Satellite fixed link offers higher operational availability than conventional ground links

Spain is upgrading its radar data distribution system by using satellite fixed links to connect remote radar sites to ATC units, and several other countries are also using such links as primary or sole links for radar data transmission.

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RADAR service provided by air traffic controllers to aircraft is highly dependent on the quality and availability of the links used for transmitting the radar data from the radar sensors to the air traffic control (ATC) units concerned. Often, the ground communication lines used for these links are not designed specifically for data transmission and in many cases are of poor quality.

Data losses due to poor quality communication lines generate extra workload for the air traffic controller, reducing the maximum number of aircraft that can be controlled simultaneously, and therefore reducing ATC capacity. Data losses also create a feeling of uncertainty and a lack of confidence in the air traffic control system for both pilots and controllers.

Ground communication lines have another drawback: they can be cut easily during accidents or as a result of sabotage, cable theft, fire, flooding and other catastrophes. Line losses can cause a considerable reduction in ATC capacity and may produce dangerous situations which could affect aircraft safety. Microwave links are not so easily damaged, but are usually expensive and difficult to implement, requiring repeaters every 20 to 30 miles in order to achieve a good quality link.

In order to provide the redundancy required for radar services, two different types of data links (with different paths) between the radar sensor and the ATC unit should be continuously available. The utilization of different types of high-quality communication links provides diversity and minimizes risk of data losses.

Radar data transmission via satellite

Satellite fixed links offer both a high level of quality and an alternative that can be used as a backup to the existing ground link in order to provide the required communications availability and reliability.

The quality of satellite fixed links is very good with an average bit error rate — for clear sky conditions — in the order of 1 to 1 billion.

The operational availability of a satellite fixed link is very high, normally much higher than the ground links in most countries. Several States (Italy, Australia, Mexico, etc.) are already using satellite fixed links as primary or sole links for radar data transmission.

Radar data sharing via satellite

A satellite fixed link can be used as a point-to-multipoint link. When a satellite fixed link is used to transmit radar data from a remote radar sensor to an area control centre (ACC), the sharing of radar data becomes easy and inexpensive. This avoids the costs of implementing and using radar networks which may need the addition of extra communication protocols, causing delay and adding unnecessary overhead.

Space segment providers charge only for uplinks, and therefore it costs the same (with respect to space segment charges) to send radar data to only one ACC as it does to send the same radar data to many centres. All users, of course, must be within the same satellite beam footprint.

The only extra cost needed for sharing radar data is associated with the relatively low cost (approximately U.S. $100,000) of installing the ground earth station (receive-only) needed by the ACC for data acquisition.

Most adjacent States, being within the same satellite beam footprint, could benefit mutually by sharing radar data while increasing quality and availability through

The Hispasat System

The Spanish multimission communications satellite system consists of two satellites (Hispasat 1A, Hispasat 1B), and a controlling earth station.

The satellites, weighing 2,150 kilograms each, have been launched using two Ariane 4 rockets and are currently located in a geostationary orbit at a height of 35,860 kilometres directly above the equator, between 30 and 31 degrees west.

Each satellite has three different payloads including the fixed service (FSS), which is the one used for radar data transmission. The FSS offers 16 operational transponders (eight per satellite) with different bandwidths. Eight of the transponders function at 36 megahertz (MHz), two at 46 MHz, two at 54 MHz and four at 72 MHz. The effective isotropic radiated power (EIRP) is better than 50 decibels above one watt (dBw) over the national territory and some parts of Europe.

In order to meet the requirements of the fixed service, Hispasat has installed 12 channels and 12 high-power amplifiers in each satellite. This provides for a maximum of eight active channels and four backup channels.

The fixed service payload of each satellite consists of a reflector antenna subsystem (1.2 metres in diameter) fed by one waveguide horn and capable of producing two spot beams, one to illuminate the Iberian Peninsula and the other to illuminate the Canary Islands.