
GSR discussion paper

Accelerating Broadband Deployment through Network Sharing and Co- investment

Work in progress, for discussion purposes

Comments are welcome!

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Table of Contents

Page

Executive summary	
1. Introduction	4
2. Advantages to governments of network sharing and co-investment.....	4
2.1 Mobile sector	5
2.2 Fixed sector.....	5
2.3 Third party access	5
2.4 Comparison with single network operator deployment.....	5
3. Examples of network sharing and co-investment in practice.....	6
3.1 Mobile sector	6
3.2 Fixed sector.....	8
4. Reasons why there is not more network sharing and co-investment	9
4.1 Loss of independence	9
4.2 Partner selection.....	9
4.3 Difficulty in reaching agreement	9
4.4 Incumbent resistance.....	10
5. Ways governments can encourage or incentivise network sharing and co-investment	10
5.1 Government co-venturing.....	10
5.2 Use of spectrum licensing	11
5.3 Regulatory certainty.....	11
5.4 Mandated network sharing.....	12
5.5 Grants and subsidies	12
6. Downsides to governments of network sharing and co-investment	12
6.1 Reduction in competitive intensity.....	12
6.2 Potential for collusive dealing and information sharing.....	13
6.3 Reduced options for services based competitors.....	13
6.4 SLA driven performance.....	13
7. Commercial models for sharing.....	13
7.1 Joint ventures	13
7.2 IRU access	13
8. Alternatives to sharing.....	14
8.1 Geographic split	14
8.2 Network hierarchy split.....	14
8.3 Third party outsourcing.....	14
9. Future applications of sharing and co-investment.....	14
9.1 Smart city environments.....	14
9.2 Virtualisation of core network infrastructure.....	15
9.3 Dynamic spectrum sharing.....	15
10. Learnings/recommendations.....	15

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Accelerating Broadband deployment through network sharing and co-investment

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Executive summary

Most governments have as a key policy objective the increasing availability of affordable broadband services. New mobile and fixed broadband networks will need to be deployed to meet these policy objectives, yet these networks are expensive to build and the construction and demand risks are high. Achieving further and faster broadband deployment, particularly outside the main urban areas, is challenging and will require innovative solutions.

This paper examines the solution of network sharing and co-investment by multiple operators and potentially other sources, including the government itself, in building this new infrastructure. Commercially driven network sharing has been prevalent in the mobile sector, particularly in those countries with very competitive mobile markets, but it is still relatively rare in comparison for co-investment to occur in the fixed sector.

Governments are likely to favour sharing arrangements as a solution to the need for further and faster broadband deployment. Given this, we consider the case for governments to encourage and incentivise network sharing and co-investment. There are a number of advantages that should benefit consumers from successful sharing arrangements.

However, in examining options for encouraging and incentivising sharing, governments also need to take note of the fact that sharing arrangements are complex and have often proven difficult for operators to commercially agree in practice and a number have not survived for very long. This paper considers some reasons why, despite the cost and risk sharing benefits to operators, there have not been more enduring sharing arrangements.

Cognisant of this, we look at some ways in which governments can encourage and incentivise sharing. We particularly favour governments contributing assets and infrastructure, potentially through utilities, in co-venturing with private operators. There is also real benefit in governments providing high degrees of up-front certainty over the regulatory treatment of sharing arrangements for new network build.

Sharing of network infrastructure has such compelling logic if it can be made to work. We finish the paper with a look at some new ways in which network sharing may arise in the future, including through the emergence of smart cities.

1. Introduction

Governments around the world recognise that there are substantial societal benefits in the deployment of new broadband networks and services – 4G and fibre – and, for many governments, current levels of investment are not going as fast or as far as they require.

Governments need to acknowledge broadband networks are very expensive, particularly if deployed nationwide, construction risks can be high and returns for operators uncertain and may be limited. Creative and innovative thinking is required by governments to find ways to encourage investment by operators, and reduce the risks that they face, in deploying these networks and providing widespread broadband services on an affordable basis.

Governments have looked to address these challenges in several ways. Some governments have chosen to build broadband networks themselves (e.g., in the access network: NBN Co in Australia, QNBN in Qatar; in backhaul/backbone to rural areas: India, Argentina and Brazil). This sort of option is beyond the reach of many governments, particularly in access networks, but potentially less so in backhaul and backbone networks (e.g., in South Africa, a middle income country, the government has invested in backhaul/backbone through Infracore).

Other governments have chosen to incentivise a single operator to deploy the network, usually accompanied by a requirement to provide open access. Examples include the agreement between the Malaysian government and Telekom Malaysia to roll out a high speed broadband network and the agreement between the New Zealand government and Chorus to rollout a fibre to the home network.

In this paper, we consider whether governments should try an alternative approach and encourage or incentivise network sharing (the term commonly used in the mobile sector) and co-investment (the term commonly used in the fixed sector) by multiple operators and potentially other sources, including the government itself, as a solution to the “further and faster” challenge of broadband deployment.

