

MPAID Second Year Policy Analysis Paper

## **Domestic Broadband Infrastructure Policy:**

Laying the Foundation for the Future of ICT in Tanzania

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## EXECUTIVE SUMMARY

With the recent launch of its submarine fiber-optic cable, SEACOM removed the most significant historical constraint to East African broadband connectivity. Nonetheless, lack of adequate domestic infrastructure still prevents widespread broadband adoption and the Tanzanian government has enacted very proactive policies in response. Determined to catalyze investment, the government recently began building a national fiber-optic backbone. Because the substantial fixed costs of fiber networks are largely capacity independent, aggregating traffic in a single backbone can significantly lower the cost of broadband service provision. By encouraging private companies to utilize the government-owned backbone, Tanzania's policy seeks to maximize cost efficiency and to enable the private sector to focus on last mile infrastructure, content, and application services.

Of concern, in the two years since Tanzania's backbone policy was first put in place, the market has shifted rapidly. Currently the private sector is eager to invest in national backbone infrastructure on a cost effective basis, which implies public investment at the scale of the existing policy is no longer required. Additionally, the current policy carries substantial risks that remain unmitigated in implementation to date: 1) the government's ownership of a single national backbone may bias policy decisions; 2) a public monopoly limits incentives for efficiency and current costs for the national backbone are higher than industry norm; 3) the government's participation in the retail market through the government-owned Tanzania Telecommunications Company Limited (TTCL) compromises neutral management of the backbone and exacerbates the concerns outlined above. As a consequence of these issues, the current policy risks undermining the very objectives it was formulated to achieve.

Recommendations for policy improvements must consider the substantial government investment to date. Furthermore, the government must take care to foster private investment and competition without creating market inefficiencies. By selling conditional indefeasible rights of use (IRUs) and dark fiber across the government-owned national backbone, Tanzania can enable competition in the wholesale broadband market alongside a consolidated infrastructure. Offering IRUs and dark fiber will shift capital away from duplicative investments in new networks and allow the government to quickly recover a substantial portion of its investment. This approach will achieve scale in the national backbone and foster competition in the last mile, updating the current policy in light of the changes that have occurred in the market since its inception. Furthermore, these policies do not carry the significant implementation risks currently observed.

## 1. INTRODUCTION

Sub Saharan Africa's Internet markets are in their infancy. Limited telecommunications infrastructure and monopoly market structures have historically led to prohibitively high access costs across the vast majority of the continent, resulting in single digit levels of penetration (Paul 12). Connection speeds are extremely slow on average, yielding a quality level that significantly impedes the Internet's potential to improve productivity. Attempts made since the 1990s to improve East Africa's infrastructure resulted in failure and long delays. But the landscape is changing at long last, and changing faster than virtually every constituent anticipated (Herlihy).

The launch of the SEACOM submarine cable along the coast of East Africa in July 2009 marked the beginning of a new era in African telecommunications, increasing international capacity by 15x and dropping the price of international connectivity from \$1,500 Mbps to \$180 Mbps (Herlihy). Four other submarine cables will launch by Q2 2111 ("Africa Undersea"). The capacity and speed of these international connections enable domestic service providers to meet pent up demand for true broadband services. Additionally, the lower cost structures allow providers to profitably serve a much larger market. In order to make this possible, governments and companies are making massive investments in domestic infrastructure (ITU 19).

These trends create an enormous development opportunity for the continent. Empirical studies suggest that broadband adoption contributes to higher incomes and economic growth. A recent World Bank study based on econometric analysis of 120 countries found that a 10% change in broadband adoption is associated with a 1.38% increase in GDP per capita growth in developing countries<sup>1</sup> (Qiang and Rossotto 45). Beyond economic growth, broadband contributes to human development by improving the efficiency of public service provision. Studies have also shown that access to information, which is greatly facilitated by broadband adoption, contributes to improved governance (Besley and Burgess 1415). In addition to directly impacting national development, Tanzania's highly advantageous geography enables it to be a regional communications hub, providing connectivity to international submarine cables to its landlocked neighbors (Mettiji; Rubio).

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<sup>1</sup> Result is statistically significant at the 10% level.

Comprehensive broadband policies are crucial to exploit this opportunity, as the presence of multiple market failures lead private actors to supply and demand service at socially suboptimal levels. Now that SEACOM and EASSY have removed the bottleneck of international infrastructure, government and the private sector are focusing attention on domestic infrastructure. This paper analyzes policies relating to one segment of the supply chain: the national backbone network. Backbone networks, specifically fiber-optic backbone networks, are critical to the broadband supply chain; they provide high capacity connections between undersea cables and the metro and last mile networks serving consumers. Absence of government intervention in national backbone networks risks the market organizing into an inefficient cost structure, leading to higher prices that make commercial service unviable in some areas. Because demand for broadband is likely to be highly elastic in low-income countries, policies impacting consumer broadband prices will significantly impact adoption and, consequently, economic growth and human development.

Tanzania, like its East African neighbors, has instituted very proactive policies to ensure sufficient investment in its national fiber-optic backbone. This paper's analysis presents policy recommendations for Tanzania's national backbone – taking into consideration the country's development objectives, current broadband policies, market conditions, and the government's internal capacity for implementation. Research for this paper uncovered important findings relating to the supply of last mile infrastructure. These findings are not analyzed in detail but are summarized with suggestions for additional analysis in Appendix C. Though not addressed in this paper, it is important to note that a comprehensive broadband policy must also consider demand-side interventions.

The remainder of this paper is organized as follows:

Section 2 reviews the economic theory and policy options for government intervention in the broadband market. The section provides an overview of the theoretical justifications for policy to intervene in the provision of broadband and details potentially relevant market failures. The section further reviews the policy options available to governments to promote the supply of broadband infrastructure.

Section 3 summarizes Tanzania's current policies around the supply of broadband infrastructure, viewed in light of the framework set forth in Section 2. The section further raises implementation considerations for the current policy regime.

Section 4 presents an overview of Tanzania's telecommunications environment. This provides a description of the historical role of the government vis-à-vis the market as well as current competitive dynamics among the major telecommunications providers.

Section 5 analyzes barriers to private investment in national backbone infrastructure, which motivate broadband policy recommendations. The section reviews constraints to investment based on interviews with key stakeholders across the domestic ecosystem (listed in Appendix A). Analysis groups constraints into four areas: return on investment, access to finance, supply-side market failures, and institutional barriers.

Section 6 presents case studies of national backbone policies in two other East African countries: Rwanda and Kenya. These case studies give reference points for Tanzania's policy and provide insights from implementation in similar markets.

Section 7 considers the policy options outlined in Section 2 in light of current government policies, market dynamics, and constraints to private investments.

Sections 8 and 9 present policy recommendations as well as an implementation and monitoring plan.

## **2. GOVERNMENT INTERVENTION: THEORY AND POLICY TOOLS**

### **2.1. Economic Theory Behind Government Intervention**

Though compelling, the significant contribution of broadband adoption to development does not alone justify direct government engagement in the broadband market. Markets are powerful tools for efficient allocation of resources and government intervention often creates distortions that lead to suboptimal outcomes. In reality, markets fail in a variety of different ways. Such issues are the basis for government intervention, which lead to more efficient outcomes by correcting market failures. When establishing policies, it is important to target specific failures directly. Failing to do so risks exacerbating market inefficiencies (Rodrik). These industrial policy principles underpin this paper's recommendations for Tanzania's national broadband backbone.

Some governments may justifiably choose to intervene in the broadband market for non-economic reasons, particularly due to concerns over equity. Given the increasing role of broadband access in extending economic and social opportunity, many argue that lack of access puts non-users at significant disadvantage (Picot and Wernick 663). Countries such as Finland and Estonia have gone so far as make broadband access a legal right for all citizens ("Internet Access"). In this light, it is important to consider non-economic objectives when formulating industrial policy but to remain mindful of the economic distortions that stem from such interventions.

### **2.2. Failures in the Broadband Market**

Broadband markets are rife with failures that impact both supply and demand (i.e., imperfect information, imperfect competition, externalities, coordination failures, and difficulties accessing finance). These market failures justify government intervention in the supply of national broadband infrastructure. This section outlines the market failures that may be present in broadband provision, with an emphasis on how they relate to the supply of infrastructure and services.



### 2.2.1. Imperfect Information

Suppliers of broadband may face significant uncertainty regarding levels of demand, especially in low penetration markets. Such uncertainty can impede investment, particularly where initial capital investment is significant and irreversible. Consumers and businesses in turn may be ignorant of the economic and social benefits of adopting high speed Internet. Such ignorance leads to an undervaluing of the benefits of Internet and broadband service, resulting in suboptimal level of demand. These informational imperfections are likely to be particularly acute in Africa due to low Internet adoption to date.

### 2.2.2. Imperfect Competition

Delivering broadband requires substantial capital investments in infrastructure. In the case of a fiber backbone, the initial investment is significant and largely independent of the capacity of the network. Estimates of the percentage of total costs associated with the civil works required to lay the fiber underground vary from 60 to 90% (Mettij; Williams 20). Because adding capacity is a nominal contribution to the expense of laying fiber, backbone networks display the characteristics of a natural monopoly in low demand markets. Natural monopolies occur when, due to economies of scale, the market is most efficiently served with a single supplier. Even when demand is sufficient to support multiple providers, substantial up front investment creates a barrier to entry that leads to imperfect competition. Faulhaber and Hogendorn's study of broadband market structures suggests competition can be supported in mature markets but that markets are likely to foster natural monopolies during early periods of growth (323)<sup>2</sup>.

Left without regulation, firms will optimize profit by charging prices that exceed marginal costs, eroding consumer surplus and excluding large swaths of the population from service. These risks have dictated government's traditional role in regulating the telecommunications market.

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<sup>2</sup> Based on game theoretic analysis wired investments to the home.

### 2.2.3. Externalities

Broadband usage is associated with numerous positive externalities, whereby people other than those directly supplying or consuming a service benefit. Since individual actors do not take these benefits into account when making private decisions, markets naturally tend towards socially suboptimal outcomes (Mas-Colell, Whinston, and Green 353).

Robert Atkinson of the Information Technology and Innovation Foundation outlines four broadband externalities: 1) network externalities, 2) “prosumer” investment externalities, 3) competitiveness externalities, and 4) regional externalities (“Case” 6). Network externalities arise because the benefits of using broadband increase as the number of total users increases. “Prosumer” externalities stem from the ability of producers and governments to implement efficiency enhancing services when adoption is widespread (Atkinson “Case” 7). Productivity improvements such as these drive economic growth and government efficiency, yet consumers ignore such externalities when making independent access purchase decisions. Evidence points to broadband adoption leading to increased competitive advantage for domestic IT companies, yielding the competitiveness externality (Atkinson “Case” 10). Finally, as broadband becomes a requisite for businesses, investment decisions based on the availability of broadband lead to capacity building, enhancing regional economic growth (i.e., creating a regional externality that Atkinson observes) (“Case” 11).

Government intervention (often in the form of subsidies) is needed to ensure private actors take social benefits into account in their decision-making. As with information imperfections, relevant failures impact both the supply and demand of broadband.

### 2.2.4. Coordination Failures

Broadband markets have the potential to suffer from many different kinds of coordination failures. For example, due to the high fixed costs associated with broadband supply, provision is only profitable when demand reaches a certain level. Similarly, the availability of applications and content requiring high-speed connectivity is a key driver for broadband adoption, however application and content designed for broadband is only viable if there are sufficient broadband users already (Atkinson “Case” 7). Governments can intervene in markets where coordination failures exist to prevent them from remaining in an

unfavorable equilibrium, either by incenting the supply or demand of a service or simply coordinating the producers and consumers in the market (Bardhan and Udry 211).

