

Hughes HeloSat™

Beyond Line of Sight SATCOM for Rotary Wing Aircraft

Helicopters and other rotary wing aircraft play a key role for supporting Intelligence, Surveillance, and Reconnaissance (ISR) missions based on their size and maneuverability. Their fast-moving blades are a valuable feature for these platforms and make them incredibly nimble. These aircraft have limited applicability in long-distance, Beyond Line of Sight (BLoS) locations because they require satellite communications (SATCOM) for connectivity. Data transmissions must pass through the blades, resulting in chopped signals and disrupt communications.

This paper describes a BLoS Wideband (WB) satellite communications system from Hughes that eliminates this obstacle by enabling communications signals to pass through rotor blades reliably. Hughes system engineering experts developed patented waveform enhancements using specialized algorithms that are embedded within software definable modem technology to create the Hughes HeloSat™ System. Designed as an open architecture solution for BLoS SATCOM in which the technical capabilities are independent of helicopter type, HeloSat operates in the X-, Ku-, and Ka-bands and employs resilient waveform technology optimized for rotary platforms and based on commercially proven systems. With this integrated BLoS connectivity, rotary aircraft can now be deployed and perform long-distance ISR missions while delivering real-time video and data for analysis.

This innovation from Hughes has overcome the limitation created by the fast-moving blades. Traditionally, rotary wing aircraft could only provide live video and data by using Line of Sight (LoS) microwave technologies where the aircraft would link to a receiver mounted on a tower. The rotary aircraft operating BLoS or in environments that do not have the necessary infrastructure could gather High-Definition (HD) video only by flying to the destination, collecting the data, and then returning to base to complete the analysis. As a result, helicopters have remained largely underutilized for long distance ISR missions that require bandwidth intensive real-time video and data.

Hughes possesses deep commercial aeronautical satellite communications expertise, tenured experience as a SATCOM systems integrator, and a long-standing legacy with the United States Department of Defense (DoD) and other Allied Ministries of Defense in the development of advanced technology solutions, such as the HeloSat system.



The Challenges for Rotary Wing Aircraft Communications

The Blades

Maintaining reliable communications on rotary wing platforms means overcoming the signal loss caused by rotating blades.

Regardless of where the SATCOM terminal is mounted on a helicopter, the blades rotating between the aircraft and the satellite will inevitably disrupt the signal, prompting a pattern of signal acquisition, loss, and reacquisition.

Adding to the challenge, different rotary aircraft platforms employ different kinds of blades. Helicopter and other rotary wing aircraft blades vary by size, materials, and shapes, each with unique properties, such as counter rotating blades or rotations per minute (RPM). A solution for one type of aircraft may not work for others due to these configurable nuances.

Going the Distance

For reliable, wideband SATCOM connectivity on long-distance helicopter missions around the globe, the solution must function BLoS. The communications that support helicopters today do not support this requirement.

Helicopters and other rotary wing aircraft have access to ample bandwidth when using LoS microwave communications with local towers. However, average LoS communications limits rotary wing aircraft to flying 60 miles (depending on flight altitude and tower height) before signal loss due to the earth's curvature. When these aircraft operate over longer distances or through mountainous terrain, they can only send and receive voice or text data because radio frequency or narrowband SATCOM services deliver very limited bandwidth. This communications technology gap has disqualified rotary wing aircraft from flying long-distance ISR missions.

Size, Weight, and Power Constraints

SATCOM system components for rotary wing aircraft must meet critical Size, Weight, and Power (SWaP) thresholds.

Small aircraft designed to be nimble and fast like helicopters, have strict limits in SWaP properties. For example, using a power amplifier on a SATCOM system might boost the signal 6–10 dB so it can transmit through the blades, but it would also dramatically increase the cost and SWaP properties, making it impractical.

Real-time Situational Awareness

To be useful for ISR missions, SATCOM solutions for rotary wing aircraft must deliver enough bandwidth to transmit HD video at a practical cost.

