Tanzania rural coverage pilots

Performance report

Connected Society

The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 300 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences.

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The GSMA Connected Society programme works with the mobile industry and key stakeholders to improve network coverage, affordability, digital skills and locally relevant content, in pursuit of the wider adoption of the mobile internet.

For more information, please visit www.gsma.com/mobilefordevelopment/programmes/connected-society

Report published in February 2018

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1 Executive Summary

Over **72,000** rural inhabitants covered by **3G services** for the first time

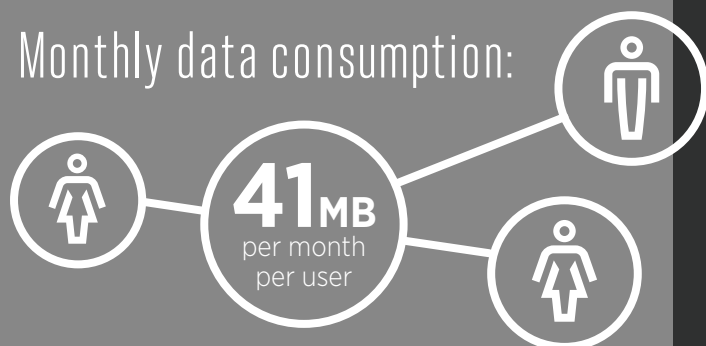**40,000** daily mobile users representing a **95%** penetration rate of addressable market

17% of mobile users access mobile broadband services on a daily basis

Monthly data consumption:
41 MB per month per user

Voice usage:
43 minutes per users per month
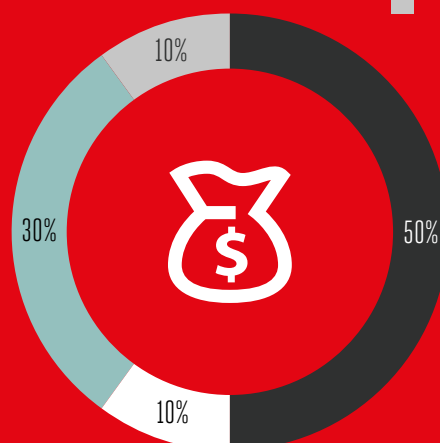
Total monthly spend per user is
$0.90
(three times the figure from 3 months ago)

Total revenue split:
- Voice
- SMS
- MFS
- Data

10%
50%
30%
10%

At current levels, projected revenues per site is estimated to reach

$62,000
per year

This is sufficient to ensure site viability from an operational cost perspective

CAPEX and taxes levels need to be addressed in order to improve the investment case

Solution

Users Feedbacks

"If I didn't have a phone, it would be very difficult to run my business. When the sellers bring the goods into the village, the different retailers will fight to get them, but if you have a phone, you can call and make the order."

"If I don't know something I can just type it into Google and find out about it. I feel more confident as a teacher and I don't need to skip sections of lessons out of fear of not knowing answers to student's questions."

"I primarily use the internet to communicate with friends and family, but I also participated in some online sports betting. Solar energy is not reliable especially in cloudy conditions."

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Introduction

Connected Society is part of the GSMA's Mobile for Development programme which brings together mobile operator members, tech innovators, the development community and governments, to prove the power of mobile in emerging markets. The Connected Society's mission is to support the mobile industry to increase the adoption of the internet for the underserved by tackling key barriers: network coverage, affordability, digital skills and locally relevant content.

Over 95% of the World's population lives within the footprint of a 2G network but the reach of 3G mobile broadband capable networks, at around 70%, is much lower. The mobile broadband coverage gaps exist primarily in developing world markets (especially in Africa and Asia) where the technical and commercial challenges to network expansion are significant.

Areas without coverage often lack basic infrastructure such as roads and electricity meaning it is significantly more expensive for mobile operators to deploy, power and maintain base stations and to install the backhaul capacity needed to provide end users with fast data connections. In addition to higher operating and capital costs, the revenue generating opportunity from base stations in rural areas is often greatly reduced compared to urban areas. Population densities are typically much lower (meaning a smaller market opportunity) as are income levels (meaning lower levels of per user spend on mobile services).

The Infrastructure Economics team works with the Mobile Industry to identify and implement commercially sustainable solutions to network coverage expansion, typically through infrastructure sharing models and the application of alternative technologies. The team also works with governments and regulators to ensure the right enabling policy environment is in place.

In August 2015, the infrastructure economics team initiated the first large scale tripartite national roaming project in Tanzania. With over 13 million citizens yet to be connected to the internet, digital inclusion in Tanzania has become a strategic priority for operators and the government alike. Connecting the remaining population in Tanzania will support an increase in GDP output and create new economic opportunities for all citizens.

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Project Background

Context

In July 2016, Airtel, Tigo and Vodacom agreed to implement mobile broadband enabled pilot sites and test for the first time a tripartite national roaming agreement in Tanzania, the first of its kind in Africa. The three operators agreed to trial a network shared 3G light cost solution on 6 pilot sites (2 per operator) spread across the country. The GSMA supported the drafting of the agreement and coordinated the operational effort to implement the pilots sites commissioning and to ensure efficient dissemination of information between all parties.

The sites were planned and deployed with the support of Nokia Networks, Ericsson and Huawei. Each vendor deployed two sites each using their most cost efficient solutions to address ultra-rural areas.

