Final report for Optus

The ACCC's consideration of the Telstra–TPG agreement

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1 Executive summary

On 21 February 2022, Telstra and TPG announced a ten-year multi-operator core network (MOCN) commercial agreement involving regional and 'urban fringe' areas in Australia, covering between 81.4% and 98.8% of the Australian population.

In the context of this agreement, and in light of the Australian Competition and Consumer Commission (ACCC)'s acknowledgment that the Telstra–TPG agreement "raises complex issues", Optus has commissioned Analysys Mason to prepare a paper on the context and considerations arising from the planned network-sharing agreement (NSA), including the leasing of spectrum from TPG to Telstra.

Types of NSAs in relation to MOCN NaaS

Different forms of active network sharing exist, according to the levels of integration between the participating mobile network operators (MNOs). The Telstra–TPG agreement can be defined as a MOCN with network as a service (NaaS) NSA.

An MOCN NaaS configuration provides similar access and roaming to that offered by a full mobile virtual network operator (MVNO). Operator A (Telstra, in this case) supplies the network and spectrum in the defined footprint upon which Operator B (the 'access' operator, TPG in this case) relies entirely, so one 'main' operator party can be identified in the agreement (Operator A, Telstra).

An MOCN NaaS is unique among active sharing agreements in that it has an inherent degree of asymmetry. An MOCN NaaS is also unlike an MOCN joint venture (JV) – which typically takes the form of a shared enterprise between equal partner-MNOs to pool their sites, equipment and spectrum with the aim of sharing costs. The contractual aspect of an MOCN NaaS agreement is therefore central to understanding the particularities of the arrangement between the main operator and the access operator, e.g. terms of access for the access operator, control and decision-making granted to the access operator, exclusivity clauses, benefits to the main operator, timeframe.

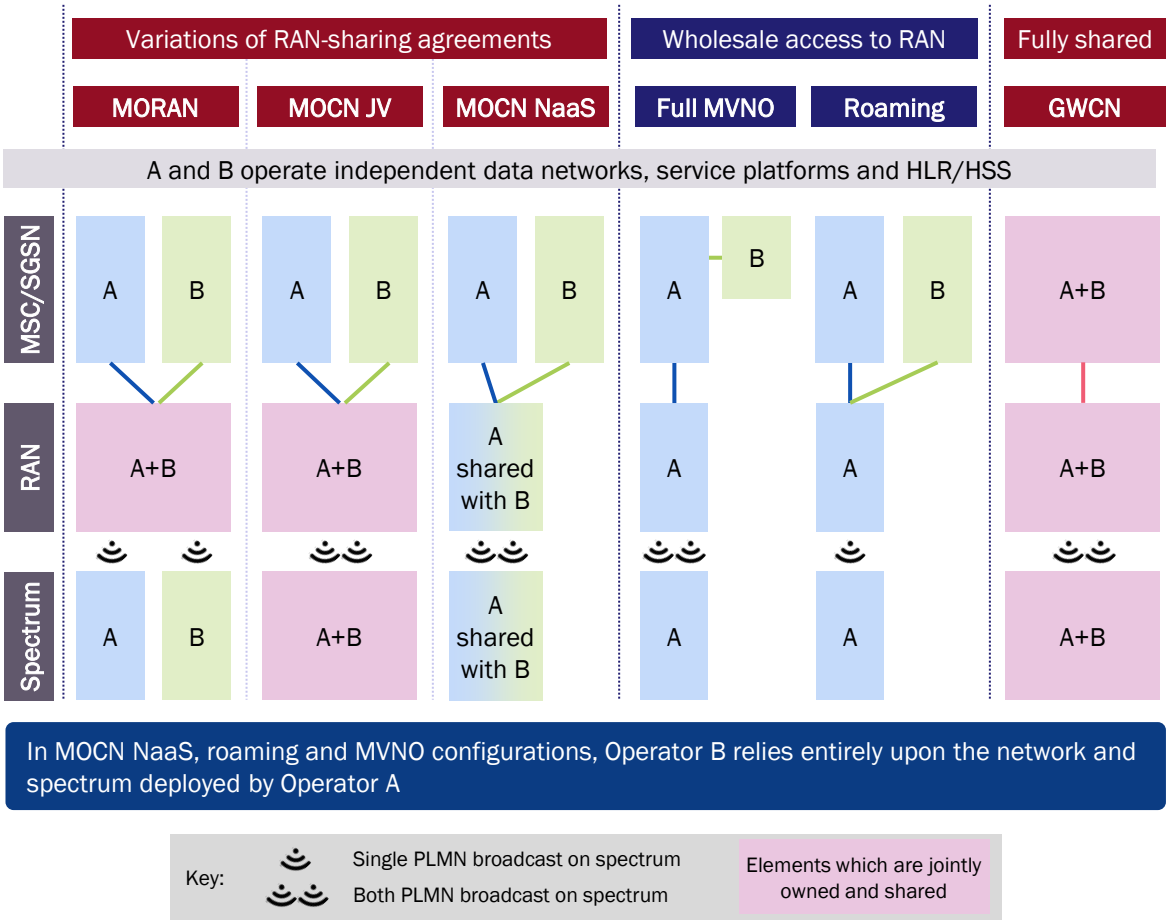
Due to the nature of the MOCN NaaS, one operator owns and controls the network, leading to differentiation limitations and control challenges. Although both operators have control over the user equipment, with each operator able to treat the radio access network (RAN) as their own using their own public land mobile network (PLMN) code and own core network (similar to a full MVNO), the access operator relies on the main operator granting access to key network features, such as access to different technologies. This can lead to concerns around limitations on infrastructure-based competition and differentiation, particularly if the access operator effectively loses the ability to expand its own coverage or quality of service (QoS) to improve its offer to customers.

In addition, the main operator has control over which technologies can be accessed by the access operator based on the contractual agreement put in place. The reliance on a single network could also lead to lack of incentives for further technology innovation due to the reduced infrastructure and vendor competition. The activation of spectrum between 4G and 5G technologies, and use of Dynamic

Spectrum Sharing (DSS) in the radio layer is likely to controlled by the main operator's needs, technology priorities and handset profiles. Hence, it is relevant to assess whether TPG may be or become constrained by a network not optimally configured to support its best competitive priorities.

Spectrum leasing is not required for an MOCN and the majority of MOCN agreements reviewed in Annex A do not include spectrum leasing. Spectrum leasing adds further complex components to the overall agreement between parties, requiring further review and influencing the terms of the MOCN NaaS agreement. Different forms of active network sharing are illustrated in Figure 1.1.

Figure 1.1: Diagram of selected active network sharing configurations between Operators A and B and comparison with full MVNO and roaming configurations [Source: Analysys Mason, 2022]



MORAN: multi-operator radio access network

GWCN: gateway core network

HLR/HSS: home location register / home subscriber server

MSC/SGSN: mobile switching centre / serving GPRS support node

As highlighted above, NSAs should be assessed on a case-by-case basis, and evidence from other countries shows that there are many differentiating factors in the MOCN NSAs assessed by other

authorities. The specific circumstances of the creation of the shared network in Australia are therefore important.

- *Assessing the impact of the spectrum leasing agreement*

Through the planned spectrum leasing agreement, Telstra will have access to a high proportion (~65%) of all spectrum available in the regional areas. The additional low-band spectrum will provide coverage benefits while the higher-band spectrum may allow Telstra to improve congestion where present in the radio network, and handle more traffic. The planned agreement will mean that Telstra has access to an amount of spectrum exceeding the spectrum caps set in recent auctions. Assessing the spectrum leasing agreement as a standalone agreement is likely to be necessary to understand the full impact of the arrangement between TPG and Telstra.

The spectrum provided by TPG to Telstra is expected to significantly increase headline speeds provided by Telstra in the regional areas. Acquiring additional spectrum allows operators to aggregate carriers and increase carrier sizes to increase offered and achieved headline speeds. The headline speed that can be offered is generally determined by the largest aggregated spectrum carrier available.

In the 3.5GHz band, Telstra will have access to a total of ~90MHz (depending on the region and up to 125MHz) compared to ~50MHz without the TPG agreement, which will allow for the deployment of a larger carrier and significantly increased speeds. In addition, Telstra's current holdings of 50MHz are not conducive to the deployment of massive multiple-input multiple-output (mMIMO) technology; however, holding 90MHz of spectrum allows for economically efficient deployment of mMIMO – allowing for a further increase in speeds by a factor of four. Optus only holds 25MHz to 35MHz in this band (depending on the region) and could therefore only offer a fraction of the speeds offered by Telstra, as shown in Figure 1.2. With the deployment of mMIMO using 90MHz carriers, we estimate Telstra could achieve speeds of 405Mbit/s, compared to speeds of 39Mbit/s for Optus, which is unable to economically deploy mMIMO due to its low spectrum holdings in this band.

A similar impact is seen in the 700MHz band, which is essential for coverage and of particular use in rural areas. We estimate Telstra would be able to achieve speeds of 45Mbit/s while Optus will only be able to offer speeds of 15Mbit/s, less than half.

Figure 1.2: Achievable 5G headline speeds in the 3.5GHz band (Mbit/s) [1] [Source: Analysys Mason, 2022]

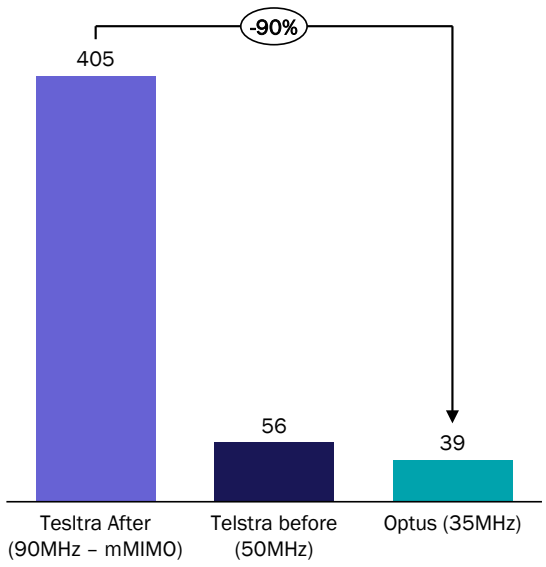
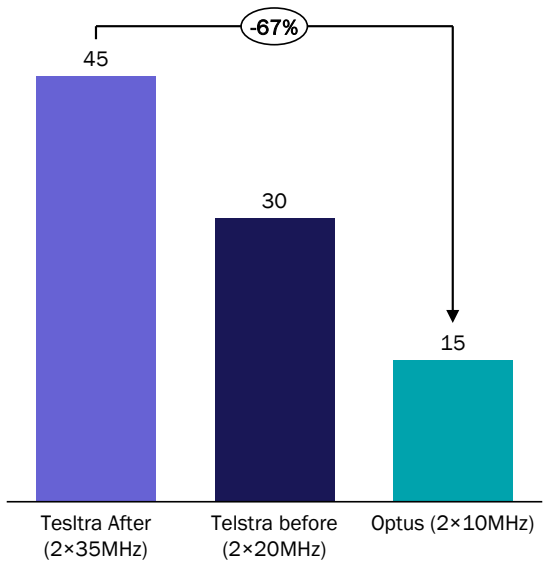


Figure 1.3: Achievable 5G headline speeds in the 700MHz band (Mbit/s) [2] [Source: Analysys Mason, 2022]



Similarly, in the mid-band, spectrum available to Telstra will increase significantly. The additional spectrum provided by TPG could enable Telstra to deploy larger carriers and/or allow for different carrier aggregation configurations. Additional spectrum in the 2100MHz band could allow Telstra to increase headline speeds. In the 2.6GHz band, Telstra holds double the spectrum Optus owns and we estimate is already able to offer double the speeds Optus can achieve on its network.