Today's airborne ISR missions on fixed, rotary winged platforms depend more than ever on reliable transmission of high-definition video and data, especially for sensitive situational awareness information that must reach decision makers on the ground. While narrowband SATCOM solutions for rotary aircraft have a natural waveform that supports transmission through



blades with minimal modification, they can only transmit low data rates (typically up to 1 Mbps) reliably. These narrowband capabilities can significantly increase operational expense, as they are typically billed at a per minute rate. Bandwidth-hungry applications, such as HD video, require more throughput for reliable transmission, at least 2 Mbps, while the Hughes HeloSat System can provide up to 45 Mbps.

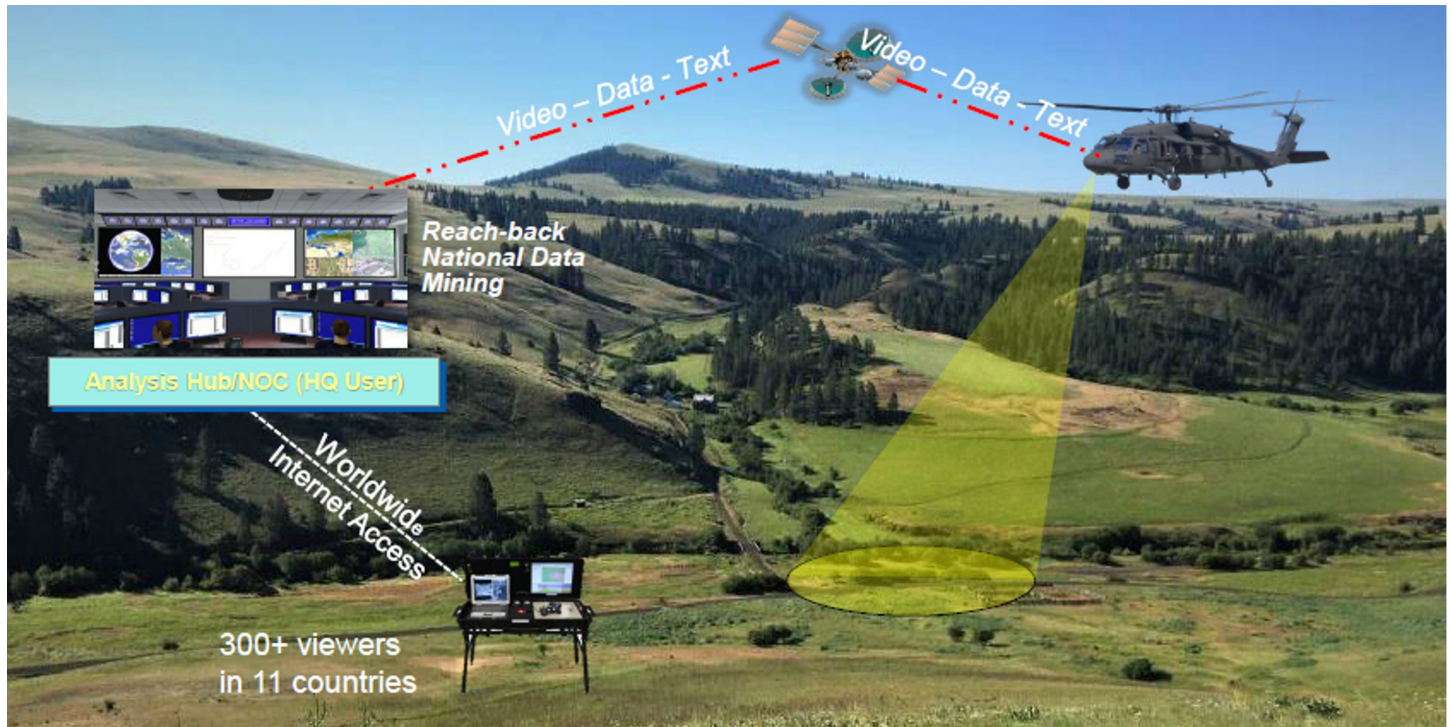
The Hughes HeloSat Solution: Overcoming the Challenges