2. Advantages to governments of network sharing and co-investment

Governments are likely to view network sharing and co-investment initiatives as being generally positive, particularly in those areas where there is limited scope for infrastructure competition. In most parts of most countries, there is limited scope for infrastructure competition in fixed access and in backhaul/backbone outside of the main routes. There is far greater scope for infrastructure competition in the mobile sector, but to a lesser degree in higher cost, low ARPU regions where it may only make sense to build a single mobile network.

We contrast in this paper the situation where a single network operator deploys a fixed or mobile network and is required to provide open access to third parties. Although this involves a sharing of infrastructure, we draw a distinction between this and the situation where multiple operators combine in a joint venture or other sharing arrangement to deploy the new network.

Sharing of infrastructure creates a new and different dynamic. It can change market structures. It is a shift from access to cost and risk sharing. It involves industry co-operation, rather than heavy handed regulatory oversight. It focuses on dynamic efficiency driven off the active layer and retail competition, rather than the passive layer.

And the logic of network sharing and co-investment will only improve over time, as the costs of passive infrastructure deployment (construction materials, labour, land etc) increase at the same time as the costs of active infrastructure reduce.

There are numerous statements from governments around the world that are encouraging of sharing arrangements. For example, as a component of the Digital Agenda, the EU Commission has stated that it specifically encourages fixed network sharing: “To foster the deployment of NGA and to encourage market

investment in open and competitive markets the Commission will adopt a NGA Recommendation based on the principles that...co-investments and risk-sharing mechanisms should be promoted.”

2.1 Mobile sector

In the mobile sector, the main advantages to government of network sharing are:

- **Provision of services in higher cost areas:** By reducing costs and sharing demand risk, network sharing will encourage mobile operators to provide services in the higher cost, low ARPU areas where the business case for an own-build network does not stack up.
- **Planning and environmental:** Avoiding duplicate infrastructure, through sharing, is often important for planning and environmental reasons. Tall towers are an eyesore and communities are resisting a proliferation of new above-ground infrastructure. There may also be limited capacity or planning restrictions in roof top sites in urban areas.
- **Consumer benefits:** Lower overall costs for individual operators as a result of sharing, combined with a competitive retail market, should lead to price reductions and better value for money for consumers.

2.2 Fixed sector

In the fixed sector, governments will see equivalent advantages, but there are other features of fixed co-investment related to market structure that will be attractive to government:

- **New sources of investment:** These arrangements enable or facilitate investment into the industry from new sources (e.g., utilities, local government, infrastructure funds); e.g., sharing between telcos and utilities in Switzerland. These non-traditional players will benefit from partnering with operators (and vice versa). Non-traditional players usually have access to finance or valuable infrastructure or other assets which they can bring to the table and operators can contribute skills, capabilities, infrastructure and capital. We discuss the ways in which government, including through utilities, can encourage co-investment through in-kind contributions in section 5 below.
- **Industry co-operation:** Co-investment is a “big tent” approach, where industry players negotiate and co-operate in deployment and operation of the shared infrastructure. In the absence of anti-competitive concerns, a consensus-based outcome is usually superior to a regulated outcome.
- **Lessening of market power:** To the extent that the incumbent is a party to the co-investment arrangement, it can result in a lessening of market power, with a corresponding reduction in regulatory burden for the regulator and for industry.

2.3 Third party access

Government will often prefer, and sometimes require, open access if there are network sharing or co-investment arrangements. However, we believe a nuanced approach to this issue needs to be considered. If sharing operators are going to assume potentially substantial construction risk and demand risk in investing in new broadband infrastructure, then there is likely to be a case for a broader view by governments and regulators of open access. In section 5 below, we discuss regulatory certainty as a key way in which the government can encourage network sharing and co-investment.

2.4 Comparison with single network operator deployment

Whether co-investment models are superior to deployment by a single network operator, incentivised in some way by the government, may be open to debate. If the single network operator was required to

provide open access to other operators on a non-discriminatory basis, at cost-oriented prices, then co-investment alternatives may not be materially superior.

It is likely to be easier to put in place bilateral arrangements between the government and a single network operator, usually the incumbent in the fixed sector, for a speedy network roll out. However, the ongoing regulatory burden will not go away and may intensify with the single network operator model. There will still be the incentive, if the single operator participates in the downstream retail market, of discriminatory behaviour, favouring the operator's retail activities. All of this suggests that a sharing arrangement is more likely to lead to a reduced regulatory burden as compared to a single network operator model.

3. Examples of network sharing and co-investment in practice

3.1 Mobile sector

Commercial network sharing arrangements have been particularly prevalent in the mobile sector in developed and emerging markets. These arrangements have mainly been entered into voluntarily between mobile operators, with only fairly light-touch encouragement from governments. Today, it is said that around 15% of operators engage in network sharing of one sort or another.

