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Global navigation satellite systems. Current trends and future prospects

INTERVIEW
Rodrigo da Costa
EUSPA Executive Director

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Letter from the president

This summer two US firms made their maiden flights to take their founders up to heights of over 80 km. These first commercial space tourist flights are only one facet of "NewSpace": an increasing number of firms are now developing and merging new technologies to harness commercial opportunities of space. Some, like PLD in Spain, are working on cheaper launchers, others, like OneWeb, on the deployment of large constellations of satellites, and others again on increasingly farsighted applications like asteroid mining. These initiatives are not without problems that need to be solved. If air traffic's contribution to air pollution is an issue, suborbital flights just for fun definitely are. Launches of large satellite constellations are slotting an unprecedented number of objects into orbit; these not only hamper astronomical observations but also very much raise the collision risk for existing satellites. And space mining, still embryonic as yet, has already sparked off a legal debate about the need to update international space agreements.

On the other hand, these initiatives inspire entrepreneurs and engineers to mastermind trailblazing space-based services with a huge multiplier effect, to judge by the widespread and varied take-up of today's institutional satellite services. Galileo, for instance, up and running since 2016, is now providing more accurate positioning services than GPS to about 1.5 billion cell phones. Other applications include precision farming, more efficient air traffic management, self-driving cars or timing services for all types of transactions. Galileo now comprises 24 operational satellites controlled since August by the latest, GMV-developed version of the GCS. There is no doubt that NewSpace opens up fascinating opportunities, especially for firms with GMV's wealth of tried-and-tested experience and expertise.

Mónica Martínez

No. 79

CONTENTS

40

12

17

31

6

34

37

44

49

56

Global navigation satelllite systems. Current trends and future prospects

With nearly 6.5 billion receivers around the world and a global market of devices, applications and services worth about 150 billion euros according to the latest study by the European Union Agency for the Space Programme (EUSPA), Global Navigation Satellite Systems (GNSS) probably represent the best success story of spinoff space technology transfers to other areas of society.

The birth of GNSS dates back to 1973, when GPS kicked off in the United States, picking up the baton from the forerunner NNSS (TRANSIT). In 1978 the first satellite was launched, building up to a complete constellation of 24 satellites and coming into operational service in 1993. Conceived as a strategic defense system, its development began under the no-nonsense slogan "drop five bombs in the same hole"; civil use

was then authorized in 1980. Unlike TRANSIT, which allowed positions to be calculated only a few times a day, GPS provided a constant and instantaneous positioning service. At that time it was hard to imagine the impact this system was to have on the daily life of billions of people only 40 years later. The original defense applications have by now become a footnote to today's vast market of civil solutions and services.

EUROPE'S GNSS: EGNOS AND GALILEO

Although Europe initially lagged behind the rate of development in other world powers like the US and the Russian Federation, in the mid-90s the European Union decided to build its own satnav capacity with the launch of its two own programs: EGNOS and Galileo.

EGNOS, standing for European Geostationary Navigation Overlay Service, was Europe's first bid. EGNOS is a regional system with EU coverage, developed according to international standards that ensure EGNOS receivers are compatible and interoperable with signals transmitted by similar systems (called SBAS) currently deployed around the world (WAAS in the US, MSAS in Japan, GAGAN in India). Although initially geared towards monitoring the security of GPS use in civil aviation, the range of EGNOS service applications has steadily broadened to take in other means of transport and fields of application. EGNOS offers users several service levels. The first, called "Open Service", takes in applications that pose no risk to life, such as personal satnavs, merchandise tracking or precision farming; it came on stream in October 2009. After an arduous certification and validation process a second service called "Safety-of-Life" was officially declared to be operational and fit for use by Europe's civil aviation in March 2011. Since then thousands of aircraft plying Europe's airspace take off and land daily using EGNOS as the main navigation system.

Galileo, launched in the late nineties, responded to the European Union's desire to have its own positioning system and not only a monitoring and GPS-enhancement system like EGNOS, thereby curtailing Europe's heavy and growing dependence on GPS satellite constellations (United States) and GLONASS (Russian Federation). Unlike the approach of other systems, heavily focused on defense applications, Galileo was born with an innovation-driven ambition to meet the growing needs of a flourishing range of applications and services. The development and orbit-validation stage was completed in

2012 with the first 4 satellites; in 2016 initial services were officially declared to be up and away with a total of 18 satellites in orbit. Since then the number of satellites has continued to grow until topping twenty. Galileo is now in definition phase of what will be its second generation.

The Galileo launch was not free of controversy; many questioned the real need for a third GNSS as well as GPS and GLONASS. Despite these early qualms, the number of GNSSs has never stopped growing in the last two decades. From an initial scenario clearly dominated by GPS, we have now moved on to a coexistence of 6 completely independent GNSSs operating both on a global scale (4 systems: GPS, GLONASS, Galileo, Beidou) and regional scale (2 systems: IRNSS in India, QZSS in Japan), to which may be added in coming years further systems now in definition phase. Although the different systems are designed to be completely compatible and interoperable, so that users are always aware of which position-calculating constellations they might be simultaneously using, for reasons of national sovereignty, strategy and security, all the systems have not been aligned around a global solution integrating the various systems in a coordinated and optimum fashion. This integration would help to trim development- and running-costs while significantly improving the performance.

PRIVATE SATELLITE-NAVIGATION INITIATIVES

Although existing GNSSs are the result of public investment by a host of governments, GNSS technology has nonetheless begun to attract the interest of diverse private operators too. Certain low-earth orbit (LEO) communication satellite operators are now mooting the possibility of transmitting positioning signals with special characteristics to fill gaps left by today's GNSSs in timing and positioning markets. Furthermore, regional satellite-based augmentation systems (SBAS) currently run by governments might soon be topped up with systems rolled out by private operators, offering a service to countries not covered by these systems, as is generally the case in the southern hemisphere. Cost-benefit studies suggest private initiative might be the only economically feasible way of rolling out a proprietary system. Conversely, a private operator might deploy a single system to service many countries in a coordinated way, optimizing operations and the use of space and ground infrastructure. The SouthPAN program promoted by Australia and New Zealand represents a first step in this direction. In 2019 the Australian government launched a public tender for procurement of a regional augmentation service capable of providing not only SBAS services themselves but also a precise positioning service. GMV is participating in this tendering process as a first-level partner in the industrial consortium led by Lockheed Martin. This initiative could prove to be the embryo of a "Global SBAS" capable of offering these same services to other parts of the world.

Although the birth of this technology dates right back to the seventies of last century, satellite positioning technology has by no means reached the end of its tether, as a never-ending series of new applications come on line. Users declare a high level of satisfaction with GNSS services, but these services nonetheless continue evolving to meet new needs as they crop up.

MAIN ROOM FOR GNSS IMPROVEMENT

■ **Security and resilience:** Today's GNSS satellite signals are extremely weak; this feebleness makes them especially prone to both deliberate and inadvertent interference. Furthermore, open signals accessible to all users normally lack any authentication mechanisms; this makes it pretty easy to generate fraudulent replicas in order to deceive applications that use GNSS to date financial transactions or give a fraudulent user position to escape toll fees, for instance. Galileo in particular is soon to provide a signal authentication service (called OSNMA), giving it a competitive edge over other GNSSs.

■ **High accuracy:** As some pundits point out, accuracy has now become a holy grail for users. GNSS precision has steadily improved over the years. GPS offered a precision of about 100 meters to civil users in the mid-nineties, which could be trimmed down to about one meter with the aid of local differential stations. Nowadays, state-of-the-art positioning algorithms can achieve centimetric accuracy by processing multiple readings in various frequencies from several GNSSs, further honed with Precise Point Positioning (PPP) readings received in real time. Precise correction services have habitually been provided by the private sector, GMV featuring among the many providers of this type of service. Galileo, however, has now declared its intention of providing an open high-accuracy service (HAS), currently in development phase. Current trends point to a combination of high accuracy services with integrity services, allowing GNSS use in "Safety-of-Life" applications, such as the satnav systems of autonomous vehicles.

■ **Integration with other non-satellite positioning technology:** Integration of GNSS with other positioning technologies is crucial in many applications. The advent of new sensors and enhanced performance of existing ones mean this integration is becoming increasingly affordable and attractive. GNSS provides absolute timing and positioning readings that are complementary to the relative positioning readings given by other sensors like cameras or LIDAR. Inertial sensors, falling in cost as they improve in performance, are also essential for ensuring positioning continuity in GNSS blind spots such as tunnels, high buildings. 5G communication technology not only provides a broadband communications channel for transmitting precise corrections to boost the accuracy of satellite positioning but also a complementary positioning source in built-up environments where GNSS struggles. The autonomous car is a good example of the integration of different sensors like GNSS, cameras, laser, 5G, odometers and inertial sensors.

■ **Integration with other satellite technology:** The mega-constellations of communications satellites run by companies like SpaceX, OneWeb and Amazon also offer good opportunities of GNSS improvement, especially in view of the planned launch of thousands of LEO and MEO satellites to provide worldwide broadband. As already pointed out, some operators are planning to broadcast positioning signals with special characteristics (greater power, authentication or encryption) from these satellites. This would make it easier to integrate a broadband communication channel at application level for receiving precise corrections and reporting the position of devices and additional information in IoT applications.

GMV IN SATELLITE NAVIGATION

I could hardly wind up this article without mentioning GMV's starring GNSS role. GMV's first satellite-navigation work dates back to the early nineties,

centering on precise orbit determination and synchronization of GPS satellites' clocks, as well as developing receivers and diverse applications. The experience built up in these early years proved to be the deal clincher in winning a big participation in Europe's EGNOS and Galileo programs, not only in design activities but also development of key systems of the ground segment.

Over the years, as fruit of this enormous innovation effort, GMV has won itself a worldwide reputation in satellite navigation and the number-one position in a whole set of technological areas. As things stand today GMV is equipped to lead the development of a complete GNSS ground segment as well as developing receivers and solutions for final users in a wide range of markets, such as intelligent transportation, self-driving and defense. GMV provides specialized GNSS engineering services, develops diverse systems and apps and offers precise-positioning correction services to a varied range of private and public clients.

In 2018 the European Space Agency (ESA) awarded GMV the contract for maintenance and upgrading of the Galileo Ground Control Segment (GCS), its biggest contract won to date (250 million euros). This contract represents a watershed moment in GMV's history, making it a worldwide leading light in GNSS development.

GMV is now busily working on the development of new EGNOS and Galileo services, such as the OSNMA authentication service or the aforementioned high accuracy service, HAS. GMV is playing a key role in the development and operation of diverse GNSS service centers, such as the European GNSS Service Center (GSC, Spain), the Galileo Reference Centre (GRC, the Netherlands), the operations center of the Galileo Search and Rescue Return Link Service Provider (SAR-RLSP, France), the Galileo Scientific Support Center (GSSC, Spain) and the Galileo security monitoring centers (GSMCs, France and Spain).

GMV is making a big contribution to definition not only of future EGNOS upgrades but also the second generation of Galileo; it is one of the main contractors working for ESA on the design of the second generation ground segment. GMV is also leading diverse contracts for the development of key technological components for the development of this second generation, such as receivers, signal simulators and navigation processing algorithms.

Finally, when we turn to GNSS solutions for the defense market we find that GMV is one of the few European firms capable of developing receivers that operate with Galileo's Public Regulated Service (PRS) services, making GMV the go-to supplier of this type of service for Spain's defense programs.

EUSPA
European Union Agency for the Space Programme

Rodrigo
da Costa

EUSPA Executive Director

On 16 October 2020, Rodrigo da Costa took up his duties as Executive Director of the European Union Agency for the Space Programme (EUSPA), formerly the European GNSS Agency (GSA). Prior to this, he was the Galileo Services Programme Manager from March 2017.

Before joining the GSA, Rodrigo da Costa held several senior project management, business development, and institutional key account management positions in the space industry, in the areas of human space flight, exploration, launchers and R&D.

Rodrigo da Costa holds a degree in Aerospace Engineering from the "Instituto Superior Técnico" in Lisbon, a Master's degree in Aerospace Engineering from the University of Delft, and an MBA from the EuroMBA consortium of Business Schools.

In May 2021 the European GNSS Agency officially switched to EUSPA. This kicked off a new era for EU's Space Programme. What are the key features of this new stage?
First of all, a unified European Union Space programme means a streamlined approach towards the development and utilisation of all EU space assets. This integrated approach ensures that each of the components, such as Galileo, EGNOS, and Copernicus, will continue providing safe, performant and secure services. It also guarantees their evolution within the current financial perspective, addressing user needs that are continuously evolving.

The EU Space Programme is bringing also opportunities to further promote space entrepreneurship, support the new space economy, and thus contribute to the sustainable growth of the European Union. It is estimated that until today, more than 250,000 jobs have been created in the European space industry, mainly in downstream applications. The number could rise to 400,000 by 2025. The space sector contributes EUR 46-54 billion to the EU economy and is expected to grow globally to EUR 1 trillion by 2040.

Lastly, it is at the heart of EUSPA's new mission to forge synergies between the space programme components, Galileo, EGNOS, Copernicus and the forthcoming GOVSATCOM. Pairing Earth Observation input with GNSS create new innovative services ranging from atmosphere monitoring via drones to asset management solutions such as inspection of photovoltaic panels. EUSPA is supporting those who seek to leverage the power of these synergies.

There's no doubt that you played a key role in the switch from GSA to EUSPA. What exactly are your responsibilities as executive director?
One of my priorities is of course to ensure that the transition from GSA to EUSPA is smooth, and seamless with respect to the users. This has to be done on many levels. In achieving this priority, one of the key elements was to effectively communicate the scope change to the driving force of EUSPA that is its staff, and to our main stakeholders, be it institutional, industry players and the EU space community at large.

As usual, our Agency priority is to ensure the continuity of the operations and the safety of the space programme – not only during this institutional change but permanently. And I must say that the roll out of EUSPA was smooth. Neither during this important change nor the COVID outbreak were any of the functions of the agency undermined.

Now that EUSPA is a fully-fledged agency, my mission is to make EUSPA the go-to, user-oriented EU Agency that provides state-of-the-art, safe, uninterrupted satellite-based services. EUSPA will become a point of reference in terms of innovation using space assets and technologies, and a hub for entrepreneurship.

My objective is to be working together with our current and future users and the entire EU Space community to turn EU investment in space into concrete services and applications that improve the lives of Europeans.

How will EUSPA and ESA interact from now on in the EU's Space Programme?
Effective cooperation between the European Union Agency for the Space Programme (EUSPA), the European Commission and the European Space Agency is important to achieve a successful EU Space Programme. Each of the partners has unique and complementary functions and competencies.

The European Commission, as project manager, steers the wheel towards

pressing societal, economic or environmental challenges where EU Space makes a difference.

EUSPA, as the EU user-oriented operational agency, makes sure that these challenges are addressed through the design, development, and delivery of new space-based services that meet the needs of the users and ensures their security and market uptake.

ESA focuses on the research and development activities that are fundamental to prepare the roll-out of new satellite technology and architecture of the systems that provide the services.

Eventually, we are all pieces of the same puzzle with distinctive roles and responsibilities. EC´s, EUSPA´s and ESA's commitment to working together is strong. The capstone of the Financial Framework Partnership Agreement (FFPA) was concluded in June 2021, and as a result, a Joint Office is being set up in Brussels in order to streamline operations and remove administrative barriers.

What new remits and responsibilities does EUSPA have in the management and running of EU's Space Programme?
We define and deliver safe and secure space-based navigation services that contribute to the strategic autonomy of the Union and meet the needs of users to develop their activities. Our first imperative is to make sure that EU Space services are delivered on time and with the needed high level of performance. This includes the 24/7 secure operations of our two highly complex navigation systems: EGNOS and Galileo.

Equally important is ensuring the protection of the EU Space assets. The

> Space will play an increasingly important role in the European economy and the lives of European citizens, driving innovation and generating jobs and services

role of the EUSPA Security Accreditation Board, now enlarged beyond Galileo and EGNOS to include all elements of the EU Space Programme, is fundamental to this. But also, EUSPA's team of engineers and security professionals are working to ensure operational security of Galileo and EGNOS, and the 24/7 operations our 2 Galileo Security Monitoring Centres in France and Spain.

We stimulate the market uptake of EU Space-based services by offering incentives and know-how to established companies, SMEs, start-ups and innovators so they make use of the services and data provided by EU Space Programme components Galileo, EGNOS, and Copernicus. Concretely, the Agency supports the development of downstream and integrated applications based on Galileo, EGNOS and Copernicus, through various funding mechanisms, the R&D European Union scheme, Horizon Europe and other innovation competitions and Prizes. For example, we launched at the beginning of the month a competition called "#myEUSpace", part of the Cassini initiative. With a prize pool of € 1 million and over 50 awards up for grabs, it targets entrepreneurs ready to explore, develop and commercialise innovative solutions that leverage EU Space data and services. We want to help SMEs, start-ups innovators to develop and market disruptive, space-based commercial solutions able to respond to emerging societal needs and serve various domains such as smart mobility and agriculture, health and leisure, and logistics and smart cities, among others including for the first time, quantum technologies.

Ultimately, our objective is to ensure that EU companies gain market share in the downstream global market for satellite navigation, earth observation, and telecommunications – but most notably, that they create value by developing integrated applications that best respond to the user needs.

Which do you see as the main challenges over the coming years

for EU's Space Programme in general and satellite navigation programs in particular?
As we look to the future, space will play an increasingly important role in the European economy and the lives of European citizens, driving innovation and generating jobs and services. It is EUSPA's mission to make this happen.

Our main challenge is not only to continue delivering safe and secure satellite-based but also to achieve the Full Operational Capability of Galileo, and to develop new services. For example, today the GNSS industry is faced with spoofing/jamming. Security and safety of the services are crucial. GNSS constellations can be prone to such threats but Galileo services.