The overall effect of licensing TPG's spectrum in the regional areas to Telstra for ten or more years provides Telstra with a dominant spectrum occupancy in the regions – which leads to substantial technical and economic benefits, allowing Telstra to offer much higher network speeds. These higher network speeds will not be achievable by Optus, the remaining competitor, or any other new entrants. This is from both a technical outlook with less spectrum and an economic outlook, given the cost–benefit consideration of deploying mMIMO without sufficient carrier bandwidth. As a result, Optus's speed-based offers in the regional area in the medium to long term are unlikely to be competitive compared to Telstra's. As data services become more significant in the mobile market, both headline speed and the quantity of data are important factors in consumers' buying decisions. A headline speed comparison would therefore be important to consider alongside other metrics such as MHz per user and the quantity of data (Gbytes) which the network can supply to users.

1 It is important to note that spectral efficiency will depend on a number of factors and vary both for users and within the cell. The estimation is based on a 5G spectral efficiency of 1.5MBit/s/MHz, we take into account overhead capacity to coordinate network (20%), a full buffer adjustment (65%) and a realistic loading adjustment (85%), additionally, for the 3.5GHz band we include a downlink spectrum multiplier (75%); mMIMO is estimated to increase speeds by a factor of four.

2 The estimation is based on a 5G spectral efficiency of 1.5MBit/s/MHz, we take into account overhead capacity to coordinate network (20%), a full buffer adjustment (65%) and a realistic loading adjustment (85%).

- *Assessing the contribution of each operator to the NSA and associated benefits*

Understanding the rights TPG will have over the network, the degree to which the operator will be able to control network features and the access to technologies will help to determine the benefits to each party and the impact on competition for customers in the regional area. Telstra will benefit from access to additional spectrum to improve network performance and TPG will benefit from greater coverage and capacity without incurring capex in the designated regions, although benefits will be offset by charges paid to the other party.

- *Assessing the impact on competition in the infrastructure, wholesale and retail markets*

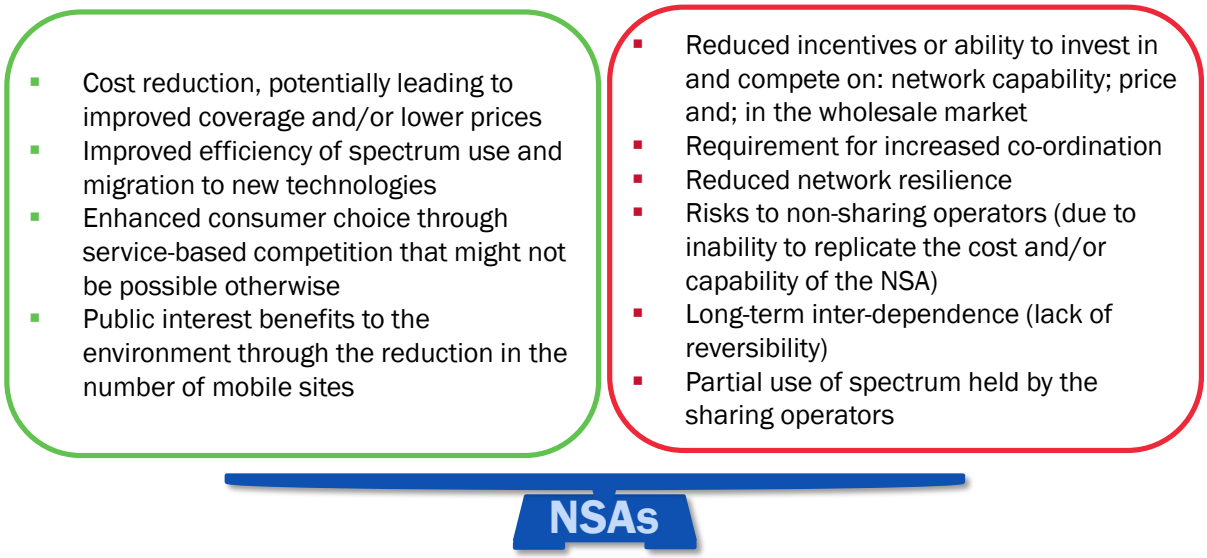
TPG is expected to rely mainly on Telstra's infrastructure, therefore reducing infrastructure competition in the regional area. The reduction in infrastructure competition directly affects the wholesale market, as well as the retail market and therefore consumers.

Although the MOCN NaaS and spectrum leasing agreements will benefit Telstra and TPG customers in the short term, it is important that the superiority of Telstra's network does not prohibit Optus or any potential new entrant from competing for customers living in, and travelling to, the regional area. Due to Telstra's superior coverage, QoS and speed combined with a low unit cost of traffic, there is a concern that Optus, and potentially also TPG, will be unable to compete with Telstra's network. Optus's incentives to invest will then be reduced where it cannot compete against the scale and performance of Telstra's network in the long term.

Benefits and drawbacks of NSAs

The main aim of NSAs is to allow MNOs to reduce costs and facilitate network expansion and technology upgrades: there are benefits as well as drawbacks to competition and the market as presented in Figure 1.4.

Figure 1.4: Potential benefits and drawbacks of NSAs [Source: Analysys Mason, 2022]



The considerations of the benefits and drawbacks of NSAs point to the need for national regulatory authorities (NRAs) and competition authorities to carefully evaluate such agreements on a case-by-case basis. A thorough evaluation is also instrumental in determining whether specific remedies should be imposed on the agreement (and, if so, how they should be framed) to counteract potential drawbacks.

Conclusions

The conclusions from our analysis indicate that there are a wide range of key aspects which we believe are essential to understanding the spectrum leasing and MOCN NaaS agreements between Telstra and TPG, and essential to assessing their likely impacts on the Australian market and consumers in the short and long-term.

2 Introduction

Following recent announcements in Australia, Analysys Mason Limited (Analysys Mason) has been commissioned by Optus to prepare a paper on the context and considerations arising from the planned network-sharing agreement (NSA) between Telstra and TPG, including the leasing of spectrum from TPG to Telstra. This paper presents Analysys Mason's research, references, analysis and independent conclusions prepared for Optus's submissions during the subsequent consideration of the NSA. As such, this report may be shared by Optus with relevant external parties including the Australian Competition and Consumer Commission (ACCC) which will be the primary authority responsible for consideration of the proposals from Telstra and TPG.

This report aims to contribute our expertise and insight to a thorough and robust analysis of the planned NSA. The remainder of this document is laid out as follows:

- Section 3 describes different forms of network sharing and focuses on multi-operator core network with network as a service (MOCN NaaS), which is the approach proposed by the parties for the planned NSA
- Section 4 sets out a range of key considerations on the circumstances for the planned NSA in Australia.
- Section 5 discusses NSAs and their main aims and possible drawbacks
- Annex A summarises relevant NSA case studies worldwide
- Annex B introduces some key objectives and criteria relevant to regulatory consideration of NSAs

3 The proposed MOCN NaaS

In this section we introduce different forms of network sharing, highlight the key features of an MOCN NaaS, and set out some of the competition questions which accompany the proposed TPG-Telstra MOCN NaaS.

3.1 Network sharing exists in different forms, including MOCN NaaS

Different forms of active network sharing have been developed by vendors and operators. They can be ordered by increasing levels of integration between the participating MNOs:

- **multi-operator radio access network** (MORAN), where base stations and access switching equipment are shared (and owned) by both operators, but spectrum is not.
- **multi-operator core network based on a joint venture** (MOCN JV), where base stations, access switching equipment and spectrum are shared (and owned) by both operators.
- **multi-operator core network based on a network-as-a-service agreement** (MOCN NaaS), where radio access network (RAN) assets and/or spectrum are owned solely by one operator, while the other operator gains access by virtue of the 'network service' agreement. A NaaS agreement can be asymmetric with one main party and one access seeker, as in the Telstra–TPG agreement, or bilateral where the lessor/lessee relationships are paired in a complementary way.
- **gateway core network** (GWCN), corresponding to a fully shared configuration, where circuit switching and packet switching core elements are shared in addition to base stations, access switching equipment and spectrum.

The Telstra–TPG agreement can be understood as an MOCN NaaS NSA, which is distinct from the JV structure used in many international examples of MOCN and MORAN. For additional comparison, other similar forms of wholesale access to the RAN are also relevant, such as 'full' mobile virtual network operator (MVNO) and mobile roaming. Roaming and full MVNO contracts are not specifically shared network arrangements, but rather ways in which a competing retail service can be provided on a common radio network. However, there are important similarities and differences with MOCN NaaS. In particular:

- An MOCN NaaS configuration provides access and roaming. Telstra supplies the network and spectrum in the defined footprint upon which TPG relies entirely, so one 'main' operator party (Telstra) can be identified in the agreement. This introduces a clear element of asymmetry between the main operator and the access operator (TPG). The main operator therefore holds a degree of control over the access operator. This configuration resembles full MVNO access and roaming.

- A full MVNO[3] wholesale access arrangement *similarly* involves the access seeker obtaining wholesale access to a switch of the host network which then broadcasts the full MVNO's public land mobile network (PLMN) alongside the host PLMN. The full MVNO's PLMN only communicates with customers using the dedicated SIM card range, but will use all the spectrum allocation of the host network (subject to any specific restrictions e.g. 4G or 5G service).