Mobile network sharing is commonplace when powerful competitive pressures mean it's necessary for operators to share to reduce costs. This will usually arise in mobile markets where there are four or more infrastructure competitors. In these markets, we have seen substantial passive sharing and increasingly active sharing, including through use of third parties such as towercos.

Sweden was one of the earliest countries to take up mobile network sharing and it appears that these arrangements have been enduring.

Case study (Sweden): 3G mania swept through Sweden in 2000 and the result was that TeliaSonera, the incumbent operator, failed to win a 3G licence. It quickly sought an extraordinary network sharing deal with Tele2, which resulted in Tele2 transferring its 3G licence to a 50/50 joint venture vehicle. The 2001 joint venture was called Svenska UMTS-Nat AB (SUNAB).

As well as owning the spectrum, SUNAB has full ownership of the WCDMA network, including parts of the core network. The joint venture enabled each sharing operator to launch services and otherwise operate independently of the other. Each party bought wholesale capacity off SUNAB and in that sense is like an MVNO operating on the joint network. Capacity charges are the same for both operators.

The Swedish regulatory framework positively supported sharing arrangements. The 3G licences permitted the sharing of network covering up to 70% of population (the remaining 30%, in practice in urban areas, was to be independent).

At around the same time, in 2001, a 50/50 3G joint venture called 3GIS was entered into between 3 and Telenor (as successors to the original parties) in Sweden. Management and operation of 3GIS has been outsourced to Nokia Siemens Networks.

In 2009, Telenor and Tele2 formed a 50/50 JV (Net4Mobility) for deployment of a LTE network. The joint venture participated in spectrum auctions and acquired 800MHz and 1.8GHz spectrum. The same supplier structure used in SUNAB was used with Net4Mobility. Net4Mobility also includes joint GSM and transmission networks.

Australia was also one of the earliest countries to adopt mobile sharing arrangements. However, for various reasons, these arrangements did not survive for very long.

Case study (Australia): The four network operators paired up in two WCDMA network sharing joint ventures in 2004. After 3 years, each of the operators began building their own 3G networks.

In 2003, Hutchison had a first mover advantage in WCDMA (2.1GHz) in urban centres of Australia. But in 2004, it gave up that advantage by entering into a network sharing deal with Telstra. It was intended to last until 2017, when the 3G licences expired.

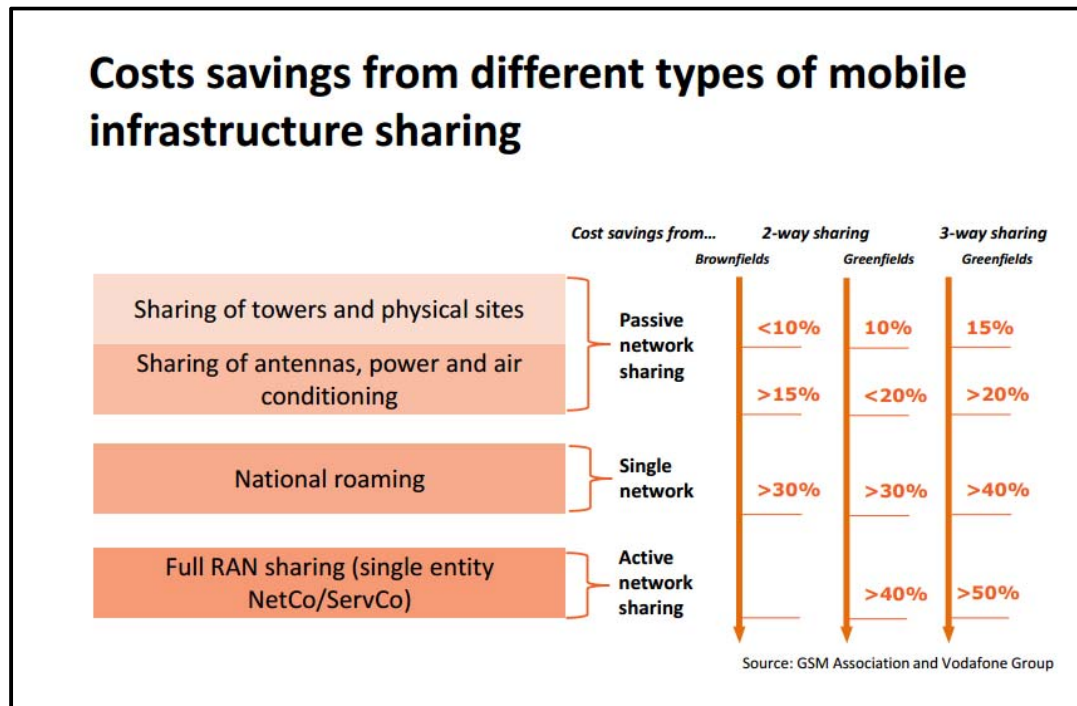
3GIS Pty Ltd was formed as a 50/50 joint venture. In consideration for 50% ownership of the joint venture, Telstra paid A\$450m to Hutchison. 3GIS Australia involved a RAN share and a partly shared core, as well as shared frequencies.