The Galileo OSNMA forthcoming service could be of great use to tackling such a threat. That is why we are currently testing it to make sure that it is performant. The Galileo OSNMA is an authentication mechanism that allows GNSS receivers to verify the authenticity of GNSS information, making sure that the data they receive is indeed coming from Galileo and have not been modified in any way.

The European share accounts for 27% of these total worldwide industry revenues. One of our main goals in EUSPA is to support the increase of this market share for European companies to 30%.

Europe's satellite navigation potential has been substantially boosted in recent years. How do you see the future of this area? Which sectors or fields are likely to benefit most from satellite navigation?
With four Global Navigation Satellite Systems (GNSS) available and more than 100 satellites in operation broadcasting multiple frequencies, the GNSS industry is witnessing a shift towards the wide adoption of multifrequency receivers across various market segments to meet the user needs of emerging applications.

Satellite navigation has indeed made significant progress not only with Galileo but also with EGNOS. The next version of EGNOS will become operational in the coming years to augment Galileo, in addition to GPS. This will bring further opportunities for new services with new levels of accuracy especially.

Moreover, in November 2020 the International Civil Aviation Organization (ICAO) approved new Standards and Recommended Practices (SARPs) paving the way for the development of new Dual Frequency Multi-Constellation Satellite Based Augmentation Systems (DFMC SBAS).

In the future, the Galileo High Accuracy Service will open up new opportunities in markets ranging from mass-market applications (smartphones, augmented reality, IoT)

to professional markets (precision farming, aviation, maritime, T&S) to Safety of Life services such as SAR.

Which technological challenges do you expect the EU's space programme to take on in the coming years?

In Europe, we have already two world-leading programmes, Galileo and Copernicus.

But, the European Union is already preparing the future.

The landscape of the space industry is being reshaped as we are entering a new era in the field of satellite communications. The use of new frequency bands, optical communications and quantum technology allows for the development of new innovative products and software. The EU is ready to harness this momentum

of digitisation and make Europe fit for the digital age under its new European Connectivity Initiative. This new initiative aims to put an end to dead zones, giving high broadband speed to everyone in Europe and some areas of Africa through a resilient & ultra-secure space and ground based system. The European Commission is working on the development of a connectivity infrastructure that could incorporate technological innovations such as quantum encryption. This is a key project to ensure the resilience of terrestrial networks and to avoid Europe's future dependence on non-European systems.

Space Situational Awareness and debris are two other pressing issues. There are many pieces up there threatening our infrastructure. Let me remind you of the recent collision avoidance manoeuvre performed by

a Galileo satellite. The manoeuvre was successfully performed and the satellite returned to service. The European Commission is working on the development of a space traffic management system to track debris and ensure autonomous access to space. This will involve ensuring the economic and technological sustainability of European launchers. I know that Commissioner Breton and the European Commission together with the Member States and the European Parliament are already preparing for the future.

Is Europe's industry ready for the new space-programme challenges likely to arise in areas like satellite navigation, telecommunications, earth observation or space-debris?
It certainly is. Europe has the technical know-how, the capacity and the resources not only to confront upcoming challenges but to go one step ahead of its time. What is needed is a coordinated approach. We

see that the technical know-how is spread unevenly across the union, and in many cases, accumulated in the so-called ''space powers''. In the field of satellite communications, for example, we observe a big fragmentation of satellite communications providers. This can result in high costs and service unavailability at times. EUSPA is changing that through GOVSATCOM and more specifically Horizon 2020 project, called ENTRUSTED. The aim of ENTRUSTED is to collect the needs of various EU governmental users in terms of satcoms to have a more unified approach when rolling out the system.

Lately, however, we see more and more non "traditionally space" countries interested in space technology. This was the case in many of our innovation competitions.

As Commissioner Breton has said, the EU Space sector in Europe needs

> The landscape of the space industry is being reshaped as we are entering a new era in the field of satellite communications

strong institutional leadership to exploit its full potential, a view that I fully share. With the EU Space programme under one roof with a budget bigger than ever, we have the means to make Europe a strong leader. EUSPA has a demonstrated record of forging partnerships with Europe's space industry and it will continue to rely on the expertise of EU companies to address future challenges and boost innovation.

SUGUS Passes Flight Test Phase

The scheduled project tests, aiming to quicken GNSS and Galileo takeup by unmanned aerial vehicles (UAVs), have now been completed

O n July 6 and 7, the ATLAS (Air Traffic Laboratory for Advanced unmanned Systems) Experimental Test Flight Center received three flight plans corresponding to the concept test as part of the SUGUS project.

Initiated in 2019, SUGUS (Solution for E-GNSS U-Space Service) is a project financed by the EU R&D+i program aimed at accelerating the use of GNSS and Galileo in the unmanned aerial vehicle (UAV) segment. Developed by a consortium led by GMV and EVERIS, the project contributes to the development of services oriented towards effective airspace integration for drones in the Open and Specific flight categories.

The project includes running a series of test flights in complex environments to demonstrate the added value of the service proposed by SUGUS in drone operations. The purpose is to raise awareness and contribute to standardizing and regulating it, to maximize the possibilities of the proposed services being implemented as a U-Space service. To do that, an initial review was conducted on the results of the previous E-GNSS projects, identifying the needs of drone operators and unmanned traffic service providers in complex operations and urban spaces. This analysis has contributed to defining and implementing a new API (Application Programming Interface) developed by GMV to provide drone users with a GNSS performance prediction and monitoring service.

The three flights conducted served to demonstrate the added value provided both by the European Galileo and EGNOS (E-GNSS) navigation systems and by the API. The flights were designed to emulate three operations that could benefit from the EGNSS-based services proposed in the project: building inspection, healthcare product delivery and precision agriculture.

The tests were a complete success and will be used to present to the unmanned aviation community the benefits of a performance prediction and monitoring system in the flight planning and development phases. It will also be used to demonstrate that the API developed by GMV as part of this project enables the integration and implementation of this type of system, facilitating the preparation and operation of unmanned flights, while increasing their safety and efficiency.

# GMV presents its UAS experience and developments at UNVEX

■ GMV exhibited its wares at the 2021 UNVEX, the country's biggest UAS event, held for the 6th time this year at the *Museo Centro Gaiás de la Ciudad de la Cultura* in Santiago de Compostela (Spain) from 7 to 9 July.

Boasting a wealth of experience in unmanned aerial systems (UAS), GMV showcased its latest developments in intelligence, surveillance and reconnaissance (ISR) systems. Pride of place here goes to the two RPASs Seeker and Passer, designed and developed by GMV and Aurea Avionics with national technology and with no ITAR restrictions. Under the JISR heading (Joint Intelligence, Surveillance and Reconnaissance) GMV

also presented the latest versions of its CSD–SIERRA and IRIS systems, both designed for mining and distributing unmanned system data. CDS–SIERRA has been developed as part of the SAPIIEM system under NATO's MAJIIC (Multisensor Aerospace /Ground Joint ISR Interoperability Coalition) project. IRIS was born under the aegis of the RAPAZ program of the Directorate General of Armaments and Material (*Dirección General de Armamento y Material*: DGAM) of Spain's MoD.

Lastly, Ricardo Sáenz, director of GMV's Defense and Security Programs, participated in the terrestrial applications block of the UNVEX agenda. His paper dealt with GMV's

expertise in command and control (C2) systems for unmanned ground vehicles (UGV). Under this umbrella GMV is currently working on the iMUGS project (Integrated Modular Unmanned Ground System), brokered by the European Commission under EDIDP 2019–2020; its remit is to create a valid scalable architecture for manned or unmanned vehicles in the interests of standardizing European ground and air systems. GMV brought its experience to bear as coordinator of the C2 component and C4ISR interoperability. GMV is also developing this capacity in UGV C2 systems under the DGAM's new ESCORPION program for assessing UGV prototypes developed by Spanish industry.
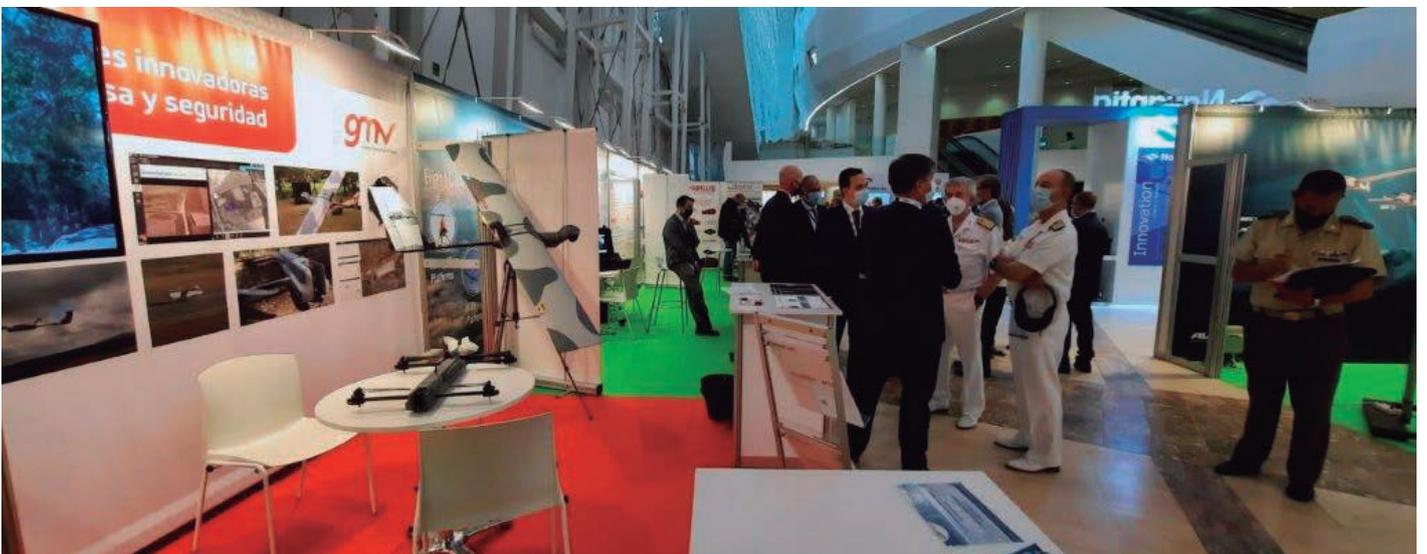
Galileo Ground Control Segment ready for Full Operational Capability

The new infrastructure of the Galileo Ground Control Segment (GCS), now fully deployed in Galileo's ground control centers, has been used for running the constellation since early August

I n early July the European Union Agency for the Space Programme (EUSPA) announced the upcoming upgrades of the Galileo GCS infrastructure in preparation for the next launch.

Today the new GCS V3.0 infrastructure has been completely deployed in the Galileo Ground Control Centres in Oberpfaffenhofen (Germany) and Fucino (Italy) and has been used to operate the Galileo Satellite Constellation since early August.

This is the result of years of hard work, since GMV was awarded the maintenance and upgrading of the Galileo GCS, until deploying the CCS V3.0 version, the most ambitious upgrade ever done on the Galileo Ground Segment.

During this period GMV, leading a large consortium of the top European Space companies, has been able to steer the whole technical challenge through the stormy waters of the COVID-19 pandemic that hase marked nearly half of this period, to pull off an unprecedented success.

The new GCS release includes upgradings to increase system capabilities, enhance virtualization and obsolescence resolution as well as operational improvements. It represents a major step forward towards the Galileo FOC (Full Operational Capability), boosting the management capacity to 38 satellites.

The new GCS not only offers state-of-the art-infrastructure and technology, but

it also features improved reliability and security, including the most advanced techniques. Nor does it stop there: the New Key Service is capable of supporting LEOP campaigns for the new coming Galileo Satellite Launches. Since 2011 all the Galileo LEOP campaigns have relied on external control centers (either ESOC or CNES) in coordination with the GCS, but, from now on, thanks to this new Galileo GCS V3.0, the LEOPs will be run directly from Galileo Ground Control Segment.

Special mention here must go to the hard work, guidance and support provided by the European Space Agency (ESA) as Galileo System Design Authority and Technical Manager of the GCS contract and particularly the European Union Agency for Space Programme, Contract Authority and ultimately responsible for Galileo Service Provision.

None of this work would have been possible without the ongoing day-to-day cooperation with the Galileo Operators (Space Opal), who have closely overviewed the improved infrastructure and its operational validation.

Particularly noteworthy too is the major effort that has been needed all around Europe to design, build and deploy this release, coordinated under a strict and harmonized quality standard masterminded by top experts.

The Full Operational Capability phase of the Galileo programme is managed and funded by the European Union.

The European Commission, ESA and EUSPA (the EU Agency for the Space Programme) have signed an agreement by which ESA acts as design authority and system development prime on behalf of the Commission and EUSPA as the exploitation and operation manager of Galileo/EGNOS.

The views expressed in this can in no way be taken to reflect the opinion of the European Union and/or ESA. "Galileo" is registered as a trademark in the database of European Union Intellectual Property Office (n° 002742237)
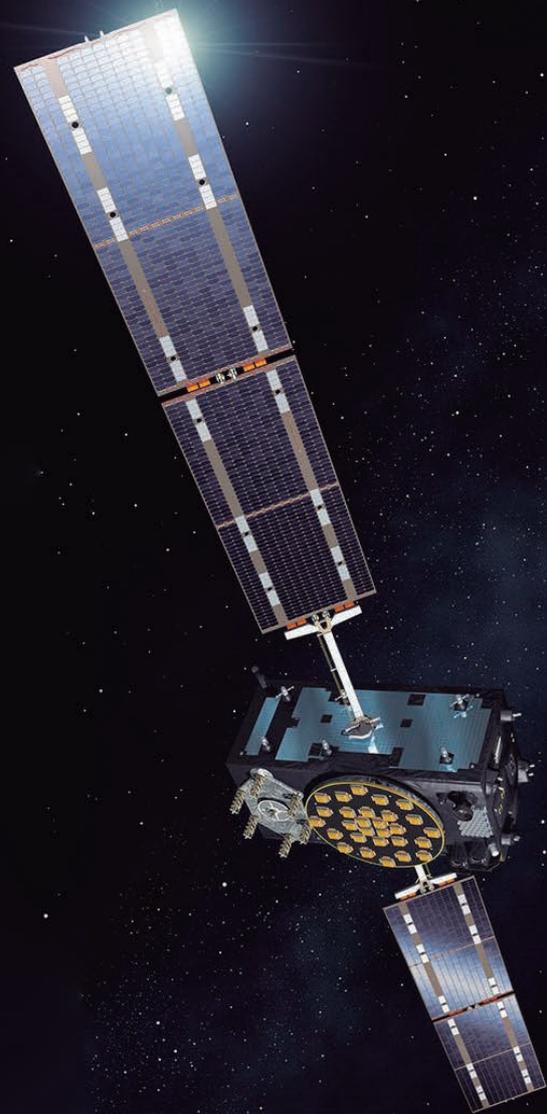
EUTELSAT QUANTUM successfully launched

■ On 30 July 2021, EUTELSAT QUANTUM satellite was successfully launched on an Ariane 5 launcher from the European Space Center in Kourou, French Guiana.

EUTELSAT QUANTUM was developed in association with the European Space Agency (ESA), Eutelsat and Airbus Defense and Space. It represents a new milestone in the evolution of commercial telecommunications satellites.

The EUTELSAT QUANTUM technology opens the way for fully reconfigurable geostationary satellites. With a software-based design, it enables complete onboard reconfiguration providing unprecedented flexibility for the needs of the clients in terms of coverage, frequency and power.

The EUTELSAT QUANTUM payload includes a ground-breaking multibeam active antena, called ELSA+ (Electronically Steerable Antenna+), developed by Airbus in Spain with the capability of electronic reconfiguration in orbit, including beam-hopping, and providing the operator with a maximum flexibility in the coverage zone.

GMV played an essential role in the development of the ground software for Eutelsat Quantum at all levels, not only in the area of the satellite control center and flight dynamics where GMV is Eutelsat's lead supplier for controlling the fleet through the Neo multisatellite control system based on **Hifly®** and the flight dynamics system **Focussuite®**, but also in the development of new flexible payload management tools for EUTELSAT QUANTUM satellite.

In payload management tools, GMV has developed new solutions in recent years that enable Eutelsat and its clients to define and implement dynamically new onboard reconfigurations optimized in coverage, power and frequency to fulfill clients' needs at any given moment.

These new tools, called CMRS (Communication Mission Reconfiguration Software) and GEOLOC (Geolocalization Software), integrating the engineering modules provided by the satellite manufacturer Airbus, include the latest-generation software technologies based on web architectures, both in the frameworks used and in deployments based on microservices and containerization, as well as the use of streamlining methodologies in the development process.

Successful launch of the Star One D2 satellite

■ At the end of July, the European rocket Ariane 5 was successfully launched, carrying on board not only the Eutelsat Quantum but also the Brazilian telecommunications satellite Star One D2. The liftoff took place from the European Space Center in Kourou, French Guiana.

Star One D2 is a high-capacity, multi-mission satellite developed by Maxar Technologies and operated by Embratel, the largest satellite operator in Brazil and Latin America. The D2 satellite is equipped with C-, Ku-, Ka-, and X-band payloads, to provide highspeed broadband, television broadcast, and telecommunications services across South America, Mexico, Central America, and areas of the Atlantic Ocean. It is designed to give service for 15 years and is based on the GEO communications and remote sensing platform, the SSL 1300 bus, which can support a broad range of applications and technology advances.

Once launched, to ensure that the satellite is operational for the established time, GMV has drawn on its proven experience in satellite control, developing the control centre of Star One D2 and updating with key technology the software of the fleet.

The new ground software includes GMV's inhouse products **Hifly®** for real-time command and telemetry processing system, the flight dynamics system based on **FocusSuite®**, for providing information of the system's status, **FleetDashboard**, and **CentralLog** for collecting events from the involved subsystems.

