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IAFI[1]

PROPOSAL FOR FURTHER UPDATES TO THE WORKING DOCUMENT TOWARDS A DRAFT NEW APT REPORT ON TECHNICAL AND REGULATORY ASPECTS OF RAN/SPECTRUM SHARING IN IMT AMONG MOBILE NETWORK OPERATORS IN ASIA PACIFIC REGION

1. Introduction and background:

This working document is for the development of a new APT Report on technical and regulatory aspects of RAN/spectrum sharing in IMT among mobile network operators in the Asia-Pacific region. The initial work was started at AWG-31, where a contribution from Viet Nam (INP-86) prompted the Study Group on IMT Technology (SMT-IMT TECH) to develop a working document (TMP-50) for further study. The document progressed during AWG-32 with additional inputs from China and Viet Nam. Viet Nam proposed further updates, while China's contribution suggested adding a new sub-section (5.1) on 5G network sharing policy in China.

During AWG-33, three further contributions were received from GSMA, Viet Nam, and Korea (INP-45, INP-90 & INP-65). Following detailed deliberations on these inputs, the working document was comprehensively updated (TMP-08). Due to a lack of new contributions for the last AWG meeting (AWG-34), the work plan was amended to finalize the study and the report during AWG-35.

2. Proposal:

Through this contribution, IAFI proposes some further updates to the working document to improve its clarity and logical flow. The proposed changes are provided in track-change mode.

Furthermore, it is recommended that the term “RAN/Spectrum sharing” and “RAN and Spectrum sharing” need to be harmonized throughout the Report before it is finalized.

[1] IAFI (ITU-APT Foundation of India) is an Affiliate Member of APT

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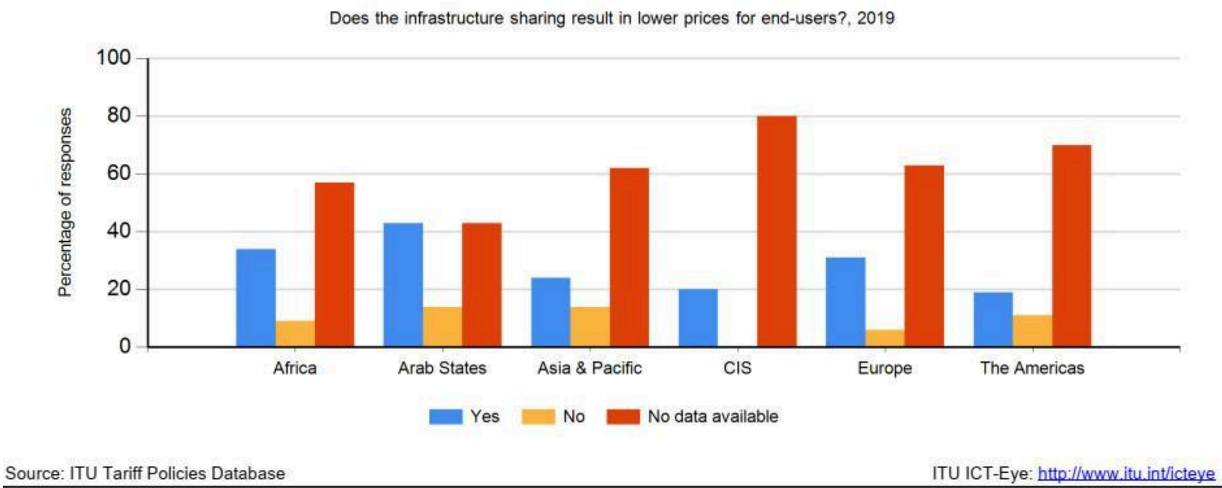
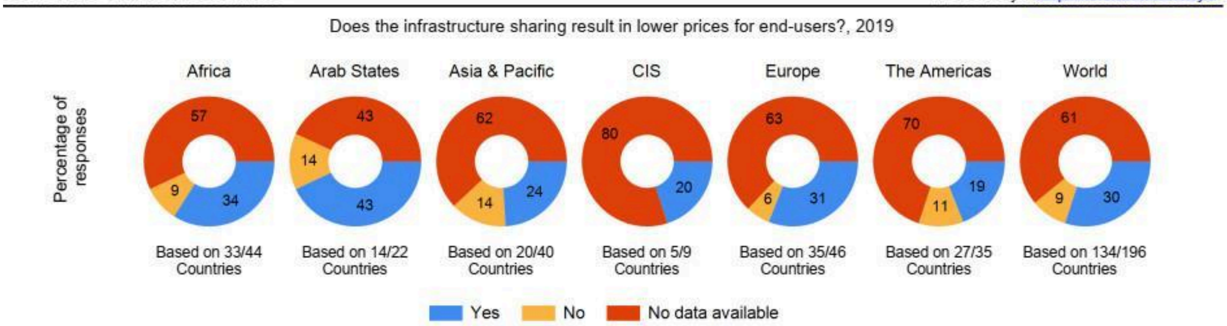
WORKING DOCUMENT TOWARDS A DRAFT NEW APT REPORT ON TECHNICAL AND REGULATORY ASPECTS OF RAN/SPECTRUM SHARING IN IMT AMONG MOBILE NETWORK OPERATORS IN ASIA PACIFIC REGION

1. Introduction

Infrastructure sharing in telecommunications refers to using the infrastructure or resource by more than one operator through an arrangement. It is a process that offers many options. Sharing decisions range from sites, towers to another network infrastructure such as RAN and spectrum. According to the literature, there is no standard for infrastructure sharing, but it is considered a practical and promising solution for reducing for deployment of mobile networks.costs. The main advantage of infrastructure sharing is the cost benefits. But it is also driven by the migration to new technologies and the deployment of mobile broadband.