Telstra launched its WCDMA services over 3GIS in 2005, but shortly after made the strategic decision to deploy a new WCDMA network (NextG) using 850Mhz spectrum, originally used in its CDMA network. Telstra launched NextG in 2006, meaning it was providing WCDMA services over two separate networks. With its lower frequencies, Next G had much greater coverage than 3GIS. Then, without much fanfare, 3GIS was closed down in 2012.

Weeks after the 3GIS joint venture was entered into in 2004, Vodafone and Optus decided to share their new WCDMA (2.1GHz) network, which was to be built from scratch. It was a RAN sharing (using MORAN), with each operator using its own spectrum and own core network, meaning it was not as integrated as the 3GIS Australia joint venture.

Around 2007, both Vodafone and Optus began to build their own 3G networks using both 2.1GHz and the lower frequency 900MHz bands that had become available for WCDMA. Vodafone subsequently merged with Hutchison to form VHA.

Most of the cost savings from network sharing (some say two-thirds) can be captured by sharing passive infrastructure. The cost savings from sharing active infrastructure are not as great, but they are still sizeable – delivering approximately 20-30% network cost savings for mobile networks. An approximation of cost savings from different types of mobile infrastructure sharing is shown below.



The pressure to share mobile networks is exacerbated by the explosion in consumer and business demand for data. Data is a lower margin business compared to earlier voice and messaging services, while at the same time the cost of running legacy networks is inefficiently high for dealing with high data volumes. New

LTE networks, which are optimised for carrying huge volumes of data, involve major new investments by operators.

Greenfields situations, that require entirely new networks, are generally considered to be easier and more suitable for sharing. This is one reason why we tend to see more network sharing deals in emerging markets than in developed markets. Although there is some sharing of existing assets, LTE is more greenfields in nature and this boosts the chances of a successful LTE network sharing deal.

3.2 Fixed sector

Co-investment in fixed markets occurs relatively infrequently, as compared to mobile network sharing. It is still fairly rare for co-investment agreements for fixed infrastructure to be entered into without some pressure or incentive by government to do so.

Case study (Netherlands): In an apparent example of a commercially driven co-investment arrangement, the Netherlands incumbent operator KPN had co-invested with Reggefiber to deploy FTTH connectivity to two million homes. The initial arrangement was that KPN would pay 41% and Reggefiber 59% of the deployment cost. However, in November 2014, KPN acquired 100% of Reggefiber, effectively bringing to an end the co-investment arrangement.

Case study (Singapore): Singapore's OpenNet was an example where there was an effective requirement to co-invest in order to benefit from a government incentive. The Singapore example was primarily driven by the policy objective of introducing a structurally separate entity at the passive layer and so a requirement that the fixed incumbent did not have a controlling stake in that entity. As a post-script, these co-investment arrangements were unwound in 2014, when all of the shareholders in OpenNet, including the incumbent, sold their interest in the company to NetLink Trust, a business trust where the incumbent is the beneficiary (to be sold down).

The other main instance where we have seen co-investment has been when competitors have gotten together to co-invest in a new network, without the involvement of the incumbent.

Case study (Portugal): Vodafone Portugal and Optimus entered into a long-term cooperation agreement, where each operator builds full Next Generation Access networks independently (mainly in Lisbon and Porto areas), with the agreement setting out conditions under which they may have access to (part of) the networks of each other.

However, these structures involving co-investment between competitors face the risk that the incumbent could adopt a cherry-picking approach and look to compete aggressively wherever the alternative co-investment entity is deploying. The very possibility of that strategy being used may deter competitors from co-investing in the first place.

In some markets, regulators have mandated network sharing in fixed networks.

Case study (France): In France, the regulator has mandated network sharing in respect of in-building wiring. This has resulted in operators that install in-building wiring to grant a passive access to other operators at the concentration point. Under the French IRU model, one operator signs a contract with the co-owners of a building and becomes the operator of the building. This operator is in charge of the construction and the maintenance of the network within the building, and offers passive access, either through a dedicated fibre line or through a shared fibre line, to other members of the co-investment agreement. Access is granted through long-term 30-year (or 24-year) cooperation agreements (granting of the IRU).

Planning and environmental considerations can also drive network sharing/co-investment, by pressuring a reduction in the passive infrastructure that can be built. This will increasingly be the case in urban areas, for tower structures, but also potentially underground works.

4. Reasons why there is not more network sharing and co-investment

Despite the apparent benefits to operators of network sharing and co-investment in terms of cost reductions and reduced demand risk, it's worth considering why it doesn't happen more often, or in other circumstances, and why a number of sharing deals don't seem to last.

