



How to Enable More Voice and Data Connections Everywhere

Reliable, High-performing Backhaul
Solutions for Mobile Network Operators

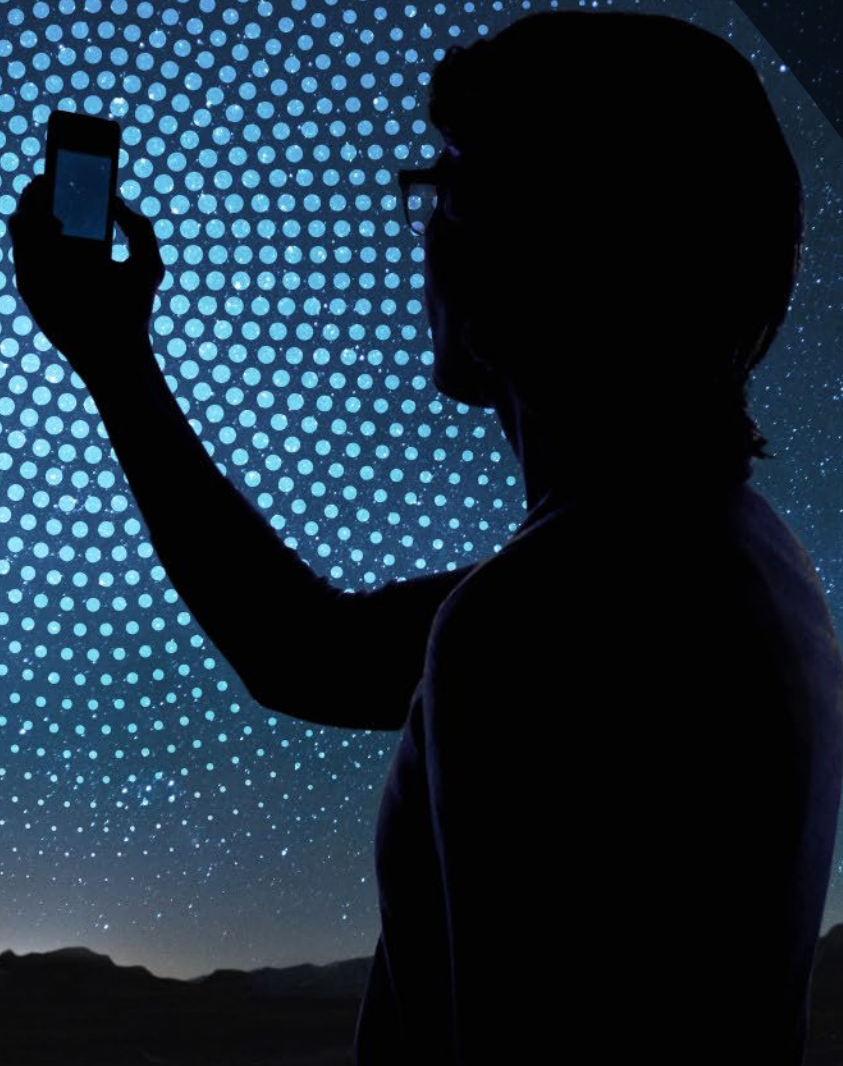


Table of Contents

- 01 Pressures Facing Mobile Network Operators**
- 02 Opportunities for Mobile Network Operators**
- 03 Three Cellular Backhaul Technology Options**
- 04 Challenges of Terrestrial Backhaul for Rural Areas**
- 05 A Unique Cellular Backhaul Solution**
- 06 Satellite Backhaul for Cellular Networks**
- 07 Uses and Applications for Satellite Cellular Backhaul**
- 08 Opportunities for Multi-orbit Backhaul**
- 09 A Complete Cellular Backhaul Managed Service**
- 10 Benefits of Intelsat's Cellular Backhaul Managed Service**
- 11 High-Quality Cellular Backhaul Performance**
- 12 Reliable Cellular Backhaul Deployments**



01 Pressures Facing Mobile Network Operators

Consumers

- Expect quality cellular coverage to be available everywhere they live, work and play, no matter how rural or remote
- Expect their current provider to offer at least the same coverage areas as other operators
- Expect services that are resilient to natural and man-made disruptions

Competitors

- Are competing for subscribers and revenue in a saturated market
- Need to densify and expand coverage, while also effectively marketing that availability

Regulators

- Are pressuring mobile operators to ensure everyone, including businesses and emergency response personnel, has access to quality mobile coverage
- Are incentivizing mobile operators to expand coverage into rural areas with subsidy programs
- May levy fines for not meeting network deployment timelines

7.8 Billion
Forecasted smartphone
subscriptions in 2028.

Source: November 2022 Ericsson Mobility Report



02 Opportunities for Mobile Network Operators

People

Over half a billion people around the world live, work, and play in areas without access to mobile broadband coverage (often the only practical means for internet connectivity).

