

Leveraging Investments in Broadband  
for National Development:

## **THE CASE OF RWANDA AND SENEGAL**



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## References

For a detailed list of references and the online version please scan QR code or visit our website at:

<http://unohrlls.org/leveraging-investments-in-broadband-for-national-development-the-case-of-rwanda-and-senegal>



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# Background

In May 2011, the international community adopted the Istanbul Programme of Action (IPoA), which has a deadline of 2020. The key objective of the IPoA is to overcome the structural challenges faced by the least developed countries (LDCs) in order to eradicate poverty, achieve internationally agreed development goals and enable graduation from the LDC category. Meeting this overarching objective would require enhancing various drivers of productive capacity, including information and communication technology (ICT).

The IPoA calls for developing modern ICT infrastructure and Internet access, including expansion into rural and remote areas, incorporating mobile broadband and satellite connections (paragraph 48.1.c of the IPoA). Similarly, Sustainable Development Goal (SDG) 9.c. calls for significantly increasing access to ICT and providing universal and affordable access to the Internet in LDCs by 2020.

While many LDCs have made progress in improving access to internet and mobile telephone, the level is still very low, on average. In LDCs, the number of Internet users per 100 people reached 12.6 per cent in 2015, up from 10.3 per cent in 2014 and triple the rate in 2010. Regarding access to broadband internet, LDCs are lagging further behind. Among others, broadband applications and services can contribute to innovative solutions for the LDCs in various areas that are important for their sustainable development, including e-health, e-education e-banking and, e-government. However, in 2015, fixed broadband penetration in LDCs represented less than 1 per cent of subscriptions and mobile phone broadband less than 20 per cent of subscriptions. By comparison, in developed countries, the penetration rate is about 30 per cent for fixed broadband and 90 per cent for mobile broadband.<sup>1</sup>

The barriers to higher penetration and uptake in LDCs include inadequate infrastructure, high cost of access, weak private sector, limited human capital and a paucity of public sector resources. For the landlocked LDCs, their geographical constraints results in greater dependence on bordering countries for broadband infrastructure development while small island LDCs face challenges



Photo: Senegal. Ericsson/Flickr

connecting to undersea cables due to the great distances.

Investing in broadband can lead to among others: employment creation especially in sectors that are likely to be using ICT in a transformative way; increased innovation and productivity; and, better governance. Therefore, investing in broadband would contribute towards meeting some of the IPoA priorities and SDG 9.c.

In order to have in-depth understanding on the level of investment in broadband and its application, UN-OHRLLS commissioned two studies in Africa: Rwanda and Senegal. The case studies document how the selected LDCs are leveraging investment in broadband to contribute towards the achievement of sustainable development.

The selection of Rwanda and Senegal as study areas was determined by the following: evidence of an upward trend in broadband penetration; clear strategies and concrete implementation; and, examples of outcomes because of investing in broadband. The selection criteria also took into consideration geographical coverage with Rwanda an East African landlocked nation and Senegal a sea facing West African country.

The assessment was informed by both background research of relevant documents and fieldwork including consultations with relevant actors within the countries.

The initial findings of this report were discussed in a regional meeting for African LDCs that took place from 28 February to 1 March 2017 in Dakar, Senegal.<sup>2</sup> There was a strong recognition at the meeting that stronger partnership between the private sector and national governments would lead to effective deployment and use of broadband. In addition, the need to subsidize deployment of broadband to underserved areas, in particular, rural areas, was emphasized.

In terms of the structure of the report, the findings of Rwanda and Senegal's progress towards becoming knowledge-based societies are treated in turn. The case studies provide lessons learned for other LDCs on how investment in broadband infrastructure can leverage sustainable development at the national level.

1 - See <http://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx>

2 - More information available at <http://unohrlls.org/event/lcds-regional-meeting-senegal/>





Photo: Rwanda. Cellanr/Flickr

# Contexte

En mai 2011, la communauté internationale a adopté le Programme d'Action d'Istanbul (PAI) qui arrivera à échéance en 2020. L'objectif principal du PAI est de surmonter les défis structurels auxquels sont confrontés les pays les moins avancés (PMA) afin d'éradiquer la pauvreté, d'atteindre les objectifs de développement fixés au niveau international et de permettre leur sortie de la catégorie des PMA. La réalisation de cet objectif global nécessitera l'amélioration de divers facteurs favorisant la capacité de production, y compris les technologies de l'information et de la communication (TIC).

Le PAI appelle au développement d'infrastructures TIC modernes et de l'accès à Internet, y compris l'expansion dans les zones rurales et éloignées, en intégrant des connexions mobiles à large bande et par satellite (paragraphe 48.1.c du PAI). De même, la cible c de l'Objectif de Développement Durable (ODD) 9 appelle à accroître de manière significative l'accès aux TIC et à offrir un accès internet universel et abordable dans les PMA d'ici 2020.

Bien que de nombreux PMA aient progressé dans l'amélioration de l'accès à Internet et au téléphone mobile, le niveau reste en moyenne très bas. Dans les PMA, le nombre d'utilisateurs d'Internet pour 100 personnes a atteint 12,6 pour cent en 2015, contre 10,3 pour cent en 2014 et correspond au triple du taux de 2010. En ce qui concerne l'accès à l'internet à large bande, les PMA sont encore en retard. Entre autres, les applications et les services des infrastructures à large bande peuvent contribuer à apporter des solutions innovantes pour les PMA dans divers domaines importants pour leur développement durable, tels que l'e-santé, l'e-éducation, banque électronique et l'administration électronique. Cependant, en 2015, la pénétration de la large bande fixe dans les PMA représentait moins de 1 pour cent des abonnements et les téléphones mobiles à large bande moins de 20 pour cent des abonnements. En comparaison, dans les pays développés, le taux de pénétration est d'environ 30 pour cent pour la large bande fixe et 90 pour cent pour la large bande mobile.<sup>1</sup>

Les obstacles qui freinent une plus grande pénétration et utilisation dans les PMA sont les infrastructures inadéquates, le coût d'accès élevé, un secteur privé faible, un capital humain limité et une pénurie de ressources dans le secteur public. Pour les pays en développement sans littoral, les contraintes géographiques entraînent une plus grande dépendance aux pays limitrophes pour le développement de l'infrastructure à large bande tandis que les petits États insulaires font face à des difficultés liées aux câbles sous-marins en raison des grandes distances.



Investir dans les réseaux à large bande peut conduire, entre autres, à la création d'emplois, en particulier dans les secteurs susceptibles d'utiliser les TIC de façon transformatrice, l'augmentation de l'innovation et de la productivité et une meilleure gouvernance. Par conséquent, investir dans la large bande contribuerait à répondre à certaines des priorités du PAI et de l'ODD 9.c.

Afin d'avoir une compréhension approfondie du niveau d'investissement dans le haut débit et de son application, UN-OHRLLS a commandité deux études en Afrique: au Rwanda et au Sénégal. Les études de cas expliquent comment les PMA sélectionnés s'appuient sur les investissements dans la large bande afin d'atteindre les objectifs du développement durable.

La sélection du Rwanda et du Sénégal en tant que pays d'étude a été déterminée par les éléments suivants: l'évidence montrant une tendance haussière de la pénétration de la large bande, des stratégies claires et une mise en œuvre concrète et des exemples de résultats liés à l'investissement dans la large bande. Les critères de sélection ont également pris en compte la couverture géographique avec le Rwanda, un pays enclavé en Afrique de l'Est, et le Sénégal, un pays côtier de l'Afrique de l'Ouest.

L'analyse a été sous-tendue à la fois par des recherches de base sur des documents pertinents et par le travail de terrain, y compris des consultations avec des acteurs impliqués dans les pays.

Les résultats initiaux de ce rapport ont fait l'objet de discussions lors d'une réunion régionale pour les PMA africains qui a eu lieu du 28 février au 1er mars 2017 à Dakar, au Sénégal.<sup>2</sup> Lors de la réunion, il a été fortement reconnu que le renforcement du partenariat entre le secteur privé et les gouvernements nationaux conduirait à un déploiement et à une utilisation plus efficace du réseau de large bande. En outre, la nécessité de subventionner le déploiement de la large bande dans les zones insuffisamment desservies, en particulier dans les zones rurales, a été soulignée.

En ce qui concerne la structure du rapport, les résultats des progrès du Rwanda et du Sénégal vers des sociétés fondées sur la connaissance sont traités à leur tour. Les études de cas fournissent à d'autres PMA des leçons sur la façon dont l'investissement dans l'infrastructure à large bande peut avoir un effet de levier sur le développement durable au niveau national.

1 - Voir <http://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx>

2 - Informations supplémentaires disponibles sur <http://unohrlls.org/event/ldcs-regional-meeting-senegal/>





Broadband in an African Landlocked LDC:

# The case of Rwanda //

Broadband offers a way to diversify and add value to the economy and information and communication technology (ICT) is key crosscutting enabler for the country's development strategy. The government is intent on increasing the service sector to reduce reliance on traditional agricultural production and exports. The country's *Vision 2020* calls for Rwanda becoming a middle-income knowledge economy with ICT considered one of the three crosscutting areas for achieving the vision.

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## Acronyms

<b>GB</b>	Gigabyte (data volume measurement)	<b>MYICT</b>	Ministry of Youth and ICT
<b>Gb/s</b>	Gigabits per second (data speed measurement)	<b>PPP</b>	Public Private Partnership
<b>EAC</b>	East Africa Community	<b>RICTA</b>	Rwanda Information and Communications Technology Association
<b>ICT</b>	Information and Communication Technology	<b>RURA</b>	Rwanda Utilities Regulatory Authority
<b>ITU</b>	International Telecommunication Union	<b>Rwf</b>	Rwanda Franc
<b>MB</b>	Megabyte (data volume measurement)	<b>US\$</b>	United States dollar. Figures converted to US\$ using annual average exchange rates.
<b>Mb/s</b>	Megabits per second (data speed measurement)		
<b>NISR</b>	National Institute of Statistics of Rwanda		

# Executive Summary

Broadband offers a way to diversify and add value to the economy and information and communication technology (ICT) is key crosscutting enabler for the country's development strategy. The government is intent on increasing the service sector to reduce reliance on traditional agricultural production and exports. The country's Vision 2020 calls for Rwanda becoming a middle-income knowledge economy with ICT considered one of the three crosscutting areas for achieving the vision.

The government has taken steps to create a competitive ICT sector. Rwanda began the process by allowing private sector investment when South Africa headquartered MTN entered the market in 1998 to provide mobile communications. This resulted in indirect competition between MTN and the fixed telephone services provided by the incumbent telecom operator Rwandatel. In 2001, Rwanda created an independent agency to regulate the sector, the Rwanda Utilities Regulatory Authority (RURA). In 2006, Rwandatel was privatized and granted a license for mobile telephony, allowing it to compete head on in the market segment with MTN. In 2009, a third mobile operator owned by Luxembourg-based Millicom was introduced. The key strategy document driving high-speed communications in the country is the 2013 *National Broadband Policy*. The policy's goal is to transform Rwanda into an Information society driven by "universal access to high speed, reliable, affordable and secure broadband infrastructure and services by 2020." The results of these steps of creating a regulator, privatizing the incumbent, introducing competition and developing a broadband strategy have resulted in a high level of broadband infrastructure in the country:

- Despite its landlocked situation, Rwanda has deployed a number of strategies to procure undersea fiber optic cable capacity in Kenya and Tanzania at reasonable prices. This includes bulk purchases by the government in order to achieve scale and lower international

bandwidth costs. It also made a 10-year agreement in 2012 with the Tanzania Telecommunications Company Limited to procure international bandwidth at an attractive price. These developments greatly expanded Rwanda's international bandwidth with some of the lowest wholesale prices in Africa. The Rwanda Internet Exchange was launched in mid 2004 in order to reduce reliance on international connectivity, lowering costs and increasing quality.

- There is a nationwide fiber optic backbone facilitating the transfer of high-speed data across the country. In 2008, the government began rolling out a national fiber optic backbone. Roll out was essentially completed in 2010 with over 3,000 kilometers of fiber distributed to all 30 districts and 11 border points. Access is open to all operators at cost-based prices.
- Liquid Telecom began offering fiber to small businesses and homes with the launch of a 100 Mbps service in 2015. RURA reported 3G mobile population coverage of 92% in June 2016 and 4G/LTE at 29%. Rwanda has adopted a unique wholesale model for the deployment of 4G/LTE technology. The 4G network launched in 2014 with the target of covering 95% of the population by 2018. Rwanda is the first country in the world to adopt a single wholesale network for 4G. Mobile broadband coverage in Rwanda compares well to African peers. Among countries for which data is available, Rwanda ranks third in the percentage of the population covered by 3G after South Africa and Lesotho and second in 4G coverage. One reason for the high 3G mobile broadband coverage in Rwanda is obligations imposed on operators by RURA. Another is the increase in competition from the entry of Airtel in the market in 2012.

The increase in broadband infrastructure has boosted Internet use. The number of Facebook users in Rwanda rose almost 600% between 2011

and 2016 from 83,00 to 570,000. However, Internet usage in Rwanda is still only average compared to neighboring countries.

Affordability does not appear to be a significant barrier to broadband access in Rwanda compared to other least developed countries (LDCs). Prices have dropped 90% since 2010. As a percent of per capita income, mobile broadband became dramatically more affordable dropping from 59% to 5%. Rwanda has the cheapest price per GB in East Africa.

In spite of widespread broadband coverage and increasing affordability, application of high-speed services remains limited across different sectors:

- An enterprise survey shows that 34% of Rwandan firms had their own website in 2011 compared to an average of 32% for sub-Saharan Africa. Another measure of firm ICT adoption is the number of secure Internet servers that reflect the level of transactional capability in areas such as finance, government services and e-commerce. With four Internet servers per 1 million people, Rwanda has less than half the rate of the Sub-Saharan Africa average.
- The computerization of government back office processes has been progressing and a number of electronic public services are available for citizens and businesses. Most ministries are connected to the Internet via fiber optic broadband. Services are provided over the Irembo (Kinyarwanda for gate) platform, accessible via both the web and mobile. Over 30 services are available ranging from birth certificates to driving tests with plans to expand to over 100.
- In the health sector, records are being digitized and transmitted through the Rwanda Health Management Information System (R-HMIS). Over 500 health facilities across the country are connected to R-HMIS through the Internet (around 94% of the total). The Ministry of Health has been using a mobile text platform called RapidSMS to track early child health. Community health workers in all of the country's villages are provided with cellphones to send text messages about the status of child

health in order to quickly track any anomalies and provide rapid treatment. One innovative application recently launched is the use of drones to deliver blood across the country.

- ESoko, derived from the Swahili word "Soko" meaning market and 'e' representing electronic, is a mobile text service providing market price information for farmers. It allows farmers to make better production and selling decisions by reducing information asymmetry. Another initiative is Buy from Women, introduced by the UN in 2016. The platform is targeted at women farmers, providing weather, pricing and other information to their mobile phones.
  - Current levels of computerization in schools are low. In primary schools, the computer ratio is 16:1 and in secondary schools, the ratio is 28:1. Only around 5% of secondary schools have computer labs. One challenge is that less than half of public schools have electricity and hence Internet access is limited to 6% of primary and 18% of secondary schools.
  - Financial inclusion is being expanded through the launch of mobile money platforms. All of the mobile operators offer systems whereby subscribers can transfer money to others and pay bills. One challenge is awareness with only around half the population familiar with mobile money. Another challenge is that some people think mobile money only works on smartphones.
- The *SMART Rwanda Master Plan* (SRMP) covering the period 2015-2020 calls for using ICTs as a transformational enabler to digitize the economy generating growth and job creation. SRMP hopes to generate greater use of broadband applications across different sectors. Several challenges stand in the way of the SRMP goals:
- Demand has not kept up with supply. While the government has complemented connectivity with electronic public services, the country is facing constraints due to its development level. Specifically it is difficult to quickly raise educational levels to match the rapid provision of ICT networks, applications and services. As a result, while the infrastructure is there, the

gap in usage challenges the “build and they will come” theory.

- Despite the advantages of always-on broadband, a number of successful examples of impact in Rwanda are based on narrowband technology. They function on basic handsets, which are far cheaper and more prevalent than smartphones. Applications such as mobile money and SMS are simple and quick to master. As a result, social and economic impacts from narrowband mobile telephony have thus far been more noticeable than those from broadband technology.

In order for broadband to have a bigger impact, there needs to be significant investment in people.

This includes the rollout of massive digital literacy programs for adults, larger deployment and integration of broadband in schools, broadband awareness for SMEs and high-level skills development opportunities to increase ICT sector employment. The Government of Rwanda realizes this and has initiatives in the pipeline to address these issues. This includes the new *ICT in Education* policy, which calls for establishing ICT classrooms across primary and secondary schools and enhancing ICT training for teachers and students. The “Internet for All” initiative will provide digital literacy to some five million Rwandans by 2020. Once these start to bear fruit, Rwanda should begin to realize its vision of ICTs having a strong impact on sustainable development.

## La large bande dans un Pays Africain sans littoral: Le cas du Rwanda

### Résumé

La large bande offre un moyen de diversifier et d'ajouter de la valeur à l'économie et les technologies de l'information et de la communication (TIC) sont des facteurs clés dans la stratégie de développement du pays. Le gouvernement a l'intention d'accroître le secteur des services pour réduire la dépendance à l'égard de la production agricole et des exportations traditionnelles. La Vision nationale 2020 du pays appelle le Rwanda à devenir une économie du savoir à revenu moyen, les TIC étant considérés comme l'un des trois secteurs transversaux pour la réalisation de la vision nationale.

Le gouvernement a pris des mesures pour créer un secteur des TIC compétitif. Le Rwanda a entamé le processus en autorisant des investissements du secteur privé lorsque MTN—une entreprise qui fournit des communications mobiles et dont le siège se trouve en Afrique du Sud—est entré sur le marché en 1998. Cela a entraîné une concurrence indirecte entre MTN et les services téléphoniques fixes fournis par l'opérateur de télécommunications historique Rwandatel. En 2001, le Rwanda a créé une agence indépendante pour réguler le secteur, l'Autorité de

régulation des services collectifs du Rwanda (RURA). En 2006, Rwandatel a été privatisé et a obtenu une licence de téléphonie mobile, ce qui lui a permis de concurrencer MTN sur le segment du marché de la téléphonie. En 2009, un troisième opérateur mobile appartenant à Millicom basée au Luxembourg a été introduit. Le document de stratégie clé qui dirige les communications à grande vitesse dans le pays est la Politique nationale sur la large bande de 2013. L'objectif de la politique est de transformer le Rwanda en une société de l'information axée sur « l'accès universel à l'infrastructure et aux services de large bande à grande vitesse, fiables, abordables et sécurisés d'ici 2020 ». Les résultats de ces étapes consistant à créer un régulateur, à privatiser l'opérateur, à introduire la concurrence et à développer une stratégie de large bande ont entraîné dans le pays une hausse des infrastructures de la large bande:

- Malgré un territoire enclavé, le Rwanda a déployé un certain nombre de stratégies pour se doter de des prix abordables d'une capacité de câble de fibre optique sous-marine à partir du Kenya et de la Tanzanie. Cela comprend des achats en gros par le gouvernement

afin de réaliser des économies d'échelle et de réduire les coûts de bande passante internationaux. En 2012, Il a également conclu un accord de 10 ans avec la Tanzania Telecommunications Company Limited pour obtenir la bande passante internationale à un prix attractif. Ces développements ont considérablement élargi la bande passante internationale du Rwanda avec des prix de gros comptant parmi les plus bas d'Afrique. Les points d'échange Internet au Rwanda ont été lancés au milieu de 2004 afin de réduire le recours à la connectivité internationale, réduisant ainsi les coûts et améliorant la qualité.

- Il existe une structure de fibre optique à l'échelle nationale qui facilite le transfert de données à grande vitesse dans tout le pays. En 2008, le gouvernement a commencé à déployer un réseau national de fibres optiques. Le déploiement a été essentiellement bouclé en 2010 avec plus de 3 000 kilomètres de fibres réparties dans les 30 districts et 11 points frontaliers. L'accès est ouvert à tous les opérateurs avec des prix établis en fonction des coûts.
- Liquid Telecom a commencé à proposer la fibre aux petites entreprises et aux foyers avec le lancement en 2015 d'un service de 100 Mbps. RURA a constaté qu'en juin 2016, 92 pour cent de la population avait une couverture mobile 3G et 29 pour cent de la 4G / LTE. Le Rwanda a adopté un modèle de gros unique pour le déploiement de la technologie 4G / LTE. Le réseau 4G a été lancé en 2014 avec pour objectif de couvrir 95 pour cent de la population d'ici 2018. Le Rwanda est le premier pays au monde à adopter un marché unique pour la 4G. La couverture à large bande mobile au Rwanda se compare bien à ses homologues africains. Parmi les pays dont on connaît le taux de couverture 3G au sein de la population, le Rwanda arrive troisième derrière l'Afrique du Sud et le Lesotho et second dans la couverture 4G. L'importante couverture mobile 3G au Rwanda peut être justifiée par les obligations imposées aux opérateurs par RURA ainsi que par l'augmentation de la concurrence causée par l'entrée d'Airtel sur le marché en 2012.

L'augmentation de l'infrastructure à large bande a stimulé l'utilisation d'Internet. Le nombre d'utilisateurs de Facebook au Rwanda a augmenté de près de 600 pour cent entre 2011 et 2016 et est passé de 8300 à 570 000 utilisateurs. Cependant, l'utilisation d'Internet au Rwanda reste encore

moyenne par rapport aux pays voisins.

Les prix abordables ne semblent pas constituer un obstacle majeur à l'accès à la large bande au Rwanda par rapport aux autres pays les moins avancés (PMA). Les prix ont chuté de 90 pour cent depuis 2010. En pourcentage du revenu par habitant, le service mobile à large bande est devenu spectaculairement plus abordable, passant de 59 pour cent à 5 pour cent. Le Rwanda a le prix le plus bas par GB en Afrique de l'Est.

En dépit d'une large couverture de large bande et d'une accessibilité croissante, l'application de services à grande vitesse reste limitée dans différents secteurs:

- Un sondage auprès des entreprises a montré que 34 pour cent des entreprises rwandaises avaient leurs propres sites web en 2011, contre 32 pour cent en moyenne pour l'Afrique subsaharienne. Une autre mesure de l'adoption des TIC par les entreprises est le nombre de serveurs Internet sécurisés qui reflètent le niveau de capacité transactionnelle dans des domaines tels que les finances, les services gouvernementaux et le commerce électronique. Avec quatre serveurs Internet pour 1 million de personnes, le Rwanda compte moins de la moitié du taux moyen de l'Afrique subsaharienne.
- L'informatisation des processus d'appui administratif du gouvernement progresse et un certain nombre de services publics électroniques sont disponibles pour les citoyens et les entreprises. La plupart des ministères sont connectés à Internet via la fibre optique à large bande. Les services sont fournis avec la plate-forme Irembo (signifie porte ou portail en Kinyarwanda), accessible via le Web et le téléphone mobile. Plus de 30 services sont disponibles, allant des certificats de naissance aux tests de conduite, le pays envisage d'étendre les services à plus de 100.
- Dans le secteur de la santé, les dossiers sont numérisés et transmis par le Système d'information sur la gestion de la santé au Rwanda (R-HMIS). Plus de 500 établissements de santé à travers le pays sont connectés à R-HMIS par Internet (environ 94 pour cent du total). Le ministère de la Santé utilise une plate-forme de SMS mobile appelée RapidSMS pour suivre la santé de la petite enfance. Les agents de santé communautaires dans tous les villages du pays reçoivent des téléphones cellulaires pour envoyer des messages-textes sur le statut de la santé de l'enfant



afin de détecter rapidement toutes les anomalies et de fournir un traitement rapide. Une application innovante récemment lancée est l'utilisation de drones pour fournir du sang à travers le pays.

- ESoko, dérivé du mot Swahili "Soko" signifiant marché et 'e' représentant l'électronique, est un service de texte mobile fournissant des informations sur les prix du marché pour les agriculteurs. Il permet aux agriculteurs de prendre de meilleures décisions de production et de vente en réduisant l'asymétrie informationnelle. Une autre initiative présentée par l'ONU en 2016 est Acheter à des Femmes. La plate-forme s'adresse aux femmes agricultrices, fournissant les prévisions météorologiques, des prix et d'autres informations directement sur leurs téléphones mobiles.
- Les niveaux actuels d'informatisation dans les écoles sont faibles. Le ratio informatique est de 16:1 dans les écoles primaires, et de 28:1 dans les écoles secondaires. Environ 5 pour cent seulement des écoles secondaires ont des laboratoires informatiques. Le fait que moins de la moitié des écoles publiques ont l'électricité est un obstacle, par conséquent, cela limite l'accès à l'internet à 6 pour cent dans les écoles primaires et à 18 pour cent dans les écoles secondaires.
- L'inclusion financière est en cours d'expansion grâce au lancement de plates-formes monétaires mobiles. Tous les opérateurs mobiles offrent des systèmes permettant aux abonnés de transférer de l'argent à d'autres et de payer des factures. La sensibilisation représente un obstacle car seulement la moitié de la population est familière avec l'argent mobile. Un autre obstacle qui se présente est que certaines personnes pensent que l'argent mobile ne fonctionne que sur les téléphones intelligents.

