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1. **Introduction**

Inmarsat has a long-standing commitment to aviation safety services: airlines the world over trust our range of market leading, secure and reliable connectivity solutions that set the standard for flight deck communications. More than 95% of the world’s oceanic fleet and over 11,500 aircraft use Inmarsat safety and operational services for communication and surveillance today. In fact, Inmarsat provided 35 million aircraft position reports last year (roughly 100,000 per day) thanks to its satellite network.

With our wholly owned and operated satellite network powering international commerce, Inmarsat is working with international aviation organisations to make flight safer, faster and more predictable. We are constantly building capabilities that anticipate the diverse and changing requirements of today’s customers.

Our newest service for the flight deck, SwiftBroadband–Safety (SB-S), enabled by digital high-speed, secure IP broadband delivers much faster communications and a host of new safety and operational applications that were never before available. This is a natural evolution of our Classic Aero services which have served airlines for over 25 years.

Inmarsat is unique in that it owns and operates satellites across multiple frequency bands, operating on a global basis to provide innovative solutions for the cabin and passenger connectivity through Inmarsat GX, and for airline safety and operational services through SwiftBroadband–Safety. Together, these services deliver a unique total connected aircraft solution that meets the safety, regulatory, priority and performance standards demanded for the flight deck, along with the economical connectivity demands of today’s airlines passengers.

**Inmarsat Aviation Safety Services**

Building on 25 years of safety heritage

Enhancing global flight safety
2. Changing Technology Delivers Major Safety Benefits

To put the power of SB-S in perspective, we can look back through history at another technology that underwent a holistic evolution: the telephone. Long before smartphones put the world at our fingertips, calling someone by telephone could take a full twenty seconds. The telephone was the indispensable technology of the mid-20th century. As we dialled, we began grinding the gears of the communications revolution that continues to unfold.

Older telephones were simple, reliable, and invaluable. They did their jobs, and nothing more. The phone continued to evolve incrementally over the decades, but its complete transformation did not occur until January 9, 2007, when we saw the reinvention of the telephone: the smartphone.

The smartphone’s most important feature was not its touchscreen, onscreen keyboard, or its music features. Its greatest achievement was its online marketplace with a vast selection of third-party applications that allowed us to interact with the world in nearly limitless ways. Infinitely more useful than a basic telephone, the smartphone was a powerful small computer always by our side.

Like analogue phones, satellites have provided reliable communications for decades. Today, we are reinventing cockpit connectivity the way the smartphone reinvented the rotary dial: by connecting satellites and airplanes the same way we connect our computers on the ground—with an internet connection provided by SwiftBroadband–Safety. The high data rates made possible by an IP-enabled cockpit will open a floodgate of possibilities for cockpit safety applications. SB-S offers the same communications and surveillance that we have been providing for decades, but our IP connection introduces safety applications that will bring the cockpit into the future.

3. Why We Developed SB-S

Mobile data consumption has increased rapidly over the past decade, with its compound annual growth rate exceeding 100 percent between 2010 and 2014. By 2019, global data consumption is expected to reach approximately 25 exabytes per month—a tenfold increase over 2014. With this explosion of data usage changing how we live and work, it is no surprise that higher data speeds are coming to the cockpit.

Modern aircraft generate huge quantities of data from their various systems on a second-by-second basis. The A380 has around 6,000 sensors throughout the plane, capturing details of every aspect of their operation. This big data has immense value if airlines can process it efficiently and in a timely manner. When bigger and better data is refined, analysed, and linked to existing enterprise data, airlines can develop a more detailed and insightful understanding of their business, which can boost productivity and stimulate greater innovation—all of which can significantly influence the bottom line. Better data ultimately leads to better knowledge, allowing pilots to fly safer and more efficiently.

Broadband connectivity is fast becoming a catalyst for change in airline operations. Connectivity is revolutionising our lives at work and home, and airlines are seeking the same solution for the cockpit.

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"We have over 50,000 data points now gathered from the performance of the system. And in fact, it's working better than other alternative satellite communication technologies."

- Dan Smith, Systems Engineering Manager, Hawaiian Airlines

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4. **SwiftBroadband-Safety**

SwiftBroadband-Safety is Inmarsat’s next generation flight deck communications platform offering global, high-speed, secure, IP connectivity for the cockpit. Always on and always secure, it delivers much faster communications along with a host of new safety applications that were never before available. SB-S also includes our aircraft position reporting service, which regularly reports latitude, longitude, altitude, speed and true heading. Using the extended bandwidth, data integrity, and security capabilities that only Inmarsat’s network of cutting-edge satellites can provide, SB-S enables innovative new applications to improve flight safety, reliability, capacity, and operational efficiency.

