Intelsat General's Broadband Solution for Government Airborne Applications

Background

Intelsat General has been offering communications-on-the-move (COTM) via satellite to remotely piloted aircraft since the early 2000s. Airborne Satellite COTM is used to address two primary applications for manned and unmanned aircraft: en-route communications for senior leadership and airborne intelligence, surveillance and reconnaissance (AISR). Over the last decade, Intelsat General has designed several Airborne Satellite COTM networks using Ku-band that have met the high customer demand for increasingly higher data rates over specific regions as well as for global coverage.

Airborne Satellite COTM for En-route Applications

Government and commercial users require en-route communications for a variety of applications, including two-way voice/data/VTC communications and Internet connectivity. Department of Defense senior leaders also need communications when in flight for operational missions.

The main challenge in designing custom en-route communications is the engineering of SATCOM links to meet specific data rate and availability requirements over the entire required coverage area. At the same time network engineers seek to maximize the number of simultaneous aircraft operations for the service for a given performance range of aircraft terminals, while minimizing the leased MHz bandwidth required. Typical en-route terminal size/performance consists of:

- 30 cm (12inch) terminals with a G/T of 8.4 dB/K and EIRP of 39.5 dBW
- 45 cm (18 inch) terminals with a G/T of 11 dB/K and EIRP of 43.1 dBW

The link is typically engineered to data rates ranging from 1.2 Mbps to 6 Mbps in the forward (to aircraft) direction, and 512 kbps to 1 Mbps in the return (from aircraft) direction. Intelsat General has experience in designing Airborne Satellite COTM networks for assured-access (i.e. guaranteed availability) en-route communications while meeting stringent requirements of information assurance and security. Intelsat General uses our parent company Intelsat's fleet of more than 50 satellites, 6 teleports and global IP/MPLS IntelsatOne^{SM} network to custom-build en-route services for commercial and government customers (See Fig. 1 below.). Additionally, Intelsat General has and will continue to integrate 3rd Party resources to ensure seamless end-to-end solutions to meet our customers' requirements.