Le Plan directeur de développement de l'application des technologies au Rwanda (SMART Rwanda Master Plan, SRMP) couvrant la période 2015-2020 appelle à utiliser les TIC comme facilitateur de transformation pour numériser l'économie générant de la croissance et des emplois. SRMP espère susciter une plus grande utilisation des applications à large bande dans différents secteurs. Plusieurs défis empêchent d'atteindre les objectifs de la SRMP:

- La demande n'a pas suivi l'offre. Alors que le gouvernement a bouclé la connectivité avec les

services publics électroniques, le pays fait face à des contraintes en raison de son niveau de développement. Plus précisément, il est difficile d'augmenter rapidement le niveau d'éducation pour le faire correspondre au progrès rapide d'accessibilité aux réseaux, aux applications et aux services TIC. En conséquence, alors que l'infrastructure est là, l'écart d'utilisation conteste l'adage «Contentez-vous de construire, l'usage viendra tout seul»

- Malgré les avantages de la connexion à large bande, un certain nombre d'exemples d'impact à succès au Rwanda sont basés sur la technologie à bande étroite. Ils fonctionnent sur des combinés de base, qui sont beaucoup moins chers et plus répandus que les téléphones intelligents. Les applications telles que l'argent mobile et les SMS sont simples et rapides à maîtriser. En conséquence, les impacts sociaux et économiques de la téléphonie mobile à bande étroite sont jusqu'ici plus visibles que ceux de la technologie à large bande.

Pour que la large bande ait un impact plus important, il doit y avoir des investissements importants dans la population. Cela inclut le déploiement de programmes massifs d'alphabétisation numérique pour les adultes, un plus grand déploiement et l'intégration de réseaux à large bande dans les écoles, la sensibilisation à la large bande pour les PME et les opportunités de développement de compétences de haut niveau pour accroître l'emploi dans le secteur des TIC. Le gouvernement Rwandais se rend compte de cette situation et a lancé des initiatives en vue de résoudre ces problèmes. Cela inclut la nouvelle politique des TIC dans l'éducation, qui appelle à l'établissement de classes de TIC dans les écoles primaires et secondaires et à l'amélioration de la formation en TIC pour les enseignants et les étudiants. L'initiative «Internet pour tous» fournira une alphabétisation numérique à quelque cinq millions de Rwandais d'ici 2020. Une fois que ces programmes porteront leurs fruits, le Rwanda devrait commencer à réaliser sa vision des TIC axée sur un impact important sur le développement durable.

# Introduction

**For a foreigner, evidence of Rwanda's drive towards a paperless, digital society may be one of the first things they witness in the country. A visitor requiring a visa on arrival at the international airport in Kigali does not need to fill in any forms; instead information is scanned from their passport and after answering a few questions posed by the immigration officer, the visa is issued in less than five minutes.**

This report examines Rwanda's progress towards a knowledge-based society, specifically the role of broadband Internet infrastructure. Despite being a landlocked least developed country (LDC) emerging from a devastating genocide a little over two decades ago, Rwanda has some of the cheapest wholesale international Internet prices in Africa and its mobile broadband coverage among the highest.

**Chapter 1** provides an overview of the geographic, demographic, social and economic forces in the country and how they relate to broadband. The **second chapter** outlines key government institutions involved with broadband and more widely, Information and Communications Technology (ICT) and relevant policies, strategies and plans. The **third chapter** looks at the supply of broadband infrastructure from international connectivity to national backbones to local access. Factors that influence usage of broadband networks such as

affordability, awareness and attractiveness are examined in **chapter four**. The **fifth chapter** identifies the direct and indirect impacts of broadband as well as its usage across different sectors of the economy. The **last chapter** concludes by highlighting Rwanda's broadband achievements as well as some challenges and proposes steps for more effectively connecting supply to demand.

Rwanda's broadband performance is benchmarked with its border neighbors and the East African Community (EAC)<sup>3</sup> to provide objective evidence of its connectivity development.

The report provides lessons for other LDCs on how Rwanda's approach to broadband has yielded a robust infrastructure with wide spread wireless coverage for users. It also debunks the "build it and they will come" myth highlighting that investment in infrastructure alone is insufficient to ensure widespread impacts.

## 1. Country Context

The Republic of Rwanda's geographic situation is not ideally suited for international broadband connectivity, a key factor for successful deployment of high-speed telecommunications networks. A member of the East African Community, Rwanda is a landlocked country surrounded by Uganda to

the north, Democratic Republic of the Congo to the west, Burundi to the south and Tanzania to the east. Rwanda is distant from undersea fiber optic networks being some 1,200 kilometers from the Indian Ocean and 2,000 from the Atlantic.

- **The country's relatively small land size and high population density make it comparatively easier to install broadband infrastructure.**

It has a land area of 24,670 square kilometers, the fourth smallest among land-based countries in Africa.<sup>4</sup> Rwanda's population was estimated at 11.5 million in 2016. Population density is 471 persons per square kilometer, the second highest in Africa after Mauritius.<sup>5</sup> The population is spatially

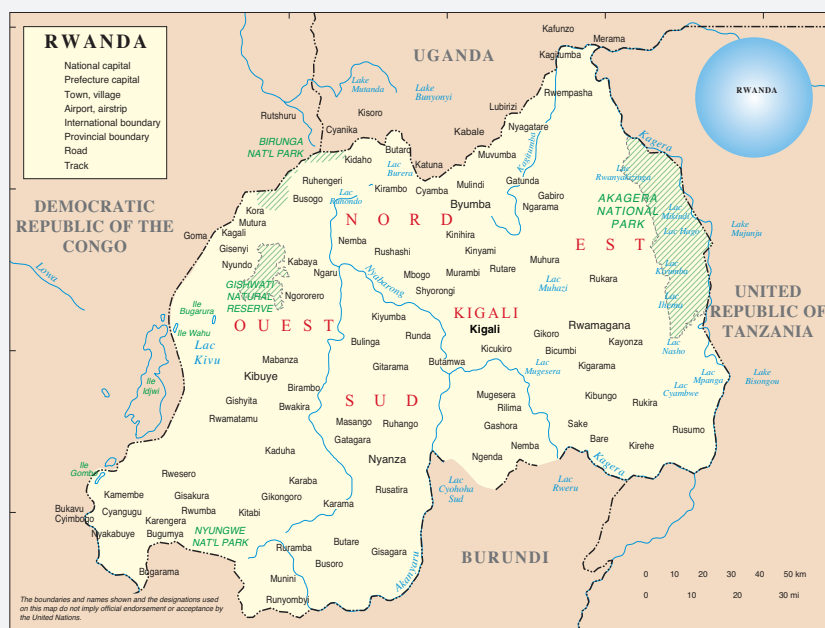
diverse with few uninhabited expanses. The combination of a relatively small land area and high population density imply that investment costs are likely to be lower than other countries.

3 - <http://www.eac.int>

4 - The smallest in terms of land area are all island states: Sao Tome and Principe, Mauritius, Cape Verde and Comoros. Rwanda is the fourth smallest African country among non-island states in Africa after Gambia, Lesotho and Swaziland. See:

<http://data.worldbank.org/indicator/AG.LND.TOTL.K2>

5 - [http://data.worldbank.org/indicator/EN.POP.DNST?year\\_high\\_desc=true](http://data.worldbank.org/indicator/EN.POP.DNST?year_high_desc=true)

**FIGURE 1.1. Map of Rwanda**

Source: <http://www.un.org/Depts/Cartographic/map/profile/rwanda.pdf>

- Rwanda's demographic and social characteristics pose a demand challenge for broadband applications and services.

According to the 2012 Census, the population is largely rural with only 17% living in urban areas (of which about half live in the capital Kigali) (NISR & MINECOFIN, 2014). A 2014 household survey found 28% of the population aged 15 and over to be illiterate (NISR 2016 a). Kinyarwanda is the national language and along with English and French one

of three official languages. According to the 2012 Census, 16% of the population aged 15 and over is literate in English and French. While Kinyarwanda is spoken in parts of DR Congo and Uganda, most speakers are in Rwanda, meaning that Internet content in the national language must be developed locally.

- Rwanda's relatively young population bodes well for the future of a knowledge society.

In 2015, 43% of the population was under the age of 15. However, efforts are needed to boost education. Only 19% of the population has a post secondary education while

secondary enrollment rates have been declining (MOE, 2016).

- Rwanda has witnessed strong and inclusive growth since 2000.

Real Gross Domestic Product (GDP) has grown almost 8% a year and poverty has been reduced.<sup>6</sup> Efforts to diversify the economy away from its traditional reliance on agriculture are slowly proceeding. By June 2016, agriculture accounted

for 33% of GDP, industry 13% and services 48% (NISR, 2016c). Tea, coffee and minerals lead exports, with tourism emerging as a promising source of earnings.

6 - IMF. 2014. Rwanda 2014 Article IV Consultation and Second Review under the Policy Support Instrument ; Staff Report, Press Release. Washington, DC: IMF. <http://dx.doi.org/10.5089/9781498370004.002>.

- **Despite impressive economic growth, Rwanda's level of income is still relatively low and could be a challenge for broadband affordability.**

Rwanda is classified as both a Least Developed Country (LDC) and Landlocked (LLDC) by the United Nations and a low-income economy by the World Bank. Low levels of income can be a barrier to take-up of broadband applications

and services due to the costs. On the other hand, the country's low-income status results in significant donor support, some of which has gone to broadband-related projects.

- **Broadband offers a way to diversify and add value to the economy and ICT is key crosscutting enabler for the country's development strategy.**

The government is intent on increasing the service sector to reduce reliance on traditional agricultural production and exports. The country's *Vision 2020* calls for Rwanda becoming a middle-income knowledge economy with ICT considered one of the three crosscutting areas for achieving the vision (GoR 2012).<sup>7</sup>

7 - In the same vein, in 2014, the ITU Plenipotentiary Conference, Member States agreed to set up the overall strategy for the ICT sector, known as Connect 2020 with 4 goals; and goal 2 calls for inclusiveness, provide broadband for all with an emphasis on LDCs. See "Connect 2020 Agenda" at: <http://www.itu.int/en/connect2020/Pages/default.aspx>.

## **2. Strategy, Policy and Regulatory Environment**

This chapter provides an overview of relevant broadband policies, strategies, plans and regulations and key government institutions responsible for different aspects of the broadband ecosystem.

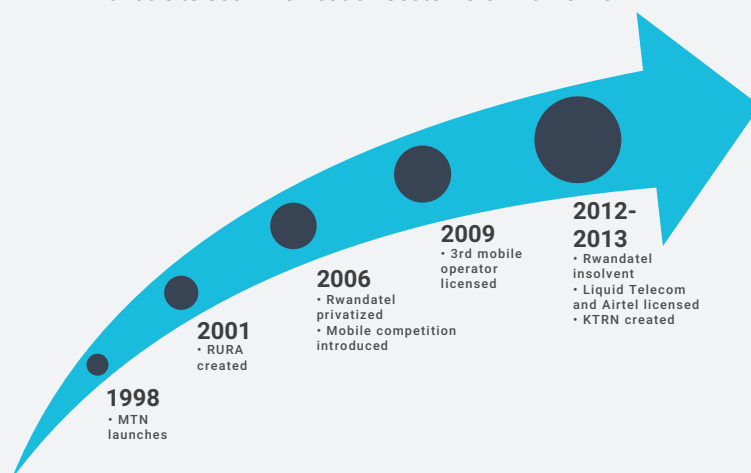
### **2.1 History of ICT**

Government-owned monopoly providers in most countries around the world have traditionally provided telecommunication services. Evidence suggests that this resulted in low levels of access and that private investment, competition and transparent regulation results in higher levels of access (Wallsten, 2001). Rwanda began the process of telecommunication sector reform by allowing private sector investment when South Africa headquartered MTN entered the market in 1998 to provide mobile telecommunications. This resulted in indirect competition between MTN and the fixed telephone services provided by the incumbent telecom operator Rwandatel. In 2001, Rwanda created an independent agency to regulate the sector, the Rwanda Utilities Regulatory Authority (RURA). In 2006, Rwandatel was privatized and granted a license for mobile telephony, allowing

it to compete head on in the market segment with MTN. In 2009, a third mobile operator owned by Luxembourg-based Millicom and operating under the TIGO brand was introduced. Rwandatel was declared insolvent in 2011 and Airtel, an Indian-based mobile group that launched operations in Rwanda in 2012, purchased its mobile assets. Liquid Telecom, a South African headquartered group that launched in 2013, purchased Rwandatel's wired network. The same year, KTRN was created as a wholesale provider of 4G services. By June 2016, there were five main nationwide infrastructure-based operators in the country (MTN, Tigo, Airtel, Liquid Telecom and KTRN), five smaller operators with specific market niches, two network facility providers (i.e., towers, fiber) and 14 retail Internet Service Providers (ISPs) licensed.

### **2.2 Key Government Institutions**

More so than perhaps other countries, there are a number of government institutions with different levels of responsibility for ICT in Rwanda. Further,

**FIGURE 2.1. Rwanda's telecommunication sector reform timeline**

they often are not purely focused on ICT but also have a mandate for other sectors. Third, they report to different entities at the highest level of government. Finally, the country's President Paul Kagame takes a strong interest in ICT ensuring it receives top-level support. This creates a dynamic unique to Rwanda. Relevant government institutions and investments include:

- The Ministry of Youth and ICT (MYICT) is responsible for ICT policy and strategy in the country in addition to youth affairs. Activities include development of key strategic documents covering ICT and broadband policy and five-year sector plans as well as coordinating the various stakeholders and activities within the ICT sector and aligning initiatives with overall national development goals.
- The Rwanda Utilities Regulatory Authority (RURA) was created in 2001 as a multi-sector regulator, which trades off the focus of a single sector regulator for economy of scale to share scarce expertise across various utilities.<sup>8</sup> In addition to telecommunications, it also is responsible for media, posts, water, energy, sanitation and transport. RURA is guided by a board of directors and reports to the Prime Minister. RURA compiles official supply side (i.e., administrative) statistics on the ICT sector for the country.<sup>9</sup> RURA is also responsible for the Rwanda Internet Exchange and the Internet country domain name (RW). These are operationalized by the Rwanda Information Communication and Technology Association (RICTA) a non-profit organization formed in 2005 to represent the Rwandan Internet community.
- The Rwanda Development Board (RDB) facilitates private sector investment such as business registration and investment promotion and works to expand the country's exports. It reports directly to the President and is guided by a Board that includes key ministries. RDB launched in 2009 through the merger of nine government agencies. This included the Rwanda Information Technology Agency, which had been responsible for national ICT plans and e-government services. Apart from managing e-government services, RDB is also involved in

8 - See "Table 6-3: Model 3 – Multi-Sector Regulator (MSR)" at: <http://www.ictregulationtoolkit.org/en/toolkit/notes/PracticeNote/2558>

9 - This is complemented by official macroeconomic and demand side ICT statistics compiled by NISR.



the infrastructure aspects of Kigali Innovation City (see Chapter 4) and currently responsible for cyber security (see Chapter 3).

Of note are the two joint ventures the government established with Korea Telecom (KT) in 2013, KT Rwanda Networks (KTRN) and Africa olleh Services (AoS). The government share is 49% in each. The government contributed its national fiber backbone network, national data center, spectrum holdings and wholesale license (valued at US\$130 million) to the 25-year joint ventures while KT will contribute US\$140 million through construction of a 4G LTE network and other investments.<sup>10</sup>

The important role that President Paul Kagame has played in Rwanda's connectivity development cannot be underestimated. He has been a strong proponent of broadband and its critical role in development:

"The broadband cannot solve all world problems but we know it can accelerate progress in overcoming biggest obstacles to global prosperity and well-being."<sup>11</sup>

The President serves as the co-chair of the Broadband Commission for Sustainable Development and was the winner of the International Telecommunication Union's 2014 World Telecommunication and Information Society Award.<sup>12</sup>

Strong government support for ICT is reflected in international rankings. Rwanda is reckoned to rank second in the world by the World Economic Forum in government success in ICT promotion (after the United Arab Emirates).<sup>13</sup> The next highest ranked African country is Kenya at 21 and the highest ranked LDC after Rwanda is Senegal at 41st.

## 2.3 National Broadband Policy

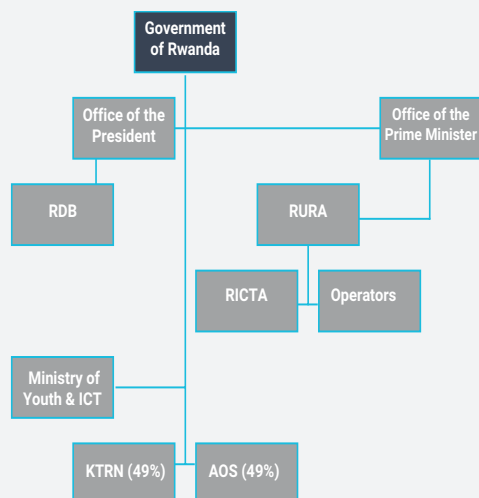
The key strategy document driving high-speed communications in the country is the 2013 *National Broadband Policy* for Rwanda (GoR, 2013). The policy's goal is to transform Rwanda into an Information society driven by "universal access to high speed, reliable, affordable and secure broadband infrastructure and services by 2020" (GoR, 2013 p. 9). This is very much in line with the United Nation's Sustainable Development Agenda Goal9c: "Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020."<sup>14</sup>

Unlike many other countries, Rwanda's broadband policy does not adopt an explicit speed in its broadband definition. Instead, it considers broadband as a widely available "always-on" technology with different speeds based on user requirements:

"A network connection that is always on, available at home, at work and on the move, that delivers progressively higher bandwidths that are capable of supporting innovative and interactive content and services, as to enhance the user-experience" (GoR, 2013 p. 10).

The policy emphasizes a wholesale / retail market structure, Public Private Partnerships (PPPs) and

**FIGURE 2.2. Government ICT entities**



10 - Bigabo, Patrick. 2014. "Rwanda contracts Nokia Networks to run LTE network." KT Press, September 5. <http://ktpress.rw/2014/09/rwanda-contracts-nokia-networks-to-run-lte-network/>.

11 - Mugabo, Peter. 2016. "Kagame says broadband can accelerate progress." News of Rwanda, September 19. <http://www.newsofrwanda.com/abanyapolitiki/31583/kagame-says-broadband-can-accelerate-progress/>.

12 - ITU. 2014. "ITU Awards President of Rwanda Mr Paul Kagame, President of Republic of Korea Ms Park Geun-hye, and Mr Carlos Slim." Press Release, May 2.

13 - <http://reports.weforum.org/global-information-technology-report-2016/networked-readiness-index/>

14 - See "Goal 9 Targets" at: <http://www.un.org/sustainabledevelopment/infrastructure-industrialization/>

service rather than infrastructure competition as the best way to promote low prices, high service quality and widespread coverage. It also recognizes that broadband is an ecosystem with both supply and demand aspects and that the latter needs to be stimulated through relevant content and applications.

The policy specifies a timeline with specific actions to be carried out by various organizations. These include: creating a public private partnership wholesale provider; updating the legal and regulatory framework in terms of relevant licensing, standards and spectrum changes to accelerate broadband rollout; establishing network rollout targets (95% of the country to be covered by June 2017); creating a digital literacy program; programs to provide affordable devices and develop content and applications; and connecting all public institutions to broadband.

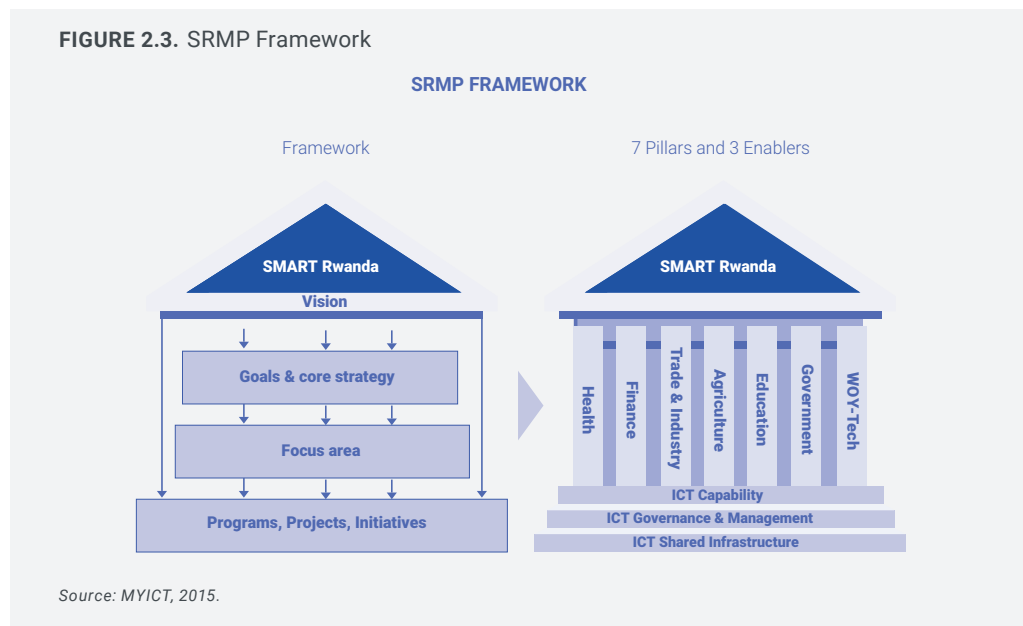
While important, the National Broadband Policy is a one-off document focused on a particular infrastructure aspect and needs to be placed in the context of more wide ranging ICT strategies and plans. This includes the five-year ICT sector plans, the first of which was published in 2000. These National Information Communication Infrastructure (NICI) plans outline the direction and goals of sector over the specified period. Each has had a specific focus with NICI-I aiming to foster an enabling

environment through appropriate legislation and institutions. NICI-II was focused on infrastructure development and NICI-III on service development.

The latest is the SMART Rwanda Master Plan (SRMP) covering the period 2015-2020 (MYIT, 2015). SRMP builds on the previous plans, with a focus on innovation in order to use ICTs as a transformational enabler to digitize the economy generating growth and job creation. The plan emphasizes three key enablers and seven strategic pillars (Figure 2.3).

Another factor critical to the success of Rwanda's ICT sector has been a high level of transparency. Unlike many other countries, interference in policy making by the incumbent telecommunication operator seeking to protect its interests has been limited and in fact, the company no longer exists (Box 2.1). The country rates relatively high in transparency and low in corruption, ranking 44th in the world (out of 167) and fourth in Africa (after Botswana, Cape Verde and Seychelles) in Transparency International's Corruption Perceptions Index (Transparency International, 2016). Transparency is also reflected in the range of published operational information on the ICT sector in Rwanda. RURA publishes an annual report while the main telecommunication operators active in the country are all part of publicly listed international groups that issue regular operating reports.

**FIGURE 2.3. SRMP Framework**



## Box 2-1

### The demise of Rwandatel

Incumbent phone companies in most developing countries have often been viewed as symbol of national pride and were typically government owned. In the wake of the introduction of mobile communications, many struggled, hindered by unregulated interconnection rates that discouraged fixed telephone line use and in some countries, the inability to obtain permission to provide mobile services.<sup>15</sup> While some incumbents are financially sustainable, a lot are struggling but nonetheless continue to exert pressure on regulators often resulting in market dominance in national and international backbone markets to the detriment of the ICT sector.

Rwandatel was the historic telecom operator in Rwanda founded in 1993. The government privatized 99% of Rwandatel for US\$20 million to a US entrepreneur in 2005.<sup>16</sup> Though Rwandatel was also allowed to provide mobile services, it selected CDMA technology that proved unpopular compared to the GSM network offered by MTN, which had a wide assortment of handsets. Following a failure to meet license obligations, the government repurchased Rwandatel in 2007 for US\$12 million.<sup>17</sup> The same year, it sold 80% to Libya's LAP Green for five times more than its previous price,

US\$100 million.<sup>18</sup> In 2011, Rwandatel's assets were frozen due to UN sanctions against Libya.<sup>19</sup> Its assets were sold to Liquid Telecom in 2013 for US\$4 million and the name not retained.<sup>20</sup> Thus, the incumbent operator has ceased to exist and it may be not be a bad thing since it cannot exert pressure on the government, as is the case in other countries to the detriment of a sustainable ICT sector. The privatization of Rwandatel put distance between it and the government providing freedom to adopt forward looking policies without being encumbered by the influence of the incumbent operator.

15 - One study noted the erosion of African incumbent telephone operators as far back as 2005: "Revenue sharing and competitive positions favorable to mobile operators as fixed incumbent operators retain no significant market power in many countries." See: Jérôme Bezzina. 2005. Interconnection Challenges in a Converging Environment: Policy Implications for African Telecommunications Regulators. <http://documents.worldbank.org/curated/en/962421468211775594/Interconnection-challenges-in-a-converging-environment-Policy-implications-for-African-telecommunications-regulators>

16 - Nixon, Ron. 2007. "Africa, Offline: Waiting for the Web." The New York Times, July 22. <http://www.nytimes.com/2007/07/22/business/yourmoney/22rwanda.html>.

17 - RURA. 2007. "The Sales and Purchase of 100% shares of TERRACOM sarl and its 99% shares in Rwandatel S.A." August 1. [http://www.rura.rw/fileadmin/docs/The\\_Sales\\_and\\_Purchase\\_of\\_100.pdf](http://www.rura.rw/fileadmin/docs/The_Sales_and_Purchase_of_100.pdf).

18 - TeleGeography. 2007. "LapGreen to buy Rwandatel stake for USD100 million." COMMSUPDATE. October 15. <https://www.telegeography.com/products/commsupdate/articles/2007/10/15/lapgreen-to-buy-rwandatel-stake-for-usd100-million/>.

19 - Rwanda News Agency. 2011. "Rwanda to freeze Libyan assets under UN sanctions." March 31. <http://www.rnnews.com/regional/4844-rwanda-to-freeze-libyan-assets-under-un-sanctions>

20 - Mugisha, Ivan R. 2013. "Liquid Telecom acquires Rwandatel assets." The New Times Rwanda, June 3. <http://www.newtimes.co.rw/section/article/2013-06-03/66372/>.

