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Unlocking broadband for all.

Broadband infrastructure sharing policies
and strategies in emerging markets

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Executive Summary

The pervasive use of the Internet globally has increased the importance of the telecommunications sector as a vital enabler of socio-economic development. As a result, ensuring citizens' access to broadband has become a public policy priority in many countries. However, limited telecommunication network deployment represents one of the major obstacles to making the Internet available in rural and geographically isolated areas. This is one of the main reasons why over four billion people still do not have any internet access, and this can also contribute to high prices and slow speeds for many of the connected.

Infrastructure sharing is a particularly effective strategy for accelerating the extension of telecommunication networks and reducing their costs. Sharing can take place between different network access providers, and also with the passive infrastructure of other utilities such as electricity grids and transport networks. Infrastructure sharing should therefore be considered as a key component of any national policy effort which aims to unleash the economic and social benefits of affordable pervasive broadband.

- The Association for Progressive Communications commissioned this study from Deloitte to examine experiences in infrastructure sharing globally, particularly in Africa, in order to identify the practical steps that governments, regulators, operators and international and regional organisations can take to promote infrastructure sharing for improving internet access.
- These conclusions are based on a worldwide review of published material, interviews and in-depth case studies of 10 countries: Kenya, Nigeria, South Africa, Uganda, Côte d'Ivoire, Mozambique, India, Indonesia, Thailand and the Philippines.

The research shows that infrastructure sharing generates many benefits:

Better connectivity	Sharing of fibre networks can improve connectivity by providing more economically viable backbones for the provision of broadband, especially in rural areas where demand is lower and costs of deployment are higher. When passive infrastructure such as roads and regional electricity networks are used, network deployment costs can be reduced even further, and when these cross borders, infrastructure sharing can similarly help improve international connectivity.
Cost savings	Sharing presents a number of commercial benefits for access providers: it reduces both the cost of network expansion and operating expenditure, and can help operators better manage their balance sheets by allowing them to sell off passive infrastructure (e.g. towers) and lease back the use of them at lower cost in an outsourcing model.
Revenue generation	Sharing of infrastructure can also benefit the host infrastructure provider (telecom or non-telecom) through rental revenues from leasing access to infrastructure. This can also be an opportunity to attract more private investment in both passive infrastructure and networks.
Competition	Infrastructure sharing reduces barriers to entry for new operators, creating the opportunity for increased competition, often in upstream markets (e.g. national or inter-city networks) that incumbent operators typically control. For operators with substantial capital requirements to meet their coverage targets, and especially in more remote areas as part of the obligations of their license, sharing offers a rapid and cost effective strategy to meeting these needs.

Public benefits, environmental impact

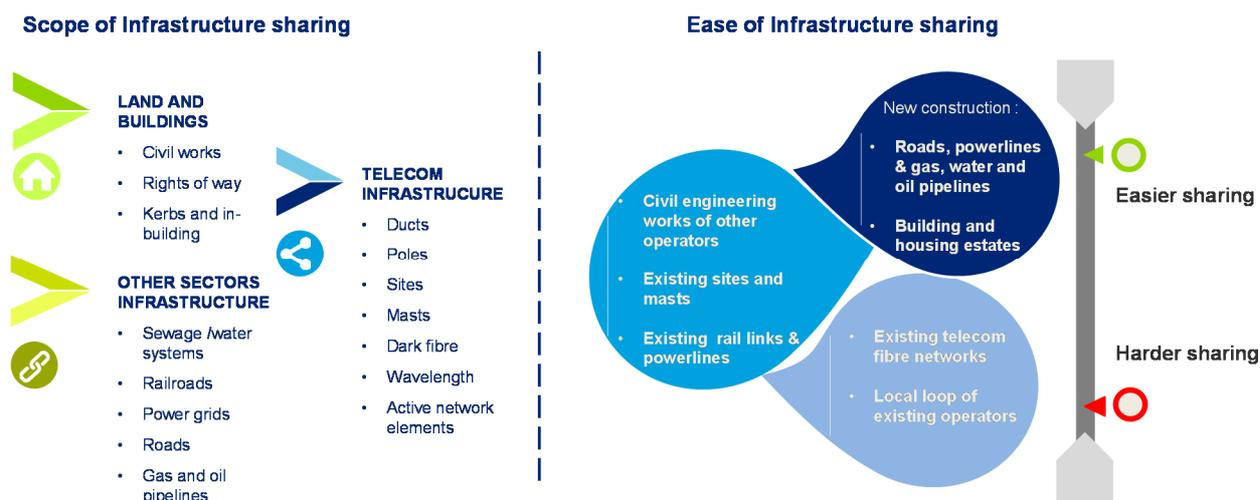
Infrastructure sharing does not just benefit operators - the public also benefits from reduced access costs that may result from more competitive and lower cost networks. Sharing can also reduce public infrastructure expenditure and create positive environmental impacts, as well as minimising disruption from multiple civil works. When network infrastructure is planned into passive infrastructure projects, sharing can also provide the technical capability for the host's own Information, Communications and Technology (ICT) needs, as well as help enable applications such as intelligent transport systems, smart grids, and integrated water management.

Many opportunities for infrastructure sharing across sectors

The scope for sharing infrastructure in telecom networks is broad. From greenfield land digs and tower sites to major civil works such as bridges, from rights of way along roads and railways, power grids, fuel, water and sewage pipelines, up to kerbs and in-building spaces, the range of infrastructure sharing opportunities for networks extends to nearly all types of basic infrastructure.

Infrastructure sharing opportunities depend to a great extent on the market and regulatory environment, and the national policies in place which may encourage or inhibit the adoption of infrastructure sharing.

Key Opportunities for infrastructure sharing



Source: Deloitte analysis

For network operators, the most common strategy is sharing some of the passive elements of their networks - non-electronic infrastructure such as ducts and poles, sites, and masts. Similarly, operators of passive infrastructure most commonly share their rights of way, or ducts in roads and on power lines, with one or more network operators.

Many network operators also come to arrangements where some of the active /electronic elements of the network are shared – for example fibres and amplifiers. Full network sharing is also an option - where a section or even the whole network is shared, such as in the case of Virtual Network Operators (VNOs) which lease and rebrand the capacity of other networks and usually do not operate any of their own network infrastructure.

Institutional models for sharing are often voluntarily negotiated private agreements between network operators, which in some cases may simply involve cable or capacity swaps. In other instances sharing may

be mandated by regulatory authorities. Commercial sharing models are also common where specialised infrastructure companies, such as tower or wholesale fibre companies, lease their networks on an open access basis to retail access providers serving the end-user. In some cases, these wholesale providers are owned by consortia of operators. There are also examples of models where governments support investment in networks through Private Public Partnerships (PPPs) or other ‘in-kind’ investment in consortia, such as buildings or rights of way. In other cases governments may own the entire network, leasing capacity, fibres or ducts to the retail operators, often via a private company contracted to manage the network.

Characteristics of different commercial sharing models

	Joint Venture	TowerCo	Fibre companies	Government-led	PPP & Consortia
Government involvement					
Risk sharing	Operators	Private investors	Private investors	Public sector	Development banks, governments, investors
Access	Operators of the joint venture	Wholesale basis	Wholesale basis	Open Access	Wholesale basis
Ownership	Operators	Private investors	Private investors, operators	Public	Operators, governments and private investors
Fibre					
Mobile/Wireless					
Funding	Private	Private	Private	Public sector, USO funding, multilateral banks	Development banks, governments, investors

Source: Deloitte analysis

Infrastructure sharing leads to substantial economic benefits

Cost savings – a key incentive for infrastructure sharing

The major benefit from infrastructure sharing is the saving in capital costs for network deployment, for example in sharing the cost of digging trenches for ducts and erecting masts for radio antennae. When existing ducts or passive infrastructure can be used (such as transport, energy and water networks), sharing has the potential to save higher amounts of capital cost, and can also reduce the time to market, with positive impacts on competitiveness and return on investment. Operators can also benefit from sharing through reduced operational costs, such as in sharing the costs of maintenance and site security.

The extent of cost savings that can be gained from infrastructure sharing depends on the number of parties that share the infrastructure, and the type of activity that is required to roll out the network. If the most costly elements, namely the civil works for trenching and laying fibre, can be shared by more operators, the savings are correspondingly higher.

Cost savings also depend on the sharing model employed: in general, the more components shared, the higher the cost savings that can be gained, but this can mean sacrificing some aspects of service differentiation with competing operators. As a result, in immature markets especially, where levels of competition are usually lower, operators may be less willing to consider strategies that involve collaborating with competitors.

To provide an indication of the magnitude of the potential cost savings, a set of estimations were developed for this study based on discussions with telecom network experts, which as far as possible reflect costs found in developing countries. The estimates are intended as broad indications. The cost of civil works and related activities (the largest component) depends mainly on the geographic features of the terrain to be traversed, while other costs depend on vendors and other local market characteristics.

These estimates suggest that the cost for the deployment of a greenfield fibre network can amount to \$20m per 1,000km of network. By sharing network roll-out with two other operators, an operator could save up to two-thirds of this cost. Sharing existing infrastructure of other sectors, such as power lines, can allow an operator to avoid almost all of the cost associated with civil works because passive infrastructure sharing does not usually add significantly to the overall cost of the infrastructure. For example, coordinating network roll-out with road construction is estimated to add only 0.9-2% to the total cost of the road. As a result, use of existing passive infrastructure could save approximately 80% of the cost, or up to \$16m per 1,000km. In this case when existing passive infrastructure is shared between three operators, the cost to each operator would drop from \$20m to approximately \$1.3m per 1,000km of fibre, plus the cost of receiving access to the infrastructure.

About 23,000km of fibre was deployed in Africa between 2010 and 2013. For this length of cable, assuming an average of three operators shared the deployments, infrastructure sharing could have generated total cost savings of up to \$300m for each operator involved. If the deployments had used other passive infrastructure projects or existing facilities of the incumbent for example, the savings could have been higher.

Sharing in mobile and fixed wireless networks often includes sharing mast sites and the tower infrastructure. The cost savings associated with this include the cost of purchasing the site and tower, and operational costs such as security. The cost savings for a two-operator sharing agreement are approximately 45% of a single operator site deployment (not 50%, due to the labour cost of provisioning each operator's equipment). Across a network of 10,000 towers costing an average of \$80,000 per site, a two-way sharing agreement across all mobile sites could save operators up to \$365m per year. As an example of the real potential impact of sharing, it is forecast that in 2015, an additional 15,000 tower sites will be built in Africa. If all of these new towers were shared between at least two operators, these could gain total cost savings of \$675m.

An increasingly common commercial sharing model in the mobile sector is the use of specialised tower operating companies which rent space on towers to the operators. Some of these tower companies (towercos) are owned by groups of operators who lease access to their shareholders and others. In 2014 almost a third of the towers in Africa were owned by towercos (47,600) and the number is growing rapidly as more mobile operators find it cost effective to sell their towers and lease back use of them, allowing them to focus more on their core business.

Operators can also gain savings from sharing the active components of networks, which can reduce overall network under-utilisation. In many cases network equipment will not be fully utilised by one operator, whereas a shared network can increase utilisation, leading to a lower effective unit cost of service provision. However, this type of sharing can have a bigger impact on competitive advantage and service differentiation, and as a result is less common across a whole network (except for Mobile Virtual Network Operators); however, it may be adopted in certain parts of a network, especially for increasing coverage.

Competition and investment impacts of infrastructure sharing

Against the background of the cost benefits described above, operators and regulators also need to consider the impacts of sharing on market competition and on network investment. A key issue is how to balance the need for competition in the sector while making sure there are sufficient investment incentives for operators. On the one hand operators need to weigh the cost and time-to-market benefits of sharing against potential loss of competitive advantage, while on the other, governments need to ensure that operators who share networks do not collude to dominate the market. At the same time governments need to take into account that operators may be reluctant to invest if regulation could mandate sharing and thereby reduce their competitive advantage.

To address the potential competition regulatory issues, infrastructure sharing can include open access requirements, either as a condition for financial support, or as regulatory requirement. In practice, the reduction in roll-out cost from sharing in an open access framework is associated with improved competition in many markets. For example, evidence indicates that as the number of towers held by independent tower companies increases (a measure of infrastructure sharing), concentration in the market decreases, benefitting competition levels.

Among other factors, increased sharing of mobile infrastructure can be also associated with falling prices. For example, in Ghana and Nigeria, prices gradually fell by 45% and 82% respectively, since independent towercos entered the market. Another example is in India, where mobile usage has increased threefold between 2007 and 2013 during which time towercos increased their network portfolio threefold.

Economic impacts of extended broadband access

The contribution of infrastructure sharing to the improvement of broadband connectivity in developing countries is particularly important because internet access has proven impacts on economic activity by accelerating communications, increasing the access to information, productivity and the potential for small scale entrepreneurs. These effects have been studied widely and the World Bank estimates that increasing broadband penetration by 10% may lead to a 1.38% increase in GDP per capita growth.

Infrastructure sharing can also play an important role in addressing inequalities by bringing connectivity to previously unconnected geographical areas which would otherwise be uneconomic to serve if infrastructure has to be duplicated. Evidence suggests that farmers' profits can increase by up to 33% if they receive real-time access to information on weather conditions, market prices, livestock tracking or disease control. In Africa, where 60% of the population lives in rural areas, mainly working in agriculture, it is estimated that 360m individuals could benefit from the increase in productivity if they received internet access.

Infrastructure sharing in emerging economies is growing

Countries such as India, Indonesia and Brazil already have flourishing tower sharing markets, and as indicated above, a growing number of African countries are now seeing their operators selling their tower assets to independent tower operating companies. Fibre sharing is less common than tower sharing, however a number of shared networks have been rolled out in recent years. In Burundi, Rwanda and Kenya, for example, new national fibre backbones were constructed which are available to all of the retail operators on a non-discriminatory and cost-related open access basis. In Tanzania a national backbone was created from fibres already available on high-tension power cable, along with fibre on rail and road infrastructure, while in many other countries, such as India, Kenya and South Africa, utilities are selling spare fibre capacity on a wholesale basis to operators.

Examples of sharing

CROSS SECTOR INFRASTRUCTURE
 Examples of cross sector sharing include:

- The Programme for Infrastructure Development in Africa, which has a priority action plan to enable fibre-optic investment along power transmission lines, roads and railways
- The Doba-Kribi oil pipeline between Cameroon and Chad involved fibre network deployment
- In Kenya and Tanzania, utilities such as power have been selling excess fibre capacity to mobile network operators and internet service providers
- In South Africa, Broadband InfraCo operates a fibre network on the energy and railway networks
- In Rwanda, it is mandatory for every new housing estate built in Kigali to cater to broadband access
- In Germany and Turkey, databases exist that map infrastructure available for sharing

WIRELESS NETWORKS
 In South East Asia and Africa, there are numerous example of mobile sharing:

- India is the pioneering market for tower sharing, with over 360,000 towers owned by towercos. Effective regulation in 2007 encouraged active sharing and introduced a subsidy system for sharing infrastructure
- In Africa, nearly 40% of existing towers are currently owned by tower companies
- In Nigeria, an estimated 4,500 are owned by Towercos and MTN and Bharti Airtel are reportedly in the process of selling a large stake of their tower portfolio to an independent towerco
- In South Africa, MTN and Telkom Mobile are reportedly discussing an active network sharing deal
- In Madagascar, a tower sharing regulatory framework promotes coverage in rural areas by incentivising operators to form sharing consortia

FIBRE NETWORKS
 Prominent examples of shared fibre networks include:

- Burundi’s Backbone System, a Public Private Partnership that was used to deploy the national fibre backbone
- An independent private wholesale fibre optic network deployed in South Africa with a sharing agreement between several operators
- National projects such as the National Optical Fibre Network in India and the Indonesian Palapa Ring project to connect the islands through a fibre network. Similar shared networks in Malawi, Rwanda and Uganda
- Phase3, which operates a fibre company that sells wholesale capacity (including wavelength and dark fibre) to MNOs and ISPs, with much of their network using the local power grid

Source: Deloitte analysis

Addressing constraints to infrastructure sharing

Aside from the market environment, there are a variety of other constraints which operators and governments may need to take into account in order to take full advantage of the benefits of sharing.

Constraints on infrastructure sharing

	Impact on Infrastructure sharing
Lack of coordination across different sectors regulation	Sharing infrastructure across different sectors is made more complex by the existing administrative barriers. Operators often note the lack of coordination across different sector regulators and different public institutions at municipal, regional and national level as key element that prevents further sharing to be implemented across sectors and can result in more frequent accidental cable cuts.
Lack of broader strategic telecoms plans	Strategic ICT plans that assess access gaps in connectivity and provide a consistent approach to sharing are seen as key by many operators to encourage investment. A road map for the sector with clear guidelines is often mentioned as missing in many African countries.
Lack of stability in licensing environment	Uncertainty about the duration and number of licenses, as well as arbitrary use of licensing policy by government and regulators are a major concern for operators to enter in sharing agreements and investment
Lack of funding	Operators often cite the lack of incentives and funding as preventing investment. Support in risk mitigation may be needed to reduce the cost required to raise capital.
Lack of spectrum/high spectrum fees	Restrictions on spectrum will restrict the number of operators who will be able to take advantage of infrastructure sharing.

Source: Deloitte analysis

Although the case studies that were undertaken for this report identify the benefits of infrastructure sharing, some projects had implementation issues that reduced the scale of these benefits. Common issues that can be encountered during implementation include:

- **A regulatory environment that is not conducive to sharing**, such as where an operator has sole control of the national network and is able to charge high lease prices as a result of its monopoly position, i.e. where the government does not allow any other operator to deploy fixed infrastructure, or where there is no competition due to other factors in the local market.
- **Insufficient stakeholder engagement** between parties such as operators, government authorities and international organisations, especially when a new network is being rolled out. This can result in targets differing and organisations taking an inconsistent approach to solve issues, potentially resulting in delays or even duplication of infrastructure which can undermine the original business model.
- **Government driven projects can suffer from inflated costs, quality issues, delays and administrative failures.** These issues can reduce the benefits of infrastructure sharing or cause operators to find alternative solutions.

Solutions to these problems vary depending on the particular circumstance, and can include:

- **A transparent set of regulations relating to infrastructure sharing can balance incentives for investment with the benefits from sharing.**
- **Adopting clearly defined implementation procedures and governance structures can more effectively engage all parties involved with the network.**
- **Relying on private rather than public sector implementation can reduce costs and delays** as operators have a greater financial incentive to ensure that these are kept to a minimum.

What can policy makers do to encourage infrastructure sharing for broadband?

A review of global experiences and discussions with telecom market experts has indicated a number of general strategies governments can take to promote sharing, both within the telecom industry as well as with passive infrastructure operators in other sectors.

- **Include obligations in planning approval procedures to ensure the inclusion of infrastructure for sharing:** when approving applications for civil works or building construction plans, governments can include obligations which require that provisions for ducts and antenna sites are included in the plans. For building permits, this would normally take place at municipal/local authority level. Provisions can include mandatory ducts along every newly constructed transport or energy link, and an obligation to reserve sufficient physical space and energy for more than one network provider to collocate their equipment, i.e. by mandating cabinet size, mast provisions or number of ducts.
- **Provide sufficient financial support to ensure infrastructure sharing can take place where public works are undertaken by the state:** related to the above, for new roads, energy links and other public infrastructure, budgets will need to include the relatively small additional cost of including elements such as ducts in the infrastructure.
- **Ensure that when public funds are used to subsidise the extension of private networks, operators receiving the funds share the subsidised infrastructure with others.** For example, when subsidies are provided through universal service funds for extending networks into more remote and rural areas, the ducts and masts deployed are available to other operators wishing to use them.

- **Create a planning database:** governments can operate national databases containing geographic information of infrastructure and projects that are publicly accessible in order to improve planning and coordination, and to limit the potential for accidental disruption to existing networks.
- **Facilitate use of rights of ways:** the complexities associated with dealing with multiple agencies and lack of timely and cost-effective permitting for provision of access to rights of ways are a key constraint to network deployment. Governments could establish a single entity which is responsible for management and tariff setting for rights of way. This includes taking into account the role of municipalities and local authorities to ensure they act quickly to insert sharing conditions in their approval mechanisms.

How can telecom regulators promote infrastructure sharing?

Telecom regulators need to balance the benefits from infrastructure sharing with the promotion of investment incentives across the sectors. International experience indicates that **the creation of a sharing framework should be included in the telecom licensing mechanism and associated regulations**. This would support the right of all licensed operators to request the option of sharing. Sharing could only be refused when based on objective reasons such as demonstrable network limitations. There may also need to be a separation of procedures into two different categories: a) providing shared access to existing infrastructure, and b) making provision for shared access in new infrastructure that is being planned. To support this strategy the following elements could also be considered:

- **Require operators to publish relevant information for infrastructure sharing.** Infrastructure sharing can be seen as an aspect of interconnection and co-location policy, for which there are normally existing requirements for operators to publish Reference Interconnection Offers (RIOs). Thus publication of 'Reference Infrastructure Sharing Offers' could be defined as part of the licensing requirement to increase the certainty and transparency of the sharing request process.
- **A rapid and effective dispute resolution mechanism** could be put in place to avoid arbitrary sharing request denials from operators. The regulator would have powers to evaluate the legitimacy of sharing claims and arbitrate in the case of disputes.

A significant risk that some operators have identified is that mandatory sharing requirements reduce the incentive to invest in new infrastructure. As such, regulators need to consider the effect of sharing policies on the investors' return and the broader impact on levels of investment. This risk can be reduced by ensuring that sharing rules are clearly and transparently set in the licensing conditions, while making clear distinctions between existing and planned infrastructure deployments. The key aspects are:

- **Including in the licence conditions clear network sharing guidelines (standards),** such as mandating network element design and characteristics (e.g. on minimum cabinet size to allow the addition of other providers' equipment, ducts size and number, and physical space to allow sharing).
- **Setting out in advance whether access terms will be commercially negotiated or regulated.** This may depend on whether an open access model is set up for the particular infrastructure, on the level of government funding, including Universal Service Obligation (USO) financing or other in-kind contributions such as land/rights of way.
- **Providing financial incentives to unlock investment in infrastructure.** Provision of financial incentives to operators willing to invest in shared infrastructure can reduce their project risk. Efficient ways to promote sharing through financial incentives include:

- **Reducing USO contribution requirements when voluntary sharing is undertaken with market competitors.** A similar approach was adopted in Malaysia, where the telecom regulator made infrastructure sharing mandatory as one of the criteria for issuing licences for 3G mobile spectrum.
- **Providing subsidies for shared infrastructure:** these could be provided to operators or consortia to compensate them for the limited extra costs in making provision for shared infrastructure.

How can international and regional organisations promote infrastructure sharing?

International and regional organisations have a number of important levers to help encourage infrastructure sharing:

- **When international financing organisations participate in infrastructure projects, they can ensure the funds made available include provision for ducts, masts and/or fibre.**
- **Make the inclusion of infrastructure sharing provisions a condition for receiving funding.** For example, in many instances, the World Bank has included as a condition of financial support that surplus fibres for telecom purposes are present on new high tension grid deployments.
- **Participate directly or indirectly in the project governance through inclusion of guidelines, checks and balances in the implementation process.**
- **Adopt regional policies and guidelines on infrastructure sharing,** such as those developed under the African Union Programme for Infrastructure Development in Africa (PIDA) and by the Economic Community of West African States (ECOWAS).
- **Support mechanisms for sharing of experiences and best practice in the area of infrastructure sharing.** Governments often lack information on the most effective infrastructure sharing methods and this is an area where international organisations can draw on their experience and resources to support knowledge sharing for improving local strategies.

1 Introduction

1.1 The role of infrastructure sharing in extending broadband in emerging markets

While basic mobile telephony is now available to the majority of the world's population, fixed and mobile broadband remain largely out of reach for many - today about 4bn people worldwide still do not have any internet access.¹ Optic fibre network expansion and wireless network upgrades have primarily concentrated on areas of higher income and denser populations, and even in these locations broadband access costs can be unaffordable for many.

A number of barriers exist that constrain the supply and demand of broadband services. On the supply side, limited backbone network development, in particular the limited use of optic fibre necessary for broadband, represents one of the major obstacles to making the Internet available in emerging markets, especially in rural and geographically isolated areas. Even in urban and other population-dense areas, the rapid growth in demand for broadband is resulting in rapidly increasing capacity requirements, and this is already leading to deployments of fibre to the kerb or to the building in the major cities of both developed and developing countries.

Against this background, infrastructure sharing represents one of the key components of any national policy effort which aims to unleash the economic and social benefits of affordable pervasive broadband. Sharing of fibre networks, especially across rural areas in developing countries, can transform connectivity by providing more cost effective backbones needed for the provision of low-cost broadband access services to the end-user. In mobile networks, tower sharing and network sharing are already popular in both developed and emerging markets. Generally, infrastructure sharing generates a number of economic and social benefits:

- It reduces the cost of network deployment and operational costs, as well as potentially speeding the time to market, with positive impacts on service costs and prices, and on operator profitability. Cross-sector sharing of broadband networks with other major infrastructure projects, such as water, electricity, railways and roads, can allow the deployment of fibre at even lower cost. Sharing of land, rights of way, of kerbs and of in-building cables also provide notable cost and speed of deployment efficiencies.
- It creates positive environmental benefits by reducing network duplication, and thereby the physical impact of necessary infrastructure.
- It increases competition, which reduces prices, improves service provision, and creates incentives for operators to extend their networks to previously unserved areas.
- Indirectly, infrastructure sharing supports better economic and social growth through its potential to improve broadband delivery.

Considering these benefits, regulators and competition authorities are increasingly encouraging infrastructure sharing between operators. In emerging markets infrastructure sharing remains more limited, albeit as this report shows, innovative and often successful models are being developed, and it is these experiences that provide valuable lessons for sharing policies and strategies in the future.

¹ITU, The World in 2014: ICT Facts and Figures

1.2 Background and structure of this paper

The Association for Progressive Communications (APC)² is a global network of civil society groups whose mission is to empower organisations, social movements and individuals through the use of information and communication technologies to build strategic communities and initiatives for the purpose of making meaningful contributions to equitable human development, social justice, participatory political processes and environmental sustainability. Founded in 1990, APC's vision is to see people having easy and affordable access to a free and open internet to improve their lives and create a more just world.

APC, recognising the benefits of infrastructure sharing in extending and improving the quality of internet access services, especially for more marginalised communities which have remained excluded from affordable pervasive broadband, commissioned this study from Deloitte to raise awareness of infrastructure sharing benefits, strategy and policy options, and in particular to:

- Examine the global experience of infrastructure-sharing models, and impacts of infrastructure sharing.
- Identify a set of best practices that governments, regulators and operators can apply to maximise opportunities for infrastructure sharing.

This report is structured as follows:

- Section 2 describes the most common technical and commercial infrastructure sharing models currently in use, and provides an overview of how these models have been applied to developing markets.
- Section 3 discusses the benefits that infrastructure sharing delivers, ranging from the cost benefits, economic and social benefits deriving from an extension of broadband usage and environmental benefits. It also provides an estimation of the potential cost savings that infrastructure sharing models deliver for operators.
- Section 4 analyses the competition benefits and regulatory issues that infrastructure sharing creates, and discusses the factors that constrain infrastructure sharing in emerging markets.
- Section 5, drawing on the analysis of sharing examples and policies worldwide and on a review of different approaches to the promotion of sharing, presents a number of considerations for governments, regulators, and local and international organisations to promote infrastructure sharing for the expansion of broadband coverage.