The 3G first pilot sites went live in Q1 2017 offering mobile broadband coverage for the first time to rural Tanzanians. Under the pilots' network sharing agreement, each operator partnered with their respective technology vendors to enable network roaming across all 6 locations. The pilot site locations were chosen in partnership with UCSAF in order to address the universal service fund priority list and assess viability in real life conditions. UCSAF provided full support in the planning stages of the new sites including the assessment of the site locations and supported operators in clearing administrative approvals for site deployments.
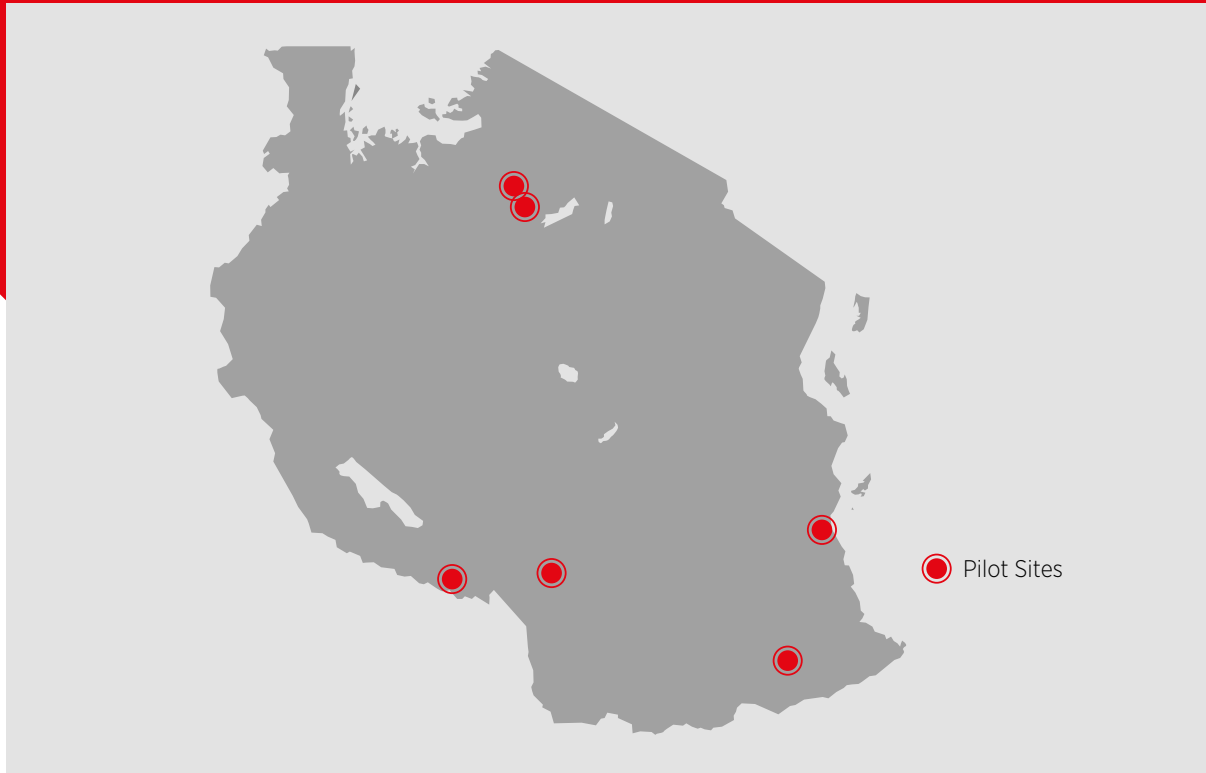
SITE	LONG	LAT	WARD	REGION	DISTRICT	POP.	ADDRESSABLE MARKET
Airtel 1	34.3214	-3.1585	Tindabuligi	Simiyu	Meatu	12034	7220
Airtel 2	34.5008	-3.5165	Mwangundo	Simiyu	Meatu	12270	7362
Tigo 1	39.1438	-8.5484	Mingumbi	Lindi	Kilwa	9948	5969
Tigo 2	38.6146	-10.5848	Chiwale	Mtwara	Masasi	11311	6787
Vodacom 1	33.3974	-9.2946	Ilembo	Mbeya	Mbeya Rural	9178	5507
Vodacom 2	34.9205	-9.2065	Ikuna	Njombe	Njombe Rural	17391	10435
Total						72132	43279

Laying the tower foundations

Tower and antennas

Solar panels and cabinet installed
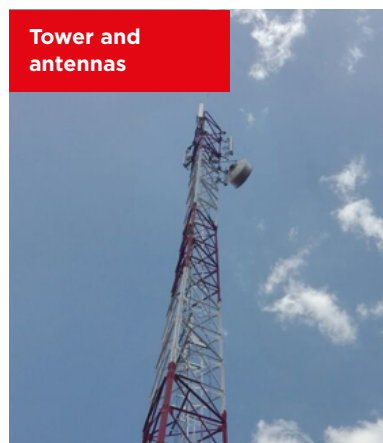
Objectives

The pilots site deployments represent the 2nd phase of the GSMA coordinated mobile broadband (MBB) coverage expansion project in Tanzania. In the first phase, the GSMA developed an economic and financial model in order to assess and identify the most viable infra-sharing solution to deploy economically viable solutions for MBB access provisioning in rural areas.

