Airborne Satellite Communications on the Move Solutions Overview

High-Speed Broadband in the Sky

The connected aircraft is taking the business of commercial airlines to new heights. In-flight systems are delivering new capabilities designed to improve the passenger experience, increase operational efficiency, and improve customer satisfaction and retention for airlines.

With nearly every major airline rolling out or planning to install some form of in-flight connectivity, service providers must work with a flexible technology solution built to maximize value and minimize the total cost of ownership.

When it comes to offering in-flight connectivity, more airlines are turning to satellite or more specifically VSAT. With VSAT, airlines are able to offer higher data rates, with coverage for both domestic and international routes. The case for VSAT becomes even stronger with new High Throughout Satellites (HTS) positioned to dramatically improve capacity economics for the commercial airline market.

The iDirect Solution

The iDirect Evolution product line is a shared, two-way Time Division Multiple Access (TDMA) system built to dynamically allocate bandwidth from a shared pool based on real-time usage requirements. For commercial airlines, this means the ability to deliver high throughput, bandwidth-efficient in-flight connectivity by sharing a pool of bandwidth across a fleet or aircraft, taking advantage of different flight patterns and time zones.

The Evolution product line features a universal hub and line card system, and specialized VSAT router boards designed for integration onboard the aircraft. Its comprehensive range of bandwidth efficiency and mobility technologies make reliable broadband possible in air, while ensuring VSAT networks are cost-effective to deploy, operate and scale.
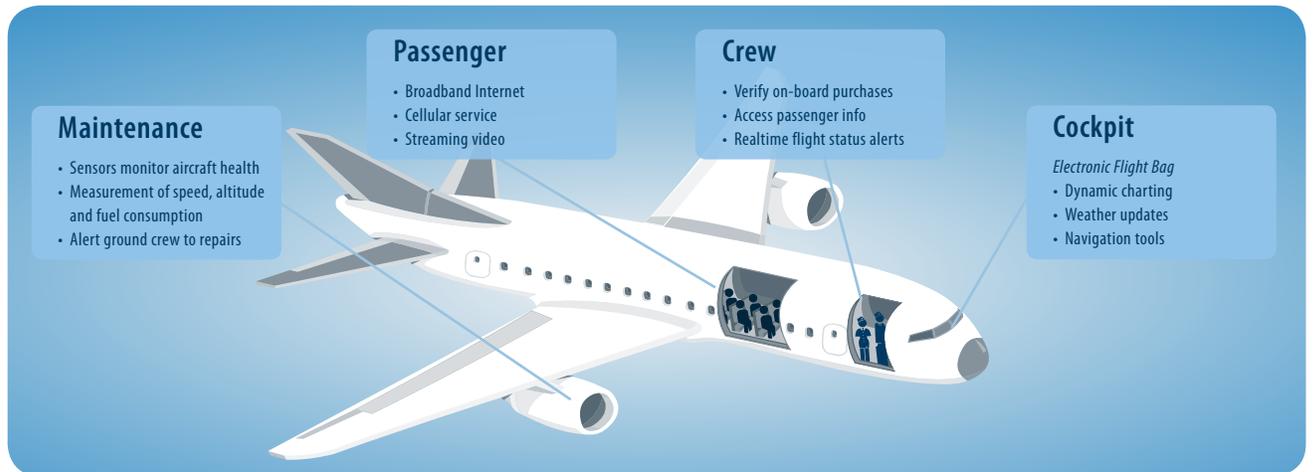
Evolution delivers carrier-class reliability through its hub diversity and redundancy, along with its seamless network failover. This also helps protect overall network integrity.
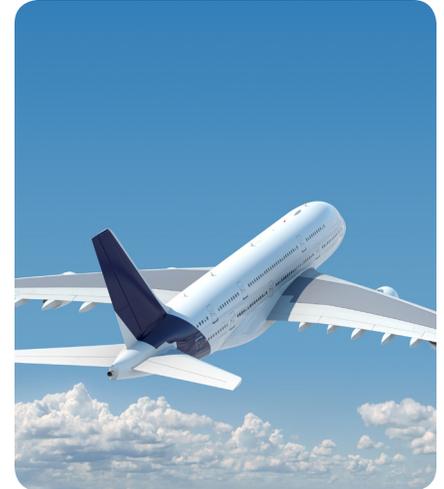
The VSAT Advantage

♦ Higher data rates for in-flight connectivity

♦ Shared bandwidth pool across a fleet or aircraft

♦ Seamless coverage across multiple geographies

♦ Real-time data related to health of aircraft, status updates

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The Connected Aircraft

Passenger
- Broadband Internet
- Cellular service
- Streaming video

Crew
- Verify on-board purchases
- Access passenger info
- Realtime flight status alerts

Maintenance
- Sensors monitor aircraft health
- Measurement of speed, altitude and fuel consumption
- Alert ground crew to repairs

Cockpit
Electronic Flight Bag
- Dynamic charting
- Weather updates
- Navigation tools

VSAT delivers specific functionality that helps improve all aspects of a commercial airline, from passenger experience to operational efficiency.

