WHITE PAPER

Connecting the Unserved and Underserved in Africa

Background

It's understood universally that people everywhere need access to the Internet to enjoy its many economic and social benefits, ranging from broader employment prospects to social services and educational opportunities. According to Pew Research:

Most sub-Saharan Africans feel positively about the role the internet plays in their country. Large majorities say the increasing use of the Internet has had a good influence on education in their country, and half or more say the same about the economy, personal relationships, and politics.

And according to Deutsche Welle (DW), "From money transfers and instant weather updates for farmers to apps that help reduce waste, save water, or find elusive parking spots — mobile Internet use has exploded throughout Africa over the past decade. Mobile broadband connections there are expected to surpass 1.08 billion by 2024, according to industry data."

Yet, there remains a stark reality. The World Bank notes that, "Across Africa…less than a third of the population has access to broadband connectivity." That divide exists because the majority of those unserved or underserved are in lower density, ex-urban, and rural regions where terrestrial broadband services are limited or nonexistent.

Reducing and ultimately eliminating this persistent digital divide is an economic imperative in all countries, developed and developing alike—which calls for governments to adopt policies that promote universal broadband service across all regions, including beyond higher density urban areas where terrestrial fixed and wireless technologies are affordable and well established. Progressive governments are accordingly embracing the most cost-effective solutions available in the marketplace to meet this challenge —combining the latest satellite as well as terrestrial fixed and wireless connectivity technologies.

This paper highlights examples of how changes in technology are ushering in competitive alternatives to the conventional wisdom of "wiring" a country, illustrating that with the certainty of continuing changes in future that government policies must only encourage and not restrict progress.

Meeting the Needs of the Unserved and Underserved

The size of the "unconnected" can be measured many ways, but one fact remains: those who have no Internet access (the "unserved") and those who have inadequate service (the "underserved") can be found in every country, largely in rural and hard to reach places, but also in semi-urban and suburban areas.

Why? Because building the networks that underlie most types of connectivity—fiber, cable, DSL, cellular and microwave—is an expensive proposition that telecommunications companies (telcos) and mobile network operators (MNOs) must justify based on expected return on their investments. When faced with building a network across difficult (and therefore costly) terrain, such as islands, mountains and unpaved roads or to serve thin populations with low subscriber potential, telcos will often choose to expand their networks elsewhere.

When looking to expand their networks and serve more customers, telcos and MNOs will make the decision that is right for their businesses, which typically means building out infrastructure where it is economically viable. Unfortunately, this business model often excludes the hard-to-reach or rural customer, leaving every nation with a portion of citizens unserved or underserved when it comes to Internet access.

In many jurisdictions, government subsidies can help offset the cost of infrastructure deployment, bringing cable and fiber connectivity to people previously unserved. In the United States, the state government of New York has offered a subsidy to network operators to extend connectivity to more New Yorkers. Yet, this undertaking in New York is still not enough to connect everyone with fiber or cable connectivity, as even with the subsidies, there are parts of the state that are too difficult and/or costly for the terrestrial providers to serve.

> Contrary to their name, "wireless" or "cellular" networks are not "wireless" alone. In fact, the cell towers that deliver service to subscribers are usually connected to the network core by terrestrial backhaul infrastructure, such as fiber, cable, and microwave systems, which can be prohibitively expensive in lower-density areas. Satellite backhaul is emerging as a cost-effective alternative to carry traffic between cell towers and the network, making it possible for mobile network operators to expand their networks to serve customers beyond the terrestrial footprint.

The Role of Satellite

Wherever terrestrial networks fall short of reaching hard-to-serve or sparsely populated areas, satellite makes the connection.

- **Direct to Consumer:** In places where cable and fiber providers cannot reach individual homes and businesses, satellite can deliver Internet access. Usually offered on a subscription basis, satellite Internet brings all the advantages of connectivity to people's homes or workplaces, enabling them to send and receive email, shop online, watch videos, take online classes, pay bills and much more. All it takes is a very small aperture terminal (VSAT) antenna outside the home or business and a modem inside to connect to the computer or other Internet-enabled devices. Wi-Fi routers are often used with the VSAT to extend service throughout the home or business, across several devices.
- **Cellular Backhaul**: MNOs looking to extend connectivity to subscribers outside the reach of their terrestrial networks can use satellite to "backhaul" mobile traffic. This entails the provision of a satellite VSAT and equipment at the cell tower to transmit the mobile traffic by satellite back to the network core. Satellite readily backhauls every type of mobile traffic—2G, 3G, 4G/LTE and even 5G.
- C**ommunity Wi-Fi Hotspots**: In places where direct-to-home service may be unaffordable for citizens or unfeasible for providers, shared service can make Internet access available to more people. This model entails a satellite VSAT and modem at the location, such as a shop, community center, library or school, along with a Wi-Fi device that extends the signal across a 50- to 100-meter radius, making service available to anyone within range of the Wi-Fi signal, accessible with any Wi-Fi enabled device. Service can then be offered for free or on a pay-per-use basis.

