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Editorial 01: A Report on Participation at 4S 2022 (KUZUOKA)

I attended the 4S 2022 Symposium. A report on our participation will be issued separately.

Editorial 02: Increasing competition in Arctic connectivity amid increasing importance for national defense (OISHI)

This month, we would like to report on various topics that will affect future trends in satellite communications and connectivity, including China's quantum communications experiments and Inmarsat's trials for mesh network communications.

Among these topics, we would like to focus on connectivity trends in the Arctic Circle from the following aspects:

- 1) Russia's ongoing invasion of Ukraine and the growing importance of connectivity in the Arctic against the backdrop of affecting applications for NATO membership by Sweden and Norway; and
- 2) U.S. government's movement to expand the use of commercial services such as Starlink and OneWeb for aspects of national security.

The table at far right summarizes the trends related to connectivity in the Arctic Circle as per space news coverage over the last year.

On the commercial side, the difficulty of Arctic voyages has been improved on due to the decrease in ice due to global warming in recent years, and demand in the Arctic commercial maritime market (i.e., merchant ships using the North Sea route, exploration-focused passenger cruise ships passing through high latitudes in the northern hemisphere, fishing, the possibility for the exploration of natural fuel resources such as oil and gas, etc.) is expected to increase.

On the other hand, from a security perspective, the U.S. military, which is emphasizing the securing of communications in the Arctic Circle, has planned and is conducting a new experiment to integrate commercial satellites with military networks for tactical and strategic communications, from around

2019 (in attempt to eliminate communication gaps in the Arctic Circle). The experiment aims to be completed by the end of the year, and the next step is to provide terminals through integrated services. In this process, the U.S. military is seeking proposals that can allow it to switch space internet providers as needed so as to avoid reliance on a single company or single constellation.

With Russia's ongoing invasion of Ukraine, etc., and as the importance of connectivity in the Arctic Circle increases, it is expected that the above plans will be accelerated in the future.

As a commercial LEO constellation, although it is unclear what size business will take, differentiation is possible by taking advantage of the characteristics of high latitude access, which is difficult with GEO satellites, and it is believed that providing services in the Arctic Circle is important for securing the U.S. military as an "anchor tenant."

Regarding satellite connectivity, that was also one of the main themes at Asia Satellite Business Week (ASBW), held in Singapore in early June. ASBW is the first conference hosted by Euroconsult in Asia, and we are planning to participate, but we are also looking forward to seeing what kind of scenery can be seen in that part of Asia, which is obviously completely different from the Arctic Circle.

Company/project name, etc.	Connectivity-related trends and plans in the Arctic
OneWeb	Currently, OneWeb has a large number of user terminals in Alaska, Canada, Greenland, and Norway. It also operates 14 antennas in Svalbard, Norway, and at a gateway station developed by Hughes. The OneWeb and Hughes teams aim to provide high-throughput services 24 hours a day. The team is using US military satellites to test the provision of communications from outposts in remote Arctic Circle areas.
Starlink/SpaceX	Launched the first batch of satellites to polar orbit in January 2021; The US military is using Starlink to conduct tests similar to OneWeb. (SpaceX has secured a DEUCSI program contract in December 2018 and has been testing for three years how the military can make use of Starlink.)
O3b mPower/SES	These players are considering using an inclined orbit to cover the North Pole via O3b mPower, which is a next-generation medium-Earth-orbit (MEO) network aiming at launching satellite deployments this year.
ASBM/Inmarsat, Norwegian Ministry of Defense, and US Air Force JVs	Two satellites will be deployed in elliptical orbit in 2023. The U.S. military has been equipped with an EHF payload. Also used by the Norwegian Ministry of Defense for X-band military communications. On the other hand, Inmarsat aims to expand the coverage area of its Global Xpress (i.e., the company's high-speed satellite communication service) via the Ka band.
RSCC/Russia	So as to extend coverage deep into the Arctic, these players plan to add four satellites in elliptical orbit to the fleet over the next few years.
Telesat/Canada	In exchange for government funding, there are promises to connect Canada's northernmost indigenous communities with a planned LEO constellation.
Iridium Communications	For decades, as the only operator capable of providing the best, continuous coverage, the company has offered bandwidth services such as for mobile phones and for various monitoring and tracking applications.