Star One D2, with 19.3 KW of power and weighing 7 tons, complements Embratel's fleet, which has five other satellites in geostationary orbit (Star One D1, C1, C2, C3, and C4).

AI for optimization of payload configuration of the new generation SATCOMs

■ Mid-April saw kickoff of the Horizon-2020, European Commission-funded ATRIA project (AI-Powered Ground Segment Control for Flexible Payloads), to be run by a GMV-coordinated consortium.

ATRIA responds to the sector's pressing need for automated configuration of flexible payloads, ahead of the new generations of satellites that will have hundreds or even thousands of configurable arrays. To do so ATRIA draws on a cutting-edge technology like artificial intelligence (AI). Models are trained up to permit not only optimization of the satellite's payload but also previous estimate of how it should be configured.

On 22 July the agreement was signed between the European Commission and GMV, as consortium coordinator, greenlighting this project's work plan. Due to run until March 2024, it will be carried out by a consortium of 7 partners with complementary skillsets from 4 European countries, including technological aerospace companies, research centers, telecommunications and satellite operators and satellite makers. Under GMV's coordination the rest of the consortium comprises the Centre Tecnològic de Telecomunicacions de Catalunya (Spain), AIKO (Italy), Eutelsat (France), Skylogic (Italy), OHB System (Germany) and the Fraunhofer Institute for Integrated Circuits IIS (Germany).

As well as leading the project as a whole, GMV will be responsible for the system-prototype work package, designed for AI-based payload configuration. GMV thereby expects to enrich its range of smart products dedicated to the management, control and reconfiguration of communication satellites' payloads.

AMOS 2021

September has once again been privy to the annual Advanced Maui Optical and Space Surveillance Conference (AMOS) on the island of Maui, the first annual conference on advanced optical and space surveillance technologies. As in previous years, GMV has formed part of the program of this twenty-second edition, held in hybrid format.

AMOS is one of the leading tech events in the area of SSA/SDA (Space Situational Awareness/Space Domain Awareness) that, year after year, welcomes a greater participation of the state, industry and academia, showing the growing interest in this area.

GMV presented two technical papers about its research work on advanced correlation and orbit estimation methods for the improvement of catalog development and maintenance tools. AMOS serves as a framework to exchange progress and developments achieved so far, as well as trends and perspectives for the future of sustainability in Space.

The first article is a study oriented towards the main cause of the increase in space debris, the fragmentation of RSO (Resident Space Objects). It addresses an innovative track-to-track association method based on optical observation to enable automatic object detection after fragmentation. The second paper showed a new methodology to improve the realism of the orbit uncertainty (covariance) in the orbit determination process, applied in GEO (geosynchronous orbit).

ALTIUS Flight Dynamics systems starts the implementation phase
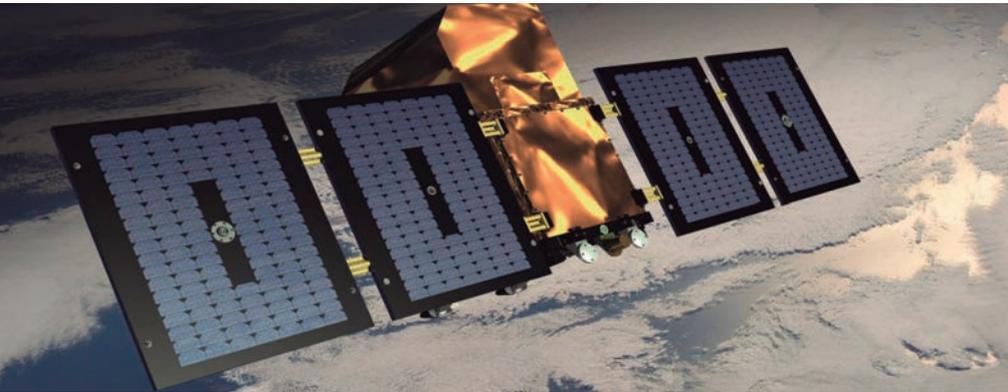
■ At the end of 2020, QinetiQ Space as prime contractor for the Altius´s Space Segment System Consolidation project awarded the provision of the Flight Dynamics System for the mission to GMV.

Currently the project has successfully completed the preliminary design phase and started the implementation while new documentation is being prepared by ESA and QinetiQ in order to complete the system's detailed design.

ALTIUS (Atmospheric Limb Tracker for Investigation of the Upcoming Stratosphere) is an ozone monitoring mission under the ESA's Earth Watch programme. ALTIUS is a micro satellite dedicated to the operational monitoring of stratospheric ozone profiles. It will detect the composition of the atmosphere and changes in the stratospheric ozone layer. The instrument that will be used differs from others used in similar missions, such as Sentinel 5P, that permits measuring the quantity of ozone below the spacecraft, without accounting for its distribution in different layers. In addition to greenhouse gases, the satellite will measure other traces of atmospheric gases such as aerosols that detrimentally affect air quality on Earth.

From the FDS point of view this mission has simple requirements well supported by *FocusSuite* (GMV's COTS for Flight Dynamics solutions): Sun-synchronous orbit with loose height requirements and a maximum local time drift of half an hour during the overall mission duration (currently five years are expected). Being a low Earth orbit mission, this introduces an interesting requirement to manage long-term predictions of the solar activity (the main cause of the atmospheric density variation that directly impacts the drag perturbation and, hence, the altitude decay of the orbit and its local time drift).

The ALTIUS FDS project, developed from GMV's Romanian headquarters at Bucharest, will become the first complete and operational Flight Dynamics system to be performed by the team of GMV in Romania.

GMV looks into new uses for Spain's S3T radar data

■ In collaboration with the Industrial Technology Research Center (*Centro para el Desarrollo Tecnológico Industrial*: CDTI) and the European Space Agency, GMV has carried out two R&D projects on use of the radar readings of Spain's space surveillance and monitoring system, S3TSR.

The first of the 2 projects, AIMLRCS, concentrates on use of machine learning techniques for extracting additional information from the radar readings already produced by the sensor. Surveillance radars produce many observations on a daily basis. These readings, however, give little information on the object under observation. Tapping into the huge amount of Radar Cross Section (RCS) readings, two machine-learning models have been trained up. The first is capable of recognizing within a precision of about 90% whether the object is stable or not, i.e., if it is out of control. The second model goes one step further and tries to identify individual satellites or platform types.

The second project, MEAQUA, involves the use of modern radar-reading correction models to cancel out ionospheric, tropospheric and object-size effects. In the case of ionospheric distortion, global 2D models have been used, like IGS GIMs, 3D models like NeQuick, used in Galileo, as well as models based on GNSS receiver data located near the radar. The data from these stations have also been used to estimate centimeter-precision tropospheric correction. Different studies have also been carried out to find out if it is possible to estimate the effect on radar readings of the observed object's size.

The results of both studies, which have been brought to a successful conclusion, bring out the quality of S3TSR radar data and also suggest all the R&D tasks that might be carried out to improve the data and boost takeup by other applications.

ESOC turns again to GMV´s experience

ESA extends framework contract with several GMV-led consortia to supply data systems and engineering services

T he European Space Agency (ESA) has extended for 5 additional years its GOF9 frame contract with several GMV-led consortia to supply data systems and engineering services for its Space Operations Centre (ESOC) in Germany.

ESOC is ESA´s operations centre "where missions come alive". ESOC tracks and controls all ESA Earth Observation and Science satellites as well as several EU Copernicus Sentinel satellites. It also provides tracking and control for third-party satellites, in particular for Launch and Early Orbit Phases. ESOC builds its own ground systems that include satellite control centers and a network of satellite tracking stations.

GMV has been supplying data systems and engineering services for ESOC for years. Following up on earlier separate GFC8 and GOF8 contracts, GOF9 started mid-2016 and was organized in different technical domains. For each of the following GOF9 domains GMV Space leads a dedicated industrial consortium that includes GMV's German branch as local subcontractor.

■ Domain Data Systems to supply satellite control center components such as mission control systems (MCS) and operational simulators. GMV is currently developing the MCS for EarthCare, ExoMars-RSP and JUICE as well as the operational simulators for EarthCare and Biomass. GMV will also develop next-generation EGS-CC based MCS for Earth Observation.

■ Domain Operations Engineering to supply engineering services for satellite control operations. GMV is currently supporting flight operations of BepiColombo, XMM and Integral and operations preparation of EarthCare and ExoMars-RSP.

■ Domain Astro Dynamics, to supply engineering services for flight dynamics, mission analysis and navigation. GMV is currently supporting all three services.

In addition, GMV also provides engineering services for mission operations infrastructure in Domain Infrastructure Technologies.

With this 5-year extension until mid-2026 GMV will further strengthen its track record in supplying ESOC with data systems and engineering services for satellite control operations.

GMV strengthens its position as ESOC's prime EO ground systems provider
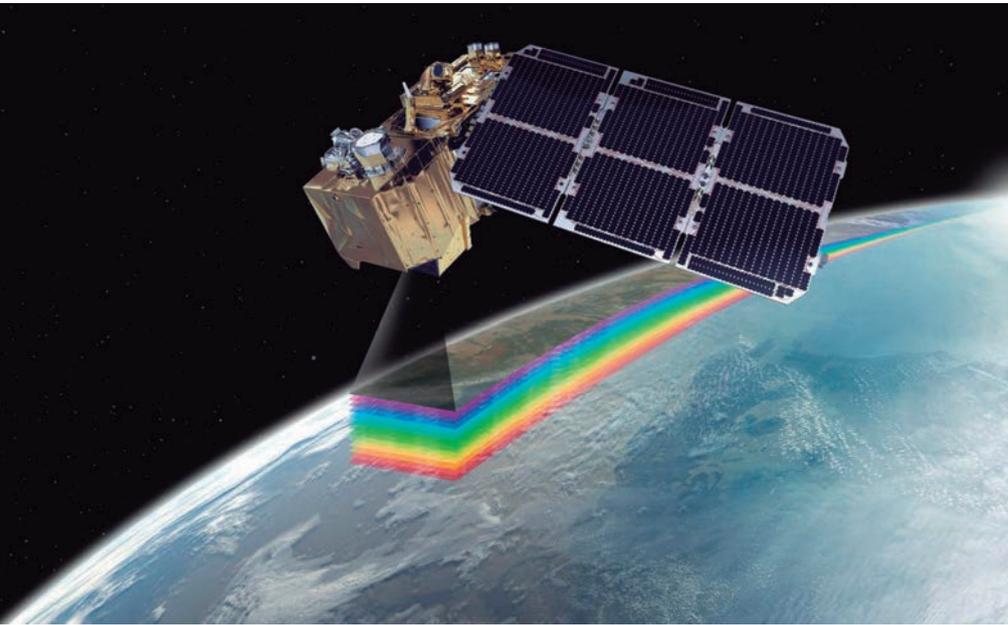
■ For several years now GMV has been the main provider of Mission Control Systems for the European Space Agency (ESA)'s operations centre (ESOC) and also one of the go-to suppliers of Operational Simulators for Earth Observations missions.

Further evidence of the European Commission (EC) and ESOC's ongoing trust in GMV comes with the recent award of a multi-year contract to a

GMV-led consortium for the maintenance and upgrading of Mission Control Systems, Operational Simulators and other ancillary systems for EC's Copernicus satellites (the Sentinels series) operated from ESOC.

The Sentinels satellites, developed specifically for Copernicus, provide, together with another ~30 contributing missions and in-situ sensors, key data made accessible on a full, free and open

basis by anyone to study the Earth's environment, thus supporting policy makers in Europe and around the world.

Initially awarded for a first 6-month preparation phase, the core of the project will be carried out in the next 4.5 years subject to the EC Multi Annual Financial Framework (MFF 2021-2027) and ESA authorization. The multi-year framework will allow GMV, together with ESA, to define a consistent technological roadmap taking into account the major breakthroughs occurring and to come in the oncoming years, with the overarching aim of increasing operational efficiency and quality.

Another important ESA EO mission for understanding our planet's carbon cycle is the Biomass mission scheduled for 2023. It is designed to provide forest height and above-ground forest biomass measurements using a groundbreaking P-band synthetic aperture radar technique. The Biomass satellite will be operated by ESOC, which has turned to GMV for the provision of the Mission Control System and the Operational Simulator; this will be especially challenging due to the complex satellite dynamics induced by the large antenna.

GMV attends the new edition of SATELLITE

Recently, the Gaylord National Convention Center (Washington D.C.), hosted representatives from the most prominent entities in the telecommunications satellite industry at Satellite 2021, the most important global satellite technology event on the scene today.

GMV, with a long track record in ground-segment development and currently the world's top supplier of control systems for telecommunications space missions, attended this gathering of the telecommunications sector,

which is becoming increasingly interlinked and connected and on which markets such as the media, transport, telecommunications, finance and even the consumer industry depend.

GMV was once again a major exhibitor, presenting operational solutions for the space mission ground segment, including *Hifly®* (satellite control), *FocusSuite®* (orbit control), *Closeap/ Focusoc* (collision risk management and associated services), *Flexplan* (satellite resource planning system), *Magnet* (tracking and receiving station control),

Smartrings (configuration management) and *Smarthz* (payload optimization); in addition to the services required for network security (cybersecurity) and vulnerability analysis.

The meeting once again served as a unique venue for showcasing GMV's space offering in situ and for giving real-time demonstrations to both current and potential clients, identifying new needs in the space industry. The event also provided a unique opportunity to network and share industry developments.

GMV contributes to sustainable development and reduction of deforestation

■ Following a year of activity, the MRV4C project (A Monitoring, Measurement, Reporting and Verification System for the Cocoa sector in the Dominican Republic) has come to an end.

MRV4C is an initiative by GMV for sustainable development, financed by the European Space Agency's Earth Observation Center (ESA–ESRIN) that addressed activity line 6 "EO for Sustainable Development" in the Agency's "ESA EO Science for Society Program". The aim was to implement a monitoring system that enabled the assessment of different parameters to improve the value chain of the cocoa sector, contribute to achieving "deforestation zero" in the Dominican Republic and, in addition, to demonstrate the role of cocoa, as an agri–forest system, in the fight against climate change.

Responding to the needs of the users, GMV designed a solution based on satellite and earth data, using geolocation systems, remote detection technologies and machine learning. Using data from the ESA's Sentinels (Sentinel–1 and Sentinel 2) and from ALOS–2 PALSAR–2, as well as other data sources from the Copernicus Climate Change Service, GMV has shown the potential of the Earth Observation data in identifying the best areas for agri–forest cocoa crops, mapping the current extension of the cocoa operations, estimating forest biomass and measuring deforestation.

MRV4C received the collaboration of the Dominican Republic's Ministry of the Environment and Natural Resources, the Ministry of Agriculture (Department of Cocoa), the DR Coca Foundation and the National Cocoa Commission, as well as the support of the World Bank.

WorldSoils and soil action against climate change

On 30 June the WorldSoils project held a User Requirements Consolidation Workshop in online format.

WorldSoils, carried out by a GMV-led consortium, is an ESA-brokered project, designed to develop a preoperational system for worldwide Soil Organic Carbon (SOC) monitoring, combining the mining of earth observation (EO) satellite data with large databases on soils and modeling techniques.

The workshop addressed various crucial areas such as Europe's regulatory framework in this field, UN soil management guidelines, the result of feasibility studies for implementing the target system and the baseline-defining requirement specification procedure. The workshop also ran its eye over the consortium's roster of user requirements and held an open debate to pinpoint new requirements or fine-tune existing ones.

Workshop participants included members of the project's steering committee (members of ESA, the European Commission's EC-DEFIS and EC-JRC), the European Environment Agency (EEA), UN-FAO, stakeholders plus interventions for consortium members.

GMV goes from strength to strength in the next generation of Copernicus satellites

■ The Sentinel-1 Next Generation mission is one of the projects designed to give continuity to the European Commission's Copernicus earth-observation program.

Copernicus runs a set of its own satellites (the Sentinel family), complemented by participating missions (other commercial or public satellites in orbit). Sentinel satellites have been custom built to meet the service needs of Copernicus and its users. The program's first operational satellite was Sentinel-1A in 2014. Although these satellites are still operational and fully valid, space missions are planned well in advance, so programs for the next generation of Sentinels have already been set in motion.

The Sentinel-1NG satellite will be dedicated to earth observation (on both its daylight and nighttime side) to observe ice and the oceans and collaborate with emergency management services. These observations will be made by its payload, which consists of a C-band synthetic aperture radar (SAR) and will include an automatic ship identification system (AIS), necessary for full backing of the mission's objectives.

GMV's Copernicus experience dates right back to the dawn of the whole program, when it was still called Global Monitoring for Environment and Security (GMES), participating in mission

analysis of practically every original Sentinel mission. Drawing on this experience, as well as its participation in phase 0 of this same mission, GMV is providing mission analysis for the mission-defining consortia: Airbus Defence and Space Gmbh and Thales Alenia Space Italia S.p.A.

Bearing in mind the competitive nature of this phase, GMV is keeping the two project teams apart. The company runs offices in several European countries, each of which has built up its own pool of experience, so it can afford to base one team in Spain and the other in Poland, thus guaranteeing separation of the teams and their developments.

Pastures in Kyrgyzstan – remote sensing and climate policy

On 13 July a webinar was held to present the study "Pastures in Kyrgyzstan – remote sensing and climate policy", a use case carried out by GMV under the Climate Resilience cluster (led by GMV) with the European Space Agency (ESA)'s EO4SD initiative, centering on the use of earth observation data for sustainable development.

The compares the state of the pastureland from 2000 to 2020 in Kyrgyzstan, and

calculates its rate of degradation using spectral indices based on Landsat satellites, digital elevation models and machine learning. Remote sensing analysis, facturing in information provided by animal herders, types of pasture, pasturing periods and heights per season, provided pasture-degradation information at 30 meters for the whole country, while also analyzing the impact on pasture of the climate change. Results show that pasture conditions in the last five years

are significantly worse than at the start of the century.