This study is based on a review of existing infrastructure sharing models, largely in Africa and Asia, and on a series of discussions with market experts and participants.

Appendix A provides a detailed overview of the development of the telecom market, of infrastructure sharing progress and of regulations in ten countries in Africa and South East Asia identified by the APC.

²<http://www.apc.org>

2 Analysis of Infrastructure Sharing Opportunities

2.1 Sharing opportunities

Over the past four decades, communication markets around the world have been steadily liberalised and deregulated. Today some level of competition prevails in most countries, mainly in the provision of value added network access (traditional internet service providers - ISPs) but also increasingly in basic telecommunication infrastructure, i.e. the physical elements of the network. At the same time, many traditional telecom operators, which previously provided unmanaged data services and voice minutes, are now also providing broadband access and content services, as are many of the mobile operators. These changes, combined with booming demand for the Internet, have led to the emergence of infrastructure sharing as an important element in strategies for rapid and cost effective deployment and operation of competitive services.

Infrastructure sharing in the communications sector primarily occurs in three ways:

1. Where one or more operators use the resources of other operators, such as their mobile towers, fibre cables or ducts.
2. Where a group of operators agree to share the ownership and/or use of the resource. In some cases this resource may be owned fully or partially by government, or by an independent (non-telecom) third party.
3. Where an operator uses the resources of other, non-telecom infrastructures, such as power lines, roads or even buildings, which can be leveraged for the deployment of fibre and/or radio equipment. From the point of view of the network operator, these are often called 'passive infrastructure', or 'alternative infrastructure', or in some cases 'linear infrastructure'.

A typical example of a cross-sectoral sharing strategy is the joint venture between an electricity and a telecom operator in Ireland, which aims to deploy a national fibre network directly to houses by using the existing electricity infrastructure.³ Other examples of sharing in developed economies include:

- Cities such as Paris, London and New York, which have deployed fibre using the existing underground sewer system.
- In Europe over the last ten years all the major mobile operators have entered network sharing agreements, in particular to run and operate shared 3G and 4G networks.⁴
- Australia's National Broadband Network Company Limited was created to build and operate a new national broadband network which allows wholesale and retail service providers to deliver broadband services.
- In the US, the Mid-Atlantic Broadband Co-operative (MBC) brought a fibre network to a rural and previously underserved part of Virginia. The project was funded partly by the government and provides dark fibre to operators on an open access basis. In return for rights of way, the MBC provided a total of 12 fibre strands for public sector use.⁵

In developing countries, infrastructure sharing has also increased in recent years. Many countries, including large markets such as India, Nigeria and Indonesia have flourishing third-party tower industries (which

³ <http://www.vodafone.com/content/index/media/vodafone-group-releases/2014/esb-vodafone-ireland.html>

⁴ <http://www.itu.int/itu-news/manager/display.asp?lang=en&year=2008&issue=02&ipage=sharingInfrastructure-mobile>

⁵ Cohen, T. and R. Southwood (2008) Extending Open Access to National Fibre Backbones in Developing Countries, ITU 8th Global Symposium for Regulators

specialise in operating the towers used by wireless networks). Sharing infrastructure across utilities such as electricity or oil companies has also taken place in many countries such as Cameroon, Kenya, Tanzania and Zambia and a growing number of developing countries have rolled out open access national fibre optic networks.

However, emerging markets tend to lag behind developed economies in the frequency with which infrastructure is shared. Considering that these countries generally have smaller markets than most developed countries, and have larger proportions of their populations that still remain unconnected, these countries stand to benefit more than developed countries from increased infrastructure sharing. Lack of awareness of the opportunities, immature markets or lack of a competitive environment are among the common reasons for more limited infrastructure sharing - factors which are addressed in more detail later in this report.

A number of common technical and commercial infrastructure sharing models have emerged, within the telecom sector as well across infrastructure projects in different sectors. These include:

- **Telecom operator consortia** where a group of operators share the costs and ownership of a common asset, such as a fibre cable. This model is most common in undersea cables but is also found in terrestrial cable deployments. The model may include partial government ownership and mechanisms to support open access for smaller operators.
- **Specialised wholesale telecom operators** including dark fibre operators, whose customers are in effect sharing the costs and use of the infrastructure provided by the wholesaler. Normally these wholesale operators do not sell services to the end-user, but where local loop unbundling of the copper access network has taken place, the original owner of the local loop (usually the incumbent) acts as wholesale provider to other retail operators, while often competing with them. Shared wholesale wireless networks are now also increasingly being deployed. These range from a variety of municipal networks, to some national Long Term Evolution (LTE) services such as Olleh Rwanda Networks (ORN) in Rwanda, and to national, regional and global hotspot providers which lease their networks of Wi-Fi hotspots to other operators for their wireless roaming services.
- **National power utilities** are probably the most common form of shared cross-sectoral or 'alternative' infrastructure due to the electric power utilities' own fibre needs for administering the supply of power over the grid. Where excess fibres are available on existing high tension grids, this can provide ready infrastructure for the deployment of telecom networks. Using the power grid's poles and pylons also provides a secure platform for rapid and low-cost additional fibre cable deployment.⁶
- **Roads, rail lines and pipelines carrying fuel, water and sewage** can all be effective hosts for ducts for telecom operators wanting to extend their fibre networks. When ducts and fibre are planned into any new infrastructure, this can dramatically cut the cost of the deployment of networks by taking advantage of the construction works (where most of the cost lies in laying cable). This model extends to new building construction, such as in all new housing estates and commercial/public construction, which is increasingly subject to conduit requirements. Planning for provision of ducts in other major civil works, such as ports, airports and bridges is also an important opportunity for reducing costs of fibre deployment.
- **Mobile networks** have historically been proactive in use of sharing opportunities: from simple site sharing and tower sharing to full Radio Access Network (RAN) sharing, mobile operators have in parallel developed commercial options such as Mobile Virtual Network Operators (MVNOs), joint ventures or tower companies to manage risks and benefits.⁷

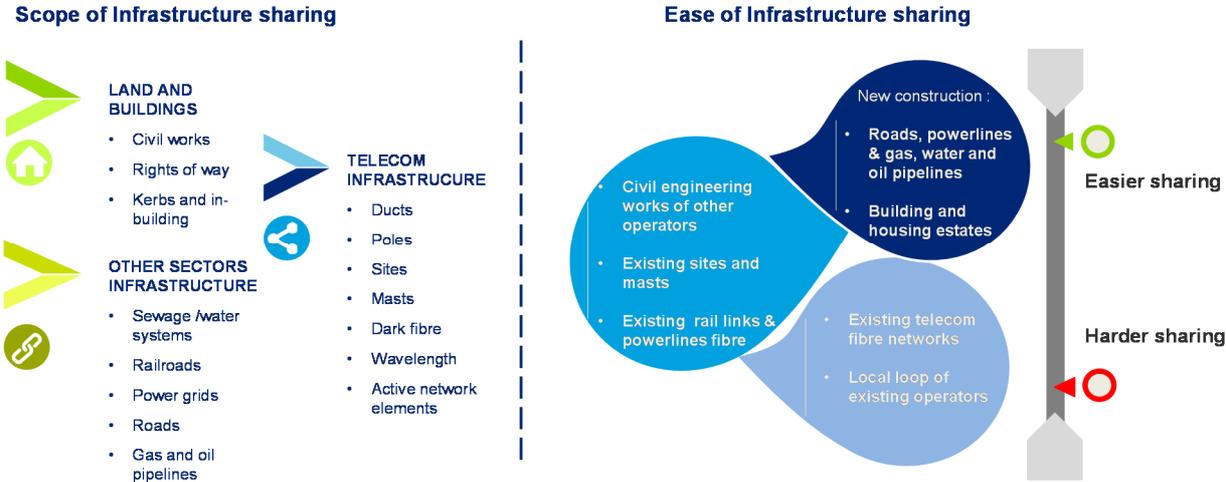
⁶ High tension power grids in particular, are by their nature unlikely to be vandalised or subject to cable theft due to the inherent danger.

⁷ See below for a description of models

While sharing infrastructure can substantially reduce both the cost of equipment and the cost of civil works to deploy networks, the use of existing alternative/passive infrastructures also solves one of the primary problems faced by operators wishing to deploy networks – **limited access to rights of way**. Purchasing or leasing land and obtaining permits to dig are often among the most time consuming and expensive components of new telecom network deployment. This can make it particularly difficult for new entrants to the market to compete with the existing (usually previously state-owned) operators which often have easier access to public land and state supported rights of way, especially when they first deployed their networks. Thus, support for infrastructure sharing is increasingly being seen as an integral part of improving the enabling environment and fostering greater competition in the sector.

National geospatial record keeping and intra-governmental coordination also need to be in place to realise the full potential of sharing the infrastructure of various sectors. By ensuring effective planning, build-outs can be synchronised and carried out more efficiently while minimising the risk of cable cuts to other fibre operators.

Figure 1: Scope and ease of infrastructure sharing



Source: Deloitte analysis

Infrastructure sharing is usually driven by two different factors:

1. **Economic interest**, which encourages operators to collaborate and/or to use alternative infrastructure due to the potential cost savings and accelerated time to market.
2. **Regulatory requirements**, where regulators seek to address imbalances in the market resulting from the power of dominant operators; and/or to require more efficient use of public resources such as land and radio spectrum; and/or to require or compensate the operators of alternative infrastructure to help ensure they make provision for telecom sharing.

In developed economies, regulators have been increasingly supporting and incentivising sharing agreements, with the US Federal Communications Commission (FCC) passing a regulation on pole sharing as early as 1978.⁸ In Europe, the European Commission has recommended the adoption of legislation that relies on sharing to help accelerate investment in next generation fixed networks.⁹

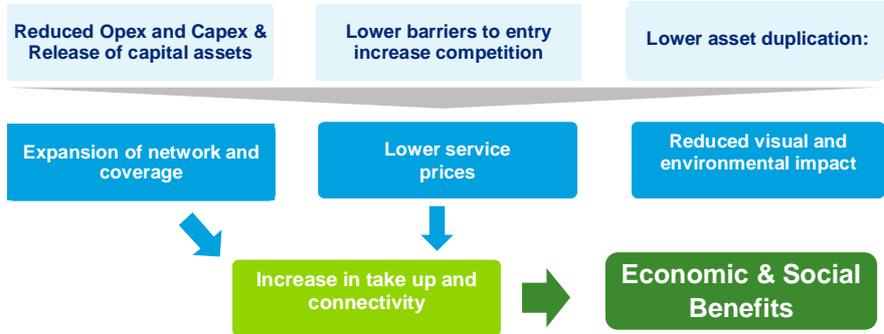
⁸ Economics of Shared Infrastructure Access, CSMG Report
⁹The European Commission, 2013. Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment – C (2013) 5761

In considering the technical and commercial models available, governments take into account the wider benefits that infrastructure sharing provides. Operational and cost benefits may inform the commercial structure that operators put in place, while potential economies of scale and scope that can increase the quality, coverage and sustainability of the services, as well as mitigating environmental impacts, are of particular concern to regulators and governments.

The economic benefits that infrastructure sharing can generate through the extension of broadband also often drive direct government involvement, e.g. through a 'National Broadband Plan' where internet access is recognised as a fundamental accelerator of economic growth, leading to increases in productivity, potentially enhanced education impacts and improved healthcare outcomes, among many others.¹⁰

The various benefits of infrastructure sharing are illustrated in Figure 2, and are described in more detail in Section 3.

Figure 2: Major benefits of infrastructure sharing



Source: Deloitte analysis

The remainder of this section discusses the prevailing technical and commercial infrastructure sharing models, and provides an overview of sharing experiences across developed and emerging markets.

2.2 Sharing of facilities across major infrastructure projects

A key opportunity in developing markets lies in the sharing of civil works across major infrastructure projects in different sectors.

Civil engineering works are the largest cost element in laying fibre, and are particularly burdensome in developing markets as a result of more complex administrative procedures, higher operational costs and management risks. In Africa, it is estimated that around 80% of the cost of rolling out new fibre is due to civil works.¹¹ This is a major contributor to the fact that infrastructure services cost twice as much on average as they do in other developing regions.¹²

When investment in infrastructure for public utilities occurs, such as in electricity lines and power grids, water, sewage and gas pipelines, oil pipelines, and roads and railways, the cost and time savings from bundling many of these together are extensive. These projects all require civil works and infrastructure, such as ducts and poles, which can be shared across different services and provide space for the installation of telecom cables or radio equipment, and the marginal cost of adding spare fibre capacity during their construction is

¹⁰ Deloitte/Internet.org, The Value of Connectivity, 2014, available at: <http://en-gb.internet.org/press/value-of-connectivity>
¹¹ <http://www.ictafrica.info/FullNews.php?id=9355>
¹² http://www3.weforum.org/docs/AF13/WEF_AF13_African_Strategic_Infrastructure.pdf

usually low.¹³ For instance, it is estimated that adding ducts to open trenches during road constructions adds as little as 0.9%-2% to the total road construction costs.¹⁴ Public utilities also often require communication networks for operation management.

The opportunity for cross-sectoral infrastructure sharing has been recognised at a continent-wide level in Africa by the Programme for Infrastructure Development in Africa (PIDA), which was adopted by the African Union heads of state meeting in 2012. It is expected that most transport sector projects envisaged under PIDA will include the installation of so called Smart Corridor Systems.¹⁵ These systems aim to make customs processes more efficient, enabling the import declaration for shipments to be transmitted electronically before the arrival of the shipment. For their own operation and for telecom operators, Smart Corridors involve the deployment of fibre along the transport routes.¹⁶ Within the PIDA ICT programme, the ICT Enabling Environment project is intended to create an enabling environment for trans-boundary and cross-sectoral investment in optic fibre links.

Figure 3: The Programme for Infrastructure Development in Africa¹⁷

All projects included in PIDA's energy and transport sector priority action plan (PAP) involve fibre-optic investments along power transmission lines, roads and railways.

The PIDA's ICT project, Terrestrial Connectivity, aims to expand the interconnecting fibre networks between countries and it is estimated that in Africa at least 22 cross-border links are necessary, in order to provide adequate regional infrastructure. PIDA works to align many of these projects with transport sector projects.

An example of such an initiative is the terrestrial optic fibre cable that is being deployed simultaneously with an oil pipeline connecting Algeria via Niger to Nigeria. There are also plans for a Trans-Saharan highway on the same route.

Examples of successful cross-sector sharing in emerging markets include:

- In Kenya and Tanzania, the electricity utilities Kenya Power and Lighting Company (KPLC) and the Tanzania Electric Supply Company (TANESCO) have been selling their excess fibre capacity along the power lines to mobile network operators (MNOs) and ISPs.
- In South Africa and India, rail and electricity infrastructure has been leveraged by government to establish national broadband providers - Broadband Infraco in South Africa using Transtel and Eskom links and the National Optic Fibre Network (NOFN) in India using PowerGrid and RailTel (see Figure 5 and Figure 6 below).
- The construction of the Doba-Kribi oil pipeline between Cameroon and Chad also involved the deployment of a fibre network. In addition to capacity for internal management purposes, the network included excess fibre strands. Whilst this project has had the potential for significant benefits, the realisation of these has reportedly been adversely affected by operators' competitive positions. For example, according to local market experts, the incumbent operator used its monopoly position to require other operators to lease

¹³ Cohen, T. and R. Southwood, Extending Open Access to National Fibre Backbones in Developing Countries, ITU 8th Global Symposium for Regulators, 2008

¹⁴ TMG report on Mobile Sharing and Joint-Trenching, ICT Sector Week at World Bank, 2011

¹⁵ <http://www.afdb.org/en/news-and-events/article/afdb-and-the-african-union-support-african-infrastructure-during-dakar-financing-summit-13305/> and market experts.

¹⁶ http://www.jica.go.jp/topics/news/2014/ku57pq00001mudxy-att/20140604_01_03.pdf

¹⁷ <http://www.nepad.org/system/files/Infrastructure-PIC1%20Matrix.pdf>;

<http://oilprice.com/Energy/General/Nigeria-Mulls-20-Billion-Trans-Saharan-Natural-Gas-Project.html>

<http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/PIDA%20note%20English%20for%20web%202008.pdf>

capacity rather than making dark fibre available on a wholesale basis, thereby reducing the impact on the sector.

Extensive negotiation or regulatory intervention can be required in some cases, to manage tendencies for utility operators to overprice their assets and use the fibre as a revenue generator, or to stop exclusive agreements with particular operators being made, as this would make it more difficult for new competitors to enter the market.

Co-Ordination Needs

One of the greatest obstacles to the sharing of facilities across different infrastructures and projects is a lack of coordination between infrastructure owners, operators and different government agencies. Harmonisation efforts by regulators, the government or international organisations can provide a remedy for this issue. In developed markets, a positive example of coordination is Germany, which set up a database mapping all of the country's infrastructure projects.

Figure 4: Germany's "Infrastructure Atlas"¹⁸

In Germany, the Federal Network Agency introduced a database called "The Infrastructure Atlas", which includes all existing infrastructure that can be used for the roll out of fibre networks. Data comes from operators in the telecom, energy and transport sectors. Before deploying new fibre, operators can check the availability of existing infrastructure and where possible, negotiate commercial terms of access and usage with the infrastructure owners.

The Infrastructure Atlas currently includes information from 650 infrastructure owners on the availability of fibre optic cables, ducts, masts and base stations. Initially, provision of data was voluntary, but after a change in legislation, it has become mandatory for all owners to disclose the location of their infrastructure. Access to the database is granted exclusively to telecom operators and government agencies.

Such databases are also in the process of being developed in several emerging market countries. In Turkey, a database called EHAB Systems will be managed by the Ministry of Transport and will keep track of all existing and planned infrastructure nationwide. Operators and analysts in Turkey have noted however that the EHAB system is currently incomplete and it may take a significant amount of time for operators to obtain information. In India and Namibia, the telecom regulators require all licensees to maintain a database of their infrastructure available for sharing on their websites.¹⁹

¹⁸http://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Breitband/Infrastruktur/atlas/infrastrukturatlas-node.html

¹⁹<http://www.cran.na/dloads/Regulations/Government%20Gazettes/GG%205505-Gen%20N192.pdf>

Figure 5: Broadband InfraCo – South Africa²⁰

Broadband InfraCo, a South African state-owned enterprise, was founded in 2007 to help drive down the costs of terrestrial fibre in the country by operating the national fibre network assets of the electricity provider Eskom and Transtel, the telecom arm of the national railway company. Since its creation, Broadband Infraco expanded the network based on the original fibre cables on Eskom's power transmission lines and Transtel's railway infrastructure.

In order to facilitate the entry of a second national operator, initially Broadband Infraco leased its network only to Neotel. In 2010, Broadband Infraco launched its commercial services to the broader telecommunications market.

This launch was delayed due to a lack of coordination between its shareholder, the Department of Public Enterprises, and the Department of Communications, which was responsible for the licensing. This delay was partly responsible for other operators deciding to develop their own fibre networks, undermining the InfraCo business model.

Figure 6: India's public sector undertakings and the National Optical Fibre Network²¹

In addition to the fibre networks of national operator BSNL and of several private operators, many of India's state-owned utility providers (e.g. Railtel and Power Grid) also have nation-wide fibre networks, which they lease to telecom operators. Most of these networks are concentrated in densely populated areas, so that broadband access in rural areas remains limited.

In 2011, the government of India approved plans for a National Optical Fibre Network (NOFN), which is going to connect all of India's 250,000 gram panchayats (village-level administrations). This will be achieved by sharing existing fibre infrastructure of public telecom and utility operators such as BSNL, Railtel and Power Grid and by deploying additional fibre, where necessary.

In order to identify connectivity gaps, the National Informatics Centre carried out a geographic information system (GIS) mapping of the existing optical fibre networks. This information was used to calculate incremental deployment of new fibre.

The project, which is estimated to cost USD\$4 billion, is funded by the Universal Service Obligation Fund (USOF). Upon completion, the NOFN will be available to telecom operators and internet service providers on an open access model. The NOFN was supposed to be completed within two years; however, due to numerous delays due to factors such as tendering processes, the deadline has been extended to June 2016.

2.3 Technical telecom sharing models

There are numerous technical ways in which operators can undertake network sharing. In general, options range from simpler sharing of passive elements, where non-electronic infrastructure such as ducts and poles, sites and masts are shared among different operators; to more sophisticated sharing where electronic elements are shared, up to full network sharing, where a whole network is shared across operators or by different parties. Sharing of kerbs and of in-building facilities also takes place, especially in urban areas and in commercial premises.

²⁰ Ibid.

²¹ <http://www.powergridindia.com>; <http://www.qailonline.com/>; <http://www.railtelindia.com> and <http://www.bbnl.nic.in/content/page/national-optical-fibre-networknofn.php>

The specific elements that are shared depends, along with commercial and regulatory considerations, on the state of the development of the market, on the size of existing networks, on the role and importance of the incumbent operators, and on the geographic characteristics of the territory. Examples of technical sharing models of fibre networks and of wireless infrastructure are discussed in more detail below.

2.3.1 Sharing of fibre networks

As noted above, national fibre backbones are required to support different types of last mile access, both fixed and wireless - fast-growing demand for data has resulted in fibre increasingly being needed to replace microwave circuits for backhaul, and for last mile networks in many urban areas too. However, the challenges of rolling out extensive fibre networks remain significant, especially in developing countries and in remote areas.

The complex geography of many developing countries often means that the costs involved in expanding networks into rural areas may include ancillary infrastructure such as access roads and energy provision equipment, and this makes the expansion of broadband more expensive. These higher costs often combine with unequal treatment compared to other industries with regards to input costs: for example, in Kenya the fuel used to power generators for network sites is not tax-exempt for mobile operators, while other industries are allowed certain exemptions.²² Similarly, in Nigeria, the National Electric Power Authority ruled that telecom operators must pay extra tax to generate their own power.²³

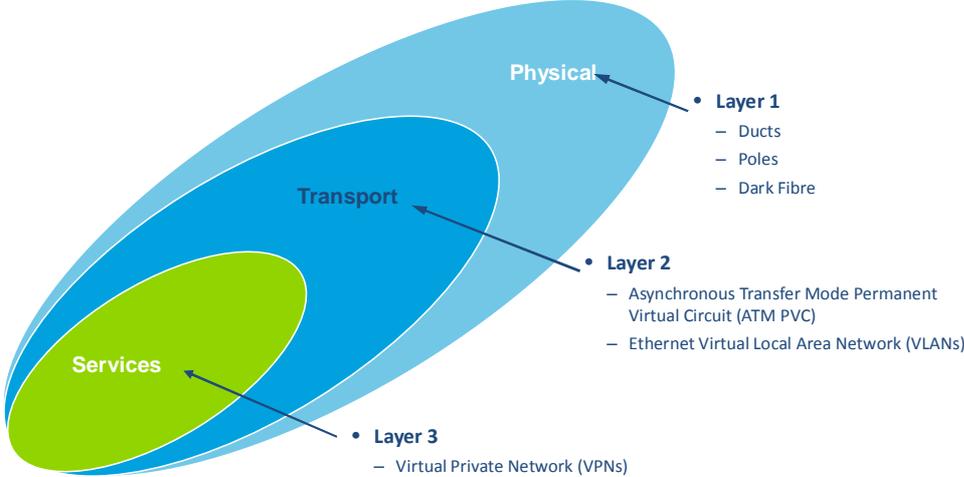
Administrative barriers, including obtaining permissions and rights of way to undertake civil engineering works and lay ducts across different local jurisdictions, make sharing more compelling. The degree of technical sharing can vary significantly. Passive infrastructure sharing involves the sharing of the physical infrastructure such as civil engineering elements or non-electrical components. Power supply is often shared under passive models as well. Active sharing models involve sharing of the electronic components of the infrastructure network such as optical node switches, software or the management systems. Finally, in the case of wholesale networks, the network is shared by operators who deliver last mile access in a number of different ways.

Figure 7 illustrates the layered network elements of a national fibre infrastructure network: these include the physical, transport and services elements. Passive sharing usually involves layer 1 components being shared, whilst sharing layer 2 and 3 is usually considered active sharing.

²² Deloitte/GSMA, "Mobile telephony and taxation in Kenya", 2011

²³ Telegeography, 2012

Figure 7: Layered network elements

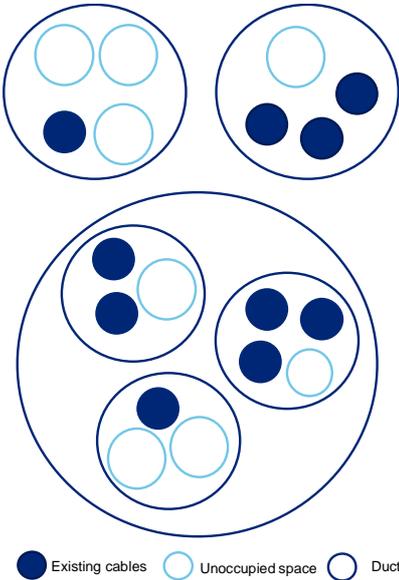


Source: Deloitte analysis based on ITU

Sharing of Ducts and Poles

Duct or pole sharing involves sharing physical facilities. This includes the conduit for enclosing cables (usually underground) and the poles on which electricity or telecom distribution cables are mounted. Ducts are the most widely used system of underground cable installation. Once deployed, ducts allow removal or installation of additional cables depending on the size of the duct and the use of sub-ducts inside the main duct.

Figure 8: Ducts sharing



Source: Deloitte analysis

Poles are the aerial alternative to underground ducts. In many countries, the middle mile and last mile to the users is still being delivered using poles due to their easy accessibility – there is no need to dig to bury the

cable. Ducts and poles can be shared by leasing their use from the owner (or assigning rights of use), or leasing the existing fibre cable included in the ducts or on the pole.

As noted above, energy or railway networks are examples of sectors where ducts or poles are also deployed, and can be shared with the telecom industry. In Africa, a number of electricity and oil companies are already providing their infrastructure for telecom operators, for example the oil pipeline connecting Cameroon and Chad²⁴ described above, and power networks in Zambia²⁵ and Kenya.

Regulations that promote sharing across sectors are therefore key areas for reducing telecom deployment costs.²⁶ In Brazil for example, the regulatory bodies for electricity, telecommunications and oil have set up a common regulatory framework for sharing infrastructure elements. In Africa, an example of cross-sector sharing requirements is present in Cameroon, which has set up a framework to coordinate duct sharing between telecommunications, television, electricity and railway operators.²⁷ In developed markets, the ducts of dominant operators are sometimes regarded as an essential facility, which can mean that providing access to this infrastructure for other operators at reasonable prices is mandatory for the owner. For example, France Telecom's ducts are considered an essential facility by the French regulator ARCEP.

Figure 9: Fibre infrastructure sharing in Nigeria²⁸

In Africa, Nigeria represents an example of a successful fibre sharing model. Phase3 Telecom is a fibre infrastructure company, which provides transmission services to MNOs, ISPs and corporate organisations. The company mainly deploys aerial fibre optic cables on high voltage transmission lines. It currently has a network of over 4,500km on which operators can lease capacity including wavelength (active) and dark fibre (passive).

