SPACEWATCH AFRICA

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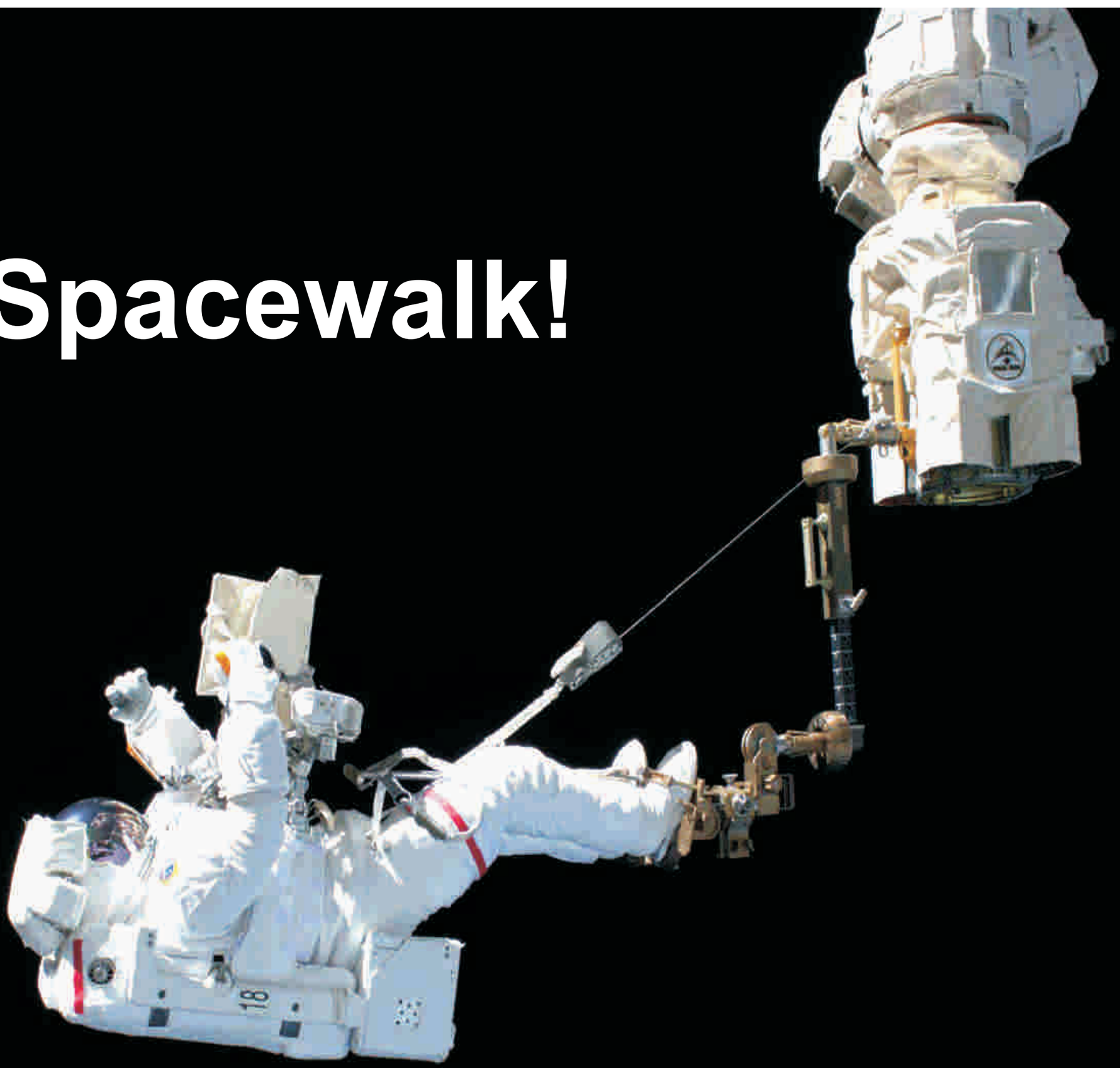
SPECIAL REPORT

African countries pushing boundaries of space exploration in 2024

Spacewalk!



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Africa:
30,301,596 sq km

Other named countries:
29,843,826 sq km

AFRICA IN PERSPECTIVE

People often underestimate quite how large Africa is, so we figured we'd put it in perspective by transposing as many of the world's other countries over it as we could. As you can see, Africa is larger than China, the USA, Western Europe, India, Argentina and the British Isles... combined!

Source: The Times Atlas

APPOINTMENTS

Orbex appoints John Bone as Chief Commercial Officer

UK-based orbital launch services company, Orbex, has announced the appointment of John Bone as its new Chief Commercial Officer. This key appointment comes as Orbex advances its preparations for the launch of Orbex Prime, expected to be the UK mainland's first vertical rocket launch.
John Bone brings a wealth of experience to Orbex, with over 20 years in the Space Industry, including 18 years in Director or C-level positions. His comprehensive knowledge of the industry and high-level contacts across Europe and the UK make him an invaluable addition to the Orbex team. John has been instrumental in the growth of various organisations in the sector, and has played a pivotal role in supporting the North East Space Industry's growth since 2014 as the chair of the North East Space Leadership Group.
In his new role as Chief Commercial Officer, John will be responsible for driving the commercial strategy of Orbex, leveraging his extensive experience and network to establish and nurture key partnerships and expand Orbex's presence in the global space market. His appointment marks a significant step for Orbex as the company gears up for the historic launch of Orbex Prime from its “home” spaceport in Sutherland, intended to be the first spaceport globally to be carbon-neutral in both its construction and operation.

Former Acting Deputy Secretary of Defense Christine Fox Joins Muon Space Board

Muon Space, a climate constellation company revolutionizing the way Earth is monitored from space, announces the appointment of former Acting Deputy Secretary of Defense Christine H. Fox, to its Board of Directors. Fox brings a distinguished career in national security and strong commitment to addressing the far-reaching impacts of Climate Change. Her appointment significantly advances Muon Space's efforts at the intersection of Climate Change and National Security.

Fox's distinguished career is underpinned by her strong commitment to innovation and technological advancement, and she is recognized for her strategic vision, particularly her ability to anticipate the potential of technology in addressing national security challenges.

She served as Acting Deputy Secretary of Defense, the Department of Defense's second highest-ranking official, from 2013 to 2014, where she was responsible for overseeing the Pentagon's annual budget and strategic planning. She has held other significant roles within the defense community, including Director of Cost Assessment and Program Evaluation (CAPE).
"Joining Muon Space's Board of Directors presents an exciting opportunity to apply my expertise in emerging technology and national security with the urgent need for climate action," said Fox. "I believe that Climate Change poses significant new national security challenges and that large-scale remote sensing constellations are key to addressing these. I am excited to partner with Muon Space in their mission to deliver actionable Earth intelligence for the betterment of the world and our country's place in it.”

Aerospacelab appoints Tina Ghataore as Group Chief Strategy and Revenue Officer, and CEO of Aerospacelab's new North American branch

Aerospacelab announces the appointment of Tina Ghataore, a San Francisco-based experienced aerospace and satcom executive, as Group Chief Strategy and Revenue Officer, and CEO of Aerospacelab new branch in North America, effective on August 7th, 2023.
Tina brings over 20+ years of experience in the aerospace, aviation and telecom industries as well as an undisputed executive expertise and forward-looking leadership. Tina has demonstrated successful go to market experience in launching satellite services business and bringing key satellite technology products to market. Armed with a global network amid leading industry players, she has a proven history of thriving in international deal making, occupying top positions in aerospace industry and leading strategic business development. Her expertise also includes sound managerial proficiency in companies with high growth potential as demonstrated by her recent award as *2021 Satellite Executive of the Year*.

Comtech Names Satellite and Defense Industry Leader John Ratigan as Chief Corporate Development Officer

Comtech, a global technology leader, announced the appointment of satellite communications (SATCOM) and defense technology industry leader John Ratigan as the company's first Chief Corporate Development Officer (CCDO).
With differentiated expertise across the global satellite technology sector, Ratigan brings over three decades of leadership experience to his position as Comtech's CCDO. Ratigan's experience is uniquely well aligned with Comtech's strategic business priorities and continued expansion into new growth markets.
Prior to joining Comtech, Ratigan served as CEO and President of iDirect Government as well as holding a position as an Executive Committee Member of ST Engineering iDirect. As its first employee, Ratigan established iDirect Government and grew the company to over $100 million in annual revenue.
During his tenure as CEO and President, Ratigan assembled a team of over 200 outstanding professionals and was responsible for taking iDirect Government from a startup to a well-known technology leader that deployed thousands of innovative modem solutions and satellite technologies supporting U.S. government and Department of Defense (DoD) customers across the globe. Ratigan was also responsible for acquiring GlowLink and its unique interference mitigation technology (CSIR) and fused it with iDirect's own Evolution technology, which helped the company become the largest provider of Time Division Multiple Access (TDMA) SATCOM capabilities for the U.S. DoD.

Sarsen Technology appoints Harry Watts as Business Development Manager

Marlborough-based Sarsen Technology Limited, a leading UK distributor of embedded hardware and software announce the appointment of Harry Watts as Business Development Manager.

Harry will be responsible for the development of key accounts in the defence, aerospace and high-end instrumentation sectors across the UK. He says, “As a Business Development Manager working for Sarsen Technology, I look forward to becoming a key point of contact for our customers. I'm excited to join a company in an industry that moves quickly, right on the cutting edge of technology, and the prospect of tackling fresh challenges and making a meaningful impact in a new work environment is really motivating.
”
Harry is an established Business Development Manager, with significant experience in account management and lead generation within the embedded technology market. His background also

WRC'23: African top researcher elected vice chairman of ITU-R study group

Nigeria's Dr. Lasisi Salami Lawal has been elected as the Vice Chairman of the ITU-R Study Group Four (Satellite Services) at the ongoing ITU World Radiocommunication Conference 2023 (WRC-23) Dubai, United Arab Emirates.

The International Telecommunication Union (ITU) is unique among United Nations agencies in allowing private companies to participate in its three areas of work —the radiocommunication, standardization and development sectors. Companies and organizations join ITU as Sector Members and Associates, while another membership category exists for Academia.
According to ITU, the ITU-R Study Group is the main vehicles for corporate and non-governmental participation are ITU's study groups, in which over 5 000 technology experts and specialists from companies, governments and other organizations around the world jointly undertake technical studies to establish international voluntary standards, — referred to as ITU Recommendations. In addition, the study groups produce various technical, operational, and procedural publications that support the advancement of telecommunications globally.
In the case of ITU's Radiocommunication Sector (ITU-R), study groups address a wide range of topics, from how satellites communicate with each other to ensuring that ships in distress can alert rescue services efficiently.

Dr. Lasisi Salami LAWAL has over 22 years of private practice, industry and Government experience and as an International Advisory Board member of International Conference on Computer, Communication and Control Technology (I4CT), Editorial Board Member of American Journal of Engineering and Technology Management (AJETM), Academic consultant and an Accreditor to Engineering Programmes of Universities on behalf of the Council of the Regulation of Engineering in Nigeria (COREN), similar to Engineering Council of UK for which he is a member as a Chartered Engineer (CEng) including being Journal and Conference Proceedings Reviewer.

He brings his professional knowledge to bear in fostering a nexus between academia and industry to strengthen going-concerns of emerging technologies traversing Communications and Satellite Technologies, Communications Satellite Applications & Services, GNSS & SBAS Technologies, Satellite Project Management with hands-on experience on two communications satellites launched for Nigeria (NIGCOMSAT-1 and NIGCOMSAT-1R) as a project team leader and acknowledging need to bridge digital hiatus in rural Africa and promote digital & health inclusion as well as promote knowledge economy using space-based ICT infrastructure.

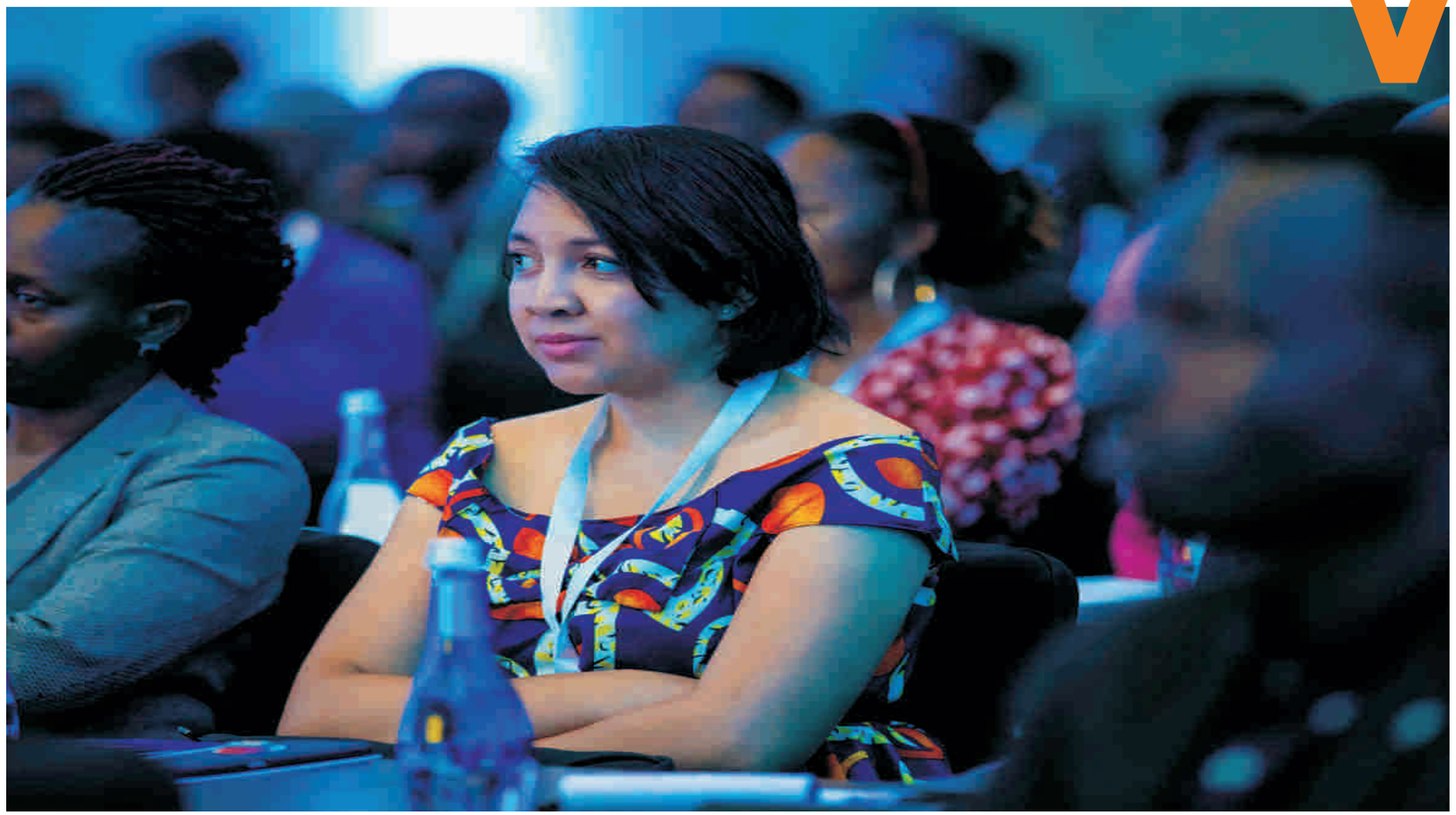
He currently works with NIGCOMSAT Ltd as Acting General Manager in the Directorate of Technical Services, Head of Department, Navigation and Project Manager for the facilitation of adoption of SBAS Technology in Africa with relevant national and international stakeholders. He is also a senior research fellow with Federal University of Technology, Minna where he had his first degree in Electrical and Computer Engineering and a visiting scholar to University of Sussex, UK where he bagged MSc and PhD in Satellite Communications & Space Systems. He is a visiting scholar to GNSS Center of Wuhan University, China.

The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs), driving innovation in ICTs together with 193 Member States and a membership of over 900 companies, universities, and international and regional organizations. Established over 150 years ago, ITU is the intergovernmental body responsible for coordinating the shared global use of the radio spectrum, promoting international cooperation in assigning frequencies and, if necessary, associated satellite orbits, improving communication infrastructure in the developing world, and establishing the worldwide standards that foster seamless interconnection of a vast range of communications systems. From broadband networks to cutting-edge wireless technologies, aeronautical and maritime navigation, radio astronomy, oceanographic and satellite-based earth and oceanographic monitoring as well as converging fixed and mobile phone, Internet and broadcasting technologies, ITU is committed to connecting the world

EVENT

RWANDA

Stepping into 2024!



In 2023, the Rwanda Space Agency RSA joined the rest of the world in the global celebration of World Space Week, which was held from October 4th to 10th. The event commemorates significant milestones in space history and applauds innovations in the space sector, emphasizing the importance of peaceful space endeavors and international cooperation.

The Space Week Conference 2023 established a forum for discussions and interactions among space professionals, corporate pioneers, and the academic community, focusing on how space can contribute to advancing development.

According to the agency, the timing of this week coincides with two pivotal events: the first launch of Sputnik 1 by the Soviet Union on October 4th, 1957, and the signing of the Outer Space Treaty OST on October 10th, 1967. These moments marked the beginning of the space age and the establishment of principles for responsible space use and collaboration.

The theme of the celebration was “Space and Entrepreneurship,” guiding RSA's two-week nationwide awareness campaign and the conference held from October 9th to 10th, 2023, at the Kigali Convention Centre (KCC). Before the Space Week Conference, RSA had planned a nationwide tour to educate and raise awareness about its vision, mission, services, products, and aspirations.

With the theme, 'How Satellites Keep Us Connected,' Global Star explored satellite technology's crucial role in global communications. It delved into cutting-edge infrastructure, emphasizing their indispensable role in maintaining seamless connectivity worldwide. The session also addressed questions about satellite technologies, innovations, bridging the digital divide, and regulatory challenges in the evolving space industry.
This session explored the diverse applications of space technology reshaping industries and global capabilities, encompassing Earth observation, climate monitoring, satellite navigation, and more. It showcased case studies and discussed the strategic imperatives for harnessing the transformative power of space technology to drive innovation and shape an interconnected future. Potential questions for ESRI focused on their use of emerging technologies in Geographic Information Systems (GIS), real-world applications across sectors, support for smart city initiatives, and efforts to promote collaboration and interoperability within the geospatial industry through partnerships and open standards.

This exclusive conversation brought together experts and visionary leaders from MAXAR, Planet and ESRI to unveil cutting-edge advancements and transformative potential in space technology. The session showcased MAXAR's satellite solutions, Planet's Earth imaging capabilities, and ESRI's geospatial insights in a riveting discussion that redefined the possibilities of space technology. Participants explored how these industry leaders reshaped the future of Earth observation, data analytics, and geospatial intelligence, catalyzing profound transformations across sectors, including environmental sustainability and national security. Potential questions addressed how these organizations assisted in solving complex challenges, democratizing access to Earth observation data, and contributing to sustainability and climate change mitigation.

Space Week campaign has positively played a pivotal role in fostering the importance of space technology in Rwanda. This initiative has not only ignited a sense of wonder and curiosity about space but has also demonstrated the immense potential for scientific and technological advancements in Rwanda. By inspiring young minds, promoting STEM education, and encouraging innovation, the Space Week campaign has set the stage for a brighter and more promising future for the nation.

As Rwandans continue to look upward they are poised to become active contributors to the global space community, harnessing the power of science and technology to drive the country to new heights. Indeed, the Space Week campaign has proven to be an inspiration, aspiration, and transformation for the people of Rwanda, reaffirming the idea that the sky is not the limit but the beginning of a limitless journey towards progress and discovery.

The space week campaign was concluded by a two days' conference, the conference brought together various participants, including government officials, industry leaders, young innovators, students, and the general public. Through this gathering, RSA celebrated the progress of space technologies for social and economic advancement, as well as promotion of networking and creation of entrepreneurial opportunities in Rwanda.

Col. Francis NGABO, Chief Executive Officer of the Rwanda Space Agency said, “With profound gratitude, we extend our warmest welcome to the distinguished guests gathered here for Rwanda Space Week Conference, the first ever! Analyses have demonstrated that space services can directly support 42% of the Sustainable Development Goals, underscoring the vast potential of space technology across various sectors. This recognition has spurred collaborative efforts between the government, the private sector, and politicians, all geared towards nurturing a thriving space industry in Rwanda”

Harnessing Space for Earth's Insights

Step into the future of data-driven decision-making with 'Harnessing Space for Earth's Insights,' session, during this session, revolutionary ways in which space technology reshaped our understanding of Earth were unveiled. From advanced Earth observation satellites to breakthroughs in remote sensing, the conversations showcased the power of space-based data analytics, providing essential insights into climate change, natural resource management, disaster response, and more. Potential questions that were addressed included inquiries about the most impactful and innovative use cases of Earth observation technology, the pivotal role of Earth observation data in addressing climate change and environmental sustainability, the opportunities and challenges in utilizing high-resolution Earth observation data, and successful applications of space technology in disaster management and humanitarian response.

Prospects of Satellite Manufacturing in Africa

With TRL's expertise and insights, attendees delved into the transformative advancements in satellite technology, local capacity building, and collaborative partnerships that shaped Africa's role in the global space arena. Potential questions addressed during the event included inquiries about the key opportunities and challenges African nations faced in establishing their own satellite manufacturing capabilities, the process of identifying and prioritizing satellite manufacturing projects to serve socioeconomic development and strategic interests, necessary regulatory frameworks and policy reforms, and strategies for capacity building and skills development through collaboration with industry leaders like TRL Space.

Capturing the African Space Journey

The Rwanda Space agency embarked on an enlightening voyage through 'Capturing the African Space Journey,' a presentation by Space in Africa. The session offered a unique opportunity to dig into the remarkable advancements and strategic imperatives that shaped Africa's ascent in the global space arena. Potential questions raised and addressed during this session included questions about the key milestones and developments in the African space sector, the role of indigenous satellite launches, international collaborations, and policy advancements. Additionally, discussions focused on Space in Africa's efforts to raise awareness and promote the utilization of space technology and data for the benefit of African nations, the opportunities and challenges faced by the African space industry in attracting investment and fostering entrepreneurship, and the ways in which Space in Africa facilitated cooperation among African nations, space agencies, research institutions, and private sector players to build capacity, share expertise, and promote innovation within the continent's space ecosystem.

