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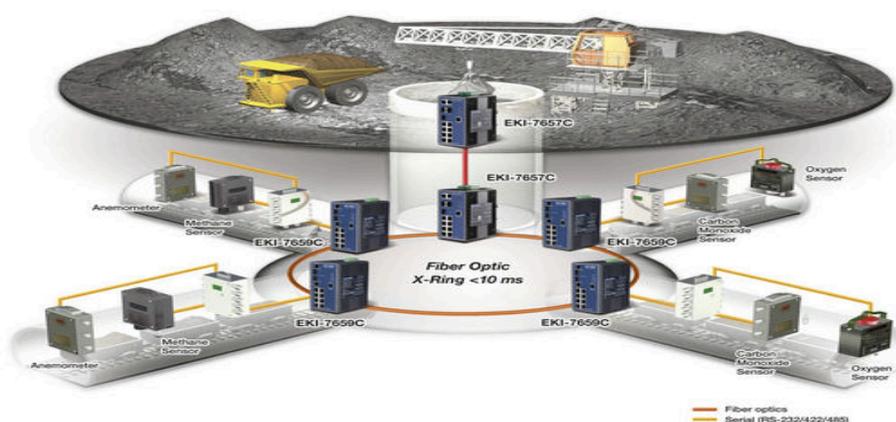


## CCSI Policy Paper

Perrine Toledano and Clara Roorda \*\*  
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### Key Points

- 1 Access to broadband infrastructure is fundamental to lift developing countries out of poverty and an estimated 1.1 billion households are still unconnected to the Internet.
- 2 Mining companies are increasingly installing fiber optic networks along their grids, railroad tracks and pipelines to improve monitoring of their infrastructure and ensure greater reliability and safety.
- 3 If mining-related Internet and Telecommunications (ICT) investments are designed to contribute to the development of public infrastructure, the incremental capital cost of building additional ICT capacity to extend the networks to nearby communities will generally be lower than the cost of building a new network from scratch; and the economic and social spillover effects can extend far beyond the mine.
- 4 Several barriers hindering shared use of mining – related ICT infrastructure could be levied by better planning and coordination between mines, telecommunications companies and the government as well as more forward- looking regulations governing the ICT sector.



## Leveraging Mining Demand for Internet and Telecommunications Infrastructure for Broad Economic Development: Models, Opportunities and Challenges

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\* Authors : Perrine Toledano is CCSI's Head of Extractive Industries and Clara Roorda is intern at CCSI.

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## 1. Background

Over the last few decades, the use of Information and Communications Technologies (ICT) has changed dramatically, becoming an integral part of people's personal and business lives. Its importance reverberates throughout the economy and it is crucial to many sectors such as education, health, transportation, energy and finance. Nonetheless, access to broadband<sup>1</sup> remains the great infrastructure challenge of the early 21st century:

*"...like electricity a century ago, broadband is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entire new industries and unlocking vast new possibilities for existing ones. It is changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge."*<sup>2</sup>

An estimated 1.1 billion households are still unconnected to the Internet, (let alone high-speed Internet), mainly in developing countries.<sup>3</sup> In addition to a deficient access, developing countries are also impacted by high costs. Residential fixed-broadband services,<sup>4</sup> for example, account for approximately 30% of average Gross National Income per capita. In more developed countries, this percentage drops to just 1.7%.<sup>5</sup>

Access to broadband infrastructure is fundamental to lift developing countries out of poverty. A World Bank study recently estimated that a 10% increase in high-speed Internet connections is associated with a 1.3% increase in economic growth in developing countries whereas a 10% increase in mobile phone subscribers is associated with an increased economic growth of only 0.8%.<sup>6</sup>

### **ICT use by the mining industry**

As broadband access is fundamental for economic development, it is also increasingly important for mining operations.

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<sup>1</sup> The term "broadband" is understood as a connection to the Internet with speed faster than dial-up. From a policy perspective, however, broadband is not only about speed or functionality, but also about being an enabling ICT platform.

<sup>2</sup> Federal Communications Commission, "National Broadband Plan: Connecting America,"(2010), available at: <http://www.broadband.gov/download-plan/>

<sup>3</sup> International Telecommunications Union (ITU), "ITU releases latest global technology development figures," (February 27, 2013), available at: [http://www.itu.int/net/pressoffice/press\\_releases/2013/05.aspx#.UtOnev0RzII](http://www.itu.int/net/pressoffice/press_releases/2013/05.aspx#.UtOnev0RzII)

<sup>4</sup> The term "fixed broadband" refers to a fixed line with transmission capacity of sufficient bandwidth to permit combined provision of voice, data, and video, with no lower limit. The opposite concept is wireless.

<sup>5</sup> World Bank Information and Communication Technologies for Development webpage (updated in March 2014) , available at:

<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22562063~pagePK:64257043~piPK:437376~theSitePK:4607,00.html>

<sup>6</sup> World Bank, "Transformation - Ready: Using ICT to Fast-Track Africa's Development Path," (2009), available at: [http://siteresources.worldbank.org/INFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/WorldBank ICT\\_brochure.pdf](http://siteresources.worldbank.org/INFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/WorldBank ICT_brochure.pdf)

Overall, ICT is employed in all phases of a mine's life: from exploration to closure and remediation. ICT's major contribution to the mining industry is the optimization of the exploitation of mineral resources through better logistics allowing virtual operations, ore grade use optimization and better exploration analyses.<sup>7</sup> At Oceana Golds Fraser mine in Macraes, New Zealand for example, the company is investing NZD\$400,000 to install fiber-optic cables expecting a 10% increase in output.<sup>8</sup> Instantaneous access to video, voice and data communications provides the mining company with the ability to use materials and human resources more efficiently. As a result, waste and delays are reduced and logistical coordination is strengthened. It also helps mitigate security risks and improve the safety of employees.<sup>9</sup>

Throughout the process, ICT infrastructure increases efficiency and improves cost savings for the mining company. For the government, the opportunity is to leverage those investments to maximize welfare gains to the population through expanded access to ICT infrastructure and in particular to broadband. Both cost savings and welfare gains can be realized simultaneously if sound regulations and efficient coordination mechanisms are in place. If mining-related ICT investments are leveraged and designed to contribute to the development of public infrastructure at the national, regional or community levels, the incremental capital cost of building additional ICT capacity and extending to nearby communities will generally be lower than the cost of building a new network from scratch, and the economic and social spillover effects can extend far beyond the mine.

## 2. Technological Context and Research Questions

### **Backbone vs. Last Mile infrastructure**

An important concept for ICT infrastructure is the difference between backbone and last mile, both of which use the types of technology described in 2.2.

