MODULE 8

BUSINESS AND PROJECT CASE STUDIES

CROSS-SECTOR INFRASTRUCTURE SHARING TOOLKIT
8 Business and project case studies

381. This module sets out 15 examples of cross-sector infrastructure sharing projects throughout the globe.

8.1 Lesotho Electricity Company

8.1.1 Introduction

382. This case study examines (1) the planning process by which Lesotho Electricity Company (Proprietary) Limited (LEC), a vertically integrated provider of electricity transmission and distribution services, decided to commercialize telecommunications access to its sharable infrastructure and (2) LEC’s early stages of implementation. For the reasons discussed, LEC adopted a business model of leasing dark fiber installed in its transmission grid and hosting third-party fiber optic cable installed on utility poles used in its distribution system.

8.1.2 Background on LEC

383. Lesotho is a small, mountainous country, located at a high altitude, with a land area of roughly 30,000 km$^2$ and a population of just over 2 million people with a relatively low growth rate. It is landlocked and bordered by South Africa on all sides.

384. LEC is the enfranchised monopoly provider of electricity transmission and distribution services in most inhabited areas of Lesotho. LEC was originally established in 1969 as a parastatal enterprise that combined both the operational and regulatory functions of transmitting and distributing electricity. In 2006 and 2007, through the passage and implementation of the Lesotho Electricity Authority (Amendment) Act 2006, the Government separated the regulatory and operational functions, with the “new” corporatized LEC succeeding to all transmission and distribution operational functions. The regulatory functions were conferred on a newly established regulator, the Lesotho Electricity Authority, which was subsequently also endowed with authority to regulate water supply and renamed as the Lesotho Electricity and Water Authority (LEWA). LEC remains wholly state-owned, but is fully corporatized and operates on a financially independent and sustainable basis as a standalone enterprise.

385. LEC’s electricity system comprises a transmission grid comprising 1,041 km in transmission lines and 42 substations and an above-ground distribution system comprising 1,720 km in distribution lines and approximately 18,000 utility poles. LEC’s transmission grid is interconnected with the transmission grid of Eskom of South Africa at the western, northern and eastern borders of Lesotho. LEC’s electricity distribution system operates at 11 kV across Lesotho from the various transmission substations. With few exceptions, the distribution system is concentrated in the western lowlands of Lesotho.

386. Beginning in 2002, LEC invested heavily in constructing an internal fiber optic network on its transmission grid to improve the reliability, efficiency and safety of its transmission grid and to support its other internal communications needs. In the first phase, LEC installed 64 km of ADSS fiber on its 33kV transmission lines. This installation was concentrated around greater Maseru, the capital city of Lesotho and the area of highest concentration of LEC customers. In 2012, LEC completed a second rollout of 383 km of fiber on its 132kV transmission and 33kV transmission lines using OPGW. LEC’s fiber optic network was built to serve its requirements for teleprotection.

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109 Information for this case study was provided by LEC.
and telecontrol of the transmission grid as well as voice and data communication between its control center and substations.

All of these fiber optic cables have 12-core fibers (6 pairs). LEC did not require high capacity telecommunications bandwidth, but did require extremely high availability and security for its telecommunications circuits. LEC used only one fiber pair for its own requirements on each of its installed fiber optic route segments, and has reserved another fiber pair as a spare. After completion of these two phases of construction, LEC’s fiber network covered 447 km of its 1,041 km of transmission lines and connected 29 of its 42 substations. LEC had plans to eventually complete the network to cover its entire transmission grid but first had to address other priorities for capital expenditures from its limited available funding sources.

8.1.3 Telecom business of LEC

Demand for fiber in Lesotho’s telecommunications sector

As of 2015, Lesotho’s telecommunications markets were dominated by two network operators. One was Econet Telecom Lesotho (Pty) Ltd (ETL). ECL was 70% owned by Zimbabwe-based Econet and 30% owned by the Government. At the time of its partial privatization, ETL (then known as Telecom Lesotho) had been the monopoly fixed-line operator. It was subsequently issued a mobile license. ETL has an extensive terrestrial fiber optic network in Lesotho which it uses to provide backbone and metropolitan transport services for its own fixed-line and mobile networks and to provide wholesale services to other operators. ETL’s fiber network is primarily installed above-ground on its own utility poles located in roadway corridors. ETL has invested significantly in its fiber network but has experienced frequent network availability issues due to vandalism, theft and other hazards to its poles and the lack of ring architecture. The resulting network outages repeatedly impacted the reliability of ETL’s services to its customers, including the Government, which had a long-term contract for data transport over ETL’s fiber network. Reports on the extent and quality of ETL’s fiber suggested that installing fiber on its own poles was not a practice ETL would continue as it expanded its network, because the network could not meet international standards for high availability of broadband networks. In the interim, ETL had no competition so its customers had no alternatives for a fixed fiber service provider, and ETL had not cost-effective options for installing its fiber (as burying fiber would have been significantly more expensive and would not necessarily have improved reliability).
The other large network operator in Lesotho is Vodacom Lesotho (Pty) Ltd (VCL), which is a wholly owned subsidiary of Vodafone Group plc. VCL operates a mobile network and does not have a fixed network. VCL had no fiber network of its own and relied primarily on microwave links to transport the bulk of the backhaul traffic to and from the tower sites used in their mobile access networks. These links are usually reliable but cannot handle the volumes of data required for 3G or 4G mobile broadband as demand and use begin to rise. Nor could VCL compete for the data transport business of the Government. By 2014, VCL had begun a multi-year process of upgrading all its mobile sites in Lesotho to 4G/LTE, starting first in the greater Maseru area. VCL knew it would eventually also need to upgrade its transmission network to handle the increased traffic volumes and anticipated employing a fiber network to do so.

In addition to ETL and VCL, Lesotho also had several small ISPs which mostly served business customers. Their networks were almost entirely wireless from end-to-end and their existing traffic volumes and near-term growth projections did not yet justify an investment in fiber. The primary exception was a link from Maseru to the border interconnection with South Africa for international traffic, for which the ISPs purchased data transport services from ETL.

In addition to these licensed commercial network operators, the Government also operated an internal network, the Lesotho Government Data Network (LGDN), which it had recently established under a 5-year contract with ETL. The network was mainly fiber-based and connected all districts in Lesotho. However, the cost of the LGDN service was very high, partly due to the high cost of fiber and partly due to lack of competition for ETL. The Government was therefore very interested in seeing competitive fiber optic facilities brought to market in order to reduce

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110 This photograph was taken on a road between Mafeteng and Mohale’s Hoek, Lesotho.
costs, increase reliability and gain greater control over its infrastructure (by procuring its own dark fiber rather than bandwidth services on someone else’s fiber).

LEC’s motivations for establishing a telecommunications business

391. Over time, LEC began to receive repeated requests from VCL, ETL and the Government to lease excess capacity on its existing fiber network. LEC had not contemplated commercialization of excess capacity when it procured its fiber network, did not have a plan for market entry and had not evaluated the options and requirements for doing so. So LEC initially demurred when it received these requests.

392. The pressure on LEC to make its excess fiber assets available for use in the telecommunications sector mounted. The Lesotho National Development Corporation (LNDC) began to lobby for Government to require LEC to open up its fiber network. According to LNDC, high broadband prices and limited international connectivity were undermining efforts to attract and retain garment manufacturing firms (which needed to be able to receive design changes electronically and were unable to do so). LNDC advocated that this had a significant adverse impact on Lesotho’s economy because garment manufacturing was one of the top export industries for Lesotho and the only one which created a large number of skilled jobs.

393. LNDC hired an international consulting firm to study options and make recommendations for addressing Lesotho’s pressing and growing need for a national fiber network. In their report, the consulting firm recommended the formation of an independent fiber company to which LEC, VCL, ETL and the Government would contribute all their existing fiber assets and in which they would all have joint ownership. These recommendations were not considered attractive by any of the network operators, LEC or Government. In LEC’s case, apart from being commercially unattractive, the proposed arrangement would have compromised LEC’s control over the efficiency, reliability and safety of its electricity transmission grid and potentially compromised one potential source of revenue that could have supported LEC in its continued financial independence and efficiency.

394. In addition to pressure to open up its fiber network, LEC had also come under pressure, from ETL in particular, to provide access to and use of its electricity distribution facilities so telecommunications operators could install their own fiber on LEC’s distribution poles. Based on its negative experience with pole cuts, ETL preferred to use LEC’s electricity distribution poles to install new fiber. By sharing poles, ETL hoped to increase reliability (because electric utility poles are much less likely to be cut due to the high voltages they carry on open lines) and reduce its costs and delay (because sharing existing poles would be cheaper and faster than installing new poles or ducts).

395. Making matters worse for VCL and ETL, Lesotho’s Communications Act 2012 did not provide licensed telecommunications operators with sufficient rights of access and use of public and private properties to enable them easily to install their own fiber facilities other than in the roadway corridors. As a result, VCL, ETL and all other licensed telecommunications operators in Lesotho had no legal means of accessing further private property to build, operate and maintain their networks, and could only use public properties if authorized to do so by the relevant authority (with no recourse under the Communications Act if such authorization were denied or granted on unreasonable terms and conditions). This left them relatively weak in their ability to assemble the lateral corridors required for backbone fiber optic installations or for extensions from these backbone networks to their radio base stations. In contrast, LEC continued to enjoy rights of use
and compulsory acquisition of public and private lands under the Lesotho Electricity Authority Act 2002, as amended.

396. Faced with this mounting pressure, and a sense of public duty, LEC’s management and board decided that LEC should undertake necessary planning, obtain any required licenses and enter the market for infrastructure sharing in Lesotho. This, of course, only began the process and would not result in immediate availability of LEC’s infrastructure to the telecommunications sector.

397. In November 2012, before undertaking its planning exercise, LEC requested a license from the telecommunications regulator, the Lesotho Communications Authority (LCA), to authorize it to provide wholesale data transport services. Then, in late 2013, LEC engaged external advisers to assist with strategy and planning for a telecommunications business.

**LEC’s explored options for establishing an infrastructure sharing business**

The first task for LEC and its external advisers was to assess the condition, coverage and capacity of its existing fiber network and other sharable infrastructure, evaluate market demand for that fiber and infrastructure among the small number of potential customers, analyze the commercial, financial, operational and regulatory implications of various business models for commercializing its existing fiber and other infrastructure, and to develop a market entry and business development strategy. Among other things, this assessment process confirmed that LEC’s fiber and other transmission and distribution assets had significant latent value which could be monetized from commercialization.

**Evaluating and selecting business models**

398. LEC’s management and board faced the threshold decision of selecting a business model for commercializing existing fiber on its transmission grid and monetizing the latent value of the remainder of its transmission grid for telecommunications use. From the market research and due diligence carried out with its external advisers, LEC expected that VCL needed to upgrade its transmission network from microwave to fiber to support 4G/LTE bandwidth requirements. LEC also expected ETL to gradually supplement or replace segments of its fiber network to increase redundancy and reach new points of presence, although LEC did not expect ETL’s initial demand for fiber on the transmission grid to be nearly as great as VCL’s. LEC also expected that both VCL and ETL would eventually want to begin linking their towers using fiber, starting with the higher traffic sites first.

399. LEC identified four potential business model options to address these market needs: (1) host third-party fiber optic cable on LEC’s transmission grid; (2) install LEC’s own fiber optic cable on the electricity transmission grid and provide dark fiber to third parties; (3) install and operate LEC’s own fiber optic network on the transmission grid and provide bulk data services to third parties; or (4) a combination of these options. Following a thorough review and comparison of the four options, and assessment of the appetite of LEC’s potential customers for each option, LEC chose the dark fiber leasing business model (option 2) for monetizing the latent value of its transmission grid. LEC made this choice for the following reasons:

400. LEC was able to dismiss the feasibility of providing bulk data services rather quickly. A bulk data service would have required significant upfront and recurring investment in equipment and personnel, and expenditures and expenses would precede revenues. This would have created significant and prolonged negative cash flow for LEC’s telecommunications business and
substantially increased its financial risk, even if LEC did not invest in expanding its existing fiber footprint. LEC did not have access to retained earnings or external capital to fund such an investment, nor did it have the appetite for the associated commercial risks. In contrast, if LEC leased dark fiber or hosted third-party fiber, these activities would generate significant revenue (which could be accelerated if LEC entered into long-term indefeasible right of use (IRU) arrangements).

401. LEC also believed it had a significant comparative disadvantage to its customers and competitors in providing bulk bandwidth services. LEC had no commercial experience in this business, whereas VCL and ETL were both sophisticated telecommunications network operators. ETL already operated a large fiber optic data network in Lesotho. VCL was part of an international group with significant fiber optic data network experience in other markets. Offering bulk data services would only improve LEC’s return in comparison with a dark fiber offering if LEC were able to implement and operate the data network less expensively and more effectively than its wholesale customers. Though this may have been the case if LEC had a large number of small potential customers, none of which could achieve its own economies of scale, it was an unlikely scenario in the case of VCL and ETL. Also, unlike the efficiencies of multiple users of separate dark fiber pairs in the same fiber optic cable, there were less potential efficiency gains from operators as large as VCL and ETL sharing the same equipment (directly or through LEC as a service provider). Any marginal inefficiency of having separate equipment would be outweighed by the flexibility and independence this would afford each operator in planning, modifying and operating its own data network.

402. Finally, LEC believed that entering the market as a dark fiber provider would not undermine its ability to offer a bulk data service to ISPs and other wholesale customers in the future.

403. Having concluded that option 3 (bulk data services) should be excluded, where LEC had already installed and maintained fiber optic cable its transmission grid, the decision also to exclude option 1 (hosting third-party fiber) was easy. This left dark fiber leasing as the obvious choice. LEC had existing fiber on some of the most sought after segments on its transmission grid and so its dark fiber inventory was immediately attractive to the market. This fiber had withstood the test of time and had proved to be extremely reliable. The existing fiber optic cable had sufficient excess dark fiber to meet the demand of all potential customers in the market. So, LEC was ready to meet the highest market needs for fiber along its transmission line routes.

404. On the remainder of its transmission grid, however, LEC still had the option to host third-party fiber rather than install its own fiber. The business case for LEC to extend its own fiber to the remainder of its transmission grid therefore required some analysis. Fiber installation requires significant capital investment and additional operating expense.

405. Intuitively, hosting third-party facilities involved less risk for LEC than new fiber builds by shifting investment risk to the customer. Hosting third-party installations would allow LEC to release at least some of the latent value of its transmission grid. If LEC had little or no existing fiber on its transmission system, hosting third-party fiber installations may have been the optimal business model for LEC’s transmission grid. However, because LEC had already invested significantly in fiber on the most valuable segments of its transmission lines, a third party was unlikely to invest in building fiber on many of the remaining segments. Under these circumstances, LEC would optimize its return (both in terms of internal network requirements) and maximizing financial returns from third parties by continuing to install its own fiber over time.
to close the gaps on its transmission grid. There was therefore synergy from reinvesting proceeds from leasing existing dark fiber in continuing to build out LEC’s fiber network on the remainder of its transmission grid. As the network was completed, LEC would also gain excess capacity, again in the form of unused dark fiber, along the new route segments. This in turn could also be used to generate additional revenue by adding to the dark fiber leasing portfolio.

LEC also held the unique position of being the only likely catalyst for bringing VCL, ETL and/or another operator together for joint use of a single fiber optic cable. As such, LEC’s incremental investment would be significantly less than the combined avoided costs of the multiple network operators who would lease dark fiber or buy services from LEC. This shared use improved the original business case for installing the dark fiber, and effectively positioned LEC as the catalyst for the shared use. LEC’s role as catalyst added significant value across the market.