4G/LTE and 5G will not connect everyone. In fact, we have all experienced instances where our connection slips to 2G instead of the expected 4G coverage. As 4G and 5G networks expand, these gaps will become more prevalent, because the coverage area of a radio base station shrinks the farther it is from the network core. Further, with users adapting applications that require faster connections, the available capacity gets used up quickly, creating more strain on the network. These gaps or underserved pockets represent a different challenge for policy makers looking at the technology mix to best deliver broadband access to their constituents. Here again, satellite is ideal for filling in those gaps with broadband service.

These scenarios illustrate some of the ways satellite can connect the unconnected, all without the investment and time required to build out the typical terrestrial infrastructure required for cable, fiber, and even wireless service.

Using USO Funds for Satellite Connectivity

For policy makers and governments exploring ways to connect the unserved and underserved in their jurisdictions, satellite fills an important gap, and governments can expedite the implementation of these solutions by assisting satellite operators, MNOs and telcos with the capital needed for reaching such locations. In fact, when considering funding to help these businesses meet universal service obligations (USO), governments would be wise to include satellite services in their requirements for operators to reach the unserved and underserved.

While it does not require installing underground cables, there is infrastructure necessary to implement any satellite network.

- **The Satellite:** Usually a national satellite operator or an international satellite operator builds and launches a satellite. The upfront cost of building the satellite and launching it is borne by the satellite provider—although there are many instances in which governments will fund them. The operator (or government) then leases the use of the satellite capacity (measured in megahertz per second or gigahertz per second) to a network operator (sometimes, the network operator and the satellite operator are one and the same). Apart from the satellite, the operator also invests in the ground based satellite tracking and control center. Usually the life span of a satellite is 12 to 15 years.
- **The Ground System:** Leasing the capacity is one thing but bringing it down to Earth and commoditizing it requires a "ground system." In loose terms, the ground system consists of large antennas (often called a "dish") and a network switch (the "Gateway Platform") that is built and serviced by a network operator, often licensed for this activity by the government.
- **The Remotes**: To deliver Internet access by satellite to a subscriber's home or business, a mobile base station or cell tower, a merchant that resells it via Wi-Fi access, or a community site where Internet access is provided to citizens, each location needs its own VSAT (a small "dish" installed outside to receive the satellite signal) and router. To install the VSAT and deliver and set up the router, the network operator may deploy its own teams or contract with installers or a systems integrator.

In many nations, a government will apply USO funding to operators using satellite to connect mobile base stations, provide Wi-Fi access points and/or connect schools, health centers, community centers, libraries and government offices (such as post offices, police stations and local government centers).

In these instances, the government will typically fund the upfront capital requirements, such as for installing the remotes. This is akin to how USO funds are often used to subsidize terrestrial infrastructure build-out. In a typical situation like this, the government will grant a network operator a one-time capital subsidy to install the necessary equipment to deliver Internet service at a specific minimum speed.

In the early 2000s, with previous generations of satellite technology, users of satellite under USO programs would often complain of:

- Insufficient capacity
- Slow speeds and network congestion during peak hours
- Sites that were shut down with no notice

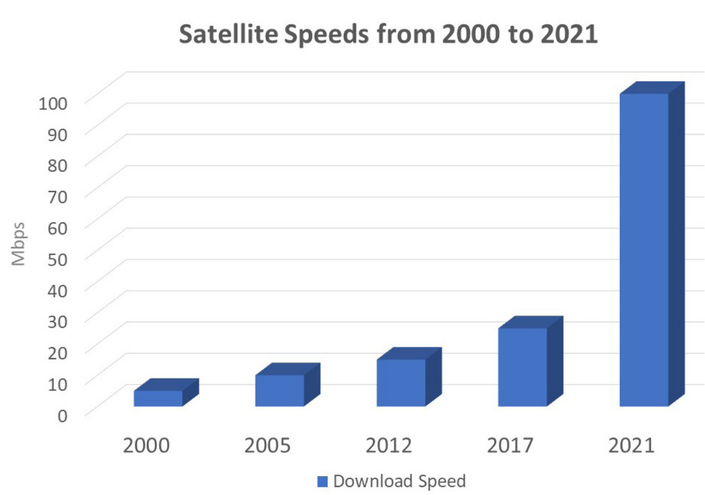
With today's high-throughput satellites (HTS) and advanced remote terminal technology, satellite service, and speeds are outperforming many terrestrial services, and governments and operators are monetizing their investments while meeting critical needs.

