REDtone

Allocation of spectrum bands for mobile broadband service in Malaysia

Response to Public Inquiry

Submitted to

Malaysian Communications and Multimedia Commission

Submitted by

REDtone Engineering & Network Services Sdn Bhd

In accordance with

Public Inquiry, Allocation of spectrum bands for mobile broadband service in Malaysia

REDtone

For and on behalf of

REDtone Engineering & Network Services Sdn Bhd

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KUALA LUMPUR, 30 Aug 2019

Place and Date

Signature of Authorized Signatory

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1.1. REDtone's perspective and position

REDtone's perspective and position

Malaysia has strong aspirations to improve broadband coverage and quality as well as to reduce nationwide broadband prices. In the long run, the country aims to leapfrog into the new technology era through development of its digital economy and by leveraging its 5G capabilities. To fully capture the nation's growth potential, sufficient industry wide collaboration and appropriate support from policymakers and regulatory bodies needs to be ensured. The three primary goals are to:

1. Mitigate high investment costs & limited infrastructure sharing
2. Foster healthy competition
3. Set the foundations for future 5G proliferation

These ambitions urgently require new, innovative models. Globally, there are a multitude of models which have attempted to tackle similar issues, of which we see a wireless open access network (WOAN) model as most relevant for Malaysia. Based on international case studies, we have identified four pillars for a successful WOAN:

1. Presence of a neutral wholesaler with network deployment and operational capabilities
2. Sufficient regulatory support regarding licensing, financial enablement and prescription of infrastructure sharing
3. Technology agnostic setup for maximal technology flexibility
4. Comprehensive and WOAN-tailored spectrum strategy

For the fourth pillar we propose the following 5 elements of a national spectrum strategy to ensure a successful WOAN in Malaysia:

1. Sufficient geographical coverage of spectrum
2. Sufficient spectrum allocation across relevant bands for both rural coverage and capacity
3. Potential to expand frequency assignment to higher bands in the future for 5G proliferation
4. Affordability of the relevant frequency bands to ensure commercial feasibility
5. Allocation of respective spectrum for a sufficient period

Considering this, Malaysia needs an experienced partner to take on the role of a neutral wholesaler. We believe REDtone is the "natural player" to play this role, given the following 5 characteristics:

1. No retail activities in the relevant business segments, especially in mobile broadband retail
2. Natural player to develop a 5G ecosystem for other industries (e.g. by leveraging on sister companies of Berjaya Group)
3. Vast, relevant experience in development and operation of comparable infrastructure
4. Proactive adoption of network sharing with a lean investment approach
5. No legacy networks

1.2. REDtone's response to questions under Spectrum Allocation PI

REDtone suggests the MCMC to consider the following key factors for the new wireless broadband frequency allocation to effectively and efficiently achieve NFCP targets and optimally serve Malaysia through a wholesale network.

Spectrum assignment mechanism: spectrum should be assigned through competitive tenders ("beauty contests") with selection criteria that support coverage and capacity related targets of the NFCP.

Spectrum assignment timeline: the relevant frequencies should all be awarded in a concurrent timeline to support the bidder's product portfolio planning and hence to maximize the commercial value of the spectrum. Therefore, the below timeline is proposed:

1. **Q4 2019**: commence assignment process
2. **Q3 2020**: complete assignment process
3. **Q4 2020**: spectrum release/ assignment by way of SA

Spectrum block assignment: sufficient blocks should be made available for the neutral wholesaler for optimal coverage and capacity

- **700 MHz:** Minimum 2x20 MHz for neutral wholesaler and remaining spectrum distributed to other players in order to counter low-band imbalance
- **2300 MHz:** 20 MHz for neutral wholesaler and 10 to 20 MHz for each other assignee
- **2600 MHz:** Minimum 20 MHz or 2x10 MHz for neutral wholesaler as well as for each other assignee

Spectrum utilisation of 2600 MHz band: interference between FDD and TDD to be mitigated through 4 main measures:

- Guard bands
- Frequency filters
- Power restrictions
- Special site engineering

Spectrum pricing: affordable spectrum price should be provided to ensure commercial feasibility and consumer benefits while being assigned for a sufficient period. For all bands should apply:

- **Price component:** MYR 290 – 840 k per MHz per year (per year for the duration), translating to 0.45 – 1.31% of 2019 forecasted revenues (for sum of 3 bands: 700 MHz, 2300 MHz, 2600 MHz); excluding rural coverage discounts of ~50%. Assuming

assignment of 15 years, the suggested price component translates to MYR 1.5 – 4.4 b which accounts for 6.81 – 19.65% of the 2019 forecasted industry revenues.

- **Annual fees:** MYR 690 k per MHz per year, translating to 1.08% of 2019 forecasted revenues (for sum of 3 bands: 700 MHz, 2300 MHz, 2600 MHz)
- **Duration:** Minimum 15 years assignment period

2. REDtone's perspective and position for a sustainable, innovative Malaysian telecom industry

2.1 Setting the stage: NFCP and 5G as the enabler of future growth

Economies are becoming increasingly aware of the importance of digitalization and technological advancements as an engine for sustainable socio-economic growth. A critical pillar in enabling nations to participate in this digital era is an accessible, reliable and high-speed broadband infrastructure.

As one of the enablers for the Rancangan Malaysia Ke-11 (RMK-11) vision of developing Malaysia into a technology society, the National Fiberisation and Connectivity Plan (NFCP) was formulated to improve broadband coverage and quality as well as to reduce broadband prices through expansion of fibre networks. As a driver for future economic growth, the NFCP has 5 key intentions that translate into 7 specific targets to be achieved by 2023, as shown in Exhibit 1 below:

Exhibit 1

Overview of NFCP

The 5 NCFP intentions...

1. **Address issues that hinder** the widespread **availability** of high quality and affordable digital **connectivity**
2. **Support** the **country needs** moving forward & **harness opportunities** offered by **new services/ technologies**
3. Provide **strategic directions** for initiatives to support the **digital economy & adoption of future technology**
4. Set **foundation for 5G**, and prepare the country to **leap-frog into 5G era**
5. Provide a **clear implementation timeline** over the **next 5 years**

...translate into 7 NFCP targets

1. **Entry-level fixed broadband** package at **1% of GNI** by **2020**
2. **Gigabits availability** in selected **industrial areas** by **2020** and to all **State Capitals** by **2023**
3. **100% availability** for premises in **State Capitals** and selected **high impact areas** with min. **500 Mbps** by **2021**
4. **20% availability** for premises in **sub-urban and rural** areas with up to **500 Mbps** by **2022**
5. **Fibre network** passes **70% of schools, hospitals, libraries, police stations and post offices** by **2022**
6. Average speeds of **30 Mbps** in **98% of populated areas** by **2023**
7. Improve **mobile coverage** along **Pan Borneo Highway** upon completion

Looking into the future, Malaysia has strong aspirations to leapfrog into the new technology era through the development of a digital economy by leveraging the country's 5G capabilities. Once available, 5G technology and related services are expected to propel Malaysia into a high-tech nation and are considered a catalyst towards the Industrial Revolution 4.0 that will be able to generate additional economic and social growth. This will

have an impact on core industries - especially manufacturing, which contributed around 22% of Malaysia's GDP in the last 5 years and accounted for over 98% of Malaysian SMEs. By 2035, IHS estimates that the global 5G value chain will directly generate USD 3.5 trillion in output and will furthermore enable around USD 12.3 trillion of total global economic output.

Given the importance of 5G for the future Malaysian economy, in 2018, MCMC established the Malaysia 5G Task Force, comprising of both public and private stakeholders in order to study and recommend a holistic strategy for 5G deployment in Malaysia. The Task Force studies the business case (user trends and requirements), spectrum management and allocation, infrastructure requirements and deployments, and regulatory standards. In the long run, 5G is expected to enable Malaysia to develop and adopt a multitude of new, innovative solutions to foster socioeconomic growth, ranging from autonomous cars to precision farming.

In this context, appropriate spectrum allocation and management is a critical element to enable and foster the sustainable development of the telecommunications industry and set the foundations for future economic growth and digitalization of Malaysia.

2.2 Challenges and limitations under current status quo

Despite the aspirations for growth and development, Malaysia faces several challenges which restrict the nation from fully capturing its growth potential. However, these challenges can be overcome through sufficient industry wide collaboration and appropriate support from policymakers and regulatory bodies.

There are 3 key issues that need to be tackled under the current status quo:

1. Mitigating high investment costs & limited infrastructure sharing
2. Fostering healthy competition
3. Setting the foundations for future 5G proliferation

1. Investment costs & infrastructure sharing

Across Malaysia, there is heterogeneity regarding population densities as well as connectivity needs and usage. Urban and suburban consumers are generally more digitally aware and demand high-quality connectivity services for high data usage, while consumers in rural and remote areas are generally less digitally aware and show limited usage of broadband connectivity.

In addition, population density is significantly lower in rural and remote areas: around 13% of the Malaysian population is spread across 75% of the total land mass. Consequently, the costs to serve rural and remote areas are significantly higher compared to urban and

suburban areas. Investments required for broadband coverage in rural areas are 5-10 times higher compared to urban areas, and it is up to 20-25 times higher for remote areas.

Exhibit 2

Population density by mukim [pop. per square km]

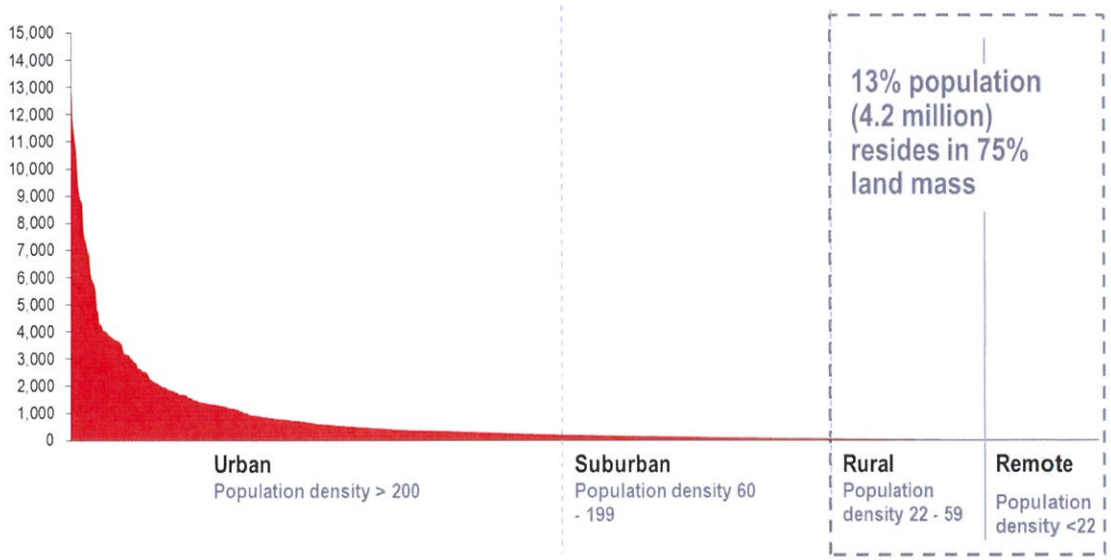
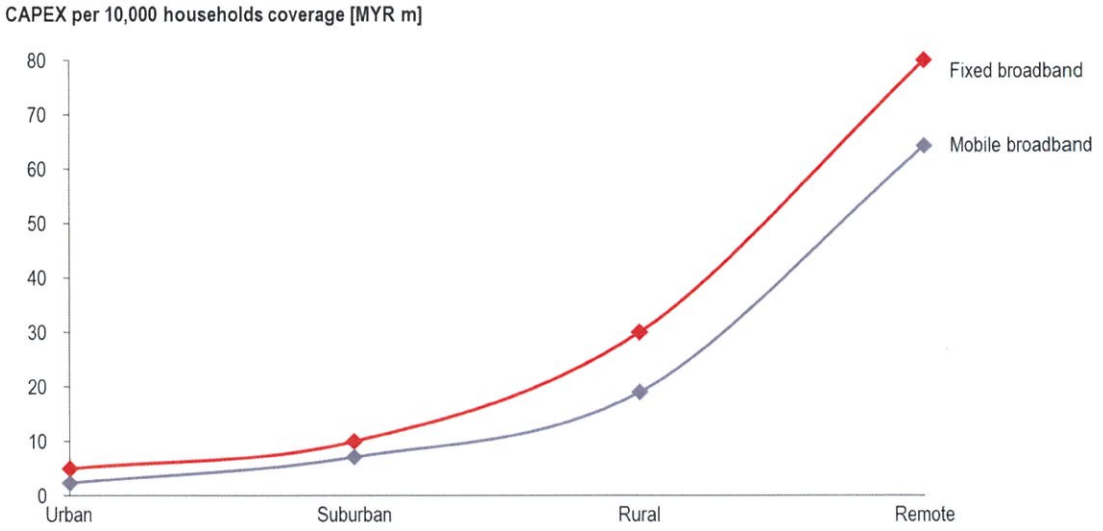


