations and construction [metric tonne, million, cumulative 2021-2025]



Source: Roland Berger

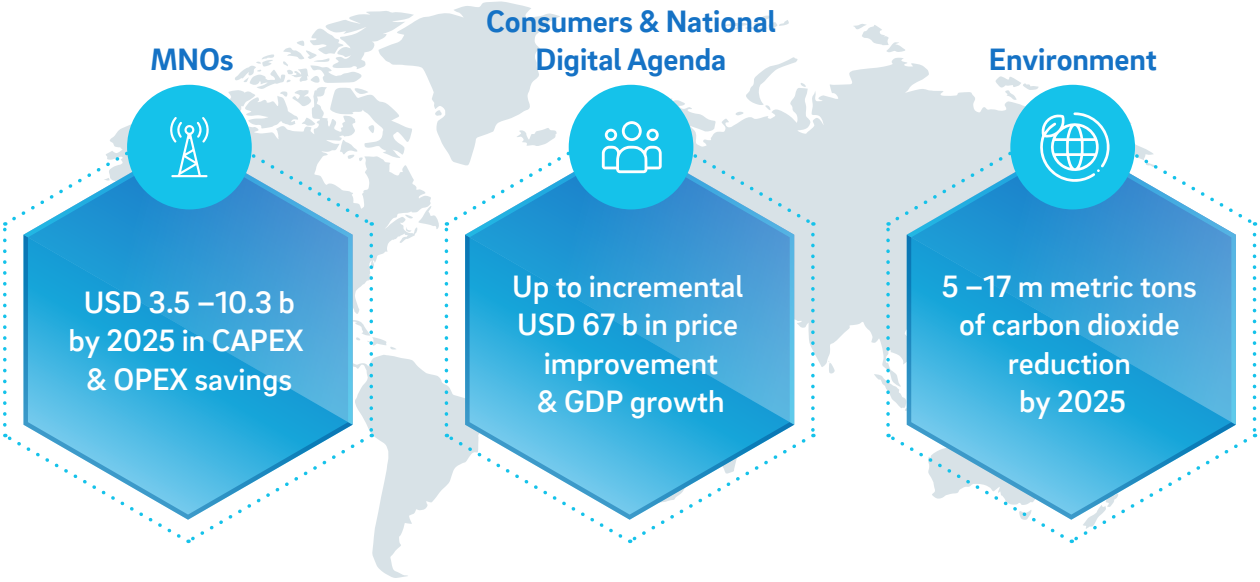
The source of reduction comes from both operational efficiencies and the reduction in the number of new towers required. Operational efficiency gains are primarily through the reduction in site energy consumption as well as lower carbon footprint from the "greening" of daily operations such as maintenance and field activities. One key proposition of TowerCos is their ability to manage environmental impact through the adoption of sustainable energy. By deploying technologies such as solar and wind energy, TowerCos are able to reduce the reliance on diesel fuel while generating cost savings through higher energy efficiency. Many leading TowerCos such as Vantage Towers are already working towards increasing renewable energy adoption through long-term power purchase agreements for renewable energy among others. Additionally, TowerCos are also leveraging advanced analytics to monitor and manage in real-time the power consumption, demand and fuel efficiency of each site. They are thus able to detect granular patterns in power consumption and use the insights to continuously explore new ways for reducing the carbon footprint of their operations.

The reduction in the number and specifications of new towers is primarily driven by the higher degree of sharing with multiple MNOs sharing the infrastructure under the TowerCo model and the usage of greener alternative materials and methods for construction – the reduction of towers alone brings down the carbon footprint by up to 3 million metric tonnes [13]. For example, TowerCos such as edotco Group have been exploring the construction of towers using alternative materials that are more sustainable and have less impact on the environment. edotco became the first TowerCo to utilize bamboo in the construction of towers, which takes only 12 days to construct and consumes significantly less energy compared to a traditional steel tower. It is reported that the bamboo tower reduces its dependence on steel by 80% and decreases its carbon footprint per site by 70%. Another alternative material the company has utilized in tower construction is Spun Pre-stressed Concrete (SPC) which not only reduces the dependency on steel, but is also highly weather resistant, requires less production time and offers improved network connectivity.

[13] Under the assumption that the construction of tower produces 75 tonnes of carbon footprint from passive infrastructure and 9 tonnes from active elements.

Environment and sustainability aspects are increasingly becoming central to the strategies, business models and operations of TowerCos – many TowerCos have committed sustainability goals, enforce sustainability standards on their vendors and disclose their environmental impact publicly.

Figure 2.3.4c Overview of the economic impact



Source: Roland Berger

In a nutshell, TowerCos are expected to bring significant benefits to MNOs, consumers, and the environment. Roland Berger estimates that in the selected 9 Asian countries alone TowerCos will save MNOs up to USD 10 billion in cumulative CAPEX and OPEX savings between 2021-2025, deliver up to incremental USD 67 billion[14] in consumer and economic benefits due to additional GDP growth and data price improvement, as well as reduce 5 – 17 million metric tonnes in cumulative carbon footprint between 2021-2025. In the long run, the value created by TowerCos is only expected to increase as the network density and footprint grows.

However, the natural evolution of TowerCos to expand as digital infrastructure providers, especially towards the sharing of active elements, comes with its own challenges. The complexity of operations and integration are barriers for TowerCos to move ahead. Conducive market environment and regulatory regimes are pre-requisites for TowerCos to fully realize their potential as shared digital infrastructure providers.

[14] Assuming maximum potential benefit at 100% TowerCo penetration

CHAPTER 3

REGULATORY SUPPORT TO POWER GROWTH

REGULATORY SUPPORT TO POWER GROWTH

As a critical player in the telecommunications value chain, TowerCos are highly dependent on a conducive regulatory environment to play its pivotal roles. A future-proof regulatory framework for TowerCos (and other infrastructure providers) becomes especially important as TowerCos move up the value chain and venture into new business models. To fully unlock the potential of the future digital infrastructure, the regulatory and policy framework should re-assess five (5) key dimensions as summarized in Figure 3a.

Regulatory reach varies significantly across different countries with developed markets typically taking a light touch approach towards licensing requirements while also mandating sharing in many cases along with strict policies towards deployment and sustainability. Emerging markets, on the other hand, tend to have more stringent licensing regimes but are less likely to mandate sharing, although exceptions do exist.

