ANNEX A

# Selected Country Case Studies

## Morocco

### *Introduction*

Market liberalization, which has been underway since 2003 and a dynamic incumbent operator have led to relatively high levels of broadband uptake in the country. This has recently been helped by investments in low-cost international connectivity and significant e-applications development. This reflects the determination of the Moroccan authorities to promote information and communications technology (ICT) as a force for social cohesion, equality of opportunity, and access to knowledge.

There are three main licensed telecom operators active in the market:[1]

- **Maroc Telecom** (IAM, incumbent) (51 percent owned by Vivendi – French media and telecom group [e.g., Canal+ and SFR], also with holdings in Africa and Latin America)
- **Méditel** (40 percent Orange/France Telecom, 30 percent Caisse de Dépôt et de Gestion [Morocco], 30 percent Finance Com [Morocco])
- **INWI** (formerly Wana) (69 percent owned by Moroccan conglomerate ONA/SNI and 31 percent by Zain [Kuwait])

Maroc Telecom continues to be the leading player in broadband both in fixed and in mobile broadband, despite strong competition from private operators, INWI and Méditel, which have relied heavily on the utility infrastructure of the railroad, power grid, and highway system to extend their backbone networks throughout the country.

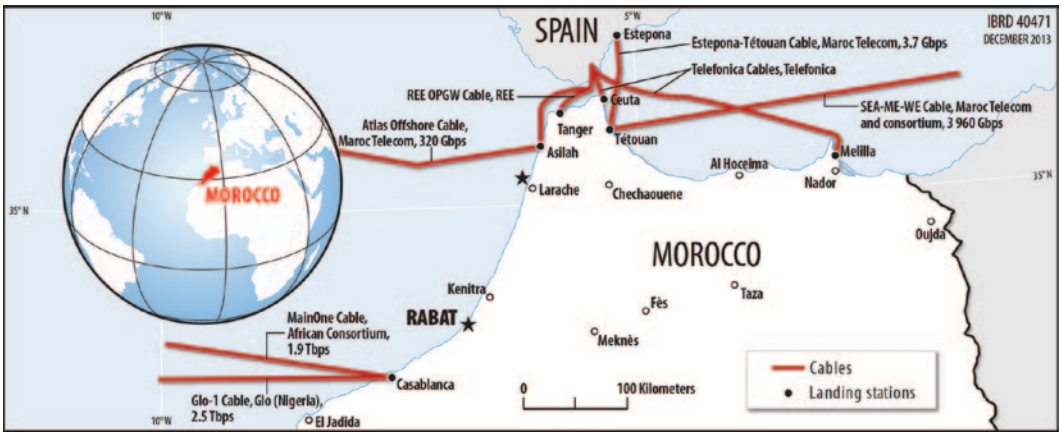
### *International/Regional and National Connectivity*

With a combined capacity exceeding 10 terabits per second (Tbps) and a variety of different submarine cables and landing stations, Morocco's international connectivity is secure and has sufficient capacity to meet current and future medium-term needs.[2] All three telecom operators have access to international connectivity, with competition resulting in a favorable price for international

bandwidth. Maroc Telecom controls three submarine stations where it is a shareholder (South East Asia-Middle East-Western Europe 4 optical fiber submarine communications cable system [SEA-ME-WE4], Atlas OffShore, and Estepona–Tétouan). Méditel has redundant connectivity with more than two submarine cables and stations, while Wana-INWI, with only one cable leased from the national electricity grid (see below), has a more fragile and insecure international connectivity. In 2012–13, two other independent cables are expected to land in Morocco: Glo1 and MainOne.

In terms of terrestrial regional connectivity, only the Ibn Khaldoun cable operated by incumbents is open. Although Maroc Telecom built fiber to the border with Mauritania, and its subsidiary in Mauritania, Mauritel, has built fiber

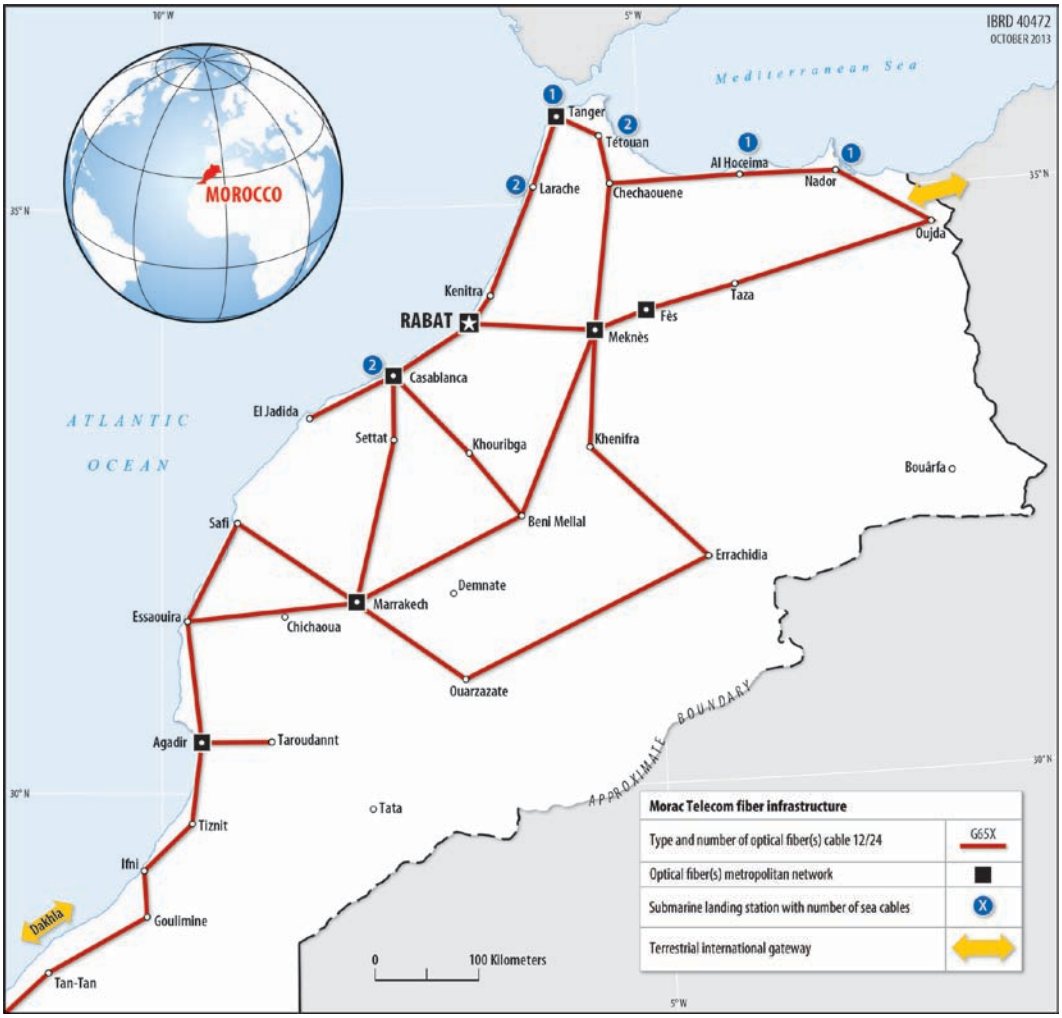
**Map A.1 International Submarine Cable Connectivity in Morocco**




*Note:* Gbps = gigabits per second; OPGW = optical ground wire; REE = ; SEA-ME-WE4 = South East Asia--Middle East--Western Europe 4 optical fiber submarine communications cable system; Tbps = terabits per second.

| *International gateways* | | | |
|---|---|---|---|
| | *Submarine cables* | | |
| *Submarine stations* | *Cable* | *Owner* | *Destination* |
| Tétouan | Estepona-Tétouan | Maroc Telecom | Spain |
| | Se-Me-We | Maroc Telecom and consortium | Europe |
| Asilah | Atlas OffShore | Maroc Telecom | Spain |
| Ceuta (Spain enclave) | Telefonica | Telefonica | Spain |
| Melilla (Spain enclave) | Telefonica | Telefonica | Spain |
| Tangier | REE OPGW | REE | Spain |
| Casablanca | MainOne | African consortium | Africa |
| Casablanca | GLO-1 | GLO (Nigeria) | Africa-Europe |
| ***Terrestrial*** | | | |
| Maroc Telecom gateways | | Algerian border | Algeria Telecom |
| | | Mauritanian border | Not open |

**Map A.2 Main Links of Maroc Telecom's National Fiber Backbone**




*Source:* World Bank.
*Note:* ADM = .

to the border with Morocco, the Mauritanian government has not yet authorized connectivity between Morocco and Mauritania.

Maroc Telecom owns and operates a fiber-optic backbone of more than 10,000 kilometers (km) that covers the whole territory using SDH and dense wavelength division multiplexing (DWDM) technology. It appears to have a wholesale offer on its fiber-optic backbone, which has not been made public.

Morocco's Telecom Law[3] has allowed competitive offerings to Maroc Telecom's fiber-optic backbone by alternative infrastructure operators, with a clear and unambiguous definition of "alternative infrastructure." However, it limits its usage of this alternative infrastructure to licensed operators and does not

authorize owners of alternative infrastructure to provide other services (such as managed bandwidth) in addition to renting extra capacity:

> *Alternative infrastructure operators may rent or lease to an operator of public telecommunications network licensee or an applicant for a license as part of a tender in compliance with legislation occupations in the public domain, the excess capacity they might have after deploying the infrastructure for their own needs and/or rights of way on public property, easements, rights of way, engineering structures, arteries and ducts, and the high points they have.*
>
> *The lease or transfer must be communicated to the ANRT for information.*
>
> *Revenues and expenses related to the sale or lease are recorded in separate accounts of the operator of alternative infrastructure.*
>
> *Rental or sale of alternative infrastructures should not prejudice the rights of way that are entitled to other operators of public telecommunications networks.*

In 2005, Finetis Maroc, part of the French Marais group, is deploying an alternative passive infrastructure network mainly on the land of the Morocco Highway Administration (Autoroute Du Maroc, or ADM) and leasing it to telecoms operators Méditel and INWI. The legal status and rights of the company Finetis Maroc are not fully clarified at the time of publication of this report.

The national railroad company, Office Nationale des Chemins de Fer (ONCF) and the national electricity and water utility, Office National de l'Electricité et de l'Eau Potable (ONEE), also made excess capacity on their fiber networks available to telecom operators Méditel and Wana-INWI under the same law.

### *Fiber-Optic Infrastructure of Finetis Maroc*

The legal status and rights of the company Finetis Maroc are not fully clarified at the time of the publication of the report. Finetis Maroc's infrastructure is 2,000 km long, deployed mainly on the rights of way of the ADM and consists of a large capacity of fiber-optic cables (72 fiber pairs) leased as dark fiber. It has also deployed infrastructure along other roads and built metropolitan networks in Casablanca, Rabat, and Tangier. The company's infrastructure covers most of the country, although there are some gaps in the eastern part of Morocco when compared with Maroc Telecom. However, this infrastructure is fragile, with a risk of breakage whenever highway civil works are undertaken.

Finetis Maroc has a potential national project to extend its network in the east and central part of Morocco. The southern part of Morocco would be covered under a proposed Western Africa passive backbone project.[4] According to information gathered during the study, rights of way fees appear to be fairly high and negatively impact Finetis Maroc's ability to finance the expansion of the network.

Finetis infrastructure is currently used by

- ADM for a private network serving internal operations management, and
- Telecom operators Méditel and INWI.

With a capacity of 72 fiber pairs, Finetis Maroc's infrastructure can offer sufficient capacity for any existing or future telecom operator in Morocco.

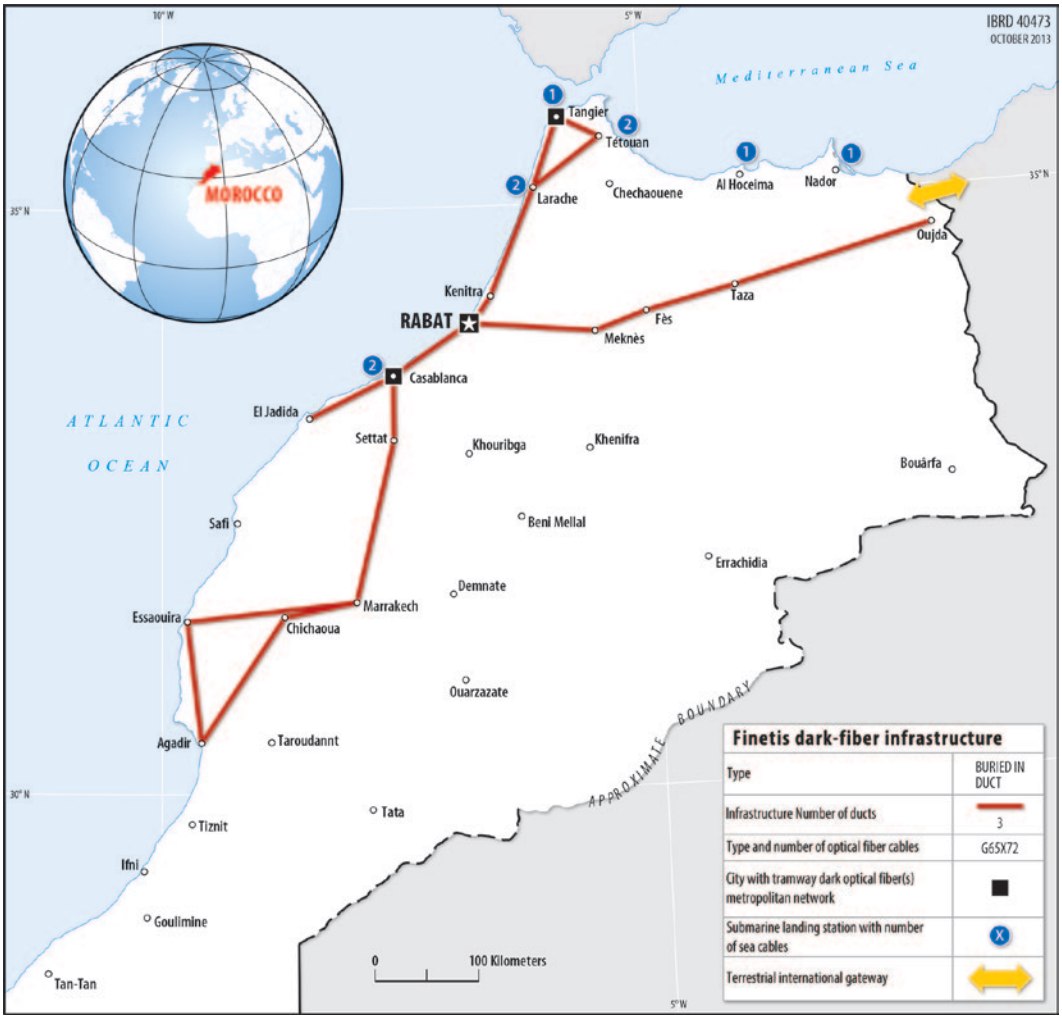
Finetis Maroc's infrastructure does not address international and regional connectivity, even though there is a potential for

- International connectivity: Finetis infrastructure could be connected to existing or future international submarine landing stations, such as MainOne and GLO-1 in Casablanca.
- Regional connectivity: Finetis infrastructure could be complemented by a terrestrial cross-border connection to Algeria at Oujda.

### *Fiber-Optic Infrastructure of ONCF*

For purposes of railroad traffic management, the national railroad company (ONCF) has deployed optical fiber along all of its railway tracks, forming a

**Map A.3 Main Links of Finetis Maroc's National Fiber Backbone**



| Finetis on Office National des Autoroutes territory | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Link | | | Passive support | Fiber characteristics | | | Usage | | Application | | Facilities | |
| Status | City A | City B | Distance (km) | Type of laying | Number | Type of fiber optic | FO per cable | FO used | FO for free | Short distance | Long distance | Maintenance services | Colocation facilites |
| | Tangier | Rabat | 250 | duct | 2 | G652 D | 72 | Some used by ADM and Finetis | Extra capacity available | | | | |
| | Rabat | Casablanca | 100 | duct | 2 | G652 D | 72 | | | | | | |
| | Marrakech | Essaouira | 180 | duct | 2 | G652 D | 72 | | | | | | |
| | Casablanca | Marrakech | 250 | duct | 2 | G652 D | 72 | | | | | | |
| | Rabat | Oujda | 350 | duct | 2 | G652 D | 72 | | | | | | |
| | Total | | 1,380 | | | | | | | | | | |
| Metropolitan networks | | | | | | | | | | | | | |
| | | | | Type of laying | Number | Type of fiber optic | FO per cable | FO used | FO for free | Short distance | Long distance | Maintenance services | Colocation facilites |
| | Tangier | | | duct | 2 | | 72 | | | | | | |
| | Rabat | | | duct | 2 | | 72 | | | | | | |
| | Casablanca | | | duct | 2 | | 72 | | | | | | |

*Source:* World Bank.
*Note:* ADM = Autoroute du Maroc (Morocco Highway Administration); FO = km = kilometer.

2,000 km fiber-optic infrastructure. However, it offers poor redundancy (no ring structure) and limited coverage of the national territory compared to Maroc Telecom (especially in the eastern part of Morocco). No plans for increasing this footprint in the next two years have been identified.

In 2005, ONCF and Méditel signed a 30-year strategic partnership agreement. Under this partnership, ONCF is leasing a fiber-optic line from Fes to Oujda to Méditel and allowing the colocation of its transmission equipment in technical areas within ONCF premises. Both parties have also jointly constructed two fiber-optic networks along railway tracks linking Casablanca, Rabat, Fez, Tangier, and Marrakech. Through this partnership, Méditel and ONCF intend to improve the quality of their services in their respective areas of activity. It also allows ONCF to further develop its communications network and Méditel to expand the reach of its telecommunications network across the country. However, ONCF has pre-emption rights if it needs the capacity for internal purposes, which could put Méditel in a difficult position for medium-term sustainability in areas where it depends on ONCF's infrastructure.

According to information gathered during the study, it appears that ONCF and Méditel are already using all of the available cables on some routes or parts of the infrastructure (such as Rabat–Fes–Oujda).

The partnership does not address international and regional connectivity, even though there is a potential for

- International connectivity: Using ONCF infrastructure, Méditel reaches the two Spanish enclaves of Ceuta and Melilla where it connects to the two submarine cables of the Spanish incumbent operator, Telefonica.
- Regional connectivity: ONCF infrastructure could be complemented by a terrestrial cross-border connection to Algeria at Oujda.[5]

***Fiber-Optic Infrastructure of ONEE***

For purposes of extra high voltage/high voltage (EHV/HV) transportation management, ONEE has deployed optical fiber (optical ground wire [OPGW] cables) and also cables separately wound on its EHV/HV pylons, forming a 4,000 km fiber-optic infrastructure partly in a ring structure and covering most of the country. However, compared with Maroc Telecom, significant gaps remain in serving the eastern and central part of Morocco. No plans for increasing this footprint in the next two years have been identified.

However, because of requirements for the construction of EHV/HV lines, the interface points on the ONEE fiber optic infrastructure are rarely close to urban areas, so that additional fiber infrastructure needs to be built to connect the fiber along the grid with the technical sites of telecom operators that are generally located in urban areas. Other issues may also impede connection with telecom operators–for instance, some fiber-optic cables are old and therefore have poor signal quality for broadband usage.

In 2007, ONEE[6] and Wana (now INWI) signed a memorandum of understanding that allows INWI to set up its backbone under a ring structure using ONEE's fiber-optic infrastructure. However, ONEE has pre-emption rights if it needs the

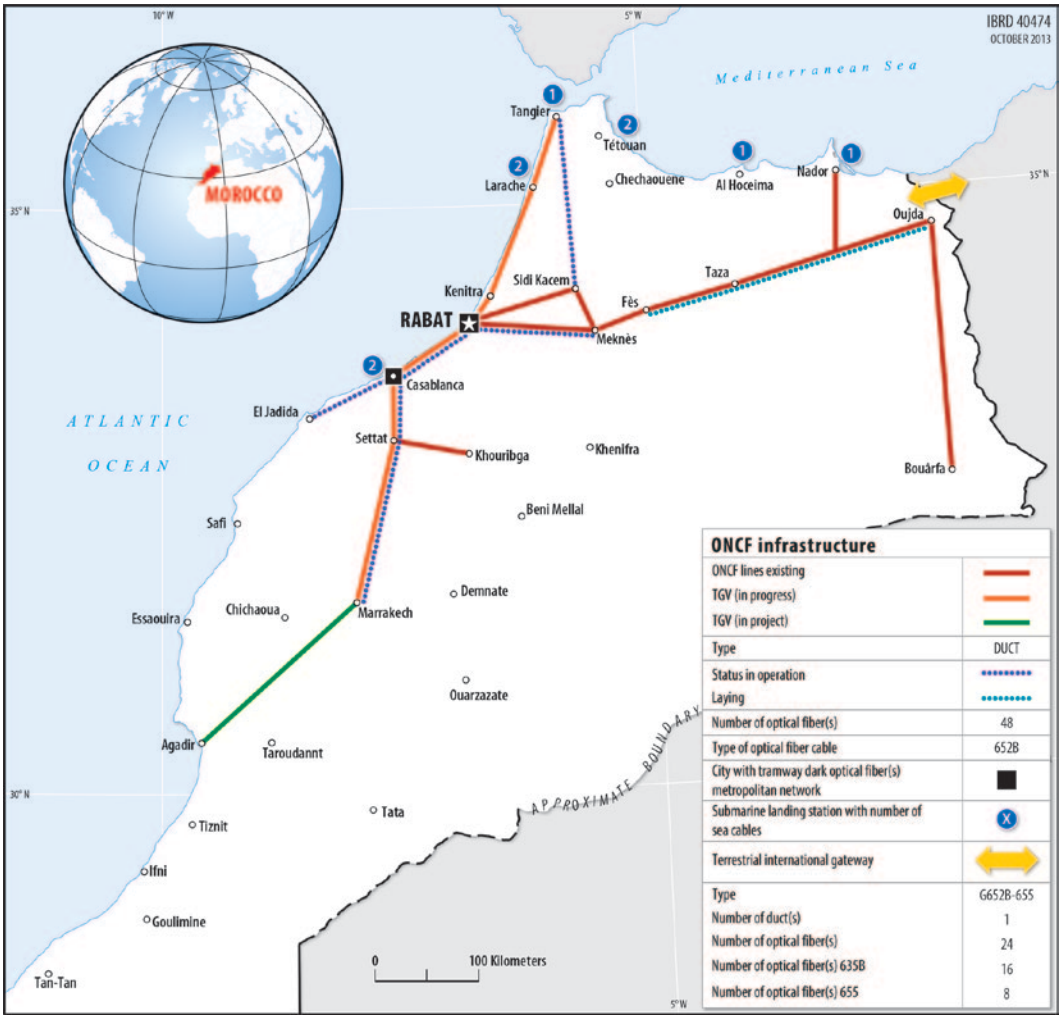
capacity for internal purposes, which could put INWI in a difficult position for medium-term sustainability in areas where it depends on ONEE's infrastructure.

According to information gathered during the case study, it appears that all of the available cables are already used by ONEE and INWI on some routes or parts of the infrastructure.