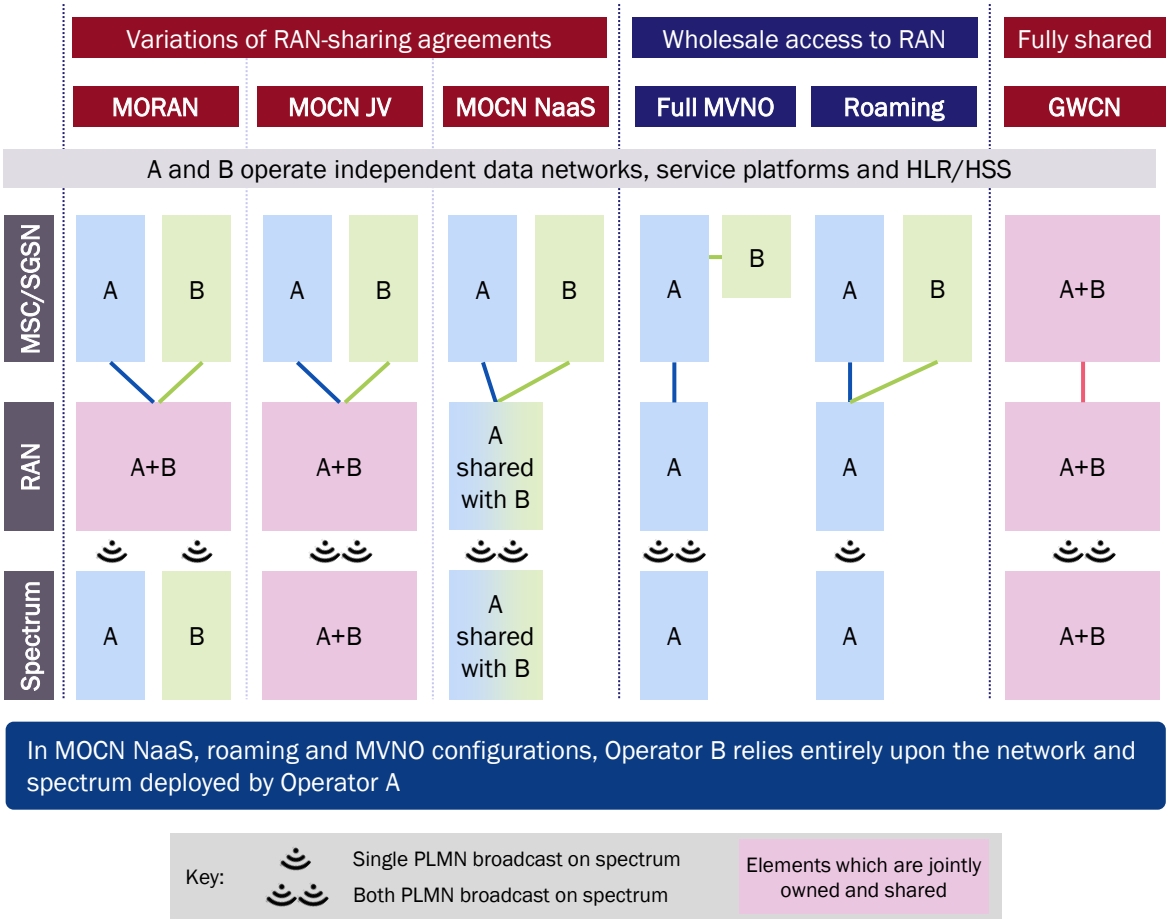
- A roaming agreement is *different* from an MOCN NaaS in that it allows the seeker's handsets to access the PLMN of the host network, in a specified radio network area permitted for roaming (in the same way that international handsets from abroad are permitted to access a PLMN to gain service while roaming away from home).

The key features and differences for an MOCN NaaS, MOCN JV and full MVNO should be carefully analysed in the Telstra–TPG situation. This is due to the close similarity of MOCN NaaS with full MVNO wholesale access, and the differences between MOCN NaaS and JV NSAs, all of which must be understood in light of the possibilities and limitations of the specific commercial agreements proposed for the Telstra–TPG case.

A diagram highlighting key differences between the configurations described above is summarised in Figure 3.1, where they are exemplified by operators 'A' and 'B'.

3 A full MVNO owns its own core network. This enables the MVNO to secure their own IMSI and MSISDN ranges, control service logic (primarily in its core and service platforms, but not in the host radio network), and also to negotiate its own voice, SMS, data and international roaming and interconnect agreements.

Figure 3.1: Diagram of selected active network-sharing configurations between operators A and B and comparison with full MVNO and roaming configurations [Source: Analysys Mason, 2022]



HLR/HSS: home location register / home subscriber server

MSC/SGSN: mobile switching centre / serving GPRS support node

We note that GWCN is not prevalent globally as operators prefer not to share core elements of their network. MORAN and MOCN are the most widely used forms of active sharing.

3.2 While an MOCN JV relies on a jointly owned network, an MOCN NaaS relies on the network of only one operator

An MOCN NaaS is a particular form of MOCN, with the main operator (or Operator A) allowing an access operator (or Operator B) to use its network infrastructure and spectrum holdings (see Figure 3.1). This section focuses on the particularities of this form of network sharing.

3.2.1 Unlike an MOCN JV where the network ownership is shared jointly between the two parties, in an MOCN NaaS configuration one player rents network services from the other player's network

An MOCN JV typically takes the form of a joint enterprise between partner MNOs to pool their sites, equipment and spectrum, with the aim of sharing costs and jointly running the shared network, while permitting each operator to have a degree of independence through separate core equipment and services. The joint entity is itself owned by all partners in the NSA agreement. MOCN JV can therefore be considered as a symmetrical form of network sharing with all partners contributing similar network elements. MOCN JVs tend to be the most common type of MOCN as shown in Annex A.

On the other hand, MOCN NaaS is unique among active sharing agreements in that it has an inherent and significant degree of asymmetry. Ownership of the different network elements is with one operator (and not both), so these elements can only effectively be shared by means of a lease or other similar access arrangements. The NaaS contractual aspect of this form of NSA is therefore central to understanding the specifics of the arrangement with its possibilities, benefits and limitations.

NSAs can include exclusivity clauses, preventing one or all parties from entering into any other NSAs with external parties. This can have an impact on future market developments, with operators locked into the arrangement for a certain length of time. The timeframe of the NSA is therefore important to consider. MOCN NaaS is essentially a capacity-leasing deal, however, unlike roaming, MOCN NaaS leads to specific network costs (to install and operate MOCN-capable hardware and software) and therefore typically covers a longer timeframe, especially if associated with a spectrum leasing agreement. Even without exclusivity clauses, the pricing arrangements of the MOCN (particularly fixed fees and/or per subscriber fees) can place an economic barrier to entering into other agreements.

3.2.2 In MOCN NaaS, one operator owns and controls the network leading to differentiation limitations and control challenges, although this could be solved in part by new network functionality

As discussed in the preceding subsection, although multiple parties can take part in an MOCN NaaS, they all rely on a single network owned by one of the partner MNOs. This means that only one of the MNOs controls, deploys and upgrades the network.

However, the advantage of an MOCN NaaS over agreements such as roaming or full MVNO is that all operators have radio access control over the service received by their customers (and user equipment), with each operator able to treat the RAN as their own using their own PLMN and own core network. In order for the network to allow this access control to operators, MOCN NaaS capabilities need to be implemented and activated by the vendor on the network equipment.

The main operator will, however, likely have significant explicit or implicit control over which technologies are enabled for MOCN NaaS. This can lead to concerns around limitations on infrastructure-based competition and differentiation. The access operator TPG will no longer be able to compete using its own infrastructure in the NSA area, as it will have decommissioned its own sites and the costs and time to rebuild in the regional areas would be substantial. The access operator becomes

reliant on the decisions of the main network, Telstra, except where the commercial agreement provides TPG with freedom to substantially direct the NaaS differently from Telstra's own services. A key consideration here is decisions on 5G upgrades, which appear in the proposed agreement to be led by Telstra and only accessible to TPG six months later. A relevant question is whether TPG can realistically take unilateral decisions on 5G in the MOCN area. Furthermore, the activation of spectrum between 4G and 5G technologies, and use of Dynamic Spectrum Sharing (DSS) in the radio layer is likely to controlled by the main operator's needs, technology priorities and handset profiles. Here, it is relevant to assess whether TPG may be or become constrained by a network not optimally configured to support its best competitive priorities.

Under an NaaS arrangement, the access operator will, at best, be able to offer services mostly equivalent to the main operator, resulting in little service differentiation due to the lack of infrastructure diversity. It is also highly unlikely that the access operator could offer services that would be superior to those of the main operator supporting the NaaS. The ability of the access operator to offer superiority and diversity will be governed by the contractual and commercial arrangements of the NSA.

New network functionalities such as network slicing, supported by virtualised network functions, could help reduce some of the disadvantages of sharing a network. A traditional 4G MOCN allows RAN sharing, however, 5G network slicing allows sharing on a more granular level and can slice traffic from different operators sharing the same RAN into multiple virtual networks. Each of these virtual networks can be based on a different topology or assigned different quality of service (QoS), thereby accommodating multiple service requirements on a shared physical infrastructure and, as a result, enabling additional service-based differentiation and improved competition. To this end, the NSA may include provisions regulating the specifics of virtual networks used by the operators (e.g. slice lifecycle, service orchestration across multiple domains, QoS differentiation).

The sharing of advanced/virtual RAN technologies and their deployment costs will benefit the NSA operators. However, there are limits to the degree of service flexibility that can be achieved through these technologies: the higher the number of slices and associated service profiles, the more complex and costly their lifecycle management and orchestration. Therefore, when evaluating the role of network virtualisation and slicing in the context of the NSA assessment, attention should be paid to the associated costs to understand whether their deployment would be sustainable and profitable for the operators involved.

3.2.3 The deployment of new technologies (e.g. 5G) is a key aspect of network sharing: access to the new technology could be imperfect for one player due to its lack of control of the network

Although an MOCN NaaS can avoid duplication of infrastructure in underserved areas, the control over the network infrastructure remains in the hands of one operator, leading to concerns around access to new technologies and technology innovation in general.

The main operator likely has primary control over which technologies can be accessed by the access operator. This issue forms a central part of the contractual agreement between the parties, with additional costs often associated with installing or having access to new technologies. Although 5G

might be deployed on the network, the access operator might not have access to the technology for a period of time and therefore might be unable to provide a sufficiently competitive level of service to its customers. We understand that TPG will have delayed access to 5G in the NSA area, which appears to reduce or deny TPG any early-mover benefits it might achieve by activating and marketing 5G improvements in regional or metropolitan areas.

The problem of primary control is also relevant for the shut-down of technologies or moving spectrum from 4G to 5G over time – the access operator TPG might prefer a different arrangement to meet its customer base and handset preferences, but will likely be unable to direct the network to best serve its own customers.

3.2.4 Spectrum leasing is not required in an MOCN NaaS, and adds further complexity to the proposed agreement between Telstra and TPG

An MOCN NaaS agreement relies on the network infrastructure and spectrum holdings of the main operator and the access operator does not contribute any (significant) infrastructure or spectrum to the agreement. This is different to an MOCN JV, in which spectrum and equipment held by both operators is pooled into one entity owned by these operators.