Exhibit 3

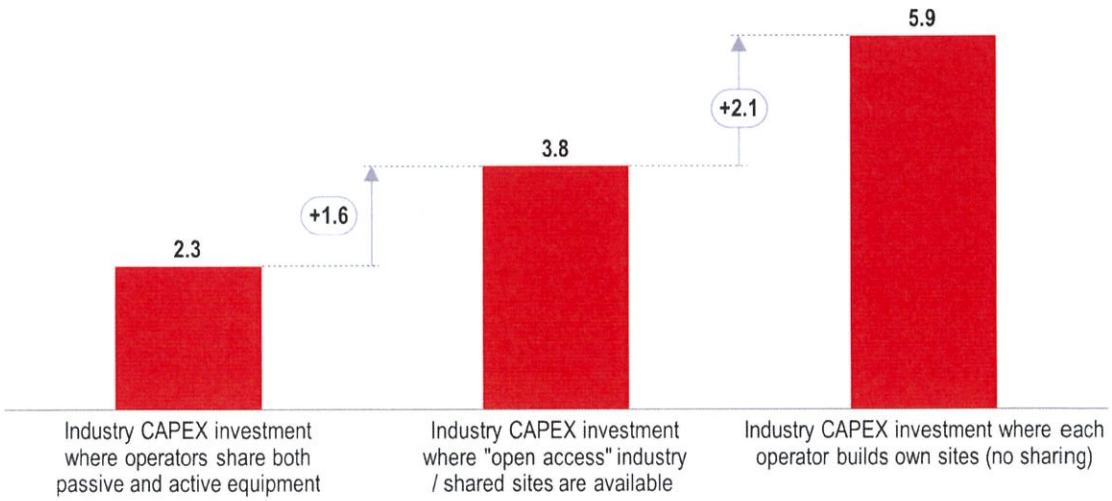
Cost of coverage comparison



Given the high costs to improve coverage in rural and remote areas, it is critical for Malaysia to seek ways to overcome this gap.

Exhibit 4

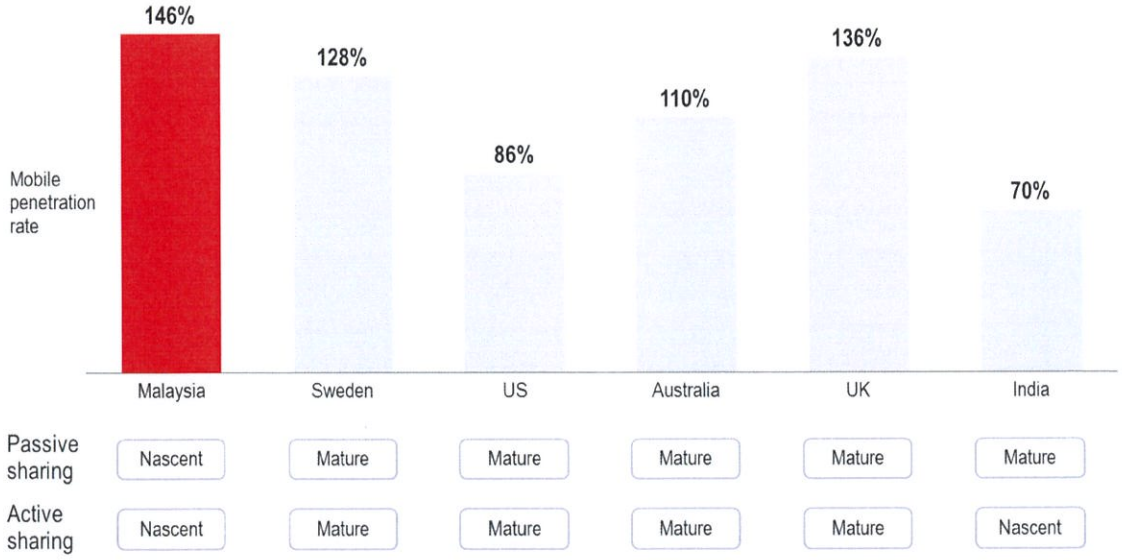
Industry mobile CAPEX investment to increase coverage from 95 to 98% [MYR bn]



Full infrastructure sharing (both passive and active equipment) is the most efficient way to increase coverage to 98%, requiring ca. MYR 2.3 b. An open access/ shared sites model places second in terms of efficiency, requiring investments of ca. MYR 3.8 b. The least efficient model is that of operators building their own sites without sharing them, which would require roughly MYR 5.9 b in industry investment.

Exhibit 5

Stages of network sharing in mature markets



However, network sharing in Malaysia is still nascent. Despite a high mobile penetration rate in Malaysia (146%), network sharing for both passive and active infrastructure is still in its infancy compared to developed markets in Europe, North-America and Asia. We identified several key factors that hinder more extensive infrastructure and network sharing in Malaysia:

- Resistance from incumbent operators to provide access to their infrastructure: Main telco players in Malaysia are reluctant to grant open and fair access to their networks in order to avoid supporting potential competitors, and in addition new players have very limited bargaining power to demand said sharing. For example, U Mobile was a pioneer for active Radio Access Network (RAN) sharing in Malaysia, but the inability to secure 4G sharing and equivalent SLAs for smaller players were key factors to discontinue this practice.
- Limited availability of "wholesale-only" access for new players: Besides networks of MNOs with retail operations, there is a dearth of options for new players to obtain access to wholesale capacity/ infrastructure.
- Inability to enforce "regulated access, services and pricing": Even though government has mandated MSA and MSAP for HSBB, TM has not yet provided any services at MSAP-defined pricing: mainly due to potential conflicts with the retail arm, TM was citing different service definitions with premium charges for higher SLAs.

Establishing a wholesale network operated by a neutral player could therefore fix the currently limiting setup and drive fair infrastructure/ network sharing.

2. Competition

A healthy competitive environment is critical for the sustainable development of the Malaysian telecommunications industry. Sufficient competition is needed to:

- Foster innovation for new technologies and solutions
- Maintain high quality of service levels
- Keep prices affordable for consumers

Currently, the Malaysian mobile market is dominated by 3 players (Maxis, Celcom and Digi), in total accounting for over 80% of subscriber market share.

New players have failed to gain traction in the market in two forms. Firstly, there are players that have received spectrum (e.g., Altel, YTL, Asiaspace, REDtone) in high frequency bands only, without allocation of spectrum in the so-called coverage bands. Hence, these players were disadvantaged regarding their roll outs due to a low network deployment cost efficiency, while at the same time being unable to obtain viable access to infrastructure of

others. Secondly, there are players without spectrum (i.e., MVNOs such as Merchantrade, Tune Talk, XOX) which have had difficulties in gaining viable access to infrastructure and capacity of others. Due to the lack of a neutral wholesaler, these players had to rely on Celcom, which resulted in a conflict of interest due to Celcom's extensive retail activities (i.e., Celcom does not have an incentive to support the retail business of its competitors).

Overall, spectrum allocation is one of the key elements that provide structural advantage. Any imbalance gives certain players (or groups of players) a competitive advantage over others. U Mobile was the only new entrant that was able to break through (with now over 10% subscriber market share). However, this breakthrough took more time than necessary – a neutral wholesaler could have accelerated the process.

Furthermore, the potential Axiata and Telenor merger (with Celcom and Digi as respective subsidiaries) has the potential to further strengthen the dominance of incumbents in the telecom industry. Celcom and Digi currently have a combined subscriber market share of ca. 55%. In addition, without reallocation of spectrum, Celcom and Digi would collectively hold 220 MHz total bandwidth in spectrum across the 900, 1800, 2100, and 2600 MHz bands. The next competitor Maxis would be trailing far behind with 115 MHz bandwidth, followed by U Mobile with 95 MHz bandwidth. A merger like this, without restructuring the spectrum allocation, has the potential to significantly reduce competition and lead to a mobile broadband oligopoly in Malaysia.

Consequently, it is important to have measures in place to have a diversified supply side. Firstly, it is crucial to support network sharing to force players to compete on their retail service levels rather than on their network coverage; ideally by assigning a neutral wholesaler to deploy and operate said network. Secondly, it is required to counter spectrum imbalance to avoid giving unfair advantage to larger players - especially to those that are currently consolidating/ merging.

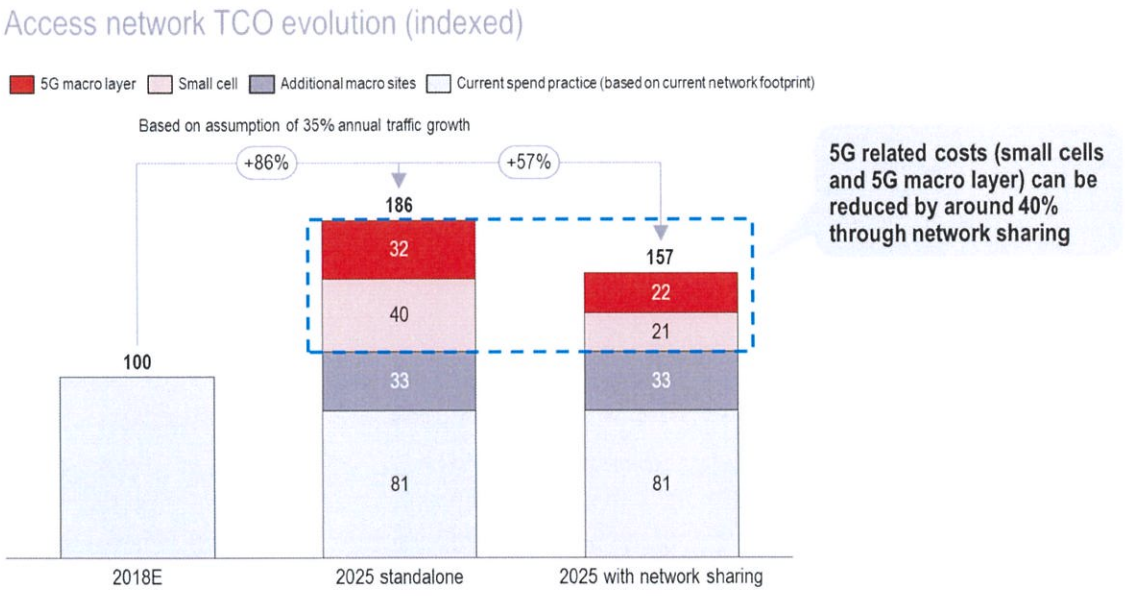
All this would help to level the playing field and to avoid an oligopolistic market setup as well as to enable niche players (e.g., players focusing on specific industry verticals) to participate in the industry.

3. 5G proliferation

As demand for data evolves in size and complexity, there will be an increased need for 5G networks. Current ways of infrastructure deployment and sharing will be strained beyond its natural limit. Therefore, the deployment of new generation 5G technologies will need large additional operational and capital expenditures in order to fulfil the following technological requirements:

1. **Denser network:** 5 to 10 times denser site deployment needed due to shorter range of millimetre waves
2. **Higher bandwidth:** Larger blocks of contiguous spectrum required per frequency band
3. **New passive infrastructure:** Investments in active and passive equipment necessary in order to implement new technologies such as beam forming and massive MIMO; for example, current towers are potentially not strong enough to carry the weight of new equipment, power supply units are likely not sufficient to cater to higher energy consumption etc.
4. **Seamless connectivity:** Introduction of new standard calls for seamless handoff needed, together with a combination of different connectivity technologies
5. **Technological flexibility:** Quickly and conveniently adjustable technical elements needed to deal with heterogeneous requirements (e.g. latencies) across industry verticals and regions

Exhibit 6



Assuming 35% annual traffic growth through standalone network deployment, there is expected to be an 86% increase in TCO, with 72% increase coming from 5G related costs. However, through network sharing, the overall increase in TCO can be reduced to 57%, with

a 40% cost reduction for 5G related costs (small cells and 5G macro layer). In addition to cost savings, network sharing will facilitate a faster route to market for telecom operators.