This study forms part of the planned use cases under the EO4SD Climate Resilience cluster, which will give geospatial climate information to diverse international financial institutions so they can take better-informed decisions to boost resilience of the population at large and sectors most prone and vulnerable to adverse effects of the climate change.

BIGMIG provides actionable insights for the aid & development community

■ The BIGMIG space-based services are designed to provide the Aid & Development community with a systematic, consistent and accurate monitoring of direct (e.g. conflicts and disasters) and indirect (e.g. food insecurity) migration drivers to support the prevention and management of current and future crises.

During the BIGMIG demonstration project funded by the European Space Agency (ESA) GMV NSL started developing the service alongside two main anchor customers.

The first service case focused on improving farming efficiency in order to provide support to the overall community's resilience to forced mitigation. In this respect, the BIGMIG team developed bespoke machine learning algorithms (Random Forest and spatiotemporal Neural Network architectures) to discriminate smallholders' crop types with high accuracy and to derive large scale landcover maps in Mozambique.

The second service case aimed at supporting humanitarian organizations in planning and improving efficiency of aid delivery in the aftermath of humanitarian crises. In particular during

the project, GMV NSL mapped the impact of cyclone Idai on infrastructure (dwellings, educational and medical facilities), transportation networks and cropland in Mozambique. Additionally, work was performed to facilitate the distribution of medical supplies and to help plan the rehabilitation of medical centers in Libya.

During the course of the pilot phase GMV NSL delivered to the customers a variety of products and actionable information via an easy-to-use, customized and interactive web platform. Overall, a total of 21 Earth Observation (EO) based products were generated, several additional customers were engaged and new partnerships were formed. The project outcomes were disseminated at renowned conferences and gained media attention.

The pilot phase culminated successfully during the final meeting with the anchor customers to discuss future steps for the full operationalization of the service that will enable them to better carry out their decision-making processes and reach their goals. Following feedback from the customers, the project's outcomes were presented to the ESA during the final milestone on July 2nd 2021.

## GMV takes part in the GEO Virtual Symposium 2021

The Group on Earth Observations (GEO) annual Symposium was held virtually from 21 to 24 June. The theme of this year's Symposium was strengthening inclusive partnerships across the GEO Work Programme. The Symposium aimed to share and compare successful practices and identify ways to accelerate the takeup of earth-observation-based products and solutions to address environmental and societal challenges.

Coordinated by GMV, the AfriCultuReS H2020 Project is a Community Activity in the GEO Work Programme 2020-22. On June-22 AfriCultuReS participated in the Symposium with a dedicated session which engaged actors across the GEO community in Europe, Africa and further afield.

Introduced by Juan Suarez, Manager of Earth Observation and Innovation for Sustainable Development Projects of GMV´s Aerospac sector,the session started with a demonstration of the AfriCultuReS platform's unified interface for services and use cases. The demonstration included a brief introduction to AfriCultuReS' climate-assessment, crop-monitoring, drought forecast and monitoring, land use characterization, livestock, observation of water quantity and quality and weather-forecasting services. Based on these services, practical use cases carried out in different African countries were showcased.

The demonstration was followed by an open discussion on the services, uses cases and opportunities for cooperation.

GMV spearheading space processing technology
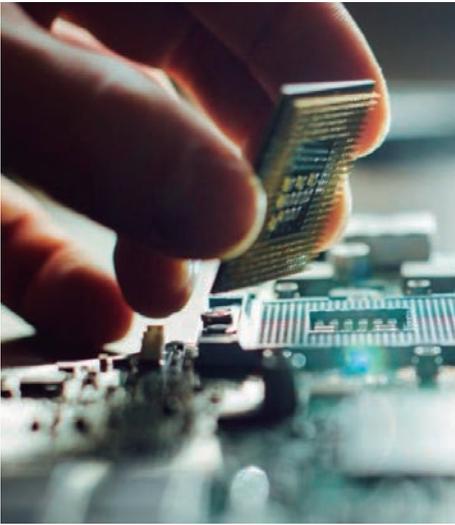
■ Space electronics shall endure harsh environmental conditions and there are very few chances of replacing damaged components (or none). For that reason, traditionally the processing chips on-board satellites or spacecrafts had focused on reliability rather than performance. On-board processors have been much less performant than most of the devices we can all find on-ground, in our mundane cell phones for instance. But now, the first radiation-hardened System-on-Chip (SoC) with competitive processing capabilities is becoming a reality and is a European development.

GMV leads the ESA project QUEENS3 evaluating the hardware and the development tools for this new chip, the NGULTRA/DAHLIA. The NGULTRA device is a Radiation Hardened By Design SRAM-based device manufactured on STM-C28FDSOI Space process and is composed of programmable logic which wraps an embedded SoC called DAHLIA.

DAHLIASoC is based on quadcore ARM Cortex-R52 divided into two clusters and different hard blocks for memory management, embedded FPGA and peripherals communications.

The French company NanoXplore has developed a range of radiation-hardened space-grade FPGAs with support from ESA and CNES. GMV was deeply involved in this new European space-grade FPGA trip from the beginning, first evaluating the little brothers NG-MEDIUM and NG-LARGE in the ESA projects QUEENS-FPGA and QUEENS2 lead by GMV and with support of NanoXplore and NTUA University.

QUEENS3, will involve a more demanding work due to the higher complexity of the FPGA SoC, for that reason we presented an improved evaluation methodology that would include implementation of space digital circuits to drive comparison metrics adequate to the higher capabilities of NGULTRA.

Thanks to QUEENS projects, along with other ESA projects using NanoXplore space chips, GMV has acquired a large expertise in this technology field. In addition, GMV participates in H2020 program EXCEED where a similar SoC computer is being created for the Homeland Security and Defense domain, counting again on NanoXplore technology and extending the security protections.

GMV at First Space-Comm Expo

In early July, GMV attended Space-Comm Expo 2021, the first event dedicated to Commercialisation of Space held in the United Kingdom. The event took place onsite at the Farnborough International Exhibition and Conference Centre, marking the return to traditional events following 18 months of virtual conferences.

GMV, as a pioneering company in the field of space, had a new stand displaying the company's space systems and solutions, with special emphasis on the developments underway at the GMV company in the United Kingdom. A highlight was the presentation of GMV's new SEXTANS GNSS receiver for space platforms. The company's stand showed visitors a demonstrator of the receiver, giving interested parties firsthand knowledge of the characteristics of this product.

GMV's offer at Space-Comm Expo 2021 was very well received over the two days of the event, visited by nearly a hundred attendees from the industry, government, academia and the administrations. Many of them came from the United Kingdom, although there were others from Europe, the United States and beyond.

The event was supported by key associations from the industry (Airbus, BAE, Northrop, Lockheed, etc.), and small and medium-sized enterprises, as well as influential organizations.

Mission analysis for ESA's Next Generation Gravity Mission (NGGM)

GMV, as part of the consortium led by Airbus Defence and Space Gmbh, is taking part in this mission, which will boost such services as hydrology, the cryosphere system, oceanography, solid earth and climate change

The worldwide climate change and associated factors like the rising sea level and desertification have a widespread effect on society and generate alterations in earth's gravity field. Understanding and quantification of these mass changes, their size and impact, is crucial for mitigating future threats and challenges.

Since 2003, therefore, the European Space Agency (ESA) has brokered studies to set scientific priorities, identify the most suitable measuring techniques, initiate associated technological developments and define the optimum scenarios of the future gravity mission, called Next Generation Gravity Mission (NGGM).

NGGM's objective is long-term monitoring of the temporal variations of Earth's gravity field at high resolution in time (down to 3 days) and space (100 km). It will observe the earth's mass change and thereby reinforce services such as monitoring of hydrology, the cryosphere, oceanography, solid earth and climate change.

NGGM takes up the baton from forerunner missions like GRACE, GOCE and GRACE Follow-On, and it will be complementary to other missions like earth observation, ESA's earth exploration program and the Copernicus missions.

Missions of this type are highly complex. Orbits are usually very low and the aerodynamic environment is very demanding, with a much higher resistance than other LEO missions. GMV boasts a wealth of experience working on gravitational missions; it took an active part in GOCE, as well as in several exploratory studies of possible gravitational missions.

In NGGM phase A GMV forms part of the consortium primed by Airbus Defence and Space Gmbh, inputting mission analysis. GMV, in particular, is responsible for analyzing the forces and moments acting on satellites for the various concepts, selection of the operational orbit that best suits requirements and design, calculation of the necessary delta-V for the whole mission life, plus upgrading of onboard memory together with optimization of land station networks. Additionally, GMV will be contributing to the mission operation concept and interactions with other missions, especially NASA's.

GMV leads the development of Harmony's optical end-to-end performance simulator

■ GMV has been awarded the contract for the development of the end-to-end mission performance simulator for the optical payload of ESA's HARMONY mission, leading a consortium completed by University College London, Royal Netherlands Meteorological Institute and Technische Universiteit Delft.

Harmony is one of ESA's latest candidates to Earth Explorer missions, which are focused at addressing scientific challenges related to Earth's system, the interactions among the different components, and the impact of human activities on Earth's processes. In particular, Harmony will study the interactions between the atmosphere and the ocean by providing simultaneous measurements of winds, waves, currents, sea surface temperature and cloud motion.

The mission concept comprises two identical satellites flying in convoy with one of the Copernicus Sentinel-1 satellites, each carrying a multibeam thermal-infrared instrument as well as a synthetic aperture radar. ESA has released separate activities for the end-to-end mission performance simulators of each instrument, which will run in parallel to the Phase A studies.

End-to-end mission performance simulators for Earth observation missions are a useful tool to assess the mission performance and support the consolidation of the technical requirements and conceptual design, as well as to allow end-users assessing the fulfilment of requirements by the mission. The development of these end-to-end simulators starts during the mission feasibility studies, so that if the mission is approved, the simulator will evolve into a support tool for the detailed design definition, preparation and validation of operations, data processing and higher-level mission products generation.

GMV is responsible for the simulator of the thermal-infrared instrument, aimed at Sea Surface Temperature and Cloud Motion Vector retrievals. The goal of the activity is two-fold: the specification and development of the simulator itself to validate the Harmony end-to-end performance for Level 0, Level 1 and Level 2, and its use in order to provide inputs to the User Consultation Meeting that will recommend which of the Earth Explorer missions shall be selected for implementation.

Ciudad Rodrigo inaugurates the first three-dimensional scale Solar System in Spain

■ The inauguration of the first Solar System model located in Spain, specifically in the Salamanca region of Ciudad Rodrigo, was held from September 3 to 5. The inauguration event was attended by representatives from the sector's main institutions, companies and entities that have collaborated in launching the project. On behalf of GMV,

Miguel Ángel Molina, director of strategy and business development for the company's ground segment and operations, took part in the inauguration ceremony.

The Astróbriga association is responsible for this initiative, which started in 2020. The aim is to stimulate society's cultural and scientific interest while promoting tourism in the town.

The scale in which this model is represented allows you to not only see the cultural heritage of Ciudad Rodrigo, but also offers a tour of emblematic locations in the region, such as the archaeological site of Siega Verde, extending as far as the Portuguese town of Vilar Formoso.

GMV joined the project right from the start, being the first big company to take a direct part in it. GMV's contribution has gone towards the construction of the planet Mars, whose monolith bears the specific reference of this collaboration.

Ciudad Rodrigo's Solar System to scale also has the collaboration of the Spanish Foundation for Science and Technology (FECYT), the Provincial Council of Salamanca and the City Council of Ciudad Rodrigo, among other collaborators.
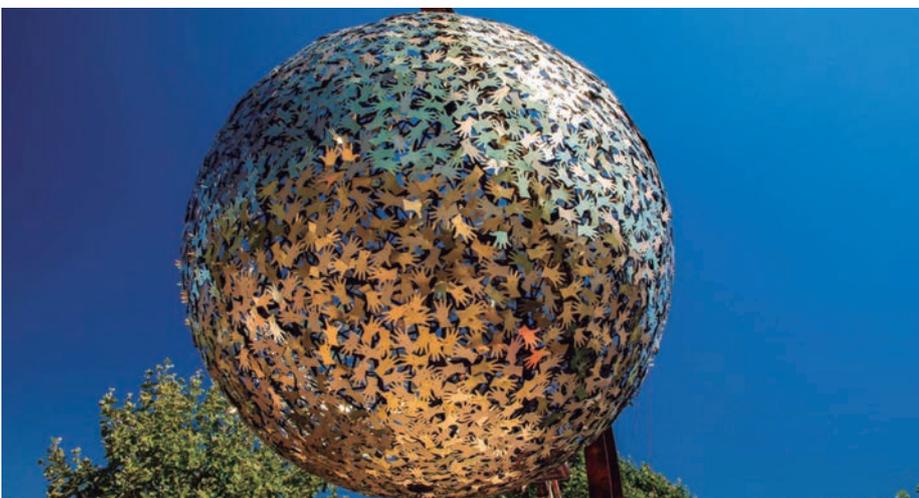
GMV provides several systems for the Mars Sample Return transfer rover arm

The robotic arm has been developed by the European Space Agency (ESA) for transferring the sample tubes from the Martian surface to the container that will be brought back to earth

In mid-August GMV began working on the operational phases of the Mars Sample Return–Sample Transfer Arm (MSR-STA).

The STA is the European robotic arm developed by the European Space Agency (ESA), designed to transfer tubes containing Martian surface samples from the Sample Fetch Rover (or the Perseverance rover) to the container that will be brought back to earth and close this container too. The robotic arm will travel to Mars onboard the Sample Return Lander developed by JPL in a joint ESA-NASA mission penciled in for a 2028 launch.

Under this activity, primed at European level by Leonardo S.P.A, GMV is developing several hardware and software systems.

In collaboration with 3DPlus and AVS, GMV will be developing the STA perception unit, comprising the cameras used to detect the sample tubes and other components of the Sample Return Lander, and the lids that will protect the cameras during the Mars landing. This hardware, fitted at the end of the arm, will be exposed to the harsh Martian conditions, with temperatures plunging to -130°C.

GMV will also be developing the high-level control software, which will demonstrate STA's mission-requirement compliance during its qualification in Europe. This software enables the sample tubes to be detected visually and their position to be pinpointed, making it possible to capture them. The high-level software also controls the manipulator for capturing the tubes and transferring them to the container totally automatically without any intervention from ground control.

Finally, GMV will be developing Electronic Ground Support Equipment (EGSE) and a simulator for helping out system engineering activities as well as STA operations on the surface of Mars.

The phase now starting will last one year, during which time the preliminary design of these systems will be completed.
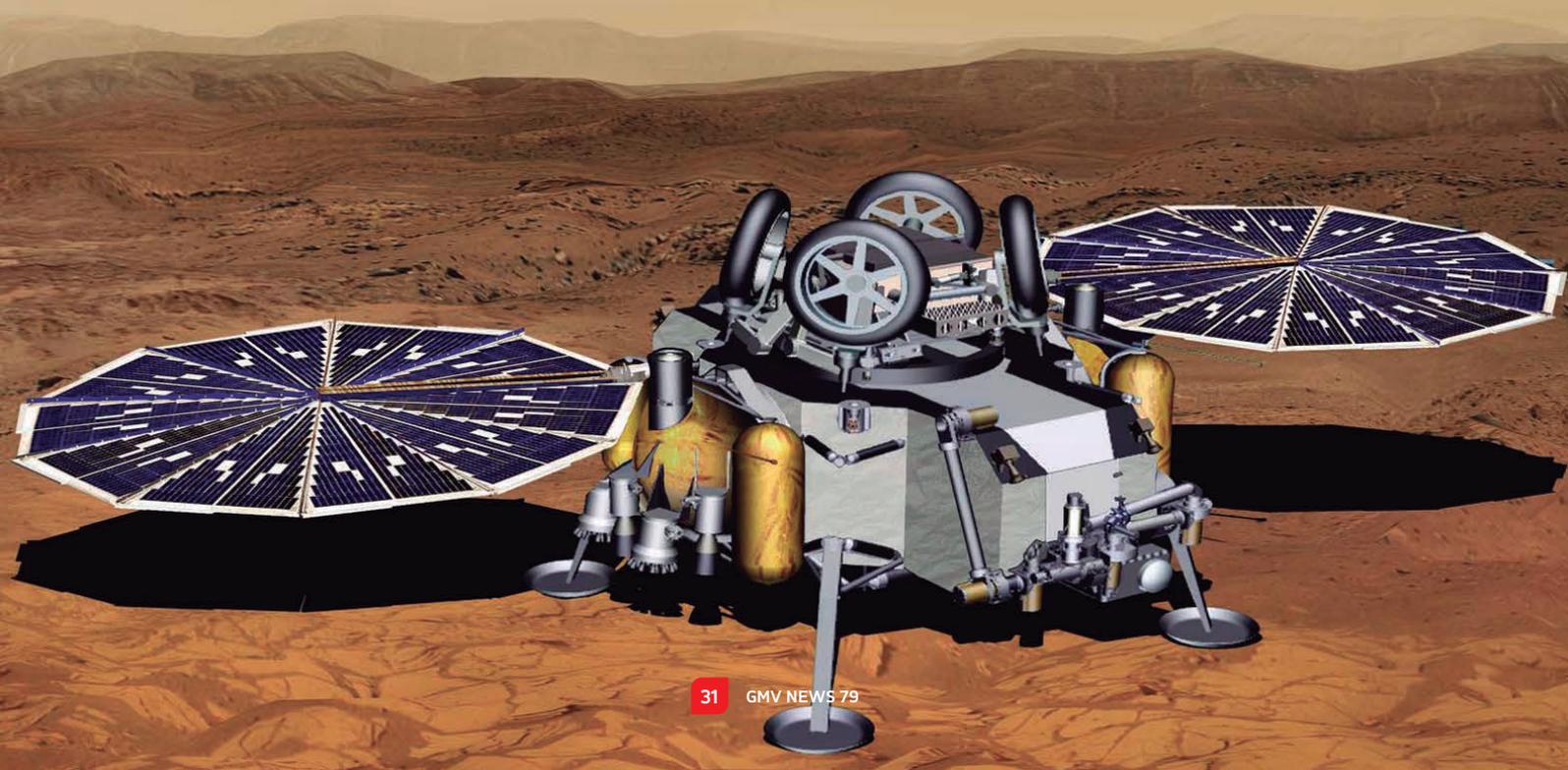
GMV supports the seventh edition of the ERC held in Poland

■ One of the largest international competitions in space robotics has been taking place since 2014, the "European Rover Challenge (ERC)". From 10 to 12 September the Kielce University of Technology (Poland) hosted the seventh edition of this meeting focusing on technological developments for space exploration

The main focus of this conference is the international ERC-Student competition aimed at university students. The objective is to build a rover similar to those used for Martian exploration and to successfully complete a series of tests similar to those that would be presented in a real case.