Beyond Borders: Satellite Communication's World-Changing Impact

As the event winds up, participants explore another key theme, 'Beyond Borders: Satellite Communication's World- Changing Impact,' a session that featured experts from E-Space, Global Star, Locus Dynamics, and BSC. This session illuminated the groundbreaking transformations driven by satellite communications technology, with a focus on how advancements in satellite technology, such as high-throughput satellites and low Earth orbit (LEO) constellations, expanded the reach and capabilities of satellite communication networks and their transformative effects on underserved industries and regions.

ASIA

Accelerating pace of China's commercial space industry development

The Long March family of Chinese launch vehicles marked a 500th spaceflight on Sunday by launching a Long March-2D carrier rocket to send a remote sensing satellite to space from the Xichang Satellite Launch Center in Sichuan Province in the southwest of China. In addition to the Long March family, China is also witnessing the boom of a commercial space industry. Many private space startups are busy creating and testing reusable rockets, sending payloads into orbit and aiming to catch up with world-leading peers in the industry.

Successful launches

China's commercial space industry has achieved notable breakthroughs in 2023 with a series of successful rocket launches completed.
One of these happened this past Sunday at the Jiuquan Satellite Launch Center in northwest China, where a Chinese commercial reusable rocket named SQX-2Y successfully completed its second flight test mission, the first reuse of such a rocket in China.

The rocket, propelled by a liquid oxygen methane engine, was developed by Beijing Interstellar Glory Space Technology Ltd., better known as iSpace. It also successfully completed a vertical take-off and landing flight test on Nov. 2.

Meanwhile, on Dec. 9 the Zhuque-2 Y-3 carrier rocket was sent into space from the Jiuquan Satellite Launch Center.
It was the third flight mission of the Zhuque-2 carrier rocket and the success of this launch mission made Zhuque-2 China's first commercial liquid carrier rocket to complete successive launches.

This same launch center also saw activity on Dec. 5 when China launched a CERES-1 Y9 carrier rocket, sending two new satellites to their planned orbits, and marking the 11th flight mission of the CERES-1 rocket series.

Developed by Beijing-based Galactic Energy, CERES-1 is a small-scale solid-propellant carrier rocket designed to send micro-satellites to low orbit.

The launch mission on Dec. 5 was the first by this commercial rocket developer to successfully send satellites to the twilight orbit.

Key technologies

The hat-trick of rocket launches in the first ten days of December can be seen as confirmation of the rapid advancement of China's commercial space industry. The high cost of rocket launches is regarded as a "roadblock" that hinders mankind's large-scale access to space, and the reusability of launch vehicles is the most important means of reducing such costs.

To develop recoverable and reusable launch vehicles is a must for commercial spaceflight companies both at home and abroad in order to pursue the highest input-output ratio, said JiHaibo, chief designer of the iSpace rocket SQX-2Y.

The two recent successful launches have verified the rapid reuse capability of this rocket, which means iSpace has made inroads into mastering a series of key technologies for the low-altitude return and landing of reusable rockets and their reuse, Ji added.
Methane is inexpensive and easy to purchase, and the characteristics of liquid oxygen methane, which is resistant to coking and carbon buildup, are conducive to the maintenance of engines and rockets, making its use one of the feasible paths to building reusable rockets, said Liu Lei, general manager of the engine R&D department of LandSpace.

Independently developed by LandSpace, the Zhuque-2 is China's first medium- and large-size liquid rocket with liquid oxygen and methane as propellants.

Soon after the successful liftoff of the Zhuque-2 Y-3 carrier rocket, LandSpace unveiled its development plan for the Zhuque-3, which will be propelled by its methane engines.

LandSpace said the first stage of Zhuque-3 will be reusable for no less than 20 launches and designed with a strong launch capability that can help build a large-scale satellite internet constellation.

All these technological breakthroughs would not have been achieved without policy support. In 2014, the Chinese government opened up the country's space sector to private investment, with numerous aerospace startups founded shortly afterwards.

Galactic Energy was co-founded by Xia Dongkun with other partners in 2018.The company provides commercial carrier rocket launch services and has unveiled research plans named after the Ceres and Pallas asteroids.

"Ceres and Pallas are asteroids that seemed far away from the Earth when they were discovered. However, now a human-made space probe has visited Ceres. We hope that rockets developed by our company will also bring space, which previously seemed so far away, closer to people's daily lives," said Xia, a former senior technician with the China Academy of Launch Vehicle Technology

Extensive application

Rockets are the most important vehicles for achieving space programs, and the main customers of commercial space companies now are commercial satellite companies.

"We are more aimed at the commercial market. What customers need is what we will seek to research and develop," said Xia.
GuodianGaoke, a Beijing-based commercial sci-tech firm, had their four satellites, Tianqi 21-24, sent to space aboard the CERES-1 rocket on Sept. 5.
The four satellites are part of the Tianqi low-Earth orbit Internet of Things constellation.
According to the company, the 38-satellite constellation will go into operation in 2024. It will provide global data services for application scenarios such as emergency communications, ecological environment monitoring, and tower detection.

Large-capacity rockets can certainly launch small commercial low orbit satellites, but the "starting price" is higher, said Pei Yao, a senior staff member at GuodianGaoke.

Commercial rocket companies have developed small-capacity, low-orbit launch plans that can accurately match this demand, and the prices they offer are much lower, providing an additional option for satellite companies, added Pei.
Commercial rockets and satellites are both important components of China's commercial space industry, and the size of this market has now exceeded one trillion yuan (about 141 billion U.S. dollars), with the number of registered and effectively operating commercial space enterprises in China exceeding 400.

"Through continuous research, development and improvement, commercial rocket companies have been able to work out a set of standardized processes applicable to the whole industrial chain, driving commercial spaceflight towards a virtuous circle and making it more and more popular," Liu said confidently.

NIGCOMSAT-1R

Every day becomes a countdown to the end.

Jane Nkechi Egerton-Idehen, the new Managing Director of the Nigerian Communications Satellite Limited, NIGCOMSAT is known to be colourful and insightful too. And she didn't disappoint. Her recent activities remains a pointer to the fact that Jane Egerton-Idehen wants to put Nigeria's communication satellite to good use after being underutilized over the last 12 years.

Despite her bold move, again she counters. She said, this may, however, be coming a little late as the 12-year-old NigComSat-1R satellite is to expire in the next 3 years. The satellite which has 15 years lifespan was launched in 2011 and is to reach its complete lifespan in 2026.

Before his exit in 2019, one of the former Ministers of Communications, Barrister Adebayo Shittu, had insisted that Nigeria needed two new satellites to act as a backup for the current one. He had announced plans to approach China-Exim Bank to secure a loan of $550 million for the purpose.
This, however, met stiff resistance from stakeholders, who argued that the current satellite operated by the country has been a wasted investment as it is not profitable and is being underutilised.

In 2021, former of NIGCOMSAT, Dr. Abimbola Alale, also announced at a stakeholder forum that the company was about to acquire two more satellites.
"I am pleased to inform stakeholders of our desire to acquire more satellites between now and 2025 with the NigComSat-2 (Hight Throughput Satellite) due for launch in 2023 while NigComSat-3 will be launched in 2025," she said at the time.
Legal Adviser and Company Secretary of the company, Alma Okpalefe, added that the planned launch of the two satellites in 2023 and 2025, would help NIGCOMSAT meet up with its mandate to commercialize satellite resources in the country and provide quality and cheap satellite services to Nigerians.

Successfully launched satellites are expected to operate for a certain period. This ends when the satellite can no longer able to perform its intended function, cannot maintain its operational altitude, or the fuel level is reaching the minimal point for a successful deorbit and disposal/return manoeuvres. Fuel is the most common reason for reaching this end-of-life point.

At the moment there are over 4,852 working satellites in orbit, playing crucial roles in communications, remote sensing and other tasks. Almost all were launched with the knowledge that if anything broke there was no way of fixing it. Most satellites also need fuel to occasionally adjust their orbits. Once that's gone they may become so much space junk, adding to the already substantial stream of debris encircling the globe.
End of life is defined as the loss of the primary mission including primary payload failure, bus failure, out of operational orbit or retirement. While actual life is defined as the time between successful launch and end of life and does not include secondary missions.
When launching satellites, the expected end-of-life is estimated–although this is always very conservative. There are many examples of satellites exceeding their expected life by years or, even, decades. However, operators always want to maximum the time their satellite is in operational orbit, which is understandable given the amount of money it costs to design, build and launch.

What happens to satellite at the end of the life?

A report by JAXA revealed that each satellite has a mission term to keep on using, called "design life". The "design life" varies depending on the type and purpose (mission) of the satellite, the orbit to launch the rocket and so on. When making a satellite, the amount of fuel, the battery size, the form of the solar cell paddle among others. are decided so that the satellite can continue to work throughout the period of "design life". There are satellites used even beyond the design life in case it is decided that the operation of the satellite can be continued. Some satellites have lived for very long periods in the past.

Once an operation is completed, the satellite will receive instructions from the ground while it has remaining the power. It will enter the atmosphere and burn up or move from its orbit without disturbing other satellites in operation. The moving satellite spins around the Earth for a while and then it will be gradually pulled closer to the Earth by the effect of the atmosphere and gravity.

Satellites in low orbits at an altitude of a few hundred kilometers from the ground will enter the atmosphere and burn up in several years to several decades. On the other hand, satellites in high orbits over 1,000 km will continue to revolve for more than 100 years. The satellites which indefinitely stay in space without falling cause a problem of space junk (space debris) and various discussions are held on this issue around the world.

No one size fits all

As the technological prowess of satellite component and prime manufacturers has developed over the past half century, satellites have increased not only in capabilities but in longevity, according to NSR, a satellite industry leading analyst. A satellite launched in the 1990s was designed to operate for an average 12 years, a life expectancy that by the 2000s increased to 15 years. Many continue to operate for 18 years or more, but 15 remains the prevailing design life. Yet with operators seeking new strategies in today's challenging market, and technology advancing at an ever-faster pace, could the 15-year GEO satellite life be a standard of the past?

NSR's Satellite Manufacturing and Launch Services 8th Edition, found that commercial GEO communications satellites in-orbit today have an average age of 8.9 years. Only 17.2% of current satellites are in the process of being replenished, indicating that a slate of new orders – or decisions to not replace aging satellites – are coming in the next few years. Fleet age and replacement status has long been a way to assess operators and better understand what lies ahead in terms of CAPEX, analyses facilitated by the 15-year standard lifetime. But as operators consider options to replenish satellites reaching end-of-life (EOL) while seeking new solutions to optimize CAPEX/OPEX and revenue generation per satellite, options for both shorter and longer lifetimes are appealing.

Longer Lifetimes

Many elements contribute to a satellite reaching EOL or experiencing a reduction in capabilities, but exhaustion of fuel most commonly drives the 15-year design life. As operators increasingly turn to electric propulsion, this driver will ease, enabling satellites to remain in station-kept orbit longer than with chemical designs. A more near-term solution to lengthen satellite lifetimes is to use in-orbit servicing vehicles, either for refueling or as a tug to provide station keeping.

Longer lifetimes allow an operator to generate more revenue from the satellite after it has been fully depreiated, increasing ROI and reducing CAPEX. Yet revenue potential is not the sole factor driving interest in longer lifetimes. Life extension also enables an operator to delay decision making and CAPEX on replacement satellites, keep an orbital slot, as well as potentially leverage more advanced technologies only available at a later date. NSR's In-orbit Servicing Market report identified demand for 8 new life extention mission annually, out of the average 19 satellites to reach EOL per year in the coming decade. Yet no systems have yet deployed, and it will be multiple years before operators can rely on this service.

However, satellites remaining in operation longer can also introduce added risk to an operator's business plan. It limits market expansion and implies keeping old, less capable technology in service while competitors launch new assets. By the end of what could be a 20+ year life, the satellite may no longer be able to competitively address demand. As new satellites are outfitted with more flexibility, particularly if software defined or with potential to be upgraded in-orbit, this risk is mitigated.

Shorter Lifetimes

Interest in short, 7-8-year lifetimes has also emerged. Given the fast pace of market evolution in recent years, it is increasingly difficult to design a satellite that will be able to competitively address demand and generate revenue over its lifetime.

A 7-8-year satellite would reduce risk on market certainty, requiring only ~9-10 years commitment to a demand profile rather than 18 for a traditional satellite. Shorter lifetimes also enable a faster refresh rate to implement new technologies, target new markets, and better compete with new terrestrial and space-based assets.

As launch costs continue to decline, this model is somewhat more feasible, yet still requires manufacturing costs to reach <50% of a traditional 15-year satellite to compensate for fewer revenue-generating years.

This is a challenging proposition, demanding development of a new bus and components suited to the shorter lifetime/lower cost model. An added challenge is that not all components can be made more cheaply in exchange for shorter reliability guarantees;

TWTAs, for instance, have a reliability that already outlives other components and cannot provide the same performance for less money and a shorter operational timespan. 7-8-year satellites would be more standardized than their 15-year+ counterparts, with specialization limited to the end of the manufacturing process and more heavily dependent on software. To justify the NRE required for these platforms and to reach the targeted prices by using mass or serial production, manufacturers will likely need pre-commitments from operators to procure a set number of satellites per year – limiting an operator's ability to run RFPs on individual orders.

Moreover, short lifetime satellites are likely to be built with smaller platforms, limiting total capacity and the applications and market that each satellite can address. It is unclear if operators are willing to accept the trade-offs to achieve such an architecture.

The Bottom Line

As operators explore diverse strategies to succeed in today's complex market, the advantages to satellites with lifetimes different than today's 15-year average are appealing. Operators will start to experiment with shorter and longer lifetimes and the largest fleet operators are expected to leverage both models. The fleets of tomorrow will be a diverse collection of assets more closely tailored to an operator's unique application and customer group targets – leaving comparisons based on a 15-year standard a notion of the past.

Long history, bright future: Geostationary satellite innovation on the rise

The satellite industry continues to buzz with promise and possibility. In 2020 alone, a record number of over 1,000 satellites were deployed according to industry analysts, with dozens more expected to launch before year's end.
At this timely moment came the third installment of ITU's satellite webinar series which have so far enjoyed an audience of over 1,500 participants from more than 120 countries, said ITU Radiocommunication Bureau Director Mario Maniewicz during his opening remarks.
The webinar focused on systems in the geostationary-satellite orbit (GSO), which refers to satellites that operate from 36,000 kilometres above the Earth, where they appear fixed in the sky when observed from the ground.

"GSOs have a long history from the first launch over the Atlantic in the 1960s for interoceanic telecommunication," noted Mr. Maniewicz. "Today, they are reaching every single populated corner of the globe."

Nelson Malaguti, moderator and Counsellor from ITU Radiocommunication Sector (ITU-R) Study Group 4, reviewed two crucial decisions made during the 2019 World Radiocommunication Conference (WRC-19) related specifically to the technical and regulatory conditions under which GSO satellites can operate.

The first was the use of additional frequency bands for Earth station in motion ESiM, which communicate with GSO satellites to connect moving platforms like vessels or planes typically beyond the reach of terrestrial networks, resulting in a total of "2.5 GHz in the downlink and in the uplink in all regions worldwide," said Mr. Malaguti.
"This is a significant achievement if we look at the results of the last two WRCs," he added.

ESIMs contribute to Sustainable Development Goal 9 (Industry, Innovation and Infrastructure) by enabling broadband connection of people on ships, aircraft and land vehicles and ensuring their safety, security and comfort while on the move. This WRC-19 decision will increase the use and foster development of ESIMs, while providing appropriate protection to other GSO and non-GSO systems, as well as terrestrial services, explained Mr. Malaguti.

The second decision was the allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (FSS) for geostationary satellite use, providing an additional 1 GHz of spectrum for supporting gateway links for very high-throughput satellites

Tripling down

Following the previous two WRCs and the recently announced WRC-23 agenda, "satellite operators are responding with investments of billions of dollars," said Daryl Hunter, Chief Technology Officer at Viasat. This positive response from operators is also demonstrated by "a tripling down of satellite activities in the 28 GHz band," he added.

Echostar Vice President of Regulatory Affairs Kimberly Baum agreed, noting how satellite broadband revenue and subscribership grew by 19 per cent and 10 per cent last year. "By 2026, Northern Sky Research (NSR) predicts 10 million GSO broadband subscribers globally," Baum noted, adding how this growth is occurring as operators bring more satellites to the market.
"There is a good chance you have already used Ka band GSO ESIM service if you have flown on commercial air service," pointed out Mr. Hunter, highlighting how in-flight connectivity (on-board Wi-Fi) relies on GSO satellite services.

According to Viasat, there are now more connected devices than passengers, with annual ESIM flights exceeding 1.83 million last year.
GSO satellites and related equipment also seem to have 'tripled down' in size, with design and technology innovations shrinking building-sized communications panels to about the size of a microwave. "Gateways themselves have also shrunk from 11 metres to around two metres," pointed out Mr. Hunter. "We are operating as small as 30-centimeter ESIMs mounted on the tail of some small aircraft," he added, noting how ViaSat thinks it can get smaller with spread-spectrum techniques.

Flexibility, integration and mission extension

Flexible, high-throughput satellites are high on operators' innovation agendas, with Intelsat Vice President of Spectrum Strategy Hazem Moakkit sharing plans for the launch of software-defined satellites. These new designs enable operators to change frequencies, move beams, shape coverage and manage power on each satellite, offering "unparalleled flexibility in terms of providing services and surgically targeting areas where you need capacity," explained Mr. Moakkit.

Jonas Eneberg, Vice President of Regulatory Engineering at Inmarsat agreed, noting how dynamically adjusting deployment of satellite capacity makes its operation much more efficient. "Compared to LEO constellations, flexible GSO satellites are more efficient because they can avoid having capacity in coverage areas where there is low traffic demand," he explained.

Another exciting advancement is the possibility to extend the life of GSO satellites, which normally have a lifespan of around 15 years, according to Mr. Moakkit. Earlier this year, Intelsat and Northrop Grumman achieved an historical milestone with the industry's first life extension vehicle bringing another commercial satellite back into service.
"When satellites go out of service, it is not because their electronics stop operating but because the satellite runs out of propellant," he explained. "This is one way to keep using satellites that improves the business case, and the efficiency of the overall business offering."

Crucial to the success of software-defined satellites is the integration and upgrade of traditional architecture, said Mr. Moakkit, noting how "satellite technology will go from hardware-based and proprietary to standards-based and virtualized." The emphasis will fall increasingly on service and value in the form of managed solutions and applications, instead of selling MHz and Mbit/s, Mr. Moakkit said. Software-defined satellites aim to get closer to customers for more flexibility, shorter-term commitments, and seamless connectivity, which is what customers expect now, he added.

Expanding affordable connectivity

One of the more important uses of GSO broadband satellites is powering community Wi-Fi in underserved areas by placing a VSAT antenna on a central location in a town, such as a government building or store. The modem is connected to a WiFi access point to provide broadband connectivity to customers in a 100-metre radius.

Retailers can then sell data packs to the public, or the service could be subsidized by the government and offered for free, as in the Curacao, Brazil example shared by Ms. Baum. Northern Sky Research (NSR) predicts that by 2027, 40 per cent of overall revenue from satellite broadband will be from this kind of community WiFi hotspot, pointed out Ms. Baum.

Mr. Hunter shared the example of Viasat Community Internet, which is aiming to offer broad coverage in remote places with limited connectivity, what he referred to as "0G service – where people have to drive to get coverage." Claiming that Viasat can drop connectivity into that kind of location within a day, Mr. Hunter noted that "Ka band coverage and capacity are key" to making that happen.
In Brazil, for instance, many people lack internet outside large cities. The telecommunications company Telebras is working with Viasat to connect every Brazilian, he added.

Learning to live together

As spectrum is a limited natural resource, it needs to be shared among different types of services and even different types of satellite constellations, such as low-Earth orbit (LEO) and medium-Earth orbit (MEO) systems which are non-geostationary (non-GSO) by definition.

An audience poll revealed that the main challenge for GSO satellite operators is staying competitive with non-GSO systems whose sharing capacity is increasing, which might explain why 53 per cent of webinar viewers felt that GSO systems should continue to benefit from the regulatory advantage contained in the Radio Regulations.

While panellists agreed that sharing spectrum is necessary to make use of current and future innovation in satellite technology, they pointed out difficulties when it comes to GSO site coordination or time-sensitive activities. "We can deploy a new broadband terminal in two days. To do that, we don't have time to go through a site coordination process," said Ms. Baum. "We need access to spectrum for those user terminals that isn't shared so that we can deploy quickly in a given country."

GSOs and WRC-23

The use of additional frequency bands for ESIM communicating with GSO space stations in the fixed-satellite service (FSS) will be considered at the next World Radiocommunication Conference in 2023 –globally and for all regions, reminded moderator Mr. Malaguti.

The second GSO-relevant agenda item deals with the provision of satellite-to-satellite links in a different set of bands, as Mr. Maniewicz pointed out. "ITU-R Study Group 4 is evaluating ways to improve space-to-space communications including with GSO satellites so growing traffic demand can be absorbed by inter-satellite links," he explained. "Among those links are GSO stations where you establish links with non-GSO satellites – a very interesting agenda item for the next conference," added Mr. Malaguti.

Mr. Eneberg of Inmarsat agreed, highlighting how there is definitely a market for GSO providers serving non-GSO satellites through inter-satellite links, with a lot of interest from non-GSO operators.

Looking ahead, "new generations of high-throughput satellites and new services are going to benefit the global customer base," affirmed Mr. Hunter, suggesting a bright future and more innovations to come.

African countries pushing boundaries of space exploration in 2024

Across Africa, space activities are growing globally, with the global space economy bucking growth trends in the wider economy. Estimates vary hugely, given differing definitions of the space economy, but what is certain is that this is a significant and growing industry, presenting a considerable economic opportunity. Two recent estimates suggest that the global space economy was worth between $386bn and $469bn in 2021.

