



**ANALYSIS**

# Rural coverage: strategies for sustainability

Country case studies

July 2015

## Reaching the unreachable: innovation and investment

Despite the expansion of mobile networks to near-ubiquitous levels, coverage gaps remain: 10% of the global population lack access to basic voice and text services, with around 30% lacking access to the internet at 3G speeds. The majority of these uncovered populations are low income and live in rural regions of Asia and sub-Saharan Africa (together these account for 3.4 of the 4.8 billion not yet on the internet). The central challenge in reaching uncovered communities is overcoming an unfavourable cost-benefit equation: the high fixed costs of laying network infrastructure and maintaining it are spread over thinly distributed populations with low purchasing power. Under these circumstances, particularly in the absence of road or electricity grid access, network investments often become uneconomical. However, the opportunity cost of not accessing the internet is as high or higher for individuals in rural and remote communities as it is for those in cities given the lack of core service access through physical channels (having a bank account, enrolling in education, seeing a doctor). Reaching the unreachable populations therefore requires both investment and innovation.

There is a lot of activity around new approaches to rural coverage being deployed by mobile operators, with infrastructure start-ups and even internet players also involved. In this spirit, we have chosen a case-study format to profile the range of strategies being employed. These can broadly be categorised into three groups:

- network sharing
  - passive
  - active
- models drawing on targeted government support
  - subsidies
  - universal service funds (USFs)
- alternatives
  - software-based networks
  - aerial.

We focus on the first two in these case studies, with analysis on the third (alternatives) included in our recent report ([Closing the coverage gap: a view from Asia](#)). Countries have been selected from all regions of the world (see below). Rural coverage has a proportionately larger impact on emerging markets due to their larger populations, but similar last-mile challenges exist and are being addressed in mature countries, providing the opportunity for read across of best practice.

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## Coverage case study: India

### The challenge

The combination of a difficult terrain, characterised by mountains and sparsely populated farmlands, high energy costs and low income levels made it uneconomical for India's mobile operators to expand coverage to rural communities, despite more than 70% of the country's population living in those areas. In 2007, the total cellular tower count in the country was 100,000, covering 40% of the land area. This left an estimated 500 million people without mobile coverage, according to the Telecommunications Regulatory Authority of India (TRAI).

### Market structure

India's unique mobile subscriber base reached 451 million at the end of 2014, a penetration of 35%. The market is served by 12 active mobile operators, providing services across different 'circles' for which they have received concession. Bharti Airtel was the biggest operator at the end of 2014, with a market share of 23%. Vodafone (19%), Idea Cellular (16%) and Reliance (11%) complete the top four. Aircel (8%), state-owned BSNL (8%) and the six other operators account for the remaining 31%.

### Strategy and players

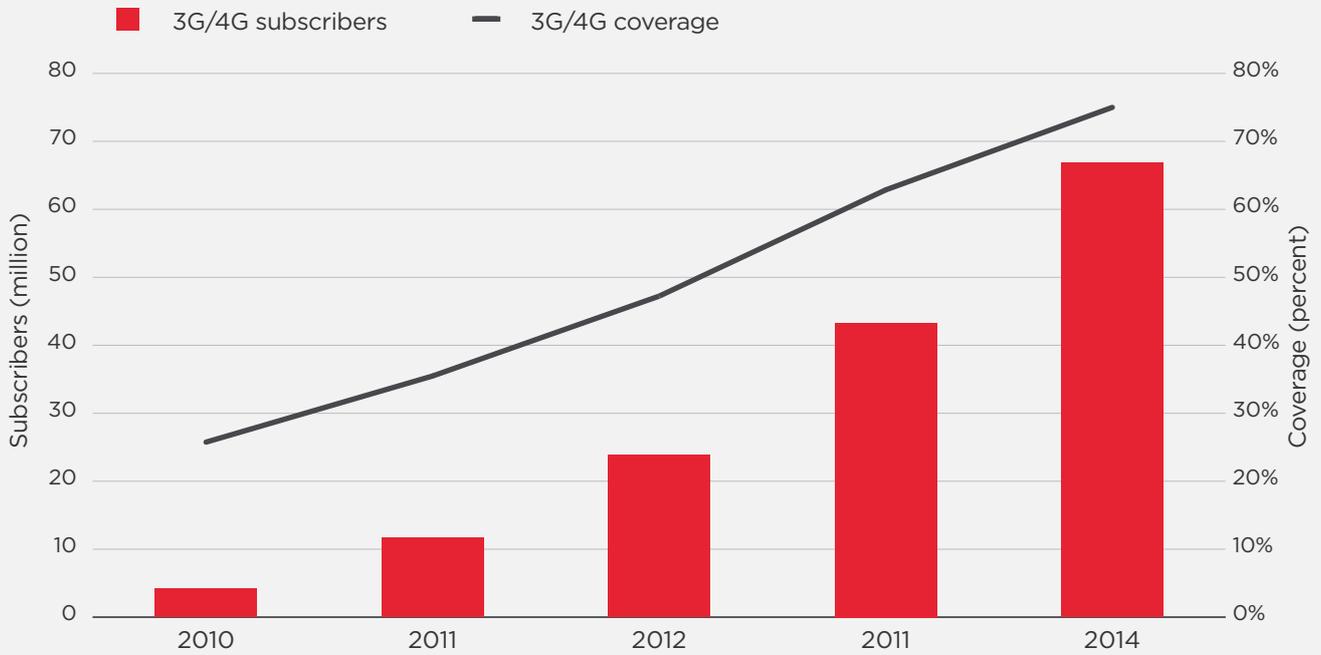
In April 2007, TRAI modified the licence agreements of mobile operators in the country to allow them to share passive network infrastructure, such as towers. The regulator also approved subsidies for tower deployment in rural areas using funds from the universal service obligation fund (USOF). Several mobile operators, including Bharti Airtel, Vodafone, Reliance and Idea, spun off their towers to newly formed towercos, such as Bharti Infratel (2007), Indus Towers (2007), Viom Networks (2008) and Reliance Infratel (2008).

In April 2008, TRAI approved active network infrastructure sharing, which allows operators to share RAN, transmission systems and other active network components to boost network coverage. In 2010, Tata and Aircel sealed a network-sharing agreement with MTNL for 3G services, and in 2015 Airtel and BSNL announced a network-sharing deal that would strengthen their mobile services in areas where either of them has a weak or negligible presence.

### Impact and learning

Tower sharing stimulated investment and competition in India's tower market, with the overall tower count rising to more than 450,000 at the end of 2014, a 4.5x uplift from 2007. As a result, 2G network coverage increased to 87% of the population, making mobile services available to previously unreachable communities. Although India launched commercial 3G service in 2010, relatively late in comparison with other markets in the region,

3G network coverage reached 75% of the population in 2014, driven by network sharing. For the operators, tower sharing has resulted in significant capex and opex savings, which the GSMA estimates at 40–50% and 20–30% respectively. Furthermore, there have been considerable improvements in quality of service as passive and active network sharing boost capacity in areas of high demand.



**Figure 1:** 3G/4G coverage and subscribers

Source: GSMA Intelligence

## Coverage case study: Malaysia

### The challenge

As part of the National Broadband Initiative introduced by the Malaysian government and the Malaysian Communications and Multimedia Commission (MCMC), the 'Time 3' coverage plan has called for MNOs to avoid unnecessary infrastructure duplication and efficiently use spectrum to address coverage in rural and remote areas. At least in part, this may help make network rollouts in these areas economically viable. The plan aims to ensure that mobile coverage is available in areas where there is a population density of at least 80 people per square kilometre. Since 2010 some 962 (of 1,000 proposed) additional towers have been built to improve coverage.

### Market structure

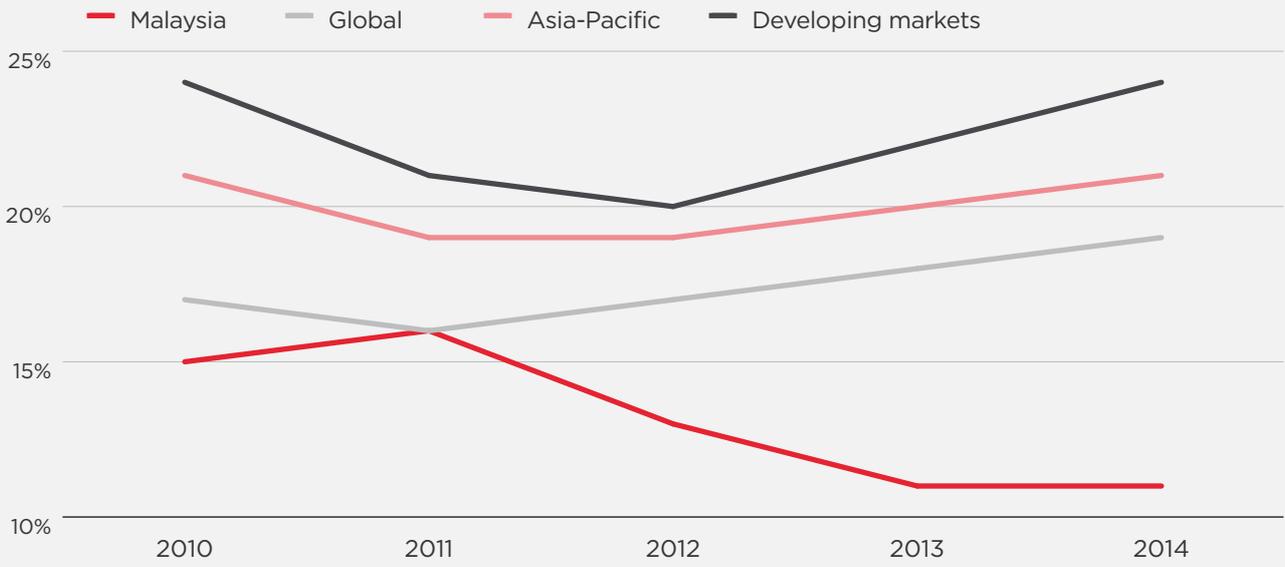
Malaysia has eight licensed MNOs, but three are dominant with almost 90% of the market. Celcom and Maxis each had about 31% of connections, as of December 2014, while DiGi had around 27%, U Mobile 7%, and others 4%. Unique subscriber penetration in Malaysia is 54%, up from 47% in 2010, while unique mobile broadband (3G and 4G) subscriber penetration is 31%, having grown from 12% in 2010.