## 3. Supply Side

The World Bank provides a useful framework for understanding the elements of broadband infrastructure (Figure 3.1). The first mile refers to international connectivity. The second mile refers to national backbones and associated elements such as data centers and Internet exchanges. The last mile refers to the local access networks that reach the end user. Finally what the Bank calls the "hidden mile" refers to essential regulatory issues such as frequency management, licensing framework, cyber security, and competition policy as well as issues distinctive to each country that create broadband challenges such as having no direct access to the sea, small market size or post-conflict situations.

### 3.1 First Mile: International Connectivity

African countries have traditionally relied on satellite connectivity for international Internet connectivity. Satellite is more expensive and has higher latency than fiber optic cable. The launch of a second competitive undersea fiber optic cable on the west coast of Africa in 2010 and the first cable on the east coast of Africa in 2009 has led to an explosion of submarine cables in the region with a dozen in operation by the end of 2016.

Rwanda's landlocked situation requires establishing connections to neighboring countries in order to access undersea fiber optic cables. Of its border neighbors, DR Congo and Tanzania have direct access to undersea fiber optic networks whereas

Uganda connects via Kenya. Given that the Indian Ocean is closer, that Rwanda is a member of the EAC and that fiber routes in eastern DR Congo are virtually non-existent, Rwanda accesses cables in Kenya and Tanzania.

The World Bank provided a grant for the Rwandan government to purchase bulk capacity in order to achieve scale and lower international bandwidth costs. This was followed by a 10-year agreement in 2012 with the Tanzania Telecommunications Company Limited to procure international bandwidth at an attractive price. These developments greatly expanded Rwanda's international bandwidth from 645 Mb/s in 2009 to 12,644 Mb/s in 2015.

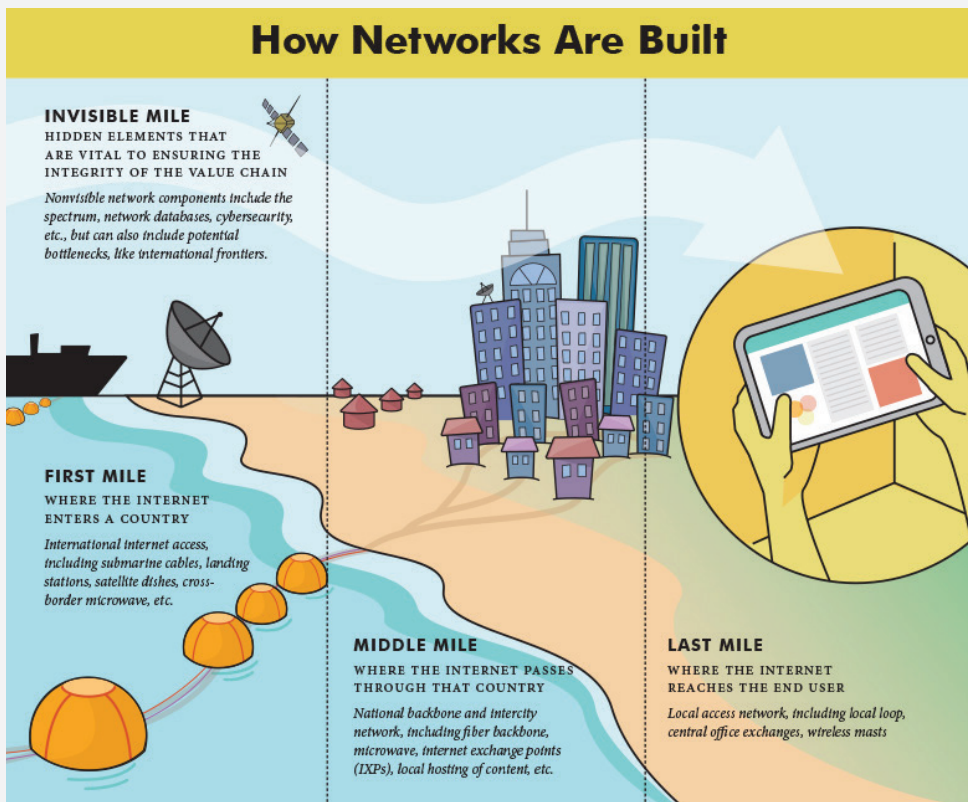
Favorable price negotiations, growing scale and open access policies drove the wholesale price

of international bandwidth in Rwanda down dramatically from US\$ 10,000 per Mb/s per month in 2008 to US\$125 in 2014, one of the cheapest prices in Africa.

### 3.2 Middle Mile: National Backbone Networks & Other Supporting Infrastructure

There is a nationwide fiber optic backbone facilitating the transfer of high-speed data across the country. In 2008, the government began rolling out a national fiber optic backbone coordinated by RDB at a cost of US\$40 million.<sup>21</sup> Roll out was essentially completed in 2010 with over 3,000 kilometers of fiber distributed to all 30 districts and 11 border points. The network consists of four rings providing resilience in the case

**FIGURE 3.1.** The “miles” of broadband networks



Source: Kelly, 2016.

of failure along one segment (Figure 3.3). If traffic goes down on one segment, it can be rerouted in the other direction to reach its destination. This network is now jointly owned by the KTRN joint venture and managed by KT. Access is open to all operators at cost-based prices. In addition, there is several thousand kilometers of fiber deployed by other operators (i.e., MTN, Liquid Telecom, Airtel and TIGO) as well as fiber optic deployed in the transmission lines of the state-owned electricity company Rwanda Energy Group (formerly Electrogaz) with some leased to telecommunication operators.

Internet Exchange Points (IXPs) reduce reliance on costly international links and improve quality. An IXP is a location where operators connect their networks to exchange data traffic among each other. This helps ensure that domestically destined traffic stays in the country, reducing the need for costly international transit and enhancing latency since traffic does not need to travel so far. The Rwanda Internet Exchange (RINEX) is an IXP launched in mid 2004.<sup>22</sup> It is managed by RICTA and had 11 participants in late 2016. Traffic is growing with peak traffic rising from around 800 Mb/s in November

2015 to over 1,000 Mb/s by November 2016, an increase of 25%. It is estimated that RINEX is handling around 7% of Rwanda's total Internet traffic.

There are several data centers in the country providing data storage and cloud computing services. The National Data Center is managed by Africa olleh Services (AoS), a joint venture between the government and Korea Telecom<sup>23</sup> providing hosting facilities for public institutions and the private sector. In addition, both Liquid Telecom and MTN have data centers offering commercial services. Data centers require significant amounts of electricity to power servers and maintain the appropriate temperature. One challenge is the price of electricity in Rwanda results in high data center costs compared to developed countries (Table 3.2). This has led content providers to host abroad resulting in high IP transit costs for local ISPs (see Chapter 4). The government is hoping to alleviate this by either subsidizing the cost of electricity at data centers or offering rebates.

### 3.3 Last Mile: Local Access Networks

The last mile refers to wired and wireless networks users subscribe to access broadband Internet. There is a range of broadband technologies in use in the country providing speeds ranging from 256 kb/s<sup>24</sup> to 1 Gb/s.

Wired broadband use is extremely limited in Rwanda. RURA reported a figure of 21,125 fixed

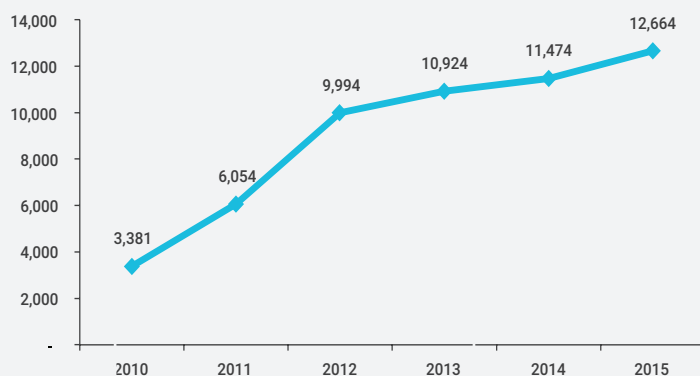
21 - This was financed by the sale of Rwandatel for US\$100 million in October 2007. See: World Bank, 2015 p.2.

22 - <http://rinex.org.rw>

23 - <http://www.aos.rw>

24 - There is no universally agreed definition of what speed constitutes broadband. The ITU uses a minimum of 256 kbps in its statistical reports but most countries in the world have adopted far higher speeds in their broadband definitions. Broadband speeds adopted by African countries in their broadband plans include 10 Mbps in Botswana, 40 Mbps in urban areas and 5 Mbps in rural areas in Kenya and between 5 - 100 Mbps in South Africa.

**FIGURE 3.2.** Rwanda's international Internet bandwidth, Mb/s



Note: Bothways.

Source: RURA, 2016b



**Table 3.1: International connectivity wholesale prices (US\$ per Mb/s per month)**

Country	2008	2009	2010	2011	2012	2013	2014
<b>Sao Tome</b>			\$9,000	\$9,000	\$9,000	\$2,500	\$2,500
<b>Kenya</b>	\$7,500	\$800	\$800	\$650	\$650	\$650	\$287
<b>Madagascar</b>	\$10,000	\$5,721	\$4,897	\$1,776	\$1,367	\$1,115	\$844
<b>Burundi</b>	\$8,000	\$6,500	\$6,500	\$6,500	\$2,800	\$500	\$300
<b>Rwanda</b>	\$10,000	\$7,200	\$2,800	\$640	\$580	\$290	\$125

Source: World Bank, 2015

broadband subscriptions in Rwanda in 2015 or just 0.18 subscriptions per 100 people. The majority of these subscriptions are fixed wireless typically providing speeds of 512 kb/s or less. Only three ISPs provide wired broadband using ADSL or fiber. Wired broadband is costlier than wireless with limited availability outside urban areas. However, fiber provides far higher speeds--up to 1 Gb/s--compared to wireless. Most wired broadband subscribers are organizations. Liquid Telecom began offering fiber to small businesses and homes with the launch of a 100 Mbps service in 2015.<sup>25</sup> It is spending US\$35 million to build the Fiber to the Premise network. The fixed broadband market has a high market concentration. MTN had a 90% market share in December 2015 (albeit mainly fixed wireless subscriptions using WiMAX technology) and only two other operators claimed more than 1% of the market.

Broadband in Rwanda is overwhelming mobile with widespread coverage. RURA reported 3.8 million mobile Internet subscriptions in 2015.<sup>26</sup> Three mobile broadband technologies are in use in the country: 3G providing maximum download speeds of 384 kb/s was launched in 2009, 3.5G providing maximum download speeds of 21 Mb/s launched in 2013 and 4G providing maximum download speeds of 100 Mbps launched in 2014. According to one of the Rwandan mobile operators, "downloading a 10-minute video clip on a 3G connection can take you up to 10 minutes; downloading the same clip

on ... LTE takes approximately 35 seconds." RURA<sup>27</sup> reported 3G/3.5G population coverage of 92% in June 2016 and LTE at 29%.

Rwanda has adopted a unique wholesale model for the deployment of 4G wireless technology. KT Rwanda Network (KTRN) a joint venture between Korea Telecom and the government was established in 2013 to among other things, deploy 4G technology. KTRN builds the network and acts as a wholesaler selling capacity to existing mobile operators and ISPs.<sup>28</sup> The 4G network launched in 2014 with the target of covering 95% of the population by 2018. One reason for this model is that the government wanted to accelerate the rollout of superfast mobile technology. The existing mobile operators were hesitant to deploy 4G until they had recovered the investment in their 3G networks. Rwanda is the first country in the world to adopt a single wholesale network for 4G (GSMA, 2015). The estimated cost of the 4G investments, to be financed by KT, is US\$140 million.<sup>29</sup> The unique 4G approach won a global award for innovation in business models in 2015.<sup>30</sup>

While the wholesale of capacity on mobile networks has been in use around the world for a number of countries, this has been infrastructure based mobile operators selling extra capacity on their networks to so-called Mobile Virtual Network Operators (MVNOs). The situation in Rwanda is quite different as a neutral party not involved in the retail end is

25 - <https://www.liquidtelecom.com/news-events/news/333-liquid-telecom-rwanda-s-ftth-service-now-available-in-kigali>

26 - This figure is misleading as these are not necessarily mobile broadband Internet users but rather subscriptions on 3G/4G networks not all of which are using the Internet. In contrast, Facebook reported just 500,000 people accessing the social network from mobile phones in Rwanda in December 2016.

27 - <http://www.tigo.co.rw/content/new-4g-promotion-proves-tigo-rwanda-continues-lead-way-4g-lte>

28 - For more on the technical details behind the 4G network see: Nokia. 2014. "Rwanda to get its first commercial LTE network with

managed services." Press Release, September 4. [http://www.nokia.com/en\\_int/news/releases/2014/09/04/rwanda-to-get-its-first-commercial-lte-network-with-managed-services](http://www.nokia.com/en_int/news/releases/2014/09/04/rwanda-to-get-its-first-commercial-lte-network-with-managed-services).

29 - Bigabo, Patrick. 2014. "Rwanda contracts Nokia Networks to run LTE network." KT Press, September 5. <http://ktpress.rw/2014/09/rwanda-contracts-nokia-networks-to-run-lte-network/>

30 - "Rwanda 4G LTE project scoops Global Telecom Business Innovation Award". News, 15 May 2015. [http://www.gov.rw/news\\_detail/?tx\\_ttnews%5Btt\\_news%5D=1193&chHash=20a177278a02e615b7520cdf478759dc](http://www.gov.rw/news_detail/?tx_ttnews%5Btt_news%5D=1193&chHash=20a177278a02e615b7520cdf478759dc)

**FIGURE 3.3.** Rwanda national fiber optic backbone

Source: <http://ktrn.rw/fixed-broadband-services.html>

providing wholesale services. This poses some interesting distinctions. One is that only data services are offered so although ISPs can provide mobile data, they cannot offer voice services and their users would in effect need two devices, one for 4G data and one for voice. 4G subscribers of the mobile operators can use voice with calls going over their existing 3G networks. Another distinction is pricing with the wholesale provider establishing the same price for all retailers who can then distinguish their tariffs through different service plans.

The new 4G network uses 800 MHz frequency which covers a large area, reducing deployment costs.

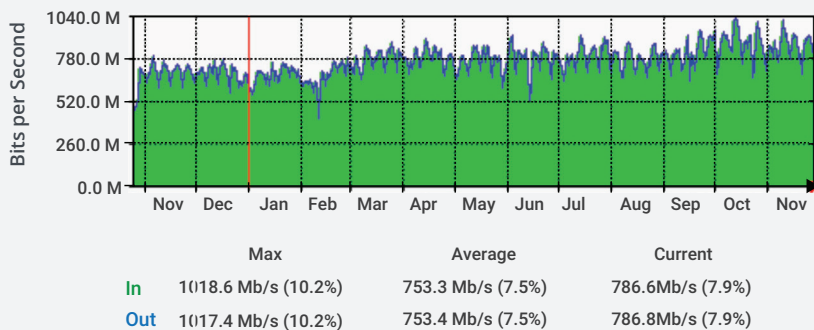
This so-called “digital dividend”<sup>31</sup> frequency was released following the completion of analog to digital broadcasting migration in Rwanda in 2013.

Mobile broadband coverage in Rwanda compares well to African peers. Among countries for which data is available, Rwanda ranks third in the percentage of the population covered by 3G after South Africa and Lesotho and second in 4G coverage. One reason for the high 3G mobile broadband coverage in Rwanda is coverage obligations imposed on operators by RURA. Another is the increase in competition from the entry of Airtel in the market in 2012 (GSMA, 2015).

### 3.4 Invisible Mile

In addition to the first, middle and last miles a number of factors—the so-called *invisible mile*—influences broadband deployment. Examples include:

- Wireless broadband requires sufficient spectrum to keep up with rising data usage. RURA publishes the National Frequency Allocation Table on its website indicating which services can utilize the different spectrum bands.<sup>32</sup> Sufficient frequency has been allocated to operators to sustain capacity and quality of mobile broadband networks. Of note is the reuse of broadcasting frequency for 4G made possible by the analog to digital migration
- Rwanda has encouraged infrastructure sharing and encoded its requirement in the 2016 Communications Law. One side effect of infrastructure sharing has been selling the masts owned by operators to tower

**FIGURE 3.4.** RINEX traffic, 2015-2016

Source: [http://www.rinex.org.rw/spip.php?page=aggregate\\_traffic](http://www.rinex.org.rw/spip.php?page=aggregate_traffic)

**Table 3.2: Getting Electricity, 2016**

	Procedures (number)	Time (days)	Cost (% of income per capita)
<b>East Asia &amp; Pacific</b>	4.5	73	715
<b>Europe &amp; Central Asia</b>	5.6	112	376
<b>Latin America &amp; Caribbean</b>	5.5	66	999
<b>Middle East &amp; North Africa</b>	5.0	82	772
<b>OECD high income</b>	4.8	76	63
<b>South Asia</b>	5.7	136	1,208
<b>Sub-Saharan Africa</b>	5.3	120	3,873
<b>Rwanda</b>	4.0	34	2,723

Source: World Bank "Getting Electricity" at: <http://www.doingbusiness.org/data/exploretopics/getting-electricity>

companies.<sup>33</sup> This lowers costs for operators and reduces the environmental impact of each operator having their own tower.

- There is a cyber security policy<sup>34</sup> and plan<sup>35</sup> as well as activities aimed at protecting government institutions and enhancing the security of electronic communications networks aiming to protect data and inspire confidence among users. This includes the Computer Security Incident Response Centre (CIRST), which monitors attacks at the cyber security operations center and implements security solutions. The Public Key Infrastructure (PKI) unit allocates digital certificates among certified public and private sector agencies in order to carry out secure digital transactions. There are plans to merge the various cyber security activities into a new National Cybersecurity Agency.
- Despite a low level of household electricity, mobile coverage is widespread. Only 23% of households reported having electricity in 2015 (NISR et al., 2015). On the other hand, RURA

reported that virtually the entire population was covered by 2G mobile technology and 88% by 3G in 2015 and 60% of households had a mobile phone. There is nationwide grid coverage and only around 10% of mobile base stations are powered by batteries or diesel generators. The discrepancy between household electricity and mobile phone availability and coverage is explained by dispersed settlements that may not be electrified but are close to locations that are and where mobile phones can be recharged.

- The Universal Access Fund (UAF) has been used to finance infrastructure deployment for schools and rural areas. The UAF is funded by an annual contribution by telecommunications operators of 2% of revenues. It has been used to provide funding for schools to connect to fiber optic cable and deployment of VSAT satellite terminals in rural areas where other connectivity options are non-existent.

31 - Alexandre Kholod and John Lewis. 2010. "The Digital Dividend." ITU News, Jan.-Feb. <http://www.itu.int/net/itunews/issues/2010/01/27.aspx>

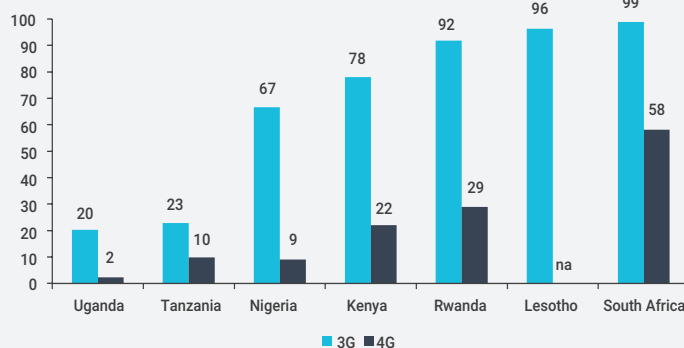
32 - Akamai. 2016. "State of the Internet Q2 2016 Report." <https://www.akamai.com/us/en/multimedia/documents/state-of-the-internet/akamai-state-of-the-internet-connectivity-report-q2-2016.pdf>.

33 - RURA. 2014. "Guidelines N°003/ICT/RURA/2014 Of 16/04/2014 On Minimum Bandwidth and Other Requirements For Internet Connectivity In Hospitality Industry." <http://www.rura.rw/fileadmin/>

[docs/GUIDELINES\\_ON\\_INTERNET\\_approved\\_and\\_published.pdf](docs/GUIDELINES_ON_INTERNET_approved_and_published.pdf).

34 - Ofcom. 2016. "Calling all Android users... join our mobile research project." Media Release, September 27. <https://www.ofcom.org.uk/about-ofcom/latest/media-releases/2016/calling-all-android-users>.

35 - [http://www.rura.rw/fileadmin/docs/National\\_Frequency\\_Allocation\\_Table\\_02.pdf](http://www.rura.rw/fileadmin/docs/National_Frequency_Allocation_Table_02.pdf)

**FIGURE 3.5.** Mobile broadband coverage (% of population), 2016 or latest available data

Note: na = Data not available. Data for Rwanda refers to June 2016; for Kenya, Lesotho, South Africa and Tanzania to March 2016 and for Uganda to December 2015.

Source: Adapted from RURA, 2016a; MTN Group Ltd. 2016. Integrated report for the year ended 31 December 2015; Safaricom Ltd. 2016. Annual Report 2016; and Vodacom. 2016. Integrated report for the year ended 31 March 2016.

## Box 3-1

### Crowdsourcing wireless broadband quality

Although Rwanda's broadband policy does not mention a specific minimum speed, the velocity of the connection is important. The faster the speed, the quicker applications will run or content will download and the more pleasurable the experience for the user. Latency is also important for if data takes too long to reach its destination, the benefits of rapid speeds are negated.

The author of the report conducted speed tests during the course of a week in November 2016 in Kigali. Speeds varied depending on the network technology, congestion and device. An Apple 5c smartphone was used to conduct the tests. This model is capable of connecting to all of Rwanda's data networks (e.g., EDGE, 3G, 3.5G, 4G) at their respective frequencies. Some 28 tests were run across Kigali with interesting results. One is that despite the smartphone's capability to access the frequency used for Rwanda's 4G network, no tests were conducted for this technology since it requires a different type of prepaid plan. In any case, 4G is currently not as prevalent as 3.5G technology. Second, network reception was sometimes constrained to EDGE, a 2G technology that is not mobile broadband. Third, speeds varied depending on the time of day and location of the test. Overall, speeds were relatively fast especially when connected to the 3.5G network. Average download speeds of 4.2 Mb/s were obtained with a peak speed of 8.9 Mb/s. Latency varied tremendously ranging from 20 to 1,447 milliseconds with an average of 31 milliseconds. Though these speeds are

representative of one set of tests conducted over several days, other smartphone users in Kigali would likely experience similar results. The speeds in Kigali fare well compared to other African countries where average download speeds were 5.2 Mb/s in Kenya, 3.1 Mb/s in Namibia, 3.0 in Nigeria and 4.9 Mb/s in South Africa during the second quarter of 2016 (albeit the country speeds refer to nationwide averages).<sup>36</sup>

Speed tests were also run over a hotel's free Wi-Fi network. This seemed relevant in the context of the guidelines RURA published on minimum bandwidth for the hospitality industry.<sup>37</sup> Though the lack of Wi-Fi might not discourage some visitors, the availability of wireless Internet is becoming increasingly important such as offering free breakfast. Hotel Wi-Fi is particularly important for overseas visitors who seek to avoid expensive roaming fees and cannot be bothered with the inconvenience of seeking out a local SIM card. Daily tests were run with an average download speed of 2.2 Mb/s and latency of 13 milliseconds. The hotel Wi-Fi speed was slower than the 3.5G network but latency was better.

This type of crowdsourcing can be valuable for regulatory authorities seeking to measure broadband quality but lacking the resources to do so. The regulator in the United Kingdom, Ofcom, recently launched a project to crowd source mobile broadband coverage and speeds.<sup>38</sup>

36 - For example in 2014, MTN Rwanda sold 550 towers for US\$48 million to IHS, a pan-African mobile infrastructure company. See "Note 5" in MTN's 2014 Financial Statements at: [http://www.mtn-investor.com/mtn\\_ar2014/financials/note5.html](http://www.mtn-investor.com/mtn_ar2014/financials/note5.html)

37 - [http://www.myict.gov.rw/fileadmin/Documents/National\\_Cyber\\_Security\\_Policy/Rwanda\\_Cyber\\_Security\\_Policy.pdf](http://www.myict.gov.rw/fileadmin/Documents/National_Cyber_Security_Policy/Rwanda_Cyber_Security_Policy.pdf)

38 - [http://www.myict.gov.rw/fileadmin/Documents/National\\_Cyber\\_Security\\_Policy/NCSP\\_Implementation\\_Plan.pdf](http://www.myict.gov.rw/fileadmin/Documents/National_Cyber_Security_Policy/NCSP_Implementation_Plan.pdf)

# 4. Demand Side

This chapter discusses broadband usage as reflected by Internet take-up among consumers and firms. Accessibility does not appear to be a major barrier to broadband use in Rwanda. There is adequate international bandwidth, a robust national fiber backbone and a high level of mobile broadband coverage. This chapter thus examines other factors that drive usage such as affordability, attractiveness and awareness (Kelly and Rossotto, 2012).

