

HELIOS

The aviation consultancy of Fgls

THE BENEFITS OF SATCOM TO AIRLINES

PREPARED BY HELIOS FOR  **inmarsat**

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WHAT IS SATCOM?

Satellite Communication, or satcom in short, is a voice and data service allowing aircraft to communicate with Air Traffic Control and its Airline Operations Centre when outside coverage of conventional ground radar and VHF stations.

Over the past 16 years, Inmarsat has revolutionised Air Traffic Control (ATC) and Airline Operational Communications (AOC) in remote regions. With a 95% market share, it is the leading service provider and processes over 100,000 air traffic messages a day. Many of these are to service the 1.5 million annual oceanic flights.

Given traffic growth, increasing numbers of operational procedures using satcom and the development of a new generation of AOC applications, the importance of satcom in the aviation industry will only continue to grow. Inmarsat is also constantly improving their service provision by introducing new capabilities to their network to accommodate growing demand.



On behalf of Inmarsat, Helios has valued the benefit that satcom has brought to airlines over the period 2001 to 2016. The work has quantified the benefits arising from the use of satcom for ATC and AOC in oceanic regions.

THE EVOLUTION OF SATCOM

Satellite services have been complemented by improved aircraft navigation capabilities allowing for not only **reduced separations in non-radar airspace** but also the introduction of more complex operational solutions such as **in-trail climb procedures, user preferred routes, tailored arrivals and dynamic airborne reroute procedures**. None of these procedures could be provided in oceanic regions without reliable satellite communications.

Up to 2015, satcom cockpit services were limited to non-broadband services allowing for a limited bandwidth connection to the aircraft. This limited bandwidth enabled aircraft to exchange text messages with relevant ground stations, but not much more.

With the introduction of the SwiftBroadband-Safety IP platform to the flight deck, Inmarsat has revolutionised flight deck applications, offering global high-speed IP connectivity and a host of new capabilities that improve safety, security and operational efficiency. These include the data-rich electronic flight bag with networked graphical weather, real-time updates to flight plans, aircraft performance status and more

BENEFITS FROM DATALINK APPLICATIONS IN OCEANIC ATC

ATC applications enable automated communications between pilot and controller and between airborne and ground systems – this enables increasingly complex ATC clearances to be issued. From an airline perspective ATC applications improve flight efficiency leading to **reduced fuel burn and flight delay**.

Procedural control has historically been used in oceanic airspace with limited communications, navigation and surveillance capability – but it is not capable of providing efficient flight trajectories as traffic density increases. Over the past two decades, Future Air Navigation Systems (FANS) applications such as Automatic Dependent Surveillance – Contract (ADS-C) and Controller–Pilot Data Link Communications (CPDLC) have revolutionised oceanic ATC. ADS-C ensures the availability of timely position reports and CPDLC is a digital link enabling reliable, non-voice, pilot-controller communications. Together, ADS-C and CPDLC have enabled lower separation minima which increased the airspace capacity trifold, allowing more aircraft to fly in the same airspace at a given time, increasing the availability of the airlines to meet customer demand.



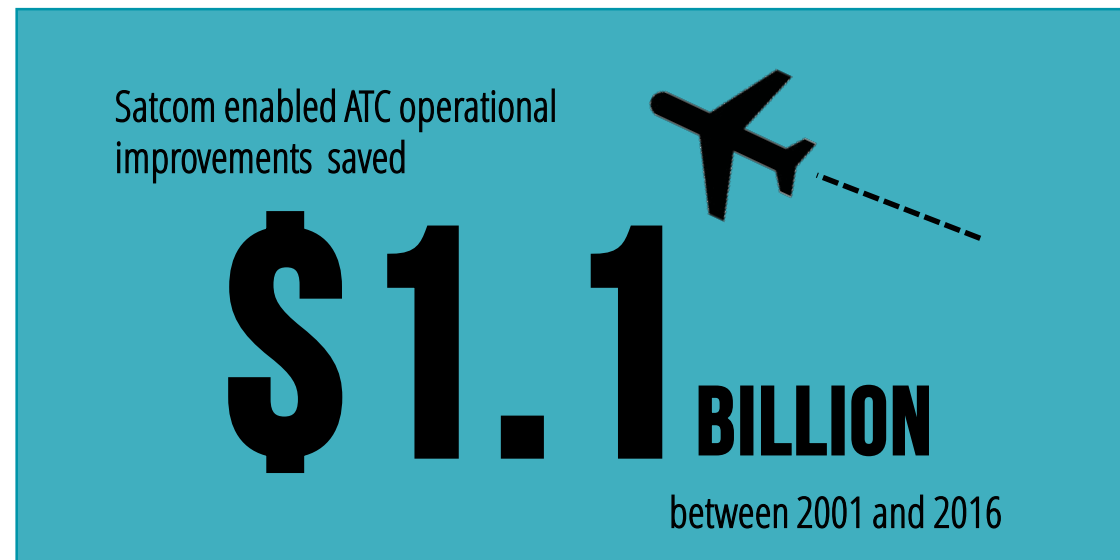
SATCOM ENABLED ATC OPERATIONAL IMPROVEMENTS

