White paper: Secure, efficient aeronautical communications

Enabling European digital sky and reducing greenhouse gases

A long-term vision of commercial aviation depends on preserving our climate, and a green recovery requires future-proof aeronautical communication networks that enable secure, efficient air travel.

L-band Digital Aeronautical Communications System (LDACS) is an innovative concept for aeronautical communication. LDACS addresses the limitations of existing technology and provides modern, secure broadband communications with more than 200 times the data throughput of the current system.

With LDACS, the future of the connected airplane becomes a reality. Aircraft operators can maintain a near-real-time picture of the precise position and status of their aircraft. Safety is boosted through higher continuity of service, guaranteed bandwidth, and reduced latency. Air Traffic Management (ATM) services can work together more efficiently across national borders in Europe. Existing radio sites can be reused for LDACS, cutting the time and cost of deployment. And with more efficient use of airspace, fuel consumption, which is responsible for up to 6.3% of global CO_2 emissions, will be significantly reduced. Achieving these goals will help operators achieve the SESAR vision of a digital European sky.

LDACS: aeronautical communications that are efficient, safe, secure, high performance, and future proof.

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New world, new communications

Progress is driven by technologies that simplify people's lives and increase efficiency. In commercial aviation, airlines want to run more flights while maintaining or even decreasing their fleets. For their part, Air Navigation Service Providers (ANSPs) want to take advantage of automation to streamline processes and reduce the risk of human error. At the same time, the entire industry is under ever-increasing pressure to make air travel greener and more cost-efficient.

These factors are driving the pursuit of more accurate flight paths that save fuel and enable more aircraft to travel in the same airspace safely. To direct aircraft more precisely, teams on the ground and crews in the air need the ability to exchange more information, faster, and more reliably.

Aeronautical data communication is a rapidly growing segment. Established aeronautical communication service providers report that their total data volumes are growing by 18-20% per year, i.e. doubling the data volume to be transported approximately every four years.

Existing aeronautical communication technology—based on principles first developed in the 1940s—does not have enough bandwidth to support these needs. Air-to-ground data communications rely on narrowband radio channels limited to a throughput of a few kilobits per second. Voice communications are broadcast on open channels without any authentication, encryption, or other embedded protection.

Clearly, a new approach is required. But because the infrastructure changes must be on a global scale, the size and complexity of this task are major obstacles.

Enter LDACS

Enhanced capabilities are on the horizon for satellite-based communications, but these will not meet the high bandwidth demands for heavily congested flight routes and airports. Satellite communications also introduce transmission delays. The International Civil Aviation Organization (ICAO) therefore foresees a future communications infrastructure that uses the terrestrial LDACS technology alongside satellite systems. Built on technologies that are used for public 4G/5G cellular networks, LDACS is adapted to and optimised for the specific requirements that a fast-moving aircraft operating at high altitudes must comply with.

Within ICAO, LDACS is being standardised and draft standards and recommended practices (SARPs) are being endorsed. LDACS enables broadband IP-based data communication between the cockpit and the ground. It provides efficient, secure, and high-bandwidth voice and data communications with embedded navigation capability. LDACS is highly spectrum-efficient, so it can work within the aeronautical spectrum without interfering with existing systems. As aircraft move between LDACS cells with overlapping coverage, the handover is seamless, automatic, and transparent—which means that the technology will support the future dynamic airspace management concept.

LDACS benefits

Performance

To support future services, LDACS can provide data throughput up to 2.6 Mbit per second—more than 200 times higher than the throughput of the current system. It offers guaranteed bandwidth, high continuity of service, and latency below 100ms, making it suitable even for safety-critical real-time applications. LDACS can also reliably transfer large amounts of operational data, e.g. engine and maintenance data, without interrupting air traffic control data. Ideally suited for the dense traffic areas typical in Europe, LDACS will also work hand-in-hand with the upgraded satellite-based communications that will serve large areas with little air traffic (such as oceanic regions).

Continuous monitoring

With significantly greater bandwidth and throughput, LDACS will enable aircraft operators to have a near-real-time view of the position and technical status of each aircraft and all its complex embedded systems. In addition to boosting safety, the early identification of potential issues will enable timely preventive maintenance.