Spectrum leasing can, and in the Telstra–TPG case is proposed to, occur alongside the MOCN NaaS agreement if the access operator holds spectrum it would not otherwise use. The access operator will typically then lease the spectrum to the main operator, giving the main operator possession and control of the spectrum (for use on the main operator's network) for a predefined period of time. Spectrum tends to be licensed over a long period of time (approx. 20–25 years), and this is the case for the planned Telstra-TPG spectrum lease (10-20 years) so that spectrum is available for the duration of installed network electronics and antennas. The spectrum leasing agreement proposed by Telstra and TPG will, in all likelihood, be signed alongside the MOCN NaaS agreement and subsequently influence the terms of the NSA. However, even if agreed at the same time, the spectrum lease and NaaS may not be technically linked as the spectrum could, in theory, be leased without an NSA, and the agreements proposed indicate that the spectrum leasing could persist separately.

Of particular note to these bilateral agreements is the possibility of price distortion. For example, the parties might be willing to agree relatively high prices[4] for both spectrum lease and NaaS access charges because, in the end, each operator's financial position will be the net of fees and charges in opposite directions.

It is important to note that spectrum leasing is typically subject to spectrum authorisation rules and regulations, as well as approval from the regulatory authority. For example, spectrum is often allocated according to spectrum caps set in auctions to avoid having too large a concentration of spectrum in the hands of one operator. In addition, the majority of MOCN agreements, as reviewed in Annex A, do not include spectrum leasing, which is generally considered as a separate agreement. The main aim of

4 Relatively low prices are also possible (e.g. almost free spectrum lease in return for almost free network access), but less likely, in our opinion, due to the risks of low network access costs to competition between main and access operators.

regulators here is to strike a balance between ensuring spectrum is used efficiently, while allowing spectrum allocation to support effective competition between players. Spectrum allocation is a key lever for authorities to implicitly foster the action of inter-operator competition. For example, if an operator with a large market share (such as Telstra) faces network congestion in certain parts of the network due to high peak traffic loads (i.e. lower QoS) as a result of having a relatively high number of subscribers compared to the proportion of spectrum it holds, then there should be an incentive for subscribers to move to the competing network operator with fewer customers as the network QoS offered should be higher.

3.3 A number of issues and their impact on competition have to be considered for the proposed MOCN NaaS that do not exist with an MOCN JV and other forms of sharing

By its nature, the MOCN NaaS is an asymmetric NSA: 'where the asymmetries are' and 'what their impact is' are key questions to be addressed when evaluating an MOCN NaaS (compared to more closely symmetrical forms of network sharing, including JVs). In particular, impact should be gauged in terms of network control and differentiation, ability to launch new services, select vendors, as well as benefits to each party, both within the agreement and in the market as a whole (i.e. for consumers and relative to other operators). Concerns also arise regarding limitations for infrastructure-based competition and technology innovation. TPG is expected to decommission its infrastructure in the regional areas; as a result, its future ability to differentiate services, coverage and determine additional site deployment to compete for regional customers will be removed. Instead this will be managed by the opportunities permitted by the economic and commercial constraints of the NSA.

The nature of the competition arising after the proposed NSA is critical to its evaluation. TPG is expected to decommission over 700 sites in the regional areas and has recently agreed to sell its passive tower assets to OMERS Infrastructure Management.[5] As a result, TPG's presence in the regional areas will be served primarily by the NaaS offered by Telstra, with very limited reversibility to re-install its own regional radio access network, especially for 4G and 5G covered by the NSA. TPG will likely significantly reduce its fixed costs (opex, capital costs and depreciation) in the regional areas by removing its network, in return for the set of contractual fixed and variable costs set by the NSA NaaS prices.

The nature of competitive pressure exerted by TPG in the regional areas will be strongly influenced by the NaaS commercial terms, i.e. wholesale price of mobile services. This is because any customer living in a regional area is likely to generate the majority of its traffic on the regional network, i.e. using NaaS wholesale services. As a result, TPG's offer to regional customers depends on those wholesale terms, and will be impacted by any differences from the current (pre-NSA) situation where TPG has invested capital (fixed costs, sunk costs) in the regional areas. One possible outcome from this is that TPG uses the regional NaaS network area primarily to provide occasional away-from-home regional coverage for its metropolitan customers, and reduces its efforts to market to customers living in the regional areas under the NaaS agreement. TPG will not be able to outcompete its host Telstra because those prices

5 https://www.omersinfrastructure.com/news/omers-infrastructure-announces-agreement-to-acquire-its-first-asia-pacific/

will be set by the agreement with the host. This situation can be considered analogous to MVNOs who face a similar limit to effective competition, due to the wholesale access prices agreed with the host network. Even with a market pricing mechanism to allow wholesale prices to be adjusted, those market prices may not fully reflect the underlying cost efficiencies gained by the MOCN network operator, as market prices are determined by the broader actions of competition.

Assessing the extent to which cost efficiencies gained by the MOCN network operator are directly passed through to the access operator is necessary, as distinct from market price trends debated by the parties before negotiating the level of price trend to apply to wholesale costs. Furthermore, an asymmetry is likely in this process – the main operator will argue that inflationary cost increases (e.g. fuel, electricity, labour) trend strongly upwards, without disclosing the economies of scale and cost benefits (achieved rapidly) with the activation of the spectrum sharing agreement. These economies would also take some time to pass through to retail prices as Telstra would be able to offer greater data volume and/or faster speed packages to its existing and future user base.

4 Circumstances of the planned NSA in Australia

In this section we outline our understanding of the key features of the planned NSA, and highlight issues regarding network coverage, amounts of spectrum, headline speed and potential impacts on competition.

4.1 Overview of the Telstra – TPG agreement

The proposed ten-year MOCN NSA involves regional and 'urban fringe' areas in Australia, covering between 81.4% and 98.8% of the population. The proposed agreement exists in three different parts; the MOCN service agreement, a mobile site transition agreement and a spectrum authorisation agreement. The agreements provide each party with a different set of benefits, with the aim of mutually complementing existing assets. In particular:

- Mobile site agreement and spectrum authorisation: Telstra will receive access to TPG's spectrum to operate 4G and 5G services in the relevant areas, increasing the capacity it has available for these services; it will also be allowed to deploy its own infrastructure on up to 169 of TPG's mobile sites. Telstra expects the agreement to generate an additional AUD1.6–1.8 billion in revenue over the ten-year period.

- MOCN agreement: TPG will receive access to approximately 3700 of Telstra's mobile network site assets, as well as its RAN, to offer 4G and 5G services in the relevant areas. This is expected to extend TPG's 4G coverage from 96% to 98.8% of the population. As a result of access to Telstra's assets, TPG will decommission 725 of its own sites that are located in areas included in the agreement.

Both operators will continue to operate separate core networks. Telstra will maintain the exclusive coverage between 98.8% and 99.4% of population, where it has approximately 750 sites. A summary of the future proposed situation (agreement-based) and current situation of Telstra and TPG is provided in Figure 4.1.

Figure 4.1: Summary of future proposed and current positions of Telstra and TPG [Source: Analysys Mason based on official press releases, TeleGeography, 2022]

Item	Current situation		Future proposed situation (Telstra-TPG agreement)	
	Telstra	TPG	Telstra	TPG
4G coverage	~99.4% of population[6]	~96% of population	*Same as the current situation*	~98.8% of population
Mobile sites in	3700 sites	725 sites plus 3G roaming on ~1700 Optus 3G sites in	Access to 169 of TPG's mobile sites to deploy own	Access to Telstra's RAN and ~3700 of its sites;

6 As of June 2021.

Item	Current situation		Future proposed situation (Telstra-TPG agreement)	
	Telstra	TPG	Telstra	TPG
agreement area		the 81.4%+ population regional area	infrastructure, implying 3869 sites in total (less than 5% increase)	decommissioning of 725 own sites, becoming fully dependent on Telstra's infrastructure
Spectrum[7]	700/850/1800/ 2100/2600/ 3500MHz	700/850/1800/ 2100/3500MHz and in some areas roaming on Optus's spectrum	Access to TPG's spectrum to operate own 4G and 5G services	None – spectrum is leased to TPG

The main direct (i.e. short- to medium-term) changes are highlighted below:

- **Increases in coverage are anticipated to be small**: fewer than 5% sites added for Telstra, which are likely to be in existing coverage areas as they come from TPG's stock of sites, therefore only enhancing network capacity in the 81.4–96% area for Telstra.
- **Increases in the presence of service competition are anticipated to be small:** Telstra, Optus and TPG are all present and offer services in the majority of the regional areas in the current situation (TPG via roaming) and in the proposed sharing situation (TPG via MOCN NaaS).
- **Increases in the availability of technologies are evident but unclear in extent:** there does appear to be an improvement in 4G coverage for TPG at the margin (96% to 98.8% of total population).
- **More spectrum is put to use in the regional area:** the main beneficiary of spectrum utilisation appears to be Telstra, with a significant increase in the active spectrum on its regional network. TPG will gain benefits from NaaS access to this spectrum, but given Telstra's substantial market share, the capacity (relieving congestion, where present in the radio network) and speed benefits will materially benefit Telstra's subscribers. There could also be improvements to Telstra's fixed wireless access (FWA) proposition and national broadband network (NBN) failover capabilities, where Telstra also has the largest market share[8] of NBN services, around 44% which is nearly double that of TPG and three times that of Optus.

We note that MOCN NaaS is an uncommon type of MOCN, especially when combined with a spectrum leasing agreement. Only a few such examples can be found worldwide, e.g. in South Africa as illustrated in Annex A Figure *A.1*: Summary of NSAs analysed [Source: Analysys Mason, 2022], albeit under very different market dynamics and operator circumstances.