By installing its own fiber on the new transmission system routes, rather than allowing a network operator to do so, LEC would thereby acquire and retain the excess dark fiber in the new cable. This inventory would enable LEC to multiply its return on investment and preserve its future upside by allowing competing network operators to “share” use of the same fiber optic cable as dark fiber customers.

Selecting third party hosting for LEC’s distribution system

For its electricity distribution system, LEC selected a business model of hosting third-party telecommunications attachments on its utility poles. LEC’s incremental cash investment required to offer shared use of its distribution poles was modest in absolute terms and insignificant in comparison with the costs avoided by network operators who would use it. The infrastructure already existed, had been paid for and was being maintained with revenue received from electricity customers.

LEC’s incremental cash investment in offering access and shared use of its distribution poles was thus limited to setting up, staffing and maintaining a small organizational unit to handle the business. LEC would also face modest incremental operating costs in initially preparing its poles for hosting and thereafter in maintaining its electricity systems, but only as and when it hosted telecommunications facilities. LEC also confirmed with potential customers that it would be possible to require that these make ready costs be prepaid, so LEC would not be out of pocket.

Moreover, LEC’s existing distribution system had tremendous latent value that could be released and realized as revenue by making it available for shared use by network operators as a hosting facility for commercial fiber optic networks. The exponential increase in end user demand for data volumes was forcing both VCL and ETL to install fiber optic links between their radio base stations, network operations centers and international gateways. Both VCL and ETL had confirmed their need for fiber optic backhaul and their intention to build out fiber to every broadband-enabled tower in their mobile access networks as quickly as they could support it with their capital budgets.

LEC chose not to install its own fiber on its distribution lines. In contrast with its transmission grid, LEC had no current or near term strategic need for fiber on its distribution system. LEC therefore did not want to invest its own capital (whether derived from dark fiber leases on the transmission grid or another source to install fiber on the distribution system). The initial commercial value of such links was also currently quite limited to only those distribution lines which connected to mobile radio cell towers. With the multitude of potential route segments
on its distribution system, LEC was unlikely to have more than one wholesale telecommunications customer on most segments. The network operators would likely pick and choose among these route segments to build only those feeder lines necessary to connect their cell towers. There was therefore no viable business case for LEC to install its own fiber on distribution lines or to provide bulk data services over a network installed on its distribution lines.

**Developing a financial and investment plan**

412. Based on its overall analysis of the commercial opportunities and its own internal planning needs, LEC established completion of its internal communications network as its initial objective. In the immediate future, this objective entailed completion of the fiber network on its transmission grid and potentially adding additional electric utility applications and connectivity that take full advantage of that network.

413. LEC was already using the fiber on existing routes to support teleprotection applications, a SCADA system and internal voice and data communications. However, the fiber network and these applications covered only 19 of LEC’s 42 substations and lacked redundancy between some of those it connected.

414. As its longer term objective, after completing its internal network, LEC planned to use the earnings from its infrastructure sharing business to provide future rate relief to electricity customers and generate unrestricted income to reinvest in underfunded electricity projects. To the extent completing and maintaining the internal communications network, including enhanced electric utility applications, improved efficiency of LEC’s electricity systems and operations, LEC’s primary objective would already provide some element of rate relief to electricity customers.

415. In addition, some of the income from LEC’s commercial telecommunications activities could be used to offset revenue requirements and hence flow through as rate relief for its electricity customers in future rate setting. At the same time, some of the income from LEC’s commercial telecommunications activities might also be treated as “unrestricted income” for purposes of its regulated electricity business allowing it to be reinvested in projects that had not been approved for recovery through electricity rates.

**Nature of LEC’s current businesses**

416. In 2015, at the request of the electricity regulator, LEC formed a wholly owned subsidiary, LEC Communications (Pty) Ltd (LECC), to conduct its commercial telecommunications infrastructure sharing business. LECC has been vigorously pursuing cross-sector infrastructure sharing opportunities for LEC.

**VCL fiber-to-the-tower arrangements**

417. LEC and LECC signed their first infrastructure sharing arrangement with VCL in mid-2015. This arrangement will provide VCL with end-to-end fiber-to-the-tower using LEC’s infrastructure, and appears to be the first such arrangement between an electric utility and telecommunications operator in sub-Saharan Africa.

418. The LEC/LECC-VCL arrangement has the following attributes:

- VCL will acquire indefeasible rights of use (IRUs) in 643 km of dark fiber on LEC’s electricity transmission grid and install its own on LEC’s electricity distribution poles to provide end-to-end high bandwidth connectivity to all of VCL’s 4G-equipped radio base
stations in Lesotho. Vodacom’s fiber extensions will interconnect with LEC-provided fiber at LEC’s substations.

- The infrastructure will be placed in service in three phases between 2015 and 2017. The first phase will extend fiber to all of VCL’s towers in metropolitan Maseru. The second will extend fiber to a large portion of VCL’s towers across Lesotho. The third phase, which will follow LEC’s installation of 185 km of additional transmission line fiber, will enable VCL to reach all its 4G-equipped towers and provide fiber-backed 4G service to its customers in Lesotho.

- The additional installations of 185 km of fiber, made possible by the sharing arrangement with VCL, will extend the reach of LEC’s existing 447 km internal fiber network to meet the requirements of its electricity businesses.

- VCL’s fiber attachments to LEC’s poles will use ADSS cable and be underhung below the electric space and above the minimum ground clearance area. As part of the infrastructure sharing arrangement, VCL will provide LEC with use of one dark fiber pair in VCL’s cables installed on LEC’s electricity distribution poles, which are expected to cover about 10% of LEC’s 18,000 distribution poles. This will facilitate LEC’s future deployment of systems to enable real-time electronic meter reading and other smart grid applications.

- LEC will continue to own all existing and new fiber network on its transmission grid, and conduct all maintenance required to keep this fiber optic network in good working order.

- Payment for the IRU will have two main components, an upfront IRU payment structured to account for the phased rollout of the fiber network as a whole and a hosting and maintenance component, which will be paid annually upfront. Payment for pole attachments will include an upfront make ready fee and annual pole rentals.

- The expansion of the network was based on the shared priorities of LEC and VCL.

- VCL’s access to LEC’s transmission line fiber will be at transmission substations and other defined access points.

- The initial term of the IRUs will be 15 years, with renewal options for VCL, and the term of the pole attachments will be automatically renewable annually at VCL’s option.

**ETL infrastructure sharing arrangements**

419. At the time of preparation of this toolkit, LEC, LECC and ETL are engaged in ongoing discussions around ETL leasing dark fiber on an annual renewable basis on selected routes to supplement ETL’s existing fiber network. LEC, LECC and ETL are also in discussions around ETL leasing pole attachment space on LEC’s distribution poles.

**8.1.4 Legal, regulatory and policy issues**

420. LEC had held a telecommunications license to operate a private mobile radio (PMR) network for many years. The licensed radio frequencies were and are used by LEC to operate a mobile communications system to support the activities of its utility line crews.

421. In anticipation of providing commercial telecommunications services to third parties, however, LEC had requested a license from the telecommunications regulator, the Lesotho Communications Authority (LCA), in late 2012. The LCA prepared and supplied LEC a draft
telecommunications license based on LEC’s indication at the time that it intended to offer bulk data and Internet services to other network operators at wholesale. However, this draft license did not properly reflect the passive infrastructure business model that LEC had eventually chosen in 2014.

422. On its face, the Communications Act 2012 did not require LEC to possess a telecommunications services license in order to engage in a passive telecommunications infrastructure business. However, the LCA has expressed its position that a license is required under the Act. On this basis, LECC has applied for the requisite license.

423. The purpose of LEC establishing LECC as a separate telecommunications subsidiary, as requested by LEWA, the electricity regulator, was to facilitate structural and accounting separation of the infrastructure sharing business from the electricity businesses. Under Lesotho’s regulatory framework, all income generated by the LEC’s electricity businesses or the use of electricity rate base assets is regulated income, and generally must be accounted for as income of the electricity businesses and applied toward LEC’s revenue requirements on which its LEC’s electricity tariffs are based. On the other hand, all telecommunications income is generally unregulated income which is not taken into account in meeting LEC’s revenue requirements or establishing its future electricity tariffs, and can generally be used by LEC for any lawful purpose.

424. However, because the business involves passive infrastructure which will continue to be jointly used by LEC, ownership and control of the infrastructure will remain in LEC. The subsidiary, LECC, will primarily act as a commercial agent of LEC in dealing with passive infrastructure customers.

425. LEC has proposed to LEWA that it approve incentive regulation whereby revenue from the passive infrastructure business be shared between LEC and its electricity ratepayers rather than trying to calculate a proportion of the cost of the shared infrastructure to remove from the regulatory asset base. As of this writing, LEC has not yet received confirmation from LEWA as to whether the regulator will require cost sharing or will instead substitute revenue sharing as requested by LEC.

8.1.5 Lessons learned

LEC is a great example of an electric utility commercializing its passive infrastructure, in the form of excess fiber on its transmission lines and space on its distribution poles. LEC carefully studied market demand and shaped its commercial offerings to meet the services that the country’s telecommunications operators needed while remaining mindful of its own strengths and weaknesses. The entire transaction between VCL and LEC was planned and negotiated entirely voluntarily without legal compulsion, serves the commercial and strategic interests of both parties, and is probably one of the more innovate cross-sector infrastructure sharing transactions that has been agreed in sub-Saharan Africa.
8.2 RailTel (India)

8.2.1 Introduction

426. This case study examines the telecommunications business of RailTel Corporation of India Ltd. (RailTel), a wholly owned subsidiary of Indian Railways.\textsuperscript{111} It focuses on the history of and context for the establishment by Indian Railways of RailTel as a separate entity for the commercialization of telecommunications assets deployed along rights of way of Indian Railways and highlights RailTel’s commercial success with cross-sector infrastructure sharing in India.

8.2.2 Background on RailTel

427. Indian Railways is the state-owned railway company of India with over 65,000 route-km of railway track.\textsuperscript{112} It operates the largest railway track network in Asia and the second largest under common management globally.\textsuperscript{113} RailTel is a wholly owned subsidiary of Indian Railways, which in turn is wholly owned by the Government of India through the Ministry of Railways.

428. Indian Railways was initially reliant entirely on the Department of Telecommunications, the former state-owned monopoly provider of telecommunications, for its internal communications needs. In the early 1970s, Indian Railways began deploying its own internal communications systems to increase circuit efficiency on its rail lines. It utilized overhead telephone lines, quad cables, microwave systems and other available technologies. In 1983, the Railway Reforms Committee decided to replace the existing communications systems and install a dedicated fiber optic telecommunications network with the goal of increased safety, reliability, availability and serviceability.

429. In 1988, Indian Railways commissioned its first fiber optic network, located in Mumbai. The network comprised 60 route-km across 28 stations and was used for train operation and control. The expansion of the Indian Railways fiber optic network was slow, growing to only approximately 4,000 route-km over the next decade. Although Indian Railways was only using a small portion of the available capacity, it was unable to commercialize its excess capacity under the existing regulatory and policy environment.

8.2.3 Telecommunications business of RailTel

Decision to enter into telecommunications business

430. Motivated by the Government of India’s New Telecom Policy, 1999 (described below), Indian Railways decided to form a separate entity to market and exploit remaining capacity on its fiber optic network, generate additional revenues and use these revenues to further expand the network. The creation of a new telecommunications subsidiary would permit Indian Railways to maintain its focus on its core activity of rail operations.

431. In September 2000, RailTel was formed as a commercial public sector undertaking, independent from Indian Railways, with a mandate to modernize the Indian Railways communications network and to significantly contribute to the realization of the goals and objectives of the New Telecom Policy, 1999. The existing fiber optic network of Indian Railways,

\textsuperscript{111} Unless otherwise indicated, information included in this case study was provided by RailTel.

\textsuperscript{112} Indian Railways, “Track/Route Kilometres” (as of Dec 2015).

\textsuperscript{113} Indian Railways, “Evolution” (as of Dec 2015)
then approximately 4,500 route-km, was transferred to RailTel on its formation in 2000 in exchange for 100% of the equity of RailTel. The equity would be held by the President of India through the Ministry of Railways. Indian Railways did not receive any cash or other compensation in the transaction.

*Telecommunications network of RailTel*

432. On its formation, Indian Railways assigned RailTel an irrevocable right to use the rights of way of Indian Railways, comprising approximately 65,000 route-km of railway track and passing through 7,000 railway stations across India. The original rights of way granted to Indian Railways were primarily for laying tracks, but also included the rights to use incidental infrastructure, such as construction of communication towers and the laying of cables for signaling and other communication functions. No modification to the scope of these rights of way was necessary to permit RailTel to lay additional fiber cables or provide commercial telecommunications services over these cables.

433. In 2001, RailTel began rolling out fiber optic cable along national railway routes, laying over 25,000 route-km by 2006 and over 45,000 route-km by early 2015. As of April 2015, RailTel was in the process of deploying another 5,000 route-km. For its last mile and other access networks, RailTel has acquired rights of way directly from local authorities. As of April 2015, RailTel’s network reached over 4,300 towns and cities across India, including many in remote and rural areas.

434. RailTel’s fiber optic network consists of armored 24-fiber cables deployed in ducts. Four fibers in each cable are dedicated for use by Indian Railways though they are maintained by RailTel. A centralized network management system in New Delhi manages the network with a backup system in Secunderabad/Kolkata.

435. In addition to its fiber optic backbone network, RailTel has rolled out:

- an MPLS-IP backbone network with points of presence in 40 cities to provide virtual private network services, broadband Internet access and multicast services;
- a Next Generation Network in 36 cities for carrying voice-based traffic as well as data and value added services; and
- a fiber access network in over 100 major cities in India.
Nature of RailTel’s business

436. In 2002, RailTel began offering wholesale bandwidth services to telecommunications network operators.\footnote{Railtel Corporation of India Ltd., “Milestone” Railtel, \url{http://www.railtelindia.com/profile/milestones.html} (last visited 11 Feb 2017).} RailTel promoted its services through direct marketing and sales to India’s
telecommunications operators. The initial services utilized by these operators were leased line services and co-location of telecommunications equipment on its fiber network and its towers.

437. RailTel initially leased dark fiber on its backbone network to telecommunications customers. However, it subsequently decided against offering dark fiber on its backbone network for two reasons. First, dark fiber leasing generated less revenue than the leased line services for which there was ample demand. Second, RailTel’s network became attractive to enterprise customers, in part because of the exclusive rights of way it acquired from Indian Railways. Leasing dark fiber to telecommunications operators would allow them to utilize the network to compete against RailTel for these same enterprise customers.

438. RailTel’s fiber optic infrastructure was initially used extensively by all of India’s mobile network operators to roll out their networks. Operators continued to rely heavily on RailTel’s network until around 2008 when increased competition and the introduction of new operators led to a significant decrease in mobile tariffs. Many operators resorted to building their own networks, which would incur costs in the short term but ensure long term sustainability by eliminating network and infrastructure leasing. Many of these operators, as well as other entities, have since built competing fiber optic networks along public roads. Yet nearly all major mobile network operators still use RailTel’s network to at least provide redundancy along a separate route.

439. RailTel’s telecommunications operator customers as of December 2015 include all major telecommunications operators in India.

440. In 2005, RailTel launched the first STM-16 network in India. It also began offering services to non-telecommunications customers, including:

- virtual private network services to enterprises, banks education institutions and government entities;
- dedicated Internet bandwidth to enterprises and education institutions; and
- dark fiber leasing to cable television operators.

441. More recently, RailTel has added other services to its portfolio, including:

- data center services;
- audio/video conferencing (telepresence) services in facilities in major cities;
- Railwire, a retail broadband initiative that utilizes partnerships with local network operators; and
- consultancy services for execution of IT and telecommunications projects.