The ATC applications of satcom have primarily been enabled through FANS-1/A and are:

Reduced separation standards – thanks to reliable communication via CPDLC and route conformance monitoring enabled by ADS-C, longitudinal and lateral separation between aircraft flying in remote oceanic areas can be reduced. This leads to an increase in airspace capacity and allows aircraft to fly more efficient routes and translates into significant fuel savings being realised by a large number of aircraft.

User preferred route (UPR) – in regions such as the Indian Ocean, airlines equipped with FANS 1/A are allowed to file and fly an individually tailored flight plan resulting in significant fuel and time savings to be realised.

Dynamic airborne reroute procedure (DARP) - allows airborne rerouting of aircraft when it is indicated that a more fuel efficient route is available. CPDLC equipage is required to make DARP requests.

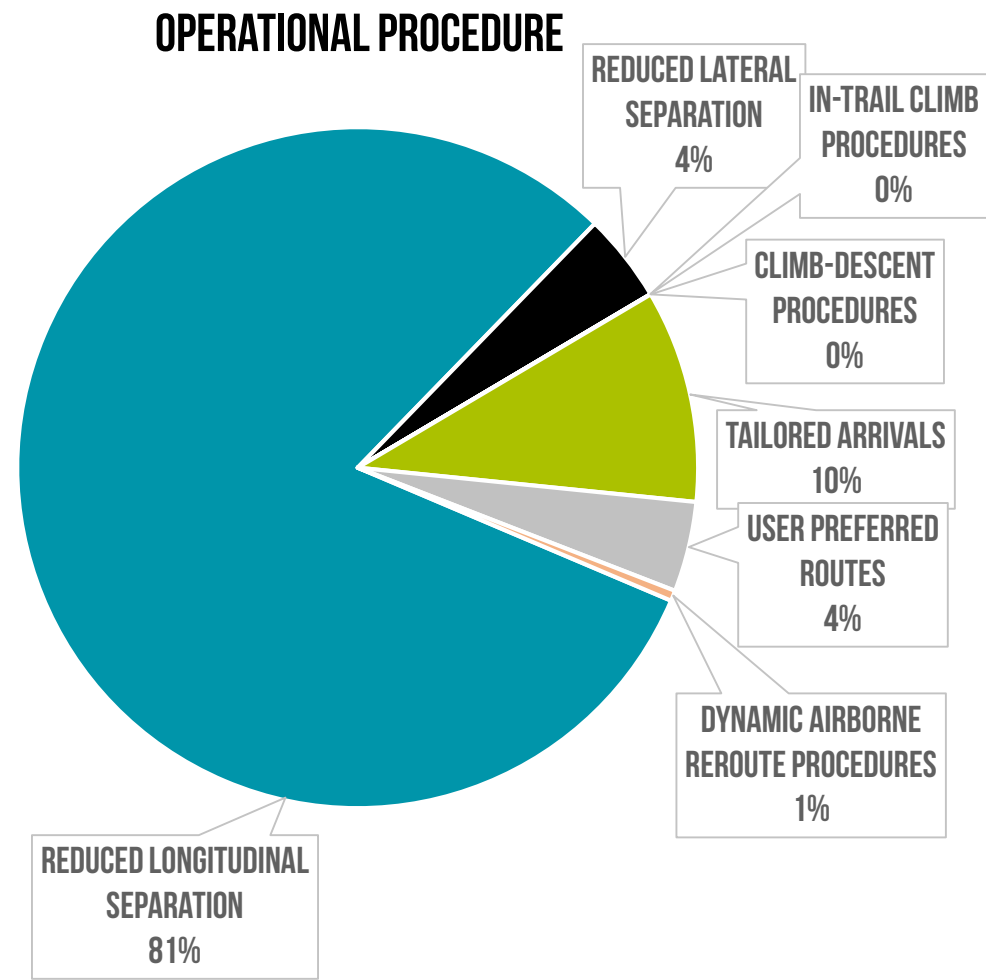
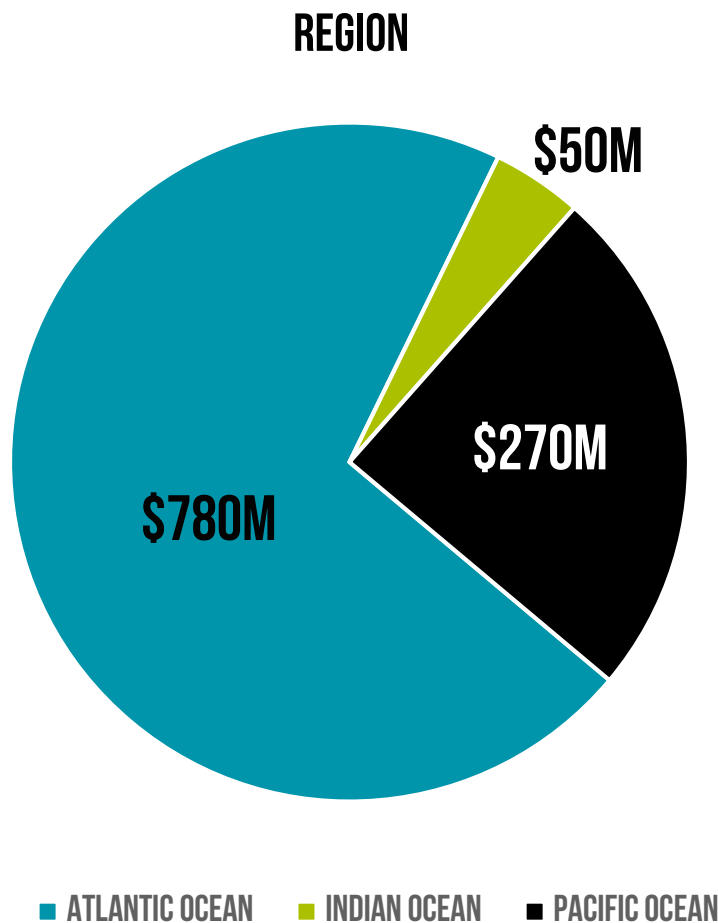
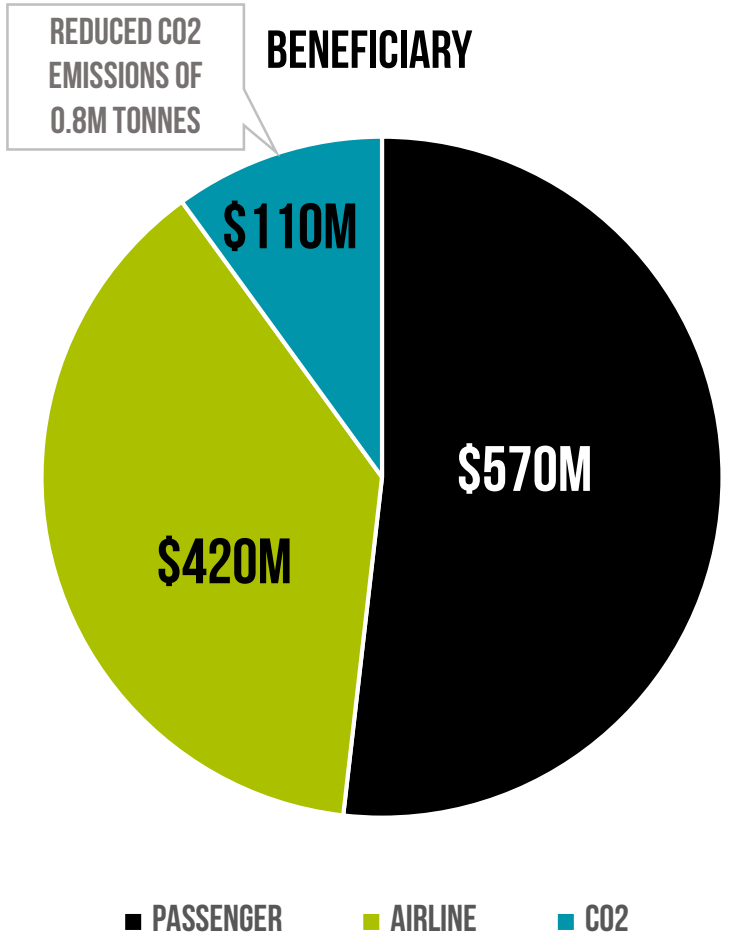