### 2.2.5. Access to Finance

Capital market imperfections may lead to lack of adequate financing for positive value investments (Kim, Kelly, and Raja 39). In such instances, governments should intervene directly in the capital markets (i.e., partially guaranteeing loans or offering soft loans).

It is critical to understand which of the above failures are present and most acute in a particular country in order to determine an appropriate policy response. As this section outlines, there are many possible sources of imperfections in the broadband market relating to both broadband supply and demand. Though this paper focuses on only one part of the supply chain (the national backbone), a comprehensive broadband policy must address market failures in other areas of the supply chain as well as demand promotion.<sup>3</sup>

## 2.3. Supply-Side Policy Tools

Governments wishing to intervene in the supply of national backbone infrastructure may employ a wide array of policies. The appropriateness of any available policy tool is contingent upon what inhibits the market from supplying broadband services and the magnitude of market failures present. If broadband is promoted for non-economic reasons, policies should create minimal market distortion. These policies are not mutually exclusive; where multiple failures exist, a combination of policies becomes necessary. Moreover, different approaches are likely to be more or less appropriate for different parts of the supply

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<sup>3</sup> The demand side is of particular importance and is often overlooked in broadband policies. In Korea, the country with the highest broadband penetration in the world, the government instituted a broad range of demand side interventions. These included subsidized training for strategic segments of the population, subsidized access for low income and educational institutions, subsidized PC access, and proficiency requirements on national college entrance exams (Choudrie and Lee 107; Lee, O'Keefe, and Yun 87).

chain (i.e., the national backbone versus last mile infrastructure). The section below summarizes major policy options available to government.

### 2.3.1. Removal of Institutional Barriers to Investment

Constraints or uncertainty related to a presiding policy may create a barrier to investment even when no significant market failure exists (Melody 19). Examples include high entry costs due to licensing requirements, service provision restrictions by oversight agencies, mandated use of an incumbent provider's service, and lack of price regulation in the face of a monopoly provider (Melody 31; Williams "Broadband" 24). The private sector may be hesitant to invest due to uncertainty over future regulation. In situations such as those above, the government would need to liberalize the market, remove specific barriers to investment, or resolve policy uncertainty (Kelly et. al. 10).

### 2.3.2. Regulation

Regulation can be used to correct for imperfect competition. Where high fixed costs foster a natural monopoly or imperfect competition, pricing regulation would be necessary to ensure competitive price levels. But, in many developing countries, the ability to regulate monopolies may fall short due to the inadequate capacity of regulatory agencies or the poor quality of governance (Spintrack 18). In these situations, the benefits of increased competition may offset the costs of overlapping infrastructures.

Governments can also use regulation to subsidize supply by lowering producers' costs. Where costs are high but demand is still significant, it may be possible to use policy measures to foster commercial viability in marginal markets. Governments can, for example, provide open access to existing passive infrastructure such as roads, railways, and electric grids (Williams "Advancing" 58). Additional measures, such as mandated sharing of infrastructure (e.g., cell phone towers and co-location facilities), improve the overall cost structure of the market by precluding unnecessarily duplicative investments (Kim, Kelly, and Raja 48). In turn, the lowered costs for individual providers enable them to extend service to users who they could not profitably serve under the higher cost structure.

### 2.3.3. Investment Incentives

Investment incentives can take myriad forms and appropriately address a host of market failures faced by investors: low returns due to imperfect information, externalities, failures in financial markets, or coordination failures. Policy tools available to governments include demand aggregation, risk guarantees, tax incentives, low interest loans, loan guarantees, or direct subsidies. Governments commonly extend investment incentives to successfully change market behavior for non-economic reasons.

Where imperfect information results in significant demand uncertainty, operators may be unwilling to make the large and irreversible investments required to build fiber backbones. Demand uncertainty is likely to be particularly problematic in sub-Saharan African countries, where broadband penetration remains in the single digits and operators are only newly able to offer low priced Internet service. Demand aggregation policies are one mechanism the government can use to overcome this uncertainty, whereby the government pre-pays for services provided to public institutions. Policy makers can also use partial risk guarantees to address demand uncertainty (World Bank cited in Williams “Broadband” 33).

Where positive supply side externalities exist, the government can directly subsidize investment to cause agents to internalize the positive externality, thereby improving social welfare (Mas-Couellell, Whinston, and Green 355). Ideally, agencies award subsidies on a competitive basis. When governments use auctions to allocate subsidies, they overcome information asymmetries between themselves and private entities; bidding requires operators to reveal the level of investment they can profitably undertake to serve a market. Governments can thereby provide subsidies at the minimum level necessary to make a market viable for operators, limiting public funding required (Wellenius et al. 4).

Low interest loans or partial government loan guarantees can address capital market failures when service providers have a business case to invest but cannot access capital in amounts required (Atkinson “Explaining” 24). If high taxation or other fees prevent the extension of access to low-income consumers, public agencies can offset low returns by tax or other related incentives (Atkinson “Explaining” 24).

#### 2.3.4. Public-Private Partnerships

Government action is often required to address large coordination failures, uncertainties, or externalities. When circumstances require substantial public investments, governments may additionally prefer to retain partial ownership of infrastructure. Ownership gives public actors an opportunity to recover state resources and affords them a direct role in infrastructure decision-making. By using public-private partnerships, governments can maintain a stake in infrastructure while still benefitting from the skills and profit incentive of the private sector. Public-private partnerships also reduce the national investment required by leveraging the market's willingness to invest in some proportion of the infrastructure.

If government partners with a single entity, it can use a competitive auction as outlined in Section 2.3.3. A consortium model is an alternative configuration to the single private partnership, whereby the government partners with multiple stakeholders in the domestic ecosystem to collectively invest in a backbone infrastructure. This minimizes the investment required from any single stakeholder and enables the members of the consortium to provide checks and balances against each other. This may be the only viable option in countries where government resources are limited. A significant disadvantage of the consortium option is that it may preclude a competitive bidding process, making it difficult to assess the minimum public investment required (Williams "Advancing" 60).

The public-private partnership model has significant implementation risks. A direct government stake in the market may bias policy making in favor of the publically invested entity. As a consequence, institutions must be structured with care to maintain independent policy decisions. If there is no competition to the government-invested infrastructure, as will more likely be the case under the consortium model, the monopoly will have incentive to take advantage of its competitive position to maximize profits. Regulation or pricing oversight will be necessary to ensure competitive price levels. Of note, decision-making and execution may also be problematic in the consortium model due to the number of stakeholders involved.

No matter what the model of public-private partnership used, it is important that management of the backbone does not create mistrust in the market. If the partner is a service provider who competes in the retail market or such entities make up the consortium – there will exist a temptation to engage in price discrimination or to provide differing service levels (Williams "Broadband" 42). The best practice in such instances is to ensure neutrality by outsourcing management to an independent third party who does not compete in the retail market. Regulation is necessary if this is not possible.

### 2.3.5. Government Ownership

Government may need to fully own all or part of the broadband infrastructure if externalities are so large or coordination failures so challenging that the private sector is unwilling to invest at all. This may also be a desirable policy option for reasons that are not purely economic, such as national security considerations or ambitions to extend access rapidly to achieve development objectives.

The implementation risks associated with public-private partnerships outlined in Section 2.3.4 (i.e., biased policymaking, monopoly pricing, and lack of operational neutrality) apply to the government ownership model as well. Here, the incentive to bias policy-making may be even more significant due to the higher levels of public investment involved. Also, since this model does not leverage private sector skills and profit incentives, a government owned backbone exhibits higher risk of inefficiency and poor services levels.

### 2.3.6. Open Access

Orthogonal to the policy options above, which address market failures relating to the national backbone specifically, is the emergence of open access principles in broadband literature. Open access principles provide guidance for the national backbone's relationship to the overall broadband supply chain:

[Open access revolves around] creating competition in all layers of the IP network, allowing a wide variety of physical networks and applications to interact in an open architecture. Anyone can connect to anyone in a technology-neutral framework that encourages innovative, low cost delivery to users. It encourages market entry from smaller, local companies and seeks to ensure that no one entity can take a position of dominant market power. (Spintrack 5)

In order to realize this, the open access approach argues for the separation of service provision on backbone and last mile networks (Spintrack 16). There is a clear economic rationale behind this; doing so realizes efficiency by aggregating traffic where economies of scale are significant (i.e., the backbone) but fosters competition where the market can support it (i.e., the last mile) (Laffont 221). Also critical to this approach is removing barriers to entry for providers of last mile infrastructure, services, and content (Spintrack 21)<sup>4</sup>. Operators of backbone networks can then become "carriers of carriers," providing

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<sup>4</sup> Easy entry for ISPs and the ability to access existing infrastructure for service provision was a key success factor in Korea's exceptional broadband adoption (Stefanotti 14).

wholesale broadband service to the market. The challenge then arises that such operators may compete with their own customers if they also offer retail services. As a consequence, the wholesale provider ideally does not compete in the retail market, leveling the playing field for retail broadband service providers.

In practice, open access refers to full open and equal access to the network for all licensees in the market (Herlihy). These principles are required to foster a truly competitive environment for telecommunications because major operators are likely to continue to enjoy substantial market share. Open access principles in turn protect against the collusion that market concentration invites.

\* \* \*

The next three sections turn to analysis of the current conditions relating to national fiber backbone infrastructure in Tanzania. This assessment provides the basis for policy recommendations in light of the theory and options outlined above.



### 3. CURRENT BROADBAND POLICIES AND REGULATORY REGIME

#### 3.1. Policy

The vision of the United Republic of Tanzania's *National Information and Communications Technologies Policy* is for "Tanzania to become a hub of ICT infrastructure and ICT solutions that enhance sustainable socio-economic development and accelerated poverty reduction both nationally and globally" (2). Information and Communication Technology (ICT) infrastructure is one of ten main focus areas, which include policy objectives to "establish mechanisms that will result in least cost access to bandwidth for institutions or individuals in Tanzania" (11).

The Ministry of Communications, Science, and Technology (MCST) instituted very progressive policies to drive broadband infrastructure supply. The primary objective of the current policy is to maximize the cost efficiency of domestic infrastructure through public investments in national and metro area networks (Yonah). This encourages the private sector to focus on last mile infrastructure as well as content and application service provision. Additional measures are in place to foster universal access and to piggyback on other infrastructure initiatives.

Tanzania's broadband policy revolves around the National ICT Backbone (NICTBB). After years of insufficient momentum in the private sector to invest in adequate backbone infrastructure, the government approached Tanzania's mobile operators to foster joint investment in a national backbone. Because operators were unwilling to work together at the time (Banigbe), the government decided to invest directly in a 20,000km national fiber-optic backbone (Yonah). The NICTBB is composed of three rings and will extend into all major population centers. It will also provide regional connectivity to Rwanda, Burundi, Uganda, Malawi, and Zambia. To date, the government has invested a total of USD \$230M in a first phase covering 10,000km of the backbone. A USD \$170M soft loan from the Chinese government and USD \$30M in annual budget allocation over the past two years has comprised funding (Yonah). In building out the NICTBB, the government is extending significant amounts of new fiber and also utilizing existing fiber from entities such as rail and electricity companies. Three of the leading mobile operators (Zain, Tigo, and Zantel) are members of an oversight committee tasked to ensure that construction of the NICTBB meets the needs of the private sector (Yonah). Testing is underway for the first phase of the NICTBB, slated to launch in March of 2010.