The memorandum explicitly addresses international and regional connectivity:

- International connectivity: interconnection is already provided with telecom operators in Spain via a submarine optical cable linked with the electrical cables running across the Strait of Gibraltar and connected to the fiber-optic infrastructure of the Spanish electricity grid, REE.
- Regional connectivity: an OPGW cable has been laid down between ONE and Sonelgaz (Algeria) but is not currently open to usage for information and communications technology (ICT).[7]

**Map A.4 Key Characteristics of ONCF's Fiber-Optic Infrastructure**



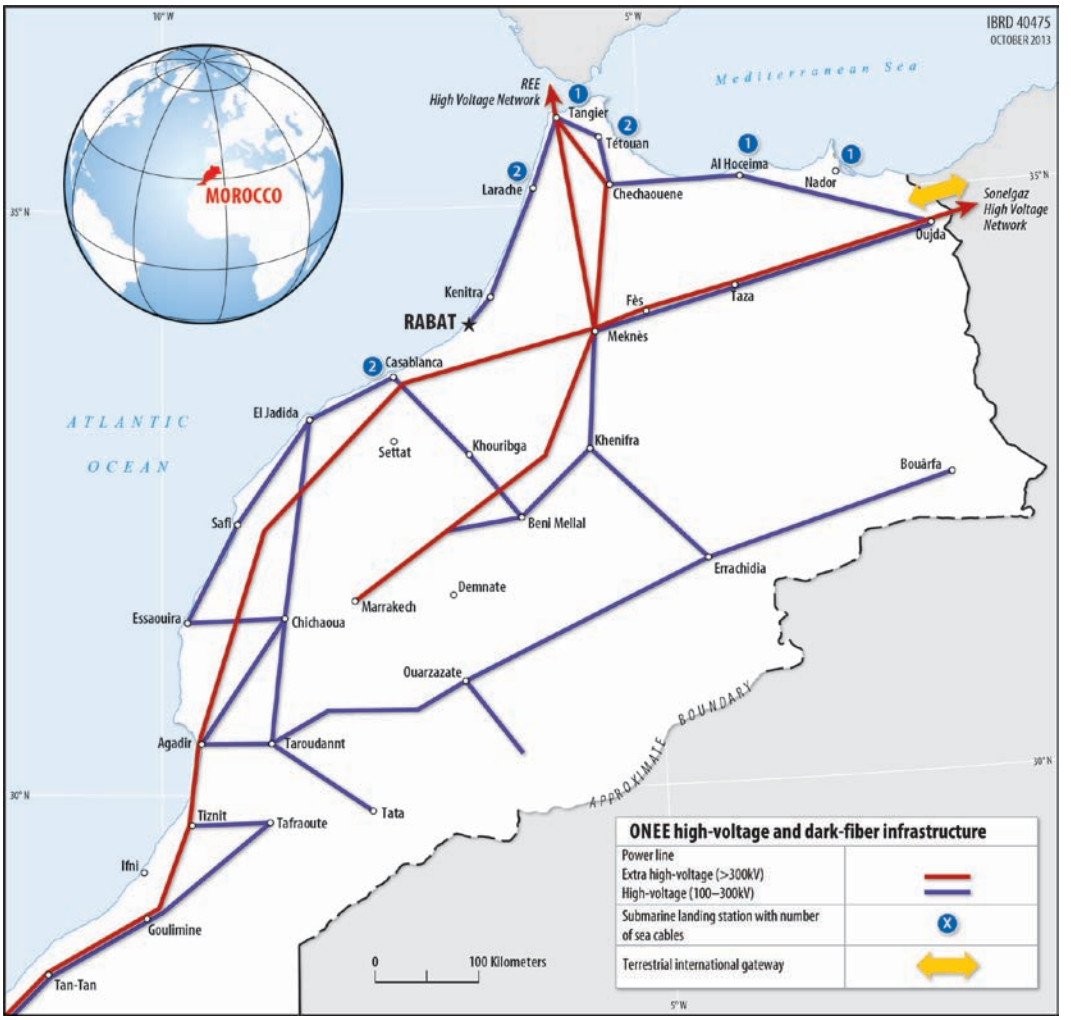
| ONCF (Office National des Chemins de Fer) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link | | | | Passive support | | | | Usage | | Application | | Facilities | |
| City A | City B | Distance (km) | Status | Type of laying | Nb | Number of FO per cable | Fiber type | FO used | FO for rent | Short distance | Long distance | Maintenance services | Colocation facilites |
| Marrakech | Casablanca | 250 | | duct | 1 | 32 | G652B | | | | | | |
| Casablanca | Rabat | 100 | | duct | 1 | 32 | | | | | | | |
| Rabat | Fes | 200 | | duct | 1 | 32 | | | | | | | |
| Rabat | Tangier | 300 | | duct | 1 | 32 | | | | | | | |
| Fes | Oujda | 380 | | duct | 1 | 12 | G652B | | | | | | |
| Taourit | Nador | 120 | | duct | 1 | 24 | G652B | | | | | | |
| Casablanca | Jorf Lasfar | 148 | | duct | 1 | 24 | | | | | | | |
| Total | | 1498 | | | | | | | | | | | |
| Project (2012–201x) | | | | | | | | | | | | | |
| Marrakech TGV | Tangier TGV | Laying with TGV progress | | | | | | | | | | | |
| Marrakech TGV | Agadir | In project | | | | | | | | | | | |
| Metropolitan network | | | | | | | | | | | | | |
| City | | | Status | type of laying | Nb | Number of FO per cable | Type of FO | FO used | FO for free | Short distance | Long distance | Maintenance services | Colocation facilites |
| Casablanca | | 12 | | OPGW | 1 | 12 | | | | | | | |
| Rabat Ville | R. Agdal | 3 | | OPGW | 1 | 12 | | | | | | | |
| Tangier | | | | OPGW | 1 | 32 | | | | | | | |

*Source:* World Bank.
*Note:* FO = km = kilometer; Nb = number; OPGW = optical ground wire; TGV =.

### *Key Lessons For the Use of Alternative Fiber-Optic Infrastructure*

From a policy perspective, there are no impediments to the implementation and use of alternative infrastructure in Morocco. The definition of a telecommunications network is clear and includes both passive infrastructure and equipment assets, while the definition of "alternative infrastructure" is unambiguous. Building upon rights of way of the national highway administration, a pure private infrastructure operator, Finetis Maroc, has been authorized to build and sell capacity to licensed telecommunications operators. Also, both the national grid and national railroad fiber networks have excess capacity, which has been made available to licensed telecommunications operators. As a consequence, competitors Méditel and INWI could develop backbone networks in competition with Maroc Telecom.

**Map A.5 Key Characteristics of ONEE's Fiber-Optic Infrastructure**




*Note:* kV = kilovolts; ONEE = Office National de l'Electricité et de l'Eau Potable.

| ONE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Link* | | | *Passive support* | | *Fiber characteristics* | | *Usage* | *Application* | | | *Facilities* | |
| General Specifications | | | OPGW | 1 | G652 | 16 | | | | | | |
| | | | | | G652 | 8 | | | | | | |
| *Ring (Wana-INWI)* | | | *Type of laying* | *Nb* | *Type of Fiber Optic* | *Number per cable* | *FO used* | *FO for free* | *Short Distance* | *Long Distance* | *Maintenance services* | *Colocation facilities* |
| Founty | Chichaoua | Pt to Pt | OPGW | 1 | G652 B G655 | 24 | Unknown at ring interconnection, some cables are saturated | | | | Unknown | |
| Founty | Glalcha Chichaoua | Pt to Pt | | 1 | G652 B G656 | 24 | | | | | | |
| Chichaoua | Tensift jorf lasfar | Ring | OPGW | 1 | G652 B G657 | 24 | | | | | | |
| Jorf lasfar-Mohammedia | Tizgui Tazart | Ring | | 1 | G652 B G658 | 24 | | | | | | |
| Mohammedia Zaer | Khenitra Tizgui | Ring | OPGW | 1 | G652 B G659 | 24 | | | | | | |
| Tizgui | BeniMellal | Pt to Pt | | 1 | G652 B G660 | 24 | | | | | | |
| Toulal Azrou | Ifrane Allal Fassi | Ring | OPGW | 1 | G652 B G661 | 24 | | | | | | |
| Allal Fassi | Bourdim | Pt to Pt | | 1 | G652 B G662 | 24 | | | | | | |
| Bourdim Oujda | Berkane Selouane | Ring | OPGW | 1 | G652 B G663 | 24 | | | | | | |
| Zaer Souq Laarbaa | Mellous Tanger Fouarat | Ring | | 1 | G652 B G664 | 24 | | | | | | |
| Mellouss | Tétouan | Pt to Pt | OPGW | 1 | G652 B G665 | 24 | | | | | | |

*Source:* World Bank.
*Note:* FO = Nb = number; OPGW = optical ground wire; Pt = port.

Scaling up of the Finetis Maroc model of passive infrastructure deployment seems to offer the most likely option to meet the medium- to long-term demand for more national broadband connectivity as an alternative to incumbent Maroc Telecom. The two other major alternative infrastructure options (power grid and rail) will probably face more challenges to meet current and future needs. Both are bound up in long-term agreements with two competing operators, the railway extends through only a small part of the country, the high voltage power transmission grid does not often pass through the populated areas that need to be served, and much of the fiber deployed on pylons is already in use or is old. However, scaling up the Finetis Maroc model would necessitate establishing a level playing field in terms of rights of way charges; at present Finetis Maroc pays DH 15.00 per mile per year (US$1.74) while ONEE and ONCF pay nothing and Maroc Telecom pays a total fee based on an old estimate of network length (at privatization) and not on the reality of today's network.

In addition, legal and regulatory provisions could enhance the contribution of alternative infrastructure to the acceleration of broadband development by

- Enabling alternative infrastructure to disseminate and provide redundant links to international connectivity, by allowing access to existing and future submarine landing stations in Morocco; and
- Enabling alternative infrastructure to set up terrestrial cross-border connections (such as with Algeria out of Oujda) to improve regional connectivity.

The 2010 strategic sector note by the prime minister[8] outlined a number of concrete measures the government planned to take by 2013 to improve access to the Internet, reduce the digital divide (broader coverage, lower prices), and increase available speeds. These included opening the sector to new entrants, including infrastructure operators; strengthening regulations on infrastructure sharing and local loop unbundling (LLU); and updating regulations on urban and land use planning and rights of way. These have been correctly identified as the most important policy and regulatory changes necessary to maximize the potential for using alternative infrastructure to meet the country's needs, assuming they are fully and consistently implemented.

## Tunisia

### *Introduction*

Tunisia has one of the most advanced ICT infrastructures in Africa, with the World Economic Forum ranking the country 50th in 2011 in terms of global ICT competitiveness and 2nd (behind the United Arab Emirates) in the Middle East and North Africa (MENA) region.

There are three licensed telecom operators active in the market:[9]

- **Tunisie Telecom** (incumbent).
- **Tunisiana,** which bought the independent Internet service provider (ISP) Tunet in 2011, and acquired a global license in 2012.
- **Orange Tunisie**, whose license was awarded in May 2010.

The incumbent, Tunisie Telecom, continues to be the leading player in broadband in both fixed and mobile broadband, despite strong competition from Orange Tunisie and, more recently, Tunisiana.

### *International/Regional and National Connectivity*

In term of international connectivity, with three submarine cables since May 2013 (with four expected in 2014), Internet Protocol (IP) connectivity with Algeria and Tunisia is secure, and with more than 3.5 terabits per second (Tbps) (6 in 2014) has sufficient international bandwidth capacity to meet current and future medium-term needs. However, Tunisie Telecom has a monopoly on all existing international facilities. There are plans by Tunisiana and Orange Tunisie to build a new submarine cable.

In terms of terrestrial regional connectivity, only the Ibn Khaldoun cable operated by incumbents is open, connecting Tunisia with Algeria and with Libya.

As a result of the country's earlier political environment, there was also a *de facto* and *de jure* monopoly on international gateways and, until the end of 2012, Internet traffic was managed by ATI (Agence Tunisienne de l'Internet).[10] Today ISPs can skip ATI for Internet third generation of mobile telecommunications technology (3G) data traffic. ATI was established in March 1996 to promote Internet services in Tunisia. It is a public corporation with the legal status of a limited liability company and is a subsidiary of Tunisie Telecom. ATI is the wholesale supplier of Internet access in Tunisia, responsible for providing access to various Internet services for ISPs and specifically provides

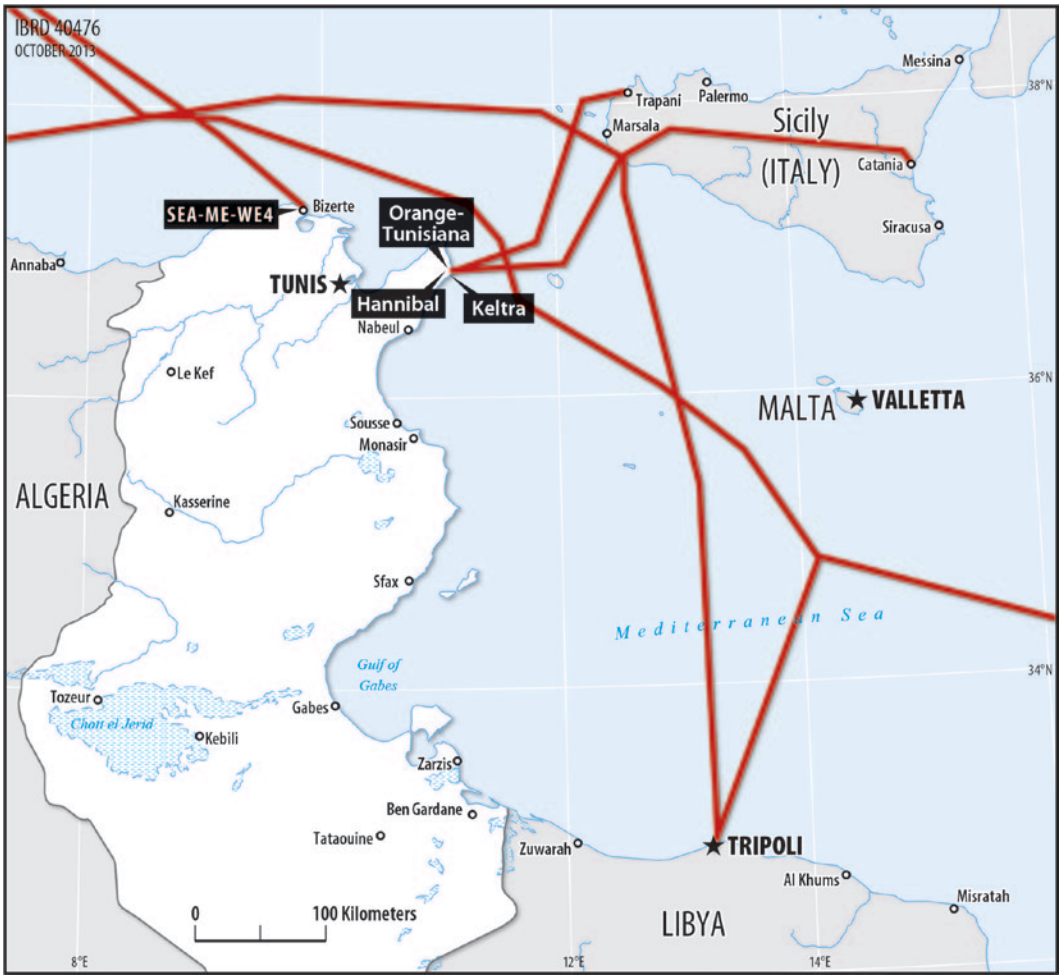
- A national Internet exchange point (national IXP) for the interconnection of ISPs to one another and the rest of the Internet;
- Management of IP addressing;
- Internet access primarily to government ministries and the Public Administrative Institutions (PAIs); and
- Website hosting for institutions, government agencies, and nongovernmental organizations.

Since the "Jasmine revolution," Tunisie Telecom has taken over from ATI the role of wholesale supplier of Internet access in Tunisia, the functions of the national IXP, as well as co-management of the national domain ".tn". In March 2013, ATI also implemented a domain name server for North Africa.

Tunisie Telecom owns and operates a 10,000 km fiber-optic backbone covering the whole territory using SDH and DWDM technology, which offers the potential for very high bandwidth with good security. Tunisie Telecom's network rings offer several λ (DWDM) or synchronous transmission mode (STM)64 loops. It also has a wholesale offer that was analyzed and reviewed by INTT in 2011.

Tunisia's telecoms laws[11] do not define specific rights of alternative infrastructure providers to make competitive offerings to Tunisie Telecom's fiber-optic backbone. This regulatory uncertainty has been identified and INTT announced in April 2012 at a FRATEL[12] meeting on fiber-optic rollout that it would launch

**Map A.6 International Submarine Cable Connectivity in Tunisia**

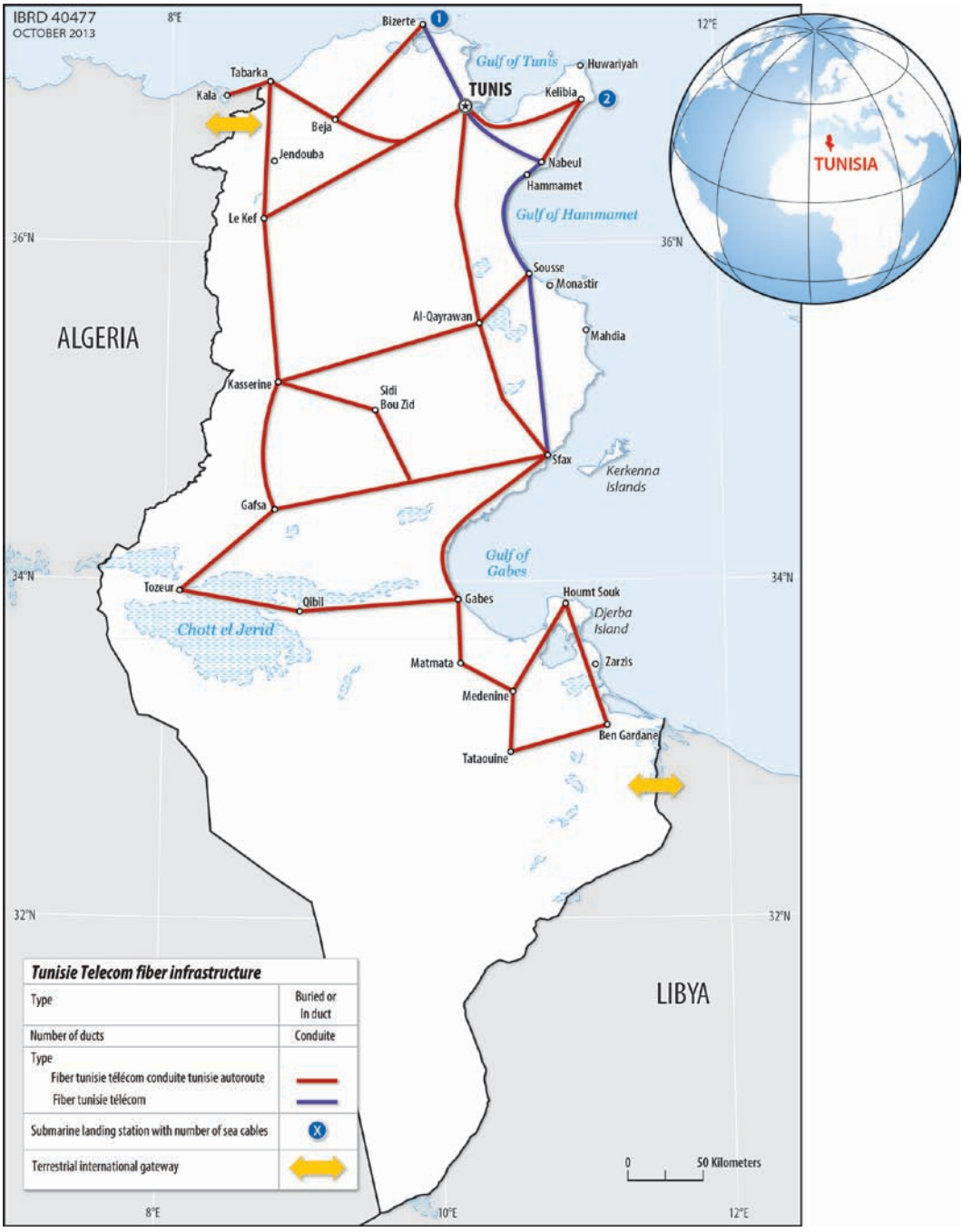



*Note:* SEA-ME-WE4 =.

| *International gateways* | | | |
|---|---|---|---|
| *Submarine cables* | | | |
| *Submarine stations* | *Cable* | *Owner* | *Destination* |
| Kelibia | Hannibal | Tunisie Telecom | Italy |
| | Keltra | Tunisie Telecom<br>Telecom Italia | Italy |
| Bizerte | Se-Me-We | Se-Me-We | Europe |
| ***Terrestrial*** | | | |
| Tunisie Telecom gateways | | Libyan border | Libya Telecom |
| | | Ghardimaou | Algeria Telecom |

*Source:* World Bank.

**Map A.7 Main Links of Tunisie Telecom's National Fiber Backbone**




*Source:* World Bank.

a review of the legal and regulatory framework in order to address alternative infrastructure providers explicitly and provide them with a similar regulatory environment to that of Tunisie Telecom.

Currently there are three major owners of alternative fiber-optic infrastructure: the national electricity and gas grid, Société Tunisienne d'Electricité et du Gaz (STEG); the national railroad company, Société Nationale des Chemins de Fer Tunisiens (SNCFT); and the national highway company (Tunisie Autoroutes). Recently, INT has approved technical and financial offers of STEG and SNCFT, enabling them to lease access to their fiber infrastructure (INT Decisions N.149/2013 and N.150/2013).

### *Fiber-Optic Infrastructure of SNCFT*

For purposes of railroad traffic management, SNCFT has deployed optical fiber along all of its railway tracks, forming a 770 km fiber-optic infrastructure, with excellent coverage of key urban areas especially in the west and south regions and many technical sites that are suitable for colocation of broadband equipment by telecom operators. Several plans for increasing this footprint by 857 km in the next two years have been identified, including links to both the Algerian and Libyan borders.