Moving forward, a higher degree of network sharing through a neutral wholesaler is required to improve the business case for continuous network upgrades and roll-outs and would hence set the foundations for the future of 5G in Malaysia. For this, innovative models need to be evaluated regarding their suitability for Malaysia.

2.3 Overcome limitations/ challenges with new and innovative models

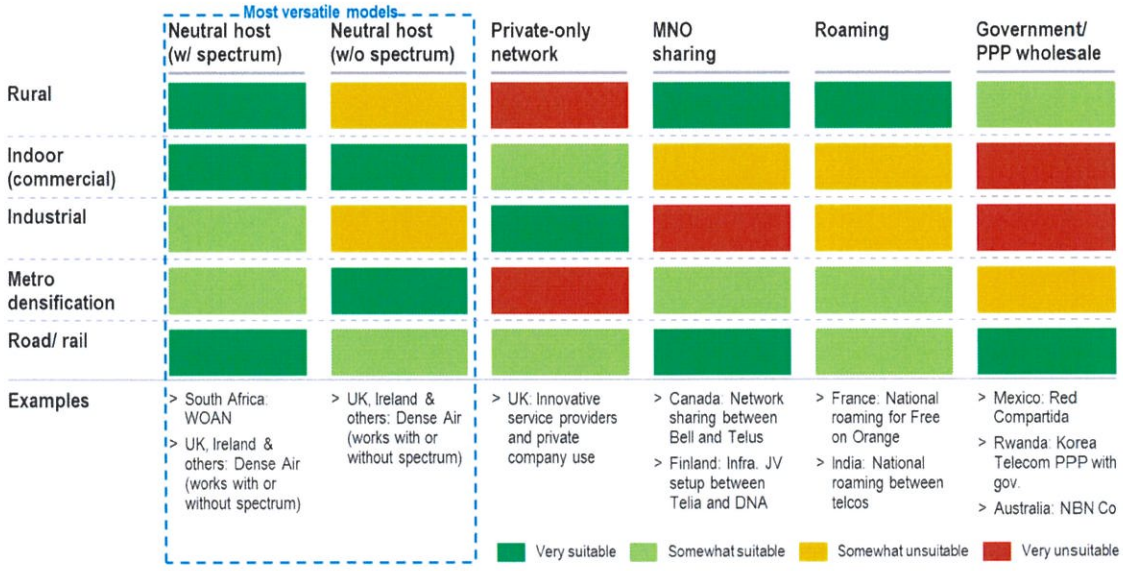
To overcome the challenges and limitations in the current Malaysian broadband market setup, new innovative models are urgently needed to drive and foster network sharing, innovation, healthy competition, and efficient utilization of resources (e.g., spectrum).

Globally, there are a multitude of different models and approaches that try to tackle similar issues that Malaysia is currently facing: high investment costs, a lack of competition and insufficient foundations for 5G. The new models mainly focus on establishing a neutral wholesaler who is separated from retail activities in order to eliminate potential conflicts of interest between the network provider and the client (i.e., telco retailers). As such, these models facilitate network sharing, in turn leading to lower investment costs, a levelled playing field for competition as well as expansion and densification of existing networks to lay the foundations for 5G.

Neutral host and other alternative models can be generally categorized into 6 groups. Each have a specific suitability rating regarding deployment in different areas, such as: across rural areas, indoors, in industrial areas, for metro densification and for roads/ rail lines.

Exhibit 7

Neutral host and other alternative models



In summary, the neutral host models (w/ or w/o spectrum) are most versatile and applicable across different areas - four case studies were selected for a deep dive and to extract key learnings that are potentially relevant for Malaysia.

Exhibit 8

Overview of key case studies

	1. Red Compartida, Mexico	2. WOAN concept, South Africa	3. Dense Air NHN, UK & others	4. KTRN, Rwanda
Model	PPP wholesale	Neutral host w/ spectrum	Neutral host w/ or w/o spectrum	PPP wholesale
Background	> High prices and low coverage due to de-facto monopoly in wireless BB to be tackled	> Low penetration/ poor affordability for BB due to limited competition and infra. duplication to be tackled	> Increased densification and extension of existing networks required for 5G deployment	> Insufficient internet backbone coverage to be overcome
Core idea/ concept	> Wireless open access network deployed and operated by neutral wholesaler consortium > Access to network awarded to highest bidding retail provider	> Concept study for nationwide wireless open access network > Deployed/ operated by neutral wholesaler > 3-phase roll-out	> Small-cell based neutral host wholesale network > Densifying and extending MNOs' existing networks to enable 5G	> Private Public Partnership (PPP) between Korea Telecom and Rwanda > 4G wholesale network deployment and operation
Spectrum used	> 700 MHz APT, i.e., 2x45MHz (Digital Dividend Mexico)	> 700 MHz (2x30), 800 MHz (2x30), 2.6 GHz (2x70), 3.5 GHz	> Preferable: 3.4 – 4.2 GHz > Potentially 26 GHz/ 64 GHz	> 800 MHz (20 MHz in use)
Infra. shared	> Main operators obliged to provide access to passive infrastructure	> Operators obliged to give full access to active/ passive infra > Add. access to Gov. infra	> None	> None (greenfield deployment)
Key success factors	> Exclusion of incumbents/ retailers > Sufficient regulatory support	> Sufficient spectrum > Sufficient infra sharing > Min. techn. prescriptions	> Sufficient HF spectrum > Sufficient regulatory support	> 4G monopoly > Sufficient spectrum > Experience/ expertise of KT

2.3.1.1 Red Compartida ("Shared Network") - Mexico (2014-today)

Background

In 2013, América Móvil had a de-facto monopoly in the Mexican wireless market, holding ca. 70% market share. This monopolistic landscape resulted not only in high retail prices, but also in a low broadband coverage due to limited investments into infrastructure upgrades and extensions.

Core idea & concept

To improve broadband access, the concept of the "Red Compartida", the "shared network", was introduced. It was conceptualized as a "Wireless Optional Wholesale Model", a network that is deployed and operated by a neutral wholesaler (i.e., by an entity/ company that does not provide any retail services), whereby the respective retailers have no obligation to access this network. However, if certain retailers wish to use this network, they can obtain access on an auction basis, i.e., the highest-bidding retailer is granted access, which ensures levelling the playing field in providing wireless retail services for both existing operators as well as potential new players. The wholesaler, in turn, is obliged to negotiate respective interconnection agreements with all providers, including for roaming, to ensure seamless connectivity.

The tender for the development and deployment of the network was won by 'ALTÁN Redes', a consortium of funds, banks and industrial - as well as strategic partners. The key

requirements for the bidding entities were to have no ties to MNOs in Mexico as well as no legacy technology in place. ALTÁN Redes is responsible for the design, deployment, operation and maintenance of the Red Compartida. To ensure a quick ramp up of the necessary infrastructure and operations, the company procured an initial funding of USD 2.3 b from various sources, including multinationals, equipment vendors, local as well as foreign banks and investors. The anticipated total network deployment cost aggregates to ca. USD 7 b.

The coverage targets were staggered, aiming at 92% of the population covered with 4G by 2024.

Spectrum used

As the Mexican Government was aware of how crucial sufficient blocks of spectrum were for Red Compartida to become a success, the Mexican regulatory authorities granted ALTÁN 20 years of network concessions for LTE, together with an option to extend this concession for another 20 years. The shared network was assigned the 2x45 MHz blocks from the 700 MHz APT band - the Mexican Digital Dividend previously cleared from analogue TV broadcasting: 703-749 MHz and 758-803 MHz.

Infrastructure shared

To ensure a quick and efficient ramp-up, the Mexican legislator enabled the regulating authority to oblige so-called preponderates (i.e., operators with more than 50% market share in respective business segments) to give access to passive infrastructure (e.g., ducts, towers etc.) on a need basis.

Key success factors

As of today, the Red Compartida is the most advanced wireless open access network (WOAN). There are two main factors that play a role in the success of the network.

1. Potential de-facto monopolies are prevented by excluding incumbents from participating in the tender and investing in the Red Compartida. This ensures that a sufficiently competitive retail market is created to fulfil its role of balancing supply and demand and consequently to bring down prices and spike up service levels for end consumers.

2. Red Compartida is enjoying adequate regulatory support without causing market distortions. The network is assigned with sufficient spectrum at minimal fees that was previously freed up by switching off analogue TV broadcasting. In a similar manner, the Mexican legislator ensured a quick and efficient ramp up as well as maximal societal benefit from operators' existing assets by giving Red Compartida the right to

access existing passive infrastructure, however granting necessary degrees of ownership to the respective MNOs to ensure future infrastructure investments in their own networks/ assets.

Status quo

The Red Compartida is constantly expanding its coverage; the next goal is to provide coverage to over 50% of the total population by 2020 (from 32% in 2018). This translates to coverage of 56 million people; 7.9 million of them in locations (e.g., towns/ villages) with less than 10,000 inhabitants.

2.3.1.2 WOAN concept – South Africa (Concept 2017)

Background

South Africa currently faces poor broadband penetration (ca. 60%) and comparatively expensive broadband costs, mainly rooted in a mobile broadband duopoly (Vodacom and MTN). The duplication of infrastructure and limited competition results in higher network costs and higher priced services, which in turn makes broadband unaffordable to large parts of the population. This has resulted in low coverage, especially in rural and remote areas of South Africa.

Core idea & concept

To tackle this problem, the South African consultancy Ellipsis suggests the establishment of a WOAN consisting of regional WOANs with regional and national points of interconnect (POIs). A nationwide network operated by a neutral wholesaler would allow new national, regional, local but also foreign players to enter the market so that increased competition will bring access to poorly served regions and drive down prices.

The concept advocates for rolling out the network in urban and rural areas to achieve nationwide LTE/ 5G coverage, and leverage on existing state-owned as well as private assets together with a build-out of more sites facilitated by subsidies. The aim is to create a wholesale offering that enables the full variety of commercial services, such as voice, streaming video, file transfer, public protection, disaster recovery etc. Technology prerequisites should be kept to a minimum to ensure maximal technology flexibility in the light of rapidly changing technological requirements.

A gradual, phased rollout is suggested for the concept, starting with sharing of existing fixed radio infrastructure before subsequently closing gaps through an infrastructure build-up supported by financial subsidies from the South African Government.

Based on the South African price levels in 2016, the deployment of the full scope-WOAN in South Africa was projected to cost ca. USD 4.7 b.

Spectrum required/ used

Ellipsis advocates the WOAN to be assigned with all unassigned high demand spectrum (HDS) in both the low bands for rural coverage and in-building penetration and higher bands for capacity. Specifically, the South African WOAN is recommended to be assigned all new low-band spectrum in the 700 MHz and 800 MHz bands (2x30 MHz respectively), but also higher frequencies such as the 2.6 GHz (2x70) band as well as the remaining spectrum in the 3.5 GHz band.

Infrastructure shared

First, the WOAN is recommended to be given access to existing state-owned assets (e.g., public buildings and infrastructure). Furthermore, the legislator should make sure that incumbent operators can be mandated to share both their active and passive infrastructure (e.g., the 11,000 existing radio sites in South Africa) through Radio Access Network (RAN) sharing, Multi-Operator Core Network (MOCN) sharing and Mobile Virtual Network Enabler (MVNE) services. The existing MNO infrastructure should be accessible on a cost increment basis.

Key success factors

The success of a WOAN in South Africa is intended to be ensured by three main pillars:

1. The network will be granted sufficient access to spectrum across low, medium and high frequency bands to achieve nationwide coverage with sufficient capacity quickly. Furthermore, respective concessions will have a wide, extendable time horizon (e.g., 20 years plus option to extend) to provide high planning security. Having more spectrum will drive down costs for the network deployment as more subscribers can be served from a relevant cell with a reasonable broadband data rate, and henceforth lowering the overall number of cells needed.
2. Minimizing technology requirements will facilitate potential changes and disruptions in the technology landscape, such as the transition from LTE to 5G as well as accommodation of and compatibility with new types of devices.
3. Regulatory support regarding access to funding and strict separation of retail and wholesale (i.e. exclusion of incumbent operators from holding a controlling stake in the network) are required to ensure commercial feasibility.

Status quo

Although the WOAN concept for South Africa has been formulated, implementation is yet to start.

2.3.1.3 Dense Air Neutral Host Network (NHN) – United Kingdom & others (Concept 2018)

Background

As of today, densification and extension of existing networks is primarily relevant for LTE/ "LTE Advanced" networks. In addition, it will also play a crucial role in the deployment of 5G networks. The emergence of 5G and 5G-enabled services, driven by new concepts such as IoT and Smart City, will require connectivity that is optimized for serving ultra-dense device populations, guaranteeing low latency and ensuring sufficient security. However, many MNOs are in a "business as usual" mode and prioritize upgrading their existing Mobile Broadband (MBB) networks rather than ramping up LTE/ 5G networks for emerging business models.