442. As RailTel is ultimately owned by the Government of India, it naturally plays a role in furtherance of the Government’s telecommunications policy initiatives. For example, RailTel is one of the implementing partners in laying fiber optic cable in furtherance of the National Optical Fiber Network. This project is led by the newly formed state-owned Bharat Broadband Network Limited (BSNL). Its goal is to provide connectivity to all the 250,000 Gram panchayat’s (village-
level units of local government) utilizing existing fiber optic cable of public utilities, including RailTel, Power Grid Corporation (India’s state-owned electric transmission utility) and BSNL. One of RailTel’s objectives is to modernize the telecommunications network of Indian Railways for safer and more efficient train operations. Every station on RailTel’s network has been provided with fiber based links to support Indian Railways’ data connectivity needs, including its passenger reservation and ticketing systems. RailTel also provides data connectivity among Indian Railways’ field organizations and offices of the Ministry of Railways, among other services. By outsourcing most of its communications needs to RailTel, Indian Railways is able to focus on its core activities and avoid major telecommunications capital expenditures.

As of late 2015, Indian Railways is in the process of introducing Wi-Fi services at its stations. RailTel is serving as implementation partner and will lead the design, operation and maintenance of the new services, including facilitating marketing and revenue collection. To achieve this, RailTel has partnered with Google, making its passive infrastructure available for use. Finances of RailTel

RailTel’s network roll-out was financed with Rs 4 billion from a consortium of banks led by the State Bank of India and Indian Railway Finance Corporation, the dedicated financing arm of the Ministry of Railways. These loans were repaid in full by January 2013, and as of 2015, RailTel is debt free, does not receive any funding from the Government of India, and uses its own revenues to finance network expansion.

Because RailTel is independent from Indian Railways, its sole shareholder, it files its own annual reports in accordance with Indian accounting rules. In its 2014-15 financial year, RailTel declared total gross revenues of Rs 5.55 billion with a net profit of Rs 1.21 billion.

Initially, RailTel was required to share 4% of its gross revenue with Indian Railways plus a fixed amount of Rs 113.4 million as compensation for use of its rights of way. This formula proved too burdensome to RailTel and was revised in 2006 to eliminate the fixed amount and increase the percentage of gross revenue share to 7%. For RailTel’s 2014-15 financial year, this revenue share amounted to Rs 192.7 million. RailTel also pays annual dividends to Indian Railways. The revenue sharing and dividends are the sole compensation that RailTel pays to Indian Railways.

As Indian Railways utilizes four fibers in each of RailTel’s 24-fiber cables, it bears a proportionate cost of capital expenditures for network deployment. In most cases, Indian Railways will initiate a project to lay fiber cable along portions of its track. Indian Railways will then pay RailTel for the cost of laying the cable plus a 13% execution charge. Railways will then transfer 20 fibers on the cable to RailTel in exchange for additional equity. Less often, RailTel will initiate a project to lay cable based on its own business requirements and will transfer four fibers to Indian Railways at cost with no execution charge. Under both scenarios, RailTel performs maintenance


118 Gross revenue excludes licensing fees paid by RailTel.
on all of the cables and Indian Railways pays RailTel for one-sixth (4 fibers/24 fibers) of that maintenance cost.

449. RailTel did not achieve its first profitable year until 2007, seven years after it began operations.\textsuperscript{119} This was primarily due to expenditures made on procurement of equipment during the initial roll out of its services and expansion of its network and the burdensome revenue share with Indian Railways which was later reduced. Since 2007, its annual profits have grown each year.

\textbf{8.2.4 Legal, regulatory and policy factors}

450. The formation of RailTel was motivated largely by policies in India that encouraged cross-sector infrastructure sharing. In particular, as part of the New Telecom Policy, 1999, the Government of India opened up national long distance services to private operators, introducing competition in the market. To support this new competitive environment, the Government encouraged cross-sector infrastructure sharing by public utilities:\textsuperscript{120}

\textit{Usage of the existing backbone network of public and private power transmission companies / [Indian] Railways / GAIL, ONGC etc. shall be allowed immediately for national long distance data communication and from January 1, 2000 for national long distance voice communications.}

451. While no government entity regulates cross-sector infrastructure sharing \textit{per se}, the Telecom Regulatory Authority of India (TRAI) is India’s telecommunications sector regulator. The TRAI sets ceilings on the tariffs that can be charged for \textit{leased line services}. However, as of April 2015, RailTel claims that its tariffs have high discount structures and therefore are effectively freely negotiated in the market. RailTel’s pricing is not otherwise directly regulated. However, its telecommunications operator customers have aspects of their pricing to customers and other operators regulated, and this regulation has an impact on how RailTel can price its services to these customers.

452. The Department of Telecommunications, under the Department of Communications & Information Technology, is responsible for granting telecommunications licenses. RailTel obtained an Infrastructure Provider Category-II (IP-2) license in 2002 which permitted it to offer leased line services to other licensed operators and enterprises. IP-2 licenses were discontinued in 2005 and the rights it granted were absorbed into the National Long Distance (NLD) license. RailTel holds a NLD license, for its provision of \textit{leased line}, voice transit and \textit{virtual private network services}, and an Internet Service Provider (Category-A)\textsuperscript{121} license, for its provision of Internet services across India.

453. RailTel is also an Infrastructure Provider Category I, which allows it to provide passive assets for telecommunications use such as dark fiber, rights of way, duct space and towers. No license is required, but registration with the Department of Telecommunications is mandatory.\textsuperscript{122}

\textsuperscript{121} Category A covers the entire geographical region of India.
\textsuperscript{122} India, Department of Telecommunications, “Infrastructure Provider,” Government of India, \url{http://www.dot.gov.in/infrastructure-provider} (last visited 11 Feb 2017).
As a wholly state-owned entity, RailTel is subject to procurement policies and falls under the jurisdiction of the Central Vigilance Commission, a government body established to prevent corruption in government institutions and public administration. However, RailTel claims that these obligations have not hampered its ability to move quickly and effectively in a dynamic and competitive market.

A Telecommunications Dispute Settlement and Appellate Tribunal has been established to adjudicate disputes, including those between two or more service providers or between a service provider and a group of consumers. However, RailTel has never been involved in a dispute before this Tribunal.

8.2.5 Lessons learned

RailTel’s cross-sector infrastructure sharing experience has been widely considered a success. This success was only possible due to the policy and legislative actions of the Indian Government which encouraged cross-sector infrastructure sharing by public utilities.

RailTel claims it is the only example in India of a public utility successfully commercializing its rights of way for cross-sector infrastructure sharing. It credits this unique success to RailTel’s structural and accounting separation from Indian Railways. While other utilities created internal departments to commercialize telecommunications assets, RailTel was able to focus entirely on its telecommunications businesses with its own sales and marketing efforts.

The experience has also benefitted Indian Railways, which is able to focus exclusively on operating a railway system. In addition, it has been able to leverage RailTel’s expertise to improve its services. For example, Indian Railways expects up to 400 railway stations to have access to Wi-Fi as a result of the current partnership between RailTel and Google.

RailTel’s extensive fiber network has permitted telecommunications operators to provide services in large areas of the country that were previously unserved or underserved with limited capital expenditures. Even today, when most major telecommunications operators rely on their own fiber optic networks buried along public roads, RailTel’s network provides redundancy along a separate route. It has also expanded its service offerings to include a wide range of IT and telecommunications services for retail and wholesale customers. RailTel credits itself as a major contributor of proliferation of telecommunications services in India.

8.3 CEC Liquid Telecom (Zambia)

8.3.1 Introduction

This case study examines the telecommunications business of CEC Liquid Telecom, an equal joint venture of the Copperbelt Energy Company Plc (CEC) and Liquid Telecommunications Holdings Limited of Mauritius (Liquid Telecom). It focuses on CEC’s experience as an equal joint venture.

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125 Khan, Danish. 2015.
126 Unless otherwise indicated, information included in this case study was provided by CEC Liquid Telecom.
electricity transmission and distribution company entering into a telecommunications business, Liquid Telecom’s entry into the Zambian telecommunications market, and the ensuing joint venture between the two companies to commercialize the telecommunications assets of CEC.

8.3.2 Background on CEC and Liquid Telecom

The Copperbelt Energy Corporation Plc (CEC)

461. CEC is a Zambian power transmission electricity distribution company that owns and operates high-voltage transmission and distribution systems. CEC supplies electricity to Zambia’s mining companies based in the “Copperbelt” region of Zambia, known for its copper deposits, and more recently, a copper mine in the Democratic Republic of Congo (DRC). Since 2005, it has also diversified into fiber optic telecommunications.

462. In 2014, CEC accounted for 39% of Zambia’s electricity generation. Its electricity generation capacity is set out in the Figure below:

Figure 25: CEC’s electricity generation capacity

<table>
<thead>
<tr>
<th>Business element</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity sales to the mines</td>
<td>4,281GWh</td>
<td>4,208GWh</td>
</tr>
<tr>
<td>Transmission losses</td>
<td>2.84%</td>
<td>2.93%</td>
</tr>
<tr>
<td>Standby generation capacity</td>
<td>60MW</td>
<td>80MW</td>
</tr>
</tbody>
</table>

Source: CEC

463. CEC was originally formed in 1952 as the Northern Rhodesia Power Corporation to secure a power supply to Zambia Consolidated Copper Mines Limited (ZCCM), which operated a number of copper mines in Zambia’s Copperbelt. In 1954, it was renamed the Rhodesia-Congo Border Power Corporation, with a mandate to supply reliable power to mines in Zambia and neighboring Congo by interconnecting separately-run thermal power stations in the mining belt at the time. In furtherance of this mandate, it constructed a 220 kV power line in 1956 from the Congo’s Katanga province to Kitwe in Zambia bringing hydroelectric power to Zambia’s mining industry for the first time.

464. At Zambia’s independence in 1964, the Rhodesia-Congo Border Corporation was renamed the Copperbelt Power Company, which it remained until 1986, when it was incorporated into ZCCM as its power division. It became CEC in 1997 when it was sold off to Cinergy Global Power (U.S.) and the National Grid (U.K.) in a privatization, which together owned 77% of the

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129 The Congo was later known as Zaire (1965-1997), and since 1997, as the Democratic Republic of the Congo (DRC).


131 Ibid.
newly-formed company. In 2007, the company was again sold to Zambian Energy Corporation. In 2008 it listed 25% of its shares on the Lusaka stock exchange.

**Figure 26: Summary of the history of CEC**

<table>
<thead>
<tr>
<th>CEC over the years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s: Rhodesia Congo Border Power Corporation</td>
</tr>
<tr>
<td>1964-1982: Post-independence: Copperbelt Power Company (CPC)</td>
</tr>
<tr>
<td>1982-1997: ZCCM Power division</td>
</tr>
<tr>
<td>1997-present: Copperbelt Energy Company Plc</td>
</tr>
</tbody>
</table>

Today CEC’s majority shareholder is Zambian Energy Corporation (Ireland) Limited (ZECI), which owns a 52% stake of the company. ZCCM Investments Holdings PLC (ZCCM-IH), which is the successor company to ZCCM, still holds a 20% stake in CEC.

**Liquid Telecom**

Liquid Telecom, a subsidiary of Econet Wireless, is a major data, voice and IP services provider in Eastern, Central and Southern Africa that supplies fiber optic, satellite and international carrier services to Africa’s largest mobile network operators, ISPs and businesses of all sizes. It also provides payment solutions to financial institutions and retailers, as well as data storage and communication solutions to businesses.

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467. Liquid Telecom was founded in 2004 as a privately-owned, Mauritius-based holding company. Originally a satellite and voice operator, in 2009 the company launched a high-speed, cross-border fiber optic cable network linking various countries in Southern Africa to the United Kingdom. As of 2015, it has operations with wholesale, enterprise and retail operations in 15 locations across Africa and beyond. As of 2017, its fiber network stretched over 40,000 km. Its wholesale network offers connectivity to five major submarine cable systems in the region, WACS, EASSy, SEACOM, SAT 3 and TEAMS.

468. When CEC Liquid Telecom was formed, Liquid Telecom had a presence in neighboring Botswana and Zimbabwe, as well as in Kenya, Lesotho and South Africa, but not yet in Zambia. The joint venture with CEC facilitated Liquid Telecom’s entry into the Zambian market, connecting the country’s existing fiber optic cable network with submarine cable systems landing in Zimbabwe.

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### 8.3.3 Telecommunications business of CEC Liquid Telecom

**CEC’s initial entry into the ICT sector**

469. One of the conditions of CEC’s privatization in 1997 was that the purchasers of CEC would be required to invest in telecommunications infrastructure by retrofitting the entire existing telecommunications network with optic fiber.\(^{135}\)

470. In 2005, CEC made the decision to commercialize its fiber optic cable network in order to diversify its business. The new telecommunications business was initially operated by a telecommunications department within CEC. However, in 2006, CEC decided that it needed to find a fully-fledged company to run the telecommunications side of its business. It engaged Realtime Technology Alliance Africa (Pty) (Realtime), a well-established ISP, which provided retail telecommunications services to most of Zambia’s large corporate entities, as its partner and bought a 50% stake in the company.

471. No additional license or right of way was required to retrofit CEC’s power lines with fiber optic cables. CEC had already been granted the right of way by means of a wayleave pursuant to section 15 of the 1995 Electricity Act from the Zambian Ministry of Lands.\(^{136}\)

**Formation of the joint venture**

472. By 2011, Realtime was not in a position to commit to the additional investment required to regionalize the fiber optic network, let alone to manage the telecommunications requirements of larger mobile phone customers that could come with the planned expansions.\(^{137}\) As a regional fiber infrastructure builder and operator, with a terrestrial fiber network linked to the submarine cable networks, Liquid Telecom was a natural partner for such a venture. In 2011, CEC entered into the joint venture with Liquid Telecom. This partnership would help extend CEC’s backbone infrastructure throughout Zambia and provide international connections to its fiber optic network.

473. From Liquid Telecom’s perspective, CEC’s established presence in Zambia, its existing fiber cable network, and the potential for leveraging its regional power transmission lines around the Copperbelt to lay further fiber optic cables were motivating factors for entering into the joint venture. Zambia was also seen as a strategic market for Liquid Telecom given its central location in Sub-Saharan Africa, and its potential to become a “nerve center of communication for the region.”\(^{138}\)

474. The equal joint venture between CEC and Liquid Telecom was announced in early 2011 and received clearance from Zambia’s Competition and Consumer Protection Commission in July of that year. CEC and Liquid Telecom each committed an initial investment of US$15 million in the joint venture. CEC additionally contributed its customer base and transferred its existing telecommunications infrastructure to the new entity under an indefeasible right of use (IRU) arrangement, although ownership of the power transmission infrastructure remained with CEC.

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\(^{135}\) Interview conducted with CEC Liquid Telecom.

\(^{136}\) Ibid.

\(^{137}\) Ibid.

While the new entity runs the commercial telecommunications business of both CEC and Liquid Telecom in Zambia, CEC carries out the operation and maintenance of the fiber optic cable network for an arm’s-length service fee. Given that it is Liquid Telecom rather than CEC bringing its telecommunications portfolio and expertise into the joint venture, CEC’s role in operating and maintaining the cable network helps to ensure the 50:50 balance in the relationship between the two shareholders.