Backbone: Backbone infrastructure refers to the connection of the major nodes of a network.<sup>10</sup> It can be established by two types of operators. The first type is a "pure infrastructure provider" (meaning, one who builds and leases the backbone, not providing other sorts of telecomm service); the second type is an "infrastructure and service provider," who besides building and leasing the backbone, also uses it to

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<sup>7</sup> Megan Wait, "Use of satellite-based communications in mining sector escalating," *Mining Weekly* (October 22, 2010), available at: <http://www.miningweekly.com/article/satellite-based-communication-saves-money-global-vs-at-forum-2010-10-08>

<sup>8</sup> Sally Rae, "Fibre-optic project could raise mine output 10%," *Otago Daily Times* (July 12, 2012), available at: <http://www.odt.co.nz/news/business/216747/fibre-optic-project-could-raise-mine-output-10>

<sup>9</sup> Wait, "Use of satellite-based communications in mining sector escalating," op. cit.

<sup>10</sup> Tim Kelly and Carlo Maria Rossotto, eds. *Broadband strategies handbook*, World Bank Publications (2011)

provide retail telecommunications services in the market.<sup>11</sup> The type adopted by a telecommunications company (TelCo) is dependent on the level of unbundling reform in the country and on the incentives provided by the government to the private sector to invest in infrastructure, in particular, in remote areas. Due to the large economies of scale, the high up-front cost associated with the backbone infrastructure, as well as the low demand in remote areas, the economics of the broadband technology will often lead to a single operator.<sup>12</sup>

Last Mile: The “last mile” is “the final leg of delivering connectivity from a communications provider to a customer.”<sup>13</sup> This leg, however, can be more than a mile, especially in remote areas. In those regions, last-mile infrastructure can represent a challenge because the cost of providing the service can be very high and the demand too small to justify an investment from a private TelCo.

### **Different technologies**

There are four key technologies that are discussed in this paper.

Fiber Optic: A fiber optic cable has the benefit of providing very large bandwidth at very high transmission speeds. Fiber optic, nonetheless, is expensive. Installing networks requires a large initial investment, due mainly to excavation costs and highly specialized and expensive tools. Importantly, however, the individual fibers do not all have to be used when installed, “dark fiber” can be activated as demand grows.<sup>14</sup>

Satellite: Satellite technology is able to cover a large geographic area at a relatively low and fixed cost. It is, therefore, particularly attractive for providing connectivity in remote areas where the cost of terrestrial solutions can be very high. Nonetheless, they may also have less transmission capacity than other options such as fiber optic cables.

Microwave: Microwave system is normally used to carry signals over relatively short distances (generally 40–70km).<sup>15</sup> Microwave systems used to be an important provider of backbone connectivity, but with the decrease in price and the development of fiber optic, they are increasingly being replaced.

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<sup>11</sup> Harsha Vardhana Singh, “Asian Backbone Study: A General Model Applied to India,” WDR Dialogue Theme 3rd cycle Discussion Paper WDR0612, The World Dialogue on Regulations for Network Economies (2006), available at: <http://www.lirneasia.net/wp-content/uploads/2006/06/Asian%20Backbone%20study%201.7.pdf>

<sup>12</sup> Raul Katz, “Impact of Broadband on the Economy: Research to Date and Policy Issues,” International Telecommunications Union (ITU), Telecommunications Development Sector Report (2012), available at: [http://www.itu.int/ITU-D/treg/broadband/ITU-BB-Reports\\_Impact-of-Broadband-on-the-Economy.pdf](http://www.itu.int/ITU-D/treg/broadband/ITU-BB-Reports_Impact-of-Broadband-on-the-Economy.pdf)

<sup>13</sup> West Virginia Broadband, Broadband Glossary, available at: <http://www.westvirginia.com/broadband/mediaroom/BroadbandGlossary.pdf>

<sup>14</sup> Kelly and Rossotto, *Broadband strategies handbook*, op. cit.

<sup>15</sup> Kelly and Rossotto, *Broadband strategies handbook*, op. cit.

Copper: Copper wire offers less capacity and slower transmission speeds than fiber optic but it may be sufficient for low-traffic routes, especially in remote areas where most mines are located<sup>16</sup>.

The choice between these technologies is not straightforward and depends on a series of variables such as distance to be covered, capacity requirements, topography, regulatory environment, and market size. Table 1 and Box 1 illustrate how the optimal choice can change depending on the distance and the capacity required.

**Optimum Choice of Backbone Technology, by Distance and Capacity<sup>17</sup>**

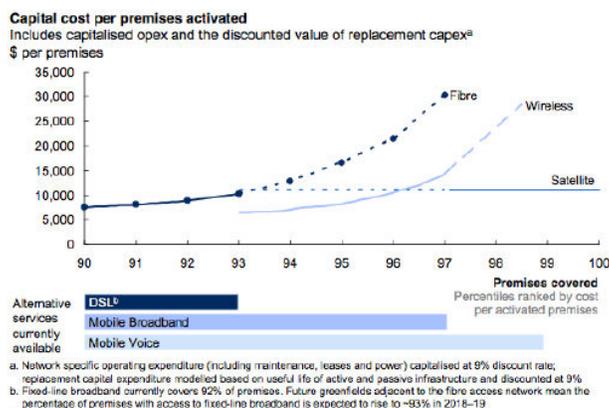
Distance (km)	Capacity (Mbit/s)		
	< 8	8–450	>450
<100	Satellite, microwave	Microwave	Fiber optic
> 100	Satellite	Microwave, fiber optic	Fiber optic

In the National Broadband Network (NBN) project in Australia, for example, the government opted to connect 93% of the population with fiber optic cables, while the most remote regions will be covered by fixed-wireless and satellite solutions (see Box 1).

**Box 1: Australia - National Broadband Network (NBN)**

The NBN is an initiative of the Australian government to provide the population access to high-speed broadband Internet. NBN will replace older copper networks owned by Telstra, with more modern technologies such as fiber optic cables to connect 93% of the population. Where fiber optic cable is not feasible (the remaining 7% of the population), NBN will use fixed-wireless and satellite solutions.

**Cost comparison of alternate technologies in the final 10%**



Source: Australian Government, Department of Broadband, Communications and the Digital Economy (2010)<sup>18</sup>

<sup>16</sup> Kelly and Rossotto, *Broadband strategies handbook*, op. cit.

<sup>17</sup> Mark DJ Williams, *Broadband for Africa: Developing Backbone Communications Networks*, World Bank Publications (2010)

NBN Co will sell wholesale services to Internet and telephone providers, who will then offer retail services to consumers. The wholesale access price will be the same across all three technologies. Overall, the NBN Co.'s business plan forecasts an approximate return on investment of 7%, but profit is not the main driving force for the project. It is the social and equity concern that mainly justifies government participation.<sup>19</sup>

### **Research questions and summary of issues**

A survey of existing institutional arrangements for broadband service options for mining companies shows the existence of several common barriers that hinder the incidence of mutually beneficial coordination between mines, TelCo and the government:

1. Lack of adequate and forward-looking regulations facilitating economies of scope between infrastructure and licensing for non-carriers;
2. Lack of perception by the mining companies of the benefits (indirect impacts) of adding telecommunications capacity and helping expand services to nearby communities;
3. Lack of coordination between TelCos, mining companies and the government;
4. Insufficient financial incentives to connect communities.