The assessment completed as part of phase 1 of the project issued the following recommendations:

Increasing Mobile Broadband coverage to 100% of the Tanzanian population using network roaming will have the following impact on the telecom industry and economy as a whole on a cumulated basis over five years:

- *Impact without Regulatory and Fiscal Adjustments:*

  - Industry revenues to increase by $390 million, representing a 2.6% yearly increase versus 1.9% on average today
  - Industry cash flow to decrease by $340 over five years, representing a decrease in CAGR of 5pp from 9.5% today to 4.5%
  - GDP would increase by $7.6 billion from its current level, representing an averaged 0.3% increase per year versus current level
  - Net Fiscal impact of extending coverage to 100% would represent an additional $1.2 billion in fiscal revenues over the period

- *Impact of decreasing the excise tax on all mobile services to 10%:*

  - Industry revenues would increase by $570 million, increasing CAGR by a further 1.1pp to 3.7%
  - Industry cash flow would improve by $250 million over the period but would still remain negative
  - An additional $2.7 billion would be added to the country GDP

The objectives of the pilots were hence threefold in order to validate the theoretical findings of phase 1:

a. **Assess Commercial sustainability**
   - To validate the best sharing solution to provide mobile broadband to uncovered population in a commercially sustainable manner
   - To validate partnerships sustainability
   - To assess mobile services uptake and usage in uncovered areas

b. **Understand Socio-economic impact**
   - To conduct field survey among both local communities to highlight benefits
   - To assess financial impact on local communities

c. **Regulatory Proof of Concept**
   - To test regulatory and fiscal dispensation and monitor benefits
   - To advocate results to policy maker for regulatory and fiscal adjustments

In addition, the GSMA engaged with various government agencies to investigate policy and regulatory enablers. The enablers highlighted as part of phase 1 of the project included the following dispensation requests:

- A waiver on the cost of access to electricity poles and public building rooftops
- A waiver on the cost of rights of way access to new sites
- Fast track planning permission for new sites
- Local taxes waiver for selected sites
- Specific 5MHz frequency band for rural coverage in the 900MHz band allowing better quality of service and faster coverage expansion
- Discounted environmental fees
- A waiver on import duties for network equipment and devices

Tigo 3G Pilot Site in Chiwale

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Users Feedback

"If I didn't have a phone, it would be very difficult to run my business. When the sellers bring the goods into the village, the different retailers will fight to get them, but if you have a phone, you can call and make the order."

" I primarily use the internet to communicate with friends and family, but I also participated in some online sports betting. Solar energy is not reliable especially in cloudy conditions. "

" If I don't know something I can just type it into Google and find out about it. I feel more confident as a teacher and I don't need to skip sections of lessons out of fear of not knowing answers to student's questions. "

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Technical Solution

Each operator selected their own specific equipment vendor to build two pilot sites providing low cost sites, to ensure economically sustainable coverage is provided to rural communities. Ericsson - who partnered with Tigo on their pilot sitess - implemented a suite of solutions to provide the operator with the capabilities needed to reduce total cost of ownership by up to 40 percent.

All sites built as part of the pilots had to meet the following technical specifications and be fully compliant with the national roaming requirements:

1	Low Cost Rural Site for a single sector Base Station equipped with 3-way splitter and 3-sector antenna system. The RAN Solution need to be able to carry the traffic for all 3 Operators (Traffic/Site to be shared).
2	Site Configuration: 2G up to 12 TRXs and 3G Single Carrier using 900 Frequency Band.
3	Backhaul transmission based on Microwave technology (Support of Fiber whenever available).
4	100% Solar Power Solution with the Flexibility to Connect to Grid Power in the Nera future.
5	Free standing tower structure of 35m length.
6	Single RAN Base Station that will support 2G/3G and should be Outdoor.
7	High Temperature batteries which can operate in environments of >40+ degrees without requiring forced/active cooling.
8	Hardware, Software, Services, Transportation, Solar solution that can support both 2G and 3G (up to 1000W load), 35m self-supporting tower, MW antennas, Fence and Civil works.
9	1000w load solution for 24/7 with an SLA of 100% availability.
10	Dual Band Antennae.
11	Site integration & initial tuning (Physical Optimization) should be Vendor's responsibility.
12	RF, TX & solar service Installation Commissioning and initial tuning.
13	DC Power solution for the sites, 100% solar with the flexibility to connect to Grid in the near future.
14	Re-use of existing BSC(s), and OSS/BSS and re-use of existing interfaces to the core network.
15	Support Existing Network Management System.
16	Network Design (HLD/LLD) should be Vendor's responsibilities.
17	Vendor to see the possibility of using the existing 900 Frequency operators have to deploy both 2G and 3G in the rural areas.