The government will wholly own the NICTBB and operate it in a transparent manner according to open access principles, providing wholesale backbone services to the market. Tanzania Telecommunications Company Limited (TTCL), the national operator, will manage ongoing operations (Chilipweli). Pricing has not yet been announced but the government has stated its intention to provide services “at the lowest prices possible that are compatible with ongoing commercial viability of the backbone facility and with the need to recover a rate of return set by the government” (MCST 20). Furthermore, the government will set a rate of return that “a) provides for a sustainable ongoing commercial backbone operation; b) meets the return on loan funds required at any given time; and c) enables prices to be kept as low as possible to facilitate demand for backbone services” (MCST 28).

The government asserts that it would not prevent operators from investing in parallel and competing backbone infrastructure where market demand is sufficient to support a business case to do so. However, the government does not believe it to be socially optimal to have competition at the backbone level due to the economies of scale associated with fiber deployment (Yonah). The MCST therefore promotes a model wherein the government owns and operates a single backbone infrastructure. Through aggregating traffic and operating on a cost-recovery basis, the policy aspires to achieve a cost-minimizing structure for domestic telecommunications infrastructure.

Although investment to date has focused on the national backbone, the government also plans to extend its network into major metro areas and is currently working with the private sector to do so. Operators will have a choice to invest in parallel network infrastructure or to utilize the government’s services (Yonah).

It is explicitly the government’s policy not to invest in last mile infrastructure but rather leave that to a competitive private sector. The low cost structure of the national and metro area networks will enable service providers to profitably extend last mile infrastructure to serve low-income customers. In rural areas that are not commercially viable despite this model, the government will use investment incentives to extend last mile infrastructure (Yonah). The Universal Communications Service Access Fund, to which all licensed service providers contribute, will fund these incentives (TCRA *Universal 12*).

Coordination policies are also in place with the Ministry of Infrastructure to piggyback on transportation investments by laying conduit (passages through which telecommunications cables are laid) in all new roads (Yonah). This will dramatically reduce the cost of deploying fiber-optical networks, since up to 90% of the expense to do so stems from the civil work required to dig into the ground (Mettiji). Government will

manage the conduit according to an open access regime, wherein service providers can purchase IRUs (indefensible rights of use) to run fiber through the ducts (Yonah). Public and private sources will back a separate entity that will provide funds to lay the conduit (Yonah).

Because the fixed costs for a national fiber backbone are a substantial percentage of total costs and largely independent of capacity, there exists a strong case to aggregate traffic on a single national backbone. If implemented as stated, the current policy would achieve lower prices across the market. This would promote adoption by increasing demand and by allowing operators to extend into newly profitable markets. Throughout, the current policy adheres to open access principles of decoupling backbone and last mile service provision so as to foster innovation and competition downstream.

Still, as outlined in Section 2, full government ownership and operation of a single national backbone carries significant implementation risks. Government ownership of the backbone may bias the MCST and compromise their neutrality in policy-making. Furthermore, public monopoly raises the specter of poor service, inefficiency, and rent seeking. In Tanzania's case, the government's ownership of the incumbent operator, Tanzania Telecommunications Company Ltd (TTCL), may undermine the NICTBB's operational impartiality. TTCL's financial struggles, outlined in detail in Section 4, make this risk particularly acute; the close ties between the MCST and TTCL personnel further exacerbate the situation<sup>5</sup> (Erasmus, Seif Mohammed).

### 3.2. Regulation

In 2003, the Tanzanian government established the Tanzania Regulatory Communications Authority (TRCA), which brought together telecommunication and broadcast regulation authorities. In 2005, the TCRA enacted progressive regulation centered on technology neutrality (*TCRA Communications*). Policy makers are reviewing new legislation that will further promote competition and cost efficiency.

In 2005, Tanzania became one of the first African countries to adopt a technology-neutral, converged license regime. Under the regime, the government issues four types of licenses: network facilities, network services, application services, and content services. With the exception of interconnection, the TCRA does

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<sup>5</sup> Many MCST employees are also former TTCL employees

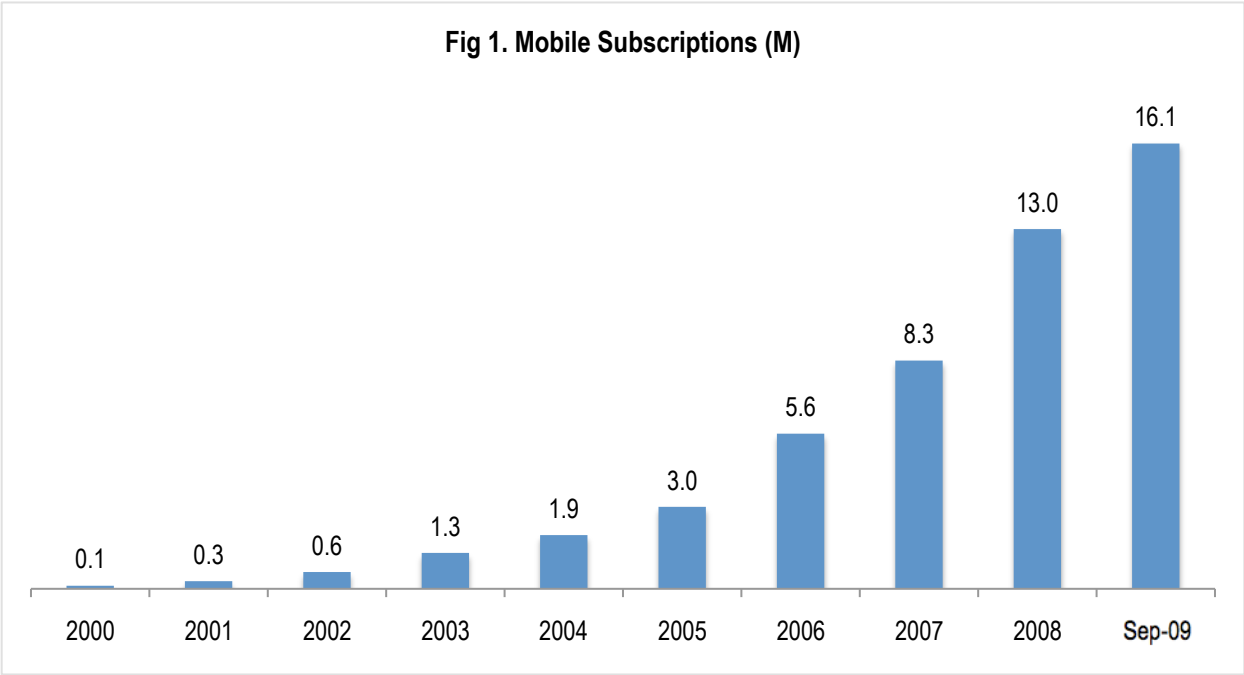
not regulate price but rather leaves it to the market to self-regulate through competition (Yonah). Interconnection is mandated and regulated. According to the act, “every electronic communications licensee has the right, for purposes of provisioning services, to negotiate an agreement for access to electronic communications network elements of any network facilities licensee and electronic communication services provided by any network services licensee” (United Republic of Tanzania *Special* 29).

The draft Electronic and Postal Communications Act includes additional measures to ensure competitive pricing and to promote cost efficiency. Licensees must determine prices based on principles of transparency, objectivity, and non-discrimination. They may not extend discounts that prejudice competitive opportunities of other licensees to provide application and content services. Licenses must also file prices with the TCRA before introducing them to the market (United Republic of Tanzania *Special* 31). The act further includes measures regarding anti-competitive practices, whereby dominant licensees may not take advantage of their market power to damage other licensees, prevent entry, or otherwise deter competition (United Republic of Tanzania *Special* 44). Specifically, the act prohibits discrimination in relation to price, quality, or the form of services (United Republic of Tanzania *Special* 45).

The act further gives the TCRA authority to regulate infrastructure sharing (United Republic of Tanzania *Special* 30), enabling the government to promote cost efficient infrastructure configuration across the supply chain.

## 4. OVERVIEW OF THE TANZANIAN TELECOMMUNICATIONS MARKET

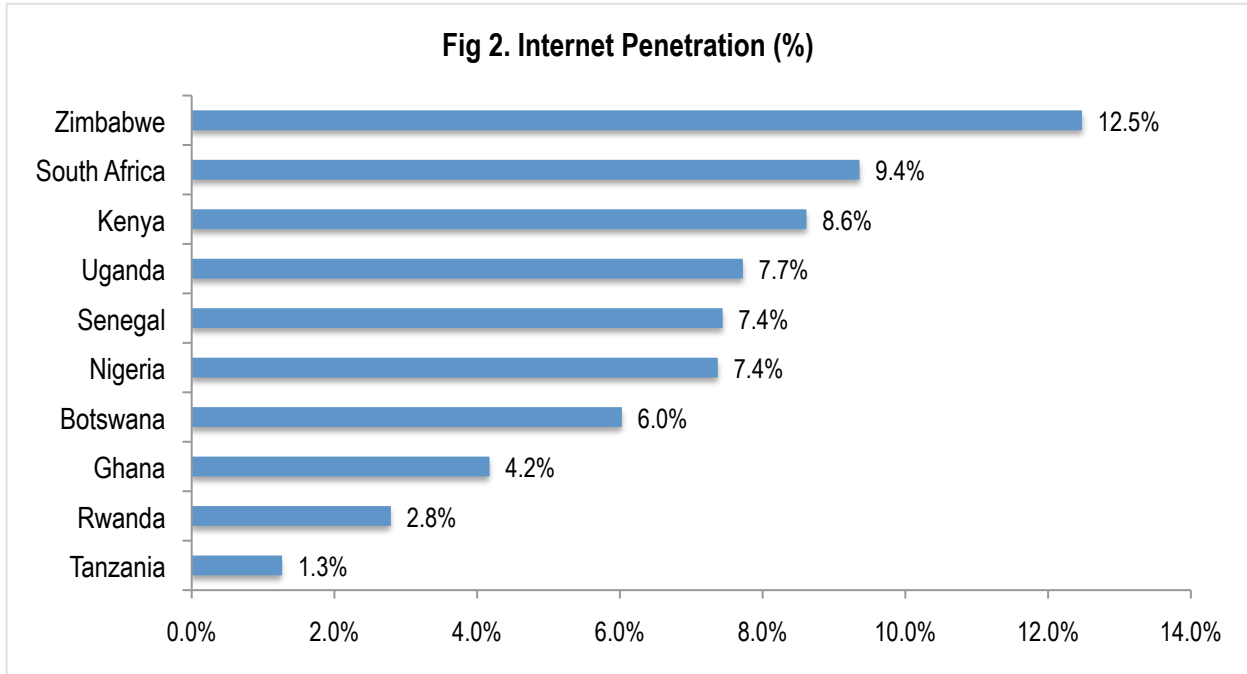
Mobile telephony dominates Tanzania’s telecommunications market, comprising 99% of the total subscriber base (TCRA “Telecommunications Statistics”). As of September 2009, there were a total of 16.1M mobile subscriptions in Tanzania, which grew at a compounded annual growth rate of 75% from 2000 to 2009<sup>6</sup> (Figure 1). This represents 38 subscriptions for every 100 Tanzanians, although actual mobile penetration may be significantly lower since many Tanzanians have multiple SIM cards.