The global space economy has demonstrated strong growth since the turn of the millennium (1.6% per year), with growth accelerating in future years (5.1% per year to 2040). It is estimated that the global space economy will be worth a staggering $1.1tn by 2045, as the new opportunities in the sector are realised.

Africa has not always been a modest continent compared to the rest of the world, says a top analyst. From glorious Ancient Egypt to the empire of Mali, the African continent has always been a place of prosperity and development of great civilisations. It remains one of the greatest paradoxes of humanity how a continent with so many resources is today considered the poorest, he said.
Africa is one of the most diverse places in the world where there are more than 1,700 languages and where, despite the perception we have from the West, there are dozens of ways of understanding economic and social policy.

Africa has 10 countries in the top 40 oil producers; 4 in the top 15 global gold producers; South Africa produces 75% of all the world's platinum; Congo produces 70% of the world's cobalt (essential for making rechargeable batteries); Botswana is the largest diamond producer; Ivory Coast and Ghana produce more than half the world's cocoa; and more than 75% of the world's phosphates are in Morocco. But none of these countries is rich.

Among the reasons why Africa is not a wealthy region is the lack of economic diversification. African economies depend on the exploitation and export of their natural resources, which makes them vulnerable to the price and value instability of raw materials, for example, the fall in the price of oil in 2014 caused economic recessions in 8 of the 10 largest oil producers on the continent, such as Nigeria, Algeria, Angola and Libya, losing 30% of the value of their GDP (Gross Domestic Product).

Another key factor is the lack of infrastructure and human capital for the development of raw materials. Investment in infrastructure would allow countries to export the final product instead of raw materials whose value is always higher. This leads to a shortage of employment generation and a glass ceiling for growth, as it is not possible to achieve higher income than the value of the raw material.

Corruption and government mismanagement play a crucial role in poverty in Africa. In Angola, hydrocarbon revenues equivalent to 25% of that year's GDP disappeared in 2011, with the government's response to the International Monetary Fund being that there had been "an accounting error". The high birth rate, the lack of access to contraception and the low education of the population put great pressure on the consumption of resources such as health, education and housing. The 25 highest birth rates in the world are in African countries and 37 of the top 40 are in Africa.

In the last few years, Africa has witnessed an unprecedented acceleration in tech products and services hinged on the outer space resource. As of August 2022, the African space industry is worth USD 19.49 billion, and is expected to grow to USD 22.64 billion by 2026, according to one industry report.

As of April, 53 satellite have been launched by 15 African counties, and of these satellites, nine were launched by commercial entities. Africa's satellite program began in 1999, with the launch of SUNSAT-1 by South Africa, and the latest launch was that of the Kenyan educational satellite, Taifa-1, launched on 11 April 2023.

Africa has a legacy in across up and downstream, covering remote sensing; telecommunications and navigations; as well as space manufacturing, and the establishment of critical infrastructure, which are all expanding.

Lately, there has been a boom in critical investment plans in Africa specifically, such as the recent plans to establish a commercial spaceport in Djibouti, which is one of multiple prospects geared towards critical investments for space infrastructure in Africa.

At the recent NewSpace Africa Conference 2023, the spirit of development cooperation towards building capacity in space is in the air. Different stakeholders in the governmental, developmental, and private sector representatives met under the theme: “Unlocking the full potential of private sector company services delivery, through space data, science, technology and services”. This theme acknowledged the private sector's role in advancing innovative solutions to African challenges and fostered a knowledge-sharing environment for both EU and AU-based entities to come to a mutual consensus on cooperation needs, with mutual reciprocity as a baseline.

In 2021 and 2022 alone, Ethiopia, Kenya, Mauritius, Angola and Uganda acquired new satellites. Africa now has 55 satellites in orbit, which is an insignificant figure compared to a total of tens of thousands. But the vast majority of them were launched in the last five to seven years, and a hundred more are in development, Oniosun said.

This enthusiasm has been driven by the advent of new space, that is to say, the emergence on the scene of the private sector in a field historically dominated by governments. This is thanks to the drastic fall in costs. African governments can now afford a nanosatellite from $50,000 (and up to more than $150 million), which can be built in less than two years by a start-up or by students, Ouattara pointed out. "Space has become very affordable for Africa. It has changed the whole dynamic."

In 2020 compared to 2019, the total budget provided in African countries to finance activities for the study and use of outer space increased by 55 percent and amounted to about $503 million. Although it is only 0.7 percent of related global spending, it would be unfair to consider it negligible, as it nearly doubled the cost of this activity in Canada

In 2022 compared to 2021, the budgetary expenditures of African countries provided for the needs of space activities increased by a rather modest amount - 2.2 percentage points, while the Asian and European regions saw a decrease in the such expenditures. In physical terms, their value amounted to more than half a billion, which, although significantly lower than in Asia, Europe and North America, is higher than in other geographical regions

African Space Agency formally inaugurated

The African Union Commission AUC and the Egyptian Government have, via a signed agreement, formally inaugurated and declared the African Space Agency AfSA open and operational. The signing happened on January 25, 2023, establishing the general

framework regulating the relationship between the parties, which will serve as a platform for space research and innovation on the continent.

The signature happened during a reception event by the Minister of Higher Education and Scientific Research, Mohamed Ashour, to a delegation from the African Union (AU) headed by the AU's Commissioner for Education, Science, Technology, and Innovation, Mohamed Belhocine. According to local media, Ashour assured the delegation of the Egyptian Government's keenness to fulfill its promise to implement a permanent headquarters for the AfSA, aiding in the continent's aspirations to advance the space science technology sector.

Its headquarters have already taken shape in Egypt's Space City, a sprawling complex of more than 5,000 square metres on the outskirts of Cairo, close to the highway linking the Egyptian capital to the major city of Suez.
Professor Mohamed Belhocine, the African Union's Commissioner for Education, Science, Technology and Innovation, and the Egyptian Minister of Higher Education and Scientific Research, Mohamed Ayman Ahmed Ashour, signed the agreement a few days ago for President Abdel Fattah al-Sisi's government to host the headquarters of the African Space Agency near the pyramids.

A new global space player, AfSA is being set up under the umbrella of the African Union (AU), the international organisation based in Addis Ababa, the capital of Ethiopia, which is the forum for dialogue between 55 of the 59 states on the black continent. It is set up, according to article 2 of its constitutive text, to "promote, advise and coordinate the development and use of science, space technologies and associated regulations for the benefit of Africa, the world and inter-African and international cooperation".

Its creation responds to the conviction of most African leaders that space-based applications are key to accelerating the development and prosperity of their respective countries and, step by step, they have brought the African Space Agency into being. The aim is to acquire technologies and build infrastructure to improve, for example, the management of water, marine and terrestrial natural resources, agriculture and the environment.

Djibouti announces construction of first spaceport in Africa

Djibouti is a country located in the Horn of Africa, in the area of influence of the countries of the so-called Islamic Arc off the Arabian Peninsula, with coasts on the Red Sea and the Gulf of Aden in the Indian Ocean. It covers an area of 23,000 square kilometres and has a multi-ethnic population of 950,000, the majority of whom profess Islam.

The geostrategic importance of this small sub-Saharan African country on the great chessboard of global dominance lies in its geographic location. It is the gateway to the Strait of Bab al-Mandeb, one of the five key points in the control of global maritime navigation and one of the most important routes to dominance and supremacy in global trade.

The Bab al-Mandeb Strait is the route that connects the Indian Ocean with the Red Sea through the Suez Canal, and in passing is the route that links the markets of the countries of the Indo-Pacific region, the Middle East and Europe. It is estimated that 30 per cent of global maritime trade and 40-90 per cent of the oil and gas consumed by Europe, Japan and other Asia-Pacific countries transit through this geographical feature.
As the pendulum of world power swings to the Indo-Pacific with the growth and dominance of the economies of China and India.

And, as rivalries grow between the US and China for dominance of Africa and the Indo-Pacific, Djibouti has become a key player in the strategic dominance of these two strategic regions and, of course, an enclave that hosts the largest number of foreign military troops on African soil. Indeed, Djibouti has become a strategic centre of military operations for the control of economic interests in Africa, the Middle East and the Indo-Pacific for the United States, China, India, France, Italy, Japan, Saudi Arabia and Turkey. A territory that concentrates the highest density of military troops per square kilometre and number of inhabitants in the world.

Although it gained independence from France 43 years ago, the Gauls have one of the best-equipped military bases in Africa on their territory. The United States has the largest military presence in Africa at the Camp Lemonnier military base, with the best-trained platoons of its special troops in the Horn of Africa.

This base is a strategic military intelligence centre for the control of its strategic interests in Africa, the Middle East and the Indian Ocean. Japan has its base next to the gringo base. Italy has had a military base and complex for seven years. Saudi Arabia built a military base three years ago to combat the Houthi rebels who attack its oil tankers transiting the Strait of Gibraltar. China four years ago agreed with the Djiboutian government to build a port, a free trade zone and a military base at Obock north of the country's capital. This military base was built as part of the String of Pearls plan that includes ports in Bangladesh, Pakistan and South Sudan.

It is a surprise announcement,. Djibouti's president, Ismael Omar Guelleh, revealed in early January plans to build a spaceport in partnership with the Chinese company Hong Kong Aerospace Technology. It is a major project for this Africa country to develop its economy. Djibouti has long relied on its strategic location at the entrance to the Red Sea, which is one of the busiest trade routes in the world. With this $1 billion (€933 million) spaceport built over a period of five years, this desert nation is betting, this time, on its close proximity to the equator.

The project is still in its infancy. So far, a memorandum of understanding has been signed. If it is built, this spaceport will be the only one in operation in Africa, which is the only continent without a launch site.

In 2021, press reports revealed Turkey's desire to establish a spaceport in Somalia, where Ankara already has a military site. But nothing has materialized since then in this country plagued by multiple crises, including the insurgency of the Shabab Islamists.

Although Africa has no spaceport, The continent is an obvious geographic location when it comes to accessing space. Some 15 countries are located on or near the equator, the ideal location for launching rockets. "Beyond the launching itself, Africa is in the middle of the world. In terms of tracking satellites and even receiving their signals and monitoring them, it is the best-placed continent," argued Tidiane Ouattara, an African Union space expert in Ethiopia. "It's full of economic potential for us, full of job creation potential and, best of all, it's full of strategic cooperation potential for all African countries."

Is Marsabit County Kenya's Next Spaceport Hub?

In Kenya, Marsabit County has emerged as the most suitable county in Kenya out of 7 key contenders to set up a Spaceport; other counties are Laikipia, Kilifi, Tana River, Isiolo, Turkana and Narok county.

This is according to a report commissioned by Viwanda Africa Group in collaboration with Longshot Space Technology, and a team of student engineering researchers drawn from Kenyatta and Nairobi universities which examined the viability of establishing a Spaceport in Kenya.

The Kenya Spaceport Research, which drew data from various national and global organizations, as well as guidance from the Kenya Space Agency (KSA), carried out an assessment among all the 47 counties where Marsabit County emerged as the most favorable location to set up a Space Port due to its large tracts of unoccupied, affordable land, sparse population density, low trafficked airspace, generally flat terrain and proximity to the LAPPSET corridor.

Speaking while receiving the report, Kenya Space Agency Acting Director General Col. Hillary B. Kipkosgey says the benefits of establishing a spaceport capable of launching rockets within Kenya are numerous and would positively impact on the growth of the country.
"The development of highly innovative industries such as this provides current and future employment opportunities in many sectors, and the potential for growth in supporting industries. Development of such a spaceport would also foster research, innovation and growth of knowledge within this country, rippling out to Kenya taking the lead globally as a significant player in the space sector," noted Ag DG Col. Kipkosgey.
Additionally, "The Space sector requires innovative, committed and forward thinking minds; something our young people have in abundance. This is therefore an area Kenya can grow and lead in.
Viwanda Africa CEO Nyambura Kamau noted the interest to carry out the survey in Kenya originated from the geographic advantages the country sits on as a potential launch site: an interest shared by the US based space start-up company Long Shot.

The benefits of establishing a spaceport capable of launching rockets within Kenya are numerous and positively impact the growth of this country. On the equator and on the east coast of Africa, Kenya is located in a geographically favorable position, able to launch vehicles very efficiently and with minimised risk to its population. This makes it an attractive launch site that many countries and private companies would be willing to pay to utilise. In addition, the development of highly innovative industries such as this provides employment opportunities in many sectors, and the potential for growth in supporting industries. Development of such a spaceport would also foster research, innovation and growth of knowledge within this country, rippling out to Kenya taking the lead globally as a significant player in the space sector.

"If you look at a World map you see that Kenya is among 6 or 7 countries in the world with ideal placement for a space launch. After researching Kenya and paying a visit to Nairobi, I discovered a further advantage the nation has which may make it unique in the world; its people," noted Longshot Space Technology CEO Mike Grace

Kenya is located in a geographically advantageous position due to its lateral coordinates. Its location on the equator provides a space vehicle being launched from Kenya with a "speed boost" equivalent to an additional speed of 1,650 km/h, due to the earth's rotation. This allows the launch vehicle to save energy and carry heavier payloads into space.

Kenyatta University Chairperson, Department of Mechanical Engineering, Dr. Eng. Victor M. Mwongera, Principle investigator and aerospace engineer said the report provides a strong initial examination on the viability of establishing a spaceport in Kenya.

"The report examines the benefits of establishing the spaceport, the ideal location, the considerations that must be made, its commercial viability as well as how the private and public sector should work together to make it a reality. The case made here shows that establishment of the spaceport is not only a viable idea, but something that we as a nation should aim to pursue", said Dr Mwongera.

According to the report, it's estimated that the initial stage of the Spaceport construction will cost Kshs 5 billion, Kshs 7 billion annual operational costs and revenue of Kshs 1 billion per launch with an estimate of 5 launches within the first year of construction and an exponential rise to 60 launches by the10th year of operation

Research was conducted on the physical, economic, environmental, social, political and cultural factors that would be considered for the establishment of a spaceport.

A decision matrix was then used to analyze the 47 counties in Kenya based on the primary factors which affect the location of a spaceport (availability of land and population density) for the purpose of narrowing down to a select 7 counties for further analysis.
A PESTEL and SWOT analysis was then conducted on the 7 counties, and a second decision matrix conducted on them. Based on these analyses, Marsabit County was identified as the ideal location for a spaceport.
Marsabit is sparsely populated, has readily available, vast arid lands, and connectivity to the LAPSSET transport corridor. The sparse population in Marsabit makes it easier to launch vehicles to space without huge disruption to normal air traffic.
However, there may be a need to construct additional supporting infrastructure such as roads, boreholes and solar farms, the report indicated.

Furthermore, Kenya is bordered by the Indian Ocean to the Southeast, which could act as a convenient drop zone and landing zone for rocket stages during launch. The Indian Ocean also provides a suitable location for the recovery of reusable rockets through ocean splashdown recovery missions, such as those used by Rocket Lab. The ocean also allows for mid-air retrieval of rocket stages using helicopters, far away from civilization due to safety factors. Other organizations such as SpaceX make use of spaceport droneships which are used to recover the first rocket stages, especially during high velocity missions which cannot carry adequate fuel to allow for a return-to-launch-site landing. SpaceX is also constructing its first ocean spaceport which is set to commence operation in 2022, thereby opening the gates for the construction of offshore spaceports
Locating a spaceport next to a large body of water is inherently attractive, as the water body acts as the downrange safety zone for the release of rocket stages during launches. Spaceports such as the Vandenberg Space Force Base and the Kennedy Space Centre take advantage of this with coastal locations, where the ocean acts as the safety zone during launches.Kenya fortunately holds the advantage of neighbouring the Indian Ocean, which was a primary consideration in the establishment of the San Marco launch platform at the Luigi Broglio Space Centre in Malindi.
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Equatorial Guinea intends to send an astronaut to space

Recently, the vice president of Equatorial Guinea, Teodoro Nguema ObiangMangue, was in

Moscow to strengthen bilateral relations in the fields of defense and security and open a framework for cooperation in the space sphere. **At the head of an important official delegation, Vice President Nguema Obiang met in Moscow with the director general of the Russian Space Agency, Yuri Borisov,** who accompanied him on his visit to the "Yuri Gagarin" Cosmonaut Training Center, located a few kilometers from the capital.

There, **the general director of the Institution since July 2021, Maxim Kharlamov, has explained the exhaustive training process followed by the selected candidates to achieve the cosmonaut qualification.** According to official Russian sources, NguemaObiang has stated that he is "very impressed" by the facilities, has recognized "how difficult" it is to prepare a person to fly to space and that "not everyone can become cosmonauts."
Train a cosmonaut and buy and launch a satellite
As a courtesy, Maxim Kharlamov has suggested to Vice President NguemaObiang the possibility of "becoming the first national of a country in the Central African region to embark on a space trip," but as long as he passes the physical and psychological tests to which that all aspiring cosmonauts must undergo.

The African delegation also held a working meeting with senior managers of Roscosmos, in which Yuri Borisov presented the perspectives for space exploration that Russia offers to the Republic of Equatorial Guinea in a framework of bilateral cooperation. Also in the multilateral scenario, where Borisov has offered to join the International Lunar Scientific Station project, led by China and Russia.

An official statement from the Government of Malabo dated December 13 explains that the vice president contemplates "great potential" in space cooperation with Russia and that Equatorial Guinea intends to "invest in different space macroprojects." One that NguemaObiang has given the status of "priority" is the participation of an Equatorial Guinean in a "manned mission" and in the launch of his own observation or communications satellite.

It clearly means that President Obiang, through Russia, intends to train and send one of his nationals into space. Also to acquire a dual-use observation satellite, civil and military, focused on the field of defense and providing security to its borders, as well as to monitor from space the country's oil and gas exploitations, as well as the forests and the waters under its jurisdiction.

SA Air Force grants rocket company PyraLink Aerospace a 'premier' launch pad in Overberg

South Africa's first private spaceport, Spaceport Overberg, a world-class facility to place satellites into polar and sun-synchronous orbits — is on track to be sited on the south coast of South Africa, near Arniston, Western Cape. It will be the first dedicated Rocket launch complex in South Africa. The satellites placed from here will lead Africa in National Security Intelligence, earth observation, imaging, broadband, and telecommunications.
PyraLink Aerospace, a two-year-old start-up that aims to build rockets in South Africa, announced a contract Thursday with the S.A. Air Force to build and operate a launch facility at the Denel Overberg Test Range in Arniston.
"Overberg Test Range is the premier launch site in Africa.," PyraLink CEO Lawrence Matjila told Medium.

The five-year "multi-user" agreement means PyraLink Aerospace can begin operating out of Launch Complex 01, or LC-01, the historic location of South African RSA-3 missile launches. There is no monetary exchange or lease payment to the Air Force for this contract. The agreement includes an option to extend for an exclusive 20-year term.

LC-01 was built by Denel in the 1980s, as a missile test site. Matjila estimates the launch facilities represent more than R10 million worth of existing infrastructure.

PyraLink's rocket is mid-priced at $7 million per launch. Matjila said the launch site will be ready before they are expected to launch at the end of 2032.
He called the site a "significant investment," although he said LC-01 solves a massive problem: Time. It would take about four years to build PyraLink's own launchpad from scratch, Matjila estimated.

"By leveraging these collaborations," Mbambo explained, "the SAAF is positioning itself at the forefront of space capabilities, actively contributing to national development."
The Chief Executive Officer CEO of the South Africa National Space Agency, SANSA Mr. Humbulani Mudau has said that South Africa has fostered exceptional engineers and scientists whose global contributions remain indelible. Yet, the complexity of the challenges before us calls for collective cooperation that transcends individual capabilities, he said.

He made this remarks recently at the inaugural National Space Conference 2023, a pivotal gathering that propels us toward a future of limitless possibilities hosted in South Africa. Having

He made this remarks during the inaugural National Space Conference 2023, a pivotal gathering that propels us toward a future of limitless possibilities organised by the agency in South Africa.

"Having assumed the role of CEO of the nation's esteemed space agency, Mr. Humbulani Mudau pledges to embark on a journey driven by a visionary purpose that kindles our spirits and binds us as one".

According to him, "The intricacies of the space industry, both multi-faceted and multifarious, stretch beyond the "capacities of any singular entity present here today. It is incumbent upon us to engineer unity among engineers, scientists, technologists, policymakers, and private enterprises", he said.

At the moment, the agency has successfully forged a collaborative bonds across disciplines, and thus poised to unlock the potential of cross-disciplinary ingenuity. This, in turn, lays the foundation for transformative solutions that steer our national space programme towards sustainable, resilient, and globally competitive horizons, says Mr. Humbulani Mudau.

Within the cosmic expanse, we not only encounter the vast universe but also glimpse our collective aspirations. "Our agency's novel vision epitomises this aspiration while envisioning a South Africa surmounting its confines, propelled by innovation, accountability, and a profound dedication to service" he said.

A new dawn rises at SANSA. "Our trajectory is set to catalyse success across diverse avenues. With profound pride, boundless excitement, and unwavering commitment, our team diligently advances an ambitious endeavour. This endeavour unites physical infrastructure with state-of-the-art Big Data technologies. It takes root in strengthening our engineering capacity and capability to focus on technologically advanced mission development for forthcoming South African satellites, amplifying satellite communication capabilities, and crafting indigenous satellite navigation augmentation systems.

These systems hold promise to significantly heighten the global navigation satellite system accuracy within our nation and the broader region", according to Mr. Humbulani Mudau

First female astronaut from a North African nation will be a Tunisian military aviator

Tunisia's first woman astronaut, who will also be the first Africa's representative onboard the International Space Station (ISS), is expected to make a spaceflight in March 2024, a spokesman for Tunisia's Telnet Holding, has said. "We plan that the flight will take place in March 2024," he said.
Scheduled for March 2024, the Tunisian mission organized as a public-private project should last 10 days, and focus on physics and medicine. It currently mobilizes eight female officers, airplane or helicopter pilots and aeronautical engineers graduated from the aviation school of Borj El-Amri. Under the leadership of Telnet, they are committed to raising the hopes of the country's more than 11 million inhabitants and taking a military woman to the International Space Station (ISS) in 2024, a year and a half after the successful launch of Challenge One, the first Tunisian satellite, into orbit.