GMV has been supporting this competition for several years. Since 2020 it has been held simultaneously in two formats: "ON-SITE" (stationary) and "REMOTE", and this year the slogan was "We inspire a new generation".

This year, GMV sponsored the first prize in the "REMOTE" category, which used a virtual platform that simulated the world's largest artificial Martian track, and which went to the DJS Antariksh team from India. The event also featured the participation of Paweł Wojtkiewicz, GMV Director for Space sector in Poland, who took part in a discussion on the benefits and challenges of manned sub-orbital flights, and Maciej Prokopczyk, Project Manager and Software Engineer of GMV's Space sector in Poland, who gave a presentation on mission control systems at the European Space Agency and how to control robotic missions on other planets.

AER Automation and UVIGO organize a debate on Industrial Automation

Industry now works in an economically globalized, fiercely competitive world where process automation has now become the golden ticket for optimizing production, meeting ever-tighter delivery times, offering affordable prices and thus satisfying demand. Industrial automation, therefore, has now become an essential factor in the survival, development and business growth of any industry.

To debate this matter, the Spanish Association of Robotics and Automation (*Asociación Española de Robótica y Automatización*: AER Automation), with the collaboration of Vigo University, organized a series of online discussion panels with experts from various firms. In these encounters GMV talked about its own experience, explaining the various trends and solutions that are turning out to be fundamental in achieving more efficient and sustainable production.

Ángel C. Lázaro, Business Partner of GMV's industry sector, mentioned some of the robotics work now underway, such as collaborative robotics systems for manipulating laboratory material for recycling. He also stressed the collaboration arrangements with various firms for working on autonomous robotics projects designed to solve the last-mile problem in cities where there are areas closed off to traffic.

GMV is now broadening its range by developing various solutions taking in all the following: robot-based industrial process automation in the energy sector; AGVs for automation of warehouses and logistics platforms; applications involving collaborative robots in farming and scientific laboratories; and the development of mobile robots to carry out diverse tasks that, jointly with other GMV-developed technology, provide highly specialized, bespoke solutions for each client.

GMV participates in a study on application of AI solutions to the IMINT process

■ The EU's Satellite Centre (SatCen) has recently awarded to a consortium including GMV a study into Artificial Intelligence (AI) solutions for Imagery Intelligence (IMINT) processes. Imagery intelligence, as its name suggests, is an intelligence gathering procedure based on the analysis of information obtained from images, generally provided by satellites or other airborne resources.

The study's main remit is to serve as preparatory work for identification of cases where AI might support the IMINT cycle, boosting its efficiency. It likewise aims to provide a framework for defining the specific AI technology and solutions that might be applied and deciding how they might best be used.

To this end the project includes a number of work packages to define and analyze user requirements, take stock of the current use of AI in IMINT, and draw up a business case integrating previous results in a framework allowing for the management of complex IMINT processes by a combination of AI solutions and definition of corresponding workflows. GMV is playing an important part in all study activities, especially in the first two work packages, which it is leading.

The study is part of a series of initiatives geared towards tackling some of the main challenges faced by the IMINT community, such as greater data availability, a shortage of human analysts and the need of generating and providing in due time and form detailed and precise intelligence on a large geographic scale. GMV's earth-observation experience and its parallel expertise in the application of AI in defense, security and intelligence systems were deal makers in winning the contract and ensuring its ongoing continuity.

GMV wins a new R&D contract under the Santiago program

■ GMV has won a new R&D project under the Spanish MoD's Santiago program, which aims to develop a demonstrator that reduces interoperability risk in upgrading of the signals intelligence (SIGINT) system in the future Phase II of the program.

The demonstrator, to be delivered to the Subdirectorate General of Planning, Technology and Innovation of the Directorate General of Armaments and Material (*Subdirección General de Planificación, Tecnología e Innovación de la Dirección General de Armamento y Material*: DGAM/PLATIN), will center on processing of Electronic Intelligence (ELINT) information in the new NATO next-gen Electronic Warfare Database (NEDB NG). The demonstrator's capabilities must include loading up of ELINT information, command and control, analysis, fusion and dissemination plus due integration of all these capabilities.

The new architecture will be geared towards services forming a federated system of all the various nodes. The demonstrator is meant to interoperate with different intelligence sensors, including not only Cooperative Electronic Support Measure Operations (CESMO) – which must be NATO STANAG 4658 compliant – but also the provision of electronic warfare information.

The proposed solution will reuse the CSD service architecture developed by GMV for the DGAM, plus the ATENEA tool for mission planning and monitoring, thus ensuring interoperability in networks based on STANAG 4559 Ed4 compliant MAJIIC2 protocols.

It is also planned for the project to include a study of application of Galileo timing- and positioning-capabilities and its Public Regulated Service (PRS) in support of the Spanish armed forces' future SIGINT and CESMO systems.

GMV has been working uninterruptedly on the Santiago program since 2002, developing the SIGINT data processing systems run by the Spanish army, navy and airforce. This project entails GMV continuity within the program for providing the MoD with state-of-the-art, interoperable NATO intelligence systems within the transition plan preparing for phase II of the program.

GMV breaks into the top 5 EDIDP-participating firms

The 7 second-call projects in which GMV is participating are worth 50.1 million euros, to be added to the 155 million of the 4 first-call projects

GMV has been awarded seven of the 26 projects selected by the European Defence Fund as part of the second EDIDP call. The European Defence Industrial Development Programme (EDIDP) sets out to boost the competitiveness of the EU's defense industry, thereby helping to build the EU's strategic autonomy. It is working with a budget of 500 million euros for 2019 and 2020 (245 million euros for 2019 and 255 million for 2020).

EDIDP aims to support the EU defense industry's equipment- and technology-development efforts,

working with EU co-financing. The seven projects with GMV participation in this second call account for 50.1 million euros, about 27% of the total budget. In the first call GMV won four projects from the selected 16, worth a total of 155 million euros, over 50% of the budget.

GMV's participation focuses anew on the company's strategically important areas. This expertise helped to clinch the deal, which in turn will improve the company's international position in key technologies. The awarded projects are centered on the development of AI, command and control, navigation, space and cyberdefense capabilities:

- AI4DEF. Demonstration of the use of artificial intelligence (AI) in defense.

- eCOLORSS. Indirect long-range fire support system.

- FIRES. Development of the next generation of 155 mm guided munitions.

- SAURON. Advanced space entity classification and identification sensors.

- INTEGRAL. Groundbreaking space surveillance and alert technology.

- ODIN'S EYE. European autonomous early-warning anti-missile defense.

- SEANICE. New generation of antisubmarine warfare.

The fine results of the first call in 2020 were key in GMV being chosen again by the European Defence Fund, strengthening its hand even more in EU's Preparatory Action in Defense Research (PADR) and building on its excellent results under the 2019 EDIDP call. In all, taking in the two EDIDP calls, GMV has been awarded 11 projects, making it the fifth biggest project winner in Europe.

Final presentation of the Andromeda project

■ Andromeda's final workshop was held in late June. Co-funded by the EU, Andromeda kicked off in September 2019 with the participation of 19 partners from 9 different countries and the aim of boosting the capability and takeup of the CISE data model. GMV has featured prominently in the project, leading the design of system architecture, inputting the *Socrates* C2 system and also taking part in one of the demo scenarios.

On 23 and 24 June the project's final demo workshop was held online to present and analyze the promising results obtained in terms of land- and sea-border security, the current state of the European Common Information Sharing Environment (CISE), extension of its data model for use in land C2 systems plus decision support tools.

As well as technical sessions, the workshop also featured top land- and sea-security experts from various countries who talked about their current problems in this sphere and their modus operandi for fighting against the daily threats they face. All of them stressed the key role played here by Andromeda, which facilitates collaboration and information-exchange between the various agencies and countries.

Another session dealt with other large-scale European projects currently underway. Experts from each project expressed their interest in Andromeda's results and stressed existing information-exchange synergies.

The event closed with a session given over to the analysis of results obtained in the project's three demo scenarios and a discussion panel giving the opinions of stakeholders and final users.

The event, a resounding success, was attended by several project partners plus high-ups from European agencies like EMSA, FRONTEX and JRC.

Opinion

Is cybersecurity expensive?

Cybersecurity is often said to be expensive. Compared to what? That's the crucial question. Many products and services, with an upfront benefit in plain sight, lend themselves to a simple, direct comparison for this purpose of deciding whether they are dear or cheap. A service, for example, might cost 15,000 euros a year, but it comes out cheap if the ensuing benefit is worth 30,000 euros a year. Calculating the return on cybersecurity is not so easy; its benefits are not direct gains but loss avoidance.

Take the example of the ransomware attack on the US company Colonial, which has cost them a $5 million bitcoin ransom payout (of which the FBI has recovered about $2.3 million). To this must be factored in too the 4 day business downtime plus this critical infrastructure's knock-on effect at national level. Not to mention the blow to the company's reputation.

We at GMV recommend the design of specific programs for our clients, focusing on their particular needs as they stand today to help them mature in the cybersecurity arena and cut down the cost-benefit ratio for potential hackers.

These programs should always begin with an initial diagnosis to weigh up the organization's current state and pinpoint what it needs. There will be cases where the stress has to be laid on the earliest phases: redesign of architecture and processes. Others might stand in need of more monitoring plus some powerful

Paula González Muñoz
Head of the Auditing Section
GMV Secure e-Solutions

> "Calculating the return on cybersecurity spending is no bagatelle. The benefit, after all, is seen not in direct gains but rather loss avoidance"

cyberdefense services; others still might need periodic vetting of their level of exposure. But in most cases the answer is a combination of all the above to fill in the gaps and fine-tune existing systems.

As we said at the start, it's common to hear that cybersecurity is dear. Such a claim is based on a mistaken comparison of the initial outlay against current costs. What is much more difficult to assess, often impossible until the company falls victim to an attack, is the implementation cost against the cost of a successful attack. This comparison relativizes the apparently high implementation cost against the much bigger expense of losing millions in a devastating attack.

CCI debate on how to bring cybersecurity into the supply chain

Spain's Industrial Cybersecurity Center (*Centro de Cybersecurity Industrial*: CCI) put on the event "The Voice of Aragon's Industry" to swap notes on cybersecurity in the automation and digitization of industry. Javier Hidalgo, architect of GMV's industry cybersecurity solutions, pointed out the main cyberthreats and gave some examples of the different types of supply-chain cyberattacks before homing in on cybersecurity principles and the good practices to be taken onboard.

Hidalgo's paper brought out the importance of designing the security approach from the premise that any company is going to suffer an intrusion of some sort sooner or later. He also argued that cybersecurity is not just a technological problem; it is also a problem of people, processes and knowledge. In industry, therefore, it is not enough just to work with the most robust system in the world; personnel also need to be made aware that systems are going to suffer incidents. The necessary controls also need to be set up as well as the suitable processes for controlling who enters and leaves the company's premises, including personnel who render no service or exchange any information with a third party.

Javier Hidalgo wound up by arguing that the supply-chain security risk must perforce be taken into account when establishing the company's logistics security. Security controls and constraints need to be properly implemented and security must be vetted in the supply chain management cycle to check the state of security and drive an ongoing security improvement.

COFIS organizes cyberdefense and cybersecurity training actions

■ At the end of June the Official Physicists' Association (*Colegio Oficial de Físicos*: COFIS) put on an online discussion panel under the title "Professional exercise of Spanish physicists in the field of citizen defense and security", held in collaboration with the Ministry of Defense and the Physics Faculty of the *Universidad Complutense de Madrid*.

Ángel Gavín Alarcón, Business Partner in GMV, talked us through the risks we face in cyberspace security and defense.

Citing several examples, he defined cyber-resilience as our adaptation capacity to be able to keep going during risk situations and bounce back quickly from any cyberattacks suffered now or in the future. He also spoke about autonomous smart systems, making sure we can protect ourselves from the cyberthreats posed by autonomous vehicles. These are only some of the challenges to be taken into account today; Ángel also tabled many other factors, such as integration of our business's existing system with the latest technology to keep up with the digital transformation; threat intelligence to ensure proper sharing of information among the various parties and decide how to defend ourselves; information credibility and integrity to fend off disinformation; digital twinning to run replicas and drills to decide how we might protect ourselves; the need of managing supply-chain security to ensure proper end-to-end protection from raw material thru to finished products and specialist cyberdefense and cybersecurity training to make sure we're ready for this new global and digital world.

VLCSOFTING brings together cybersecurity experts

■ Cybercrime in Spain soared by 125% in 2020, with over 40,000 cyberattacks a day. This is just one of the most striking figures thrown up by VLCSOFTING, the annual congress put on in June by Spain's IT Technology Institute (Instituto Tecnológico de Informática: ITI) with the participation of top cybersecurity experts.

VLCSOFTING featured this year a paper by Carlos Sahuquillo, automotive cybersecurity consultor in GMV's Secure e-Solutions sector, focusing on cybersecurity of the connected vehicle. He pointed out that there is an increasing number of vehicle access options, including 4G vehicle GPS trackers.

Sahuquillo talked about his experience in the automotive sector before presenting some examples of GMV's lab simulations of attacks, such as the CAN-BUS hack known as BUS-OFF. This bears many similarities to the better-known Denial of Service (DoS) attack. Yet another hack vector involves taking over the Parking Assistant Module (PAM) ECU to send commands and swivel the steering wheel at any moment. Then there is also the well-known GPS spoofing option for sending a misleading tracking signal and diverting an autonomous car from its intended path. In sum, Sahuquillo argued that there are now many ways of taking over vehicle control. Carmakers are now busily working on countermeasures with a stress on design-up vehicle cybersecurity.

Phishing Report

■ Phishing or identity theft means passing yourself off as someone else, usually on a computer, to be able to perpetrate criminal activities such as stealing sensitive data, embezzling money, cyberbullying, extortion, grooming, etc. Phishing has been driven by today's exponential increase in communication and the use of telematic resources. Identity theft has been given another alarming leg-up by the current pandemic.

To deal with this problem the Regulation Group of the Spanish Association of Telecommunication and Information Society Users (*Asociación Española de Usuarios de Telecomunicaciones y de la Sociedad de la Información*: AUTELSI) has just brought out the study "Suplantación de la Identidad" (Identity Theft) to ascertain the phishing risks faced by companies and the public at large. This study pinpoints the main methods used by hackers and also defines a series of good practices to respond to and minimize these risks and their legal consequences.

As a member of Autelsi's Regulation Group, Mariano J. Benito, CISO of GMV's Secure e-Solution sector, has helped to draw up this report together with other phishing experts. One of the main conclusions drawn is that both public and private companies should take the appropriate technical measures for the correct identification of their clients and users. It also stresses the need for raising users' awareness in their identification processes, the use of proper technology and systems and the importance of bringing organizations' identification and authentication processes fully into line with current laws and regulations.

Tourism Digital Security Webinar

■ Tourism, handling as it does a huge amount of sensitive client information, is by no means immune to the current rash of cyberattacks. To make matters worse its cybersecurity maturity level is lagging well behind the Spanish average. Only 5% of tourism companies are rated as cyber experts ("Cyber Readiness Barometer of the Leisure and Tourism Sector 2021", Hiscox). All these factors mean tourism's digital security is a cause for widespread concern.

To tackle this issue, Horeca Zaragoza, Professional Association of Hospitality Entrepreneurs of Zaragoza (*Asociación Profesional de Empresarios de Hoteles y Restaurantes de Zaragoza*), with the collaboration of Spain's Technological Hospitality Institute (*Instituto Tecnológico Hotelero*: ITH) and economic support from Zaragoza city council, have held a tourism digital security webinar.

Present at the event were Joan Antoni Malonda, Tourism Business Developer of GMV's Secure e-Solutions sector, who ran through the main risks faced by tourism companies. Under the current pandemic the proportion of tourism employees with remote access has soared from 13% to 59% (according to Hiscox's figures); it would therefore seem likely that the attack risk will also rise unless this remote access granted to clients, suppliers and employees is hedged in with proper security measures; this in turn calls for previous security diagnoses. Malonda also underlined the importance of raising staff awareness of these risks and also training these employers to deal with them properly.