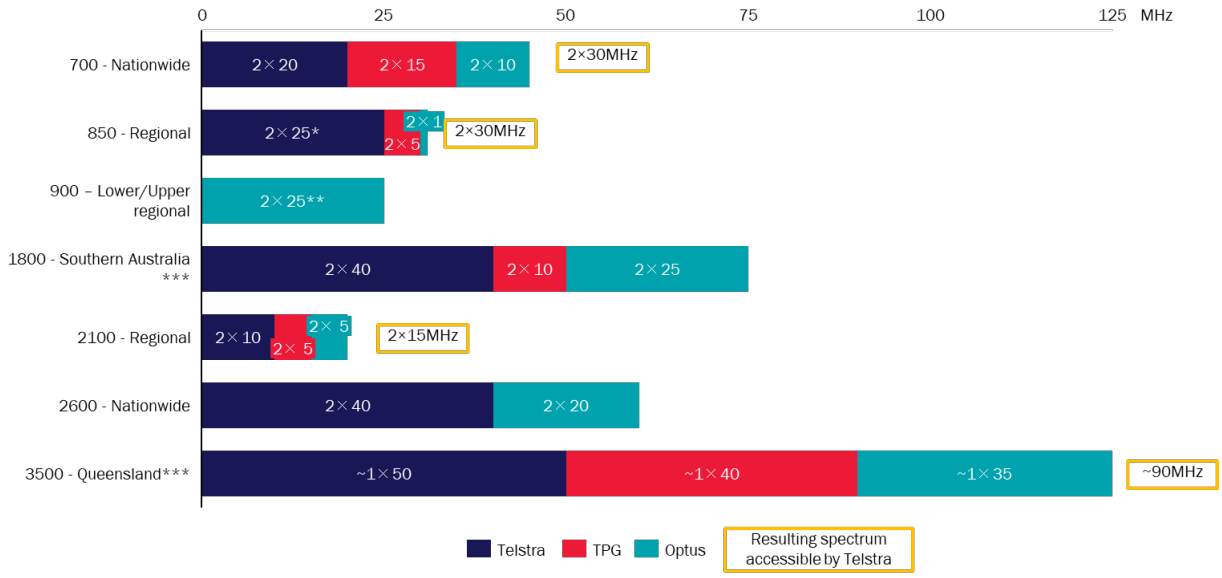
8 ACCC Communications Market Report 2020-21

4.2 Telstra will hold ~65% of all spectrum with the lease from TPG: this agreement might be subject to spectrum caps and require review to ensure other parties are not adversely affected

Quantity of spectrum

With the aim of estimating the impact that the spectrum leasing agreement associated with the Telstra–TPG NSA would have on spectrum holdings, below we present a high-level analysis of existing licences. Starting from a list of spectrum holdings based on data published by the Australian Communications and Media Authority (ACMA), we segmented licences by MNO and spectrum band. As different licences often assign the same spectrum bands on a geographical basis, i.e. in different areas of the country, we included the spectrum allocation where relevant in regional areas or representative regional areas. A summary of spectrum distribution is reported in Figure 4.2.

Figure 4.2: Main spectrum distribution amongst operators [Source: Analysys Mason based on TeleGeography, ACMA Register of Radiocommunications Licences, 2022]



* of which 2×10MHz only available in 2024

**only available in 2024

*** Representative regional allocation, other regions have different spectrum allocations

Our analysis shows that the combined spectrum held by Telstra in the MOCN NaaS arrangement would amount to ~65% of total spectrum available;[9] compared to the ~46% of spectrum currently held by Telstra alone. The spectrum leasing agreement is therefore expected to significantly affect spectrum distribution between competitors in Australia, skewing it towards the main NSA operator Telstra by a substantial degree.

Telstra will hold – via ownership and leasing – 2×60MHz of low-band spectrum (700/850/900MHz) and Optus will have access to 2×36MHz of low-band spectrum (of which 2×26MHz from July 2024). Low-band spectrum is key for coverage due to its favourable propagation characteristics; limited access to low-band spectrum would affect an operator's ability to provide adequate coverage of high-speed mobile broadband, especially in remote areas. We understand the ACMA set a spectrum cap of 92MHz below 1GHz in the regional areas in the latest spectrum auction in 2021.[10]

Telstra will also hold – via ownership and leasing – ~2×95MHz of mid-band spectrum (1800/2100/2600MHz) and ~90MHz of 3.6GHz spectrum (up to a maximum of 125MHz), compared to ~2×50MHz mid-band spectrum and a maximum of ~35MHz of 3.6GHz spectrum for Optus. Spectrum in the mid and high bands is key to providing capacity, less spectrum in these bands could affect an operator's ability to support traffic and provide adequate QoS and speed to its subscribers. We understand that in the 3.6GHz auction in 2018, the ACMA set a spectrum cap of 80MHz of spectrum in the regional areas.[11] When combining Telstra and TPG's spectrum in this band, the spectrum cap is exceeded by 10 to 45MHz[12].

As discussed in Section 3.2.4, spectrum leasing is not specifically required for an MOCN NaaS arrangement. The spectrum leasing agreement itself will have technical and commercial effects on operators and a change in spectrum distribution can significantly affect competition dynamics in the market due to its fundamental role in supporting coverage, capacity, headline speed and technology generations. The spectrum leasing agreement could therefore effectively "lock-in" the market structure in the short and medium term, with no new spectrum available for existing and new MNOs. This would significantly reduce the competitive rebalancing effect which arises when an operator gains a large share of the market without a corresponding large share of spectrum – the rebalancing occurs because the operator suffers congestion and offers lower QoS as a result. Assessing the spectrum leasing agreement as a standalone agreement is likely to be necessary to understand the full impact of the proposed arrangement between TPG and Telstra. We note that the spectrum authorisation agreement does not automatically expire if the MOCN agreement expires or is terminated, meaning it could continue as a standalone agreement if both parties wished it.

In general, and in the light of these estimates, if a spectrum leasing agreement was not included in the NSA, spectrum holdings would be less likely to be concentrated in the hands of a single operator.

9 Taking into account spectrum already assigned for future use.

10 https://www.acma.gov.au/spectrum-allocation-and-auction-summary-850900-mhz-band-2021

11 https://www.acma.gov.au/auction-summary-36-ghz-band-2018

12 In Regional Western Australia Telstra holds 80MHz and TPG holds 45MHz

Conversely, a separate leasing agreement would require an additional, thorough, spectrum review to ensure that no operators control excessive amounts of spectrum on a standalone basis.

Looking forward, while the spectrum leasing agreement does not appear to constrain TPG's activities in bidding for new spectrum, in the regional areas TPG will have little or no infrastructure with which to use such spectrum. This could potentially lead to a situation with new spectrum awards where Optus and potential new entrants found themselves bidding for spectrum against both:

- Telstra and
- TPG backed by the Telstra network and TPG's ability to monetise further spectrum in more leasing to Telstra.

Also, TPG may only be interested in acquiring a notional amount of additional spectrum in regional areas to be able to further negotiate better NaaS in return for further spectrum lease.

Headline speeds

The spectrum TPG provides will allow Telstra to further optimise carrier aggregation between different bands and increase carrier sizes. This will allow even higher speeds and, consequently, a significant increase in headline speeds in the regional areas – potential headline speed is generally determined by the largest aggregated spectrum carrier available. Telstra's potential speeds are unachievable on Optus' network due to its significantly lower spectrum holdings. Currently, absent the proposed spectrum share, Optus's speed capabilities can be considered broadly comparable to Telstra's speed (we estimate approximately 50–33% slower in key bands, before aggregation).

In the 3.5GHz band, Telstra will have access to a total of ~90MHz (depending on the region) compared to ~50MHz without the TPG agreement, which again will allow for the deployment of a larger carrier and significantly increase speeds. In addition, Telstra's current holdings of 50MHz are not conducive to the deployment of mMIMO technology. Holding 90MHz of spectrum, however, allows for economically efficient deployment of mMIMO, allowing a further increase in speeds by a factor of four. Optus only holds 25–35MHz in this band (depending on the region) and could therefore only offer a fraction of the speeds offered by Telstra, as shown in Figure 4.3. With the deployment of mMIMO using 90MHz we estimate Telstra could achieve speeds of 405Mbit/s, compared to the speeds of 39Mbit/s for Optus, which is unable to economically deploy mMIMO due to its low spectrum holdings in this band.

The latest 3GPP specifications allow for aggregation of multiple 5G carriers to above 100MHz, which means that Telstra is likely to be able to further increase headline speeds in the regional areas by aggregating the 3.5GHz band with other 5G spectrum or acquiring additional spectrum in a future auction.

A similar impact is seen in the 700MHz band, which is essential for coverage and of particular use in rural areas. Telstra is expected to be able to achieve speeds of 45Mbit/s while Optus will only be able to offer speeds of 15Mbit/s, less than half. This analysis doesn't take into account the impact of

optimised carrier aggregation which could further benefit Telstra given a broader portfolio of spectrum with the proposed sharing agreement.

Figure 4.3: Achievable 5G headline speeds in the 3.5GHz band (Mbit/s) [13] [Source: Analysys Mason, 2022]

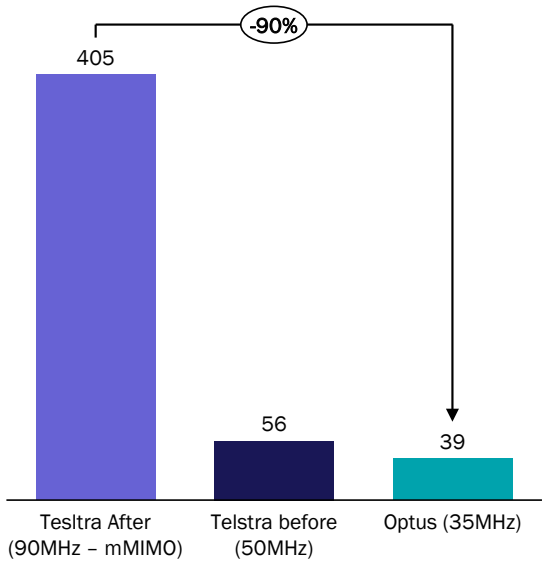
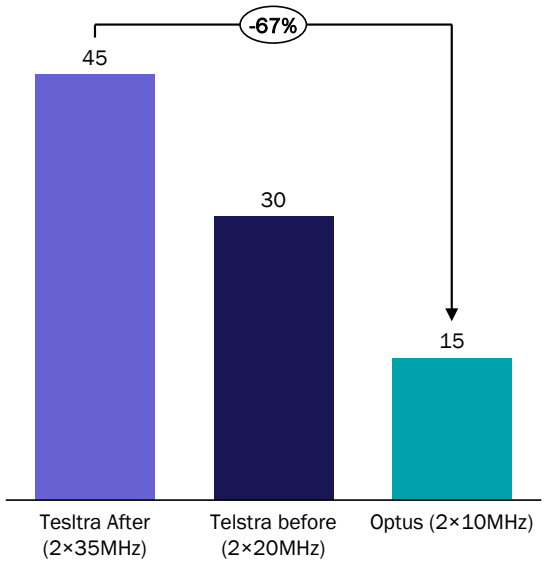


Figure 4.4: Achievable 5G headline speeds in the 700MHz band (Mbit/s) [14] [Source: Analysys Mason, 2022]



Similarly, spectrum available to Telstra will increase in the mid-band, with additional spectrum in the 2100MHz band allowing Telstra to increase headline speeds. The additional spectrum provided by TPG could enable Telstra to deploy larger carriers and/or allow for different carrier aggregation configurations. In the 2.6GHz band, Telstra holds double the spectrum Optus owns and is already able to offer double the speeds Optus can achieve on its network.

The overall effect of licensing TPG's spectrum in the regional areas to Telstra for ten or more years provides Telstra with a dominant (~65%) occupancy of spectrum in the regions. This leads to substantial technical benefits, allowing Telstra to offer much higher network speeds. These higher network speeds will not be achievable by Optus, the remaining competitor, from a technical standpoint, as Optus has less spectrum and from an economic standpoint, due to the cost–benefit consideration of deploying mMIMO without sufficient carrier bandwidth. As a result, Optus's speed-based offers (or that of any potential new entrant) to customers in the regional areas are unlikely to be competitive in the medium to long term compared to Telstra's.