Editorial 03: Regarding ride-share businesses (MURAKAMI)

Ride-sharing refers generally to "carpooling" and to vehicle dispatch services. Of course, carpooling services on the ground have been expanding significantly around the world. It has become common to match people with cars using apps. Uber, Lyft, and Grab (in Southeast Asia) are well-known and well-established businesses.

On the other hand, in Japan, services that combine taxis and apps are being developed, but the ride-sharing wave has not penetrated the market there very much. The reason for this has to do with legal recognition, along with a bit of an exclusionist policy.

Looking at ride sharing in the field of space launches, Spaceflight started a service that has provided launch opportunities for smallsats in the United States in 2011, and since then, the company has developed a ride-sharing system called "Tag," which is equipped with a propulsion system. The company has been developing a service to put it into orbit as according to a user's request. Originally, the company was in a position to mediate launch opportunities as a launch broker but has evolved to provide consistent services, from sales to integration.

In the United States, Momentus Space, which has strengths in propulsion systems, is also developing services, from ride sharing to refueling. Launcher Space, which has an office in the immediate vicinity of the SpaceX factory (and which works closely with SpaceX), is also about to start services as a startup company.

Looking to Europe, Exolaunch, which started as a spin-off from the Berlin Institute of Technology, has gained a track record with Russia's Soyuz rockets and is now working on a ride-sharing mission with SpaceX. Also, ISIS, in the Netherlands, also offers ride sharing, albeit on a smaller scale.

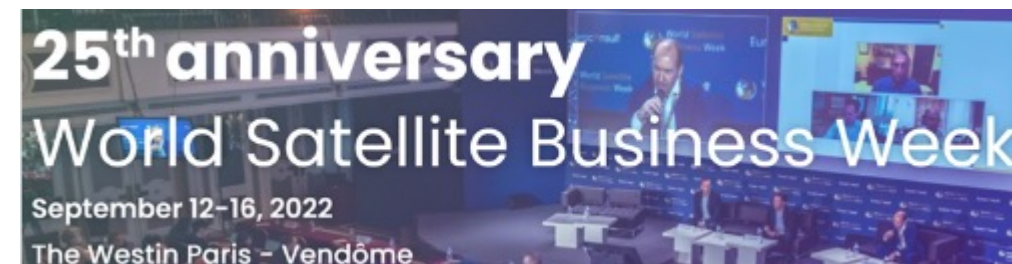
The business model is not that complicated. It is a combination of broker functions, integration, and transportation, and is relatively simple. However, smallsats are subject to frequent schedule changes, and contractually, they have to be more flexible than large satellites, so the reality is that they take time and effort. Since the number of customers for large satellites is sometimes even just one or two, the effort required to respond is not so substantial, but in the case of 100 satellites, it is inevitable that it would take major time to respond to customers.

To alleviate these tasks as much as possible, certain measures have been taken, such as by simplifying integration through sales via the internet and digitization and securing a position based on collected customers and government missions.

Development intending to add a ride-sharing function to Japan's H3 rocket was included in the priority measures for reviewing the basic plan announced the other day. Currently, it is thought to be desirable to

add a ride-sharing function that can be deployed overseas. In addition to hardware, I hope that Know-How, a Japanese company that has a ride-sharing business, can be utilized to lead such business to success.

And coming soon...



May 2022 Space Business-related Topics by Business Position/Market Field

OldSpace, etc.

Mixed space, etc.

NewSpace, etc.

Satellites



- NOAA seeks input on new satellite sensors and digital twin
- SES and ESA to enable GovSatCom with MEO constellation (Fig.1)
- China Siwei releases 30 cm imagery from SuperView Neo
- Telesat to order 100 fewer satellites for LEO constellation
- China's QUESS project sets world record in long-distance (1,200 km away) quantum states transmission
- China succeeds in launching Jilin-1 Kuanfu 01C remote sensing satellite into space
- SES mulls direct-to-handheld 5G satellite business
- Southwest Airlines selects Viasat's IFC system (Fig.2)
- Spacecom plots maritime expansion after netting first customer
- Military experiment demonstrates intersatellite laser communications in low Earth orbit
- NASA selects Telesat Government Solutions for space-to-space high-data-rate connectivity
- Kongsberg orders satellites for Norwegian maritime surveillance
- Telesat tests LEO broadband prototype in India
- Inmarsat uses ships as stepping-stones in mesh network trial (Fig.3)
- Inmar ORCHESTRA: Providing additional capacity at major ports, etc.
- Kcell and SES successfully demonstrate cellular network connectivity in Kazakhstan