Active sharing

Active sharing models for fibre network involve sharing of the powered/electronic elements of the networks; i.e. the Layer 2 and Layer 3 identified in Figure 7. Where this type of sharing can provide the highest saving, as even less of the network is duplicated, this can also increase the technical and institutional complexity of sharing agreements, and can limit the potential for service differentiation between those sharing an active network.

Nevertheless when operators lease capacity to other operators (rather than selling them ducts or dark fibre), they are effectively providing a shared active network for use by their customers. This is currently amongst the most common of the commercial models for the provision of backbone links. However, owning a complete fibre pair gives competing telecom operators greater potential for service differentiation and more flexibility and control over the type of electronics to use, and in the amount of capacity. Many larger operators therefore prefer dark fibre to capacity. This option may not be feasible for the smaller operators with traffic that may not be able to justify the expense of a full fibre pair, at least initially, but this option may still be of interest in the long term if their traffic is expected to grow.

²⁴ Botswana Telecommunications Authority, 2009. Communications Infrastructure Sharing: Concept Paper

²⁵ [http://www.ey.com/Publication/vwLUAssets/Inside_Telecommunications_1Q_2012/\\$File/Inside_Telecoms15_final.pdf](http://www.ey.com/Publication/vwLUAssets/Inside_Telecommunications_1Q_2012/$File/Inside_Telecoms15_final.pdf)

²⁶ ITU 2008, Extending Open Access to National Fibre Backbones in Developing Countries

²⁷ ITU 2008, Extending Open Access to National Fibre Backbones in Developing Countries

²⁸ <http://www.phase3telecom.com/phase3%20Telecom%20Brochure.pdf>

Shared fixed access in the local loop

Opportunities to share access to local loops (shared copper as well as last mile fibre) is being adopted in urban areas where there is already significant copper infrastructure, or where population density combines with growing demand for broadband to make fibre to the kerb/home/premises ('FTTx') a viable option. Copper local loop unbundling is now standard practice in most developed markets, usually through adoption of regulations which require the legacy fixed line operator to become a wholesale reseller of its local cables to other fixed broadband providers.

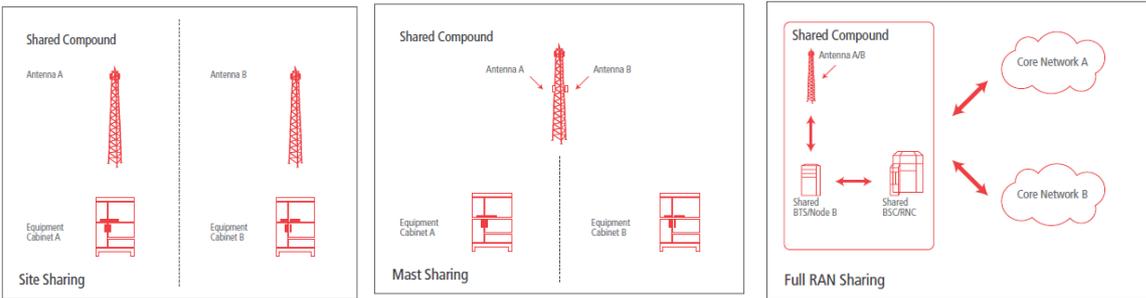
In deploying fibre in the local loop there are a variety of technologies and architectures which can be used; however the policy/regulatory environment may need to influence the choices of architecture made by operators. Some of the more popular methods, such as curbside single-wavelength Passive Optical Network (PON) with pole-mounted splitters, have relatively low costs to deploy, but are less suitable for optimising competition. In this respect, more costly but fully unbundled network architectures that provide dark fibre to the premises (e.g. Home Run) or use Optimal Fibre Aggregation Points (OFAPs) do not present this problem.²⁹

2.3.2 Wireless networks

Wireless networks include both mobile GSM-based 2/3/4/5G systems which are now converging on LTE and the fixed wireless technologies for microwave backhaul and local access, such as Wi-Fi, and WiMAX, as well as the new dynamic spectrum access systems used on software defined radio frequencies, such as TV White Space (TVWS).

Site sharing, mast sharing and RAN sharing are the main wireless network sharing models that have emerged. Site and mast sharing are termed passive sharing because only physical infrastructure or space is shared and network operators do not actively coordinate any other activity. RAN sharing is usually defined as active sharing, with operational co-ordination of electronic and software elements.³⁰ RAN sharing usually takes place in mobile networks, but fixed networks of shared Wi-Fi hotspots are also a RAN sharing option. Site sharing can also fall between passive and active infrastructure sharing when it includes sharing power supplies or backup power systems and air conditioning.

Figure 10: Sharing models illustration



Source: Deloitte/GSMA

²⁹ For a more detailed summary of the issues, see for example: https://www.academia.edu/2850968/FTTP_Networks_Topology_and_Competition and <http://repository.cmu.edu/cgi/viewcontent.cgi?article=1451&context=tepper>

³⁰ Core network and network roaming are other common sharing models but are out of the scope of this paper.

Site Sharing

Site sharing has been adopted by mobile operators for many years and because of its simplicity, it is one of the most common forms of network infrastructure sharing undertaken by mobile operators. They share the same plot of land, or rooftop, for example. New sites may either be jointly planned, or if there is sufficient land space, an operator with a pre-existing base station may lease part of the site to other operator(s). All the network components and power supply (masts/towers, cabinets, antennas, backhaul equipment, and backup generator if needed) are installed and owned independently by each operator, as shown in Figure 10, where the solid line represents the fenced-off compound that the operators either own or lease. Power supply and air conditioning, along with support equipment, such as shelters and security systems, may also be shared.

In building out mobile networks the major cost is in deploying the base stations, so to minimise the high costs of site rental or purchase, operators often seek sharing opportunities with others. Securing land rights in the rural areas of many developing countries can also be a very time consuming process, so use of existing sites can significantly reduce time to market in these cases. Sharing is also encouraged through necessity in many urban and suburban areas where there is a shortage of available sites or onerous planning requirements. Further, financial and logistic incentives for site sharing exist in remote and rural areas, where construction costs, power supply and access roads can represent a major portion of the total cost of network deployment in these locations.

There may be instances where operators may resist requests to share existing base station sites, in light of the investment made which can create a competitive advantage. This can be particularly effective in locations where it has been prohibited to install additional sites, or because the site may be located in a costly area. In these cases the incumbents or dominant mobile operators have been incentivised by regulation to share sites. However, in most other cases site sharing tariffs are usually left to commercial negotiations.

Mast Sharing

Where operators share masts, not only do they co-locate their sites but they also share the same mast or antenna frame. Other structures such as chimneys or steel power pylons may also be shared to accommodate many antennas.

Operators typically install their own radio infrastructure, from the antennas down to the cabinets and electronics. If a mast is to be used by multiple operators, it should be designed accordingly, or it may need to be strengthened to accommodate several sets of antennas.

The popularity of this sharing model has combined with mobile operator strategies to outsource non-core operations, resulting in a number of specialist tower operating companies emerging across Africa, Asia and elsewhere, such as Helios and American Tower Corp. Many of these are expanding their networks in sale-and-leaseback deals, where they buy towers from the operators and then charge them for their active equipment on them.

The tower sharing model has been particularly popular in India, which is now the world's largest tower market. Most tower companies in India have tenancy ratios of around 2.4, i.e. across their portfolios on each tower more than two operators have installed their antennas.³¹ In 2014 almost a third of the towers in Africa were owned by towercos (47,600) and the number is growing rapidly as more mobile operators find it cost effective.

³¹AT Kearney 2012, The rise of the tower business.

RAN sharing

Operators can also gain savings from sharing the active components of networks, commonly known as Radio Access Network (RAN) sharing, which reduces network under-utilisation. In many cases, network equipment will not be fully used by one operator, whereas a shared network can increase overall utilisation, leading to a lower effective unit cost of service provision. However this type of sharing can have a bigger impact on competitive advantage and service differentiation than site or mast sharing, and as a result is less common across a whole network (except for MVNOs), but may be adopted in certain parts of a network, especially for increasing voice or data coverage.

RAN sharing involves all of the access equipment being shared: antennas, masts and the radio equipment. At the point of connection to the core network, traffic then splits into the separate networks. RAN sharing can deliver substantial saving to operators, especially for rural areas, where it becomes more commercially attractive to deliver service in locations with lower Average Revenue Per User (ARPU) and subscriber density.³² However even for urban areas, not only does RAN sharing reduce the cost of equipment for new locations, in existing locations where infrastructure is duplicated it provides the operators with the option to redeploy radio equipment to previously underserved areas.

Aside from the lower levels of independence that RAN sharing operators have, potential barriers to RAN sharing may arise from technical differences between the existing networks whose architecture may have evolved independently. This can have implications for inter-working of equipment purchased from different vendors, operational procedures and control mechanisms.³³

Nevertheless, in Europe and the US, RAN sharing is widespread. For example, in the UK, mobile operators EE, Three, Vodafone and O2 run parts of their networks through RAN sharing. RAN sharing remains more limited in emerging markets although it is progressively being implemented in some countries. For instance, in early 2014 the South African mobile network operators MTN and Telkom SA (through Telkom Mobile) confirmed talks on a proposed RAN sharing agreement. The deal would involve MTN taking over the management of the rollout and operation of Telkom's RAN network.³⁴ It should also be noted that roaming agreements between operators also represent a form of RAN sharing.

2.4 Commercial models

To implement infrastructure sharing a number of commercial models have been implemented by operators, often with other parties in the wider telecom ecosystem. In addition to operators, equipment vendors, investors, governments, municipalities, international organisations, as well as private non-telecom companies may also be involved in sharing agreements.

Commercial models range from completely private companies to government-led entities, each with different ownership models, access terms for telecom providers and shareholder involvement. Importantly, especially in developing markets, licensed telecom operators are not always the initiators of such models. In addition to the owner-tenant model whereby the operator leases space/ access at a regulated or market price, commercial models that are described in this report include Joint Ventures, Tower companies, Fibre companies, Government-led network companies, Public Private Partnerships (PPPs) and Consortia.

When stakeholders agree to one of these models, a number of commercial and public policy drivers are considered, as illustrated in Table 1. In particular, elements such as risk sharing (especially for new networks),

³² GSMA estimates that cost saving from RAN sharing could increase free cash flows by up to 20% for a typical European operator. GSMA, Mobile Infrastructure Sharing.

³³ GSMA, Mobile Infrastructure Sharing

³⁴ <http://www.meamonitor.com/industry-trend-analysis-bmi-view-mtn-telkom-network-sharing-agreement-may-2014>

access conditions for the participants or for other telecom operators, type of ownership and Profit and Loss implications of capex and opex costs, as well funding models, are important considerations.

Table 1: Commercial models

	Joint Venture	TowerCo	Fibre companies	Government-led	PPP & Consortia
Government involvement					
Risk sharing	Operators	Private investors	Private investors	Public sector	Development banks, governments, investors
Access	Operators of the joint venture	Wholesale basis	Wholesale basis	Open Access	Wholesale basis
Ownership	Operators	Private investors	Private investors, operators	Public	Operators, governments and private investors
Fibre					
Mobile/Wireless					
Funding	Private	Private	Private	Public sector, USO funding, multilateral banks	Development banks, governments, investors
Examples	Three operator fibre network in South Africa	Helios Towers, Eaton Towers, IHS Towers	Phase 3	NOFBI-Kenya Broadband Infraco-South Africa	Burundi Backbone System

Source: Deloitte analysis

2.4.1 Joint Ventures

A Joint Venture (JV) is a commercial arrangement where two or more companies pool their capital resources in order to finance a specific project. In the context of infrastructure sharing, this is most commonly a fibre optic network or a tower company (see below).

Funding is typically private, raised by telecom operators which use the network for their customers exclusively; although in rarer examples they can provide capacity to other operators. In the UK, MBNL is a JV between mobile operators EE and Three to manage a 3G and 4G network. Across Africa and Asia, there are several tower companies that have been formed as joint ventures between operators. The most notable example is Indus towers in India, a joint venture between Bharti Airtel, Vodafone and Idea, and with 110,000 towers, is the largest tower company in the world.

Figure 11: Joint Venture example: Neotel and MTN roll out private fibre optic network in South Africa³⁵

With over 140,000km of fibre, Telkom SA, the incumbent national operator, owns South Africa's largest fibre optic backbone network. Up to 2009 the competitors Neotel and MTN were both dependent on Telkom for leasing infrastructure, reportedly paying over ZAR1bn of transmission costs every year.

In order to reduce costs and expand their services, Neotel and MTN entered into a sharing agreement in 2009 for the joint construction of a national fibre optic network. The venture was joined by mobile operator Vodacom one month later.

The first phase of the project involved connecting Johannesburg and Durban to Neotel's Seacom landing station. In later stages, Johannesburg was linked to Cape Town. While each operator still has their own fibre cables, they only dug up a single trench on their routes across the country.

2.4.2 Tower companies

Tower companies (towercos) are infrastructure companies that do not operate their own networks but manage and lease towers to mobile and other fixed wireless operators (including broadcasters). They are typically not owned by telecom operators but by separate independent companies, which may have operator shareholding, while others may be majority-owned by private funds.

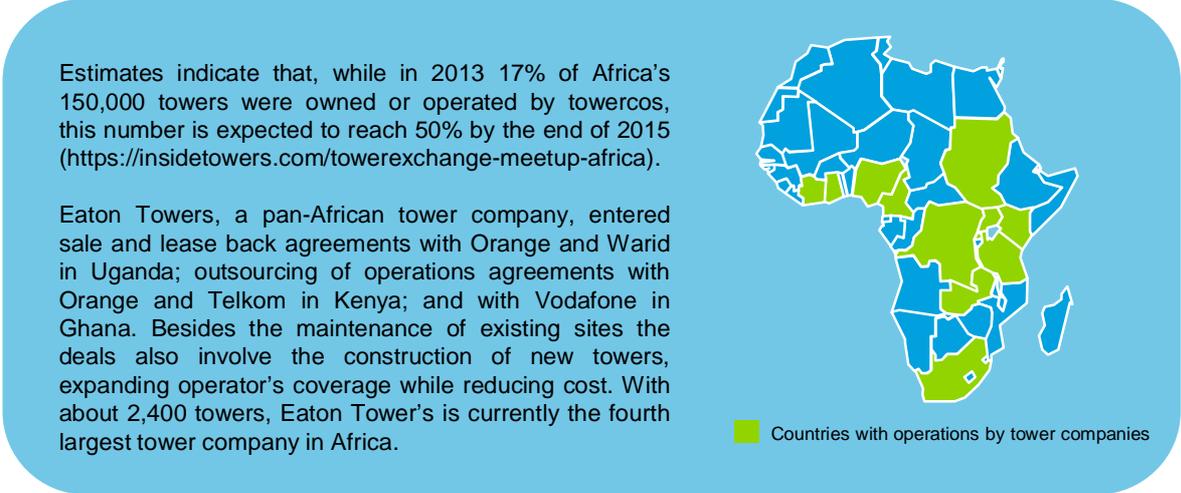
There are two broad structures of tower deals:

- **Sale and Leaseback:** this involves a mobile operator selling towers to an independent tower company. The towers are leased back to the operator as well as to other clients of the tower company. Besides operation and maintenance, the towerco may commit to future network rollouts. In some cases the sale of the towers has involved the operator taking a share in the tower company.
- **Outsourcing:** instead of selling their towers, operators opt to solely transfer the responsibility of operation and management to the towerco and/or lease access to some of the towerco's existing sites.

As evidenced by the growing number of towers under independent operation, the tower company model is increasingly attractive for operators. It eliminates the capex costs and saves on opex through sharing. In addition this monetises the operator's tower assets. From a regulatory or public interest perspective, reduction in capex particularly facilitates new smaller and more local entrants, as the cost of rolling out a whole new network can often be a constraining factor in network deployment. Reduced opex and capex similarly means that networks can be expanded into areas with lower revenue generation potential, such as more rural areas, thereby ultimately increasing overall coverage among the population.

³⁵ South Africa – Fixed-line Market and Fibre Infrastructure 2014, Buddecom Reports

Figure 12: Africa's rising tower business and the case of Eaton Towers in Kenya, Uganda and Ghana³⁶



2.4.3 Fibre Companies

Similarly to tower companies, independent fibre infrastructure companies provide fibre optic backbone resources, either on a wholesale capacity basis, or without operating a network, by simply selling dark fibre or ducts on a per kilometre basis. These companies commonly provide services to mobile and fixed operators under a commercial contract, usually on an open access basis, and are often present on national backbone routes and in populated areas where it is more commercially attractive to provide fibre services. Duct operating companies may also follow this model.

Sprint was one of the originators of this model when in 1973, as part of Southern Pacific Railroad in the US, it began by selling surplus microwave capacity on its internal network, and then by selling capacity on the fibre it subsequently laid along the rail track.³⁷ Since then the wholesale infrastructure company model has become common in developed countries and there are now an increasing number of examples in developing countries. For instance, in South Africa, wholesale companies such as Dark Fibre Africa and FiberCo are rolling out nation-wide fibre backbones connecting most major towns and cities.³⁸ In Nigeria one of the main fibre companies is Phase3 Telecom, which operates a national backbone based mainly on optic fibre laid on power lines.³⁹ In Indonesia, Power Telecom has constructed a dark fibre network on the island of Java which it leases out to operators.⁴⁰

2.4.4 Government-led network companies

When there is no commercial appetite to address potential demand for backbone fibre, such as in more remote areas or in other cases where roll-out is less likely to be profitable or the degree of risk is high, government intervention may be necessary. Common models for government-led projects with varying levels of public sector involvement are consortia and PPPs which may also involve the participation of a multilateral/development bank or international organisation. Under these models, governments and multilateral banks absorb the primary business risk by encouraging investment, and devise a fair and efficient mechanism to share this resource with existing market players or new entrants.

³⁶ <http://www.towerxchange.com/towerxchanges-market-size-and-growth-forecasts-for-the-african-tower-industry>
³⁷ Discussion with market experts
³⁸ South Africa – Fixed-line Market and Fibre Infrastructure 2014, Buddecom Reports
³⁹ Nigeria – Fixed-line market and fibre infrastructure – Overview and statistics 2014, Buddecom Reports
⁴⁰ http://www.indonetnetwork.co.id/pt_power_telecom

A number of developing countries have established government-led telecom network projects, often implemented as part of a national broadband strategy, with the goal of expanding broadband coverage to previously underserved areas and/or to help drive down prices on competing private networks. For example in Brazil the government established a new state-owned backbone because it became apparent that private sector competition alone was not reducing connectivity costs sufficiently.

Aside from the Brazil example above, other instances of government-led fibre networks include the National Optic Fibre Backbone Infrastructure (NOFBI) in Kenya, the NOFN in India, the National ICT Broadband Backbone (NICTBB) in Tanzania, the National Broadband Network (NBN) in Jordan, and similar projects in Cote d'Ivoire, Rwanda and Uganda (see below).

Funding for these projects can be provided by bilateral or multilateral loans (particularly the World Bank and the Chinese Export-Import Bank), which may be combined with use of existing state owned passive infrastructure such as power lines and rail links. An alternative method of financing these projects is to use the Universal Service Funds (USFs) that telecom operators are required to contribute to as part of their license agreements, such as the Cote d'Ivoire example below.

Figure 13: National Optical Backbone in Cote d'Ivoire⁴¹

While Cote d'Ivoire has a high mobile penetration rate (91%), the country had only about 1m internet users by 2013. Currently, 85% of internet users reside in the capital Abidjan.

In order to bring broadband access to the country's more rural areas, the government began construction of a state-owned National Fibre Optical Backbone in 2012. The project is financed with the help of the National Telecommunications Fund, which is funded by taxes paid by operators.

Upon completion, the network is expected to measure 6,700km and connect up to 30% of the country's population to the internet. Phase I was completed in 2012 and Phase II started in 2013.

Although government-led projects mainly involve the construction of fibre backbones, there are also examples of government-led investments in mobile infrastructure. For instance, in 2014 the government of Zambia tasked the local telecom regulator to fund the implementation of 169 towers in rural areas. The towers are planned to be leased to mobile operators to provide communication services to 200,000 previously underserved consumers.⁴² Similarly, the government of Papua New Guinea is using World Bank funding to help finance the deployment of additional base stations by one of the mobile operators, however the towers must be shared by other operators wishing to use them.

In some cases government-led projects have suffered from inflated costs, technical inefficiencies or may be subject to corruption and administrative failures. For example, the government backbone in Rwanda is reported to have cost US\$38m for 2,300km of its fibre network, whereas a similar initiative in Uganda cost almost double - US\$62m for 2,100km. In the Uganda case, cables were only buried at a depth of 0.9 meters instead of the recommended 1.2 meters and are also reported to be of inferior quality.⁴³

2.4.5 PPPs and Consortia

PPPs formed between government and one or more private companies to finance telecom projects are also well recognised in infrastructure sharing strategies. Examples include the Burundi Backbone System (BBS), where the government, together with several operators rolled out a national fibre backbone, and the East African Submarine cable (EASSy), which runs from South Africa along the east coast of the continent. In

⁴¹<http://www.reuters.com/article/2013/07/20/ivorycoast-telecoms-idUSL6N0FP2EQ20130720>

⁴²<http://allafrica.com/stories/201404211336.html>

⁴³<http://www.telecompaper.com/news/ugandan-president-orders-probe-of-huaweis-fibre-optic-grid--898979>

Rwanda, the government established a joint venture with Korea Telecom to roll out a wholesale 4G network based on the government's fibre backbone, which is being resold by the mobile operators and other retail providers. Similarly, in Mexico a recent telecommunications reform initiative established the deployment of a wholesale network in the 700 MHz band that will serve MVNOs, while in Madagascar, a government tender to build out towers was awarded to a consortium of operators federated around an infrastructure company.

Consortia are often formed for the deployment of international fibre optic submarine cables. For example, the ACE (African Coast to Europe) cable, which connects Sao Tome to France with many landing stations along the West African Coast, was initiated by Orange/France Telecom and is administered by a consortium of 18 operators and governments from across the participating countries.⁴⁴

Another example is Indonesia's Palapa Ring. Although the project started out as a purely private consortium, the fibre project now relies heavily on government funds after several operators pulled out, illustrating some of the potential issues with these models, as discussed further below.

Figure 14: Burundi's national fibre backbone⁴⁵

Before Burundi gained access to an international fibre cable in 2012, internet access was dependent on expensive satellite connections and was limited to a small number of urban subscribers. In rural areas the backbone network remained underdeveloped.

To solve this problem the government created a PPP with the Burundi Backbone System (BBS) in 2010. BBS is a company that was formed as a joint venture between four of the country's leading telecom operators and one ISP.

The World Bank provided the Burundian government with a grant of US\$11.5m to help finance the US\$25m project.

The project involves the creation of a 1,250km fibre optic backbone connecting all 17 provinces. Network connection points at the borders with Rwanda and Tanzania will provide the landlocked country with access to the landing points of international submarine cables in Mombasa and Dar es Salaam.

Although the BBS has been relatively successful, a number of implementation issues have emerged. For example, the government commissioned the Metropolitan Area Network (MAN) in Bujambura with the aim of connecting government institutions with fibre. This was reportedly seen as a sign of disengagement with the BBS which were also being constructed in Bujambura. In addition, the government awarded an additional licence to Viettel who are rolling out their own national 3G network without using the national backbone. This potentially jeopardises the return on the investment for the operators.

⁴⁴<http://www.ace-submarinecable.com>

⁴⁵ Burundi – Telecoms, Mobile and Broadband – Market Insights and Statistics 2014, Buddecom Report

Figure 15: Connecting the Islands - Indonesia's Palapa Ring Project⁴⁶

With over 900 islands, the construction of a fibre backbone network in Indonesia is challenging. Until recently, efforts have mainly been concentrated in the Western part of the country and the major islands surrounding Jakarta.

In an effort to bring broadband access to the Eastern provinces of the country and to interconnect all of Indonesia's major islands, the government encouraged a consortium of 9 telecom operators in 2005. The project involves the construction of six fibre rings providing broadband access to over 40,000 villages and 33 out of 34 provinces. Over 30,000km of optical fibre will link Indonesia's main island groups.

By 2009, all but three operators abandoned the project due to the financial crisis, leaving the government to direct funds from the Universal Service Obligation (USO) to the construction of the Palapa Ring project. By 2013 one out of the six fibre rings had been completed and the tendering process for the second one, which will bring internet access to the Eastern provinces Manado and Papua had started.

PPPs provide a framework in which public entities and private companies can deliver infrastructure projects, often involving quite complex contractual arrangements. PPP structures usually involve risk allocation and financing requirements which are absorbed by more than one party and therefore facilitate the mitigation of potential risk, by keeping it separate from the existing business of the sponsors. Similarly, the entity created by the partnership can borrow funds and this debt is usually paid back from the cash flow generated by the project.⁴⁷

Particular issues that need consideration for this model include the access terms provided to shareholders who may also be licensed operators and new entrants or operators that do not participate in the venture. In order for PPPs to be successfully implemented, strong legal frameworks and enforcement procedures are also needed, given the complexity of the contract structure. Most PPP failures in developing markets are often attributed to inadequate feasibility studies. Similarly, risk needs to be appropriately assessed and shared, which demands realistic revenue and cost estimations and sound financial and economic analysis.⁴⁸

⁴⁶ Indonesia – Telecoms, Mobile, Broadband and Forecasts 2013, Buddecom Report

⁴⁷ ITU 2013, Providing broadband services through PPP models, Regional Seminar on Cost and Tariffs for Asia and Pacific and meeting of the SG3RG-AO.

⁴⁸ European Investment Bank 2009, Review of Lesson from Completed PPP projects Financed by the EIB

3 The Benefits of Infrastructure Sharing

This section discusses the different ways in which infrastructure sharing generates a number of economic and other benefits for operators, consumers and governments. In summary:

- By reducing the cost of network expansion and operational costs it leads to substantial cost savings.
- These savings can generate positive impacts on service cost and prices, benefitting consumers, and operator profitability, leading to more investment.
- Infrastructure sharing creates positive environmental benefits by reducing the carbon footprint and visual impact of infrastructure and installed equipment.
- Higher broadband coverage and lower prices can lead to significant increases in broadband connectivity; this in turn has benefits for economic growth, and social developments - extensive literature exists on the link between broadband uptake and economic and social growth, especially in developing markets.

Typically, regulators have considered that these benefits outweigh any negative impacts on competition and investment. The implications of infrastructure sharing on market competition and on investment incentives are discussed in more detail in the next section.

3.1 Cost savings delivered by infrastructure sharing for new investments

As discussed in Section 2, a number of sharing options are available across many types of infrastructure projects and for telecom operators that share a part or the whole of their existing network. As such, the cost savings that an operator will gain as a result of infrastructure sharing will depend on:

- The number of parties that share the costs.
- The type of activity that is required to roll out the infrastructure: if very costly elements such as civil works can be shared across a number of operators (and across different sectors and utilities), the savings will be correspondingly higher.
- The sharing model employed: in general, the more components shared, the higher the cost savings that can be gained by operators.