The rest of the Policy Paper will highlight situations where those barriers have been lifted, *differentiating between the two following cases*:

- *Mines build their own broadband network (Situation One),*
- *Mines do not build the infrastructure (Situation Two)*

Finally, Section 4 discusses the regulatory actions that governments should consider in order to facilitate the sharing of ICT infrastructure discussed in Section 3.

## **3. Different Situations, Opportunities and Synergies**

### **Situation One: Mines build their own ICT infrastructure**

Where the ICT services do not exist or are insufficient, mining companies may opt to construct their own infrastructure. In this case there are 2 opportunities with respect to leveraging this infrastructure.

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<sup>18</sup> Australian Government, Department of Broadband, Communications and the Digital Economy, "National Broadband Network Implementation Study," (2010), available at: [http://www.archive.dbcde.gov.au/2013/september/national\\_broadband\\_network/national\\_broadband\\_network\\_implementation\\_study](http://www.archive.dbcde.gov.au/2013/september/national_broadband_network/national_broadband_network_implementation_study)

<sup>19</sup> NBN Co, "Corporate Plan 2011-2013," (December 17, 2010), available at: <http://www.nbnco.com.au/assets/documents/nbn-co-3-year-gbe-corporate-plan-final-17-dec-10.pdf>

## OPPORTUNITY 1: Mines build infrastructure and TelCos add capacity

Using mining companies' infrastructure to add ICT capacity can provide tremendous cost savings for TelCos. Mining companies are increasingly installing fiber optic networks along their grids, railroad tracks and pipeline to improve monitoring of their infrastructure and ensure greater reliability and safety. This makes it economical for TelCos to add telecommunications capacity to this infrastructure given that the mining company pays for the most costly step, the installation (according to a study by the OECD, civil works account for approximately 68% of the first year costs when building a fiber network ).<sup>20</sup> An example in Peru illustrates this situation (see Box 2). In this case, the government should adopt regulations that facilitate TelCos' access to mining infrastructure (see Section 4).

### **Box 2: Peru – Partnering with a TelCo to use mine's fiber optic network and provide telecommunications services at lower cost:**

Part of the infrastructure built by Compañía Minera Antamina in Peru was a 304km copper and zinc concentrate slurry pipeline system to transport the commodities from the mine site, to terminal facilities at Huarney<sup>21</sup>. Parallel to it, the company built a US\$ 2 million fiber optic network to carry information about the pipeline detecting disturbances and avoiding damage.<sup>22</sup>

The fiber optic also makes it easier and cheaper for Telefonía del Perú to service the Huaylas and Conchucos areas with telecommunications services.<sup>23</sup> In order to benefit from it, Telefonía and Antamina signed a partnership in 2011 to increase mobile and Internet coverage in the surrounding areas of the mines.<sup>24</sup>

Similarly, APLNG, a joint-venture between energy companies Origin, ConocoPhillips and Sinopec, established to supply gas from wells in central Queensland to a liquefied natural gas facility in the Port of Gladstone, has built its own private telecommunications network that covers 500km to support its operations. Recently it has decided to open this network to TelCos for them to improve mobile phone coverage in the region (see Box 13).<sup>25</sup>

<sup>20</sup> Mark DJ Williams, *Broadband for Africa: Developing Backbone Communications Networks*, op. cit.

<sup>21</sup> Ausenco, "Antamina Slurry Pipeline SCADA & Telecommunication Systems," available at:

<sup>22</sup> Antamina, "Sustainable report 2011," available at: [www.antamina.com/es/descarga.php?pid=891](http://www.antamina.com/es/descarga.php?pid=891)

<sup>23</sup> Info Mine - Antamina mine, available at: <http://www.infomine.com/minesite/minesite.asp?site=antamina>

<sup>24</sup> "Fondo Minero Antamina y Telefónica suscriben convenio," *CIO Perú*, (September 27, 2011), available at: <http://cioperu.pe/articulo/8204/fondo-minero-antamina-y-telefonica-suscriben-convenio/>

<sup>25</sup> Spandas Lui, "Govt launches consultation for APLNG carrier licence exemption," *ZD Net*, (July 1, 2013), available at: <http://www.zdnet.com/au/govt-launches-consultation-for-aplng-carrier-licence-exemption-7000017510/>

## OPPORTUNITY 2: Mines build extra capacity and lease to TelCos

Mining companies can also add telecommunications capacity to their own ICT infrastructure and lease the additional capacity to a TelCo. This can create another source of revenue and sometimes avenues for diversification (see Box 3).

### **Box 3: Brazil - Vale do Rio Doce interested in leasing dark fiber capacity**

In 2001, Companhia Vale do Rio Doce, a Brazilian mining company, and its railroad sector partners planned to create a new company, RailCom to take advantage of a significant business opportunity in offering telecommunications infrastructure. The goal was to install dark fiber optic cables along 10,000km of rail lines, belonging to Vale and other partners, in the Southeast and Northeast of the country at an investment of US\$ 100 million, and lease it to TelCos. However expensive, Vale expected a financial return of US\$ 300 million in 5 years. The project however failed because of licensing uncertainty and lack of governmental and non-governmental financial partners.<sup>26</sup>

Similar examples are more numerous in the energy sector. For instance Williams Companies, an Oklahoma-based American energy company created a new venture by adding fiber optic along its natural gas pipelines.<sup>27</sup> GAIL, the Gas Authority of India Limited, is also engaged in the telecommunications market by leasing bandwidth from its fiber optic network available on its gas pipelines to TelCos.<sup>28</sup>

In most cases, extractive industry companies have opted to partner with TelCos instead of building a new venture. In Malaysia, Celcom, one of the main TelCos in the country and Petroliam Nasional Berhad (Petronas), Malaysia's national oil and gas company, have together built Celcom Petro Network. Realizing benefits for both companies, they installed a fiber optic network to address Petronas's telecommunications needs and lease the spare capacity to other companies. The system runs parallel with the national gas pipeline and includes almost 1,400km of extension (covering almost 90% of the country).<sup>29</sup>

Alternatively, some governments are considering requiring mining companies to add extra ICT capacity to their longitudinal infrastructure under concession agreements in

<sup>26</sup> Heloisa Magalhães, "Vale cria a RailCom e planeja investir até US\$ 100 milhões," website of the Ministério dos Transportes, Brazil (November 12, 2001), available at: <http://www.transportes.gov.br/noticia/conteudo/id/25574/module/default>

<sup>27</sup> Jane Tanner, "New Life for Old Railroads; What Better Place to Lay Miles of Fiber Optic Cable," *New York Times* (May 6, 2000), available at: <http://www.nytimes.com/2000/05/06/business/new-life-for-old-railroads-what-better-place-to-lay-miles-of-fiber-optic-cable.html>

<sup>28</sup> The Economic Times website, available at: [http://economictimes.indiatimes.com/gail-\(india\)-ltd/infocompanyhistory/companyid-4845.cms](http://economictimes.indiatimes.com/gail-(india)-ltd/infocompanyhistory/companyid-4845.cms)

<sup>29</sup> "CPN Optic Network Never Blinks," *Agilent Technologies* (January 7, 2002), available at: <http://literature.agilent.com/litweb/pdf/5988-3723EN.pdf>

order to facilitate and reduce the costs of future provision of telecommunications services (see Section 4).