According to information gathered during the case study, SNCFT understands the role that it could play as a provider of alternative fiber-optic infrastructure to the telecommunications industry, and has defined a strategy that has evolved over time. It now appears that SNCFT's strategy is proactive and open to any operator's request:

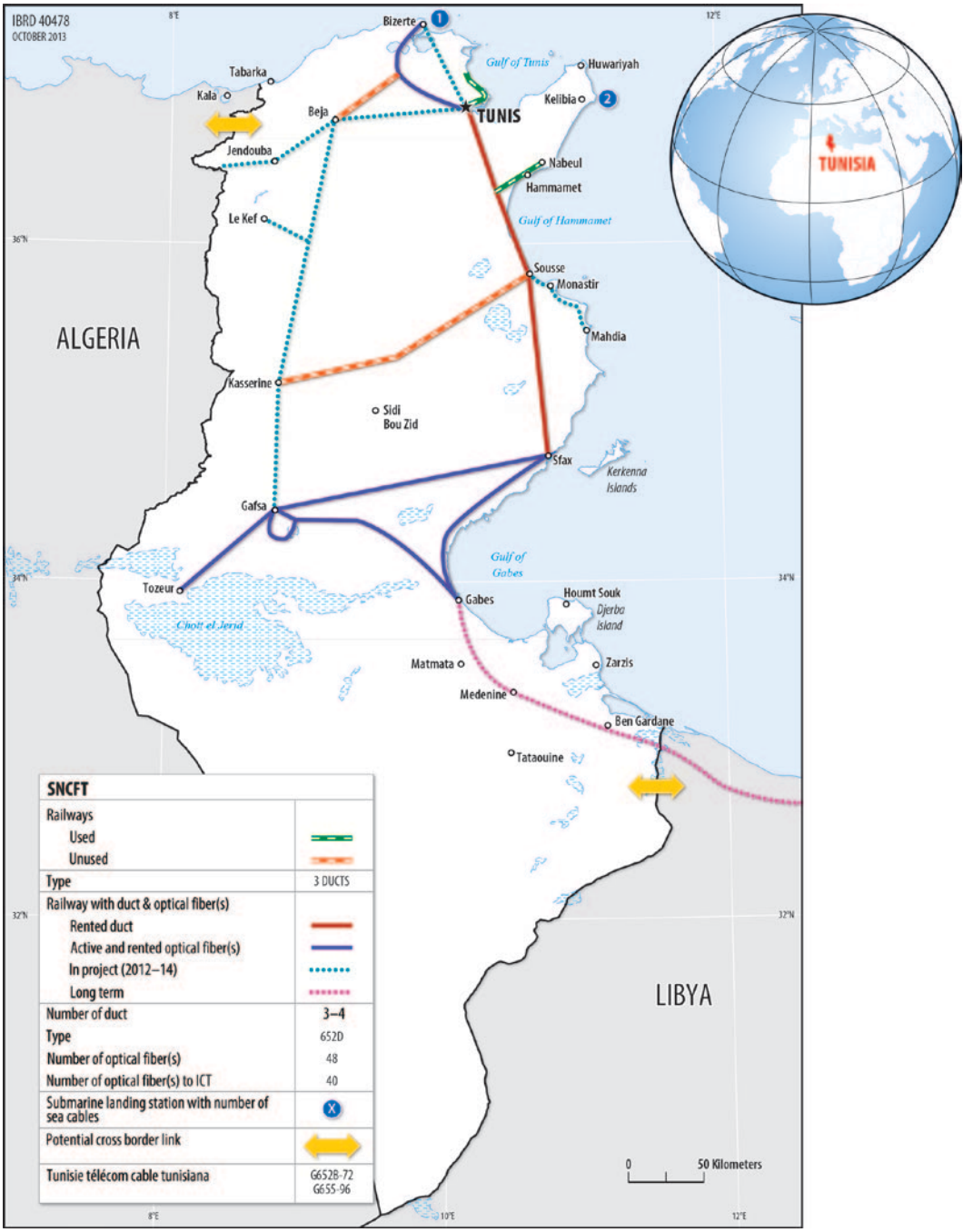
- On the Tunis–Sfax link, SNCFT granted 10-year concessions to Tunisie Telecom and Tunisiana on one duct each and retained the remaining duct (equipped with six fiber-optic cables installed by operators).
- On the Sfax–Gabes–Tozeur link, SNCFT laid down optical fiber cables and is proposing to rent ducts (equipped with six fiber-optic cables) to operators. Orange Tunisie is currently renting one duct from SNCFT, although the lease is on an annual basis.[13]

### *FIber-Optic Infrastructure of Tunisie Autoroutes*

The national highway company, Tunisie Autoroutes, deployed 435 km of ducts (three ducts in general along the highways) for optical fiber mostly in the eastern region, providing opportunities for telecom operators to create long-distance links (in particular for redundancy purposes because the highways only go near the larger cities where the operators generally have their technical sites). As part of road infrastructure development in Tunisia and the road project of the North African corridor,[14] Tunisie Autoroutes has several projects currently running or under feasibility study that would significantly expand the coverage of its fiber-optic infrastructure, including possible cross-border connections with both Algeria and Libya.

However, Tunisie Autoroutes did not deploy fiber-optic cables in any of its ducts. In 2010 it signed an exclusive agreement with Tunisie Telecom that,

**Map A.8 Key Characteristics of SNCFT's Fiber-Optic Infrastructure**



| SNCF (Societe National des Chemins de Fer) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Link* | | | | *Passive support* | | | | *Usage* | | *Application* | | *Facilities* | |
| *City A* | *City B* | *Distance (km)* | *Status* | *Type of laying* | *Nb of ducts* | *Number of FO per cable* | *Fiber type* | *FO used* | *FO for rent* | *Short distance* | *Long Distance* | *Maintenance Services* | *Colocation facilites and interconnectivity* |
| Tunis | Sfax | 260 | | Duct | 3 | TT cable/72 | G652B | SNCFT 8 | >40 | | | TT | SNCFT Offer |
| | | | | | | Tunisia cable/96 | G655 | | >70 | | | Tunisia | |
| Sfax | Gabes | 160 | | Duct | 3 | 48 | G652 D | 8 | 40 | | | | |
| Gabes | Gafsa | 150 | | Duct | 3 | 48 | | | | | | | |
| Sfax | Gafsa | 200 | | Duct | 3 | 48 | | | | | | | |
| Total | | **770** | | | | | | | | | | | |
| ***Project (2012–14)*** | | | | | | | | | | | | | |
| Jedeida | Bizerte | 72 | 2012–14 | Duct | 3 | 48 | | | | | | | SNCFT Offer |
| Sousse | Madhia | 65 | | ACCS | 2 | 24 | G652 D | 8 | 40 | | | | |
| Tunis | Algerian border | 220 | | Duct | 3 | 48 | | | | | | | |
| Tunis | Tozeur | 420 | | Duct | 3 | 48 | | | | | | | |
| Gafsa | Tozeur | 80 | | Duct | 3 | 48 | | | | | | | |
| Total | | **857** | | | | | | | | | | | |
| ***Project (Long Term)*** | | | | | | | | | | | | | |
| Gabes | Libyan border | | 2020? | OPGW | Not yet decided | | | | | | | | |

*Source:* World Bank.
*Note:* ACCS = ; FO = ; km = kilometer; Nb = number; OPGW = optical ground wire; TT = .

according to information gathered during the case study, gives access to one duct on the Bizerte–Tunis–Hammame–Sousse–Sfax route to Tunisie Telecom for the purpose of laying its fiber and provides for Tunisie Autoroutes to lease some of those optical fibers for its internal operations management. Access to this alternative infrastructure has allowed Tunisie Telecom to improve the redundancy of its fiber-optic backbone by creating loops with its own fiber-optic infrastructure (see map A.9).

### *Fiber-Optic Infrastructure of STEG*

For purposes of EHV/HV transportation management, the national electricity and gas grid (STEG) has deployed 890 km of optical fiber (OPGW as well as enameled copper clad aluminum [ECCA] cables), covering most of the country with good reliability (Coastal zone: from Nabeul–Zarzis; Central zone: Gabes–Sidi Bouzid–Le Kef; Western Region: Tozeur–Gafsa–Kasserine–Kebili–Beja) and providing links to both the Algerian and Libyan borders. Several plans for increasing this footprint in the next two years have also been identified (e.g., Beja–Kef–Kasserine), for an additional 882 km.

However, because of requirements for the construction of EHV/HV lines, the interface points on the STEG fiber-optic infrastructure are rarely close to urban areas, so that additional fiber infrastructure needs to be built to connect the fiber along the grid with technical sites of telecom operators, which are generally located in urban areas. Also, some of the fiber cables are likely to be old (FO 652 A type) and not suitable for telecom backbone.

STEG has excess capacity on its fiber-optic infrastructure, some of which would be particularly beneficial for broadband development in the western region of Tunisia. However, according to information gathered during the case study, STEG has not yet leased excess capacity despite various requests from telecom operators. [15]

### *Key Lessons For the Use of Alternative Fiber-Optic Infrastructure*

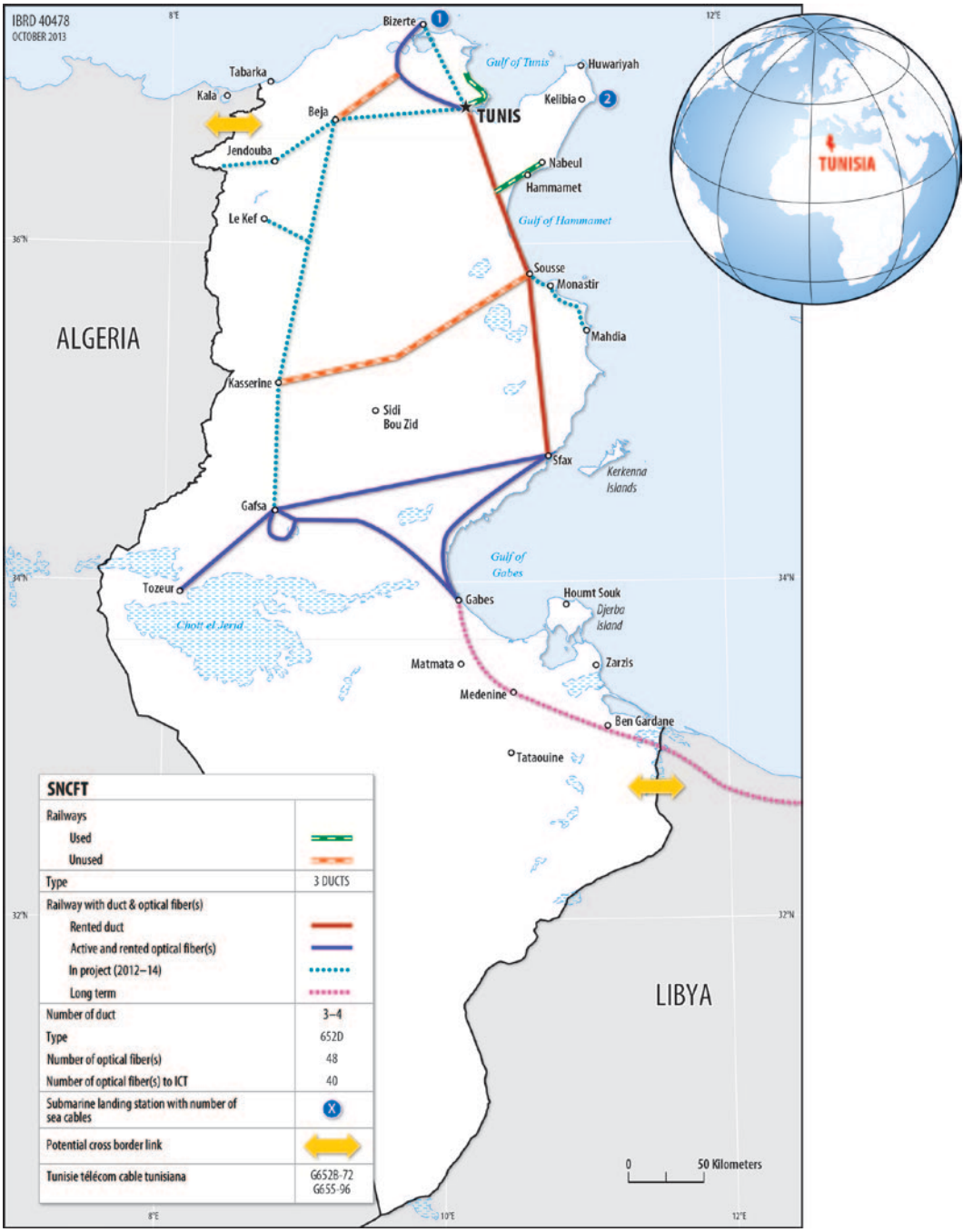
From a policy perspective, Decisions N.149/2013 and N.150/2013 have created an appropriate for the implementation and use of alternative infrastructure in Tunisia. So far competitors Tunisiana and Orange only have access to the excess capacity of the national railroad company (SNCFT). However, it is expected that they will also be able to access STEG's infrastructure soon.

Scaling up of all alternative infrastructure (existing and planned) usage seems to offer the most significant potential to meet the medium- to long-term demand for more national broadband connectivity as an alternative to incumbent Tunisie Telecom.

In addition, legal and regulatory provisions could enhance the contribution of alternative infrastructure to the acceleration of broadband development:

- Enabling alternative infrastructure to disseminate and provide redundant links to international connectivity, by allowing access to existing and future submarine landing stations in Tunisia;

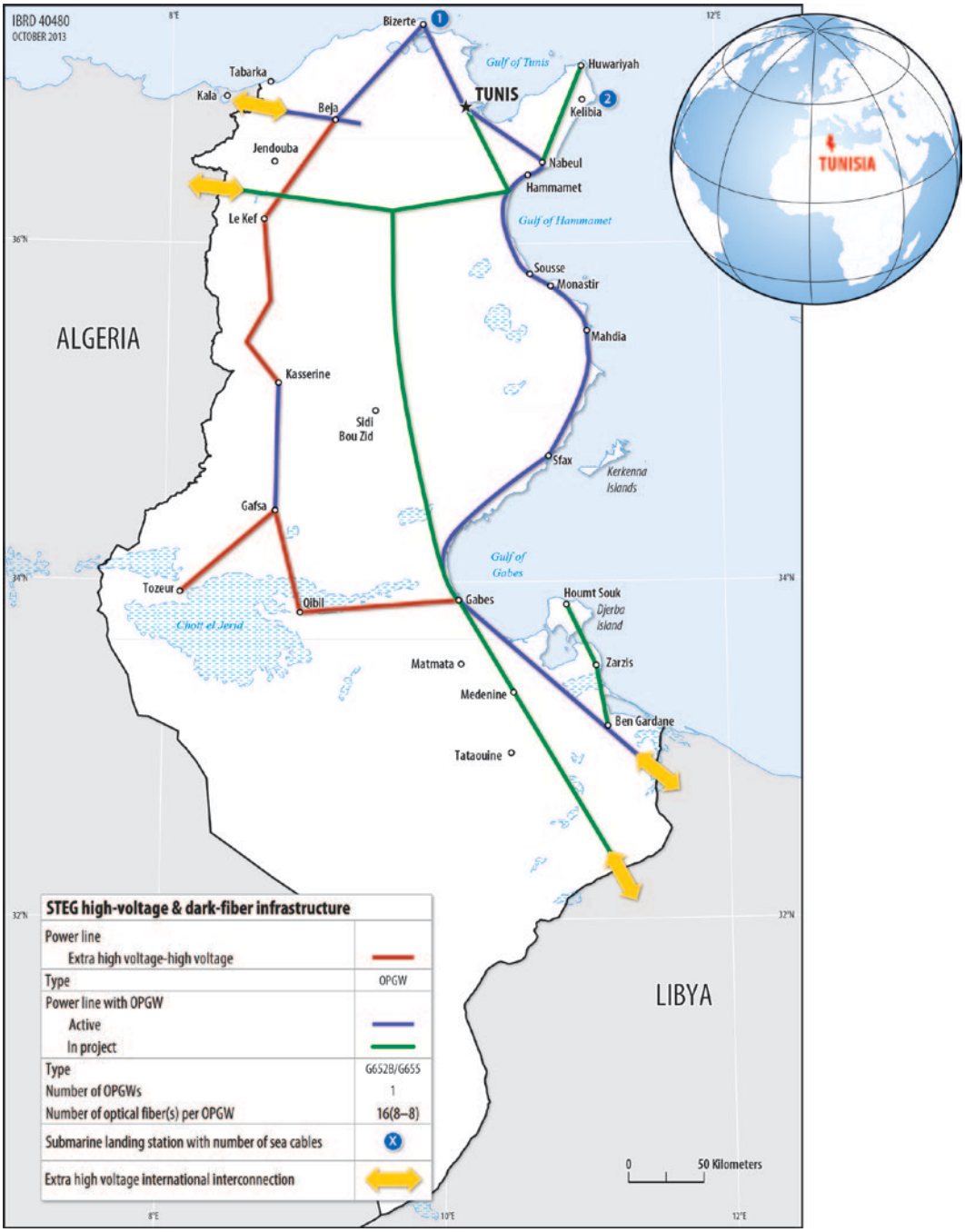
**Map A.9 Key Characteristics of Tunisie Autoroutes' Fiber-Optic Infrastructure**



| Tunisie Autoroutes (Motorways authority) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link | | | | Passive support | | | | Usage | | Application | | Facilities | |
| City A | City B | Distance (km) | Status | Type of laying | Nb of ducts | Number of FO per cable | Fiber type | Duct used | FO for rent | Short distance (<30 km) | Long distance | Maintenance services | Colocation facilites and interconnectivity |
| Tunis | Sfax | 280 | | Duct | 3 | TT cable/72 | G652 B | 1 | | | | Tunisie Telecom | |
| Tunis | Bizerte | 75 | | | 3 | TT cable/72 | G652 B | 1 | | | | | |
| Tunis | Mejez el bab | 80 | | | 5 | TT cable/72 | G652 B | 1 | | | | | |
| Total | | **435** | | | | | | | | | | | |
| ***Project (2012–18)*** | | | | | | | | | | | | | |
| Sfax | Gabes | 140 | 2013 | Duct | 5 | 48 | It is not in the Tunisia Autoroute Strategy to lay fiber-optic cable. They prefer to rent (TT exclusivity?) duct with 6 FO for TA usage | | | | | | |
| Gabes | Libyan border | 200 | 2016 | | 5 | 24 | | | | | | | |
| Mejez el bab | Bousalem | 80 | 2015 | | 5 | 48 | | | | | | | |
| Bousalem | Algerian border | 70 | 2018 | | 5 | 48 | | | | | | | |
| Gabes | Libyan border | 200 | 2016 | | 5 | 48 | | | | | | | |
| Total | | **690** | | | | | | | | | | | |
| ***Project (long term)*** | | | | | | | | | | | | | |
| ECOSO | Tunis–Kasserine-Gafsa | 400 | 2020 | Duct | | | | | | | | | |
| Total | | **400** | | | | | | | | | | | |

*Source:* World Bank.
*Note:* ECOSO = ; FO = ; km = kilometer; Nb = number; TA = Tunisie Autoroutes; TT = .

**Map A.10 Key Characteristics of STEG's Fiber-Optic Infrastructure**



| STEG (Societe Tunisienne d' Electricite et de Gaz) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link | | | | Passive support | | | Fiber Caracteristics | | Usage | | Application | | Facilities | |
| City A | City B | Distance (km) | Status | Type of laying | Nb of cable | Nb of FO per cable | G652 B | G655 | FO used | FO for free | Short distance | Long distance | Maintenance services | Colocation facilites |
| Tunis | Bizerte | 70 | Active | OPGW | 1 | 16 | 8 | 8 | 4 | 12 | 4 | 12 | | |
| Bizerte | Algerian border | 190 | | OPGW | 1 | 16 | 8 | 8 | 4 | 12 | 4 | 12 | | |
| Tunis | Sidi Mansour | 220 | | OPGW | 1 | 16 | 8 | 8 | 4 | 12 | 4 | 12 | | |
| Sidi Mansour | Gabes | 150 | | OPGW | 1 | 16 | 8 | 8 | 4 | 12 | 4 | 12 | | |
| Gabes | Libyan border | 260 | | OPGW | 1 | 16 | 8 | 8 | 4 | 12 | 4 | 12 | | |
| Total | | **890** | | | | | | | | | | | | |
| ***Project (2012–18)*** | | | | | | | | | | | | | | |
| Tejourine | Algerian border | 122 | Project 2012 2014 | OPGW | 1 | | 8 | 8 | | | | | | |
| Tunisia | Enfidha | 80 | | OPGW | 1 | | 8 | 8 | | | | | | |
| Enfidha | Rwis (Lybia) | 580 | | OPGW | 1 | | 8 | 8 | | | | | | |
| Enfidha | Menzel | 100 | | | | | | | | | | | | |
| Total | | **882** | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Jendhouba | Kasserine | 190 | | THT without OPGW | | | | | | | | | | |
| Mdhila | Tozeur | 80 | | | | | | | | | | | | |
| Mdhila | Gabes | 180 | | | | | | | | | | | | |
| Total | | **450** | | | | | | | | | | | | |

*Source:* World Bank.
*Note:* FO = ; km = kilometer; Nb = number; OPGW = optical ground wire; THT = .

- Enabling alternative infrastructure to set up terrestrial cross-border connections (with Algeria and Libya in particular) to improve regional connectivity;
- Review of existing exclusive agreement between Tunisie Autoroutes and Tunisie Telecom; and
- Enabling other holders of alternative infrastructure in Tunisia to offer fiber assets to licensed telecommunications operators.

## The Arab Republic of Egypt

### *Introduction*

ICT has been a part of Egypt's national development strategy for the past decade, and the government has been developing a framework to move the country into the information age through promoting partnerships of public, private, civil society, and multilateral stakeholders. The recent wave of reform has stimulated the government of Egypt to speed up the deployment of services and enhance the current broadband infrastructure. The tremendous demand for more bandwidth coupled with consumer appetite for video content, news, and multimedia services led the government to introduce in 2011 a new ICT strategy for broadband: the *eMisr National Broadband Plan*. According to the *Balancing Act*[16] study, Egypt and South Africa are the two countries with the most data centers in Africa.

The telecom market is divided between several operators:

- **Telecom Egypt** (TE, incumbent) has a monopoly in terrestrial infrastructure (fiber-optic backbone and copper access network) but is not active in the mobile market; it participates in the Internet retail market through an ISP subsidiary, TE Data.
- **Three mobile operators with a 3G license:** Mobinil, Etisalat, and Vodafone. All mobile operators also have Internet subsidiaries.
- **Seven ISPs** authorized to market the asymmetric digital subscriber line (ADSL) service of the TE access network (among which four are subsidiaries of operators).

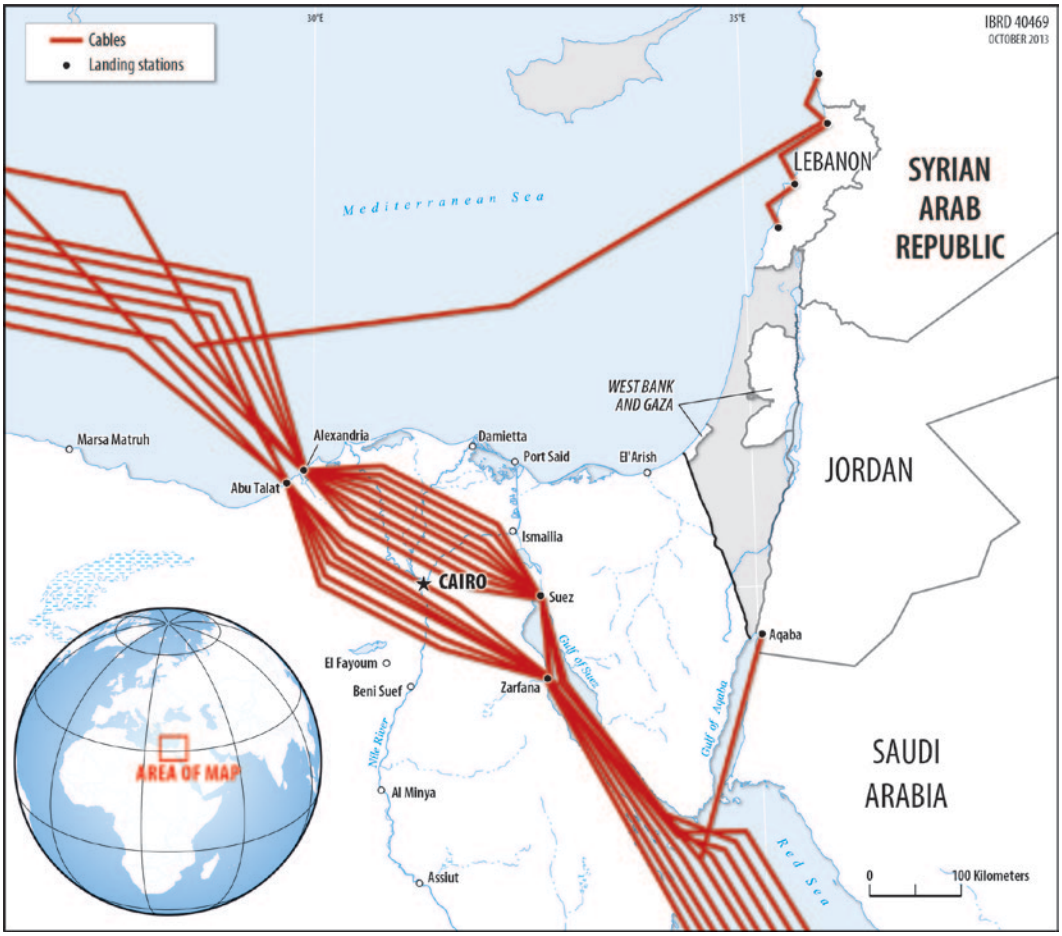
TE plays no role at the retail level in either fixed or mobile broadband.