There are two types of savings that operators consider when they evaluate sharing options for new investments:

- Savings in capital costs (CAPEX): investment in the network's civil works elements, and the capitalised labour costs associated with them, represents a key saving element, and one which impacts both an operator's Balance Sheet and their Profit and Loss statement via depreciation. Operators that undertake sharing arrangements are able to gain their desired level of network coverage without incurring the full cost of rollout. This has the effect of reducing the relative investment risk for operators with constrained sources of capital. Capex reduction is equally beneficial to operators that are expanding or refreshing their network operations.
- Savings in operational costs (OPEX): annual opex includes elements such as energy costs, network maintenance and security, the latter being an important cost category in some developing markets. Operators also gain significant cost efficiencies from network sharing by reducing overall network under-utilisation. In many cases, network equipment will not be efficiently utilised by only one operator. In contrast, a shared network increases utilisation, leading to a lower effective unit cost of service provision

for both operators. Network sharing arrangements may also lead to other operational benefits, such as allowing operators to select optimal site locations and to jointly outsource logistics or other non-core operations.

To provide a high level indication of the magnitude of these savings, the examples presented below include the cost savings in new deployments that are achieved by sharing fibre networks or mobile sites.

The estimations are based on discussions with telecom network costing experts and information has been as far as possible calibrated to costs in African countries. These estimates are intended as broad indications because civil works and major infrastructure costs (the largest cost component) will depend largely on the geographic features of the terrain to be traversed: i.e. ground type (asphalt, concrete, flag stones, soil, hard rock); topography (mountainous, flat); surface features (urban, suburban, forest, desert, agricultural fields); and other local market characteristics. These include political stability and other risks associated with construction in complex and unstable areas, local labour and other administrative costs. Additionally, network cost elements vary greatly depending on the vendor employed and the type of financing (soft or commercial loans, equity and vendor financing). Also, lower upfront equipment costs may result in higher maintenance costs or lower reliability. Standard assumptions on these cost categories have been used in this analysis to give an indication of the magnitude of the potential savings.

3.1.1 Examples of cost savings in fibre networks

For new deployments, in addition to the civil works associated with fibre laying (digging of trenches and placing ducts) or the installation of poles, the capital cost associated with laying a kilometre of fibre backbone comprises fibre cabling materials, the plant infrastructure, labour cost and signal repeaters as illustrated in Figure 16.

Figure 16: Fibre network cost components



Source: Deloitte analysis

Fibre may be deployed through existing duct and manhole infrastructure systems, or using more cost effective micro-trenching and micro-ducting systems that have recently been developed. This process is quicker, incurs lower labour costs and has less impact on the environment (the trench is much smaller). Alternatively in some locations, light-weight (often lower fibre count) fibre cables may be hung from existing overhead poles. Overhead deployments may be significantly less expensive than micro-ducting, with the cost of preparing the route and infrastructure being up to 90% cheaper than for the equivalent underground cable deployment.⁴⁹

⁴⁹Estimation based on discussion with market and costing experts, review of available evidence and of African operators' information.

The cost of the fibre cabling per km is also dependent on the number of fibres used in the cable and the number of joints/splices required to form the network routes, but is broadly estimated to be \$100/km per fibre pair.⁵⁰

Based on the review of these cost elements, high level estimates of the total cost to deploy one km of fibre in a typical African country range from approximately \$4,000 per km (for overhead fibre, with a lower fibre count per cable), to \$20,000 per km for a higher fibre count underground deployment, including civil engineering works.⁵¹ Considering that the high fibre-count underground burial method is most likely to be used, the figures suggest that the capital cost of 1,000km of fibre can be expected to be as high as \$20m, in which case it can be estimated that when three telecom operators share a fibre network, each of them can save up to \$13.3m for every 1,000 km of network.

If the cost of the civil works can be avoided by using other infrastructure, cost savings could be notably higher. As a rule of thumb, over 80% of the total costs incurred for an underground fibre network deployment can be saved by using existing infrastructure such as power transmission lines, railways or oil pipelines. Hence, by sharing infrastructure with utilities or the transport sector, an operator could save costs of at least \$16m for every 1,000km of network deployed.⁵² If the network is also shared with two other operators, the total cost to the operator drops from \$20m to \$1.3m.

3.1.2 Examples of cost savings in mobile and fixed wireless networks

Similarly to fibre network sharing, the extent of cost savings achievable by wireless operators through sharing is dependent on the type of sharing model adopted, as well as the number of operators participating in the sharing arrangement.

In relation to OPEX, operators may either share in the actual acquisition cost of a site, such as site lease or purchase, or reduce the average per site cost through contributing their sites to a pool of shared sites. For an average 2G and 3G site maintenance and site rental costs can amount to \$40,000 per year.⁵³

The CAPEX cost savings through sharing new deployments are typically based on dividing the standalone cost by the number of operators sharing, with an adjustment uplift for costs that remain dedicated to each operator, such as capitalised labour costs for provisioning the operator's equipment on the site. As a consequence, a typical two-operator sharing arrangement may be expected to net savings of approximately 45% of the cost of a standalone site deployment.

Accounting for both opex and capex savings, for each urban site an operator may save about \$38,000 per year and \$45,000 for a rural site.⁵⁴ Across a network of 10,000 sites, a two-way sharing agreement could save operators \$365m per year, across a broad range of site types and technology deployments.⁵⁵

Based on existing sharing agreements seen in the market in rural areas (assumed to account for approximately 15% of sites) and partial sharing in suburban areas (approximately 33% of sites), the estimated cost saving for an average of both passive and active sharing agreements are summarised below:

⁵⁰Based on discussion with market and costing experts, review of available evidence and of African operators' information.

⁵¹Based on information provided by operators

⁵³Based on a two-operator active sharing model, with a straight-line accounting depreciation methodology and including rooftop sites in metro urban areas.

⁵⁴On an annualised expense basis (accounting for capital expenses through depreciation charges), a typical urban site may cost approximately \$67,000. In contrast, a rural site may cost approximately \$82,000. This difference is primarily accounted for by higher site costs associated with more extensive and expensive civil works at rural sites and offsets the fact that urban sites are deployed with greater capacity capabilities (e.g. higher sectorisation and more transceivers).

⁵⁵Assuming operators share 100% of their sites

- In the case of tower or site sharing in rural areas operators could achieve cost savings of 3-6% of total opex and 15-20% of total capex, across their national portfolio of sites. In aggregate, this could lead to a cost saving of between 6-13% of network costs.
- Under the scenario where both active and passive infrastructure is shared, across the same distribution of sites and backhaul transmission links, the implied cost saving could be of approximately 20% of opex and 20-30% for capex. As a consequence, the overall implied cost saving could be as high as 18-37% of network costs.

Using the Indian market as an example, mast and site sharing together may allow operators to save approximately 30% on CAPEX and OPEX. RAN sharing can produce further savings for operators estimated at 20% for a typical European operator.⁵⁶

3.1.3 Cost savings in Africa

Operators in Africa have increasingly been taking advantage of these savings in recent years. Examples of tower companies have increased notably as discussed in Section 2, and mobile towers have grown by over 30% within the past five years, as shown in the figures below. As of December 2014, almost a third of Africa’s towers (47,600) were owned or operated by independent towercos, with a further 20,000+ for sale or being transferred to towerco ownership.

Figure 17: Internet users in Africa

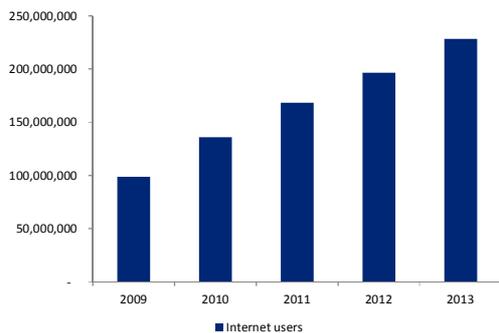
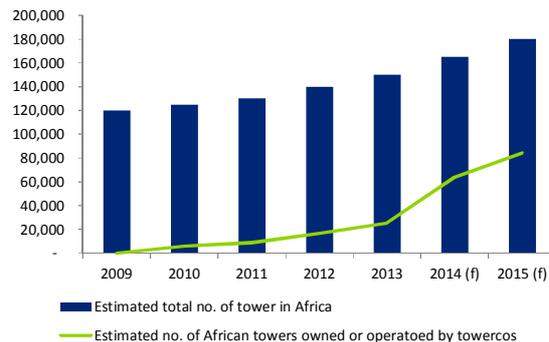


Figure 18: Mobile Towers in Africa



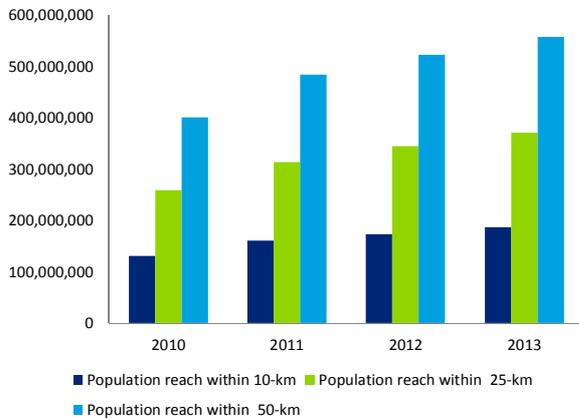
Source: Deloitte analysis based on World Bank data

Source: Tower exchange

Sharing in fibre networks is at an earlier stage of development when compared to tower sharing. It nevertheless has also increased as many developing countries have gained access to submarine cables, reducing their dependence on high-cost satellite services, resulting in increased demand for terrestrial fibre to access the lower cost international capacity.

⁵⁶GSMA, Mobile Infrastructure Sharing

Figure 19: Fibre network reach in Africa



Source: Hamilton Research

Figure 20: Fibre networks in Africa



Source: Steve Song, AfterFibre.net (2014)

However, as nearly 60% of the population lives in rural areas in Africa – up to 70% in Sub Saharan Africa - extending the coverage of fibre access to less dense areas remains a challenge. Against this background, the implications of the cost savings discussed above could have a major impact on the viability of fibre network extension into more remote and rural areas.

Between 2010 and 2013 the proportion of people in Sub-Saharan Africa who lived within a 10km reach of a fibre network increased from 15.6% to 21.2% (Figure 19). To provide an indication of the savings, applying the same growth rate to the length of the total fibre network means an additional 23,000km of fibre would be deployed. For this length, effective infrastructure sharing (assuming three operators share) could generate total cost savings of up to \$300m for each operator involved.⁵⁷ Should sharing occur in conjunction with major infrastructure projects or using existing facilities, the saving could be much higher. Additional examples of these savings in relation to Liberia, Chad and Kenya are provided below.

Figure 21: Liberia: shared submarine landing station and potential cost savings for a hypothetical national fibre backbone⁵⁸

With the help of a loan from the World Bank, the Cable Consortium of Liberia (CCL), a PPP, managed to acquire access to international fibre connectivity. In 2011 the ACE cable landed in Monrovia and in 2012 the cable went live.

The CCL is a PPP based on an investment of \$25 million dollars facilitated through a grant from the World Bank to the Government of Liberia, which established a Special Purpose Vehicle (SPV) owned by the existing operators (LibTelCo 20%; Cellcom and Lonestar 10% each), while the Government holds the remaining 60% to be eventually divested to the existing and new entrants to the market.

Besides a metropolitan fibre network in the capital Monrovia, Liberia currently does not have a national fibre backbone. Hypothetically, connecting the major cities, Monrovia, Gbarnga and Harper would consist of a network, measuring approximately 1,600km. Based on high level indicators on fibre deployment cost, deployed by a single operator such a network could cost at least \$32m. Shared by three operators, cost savings of up to \$10.3m per operator could be achieved.

⁵⁷ Total cost of such a network would be $\$20,000 \times 23,000\text{km} = \460m . Shared by three, the savings for each operator = $\$306.67\text{m}$ (cost= $\$460\text{m}/3 = \153.3m). The total cost savings are the savings of all three operators combined = $\$306.67\text{m} \times 3 = \920m

⁵⁸ http://tlcafrica.com/news_libtelco_will_launch_liberia_first_fiber_optic_cable.htm

Figure 22: Potential cost savings for a hypothetical national fibre network in Chad⁵⁹

Currently, Chad's only connection to an international submarine cable is through its border with Cameroon and was established in 2012. Although the country has 830km of fibre optic cable, according to local market analysts, this cable is no longer accessible, virtually leaving the country with not national fibre backbone.

A hypothetical fibre network connecting Chad's major cities (N'Djamena, Moundou, Sarh and Abeche) would measure around 2,300km. Deploying an additional route between N'Djamena, the capital and Abuja in Nigeria in order to gain access to additional international fibre connectivity would amount to an additional 1,150km. All together this could suggest the deployment of 3,450km of fibre.

On the basis of high level indicators on fibre deployment cost, a network of this size could cost up to \$69m. Sharing it among three operators, each operator would only incur a cost of around \$23m, saving \$46m.

Figure 23: Potential cost savings for a fibre route between Nairobi and Mombasa⁶⁰

Assuming the above costs, an underground fibre network of 480km between Nairobi to Mombasa would cost \$9.6m. Instead of three operators each digging their own trenches and deploying their own networks, infrastructure sharing could result in substantial cost savings:

- Employing a joint venture among the three operators could result in total cost savings of up to \$19.2m, or \$6.4m for each operator.
- Cross-sectorial infrastructure sharing by using existing electricity transmission lines could even result in cost savings of up to \$23m.

With regard to mobile sites, it is forecast that in 2015 an additional 15,000 sites will be built in Africa.⁶¹ If all of these towers were shared between at least two operators, operators could gain total cost savings of \$675m across the whole of Africa.⁶²

The magnitude of these figures is important, especially when considering the cost of raising capital for infrastructure projects in developing markets. These savings therefore can create a number of efficiencies for operators, and these can lead to further investment, or the savings can be passed on to consumers through lower service prices.

3.2 Environmental benefits

In addition to cost savings for operators and efficiencies for investors, operators and consumers, infrastructure sharing can also deliver significant environmental benefits because it provides telecommunication operators with a cost effective opportunity to reduce their carbon emission footprint and other environmental impacts.

➤ Reduction in materials

Significant benefits of sharing infrastructure arise from the material, energy and emissions savings that ensue from building a single tower instead of several, or from the construction of a single fibre network instead of several. For example, savings in resources are very significant, as a smaller amount of steel, concrete and other building materials are used due to the lower duplication of sites.⁶³

Similarly, minimising environmental impact can be realised by sharing the construction or utilising existing infrastructure to expand fibre coverage. For fibre networks, the impact can be reduced by avoiding duplication

⁵⁹ Chad Budde Report and <http://www.globaltimes.cn/content/810511.shtml>

⁶⁰ Analysis based on fibre network cost saving estimation described above

⁶¹ <http://www.towerxchange.com/towerxchanges-analysis-of-the-independent-tower-market-in-africa/>

⁶² This considers savings across the whole region for two hypothetical operators sharing 15,000 sites across Africa.

⁶³ African Development Bank, 2012. Shared Telecom Infrastructure Project, Environmental and Social Management Plan Summary.

of fibre cable materials; as well by avoiding the duplication of the associated civil works that would have a material impact in terms of CO₂ emissions.

➤ Visual impact of masts

One of the most visible environmental impacts of telecom networks is the proliferation of masts. While the services provided by networks are in demand, the infrastructure required to deliver the service is often criticised due to aesthetic and broader environmental concerns. This gives operators the challenging task of providing services while at the same time addressing the environmental concerns of their customers.

When two or more operators enter a sharing agreement, this allows for a reduction in the total site portfolio of the combined network. The reduction in sites reduces the number of towers and masts. Further benefits can be achieved in the near future as new technologies allow multiple antennas to be fitted in close proximity on the same mast.

➤ Power and emissions savings

The deployment of fibre is more environmentally friendly than many other telecom technologies and it is estimated, for example, that fibre broadband could deliver CO₂ savings that are nearly three times that of ADSL broadband.⁶⁴ While this is a positive outcome, the power required to operate mobile and fibre networks remains significant. Operators often have to cover large geographic regions and install thousands of sites to provide services. Telecom networks have to keep running (including for security purposes) on a continuous basis, regardless of the level of utilisation.⁶⁵ Demand for service may drop during night time hours on certain sites and services but operators do not have the option to switch the site off during these hours as they cannot predict subscriber movements. As a function of their size and operating requirements, networks consume large quantities of power, with all the associated carbon footprints. With mobile networks, power requirements can double when they are upgraded from 2G voice services to 3/4G data services at the individual base station level, while further overall power requirements increase because more base stations are required for 3/4G networks.⁶⁶

According to an Italian study by Huawei and Telecom Italia in 2010, the annual carbon footprint of fibre networks can be up to 36% lower if the network has been deployed utilising existing infrastructure; by sharing ducts, for example.⁶⁷ The more infrastructure and its power can be shared, the more positive the environmental impacts. In areas of uncertain power supply such as in Africa, use of a single shared back-up power generator to serve an area where there otherwise would be many, can result in continuous reductions of harmful emissions.⁶⁸

Sharing of mast sites can also make it more economically feasible for each operator to share the higher cost of a solar/and or wind powered power installation, and this can have a massive impact on the carbon footprint compared to use of diesel or grid-powered energy. The government of India, for example, has recognised the importance of renewable energy in decreasing carbon footprints of telecom networks - annually more than 2.6bn litres of diesel are consumed to operate the country's telecom towers, emitting 7m metric tonnes of CO₂.⁶⁹ The government intention is use renewable sources of energy to power 50% of rural and 20% of urban telecom towers by 2015. By 2020, the telecom companies have to convert 75% of rural towers and 33% of urban towers to run on hybrid power.

⁶⁴ Based on a British Telecom and Massachusetts Institute of Technology (MIT) net benefits model for the UK. <http://www.btplc.com/BTToday/NewsList/Studyshowsibreisgoodfortheenvironment/index.htm>

⁶⁵ GSMA, Mobile Infrastructure Sharing

⁶⁶ Typically a basic 2G voice-only base station might consume about 4.5Kw while a fully equipped 3G base station would consume up to 8.5Kw. See for e.g. <http://www.humanpub.org/ijs/ppl/ijs9ppl.pdf>

⁶⁷ Based on 'Carbon Efficiency evaluation of FTTx deployment' (Hamilton Research, Andrea A.S.G. and Griffa Gianluca, 2010) and IMF and ITU data.

⁶⁸ Ibid

⁶⁹ World Bank, Making ICTs Affordable in Rural Areas, <http://www.cto.int/media/events/pst-ev/2014/CTO-Forum/presentations/Making%20ICT%20Affordable%20in%20Rural%20Areas.pdf>

3.3 The wider economic and social benefits of extending broadband access

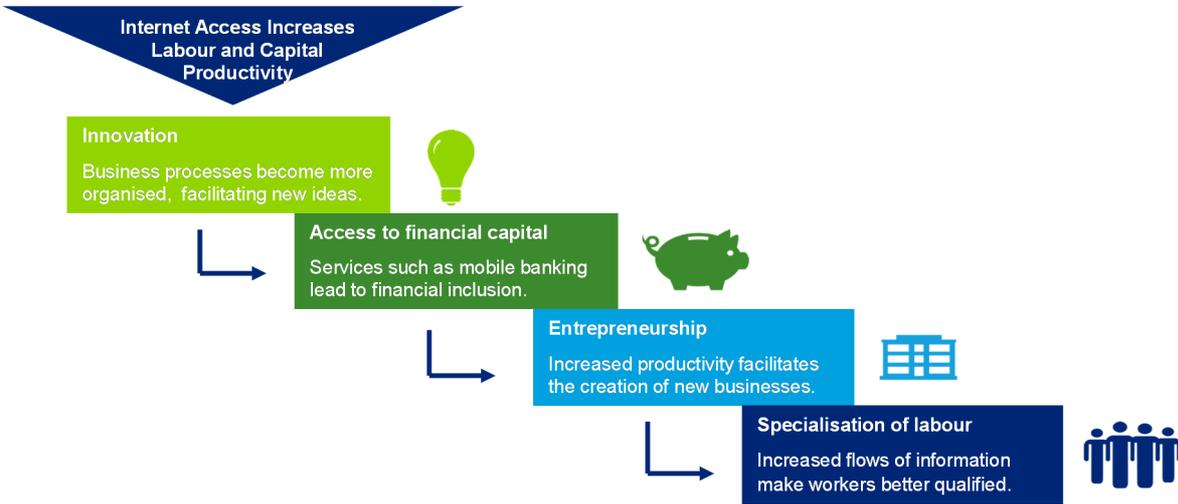
Infrastructure sharing is one of the key factors that can unlock the extension of broadband connectivity in developing countries, which has the potential to deliver remarkable economic and social benefits, especially in the less connected areas of the world. Extending voice and internet connectivity generates spill over effects across many sectors, improving countries' economic performance and enabling internet-based public services such e-health and e-education, with transformational social benefits. But today, of the world's 7bn people, only about 3bn have access to the Internet, and the majority of the unconnected live in developing countries. For example, internet penetration in Africa, South East Asia and India hardly surpasses 20%, compared to over 80% penetration of North America, over 70% in Europe, and nearly 45% in China and Latin America.⁷⁰

As indicated above, infrastructure sharing enhances economic efficiency by avoiding duplication of investments, which enables funds to be used for further investment in network build-out and price reductions in services. Savings through sharing can lead to greater coverage of broadband services by reducing the cost of deploying those services, thereby making it commercially viable to serve previously unconnected geographical areas. As sharing makes it economically viable for more players to serve the same markets, the resulting increase in competition is also likely to be a driver for greater coverage, improved quality of services and reduced prices.

3.3.1 Economic impacts of extended broadband access

Internet access has proven impacts on economic activity by accelerating communications, increasing access to information, increasing productivity and the potential for small scale entrepreneurs.

Figure 24: Enabling effects of the Internet



Source: Deloitte analysis

The World Bank estimates that increasing broadband penetration by 10% may lead to a 1.38% increase in GDP per capita growth.⁷¹ Recent studies also show that in Africa, it is estimated that the economy could increase its long run productivity by nearly 30% if internet penetration increased to the levels seen in the

⁷⁰ Estimate based on ITU, IMF data.
⁷¹ Qiang, C. Z., & Rossotto, C. M., "Economic Impacts of Broadband. In Information and Communications for Development 2009: Extending Reach and Increasing Impact 35–50. Washington, DC: World Bank", 2009.

developed world today.⁷² Internet access also enables the creation of new jobs in the economy. For instance, the ITU estimates that an increase of 10% in internet penetration may lead to an increase of 2.8% in the employment rate.⁷³

Infrastructure sharing can also play an important role in addressing inequalities by bringing connectivity to previously unconnected geographical areas, and in this sense sharing can help unlock higher economic value for the under-served and for services that today cannot rely on connectivity. For example, evidence suggests that farmers' profits can increase by up to 33% if they can receive real-time access to information on weather conditions, livestock tracking or disease control.⁷⁴ In Africa, where 60% of the population lives in rural areas, mainly working in agriculture, it is estimated that 360m individuals could benefit from the increase in productivity if they received internet access.⁷⁵

Internet availability also makes financial services accessible to rural people that today remain unbanked, and reduces transaction costs of financial services for those unable to access traditional banking. A prominent example is the M-Pesa service in Kenya, which has brought mobile-based financial payments to small businesses and consumers, further supporting economic growth.

3.3.2 Social benefits

Access to the Internet also has the potential to increase living standards in developing countries by providing access to information, complementing the provision of basic health and education services.

Figure 25: Impacts of Internet in healthcare

Access to the internet can improve health conditions by reducing the incidence of diseases through better information for both patients and health practitioners.

In addition to extending access to medical information, mobile and internet technologies have the potential to improve medical behaviours for patients and healthcare professionals by releasing doctors' time through reduced travel and increased efficiency; reminding individuals of their due treatments or medications; and providing easy access to information and enabling connectedness between patients and doctors, and between doctors in different locations.



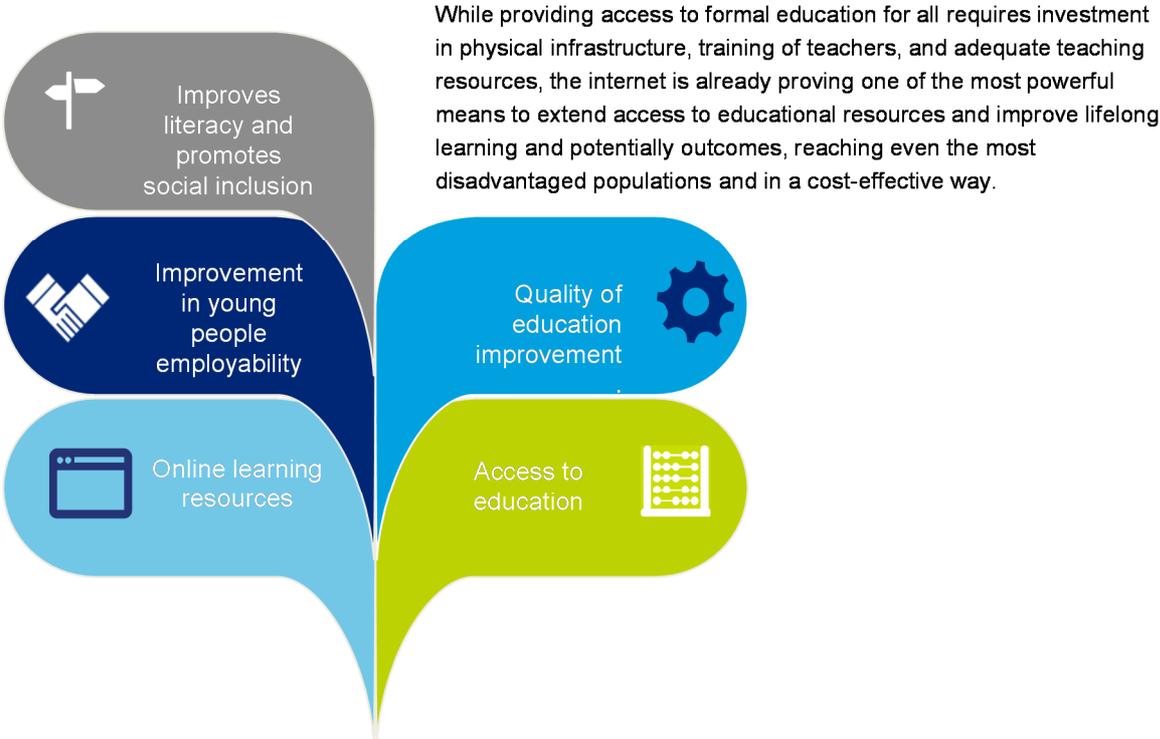
Source: Deloitte analysis

This impact is likely to be particularly significant in rural communities, where the traditional health infrastructure is harder to reach, by enabling information on health conditions to be shared remotely with hospitals for prompt treatment. There have already been numerous e-health initiatives and pilot projects that

⁷² Deloitte estimate based on ITU, IMF and CISCO data.
⁷³ ITU, "Impact of Broadband on the Economy", 2012.
⁷⁴ Goyal, "Information, Direct Access to Farmers and Rural Market Performance in Central India", American Economic Journal, 2010.
⁷⁵ World Bank population estimates and Deloitte analysis

have proved beneficial to local communities and could potentially generate sustainable benefits for larger populations.

