

■ Editorial 01: Reasons Why Satellite Ground Stations are Becoming More and More Important (Kuzuoka)

■ Editorial 02: Notable Trends Related to Satellite Cryptographic Communications Technology (Oishi)

■ Editorial 03: Two Lunar Plans, and Where is Harmony? (Murakami)

Editorial 01: Reasons Why Satellite Ground Stations are Becoming More and More Important (Kuzuoka)

This month saw a plethora of news regarding Microsoft Azure and Amazon AWS strengthening ground station services for orbiting satellites. Also, Leaf Space, a startup that provides ground station services, has also increased its own stations and further expanded its coverage. It seems that, with more and more satellite constellations employing Earth observation (EO) satellites, it is certain that the market for the ground station services will further expand.

This expansion of ground station services isn't meant only to cope with an increase in EO satellites, however. We believe that companies strengthening ground station services are looking ahead to a situation where the conventional concept of orbiting satellites only being able to communicate within the visible range of ground stations will significantly change. Thus, by increasing the number of ground stations in operation, the time that satellites can engage in communication will be expanded. With this, it would seem that we are heading toward a world where orbiting satellites can ensure secure communications 24 hours/day, seven days/week.

So, what types of new possibilities will all this entail? First of all, it will become possible to operate a new type of EO satellite technique: Tip & cue. Tip & cue is an operation that transmits images observed by observation satellites to the ground in real time but that formulates and executes observation plans for subsequent satellites also in real time according to the results. In order to realize this automatic tipping and cueing operation, not only downlinks but also commands must be connected at all times. If realizing a non-stop connection, in addition to tip & cue, it is expected that the real-time operation of orbital services such as those for debris removal, manned activities, and IoT satellite operability & safety will be dramatically improved. Ultimately, it is expected that various applications that use cloud processing and the internet can be used even while in orbit.

Furthermore, as an ultimate way to increase the number of ground stations in operation, data relay services aim for the constant connection and real-time operation of orbiting satellites by installing ground stations from orbit. Conventionally, governments have engaged in using data relay services for geostationary satellites, such as the Tracking and Data Relay Satellite System (TDRS), but Japanese startup

WARPSPACE is working on a data relay service using medium-altitude orbiting satellites and intersatellite optical communications (i.e., the Laser Utilizing Communication System [LUCAS]). Also, in June, to provide proof-of-concept, the U.S. Department of Defense (DOD) announced that a commercial EO satellite will be used to provide data for Tranche-series inter-satellite communication services planned by the DOD's Space Development Agency (SDA).

Originally, the Tranche series is a constellation with multiple missions, including an early missile warning system, but there has been an announcement such that the developed data relay service will be open to private-sector enterprises. However, despite the backdrop of the demand for constant connection and real-time operations increasing amid the construction of data relay services by both the public and private sectors, it's not yet clear if private-sector enterprises will be able to use the Tranche series purely for private data collection.

As such, ground stations and data relay services are being combined, and in the future, the constant connection and real-time operation of orbiting satellites will become a reality more and more. Then, as a next step, we feel the following two questions will arise:

- 1) Who will build an integrated network system that combines multiple always-on services and that will allow users to transmit data without worrying about communication pathways?
- 2) What kinds of new services can be realized by making good use of always-on platforms?

In the first place, it is natural for terrestrial communications to be able to always be connected and to be able to use communication pathways without worrying about the user. This topic is also being discussed for communications satellites being integrated with terrestrial communications. Even with orbiting satellites, data relay services have been integrated with multiple ground station service companies so that users can make use of these without worrying about communication pathways, so, even in a true sense, satellite communications as a service (SATCOM as a Service) for orbiting satellites will be established, and it will be possible to provide new satellite services on such a basis.

Editorial 02: Notable Trends Related to Satellite Cryptographic Communications Technology (Oishi)

Last month, we touched on the subject of cybersecurity in Mr. Kuzuoka's editorial, and this month we have similar news to report related to cryptography in satellite communications, such as regarding quantum cryptography and Viasat's inline network encryptor (INE).