### **Situation Two: Mines do not build infrastructure**

The involvement of mining companies in large-scale roll-out of ICT networks is not common, mostly because the investments required are usually large and the activity is out of the scope of the mining company's business. In this case the challenge is how to leverage the mine's demand as anchor demand to improve the ICT coverage in the area. Several options are available and described below.

#### **OPPORTUNITY 1: Mines attract significant demand and share costs of the infrastructure with TelCo**

In remote areas where most mines are located, the costs of installing the infrastructure may be substantial and the enterprise might not be viable for a TelCo when demand is not significant. In those situations, the mine can constitute an anchor demand for the TelCo with a guaranteed offtake. The mining company and the TelCo can enter into an agreement to cover the costs of building the infrastructure. In most cases, the cost will be split between both companies with the proportion depending on the potential additional market for the TelCo in the region. In this case, the government should adopt regulations that incorporate obligations to ensure that the infrastructure would also support nearby communities, such as coverage obligations (see Section 4).

#### **Box 4: Canada - Mining companies coordinate to attract a TelCo**

The three diamond mines in the Northwest Territories of Canada used satellite communications for their operations, which often resulted in delays and a limited amount of information transferred.<sup>30</sup> To improve the service, the companies then coordinated efforts to support Northwestel's (a TelCo service provider) project to install a series of microwave towers to link them to the telecommunications network in the south of the country.<sup>31</sup>

Northwestel signed a deal with the three diamond mines to share the cost of building the microwave towers and each tower has a radius of approximately 5km of service range which will be used to provide service to nearby communities. Despite sharing the cost, the infrastructure is owned by the TelCo.<sup>32</sup>

<sup>30</sup> Guy Quenneville, "A new Inuvialuit connection," *Northern News Service* (September 8, 2008), available at: [http://www.nnsi.com/frames/newspapers/2008-09/sep8\\_08net1.html](http://www.nnsi.com/frames/newspapers/2008-09/sep8_08net1.html)

<sup>31</sup> Gilles Rhéaume and Margaret Caron-Vuotari, "The Future of Mining in Canada's North," The Conference Board of Canada (2013), available at: <http://www.nodn.com/upload/documents/ecdev-net/4sector-based/mining/the-future-of-mining.pdf>

<sup>32</sup> Guy Quenneville, "A new Inuvialuit connection," op .cit

When the mine's demand proves to be insufficient, the government could help further alleviate some of the risks associated with the high up-front costs. It could, for example, increase the demand for telecommunications services by adding its own demand, coordinating demand from public administration, local schools, and health care facilities; or by subsidizing subscribers to reduce prices for the population.<sup>33</sup>

## **OPPORTUNITY 2: Companies build required infrastructure to serve the mines and add telecommunications capacity at a lower cost**

There is also an economic case for using the infrastructure of other companies serving the mines (e.g., power utilities, railways and pipelines among others) to add telecommunications capacity. Because a significant part of the costs of building a fiber network are related to civil works, leveraging the use of those other types of infrastructure could result in important savings for the companies and an additional source of revenue. In Africa, for example, both private and government utilities have employed their infrastructure to lease excess capacity or provide telecommunications services themselves (see Box 7).

### **Box 7: Africa – Leveraging national power utilities serving the mines**

Motraco, a joint venture company equally owned by three power utilities from South Africa, (Eskom), Swaziland (SEB), and Mozambique (EDM) was created to sell power to the Mozal aluminum smelter in Maputo, Mozambique. In order to improve the management of its network, the company installed fiber optic cables over the power line infrastructure. The capacity available, however, is much bigger than is required by the company and Motraco has been interested in leasing bandwidth to other operators.<sup>34</sup>

Another illustrative example is from Zambia where in 2002, CEC, an electrical utility in the Copperbelt Province installed fiber optic on its power lines to enhance the quality of its ICT infrastructure. The company had approximately 500km of network connecting Zambia's mines in the region and enough spare capacity to lease to licensed entities,<sup>35</sup> and in 2009 it entered into a joint venture agreement with Realtime Technologies to sell this capacity to TelCos.<sup>36</sup> Prior to this agreement, Realtime was

<sup>33</sup> Raul Katz, "Impact of Broadband on the Economy: Research to Date and Policy Issues," op. cit.

<sup>34</sup> New Partnership for Africa's Development (NEPAD) e-Africa Commission, "Backbone telecommunications infrastructure development initiatives in Southern and East Africa," (2004), available at: <http://event-africa-networking.web.cern.ch/event-africa-networking/cdrom/Worldbank/RegionalRationalizationStudy-EastandSouthernAfrica.pdf>

<sup>35</sup> New Partnership for Africa's Development (NEPAD) e-Africa Commission. "Backbone telecommunications infrastructure development initiatives in Southern and East Africa," op. cit.

<sup>36</sup> Russell Southwood, "Getting wider Broadband Access – African strategies to speed up network roll-out and access," 11th Forum on Telecommunications/ICT Regulation and Partnership in Africa (FTRA 2010) *'Fibre optic broadband and sharing the capacity and open access principles to achieve Connect Africa Goal 1. Partnership and*

the last-mile service provider for CEC's fiber optic network, enabling all towns on the Copperbelt to be connected.<sup>37</sup> In 2011, CEC signed another joint-venture agreement with Liquid Telecommunications Holding Limited to form CEC Liquid Telecom to build and operate a country-wide fiber network to provide wholesale capacity to both licensed public and private operators, with the goal to increase broadband capacity into and within Zambia, raise competition and ultimately reduce end-user prices.<sup>38</sup>

In some cases, particularly in remote areas where mines are generally located, the cost savings of using other types of infrastructure such as power lines will prove crucial to making telecommunications services economically viable (see Box 8).

### **Box 8: Canada – Leveraging mine's power lines**

FNEI (Five Nations Energy Inc.) is the owner and operator of the Omushkego Ishkotayo transmission line that connects the communities of Fort Albany, Kashechewan, Attawapiskat and more recently, De Beers Canada's Victor Site diamond mine to the electricity grid.