### *International/Regional and National Connectivity*

Egypt is one of the main submarine landing hubs in Africa, mainly because of its unique geographical situation between the Red Sea and the Mediterranean. With a combined capacity exceeding 2 Tbps, Egypt's international connectivity is secure and has sufficient capacity to meet current and future medium-term needs.

International submarine cables are open to competition but TE exerts significant market power on access to any submarine stations because it has a monopoly in terrestrial backhaul.

**Map A.11 International Submarine Cable Connectivity in Egypt**




| *Landing station* | *Alexandria* | *Abu Talat* | *Zafarana* | *Suez* |
|---|---|---|---|---|
| Submarine cable | Aletar | Europe India Gateway (EIG) | Europe India Gateway (EIG) | FLAG Europe-Asia (FEA) |
| | FLAG Europe-Asia (FEA) | Middle East North Africa Cable System | Middle East North Africa (MENA) | FLAG FALCON |
| | Hawk | TE North | SEACOM/Tata TGN-Eurasia | IMEWE |
| | IMEWE | | | SEA-ME-WE3 |
| | SEA-ME-WE3 | | | SEA-ME-WE4 |
| | SEA-ME-WE4 | | | |

*Source:* World Bank.
*Note:* FLAG = ; IMEWE = ; SEA-ME-WE3 = ; SEA-ME-WE4 = ; SEACOM = ; TE = .

However, in terms of terrestrial regional connectivity, Egypt is only connected to Israel (Jordan is connected by a submarine cable along the power line connecting the two national grids in Egypt and Jordan).

TE owns and operates a 15,000 km long fiber-optic backbone, based on SDH and DWDM technology, extending to nearly all populated areas in Egypt, usually

down to the second level Egyptian administrative localities (Qism and Markaz). TE has a wholesale offer on its fiber-optic backbone, which is public.[17]

With TE having a monopoly on fixed infrastructure, no competitive offerings to its fiber-optic backbone by alternative infrastructure operators have been allowed. Although recent steps have been taken towards allowing mobile operators to build their own core infrastructure, their licenses do not allow for infrastructure leasing to other parties.

However, some utility infrastructure could be suitable for the telecom operators to transmit their payload, especially for long distances (or between governorates) such as the Egyptian Electricity Transmission Company (EETC) or national railroad company (ENR).

The oil and gas sector has more than 4,000 km of pipeline, part of which is used for gas interconnection with some of the neighboring countries, but mainly it is used to link gas liquidating and production refineries up to the gas distribution companies and large industrial customers. No precise information could be gathered about the extent of fiber-optic infrastructure, though it appears that oil and gas companies could have about 4,000 km of fiber-optic cables throughout these pipelines.

### *Fiber-Optic Infrastructure of EETC*

For purposes of EHV/HV transportation management, the national electricity grid (EETC) has deployed 7,000 km of optical fiber (OPGW cables and also cables separately wound on its EHV/HV pylons), covering most of the country (inhabited areas) without significant gaps.[18] There is also a terrestrial connection with Libya.

However, because of requirements for the construction of EHV/HV lines, the interface points on the EETC fiber-optic infrastructure are rarely close to urban areas, so that additional fiber infrastructure needs to be built to connect the fiber along the grid with technical sites of telecom operators, which are generally located in urban areas.

According to information gathered during the study, EETC has excess capacity on its fiber-optic infrastructure, some of which would be particularly beneficial for the development of broadband in the country.

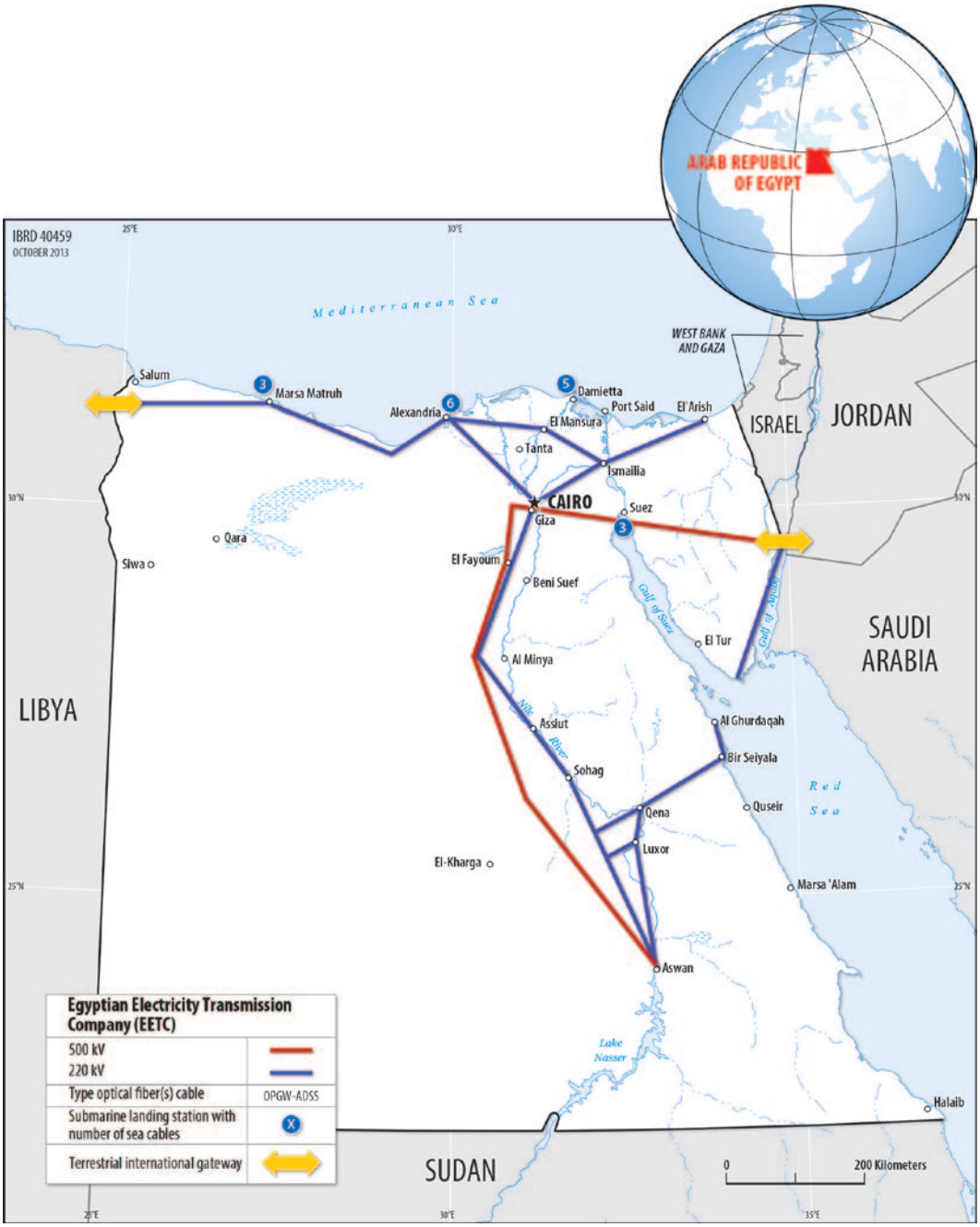
### *Fiber-Optic Infrastructure of ENR*

For purposes of railroad traffic management, the national railroad company (ENR) has deployed optical fiber along its rail tracks, but has excess capacity only on a limited route (Qalub–Shibin El-Qanater). According to information gathered during the study, several planned projects over the next two years could provide more than 885 km of fiber-optic infrastructure with excess capacity.

## *Key Lessons on the Use of Alternative Fiber-Optic Infrastructure*

From a policy perspective, implementation and use of alternative infrastructure is currently forbidden in Egypt because Telecom Egypt has a monopoly on fixed infrastructure. Although recent steps have been taken toward allowing mobile

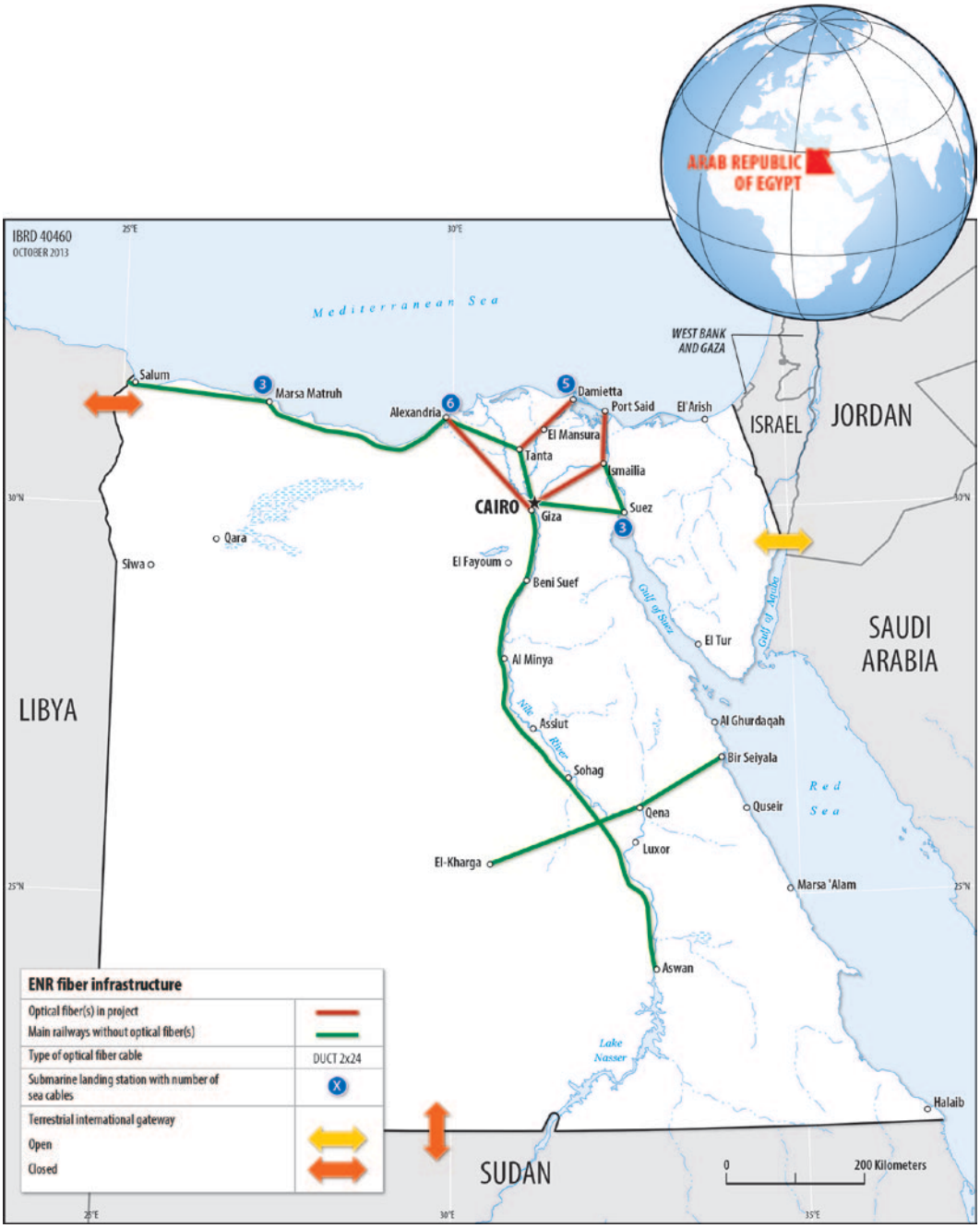
**Map A.12 Key Characteristics of EETC's Fiber-Optic Infrastructure**



| EETC (Egyptian Electricity Transmission Company) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link | | | | Passive support | | | Fiber Type | Usage | | Application | | Facilities | |
| City A | City B | Distance (km) | Status | Type of laying | Nb of cable | Number of FO per cable | G652 or G655 | FO used | FO for rent | Short distance (<30 km) | Long distance | Maintenance services | Colocation facilites |
| Cairo | Assiut | 380 | | OPGW | | 24 | **Unavailable Information** | | | | | | |
| Assiut | Aswan | 530 | | OPGW | | 24 | | | | | | | |
| Luxor | Hurghada | 300 | | OPGW | | 24 | | | | | | | |
| Cairo | Suez | 150 | | OPGW | | 24 | | | | | | | |
| Suez | Jordan border | 260 | | | | | | | | | | | |
| Cairo | Alexandria | 210 | | OPGW | | 24 | | | | | | | |
| Alexandria | Libyan border | 490 | | OPGW | | 24 | | | | | | | |
| Alexandria | Port Said | 260 | | | | | | | | | | | |
| Port Said | Ismaila | 80 | | | | | | | | | | | |
| Ismaila | Cairo | 150 | | | | | | | | | | | |
| Total | | **2,800** | | | | | | | | | | | |

*Source:* World Bank.
*Note:* FO = ; km = kilometer; Nb = number; OPGW = optical ground wire.

**Map A.13 Key Characteristics of ENR's Fiber-Optic Infrastructure**



| Egyptian National Railways | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Link* | | | | *Passive support* | | | | *Usage* | | *Application* | | *Facilities* | |
| *City A* | *City B* | *Distance (km)* | *Status* | *Type of laying* | *Nb of cable* | *Nb of FO per cable* | *Fiber Type* | *FO used* | *FO for rent* | *Short distance (<30 km)* | *Long distance* | *Maintenance services* | *Colocation facilites* |
| Qalub | Shibin El-Qanarter | 19 | | Duct | 4+4 | 24 | G652 | 6 | 18 | No rent possible | | | |
| Total | | **19** | | | | | | | | | | | |
| Project (2012–14) | | | | | | | | | | | | | |
| Cairo | Asyut | 370 | WB Funding | Duct | 4+4 | 24 | | | | not possible to rent | | | |
| Cairo | Alexandria | 207 | WB Funding | Duct | 4+4 | 24 | | | | | | | |
| Cairo | Port Said | 191 | Arab Funds | Duct | 4+4 | 24 | | | | | | | |
| Tanta | Domiets | 117 | Koweity Bank | Duct | 4+4 | 24 | | | | | | | |
| Total | | **885** | | | | | | | | | | | |

*Source:* World Bank.
*Note:* FO = ; km = kilometer; Nb = number; WB = World Bank.

operators to build their own core infrastructure, their licenses do not allow for infrastructure leasing to other parties.

Scaling up of all alternative infrastructure (existing and planned) usage would, however, increase competition in the backbone and backhaul market segments, and contribute to benefiting areas with a significant number of inhabitants that are currently underserved by broadband.

## Jordan

### *Introduction*

In 2003, the government of Jordan adopted a statement of ICT sector policy favoring liberalization. The policy was replaced with a new policy statement in 2007, which focused on creating the conditions for effective competition in the ICT sector in order to promote the sector's development. Competition is allowed in all segments of the market and is predominantly infrastructure-based.

Twenty-five individual licensees are active in the market:[19]

- **Twenty-two for fixed networks**, including: Jordan Telecom Group (JTG) (incumbent, 51 percent owned by Orange), Vtel, Damamax,[20] several cable access television (CATV) operators, and TE-Data (Aqaba).
- **Three for mobile (3G) networks**: Orange (JTG), Zain, Unamiah.

The incumbent, JTG, continues to be the leading player in fixed broadband but faces strong competition in mobile broadband from Zain and Unamiah.

### *International/Regional and National Connectivity*

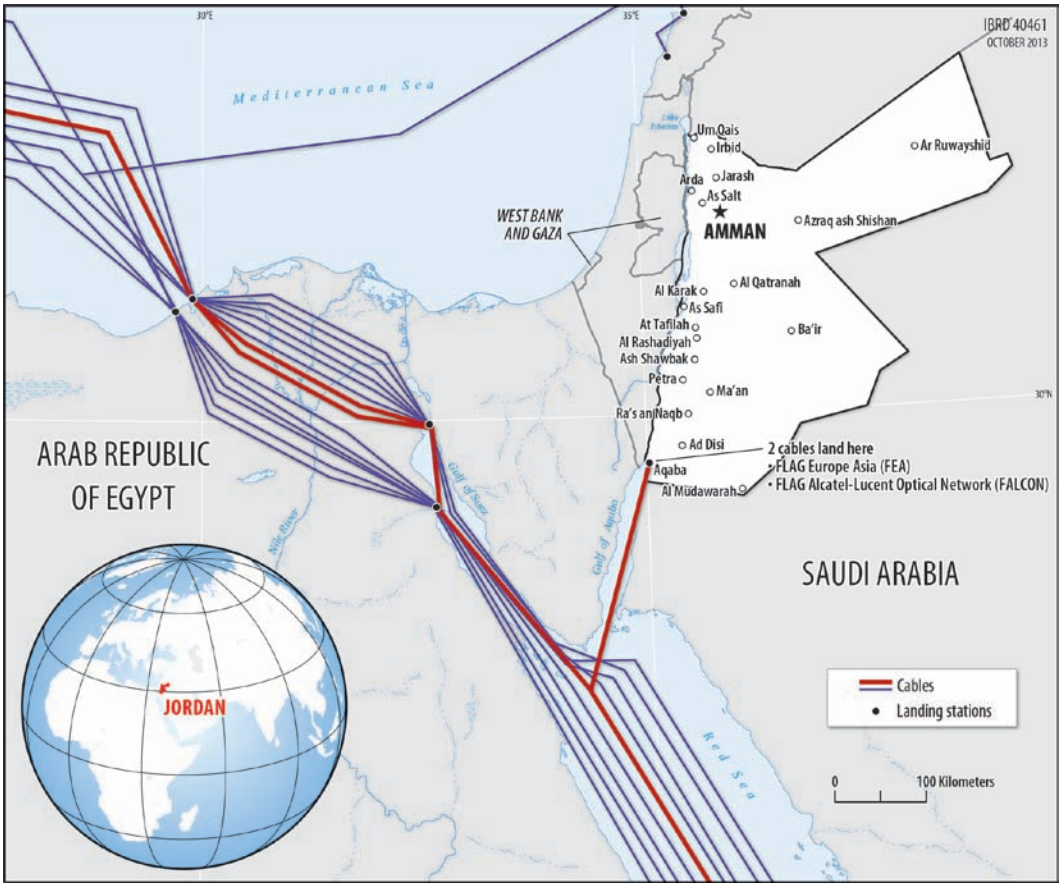
With a combined capacity exceeding 1 Tbps, and access to multiple submarine cables and terrestrial cross-border connections, Jordan's international connectivity is secure and the country has sufficient capacity to meet current and future medium-term needs. All telecom operators have access to international connectivity, with full competition resulting in a favorable price for international bandwidth, which is a key prerequisite for broadband development in the country.

At Aqaba on the Red Sea, two submarine cables provide international connectivity on an open access basis. In addition the national grids in Jordan (National Electricity Power Company [NEPCO]) and Egypt (EETC) have installed a submarine fiber-optic cable alongside a high voltage power line interconnecting their networks and making the excess capacity available to telecom operators in Jordan.

In terms of terrestrial regional connectivity, Jordan is perfectly interconnected at the regional level with cross-border links to Egypt, Syria, Israel and the Palestinian territories, and Saudi Arabia. NEPCO also provides connections with Syria and the Palestinian territories (Jericho).

JTG owns and operates a 4,000 km long fiber-optic backbone covering a large part of the territory, which uses SDH and DWDM technology and offers the potential for high bandwidth with good security. Jordan Telecom has a wholesale offer which is publicly available on the JTG group website.[21]

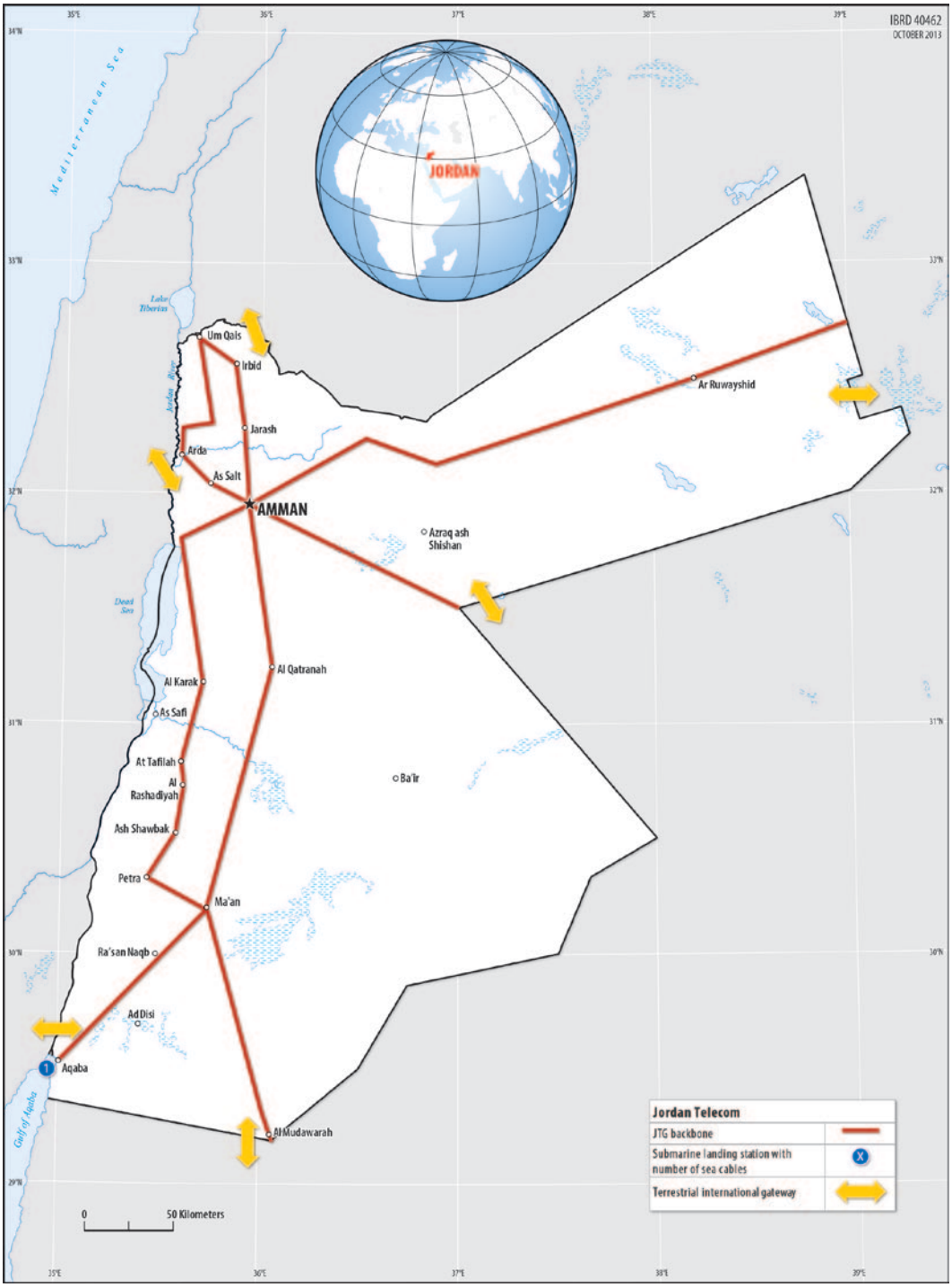
**Map A.14 International Submarine Cable Connectivity in Jordan**




| *International gateways* | | | |
|---|---|---|---|
| *Submarine cables* | | | |
| *Submarine stations* | *Cable* | *Owner* | *Destination* |
| Aqaba | **FEA** | | EU and Asian countries |
| | **FALCON** | | EU and Asian countries |
| ***Alternative submarine Infrastructure*** | | | |
| Aqaba | | NEPCO- EETC | Jordan; Egypt, Arab Rep. |
| ***Terrestrial*** | | | |
| Jordan | | | Syrian Arab Republic |
| | | | Israel |
| | | | Palestinian territories |
| | | | Egypt, Arab Rep. |
| | | | Saudi Arabia |
| | | | Iraq |

*Source:* World Bank.
*Note:* EETC = ; EU = ; FEA = ; NEPCO =.