First of all, regarding Viasat's INE, this is the first military-grade encryption device for Link 16*-compatible LEO satellites developed for the U.S. Air Force Research Laboratory program. The device is

(Continued on the next page) 1

(Continued from the previous page)

palm-sized and very small, as shown in Fig.1 at the bottom left of page 3 of this text.

For Link 16 correspondence, the Transport Layer satellite under construction by the SDA is planned to have a linkage function. However, the U.S. Air Force and the SDA have decided to move to the Blackjack execution phase of DARPA's development, as there are projects competing with each other (i.e., CASINO and the Transport Later project, respectively).

Therefore, at present, we have not been able to grasp whether or not the INE developed this time will be mounted on SDA's LEO satellite. However, while commercial constellations such as Starlink and OneWeb are gaining attention, we will be keeping our eye on this as one of the trends related to military LEO constellations being steadily developed.

Next is quantum communication. As for trends this month, along with the launch of a consortium for the study of EuroQCI (QCI: Quantum Communication Infrastructure), a quantum communications network that will include Europe's space sector in the future, there are two federated system concepts (i.e., the Federated Quantum Systems [FQS]) to pay attention to and which were agreed on at the recent G7 meeting in the United Kingdom. Of these, EuroQCI aims to enable ultra-secure communication between critical infrastructure and government agencies throughout the European Union.

Then, regarding FQS, this is based on the development work by British startup Arqit (est. 2017) for commercial customers toward aiming to take advantage of breakthroughs in quantum technology so as to provide protection against cyber-attacks, which have become increasingly sophisticated. In addition to Arqit being listed via a special-purpose acquisition company (SPAC), investment from the three companies of Sumitomo Corporation, Heritage Group, and Virgin Orbit has also been announced.

The quantum cryptography technology that Arqit is developing is known as "quantum key distribution" (QKD), which is one of the cutting-edge technologies that are attracting attention as a next-generation communications security technology. In 2023, two demonstration satellites will be scheduled to be launched via Virgin Orbit's LauncherOne to verify this technology. (Reportedly, the cost of the project, including the first satellite, is expected to cost over \$70 million, funded by a government consortium and commercial partners.)

Also, in the QKD field, China is leading the way. It launched the "Micius" quantum cryptography satellite in 2016 and realized intercontinental QKD at a distance of 7,600 km to Austria in 2018.

At the recent G7 meeting, the point of standing united as a counterweight to China was confirmed (not by all countries, however... no united consensus was achieved), but also regarding agreement on FQS, it seems that the attendees were conscious of the activities of China, which is leading the way in quantum communications.

Editorial 03: Two Lunar Plans, and Where is Harmony? (Murakami)

So, where is the International Space Station's (ISS) Harmony module going?

The ISS's Node 2 (commonly referred to as "Harmony") connects the modules of each country to the

ISS and connects HTVs.

Having "harmony" is a symbol of a good era, but the next era might not be a walk in the park.

At the Global Space Exploration Conference (GLEX) held on June 14–18, 2021 and hosted by the IAF in St. Petersburg, Russia, the complete plan for a lunar facility to be implemented via cooperation between China and Russia was announced. Meanwhile, a group centered on the U.S. is trying to promote the Artemis program, and it is unlikely that the U.S. and China will merge efforts, as they view each other as competitors. What's more is that the NASA administrator publicly views China as a threat to U.S. space activity and has stated that the U.S. needs to accelerate all development, including exploration programs.

We feel that, in the background, there is the perception of a threat in China's hegemonic movement and that this is becoming common knowledge in the U.S. Certainly, China is moving forward very fast and is very comparable to the United States not only in economic might but in military power as well, and with this as a backdrop it does seem that China is in the running to try to overtake the U.S. The domain of space is very important for the U.S., however, toward maintaining military supremacy, and this aspect also has influence on plans for space exploration.