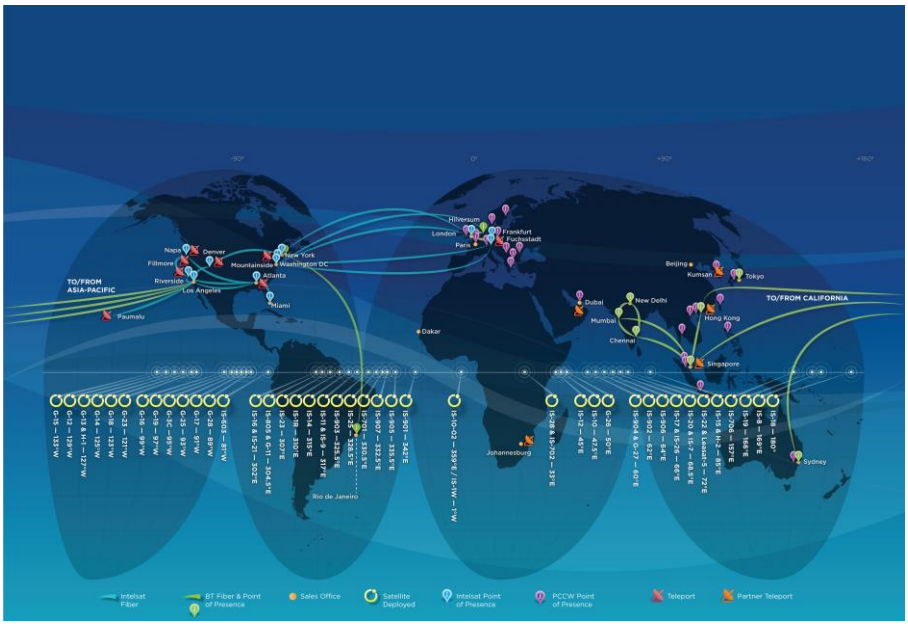

Fig 1: Overview of the Intelsat Satellite Network

Airborne Satellite COTM for Manned ISR Applications

For manned ISR, aircraft are outfitted with SATCOM terminals similar in size and performance to those described above. Compared to en-route, in manned ISR the asymmetry of usage is flipped – with the forward link, used for command and control ranging in the few to several 10s of kbps (used with spreading) and typical data rates on the return link (off the airframe) ranging from 2 to 10 Mbps. Due to the short range (typically less than 1,500 miles) of these missions, the primary challenge is the availability of contiguous satellite bandwidth to support connectivity back to the ground station location (which may or may not be in the same beam) at the time of mission-need. Intelsat General is the ideal SATCOM partner for this service as it can leverage the owner-operator benefits of Intelsat's satellite fleet to provision capacity by performing carrier grooming. These services can also be provisioned with rapid-response back-up services with equivalent coverage/capacity, and the ability to steer beams to coverage areas when needed.

Airborne Satellite COTM for Unmanned ISR Applications

Airborne ISR using unmanned remotely piloted aircraft requires SATCOM terminals with higher performance capabilities than in previously mentioned applications. Predator/Reapers (MQ-1/9) are typically outfitted with 76cm (30 inch) antennas with an EIRP of 53.5 dBW and a G/T of 12 dB/K. Global Hawks are known to be outfitted with 1.2m (48 inch) antennas with an EIRP of 64.7 dBW and a G/T of 14 dB/K. The typical rate for the forward command link is 200 kbps. The return links vary as follows: Predator, 3.2 Mbps; Reaper, 6.4 Mbps; and Global Hawk, 8.58-47.85 Mbps. The availability of contiguous satellite bandwidth to support connectivity back to the ground station location is more of a challenge than with manned ISR because the data rates are higher.

The use of spread spectrum in the command links results in aggregate MHz (forward + return) requirements of 9-15 MHz for Predator/Reapers and 9-70 MHz for Global Hawks. Global Hawks typically require use of 72-MHz transponders. Intelsat General is a market leader in this segment with

approximately 40% share of the market. Figure 2 below shows current Manned/Unmanned Airborne ISR networks supported by Intelsat General using Intelsat and third-party satellites.

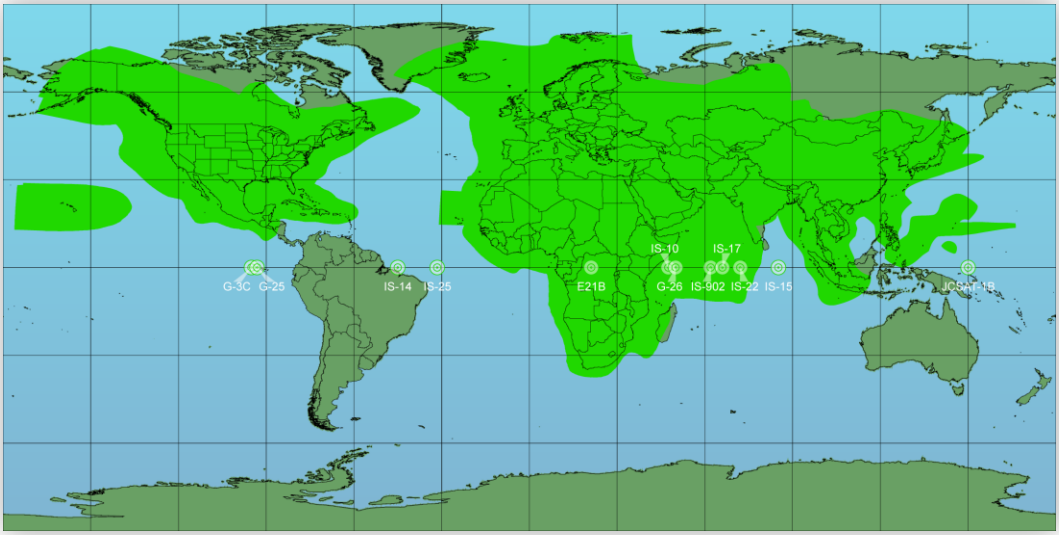

Fig 2: Manned/Unmanned Airborne ISR Reachback Coverage by IGC

Intelsat General's Next-Generation Airborne Satellite COTM

Intelsat General specializes in developing satellite-centric solutions for government agencies that meet the unique needs of each customer. Our SATCOM solutions are designed to be future-proof. Architectural elements are chosen to ensure that end users' capabilities can be propelled forward with minimal adjustments and changes over time.

