The Intelsat Epic^{NG} Platform: High Throughput, High Performance to Support Next-Generation Requirements

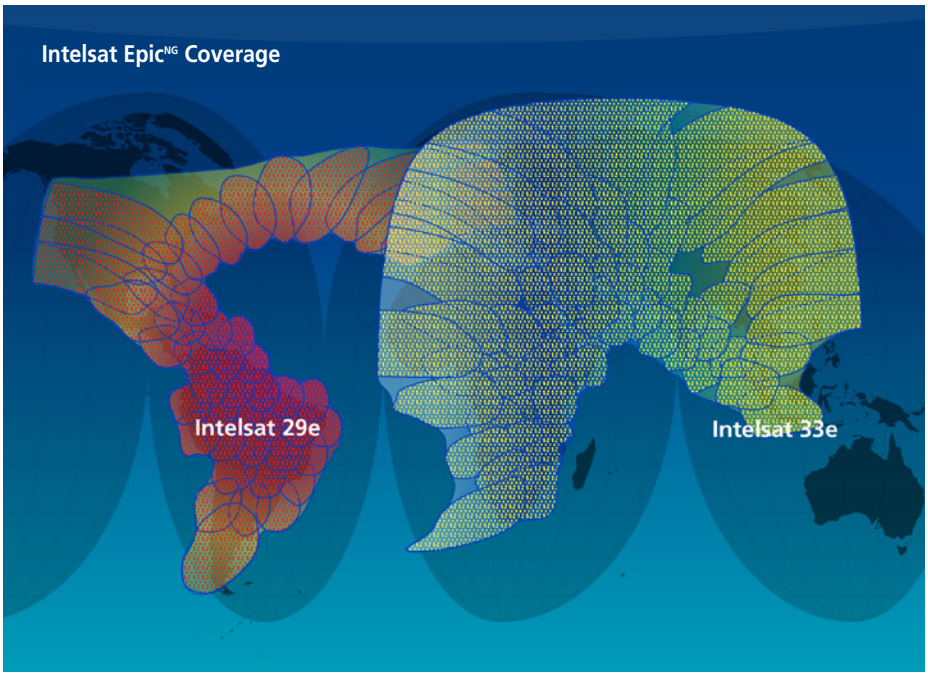
Global broadband requirements are expected to continue to increase, driven by the globalization of business, the penetration of wireless communications and the need to be connected at all times. Broadband demand is also being impacted by bandwidth-hungry mobility applications and the growing convergence of data and video.

Fixed and wireless telecommunications operators, private data network providers and mobility solutions leaders in the aeronautical, maritime and government sectors require carrier-grade infrastructure in order to expand their respective broadband offerings. Terrestrial backbones have limited availability or reliability in some of the fastest growing regions due to vast, undeveloped territories and other challenges, and also are unavailable on the oceans and in the air. ***Satellite systems, an integral part of global communications for decades, are evolving to support broadband requirements.***

Intelsat designed its next-generation platform, Intelsat Epic^{NG}, to meet the demands of the new global broadband infrastructure. Intelsat Epic^{NG} is designed to provide higher throughput and efficiency in an open architecture platform, providing highly reliable next-generation capabilities that build upon operators' existing networks.

The Intelsat Epic^{NG} platform represents the progressive evolution of Intelsat's leading global satellite and terrestrial infrastructure. Intelsat Epic^{NG} incorporates C, Ku and Ka spot beams in a high-performance platform that delivers ***significantly more capacity and more throughput per unit of spectrum***, an important technical and economic benefit for service providers delivering solutions customized for specific regions or applications.

Intelsat Epic^{NG} will serve telecommunications and value-added service providers that need to satisfy these connectivity demands, as well as energy, maritime, aeronautical, media, corporate networking and government customers that require broadband applications for the distribution and collection of content to regions often out of reach of traditional terrestrial connections.



Coverage area representative, subject to change.

More than 90 percent of the commercial satellite industry customer base is comprised of professional, carrier- or enterprise-grade service providers offering service in the C- and Ku-bands. Intelsat Epic^{NG} is designed to build upon the success of these commercial and governmental entities, allowing them to expand offerings and enter new regions and vertical markets without abandoning previous infrastructure investments.