Source: Tanzania Communications Regulatory Authority (TCRA)

In contrast to its mobile market, Tanzania’s Internet market is nascent with only 520,000 users (“Internet Usage”). This represents an Internet penetration of 1.3%, which is lower than corresponding figures for Tanzania’s East African neighbors and other comparable West and South African countries (Figure 2).

<sup>6</sup> Compounded annual growth rate was based on author calculation, estimating 2009 total subscribers 2008 subscribers + 1.333x net new subscriptions from January through September 2009.

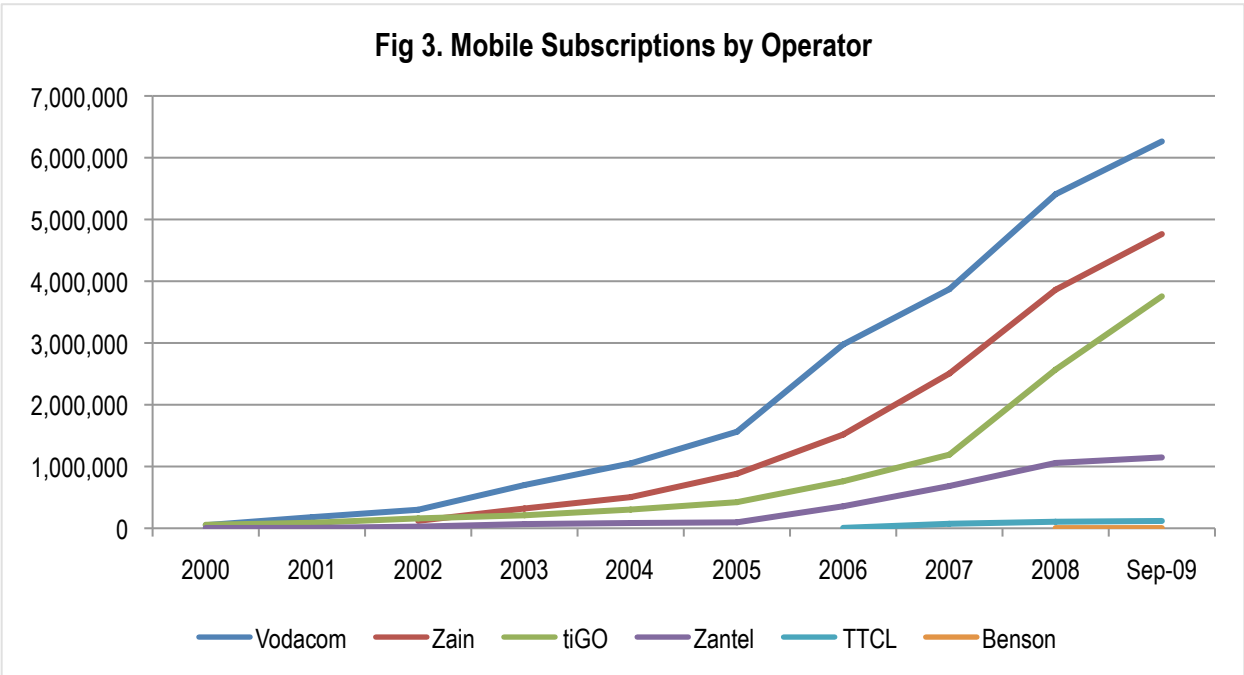


Source: InternetWorldStats

Liberalization of the telecommunications sector began in 1993 when the government split the Tanzania Posts and Telecommunications Corporation (TPTC) into three separate entities – Tanzania Posts Corporation (TPC), Tanzania Telecommunications Company Limited (TTCL), and Tanzania Communications Commission (TCC, later to become TCRA). TTCL began operations in 1994 with responsibility for establishing, developing, and operating the telecommunications sector in Tanzania (TTCL “History”). TTCL was partially privatized in 2001, when 35% of the company was sold to a consortium comprised of Dutch MSI (later to become Celtel) and German Detecon (who subsequently sold their stake to Celtel). Under the privatization agreement, the consortium took control of TTCL’s board and managed the company. Though the original contract mandated allocations to domestic financial institutions (14%), international financial institutions (10%), and TTCL employees (5%) – this allocation was never executed, leaving the government with a 65% ownership share that remains today (TTCL “Background”).

TTCL operates in a highly competitive market led by three mobile operators: Vodacom, Zain, and tiGO. TiGO was the first mobile operator in Tanzania, established in late 1993 as a joint venture but now fully owned by Millicom International Cellular (Millicom 27). Vodacom entered the market in 1999 and gained

market leadership within one year of launch (Vodacom). Celtel (now operating under the Zain brand) began providing service in 2001. All three operators are subsidiaries of major global telecommunication providers. Vodacom is the leading mobile provider with a 39% market share, followed by Zain (30%), Tigo (23%), Zantel (7.1%), TTCL (0.7%), and Benson (<1%) (TCRA “Telecommunications Statistics”). Vodacom has retained its leading market position (Figure 3).



Source: Tanzania Communications Regulatory Authority (TCRA)

In addition, Tanzania has 62 licensed ISPs & data operators (TCRA “Telecommunications Statistics”). Although Internet penetration remains low, the significant number of service providers indicates that the market is large enough to sustain a highly competitive environment in voice and data services. Even with current penetration levels, ISPs describe the environment as a “price war” (Ayittah; Lekamoi).

It is important to note the potential complications stemming from the Tanzanian government’s persisting majority stake in TTCL. Government ownership of the incumbent in the market has the potential to bias decision making towards promoting the government asset over social goals (Spintrack 9). A study by the World Dialogue on Regulation found that, in all developing countries studied, “investment risk was increased by arbitrary and unexplained usurpation of regulatory decisions by ministers or government

departments, often at the bidding of incumbent operators” (Mahan and Melody 7). TTCL’s financial, operational, and management struggles create additional political pressure. In July 2009, Canadian firm Sasktel backed out of a three year contract to manage “all aspects of the operations, maintenance and expansion of TTCL to improve the company's financial, commercial and technical performance,” citing inability to raise the funds necessary to turn TTCL around (Edwin). Last October, members of the Parliamentary Committee on Infrastructure asked the government to bail out TTCL with an injection of USD \$150M to prevent its collapse (Mnyanyika). Due to its financial condition, the company requires public backing to access financing but the government has not yet committed to support TTCL (Chilipweli). Finally, the government suffers from a strained relationship with Celtel, who owns a 35% stake in TTCL and is reportedly in the process of selling their ownership interest (Mnyanyika).



## 5. CONSTRAINTS TO INFRASTRUCTURE SUPPLY

Interviews with key stakeholders across the domestic ecosystem in Tanzania (listed in Appendix A) afford an understanding of the current constraints to private sector investment in national backbone infrastructure. Analysis categorizes constraints into four areas: return on investment (i.e., whether there is a business case), access to finance, market failures, and institutional barriers.

### 5.1. Return on Investment

The presence of demand externalities and information imperfections may result in insufficient levels of demand to justify private investments in a national backbone. Demand uncertainty may also lead providers to estimate returns insufficient to warrant significant investments. Interviews with senior technical staff at the four leading mobile operators – Vodacom, Zain, tiGO, and Zantel – reveal that investments in Tanzanian national backbone infrastructure do not lag because of low projected returns. Furthermore, the operators expressed interest in collaborating with the government to develop a cost efficient national infrastructure (Erasmus; Mettiji).

Major service providers believe there is substantial unmet demand for broadband services in the Tanzanian market (Banigbe; Cabral; Chilipweli; Fernandes). Anticipating drops in international connectivity prices due to new submarine cables, each operator put in place plans to make major investments in national and metro level optical fiber infrastructure. Vodacom has had plans to invest in a fiber backbone and metro level fiber since 2006 (Erasmus). Zain, tiGO, and Zantel each realized the need to invest in fiber and began moving forward with their own infrastructure projects – all three were poised to invest between USD \$20M and USD \$40M in independent networks, at the national backhaul level as well as across major metro areas (Baingbe; Rubio).

In 2008, recognizing that any competitive advantage from laying their own fiber would be obviated by parallel investments, the major mobile operators formed a consortium to jointly invest USD \$80M in a national fiber backbone (Banigbe; Mettiji; Rubio) whose operation and management would be the responsibility of an independent third party (Banigbe). The consortium is operated on an equal investment and equal maintenance basis, with membership open to all service providers (Banigbe; Seif Mohammed). Vodacom subsequently opted against participation in order to privately pursue investment, presumably

because of the head start it already had in its independent fiber roll out. Simbanet has since joined the consortium (Banigbe; Mettiji).

Vodacom is currently laying fiber between Dodoma and Dar es Salaam as well as in a metro ring in Dar es Salaam (Erasmus). The Zain-tiGO-Zantel-Simbanet consortium has proposed to fund and build national backbone and metro area infrastructure to be owned by the government, in exchange for 30-year indefensible rights of use (IRUs) to cover its collective capacity needs (Banigbe; Rubio; Seif Mohammed). This backbone would provide redundancy for the NICTBB and would utilize railroads for deployment. Alternatively, parts of the consortium built backbone could substitute for incomplete sections of the NICTBB (Rubio).

The current dynamics in the market thus demonstrate that low returns do not constrain investment in a national backbone or prevent backbone infrastructure from reaching all the major population centers in the country. Moreover leading operators are willing to invest in cost efficient infrastructure in partnership with the government.

## **5.2. Access to Finance**

Many African banks are willing to invest in additional telecommunications infrastructure because they enjoyed substantial returns from Africa's mobile boom (Herlihy). Furthermore, the Government of China continues to make massive investments in telecommunications infrastructure across Africa, financing the majority of large public projects (Herlihy). As a consequence, for major telecommunications investments such as national fiber networks, access to finance does not pose a constraint. The major operators' desire to invest in fiber networks further supports this.

One operator (TTCL) did cite access to finance as its primary constraint, due to its current financial condition and not as a result of capital market failures (Chilipweli). Additionally, access to finance is one of the most significant constraints for ISPs and other potential entrants in the application and content services market (see Appendix C for further findings) (Ayittah; Fernandes; Wilmore).

### 5.3. Market Failures<sup>7</sup>

While imperfect information and externalities relating to broadband provision may be present in Tanzania's broadband market, they do not constrain the supply of national backbone infrastructure (as elaborated on in Section 5.1). Imperfect competition does exist in the wholesale broadband market due to TTCL's effective monopoly over wholesale provision in Dar es Salaam. This does not impact national backbone investments but is important for last mile policies. Findings are discussed in more detail in Appendix C.

Coordination failures clearly contributed to the lack of historical investment in domestic infrastructure and this can easily be seen as justification for current policy formulation. But because demand has swelled with the launch of SEACOM and EASSY, a coordination failure no longer exists. This is evidenced by the major mobile operators' willingness to invest in national backbone infrastructure.

### 5.4. Institutional Barriers

A number of institutional barriers pose the most significant constraint to investment in Tanzania's national backbone infrastructure. These include challenges to securing the necessary permits for deploying fiber infrastructure and other requirements that significantly increase the cost of fiber investment.

Though many service providers have licenses that enable them to invest in fiber infrastructure, most players have been unable to obtain right of way agreements from the Ministry of Infrastructure<sup>8</sup> (Banigbe; Cabral; Erasmus; Kahama-Rupia; Mettiji). Only TTCL<sup>9</sup> and Vodacom have been able to secure necessary permits. The Zantel, tiGO, and Zain consortium obtained the requisite rights but they were subsequently taken away (Rubio). As a result, operators other than Vodacom have not been able to move forward with planned investments, though many have already purchased networking equipment (Banigbe). This is without question the single biggest impediment to investment in fiber backbone infrastructure today.