From a technological point of view, small cells would be particularly suitable for densification and extension of networks. Small cells are low-powered cellular radio access nodes that operate in licensed and unlicensed spectrum that can, if deployed into MNO weak spots, considerably increase efficiency of the respectively supported macro cell network and extend existing footprint.

Therefore, small cell networks/ network improvements can be provided to existing operators by third parties as a service, without interfering with retail (i.e., operating in a "neutral host model"). This could considerably facilitate 5G rollout through lowering costs (due to cost sharing) and shortening network deployment times, henceforth playing an enabler role in the realization of the full potential of 5G and related business models such as IoT, industrial applications, etc.

Core idea & concept

The UK-based company Dense Air Group presented a concept in 2018 that suggests a small-cell based wholesale mobile network, operated on a neutral host basis, i.e., as "Small cells as a Service" (SCaaS). The concept builds on the idea of deploying small cells in urban areas to densify and extend existing networks as well as to improve spectral efficiency. However, providing SCaaS where macro/ micro cell coverage is poor or not yet deployed requires installing the cells in the right locations and at the right density – for this, Dense Air chooses an AI/ Big Data driven tool in order to determine where exactly to deploy new small cells to ensure maximal efficiency of network improvement.

Dense Air will provide the service to operators as a neutral wholesaler (i.e., there will be no interference with the respective MNOs' retail business). MNOs will be able to evaluate Dense Air's offering on a pure cost-saving basis without having concerns about supporting retail competition.

The Dense Air concept limits the scope of network deployment to certain areas (e.g., cities, districts etc.). The networks can rather be seen as "sub-networks", i.e., localised networks/ network patches that fill the gaps of MNOs' networks in terms of density and extent/ footprint.

Spectrum required/ used

The Dense Air concept is applicable with licensed, shared and unlicensed spectrum. Using unlicensed spectrum, however, would face certain downsides regarding reliability, security and predictability.

In 2018, Dense Air acquired 2.6 GHz spectrum management rights from Blue Reach and Cayman Wireless in New Zealand. This band would support deployment of neutral host 4G and 5G small cells, in order to help MNOs and MVNOs improving their business cases for pervasive 4G and 5G networks.

Regarding additional mid-band licensed spectrum to be used, Dense Air assesses 3.4 - 4.2 GHz as preferable: this enables sufficient capacity while not interfering with the MNOs' existing MBB business. However, Dense Air also considers including higher spectrum bands into the mix, such as 26 GHz and 67 GHz.

Infrastructure shared

There is no infrastructure sharing foreseen per se. The company merely aims to deploy (their own) localized sub-networks that can then be accessed by operators of macro networks.

Key success factors

The following 6 factors are major determinants of a potential success or failure of Neutral Host Networks, particularly in the broader LTE/ 5G context:

1. Availability of handsets and IoT devices, especially for 3.4GHz - 3.8 GHz
2. Licensed spectrum allocated for NHNs to ensure affordability (e.g., 3.4 GHz)
3. Lowering of administrative barriers for deployment of small cells
4. Access to sites, backhaul and power - as well as highly automated equipment approvals

5. Framework for vertical industries to participate and potentially co-invest in a Neutral Host Network model (e.g., automotive, manufacturing)
6. Securing the support of MNOs by eliminating conflicts of interest due to retail-wholesale overlaps (i.e., neutral host must be wholesale only)

Status quo

Dense Air initially intended to operate their UK small cell subnetwork in the licensed spectrum of 2.3 GHz and 3.4 GHz (TDD), however the company was not able to win the bidding in 2018. The required 20 MHz were assigned to a competitor for the price of USD 224 m.

However, Dense Air holds relevant frequency blocks in several other countries (Ireland, Portugal, Belgium, New Zealand and Australia). In May 2019 Dense Air announced that it will have completed the first phase of a pilot/ trial 5G small cell network deployment in Dublin City (Dublin Docklands and city centre areas). Key objective is to determine potential challenges and create a process template for industry and/ or city engagements for future deployments.

2.3.1.4 Korea Telecom Rwanda Networks (KTRN) – Rwanda (2013 - today)

Background

In the early 2000s, African nations were facing the common problem of insufficient internet backbone coverage. Rwanda tackled this problem with its National Information Communication Infrastructure plan for 2005-2010. To realize this strategy, Rwanda contracted Korea Telecom (KT) to supply a network comprising 2,300 km of fibre nationwide. As a follow-up project, KT was assigned with the provision of a nationwide 4G wholesale network.

Core idea & concept

In 2013, a 25-year Public Private Partnership (PPP) was established between the Government of Rwanda and Korea Telecom. The contract comprised installing, activating and operating a nationwide LTE mobile broadband network. By regulation, no other operator but KT would be allowed to invest in 4G networks in Rwanda.

Both parties of the PPP were obliged for equity investment. The Rwandan Government equity investment of 49 percent was contributed to the PPP in the form of providing fibre optic network assets, necessary spectrum as well as a wholesale license. In turn KT provided USD 140 m to the partnership, mostly in form of infrastructure and expertise.

As an initial target, 95% of the Rwandan population was aimed to be covered by the network within three years from inauguration.

Spectrum used

The PPP is provided with the digital dividend spectrum of Rwanda: 800 MHz frequency (20 MHz bandwidth currently in use) that was freed up after phasing out analogue TV broadcasting.

Infrastructure shared

The partnership is assigned to design, deploy and operate the 4G network from scratch; there was no infrastructure sharing foreseen between existing operators and the newly formed partnership.

Key success factors

The PPP between Rwanda and Korea Telecom has three elements inherent that strongly facilitated the deployment of the 4G network.

1. **4G Monopoly:** the PPP was granted an exclusive wholesale license for deploying and operating a 4G network, hence there is no competition for this technology standard – every retailer that wants to provide 4G in retail has to purchase access from the wholesaler (i.e., the PPP).
2. **Sufficient, exclusive 4G spectrum:** in line with the 4G monopoly, the partnership is given full access to the 800 MHz band to obtain sufficient coverage and capacity and to prevent other players from using the band.
3. **Operational expertise and domestic experience:** Korea Telecom deployed their Korean 4G/ LTE network in 2012 and was actively doing business in Rwanda since 2007. Consequently, Korea Telecom has sufficient operational expertise and understanding of the Rwandan specifics to ensure a quick and efficient network deployment.

Status quo

In terms of coverage, the network deployment progressed as planned. One year after inauguration, 17 percent of the population could theoretically access the network, while the population coverage rose to about 30 percent until July 2016. In January 2018, the reported population coverage reached the initially anticipated 95 percent.

Despite the reported success in terms of coverage, 4G in Rwanda faced slower adoption than anticipated and still enjoys comparatively low popularity compared to alternatives such as 2G/ 3G. This is primarily because LTE in Rwanda is perceived as a premium product,

hence only potentially marketable by decreasing respective retail prices. Furthermore, existing MNOs have shown to prioritize utilization of their own assets, therefore pushing 3G (rather than 4G) in their retail operations.

2.3.1.5 Further insights – what else works, what does not?

In addition to the four key case studies above, there are several cases of wholesale networks/ network sharing attempts which deserve reflection in the context of Malaysian wireless broadband.

- **What else works**
  - **Peru** example: 4G deployment collaboration across different sectors (e.g., telecom, banking etc.) allows leveraging of cross-sector capabilities for effective network deployment
  - **South Korea** example: 5G deployment cost sharing between telecom companies can save costs and speed up Go-to-Market process
  - **Brunei** example: Neutral wholesaler can allow for retail operators to fully focus on retail operations to maximize service quality for end consumers
- **What doesn't work:**
  - **Russia** example: Retailer involvement in WOAN deployment and operation removes neutrality of wholesaler to support other retailers
  - **Kenya** example: Incumbent involvement in WOAN deployment and operation removes neutrality of wholesaler to support other retailers

Exhibit 9

Additional learnings from other case studies – What else works

	1. 4G deployment collaboration, Peru	2. 5G deployment cost sharing, South Korea	3. Network infra. pooling, Brunei
Background/ context	> 30% of Peruvian population lives in remote towns, where there are significant barriers for mobile operators to deploy network (e.g., mountains, jungles and rivers) > From profitability and cost perspective, there is stronger economic rationale to upgrade urban infrastructure instead of expanding rural coverage	> South Korea is already characterized by dense 3G/ 4G coverage at high speeds > Nation had aspirations to be one of the first to launch 5G commercial services	> Brunei's telecom (fixed and mobile) market consists of only 3 players: Telekom Brunei, Datastream Technology and Progresif Cellular > Network infrastructure of all 3 telcos is owned by Darussalam Assets (company with portfolio of Government linked companies)
Solution model	> Collaborative entity formed to establish WOAN, with founding members Facebook, Telefonica and two development banks > New entity plans to deploy 4G technology on 3,130 sites acquired from Telefonica and build new 1,000 towers between 2020 and 2021	> The leading telecom companies, SK, KT, LG Uplus and SK Broadband plan to share deployment costs of 5G network, to save almost USD 1 bn in costs over a decade > KT has already piloted services in Seoul metro area, most parts of over 90 other cities, 70 large shopping malls and 464 college campuses	> New entity called Unified National Networks (UNN) created to consolidate all telecom infrastructure > UNN to provide neutral wholesale access to infrastructure for all 3 telcos > UNN to be supported from technical aspects through partnership with Deutsche Telekom
Key takeaways	**Cross-industry collaboration can help bring in competencies/ capabilities from different areas, e.g., financing from banks, network assets and future deployment from telco, etc.**	**Sharing 5G network deployment costs (or potentially the infrastructure itself) can save costs and also speed up Go-to-Market process for operators**	**Presence of neutral wholesaler can allow telecom operators to fully focus on retail operations, to maximize service quality for end consumers**

Exhibit 10

Additional learnings from other case studies – What doesn't work

	1. Retailer involvement in WOAN, Russia	2. Incumbent involvement in WOAN, Kenya
Model attempted	> WOAN model attempted to be established in 2010 – Yota (a telecom operator with retail arm) was allocated 40 MHz in the 2.6 GHz band to roll out LTE services under condition of wholesale access to other mobile operators – Yota entered discussions with four other mobile operators to utilize Yota's network on a wholesale basis	> Kenyan government expressed interest in creation of of a WOAN in 2011 > In 2012, a consortium was formed between 9 companies, including local mobile operators and equipment manufacturers, to set up PP for construction of new network
Issues faced	> Operators failed to reach an agreement and went on their own path for LTE network deployment and rollout – Yota had limited incentives to offer attractive wholesale terms to its retail competitors (given the fact that Yota also had a retail arm)	> In end of 2013, largest incumbent Safaricom exited the consortium, citing reasons of: – Concerns with successful establishment of WOAN facilitating new retail competitors – Slow progress towards establishment of new wholesale operator – Frequency band ultimately appointed (2,600 MHz) differed from the one originally agreed (800 MHz)
Key takeaways	**Retail-wholesale separation is a must; retailer cannot be involved in deployment and operation of wholesale network due to limited incentives in enabling competitors' retail businesses**	**Incumbents should be restricted from participation in deployment of a WOAN as they have incentives to keep out new retail entrants using the network**

2.3.2 Lessons learned for a tailored Malaysian wholesale network

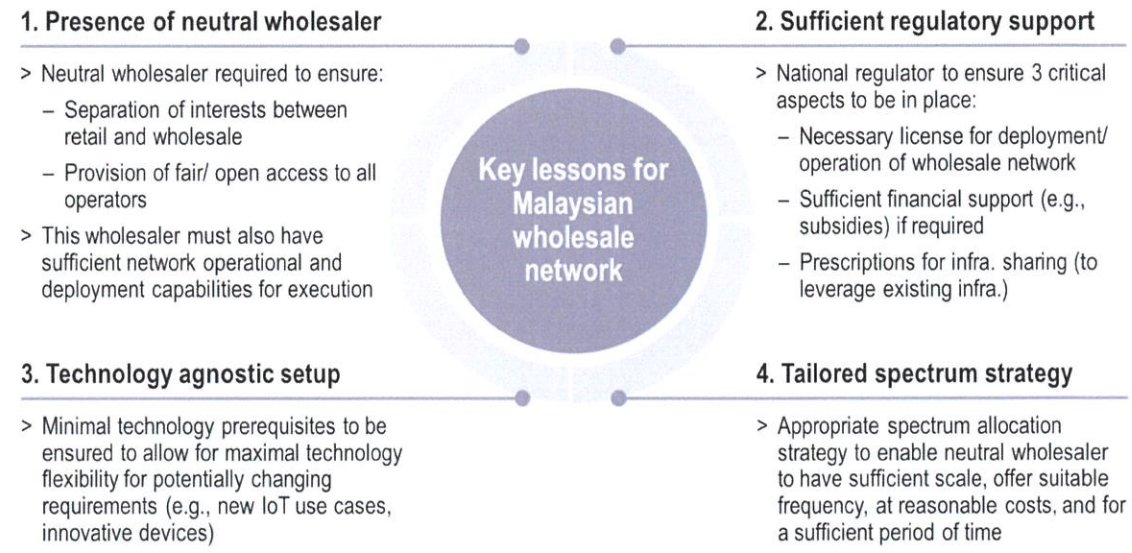
Malaysia's broadband market is at a crossroad. With progressing global technological developments and certain disadvantages that the country's internet landscape is currently facing, Malaysian regulators need to make a bold decision on how to tackle the challenges ahead.