**Map A.15 Main Links of Jordan Telecom's National Fiber Backbone**




*Source:* World Bank.
*Note:* JTG = .

Competitors Zain and VTEL Jordan also own and operate their own fiber-optic backbone. VTEL Jordan is a wholly owned subsidiary of VTEL Holdings, a regional telecom operator. It launched its operations in 2008 with the goal of becoming the country's first next generation network (NGN) operator providing data, voice, and related added value services to the wholesale, corporate, and residential markets. Within two years, VTEL Jordan became one of the largest 100 percent fiber-optic backbone operators in Jordan and has made strategic alliances with local and international companies in order to offer clients broadband through fiber optics. It has invested in the first FTTB and Gigabit Passive Optical Network (GPON) and services in order to deliver faster broadband: VTEL Jordan has built over 150 km of fiber-optic rings in Amman and the surrounding areas. In addition, VTEL Jordan built the largest Tier 3 Data Center in Jordan dedicated to colocation services, disaster recovery, and hosting.

Under the Telecommunications Law, competitive offerings to JTG's fiber-optic backbone by alternative infrastructure operators are allowed.

Currently there are two major owners of alternative fiber-optic infrastructure: the national electricity grid (NEPCO), the three electricity distribution companies (JIPCO, EDCO, IDCO), and the National Broadband Network (NBN) established by the government of Jordan along the motorways. Railroad infrastructure in Jordan is old and limited (Amman–Damas for passenger services, Amman–Aqaba for goods transportation), with some new developments financed under European Union (EU) assistance, but the national railroads do not have any fiber-optic infrastructure at present.

### *Fiber-Optic Infrastructure of NEPCO, JIPCO, EDCO, and IDCO*

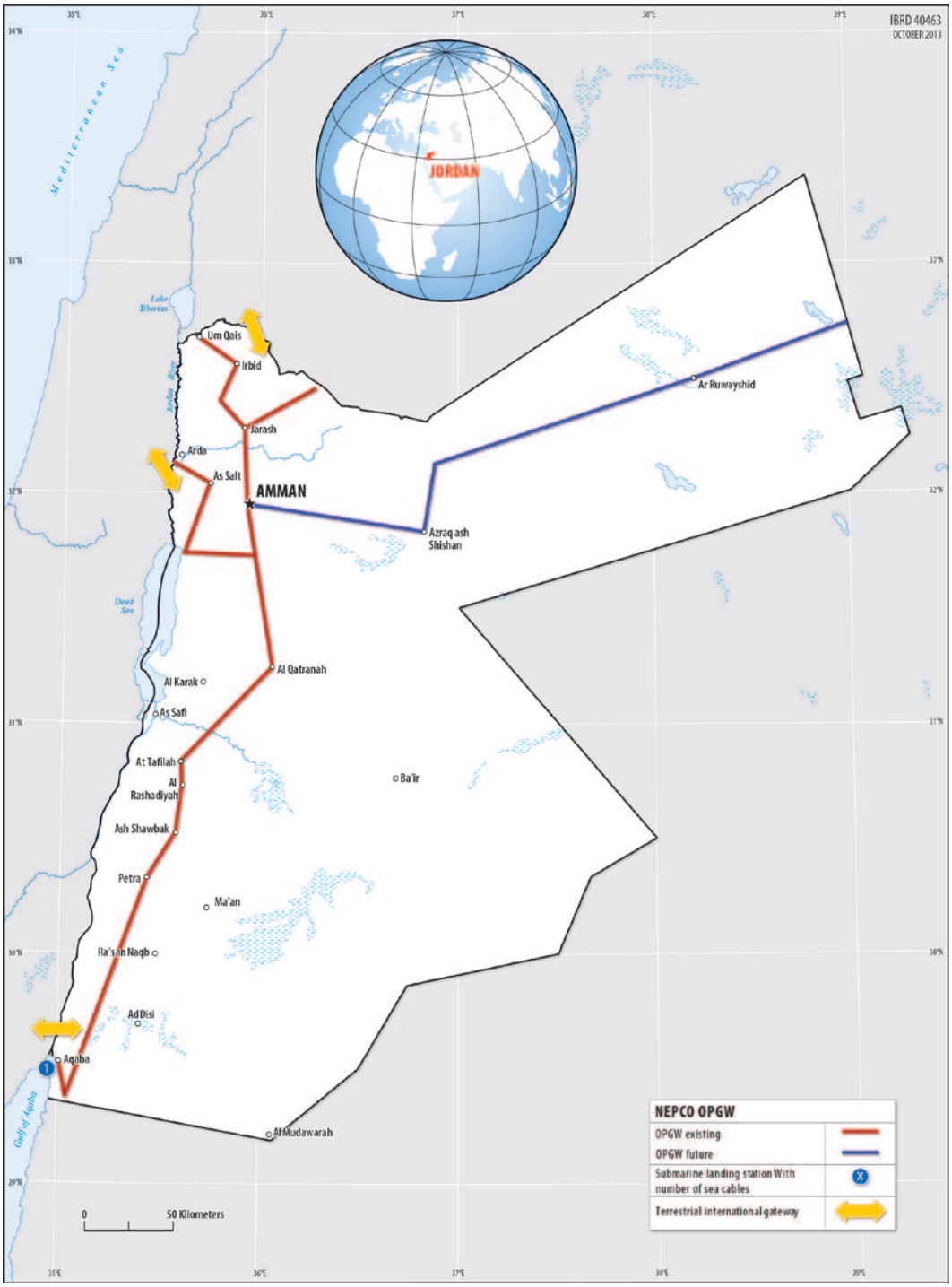
Because of its geographical structure, Jordan's population is concentrated in a small area of land (90 percent of the population live in about 10 percent of the territory). This feature has resulted in high penetration of the electrical distribution system, with the national electricity grid NEPCO being in charge of EHV (extra high voltage) transportation with the three electricity distribution companies (JIPCO, EDCO and IDCO) in charge of HV (high voltage).

For purposes of EHV transportation management, NEPCO has deployed optical fiber (OPGW cables) and also cables separately wound on its EHV, forming a 1,270 km fiber-optic infrastructure that covers all of Jordan's inhabited areas without significant gaps. Several plans for increasing this footprint in the next two years have also been identified, for an additional 490 km, with interconnectivity with neighboring countries, and NEPCO is open to installing new OPGW cables if required by the telecom operators.

However, because of requirements for the construction of EHV lines, the interface points on the NEPCO fiber-optic infrastructure are rarely close to urban areas, so that additional fiber infrastructure needs to be built to connect the fiber along the grid with technical sites of telecom operators, which are generally located in urban areas.

However the potential alternative infrastructure of the three electricity distribution companies (JIPCO, EDCO, and IDCO) could also be used by telecom

**Map A.16 Key Characteristics of NEPCO's Fiber-Optic Infrastructure**



| NEPCO (National Electricity Power Company) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link | | | | Passive support | | | | Usage | | Application | | Facilities | |
| City A | City B | Distance (km) | Status | Type of laying | Nb | Number of FO | Fiber type | FO used (NEPCO-Gov) | FO for rent | Short distance | Long distance | Maintenance services | Colocation facilites |
| Amman | Aqaba | 330 | | OPGW | 1 | 16/32 | G652 B | 4–8 | | | | | |
| Aqaba | Egypt | 20 | | Submarine | 2 | 16 | | 4–8 | | | | | |
| Qatrana | Ghorsafi | 60 | | OPGW | 1 | 32 | G652 B | 4–8 | | | | | |
| Qaia | Jericho border | 60 | | OPGW | 1 | 16/32 | G652 B | 4–8 | | | | | |
| Amman | Waqqas | 110 | | OPGW | 1 | 16/32 | G652 B | 4–8 | | | | | |
| Amman | Irbid | 110 | | OPGW | 1 | 32 | G652 B | 4–8 | | | | | |
| Amman | Syria Border | 180 | | OPGW | 1 | 16 | G652 B | 4–8 | | | | | |
| Amman | Mafraq-Rehab | 120 | | OPGW | 1 | 32 | G652 B | 4–8 | | | | | |
| Amman | K. Samra | 30 | | OPGW | 2 | 32 | G652 B | 4–8 | | | | | |
| Amman | Zarka-Hashmiya | 40 | | OPGW | 1 | 16/32 | G652 B | 4–8 | | | | | |
| Zarka | Manara | 25 | | OPGW | 1 | 16 | G652 B | 4–8 | | | | | |
| Manara | Amman | 15 | | OPGW | 1 | 16 | G652 B | 4–8 | | | | | |
| Amman | Bayader | 20 | | OPGW | 1 | 16 | G652 B | 4–8 | | | | | |
| Amman city network | | 150 | | OPGW | 1 | 16 | G652 B | 4–8 | | | | | |
| Total | | **1,270** | | | | | | | | | | | |
| ***Project (2012–14)*** | | | | | | | | | | | | | |
| Qwaira | Shedia | 140 | | | | 32 | | | | | | | |
| Sahab | Safawi-Riesha | 350 | | | | 16–32 | | | | | | | |
| Total | | **490** | | | | | | | | | | | |

*Source:* World Bank.
*Note:* : FO = ; Gov = government; km = kilometer; Nb = number; OPGW = optical ground wire.

operators to connect the national grid and their technical sites. At present, NBN signed a pole rental agreement with EDCO and IDCO to install aerial fiber cables on their poles.

NEPCO provides excess capacity of its alternative fiber-optic infrastructure to the telecommunications industry on request, and has set up a dedicated team to provide maintenance services on its infrastructure. However, according to information gathered during the study, the price levels appear to be too high to scale up usage by telecom operators.[22]

- The interconnection with Egypt via its submarine optical fiber cable is currently used by TE Data, a subsidiary of Telecom Egypt, to provide Internet in Aqaba.
- Some fibers (4–6) of NEPCO's fiber-optic infrastructure are used by the ICT ministry for the NBN project under an indefeasible right of use agreement. In exchange, NBN allows access to some fiber on its own network to NEPCO for backup purposes. NBN also uses fiber from the distribution companies to provide connectivity to schools.

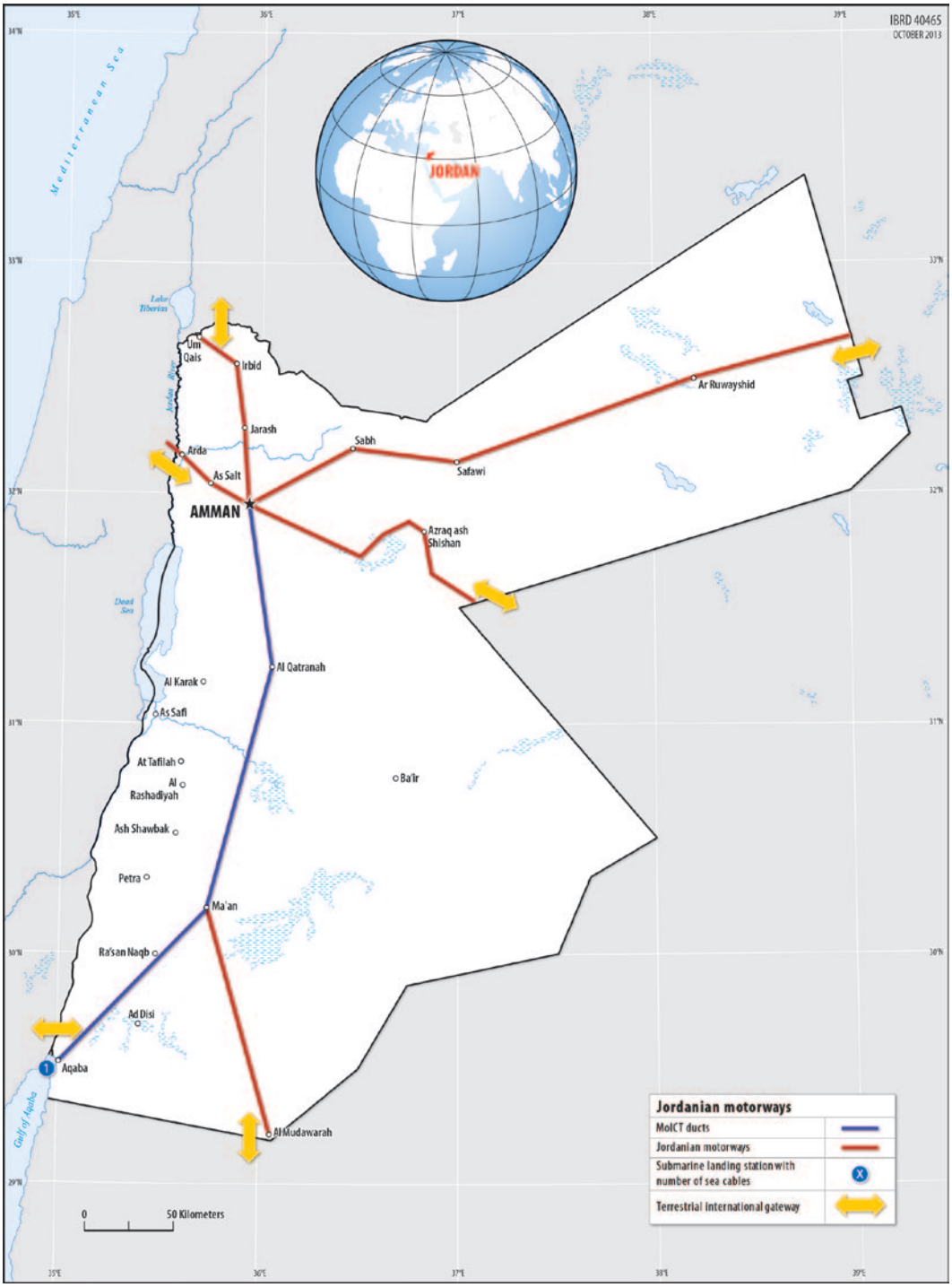
### *Fiber-Optic Infrastructure of NBN*

The government of Jordan adopted a universal service policy for the telecommunications sector in 2004 to ensure the availability and affordability of basic telecommunications services to all citizens. This policy is being continuously reviewed for the purpose of expanding the scope of coverage of telecommunications and information technology services, both horizontally and vertically, in such a way as to meet the requirements of comprehensive economic and social development in the kingdom. This has been achieved through building the NBN, the open broadband network of the government of Jordan under the responsibility of the Ministry of Information and Communications Technology. NBN has, since its launch in 2004, connected 612 schools, 56 government entities, and 45 healthcare institutions (74 healthcare institutions have been provided with fiber connection only), including eight universities at 10 sites and 22 Knowledge Stations around the kingdom with a fiber-optic network of 100 megabits per second (Mbps) capacity per site, in a bid to provide a high-speed broadband platform for Jordan to improve both its educational and healthcare systems as well as to increase access in underserved areas.

NBN was constructed on the basis of its own fiber-optic infrastructure along the highway between Amman and Aqaba (open for service at the end of 2010) and of dark fiber cables provided by NEPCO and the three local electricity distribution companies (JIPCO, EDCO, and IDCO).

However, NBN's own infrastructure provides limited coverage as it consists merely of the Amman–Aqaba link. Some of the extra capacity of NBN's four ducts on this link is used by Damamax, which has rented a duct and laid a fiber-optic cable in substitution of the NEPCO fiber optic it rented in the past. According to information gathered during the study, the quality of the link is poor as it is often cut.

**Map A.17 Key Characteristics of NBN's Fiber-Optic Infrastructure**



| | NBN | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Link | | | | Passive Support | | | | Usage | |
| Owner | City A | City B | Distance (km) | Status | Type | Nb | Nb of used ducts | Fiber Type | FO used (Nepco-Gov) | Duct for rent |
| MoICT | Amman | Aqaba | 330 | | Duct | 5 | 1 | | 6–10 | 4 |
| | Total | | 330 | | | | | | | |

*Source:* World Bank.
*Note:* FO = ; Gov = government; km = kilometer; Nb = number; MoICT = ; OPGW = optical ground wire.

### *Key Lessons For the Use of Alternative Fiber-Optic Infrastructure*

From a policy perspective, there is significant infrastructure-based competition for national backbones. There are no impediments to the implementation and use of alternative infrastructure, and the electricity utility networks have some excess capacity that could be made available to licensed telecommunications operators and also for private networks. However, tariff regulation may be necessary to ensure that these resources are accessible at an economically feasible price.

Scaling up of all alternative infrastructure (existing and planned) usage could be further enhanced by the rapid institution of new requirements for ducting on all new roads and other utility infrastructure, fostering the inclusion of an ICT component in each new project, and avoiding exclusive agreements between operators and alternative infrastructure providers. This would particularly benefit areas with a significant number of inhabitants that are currently underserved by broadband.

## Algeria

### *Introduction*

As with other countries in the MENA region, the opening of the telecommunications market began with the issuing of three mobile licenses (in 1999, 2002, and 2004), which has largely addressed the demand for voice services in the country.[27] The opening of the market resulted in a rapid growth in penetration.

Today the fixed telephony sector is exclusively served by Algeria Telecom (AT), the incumbent state-owned operator, which holds a monopoly on basic services after the attempt to introduce competition failed in 2009.

The mobile sector in Algeria is shared between three operators:

- **Mobilis–AT** (licensed in 1999) (100 percent state-owned)
- **Djezzy Orascom** (licensed in 2002) (51 percent Vimpelcom)
- **Nedjma** (licensed in 2004) (Qtel)

In contrast to other countries where the incumbent operator also has a mobile license, the AT group and its Mobilis subsidiary are not the leaders of the voice market in spite of their position as incumbent operator and being the first

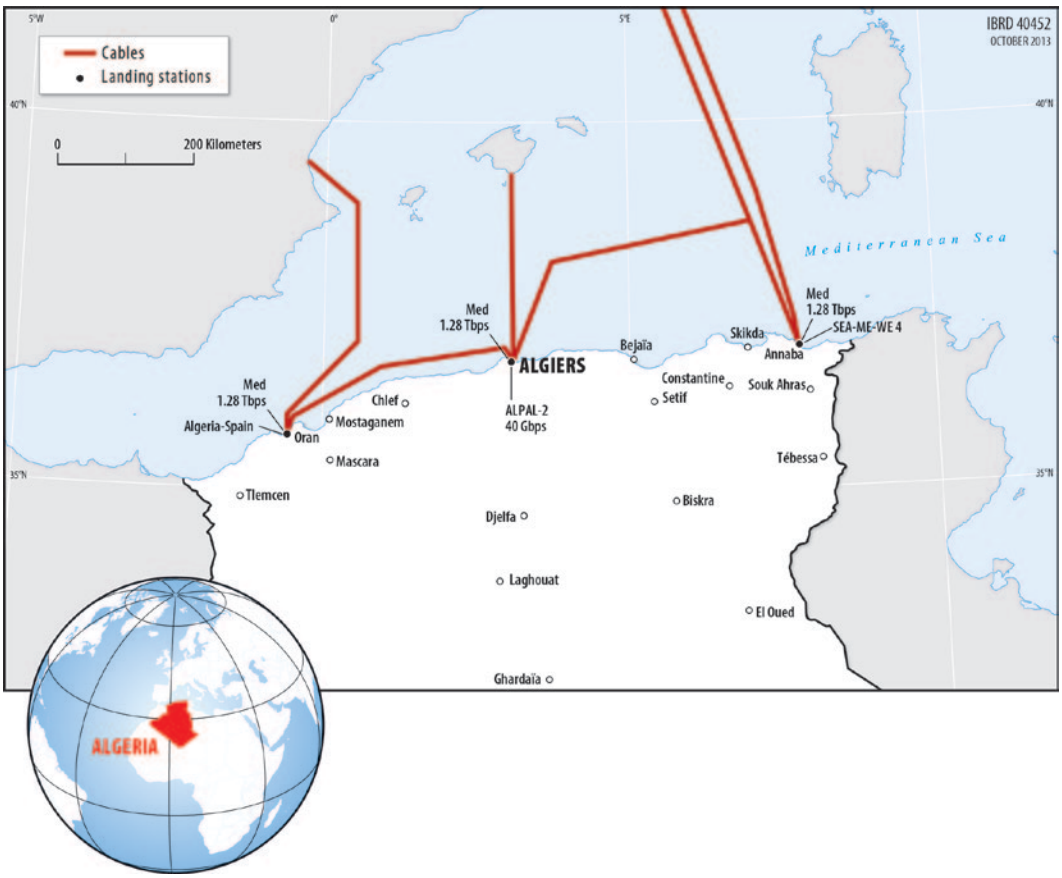
operator to be awarded a mobile license. The AT group represents only 35 percent of the overall voice market and 30 percent of the mobile sector.

The Internet access market is shared between AT, three ISPs[23] with Worldwide Interoperability for Microwave Access (WiMax) services, and the GPRS services of the mobile operators. The broadband market is largely restricted to AT's ADSL service because the number of subscribers using ISPs with WiMAX access is not significant. With only about 1,500 subscribers in total, this can be described as a niche market. About 45 percent of AT's lines are equipped with ADSL. AT's broadband services are supplied by its ISP subsidiary, djaweb SPA.

### *International/Regional and National Connectivity*

Algeria's international connectivity is provided by submarine cable and microwave links. Algeria is currently connected by three submarine cables, which provide international access to Europe, and to Asia, through SEA-ME-WE4.

**Map A.18 International Submarine Cable Connectivity in Algeria**




*Source:* World Bank.

AT has shares in two submarine cables giving it a total capacity just over 140 gigabits per second (Gbps). In mid-2013, AT's international traffic was 130 Gbps for the Internet, and about 2.5 Gbps for voice, via SEA-ME-WE4 and Alpal. In this context, in 2013, a new cable was expected to be set up by AT between Algeria and Spain.

In 2013, Djezzy via its Global Telecom Holding acquired the Med Cable, assuring it independent international connectivity along with a festoon system to provide redundancy for its terrestrial infrastructure. Having no broadband service, this cable is used by Djezzy mainly for voice services and a small part for IP traffic generated by GPRS services.

Algeria's international connectivity, and more particularly that of AT, is not guaranteed by its two submarine connections. Alpal, which lands at the island of Majorca, is relatively old and of low capacity (40 Gbps) and furthermore it needs to transit via Telefonica's submarine cable to link with the European submarine landing stations. It appears that AT has increased its capacity on SEA-ME-WE4 because the capacity available in 2012 was not sufficient in the short term to provide the international IP transit that would potentially be required for broadband development in Algeria. At the end of 2012, the IP bandwidth in use was 100 Gbps, while an estimation based on international benchmarks suggests that it would be necessary to have more than 180 Gbps to fully support a broadband penetration of 7 percent.

The monthly fee for a 2 Mbps IP link to the international backbone is approximately US$1,000/Mbps per month, which is one of highest priced fiber services among all the MENA countries and in Africa today.

In terms of regional terrestrial connectivity, AT uses the Algerian part of the Ibn Khaldoun optical cable, which connects to Morocco and Tunisia. AT has also recently deployed a terrestrial cable reaching the Niger border, as part of a project to lay fiber via Niger to Nigeria, along the route Algiers–Zinder–Abuja. On the Algerian side, a terrestrial cable was deployed in 2012–13 up to Niger's border. Onward connectivity with the infrastructures of Niger and the other ECOWAS countries has not yet been achieved. This cable is part of a priority set of presidential projects supported by the government. AT, with this Sub-Saharan connectivity, hopes to transform Algeria into a hub for the region for international connectivity, in competition with international submarine cables passing the coastal countries of ECOWAS (WACS, MainOne, Africa Coast to Europe submarine cable [ACE], Glo-1 and SAT-3).