Inmarsat built SB-S to accelerate and enhance connectivity to and from the cockpit, in order to deliver safety, efficiency, and operational performance benefits for airlines and airspace authorities. Our solutions will redefine the way airlines operate. SB-S sets a new standard for flight deck communications, enabling the aviation industry to take full advantage of the possibilities of cockpit connectivity. Using our global L-band satellite network, it delivers speeds several orders of magnitude faster than what is available today, providing airlines with cockpit communications fit for the digital age. SB-S uses spot beam technology over Inmarsat’s I-4 constellation to dynamically allocate resources to the areas where it is most needed. This helps ensure that safety-critical information is available on-demand for the pilot, the airline, and air traffic controllers.

SB-S enables a new world of flight deck applications, from continuous positional awareness and Electronic Flight Bag (EFB) updates to airline operational control centre voice and data. The added bonus for airlines is that greater capacity communications create opportunities for new applications to improve flight safety, allowing more efficient and streamlined service to customers and cost savings through continuous monitoring of aircraft performance and fuel.

![SwiftBroadband - Safety](image)

**Figure 2: SB-S Throughput Comparison**
4.1. A Unique Communications Platform

SwiftBroadband–Safety is unique among satellite communications systems. Only Inmarsat can prioritise broadband data to the cockpit, providing segregation between regulated safety services for the cockpit and cabin communications for passengers. This data segregation creates a “fortress door,” ensuring the highest levels of information security. SB-S services are provided over three types of connections:

1. Aircraft Communications Addressing and Reporting System (ACARS) – character-based data protocol that provides prioritised data services:
   - Automatic Dependent Surveillance - Contract (ADS-C)
   - Controller Pilot Data Link Communications (CPDLC)

2. Prioritised IP channel – a connection that provides additional availability and assurance on IP data throughput for voice and data Air Traffic Safety (ATS) and Airline Operations Centre (AOC) applications:
   - ADS-C
   - CPDLC
   - Real-time position reporting
   - Electronic Flight Bag uploads and downloads
   - Flight data streaming or “Black Box in the Cloud”
   - Meteorological and environmental information
   - Aircraft performance data downloaded in real time to the airline maintenance department or to the aircraft or engine manufacturer
   - Support for real-time medical emergency applications such as remote diagnoses

3. IP channel – voice and data communication channel for use of Airline Administrative Control (AAC) and AOC applications:
   - Providing passenger details to the destination
   - Exchange of passenger transfer information by the airline

![Faster communications](image1)
![Data fortress door](image2)
![Real-time position](image3)
![Black box in the cloud](image4)

Figure 3: SB-S Capabilities

4.2. Features and Applications

With the capability to increase connectivity in the cockpit comes a number of exciting new safety and operational features and applications, limited only by the speed at which they can be imagined and developed. This section illustrates the new features and applications made possible by SB-S.

"The amount of information that we can provide to crew members in flight, to the pilot, crew in flight is vastly improved by having this installation on the aircraft.”

- Ken Rewick, Vice President, Flight Operations, Hawaiian Airlines
4.2.1. **Electronic Flight Bag and Flight Data Streaming**

The EFB is one cockpit technology that enables gate-to-gate connectivity. High-speed broadband will enable more powerful apps, such as graphical weather, telemedicine, passenger data, aircraft documentation, and so much more. With a plug-and-play concept and apps that update over the air, airlines can customize their EFB platforms and applications according to their operational needs.

![Figure 4: EFB Capabilities](image)

The future of airline operational efficiency, safety, situational awareness and decision support will be enabled by the secure, robust broadband capabilities of Inmarsat’s SwiftBroadband–Safety. Offering throughput hundreds of times greater than current competing services, SB-S will open the door to capabilities previously not considered possible.

**SwiftBroadband - Safety enables effective communications, reducing fuel consumption**

![Figure 5: Average annual operational expenditures for satellite communications and jet fuel](image)

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2 IATA Profitability and the air transport value chain 2013, ATAG, Oxford Economics 2016
Flight optimisation: Applications use multiple data sources from the aircraft and from the ground to present continuous time or cost-saving opportunities to the flight crew, improving operational efficiency and decision-making.

