WHITE PAPER

Overcoming Barriers to Providing Mobile Coverage Everywhere

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INTELSAT

MOBILE WORLD LIVE

Introduction

New international efforts to tackle digital inequality have made expanding broadband infrastructure a global priority. The United Nations' Broadband Commission for Sustainable Development recently set ambitious targets for 2025 to connect the remaining half of the world's population to the Internet. The goals include a mandate for all countries to establish funded national broadband plans, or broadband universal service requirements, as well as making affordable broadband services available in developing countries (costing less than 2% of monthly gross national income per capita) by 2025.

Mobile Internet connectivity will be key to achieving these broadband sustainable development goals that will bring economic and social benefits to billions of people worldwide. There are two categories of unconnected people: those that are covered by mobile broadband, 3G or 4G, infrastructure but do not use Internet services and those with no access to mobile networks at all. According to the GSMA, about 3.3 billion people are covered but not connected, while 1 billion people are not covered.

The challenge for mobile operators is that 60% of the world's unconnected people live in rural areas, which requires significant time and investment to build networks in extremely difficult environments. To put the size of the challenge into perspective, the International Telecommunication Union (ITU) estimates that it will cost US$450 billion to connect the next 1.5 billion people.

As national governments implement the UN's broadband targets, mobile network operators have an opportunity to expand network coverage to close the connectivity gap and offer affordable Internet services to unserved communities in developing as well as developed countries. Reaching into new territories allows them to add new subscribers in the short term while stimulating local economic growth that will deliver higher returns on the investment in the longer term.

While connecting the unconnected is an important driver for expanding coverage, it's not the only one. Operators in developing and developed countries are under pressure to build out infrastructure for a variety of business and regulatory reasons. Depending on the market, operator requirements include meeting coverage obligations attached to spectrum licenses, providing national emergency or disaster recovery services, reducing roaming and leased line costs and growing their customer base.

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But mobile network expansion plans are often hindered by the high cost and slow pace of traditional infrastructure deployment methods and deterred by low returns on investment. This white paper examines the challenges of expanding mobile networks in remote areas and explains how space-based managed backhaul solutions offer an alternative to traditional deployments that allow operators to rapidly and cost efficiently build out coverage anywhere in the world.

The Remote Coverage Imperative

Mobile operators worldwide need to expand network coverage for a variety of regulatory and business reasons.

Tougher Coverage Targets. Despite government targets for population coverage, many people still have poor mobile service quality. European operators can claim 90% population coverage for 4G, but this measure ignores large regions where people cannot get mobile signals, let alone 4G mobile broadband. In Sweden, a mobile operator could have 90% population coverage but only cover 50% of the country's land mass.

To make mobile services available to all citizens, national regulators are attaching stricter coverage obligations to new spectrum licenses by mandating targets for geographic coverage rather than population coverage, along with hefty fines for missed targets. This trend is well underway in the EU as regulators in Denmark, France, Portugal and Sweden have already imposed geographic coverage requirements.

Meeting these regulatory demands and avoiding onerous penalties requires faster, more cost-effective ways to expand coverage. If operators can demonstrate the ability to rapidly build out networks to unserved areas to meet national coverage goals, they also will be in stronger positions to negotiate better terms and lower license fees when spectrum licenses are up for renewal.

> "Rapid network expansion in remote areas creates first-mover advantage for winning new customers."

> "National regulators are mandating tougher coverage obligations along with hefty fines for missed targets."

Competition for New Subscribers. Operators that can quickly build out coverage to remote areas will have the first-mover advantage in winning new customers and increasing market share, whether they are in a developing or developed market. And since network coverage is also one of the biggest factors that determines customer satisfaction, a sure way to keep subscribers happy and minimize churn rates is to provide consistently good mobile service, even in remote areas.

Roaming and Leased Capacity Costs. Operators in some markets depend on leased transmission or roaming agreements to fill coverage gaps, which incurs high, unpredictable operating costs. Minimizing and controlling these costs are big incentives for operators to expand their own infrastructure.

Disaster Recovery and Emergency Services. In locations that are vulnerable to earthquakes, hurricanes, floods or other natural disasters, operators need infrastructure to provide backup communications for disaster recovery efforts. Also, 4G-based emergency services are emerging that require near-ubiquitous geographic coverage. Without consistently reliable network coverage, mobile operators will miss the opportunities to deliver these services.