475. After the joint venture was formed, Realtime and CEC Liquid Telecom were operated as separate companies, with CEC owning a 50% share in each company. In 2012, the CEC Liquid Telecom board decided to merge CEC Liquid Telecom and Realtime, a transaction that was finally completed in May 2015 when Liquid Telecom acquired the remaining 50% shares of Realtime.139

Nature of CEC Liquid telecom’s business

476. Since its formation in 2011, CEC Liquid Telecom has constructed a fiber optic network within the main commercial centers in Zambia and provided two international links to submarine fiber optic cables through Zimbabwe to South Africa, linking Zambia to other African countries and other continents. As of 2015, CEC Liquid Telecom is in the process of constructing a third fully redundant route out of Zambia through Livingstone as part of its Lusaka-Livingstone-Victoria-Falls fiber project. As of 2015, CEC Liquid Telecom has become one of Zambia’s main carriers of international Internet traffic.

477. CEC Liquid Telecom operates primarily as a wholesaler of transmission capacity services, with its backbone infrastructure in Zambia now spanning from Chirundu along the Zambezi River that marks the border between Zimbabwe and Zambia to Kasumbalesa, the border town between Zambia and the DRC’s Katanga province. In an interview, the CEO of CEC Liquid Telecom noted that the company had already rolled out 683 kilometers of backbone fiber in Zambia, had retrofitted around 520 km of OPGW owned by CEC in the Copperbelt, and was in the process of rolling out a further 560 km of fiber optic cable nationally to connect all provincial towns to the network, with the bulk of the investment being spent on laying fiber cables along railway lines.140 CEC Liquid Telecom also provides some last mile fiber to residential homes in Lusaka and the Copperbelt as part of its fiber to the home (FTTH) project.141

8.3.4 Legal, regulatory and policy factors

478. Zambia’s telecommunications sector was first liberalized in 1994. At the time, the state-owned Posts and Telecommunications Corporation (PTC) operated both the postal and telecommunications services in Zambia and also regulated these sectors. The 1994 Telecommunications Act (1994 Act) dissolved the PTC, established a separate regulator, the Communications Authority of Zambia (CAZ) to regulate the telecommunications and postal sectors, and created two new state-owned entities, the Zambia Telecommunication Company

(ZAMTEL) and the Zambia Postal Corporation (ZAMPOST) to run telecommunications and postal services in Zambia, respectively.

479. The 1994 Act also opened up the telecommunications market to new entrants in all segments except the public switched telephone network and the international gateway, which were maintained as the preserve of ZAMTEL. However, little progress was made in improving the breadth and quality of telecommunications coverage in the country following the liberalization of the sector. After an extensive multi-stakeholder consultation with the private sector, civil society, academia, and government, a National ICT Policy was adopted in 2006 by the Ministry of Transport, Works, Supply, and Communications with the aim of promoting investment and building human capacity in the telecommunications sector to further the country’s sustainable national development and policy reduction goals.

480. Improved access to and uptake of telecommunications services through the creation of a competitive and inclusive telecommunications sector has been a national priority in Zambia since the country’s 2005 five-year national development plan. A National ICT Policy was adopted in 2006 to guide the development of the sector.

481. In 2009 the Zambian government enacted the Information and Communication Technologies Act (No. 15) (ICT Act), which replaced the 1994 Act. The ICT Act sought to “provide a conducive and enabling regulatory environment that will foster a competitive and efficient ICT sector in Zambia.” It implemented some improvements to the legal and regulatory framework in relation to the regulation and licensing of the telecommunications sector, and facilitated the sharing of infrastructure through open access and colocation provisions, as well as a simplified procedure for obtaining access to public or private land for the purpose of laying fiber optic cable. The ICT Act renamed the CAZ as the Zambia ICT Authority (ZICTA) and empowered it as an independent legal body to regulate the telecommunications sector with a broader mandate and greater autonomy from the Ministry of Transport, Works, Supply, and Communications.

482. In 2010, the Government issued Statutory Instrument No 34 of 2010, which effectively ended ZAMTEL’s monopoly on the international gateway by drastically reducing the cost of the license fee to operate internationally and thereby encourage private sector companies operating in the telecommunications sector to connect with telecommunications infrastructure in the region.


144 ICT was included as a priority sector in Zambia’s Fifth National Development Plan 2006-2010 with a view to promoting “a stable, fair and competitive investment climate that facilitates the development of Zambia as the hub for meteorology, information and communications technology in the region”.


145 See sections 41, 43, 61, and 63 of the ICT Act (No. 15) of 2009.

Since its establishment, ZICTA has been promoting the sharing of infrastructure to accelerate the laying of fiber optic cables, as well as the connection of Zambia’s fiber optic cable network with regional networks. This has facilitated CEC Liquid Telecom’s retrofitting of CEC’s power transmission lines with fiber optic cable, as well as its 2014 expansion of its fiber optic cable network in North Western Province in Zambia and to all the provincial capitals by capitalizing, in large part along existing railway lines.\textsuperscript{147} While ZICTA has encouraged shared use, open access and colocations of telecommunications infrastructure, it has not coordinated, or required the coordination of the investments in fiber optic cable networks of the public utilities across the country.

\textbf{8.3.5 Lessons learned}

CEC Liquid Telecom’s cross-sector infrastructure sharing experience in Zambia has been considered a success. The policy and legislative actions of the Zambian Government to promote the ICT sector reduced the regulatory barriers to expansion of CEC Liquid Telecom’s optic fiber network along existing infrastructure rights of way. However, CEC Liquid Telecom’s success is also an example of a successful commercially driven arrangement between parties with common interests. It also shows the value of an infrastructure owner partnering with an experienced telecommunications operator to effectively commercialize telecommunications assets.

\textbf{8.4 Baltic Optical Network (Estonia)}

\textbf{8.4.1 Introduction}

This case study examines the structure and formation of the Baltic Optical Network (BON), a commercial alliance comprising a regional fiber optic network spanning Estonia, Latvia and Lithuania.\textsuperscript{148} It also provides detail on the Estonian portion of the BON, operated by Televõrgu Limited (Televõrgu).

\textbf{8.4.2 Background on BON}

\textit{Overall network}

Established in August 2002, the BON is a commercial alliance among three telecommunications operators from three countries: Televõrgu from Estonia, Latvenergo AS (Latvenergo) from Latvia and Data Logistics Center from Lithuania.\textsuperscript{149} This commercial alliance allows each of these three operators to provide telecommunications services to customers across three OPGW networks constructed by each country’s state-owned electric utility. Each operator is thus able to provide coverage to customers across the entire region.

The three networks comprising the BON have collectively over 8,000 km of OPGW (up to 24 fiber pairs) installed along electric transmission lines in Estonia, Latvia and Lithuania.\textsuperscript{150} The transmission capacity of this OPGW network is STM-16 (2.5 Gbps).\textsuperscript{151}

\textsuperscript{147} TeleGeography. 2015. “CEC Liquid Telecoms to Spend USD15m on Infrastructure Upgrade.”

\textsuperscript{148} Unless otherwise indicated, information included in this case study was provided by Televõrgu.

\textsuperscript{149} BON (Baltic Optical Network) website, \textit{BON}, Baltic Optical Network (as of Dec 2015).

\textsuperscript{150} Ibid.

\textsuperscript{151} Ibid.
**BON in Estonia**

488. The Estonian portion of the BON utilizes infrastructure owned by Eesti Energia AS (Estonian Energy), the Estonian state-owned energy company. In 2000-01 Estonian Energy updated its electricity infrastructure and installed **OPGW** on its electricity transmission lines. The **OPGW** was installed for internal uses, including operation of a **SCADA** system and provision of internal telecommunications.

489. Initially the **OPGW** network was operated by an internal department of Estonian Energy that was previously responsible for operating the existing copper line telecommunications infrastructure. In 2001, Estonian Energy formed Televõrgu as a wholly owned subsidiary responsible for management and operation of the **OPGW** network, staffed with the same personnel that had operated the internal department.

490. At the same time, the Estonia’s telecommunications sector was in the process of liberalization. The monopoly of the state-owned telecommunications operator was terminated and competition was introduced into the sector. Televõrgu saw an opportunity to provide commercial telecommunications services in addition to the services it provided to Estonian Energy. It entered the market as a wholesale provider of capacity to mobile operators and **ISPs**. By 2010, only 25% of its business was dedicated to servicing Estonian Energy.

491. In 2012, Estonian Energy decided to sell Televõrgu to focus on its primary electricity business. It was purchased by Tele2 Estonia AS, a mobile operator that was one of Televõrgu’s primary customers.
492. At the time of writing, Televõrgu’s network includes over 2,700 km of OPGW installed on Estonian Energy’s electricity infrastructure. Estonian Energy continues to own the OPGW, but Televõrgu retains the rights to operate and manage it.

493. Televõrgu’s fiber networks extend beyond the OPGW infrastructure to include other networks in Estonia, including metro fiber networks in urban areas. Televõrgu operates as a carrier’s carrier, providing backbone transmission capacity services to television service providers, ISPs, state owned companies and traditional telecommunications operators, including competitors of its parent company.

![Figure 29: Televõrgu’s network](source: Televõrgu)

**Brief description of BON in Latvia and Lithuania**

494. The Latvian portion of the BON is operated by Latvenergo AS (Latvenergo), a public utility company engaged in generation of electricity and thermal energy and provision of telecommunication and information technology services. Latvergo provides approximately 90% of all electricity generated in Latvia, satisfying more than a half of the electricity demand in Latvia. All shares of Latvenergo are owned by the government and held by the Ministry of Economics.

495. The Lithuanian portion of the BON is operated by Data Logistics Center, which was established in 2010. Data Logistics Center is part of Lietuvos Energija group, a state-controlled

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entity which operates power and heat distribution and supply, natural gas trade and distribution as well as construction and maintenance of power plants and the electricity grid in Lithuania.\(^{156}\)

### 8.4.3 Commercial structure

496. The BON is not a legal or commercial entity. Rather, it is a commercial alliance among three separate and independent telecommunications operators. Customers engage with one of the operators to find solutions that may span the networks of these three operators under the alliance. In some sense they operate as competitors, as customers may compare the specific solutions and pricing offered by each of the three operators. The three operators meet frequently to coordinate their services and resolve technical and commercial issues that arise.

### 8.4.4 Legal, regulatory and policy issues

497. As a purely commercial alliance of three separate telecommunications operators in three countries, there are no specific regulatory or policy developments that apply specifically to the BON. However, each operator is subject to the domestic policies and regulatory frameworks in its home country, including requirements of the EU.

### 8.4.5 Lessons learned

498. BON is an excellent example of regional sharing of electricity infrastructure for telecommunications use. Within each country, existing OPGW resources held by public utilities are made available for commercial telecommunications services. The formation of BON as a transnational alliance was not driven by policy or regulatory forces, but rather by the commercial desire of three telecommunications operators to extend the reach of their networks beyond the confines of their respective nations’ borders.

### 8.5 Kennedy Interchange (United States)

#### 8.5.1 Introduction

499. This case study examines the construction of the Kennedy Interchange, a roadway construction project in Atlanta, Cobb County, State of Georgia, United States. This project was unusual, if not unique, in that two electrical utilities and several telecommunications utilities jointly constructed a duct bank in a road construction project and shared in the cost this construction. The joint construction benefited taxpayers and ultimately the utilities’ rate payers by reducing the costs of the project.

#### 8.5.2 Background on the Kennedy Interchange

500. In the late 1980’s, the Kennedy family\(^{157}\) wanted to sell an undeveloped tract of land that they owned in Atlanta. The property was located near the intersection of I-75 and I-285, two major interstate highways.\(^{158}\) This intersection was in one of the busiest areas of Atlanta near a local

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\(^{157}\) The Kennedy Interchange was ultimately named after the family that owned the property which, to the authors’ knowledge, has no immediate relationship to the well-known American political family.

\(^{158}\) Unless otherwise indicated, information included in this case study was provided by Thomas Jackson, former Manager of Joint Use and DOT at Georgia Power Company from 1995 to 2001 and Supervisor Joint Use and DOT from 1989 to 1995.
shopping mall and the Galleria complex, a collection of hotels and shops. It was generally a very desirable location for future real estate development. However, it was difficult for the Kennedy family to market the property as ripe for development for a number of reasons.

501. First, there was no direct road connection to or from I-75 or I-285. Only Akers Mill Road, a two-lane road, provided limited access to the property. It could not be easily expanded and directed to one of the highways because it ran adjacent to an electrical substation owned by Georgia Power Company (GPC), the local electricity transmission and distribution company. Moving the substation was cost prohibitive.

502. Creating new road access would also be difficult. The property was blocked on one side by the Rottenwood Creek National Scenic Area, which, under federal law, could not be disturbed. This made construction of an entirely new road impossible. The property was also located at the bottom of a large hill, about 40 feet below the surrounding terrain. The elevation change was abrupt making access difficult, even from the existing Akers Mill Road.

503. The businesses in the shopping mall and the Galleria complex also desired better access to the area from I-75 and other locations in that direction. Under a development regime created by the State of Georgia, these businesses had previously formed a special tax district, the Cumberland Development Authority (CDA). The CDA had been collecting a one-percent sales tax on customers, the proceeds of which could be used for development of roadways and infrastructure that were approved by the State.

504. The Kennedy family and the CDA saw an opportunity to cooperate for mutual benefit. They agreed to work together to construct a new four-lane road that would connect the Kennedy family property and the shopping mall and surrounding businesses with I-75. The family agreed to donate the rights of way required for the road to traverse their property to connect with the shopping mall and the businesses. The CDA agreed to provide funding for the project, by directly providing resources and organizing any shortfall from other sources. They jointly engaged an engineering firm to develop plans for the area.

505. The plans were soon developed into a proposal which the CDA submitted to the Georgia Department of Transportation (DOT), the state agency responsible for, among other things, planning, constructing, maintaining and improving the State of Georgia’s roads and bridges. DOT agreed to be the project manager and provide limited funds, with the balance of the funding coming from CDA and Cobb County. CDA, using the funds from the sales tax, and Cobb County, using infrastructure funds, would provide the rest. The estimated cost of the project was US$100 million.

8.5.3 Joint construction of infrastructure

Motivation for construction of the duct bank

506. Several utilities had existing underground facilities that would have to be relocated if a new road was constructed in the area. These included telecommunications utilities Bell South and AT&T, cable television utility Smyrna Cable and electric utilities GPC and Cobb EMC. GPC also had above-ground 115 kV distribution lines that extended from the substation and were installed

on a right of way that ran along the Kennedy property. These would have to be moved to accommodate a new road.

507. Once the plans were approved by DOT, it was time to approach the utilities that owned facilities in the area about the potential conflicts. GPC was the primary concern, as it owned the substation, the 115 kV electric distribution lines serving the substation and related rights of way and buried duct lines carrying electric distribution lines. The estimated cost for relocating just GPC’s ducts and the distribution lines exceeded US$3 million.

508. It soon became apparent that additional utilities would need to install ducts. AT&T had a switching center located near I-75 that would be accessible from the new road and an overpass crossing I-75. Many utilities needed access to the AT&T facility because it was a major switching center in the area.

509. Finding an appropriate place to locate the new ducts lines was challenging. The nature of the terrain prevented any construction along the edge of the road, the location where the ducts would typically be buried. As a result, the only place to install the new duct lines was in a duct bank in the median of the new road.

Cost sharing for joint construction

510. DOT contacted the utilities to see if they were interested in participating in a duct bank. By bringing in other utilities, and requiring them to contribute to construction costs, DOT could reduce its costs of construction. The duct bank would complicate the project because safety codes mandated that electrical and telecommunications ducts required separate “vaults,” the places where necessary periodic connections were made along the duct. On the new bridge, space was limited in the median so the ducts would have to run along each side of the bridge, not the best of locations for future work or maintenance.

511. On one section of the road, there the telecommunications companies wanted, collectively, 26 ducts and GPC wanted 8 for a total of 34 ducts on that section. On other sections, fewer utilities participated.