- Arctic connectivity competition intensifies
- Global satellite laser communication system market size expected to grow many multi-millions by 2030
- Black Sky, Maxar, and Planet win 10-year NRO contracts for satellite imagery
- UK's Open Cosmos gets ESA funding for space weather constellation

- PlanetIQ succeeds in launching GNSS navigation and occultation measurement satellite (GNOMES)
- Spire Global's new weather insights solution supports smooth sailing in maritime industry
- AST Space Mobile acquires test satellite connection license for US mobile phone
- Satellogic to launch 68 satellites with SpaceX
- Spire Global adding high-capacity Ku-band antennas to satellites
- Tomorrow.io reveals plans for 1st commercial multi-sensor meteorological satellite constellation program (Fig.10)
- Operational AST SpaceMobile satellites: Can proceed with no prototype (Fig.11)
- Uzbekistan woos Starlink, OneWeb to bring satellite broadband
- Azure Space offers Custom Vision tools for satellite imagery
- Starlink's RV service allows users to skip line for one price
- Ursa Space's image archive ordering and new tasking now possible via AWS Data Exchange
- ICEYE launches five new SAR satellites on SpaceX's Falcon 9 smallsat rideshare Transporter-5 mission
- Starlink receives licenses to operate in Nigeria and Mozambique
- The Philippines: First Southeast Asian country to approve Starlink

Launches



- China launches rocket, 5 satellites to orbit from platform at sea (Fig.4)
- Atlas 5 launches Starliner on second uncrewed test flight

- NRO partners with UK to launch Virgin Orbit rocket

- GomSpace signs supply contract with KSAT for ESA mission control system for Arctic satellite missions
- U.S. Space Force selects 125 industry proposals for in-orbit service technology
- SpaceX Crew Dragon Freedom launches, makes first docking at ISS on Crew-4 mission
- Japan Air Self-Defense Force places contract with LeoLabs
- Lockheed Martin, Filecoin plan demonstration of decentralized data storage in space (Fig. 9)
- Supply chain challenges: Bringing opportunities to the space industry
- Boeing lands new Starliner capsule craft, completing a crucial test flight for goals for practical use
- Additive manufacturing progresses far beyond brackets
- Space logistics experts widely support standardization
- Gogo's OneWeb partnership: Could face Starlink in the business aviation market

- South Korea's Innospace schedules December test launch carrying Brazilian military payload
- Rocket Lab successfully captures first stage of Electron rocket mid-air
- Virgin Orbit launches QPS-SAR-5 satellite from QPS Institute
- Chinese rocket company suffers third consecutive launch failure
- Chinese launch startup Orienspace raises \$59.9M in Series A funding round
- SpaceX launches third Starlink mission in five days

Others



- Extravehicular activity at ISS, Russian section: First operation of European robot arm
- NASA announces extension of 8 planetary science missions
- DARPA promotes development of nuclear spacecraft (Fig.5)
- KSAT's KSATlite ground network experiences record-high traffic
- China manufactures flagship-class space telescope (Fig.6)
- China successfully launches "Tianzhou-4" space station supply ship
- Tianzhou-4 cargo craft auto rapid docks with space station combination
- Inmarsat agrees to relocate ground station from the Netherlands
- Boeing's "Starliner" docks at ISS (Fig.7)
- Quad nations unveil satellite-based maritime monitoring initiative
- BRICS countries launch joint committee on space cooperation, begin satellite data sharing
- General Dynamics secures order from SDA for a megaconstellation ground system

- For satellites manufactured in Kyushu: From Kyushu to space! QPS Laboratory SAR satellite to be launched via Epsilon No. 6
- Start of the JAXA New Business Promotion Department: Newly launching the "Transportation / Microsatellite Mission Expansion Program, with a call for ideas"

- Redwire warns of volatility in commercial space markets
- Space systems dominate Rocket Lab revenue
- AWS selects 10 startups as space accelerators for 2022

Japan



- Holding of space business exploratory business contest, such as at Japan's Cabinet Office
- Mitsubishi Electric develops antenna manufacturing technology in space (Fig.12)
- China: First confirmation of JASDF missile target installation (Fig.13)
- Prime Minister Kishida announces strengthening launch capability of domestic rockets
- Toward a Japanese astronaut landing on the moon: Japan's participation in the U.S.'s space program
- Toward Japan's government expanding domestic rocket launch equipment, in terms of Ukraine