The site designed for the pilots met all the required technical and cost specifications. The new suite of solutions that was commissioned for the first time in Africa as part of the pilots included:

Solar power solution with site controller:

- **Solar panels:**
  - 2.3Kw solar installation
- **Power charger:**
  - Solar converter to enable renewable energy for remote telecom installations
  - Combined with efficient operation of generator sets
  - Up to 80% reduction of operational cost
- **Batteries:**
  - Optimal power draw and 96.5% conversion efficiency ensuring nearly complete utilisation of the energy generated by the PV panels
- **900 MHz antenna:**
  - 790-960 Frequency Range
  - Max power input 500W
- **MINI-LINK backhaul:**
  - MINI-LINK 6351 is an outdoor units for the V -band, i.e. 60 GHz
  - MINI-LINK 6351 is an 1 Gbps microwave node optimised for small cell deployments
  - The integrated 60 GHz radio and antenna provides capacity, easy installation and minimum visual impact
- **EVO BSC/RNC:**
  - EVO Controller 8000, a controller combining BSC (Base Station Controller) and RNC (Radio Network Controller) in one unit.
  - The unit is fully flexible and adjustable between GSM and WCDMA traffic while offering high capacity and small footprint
- **Light enclosure**
  - Cost-optimised solution
  - Designed to support multiple combinations of baseband, power and backhaul in the same cabinet
- **45m self-supporting lattice tower**
  - Self supported universal tower for medium loads, with maximum height of 60m.
  - The tower type is well suited for telecommunication systems, both onshore and offshore, and for large flow-light systems.

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Pilot Sites
Commercial Results

Six 3G pilot sites were activated by Airtel, Tigo and Vodacom in 2017. Three sites were built in areas where only 2G coverage was available, the other three in areas without any mobile coverage. Across all six commissioned sites mobile broadband connectivity was provided to 70,000 people for the first time representing an addressable market of 43,000 mobile users. Rural network national roaming was enabled on all sites with customers benefiting competitive offering at retail level from all three operator from a single infrastructure deployment.

National Roaming (*)

Rural

HSS HSS

Core Core

BSC RNC BSC RNC
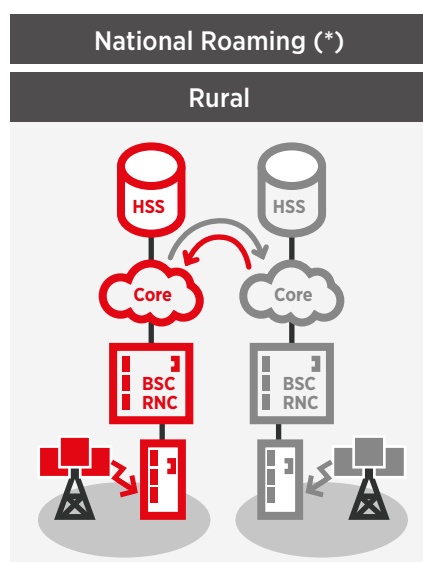
Wholesale arrangement geographical partnership

- Geographical sharing
- One frequency sufficiant
- Wholesale/cost-sharing

- 1 infrastructure owned by a single host

- Customers from partner MNOs allowed to roam on the site and identified at core level

- Full competition at retail level allowing for end user to choose from the all range of offers on the market

Despite some technical issues due to the implementation of roaming and delays due to environmental challenges in rainy season all sites were live in June 2017.

Users & Adoption

Uptake of mobile broadband services around pilot sites showed very positive results over the period. Despite a hesitant first two months, adoption levels increased significantly from month three onwards to reach 64% of mobile penetration by the end of month four. The slow uptake in month one and two was due to multiple technical issues after the sites were commissioned. Two sites reported ongoing solar power issues and damaged equipment due to the rainy seasons affecting the stability and quality of power supply at the sites. Network roaming was also only enabled from month two onwards, restricting customers options in terms of services and tariffs. The performance report indicates that as soon as retail level competition was introduced, adoption levels improved.

Mobile Services Adoption at Pilot Sites

TOTAL Subscribers — MOBILE SERVICE ADOPTION/Addressable Market — DATA SERVICE ADOPTION/Addressable Market
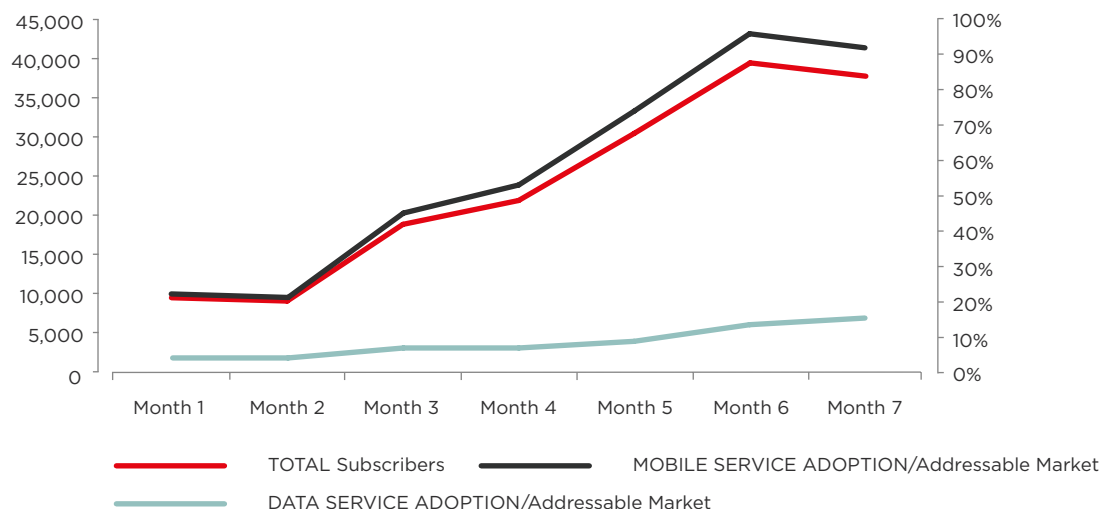
Within 4 months, adoption levels in the villages around the sites reached the current Tanzanian average which stands at 65%. These figures indicate a very strong adoption performance given the challenging economic conditions of nearby populations. The GSMA estimates revenue per capita in the surrounding areas at less than a dollar a day.