Figure 3a Key dimensions of regulatory framework and corresponding considerations

1 DIGITAL INFRASTRUCTURE MANDATE

- Overarching directives for digital inclusivity, internet access, coverage obligations, etc.
- Clear timelines , performance indicators and accountability
- Effective USP / USO– with role for neutral host to play
- Enable innovation in models and rural connectivity

2 LICENSING AND OWNERSHIP

- Simple, transparent licensing regime for infrastructure provider
- Optimized number of infrastructure providers
- Conducive license fees and royalties
- Support for carve-outs, infrastructure transactions
- Support broad scope of infrastructure sharing

3 NETWORK SHARING

- Guidelines and promotion of active and passive sharing
- Mandate sharing/ solo builds restriction

4 INFRASTRUCTURE DEPLOYMENT

- Streamlined right-of-way, local government permits and construction codes including environmental regulation
- Favourable regulations in supporting areas such as taxation, custom/import duties, business set-up
- Facilitate access and usage of public facilities for infrastructure roll-out

5 ENABLING ADJACENCIES

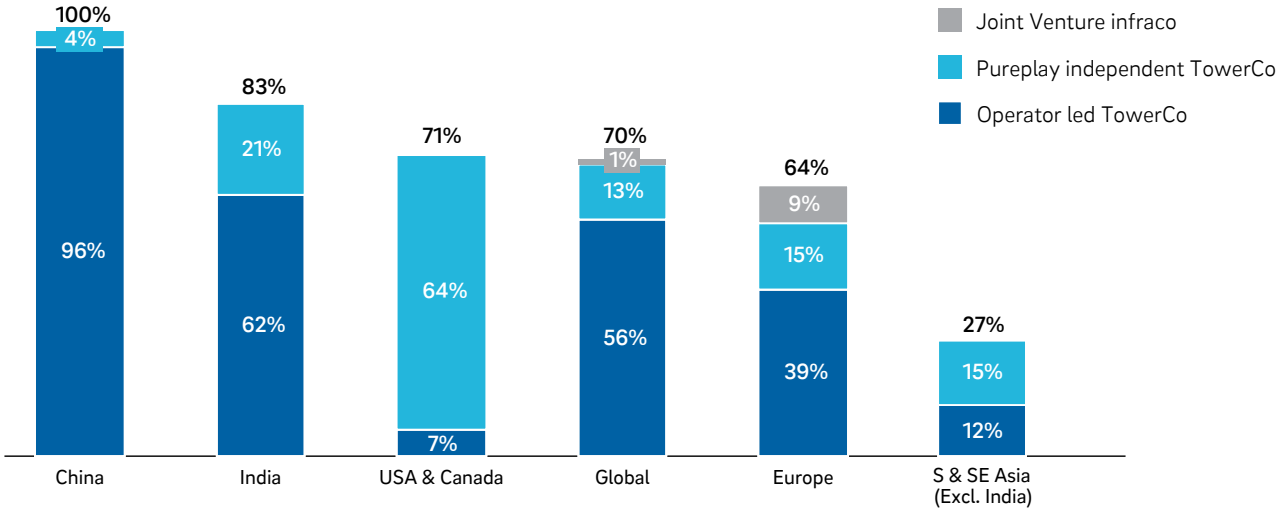
- Support infrastructure providers to venture into adjacent businesses such as Network-as-a-service, power generation, edge DC, advertising, etc.

Source: Roland Berger

The need for conducive regulatory and policy framework is especially relevant within the SEA and SA regions (excluding India) context. Despite the significant benefits brought by TowerCos, its penetration in these regions lag other regions and markets such as China (100%), India (83%) and USA & Canada (71%) with TowerCo penetration in these regions (27%) far below global average as shown in Figure 3b. Significant challenges and barriers still hinder the development of the TowerCo model, ranging from limitations in national digital infrastructure mandates and policies, stringent licensing requirements and fees, and inefficient deployment processes, among others. Figure 3c on the following page summarizes the current situation, challenges, and gaps across the key regulatory dimensions for the 9 selected emerging Asian countries.

Figure 3b TowerCo penetration by region, 2019 (% of towers)

Comparison of TowerCo penetration – Asia vs other parts of the world



Source: TowerXChange, Roland Berger

Figure 3c Summary of regulatory landscape and gaps across selected Asian countries

Regulatory landscape across target and aspiring markets

	Digital Infrastructure mandate	Licensing and ownership	Network sharing	Infrastructure deployment	Enabling adjacencies
Malaysia	> Jendela–policy target for 4G, 5G and fiber > Malaysia Digital Economy Blueprint > Detailed phased approach present	> Annual license fee 0.5% gross annual rev > Other miscellaneous charges applies	> Passive and active sharing allowed > Terms of access are highly regulated > Prices are generally commercially negotiated	> No special tax for telco infra. providers > Capital allowance > Complex approval > High permitting fees at state level	> Potential to expand into adjacencies as active infrastructure sharing is allowed
Bangladesh	> National Broadband Policy is under review > No clear sector target	> Tower license fee – 5.5% revenue sharing > Other miscellaneous charges applies > Full foreign ownership is under review	> Mandated passive infrastructure sharing > Limited guidelines on Active Sharing > Tower rollback by 2023	> Elevated customs duty tax on cells and antenna > Bureaucratic approval process e.g. NOC approval	> Guideline for active sharing under review > 5G policy guidelines pending
Cambodia	> No overarching sector policy > No clear sector target	> Annual license fee goes up to 6% > Migration to new licensing regime pending > 100% foreign ownership permitted > Fiber exclusivity expiring in 2022	> Only passive sharing allowed > Mandated infrastructure sharing for new built > Migration to new licensing regime will enable active sharing	> Network deployment guidelines and Built Permit processes under review > Type Approval and importation processes are under review	> Migration to new licensing regime will enable active sharing business model > 5G policy guidelines pending