- Astroscale debris-removal demo makes close approach despite thruster issues (Fig.14)
- High-precision positioning with GSNN: Magellan Systems Japan develops small receiver module
- Kyushu Institute of Technology, Zimbabwe, Uganda and microsatellite development
- Support via government procurement: IST President Inagawa and the Liberal Democratic Party

- GITAI succeeds in demonstrating in-orbit service work in simulated spacecraft environment
- Terraspace starts development of "paper satellite" (Fig.15)
- Satellites with onboard lasers aid in mountain emergencies, from space (Fig.16)
- Mitsubishi Corporation invests in Morgenrot to build distributed computing service
- Astroscale raises funds for 2024 debris-removal mission
- Established private space startup "AstroX": Develops satellite orbit insertion rocket via an in-air launch method

OldSpace, etc.



Fig.1: SES has announced that its non-stationary MEO satellite network will be part of the GovSatCom-grade satellite communications platform jointly funded by the ESA.



Fig.3: According to Inmarsat, mesh networks can supply up to 100 megabits/sec for a single vessel (Credit: Inmarsat).

Mixed space, etc.



Fig.6: Conceptual image of a Chinese space station telescope (Credit: Interviewee source)

NewSpace, etc.



Fig.9: Filecoin Foundation and Lockheed Martin are working together to deploy the "InterPlanetary File System" (IPFS) in space. (Credit: Filecoin Foundation)



Fig.10: Tomorrow.io has announced the use of a microwave sounder as an additional sensor to the satellite constellation planned by the company.



Fig.2: Viasat, Inc. has announced that Southwest Airlines has chosen to install Viasat's next-generation Ka-band satellite in-flight connectivity (IFC) system as factory equipment for the delivery of all new aircraft, starting this fall.



Fig.4: This is the first time that China has succeeded in the "one-stop" marine launch of a carrier rocket. The assembly, various checks, port hauling, and launch processes have been integrated, reducing mission completion times by a third.



Fig.5: Image of the Demonstration Rocket for Agile Cislunar Operations (DRACO) program; DARPA plans to develop a nuclear thermal rocket engine. (Credit: DARPA)



Fig.7: Boeing's new "Starliner" spacecraft, approaching the International Space Station (ISS) (Credit: NASA TV)



Fig.8: Overview of Space Development Agency's (SDA) low-Earth-orbit architecture (Credit: SDA)



Fig.11: AST SpaceMobile's BlueWalker 3 prototype satellites will be launched via SpaceX's Falcon 9 this summer. (Credit: AST Space Mobile)

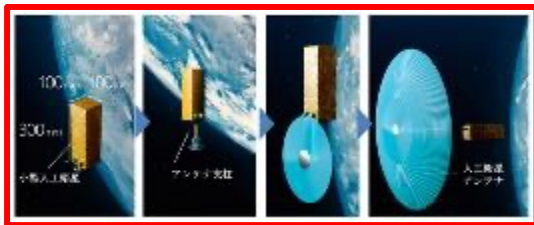


Fig.12: Conceptual image of an antenna manufacturing process for smallsats via Mitsubishi Electric's 3D printer (from antenna manufacturing start to operational status)



Fig.13: First confirmation of China's installation of a Japan Air Self-Defense Force missile mockup target for missile testing, via satellite imagery

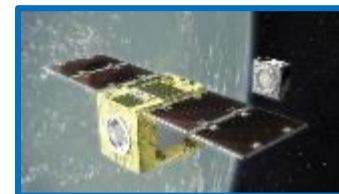


Fig.14: Astroscale successfully captured and released a small client satellite manufactured by SSTL during a test on August 25. (Credit: Astroscale)



Fig.15: Conceptual image of the "ReCell" mounted on "TATARA-1," which is Terraspace's first microsatellite (Credit: Terraspace, Hokuetsu Corporation)

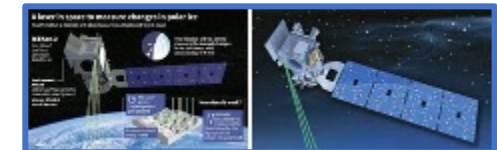


Fig.16: Crowdfunding paved the way for issuing a membership card to those that purchase a key chain equipped with high-intensity retroreflective material, involving a proposal for mission requests for searching for people in mountain emergencies via satellites with onboard lasers (ICESat-2, etc.)