Places

There are many places where cellular demand changes with the seasons, shifting population, or unforeseen events, driving a need for efficient and flexible solutions.

Things

The Internet-of-Things (IoT) is more than smart appliances and home automation. It's vital to smart farming, remote monitoring, and a host of other rural and industrial IoT applications.





Intelsat Helps Mobile Network Operators Connect More

More **People**

More **Places**

More **Things**

More **Quickly**



The need for connecting more people, places, and things translates into significant opportunities for MNOs to:

- Make more voice and data connections possible
- Grow and retain subscribers
- Provide competitive coverage everywhere
- Support disaster recovery needs
- Generate new revenue

Expansion of coverage into rural and hard-to-reach areas also translates into an opportunity for MNOs to quickly enter new markets and fulfill government regulatory requirements.

03 Three Cellular Backhaul Technology Options



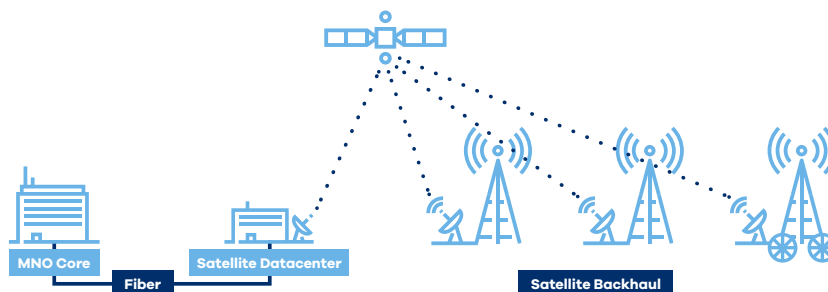
Fiber Backhaul

Optical fiber can be used to connect cell sites to the core network and is typically installed below ground. It's good for urbanized areas and main roads, and for applications requiring ultra-high speed and ultra-low latency. It's not, however, practical for rural locations, hard-to-reach deployments, or for addressing shifting or short-term demand.



Microwave Backhaul

Microwave links can provide a fast and less expensive means of servicing areas at the edge of the fiber backbone. Unfortunately, microwave is a line-of-sight technology, which means topography can greatly increase deployment costs in rural and hard-to-reach areas. And like fiber, it can't easily be moved if customer demand shifts.



Satellite Backhaul

Satellite can transport voice and data traffic between cell sites and the core network via a network that combines space and ground infrastructure. It supports 2G/3G/4G/5G applications, and especially use cases for rural coverage, short-term or seasonal demand, and network continuity.



04 Challenges of Terrestrial Backhaul for Rural Areas

There are four major challenges mobile network operators face when considering terrestrial fiber or microwave backhaul:

Limited Access Due to Geographic Location

Mountains, forests, and islands limit access and feasibility of fiber or microwave.

High Per-site CAPEX Investment

As distance to a rural site increases (requiring more fiber or microwave stations), CAPEX increases. And when topographical challenges like mountains and rivers are added, the cost increases even more.

Lengthy Deployments of Backhaul Infrastructure

Installation can take months or longer across long distances, challenging time-to-market advantages and limiting an MNO's ability to address shifting needs.

Low Per-site Return on Investment

Low regular volume of rural site traffic typically means lower return on investment and can challenge business cases.

Terrestrial Backhaul

Distance and location of each rural cell site are factors of CAPEX investment, ROI, and speed to market.





05 A Unique Cellular Backhaul Solution

Mobile operators are looking for more ways to accomplish their business objectives in a cost-effective, timely, and agile manner. This is especially the case when planning network coverage. That's why they need a cellular backhaul option that addresses multiple needs and challenges.



Quick and Cost-effective

Can be deployed quickly and cost-effectively when and where mobile coverage is needed.



Operationally Efficient and Completely Managed

Eliminates complexity and frees up critical resources, with day-to-day operations management and guaranteed SLAs.



Scalable Across Multiple Sites

Makes economic sense for multiple rural sites across large geographic areas, even entire countries.



Without Geographic Limits

Available everywhere and not limited by geographic and topographic barriers.

"We shall have no better conditions in the future if we are satisfied with all those which we have at present."

