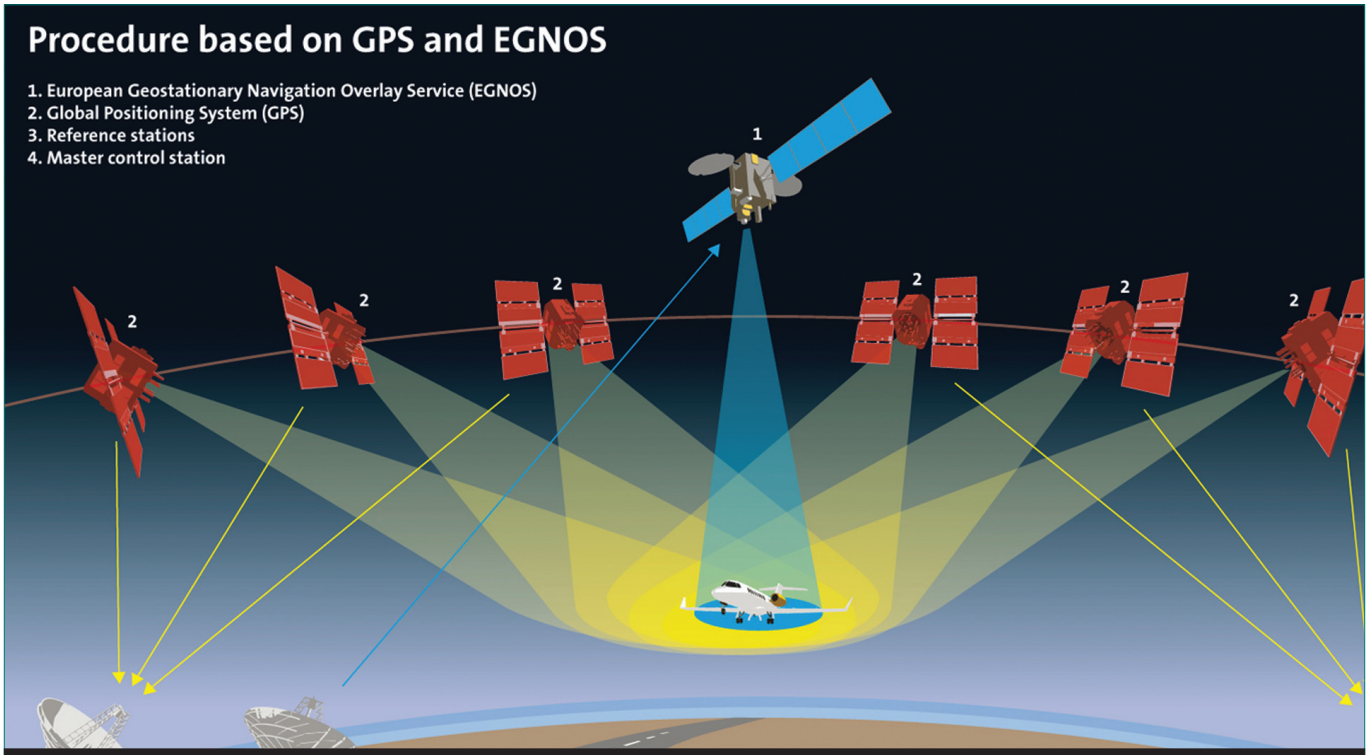

EGNOS payload, to be hosted on the EUTELSAT 5 West B satellite. Photo courtesy of European Global Navigation Satellite Systems Agency (GSA)

Developments in hosted payloads

Hosted payloads are an attractive way of gaining access to space at reduced cost, and within a reduced timeframe. The benefits are many, but several government agencies are hesitant in their use due to security concerns. The overall hosted payload market is a growing one however; here, we take a look at notable recent developments.

Launching satellites is an expensive business. From design, manufacturing, insurance, launch and operation, the costs can run into the hundreds of millions, depending on the parameters. And that's if everything goes smoothly – the years of planning and design can be further lengthened by launch delays, which can be costly and extremely inconvenient.

Hosted payloads offer an extremely cost-effective solution, ideal for small start-ups or government agencies. The hosted payload model allows a communications module to be attached to a (usually) commercial satellite, which shares the satellite's power supply and transponders, but operates independently.

With a hosted payload, entities gain access to in-orbit capabilities without having to pay the entire cost of building and launching a satellite. Other benefits of the hosted payload model include reduced time to orbit.

So, what can you achieve with a hosted payload? The same as many other satellites – Space Situational Awareness (SAA), data collection, Earth observation, communications, R&D, etc. The possibilities are endless, making the hosted payload model highly attractive for many. With budgets constrained in many government agencies right now, hosted payloads are expected to grow in the coming years, however, some defence sectors are still uneasy over their use, given that they don't control the entire satellite.

