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SATELLITE COMMUNICATION FOR ROTARY AIRCRAFT

OPPORTUNITIES, CHALLENGES AND NEEDS OF THE MARKET

Currently the market for satcom solutions under the rotor has great prospects. Most government authorities have expressed the requirement to have wideband satellite capacity on board helicopters.

A few players are addressing the global need for modems able to overcome blade obstruction. These modem products are subject to ITAR constraints, which limit their possible uses. To bypass this limitation, the German satellite communication company ND SATCOM builds and certifies an ITAR-free European helicopter satcom solution for government authorities and military end-users.

A recent market research report highlighted “a focus on developing and modernizing airborne SATCOM systems with advanced features to conduct effective ISR missions and border protection & surveillance” [1]. Another projected Europe “to be the fastest-growing market for helicopters, due to high procurement of military and civil & commercial helicopters” [2]. Yet another highlighted the global market potential for a satcom solution: “The government & defense segment would witness a faster CAGR during the forecast period. This is attributed to the multiple initiatives taken by governments of several nations to facilitate the manufacturing of the military communication market” [3].



ND SATCOM'S SOLUTION

ND SATCOM is leveraging its advanced technical capabilities and know-how, long relationships with relevant government authorities and global sales reach to address this market opportunity. Complementing this is ND SATCOM's teamwork with an Italian partner and its avionics platforms for live testing and field results.

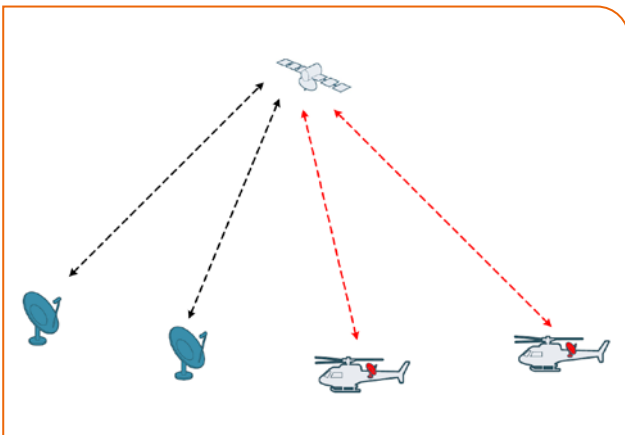
ND SATCOM has already conducted tests with a helicopter antenna under the rotor, and has demonstrated results from an ongoing SKYWAN modem waveform adaptation. The plan is to add the new waveform to the SKYWAN product, where under-the-rotor modems must use an adapted SKYWAN hardware unit.

ND SATCOM TECHNOLOGY

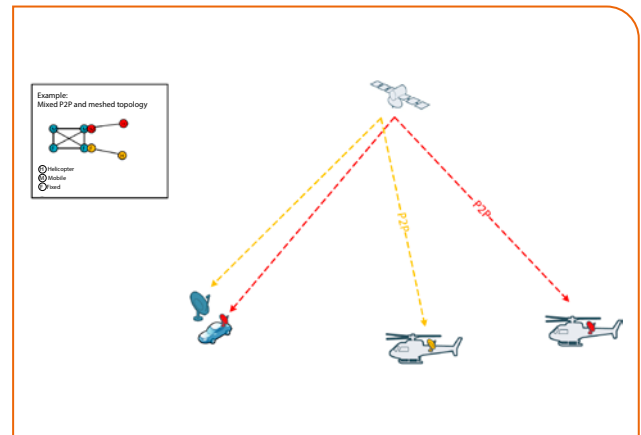
The logical next step is to extend the SKYWAN waveform to send broadband data streams through the rotor to a GEO satellite using a helicopter-ready antenna subsystem.

The goal is an ultra-reliable satcom link under the rotor for broadband data rates not feasible with L-band solutions.

In Phase 1 ND SATCOM has already finalized several customer tests with positive results. In this Phase 1 GEO stationary satellites were used; other network scenarios are planned in Phase 2.