Figure 26: Impact of Internet on education



Source: Deloitte analysis

Broadband access also promotes social inclusion, i.e. the participation of individuals and groups in society’s political, economic and social processes. One particularly important way in which broadband technologies expand inclusion is through the potential for more effective public services that make use of this infrastructure, and through digital inclusion, i.e. supporting the ability of people to use technology. These three aspects are deeply intertwined, and they span dimensions as diverse as disaster relief, food security, and the environment, as well as citizenship, community cohesion, self-expression and equality.

4 Investment in shared infrastructure: competition and regulation issues

Depending on the country, a number of policy and regulatory factors may constrain operators in the deployment of services using shared infrastructure. Constraints include lack of coordination between cross-border, national and local infrastructure projects, uncertainty in sector specific policies and regulations affecting investment returns, and policy positions on infrastructure sharing driven by competition and investment concerns.

This section reviews the impacts of infrastructure sharing on competition, and discusses the existing policy constraints to infrastructure sharing.

4.1 Infrastructure sharing, levels of competition and prices

Infrastructure sharing has a number of potential impacts on operator market power, on competition, and on outcomes for consumers. As a result, concerns have been raised ranging from increased risk of collusion between operators to risks of generally reduced competition levels and impacts on pricing and innovation.

Operator views on the competitive impacts of sharing vary, mainly based on their market position. Most operators support sharing when done on a commercial basis but maintain that mandating sharing especially in highly competitive markets, can damage businesses and provide negative incentives for investment. Smaller operators and new entrants tend to be more supportive of regulated sharing arrangements. For large and complex projects such as national fibre networks, operators have also noted a number of administrative, regulatory and policy barriers to effective and profitable investment which can influence the outcomes of infrastructure sharing aspects.

Nevertheless, the policy and regulatory balance has been shifting significantly in favour of sharing in recent years, with regulators in US and EU supporting sharing, and with the EU Commission indicating sharing as a way forward for the roll out of next generation networks.

Examples of shared telecom networks in developing markets also indicate that appropriate sharing delivers positive impacts on market outcomes. While information on wholesale prices is typically not publicly available, and there are many other factors that can influence capacity pricing, conversations with market experts have indicated that the sharing of fibre infrastructure is typically associated with lower prices:

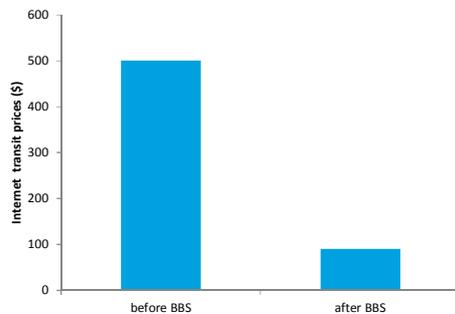
- In Burundi, internet transit prices have decreased fivefold after the construction of the BBS, the national open access fibre network created through a PPP (see Figure 27).⁷⁶
- In Malawi, the incumbent operator, Malawi Telecommunications Limited (MTL), introduced a fibre optic backbone in 2009, which it shares on a commercial basis with other operators. The CEO of MTL noted in 2013 that, since the construction of the backbone, the price for a leased line of 128 kbps had dropped by about 84%.⁷⁷

⁷⁶ Interview with a market expert

⁷⁷ <http://mwnation.com/fibre-optic-backbone-yielding-fruits-ntl/>

- Similarly, in Rwanda, the CEO of the internet provider Broadband System Corporation indicated that, following the roll out of national backbone, which was completed in 2011, “the charges per megabyte gradually reduced from \$2,500 before 2009 to \$125 in 2012”.⁷⁸

Figure 27: Internet transit prices before and after the Burundi Backbone System



Source: Deloitte analysis based on local market expert

Whilst most of the competition and regulatory attention has been focussed on potential negative impacts of sharing, less attention has been given to positive impacts. As sharing is more advanced in the mobile sector, there are more examples of how the sector has developed as a result of sharing, and a number of positive competition benefits have emerged from the research.

Risks of market entry deterrence in connection with sharing appear low:

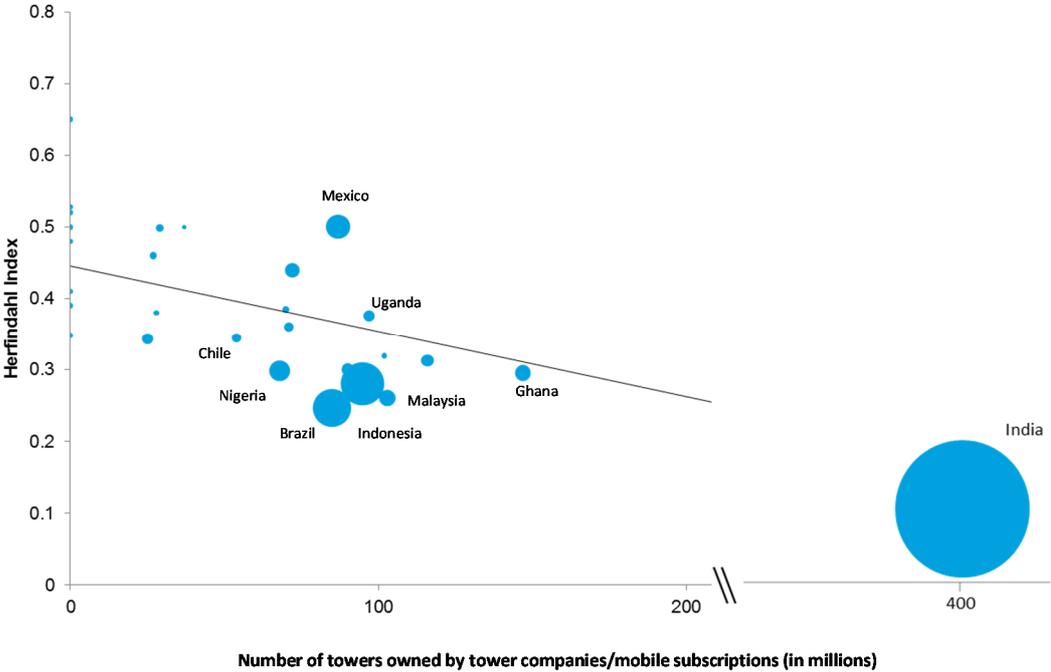
- The emergence of sharing models such as independent tower companies and wholesale fibre businesses reduces the concern that leading operators could dominate the market by sharing infrastructure exclusively, e.g. by refusing access to the smaller operators. In such a case, smaller operators wishing to access shared towers or fibre routes could turn to independent tower and fibre companies.
- Smaller market players can lease network capacity in otherwise unprofitable areas and therefore expand coverage and compete with larger players.
- In countries such as Nigeria and South Africa, it was the smaller mobile operators (e.g. Starcomms and Cell C) that took the lead in selling their tower assets to tower companies.

Using a dataset of emerging market countries across Africa, Asia and Latin America, Figure 28 shows that, as the number of towers held by independent tower companies increases (a measure of infrastructure sharing), concentration in the market as measured by the Herfindahl Index of market concentration⁷⁹ decreases. This is an indication that extensive tower sharing is consistent with competitive markets.

⁷⁸ <http://www.newtimes.co.rw/news/index.php?i=15282&a=64384>

⁷⁹ The Herfindahl index is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them. Increases in the Herfindahl index generally indicate a decrease in competition and an increase of market power, whereas decreases indicate the opposite.

Figure 28: Relationship between the number of towers owned by tower companies, the size of the tower sharing markets, and market concentration⁸⁰



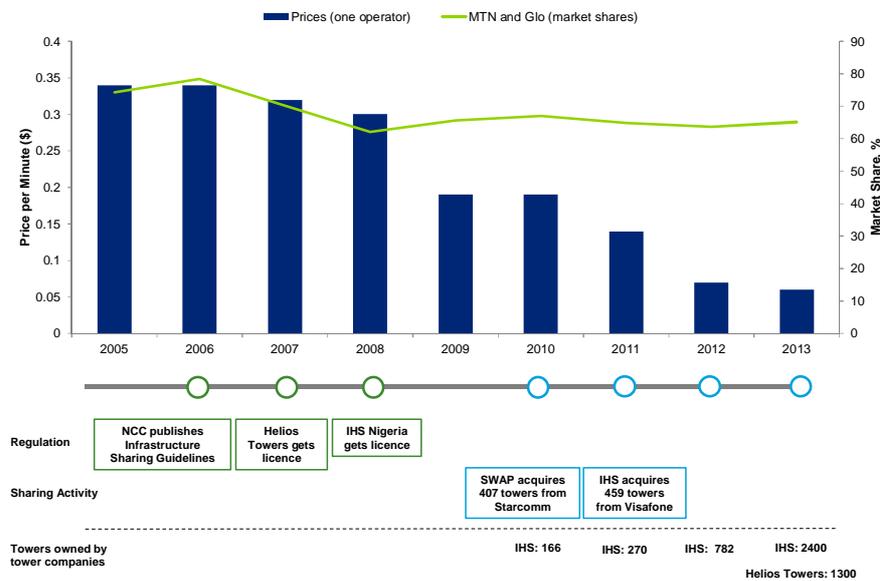
Source: Deloitte analysis based on Tower Exchange and GSMA data

This finding is further reinforced when considering a number of large markets such as Nigeria, India and Ghana. In these markets, the combined market shares of the two leading mobile operators did not increase with increasing tower sharing activity. This is particularly important given that in these markets significant consolidation across operators has occurred in recent years.

Examining the evolution of the effective price per minute in Nigeria and Ghana, the analysis shows that, as infrastructure sharing activity increased, mobile prices continued to decrease significantly, therefore suggesting that sharing does not appear to prevent competition reducing prices. In India, as infrastructure sharing increased, mobile usage per user nearly doubled.

⁸⁰ The size of the bubbles illustrates in relative terms the number of towers owned by tower companies in each country.

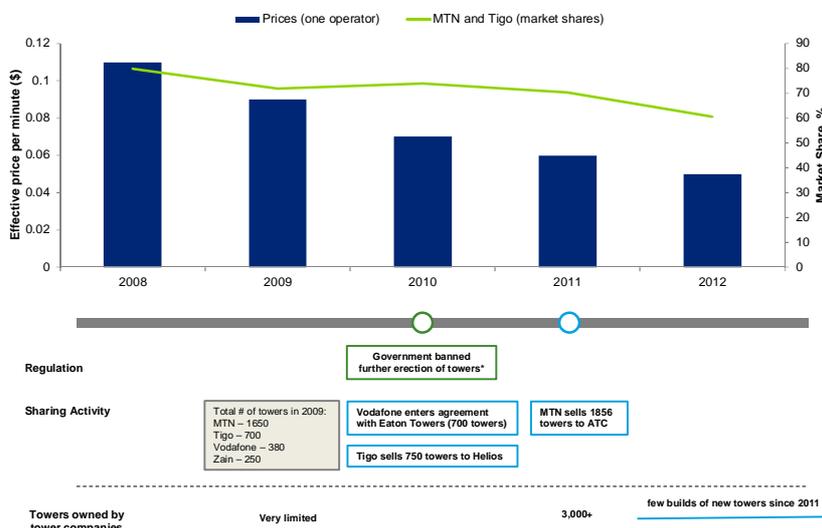
Figure 29: Nigeria: Evolution of prices and infrastructure sharing in the mobile market



Nigeria has seen increased sharing activity after the Nigerian Communications Commission (NCC) passed guidelines in 2006 to promote passive infrastructure sharing and set out requirements for the negotiated terms. The country's two major tower companies, Helios Towers Nigeria and IHS Towers, received their co-location licences in 2007 and 2008 respectively, and have since been expanding their tower portfolios. Between 2006 and 2013 prices have decreased fivefold from \$0.34 to \$0.06.

Source: Deloitte analysis based on GSMA data

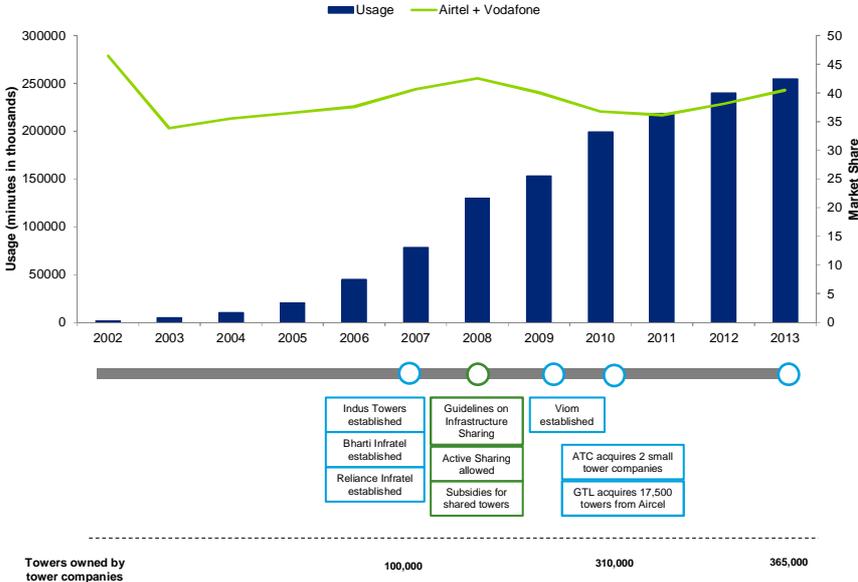
Figure 30: Ghana: Evolution of prices and infrastructure sharing in the mobile market



While tower sharing was still relatively limited in 2009, by 2011 all three of the major operators in Ghana - MTN, Vodafone and Tigo - had sold their tower assets to independent tower companies. Infrastructure sharing was reinforced by a temporary ban by the Ministry of Environment, Science and Technology to erect further towers in 2010. Between 2009 and 2012 mobile prices in Ghana decreased by 45%.

Source: Source: Deloitte analysis based on GSMA data

Figure 31: India: Evolution of usage and infrastructure sharing in the mobile market



Since 2000, companies in India could obtain licences to act as “infrastructure providers” and lease passive infrastructure on commercial terms to operators.⁸¹ However, by 2007 only around 25% of all infrastructure in India was shared.⁸² The following two years saw many key events for India’s infrastructure sharing environment. All three of today’s largest tower companies were established in 2007 (Indus Towers, Bharti Infratel and Reliance Infratel) and in 2008 the Telecom Regulatory Authority of India (TRAI) passed updated guidelines on infrastructure sharing, allowing the sharing of active infrastructure and introducing subsidies for shared passive infrastructure.

As a result, during the following years additional tower companies were established and many operators agreed to sale-and-leaseback deals. Between 2007 and 2013 the number of towers operated by tower companies more than tripled and access to mobile telecommunications (measured as usage in minutes) increased threefold.

Source: Deloitte analysis based on GSMA data

4.2 Factors that constrain infrastructure sharing

While the business case for infrastructure sharing is clear, there still exist several risks and constraints that can prevent the benefits from infrastructure sharing to be fully realised in developing markets.

➤ Lack of national, international and cross industry coordination

One of the most important barriers to achieving more sharing appears to be the lack of coordination in cross-border, national and local government policies on access to rights of way, and across regulators of different sectors, in relation to major infrastructural projects that are being planned or implemented in developing markets. While a multitude of infrastructure projects may be underway, data and information are often not in the public domain, which makes it difficult for telecoms operators to incorporate them into their strategic planning.

In addition, the lack of a common approach among different countries in the same region, and lack of guidance from international and regional organisations increases the costs for large multinational investors in dealing with many, often small and fragmented market environments.

⁸¹ <http://www.dot.gov.in/carrier-services/infrastructure-provider>
⁸² Recommendations on Infrastructure Sharing – TRAI India 2007

A typical example of lack of coordination is encountered when investors in major infrastructure programmes, including in the telecom sector, have to negotiate with national and state governments as well as local municipalities for rights of way to lay down infrastructure. The fees imposed are often designed primarily to raise revenue for the government rather than supporting the development of the sector. The lack of coordination between different government entities also raises the cost of network construction and creates delays. Central coordination or guidelines to local authorities may be required to overcome these problems. For example, the OECD has indicated a number of policy guidelines to improve access to rights of way and to reduce the costs associated with access.⁸³

➤ **Lack of stable and transparent regulations**

Telecom networks involve large sunk costs and a long period for the investment to be recovered, which creates risks to operators and investors. This is in addition to other investment risks, e.g. from dealing with instability, higher costs and lack of resources that are typical in developing and often unstable markets.

In developing markets where networks are often in early stages of implementation, operators are often reluctant to take the initiative and invest in new infrastructure due to the concern that subsequent regulation may reduce investment profitability. For example, in Burundi, after the government and the operators invested capital in a national fibre network, the government unexpectedly issued an additional licence, jeopardising return on investment.

Equally, in cases where an operator expects to gain a competitive advantage by investing in underserved areas, any ex post obligations that mandate sharing on terms that do not compensate for a fair return on investment will affect the initial incentives to invest. As such, regulatory inconsistency in developing markets means that investors may fear that the return on investments will be diminished by regulators on the grounds of competition policy or national interest. This adds a premium to investment, and often, even if sharing could deliver significant benefits, a combination of this premium with a marginal business case, e.g. in rural underpopulated areas, can lead to no investment at all. Depending on the situation, investors may need to balance these risks against that fact that infrastructure sharing can reduce the overall capital required for deploying the network.

➤ **Competition concerns**

The significant cost efficiencies and economic benefits of infrastructure sharing have been discussed in detail above, and regulators have recognised that, especially in the context of extending broadband access to rural areas, infrastructure sharing represents the most efficient technical solution. The review of impacts of infrastructure sharing in developing markets suggests that many benefits can be delivered as a result of sharing. However, some regulators and governments have expressed concern that sharing may also create risks of anticompetitive behaviour.

There are two main areas of concern:

- Collusion between sharing operators is a concern often raised by regulators and smaller operators: it may arise in the context of two or more operators being able to coordinate (tacitly or explicitly) their activities as a result of sharing. Exclusive sharing agreements between operators may prevent other operators being able to access the infrastructure, effectively increasing their market power. Risks of refusing to share infrastructure with smaller competitors on arbitrary grounds can be mitigated by establishing transparent sharing negotiation mechanisms such as those adopted in Nigeria.

⁸³ Organisation for Economic Co-operation and Development, "Public rights of way for fibre deployment to the home", 04-Apr-2008

- Risks of abuse of dominance arise if an operator can increase its market share as a result of sharing. Risks to service innovation and reduced investment could arise if oligopolies are reinforced through sharing, however the pace and innovation of the telecom market suggests these risks are limited.

Typically, regulators have considered that the benefits from sharing outweigh the potential competition implications. This is supported by the review of the impacts of tower sharing on mobile markets outlined above, which suggests that market concentration decreases as tower sharing increases, the combined market shares of the largest operators have not increased over time, and no impacts on prices and usage have been registered in markets where high tower sharing has occurred. Evidence from shared fibre networks also indicates positive impacts on prices.

➤ **Lack of financial incentives**

In most countries, there remain certain geographic locations where the business case is so marginal that operators would not invest even with infrastructure sharing. During the research, operators noted that financial incentives may be required to unlock investment in these instances.

The constraints discussed in this section are summarised in Table 2, and considerations on how to address these constraints are reported in the next section.

Table 2: Summary of key constraints

	Impact on Infrastructure sharing
Lack of coordination across different sectors regulation	Sharing infrastructure across different sectors is made more complex by the existing administrative barriers. Operators often note the lack of coordination across different sector regulators and different public institutions at municipal, regional and national level as key element that prevents further sharing to be implemented across sectors and can result in more frequent accidental cable cuts.
Lack of broader strategic telecoms plans	Strategic ICT plans that assess access gaps in connectivity and provide a consistent approach to sharing are seen as key by many operators to encourage investment. A road map for the sector with clear guidelines is often mentioned as missing in many African countries.
Lack of stability in licensing environment	Uncertainty about the duration and number of licenses, as well as arbitrary use of licensing policy by government and regulators are a major concern for operators to enter in sharing agreements and investment
Lack of funding	Operators often cite the lack of incentives and funding as preventing investment. Support in risk mitigation may be needed to reduce the cost required to raise capital.
Lack of spectrum/high spectrum fees	Restrictions on spectrum will restrict the number of operators who will be able to take advantage of infrastructure sharing.

Source: Deloitte analysis

➤ **Implementation issues**

Even where governments and regulators encourage infrastructure sharing, a number of issues often materialise in the implementation of these projects. While these issues are often specific to a country’s particular local market and political environment, there are also a set of common implementation problems.

The regulatory and competitive environment within a country can have a significant impact on the success of a shared network once it has been completed. For example, if it is not conducive to sharing this can result in an operator using its market position to charge high prices for access, such as in Cameroon with the Doba-Kribi oil pipeline project where the incumbent was reportedly able to charge high lease prices as a result of its dominant position. This has negatively affected the success of the project and the benefits of infrastructure sharing are not being realised.

The nature of infrastructure sharing means that many parties and stakeholders are involved. In many cases this involves central and local government authorities as well as operators and international organisations. The management of these different parties, with their various aims and targets, can have a significant impact on the overall success of the project. If the governance of these parties is poorly managed, disengagement and delays may arise. This can result in targets differing and organisations taking their own approach to solve these issues, potentially resulting in the duplication of infrastructure and undermining of the original business model. For example, in Burundi the government has started another fibre rollout within the capital and awarded a new operating license after the investment in a common national network began. These issues all affect the return on investment for the original network.

Government-led projects can suffer from inflated costs, quality issues, delays and administrative failures as a result of poor public management. For example, the government-led fibre backbone project in Uganda referred to earlier cost almost twice as much as a similar project in Rwanda, and is understood to have been significantly more expensive (on a per km basis) than other projects⁸⁴. These issues can reduce the benefits of infrastructure sharing or cause operators to find alternative solutions. In South Africa, delays to the project resulted in operators investing in their own networks.

⁸⁴<http://www.telecompaper.com/news/ugandan-president-orders-probe-of-huaweis-fibre-optic-grid--898979>

5 Best practice policies and strategies to incentivise sharing

This study has highlighted the significant benefits that infrastructure sharing can deliver to expand voice and broadband connectivity in developing markets.

When implemented within appropriate policy and regulatory frameworks, shared infrastructure can stimulate competition in telecom markets and promote affordable services. As discussed in section 4 above, policy and regulatory intervention may be necessary to encourage sharing or to address barriers that may constrain sharing, thus preventing the delivery of the full potential of savings and benefits. This section, drawing on the analysis of sharing examples and policies worldwide and on a review of different approaches to the promotion of sharing, presents a number of considerations for governments, regulators, and local and international organisations to support infrastructure sharing and the expansion of broadband coverage.

5.1 What can policy makers do to encourage infrastructure sharing for broadband?

Governments can play a key role in promoting infrastructure sharing. A combination of effective public infrastructure investment with an efficient policy and regulatory environment can reduce costs for both telecoms and other networks. It can also stimulate further private investment and competition.

- The first set of strategies described in sections 5.1.1 and 5.1.2 involve no costs to governments and investors but can trigger large cost savings and efficiencies across major projects in utilities, networks and more generally any type of infrastructure. These solutions have been considered by several international organisations and represent government best practice not just in telecom policy but across all infrastructure and policy areas.
- A second set of solutions described in sections 5.1.3 and 5.1.4 considers a country's ICT and digital inclusion policies, and can be realised through the effective combination of policies at government and regulatory levels. Transparent and stable legislation can provide effective incentives to investors in complex and risky investment environments.

5.1.1 Promoting infrastructure sharing across different sectors

Improving infrastructure sharing for telecoms across different sectors is one of the keys to maximising the potential savings for network deployment. By adopting a set of simple rules, governments can achieve multiple 'easy wins' across projects, especially in relation to projects that are still in planning. Important suggestions identified by this review to promote sharing across utilities, and also within the telecom industry are:

- **Include sharing obligations in building planning provisions:** when approving planning permissions and new buildings, governments could consider attaching obligations to ensure provision for ducts for broadband access are included in the construction plans. This maximises the potential for multiple operators to provide services to the building occupants. For example in Rwanda, to obtain planning permission, it is now mandatory for every new housing estate built in the capital, Kigali, to cater for broadband access with the installation of the appropriate ducts. A similar provision is in place in Botswana⁸⁵ and in many European countries.

⁸⁵ http://www.bta.org.bw/sites/default/files/documents/Draft_Final_Report_on_Infrastructure_Sharing.pdf

- **Include obligations to support duct sharing in cable laying and other public utility infrastructure:** planning authorities could consider developing a set of design conditions to support sharing of ducts or overhead cable space when approval takes place for cable laying and other utility infrastructure works. For example, in an increasing number of countries, operators laying fibre are required by regulation to make duct space available for other operators and also for government structures, particularly municipalities. This includes mandating larger cabinets or ducts, or through appropriate digging and network protection facilities and use of microducts. This policy could extend to transport (roads and rail), energy links (liquid and gas fuel pipelines and electricity grids), and waterways (canals, water pipelines and sewage systems).
- **Create a cross-sectoral infrastructure planning database:** sector regulators could operate a common national database of the existing and planned infrastructure of different sector utilities, such as Germany's Infrastructure Atlas which allows the coordination of works across utilities at small additional cost.
- **Coordinate rights of ways:** government could address constraints in obtaining timely and effective access to rights of way by working with municipalities to streamline responsibilities and the management of rights of way. This would include regulating the fees charged and assisting operators coordinate the complexities associated with dealing with multiple agencies.

These policies require the **alignment of several different ministries and regulators** (e.g. energy, telecom, planning, and transport) **and of municipalities**. Often regulators and municipalities apply fragmented approaches to facilitation of infrastructure deployment and local authorities may lack planning capacity or they may view payments from telecom operators as a significant revenue source. As a result, municipalities can be a risk factor in delaying or halting investment. Work to align municipal policies (and in some cases provincial/state policies) with national policy may be needed, and it may be necessary to impose **tariff caps on leasing of municipal and other utility infrastructure**. Governments could also consider rewarding municipalities that act quickly in inserting sharing conditions in their approval mechanisms.

5.1.2 Unlocking sharing within the telecom sector

Recognising the importance of ICT in economic and social development, most governments have set out ambitious broadband connectivity plans, often aligned with objectives set by international and regional organisations. As a key contributor to their success, **infrastructure sharing should have a prominent role in national ICT and broadband plans**.

To help determine the best strategy, governments may need to assess a variety of market factors and development goals when considering policy options. Market participants and experts have noted that the lack of a comprehensive assessment often leads to incoherent policies. Generally, policies as well government intervention in the markets (such as through partial ownership of an operator), should be considered in the light of the incentives and potential negative impacts on the existing market players. In this respect regulations need to balance the benefits from infrastructure sharing with the promotion of investment incentives. Areas that may need attention include:

- The existing level of market competition across fixed and mobile markets.
- The location of fibre networks that are being deployed in the country and where no networks are planned.
- Local, regional and international network interconnection needs.
- Actual and planned deployment of electricity grids to support needs for power by telecom networks and by the end user.

Against these factors, a set of targeted policies, financial and other incentives, and opportunities for intervention can be considered more effectively.