Eutelsat to host next-generation EGNOS payload

While some government agencies remain uncertain over the security of hosted payloads, particularly when it comes to military applications, there are fewer concerns for key non-defence projects.

In March 2017, the European Global Navigation Satellite Systems Agency (GSA) selected Eutelsat Communications to develop, integrate and operate its next-generation EGNOS payload, to be hosted on the EUTELSAT 5 West B satellite, that is due for launch end of this year. The new payload marks a replenishment of current EGNOS capacity and is expected to start service in 2019 for a duration of 15 years. Airbus Defence and Space is building the satellite's commercial Ku-band payload and the EGNOS payload, while the platform is being manufactured by Orbital ATK.

EGNOS is a European Geostationary Navigation Overlay Service that acts as an augmentation service to Global Positioning Systems (GPS) to improve the accuracy and reliability of positioning information. EGNOS also provides a crucial integrity message regarding the continuity and availability of a signal which is essential in aviation where GNSS alone does not satisfy operational requirements set by the International Civil Aviation Organisation (ICAO) for use in critical flight stages, such as final approaches. With the addition of EGNOS, which has been certified for civil aviation since 2011, systems such as GPS and Galileo can satisfy ICAO standards.

The EGNOS GEO-3 payload on EUTELSAT 5 West B will comprise two L-band transponders that will act as an augmentation, or overlay, to GNSS messages. Data from GNSS measurements received by an interconnected ground network of positioning stations across Europe will be transferred to a central computing centre, where differential corrections and integrity messages will be calculated and then broadcast by EUTELSAT 5 West B to users. The new payload will be the first step towards the deployment of the EGNOS next generation, EGNOS V3. This new generation of EGNOS will augment both Galileo and GPS, and is planned to be qualified by 2022. EGNOS V3 will provide a higher level of performance and robustness than the current EGNOS legacy services, as required by the growing use and reliance on such services.

United Launch Alliance launches SBIRS GEO-4 early warning satellite

SSL to demonstrate hosted payload security for US Air Force

The role of hosted payloads has been on the rise in recent years as demand for space-based communications increases faster than actual capabilities. However, as previously highlighted, hosted payloads have not been widely accepted by government agencies because they are uncertain about the levels of security available.

Innoflight, Inc., a veteran-owned business specializing in electronics systems for defence and aerospace, plans to alleviate those fears. In September 2017, SSL announced that it had been selected by Innoflight to provide a high-fidelity simulation environment for testing the security of hosted payloads on commercial satellites.

The capability, which is being developed for the US Air Force Space and Missile Systems Center (SMC) as part of its Secure IP Payload Accommodation Demonstration Project, will enable SMC to demonstrate cybersecure payload hosting scenarios, concepts of operation, and cybersecurity controls. It will also demonstrate advanced, secure Internet protocol connections between a government payload operations centre and the hosted payload using the existing satellite operator's networking infrastructure, eliminating the high cost of specialised space-based communication systems.

"SSL has significant experience integrating hosted payloads into our leading commercial spacecraft platform, the SSL 1300," said Richard White, President of SSL Government Systems. "Our commercial experience positions us well to provide the precise test environment that Innoflight requires to demonstrate how its secure interface solution will ensure cybersecurity for US government missions. This work will become an integral part of SSL's secure interface for hosted payloads and will make the benefits of the hosted payload model more readily accessible to both government and commercial customers."

The hosted payload interface is expected to play a key role in enabling resilient, next-generation space architectures. "A key factor in our selection of SSL to work with us in support of SMC was the company's leadership in commercial satellite design," said Jeffrey Janicik, President of Innoflight. "Our test environment will benefit from SSL's global reach and high-level experience with hosted payloads and secure communications."

SES-15 begins operations for WAAS hosted payload

Despite longstanding uncertainty surrounding the hosted payload model, the US Federal Aviation Administration (FAA) has placed its faith in hosting some of its payloads onboard commercial satellites for the last two decades, making significant cost and time savings.

January 2018 saw SES-15 begin operations at the 129 degrees West orbital position, providing services over North America, Mexico, Central America and the Caribbean. The all-electric satellite, which took six months to reach its orbital position and complete testing, carries a hybrid payload of Ku-band wide beams and Ku-band High Throughput Satellite (HTS) capabilities with connectivity to gateways in Ka-band.

In addition to providing key inflight connectivity and entertainment services, SES-15 also carries a Wide Area Augmentation System (WAAS) hosted payload, which will enable the FAA to augment existing GPS with the goal of improving accuracy, integrity and availability of the system for the aviation industry.