According to the results of an ITU's survey about infrastructure sharing, most countries find that infrastructure sharing really has an impact on the price of end-users:





Infrastructure sharing models are divided into two broad categories: active and passive sharing. Passive infrastructure sharing means sharing of physical sites, buildings, shelters, towers/masts, power supply and battery backup, etc. Active infrastructure sharing involves sharing the active electronic network elements, the intelligence in the network – embodied in base stations and other equipment for mobile networks and access node switches and management systems for fibre networks.

Spectrum sharing is of utmost importance to ensure optimal utilization of the available spectrum. The basic objective of spectrum sharing is to enhance spectral efficiency by combining/pooling the spectrum holding of two licensees. The gain in spectral efficiency increases non-linearly with the quantum of spectrum.

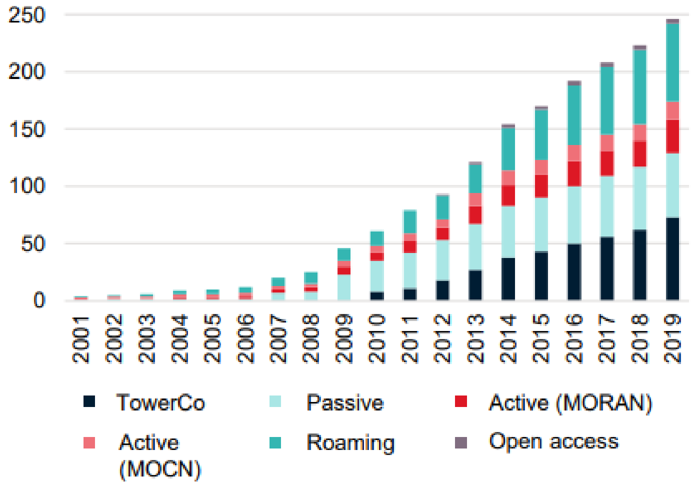
Appropriate regulatory framework that promotes infrastructure-based competition, in addition to service-based competition, needs to be devised that also promotes innovation. Infrastructure sharing, however, may also lead to reduced competition and therefore appropriate country-specific policies in the National interest needs to be devised. Depending on the market, policies and regulations should encourage and facilitate the highest level of infrastructure sharing possible. Governments and regulators need to be proactive in establishing enabling frameworks for infrastructure sharing to boost the growth of the telecom sector.

2. Scope

The purpose of this report is to provide technical and regulatory consideration of RAN/spectrum sharing in IMT among Mobile Network Operators in Asia Pacific region.

3. Global trend of RAN/spectrum sharing

Network and spectrum sharing arrangements are generally voluntary in nature and increasingly common. Several well-known mobile industry trends have driven a steady rise in the development of network sharing deals among operators over the past 20 years. These include the rising importance of mobile broadband coverage and adoption, the increasing costs of network deployment, and the focus on sustainability concerns and creation of green, energy-efficient networks.



Global trend of Network sharing: announced deals by type of sharing (cumulative).
Source: Coleago, GSMA Intelligence

4. Techniques for RAN/spectrum sharing in IMT among MNOs

[Edito’s note: General RAN/spectrum sharing techniques in IMT among MNOs

-MORAN

-MOCN/Spectrum sharing and Shared Access Licence

- Roaming

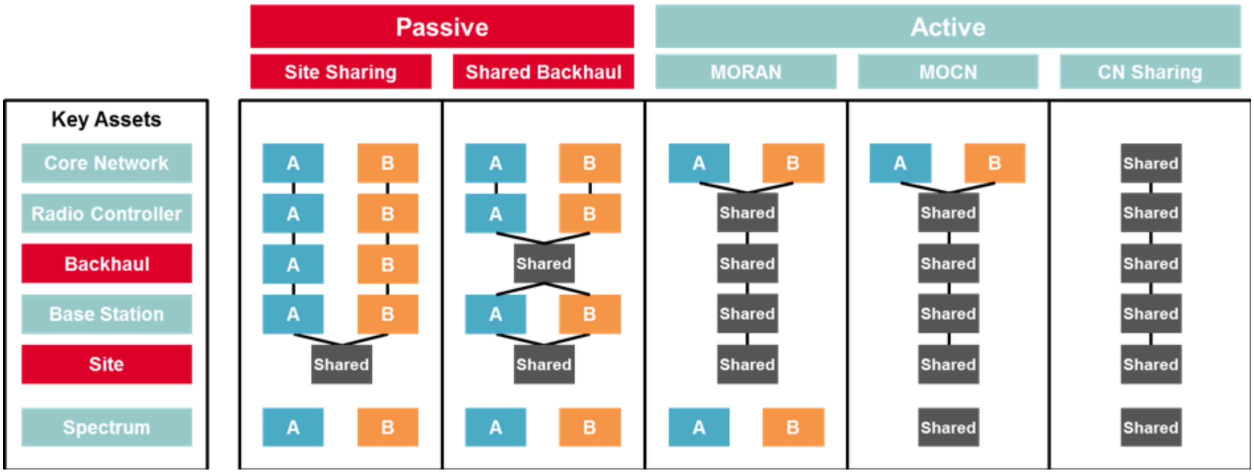
- Virtual Network Operators

….]