Intelsat Epic^{NG} will support:

- Fixed and wireless telecommunications operators
- Telecommunications service providers for the oil and gas industry
- Government and military communications
- Private data network service providers
- Maritime and aeronautical data service providers
- Global organizations, including corporations and intergovernmental organizations
- DTH and other television distribution and broadcast service providers

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Envision. Connect. Transform.

Technical Characteristics of Intelsat Epic^{NG}:

- C, Ku or Ka spot and broadcast beams
- Anticipated throughput of 25-60 Gbps per satellite
- Open architecture
- Strong flight heritage
- Full integration with Intelsat satellite fleet and IntelsatOne

Intelsat Epic^{NG} Benefits Include:

- Higher performance (bits/Hz) that reduces the cost per-bit for operators
- Wide beams and spot beams providing the combined benefits of broadcast and high throughput connectivity
- Multiple frequencies aligned to region- and application-specific requirements
- Backward compatibility, allowing the use of existing ground infrastructure and customer-preferred network topology, whether star, mesh, or loopback
- Forward compatible as ground technology advances
- High throughput, high efficiency, high availability enables smaller terminals, supporting new applications such as maritime and aeronautical mobility, and benefitting increasingly data-centric services like cellular backhaul

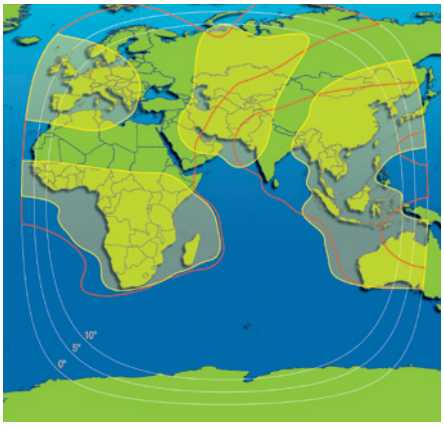

Figure 1. C-band Beams on Intelsat 904

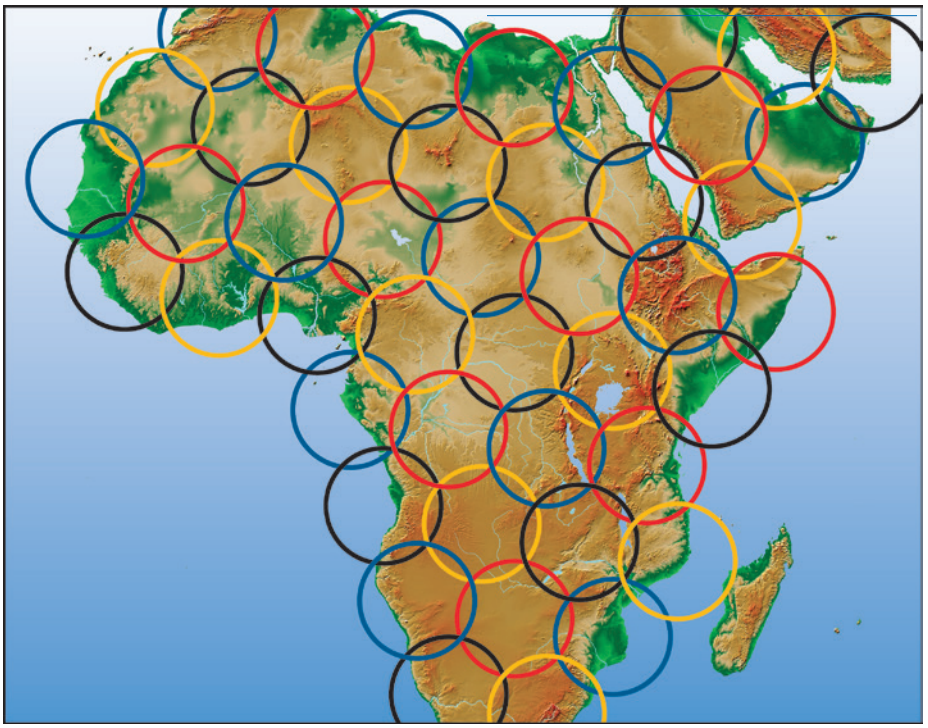

Figure 2. Multiple Spots With Frequency Reuse

Spectrum & Multi-Spot Overview

Spectrum is a valuable resource. Irrespective of the frequency band (C, Ku, Ka), there is a limited amount of spectrum available, so it needs to be utilized efficiently. One approach is to employ frequency reuse, which refers to a satellite using the same frequency multiple times simultaneously. ***The more frequency reuse supported, the greater the total bandwidth that spectrum can deliver.*** Frequency reuse is a concept that is used both terrestrially (e.g. cellular networks) and on satellites.