Evolution's fundamental system design and its ability to handle unique high-speed COTM challenges make it the right platform for service providers looking to build the most complete and scalable solution for commercial aero.

- *Flexible core architecture:* With VSAT, service providers will need to manage a complex network in order to have constant coverage during various flight routes. The complex network can comprise multiple satellites, frequencies and bands. iDirect's Evolution hub can support such diversity from one system, providing a high degree of technology flexibility.

- *Bandwidth efficiency:* Evolution is designed to deliver high-quality broadband connectivity wherever and whenever it's needed. Evolution is built on DVB-S2/ACM with Adaptive TDMA and multiple efficiency technologies to allocate bandwidth efficiently over distributed networks, while automatically adjusting to dynamic traffic demands and changing network conditions. Service providers can build high-performing satellite networks that improve bandwidth efficiency and lower operating costs.

- *Modular design for scalability:* Deploying an aero network requires a significant capital outlay. Thus, a key platform requirement is the ability to build out infrastructure in line with demand. iDirect delivers a hub chassis that can be populated with network line cards that enables airlines and service providers to scale in a pay-as-you-grow manner.

- *Advanced quality of service:* To maximize the value of a shared TDMA bandwidth pool, iDirect has engineered an advanced quality of service technology for traffic prioritization and bandwidth management. An airline can establish distinct QoS settings by remotes, bandwidth groups and applications. As bandwidth demands fluctuate across a fleet of aircraft and among end users onboard – all of which are sharing a common pool of bandwidth – SLAs can be configured and prioritized in highly flexible ways over conventional QoS.

- *Superior network management:* Increasingly, network management is the measure of an operator's success. It represents the epicenter of a very complex set of operations – managing large-scale deployments, monitoring network activity, driving profitability and ensuring customer satisfaction.

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Advanced Mobility Features

Building on the core features of Evolution, a ground infrastructure platform must meet unique mobility requirements. This includes the hardware like antenna and remote portfolio, various waveform considerations and beam switching as the aircraft traverses the different coverage zones within the satellite network.
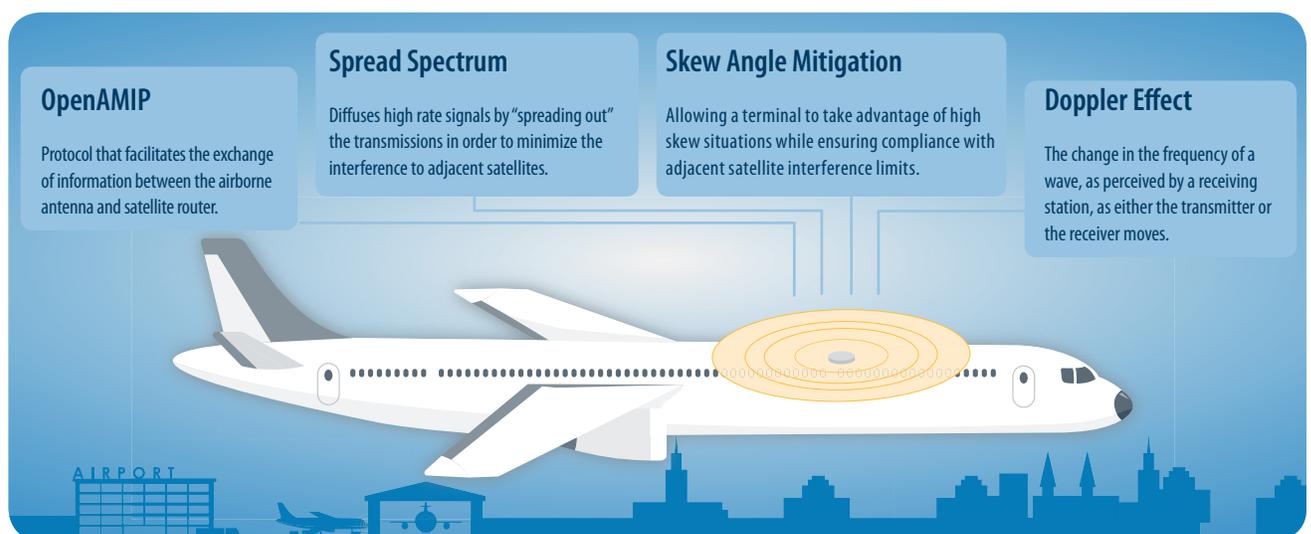
Antenna Parameters

One of the most important considerations of any in-flight implementation is the equipment, starting with the antenna. iDirect works closely with a range of antenna manufacturers to ensure compatibility between the technology. iDirect is antenna agnostic and uses the OpenAMIP protocol to work with all major stabilized VSAT antenna manufacturers. OpenAMIP facilitates the exchange of information between an antenna controller unit and a satellite router, allowing the router to command the antenna without proprietary coding. This ensures compatibility between the technology and any antenna mounted on the airframe.

