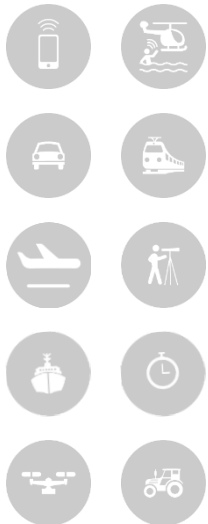


Market & Technology Trends

2021 / Edition 4



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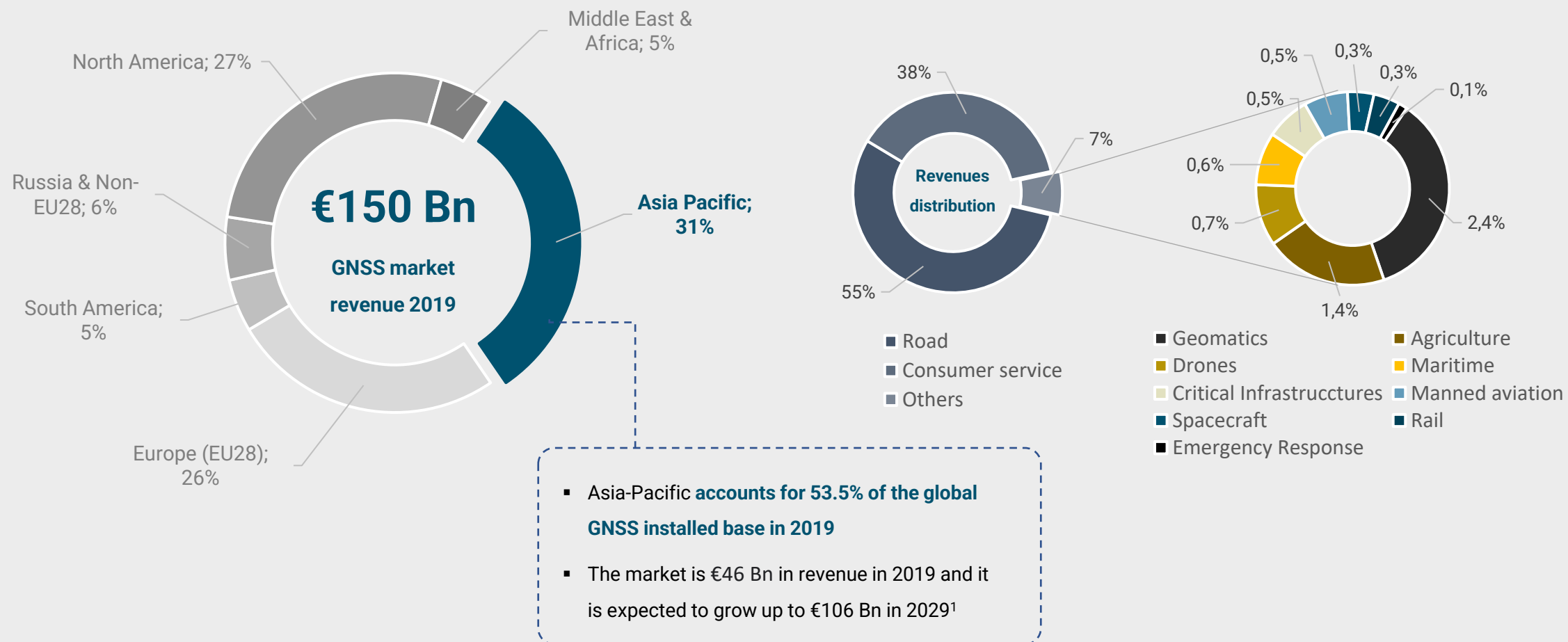


GNSS.asia is funded by the European Union within Horizon 2020, the EU Framework Programme for Research and Innovation, under grant agreement no 870296.

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THE GNSS MARKET IN ASIA-PACIFIC IN A NUTSHELL



1: https://www.euspa.europa.eu/system/files/reports/market_report_issue_6_v2.pdf

KEY GNSS MARKET & TECHNOLOGY TRENDS IN ASIA-PACIFIC

US-KOREA SUMMIT BOOSTED COLLABORATION

The summit meeting between Korean President Moon Jae-in and US President Joe Biden in May 2021 was a defining moment for South Korea's major space programmes in the years to come. The joint statement laid out an unprecedented level of technology cooperation for the future, including space development.

In October 2021 MICHIBIKI's first satellite successor was launched from the Tanegashima Space Centre. In addition to its various functionalities, it not only aims to improve the positioning accuracy of car navigation systems, but also to contribute to the development of autonomous driving.

MICHIBIKI SATELLITE HAS BEEN LAUNCHED

SOUTH KOREA'S GNSS PROJECT TO TAKE OFF WITH €2.8 BILLION BUDGET

In June 2021, the Korea Positioning System (KPS) proposal passed the budget feasibility study, paving the way for a KRW 3.72 trillion (€2.8 billion) project by the Ministry of Science & ICT (MSIT). With the budget approval, the project will begin next year to launch 8 satellites (3 GEOs, 5 IGSOs) by 2035.

BeiDou adoption is being promoted heavily across China and many new application areas of the GNSS have emerged in the past year. For example, to support operations and safety requirements, BeiDou is used for railroad inspections since January and is also being employed increasingly to support rescue missions.

APPLICATION AREAS OF CHINA'S GNSS ARE EXPANDING

BEIDOU SHORT MESSAGE COMMUNICATION FUNCTION REALISED

In May 2021, China North Industries Group published the results of the integration of Beidou-3 short message communication into mobile phones for the general public in Beijing. Consumer smartphones successfully completed the interchange of short message information, marking BeiDou short message communication service able to provide direct services on smartphones.

Apart from the ongoing expansion of Australia's GNSS ground network, the country is working on fostering its space sector with international partnerships. In February, the UK and Australia signed a partnership agreement titled 'Space Bridge' and India has signed an MoU in the same month for more collaboration on Space topics

AUSTRALIA IS STRENGTHENING ITS SPACE PARTNERSHIPS

TAIWAN INVESTS €800 MN IN ITS LOCAL SPACE INDUSTRY

Taiwan is trying to secure a strategic position in the space industry's supply chain by leveraging its competitive capacity in semiconductor and precision engineering. With the "Space Development Promotion Act" passed in May 2021, the Taiwanese government declared to invest NT\$25.1 Bn (€800 Mn) in the local space sector by 2028.

The Satellite Based Augmentation System (SBAS) of Australia and New Zealand has officially been named the Southern Positioning Augmentation Network, or SouthPAN. It augments data from the GPS and Galileo constellations across the two countries to improve accuracy from 5-10 metres down to 10 centimetres.

AUSTRALASIA'S SBAS HAS A NAME

KEY GNSS STAKEHOLDERS IN ASIA-PACIFIC

	INSTITUTIONS	HARDWARE MANUFACTURERS	SYSTEM INTEGRATORS / PROVIDERS
Japan			
Korea			
China			
Taiwan			
India			
Australasia			

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OVERVIEW OF KOREAN MARKET TRENDS

- Korea is promoting the space sector by investing heavily (> €4 Bn in total) in space projects such as launch vehicles, a regional satellite navigation system (KPS), and even a lunar exploration programme
- The Korean New Deal includes both a Digital and Green New Deal. It embraces megatrends such as Digitalisation, Data, AI, and Climate Change, all of which rely on GNSS-powered solutions such as autonomous driving, shipping, and smart cities

KEY TRENDS IN EDITION FOUR

- Korea is **strengthening partnership with USA and European countries** about space collaboration and defence
- Korean new **domestically developed launcher** promises to boost the upstream sector
- **Location Based Services (LBS)** drove the market **during pandemic** helping commercial activities to continue their business
- Drone market faced a **significant growth** mostly driven by autonomous smart applications such as surveillance and maintenance
- Government and companies are increasing their participation in **AI-based initiatives**



US-Korea summit boosted collaboration between the two countries in the space domain

US-KOREA SUMMIT CREATES NEW ROUTES FOR COLLABORATION

The summit meeting between Korean President Moon Jae-in and US President Joe Biden in May 2021 was a defining moment for South Korea's major space programmes in the years to come. The joint statement laid out an unprecedented level of technology cooperation for the future, including space development. Reflecting the US focus on an emerging strategic competition in the Indo-Pacific region, the

bilateral agreement emphasized high-tech partnership, resilient supply chain, and space capabilities that have both civilian and military implications. With regard to cooperation on space, there were three key points that would have a fundamental impact on South Korea's space activities:

Termination of the bilateral Missile Guidelines

The two leaders agreed to terminate the decades-long restrictions on South Korea's development of launch vehicles/ballistic missiles signed initially in 1979. The US had pressured the guidelines out of concern that South Korea's growing missile capabilities could cause a regional arms race. In return, the US would provide technologies within the restrictions. Since then, the agreement went through four revisions allowing South Korea for more payload and more extended range. The most recent revision in July 2020 granted the country to use of solid-fuel propellants for launch vehicles. With any conditions on payload, range, and propellants lifted, South Korea's rocket capabilities will likely affect the regional security dynamic as well as the country's planning on space activities.

Participation in international civil space exploration

The joint statement said, "[E]xpand cooperation on space exploration facilitated by the Republic of Korea's decision to sign the Artemis Accords, joining nine other nations focused on returning to the moon by 2024 and ultimately expand and deepen space exploration." South Korea's subsequent signing of the Artemis Accords (see below) will qualitatively upgrade its relationship with international partners in exploring outer space.

Korea Positioning System

The joint statement clearly affirmed the "Support for the ROK's development of its own satellite navigation system, the Korean Positioning System, and enhance its compatibility and interoperability with the Global Positioning System." Soon afterwards, the KPS proposal passed the budget feasibility review in June and would begin developing next year.

Following up on the South US-Korea Summit where the two presidents agreed to strengthen cooperation in civil space research and development, South Korea signed two agreements in May 2021. First, it signed the Artemis Accords as the 10th signatory to join in the NASA-led lunar exploration programme. Second, South Korea signed the "civil global navigation satellite systems cooperation" agreement on the same day.

KOREA SIGNS AN AGREEMENT ABOUT GNSS COLLABORATION

Korean upstream takes advantage of the new developed homegrown launch vehicle

ROKAF AND USSF AGREED ON FUTURE COLLABORATION

In August 2021, South Korean Air Force (ROKAF) chief, Gen. In-ho PARK, visited the United States, met General James Dickinson, the US Space Force Commander, and signed an agreement on bilateral military space cooperation.

