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## Unlocking broadband for all.

Broadband infrastructure sharing policies  
and strategies in emerging markets

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# Contents

Executive Summary ..... 2

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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:

<b>Better connectivity</b>	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.
<b>Cost savings</b>	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.
<b>Revenue generation</b>	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.
<b>Competition</b>	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**

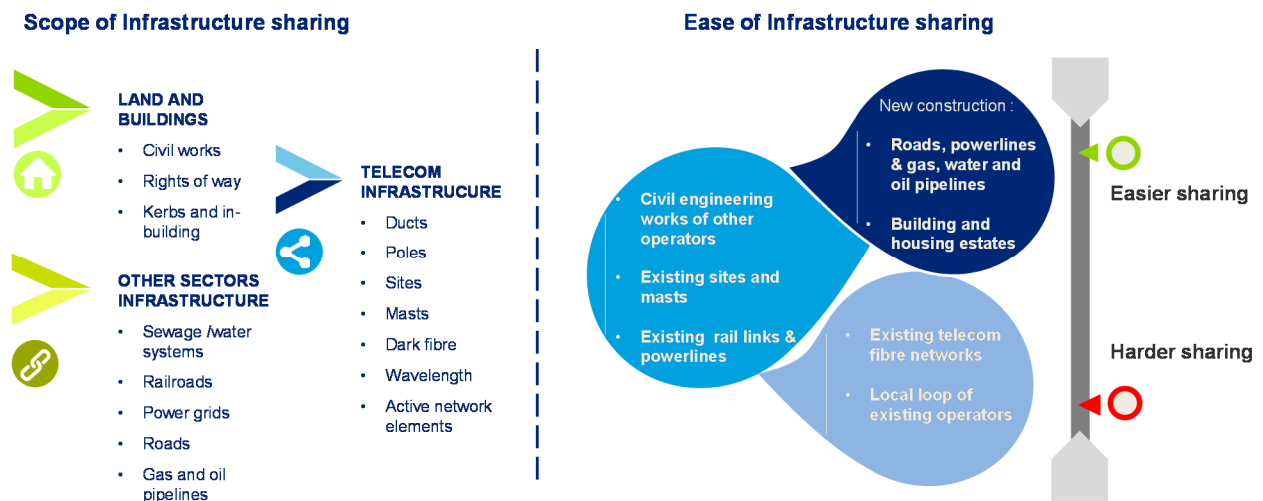
Infrastructure sharing does not just benefit operators - the public also benefits from reduced access costs that may result from more competitive and lower cost networks. Sharing can also reduce public infrastructure expenditure and create positive environmental impacts, as well as minimising disruption 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
<b>Government involvement</b>					
<b>Risk sharing</b>	Operators	Private investors	Private investors	Public sector	Development banks, governments, investors
<b>Access</b>	Operators of the joint venture	Wholesale basis	Wholesale basis	Open Access	Wholesale basis
<b>Ownership</b>	Operators	Private investors	Private investors, operators	Public	Operators, governments and private investors
<b>Fibre</b>					
<b>Mobile/Wireless</b>					
<b>Funding</b>	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
<b>Lack of coordination across different sectors regulation</b>	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.
<b>Lack of broader strategic telecoms plans</b>	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.
<b>Lack of stability in licensing environment</b>	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
<b>Lack of funding</b>	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.
<b>Lack of spectrum/high spectrum fees</b>	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.

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