Supply side statistics are not appropriate for measuring ICT usage among the population. Subscription data are based on the administrative records of operators. They can be misleading particularly for mobile Internet subscriptions since operators include subscriptions to mobile broadband networks even if users are only using voice or text services and some users can have more than one subscription.<sup>39</sup> Actual usage can only be determined by a demand side survey. Although NISR carries out

surveys related to ICT availability in households it does not survey the population on Internet usage. Therefore, there are no *official* statistics on proportion of the population using the Internet and existing figures are either based on misleading supply side data or are estimates.<sup>40</sup>

Given the lack of official data on Internet usage, a proxy measure of Facebook users is used. This also provides a consistent benchmark for comparing to other countries. Countries where Internet usage surveys have been carried out find a majority of users also use social networking.<sup>41</sup> For example, an average of 79% of Internet users in Kenya, Tanzania and Uganda use social networking. Therefore, a figure for Internet use can be derived from the proportion of the population that use social networking. The number of Facebook users in different countries is available from the Facebook Ad engine.<sup>42</sup>

39 - For example, one study comparing mobile broadband subscription data with survey data found that the subscription data misrepresented actual mobile broadband users by 85%. "Mobile Internet in Europe." *ictDATA*, 16 January 2013. <http://www.ictdata.org/2013/01/mobile-internet-in-europe.html>

40 - For example, ITU data are based on estimates rather than actual survey data. See "Percentage of Individuals using the Internet" at: <http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

41 - Based on nationally representative face-to-face household surveys carried out in those countries. Pew Research Center, February, 2016, "Smartphone Ownership and Internet Usage Continues to Climb in Emerging Economies" <http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/>  
42 - <https://www.facebook.com/business/learn/facebook-ads-choose-audience>

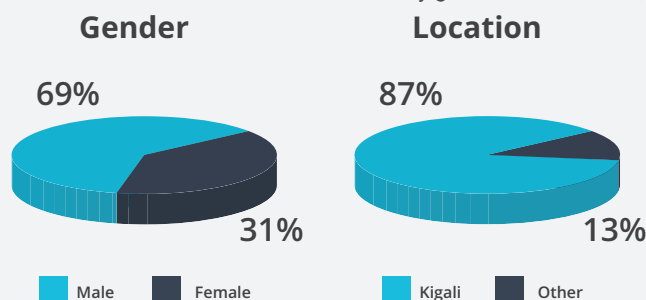
**Table 4.1: Facebook users and Internet estimates, 2016**

	Population			Facebook users		Cost (% of income per capita)	
	Total (000s)	< 15 (%)	15+ (000s)	(000s)	As % of 15+ population	Using social networking (%)	As % of population
<b>Burundi</b>	11,179	45%	6,148	470	8%		10%
<b>DR Congo</b>	77,267	46%	41,724	2,600	6%		8%
<b>Kenya</b>	46,050	42%	26,709	6,500	24%	82%	30%
<b>Rwanda</b>	11,610	41%	6,850	570	8%		11%
<b>Tanzania</b>	53,470	45%	29,409	4,700	16%	78%	20%
<b>Uganda</b>	39,032	48%	20,297	2,400	12%	76%	16%
<b>AVERAGE</b>					<b>12%</b>	<b>79%</b>	<b>16%</b>

*Note: The simple average share of Internet users using social networking of countries surveyed (Kenya, Tanzania and Uganda) is used to derive the number of Internet users in the non-surveyed countries.*

*Source: Adapted from Facebook Ad Engine, Pew.*



**FIGURE 4.1.** Distribution of Facebook users in Rwanda by gender and location, November 2016

Source: Adapted from Facebook Ad engine.

The number of Facebook users in Rwanda rose almost 600% between 2011 and 2016 from 83,00 to 570,000. However, Internet usage in Rwanda is average compared to neighboring countries (Table 4.1). For example it is three times less than Kenya, half the rate of Tanzania, five percentage points less than Uganda, similar to Burundi and slightly higher than DR Congo.

There are significant digital divides in Rwanda. Almost 70% of Facebook users in the country are male and 87% are in Kigali (Figure 4.1).

## 4.1 Affordability

Affordability does not appear to be an overwhelming barrier to broadband access in Rwanda compared to other LDCs or African countries. MTN's least expensive monthly prepaid data package is Rwf 2,000 (US\$ 2.8) for 750 MB of data. This is 90% less than what it cost in 2010 (in US\$). As a percent of per capita income, mobile broadband became dramatically more affordable dropping from 59% to 4.8% Figure 4.2a).

Mobile data prices in Rwanda are comparable to neighbors and on a volume basis are the cheapest. A prepaid monthly data bundle of at least 1 GB costs US\$ 5.5 in Rwanda, similar to prices in Burundi, Tanzania and Kenya and far cheaper than Uganda or DR Congo (based on the prices of the largest mobile operator) (Figure 4.2b).<sup>43</sup> Given that in Rwanda there is no bundle providing exactly 1 GB per month, a

user would need to purchase two 750 MB per month bundles receiving 1.5 GB of data. On that basis, Rwanda has the cheapest price per GB among the leading mobile operators in its region.

Given that smaller denomination bundles are available, users can tailor their need to their budget. This suggests that affordability is not blocking potential Internet users in Rwanda since users can tailor usage to their budget. Operators also make available slimmed down versions of popular applications such as Facebook free or at a reduced cost. MTN offers Facebook USSD, a text-based version of the social networking application that does not require mobile broadband. The first week is free after which users can pay daily, weekly or monthly. Facebook USSD costs Rwf 35 daily (US\$ 4), Rwf 150 weekly (US\$ 21), and Rwf 350 monthly (US\$ 49). There are also discounted social networking bundles offering access to Whatsapp, Twitter and Facebook.

While this constraint is not likely to have a big impact on those primarily using the Internet for entertainment such as social media, it is likely to impact experimentation and affect the young and digital start ups. This is ameliorated to some extent by tech savvy youth accessing the Internet at free hotspots at educational institutions and other locations. For example, free Wi-Fi is being provided at selected locations throughout Kigali as part of the SMART Rwanda program.<sup>44</sup>

43 - According to Swedish telecom equipment manufacturer Ericsson, the average smartphone usage per month in Sub-Saharan Africa was 1GB in 2016. Ericsson. 2016. "Sub-Saharan Africa Mobility Report." <https://www.ericsson.com/assets/local/mobility-report/documents/2016/ericsson-mobility-report-november-2016-rssa.pdf>.

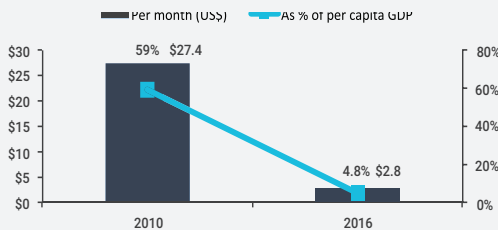
44 - "#KnowYourAfrica: Kigali's free Wi-Fi for everyone." CGTN, 6 July 2016. <http://africa.cgtn.com/2016/07/06/knowyourafrica-kigali-free-wi-fi-for-everyone/>

## 4.2 Attractiveness

Given that Kinyarwanda is the main language in the country, local content is essential to drive demand for broadband services. It is difficult to quantify the amount of local Internet content available in Rwanda. There is data on the number of websites using the RW domain name and this has been increasing over the last few years. In order to increase usage of the RW domain name, RURA dramatically slashed registration fees in 2016.

**FIGURE 4.2. Mobile data prices**

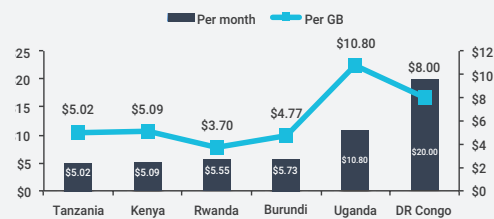
**FIGURE 4.2a** Rwanda, price of mobile data (750 MB per month, US\$)



A & B Source: Adapted from price lists of largest mobile operators by subscription market share.

One challenge has been that some content providers in the country host abroad, which drives up costs for local ISPs and makes access slower for local users. One study found that of the top 20 Rwandan websites, only six were hosted in Rwanda, all government. The study found that it was cheaper to host web sites abroad--one content developer achieved a saving of US\$ 111 per year by hosting overseas-- , but that this imposed higher costs on local ISPs to deliver the content -- some US\$ 13,500 in transit costs in one

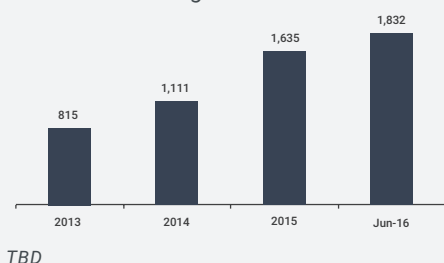
**FIGURE 4.2b** Mobile data prices 2016 (at least 1 GB per month, US\$)



**Table 4.2: Top 20 Rwandan websites and server locations**

Top 20	Website	Server Location
1. IGIHE	www.igihe.com	USA
2. Umuseke	www.umuseke.rw	USA
3. Kigali Today	www.kigalitoday.com	USA
4. Umuryango	www.umuryango.com	USA
5. Inyarwanda	www.inyarwanda.com	USA
6. Tohoza	www.tohoza.com	Switzerland
7. The New Times	www.newtimes.co.rw	USA
8. Imali	www.imali.biz	USA
9. Rwanda Directorate General of Immigration and Emigration	www.migration.gov.rw	Rwanda
10. University of Rwanda	www.nur.ac.rw	Rwanda
11. College of Science and Technology, University of Rwanda	www.kist.ac.rw	Rwanda
12. Rwanda Broadcasting Agency	www.orinfor.gov.rw	Rwanda
13. Living in Kigali	www.livinginkigali.com	USA
14. Ubugingo	www.ubugingo.com	USA
15. Rumalex	www.rumalex.net	Germany
16. Zion Temple	www.ziontemple.rbm.tv	USA
17. Job in Rwanda	www.jobinrwanda.com	France
18. Rwanda National Police	www.police.gov.rw	Rwanda
19. Rwanda Revenue Authority	www.rra.gov.rw	Rwanda
20. YEGO Rwanda	www.yegorwanda.net	USA

Source: Kende and Rose, 2015.

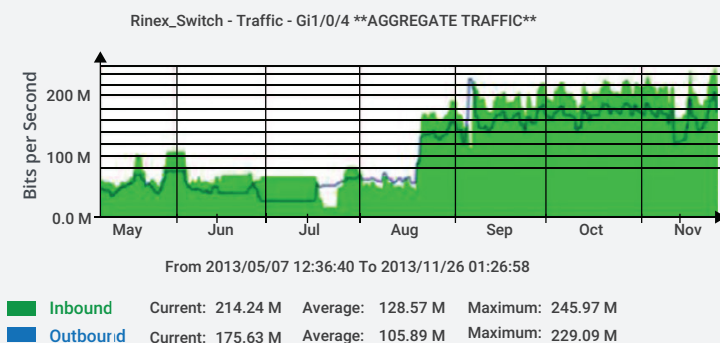
**FIGURE 4.3** RW registrations

case. Latency was significantly lower with overseas content often 350ms for accessing Rwandan website sites hosted in the USA or Europe, and peak latencies of 800- 1000ms during congested evening hours. This compares to latency of around 10ms for

sites hosted in Rwanda (Kende and Rose, 2015). This makes the Internet experience slow and frustrating, with a corresponding negative impact on usage.

The study also found that storing popular content on RINEX results in improved quality and higher usage. For example, a Google cache featuring mainly YouTube videos was put on RINEX in August 2013 resulting in a four-fold jump in traffic. Similar results were noted when Akamai was placed on RINEX. Latency decreased, user speeds increased and usage grew.

There is a project underway to encourage more Rwanda hosted content. RICTA's 10 K initiative aims to host 10,000 Rwandan websites in the country. Funded by the UAF, the first phase resulted in 44 web sites being "repatriated" back to Rwanda.

**FIGURE 4.4.** Traffic through Rinex Switch

Source: [http://www.rinex.org.rw/spip.php?page=aggregate\\_traffic](http://www.rinex.org.rw/spip.php?page=aggregate_traffic)

## 4.3 Awareness

Digital literacy would appear to be a major, if not the most important factor inhibiting Internet usage in Rwanda. According to EICV4, only 7.1% of the population aged ten years and older was computer literate in 2014, significantly less than the literate population, those with a post primary education or those who are literate in English and French (Figure 4.5, left). There is a well-documented link between education and Internet use. This relationship is apparent when comparing years of schooling and

Facebook use in Rwanda to its neighbors. For each extra year of schooling<sup>45</sup> among the population aged 25 and over, Facebook penetration increases by 4% (Figure 4.5b).

The challenge for Rwanda if it wants to accelerate Internet use is to try to delink years of schooling from Internet take-up by another approach to massive digital literacy. Years of schooling have risen only by a year and half over the last decade; at that rate it would take decades to get half the population online. If all those with a post-primary education became computer literate, that would almost double

Internet penetration. New approaches will be needed to reach out to adults who are literate but have less than a secondary education.

Despite the potential of a youthful population, the net secondary enrollment rate was only 28% in 2015 and secondary school enrolments have been declining (MOE, 2016). This needs to be reversed to boost the drive towards a knowledge society.

The government has launched a number of initiatives to boost digital awareness (Box 4-1).

Several recent developments have the potential to dramatically raise digital literacy. The new Ministry of Education ICT policy calls for installing smart classrooms in all primary and secondary schools and enhancing ICT training for teachers and students (MoE, 2016b). In January 2015, the government signed a Memorandum of Understanding (MoU) the International Computer Driving License (ICDL)

program.<sup>46</sup> ICDL offers computer certification and as part of the MoU will translate its introductory level module to Kinyarwanda. They will also with the government on training initiatives in the SRMP including certifying 85,000 government workers and the public in digital literacy. MYICT is spearheading an "Internet for All" program targeting the general population, SMEs and experts to provide different levels of computer skills suited to the audience and aims to provide digital literacy skills to five million citizens by 2020.<sup>47</sup>

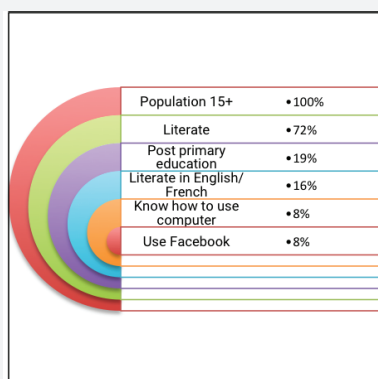
45 - See "Mean years of schooling (of adults) (years)" at: <http://hdr.undp.org/en/content/mean-years-schooling-adults-years>

46 - "Government of Rwanda and ICDL to advance digital literacy in Rwanda." News, 29 January 2015. [http://www.gov.rw/news\\_detail/?tx\\_ttnews%5Btt\\_news%5D=1046&cHash=060451e64b-0f728ee0e106080b4fa094](http://www.gov.rw/news_detail/?tx_ttnews%5Btt_news%5D=1046&cHash=060451e64b-0f728ee0e106080b4fa094)

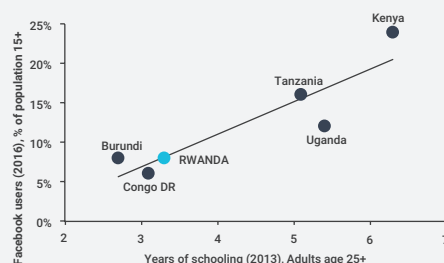
47 - Julius Bizimungu. 2016. "Internet for All" initiative targets to connect five million Rwandans." The New Times, 10 December. <http://www.newtimes.co.rw/section/article/2016-12-10/206142/>

**FIGURE 4.5.** Educational characteristics in Rwanda and years of schooling and Facebook use in East Africa

**FIGURE 4.5a**



**FIGURE 4.5b** Relation between years of schooling & Facebook use



A & B Source: Adapted from NISR, Facebook Ad Engine and UNDP ("Mean years of schooling (of adults) (years)" at: <http://hdr.undp.org/en/content/mean-years-schooling-adults-years>).

## Box 4-1



### Boosting awareness

- Special buses have been outfitted with Internet access that go to rural areas where there is a lack of electricity.<sup>48</sup> The four ICT Buses provide relevant information to local communities such as commodity prices, weather forecasts, health tips and information about government programs.
- ICT awareness campaigns in rural areas led by MYICT in collaboration with the private sector where operators display their offerings.<sup>49</sup>
- RURA's Universal Access Fund has been deployed to finance ICT literacy in rural areas by establishing e-learning and e-service centers.

48 - Reuben Kyama and Eric Kabeera. 2011. "ICT buses delivering the Internet to rural Rwanda." eLearning Africa News Portal. 8 June. <http://>

[ela-newsportal.com/ict-buses-delivering-the-internet-to-rural-rwanda/](http://ela-newsportal.com/ict-buses-delivering-the-internet-to-rural-rwanda/)

49 - [https://www.dotrust.org/blog/archive/introducing\\_rural\\_communities\\_to\\_technology\\_dot\\_rwanda\\_and\\_the\\_ict\\_1](https://www.dotrust.org/blog/archive/introducing_rural_communities_to_technology_dot_rwanda_and_the_ict_1)

## 5. Sectoral Use and Impacts

This chapter analyzes the economic and social impacts of broadband. It describes the digital sector and contribution to economic growth. It also outlines the status of tech entrepreneurs and innovation. The use and impact of broadband in sectors such as business, education, health, agriculture and government is also reviewed.

### 5.1 The ICT Sector

The ICT sector has both direct and indirect impacts on the economy. The direct impact is assessed by looking at the size of the sector in relation to Gross Domestic Product (GDP). The Rwanda National Institute of Statistics compiles sector GDP statistics based on the United Nations International Standard Industrial Classification of All Economic Activities, Rev.4.<sup>50</sup> Telecommunications and software industries are included in the Information and Communications (InfoComm) sector.<sup>51</sup> The value added of the InfoComm sector, worth Rwf 167 billion (US\$ 232 million) in 2015, has risen from 2% of GDP in the first quarter of 2006 to 3.1% in the first quarter of 2016. Value-added in the InfoComm sector grew 17% in 2015, contributing 0.6 percentage points to

GDP growth or 8% of the total percentage change. Nevertheless, there is room to grow since the contribution of the InfoComm sector to GDP is smaller in Rwanda than neighboring countries for which data is available (see figure 5.1).

There were 4,734 people employed in the InfoComm sector in February 2016 accounting for just 0.2% of total employment.<sup>52</sup> However, it is a highly educated sector with all employees having an upper secondary education or higher. According to RURA, employment in the telecom sector has been rising steadily from 826 in 2012 to 957 in 2015.

A number of studies have quantified the indirect impact of ICT technologies on the economy.<sup>53</sup> A World Bank study found that the impact increased as access moved from fixed to mobile telephony and Internet to wired broadband access.<sup>54</sup> Most studies found that until countries have reach a certain threshold penetration in wired broadband, there is no statistically significant impact.<sup>55</sup> This is Rwanda's situation where wired broadband penetration is extremely low (just 0.18 penetration as of December 2015). Therefore, indirect economic impacts in Rwanda are likely to flow from basic

50 - <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27>

51 - There is an alternative classification for the ICT sector which covering equipment manufacturing, telecommunication services and software ([http://unstats.un.org/unsd/cr/registry/docs/i31\\_ict.pdf](http://unstats.un.org/unsd/cr/registry/docs/i31_ict.pdf)). However this is not available for Rwanda; in any case ICT manufacturing is negligible in the country. Information and Communications includes the following industries: 58 - Publishing activities; 59 - Motion picture, video and television programme production, sound recording and music publishing activities; 60 - Programming and broadcasting activities; 61 - Telecommunications; 62 - Computer programming, consultancy and related activities and 63 - Information service activities (<http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27&Lg=1&Co=J>)

52 - NISR. 2016. Labour Force Survey Report - Pilot (February 2016). <http://www>

[statistics.gov.rw/publication/pilot-labour-force-survey-report-february-2016](http://statistics.gov.rw/publication/pilot-labour-force-survey-report-february-2016)

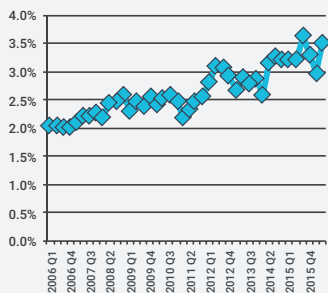
53 - Minges, Michael. 2016. "Exploring the Relationship between Broadband and Economic Growth." 102955. The World Bank. <http://documents.worldbank.org/curated/en/178701467988875888/Exploring-the-relationship-between-broadband-and-economic-growth>.

54 - Qiang, Christine Zhen-Wei, Carlo Rossotto, and Kaoru Kimura. 2009. "Economic Impacts of Broadband." In Information and Communications for Development. Washington D.C.: World Bank. [http://siteresources.worldbank.org/EXT/IC4D/Resources/IC4D\\_Broadband\\_35\\_50.pdf](http://siteresources.worldbank.org/EXT/IC4D/Resources/IC4D_Broadband_35_50.pdf).

55-Minges,Michael 2013."Movingtothenextstep:Standardizingbroadbandeconomic impact measurements." Presented at Measuring the Economic, Social, and Political Impact of the Web,George Washington University, Washington DC. 14-15 November.

**FIGURE 5.1. Information and Communications as a % of GDP**

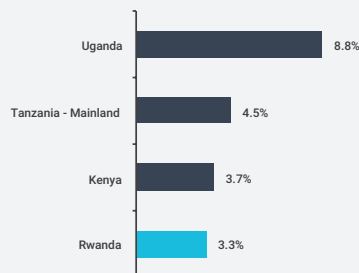
**FIGURE 5.1a Rwanda**



A & B Note: Constant 2011 prices (left chart).

Source: Adapted from NISR and UN.

**FIGURE 5.1b Information and communication as a % of GDP, 2015**



mobile telephony and mobile broadband. Data to create a Rwandan model to measure the impacts are not available.<sup>56</sup> However, impacts can be gauged based on existing cross-country models.

Based on experiences in other countries, it estimated that the growth in mobile broadband in Rwanda contributed 2.4 percentage points to the country's 12% real GDP per capita growth between 2012 and 2015.<sup>57</sup> This is equivalent to around one fifth of the total percentage change in GDP growth over that period.

### 5.1.1 Investment

Investment in Rwanda's broadband networks has largely emanated from three sources: telecommunications operators, the government and to a lesser extent, multilateral assistance agencies. It is important to note that steps Rwanda has adopted to reduce investment requirements through infrastructure sharing, open access and appropriate spectrum have also been critical.

Telecommunication operators in Rwanda have made significant investments in infrastructure. Although initial investments may be have been fresh capital financed by the group, bank loans or equipment vendor financing, follow-on investments have generally been made from operational gains.<sup>58</sup> MTN has invested Rwf 130 billion (US\$ 180 million) over the last five years.<sup>59</sup> Tigo invested US\$ 310 million since its launch with plans to invest a further US\$ 80 million over the next five years.<sup>60</sup> Airtel announced in 2012 that it would spend US\$100 million over the next three years.<sup>61</sup> KTRN committed US\$ 140 million to its PPP with the government. Liquid Telecom will invest more than US\$35 million deploying fiber to the premise.<sup>62</sup> Cumulatively, these

investments amount to over US\$800 million and have significantly boosted broadband connectivity while future investments will extend high-speed signal coverage to 95% of the population.

According to RURA, investments by telecommunication operators totaled Rwf 44 billion (US\$ 61 million) in 2015 (RURA, 2016b). This is equivalent to 2.9% of total Gross Fixed Capital Formation in the country and a little over a fifth of telecommunication revenue. Further, given that the leading operators are part of large international groups, their spending accounts for a significant amount of the country's foreign direct investment (FDI). In 2014, the ICT sector accounted for the largest portion of FDI inflows (US\$116 million or 29% of the total) and ICT foreign investment stock was highest in the country at US\$613 million.<sup>63</sup>

The government has also invested significantly in broadband and related initiatives. For example, it spent US\$40 million to construct the national fiber optic backbone (financed from the 2007 sale of Rwandatel). Implementation of the Smart Rwanda plan will cost around US\$ 519 million with the government reckoning it will generate an economic impact of twice that amount between 2015 and 2020. It also estimates that around 100,000 direct and indirect jobs will be created from the investment.

The role of the World Bank in Rwanda's connectivity development is also worth noting. A grant of US\$ 10 million was provided for the development of e-government services and another grant of US\$ 13 million was provided for the procurement of international bandwidth as part of the Regional Communications Infrastructure Program (World Bank, 2015).

56 - Typical country regressions to measure indirect ICT impacts require at least 30 observations of quarterly capital stock and labor force statistics, neither of which is available for Rwanda. For an example from Senegal see: Katz, Raul, and Pantelis Kourtroumpis. 2012. "The Economic Impact of Telecommunications in Senegal." *Communications & Strategies* 2 (86): 21–42. [https://www8.gsb.columbia.edu/citi/sites/citi/files/files/Senegal\\_Telecoms\\_Report\\_version%20finale%5B1%5D.pdf](https://www8.gsb.columbia.edu/citi/sites/citi/files/files/Senegal_Telecoms_Report_version%20finale%5B1%5D.pdf)

57 - Based on a 96-country panel study covering 2008-2011 finding that each 10% increase in 3G penetration increases GDP per capita by 0.15 percentage points. See: Deloitte. 2012. What is the impact of mobile telephony on mobile growth? <http://www.gsma.com/publicpolicy/wp-content/uploads/2012/11/gsmadeloitte-impact-mobile-telephony-economic-growth.pdf> Real GDP per capita is based on constant 2010 prices and sourced from the World Bank at: <http://data.worldbank.org/indicator/NY.GDP.PCAP.KD>. Rwanda's 3G subscriptions are sourced from GSMA Intelligence at: <https://www.gsmaintelligence.com/>

58 - For example, in 2009 MTN borrowed from local banks as well as

arranging vendor financing. See: Alex Ngarambe. 2009. "100 percent of MTN Rwanda's annual budget utilised." *The New Times*, 29 October. <http://www.newtimes.co.rw/section/article/2009-10-29/12793/59> - <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27>

60 - <http://www.millicom.com/where-we-operate/#rwanda>

61 - <http://www.africa.airtel.com/wps/wcm/connect/africarevamp/rwanda/home/personal/about-us/media-room/press-release/may-25-2012>

62 - <https://www.liquidtelecom.com/news-events/news/333-liquid-telecom-rwanda-s-ftth-service-now-available-in-kigali>

63 - National Bank of Rwanda. 2016. Foreign Private Capital In Rwanda 2015. [http://www.bnr.rw/fileadmin/AllDepartment/Statistics/Foreign\\_Private\\_Capital\\_in\\_Rwanda\\_2015.pdf](http://www.bnr.rw/fileadmin/AllDepartment/Statistics/Foreign_Private_Capital_in_Rwanda_2015.pdf)

## 5.1.2 Digital Entrepreneurship and Innovation

A number of initiatives are fostering a tech startup ecosystem aimed at leveraging broadband connectivity to create innovative applications and services for domestic and export consumption.