Under the agreement, ROKAF joins in the US Space Force-led drills, share space surveillance information, and establish a joint consultative body to coordinate space policy. The consultative body will also discuss the development of Korea Positioning System (KPS).

KPS PROPOSAL PASSED BUDGET FEASIBILITY STUDY

In June 2021, the Korea Positioning System (KPS) proposal passed the budget feasibility study, paving the way for a KRW 3.72 trillion (€2.8 billion) project by the Ministry of Science & ICT (MSIT). With the budget approval, the project will begin next year to launch 8 satellites (3 GEOs, 5 IGSOs) by 2035. The first satellite will be launched in 2027, and a trial service will be scheduled in 2034.

Designed to be fully compatible with the American GPS system, KPS is expected to reduce the current GPS error of maximum of 20 metres in South Korea to 2.5 centimetres. Such accuracy in positioning will make possible self-driving vehicles, urban air mobility, and other solutions that need highly accurate location information. The coverage of the system will reach Southeast Asia, Australia and New Zealand.

KPS had failed its feasibility study a year ago. It appears that strategic considerations were the key to its revival. During the US-Korea summit in May, US President Joe Biden promised to support the project while ensuring its interoperability with the existing GPS. South Korea and the US signed a "civil global navigation satellite systems cooperation" to seal the deal on 27 May 2021.

South Korea's first next-generation mid-sized Earth Observation satellite, categorized as CAS-500 (Compact Advanced Satellite, 500kg-class), was successfully launched on March 2021 in Kazakhstan. KARI confirmed that all systems were nominal, and it reached its orbit without a problem.

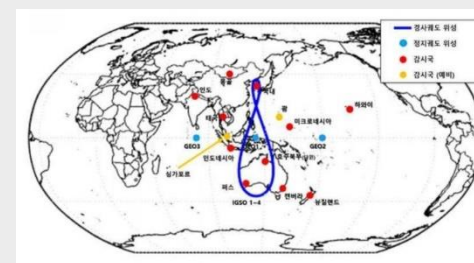
From the industrial perspective, the CAS-500-1 marks the beginning of a more private sector-driven space development. KARI has developed the satellite with a group of industry partners, transferring key technologies to private aerospace companies which will take the lead in the development of satellites in the future.

The second Korea Space Launch Vehicle (KSLV-II), nicknamed NURI, has been launched in October 2021. The three-stage KSLV-II had four 75-tonne liquid-fuelled cluster engines in the first stage rocket, a single 75-tonne engine in the second-stage booster, and a 7-tonne engine in the third stage.

The vehicle completed its full flight sequence but failed in its goal of putting a dummy satellite in orbit due to technical issues. The next flight is scheduled in May 2022, and it will bring a 200kg satellite in orbit.

FIRST CAS-500 SATELLITE LAUNCHED

FIRST SPACE FLIGHT OF A KOREAN LAUNCHER



KPS coverage area



KSLV-II NURI

Korean space market attracts new public and private investments

DAPA UNVEILS INVESTMENT ROADMAP FOR DEFENCE AND OUTER SPACE

In August 2021, South Korea's Defense Acquisition Program Administration (DAPA), responsible for the country's arms procurement, unveiled a draft roadmap to invest KRW 16 trillion (€11.5 billion) in the next 10 years to boost defence capabilities in outer space. The roadmap has been shared with relevant ministries and is subject to coordination to smooth out regulatory, technological, and industrial issues. It is confirmed to include a KRW 1.6 trillion (€1.15 Bn)

investment in core technologies for military satellites. South Korea's defence sector has started to double down its effort to bolster space capabilities since the Missile Guidelines imposed by the US was terminated in May 2021

HANWHA GROUP INVESTS \$30 MN IN SATELLITE COMMUNICATION

Hanwha Group is the most visible player in an emerging "New Space" in Korea. Starting with the acquisition of Phasor Solutions, British satellite antenna developer in June 2020 by Hanwha Systems, the conglomerate has continued to increase its investment in the space sector. In December 2020, Hanwha Systems invested \$30 million (a 10% stake) in a US-based satellite communications company, Kymeta, and formed a partnership for entering low Earth orbit antenna market.

In January 2021, Hanwha Aerospace announced its purchase of a 20% stake (eventually 30%) in Satrec Initiative, South Korea's only domestic manufacturer capable of developing electro-optical satellite system. In March, Hanwha Systems announced its plan to deploy 2,000 LEOs by 2030 to provide connectivity for the operations of urban mobility and drones. More recently, in August, Hanwha Systems committed \$300 million (€254 million), an 8.8% stake in OneWeb, British satellite broadband company. In addition, Hanwha is participating in government projects – including KSLV-II engine development, and the construction of launch facilities. It seems likely that the Hanwha Group will continue playing a significant role in commercial space activities in the years to come.

In April 2021, Korea Aerospace Industries (KAI) announced that it would invest KRW 1 trillion (€745 million) over the next five years to expand its space business. The company plans to acquire companies or establish partnerships to strengthen ground station and satellite imagery analysis technologies.

The aerospace company has been involved in major government-led space projects since 1999, securing technology and know-how in various mid-sized and large satellite development. Notable projects KAI has participated in include Korea Multi-Purpose Satellites 1 to 7 (KOMPSAT, Arirang 1-7), a geostationary multi-purpose satellite, the first private-led mid-sized next-generation satellite, and a defence satellite. It will also be a leading company to inherit satellite manufacturing technologies from KARI (see below) and plays a central role in forming a consortium to advance space-related research.

Satrec Initiative has been well known for manufacturing small and medium-sized Earth observation satellites. Founded in 1999 by engineers who had participated in building South Korea's first satellite, Satrec Initiative is specialized in EO satellites and ground systems. With the recent investment from Hanwha, Satrec Initiative will still be managed independently but leverage financial resources and strategic backing from Hanwha. The strategic partnership between the two companies is expected to be an edge in the international market.

After investments coming from USA, Japan, and France, Hanwha Systems, a Korean technology company, invested €265 Mn in OneWeb for an 8.8% share. OneWeb's total equity investment is now worth to €2.4 Bn. The investment is expected to be completed in the first half of 2022, subject to regulatory approvals.

KAI ANNOUNCED €745 MN TO EXPAND SPACE BUSINESS

SATREC INITIATIVE RAISES FUNDING

HANWHA SYSTEMS INVESTS €265 MN IN ONEWEB

Location Based Services (LBS) supported commercial activities during pandemic

LBS INDUSTRY STATUS AND TRENDS FOR 2020 PUBLISHED IN MARCH 2021

In March 2021, the Korea Internet & Security Agency (KISA) published LBS Industry Status and Trends for 2020, reviewing the market status and service developments. According to the report, the sales volume had reached KRW 2.33 trillion (€1.7 billion), marking a 13.7% year-on-year increase. The estimated sales for 2021 was KRW 2.517 trillion. The survey data show that, as of 2020, 34% of location-based services

were for person/object tracking, followed by map and navigation (29.1%) and entertainment (23.5%).

Regarding the prospect of new business opportunities with location information, 24% of those who responded picked big data analysis, and 13.7% advertising and marketing. Moreover, location information and services will be available on more diverse platforms and devices. Currently, they are used almost exclusively on smartphones, wearables, tablet PCs, and regular PCs. In the future, however, autonomous vehicles, drones, and robots are likely to be new platforms to process location information.

In addition to the market growth, some qualitative developments have been noticed in 2021: the COVID pandemic is reshaping consumption patterns - one of which is a trend of "hyperlocal." There is an effort to complement GNSS positioning with 5G connections. Meanwhile, Samsung unveiled the industry's first 5-nanometer processor for wearables.

GNSS HAD AN ESSENTIAL ROLE DURING PANDEMIC IN SUPPORTING BUSINESS

With social distancing restrictions in place, people look for commercial opportunities within a neighbourhood. The combined use of mobile apps and GNSS is essential in finding places of interest and making business transactions. In line with this trend, apps sharing local information and online trading platforms in a well-defined community have expanded their services.

Karrot Market (Danggeun Market): Danggeun means "in your neighbourhood" as well as "carrot" in Korean. Founded in 2015, it is a second-hand goods trading app designed to use your location to identify potential buyers and sellers near you. What differentiates the app from other online marketplaces is its 6km rule. Only users within a 6 km range can trade with each other. The application is expanding its service areas to job opportunities and real estate in the neighbourhood. More recently, local governments/district offices have employed the platform to share information on polling stations, district events, local SME support projects, and administrative notice.

Naver: South Korea's largest online platform and search engine added a "neighbour service" to its community app (called café) in December 2020. Based on a user's location, the service shows communities related to a user's neighbourhood, second-hand trading cafés (communities) near the user, and the most viewed posts in the area. The "Neighbour Talk" function was added in March 2021 to communicate with residents nearby once the user's location information is verified.

In June 2021, LG U Plus, BIDC, and Russell Robotics signed an MoU for cooperation in the automated logistics business. The three signatories would collaborate to increase operational efficiency at Busan New Port with 5G-based automated logistics equipment and high-precision location solutions.

The logistics equipment will be able to transmit a large amount of data, through a 28GHz 5G network, to the Busan Mobile Edge Computing (MEC) Centre, being built by LG U plus. It will also provide a high-precision location data RTK solution, which will be used as basic information for a digital twin and 5G networks. The RTK-GNSS terminal will communicate with the RTK server and correct GNSS signals in real-time via 5G.

BUSAN'S NEW PORT WILL BENEFIT FROM GNSS ENHANCED LOGISTIC SERVICES

Driven by consumer applications, drones market is getting traction in Korea

HANCOM IS INCREASING ITS PRESENCE IN THE DRONE INDUSTRY

Hancom, well-known for its indigenous word processor 'Hangul' that still has market power in Korea, expands its business to drone and space sectors. In 2020, Hancom acquired InSpace, a venture company specialising in space photogrammetry image analysis, and developed drones.

Now, the company is developing a multi-purpose fire drone operation system called "Drone SAT" under a contract with a local government for fire monitoring. Drone SAT is an unmanned system where drones collect weather data automatically by default set by the ground station, operate data collecting missions accordingly, and self-charge batteries once they return to the station. Moreover, the system is capable of real-time monitoring and data transmission with its own image analysis and AI technologies, providing results for image processing, object tracking, and 3D mapping.

ADD ANNOUNCES DEVELOPMENT OF AUTONOMOUS UAV NAVIGATION TECHNOLOGY

In May 2011, South Korea's Agency for Defence Development (ADD) announced that it had developed a new autonomous navigation technology for unmanned aerial vehicles (UAVs). The system sets a flight path independently and generates an algorithm to reach the pre-set destination. It also enables a UAV to avoid potential threats and obstacles using information collected from a sensor mounted on it.