This cable could provide strategic support for regional integration frameworks on the continent and allow the interconnection from the North to the South. However, the tariffs on the connection from Morocco and Mauritania are expensive. An analysis based on AT's interconnection catalog indicates that the monthly price between the Niger border and Algiers would be of the order of US$6,000/Mbps monthly (for a capacity purchase of 400 Mbps). In these conditions, it would be difficult for this connection to be used by operators of the Sub-Saharan countries to reach AT's international landing stations.

**Table A.1 Algerian International Gateways: Landing Stations, Terrestrial, and Potential Alternatives**

| *International gateways* | | | |
|---|---|---|---|
| *Submarine cables* | | | |
| *Submarine landing stations* | *Cable* | *Owner* | *Destination* |
| Annaba | SEA-ME-WE4 | Algérie Télécom | Europe-Middle East |
| Algiers-Annaba-Oran | Med | Djezzy<br>Global Telecom Holding et Optimum Algérie Télécom | Marseille |
| El Djemila | ALPAL-2 | Algérie Télécom-Orange France | Covetes (Spain (Majorca)) |
| Oran | Algeria-Spain | Algérie Télécom | Valence (Espagne) |
| ***Terrestrial*** | | | |
| Algérie Télécom gateways | | Tunisia border | Tunisie Télécom |
| | | Morrocco border | Maroc Telecom |
| | | Niger Border | Not connected to Niger part |
| ***Potential alternative gateways*** | | | |
| Sonatrach | | Oujda | Morocco<br>Spain |
| | | Souk Ahras | Tunisia<br>Italia |
| | | Beni Saf | Spain |
| | | El Kala | Sardaigne |
| Sonelgaz | | Oujda | ONE Morroco<br>Spain |
| | | Tebessa | STEG Tunisia |
| | | Souk Ahras | STEG Tunisia |
| Railways | | Oujda | ONCF Morroco |
| | | Tebessa | SNCFT Tunisia |
| | | Souk Ahras | SNCFT Tunisia |

*Source:* World Bank.

Several alternative infrastructures, currently not used by the ICT sector, have cross-border connections:

- **Energy:** the infrastructures of Sonelgaz (in charge of Algeria's energy sector) and Sonatrach (in charge of transport of oil and gas in Algeria) are equipped with fiber-optic cables and are interconnected with those of STEG (Tunisia), ONEE (Morocco), and Libya.
- **Railroads:** the infrastructure of SNTF (Algeria's railway company) provides several potential points of interconnection with those of ONCF (Morocco) and SNCFT (Tunisia).
- **Alternative submarine cable:** parts of Sonatrach's infrastructure are equipped with fiber-optic cables that link Algeria to Spain and Italy offering international capacity that is unused.

These could enable the creation of a regional network infrastructure similar to that of Ibn Kaldoun, which is managed by the incumbent operators of the participating countries. However, at the regional level the legal and regulatory framework of Algeria has been the major bottleneck, particularly for the current Programme for Infrastructure Development in Africa (PIDA) projects of NEPAD/NPCA, since AT has held a *de facto* monopoly which has made it impossible to create a competitive alternative regional infrastructure or to establish a regional operator.

However, in July 2013, a new company was created to manage the country's terrestrial telecommunication infrastructure.[24] The Company of Telecommunications Infrastructures Algeria (CITA), a public national company for management of the national fiber-optic network, was established on July 8, 2013, with capital of DA 500 million (US$6.33 million).

CITA has four public shareholders, namely:

- Algeria Telecom (AT, 55 percent),
- Sonatrach (20 percent),
- Sonelgaz (20 percent), and
- la Société nationale du transport ferroviaire (SNTF, 5 percent),

CITA was created by the reorganization of AETC[25]; it incorporated new shareholders from AT and SNTF and expanded its mission. According to the government, its role will be "to manage the available resources of fiber optics, to develop capacities on the subject, to implement the strategy of mutulization of the alternative networks and to contribute to the digital development of the territory." Among others below are listed more specific objectives of CITA related to development of the broadband networks:

- Develop additional fiber capacity;
- Implement the strategy for the development of the alternative networks;
- Contribute to implementing the development plans for the alternative networks with the aim of optimizing the investments funded by the national budget;
- Reduce the barriers to accessing transmission capacity and to broaden services to the various other operators;
- Prepare the high-speed broadband deployment of networks over the whole national territory; and
- Deploy fiber optics along the electricity networks of lower tension systems of Sonelgaz to ensure coverage of the rural zones and the opening up of more isolated regions.

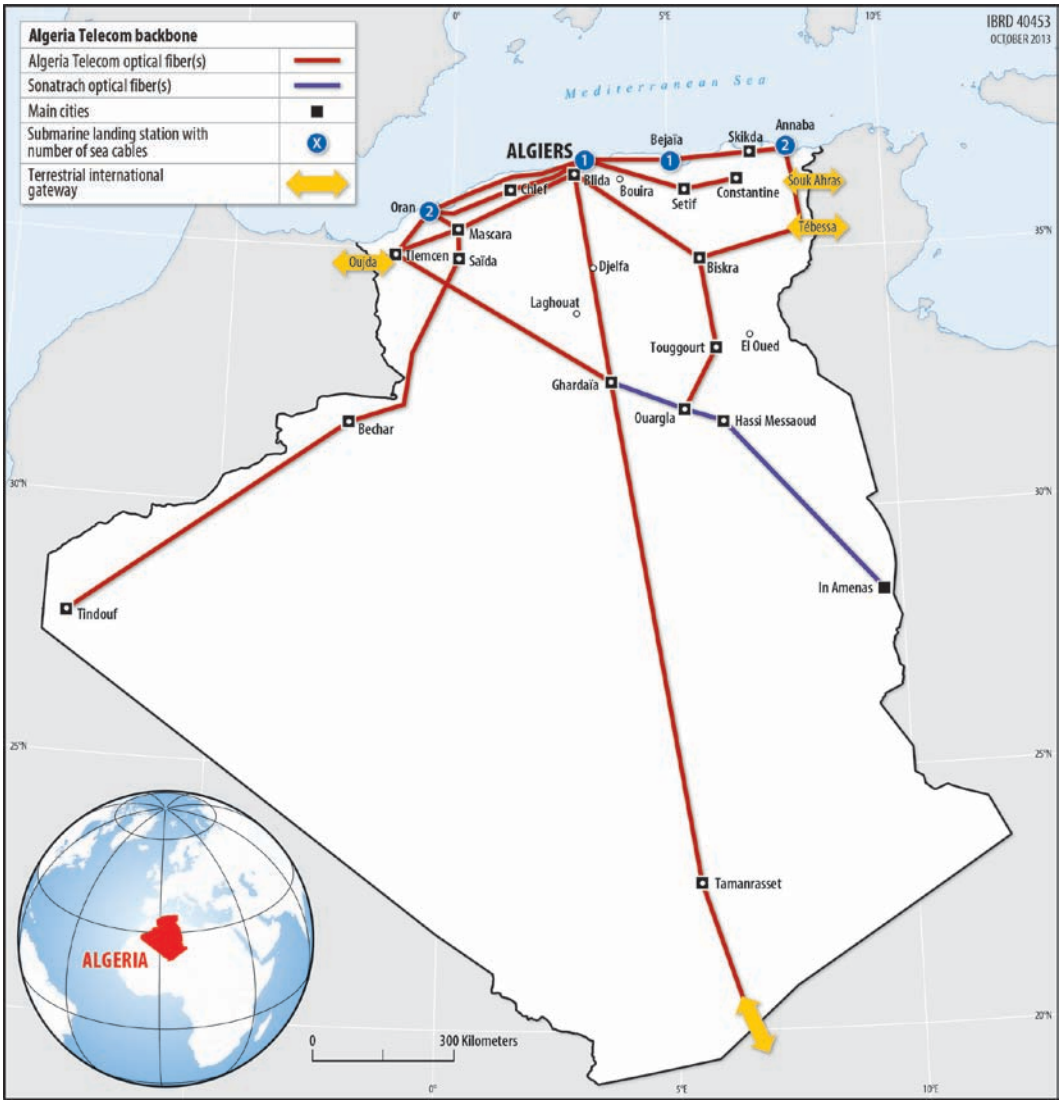
In this new policy framework AT, or an independent department, will handle management, operation, and maintenance of the network put at the disposal of CITA, and will supply telecommunications services for telecoms operators and licensed ICT service providers or those authorized to establish telecommunication networks open to the public, as defined in the legislation

and the regulations in force. It appears that CITA will be relatively independent from AT and will offer to the operators mainly the rent of bandwidth and not the rent of passive infrastructure (dark fiber, ducts, etc.).

### *Fiber-Optic Infrastructure of Algeria Telecom*

AT has a terrestrial fiber infrastructure covering the main cities of Algeria and majority of the inhabited territories, totaling more than 40,000 km of optical cables. In 2013, AT planned a new extension to link about 900 cities of more than 1,000 inhabitants that have remained unconnected.

**Map A.19 Main Links of Algeria Telecom's National Fiber Backbone**




*Source:* World Bank.

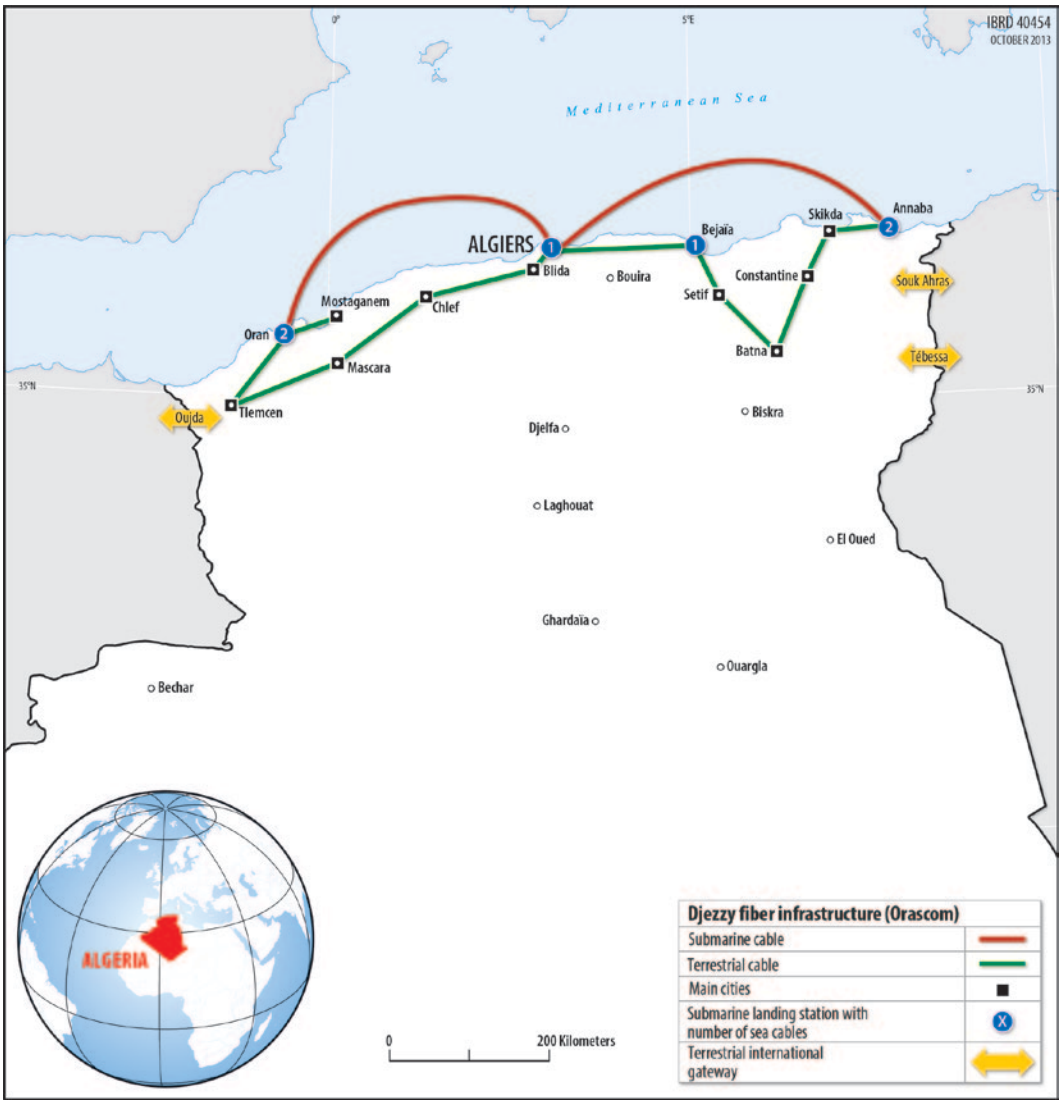
Algeria Telecom has a network based partially on optical infrastructure using SDH and DWDM technologies in its network and has set up an IP MPLS network covering the greater part of the country.

*Fiber-Optic Infrastructure of Djezzy*

The leading mobile phone operator Djezzy has laid its own national backbone that consists of

- Terrestrial segments: connecting the main cities of the North, and
- Submarine segments: a festoon providing security for the terrestrial infrastructure with three landing stations at Oran, Algiers, and Annaba.

**Map A.20 Main Links of Djezzy's National Fiber Backbone**



| Algeria | | | | | | | |
|---|---|---|---|---|---|---|---|
| Djezzy | | | | | | | |
| Link | | | | Passive support | | | |
| City A | City B | Distance (km) | Status | Type of laying | Nb of cable | Number of fiber optics per cable | Fiber Type |
| Annaba | Batna | 250 | | Duct | 2 | 72 | G 652 D G 656 |
| Batna | Bejaia | 240 | | Duct | | | |
| Bejaia | Algiers | 240 | | Duct | | | |
| Algiers | Tlemcen | 540 | | Duct | | | |
| Tlemcen | Mostaganem | 200 | | Duct | | | |
| Total | | **1,270** | | | | | |
| ***Project (2012–14)*** | | | | | | | |
| Oran | Alger | 500 | | Duct | | 8 | G652 |
| Alger | Annaba | 700 | | Duct | | | |
| Total | | **1,200** | | | | | |

*Source:* World Bank.
*Note:* km = kilometer; Nb = number.

### *Fiber-Optic Infrastructure of Sonatrach*

Since the 1990s, Sonatrach has laid fiber-optic cables along its gas or oil pipelines under construction. These are partially used for the management of the SCADA systems in the intermediate pumping plants and to meet the needs for telephone and internal ICT purposes. The main value of the extra fiber capacity of Sonatrach would be in the creation and/or the strengthening of the national infrastructure, although it provides little local connectivity for cities and villages. Sonatrach has about 8,000–10,000 km of optical cables with 10–24 fiber optics per cable. Nevertheless, Sonatrach's infrastructure presents a major opportunity for regional integration with

- Regional access through connections to Morocco, Tunisia, and Libya; and
- International access through connections to Spain and Italy.

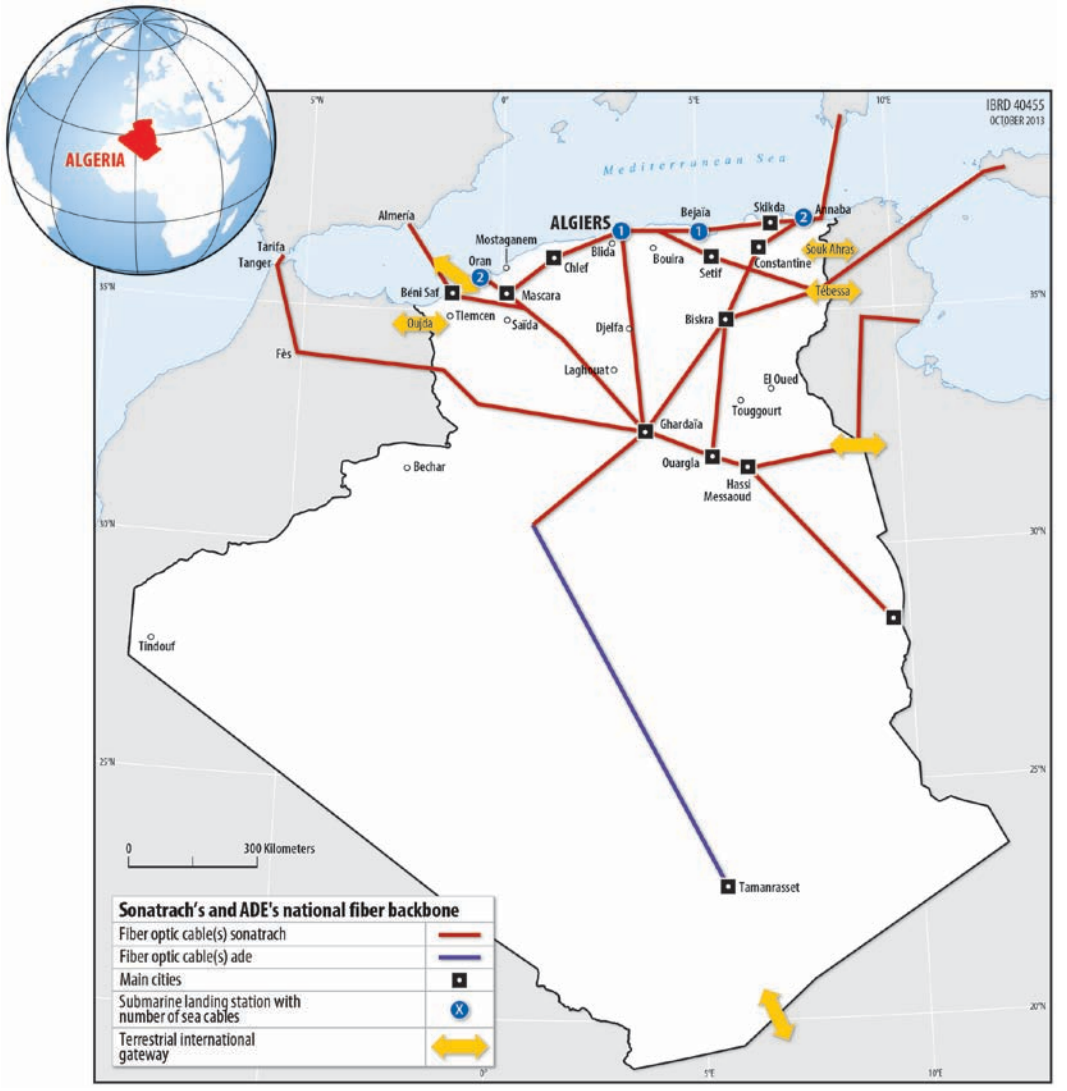
### *Fiber-Optic Infrastructure of ADE*

In 2011, the water distribution agency, Algérienne des Eaux (ADE), laid a new link of 750 km of optical fiber to support the administration of water transfer in Salah–Tamanrasset, illustrated in map A.21.

### *Fiber-Optic Infrastructure of Sonelgaz*

With the aim of meeting its own needs for transmission and telecommunications, and to help it address the inadequacies of AT's existing national network, the national electricity and natural gas distribution company, Sonelgaz,[26] has created its own national network as well as an entity, GTRE, charged with the

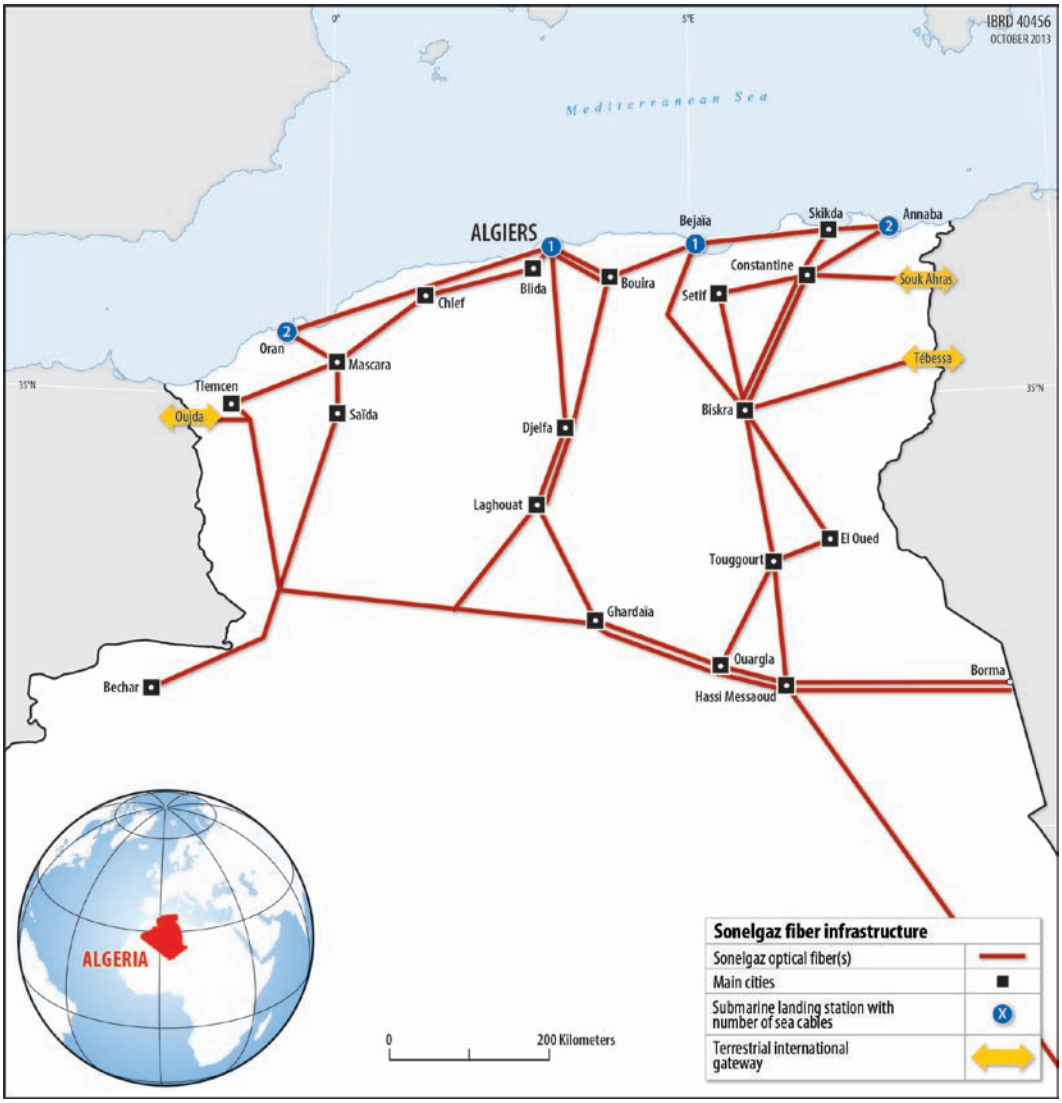
**Map A.21 Main Links of Sonatrach's and ADE's National Fiber Backbone**




*Source:* World Bank.

implementation and resource management of telecommunications. To meet its needs for management of electricity distribution lines, Sonelgaz has deployed more than 13,000 km of fiber-optic cables. The type of fiber optics used by Sonelgaz/GRTE is a mix of G652B and G656 cables, some of which are lashed onto existing cables, while OPGW has been deployed on new infrastructure. The network has a capacity of 24 fibers for the OPGW and lashed network, and 48/96 fibers for the subterranean lines.