In addition to showing high mobile adoption levels, data services were also in high demand. By end of

month 7, 16% of potential users were using 3G data services daily on their phone, representing 17% of unique mobile users by the end of the period. 3G services were specially praised by school teachers and businessmen in the area enabling them to access information unavailable in their vicinity. The data adoption figure in the pilot areas equals to the Tanzanian average. By YE2016, 17% of Tanzanians were accessing data services on their mobile phones on a regular basis.

Mobile Data Services Adoption at Pilot Sites

DATA SERVICE ADOPTION/Addressable Market — DATA SERVICE ADOPTION/Mobile Users
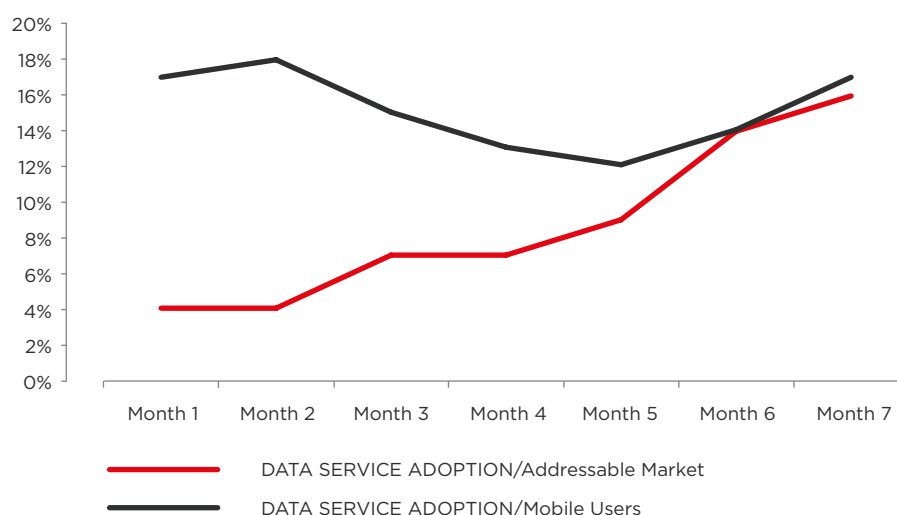
12% of subscribers have been roaming on host sites over the period. However, if Airtel's sites are here excluded (due to technical issues affecting roamers) this figure rises to 20%. This fact shows that despite competition being introduced at retail

level, subscribers tend to choose the host provider. Roaming allows for more choice at retail level and, as seen above, tends to boost adoption levels when introduced.

Usage

The pilot sites have posted strong results in terms of usage per subscriber revealing sustained subscribers' engagement across all services. As adoption increased SMS became the most frequently used service with 70 SMS sent per user per month by the end of the period. Voice usage was reasonable with 43 outgoing minutes per user per month by month 7 in line with rural Africa benchmarks.

The 17% of mobile subscribers using data services consumed 41MB per month on average by month 7.

A drop in data usage is observed between month 2 and 3 as penetration levels increased substantially, reflecting mobile services adoption by lower quintiles of the population.

Monthly Usage per Unique Subscriber
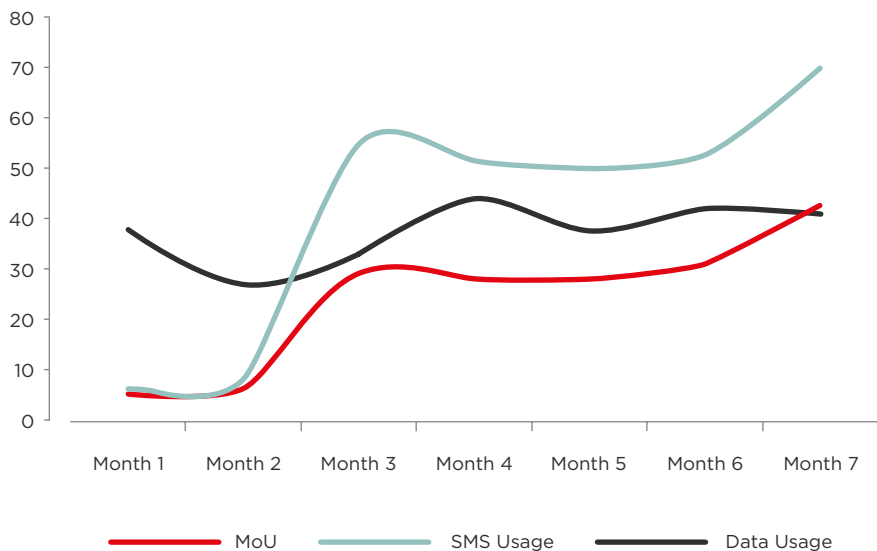
Revenues