Drone show in Seoul



Drones for golf courts maintenance

Paju City, 28km northwest of Seoul, organized a joint public-private inspection team and conducted a safety inspection of outdoor advertisement boards ahead of storms and floods in the summer.

For the first time in the country, in June 2021, the joint inspection team used drones to examine protruding signs and advertising boards on the walls of buildings, especially buildings around busy streets where a large crowd could gather or many pedestrians walk by. The inspection checked up whether signs were firmly attached. If drones spotted any loosely attached boards, they would be subject to urgent administrative action leading to immediate repair or removal.

PAJU CITY TO EMPLOY DRONES TO INSPECT OUTDOOR AD BOARDS

Remotely controlled grass watering system, GNSS-based system to analyze grass conditions and soil temperature, and golf carts with set-top boxes sending warning signals to other carts nearby to prevent accidents. These are part of solutions that IoT start-up SwingSaver has introduced to golf clubs in Korea as well as in Japan and Hawaii.

Although managing golf courses are still labour-intensive in South Korea, interest in automated solutions is growing. For example, Hancom InSpace, a satellite and drone manufacturing arm of Hancom Group, signed an agreement with a drone data analyzer, UFO Astronaut, in May 2021 to develop drone solutions for golf course management. Drones will monitor grass conditions sensitive to weather and transmit video data for analysis and further management. Meanwhile, Kolon Hotel has adopted an AI golf cart service, HelloCaddy. The self-driving golf carts not only carry golf bags but also keep golfers on course.

GOLF COURSES USED DRONES FOR MAINTENANCE

Emergency response and agriculture are key thematic in Korean GNSS environment

JEJU LAUNCHED A GNSS EMERGENCY RESPONSE SYSTEM

In March 2021, a new emergency response/rescue system based on high-precision GNSS and designed with public-private partnership launched its first service in Jeju island. The purpose of the system is to ensure transportation and transfer of emergency victims/patients within a critical period. High-accuracy GNSS positioning information and the network of public and private medical institutions constitute an essential part of the new emergency response structure as they enable the system to optimize transfer routes and secure medical resources. The Jeju Provincial Government, Jeju Fire Safety HQ, Maritime Police Agency joined the initiative along with general hospitals, public health clinics and telecommunication companies in Jeju.

The service will notify accident victims of the position of a rescue unit and the estimated time of arrival, reassuring them under stressful situations. Moreover, emergency vehicles can take the shortest route according to real-time guidance, and paramedics will be able to check the availability of medical resources and hospital capacity. Overall, the dispatch time is expected to be considerably reduced.

SKT-KEC TO EXPAND ACCIDENT RESPONSE SERVICE

In case of a collision in an expressway, the risk of secondary accidents is high as the following vehicles must make sudden stops. It is not uncommon that disrupted traffic around the collision spot puts other cars at risk even 15-20 minutes after the accident. SK Telecom's LITMUS, an AI-based location analysis platform, helps prevent additional accidents using V2X (Vehicle to Everything) to send notifications. Korea Expressway Corporation and SK Telecom expanded this service to operate on T-map app, SK Telecom's mobile map application, from May 2021. LITMUS collects traffic data to detect unusual signs. Once an accident is detected, LITMUS will notify KEC. Then KEC confirms the site situation through nearby CCTV and sends out a notification to vehicles within the 2km range of the accident through T-map. As a result, cars approaching the accident site will be warned and prepared to drive more safely.

The agriculture sector faces numerous challenges, of which demographic decline and the subsequent shortage of labour needs addressing urgently. Also required are efforts to improve productivity and create added value. For these reasons, ICT convergence and self-driving technologies are often regarded as effective solutions to the challenges.

Back in 2019, the Ministry of Agriculture, Food and Rural Affairs (MAFRA), the Rural Development Administration (RDA), and the Korea Forest Service (KFS) announced the 3rd Comprehensive Plan to apply science and technology for the agriculture and forestry sectors. Moreover, the government agencies are expanding the scope of research to cover smart farming, drones, big data and AI-based platforms, in addition to eco-friendly farming (fertilizers, renewable energy, biotechnology).

RDA and Gangwon Agricultural Technology Institute have developed autonomous driving based on image recognition technology while improving self-driving tractors with RTK-GPS.

The self-driving tractor drives straight and turns along the pre-set paths by utilizing real-time location information (from the National Geographic Information Service) as correction signals. It operates on high-precision positional information within a 2-3 cm measurement error. The self-driving tractor by AI-enabled image recognition technology has a front camera. The camera continuously takes photos of soil crushing work while driving; then, a processor analyses them with a deep-learning model and discerns cultivated paths' boundaries. Finally, the system keeps calculating errors from the pre-programmed driving baseline and controls the tractor accordingly. The image recognition system has turned out to operate on a smaller margin of error compared to a human driver, and it has the advantage of coping with unexpected situations or obstacles. Moreover, it is likely to replace some GNSS-controlled self-driving tractors, for it is more cost-effective than GNSS-based models.

RDA ANNOUNCED A PLAN TO APPLY SCIENCE AND TECHNOLOGY FOR THE AGRICULTURE

AUTONOMOUS DRIVING FOR AGRICULTURE

Robot and AI sectors are taking advantage of increased government and private interest

TELECOM COMPANIES FOUND NEW GROWTH POTENTIAL IN ROBOT INDUSTRY

South Korea's three major telecommunication companies - SK Telecom, KT, and LG U Plus - have found new growth potentials in the robot industry. Armed with 5G technologies and networks, the telecommunication giants are stepping up their robot development and control efforts.

5G technology is particularly important for robots. The "hyper-connectivity" and low delay, essential for sophisticated robot control,

are only available in the 5G environment. It is because 5G can connect a large number of complex electronic devices with little latency, whereas even LTE networks are primarily for mobile communication. 5G also has an overwhelming advantage in location accuracy - with a 10cm margin of error compared to 50m in the LTE network.

From the market perspective, the telecommunication industry expects 5G-related B2B (including robotics) to take up over 72% of the 5G market in five years. With the traditional mobile phone market saturated, telecommunication companies have a good reason to cultivate and expand the robot industry.

Some examples of the growing attention towards robots follow:

- **SK Telecom:** In collaboration with Yonsei Severance Hospital, it has successfully commercialized a multifunctional disease control/quarantine robot solution for the first time in the world. The robot - called "Keemi" - operates in the 5G network and the real-time location tracking system (RTLS). Its primary function is to provide contact-free basic care service: identifying visitors using the embedded AI-enabled face recognition system, measuring their body temperatures, checking if a person wears a mask, and giving social distancing guidelines when more people are gathered than allowed.

- **KT** has launched the pilot "AI Robot Mail Delivery Service" for employees working in central Seoul's main office building. With mails and parcels loaded, the robot rides in the elevator and autonomously moves to offices tagged in advance where recipients are. This is the first indoor logistics service that KT has attempted using AI robots. The company plans to expand the service to general offices.
- **LG U+** has rolled out a self-driving AI robot to collect air quality and atmospheric environment data in Jeonju-si, 200km southwest of Seoul. The robot transmits the collected environmental data to a Mobile Edge Computing Centre (MEC) located in Gwangju city, 70km away, through 5G.

South Korea ranks fourth in terms of the number of AI-related patents, yet the impact or quality of the patents falls short, according to a report from Clarivate Analytics and KAIST Center for Innovation Strategy and Policy in May 2021.

SOUTH KOREA RANKED HIGH IN AI PATENTS

South Korea was ranked fourth with 6,317 registered AI patents between 2010 and 2019. China topped the chart with 81,236 registered patents, followed by the US with 24,708 patents, and Japan with 6,754 patents. However, when the combined patent impact (CPI) index that weighs the usefulness of patents is applied, the US was ahead of all other countries, holding 43% of useful patents, followed by Canada with 26%. South Korea had 8%, standing below average (14%).

The gap was attributed to weak basic research, over-regulation, and insufficient investment by analysts. The index both shows South Korea's rise in the AI field as well as its shortcomings.



SK Telecom robot

OVERVIEW OF JAPANESE MARKET TRENDS

- QZSS, Japan's satellite-based augmentation system is driving innovation across many downstream application domains as its uptake increases
- Significant government investment into both space and space-enabled businesses, including spearheading R&D throughout the Asia-Oceania region

KEY TRENDS IN EDITION FOUR

- New developments in the **upstream** are **boosting the GNSS development** and adoption in all areas of Japan
- **Autonomous driving experiments** have been conducted in Japan. Several sectors, ranging from food delivery to smart mobility, have been involved
- Industrial players are willing to invest in **GNSS, 5G, and IoT technologies** to boost efficiency in production and service providing



Japanese satellite ecosystem is enriching of new satellites

QZSS REPLACEMENT SATELLITE HAS BEEN LAUNCHED

In October 2021, MICHIBIKI's first satellite successor was launched from the Tanegashima Space Centre. In addition to its various functionalities, it not only aims to improve the positioning accuracy of car navigation systems, but also to contribute to the development of autonomous driving.

The first MICHIBIKI satellite was launched in September 2010, and the second through fourth satellites were added in 2017. The satellite launched in 2021 brings the total number of QZSS satellites in operation to five.

QPS RESEARCH INSTITUTE IZANAMI SAR SATELLITE LAUNCHED

QPS Laboratory (Fukuoka, Japan), a space venture from Kyushu University, launched its second small SAR (Synthetic Aperture Radar) satellite in April 2021. The company developed an earth observation system using various satellites, and it aims to provide observation data to the market.

The company's small SAR satellite, named "Izanami," was developed jointly with small and medium-sized enterprises in various parts of Kyushu. It was equipped with a large, yet light-weight antenna developed originally for small satellites. It weighs about 100 kilograms, and its development cost has been reduced through the use of consumer products.



MICHIBIKI Satellite



Bicycles smart lock

Morito Japan has started to offer a tracking service called "Mimaruku" for children and elders, employing GNSS trackers. The monthly service allows checking the device holder's location and travel history from smartphones and tablets. As this satellite

positioning service supports GPS, QZSS (MICHIBIKI), GLONASS, Galileo, BeiDou, and Wi-Fi positioning, the locations can also be estimated in places where satellite coverage is absent. The communication system used by "Mimaruku" is LTE-M and is compatible within the NTT Docomo LTE area.