Tailored arrivals – in some regions CPDLC is used to plan arrival times and allow an ideal descent profile without holding or altitude penalties.

Thanks to CPDLC and ADS-C, in some oceanic regions aircraft are allowed to preform **in-trail climb** (ITP) and **climb/descend procedures** (CDP), which enable aircraft to climb or descend through an altitude which is occupied by another aircraft.

For each benefit mechanisms, we have isolated the per-flight benefit through fuel and time saving. We have also determined the number of flights in each oceanic region per year and the rate of use of each application.

THE \$1.1 BILLION ATC BENEFIT DELIVERED BETWEEN 2001 AND 2016 WAS ATTRIBUTABLE TO A VARIETY OF BENEFICIARIES, REGIONS AND PROCEDURES



REDUCING LONGITUDINAL SEPARATION MINIMA CREATED A BENEFIT OF \$890 MILLION

Using satcom, an aircraft can frequently relay its position to ATC without involving the pilot or controller. Satcom is used to allow aircraft to fly closer together, increasing the availability of optimum flight levels and routes, and enabling fuel and time savings.

The Reduced Longitudinal Separation Minimum (RLongSM) benefit constitutes 81% of the overall \$1.1 billion ATC benefit accrued between 2001 and 2016. This RLongSM benefit is composed of the following savings:

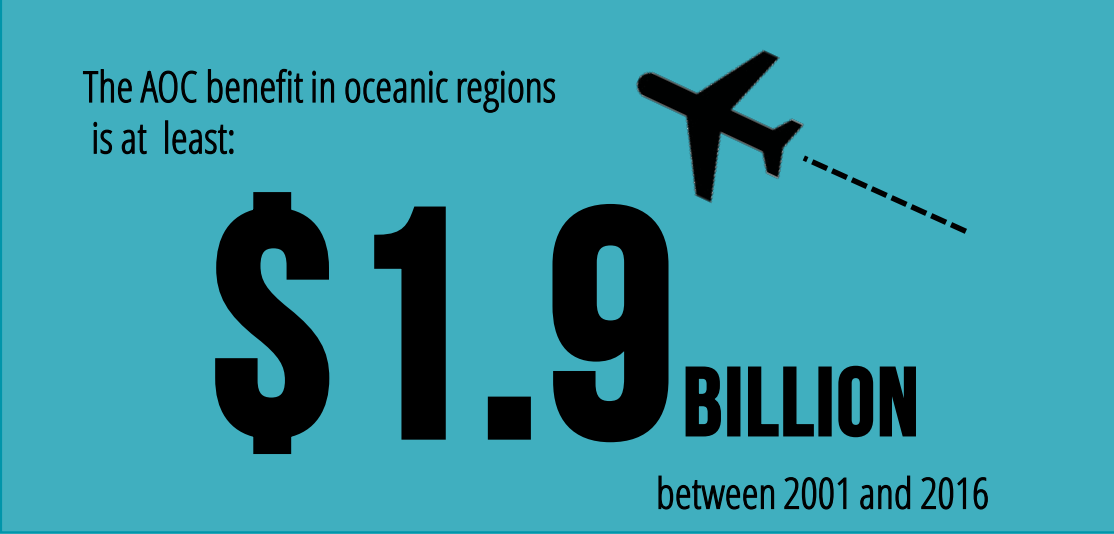
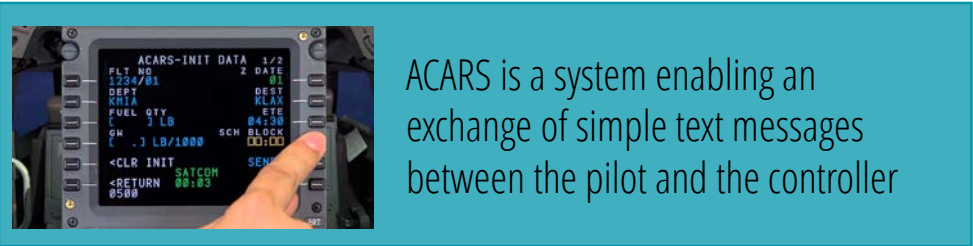
- A direct airline benefit of **\$340M**
- Reducing the environmental impact of aviation by **\$85M**
- Passenger time savings valued at **\$460M**