There are several reasons why it has proven difficult for operators to commercially reach enduring network sharing or co-investment arrangements. The commercial dynamics of sharing are so complex - these obstacles need to be borne in mind by governments that are looking to encourage, or incentivise, sharing arrangements.

The reasons why it has proven difficult for operators to commercially agree enduring network sharing or co-investment arrangements include the following:

4.1 Loss of independence

With a sharing arrangement, it is inevitable that an operator will no longer have full control over network strategy and investment. An independent network operator can dictate the direction that its network will take, its rollout strategies and vendor choices. Network sharing involves ceding some of this control, in return for the benefits that are available.

This sometimes manifests itself in concerns that the sharing partner, who is also a competitor, will stymie new competitive developments in the shared network that the other operator wishes to make.

For a sharing deal to succeed it will be necessary for the operators to reach agreement on where full independence needs to be maintained, where agreement is required with the sharing partner and where operational and network control may be ceded.

These concerns over loss of independence mean that neutral or independent governance is critically important in network sharing transactions. This is one reason why separate joint venture structures are used and is said to be an added benefit of third party involvement (e.g., as an investor, an outsourced provider or independent JV management). The success of the towerco model is partly due to the neutrality that an unrelated third party management company can provide.

Neutral or independent governance means that a subset of decisions may be entrusted to the joint venture, without requiring agreement between the sharing parties. The need to reach agreement with the other operator over issues of when and where to invest in networks is likely to be time consuming and is a prime area for contentious disputes in the implementation of these transactions.

4.2 Partner selection

Having a compatible sharing partner will alleviate some of these concerns. The selection of a compatible partner involves considerations of whether there is an alignment on network evolution and deployment and investment plans and strategies. This is particularly the case with mobile network sharing.

As well as plans and strategies, a mobile operator with a similar network will mean that neither party has a material advantage over the other in entering into the arrangement. In contrast, when say a large operator and a new entrant are considering a network sharing deal, there can be real difficulties in reaching agreement on key issues such as valuation and allocation of benefits.

4.3 Difficulty in reaching agreement

It is never easy to reach agreement on a network sharing deal with a competitor, due to the healthy distrust that each management team has of the other. Shareholder support can be important in getting a sharing deal across the line, including incentives for management to put in place and then implement the arrangement.

A network sharing deal will often involve transfer of existing assets into a joint venture structure (or to a third party) and will often involve decommissioning of some sites. It is often said that disagreements over asset valuation is one of the main reasons why non-greenfields network sharing deals do not proceed.

Transfer pricing issues and service levels for ongoing services will also need to be resolved, as well as vendor strategy. This includes the role of third party vendors, which vendors will perform which functions (e.g., maintenance, repair, field services) etc. Although it will be difficult to exit a network sharing agreement, exit provisions also will need to be agreed.

4.4 Incumbent resistance

In the fixed sector, where there is not usually the intensity of infrastructure competition that is experienced in mobile, incumbents can be reluctant to depart from the status quo and consider novel co-investment options, particularly any options where they are likely to lose control.

5. Ways governments can encourage or incentivise network sharing and co-investment

To date, governments have generally encouraged, in a light-touch way, network sharing and co-investment. A number of countries have mandated network sharing, but there have been few examples of governments actively incentivising network sharing or co-investment.

In this section, we consider what steps governments could take to actively incentivise network sharing and co-investment.

5.1 Government co-venturing

Governments can play a significant role in fostering co-investment through co-venturing with private sector operators. We see this as one of the most important steps that a government can take to encourage broadband deployment, particularly in greenfields areas.

Governments have very valuable assets and infrastructure that, if made available, would speed up, and potentially reduce the cost of, broadband deployment. Governments can contribute assets, access to utility infrastructure or wayleaves etc.

It is not essential for governments to provide its in-kind contribution through a co-venture with private sector operators, but it is a key option. An auction could be used to determine private sector participation and the valuation of government contribution could, for example, be at replacement cost using modern equivalent assets. Alternatively, government in-kind contribution could be leased to a co-investment entity, rather than the government participating at an equity level.

Participation by public utilities in the rollout of next generation access can be a strategy that governments can pursue more actively. Co-investments are already happening between public utilities and private operators in European countries such as France, Germany and Switzerland. In Switzerland, the co-investment arrangements have been said to have increased competition in the market as well as facilitating deployment of next generation access networks.¹ Interestingly, in regions of Switzerland where public utilities have not entered, the incumbent operator hasn't shown the same levels of investment activity.

Case study (Ireland): In 2014, EDS (an Irish electricity utility) and Vodafone Ireland entered into a 50/50 incorporated joint venture to build and operate a wholesale only, open access fibre-to-the-building (FTTB) network to homes and businesses in certain parts of Ireland. The joint venture entity will deploy fibre on ESB's existing overhead and underground infrastructure in return for a fee from the joint venture. The joint venture will provide a wholesale virtual unbundled local access (VULA) product to retail operators, as well as a higher quality, point to point service suitable for mobile backhaul and business customers.