### Strategy and players

With support from the government, Malaysia has some of the most extensive network and spectrum sharing between MNOs in the world. Celcom and DiGi share infrastructure including sites, masts, and backhaul, and Celcom has had a roaming agreement with U Mobile since 2007. Maxis has had a 3G network-sharing agreement with U Mobile since 2011, while Maxis and REDtone have shared infrastructure and spectrum since 2012 to roll out 4G. Since 2013 Celcom has also shared active elements including spectrum with Altel, which is investing \$270 million over five years to roll out a 4G network.

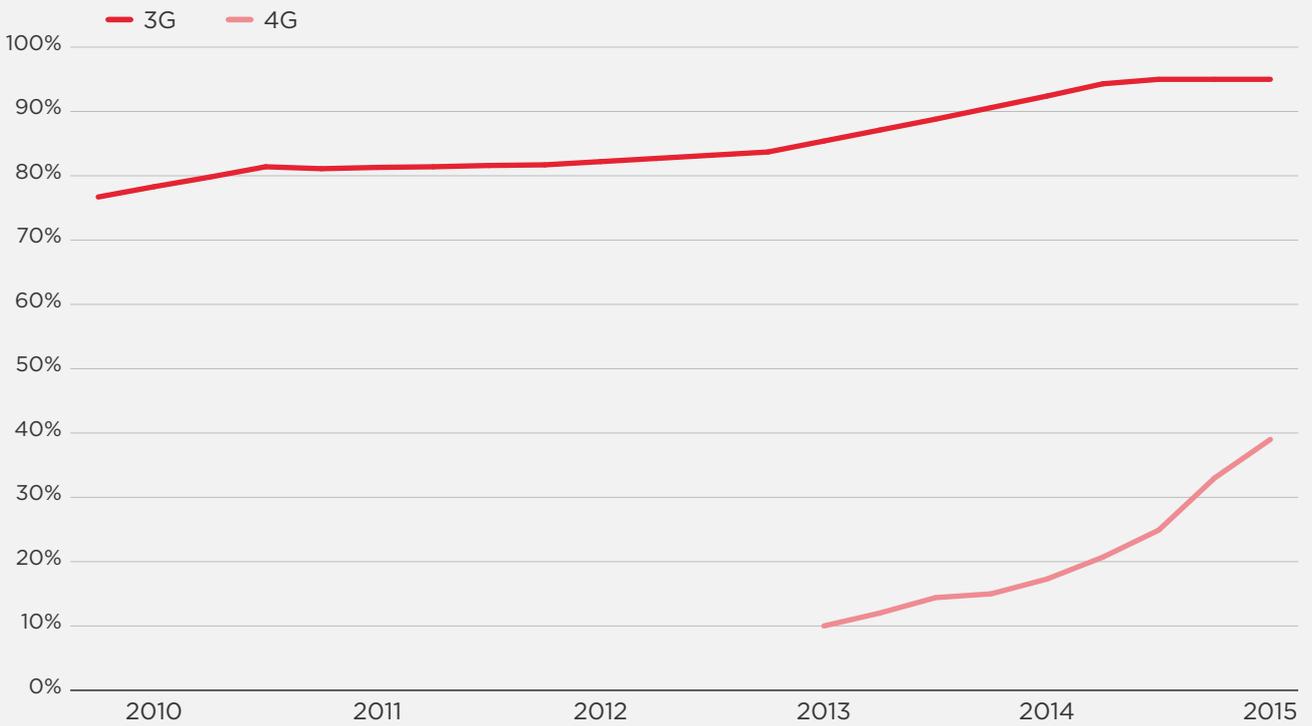
### Impact and learnings

3G coverage in Malaysia has grown from 74% of the population at the beginning of 2010 to 95% currently. 4G, which is the focus of most recent network-sharing and spectrum-pooling agreements, increased from 10% at the start of 2013 to 39% by the first quarter of 2015. This has allowed capex as a percentage of revenues for Malaysia, which has historically been lower than regional or global averages, to open up an even wider gap over the past three years. Despite the moderate level of capex, the expanded mobile broadband coverage helped to drive penetration to nearly triple the level at the start of the decade. Although network-sharing agreements are used in other markets, the scale of those in Malaysia is unique. Sharing of spectrum, given its scarcity and cost, could especially prove useful elsewhere if regulators are supportive and competition concerns can be addressed.



**Figure 2:** Capex intensity (capex as a share of mobile revenues)

Source: GSMA Intelligence



**Figure 3:** Network sharing has helped expand mobile broadband coverage

Source: GSMA Intelligence

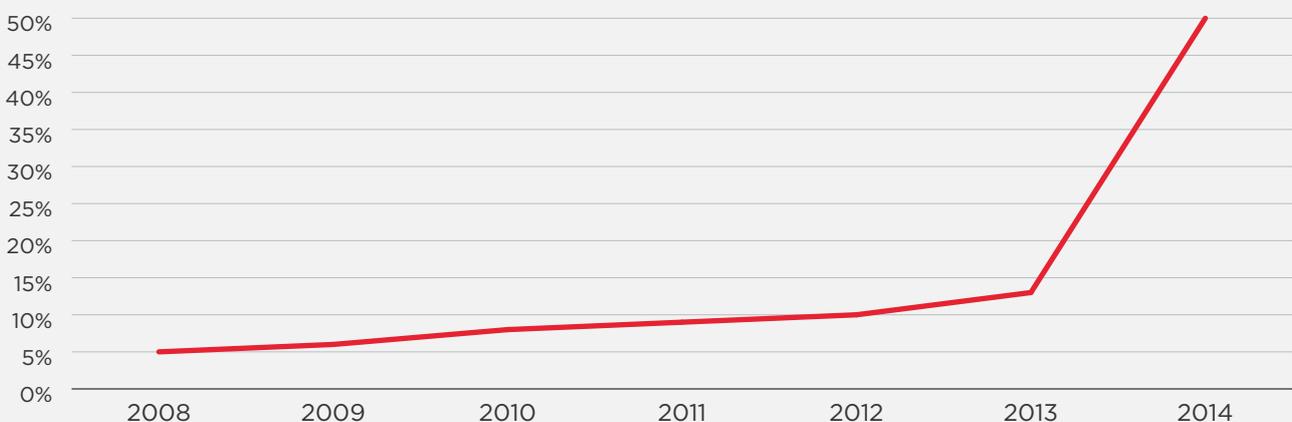
## Coverage case study: Myanmar

### The challenge

Before 2013, the mobile network of state-owned operator Myanmar Post and Telecommunications Company (MPT) covered only the capital Yangon and a few other cities in the country. Although the operator had launched 3G service, this was not commercially available to consumers. Indeed, a considerable proportion of the population, mostly in rural areas, did not have any form of mobile service, leaving a large digital divide. In June 2013, the Ministry of Communications and Information Technology (MCIT) selected Telenor and Ooredoo to build and operate two new mobile telecommunications networks as part of the government's liberalisation of the telecoms sector. The government also set a voice and data coverage target for the operators at 75% of the population within five years, a requirement that would involve deploying and running network infrastructure in regions lacking grid electricity and in difficult terrains (mountains, glaciers and forests) amid adverse weather conditions, notably heavy rains and severe flooding during the monsoon season.

### Market structure

The number of unique mobile subscribers in Myanmar reached 10.6 million at the end of 2014, a penetration of 20%. Most of the growth in the previous two years was recorded in the second half of 2014 following the launch of commercial services by new entrants Telenor and Ooredoo. The two operators have already established strong footholds in the market, securing a combined market share of 38% – Telenor (23%) and Ooredoo (15%) – at the end of 2014. Incumbent MPT had a market share of 62% at the end of the same period. We estimate 3G coverage in Myanmar has increased to 50% of the population, a spike from the sub-20% levels of the previous five years, driven by network expansion from the two new entrants as part of license obligations.



**Figure 4:** 3G coverage (population)

Source: GSMA Intelligence

## Strategy and players

In line with their coverage obligations, Telenor and Ooredoo set initial voice and data coverage targets of 84% or more within the first five years of commercial launch. To achieve their coverage targets, both operators adopted a tower-sharing strategy to accelerate the rollout of new towers and share inherent risks, including deployment costs, with other investors in the infrastructure market. Ooredoo selected Digicel Myanmar Tower Company (Digicel MTC) to build and manage its first set of towers, while Telenor selected Apollo Towers to build and manage 1,001 towers and Irrawaddy Green Technology (IGT) to build and manage another 2,000 towers.

In February 2015, the MCIT awarded Network Facilities Service (Class) licences to independent tower firms operating in the country, thereby formalising their operations and recognising the activities of towercos as a vital component of the country's telecoms infrastructure market. The move removes any uncertainty over the long-term operations of the towercos, at least for the initial 15-year validity of the licences. This should attract more capital to the towercos to finance infrastructure rollout plans and will also allay any concerns among the mobile operators about the stability of the towercos or the sustainability of the tower-sharing strategy.

## Impact and learning

Ooredoo's reported figures indicate its network covered 15% of the overall population at launch in August 2014, but increased significantly to 40% on 3G by the end of year. The operator expects coverage to reach 80% of the population by the end of 2015, and 97% within the next five years.