Barriers to Expanding Mobile Coverage

Despite many drivers for expanding coverage, it's difficult to make the business case for building out beyond existing infrastructure. Deployments involve costly construction over long distances -- sometimes with difficult terrain and no power facilities -- to serve small communities that will deliver lower traffic volumes. If the same deployment models are used as in the rest of the network, the practical challenges of remote buildouts often defeat the most well-intentioned coverage plans and national broadband strategies. Operators need to consider new deployment solutions as well as the ratio between capital and operating expenditure (CAPEX and OPEX) in the cost equation.

Cost is the Highest Hurdle. The biggest barrier to remote deployments is cost, both in terms of CAPEX and OPEX. Generally, the Radio Access Network (RAN) is the most expensive part of the mobile network, and a major component of RAN costs is the backhaul transport network that connects base station sites to the core network.

Since remote sites can be located anywhere from 10 to 70 kilometres or more from the core network's nearest endpoint, installing terrestrial backhaul using fibre connections or microwave links quickly becomes cost prohibitive. For just 9.65 kilometres of fibre (with tubing), for example, the cost can range from US$31,680 – US$190,080 in the U.S. And the longer the distance, the higher the cost of fibre backhaul. Costs also dramatically increase when fibre needs to be deployed in places where there are mountains, rivers, or rocky terrain that is difficult to dig.

For microwave backhaul, the costs to reach a remote site in a network can reach an average of US$100,000 per site. Considering that microwave requires line of site and that signals start to fade after 48 to 64 kilometres, operators need to install many repeater towers to cover longer distances. Just one microwave repeater system can cost more than US$160,000. Microwave costs escalate in relation to the number of sites needed to cover longer distances and when mountains or dense forests block line of site.

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The initial CAPEX for traditional terrestrial backhaul solutions is a big hurdle. But OPEX considerations also affect network expansion plans, such as energy costs. The monthly energy bill for bringing power to multiple microwave repeater and base station sites can be significant in remote areas. In some places, the infrastructure sites are powered by diesel generators, which incurs costs not only for the fuel but also for the trucks and drivers needed to deliver the fuel to the sites.

Delayed ROI Challenges the Business Case. Remote territories can have sparse populations or low-income communities, which create the conditions for low usage or low Average Revenue Per User (ARPU). In these markets, it takes longer for operators to reach ROI thresholds in the business case. To achieve ROI in a reasonable timeframe, the deployment costs must be extremely low. This is entirely possible with alternative backhaul solutions that spread the cost of each site over multiple sites based on average demand and usage scenarios, rather than traditional deployments that allocate costs to provide a fixed amount of bandwidth to every site.

Remote Deployments Take Too Long. The faster an operator can get to market, the bigger the competitive advantage. Laying fibre is especially time consuming. It can take an entire day to lay just 30 – 50 metres of fibre in challenging geological environments. To lay 10 kilometres of fibre can take anywhere from six months to one year.

> "Sometimes it's just not feasible to reach a planned site, especially when mountains, valleys, rivers or dense jungle stand in the way."

Fibre and Microwave Can't Be Deployed Everywhere. Sometimes it's just not feasible to reach a planned site, especially when mountains, valleys, rivers or dense jungle stand in the way. Access is often limited due to eroded roads, no river crossings, treacherous roadways along steep cliffs, or no roads at all, making it impossible to use the usual large trucks to transport heavy network equipment and building materials. In some cases, the only options for hauling equipment to the remote site are via small all-terrain vehicles or by carrying it all on foot, which are impractical workarounds that add time and cost to the project.

Remote Maintenance Challenges Workforce Logistics. Once it's up and running, the infrastructure needs regular maintenance and that requires teams of skilled field engineers. In remote regions, field personnel need to make regular site visits, sometimes in harsh conditions, to maintain equipment, check power supply, inspect backhaul connectivity and repair network faults when they occur.

New Deployment Models Overcome Remote Coverage Challenges

Traditional fibre and microwave backhaul infrastructure are simply not cost effective for rapid expansion of mobile networks in developed and developing markets. New deployment models are available today that can change the equation for operators by taking time and cost out of remote network projects.