MORITO JAPAN LAUNCHED A GNSS TRACKING SERVICE

Ashirase, a company established by Honda, showcases a technology which will help people with visual impairments to navigate safely while walking in the streets. A GNSS tracker is installed in their shoes helping them to better interact with the environment they are in.

ASHIRASE CO., LTD., RAISED A TOTAL OF €400 K IN FUNDING

AlterLock is a smart lock with GNSS tracking and vibration detection alarm developed for bicycles. It is developed by the Japanese IT company NextScape Corporation. The main unit is equipped with a GNSS module, a speaker for the alarm, an

accelerometer and a Wi-Fi module. Even if the bicycle is taken despite the alarm warning on, the built-in tracker will help locate it and showing the real-time location on a smartphone app.

BICYCLES SMART LOCK LAUNCHED IN JAPAN

Autonomous driving experimentations increased in number during pandemic

GNSS ANTENNAS FOR AUTOMOTIVE APPLICATIONS

Yokowo Co. Ltd. Announced in March 2021, that it will provide its GNSS antennas, which are mainly used in automotive applications, to drone manufacturers.

The company's GNSS antennas are mainly used for car navigation and vehicle emergency call systems. They are equipped with low-noise amplifiers that can transmit signals to GPS receivers, and feature excellent environmental resistance, making them resistant to temperature changes and deteriorating weather conditions. Yokowo suggests that the drone market is expected to expand in the future, with the Japanese government working to enforce rules for the commercialization of drone-based logistics and other services

ROAD TO THE L4 PROJECT FOR AUTONOMOUS DRIVING

The ministry of land and transport has published in March 2021 its plan towards the implementation of Level 4 Automatic Driving. The initiative is materialized through the "RoAD to the L4" Project launched in September 2021, announcing details about the plan for L4AD towards 2025.

In addition to the technical aspects, other topics, such as standardization, regulation, business model, and industrial ecosystem development will also be addressed during the project duration.

The purpose is to promote the early implementation of technologies and services in Japan, relative to advanced MaaS (Mobility as a Service). The project will last for five years until 2025 and target more than 40 regions.

A demonstration experiment of remote autonomous driving has been conducted in November 2021, in Nishi-Shinjuku, Tokyo. An autonomous taxi drove to the place where the customer was waiting and then to the destination, without any human intervention. The vehicle used for the experiment was a JPN TAXI Takumi (Format: DAA-NTP10) and it was equipped with six LiDAR sensors, six object recognition cameras, two street signal recognition cameras, GNSS receiver, and an IMU (inertial measuring unit). Previously in the same year, a similar successful experiment in Tokyo involved an autonomous vehicle used for food delivery

In March 2021, ANA (All Nippon Airways) and Toyota Industries ran a demonstration experiment for autonomous towing tractors at Haneda Airport. The tractor was equipped with GNSS and offline sensor such as camera, IMU (Inertial Measuring Unit), and LiDAR. The combinations of these technologies made automatic driving seamlessly possible both indoors and outdoors.

Shimizu Corporation has developed an unmanned observation system that uses GNSS to detect ground displacement on the top & sides of structures with high accuracy and low cost. It will come to implementation in 2022. The system uses commercially available antennas, receivers, and analysis equipment. The algorithm has been developed with Tokyo University of Marine Science and Technology, to enable real-time measurement with a precision of about 1 cm. This system can be used in civil engineering and constructions sites in the city to avoid positioning errors

UNMANNED TAXI DEMONSTRATION PERFORMED ON PUBLIC ROADS

AUTONOMOUS TOWING TRACTORS TESTED AT HANEDA AIRPORT

GNSS TO PREVENT ERRORS IN CONSTRUCTIONS

IoT applications based on GNSS and 5G are increasing efficiency of several industrial sectors

QZSS USED IN SAILING EVENTS AT TOKYO OLYMPICS

A tracking system using QZSS was used to support the operations of the 2020 Tokyo Olympic Games sailing events. The N-Sports Tracking Lab LLC (NSTL), which has a proven track record with its HAWKCAST water sports tracking and visualization system, have

supported the Games Organizing Committee's monitoring operations to ensure safe competition management.

By providing real-time location information to the Organizing Committee, the NSTL supported centralized management of boats arriving and departing from the port and, emergency management in case of abnormal conditions such as windbreaks or high waves.

The centralized monitoring of the arrival and departure of up to 400 boats was the largest ever in a sailing event and it was the first time that sub-meter accuracy has been used.

DEVELOPED A 3D SURVEYING APPLICATION

OPTiM, a market leader in AI, IoT, and Big Data platforms introduced "OPTiM Geo Scan," an application that enables users to scan and survey objects with smartphones or tablets equipped with LiDAR sensors. The application is expected to reduce the cost of surveying

equipment, shorten surveying time, and contribute to disaster recovery activities by collecting and utilizing 3D data. The utilization of this application involves GNSS receivers to add positional coordinates to the scan.

IOT GNSS POSITIONING TECHNOLOGY SUPPORTS THE RAILWAY INDUSTRY

JR Kyushu and Nippon Signal started to test on the Kashii Line in January 2021, a newly developed automatic train operation system developed based on the ATS-DK (Automatic Train Stop-DK) system.

The combination of onboard and ground systems with high-precision GNSS positioning will help drivers and controllers in performing their activities.

The system can be helpful in several different circumstances. For example, the merging of two trains together was previously guided by ground or onboard personnel standing near platforms or locomotives to visually help the crew on board, now, drivers can just use the high-precision position provided by the system.

GNSS is also expected to help determine the location of stranded trains in the event of a disaster, and to improve the density and safety of bullet trains and high-speed trains. Although automated driving is now a reality in cars and trucks. This technology is slowly spreading to the railway industry as well.

FJ Dynamics (FJD) developed a retrofitted automatic steering system for agricultural machinery. It uses RTK-GNSS positioning, and a high-precision steering motor developed in-house to achieve a high level of operating accuracy ($\pm 2.5\text{cm}$) at a low cost. This system can be added to existing tractors, rice planters, and other agricultural machinery.

In March 2021, Nishimatsu Construction Co., Ltd. presented a system for constructions that automatically moves cable cranes to lift concrete buckets. Using GNSS positioning technology and linking it to a Common Information Model (CIM) model, the system has already been successfully used in construction sites.

In July 2021, U-Blox Japan Co. Ltd., announced two new chips for automotive-grade positioning, which can operate at up to 105°C. Both modules were based on the U-Blox M9 GNSS platform and provide advanced positioning information using Dead Reckoning (DR) and GNSS signal spoofing detection.

AUTOMATIC STEERING SYSTEMS TO BOOST AGRICULTURE

AUTOMATED CABLE CRANE USED IN CONSTRUCTION

DR MODULE WITH ANTI-SPOOFING FOR AUTOMOBILES

OVERVIEW OF INDIAN MARKET TRENDS

- India's space industry is primarily managed by the Indian Space Research Organization (ISRO), which has received international acclaim for its achievements in space missions and explorations
- India space economy is valued about \$7 Bn (€6.2 Bn) which accounts for 2% of the global space economy. The target for the upcoming years is set to \$50 Bn (€44 Bn)

KEY TRENDS IN EDITION FOUR

- The rapid growth of smart devices usage and affordable internet has led to the development of many **GNSS-based technologies**
- The **drone industry is in upcycle** and is expected to grow with an 18% CAGR
- India is **strengthening partnership with European space player** for collaboration in different areas of the space ecosystem



GNSS in India is in upcycle due to adoption in different sectors

INDIA WILL BE TOLL BOOTH FREE WITHIN ONE YEAR

Mr. Nitin Gadkari, Union Minister, announced in Lok Sabha that India will be toll booth free by 2022 and would implement a satellite-based toll collection system. Currently, India is using electronic payment method (FASTag). The new system will make use of Global Navigation Satellite System (GNSS) and General Packet Radio Service (GPRS).

The National Highways Authority of India is currently working on a detailed project report for the first phase of the Delhi-Jaipur-Dwarka expressway.

MG MOTOR BRINGS CONNECTED CAR SOLUTIONS TO INDIAN MARKET

Collaboration and co-creation are the key to success of a company. Automotive market leader MG Motor has partnered with digital service provider Jio to integrate Internet of Things (IoT) features. The partnership brings consumers real-time telematics and access to digital life on the go. Jio is developing innovative products and solutions to give user a better driving experience. Initially, MG Motor is launching these features in mid-size vehicles only.

IOT-ENABLED GNSS DEVICES FOR PRIVATE CARS

The government of Andhra Pradesh recently launched Abhayam App for women's safety. As part of this initiative, around 1,000 city vehicles have been outfitted with the Internet of Things powered GNSS devices. The system helps the police to monitor the vehicle movement and could be accessed via a dedicated app.

In case of any emergency or threat, passengers could press a button on the car meter or in their app, which will alarm the police to come to the rescue.

Vaccine to all citizens of India is the motto of federal government but in this unprecedented pandemic time, delivering vaccines and drugs is a great challenge for the government. The Indian Council for Medical Research (ICMR) has come forward to use drones to deliver drugs to remote areas of India. ICMR has partnered with IIT Kanpur to conduct a feasibility study for the project. GNSS will allow drones to navigate through territories difficult to reach using terrestrial vehicles

DRONES TO DELIVER COVID-19 VACCINES IN REMOTE AREAS

MapMyIndia is to install GNSS devices for free in any vehicles that are carrying medical supplies and/or oxygen tankers in order to ensure that they reach patients and hospitals on time. This move allows key stakeholders such as government officials and hospital staff to see the live location of these vehicles and to receive an alert if there is a problem such as a roadblock or excessive congestion.

GNSS USED TO TRACK MEDICAL SUPPLIES IN INDIA

Garmin, a renowned manufacturer for innovative GNSS technology, has launched two handheld devices utilising the Indian Space Research Organization's Navigation with Indian Constellation (NavIC). According to some, the ISRO asked Garmin to integrate NavIC into all upcoming satellite-navigation-based devices, taking a big step towards India's self-reliance.

NAVIC TO BE INTEGRATED INTO PORTABLE DEVICES

GNSS technology is enhancing automation in railway, drone, and transport industry

FOGPASS DEVICE INTRODUCED IN INDIAN RAILWAYS

During foggy days, trains drivers have challenges to see the surrounding locations and approaching signals. The actual solution consist in holding down the speed of trains generating delays on the railway. To overcome these challenges Indian Railways have installed FogPASS device.

The FogPASS device is GNSS based portable device which serves as guide for the crew during foggy weather using audio visual alarm. The device alerts drivers in advance about approaching signals, level crossings, and stations. The use of device improved the punctuality of the trains and limited the chance of accidents.