Given the current budgetary climate, government agencies and commercial entities want to leverage the existing investments made in their hub and terminal infrastructure for Ku-band satellites. Intelsat General's future Airborne Satellite COTM networks will do this through Intelsat's new Epic^{NG} family of High Throughput Satellites (HTS). These spacecraft are designed expressly to deliver higher performance in the most cost-efficient and backwards-compatible manner with no restrictions on vendor or connectivity topologies.

Table 1 illustrates typical data rate enhancements with an Intelsat Epic^{NG} platform. These performance improvements could be used either as an overlay in areas requiring high-throughput, or as a stand-alone high-performance mobility fabric.

Terminal/ Application	Wide-beam (Forward/Return) Data Rates	Intelsat Epic^{NG} (Forward/Return) Data Rates
45cm/ En-route (7m Hub)	6 Mbps/1Mbps - typical	Up to 52 Mbps/Up to 12 Mbps
45cm/ MISR (2.4m Hub)	10s of kbps/ Up to 3 Mbps	100s of kbps/Up to 9 Mbps
76cm/ Predator or Reaper	200 kbps/3.2, 6.4 Mbps	200 kbps /50+ Mbps
1.2m/ Global Hawk	200 kbps/8.58-47.85 Mbps	200 kbps/274 Mbps

Table 1: Typical Data Rates for Common Terminal Sizes and Applications Using Airborne Satellite COTM

Starting with IS-29e and IS-33e (Fig 3), Intelsat Epic^{NG} heralds the era of uniform high performance on a world-wide series of high-performance satellites. These spacecraft supplement existing and future Ku-band wide-beam and steerable-spot-beam offerings by using a unique mix of Ku-band spot and wide beams on the same Intelsat Epic^{NG} satellite.

