

How to Enable More Voice and Data Connections Everywhere

Reliable, high-performing satellite backhaul
solutions for mobile network operators



Table of Contents

1. Pressures Facing Mobile Network Operators
2. Opportunities for Mobile Network Operators
3. Three Cellular Backhaul Technology Options
4. Challenges of Terrestrial Backhaul for Rural Areas
5. A Unique Cellular Backhaul Solution
6. Satellite Backhaul for Cellular Networks
7. Uses and Applications for Satellite Cellular Backhaul
8. Opportunities for Multi-orbit Backhaul
9. A Complete Cellular Backhaul Managed Service
10. Benefits of SES's Cellular Backhaul Managed Service
11. High-quality Cellular Backhaul Performance
12. Reliable Cellular Backhaul Deployments



01 Pressures Facing Mobile Network Operators (MNOs)



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

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



Regulators

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

8.5B

Forecasted smartphone subscriptions in 2031

Source: June 2026 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).



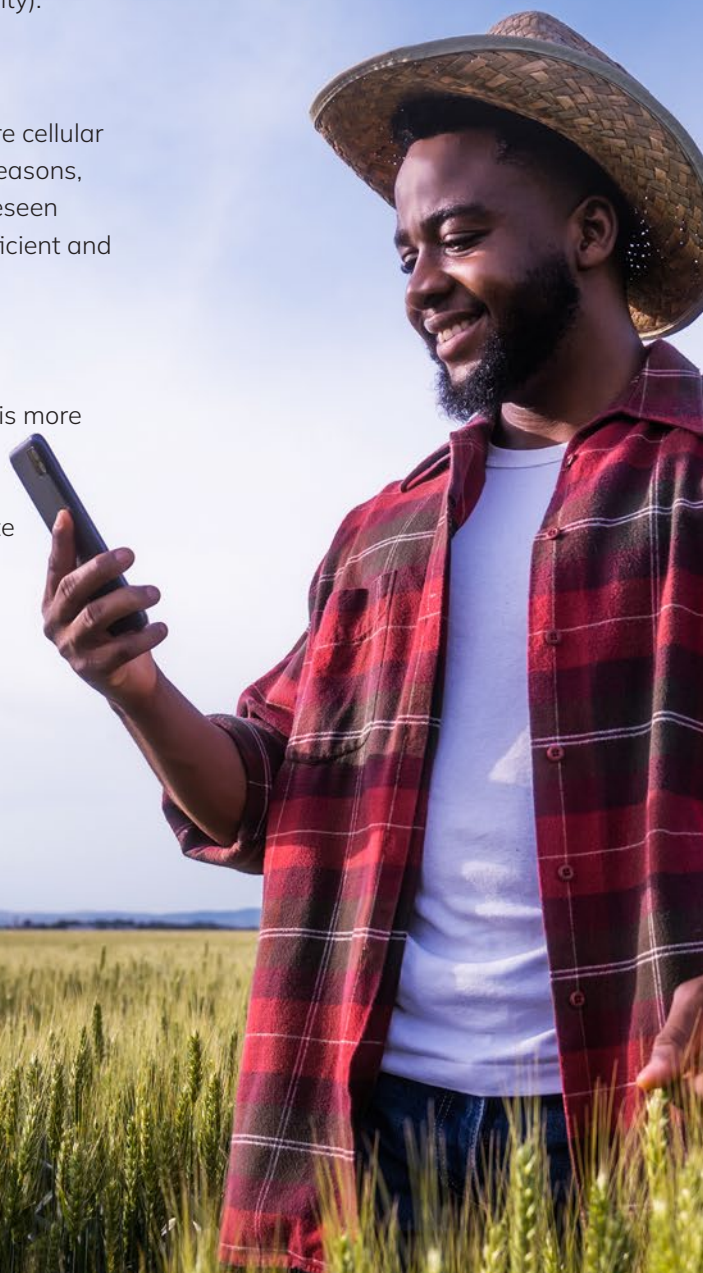
Places

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.



SES 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

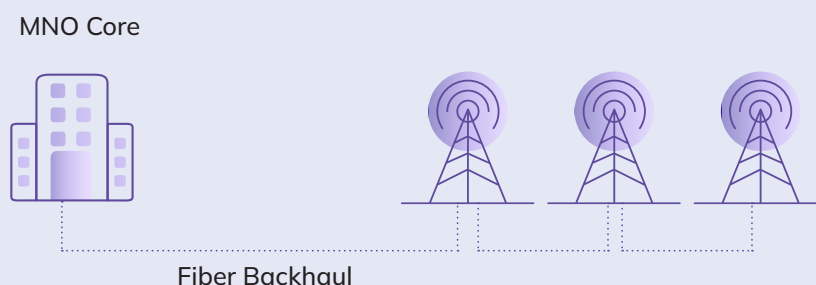
Expansion of coverage in to rural and hard-to-reach areas also translates into an opportunity for MNOs to quickly enter new markets and fulfill government regulatory requirements.