INDIAN RAILWAYS TO EQUIP FREIGHT TRAINS WITH EOTT

End of Train Telemetry (EoTT) equipment has been introduced by the Indian Railways, which will eliminate keeping guards on End of Train (EoT). The system allows to handle EoT operations remotely from the cab of locomotive. The EoTT system is a combination of a cab display unit (CDU) installed on the locomotive and the sense and brake unit (SBU) installed on the train's last coach or wagon. Further, The system is equipped with GNSS to indicate the location of the train and GSM connectivity to transfer data to a server.

ISRO TO ASSIST DEVELOPMENT PROJECTS IN NORTHEAST INDIA THROUGH SPACE TECHNOLOGY

With the new space reforms operated by Indian Government, ISRO influence has been extended outside the space domain, supporting government in downstream applications such as flood risk assessment, infrastructure projects, telemedicine, agriculture etc.

ISRO is already monitoring 67 projects in 221 sites in Northeast region. Discussions about how to maximise the use of satellite imaging and other space technology for better completion of infrastructural projects are on the way.

Snapdeal an eCommerce giant in India tested last mile delivery robots. Snapdeal partnered with Ottonomy IO – an autonomous mobility startup, to autonomously deliver orders to consumers. Initially, Snapdeal tested robot delivery at Delhi NCR area. The

robots were placed at the gates of the company building where the delivery agent placed the parcels inside a compartment. The delivery was autonomously performed by the robot using GNSS in addition to other sensors.

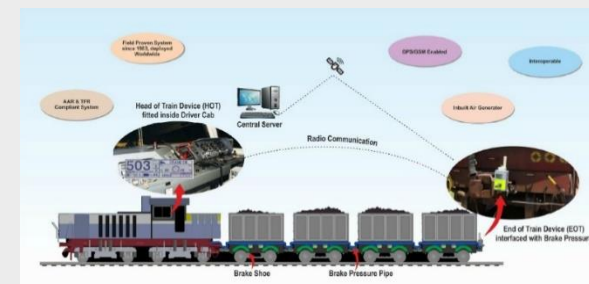
Digitisation of governance is the vision of Prime Minister Narendra Modi. The federal government aims to survey and map more than 6000 villages in India. Due to current manual mapping method, citizens are facing many land disputes. The new method will use professional survey grade drones fitted with GNSS & IMUs (Inertial Measurement Unit) to complete the project by 2024.

With the increasing population in metropolitan areas, waste management is great challenge for any Municipal Corporation. As government is keen to utilise space technology, Chumukedima Municipal Corporations is equipping with GNSS based devices to all waste dumping trucks for efficient fleet management. This enable the administrators to monitor the location and distance travelled by the vehicles other than check if all the areas have been covered by drivers.

SNAPDEAL TESTED ROBOTS FOR DELIVERIES

DRONES USED FOR LAND MAPPING

GNSS TECHNOLOGY FOR WASTE MANAGEMENT



EOTT system schematic

India government is promoting legislation and partnerships to support GNSS sector

INDIAN FEDERAL GOVERNMENT PROGRESS ON LIBERALISATION OF SPACE POLICIES

Liberalisation of space policy is a great step from the Federal Government; this will enhance participation from the private sector. Access to geo spatial data with simplified procedures is a great opportunity for startups, and researchers. Department of Science and Technology is encouraging private players to utilise the ISRO assets and accelerate the commercial use of space technology.

INDIA SIGNS COOPERATION AGREEMENTS WITH SPACE AGENCIES

Indian Space agency ISRO is open to collaborate with global space agencies for efficient space technology. During a bilateral meeting between Indian space agency ISRO and Japan Space Agency JAXA, ISRO signed an agreement with JAXA for the cooperation in satellite navigation, earth observation, collaborative activities on rice crop, and air quality monitoring.

India's Department of Space (DoS) has announced its plans to create a new national policy for satellite-based navigation – the Indian Satellite Navigation Policy – 2021. With this policy they aim to achieve self-reliance, focused on ensuring availability and quality while enhancing usage, and promoting research and development for satellite-based navigation and augmentation services. According to the draft there exists a need for secured services that are exclusive to the Indian strategic community, which is why the Government of India has established a resilient and independent system, Navigation with Indian Constellation (NavIC).

INDIA TO CREATE A NEW GNSS POLICY

OVERVIEW OF CHINESE MARKET TRENDS

- A complete industrial chain integrating chips, modules, boards, terminals, and operation services has been established with the launch of the BeiDou-3 global satellite navigation system
- China's 14th Five-Year Plan maps out the strategic position of innovation to bring high-quality growth to its economy in the next five years (2021-2025). The BeiDou industry continues to attract new policies and regulation, both from the central and local government, to guide its development

KEY TRENDS IN EDITION FOUR

- The **White Paper on the Development of China's Satellite Navigation and Location Services Industry (2021)** has been released in May 2021. According to it, China's satellite navigation and location services industry reached €56 Bn in 2020
- The BeiDou industry is expected to enter a stage of **high-speed development** driven by further application and cross-industry cooperation
- **Autonomous driving is leading the adoption of BeiDou+5G** solutions in sectors ranging from smart mobility to agriculture and drones



Satellite manufacturing ecosystem in China is growing in terms of capabilities

IOT XINGYUN PROJECT SATELLITE CONSTELLATION TO BE COMPLETED

The second phase of the Xingyun network construction will be completed in 2021 when small-scale business operations and space-based Internet of Things (IoT) services will be initially realised. The two experimental satellites of the Xingyun Project already active, verified several critical technologies in orbit, breaking the bottleneck constraints of space information transmission between IoT satellites.

The Xingyun Project carried out industry application tests and live demonstrations in the fields of scientific research, geological disaster monitoring, meteorological forecasting, shipping supervision, forestry monitoring, and container supervision.

The project targets a space-based IoT constellation consisting of more than 100 low-orbit communication satellites around 2023.

SPRING EQUINOX I CHIP IN SERVICE

The Meteorological Observation Centre of China Meteorological Administration and Shenzhen Huada BeiDou Technology Co., Ltd. successfully developed the "Spring Equinox I" chip module. It is a

system-on-chip dedicated to satellite navigation, whose relevant indicators are claimed to be equal or partly better than the U-BLOX chip, which currently occupies 95% of the global market share.



Xingyun project satellite

The Second Academy of Aerospace Science and Industry has completed China's first smart satellite production line. It is expected to achieve the design capacity target of more than 240 small satellites per year. Adopting advanced manufacturing technology The satellite smart production line offers real-time quality control, data collection, and management of the whole manufacturing process. The essential process links are all replaced by machines, and the production efficiency can be increased by more than 40%.

In February 2021, the satellite factory of Geely Technology Group, namely Taizhou StarSmart obtained the commercial satellite manufacturing license approved by the National Development and Reform Commission. Taizhou is expected to start production in October this year with an annual output of more than 500 satellites. In January 2021, the two low-orbit satellites developed by Geely have successfully passed the qualification review.

In May 2021, China North Industries Group published the results of the integration of Beidou-3 short message communication into cell phones for the general public in Beijing. Consumer smartphones successfully completed the interchange of short message information, marking BeiDou short message communication service able to provide direct services on smartphones.

CHINA'S FIRST SMART SATELLITE PRODUCTION LINE IS IN TRIAL

GEELY'S SATELLITE MANUFACTURING FACILITY RECEIVED CERTIFICATION

BEIDOU SHORT MESSAGE RELEASED

Mobility solutions keep receiving considerable support from institutions and industry

AUTONOMOUS DRIVING ALLIANCE LAUNCHED IN CHINA

In December 2020, T3 Go, Suzhou High Speed Railway Zone, Jiangsu Dayun Group, and more than 30 other partners jointly launched Auto-union, the first domestic autonomous driving operation alliance. At the same time, T3 Go also signed a strategic cooperation agreement with Jiangsu Dayun Group and Suzhou High-Speed Railway Zone to reach in-depth cooperation in the field of compliance and travel capacity.

The Auto-union will enhance industry regulation, and also actively promote the development and validation of new technologies, commercial demonstration applications, the construction of standard systems and the industrialisation of technical achievements.

AUTONOMOUS TAXI FOR SAFER ROADS

WeRide Robotaxi, China's first self-driving taxi service open, announced its first anniversary of operation: 147,128 trips were safely completed with over 60,000 users served without active liability accidents. On its first anniversary, WeRide and the Institute of Transportation Studies of Tsinghua University jointly released China's first Robotaxi passenger survey report, which shows that WeRide Robotaxi has accumulated nearly 30% of loyal users who use the service at least once a week. This milestone represents the initial footprint of L4 level autonomous driving landing in China.

NEW FUNDING FOR CHINA'S SMART DRIVING SECTOR

At the beginning of 2021, DiDi, WeRide, Pony Smart, Horizon, and Harness Technology have completed a new round of financing of hundreds of millions of dollars. In January, DiDi Autopilot completed a \$300 million financing round; WenYuan Zhixing raised a total of \$310 million in Series B financing and started Series C financing at the same time; Harness Technology completed a new round of financing of over \$1 billion in January; Pony Smart announced \$100 million in Series C+ financing in February; and Horizon has raised \$900 million in Series C financing.

UniStrong released the first aviation receiver that supports BeiDou's satellite-based augmentation service. As it is difficult for satellite navigation services to meet the high integrity requirements of civil aviation applications in different flight phases, ICAO requires airborne aviation terminals to implement one or more

augmentation functions such as satellite-based augmentation, ground-based augmentation, or air-based augmentation. Compared with traditional GNSS receiver products, AIR20 supports satellite-based augmentation services, single-frequency SBAS and dual-frequency multi-constellation SBAS services; supports multi-level integrity monitoring, enables fault detection and troubleshooting, and improves receiver positioning and navigation performance.

JD Logistics Group's new regional logistics drone - JDY-800, a fixed-wing cargo drone, successfully carried a test flight in Zigong Fengming Airport. JD Unmanned Systems Research Institute is now planning the construction of a test operation base for JD's logistics drones.

The 14th Five-Year Development Plan for the Maritime System compiled by the Ministry of Transport proposes to promote the construction of an integrated water transportation security system, using technologies such as BeiDou navigation, satellite communication and remote sensing.