From our point of view, a WOAN can strongly mitigate the existing problems of low coverage as well as lacking affordability and hence enable Malaysia to leapfrog into the 5G era. In this context, Malaysia is in the exceptionally advantageous situation of being able to learn from countries that were successful and from those that were not.

In summary, based on the case studies, we have identified four pillars of a successful WOAN that need to be in place:

1. Presence of a neutral wholesaler with network deployment and operational capabilities
2. Sufficient regulatory support
3. Technology agnostic setup
4. Comprehensive and WOAN-tailored spectrum strategy

Exhibit 11



2.3.2.1 Presence of a neutral wholesaler with network operational and deployment capabilities

To successfully run a WOAN, it is necessary to have a neutral wholesaler. A neutral wholesaler is needed to:

- Avoid potential conflict of interest between retail and wholesale
- Level the playing field by providing fair and open access to all mobile operators

As the failed approaches in Russia and Kenya have proven, it is an imperative for the network setup to be deployed and operated by a so-called neutral wholesaler. This means that the operating entity cannot have any affiliations with retail service provisions. It does not mean, however, that the network must be operated by a single company. It could also be a consortium of companies and organisations that have relevant capabilities or resources that synergistically complement each other, as the examples of the Mexican and Peruvian networks show. However, retailers and incumbents need to be strictly excluded from the setup to rule out any distortions and conflicting interests from the beginning. Similarly, these entities should also be excluded from investing into the network. However, if raising capital could become an issue and investments from retailers/ incumbents therefore required, it should be at least ensured that these players will be prevented from achieving a controlling stake.

Furthermore, the wholesaler must have sufficient experience and expertise in installing, activating and running networks to ensure a quick ramp up, illustrated by the role that Korea Telecom took in Rwanda (i.e., leveraging on the experiences from previous, comparable network deployment projects conducted in Korea).

2.3.2.2 Sufficient regulatory support

Establishing a shared network is a crucial task on a national scale. As successful examples have shown, this must be reflected in regulatory (and respectively legislative) support that the shared network enjoys. Particularly, the national regulator must ensure 3 crucial aspects to be in place.

Firstly, the respective operator needs to have the necessary licensing granted – most importantly, a wholesale license, like the one awarded to the Rwandan PPP. Although this is subject to pre-existing regulations, the regulator needs to award exclusive rights to deploy and operate this specific type of network.

Secondly, the regulator needs to grant considerable and sufficient financial support to the entity deploying the respective network. The most feasible solution would be a system of subsidies, as pointed out in the concept for the South African WOAN. The key is to ensure that a sufficient coverage can be reached, even if installing particular parts of the infrastructure is not commercially or financially attractive per se (e.g., in areas with insufficient population density). Other means of financial support or a combination thereof can be considered, such as financial guarantees, low-/no interest loans, involvement of national development funds, setup of frameworks to enable investments from vertical industries (e.g., automotive for IoT applications) etc.

Thirdly, the regulator must facilitate a quick ramp up by setting the necessary prescriptions regarding infrastructure sharing. A nationwide network on a geographical scale of Malaysia cannot be built from scratch – leveraging on existing infrastructure is a key prerequisite from both a financial but also logistical perspective. The government need to ensure that the new network can access active and passive infrastructure that is already in place. This means that existing MNOs must be mandated/ obliged to provide access to their infrastructure if necessary. In a similar way, the access to government infrastructure must be legally enabled as well and respective approvals given on a fast-track basis.

2.3.2.3 Technology agnostic setup

Due to the dynamically changing and hardly predictable development of use cases in the 5G universe, a set up with minimal technology prerequisites is crucial. It needs to be ensured that the network enjoys as well as provides maximal technological flexibility for potentially changing requirements (e.g., new IoT use cases, innovative devices etc.). This includes that the companies that will set up the network should have minimal legacy networks (ideally no legacy network at all).

2.3.2.4 Comprehensive and WOAN-tailored spectrum strategy

An appropriate spectrum allocation strategy is a critical pillar in determining the success of Malaysia's WOAN. It is a key enabler for the neutral wholesaler to have sufficient scale, offer suitable frequencies at reasonable costs and for a sufficient period.

In particular, the important aspects are (to be discussed further in the following sub-chapter):

1. Sufficient geographical coverage of spectrum
2. Sufficient spectrum allocation of bands for both rural coverage and capacity
3. Potential to expand frequency to higher bands in the future for 5G proliferation
4. Affordability of the relevant frequency bands to ensure commercial feasibility
5. Allocation of respective spectrum for a sufficient period

2.4 Spectrum as a critical enabler of new models

There are concepts where a wholesale network could provide its services to retailers without having licensed spectrum assigned, namely geographically constrained networks (e.g., local, small-cell based networks), which could theoretically provide their services by using unlicensed spectrum or alternatively the respective clients' spectrum (i.e., the MNO's/ retailer's spectrum). However, this approach would have very limited feasibility and socioeconomic impact due to the low number of potential use-cases and its small geographical reach. For Malaysia, this limited patchwork approach will be far from sufficient to overcome the challenges at hand and leapfrog Malaysia into the new broadband era.

In order to unlock and realize the potential benefits of a WOAN for Malaysia, the right spectrum strategy is an absolute imperative. Moreover, the degree of benefit-reaping is strongly correlated to how well the spectrum strategy serves the network. Therefore, it is in the interest of the Malaysian society and economy to have a comprehensive and suitable spectrum strategy to enable these new models.

The future wireless network wholesaler does not only need sufficient amounts of spectrum – it needs the right amounts of spectrum, in the right frequency bands, at the right conditions. We identified five characteristics of a spectrum strategy that need to be in place in order to enable the new network models for Malaysia:

1. Sufficient geographical coverage of spectrum
2. Sufficient spectrum allocation of bands for both rural coverage and capacity
3. Potential to expand frequency to higher bands in the future for 5G proliferation
4. Affordability of the relevant frequency bands to ensure commercial feasibility
5. Allocation of respective spectrum for a sufficient period

2.4.1 Sufficient geographical coverage of spectrum

Due to the geographical shape of Malaysia, territorial sharing of frequency bands is currently a common way to achieve compromises between MNOs - for example, Asiaspace and REDtone share a block in the 2300 MHz band between West and East Malaysia.

This practice of geographical frequency sharing must be avoided in the case of spectrum allocation for a wholesale network. As the main goals of the shared network are to increase coverage and affordability through cost sharing as well as potentially cross subsidizing not profitable cells with profitable ones. Artificially narrowing down the territorial extent of the network will diminish its effectivity and efficiency. The open access network will only stand true to its aim of serving the entire rakyat and bringing broadband to the whole population if it

will spread over all Malaysian territories – Peninsular Malaysia, Sabah, and Sarawak. Therefore, the spectrum allocation needs to be nationwide.

2.4.2 Sufficient spectrum allocation of bands for both rural coverage and capacity

In its core, the wholesale network aims at providing both high coverage as well as high capacity rates. High coverage rates are required to live up to the NFCP targets of bringing affordable broadband to the entire rakyat including rural and less accessible areas. High capacities are required to maximize socio-economic benefits, including enablement of new, innovative offerings and use cases while setting up the foundation for the future Malaysian 5G network. Henceforth, these ambitious targets require ambitious spectrum allocations.

For the coverage, it should be ensured through allocation of a sufficiently large block in the Digital Dividend spectrum after the Analogue Switch Off in Malaysia in the 3rd Quarter of 2019. An allocation of the maximum possible blocks proved to be ideal in similar concepts (e.g., Red Compartida). Therefore, an allocation of the maximum possible blocks of 2x20 MHz of the Malaysian Digital Dividend would serve as a strong enabler for nationwide broadband coverage.

Similarly, to ensure high capacities, a wholesale network would need sufficient blocks in the mid- and high frequency bands as well. In the concept for a South African WOAN, an allocation of a 2x70 MHz in the 2600 MHz band was proposed.

2.4.3 Potential to expand frequency to higher bands in the future for 5G proliferation

In order to satisfy the target of the network being a key enabler of the future Malaysian 5G network, it needs to be ensured that the allocated frequencies can be expanded if need arises, e.g., when triggered by technological developments or innovations. Most importantly, it needs to be ensured that the wholesale network will be awarded a preferential position in the allocation of future 5G frequencies in the spectrum of 3.4 - 4.2 GHz as suggested by Dense Air.

Similarly, however within a longer time horizon, the right pre-cautions need to be taken to ensure a favourable positioning of the shared network in much higher frequency bands such as 26 GHz and 64 GHz, as these are intended to enable the most disruptive use cases.

2.4.4 Affordability of the relevant frequency bands to ensure commercial feasibility

Successful deployment and operation of a wholesale network requires commercial feasibility. Apart from financial support from the Government/ regulator, this key success factor must be reflected in the spectrum strategy as well, namely by ensuring affordability of the assigned frequency blocks. Attempts from Dense Air to deploy a small cell network in the

UK failed due to the company's insufficient financial resources to obtain the necessary spectrum in a conventional spectrum bidding.

Consequently, the Malaysian shared network has to ensure that the deploying and operating entity can obtain and use the required spectrum blocks at either a no fee basis, as is the suggested approach in the South African WOAN concept, or at minimal fees, as is the case for the Red Compartida: in Mexico, the operator got assigned a 20-year spectrum LTE license at an annual fee of USD 0.02/MHz-population, which can be considered extraordinarily low.

2.4.5 Allocation of respective spectrum for a sufficient period

Deployment and operation of the shared network requires considerable resources, while the deployer faces severe uncertainties of commercial and economic nature. Therefore, it is in the interest of the country's regulatory authority to reduce uncertainties and business risks where possible. With regards to the spectrum strategy, a sufficiently long-time horizon of the frequency allocation needs to be ensured.

The South African WOAN concept suggests a 20-year concession period within which the network model including the spectrum rights will not be substantially changed, following the example of the Mexican Red Compartida.

Furthermore, an option that is given to the operator to extend the given concession period for an additional 20 years would further increase commercial feasibility and reduce legal and regulatory uncertainties in the light of a potential multi-decade 5G network evolution.

Given these international examples, we suggest a minimum period of 15 years for spectrum allocation (with an option to extend).