512. It was agreed that the cost of construction of the duct banks would be shared by the participants based on the percentage of the ducts a company wanted in that section of the road. For example, if a utility wanted 4 ducts in the section that had 34, then it would pay 4/34ths of the construction cost. The telecommunications companies would be responsible for the cost of construction for the telecommunications vaults, and Georgia Power Company and Cobb EMC would be responsible for cost to construct the electrical vaults.

513. Construction of the four-lane road and bridge began in 1996 and took about two years to complete, including relocating all of the ducts and the 115 kV electric distribution lines. The entire project was known as the Kennedy Interchange. The new four-lane road, eventually named Cumberland Boulevard, allowed easier access to shopping mall and the Galleria complex. With the new road in place, Cobb County was later able to construct a convention center in the area. The Kennedy family was soon able to sell their property. After donating the rights of way across their property to the project, about 70 acres remained for development. As of 2015, there have been three multiistory buildings constructed on the land that comprised their property, with space remaining for future development.
8.5.4 Lessons learned

514. The project was a success and provides an excellent example of how utilities from multiple sectors, including direct competitors, can work together to reduce costs on an infrastructure project. In addition, the leadership of the DOT, a state agency, helped to bring together these various stakeholders to allow for cooperation and cost sharing.

8.6 Bombay Gas (India)

8.6.1 Introduction

515. This case study examines the telecommunications business of Bombay Gas Co. Ltd (Bombay Gas), which utilizes piped gas infrastructure buried under Mumbai, India, to lay fiber. This case study is unusual in that the existing non-telecommunications passive infrastructure had not been used for its original purpose in decades.

8.6.2 Background on Bombay Gas

516. Bombay Gas, a privately owned company based in Mumbai, India, was formed in 1863 to install and operate piped gas infrastructure in what was formerly the Presidency of Bombay. Bombay Gas deployed pipes, conduits, service-pipes and other infrastructure under streets and bridges in what is now the city of Mumbai. The completed infrastructure network included 478 km of spigot and soffit cast iron gas distribution mains of diameters varying between 75 mm and 600 mm. The infrastructure construction was entirely funded by the owners of Bombay Gas and did not receive any government or other external funding.

517. Bombay Gas delivered coal-based piped gas to homes and businesses in Mumbai for over a century. In the mid-1980s, the piped gas business was discontinued at the direction of the Government of India. The Government favored development of natural gas, which had greater availability and less environmental issues associated with it than coal-based gas. The infrastructure has not been used for distribution of gas since then. Bombay Gas is now owned and managed by the Jalan family, an Indian family with various interests in real estate, finance, electrical design and equipment manufacturing in India and the United Kingdom.

8.6.3 Telecommunications business of Bombay Gas

Decision to enter into telecommunications business

518. About a decade ago, Bombay Gas recognized the utility of its existing gas infrastructure and rights of way for laying fiber optic cable. It tried to market its infrastructure to telecommunications operators and had negotiations with at least one. However, at the time there was not sufficient demand for fiber in Mumbai to justify a dense fiber infrastructure that the gas infrastructure would provide.

519. While Mumbai’s residents largely obtain natural gas in cylinders, Mahanagar Gas Limited (MGL), a natural gas distribution company, is currently rolling out new gas ducts to service homes and businesses in Mumbai. Bombay Gas considered offering its infrastructure to MGL to retrofit the existing pipeline with new ducts for natural gas distribution. However, MGL was ultimately

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160 Unless otherwise indicated, information included in this case study was provided by Bombay Gas.
not interested. Bombay Gas believes this is primarily because its piped gas infrastructure has been unused and unmonitored for 30 years and would require extensive work to make it usable by MGL. Much of the distribution infrastructure requires repair or replacement and some sections have been removed to accommodate water mains or stolen. Bombay Gas also cites commercial differences with MGL.

520. Ultimately, Bombay Gas decided to launch its own telecommunications business, using the existing gas infrastructure and rights of way to lay fiber optic cable throughout Mumbai. There was no government policy encouraging or incentivizing this use. Rather, the idea came to the owners from a foreign investment banker who saw the potential of monetizing the rights of way.

*Telecommunications network of Bombay Gas*

521. In 2012, Bombay Gas laid its first 4 km of fiber as a proof of concept. As of May 2015, it had laid a total of 106 km of fiber. Five cables were deployed in most ducts, except where space was limited and only three cables could be accommodated. Except for 1.5 km of 96-core cables used in the initial rollout, all of the cables deployed are 144-core. Hand holes are created every 50 to 100 meters along the route to ensure easy access for building connectivity and creating new spurs. The deployment of the telecommunications infrastructure was privately funded by the Jalan family.

522. Bombay Gas has relied mostly on the original rights of way granted in the Gas Company Act of 1963. No modifications to the rights of way were required to accommodate the telecommunication equipment installed in the existing infrastructure or its usage. Most of the existing rights of way were for use underneath footpaths alongside roads. However, as roads have expanded over the last 150 years, some of the infrastructure that was originally installed under footpaths along the side of a road are now located near the center of the road. The Municipal Corporation of Greater Mumbai, the primary agency responsible for urban governance in Greater Mumbai, does not permit Bombay Gas to use the gas infrastructure in the center of roads to minimize disruption to traffic during installation and in case of maintenance or repairs. In those situations, Bombay Gas has been able to acquire new rights of way under the new footpath. Bombay Gas also obtained new rights of way for portions of the network that could not use the existing infrastructure.

*Nature of Bombay Gas’ business*

523. As of May 2015, the main business of Bombay Gas is leasing dark fiber to India’s telecommunications operators for backhaul and trunk connectivity. Bombay Gas provides point to point routes with connectivity to specific towers or network operation centers along the route. As of mid-2015, its customers include Vodafone India and Idea Cellular, with Bharti Airtel expected shortly. To avoid competing with its customers, Bombay Gas does not provide or expect to provide any enterprise services or even its own Wi-Fi services to retail users.

524. The pricing of its dark fiber leasing is not publicly available. It is negotiated on a case by case basis and depends on quality, length of the lease and other factors. Initially Bombay Gas priced its dark fiber leasing at a deep discount to attract customers.

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525. Bombay Gas currently has limited competition. Indian mobile network operators are laying their own fiber networks in Mumbai, but face right-of-way issues and are often limited to using aerial fiber which is more likely to succumb to vandalism and the elements. MGL is not rolling out fiber as it constructs its new natural gas infrastructure.

526. Bombay Gas plans to offer additional services over time. As of May 2015, it plans to start offering transmission capacity services to telecommunications operators allowing for backhaul on demand. To address a shortage of available spectrum, Bombay Gas also plans to offer BTS hoteling with remote shared microsites. This technology allows telecommunications operators to use and reuse spectrum more efficiently through the use of microcells that only operate over short distances in high density areas. In the next 1-2 years, Bombay Gas plans to roll out blanket Wi-Fi coverage for operators to use for traffic offloading. Finally, in 2-3 years Bombay Gas hopes to offer carrier neutral dark fiber to the home with speed capabilities of up to 1 Gbps.

8.6.4 Legal, regulatory and policy issues

527. The Telecom Regulatory Authority of India (TRAI) is India’s telecommunications sector regulator. The Department of Telecommunications, under the Department of Communications & Information Technology, is responsible for granting telecommunications licenses. Bombay Gas is an Infrastructure Provider Category I, which allows it to provide passive assets for telecommunications use such as dark fiber, rights of way, duct space and towers. No license is required, but registration with the Department of Telecommunication is mandatory.\(^{162}\)

8.6.5 Lessons learned

528. The success of Bombay Gas demonstrates that cross-sector infrastructure sharing can extend to use of repurposed non-telecommunications infrastructure that is no longer in service. It also provides an example of the use of passive infrastructure owned by the private sector to deploy a telecommunications network.

8.7 Electricity Supply Corporation of Malawi

8.7.1 Introduction

529. This case study examines the decision of Electricity Supply Corporation of Malawi (ESCOM), Malawi’s monopoly provider of electricity generation, transmission, distribution services, to establish and operate a commercial telecommunication business. It highlights ESCOM’s decision to enter into a partnership with a Globe Internet, a Malawi ISP.\(^{163}\)

8.7.2 Background on ESCOM

530. ESCOM is the state-owned electric utility in Malawi, incorporated as a private company in 1988. It has exclusive control over electricity generation, transmission and distribution in Malawi. Nearly 95% of Malawi’s electricity supply is provided by hydropower from hydroelectric power


\(^{163}\) Unless otherwise indicated, information included in this case study was provided by ESCOM.
plants. These plants, plus a diesel plant and standby thermal plants, yield a total installed capacity of 288 MW.  

531. ESCOM’s transmission system spans 2,395 km, with 1,121 km of lines operated at 66 kV and 1,274 km of lines operated at 132 kV. The lines are constructed on both wood and steel structures. The system does not interconnect with the transmission system of neighboring countries, other than by supplying electricity to small cross-border towns in Mozambique and Zambia through ESCOM’s distribution system. ESCOM distributes electricity to approximately 325,000 customers. 

532. In 2004, ESCOM established a fiber optic unit tasked with providing reliable fiber connections between substations and power stations to support a SCADA system, teleprotection applications and internal voice communications. The unit installed fiber on a small portion of the transmission system. The installations were part of line refurbishments, so the true cost of the installation is not known to ESCOM. The fiber installed on the transmission system was 12-core OPGW at the transmission level and 12-core ADSS at the distribution level. Two pairs were reserved for ESCOM exclusive use.

8.7.3 Telecommunications business of ESCOM

ESCOM’s initial entry into the telecommunications sector

533. In around 2009, ESCOM’s fiber optic unit became motivated for commercial reasons to commercialize its existing fiber assets. It hired Globe Internet (Globe), a Malawi ISP and telecommunications service provider, as a consultant to advise it on commercialization of its fiber. However, in part due to institutional limitations and regulatory restrictions, very little materialized over the next two years. Near the end of this period, two telecommunications operators, Telekom Networks Malawi (TNM) and Access Communications (Access), each leased a dark fiber pair between Blantyre and Lilongwe from ESCOM.

ESCOM’s partnership with Globe

534. Six months after entering into the initial dark fiber leases with two customers, ESCOM decided to provide transmission capacity services instead of leasing dark fiber. To facilitate this change, ESCOM entered into a 10-year revenue sharing partnership with Globe.

535. ESCOM senior management has explained this shift in strategy as due to a lack of available fiber pairs on their 12-core fiber. Also, ESCOM was concerned that telecommunications operator customers who leased dark fiber would make substantial returns by selling unused bandwidth in competition with ESCOM. To address this latter issue with its existing fiber leasing customers, ESCOM required that those customers only carry their own traffic. However, ESCOM believed that this might not be a viable option for smaller operators. According to Globe senior management, in addition to these motivations, ESCOM’s lack of experience and credibility as a telecommunications operator required a partnership with an experienced player.

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536. Under the terms of their partnership, Globe is responsible for ESCOM’s network expansion and provision of bandwidth services. ESCOM is still able to offer dark fiber leasing on its pre-existing lines and Globe is able to enter into arrangements with customers that do not involve ESCOM’s network. Globe senior management has described their arrangement with ESCOM as a public private partnership. Globe, as a major ISP, considers itself a customer of ESCOM, in addition to its partner.

537. Globe has expanded ESCOM’s fiber network to the borders with Zambia and Mozambique using ADSS installed on ESCOM lines and has established a metro fiber extension in Blantyre on 11 kV lines with 36-core ADSS. As of 2014, ESCOM had 700 km of fiber in total, though most of its substations are still not connected by fiber.

538. As of 2014, according to ESCOM senior management, ESCOM’s fiber optic revenue is derived 30% from dark fiber leasing and 70% from transmission capacity services under its partnership with Globe. However, these figures may not accurately capture the revenue breakdown as it is not clear if they take into account the revenue sharing arrangement with Globe on transmission capacity services. Also as of 2014, the Globe/ESCOM partnership had overtaken incumbent Malawi Telecommunications Limited to acquire the largest share of the “carrier of carriers” market in Malawi, with all major ISPs and operators Airtel, TNM and Access as customers.

539. Although ESCOM does not require a telecommunications license for internal communications, to conduct its fiber optic business it has obtained a carrier of carriers license, an ISP license and an interconnect license.

8.7.4 Lessons learned

540. ESCOM’s success in Malawi is an example of a public utility partnering with an experienced telecommunications services provider to help it succeed in entering the telecommunications services business.

8.8 Adif (Spain)

8.8.1 Introduction

541. This case study examines the dark fiber business of Administrador de Infraestructuras Ferroviarias (Adif) and its recent agreement with Red Eléctrica de España (REE) to manage its network.

8.8.2 Background on Adif and REE

Background on Adif

542. Adif is a state-owned utility under the Ministry of Transport and Public Works. It is the owner and manager of 15,130 km of railway lines and owns all of the corresponding rights of way. Adif is the legal successor to Red Nacional de los Ferrocarriles Españoles (RENFE), which was established in 1941 as part of a nationalization of Spain’s railways.167

543. Adif began operations in 2005 as a result of the Spanish Railway Sector Law, which divided RENFE into the newly formed RENFE Operadora, which would have the responsibility for

167 Unless otherwise indicated, information included in this case study was provided by Adif.
railway operations, and Adif, which would have the responsibility for railway infrastructure. This legislation was passed in compliance with the European First Railway Directive 91/440/EC, which requires member states to separate the organizations that operate the infrastructure from the ones that operate the services.

544. Adif has a fiber optic network that was traditionally used for internal railway uses. It has commercialized excess capacity on that network for use by telecommunications companies. As of 2014, Adif was Spain’s largest provider of dark fiber. It managed 25% of Spain’s commercialized dark fiber optic network throughout the country (17,868 km), consisting of 11,793 km along the long haul trunk railway lines, 3,036 km along urban metro networks and 3,039 km along the high-speed railway network. Its network also connects to Spain’s islands and to the telecommunication networks in France and Portugal. Because of the expansion of residential broadband and mobile data in metropolitan areas, Adif has invested in expansion of its network along the metropolitan railway rings of Madrid and Barcelona, as well as Bilbao, Seville and Valencia. In addition, Adif owns 6,600 square meters of co-location facilities equipped for communication equipment located in a total number of 158 points and 430 telecommunications towers.

545. In 2014, Adif tendered a concession to manage and use its fiber optic network. This excluded the fiber optic capacity required for the rail operations. Neo Sky and REE submitted tenders, with the latter winning with a €433.7 million bid for a 20-year concession. Under the negotiated agreement, Adif continues to own its fiber optic network.

**Background on REE**

546. REE is a partly state-owned and public limited Spanish corporation that was founded by the Government in 1985 to operate the Spanish electricity transmission system. REE started to deploy fiber optic cables along electricity transmission lines in 1989 and commercialized excess fiber optic capacity after the liberalization of the telecommunications sector in 1998.

547. With the new concession to manage Adif’s network, REE doubled its network under management to 32,000 km (Figure 30 below shows Adif’s network in green and REE’s network in black). Apart from taking over operations, REE will also gain Adif’s costumers, which include Al-Pi, British Telecom, Cableeuropa, Cogent, Colt, Islalink, Jazztel, Orange, Telefónica, Vodafone and VSNL. In order to manage, commercialize and lease the dark fiber optics network, REE created the Red Eléctrica Infraestructuras de Telecomunicación (Reintel) subsidiary in 2015.

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8.8.3 Motivations for the Adif-REE agreement

548. Prior the concession agreement with REE, Adif’s fiber optic network commercialization division was its most profitable entity. It was estimated to have contributed to annual earnings before interest, taxes, depreciation and amortization of €49.5 million.