¹ Financing of the Roll-Out of Broadband Networks: Note by Switzerland (OECD, 16 June 2014) DAF/COMP/WP2/WD(2014)17.

Co-investment between a utility and a private sector operator avoids some of the obstacles referred to in the previous section around reaching agreement between competitors. Loss of independence will still be a concern for private sector operators, but potentially arrangements with utilities may permit operators a greater level of control over key network decisions than might be the case in a pure sharing arrangement between private operators.

It may not just be utilities that get involved in these sorts of activities. Other government entities with widespread infrastructure, such as road or railway entities, can be key partners for private sector operators looking to roll out new broadband networks. In emerging markets, where there is often a government policy priority to push out electricity, road and rail networks into more rural areas, there can be a particular synergy with telecoms operators in building broadband networks in the same areas at the same time.

5.2 Use of spectrum licensing

The dynamics are different in the mobile sector and a lighter-touch may be all that is required from the government to encourage network sharing. One of the most potent means available to the government is through 4G spectrum licensing conditions. This scarce spectrum is in high demand and, through licence conditions, governments can facilitate sharing. Licence conditions are not costless, as they may potentially reduce licence proceeds for the government.

As an example of how licence conditions may facilitate sharing, each licensee may be required to provide widespread nationwide coverage, but network sharing is permitted. This creates a strong incentive for licensees to share, particularly in higher cost, low ARPU areas. Alternatively, the licence conditions may require each licensee to build a network in rural areas in one part of the country, while allowing sharing or roaming in the rural areas where they have not built.

5.3 Regulatory certainty

We referred above to the question of whether sharing or co-investment arrangements that are entered into commercially should be subject to open access by third parties. This is a subtle issue. On the one hand, open access policies are usually thought to promote competition, but this has normally been in the context of existing networks with long-since sunk investment. When it comes to new investments, the risk of imposing stringent open access requirements, or the potential threat of it, may discourage operators from agreeing to invest in the first place.

This means governments can assist in providing high degrees of up front regulatory certainty for co-investing entities, to address the risk of regulatory intervention post sunk investment. Governments or regulators may be prepared, for example, to provide clarity that any access pricing will recognise the build and demand risk at the time of investment. One of the major concerns of investors in new broadband networks is that, if they build and it is a success, access will be imposed on terms that don't take into account the risks at the time of investment.

Other possible approaches include:

- long-term regulatory commitments, such as NBN Co's 27 year special access undertaking accepted by the Australian regulator, which provided high degrees of certainty for NBN Co;
- applying a utility-style regulatory asset base approach to the new broadband network, providing a revenue ceiling for the new entity;
- providing the sharing operators with a period of exclusivity, before being required to offer open access, which may be acceptable in recognition of the operators' commitment to invest and deploy the new network; and
- enabling the sharing operators to access at say the passive layer, with third parties being entitled to access at the active layer only, but otherwise on a non-discriminatory basis.

Regulators may more likely to be prepared to provide regulatory certainty to a shared entity, where no single operator has control, as compared to a new build, single owner model. At the very least, governments should review the regulatory environment to ensure there are no unintended roadblocks that may harm the potential for commercial network sharing and co-investment arrangements to arise.

5.4 Mandated network sharing

We have seen mandated mobile network sharing or roaming obligations being imposed by some regulators (e.g., Colombia, France, US) to encourage new entrants, often intended to be on a temporary basis and usually for the purposes of matching existing coverage, rather than increasing coverage. We can see merit in these situations in brownfields environments, but otherwise we are sceptical whether mandated network sharing is likely to be productive in encouraging greenfields investment.

Again, this may come down to regulatory certainty. As long as the investing operator building a new network in a greenfields environment has certainty of the basis on which mandated network sharing will be required before making the investment, then there can be little objection so long as they have the choice of whether to invest. But care is required that the regulator does not stymie investment in the first place by overly rigorous requirements for mandated sharing.

Case study (Indonesia): In Indonesia, the regulator, Kominfo, has restricted the construction of new towers in the vicinity of an existing tower in order to persuade operators to undertake infrastructure sharing. Under the terms of the regulation, a new tower can only be constructed if for some reason the existing tower cannot be shared. The regulation provides a guideline for the construction and development of joint mobile towers. Under the regulation, the owner of a mobile tower is required to give non-discriminatory access to other telecommunications operators. The tower owners are also required to give information in terms of the tower capacity to potential access-seekers in a transparent manner.

5.5 Grants and subsidies

There have been some particularly successful examples of the use of relatively modest grants and subsidies by government to overcome what would be expected to be stiff resistance particularly from fixed incumbent operators. We have referred to the Singapore example above where a co-investment arrangement arose from a government financial incentive. Although not a co-investment, the New Zealand ultra-fast broadband initiative, with the lure of a government grant that was tendered to deploy a fibre to the home network, was sufficient to incentivise the fixed incumbent to structurally separate in order to participate in the initiative.