After 7 months of operation, all six sites reported healthy revenue levels validating the sustainability of the roaming model chosen for the pilots. At the end of month 7, each site generated on average $5,200 in revenues per month excluding wholesale revenues generated from the roaming itself. On average, each subscriber spent $0.90 per month by the end of the period split per service as follows:

MFS 30%
SMS 10%
DATA 10%
Voice 50%
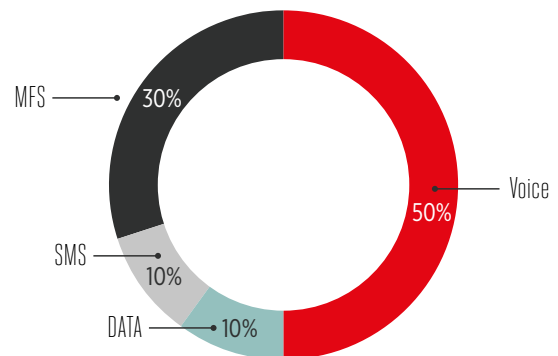
Monthly Spend per Unique Subscriber
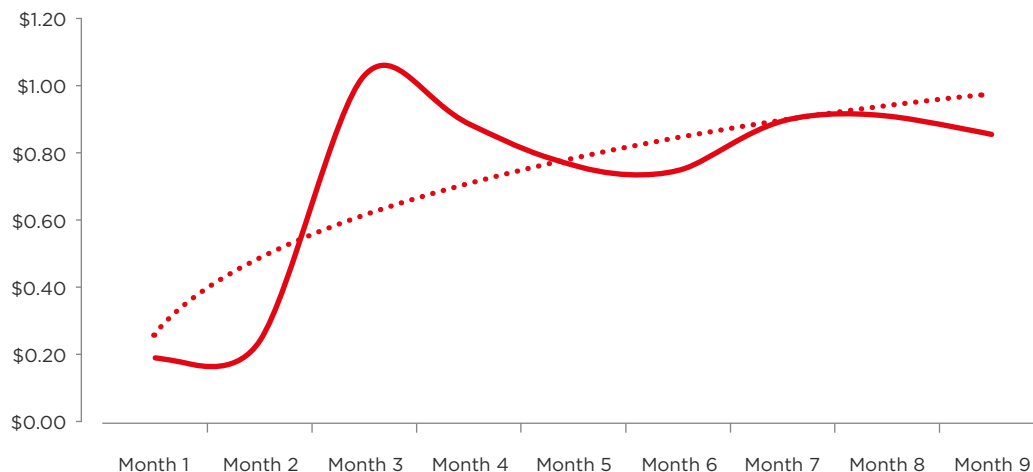
The 17% who were using mobile data, spent an average $0.33 per month on the service. Most internet users go online to search for news and information and access entertainment content. The vast majority of respondents would like to increase their use of mobiles and of the internet but are constrained by their income. Currently villagers allocate on average, 5% of their monthly income to mobile services across pilot sites.

Mobile Financial Services (MFS) have been a prime revenue generator since the activation of the sites. This proves the strong demand for MFS in rural areas. Remittances in rural areas of Tanzania are paramount to daily life. The money is often sent from family and businesses based in urban areas. Cash is used to meet immediate needs as well as to purchase food including meat and vegetables, clothes, and mobile credit. For many rural inhabitants, mobile money also provides an important safety net in emergency situations. Interoperability agreements between mobile money providers in Tanzania make it easy for mobile money users to send money across domestic networks (Vodafone, Tigo and Airtel). Local farmers and traders have also been using MFS around the sites to transact with local customers.

Blended Monthly Revenues for all 6 Pilot Sites

Legend:
- MFS
- Voice Revenues (1 day based)
- SMS Revenues (1 day based)
- Data Revenues (1 day based)
- Total monthly Revenues

Costs & Profitability

At current levels, projected revenues per site is estimated to reach $62,000 per year. This is sufficient to ensure site viability from an operational cost perspective.

The total OPEX for the sites is estimated at $35,000 on average the first year as a result of backhaul cost, maintenance, security and power provision. The average OPEX for the sites is inflated due to the use by one operator of fuel powered generators. The other sites are using solar panels for power generation which come at an average OPEX of $5,000 per year.