03 Three Cellular Backhaul Technology Options

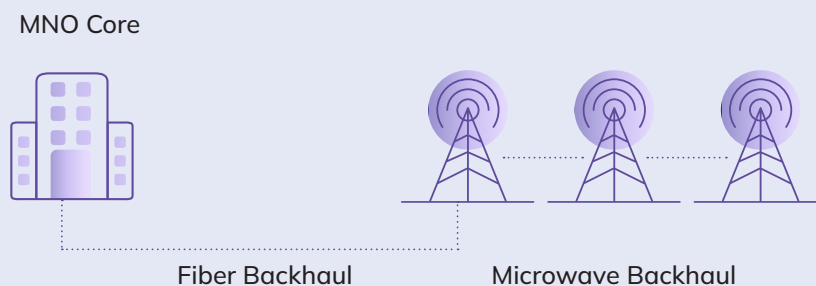
Fiber backhaul

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.



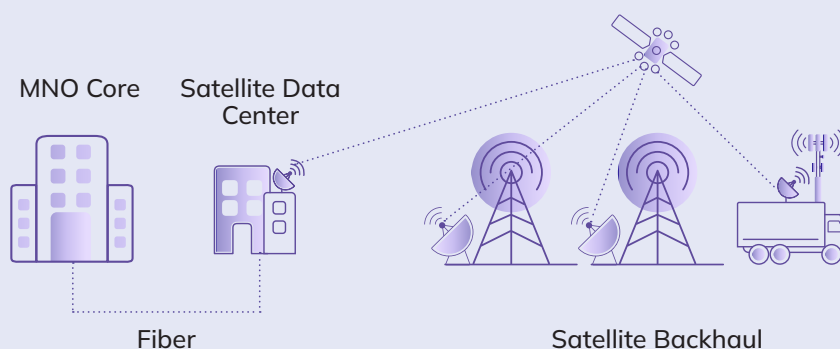
Microwave backhaul

Microwave links can provide a 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

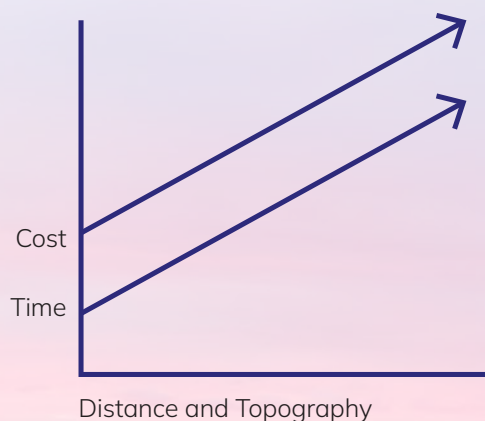
Installation can take months or longer across long distances, challenging time-to-market advantages and limiting an MNO's ability to address shifting needs.

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 virtually everywhere and not limited by geographic and topographic barriers.

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



Internet of things

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



Time to market

Expand network footprints more quickly without the need for fiber buildout



Public safety

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



Network resilience

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



4G upgrades

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



Private networks

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



Mobile towers

Connect roving towers to keep ahead of user demand as it moves from location to location

08 Opportunities for Multi-orbit Backhaul



SES's cellular backhaul solutions are powered by its fleet of 90+ high-performing satellites located in geostationary (GEO) orbit, combined with 30 O3b mPOWER medium-Earth orbit (MEO) satellites enabling high-throughput, lower-latency services.

Hybrid GEO/MEO backhaul solutions combine the predictable service levels and proven reliability of GEO satellites with the lower latency of MEO 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, SES can offer an optimized solution tailored to different application needs. The SES solution intelligently routes latency-sensitive applications via the MEO network, while traffic that is not sensitive to latency is routed over the GEO network that also provides a consistently reliable connection.

SES'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 MEO 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.

The MEO satellites in SES's O3b mPOWER network orbit at 8,000km (5,000 miles) from Earth's surface. The velocity of MEO satellites is higher to counteract gravity and maintain their orbit, so will move across the sky relative to a given place on the Earth's surface. A key advantage of O3b mPOWER satellites is:

- Dependable, lower latency – the time for signals to go from the ground to the satellite and back – due to the lower orbit and design of the O3b network. This can improve service predictability and the experience of users and their applications.
- The option for uncontended bandwidth (versus most LEO (low-Earth orbit) options) to meet carrier-grade service levels.