By outsourcing the build-out and management of tower infrastructure, Telenor and Ooredoo are able to focus on developing a variety of value-added services. Furthermore, both operators have been able to transfer some of the cost savings from tower sharing to consumers in the form of lower service tariffs. Voluntary infrastructure sharing can be applied in other markets to drive coverage expansion and optimise the utilisation of network assets. For new entrants, tower sharing provides a useful opportunity to accelerate service rollout and minimise infrastructure deployment costs.

## Coverage case study: Saudi Arabia

### The challenge

Saudi Arabia's geography is dominated by the Arabian Desert, at the centre of which is the Rub' al Khali ("Empty Quarter"), the largest continuous sand desert in the world. With a population of 29.6 million spread over a land area of 2.15 million square kilometres, Saudi Arabia is the second most sparsely populated country in the Middle East (after Oman), with only 13.4 people per square kilometre. The last half of the 20th century saw rapid urbanisation; about 83% of Saudis now live in urban metropolitan areas – specifically Riyadh, Jeddah or Mecca. The challenge therefore is how to provide the rural population with mobile connectivity, overcoming the physical barriers inherent in the desert terrain of the country.

### Market structure

Saudi Arabia's unique mobile subscriber base reached 21.9 million at the end of 2014, a penetration of 74%. The market is served by three active mobile operators; state owned STC (Saudi Telecom) is the largest with 45% of connections (excluding M2M) as of December 2014. Mobily, owned by Etihad Etisalat, is second with 39%, and Zain is third with 17%. Unique mobile broadband (3G and 4G) subscriber penetration is 47%.

### Strategy and players

In 2006, Saudi Arabia set policy targets to expand connectivity to the whole of the population. A government study found that around 1,000 communities were not served by at least a low-quality outdoor 2G signal. In order to reach voice and broadband targets, the reach, speed and quality of the network would need to be improved via a unified approach. To this end, two policies were established: Universal Access (UA) – providing useable data access to within 10 kilometres of localities with fewer than 100 residents, and Universal Service (US) – targeting ubiquitous access to 512 kbps internet in all localities with a population of over 100. In 2010, with the target deadlines approaching (2011 for UA and 2013 for US), the Communication and Information Technology Commission (CITC) launched a seven-year \$1.3 billion universal service fund (USF) program. The pilot project was awarded to Mobily (subsidy of \$13.3 million), and both the other operators were also awarded subsidies – STC was awarded \$7.9 million, and Zain was awarded two projects of \$10.7 million and \$4 million each. All three proposed an exclusively 3G program, primarily using 900 MHz spectrum due to its geographical coverage.

### Impact and learning

In February 2012, Mobily announced the completion of the pilot project for the USF project, which aimed to provide voice and broadband Internet connectivity to the residents of the districts of Khulais and Al-Kamel in the Makkah region, and the district of Mahd Al-Dhahab in the Madinah region. Mobily said 482 villages in these regions had been covered in a

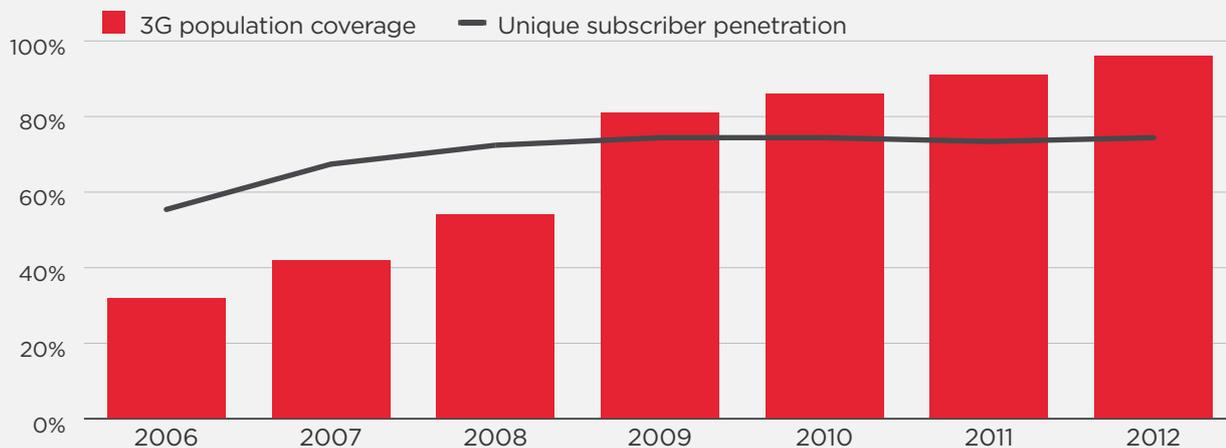
record time despite the region’s challenging terrain, and 153 locations had been connected with a 3G network.

In the same month, Zain confirmed that it had completed the work on the second project for the USF project, providing telecoms services and broadband to each of the provinces of Aldayer, Darb and Raith in the Jazan region, all provinces in the Al-Jawf region (Qurayat, Dawmat Al-Jandal and Sakaka) and all provinces in the Northern Borders region (Arar, Rafha and Turaif). The company said it had completed the entire project covering about 550 villages, extending its services to more than 175,000 people.

The third project by STC aimed to provide broadband voice and internet services to all the municipalities of Al-Baha district (Al-Aqiq, Al-Baha, Al-Mandag, Al-Mukhwah, Al-Qurah, Belgorashi, Qolwah), municipalities of Asir district (Al-Nammas, Belgarn, Bisha), and Qonfothz municipality in Makkah district. However, the results are yet to be published.

A fourth project (the second by Zain) aimed to bring mobile broadband to municipalities of Riyadh Province (Al-Majma’ah, Rammah), in addition to the municipalities of Eastern Province (Khafji, Hafer Al-Batin) but again, details of the results are yet to be announced.

It is estimated that the combination of the UA and US policy targets and the USF projects benefited more than 890,400 people in 3,415 locales throughout Saudi Arabia, and has driven an increase in unique subscriber penetration in Saudi Arabia from 54% in 2006 to 74% in 2012. Over the same time period, 3G population coverage increased from 32% to 96%.



**Figure 5:** Saudi Arabia coverage expansion

Source: GSMA Intelligence

These programmes are a good example of the key role that USFs can play in ICT market expansion. They show how effective management of the USF, a technology- and service-neutral approach, flexible regulation in support of cost-effective goals, and collaboration with operators can bring about major benefits to a country.

## Coverage case study: Rwanda

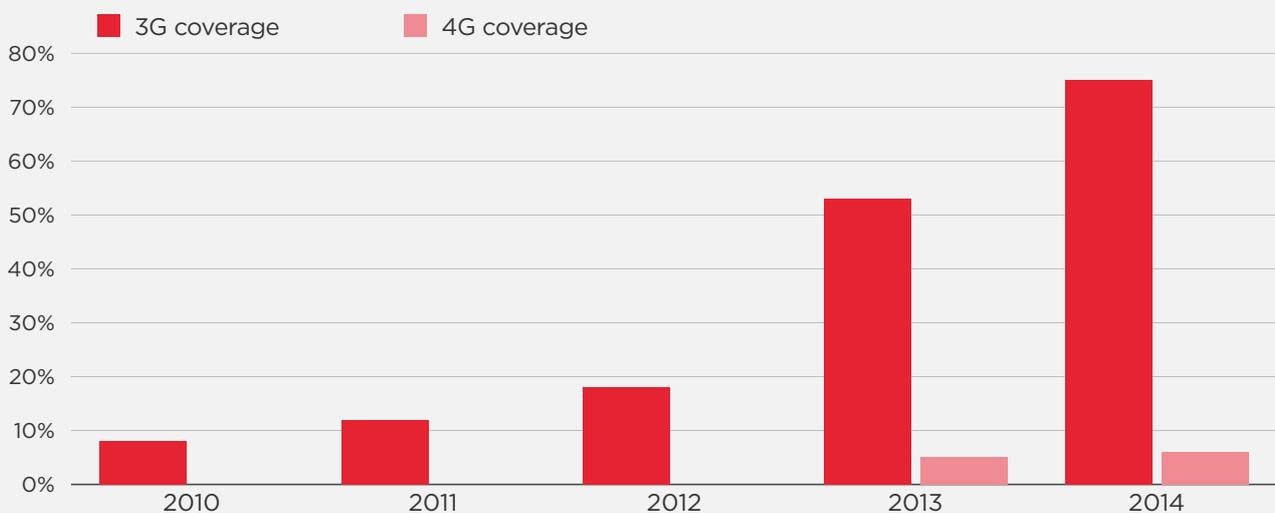
### The challenge

Rwanda is one of 15 landlocked countries in Africa. The lack of a sea border and consequent reliance on expensive air and road freight for the importation of equipment is partly responsible for the high cost of network deployment in the country. Other notable factors include the cost and logistical challenges of network rollout in rural areas, where more than 70% of the population live, and the lack of grid electricity in remote and sparsely populated villages. The low spending power of rural consumers further weakens the business case for capital-intensive infrastructure rollout in these communities.

Rwanda has achieved near-universal 2G network coverage; around 98% of the population is covered by 2G network services, mainly due to mobile operators' compliance with strict coverage obligations set by the government. However, this has cost implications for mobile operators – the defunct operator Rwandatel's inability to meet its coverage obligations was partly responsible for the revocation of its mobile licence in April 2011. Imposing similar coverage targets for 4G services could prove challenging, considering the cost and affordability issues, and a greater incentive for operators to concentrate their investments on urban areas, which have the potential for quicker returns on their investments.