In order to realise the public-private project, the air force under the command of Air Chief of Staff General Mohamed El Hajjam has shortlisted eight experienced female officers, aircraft and helicopter pilots and aeronautical engineers, who have already passed the preliminary tests.
Presented to the public last year at the headquarters of the Tunisian engineering group, the little that is known about the eight nominees are their faces, their names - Hala Awassa, Ibtihal Youssef, Wafa El-Baldi, El-Yomna Dalali, Olfa Lajnef, Rahma Trabelsi, Hind Safferi and Malika Mabrouk - and that they are captains and commanders trained at the Bordj El-Amri Aviation Academy, 23 kilometres from the capital. Telnet's CEO Mohamed Frikha anticipated that the goal is "to fly the selected one to the ISS in March 2024".

The day chosen for the presentation of the eight astronaut nominees is no coincidence. Women's Day is celebrated in Tunisia every 13 August - and not on 8 March, which is International Women's Day - because on that date in 1956, the Personal Status Code was adopted, granting women in the country legal equality with men in the field of private life.
They will be trained at the Yuri Gagarin Cosmonaut Training Centre. Tunisia lacks the means to transport astronauts to the ISS and return them to Earth. To do so requires the cooperation of the United States or Russia, the only countries with manned transport means to access the orbital complex. The Carthage government once again turned for a second time to the Kremlin and its space agency, Roscosmos, for support.

At the moment, the immediate plans of the Ministry of National Defence and Telnet are for the eight candidates to undergo second medical tests in the country and an intensive Russian language course. The results will pave the way for six of them to travel to the Yuri Gagarin Cosmonaut Training Centre in Moscow at the end of the year or early 2023, where they will undergo a thorough final selection process.
Over several weeks, they will undergo numerous interviews, clinical analyses, medical, physical, psychological and intellectual tests. Before pronouncing their final verdict, the Russian instructors will also assess their ability to work as part of a team, their strength to cope with extreme situations, as well as their spatial vision and mechanical comprehension skills.

Once the selection stage has been completed, two of them will be admitted to the cosmonaut course, which will last for about one academic year. Although both will receive exactly the same theoretical and practical training, the more suitable of the two will be the titular candidate and the other will be her alternate, in case she has to be replaced in the event of a last-minute incident.

The agreement with Russia dates back to the summer of 2021. In mid-August 2021, Tunisia's ambassador to Russia, Tarak Ben Salem, the then director general of the Russian Space Agency, Dimitri Rogozin, and Mohamed Frikha from Telnet signed an agreement in Moscow to train in Russia the astronaut candidates proposed by the Tunisian authorities. President Kais Said himself was present via video conference.

The Tunisian administration has ruled out the possibility of the military astronaut travelling to the ISS as a tourist. She is expected to "stay on board the ISS for 10 days and carry out scientific experiments in the fields of physics and medicine," said Mohamed Frikha.

The North African nation does not have a space agency, unlike neighbouring Algeria. This is why the orbital research project "is in the study phase and will be unveiled in March", according to the Ministry of Higher Education and Scientific Research, which is headed by physicist Moncef Boukthir.

It should be recalled that the North African country's first space milestone was reached on 22 March 2021, when the Challenge One nano-satellite built by a team of 20 Tunisian engineers from Telnet was launched into orbit at an altitude of 550km by a Russian Soyuz rocket from the Baikonur Cosmodrome in Kazakhstan. Taking the Tunisian cosmonaut to the ISS will be the second major achievement of public-private cooperation.

Egypt opens Astronaut selection competition

The head of the Egyptian Space Agency, Mohammed el-Qousy, announced that the agency will launch a nationwide, six-year long competition to select Egypt's first astronaut.
Addressing a delegation of the Education and Scientific Research Committee of the Egyptian House of Representatives, el-Qousy said that the selection process will comprise of several phases, each lasting two to three years. The first stage will assess applicants for their physical and psychological aptitudes for spaceflight, as well as their technical skills and qualifications. Once that phase has been completed, el-Qousy added, the second phase will whittle down the remaining applicants through a series of rigorous testing and training to select the final group from which one individual will be sent to the International Space Station (ISS).

“This is a six-year programme. At the first stage, which will take from two to three years, the selection of candidates in accordance with established international standards is planned,” el-Qousy is quoted as saying by the Egyptian national news agency, MENA.
El-Qousy stressed that the Egyptian astronaut selection competition is open to all young Egyptian men and women and that ultimately two individuals will be selected, and only one of whom will go to the ISS. El-Qousy provided no launch dates for an Egyptian astronaut, and nor did he provide any details as to which country, if any, is assisting Egyptian authorities in the astronaut selection process.

The announcement by the Egyptian Space Agency is the latest in a number of Middle Eastern countries having sent, or have expressed an interest in sending, an astronaut into space. In September 2019, the United Arab Emirates sent, with Russian assistance, its first ever astronaut to the ISS, Hazza Al Mansoori. The UAE announced its second astronaut selection process in early December 2019, and it is understood that Russia has offered to assist Bahrain and Saudi Arabia with similar astronaut programmes.

The Emirati astronaut mission appears to have started a regional rush to send astronauts to space, and Russia seems to be happy to help countries bolster their international prestige. Indeed, after the safe return to Earth by Hazza Al Mansoori last year, Iran also announced its intention to seek Russian assistance in sending an astronaut into space. This trend is not just restricted to the Middle East either, as Hungary and Malaysia have also expressed varying degrees of interest in having Russia train and launch astronauts for them as well.

One potential issue for Egypt is that the UAE paid its own way to have Russia train and launch Al Mansoori to the ISS, and presumably Bahrain and Saudi Arabia possess the financial resources to do the same should they decide to send their own astronauts to the ISS. For Cairo, however, those financial resources do not necessarily exist, and even if they did, the decision to spend them on an Egyptian astronaut could be politically controversial in a country that is still going through considerable economic hardship.

Egypt and Russia enjoy close and friendly relations, and Egypt is a large purchaser of Russian arms and technology – to include satellites – and there are even rumours that Cairo and Moscow are discussing the possibility of establishing a Russian military base in Egypt. Within that context Russia might offer to train and launch an Egyptian astronaut to the ISS in the coming years without any cost as part of a wider strategic relationship.

Mapping Ethiopia's space interest

AbdisaYilma is the director general of Ethiopia's Space Science Technology Institute (ESSTI). Established just five years ago, the institute is already charting Ethiopia's growing interest in space.

Q: As a young institute, what are your achievements so far?

AbdisaYilma: The institute was established in October 2016. Our biggest achievement has been conducting a thorough research and study. We've also been involved in the improvement of satellite technology in Ethiopia and human capital development.
A lot of studies have been carried out in the sectors of astronomy, space science and application using remote sensing and Geotechnical Database System (GeoDASY). So far, we have published 212 papers in world acclaimed journals, of which 123 have been in astronomy and astrophysics, 14 in GeoDASY, 38 in remote sensing and 34 in space science and application, raising Ethiopia's profile in the global scientific community.

We have also managed to secure patents for three innovations. We've developed 3D printers in-house, made an eight-inch telescope right here in Ethiopia using our own engineers and built a device to measure body weight anywhere in space, called planet weight.
We've also made a small refractor telescope and given trainings to academic institutions including TVET's on how to work on these technologies themselves.
Currently, we're engaged in some 43 research and technology development programs. In regard to infrastructure, the observatory which is the first in East Africa, continue to be functional.

We have also started our own space science journal called Abay Journal of Space Research and have several UAV projects under way, on top of which we are mobilizing manpower in collaboration with Addis Ababa University. We have managed to organize four courses for masters and PhD programs, with 18 PhD and 28 master's students graduating from our program so far, with most joining our team at the ESSTI.
In a bid to produce aerospace engineers, we've been working with the Addis Ababa Science and Technology University at kilinto, to develop aerospace engineering curriculum in the past three years.
The masters and PhD program in aerospace engineering started this March.
In terms of satellite development, in collaboration with the People's Republic of China, the first ever Ethiopian satellite was launched in December 2019, the second one a year later.

In June 2021, we opened up a satellite center at Entoto. The two satellites Ethiopia has launched so far are not sufficient to get optimal information, since Ethiopia has a huge geographical area of around 1.2 million square kilometers. However, we have built a satellite information receiving center that gets optimal information from all kinds of satellites.
The center is able to receive information from five satellites and it is compatible with the technology of all information satellites around the world.
Ethiopia does not have a communication satellite. So, we have finalized the feasibility studies to launch Ethiopia's first communication satellite, which only awaits financing, to start working on the launch of the satellite. We then can have our own platform for all local broadcasting centers. Ethiosat is functional and around 95 percent of broadcasting companies use it locally.

We have also made great strides in infrastructural research for future investment. We've joined the World Astronomy Association and we've been receiving support from international partners. We've also formed the Ethiopian Space Kids Club. These are the things we would list as the major achievements we have registered so far.

Q: Are you using 3D printing technology and if so, for what type of production?

3D printer technology allows you to produce without the need for molds.
The machine would just print out a 3-dimensional object, and all you have to do is put in the specifications in the computer and it produces the desired object. It is an emerging technology. We invented the 3D machine, with local manpower and inputs.
Each and every component including the coding and hardware of the 3D machine was made locally.

Q: What is the main target of the 10-year space science strategy?

The 10-year research and technology plan outlines our targets in capacity development, scope, infrastructure, manpower and cooperation we need with other institutes
.

Q: How much does the government plan to spend on space research?

The question is more than space. A country's growth in science and technology can be assessed from three standpoints; input, outcome and solution. When we say input, we mean how much is being set aside for research and development (R&D). Countries like Israel spend five percent of their GDP on R&D. African countries have reached a consensus to set aside at least one percent of their GDP on R&D.

Sadly, no country has met that goal. Compared to others, Egypt and South Africa fare better. Some eight years ago, Ethiopia planned to earmark 0.6 percent but only managed to set aside 0.3 percent of its GDP for R&D.

Inputs can also be described in terms of the number of people engaged in research per a population set. An indicator of outcome is how many patents are registered and papers are published. We lag behind most countries in the number of patents registered per year.
The solution aspect is measured by how much our products are compatible with the technology on the world market. These are indicators. Space science research is viewed through this as well.

Q: What is the objective of the 43 research centers?

The 43 space research projects we mentioned are carried out in every sector – in space science, remote sensing, GeoDASY and space engineering. For example, out of the research projects undertaken on remote sensing and agriculture-based research using satellite information, we have devised a 10-year research plan with the Ministry of Agriculture to conduct researches.

The project has identified around 37 intervention spots that can be considered as projects themselves. Right now, we're working on identifying acidity of soils in five *woredas* in five different selected regional states.

We have also a project on cotton farms, with the former Ethiopia Cotton and Textile Institute (ETIDI). We are executing a joint project that maps areas suitable for cotton farming to help investors select feasible areas, using satellite observation.
Our institute in collaboration with the Geospatial Institute and Arba Minch University is working on using satellite images for tourism. We are taking Omo and Gamo zones as pilot projects for this and we plan on completing this work this year and then scale-up nationally.

Another thing we're doing is to map ou Ethiopia's forest coverage, working with universities, to avail a platform where they can ask questions about any spot they have identified online. They can then send coordinates from wherever they are without coming to the office.

Following the formation of the new cabinet in September, our institute merged with the Geospatial Information Institute, making up the Space Science and Geospatial Institute.
The proclamation was ratified this past Saturday, with the merger to be finalized soon. This would hopefully enable us utilize satellite and earth information to the fullest.

Q: Have you started manufacturing Unmanned Aerial Vehicles (UAVs) or drones?

There are three UAV projects underway. Right now, we've begun work on the drone frames, while the software design as well as simulation work has been completed.
Our biggest hurdle has been finding space for a production facility plus a dearth of inputs that can be sourced locally.

Q: You said you have already starting PhD programs in aerospace engineering. It is a sought-after career path that pays lucratively. Can you afford paying huge salaries, given the brain drain to international space institutions like NASA?

We're training manpower that we aren't able to find on the market. Our plan is to have these trained aerospace professionals that are educated locally or internationally to work in Ethiopia.
They can do their own private thing or work outside the country but we would like them to contribute to the country's growing field. They are the country's treasure wherever they are, after all.

Q: Ethiopia is sourcing information from five other satellites owned by other countries. How much cost is associated with it?

Since a lot of institutes are covering their own costs individually, we don't know the total cost of land observational satellites. There are

more than 1,000 observational satellites and our receiver is compatible with all.
We get most information for free and pay for the ones that require payment. Even if we didn't have our own satellite, we could use this ground observational center to receive information from any satellite.
The price differs with the kind of information you're requesting. High resolution earth observational images may cost anywhere between USD 15 to USD 20 per square kilometer.

Q: What portion of Ethiopia's surface area has been observed by the two satellites launched two years ago?

The first Ethiopian satellite could cover an 80 kilometers wide view at once. So, a single image sent to us is 80 kilometer × 80 kilometer of land. So, a single image covers 1,600 sq. km. The storage capacity determines how many pictures it takes.
It takes 31 days to return to the same spot because it rotates the earth every 90 minutes but viewing the same spot again needs maneuvering the camera from control centers here at Entoto. We can make it take a picture of the same spot within four days. That's why more satellites are needed, to shorten the observation frequency.

Q: Is there a plan to launch more satellites in the future?

There is a plan to launch three more satellites within the 10-year plan. It is all a matter of finance. For example, we are doing the feasibility test to launch a high-resolution observational satellite.

Q: Is it different from the ones that have already been launched?

This one is a high-resolution earth observation satellite. We have also completed feasibility tests for a communication satellite; we have accessed the orbiting line from International Telecommunication Union (ITU), to place our satellite 58.3 degree east. This is a very suitable orbiting line for any satellite receiver in the sub-Saharan region. Many countries want this orbiting line.

Q: Is Ethio-telecom going to use the communication satellite too?

Exactly. It can give service both for telecommunication and broadcasting institutes. Right now, Ethio-telecom pays rent for this service.

Q: A lot has improved since the advent of Ethiosat. How do broadcasters get the service? Can broadcasters co-invest in the communication satellite? Or do they fund it themselves? How much rent are local broadcasters paying for foreign satellites?

The cost for launching a geostationary communications satellite is estimated to range from USD 300 million to USD 350 million, with its active service years lasting up to 15 years.
We're looking into multiple financing options at the moment.

Q: Is there a tentative timeline for the launch of the communication satellite?

The main thing is finding finance. If financing is secured, it can be completed within three years, as soon as the business model issue is solved.

Q: How do you evaluate the return of investment on the communication satellite?

It is believed that per every dollar spent on the project, it is supposed to bring in USD three back. That is a good return, according to our studies.

Q: Some people claim that the satellites launched two years ago are defunct. What has their contribution been so far and how would you evaluate it?

Those who say it isn't effective have come to that conclusion hastily without asking us about it. Without the proper knowledge it takes to understand what it is contributing, some have formed their own opinions. These satellites are Ethiopia's first.
Satellites can fail without breaking the atmosphere even. Maintenance is really hard once it has launched; it could even lose its signal once it has reached its destination. So, we've managed to keep it in one piece so far. The satellites are functional.

Meanwhile, soon after ETRS1 was launched, Covid-19 struck and our agreement to keep a close eye on it from China was breached. As a result, we had to monitor everything from afar. We've managed to create the capacity to make and control a satellite, and decode and interpret information from a satellite.

And this information will continue to be useful. Even if we haven't reached our full potential, I believe we have done a lot to make us proud of.

Q: It is claimed by some people that the encrypted information sent from the two Ethiopian satellites could not be decoded and translated by the team at the Observatory.

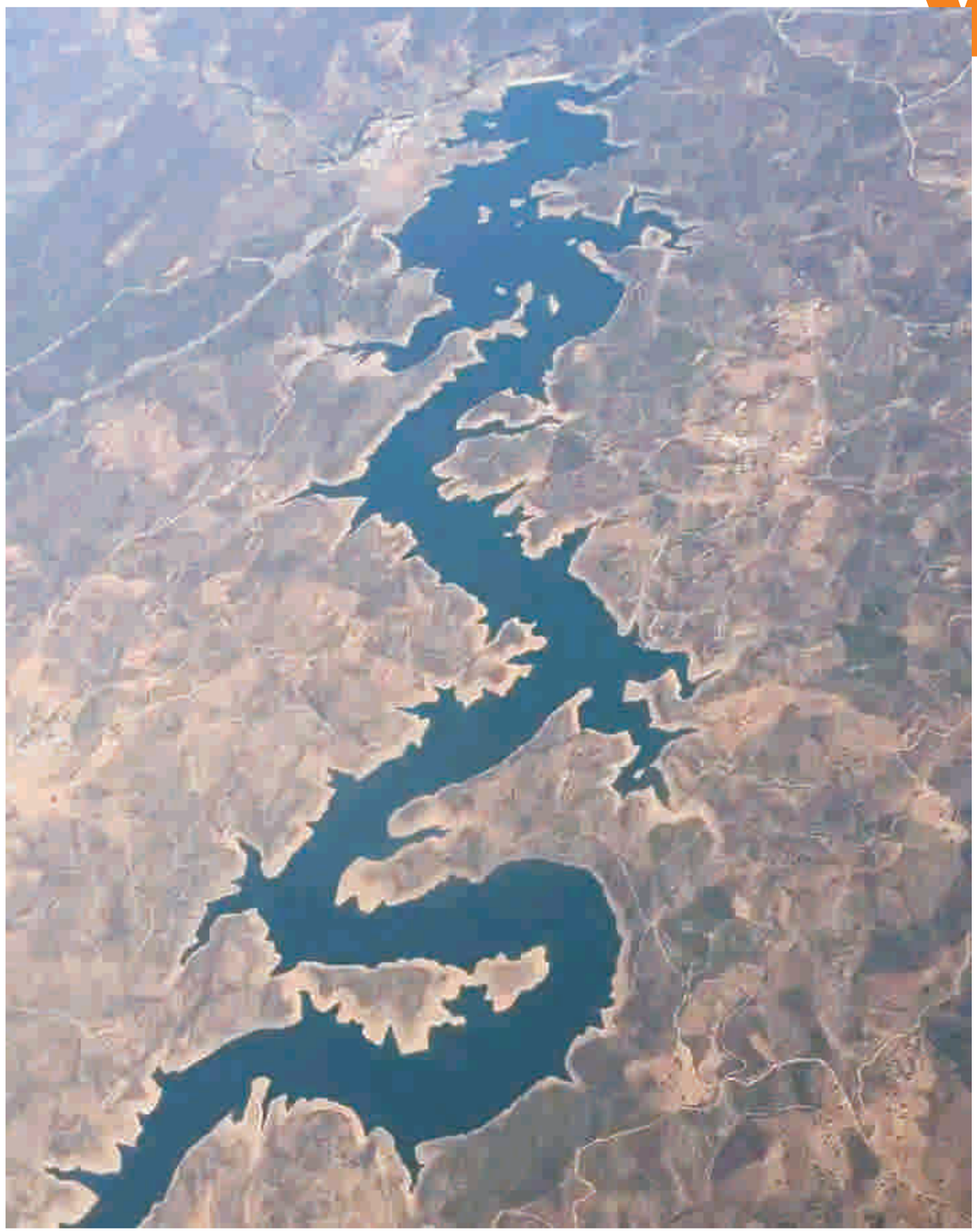
In our institute, we have 136 employees, of which, 20 have PhDs. The raw data comes in hexadecimal form so you can't use it directly. There are built-in software's to process and change the format.

Q: Is there progress in making launch pads in Ethiopia and rent for other countries and multinational institutions?

We've identified spots for it. But, is it economically feasible, is another question. Ethiopia is located at the right place for a satellite launch.

Q: Is your institute planning to use space science for military? And what are you doing concerning cyber security issues?

Space is not owned by anyone, it's everyone's. So any country's ownership stops at 100 km above the atmosphere. Anyone can take pictures of any other country. You can't deny or stop anyone so you can only join in.
There are military satellites used for surveillance purposes. Some countries have a space force; some may entertain dreams of having an alternative abode for when the earth runs out of space. Some have started thinking in terms of asteroid mining, in a bid to get the upper hand.



CONNECTIVITY

MTN Group to leverage LEO satellites to accelerate digital inclusion

Pan-African telco group MTN is seeking to improve digital inclusion across Africa by exploring multiple partnerships with low-earth orbit (LEO) satellite companies, such as OneWeb and Elon Musk's Starlink.

The operator announced it is “exploring the skies” in its bid to provide broadband coverage to 95% of the population across its multimarket footprint by 2025 (from 88% in 2022). In the longer term, it hopes to achieve “universal access” across its operations on the continent.

MTN sees LEO satellite constellations as a perfect fit for its ambitions, as their orbit trajectory at altitudes of between 160km and 2,000km makes for shorter orbital periods, which results in lower signal travel times and reduced latency.

However, the technical capabilities are not the only attractive feature of LEO satellites – the “sharp fall in the cost of launching 1kg of payload into space (from US$85,000 in the 1980s to around US$1,000 now)” has also added to their allure.
Mazen Mroué, MTN Group chief technology and information officer, explained that MTN has focused on two “distinct yet complementary” LEO-based solutions for connectivity enhancement.

The first uses direct-to-cellular technology to augment network access in traditionally underserved regions. “Importantly, this technology is device-agnostic, ensuring compatibility with existing mobile units and requiring no special modifications,” Mroué said.
The second solution uses LEO satellites to deliver “critical” fixed connectivity to enterprise customers and backhaul connectivity for MTN cellular sites. “This is particularly relevant in remote and rural locations, where it offers a more affordable and efficient alternative,” he added.

To advance its work, the company has been relying on a number of partnerships with satellite players to test the capabilities of such technologies. One of the initiatives will see it trial direct-to-cell technology with Lynk Global in South Africa and Ghana. MTN is also in discussions with providers, such as AST SpaceMobile for direct-to-cell trials in Nigeria and South Sudan, and has committed to enterprise-grade satellite broadband trials in Rwanda and Nigeria with SpaceX's Starlink. Finally, it is also in discussions with Eutelsat OneWeb for a planned satellite broadband pilot in its home market of South Africa.

“While the typical financing model would be a revenue-sharing one (where the customer is MTN's and the satellite infrastructure belongs to the LEO satellite vendor), our agreements with various vendors are negotiated on a case-by-case basis,” Mroué noted.