09

A Complete Cellular Backhaul Managed Service

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



SES 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).

SES One

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



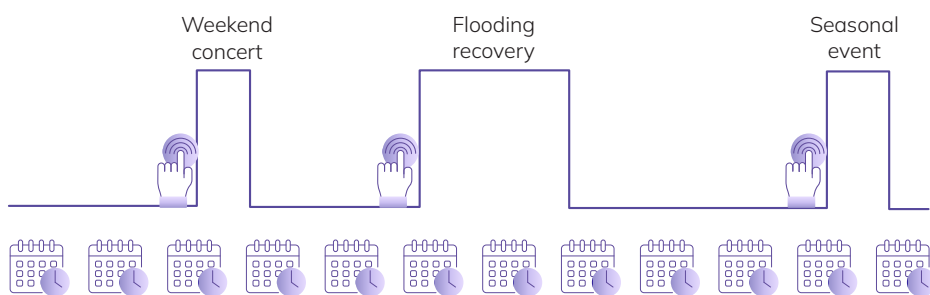
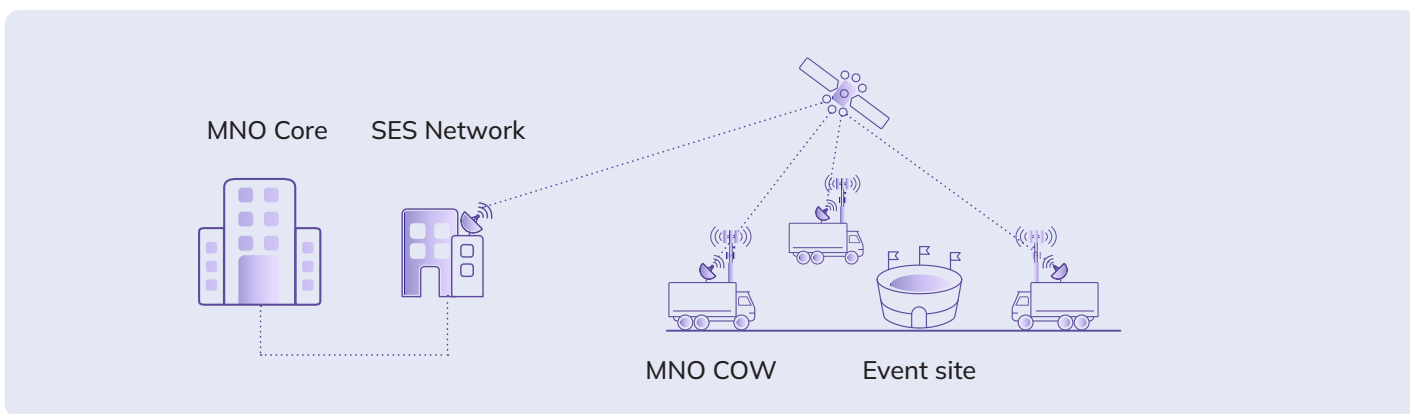
CellBackhaul ready

SES'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

- 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 capability 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 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 SES team.



10

Benefits of SES's Cellular Backhaul Managed Service



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



Reliable & high performing

Delivers always-on, high-performing connectivity to cell sites through single-orbit or managed multi-orbit solutions, meeting mobile operator quality of service and quality of experience requirements multi-orbit options.



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.



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-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.



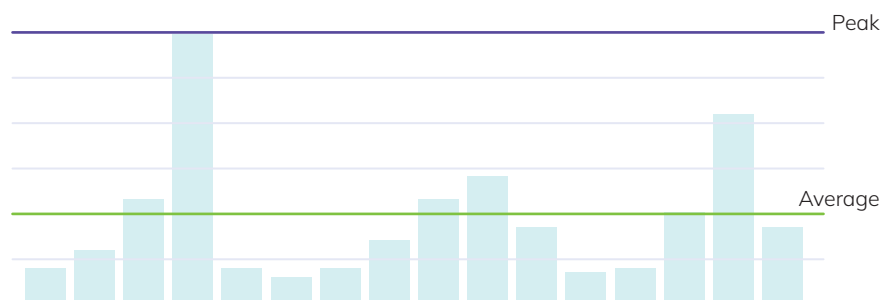
Scalable & efficient

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

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?

SES 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.



And if your sites demand dedicated bandwidth to meet application and user requirements, your network

design can include uncontended capacity to be used exactly where it's needed.