FNEI had been contemplating installing fiber optic cable along its network to allow its system to operate in a more efficient and secure way. The project, however, had been considered too expensive. The opportunity to install the network at a lower than expected cost was presented when De Beers' Victor Mine required upgrades in its electricity systems.<sup>39</sup>

At the commencement of the planning in 2005, FNEI approached De Beers to discuss the possibility of installing the fiber optic cable during the construction of a new transmission line for a cost of CAD\$ 1.6 million. FNEI then installed a separate fiber optic line that connected this cable to the community of Attawapiskat, 90km east of the mine at a cost of approximately CAD\$ 6.4 million. The total cost of CAD\$ 8 million was financially supported by local governments and agencies.<sup>40</sup> At the completion of

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*regulatory challenges*, Banjul (Gambia), 12 - 14 July 2010, available at: <http://www.itu.int/ITU-D/afr/events/FTRA/2010/documents/FTRA2010-southwood.pdf>

<sup>37</sup> Copperbelt Energy Corporation, "Realtime Zambia is a joint venture between CEC's telecoms division, CEC Liquid Telecom and Realtime Technology Alliance Africa (RTAA)," available at: <http://cecinvestor.com/about-us/realtime/>

<sup>38</sup> "CEC and Liquid Telecom Launch Wholesale Operator in Zambia," *Liquid Telecom* (March 25, 2011) available at: <http://www.liquidtelecom.com/blog/cec-and-liquid-telecom-to-form-industry-leading-wholesale-telecommunications-business-through-joint-venture>

<sup>39</sup> Five Nations Energy, History of Five Nations Energy Inc. available at:

<http://www.fivenations.ca/index.php/conservation/events/itemlist/category/50-about>

<sup>40</sup> Rick Garrick, "Canada: Nunavut: High-speed Internet arrives on James Bay," *Wawatay News Online* (March 4, 2010), available at: [http://www.wawataynews.ca/archive/all/2010/3/4/Highspeed-Internet-arrives-on-James-Bay\\_19291](http://www.wawataynews.ca/archive/all/2010/3/4/Highspeed-Internet-arrives-on-James-Bay_19291)

the project, De Beers also started investigating the possibility of extending the fiber optic to the mine site.<sup>41</sup>

To leverage the opportunity offered by infrastructure providers, the government should facilitate the access to carrier license for non-telecommunications companies (see Section 4) so that other companies can offer services instead of just leasing capacity to operators. This approach will increase competition and reduce the cost of telecommunications services for the mine and the communities.

### **OPPORTUNITY 3: Government, TelCos and mining companies coordinate efforts and investments**

Governments' financial participation in the deployment of a broadband solution can of course jump-start the equipment of remote communities with ICT services.

Governments' interventions in the remote regions where mines operate are facilitated because the mine will either serve as an anchor demand (Box 9) or as a co-investor or both (Boxes 10 and 11). In Australia, for example, as seen in Box 1, the government is building the infrastructure (NBN) across the country and will sell wholesale services to Internet and telephone providers (see Boxes 1 and 9). Because of the appeal a guaranteed demand from the mines to the service providers, the government program could prioritize some remote areas where mines operate.

#### **Box 9: Australia - NBN and mine cities**

Due to the importance of the mining sector in the national economy, the significant demand of telecommunications services of mine sites, and the significant number of workers who live in nearby cities, some mining cities have been included in the first years of the NBN program (as described in Box1).

NBN Co, for example, has started rolling fiber optic to one of the BHP Billiton villages at Newman, located in the iron ore-rich Pilbara region of north-west Western Australia. Other towns such as Tom Price and Paraburdoo, where many of Rio Tinto's employees live, are also selected to receive NBN infrastructure within the first few years of the program.<sup>42</sup>

While a government might desire to build the infrastructure, it may not always have the required economic resources. In those situations, the government, the telecommunications and the mining company could coordinate efforts to build the

<sup>41</sup> "Proving the nay-sayers wrong," *Native Journal* (May, 2008), available at: [http://www.nativejournal.ca/pages/2008%20sections/\\*2008.05.sections/2008.05.Mining.html](http://www.nativejournal.ca/pages/2008%20sections/*2008.05.sections/2008.05.Mining.html)

<sup>42</sup> Ry Crozier, "Mine workers in line for NBN connections," *IT News* (June 14, 2012), available at: <http://www.itnews.com.au/News/304698,mine-workers-in-line-for-nbn-connections.aspx>

infrastructure together in a mutually beneficial arrangement that enables the government to include remote communities, the mining company to connect its mine, and the TelCos to increase its coverage, all at a lower cost than if each decided to act on its own. The Groote Eylandt project (see Box 10) illustrates a situation where the three organizations benefited by coordinating efforts and investments.

**Box 10: Australia - Groote Eylandt project**

Groote Eylandt is an island and the home of four towns and communities: Alyangula, Umbakumba, Milyakburra and Angurugu, as well as a manganese ore mining operation owned by BHP Billiton's subsidiary Gemco.<sup>43</sup> Through the Groote Eylandt project, those communities are now connected to the national fiber optic infrastructure. BHP Billiton/Gemco, the local government (particularly interested in connecting indigenous communities, with a strong focus on e-health and remote education applications) and Telstra coordinated among themselves to support the project, and Telstra installed the 3.5km of terrestrial fiber optic and 95km of submarine cable.<sup>44</sup>

In Northern Australia, Rio Tinto had a similar partnership with Telstra and the government (see Box 11). In this situation the territory government also helped finance the infrastructure.

**Box 11: Arnhem Land Fiber Project in Northern Australia**

In 2009, Telstra announced the completion of the Arnhem Land Fiber Project, a AUS\$ 34 million scheme, which received funding from the Australian Northern Territory Government (approximately AUS\$ 6.8 million) and Rio Tinto Alcan. The completed project linked Jabiru to Nhulunbuy, where Rio Tinto owns a bauxite mine and an alumina refinery, and on its way, nine indigenous communities to the national fiber optic infrastructure connecting a total of more than 10,000 people. Overall, the project involved laying over 990km of fiber optic cable and five radio systems.<sup>45</sup>

It is important to keep in mind, however, the overall impacts of government intervention in the market. This intervention should lessen the constraints of businesses while at the same time stimulate private investment. According to Katz, when the broadband project is already profitable, the government intervention could result in a reduction of private investment (crowding out effect). If the project is not profitable, however, then the role of

<sup>43</sup> Luke Coleman, "Telstra planning NT submarine cable," *Commsday* (September 27, 2009), available at: <http://www.commsday.com/commsday-australasia/telstra-planning-nt-submarine-cable#sthash.VnkPDzFm.dpuf>

<sup>44</sup> John Gibbs, "Submarine cable enables remote island communities," *Telstra Exchange* (March 17, 2011), available at: <http://exchange.telstra.com.au/2011/03/17/submarine-cable-enables-remote-island-communities/>

<sup>45</sup> "Infrastructure Report Card 2010 – Northern Territory," Engineers Australia (2010), available at: <http://search.informit.com.au/payPerView?type=pdf;res=IELENG;action=showPaymentForm;dn=532848060684766>

the government should be to lessen the structural constraints (typically a low demand and very expensive equipment) to create incentives for private sector participation.<sup>46</sup>

#### 4. Regulations Required

Based on the case studies illustrated in the paper, we conclude that in order for a government to leverage mining demand for ICT services and the mining investment in ICT infrastructure, it should develop specific regulations according to the country's context.