**Map A.22 Key Characteristics of Sonelgaz's Fiber-Optic Infrastructure**

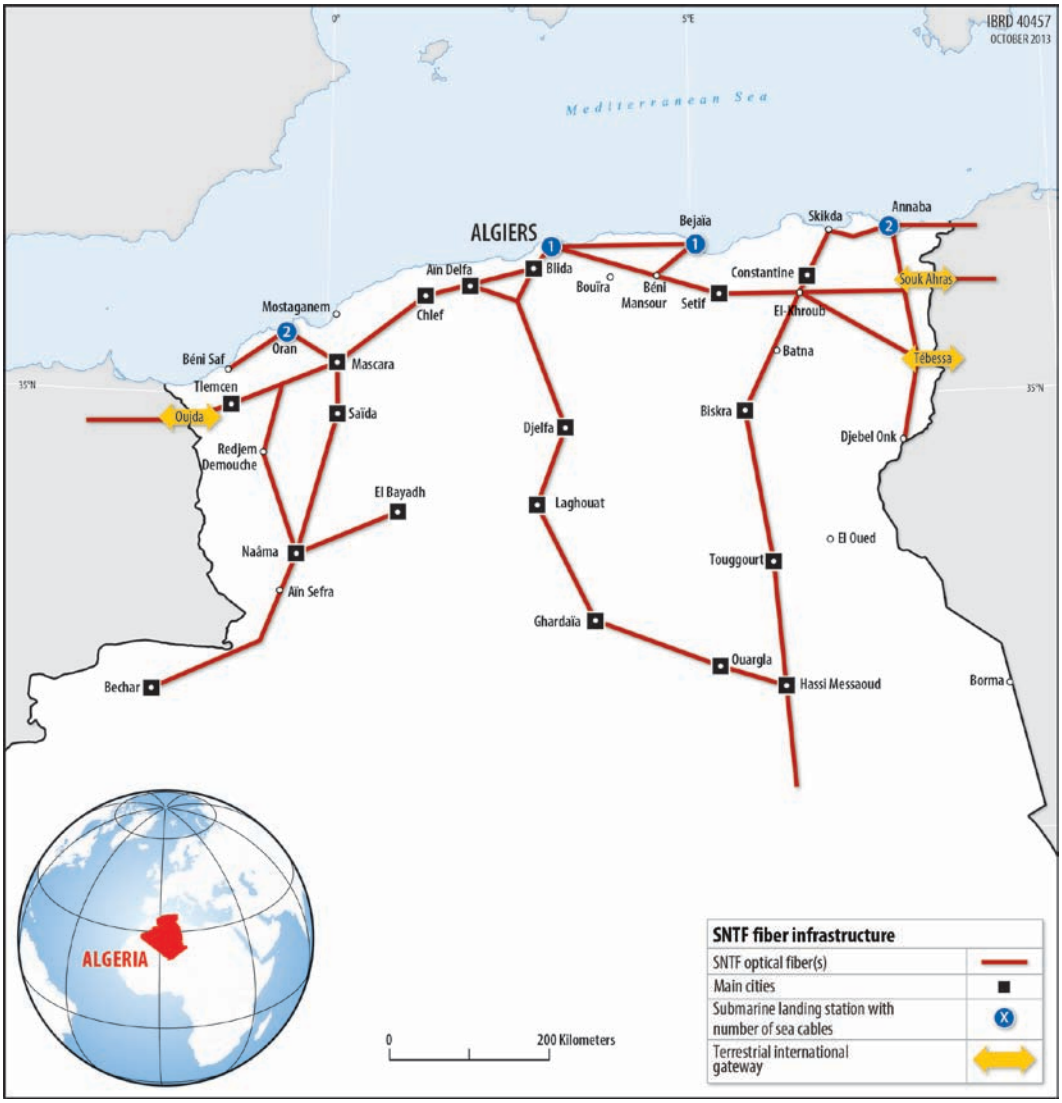



*Source:* World Bank.

### *Fiber-Optic Infrastructure of SNTF*

Within the framework of its modernization program and plans to improve railroad traffic management, SNTF is in the process of laying optical fiber along its railroad infrastructure. By 2015 it is expected that about 5,000 km of fiber-optic cables will be deployed. The extra capacity of the SNTF network could be used to carry high-speed traffic from cities with railway stations, provided that the engineering of the network takes into account the needs of the ICT sector.

**Map A.23 Key Characteristics of SNTF's Fiber-Optic Infrastructure**




*Source:* World Bank.

### *Key Lessons for the Use of Alternative Fiber-Optic Infrastructure*

Alternative fiber-optic infrastructures in Algeria provide extensive geographical coverage. However, due to legal and regulatory constraints, those alternative infrastructures have not been fully leveraged to boost the ICT sector growth. Creation of CITA may unleash this much needed potential if associated with an effective open access framework under a strong regulatory oversight.

Even a marginal increase in broadband penetration in Algeria may not be sustained by the existing international capacity and increase of total international bandwidth (which at the moment of drafting this report was approximately 140 gigabits [Gbs]) is likely to be required in the short- to medium-term.

## Libya

### *Introduction*

The ICT market structure in Libya is under the control of the government and is organized around **LPTIC Holding (Libyan Post, Telecommunications and Information Technology Company** [http://www.lptic.ly]), which is not only a financial holding company but also the main actor in the ICT sector. LPTIC has eight subsidiaries, of which six are involved in ICT services, as shown in figure A.1 below.

Two of the subsidiaries offer infrastructure-specific services:

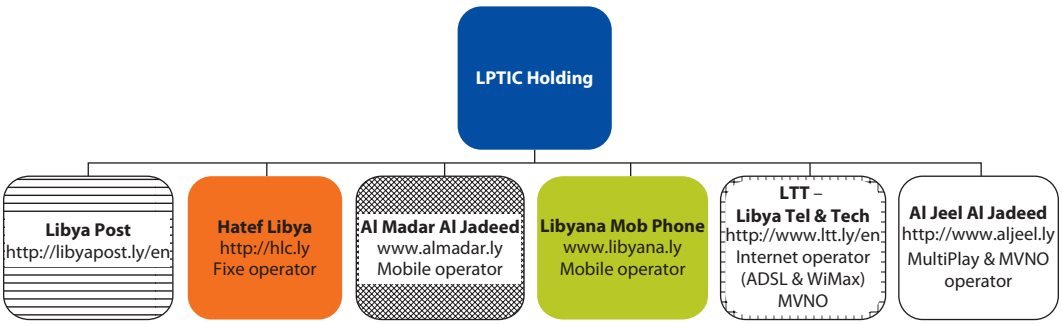
- **Libya International Telecom Company (LITC)** (http://www.litc.ly): International communications. LITC is the owner of the various submarine cables and manages international access.
- **Al Bunya Investment and Services Company**: Infrastructure deployment and maintenance.

The Libyan market structure is atypical and is organized around service-type separation: one company for fixed networks and two for mobile.

**LPTIC Holding Company**: LPTIC manages the different subsidiaries but does not offer services directly to Libyan consumers. It is in charge of strategy and implementation.

**Fixed Operator Hatif Libya**: The state-owned company Hatif Libya (http://hlc.ly) is in charge of developing and operating fixed wire and wireless telephone services and the associated terrestrial infrastructure.

**Figure A.1 Libyan Market Structure**



Mobile market is shared between two state-owned operators: Libyana and El Madar. Both networks are government owned but offer different services and pricing.

**Libyana** ((global system for mobile communications/second generation of mobile telecommunications technology [GSM/2G] license in 2004; global system for mobile communications/third generation of mobile telecommunications technology [GSM/3G]- HSDPA 3.6 Mbps in September 2009): In April 2013, a tender was launched to modernize the 3G network and deploy fourth generation of mobile telecommunications technology/long-term evolution (4G/LTE) hotspots (the investment is estimated at US$200 million).

**El Madar Al Jadid** (GSM/2G license in 2000; license was modified to GSM/2G-EDGE in 2008): As of today, El Madar offer GPRS services[1] providing low speed data connectivity services allowing end users to access e-mails and/or read news. In June 2013, El Madar launched an international tender to rollout 3G network and 4G/LTE (hotspots) (this investment is estimated at US$65 million).

Two ISP/MVNO licenses were awarded to Aljeel Aljadeed and Libya Telecom and Technology (LTT).

**Aljeel Aljadeed:** Aljeel Aljadeed was created primarily to contribute to the improvement and development of Libya's telecommunications sector. The company is seeking to launch the tripleplay offer in Libya, and is mainly using the existing infrastructure managed by LPTIC and Hatef.

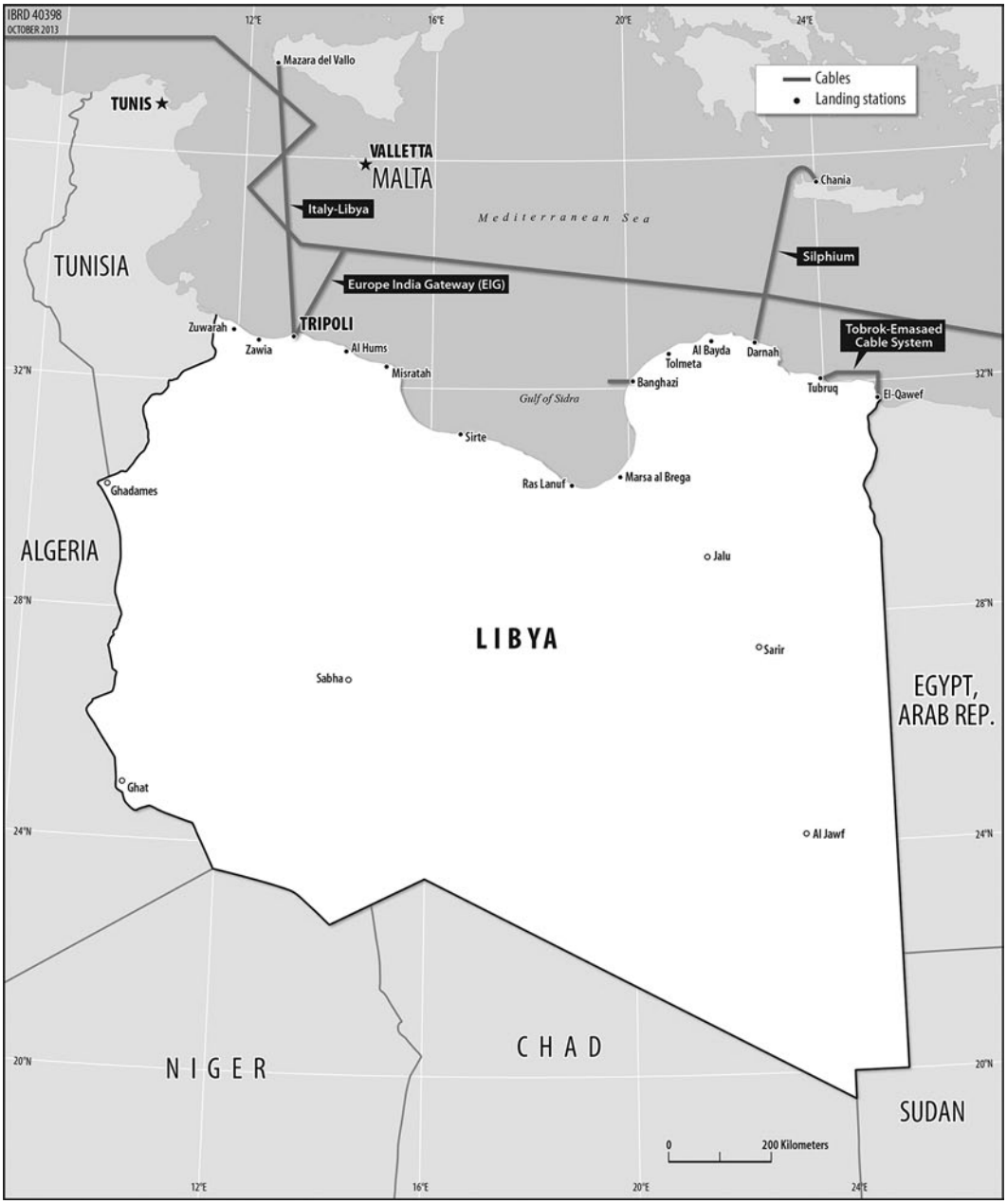
**Libya Telecom and Technology**: At the time of this writing appendix, LTT had four different internet access offers: Dial up access; Libya ADSL, Libyamax (based on WiMax), and Satellite DVB-RCS Access. LTT operates one data center. Until the end of 2012, LTT had a monopoly on provision of ADSL services, but in 2013 the government authorized 19 private ISPs to offer ADSL services.

### *International/Regional and National Connectivity*

With a combined capacity exceeding 4 Tbps, three submarine cables (arriving at two submarine landing stations), plus two terrestrial cross-border connections,[2] the international connectivity of Libya is secure and has sufficient capacity to meet current and future medium-term needs. However, as a result of the country's former political environment, there is a de facto and de jure monopoly on international Internet gateways managed currently by Libya International Telecom Company.

In terms of terrestrial regional connectivity, the Ibn Khaldoun cable connecting Libya with Tunisia and Algeria (operated by the incumbent operators of those respective countries) seems to be the only alternative. Libya and Tunisia are interconnected via a point-to-point link between Ras Adjir and Ben Gardane (total capacity of 24 optic fibers, of which only two are used). Libya is interconnected with Algeria via a point-to-point link which goes from Ghadamès to Debdab (total capacity of 8 optic fibers, with a total used bandwidth of only 622 Mbps).

**Map A.24 International Submarine Cable Connectivity in Libya**




*Source:* World Bank, based on TeleGeography Interactive Submarine Cable Map (http://www.submarinecablemap.com/. Accessed September 2013)

| *International gateways* | | | |
|---|---|---|---|
| *Submarine cables* | | | |
| *Submarine stations* | *Cable* | *Owner* | *Destination* |
| Tripoli | EIG | **LITC** as shareholder of consortium | Europe, Asia |
| | Italy Libya | Telecom Italia Sparkle, **LITC** | Italy |
| Damah | Silphium | **LITC** | Greece |
| ***Terrestrial*** | | | |
| Libya Telecom gateways | | Tunisia border | Tunisie Telecom |
| | | Algeria border Ghardimaou | Algérie Télécom |
| | | Egypt, Arab Rep.[3] | Telecom Egypt |

*Source:* World Bank.

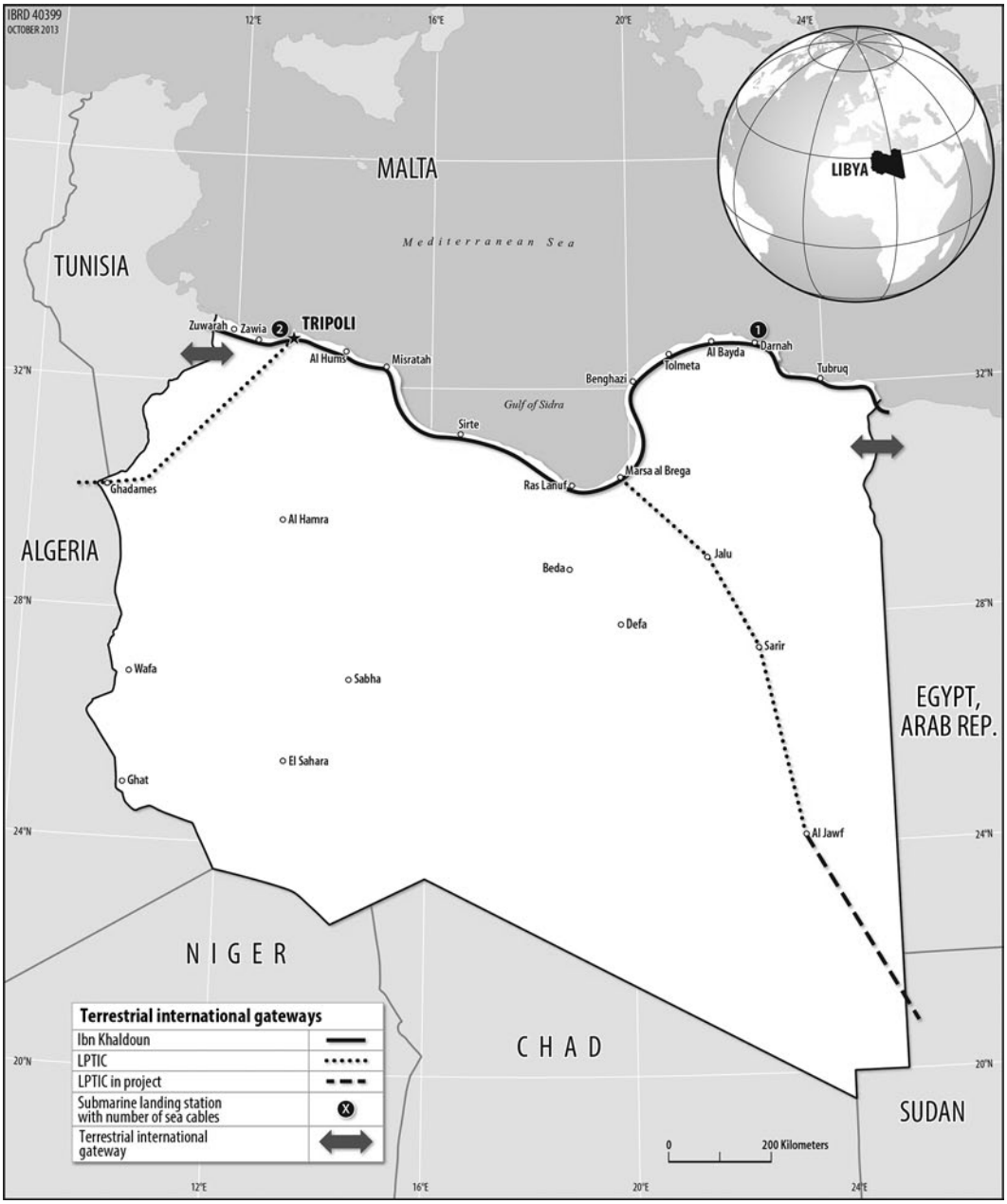
Egypt is currently interconnected with Libya by a microwave radio link (at Emsaed). Only a few[4] km of fiber-optic infrastructure missing at the Libya–Egypt border would complete terrestrial connectivity from Morocco to the Gulf Cooperation Council (GCC). Completing this link will have a huge impact on facilitation of direct traffic exchange with that country and to provide better and more resilient regional connectivity (with the rest of North Africa in the MAU economic zone[5] and with Arab countries of the Gulf via Egypt).

It is also planned to establish broadband connectivity with Sudan in 2013 though 300 km of fiber (an investment of about US$6 million). Interconnectivity with Sudan is important for the regional integration, particularly for opening terrestrial connectivity between South Africa and the Mediterranean coast.

Alternative fiber-optic infrastructures are in place in Libya, but only the electricity transmission grid infrastructure has cross-border fiber-optic connections with the electricity utilities of Tunisia and Egypt. It is equipped with fiber-optic cables and is interconnected with the networks of STEG (Tunisia) and EETC (Egypt). A few sections of OPGW are currently missing. This interconnectivity could offer competition to the MAU backbone project envisaged by the incumbent operators, and is part of the NEPAD/NPCA African connectivity program (PIDA). Other alternative infrastructure operators (such as oil or railways) have deployed fiber-optic networks, but at the moment of writing this appendix are currently not able to provide alternative international gateways due to the lack of the fiber-optic links reaching the borders of the country.

In terms of national connectivity, Libya is one of the MENA countries with well-developed national terrestrial fiber-optic infrastructure which (whenever used for that purpose) may have a great impact on development of national broadband connectivity. Since 1996 state-owned companies (LPTIC, Hatif) as well as various utilities (energy grid, oil companies, and water) were deploying network infrastructure which may be leveraged for that purpose[6].

**Map A.25 Libya–Tunisia–Egypt Terrestrial Interconnectivity, 2011**




*Source:* World Bank.

### *LPTIC Infrastructure*

LPTIC is the owner of the fiber-optic infrastructure covering the main cities of Libya. The LPTIC infrastructure can be split into two different parts:

### *Legacy Infrastructure (Hatif )*

The legacy infrastructure was laid in the 1990s by Pirelli and Sirti as passive fiber-optic infrastructure which interconnects 107 cities mainly along the Mediterranean coast. A large part is based on festoon cable augmented with some terrestrial links in different areas.

### *NGBN Infrastructure*

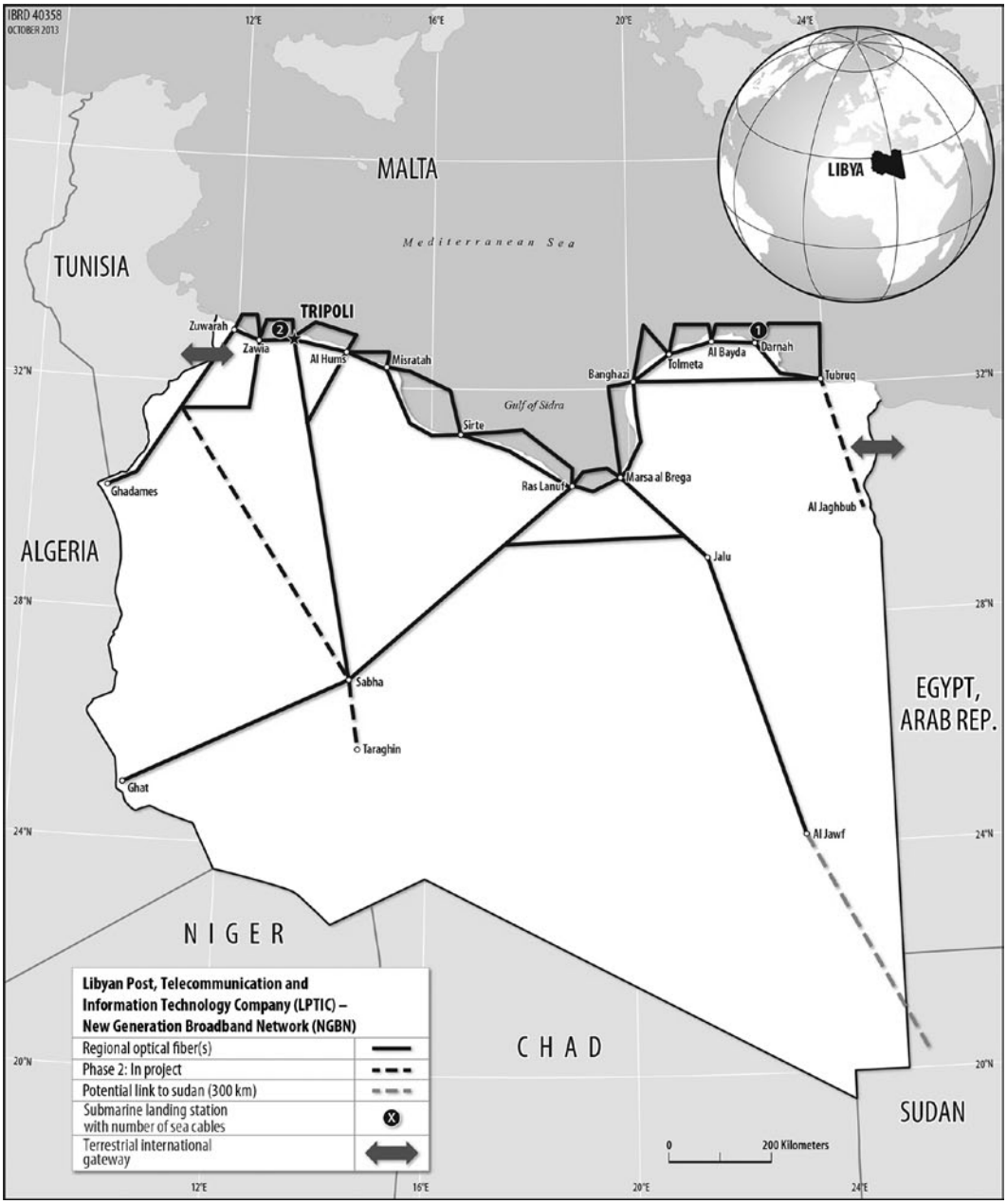
The Next Generation Backbone Network (NGBN) project was launched in 2008. The aim of this project is to increase national fiber-optic

**Table A.2 Key Features of Libya's NGBN Infrastructure, 2013**

| | *Hatef legacy infrastructure* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Link* | | | | *Passive support* | | | | *Usage* | |
| | *City A* | *City B* | *Distance (km)* | *Status* | *Type of laying* | *Number of ducts* | *Number of FO per cable* | *Fiber type* | *FO used* | *FO unsed* |
| Festoon | Festoon cable | | 1,640 | NA | Submarine | _ | 12 | G 654 | 12 | NA |
| Central ring and Tripoli area | Tripoli | Swani | NA | NA | NA | NA | 24 | G 654 | NA | NA |
| | Tripoli | Suk El Giuma | NA | NA | NA | NA | 24 | G 654 | NA | NA |
| | Tripoli | Suk El Khamis | NA | NA | NA | NA | 24 | G 654 | | |
| | Suk El Khams | Sid Alsaeh | NA | NA | NA | NA | 24 | G 654 | | |
| | Janzour | Ngihla | NA | NA | NA | NA | 24 | G 654 | | |
| | Hay El Senaie | Hay El Wheda | NA | NA | NA | NA | 24 | G 654 | | |
| | Al Khadra | Tarhona | NA | NA | NA | NA | 24 | G 654 | | |
| | Zelleten | Tarhona | NA | NA | NA | NA | 24 | G 654 | | |
| | Zelleten | Suk Atulata | NA | NA | NA | NA | 24 | G 654 | | |
| | Sirt | Al Ghrybat | NA | NA | NA | NA | 24 | G 654 | | |
| Eastern ring | Toprog | Emsaed | NA | NA | NA | NA | 24 | G 654 | | |
| | Tripoli | Naloot | NA | NA | NA | NA | 24 | G 654 | | |
| Western ring based on Gaz alternative infrastructure | Naloot | Derrje | NA | NA | NA | NA | 6 | NA | | |
| Southern infrastructure | Tripoli | Sebha | NA | NA | NA | NA | NA | NA | NA | NA |

*Sources:* World Bank; Ministry of Communications and Informatics, Libya.