According to the lunar plans announced by China/Russia, manned bases are to be set up during the 2030s, and, while the Artemis program does seem to be superior in terms of schedule, it is also being developed by teams from multiple countries and is being implemented with the participation of the private sector and via international cooperation. However, in terms of propulsion capability, China and Russia seem to have the upper hand. From the perspective of international cooperation though, China/Russia are also able to cooperate not only in systems but also in equipment and ground stations and are also calling on countries that have traditionally had high skill in space to collaborate with them. And if looking at its Belt and Road Initiative or its in vaccine diplomacy, it would seem likely that China's network of influence will continue to grow.

Meanwhile, in the U.S., concerns have been raised about the development of the manned lander program and how the situation has become dominated by one company: SpaceX. However, there are plans to include other companies and to add to the overall budget. We think that this is very important—but it is also important to ensure the overall plan.

The words "service procurement" and "promotion of international cooperation" sound great and all, but we feel that if risks aren't properly managed, there is the possibility for programs to go astray, such as in the Space Shuttle program.

Amid a situation confused by the COVID-19 crisis, and amid the commemoration of the 60th anniversary of Yuri Gagarin's flight, participating in GLEX in Russia via the web gave us a feeling of crisis.

* Link 16 is the main tactical data link for the U.S. Department of Defense and for the North Atlantic Treaty Organization (NATO).

June 2021 Space Business-related Topics by Business Position/Market Field

OldSpace and other topics

- China accelerates its "BeiDou" Navigation Satellite System and nuclear fusion development with new technology (no.002)
- Airbus: Leading the European EuroQCI quantum internet (no.006)
- Satellite operators: Satisfying the requires for clearing 120 MHz C-band (no.015)
- Viasat offers enhanced military-grade cryptography for the first Link 16-compatible LEO satellite (no.017) (Fig.1)
- Korea's KAIST goes full-out for smallsat (no.018)
- China: "Fengyun 4B" (FY-4B) weather satellite launched, enabling enhanced accuracy in observing typhoons and sandstorms (no.022)
- EchoStar expected to secure spectrum for global S-band planning (no.035)
- Viasat concludes Ka-band capacity lease agreement with Avanti Comm (no.036)
- EUSPA orders Galileo high-precision data generator from GMV (no.052)
- G7 forms government alliance for quantum cryptography satellite network (no.054)
- 4iG buys majority stake in Spacecom (no.066)
- Satellite manufacturers face component shortage (no.078)
- Yahsat participates in the public market listing rush (no.088)
- Iridium selected for P/L development for US Army LEO satellite navigation system (no.096)
- NOAA replaces GOES17 satellite earlier than planned (no.098)
- MEASAT-3 service returns to normal (no.101)

- Rocket exhaust changed from red to white, thrust of Long March 7 improved by 60% (no.007)
- US Space Force launches successfully from Tristar rocket mothership (no.060)

- China accelerating space station construction, successful docking supply ship (no.001)
- Lockheed Martin and General Motors jointly develop lunar rover for the Artemis program (no.003) (Fig.2)
- New Zealand signs Artemis Accords (no.012)
- Space debris collides with the ISS, hole caused in robotic arm outside the ship (no.019)
- Gilat acquires domestic internet service distribution contract in Peru (no.026)
- Lockheed Martin concludes SBIRS ground system operations contract (\$1B) (no.032)
- European Space Agency (ESA) announces selection of the "EnVision" Venus exploratory mission (no.058)
- China and Russia announce roadmap for international lunar base (no.067)
- Brazil joins Artemis Accords (no.075)
- Three astronauts arrive at Chinese space station (no.076) (Fig.8)
- World Economic Forum and ESA launch new space sustainability rating (no.082)
- First ISS solar cell array "iROSA" to be deployed (no.093)



Fig.1: Viasat's cryptographic device, the inline NW encryptor (INE) (credit: Viasat) (no.017)



Fig.2: Lockheed Martin and General Motors jointly develop lunar rover (credit: GM/LM) (no.003)



Fig.3: Space debris collides with the robotic arm of the ISS; hole of about 5 mm confirmed (credit: NASA, CSA) (no.019)



Fig.4: Astronaut boarding the core module of China's "Tenwa" Space Station (no.076)



Fig.5: General Atomics manufactures two CubeSats for optical communications demonstration (credit: General Atomics EMS) (no.016)