Mobile communication network sharing refers to the sharing of infrastructure or communication equipment among multiple operators. The infrastructure includes towers, buildings, and equipment rooms used for deploying base stations, whilst the communication equipment includes RAN, transport network, and CN equipment.

Active infrastructure sharing is sharing of electronic infrastructure of the network including radio access network (consists of antennas/transceivers, base station, backhaul networks and controllers) and core network (servers and core network functionalities). This form can be further classified into:

4.1.MORAN and MOCN



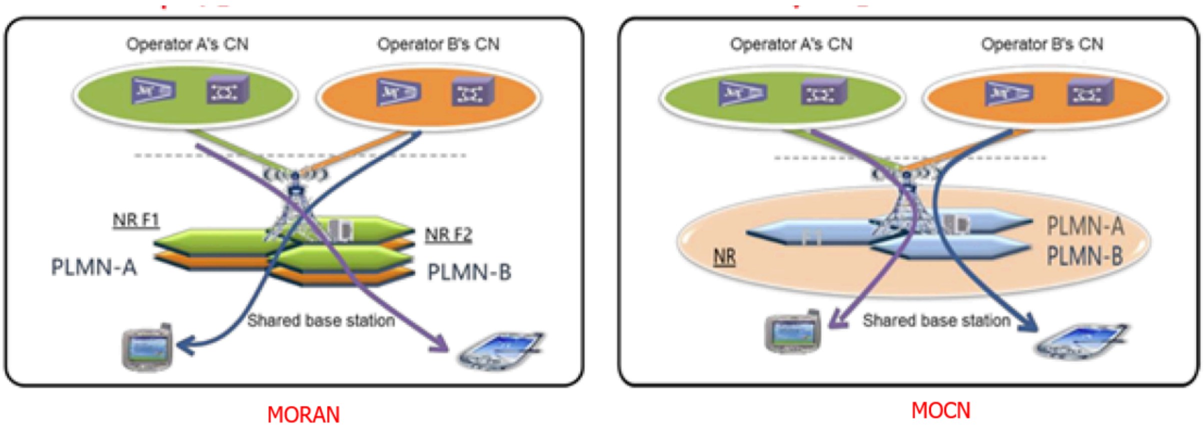
Network Resource Sharing Models (Source: GSMA)

- **MORAN** (Multi-Operator Radio Access Network), where radio access networks are shared and dedicated spectrum is used by each sharing operator. With MORAN everything in the RAN (antenna, tower, site, power) except the radio carriers is shared between two or more operators.

- **MOCN** (Multi-Operator Core Network), where radio access networks and spectrum are shared, and core network sharing, where servers and core network functionalities are shared. With MOCN, two or more core networks share the same RAN meaning the carriers are shared. The existing core networks could be kept separate. MOCN is the most resource efficient solution as it gives the mobile operators the opportunity to pool their respective spectrum allocations, resulting in improved trunking efficiency. For UMTS, MOCN has been supported since 3GPP Release-6. For LTE since Release-8 and Support for GERAN was added as part of Release-11.

As in the case of site sharing, MORAN and MOCN can be implemented per sites and enables strategic differentiation. However, operation of network equipment needs to be shared (or at least issues must be shared with participants) and therefore increases the complexity of sharing relative to site sharing. The cost-saving potential is greater than site sharing. Core network enables greater cost-saving potential but is complicated to operate and to maintain strategic differentiation.

The Difference between MOCN and MORAN



Comparison Between MORAN and MOCN (Source: GSMA)

In MORAN, multiple independent carriers are configured and the PLMN IDs of operators are broadcasted on the carriers. Baseband Units (BBUs) are shared, and connected to Remote Radio Units (RRUs) and Active Antenna Units (AAUs) provided by the same vendor of BBUs. Each carrier is independently configured and managed. The RAN infrastructure provides logically and physically separated cell resources and core network connectivity on a per-operator basis.

The MORAN solution features simple RAN infrastructure sharing and O&M and is applicable to scenarios where operators need to maintain service and deployment independence in shared networks.

In MOCN, one or more carriers are configured for frequency sharing. Operators share their cells – physically and logically; in each cell, multiple Public Land Mobile Networks (PLMNs) are broadcasted. Sharing radio resources among participating operators is performed according to service level agreements.

Parameterization of cell-level features needs to be negotiated among all operators. UEs accessing shared cells select one of the broadcast PLMNs and communicate this selection to the gNodeB, which connects UEs to their (selected) core network. MOCN is used when operator A has a spectrum license, and the operator does not have a spectrum license but would like to use the spectrum of operator A.

We can say that MORAN is about a more independent network and MOCN is about the unified way of network implementation and sharing.

4.2.Roaming

Roaming is a method of infrastructure sharing. National/domestic roaming refers to roaming agreements in the national/domestic context. For example, national roaming, a subscriber from Vodafone Spain may roam into Telefonica's network when entering into non-overlapping coverage provided by Telefonica and vice versa. This type of sharing enables cost saving comparable to or greater than core network sharing. However, national roaming comes with complexity (e.g., when to choose home network over visited network has given signal strength) and there can be regulatory issues where regulators may be concerned with reduced competition.