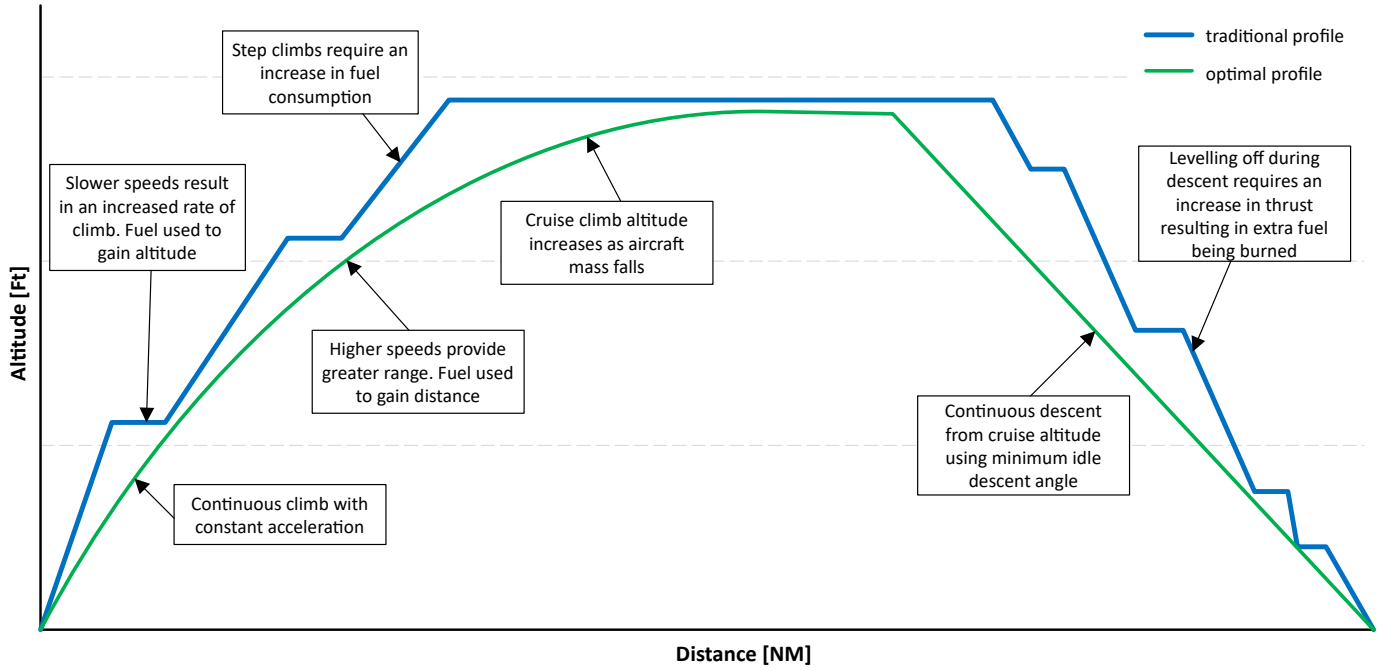
Data security

LDACS will use a dedicated aeronautical Public Key Infrastructure with end-entity certificates to cryptographically assure the identity of all participants, creating a chain of trust to ensure secure transmission of voice and data.

Data prioritisation

With today's technology, there is a significant risk of long data messages transmitted by an aircraft blocking air traffic control messages. An in-built Quality of Service (QoS) function will enable some services to be prioritised over others (e.g. Air Traffic Communications versus

Figure 1: Comparison of traditional and optimum profiles



Airline Operational Communications), giving precedence to critical information in order to enhance safety.

Digital voice

LDACS digital voice capabilities will deliver better quality, as well as enabling new concepts such as Flight Centric Operation. It will also provide a foundation for new features such as aircraft authentication and pilot/air traffic control identification.

Scalability

In high-density areas containing multiple airports and numerous aircraft, LDACS cells can be adapted to demand and to optimise performance. For greater efficiency in less busy areas, the cells can be increased in size while transmitting power is adapted as appropriate.

LDACS can be deployed step-by-step, starting in high-density areas with the greatest need for secure broadband communications.