### Market structure

Rwanda's mobile market had a unique subscriber base of 4.1 million and a penetration rate of 34% at the end of 2014. The number of 3G/4G mobile internet subscribers in the country edged above 1 million by the end of 2014, equivalent to 26% of the unique mobile subscriber base. MTN Rwanda is the biggest mobile operator in the country, with a market share of 51% as of December 2014, followed by Tigo Rwanda (33%) and Airtel Rwanda (16%).



**Figure 6:** Rwanda: Will SWN boost 4G coverage?

Source: GSMA Intelligence

## Strategy and players

3G network coverage and subscriber uptake in Rwanda has benefitted from the mobile operators' coverage obligation and market competition. The impact of the latter is particularly reflected in the sharp rise in 3G coverage in 2013. Following the exit of Rwandatel in 2011, MTN and Tigo maintained a duopoly in the mobile market, but this was broken by the arrival of Airtel in 2012. The ensuing increase in competition stimulated investments in network upgrade from 2G to 3G by the incumbent operators looking to maintain their competitive edge and by the new player trying to gain a foothold in the market.

Despite the market-driven 3G network rollout, the government of Rwanda has opted for a different approach for 4G services in the country. In June 2013, the government and South Korea's KT formed a joint venture (JV), called *oRn* Rwanda networks (*oRn*), to build and manage a nationwide 4G network based on a public-private partnership (PPP) model. The government allocated 800 MHz and 1800 MHz spectrum to the JV, and mandated it to provide access to internet service providers (ISPs) in the country, including the incumbent mobile operators, on a wholesale basis. As part of the agreement, KT will invest \$140 million in *oRn* and control the management of the firm with an exclusive licence for 25 years, while the Rwandan government will provide financial and administrative support, including the provision of access to its national fibre-optic networks and spectrum.

## Impact and learning

*oRn* launched commercial services in November 2014. MTN and Airtel utilised the network to launch 4G services to their subscribers in the same month, while Tigo followed suit in January 2015. *oRn* also provides 4G access to as many as 10 other ISPs in the country, including Broadband Systems Corporation (BSC), New Artel, Axiom Networks, TNSP, and ISPA as distribution partners. At launch in November 2014, the single wholesale network (SWN) comprised 65 cell sites in the capital Kigali, covering around 95% of the city's population. Deployment to other parts of the country is scheduled to commence in 2015, and the government expects *oRn*'s 4G network to cover 95% of the population by 2018.

The Rwandan government's main aim for adopting the SWN strategy is to ensure that large swathes of the population living in rural areas have access to and can afford mobile broadband services, considering the potentially high cost of separate network rollout by individual service providers. However, SWNs risk limiting network-based competition. Rwanda is the first country globally to execute a mobile SWN strategy, and although it is too early to assess the performance of the initiative, other countries with similar plans will be closely watching its impact.

## Coverage case study: Lesotho

### The challenge

A combination of difficult terrain, a dispersed population and low ARPU have limited growth of coverage in Lesotho. The terrain is mountainous, it is the only country in the world to lie entirely above 1,000m altitude, and basic infrastructure (such as roads and electricity) is lacking. As a result, establishing physical infrastructure is difficult and expensive. In addition, GDP per capita stands at just \$1,075, 98% of the market is prepaid, and the population is thinly spread across the country, with a rural population of 74%. Monthly ARPU is consequently around \$5, making investment in coverage difficult to justify.

### Market structure

Lesotho's unique mobile subscriber base reached a penetration of 40% at the end of 2014. The market is served by two active mobile operators. Vodacom, majority-owned by Vodafone Group, has 75% of connections (excluding M2M), with Econet Wireless controlling the remaining 25% as of December 2014.

### Strategy and players

In 2009 the Universal Service Fund (USF) was launched with a mandate most recently confirmed in the 2012 Communications Act. It aims to ensure that all areas of the country have access to voice telephony, internet, broadcasting and postal services. To achieve this, the USF imposes a 1% levy on operators and receives a minimum 25% of revenues raised by its parent body, the Lesotho Communications Authority.<sup>1</sup> These funds are invested into infrastructure projects across the country, usually in areas that an MNO may consider uneconomical.

Despite the USF's broad brief, investment in the expansion of mobile coverage has been a key aim of the fund alongside the development of broadband and establishing a national domain registry. As a result of the country's limited infrastructure, around 25% of the USF budget is spent on developing the necessary roads and electrical infrastructure.<sup>2</sup>

In the year ending March 2014, the USF raised just over \$1.07 million (LSL13.01 million) and spent more than 90% of that in the same period.<sup>3</sup> The USF is also in negotiations with the African Development Bank for additional funding in the form of grants to the government of Lesotho.

<sup>1</sup> GSMA, *Universal Service Fund Study* (2013)

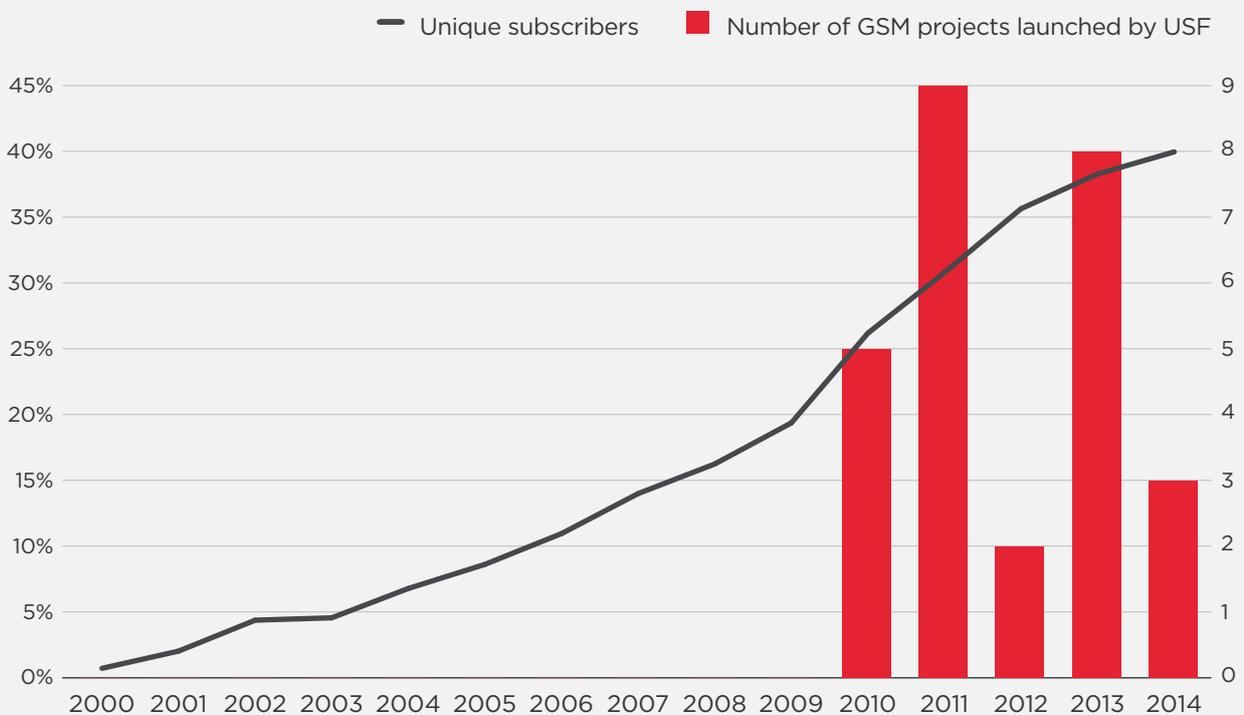
<sup>2</sup> Lesotho Communications Authority, *Africa's Untold Universal Service Agency Story* (2014)

<sup>3</sup> Lesotho Communications Authority, *Annual Report, 2013-14* (2014)

## Impact and learning

Universal service funds have been established in several countries, with mixed success. A GSMA report in 2013 examined 64 of these and concluded that ‘most remain inefficient and ineffective’.<sup>4</sup> Lesotho’s USF could be seen as an exception, with the Indian USF providing a further example (see [Coverage Case Study: India](#)).

Since its inception in 2009 the USF has subsidised 27 GSM projects and claims this has helped at least 63,400 people across 320 villages.<sup>5</sup> The majority of the base stations are now profitable on an opex basis. Nthabiseng Pule, executive secretary of the USF, has said that ‘Some of the towers with the highest traffic are in the rural areas’. Indeed the USF is struggling to meet the high demand for its services; a further six projects have had to be delayed until 2016 when more funds become available.