2.5 REDtone as the "natural player" to support industry development

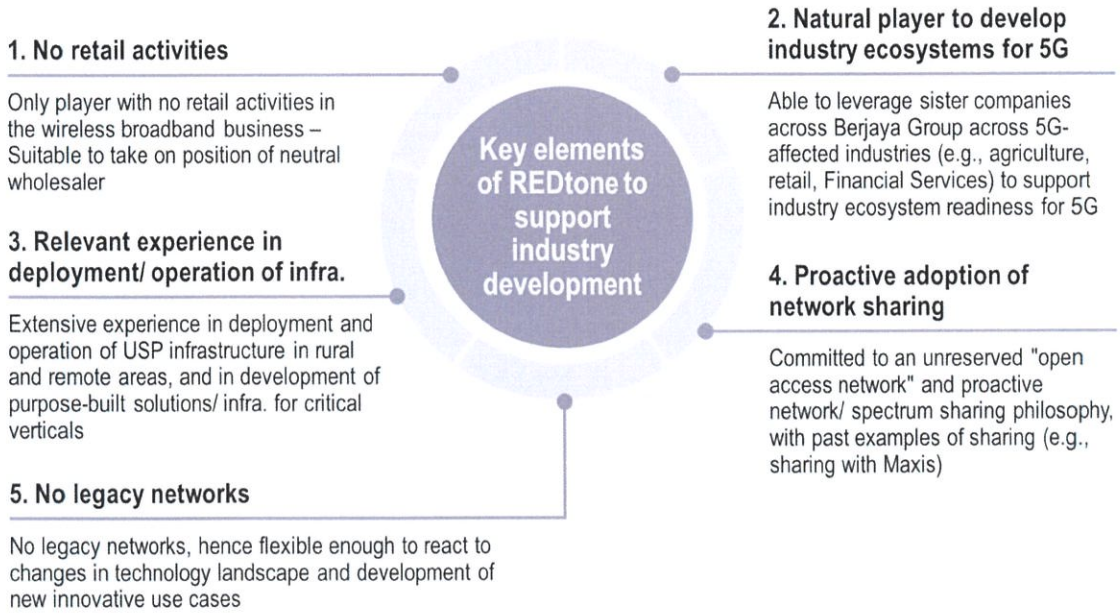
Given the challenges that the Malaysian broadband market is currently facing and taking into consideration that these challenges will intensify further at a rapid speed, decisive action must be taken now. Specifically, Malaysia has to tackle three major issues: enable 5G services, expand broadband access and increase broadband affordability across the country.

These challenges cannot be solved by Malaysian regulators or legislators alone, but they require a strong and experienced partner that will enable the country to move into the next broadband generation. The key levers that can be used to achieve these objectives are open access networks/ neutral host networks respectively.

Be it bringing affordable, high-speed wireless internet to every Malaysian citizen by deploying and operating a nationwide WOAN or be it driving socio-economic benefits by enabling 5G services through filling existing white spots via a neutral host network, REDtone is the natural choice for a mobile market enabler that will assist Malaysia on its journey into the new digital age – mainly for 5 reasons:

1. No retail activities in the relevant business segments
2. Natural player to develop a 5G ecosystem for other industries
3. Vast, relevant experience in deployment and operation of comparable infrastructure
4. Proactive adoption of network sharing with a lean investment approach,
5. No legacy networks

Exhibit 12



1. REDtone is the only player in Malaysia that could potentially take the position of a **neutral wholesaler** in the context of a wholesale network, as REDtone has **no retail activities** in the wireless broadband business segment.

   To ensure success of an open access wholesale network, deployment and operation must be carried out by an entity that has no ties to the retail side (i.e. a "neutral player"). Examples of failed wholesale network deployment attempts illustrate how crucial a strict separation between the wholesale operator and retail service providers is. Not adhering to this principle causes high risk of failure for a wholesale network, as the example of Russia shows.

   In Russia, the WOAN initiative failed as carriers were not able to reach an agreement and went their own way on LTE, after reportedly insisting on choosing their own vendors. The main issue was that the government allowed the appointed wholesale network deployer/ operator to act as both a wholesaler and retailer, thereby limiting the company's incentives to offer wholesale terms attractive to other operators with which it would compete at the retail level.

   REDtone can be considered as a niche player that conducts business primarily in enterprise connectivity and is taking the leading role in provision of infrastructure for Universal Service Provision (USP). Hence, REDtone is perceived as a neutral 3rd party by other relevant industry players and known for not positioning itself as a competitor in the "traditional bread and butter" consumer mobile market segment. This positioning enables REDtone to cooperate with multiple other Malaysian MNOs in the areas of network sharing, as illustrated by the high willingness of Malaysian MNOs, such as Maxis and U Mobile, to enter and execute sharing agreements (e.g., the industry-first spectrum sharing agreement).

2. REDtone is the **natural player to support 5G ecosystem development in other industry verticals**, leveraging its sister companies across Berjaya Group, one of the most diversified conglomerates in Malaysia. Industries under Berjaya Group include agriculture, retail, food & beverage, property, hospitality, financial services, automotive, environmental services and education.

   Application of 5G technology goes well beyond achieving faster mobile internet connectivity. 5G will also transform industries due to the technology's lower latencies and faster data transfer speeds. Industries to be transformed overlap with those covered by Berjaya Group, such as:

   - Agriculture: 5G can power IoT technology to optimize agriculture processes such as water management, fertigation, livestock safety and crop monitoring

- Retail: 5G can enable new retail experiences such as virtual reality (VR) dressing rooms
- Financial services: 5G can enable remote tellers and increased security/ speed for consumer transactions

Therefore, REDtone is in a unique position to support industry ecosystem readiness for 5G. REDtone can leverage Berjaya's presence in the core industries with high applicability of 5G to deploy and test 5G solutions.

3. REDtone possesses **extensive experience in deployment and operation of USP infrastructure** in rural and remote areas as well as in development of purpose-built solutions/ infrastructure for critical verticals. REDtone enjoys wide acknowledgement as Malaysia's large-scale data, broadband and Wi-Fi infrastructure builder – REDtone has a strong track record in the following areas:

    a. Planning, designing, deploying, and maintaining networks

    b. Successful deployment and operations of USP infrastructure as the largest single implementer of USP sites

    c. Development of purpose-built networks and solutions for enterprises

    Furthermore, REDtone successfully deployed some of the major, large-scale Government sector projects in Malaysia, most notably:

    a. Wi-Fi Komuniti (WK)

    b. Time-3 (T3)

    c. Pusat Internet 1Malaysia (PI1M)

    d. Multiple other USP initiatives

    MCMC has awarded REDtone with an "Appreciation Award" for its contributions and support during the Sarawak Recovery Project. REDtone has no record of CMA compliance breach.

4. REDtone is a **proactive adopter of network and infrastructure sharing**, with a lean network investment approach

    REDtone commits to an "open access network" philosophy and to pro-active sharing of its network and spectrum assets. REDtone would be a reliable and willing partner to others, both in providing open access to its network as a neutral party and in developing workable sharing agreements covering passive and active sharing with others.

Prime examples for REDtone's support of network sharing and for its commitment to be a main driver thereof are on the one hand its current engagement with Maxis in infrastructure sharing for the 2600 MHz spectrum and on the other hand its Network Sharing and Alliance Agreement (NSAA) with Maxis which allows sharing the LTE infrastructure that is being built. REDtone and Maxis are currently sharing physical facilities, network capacities, network capabilities, network facilities, and spectrum in order to allow both parties to optimize network cost and provide best LTE experience to the joint subscriber bases.

Moving forward, REDtone is also exploring possible synergies and business models for infrastructure sharing with U Mobile. As U Mobile is currently active in deploying their own LTE infrastructure, there will be an opportunity for REDtone to work together to develop an infrastructure sharing model that is beneficial to both companies.

5. REDtone has **no legacy networks** and is therefore the perfect candidate to drive coverage and 5G, while at the same time being flexible enough to react to changes in the technology landscape and adopt new developments to enable future innovative use cases.

   Minimizing technology requirements will facilitate potential changes and disruptions in the technology landscape, such as the transition from LTE to 5G, accommodation of and compatibility with new types of devices as well as enablement of new business models and verticals, such as Smart City/ IoT applications, especially as IoT applications are approaching market readiness in a rapid tempo, such as REDtone's CitiSense Smart City IoT solution.

3. REDtone's response to questions under Spectrum Allocation PI

#	Responses/ Comments
0.	**REDtone's overall philosophy and principles** In order to capture the full growth potential for Malaysia associated with wireless, nation-wide broadband, the country needs a shared network operated by a neutral wholesaler. This would enable the country to overcome the challenges that are currently stalling progress: high investment costs, a lack of competition and a lack of foundations for 5G. REDtone positions as the natural choice for this role, given that it fulfils all the requirements necessary to successfully deploy and operate a shared network: 1. No retail activities in relevant business segments 2. Natural player to develop 5G ecosystem for other industries 3. Vast, relevant experience in deployment and operation of comparable infrastructure 4. Proactive adoption of network sharing 5. No legacy networks Consequently, REDtone suggests the MCMC to consider the following key factors for the new wireless broadband frequency allocation to effectively and efficiently achieve NFCP targets and optimally serve Malaysia through a wholesale network. - **Spectrum assignment mechanism:** spectrum should be assigned through competitive tenders ("beauty contests") with selection criteria to support coverage and capacity related targets of the NFCP. - **Spectrum assignment timeline:** the relevant frequencies should all be awarded in a concurrent timeline to support the bidder's product portfolio planning, and subsequently maximize commercial value of the spectrum. The below timeline is proposed: 1. **Q4 2019**: commence assignment process 2. **Q3 2020**: complete assignment process 3. **Q4 2020**: spectrum release/ assignment by way of SA - **Spectrum block assignment:** sufficient blocks should be made available for the neutral wholesaler for optimal coverage and capacity o 700 MHz: Minimum 2x20 MHz for neutral wholesaler and remaining spectrum

	distributed to other players in order to counter low-band imbalance o 2300 MHz: 20 MHz for neutral wholesaler and 10 to 20 MHz for each other assignee o 2600 MHz: Minimum 20 MHz or 2x10 MHz for neutral wholesaler as well as for each other assignee - **Spectrum utilisation of 2600 MHz band:** interference between FDD and TDD to be mitigated through 4 main measures: o Guard bands o Frequency filters o Power restrictions o Special site engineering - **Spectrum pricing:** affordable spectrum price should be provided to ensure commercial feasibility and consumer benefits while being assigned for a sufficient period. For all bands should apply: o **Price component:** MYR 290 – 840 k per MHz (per year for the duration), translating to total cost of 0.45 – 1.31% of 2019 forecasted industry revenues based on WCIS data (for sum of 3 bands: 700 MHz, 2300 MHz, 2600 MHz); excluding rural coverage discounts of ~50%. Assuming assignment of 15 years, the suggested price component translates to total cost of MYR 1.5 – 4.4 b which accounts for 6.81 – 19.65% of the 2019 forecasted industry revenues o **Annual fees:** MYR 690 k per MHz per year, translating to 1.08% of 2019 forecasted industry revenues based on WCIS data (for sum of 3 bands: 700 MHz, 2300 MHz, 2600 MHz) o **Duration:** Minimum 15 years assignment period
1.	**Question 1** ***MCMC would like to seek views on the proposed allocation plan for the 700 MHz band, in particular on:*** ***i. Award mechanism*** REDtone shares MCMC's view on the preferable award mechanism, i.e. on awarding the blocks of the 700 MHz band in a competitive tender ("beauty contest") rather than in a conventional bidding auction. Prominent examples of spectrum auctions that reached extraordinarily high prices

emphasize the risk of spectrum auctions: In 2000, a 3G auction in Germany raised more than EUR 50 b – a price that was welcomed by the German budget, but ruinous for the bidders, as it forced some players out of the market and others to merge. Subsequently, financial resources of the operators were too constrained to ensure a quick infrastructure ramp up, ultimately limiting benefits for end consumers and German society.

Therefore, we advocate a competitive tender that has decision criteria in line with the NFCP targets relevant for wireless connectivity. As we see driving coverage as one of the key purposes of the 700 MHz band, we suggest conducting an assignment mechanism that favours players who can in particular ensure achievement of the following, coverage-related targets:

1. 100% availability for premises in State Capitals and selected high impact areas with minimum speed of 500 Mbps by 2021
2. 20% availability for premises in sub-urban and rural areas with up to 500 Mbps by 2022
3. Average speeds of 30 Mbps in 98% of populated areas by 2023
4. Improve mobile coverage along Pan Borneo Highway upon completion

Ensuring achievement of these overarching targets will also, in consequence, maximize overall Quality of Service (QOS) for the end consumer.

ii. Timeline for assignment

Spectrum assignment timeline plays a critical role in the product portfolio planning of operators. Overall product planning is dependent on the timing of availability of spectrum bands. From a commercial perspective, it is optimal to have as many frequency bands as possible assigned at the same time. This enables the operators to develop a maximum range of products while ensuring attractive prices and high quality of service.

Therefore, REDtone advocates for a streamlined frequency assignment timeline, synchronized throughout all three frequency bands while simultaneously satisfying superordinate timelines that figure as "natural" guidelines, e.g. the Analogue Switch Off process for the 700 MHz band.

Consequently, we suggest synchronizing the timelines for the 700 MHz, 2300 MHz and 2600 MHz frequency bands so that all frequencies will be ultimately assigned and ready to use for mobile broadband by the 4th quarter of 2020.