In places with inadequate backbone, the policy should focus on incentives for the establishment of such backbone such as increasing the flexibility of the telecommunications licensing process. Where the existing backbone is adequate, the policy focus needs to be on increasing access to that backbone infrastructure with infrastructure sharing policies.

#### Licensing

Traditional licensing has typically required different and separate licenses for different technologies as well as for different types of services. However, in order to optimize broadband services, governments are increasingly allowing flexible use by adopting technology and service neutrality.<sup>47</sup>

Botswana, Ghana, Kenya, South Africa, Tanzania, and Uganda, are some of the countries that have already adopted those licensing frameworks.<sup>48</sup> In order to increase flexibility, regulators have also begun to adopt more unified frameworks such as unified or general authorizations.<sup>49</sup>

In the mining sector, the different types of licenses can create incentives or constraints for mining companies to supply broadband services to nearby communities. In Ethiopia, for example, companies that acquire VSAT are not allowed to provide services to third parties.<sup>50</sup>

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<sup>46</sup> Raul Katz, "Impact of Broadband on the Economy: Research to Date and Policy Issues," op. cit.

<sup>47</sup> "Technology neutrality" means network operators are allowed to use the technology or equipment they choose in order to meet market demands.

"Service neutrality" means that network operators are allowed to provide any service their technology and infrastructure can deliver.

<sup>48</sup> Kelly and Rossotto, *Broadband strategies handbook*, op. cit

<sup>49</sup> "Unified or General Authorizations" are technology and service neutral authorizations that allow the licensees to provide any type of service under a single authorization

<sup>50</sup> Yelibenwork Ayele, "Companies in Ethiopia Permitted to Use VSAT," *The Reporter* (October 3, 2011), available at: <http://www.2merkato.com/news/alerts/380-companies-in-ethiopia-permitted-to-use-vsats>

License exemption: Carrier licensing is normally costly and out of scope for a mining company. In some cases, it becomes a barrier that reduces the potential to leverage the use of ICT infrastructure. Some companies, therefore, might require a license exemption from the regulatory agency, in order to provide access to their network (see Box 12).

**Box 12: Australia – Carrier license exemption**

Australia Pacific LNG (APLNG), a joint-venture company established to supply gas in central Queensland to a liquefied natural gas facility in the Port of Gladstone has recently requested an exemption from the carrier license requirements of the *Telecommunications Act 1997*.

APLNG is building its own private telecommunications network that covers 500km to support its liquefied natural gas operation. Since APLNG initially intended to close the network to the public, it did not require a telecommunications carrier license. However, more recently, APLNG decided to provide access to its infrastructure to telecommunications providers in order for them to improve mobile phone coverage in the region, which APLNG's community of workers and partners will benefit from as well. Such a situation normally requires a license but APLNG has requested a carrier license exemption.

The Department of Broadband, Communications and the Digital Economy has proposed granting the exemption for ten years on the basis that it “may assist in improving the supply of mobile phone services to the public in the region.” The exemption is also subject to a condition that access to APLNG designated infrastructure is available on an open-access basis to any carrier, without charge.<sup>51</sup>

Spectrum License: It is also important to adopt licenses that maximize the use of spectrum.<sup>52</sup> New technologies enable multiple services to be provided using the same spectrum, which increases the need for regulators to allocate spectrum rights more efficiently. In some regions, such as parts of Australia, current access to appropriate licensed spectrum (for the chosen technology) is not readily available to non-telecommunications carrier entities such as mining companies, which reduces the potential for those companies to provide telecommunications services (see Box 13).

<sup>51</sup> Australia’s Department of Broadband, Communications and the Digital Economy, “Consultation on a proposed carrier license exemption for the Australia Pacific LNG Pty Ltd (APLNG) Network QLD,” available at: [http://www.communications.gov.au/policy\\_and\\_legislation/competition\\_policy\\_and\\_framework/licensing\\_of\\_carriers\\_and\\_service\\_providers/APLNG\\_carrier\\_licence\\_exemption](http://www.communications.gov.au/policy_and_legislation/competition_policy_and_framework/licensing_of_carriers_and_service_providers/APLNG_carrier_licence_exemption)

<sup>52</sup> “Spectrum” is the range of electromagnetic waves used to transmit information using ICT infrastructure. It is divided into different frequency bands that are dedicated for specific services. Different bands of spectrum are able to transmit more data than others.

### **Box 13: Australia – Spectrum license in Pilbara for mining companies**

With the emergence of 4G technologies, ACMA (Australian Communications and Media Authority) is anticipating a growth in demand for access to the 1800 MHz spectrum band in remote areas, including those with mining operations. The organization is therefore reviewing its regulations in order to ensure that the spectrum is allocated to its highest value use (industry and type of license) and supports communities' needs.<sup>53</sup>

Currently, access to an appropriate licensed spectrum is not readily available to non-telecommunications carriers, but the 1800 MHz band will help facilitate the deployment of LTE services<sup>54</sup> in remote regions, and according to ACMA, in addition to mobile TelCos, rail operators, mining companies and the energy sector are all interested in having access to this band.<sup>55</sup> For mining operations specifically, the 1800 MHz band is increasingly being used to support safety and operational systems on mine sites and to support communications systems and automated equipment technologies.

Telstra, in remote parts of the country, is the biggest holder of spectrum licenses across all mobile spectrum bands and in addition owns around 85% of the fixed-service license of the 1800 MHz band.<sup>56</sup> Mining companies are asking ACMA to amend the regulation to allow for a greater participation of other companies. BHP Billiton is defending a “use it or lose it” license condition to enable access to the spectrum by other companies if the carrier does not deploy the needed infrastructure in a set amount of time.<sup>57</sup>

Coverage Obligation: The simplification of the licensing process for non-carriers such as miners and infrastructure providers should be accompanied by a “coverage obligation” ensuring that communities benefit from this increased access to telecommunications licenses granted to the non-carriers. This obligation is a regulatory incentive that encourages the deployment of telecommunications services in remote regions. This requirement, however, should be taken into consideration carefully. If it is too strict, it

<sup>53</sup> Australian Communications and Media Authority (ACMA), “1800 MHz—a shared strategy: Consultation paper,” (2012), available at: [http://www.acma.gov.au/webwr/\\_assets/main/lib550036/ifc41-2012\\_1800mhz-a\\_shared\\_strategy.pdf](http://www.acma.gov.au/webwr/_assets/main/lib550036/ifc41-2012_1800mhz-a_shared_strategy.pdf)

<sup>54</sup> “LTE services”: Long Term Evolution services referring to the 4th Generation standard for wireless communication of high-speed data