– Thomas A. Edison





06 Satellite Backhaul for Cellular Networks

When comparing options for rural, short-term, and disaster recovery needs, only satellite backhaul is practical from an economical, efficiency, and feasibility standpoint.

What makes it economical?

- Bandwidth to support an entire network of rural cell sites - no matter how remote
- Based on average planned usage across backhauled sites
- Cost of bandwidth distributed to backhauled sites based on per-site demand
- One-time investment in low-cost equipment

What makes it efficient?

- Speed to market
- Quicker and simpler installation and connection
- Network expansion in weeks instead of months or longer
- Deploy for disaster recovery or event-specific use in just days, even hours

What makes it feasible?

- Coverage isn't limited by terrain, location, or terrestrial line-of-site
- Cell sites can be backhauled virtually anywhere (even island geographies)

Factors	Fiber	Microwave	Satellite
Bandwidth readily available virtually anywhere in the world, covering 99% of populated areas	No	No	Yes
Deployable in any location, regardless of topography or terrain	No	No	Yes
Can be installed in weeks, days – even hours – in virtually any location	No	No	Yes
Quickly re-deployable for use at new sites	No	Yes	Yes
Point-to-multipoint capable with bandwidth shared across hundreds or thousands of cell sites	No	No	Yes
Minimal CAPEX associated with installations in distant, hard-to-reach areas	No	No	Yes
Meets quality of service (QoS) and quality of experience (QoE) requirements	Yes	Yes	Yes



07 Uses and Applications for Satellite Cellular Backhaul

Wide Coverage



Deliver mobile services in all the places where terrestrial backhaul is not practical or feasible

Network Resilience



Ensure network resiliency for terrestrial backhauled sites at high risk of disaster-related outages

Internet of Things



Connect IoT devices and sensors to a cellular IoT network for farming & mining

4G Upgrades



Quickly extend 4G coverage to keep up with customer expectations and universal service policies

Time to Market



Expand network footprints more quickly without the need for fiber buildout

Private Networks



Take advantage of enterprise demand for robust private cellular (including 5G) networks, regardless of location

Public Safety



Quickly bring up connectivity to support disaster recovery efforts and get communities back on their feet





08 Opportunities for Multi-Orbit Backhaul

Intelsat's cellular backhaul solutions are powered by its fleet of 50+ high-performing satellites located in geostationary (GEO) orbit, combined with strategic partnerships with satellite operators operating Low-Earth Orbit (LEO) constellations.

Hybrid GEO/LEO backhaul solutions combine the predictable service levels and proven reliability of GEO satellites with the lower latency of LEO satellites to provide MNOs with a versatile service that meets the needs of different applications and users.

By intelligently leveraging the strengths of both orbits, Intelsat can offer an optimized solution tailored to different application needs. The Intelsat solution intelligently routes latency-sensitive applications via the LEO network, while traffic that is not sensitive to latency is routed over the GEO network that also provides a consistently reliable connection.

Intelsat's hybrid backhaul solution also allows MNOs to benefit from the extensive coverage of the globe-spanning GEO network, while still taking advantage of the low latency capabilities of LEO satellites as needed. It provides flexibility and adaptability to meet the varying requirements of different regions and network conditions.



GEO orbit is located 36,000km (22,300 miles) from Earth's surface. Satellites located in this orbit are always in the same position (located in a specific "orbital slot") relative to a given place on the Earth's surface, orbiting in synch with the Earth's rotation. A couple of key advantages to geostationary satellites are:

- Can leverage smaller, less costly remote antennas at MNO cell sites that can be aimed once and left in position without further adjustment.
- Cover a broad geographic footprint that can support point-to-multipoint connectivity where a single pool of bandwidth from one satellite can be shared dynamically across hundreds, even thousands of MNO cell sites, providing efficient, uninterrupted connectivity.