Sharing form	Pros	Cons
Passive infrastructure sharing	• Significant CAPEX/OPEX savings • Lowered risk of site acquisition • Full differentiation and complete control of spectrum • Control over sites to be shared • No/little regulatory obstacles • Easy migration to other sharing forms. • Environmental benefits	• Availability of free space in existing sites (if existing sites are to be shared) • Similar cell planning may be required
MORAN, MOCN	• Limited marginal CAPEX savings compared to Site Sharing • Substantial marginal OPEX savings compared to passive infrastructure sharing • Control over base stations to be shared • Reduction of network footprint by sharing operators	• Regulatory approval necessary • Complexity of operation • Requires long term commitment between operators • Difficult to exit from sharing agreement
Core Network sharing	• Further CAPEX/OPEX savings compared to MORAN/MOCN • Significant investment can be diverted to services • Maximum sharing for operators sharing existing infrastructure	• Regulatory approval necessary • Complexity of operation and tight integration • Challenging to differentiate quality of service
National Roaming	• Significant CAPEX/OPEX savings • Clear ownership of equipment • Differentiation based on service layer • Low risk solution for both incumbent and new entrant	• Regulatory approval necessary • Interconnection required • Reduced control over the network (e.g., outage of visited network can affect home network service) • End to end inter-PLMN QoS and inter-PLMN handover very challenging

Comparison of infrastructure sharing forms (technology)(Source: GSMA)

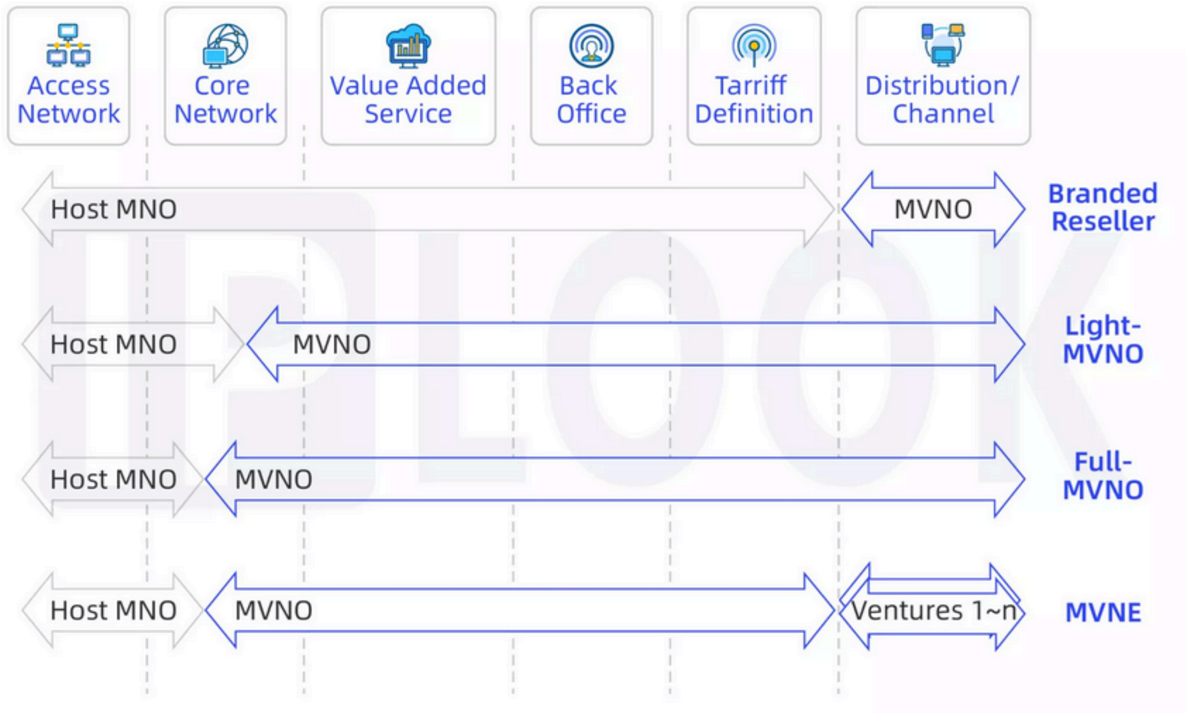
4.3.MVNO - Mobile Virtual Network Operators

The Mobile Virtual Network Operator(MVNO) business is the fastest growing trend today and a very lucrative opportunity in mobile telecommunications. The MVNO provides wireless communication services without the full infrastructure or license to use radio frequencies. It provides wireless communications with agreements already in place with mobile network operators (MNOs). These companies obtain bulk access to mobile communications networks for their consumers at set retail and wholesale prices.

MVNO business models

MNOs are realizing the significance of MVNO partners to reach out to niche audiences with unique needs using suitable low cost business models & pricing strategies. As a result, MVNOs are fast emerging across segments such as telecom, roaming, retail, media, business, discount, lifestyle, and M2M.

The different business models in the MVNO market are based on how the value chain is restructured. Therefore, four main business models that emerge are : Branded Reseller, Light-MVNO(with HSS/HLR,BOSS), Full-MVNO(with more like, STP, DRA, GTP-Router, PGW/GGSN, PCRF, SMSC/USSD GW) and MVNE(with more like MME, SGW, SGSN, MSC, GMSC).