	Digital Infrastructure mandate	Licensing and ownership	Network sharing	Infrastructure deployment	Enabling adjacencies
Myanmar	> Digital economy roadmap 2020-2025 > Improve mobile network coverage from 93-98% > Detailed phased approach present	> Annual license fee – 0.5% gross annual revenue > Other miscellaneous charges applies > 100% foreign ownership permitted	> No detailed guideline provided for active sharing	> No single one-stop approach to approval process	> No detailed guideline provided for active sharing > 5G policy guidelines pending
Pakistan	> The Philippines Digital Strategy 2011-2016 > National Broadband Plan released in 2017 > No clear sector targets with timelines	> Low barrier of entry on licensing and fee > Common Tower Policy 2020 requires investor to register for Certificate > 100% foreign ownership permitted	> Passive and active sharing allowed > Mandated infrastructure sharing > No guideline on active sharing	> Streamlined process for business-related permits > Lack of transparency on permit fees imposed by Local Government Units	> Potential to expand into adjacencies as active infrastructure sharing is allowed
Philippines	> National Broadband Policy is under consultation > Specific targets and timelines are provided in the Draft Policy	> Annual license fee – 0.5% gross annual revenue > Other miscellaneous charges applies > 100% FDI permitted	> Only passive sharing allowed for tower providers > Active infrastructure sharing to be formalized	> 'Single Window' Act > Reduction of customs duty (20% to 5%) and regulatory duty (7 to 3%) > Public and Private ROW Policy Directive 2020	> Telecom Tower Providers (TTP) supports passive sharing > Telecom Infrastructure Provider (TIP) enables wider form of sharing
Sri Lanka	> Policy only provides high-level principles > No specific targets and timelines	> IndependentTowecos model is not permitted except for shareable poles > Public Consultation on new licensing regime was held with minimal progress > Potential amendment to Telecommunications Act 1996 > 100% FDI permitted	> Ambiguity on the licensing requirements forTowerCos > Passive sharing amongst neutral host is limited to poles > No detailed guidelines provided on shared infrastructure	> No streamlined process asTRC issues individual license for customs, imports, etc. > High annual Cellular Tower Levy – USD 2.6K/ year	> Limited opportunities
Indonesia	> National Broadband Plan 2014-2019 requiring update > Stronger emphasis on digital economy with infrastructure as foundation > Rural access program	> Business activities only require registration > 100% FDI permitted but some tower operations activities are subjected to foreign ownership limit	> Passive and active sharing allowed > Infrastructure sharing is highly encouraged > Government can intervene on pricing	> Clear guidelines on building permits > Extensive approval process > Lack of transparency on permitting fees and processes at district level	> Potential to expand into adjacencies as active infrastructure sharing is allowed
Thailand	> Digital Thailand > Specific targets mentioned > Detailed phased approach present (priority activities listed)	> 1.5% annual license > Foreign ownership capped at 49% > Two distinct regulatory regime for TowerCos i.e.Type-3 licenceand Digital Infrastructure Fund (DIF)	> Passive and active sharing allowed > Active sharing is encouraged with approval process is being simplified	> Stronger emphasis on improve permitting process > Streamlining of fiber rollout	> Potential to expand into adjacencies as active infrastructure sharing is allowed

Source: Regulatory websites, Roland Berger analysis

3.1 Strong digital infrastructure mandate

While most countries in the region have a digital infrastructure mandate of some kind, there are significant variations in terms of the extent and robustness of the mandate. These mandates often form the basis for other components of the regulatory framework. As a cornerstone for national digital infrastructure development, it is important that these mandates provide a specific roadmap with timelines, initiatives and outcomes clearly being outlined, as opposed to only high-level principles, objectives and frameworks without an actionable plan that provides an implementable pathway and horizon for achieving the desired outcomes.

A growing number of countries in the region such as Malaysia and Pakistan have developed comprehensive mandates to guide the development of digital infrastructure within their respective countries.

Case in Point: Pakistan

Pakistan developed the National Broadband Policy 2021 which aims to accelerate digital inclusion to every citizen through evolving policy and regulatory measures. To spur digital development, the Policy has defined clear targets by phases along key pillars of the Policy, supported by numerous policy actions covering areas such as infrastructure, licensing among others.

Case in Point: Malaysia

The Jalinan Digital Negara (JENDELA) is a digital infrastructure plan that has been initiated by the government to ensure quality digital connectivity by 2025. It aims to improve connectivity through better network quality and coverage. There are many specific targets the plan hopes to achieve from 2020-2022 such as increasing 4G coverage from 91.8% to 96.9%. To optimize resources, the plan is being implemented in a phased approach. In phase 2 of the JENDELA plan, focus is on deploying 5G building on existing 4G infrastructure that is being enhanced by initiatives under in phase 1.

In addition to JENDELA, the government has developed **the Malaysia Digital Economy Blueprint, where it lays the roadmap to achieve Malaysia's vision to become regional leader in digital economy. One of the targets in the blueprint is for broadband to be mandated as a basic utility. In order to achieve this target, KKMM plans to streamline the legislation relating to broadband as a basic utility at the federal and state levels by 2025.**

Source: Pakistan National Broadband Policy, JENDELA, MyDigital

Key considerations of policy support:
Detailed and all-encompassing digital infrastructure mandate

The development of a detailed and holistic digital infrastructure mandate is critical in establishing a guiding principle for investors in the infrastructure sector. With overarching policy targets supporting digital inclusivity, key stakeholders will be equipped with a north star to guide investment and business decisions. Additionally, a comprehensive policy sends the right signals to the private sector and sets up an environment that is conducive for businesses to grow. National mandates are also a powerful tool to drive partnerships and sharing agreements for improved and more efficient rural coverage.

Example

United Kingdom's Shared Rural Network initiative

In 2020, the UK government announced the creation of a Shared Rural Network. The network is being built by Digital Mobile Spectrum, a joint venture of the four largest MNOs (EE, O2, Three, and Vodafone) with a target to deliver 95% 4G coverage. The program is split between public and private funding elements. Government is investing USD 685 million to significantly reduce areas with no coverage. The four operators collectively invest USD 726 million to extend their coverage by upgrading their existing networks, working together on shared infrastructure and building new sites, with new government-funded towers being built to target areas with no mobile coverage. The program will bring an extra 280,000 premises and an additional 16,000 km of UK roads in range of a 4G signal.

Source: DCMS

3.2 Simple and conducive licensing and ownership requirements

Stringent licensing requirements can present a significant barrier to entry and inhibits operations for TowerCos. Although regulations are in place to safeguard against misconduct, allay national security concerns and ensure compliance to technical standards, onerous licensing requirements can prove burdensome and costly for TowerCos. While issuing licenses with high acquisition and recurring fee generate direct revenues for the government, such approach may result in sub-optimal outcomes, more so when it deters TowerCos from operating across wider range of infrastructure sub-markets.

In certain countries within the region, the annual licensing/ regulatory fees are extremely high and can reach up to 6% share of revenue. Further, separate licenses or explicit approvals are required to own and operate different types of infrastructure (tower, transmission, etc.). These limitations act as potential deterrents and barriers to the development of a healthy telecommunications infrastructure market. Additionally, limited support for tower or infrastructure carve-out transactions could also hinders the creation of more efficient independent infrastructure operators within a country. In short, regulators need to strike a good balance on license obligations, license fees and scope of activities, taking into account multiple factors such as revenue generation for the government, cost of compliance, overall national aspirations and investor appetite, amongst others.