In addition to these upcoming plans, the telco group highlighted that it has already conducted several tests to demonstrate the “transformative potential” of satellite-powered technology, including with Lynk Global and Omnispace for the use of S-band for satellite services, adding that it plans to combine its terrestrial mobile networks with Omnispace's non-terrestrial network (NTN), to service consumer mobile and enterprise internet of things (IoT) offerings.

“We will also consider opportunities to work together in developing and growing an ecosystem of devices and software,” Mroué noted, adding that these new approaches to connecting the unconnected are paving the way for “an 'always-on' future where a modern connected life is accessible to everyone”.

LEO satellite technology is increasingly seen by telcos as a suitable way to increase connectivity, especially in hard-to-reach locations. Other operators that are exploring the technology include Telstra in Australia, Softbank in Japan and AT&T in the US.
Basic internet access is the gateway to the digital world, creating opportunities to transform individuals' lives, companies' prospects and society's sustainability, according to MTN Group.. In the telco industry, it said, the major obstacles to ubiquitous broadband access are well understood: they range from gaps in coverage, to expensive handsets, to data unaffordability, to low levels of digital literacy.
In the past few years there has been notable progress to address these barriers to internet access for all. For example, the GSMA says the coverage gap in sub-Saharan Africa narrowed to 17% in 2022 from 50% in 2014.

No time to lose

At MTN, we are inspired by our belief that everyone deserves the benefits of a modern connected life. We are driven to deliver on our ***Ambition 2025*** strategic intent of '***Leading digital solutions for Africa's progress,***'. reports MTN Group
Time is of the essence, so we recognise that we cannot do it alone. Partnerships are essential. In recent years we have helped narrow coverage gaps in rural areas by collaborating with several rollout partners and by deploying new technology using OpenRAN.
To complement our terrestrial network – where the terrain can be difficult for radio sites and backhaul transport and sparse population distribution often makes regular cellular rollout uneconomical, we are now exploring the skies. Specifically, MTN Group is partnering for low earth orbit (LEO) satellite connectivity to connect the unconnected, extend mobile connectivity to more rural and remote areas and improve resilience.
In this way, we are working to achieve our goal of 95% broadband population coverage across our footprint by 2025, from 88% in 2022. And in the longer term, we are determined to achieve universal access.
LEO satellites typically orbit the Earth at altitudes of between 160 and 2 000 km, making for shorter orbital periods (of between 90 minutes and a few hours) which is good for applications that need rapid data communication or frequent re-visits of specific areas.
The lower altitude contributes to lower signal travel times, resulting in lower latency. This is crucial for real-time communication, video conferencing and online gaming. And the sharp fall in the cost of launching 1kg of payload into space (from US$85 000 in the 1980s to around US$1 000 now) has added to the attractiveness of using LEO satellites

New approaches and complementary solutions

The MTN Group said, the company will first employs direct-to-cellular technology to augment network access in traditionally under-served regions. Importantly, this technology is device-agnostic, ensuring compatibility with existing mobile units and requiring no special modifications.

The second solution, according to MTN Group, uses LEO satellites to provide critical fixed connectivity for enterprise customers and efficient backhaul connectivity for MTN cellular sites. This is particularly relevant in remote and rural locations, where it offers a more affordable and efficient alternative.

In advancing this work, multiple initiatives are underway, including upcoming direct-to-cell trials with Lynk Global in South Africa and Ghana. Discussions are also taking place with providers like AST SpaceMobile for trials in Nigeria and South Sudan. Concurrently, there are ongoing engagements with SpaceX's Starlink, with enterprise-grade trials underway in Rwanda and Nigeria. In parallel, we are advancing discussions with Eutelsat OneWeb for a planned pilot in South Africa.

While the typical financing model would be a revenue-sharing one (where the customer is MTN's and the satellite infrastructure belongs to the LEO satellite vendor), our agreements with various vendors are negotiated on a case-by-case basis.
We have also approached each partnership with a profound sense of purpose. Each collaboration, each pilot, and each successful trial and commercial deployment represents a deliberate step toward narrowing the digital divide, enriching lives, and empowering the communities we serve.

AFRICA

Bridging the Digital Divide through LEO

Broadband has proven to be a critical enabler for global “trade, employment, learning, leisure, and communications.” Access to the rapidly growing digital economy, which comprises roughly 15.5 percent of global gross domestic product (GDP), can be transformational for previously unconnected and underdeveloped regions. The World Bank estimates that a 10 percent increase in
broadband access can cause a 1.38 percent jump in GDP among low- and middle-income countries.

Particularly in remote, hard-to-reach areas where building dedicated ground infrastructure is too expensive or simply not possible, LEO systems can provide quality internet connectivity to populations that are unreliably served by legacy technology. In the case of outages or gaps in service, such as during conflict or natural disaster, LEO constellations can boost the resiliency of communications networks and help fill the gaps in global connectivity.

For rural households across the globe, 63 percent of which do not have access to the internet as of 2020, satellite internet may be the only option for connectivity.13 Unlike other terrestrial forms of internet delivery, satellite terminals receivers for space-based signals require only a mostly unobstructed view of the sky and an electric connection. Current broadband services such as

fiber optic cables, digital subscriber lines (DSL), or copper-based cable internet require extensive infrastructure particularly underground cable ducts or network tower construction to become operational. The minimal and lower-cost ground-infrastructure requirements of satellite-based internet, coupled with LEO's ability to provide broadband of a superior quality than other forms of satellite broadband especially higher data rates with lower latency makes LEO an extremely compelling solution for bridging

gaps in the digital divide. Yet while there is great potential for space-based broadband, companies will need to improve quality, reliability, and affordability in order to meaningfully expand coverage.
Though the barriers to entry and sustained operation are high, several operators throughout North America, Europe, and Asia are moving forward with LEO broadband plans. In the United

States, SpaceX's Starlink, Amazon's Project Kuiper, and Boeing are expected to be top competitors in the market. In January 2015, Elon Musk, SpaceX's CEO, first announced a $10-billion space internet plan. This service, now known as Starlink, would reportedly come online after five years and would be a
revenue stream for SpaceX to pursue founding a city on Mars.

As of November 2022, Starlink has launched over 3,500 satellites, all on SpaceX launch vehicles, and offers coverage in more than 50 markets across North America, South America, Europe, Japan, Australia, and New Zealand. Amazon's Project Kuiper constellation has been in progress since 2019 and is projected to launch its first prototype satellites in early 2023, with the full constellation being implemented over the following five-year period.16 Named for the Kuiper Belt, a band of icy celestial bodies just beyond Neptune's orbit, Kuiper is meant to be available to residential customers as well as an anchor for Amazon Web Services (AWS) cloud computing.

According to its operating license granted by the Federal Communications Commission (FCC), half of Kuiper's 1,618 satellite constellation must be launched by 2026, and the full constellation by 2029. In April 2022, Amazon announced landmark launch agreements with Arianespace, Blue Origin, and United Launch Alliance (ULA) for a total of 83 launches of Kuiper satellites over a period of five years.
Companies such as Verizon and T-Mobile are testing telecommunications integration with LEO
satellites to create more robust fifth-generation (5G) wireless services.

This added competition from traditional terrestrial broadband providers will likely drive down prices in previously monopolized markets. In October 2021, Verizon and Project Kuiper announced a collaboration that would enable Project Kuiper satellites to “deliver backhaul solutions to extend Verizon's 4G/LTE and 5G data networks, connecting rural and remote communities in the U.S.” In August 2022, SpaceX and T-Mobile announced a similar agreement that would enable next-generation Starlink satellites launched in 2023 to communicate with cell phones consumers already own, theoretically eliminating dead zones in the T-Mobile cellular network. Customers could then call, text, and possibly stream videos without connection to a cell tower.

Boeing has been publicly discussing investing in satellite internet since 2015, hoping to substantially increase internet capability while driving down the cost of satellite networks. After it failed to gain FCC approval for a 3,000-satellite LEO broadband constellation in 2017, an updated plan for a 147-satellite constellation was approved in 2021. This “V-band Constellation,” as it is called in its FCC application, would provide internet and communication services to the United States and its territories before expanding globally. The 147 satellites are to be broken down into LEO and GEO segments, with 132 satellites orbiting at 1,056 kilometers (656 miles) and 15 additional satellites orbiting between 27,355 and 44,221 kilometers (16,998 and 27,478 miles).

According to its operating license granted by the FCC, half of the constellation must be launched by November 2027, and the rest by November 2030.24 Telesat, established by the Canadian parliament in 1969, has continued to operate domestic satellite communications networks in the years since, even after the company officially separated from the Canadian government in 2008.

Telesat announced its Lightspeed LEO

constellation in 2016, creating a network of 188 satellites orbiting at 1,000 kilometers (620 miles) above Earth. Lightspeed does not aim to be a consumer broadband company but will instead market to cruise ships, airlines, and rural municipalities.

LiLEO Economics

Today, the LEO satellite internet industry is heavily concentrated among a few private sector companies and government-backed or -owned ventures. The high capital expenditure requirements for launching, maintaining, and manufacturing LEO constellations, along with the competition over finite spectrum resources and near-Earth orbital space contribute to the market having only a few
major players.
LEO constellations are expensive in both resources and time. Establishing a satellite constellation capable of global coverage necessary for continuous broadband service in any one location is a long-term endeavor. Furthermore, licensing and regulatory requirements are extensive and highly variable across different countries, leading to greater uncertainty and high compliance
costs. Investing in LEO broadband is a long-term venture with many uncertainties and risks. However, the business case for LEO broadband is strong. Global demand for connectivity remains High and so does the demand for low latency and quality service.

Rural areas are a key potential consumer base for satellite-broadband operators, and the quality promised by LEO-based constellations make them a favored avenue to satisfy demand. In the United States alone, 28 percent of rural households roughly 4.8 million Americans) remain unconnected31but a MossAdams study reports that both subscribership and average revenue per user in U.S. rural areas are also on the rise.
Other key consumer bases for LEO-based services include business-to-business B2B applications, Non-stationary customers such as airlines and shipping conglomerates, and developing economies. Some LEO providers, Telesat and OneWeb included, are focusing entirely on B2B applications

Another difficulty for the LEO broadband business case is that it requires substantial and costly infrastructure: hardware and software for satellites, ground stations, secure launch vehicles, and space situational awareness SSA, just to name a few. Every segment needs to successfully work together and provide a high-quality product for the business to draw in customers and make a return on investment. Because of the growing desire for worldwide connectivity, experts assess that a strong and
growing market will reach a 20 percent compound annual growth rate by 2030.

Following the establishment of a LEO-based constellation, companies will be able to offer a range of services beyond simple connectivity, such as cloud computing, entertainment streaming, remote internet of things (IoT) applications, and government and military uses.

Once high initial barriers to connectivity are satisfied, extending service offerings involves relatively low marginal costs. Indeed, operators are already exploring LEO-constellation applications beyond direct broadband delivery. Private sector investment in space companies exceeded $10 billion in 2021, 60 to 70 percent of which is now directed into LEO-related ventures. Venture capitalists, encouraged by decreasing launch costs and the development of commercially viable applications, have also turned their attention toward space firms operating in LEO.

While investment is increasing, current levels may not be enough to sustain a crowded industry due to the long-term nature of the LEO broadband enterprise. Building and operating large LEO constellations are incredibly complex and expensive, and today the industry is primarily driven by large companies with vast monetary reserves or by SOEs, a paradigm reinforced by structural and policy challenges. McKinsey estimates a $5 to $10 billion price tag for deploying an operational LEO satellite constellation.

On top of that, recurring operating and maintenance costs are predicted to run companies $1 to $2 billion per year. In October 2022, Elon Musk said that the cost of the Starlink operation in Ukraine including providing terminals and maintaining satellites and ground stations, among other expenditures would reach $100 million by the end of the year.

Though extenuating circumstances are driving this estimate up to much higher than-average national operating costs, it is an example of the large funding necessary to maintain a successful and operational network in a time of crisis. High barriers to entry have resulted in the need for continuous and substantial investment financing for the industry.

LEO constellations have the potential to reshape global networks, both those in orbit and on the ground. While reliant on the placement of numerous ground stations to extend service, the development of optical intersatellite links communication channels that allow satellites within the same constellation to transfer data seamlessly between one another will when operational further reduce the need for expensive ground infrastructure. Despite these advancements, one of the largest barriers to wide

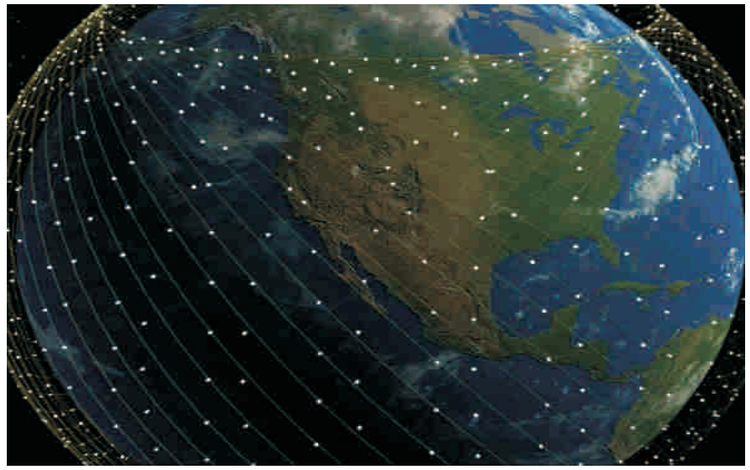
commercial adoption of LEO broadband services remains affordability. While end-user terminals allow communities to bypass the large infrastructure needs of traditional broadband delivery, production costs range anywhere from $1,000 for a home-use terminal to $10,000 for an airborne terminal, making them prohibitively expensive for most customers in developing economies.

Industry experts estimate the price of home terminals will be cut in half by the 2030s, with Amazon's Project Kuiper already reporting terminal production costs will be under $500 per unit. Still, LEO satellite terminals are estimated to be approximately three times more expensive than GEO satellite terminals and seven times more expensive than traditional internet routers. Companies are likely to highly subsidize current and future terminals to incentivize adoption.

The future of LEO satellites in Africa

According to the recently released Global System for Mobile Communications (GSMA) “State of the Mobile Internet Connectivity Report 2021,” hundreds of millions of people in both high- and lower-income countries still have limited access to a fast, reliable, and affordable fixed internet connection, an issue ever more important during the ongoing COVID-19 pandemic and related economic upheaval. Generically, the share of internet users is twice as high in urban areas than in rural areas. The number of people worldwide without access at all to a fixed or mobile broadband signal, estimated to number at 450 million people, remains mostly concentrated in the developing world.

The idea of using satellites to close such coverage gaps has been pursued since the early 1990s, but most space-pioneering companies fell short, despite significant capital investment. In hindsight, these companies, such as Teledesic and early versions of Iridium and Globalstar, had originally designed their systems to appeal to business and government travers willing to pay high fees for global access. Unfortunately, satellite development and deployment took more time than planned, and terrestrial infrastructure deployed more



quickly than anticipated to well populated, business-friendly destinations. Equipment costs were too high for the population in mass, thus eroding its potential for profitability.

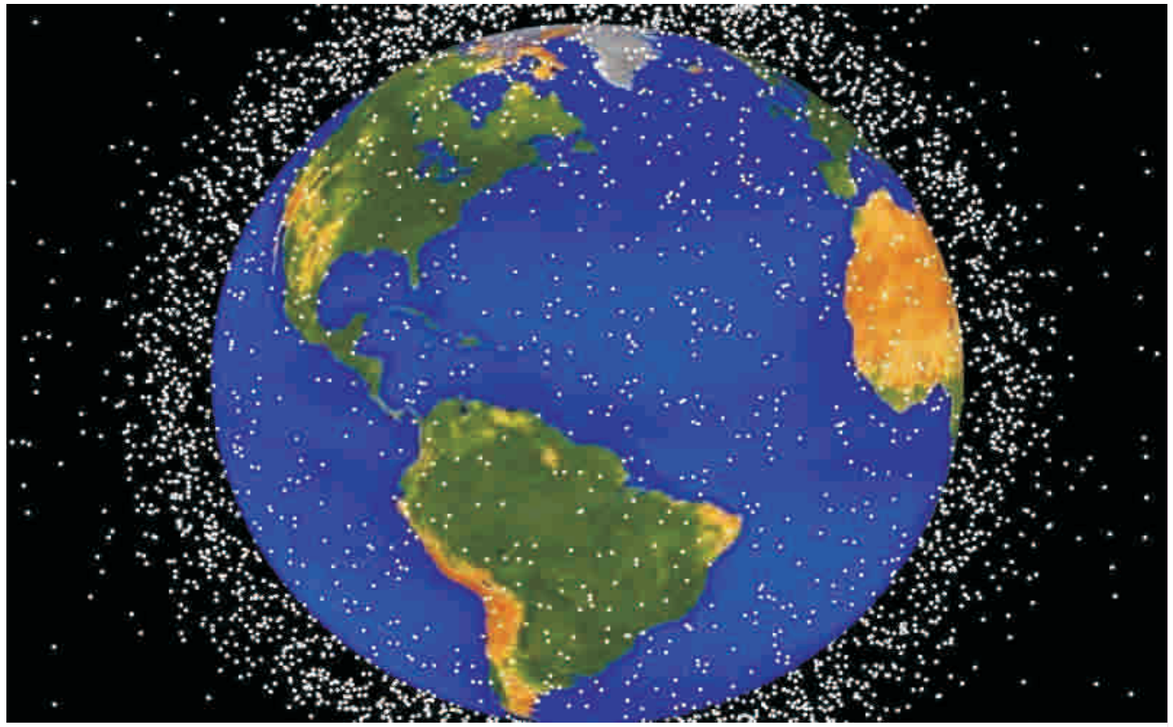
Today, new technology, combined with a more robust and diversified private space sector, lowering launch costs, ever-increasing demand for broadband, strong resurgence of capital investment and government support, and new market strategies that rely on more than subscriptions, have resulted in a stronger baseline business case, setting space-based communications on a course to offer more affordable broadband to those who are currently on the dark side of the digital divide.
With all of that in mind, governments should consider emerging space-based commercial options to pragmatically close remaining hard infrastructure gaps. Any such program should be approached holistically, with lines of effort also dedicated to maximizing the beneficial use of available networks including “closing the usage gap”.

Resources should also be allocated for last-mile implementation projects that concretely support health, education, and other development goals.40 New space-based hard infrastructure options should be weighed against other available technologies. Governments should participate in their regional telecommunication organization and be proactive in developing policy and regulations that emphasize the importance of affordable telecom services to encourage a fair balance of motivating profit, necessary cost, and the public good.41 Public private partnerships, subsidies, tax incentives and mandatory coverage regulations are available tools to expand broadband access.

In addition, bilateral and multilateral aid and development finance agencies should consider new satellite constellations as a viable option when advising partners regarding telecommunications infrastructure. As more NGSO companies become operational, it will be increasingly important to champion transparency from all actors on system capabilities, cost, and best practices—particularly in the establishment of and encouragement to follow, regarding regulations and licensing. Development agencies should increase “space proficiency” in the development sector. Space-related capabilities, be it in telecommunications, remote sensing or geolocation services, have become baseline infrastructure needed to participate in the world economy and an economic driver for developing and developed countries alike.

Also, private space sector actors should make every effort to avoid technical and jargony language that creates an incomprehensible mystique when explaining services, system capabilities, and pricing, and expect to work closely with governments and aid and development agencies to ensure complimentary infrastructure, like power, is coordinated along with licensing and regulatory compliance. These groups should continue to ruggedize equipment, and drive down power and maintenance requirements, to accelerate access to and use of space-based hard infrastructure in low- and middle-income countries. In addition to doing the usual research to understand a country's priorities, challenges, and aspirations, the private sector should also be aware there has been a rapid expansion of space agencies and general interest in the use of space worldwide, to include lower-income countries. Multiple countries and regions have established space strategies and policies relevant to telecommunications.

WRC’23: Still many issues



It was originally the International Telegraph Union, 11 years before Alexander Graham Bell's telephone, earning the distinction of being just the second international agency ever to be established. ITU is best known for hosting the quadrennial World Radio Conference that decides on spectrum allocation for every industry player that uses electromagnetic band.

Despite ITU's longevity, and status as a UN organization, it still has little direct bearing on the functioning of the modern telecom world, says one industry analysts. Ironically, perhaps the information revolution of the past decades has had the effect of further marginalizing the ITU. As a slow moving intergovernmental body, it's always going to be playing catch-up, says the analyst.

In recent years, large entities such as Starlink have filed for multiple orbital space slots in large bunches; such slots are used by multiple small satellites that together comprise a constellation. These are needed because the satellites are deployed in a geosynchronous orbit, which means multiple satellites are needed to create networks over large geographical areas, such as countries.

Prior research has shown that as more satellites are launched into low orbit, the belt around the planet becomes more crowded eventually, there will no longer be room for any new satellites. In response, many entities such as Starlink have begun overfilling filing requests for satellites that have not even been built yet. And some, like Starlink, have attempted to skirt the system by making multiple filings from different countries.

In this new effort, the researchers analyzed the ITU database and found that filing requests are on a path that will choke the system. They found, for example, that there are currently filings in place that represent approximately 1 million new satellites, which includes plans for deploying 300 mega-constellations. They note that such figures represent a 115% increase over current low-orbit traffic. Such large numbers of satellites, they note, need to be better regulated to prevent collisions and to find the eventual cut-off point.

At the moment, spectrum, while vast, is still a fairly finite resource when it comes to those frequencies that are able to be harnessed today. There are many different users or potential users vying for each of these bands. Sharing of frequencies presents an opportunity and a challenge to develop ways to co-exist. WRC is a four or sometimes an eight year or more process. All of this has cost and time involved and the key is to find those sweet spots where the advances in technology, spectrum availability and harmonization will allow new companies like ours to flourish.

The ITU Radio Regulations and ITU Constitution (No. 197 of Article 45) provide that “all stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Members, recognized operating agencies, or other authorized operating agencies which carry on a radio service, and which operate in accordance with the Radio Regulations".

In part due to the growth of satellite constellations, space generally, and GSO slots more specifically, are becoming increasingly crowded. There is therefore greater potential for radio-interference between services, as well as space junk or space debris, and the issue of what to do with all the satellites, as they reach the end of their working life – retrieving obsolete satellites and launchers is becoming a bigger issue.