FIRST AVIATION BEIDOU SUPPORTING SBAS RECEIVER LAUNCHED

LOGISTICS DRONE SUCCESSFULLY TESTED

THE FIVE-YEAR DEVELOPMENT PLAN FOR THE MARITIME IS OUT

Application areas of China's GNSS are expanding

BEIDOU FOR FOREST FIRE PREVENTION

In recent years, Hebei Province built a warning monitoring and control network for forest fire prevention. GNSS is used to assist forest rangers and firefighters, and for fire trucks fleet management.

BEIDOU FOR RAIL INSPECTION

In January 2021, the railroad inspection system installed by the Xinjiang railroad department was officially put into use. Relying on the BeiDou system, the positioning accuracy has been significantly improved not only to meet the requirements of remote mountainous railroad, but also to assist inspection vehicles during their operations.

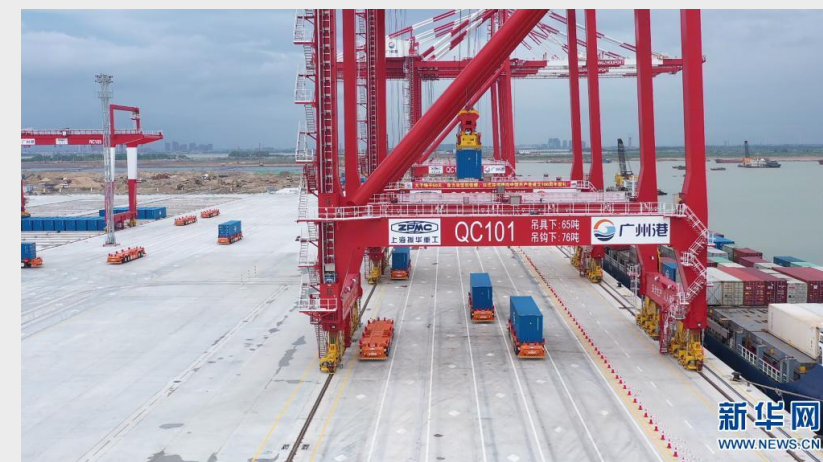
THE FIRST FULLY AUTOMATED TERMINAL IN THE GREATER BAY AREA

In June 2021, the first fully automated terminal in the Guangzhou Port successfully carried out autonomous operations. This automated operating system incorporates advanced technologies such as BeiDou navigation, 5G communication, artificial intelligence, cloud computing and big data analysis.

In January 2021, the Ministry of Industry and Information Technology (MIIT) released the "2020 Communications Industry Statistical Bulletin", showing that in 2020, the total number of mobile communication base stations nationwide reached 9.31 Mn

The total number of 4G base stations reached 5.75 million, with comprehensive coverage of city and town areas. Over 600,000 5G base stations have been newly built. The total number of 5G stations in full operation exceeds 718,000. The revenue of data center business, cloud computing, big data and IoT business has increased by 22.2%, 85.8%, 35.2% and 17.7% respectively over the previous year.

COMMUNICATIONS INDUSTRY BULLETIN RELEASED



Guangzhou port autonomous terminal

China is officially starting the pilot project for smart cities

BEIDOU CHIPS TO REGULATE PARKING OF SHARED BIKES

In Xindu District, Chengdu, Bluetooth markers are being used to regulate parking of shared bikes. The first trail covers more than 2,500 bicycles, using GPS, BeiDou, Bluetooth and Wi-Fi to precisely locate the vehicle.

BEIDOU FOR WILDLIFE TRACKING

The Institute of Northeast Geography and Agroecology of the Chinese Academy of Sciences put a wildlife satellite tracker on mandarin ducks living in Harbin discovering Lianyungang to be their favourite wintering

habitat, breaking the previous perception that they only winters in Hubei.

This solar-powered, lightweight and waterproof satellite tracker uses BeiDou satellite positioning technology and is expected to last three to five years. From this tracker, researchers can receive information on the longitude, latitude, speed and altitude of the mandarin ducks flight.

SMART CITY PROJECT IS OUT

The Ministry of Housing and Urban-Rural Development (MOHURD) and the Ministry of Industry and Information Technology (MIIT) issued a notice identifying the first batch of six pilot cities for the collaborative

development of smart city infrastructure and intelligent network-linked vehicles. The six pilot cities are Beijing, Shanghai, Guangzhou, Wuhan, Changsha and Wuxi.

In December 2020, Guangzhou Hi-Target Navigation Tech Co.,Ltd., completed the initial public offering of shares of its Shenzhen IntelliFusion Technology Co., Ltd. and its application for listing on the Science and Technology Venture Exchange was accepted by

the Shanghai Stock Exchange. IntelliFusion is an artificial intelligence company, which develops and sells AI products and solutions for application scenarios with AI algorithms and chip technology at its core.

INTELLIFUSION TO BE LISTED AT THE SHANGHAI SE

OVERVIEW OF TAIWANESE MARKET TRENDS

- Home to some of the largest chip manufacturers and board integrators, Taiwan holds a significant position in the global GNSS industry value chain
- Strong foundation in hardware manufacturing has resulted in companies moving on to integrate hardware and software
- New business opportunities are consolidating in the fields of consumer solutions, smart transportation, electronics, and IoT

KEY TRENDS IN EDITION FOUR

- Taiwanese government launched a four-year, \$145 Mn (€128 Mn) project in 2021 with the aim of **launching its first LEO communications satellite in 2025**
- **Autonomous driving is getting traction in Taiwan.** More and more funding is available to make roads safer and faster
- Due to the pandemic, **automation becomes crucial** for efficient and resilient production in the industrial environment. Lack of skilled workers drove manufacturers to seek new ways to optimise the production processes



Taiwan is increasing its spending on the space industry

TAIWAN INVESTS IN BUILDING SPACE CAPABILITIES

Taiwan is trying to secure a strategic position in the space industry's supply chain by leveraging its competitive capacity in semiconductor and precision engineering. With the "Space Development Promotion Act" passed in May 2021, the Taiwanese government declared

to invest about \$900 Mn (€791 Mn) in the local space sector by 2028. The Space Development Promotion Act lays the legal foundation for the development of Taiwan's space programme, ensures the public sector and private enterprises comply with the rules, and encourages the development of new technologies to enhance the competitiveness of space-related industries.

NSPO PLANS TO MANUFACTURE TEN NEW SATELLITES

Taiwan's National Space Organization (NSPO) plans to manufacture ten satellites by 2028, which helps to build Taiwan's satellite supply chain. Two Taiwanese CubeSats, YUSAT and IDEASSat, along with many other satellites were launched to orbit by SpaceX in January.

The IDEASSat, made by National Central University, is designed to improve GPS positioning, while the YUSAT, made by MoGaMe Mobile Entertainment, KYLink Communications Corp and National Ocean University, will monitor the maritime and ground traffic. During 2019 to 2029, three major satellite projects will be launched respectively: FORMOSAT-8 of six high-resolution optical remote sensing satellites, FORMOSAT 9 of two satellites with ultra-high resolutions, and FORMOSAT-10 of two satellites with Synthetic Aperture Radars. Under Taiwan's Beyond 5G (B5G) programme, two LEO communication satellites will be launched between 2025 and 2026. The Taiwanese satellite industry will focus on the development of an optical system, flight control system, electric system, and mechanical system. Companies such as Gongin Precision Industry Co. and Tong Hsing Electronic Industries have gotten involved in the programme. NSPO also plans to launch the second self-made satellite, the Triton in 2022, with the FORMOSAT-8 scheduled for 2023 and the B5G low-orbit communication satellite for 2025.

One of Taiwan's space development goals is to manufacture its own LEO satellites. The government launched a four-year, NT\$4 billion (US\$145 million) project in 2021 with the aim of launching its first LEO communications satellite in 2025. With strong semiconductor and electronics manufacturing, Taiwan is on the right track to expand its role in the LEO satellite supply chain. As of 2019, there were 898 local companies related to the space industry. Most of them were ground equipment suppliers, specialized in antennas, communication modules and power supplies. Since Taiwan has had no success in rocket launch yet, the crucial challenge for Taiwan's space industry is to get products validated for space applications. The NSPO has begun to work with domestic institutions to provide an integrated, one-stop validation service for companies, and cultivate system integrators in the private sector. Taiwan is also seeking for solid international partnerships with Europe, the US, and Asian countries to acquire the latest space technologies.

TAIWAN'S PLAN FOR LEO DEVELOPMENT

Taiwanese ODMs are looking for new opportunities in mobile computing. The most common wearable devices in Taiwan are smartwatches, smart glasses, smart fabrics, and tracking

bracelets. Most wearables focus on sport and entertainment purposes, and the demands for medical and smart healthcare wearable devices are growing due to the pandemic, more awareness on work-life balance, and the ageing society. Smart glasses have been considered as the next platform of mobile computing. As Apple and Facebook respectively expand into the AR/VR glasses industry, Taiwan's electronics ODMs are also looking for new business opportunities. Quanta Computer has collaborated with STMicroelectronics in 2015 to develop the optical, electronic and photonics design for the volume production of smart glasses. In 2016, Quanta invested in Lumus, an Israeli optics startup aiming to accelerate AR smart glasses manufacturers' time to market. Quanta is also interested in partnering with Luxexcel, a Dutch startup specialized in 3D printing smart prescription lenses.

WEARABLE MARKET SPRINTS IN TAIWAN

GNSS is utilised to make traffic in Taiwan safer and smarter

5G OPENS THE ROAD FOR NEW SMART SERVICES

Taiwan's market is thriving as it has entered the 5G era. Relevant services will mature in the next two to five years and drive a significant increase in general demand. Semiconductor and Telecom companies are building the backbones for more 5G products and services, such as MediaTek and Chunghwa Telecom.

MediaTek introduced a new chipset, Kompanio 900T, designed for mid-range 5G tablets and notebooks. The new chip is built using TSMC 6nm process technology. It has an octa-core CPU, which features two Arm Cortex A78 performance cores and six Arm Cortex-A55 cores. The chipset also features an Arm Mali-G68 GPU and the company's own APU for AI-related functions.

VISITOR MANAGEMENT ENSURES SAFETY

Due to COVID-19, Taiwan's Forestry Bureau launched traffic control measures for visitors to the Alishan Forest Recreation Area during the cherry blossom season. When the number of tickets sold reached a cap, visitors were notified through LBS messages and changeable

message signs, and entry was restricted until some people left. Visitors could also navigate with the Alishan forest tour app, equipped with GIS and GPS data and technology.