The connection is then made available to the local MNOs or telcos to provide service to the population surrounding the remote site.

Today's Satellite Technology

As demand for broadband has exploded worldwide, advances in the satellite industry over the past 10 years have enhanced the user experience dramatically. Governments today have new options for satellite service that delivers the performance and speed that today's consumer expects.

The newest generation of satellites are known as "high-throughput satellites" (HTS). A step-change in the HTS technology over earlier versions ("conventional" satellites) enables the re-use of spectrum frequencies—for more efficient delivery of capacity—as well as "Spot Beams" which target more capacity over a specific area. Combined, these advances vastly increase the amount of capacity that a single satellite can deliver.



Another significant change in satellite services comes from the wide adoption of the Ka-band spectrum. Compared to C-band and Ku-band satellites, Ka-band makes more capacity available and enables the use of smaller, and therefore, less costly terminals.

Other advances in the satellite industry, such as reusable rocket technology from companies like SpaceX and Blue Origin has launch costs for putting up these satellites dropping by close to 50% when compared to a few years ago.

And manufacturing costs are coming down, as satellite engineers innovate new ways to deliver ever more capacity from a single satellite—an order of magnitude greater than previous generations.

All told, these HTS Ka-band satellites have ushered in a new era of pragmatic and economically viable satellite solutions that many operators are leveraging to meet USO requirements. Where available, such satellites have bought down the cost of delivering broadband service that meets customers' need to high-speed Internet access. As one example, Hughes operates the world's largest satellite Internet service, HughesNet® with millions of subscribers across the Americas. Other examples can be found in Europe, with Eutelsat; in Thailand, with Thaicom; in Russia with RSCC; and in Australia with the government-owned MBN.

Moreover, the future looks bright, as still larger satellites with even more capacity are being developed and promise to deliver end-user speeds of up to 100 Mbps. The Hughes JUPITER™ 3 satellite (designated "EchoStar® XXIV") is just one example.

The Outlook is Bright for Satellite Solutions

Despite billions of dollars invested by governments in fiber infrastructure, the problem of connecting everyone, everywhere to the Internet has not been solved. To connect the unserved and underserved, governments today should consider satellite as an essential part of the mix of Internet access technologies made available to their citizens. Capacity and speeds are increasing while cost is coming down, making satellite the ideal connection to fill any nation's gaps in connectivity.

Newer technologies have brought down the cost of satellite service, making it a practical alternative for delivering Internet access beyond the reach of terrestrial technologies—whether by subsidizing the cost of the remote terminals or the entire service (to provide free public Wi-Fi access). Policy makers can also subsidize cellular backhaul by satellite to enable MNOs to extend their network reach to serve more customers.

Some options to consider:

- **The Satellite:** While many governments build their own satellites, most share space on commercial satellites. In many instances, governments will use a combination of owned and leased satellite capacity.
- **The Ground System:** Since the early days of satellite, the cost of building a ground system has come down dramatically, with many options for implementation. For example, it can be procured directly or leased as part of a managed service to meet various government needs.
- **The Remotes:** Finally, the equipment at the site—whether a cellular base station, a community center or a subscriber's home—can be purchased, leased or subsidized in any number of ways to make the service economically viable for those unserved and underserved by other forms of Internet access. In fact, a fraction of the cost of a high-end 4G mobile handset, one can have a satellite terminal capable of speeds of up to 200 Mbps. For a little more, the satellite terminal can have advanced features required for use in mobile networks to connect 4G base stations.

Satellite makes a convincing complement to fiber, cable, and wireless networks, enabling MNOs and telcos to extend their networks and reach more subscribers in numerous ways. In fact, in order to build a network that reaches everyone, everywhere, satellite must be part of the mix of technologies.

On the horizon, an innovative concept of "Software-Defined Satellites," will eliminate the need for a fully customised engineering approach to each new satellite built. This innovation makes way for standard satellite designs that can be built the way we build anything today on an assembly line. This could bring the cost of building a satellite from over half a billion dollars to around $200 million as soon as 2024.

Proprietary Statement

Contact us today to talk with a Hughes representative about how satellite can help extend connectivity throughout your region.

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