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<sup>7</sup> Failures relating to demand were not investigated in detail for the purposes of this study but are also likely to exist. While policies targeting these market failures are not necessary to ensure national backbone investments, they are likely to be required to ensure adoption levels that realize the social benefits of broadband access.

<sup>8</sup> The author was unable to interview the Ministry of Infrastructure for this analysis to further explore why this is the case.

<sup>9</sup> Despite having right of ways TTCL has been unable to make investments due to access to finance constraints (Chilipweli).

The government also imposes requirements for fiber-optical networks that significantly raise costs. In Tanzania, providers must lay fiber at a minimum of 1.5 meters underground, which substantially increases the cost for civil works (Erasmus). Additionally, providers must lay fiber at the edge of the far shoulder of roads versus next to existing roads (Erasmus). Trees, bushes, and even housing often obstruct the path of fiber at this distance, requiring removal that further increases the difficulty of fiber deployment. Finally, service providers must pay an annual fee of USD \$1,000 per kilometer for right of way to the Ministry of Infrastructure (Banigbe; Erasmus; Rubio), a cost which is reviewed each year and subject to change (Erasmus). Together, the three requirements raise the cost of deploying a fiber-optical network to between two to three times what it would otherwise be (Erasmus).

\* \* \*

Meetings with key stakeholders across Tanzania's private sector indicate that the primary constraints to broadband infrastructure investment at the national backbone level are institutional barriers, not market failures. This does not imply that there is no role for the government in the facilitation of the national backbone, but it does indicate that government investment at the scale of the current policy is not necessary.

## 6. CASE STUDIES

### 6.1. Rwanda

The promotion of information and communication technology (ICT) is central to Rwanda's development agenda, which seeks to transform the country from a low-income agriculture based economy to a middle-income knowledge based economy by the year 2020 (Ministry of Finance *Vision 2020* 9). As such, the government has comprehensive and proactive policies across all areas of ICT (International Monetary Fund 26). Core to Rwanda's development agenda is significant government investment in national backbone, metro area, as well as last mile infrastructure (Government of Rwanda 11). With the assistance of a USD \$24M grant from the World Bank, the government invested USD \$38M in a 2,300km national backbone (Hitimana; RITA). The primary objectives of the national backbone are to provide high-speed Internet access to government institutions and ensure equitable access to broadband throughout the country ("Rwanda National"). The backbone also provides wholesale broadband services to the market and the government controls infrastructure in order to ensure neutrality. A second phase of investments is underway, with the ultimate goal to provide high-speed access to 70-90% of the population. In addition, the public sector is investing in a fiber ring and Wi-Bro wireless access network that will cover Kigali ("Rwanda National").

The government has executed these policies within a competitive telecommunications market and has faced private sector concerns over increased competition (Price). Rwanda has been very strategic in its liberalization of the telecommunications sector in order to carefully manage competition. There are only three mobile operators present in the market: Rwandatel, MTN, and tiGO. The government began liberalizing the market in 1998, awarding MTN a license to become first mobile service operator ("MTN Group"). The incumbent Rwandatel was first privatized in 2005 and later re-privatized and sold to Libyan Consortium Lap Green Networks in 2007 ("Rwandatel"). In 2008, the government employed a competitive bidding process to license Millicom (operating under the tiGO brand) as the third national operator; tiGO launched services in November 2009 (Millicom 12; "Millicom Launch").

Both Rwandatel and MTN are deploying national fiber backbone networks that will compete with the government owned backbone in the wholesale broadband market (Price; ZTE). The state-owned electricity company, Electrogaz, is rolling out a fiber-optic backbone using its transmission network, which will have additional capacity to sell to the telecommunications sector (Ochudho). Thus, while the government

backbone provides wholesale services to the private sector, the government does not discourage private sector investments in national fiber backbones.

There are several benefits to Rwanda's approach. By investing in a national fiber backbone with support from the highest levels, the Rwandan government ensured a rapid roll out of infrastructure critical to its ICT-centric development goals. At the same time, by allowing private sector investments that overlap the government owned network, Rwanda harnessed competition to ensure that backbone services meet market needs and protected against the risks of a public monopoly. Because Rwandatel has been fully privatized, the government could execute the national backbone project without compromising its impartiality towards retail service providers.

There are also potential downsides to Rwanda's approach. While it may be in a private operator's best interests to make additional fiber investments, doing so allocates traffic across multiple networks and raises average costs across the market. As a consequence, entrance of additional suppliers of fiber infrastructure may reduce overall market efficiency. The risk this translates into higher prices for consumers is potentially mitigated in Rwanda's case; because the government participates in the market it may charge lower prices than for-profit enterprises would. Additionally, by building a Wi-Bro wireless network in Kigali, the government has moved into a retail market where demand is sufficient to facilitate competitive service provision. Government's entrance into retail may be justified by Rwanda's specific development strategy. However, this policy distorts the market and allocates public funds where they are not technically necessary.

## **6.2. Kenya**

Kenya benefits from having the highest Internet penetration rate in East Africa, at 8.6% with a total of 3.4M Internet users ("Internet Usage"). Like Tanzania, Kenya also benefits from a highly advantageous geographical position for regional telecommunications. As such, Kenya is Tanzania's competition for extending capacity from submarine cables to land locked countries.

One of the Kenyan government's primary ICT policy objectives is to "create a modern and efficient telecommunications infrastructure in order to position Kenya as a hub of industrial, commercial, and financial services in the region" (ITU 73). The strategy outlined for information technology infrastructure

advocates the establishment of a nationwide network consisting of fiber-optic, satellite, and terrestrial radio communication systems. The government states explicit goals to promote public-private partnerships, to foster infrastructure sharing and co-location, and to leverage passive infrastructure by encouraging capacity sharing with public utility providers (ITU 76; Ministry of Information *National 10*).

As a consequence of Kenya's policies, fiber infrastructure investments have flourished. The International Telecommunication Union's "Report on Regional Broadband Master Plan for the East African Community" includes a list of five separate fiber projects run by power and rail companies alone, which were built with the intention of leasing excess capacity to telecommunications operators (76). In addition, the government invested USD \$66M directly in a 5,000km national fiber-optic backbone infrastructure (NOFBI) in partnership with the World Bank, the Chinese government, and private companies (Ndemo). The backbone was completed in 2009 and covered three regions: Western, Central, and Coastal/Northern. Three separate companies (Huawei, ZTE, and Sagem) constructed different regions (ITU 83). Moreover, management of the operations and maintenance of the backbone was awarded through a competitive auction to Telkom Kenya alongside required conditions to uphold open access principles. In order to ensure neutrality, the government required that all existing licensed operators wishing to bid first demonstrate structural, functional, and accounting separation from any parent licensed operator (Ministry of Information "Expression"). As in Tanzania's case, the NOFBI aimed to stimulate private sector participation in last mile investments.

Kenya's telecommunications market is competitive across both services and infrastructure. The sector was first liberalized in 1998 with the Kenya Communications Act. This act split Kenya Posts and Telecoms Corporation into Telkom Kenya, Postal Corporation, and the regulatory Communications Commission of Kenya (CCK) (ITU 63). Telkom Kenya was partially privatized in 2007, with a France Telecom led consortium taking a 51% stake in the company, and now operates as Orange Kenya ("Orange"). Today there are many licensed operators in Kenya. Safaricom leads the mobile market with 14.5M subscribers and a 78% market share ("Safaricom"). Zain is the next largest operator with 2.4M subscribers, followed by Orange Kenya with 1.2M subscribers (Zain 3; "Update"). Importantly, Kenya's licensed operators include Kenya Data Networks (KDN), a "carrier of carriers" who does not directly provide retail services but rather extends wholesale national and international broadband to carriers, ISPs, and large customers (Spintrack 16). KDN has also made extensive investments in its own national fiber network (Ndemo).

By enabling a carrier network to enter the market, Kenya encouraged purely wholesale broadband provision and competition at the backbone level (Williams “Advancing” 54); evidence indicates there is substantial competition. In February 2010, Kenya Power and Lighting Company (KPLC) announced agreements with Safaricom and two other companies to lease three dark fiber pairs on its Mombasa-Nairobi link. This allows these companies to operate their own network using KPLC’s fiber (Kinyajui). Utilizing this infrastructure, Safaricom plans to enter the wholesale market and compete with KDN, NOFBI, and utility providers such as KPLC.

Kenya’s policies exemplify government fostering competition while taking a proactive approach to improve efficiency. In addition to establishing a national backbone infrastructure to reach the entire country, the government facilitated the use of existing utility infrastructure to lower the capital investments required to deploy fiber. As a consequence, retail broadband providers can choose between multiple suppliers of wholesale broadband service. Importantly, providers also have the ability to operate their own networks through agreements such as the recent one between KPLC and Safaricom. Critically, Kenya demonstrates that competition can be viable in wholesale broadband provision, even in markets with low penetration.

Ultimately, Kenya may exhibit an over supply of broadband infrastructure. If demand does not prove sufficient to support so many overlapping networks, the market will exhibit higher costs overall and may suffer a painful consolidation period. In that light, irreversible investments may have consumed capital that could otherwise have been channeled into more productive activities.



## 7. CONSIDERATION OF POLICY OPTIONS

This section reviews the spectrum of government options outlined in Section 2 in light of Tanzania's current policies, the market environment described in Sections 3 through 5, and the case studies presented in Section 6.

### 7.1. Removal of Institutional Barriers to Investment

Analysis of the constraints to private investment presented in this report indicates that, if government reduced the institutional barriers to investment, the market would supply additional national fiber backbone infrastructure. At a minimum, the Zain-tiGO-Zantel-Simbanet consortium would move forward with its backbone plans.

Wherever institutional barriers persist, market distortions will arise unless the barriers offset specific market failures. In Tanzania, it is unclear whether such a rationale exists for prevailing constraints to investment (i.e., challenges to obtain right of ways, design requirements that increase costs, and high annual fees to the Ministry of Infrastructure). A compelling case may exist to remove these barriers but additional investigation is needed to determine what specific adjustments to the status quo are optimal. Fostering competition by removing institutional barriers would also curtail many issues that might arise from a public monopoly presiding over the national backbone.

In any event, letting the market simply run its course would raise concerns. Because of the natural monopoly characteristics of the national backbone, the effect of introducing competition is ambiguous. On one hand, additional competition for wholesale broadband provision has the potential to lower prices and improve service. On the other hand, additional backbones would create a higher cost structure since fixed costs would not be shared across aggregated traffic. Furthermore, operators would allocate capital to new networks that may have been more efficiently allocated to last mile infrastructure and service provision. This is the policy risk illustrated in the Rwanda and Kenya case studies.

Looking beyond market considerations, since the government has made very large investments in a national backbone to date, a policy that would result in an additional backbone from the consortium may be politically infeasible. With Vodacom pursuing independent fiber investments, if the consortium members

cease to be customers for the NICTBB, the government is unlikely to recover its investment. This illustrates the dilemma created by government being both service provider and policy maker.

## **7.2. Regulation**

Regulation is not necessary to promote the supply of national backbone infrastructure, since all of the major operators wish to do so in the current market environment. Furthermore, regulation is not necessary to promote cost efficient market structures since the major operators in Tanzania's market have self-organized into a consortium. Still, the mandated infrastructure sharing measures included in the Draft Electronic and Postal Communications Act can help to foster incremental efficiency in the long run.