GMV's telemedicine platform helps to delay the onset and progression of frailty in the elderly

Antari® allows clinicians to remotely prescribe a personalized therapy plan to suit the continuously monitored progress of patients in their own homes
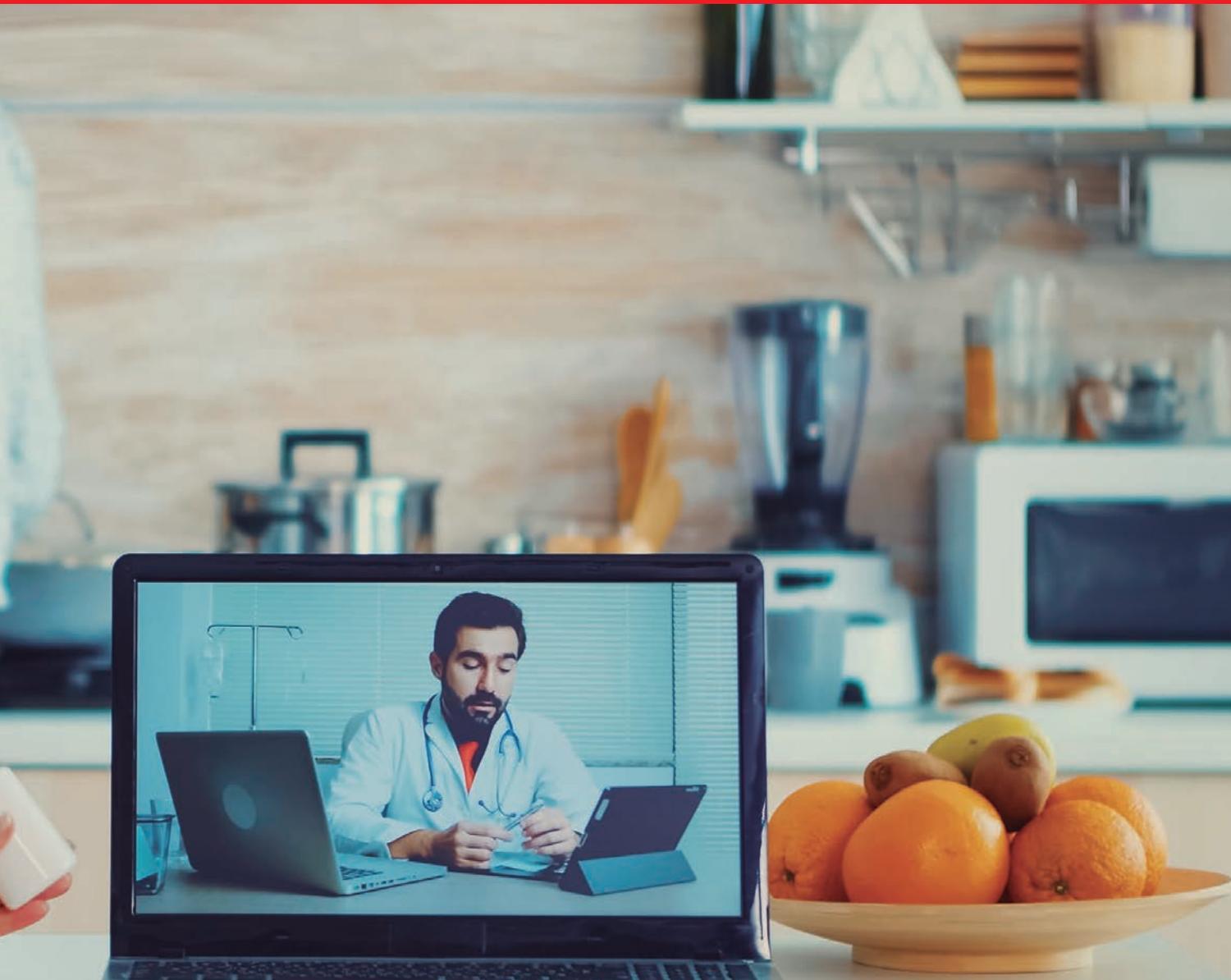
The Geriatric Services of Getafe and Albacete Hospitals, prestigious at national and international level, have taken part in the European research project (FACET) to monitor frailty care at home. GMV has taken on technological coordination of the project, using its inhouse telemedicine platform *Antari®*. This GMV product allows the physician to prescribe remotely a personalized therapy plan to suit patients' development as monitored continuously in their homes.

The clinical trial (prospective, randomized and blind) was held over one full year, studying the health trend in males with an average age of 82 and females with an average age of 65, monitored to detect the onset of frailty and keep track of it thereafter. Sensors were set up in their homes to record a series of key frailty factors such as level of physical exercise (walking speed, limb power, etc.), adherence to the therapeutic plan or recommended diet.

This research has thrown up a frailty report on those persons most likely to suffer functional deterioration and develop disability or suffer adverse events (falls, frequent hospital stays, etc.). The trial shows that, as from the third month of observation, the progression of frailty was slowed down in persons monitored with the telemedicine platform and likewise the transition from non-frail to frail.

The net result is a reduction in the use of healthcare resources. Physicians were able to monitor changes in the patients' functional state and prescribe therapy plans in line with the evolution of the main process and any concomitant ailments. Physical exercise, diet recommendations to suit each person's needs and observance of the therapy plan prescribed in each case are the keys to delaying frailty or disability in this group.

In the words of Doctor Carlos Royo, healthcare strategy director of GMV's Secure e Solutions sector, the *Antari® Professional Care* telemedicine platform for clinical management of the elderly and pre-frail incorporates therapy plans and personalized interventions (nutritional algorithms, medication, physical exercise plans) for all-in, coordinated and continuous care, involving all stakeholders (clinicians and patients). GMV has also developed the necessary technology for guaranteeing research-data privacy, pursuant to current law and regulations. FACET, after all, is one of the few frailty randomized controlled trials (RCT) at national and international level.

GMV involved in the development of iDocStation, the smart, portable telemedicine device

■ The worldwide crisis caused by the coronavirus SARS-CoV-2 pandemic and the ensuing illness, COVID-19, has brought telemedicine into the limelight. The need of obtaining the patient's biometric data during the consultation hinders the achievement of a diagnosis to suit each particular situation.

This problem, however, can be solved by means of several medical devices capable of culling the necessary data and passing it on by a telemedicine IT app.

Along these lines, GMV, in collaboration with other organizations (MD, ALMADESIGN, INEGI), has developed a portable healthcare device with built-in biosensing equipment that passes on the information to a telemedicine IT app, thus providing clinicians with all necessary information for making a concise, personalized diagnosis, even by means of teleconsultations.

Enter iDocStation. This smart, portable telemedicine device cuts down the number of visits to sites where the risk of catching SARS-CoV-2 is high, such as health centers or care homes.

This project aims to set up a national value chain in order to tap into telemedicine resources and pave the way for a smooth return to work post lockdown.

"8ᵗʰ Obstetrics And Gynecology For Nursing Updating Symposium"

The Colombian Federation of Obstetrics and Gynecology (*Federación Colombiana de Obstetricia y Ginecología*: FECOLSOG) held the "8ᵗʰ Obstetrics And Gynecology For Nursing Updating Symposium" (VIII Simposio de Actualización de Obstetricia y Ginecología para enfermería) on 29 and 30 July in virtual format.

Carlos Royo, director of GMV's health strategy, was invited to give a paper on "Telehealth in a pandemic", explaining how GMV's inhouse telemedicine platform *Antari® Professional Care* can help in the monitoring of pregnancies, births and the postpartum period.

Opinion

Vaccination, the new lure for cybercriminals

During 2020 the COVID-19 pandemic hit the digital world hard. Online frauds and scams soared around the world. In Spain, in particular, the number was well up on the previous year, especially in healthcare and government institutions and authorities. Organizations like National Insurance, Inland Revenue and the Road Traffic Authority, among others, all suffered identity-theft attacks in order to propagate malware or perpetrate frauds. Others suffered serious incidents, their activity sometimes even grinding to a halt due to ransomware attacks.

Ransomware, indeed, has become the main concern of organizations in this IT maelstrom, due to the ease of obtaining "as a service" versions on the black market. Furthermore, the attacks are also becoming more aggressive; the quickest, most efficient and even cheapest forms of propagation are campaigns of phishing, smishing and any e-messaging method; social engineering strategies are applied to hoodwink users with messages that pique their curiosity, fear or any other feeling related to SARS-CoV-2 and jabs.

We in GMV's Threat Intelligence Team would dare to claim that vaccination is nowadays a worldwide cybersecurity concern; it is also the flank most open to attack by cybercriminals, without downplaying other aspects of the pandemic, such as subsidies designed to offset economic losses.

One of the most sensitive aspects on this vaccination flank is the supply chain (Laboratories / Logistics / Vaccination Centers / Hospitals) where threats are piling up. Social engineering arguments are used to perpetuate attacks against any of the agents in this supply chain, whose identities might be robbed to spread the infection to the rest of the agents in the chain. We should remember that we are dealing here with critical, high-value data for human life (on the black market healthcare data fetches prices even higher than financial). This

Juan Ramón Gutiérrez.
Head of the Threat Intelligence and Forensic Section
GMV Secure e-Solutions

"Vaccination, without downplaying other aspects of the pandemic, is nowadays the flank most open to attack by cybercriminals"

data, therefore, might easily become the object of blackmail with ransom requests or sold on the black market.

GMV wins a contract for Barcelona Metropolitan Area (Àrea Metropolitana de Barcelona: AMB)

The contract, awarded by Avanza, comprises a fleet management system, passenger information system, onboard video-surveillance system and ridership counting system

Grupo Avanza turns once more to GMV for fitting an advanced fleet management system to the vehicles included in its new concession for running the 200-vehicle urban passenger service between Castelldefels, Gavà, Viladecans, Barcelona and other built-up areas of AMB. This consolidates GMV's longstanding business relationship with Avanza, broadening its range from the previous areas of urban and interurban and long-haul transport.

The project awarded by Avanza to GMV comprises a fleet management system, passenger information system, onboard video-surveillance system and ridership counting system.

On this occasion Avanza has opted for one of GMV's latest inhouse developments, its **ITS Suite**, which represents a great leap forward in state-of-the-art fleet management systems. This is a cloud computing-native product, based on a micro-service and docker approach on a Kubernetes orchestration platform. This solution is a perfect fit for the customer requirements of responsiveness, scalability and trustworthiness of modern cloud
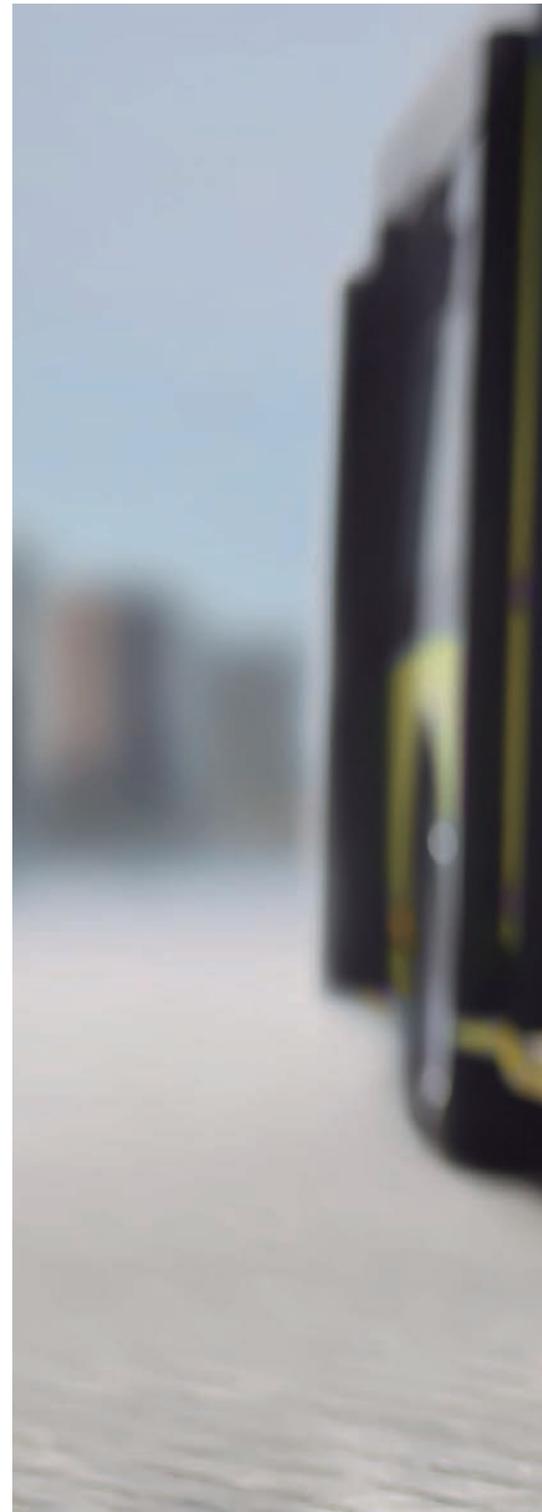
applications, as against the traditional monolithic applications, which have now fallen out of synch with current demands of development cycle speeds and availability. Microservices have helped major firms such as Netflix, Amazon, Twitter, etc, to become more responsive and innovative.

Onboard equipment consists of an architecture based on the *REC30*

device, which will act as a fleet management system, passenger information system and recorder of the video-surveillance system. Depending on vehicle type, one to three 24" monitors will also be fitted to display passenger information plus 4 to 6 video-surveillance cameras.

One of the challenges posed by the product, besides setting up the

ITS Suite, will be to meet the tight deadline for bringing the system into operation, scheduled for December 2021. This will entail installation of a temporary server to ensure Avanza can run its operations normally until full deployment of the final system, as well as phasing in 40 new vehicles to be brought on stream on the abovementioned date.

GMV with subsequent contracts in Poland

■ GMV has been trading in Poland since 2009, successfully implementing public-transport ITSs in many Polish cities. Most of the systems launched in the first years of the company's operation are still being maintained and developed.

In Toruń, GMV is carrying out upkeep and post-warranty maintenance of the tram system launched in 2014. The

project to implement a new Passenger Information and Fleet Management System for 150 city buses is also nearing completion.

2020 saw completion of the start-up of the software for the new control center and the installation of the on-board units in buses. At present, installation of 73 bus-stop passenger Information displays is being finalized in the city.

In parallel to the implementation of the new system, in 2021 GMV has obtained and already partly completed deliveries of on-board devices for 14 new Solaris buses, 5 new Pesa trams, as well as 8 LED RGB displays of the dynamic passenger information system at stops.

The situation is similar in other Polish cities where GMV Fleet Management and Passenger Information Systems are in operation. In August this year, GMV won a public tender held by the Public Transport Authority for the replacement of the 8 oldest displays of the Dynamic Passenger Information System located at the

Łostowice-Świętokrzyska integration node in Gdańsk. The old displays made in LCD technology will be replaced by new and durable displays with LED matrices, equipped with GMV **CEP10** control units, which ensure integration with the fleet-control software operating within the TRISTAR system.

In September, GMV won the tender of the Gdańsk Public Transport Authority for the delivery of 19 sets of integrated TFT touch-screen terminals and on-board units **OBU-M20**, which are to be used in newly introduced vehicles, and the delivery of 82 TFT driver terminals, which will eventually replace the C11 driver terminals used since 2009.

The replacement of the driver consoles with the new TFT type ones will enable the presentation of the adjustment time to the bus driver in a more user-friendly and readable way, more effective communication between the driver and the dispatcher, and in the future will allow the implementation of new system functions.

Warsaw Trams once again chooses GMV

■ The capital city of Warsaw runs Poland's biggest public transport system. This system also includes the largest tram fleet in the country, consisting of approximately 530 vehicles belonging to the city operator, Warsaw Trams.

GMV has been providing the operator with IT solutions and services related to Dynamic Passenger Information continuously since 2012.

In mid-2021, the company again chose GMV's proposal for providing data processing services within the scope of the Passenger Information System (PIS) for the next 3 years. As part of the service, GMV software (SAE-r) installed

in a cloud environment performs advanced calculations and estimated times of arrival (ETAs) at all tram stops in the Polish capital.

The software receives real-time data on current position and speed from the geolocators installed in the vehicles and then, taking into account the information imported from the timetable and the assigned transport tasks, using proprietary GMV algorithms, estimates the trams' ETAs for the stops. The ETAs are transferred to the software module of Warsaw Trams, from where they are propagated to all LED dynamic passenger information displays at stops, to the website, or to the Open Data portal.

At present, GMV is also responsible for the maintenance of on-board geolocators in 530 Warsaw Trams vehicles and for providing data on the GPS positions of the vehicles to the operator´s control center.

The information from the geolocators feeds not only the Dynamic Passenger Information but also other company systems, such as the travel-priorities system, which enables the trams to travel faster and thus generates savings for the company thanks to a better use of the fleet.

At the end of 2021, Warsw Trams plans the renewal of the geolocator equipment in all tram sets, replacing the current ones used for over 10 years.

GMV incorporates a system based on *SAE-R®* into the infrastructure of ETS
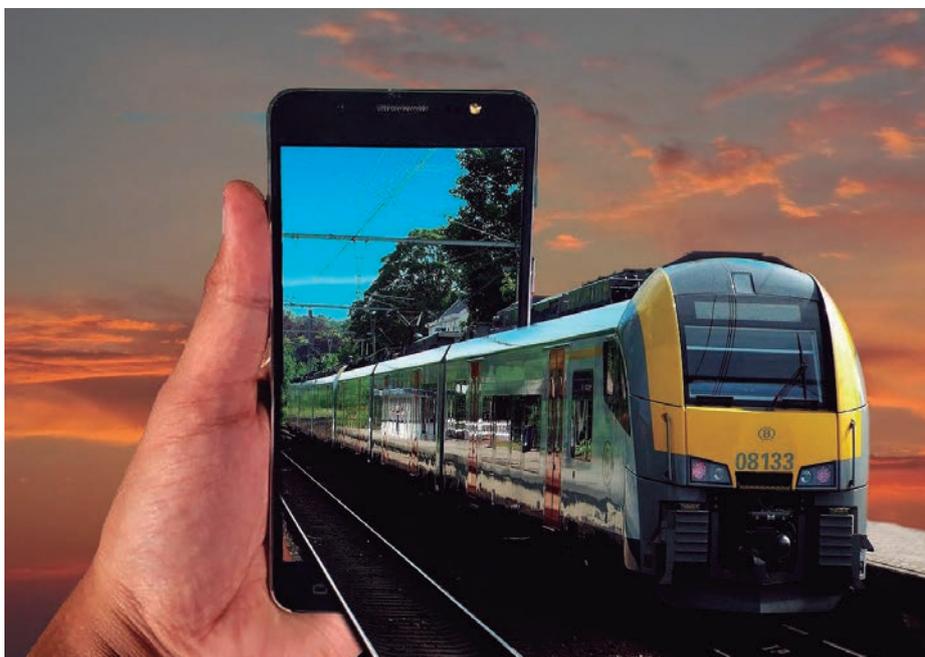
■ The Basque railway-infrastructure manager, Euskal Trenbide Sarea (ETS), has awarded GMV a contract for upgrading its Graphic Service Application (Aplicación Gráfico de Servicio: AGS), previously supplied by GMV.