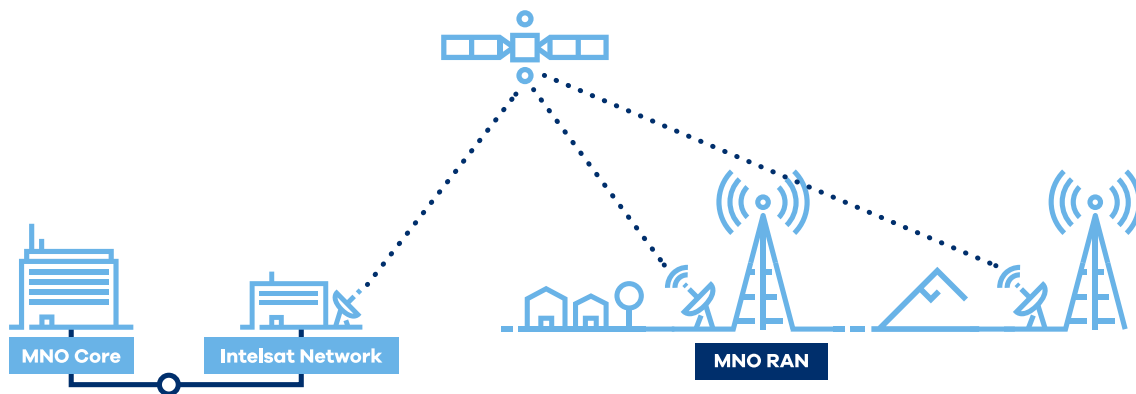
LEO orbit is 2,000km (1,200 miles) or less from Earth's surface. The velocity of LEO satellites is much higher to counteract gravity and maintain their orbit, so will move across the sky relative a given place on the Earth's surface. A key advantage of LEO-based satellites is:

- Reduced time for signals to go from the ground to the satellite and back, due to the satellite being closer to the Earth. This can improve the experience of users of certain latency-sensitive applications.



09 A Complete Cellular Backhaul Managed Service

Intelsat CellBackhaul is a cost-effective and highly efficient end-to-end managed service for MNOs. It utilizes Intelsat's high-performing, global network to manage transmission of voice and data services between remote cell sites and the MNO's core network.



Intelsat CellBackhaul Features

Performance SLAs & Reporting

Defined per-site SLAs for latency, jitter, speed, and availability. Customer visibility to online reports highlighting performance metrics.

Flexible Pricing

Per-site pricing. Tiered pricing based on required speed. Easy transition between tiers as needed.

Satellite Hub Setup & Management

Capacity sizing, servicing, hub provisioning, and teleport services

Operational Support

24x7 proactive monitoring. L1/L2/L3 support. Guaranteed support SLAs.

Site Configuration & Management

Initial and ongoing configuration updates, including OTA software upgrades.

Field Services

Optional site installation, maintenance, and return merchandise authorization (RMA).

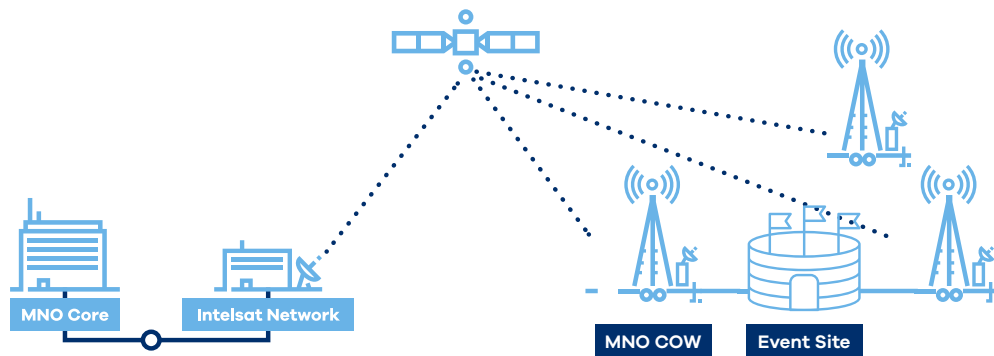
IntelsatOne

Our global terrestrial network delivers a closer handoff to the internet or the MNO core.