Mixed space topics

- SDA plans to launch laser communications experimental satellite via the SpaceX rideshare program (no.016) (Fig.5)
- Viasat as competitor seeks to stop Starlink (no.020)
- Skylo launches connected device service in India using Inmarsat network (no.040)
- OQ Tech concludes "5G via satellite" contract from ESA (no.041)
- ESA adds Iceye data to TPM portfolio (no.051)
- Hanwha, etc.: Leading the development of Korean private-sector-led satellites (no.059)
- Independent European central satellite communications constellation program launched, initiated by ROVIAL SAS (no.064)
- Australian Space Agency grants "Moon to Mars Improvement" grant to Fleet Space (no.069)
- Capella Space concludes research contract with SDA (no.077)
- Expansion of SES as cloud leadership by AWS Direct Connect Partner (no.079)
- NASA's StarBurst smallsat, Space Flight development (no.107)

- FAA approves Rocket Lab launch resumption (no.021)
- PLD concludes contract with ESA for realizing reusable space rocket (no.027)
- Sierra Space signs agreement with U.K. spaceport (no.045)
- SpaceX: Successful launch of the "SXM-8" radio broadcasting satellite (no.049)
- South Korea: Construction of private rocket launch site (no.053)
- Falcon 9 launches GPS satellite for national security missions for first time with reused booster (no.074)
- US EXIM bank funds SpaceX launch transactions (no.090)
- SpaceX to launch first satellite of the SDA (no.103)

- Survey for use of commercial rockets for transportation of US air force goods (no.030) (Fig.6)
- Nexus, Ethereum blockchain network installed on ISS (no.037)
- Kymeta expands government and military network offering through strategic partnership with Comtech (no.046)
- US Army evaluates Kymeta's flat antenna for mobile connectivity (no.089)

Mixed space topics

NewSpace

- German startup raises funds for forest fire monitoring satellite (no.010)
- Climavision emerges from stealth mode with \$100M meteorological intelligence network (no.028)
- Astra acquires satellite propulsion company Apollo Fusion (no.034)
- Kepler announces expansion plan with \$60M in funding (no.044)
- SkyWatch raises \$17.2M in Series B funding (no.063)
- Tyvak and Lawrence LNL release Earth/orbital images (no.073)
- Intuitive Machines plans to deploy and operate the first lunar communications satellite in 2022 (no.086)
- Benchmark Space Systems announces MaaS business in space (no.091)
- Iceye establishes office for Japanese market (no.092)
- SWISSto12 and SatixFy team up on latest payload for MEO and GEO communications satellite programs (no.097)
- Leostella delivers first Loft Orbital satellite (no.102)

- D-Orbit announces third mission for its ION satellite carrier (no.011)
- Axiom Space: Purchases Crew Dragon mission (no.023) (Fig.7)
- Relativity Space: Terran R rocket financing (no.042) (Fig.8)
- SpaceX plans to build sea-based spaceport, scheduled to open in 2022 (no.043)
- Launcher develops inter-orbit transport aircraft (no.068)

- Leo Labs raises \$65M in Series B funding (no.024)
- Kymeta obtains ISO 9001 certification for international quality (no.025)
- 10 AWS startups selected as accelerator programs (no.050)
- Seat on Blue Origin's New Shepard auctioned off for \$28M (no.055)
- Leaf Space expands ground station network to support SpaceX rideshare missions (no.095)
- Astroscale/ELSA-d: Leading the way with innovative ground station solution (no.106)



Fig.6: US Air Force aims to explore commercial rocket use research program for freight transport (credit: US Air Force) (no.030)



Fig.7: Contracted Crew Dragon mission this time to be used for the missions of private-sector astronauts to the ISS until 2023 (credit: NASA) (no.023)



Fig.8: Terran R fully reusable and can launch 20 tons of payload (credit: Relativity Space) (no.042)



Fig.9: Leaf Space adding more ground stations to support the rapidly expanding smallsat industry (credit: Leaf Space) (no.095)

Satellites

Launching

Others