According to ITU, Member States of the International Telecommunication Union (ITU) agreed on revisions to the global treaty governing the use of the radio frequency spectrum, both on Earth and in space, at the close of the World Radiocommunication Conference 2023 (WRC-23) today in Dubai, United Arab Emirates.

The agreement on updates to the Radio Regulations identifies new spectrum resources to support technological innovation, deepen global connectivity, increase access to and equitable use of space-based radio resources, and enhance safety at sea, in the air, and on land.

“WRC-23 puts the world on a solid path towards a more connected, sustainable, equitable and inclusive digital future for all," said Doreen Bogdan-Martin, ITU Secretary-General. “Key regulatory achievements on spectrum for space, science and terrestrial radio services build on the momentum of ITU's ongoing work to achieve universal connectivity and sustainable digital transformation."A total of 151 Member States signed the WRC-23 Final Acts. The Final Acts constitute a record of the decisions taken at the conference including both the new and revised provisions of the Radio Regulations, all Appendices, and the new and revised Resolutions and ITU-R Recommendations incorporated by reference into the treaty by the conference.
“The agreements reached at WRC-23 are a testament to the unwavering spirit of cooperation and compromise among all of our members," said Mario Maniewicz, Director of the ITU Radiocommunication Bureau. “Navigating the complexities of spectrum sharing to update the Radio Regulations has helped us forge a path that provides a stable, predictable regulatory environment essential for the development of innovative radiocommunication services for all.”

Outcomes of WRC ‘2023

WRC-23 Agenda Item 1.18 failed to provide new allocations to the mobile-satellite service in the frequency bands 1 695-1 710 MHz, 2 010-2 025 MHz, 3 300-3 315 MHz and 3 385-3 400 MHz due to the lack of agreement on the interpretation of Resolution 248 (WRC-19) and the pre-requisite to make this spectrum available for the exclusive use of low duty cycle narrowband applications.

erative access

ITU manages a cooperative system of international coordination on the radio frequencies used by satellites, aimed at preventing such systems from interfering with each other or with other radio systems. It oversees a satellite frequency registration process whereby an ITU Member State sends a description of the radio frequencies planned to be used in a project of its satellite operators.

The ITU Radiocommunication Bureau examines the conformity of such descriptions with the Radio Regulations and publishes descriptions and results of ITU's examinations to all other ITU Member States. Member States concerned that a project might affect their existing systems, including those submitted to ITU as plans, can then contact the initiating ITU Member State to bilaterally discuss technical solutions to ensure that both systems can coexist without interfering with each other. During these bilateral discussions, both parties should make every possible mutual effort to overcome the difficulties, in a manner acceptable to the parties concerned.
The result is a cooperative system managed and overseen by ITU as the UN specialized agency for information and communication technologies (ICTs), and by the ITU Radiocommunication Bureau in particular, whereby ITU Member States collaborate to allow satellite systems to operate harmoniously in outer space, free from radio interference. Jurisdiction, frequency assignments, and milestones

Licensing is a matter under the jurisdiction of ITU's Member States. They license satellite systems, with each state ensuring that its own satellite operators follow the rules and conditions contained in the Radio Regulations, in the outcomes of relevant bilateral discussions, and in any specific domestic rules. Each Member State is free to enact such domestic rules, as long as those do not contradict the international commitments it has undertaken by signing the Radio Regulations.
'Radio-frequency spectrum warehousing' refers to the practice of 'reserving' radio frequencies and associated orbital resources without putting them into use, thereby preventing other parties from using those resources. To avoid the warehousing of radio frequencies, the frequencies assigned in response to a satellite filing must be brought into use within a specified timeframe (currently seven years from the date of receipt of the request) or else their validity expires.

SpaceX Starlink Applied to FCC, ITU for 29,988 Satellites

SpaceX has applied to the ITU to place an additional 29,900 new satellites into orbit. SpaceX is using the Pacific island state of Tonga as its regulatory source and using TongSat which is looking to profit from the satellite industry. SpaceX has about 4200 active satellites now out of 5100 launched.
The satellites will operate in the W-band, which is the microwave portion of the frequency band, and operates in the 75-110 GHz and just above the V-band. W-band is increasingly favoured for its us by High Throughput Satellites.

SpaceX applied to the FCC for the 29,988 as well. This wold be in 288 orbital planes ranging from 614 kms altitude down to 340 kms. It also wants the new satellites to be able to operate within all the popular frequency bands for satellite communications, that is Ka-band, Ku-band and W-band. SpaceX has volunteered to abandon plans for an already approved 7518 satellites using V-band spectrum provided the FCC allowed the new application to incorporate V-band frequencies into its 'Gen-2' designs.

Experts believe that this application is an attempt by the company to modernize Starlink in the face of growing competition.
“Partly this is an attempt to just grab spectrum that no one else is thinking about yet,” said satellite communications consultant Tim Farrar.

His opinion is confirmed by the fact that SpaceX's application mentions the use of satellites for communication in the frequency range from 123,000 MHz to 174,500 MHz, which Starlink does not yet work with.
Experts believe that this application is an attempt by the company to modernize Starlink in the face of growing competition.
“Partly this is an attempt to just grab spectrum that no one else is thinking about yet,” said satellite communications consultant Tim Farrar.
ITU is a global regulator that oversees the allocation of radio frequencies for satellite providers. Therefore, SpaceX's application may be an attempt by the company to expand the radio frequency range before the Starlink upgrade.
The document states that the satellites are planned to be used in 288 orbital planes at altitudes ranging from 350 to 614 km. It is noteworthy that initially, the ITU website did not mention SpaceX in this context. Instead, there was information that the application came from the Kingdom of Tonga. However, the union later confirmed that it was SpaceX.

The new mobile satellite systems: What can they really deliver?

iLast November, the ITU will host its World RadioCommunication Conference in Dubai and for some time focused around the Global Mobile Personal Communications by Satellite (GMPCS). This rather unwieldy acronym is the generic term encompassing a number of exciting new satellite systems that have the potential to fundamentally change the way people around the world communicate.

Increased personal mobility, restructuring of world trading arrangements, and cheaper and faster international transport have combined with dramatic improvements in the field of communications to bring about a rapid globalization of the world's economy. This process has profoundly changed the world we live in, and is the driving factor behind the development of these new mobile satellite systems.

While cellular telephony has changed modern working practices by making staff more mobile and more easily reachable, two problems still remain. The first is that the user of a mobile phone is only contactable while within a mobile phone 'cell'. Many countries' cellular networks do not provide 'blanket coverage', that is, there are places where the phone will not work. This is especially true in remote areas or areas of low population density, where it may not be economically feasible to install the equipment necessary to support the network.

Additionally, while it may be possible to contact colleagues who are out of town on business, contacting them when they are out of the country is much harder. The first mobile telephone systems were designed for use within a single country. Later, it was recognized that the ability to use a mobile phone internationally was also desirable, particularly in regions such as Europe where business travellers frequently cross national borders. This thinking led to the development of the GSM system for mobile telephony, which offered users a feature known as 'international roaming'. This allows a user to telephone from, and be telephoned in, any other country with a GSM network which has a 'roaming agreement' in place with the home country. The problem with this system is that it now seems unlikely to meet the original need for seamless international communication. Several countries in the world have implemented a GSM network, but some may have such a system but not allow users from certain countries to call or be called because a roaming agreement is not in place.

For these reasons, some companies have devised new systems which will ensure that all users are contactable at all times, no matter where they happen to be. These systems employ networks of satellites, and will be the GMPCS systems of the future.

GMPCS systems in fact represent more than just a new kind of global mobile phone; the kinds of new capabilities they offer will be much more profound. Imagine, for example, that you are travelling on business in a remote part of China. On the basis of your work, you need to telephone a colleague in your Paris office. You also want to send a client in Moscow an urgent fax from your laptop computer, for which you will need access to data from a spreadsheet located on the network drive at your company's corporate headquarters in Montreal. Unfortunately, today, you'd have little hope of making these connections. For a start, you would not be able to telephone Paris, since even with your GSM phone you're way out of cellular range. What's more, there is no international GSM roaming agreement between France and China. And because you're not near a fixed line telephone, you can neither send the fax or get hold of the data you need from the corporate server in Canada.

GMPCS systems promise to change all that. The new non-geostationary satellite constellations, due to come into operation over the next few years, plan to offer global, seamless communications between any points, no matter where they are on the Earth's surface. What's more, you'll be able to transmit not just voice, but data, sound, and images, so you could send your Russian client not only the figures for your joint project – say a new oil well – but even plans of the proposed installation and a computerized fly-through of the model. In theory, you could also have the possibility of initiating a conference call with colleagues at other sites around the world, with the ability to hear and see your co-workers in broadcast-quality video and to perform real-time revision-marking of shared documents on the computer screen.

Naturally, some of these kinds of sophisticated multimedia capabilities are still many years away. For example, the computer technology needed to handle complex tasks, such as real-time video on a laptop PC delivered via a moving satellite, is still just a pipe dream. And even if the current range of planned new satellite systems come into operation according to schedule, there may be many technical problems to iron out before they are able to deliver a simple, reliable, voice circuit. What's more, initially, at least, services are likely to be too expensive for the mass market.

Nevertheless, we have today within our reach the promise of global communications never before dreamt of, opening up a whole range of new commercial opportunities for savvy entrepreneurs and established communications providers alike, and a wealth of exciting new services for users. Like the Internet – once the sole domain of ivory-towered academics, but now dominated by young, hip and computer-literate Web surfers – the new global mobile services should quickly find themselves widely used as the market grows and prices fall, although they are likely, initially, to attract only a small base of corporate users. And, as with the Internet, we can only speculate on the types of services users of these new satellite networks may find 20 years from now. How many in the academic community would have dreamt that their esoteric research network would one day be providing a mass market with news, weather forecasts, horoscopes, retail and banking opportunities and consumer information?

So how will the new GMPCS systems take shape? And when? Firstly, there is an important distinction to make between the two main types of system currently in the pipeline. The first, known generically as 'Little LEO' satellites, will offer a range of text and data services. The second type of satellite, known as Big LEOs, and will offer users seamless global voice, fax and possibly even broadband* services.

The 'Low' of LEO's Low Earth Orbit refers to the distance of 700 to 1,500 km at which the satellites are located above the Earth's surface – they are only 'low' in relation to traditional geostationary communications satellites, which orbit the Earth at a distance of 36,000 km. In fact, these Low Earth Orbit satellites are still nearly twice as high as Space Station Mir, which orbits at around 400 km from Earth. Both types of system are non-geostationary, meaning that the position of the satellites changes in relation to the surface of the planet. In operation, they will form a moving constellation, circling the globe and relaying messages back and forth between each other and users, and/or earth stations.

The Little LEOs will almost certainly be the first systems in full operation, with some systems already partially on-line, and most due to start offering services between 1997 and 1998.
Little LEOs are generally smallish satellites around 1m3 in size and weighing about 100 kg. Most ventures currently in the pipeline propose to use the satellites as either 'bent pipe' systems, or store-and-forward systems. The so-called bent pipe system relays messages directly between users, while the store-and-forward approach means that a satellite receives information from a ground station, stores it in on-board memory, continues on its orbit, and releases the information to the next appropriate ground station, or user. Users will access the new Little LEO systems using small hand-held messaging units weighing less than 0.5 kg, and incorporating a low-power omni-directional antenna.

Little LEO services will tap into a range of markets. Messaging is expected to be a high-demand service, and will include e-mail, limited Internet access, two-way paging and fax. Remote data communications will also be an important area, especially for Emergency Services.

Other important niche markets will be digital tracking (for the transportation management market), environmental monitoring, and SCADA (Supervisory Control and Date Acquisition – a system which provides remote monitoring of isolated facilities such as mines, oil refineries etc). The Little LEO proponents hope to gain by offering fast and inexpensive services, and by getting a foothold in the market well ahead of their bigger cousins.

But while these systems may well be first to market, it will be the Big LEOs that will attract the lion's share of media attention. Most of these systems won't be up and running until 1998 or later, but they do promise users a greater range of services. The most well-known of these is global mobile telephony – the ability to make and receive calls on a mobile telephone anywhere in the world. Other services, though, will include data and fax, and even (in the case of one proposed system in any case) broadband video. In this highly competitive market, the main contenders will offer small hand-held mobile terminals only a little larger than today's diminutive cellular phones, and which incorporate a largish aerial. (The appearance of the units is, in fact, not unlike the analogue mobile telephones of the mid-1980s).

The Big LEO systems will comprise a constellation of several satellites, moving around the globe and picking up and relaying users' telephone calls from one region, country, or continent, to another. Some of the proposed systems support satellite to satellite communications, making them, in reality, an enormous wide area network. Most, though, rely on uplinks and downlinks to earth stations to complete the call circuit.

The advantages of the Big LEO systems seem obvious – until you factor in the cost. Compared with the Little LEOs, the cost of a call, at least initially, will probably be prohibitive for most users, with the exception of large corporations with a genuine need for instant global voice communications to remote areas at any time. Those users simply needing a global voice network, or a global high-speed computer network, can in many instances already meet their needs with existing fibre optic networks or via the kinds of value added networking services now being offered by most of the leading telecommunications carriers.

What's more, the very services offered exclusively by the Big LEOs are already available, to some extent. The INMARSAT 3 mobile satellite system has already accepted its first calls, using new spot-beam satellites. This system uses small (although not hand-held) phonesets and charges about the same for a call as the Big LEO systems. True, the transmission time delay on the system is a little longer, and INMARSAT 3 cannot offer walk-while-you-talk capabilities; but the fundamental elements of many of the planned Big LEO systems are available today to the serious user who is ready to pay for the privilege.

Which brings us to the hottest issue – that of call pricing. What exactly will users be expected to pay, both for the handset and for the call airtime? At the moment, the figures are a little hazy, but it would probably be safe to say that most systems plan to offer voice service at US$1-3.00 per minute. However, since most operators will market their services via resellers, this may not reflect the cost to the user, which could be substantially higher. Furthermore, the cost of buying a handset is expected to come in at US$700-3,000.

But before writing off the system as just too expensive to be feasible, it pays to bear in mind that the first analogue mobile phones sold for similar kinds of prices, and that the cost of calls on cellular networks around the world has dropped significantly as the volume of users has grown and markets have matured. There is every reason to expect that the same kind of thing will happen with the new global satellite services, although the time frame for a meaningful reduction in pricing will depend on how many people sign up for the service in its early stages.

The Little LEO and Big LEO markets will be examined in a subsequent article, but one operator needs to be singled out at this stage, since technically it qualifies neither as a Big LEO nor a Little LEO. This is the Teledesic system proposed by the company set up by Bill Gates of Microsoft, together with Craig McCaw (founder of McCaw Cellular, which was acquired in 1994 by AT&T). Like the Big LEOs, the system will be able to support voice as well as data and fax. But unlike the Big LEO systems, Teledesic's offering will be targeted at the computer market, and will focus more on high-speed data transfer capabilities than on the provision of mobile telephony.
Teledesic's system, which comprises by far the largest number of satellites (estimated at a constellation of hundreds of units spinning around the planet in non-geostationary orbit), aims to provide users with broadband multimedia-type services, allowing them to rapidly access and transfer data, text, still and moving images and sound, anywhere in the world. The system is highly ambitious, and is not due to come into operation until the year 2001 – yet, if realized, it could represent a most significant change in business and personal communications. The company claims that the cost of calls – which will mostly be data transfer links – will be much lower than other systems. The price of user terminals is still up in the air.

The would-be GMPCS system operators still have a lot of work cut out for them before the systems become a commonplace part of the global telecommunications environment. For a start, there are a number of technical problems to overcome in setting up, launching and operating such complex satellite constellations. And since these kinds of systems have never existed before, there will inevitably be teething troubles before they function smoothly and can guarantee problem-free, high-quality service.

In addition, competition for a niche in this new market is very high, and many industry analysts have remarked that it is unlikely that the market can support the number of players currently lined up to provide services. It seems certain that there will be some casualties along the way as market forces work to weed out those operators who are unable to raise the necessary capital, who are less-competitive, or who fail to make the grade in terms of service provision.

International licensing, too, may prove a sticking point for operators. The incompatibility problems which plague current cellular networks when roaming from country to country could be just as bad for the new GMPCS networks, unless most operators can secure operating licences in at least the majority of the world's nations.
Finally, operators will have a tough job persuading customers to fork out what is, after all, a sizeable amount of cash for the ability to use a system many people may not actually need. It's great to have the ability to call anybody, anywhere, at any time – but after the initial novelty wears off, how many of us really have a need, or even a desire, to do so? Perhaps, when system costs fall, we may feel it's worth paying a little more for the option, but that initial fight for market share is likely to be hard and bloody.
All that said, there is no doubt that the new GMPCS services will play a key role in the development of world communications, and are certain to have a profound influence on the way the telecommunications and information technology markets develop over the next 10 - 20 years.

The political, social, socio-economic and regulatory issues raised by the provision of these new global services will be dealt with in a future article, and will also be the subject of the International Telecommunication Union's World Telecommunication Policy Forum in October. At this meeting, carriers and service providers will get together with representatives of the world's telecommunication administrations and regulators to forge a strategy for the implementation of GMPCS.
We are witnessing the birth of a new way of communicating. How difficult that birth proves to be is largely in the hands of industry and government.

REPORT

Between transponders and satellite communication system

BY Vinay Kumar Singh and Hridaya Nand Sah

ISatellites are object which sometimes are called artificial satellites to distinguish them from natural satellites such as the Moon. Satellites are useful for a number of purposes. They are used for communications, navigation, map-making, astronomical observations, scientific experimentation, and monitoring of the Earth's environment and weather conditions. Some satellites with military missions may conduct espionage or carry weapons to destroy enemy warheads and satellites. In satellite communications, transponder performs the functions of both transmitter and receiver-Responder in a satellite.

Russia had launched the world's first artificial satellite named, Sputnik 1 in 1957. Nearly after 18 years, India also launched the artificial satellite named, Aryabhata in 1975. The first satellite that was used for communication purpose in India was Aryabhatta and it was launched in 19th April.1975. It was made and assembled by an organization called Indian Space Research Organization (ISRO).

In the year 1981, a satellite named APPLE was launched in space which was the first Indian Experimental communication satellite. The unique feature of it was that it was a three axis stabilization geosynchronous satellite and weighed around 645 kg. The term APPLE is an abbreviation for Ariane Passenger Payload Experiment.

It consisted of 6/4 GHz processing equipment called Transponder. Various experiments were carried out with APPLE, SITE, STEP Other satellite telecommunication experiment projects and the results obtained from these experiments provided an impetus for Government of India to have its own multipurpose Geosynchronous Earth Orbit satellite under INSAT Indian National Satellite program. The first satellite INSAT-1A was launched in the year 1982 which was under this INSAT program, but this effort went in vain as the power house of this satellite consisting of solar cells did not operate properly(failed to open) and this satellite was unused latter on. The average electrical power required by INSAT-1 was approximately 1000W and was provided by the power house subsystem of the satellite.

The payload was one C-band transponder and two S-band transponders. Later succession of INSAT-1 series was launched like INSAT-1B, INSAT-C, and INSAT-D. After this due to the success of the first generation satellites, INSAT-2 series was launched viz. INSAT-2A, INSAT-2B, INSAT-2C, INSAT-3D and INSAT-2E which provided variety of services. In general terms, a satellite is a smaller object that revolves around a larger object in space. For example, moon is a natural satellite of earth.

The Communication refers to the exchange of information between two or more entities, through any medium or channel. In other words, it is nothing but sending, receiving and processing of information. If the communication takes place between any two earth stations through a satellite, then it is called as satellite communication. In this communication, electromagnetic waves are used as carrier signals. These signals carry the information such as voice, audio, video or any other data between ground and space and vice-versa.

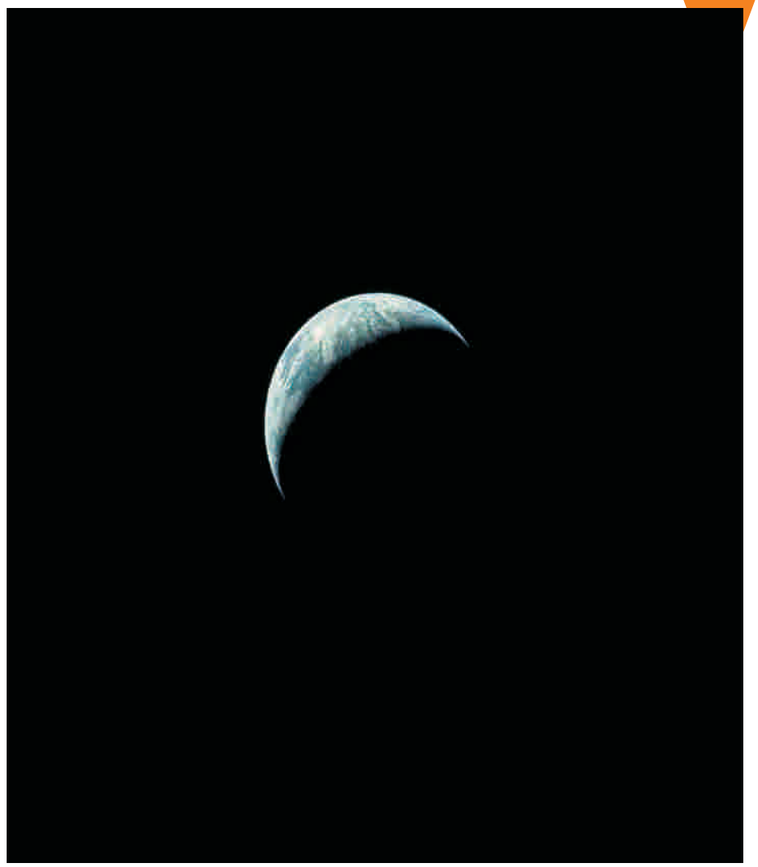
How a satellite works

A satellite is a body that moves around another body in a particular path. A communication satellite is nothing but a microwave repeater station in space. It is helpful in telecommunications, radio and television along with internet applications. A repeater is a circuit, which increases the strength of the received signal and then transmits it. But, this repeater works as a transponder. That means, it changes the frequency band of the transmitted signal from the received one. The frequency with which, the signal is sent into the space is called as Uplink frequency. Similarly, the frequency with which, the signal is sent by the transponder is called as Downlink frequency.