The Knowledge Lab (kLab) features an open space with room for around 60 people providing free and fast Wi-Fi.<sup>64</sup> It organizes various events such as workshops and hackathons and provides a unique networking opportunity for Kigali's young techies by providing mentoring to help them turn their ideas into business models.

Next door to kLab is the Rwanda FabLab, which opened in 2016 as the first hardware space in Central Africa.<sup>65</sup> The FabLab is supported by a number of institutions: ICT Chamber in partnership with Rwanda Development Board (RDB), Japan International Cooperation Agency (JICA), Ministry of Education, SolidWorks Corporation, MIT-CBA, and Gasabo3D. There is a range of equipment for hardware techies to experiment with such as 3D printers, milling machine, shopbot and laser cutter.

Kigali Innovation City (KIC) aims at uniting multinational information technology firms with domestic startups alongside higher education institutions to create a tech ecosystem. The hopes are that the synergies from anchoring educational institutions alongside tech companies in a cluster will generate innovative applications and services and help grow the domestic ICT industry as well as generate exports. The roughly US\$ one billion KIC is a mixed-use development including retail establishments and living spaces located on the outskirts of Kigali in special economic zone. KIC began to take shape in 2016 with the launch of the Rwanda Innovation fund, a US\$100 million venture capital vehicle that will provide startup financing. Carnegie Mellon University of the United States is one of the core anchor institutions and the first phase of its campus is scheduled for completion in

2017.<sup>66</sup> An innovation lab and skills academy is also scheduled for completion by then. Construction will continue up to 2022 with additional educational and tech company tenants. Large companies are being offered an attractive range of incentives to locate at KIC. The government has identified seven core areas for investment support: finance; bio-medical; data, knowledge and content; cyber-security; energy; logistics and agriculture. The projected impacts of KIC include:

- 4,500 highly skilled ICT jobs by 2022.
- Export earnings up to an estimated US\$180 million by 2022.
- Top 10 companies generating combined annual revenues of \$500 million by 2025.
- By 2030, Rwanda will have attained at least 90% self-reliance in skilled human capital and in financial capital required to sustain its digital transformation.<sup>67</sup>

## 5.2 Sector Use and Impacts

The intensity of broadband use varies across different sectors of the economy. Social sectors such as health and education have been mainly involved in digitizing records and then moving to transactional activities and integration of ICTs for users. Most of the social sectors have their own ICT strategy.

### 5.2.1 Business

Rwanda businesses have a high take-up of ICTs compared to neighboring countries. An enterprise survey shows that 34% of Rwandan firms had their own website in 2011 compared to an average of 32% for sub-Saharan Africa.<sup>68</sup> The figures for Rwanda are higher than any of its neighbors. In Kenya, 46% of enterprises had a web site in 2013. This should be put in the context that the latest Rwandan data is five years old and almost doubled from the previous five-year period. More than three quarters of Rwandan firms were using email to communicate

64 - <http://www.klab.rw>

65 - <http://www.fablabrw.org>

66 - <http://www.cmu.edu/rwanda/about-cmur/future-campus/index.html>

67 - RDB. "Kigali Innovation City." [http://rdb.rw/fileadmin/user\\_upload/](http://rdb.rw/fileadmin/user_upload/)

Documents/kigali/KIC\_Booklet\_Updated\_2nd\_MAY\_.pdf

68 - See the Rwanda Enterprise Survey at: <http://www.enterprisesurveys.org/data/exploreeconomies/2011/rwanda>



with clients or suppliers in 2011, a figure higher than all its neighbors as well as exceeding the Sub-Saharan Africa and world averages. Another measure of firm ICT adoption is the number of secure Internet servers.<sup>69</sup> Secure servers proxy for the level of transactional capability in areas such as finance, government services and e-commerce. With four Internet servers per 1 million people, Rwanda ranks ahead of its neighbors but less than half the rate in Kenya or the Sub-Saharan Africa average. There are anecdotal stories of SMEs in Rwanda using the Internet to boost sales of their products.<sup>70</sup>

## 5.2.2 Government

The computerization of government back office processes has been progressing and a number of electronic public services are available for citizens and businesses. This was supported by the World Bank eRwanda project (2006-2010), a US\$ 10 million grant aimed at the deployment of local area networks in government offices, development of government applications and services and training for staff.<sup>71</sup> Today, most ministries are connected to the Internet via fiber optic broadband.

In 2013, the government has entered into a 25 year PPP with Rwanda Online Platform Limited (ROPL) for the provision of online government services.

Although moving services online has reduced costs, user fees have remained the same in order for ROPL to earn income. Services are provided over the Irembo (Kinyarwanda for gate) platform, accessible via both web and mobile.<sup>72</sup> Over 30 services are available ranging from birth certificates to driving tests with plans to expand to over 100. Some 90,000 transactions are processed a month.<sup>73</sup> ROPL has partnered with banks and mobile money providers to enable payments to be made online. Over 200 service centers are spread throughout the nation for citizens to learn how to use the system or have an intermediary carry out the transaction for them. There are anecdotal stories of how the system has reduced waiting times and the number of offices that need to be visited for government services.<sup>74</sup>

Despite the development of e-government in Rwanda, the United Nations only ranks it average compared to its neighbors. According to the 2016 E-government Development Index, Rwanda ranks

69 - <http://data.worldbank.org/indicator/IT.NET.SECR.P6>

70 - Rwanda: "Internet is everything for us." ONE, 24 November 2016. <https://www.one.org/international/blog/rwanda-internet-is-everything-for-us/>

71 - <http://documents.worldbank.org/curated/en/999461468305057195/Rwanda-eRwanda-Project>

72 - <https://irembo.gov.rw>

73 - <http://rwandaonline.rw/in-the-works.php#sthash.1L9AqloY.dpuf>

74 - RwandaOnline. 2014. "How online platform will curb queuing at government offices," September 9. <http://www.rwanda-online.rw/press-detail.php?url=How+online+platform+will+curb+queuing+at+government+offices+&ref=2>

**Table 5.1: Enterprise use of ICTs**

Economy	Year	Percent of firms having their own Web site	Percent of firms using e-mail to interact with clients/suppliers	Secure Internet servers (per 1 million people) (2015)
All Countries		44.7	72.3	209
Sub-Saharan Africa		32.4	60.0	10
Burundi	2014	25.6	67.0	0.5
Kenya	2013	46.4	72.5	9
Rwanda	2006	18.1	38.8	4
Rwanda	2011	34.2	76.5	
Tanzania	2013	22.6	30.0	2
Uganda	2013	19.2	39.7	2
Congo, Dem. Rep.	2013	17.0	31.4	0.3

Source: Adapted from World Bank.

**Table 5.2: UN E-government Development Index, 2016**

Country	Rank 2016	EGDI 2016
Kenya		44.7
Uganda		32.4
United Republic of Tanzania	2014	25.6
Rwanda	2013	46.4
Burundi	2006	18.1
Democratic Republic of the Congo	2011	34.2

Source: <https://publicadministration.un.org/egovkb/en-us/Data/Compare-Countries>

138th in the world and after Kenya, Uganda and Tanzania. This is partly due to Rwanda's lower level of Internet access and literacy which are considered in the index and which lowers its score rather than the scope of services available compared to its neighbors.

## 5.2.3 Health

A major achievement in the health sector is records digitization and transmission through the Rwanda Health Management Information System (R-HMIS). Over 500 health facilities across the country are connected to R-HMIS through the Internet (around 94% of the total). The system has been progressively updated adding new tracking features such as child death reporting, tuberculosis and HIV patients.

The Ministry of Health has been using a mobile text platform called RapidSMS to track early child health ("the first 1,000 days").<sup>75</sup> Community health workers in all of the country's some 15,000 villages are provided with cellphones to send text messages about the status of child health in order to quickly tract any anomalies and provide rapid treatment. By 2015, some 186,719 children were being monitored through the platform.<sup>76</sup>

One innovative application recently launched is the use of drones to deliver blood across the country.<sup>77</sup> The service is operated by Zipline a US startup. The blood packages are dropped by parachute and then

the drone returns to its base. The first phase involves 15 drones delivering the blood to hospitals in rural western Rwanda. They use GPS navigational data and the cellular network to transmit information to air traffic control and the base station and for health workers to send text messages when blood is needed. Although the cost is roughly the same as motorbike or ambulance, it is much faster.

## 5.2.4 Agriculture

Agriculture is a key industry in the country accounting for almost a third of GDP and employing 60% of population. Therefore, it is an important sector for ICT interventions. Several initiatives have been deployed to enhance the economic and social well being of those involved in the agricultural sector.

ESoko, derived from the Swahili word "Soko" meaning market and 'e' representing electronic, is a mobile text and web-based service providing market price information for farmers. The platform has been introduced in several African countries including Rwanda. It allows farmers to make better production and selling decisions by reducing information asymmetry. Launched in Rwanda in 2011,<sup>78</sup> it presently covers 50 markets across the country providing pricing info on almost 80 commodities.<sup>79</sup>

Another initiative is Buy from Women, introduced by the UN in 2016. The platform is targeted at

75 - Ministry of Health. n.d. "The Use of RapidSMS in Nutrition." [http://www.moh.gov.rw/fileadmin/templates/Summit3/22\\_The\\_Use\\_of\\_RapidSMS.pdf](http://www.moh.gov.rw/fileadmin/templates/Summit3/22_The_Use_of_RapidSMS.pdf).

76 - [http://www.myclt.gov.rw/fileadmin/Documents/ICT\\_Sector\\_Profile\\_2015/ICT\\_Sector\\_Profile\\_2015.pdf](http://www.myclt.gov.rw/fileadmin/Documents/ICT_Sector_Profile_2015/ICT_Sector_Profile_2015.pdf)

77 - Simmons, Dan. 2016. "Rwanda begins Zipline commercial drone deliveries." BBC News, October 14. <http://www.bbc.com/news/technology-37646474>.

78 - World Bank. 2011. "Rwandan Farmers get Food Price Updates by Mobile Phone." <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSD-NET/0,contentMDK:22897284~menuPK:64885113~pagePK:7278667~piPK:64911824~theSitePK:5929282,00.html>.

79 - See "ESoko" at: <http://www.rdb.rw/departments/information-communication-technology/infrastructure.html>

women farmers, providing weather, pricing and other information to their mobile phones. Some 700 women from two cooperatives have already registered with plans to extend the system to ten more cooperatives. The system also allows farmers to calculate production capacity based on their land size, matching it to cooperative requirements.<sup>80</sup>

## 5.2.5 Education

Providing broadband and computers to schools is essential for preparing Rwanda's youth for a knowledge society. There are some 2,753 primary and 1,543 secondary schools (note there is some overlap as some schools are used for both levels) serving 2.5 million primary and 543 thousand secondary students (MoE, 2016).

Current levels of computerization are low: around 150,000 computers in primary schools for a computer ratio of 16:1 and just over 19,000 in secondary schools for a ratio of 28:1. One reason for the lower ratio in secondary schools is that a One Laptop per Child (OLPC) program<sup>81</sup> was launched for primary students whereas the focus for secondary schools has been on deploying computer labs. Around 250,000 laptops were deployed to 764 schools reaching around 10% of primary school students. Only around 5% of secondary schools have computer labs. One challenge is that less than half of public schools have electricity and hence Internet access is limited to 6% of primary and 18% of secondary schools.

The new education sector ICT policy has a shift in focus from OLPC to "Smart Classrooms" for all schools by 2019 (MoE, 2016b). It is felt this will lower costs and increase access for more students. There will also be more emphasis on better integrating ICT into the learning process and monitoring impacts. Teachers will be required to take training courses

and provided the option of purchasing a subsidized computer with repayment over two to three years. The total budget for the four-year plan is Rwf 36 (US\$ 50 million) billion.

## 5.2.6 Financial Access

Financial inclusion is being expanded through the launch of mobile money platforms. All of the mobile operators offer systems whereby subscribers can transfer money to others and pay bills. According to a 2016 financial access report, 38% of respondents had a mobile money account.<sup>82</sup> Of those using mobile money, most are using it for receiving or sending remittances with bill payment and airtime payments also used. One challenge is awareness with only around half the population familiar with mobile money. Another challenge is that some people think it only works on smartphones.

Several initiatives exist utilizing mobile money for targeted beneficiaries. For example, farmers at tea plantations get their salaries deposited in a mobile money account or receive a text message advising them they can retrieve their salaries in cash at a local mobile money agent. The tea farmers no longer need to travel to local cooperatives and wait in line to receive payment. According to one farmer, before they would often wait overnight before receiving payment due to the long lines. Mobile operator Tigo assisted some 7,000 farmers who cannot afford a cellphones buy making a bulk purchase to make them more affordable. At the launch ceremony, the Minister of Youth and ICT noted:

"Currently, about 80% of Rwandans live in rural areas; so while we can talk of 'Smart Cities', we also cannot forget to talk about 'Smart Villages' as well."<sup>83</sup>

80 - United Nations Rwanda. 2016. "UN Women Launches 'Buy From Women' to Empower Smallholder Farmers" News, November 1. <http://www.rw.one.un.org/press-center/news/un-women-launches-%E2%80%9Cbuy-women%E2%80%9D-empower-smallholder-farmers>.

81 - Wadhams, Nick. 2010. "Can One Laptop per Child Transform Rwanda's Economy?" Time, June 18. <http://content.time.com/time/world/article/0,8599,1997940,00.html>.

82 - Access to Finance Rwanda (AFR). 2016. Financial Inclusion in Rwanda 2016.

83 - See: "Tigo Rwanda launches the 'Tigo Payment Solution for Agriculture' to improve farmers' lives." at: <http://www.tigo.co.rw/content/tigo-rwanda-launches-%E2%80%9Dtigo-payment-solution-agriculture%E2%80%99-improve-farmers%E2%80%99-lives>.

## 6. Conclusions

Rwanda has made impressive strides in ICT connectivity since the devastating genocide a little over two decades ago. It emerged from the conflict with a strong conviction that ICTs were indispensable for development and lifting the country to middle income status. Driven by strong political commitment, Rwanda laid the groundwork for broadband connectivity early on by allowing private sector investment (1998), introducing enabling laws for the ICT sector and creating a regulator (2001), privatizing its incumbent telecommunications operator (2006) and introducing wireless competition (2006). These steps have encouraged by significant private sector investment (over US\$ 600 million since 2009) as well as government support to ensure that networks reached all parts of the country and not just those where it was commercially lucrative (92% mobile broadband coverage by June 2016 and 95% 4G mobile broadband by the end of 2017). Equally important was a transparent public administration fully committed to ICT promotion (ranked 2nd in world in 2016). Being landlocked has not presented a major barrier to international connectivity due to enlightened open access policies and initial donor support for making bulk capacity purchases to lower costs.

Investment has flowed from a competitive private sector driven market with operators backed by large multinational groups. Strong government commitments to ICT and clear regulations have created a conducive investment environment. In addition, investment has been made more efficient through infrastructure sharing, open access, a wholesale model for 4G and sufficient spectrum allocation.

As a result, the country has one of the most widespread and high quality broadband networks in Africa. There is abundant international connectivity with high-speed connections to submarine cables off the coasts of Kenya and Tanzania, a nationwide fiber optic backbone and the third highest level of mobile broadband coverage in Sub-Saharan Africa (and third among LDCs).<sup>84</sup> Rwanda is hoping to leverage these achievements to emerge as a hub for Sub-Saharan Africa (Box 6-1).

### Box 6-1

#### From Smart Rwanda to Smart Africa

One of the goals of the government is to leverage Rwanda's location and official languages combined with its promotion of ICT to become an African ICT hub. As the government puts it: "Given Rwanda's leadership in the area of ICTs, we hope to share the lessons learnt from implementation of the SMART Rwanda Program with our African brothers in particular as well as the ICT world in general."<sup>85</sup> It is already headquarters to the East African Communications Organization (EACO) a regional organization consisting of stakeholders in the communication sector from Burundi, Kenya, Rwanda, Tanzania and Uganda.<sup>86</sup>

One key development in the aspiration to becoming a hub was the SMART Africa Manifesto signed in Kigali at the end of the Transform Africa Summit in October 2013.<sup>87</sup> It was later endorsed by all Heads of State and Government of the African Union at the 22nd Ordinary Session of the Assembly of the African Union in Addis Ababa in January 2014. The Manifesto has five key principles: 1) having ICT play a key role in national development strategies; 2) improving access to ICTs and in particular broadband; 3) enhancing transparency and efficiency through ICTs; 4) stimulating the private sector and 5) leveraging ICT for sustainable development. This led to the establishment of the Smart Africa Alliance secretariat in Kigali and in October 2015 Hamadoun Toure, former Secretary General of the ITU, was appointed as the Executive Director.

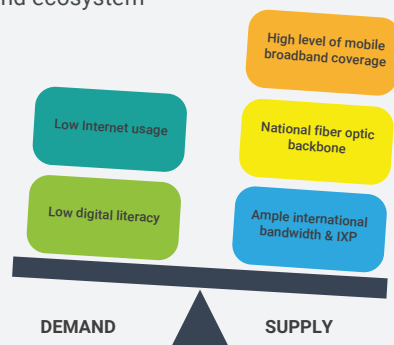
84 - After South Africa and Lesotho in Sub-Saharan Africa and Timor-Leste and Lesotho among LDCs. See: "Indicator : 9.c.1 - Proportion of population covered by a mobile network, by technology" on the SDG Indicators Global Database at: <http://unstats.un.org/sdgs/indicators/database/?indicator=9.c.1>

85 - <http://www.myclt.gov.rw/ict/smart-rwanda/smart-rwanda-concept/>

86 - <http://www.eaco.int/index.php>

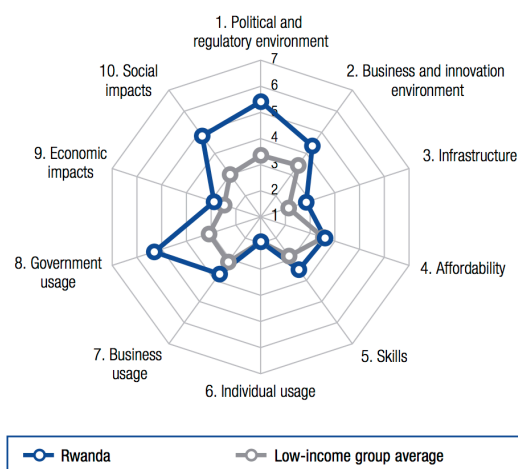
87 - See "The Smart Africa Manifesto" at: <https://www.smartafrica.org/?Manifeste-SMART-Africa-2013-French-Version>

**FIGURE 6.1** Unbalanced demand and supply in Rwanda's broadband ecosystem



Despite these accomplishments, demand has not kept up with supply. While the government has complemented connectivity with electronic public services and there is growing domestic content, the country is facing constraints due to its development level. Specifically it is difficult to quickly raise educational levels to match the rapid provision of ICT networks, applications and services. As a result, while the infrastructure is there, the gap in usage challenges the “build and they will come” theory. These demand side constraints are partly a cause of Rwanda’s relatively low international ICT development rankings (Box 6-2).

**FIGURE 6.2** Rwanda’s scores in 2016 Network Readiness Index



Source: World Economic Forum.

Despite the advantages of always-on broadband, a number of successful examples of impact in Rwanda are based on narrowband technology. One reason is these work on lower speed 2G technology which covers the entire country. Second, they function on basic handsets, which are far cheaper and thus more prevalent than smartphones. Third, applications such as mobile money and SMS are simple and quick to master. As a result, social and economic impacts from narrowband mobile telephony have thus far been more noticeable than those from

## Box 6-2

### Rwanda in international indexes

Rwanda’s impressive broadband infrastructure achievements—a nationwide fiber optic backbone, high level of international connectivity and widespread high speed mobile coverage—are not reflected in international indexes that measure ICT progress. For example the ITU’s ICT Development Index (IDI) ranks Rwanda 150th in the world in 2016 (out of 175 economies), ahead of all of its neighbors, but still only a four position improvement since 2010.<sup>88</sup> Although its IDI score rose 45% between 2010 and 2016, from 1.47 to 2.13, it rank has stagnated because other countries have also increased their score. One reason is that the IDI includes a skills subcomponent featuring indicators such as literacy where Rwanda ranks low and which thereby reduces its infrastructure achievements. Second, the selection of some indicators such as fixed telephone and fixed broadband subscriptions are not relevant for Rwanda while others such as mobile broadband coverage are not included. The situation of LDCs such as Rwanda where ICT is led by wireless technology is not well reflected in the IDI.

The World Economic Forum’s (WEF) Network Readiness Index (NRI)<sup>89</sup> presents a more comprehensive view of digital progress by factoring in the legal and regulatory environment and impacts. WEF reckons that Rwanda ranks 80th in the world (out of 139 economies) in 2016 and fourth in Africa.<sup>90</sup> Still it has only progressed two positions since 2012. Nonetheless, Rwanda ranks above the low-income group average in almost every WEF metric and is considered to be doing particularly well in the political and regulatory environment, government usage and social impacts.

88 - ITU. 2016. Measuring the Information Society 2016.

89 - WEF. 2016. The Global Information Technology Report 2016.

90 - See “Infographics and shareables” at: <http://reports.weforum.org/global-information-technology-report-2016/infographics-and-shareables/>

broadband technology.

The government’s rapid push to transform the country into a knowledge based middle-income economy by 2020 is running into the harsh realities of being an LDC. While broadband infrastructure is relatively widespread given Rwanda’s level of income, usage has not caught up. In order for broadband to have a bigger impact, there needs to be significant investment in people. This includes the rollout of massive digital literacy programs for adults, larger

deployment and integration of broadband in schools, broadband awareness for SMEs and high-level skills development opportunities for those working in the ICT sector. The Government of Rwanda realizes this and has initiatives for all of these activities in the pipeline. This includes the new ICT in Education policy, which will establish ICT classrooms across primary and secondary schools and enhance the

integration of ICT training for teachers and students. The "Internet for All" initiative will provide digital literacy to some five Rwandans by 2020. Once these start to bear fruit, Rwanda should realize its vision of ICTs having a strong impact on sustainable development.

## Institutions Consulted

Name
Airtel
International Monetary Fund (IMF)
Liquid Telecom
Ministry of Youth and ICT (MYICT)
Nokia Networks
Rwanda Development Board (RDB)
Rwanda Utilities Regulatory Authority (RURA)
Rwanda Communication & Information Technology Association (RICTA)
Rwanda ICT Chamber
Smart Africa

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Broadband in an African LDC with Access to the Sea:

# The case of Senegal //

The 2014 *Emerging Senegal Plan* (ESP) envisions Information and Communication Technology (ICT) as a fundamental crosscutting enabler to transform the economy and achieve the status of an emerging economy by 2035. The ESP calls for spreading broadband and Internet access across the territory and leveraging Senegal's infrastructure and human capacity to become an ICT hub for West Africa.

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## Acronyms

<b>AIDE</b>	Agence de l'Informatique de l'Etat (State Informatics Agency)	<b>GB</b>	Gigabyte (data volume measurement)
<b>ANSD</b>	Agence Nationale de la Statistique et de la Démographie (National Statistical and Demographic Agency)	<b>Gb/s</b>	Gigabits per second (data speed measurement)
<b>ARTP</b>	Autorité de Régulation des Télécommunications et des Postes du Sénégal (Telecommunications and Post Regulatory Authority of Senegal)	<b>EAC</b>	East Africa Community
<b>ECOWAS</b>	Economic Community of West African States	<b>ICT</b>	Information and Communication Technology
<b>FCFA</b>	Franc Communauté Financière Africaine. Refers to the currency of Central Bank of West African States used in Senegal	<b>ITU</b>	International Telecommunication Union
		<b>MB</b>	Megabyte (data volume measurement)
		<b>Mb/s</b>	Megabits per second (data speed measurement)
		<b>MPT</b>	Ministry of Posts and Telecommunications
		<b>PPP</b>	Public Private Partnership
		<b>US\$</b>	United States dollar. Figures converted to US\$ using annual average exchange rates.



# Executive Summary

The 2014 *Emerging Senegal Plan* (ESP) envisions Information and Communication Technology (ICT) as a fundamental crosscutting enabler to transform the economy and achieve the status of an emerging economy by 2035. The ESP calls for spreading broadband and Internet access across the territory and leveraging Senegal's infrastructure and human capacity to become an ICT hub for West Africa.

Senegal began the process of ICT sector reform early on by partly privatizing its incumbent telecommunication operator SONATEL in 1997. The government licensed a second mobile operator in 1998, created a sector regulator in 2001 and issued a third operator license in 2007. Though most of these steps took place in the "narrowband" era, they laid the foundation for deployment of broadband technologies:

- Senegal is connected to three undersea fiber optic networks. Each new cable connection has added a dramatic increase in international bandwidth.
- There is some 9,000 kilometers of fiber optic cable deployed across the country.
- The country has launched 3G and the latest 4G mobile broadband networks and fiber optic connections up to 100 Mbps are available.

The increase in broadband infrastructure has boosted Internet use. Penetration grew over 80% between 2009 and 2015 from 15% to 27% of the population. Senegal ranked fourth among nine sub-Saharan African countries and first among African Least Developed Countries according to a 2015 Internet usage survey.