Open framework

Efficient communications are the key enabler for smooth and reliable commercial aviation. Aeronautical communication services must therefore be provided in compliance with a strong European regulatory framework. LDACS supports this vision, and is being developed primarily by European companies, helping to generate innovation, skills and leadership.

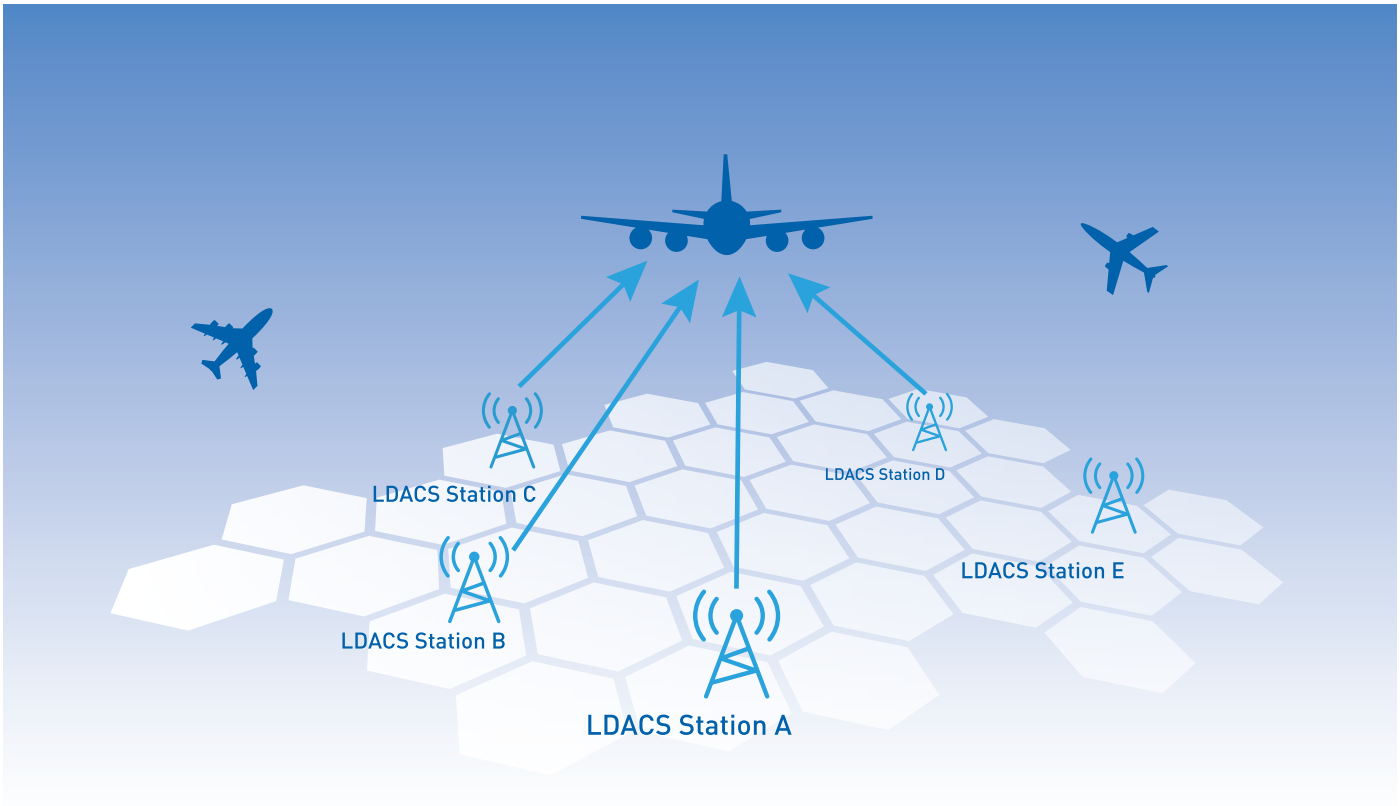
Built-in navigation and surveillance

The significant increase in bandwidth means that LDACS can provide additional features such as surveillance and navigation functions. LDACS is highly spectrum-efficient, designed to be placed within those parts of the L-band where no other service could be allocated.