Of concern, while infrastructure sharing is an accepted practice for lowering costs, the current draft gives TCRA power over the rates charged rather than allowing the market to determine price for the TCRA's review ("Telecom Bill" 8). It is unclear what rationale exists for the TCRA to regulate rates directly since much of the notionally shared infrastructure would not be held on monopoly terms. As a consequence, such oversight would unnecessarily constrain the market and burden the TCRA.

## **7.3. Investment Incentives**

Investment incentives would not be necessary at the backbone level because the major operators in the market are willing to fund and build complete backbone networks. Offering incentives such as demand aggregation, risk guarantees, tax incentives, or subsidies would therefore be an inefficient use of public funds. Nonetheless, incentives are necessary to stimulate last mile investments – both in areas that are commercially viable and in those that are not (see Appendix C for elaboration).

## **7.4. Public-Private Partnerships**

A public-private partnership for a national backbone is not a requisite for adequate national backbone infrastructure because there is a strong desire by operators to make countrywide investments. Technically,

the government could convert the NICTBB into a public-private partnership. This model would enable the government to maintain a central role in the NICTBB to ensure it meets development objectives while reducing the government's direct investment.

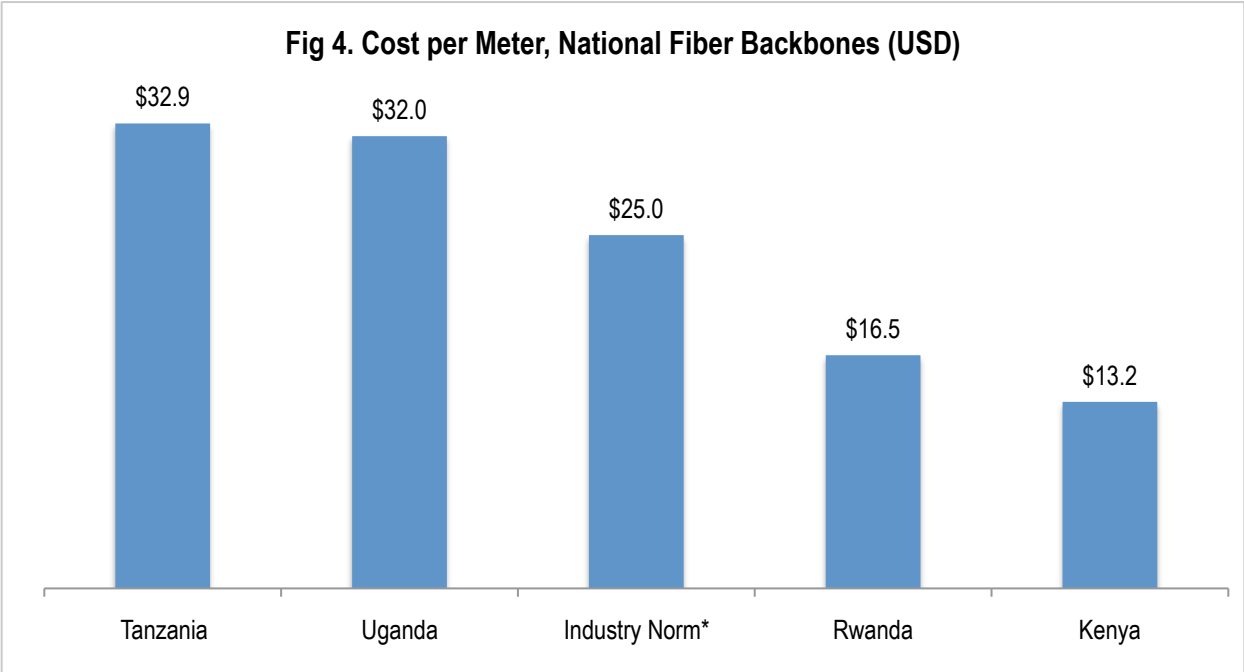
Due to the scale and timing of the investment to date, converting the NICTBB into a public-private partnership is unlikely to be politically feasible. Changing course before the network begins operations could be considered tantamount to admitting fault with the current strategy.

Even if the public-private partnership model could overcome political barriers, it will be difficult to create a structure that would be attractive to the private sector. Vodacom is not likely to abandon its current fiber roll out for the same strategic reasons that led it to opt out of the consortium in the first place. This leaves the Zain-Zantel-tiGO-Simbanet consortium as the most feasible partner for government. A public-private partnership with the consortium would require giving equal stakes to the five members, since the consortium's model is one of equal ownership. This may be difficult to achieve because the government has invested USD \$230M in the national backbone to date, compared to the USD \$80M investment the consortium is poised to make in an independent backbone. While the length of the proposed consortium backbone is unclear, its members are unlikely to want to make investments that would significantly surpass the USD \$20M that each has pledged to build the consortium infrastructure. Furthermore, the government would be unwilling to share ownership equally without recovering more than USD \$80M of its investment.

## **7.5. Government Ownership**

As with public-private partnerships, government investment and ownership in a national backbone is not a requisite to ensure a cost-efficient supply of national backbone infrastructure in Tanzania. Moreover, the consortium is willing to fund and build additional phases of the NICTBB in exchange for 30-year Indefensible Rights of Use (IRUs) or dark fiber allocations (Seif Mohammed). This makes it clear that the extent of government investment in current policy is not technically necessary, raising concern over whether public resources are being efficiently allocated. Additionally, as outlined in Section 2, government ownership carries considerable implementation risks. Early signs of the government's management of the NICTBB indicate these risks are not sufficiently mitigated.

Since the current policy favors a monopoly structure, a lack of competitive pressure may not provide sufficient incentives for cost efficiency. The government to date has invested USD \$230M in 10,000km stretch of the NICTBB, of which over 7,000km is new (Yonah). This equates to a cost of approximately USD \$32.9 per meter of new fiber construction, higher than the standard benchmark of USD \$25 used for multi-duct fiber networks (Herlihy). Based on interviews and reports from government agencies, it appears that Tanzania’s costs are higher than those of other African government investments in national backbones (Figure 4). Only Uganda has comparable backbone costs, where the national backbone project is currently suspended due to concerns over corruption (Kisambira and Malakata). However, without knowing the detailed specifications of the networks, precise comparisons are difficult to make<sup>10</sup>.



\* Refers to high quality multi-duct specifications.

Sources:

- Tanzania: Author interview with Dr. Zaipuna Yonah, Director of Information and Communications Technology, MCST.
- Uganda: Sunday Monitor <http://www.monitor.co.ug/News/National/-/688334/855174/-/view/printVersion/-/1mt6u/-/index.html>.
- Rwanda: Rwanda Information Technology Authority <http://www.rita.gov.rw/spip.php?article178>.
- Industry Norm: Author interview with Moncef Mettiji, Chief Technical Officer, Zantel.
- Kenya: Author interview with Bitange Ndemo, Information Permanent Secretary, Government of Kenya.

<sup>10</sup> Specifications detail the depth of the underground network as well as describe whether it has a multiple or single ducting systems or no ducting at all.

The level of capital expenditure to date may compromise the government's cost efficiency objectives. While the length of the consortium proposed backbone is unclear, interviews indicated that only USD \$40M is needed for commercial needs and an additional USD \$40M would be used to complete the backbone. As such, the level of government investment still significantly exceeds the level that the private sector believes is required to roll out a national backbone (Banigbe; Rubio; Seif Mohammed). Since there has been a lack of transparency regarding relevant investments, it is unclear why the NICTBB's costs are as high as they are (Kahama-Rupia; Lekamoi). A possible explanation comes from conditions associated with the loan from the Chinese government (e.g., requirements to contract to Chinese firms to build the network)<sup>11</sup>. These high costs create concern in the market over pricing, even if the government plans to operate on a cost recovery basis. There has also been a lack of transparency around pricing for NICTBB wholesale services, exacerbating such concerns (Banigbe; Seif Mohammed; Rubio).

As outlined in Section 4, the government's ownership of TTCL has the potential to bias management of the NICTBB. Of concern, the government gave TTCL responsibility over the operations of NICTBB because TTCL is a government asset (Yonah), rather than using a competitive bidding process. Concerns over neutrality are further exacerbated because TTCL competes in the retail market. In order to mitigate this risk, TTCL has created separate divisions for wholesale and retail broadband services. Furthermore, TTCL's retail service will purchase broadband from the backbone under the same contract as available to the rest of the market (Chilipweli). Still, the current agreement leaves little recourse for the private sector if service levels are unmet, creating concern that bias towards TTCL will compromise operational quality (Seif Mohammed).

The government's stake in TTCL also has the potential to exacerbate the risks associated with a public monopoly. Because the contract to manage the backbone was not awarded through a competitive bidding process, there is concern that high backbone operating costs will cause higher wholesale broadband prices (Seif Mohammed). Additionally, due to TTCL's service performance in the wholesale broadband market to date, public institutions and licensed operators worry that the NICTBB's wholesale service levels will not meet their requirements (Ayittah; Banigbe; Fernandes; Lekamoi; Mshinda; Rubio).

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<sup>11</sup> The USD \$32 per meter cost of Tanzania's backbone is consistent with the USD \$32 per meter costs reported for the Ugandan government backbone, both of which were built in partnership with Huawei Technologies (a Chinese company) and partially funded by loans from China's EXIM bank (Butagira, Jijun).

Finally, there are signs of anti-competitive practices that could entrench a public monopoly at the backbone level. As outlined in Section 5, the primary constraints to private investment in national fiber backbone infrastructure are institutional barriers. Though this analysis did not find clear rationale for these barriers, the private sector believes they exist to impede competition to the NICTBB (several anonymous interviews).

Evidence indicates that current policies threaten to undermine Tanzania's stated development objective: to provide the most cost efficient infrastructure in order to enable broadband access across the country. Based on interviews with major operators and ISPs, concerns over the NICTBB's pricing and service levels may impede private investment in last mile infrastructure (Ayittah; Cabral; Fernandes). This would be directly at odds with what the current policy declares as its objective.

## 8. POLICY RECOMMENDATIONS

Policy recommendations for Tanzania's national backbone infrastructure must go beyond a traditional economic assessment of market failures. Constraints posed by substantial government investments in NICTBB to date must also be taken into account. In the absence of such constraints, removing institutional barriers to investment and imposing regulation to achieve open access would yield Tanzania's desired outcomes for national backbone infrastructure supply. However, creating unbridled competition or abandoning the NICTBB is politically infeasible since the government has invested USD \$230M and the backbone is yet to go live. A creative policy solution is therefore needed.

Tanzania should maintain its policy of aggregating traffic in the NICTBB. At the same time, the government should foster competition in the wholesale broadband market by offering services attractive to both large and small licensees. Specifically, Tanzania's government should implement two key policies:

- Remove institutional barriers to investment that currently distort the market. This will beneficially yield competitive pressure and necessitate improvements in the management of the NICTBB.
- Offer conditional indefensible rights of use (IRUs) and dark fiber across the NICTBB infrastructure. This will enable competition in wholesale broadband without requiring duplicative investments.

These recommendations protect against the public monopoly risks inherent in the current approach. At the same time, these policies foster cost efficient infrastructure by consolidating traffic into the NICTBB. Additional policies are needed to promote the supply of last mile infrastructure and to ensure that ISPs targeting low-income customers can easily enter the market (as reviewed in Appendix C).