549. REE re-contracted Adif to provide maintenance on its leased dark fiber network under a servicing agreement for an annual fee of €9.5 million per annum for the 20-year concession. According to Adif the concession agreement with REE was part of a broader restructuring process to offload non-core railway network activities. Additional funds were also desperately needed to finance in the expansion of its high-velocity railway network (Adif’s debt is expected to be above €17.3 billion at the end of 2015). Adif believes that the servicing agreement makes economic sense for both parties given that Adif already has to service its fiber optic network related to the

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172 Two additional contracts were signed as part of the agreement for Adif to support the management of the network (€3.1 million per annum for 6 years) and further services under the provision by Adif High Speed mandatory services (€4.3 million per annum for 20 years).

173 Collantes, Pau. 2015.
railway operations (which was not outsourced). Hence there are significant economies of scale that led to this servicing agreement.\textsuperscript{174}

\textbf{8.8.4 \textit{Legal, regulatory and policy issues}}

550. In 2014, Spain passed the telecommunications act 9/2014, which encourages the provision of telecommunication infrastructure in urban development projects and civil works funded with public resources. The Government will make this telecommunications infrastructure available to potential telecommunications operators on a non-discriminatory basis.

551. Furthermore, the process to acquire licenses has been simplified and licenses are not required except for use of scarce resources. Development of other facilities and infrastructure generally only requires a statement of compliance. No authorization is needed for execution of technological innovation improvements that do not alter the underlying infrastructure.\textsuperscript{175}

552. The Comisión Nacional de los Mercados y la Competencia (CNMC), the independent national regulatory authority, which replaced the Comisión del Mercado de las Telecomunicaciones (TMC) in 2013, is responsible for implementing the new act. Apart from the telecommunications sector, it also regulates the audiovisual, transport, postal and energy sectors.

\textbf{8.8.5 \textit{Lessons Learned}}

553. Both Adif and REE are examples of non-telecommunications utilities whose commercialization of excess dark fiber has been very profitable.

\textbf{8.9 \textit{Tokyo Metropolitan Government (Japan)}}

\textbf{8.9.1 \textit{Introduction}}

554. This case study examines the communications business of the Tokyo Metropolitan Government.\textsuperscript{176} It focuses on the history and the context for the establishment by its Bureau of Sewerage of an optical fiber network throughout Tokyo, Japan and commercialization of excess capacity and excess space in existing fluid conduits.

\textbf{8.9.2 \textit{Background on the Tokyo sewage system}}

555. Construction of Tokyo’s sewage system began in 1884 and today it extends to all of Tokyo’s special wards. It includes 13 water reclamation plants, two sludge plants, 15,700 km of sewers and 84 pumping stations. The system controls flooding, opens and closes tide gates and provides efficient wastewater management. The plants treat approximately 5.5 million cubic meters of sewage each day.

556. In the 1980s, the city found itself burdened by a shortage of skilled manpower to maintain the sewers. A sewer treatment plan operator’s strike in 1998 further strained the system. Policymakers reacted with an innovative plan to deploy fiber optic cables to connect sewage pumping stations, treatment plants, control structures, and other system facilities. This fiber

\textsuperscript{174} Ibid.


\textsuperscript{176} Information from this case study was provided by Dr. Jey K. Jeyapalan, P.E., who served as a consultant to CityNet Telecom and Nippon Hume for the transfer of knowledge and experience on sharing conduits for multiple functions.
network provided the communications infrastructure to support the functioning of an unmanned sewage management system capable of providing 24/7, reliable operations at a much lower cost.

557. Instead of laying new conduits for the new fiber optic network, which would require new construction in highly trafficked city streets, Tokyo Metropolitan Government embraced deployment of cables in existing fluid conduits. Tokyo Metropolitan Government and its wholly owned subsidiary, Tokyo Metro Sewer Service Corporation, promoted this concept widely as their Sewer Optical Fiber Teleway Plan. The deployment of the cables commenced in 1988, and by 2001, the Tokyo sewage system had more than 1050 km of 12-pair fiber cables in the sewer.

8.9.3 The telecommunications business of Tokyo Metropolitan Government

Shared usage of fluid conduits

558. Shared use of fluid conduits is not a new concept. Early attempts were made in Paris over a century ago but poor results led to abandonment of the concept of installing multiple utilities in the same underground tunnels. There also were a number of projects in the United States in the twentieth century where telephone companies were permitted to lay their cables inside of drinking water lines. The idea of using existing fluid conduits for additional functions not originally intended, emerged again in 1983 in dams in the States of West Virginia and Virginia in the United States.

Nature of Tokyo Metropolitan Government’s business

559. The fiber optic cable installed in Tokyo’s sewage system has far more capacity than needed to operate the sewage management system. Accordingly, Tokyo Metropolitan Government recognized the potential for additional revenues in commercializing the excess capacity. Unused dark fiber is leased to major telecommunications operators such as Nippon Telephone and Telegraph and KDDI. In addition to leasing dark fiber, Tokyo Metropolitan Government also leases space in existing fluid conduits needed to install additional fiber optic cables.
8.9.4 Lessons learned

560. Tokyo Metropolitan Government has taken advantage of an innovative technology to share existing infrastructure and deploy fiber optic cables throughout the city of Tokyo with minimal disruptions. This has allowed it to generate additional revenues to support the sewage system. It has also allowed telecommunications operators to access a fiber optic network that has wide reach within a congested urban area.

8.10 Ghana’s Electricity Transmission Line Fiber

8.10.1 Introduction

561. This case study examines the Government of Ghana’s interventions in the market for OPGW installed by the Volta River Authority (VRA) on its electric transmission lines.

8.10.2 VRA commercializes excess internal network capacity

562. VRA is a state-owned enterprise established on 26 April 1961 under the Volta River Development Act. Originally, VRA’s core business included both generation and transmission of electricity.¹⁷⁷ VRA had installed OPGW on its electricity transmission lines for internal use in providing protection, SCADA and other services in the operation of its transmission business. VRA’s OPGW network was established to provide operational telecommunications services for the electricity transmission network, such as teleprotection, signaling, voice and data transmission.

At the time, VRA had 2,000 km of OPGW with a minimum of 18-fiber cores (9 fiber pairs) installed on its transmission lines, but typically only required a maximum of three fiber pairs on each transmission line. In 2004, VRA established Voltacom as a wholly owned subsidiary to commercialize the excess capacity on its fiber network.  

### 8.10.3 Government restructures VRA’s role in electricity sector

563. In 2006, the Government began a process of restructuring the electricity sector, which would include, among other steps, separating VRA’s electricity transmission functions from its power generation and other functions. As part of this electricity sector restructuring, VRA’s electricity transmission assets and functions were to be transferred to Ghana Grid Company Limited (GRIDCo), which was newly incorporated as a wholly state-owned enterprise to serve as the designated national electricity transmission provider pursuant to the Volta River Development (Amendment) Act 2005. GRIDCo began operations in 2008 following the completion of the transfer of core transmission staff and power transmission assets from VRA to GRIDCo.

564. Today, GRIDCo is by law the sole electricity transmission licensee in Ghana and is regulated as an enfranchised monopoly in its rates and activities. GRIDCo owns and operates about 5,000 km of high voltage transmission lines across Ghana. As part of the West African Power Pool integrated regional transmission grid, GRIDCo’s electricity transmission grid interconnects with the electricity transmission grids in Cote d’Ivoire, Togo and Benin and construction of a new transmission line to link GRIDCo’s grid to the grid in Burkina Faso has also commenced.

### 8.10.4 Government restructures then privatizes VRA fiber business

565. As early as January 2004, Government officials indicated publicly their intention to remove ownership and control of the fiber provided by Voltacom from VRA. The Government also mentioned similar plans to separate ownership and control of the fiber assets of Ghana Telecommunications Company Ltd (Ghana Telecom), which was the state-owned former incumbent fixed line monopoly operator. The intention was to establish an open access national backbone utility which was independent of any operator.

566. In keeping with these intentions, during the process of transitioning VRA’s electricity transmission assets (including its OPGW assets) to GRIDCo, the Government approved the transfer of rights of use of VRA’s fiber assets to a state-owned new national fiber optic backbone operator. For this purpose, in late 2007, the Government established National Communications Backbone Company (NCBC) as a wholly state-owned enterprise. NCBC took over management of the excess fiber on the electricity transmission grid (then still operated by VRA), which had been managed by Voltacom since 2004. NCBC was granted a right of use 10 of VRA’s then-existing 18 OPGW fiber cores. No consideration was provided to VRA in exchange for the transfer.

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of rights of use of its spare OPGW fibers to NCBC. VRA therefore lost the opportunity to recover capital or operating income from commercialization of fiber on its transmission grid.

Figure 32: Map of VRA fiber network in mid-2008 (existing in green, planned in red)

During the same timeframe, the Government had in June 2006 signed a US$ 100 million loan agreement with the Chinese government to provide funding to expand the OPGW fiber network. Drawing on the loan facility with the Chinese Government, NCBC also contracted with Huawei to upgrade and expand the OPGW fiber network, and the first phase was completed in December 2007.

As of May 2008, one author summarized the Government’s intentions for NCBC as follows: “The network will be run by a private enterprise on behalf of the Ghanaian government, which wants it to be considered an essential national utility, similar to roads, water and electricity. This is in line with the open access model adopted by some governments around the world.”

However, the Government’s plans for NCBC changed during the process of privatizing Ghana Telecom. Thus, rather than transferring Ghana Telecom’s fiber assets to NCBC, in August

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182 Ibid.
2009, the Government transferred 100% ownership of NCBC to Ghana Telecom pursuant to the purchase and sale agreement by which the Government privatized a 70% stake in Ghana Telecom to Vodafone Group plc. In addition, as part of the transaction, VRA was contractually required not to compete with NCBC for five years, ending in 2013. However, VRA retained responsibility for operation and maintenance of the OPGW as part of its transmission grid. These rights and responsibilities in respect of the fiber on the transmission grid were transferred to GRIDCo together with VRA’s transmission assets in 2008 as part of the electricity sector restructuring.

570. The partial privatization of Ghana Telecom to Vodafone resulted in public outcry over alleged irregularities in the process and the transaction documentation. Among other aspects of the transaction, the inclusion of NCBC was highly criticized. A national election occurred soon after and the previous minority party acquired a majority position in Government. Fulfilling a campaign pledge, in May 2009, the new Government appointed an inter-ministerial review committee to review the transaction and report its findings. The committee completed its work and reported its findings to Government several months later. The Government published the report in full in October 2009.

571. Among other conclusions, the Vodafone review report concluded, as one of 18 separate findings, that: “The National Communications Backbone Company (NCBC) which was added to create the Enlarged GT [Ghana Telecom] Group was grossly undervalued. The fibre optic network is a strategic national asset and should have remained an independently operated infrastructure as originally intended.” The committee recommended that “The NCBC must be decoupled from the Enlarged GT Group and a public entity established with a nationalistic mandate and given the resources to complete and expand the backbone to all socially and economically necessary locations to enable it act as the foundation for Government's ICT Policy.” For its part, the Government said it “has taken note of the Committee's findings and recommendations, and will soon make public its position on the recommendations.” In the end, not action was taken to reverse the inclusion of NCBC as part of the package of assets partially privatized to Vodafone and it remains part of Vodafone’s Ghana operations, now rebranded as Vodafone Wholesale.

Subsequent to its acquisition of Ghana Telecom, Vodafone has caused former Ghana Telecom, now branded as Vodafone Ghana, to continue investing in fiber in addition to the fiber it inherited from Ghana Telecom and NCBC in 2008. Today, Vodafone has significant national coverage in Ghana as depicted in the following map.

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Vodafone Wholesale acts as a wholesale capacity provider of fiber optic services in Ghana and beyond in West Africa to ISPs and mobile network operators. It offers both national fiber backbone products and international IP and international private leased line services. Meanwhile, the non-compete applicable to GRIDCo as VRA’s successor has expired. Based on inquiries from Vodafone’s competitors in the retail access markets, and with encouragement from the Government, GRIDCo has undertaken to prepare a Telecommunications Master Plan which envisions that GRIDCo will enter the wholesale market to provide dark fiber and/or bandwidth services as well as continue to develop its own internal communications network. Since 2008, GRIDCo has constructed several new transmission lines and replaced some of its older lines, and all of these new or rebuilt transmission facilities include OPGW, giving GRIDCo as

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substantially larger footprint than that covered by the fiber it hosts for Vodafone. In addition, GRIDCo has several additional new or replacement transmission lines in the planning stages, and these will continue to enlarge its footprint. GRIDCo’s entry into the wholesale market, planned for 2016, will provide increased competition for Vodafone Wholesale and more options (both in terms of providers and routes) for Ghana’s telecommunications network operators. While Ghana’s wholesale fiber market may have fared worse during the intervening years from 2008 through 2016 than it would have had NCBC remained independent, GRIDCo’s entry into the market may yield a better result going forward than would have subsisted with a single open access national backbone company. Time will tell.

Figure 34: Map of GRIDCo fiber (existing and construction in process) in late 2015

Source: Andrew Johnson based on data supplied by GRIDCo
8.10.5 Lessons learned

The Government of Ghana may have had good intentions in implementing two major telecom policies, first, by creating a national backbone operator and transferring ownership and control of excess dark fiber capacity on the transmission grid, and, second, in including the national backbone operator in the package when the state-owned incumbent operator was partially privatized.

However, the political interference with the fiber commercialization activities of the state-owned electricity transmission utility resulted in a loss of a much-needed revenue source for the utility. The subsequent sale of the national backbone operator, coupled with a non-compete from the national electricity transmission utility, precluded it from re-entering the market with any remaining existing fiber or new fiber for a period of years.

Moreover, by selling the national backbone operator to the parent company of one of the country’s mobile operators, Government forced other mobile operators to choose between purchasing wholesale fiber capacity from their competitor or building their own fiber networks. Apparently, both consequences have occurred to varying degrees. Mobile operators in Ghana have complained about high prices for access to Vodafone Wholesale’s fiber network. In addition, GRIDCo was prevented from commercializing its valuable excess capacity for a minimum of five years. Fortunately, GRIDCo appears now to be undeterred by the past as it makes plans to re-enter the wholesale market for fiber. It hopes not to encounter any further political interference this time around.

8.11 Tunisian Railways

8.11.1 Introduction

574. This case study examines the decision of the Tunisian Railways (Société Nationale des Chemins de Fer Tunisiens, SNCFT) to expand its traditional activity of managing the Tunisian railways network and become an alternative supplier of fiber optic infrastructure.

8.11.2 Background on SNCFT

575. SNCFT is a financially autonomous public company whose mission is to manage, maintain and operate the Tunisian railways network. The network is 2,153 km long, consisting of 23 lines and 200 stations, and reaches remote areas of the country. 187

576. Although Tunisia enjoys one of the most advanced ICT network infrastructures in the region, the country faces significant challenges in providing broadband Internet access to its population at a reasonable cost. This is particularly the case in isolated rural areas. The World Bank estimates that that on average, a family in the lowest 40 percent income bracket in Tunisia would need to spend over 40 percent of disposable income to cover the cost of fixed broadband and nearly 45 percent to cover the cost of mobile broadband. 188

187 Unless otherwise indicated, information included in this case study was provided by SNCFT.

8.11.3  Telecommunications business of SNCFT

Telecommunications network of SNCFT

577. SNCFT has fiber optic infrastructure laid along portions of its network of railway lines. As of late 2014, SNCFT’s fiber optic network is approximately about 1,000 km long\(^{189}\) and is deployed in underground pipes along the railway lines\(^{190}\). The deployment was financed by the SNCFT’s own funds. The fiber optic network is mostly deployed along railway lines in the west and south of Tunisia. It connects the main urban centers in the country, including many technical sites that are very useful for installing broadband equipment by telecommunications operators. SNCFT is also in the process of extending its network, by connecting it with the fiber networks of the national electricity and gas grid, Société Tunisienne d’Electricité et du Gaz, and the national highway company, Tunisie Autoroutes, with a view to building a national backbone. SNCFT is also examining a potential extension project to Algeria.