Licensing and ownership regulations shape the market structure through its influence on barriers to entry, market structure and the level of competition within the industry. Several countries within the region are progressively reforming their licensing rules and reviewing their ownership restrictions to support t he development of TowerCos.

Case in Point: Bangladesh

BTRC has launched a consultation paper to seek feedback from licensee on the proposal to fully liberalize its telecommunications sector and to attract fresh capital, innovation and technological know-how through foreign direct investment. Such openness will bring further advancement to the telecommunications industry through more foreign investment and industry expertise.

Case in Point: Malaysia

The license for TowerCos - Network Facilities Provider license – covers a range of infrastructure including towers, earth stations, fiber optic cables, satellite hubs and submarine cable landing. The annual licensing fee of only 0.5% of gross annual revenue which is amongst the lowest in the region as well as simplified licensing framework has ensured vibrancy to its infrastructure market.

Source: Desk research, MCMC

Key considerations of policy support:
Simplified licensing regime with more relaxed conditions for foreign ownership

A simplified licensing regime without restrictive granularity – for example providing common licenses for active & passive sharing, allowing higher share (>70%) of foreign investments and encouraging M&A activities to scale up tower / infrastructure portfolios, and fast tracking anti-competition reviews - can significantly boost infrastructure sharing and the development of TowerCos within a country. According to IFC, countries which have relatively high TowerCo penetration such as USA and various EU countries typically have a light-touch regulatory environment (i.e. one with no additional license or requirements beyond what is deemed expected for a regular business).

Example : Light-touch regulatory environment in Sweden and Denmark

Countries such as Sweden and Denmark only require a general authorization whereby any registered company can operate as a TowerCo without special entry conditions and fees. TowerCos registration processes is similar to that for general businesses which reduces barriers to entry and increases competition in the telecommunications infrastructure landscape.

Source: Expert interviews, press articles

Key considerations of policy support:
Low annual license / regulatory fee taking into account TowerCos benefit and impact to consumers and national digital economy

Given the significant economic impact that TowerCos can bring to a country, regulators should review the substantial license fees charged to TowerCos. High annual license and regulatory fees impact smaller TowerCos as they tend to have lower economies of scale and, in turn, lower margins. With a lower fee, there is potential for better margins which could attract more competition and greater foreign direct investment into the sector.

Example : Annual license fee for infrastructure providers

Countries such as Malaysia and Myanmar have annual license/regulatory fee of 0.5% of gross annual turnover. This is significantly lower than the requirements in some markets such as Bangladesh with annual revenue sharing requirements of 5.5% every year from the 2nd year onwards and Cambodia at 6% annual revenue sharing per annum.

Source: Country legislation, expert interviews

3.3 Active promotion and guidelines to encourage network and infrastructure sharing

Inefficient network sharing guidelines raise ambiguity that inhibit investment decisions and ultimately hamper network rollout. In some countries, operators still maintain their tower portfolios for differentiation, causing further duplication of network investment and constricted wholesale market. Such scenarios call for governments to intervene and mandate sharing of network infrastructure especially for new built to accelerate expansion of shareable cell sites and network rollout.

Clear and transparent network sharing guidelines provide clarity to the industry players and can expedite access and usage of shared infrastructure through a more efficient negotiation process as well as reducing potential disputes. As such, an increasing number of countries are now mandating infrastructure sharing especially for new rollouts and regulate some key terms on access to expedite network deployment, promote industry competition at retail level and for aesthetic reasons, while leaving it to the licensees to negotiate site-sharing agreements, especially pricing, in good faith.

Case in Point: Philippines

Common Tower Policy (CTP) 2020 requires that any tower built provides ample access slots for all operators and the Department of Information and Communications Technology (DICT). All new installation will have to be located on shared towers unless otherwise approved by the DICT. Furthermore, the DICT requires Independent Tower Companies to lease its telecommunications towers for a specified lease term that is transparent and fair to access seekers.

Case in Point: Indonesia

Leasing prices are unregulated with TowerCos and operators free to negotiate and mutually agree on the leasing price. However, the central government has the power to determine the upper and lower limits of pricing for telecommunications network and services to prevent tariff wars and boost healthy competition.

Source: DICT, International Telecommunication Union, press release

Key considerations of policy support:

Mandated site sharing – especially for 5G technology

With the rollout of 5G network and significantly larger number of towers needed for coverage, mandated site sharing can dramatically reduce the number of single-tenanted sites and deployment cost. Various approaches including sharing obligations and incentives can be leveraged to empower site sharing mandate.

Example : Infrastructure sharing obligations and incentives

Following the transposition of the broadband cost reduction directive (BCRD1) the European TowerCos are operating under general passive infrastructure sharing obligation. For instance, in Liechtenstein, operators are obliged to share passive infrastructure assets and sites subject to available capacity. In Turkey, during 2011-16, exemptions from administrative fees were used as an incentive to encourage sharing agreements; exemptions have now been withdrawn but obligation for sharing continues.

Source: BEREC

Key considerations of policy support:

Promote active sharing with clear and detailed frameworks

Active infrastructure sharing remains nascent but is increasingly gaining traction as operators embark on 5G investments to address network densification and expand rural network. Clear guidelines and frameworks that are broadly aligned with international best practice and regulators supportive of network trials can help accelerate adoption of innovation in active sharing, including Open RAN.

Example : Active infrastructure sharing guidelines in Brazil

In Brazil, infrastructure sharing is in full operation, including base station, radio access network (RAN), mobile virtual network operators (MVNOs) and electricity distribution poles.

Radio spectrum sharing is one of Anatel's spectrum management goals and is regulated by the Radio Frequency Spectrum Use Regulation, and the Radio Frequency Use Conditions Regulations. These regulatory frameworks aim to guarantee the efficient, rational and adequate use of the resource pursuant to its telecommunications law, as long as there is technical feasibility, and it meets the public interest and economic order. As a result, radio access network (RAN) sharing has been increasingly used due to its evident benefits for the development of the sector, especially as a way of optimizing the use of the scarce spectrum resource.