Falling Internet prices has stimulated Internet demand. The price of Internet access has dropped 60% since 2011. Nevertheless, monthly plans remain high in terms of average incomes in the country. There are a variety of different plans that make Internet more affordable though constraining use. This includes hourly, daily and weekly data bundles.

Telecommunications services account for a relatively high share of the Senegalese economy. The value added of the telecommunications and postal sector was FCFA 602 billion (US\$ 1.0 billion) in 2015 or 10.1% of GDP. The contribution of telecommunications and posts to GDP in Senegal is high compared to other West African nations, ranking second after the Gambia. However, broadband penetration is relatively low and has yet to have a statistically significant indirect impact on the economy. On the other hand, basic mobile communications has had a significant contribution with each percentage point increase in mobile penetration contributing 0.05% to GDP. These findings are supported by evidence from different sectors where broadband applications have yet to become ingrained and many services are narrowband:

- A 2014 World Bank enterprise survey of 601 Senegalese enterprises found that 35% had their own website compared to an average of 33% for sub-Saharan Africa. There is a large gap between large and small Senegalese enterprises in ICT adoption. While 83% of large firms had a web site, the corresponding figure for small ones is only 16%. Another measure of firm ICT adoption is the number of secure Internet servers. Secure servers reflect the level of transactional capability in areas such as finance, government services and e-commerce. With five secure Internet servers per 1 million people, Senegal has half the rate of the Sub-Saharan Africa average.
- The Senegalese government has been progressively automating its operations and a broadband backbone connects government buildings. While internal government connectivity and automation of back office processes are proceeding, deployment of online public services is limited. Thus far, only two procedures are interactive.
- In health, medical records are being computerized. One of the flagship applications

in the health sector is m-Diabetes that uses a SMS platform to send text messages to diabetics with diet reminders. There is a telemedicine project connecting several hospitals. It uses videoconferencing to support consultations with experts and provide distance education for health professionals. In 2013, the Ministry of Health installed a cloud-based system at hospitals in Dakar, Thies and Diourbel. Patient records are routed through the cloud to those needing access.

- In agriculture, text-based messaging systems informing farmers about market prices have been in place for some time. Manobi pioneered this and its Xam Marsé service has been used by thousands of farmers to raise their incomes. Manobi also launched a GPS-based service for protection of fishermen at sea. Manobi has started to exploit the features provided by broadband networks and smartphones in areas such as water management.
- In education, all universities are interconnected and provide free Internet access to students. There is growing access to international content and university bandwidth has grown. The connectivity situation is not as evolved for primary and secondary schools. There are no official data on the number of schools connected to the Internet but the figure is believed to be low. The Digital Resources for All ("Ressources numériques pour tous", (RNPT)) initiative is providing tablet computers to the country's 308 secondary schools ("Lycées"). The Sankoré project has installed some 700 digital blackboards for accessing educational content in primary schools. Smartphones are being piloted for the registration of births, particularly relevant since a birth certificate is needed for school enrolment.
- Financial inclusion is being expanded through mobile money platforms allowing users to transfer funds and pay for goods and services using their cellphone. Services are being expanded such as the ability to receive remittances from overseas and apply for micro insurance.

The 2016 *Digital Senegal Strategy* calls for making broadband a priority with the vision of "...digital for all..." by 2025. It recognizes the need for leveraging the country's infrastructure to apply broadband across different areas such as connecting schools, putting government services online and wider use of electronic commerce. However, the following areas will need attention for the strategy to achieve its goals:

- Senegal faces challenges in developing a robust, competitive and innovative ICT ecosystem. The influence of the incumbent operator is inevitable given its financial might. SONATEL also has multiple stakeholders (i.e., Orange France, public shareholders, employees and the government itself) that all have a stake in ensuring the company maximizes profits. This comes at the expense of greater competition in the sector. For example, the existing operators cannot afford to pay the same amount SONATEL paid for 4G frequencies and be profitable. Further SONATEL's control over key international and national backbone infrastructure places it in an enviable position.
- High license fees as well as other taxes raise the costs of communications in Senegal and reduce funding for investment. This must be put in the context of the government decision to use the telecom sector as a significant source of its revenues for activities it carries out across the entire economy. The drawbacks are that this diverts money from potential investment into the network. Given these constraints, Senegal needs to do all it can to maximize existing infrastructure, minimize duplication and stimulate greater competition by enhancing incentives for infrastructure sharing, ensuring cost-based access to key facilities and supporting an Internet Exchange Point.
- Steps are needed to boost digital literacy and enterprise use of ICTs. Senegal is approaching the limit in regards to the addressable Internet market. In order to expand this, steps must be taken to provide digital literacy for those out of school on a large scale. The low level of ICT adoption by SMEs needs to be addressed

through awareness raising and incentives such as attractive device and connectivity packages targeting small firms.

- Senegal needs to make greater use of its high-speed infrastructure to put in place true broadband applications and services across important sectors. Notable applications such as m-diabetes for health, market pricing information for farmers and mobile money are narrowband and text-message based. While they have had impacts, evolving to the features offered by broadband networks and smartphones could take these types of

services to a new level. Broadband applications for schools and interactive electronic public services are two particular areas that merit more emphasis.

The government aims to tackle these challenges through an ambitious array of initiatives in its *Digital Senegal Strategy*. It is imperative that it adheres to the stated level of funding for the strategy backed by a monitoring and evaluation system to ensure that Senegal benefits from the potential of broadband applications and services to help it achieve its national development goal of becoming an emerging nation.

## Large Bande dans un PMA africain avec accès à la mer: Le cas du Sénégal

### Résumé

Le Plan Sénégal Emergent de 2014 (PSE) envisage les technologies de l'information et de la communication (TIC) comme un facteur fondamental pour transformer l'économie et atteindre le statut d'une économie émergente d'ici 2035. Le PSE appelle à étendre l'accès à large bande et à Internet sur l'ensemble du territoire et à exploiter l'infrastructure et la capacité humaine du Sénégal pour devenir un centre TIC pour l'Afrique de l'Ouest.

Très tôt, dès 1997, le Sénégal a commencé le processus de réformes du secteur des TIC en privatisant partiellement son opérateur historique de télécommunications SONATEL. Le gouvernement a autorisé un deuxième opérateur mobile en 1998, il crée également un régulateur sectoriel en 2001 et délivre un troisième permis d'exploitation en 2007. Bien que la plupart de ces démarches ait eu lieu dans l'ère de la «bande étroite», elles ont jeté les bases du déploiement des technologies à large bande:

- Le Sénégal est relié à trois réseaux de fibres optiques sous-marins. Chaque nouvelle connexion par câble a ajouté une augmentation spectaculaire de la bande passante internationale.

- Il existe environ 9 000 kilomètres de câble à fibre optique déployés à travers le pays.

- Le pays a lancé la 3G et les derniers réseaux à large bande mobile 4G, les connexions de fibres optiques sont disponibles jusqu'à 100 Mbps.

L'augmentation de l'infrastructure à large bande a stimulé l'utilisation d'Internet. La pénétration a augmenté de 80 pour cent entre 2009 et 2015 et l'utilisation est passée de 15 pour cent à 27 pour cent de la population. Selon un sondage réalisé en 2015 sur l'utilisation d'Internet, le Sénégal est arrivé quatrième parmi neuf pays d'Afrique subsaharienne et premier parmi les pays les moins avancés d'Afrique.

La baisse des prix de l'Internet a stimulé la demande pour Internet. Le prix de l'accès à Internet a chuté de 60 pour cent depuis 2011. Néanmoins, les forfaits mensuels restent élevés par rapport aux revenus moyens dans le pays. Il existe une variété de forfaits qui rendent l'utilisation Internet plus abordable mais qui restent contraignants. Cela comprend des offres limitées de données horaires, quotidiennes et hebdomadaires.

Les services de télécommunications représentent une part relativement élevée de l'économie sénégalaise. En 2015, la valeur ajoutée du secteur des télécommunications et du secteur postal s'est élevée à 602 milliards de FCFA (1,0 milliard de dollars EU), soit 10,1 pour cent du PIB. Par rapport à d'autres pays d'Afrique de l'Ouest, la contribution des télécommunications et des services postaux au PIB du Sénégal est élevée, le pays arrive deuxième après la Gambie. Cependant, la pénétration de la large bande est relativement faible et n'a pas encore d'impact indirect statistiquement significatif sur l'économie. D'autre part, les communications mobiles de base ont eu une contribution significative sur chaque augmentation en pourcentage de la pénétration mobile contribuant à 0,05 pour cent au PIB. Ces résultats sont étayés par des éléments provenant de différents secteurs où les applications à large bande sont encore loin d'être enracinées et de nombreux services sont à bande étroite.

- En 2014, un sondage de la Banque mondiale auprès de 601 entreprises sénégalaises a révélé que 35 pour cent avaient leurs propres sites Web comparé à une moyenne de 33 pour cent pour l'Afrique subsaharienne. Il existe un grand écart entre les grandes et les petites entreprises sénégalaises dans l'adoption des TIC. Bien que 83 pour cent des grandes entreprises aient un site Web, le chiffre correspondant pour les petites entreprises est de seulement 16 pour cent. Une autre mesure de l'adoption des TIC par les entreprises est le nombre de serveurs Internet sécurisés. Les serveurs sécurisés reflètent le niveau de capacité transactionnelle dans des domaines tels que les finances, les services gouvernementaux et le commerce électronique. Avec cinq serveurs Internet sécurisés pour 1 million de personnes, le Sénégal a la moitié du taux moyen en Afrique subsaharienne.
- Le gouvernement sénégalais a progressivement automatisé ses opérations et un réseau à large bande relie les bâtiments du gouvernement. Bien que la connectivité interne du gouvernement et l'automatisation des processus de l'appui administratif se poursuivent, le déploiement des services publics en ligne est limité. Jusqu'à présent, seules deux procédures sont interactives.
- Dans le domaine de la santé, les dossiers médicaux sont informatisés. L'une des applications phares du secteur de la santé est m-Diabetes qui utilise une plate-forme SMS pour envoyer des messages-textes

aux diabétiques avec des rappels de régime. Il existe un projet de télémédecine reliant plusieurs hôpitaux. Il utilise la vidéoconférence pour soutenir les consultations avec des experts et fournir une éducation à distance pour les professionnels de la santé. En 2013, le ministère de la Santé a installé un système basé sur le cloud dans les hôpitaux de Dakar, Thies et Diourbel. Les dossiers des patients sont acheminés via le cloud vers ceux qui ont besoin d'y accéder.

- Dans le domaine de l'agriculture, des systèmes de SMS informent les agriculteurs sur les prix du marché qui sont en place depuis un certain temps. Manobi a été le pionnier de ce projet et son service Xam Marsé a été utilisé par des milliers d'agriculteurs pour augmenter leurs revenus. Manobi a également lancé un service GPS pour la protection des pêcheurs en mer. Manobi a commencé à exploiter les fonctionnalités fournies par les réseaux à large bande et les téléphones intelligents dans des domaines tels que la gestion de l'eau.
- Dans le domaine de l'éducation, toutes les universités sont interconnectées et offrent un accès Internet gratuit aux étudiants. Il y a un accès croissant au contenu international et la bande passante universitaire a augmenté. La connectivité n'est pas aussi évoluée pour les écoles primaires et secondaires. Il n'y a pas de données officielles sur le nombre d'écoles connectées à Internet, mais on estime que le nombre est faible. L'initiative « Ressources numériques pour tous » (RNPT) fournit des ordinateurs tablettes aux 308 écoles secondaires (« Lycées ») du pays. Le projet Sankoré a installé environ 700 tableaux numériques pour accéder au contenu éducatif dans les écoles primaires. Les téléphones intelligents sont particulièrement mis à l'essai pour l'enregistrement des naissances, dus à la nécessité de posséder un certificat de naissance pour une inscription scolaires.
- L'inclusion financière se développe grâce à des plates-formes monétaires mobiles permettant aux utilisateurs de transférer des fonds et de payer des biens et des services en utilisant leur téléphone portable. Les services sont en expansion avec la possibilité de recevoir des envois de fonds de l'étranger et de demander une micro-assurance.

La Stratégie Sénégal Numérique de 2016 appelle à faire de la large bande une priorité avec la vision du "... numérique pour tous ..." d'ici 2025. Elle reconnaît la nécessité de tirer parti de l'infrastructure du pays pour appliquer la large bande dans différents domaines tels que relier les écoles, mettre à disposition des services gouvernementaux en ligne et l'utilisation plus large du commerce électronique. Cependant, afin d'atteindre les objectifs de la Stratégie les domaines suivants auront besoin d'attention:

- Le Sénégal est confronté à des défis dans le développement d'un écosystème TIC robuste, compétitif et innovant. L'influence de l'opérateur historique est inévitable compte tenu de sa capacité financière. SONATEL a également plusieurs parties prenantes (c'est-à-dire Orange France, les actionnaires publics, les employés et le gouvernement lui-même) qui ont tous un intérêt à s'assurer que l'entreprise maximise les bénéfices. Cela se fait au détriment d'une concurrence accrue dans le secteur. Par exemple, les opérateurs existants ne peuvent pas faire de bénéfices tout en payant le même montant que SONATEL a payé pour les fréquences 4G. D'autre part, le contrôle de SONATEL sur l'infrastructure clé principale internationale et nationale le place dans une position enviable.
- Les droits de licence élevés ainsi que des taxes divers augmentent les coûts des communications au Sénégal et réduisent le financement des investissements. Cela doit être mis dans le contexte de la décision du gouvernement d'utiliser le secteur des télécommunications comme une source importante de ses revenus pour les activités qu'il réalise dans l'ensemble de l'économie. Cela a pour inconvénient de rediriger ailleurs les ressources qui auraient servi aux investissements dans le réseau. Compte tenu de ces contraintes, le Sénégal doit faire tout son possible pour maximiser les infrastructures existantes, minimiser les doubles emplois et stimuler une concurrence accrue en améliorant les incitations au partage des infrastructures, en assurant un accès basé sur les coûts aux installations clés et en soutenant un point d'échange Internet.
- Des étapes sont nécessaires pour stimuler l'alphabétisation numérique et l'utilisation des TIC par les entreprises. Le Sénégal approche la limite en ce qui concerne le marché de l'internet adressable. Afin d'élargir cela, des mesures doivent être prises à

grande échelle pour fournir une éducation numérique pour les personnes non scolarisées. Le faible niveau d'adoption des TIC par les PME doit être abordé grâce à la sensibilisation et aux incitations telles que des dispositifs attractifs et des programmes de connectivité destinés aux petites entreprises.

- Le Sénégal doit utiliser davantage son infrastructure à grande vitesse pour mettre en place dans des secteurs importants de véritables applications et services à large bande. Les applications notables telles que le m-diabète pour la santé, les informations sur les prix du marché pour les agriculteurs et l'argent mobile sont basiques et basées sur le SMS. Bien qu'ils aient eu des impacts, l'évolution des fonctionnalités offertes par les réseaux à large bande et les téléphones intelligents pourrait faire évoluer ces types de services à un niveau supérieur. Les applications à large bande pour les écoles et les services publics électroniques interactifs sont deux domaines particuliers qui méritent le plus d'attention.

Le gouvernement vise à relever ces défis grâce à une série d'initiatives ambitieuses dans sa Stratégie Sénégal Numérique. Il est impératif d'atteindre le niveau de financement indiqué pour la stratégie, soutenue par un système de suivi et d'évaluation afin de s'assurer que le Sénégal bénéficie du potentiel des applications et des services à large bande pour l'aider à atteindre son objectif de développement national, à savoir devenir un pays émergent.

# Introduction

**The 2014 *Emerging Senegal Plan* (ESP) envisions Information and Communication Technology (ICT) as a fundamental crosscutting enabler to transform the economy and achieve the status of an emerging economy by 2035. The ESP calls for spreading broadband and Internet access across the territory and leveraging Senegal's infrastructure and human capacity to become an African reference point for the digital economy.**

This report examines Senegal's progress towards a digital economy, specifically the role of broadband Internet infrastructure. **Chapter 1** provides an overview of the geographic, demographic, social and economic forces in the country and how they relate to broadband. **The second chapter** outlines key government institutions involved with broadband and more widely, ICT and describes relevant strategies. **The third chapter** looks at the supply of broadband infrastructure from international connectivity to

the national backbone to local access. Factors that influence usage of broadband networks such as affordability, awareness and attractiveness are examined in **the chapter four**. **The fifth chapter** identifies the direct and indirect economic impacts of broadband while **chapter six** looks at usage across different sectors of the economy. **The last chapter** concludes by highlighting Senegal's broadband achievements as well as challenges.

## 1. Country Context

The Republic of Senegal is located on the west coast of Africa, ideally suited for connectivity to undersea fiber optic cables, a key building block for broadband networks. A member of the Economic

Community of West African States (ECOWAS), Senegal is bordered by Mauritania to the north, Mali to the east, Guinea to the southeast, Guinea-Bissau to the south and surrounds the Gambia (Figure 1.1).

- **Senegal's population distribution poses a challenge for deploying infrastructure in large, less inhabited eastern regions of the country.**

It has a land area of 196,722 square kilometers and its population was estimated at 13.5 million at the 2013 census. Population density is 65 persons per square kilometer and unevenly distributed across the country's 14 regions. For example, the region of

Tambacounda accounts for over a fifth of Senegal's land area but just five percent of the population. Some 55% of the population lived in rural areas according the 2013 census.

- **Demographic and social characteristics pose a demand challenge for broadband applications and services.**

The 2013 census found less than half the population aged 10 and over to be literate (45.4%), largely due to the oral nature of Senegal's languages. Although French is the official language, there are six principal

languages and Arabic is spoken by part of the population. Yet only 13% of the population is literate in French or Arabic.

- **The structure of Senegal's economy contributes to high use of ICTs.**

With a per capita Gross Domestic Product (GDP) of US\$ 900 in 2015, Senegal is classified as a low-income economy and falls into the category of Least Developed Country (LDC). Despite over

half the population living in rural areas, agriculture accounted for just 15% of economic value-added in 2014, one of the lowest proportions in Sub Saharan Africa.<sup>91</sup> The service sector, a big user of

FIGURE 1.1. Map of Senegal



Source: <http://www.un.org/Depts/Cartographic/map/profile/senegal.pdf>

ICT, contributed 60 percent of value added in 2014.<sup>92</sup> In 2005, it was estimated there were almost half a million Senegalese residing abroad,<sup>93</sup> some four percent of the population and 70% of households had at a member living abroad. As a result, remittances

are significant at US\$ 1.6 billion in 2015 or 12% of GDP.<sup>94</sup> This relatively large overseas population is a substantial user of ICTs for connecting with relatives and friends.

- ICT is seen as a critical enabler of economic growth by the government.

The 2014 *Emerging Senegal Plan* ("Plan Sénégal Emergent") aims to trigger economic growth of some seven percent a year to boost the country to an emerging nation by 2035.<sup>95</sup> ICT is seen as a critical enabler of this growth through its crosscutting impact on different sectors of the economy as well as an important industry in its own right.

91 - [http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?year\\_high\\_desc=true](http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?year_high_desc=true)

92 - <http://data.worldbank.org/indicator/NV.SRV.TETC.ZS>

93 - See the Focus Migration web site at: <http://focus-migration.hwwi.de/Senegal.2636.0.html?L=1>

94 - <http://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS>

95 - "IMF Survey: IMF Extends Support for Senegal's Plan to Be Emerging Economy," 25 June 2015. <http://www.imf.org/external/pubs/ft/survey/so/2015/CAR062415A.htm>

## 2. Strategy, Policy and Regulatory Environment

This chapter provides an overview of relevant broadband policies, strategies, plans and regulations and key government institutions responsible for different aspects of the broadband ecosystem.

### 2.1 ICT History

Senegal began the process of ICT sector reform by partly privatizing its incumbent telecommunication operator SONATEL<sup>96</sup> in 1997. The government licensed a second mobile operator in 1998, created a



sector regulator in 2001 and issued a third operator license in 2007 (Figure 2.2).

SONATEL is a major force in the domestic ICT sector, dominating the fixed and mobile broadband markets, and is a significant player in the region. Following SONATEL's partial sale to France Telecom (now Orange) in 1997, some of its shares were listed on the regional stock exchange Bourse Régionale des Valeurs Mobilières (BRVM) and some were offered to employees. Today, SONATEL's ownership is divided among the Orange France group (42%), the government of Senegal (27%), publicly held (25%) and employees (8%) (Figure 2.2a). SONATEL has also emerged as a significant regional investor establishing operations in Mali in 2002, Guinea and Guinea-Bissau in 2007 and Sierra Leone in 2016 (Figure 2.2b). In 2006, it adopted the Orange brand for its services.<sup>97</sup> The company is Senegal's largest<sup>98</sup> with revenues of FCFA 905 billion (US\$1.5 billion) in 2016 and SONATEL is the largest traded company on the BRVM with a market capitalization of FCFA 2,290 billion (US\$ 3.8 billion) at 30 June 2016, accounting for 30% of the stock exchange's total.<sup>99</sup>

The two other foreign-owned competitors have faced challenges competing in the market. TIGO,<sup>100</sup> a subsidiary of Luxembourg headquartered MILLICOM, has been in the Senegalese market since 1999 mainly providing mobile services. TIGO has

been confronted with ongoing regulatory disputes dating back to the issuance of its license and referred to the International Centre for Settlement of Investment Disputes in 2008.<sup>101</sup> The situation was resolved in 2012 when MILLICOM agreed to pay US\$ 103 million that regularized its license and allowed it to provide a broader range of services.<sup>102</sup> In February 2017, MILLICOM announced the sale of TIGO to the WARI Group, a Senegalese digital financial services group.<sup>103</sup> EXPRESSO<sup>104</sup> entered the Senegalese market in 2007 paying US\$200 million for a full service license. It launched operations in 2009 and is a subsidiary of SUDATEL, the incumbent telecommunication operator in Sudan. EXPRESSO has been under investigation in relation to a United States government blacklist<sup>105</sup> and its Chief Executive Officer was replaced in 2014 reportedly due to the poor performance of the company.<sup>106</sup>

The government has been moving to further liberalize the ICT sector. A universal service provider launched operations in the region of Matam in 2013. In early 2017, three new Internet Service Provider (ISP) licenses were issued. There is also discussion about establishing neutral wholesale international and national backbone operators. Nevertheless, SONATEL remains dominant with a 65% share of the Internet market in December 2016.<sup>107</sup>

96 - <http://www.sonatel.com>

97 - <https://www.orange.sn/2/particuliers/1/3/homepage-1.html>

98 - [http://www.dakaractu.com/Le-Magazine-Reussir-dresse-la-liste-des-100-plus-grandes-entreprises-du-Senegal\\_a38482.html](http://www.dakaractu.com/Le-Magazine-Reussir-dresse-la-liste-des-100-plus-grandes-entreprises-du-Senegal_a38482.html)

99 - BRVM. 2016. "Statistiques trimestrielles No. 71." <http://www.brvm.org/fr/statistiques-trimestrielles>

100 - <https://www.tigo.sn>

101 - <https://icsid.worldbank.org/en/Pages/cases/casedetail.aspx?Case-No=ARB/08/20>

102 - <https://www.telegeography.com/products/commsupdate/articles/2012/08/29/mic-ends-senegal-dispute/>

103 - <https://www.tigo.sn/espace-presse/millicom-a-signe-un-accord-avec-wari-pour-la-cession-de-sa-filiale-au-senegal>

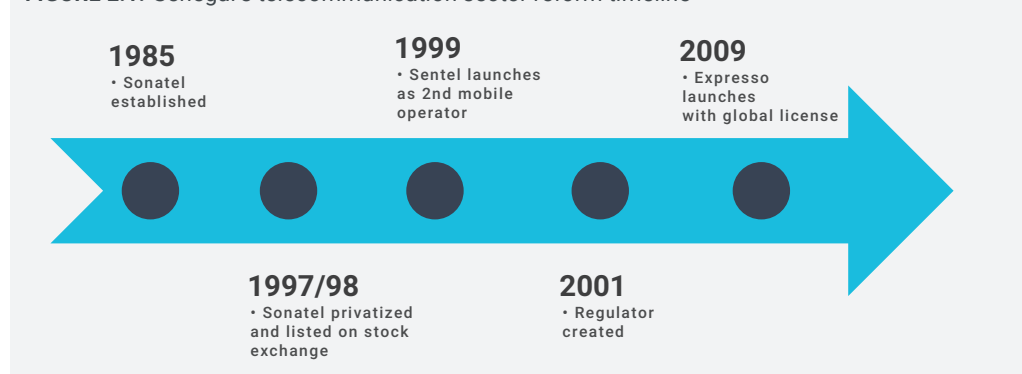
104 - <https://www.expressotelecom.sn>

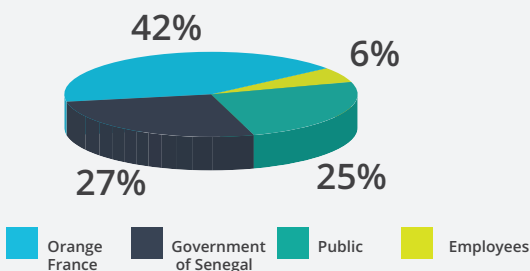
105 - <https://www.telegeography.com/products/commsupdate/articles/2012/12/04/us-investigators-arrive-in-senegal-to-resolve-sudatel-mobile-license-dispute/>

106 - <https://www.telegeography.com/products/commsupdate/articles/2014/11/06/sudatel-axes-ceo-in-wake-of-expressos-poor-performance/>

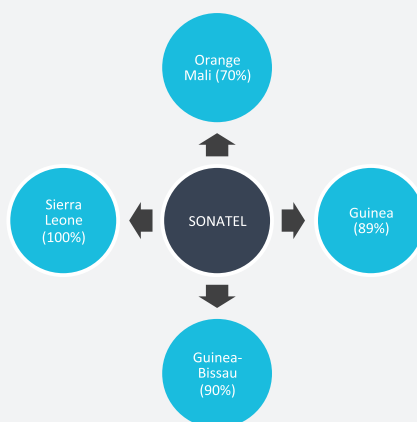
107 - ARTP. 2017. "Observatoire De l'Internet, Tableau de bord au 31 décembre 2016." [http://www.artpsenegal.net/images/documents/TB%20Internet\\_31%20dec\\_16.pdf](http://www.artpsenegal.net/images/documents/TB%20Internet_31%20dec_16.pdf)

**FIGURE 2.1. Senegal's telecommunication sector reform timeline**



**FIGURE 2.2. SONATEL Group****FIGURE 2.2a SONATEL ownership, Dec. 2016**

A & B Source: Adapted from SONATEL.