Intelsat has implemented frequency reuse in its satellites for several decades. It has been employed by "traditional" (wide-beam) satellites but in a relatively limited way. Take, for example, the C-band hemi (red outline) and zone (yellow shade) beams on Intelsat 904, shown in Figure 1. Each of the four zone beams uses the same frequencies; however, the beams cover different regions of the Earth. Similarly, each of the two hemi beams uses the same frequency, with different coverage. Different types of polarization, or orientation, of transmissions are used to further differentiate signals to avoid interference.

Intelsat Epic^{NG} takes advantage of satellite antenna technology that enables multiple smaller beams to be deployed. This is similar to how consumer-focused Ka-band platforms have been deployed over small regions, but in this case, the implementation is expanded to the frequency band and beam configuration that is most appropriate for each region, application and customer set. As shown in Figure 2, the beams can be arranged in a honeycomb to provide coverage of a specified region.

Each circle of a given color shown in Figure 2 represents a unique combination of frequency and polarization. This example shows a scheme that is referred to as 4-color reuse. Any beam of a given "color" (frequency/polarization) is separated by one beam width from other beams using the same "color." This separation is necessary to avoid interference between beams of the same frequency and polarization. Other frequency reuse schemes are possible, based on the amount of spectrum available and the amount of spectrum serving a given area.

Many have the false impression that spot-beam frequency reuse is restricted to Ka-band. Intelsat Epic^{NG} will apply multi-spot technology to Ku-band and C-band, as well as Ka-band, providing increased throughput on a highly efficient basis.

The physics of satellite communications are well understood: ***for the same satellite power, the same spot beam size and the same terminal size, all frequency bands provide the same throughput in clear sky conditions.*** The selection of the best frequency for a given application is therefore driven by many other considerations.

From a satellite antenna design perspective, smaller spot sizes are easier to achieve at higher frequencies. Some examples of the minimum size of spot-beam coverages across the different frequency bands, with a standard satellite antenna size, are:

- C-band: ≈1,750 km (1,100 miles)
- Ku-band: ≈1,000 km (620 miles)
- Ka-band: ≈350 km (220 miles)

The wider beam width associated with C-band translates to larger spot sizes; however, it is possible to generate small spots even in C-band with larger satellite antennas.

There are many variables that go into making a decision with regard to spot size and frequency, such as:

- To cover a larger geographic area such as the Americas with a single spacecraft, larger Ku- or C-band spots will be required.
- The bandwidth available in a spot should be matched to the traffic requirement of the region it covers.
- Customer service availability requirements may drive the choice of frequency to minimize the impact of rain fade. This may, in turn, dictate the use of lower frequency bands.
- Customers may have gateways and user terminals already deployed, and economics may dictate transitioning to a high performance satellite platform that uses the same frequency.
- A broader choice of ground technologies in a given frequency band may lead to the selection of the same band on the satellite to maximize flexibility.
- Satellite operators may be constrained by the frequency rights that they have at a given orbital location.
- If a satellite operator is replacing a spacecraft on orbit, service continuity commitments will require the new satellite to operate in the same frequency.
- A customer may want to combine different frequencies on their network in order to provide services optimized for multiple regions and applications.
- Spacecraft resources (mass, power, size) influence the choice of frequency bands used by the satellite payload.
- A broad choice of vendors and a strong flight heritage in certain frequency bands are also important considerations.

What's Epic about Intelsat Epic^{NG}?

There are several high throughput satellites (HTS) either in operation today or nearing deployment. While they each have distinct features, a common design element among most of these systems (typically Ka-band) is a network topology that limits connectivity and has lower isolation of co-channel spots. As a result, most of these systems are designed with an architecture that is proprietary and closed. This topology is a severe limitation for many operators.

Intelsat Epic^{NG} allows connectivity among multiple spot beams, including star and mesh, as well as loopback within the same user beam.

This guarantees backward compatibility with existing networks, and forward compatibility with full flexibility to evolve the network design and technology as and when customers want.