Due to its unique traffic density and associated track structure, the majority of this benefit has been generated in the North Atlantic oceanic region.

SATCOM ENABLED AIRLINE BENEFITS THROUGH AOC

Airline Operational Control (AOC) describes the applications that airlines use to manage their flight operations. Traditionally AOC is provided over the Aircraft Communications Addressing and Reporting System (ACARS) and supports simple applications such as “Out-Off-On-In” reports that automate some elements of the airline operation. As satcom bandwidth capacity increases there will soon be an explosion of IP-based AOC applications, allowing airlines to further optimise flight operations and fleet management.

AOC applications enable improvements for airlines in a number of areas through the provision of real-time information – for example, to improve flight safety or to enable airlines to provide a more efficient service at lower cost.



The benefits of AOC applications include:

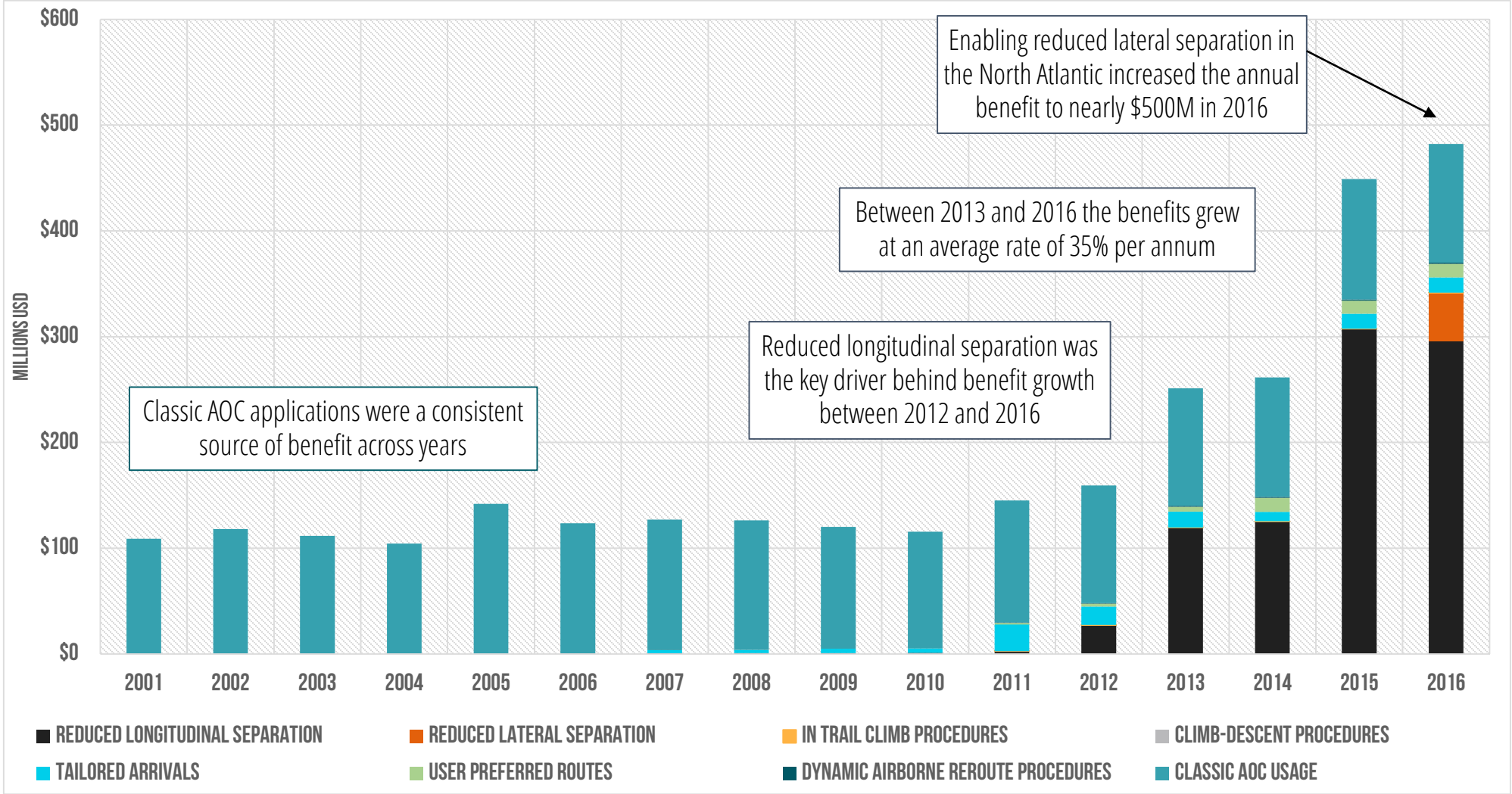
- Improved delay management and scheduling
- Improved maintenance capability
- Better fleet management
- Better flight crew management
- Reduced turnaround time
- Increased efficiency and predictability

Emerging applications are:

- Electronic Flight Bag
- Aircraft Health Monitoring

BETWEEN 2001 – 2016, IN OCEANIC REGIONS, SATCOM GENERATED A \$3 BILLION BENEFIT

**ANNUAL BENEFITS
HAVE GROWN RAPIDLY
IN RECENT YEARS
AND THE TREND IS
SET TO ACCELERATE**



BREAKDOWN OF BENEFITS ENABLED BY SATCOM IN OCEANIC REGIONS

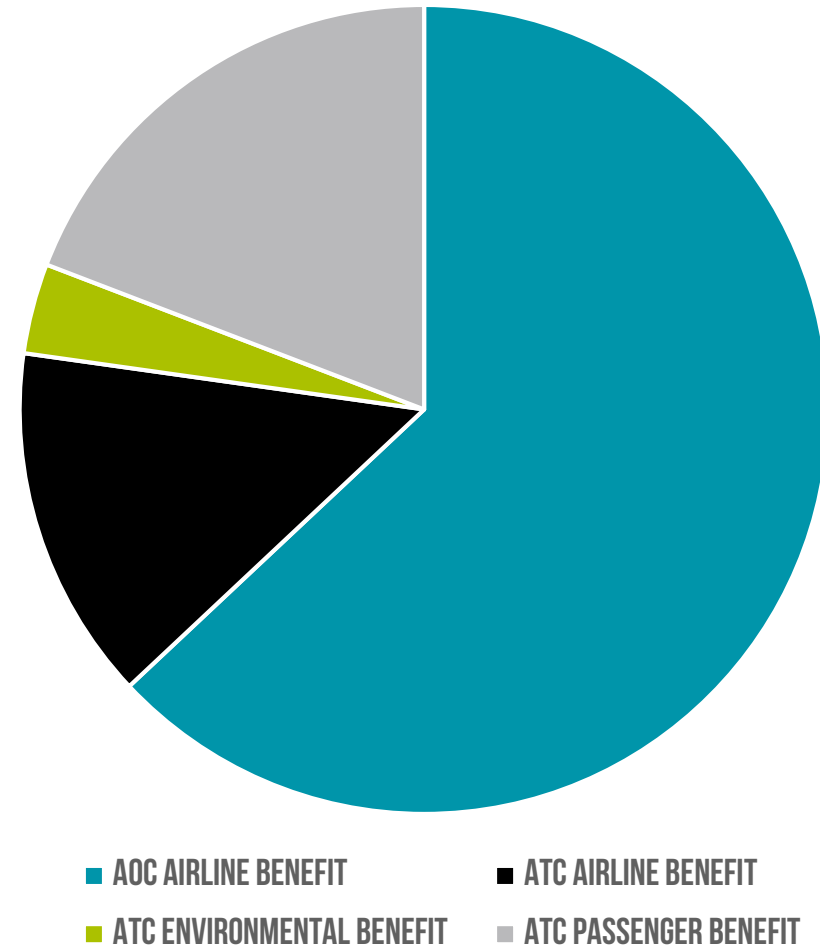
Through our analysis we have estimated that the use of satcom in oceanic regions has enabled a total benefit of \$3 billion from 2001-2016. 4% of that benefit is related to a reduced environmental impact, 19% to passenger time savings and the remaining 77% to airlines.