	In particular, we suggest the following 700 MHz awarding timeline: 1. **Q4 2019:** commence assignment process 2. **Q3 2020:** complete assignment process 3. **Q4 2020:** finish ASO and release spectrum for mobile broadband usage
2.	**Question 2** ***MCMC would like to seek views on the optimum spectrum block per operator for assignment of the 700 MHz band*** International examples of shared wholesale networks have in common that sufficient spectrum of the 700 MHz bands is dedicated to them in order to ensure nationwide broadband coverage (i.e., Mexico, Rwanda, South Africa concept). In general, LTE coverage and performance of a wholesale network are optimized by allocating the maximum channel bandwidth set by the 3GPP, which is 2x20 MHz. As such we suggest 2x20 MHz to be reserved for a neutral wholesaler. Although some open access networks have even higher channel bandwidths assigned to them (e.g. 2x45 MHz), this is mainly due to monopoly positioning of the wholesaler – spectrum beyond the maximal 2x20 MHz remains unused. The remaining spectrum should be assigned to other players in order to address a low-band imbalance. Channel bandwidths of 2x5 MHz or 2x10 MHz are advisable to ensure a variety of players providing LTE in Malaysia.
3.	**Question 3** ***MCMC would like to seek views on the proposed allocation plan for the 2300 MHz band, in particular on:*** ***i. Award mechanism*** REDtone shares the MCMC's view to employ a competitive tender rather than an auction for the 2300 MHz band. From our point of view, the argument presented in Question 1 applies for the 2300 MHz band as well. With regards to the geographical scope of the assignment, REDtone agrees to the suggestion of the MCMC to allocate the spectrum nationwide. Especially in the context of a potential shared network, refraining from continuation of the current geographical frequency sharing is a pre-requisite of a wholesale network. Nationwide frequency assignment would support coverage increases and affordability through cost sharing as well as potentially through cross subsidizing not

	profitable cells/ areas with profitable ones. Similar to the 700 MHz competitive tender, we advocate for decision criteria in line with the NFCP targets relevant for wireless connectivity. From our point of view, ensuring high capacity is one of the key purposes of the 2300 MHz band and we therefore suggest use an assignment mechanism that favours players who can in particular ensure achievement of the following, capacity-related NFCP targets: 1. 100% availability for premises in State Capitals and selected high impact areas with minimum speed of 500 Mbps by 2021 2. 20% availability for premises in sub-urban and rural areas with up to 500 Mbps by 2022 3. Average speeds of 30 Mbps in 98% of populated areas by 2023 Similar to the 700 MHz band, ensuring achievement of these overarching targets will also maximize overall Quality of Service (QOS) for the end consumer as a natural consequence. ***ii. Timeline for assignment*** As explained in Question 1, we suggest a synchronized timeline for the 700 MHz, 2300 MHz and 2600 MHz frequency bands so that all frequencies will be ultimately assigned and ready to use for mobile broadband by the 4th quarter of 2020. In particular, we suggest the following 2300 MHz awarding timeline: 1. **Q4 2019:** commence assignment process 2. **Q3 2020:** complete assignment process 3. **Q4 2020:** assign by way of SA
4.	**Question 4** ***MCMC would like to seek views on the optimum spectrum block per operator for assignment of the 2300 MHz band.*** REDtone agrees to the MCMC's proposition of vacating and reassigning the 2300 MHz band nationwide. We agree to the MCMC's point of view that assigning channel sizes of 10 or 20 MHz would ensure more flexibility in the band plan. For the neutral wholesale network, however, we see a strong necessity to assign a 20 MHz block. This bandwidth would ensure optimum performance of a shared LTE network and enable provision of innovative WTTx solutions.

5.	**Question 5** ***MCMC would like to seek views on the proposed allocation plan for the 2600 MHz band, in particular on:*** ***i. Award mechanism*** In general, REDtone follows the MCMC's argumentation for assigning channel sizes of at least 20 MHz or 2x10 MHz to ensure optimum LTE deployment and operation, especially given the key purpose of the 2600 MHz band as capacity provision in areas with dense population. This assignment would also reflect the de-facto utilization as of today and thus not disrupt services for the end customers. However, REDtone strongly disagrees with the suggested assignment of blocks to particular operators based on current utilization. Firstly, a limitation of the total number of operators that hold spectrum in the 2600 MHz band is advisable in order to avoid interferences: the currently outlined assignment to 6 operators is sub-optimal as it would require large efforts for coordination. Secondly, the needs of a potential shared wholesale network have to be considered. The 2600 MHz band in Malaysia is the key to provide sufficient capacity (specially to provide foundations for 5G) and to achieve the capacity-related NFCP targets. Therefore, we strongly advocate allocating 20 MHz or 2x10 MHz to a potential neutral wholesaler. ***ii. Timeline for assignment*** As explained in Question 1, we suggest a synchronized timeline for the 700 MHz, 2300 MHz and 2600 MHz frequency bands so that all frequencies will be ultimately assigned and ready to use for mobile broadband by the 4th quarter of 2020. In particular, we suggest the following 2600 MHz awarding timeline: 1. **Q4 2019:** commence assignment process 2. **Q3 2020:** complete assignment process 3. **Q4 2020:** assign by way of SA
6.	**Question 6** ***MCMC seeks suggestions on approaches to mitigate interference between FDD and TDD blocks to facilitate efficient spectrum utilisation in the 2600 MHz band.*** Use of both FDD and TDD bands for 2600 MHz causes inefficient spectrum use, mainly for two reasons.

- 2x5 MHz remain unused as guard bands that separate the TDD and FDD bands
- FDD bands need to be paired in order to ensure simultaneous exchange of information between uplink and downlink – which, due to the natural dominance of downlink traffic, results in sub-optimal utilisation of the spectrum

Despite these disadvantages however, REDtone agrees to the MCMC's suggestion to keep the current band plan for 2600 MHz in Malaysia, i.e. to keep Band 7 separate from Band 38, for the following reasons:

- Equipment legacy: Switch to full TDD would potentially diminish the value of currently used equipment and might lead to service interruptions for consumers
- Greater coverage/ lower costs: FDD deployments provide greater coverage than TDD due to mobile devices transmitting on a continuous basis in an FDD system vs transmitting on a periodical basis in a TDD system. Consequently, FDD systems need fewer base stations than TDD systems (up to 65% less sites to achieve the same coverage as TDD) and therefore have a significant cost advantage compared to TDD (CAPEX and OPEX considered similar for both duplexing forms)

However, as the 2600 MHz spectrum allocation will take place nationwide and to several operators, the resulting co-location deployment (rather than a TDD/ FDD heterogeneous network deployment) leads to close proximity of antennas and creates the risk of cross-link interference (i.e., downlink transmission of one base station might interfere with the uplink reception of the co-located base station).

Given increasing demand for quality of service, and consequently spectrum, ensuring coexistence of both bands is an imperative for Malaysian wireless broadband. To mitigate the risk of interference and naturally lower utilization, we propose the following four solutions: (1) guard band separation, (2) front-end filters, (3) power restriction ("restricted channel"), and (4) special site engineering.

These solutions should not be considered in isolation but in conjunction with each other. For example, guard band separation should be considered in combination with front-end filters or power restriction. Also, a restricted channel of 25 dBm EIRP in combination with front-end filtering could already provide sufficient interference avoidance. Alternatively, instead of using a front-end filter, the base station could be located indoors or out of sight from other potentially interfered base stations. For the

co-location case, vertical antenna separation in addition to front-end filters (applied to both base stations co-located) could potentially already result in sufficiently low interference.

1. **Guard band separation**

   Cross-link interference diminishes with rising separation between FDD and TDD spectrum. Hence, a guardband of 2x5 – 2x10 MHz between the FDD and TDD bands would greatly reduce risk of spurious emission of signal to base stations.

2. **Front-end filter**

   A front-end filter improves the selectivity of the receiver by a certain number of dB (e.g., 50 dB filter). It helps to prevent "unwanted" signals (i.e. interfering signal from adjacent frequency bands). However, as a downside, it also increases the respective network's complexity.

3. **Power restriction ("restricted channel")**

   The concept of power restriction is based on restricting the maximum power of certain channels to achieve coexistence properties. For example, a TDD channel adjacent to an FDD uplink channel has its base station power restricted to 25 dBm per 5 MHz EIRP, so that it mimics the interference caused by FDD terminals to the FDD base stations.

4. **Special site engineering (for co-location)**

   For the scenario of co-locating equipment at one site, site-engineering solutions should be considered. Specific engineering guidelines can reduce interference by increasing coupling loss - for example, separating antennas in the vertical direction of 3 meters increases the coupling loss by 30-35 dB.

7. **Question 7**

MCMC would like to seek views on the appropriate range (per MHz) for SA fees (price component and annual fee component) and the rationale for the proposed fees, for the following spectrum bands:

i) 700 MHz

ii) 2300 MHz

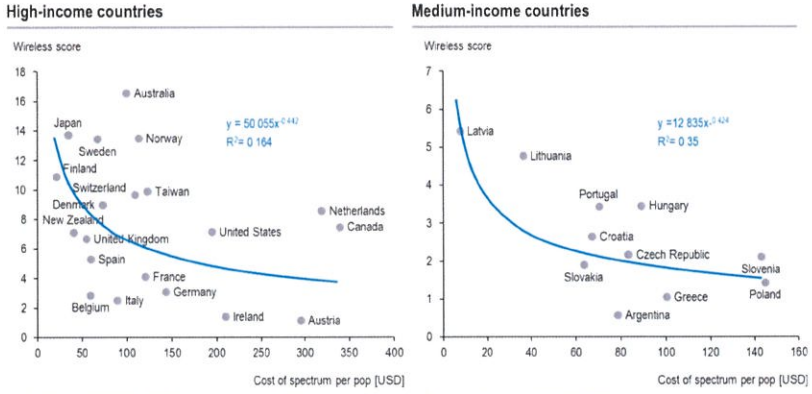
iii) 2600 MHz

As guiding principles, REDtone believes that the following 5 pricing rules should be followed regardless of the respective spectrum bands:

1. **Affordable/ low spectrum pricing**: There is a strong correlation with quality of mobile broadband services as well as retail prices:

Exhibit 13

Wireless score and spectrum cost relationship analysis

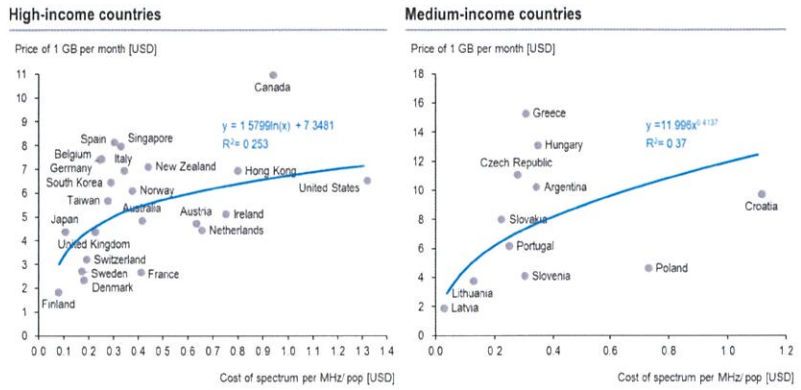


Note: Wireless score measures quality and uptake of data services, covering 3G/ 4G coverage, 4G subscriber penetration and average speed

A GSMA study ("Effective spectrum pricing: Supporting better quality and more affordable mobile services") has shown strong negative correlation between spectrum pricing and quality of mobile broadband services. The study supports the common hypothesis that high spectrum cost will hinder investments which in turn will result in poor network quality. Although spectrum cost is not the only factor that affects the total investment cost (e.g., deployment cost would be higher in difficult terrain/ countries with multiple islands), the study shows that spectrum cost is in fact an important factor to consider.

Exhibit 14

Retail price and spectrum cost relationship analysis



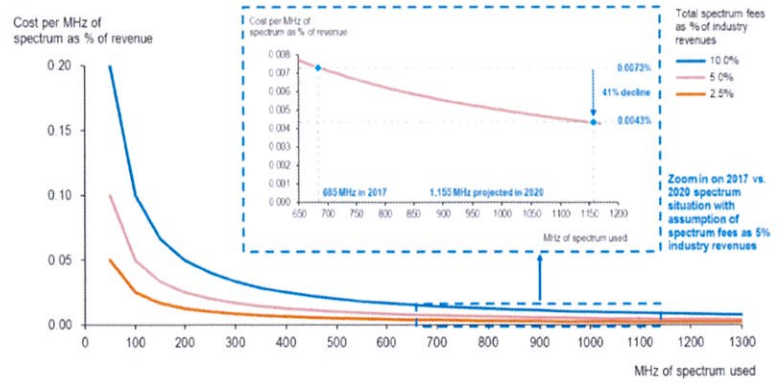
Similarly, a strong correlation can be observed between spectrum costs and retail prices for the end user.