Average NPV* Profile per Pilot Site
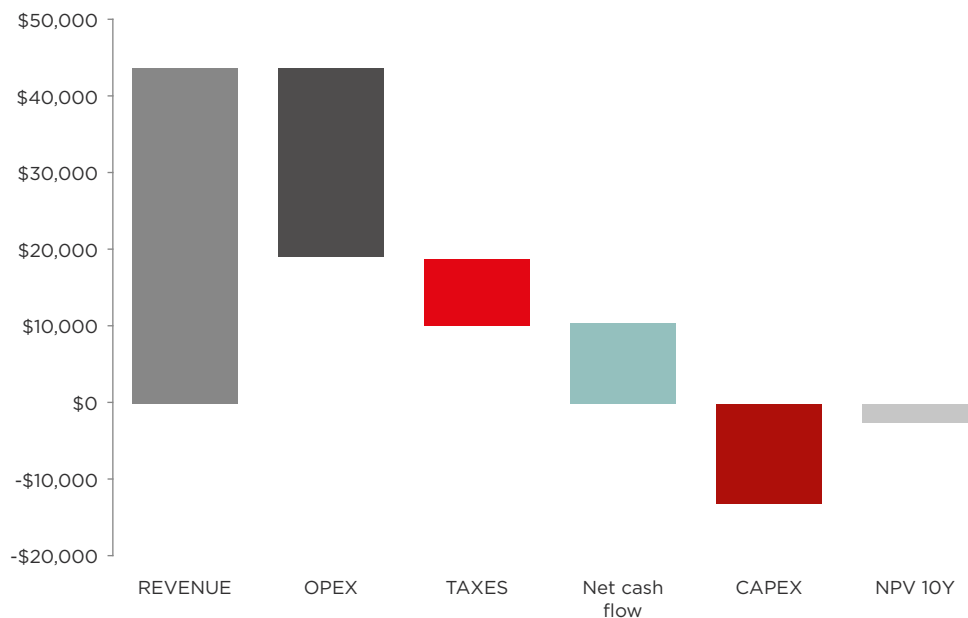
*excluding terminal value

Given current revenue and OPEX levels, the sites post a positive EBITDA margin of 44% suggesting that the sharing model is viable from a strict revenue/OPEX perspective.

However, CAPEX and taxes levels render rural sites unprofitable. The savings generated by the sharing agreement are not sufficient to compensate for the whole investment unless some solutions are considered among which:

- Government financial support in the form of grant or equity partnerships
- Implementation of low cost access solutions
- Lower taxes for selected sites
- 0 rated Long term debt

The table below shows potential ways to structure investment in order to ensure rural sites viability over the long term:

a. The allocation of USF subsidy up to 50% of sites cost is required in order to close the investment gap

b. In addition, we recommend operators to obtain long term debt support for the targeted sites with a minimum 5 years amortization scheme

Parameters	Value per Site
Discount rate	14%
Inflation	6%
Taxes (on profits)	45 %
Initial Annual Revenue	$62,404
Initial Annual OPEX	$35,000
Site cost	$130,000
Site subsidy	53%
NPV 5 years	$575
NPV 10 years	$44,394

In order to incentivize investment in rural areas, we also encourage the Tanzanian government to issue taxes waiver on specific items including:

- A waiver on the cost of rights of way
- Local taxes waiver for selected sites
- Discounted environmental fees
- A waiver on import duties for network equipment and devices

7

Pilots Technical Performances

The Technical KPI's have been shared by only one operator to date, therefore limiting the GSMA's ability to provide a holistic view of all site performances. Some key instances regarding site technical performances where highlighted and are reported below.

The quality of service provided for voice services is in line with the current regulator's recommendations, with less than 2% drop call rate at the end of the period. Data RAB and PDP establishment success rate reached 96%.
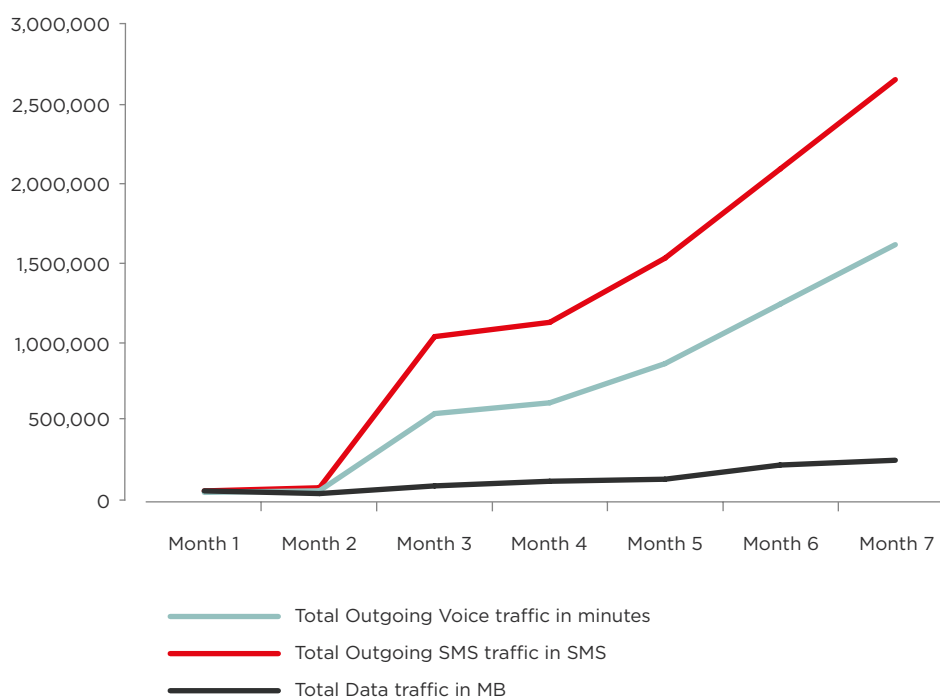
Both Tigo sites suffered power and backhaul outages in early April, which impacted customers'

perception of the operators' service. Users reported experiencing network quality issues during and after the outage period. Some users also reported very limited data speeds to the point of the service not being usable. The technical monitoring shows however a reasonable site availability ratio of 85% on average across sites.

Power and backhaul reliability needs to be addressed and improved, particularly during the rainy season if levels of performance are to be maintained.