CONNECTING CITIES THROUGH THE SHARING ECONOMY

New connectivity technologies and digitalisation (e.g. 5G, IoT, AI, and VR) will enable automobiles, people, and traffic infrastructure to be digitally connected. This development will open-up demand for individualised products and services, including flexible ownership of

vehicles and premium mobility solutions. As car-to-driver connectivity is already a reality, the industry is getting ready for more aspects of car-to-environment connectivity, to further enhance user-centricity, road safety, and

access to public sharing solutions. Together with a technology evolution, the Taiwanese government is trying to facilitate Taiwan's technological leadership, by renewing and easing homologation methodologies and adopting the reports of overseas certification bodies.

The Ministry of Transportation and Communications (MOTC) had passed a smart transportation system development and infrastructure initiative in 2020, showing increased budget from 2021 to 2024 in related infrastructure projects. Projects included a field test area in New Taipei City's Danhai area, which focuses on strengthening and developing the domestic 5G and Vehicle-to-everything (V2X) industry clusters.

Weltrend Semiconductor, a Taiwanese IC designer, has entered in the supply chain of advanced driver-assistance systems (ADAS). Weltrend specializes in a variety of ICs that have seen increasing application scenarios in EVs, from display drivers to power management controllers. Weltrend has developed a series of processors for ADAS applications, including Blind-Spot Detection (BSD), Lane-Departure Warning (LDW), Moving-Object Detection (MOD), Active High Beam (AHB).

NEW ADAS PROCESSORS AVAILABLE

Caravision Technology, the subsidiary company of HI SHARP Electronics, provides in-vehicle security and surveillance equipment. For large commercial vehicles, Caravision provides

automotive video products with various AI intelligent video identification technology, ADAS, driving vision assistance system integration, and fleet management services. Its millimetre wave radar integrated with fusion technology of in-car cameras can detect objects in bad weather conditions. Its products can also provide real-time image transmission to fleet management platforms, reduce dispatching time to improve fleet management, while performing AI image digital value-added analysis services to enhance operational efficiency.

AI FOR IN-VEHICLE SECURITY

Taiwanese industry players are investing in infrastructure for smart manufacturing and mobility

SMART MOBILITY PLAYERS ARE INVESTING IN INFRASTRUCTURE

Taiwan's state-owned utility provider, Gogoro has been developing a low-voltage, bidirectional power distribution technology that can connect Gogoro's network of batteries to grid. Currently, Gogoro operates more than 2,100 battery swapping stations in Taiwan and is expected to expand the network to 10,750 stations by the end of 2021..

The company is also expanding its presence globally, notably in China and India. Chinese e-scooter makers DJI and Yadea have started to develop vehicles built for Gogoro's battery swapping platform. Gogoro is also developing its battery swapping network with Hero MotoCorp. in India.

SKYNAV LAUNCHES A NEW CLASS-B TRANSPONDER

SkyNav Technology offers a CSTDMA dual channel Class B AIS transponder, AIS-700, which is designed to receive Class A and Class B AIS signal and transmit the information of Class B. It can be connected to many brands of chart plotter. The product is equipped with GPS.

SKYNAV is a GPS/AIS/RF/M2M hardware and solution manufacturer specializing in mobile and marine products, including AIS/GPS/GSM tracker, GPS receivers, AIS Transponder, AIS Transmitter, AIS BUOY Tracker, GPS Antenna, and VHF Antenna.

Since 2018, ASUS started to focus on smart manufacturing, alongside smart healthcare, and smart retail. Located in Taiwan, the company is planning to build a production line, which will manufacture industrial/military grade and medical AIoT products. It will also facilitate its gradual transition from consumer products to commercial ones.

ASUS FOCUS ON ADVANCED SMART MANUFACTURING

LOCOSYS Technology launched the world's smallest multi-frequency / multi-system RTK module in early 2021. The RTK-1010 measures 10.1 x 9.7 x 2.2mm, giving system integrators and design engineers the option to include the new module in a wider range of smaller devices to provide enhanced positioning accuracy.

TINY RTK MODULE LAUNCHED IN TAIWAN

OVERVIEW OF THE AUSTRALASIAN MARKET

- The Australian Public Service Commission (APS) has recognised the increasing importance of geospatial information and has created a **Location Inter-Departmental Committee** (IDC) to improve place-based policy, program and service delivery through strategic coordination and collaboration on location analysis, data and capabilities across the APS.
- Work on the ground station network in Australia has begun and new GNSS stations are continuing to be built. The target is to expand from 200 to 500 stations.

KEY TRENDS IN EDITION FOUR

- Consumer solutions are driving the GNSS market in Australasia
- Australia has named their SBAS the Southern Positioning Augmentation Network
- In February 2021 **Australia and the UK announced their partnership** for more knowledge exchange and investment across their space sectors titled 'Space Bridge'
- Australia is expanding the usage of **digital twin models** of the country through adding data layers and improving the data platforms available
- Geoscience Australia is developing an **open-source correction software** that is supposed to be fully operational and deliver 3-5cm accuracy in 2022



GNSS-enabled Consumer Solutions are mainly found in sports applications

GNSS WILL HELP RESEARCH STUDIES ON EARTHQUAKES

Some of the earthquake activity in New Zealand has been observed to be accompanied by foreshocks and 'slow slips' near the plate boundary of the Pacific and Australian plates. Scientists now want to install passive seismic and GNSS devices to record more data about the earthquake activity to understand why some earthquakes start in

different ways than others in the hopes of being able to improve earthquake forecasting methods. Researchers from New Zealand, America and Japan will collaborate and filter data catalogues from various sources which include datasets from prior records of GeoNet and Victoria University.

GNSS HELPS TO BRING MORE FAIRNESS TO TRIATHLONS

To prevent injury and maintain fairness, Triathlons have drafting rules. They define a minimum distance between bikers throughout the competition. However, this rule is difficult to enforce and therefore often disregarded. Two Triathletes from New Zealand have now developed two small devices equipped with a combination of Ultrawideband (UWB), Bluetooth, GPS/GNSS, and LoRa that weigh

below 100 grams and will be attached to the front and rear of the bike. The front, fork-mounted device will sense the other devices around it, while the rear will also act as a sensor and provide a visual cue to riders behind.

3D MAPS MAKE CONSTRUCTION SITES SAFER

To make construction sites safer, Australian Construction Technology Provider SITECH WA collaborated with Coates Hire and Downer to test out their new 3D Avoidance Zine System barrier and deliver the technology across construction sites nationwide. The technology

consists of SITECH WA's tremble machine control system Earthworks as well as GNSS satellite technology and the Trimble Marine Construction Software (TMC). It creates a map of the work area containing the position of each machine and compares it to a 3D model on which restricted areas are marked. In comparison to existing 2D solutions this 3D technology allows for increased safety since it is not relative to the machine positioning.

Sport technology company Catapult from Australia launched their enhanced baseball Analytics solution in November. It features a new algorithms that uses data captured by the smallest GNSS/LPS device, Vector to prevent injuries.

The enterprise and public sector customers in Australia and New Zealand are now able to purchase the autonomous drone Skydio 2 and its integrated software solutions from the US drone manufacturer Skydio. This marks the next steps in the company's international expansion strategy in Asia Pacific after opening an office in Japan in Q4 2020.

A new version of the popular E-scooters will be tried out in Australia. They include a new operating system and new sensors that are supposed to detect dangerous riding behaviour like aggressive swerving, sidewalk riding or curb jumping. The

technology updates are based on the usage of high accuracy GNSS data and are expected to increase safety and include an IoT layer to educate the users verbally in many different languages

GNSS TO PREVENT SPORT INJURIES

SKYDIO EXPANDS DRONE BUSINESS TO ASIA PACIFIC

E-SCOOTERS ARE EQUIPPED WITH NEW SOFTWARE

Australia is strengthening its international Space partnerships

THREE GNSS GROUND STATIONS PLANNED TO BE BUILT AUSTRALIA

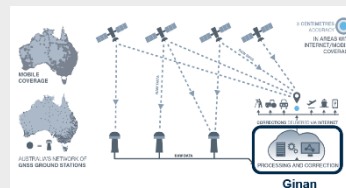
In the Western Australian region Kimberly, three new GNSS ground stations are scheduled to be built by the middle of 2022. This is part of Australia's programme to update its GNSS ground infrastructure nationwide, which will increase the accuracy to centimetres and in some cases even millimetres according to researchers. Authorities expect the main beneficiaries to be mining, agriculture and indigenous land management.

AUSTRALIA AND UK STRENGTHEN PARTNERSHIP

for space and aims at unlocking better access to trade, business and innovative bilateral collaborations and academic research opportunities. On top of the Agenda is a collaboration on earth observation and robotics as well as artificial intelligence.

GEOSCIENCE AUSTRALIA IS DEVELOPING CORRECTION SOFTWARE

Currently only available as an alpha version, the open-source software Ginan, developed by Geoscience Australia, is going to deliver real-time GNSS signal corrections. Ginan is estimated to improve accuracy from 10 metres down to 3 - 5 centimetres. The first official version will be available in June 2022 and the beta version will already be published for testing in February 2022.



Ginan concept overview

The Satellite Based Augmentation System (SBAS) of Australia and New Zealand has officially been named the Southern Positioning Augmentation Network, or SouthPAN. It augments data from the GPS and Galileo constellations across the two countries to improve accuracy from 5-10 metres down to 10 centimetres. SouthPAN, led by Geoscience Australia and Land Information New Zealand (LINZ), will be the first SBAS in the Southern Hemisphere and was made possible as part of the Australia New Zealand Science, Research and Innovation Cooperation Agreement.

AUSTRALASIA'S SBAS HAS A NAME

The National Emergency Warning System (NEWS) is a software that delivers location-based early warning system emergency alerts all over Australia. The critical communication system provider Genasys Inc. rolled out this service as part of the company's contracts with two of Australia's biggest telecom providers.

NEW EARLY WARNING SERVICE AVAILABLE IN AUSTRALIA

The Australian Space Agency and the Indian Space Research Organisation (ISRO) signed an MoU in February 2021 to open up chances for more collaboration on Space topics. They will join forces on Space science, technology and research in order to support social and economic growth.

INDIA AND AUSTRALIA ARE STRENGTHENING PARTNERSHIP

Digital Twins and 3D maps are becoming more advanced and support infrastructure monitoring

3D MAPPING WILL BECOME EASIER THROUGH NEW GEOSPATIAL DATA PLATFORM

Euclidean, an Australian 3D data specialist is building the world's largest geospatial data platform, planned to include more than 100 petabytes of 3D data. Their high-speed udStream 3D render technology will be used in the visualisation as a service (VaaS) platform and claims to be able to visualise petabytes of data within a second. Data like this is of high importance for digital twins or smart city applications.