13 It is important to note that spectral efficiency will depend on a number of factors and vary for users and within the cell. The estimation is based on a 5G spectral efficiency of 1.5MBit/s/MHz, we take into account overhead capacity to coordinate network (20%), a full buffer adjustment (65%) and a realistic loading adjustment (85%), additionally, for the 3.5GHz band we include a downlink spectrum multiplier (75%).

14 The estimation is based on a 5G spectral efficiency of 1.5MBit/s/MHz, we take into account overhead capacity to coordinate network (20%), a full buffer adjustment (65%) and a realistic loading adjustment (85%).

4.3 The NSA will have an impact on competition in the infrastructure, wholesale and retail markets as well as between MNOs

As discussed in Section 3, MOCN NaaS is proposed as an asymmetric NSA, meaning Telstra will have primary control over the network infrastructure including the backhaul, sites, network equipment and spectrum. TPG will be reliant on the network and its access to different technologies (4G/5G) will be determined by the contractual conditions of the NSA. Although TPG will be able to treat the RAN as its own, service differentiation will likely be limited due to its reliance on Telstra's infrastructure, choice of vendors and software upgrades – as a result, TPG is unlikely to be able to offer better services than Telstra.

TPG is expected to decommission 725 sites and rely on Telstra's infrastructure in the regions covering the remaining 81.4–98.8% population. Optus will offer the only alternative 4G network in the regions covering 81.4–98.5% of the population; in this area, Telstra has ~3250 sites while Optus has ~2250.[15] The overall impact of the NSA is therefore a reduction in infrastructure and infrastructure competition. In addition, the agreement is not expected to increase coverage in the remote areas or increase coverage of the 5G network in the regions covered by the NSA. A possible effect is a reduction in demand for tower infrastructure, which may lead to reduction in the number of players competing to offer tower infrastructure to MNOs (i.e. upstream concentration). Whilst there are benefits to be gained from reducing duplication of tower infrastructure, the effect on the infrastructure market could have implications for Optus which leases sites from various tower owners, potentially including Telstra and TPG (who plan to consolidate infrastructure use as a result of the NSA).

The reduction in infrastructure competition directly affects the wholesale market, with fewer networks available to offer wholesale services to other operators or MVNOs. This may be seen in two areas. First, TPG may have limitations in terms of the MVNOs or other parties (such as 5G-only private network enablers) it could support with wholesale services. Second, the current wholesale market regional roaming will be substantially reduced, or at least not broadened, for the likely duration of the NSA.

The reduction in the number of networks also affects the retail market and therefore consumers. The impact on consumers will differ depending on their host MNO:

- Telstra customers are expected to benefit from improved QoS and speeds due to the additional spectrum available on Telstra's network through the spectrum leasing agreement.
- TPG customers will benefit from access to a network with better coverage, QoS and speeds.
- Optus customers will see no benefits from the Telstra–TPG NSA, and the customers sensitive to coverage and/or QoS and/or headline speed might consider switching operators to access Telstra's network (via Telstra or TPG depending on the retail choices available).

It is also important to note that the costs faced by Telstra and TPG will be different, depending on the details of the charging mechanism. Telstra is faced with the fixed costs of its network, therefore as

15 As at March 2022.

traffic load increases, its unit costs of traffic decreases. On the other hand, TPG is faced with a combination of fixed and variable wholesale costs, meaning that as TPG's traffic demand increases its unit costs will not decline in the same way as Telstra, and could even increase depending on the wholesale price rules. It is therefore important to understand the dynamics and impact of the charging mechanism in comparing the marginal and average unit costs and hence competitiveness of Telstra and TPG in the regional proportion of their traffic for regional residents and for regional visitors (from urban areas).

The evolution of wholesale prices (particularly mobile data) over time is also a key determinant of TPG's competitiveness and Telstra's profits. Reference wholesale prices are intended to be linked to industry trends[16] but the functioning of this mechanism is important to understand. While TPG may be able to 'keep pace' with retail price trends, at the same time Telstra could benefit from much greater profits as a result of substantially declining network unit costs (driven by improved spectrum portfolio and regional network economies of scale). This mechanism for determining the retail price trend should be assessed: e.g. Is it a function of all relevant segments of retail competition dynamics? Does it suffer from significant lag or numerical bias such as only referring to headline prices?

In addition, even if there was no contractual restrictions to TPG agreeing other network deals in regional areas, it should be assessed if there are effectively economic restrictions arising which reduce TPG's competitive optionality. For example, economic restrictions could arise from price structure (e.g. having to pay fixed and per-user fees regardless of the amount of traffic carried by the Telstra NaaS).

Although the MOCN NaaS and spectrum leasing agreements will benefit Telstra and TPG customers in the short term, there is a risk that the intended superiority of their network prohibits Optus (or any potential new entrant) from competing and harms competition in the long term. Due to its superior coverage, QoS and speed (combined with a low unit cost of traffic), there is a concern that no other operator will be able to compete with services offered on Telstra's network. This concern has been justifiably expressed by Optus in relation to competition potential with Telstra's further-endowed (with spectrum) network. It is also relevant to consider whether TPG can effectively compete against Telstra's retail market offers, according to the commercial arrangements of the NSA, particularly as we understand that there will be a delay in TPG's access to the 5G network sites. Optus's incentives to invest would be reduced in the long term where it does not have the prospect of effectively competing against the scale and spectrum advantages of Telstra's network.

16 Paragraph 116c of the Application document

5 The aims and drawbacks of NSAs

In this section, we summarise the main aims of NSAs, introduce potential drawbacks which should be weighed against those benefits, and conclude with a variety of questions which the ACCC could analyse in considering whether the spectrum sharing and NSAs are in the long-term interests of end users.

5.1 The main aim of NSAs is to allow mobile network operators (MNOs) to reduce costs and facilitate network expansion and technology upgrades

As mobile markets have matured, competing operators have deployed software and/or hardware upgrades to their network equipment which enable active[17] network infrastructure and electronics (amongst other network elements) to be shared by those operators. Network sharing has also been driven by decreasing ARPUs and the need to maintain or increase profitability. By sharing network deployment, and some associated operations and maintenance, the main cost-reduction aim of NSAs can be achieved. A key feature of NSAs is that they enable both (or all) of the sharing operators to transmit their individual public land mobile network (PLMN) codes to their subscribers, and hence their end-users' handsets remain 'on their own network' even though the RAN is delivered through shared active electronics.

This section considers the benefits and the drawbacks that can be associated with NSAs. We include in this section the views set out in the BEREC's[18] common position on mobile infrastructure sharing,[19] which was issued in June 2019. The document highlights several points that are relevant to NSAs in non-EU jurisdictions. BEREC's common position presents benefits and drawbacks to mobile NSAs; we have summarised these below and also expanded the list based on our own expertise.[20]

5.1.1 Intended benefits of NSAs are centred around cost reduction and improved services for customers

The intended benefits to be gained from network sharing are material. The opportunity for operators to share infrastructure, pool resources and reduce duplication of equipment across many thousands of radio sites in a country can generate millions of dollars of (saved) asset value for the sharing operators over time. The way in which this value is realised will have a fundamental impact on suppliers and consumers in the market. Some of these intended benefits will be certain and quantifiable (e.g. if the NSA specifies

17 This report focuses on active network sharing, i.e. electronics and network transmit/receive equipment, as opposed to passive network sharing, where only passive equipment is shared e.g. towers, containers, etc.).

18 Body of European Regulators for Electronic Communications, which comprises the national regulatory authorities (NRAs) of the Member States of the EU.

19 BEREC, *BEREC Common Position on Mobile Infrastructure Sharing* (2019; BoR (19) 110). Available at https://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/8605-berec-common-position-on-infrastructure-_0.pdf

20 We note that the BEREC's common position describes the list of criteria as non-exhaustive.

the numbers of sites to be deployed jointly in a new coverage area), whilst others will be less certain or not easily measurable (e.g. public interest benefits).

Cost reduction (potentially leading to improved coverage and/or lower prices)

In general, mobile network sharing provides cost savings compared to building separate networks; savings may apply to both existing and future coverage. The cost saving potential is highly context-specific and is dependent on a wide range of factors including network design (spectrum and technologies deployed), location/geography of sharing, the type of sharing and the level of demand in different areas of the country.

These reduced costs can lead to the choice to serve more rural areas with the deployment of improved coverage. Reduced costs can also lead to lower consumer prices (as a result of lower unit costs of traffic) if there is enough competitive pressure to do so. Here it is relevant to consider whether operators have sufficient incentives to realise these benefits for consumers, either because there is unmet demand or desire for extra presence in uncovered rural areas, or because competitive pressure in the market will reduce operator surplus and enable lower costs to be passed through to consumers in lower prices.

Improved efficiency

Where spectrum is shared, this can result in more efficient use of this scarce resource, by allowing the spectrum resources to support more users (and traffic). This is particularly the case if one of the operators has more subscribers per unit spectrum in a band or bands of interest. It should be noted, however, that any efficiency gains may be counterbalanced by leaving the available spectrum partly unused (see Section 5.1.2).

Spectrum sharing or spectrum pooling can also allow sharing operators a feasible migration path from one technology to another within an existing band; this can be useful in situations where neither operator is in a position to operate both technologies simultaneously in that band. By allowing such a migration to more modern technologies that use the spectrum in a more efficient way, it can benefit overall efficiency.

All other factors being equal, pooled spectrum can also allow services offering higher peak speeds, due to the use of wider contiguous bandwidths. Depending on the antenna technologies in place, wider spectrum bandwidths can be of particular benefit to transmission using multiple input multiple output (MIMO).

Enhanced consumer choice

In some areas (e.g. rural areas), mobile network sharing may allow service-based competition, which would not otherwise be present (e.g. if operators decided not to deploy their own individual competing networks in these areas on the basis that it would not be economically viable to do so). This is similar

to the "increased coverage" benefit which can result from reduced costs (if operators perceive that customers want increased choice of operators with coverage).

Public interest benefits

Mobile network sharing requires fewer mobile sites than there would be under equivalent network deployments without sharing arrangements. Fewer sites may be considered better from an environmental/local impact perspective. It is also possible that the smaller number of sites may consume less energy (certainly fewer resources would be expended in their construction, for example).

5.1.2 Possible drawbacks can occur due to the reduced incentives to compete and cost reduction failing to reach customers, and adverse effects on other operators therefore affecting competition

Alongside the intended benefits, there is a range of possible drawbacks arising from an NSA. Some of these drawbacks are linked to the detailed commercial and technical nature of the sharing agreement, and hence may require deeper investigation to ascertain, estimate or quantify. Others are important to investigate, but arise indirectly as impacts on the wider market.