Under this new project an App will be developed for Android handhelds and a handheld-adapted website, plus the services associated with both. This will enable personnel working on ETS's railway infrastructure to keep a constant track of the trains closest to them on the basis of proximity alerts sent to them when a train is approaching their workplace.

Various upgrades will also be phased into the AGS, such as integration with the active ETS directory and a new facility for automatic generation of freight-train documents, including automatic calculation of braking percentages and top speeds for each train according to the route to be run and the features of the particular train (locomotive, wagons, load, etc).

The AGS stems from a personalization of GMV's inhouse advanced railway fleet-management system *SAE-R®* to cover the many stages of railway fleet-management. The first stage (scheduling) involves drawing up the running plans to be used in the future; these plans, containing all the railway network's planned traffic for a given day, are then sent up to the CTC systems.

The next, real-time stage provides for daily monitoring of trains, reacting accordingly to any deviations in planned running. The system thus caters for diverse amendments throughout the day, keeping a series of external systems updated, such as station indicator screens, the CTC systems, Euskotren's published schedules and the company's Tetra systems.

Finally, in the last stage, an analysis is made of past running, producing a series of personalized reports.

GMV renews the transport maintenance contract of MPT

■ In July GMV renewed the maintenance contract of Malta Public Transport (MPT), taking in a fleet management system, video-surveillance system and electronic fare collection system for a 400-bus fleet.

GMV's maintenance arrangements under this contract renewal are based on a remote support system to deal with any software incidents in applications of the central control office and in the firmware of onboard equipment of the fleet-management, video-surveillance and passenger-information systems, plus third-level maintenance, i.e. repair of the hardware of onboard equipment supplied by GMV.

The fleet-management/video-surveillance system is made up by GPS-, 3G- and WiFi-enabled onboard equipment, door sensors, connection to 1440 onboard CCTV cameras with real-time streaming and recording facilities, plus a complex fare collection system made up by ticket vending machines with QR reader and integration with a contactless "Tallinja card".

There will also be a recharging network formed by seven recharging points and customer attention in offices, SMS coupons for online recharging and a website for online charging requests and checking remaining travel credits.

This is a complex system that will need to cater for nearly 1800 online recharges (70% of total recharges) per day spread over the whole bus fleet in quasi real time. The maintenance system needed to be up to this challenge.

GMV upgrades MONBUS 's fleet-management and ticketing systems

■ GMV contracted with Monbus and beneficiaries the supply of the fleet-management and ticket systems for the 500+ buses running on its most recently awarded concessions since 2020.

The project is part and parcel of the Galician Regional Authority's renewal of its concession procedures, pivoting around two public tenders under which Galicia's transport operators have renewed their existing concessions or won new ones for a ten-year running period.

Technically, GMV has equipped Monbus buses and their beneficiaries with a travel-credit sales console enabled for contactless farecards of the Regional Authority (Xunta) of Galicia and also EMV fare payments and QR code readers. The same console also acts as onboard fleet-management equipment driven by a 4G router as communications module. At control center level GMV has equipped Monbus and its beneficiaries with its ticketing backoffice and fleet management systems, which pass on the same running information to the central systems of the Xunta de Galicia.

Lastly, in July Monbus contracted a series of additional developments and complements to its fleet management and ticketing system, to be phased in as from next March. These are all listed below:

- Enlargement of communication interfaces with new external passenger information panels on the buses.

- Obtaining new KPIs of the fleet management system.

- Implementation of personalized QR code validation.

- Improved and quicker driver authentication.

- Faster ticketing settlements.

- Adaptations in shifts and dispatches.

- Improvements in system data exporting.

These new GMV enhancements make Monbus one of Galicia's ITS spearheads.

Rider, the New App developed by GMV

■ Rider is the new agency-branded Rider App desineg with our American market users in mind, full of information transit riders need. The app lets users access real-time arrival information at nearby stops and routes, receive updates on service alerts, find more information from their local transit agency, and even save their favorite routes.

To create a successful new product, it takes a small army of product managers, designers, and developers all working together. It also takes plenty of participation and feedback from our users. We've taken that user feedback and designed a brand-new interface for the Rider App. This new experience allows users to digest information about their surroundings in a simpler way.

We've also improved alerts by providing additional context. Users receive more personalized alerts based on their app preferences, making information in the app more meaningful. This method of proactive and contextualized alerts has been a key tenet of our Dispatch software, and the new Rider App brings the same philosophy to our rider-facing product.

We purposefully designed the app utilizing accessibility best practices. The new navigation bar at the bottom of the screen is more easily accessible when holding the device. Bigger and bolder text allows users to read and understand information more quickly. We increased the size of touch targets on screen, so users can interact with every part of the app efficiently. We also wrote the app specifically to work with native screen readers on Android and iOS, giving users who are blind or visually impaired an app experience that better fits their needs.

Finally, customization and branding features allow customer marketing and communication teams to configure the app's logos, colors, and other information to reflect their brand.

TISAX assessment completed of GMV's Valladolid and Lisbon sites

■ GMV gives information-integrity, -availability and -confidentiality top priority. The company has therefore set up a wide-ranging roster of measures to protect sensitive or confidential information.

Nearly two years ago now it was decided to adopt the catalogue of information security assessment (ISA) criteria drawn up by the Association of the German Automotive Industry (*Verband der Automobilindustrie*: VDA), which in turn applies the checks laid down by the ISO/IEC 27001 standard (requirements of an information security management system).

The ENX association (European information exchange network), on behalf of VDA, is in charge of running the mechanism known as Trusted Information Security Assessment Exchange (TISAX), which, as the name suggests, supports the exchange of information security assessments (*https://enx.com/tisax*). All TISAX assessments are carried out regularly by qualified auditing firms. In no circumstances, however, are TISAX assessment results made public.

In 2020 the auditing firm TÜV Rheinland completed the TISAX assessment of GMV's Tres Cantos site for the objective "Connection to 3rd Parties with Very High Protection Level".

This year the TISAX assessment has been extended to GMV's Boecillo and Lisbon sites as part of the ongoing process of continuing improvement to GMV's automotive development projects, which kicked off with the rollout of its own information security management system.
This extension has now been completed too; the result is available solely on the ENX portal: *https://portal.enx.com/en-US/TISAX/tisaxassessmentresults*.

Since 2017 TISAX has been providing a common security auditing information assessment and exchange arrangement under the VDA ISA family of standards, which is now being used by over 2500 companies in more than 40 countries. The German automotive industry has without any shadow of a doubt now set out the roadmap for guaranteeing information security in operations with suppliers.

The result obtained by GMV represents a new milestone in the information security management system of the company's intelligent transportation system (ITS) information. It also offers a series of benefits in management of clients' own information security and guarantees total alignment with the supplier requirements laid down by the automotive sector.

GMV with sustainable mobility

EcoMobility, the sustainable mobility conference for the efficient, sustainable and environmentally-friendly automotive sector, took place at the beginning of July. GMV sponsored the event and took part in the round table discussion, held to discuss the advantages and challenges in the transport and mobility sector.

Carlos Barredo, head of the Aftermarket and R&D divisions of GMV's Intelligent Transportation Systems Automotive Business Unit, shared the table with Rosario Chávez, Councilor of Innovation, Economic Development, Employment and Commerce in Valladolid City Council; Carlos Bergera, Head of External Relations of Iberdrola's Smart Mobility; and Laurentino Gutiérrez, founding partner of eKiwi Movilidad.

Barredo highlighted other fields of action to move forward in the transition to the new model of smart, sustainable mobility, such as access management to Low Emisions Zones (LEZ) using GNSS technology. Another aspect that was discussed was the added value of establishing partnerships between the public sector and industry; in this regard, the European Remourban project was highlighted.

Within the context of this project, a more sustainable urban regeneration model was created, focusing on promoting more efficient cities, reducing the environmental impact, encouraging citizen participation, implementing innovative technologies and improving the sustainability of urban transit.

GMV was responsible for the car-sharing system set up for the employees of Valladolid City Council, as well as the monitoring system for the electric vehicles involved in the project.

In this project, GMV was also responsible for monitoring five extended autonomy electric hybrid buses that operate 100% in electric mode in the "Low Emissions Zone" (ZBE).

Smartphones and GNSS technology feature prominently in the rollout of electronic pay-per-use tolling systems

■ GMV has drawn up a GNSS-based toll payment study for BiP&Drive, paying special attention to the potential use of smartphones as the onboard payment method.

Bip&Drive, an investee company of Abertis, Caixa-Bank, Cintra and Itinere, is Spanish leader in electronic tolling systems with over 1 million Via-T devices now rolled out; it also runs an even wider-ranging mobility services payment platform.

One of the study's objectives was to analyze GNSS as a key component in the rollout of vendor-independent pay-per-use systems both in built-up areas and on the open road. Within the roadmap of GNSS receiver development the study looked into likely smartphone improvements in the next few years, making them more conducive to successful employment in pay-per-use and related services.

The reference framework was an analysis of the state-of-the-art GNSS solutions now on the market, looking at the various alternatives and deployments for both light and heavy vehicles. Another factor taken into account was the smartphone's toll-payment potential, checking any limitations on the various scenarios under study and the GNSS-use improvements that might soon be brought into the smartphone to mitigate these weak points.

Yet another important factor was the synergy of the smartphone app with the connected car and services, and the possibilities of developing it from a smartphone app to a future service built into the vehicle's own display screen.

Grupo Antolín turns to GMV for cybersecurity training

■ This agreement reflects the keenness of Tier-1 and OEM suppliers to abide strictly by cybersecurity obligations laid down in Europe and elsewhere, such as the regulation UNECE R-155 (Uniform provisions concerning the approval of vehicles with regards to cybersecurity and cybersecurity management system) and UNECE R-156 (Uniform provisions concerning the approval of vehicles with regards to software update and software updates management system), which in turn come under the aegis,

respectively, of the automotive cybersecurity standard ISO 21434 and the road vehicle Software Update Management System ISO 24089.

Both regulations call for compliance with a series of requirements applicable not only to the company's own internal processes but also the vehicle lifecycle, impinging on the whole value chain of the automotive market. The regulation will be binding for all new types of vehicle as from

July 2022 and for all vehicles of any type as from July 2024.

The course has been given by representatives from the telecommunications and information technology sector, as cybersecurity experts in the fields of IT and infrastructure and from the intelligent transportation systems sector, in particular the automotive business unit, as experts in the automotive and onboard-cybersecurity world.

GMV collaborates in defining the new ISO / SAE 21434 standard on cybersecurity in automotive engineering

On 31 August, SAE International (Society of Automotive Engineers), in collaboration with the International Organization for Standardization (ISO), officially published Standard ISO/SAE 21434: 2021 "Road vehicles — cybersecurity engineering".

This standard will help the automotive industry to define a structured process to guarantee cybersecurity is included in the design of electrical and electronic (E/E) systems in road vehicles, and thus address the changing pace of new technologies and new cyberattacks.

The standard, developed by a technical committee of experts (ISO/TC 22/SC 32/WG 11) including participation from GMV, is a major milestone in cybersecurity for the automotive industry as it will enable organisations to define cybersecurity policies and processes, manage cybersecurity risks, and foster a cybersecurity culture.

ISO/SAE 21434 was developed in parallel to the mandatory regulation UNECE WP.29 / R155, to provide a harmonised regulatory framework for developing secure vehicles.

Today's vehicles work with several different technologies for connectivity and autonomous driving, hence they are sensitive to various threats and vulnerable to cyberattacks.

For several years, GMV has been working to make automotive cybersecurity a reality, incorporating it throughout the product life cycle, including hardware, software, ECUs and remote vehicle supply platforms to encourage the principle of "security by design".
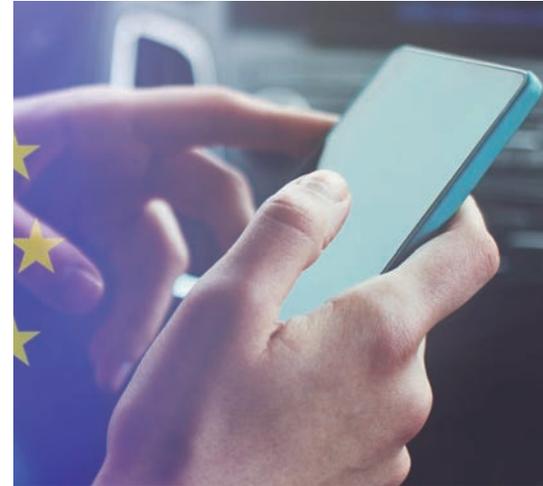
The services GMV offers its clients include support in complying not only with the principles of ISO/SAE 21434, but also the scope of UNECE WP.29 / R155 and making better use of secure development best practices in the automotive industry.

Presentation of the UNE's report on standardization of automated and connected mobility security

The Spanish Standardization Association (Asociación Española de Normalización: UNE) has held the encounter "Cybersecurity standardization needs for smart mobility", in which today's top experts underlined the need for new technical standards in the field of connected and automated mobility in order to come up with a response to the inherent cybersecurity and privacy risks bound up with the latest breakthroughs and advances in this field. The digitalization, cybersecurity and smart mobility of the automotive sector are now being driven by these standards.

One of the sessions at this encounter was given over to a presentation of the report "standardization of automated and connected mobility security", published by UNE in collaboration with the organizations participating in the technical standardization group CTN 320/GT CAV (standing in Spanish for "vehicle cybersecurity"). Carlos Sahuquillo, automotive cybersecurity consultant of GMV's Secure e-Solutions sector, showed some of the most frequent cyberattacks that any connected vehicle might suffer, before moving on to discuss the work currently being carried out by GMV.

The aim of the report presented in the encounter is to lay down a solid base for developing standards that guarantee the interoperability, security and privacy of connected autonomous vehicles and intelligent transportation systems in order to speed up the development and widespread takeup of these standards.

The report identifies the technical standardization bodies, the most important cybersecurity and privacy standards and initiatives in the field of connected automated mobility (CAM) and in the particular case of connected automated vehicles (CAVs), intelligent transportation systems (ITS) and the communication and connectivity technologies involved in these endeavors.

Standardization in these areas is bound to be a strong support for mobility cybersecurity, to the benefit of both public and private organizations.

Furthermore, future smart mobility and connectivity standards will favor successful fulfilment of UN SDGs 1, 9 and 11.

uQuery®, language technology against the new digital communication challenges

GMV's solution is able to manage data based on human language in order to obtain understandable, structured results that enhance the store of available information

The amount of information we generate is constantly increasing; a growing proportion of this information too is unstructured. Few insights are extracted from this information swarm because its processing is usually very complex and resource-intensive. Nonetheless, it is crucial to understand and process all this unstructured information in a short period of time to strengthen our company and rise to the challenges posed by the digital transformation.

Texts are unstructured information and therefore often fall by the wayside, despite their huge potential. In this context natural language processing (NLP) is now coming into its own; it can analyze the textual content, helping to extract knowledge and underlying relations, breaking through the glass ceiling of unstructured-data analysis.

GMV's inhouse solution **uQuery**® is designed to help organizations meet these challenges, especially harnessing the full potential of information stored in texts.

Features

- **Data mining**: facilitates the extraction of data insights and easy access thereto.

- **Quality and accuracy**: all data insights gained in less time, helping to streamline the whole process.

- **Simplicity**: intuitive access to knowledge and easy integration in corporate flows.

- **Technological approach**: tried-and-tested approaches of proven performance.

uQuery®, based on language technology, enables understandable and structured results to be obtained from data based on human language, helping to enrich the store of available, harnessable information.

Drawing on machine learning and NLP, uQuery® works with a very intuitive interface that eases access to and analysis of organizations' information, extracting much more in a much shorter period of time.