**FIGURE 2.2b SONATEL Group**

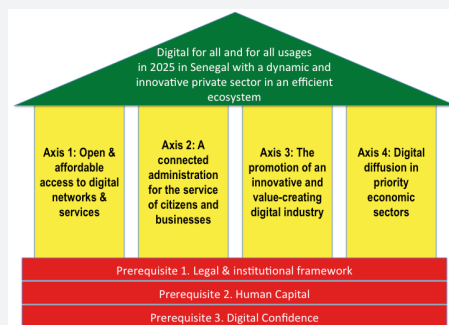
## 2.2 Key Government Institutions

There are three main governmental institutions with different levels of responsibility for ICT in Senegal.

- The *Ministry of Posts and Telecommunications* (MPT) is responsible for ICT policy and strategy in the country.<sup>108</sup>
- The *Autorité de Régulation des Télécommunications et des Postes* (ARTP) was created in 2001 as sector regulator.<sup>109</sup> The 2011 *Code of Telecommunications* lays out its activities.<sup>110</sup>
- The *Agence de l'Informatique de l'Etat* (ADIE), created in 2004, is responsible for e-government in the country.<sup>111</sup>

## 2.3 Key Policy Documents

The key policy document influencing high-speed communications in the country is the 2016 Digital Senegal Strategy (MPT, 2016). It calls for making broadband a priority by supporting public private partnerships for infrastructure sharing and deploying networks in un-served areas. The policy's vision is "...digital for all..." by 2025. It establishes the minimum download speed as 30 Mb/s by 2025 with

**FIGURE 2.3. Digital Senegal Strategy, 2016-2025**

90% of the population covered.

The strategy is an all-encompassing document covering infrastructure, the legal environment, human capacity development and application of ICT across different sectors. It is underpinned by three prerequisites and four axes and features 28 reforms and 69 projects (Figure 2.3). The strategy calls for wider connectivity and application of broadband across different areas such as connecting schools, putting government services

108 - <http://www.mcten.gouv.sn>

109 - <http://www.artpsenegal.net>

110 - [http://www.artpsenegal.net/images/documents/document\\_Loi\\_2011-01\\_du\\_24\\_fevrier\\_2011\\_portant\\_code\\_des\\_Telecommunications\\_109.pdf](http://www.artpsenegal.net/images/documents/document_Loi_2011-01_du_24_fevrier_2011_portant_code_des_Telecommunications_109.pdf)

111 - <https://www.adie.sn>

online and wider use of electronic commerce. The plan is budgeted at FCFA 1,361 (US\$ 2.3) billion of which 17% would be financed by the government with the remainder supported by the private sector and public private partnerships (PPPs).

## 3. Supply Side

The World Bank provides a useful framework for understanding the elements of broadband infrastructure (Kelly, 2016). The first mile refers to international connectivity. The second mile refers to national backbones and associated elements such as data centers and Internet exchanges. The last mile refers to the local access networks that reach the end user. Finally, what is called the hidden mile refers to important regulatory issues such as frequency management, licensing framework, cyber security, and universal service.

### 3.1 First Mile: International Connectivity

Leveraging its favorable geography of being situated on the west coast of Africa, Senegal was one of the first countries in the region to connect to an undersea fiber optic network through the Atlantis-2 cable in 2000. Since then, two other cables along the west coast of Africa have landed in Dakar: SAT-3/WASC in 2002, and Africa Coast to Europe (ACE) in 2012. Each new cable connection has added a dramatic increase in international bandwidth from 36 Mb/s in 2000 to 310 Mb/s in 2003 to 5,200 Mb/s in 2011 and 25,000 Mb/s by mid-year 2016.

Senegal has been a significant transit point for providing international connectivity to neighbors. The national backbone extends to border crossings in Mauritania, Gambia, Mali and Guinea enabling these countries to avail of international bandwidth on submarine cables landing in Senegal. This has been mitigated somewhat due to the arrival of the ACE cable, which provided direct undersea fiber optic access for the first time to Mauritania, Gambia and Guinea.

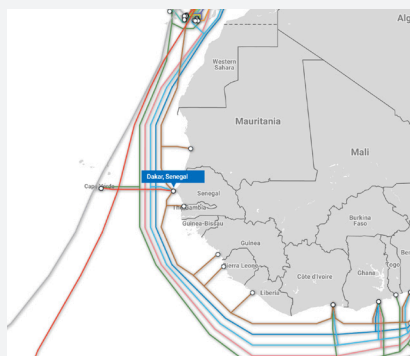
The consortium structure of the cables poses a challenge for open and cost-based access for all operators. All of the cables landing in Senegal are

owned by groups of operators. These operators have the exclusive right to carry traffic over the cable. In the case of Senegal, SONATEL has ownership interests in all three cables while EXPRESSO has an interest in ACE through its parent company SUDATEL. This means that other operators in Senegal must go through either SONATEL or EXPRESSO for access to international fiber optic cables. Consequently, pricing is not transparent and it is not clear that wholesale prices are cost-based.

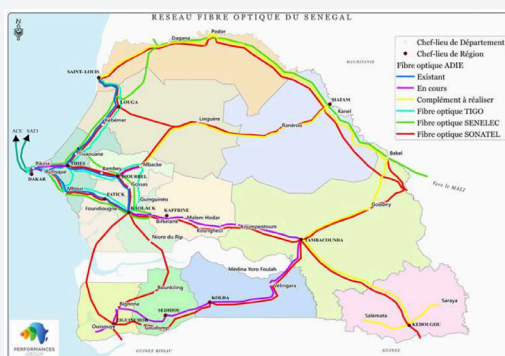
### 3.2 Middle Mile: National Backbone Networks & Other Supporting Infrastructure

There is some 9,000 kilometers of fiber optic cable deployed across the country (Figure 3.2). SONATEL and ADIE have their own nationwide backbones while the other two operators also have some fiber optic infrastructure as does the electrical utility (Société Nationale d' Electricité du Sénégal, SENELEC). SONATEL leases access to its backbone with pricing published in an interconnection catalog approved by ARPT. SONATEL's prices are a function of bandwidth and distance with three speeds on offer (2 Mb/s, 34/45 Mb/s and 155 Mb/s) for three distances (<10 km, >10 and <50 km and >50 km). ADIE does not provide access to its fiber backbone because it does not have a telecommunications operator license. Likewise, SENELEC does not currently offer access to its fiber assets. A regional energy project calls for the involved electrical utilities including SENELEC to rent excess fiber communications capacity to public telecommunication operators.<sup>112</sup>

Internet Exchange Points (IXPs) reduce reliance on costly international links and improve quality. An IXP is a location where operators connect their networks to exchange data traffic among each other. This helps ensure that domestically destined traffic

**FIGURE 3.1** Undersea fiber optic cables

Source: <https://www.submarinecablemap.com/#/landing-point/dakar-senegal>

**FIGURE 3.2** Senegal national fiber optic backbone

Source: MPT, 2016.

stays in the country, reducing the need for costly international transit and enhancing latency since traffic does not need to travel so far. There have been discussions for several years to establish an IXP in Senegal ("SENIX"). However, it has been delayed reportedly due to the resistance of SONATEL.<sup>113</sup> SENIX is however envisioned to begin operating in 2017.

There has been a rise in data center construction providing data storage and cloud computing services. SONATEL announced construction of a second data center in Rufisque in 2015 with the state of the art facility becoming operational in 2016. TIGO also is nearing completion of a data center. There is a government data center with a second one under construction.

### 3.3 Last Mile: Local Access Networks

The use of wired broadband Internet is low in Senegal. ARTP reported 98,353 fixed broadband subscriptions in Senegal in December 2016 or just 0.7 subscriptions per 100 people. These subscriptions are all ADSL and provided by the incumbent SONATEL. Although fiber optic connections are

available and offered by all operators, they are mainly targeted at large businesses or government and there has been scarce effort to broaden the fiber to the building (FTTB) broadband market. Maximum speeds on offer with ADSL range from 2-20 Mbps and up to 100 Mbps for fiber. A main attraction for wired broadband is that there are generally no data caps.

Broadband in Senegal is driven by mobile. In 2009, EXPRESSO launched the country's first wireless broadband network based on lesser-used CDMA technology. In 2010, it then launched a 3G+ network, followed by SONATEL in 2011 and TIGO in 2013. ARTP reported 8.5 million mobile Internet subscriptions in September 2016. However, these include both narrowband and broadband subscriptions. According to GSMA, there were two million mobile broadband subscriptions in 2015. There are no recent official data on the extent of 3G population coverage. According to one source, 77% of Senegal's 17,365 localities were covered by a 2G GSM signal compared to 30% receiving a 3G signal.<sup>114</sup> Population coverage is much higher given that more populated localities would be covered first.

Operators have been piloting 4G technology. The ARTP authorized them to conduct tests in a few

112 - <http://documents.worldbank.org/curated/en/442701468194079362/pdf/895940PAD0P146010Box-391424B000U0090.pdf>

113 - FranceIX. 2014. "SENIX - Senegalese Internet Exchange Point." [https://www.franceix.net/media/cms\\_page\\_media/841/SENIX.pdf](https://www.franceix.net/media/cms_page_media/841/SENIX.pdf)

114 - [http://www.seneweb.com/news/Societe/licence-3g-5261-localites-couvertes-cont\\_n\\_182399.html](http://www.seneweb.com/news/Societe/licence-3g-5261-localites-couvertes-cont_n_182399.html)

locations during 2014 and the early part of 2015. SONATEL reported achieving speeds of 150 Mb/s during the trial.<sup>115</sup>

An invitation to bid to offer 4G services was issued by ARTP in 2015. However, operators considered the reserve price for the license—CFA 30 billion (US\$ 49.86 million)—did not make financial sense and did not bid.<sup>116</sup> In July 2016, SONATEL paid FCFA 100 billion to renew its license for 17 years. Within that context, it was also awarded the right to provide 4G services including the necessary frequency spectrum for which it reported that it paid FCFA 32 billion (US\$54 million) or more than the original reserve price.<sup>117</sup> SONATEL commercially launched 4G that same month. Meanwhile the other two operators have yet to obtain permission to provide 4G services.<sup>118</sup>

Coverage of 4G is currently limited. Under the conditions of its license renewal, SONATEL is obligated to provide 4G coverage to 70 percent of the population by 2020 and 90 by 2025.<sup>119</sup> Given the necessity of having a 4G capable smartphone and the prolonged deployment obligation, it will be awhile before a majority of Senegalese population has access to high-speed 4G networks.

### 3.4 Invisible Mile

In addition to the first, middle and last miles a number of factors—the so-called invisible mile— influences broadband deployment. There have been a series of obligations on telecommunications operators to contribute to funds for universal service. The Telecommunications Code established the *Fonds de Développement du Service Universel de Télécommunications* (FDSUT). This was replaced in 2012 by the introduction of the *Contribution au Développement du service universel des Télécommunications et du secteur de l'Energie* (CODETE) to which operators contributed 5% of revenues. CODETE aims at primarily expanding electricity access as this then benefits the telecom sector. In 2017, CODETE was replaced by another program with operators contributing 3% of revenues for economic development.

Universal service funds have not been widely used for directly improving access to telecommunication

networks in underserved areas. However, there was a request for bids issued in 2009 to provide telecommunication services in underserved parts of the country. The winning criteria included high points for the least level of subsidy requested. The *Consortium du Service Universel* (CSU) won the bid and did not request any subsidy. Operating under the brand HALO, it launched operations in the Matam region in 2013. It has deployed a network based on wireless technology serving around 10,000 customers.

Senegal enacted a number of laws relevant to ICT in 2008 covering electronic transactions, cybercrime, information society and personal data<sup>120</sup>:

- Law No. 2008-08 on the Electronic Transactions
- Law No. 2008-11 on Cybercrime
- Law No. 2008-10 on the Orientation Law on the Information Society
- Law No. 2008-12 on the Protection of Personal Data

Some of these laws merit updating considering they are almost a decade old. Further, additional effort is needed to operationalize monitoring and enforcement. For example, although there is a law on cybercrime there is no formal *Computer Incident Response Team* (CIRT).

115 - <http://www.sonatel.com/renouvellement-convention-de-concession-et-du-cahier-des-charges-et-attribution-frequences-4g/>

116 - <https://www.telegeography.com/products/commsupdate/articles/2016/01/19/senegals-incumbent-cellcos-boycott-4g-licence-tender-artp-invites-bids-from-new-entrants/>

117 - [http://www.jo.gouv.sn/spip.php?page=imprimer&id\\_article=10896](http://www.jo.gouv.sn/spip.php?page=imprimer&id_article=10896)

118 - <http://www.metrodakar.net/4g-aucune-licence-attribuee-a-un-operateur/>

119 - [http://www.jo.gouv.sn/spip.php?page=imprimer&id\\_article=10896](http://www.jo.gouv.sn/spip.php?page=imprimer&id_article=10896)

120 - Text available at: <http://www.wipo.int/wipolex/en/profile.jsp?code=SN>

## 4. Demand Side

This chapter discusses factors that affect broadband usage. It first looks at overall Internet penetration in the country and then examines fundamental factors that drive usage such as affordability, attractiveness and awareness (Kelly and Rossotto, 2012).

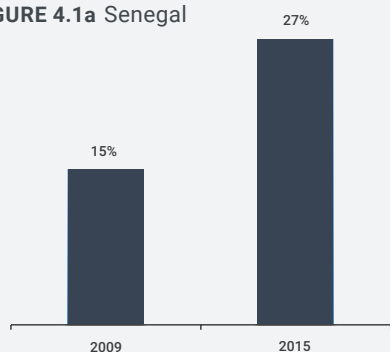
Supply side statistics are not appropriate for measuring ICT usage among the population. Subscription data are based on the administrative records of operators. They can be misleading particularly for mobile Internet subscriptions since operators include subscriptions to mobile broadband networks even if users are only using voice or text services and some users can have more than one subscription.<sup>121</sup> Actual usage can only be determined by a demand side survey. ARTP carried out a survey in 2009 to gauge ICT use among the Senegalese population.<sup>122</sup> In 2013, ARTP launched an expression of interest to carry out a new survey

but this has not yet borne fruition.<sup>123</sup> Therefore, there are no recent official statistics on the proportion of the population using the Internet and existing figures are either based on misleading supply side data or are estimates.<sup>124</sup> In 2015, the Pew Research Center carried out a survey on Internet use in Senegal as well as some other countries.<sup>125</sup> The survey found that 27% of the Senegalese population 18 years and older used the Internet. Most Senegalese access the Internet over mobile networks with the percentage of cellphone owners using a smartphone rising from 16 in 2013 to 23 in 2015.

Internet penetration grew over 80% in Senegal between 2009 and 2015 from 15% to 27% of the population (Figure 4.1, left). Senegal ranked fourth among nine sub-Saharan African countries and first among African LDCs surveyed by Pew in 2015 (Figure 4.1, left).

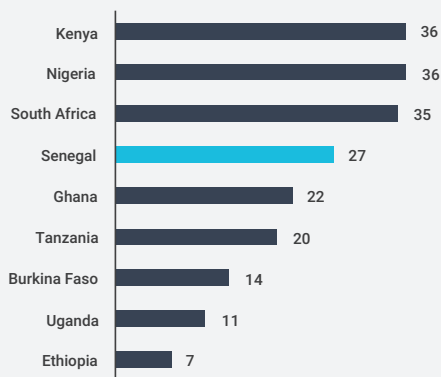
**FIGURE 4.1** Internet penetration

**FIGURE 4.1a** Senegal

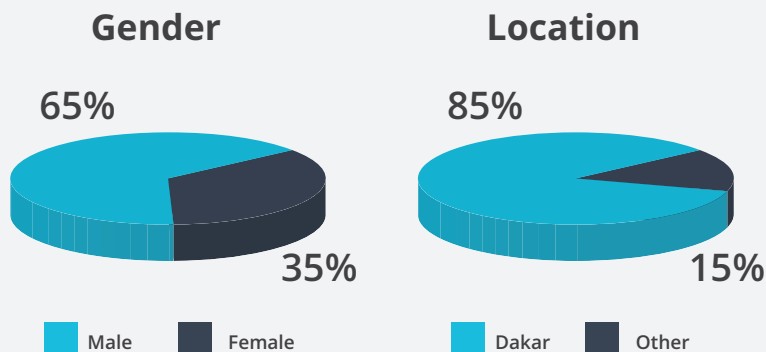


A & B Source: Adapted from ARTP and Pew.

**FIGURE 4.1b** 18+, 2015



**FIGURE 4.2.** Distribution of Facebook users in Senegal by gender and location, February 2017



Source: Adapted from Facebook Ad engine.

There is a significant gender and regional digital divide in Senegal. Some 65% of Facebook users in the country are male and 85% are in Dakar (Figure 4.2).

Senegalese are big consumers of voice and data services. During the first six months of 2016, the average Senegalese mobile phone user spent 116 minutes per month on outgoing calls, a high figure by Sub Saharan African standards (Figure 4.3, left). Data utilization is particularly striking where average usage in Senegal vastly exceeds those in other African countries (Figure 4.3, right).

## 4.1 Affordability

The price of Internet access has dropped since 2011. SONATEL's least expensive monthly mobile Internet plan dropped 80% between 2011 and 2017 from FCFA 25,000 to FCFA 5,000. However, while the 2011 plan included 5 GB of data and the latest plan exactly half that amount, the reduction in price per GB was 60%.

Internet prices as a percentage of per capita GDP

121 - For example, one study comparing mobile broadband subscription data with survey data found that the subscription data misrepresented actual mobile broadband users by 85%. "Mobile Internet in Europe." *ictDATA*, 16 January 2013. <http://www.ictdata.org/2013/01/mobile-internet-in-europe.html>

122 - [http://ascosen.org/resultats\\_de\\_ENTICS\\_2009\\_316.pdf](http://ascosen.org/resultats_de_ENTICS_2009_316.pdf)

123 - [http://www.artpsenegal.net/index.php?option=com\\_content&view=article&id=108:l-artp-lance-un-avis-a-manifestation-d-interet-relatif-a-une-enquete-nationale-sur-les-technologies-de-l-information-et-de-la-communication-au-senegal&catid=14&Itemid=167](http://www.artpsenegal.net/index.php?option=com_content&view=article&id=108:l-artp-lance-un-avis-a-manifestation-d-interet-relatif-a-une-enquete-nationale-sur-les-technologies-de-l-information-et-de-la-communication-au-senegal&catid=14&Itemid=167)

124 - For example, recent ITU data for Senegal are based on estimates rather than actual survey data. See "Percentage of Individuals using the Internet" at: <http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

125 - Pew Research Center, February, 2016, "Smartphone Ownership and Internet Usage Continues to Climb in Emerging Economies" [http://www.pewglobal.org/2016/02/22/smartphone-owner-](http://www.pewglobal.org/2016/02/22/smartphone-owner-ship-and-internet-usage-continues-to-climb-in-emerging-economies/)

are twice the Broadband Commission target.<sup>126</sup> The average monthly entry-level mobile Internet plan is equivalent to 11% of per capita GDP in the country. Despite competition, there is not a significant difference in price between SONATEL and TIGO. While EXPRESSO's tariffs are cheaper, less than 10% of subscriptions are accessing that network.

Despite relatively high monthly prices, there are a variety of different plans and options that make Internet more affordable though constraining use. This includes daily, weekly and monthly volume plans as well as flat rate hourly, daily, weekly and monthly options.

Low cost basic smartphones are available. Orange was selling a self-branded Klif<sup>127</sup> smartphone for FCFA 14,900 (US\$ 25) in February 2017.<sup>128</sup>

Free public Wi-Fi and telecentres assist with affordability. Operators have installed free hotspots in some areas.<sup>129</sup> Some government-sponsored telecentres are also available in underserved communities.<sup>130</sup>

ship-and-internet-usage-continues-to-climb-in-emerging-economies/. The Senegalese survey was based on face-face interviews carried out in French and Wolof in April and May 2015 and conducted among 1,000 people age 18 and older. The survey is nationally representative with a margin of error of 3.7 percentage points. For more details see: [http://www.pewglobal.org/international-survey-methodology/?country\\_select=Senegal&year\\_select=2015](http://www.pewglobal.org/international-survey-methodology/?country_select=Senegal&year_select=2015)

126 <http://broadbandcommission.org/Documents/Targets-Separated/Target-2.pdf>

127 - James Temperton. 2015. "Orange Klif: hands on with Mozilla's £25 smartphone." *WIRED*, 3 March. <http://www.wired.co.uk/article/mozilla-orange-klif>

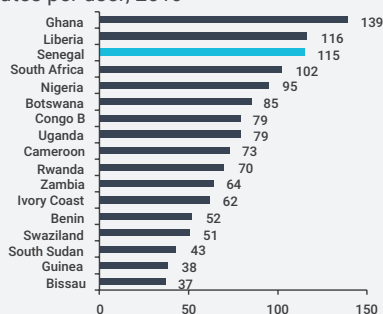
128 - <https://www.orange.sn/2/particuliers/1/26/orange-klif-471.html>

129 - <http://www.sonatel.com/projet-sonatel-wifizone-en-phase-experimentale-dans-trois-communes-de-dakar/>

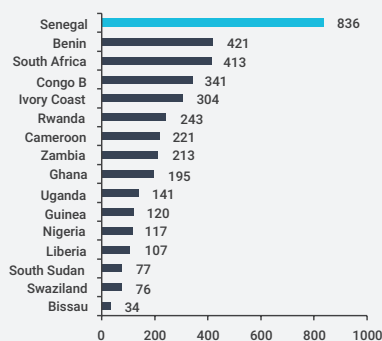
130 - <http://www.comminet.com/africa/content/community-multi-media-center-cmc-scale-project>

**FIGURE 4.3** Outgoing mobile phone minutes of use and mobile data usage, 2016

**FIGURE 4.3a** Outgoing monthly mobile phone minutes per user, 2016



**FIGURE 4.3b** Monthly mobile data per user (Mb), 2016



A & B Note: Data usage figures for Senegal refer to the full year 2016 whereas all other data refers to the first six months of 2016.

Source: Adapted from ARPT, MTN and SONATEL.



## 4.2 Attractiveness

The number of different languages used in Senegal and their oral nature poses a challenge for the development of local Internet content to drive demand for broadband services. It is difficult to achieve economy of scale in any one language given the spread of tongues: the official language French, six other principal languages and Arabic. Of the top ten web sites in Senegal, half are Senegalese while the others are popular global sites. It is interesting to note that the Senegalese sites tend to have a higher level of engagement (e.g., more time spent on the

site).

Entertainment is one of the main uses of the Internet in Senegal. According to one report, YouTube accounts for 20% of the country's international Internet traffic.<sup>131</sup> As shown in the table above, the YouTube website is the most popular in Senegal. Another attraction of multimedia content is that it does not require a high level of computer literacy to access and content can be made available in the various languages spoken in the country.

131 - RFI. 2016. "Les Jeunes Sénégalais À L'assaut de YouTube." RFI Afrique, January 29. <http://www.rfi.fr/afrique/20160113-senegal-youtube-videos-buzz-sandale-man>

**Table 4.1: Top websites in Senegal, February 2017**

	Site	Daily Time on Site	Daily Page Views per Visitor	Total Sites Linking In
1	Youtube.com	9:40	5.56	2,508,371
2	Google.sn	7:04	4.21	498
3	Google.com	9:02	8.85	3,234,701
4	Seneweb.com	11:15	3.07	3,162
5	Senego.com	11:11	3.38	1,374
6	Yahoo.com	4:32	4.00	574,818
7	Leral.net	7:27	2.80	1,480
8	Dakaractu.com	5:18	2.34	1,317
9	Buzzsenegal.com	5:03	2.45	329
10	Live.com	4:28	3.32	49,296

Source: <http://www.alexa.com/topsites/countries/SN>

## 4.3 Awareness

Low levels of literacy are a major barrier to knowledge and usage of the Internet. Under half the population (45%) aged 10 and older was literate according to the 2013 census (ANSD, 2014). This is a major challenge

to boosting computer literacy since many of the illiterate are out of school. There is no major program for training this group.

# 5. The ICT Industry

The ICT sector has both direct and indirect impacts on the economy. The direct impact is assessed by looking at the size of the sector in relation to Gross Domestic Product (GDP). The ANSD compiles GDP statistics based on the United Nations International Standard Industrial Classification of All Economic Activities, Rev.3.1 where telecommunications and postal services are identified as a specific sector.<sup>132</sup>

Telecommunications services account for a relatively high share of the Senegalese economy indicating the potential for the country to be a regional ICT hub. The value added of the telecommunications and postal sector was FCFA 602 billion (US\$ 1,018 million) in 2015 or 10.1% of GDP (Figure 5.1, left). Telecommunications and posts have grown more slowly than overall GDP growth the last

few years with its contribution dropping from a peak of 10.6% of GDP in 2013. The contribution of telecommunications and posts to GDP in Senegal is high compared to other ECOWAS members for whom data is available, ranking second after the Gambia (Figure 5.1, right).