DIGITAL TWIN PROJECT IS EVOLVING MAPS

Government-owned geospatial data company Geoscape Australia is upgrading its 3D digital maps of Australia. They will use patented AI technology from an Israeli start-up, GeoX, to increase the accuracy of the digital models and create an even better reflection of the real

world. Digital twins like this can be used for risk assessment insurers, architects, infrastructure planning or noise modellers. Increasing the information available through such models all over Australia can increase efficiency, reduce costs and generate insights as well as revenue. According to the Co-founder and CEO of GeoX this digital twin of Australia is the "most extensive and advanced project(s) in the world in terms of in-depth mapping of a country's buildings".

NSW DIGITAL TWIN SUPPORTS DURING MOUSE PLAGUE

The New South Wales Spatial Digital Twin (SDT) now has a data layer that reflects mouse plague data to inform landholders, industry and government. Sighting locations are reported by landholders through an app that marks their precise location with GNSS data. This information

together with complementary data like soil moisture, crop species and wind are supposed to support landholders, industry and government in managing the plague numbers.

US company Woolpert, that specialises in architecture, engineering, geospatial and strategic consulting merges with the leading Australian geospatial company AAM. They will complement each other with their cloud-based, artificial intelligence processing pipelines so that product delivery and data processing will happen faster. Moreover AAM can leverage additional aircraft and sensor technologies to have larger aerial acquisition capacity. The merger with AAM also was a strategic choice for Woolpert to increase their presence in Asia-Pacific and Africa as two geospatial leaders join forces to increase capabilities worldwide. The two companies intend to develop more subscription service products that focus on spatial digital twins, 3D GIS content and building information modelling (BIM) integration into GIS and engineering workflows.

TWO GEOSPATIAL LEADERS JOIN FORCES WITH A MERGER

Australian geospatial innovation company Klau Geomatics has elevated its sophisticated hardware and software solution, KlauPPK. is a PPK processing software and established choice of professionals in drone and light manned aerial mapping. Recently Klau Geomatics has added the KlauPPK mobile App to support surveyors in their work and eliminate the need for additional spending on specialised RTK survey equipment.

KLAU GEOMATICS IS EXTENDING SERVICE

After a year of evaluating proposals, the Australian Tech company Locata Corporation was among the seven chosen contractors who will participate in a pre-feasibility study and technological demonstration of alternative PNT solutions. The European Union

aims at analysing technologies that can act independently from GNSS and will be able to provide data in the case of GNSS signal disruption or in areas where GNSS is not available. Locata received two awards, one for a proposal on positioning and one for a separate proposal on timing. The evaluation will now go on for several months and will be concluded with an event in April or May 2022, followed by a detailed report a month later

LOCATA RECEIVED EU GRANT TO TEST PNT ALTERNATIVES

UAMs are used and tested for various applications and infrastructure is extended

CARBONIX PARTNERS WITH ROBOTIC SKIES

Australian designer, manufacturer and operator of unmanned aerial data capture solutions Carbonix has partnered with Robotic Skies, Inc., a global marketplace for commercial drone maintenance services, to enhance their post-purchase service. They now will be able to aim even more energy towards developing and safely deploying UAV technology.

DRONES ARE PART OF LAND CARE PROGRAMME TO FIGHT EXOTIC WEED

Australia has been struggling with invasive weeds – the African Lovegrass (ALG). Now, as part of a land care programme to stop the spread of ALG, tests are being done to estimate the effectiveness of precision spraying and revegetation with the help of drones. In New South Wales, three different trial sites have been set up that will receive three different treatments. Zone one will spray isolated

patches of ALG, in zone two the drones are spraying pesticides in between rows of trees to remove the weeds that would compete with the trees for resources and in the third area, the drones are distributing native grass seeds after ALG was mechanically removed prior.

FIRST AUSTRALIAN MILITARY UAV

In February 2021, Boeing Australia and the Royal Australian Airforce (RAAF) successfully completed the first test flight of an uncrewed aircraft named Loyal Wingman. This marks a big first step in a large-

large-scale project that seeks to integrate autonomous systems and artificial intelligence into the creation of smart human-machine teams. The Loyal Wingman performed a self-powered take-off before flying a pre-set route at varying speeds and altitudes to check flight functionality and demonstrate the performance of the Airpower Teaming System design.

In April, Army Robotics Exposition in Brisbane took place to facilitate observation and demonstration of Robotics Autonomous System (RAS) concepts and technologies. Among the invitation-only industry participants was Department 13, a leading drone manufacturer. The patented MESMER technology from Department 13 is able to control hostile drones without jamming GNSS signals. In front of an audience of the most powerful members of Australia's military and defense industries, solutions were presented that support the five fields of the Army RAS Strategy:

1. Maximising Soldier Performance
2. Improving Decision Making
3. Generating Mass and Scalable Effects
4. Force Protection
5. Efficiency

The American urban air mobility (UAM) company Wisk started the implementation phase of its Transport Trial in New Zealand with support of Insitu Pacific, a Boeing subsidiary. With this Trial the company hopes to address challenges with airspace integration and realise more opportunities of UAM industries and applications

ARMY ROBOTICS EXPOSITION SHOWCASES NEW APPLICATIONS

UAM TRIALS IN NEW ZEALAND

ABOUT GNSS.ASIA

WHO ARE WE?

Since 2012, GNSS.asia has been **bridging GNSS industries from Asia-Pacific and Europe**. Its objective is to facilitate industrial cooperation between the two regions, to support institutional relations, and to maximise Galileo adoption. The project, offers a series of services to EU industry and institutions, ranging from market analyses and stakeholder mapping, to business matchmaking, local marketing opportunities and the latest technology trends.

Our **team members** in Japan, South Korea, India, Taiwan, and China keep their ground presence and their fingers on the pulse of local GNSS market developments..

The logo for GNSS.asia, with 'GNSS' in large yellow letters and '.asia' in white letters below it.

www.gnss.asia

**Facilitate industrial cooperation on GNSS
across continents**

Via a network of local representatives across Asia, supplemented with expert knowledge of technology trends, GNSS.asia has three objectives:

- **Leverage industrial cooperation across continents:** GNSS.asia aims to stimulate the creation of partnerships through industrial matchmaking and outreach events. These include workshops, industry seminars, delegation visits and roundtables
- **Support institutional relations:** Via a network of local institutional partners, GNSS.asia can support EU and Asia-Pacific civil institutions in their aims of cooperation and standardisation
- **Drive EGNSS adoption:** GNSS.asia promotes the benefits of Galileo and EGNOS as service enablers and performance enhancers in the multi-GNSS hotspots of Asia-Pacific

WHAT ARE OUR OBJECTIVES?

WHAT CAN GNSS.ASIA DO FOR YOU?

GNSS.asia promotes the benefits of Galileo and EGNOS to industrial and institutional stakeholders in Asia-Pacific providing a series of services:

- **Networking & Matchmaking Support:** Personalised interviews to identify your organisation's priorities; Introduction to key stakeholders including our institutional and industrial partners; Organisation of moderated matchmaking sessions to assist in your networking
- **Dissemination & Marketing Support:** Key speaking slots at our GNSS.asia workshops and seminars; Distribution of your promotional material at international events; Demonstration and exhibition of your products/services; The ability to showcase your company through our innovation blog
- **Market Entry Support:** Information on market trends via our Market and Technology Trends report; Access to the latest GNSS-related news via our newsletter; Identification of business opportunities for your organization; Access to local teams with in-depth market knowledge and other key stakeholders

ANNEX: METHODOLOGY

Methodology

The **Market and Technology Trends Report** is released by GNSS.asia to monitor the development of the Global Navigation Satellite System markets in the Asia-Pacific region.

The GNSS downstream component is made by all the entities which rely on signals and infrastructures provided by the upstream component of the GNSS value chain to enable their application and services. This downstream industry can be broken down into three segments: **manufacturers** of GNSS components such as receivers, chipset, antennae; **system integrators**, which enable GNSS in larger systems such as vehicles; **service providers**, which offer GNSS enabled services such as maps, health tracking, etc.

The **Market and Technology Trends Report** covers different application areas in which GNSS finds use. They are divided into Six priority areas: Digital, Agri-Food, Mobility-Transport, Raw materials, Renewable energy, Construction; and eight other areas: Aerospace & Defence, Textiles, Electronics, Health, Retail, Proximity & Social Economy, Tourism, Creative & Cultural Industries.

Sources

This report makes use of publicly available data and information, stakeholder consultation, and reports published by private publishers. Sources used include:

3SNEWS, Analytics India Magazine, ASE Global, Autohome, Aviation Voice, BeiDou, Bridgestone, Business Today, BYNAV, CAS, CDAC, CGTN, China News, Civils Daily, CNBC, Coretronic-Robotics, CPC People, Digitimes, DNAINDIA, EGISTEC, EMCTW, ESA, EUJC, EUSPA, FEG, Financial Express, Furuno, GARMIN, Gongin, GPS World, GSC-Europa, Guancha, Hangzhou, Harvard, ICAO, Indian Express, ISRO, Kinpo, Komiemusen, Ledger Insights, Mitsubishi Corp, MLIT, Monash, MTI Group, Nature, NCHC, NDTV, New Indian Express, Nikkei, NSFC, NSPO, OGC, QXWZ, Reuters, Sensible4, Sina, SOHU, SOIC, Sony, SpaceChina, Statista, Subaru, Synopsys, Taipei Time, Taiwan Today, Taiwanese Customs, Teco, The ASEAN Post, The Hindu, Theil, Times of India, TomTom, UMT TW, Ventec Group, WinTec, Xinhuanet, Xinmin, ZeeNews, and Zenrin amongst other sources.

GNSS.asia relies on local teams of experts based in Japan, South Korea, India, Taiwan, and China. Each team, supported by the European team, put significant effort in selecting the most relevant trends and news coming from their selected region. This research involves obtaining input for key stakeholders in industry, institutions, event-specific news, and the translation of articles and reports that are not available in the English language.

Disclaimer

The GNSS.asia Market & Technology Trends Report Edition 4 was carried out by the GNSS.asia project team with the support of SpaceTec Partners, the Investment Innovation and Research Alliance, the European Chamber of Commerce in China, the European Chamber of Commerce in Taiwan, and the EU-Japan Centre for Industrial Cooperation.

The information provided in this report is the project teams best estimates at the time of publication, and although GNSS.asia has taken utmost care in checking the content, GNSS.asia accepts no responsibility for the further use made of the content of the report.

Any comments to improve the next issue are welcome and should be addressed to: hello@gnss.asia



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