Source: International Telecommunications Union (ITU)

3.4 Streamlined regulations and processes for infrastructure deployment

Inefficient and bureaucratic infrastructure deployment processes often lead to delayed deployments and deprive consumers from enjoying satisfactory services. Without clear and detailed guidelines by central governments, key stakeholders such as building administrators and local government units impose their own requirements, thus increasing ambiguity and impeding rollout. Robust deployment guidelines ensure common understanding and expectation of the approval process and serve as a reference point for all stakeholders.

Permit costs and requirements constitute a major part of deployment costs, warranting the need for these requirements to be re-assessed and normalized to a reasonable level. In addition, regulations in adjacent areas such as taxation, custom, import duties, and construction / building regulations will need to be reviewed too as these also have bearings on the ease of deployment.

Many countries within the region are taking aggressive steps in reforming their related infrastructure deployment regulations and simplifying permit application processes as they strive towards improving public service delivery.

Case in Point: India

India's Telecommunication Department introduced its Right of Way Rules 2016 to regulate the establishment of optical fiber and tower infrastructure. The rules provide the license application framework and supporting documentation requirements for licensees. Under the rules, the authority must examine and approve or reject any license application within 60 days. The new ruling has been well-received by industry players, who believe it will help accelerate infrastructure roll-out.

Case in Point: Malaysia

As part of JENDELA's objectives to enhance broadband access for the population, Malaysia Communications and Multimedia Commission (MCMC) and licensees are engaging relevant state authorities across all states to secure blanket deployment approval for USP sites, adoption of digital infrastructure as public utility, reducing the permitting fees for new tower and rooftop structure as well as the renewal fees towards median and average fees.

Case in Point: Philippines

DICT along with the Anti-Red Tape Authority (ARTA) and other government agencies including Local Government Units have released a harmonized guideline that streamlines permitting processes, timelines, documentation requirement and approvals for installation of poles, fiber and cables to support licensees in accelerating the rollout of various digital infrastructures.

Source: Country legislation, International Telecommunication Union (ITU), desk research

Key considerations of policy support:

Uniformed and streamlined permitting process for site approvals

Inefficient and bureaucratic permit processes cost local governments potential revenue, time and valuable resources. It can also deter TowerCos from bringing in digital infrastructure investment into the required areas and can cause public resentment as capacity and coverage for broadband services are not built on timely basis to cater the demand.

A uniformed and streamlined processes that are built on digital platforms will enable faster permit application and verification processes, avoid duplication of submissions, facilitate more efficient information sharing amongst authorities, enable more transparent tracking of progress as well as ease compliance auditing. Not just benefiting the TowerCos, such reforms will also yield tangible benefits to the local governments, mainly by enhancing the degree of compliance to the local regulations, reducing administrative costs, freeing up resources to be deployed for other more strategic activities, addressing potential revenue leakage due to better performance tracking while ensuring timely provisioning of digital infrastructure for the general public.

Example : 2015 General Antenna Law Brazil

The 2015 General Antenna Law harmonized the rules for the installation of cellular antennas and related telecommunications infrastructure. Under this law, each state must streamline its approval procedures to operate as a 'one-stop shop' and respond within 60 days. If the municipality does not respond within the stipulated timeframe, the decision would be transferred from the municipality to ANATEL. Additionally, the law prohibited charging for the right of way for public roads, waysides, and other public properties of common use, even those operated by private concessionaires. The law was enacted following the collaboration of various ministries including the Ministry of Infrastructure, the Ministry of Economy, the Ministry of Science and Technology, and the Ministry of Mines, Energy and the Environment.

Source: Country legislations, press releases

Key considerations of policy support:

Establishment of central information repositories

The establishment of central information tools and databases can help the industry to better plan their cell site locations, enhance real-time broadband demand intelligence for a more coordinated measures in addressing coverage and speed gaps, enables more transparent infrastructure sharing, optimize deployment cost and minimize environmental disruption.

Example : Central infrastructure databases in Europe

Operators are obliged to publish information on passive infrastructure sharing opportunities in countries such as Belgium, Bulgaria, Croatia, and Greece. In Norway – although there is no mandatory obligations, there is a privately organized database of cell site locations. There is a requirement that operators must minimize environmental disruption; thus, this database is a tool used to coordinate site planning.

Source: BEREC

Key considerations of policy support:

Facilitate access to public infrastructure and provide preference for shared deployments

5G presents an increasing need for network densification, particularly in hotspots such as town centers, transport hubs and event locations. It is thus important that regulators facilitate access to site locations including public spaces and facilities by simplifying the site acquisition rules, providing transparent access to government buildings and public spaces, designating dedicated zones for common infrastructure as well as designating small cells as Low Impact Facilities, which are exempted from obtaining local government approvals.

Example : Facilitating access to public infrastructure

USA

American Tower and Philips Lighting have jointly developed "Smart Fusion Poles" combining city lighting with integrated cell antennae. This initiative is supported by the City of Huntington Beach, which provided access to 200 existing lighting pole locations. These locations, predominantly situated along highways and congested downtown areas, blend into the urban landscape providing connectivity for several smart city initiatives with minimal disruption.

Singapore

IMDA has required "mobile deployment spaces" to be provided free of charge for the deployment of telecommunications infrastructure.

United Kingdom

The UK's Electronic Communication Code provides guidelines to facilitate access to macro and small cell infrastructure on both public and private land.

Source: Country legislations, press releases

3.5 Enable TowerCos to venture into small cells and adjacent businesses

TowerCos are well-positioned to expand their services into new areas such as small cells and other adjacent businesses such as data center operations, power generation, smart advertising and Industrial IoT which are increasingly relevant with the increasing adoption of new 5G use cases. Restrictions on the scope of activities will limit TowerCos from evolving their business models, denying the full potential it can bring to enrich the 5G ecosystem as a neutral host. Recognizing the need to promote vibrancy in the 5G ecosystem, a growing number of countries are exploring permitting infrastructure providers to venture into new areas.

Case in Point: India

The Telecommunications Regulatory Authority of India (TRAI) recommended that companies registered as Infrastructure Providers (IP-I) should be allowed to own, establish, maintain and operate all infrastructure items required for establishing fixed line, mobile networks and transmission links, including active infrastructure. In its recent recommendation, TRAI reaffirmed its position to include active infrastructure sharing within the scope of IP-I. **Tower and Infrastructure Providers Association believes that the neutral hosts-driven active sharing will yield a cost-effective network infrastructure and faster time-to-market for operators**, as well as open up more investments in the sector.

Source: Expert interviews

Key considerations of policy support:

Allow TowerCos to offer adjacent offerings such as small cells, data centers, power generation, etc.