The transmission of signal from first earth station to satellite through a channel is called as uplink. Similarly, the transmission of signal from satellite to second earth station through a channel is called as downlink. Uplink frequency is the frequency at which, the first earth station is communicating with satellite. The satellite transponder converts this signal into another frequency and sends it down to the second earth station. This frequency is called as Downlink frequency. In similar way, second earth station can also communicate with the first one. The process of satellite communication begins at an earth station. Here, an installation is designed to transmit and receive signals from a satellite in an orbit around the earth. Earth stations send the information to satellites in the form of high powered, high (GHz range) frequency signals. The satellites receive and retransmit the signals back to earth where they are received by other earth stations in the coverage area of the satellite. Satellite's footprint is the area which receives a signal of useful strength from the satellite.

Satellite Communication: Transponders

The subsystem, which provides the connecting link between transmitting and receiving antennas of a satellite, is known as Transponder. It is one of the most important subsystems of space segment subsystems. Transponder performs the functions of both transmitter and receiver Responder in a satellite. Hence, the word 'Transponder' is obtained by the combining few letters of two words, Transmitter which comes from Trans and Responder from ponder.



Need of satellite communication

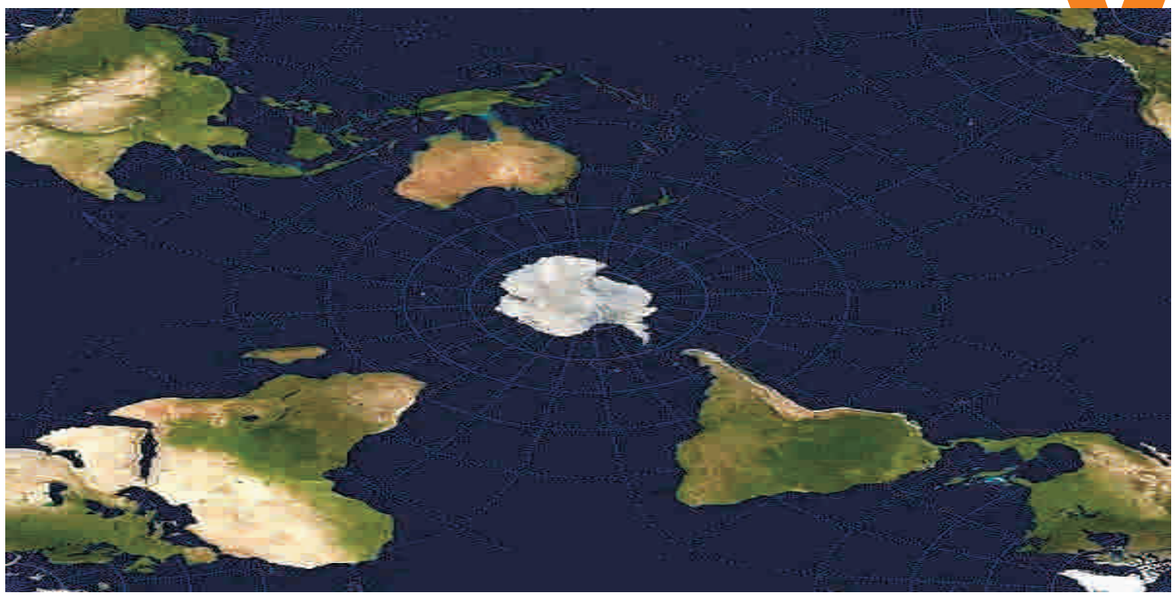
The following two kinds of propagation are used earlier for communication up to some distance. Ground wave propagation - ground wave propagation is suitable for frequencies up to 30MHz. This method of communication makes use of the troposphere conditions of the earth. Sky wave propagation - the suitable bandwidth for this type of communication is broadly between 30– 40 MHz and it makes use of the ionosphere properties of the earth. The maximum hop or the station distance is limited to 1500Km only in both ground wave propagation and sky wave propagation. The satellite communication overcomes this limitation. In this method, satellites provide communication for long distances, which is well beyond the line of sight. Since the satellites locate at certain height above earth, the communication takes place between any two earth stations easily via satellite. So, it overcomes the limitation of communication between two earth stations due to earth's curvature.

Conclusion

It is clear to see that satellites have a whole host of applications, many of which are in the telecommunications field. It is not as simple as launching a platform containing antennas into space and sending transmissions through it. The huge amount of data and voice transmitted today demands that constant improvements be made in security and data throughput. Furthermore, it is essential that cheaper operating and construction costs are realized because these satellites are going to wear out from the huge demands placed on them. Any efficiency that can be gained in data throughput, power generation, and launch cost will have positive implications for the future. One can never rest in this field; research must be constantly striving to improve cost of ownership, security, and data transmission rates, as well as developing newer and better protocols for how bandwidth is managed. Huge strides have already been made just since the Internet became mainstream.

How AI is disrupting the new space economy

An interview with Fintan Buckley, CO-FOUNDER & CEO of Ubotica



Q: Why did you create Ubotica with your Co-Founders?

Our main motivation was to take technology that had been developed for terrestrial applications and look to deploy that in orbit, in space. That opportunity came out when a large company, Movidius was acquired by Intel in 2016. Movidius had industry-leading technology for the processing of video data, deployed in security cameras, drones, etc.
There had been preliminary discussions with the European Space Agency around taking this technology and assessing its suitability for use onboard space craft. Intel had no real desire to proceed with this investigation because the silicon sales volume involved in space applications would be minute and Intel is more interested in higher volume applications for silicon sales. So, that's where the opportunity came for us to step in and become involved as a new technology company.

Q: What does your role as CEO of Ubotica involve?

My background is in systems engineering and software engineering. In the early days of the company, I was using that expertise on a fairly technical basis to help architect some of the products we now have.
As the company has grown, my involvement in the technical side has diminished. Now, it's really all about making sure that the team of people that we have hired, who are world-class, have all the necessary tools that they need to do their jobs and ensuring that the organisation succeeds as a whole. Part of my role is evangelising, part is networking and part is making sure that everyone is happy in terms of customers and employees.

Q: Ubotica has an international team of experts?

Absolutely. The technology is now available for us to work remotely and we have been very fortunate that we have the infrastructure in place to interact together wherever our people are based. For example, since the pandemic started, we have opened up an office in Spain and another in Delft without ever going to Holland or even meeting the people we employed there. We have one guy in Canada and have even started building a team in Tunisia – all doing so remotely.
We are doing it this way because we have identified where we can find very talented people and we have the infrastructure to support them working remotely. It has required a bit more effort doing it this way and we have more meetings and calls than we might have if everyone was in one office, but the payoff is well worth any extra work we have to do.

Q: Soon, you are going to be launching your own Ubotica satellite?

Yes, this is a really exciting project for us. We will be launching a satellite in 2024. The purpose of the mission for us is putting together a lot of the concepts and technology that we have developed and actually operating them in orbit.
This includes our first- and second-generation technology that we have already flown, as well as other applications that we will run on top of that such as our compression engine. It's a very exciting time for us and a lot of hard work going on right now.

Q: Have you designed and manufactured the satellite yourselves?

No, we have been working with our technology partner – a company based in the UK called Open Cosmos. They are also our partner for a number of other missions. So, when we decided that this was something that we wanted to do, but we needed complete control over the payload, we decided to go with Open Cosmos because we recognised that they are very like Ubotica in a number of ways in terms of their disruptive nature and their vision and focus on doing things a little differently than elsewhere in the industry today. They have been a great partner to work with.
They provide the backbone. They provide the housing, and all the traditional pieces of a satellite. Everything that you need to get it up there and to control it once it is in space. Our IP is the payload on this, which is what we are providing. The AI engine, the applications, etc.

Q: Right now, you are in the integration stage?

The integration stage is essentially the stage of the project where all the various hardware components of the satellite are integrated together. We are actually building the physical satellite at this point in time. One of the big challenges around pulling the satellite together has been disruption in the supply chain. Covid-19 and the whole pandemic has been one element of this, and what's going on in Ukraine is another.

So, there has been a lot of work happening from ourselves and Open Cosmos to actually source the various components that are needed to make the satellite. Some things that you would think are ubiquitous and very common suddenly become very difficult to get. A lot of management, talking and networking goes on just to make sure that we can buy and source and get delivered on time all the various pieces of the puzzle that we need.

Q: How long will the satellite be up in space for?

This is a low orbit satellite, so lifetime is typically three to five years. From a commercial point of view, this is a real underpinner of our business model. The assets that we will be designing into will have to be refreshed on a continuous basis every three to five years. This is really where a lot of the driver for our new space technology is coming from. We're taking technology that has not been designed for space and building products with it.
Launch costs are much cheaper than they would have been five or ten years ago, as are the operating costs. We have been able to take advantage of all of this, build an asset and put it in orbit within a reasonable cost model.

Q: In three to five years you will have enhanced your AI technologies. You might be looking at a slightly different satellite?

We might be. One of the ways that we are benefitting from this is that once you get a design into a satellite, in many cases there is a reluctance to change the architecture of that satellite. So, we may end up shipping the same product for much longer to the same customers. As new AI models are developed or existing models evolve through continuous training, they can be deployed on our satellite as the platform is very programmable.

Q: This is aUbotica satellite, in partnership with Open Cosmos, and not intended for any particular customer. It's yours and once you have done this launch, will you start making satellites like it for other customers?

No, we will not be a satellite builder or operator. This satellite will have commercial elements that we will be able to sell. We are much more focused on being able to prove the capabilities of this satellite delivering AI in space and selling our technology to the incumbents in this area.
Our key customers are the companies that build satellites and our focus with them is getting our technology designed into the payloads of their satellites. So, when their end customers come to them, they can say that they already have an AI engine in our platform that has been flight proven. Our other set of target customers are the end users themselves. We work with them to develop their AI applications and then jointly go to the satellite builders to show them a solution that runs on AI accelerator, ready to be designed into a satellite. We never envisaged being a satellite operator ourselves on a mass scale. Other companies have been doing it for ages and they are already very good at it.

Q: Can the Ubotica satellite be re-purposed?

One of the key benefits of our solution is that it is software-based and easily repurposable in orbit. So, you can prepare the platform to run one app when it is over land and another when it is over sea. This is all done through the software. That is a key difference to some of the other technologies that are used in doing AI in orbit. The cost of reconfiguring some of these platforms is significant in terms of power.

One of the key parameters for satellites is balancing functionality versus power budget. Satellites are powered using solar panels, charged using the sun and then people want particular areas of the Earth imaged. You use the satellite to take images and use the AI to process them. However, this is all traded off against how much power there is and how many images can be taken and processed.

Q: How does the Ubotica satellite get images quicker to the end customer?

It will get the output of AI to the end user as quickly as possible. It is about bypassing the traditional data path from satellite to end user, which is satellite to ground station, then processing on the ground and then providing, in most cases, just the image to the end user.

Using our satellite, we will demonstrate the ability to send an insight, generated using AI in space, directly to the end user. So, if the end user wants to know if there is shipping in a particular location of the world, we will provide that information directly to the end user, far more quickly.

Q: Where do you see Ubotica going in the future?

We are focused right now on Earth observation. Low Earth orbit satellites are imaging the Earth and using sensors to capture data that are more and more powerful, with higher resolutions. A lot more data is being generated and AI is processing the images to work out for the satellite if a) there is any value in the data captured and b) can you extract the real insight from the data and get that back to Earth.

That is all about trying to disrupt an existing market where there are satellites that do imaging and the processing is done back on Earth. Where the product that these companies are providing for their end users is not all that satisfactory. They are just providing the image data and the customer has to wade through them to see if there is any value attached.

Where we are going next is not only on Earth observation, but also situational awareness. This is where you get into the realms of “is this really possible?” Situational awareness is putting cameras in position to be the eyes of space assets in orbit. Providing the ability to do vision-driven applications, such as object retrieval, debris tracking, debris removal, propulsion, refuelling, manufacturing in orbit.All of these things. They are going to need vision to assist in these applications.
That is our next big challenge. Also, it's going to be AI-driven, that is for sure. That's where we see things going above and beyond Earth observation.

Nigeria plans to send Astronauts to space in 2023

The Nigeria's National Space Research and Development Agency, simply NASRDA was established in 1999 with the mission to “pursue the development and application of space science and technology for the socio-economic benefits of the nation”

Nigeria's desire to venture into space technology gave rise to the establishment of National Space Research and Development Agency, NASRDA in 1999. In order to actualise this desire, and in line with the directive of the then President, Chief Olusegun Obasanjo, NASRDA was assigned the mandate to vigorously pursue the attainment of space capabilities.

In Sept. 2003, Nigeria officially joined Algeria, Egypt, and South Africa as the only African countries to have launched a satellite, when it launched the NigeriaSat-1. Nigeria paid $13 million to United Kingdom-based satellite technology company, Surrey Space Technology Limited (SSTL ltd), and the satellite was launched on Kosmos-3M rocket from the Plesetsk spaceport in Russia. NigeriaSat-1 lasted until 2012, four years longer than expected.

It was succeeded by NigeriaSat-2 and NigeriaSat-X, which both launched in 2011 carrying similar instruments. These satellites were also made at SST, with Nigerian engineers helping to build the latter. In addition to a continued environmental mission, the satellites' high-resolution images of the country will help Nigeria review electoral boundaries ahead of its general elections in 2015.

The NigeriaSats are also part of the international Disaster Monitoring Constellation, coordinated by SST. This network of satellites includes Chinese, Spanish and UK spacecraft that can provide rapid images from space when environmental disasters strike.
In 2005 NigeriaSat-1 was the first satellite to send back pictures of the east coast of the US following Hurricane Katrina, says Nice. And the orbiter contributed images to aid workers following the 2004 Indian Ocean tsunami. Nigeria provides disaster-related imagery for free, but the country generates income from the satellites by selling other image data.

The objective of the NigeriaSat-2 mission is to provide high-resolution imagery in a swath width of 20 km. NigeriaSat-2 also carried a continuity “payload” to continue with the work NigeriaSat-1 was doing. The imagery of both spacecraft would serve as a catalyst to the development of Nigeria's NGDI (National Geospatial Data Infrastructure) programme. By 2013, the two satellites had sent over 1,400 images. These images, apart from assisting in studies on flooding, erosion, deforestation, desertification etc, are also invaluable in planning security operations and emergency response.

To make Nigeria's security capacity better, in 2011, Nigeria launched the first satellite built by an African country, the NigeriaSat-X. The satellite was intended to complement existing satellite infrastructure and to improve the security of foodstuff, lives, and land in Nigeria

Space aspirations in Africa

The concept for an African Space Agency provides an opportunity for African nations to begin independent ventures into space.

Human spaceflight has been heralded as a triumph of our evolution, and is seen as the next step in an expansion of human capability across our solar system. Experts argue that the benefits it brings to earth seem to be primarily its potential to take us away from it. However, human spaceflight is not merely an overfunded attempt to leave most of humanity behind. When astronauts go into space, they can perform experiments that are unique to the anti-gravity environment, and bring back new discoveries in health, technology, and agriculture.

During the height of the Cold War, Zambia's infamous schoolteacher, Edward Mukuka Nkoloso, recruited twelve “Afronauts” for his mission to the moon. His first astronaut class, mostly composed of high school students, were trained for missions to the moon and Mars by spinning in oil drums and learning to walk on their hands.

As you may have guessed, the Zambian Space Program never got off the ground. “My spacemen thought they were film stars. They demanded payment,” Nkoloso told the AP. in August, 1965. “Two of my best men went on a drinking spree a month ago and haven't been seen since . Another of my astronauts has joined a local tribal song and dance group.” Even in the early days, Nkoloso had complained that “they won't concentrate on space flight there's too much love making when they should be studying the moon.” Matha Mwamba eventually got pregnant and dropped out. The program suffered from a lack of funds, for which Nkoloso blamed “those imperialist neocolonialists” who were, he insisted, “scared of Zambia's space knowledge.”
In the film, set on the night of the Apollo 11 moon launch, in 1969, “a group of exiles in the Zambian desert are rushing to launch their rocket first.” It is just one of several projects inspired by the Zambian Space Program that have emerged over the last five years, as part of the recent resurgence of interest in black science and science fiction.

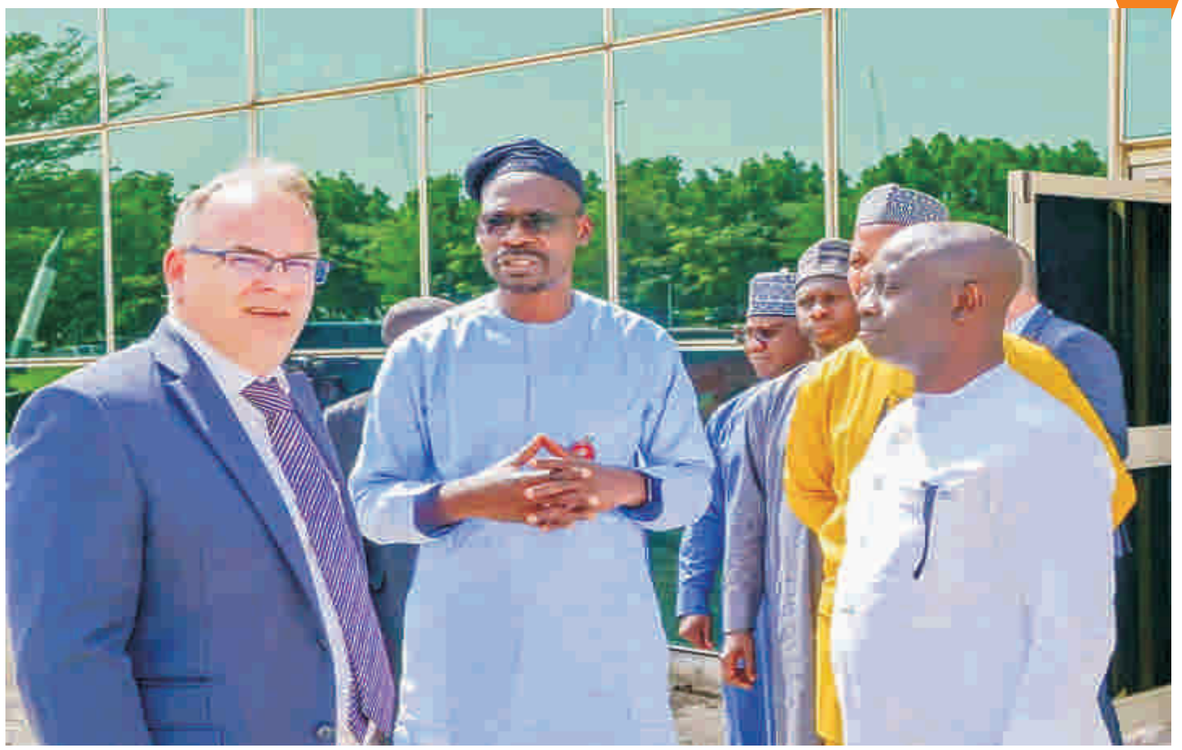
While his efforts were ridiculed as excessive daydreaming, naivety, or even madness, the desire to go to space still persists with government-funded initiatives across the African continent.

From an American perspective, it is a common fact in our collective memory that the landing of Neil Armstrong on the moon in 1969 was a significant moment for our country and our planet. Although a Nigerian might not reach the moon within the next decade, even a low-orbit mission could present a new cultural mood in the country.

In 2016, the Nigerian space program employed approximately 2,000 workers. Prior to his appointment as Director-General of NASRDA in April 2021, Dr. Halilu Shaba Ahmad presented plans to UNOOSA in 2012 to train Nigerian astronauts and develop a rocketry and propulsion system. Consequently, long-term investment into a human spaceflight program could grant a plethora of jobs in the country; from engineers, to public relations officers, to astronaut candidates, the range of opportunity for employment are expansive and applicable to a variety of skills. Furthermore, the first African astronaut would represent a giant leap in international significance, respect, and accomplishment for the African continent.

The greatest hindrance to the Nigerian space program is the lack of resources available to it. In 2021, NASRDA's budget was increased by 54% to 86.5 million USD.

The Nigerian space program's budget is



significantly smaller than that of India, China or Russia. However, a careful allocation of resources to the right initiatives could create clever and cost-efficient routes to space. Nigeria's satellites have varied in cost over the past twenty years. NigComSat-1, Nigeria's first communications satellite, had an overall cost of 300 million USD, including construction, launch and insurance, when it launched in 2007, and its EduSat-1, a nanosatellite, launched in 2017 from Kennedy Space Center for 500,000 US.

Nigeria to earn $20m from spaceport

The National Space Research and Development Agency (NASRDA) says Nigeria can generate $20 million from the launch of one satellite, if it develops its Assembly, Integration and Testing Lab (AITL). Dr Halilu Shaba, the Director-General of NASRDA, stated this recently, in Abuja, and restated that the 25-year Space Policy Roadmap could be achieved.

Part of the content of the roadmap which included launching satellites into the orbit from Nigerian soil, Shaba said, was crucial to the development of Space Science and Technology. He said that achieving such facility was a humongous project that required huge resources which their annual budgetary allocation could barely handle.

Dr Halilu Shaba explained that NASRDA was engaging in advocacies to local investors and other countries to see how partnerships could float the project because the government might not have the sole capacity. “We are thinking out of the box because it can bring money and we are letting people know that this can bring money.

“The government can partner with the public on that because for you to launch any satellite, the initial deposit you give for the launch of the satellite minus the kilometres you cover is $20 million to launch one satellite. “We are also at the equator and getting windows for launch are higher and then the distance to the orbit is shorter.

“If we can be a launching destination, it means that if we are launching 20 satellites from Nigeria every year, that gives you about $400 million," Shaba said. According to him, let's start and then identify the other issues, and Nigeria will be launching destination for other African countries and the world.

The NASRDA boss further said they were talking to other countries due to their interest. He added that they were making offers to some other countries that would want Nigeria to develop the AITL and grant them access over a period. He said “They can come, we develop this together, we share the profit, they can launch and as well have a launch pad. Whatever option we are looking at, it has to be to the benefit of Nigeria.”