MVNO business models (Source: IPLOOK)

Branded reseller

Branded reseller is the lightest MVNO business model, where the venture just provides its brand and, sometimes, its distribution channels. While the mobile network operator (MNO) provides the rest of the business, from access network to the definition of the mobile service offer. This is the model that requires the lowest investment for a new venture, therefore the fastest to implement. However, most of the business levers remain with the network provider (MNO or MVNE). Therefore, the new venture has a very limited control of the business levers and value proposition of the service.

Light-MVNO

Light-MVNO is an intermediate model between a branded reseller and a full-MVNO. This model allows new ventures to take control of the marketing and sales areas and, in some cases, increase the level of control over the core network, back-office processes and valued-added services definition and operations.

Full-MVNO

Full-MVNO is the most complete model for a new venture, where the mobile network operator just provides the access network infrastructure and part of the core network, while the new venture provides the rest of the elements of the value chain. This MVNO business model is typically adopted by telecom players that could gain synergies from their current business operation.

Network enablers

Network enablers, typically known as Mobile Virtual Network Enablers (MVNE), this is a third-party provider focused on the provision of infrastructure that facilitate the launch of MVNO operations. An MVNE can be positioned between a host MNO and an MVNO venture to provide services ranging from value added services and back office processes to offer definition. MVNEs reduce the entry barriers of MVNO ventures, given that an MVNE aggregates the demand of small players to negotiate better terms and conditions with host MNO. They pass on some of these benefits to their MVNO partners. Moreover, the all-in-a-box approach to launch an MVNO through a MVNE has accelerated, even more, the explosion of the MVNO market.

4.4.Spectrum leasing

Spectrum leasing is another form of sharing. In a spectrum leasing model, licensed bands that have already been assigned to an operator on an exclusive basis can be rented by another user. Spectrum leasing typically involves a partial transfer of a licensee's rights to spectrum to another user for a limited period and/or for a portion of the spectrum included in the licence. Spectrum leasing (as well as other secondary market transactions) is often subject to regulatory approval. In general, stakeholders taking part in such transactions can be mobile operators or other companies that have a spectrum licence on one side, and a party such as another mobile operator or other entity requiring access to spectrum on the other side.

5. Regulations for RAN/spectrum sharing in IMT among MNOs

[Editor: Regulations for RAN/spectrum sharing in IMT among MNOs

- How to ***ensure a healthy competition*** in the market: for example, giving CAP for the spectrum that TSPs are allocated…

- ***Spectrum fees/charge*** (licence fees, annual fee, trading/leasing fee) and non-technical licence conditions…

- ***Technical conditions***: for example, out-of-block emission limits and synchronisation.

…..]

When Mobile Network Operators (MNOs) engage in Radio Access Network (RAN) sharing in IMT, regulatory frameworks must balance competition, fair market practices, and technical efficiency. Below are key considerations:

5.1. Ensuring healthy competition in the market

Spectrum CAPs impose limits on the amount of spectrum any single MNO can hold. Spectrum CAPs can prevent dominance mobile market by one operator and ensures other players have access to necessary spectrum resource. Together with normal spectrum CAPs that individually applied to each MNO, national regulators can consider additional spectrum CAPs apply to MNOs engage in RAN/spectrum sharing.

5.2. Technical conditions

Out-of-Block Emission Limits and TDD synchronization are technical conditions to reduce interference between operators. Therefore those technical conditions are widely used when licensing to MNOs.

[Editor's note: Below texts should be explained more about need of additional condition.]

When MNOs apply RAN/spectrum sharing, national regulators could consider to introduce additional Out-of-Block Emission Limits and/or TDD synchronization to prevent interference to other MNO operating in adjacent spectrum block.

5.3.Consideration on network and spectrum sharing

Network and spectrum sharing is only possible if regulations do not prohibit it, commercial measures incentivise it, and it is technically practical (i.e. different users can operate effectively without interference). Regulators can enable sharing by giving incumbent users the right to share their spectrum voluntarily through commercial agreements or by awarding rights to use spectrum in areas and/or at times when the incumbent is not using it.[2]

The right regulatory framework could support leasing and help overcome potential concerns around the implications for competition. This can be achieved by providing clarity with respect to several components, including considerations for the granting of permission to lease spectrum and the roles and responsibilities of the lessor and lessee when it comes to network coverage and rollout, and fees, as well as licence obligations relating to technological neutrality, quality of service and consumer protection.[3]

Some of the key regulatory considerations for spectrum sharing are as follows:[4]

- Exclusive licensing has been central to the success of mobile services and must continue. Any spectrum sharing mechanisms should be considered as a complementary possibility.
- Licensing authorities should allow voluntary spectrum sharing, leasing and trading amongst operators and facilitate such mechanisms through clearly defined spectrum rights, long licence terms, and limited administrative costs.
- Sharing will only be useful for operators if the proposed band is harmonised for mobile use and is available and usable in sufficient quantities in areas and at times where needed.
- Operators favour a simple sharing framework that is investment-friendly and supports reliable, high quality mobile services.
- Competition issues should be assessed considering the specific circumstances of sharing, leasing and trading agreements. Certain safe harbours can be established where the spectrum represents a small share of the market capacity or where a market share is below a certain threshold.

6. Case studies in APT Countries

6.1.Vietnam

- Policy and Regulations in the Telecommunications Law:

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[2] GSMA. Spectrum Sharing. June 2021. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2021/06/Spectrum-Sharing-Positions.pdf

[3] GSMA. Spectrum leasing in the 5G era. January 2022. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2022/01/Spectrum-Leasing-5G-Era.pdf

[4] GSMA. Best Practice in Mobile Spectrum Licensing. February 2022. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2022/02/Mobile-Spectrum-Licensing-Best-Practice.pdf

- The sharing of telecommunications infrastructure is carried out through contracts on the basis of ensuring the legitimate rights and interests of the parties involved.