Hence, REDtone believes that a policy of overall low spectrum pricing (i.e., overall spectrum cost per year for the duration should not exceed 5% of the industry) should be adopted in Malaysia in order to incentivise efficient use of spectrum, promote investment in network deployment, ensure widespread communication services and ensure that retail prices are affordable. With more spectrum expected to be needed, price per MHz needs to be relatively lower than historical auctions/ assignments.

2. **Discount to account for higher spectrum needs in the future**: More spectrum bands will be required to deploy 5G and future technology

Exhibit 15

Analysis on decline on spectrum price per MHz vs. increase in mobile spectrum usage



To enable telco players to continuously invest in their network, a discount to account for higher spectrum needs is required. If the spectrum cost is assumed to be constant (e.g., at 2.5/ 5/ 10% of revenue), the cost per MHz of spectrum needs to decrease by 41% to accommodate higher spectrum demand in the future (e.g., on average the telco industry would require 685 MHz in 2017 and 1,155 MHz in 2020).

3. **Discount for rural and remote coverage obligations**: There is a strong correlation with high network coverage

   Three examples have been selected to showcase a discount on spectrum prices for spectrum lot with coverage obligations:

   a) Norway example: an 800 MHz auction (2013) had reserve prices which were 60% lower for those with specific coverage obligations compared to those without coverage obligations. Norway ranks 3rd world-wide in terms of 4G availability (92%).
   b) UK example: an 800 MHz auction (2013) had reserve prices which were 44% lower for those with specific coverage obligations compared to those without coverage obligations. Regarding 4G, UK places within the global top 15, with 87% 4G availability.
   c) Sweden example: an 800 MHz auction (2011) used a different approach: operators were allowed to count the investments in rural infrastructure as part of their bid – this created an implicit discount. Sweden, similarly to the UK, places within the global top 15, with 87% 4G availability.

   It is important to note that regulators would typically only apply the coverage obligation for selected spectrum lots/ licenses to avoid duplication of networks and improve the business case for rural/ remote coverage.

   In the Malaysian context, REDtone believes that a similar discount scheme for spectrum with coverage obligations is needed in order to support the business case for rural/ remote coverage and to ensure that the country is able to achieve the NFCP targets.

4. **Long term assignment**: 15 years as minimum assignment period is recommended

   REDtone believes there are 2 main reasons to provide long term assignment for the spectrum bands discussed in this document:

- Recommendation from GSMA study ("Effective spectrum pricing: Supporting better quality and more affordable mobile services") to adopt 20 to 25 years period of assignment, as this ensures commercially viable network development and hence supports economic growth as well as provides high quality of service to the customers
- Best practice cases in other jurisdictions offer at least 15 year assignment periods: (1) Singapore, who initially intended to assign its 700 and 900 MHz band for a period of 12 to 16 years, has opted for a 15 years assignment period after a public consultation, (2) Minimum 15 years assignment in Thailand for its 2012 and 2015 auctions on 900, 1800, 2100 MHz spectrum bands, (3) 20 years assignment period for Norway's auction on the 800 MHz band in 2013, (4) Sweden opted for a 25 years assignment for its 800 MHz auction in 2011, which is considered one of longest mobile license terms

Considering the 2 main reasons mentioned above, REDtone believes that within the Malaysian context, the spectrum assignment period should be at least 15 years.

5. **No premium for low (700 MHz) band**: Similar pricing level across 700, 2300, and 2600 MHz band

   We have observed similar pricing (per MHz per capita) applied to the 700 MHz band (2015 – inflation has been taken into account) and to the 2100 MHz band in Germany (2019). The ratio between the 700 MHz band price to the 2100 MHz price is 0.97 – the 2100 MHz pricing is only marginally higher compared to the 700 MHz. Hence, REDtone believes that no premium pricing for the 700 MHz band should be applied.

- **Price Component (for 700, 2300, 2600 MHz)**

  To propose an appropriate range for the price component, REDtone applies the following rationale/ methodology:

  a) Benchmark of fair/ at market value spectrum price range (floor and ceiling)

  b) Discount to account for higher spectrum needs in the future

  c) Discount for rural and remote coverage obligations

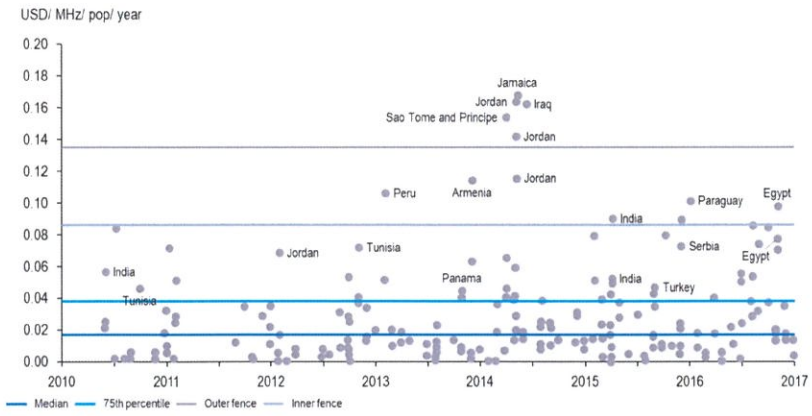
a) Benchmark of fair/ at market value spectrum price range (floor and ceiling)

REDtone derived the floor price based on recent historical price structures used for the 2100 MHz assignment in 2018. As previously mentioned, we believe that the price per MHz should be kept at least at a similar level as the lowest price level in previous auctions/ assignments. Based on this assignment, the effective price component translates to MYR 0.5 m/ MHz per year of duration and serves as the floor for the price component.

For the case that the regulator would have to charge a higher upfront fee, we believe that the price level should not exceed the final spectrum price in developing countries – considering a discount from the median price to a level with higher probability of successful case (i.e., positive correlation of providing cheaper price per MHz to mobile network quality).

Exhibit 16

GSMA developing countries price component benchmarks (IMF PPP)



4 main data points have been gathered to calculate the median of the final spectrum price in developing countries:

1) Median price ~ USD 0.017 / MHz/ pop/ year (2010-2017, GSMA)
2) 32.58 m population (Q2 2019, DOSM)
3) Exchange rate of 4.07 MYR/ USD (2019E, Oxford economics)
4) 37% discount from median price (2017, Nera)

Calculating the above data points, we arrive at MYR 1.4 m/ MHz/ year as the upper ceiling for the price component.

b) Discount to account for higher spectrum needs in the future

As explained in the guiding principle #2, a discount rate of 41% is suggested to be applied in order to account for higher spectrum needs in the future. Applying the discount rate gives us a price range of MYR 290 – 840 k/ MHz/ year.

c) Discount for rural and remote coverage obligations

As elaborated in guiding principle #3, it can be considered as a best practice approach to apply a discount for spectrum lots with coverage obligation.

Assuming a ~50% discount rate for the rural coverage obligation is applied in the 700 MHz band (taking Norway and UK as benchmark examples with 60% and 44% discounts respectively), the resulting price range is MYR 145 – 420 k/ MHz/ year.

REDtone believes the fair/ at market value price for the price component per year of duration should lay between MYR 290 – 840 k/ MHz/ year. This price range would translate into a cost of 0.45 – 1.31% for the forecasted industry revenue 2019 based on WCIS data (for spectrum within the scope of this document, not taking into account discounted prices for spectrum with coverage obligations).

Assuming a 15-year assignment period for the bands, the price component would be MYR 4.4 – 12.6 m/ MHz. The suggested price component translates to total costs of MYR 1.5 – 4.4 b which accounts for 6.81 – 19.65% of the forecasted industry revenues 2019.

- **Annual fee component (for 700, 2300, 2600 MHz)**

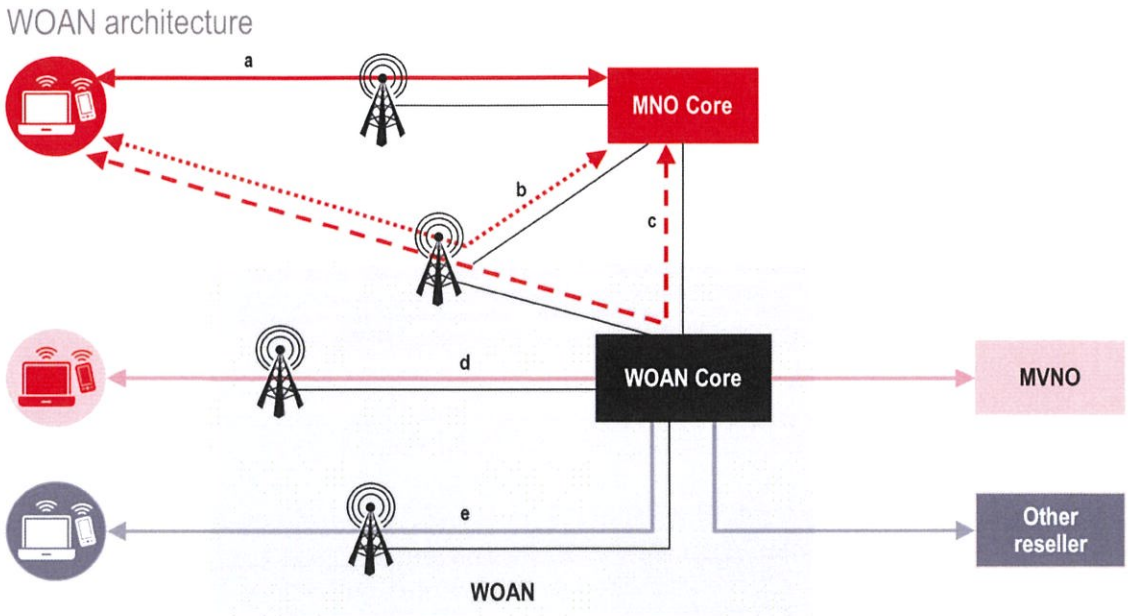
It is important to note that, based on the GSMA recommendation "Best practice in mobile spectrum licensing", the annual fee should be set at a level that covers spectrum-management cost. If a regulator decides or is required to impose higher annual fees, it will potentially deteriorate commercial feasibility of the network deployment. Hence, REDtone believes that it is fair to apply a historical "annual fee component" from the 2016 spectrum assignment which results in MYR 1.2 m/ MHz. Applying similar discounts to consider higher spectrum needs in the future results in MYR 690 k/ MHz, translating to 1.08% of the forecasted industry revenues 2019 based on WCIS data (for spectrum within the scope of this document).

REDtone believes that by implementing the pricing strategy outlined above, the

	regulator will (1) incentivise efficient use of the spectrum (2) promote investments into network deployment (3) ensure widespread communication services and (4) enable affordable retail prices. The total price range per year of duration (for both price component and annual fees) translates to 1.53 – 2.39% of the forecasted industry revenues 2019 based on WCIS data (for spectrum within the scope of this document).

4. Appendix: WOAN models

Exhibit 17



There are 3 models for WOAN:

1. RAN sharing (MOCN style, shared RAN only)
2. MOCN (MOCN style, shared RAN + regional/ national transport)
3. MVNE (shared RAN + transport + shared core + interconnect/ roaming)

1. RAN sharing

Shared RAN is illustrated by path b, where an incumbent MNO purchases from the WOAN a share of the WOAN's available capacity. There is no transportation provided by the WOAN; MNO uses their own transport (path b). A standards-based capacity/ RAN sharing arrangement, which is enabled through capacity slicing model, allows for multiple independent operators to control radio resources as though it were their own RAN. WOAN capacity, which can be made available on the basis of a static or dynamic allocation of radio resources, allows the MNO to manage its traffic (e.g., bearers, number of connections, QoS, etc.).

2. MOCN (multi-operator core network)

The second case, "MOCN" adds transport to the operator's own core from the shared RAN, per path c. The MNO subscriber, with the appropriate multi-band device (support for MNO spectrum and WOAN spectrum ands) would benefit from coverage offered through the MNO service footprint (path a) and the WOAN footprint (b and/ or c).

3. MVNE (mobile virtual network enabler)

The third case, "MVNE" involves an MVNO which relies entirely on the WOAN infrastructure, including RAN, transport, and core resources, for end-to-end services. As an MVNE and as a new greenfield infrastructure provider, the WOAN is also expected to ensure roaming capabilities onto other MNO networks.