The end result: the Intelsat Epic^{NG} design increases cost-effectiveness of the bandwidth, minimizes capital expenditures by providing backward compatibility with existing networks and allows customers full control over the topology and management of their network and the services they provide to the end user.

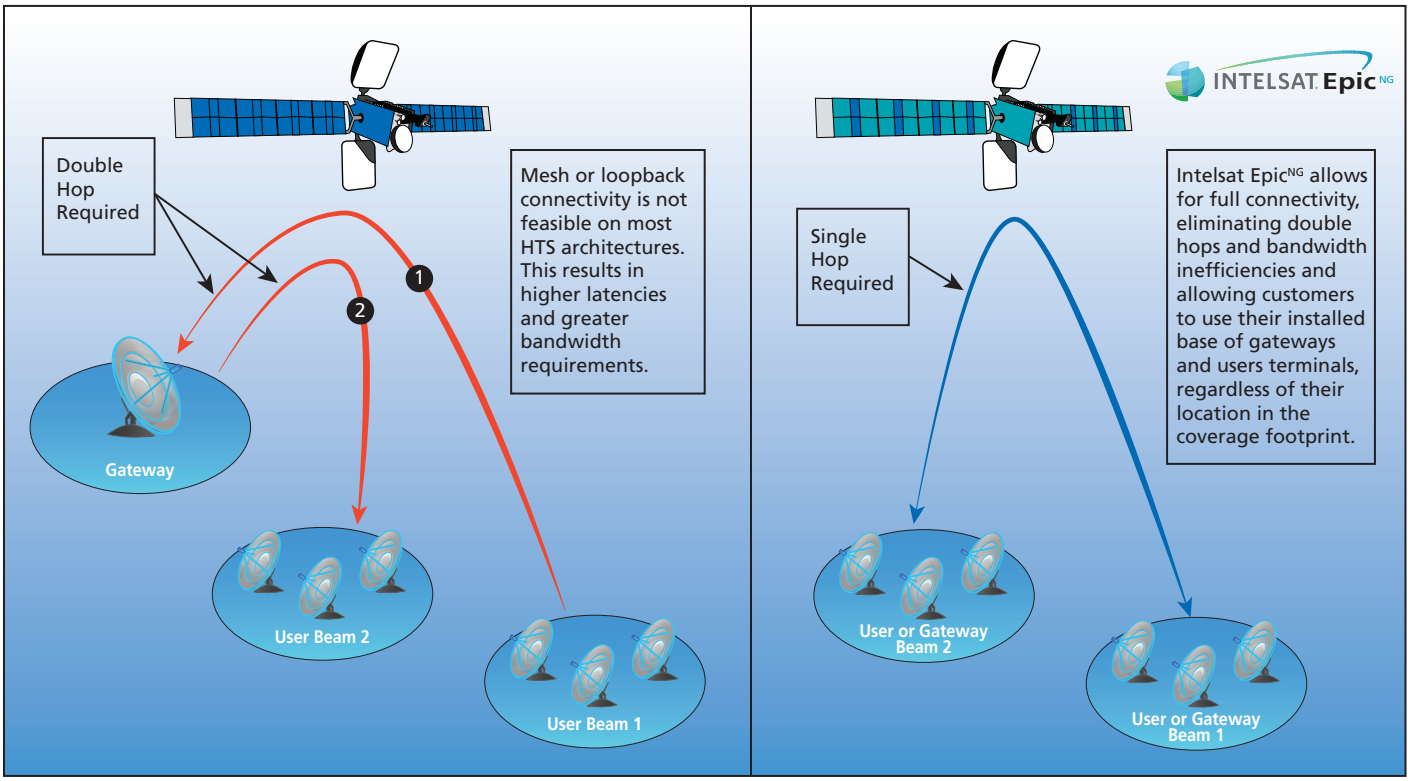

Figure 3. Intelsat Epic^{NG} Eliminates Need for Double Hop

Open Architecture Means Customers Select Their Hardware

The use of multi-spot C-band and Ku-band in a bent-pipe architecture will allow for an open network architecture that is backward-compatible in most instances with operators' current network infrastructure, and is future-proof depending on existing network configuration. This will enable service providers to easily implement Intelsat Epic^{NG} into their existing architecture, building upon their current business success and limiting the hardware investment they will need to make. Operators will use the hardware of their choice and customize their service characteristics.