578. Originally, SNCFT’s fiber optic network was only used by SNCFT for its own railway management needs. However, in response to the legislative changes that permitted use in the telecommunications sector, SNCFT decided to commercialize the excess capacity on its network for use by telecommunications operators. SNCFT’s fiber optic network now provides an alternative to those of traditional telecommunications operators. It also offers customers redundancy in international connectivity via its access to submarine cables.

\(^{189}\) As of late 2014, 500 km were under construction and 800 km are planned after 2015.

\(^{190}\) As of late 2014, SNCFT planned to erect pylons for carrying future cables rather than burying them to reduce costs.
In commercializing its fiber optic network, SNCFT elected to offer dark fiber leases rather than transmission capacity services. It found that operators generally do not wish to purchase IRUs (indefeasible rights of use) and rather prefer dark fiber leases. Sixteen fibers are available for 10-year leases on the links of SNCFT’s South Network, and 4 are available on the Tunis–Sousse–Sfax links. SNCFT directly markets the dark fiber to licensed telecommunications operators. Under the terms of its offer, the leased fiber may not be released to third parties. Operators must
provide their own interconnection links to the access points located in the technical offices of SNCFT. Operators can have cable access every 500 meters.

580. Rates for dark fiber leases vary by segment. They are lower in the inland areas of the country, where demand for dark fiber is lower. The fees charged to the customer is calculated according to a base rate for two dark fibers and by connection. Fees are annual and invoiced by linear meter, but payment is quarterly and payable in advance. SNCFT does not directly maintain its fiber optic network itself. Rather, maintenance is performed by a third party and is paid in part by the operator customers.

581. As of late 2014, only two operators had leased dark fiber from the SNCFT network, Ooredoo and Orange.

8.11.4 Legal, regulatory and policy factors

582. Tunisian policymakers have encouraged the use of telecommunications infrastructure belonging to public utility companies in the transport and electricity sectors. In 2013, the Telecommunications Code was amended to integrate alternative fiber optic infrastructures into the telecommunications sector. These alternative infrastructures would be subject to the same rules and conditions that apply to the public telecommunications networks.

8.11.5 Lessons learned

583. Although considered a success, SNCFT has faced some challenges. In particular, it has found that the typically slow pace of decision making of the public sector, of which SNCFT is a part, is at odds with the constantly dynamic telecommunications market. SNCFT is considering whether operating its dark fiber leasing business through a separate commercial entity, which could have greater autonomy and flexibility, might be able to more effectively respond to the expectations of customers.

8.12 SOGEM (Mali, Mauritania, Senegal)

8.12.1 Introduction

584. This case study examines the decision of Société de Gestion de l’Energie de Manantali (Society for the Management of the Energy of Manatali) (SOGEM) to commercialize unused capacity on OPGW installed on its electricity transmission network.191

8.12.2 Background on SOGEM

585. The Manatali Dam is a 1,460 meter dam on the Senegal River in Mali that regulates water flow to generate hydroelectric energy, provide irrigation resources and ensure navigability.192 The electricity generated by the dam provides power to Senegal, Mali and Mauritania, three Member States of Organisation de la Mise en Valeur du Fleuve Senegal (Organization for the Development of the Senegal River) (OMVS) through a network of transmission lines. SOGEM plans to eventually expand the electricity network into Guinea, the remaining Member State of OMVS.

191 Unless otherwise indicated, information included in this case study was provided by SOGEM.
586. SOGEM was established in 1997 as a public company owned in equal shares by Senegal, Mali and Mauritania. It is responsible for the maintenance and operation of the dam, and the generation of and transmission of electricity along the network.\(^{193}\)

### 8.12.3 Telecommunications business of SOGEM

**Motivation to commercialize excess capacity**

587. SOGEM’s electricity network has 1,728 km of 6-pair OPGW fiber optic cables installed. The installation was financed jointly by the incumbent telecommunications operators in its three constituent countries: Sotelma in Mali, Mauritel in Mauritania, and Sonatel Orange in Senegal. In return, these three telecommunications operators were each granted a right to use a single fiber pair until January 2018. SOGEM believes they are likely to wish to continue using SOGEM’s fiber thereafter. SOGEM currently has two fiber pairs that are unused, and may be able to make an additional pair available in 2018.

588. SOGEM’s unused fiber presents a significant strategic economic opportunity and has substantial financial value. Its fiber network could be used to transmit telecommunications traffic to and from existing submarine cable landing stations in Dakar, Senegal and Nouakchott, Mauritania and inland to Bamako, Mali. It could thus improve access to international communications networks and the global Internet in all three SOGEM countries.

589. As of late 2015, SOGEM plans to extend its network with an additional 1,960 km of transmission lines by 2019, including lines to Conakry, Guinea and other lines in Senegal, Mauritania and Mali. These extensions could also be equipped with OPGW, enlarging the reach of SOGEM’s fiber network. In addition SOGEM’s electricity network is interconnected with the West Africa Power Pool network, a regional institution that connects the electricity networks of 14 ECOWAS countries,\(^{194}\) and so offers a potentially wide regional reach.

590. The particular strategic economic value of SOGEM’s fiber network arises from the limited amount of alternative open-access backbone networks in the three countries it crosses. As of late 2015, these are effectively controlled by the Orange and Maroc Telecom groups. The lack of

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competition in providing international bandwidth results in very high prices for international bandwidth and Internet access, particularly in Mali. Being a landlocked country, Mali depends on other countries for its access to the submarine cable landing stations. Making SOGEM’s fiber optic cable available for telecommunications services could greatly increase competition among telecommunications service providers addressing the retail market. As a result, the prices of international calls, Internet access and other international data services in the three countries would be expected to decline significantly, boosting usage by the population, businesses and governments of these services.

591. There is likely to be substantial demand and readiness among telecommunications service providers to pay to use excess capacity on SOGEM’s network. Mobile operators and international carrier companies in the region will likely benefit from significant cost savings and business opportunities from using SOGEM’s network.

Considering potential business models

592. In 2014-15, the World Bank financed a consultancy to assist SOGEM in considering several business models for commercializing unused fiber on its network. These ranged from the very simplest in the telecommunications sector value chain all the way up to providing a full set of transmission capacity services. In considering these alternatives, SOGEM was cautious in recognizing that it had no experience as a telecommunications service provider. Its comparative advantage lay in the rights of way, pylons and fiber optic cable itself. It had little comparative advantage in venturing into the market to become a telecommunications service provider, which would present significant risk and cost. Higher levels of involvement in the market therefore would necessitate increasing dependence on partners that had sufficient expertise, experience and even established businesses and customers.

593. SOGEM narrowed the possible business model options to four that met several criteria. The models considered had to respond to the actual demand of the telecommunications market in a manner that would be technically efficient and financially prudent. Each model needed to allow SOGEM to respect its existing contractual obligations to and potential future relations with the incumbent telecommunications service providers. Finally, each model had to minimize unnecessary administrative and regulatory hurdles and ensure that SOGEM itself has sufficient flexibility and motivation to advance the project.

Model No. 1: Dark fiber leasing

594. The first model considered was at the most basic end of the value chain. SOGEM could simply lease the right to use the fiber directly to telecommunications service providers without SOGEM installing any equipment or providing any service. The asset is referred to as “dark fiber” and “passive infrastructure” because it would not involve SOGEM installing or operating any electronic equipment. Under this model a customer would be entirely free to use the leased fiber pair as it wished.

Model No. 2: Dark fiber leasing with customer obligations

595. The second model was based on the first but introduced an obligation on the customer to offer wholesale bulk data services on the fiber in its market. This obligation would address the problem that the number of customers seeking to use SOGEM’s network exceeded the small number of available fiber pairs on it. This model would help unlock competition in the wholesale bulk data services market.
596. Both the first and second models had the strong benefit of simplicity, alignment with SOGEM’s comparative advantage in providing dark fiber and avoidance of risk.

Model No. 3: **DWDM wavelength leasing**

597. The third model increased the involvement of SOGEM in the telecommunications market. SOGEM could install electronic “multiplexing” equipment enabling it to divide the capacity on a fiber optic pair into a large number of wavelengths and lease each of these to the telecommunications service providers (referred to as **“DWDM wavelengths”**).  

598. Under this business model, SOGEM would establish a subsidiary to run the **DWDM wavelength** leasing business, which would enlist the technical support of an experienced telecommunications expertise in the fiber services market. The cost of installation of the necessary equipment in all substations would be rather modest.

599. This model would put fiber optic wavelengths directly onto the market without a new intermediary telecommunications licensee. SOGEM would thus participate in, and have an opportunity to capture some of the economic benefits of, the higher layer of the value chain. The model minimized SOGEM’s disadvantages by outsourcing key aspects of design, operation and marketing to a partner. However, this model introduced the challenging problem of establishing a new subsidiary, hiring personnel to run the business and experts in sales and marketing, engaging a technical partner, and obtaining telecommunications licenses in each country.

Model No. 4: **Transmission capacity services**

600. The fourth model considered required SOGEM’s fullest level of involvement and highest level in the value chain. Equipment could be installed on SOGEM’s network that would enable the provision of a full range of **transmission capacity services** to telecommunications service providers. SOGEM would address the operational and cost disadvantages, and commercial and financing risks, of a bulk data model by involving a third party as a partner. For example, an international telecommunications operator could bring its experience of developing, commercializing and managing **transmission capacity services**. A telecommunications operator might also bring capital to fund the investment, as well as many cost efficiencies not available to SOGEM through discounts on equipment procurement and employment of existing human resources.

601. The partner, through offering disaggregated **transmission capacity services** (instead of leasing or selling dark fiber pairs) would be able to meet market demand. Instead of simply granting the use of the asset at a price fixed today, SOGEM would participate in the growth of the market under the leadership of an experienced operator. The most obvious structure for this scenario would be for SOGEM to grant a 10 to 15-year concession contract over the dark fiber pairs to the international partner’s affiliate(s) and for SOGEM to receive a percentage of the revenues over the course of the concession.

602. This model also had the advantage that it involved bringing in a new entrant telecommunications operator perhaps from outside the region to act as a carrier’s carrier, thereby boosting the region’s wholesale market in international capacity and backhaul services. The impact on the market – competition, reduced prices and economic growth – would likely be high. Although the profitability to SOGEM would depend entirely on what SOGEM would be able to negotiate with the partner, this model would also have substantial economic value to SOGEM. It
would benefit from the synergies and economies of scale and scope of an international operator while limiting SOGEM’s economic investment and risk.

**Further developments**

603. At time of writing, SOGEM has selected the fourth model, [transmission capacity services](#) led by a partner telecommunications operator, and is beginning to explore this model more deeply and move towards implementation. Its decision was based on both the high potential profitability of this model as well as the ability to meet market demand and spur economic growth in the region.

**8.12.4 Lessons learned**

604. SOGEM is still in the initial stages of establishing a commercial telecommunications business. However, it has carefully considered a wide range of potential business models and evaluated them with its own goals, strengths and weaknesses in mind. This careful evaluation process should increase SOGEM’s chances of success.

**8.13 Information Broadband Infrastructure System (Poland)**

**8.13.1 Introduction**

605. This case study examines the development in Poland of the Information Broadband Infrastructure System (SIIS), an electronic GIS mapping system that gathers and presents information on infrastructure deployment in the country.

**8.13.2 Background on SIIS**

606. By the mid-2000’s, Poland lagged behind its neighbors in broadband deployment. With a broadband penetration rate of 13 connections for every 100 inhabitants, Poland had one of the lowest broadband penetration rates in Europe.\(^{195}\) It also had a telecommunications infrastructure gap estimated at over €1.5 billion.\(^{196}\)

607. In 2007, the European Structural Fund allocated over €4.5 billion to Poland in order for the country to increase broadband deployment.\(^{197}\) Using a portion of these resources, the Polish Ministry of Infrastructure, in collaboration with the National Institute of Telecommunications and the Office of Electronic Communications (OEC), Poland’s communications regulator, launched a program to support the development of broadband networks in Poland. This program resulted in the development SIIS, an electronic system that gathers, processes, presents and shares information about existing telecommunications infrastructure, public telecommunications networks, collocation buildings and broadband telecommunications services. Development of SIIS began in 2009 and was completed in late 2012.

608. The primary purpose is to accelerate deployment of broadband infrastructure through information sharing. For example, SIIS enables local governments to obtain geo-referenced information to support public investment in broadband infrastructure. This information allows the various levels of government to have a common understanding of the current level of broadband

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\(^{195}\) OEC (The Observatory of Economic Complexity). June 2011. Presentation sent from the NaN PT TRIS Meeting, Riga, Latvia, 21-22.

\(^{196}\) Ibid.

\(^{197}\) Ibid.
deployment in a given area and identify locations that lack access to broadband and would benefit from a public intervention. SIIS also enables telecommunications operators to identify network access points and passive telecommunications infrastructure for sharing to optimize broadband deployment. Specifically, SIIS provides operators with detailed information to make business decisions on new investment projects, modification of existing infrastructure and market competitiveness. In addition, SIIS has also been used by non-telecommunications businesses and investors to evaluate potential business locations by providing information on access to existing telecommunications technologies.

At the time of writing, SIIS does not yet gather information regarding non-telecommunications infrastructure, but this is expected to be added within the next two years.

### 8.13.3 Legal, regulatory and policy issues

Once the development of SIIS began, it became clear that there were several obstacles for gathering infrastructure information. For example, there were no harmonized rules among local governments, utilities and operators regarding how to assess existing infrastructure. To make matters worse, some operators were reluctant to share information on infrastructure because they feared that there were inadequate legal protections in place to protect the confidentiality of their information. Many of these obstacles were addressed in the Act on supporting the development of telecommunications services and networks (Broadband Act), enabling legislation enacted in May 2010.

Article 29 of the Broadband Act provides “a legal basis of drawing up the inventory of existing telecommunications infrastructure and public telecommunications networks on the territory of Poland (in electronic form) with a separate indication of coverage of the country by optic links, wireless networks and building to enable collocation.” Article 29 further obligates most state and local government entities, public utilities, telecommunications operators and others to send the OEC information related to telecommunications infrastructure. Regulations issued under the Broadband Act clarify which specific information must be provided. This includes routes of backbone and distribution telecommunications networks (indicating the type of technology used), locations of telecommunications nodes, connection points with public telecommunications networks, and collocation buildings, among other telecommunications infrastructure information. These entities are also required to review the information they submitted once each year and submit any updates. Article 29 is limited to telecommunications infrastructure and does not address infrastructure of entities from other sectors.

To give comfort to private operators who are often reluctant to share information on their infrastructure, the Broadband Act preserves the confidentiality of the information collected. The SIIS user interface does not enable the user to identify the operators’ infrastructure. Rather, when a user wants to access information on infrastructure identified through SIIS, the user contacts

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199 Interview with the Office of Electronic Communications.

200 NaN PT TRIS meeting in Riga, Latvia, 21-22 June 2011.


203 Interview with Polish Regulator.
OEC. OEC then in turn contacts the infrastructure owner to obtain permission to share its information. If the infrastructure owner objects, which rarely happens in practice, the OEC tries to find alternative solutions.