The 14-year contract for the hosted payload was awarded by Raytheon Integrated Defense Systems, and includes 11 years of on-orbit operations with options to extend on an annual basis. At the time of the contract award, President and CEO of SES Government Services, Pete Hoene, stated: "We are honoured to have been chosen by Raytheon and the FAA to host this payload on our satellite. This is a great example of how the commercial satellite industry can provide the US Government timely and affordable access to space."

The FAA's WAAS is a highly-accurate navigation system developed from 1994 for civil aviation. It provides horizontal and vertical navigation for approach operations for all users at all locations. It covers almost all the National Airspace System (NAS), providing augmentation information to GPS receivers to enhance the accuracy and reliability of position estimates. Signals from GPS satellites are received across the NAS at widely-spaced Wide Area Reference Stations (WRS) and forwarded to the WAAS Master Station (WMS) via a terrestrial communications network. There, the WAAS augmentation

SES 15 launch. Photo courtesy of Arianespace

messages are generated; these contain information that allow GPS receivers to remove signal errors, vastly increasing accuracy and reliability. The messages are sent form the WMS to uplink stations, where they are transmitted to navigation payloads on satellites.

Those satellites broadcast the messages on a GPS-like signal, and the GPS/WAAS receiver processes the message as part of estimating position. WAAS also provides indications to GPS/WAAS receivers of where the GPS system is unusable due to system errors or other effects. It's an essential system in today's world.

NASA sees GOLD hosted payload launch

In the same month as the SES-15 satellite with its FAA hosted payload coming online, January 2018 saw the successful launch of SES-14, which will provide coverage of the Americas, Atlantic Ocean, Western Europe and Northwest Africa with HTS services, and Ku and C-band wide beam services. NASA's Global-Scale Observations of the Limb and Disk (GOLD) hosted payload also has a place onboard SES-14.

"Using a host satellite makes access to space quicker and more cost efficient, while meeting the increasingly more sophisticated needs governments have nowadays. SES has extensive experience in hosted payload projects and is well-suited to meet these needs," said Pete Hoene, President and CEO of SES Government Solutions. "We are very excited about hosting GOLD and looking forward to it starting its important mission in space."

NASA's GOLD hosted payload features an ultraviolet imaging spectrograph to measure densities and temperatures in the Earth's thermosphere and ionosphere in response to Sun-Earth interaction. It aims to revolutionise scientists' understanding of this part of the space environment and its impacts on low Earth orbit (LEO) satellite drag, and ionospheric disruptions of communication and navigation transmissions. GOLD will take unprecedented images of the temperature and composition changes over a hemisphere.

GOLD is a result of collaboration among several world-leading entities. NASA's Goddard Space Flight Center is providing overall NASA program management, while the University of Central Florida's Florida Space Institute is the Principal Investigator for the project. The GOLD instrument was built and will be operated by the University of Colorado Boulder Laboratory for Atmospheric and Space Physics. SES and its fully-owned subsidiary SES Government Solutions, meanwhile, are providing the host satellite, mission operations, and science data transport.

Detecting missile launches with hosted payloads

With global tensions on the rise, early warning systems of impending attacks have become more important than ever. Accuracy is key, as we've learned from the recent false ballistic missile alert issued by the Emergency Alert System in Hawaii, which caused large-scale panic and chaos. Accordingly, satellite systems have long been utilised to provide timely, accurate data, and there's definitely a place for hosted payloads within these systems.

In January 2018, United Launch Alliance's Atlas V rocket took flight, transporting the SBIRS GEO-4, an early warning missile satellite, into orbit. SBIRS GEO-4 is the fourth geostationary satellite in the Space Based Infrared System (SBIRS), a constellation of satellites that use infrared sensors to detect and track missile launches. The SBIRS GEO-4 satellite carries two infrared sensors: A scanning sensor which watches the full disc of the Earth for infrared events, and a 'staring' sensor to detect smaller short-range missiles which do not produce as much infrared radiation.

In addition to its geostationary satellites, SBIRS also uses four hosted payload sensors mounted onboard satellites in highly elliptical orbit (HEO), including the National Reconnaissance Office's Trumpet-class signals intelligence satellites. These SBIRS-HEO sensors provide additional observations of Earth's polar regions, which are less visible from geostationary orbit.

SBIRS is designed to provide the USA with advance warning of an enemy nuclear strike, while also allowing the country to monitor other missile and rocket launches around the world. As well as detecting missile launches, SBIRS is also used for intelligence-gathering, helping to identify and characterise events that result in the emission of infrared radiation and to improve general battlefield awareness. Two further geostationary satellites, GEO-5 and GEO-6, were ordered in 2012 for launch in the next decade. **GMC**

Photo courtesy of Thales

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