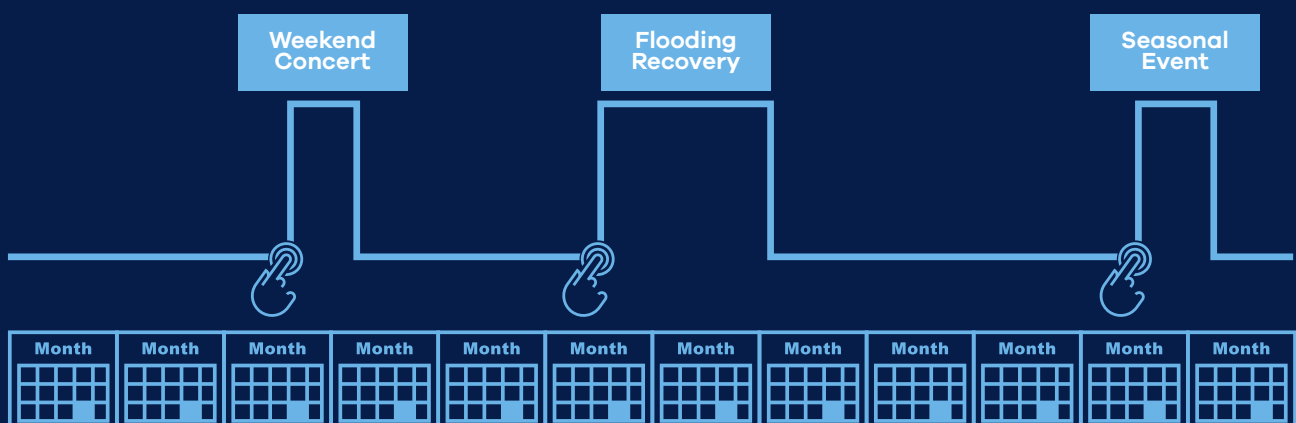
CellBackhaul Ready

Intelsat's CellBackhaul Ready option is ideal for delivering temporary cellular coverage. It is well suited for short-term events as well as rapid deployment scenarios, such as emergency situations due to natural disasters. This flexibility allows MNOs to leverage the same SLAs and operational support as the fulltime CellBackhaul service to support temporary spikes in demand, without incurring the costs of permanent infrastructure or fulltime backhaul service.



Use cases for CellBackhaul Ready include:

- Emergency response and disaster recovery
- Public safety and law enforcement activities
- Temporary events such as music festivals, sporting events, and rallies
- Network testing and maintenance



A key component of CellBackhaul Ready is the flexibility to pay for service only when the need arises. The service is kept on standby, then when ground units such as a Cell on Wheels (COW) or Cell on Light Trucks (COLT) are deployed, on-demand activation can occur within 10 hours of a request being received by the Intelsat team.



10 Benefits of Intelsat's Cellular Backhaul Managed Service

There are many benefits to using Intelsat CellBackhaul, an end-to-end managed cellular backhaul service.



Reliable & High Performing

Delivers always-on, high-performing connectivity to cell sites, meeting mobile operator quality of service and quality of experience requirements.



Cost-effective Deployment

Provides a cost-effective solution because it distributes bandwidth to a network of sites based on per-site demand. Bandwidth is allocated where and when needed.



Comprehensive Solution

Delivers a complete managed backhaul service, meaning mobile operators don't have to worry with adding satellite-focused resources or third-party vendors.



Scalable & Efficient

Can be installed virtually everywhere, no matter how remote, backhauling dozens or more cell sites.



Trusted Relationship

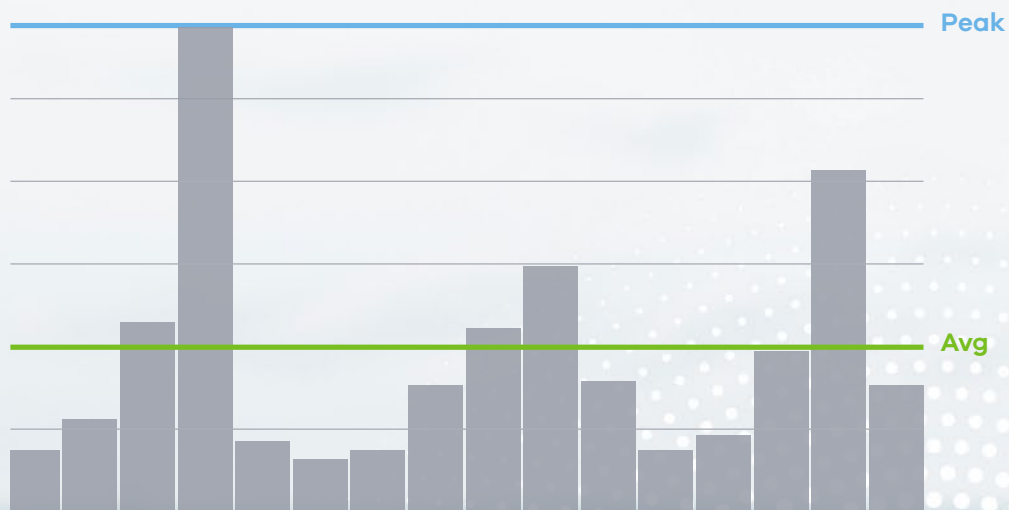
Enables MNOs to work with the experts in the satellite industry, establishing a direct relationship with backhaul capacity providers and the complete cellular backhaul managed service.