Shaba disclosed that the agency was developing on its Rocketry and Propulsion experience, although its profits were coming in trickles. He said that the agency was exploring to engage every platform to educate Nigerians about Space Science and Technology. Avenues being explored included expanding the scope of their social media engagements targeted at the youths and the banks for development of visibility tools, he stated.

“We are also looking at expanding broadband reach to rural areas which we got the approval from the Federal Executive Council in November 2022. “We are already ahead with that, some of the equipment are here already and we are testing the broadband to see its speed," Shaba said. According to him, when you talk of digital economy, you cannot remove satellite and we want our youths to identify with all these areas because we are open to anyone.

ASTRONAUT

Thomas Pesquet

TBorn in Rouen, France, on 27 February 1978, Thomas Pesquet is a black belt in judo and enjoys basketball, jogging, swimming, squash and outdoor sports such as mountain biking, kite surfing, sailing, skiing and mountaineering and pilot before he was selected to join ESA's Astronaut Corps.. He also has extensive experience in scuba diving and skydiving. His other interests include travelling, playing the saxophone and reading. As the youngest of ESA's new recruits, he completed the basic training programme designed to prepare trainee astronauts for the mental and physical challenges ahead.

Education

Thomas graduated from the competitive French “classes préparatoires aux grandes écoles” at the Lycée Pierre Corneille in Rouen, France, in 1998. In 2001, he received a master's degree from the École Nationale Supérieure de l'Aéronautique et de l'Espace in Toulouse, France, majoring in spacecraft design and control. He spent his final year before graduation at the École Polytechnique de Montréal, Canada, as an exchange student on the Aeronautics and Space Master course. Thomas graduated from the Air France flight school in 2006. This led to an Air Transport Pilot License-Instrument Rating (ATPL-IR).
Thomas is a member of the French Aeronautics and Astronautics Association (3AF) and of the American Institute of Aeronautics and Astronautics (AIAA).

Experience

From April to September 2001, Thomas was a trainee engineer with Thales Alenia Space in Cannes, France, where he developed a satellite system design tool using concurrent engineering techniques.
From October 2001, he worked as a spacecraft dynamics engineer on remote sensing missions for GMV S.A. in Madrid, Spain.

Between 2002 and 2004, Thomas worked at the French space agency, CNES, as a research engineer on space mission autonomy. He also carried out studies on future European ground segment design and European space technology harmonisation. From late 2002, he was a CNES representative at the Consultative Committee for Space Data Systems, working on cross-support between international space agencies.

An avid private pilot in his spare time, Thomas was selected in 2004 for Air France's flight training programme. He went on to become a commercial pilot for the airline, where he started flying the Airbus A320 in 2006. Having logged more than 2300 flight hours on commercial airliners, he became a type rating instructor on the A320 and a Crew Resource Management instructor.

Thomas was selected as an ESA astronaut in May 2009. He joined ESA in September 2009 and completed basic training in November 2010. After graduation, he worked as a Eurocom, communicating with astronauts during spaceflights from the mission control centre. He was also in charge of future projects at the European Astronaut Centre, including initiating cooperation with new partners such as China.To be ready for a space mission, he r

eceived further technical and operational training in Europe, Russia and the USA: on the Russian Soyuz spacecraft, on the US and Russian spacesuits, and on Space Station systems. He took part in exploration training courses: living and working underground on ESA's CAVES training course in 2011, and underwater on NASA's Seatest-2 mission.
On 17 March 2014, Thomas was assigned to his first long-duration mission on the International Space Station.

Spaceflight

Thomas was launched to the International Space Station on 17 November 2016 for his six-month Proxima mission, as a flight engineer for Expeditions 50 and 51.
Thomas was the 10th astronaut from France to head into space after a nine-year gap since ESA astronaut Léopold Eyharts during Expedition 16. His busy mission was the first to see all four cargo vehicles in operation at the time (HTV, Cygnus, Dragon and Progress) travelling to the Space Station. He tracked and captured two of them using the Station's robotic arm.
In 2016 Thomas became the fourth French astronaut to travel to the ISS, launched inside a Russian Soyuz crew module from Baikonur in Kazakhstan. He spent almost six months onboard the Station as flight engineer, during which he worked on an international programme of experiments and carried out maintenance tasks including two spacewalks.
After returning to Earth, Thomas worked as a CAPCOM, acting as an interface between astronauts and ground control at NASA's Johnson Space Center.
He also began preparing for the upcoming Alpha mission, which will see him return to the ISS.
Throughout training, his spaceflight experience has made him a valuable asset to both colleagues and instructors.

During his stay in space, he took part in over 50 experiments and the six crew members set a record for hours of time spent working on science. Other highlights of his mission included two spacewalks to maintain the Station: one to replace batteries on an electrical channel, and one to fix a cooling leak and service the robotic arm.

Thomas returned to Earth on Soyuz MS-03 on 2 June 2017 after spending 197 days in space.
Thomas' second spaceflight was announced on 28 July 2020. He traveled to the International Space Station on the second SpaceX Crew Dragon mission together with JAXA astronaut Akihiko Hoshide and NASA astronauts Shane Kimbrough and pilot Megan McArthur. The mission was called Alpha, after Alpha Centauri, the closest stellar system to Earth, following the French tradition to name space missions after stars or constellations. Thomas was the first European to fly to the Space Station in a Crew Dragon, and the first European to fly time from USA in over a decade.

In addition to supporting 200 investigations in space, including 40 European ones and 12 new experiments led by the French space agency CNES, Thomas saw seven spacecraft come and go, the 20-year old Pirs module leaving for good and the arrival of the Russian Nauka laboratory module with a very special passenger, the European Robotic Arm.

During Alpha, Thomas performed four spacewalks to install new solar array equipment and upgrade the International Space Station's power system. Holding the European record for most cumulative hours spent spacewalking, a total of 39 hours and 54 minutes.

Shortly before the end of his mission, on 4 October 2022, Thomas became the fourth European and first French in command of the International Space Station.

The Crew Dragon Endeavour transporting Crew-2 autonomously undocked from the International Space Station and after a series of burns to take pictures of the Space Station's exterior, the spacecraft entered Earth's atmosphere and deployed parachutes for a soft water-landing, splashing down off the coast of Florida, USA on 9 November 2021 at 03:33 GMT (04:33 CET).
Thomas has trained at centres across the world with the Station's international partners, becoming familiar with latest procedures and new hardware. By launch, he'll be ready for every eventuality in orbit.
The training is very diverse, every Space Agency is responsible for their own parts and bits and pieces so you go from NASA to Russia and here in ESA, and the specific that we have here in Europe is that there's another layer there's a European component run by ESA, and then there's a
national component run by CNES, they pick some experiments, they're funding them and they're sending them to the ISS.

Spacewalk season

According To him, two spacewalks into the Alpha mission and a lot has happened for our spacewalking duo ESA astronaut Thomas Pesquet and NASA astronaut Shane Kimbrough.
The spacewalks are to install new solar arrays over the existing arrays on the farthest port side of the International Space Station. These arrays, called IROSA for ISS Roll-Out Solar Array, had to be taken from their storage area outside the Space Station, passed from spacewalker to spacewalker to the worksite.

There the rolled arrays were secured, unfolded, connected and then unfurled.
During the first spacewalk, a small technical problem in Shane's spacesuit required him to return to the airlock and restart his Display and Control Module. This module provides astronauts with continuous information on pressure, temperature and other vital data during a spacewalk. Though the restart was successful and Shane was in no danger, it delayed the duo's work, preventing them from completing installation of the first new solar array as planned.

After 7 hours and 15 minutes of spacewalking they secured IROSA and cleaned up the worksite for another day before returning to the Quest airlock.
On Sunday 20 June Shane and Thomas were helped into their spacesuits yet again for their fourth spacewalk together. This time it was to complete installation of the first new solar array and get ahead on the second.
During this spacewalk the duo unfolded the solar arrays that are rolled into tubes for transport, aligned them, connected data cables and secured them to the mounting bracket. Connecting the power lines must be done during the orbital night-time as a precaution to avoid any chance of electric shock.

As Thomas and Shane waited for the night to arrive, Shane's helmet lights and camera partially detached from his helmet but Thomas used some wire to successfully reattach them as a temporary fix.
From there the spacewalk went smoothly. Shane and Thomas connected the new solar array, watched it unfurl and prepared for the installation of the second new solar array. The second spacewalk lasted 6 hours and 28 minutes, with the duo arriving back at the airlock at 20:10 CEST

The Mawazo Institute: Home of African female researchers

Sylvia Mutinda, an avid researcher and a PhD student of molecular biology and biotechnology, contributed to the identification of new strains of sorghum that are striga-resistant and can be cultivated in Western Kenya.The Pan African University students' research focused on host-parasite interaction, including screening a large panel of sorghum strains and identifying natural mutants resistant to the parasite with the aim of helping farmers in Kenya and the wider region of Sub-Saharan Africa increase crop yields.

The RISA Fund contributed to the study through support of the Mawazo Institute fellowship programme, providing financial support towards Ms. Mutinda's research.

“Initially, I was not able to conduct sequencing to identify the smaller fragments in the research, since the seed funding received from Pan African University was not sufficient. Mawazo came in handy, offered financial support and I conducted sequencing of the rest of the samples. I am happy to say, we have got six more mutants, and this makes it twenty lines in total. Now we have twenty sorghum varieties that have been identified to be resistant based on marker assisted analysis,” says Sylvia Mutinda.

Prior to joining Mawazo, I served as both a senior marine research scientist (with a focus on applied microalgae and seaweed research) and a marine programme manager. During my time as programme manager at Dahari, I had the opportunity to lead community-led, research-based marine conservation efforts in the Comoros, where environmental degradation has had negative impacts on both the ecosystem and the communities that depend on it. Despite the limited resources available in the small East African island nation, ourteam at Dahari worked with the local fisher communities to support them in the management of their marine resources. One of my highlights was working with a fisherwomen's association who were so passionate about protecting their natural resources and quickly became changemakers and leaders in their communities, helping them to live more sustainably with their marine ecosystem.

African women researchers lack access to funding, mentorship and networks, and have to contend with gender-insensitive university policies, unequal domestic responsibilities and outright discrimination; all impacting their mental, emotional and physical wellbeing. This has led to the exclusion of African women and their authentic perspectives and voice in academia, research and development spaces— places where key decisions affecting Africa's development are made. As a leader in this space, I am supporting the inclusion of the ideas and perspectives of African women in conservation and beyond, leading to the implementation of innovative, holistic and homegrown solutions for Africa.

Mawazo Institute calls for more representation of women in science, research

As the world marks International Women's day, empirical evidence shows that, globally, women remain underrepresented in research and as a scientific field.

According to the latest UNESCO Institute of Statistics database, only 31 per cent of women within Sub-Saharan Africa are scientists. As a result, women remain locked out of policy and decision-making processes on paramount developmental issues affecting the continent and their lives.

The Mawazo Institute is a women-led African organisation based in Nairobi,Kenya supporting early career women researchers as they work to find solutions to local and global development challenges.
"We need more women voices in these spaces. Enhancing their representation will enable them to take spaces not just in the public sector but also in other industries", says Fiona Moejes, the CEO and Director of Programs at the Mawazo Institute.

Fiona says she is motivated by the opportunity science presents to understand and improve how we live with our natural environment. She has a background in developing and implementing multi- and transdisciplinary projects focused on marine biotechnology, sustainable aquaculture, with a strong focus on microalgae and seaweed, and community-led marine conservation in the Comoros and Kenya.

According to Fiona, the Mawazo Institute which was founded 5 years ago, is mentoring and training women in Agriculture, science, public health, space astrophysics, women studies among others.
"I strongly believe in the need for diversity to drive innovation and ensure impact, and we are glad it's getting broad. Our main aim is build the capacity of these women so that they be able to compete on a global level," says Fiona.
Fiona says that as women move up the ladder they are left out of decision-making processes, something she thinks needs to change.

The Mawazo Institute gives grants to women who are pursuing their PhD and are below forty years old, to facilitate their research.

"They have to be African and pursuing PhD from Universities in Kenya, Uganda, Tanzania or Rwanda. They must also show that their research is geared towards African development", says Elaine Mungai, the program manager for Mawazo Institute.
So far,52 women have benefited from the Mawazo Institute programme since its inception

31-year-old Judy Ngina is a beneficiary of the programme and she says being part of the Mawazo Institute has been an eye-opener for her.
"I have received mentorship not just for my research but also in my career progression and I would recommend it to any woman below the age of 40 and has registered for their PhD studies”, says Ngina.

Ngina who is pursuing her PhD in Gender relations in Climate-Smart Agriculture for improved household food security in Kenya is of the opinion that women need to be given more chances to make decisions that affect their lives and that of people around them.
"We need women on the table, and we need them to be part of decision-making processes. Issues like climate change and food security are interconnected and you find that many women want to do farming. But they do not have the chance to own land, which is majorly owned by the men...the question is, can these women own this land so they can be able to actively participate in climate-friendly activities for a better future?"

According to Dr Joy Kiiru who is a senior lecturer at the University of Nairobi and the Deputy Board Chair of Mawazo Institute, women need to be given equal rights and opportunities for society to thrive.

"Africa needs many more women who are doctoral authors, but we find that women enrol less for their PhD studies and take longer to complete. They also tend to publish less.I", she says.

Dr Kiiru adds that "We are facing serious imbalances in post-secondary education in Sub Saharan Africa which is at 7 per cent compared to the global average which is at 42 per cent."

The rise of Japan into New Space

A quiet revolution is underway in space exploration and development, and Japan is well placed to be a part of it

“The world's space industry is in the throes of a major transformation,” says Masayasu Ishida. An energetic Tokyoite, Ishida is a principal at the management consulting firm A.T. Kearney and co-founder and president of the Spacetide Foundation, an organization dedicated to promoting space businesses globally.

Historically, space has been the exclusive domain of government and multinational projects, but increasingly private enterprises are venturing above in a movement dubbed 'new space'. Entrepreneurs such as Jeff Bezos, Elon Musk and Richard Branson have captured the headlines, but this movement is not restricted to famous entrepreneurs or huge corporations. Increasingly, small to medium-sized businesses are becoming involved.

Ishida, who has written a book on promoting the space industry to the private sector, is excited about Japan's involvement in new space. “I think Japan has the potential to be one of the world's new-space industry hubs,” he says.

“Future space exploration needs innovative technologies like robotics, artificial intelligence, advanced communication, and new materials, which will be brought by non-space industries,” he explains. “Japan is home to many of the world's leading industries, and has a variety of technological assets. Their involvement could be of help in the global space exploration effort.”

Yasuhiro Yukimatsu, deputy director-general of the National Space Policy Secretariat, Cabinet Office, notes that Japanese companies and universities have developed micro-, nano- and even pico-satellite technology, which allows countries that have yet to join the space community affordable access to space. Ishida concurs: “Japanese space-related business players have unique technologies and are working on projects such as small launchers, space debris removal, and space resource mining.”

Japan in space

Japan has a proud history of 'old space' government-funded exploration. It was the fourth country to venture into space, and the third one to send spacecraft to both Mars and the Moon. It has the distinction of being the only country to have brought a sample back from an extraterrestrial body besides the Moon, when Hayabusa landed in the Australian outback in 2010 with a sample collected from the surface a deep-space asteroid.
But times are changing. “For the industry to realize sustainable growth, a shift from the government to the private sector is urgently needed,” says Masanori Tsuruda from the Ministry of Economy, Trade and Industry (METI). This shift is driven in part by shrinking government budgets for big projects as well as the many emerging possibilities for enterprises to profit from space.

However, business cannot go it alone in space because the capital costs and risks are too high. Companies need a supportive environment to be able to flourish in space. The Japanese government is now undertaking various initiatives to nurture the domestic commercial space industry. Ishida notes three areas in which government can help businesses invest in space: law and legislation, government procurement, support of innovation, and contests.

In the legal realm, Ishida considers the enacting of the Basic Space Law in 2008 and the Basic Plan on Space Policy in 2013 as a significant turning point. These spelled out the three main goals of Japanese space policy, namely encouraging the private sector to invest in the space industry, enhancing national security by utilizing space, and maintaining and strengthening the science and technology and industrial basis. In 2017, the Japanese government published its Space Industry Vision 2030, which sets an ambitious target of doubling the size of the space industry by the early 2030s. The strong government support of the private sector is one of the advantages that Japan has in developing new-space technologies, says Ishida.

In terms of government procurement, Japan's space agency JAXA seems to be following NASA's example of moving from government owned and operated systems to contracting companies to work on specific projects. In this model, the government agency serves as the lead investor and customer.

“Looking to the future, I expect an influx of new players, new investments, new business models, and new customers from outside the industry.”

The government is also actively seeking to support innovation in space technologies through funding research and development and it has started a competition to stimulate ideas from the business community for space-related commercial ventures. Called S-Booster it offered prizes of up to three million yen.

The transition is not without its challenges. “Japan's domestic market size is considerably smaller than those of the US or Europe,” says Yukimatsu. “As a result, the Japanese space industry is not as globally competitive, since the world's space industries still depend on public demand.” But Ishida is upbeat about the prospects for new space gaining ground in Japan. “Looking to the future, I expect an influx of new players, new investments, new business models, and new customers from outside the industry,” he says. “We need all these elements to create an ecosystem.”

Morality of drone warfare

On the afternoon of September 2nd 2012, a group of Yemeni villagers climbed aboard the Toyota which acted as a shuttle bus that travelled most days between their village, Sabool, and the regional capital Radda. Some had travelled to the city earlier that day to sell goods in the market, while others had visited the health clinic. As they made their way slowly back to their village, unbeknown to them, in the skies above, a US drone was hunting Abdulraouf al Dahab, an Al Qaeda militant thought to be living in the area.

Exact details of what happened are unclear. Whether the US had faulty intelligence that al Dahab was on the bus or whether something much more basic went wrong is not publicly known. But shortly before 4pm a missile slammed into the vehicle carrying the villagers killing twelve people including two children.
“The bodies were charred like coal. I could not recognize the faces,” said Ahmed al-Sabooli, 22, a farmer whose parents and 10-year-old sister were among the dead. “Then I recognized my mother because she was still holding my sister in her lap. That is when I cried.
”
Initial press reports, quoting local security officials, stated that a number of extremists and their women companions had been killed in the strike, but that the target himself had mysteriously escaped unharmed. However it soon became apparent that something had gone very wrong. After relatives threatened to bring the bodies to the capital and lay them at the feet of Yemeni president: officials admitted that the strike had in fact been an accident. “My sister was so excited about going out that morning so she wore a brand new dress,” Ahmed al-Sabooli told the BBC a year later. “I never thought it would be the last time

I saw her.” While US officials admitted in an off-the-record briefing to the Washington Post that the strike had been carried out by the US, no apology was ever issued or public investigation undertaken.

A film, *Eye in the Sky,* is the first to take us inside a top secret drone operation involving a large group of soldiers, military commanders, politicians, and lawyers. The recent film Good kill also dealt with drone warfare but it focused on the aftershock suffered by a Navy pilot on a deadly mission.

It's the moral quandaries of the operations that has become supremely important in the “drone warfare” age, and director **Gavin Hood**'s effective, smart thriller *Eye in the Sky* tackles the issue of mortality visa-viz “What's the right thing to do?” head on as it charts a single mission involving a drone strike from the points of view of the various people involved in pulling the trigger. While the film's melodramatic conclusion threatens to undo the goodwill of its first two thirds, it's mostly an intelligent, engaging, and sometimes darkly funny drama about the process and cost of 21st century warfare.

In the opening scenes of the film, Alia, real name Aisha Takow, a nine-year-old girl who lives with her parents in a Nairobi slum. While her mother, Fatima, real name, Faisa Hassan, makes bread for her to sell in the streets, she twirls a hula hoop her handyman father named Armaan Haggo has made for her. He warns her not to play with it in front of any of his religiously fanatical clients who do not approve of such things.

Colonel Katherine Powell has been tracking a UK citizen and her husband for six years; they are terrorists on the most wanted lists of several countries. Working from a bunker in London's Government Communications Headquarters, she is elated when Major Moses Owiti, an African who is working with the British military with the support of the United States, confirms that the two terrorists along with others have been located in a house in Nairobi.

She began putting together Operation Cobra code named, a capture mission by roping in British Lieutenant General Frank Benson, who is located in London alongside British Attorney General George Matherson and other high-level members of the British government. Also involved is Nevada-based drone operator Steve Watts, who is tasked with being the team's “eye in the sky” while the capture mission is enacted.

But when their main person of interest diverts course into a crowded, heavily guarded residential area, Operation Cobra is forced to change from a capture mission to a kill mission, with the drone as its weapon of choice.

Also part of this mission are Lt. Colonel Frank Benson, a gung-ho military man who believes that politicians should let experienced warriors make the decisions regarding when and where to kill terrorists and suicide bombers. As he sits in a Whitehall boardroom in London, he is forced to cope with a small group of British politicians and lawyers who must be consulted after Powell's mission turns from a "capture" to a "kill" mission.
Further complicating matters is Nairobi-based asset Jama Farah working on the ground in close proximity to the house of interest, as well other factors that present the entire team with a dilemma that blurs the lines between legality and morality. As the various powers that be argue over how best to take action, the clock ticks down and their window of opportunity dwindles.

While the beginning of the film feels like it's setting the audience up for a somewhat boring lesson on drone warfare, the thriller aspect of the film becomes abundantly clear as the series of events play out in semi-real time over the course of one day. But this isn't an episode of *24* that's all action, little talk.

Hood is fascinated by the decision-making process that leads directly to a drone strike, and so we watch as egos rise and responsibility is passed on through the ranks. The interplay amongst the government and military officials at times feels like an episode of *The West Wing*, with **Guy Hibbert**'s sharp script dropping in enough humor to ensure that what's essentially a series of conversations keeps the audience on the edge of its seat.

The performances from the entire ensemble are top notch, with each person filling his or her emotional role perfectly. Mirren is the driven hard-ass with years of investment in this one asset, Rickman tries to bridge the gap to the British government, and Paul is the one that actually has to come to terms with pulling the trigger. Hood balances all of these perspectives wonderfully, and even makes time to address the United States' position on drone warfare as you can probably guess, it's not exactly flattering.

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