“From a safety standpoint, if we can deviate around weather sooner or if we have an emergency situation where the aircraft needs to divert to an alternate airport, we get that information out to the air traffic control, to dispatch, other entities in a rapid manner, we get responses rapidly and we can operate safer that way.”

- Captain David Valente, Boeing 767 Fleet Captain, Hawaiian Airlines

Real-time high-resolution weather can be reliably and cost-effectively received on the aircraft, whether over the continents or the vast oceans. Not only does such information improve the passenger experience and comfort level, better situational awareness and real-time data can help flight crews avoid unexpected weather and turbulence encounters which can lead to costly inspections, damage or personal injury.

Disruption Management: Diversions due to weather, runway closure, ATC Congestion, or in-flight medical emergencies can be costly and disruptive, increasing fuel use, leading to missed connections and incurring other costs. While many of these diversions are medically necessary, some are not. Telemedicine applications enable expert medical professionals to diagnose situations using real-time patient information transmitted from the aircraft to the ground, providing valuable decision support and risk management information to the flight crew.

Preventative Maintenance: Real-time flight data monitoring, quality assurance, exceedance alerts and fuel use monitoring can help reduce delays and hence reduce compensation claims, unplanned maintenance, fuel bills, and even offer the potential for real-time intervention in developing safety or security situations.

- Applications and services which interface to aircraft, engine and other systems enable real-time diagnostics to take place on the ground, providing the ability to drill down into data and control the amount and type of information streamed to the ground. From this information, pre-positioning of the right parts, equipment and personnel at the gate can help keep turnaround times on schedule and asset utilisation up.

Real-time updates: Flight-critical databases can be updated instantly help ensure mandates are met for currency of information, while at the same time enable amplified information, manuals, etc., to be centrally accessed and managed.

Airline enterprise mobility applications: Applications to streamline workflows for flight and cabin crews, reduce paperwork through electronic forms and schedules, improve the availability of accurate, up to date information for the entire operation, and provide accurate records and logs

These capabilities and accompanying benefits will define the future of airline efficiency and safety, and they are all enabled by the unique advantages of the next generation of broadband flight deck connectivity – SwiftBroadband–Safety. With jet fuel prices at current lows, there has never been a better time to invest in technologies that will drive operational cost savings and efficiencies for the long term.
4.2.2. **Regulated Safety Services over IP**

The powerful Air Traffic Services applications that have enabled the expansion of oceanic airspace by over 300% will be faster, stronger, and more reliable on SB-S. With SB-S powering cockpit avionics, surveillance with ADS-C and communication with CPDLC will help airlines exceed the minimum performance standards required by aviation regulators across the world.

**Communications - CPDLC**

**Surveillance – ADS-C**

Figure 7: Regulated Safety Services
4.2.3. **Real-time Flight Tracking**

Real-time flight tracking, often one of the most talked-about features that will be enabled with SB-S, is a separate and fully automated function that provides regular transmission of position reports and flight performance data – in addition to ADS-C position reports. This real-time flight tracking provides latitude, longitude, altitude, true heading, and groundspeed, at an interval that is configurable from the ground.

“In the past, prior to this system, it would take several minutes to send and receive messages via data link, and now it just take seconds. The quality of voice communication has improved so much that it's like using a telephone, or your cell phone, or a very good landline.”

*Captain David Valente, Boeing 767 Fleet Captain, Hawaiian Airlines*

![Figure 8: Hawaiian Airlines Routes Using SB-S](image)

4.2.4. **Global Aeronautical Distress and Safety System (GADSS)**

Inmarsat has a rich heritage of supporting safety and security on land, sea and air. In fact, it is how our organisation began – as a provider of Safety of Life services at sea. Inmarsat is currently the only Global Maritime Distress and Safety System (GMDSS) satellite safety service provider in the world. The International Civil Aviation Organisation recently developed the GADSS concept, aimed at preventing the loss of aircraft experiencing distress. In the event of an abnormality in flight, an aircraft’s position reporting interval must decrease to 1 minute, thereby significantly enhancing the positional awareness of that particular flight. This shortened interval phase is called Autonomous Distress Tracking – and SB-S allows vital Flight Data Recorder information to be streamed off the aircraft in real time.
4.3. **Hardware**