TowerCos are well positioned to enhance value-creation through adjacencies such as tower fiberization, public wi-fi, electricity usage optimization, and edge data centers. For countries to cement themselves as digital leaders, necessary legislation and policy support needs to be developed at an early stage.

To maximize value from TowerCos, policymakers should consider the various adjacent offerings TowerCos can provide. Upon recognizing the high potential of TowerCos, policymakers should ideally aim to (1) provide incentives and exemptions for the construction of these related infrastructures, (2) enhance the processes required to support these adjacencies (RoWs, streamlining of administrative procedures etc.) and (3) consider allowing active infrastructure sharing.

Example : Regulatory support for adjacent services

United Kingdom

The department for Digital, Culture, Media and Sport (DCMS) recognizes that 5G may require wider deployment of small cells. As a result, Ofcom has allowed neutral hosts and TowerCos such as Dense Air and Arqiva to offer small cells and active sharing. In 2018, O2 (MNO) and Arqiva (infrastructure provider) announced plans to deploy 300 small cells around London to improve connectivity in high-traffic areas (e.g., shopping malls, stations, etc.) Under planning legislation in the UK, small cells deployment fall under a permitted development category and is not subjected to planning application (subject to meeting certain criteria).

United States

To accelerate the small cell growth, the Federal Communications Commission (FCC) has removed barriers to wireless infrastructures by stipulating how much cities can charge carriers for small cells permit, the maximum annual charge for the use of the right, and the permit processing time. One example is from the city of Charlotte where the local power company and tower company work together to deploy small cells to the existing streetlight poles.

Source: Press releases

Key considerations of policy support:
Allow TowerCos to operate as NetCos

Infrastructure players are also exploring opportunities to provide wholesale access to its active network infrastructure. Under this model, MNOs will retain ownership and operation of spectrum and core network while access network will be provided by the NetCo. NetCos can focus entirely on the operational efficiency and development of the network while maximizing sharing - allowing it to deploy the necessary infrastructure/network cost-effectively across the country. In rural areas, where it is economically unviable for individual MNOs to deploy individual networks, a shared netco model can be a potential solution. Additionally, for specific rural deployments, regulators can provide support in the form of subsidies, fast-tracked acquisition of land and permits or supporting the partnership between NetCos and MNOs.

Example : Regulatory support to operate as NetCo

Poland

In February 2021, Poland's Competition Authority (UOKiK) approved the acquisition deal: Cellnex purchased all the components of Polkomtel Infrastruktura's network (passive, active, and backhaul) under a long-term NaaS (Network-as-a-service) agreement. According to UOKiK, this acquisition did not raise competition concerns that could affect the normal development of telecommunications infrastructure in Poland.

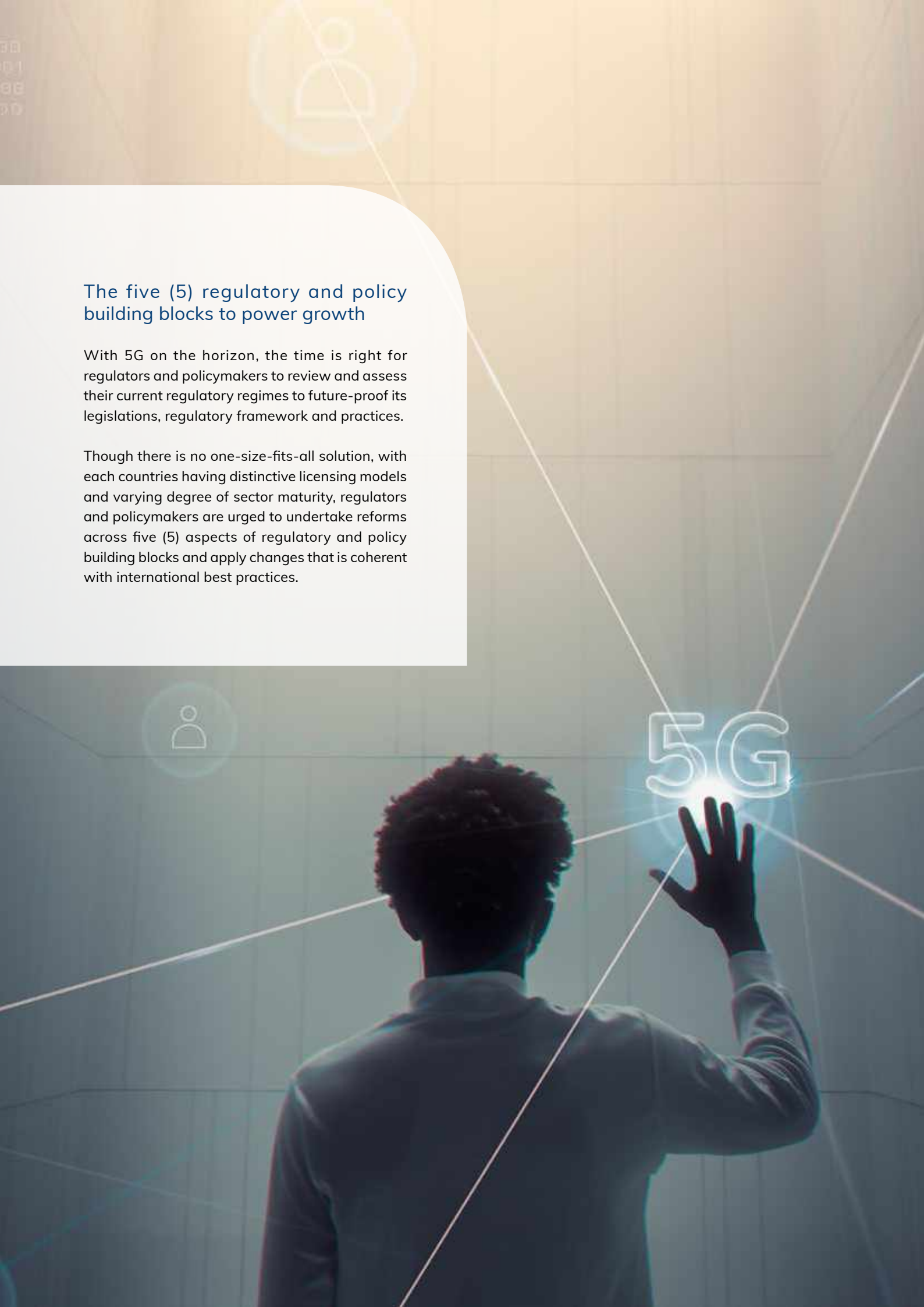
"[This deal]...exemplifies our commitment to evolving the traditional tower operator model towards an integrated telecommunications infrastructure management model, combining the operation of passive elements (towers) and active elements such as transmission equipment, radio links and fiber-to-the-tower." – Tobias Martinez, CEO Cellnex.