Reduced incentives or ability to invest in and compete on network capability

Mobile NSAs can restrict operators' incentives to invest in additional network capability, as they will not be the sole beneficiary. Depending on the type of sharing agreement, investments they make for their own services may also provide benefits to their sharing partner. Investments in additional network capability can include:

- coverage (i.e. providing more sites and/or deploying lower-frequency spectrum)
- capacity, including peak and average network speeds (i.e. activating more spectrum on each site and/or deploying new higher-capacity radio techniques, such as higher modulation schemes, carrier aggregation, MIMO, and/or upgrading to 5G)
- functionality (i.e. other non-coverage non-capacity functions, such as convergence with fixed services).

Concerns over investment can potentially be managed by including certain commitments or KPIs in the agreement, to ensure that investment is not stifled.

The question of capacity and peak/average network speeds is of particular relevance to 4G and 5G NSAs in situations where spectrum is involved in the sharing arrangement. This is because operators with fewer subscribers and larger spectrum bands can offer higher speeds than operators with more subscribers and (relatively) less spectrum. This speed differential is a key

competitive differentiator between mobile operators, and of great significance to smaller competitors which can challenge larger players 'on quality'. Average and peak speed is of importance to consumers who are increasingly aware of the performance (or poor performance) of their mobile data services when the 3G, 4G or 5G icon is present on their smartphone screen.

In addition to changing their *incentives*, sharing agreements may also restrict operators' *abilities* to compete/differentiate their networks, in particular on coverage. The impact of reduced incentives to invest and ability to compete will be highly context-specific and depend on the type of agreement and local market and geo-demographic landscape.

Reduced incentives or ability to compete on price

Sharing operators will be making use of the same network in certain parts of the country, and so share a similar cost base. The marginal costs faced by each operator however will be dependent on the charging mechanisms agreed in the sharing agreement. For example, the sharing operators might face similar marginal costs of traffic (for example, if the shared network charged each operator on the basis of a price per minute or per MB). In such circumstances, the retail offers of the operators might become more similar, limiting their ability to create innovative retail offers and dampening retail competition. In the Telstra – TPG case, the two operators are not charged the same prices and price structure, and so an issue to be assessed is what impact this asymmetry has on competition.

Reduced incentives or ability to compete in the wholesale market

In a related way, a sharing agreement could reduce the incentive or ability of operators to compete at the wholesale level (i.e. support mobile virtual network operators (MVNOs) and/or national roaming operators), if the sharing payments between the operators were based on the volume of users or traffic. Again, the charging mechanisms in the agreement are key, as well as commercial exclusivities or permissions allowing each MNO to host MVNOs, service providers, etc.

Requirement for increased co-ordination

The requirement for increased co-ordination between the sharing operators creates a greater level of information exchange, which might (but should not if properly controlled) result in exchange of commercially sensitive information in breach of competition law or in tacit collusion between the operators. This could affect service dynamics beyond those covered by the sharing agreement.

A second risk is that the co-ordination requirement creates delay, due to the time taken for additional joint decision-making processes, and bureaucracy (not least to prevent the unwanted illegal information leakage). These delays

can happen at both the strategic level (e.g. network design and strategy) and the operational level (e.g. network deployment[21]).

A third co-ordination risk is that depending on the nature of the agreement, one operator may know that the other operator will learn of its plans ahead of launch and may be discouraged from making such investments as it will gain limited first-mover advantage. Even if investments are not reduced as a result of this effect, the joint plans for network upgrade are likely to be discussed in some detail during the preparation of the NSA. There can also be associated co-ordination effects in non-shared parts of the network, as core network and standalone urban deployments must be consistent and compatible with the shared network area. For example, creating a barrier or delay to 5G upgrade in the shared network could affect one party's decision to upgrade to 5G in other parts of its network. The choice of future core network vendor might also be restricted by the need to support the NSA part of the network, and not all vendors may be compatible.

Finally, the operation of an NSA requires mechanisms for information interchange and mechanisms to punish breaches. Unless care is taken, the information flows and inter-payments associated might lead to effective understanding of the competitor's behaviour.

Reduced network resilience

Sharing mobile network infrastructure may in some ways reduce the overall resilience of the telecoms networks in a given location or geographical area. The level of sharing affects the network resilience risk: if only masts or towers are shared then the risk is only to a particular site, and only if the site is physically compromised (e.g. fire, flood, landslip or earthquake). However, if the level of network sharing is more comprehensive, potentially a single fault in the network controllers could affect both networks on a wide-area basis.[22]

Risks to non-sharing operators (due to inability to replicate the cost and/or capability of the shared network)

There are two risks to non-sharing operators in the market:

- The cost saving benefits to the sharing parties might damage competition in the long run if similar cost savings are not available to, or cannot be achieved by, other operators in the market. Three-player markets where two players share could be a particular concern for the remaining player.

21 E.g. deciding which sites to prioritise for maintenance scheduling.

22 It is notable that high-profile network outages for O2 in the UK did not affect the services of Vodafone, despite their active NSA. This is because the outages were due to a fault in the core, which is not shared between the operators. https://www.ofcom.org.uk/__data/assets/pdf_file/0014/175010/o2-network-outage-cceb.pdf

- Similarly, if the sharing operators are using spectrum pooling, they could offer higher peak speeds than could be offered by competing non-sharing operators.

Market structure is critical to this concern. In a four-MNO market, sharing between two operators would still leave the remaining two operators with the option to also form a sharing deal. However, in a three-MNO market such as Australia, sharing by two of the operators might mean that the remaining operator could be unable to replicate the costs and performance of the shared network.

Long-term inter-dependence (lack of reversibility)

Depending on the nature of the NSA, the operators might lose their ability to withdraw from the agreement in the future. Regulators consider such a lack of reversibility a concern, especially if the agreement is leading to other drawbacks (discussed elsewhere in this section).

Practical concerns also apply: it is easier to reverse a NSA if the operators each still have access to the relevant hardware and software platforms, local maintenance teams, as well as staff with the relevant skills and experience in house. This highlights the advantage of NSAs which divide the geographical area in two, with each operator looking after half the country. Although the scale of each operator's resulting network (and network staff) will be smaller than if they were operating nationally, it means that they are in a position to reverse the agreement in a reasonable timescale if necessary, by scaling up capabilities they have maintained in house.

Partial use of spectrum held by the sharing operators

A corollary of reduced unit costs is that in some geographies, and depending on end-user demand levels and the nature of competition, sharing operators might choose not to put all their spectrum into use. It is uncertain whether this could arise depending on the amount (scarcity or excess) of spectrum which the shared network was operating, however if this behaviour were sufficiently widespread it would in effect result in some of this public resource remaining unused and therefore in lost opportunity costs.

Two related issues are that:

- the sharing agreement might result in the sharing operators having control over too high a proportion of the total available spectrum (either in total or in particular bands); and/or
- the sharing agreement might result in the sharing operators having a total spectrum holding which is in excess of any caps imposed during the process to award that spectrum.

It might therefore be that end users would be better served if some or all of the spectrum held by the sharing operators were made available to competing operators.

Possible distortions of related markets

As noted, mobile network sharing typically leads to a reduction in the number of mobile sites that would be needed in the absence of an agreement, prompting operators to decommission fixed assets (e.g. mobile towers) that they no longer require. As a consequence, all other things being equal, the value of such assets is likely to decrease irrespective of their residual lives. It can also reduce the ability of towercos to support diversity in competition in the end-user market (e.g. with better deployment terms, new site types, small cells, etc.) because there are fewer buyers of sites (only the shared network entity purchases site access).

5.2 It is important to weigh up the possibility of drawbacks that could harm consumers alongside the intended benefits from an NSA

The considerations set out above on the benefits and drawbacks of NSAs point to the need for NRAs to carefully evaluate such agreements on a case-by-case basis.

While on some elements – such as network resilience and strictly controlled co-ordination between parties – reassurance can be provided by sharing operators, other aspects may pose significant risks. In the case of a three-player market such as Australia, the impact on competition of an agreement between two operators is a key issue, especially in respect of the competitive landscape for the two sharing operators competing against the remaining non-sharing operator. The differing effects on the three players in the market influence each player's decisions on investments in network infrastructure and, in turn, the provision of service to consumers.

5.3 Conclusions

The conclusions from our analysis indicate that there are a wide range of key aspects which we believe are essential to understanding the spectrum leasing and MOCN NaaS agreements between Telstra and TPG, and essential to assessing their likely impacts on the Australian market and consumers in the short- and long-term.

Annex A Review of international case studies for MOCN NSAs

Analysys Mason reviewed relevant NSAs worldwide to better understand the context and considerations arising from the planned NSA between Telstra and TPG, including the leasing of spectrum from TPG to Telstra. The table below summarises the key findings.

Figure A.1: Summary of NSAs analysed [Source: Analysys Mason, 2022]

Countries	No. of MNOs[23]	Market share[24]	JV	Technology generations	Shared spectrum[25]	Geography[26]	Regulatory position	Regulatory highlights
Examples of MOCN NSAs								
Australia	3 → 2	69%		4 5	~70%	Suburban; rural	Pending	Pending assessment
Latvia & Lithuania	3 → 2	62% LVA 73% LTU	Y	2 3 4 5	~57% LVA ~67% LTU	Urban; suburban; rural	Remedies imposed	Imposed regulatory limits on spectrum sharing; terminated by operators
Czech Republic[27]	3 → 2	74%		2 3 4	No	Urban (partly) ; suburban; rural	Pending	Remedies imposed, approval pending

23 Total market MNOs → MNOs considering NSA combinations

24 Market share of combined entity

25 Spectrum licenced to NSA MNOs (or JVs) as a share of total licenced spectrum (actual NSA perimeter may differ; when information was available we took it into account in the calculation)

26 The estimations are inherently approximate as geographical definitions are not fully consistent between countries. Only some countries are considered to contain Distant geographies covered by mobile networks (Australia, France, Sweden, Canada)

27 T-Mobile CZ, CETIN and O2 CZ offered the following commitments to address the Commission's competition concerns (https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4986):

- "to modernise the mobile network, through the deployment of multi-standard Radio Access Network equipment in certain radio frequency layers"
- "to set and review the financial conditions for unilateral network deployments, in order to ensure cost-based pricing of any investments or services provided by the operator responsible for the shared network in that part of the country on behalf of the other operator"

Countries	No. of MNOs[23]	Market share[24]	JV	Technology generations	Shared spectrum[25]	Geography[26]	Regulatory position	Regulatory highlights
Examples of MOCN NSAs								
Denmark	4 → 3	40%	Y	2 3 4 5	~27%	Urban; suburban; rural	Remedies imposed	Substantial obligations imposed including licenced spectrum limits, third-party access
Taiwan	5 → 4	30%		5	45%	Urban; suburban; rural	Remedies imposed	Substantial obligations imposed including coverage commitments; operators merged
France (SFR)	4 → 3	52%	Y	2 3 4	No	Urban (partly) ; suburban; rural	Part blocked	Amended based on regulatory guidelines
France (Orange)	4 → 3	49%		2 3	Roaming	Rural	Time-limited	New entrant only; due to cease in 2022
France (remote)	4 → 1	100%		3 4	N/A	Rural and remote	Encouraged	Sharing encouraged in remote areas
Sweden (Net4Mobility)	5 → 4	49%	Y	2 4 5	~26%	Urban; suburban; rural	Approved	
Poland	4 → 3	53%	Y	3 4	~14%	Urban; suburban; rural	Approved	
Hungary	4 → 3	71%		4	~4%	Urban (partly) ; suburban; rural	Approved	
Finland	4 → 3	61%	Y	4 5	~1%	Northern and eastern regions	Approved	
Sweden (3GIS)	5 → 4	37%	Y	3	~8%	Suburban; rural	Approved	One operator opted-out due to regulatory constraints
Canada	7 → 6	57%		3 4 5	Area-based	East–West exchange	Approved	
Singapore	4 → 3	44%		5	N/A	Urban; suburban[28]	Approved	

- "to improve the NSAs contractual provisions to limit information exchange to the absolutely necessary for the operation of the shared network"
- "In relation to the MNSA, to implement measures to ensure that CETIN effectively prevent information spill-over between T-Mobile CZ and O2 CZ".