### 8.1. Removal of Institutional Barriers to Investment

Tanzania should address and remove those institutional barriers to investment that do not appear to be grounded in economic principles. Most importantly, government should ensure that licensed providers who want to make investments in fiber networks are able to secure the requisite rights of way from the Ministry of Infrastructure. Additionally, the MCST and the TCRA should reassess current specifications that fiber must be laid 1.5m below the ground and placed at the shoulder of roads. Because these requirements

significantly raise the cost of fiber deployment, they will result in higher pricing to end-users and will hinder adoption. Finally, the Ministry of Infrastructure should reevaluate the current USD \$1,000 per kilometer annual fee that providers must pay for rights of way.

## **8.2. Offer of Conditional IRUs and Dark Fiber Across the Government Backbone**

In parallel, however, the government should institute measures that protect against the concerns regarding removing institutional barriers outlined in Section 7.1. A closer look at the NICTBB reveals an opportunity to do so. The backbone can be disaggregated into two fundamental parts: the physical infrastructure (conduit containing fiber underground, manholes to get down to it, etc.) and the transmission layer (i.e., networking equipment that connects to the fiber and routes traffic). Considering the backbone in these terms enables the government to offer services that are attractive to all market players and thereby foster an efficient market structure.

Under the current operational plan for the NICTBB, TTCL will operate the network and provide wholesale broadband services to licensed operators. This means that TTCL maintains the physical network and operates networking equipment across the transmission layer. Pricing is not yet known, but it is widely assumed that the NICTBB will offer standard leased lines.

In this model, the government may also sell indefensible rights of use (IRUs). IRUs allow service providers to pay up front and essentially own a fixed amount of capacity on the network for a predetermined period. Because IRUs commit customers to an agreed upon volume of service over an extended period of time, they are priced at a discount relative to standard leased lines. Offering IRUs will facilitate the entrance of “carrier of carriers,” who can buy capacity in bulk and resell to ISPs. As referenced literature and Kenya’s case study suggest, wholesale broadband service providers who do not participate in retail level the playing field in the retail market and foster adoption.

Additionally, the 7,000km stretch of the 10,000km backbone that has been newly constructed will have capacity that exceeds the needs of the market. This means that fiber strands will remain unconnected to networking equipment, comprising “dark fiber”. Such dark fiber can be sold to the market, with the government maintaining responsibility for managing the physical network. In this model, service providers “light” the fiber; they invest in network equipment and operate stretches of the backbone network



themselves. Substantial capital investment is still needed to secure networking equipment in the transmission layer. However, the high and irreversible costs associated with digging into the ground motivate the need for a consolidated backbone. By selling dark fiber, the government can realize cost efficiency where it is needed most, in the physical network, while enabling competition in the transmission layer. For sections of the backbone that utilize pre-existing fiber from rail and electric companies, additional fiber investments may be required. The private sector will likely meet this need if enabled by the removal of institutional barriers to investment (as outlined above).

By selling indefeasible rights of use (IRUs) and dark fiber in addition to offering standard lease agreements, the government can extend a single cost efficient national backbone infrastructure that is attractive to all service providers. Critically, IRU and dark fiber offerings will channel the market's desire for investing in new fiber networks into investments within the NICTBB's physical infrastructure. In the absence of an IRU offering, a "carrier of carriers" wishing to enter the market may opt to invest in its own network. Large operators like Zain, tiGO, and Zantel prefer to manage their own networks for strategic reasons and have the resources to do so. Selling dark fiber would enable them to operate their own networks in parallel to TTCL's but allow them to use the same NICTBB physical network. This would significantly improve overall market efficiency relative to the consortium or other providers investing in new fiber networks.

By redirecting capital from duplicative investments in new networks to the NICTBB, selling IRUs and dark fiber will facilitate short-term recovery of a substantial portion of the government's investment in the NICTBB. As a result, this recommendation would have strong political support. Major players, represented by the Zantel-Zain-tiGO-Simbanet consortium, will welcome IRUs and dark fiber; the consortium has already offered to purchase IRUs on the government backbone and several operators have already purchased networking equipment (Rubio). Critically, IRUs and dark fiber will also create competitive pressure for TTCL to manage the NICTBB's operations efficiently and to maintain high service levels.

Still, even if the major operators purchased dark fiber and operated parallel networks within a single infrastructure, there remains risk that competition would suffer in the absence of a strictly wholesale provider. In order to protect against the imperfect competition that arises when wholesale providers also compete in the retail market, the government should extend IRUs and dark fiber conditionally, requiring that wholesale broadband service providers utilizing the NICTBB maintain open access principles. This will ensure neutrality towards all providers and promote competition in last mile infrastructure. Open access

requirements are unlikely to constrain demand for IRUs and dark fiber, as the major operators interviewed did not view wholesale broadband service as their core business (Rubio; Seif Mohammed). Additionally, open access is a principle of the consortium.

\* \* \*

Importantly, these policy changes do not undermine the current government effort to promote a single, cost-efficient backbone. If the government-owned backbone is operated in accordance with the recommendations in this report, service providers will have a strong financial incentive to utilize the NICTBB in lieu of rolling out new fiber investments. These recommendations will foster scale in the national backbone and promote competition in the last mile, updating the current policy in light of market changes that have occurred since it was first instated. Importantly, these proposals also mitigate issues with the current policy outlined in Section 7.5.

## **9. IMPLEMENTATION AND MONITORING PLAN**

### **9.1. Removal of Institutional Barriers to Investment**

The government should institute a review of those policies that currently constrain investment to determine whether justifications exist. Specifically, government should determine why the Ministry of Infrastructure has refused rights of way to most service providers. Additionally, it is important to reassess the design requirements and annual fees that significantly raise the cost of fiber investments. If the government cannot find a sound rationale for requirements that fiber be put 1.5m underground and placed at the extreme edge of roadways, then requirements should be adjusted so as to facilitate investment. Finally, the annual right of way fees to the Ministry of Infrastructure must be reevaluated. The annual fee should be based strictly upon incremental costs to the Ministry as a result of relevant infrastructure investments and not be considered an opportunity to extract rents from the private sector. Implementing this recommendation will require resources to conduct the review but will not create ongoing administrative burden for government. Because of the TCRA's independence, it is the best-positioned entity to conduct recommended reviews.

### **9.2. Offer of Conditional IRUs and Dark Fiber Across the Government Backbone**

In order for IRUs and dark fiber to be attractive to the market, particularly the Zain-tiGO-Zantel-Simbanet consortium, the government must set prices so that operators financially prefer IRUs and dark fiber to investing in separate fiber networks. While determining pricing will require resources, the capacity to do so overlaps with the NICTBB's current capabilities. As a consequence, implementing this recommendation should not trigger concerns regarding operational capacity.

Some regulatory oversight is required to ensure that backbone providers continue to maintain open access conditions and do not engage in anti-competitive practices. Since such measures are included in the current draft Electronic and Postal Telecommunications Act ("Telecom Bill" 9), oversight would require minimal incremental TCRA resources.

### 9.3. Monitoring Plan

Due to the degree of externalities associated with broadband adoption and its effects across both economic and human development, true impact evaluation of Tanzania's broadband policies is not achievable. However, the government can put in place efforts to monitor the output and outcomes of its national backbone policy to assess whether objectives are met. This includes defining key success factors and benchmarking against other countries. A forum for dialogue among the key constituents in the broadband ecosystem is also necessary to ensure the market serves Tanzania's development needs.

The objective of Tanzania's current policy yields key success factors that are measurable outputs: the cost of the national backbone, the pricing of wholesale broadband, the pricing of retail broadband, service levels for the NICTBB, and the number of licensed application and content service providers. Costs of the national backbone, both in terms of capital outlays and operating expenditures, will indicate whether the NICTBB is meeting cost efficiency objectives. Pricing in the wholesale and retail markets will determine whether competition has translated costs into appropriate prices. Service levels can be measured by the average time to procure service and the average time to respond to network outages, showing whether the NICTBB is maintaining quality standards. Finally, the number of licensed application and content providers operating in the market will imply the level of competition in the retail market.

These metrics should be monitored on a quarterly basis and benchmarked relative to other East African countries such as Rwanda, Kenya, and Uganda. Due to its independence, the TCRA should be given responsibility for monitoring these metrics. The TCRA should also present a summary report to the Office of the President and the MCST each quarter. Monitoring these outputs will create transparency in backbone investments and provide ongoing indication of whether or not government agencies have implemented policy in accordance with stated objectives. Such division of responsibility would create minimal incremental demands on the TCRA, as the authority already tracks prices and oversees licensees.

The government should also monitor outcomes to provide a better indication of how policies contribute to development objectives. MCST should measure various results on an ongoing basis: Internet adoption (ideally expressed as Internet users per capita), access to the Internet (as shown by percentage of households with access to Internet), and the share of regional traffic that routes through Tanzania.

In practice, measuring Internet adoption is challenging in developing countries. Since many users access the Internet primarily through shared resources such as Internet cafes, subscriber data does not give a proper indication of usage. If the number of Internet users is too difficult to obtain, Internet subscribers can serve as an easy proxy because subscriber data is tracked by the TCRA. Subscriber data can also be coupled with a sampling exercise to measure Internet users, where surveyors poll a representative sample of the population for both Internet usage and subscription. Access to the Internet is easier to measure. Shared usage behavior does not complicate measurement because last mile access will be largely delivered over wireless technologies. Therefore access can be tied to mobile operator's data coverage and ISP's wireless service areas. The percentage of regional traffic (i.e., from Rwanda, Burundi, Zambia, and Malawi) that routes through Tanzania will give an indication of whether the national backbone is competitive with Kenya.

In addition to the quantitative monitoring outlined above, ongoing dialogue with the private sector is necessary to ensure that the market can further Tanzania's development goals. In order to facilitate an ongoing exchange with the private sector, the MCST should chair a committee of key constituents in the broadband market: the TCRA, the TTCL, Vodacom, Zain, tiGO, Zantel, and representative ISPs. The ability of new entrants to service low income consumers is central to expanding broadband access. Therefore, it is important that the committee include members from both large ISPs and new players. This committee could meet on a bi-annual basis and would provide a forum for the private sector to communicate constraints to investment and user growth. The bottlenecks identified would in turn inform Tanzania's national backbone and last mile broadband policies.

## 10. CONCLUDING REMARKS

As the analysis in this report outlines, many market failures may create the need for government intervention in the supply of a national fiber backbone. The fixed costs of fiber backbones and adverse development implications of a high cost structure create a compelling argument for the government to safeguard efficiency. Moreover, by ensuring that wholesale broadband is available on an open access basis, the government can promote competition in the retail market and directly impact adoption levels. Despite such benefits, Tanzania's current policy carries significant implementation risks by promoting a public monopoly in the national backbone. This study makes the case that the current implementation of Tanzania's broadband policy raises significant concerns.

The pace at which markets evolve creates a key challenge to successful industrial policy making; Africa's telecommunications markets are currently undergoing a revolutionary transformation. Changes in the market since the MCST first formulated its national backbone policy imply that cost-efficient competition in the wholesale broadband market is newly viable. An adaptation to the current policy is therefore needed.

Institutional barriers to investment are the primary constraint to backbone provision. Removing them will ameliorate the distortions that currently impede the market. In tandem, offering conditional IRUs and dark fiber across the NICTBB will foster a cost efficient infrastructure while allowing competition. Critically, this approach enables the government to quickly recover a substantial portion of investment to date. As can be seen from the evidence put forth in this study, wholesale competition is vital to protecting against the risks of a public monopoly that are intrinsic to the current national backbone policy. Making the IRUs and dark fiber conditional on open access will protect against the conflicts of interest that providers face when offering wholesale service to their competitors in the retail market.