<sup>55</sup> Adam Bender, “ACMA seeks 4G in rural Australia through 1800 MHz rule changes,” *Computer World* (December 7, 2012), available at: [http://www.computerworld.com.au/article/444050/acma\\_seeks\\_4g\\_rural\\_australia\\_through\\_1800\\_mhz\\_rule\\_changes/](http://www.computerworld.com.au/article/444050/acma_seeks_4g_rural_australia_through_1800_mhz_rule_changes/)

<sup>56</sup> Josh Taylor, “Leave Telstra last in 4G spectrum extension: Vodafone,” *ZDNet* (March 10, 2013), available at: <http://www.zdnet.com.au/leave-telstra-last-in-4g-spectrum-extension-vodafone-7000012310/>

<sup>57</sup> Ry Crozier “BHP, Rio Tinto clash over spectrum,” *IT News* (March 7, 2013), available at: <http://www.itnews.com.au/News/335614,bhp-rio-tinto-clash-over-spectrum.aspx>

might reduce the interest and incentives for a company to invest in the infrastructure. If it is too loose, then it would fail to provide the desired impact.<sup>58</sup>

## Access to Infrastructure

Open Access: In most remote regions, due to the low density, it may be inefficient to have competing networks. In those situations, it is optimal to have one single network while ensuring competition among service providers (in other words to keep the monopoly only for the natural monopoly infrastructure (the backbone)).

In many cases, however, mining companies end up having to rely on an integrated monopolist (providing both the infrastructure and the services) for connections and negotiate prices with no competition. In Australia, for example, in areas where there was no competition against incumbent infrastructure such as in Pilbara, the mining area in Western Australia, the cost of access to backhaul in 2009 was up to 700% higher than in Perth or Sydney.<sup>59</sup> When BHP Billiton wanted to have a backup network parallel to their train tracks in Pilbara, the company could only negotiate with Telstra because the TelCo's interconnection point was the only one reasonably close to the mine and no other carrier had access to it.<sup>60</sup>

Such situations generally lead to higher retail prices, reduced area covered by broadband services and mining companies building their own private networks close to remote villages without connecting them. For this reason, regulators are increasingly adopting open access policies (defined as providing effective, wholesale access to network infrastructure or services at fair and reasonable prices, and on transparent and non-discriminatory terms) to deliver affordable and widespread access to broadband services.

Open policy should be, especially, applicable to the Last Mile. In Europe, as well as in many other countries such as Japan, Nigeria, Saudi Arabia and South Africa, regulators are adopting Local Loop Unbundling (LLU) obligations.<sup>61</sup> LLU is the regulatory process where the incumbent operator makes its local network (including last mile) available to other companies.<sup>62</sup> In remote regions, where most mine sites are located, the network that connects the mine is generally Last Mile and adopting such regulations are

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<sup>58</sup> Kelly and Rossotto, *Broadband strategies handbook*, op. cit

<sup>59</sup> Department of Commerce, State Government of Western Australia, "Response to the National Broadband Network (NBN): Backhaul Blackspots Initiative Stakeholder Consultation Paper," (2009), available at: [http://www.communications.gov.au/\\_\\_data/assets/pdf\\_file/0003/113457/Department\\_of\\_Commerce\\_WA.pdf](http://www.communications.gov.au/__data/assets/pdf_file/0003/113457/Department_of_Commerce_WA.pdf)

<sup>60</sup> Department of Commerce, State Government of Western Australia, "Response to the National Broadband Network (NBN): Backhaul Blackspots Initiative Stakeholder Consultation Paper," op. cit.

<sup>61</sup> Kelly and Rossotto, *Broadband strategies handbook*, op. cit.

<sup>62</sup> Ofcom, "What is Local Loop Unbundling?," available at:

[http://www.ofcom.org.uk/static/archive/oftel/publications/broadband/dsl\\_facts/LLUbackground.htm](http://www.ofcom.org.uk/static/archive/oftel/publications/broadband/dsl_facts/LLUbackground.htm)

important to reduce the monopoly of the telecommunications services (and consequently the cost of access) and increase the coverage in the area.

One of the most important challenges faced by regulators is balancing competition and the need to create incentives for investment in new infrastructure. Companies that have built the infrastructure may reduce future investment if their facilities are open to competitors at low rates. If access prices are too high, on the other hand, competitors may decide not to enter the market or build their own networks, which would inefficiently duplicate the existing infrastructure.

Sharing Infrastructure: In order to reduce costs, it is also important to improve the coordination of cross-sector infrastructure. As we mentioned, fiber optic cables have been used for leak and temperature detection in oil pipelines, internal communications in power systems, traffic monitoring along highways, and signaling along railway lines.<sup>63</sup> The goal is to capture economies of scope from civil works and deliver more affordable services. To that end, regulators could, for example, increase incentives for additional investment in backbone networks by making rights-of-way readily available, especially in public property, limiting the fees charged and simplifying the legal process involved.

As illustrated by De Beers' mine in Canada (see Box 8), cross-sector coordination is relevant to the development of ICT infrastructure through mining companies' investments. In that situation, FNEI added fiber optics cable at a lower than expected cost by coordinating its installation with De Beers' electricity systems upgrades. Perceiving this opportunity, governments are increasingly requiring utilities (see Box 14) and other private companies (see Box 15) to include telecommunications capacity in their infrastructure.

**Box 14: Southern Africa – Requiring the installation of telecommunications capacity**

The Southern African Power Pool (SAPP) is a cooperation of the national electricity companies from 12 African countries<sup>64</sup> under the umbrella of the Southern African Development Community (SADC). It was founded in 1995 and has created common power grid and common market between its members. Recently, with the goal of leveraging the use of their infrastructure and facilitating connectivity to the underserved areas, the organization has started requiring all new power lines to be equipped with optical ground wire (OPGW).<sup>65</sup>

<sup>63</sup> "Fibre Optic Infrastructure: Using the Valuable Resource for Multiple Tasks," *ICT Africa* (June 6, 2013), available at: <http://ictafrica.info/FullNews.php?id=9592>

<sup>64</sup> Angola, Botswana, Democratic Republic of Congo, Lesotho, Mozambique, Malawi, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe

<sup>65</sup> "Fibre Optic Infrastructure: Using the Valuable Resource for Multiple Tasks," *ICT Africa*, op. cit

Alternatively, the government could require mining companies to add ICT capacity as a condition for granting a railway concession. This policy is currently being discussed in Brazil and could have a significant impact on mining companies. Vale do Rio Doce, for example, has more than 1,700km of railway concessions in the country.<sup>66</sup>

**Box 15: Brazil – Requiring additional fiber optic cables in the concession of railways**

A new policy for the telecommunications sector being discussed by the Brazilian government will require the concessionaire of a government railway to construct fiber optic cables along the line. The government owns 10,000km of railway around the country.