**Figure 7:** Unique subscriber penetration in Lesotho compared with number of projects launched by USF

Source: GSMA Intelligence

<sup>4</sup> GSMA, *Universal Service Fund Study* (2013)

<sup>5</sup> Lesotho Communications Authority, *Annual Report, 2013-14* (2014)

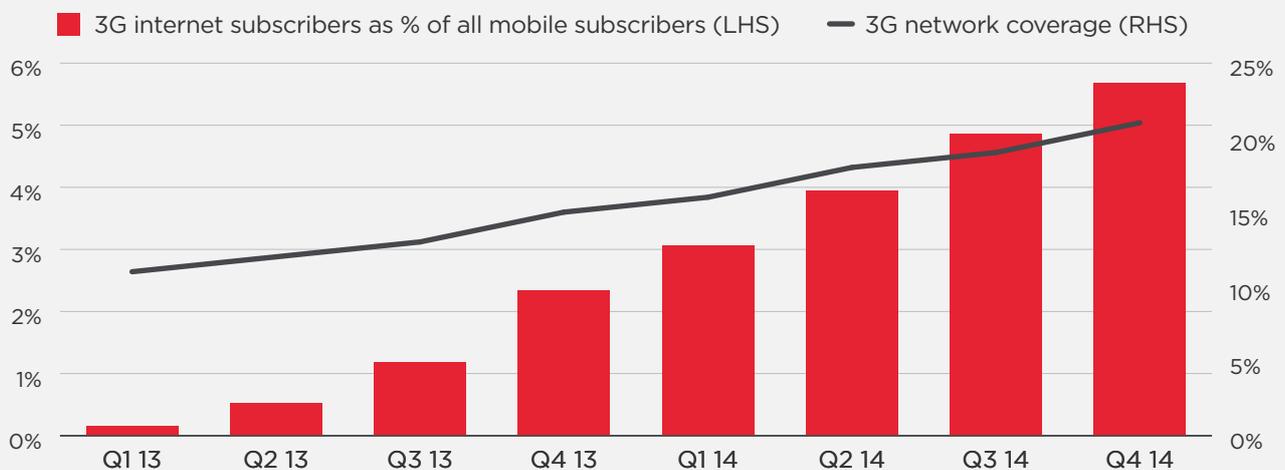
# Coverage case study: Benin

## The challenge

More than 55% of Benin’s 10 million inhabitants live in rural areas. Extending network coverage to these areas is challenging for mobile operators due to the high cost of building and maintaining network infrastructure in hard-to-reach communities, many of which are not connected to the electricity grid. The problem is further compounded by low income levels in rural areas and the lack of a critical mass of users in hundreds of sparsely populated communities to justify the deployment of conventional cellular network infrastructure, estimated to cost around \$200,000–250,000 per site. As of 2013, 65% of the population and 35% of the land area in Benin were covered by 2G network from at least one of the country’s licensed mobile network operators, and only 15% of the population were within reach of a 3G network.<sup>1</sup> This left around 3.5 million outside the reach of any telecommunication service and around 8 million people without access to data connectivity.

## Market structure

The number of unique mobile subscribers in Benin reached 4.6 million at the end of 2014, a penetration rate of 43%. 3G mobile Internet subscribers as a proportion of total unique mobile subscribers is much lower at just 6%. Benin’s mobile market is served by five mobile operators – MTN Benin, Moov (Maroc Telecom), Bell Benin Communications (BBCom), Globacom (Glo) and Libercom (Benin Telecoms). MTN was the biggest operator at the end of 2014, with a market share of 41%. Moov was the second biggest with a market share of 34%, followed by Glo (19%). BBCom (4%) and Libercom (1%) were the two smallest players in the market at the end of 2014. MTN and Moov were the first operators to launch 3G services in the country, and are mainly responsible for the 3G network coverage and subscriber uptake so far achieved.



**Figure 8:** Benin: Rural coverage key to 3G uptake

Source: GSMA Intelligence

<sup>1</sup> Source: AMN

## Strategy and players

Africa Mobile Network (AMN) finances, builds and operates solar-powered mobile base stations in remote and unconnected communities with a population of 4,000 or more people. The base stations are then connected to a partner mobile operator's network to provide voice and data services to subscribers in rural areas on a revenue-share basis and zero capex requirement for the operator. In January 2014, AMN launched its first base station in the remote community of Koabagou in northern Benin. The base station was integrated with the core network of BBCom. In July 2014, the firm finalised the finance structure for the construction of up to 200 base stations throughout Benin over a two-year period from 2014 to 2016. Five of those base stations, located in rural areas in the north and east of Benin, were completed in December 2014.

The standard base station is designed to serve multiple settlements more than 10 kilometres from the tower with high-gain directional antennae (for AMN, a single base station serving multiple settlements means a lower level of capex than multiple lower-cost base stations). However, AMN is working on solutions that will be able to serve 300 subscribers economically in communities of around 1,000 people, assuming a subscriber to population ratio of 1:3.

## Impact and learning

AMN's first base station in Benin connected between 6,000 and 7,000 people to voice and data services for the first time (5,000 people in the host community and residents of three other adjoining communities with populations of 500–1,000 people). The five new base stations completed in December 2014 extend mobile network coverage to a further 35,000 rural dwellers in communities with no existing telecommunications service, and the completion of new base stations in 2015 could enable BBCom to extend coverage to around 150,000 people in previously unconnected communities. For operators, especially those with limited resources for network build-out, AMN's low-risk, zero-capex, shared revenue model offers an attractive proposition for extending coverage to underserved communities where using conventional methods may prove uneconomical.

## Coverage case study: Chile

### The challenge

Mobile broadband coverage (entirely 3G at the time in 2010) was not particularly low in Chile by international standards, and its population is highly urbanised (around 85%). However, the topography of the country where the remainder of the population lives presents some of the most challenging terrain in the world to reach with traditional technologies, especially fixed copper- or cable-based technologies: the Andes mountains (some of the tallest and steepest in the world), glaciers, the Atacama desert (the world's driest), forests, islands, and tundra account for most of the non-metropolitan areas of the country.

### Market structure

Chile has five licensed MNOs, but three of these are dominant: Telefónica's Movistar has a 40% share of connections as of 2014, Entel has 37%, América Móvil's Claro has 22% and the others account for less than 2%. The unique subscriber penetration rate stands at 63%, up from 54% prior to the rollout of the program (in Q2 2010).

### Solution and rationale

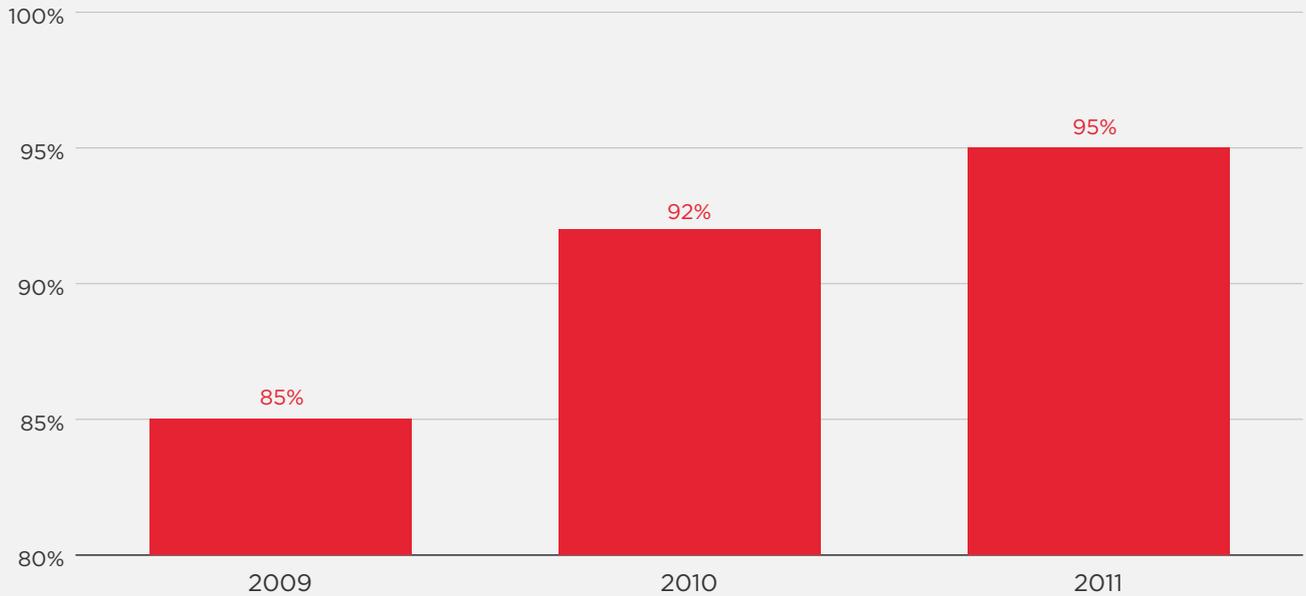
The project was proposed by telecoms regulator Subsecretaría de Telecomunicaciones (Subtel) and funded jointly by the Fondo de Desarrollo de las Telecomunicaciones (Telecommunications Development Fund), the central government of Chile, the 15 regional governments and the second-largest operator Entel. It aimed to cover approximately 1,500 rural communities in total, stretching from the Atacama desert in the north to Patagonia and Tierra del Fuego in the far south. The scheme, called 'Todo Chile Comunicado' (all of Chile communicating), aimed to invest a total of \$110 million over an accelerated timeframe between September 2010 and the end of 2011. Of the \$110 million, government sources contributed \$45 million and the remainder was private funding from Entel.

### Impact and learning

The scheme was completed in three phases, and by the end of the final phase in late 2011, some 3 million people had broadband access as a result of the program. Residents, students and workers in around 1,500 communities can subscribe to Entel's 'Todo Chile Comunicado' mobile broadband plans at preferential prices (national roaming is also available at normal rates per day, week or month).