6. Downsides to governments of network sharing and cco-investment

There are potential downsides for governments of network sharing and co-investment, but they are generally regarded as fairly manageable, in the right circumstances.

6.1 Reduction in competitive intensity

Reduction in competitive intensity can be a concern, as competition will be confined to the services layer, rather than services and infrastructure layers, with a sharing arrangement.

The common view that seems to have been taken by regulators is that, at least for passive network sharing in the mobile sector, there is little competitive benefit in pure coverage, so infrastructure sharing is unlikely to harm competition. Similarly, with most types of active network sharing in the mobile sector, so long as sharing operators have the ability to differentiate their services from one another, the impact on competition is fairly benign.

However, once there is integration at the infrastructure layer as a result of a sharing arrangement, it's very difficult to unwind, leading to potentially a permanent reduction in infrastructure competition.

6.2 Potential for collusive dealing and information sharing

There is the potential for collusive dealing between sharing operators (may be easier to establish a focal point and monitor/punish behaviour, plus limited outside pressure). Regulators need to carefully evaluate this issue and is likely to require ongoing monitoring.

Sharing of commercially sensitive information among co-investors is also a concern, but is an inevitable feature of sharing arrangements. Appropriately structured procedures/protocols can be implemented to reduce the competitive impact of this information sharing.

6.3 Reduced options for services based competitors

A reduction in infrastructure competition may lead to reduced options, and more limited capacity, available for services based competitors (such as MVNOs). This may not be such an issue where sharing operators retain their competitive independence and so the motivations for agreeing to enter into MVNO type arrangements should not change. Limited capacity could be an issue, but most sharing or co-investment arrangements would be expected to provide for sufficient capacity for sharing operators and potential services based competitors as well. If this remains a concern for regulators, they could require (and provide upfront regulatory certainty on) provisioning of sufficient capacity for services based competitors.

6.4 SLA driven performance

In the absence of infrastructure competition to drive efficiencies etc, there will be a requirement for SLA-driven performance to incentivise the shared network to perform. Depending on the effectiveness of the SLA regime, this can be effective in ensuring efficient operation of the network.

7. Commercial models for sharing

The main commercial models for network sharing and co-investment are joint ventures and long-term co-operation agreements (**IRU access**).

7.1 Joint ventures

Joint ventures are a common structure adopted for network sharing (usually incorporated, sometimes unincorporated). Normally, the joint venture owns, operates and maintains the joint network. In these circumstances, sharing operators contribute financial and human resources to the joint venture, although aspects may be outsourced to third party vendors. Sometimes it is only an asset owning JV. The joint venture may acquire assets from one or both sharing partners and will undertake joint build of the new network.

Joint ventures are also a feature of co-investment in fixed networks. In the Irish example referred to above, a 50/50 incorporated joint venture was formed between ESB and Vodafone Ireland. The parties each provided 50% of the share capital for the joint venture and 50% of the voting rights, with equal board representation. The joint venture has a management team dedicated to its day-to-day operations and each party committed to sufficient funding until the joint venture becomes self-funding.

7.2 IRU access

Indefeasible rights of use (**IRUs**) have been a feature of the telecommunications industry for many years, particularly for long haul transmission and subsea cables. Legally, IRUs are an arrangement by which a party acquires the right to use network infrastructure (such as dark fibre), or an amount of capacity (including transmission) or a network facility (such as ducts) for most of the life of the asset. IRU arrangements are often for around 25-30 years and are normally non-renewable.

As well as access to the main infrastructure, the IRU will usually also allow access to ancillary infrastructure, such as manholes and cabinets where duct access is provided, as well as colocation and access to splicing/junction nodes.

An IRU may be seen as a form of co-investment or network sharing. Through its up-front commitment, the acquirer of the IRU effectively shares the infrastructure with the grantor of the IRU and other IRU users. IRUs have been a particular feature of the French FTTH projects, referred to above. IRUs can also arise in mobile network sharing arrangements.

8. Alternatives to sharing

What are the alternatives to network sharing/co-investment?

8.1 Geographic split

Although not a classic network share, one operator could simply provide wholesale network services to another operator, which may include national roaming or MVNO services for example in the mobile context. This may arise where the parties agree that one operator will build, own and operate the network in one geographic area and allow the other to use the network, with the same arrangement in reverse in another geographic area.

This sort of arrangement can also apply in relation to fixed networks.

Case study (Switzerland): In Geneva, the utility SIG builds the access network in the agglomeration of Geneva and Swisscom builds the access network in the inner city. Dark fibre access is granted by both SIG and Swisscom to the other and the roll-out cost is split 60% Swisscom and 40% SIG.

8.2 Network hierarchy split

In the fixed network context, there are instances of one partner building the terminating segment and another building the backhaul segment.