NLP-driven systems are capable of obtaining discrete and processable data from texts, enabling machines to analyze much more information than humans can and doing so quickly, consistently and impartially with 24/7 availability. NLP algorithms, furthermore, can adapt to meet the particular needs and criteria of each industry and company, catering for the complex and specific language of each sector in order to correct misused words.
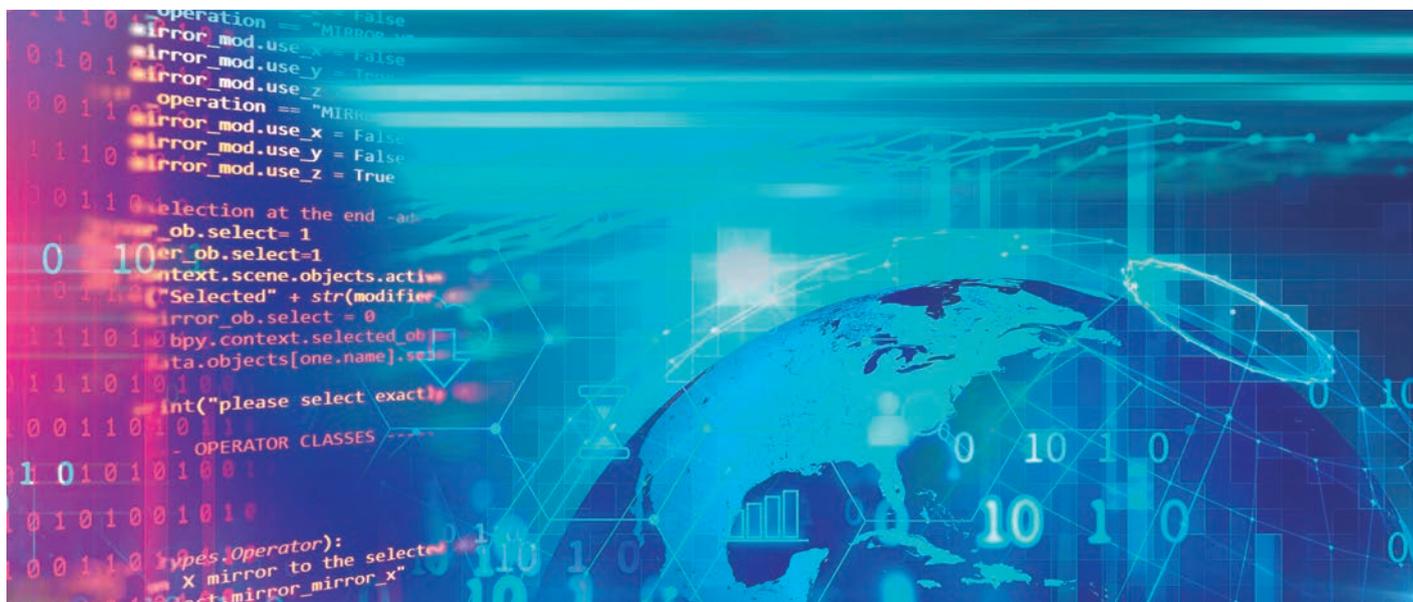
"It is estimated that between 80% and 90% of any organization's information is unstructured, normally in text form"

Technologies that are part of *uQuery*®

- Pseudonymization, Ontologies, Named-Entity Rocognition, Search Engine,

- Language Patterns,Text Summarization, RegEx

- Machine Learning, Keyword Extraction, Text Similarity, Thesaurus, APIs,

- Taxonomies, Deep Learning, Indexing, Topic Modelling

enerTIC encounter on the keys to a competitive and sustainable industry

In late June GMV was present at the encounter "Intelligent Industry & Mobility", organized by the enerTIC platform, which analyzed sensorization, automation and robitization initiatives, projects and technology designed to meet the challenge of bringing in a more sustainable industry.

Miguel Hormigo, Industry Manager of GMV's Secure e-Solutions sector, began his intervention by explaining the current situation in which we are systematically destroying our planet. He then moved on to a method of hope, arguing we are still in time to turn the situation around and improve our future, focusing on three main thrusts: the environment, economic viability and fairness. He argued for a long-term industrial view, seeking competitive advantages, with Spain spearheading technological development and pursuing a sustainable, efficient and ecofriendly energy policy.

In this endeavor industry needs smart software to fix the weak points, focusing on the creation of value, improvement of productivity, discovery of knowledge, management of risks and streamlining of costs. With the right technology companies can become incredibly fleet-footed and responsive in husbanding costs, boosting efficiency and avoiding costly errors. A combination, moreover, of digitalization, automation and data-based knowledge, with a focus on new sustainable business models, could add up to a key driving force that enables us to become competitive without destroying the planet.

Re-encounter for the Recovery and Reinvention of our Economy, Industry and Society

■ The 35th Congress of the Digital Economy and Telecommunications (*Congreso de la Economía Digital y las Telecomunicaciones*) organized by the Spanish Association of Electronics, Digital Contents and ICT Companies (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*; AMETIC) was held onsite in Santander from 1 to 3 September. Under the banner theme "Re-encounter, Recovery and Reinvention", the congress centered on the digital transformation and environmental transition as the basis for the recovery and reinvention of our economy, industry and society.

Luis Fernando Álvarez-Gascón, director general of GMV's Secure e-Solutions sector and AMETIC vice-president, moderated the session analyzing the EU's Next Generation Funds and how best to use them.

As in previous congresses GMV took part in several sessions to discuss the best way of tackling the digital transformation sorely needed by the country at this moment.

Carlos Royo, health-strategy director of GMV's Secure e-Solutions sector and president of AMETIC's Digital Health Committee, gave his take on "The

transformation of the healthcare sector in a digital world". Royo advocated the need for innovation in the healthcare sector; the current model, he argued, is no longer sustainable. "It is unsustainable due to ageing of the population and the increase of chronic, high-cost patients. Eighty percent of Spain's healthcare expenditure goes to 4 chronic illnesses and 90% of individual healthcare spending is crammed into the last ten years of life".

José Carlos Baquero, Artificial Intelligence and Big Data manager of GMV's Secure e-Solutions sector took part in the panel "Artificial Intelligence and the Recovery Plan", centering on the role of Spain's industry and artificial intelligence on a European and worldwide scale. The European Commission is now drawing up a new regulation on AI use. Baquero stressed the concomitant benefits of this regulation, arguing that "it will enable us to tackle AI projects with less risk. There will also be a level playing field for all European firms". Finally he pointed out that Data Sharing initiatives and the creation of "Data Spaces", promoted by the European Commission, represent a chance for European firms "helping us to improve our AI algorithms while abiding by the GDPR and respecting organizations' privacy and confidentiality".

Solution for detection and extraction of information from judicial notifications

■ Public prosecutors, lawyers and payment-collection firms have to process hundreds of judicial notifications a day. This is an unwieldy, costly and error-strewn manual process.

GMV and Atomian have therefore put their heads together to offer the legal sector a solution to automate the detection and extraction of information from judicial notifications, such as the court of first instance, procedure and parties, number of indictments, appeal court, procedure heading, classification of content, objections or key dates. Thanks to cognitive computing, Atomian's solution is capable of construing the text like a person, extracting generic and specific indicators, transcriptions and conclusions from any text and doing so with great precision.

It can also generate a summary and codify indicators. This summary would indicate the objective of the notification on the basis of the literal extract as well as verbalization of the fields extracted both from the procedure heading and classification of content.

Automation of the reading process and the extraction of key information from judicial notifications slash costs and time and cut out human error.

UCM XV Modelling Week

For yet another year GMV has collaborated with the "UCM XV Modelling Week", to promote teamwork, communication, performance orientation and problem solving for mathematics master students in Spanish and foreign universities.

In this year's modelling week, held in June, GMV's big data and artificial intelligence team proposed a real technological problem. This involved the creation of an image-classifying artificial intelligence model using machine learning techniques to train up algorithms in a decentralized architecture formed by multiple devices containing their own local and private data (federated learning). The students worked for a week under the eye of GMV's expert instructors, finally presenting the results and handing in a report on the problem studied.

Federated learning, also known as collaborative learning, is used to train machine learning algorithms (e.g., deep neural nets) on multiple local datasets contained in local nodes without actually exchanging data samples, thus keeping them private. To this end the students were working with *uTile PET*, GMV's inhouse technology for harnessing confidential data in order to improve machine learning algorithms and analytical models, complying at all times with the organizations' requirements, guaranteeing data privacy and law abidance.

GMV in the training of future professionals

■ Talent and training go hand in hand; having a qualified team that is always up to date with state of the art advances is what keeps GMV innovating and providing groundbreaking solutions. With the aim of supporting qualified training in the scientific-technological field, GMV collaborates with around fifty educational centers each year. An example of this is the support and participation in the Space Studies Program (SSP), offered by the ISU (International Space University). This program, aimed at professionals from different disciplines and graduate students, offers interdisciplinary higher education in different areas related to the space sector, ranging from the fields of engineering and physics to the humanities, law, business administration and even life sciences.

The 2021 edition took place from June 28 to August 27. Due to COVID-19 health recommendations, it was held in a hybrid format, combining in-person events with limited capacity and online training with the University of Granada and the ISU headquarters in Strasbourg. GMV, as a collaborating entity, sponsored the course's opening ceremony held in Granada and has been actively involved throughout the program.

One of the kickoff events was the round table on Spain's space industry, moderated by Ricardo Martí, president of TEDAE. Pedro Schoch, Director of Corporate Development, Marketing and Communication of GMV, took part in this forum together with leading industry representatives to talk about the role of Spain's industrial fabric in the global space sector, the importance of international cooperation and future prospects, among other aspects.

As part of this program, Mariella Graziano, Executive Director of Strategy and Business Development of Flight Systems and Robotics of GMV's Aerospace sector, took part in a meeting on employability in the space industry to discuss the knowledge and skills that will be demanded of future professionals in this sector.

Misbahur Rehman-Saad, from Flight Dynamics and Operations Business Unit of GMV's Aerospace sector in Germany and member of ESA's European Astronaut Center (EAC) training team, also took part in one of the program sessions on space operations and in the workshop on onboard activity planning for manned spaceflight missions.

On July 23 it was GMV's turn, which, through a virtual meeting, shared its knowledge of robotics with the students, specifically on-orbit mobility and manipulations.

#EsElMomento campaign

■ Over the past year and a half, the pandemic has highlighted our ability to adapt, the importance of togetherness and the need to be resilient. GMV's president, Mónica Martínez Walter, talks about this in the context of the #EsElMomento campaign (It is The Moment) recently launched by the German Chamber of Commerce for Spain.

This campaign, geared towards the industrial fabric, aims to encourage economic reactivation, with special emphasis on the benefits that relations between Spain and Germany can bring. Through short testimonials, industry and political entities add their vision to the message that the AHK wants to convey in this campaign regarding the importance of working together towards a more competitive, sustainable and innovative future. In this sense, Mónica Martínez points out the value of technological innovation to boost business activity in favor of economic recovery, highlighting the fundamental role that technology has played during the pandemic.

GMV uses technology to develop groundbreaking solutions for progress. From the outset, technological innovation has been and continues to be the mainstay of GMV's growth, and has now become an essential development factor for tackling the challenges that societies demand.

GMV, acts as nexus between today's and tomorrow's vocational training

GMV collaborates with different training centers to pass on companies' real needs of skillsets and technology

Our parents would probably have dismissed it as science fiction if we'd told that that in the future we could be operated on by clinicians hundreds of kilometers away, that vehicles would be safely driving themselves or that robots would be sent into space.

But all this and more has become possible thanks to the ongoing collaboration of firms like GMV with various teaching centers, passing onto them the technology needed now and in the future and the skillsets to be built in tandem by both parties,

making what had once seemed wild dreams come true.

Pride of place among these training collaborations go to the following: internships for university and vocational-training students: site visits by 10th grade pupils to find out what makes industry tick; participation in the definition of vocational-training syllabi up to master level and industrial PhD projects. New technologies and innovation have enabled these activities to carry on despite the COVID-19 lockdowns, mainly by switching to online procedures. These

contributions will help to guarantee future skillsets that match ongoing commercial and industrial needs while also helping society to forge ahead in the future on the strength of the new technologies we are developing today.

GMV runs its own stable of training experts but also invites in special guests to talk about their own specialties, while others collaborate in various ways with universities or training colleges to explain companies' needs today and encourage development of the appropriate skills and knowledge now and into the future.

Carlos Barredo
Intelligent Transportation Systems

During my student years I belonged to the University Astronomy Group housed in the Science Faculty of Valladolid University. This has since allowed me to keep in touch with each year's crop of students as they pass through the university.

Since 2002 this contact has picked up in intensity as I began to collaborate in some subjects with the Signal Theory and Communications Department and, in more recent years, with the Electronics Department in the university's Higher Telecommunications Engineering School.

Since then I have been intermittently giving lectures on some eminently practical subjects related to project analysis or electronics and programming practices, areas with the best match of expertise and experience between a firm like GMV and the university.

In recent years the university has been going through a digital transformation, fast-tracked to deal with the COVID-19 pandemic. On-site training has now been enriched with other means of virtual teaching. Theory class videos, online tutorials and remote access to lab resources are all overhauling the teaching models we have become used to, enabling teachers to address subjects from multiple angles and students to choose different ways of learning them.

GMV's flexibility enables us to keep abreast of the university's teaching activities and syllabi while also keeping close tabs too on the next generation of experts who might well end up as GMV employees.

Carlos Moreno
Digital Strategy for Business

In 2020 GMV set up the dual vocational training initiative (FP Dual) with the Higher Studies Institute (IES in Spanish initials) Clara del Rey. The main aim of this initiative is to set up smoother working arrangements between interns, their schools and their workplace. This model divides the training into two years, the first 100% theory and the second 100% onsite internship. This makes students' adaptation to their new posts more gradual, to the benefit of their overall results at the end of the year. Unlike other internship arrangements, under this model the firm participates in the students' marks, GMV chipping in with 20% of the final qualification at the end of the training cycle.

This new training model allows schools and universities to achieve better adaptation to new technologies, methodologies, etc. For a whole year, after all, students are given insights into the collaborating firm's state-of-the-art technology and greater familiarity and expertise in using this technology, in this case GMV's. This technology is likely to be much more up to date than any that could be realistically offered by a school or university.

True it is that one year might be a short span of time for gaining a sound technological base. Maybe this needs some looking at. Here is where the company comes in, topping up the training not only with the students' hands-on experience but also short courses firmly oriented towards the jobs of the future. Students only need to do their own bit to make sure they can join the working world with all guarantees of future success.

This model is time-consuming if it is to work properly. But there is no doubt that it is a forward-looking policy that, properly managed, will ensure our future staff is not only highly skilled but also firmly committed to GMV.

Global solutions for the space sector

We at GMV do all within our power to provide the best possible bespoke solutions for our space clients' needs. Over the last 35 years GMV has proved itself to be a reliable, proactive and listening partner, working in a team to seek groundbreaking, value-adding solutions that keep the sector up to speed with the constantly evolving challenges.

marketing.space@gmv.com
gmv.com

gmv®

INNOVATING SOLUTIONS

GMV in the world

SPAIN
Headquarters
Isaac Newton 11 P.T.M. Tres Cantos – 28760 Madrid
Tel.: +34 91 807 21 00 Fax: +34 91 807 21 99

Santiago Grisolía, 4 P.T.M. Tres Cantos – 28760 Madrid
Tel.: 91 807 21 00 Fax: 91 807 21 99

Juan de Herrera No. 17 P.T.Boecillo – 47151 Valladolid
Tel.: +34 983 54 65 54 Fax: +34 983 54 65 53

Andrés Laguna, n.º 9-11. P.T.B. – 47151 Boecillo, Valladolid
Tel.: 98 354 65 54 Fax: 98 354 65 53

Albert Einstein, s/n 5ª Planta, Módulo 2 Edificio Insur Cartuja – 41092 Seville
Tel.: +34 95 408 80 60 Fax.: +34 95 408 12 33

Edificio Nova Gran Via, Avda. de la Granvia 16-20, 2ª planta
Hospitalet de Llobregat, 08902 Barcelona
Tel.: +34 932 721 848 Fax: +34 932 156 187

Mas Dorca 13, Nave 5 Pol. Ind. L'Ametlla Park
L'Ametlla del Vallés – 08480 Barcelona
Tel.: +34 93 845 79 00 – +34 93 845 79 10 Fax: + 34 93 781 16 61

Edificio Sorolla Center, Nivel 1 Local 7, Av. Cortes
Valencianas, 58 – 46015 Valencia
Tel.: +34 963 323 900 Fax: +34 963 323 901

Parque Empresarial Dinamiza. Avda. Ranillas, 1D – Edificio Dinamiza 1D,
planta 3ª, oficinas B y C – 50018 Zaragoza
Tel.: +34 976 50 68 08 Fax: +34 976 74 08 09

BELGIUM
Rue Belliard, 40 – Bureau No. 117 1040 Brussels
Ph.: +32 278632 25

COLOMBIA
St. 81 no. 11-08 Plant 05 – Office 05-120, 110221 Bogotá
Ph.: +57 3208073919

FRANCE
17, rue Hermès – 31520 Ramonville St. Agne. Toulouse
Ph.: +33 (0) 534314261 Fax: +33 (0) 562067963

GERMANY
Münchener Straße 20 – 82234 Weßling
Ph.: +49 (0) 8153 28 1822 Fax: +49 (0) 8153 28 1885

Friedrichshafener Straße 7 – 82205 Gilching
Ph.: +49 (0) 8105 77670 160 Fax: +49 (0) 8153 28 1885

Europaplatz 2, 5. OG, D-64293 Darmstadt
Ph.: +49 (0) 6151 3972970 Fax: +49 (0) 6151 8609415

MALAYSIA
Level 8, Pavilion KL 168, Jalan Bukit Bintang, 55100 Kuala Lumpur
Ph.: (+603) 9205 8440 Fax: (+603) 9205 7788

POLAND
Ul. Hrubieszowska 2, 01-209 Warsaw
Ph.: +48 22 395 51 65 Fax: +48 22 395 51 67

PORTUGAL
Alameda dos Oceanos, 115, 1990-392 Lisbon
Ph.: +351 21 382 93 66 Fax: +351 21 386 64 93

ROMANIA
SkyTower, 246C Calea Floreasca, 32nd Floor, District 1, postal code 014476, Bucharest
Ph.: +40 318 242 800 Fax: +40 318 242 801

UNITED KINGDOM
GMV NSL
HQ Building, Bldg 77. 1st floor. Thomson Avenue, Harwell Science and Innovation Campus, Didcot,Oxfordshire OX11 0QG
Ph: +44 (0) 1865954477 Fax: +44 (0) 1865954473

GMV NSL
Sir Colin Campbell Building. Innovation Park. Triumph Road Nottingham NG7 2TU
Ph: +44 (0) 1157486800 Fax: +44 (0) 1159682961

USA
2400 Research Blvd, Ste 390 Rockville, MD 20850
Ph.: +1 (240) 252-2320 Fax: +1 (240) 252-2321

GMV SYNCROMATICS
523 W 6th St Suite 444 Los Angeles, 90014
Ph.: +1 (310) 728-6997 Fax: +1 (310) 734-6831

GMV SYNCROMATICS
15503 W. Hardy Road Houston, Texas 77060