11 High-quality Cellular Backhaul Performance

Through a combination of SES's MEO space and ground infrastructure, 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.

SES CellBackhaul average one-way latency as low as

<100 msec

SES CellBackhaul average jitter

<20 msec

Speed

Peak download speeds of 1 Gbps and peak upload speeds of 200 Mbps.

Jitter

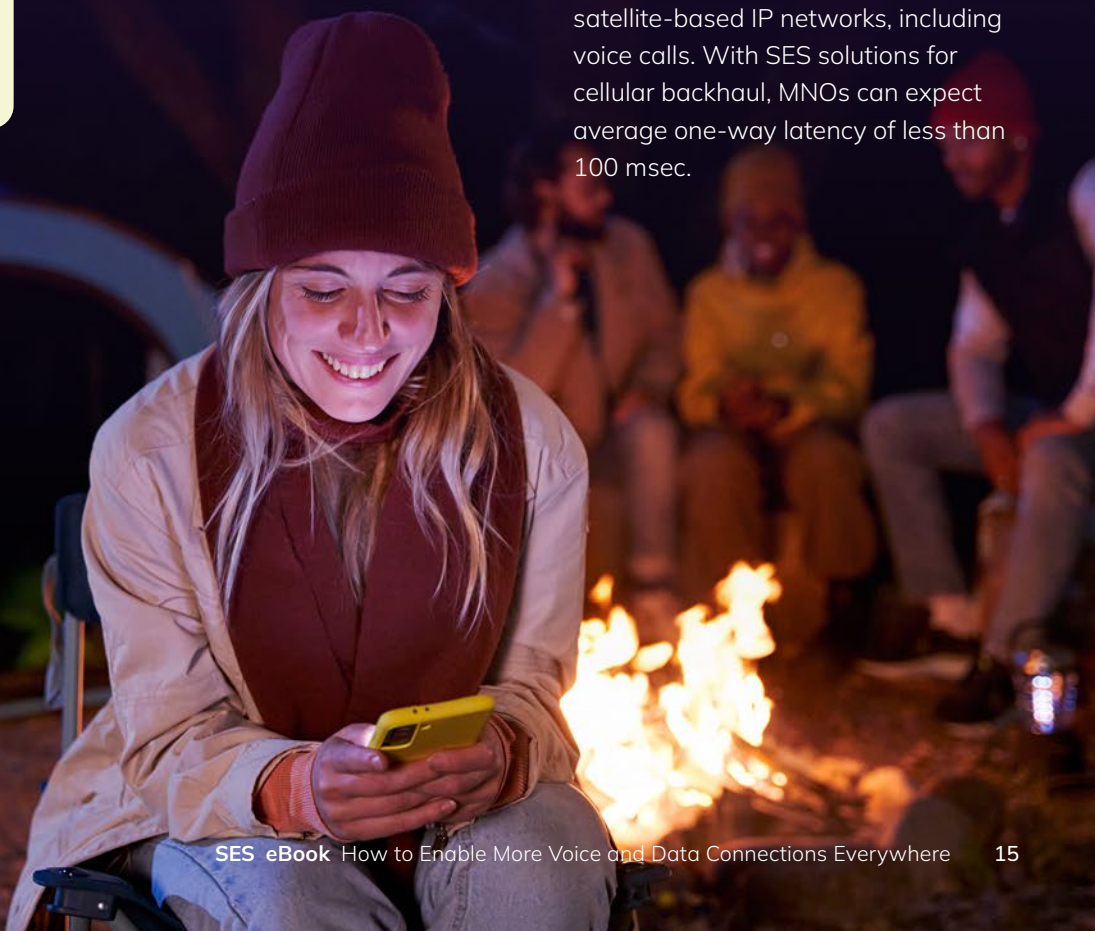
Jitter of less than 20 msec.

Latency

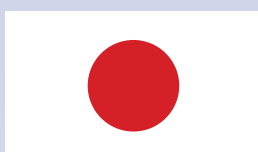
Latency of less than 200 msec round trip transmission time (RTT) – less than 100 msec one way.

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. SES 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 SES solutions for cellular backhaul, MNOs can expect average one-way latency of less than 100 msec.



12 Reliable Satellite Cellular Backhaul Deployments



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

SES 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.

"SES 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

SES 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 SES, with whom we work especially in the [remote] northern region.”

– Tier 1 Telecommunications Provider in Brazil



SES 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



Solve.
Empower.
Soar.



Learn more about our
purpose-built satellite
and connectivity
solutions at ses.com

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