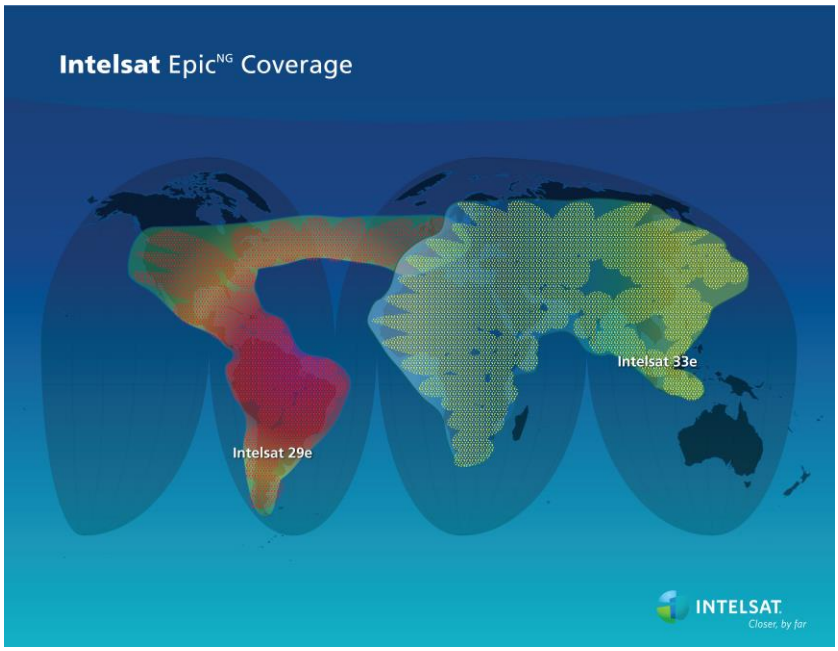

Fig 3: Example Coverage of IS-29e and IS-33-e

Multiple Intelsat Epic^{NG} satellites have been planned per region. Large fields of efficient spot beams – designed to create continental-scale coverage – are an integral part of Intelsat's Next Generation Epic^{NG} fleet investment, currently under way. The Epic^{NG} satellites have 3.5 times the number of spot beams found on WGS satellites, allowing unrestricted beam-to-beam connectivity and an inherent carrier-replication capability. Intelsat Epic^{NG} will provide new levels of data-path agility that will lead to new data-flow architectures, providing full adaptability to operational requirements and locations that change over time. Figure 4 illustrates how the current wide-beam airborne en-route mobility-fabric would be enhanced with the Epic^{NG} (IS-29e/IS-33e) overlay.

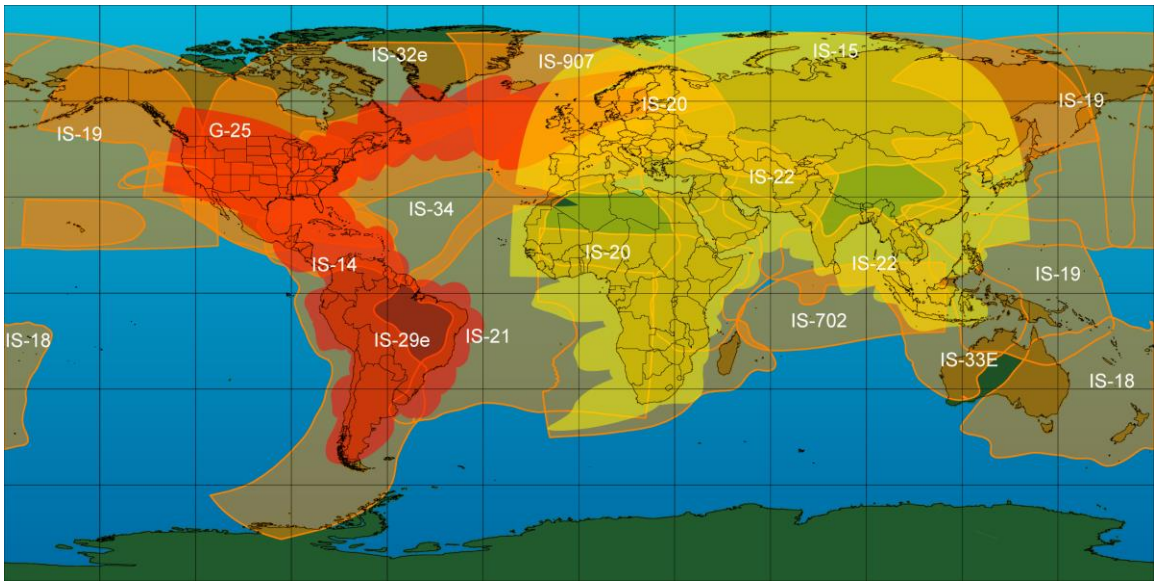

Fig 4: Example future IGC En-route Network

For manned ISR applications, Intelsat Epic^{NG} will enable simultaneous transmission of an ISR feed to the mobile hub to the reach-back-site. For UAV applications, this could lead to new architectural possibilities, in addition to the current remote-split-operations scenario depicted in Fig 5 below. Epic^{NG} is unique in its ability to reach AISR objective rates using existing Ku-equipment on deployed UAV platforms. Intelsat and Intelsat General are currently working with major vendors to ensure that all aspects of mobility on Intelsat Epic^{NG} satellites meet the high-availability and high-performance needs of each application seamlessly, across the entire coverage area.