Source: Press releases, desktop research

The five (5) regulatory and policy building blocks to power growth

With 5G on the horizon, the time is right for regulators and policymakers to review and assess their current regulatory regimes to future-proof its legislations, regulatory framework and practices.

Though there is no one-size-fits-all solution, with each countries having distinctive licensing models and varying degree of sector maturity, regulators and policymakers are urged to undertake reforms across five (5) aspects of regulatory and policy building blocks and apply changes that is coherent with international best practices.



APPENDIX

TOWERING ABOVE:
BUILDING TOMORROW'S DIGITAL
INFRASTRUCTURE IN ASIA

4.1 Selected detailed case studies

Leading TowerCos are transforming their business models. Below are perspectives on how 3 global TowerCo companies are expanding and bringing a new dynamic to the TowerCo business model. Various pathways have been taken by leading TowerCos to transform their business models – but common themes include actively expanding asset base through both organic and inorganic means, leveraging on partnerships to expand capabilities and offering, and building on core advantages to provide compelling propositions for players in the ecosystem.

Figure 4.1a Case study on Cellnex

Case Study: Cellnex

cellnex

Overview

Footprint Seven European countries

Portfolio 128,000 sites

Annual revenue USD 1.8 b

Competitive strategy

> Customer-focused: works with MNOs to offer solutions on an individual basis. For example, tailoring service models when deploying small cells solutions to meet the specific landscape environment.

> Inflation-linked contract: offer long duration contracts with inflation-linked and fixed price increases to make business more resilient

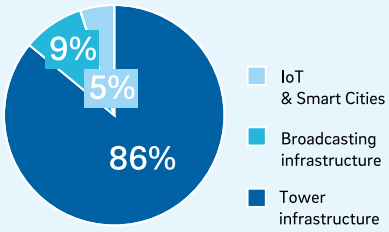
Core business and operations

Business offerings

> A carrier-neutral network operator specialized in owning, managing and leasing access to network assets on a neutral basis to multiple tenants.

> Entered active infrastructure sharing space recently (for instance, Cellnex Poland).

Revenue breakdown (Q3 2021)



> 30% more DAS nodes and small cells as compared to 2020; 17 p.p increase in revenue generated from tower infrastructure

Expansion into adjacencies

Distributed Antenna System & Small Cells Solutions

> Offers DASaaS to improve mobile coverage and scalability in meeting future capacity demand.

> Completed over hundreds of small cells projects as of today; having access to over 200,000 street furniture assets across 14 London Boroughs.

Smart healthcare system

> Planning to offer smart digital solutions to UK hospitals by connecting patients and doctors via devices to improve overall efficiency.

Source: Cellnex, Roland Berger

Figure 4.1b Case study on Crown Castle

Case Study: Crown Castle

Overview

Footprint United States, U.K., Australia, etc.

Portfolio 40,000 cell towers

Annual revenue USD 5.8 b

Competitive strategy

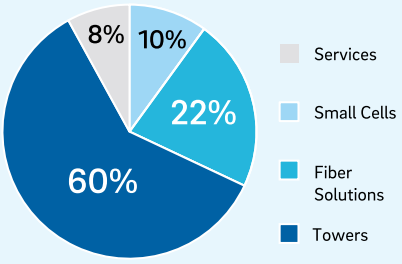
> Focus on small cells and fiber: invested heavily in new small cells and fiber assets to enhance the network density, together with its acquisition of FiberNet, Wilcon and Lightower to expand fiber footprint

> Deployment of edge technology through partnerships: offering more flexibility to which data centers customers want to connect

Core business and operations

Business offerings > A real estate investment trust that offers shared infrastructure services to lower cost for MNOs, which generates greater returns for its shareholders as assets are leased up.

Revenue breakdown (Q3 2021)



> Revenue for small cell is growing at 30% on a year-on-year basis.

Expansion into adjacencies

Small Cells Solutions > Deployment of over 50,000 small cells as of 2021, which represents 50% market share.

Fiber

> Owns approximately 80,000 route miles of fiber

> Largest dark fiber network provider in the world that offers unlimited bandwidth

Internet of Things (IoT) > Planning to offer smart digital solutions to UK hospitals by connecting patients and doctors via devices to improve overall efficiency.

Source: Crown Castle, Roland Berger

Figure 4.1c | Case study on American Tower

Case Study: American Tower

AMERICAN TOWER®

Overview

Footprint > 25 countries (e.g. Canada and U.S.)

Portfolio 219,000 sites

Annual revenue USD 8 b

Competitive strategy

> Duration of contract: non-cancellable initial contract for a period of 5 – 10 years that increases tenants' switching cost by USD 35,000 to 40,000

> Aggressive expansion strategy: acquiring towers across several countries. For example, acquisition of Telxius to gain 31,000 sites across European countries and Latin America

Core business and operations

Business offerings > Create value for MNOs by maintaining tower and ensuring the percentage of time towers are operational is nealy 100%, allowing operators to benefit from lower cost. The long-term nature of the contract provides revenue visibility for the firm.

Revenue breakdown (Q3 2021)

Acquisition of data center developer CoreSite for USD 10 b

Six data centers and three metro data centers across the U.S.

Expansion into adjacencies

Edge infrastructure > Deployed a network of small data centres at the base of cell towers in six U.S. cities and acquired DataSite to boost its metro edge presence

Smart cities > Deployment of smart poles to replace traditional streetlight poles that integrate energy-efficient LED lighting and wireless communications infrastructure

Autonomous vehicles > Exclusive agreement with travel center operators to identify ideal locations for 5G applications such as autonomous vehicles

Source: American Tower, Roland Berger

4.2 Methodology and key assumptions behind value estimation model

A quantification of economic impact on MNOs, consumers, national digital agenda and environment was calculated to estimate the full effect of TowerCos. The underlying assumptions are detailed below.