- In case the parties cannot agree on the price to share telecommunications infrastructure, negotiations shall be carried out in accordance with the law on prices. In case the parties cannot agree on other contents about sharing telecommunications infrastructure, the competent state agency shall decide.

- Roaming and MVNO: Ensure provision of services with fair, reasonable and non-discriminatory prices and related conditions; Transparent information about prices, technical standards and regulations, the quality of networks and services.

- Under the Telecommunications Law:

  Active infrastructure sharing must ensure: Comply with the provisions of the Telecommunications Law; Comply with the Competition Law, the Radio Frequency Law and other relevant laws.

- Under the Radio Frequency Law:

  Active infrastructure sharing according to the MORAN model is feasible and does not violate the provisions of the Law on Radio Frequency, while according to the MOCN model, appropriate policies are being studied.

There are 5 MNOs in Vietnam. Basically, they all have different domestic and international roaming agreements. For example: Viettel - Vietnam's largest network operator currently has data roaming agreements with more than 500 network operators in 213 countries/territories around the world. Viettel's international roaming service is very diverse, with many support utilities such as: callback messages when roaming internationally (Roaming call back), unlimited data roaming rates,...

Up to now, MIC-Vietnam has licensed for 5 MVNOs: Indochina Telecom, Mobicast, ASIM, Digilife and FPT Retail. In particular, Indochina Telecom and Mobicast use VinaPhone's infrastructure, while ASIM, Digilife and FPT Retail networks use MobiFone's infrastructure. Only Viettel does not cooperate with any MVNO, even though Viettel is said to have the strongest infrastructure today.

6.2.China

The Ministry of Industry and Information Technology(MIIT) of the People's Republic of China has published "Notice on Supervision of Radio Frequency Sharing in 5G Systems" in 2021, which proposed two methods of spectrum sharing among IMT operators: (1) spectrum sharing on base station side, (2) spectrum sharing on user terminal side[5].

- spectrum sharing on the base station side, the 5G base stations of one telecommunication operator A change the transmission or reception frequency range specified in its radio station licenses, providing 5G services to its own user terminals and the user terminals of other operators (B or C) using the 5G frequency licensed to other operators. By this sharing method, the telecommunication operators sharing the frequency shall apply for a new radio frequency sharing license.

- spectrum sharing on user terminal side, the user terminals of one telecommunication operator A change the transmission or reception frequency range, connect to 5G base stations owned by other telecommunication operators (B or C), and access 5G service from other operators. By this sharing method, the base stations of other operators (B or C)

[5] https://www.miit.gov.cn/zwgk/zcwj/wjfb/tz/art/2021/art_771cac9bf8ac4f4d97ee87cc5bd2362e.html

maintain the transmission or reception frequency range specified in its radio station licenses.

At the World Telecommunication and Information Society Day conference on May 17, 2023, China Telecom, China Mobile, China Unicom, and China Broadcasting Network jointly announced the official launch of the world's first 5G inter-network roaming commercial trial in Xinjiang, China. 5G inter-network roaming refers to the user terminal could use 5G services by accessing to other operators' 5G networks and continue using 5G services, when the respective operators have no 5G network coverage[6].

China is guiding IMT operators to enhance coordination and cooperation, fully boost market dynamism, integrate prime resources, carry out 5G network sharing and inter-network roaming, accelerate efforts to form a network pattern with multiple networks coexisting in hotspots and one network ensuring basic needs in remote areas, and create 5G networks with intensive resource and efficient operation[7].

6.3.Republic of Korea

The Ministry of Science and ICT(MSIT) announced a "Rural 5G Network Sharing Plan" in April 2021 with three mobile network operators in Korea, SK Telecom, KT and LG Uplus. To implement the rural 5G network sharing plan, the three operators signed an agreement to enable 5G users to access the 5G network in rural and remote areas regardless of which operator they subscribe to, with the aim of providing nationwide 5G service.

Following the launch of the world's first commercial 5G network service, discussions began on building a joint network to rapidly expand the nationwide 5G network and bridge the 5G divide between urban and rural areas. As 5G network is known to take longer to deploy nationally compared to LTE, the MSIT and three operators agreed on a RAN sharing policy to accelerate the delivery of 5G coverage rapidly, not just in some metropolitan regions but in rural areas.

This is the worldwide first case of a 5G RAN Sharing agreement involving all operators in a nation to accommodate all MNO and MVNO subscribers and global roamers without differentiating customer experience. It is designed to provide all subscribers with the same quality as their independent network when on a shared network.

Under the plan, the three operators jointly built and shared 5G systems in 1342 rural areas across the Republic of Korea, and in April 2024, the construction of a nationwide 5G network was completed, covering all rural areas in addition to urban areas where the three MNOs had already independently built 5G networks. MSIT and three MNOs will continuously improve the network stability, quality, etc. in rural 5G network sharing areas.

After discussing which technology method to implement, the Multi-Operator Core Network (MOCN) radio access network sharing architecture is selected for this 5G network sharing plan, where only the RAN is shared in the 5G network. MOCN enables two or more operators with distinct core networks to use shared RAN and spectrum. Figure 5.1 describes the MOCN implementation for the 5G network sharing system in Korea.