Total Traffic across all 6 pilot sites

Total Outgoing Voice traffic in minutes
Total Outgoing SMS traffic in SMS
Total Data traffic in MB

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Social Impact

In July 2017, the GSMA visited two villages Mingumbi and Nambpunga located within the range of the new network pilot sites. Both locations are remote, rural areas and are accessible only via an unpaved road located 30km from the nearest main road. Mingumbi is a large village. It hosts the main market for the ward and boast a few shops including a convenience store. Nampunga is slightly more remote, with less shops and businesses. In total, the Mingumbi ward is home to 10,000 people.

Both communities are living in difficult, poverty stricken conditions with poor infrastructure, including lack of access to basic amenities, such as electricity and running water. The community is characterized by unstable, fluctuating sources of income that differ for men and women.

Men are primarily smallholder farmers (coconuts, cassava, rice, millet, maize) with livestock for personal consumption. Many have other sources of income (e.g. trading and transporting produce, working as transport agents selling bus tickets). Women are less likely to work or have their own source of income. Some are involved in farming, run small trading businesses (e.g. selling clothes and food at the market). The level of education is low and so is traditional and digital literacy. Many in the older generation have not been to school. Access to mobile network services in the local population are mostly through basic and feature phones, although smartphones are desired.

Before the installation of the network pilot site, access to mobile coverage was limited in Mingumbi. People were travelling on average 3km to the closest coverage site. Network reliability was also a challenge that they needed to overcome to access mobile internet. Consumers in locations with less reliable network, have sophisticated strategies to increase reliability:

• Multiple SIMs: Users and non-users often have multiple SIMs, to get coverage in different areas. Most people in our rural sample had one particular network SIM to cover them when they are in the village and another network SIM to cover them when they travel to more urban areas

• Specific locations/specific times of day: Users often know specific locations where they can get internet coverage, at specific times of day and feel that to get strong mobile broadband coverage they need to travel to more urban areas

Since the deployment of the new network roaming 3G site, people have seen their lives improve significantly. The reaction to the tower installation was very positive and people living in the villages around were very enthusiastic about the improvement in mobile broadband coverage. Moreover, demand is high and the site is reported to be operating at full capacity. The high demand can however, limit the strength and usability of the network during the day. Mobile users reported having to wait until night to make use of the more reliable network.

Customers' feedback:

• "I primarily use the internet to communicate with friends and family. Solar energy is not reliable especially in cloudy conditions."

• "The network is slow. I might have a good phone, to stream live matches, but streaming is problematic. The network isn't stable right now, my friends who use internet complain it's not stable right now, which demotivates me" *Male, non-user, rural*

• "Sometimes the challenges that I encounter when am using my phone is internet, my customers wants me to send them some picture and I can't because the internet is down" *Female, user, urban*

Mingumbi

Nampunga

9

Conclusions

Overall, the pilot site deployments reveal a strong appetite from local rural populations for mobile services. For all types of mobile services including 3G data, the pilots posted strong adoption levels. Over a short period the sites showed steadily increasing revenue levels despite a drop in ARPU.

Network sharing, in this case roaming, revealed significant benefits on both supply and demand side. On the supply side, roaming has allowed operators to cut down their costs significantly allowing for the deployment in unserved rural areas. From an adoption perspective roaming has boosted significantly adoption level as it introduced more choice and better availability of products including SIM cards and airtime. Where a non-shared model would have seen only one distributor coming to the villages, the roaming model has multiplied distribution channels by the number of operators. Hence on the demand side, customers benefited from better allocation of products, tariffs and services as well as enjoying full competition. The only downside perceived is

related to quality of service. In fact, if the site is down due to technical or climate conditions then all customers are affected.

The investment case given fiscal constraints appears difficult and creates unnecessary barriers for further rural MBB coverage expansion. The GSMA believes that policy makers and the regulator in Tanzania can play a significant role in facilitating the expansion of mobile broadband coverage to uncovered populations. Targeted tax incentives, adjusted regulation and improved administrative processes will be key in enabling further network expansion.

The GSMA also wishes to commend the collaboration between UCSAF and local mobile operators to overcome the investment deadlock. The provision of correctly allocated subsidies can significantly help mobile operators to scale the current national roaming agreement.

Acronyms

BSC   –   Base Station Controller

CAGR   –   Compound Annual Growth Rate

CAPEX   –   Capital Expenditure

DC   –   Direct Current

GDP   –   Gross Domestic Product

HLD/LLD   –   High Level Design/Low Level Design

HSS   –   Home Subscriber Server

KPI   –   Key Performance Indicator

Kw   –   Kilo Watt

MBB   –   Mobile Broadband

MFS   –   Mobile Financial Services

MHz   –   Mega-Hertz

NPV   –   Net Present Value

OPEX   –   Operational Expenditures

OSS/BSS   –   Operations support systems/ business support systems

PDP   –   Packet Data Protocol

RAB   –   Radio Bearer

RAN   –   Radio Access Network

RF   –   Radio Frequency

RNC   –   Radio Network Controller

TRX   –   Transceiver

UCSAF   –   Universal Communications Service Access Fund

WCDMA   –   Wideband Code Division Multiple Access

For more information please visit the GSMA
website at **www.gsma.com**