Enabling small antennas with Spread Spectrum

Providing high-speed connectivity through small mobile antennas can prove to be a challenge. The form factor of the antenna plays a major role in the integration, aero dynamics and fuel costs. The use of smaller antennas, such as flat panel becomes more prevalent, but it also comes with the risk of creating adjacent satellite interference when transmitting from the aircraft to the satellite. One solution comes in the form of spread spectrum, which diffuses high rate signals by "spreading out" the transmissions in order to minimize the interference to adjacent satellites without limiting connectivity to the target satellite.

Direct Sequence Spread Spectrum ensures even more space segment is conserved, thus lowering overall bandwidth requirements.

Antenna Considerations

OpenAMIP

Protocol that facilitates the exchange of information between the airborne antenna and satellite router.

Spread Spectrum

Diffuses high rate signals by "spreading out" the transmissions in order to minimize the interference to adjacent satellites.

Skew Angle Mitigation

Allowing a terminal to take advantage of high skew situations while ensuring compliance with adjacent satellite interference limits.

Doppler Effect

The change in the frequency of a wave, as perceived by a receiving station, as either the transmitter or the receiver moves.

iDirect works with all leading anternna manufacturers to ensure compatability between the technology and the equipment.

Efficient Waveforms In High-Speed

Efficient waveforms are critical for offering a bandwidth-efficient and cost-effective service, but satellite transmissions to fast moving antenna are a challenge. iDirect has developed doppler effect and skew angle mitigation features to deal with those challenges. The Doppler Effect is the change in the frequency of a wave, as perceived by a receiving station, as either the transmitter or the receiver moves. Historically, the Doppler Effect in satellite transmission has been a secondary consideration arising from the satellite's motion in it station-keeping position within its assigned orbital location. With aircraft, however, the Doppler Effect has a great impact on the effectiveness of antennas. iDirect has developed technology to manage the Doppler Effects caused by aircraft movements.

Another antenna consideration is skew angle support which refers to the angle at which a beam hits the satellite. This is primarily dependent on the location of the antenna on the Earth. Due to the oval shape of some antennas, for example, the beam will leave an aircraft in a wide direction vertically and a narrow direction horizontally, thus running the risk of hitting the adjacent satellite with more power. The iDirect platform includes Skew Angle Mitigation to help adapt to the skew angles of such antennas. This allows a terminal to take advantage of high skew situations while ensuring compliance with the adjacent satellite interference limits.

In addition, iDirect's platform incorporates enhanced frequency and phase tracking of waveforms technologies to be more bandwidth efficient.

Global Coverage

As planes move across the Earth they frequently change coverage areas between different satellite beams. Keeping switching time to a minimum is critical to enhancing the customer experience, and becomes more important within the multi-spot beam architecture of HTS.

Automatic Beam Switching and Global NMS

Automatic Beam Selection (ABS) enables an airborne remote to switch from one beam to another. Global NMS allows for effective monitoring and management of each traveling remote as it passes through separate networks.

![iDirect]

iDirect has developed a switch-over technology called Automatic Beam Selection (ABS), that enables remotes to travel across satellite footprints and maintain seamless connectivity without the need for manual intervention. Through exact GPS positioning and constant data-point comparison, the platform determines the best satellite coverage at any time. When it is determined that a travelling remote is reaching the beam edge, the router initiates an automatic repointing of the antenna and transfer of the connectivity to the new beam, enabling the continuous delivery of communication services.

Achieving the goal of global coverage means that airborne remotes must move among networks on various transponders and satellites, controlled from a variety of hubs and networks. This poses a number of challenges for IP networks and Network Management Systems (NMS) with relation to the tracking and authenticating of remote units. The ability to monitor service reliability, as well as manage and control SLAs.

iDirect has developed a Global NMS, enabling network operators to monitor and manage each traveling remote, ensuring a consistent connection as it passes through separate networks around the world.

Broadband in the Sky

VSAT has become the enabling technology for commercial airlines, and iDirect's aero solution maximizes value creation, while minimizing the total cost of ownership. iDirect's ability to meet both challenges over a single system solidifies its leadership role serving the commercial airline market.

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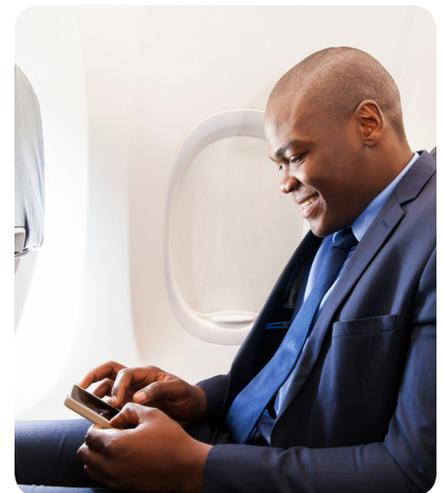
For more information about Airborne Satellite Communications, please contact your Sales Representative at sales@idirect.net.