If government operates the NICTBB in accordance with the recommendations in this report, service providers will have a strong financial incentive to utilize a single national backbone infrastructure in lieu of rolling out new fiber investments. This will ensure the government's stated objective that "the backbone shall be the infrastructure of choice for all communications operators in Tanzania" (MCST 12).

This paper would be remiss in not stressing the need for comprehensive broadband policies that address market failures across supply and demand. Demand side policies can take many forms (e.g., providing assistance to purchase broadband access, subsidizing computers, providing basic ICT training, or

promoting local content creation). It is worth noting that most of the world leaders in broadband penetration put in place comprehensive national broadband strategies (Kim, Kelly, and Raja 36).

\* \* \*

The new era of telecommunications thrust upon Africa promises to profoundly accelerate social and economic progress across the wider continent, but especially in Tanzania. By creating a cost efficient national backbone infrastructure that major service providers utilize, Tanzania can lay the foundation for the future of ICT within its borders. Ultimately, by enacting multi-faceted broadband policies, Tanzania can dramatically and sustainably advance development.

## 11. APPENDICES

### APPENDIX A: LIST OF INTERVIEWEES

<b>Organization</b>	<b>Interviewee(s)</b>	<b>Position</b>
AfricaOnline; Tanzanian ISP	Stanley Ayittah	General Manager
Cats-net; Tanzanian ISP	Melwyn Cabral Savio Fernandes	General Manager, Cats-net Managing Director, CATS
Ghana ISP Association	Eric Osiakwan	Secretary
Government of Kenya	Dr. Bitange Ndemo	Information Permanent Secretary
Ministry of Communications, Science, and Technology (MCST)	Dr. Zaipuna Yohan	Director of Information and Communications Technologies
Ministry of Telecom and Postal Services, Southern Sudan	Shem Ochuodho	Senior Advisor
SEACOM	Brian Herlihy Anna Kahama-Rupia	Chief Executive Officer General Manager, Tanzania
Tanzania Commission for Science and Technology	Dr. Hassan Mshinda	Director General
tiGO; Tanzania mobile operator	Obafemi Banigbe	Chief Technical Officer
TTCL; Tanzania state owned national operator	Priscilla Chilipweli	Chief Technical Officer
Vizada; Tanzania network service provider	Lenjore Lekamoi	Managing Director
Vodacom; Tanzania mobile operator	Sewes Erasmus	Head of Department, Transmission
Zain; Tanzania mobile operator	Georges Alain Rubio	Technical Director
Zantel; Tanzania mobile operator	Moncef Mettiji Ahmed Seif Mohammed	Chief Technology Officer Project Team Leader, Planning and Infrastructure



## APPENDIX B: SUMMARY OF POLICY OPTIONS

The following table summarizes the major considerations for each policy option:

	Technical Correctness	Political Feasibility	Operational Capacity
Regulation: barriers removal	<ul style="list-style-type: none"> <li>Will result in the competitive supply of a complete national infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>Resistance since creates competition for the gov't-owned national backbone</li> <li>Decreases revenue from Ministry of Infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>No requirements, only policy changes</li> </ul>
Regulation: cost reduction	<ul style="list-style-type: none"> <li>Will facilitate cost efficiency in backbone investments</li> </ul>	<ul style="list-style-type: none"> <li>Policy has political support; in current draft legislation</li> </ul>	<ul style="list-style-type: none"> <li>Requires enforcement and oversight by TCRA</li> </ul>
Incentives: risk mitigation	<ul style="list-style-type: none"> <li>Unnecessary since business case exists</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Incentives: Loan facilitation	<ul style="list-style-type: none"> <li>Unnecessary for backbone due to operator parent companies</li> </ul>	<ul style="list-style-type: none"> <li>Needs to be determined for last mile polices</li> </ul>	<ul style="list-style-type: none"> <li>Requires significant human capacity for proper implementation; may be constraint</li> </ul>
Incentives: tax holidays	<ul style="list-style-type: none"> <li>Unnecessary since business case exists</li> </ul>	<ul style="list-style-type: none"> <li>Tax holidays already in place for all computing equipment</li> </ul>	<ul style="list-style-type: none"> <li>No incremental capacity required</li> </ul>
Incentives: subsidies	<ul style="list-style-type: none"> <li>Unnecessary since business case exists</li> </ul>	<ul style="list-style-type: none"> <li>Resistance since creates competition for the gov't-owned national backbone</li> </ul>	<ul style="list-style-type: none"> <li>Requires management of auction process</li> </ul>
Public Private Partnership	<ul style="list-style-type: none"> <li>Unnecessary since business case exists</li> </ul>	<ul style="list-style-type: none"> <li>Private sector open to PPP</li> <li>Can enable recovery gov't investment</li> <li>Current policies indicate government preference to own vs. subsidize</li> </ul>	<ul style="list-style-type: none"> <li>Requires regulatory oversight of pricing</li> </ul>
Government Ownership	<ul style="list-style-type: none"> <li>Unnecessary since business case exists</li> <li>Incentive challenges from public monopoly</li> </ul>	<ul style="list-style-type: none"> <li>Strong support given significant investments to date</li> </ul>	<ul style="list-style-type: none"> <li>Requires regulatory oversight of pricing</li> <li>Risk of inefficiencies and monopolistic behavior</li> </ul>

## APPENDIX C: LAST MILE FINDINGS

This analysis did not include a comprehensive assessment for last mile infrastructure, however interviews uncovered information that is of use to policy makers. These findings are summarized below.

### Constraints to Investment

At the last mile level, the following appear to constrain investment:

- High energy prices, due to the need to back up operations with diesel powered generators.
- Difficulties accessing finance, due to collateral requirements.
- High prices for wholesale broadband, due to TTCL's de facto monopoly.
- Difficulties accessing spectrum, due to an over allocation of frequency.
- Concern over pricing and service quality of the national backbone.

### *Low Returns*

There are of course, substantial rural areas where it is not commercially viable to extend last mile infrastructure. Where service providers do have operations, several interviews revealed a contributing factor to low returns was the high cost of power due to the need to run diesel power generators to maintain operations (Ayittah; Bangibe).

### *Access to Finance*

Access to finance is a constraint for ISPs and other potential entrants in the application and content services market. Several ISPs interviewed cited it as the single biggest constraint to their business (Ayittah; Cabral; Fernandez; Wilmore). Current ISPs face difficulties securing finance due to collateral requirements, one interviewee had to use his house as collateral (Ayittah; Wilmore).

### *Market Failures*

While the simplicity and technology neutrality of the converged regime facilitates market entry and competition, evidence from interviews with key constituents in Tanzania's telecommunications market suggests that competition is insufficient in some areas of the market for self-regulation. TTCL's wholesale business is not regulated (Banigbe; Chilipweli) despite their de facto monopoly in the market and excessively high prices (Ayittah; Banigbe; Fernandes; Lekamoi). Although TTCL's official monopoly over fixed line telecommunications services ended in 2005, it has remained the sole reliable provider of wholesale broadband due to government related constraints on investment (CTV offers competing services but their infrastructure is above ground and as a result is unreliable) (Cabral; Lekamoi). TTCL charges seven thousand dollars per month; two to three times what is typical in a competitive environment (Fernandes; Lekamoi). TTCL's service levels are also problematic; outages in excess of twenty-four hours are not uncommon. This monopoly pricing and low service levels pose a constraint on last mile investment for ISPs and would be entrants into the market (Cabral; Fernandes).

Human capital is scarce in Tanzania and the market is extremely competitive for labor with skills in the telecommunications sector. The scarcity of human capital is seen as a constraint to growth by some (Cabral; Fernandes), and for others it has created an environment wherein firms do not reap the full value of training employees to overcome the skills gap. Firms generally hire college graduates and train their own employees, but there is substantial poaching, particularly from ISPs to operators (Ayittah). This creates some disincentive to fully invest in employees and as a result an underinvestment in training.

### *Institutional Barriers*

The most frequently cited institutional barrier to investment is problematic frequency allocation (Ayyitah; Banigbe; Erasmus; Fernandes; Wilmore). This is due to over-allocation of frequencies, which creates interference for those who have spectrum allocated. For new entrants into the market, the issue is an inability to procure the spectrum necessary to offer service.

There is also a lack of trust between the government and the private sector due to the presence of TTCL, a majority owned government entity, as a competitor in the telecommunications market (Chilipweli; Fernandes; Lekamoi). This lack of trust was exacerbated by the recent decision to award the contract for

management of the national backbone to TTCL without a competitive bidding process. Though service levels are agreed upon to purchase capacity on the backbone, private operators have no recourse if they are not met and are highly concerned due to TTCL's performance to date. This perception of bias towards TTCL, whether it is real or not, further inhibits infrastructure investments.

The implementation to date of the national fiber backbone has the potential to impede last mile investments, especially outside of Dar es Salaam. The government has not yet announced pricing, despite repeated request from the market, which has created substantial fear of monopoly pricing levels. As a result of the anticipated high costs to connect through the government backbone and service level concerns with TTCL's management, service providers are reconsidering investment plans in other major metropolitan areas (Cabral; Fernandes).

## **Consideration of Policy Options**

### *Regulation*

Improvements to spectrum regulation appear to a priority to enable last mile investments, as the vast majority of last mile networks will be wireless (Wireless 1). Additional investigation is needed to determine how improvements can be made to the existing allocations while considering political difficulties – companies who have paid for spectrum allocations are unlikely to be willing to give them back to the government. Based on interviews, the government is currently investigating allocation improvements.

Infrastructure sharing is also critical for last mile infrastructure, as it will facilitate market entry. ISPs with low cost operating models will be able to take advantage of these regulatory measures to enter the market and bring access to marginal, low-income markets.

### *Investment Incentives*

Incentives are necessary for last mile access, both in areas that are commercially viable and those that are not. Where there is a business case for last mile provision, challenges accessing finance due to the collateral requirements of local banks inhibit investment. One way the government can overcome this is to

partially guarantee or directly offer loans to existing ISPs and new entrants. There may be political pushback if financial resources are limited, particularly considering the intense competition in the ISP market today. Implementing this policy would also require the government to determine the correct mechanism for incentives while protecting against moral hazard, as well as the appropriate interaction with banks. Such policies are difficult to get right and may be a challenge depending on human capacity constraints.

Where bringing broadband to Tanzanians is not commercially viable, the government would need to directly subsidize investments in infrastructure. This is the purpose of the Universal Access Fund. The government should minimize the subsidy required by implementing a competitive bidding process, whereby operators would bid on the level of subsidy required to build out access (Wellenius, Foster, and Calvo 7). Awarding the subsidies could be conditional on pricing and service levels to protect against a monopoly environment. In some cases, the existence of a newly subsidized infrastructure coupled with mandated infrastructure sharing may enable other ISPs to enter rural markets and create competition. The challenge with utilizing the Universal Access Fund is the disproportionate contribution to the fund of the major operators in the market, who may create political pressure to utilize the fund to subsidize their operations.

Preliminary evidence thus indicates that a complex set of policies are needed to promote the supply of last mile infrastructure and service provision – particularly around spectrum allocation, access to finance, and access to competitive wholesale broadband services. It is critical to highlight the need for ISPs targeting low-income customers to easily enter the market. In order to serve low-income customers profitably, companies will need to devise innovative operating models. The current players may not be willing to make significant operational changes in order to pursue marginal markets. As a consequence, in order to meet Tanzania's development goals of extending access across the country, it is crucial that ISPs can easily enter the market and target this segment.

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