The mix of spectrum available (C, Ku and Ka-bands) through Intelsat Epic^{NG} will let network operators and value-added service providers improve the quality of their service in a cost-efficient manner while maintaining control of their own systems.

Providing Increased Efficiency and Throughput

The Intelsat Epic^{NG} satellites will provide four to five times more bandwidth capacity (in MHz) than our traditional satellites. This is as a result of frequency reuse through spot beams. In addition, because of the higher power available per spot beam and a prudent design that minimizes RF interference between spots, the efficiency (number of bits per MHz) will be multiplied by two to three times. In total, the expected aggregate throughput on an Intelsat Epic^{NG} satellite will vary according to application served and satellite but is anticipated to be in the range of 25-60 Gbps.

Whereas most high throughput satellites offer a best effort, contended service using proprietary ground equipment, Intelsat Epic^{NG} offers Committed Information Rate (CIR) MHz using operator-selected ground platforms. The use of spot beams on Intelsat Epic^{NG} provides two additional benefits that translate into improved spectral efficiency offered to customers; that is, the Mbps that can be achieved in a MHz of satellite bandwidth. Both relate to the use of smaller beam size. One is the increase in receiver performance (higher G/T), and the second is the higher downlink power (EIRP) that can be provided.

The combination of increased MHz on Intelsat Epic^{NG} and improved spectral efficiency enables service providers to achieve significantly higher throughputs (overall Mbps).

User Benefits

Coverage: Intelsat Epic^{NG} will provide coverage in nearly all populated regions to accommodate service providers.

Open architecture: The open architecture allows operators the freedom to choose their own ground technology to complement their existing services.

Connectivity: Intelsat Epic^{NG} has built-in flexibility to allow connectivity between beams. Intelsat Epic^{NG} will include use of Ka-band, as Intelsat has rights across the spectrum and will tailor the choice of spectrum to best meet operator requirements.

Performance & Economics: Intelsat Epic^{NG} provides performance that will allow customers to improve the number of bits they can extract from a MHz. This translates directly to better economics through lower total cost of ownership.

Some customers will benefit from consolidation of their capacity from multiple satellites onto one or two Intelsat Epic^{NG} satellites. Others will benefit from the high throughput in a given region or from the high efficiency that enables the use of small terminals. The specific benefits will depend on the application and the customer requirements.

Intelsat plans to deploy Intelsat Epic^{NG} at multiple orbital locations. Our initial deployment will be two satellites expected to be operational in the 2016. Over time, Intelsat will progressively evolve its global satellite network, incorporating Intelsat Epic^{NG} satellites as needed to address customer requirements.

Intelsat Epic^{NG} is fully integrated with Intelsat's existing infrastructure – our fleet of more than 50 satellites and the IntelsatOne IP/MPLS-based terrestrial network. Solutions and networks may leverage the Intelsat Epic^{NG} platform, traditional satellites and teleports. For example, Intelsat's global Ku-band mobility capacity will complement the coverage of Intelsat Epic^{NG}, providing the optimum solution for throughput, service delivery and economics.

Integration with an existing fleet, as opposed to a "green field" satellite system, also provides customers with the security of back-up solutions and service recovery options in case of a technical anomaly on orbit.

Summary

Intelsat's Epic^{NG} platform represents a major design breakthrough, providing high performance and increased throughput via Intelsat's collection of C-, Ku- and Ka-band spectral rights. This multi-frequency flexibility allows offerings to be customized to provide the best solution for each application and region.

Customers will enjoy a seamless transition to Intelsat Epic^{NG}, leveraging their current hardware investment with existing and new capacity. The approach allows users to maintain control of their network topology and business model, while offering future compatibility thanks to the open architecture design of Intelsat Epic^{NG}.

About Intelsat

Intelsat S.A. (NYSE: I) is the world's leading provider of satellite services, delivering high performance connectivity solutions for media, fixed and mobile broadband infrastructure, enterprise and government and military applications for 50 years. Intelsat's satellite, teleport and fiber infrastructure is unmatched in the industry, setting the standard for transmissions of video and broadband services. From the globalization of content and the proliferation of HD, to the expansion of cellular networks and mobile broadband access, with Intelsat, envision your future network, connect using our leading satellite technology and transform your opportunities. Envision…Connect…Transform…with Intelsat.

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