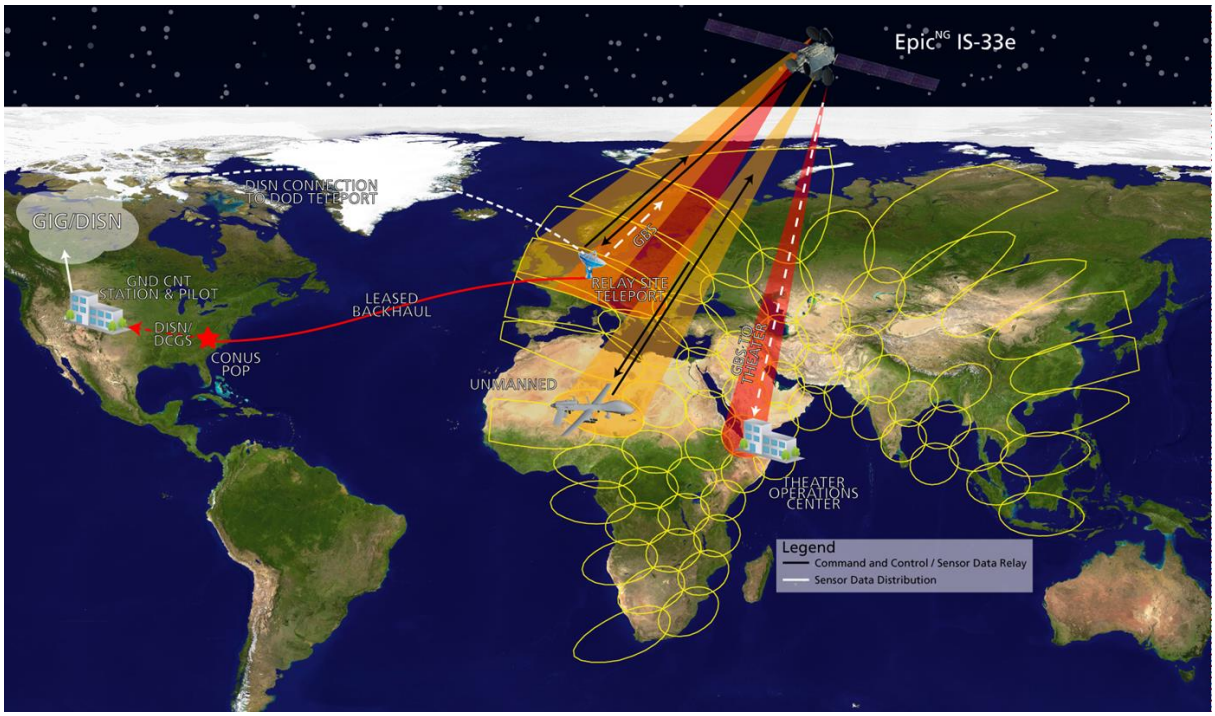

Fig 5: Example future IGC Unmanned ISR Network

The Intelsat Epic^{NG} platform also has enhanced information-assurance capabilities, features needed to maintain information dominance in contested environments. Being fully integrated with the existing Ku-band platform offers the resilience of the entire Intelsat Ku-band fleet, for unmatched disaster resiliency.

Conclusion

Intelsat General has deep experience designing custom Ku-band solutions that cater to all three Airborne Satellite COTM applications. The company's Ku-band Airborne Satellite COTM solutions can be scaled to meet broadband needs of the future through the Intelsat Epic^{NG} overlay. Airborne Satellite COTM networks based on Epic^{NG} will be truly revolutionary, as the next-generation multi-spot beam architecture will allow customers to retain all the advantages of an Intelsat General solution. These include maximum flexibility, control over the vendors involved, customized connection topologies, and management of the network. Intelsat Epic^{NG} will also offer our customers the next generation of satellite technology in the most cost-effective manner across all applications and make increased capabilities available in contested environments. In summary, the open architecture, backward compatibility and future-proof Ku-band-based strategy from Intelsat General is the best approach for government aqnc commercial customers to optimally meet current and future demands in Airborne Satellite COTM in the current fiscally-constrained environment.