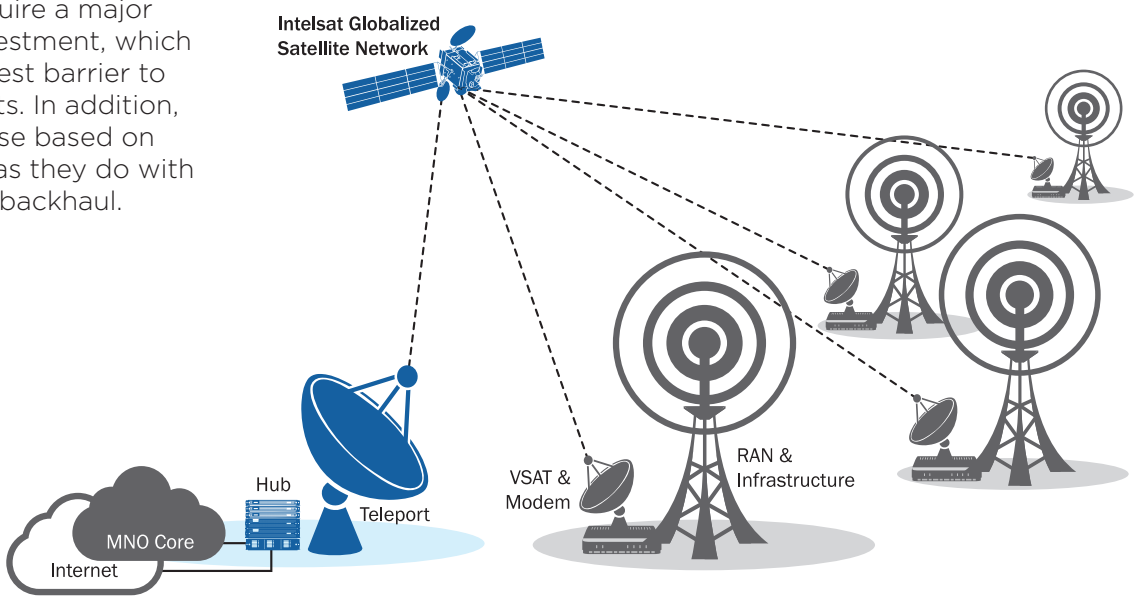
Where fibre and microwave backhaul are not practical, operators can deploy space-based cellular backhaul managed services or turnkey solutions for fast deployment to multiple remote site locations. Satellite-based backhaul connects remote sites and the mobile core network using High-Throughput Satellites (HTS) and satellite-based terrestrial network technology. Once the cell sites are built, satellite-based backhaul provides instant connectivity.

Rapid Deployment. Satellite backhaul services can be deployed quickly anywhere in the world with no geographic or topology limitations, whether coverage is needed in rural, remote or the suburban edge of the network. Provided as a managed service, it is the most cost-efficient way to connect hundreds – even thousands – of remote cell sites to the core network.

Low Capex. Space-based backhaul services do not require a major upfront CAPEX investment, which eliminates the biggest barrier to remote deployments. In addition, costs do not increase based on distance or terrain as they do with fibre or microwave backhaul.

Cost Efficiency Enables ROI. In addition to low CAPEX, the key to the cost efficiency of space-based managed cellular backhaul is that it is a point-to-multipoint system that enables the cost of bandwidth to be shared across all the sites (100s or even 1,000s) connected to the mobile operator's core network using dynamic bandwidth allocation. The dynamic allocation of capacity is determined by the average usage across all sites, which is typically low in remote areas, while also supporting bursts of peak usage whenever they occur on any site. Rather than calculating the cost of bandwidth on a per-site basis and over-provisioning fixed capacity to low usage remote sites to allow for traffic bursts, operators can spread the bandwidth costs across the entire remote deployment while delivering consistently high quality of service.

Simplified Deployment and Management. The managed services are also easily re-deployable to new sites, which gives operators flexibility and minimizes deployment times. The managed service solution also provides expert field resources for ongoing management of the space-based technologies as well as the remote site infrastructure.



The Case for Satellite-Enabled Backhaul Managed Solutions

A leading Asia/Pacific operator wanted to expand 3G and 4G coverage into rural and remote areas to grow its subscriber base in a highly competitive, developed market. It also needed to reduce its dependency on leased transmission capacity as well as establish robust infrastructure for disaster recovery services. The area to be covered was mostly remote island locations where summer holiday and winter ski resorts have seasonal visitors.

When planning the network deployment, the operator determined that fibre backhaul was cost prohibitive and microwave backhaul was unfeasible for the terrain. In the search for the right solution, the operator found that satellite-based managed services allowed them to quickly and cost-effectively roll out the network.