5.1.3 Promoting infrastructure sharing through regulation

Considering that one of the primary aims of telecom policy is to ensure a vibrant competitive market and a level playing field, telecom regulation aimed at supporting infrastructure sharing can promote not only broadband network extension but also encourage competition amongst market players. Telecom regulators need to balance the benefits from infrastructure sharing with the promotion of investment incentives across sectors.

Regulations on sharing need to cover two instances: a) providing shared access to existing infrastructure, and b) making provision for shared access in new infrastructure that is being planned. Effective sharing regulations typically include the following elements:

- **All operators should have a right to request the option of sharing.** Any licensed operator should be able to request to share another operator's infrastructure. The recipient of the request could be expected to negotiate in good faith and should not refuse unless there are clear technical reasons why sharing is not possible (for example, limited capacity, lack of physical space, risk of jeopardising network security). Reasons for refusal need to be presented in writing so that the regulator can evaluate the legitimacy of these claims. Infrastructure sharing guidelines state that 'prices for infrastructure sharing should be non-discriminatory, reasonable, and based on the actual costs incurred by the owner of the facility'⁸⁶.
- **Require operators to publish relevant information for infrastructure sharing.** Infrastructure sharing can be seen as an aspect of interconnection and co-location policy, for which there are normally existing requirements for operators to publish Reference Interconnection Offers (RIOs). Thus publication of 'Reference Infrastructure Sharing Offers' would increase certainty around the request process. These offers could be standalone, or required as part of RIOs, both of which should be readily available to other operators. Where necessary, commercially sensitive data on network infrastructure could be provided directly to regulators (to retain operator confidentiality of information on client locations).
- **Establish a rapid and effective dispute resolution/arbitration mechanism.** In the event of disputes over sharing between operators, a transparent and credible system to deal with disputes between operators in relation to sharing requests usually needs to be put in place by the national regulatory authority.

Some of these regulations could be included as part of telecom licensing requirements or as standalone regulations for existing licensed operators.

Figure 32: Nigeria's dispute resolution mechanism⁸⁷

After the implementation of Nigeria's infrastructure sharing guidelines, a dispute arose between fixed-wireless operator Multi-Links and long distance operator TNSL. Multi-Links refused to grant TNSL access to one of its ducts where TNSL wanted to lay its own cable. NCC intervened and ruled that the two parties should commence negotiations on infrastructure sharing.

Regulators need to balance certainty for investors with the opportunity to promote sharing in future investment. By establishing a transparent regulatory framework that incorporates sharing conditions within

⁸⁶ Guidelines on Collocation and Infrastructure Sharing http://www.ncc.gov.ng/files/Legal-Guidelines_Collocation_and_Infrastructure_Sharing.pdf

⁸⁷ Nigeria – Telecoms, Mobile, Broadband and Forecasts 2014, Budde Report

licences, regulators can both promote infrastructure sharing while at the same time providing a stable environment for investors. In this respect regulators can consider:

- **Including clear sharing guidelines in licence conditions (standards)**, such as mandating sharing features in network element design (e.g. on cabinet minimum size to allow additions of other providers' equipment, duct size and tower capability to hold equipment from multiple operators). For example, in France any operator wishing to lay fibre cable must also include spare ducts to allow other operators to use the network. Under these regulations, any new ducts become an 'essential facility' which must be shared with other operators.
- **Setting out in advance whether access terms on sharing will be regulated or can be commercially negotiated.** This would include describing what the regulations would entail, whether an open access model is being applied and the level of government funding available.
- **Providing clear pricing rules:** if price regulation is deemed appropriate, regulators should set out clearly which costing approach will be employed.
- **Providing guidance on shared local access and local loop:** when copper or fibre local sharing is mandated the terms should be clearly defined in advance.

Figure 33: Sharing guidelines in Malaysia⁸⁸

Malaysia's MCMC identified infrastructure sharing as one of the criteria for issuing licences for 3G mobile spectrum. Applicants must show that they can and will share infrastructure, including physical facilities and network capacity. The aim was to maximize use of existing network resources, including capacity, base stations and backbone facilities.

The infrastructure sharing strategies outlined above are aimed at promoting certainty and stability to allow more sharing to occur on new and existing networks. Should market failures require additional ex-post intervention regulators can consider actions which strike a balance between promoting more competition and the reward to investors which have already taken commercial risks. Areas to consider include:

- **New licences:** if new conditions such as open access are imposed on existing network operators, the issuing of new (especially unplanned) licences needs to be considered in the light of the impact on existing investors and market players.
- **Price regulations** should be adopted in circumstances where existing operators are unable to reach commercial agreements or where unreasonable pricing behaviour is proved. This should be carried out within the general regulatory framework of market analysis and design of remedies.
- **Price regulation** could also be considered in instances where market dominance in other utility sectors affects telecom markets. For example, if power grid operators that operate a single/ monopoly network also use it for telecom purposes, access conditions and price regulations could be considered in relation to their market power.

5.1.4 Financial incentives and government investment

Freely negotiated agreements between operators are clearly the preferred option in relation to infrastructure sharing, especially if they take place in a regulatory environment that promotes competition and sharing.

⁸⁸ <http://www.itu.int/itu-news/manager/display.asp?lang=en&year=2008&issue=02&ipage=sharingInfrastructure-mobile>

However, there may be instances where financial incentives or commercial involvement by government may be required to improve the level of sharing. Market incentives may not be sufficient, even when the cost of the investment can be shared, particularly for broadband networks in rural and geographically complex areas.

Two models typically prevail in these instances: a) where governments provide financial incentives to share; and b) where governments intervene directly by making their own investments in shared networks.

a) Financial incentives can increase operator willingness to share by reducing their project risk and capital requirements. Strategies include:

- **Reduction in USO contributions when sharing takes place.** This approach was adopted in Malaysia for its 3G licensees, as described in Figure 33 above.
- **Provision of subsidies to operators for deploying infrastructure that can be shared.** Subsidies can be provided to individual operators or consortia for network deployments which explicitly include an obligation to share the infrastructure invested in (for example through the system of reverse auctions, whereby funds are allocated to the lowest bidder).
- **Other tax breaks contingent on sharing.** These can be provided as an alternative or in addition to the strategies above, and would normally be linked to clear milestones in shared rural investment, and to mandates for sharing.
- **Low interest loans and debt guarantees contingent on sharing.** For example, through regional and multilateral banks funding and mitigation vehicles (e.g. EU Connecting Europe Facility), where the provision of these funds is contingent on sharing the infrastructure or making provision for access by telecom operators to other passive infrastructure.
- **Compensation for providers of other utility sectors' infrastructure.** USO or other funds can be used to pay for the (usually minor) additional costs incurred for ensuring the inclusion of telecom equipment in their infrastructure.

Figure 34: Sharing obligations in India⁸⁹

The Indian Universal Service Obligation Fund launched a scheme in 2008 to provide subsidies for setting up towers in rural areas with no wireless coverage. Subsidies are only given for infrastructure that is shared by at least three operators.

b) Direct market intervention. A number of governments have invested in wholesale telecom operators as a strategy for promoting better access by providing a shared network for commercial retail operators. In some cases this type of intervention may be required to unlock investment. However, in a number of cases telecom operators noted that governments should first determine whether less interventionist approaches to boosting investment and telecom access can be identified. Should a direct intervention be considered, a review of instances suggests that the creation of a consortium with several participants including government, may be more effective than an entity where the government is the only participant. In cases where consortia or PPPs that include government are considered there are a variety of dimensions that need to be addressed:

- **Shareholder composition:** The involvement of private operators should be promoted to improve the efficiency of the network. When telecom operators are also shareholders, governments should support a

⁸⁹ <http://www.thehindu.com/todays-paper/tp-business/tra-i-proposes-sharing-of-telecom-infrastructure/article1826958.ece>

balanced decision making process in the boardroom, making sure that dominant positions are not replicated within the board.

- **Funding:** The financial sustainability of the network and the shareholders can be strengthened by involving a broad base of private sector participants and, where possible, international and regional bodies. For example, in the case of Indonesia's Palapa Ring project, the government was left to bail out the project after a number of other shareholders left the consortium. Once the entity is commercially successful governments can consider reducing their presence in favour of the private sector
- **Role of government in management:** Governments are usually not well placed to manage the operational aspects of a network, often lacking the capacity to rapidly respond to changing market demands or to negotiate with vendors and suppliers. The risks of corruption and cost inflation often increase if no private parties or telecom operators participate in the deployment and operational side of the venture.
- **Access terms (assuming a multi-party arrangement):** How investors are rewarded can be key to undertaking investment. Two models have prevailed in practice: one where telecom investors are treated on an equal basis in receiving access compared to other customers; and one where they receive preferential access terms, e.g. exclusive access for a limited period of time. If the latter is adopted, clear guidelines on conditions that will prevail after the exclusivity period has passed should be set out in advance. Governments should also consider the role of future market players by reserving spare fibre capacity (or share ownership when it is tied to capacity levels) for potential future entrants.

5.2 How can international and regional organisations promote infrastructure sharing?

The role of international Development Finance Institutions (DFIs) such as the World Bank, the regional development banks, and the regional economic organisations, such as the Asia Pacific Economic Cooperation (APEC), the Economic Community Of West African States (ECOWAS), and the Southern African Development Community (SADC), can be very important in promoting sharing and have proved effective where investment in shared networks has occurred. Some of the roles that these organisations can successfully play include:

- When participating in infrastructure projects, **ensure that the funds available for utility infrastructure are sufficient to include the cost of provision of ducts or fibre.** An example is the Smart Corridor projects in Africa proposed by PIDA.⁹⁰
- **Attach conditions for infrastructure sharing to qualify for the funding.** For instance the World Bank includes a funding condition that fibre is introduced on new high tension grid deployments.
- **Participate directly or indirectly in the project governance design.** As indicated above, effective governance of shared wholesale infrastructure projects is often a key to their success. International organisations can help with supporting best practice in the design of the governance structures and operational frameworks for these networks.
- **Support information sharing and capacity building on effective infrastructure sharing policies and strategies.** Governments often lack information on the most effective infrastructure sharing methods and this is an area where international organisations can draw on their experience and resources to support knowledge sharing for improving local strategies.

⁹⁰ Discussed in Section 2.

- **Provide regional guidelines on sharing strategies.** Aside from supporting mechanisms for sharing of experiences and best practice, regional economic bodies have an important role in encouraging their member states to adopt best practice in infrastructure sharing through the publication of directives and guidelines.

Appendix A African and South East Asian markets

This appendix provides more details on the development of the telecom market, on infrastructure sharing progress and regulations in ten countries in Africa and South East Asia. These are: Kenya, Nigeria, South Africa, Uganda, Côte d'Ivoire, Mozambique, India, Indonesia, Thailand and the Philippines. The research presented in this appendix was undertaken in Q3 2014.

A.1 Kenya

A.1.1 Market Summary

With a mobile penetration rate of 76%, Kenya's mobile market lies above the regional average (Tanzania 54%, Rwanda 54% and Uganda 51%).⁹¹ In addition, mobile broadband connections have long overtaken fixed broadband connections (13.8m versus 0.08m). Kenya is also the global leader of mobile money transfers through M-PESA (70% of global m-money).⁹² Kenya's telecom market statistics are summarised in Table 3 below and Table 4 provides an overview of the market players.

Table 3: Kenya Market Statistics, 2014

		Penetration (as a % of population)
Population	44.6m	
Mobile Subscriptions (SIM cards)	34m	76%
Internet Users	27m	61%
Broadband Subscriptions, mobile	13.1m	29%
Broadband Subscriptions, fixed	0.06m	<0.1%
International Submarine Cables	4	

Source: Budde Report Kenya 2014, World Bank

Table 4: Kenya Market Players, 2014

Mobile Operators		Safaricom B Yu Orange Safaricom AirtelBharti Airtel Yu (Essar Telecom Kenya) Orange
Fixed Operator	1	Telkom Kenya (Orange)
ISPs	10+	Including: Telkom Kenya Wananchi Liquid Telecom Access Kenya Jamii Telecom

Source: Budde Report Kenya 2014

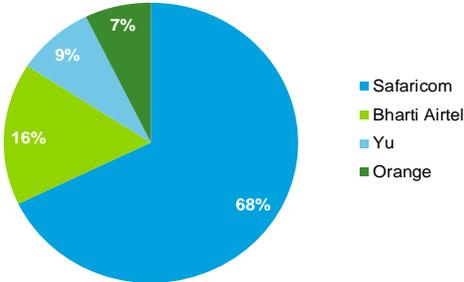
Kenya's mobile communications sector has seen an increase in the number of players in recent years, currently hosting 4 MNOs. While 2008 saw the entry of a third and fourth MNO, Yu and Orange, in addition to Safaricom and Airtel, Safaricom remains the largest operator with over 65% of total market. After the entry of

⁹¹ GSMA

⁹² <http://www.gsma.com/mobilefordevelopment/insights-on-the-economics-of-mobile-money-m-pesa-key-revenue-driver-for-safaricom>

two smaller operators, the mobile market experienced reductions in the average price per minute (down by 21.9%) and an increase in unique subscribers by 2m.⁹³

Figure 35: Kenya Mobile Market Shares, 2014



Source: GSMA

Telkom Kenya was privatised in 2007 and is now partly owned by Orange and by the Kenyan government. The company is the sole provider of fixed-line telephone services in Kenya. Due to the steady increase in demand for mobile services, the total number of fixed lines in service has decreased from 328,000 in 2003 to 57,000 in 2013.⁹⁴ Telkom Kenya also provides fixed broadband services.

Kenya has over 10 ISPs; however each of these fixed broadband providers has a market share of less than 1% of the total broadband market.

A.1.2 Fibre Infrastructure

In addition to the existing mobile and fixed networks, the national fibre backbone in Kenya is being built up through a combination of government initiatives and private sector investments, which are described below:

National Optic Fibre Backbone Infrastructure (NOFBI):

- Phase 1 involved a roll out 4,300km of fibre and was completed in 2012.
- Phase 2 commenced in July 2014 and is expected to connect all 47 country governments through an additional 1,600km of fibre.⁹⁵ The project, which is being funded through a Chinese concessional loan of 6bn KES, is expected to be completed in 2016.⁹⁶

Private Sector Networks:

- To compete with Telkom Kenya, several major ISPs and MNOs have also been rolling out their own networks. By 2012, JamiiTelcom had around 4,000km and Safaricom around 600km of optic fibre links, with more in planning.⁹⁷
- The Kenya Power and Lighting Company (KPLC), a major electricity distributor, is rolling out a fibre network along its power lines. As KPLC only needs around a quarter of the capacity for its own operations, the company has gained a licence in 2010 allowing it to sell fibre capacity to third parties.

⁹³ GSMA
⁹⁴ Kenya – Telecoms, Mobile, Broadband and Forecasts, 13th Edition, Buddecomm Report
⁹⁵ <http://www.cio.co.ke/news/top-stories/phase-two-of-nofbi-to-commence-in-july>
⁹⁶ <http://china.aiddata.org/projects/30384>
⁹⁷ Kenya – Telecoms, Mobile, Broadband and Forecasts, 13th Edition, Buddecomm Report

International Terrestrial Fibre Links:

In addition to the national fibre backbone, Kenya is also connected to many of its neighbouring countries through terrestrial international fibre links:

- The Eastern Africa Backhaul System is a Joint Venture among national operators and involves a 4,000km fibre backbone, connecting Kenya, Uganda, Tanzania, Burundi and Rwanda.
- As part of a project, linking the countries' electricity grids, Kenya has established fibre connections with Tanzania and Zambia.

A.1.3 Infrastructure Sharing Regulations

In 2009 the regulator, the Competition Authority of Kenya (CAK) (formerly known as the Communications Commission of Kenya, CCK) developed the "Code of Practice for the Deployment of Communication Infrastructure".⁹⁸

The code applies to all forms of passive communication infrastructure including towers, masts, ducts and overhead, underground and submarine cables.⁹⁹ Concerning site sharing and co-location the code gives the following provisions:

- Site Sharing is to be pursued as the first option by telecom operators. The commercial terms have to be mutually agreed upon and agreements are to be done on a first come first serve basis (4.5.1).
- An operator who declines a request for site-sharing has to give reasons in writing to the requesting operator and the administrator of the code (4.5.4). A complaint can be filed by the requesting operator (4.5.5).

The code further provides guidance on the sharing of duct and cable infrastructure:

- Operators must share ducts and cables whenever technically possible (4.10.1).
- Sharing of cable infrastructure is contingent on the availability of duct space (4.10.2).

While the code encourages the sharing of passive infrastructure, it is not set in mandatory terms and it is largely left to the discretion of the operators to decide whether or not it is technically feasible to share their infrastructure.¹⁰⁰ However, in June 2014, the CAK announced that it intends to enforce infrastructure sharing among mobile operators. The regulator further announced that it plans to penalise those operators who fail to comply.¹⁰¹

The code does not include any provisions for active infrastructure sharing. This suggests that for this case there is no regulatory framework in place.

A.1.4 Infrastructure Sharing Projects

The sharing of passive infrastructure such as ducts, fibre and towers is permitted by the government in Kenya. Consequently, there are several examples of such initiatives:

⁹⁸ Code of Practice for the Deployment of Communications Infrastructure in Kenya

⁹⁹ Code of Practice for the Deployment of Communications Infrastructure in Kenya, Chapter 2

¹⁰⁰ Nojiyeza and Muthoka, "Barriers to Entry of Kenya's Telecommunication Industry: Is there a Market Slice for New Entrants?", Journal of Management and Administration, 2013

¹⁰¹ <http://allafrica.com/stories/201406250311.html>

Fibre optic business:

- Through its fibre optic business, KPLC has been selling capacity on its national fibre routes to the majority of Kenya’s telecommunications operators including Safaricom, Airtel, Wananchi, Liquid Telecom, Jamii and Indigo.¹⁰²

Tower Sharing:

- While towers were mainly seen as competitive assets to fulfil licensing obligations, since 2003 most operators in Kenya share their tower infrastructures on a commercial basis.¹⁰³

Tower companies:

- In 2013, as part of Kenya’s first tower deal, Telkom Kenya entered a tower management agreement with Eaton Towers. Under a 15 year partnership, Eaton Towers will manage Telkom’s portfolio of over 1,000 towers and invest in new ones in order to expand coverage.¹⁰⁴

A.2 Nigeria

A.2.1 Market Summary

With over 125m subscriptions, Nigeria is Africa’s largest mobile market. A summary of the Nigerian telecom market can be found in Table 5 below and an overview of the market players in Table 6.

Table 5: Nigeria Market Statistics, 2014

		Penetration (as a % of population)
Population	174m	
Mobile Subscriptions (SIM cards)	125m	72%
Internet Users	95m	55%
Broadband Subscriptions, mobile	63m	36%
Broadband Subscriptions, fixed	0.17m	0.1%
International Submarine Cables	5	

Source: Budde Report Nigeria 2014 and NCC

Table 6: Nigeria Market Players, 2014

Mobile Operators	7	MTN Bharti Airtel Etisalat Glo Mobile Visafone Smile Multi-Links
Fixed Operators	80+	Including: Nitel Globacom 21 st Century Technologies Multi-Links Telecom
ISPs	100+	Including: CyberSpace 21 st Century Technologies Internet Solutions Nigeria

Source: Budde Report Nigeria 2014

¹⁰²<http://kplc.co.ke/content/item/35>

¹⁰³ Industry Interviews

¹⁰⁴http://eatontowers.com/telkom_kenya_signs_tower_management_partnership.php

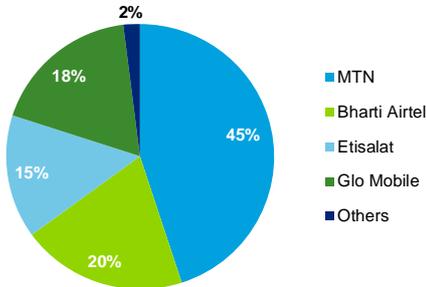
Since 2006 a unified licencing regime applies in Nigeria whereby operators are allowed to offer fixed and mobile services, which significantly increased competition in the market.¹⁰⁵ As a result, there are over 80 fixed operators and 100 ISPs.

Besides the incumbent Nitel, the Nigerian fixed market also features a second national operator, Globacom (whose mobile arm is branded as 'Glo Mobile') who received its licence in 2002. After numerous failed privatisation attempts the national telco Nitel is currently under liquidation.

The Nigerian mobile telecommunication market hosts seven mobile network operators. With a 45% share, MTN is the largest operator, followed by Airtel, Glo and Etisalat. Combined, the three smaller players, Visafone, Smile and Multi-Links have about 2% of the market share.

Annual mobile subscription growth rates of over 10% have reportedly led to network congestion, and the regulator has complained about declines in quality of service. MNOs are responding to the resulting sanctions and fines by the regulator with increased investments in infrastructure rollouts.¹⁰⁶

Figure 36: Nigeria Mobile Market Shares, 2014



Source: GSMA

A.2.2 Fibre Infrastructure¹⁰⁷

In addition to Nitel’s national backbone network, mobile operators have begun rolling out their own alternative fibre backbone.¹⁰⁸ While major cities and state capitals are reasonably well connected, a vast number of rural communities are still underserved.

Public Sector Networks:

- Upon the onset of competition, Nitel installed optic fibre rings in Lagos, Ibadan, Enugu, Kaduna and Abuja. Coverage remained limited to a few major cities and the company is currently under liquidation.
- Globacom completed construction of a 10,000km fibre optic ring, connecting all major Nigerian cities.

Private Sector Networks:

- Several mobile operators have rolled out their own fibre optic network, including MTN Nigeria (>6,000km by 2012), Bharti Airtel (>8,500km by 2011) and Multi-Links (8,232km). The Multi-Links network is the only open-access and independent national fibre optic transmission network.¹⁰⁹

¹⁰⁵ Nigeria – Telecoms, Mobile, Broadband and Forecasts 2014, Budde Report

¹⁰⁶ Nigeria – Mobile Market - Overview, Statistics and Forecasts 2014, Budde Report

¹⁰⁷ Source unless noted otherwise: Nigeria- Fixed-Line Market and Fibre Infrastructure – Overview and Statistics 2014, BuddeCom Reports

¹⁰⁸ Nigeria – Telecoms, Mobile, Broadband and Forecasts 2014, Budde Report

- There are a number of infrastructure companies selling fibre to operators: Phase3Telecom, Suburban Telecom and Backbone Connectivity Nigeria Limited. In 2013, Phase3Telecom received funding from the Universal Service Provision Fund (USPF) to start extending its backbone network into more rural areas.

International Terrestrial Fibre Links:

There are several existing and proposed terrestrial fibre links to Nigeria's neighbouring countries:

- Suburban Telecom and Phase3 Telecom have established fibre links to Benin, Togo and Ghana.
- Central African Backbone (CAB) is a PPP initiated by the World Bank, aiming to develop a regional fibre optic backbone. Cameroon, the Central African Republic and Chad are already participating and Nigeria is eligible to participate.

A.2.3 Infrastructure Sharing Regulations¹¹⁰

In 2006 Nigeria's telecom regulator, the Nigerian Communications Commission (NCC), published 'Guidelines on Collocation and Infrastructure sharing' in order to establish a framework for infrastructure sharing agreements between operators.¹¹¹

The objectives of the guidelines on infrastructure sharing include:

- Minimising or completely avoiding the unnecessary duplication of infrastructure.
- Protecting the environment by reducing the proliferation of installations.
- Encouraging operators to pursue a cost-orientated policy, ultimately reducing the tariffs for consumers.
- Promoting fair competition through equal access.

The guidelines further define the infrastructure suitable for sharing, i.e. which can be shared without reducing competition. This includes rights of way, tower structures, ducts and trenches, space in buildings and electrical power.

The Commission does not promote or encourage the sharing of active infrastructure as it states that this could lead to a *"risk of a lessening of competition"*. Such infrastructure includes complete network structures, switching centres, radio network controllers and base stations.

The guidelines identify three admissible grounds for refusing access to infrastructure: insufficient capacity; safety, reliability and incompatibility of facilities; and general engineering considerations. Furthermore the guidelines demand that any prices for infrastructure sharing must be non-discriminatory, reasonable and based on actual costs.

Upon refusal to access, the guidelines give the NCC the right to request reconsideration of the decision, or to impose an infrastructure agreement on the parties should the grounds of refusal be found unacceptable.

A.2.4 Infrastructure Sharing Projects

Due to the aforementioned difficulties of operators to keep pace with subscriber growth, infrastructure sharing is encouraged by the National Broadband Plan 2013-2018.¹¹² Initiatives up to date mainly involve the sharing of passive infrastructure and include:

¹⁰⁹ <http://www.multilinks.com/About.aspx>

¹¹⁰ Source unless noted otherwise: Guidelines on Collocation and Infrastructure Sharing, Nigerian Communications Commission, 2006

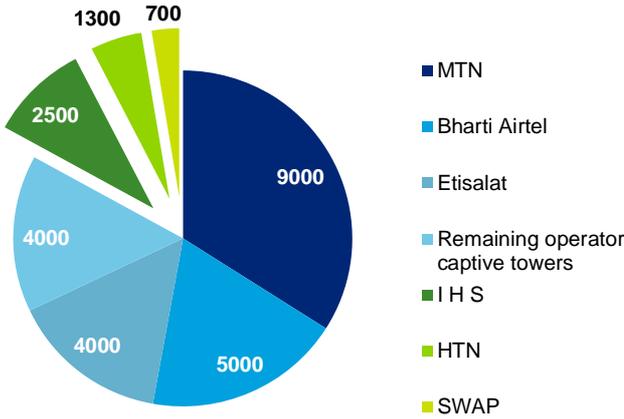
¹¹¹ Nigeria- Fixed-Line Market and Fibre Infrastructure – Overview and Statistics 2014, BuddeCom Reports

Tower Companies:¹¹³

- In 2007, Helios Towers Nigeria, one of Africa’s first tower companies, received a licence for co-location of infrastructure. Deals with Multi-Links and Gateway Business Nigeria took the company’s portfolio of managed sites to over 1,000 towers.
- In 2011, the MNO Visafone entered into a tower sale-and lease-back agreement with the tower company IHS Nigeria.
- By 2014, an estimated 4,500 towers in Nigeria will be owned by independent tower companies.¹¹⁴ Furthermore, market experts report that Nigeria’s two largest MNOs, Bharti Airtel and MTN, are in the process of selling a large stake of their tower portfolios to independent tower companies. The deals are expected to be completed by the end of 2014.¹¹⁵

Figure 37 below shows estimated counts of towers for sale (labelled in blue) as well as towers that are already owned by the three independent tower companies, IHS Holdings Limited (IHS), Helios Towers Nigeria (HTN) and SWAP.