When completed, the fiber optic networks must be delivered to Enterprise Planning and Logistics (Empresa de Planejamento e Logística S.A.- EPL), a public company launched in 2012 to help carry out the investment plans for roads and railways. EPL will then decide how to use the networks. So far, however, it has not been decided who will finance the infrastructure, the government or the owner of the concession.<sup>67</sup>

In 2011, the Australian government amended the 1997 Telecommunications Act adding, in particular, Part 20A, which enables carriers to seek access to passive infrastructure that is owned by a non-carrier for the purposes of installing optical fiber.<sup>68</sup> Where non-carrier companies lay fiber networks as part of their development, they must now give TelCos access to the facility if requested to do so. In this case, if a mining company is not a licensed carrier,<sup>69</sup> then a carrier may use its infrastructure to add fiber optic at a lower cost. Access to the infrastructure should be negotiated between parties involved, but if they do not reach an agreement on the terms, then an arbitrator, such as the Australian Competition and Consumer Commission will determine the conditions<sup>70</sup> (see Box 16).

<sup>66</sup> Agência Nacional de Transportes Terrestres (ANTT), “Ferroviário – Concessões,” available at: <http://www.antt.gov.br/index.php/content/view/5262/Concessoes.html>

<sup>67</sup> Carlos Alberto Sardenberg, “No Balcoes do Governo,” *O Globo* (March, 21, 2013), available at: <http://oglobo.globo.com/opiniaao/nos-balcoes-do-governo-7898784>

<sup>68</sup> Christine Covington, James North and Thomas Jones, “Time to Get ‘Fibre-Ready’ – New Mandatory Requirements for Construction Development Projects,” *Corrs In Brief* (October 10, 2011), available at: <http://www.corrs.com.au/publications/corrs-in-brief/fibre-ready-new-mandatory-requirements-construction-development-projects/>

<sup>69</sup> And does not have a nominated carrier in place

<sup>70</sup> Australian Government, “Telecommunications Act 1997,” available at: [http://www.comlaw.gov.au/Details/C2012C00392/Html/Text#\\_Toc321928154](http://www.comlaw.gov.au/Details/C2012C00392/Html/Text#_Toc321928154)

**Box 16: Part 20A—Deployment of optical fiber etc.<sup>71</sup>**

**Division 4—Third party access regime**

**372L Third party access regime**

[...] *Access to facility*

- (2) The owner or operator of the facility must, if requested to do so by a carrier, give the carrier access to the facility.

[...]

**372M Terms and conditions of access**

- (1) The owner or operator of a fixed-line facility must comply with subsection 372L(2) on such terms and conditions as are:

- (a) agreed between the following parties:
- (i) the owner or operator of the facility;
  - (ii) the carrier who made the request under that subsection;
- or
- (b) failing agreement, determined by an arbitrator appointed by the parties.

If the parties fail to agree on the appointment of an arbitrator, the ACCC is to be the arbitrator.

This strategy, however, requires significant and not always easy coordination among parties, as well as long-term planning. Most developing countries have enacted some laws that address cross-sector infrastructure sharing, but they often fail to have the expected results as generally neither the telecommunications operator nor the regulator has authority to force shared use of the infrastructure. Typically such laws would leave the details of the implementation (access charges, rights, obligations) to the parties' negotiation – which is considered as good practice but requires strong dispute resolution mechanisms. In addition, the obligation of sharing would be subject to the condition that the arrangement is "technically and economically feasible." Such a clause is generally difficult to enforce in practice: service providers easily claim the lack of feasibility of the arrangement, particularly when the regulator suffers from a strong asymmetry of information.

Stronger language can currently be found in the proposal for "Regulations on the Installation of Telecommunications Infrastructure in Building and Public Works" developed by Mozambique's regulator, INCM (Box 17).

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<sup>71</sup> Australian Government, Act No. 47 of Telecommunications Act 1997 as amended, taking into account amendments up to Telecommunications Legislation Amendment (National Broadband Network Measures—Access Arrangements) Act 2011, available at: [http://www.comlaw.gov.au/Details/C2012C00392/Html/Text#\\_Toc321928154](http://www.comlaw.gov.au/Details/C2012C00392/Html/Text#_Toc321928154)

**Box 17: Mozambique - Capitulo 3 - Artigo 10 - Direito de acesso às infra-estruturas públicas<sup>72</sup> - Translation<sup>73</sup>**

**Chapter 3 - Article 10 - Right of access to public infrastructure**

1. Operators and providers of telecommunications services have a right of access to infrastructure suitable for the accommodation of telecommunications networks owned or operated by the state, municipalities, and entities related to the areas of roads, bridges, railways, electricity, gas and petroleum products.
2. The access referred to in the preceding paragraph shall be provided on terms of equality, transparency and non-discrimination through tariffs that reflect costs.
3. The procedures for obtaining the right of access should be timely, transparent and advertised; and cannot exceed the maximum period of 30 days after receipt of the demand for access.

The other Articles under this Chapter stipulate the prohibition of exclusive use of public infrastructure, the conditions for the denial of access to public infrastructure, the procedures in the event of denied access, the obligations of the entities owning or managing public infrastructure, the fees for access to and use of public infrastructure, the procedures and conditions for access to and use of public infrastructure, the details of the request for access to public infrastructure, the conditions of use of public infrastructure and co-location.

**Further Research**

This Policy Paper has set out preliminary findings on appropriate commercial, financial, technical and regulatory models to leverage the mining industry's ICT own-infrastructure and demand for infrastructure to expand broadband access to communities. Those findings have led to a refined framework to approach the issue of shared use available on the CCSI website:

Toledano P., Thomashausen S., Maennling N., Shah A., A Framework to Approach Shared Use of Mining-Related Infrastructure, Chapter 4, Columbia Center on Sustainable Investment, Columbia University, New York (2014).

<sup>72</sup> Article 10 of the "Proposta de Regulamento sobre Instalação de Infra-Estruturas de Telecomunicações em Edifícios e Projectos de Obras Públicas," Ministério dos Transportes e Comunicações (May 2013), available at: [http://www.incm.gov.mz/c/document\\_library/get\\_file?uuid=88429f5e-129e-4ee0-a52a-e52b0addabb9&groupId=10157](http://www.incm.gov.mz/c/document_library/get_file?uuid=88429f5e-129e-4ee0-a52a-e52b0addabb9&groupId=10157)

<sup>73</sup> Nicholas Maennling, Alpa Shah and Sophie Thomashausen, "A Framework to Approach the Issue of Shared Use of Mining-Related Infrastructure: Case Study: Mozambique," Columbia Center on Sustainable Investment, Columbia University, New York (2014), available at: [http://ccsi.columbia.edu/files/2014/05/Case-Study\\_Mozambique-FINAL.pdf](http://ccsi.columbia.edu/files/2014/05/Case-Study_Mozambique-FINAL.pdf)

Further research will include a closer examination of the scope for cost savings for the country and the company under different arrangements, laying the emphasis on a quantitative analysis of the different situations.

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