8.13.4 Impact of SIIS

613. By the time of writing, SIIS has achieved a large increase in the quantity and quality of information held by OEC on existing telecommunications infrastructure. For example, SIIS has resulted in the identification of over 2,800 locations able to provide collocation of telecommunications equipment. The percentage of villages with no telecommunications node has declined by more than 9 percentage points, but according to OEC this is not the result of increased deployment. Rather it reflects more accurate information collection. SIIS has not yet had a measurable impact on broadband deployment.

8.13.5 Lessons learned

614. Through the development and implementation of SIIS, Poland has begun to assemble a comprehensive and living archive of all telecommunications infrastructure in the country. Implementation of SIIS required a number of regulatory changes necessary to mandate information provision, harmonize rules on infrastructure assessment, and protect confidentiality. Although there has not been a measurable impact on broadband deployment, SIIS is still in its infancy. SIIS is still gathering information on telecommunications infrastructure, and expects to incorporate non-telecommunications infrastructure beginning in the next two years. The effects on broadband deployment need to be monitored over the next few years to measure its success.

8.14 KOSTT (Kosovo)

8.14.1 Introduction

615. This case study examines the steps currently being taken by KOSTT j.s.c (KOSTT), Kosovo’s state-owned electricity transmission, system and market operator, to commercialize excess capacity on its OPGW network.

8.14.2 Background on KOSTT

616. Established in 2006, KOSTT is responsible for, among other things the planning, operation, maintenance, and development of Kosovo’s electricity transmission system. KOSTT has already deployed OPGW along its high voltage transmission network which covers Kosovo’s main urban areas (Pec, Prizren, Pristina, and Mitrovica) and is in the process of retrofitting its international connections to Albania, Montenegro, Serbia, and Macedonia. KOSTT’s OPGW was installed for its internal use. The map in the Figure below shows KOSTT’s transmission lines as of 2013.


8.14.3 Telecommunications business of KOSTT

Motivations for commercializing excess capacity

Kosovo has the lowest GDP per capita in the Balkans, with a young population (median age of 27.8 years), high unemployment rate and large rural population (over 50% of inhabitants). Kosovo’s Ministry of Economic Development (MED) hopes to tackle high unemployment and low growth through the expansion of broadband services, particularly in rural areas, as a means of fostering business opportunities and improving the quality of life of the population. MED hopes to encourage the sharing of public infrastructure to reduce the capital expenditures required to expand fiber optic deployment.

The fiber optic network of KOSTT presents one such opportunity. Excess capacity can be used by telecommunications operators to increase coverage, gain route redundancy, and provide alternatives for international traffic management. For KOSTT, commercialization of excess capacity would present a new revenue stream by further monetizing capital investments it has already incurred for its energy business.

KOSTT already has an extensive electricity transmission network, some of which is already retrofitted with OPGW infrastructure, and for which there are plans to retrofit the remaining interconnecting transmission lines with optic fiber in the coming months.

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KOSTT has not previously commercialized its fiber capacity due to a lack of technical and commercial knowledge of the telecommunications sector. To overcome these difficulties, MED requested the assistance of the World Bank in 2014. With the help of a World Bank-directed technical assistance program supported by Public Private Infrastructure Advisory Facility (PPIAF), MED has now conducted market studies of the broadband sector to forecast demand for the broadband market and assist KOSTT in developing a viable business model.

**Selecting a business model**

After assessing potential business models, KOSTT has opted to lease dark fiber capacity to telecommunications operators to be used in their backbone networks. Given the layout of KOSTT’s network, as shown in the Figure below, KOSTT has concluded that its transmission network is best suited to provide backbone services to telecommunications operator rather than to provide “last mile access.” Little additional capital investments above and beyond what network expansion is already planned would be required to lease dark fiber on its network. The only additional expenses will be operational expenditures in the form of hiring staff to support additional control in installations and handle the commercialization of the optic fiber.

With the help of the World Bank-directed technical assistance, KOSTT has developed a long run incremental cost (LRIC) model to ensure that the excess dark fiber is leased at prices that ensure a positive return on the investment. This cost analysis of the relevant infrastructure assets was based on KOSTT’s internal information as well as regional pricing data. A benchmark of dark fiber price analysis was performed to ensure that KOSTT’s deployment costs are aligned with other similar countries in the Balkans. Using this information, KOSTT prepared a draft reference offer price, but at the time of writing this has not yet been made public.

210 Ibid.
Kosovo’s existing telecommunications operators are KOSTT’s potential customers for excess capacity, but may also serve as its main competitors to the extent they maintain and deploy telecommunications networks using their own infrastructure. Currently the three major telecommunications operators have deployed their own transport networks, and the Kosovo Electricity and Distribution and Supply is also leasing excess capacity to telecommunications operators.

Existing backbone networks will, in many regions operate parallel to KOSTT’s fiber optic cables, but market studies conducted in 2015 have concluded that there are opportunities for all players to operate profitably in the market. Most of the 50 existing broadband providers in Kosovo are likely to be leasing capacity on the infrastructure from Kosovo’s major telecommunications operators, and would likely consider KOSTT’s infrastructure as an alternative. KOSTT’s nationwide network and cross-border interconnections can also offer local telecommunications operators the opportunity to expand their coverage to new parts of the country and to connect to networks in neighboring countries. Finally, the major telecommunications operators may be interested in leasing excess fiber from KOSTT to ensure network redundancy. This is especially critical for operators providing services to enterprises who usually demand service level agreements which include strict terms regarding network failures and therefore require operators to have redundant capacity. Once KOSTT’s transmission lines to the borders are retrofitted with OPGW, other telecommunications operators may also be interested in gaining access to international interconnections.

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8.14.4 Legal, regulatory and policy issues

622. While there is broad support for infrastructure sharing and the commercialization of excess capacity in the fiber networks of public utilities, including KOSTT, MED has struggled to operationalize infrastructure sharing. This has been attributed to a variety of reasons including lack of an operational framework, poor information sharing among public utilities and private telecommunications companies about the opportunities for sharing infrastructure, and a lack of technical capacity in government (policymakers and regulators) to implement shared infrastructure projects. As described above, MED has requested assistance from the World Bank to overcome these difficulties. In addition, MED is also receiving assistance from the World Bank to develop a GIS atlas that will serve as an inventory of existing and planned infrastructure assets so that the scope and opportunities for the sharing of infrastructure can be better visualized by public utilities and telecoms companies.

623. The Authority of Electronic and Postal Communications (Autoriteti Rregullator i Komunikimeve Elektroneike dhe Postare) (ARKEP) is Kosovo’s national regulator for electronic communications and postal services. ARKEP was established in 2004 as an independent regulatory agency and is responsible for, among other things, licensing and supervising the providers of telecommunications services in Kosovo, encouraging the private sector participation and competition in the sectors, and setting standards for all service providers in Kosovo. In 2014 KOSTT notified ARKEP of its intention to commercialize its dark fiber and has subsequently received regulatory approval.

624. While Kosovo has not yet regulated access to or use of dark fiber, the existing European Commission regulatory framework requires access and backhaul network segments to be priced on the basis of LRIC modelling and mandate a reference interconnection offer. It is expected that any legislation Kosovo enacts in relation to dark fiber will follow the existing legislation in the European Union.

8.14.5 Lessons learned

625. KOSTT is in the process of developing a promising commercial dark fiber leasing business. This is a direct result of the Government’s policies to stimulate cross-sector infrastructure sharing, including through seeking technical assistance from the World Bank. At time of writing, market study reports have been completed and an LRIC cost model and draft reference offer price have been developed. Next steps include identifying potential customers and preparing a public reference offer. KOSTT’s efforts will need to be evaluated once the business is launched.

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215 Interview with World Bank representative.

216 Directive 97/33/EC (June 30, 1997) outlines the charges for interconnection and that prices should be based on a price closely linked to the LRIC, and Recommendation 98/195/EC (January 8, 1998) recommends the use of LRIC to assess costs oriented interconnection tariffs for terminating access.
8.15 Portugal’s Rapid Increase in Fiber Access

8.15.1 Introduction

626. This case study examines the contributing factors that led to the rapid increase in access to fiber optic networks in Portugal beginning in 2009. It focuses on three likely contributing causes:

- Autoridade Nacional de Comunicações (ANACOM)’s implementation of statutory powers to ensure access to the infrastructure of incumbent telecommunications operator Portugal Telecom (PT) and ANACOM’s subsequent regulation of access prices;
- a restructuring of the telecommunication market following PT’s spin-off of its cable television (CATV) business, which encouraged PT to invest in expansion of its fiber optic network to homes and buildings (FTTH/B); and
- the implementation of a symmetric regulatory framework that mandated open access to all public infrastructure and established a Centralized Information System (CIS) to coordinate access to and construction of civil works.

8.15.2 Background on Portugal’s increase in fiber access and ANACOM

627. Since 2009, Portugal has seen a rapid increase in broadband access, with access to fiber networks increasing by 35% on an annual basis (see the first Figure below). While still lagging behind many of its EU neighbors in terms of broadband penetration, its FTTH/B access rate is significantly higher. Portugal also performs among the top four countries when it comes to the speed of broadband access (see the second Figure below). This can largely be traced back to the expansion of fiber optic networks, which has increased by around 50,000 customers per quarter. In Portugal FTTH/B technology makes up 22% of total broadband access, while the average among EU Member States is only 8%.

628. As of the second quarter of 2015, there are 56 registered providers of fixed internet access providers in Portugal with three operators dominating the market. These are PT (operating under the MEO brand) (51%), NOS Comunicações, S.A. (35.5%) and Vodafone (13.2%).

629. ANACOM is the postal and electronic communications regulatory of Portugal established in 1989. Its key responsibilities include regulating the telecommunications sector to ensure transparent and equal open access to infrastructure, promote competition among the telecommunication operators and grant rights to operators entering the sector.

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217 Unless otherwise indicated, information included in this case study was provided by the Autoridade Nacional de Comunicações (ANACOM).

218 PT was acquired by Altice Group in June 2015. Although PT currently operates under the brand MEO (Serviços de Comunicações e Multimédia), for the sake of clarity this case study will refer to PT as such. See, “Portugal Telecom continues transformation as MEO brand replaces TMN” European Communications. 28 January 2014. Available at http://www.eurocomms.com/industry-news/9858-portugal-telecom-continues-transformation-as-meo-brand-replaces-tmn# (last visited 11 Feb 2017).

219 In January 2015, broadband penetration was 27.4 per 100 inhabitants as compared to the EU28 average of 31.1 per 100 inhabitants.


221 This constitutes 722,000 households and is the preferred means of access for new customers.
Figure 39: Number of Fixed Broadband Access in Portugal

![Graph showing the number of fixed broadband accesses in Portugal from 2007 to 2015. The y-axis represents the number of accesses, ranging from 0 to 3,200, and the x-axis represents years from 2007 to 2015. The graph includes different technologies such as ADSL, Cable Modem, and Optical fibre accesses, with a forecast line. Unit: Thousands of accesses. Source: ANACOM (2015).]

Figure 40: Fixed Broadband Access in EU28 by Download Speed (January 2015)

![Bar chart showing the percentage of fixed broadband accesses in EU28 countries in January 2015, categorized by download speed. The bars are color-coded to represent different speed ranges: >= 100 Mbps, >= 30 Mbps < 100 Mbps, > 144 Kbps < 30 Mbps. Source: CE, Digital Agenda Scoreboard, January 2015.]

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### 8.15.3 Contributing factors to the increase in fiber access

**Factor 1: ANACOM’s statutory powers to ensure access to the infrastructure of PT and regulatory authority to regulate prices**

630. ANACOM’s statutory powers to regulate access to the infrastructure of PT were a contributing factor to Portugal’s recent increase in fiber access. Article 26 of the 2004 Electronic Communications Law granted ANACOM the authority to regulate access to the telecommunications infrastructure of PT. Specifically, ANACOM was able to mandate that PT create a wholesale reference offer for access to its infrastructure.

631. In July 2004, ANACOM issued a decision obliging PT to offer access to its ducts, poles and other related infrastructures to other telecommunications operators and to publish access price and conditions in a wholesale reference offer. The decision required PT to allocate at least 20% of the internal space within its ducts to operators that request access. The 2004 decision also obligated PT to inform ANACOM annually about its current network specifications and any expansion plans. These asymmetric requirements apply only to PT as the incumbent.

632. In addition, ANACOM has subsequently identified PT as having significant market power in the wholesale market for access to physical infrastructure. Since 2007, utilizing its regulatory authority under the Significant Market Power Regulation, ANACOM has imposed an additional obligation on PT to grant access to its ducts to telecommunications operators. Under this regulation, ANACOM has utilized its authority to review PT’s access prices and determine whether they are excessive.

**Factor 2: Restructuring of the telecommunications sector**

633. The restructuring of Portugal’s telecommunications sector was also a contributing factor to the recent increase in fiber access. In February 2006, Sonae, a large Portuguese company with a diverse portfolio of business, launched a hostile takeover bid of PT. One of the main reasons put forward by Sonae for its bid was that PT lacked competitors in the market. At the same time, ANACOM and Portugal’s Competition Authority were applying pressure on PT to reduce its dominant position in the telecommunications sector. As a means of successfully defending against the takeover bid and satisfying these regulatory pressures, PT decided to spin off its successful CATV and broadband business.

634. Overnight PT lost its dominant position in the cable TV and broadband markets. It now had no CATV business and its remaining broadband business had a similar market share as that of the second largest operator. In order to stay competitive, PT decided that a high-speed triple play package product would be the best strategy to win back market share and rebranded itself as MEO. Rather than investing in ADSL technology, PT invested in expanding its FTTH/B network. Other operators, such as Vodafone, took advantage of PT’s obligations to offer access to its ducts (described above) and piggy-backed on this expansion by installing their own fiber optic networks in these new ducts.

**Factor 3: Implementation of a new symmetric regulatory framework**

635. The implementation of a new symmetric regime also contributed to Portugal’s recent increase in fiber access. In 2008, the Portugal’s Council of Ministers signed resolution no. 120/2008, which established the promotion of next generation access networks as a strategic
priority of the country. Decree Law 123/2009 (2009 Law)\textsuperscript{224} and its amendments establish the legal and regulatory framework that governs construction and access to passive infrastructure for telecommunications use.

636. The 2009 Law imposes symmetric obligations on all owners of public infrastructure, telecommunications and non-telecom, to ensure open access to existing and planned infrastructure. Specifically, it mandated open and non-discriminatory access to all suitable public infrastructure buildings, including piping networks, masts, ducts, inspection chambers, manholes, cabinets or buildings, as well as any other infrastructure that may contain cabling or network equipment. Infrastructure owners were required to make public any future construction to give telecommunications operators the opportunity to participate. In addition, all new urban housing developments were required to include fiber optic cable for connections to fiber networks.

637. The 2009 Law also established CIS to maintain updated information regarding the existing infrastructures. CIS is a GIS tool that incorporates and shares the location, layout and ownership or management of civil infrastructure. It also includes information on planned civil infrastructure construction, allowing interested telecommunications operators to join in construction efforts.

638. ANACOM is charged with maintaining CIS and provide the information to interested parties. ANACOM launched an international tender for the management of CIS in late 2010, but it was closed in 2011 on procedural grounds.\textsuperscript{225} A new tender was launched in early 2014 with the contract awarded in December of that year. CIS is expected to be operational in 2016.

\textbf{8.15.4 Lessons leaned}

639. Portugal’s increased roll out of its fiber optics network in recent years has been impressive. The three factors discussed in this case study likely contributed to this increase by allowing for a more competitive telecommunications sector and reducing costs for operators to expand their fiber optic networks through telecommunications and cross-sector infrastructure sharing. Going forward, ANACOM is hoping to further increase sharing of infrastructure within the telecommunications sector and across sectors through the implementation of CIS.