**Map A.26 LPTIC NGBN Infrastructure, 2013**




*Source:* World Bank, Ministry of Communications and Informatics.

connectivity and to strengthen the legacy infrastructure with limited capacity (mainly six fiber-optic cables based on the G652 standard). It is planned to install 24,000 km of new fiber-optic infrastructure across the country and to secure international access with seven international gateways (two with Europe, three with neighboring MENA countries (Tunisia, Egypt, and Algeria) and two with Niger and Sudan. In addition, the project will implement an MPLS-based NGBN. Deployment is managed by LPTIC; the first phase (13,943 km costing US$200 million) is operational; and the second phase (9752 km costing US$150 million) is expected to be completed in 2015.

For the construction of the NGBN, LPTIC and Hatif have also used the spare fiber-optic capacity of alternative infrastructures of Man-Made River and GECOL among others.

### *GECOL Energy Grid*

The energy grid company GECOL has a large fiber-optic infrastructure based on OPGW along its THT/HT power lines. Fiber infrastructure is used by GECOL for its energy distribution management and some is made available to the NGBN Project. In total GECOL has about 1,300 km of OPGW mainly mixed fiber-optic cable of 24 fiber optics (12 G652, 12 G655).

In the main cities of Libya, GECOL has deployed metropolitan fiber-optic infrastructure which is used to manage power distribution. GECOL also plans to use its fiber-optic network to rollout a smart grid. Metropolitan networks of GECOL are located in the Bengazi area, Sebha, Zawia, and Tripoli.

### *Libyan Oil and Gas Companies*

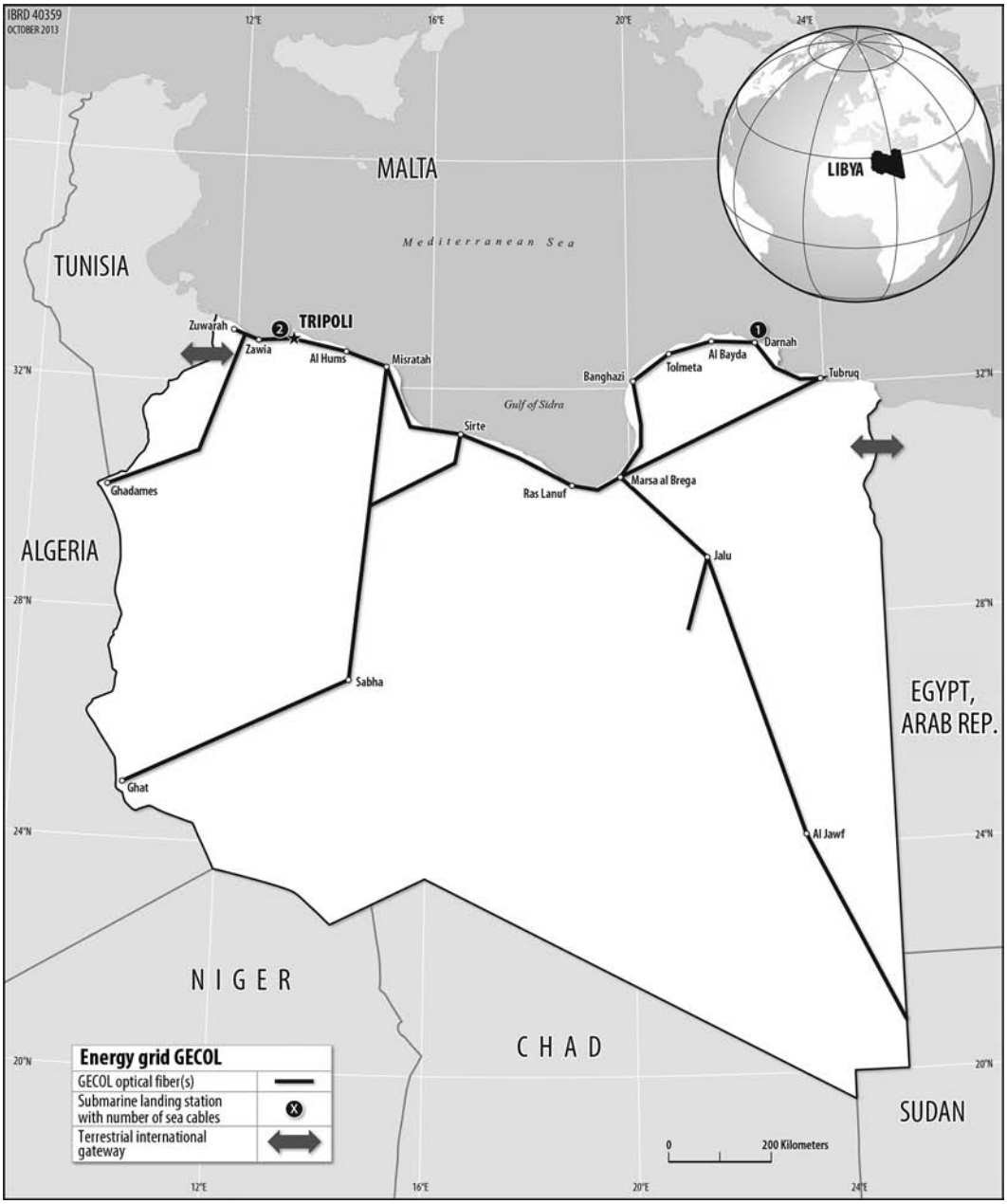
Various Libyan oil and gas companies have laid fiber-optic cable along their pipelines. Some of the fiber-optic cables are used to manage distribution processes

**Table A.3 Key Features of GECOL Fiber Optic Infrastructure, 2013**

| *GECOL (energy grid)* | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Link* | | | | *Passive support* | | | *Usage* |
| *City A* | *City B* | *Distance (km)* | *Status* | *Type of laying* | *Number of FO per cable* | *Fiber type* | *FO used* |
| Zwara | Tubruq | NA | NA | OPGW | 24 | 12-G652 B; 12-G655 | Between 6 and 18 FO are available |
| Tripoli | Sabha | NA | NA | OPGW | | | |
| Sabha | Ghat | NA | NA | OPGW | | | |
| Al Brega | El Jawf | NA | NA | OPGW | | | |
| Al Brega | TUBRUQ | NA | NA | OPGW | | | |
| El Jawf | Sudanese border | NA | NA | OPGW | | | |
| Total | | **1,300** | NA | NA | NA | NA | NA |

*Source:* World Bank based on GECOL.
*Note:* FO = ; GECOL = ; km = kilometer; OPGW = optical ground wire.

**Map A.27 GECOL's National Fiber Optic Infrastructure, 2013**




*Source:* World Bank based on Ministry of Communications and Informatics.

**Table A.4 Fiber-Optic Infrastructure of Libyan Gas and Oil Companies, 2013**

| *Infrastructure of gas and oil companies* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Link* | | | | *Passive support* | | | *Usage* | | |
| *City A* | *City B* | *Distance (km)* | *Status* | *Type of laying* | *Number of FO per cable* | *Fiber type* | *FO used* | *FO for rent* | *Owner* |
| Zwara | Wafa | 550 | NA | Duct | 24 | G655 | 24 | 0 | Enigas Millita |
| El Sahara | Zawia | 750 | NA | Duct | 12 | G652 | 12 | 0 | Repsol |
| Sarir | Tubruq | | NA | NA | NA | G652 | NA | NA | Agoco |
| Brega | Benghazi | 350 | NA | NA | 12 | G652 | NA | NA | Sirte Oil |
| Sarir | Natoora | NA | NA | NA | NA | G652 | NA | NA | Agoco |
| Brega | Attahady | 450 | NA | Duct | 24 | G652 | 16/18 | 6 | NA |

*Source:* World Bank based on Ministry of Communications and Informatics.
*Note:* Note: FO = ; km = kilometer.

(e.g., SCADA) and also to provide corporate (not public) communications services (e.g., voice, data, etc.) A number of the fiber-optic cables have also been made available to the NGBN project.

### *Man-Made River Project*

The Man-Made River (MMR) Project is a network of pipes that supplies water to the Sahara Desert in Libya from the Nubian Sandstone Aquifer System fossil aquifer. It is the world's largest irrigation project to date.

A large portion of the pipe infrastructure has been equipped with fiber-optic cable, used partly for the management of MMR. Some spare capacity has been made available to the NGBN Project.

## *Key Lessons for the Use of Alternative Fiber-Optic Infrastructure*

With the existing (Tunisia, Algeria) and planned (Egypt, Sudan, and Niger) international fiber gateways, Libya is a key building block to the regional integration across MENA and with a Sub-Saharan Africa. Libya is endowed with well-developed national alternative fiber-optic infrastructure which (whenever used for that purpose) could have a great impact on development of broadband connectivity nationwide if associated with a revision of the existing legal and regulatory framework, taking due account of best practices.

At the moment of writing this appendix, Libya is deciding both upon the new draft law (which is currently being debated in the parliament) and upon the potential new market structure (which may soon be decided by the government). Both could create an enabling environment for usage of alternative infrastructure and boost regional integration.

**Map A.28 Fiber-Optic Infrastructure of Libyan Gas and Oil Companies, 2013**

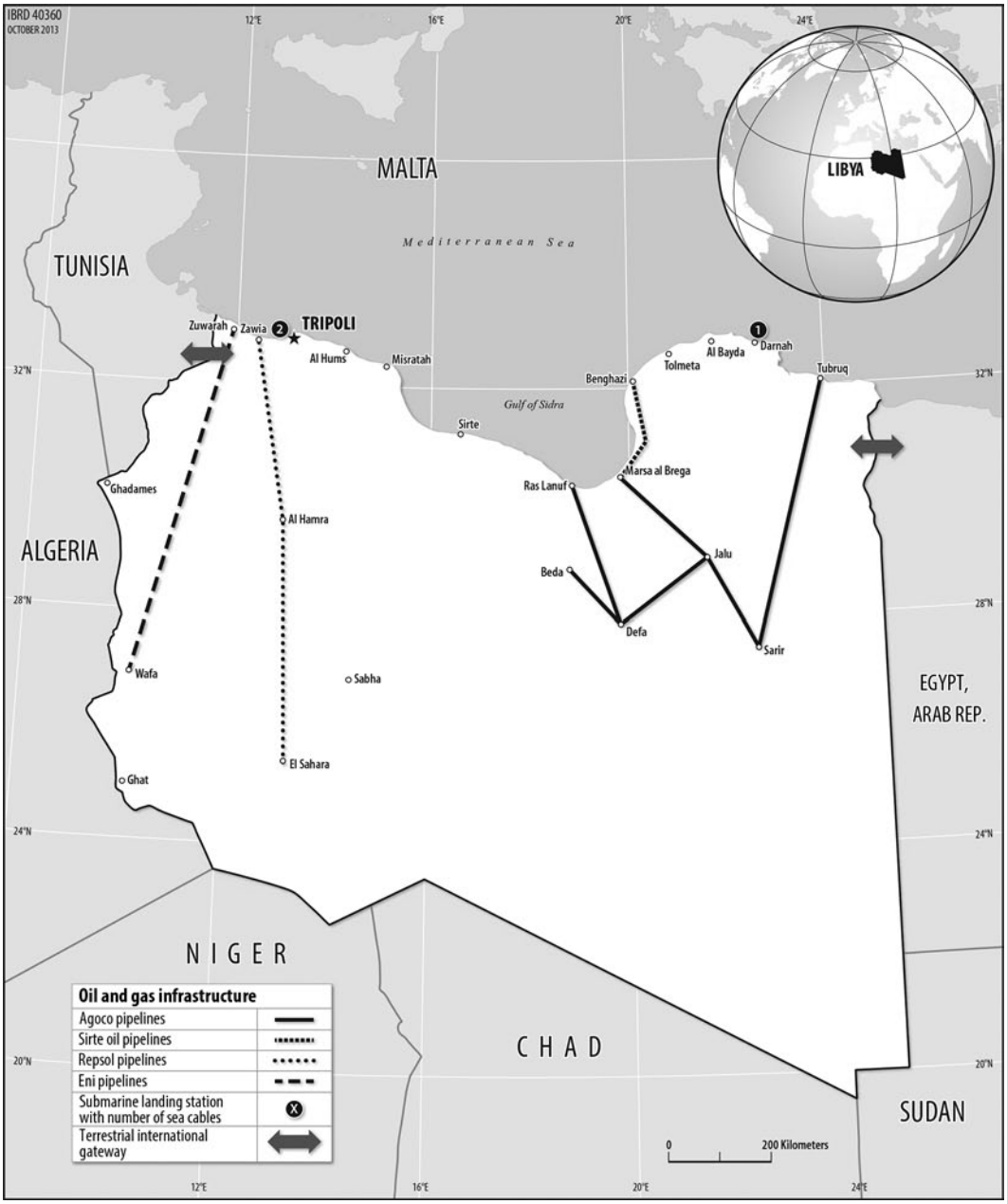
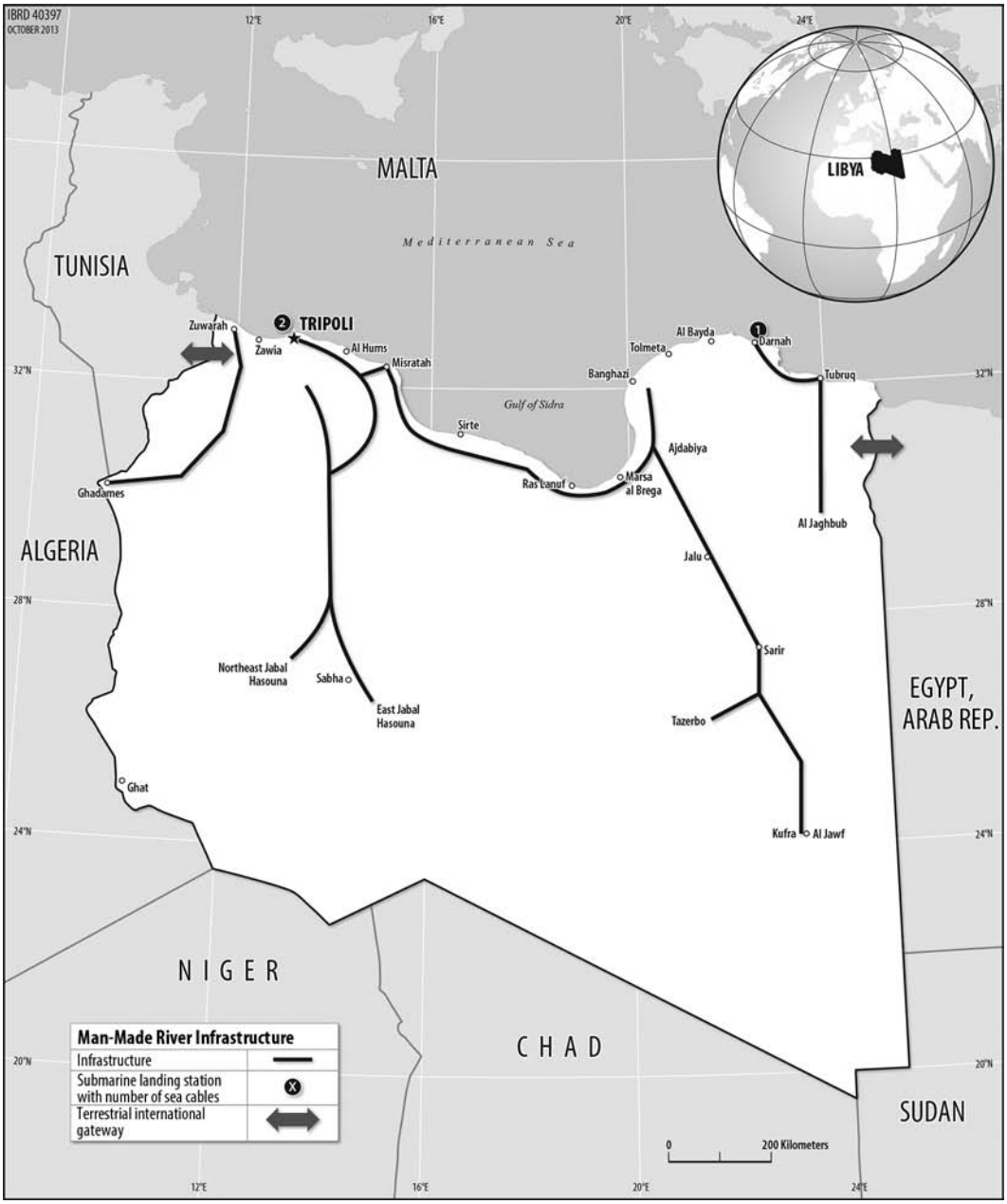


**Table A.5 Key Features of the MMR Infrastructure**

| *MMR (Man-Made River)* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Link* | | | | *Passive support* | | | *Usage* | |
| *City A* | *City B* | *Distance (km)* | *Status* | *Type of laying* | *Number of FO per cable* | *Fiber type* | *FO used* | *FO for rent* |
| El Rawagah | Eshwiref | 450 | NA | Duct | 24 | G652 | 16/18 | 6 |
| Eshwiref | Tarhona | 350 | NA | Duct | 24 | G652 | 16/18 | 6 |
| Eshwiref | Nejh | 300 | NA | Duct | 24 | G652 | 16/18 | 6 |
| Assada | Sirte | 160 | NA | Duct | 24 | G652 | 16/18 | 6 |
| Total | | **1,260** | NA | NA | NA | NA | NA | NA |

*Source:* World Bank based on Ministry of Communications and Informatics.
*Note:* Note: FO = ; km = kilometer; MMR = Man-Made River.

**Map A.29 Fiber-Optic Infrastructure of MMR, 2013**




*Source:* World Bank based on Ministry of Communications and Informatics, Libya.

## Notes

1. There are no significant Internet service providers (ISPs) except those associated with these operators.
2. Global capacity and competition in submarine cables offer a favorable environment for Morocco to increase capacity and reduce price of international bandwidth.
3. Article 7 of Telecoms Law 24-96, as amended by Article 3 of Law No. 55-01 of November 4, 2004.
4. This project consists in setting up a whole independent optical fiber infrastructure offering carrier-to-carrier services inside ECOWAS and Arab Maghreb Union (AMU). This infrastructure is scheduled to be built by 2015 according to the following specifications: 18,600 kilometers (km) of 36 pair cables connecting 16 countries; 700 km of 36 pairs cables within 17 cities among which 12 capital cities; and international connection points including Southern Europe. Feasibility studies and business plans have been completed. The commercialization strategy consists in selling IRU (€2m/pair over 15 years), as a first step, and then selling Internet Protocol (IP) transit depending on regulatory conditions. The total project cost is estimated at US$300 million, and financing is currently being sought for implementation.
5. In Algeria, Sonelgaz and Société Nationale des Transports Ferroviaires (Algerian Railways) have fiber-optic infrastructure that reaches Oujda.
6. The Office National de l'Electricité (ONE) has since merged with the Office National de l'Eau Potable (ONEP) to form the Office National de l'Electricité et de l'Eau Potable (ONEE).
7. Algeria Telecom has a monopoly on terrestrial infrastructure and Sonelgaz is not authorized to rent extra capacity.
8. Note d'orientations générales pour le développement du secteur des télécommunications à l'horizon 2013, February 25, 2010.
9. There are two other significant ISPs, Hexabyte and Gnet, in competition with the three operators with global locenses.
10. http://www.ati.tn/en.
11. Law No. 2001-1 of 15 January 2001, promulgating the Telecommunications Code; Law No. 2008-1 of 8 January 2008, amending and supplementing the Telecommunications Code promulgated by Law No. 2001-1 of 15 January 2001; and Law No. 2005-60 of 18 July 2005, amending and supplementing Law No. 91-64 of 29 July 1991, on competition and price.
12. Réseau Francophone de la Régulation des Télécommunications (Network of French Speaking Telecom Regulators).
13. According to information gathered during the case study, operators would be interested in an Indefeasible Right of Use (IRU) type of lease of 10/15 years.
14. See PIDA Study Transport report 2011 AfDB.
15. http://www.thd.tn/index.php?option=com_content&view=article&id=1714.
16. http://www.balancingact-africa.com.
17. http://www.telecomegypt.com.eg/english/wholesale_Bandwidth_Services.asp.
18. More than 2,800 km as backbone, the rest in cities and rural areas.
19. Individual class licensees use scarce resources such as numbers, spectrum frequencies, and rights of way, whereas general class licensees do not. In December 2011, there were 53 class licensees in Jordan.

20. Damamax Jordan is one of the leading wholesale providers of telecommunications services and broadband solutions serving the business segment. Damamax is also one of the most recent companies to offer fiber-optic telecommunications services in Jordan. The company also operates a datacenter and provides web hosting services.
21. http://www.jordantelecomgroup.jo.
22. In the past, NEPCO rented some fiber-optic links to Damamax, an agreement that has now been terminated, mainly for economic reasons.
23. SLC, AnwarNet, and Iconsnet.
24. http://www.lafibreoptique.com/a-l-etranger/31102012,algerie-une-entreprise-mixte-pour-mutualiser-la-fibre-optique,433.html#7CVro06R46ktcdkJ.99.
25. The Algerian Energy Telecom Company, a jointly owned company created in 2007 by Sonatrach and Sonelgaz.
26. http://www.sonelgaz.dz/IMG/pdf/GRTE-2.pdf.
27. Algeria has introduced 3G mobile broadband on 12/23/2013, as the report was being printed.