The Hughes HeloSat System capitalizes on proven commercial, open-standards technologies to provide two-way BLoS SATCOM for rotary wing aircraft. HeloSat features an optimized modem and antenna form factor with reduced SWaP properties to accommodate payload limitations. This technology system, in conjunction with a variety of small, lightweight antenna options, provides powerful connectivity to support real-time situational awareness on different rotary wing platforms that operate where LoS communications are unavailable.

This innovative solution enables a customizable system of sharing real-time situational awareness from the sky to decision-makers on the ground. The Hughes HeloSat System technology functions over several key operational frequency bands (Ku-, Ka-, and X-), to meet modern military application needs. Communicating in any of these bands, a typical military command can achieve up to 10 Mbps off the aircraft itself by using commercial high-throughput satellites (HTS). The HeloSat solution together with HTS lowers costs significantly.

Powered by the Hughes HM System

The foundation of HeloSat is the Hughes HM System. Engineered based on software-definable modem (SDM) technology and the Hughes Scrambled Code Multiple Access (SCMA) waveform, the HM System provides cost-effective and Commercial-Off-The-Shelf (COTS) communications products and solutions ideal for military applications. The HM System employs commercially-based, open-standards architecture and a frequency band-agnostic platform that delivers affordability and resiliency to meet a wide variety of government mobility and portability requirements.



Waveform Enhancements

The patented SCMA waveform continues the Hughes legacy of innovative satellite solutions. The waveform utilizes the latest software-definable SCMA technology, delivering high-data throughput and secure, efficient bandwidth sharing. The Hughes SCMA waveform technology works well with extremely small antennas (micro-terminals), which also allows for rapid signal acquisition and recovery. The waveform includes Upper-Layer Protocol Enhancements (ULPEs) for high-speed transmission with zero packet loss through the rotating helicopter blades.

The advanced waveform implementation also has a Single Channel per Carrier (SCPC) component that utilizes a similar algorithm for both forward and return transmission. The HeloSat hardware platform is the same for the two links since both transmissions must overcome the rotary blade blockage. Whether the transmissions are video, data, or voice traffic encapsulated in an IP packet, communications between the hub and the aircraft become independent connections with continuous transmissions up and down even when no active messaging is helping to frame synchronization and reacquisition.

HM400 Modem

Building on the success of the award-winning HM200, the HM400 COTM modem (Appendix B) utilizes Hughes innovative SCMA waveform technology that enables efficient bandwidth usage with smaller antennas. Designed with flexibility in

mind, the HM400 leverages its open architecture for use with a range of qualified system components that are suited for meeting mission-specific requirements. The HM400 provides one critical enhancement-increased resiliency, which enables reliable BLoS communications even in harsh or contested environmental conditions, such as ultra-high-altitude flight, lightning strikes, and Electromagnetic Interference (EMI). This strength makes the unit ideal for use in disaster response, storm tracking, military operations, agriculture and geological surveys, and other applications.

Tested. Proven. Ready.

Hughes HeloSat enables rotary wing aircraft to stay connected and communicate high data rate information from farther distances than ever before. The Hughes HeloSat system adapts easily for any rotary wing platform, regardless of the number of blades or where the antenna is installed. The patented technology has been tested and proven on nine different rotary platforms to date, showcasing its ability to overcome rotary blade interference to deliver high-throughput speeds for high-definition video, SIGINT sensor data, voice over IP, and other critical data transmission needs with zero packet loss.

With its open architecture, Hughes HeloSat can support multiple mission sets, including ISR, border security, law enforcement, and disaster response. Helicopters and rotary wing aircraft can finally go the distance for the critical ISR mission that they are well suited to support.



Hughes HeloSat™

Let Nothing Block Your Mission

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