The operator deployed over 4,000 3G and 4G small cells, macro cells and disaster recovery sites and leveraged satellite backhaul managed services. The average traffic across the sites during peak usage times is less than 1 Mbps.

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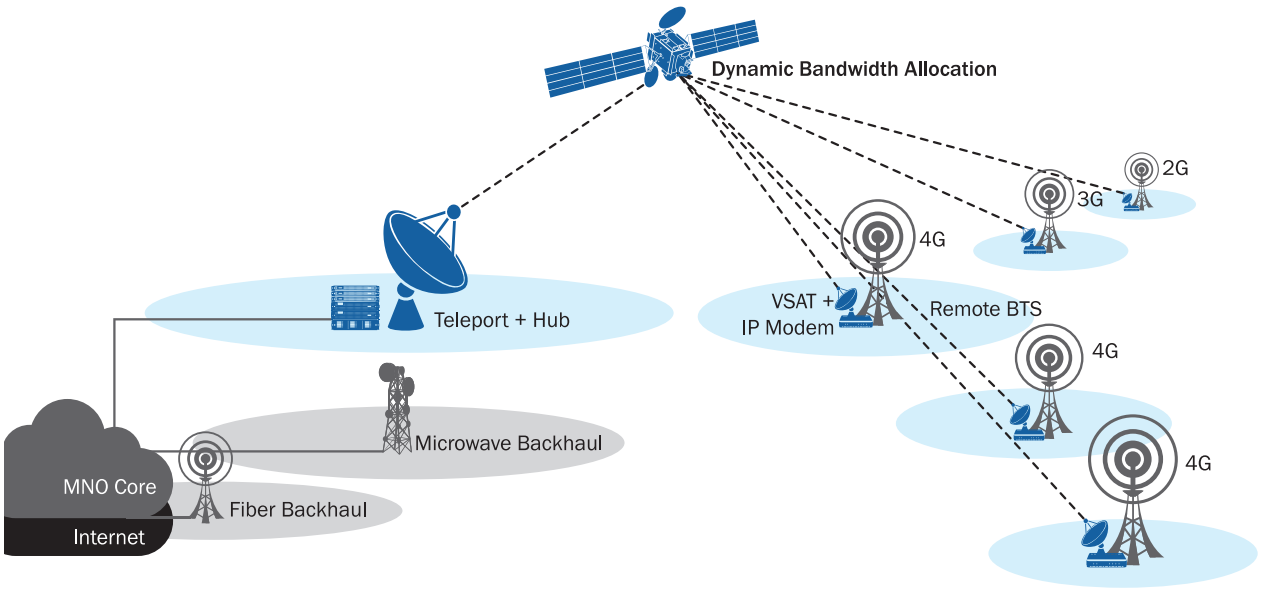
Transmission capacity is dynamically allocated where it is needed and shared across many sites – often more than 100 sites -- so that the transmission profile is configured to deliver 100 Mbps on the downlink and 10 Mbps on the uplink. A user at a remote ski resort, for example, can experience a 50-60 Mbps 4G service, while one user could potentially burst to 100 Mbps.

With a low CAPEX outlay for the backhaul network, the operator was able to reduce costs for leased transmission and deliver high-quality 4G services to customers in the remotest parts of the country at any time of year. In addition, this network expansion also ensured that backup communications are in place for disaster recovery.



Satellite Innovations Take Mobile Coverage Farther, Faster

While mobile operators have historically viewed satellite as a last resort – mainly due to perceived high costs, complexity and inferior service quality – recent innovations have greatly improved satellite performance, quality and cost efficiency to support mobile network expansion.

High-Throughput Satellites (HTS). HTS systems, like Intelsat Epic^{NG}, are next-generation satellites that deliver up to 10 times more throughput using the same amount of frequency on orbit compared to traditional fixed-satellite service (FSS). For mobile backhaul deployments, the high capacity of HTS systems easily support 4G speeds on each cell site in a network. HTS systems also dramatically lower the cost-per-bit for delivering services.