SB-S terminals are smaller, lighter, easier to install, more efficient, and generate less heat. Terminals are being produced by Inmarsat’s partners Cobham, Thales and Honeywell. All terminal types will support global coverage down to 5 degrees elevation, and provide voice and ACARS data performance that is better than Classic Aero and ground-based radio, while also supporting Prioritised IP data communications to the cockpit, as well as the position reporting service. Specifically, SB-S hardware weighs about 8 kilos (about 18 pounds) as compared some current systems that can weigh approximately 120 kilos (about 265 pounds). SB-S antennas are about the size of an tablet computer, compared to the current antenna that is the size of a surfboard. SB-S systems are ten times smaller and lighter, yet ten times more capable, and translate into big savings and flexibility for the airline. In many cases, SB-S terminals can replace existing terminals with the ease of ‘plug and play,’ causing minimal disruption.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Line-fit availability</th>
</tr>
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<tbody>
<tr>
<td>Cobham 350D</td>
<td>Available today (retrofit)</td>
</tr>
<tr>
<td>Cobham Aviator S series</td>
<td>Q1 2018</td>
</tr>
<tr>
<td>Honeywell Aspire 400 series</td>
<td>Q3 2018</td>
</tr>
</tbody>
</table>

Figure 10: Terminal Availability
4.4. **Availability**

SB-S performance is currently undergoing commercial in-service evaluations. An Inmarsat / Hawaiian Airlines / Cobham Satcom partnership was announced last year, using SB-S on the Hawaiian Airlines’ Boeing 767-300 fleet. The evaluation has been taking place for more than a year and has been immensely successful, with demonstrated speed and quality of SB-S applications.

Additionally, Airbus recently announced it will outfit their aircraft fleet with the Inmarsat SB-S solution from 2018 onwards, and Boeing announced a signed Technical Service Agreement with Cobham for SB-S earlier this year. Inmarsat continues to work with manufacturers to add SB-S to even more aircraft.

<table>
<thead>
<tr>
<th>Boeing</th>
<th>Airbus</th>
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<tbody>
<tr>
<td>Next Generation 737</td>
<td>A320 family</td>
</tr>
<tr>
<td>737 Max</td>
<td>A330 family</td>
</tr>
<tr>
<td>777-300R</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 11: Aircraft with plans for SB-S*

4.5. **Security**

Cybersecurity is on top of the agenda for virtually every major organisation – whether public or private. As the world’s leading provider of global mobile satellite communications, Inmarsat has full confidence in the security of its network and dedicates significant resources to ensuring its protection. Our safety and operational services include the latest security architecture in keeping with the most recent security standards determined by the Radio Technical Commission for Aeronautics (RTCA) and the Airlines Electronic Engineering Committee (AEEC) as agreed to by the aviation industry. These standards establish advanced firewalls and segregation of systems that adhere to the latest software security standards. This protects the integrity of the data at the highest level by keeping each system functioning independently from the others.

5. **SB-S Will Power the Next Generation Flight Experience**

The aviation industry is booming, and broadband for the cockpit is arriving at the perfect time. The industry has grown 85% in the last 15 years, and about 3.5 billion passengers took flight last year alone – equal to nearly half the world’s population. In the next 20 years, that number is expected to double to 7 billion passengers, as aircraft manufacturers are expected to deliver more than 33,000 new aircraft.

To accommodate this increased demand for air travel, aviation authorities in North America and Europe are comprehensively overhauling their airspace systems: The FAA’s NextGen and similar efforts in Europe such as SESAR and the Inmarsat-driven Iris programme, are leading the effort to modernise the way air traffic is managed. These programs will...

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*"The results thus far have been very promising. And frankly as we learn more of the capabilities that will continue to evolve, I suspect we will continue to develop uses of the product that we haven't even imagined."*

- Ken Rewick, Vice President Flight Operations, Hawaiian Airlines

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offer momentous benefits – at the highest level they will boost economic vitality, spare the environment from unnecessary emissions, and increase safety – but these benefits would not be possible without the power of satellite networks and systems. Satellites will guide, track, and connect aircraft more precisely and efficiently, allowing us to fit more planes closer together, reduce in-flight delays, and avoid bad weather. And with SB-S, Inmarsat offers the most capable satellite services in the sky.

Broadband data over IP is the game-changer. Today, our space-based communications technology finally exceeds the capabilities of ground-based data link. Satellite broadband is faster, more robust, and can reach over oceans and continents.

The modernisation of the world’s air transportation system is not simply assisted by satellite technology – it relies on satellite technology. SB-S is here now – proven and reliable – and ready and able to support airlines and airspace authorities in the next era of air traffic management, delivering improved safety, increased capacity, analytics, and cost savings.