The ICT sector also makes significant contributions to the government through taxes and license fees. For example, SONATEL paid FCFA 214 billion in 2015 to the Senegalese government for import duties, taxes and social contributions, among others (SONATEL, 2016). The three main operators have paid almost US\$ 500 million in direct license fees over the last decade (Table 5.1).

Senegal's telecommunication operators contribute to both direct and indirect employment. Indirect employment includes distributors of their products such as prepaid airtime and SIM cards, mobile phones and other equipment and subcontractors. Due to the prevalence of mobile phones, indirect

employment has dropped from the high levels of the past when there were many public phone centers. SONATEL employed 1,734 people in Senegal in 2015, down from 1,933 in 2012 and has over 60,000 indirect distribution partners (Orange, 2016) TIGO directly employed 370 people in 2015 and has some 15,000 indirect employees.<sup>133</sup> According to the ANSD, 0.5% of employment was in the Information and Communication sector in June 2016 equivalent to around 8,600 people.<sup>134</sup>

A number of studies have quantified the indirect impact of ICT technologies on the economy.<sup>135</sup> A World Bank study found that the impact increased as access moved from fixed to mobile telephony and Internet to wired broadband access.<sup>136</sup> Most studies find that until countries have reach a certain threshold penetration in wired broadband, there is no statistically significant impact.<sup>137</sup> This is Senegal's situation where wired broadband penetration is extremely low (just 0.7 penetration at September 2016).

132 - See: <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17>. There is a classification for the ICT sector covering equipment manufacturing, telecommunication services and software ([http://unstats.un.org/unsd/cr/registry/docs/i31\\_ict.pdf](http://unstats.un.org/unsd/cr/registry/docs/i31_ict.pdf)). However, this is not available for Senegal.

133 - <http://www.millicom.com/map-data/countries/senegal/detail-page/>

134 - The Information and Communication sector comprises publishing, broadcasting, film, telecommunications, computer software and information services. ANSD. 2016. Enquête Nationale sur l'Emploi au Sénégal (ENES), deuxième trimestre 2016.

135 - Minges, Michael. 2016. "Exploring the Relationship between Broadband and Economic Growth." 102955. The World Bank. <http://documents.worldbank.org/>

curated/en/17870146798875888/Exploring-the-relationship-between-broadband-and-economic-growth

136 - Qiang, Christine Zhen-Wei, Carlo Rossotto, and Kaoru Kimura. 2009. "Economic Impacts of Broadband." In Information and Communications for Development. Washington D.C.: World Bank.[http://siteresources.worldbank.org/EXT/IC4D/Resources/IC4D\\_Broadband\\_35\\_50.pdf](http://siteresources.worldbank.org/EXT/IC4D/Resources/IC4D_Broadband_35_50.pdf).

137 - Minges, Michael. 2013. "Moving to the next step: Standardizing broadband economic impact measurements." Presented at Measuring the Economic, Social, and Political Impact of the Web. George Washington University, Washington DC. 14-15 November.

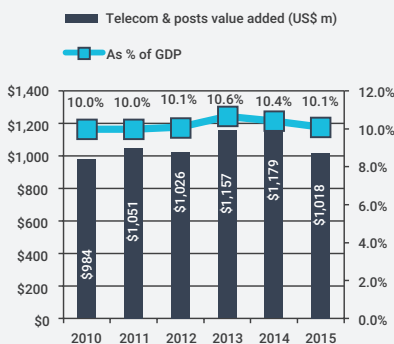
**Table 5.1: Telecommunication license fees**

Year	Operator	US\$ m	Note
2016	Sonatel	171	17 year license extension including 4G
2013	Sentel	103	Regularization of license
2007	Expresso (Sudatel)	200	Full service license except 4G
<b>TOTAL</b>		<b>474</b>	

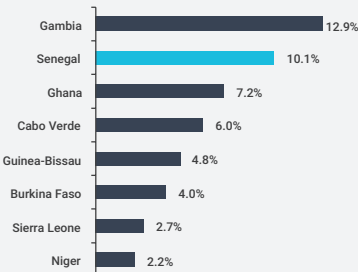
Source: Adapted from company and news reports.

**FIGURE 5.1 Telecommunications and posts as a % of GDP**

**FIGURE 5.1a Senegal**



**FIGURE 5.1b Telecom & posts as % of GDP, 2015 or latest, constant prices**



A & B Note: Constant prices.

A & B Source: Adapted from ANSD and UN.

Basic mobile telephony has the biggest indirect impact on Senegal's economy. A study on the economic impact of ICTs in Senegal found no statistically significant impact from broadband on the economy due to low levels of penetration.<sup>138</sup> On the other hand, it found that mobile had a significant contribution with each percentage point increase in mobile penetration contributing 0.05% to GDP.

## 5.1 Investment

Investment in Senegal's broadband networks has largely emanated from the country's three telecommunications operators and to some extent the government for its own needs. Official data on the extent of such investments is however lacking. One can look at the results of such investment in terms of the existing infrastructure: connectivity to three fiber optic undersea cable networks; some 9,000 km of fiber optic in the national backbone and upgrading of mobile networks.

ICT accounts for a significant proportion of private sector investment in Senegal. According to the World Bank, ICT accounted for over 60% of the value

of the top ten infrastructure projects in Senegal (Table 5.2).<sup>139</sup>

Telecommunication operators in Senegal have made significant investments in infrastructure. Investment peaked in 2007 when it reached over US\$350 million, equivalent to 12.4% of Senegal's total Gross Fixed Capital Formation (GFCF) (Figure 5.2, left). It has declined since then given that the major investment to install mobile sites had already been made and additional investments have involved transforming the radio access network from 2G to 3G and 4G. SONATEL invested US\$ 320 million between 2013 and 2015, equal to 12% of its revenues, most of it funded by its own cash flow and vendor financing (Sonatel, 2016). Over half of SONATEL's 2015 investment was spent on upgrading, extending coverage and improving quality of mobile networks; just over ten percent on transformation of the network to next generation Internet Protocol (IP); and one third on other areas such as data centers, land, buildings and vehicles (Figure 5.2, right). TIGO reports investing around US\$ 350 million between 2009 and 2014.<sup>140</sup> In July 2016, TIGO announced plans to invest US\$194 million to

138 - Katz, Raul, and Pantelis Koutroumpis. 2012. "The Economic Impact of Telecommunications in Senegal." Communications & Strategies 2 (86): 21–42. [https://www8.gsb.columbia.edu/citi/sites/citi/files/files/Senegal\\_Telecoms\\_Report\\_version%20finale%5B1%5D.pdf](https://www8.gsb.columbia.edu/citi/sites/citi/files/files/Senegal_Telecoms_Report_version%20finale%5B1%5D.pdf)

139 - The figure includes license fees. See: <http://ppi.worldbank.org/snapshots/country/senegal>

140 - <https://www.tigo.sn/notre-entreprise>

**Table 5.2. Top 10 private participation in infrastructure projects**

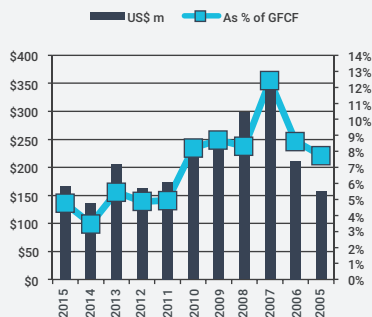
Project	Investment (US\$ m)
Orange Sonatel	2,270
Blaise Diagne International Airport	730
Millicom Senegal	538
Senegal Thermal Facility	344
Dakar Diamniadio Toll Road	264
Sudatel Senegal	260
Dakar-Diamniadio Toll Road Extension	173
Tobene IPP	165
Dakar Seaport	134
Dakar Port Terminal	132
ICT	3,068
ICT (%)	61%
<b>TOTAL</b>	<b>5,010</b>

Note: Including license fees.

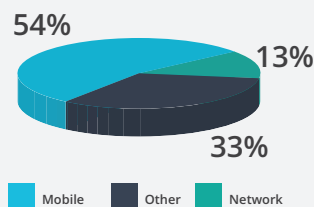
Source: Adapted from World Bank Private Participation in Infrastructure Database.

**FIGURE 5.2** Telecom investment by Senegalese operators and areas of SONATEL investment

**FIGURE 5.2a** Telecom investment



**FIGURE 5.2b** Sonatel investment areas 2015



A & B Note: Excluding license fees.

A & B Source: Adapted from World Bank Private Participation in Infrastructure Database.

upgrade its network to 3G+.<sup>141</sup> However, the status of this investment is unclear following its sale to Wari, a Senegalese financial group for US\$129 million in February 2017.<sup>142</sup> The *Digital Senegal Strategy* calls for an investment of FCFA 994 (US\$ 1.7) billion by the private sector in ICT infrastructure between 2016 and 2025.

The government has also invested in broadband for its own connectivity. This includes over US\$250 million for a fiber optic backbone, cabling of government buildings and data centers.<sup>143</sup> Government spending on the Digital Senegal Strategy is budgeted at FCFA 231 billion (US\$ 400 million) while Public Private Partnerships is budgeted at FCFA 136 billion (US\$ 200 million) between 2016 and 2025.

License fees affect amounts available for infrastructure investment while the lack of infrastructure sharing contributes to higher investment requirements. The three main operators have spent almost US\$ 500 million on license fees since 2007 roughly equal to around one quarter of the amount invested in telecommunication networks. Infrastructure sharing, cost-based wholesale pricing

and open access are not widely practiced, adding to duplicate investment (and higher prices). In addition, operators pay a range of other taxes and fees reducing amounts available for infrastructure investment.

## 5.2 Tech Ecosystem

Senegal is emerging as the digital entrepreneurship hub of West Africa.<sup>144</sup> A number of facilities and initiatives aim to leverage broadband connectivity to create jobs and boost the digital economy. This includes five tech hubs such as CTIC Dakar, the first incubator launched in West Africa in 2011. Some 75 entrepreneurs have received incubation at CTIC generating over 200 jobs.<sup>145</sup>

A large technology park is being constructed near Diamniadio, around 100 kilometers from Dakar. With state of the art broadband infrastructure, it aims to be the leading ICT cluster in West Africa. The African Development Bank is making an €61 million investment in the park with aims to generate 30,000 direct jobs by 2025 (AfDB, 2015).<sup>146</sup>

141 - <https://www.telegeography.com/products/commsupdate/articles/2016/07/13/tigo-senegal-to-invest-usd194m-on-3g-upgrade/>

142 - <http://www.reuters.com/article/senegal-telecoms-idUSL5N1FS6Y0>

143 - [http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/local\\_content\\_study.pdf](http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/local_content_study.pdf)

144 - <http://www.worldbank.org/en/news/feature/2016/12/09/shining-the-spotlight-on-west-and-central-africas-entrepreneurs>

145 - <http://www.cticdakar.com/fr/qui-sommes-nous/nos->

resultats-2/

146 - <https://www.afdb.org/en/news-and-events/article/afdb-board-approves-eur70-million-for-construction-of-senegal-digital-technology-park-14845/>

## 6. Sector Use and Impacts

The intensity of ICT use varies across different sectors of the economy as does the degree to which applications and services exploit broadband networks.

### 6.1 Business

Senegalese businesses have an average take-up ICTs. A 2014 World Bank enterprise survey of 601 Senegalese enterprises found that 35% had their own website compared to an average of 33% for sub-Saharan Africa (Table 6.1).<sup>147</sup> Some 65% of Senegalese firms were using email to communicate with clients or suppliers, a figure slightly higher than the Sub-Saharan Africa average. There is a large gap between large and small enterprises in ICT adoption. While 83% of large firms had a web site, the corresponding figure for small ones is only 16%. Another measure of firm ICT adoption is the number of secure Internet servers.<sup>148</sup> Secure servers proxy for the level of transactional capability in areas such as finance, government services and e-commerce. With five secure Internet servers per 1 million people, Senegal has half the rate of the Sub-Saharan Africa average, suggesting the scope for more widely expanding web sites deploying financial transactions.

### 6.2 Government

The Senegalese government has been progressively automating its operations. This includes a backbone

consisting of fiber optic and high-speed wireless links across the country. The backbone connects government buildings nationwide and has lowered the costs of communications. The state saved FCFA 10 billion (US\$17 million) between 2014 and 2016 from having its own internal communications network.<sup>149</sup> Employees have been provided with computers and mobile phones resulting in a high level of connectivity and device availability in the public administration. Government investment has been significant with some US\$ 200 million funded through a combination of loans and grants primarily from China and the Republic of Korea (OECD, 2013). A 2015 agreement with China will see the government's fiber optic network extended some 2,500 kilometers to reach 4,000 kilometers in total as well as construction of a new data center at a cost of FCFA 51 billion (US\$ 85 million).<sup>150</sup> Despite extensive capacity, the government's fiber optic network is for its exclusive use and not available for sharing with the country's telecommunications operators.

While internal government connectivity and automation of back office processes are proceeding, deployment of interactive online<sup>151</sup> public services is limited. The procedures for carrying out some 700 administrative processes are available online as is the Official Journal,<sup>152</sup> enhancing transparency and saving some steps for citizens and businesses by making them better informed by how to go about their transactions with the government. However, thus far only two procedures are interactive (i.e.,

**Table 6.1. Enterprise use of ICTs**

Economy	Percent of firms having their own Web site (2014)	Percent of firms using e-mail to interact with clients/suppliers (2014)	Secure Internet servers (per 1 million people) (2015)
All Countries	44.7	72.3	209
Sub-Saharan Africa	32.8	61.7	10
Senegal	34.6	64.7	5
- Large (100+ employees)	83.0	97.4	...
- Medium (20-99 employees)	58.9	85.9	...
- Small (5-19 employees)	15.5	50.2	...

Source: Adapted from World Bank.

construction authorization and application to the *National Administrative University* (ENA)). The Digital Senegal Strategy calls for 40% of administrative services to be delivered electronically by 2025.

## 6.3 Health

The *District Health Information System* (DHIS) 2 has been implemented for managing medical records. This is part of a wider regional effort to share medical records and achieve efficiencies through use of common software.<sup>153</sup>

One of the flagship applications in the health sector is m-Diabetes. This program is supported by the *World Health Organization* (WHO) and *International Telecommunication Union* (ITU)<sup>154</sup> and uses a SMS platform to send text messages to diabetics with diet reminders. While the front-end system consists of basic text messages, the back end features cloud-computing software. There are some 50,000 people registered to use the system out of some 123,000 with diabetes in Senegal.<sup>155</sup>

There is a telemedicine project connecting several hospitals. It uses videoconferencing to support consultations with experts and provide distance education for health professionals.<sup>156</sup> This is part of the *Pan-African e-Network Project*, supported by the government of India connecting hospitals and educational institutions across the region.<sup>157</sup> In 2015, there were 667 telemedicine consultations and 4,862 health-training sessions over the network.<sup>158</sup> In 2013, the Ministry of Health installed a cloud-based system at hospitals in Dakar, Thies and Diourbel.<sup>159</sup> Patient records are routed through the cloud to

those needing access. The system saves time and travel to retrieve records and health practitioners receive results faster.

## 6.4 Agriculture

Text-based messaging systems informing farmers about market prices have been in place for some time. Manobi, established in 2001, pioneered this and its Xam Marsé service has been used by thousands of farmers to raise their incomes.<sup>160</sup> Manobi also launched a GPS-based service for protection of fishermen at sea.<sup>161</sup> Manobi has started to exploit the features provided by broadband networks and smartphones in areas such as water management.<sup>162</sup>

## 6.5 Education

Tertiary institutions are relatively well connected. All universities are interconnected and provide free Internet access to students. There is growing access to international content and university bandwidth has grown from 20 Mbps to 620 Mbps by mid-2016. There are a growing number of courses available online.<sup>163</sup>

A virtual university project supported by the African Development Bank aims to democratize access to higher education by establishing access points in all of Senegal's 45 departments.<sup>164</sup> These so-called Open Digital Spaces ("*Espaces numériques ouvert* (ENO))" would also support access to online learning and content for the wider public.<sup>165</sup>

The connectivity situation is not as evolved for primary and secondary schools. There are no

149 - ADIE. 2017. "De 22 Milliards Cfa En 2015, La Facture Téléphonique de l'Etat Est Passée À Moins de 12 Milliards En 2016." February 20. <https://www.adie.sn/fr/%C2%AB-de-22-milliards-cfa-en-2015-la-facture-t%C3%A9l%C3%A9phonique-de-l%E2%80%99etat-est-pass%C3%A9e-%C3%A0-moins-de-12-milliards>.

150 - Ministry of Economy, Finance and Planning. 2015. "Signature D'accord de Prêt Chine / Sénégal: La Chine Met À Disposition 50,88 Milliards de Cfa Pour Le Projet Large Bande." News, November. <http://www.finances.gouv.sn/index.php/actualites/248-signature-d-accord-de-pret-chine-senegal-la-chine-met-a-disposition-50-88-milliards-de-cfa-pour-le-projet-large-bande>.

151 - <http://www.servicepublic.gouv.sn>

152 - <http://www.jo.gouv.sn>

153 - [https://docs.dhis2.org/master/en/user-stories/html/user\\_story\\_waho.html](https://docs.dhis2.org/master/en/user-stories/html/user_story_waho.html)

154 - Gaudry-Perkins, Florence. 2014. "mDiabetes Program: Mobile Technologies Are Catalysts for Development in Senegal." Nokia Networks, July 2. <https://networks.nokia.com/blog/2014/mdiabetes-mobile-technologies-catalysts-development-senegal>.

155 - Orange. 2016. "mDiabetes in Senegal: Advice via Text Message for Improving the Management of Diabetes." Orange Healthcare, August 16. <http://healthcare.orange.com/en/Live/2016/mDiabetes-in-Senegal-advice-via-text-message-for-improving-the-management-of-diabetes>.

156 - <http://www.vizocomsat.com/blog/telemedicine-satellite-africa-part-3/>

157 - <http://www.panafricanenetwork.com/index.jsp>

158 - Ibrahim Ba. 2016. "Sénégal: Réseau panafricain de services en ligne - Yaya Abdoul Kane se félicite des résultats du projet." Le Soleil, 15 January. <http://fr.allafrica.com/stories/201601160091.html>

159 - <http://www.vepro.com/eng/news/senegal-acquires-the-vepro-telemedicine-solution-.html>

160 - Sylla, Ibrahim. 2017. "TIC et accès des ruraux à l'information : l'exemple du Xam Marsé de Manobi au Sénégal." <http://revues.mshparisnord.org/netsuds/index.php?id=209>.

161 - <http://www.manobi.sn/sites/za/index.php?M=9&Cle=14&SM=20>

162 - [https://www.wsp.org/sites/wsp.org/files/publications/Eng\\_mWater%20Field%20Note.pdf](https://www.wsp.org/sites/wsp.org/files/publications/Eng_mWater%20Field%20Note.pdf)

163 - Kamil, Hamoud Abdel Wedoud. 2016. Senegal - Senegal Tertiary Education Governance and Financing For Results: P123673 - Implementation Status Results Report : Sequence 10. Washington, D.C. : World Bank Group. <http://documents.worldbank.org/curated/en/852111468940962174/Senegal-Senegal-Tertiary-Education-Governance-and-Financing-For-Results-P123673-Implementation-Status-Results-Report-Sequence-10>

164 - <https://www.afdb.org/en/documents/document/senegal-senegal-virtual-university-support-project-appraisal-report-34916/>

165 - <http://www.mesr.gouv.sn/?p=1527>

official data on the number of schools connected to the Internet but the figure is believed to be low. There are several school ICT initiatives. The Digital Resources for All (*"Ressources numériques pour tous"* (RNPT)) initiative is providing tablet computers to the country's 308 secondary schools (*"Lycées"*).<sup>166</sup> The Sankoré project has installed some 700 digital blackboards for accessing educational content in primary schools.<sup>167</sup> There have also been initiatives to provide computers to schools through corporate social responsibility or bi-lateral development assistance (OECD, 2013). The *Digital Senegal Strategy* calls for all students to have access to a device and half of schools to be connected by 2025.

Smartphones are being piloted for the registration of births. This is relevant because a birth certificate is needed for school enrolment. According to a study, just over half of children in Senegal are registered at birth.<sup>168</sup> The NGO Aide & Action worked with SONATEL to develop a smartphone application used by village chiefs to capture relevant information that is then transmitted to the State Register. A registration number is then transmitted back to the village, which the parents use to collect the certificate at a government office. The first pilot covering 30 villages registered 100% of the births (300) over a two-month period.

## 7. Conclusions

The Senegalese government views ICT in general and broadband in particular as critical for the country's economic development. This is evident both in the national economic development plan and sector strategy. The latter lays out ambitious goals to create a digital Senegal by 2025.

The country has pieces in place for a robust broadband infrastructure. This includes connectivity to three undersea fiber optic cables and national fiber backbones. It has been expanding its 3G mobile broadband infrastructure and recently commercialized 4G technology. A number of data centers have recently been constructed, the national Internet Exchange Point is about to launch and construction is underway for a digital technology

## 6.6 Financial Access

Financial inclusion is being expanded through mobile money platforms allowing users to transfer funds and pay for goods and services using their mobile phone. Orange Money, launched in 2010, had around 2.1 million registered customers at end-2015, representing a quarter of SONATEL's mobile customer base and the volume of transactions grew 73% during the year. TIGO launched its Cash mobile money service in April 2014. By the end of 2014, there were 1.1 million active users of mobile money in Senegal, some 13% of the adult population and the value of transactions was equivalent to 2.5% of GDP.<sup>169</sup> Services are being expanded such as the ability to receive remittances from France<sup>170</sup> and apply for micro insurance using mobile phones.<sup>171</sup>

166 - <http://www.aps.sn/actualites/societe/article/le-projet-ressources-numeriques-pour-tous-lance-a-dahra>

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park at Diamniadio. Senegal is also a regional connectivity hub and the nation's incumbent telecommunications company, SONATEL, has operations in several neighboring countries.

Despite challenging socio-economic conditions, the country has relatively high Internet usage compared to other Sub-Saharan African countries (and LDCs) and ICT contributes a notable share of GDP. It is among the leading Sub-Saharan nations in Internet penetration and ICT contributes over ten percent of GDP, high for the region as well as globally.

Despite these accomplishments, Senegal faces challenges in developing a robust, competitive and innovative ICT ecosystem. The influence of the incumbent operator is inevitable given its financial



might. SONATEL also has multiple stakeholders (i.e., Orange France, public shareholders, employees and the government itself) that exert influence on the ICT sector. They all have a stake in ensuring the company maximizes profits. This comes at the expense of greater competition in the sector. For example, the existing operators cannot afford to pay the same amount SONATEL paid for 4G frequencies and be profitable. Further SONATEL's control over key international and national backbone infrastructure gives it an enviable position. Market dynamism is also a concern. MILLICOM has announced the sale of TIGO and EXPRESSO has less than ten percent of the Internet market a decade after receiving a license. At the same time, Senegalese operators are facing competition from so-called "*Over the Top*" (OTT) services such as Viber and WhatsApp that threaten their future investment capability. According to SONATEL, it estimates it will lose over US\$400 million from OTT applications between 2016 and 2020.<sup>172</sup>

High license fees as well as other taxes raise the costs of communications in Senegal and reduce funding for investment. This must be put in the context of government decision to use the telecom sector as a significant source of its revenues for activities it carries out across the entire economy. The drawbacks are that this diverts money from potential investment into network. License fees also hamper competition, the situation with 4G services where the operators felt that the reserve price did not make business sense. Given these constraints, Senegal needs to do all it can to maximize existing infrastructure, minimize duplication and stimulate greater competition by enhancing incentives for infrastructure sharing, ensuring cost-based access to key facilities and supporting success of the SENIX Internet Exchange Point.

Steps are needed to boost digital literacy and enterprise use of ICTs. Senegal is approaching the limit in regards to the addressable Internet market. In order to expand this, steps must be taken to provide digital literacy for those out of school on a large scale. The low level of ICT adoption by SMEs needs to be addressed through awareness raising and incentives such as compelling device and connectivity charges targeting small firms. The tech

ecosystem would benefit from deeper support and understanding. While Dakar has emerged as a hub for digital entrepreneurship, West Africa lags East and South Africa in the number of companies that have successfully made the transition from startup to enterprise.

Senegal needs to make greater use of its high-speed infrastructure to put in place true broadband applications and services across important sectors. Notable applications such as m-diabetes for health or market pricing information for farmers are narrowband and text-message based. While they have had impacts, evolving to the features offered by broadband networks and smartphones could take these types of services to a new level. Broadband applications for schools and interactive electronic public services are two particular areas that merit more emphasis.

The government aims to tackle these challenges through an ambitious array of initiatives in its Digital Senegal Strategy. It is imperative that it maintains the stated level of funding for the strategy backed by a monitoring and evaluation system to ensure that Senegal benefits from the potential of broadband applications and services to help it achieve its national development target of becoming an emerging nation.

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<sup>172</sup> - Sonatel. 2015. "The impact of OTT on telecommunication services provided by operators in Senegal." [http://wholesalesolutions.orange.com/content/download/47961/1369504/version/1/file/OTT+in+Senegal\\_Birago+Beye.pdf](http://wholesalesolutions.orange.com/content/download/47961/1369504/version/1/file/OTT+in+Senegal_Birago+Beye.pdf)

# Institutions Consulted

Name
Agency for State Informatics (ADIE)
Authority for Regulation of Telecommunications and Posts (ARTP)
Consortium of Universal Service (CSU)
CTIC
EXPRESSO
HAYO
International Telecommunication Union (ITU)
Ministry of Posts and Telecommunications
SONATEL
TIGO
World Bank

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Investing in broadband can lead to among others: employment creation especially in sectors that are likely to be using ICT in a transformative way; increased innovation and productivity; and, better governance.



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