28 There are no Rural and Remote regions in Singapore

Countries	No. of MNOs[23]	Market share[24]	JV	Technology generations	Shared spectrum[25]	Geography[26]	Regulatory position	Regulatory highlights
Examples of MOCN NSAs								
Malaysia	6	100%		5	N/A	Urban; suburban; rural	Approved	Publicly-owned single wholesale network
South Africa (Vodacom)	5 → 3	42%		4	35%	Urban; suburban; rural	Approved	
South Africa (MTN)		43%		3 4	26%	Urban; suburban; rural	Approved	

Other examples of NSAs	
New Zealand	• MORAN NaaS on regional roads and in remote areas between 2degrees and Vodafone; 2degrees makes use of its own spectrum on Vodafone's MORAN hardware
Mexico	• "Last mile wireless capacity access agreement" between Telefónica Movistar and AT&T, with the former gaining access to the latter's 3G and 4G (and future technologies) access networks nationwide; as a result of the agreement, Telefónica relinquished its entire holding of 1900MHz and 2500MHz spectrum, together with the coverage obligations that came with it
United Kingdom	• MORAN between O2 and Vodafone, nationwide excluding top 23 cities • MORAN between EE, Three UK, O2 and Vodafone in rural areas • 3G-only nationwide MORAN between EE and Three UK
Italy	• MORAN in areas with fewer than 100 000 inhabitants between TIM and Vodafone for 4G and 5G service
Spain	• "Virtual active sharing mode" agreement for 5G access by MásMóvil on Orange's network in some urban areas • MORAN in rural areas with fewer than 25 000 inhabitants between Orange and Vodafone
Belgium	• Nationwide MORAN JV between Orange and Proximus; agreed in 2019 and still being implemented due to regulatory challenges raised by competitors
Greece	• MORAN between Vodafone and Wind Hellas; 70% rural, 40% urban

Annex B Regulatory considerations for NSAs

B.1 In the EU, BEREC identified three main objectives that should be pursued when considering an NSA

BEREC sets out three main overall objectives that should be pursued when considering the agreements: effective competition, better connectivity and the effective use of spectrum. These are reported in Figure 5.2.

Figure 5.2: Overall objectives of mobile NSAs [Source: Analysys Mason based on BEREC, 2022]

Objective	Rationale	Benefit/Disbenefit
Effective competition	Infrastructure-based competition provides the greatest ability and scope for operators to compete by developing differentiated services. However, this must be balanced with the fact that, in some circumstances, it may be more economically efficient for operators to share infrastructure (e.g. providing coverage in rural areas). Service-based competition still allows significant scope for differentiation, which may be sufficient to alleviate competition concerns, while realising cost reduction benefits.	Cost reduction (leading to improved coverage and/or lower prices).
Better connectivity	NRAs should consider how NSAs could improve connectivity for consumers, including improved coverage, improved quality (speed, throughput, latency and reliability) and new services (IoT, M2M, network slicing, management of legacy technologies).	Enhanced consumer choice. Although not explicitly mentioned by BEREC, any consumer interest benefits (e.g. lower visual footprint, lower carbon/energy savings) could be considered.
Efficient use of spectrum	Spectrum is a scarce resource and if too much of it (in a particular band) is held by one operator, this could unduly create a barrier for other operators to either enter the market or expand their networks. Mobile NSAs could increase the efficiency of spectrum use either by allowing spectrum-poor operators access to spectrum to serve their customers or by enabling migrations to newer and more efficient technologies.	Improved efficiency; possibility too much spectrum is held by the sharing operators.

BEREC recommends that NSAs are evaluated by means of a counterfactual analysis, whereby the market situation is compared with and without the sharing agreement.

All objectives identified by BEREC aim at generating benefits for consumers. Effective competition is likely to bring about better service and/or lower prices. Joint use of infrastructure is in the public interest when it enables the provision of better/additional services and/or a lighter environmental footprint. An NSA (or lack thereof) should maximise spectrum efficiency to yield the benefits associated with it.

Hence, assuming that these principles should hold in general, in their assessments of NSAs NRAs ought to consider primarily whether (a majority of) consumers would be better off in the factual or counterfactual scenario.

B.2 Specific criteria may be identified to evaluate whether an NSA distorts the market

BEREC defines five criteria against which NRAs should assess mobile network-sharing deals, in order to meet the objectives it sets for such agreements. These criteria are summarised in Figure 5.3.

Figure 5.3: Criteria for regulators to assess mobile NSAs [Source: Analysys Mason based on BEREC, 2022]

Criterion/sub-criterion	Rationale	Benefit/Disbenefit
1: Impact on competition / evolution of competitive market	BEREC notes that mobile NSAs are likely to affect competition. It has defined several sub-criteria which it recommends NRAs use when considering whether the agreement will have a detrimental effect on the market.	
Market shares / competitive forces	Effective competition needs to be maintained. NRAs should be careful in particular that a sharing agreement does not allow an MNO with an already strong position to increase its ability to operate independently of competitors or customers (i.e. exert market dominance). An operator with a dominant position may have the incentive and ability to inflate prices, reduce QoS, and/or withhold investment in new technology.	Reduced incentives or ability to compete on network capability. Reduced incentives or ability to compete on price, and in the wholesale market.
Number of operators involved in sharing	BEREC highlights the importance of the number of players involved in sharing compared to the market. In particular, markets involving three operators (whereby a sharing agreement between two of those operators would concentrate infrastructure decisions) should be cautiously assessed. In this case, the remaining player in the market may not be able to provide a meaningful competitive constraint on the strategy of the sharing operators.	Risks to non-sharing operators (due to inability to replicate the cost and/or capability of the shared network). Although not specifically mentioned by BEREC, any disadvantage associated with inferior system resilience could be considered under a more general "too few networks" theme.
Technologies involved	The extent to which the different generations of mobile technology (2G, 3G, 4G, 5G) are included in the sharing agreement should be considered.	Impact on most competitive parts of the market: sharing of contemporary technologies which drive competition (e.g. 4G, 5G) may be more of a concern than legacy technologies (e.g. 2G, 3G).
Geographic scope	BEREC includes geographic scope under this high-level criterion, though	

Criterion/sub-criterion	Rationale	Benefit/Disbenefit
	covers this issue in more detail in the next main criterion when considering the feasible level of competition.	
Timeframe	The timeframe of the agreement has a relevant influence on the potential impact on the market. For example, a temporary sharing agreement (e.g. asymmetrical national roaming) to allow a new operator to enter the market is of less concern than a long-term agreement between two established MNOs.	
2: Geographic extent of sharing and feasible level of competition in those areas	BEREC highlights that the feasibility of competition depends strongly on geographic area, and more specifically on the local population density and the performance of different spectrum bands in providing coverage and capacity. These differences may be seen on a whole country (member state) basis (e.g. densely populated vs. moderately populated countries) and within a country (e.g. urban vs. rural areas). BEREC defines three types of area, each with a different level of expected infrastructure competition feasibility.	
Areas where full infrastructure competition is reasonably feasible	These areas are most likely to be found in densely populated areas (e.g. towns and cities).	BEREC notes that the promotion of infrastructure-based competition is preferable as it is a) commercially/economically viable in these areas, and b) encourages investment, innovation and effective competition. Sharing in these areas is therefore not preferred.
Areas where feasibility of infrastructure competition required case-specific assessment	These areas represent the middle case between the first and third case.	In these areas, the benefits of network sharing (e.g. cost reduction) trade off more evenly with the drawbacks (e.g. impaired competition), requiring a case-by-case assessment.
Areas where full infrastructure competition is not reasonably feasible	These areas are most likely to be found in low density areas (e.g. rural areas and villages). In these areas the large area to be covered, coupled with the low density of users (who provide demand and revenue) make competing standalone networks more challenging. Mobile network sharing in these areas can be helpful to bring a sensible level	Brings competitive coverage at reasonable level of cost.

Criterion/sub-criterion	Rationale	Benefit/Disbenefit
	of service, while minimising costs. Other examples could include locations with a scarcity of options to locate a site, e.g. within tunnels, train stations and other indoor coverage.	
3: Type of sharing	The different types of sharing can have different impacts on competition. BEREC highlights that passive sharing may be considered as having a lower impact on competition (while being easier to implement) than active sharing. BEREC also highlights that national roaming agreements can limit the roaming operator's incentives to invest.	Potential negative impact on competition. Potential negative impact on incentives to invest.
4: Information sharing and impact on ability to compete	NRAs should aim to ensure that the sharing of information between the sharing operators is limited to the bare minimum necessary to undertake the agreement. This would include restricting the access to information to a limited number of persons within each operator's organisation.	There is a risk that too much sharing of information between operators could restrict the ability and incentive of those operators to compete (and it could create competition law issues). This risk can be alleviated through appropriate governance protocols, e.g. restrictions on the two parties jointly approaching suppliers, restrictions on sharing information on prices, volumes and discounts, and restrictions on sharing information on current/forecast subscribers and traffic.
5: Flexibility, reversibility and contractual implementation	Sharing agreements are necessarily inflexible in certain respects, in order to give certainty to the sharing operators over the future performance and availability of the shared networks. However, it should be ensured that where possible, elements which do not need to be fixed are kept as flexible as possible, to allow upgrades, expansions and other activities. The reversibility and contractual implementation of the agreement (e.g. joint venture, exchange of assets, wholesale agreement) have a strong impact on flexibility.	Lack of flexibility; long-term inter-dependence (lack of reversibility).