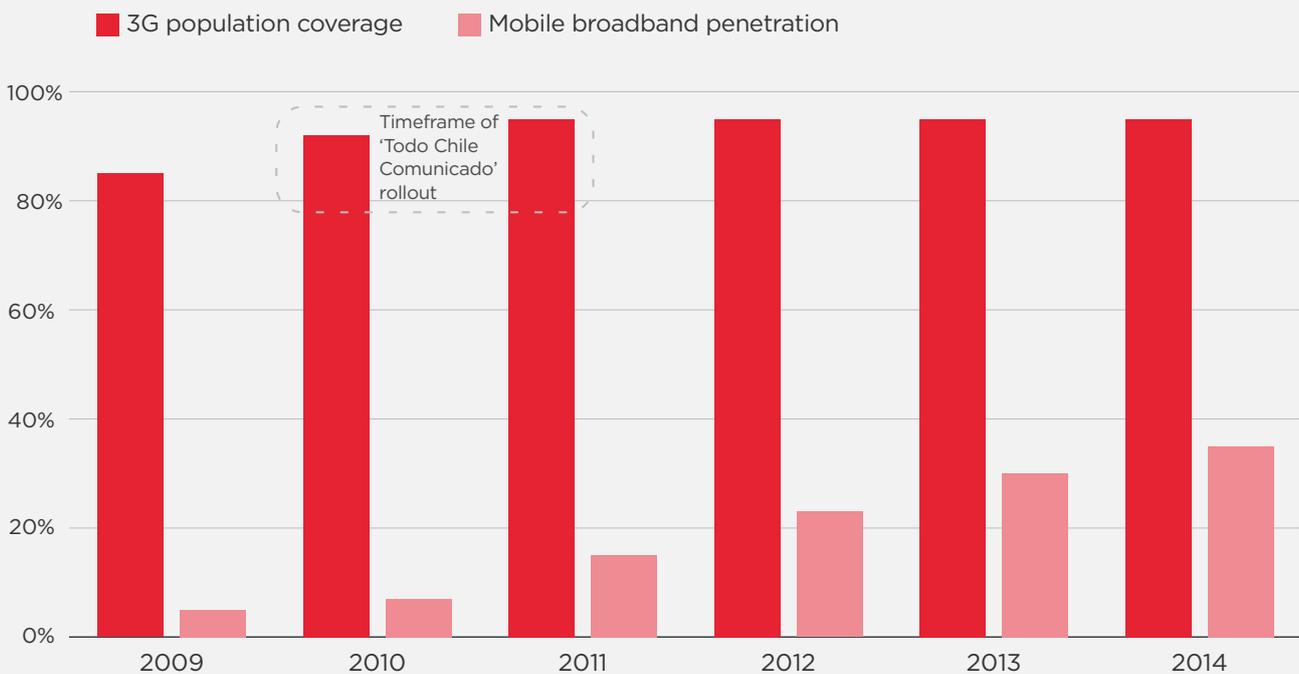
Mobile broadband coverage was directly affected by the scheme, rising from 88% in Q2 2010, the quarter prior to its commencement, to 95% when the scheme was completed at the end of 2011. Most of the improvements to coverage were in rural areas (Chile has a rural population of 15%). Mobile internet penetration overall rose from 25% to 40% over the same timeframe and has risen to 49% today. Mobile broadband penetration (3G and 4G) rose from 3% to 15% during the scheme, and has since reached 36%.

The principles and strategies of the plan could be readily applied to other countries; for example, investing unutilised universal service funds or utilising this scheme as part of a national broadband program, augmented by private investment. However, there was only one participating operator in Chile (Entel), and it shouldered the entire private element of the \$110 million investment; in other countries the investment costs and benefits could be structured so that they are shared more broadly among more or all operators.



**Figure 9:** Mobile broadband coverage increased 10pct pts from before to after ‘Todo Chile Comunicado’ rollout

Source: GSMA Intelligence



**Figure 10:** Mobile broadband in Chile

Source: GSMA Intelligence

## Coverage case study: Paraguay

### The challenge

With a population of around 7 million, Paraguay is a small country with a low overall population density of 16.4 people per square kilometre, according to 2012 government estimates.<sup>1</sup> It has high levels of poverty, inequality and illiteracy. These issues are even more challenging in the large regions of the country that are extremely sparsely populated and lack utility services. Although poverty levels in the country have fallen in recent years thanks to strong economic growth (it has had double-digit percentage GDP growth in many years since 2000), more than one-third of the country still lives below the poverty line and nearly one-fifth in extreme poverty. Moreover, over two-thirds of those living in such conditions live in the rural areas.<sup>2</sup> The country overall has an urbanisation rate of only 56%; even the capital and largest city, Asunción, accounts for only about 10% of total inhabitants.

The Paraguayan part of the region referred to as the Chaco comprises all of the land to the west of the Paraguay River, which runs vertically through the centre of the country. Although it accounts for a majority of the country's land mass, this region contains only about 3% of the country's population; in fact the population density of the Chaco region overall is only 0.7 inhabitants per square kilometre.<sup>3</sup> Electricity and other utility services are rare, as is formal education, so illiteracy is high.

### Market structure

Unique subscriber penetration in Paraguay is 54%, with mobile internet penetration of about 25% but mobile broadband penetration of just 10%. There are four licensed MNOs: Tigo (Millicom) is the dominant operator with 52% market share, Personal (Telecom Argentina) has 33%, Claro (América Móvil) has 8% and Vox has 7%.

### Solution and rationale

In December 2014, regulator La Comisión Nacional de Telecomunicaciones (Conatel) announced an agreement to expand broadband coverage (including fibre) to the Alto Chaco, including the eastern Chaco with a population of just under 500,000 and the geographically much larger western Chaco, which has a population of only about 160,000. The scheme is a public-private partnership between the government and the leading operator, Tigo. The government is providing subsidies to encourage investment in an area that it recognises would otherwise not be economically viable to cover. The program calls for total investment in the eastern Chaco of PYG4.9 billion (just under \$1 million) and PYG21.7 billion (\$4.3 million) in the western Chaco. Government subsidies cover 54% of investment in the eastern Chaco and 73% in the western Chaco (reflecting the challenges and economics there). In the

<sup>1</sup> STP/DGEEC, *Paraguay: Evolución de la Población Total. Periodo: 1950–2002. Proyección 2012*

<sup>2</sup> ABC Color, *En Paraguay, disminuyó la pobreza entre 2003 y 2009* (2011)

<sup>3</sup> STP/DGEEC, Population census (2012)

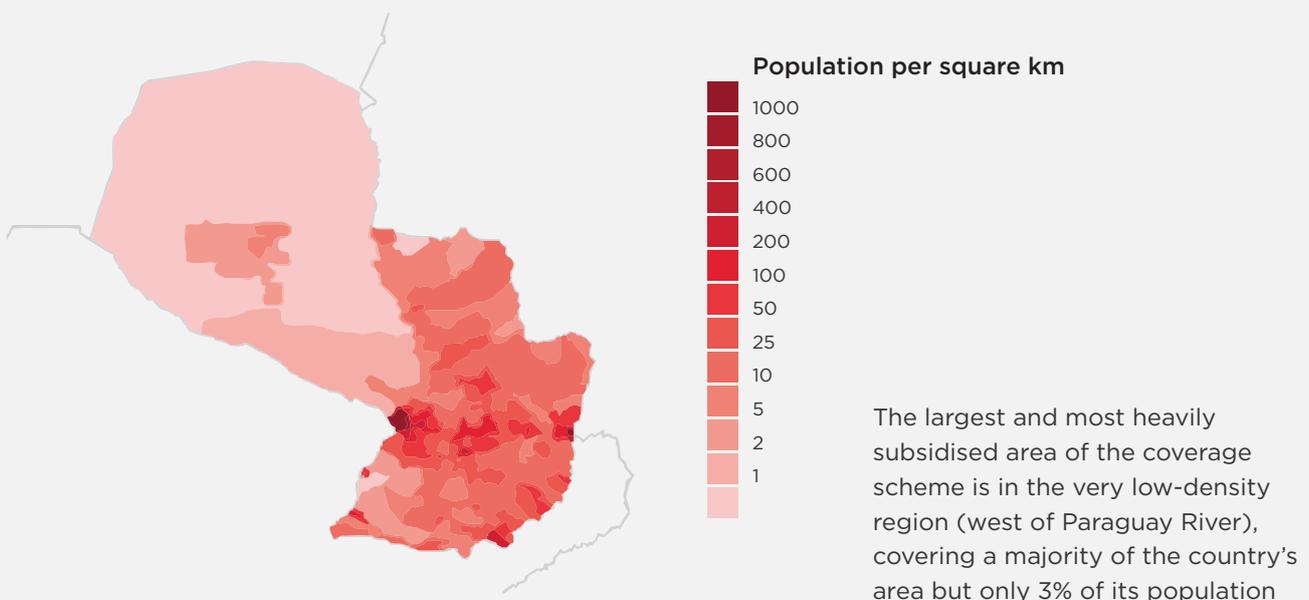
western Chaco, this equates to a government subsidy of nearly \$7 per person (topped up by more than \$2 per person by Tigo). The build-out was expected to commence early in 2015, with a timescale for completion of 6–7 months in the eastern Chaco and 18–24 months in the western Chaco. Given the lack of electrical infrastructure, solar panels, wind turbines, and generators will need to be installed at base station sites.

## Impact and learnings

The Paraguayan government clearly recognized that broadband connectivity is essential to economic growth and lifting more people out of poverty, but that it is simply unrealistic to expect operators to invest large sums on coverage in poor, rural and sparsely populated areas. Aside from purely economic impacts, the government also expects the programme to improve agricultural productivity (the name Chaco derives from an indigenous Quechua word meaning hunting land) and provide important social benefits, such as emergency services access, a crucial consideration as residents currently may have to walk several kilometres to place a distress call.

Although this public-private partnership involves only one operator, it is the leading operator in the country by connections, meaning that it has the broadest possible impact. However, critics might argue that it reinforces that operator’s dominance to the detriment of competitors.

Other countries, such as Chile and Colombia, have also subsidized broadband networks in rural areas. Paraguay’s very heavy subsidization of networks in the most sparsely populated areas should provide guidance to other countries struggling to bring connectivity to isolated populations.