Case study (Switzerland): In Switzerland, the utility usually builds the terminating segment (OTO-CP) and Swisscom builds the feeder and backhaul network (CP-ODF) and provides collocation. The partners exchange IRUs over their infrastructure.

8.3 Third party outsourcing

Another option is third party outsourcing, where the sharing operators transfer their assets and outsource the management and operation of their shared network to a third party vendor. This is an attractive arrangement as it removes aspects of trust issues that can complicate, for example, joint ventures.

More commonly, third party managed services for the management and operation of RAN, core and transmission networks are entered into with individual operators (about 25% of operators have entered into these arrangements). Equipment vendors such as Alcatel-Lucent, Ericsson, Fujitsu, NEC, Nokia, Huawei and KT Corp provide various types of third party outsourcing arrangements that may be suitable in a network sharing arrangement.

The involvement of a third party will reduce the savings available to the sharing parties and results in SLA-driven control of that third party. Outsourcing to a third party also involves loss of competence within the operator's organisation, which can have long term implications.

9. Future applications of sharing and co-investment

What are the future applications of the sharing and co-investment model?

9.1 Smart city environments

Extensive and ubiquitous high-speed connectivity is a key enabler for the success of smart cities. Telecoms operators (and perhaps disrupters to the telecoms sector) have the opportunity to provide connectivity solutions that allow users to consume smart city solutions.

Connectivity solutions will go beyond fixed and mobile broadband connectivity and extend to proximity connectivity using WiFi, NFC, Bluetooth, RFID and the like. There will also be a need for other progressive connectivity solutions.

It will be necessary for governments, telecoms operators, utilities and private entities to share and provide access to key infrastructure necessary for the proliferation of smart city solutions, such as buildings, cabinets and light poles. Sensors and other smart components may need to be installed in strategic locations that are owned by these parties, and it may make sense to make those sensors and components available for use by other players in the smart city ecosystem.

But it won't just be access to infrastructure that will need to be shared in smart cities. Data sharing and access will also play a critical part in the success of smart cities and in this case clear rules and perhaps regulatory intervention may be needed. For example, in the context of a smart emergency services solution, energy utilities may need to share smart grid data with emergency services agencies so that they can respond immediately – or even pre-emptively – to power outages or power-related emergencies on the basis of that data.

9.2 Virtualisation of core network infrastructure

We can expect cloud based infrastructure to be increasingly used by telecoms operators, in terms of their data centre, platform or application requirements to run their network. This is a form of sharing, as logical separation through virtualisation will mean it will be possible for core network infrastructure and functions to sit on physical infrastructure that is used by other parties and potentially other operators.

9.3 Dynamic spectrum sharing

Spectrum sharing is likely to increasingly feature in RAN and optical fibres (dynamic wavelength allocation). Traditionally, mobile network operators have been reluctant to consider spectrum pooling, or sharing of spectrum between operators, as they seek to maintain maximum flexibility to manage their networks and also because frequency allocations are often not equal. India, for example, does permit some RAN spectrum sharing, but it is not permitted in many countries.

Up until now, and for the foreseeable future realistically, governments allocate spectrum mainly on a dedicated basis. This has allowed operators to use higher power equipment, with resulting wider coverage, while limiting interference. The exceptions have been the unlicensed spectrum, used by (among other things) Wi-Fi networks.

Dynamic spectrum access (DSA) technologies allow devices to use spectrum where it is not being used in the particular geographic area, or at the particular time. This way, multiple users can “share” the spectrum, while minimising interference to others.

The greatest near term opportunities for deploying spectrum sharing are likely to be in those bands with substantial government uses, which are suitable for mobile broadband, but where clearing these government users off the spectrum cannot be done in a reasonable timeframe. In Europe, the 2.3GHz band is being considered for spectrum sharing between government and commercial users. In the United States, the FCC is considering shared access to the 3.5GHz military band for use by small cells.

10. Learnings/recommendations

Achieving “further and faster” broadband coverage is a key issue for most governments around the world. One of the options available to governments is to encourage or incentivise network sharing or co-investment. Achieving deployment of new broadband networks through network sharing and co-investment will bring a range of benefits for governments as compared to other options – little or no

investment may be required from government to make it happen, we could see speedier deployment, and we should see cost savings passed on to consumers and a reduced ongoing regulatory burden.

However, it is undoubtedly a challenge for sharing operators to create, implement and maintain a successful network sharing or co-investment arrangement. It is always difficult to clearly establish reasons why potential sharing arrangements do not go ahead and parties are loathe to publicly explain why sharing arrangements prematurely come to an end (e.g., in Australia). Nevertheless, given all the benefits that are available to operators, it is somewhat surprising that sharing does not occur more frequently.

It is clearly more difficult to achieve co-investment in fixed networks, where there is less infrastructure competition than in mobile. This is an area where government incentives, including in-kind contributions, could bring about a breakthrough. We can see particular merit in governments (including through utilities) co-venturing with telecoms operators to facilitate the rapid rollout of fixed broadband networks.