Decentralised solution

As a distributed system with no central single point of failure, LDACS is more resilient than satellite-based systems. It also provides a maintenance approach that

Figure 2: LDACS cellular concept



allows coverage from another site during repairs, further reducing downtime.

Cost-efficiency

It is hard to find and develop new radio sites. LDACS operates in a different frequency band to existing radio infrastructure, so it can be deployed at existing radio sites without the risk of interference. This protects the large investments in building, telecommunication, and energy infrastructure, as well as avoiding the considerable time and expense involved in finding and developing new sites.

For a similar cost to today, LDACS equipment can provide a bandwidth that is 50 to 200 times higher, i.e. transporting data will only cost 0.65% to 3% per Mbit of what it costs currently.

CO_2 and noise reduction

Aviation was responsible for approximately 4.5% of CO_2 emissions in 2017 (source: EEA) and represented one of the fastest growing sources of greenhouse gas emissions prior to the COVID-19 pandemic. LDACS can indirectly help reduce emissions by improving the efficiency of flight operations. Faster and more detailed communications will optimise trajectories both in the air and on the ground, resulting in reduced fuel consumption and emissions. As a side-benefit, noise levels over populated areas can also be reduced. It is estimated that air traffic management could become responsible for approximately 6.3% of the planet's total fuel consumption. As a result, LDACS could potentially make a significant contribution to greener aviation.

Find out more

LDACS is a key part of ICAO's GANP, SESAR's ATM Master Plan and Europe's future communications infrastructure (FCI). ICAO standardisation was initiated in 2016, with the aim to reach an applicable standard from 2024.

LDACS is coming—putting the future of the European digital sky within reach. Contact Frequentis or DFS today to learn more about preparing for and getting the best out of this exciting new technology.

Points of contact:

DFS: info@DFS.de
Frequentis: marketing@frequentis.com

About DFS

DFS Deutsche Flugsicherung GmbH, the German air navigation service provider, is a State-owned company under private law with 5,600 employees as at 31 December 2020. DFS ensures the safe and punctual flow of air traffic over Germany. Before 2020, around 2,200 air traffic controllers guided up to 10,000 flights in German airspace every day, more than 3 million movements every year.

The company operates control centres in Langen, Bremen, Karlsruhe and Munich as well as control towers at the 16 designated international airports in Germany. The subsidiary DFS Aviation Services GmbH markets and sells products and services related to air navigation services, and provides air traffic control at nine regional airports in Germany and at London Gatwick Airport and Edinburgh Airport in the UK. R. Eisenschmidt GmbH is another DFS subsidiary which markets publications and products for General Aviation.

Kaufbeuren ATM Training (KAT) is responsible for training military air traffic services personnel. DFS has been working on theintegration of drones into air traffic since 2016 and has set up a joint venture, Droniq GmbH, with Deutsche Telekom.

For more information, visit www.dfs.de

About Frequentis

Frequentis, headquartered in Vienna, is an international supplier of communication and information systems for control centres with safety-critical tasks. Such 'control centre solutions' are developed and marketed by Frequentis in the business sectors Air Traffic Management (civil and military air traffic control, air defence) and Public Safety & Transport (police, fire brigade, ambulance services, shipping, railways).

As a global player, Frequentis operates a worldwide network of branches, subsidiaries and local representatives in more than 50 countries. Products and solutions from Frequentis can be found in over 30,000 operator working positions and in approximately 140 countries.

Founded in 1947, Frequentis considers itself to be the global market leader in voice communication systems for air traffic control with a market share of around 30%. In addition, the Frequentis Group's AIM (aeronautical information management) and AMHS (aeronautical message handling) systems, as well as GSM-R systems for Public Transport are industry-leading global solutions. The shares of Frequentis AG are traded on the Vienna and Frankfurt Stock Exchange under the ticker symbol FQT (ISIN: ATFREQUENT09). In 2019, the Frequentis Group had about 1,850 employees worldwide and generated revenues of EUR 303.6 million and EBIT of EUR 17.2 million.

For more information, visit www.frequentis.com

FREQUENTIS AG
Innovationsstraße 1
1100 Vienna, Austria
www.frequentis.com

DFS DEUTSCHE FLUGSICHERUNG GMBH
Am DFS-Campus 10
63225 Langen, Germany
www.dfs.de

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