4.2.1 Economic impact on MNOs

To assess the economic impact of TowerCos on MNOs, key value drivers such as CAPEX and OPEX savings that can be achieved from 2020 to 2025 on a per tower basis were quantified. The methodology also estimated the growth in the total number of towers. The underlying assumptions are as follows:

No.	Key assumptions

1. Average CAPEX and OPEX per tower

Construction of each tower costs about USD 85,000 to 140,000 in emerging Asian economies

- Construction of the passive infrastructure costs estimated between USD 70,000 to 100,000 per tower.
- RAN assumed to cost USD 15,000 to 40,000 per tower.

OPEX of each tower ranges from USD 9,000 to 11,000 per year in emerging Asian economies.

2. Tower growth forecast for selected 9 Asian markets

Total number of towers in the selected 9 Asian markets is expected to grow in line with expected growth in mobile subscriptions

2020	2021	2022	2023	2024	2025
318,000	343,000	357,000	366,000	375,000	386,000

Assume all new towers from 2021 to 2025 will be built by TowerCos

3. Estimated CAPEX and OPEX savings per tower

The model creates a hypothetical scenario that quantifies the maximum savings that TowerCos can bring for MNOs.

For CAPEX, MNOs can achieve 16% to 35% savings through passive infrastructure sharing and 33% to 35% through active infrastructure sharing based on savings percentages estimated by BEREC. Total CAPEX savings from 2020 to 2025 is calculated based on the assumption that all new towers are going to be built by TowerCos

For OPEX, MNOs can achieve 16% to 35% savings through passive infrastructure sharing and 25% to 33% through active infrastructure sharing based on savings percentages estimated by BEREC. The calculation of OPEX savings is based on the cumulative annual OPEX savings assuming a scenario where TowerCos capture 100% market share each year.

4.2.2 Economic impact on consumers and national digital agenda

The assessment on the impact of TowerCos for consumers and the national digital agenda takes into account data price savings and incremental GDP growth due to increased mobile internet penetration brought about by TowerCos. The methodology captures the current mobile internet penetration, GDP/ capita and price per GB of data in each country (taking 2020 baseline), then estimates how these may be impacted by the development of TowerCos:

No.	Key assumptions
1.	1 percentage point increase in TowerCo penetration will lead to 0.06 percentage point increase in mobile internet penetration and 0.02 percentage point reduction in price in markets with less than 50% TowerCo penetration. • As indicated by a research published by IFC, markets with TowerCos (50% average market share) have a higher mobile internet penetration (+3 percentage point) and a lower mobile internet price as % of GNI/ capita (-1 percentage point) compared to markets with no TowerCos (<5% market share)
2.	For markets with more than 50% TowerCo penetration, the impact is assumed to be half (reduced due to the principal of diminishing marginal return).
3.	Every 10% increase in mobile internet penetration is assumed to lead to 2.0% and 1.8% increase in GDP capita growth for low income and middle-income countries respectively (based on ITU report on economic contribution of broadband and digitalization)
4.	An average person in emerging Asian countries consumes 72 GB of mobile data per year.
5.	The impact on GDP growth and on price savings is assessed assuming the hypothetical scenario that TowerCos will have 100% market share as the model aims to assess the maximum benefit that TowerCos can bring for consumers.

4.2.3 Economic impact on environment

The key factors contributing to carbon footprint reduction are operational efficiencies and the reduction in the number of new towers constructed under infrastructure sharing method. The methodology estimates the reduction in carbon footprint for each tower and quantify the total impact by accounting for the number of towers affected. The key assumptions are as follows:

No.	Key assumptions
1.	The operation of each tower is assumed to produce 32 metric tonnes of carbon footprint per year. Based on the average carbon footprint of Asia TowerCos such as Indus Tower, edotco Group and American Tower Asia. This considers both direct (e.g. combustion from diesel generator, fugitive emission from cooling plant) and indirect (e.g. emission at the coal-fueled plant) emissions.
2.	Construction of passive infrastructure is assumed to produce 50 to 75 tonnes of carbon footprint per tower. • Each tower is assumed to consume 25,000 to 38,000 kg of steel depending on the height of the tower, effective projected area of antenna, load, and wind speed. • Each ton of steel produces 1.85 ton of carbon footprint. • The process of construction (e.g. labor) is assumed to produce 10% of the total carbon footprint generated from steel.
3.	Construction of active elements on each tower may generate 4.5 to 9 tonnes of carbon footprint. • Based on a published article by Ericsson, a radio base station generates approximately 4.5 tonnes of carbon footprint and each tower may have 1-2 radio base stations.
4.	Operational efficiency through shared infrastructure usage and “greener” operations are assumed to reduce site operations carbon emission by 30%
5.	50% reduction in construction-related carbon footprint due to reduction of new infrastructure built and sharing of infrastructure assuming 1.0x as the tenancy ratio for MNO-owned towers as compared to a tenancy ratio 2.0x for towers owned by TowerCos.
6.	Total carbon footprint reduction is assessed with the assumption that TowerCos will achieve 100% market share from 2020 to 2025 and all new towers are built by TowerCos as the model aims to assess the maximum carbon footprint reduction that TowerCos can achieve by 2025.

List of Abbreviations

ANATEL	National Telecommunications Agency
AR	Augmented Reality
ARPU	Average Revenue Per User
BTO	Build-Transfer-Operate
CADE	Administrative Council of Economic Defense
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CTP	Common Tower Policy
DAS	Distributed Antenna System
DASaaS	Distributed Antenna System as a Service
DC	Data Center
DICT	Department of Information and Communications Technology
DNB	Digital Nasional Berhad
EETT	Hellenic Telecommunications and Post Commission
EV	Electric Vehicle
FDI	Foreign Direct Investment
GB	Gigabyte
GSMA	Global System for Mobile Communications
IFC	The International Finance Corporation
IoT	Internet of Things
ITU	The International Telecommunication Union
JENDELA	Jalinan Digital Negara
MNO	Mobile Network Operator
NaaS	Network as a Service
NFCP	National Fiberization and Connectivity Plan
OFCOM	Office of Communications (United Kingdom)
OPEX	Operational Expenditure
PV	Photovoltaic
RAN	Radio Access Network
RBI	Rural Broadband Initiative
ROI	Return on Investment
RoW	Right of Way
SCasS	Small Cell-as-a-Service
SPV	Special Purpose Vehicle
SWN	Single Wholesale Network
TCO	Total Cost of Ownership
TowerCo	Tower Company
UFB	Ultra-Fast Broadband
UOKiK	Office of Competition and Consumer Protection (Poland)
VR	Virtual Reality
VULA	Virtual Unbundled Local Access
WACC	Weighted Average Cost of Capital

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