Figure 37: Nigerian towers for sale (estimated counts)



Source: Towerxchange

Fibre Sharing

- A large part of Nigeria’s infrastructure has been rolled out by private fibre companies such as Phase3Telecom and Suburban Telecom who sell capacity on a wholesale basis to telecom operators.
- The mobile operator Multi-Links operates a national fibre optic network which connects 21 out of 36 states. Multi-Links provide both retail and wholesale services to end users and operators.¹¹⁶

Government-led

¹¹² The Nigerian National Broadband Plan 2013-2018
¹¹³ Nigeria – Telecoms, Mobile, Broadband and Forecasts 2014, Budde Report
¹¹⁴ <http://www.towerxchange.com/the-changing-shape-of-the-nigerian-tower-industry/>
¹¹⁵ <http://www.bloomberg.com/news/2014-03-25/mtn-said-to-join-phone-operators-planned-sales-of-africa-towers.html>
¹¹⁶ <http://www.multilinks.com/About.aspx>

- The government plans to provide an open-access and non-discriminatory nation-wide broadband fibre network for all operators. For the construction of the Next Generation Broadband Network (NBN), the NCC planned to licence seven infrastructure companies in December 2014 to roll out the network.¹¹⁷

A.3 South Africa

A.3.1 Market Summary

At 154%, South Africa has one of the highest mobile penetration rates and is the most developed telecom market in the region. Compared to many other African countries, South Africa also has a high penetration rate of internet users and mobile broadband subscriptions. For detailed market statistics, see Table 7 below. Table 8 provides an overview of the market players in the South African telecommunications sector.

Table 7: South Africa Market Statistics, 2014

		Penetration (as a % of population)
Population	52.4m	
Mobile Subscriptions (SIM cards)	81m	154%
Internet Users	28m	53%
Broadband Subscriptions, mobile	25m	48%
Broadband Subscriptions, fixed	1.6m	3%
International Submarine Cables	5	

Source: Budde Report South Africa 2014, GSMA and World Bank

Table 8: South Africa Market Players, 2014

Mobile Operators	4	Vodacom MTN Cell C Telekom Mobile
Fixed Operators	2	Telkom SA Neotel
ISPs	20 major	Including: Telkom Internet MWEB Internet Solutions

Source: Budde Report South Africa 2014

There are currently two fixed operators and over 20 ISPs in South Africa. Neotel gained its licence as the second national operator in 2005, ending Telkom's monopoly on fixed lines. Neotel's estimated market share in 2013 was around 4%. According to an announcement by Vodacom in September 2013, Neotel is in the process of being acquired by mobile operator Vodacom.¹¹⁸

Additional competition for the existing fixed-line operators comes from national and private infrastructure companies and recently also from MNOs which, under a new service-neutral regulatory framework, can now enter the fixed-line, fibre-backbone and mobile banking markets.¹¹⁹

South Africa's mobile telecommunications market currently hosts 4 MNOs. The fourth operator, Telekom Mobile, the mobile arm of public Telkom SA, entered in 2008, but has not been able to capture a significant market share (3% in 2014).

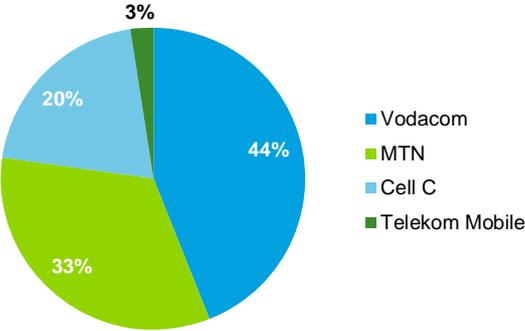
¹¹⁷ Nigeria – Telecoms, Mobile, Broadband and Forecasts 2014, Budde Report

¹¹⁸ http://www.vodacom.co.za/cs/groups/public/documents/vodacom.co.za_portal_webassets/pocm01-810687.pdf

¹¹⁹ South Africa – Telecoms, Mobile, Broadband and Forecasts 2014, Buddecom Reports

In December 2013 Telkom SA announced it may want to sell Telkom Mobile before it entered talks with MTN about a possible active network sharing deal.¹²⁰

Figure 38: South Africa Mobile Market Shares 2014



Source: GSMA

A.3.2 Fibre Infrastructure

South Africa's national fibre backbone network is made up of a combination of fibre routes rolled out by the national telecom operators Telkom SA and Neotel, mobile operators and public and private infrastructure companies.

Public Sector Networks:

- Telkom SA currently has the largest optical fibre network in Africa with over 140,000km of fibre, connecting all major centres. In 2013, Telkom SA announced investment of ZAR 12bn in a next generation broadband network.
- Since 2009, the second national operator Neotel has been spending ZAR 500m a year on infrastructure and by 2013 the Neotel's fibre optic network was about 15,000km long.
- Broadband InfraCo is an umbrella infrastructure company for all fibre optic backbone networks of state-owned companies Eskom (the national power grid operator) and Transnet (the national rail operator). It operates a national long distance fibre network of about 12,000km. Neotel is the primary user of the network.

Private Sector Networks:

- DarkFibre Africa is a private infrastructure company leasing 8,000km of backbone fibre infrastructure to MNOs and ISPs such as Cell C, Vodacom, MTN, Telkom SA and Internet Solutions.¹²¹
- Mobile operators such as MTN and Vodacom entered the fixed-line market and have also been rolling out their own networks. MTN owned 12,000km of fibre in 2014.
- FibreCo, established in 2010, has started to roll out a network in major cities and secondary towns, which is expected to measure 12,000km upon completion.

International Terrestrial Fibre Links:

¹²⁰ South Africa – Telecoms, Mobile, Broadband and Forecasts 2014, Buddecom Reports
¹²¹ <http://www.dfafrica.co.za/company/>

South Africa hosts landing points to five international submarine fibre optic cables and as such serves as an access point for several of its land-locked neighbours. South Africa has terrestrial fibre links with Botswana, Lesotho, Mozambique, Namibia and Swaziland.

A.3.3 Infrastructure Sharing Regulations

While the sharing of infrastructure in South Africa is allowed, there is no formal coordination of the process by regulatory frameworks. When rolling out fibre, operators have to obtain individual way-leave permissions from the telecom regulator, Road Agency and municipalities.¹²²

A.3.4 Infrastructure Sharing Projects

Tower Companies:

- The first tower sale-and-leaseback deal occurred in 2010 when American Tower Co acquired 1,400 operational towers from Cell C (plus an additional 1,800 under construction).
- MTN also entered talks with American Tower Co in 2012, involving a tower deal for about half of its 6,000 towers. MTN, however, reconsidered its strategy in 2013 and the deal was never completed.¹²³

RAN Sharing:

- In early 2014, MTN and Telkom SA (Telekom Mobile) confirmed talks on a proposed RAN sharing agreement, which would involve MTN taking over the management of the rollout and operation of Telkom's RAN network. The agreement has not yet been finalised.¹²⁴

Joint ventures for fibre deployment:

- MTN, Neotel and Vodacom entered a joint venture for the roll-out of a national long-distance fibre network in 2009. The project involved 5,000km of fibre, connecting South Africa's major centres such as Johannesburg, Cape Town and Durban. The venture was South Africa's first major co-build agreement and the first time MNOs started rolling out their own infrastructure.¹²⁵

Fibre Companies:

- A number of private (DarkFibre Africa and FibreCo) and public (Broadband InfraCo) infrastructure companies have been rolling out fibre networks in South Africa, on which they now sell capacity to ISPs and MNOs.
- FibreCo was formed as a joint venture between Cell C, an ISP and an investment firm. The company has operates under an open-access principle and describes itself as a "carrier neutral, national network operator" who is committed to generate economic and environmental benefits through infrastructure sharing.¹²⁶

¹²² Understanding What's Happening in ICT South Africa

¹²³ South Africa – Mobile Market - Overview, Statistics and Forecasts 2014, Buddecom Reports

¹²⁴ <http://www.meamonitor.com/industry-trend-analysis-bmi-view-mtn-telkom-network-sharing-agreement-may-2014>

¹²⁵ South Africa – Fixed-line Market and Fibre Infrastructure 2014, Buddecom Reports

¹²⁶ <http://fibreco.co.za/About/The-FibreCo-Difference>

A.4 Uganda

A.4.1 Market Summary

A summary of the statistics describing the Ugandan telecommunications market can be found in Table 9 below. Table 10 lists the main market players.

Table 9: Uganda Market Statistics, 2014

		Penetration (as a % of population)
Population	38m	
Mobile Subscriptions (SIM cards)	19.5m	52%
Internet Users	6.8m	19%
Broadband Subscriptions, mobile	3.5m	9%
Broadband Subscriptions, fixed	0.09m	0.2%
International Submarine Cables	3 (access via Kenya)	

Source: Budde Report Uganda 2014 (based on UCC and ITU data)

Table 10: Uganda Market Players, 2014

Mobile Operators	7	Bharti Airtel MTN UT Mobile (Uganda Telecom) Orange I-Tel Smile Smart
Fixed Operators	2	Uganda Telecom MTN
ISPs	10	Including: All major telcos Infocom Africa Online

Source: Budde Report Uganda 2014

Uganda's fixed-line and fixed broadband market currently hosts two national operators and more than 10 ISPs. The incumbent operator, Uganda Telecom (UT) was the only operator in the fixed-line market before MTN was licenced as the second national operator in 1998. Their licences allow both operators to compete in all telecommunications services, including fixed-line, mobile data and internet.¹²⁷

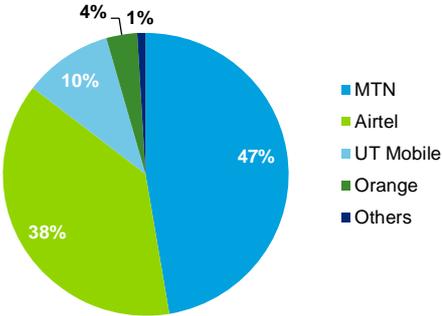
As 97% of all internet subscriptions are mobile, the fixed-broadband market is facing considerable competition from MNOs. Since 2008, the Ugandan mobile market saw the entry of four additional players, bringing the total number of MNOs in the market to 7. During the same time, subscriptions more than doubled (from 8m in 2008 to 19m in 2013) and ARPU rapidly decreased. For example, MTN's ARPU fell from \$8 in 2008 to \$3.58 in 2013.¹²⁸ However, mobile money transfers and 3G broadband services are starting to generate new additional revenue for mobile operators.

In the market, MTN is the largest player controlling a market share of just under 50%, with Airtel controlling nearly 40% of the market. Together, the four MNOs that entered since 2008 hold a market share of around 5%.

¹²⁷ Uganda – Key, Statistics, Regulatory and Fixed-line Telecoms Overview, 2014, Buddecom Report

¹²⁸ Uganda – Mobile Market – Overview, Statistics and Forecasts 2013, Buddecom Report

Figure 39: Uganda Mobile Market Shares, 2014



Source: GSMA

A.4.2 Fixed Infrastructure

While the National Backbone Infrastructure (NBI) is still under construction, the national operators (UT and MTN) and some ISPs have been rolling out their own networks.

National Backbone Infrastructure:¹²⁹

- Commissioned in 2006, this government-led project is financed through a \$106m loan from the Chinese Export-Import Bank. Currently, the NBI includes 1,585km of fibre connecting 20 out of Uganda’s 111 districts to the national backbone.
- Phase 2 of the project was completed in 2011, two years after the expected completion date of the entire project.
- Phase 3 is currently under construction. This is expected to add another 400km of fibre and connect Rwanda and Burundi to the East African submarine cables. A fourth phase, which would connect the currently underserved Northern region, is under discussion.

Private Sector Networks:

- In 2013, Google launched a metropolitan fibre optical ring in Kampala. The company is leasing capacity on a wholesale basis to ISPs and mobile operators.

International Terrestrial Fibre Links:

As a land-locked country, Uganda has to rely on terrestrial fibre links to its neighbouring countries to gain access to international submarine cables.

- The Ugandan ISP Infocom joined Kenya Data Networks (both now purchased by Liquid Telecom of Zimbabwe) to lay a fibre route between Mombasa and Kampala, connecting Uganda to the Seacom international submarine cable.
- MTN and UT are partners of the 4,000km Eastern African Backhaul System through which Uganda gained access to the EASSy submarine cable.

¹²⁹ Uganda – Key, Statistics, Regulatory and Fixed-line Telecoms Overview, 2014, Buddecom Report

A.4.3 Infrastructure Sharing Regulations

Infrastructure sharing is permitted by the telecom regulator, the Uganda Communications Commission (UCC). The Public Infrastructure Provider License (PIP) permits its holder to build, operate and maintain infrastructure for the provision of telecommunications services. It further allows the holder to offer its infrastructure commercially to other operators (Public Service Providers).¹³⁰

However, there are no explicit guidelines on infrastructure sharing, yet. The UCC announced that in 2014 it will implement guidelines, which will require operators to share passive infrastructure such as ducts and masts. While not mandated, the guidelines will also permit the sharing of active infrastructure.¹³¹

A.4.4 Infrastructure Sharing Projects

Consortia:

- In 2009, MTN, Zain, UTL and Warid formed a consortium to share costs in connecting their sites to the electricity grid. One of the main problems for operators rolling out networks in rural Uganda is the lack of access to electricity.

Tower companies:¹³²

- In 2011, a joint venture between MTN and American Tower established ATC Uganda. American Tower paid \$89m to acquire a stake of 51% in the new company, which now manages MTN's portfolio of 1,000 towers.
- In 2012, there were sale-and-leaseback deals between Eaton Towers and Orange as well as Eaton Towers and Warid (later acquired by Bharti Airtel). The deals involved the outsourcing of management and maintenance of the MNO's portfolios of 300 and 400 towers, respectively.

A.5 Côte d'Ivoire¹³³

A.5.1 Market Summary

Mobile penetration in Côte d'Ivoire stands at 91%, well above the African average of 74%. Mobile broadband subscriptions, which are still at a relatively low level, have been increasing exponentially since the first 3G licence was awarded in 2012. They have more than tripled in the past year (from 250,000 in Q2 2013 to 800,000 in Q2 2014).¹³⁴ Table 11 below summarises Côte d'Ivoire's market statistics, while Table 12 lists the main fixed and mobile market players.

¹³⁰ <http://www.ucc.co.ug/data/smenu/88/Licensing-Overview.html>

¹³¹ <http://www.towerxchange.com/regulations-to-support-infrastructure-sharing/>

¹³² <http://www.towerxchange.com/the-current-state-of-the-african-infrastructure-sharing-market/>

¹³³ Source unless noted otherwise: Côte d'Ivoire – Telecoms, Mobile and Broadband – Market Insights, Statistics and Forecasts 2014, Buddecom Reports

¹³⁴ GSMA Market Data Côte d'Ivoire

Table 11: Côte d'Ivoire Market Statistics, 2014

		Penetration (as a % of population)
Population	23.4m	
Mobile Subscriptions (SIM cards)	21.3m	91%
Internet Users	1m	4.2%
Broadband Subscriptions, mobile	0.8m	3.4%
Broadband Subscriptions, fixed	0.07m	0.2%
International Submarine Cables	3	

Source: Buddecom Report Côte d'Ivoire 2014, GSMA, World Bank

Table 12: Côte d'Ivoire Market Players, 2014

Mobile Operators	6	MTN Orange (CI-Telecom) Moov koZ GreenN Café Mobile
Fixed Operators	2	CI –Telecom Arobase Telecom (MTN)
ISPs	23	Including: AfNet (MTN) Aviso (CI-Telecom) Others

Source: Budde Report Côte d'Ivoire

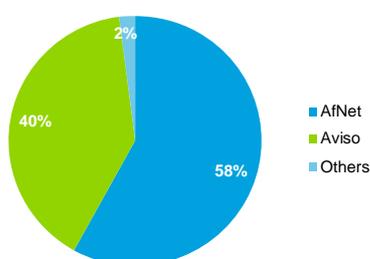
CI-Telecom is the incumbent national operator of the fixed-line market. The country also has a second national operator, Arobase Telecom (MTN).

France Telecom (now Orange S.A.), which is the parent company of CI-Telecom and the mobile arm Orange, controls all three international submarine cable landing stations in Côte d'Ivoire. CI-Telecom also controls about 96% of the fixed-line voice market.

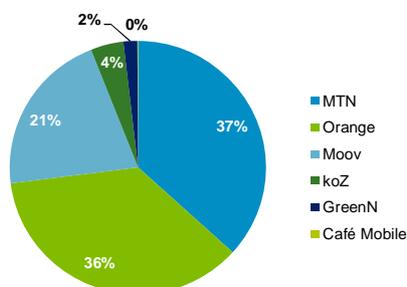
Arobase obtained its licence for national and international communication services in 2000. In 2006, MTN took over ownership of the company and with its existing GSM licence the group became the country's second national operator.

Both fixed operators also have their own ISPs. Together, MTN's AfNet and CI-Telecom's Aviso control about 98% of Côte d'Ivoire's non-mobile internet market (see Figure 40 below).

Figure 40: Côte d'Ivoire ISPs Market Shares, 2014 **Figure 41: Côte d'Ivoire Mobile Market Shares, 2014**



Source: Budde Report Côte d'Ivoire 2014



Source: GSMA

The mobile phone sector in Côte d'Ivoire has undergone much liberalisation in recent years and is now hosting six mobile network operators (MNOs). Combined, the three largest players, MTN, Orange and Moov, have 94% of the market share, as shown in Figure 40 above.

A.5.2 Fibre Infrastructure

Three fibre networks are currently being rolled out in the country:

National Fibre Optical Backbone:

- Construction on a state-owned fibre optical backbone began in 2012. It is financed with the help of the National Telecommunications Fund (the national USF) which is financed through taxes paid by operators in order to expand services to rural areas. A total of 6,700km of fibre are being deployed with the expectation to connect up to 30% of the country's population to the Internet within the next 5 years.¹³⁵

Public Sector Networks:

- The national operator CI-Telecom has deployed 20,000km of fibre optic cables and 3,700km of radio relay links.

Private Sector Networks:

- According to local market analysts, mobile network operators such as MTN and Orange have also been rolling out their own terrestrial fibre links.

International Terrestrial Fibre Links:

As a landing point for three international submarine fibre cables, Côte d'Ivoire has several terrestrial fibre links with its neighbouring countries. Togo, Mali and Burkina Faso both have access to the SAT-3/WASC landing station via a terrestrial fibre link with Côte d'Ivoire.

A.5.3 Infrastructure Sharing Regulations

While passive infrastructure sharing is implicitly allowed by the telecommunications regulator in Côte d'Ivoire, there are currently no explicit regulations or guidelines. However, according to a local market expert, the Autorité de Régulation des télécommunications/TIC de Côte d'Ivoire (ARTCI) is currently in the process of developing legislation aimed to encourage infrastructure sharing.

A.5.4 Infrastructure Sharing Projects

Infrastructure sharing is occurring on mobile networks, while limited information was available on sharing in fibre networks.

Tower companies:

- SWAP was the first tower company to start operations in Côte d'Ivoire in 2010. Although some mobile operators are among SWAP's clients, the company only owns a limited number of towers in the country.¹³⁶

¹³⁵<http://www.reuters.com/article/2013/07/20/ivorycoast-telecoms-idUSL6N0FP2EQ20130720>

¹³⁶<http://www.towerxchange.com/cote-divoire-market-dynamics-good-for-tower-sharing/>

- In 2012, IHS acquired 931 towers from MTN which it will lease back to the operator. IHS will provide full management services for these towers and they will be available to be shared with other operators.¹³⁷
- Orange also entered a deal with IHS Africa in 2013. The deal involved 2,000 of Orange's towers in Côte d'Ivoire and Cameroon. However, unlike MTN, Orange did not sell its towers to IHS but merely signed over their operation to the tower company.¹³⁸

A.6 Mozambique¹³⁹

A.6.1 Market Summary

Mobile penetration in Mozambique stands at 48%, marginally below African average. Further statistics of the telecom market in Mozambique can be found in Table 13 below. Table 14 summarises the main market players.

Table 13: Mozambique Market Statistics, 2014

		Penetration (as a % of population)
Population	26.2m	
Mobile Subscriptions (SIM cards)	12.7m	48%
Internet Users	1.7m	6.5%
Broadband Subscriptions, mobile	1.4m	5.3%
Broadband Subscriptions, fixed	0.02m	<0.1%
International Submarine Cables	2	

Source: Budde Report Mozambique 2013, World Bank, GSMA

Table 14: Mozambique Market Players, 2014

Mobile Operators	3	mCel Vodacom Movitel
Fixed Operators	1	Telecomunições de Moçambique (TDM)
ISPs	18	Including: TDM/Teledata NetCabo Intra

Source: Budde Report Mozambique 2013

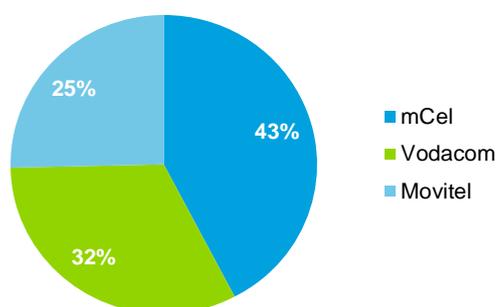
The state-owned company, Telecomunições de Moçambique (TDM), started operations in 1992 and is the only operator in the country's fixed-line market. The number of fixed lines in service peaked in 2001 and has been declining ever since. While in 2008 the government announced plan to award a second fixed licence, as of today TDM remains the sole player.

Three mobile operators are active in Mozambique. mCel, the mobile subsidiary of TDM, remains the largest player in the market with a market share of 43%. The entry of Vodacom in 2003 first introduced competition into the market while the third operator Movitel (Viettel) entered the market in 2012 and has since managed to capture a market share of 25%.

¹³⁷ <https://www.mtn.com/PressOffice/in-the-media/Pages/FullContent.aspx?pid=176>

¹³⁸ <http://www.orange.com/en/press/press-releases/press-releases-2013/Orange-and-IHS-sign-tower-leasing-agreement-to-improve-mobile-networks-in-Cote-d-Ivoire-and-Cameroon>

¹³⁹ Source unless noted otherwise: Mozambique- Telecoms, Mobile and Broadband – Market Insights, Statistics and Forecasts 2013, BuddeCom Reports

Figure 42: Mozambique Mobile Market Shares, 2014

Source: GSMA

A.6.2 Fibre Infrastructure

In addition to TDM's fixed line network, private-sector operators, in particular Movitel, are currently in the process of rolling out fibre backbone networks to meet the growing demand for data services.

Public Sector Networks:

- TDM started rolling out a national fibre optic backbone in 2006, connecting all 10 provincial capitals. Although the construction of the network has been completed, there are reported network interruptions of an average of 180 hours per month.¹⁴⁰

Private Sector Networks:

- Vodacom has its own microwave backbone, linking most main cities. It also rolled out a fibre optic network in Maputo and is planning to roll out its own national fibre backbone.
- By 2014, Movitel had a national fibre network of over 25,000km, connecting 105 of the country's 128 districts. The operator claims that its network represents 70% of Mozambique's total fibre network and 50% of all mobile towers.

International Terrestrial Fibre Links:

- South Africa's state-owned fibre company, InfraCo, completed a fibre link with Mozambique in 2009.
- Zimbabwe and Malawi have also rolled out fibre links across the border to Mozambique in order to access global connectivity through the international submarine fibre optic cables landing in Mozambique.

A.6.3 Infrastructure Sharing Regulations

The Basic Telecommunications Law of 2004 was revised by the government in 2013. According to local market experts, the revision of the law included measures which are intended to help operators to share network infrastructure. The objective is to reduce costs of investment in rolling-out telecom networks and expanding coverage. However, limited information is publicly available on this legislation.

¹⁴⁰ OECD Investment Policy, Policy Reviews: Mozambique 2013

While this suggests that regulatory agency of Mozambique, the Instituto Nacional das Comunicações de Moçambique (INCM), encourages network operators to share telecommunication infrastructure, the details of these policies are not clear.

A.7 India

A.7.1 Market Summary¹⁴¹

With over 900m subscriptions, India is the second largest mobile market in the world. The country also has 200m internet users, a number which not only includes subscribers but also people accessing the Internet from their work or cyber cafes. Table 15 summarises key statistics of the Indian telecom market and Table 16 provides an overview of the market players.

Table 15: India Market Statistics, 2014

		Penetration (as a % of population)
Population	1.23b	
Mobile Subscriptions (SIM cards)	904.5m	74%
Internet Users	200m	16%
Broadband Subscriptions, mobile	78.5m	6.4%
Broadband Subscriptions, fixed	14.9m	1.2%
International Submarine Cables	9	

Source: Budde Report India 2014, GSMA

Table 16: India Market Players, 2014

Mobile Operators	13	Including: Bharti Airtel Vodafone Reliance Communications Idea Cellular BSNL Aircel Tata DOCOMO Uninor
Fixed Operators	8	Including BSNL (state-owned) MTNL (state-owned) Bharti Airtel
ISPs	150+	Including: BSNL MTNL Bharti Airtel

Source: Budde Report India 2014

The fixed-line market is dominated by two state-owned telcos, BSNL and MTNL, which held almost 80% of the market share in 2013. While MTNL is designated to operate in Delhi and Mumbai exclusively, BSNL covers the rest of India, excluding those two cities.

Although there are over 150 operational ISPs in the market, by 2013 the five leading ISPs (BSNL, Reliance, MTNL, Bharti Airtel and Hathway Cable and Datacom) were controlling close to 90% of the Internet market. BSNL alone had at 60% market share.¹⁴²

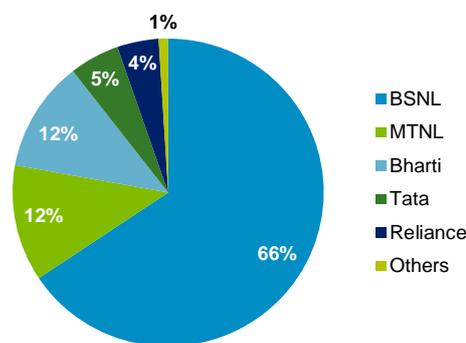
The mobile market in India has 13 MNOs. With 23%, Bharti Airtel has the largest market share, followed by Vodafone, Idea and reliance. A detailed distribution of the mobile market shares can be seen in Figure 43.

¹⁴¹ Source unless noted otherwise: India – Major Telecommunications Operators 2014, Buddecom Reports

¹⁴² Open Government Data (OGD) Platform India

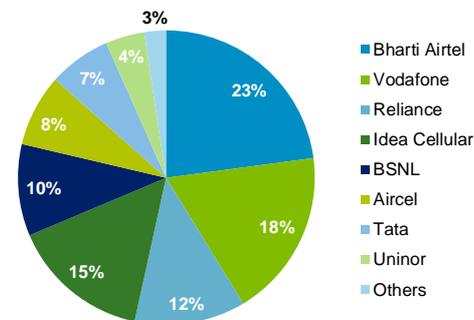
A decision by the Supreme Court in 2012 to cancel all 2G licenses that were awarded in 2008 resulted in a decline in competition and an increase in uncertainty in the market. As a result, the subscription base decreased by 8% between June 2012 and the end of 2012. By 2014, however, the market had recovered and exceeds pre-2012 levels.¹⁴³

Figure 43: India Fixed-line Market Shares, 2014



Source: Budde Report India 2014

Figure 44: India Mobile Market Shares 2014



Source: GSMA

A.7.2 Fibre Infrastructure

While much of the early infrastructure was rolled out by the state-owned telcos, many private sector companies have also been building their own networks in recent years. Additionally, in 2012 the government announced that it intends to build a national optical fibre network.