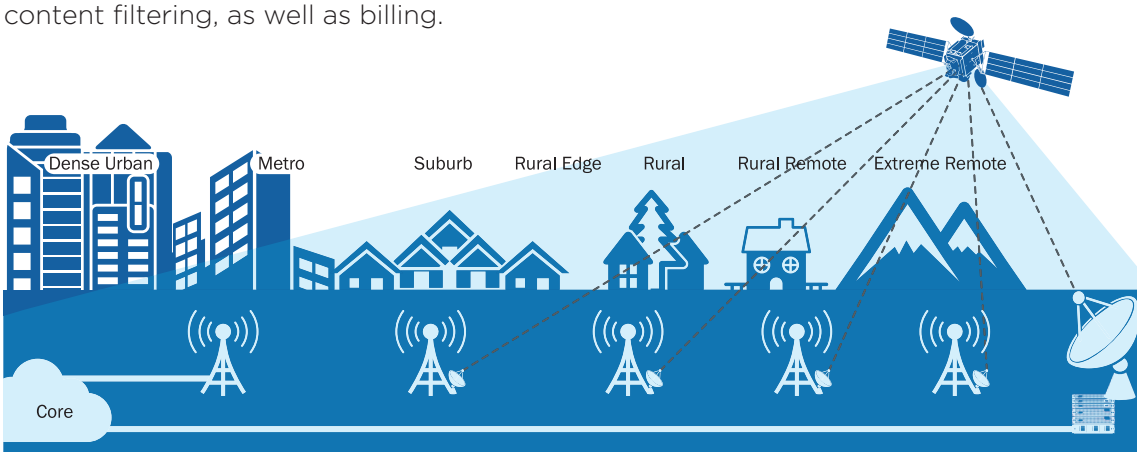
HTS systems feature high power density, which allows mobile operators to leverage smaller VSAT antennas. Particularly in remote coverage scenarios, smaller equipment is easier to deploy and install.

Intelsat Epic^{NG} satellites cover 99% of the globe to provide truly ubiquitous coverage, which enables mobile operators to expand their networks anywhere in the world. Intelsat's next-generation satellites also feature a flexible architecture that can be configured to deliver backhaul transmission in any country. That is, any traffic carried over Intelsat satellite backhaul from a cell site to the core is landed in the same country and doesn't leave the country's borders. This capability allows mobile operators to meet regulatory requirements for lawful intercept, content filtering, as well as billing.

Mobile Network Integration. Satellite networks can easily interface with mobile operator's 4G all-IP Evolved Packet Core (EPC) networks. This makes satellite backhaul services less complex and easier to manage. The integration also enables mobile operators to deliver consistent quality of service and policies across the terrestrial and satellite networks.

Managed Services and Turnkey Solutions. Intelsat's managed mobile backhaul services support any mobile technology, whether it's 2G, 3G and/or 4G, and are flexible to support and interoperate with any RAN vendor as chosen by the mobile operator. Intelsat also partners with leading small cell and VSAT vendors to provide complete turnkey solutions for network deployments to support basic mobile services, mobile data or high-speed mobile broadband in remote areas. The satellite service provider shoulders the burden of managing the entire mobile backhaul solution, reducing complexity and costs and speeding deployments for mobile operators.

Future Satellite Advances. Looking ahead to new satellite developments, low earth orbit (LEO) satellites will provide an additional layer of low latency coverage and capacity to support mobile networks. Meanwhile, new antenna technology and design will create smaller satellite antennas that are easier to install and more powerful than previous generations. These advances will make it even easier for mobile operators to access flexible, high-throughput satellite capacity.



Conclusion

Satellite-based mobile backhaul managed services open new territory for mobile network expansion. In sparsely populated communities with limited or slow return on investment, far from any existing power, transport and communication infrastructure, satellite-based backhaul allows mobile operators to rapidly and cost effectively deliver services to these unserved markets. But the benefits are not limited to the remotest corners of the globe. In underserved markets, where mobile coverage is patchy or not dense enough to deliver broadband quality of service, satellite-based backhaul services enable operators to fill in these areas quickly and at low cost. With ubiquitous coverage, satellite services enable mobile operators to reach further, faster and wherever they want to go.

As the foundational architects of satellite technology, Intelsat operates the largest, most advanced satellite fleet and connectivity infrastructure in the world. We apply our unparalleled expertise and global scale to reliably and seamlessly connect people, devices and networks in even the most challenging and remote locations. Transformation happens when businesses, governments and communities build a ubiquitous connected future through Intelsat's next-generation global network and simplified managed services.

At Intelsat, we turn possibilities into reality. Imagine Here, with us, at Intelsat.com.

For more information, visit www.intelsat.com.

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