**Figure 11:** Paraguay population density

Source: National census

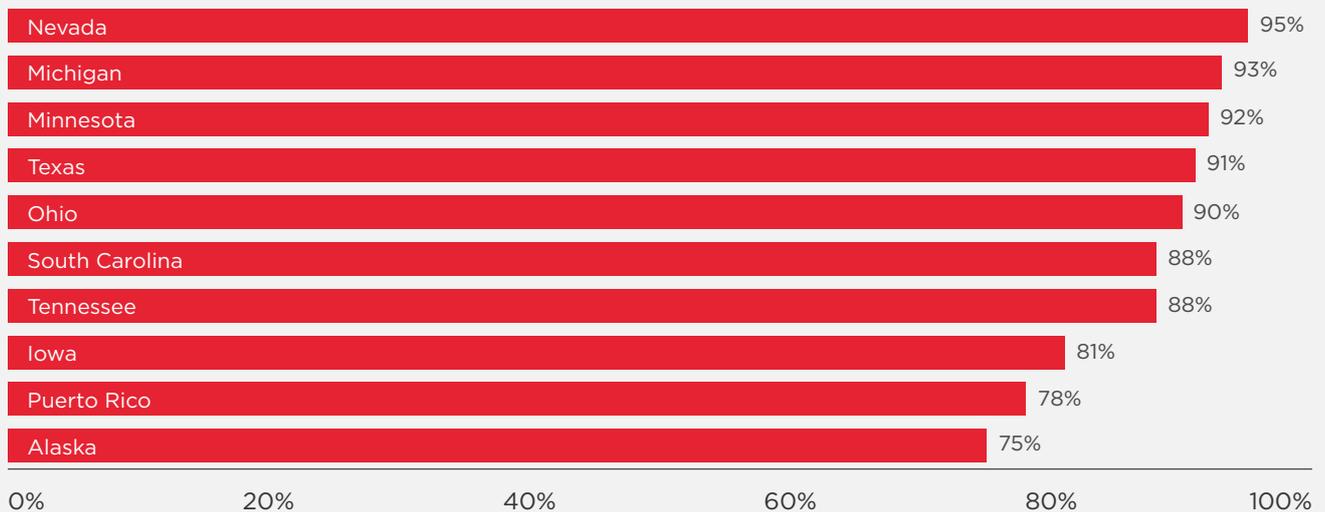
## Coverage case study: Alaska, US

### The challenge

Alaska is the largest and most sparsely populated state in the US; it has a total land area of 1.7 million square kilometres and a population of just 736,000 (2014). The state is also known for its dramatic, diverse terrain of wide open spaces, icy mountains and rivers, and forests, as well as a challenging climate that can affect construction for significant periods of the year. Before 2009, 2G and 3G services in rural areas in Alaska were only available along roads, excluding large swathes of rural dwellers in isolated communities; rural coverage is constrained by low population density, large distances between communities and a difficult terrain. In 2009, 77% of the population was covered by 3G network, leaving approximately 161,000 people, mostly in rural areas, without coverage. As a result, Alaska fell short of the FCC's broadband target of 4 Mbps downlink/1 Mbps uplink per household (10 Mbps/1 Mbps from December 2014).

### Market structure

The total number of mobile connections in Alaska was 700,000 as of December 2014, equivalent to 95% of the state's total population. However, unique penetration would be much lower given the US unique subscriber penetration of 71%. The state has more than 10 operators including local telephone cooperatives and national carriers. AT&T and GCI have a combined market share of more than 70%.



**Figure 12:** Connected Nation states: Households with access to high-speed broadband, 2014

Source: GSMA Intelligence, FCC

### Strategy and players

For many years, wireless services in Alaska were limited to urban, fibre-served communities. In order to provide first-time wireless services throughout rural Alaska, local provider GCI

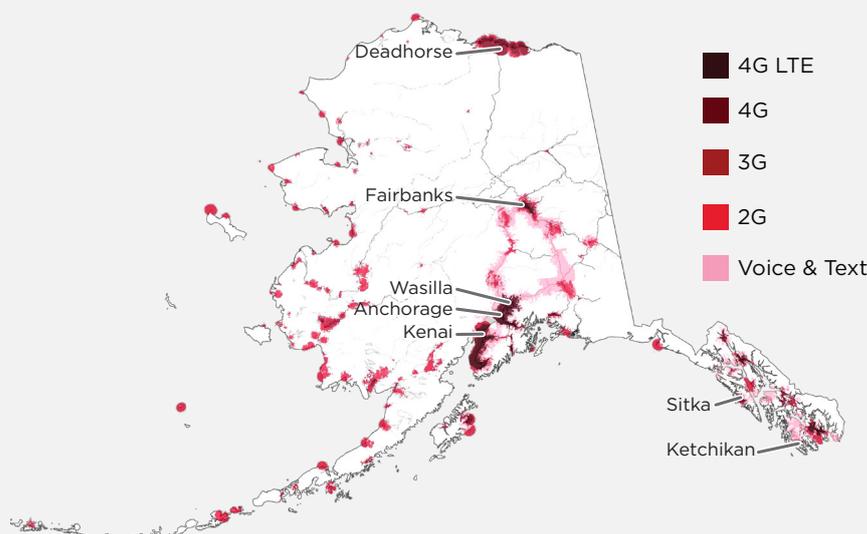
launched a community-based, soft-switch technology, with local in-village call completion and ‘emergency standalone’ capability to avoid the costly satellite link to the core network centre. With upgradable base stations and soft switches, equipment can be remotely configured and upgraded without costly forklift upgrades in hard-to-reach locations. Access to universal service support funding, administered by the Federal Communications Commission, was essential to GCI’s ability to invest in this critical infrastructure.

These advancements were transformational for statewide coverage, but by 2011, reliance on satellite backhaul limited many rural Alaskans to a 2G data experience. In 2011, GCI launched an initiative called Terrestrial for Every Rural Region in Alaska (TERRA) to extend next-generation communications network to remote and rural areas of Alaska. The initiative uses a combination of microwave and fibre-optic technologies to enable mobile broadband services in remote communities. Through a competitive application process, TERRA received support from the US Department of Agriculture’s Rural Utilities Service, which awarded GCI \$88 million (a \$44 million loan and a \$44 million grant) in 2010 for the initial project phase. Expenditure for the project exceeds \$200 million to date. GCI secured additional universal service funding through a competitive bidding process to support 3G upgrades for 38 communities.

Technological innovation continues; GCI plans to deploy LTE-over-satellite to nine additional communities by 2016, supported by funding secured through the same competitive bidding process.

### Impact and learning

Since its rural wireless launch, GCI has brought mobile services to 137 rural communities, connecting more than 73,000 residents. Almost three-quarters of those will have access to 3G or better services by the end of 2016. Critical to the success of this project is access to government funding, through competitive bidding for technology-neutral deployment, which allows for flexibility and optimisation of available solutions across fixed, wireless and satellite technologies. The GCI project underscores the importance to rural coverage initiatives of innovation, government support that stimulates further private investment, and the implementation of investment-friendly policies, such as technology-neutral eligibility.



**Figure 13:** Alaska: GCI network coverage by technology, June 2015

Source: GCI

## Coverage case study: Sweden

### The challenge

Sweden is a large country with a relatively small population and a population density of just 24 people per square kilometre. Around 85% of the population live in urban areas, while 3% live in small towns and around 12% are scattered around rural areas. This presents significant challenges to building physical infrastructure. Rural areas in northern Sweden in particular have poor access to fixed broadband; according to the Swedish authorities, a third of small and medium-sized businesses in these areas still have dial-up modem access.

### Market structure

Sweden's unique mobile subscriber base reached 8.3 million at the end of 2014, a penetration of 86%. The market is served by six active mobile operators, but four account for almost 97% of the market. Telia, owned by TeliaSonera, is the largest with 42% of connections (excluding M2M) as of December 2014. Tele2 is second with 25%, followed by Telenor with 17% and 3 (Hutchison) with 13%. Unique mobile broadband (3G and 4G) subscriber penetration is 61% in Sweden, the highest in Europe, and the highest outside of Asia Pacific.

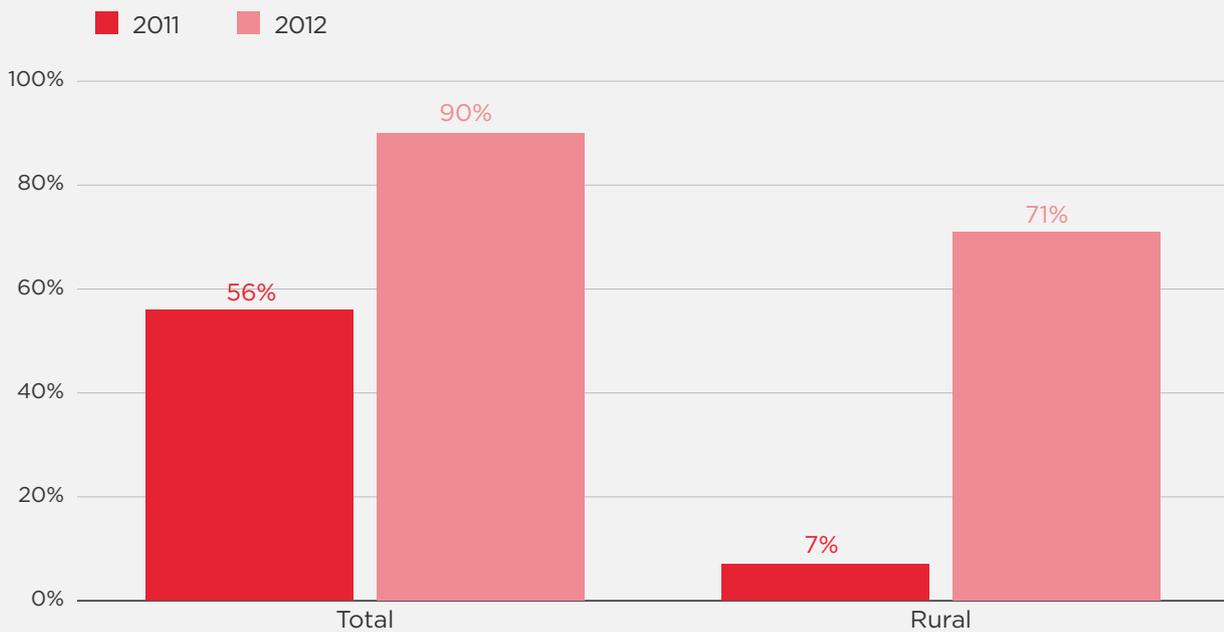
### Strategy and players

Sweden was quick to embrace 3G mobile technology, reaching 50% population coverage by the end of 2005, only three years after launch. Network sharing was instrumental in bringing 3G to all parts of the country. The four main operators formed two separate consortia of two operators each – Svenska UMTS-nät AB (SUNAB) formed by Telia and Tele2, and 3G Infrastructure Services AB (3GIS) formed by Telenor and 3 (Hutchison). Each consortium built out a joint network, with a regulatory requirement that each operator maintain 30% of its network separately. By the end of 2011, 3G population coverage had reached 99.6%, according to the Swedish telecoms regulator (PTS).