Cost-efficient Use of Bandwidth

Why waste bandwidth when high-performing capacity can be distributed to each rural cell site across your network, when and where it is needed?

Intelsat engineers will work with you to design your network based on per-site peak usage to ensure capacity is distributed to each site as needed. This maximizes use of bandwidth for a cost-efficient solution.





11 High-Quality Cellular Backhaul Performance

Through a combination of advanced space and ground infrastructure, as well as advances in VSAT technologies, plus a well-designed end-to-end solution, satellite-enabled cellular backhaul can deliver high-performing connectivity that meets operators' quality of service (QoS) and quality of experience (QoE) requirements.



Speed

Intelsat CellBackhaul supports peak download speeds of 100 Mbps and peak upload speeds of 20 Mbps.



Jitter

Intelsat CellBackhaul delivers jitter of less than 20 msec.



Latency

Intelsat CellBackhaul achieves a latency of less than 600 msec round trip transmission time (RTT) – less than 300 msec one way.

There are many factors other than latency to be considered when determining the right cellular backhaul solution, including data throughput rates, coverage, availability, security, QoS, and total cost of ownership. Intelsat CellBackhaul meets and even exceeds mobile backhaul requirements for rural and hard-to-reach areas.

The ITU-T Y.1541 recommends a one-way delay limit of 400 msec for real-time service applications over satellite-based IP networks, including voice calls. With Intelsat solutions for cellular backhaul, MNOs can expect average one-way latency of less than 300 msec.

**<300
msec**

Intelsat CellBackhaul
Average One-Way Latency

**<20
msec**

Intelsat CellBackhaul
Average Jitter



12 Reliable Satellite Cellular Backhaul Deployments

MNO Broadens 4G Connectivity Landscape to Include Japan's Remote Regions

Intelsat worked with a leading Japanese telecommunications provider to look for a way to quickly and cost-effectively deploy 3G and 4G coverage to thousands of sites on islands in rural and often hard-to-reach places.

“Intelsat fully meets (or exceeds) the contracted technical and operational performance service level agreement.”

–**Tier 1 Telecommunications Provider in Japan**

Mobile Carrier Brings Growth and Safety to Isolated Communities

In support of their strategic initiative to bring mobile services to deep rural sites in DRC, a leading mobile communications provider sought a satellite backhaul solution to complement terrestrial solutions to enhance and upgrade rural communication services.

“Expanding mobile service to the underserved and unserved population of the Democratic Republic of Congo [with CellBackhaul] is a key pillar of our Vision 2025 strategy.”

– **Leading Mobile Communications Provider in DRC**



Brasil MNO Implements the Largest Satellite Network in Latin America and Expands 4G Coverage to the Northern Brazil Region

Intelsat provides service to a leading Brazilian telecommunications provider in support of their initiative combining satellite connectivity and sustainable cellular infrastructure to sustainably extend the reach of services to remote off-grid locations.

“We want to support Brazil in digital inclusion with the Sky Coverage project and for that, we have important partners, such as Intelsat, with whom we work especially in the [remote] northern region.”
– **Tier 1 Telecommunications Provider in Brazil**

Intelsat and MNO to Bring High-Speed Mobile Connectivity to Rural and Remote Parts of Germany

A leading German MNO sought an efficient means to strengthen and expand its national 4G network coverage and extend digital services to areas of Germany that could not be reached by traditional technologies such as microwave or fiber.

“[CellBackhaul] will allow us to provide 4G connectivity in a fast and cost-efficient way in those places where terrestrial solutions are not available.”
– **Tier 1 Telecommunications Provider in Germany**



About Intelsat

Intelsat's global team of professionals is focused on providing seamless and secure, satellite-based communications to government, NGO and commercial customers through the company's next-generation global network and managed services. Bridging the digital divide by operating one of the world's largest and most advanced satellite fleet and connectivity infrastructures, Intelsat enables people and their tools to speak over oceans, see across continents and listen through the skies to communicate, cooperate and coexist. Since its founding six decades ago, the company has been synonymous with satellite-industry "firsts" in service to its customers and the planet. Leaning on a legacy of innovation and focusing on addressing a new generation of challenges, Intelsat team members now have our sights on the "next firsts" in space as we disrupt the field and lead in the digital transformation of the industry.

Are You Ready to Connect the Rest of the World?

Expand the reach of mobile broadband coverage efficiently and cost-effectively.

Learn more about the advantages of satellite backhaul today.

intelsat.com/cellbackhaul



intelsat.com