National Optical Fibre Network (NOFN):

- The government announced a plan to roll-out a national network involving over 500,000km of fibre, expanding connectivity into rural areas. However, construction has not started yet.¹⁴⁴

Public Sector Networks:

- India's incumbent national fixed-line operator BSNL has the country's largest fibre optic network, spanning over 600,000km. The company has not yet negotiated any fibre sharing agreements for its network.¹⁴⁵
- RailTel (100%-owned by Indian Railways) has built a nationwide broadband network by laying fibre optic cable along its 62,000km of railway tracks. The company leases capacity on its network to telecom operators.¹⁴⁶
- PowerGrid, one of India's main electricity providers, has deployed an optical fibre network of almost 30,000km on its power transmission lines.¹⁴⁷ Major users of the network include Bharti, BSNL and VSNL (Tata).
- GAILTEL, the telecom arm of the Gas Authority of India (GAIL), a state-owned enterprise, has deployed a network of around 13,000km along its gas pipelines, connecting 150 towns and cities. The company

¹⁴³ India – Major Telecommunications Operators 2014, Buddecom Reports

¹⁴⁴ <http://www.bsnl.nic.in/content/page/national-optical-fibre-networknofn.php>

¹⁴⁵ India – Major Telecommunications Operators 2014, Buddecom Reports

¹⁴⁶ http://www.railtelindia.com/index.php?option=com_content&view=article&id=50&Itemid=83&lang=en

¹⁴⁷ http://www.powergridindia.com/_layouts/PowerGrid/User/ContentPage.aspx?Pid=151&LangID=english

leases dark fibre and duct space to telecom operators such as Vodafone, VSNL (Tata), Bharti Airtel and Idea Cellular.¹⁴⁸

Private Sector Networks:

- Reliance Infocomm rolled out a fibre optic infrastructure, covering more than 110,000km and over 2,500 cities and towns.¹⁴⁹
- Other operators such as Bharti Airtel and Tata Teleservices have also been rolling out their own fibre optic networks, which reach most of the country's major cities.

International Terrestrial Fibre Links:

While India's main international cable connections are via submarine cables, the country has also established some terrestrial fibre links with its neighbours.

- In July 2013, Bharti Airtel established a terrestrial fibre link with Bangladesh, providing an alternative international connection for Bangladesh, which currently only has access to one international submarine cable.¹⁵⁰
- While VSNL has installed a terrestrial cable link with Pakistan as early as 2006, continuous tensions in the region have prevented it from going live so far.¹⁵¹

A.7.3 Infrastructure Sharing Regulations

A.7.3.1 Before 2008

Infrastructure Provider, Category I:

Since 2000 private companies could be registered as Infrastructure Provider, Category I (IP-I) and as such could provide passive infrastructure such as dark fibre, rights of way, duct space and towers on agreed commercial terms and conditions. This encouraged a new business model, enabling the operation of tower companies and fibre businesses. Currently, there are close to 450 Infrastructure Providers in India.¹⁵²

Unified Access Service Licences (UASL):

India implemented a unified licencing regime covering both, fixed and mobile operators in 2003. According to clause 33 of the Unified Access Service Licence, all licenced operators are allowed to share passive network infrastructure.¹⁵³ This includes infrastructures such as buildings, towers and dark fibre.¹⁵⁴

A.7.3.2 After 2008

Although permitted through the licences, only about 25% of all sites were shared in 2007.¹⁵⁵ As a result of the high growth levels that the telecom sector was experiencing, the Telecom Regulatory Authority of India (TRAI) introduced advanced sharing provisions in 2008, which introduced active sharing and provided financial

¹⁴⁸<http://www.gaiionline.com/>

¹⁴⁹ India – Major Telecommunications Operators 2014, Buddecom Reports

¹⁵⁰<http://www.telegeography.com/products/commsupdate/articles/2013/07/23/bharti-airtels-india-bangladesh-fibre-link-goes-live/>

¹⁵¹ India – Telecommunications Infrastructure and Forecasts 2014, Buddecom Report

¹⁵²<http://www.dot.gov.in/carrier-services/infrastructure-provider>

¹⁵³<http://cis-india.org/telecom/resources/govt-policy-and-guidelines>

¹⁵⁴ License Agreement for Provision of Unified Access Services

¹⁵⁵ Recommendations on Infrastructure Sharing – TRAI India 2007

incentives for sharing. The overall goals of the guidelines included a reduction of input costs for telecom access providers, facilitating reduced tariffs and increasing teledensity in rural areas. The main provisions made by the guidelines are the following:¹⁵⁶

- Service Providers may share passive infrastructure in accordance with the existing provisions in the licenses of UASL.
- Active Infrastructure Sharing is permitted in relation to antennas, feeder cables, node Bs, and RAN and transmission systems.
- Sharing of allocated spectrum is not permitted.

The guidelines also introduce financial incentives for infrastructure sharing: in urban areas, state governments have to charge the same amount for setting up shared towers (irrespective of the number of service providers sharing) as for unshared towers. In rural areas, subsidies are provided for Service Providers or Infrastructure Providers who set up sites (towers) for sharing.

A.7.4 Infrastructure Sharing Projects

Due to a favourable regulatory environment, which allowed private companies to offer passive infrastructure for sharing on commercial terms as early as 2000, India has successfully seen many projects that involved the sharing of passive infrastructure such as towers and fibre networks.

Tower companies:

With 365,000 towers in 2012 and a tenancy ratio of 2.4 (meaning on average each tower hosts the equipment of 2.4 operators) India hosts one of the world's largest tower sharing markets. Since the policy change initiated by the TRAI in 2007, there has been an increased number in sharing agreements.¹⁵⁷

- Merging their tower assets in 2007, India's three leading MNOs, Bharti Airtel, Vodafone and Idea Cellular, formed a joint venture to create an independent tower company. Indus Tower offers its portfolio of over 100,000 shared towers on a non-discriminatory basis to other telecom operators.¹⁵⁸
- After the separation of the tower assets owned by Reliance Communications in 2007, Reliance Infratel operates as an independent tower company with a portfolio of over 50,000 towers. The company holds an IP-I license and is the only tower company in India not created through mergers and acquisitions.¹⁵⁹

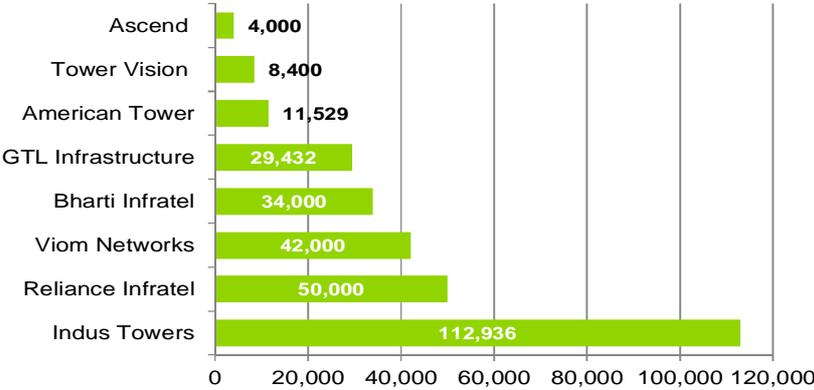
¹⁵⁶ <http://pib.nic.in/newsite/erelease.aspx?relid=37053>

¹⁵⁷ The Rise of the Tower Business – AT Kearney

¹⁵⁸ India – Telecommunications Infrastructure and Forecasts 2014, Buddecom Reports

¹⁵⁹ http://www.rcom.co.in/Rcom/aboutus/overview/overview_infra.html

Figure 45: Estimated number of towers managed by tower companies in India, 2014



Source: Towerxchange

Fibre optic business:

It is also common practice among India’s operators to lease capacity on other operators’ fibre backbones:

- In 2004 VSNL (now Tata) paid Bharti Group INR5bn to lease around 100,000km of its long distance fibre backbone for an estimated period of 15 years.¹⁶⁰
- As part of a series of sharing agreements and its efforts to rollout a 4G network, the operator RelianceJioInfocomm signed a deal with Reliance Communications in April 2014 allowing it to lease optical fibre cable within major cities.¹⁶¹
- State-enterprises such as the Indian Railways, the Gas Authority of India and India’s electricity provider PowerGrid lease capacity on their fibre networks which they have rolled out along their rail tracks, pipelines and electricity networks to telecom operators.

Government-led:

- In 2012, the government announced plans to provide rural areas with high-speed broadband by rolling out 500,000km of fibre, which upon completion would be shared under an open-access model with other telecom operators. For the establishment and the management of the National Optical Fibre Network (NOFN), the government set up Bharat Broadband Network Limited as a Special Purpose Vehicle (SPV).¹⁶²

When completed, the NOFN will connect all of India’s 250,000 gram panchayats (self-administered units at the village level) which are currently underserved by the existing fibre backbone. This will be achieved by sharing existing fibre infrastructure of private sector undertakings (PSU) such as BSNL, Raitel and Power Grid and by deploying additional fibre, where necessary.

¹⁶⁰ India – Telecommunications Infrastructure and Forecasts 2014, Buddecom Reports
¹⁶¹ Ibid
¹⁶² <http://www.bbnl.nic.in/content/page/national-optical-fibre-networknofn.php>

A.8 Indonesia¹⁶³

A.8.1 Market Summary

Indonesia is one of the largest telecommunication markets in the world having surpassed the 300m mobile subscription mark in 2014. Additional statistics on the market can be found in Table 17.

Table 17: Indonesia Market Statistics, 2014

		Penetration (as a % of population)
Population	251.3m	
Mobile Subscriptions (SIM cards)	314.9m	125%
Internet Users	53.9m	21%
Broadband Subscriptions, mobile	85m	34%
Broadband Subscriptions, fixed	5.5m	2.2%
International Submarine Cables	5	

Source: Budde Report Indonesia, GSMA

Table 18: Indonesia Market Players, 2014

Mobile Operators	6	Telkomsel XL (Axiata) Indosat (Ooredoo) 3 (Hutchison) Smartfren Ceria
Fixed Operators	3+	Including: PT Telkom PT Indosat PT Bakrie Telecom
ISPs	150+	Including: Indonesia Online Access IndosatNet Telkom Net Wasantara Net

Source: Budde Report Indonesia

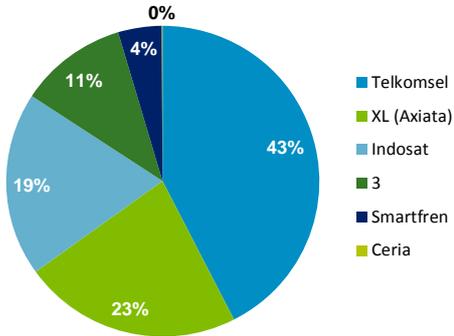
The fixed-line market in Indonesia has three major operators. The incumbent PT Telkom held almost 70% of the market share in 2012. Although partially privatised in the 1990s, the government still retains shares in both PT Telkom (over 50%) and PT Indosat.

Due to increasing mobile penetration, demand for fixed-line telephone services has been declining. Fixed operators such as PT Telkom are now increasingly focusing on broadband services as an alternative source of revenue.

The mobile telecommunications market has 6 MNOs and Telkomsel, with a 43% market share, is the largest player, followed by Axiata and Indosat. The number of subscriptions grew by around 10% in 2013 and, as smartphones are becoming more wide-spread, demand for mobile broadband is also growing rapidly. After having been delayed four times, an auction in 2013 released more 3G spectrum for mobile broadband.

¹⁶³ Unless noted otherwise: Indonesia – Telecoms, Mobile, Broadband and Forecasts 2013, Buddecom Report

Figure 46: Indonesia Mobile Market Shares, 2014



Source: GSMA

A.8.2 Fibre Infrastructure

With over 900 inhabited islands spread over a vast area, Indonesia’s efforts in rolling out a national fibre backbone are affected by complex geographical challenges. Besides terrestrial fibre cables, the national backbone network also relies on submarine cables connecting the islands. Until recently, infrastructure development has mainly focused on the Western provinces.

Palapa Ring Project:

- A PPP between the government and three telcos (PT Telkom, PT Indosat and PT Bakre Telecom), this project involves six fibre rings connecting 33 of Indonesia’s 34 provinces. The main focus is to provide Indonesia’s eastern parts with access to telecommunications. So far, one of the rings (Nusa Tenggara) has been completed. Another ring is currently in the tendering process.

Public Sector Networks:

- PT Telkom’s Jasuka Project, initiated in 2005, saw the development of the first three of Telkom’s plan of eight fibre rings, connecting Sumatra, Java, Kalimantan and Sulawesi.

Private Sector Networks:

- Power Telecom, a provider of dark fibre infrastructure in Indonesia, has rolled out a network on the island of Java (population: 170m) connecting Bandung, Greater Jakarta and Surabaya. Power Telecom has leasing agreements for its backbone capacity with several operators.
- NTT Indonesia, a subsidiary of Japan’s NTT Com, became the first foreign carrier in 2011 to operate its own fibre network in Indonesia, focusing largely on industrial parks in Jakarta.¹⁶⁴

International Terrestrial Fibre Links:

Since Indonesia is a nation consisting of islands, it does not have any international terrestrial fibre links. Its international connection relies solely on submarine cables. Indonesia’s main connections are with Australia, Singapore, Thailand, Japan and Western Europe (SEA-ME-WE 4 cable).

¹⁶⁴http://www.ntt.com/aboutus_e/news/data/20120305.html

A.8.3 Infrastructure Sharing Regulations¹⁶⁵

In Indonesia, the sharing of passive infrastructure, in particular the joint usage of towers, is permitted and encouraged by the regulator. In 2008, the Minister of Communication and Information Technology issued a “Guide for the Construction and Usage of Joint Tower of Telecommunication”, whereby it suggests an open access principle for shared networks.

Furthermore, the guidelines attempt to protect competition by enforcing a “legal provision regarding the prohibition of monopoly practice and unhealthy business competition. “Hence, tower operators must provide transparent information on the availability of the capacity of their towers to potential tenants and tenancies must be awarded on a first come first serve basis.

The sharing of active network infrastructure and particularly RAN sharing is currently not permitted in Indonesia. As a result there are also no MVNOs operating in the country.¹⁶⁶

A.8.4 Infrastructure Sharing Projects

Tower companies:

- One of the major tower companies, Protelindo, acquired some 3,630 towers from MNO Hutchison in 2009. Protelindo currently owns and operates over 10,000 towers in Indonesia.¹⁶⁷
- In 2012, Indonesia’s second major tower company, PT Tower Bersama Infrastructure, signed a sale-and-leaseback deal with telecom provider Indosat involving 2,500 towers. Indosat entered a lease agreement for a period of at least 10 years.¹⁶⁸

Public Private Partnership (PPP):

Indonesia’s largest infrastructure sharing project up to date, the Palapa Ring Project, started out as a consortium of 9 operators in 2005 and is still under construction:¹⁶⁹

- **Objectives:** The project was part of the government’s plan to increase telecommunication penetration, especially in rural areas and Eastern Indonesia, where infrastructure remained underdeveloped.
- **Plan:** Once completed, the network is to provide internet services to over 40,000 villages, connecting 33 out of 34 provinces with an estimated 35,280km of submarine and 21,807km of terrestrial fibre optic cable. The project involves the construction of six interconnected fibre optic rings on the main island groups – Sumatra, Java, Kalimantan, Bali and Nusa Tenggara, Sulawesi and Papua. The rings and their distance are listed in Table 19 below.
- **Commercial Developments:** By 2009, almost all companies except for PT Telkom, PT Indosat and PT Bakrie Telekom had pulled out of the project, forcing the government to fund the project with the use of funds from the USO.

¹⁶⁵ Source unless noted otherwise: “Guide for the Construction and Usage of Joint Tower of Telecommunication”, Decree No. 2/2008

¹⁶⁶ <http://www.towerxchange.com/an-introduction-to-the-thriving-tower-industry-in-indonesia/>

¹⁶⁷ AT Kearney – The rise of the tower business

¹⁶⁸ http://www.tower-bersama.com/investor.php?id_cat=5&id_content=18&id_sub=25

¹⁶⁹ Indonesia – Key Statistics, Telecommunications Market, infrastructure, Regulatory Overview 2014, Buddecom Reports

- **Construction Developments:** Phase I was completed in 2013 (Bali and Nusa Tenggara Ring involving over 1,000km of fibre). Phase II (over 5,600km connecting the Eastern provinces of Manado and Papua) is currently in the tendering process and expected to be completed in two years.

Table 19: Palapa Ring Project – specification of rings

No.	Name of Ring	Distance
1	Sumatra	6,891km
2	Java	8,178km
3	Kalimantan	4,293km
4	Sulawesi	5,422km
5	Bali and Nusa Tenggara	1,490km
6	Manado – Papua	5,693km

Source: BuddeCom based on industry data

A.9 Thailand

A.9.1 Market Summary

Compared to the rest of South East Asia, Thailand's mobile broadband penetration rate of 79% is very high and demand for both fixed and mobile broadband services is also rising. Further statistics on the Thai telecommunications market and its market players can be found in Table 20 and Table 21 below.

Table 20: Thailand Market Statistics, 2014

		Penetration (as a % of population)
Population	67.1m	
Mobile Subscriptions (SIM cards)	92.7m	138%
Broadband Subscriptions, mobile	53.5m	79%
Broadband Subscriptions, fixed	4.9m	7.4%
International Submarine Cables	11	

Source: Budde Report Thailand 2013, GSMA and World Bank

Table 21: Thailand Market Players, 2014

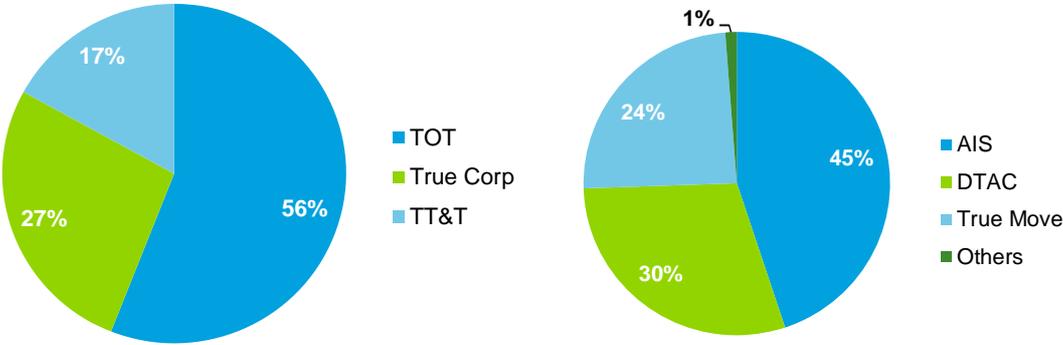
Mobile Operators	6	AIS DTAC (Telenor) My (CAT Telecom) TOT True Move WE PCT
Fixed Operators	3	TOT Corp (state-owned) True Corp TT&T
ISPs	20	Including: CAT Telecom Public Jasmine Internet KSC Commercial Internet

Source: Budde Report Thailand 2013

Besides the state-owned operator TOT, Thailand's domestic fixed-line market has two more operators, True Corporation and TT&T. TOT has coverage for both the Bangkok Metropolitan Area (BMA) and the provinces. True Corp's market is only in the BMA and TT&T is providing services to all other areas.

Traditionally, international telephone services have been divided between two state-owned operators, TOT for all calls to neighbouring countries and CAT for all other international calls.¹⁷⁰

Figure 47: Thailand Fixed-line Market Shares, 2013 **Figure 48: Thailand Mobile Market Shares, 2014**



Source: Budde Report Thailand 2013 Source: GSMA

There are 6 MNOs in the Thai mobile market and the three largest operators are AIS, DTAC and True Move. In December 2012, the first 3G licenses were awarded to the three leading MNOs. As a result from Q2 in 2013 to Q2 in 2014 3G connections more than tripled from 15m to 53.5m.¹⁷¹

A.9.2 Fixed Infrastructure

The deployment of fibre infrastructure in Thailand was initially led by state-owned operators TOT and CAT. Recognising the benefits of private sector investment, however, the regulator has devised a system that seeks to promote private investment: Private companies that are interested in rolling out infrastructure are given concessions by CAT and TOT and can enter Build-Transfer-Operate (BTO) agreements. Under these agreements, private companies have to transfer the ownership of their infrastructure to CAT/TOT upon completion. In return, they were given 25-30 years of exclusive operation of these networks.¹⁷²

While the concession system ended with the state monopoly of TOT and CAT in 2001, the law still upheld the legitimacy of the existing BTO concessions. Many of these concessions are to run out in the coming years.

A.9.3 Infrastructure Sharing Regulations

In 2009, the National Telecommunications Commission (now NBTC) published "Criteria and Procedures for Exercising Rights-of-way in Erecting Poles, Laying Ducts or Cables and Installing any Accessories for Providing Telecommunication Services". This document gave all telecom licensees the right to access any poles and ducts of public utility providers in order to deploy their fibre infrastructure. The utility provider is to charge an appropriate fee for the usage of their infrastructure and may restrict access on grounds of lack of capacity, safety standards or technical difficulties.¹⁷³

In 2013 the Thai regulator passed regulations on infrastructure. According to market analysts, the regulations require infrastructure owners, essentially TOT and CAT, to make their mobile towers and fibre optic networks

¹⁷⁰ Thailand – Major Telecom Operators 2013, Buddecom Reports
¹⁷¹ GSMA
¹⁷² "Telecom Regulatory and Policy Environment in Thailand", Thailand Development Institute
¹⁷³ World Bank Thailand MICT Broadband Study

available to other operators for sharing.¹⁷⁴ If compliance is voluntary, owners of key infrastructure will be given preferential pricing on licence fees.

The regulations allow the sharing of mobile infrastructure in three categories: site sharing, tower/mast sharing and network sharing.¹⁷⁵ Owners of infrastructure shall charge reasonable and non-discriminatory fees for providing access to their sites, towers or networks and refusal can only be given in the case of lack of capacity or technical difficulties.

A.9.4 Infrastructure Sharing Projects

Tower companies:

- In 2014, True Corporation has set up Thailand's first national tower company, the True Growth Infrastructure Fund (TRUEGIF). The operator is planning to transfer its tower assets (around 6,000 existing and planned) to the tower company over the course of the next two years.¹⁷⁶

A.10 Philippines

A.10.1 Market Summary¹⁷⁷

While mobile subscriptions continue to increase, demand for broadband services has also been rising rapidly. Mobile broadband penetration was at 38% in 2014 and operators continue to invest in the expansion of network access. Statistics of the Filipino telecommunications market can be found in Table 22 and an overview of the market players is provided in Table 23.

Table 22: Philippines Market Statistics, 2014

		Penetration (as a % of the population)
Population	99.2m	
Mobile Subscriptions (SIM cards)	109.3m	110%
Broadband Subscriptions, mobile	38m	38%
Broadband Subscriptions, fixed	2.6m	2.6%
International Submarine Cables	>10 landing points	

Source: Budde Report Philippines, GSMA, World Bank

Table 23: Philippines Market Players, 2014

Mobile Operators	6	Smart (PDLT) Globe Telecom Express Telecom ABS-CBN Convergence Next Mobile Wi-tribe
Fixed Operators	10	Including: PLDT Bayantel Digitel

Source: Budde Report Philippines 2014

¹⁷⁴ <http://www.telecompaper.com/news/nbtc-introduces-draft-regulation-on-infrastructure-sharing--873048>

¹⁷⁵ "Infrastructure Sharing in Thailand: Challenges and the Way Forward." Pratompong Srinuan, NBTC Thailand, ITU Conference on Infrastructure Sharing Models and Practices.

¹⁷⁶ <http://www.towerxchange.com/introduction-to-the-southern-and-south-east-asian-telecom-tower-industry/>

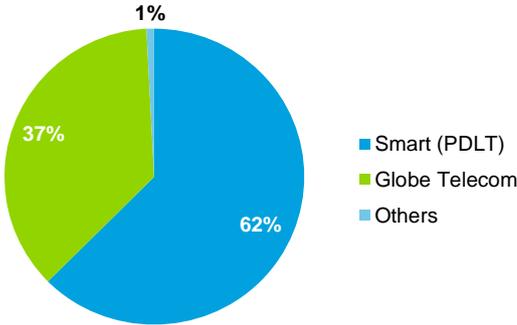
¹⁷⁷ Source unless noted otherwise: The Philippines –Key Statistics, Telecommunications Market, Infrastructure and Forecasts 2014, BuddeCom Reports

There are 10 fixed operators in the Philippines fixed-line market, including Globe Telecom as the second national operator. With a market share of 56% in 2012, the national operator PLDT (Philippines Long Distance Telecom) is the largest player in the market.

All operators contributed to an early effort by the government to expand fixed-tele-density. With 7m lines rolled out, the target was exceeded, however, due to lack of the demand by 2011 only about 3m of them were operational.

The mobile telecommunications market in the Philippines currently has 6 MNOs, but the two operators Smart and Globe Telecom control nearly the whole market.

Figure 49: The Philippines Mobile Market Shares, 2014



Source: BuddeCom based on industry data

A.10.2 Fixed Infrastructure

While several mobile operators have rolled out their own fibre backbone, in the Philippines the national fibre backbone is mainly made up of two competing networks, the Domestic Fibre Optic Network (DFON) and the National Digital Transmission Network (NDTN).

Public Sector Networks:

- The Domestic Fibre Optic Network (DFON) is owned by the national carrier PLDT. In 2013, the company announced to expand its network by 5,000km, which would increase its total fibre deployment to 60,000km.

Private Sector Networks:

- The National Digital Transmission Network (NDTN) is a fibre optical network rolled out and operated by Telecphil (Telecoms Infrastructure Corporation of the Philippines), a consortium of PLDT’s competitors led by Bayantel. The network is used by its various co-owners to lease fibre capacity.
- Bayantel, PT&T and Globe Telecom also operate their own nation-wide backbone networks but without sharing their capacity.

International Terrestrial Fibre Links:

As a nation of islands, the Philippines do not have any international terrestrial fibre links to neighbouring countries, but instead, have landing stations of over ten international submarine cables.

A.10.3 Infrastructure Sharing Projects

Network Sharing

In 2013, the regulator NTC (National Telecommunications Commission) approved a network sharing agreement between ABS-CBN Corp and Globe Telecom, which represented a significant regulatory development:

- ABS-CBN announced that this deal was part of its intended effort to become the country's third player in the telecom market.
- The deal involved the purchase of capacity from Globe Telecom under a five-year agreement.
- NTC required both companies to comply with levels of quality of service and performance standards.¹⁷⁸

Infrastructure Companies

Although confined to the Greater Manila area, there are some examples of infrastructure companies offering fibre for operators to lease:

- A company called Radius has 2,500 km of fibre deployed across 86 municipalities in the Greater Manila area, which it leases to ISPs and telecommunications operators.¹⁷⁹

Tower Companies

- With only two possible anchor tenants, there are no independent tower companies in the Philippines yet. Neither Smart (PLDT) nor Globe Telecom have outsourced any of their tower assets.¹⁸⁰

¹⁷⁸ The Philippines – Telecoms, Mobile, Broadband and Forecasts 2014, Buddecom Reports

¹⁷⁹ <http://www.radius.net.ph/about-radius/>

¹⁸⁰ <http://www.towerxchange.com/an-introduction-to-the-thriving-tower-industry-in-indonesia>

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