In March 2011, PTS announced the result of the auction of the 790–862MHz band – the “digital dividend” band. Telia, Net4Mobility (a mobile operator formed through a joint venture between Tele2 and Telenor, separate from the network-sharing consortia described above) and 3 (Hutchison) each won 2x10 MHz paired spectrum licenses, and planned to use the spectrum to reinforce deployment of 4G (LTE) networks. In addition, Net4Mobility was subjected to significant coverage obligations to promote mobile broadband development in rural areas. Under this agreement, by the end of 2013 Net4Mobility had to cover all permanent homes and fixed places of business that did not have data services of 1 Mbps (identified by PTS).

## Impact and learning

Following the auction of the digital dividend band, 4G coverage increased rapidly. By the end of 2012, 4G population coverage reached 90% across Sweden, up from 56% in 2011. By Q1 2013 it had reached 99%, the second highest in the world behind South Korea. This increase was driven mostly by the expansion of 4G into rural areas where, according to a study by Point Topic, coverage passed 70% by the end of 2012, up from 7% in 2011 – a significant increase, demonstrating the success of the 800 MHz band in reaching underserved rural areas.



**Figure 14:** Sweden 4G population coverage

Source: GSMA Intelligence (Total), Point Topic (Rural)

# Coverage case study: Finland

## The challenge

Finland is one of the most rural and sparsely populated countries in Europe. The total population is 5.4 million, with a population density of 18 people per square kilometre (the third lowest in Europe behind Iceland and Norway). About 85% live in towns and cities, with 1 million living in the Helsinki Metropolitan Area alone. In Arctic Lapland, on the other hand, there are only two people to every square kilometre. Mobile coverage is therefore a challenge, particularly in northern and eastern areas of the country.

## Market structure

Finland's unique mobile subscriber base reached 4.9 million at the end of 2014, a penetration of 90%, which is the highest in Europe and the highest outside of Asia Pacific. The market is served by five active mobile operators, but three are dominant with almost 98% of the market. Elisa is the largest with 40% of connections (excluding M2M) as of December 2014. Sonera, owned by TeliaSonera, is second with 33%, and DNA is third with 25%. The two remaining mobile operators are Ukko Mobile (2%) and Ålcom (less than 1%). Unique mobile broadband (3G and 4G) subscriber penetration is 52%.

## Strategy and players

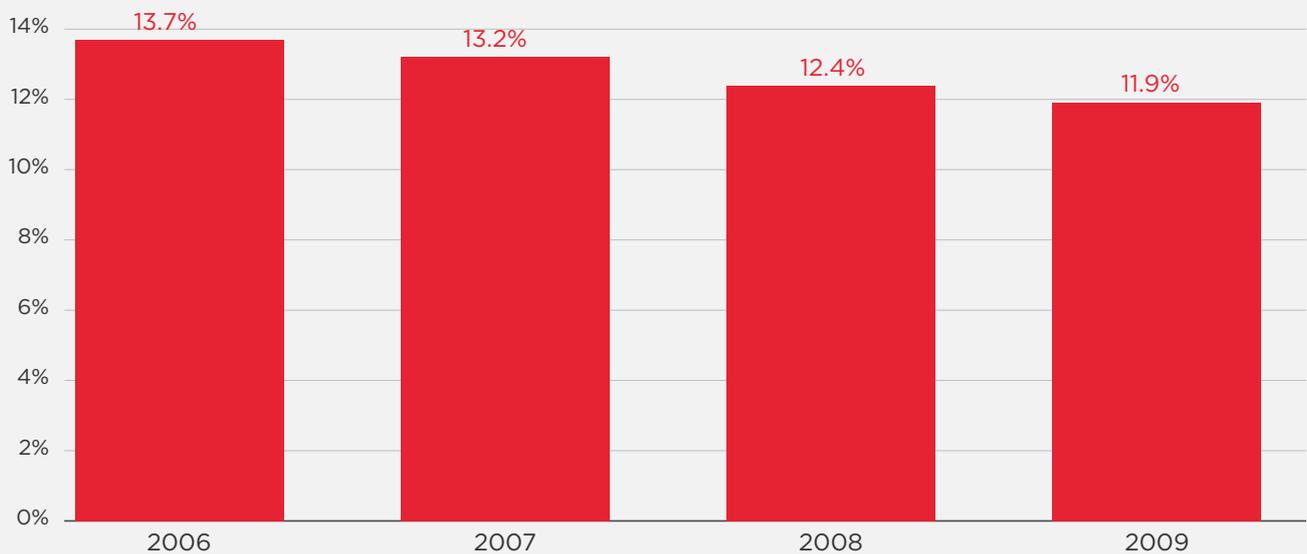
In November 2007, Elisa, in partnership with Nokia Siemens Networks (NSN), launched the world's first commercial WCDMA 900 MHz network, re-farming spectrum previously used for 2G services and bringing mobile broadband to its customers in sparsely populated rural areas. With 900 MHz spectrum, the increase in 3G network coverage was achieved in a cost- and energy-efficient way due to the re-utilisation of existing GSM spectrum and network assets.

In August 2014, Sonera and DNA entered a network-sharing agreement that saw the two share resources and spectrum in the sparsely populated northern and eastern regions of Finland. This allowed for a more efficient build out and operation of mobile networks in an area accounting for 50% of Finland's total territory but home to only about 15% of the population.

In January 2015, Ukko Mobile, in cooperation with Huawei, launched the world's first fully nationwide LTE 4G network using the long-range 450 MHz band. With a single base station able to transmit signals as far as 20–50 kilometres, the mobile operator claims to be able to deliver 4G to even the most remote areas of Finland.

## Impact and learning

3G at 900 MHz costs far less than at 2100 MHz, because at the lower frequency, cell sizes are two to three times larger, enabling coverage with fewer sites. Furthermore, as existing sites can be re-used, new site acquisition and building work is eliminated, reducing capex and opex, and speeding up the rollout of the network. Elisa estimated that rolling out a 3G network on 900 MHz brought about savings (including both capex and opex) of between 50% and 70% versus 3G at 2100 MHz. This in part contributed to Elisa's capex declining from 13.7% of revenue to 11.9% between 2006 and 2009. Elisa also announced that from the start of 2008, around 75% of the population in 130 municipalities would be covered by this new 3G network, initially at speeds of up to 2 Mbps, but increasing to 10 Mbps by the end of 2008.



**Figure 15:** Elisa Finland capex as percent of total revenue

Source: Elisa

It is too soon to fully see the impacts of the network-sharing agreement between Sonera and DNA. However, Sonera is required to reach 99% of the population with 4G coverage by the end of 2018, and the agreement will help the company to reach this goal more efficiently.

Ukko Mobile, meanwhile, claimed its LTE 4G network covered 99.9% of the country's population at launch. Initially Ukko Mobile is focussing on the enterprise, business-to-business (B2B) and governmental sectors (some of the country's largest transportation companies such as the Finnish National Railways are its customers), with a particular focus on moving vehicles and equipment. However, it plans to expand its offerings to the consumer residential market in 2015, with prepaid, family-oriented mobile broadband services designed for those living in rural and remote regions. With this strategy, Ukko Mobile is hoping to gain ground in the Finnish market, expanding on its 2% share of connections at present.

## About the authors



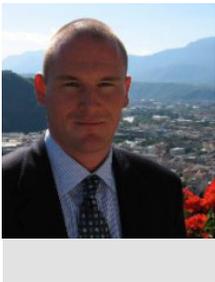
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Tim is a Senior Manager at GSMA Intelligence, having joined the team in October 2012. In this capacity, Tim has responsibility for the team producing research reports and presenting externally at conferences and public speaking engagements. Prior to joining the GSMA, Tim spent 6 years in London as an analyst covering telecoms and a variety of other sectors.



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Jan is a Senior Analyst at GSMA Intelligence, having joined in June 2014, responsible for producing research reports on the global mobile economy as well as mobile for development initiatives in emerging markets. Jan has over 8 years' experience in the telecom industry, working in the strategy department of Vodafone UK, and before that as a market analyst at Qualcomm.



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## About GSMA Intelligence

GSMA Intelligence is the definitive source of mobile operator data, analysis and forecasts, delivering the most accurate and complete set of industry metrics available.

Relied on by a customer base of over 800 of the world's leading mobile operators, device vendors, equipment manufacturers and financial and consultancy firms, the data set is the most scrutinised in the industry.

With over 26 million individual data points (updated daily), the service provides coverage of the performance of all 1,400+ operators and 1,200+ MVNOs across 4,400+ networks, 65 groups and 237 countries and territories worldwide.

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## About GSMA Digital Inclusion

GSMA's Digital Inclusion programme supports the connection of an additional two billion people to the mobile internet by 2020. The programme focuses on working with mobile operators, development organisations and governments to address the barriers to mobile internet adoption through network infrastructure and policy, affordability and tax, digital literacy and local content.

For more information, please visit the GSMA Digital Inclusion website: [gsma.com/digitalinclusion](http://gsma.com/digitalinclusion)

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