ATC operational improvements have resulted in a benefit of \$1.1 billion, while AOC applications provided a benefit of more than \$1.9 billion.

The ATC benefits are not equally distributed across regions, with 71% arising in the Atlantic Ocean, 25% in the Pacific Ocean and 4% in the Indian Ocean Area.

At a 81% ATC benefit share, the reduced longitudinal separation has been the key benefit driver. Reduced lateral separation accounts for 4% of the benefit, Tailored Arrivals for 10%, User Preferred routes for 4% and the remaining three procedures (ADS-C CDP, ITP and DARP) all have a share smaller than 1%.

THE \$3 BILLION ATC AND AOC BENEFIT OBSERVED IN 2001-2016 WAS DIVIDED ACROSS A NUMBER OF BENEFICIARIES



THE FUTURE OF SATCOM IN AND BEYOND THE OCEANIC REGIONS

Continental applications

This analysis has examined the benefits of satcom in oceanic regions, but airlines require a seamless service across land and sea.

More and more frequently, satcom is seen as a viable complement to terrestrial air-ground data communications, enabling an increase in operational efficiency and capacity.

The benefits of continental applications are a similar size to oceanic applications and they are also growing at a similar rate. There are many established and emerging continental applications – both AOC and ATC - some which are the same/similar to oceanic ones and others that are very different.

The increasing ambition of continental and oceanic applications will require a new generation of satellite capabilities. Programmes such as Iris will meet this challenge.

Iris

Iris is a new generation of satellite based datalink communications being developed by the European Space Agency with support from Inmarsat, Airbus, Boeing, NATS, Thales Alenia Space, Alitalia and other aviation companies.

According to the European Space Agency, by 2018 the first new-generation solution, the Iris Precursor, will deliver ATM benefits by enabling a precise flight path definition known as the '4D' flight path control. This will provide the information to optimise flight speed and descent profiles and allow for a more strategic approach to managing arrival flows. Such a capability will deliver large delay reductions in dense continental airspace, particularly around large hubs.

AOC applications will benefit similarly from the new IP-based services with higher capacity.

ACRONYMS

ACARS	Aircraft Communications Addressing and Reporting System
ADS-C	Automatic Dependent Surveillance-Contract
AOC	Airline Operational Communications
ATC	Air Traffic Control
CDP	Climb/Descend Procedure
CNS	Communication, Navigation, Surveillance
CPDLC	Controller–Pilot Data Link Communications
DARP	Dynamic Airborne Reroute Procedure
FANS	Future Air Navigation Systems
IP	Internet Protocol
ITP	In-Trail Climb Procedure
RLatSM	Reduced Lateral Separation Minimum
RLongSM	Reduced Longitudinal Separation Minimum
satcom	Satellite Communications
TA	Tailored Arrivals
UPR	User Preferred Route

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