HELICOPTERS EXTEND THE NETWORK USING GEO SATELLITE LINKS

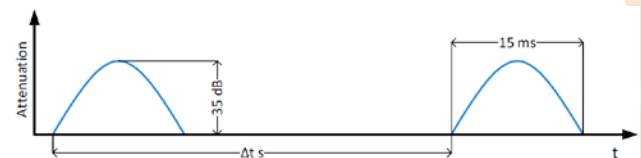


NETWORK WITH HIGH-SPEED, BIDIRECTIONAL HELICOPTER-TO-GROUND (POINT-2-POINT) CONNECTIVITY

ADVANTAGES OF OUR SOLUTION

- GEO satellite solution for helicopter integration
- under-the-rotor helicopter modem for high-speed, two-way transmission
- integrated package with Ka- and Ku-band airborne antenna with antenna control unit

SKYWAN modems use a robust TDMA burst waveform in both directions to compensate for Doppler and fast and strong RF signal changes but also to transmit and receive the waveform through the rotor. The new implementation optimises the TDMA waveform such that high flexibility is given to the helicopter manufacturers as to where to place the helicopter antenna under the 2-5 blades of the main rotor hub.



ATTENUATION OF SATELLITE LINK SIGNAL BY ROTOR OVER TIME

In general, the rotors operate at a fixed RPM (within a narrow range of a few percent). Nevertheless, when transmitting or receiving data, the new waveform is adapting to the disturbance of the rotor blades over the installed satcom antenna: the waveform adaptation in the TDMA modem compensates for the temporary line-of sight blockings in both directions.

The new SKYWAN waveform automatically adapts/calibrates to a specific helicopter model and its rotor type/speed. Another future advantage of the SKYWAN new waveform is multiple helicopters may share the same satellite carrier: no exclusive point-to-point links are required. The waveform is not blocking a helicopter-to-helicopter single-hop communication.

Antenna testing with helicopters is ongoing. The satellite link signal from the antenna in real-life mode under the rotor is quite different to a fixed ground station terminal or even a COTM terminal. Certain extensions to the RF path of a classical ground station modem are necessary and part of the solution.



ANTENNA CONTROL UNIT FOR ANTENNA AND INTEGRATED SKYWAN MODEM

The integrated one-box unit will be certified for avionic use according to RCTA DO-160 criteria and comes with fully integrated Modem, ACU and power supply.

With its rotor-agnostic modem waveform, other helicopters may be used as well.

FIELD TESTS & FUTURE

ND SATCOM's innovative solution with the SKYWAN modem and helicopter antenna fits both AW149 or AW169 helicopters used by several governmental customers in Italy.



AW169 HELICOPTER IN UNDER-THE-ROTOR TESTS WITH THE HELICOPTER ANTENNA

AW139 helicopters are in service at several governmental customers in Italy. This helicopter model was already used for antenna robustness tests. Flight tests with the AW139 and the 37cm Ku-band antenna were done in October 2021.

Future possibility: ND SATCOM envisions remotely piloted or autonomously flying helicopters or air taxis as benefitting from this new solution.



SW-4 SOLO HELICOPTER

MARKET REPORTS

[1] **Airborne SATCOM Market by Platform** (Commercial Aircraft, Military Aircraft, Business Jets, Helicopters, UAVs), Application (Government & Defense, Commercial), Installation Type, Component, Frequency (Ka-band, Ku-band), and Region - Global Forecast to 2025, Research and Markets, February 2020.

[2] **Helicopters Market by Point Of Sale** (OEM, Aftermarket), OEM Type (Light, Medium, Heavy), OEM Application (Military, Civil & Commercial), OEM Number of Engine, OEM Component & System, Aftermarket by Component & System, and Region - Global Forecast to 2025, MarketsAndMarkets, July 2020.

[3] **Airborne SATCOM Market By Platform** (Commercial Aircraft, Military Aircraft, Business Jet, Helicopters, and UAV), By Component (SATCOM terminals, Transceivers, Airborne Radio, Moderns & Routers, SATCOM Radomes, and Others), By Application (Government & Defense and Commercial), By Frequency, By Installation Type and By Region – Global Opportunities & Forecast, 2020-2027, GMI, November 2020.

[4] **Global Airborne SATCOM Market Report: By Component** (Transponders, Transceivers, Antennas, Transmitters, Receivers, Airborne Radio, Modems & Routers, SATCOM Radomes and Others), Frequency Type (C Band, L Band, Ka-Band, Ku Band, UHF Band and Others), Platform (Civil Aviation, Military Aviation and Unmanned Aerial Vehicles (UAV)) and Region (North America, Europe, Asia-Pacific, the Middle East & Africa and Latin America) - Forecast till 2027, Market Research Future, February 2021.

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