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[6] https://www.miit.gov.cn/xwdt/gxdt/sjdt/art/2023/art_9d2f16ff8d6242f49706ef73ba8692cb.html

[7] https://www.miit.gov.cn/jgsj/txs/wjfb/art/2020/art_72744a8f6ad146b6b6336c0e25c029c6.html

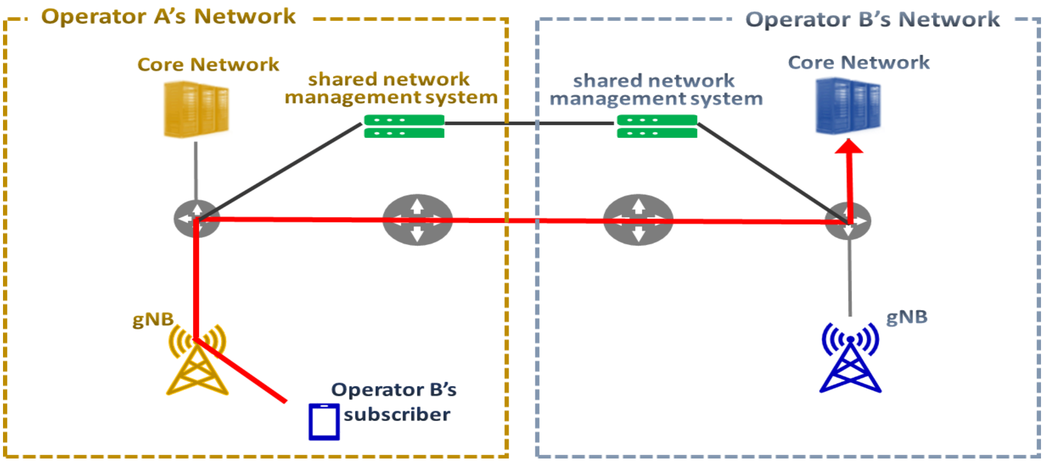


Figure 5.1 MOCN for Korea 5G Network Sharing System

The all information on each operator's radio access networks, including coverage, parameters, etc. is shared by "shared network management system". It is newly developed for shared network to integrate quality management through which three operators monitor and immediately address service performance, load, defects, errors etc. on the shared network. For interoperability between each operator's own access network and the others' core networks, the operators designated edge communication bases when connecting the backbone networks to ensure stability and reduce latency. The bases are configured to process traffic within the region and ensure stability by ensuring route redundancy between base data centers when interoperating between networks.

7. Conclusion

[Editor's note: Texts should be developed for finalization.]

[TBD]

Annex:

Policy and Regulatory aspects of Infrastructure sharing- Outside of APT's members

1. BEREC (Body of European Regulators for Electronic Communications) Report on infrastructure sharing

- Current regulations and legal framework for infrastructure sharing in different countries, including information-sharing requirements, NRA powers, infrastructure sharing obligations and any guidelines in place to support operators.

- Current sharing arrangements: Active sharing with joint deployment, National roaming (without joint deployment), Passive sharing, Special agreements, Further agreements; Assessments and/or decisions on infrastructure sharing.

- Benefits and challenges from infrastructure sharing arrangements: Benefits of sharing, Challenges and downsides associated with sharing, General experiences with sharing agreements (including of Negative experiences, Neutral experiences and Positive experiences, Barriers to increase infrastructure sharing

- Future evolution of sharing arrangements and the role of 5G in shaping requirements/regulatory framework: Most countries expect that infrastructure sharing will become more important in the future.

Most NRAs, however, believe that continued market monitoring will be required before NRAs can take informed decisions in the context of deployment of 5G. The development of best practices – and their relevance to 5G – will also rely on past experiences of NRAs in addressing potential challenges related to infrastructure sharing agreements.

Some NRAs state that local authorities and/or legislation should support 5G (Bulgaria, Norway). Some countries think that the regulatory framework is appropriate and sharing agreements have to be mainly commercially based (Finland, Netherland, Sweden, Switzerland, Turkey, UK) and competition law provides a sufficient framework to assess which sharing is desirable (and allowed) and which not (Netherland). Some countries think that infrastructure sharing might be related to licence exempt spectrum bands (Denmark, Ireland).

Some countries explicitly mention that competition has to be maintained (Czech Republic, Denmark, Serbia). Individual countries see a risk that MNOs through exclusivity agreements with infrastructure owners could impede the rollout of other MNOs (France) or want to impose the sharing of passive sites. An individual country states that service competition may suffice (Belgium).

To sum up, countries expect that 5G will be especially related to more small cells and higher backhaul capacity. It is believed that there will be an increase or at least an increased need in sharing (passive, active, backhaul, active indoor spectrum and others). Some countries state that operators concluding exclusivity agreements with infrastructure owners could impede other operators' rollout. It should therefore be ensured that sharing does not lower competition.

- Annex – Individual assessments of active sharing in various countries.

2. Shared Access Licence - Guidance document (OFCOM):

- The Shared Access licence is part of a new framework for enabling shared use of spectrum and is currently available in four different bands: the 1800 MHz shared spectrum; the 2300 MHz shared spectrum; 3.8-4.2 GHz; the lower 26 GHz band.

- There are two kinds of licence: low power and medium power Shared Access licence (including technical conditions).

- Licence fees and non-technical licence conditions (Licence duration and revocation; Trading the licence to someone else; Keeping records and providing information to Ofcom; Accessing, modifying and shutting down your equipment if something goes wrong; Changing frequency if we ask you to do so).

Country	Licensing Approach	Spectrum Available
France	Local licences available on a trial basis from 2019[3]. Trial extended to December 2023.	3.8-4.2 GHz
Germany	Spectrum for local network usage for private companies from 2019. Users include Bosch, BMW and Siemens[4].	3.7-3.8 GHz
Norway	Nkom announced local access licences to be made available in 2022. Intended uses include provision of standalone private networks and FWA[5].	3.8-4.2 GHz
Sweden	Section of auctioned spectrum reserved for local and regional licences[6].	3720 – 3800 MHz
Finland	Spectrum available for local access[7]. Traficom envisage these licences being used for factories, ports, airports and shopping centres.	2300-2320 MHz and 24.25-25.1 GHz

Examples of Shared Access spectrum developments in Europe (Source: Ofcom)

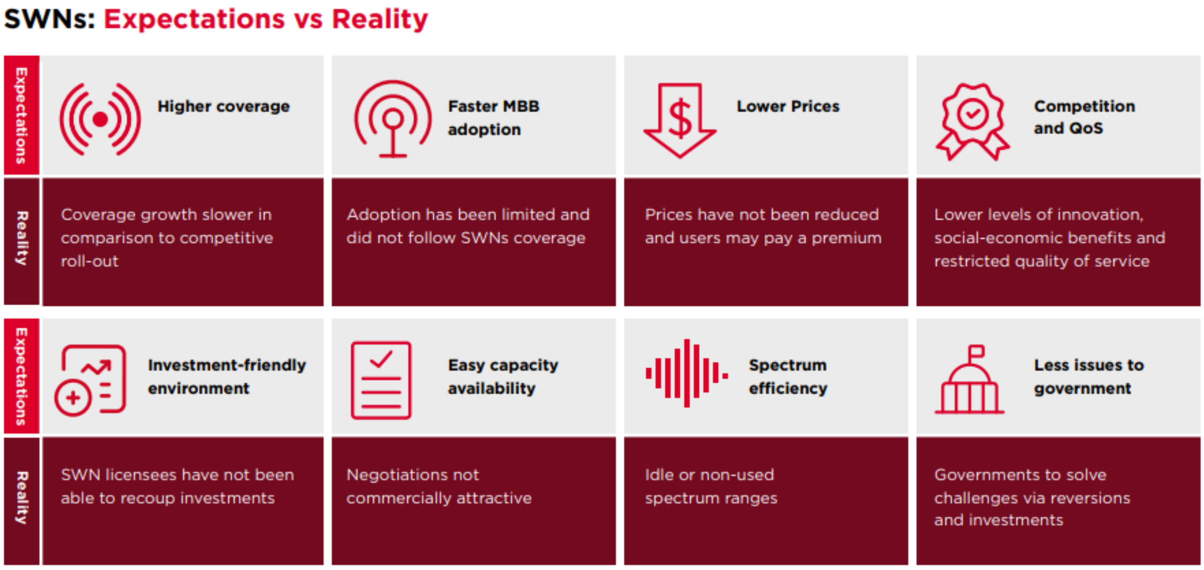
Mandated sharing and risks of SWNs

Single wholesale networks (SWNs) or wholesale open access networks (WOAN) are much less common. Like network sharing arrangements, SWNs are also based on rationale of reducing both network capex requirements and end-user service costs. Unlike voluntary sharing agreements, SWNs are mandated – they are not voluntary and lack the flexibility for operators to determine the best arrangement for sharing. Instead of relying on competing mobile networks and voluntary network and spectrum sharing arrangements to deliver mobile broadband services in their country, such proposals specify at least partial network ownership and financing by the government.

While there are variations in the SWN proposals discussed and implemented by different governments, in most cases, operators are also limited to provide mobile broadband in one technology (4G or 5G) solely via the SWN. There have been examples of such arrangements in Mexico and Rwanda, and most recently in Malaysia[8].

SWNs have not proved successful to date and the plans have largely been abandoned for competition-based approaches. Two important reasons are the lack of take-up of their services and the fact that coverage improvements have been slower compared to competitive rollouts. SWNs lead to highly controlled and monopolistic networks, tend to encourage high consumer prices, which has resulted in low adoption. Other shortcomings illustrated by real-world use cases include SWN licensees that have been unable to recoup investments. The results of nearly all SWN initiatives have been idle spectrum, lower levels of innovation, limited socioeconomic benefits, and restricted quality of service.

[8] GSMA. Policy Trends in Policy Trends in the Aftermath of Single Wholesale Networks. January 2024 https://www.gsma.com/connectivity-for-good/spectrum/gsma_resources/swn-single-wholesale-networks/


SWNs: Expectations vs Reality
Expectations
Reality
Higher coverage
Coverage growth slower in comparison to competitive roll-out
Faster MBB adoption
Adoption has been limited and did not follow SWNs coverage
Lower Prices
Prices have not been reduced and users may pay a premium
Competition and QoS
Lower levels of innovation, social-economic benefits and restricted quality of service
Expectations
Reality
Investment-friendly environment
SWN licensees have not been able to recoup investments
Easy capacity availability
Negotiations not commercially attractive
Spectrum efficiency
Idle or non-used spectrum ranges
Less issues to government
Governments to solve challenges via reversions and investments

Source: GSMA