

■ **Editorial 01: Current status and issues regarding space industry infrastructure as considered by the U.S. Air Force and NASA (Kuzuoka)**

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Editorial 01: Current status and issues regarding space industry infrastructure as considered by the U.S. Air Force and NASA (Kuzuoka)

This month, we introduce the "State of the Space Industrial Base 2021" document, which was written by the United States Space Force, Defense Innovation Unit, Air Force Research Laboratory. The preamble to the document was written by NASA Administrator Mr. Bill Nelson and John W. "Jay" Raymon, who is the Chief of Space Operations, United States Space Force. The preamble features their signatures and photos.

As for the contents of the document, it begins with an analysis of the current state and issues of the U.S. space industry, and it also lists recommendations. In the analysis of the current situation and the issues, while stating the importance of space, the text relates that the current space industry is tactically strong but strategically dangerous, along with positing that space policy is not linked to national policy.

The recommendations themselves total 18 and are addressed to the White House, to the National Space Council Users' Advisory Group (NSpC UAG), to the U.S. Department of Defense, and to venture capital firms and investors. The recommendations establish a special space zone and advise using all means possible to grow the space industry. This information comprises various miscellaneous items, such as requesting the use of further commercial services by the U.S. Space Force; but for now, let's take a look at the first and second recommendations.

The first recommendation involves space exploration and colonization via the "North Star" vision, which aims to further expand the 2020 NSpC UAG's vision for deep-space exploration and development toward integrating the lunar/"cis-lunar space" economic zone with Earth's economic zones. Targeting 2050, it is said that this vision is necessary toward integrating economic activities on Earth as well as in "cis-lunar space"/lunar areas, along with implementing resource exploration on asteroids, space solar power generation, planetary defense, and space colonization, etc., thereby allowing human beings to be the first organisms to survive on multiple planets.

The second recommendation involves building a "space superhighway," aiming to link the lunar economy to Earth's economy by building a highway consisting of both digital and physical transportation networks that closely connect the Moon and Earth. The "North Star" vision considers the lunar economy as part of the Earth's economy and thus proposes a highway to realize such integration.

In this way, it is the insistence of this document that deep-space exploration such as that involving the Moon should be expanded not only to scientific activities but also to industry and national security, and that it needs to be integrated with the Earth's economy. In South Korea, not just the above two are being brought to the fore, but it is also being said that the current Artemis Accords should not be exclusive to NASA but should be expanded to industry and the military as well, and there is also a recommendation for VCs and investors to cross over the LEO trajectory (in thinking about deep space) and to seek balanced investment.

Honestly, there are many parts of this document that haven't been elaborated on yet, and I feel that the U.S. military and NASA have just gone all-out on their requests and recommendations. However, it can be seen that the U.S. military and NASA are keeping pace in the space industry and are trying to position themselves onto the lunar region/"cis-lunar space" as an economic zone integrated with the Earth's economic zone. And, behind this document seems to be a sense of crisis that China is expanding its "Belt and Road" vision and actively embarking on space ventures. It is common in any country or organization to lament that space policy is not linked to a main strategy and that there is a lack of vision or strategy. However, it is not easy to actually propose a vision/strategy by oneself. Regardless of feasibility and the method of realization, the U.S. military and NASA will come up with a dream-like scenario for integrating the lunar regions and the "cis-lunar space" economic zones with Earth's economic zone, toward unifying its vision and strategy, while also increasing the advancement of the U.S. private-sector space industry.

https://assets.ctfassets.net/3nanhbkr0pc/43TeQTAmYrym5DTRhd3/a37eb4fac2bf9add1ab9f71299392043/Space_Industrial_Base_Worshop_2021_Summary_Report_-_Final_15_Nov_2021c.pdf

Editorial 02: Russia's ASAT experiment and China's "silence" (Oishi)

Reported this month is the implementation of an ASAT experiment by Russia, which has provoked shock, anger, and disappointment around the world. Europe, the United States, and Japan have issued protest statements expressing their outrage. I will not touch on a series of reports here, but the reports include evacuation activities on the ISS that included Russian crew members.

On the other hand, what I was interested in was the trend in China that was not mentioned in each report on this topic. China is building its own space station, and if danger from debris occurs, it could be affected in some way like the ISS, but so far China has remained silent about this.

There are three possible reasons for this silence:

1) Since they have conducted similar ASAT testing the past, they might feel that they shouldn't point fingers at other countries.

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- 2) They don't want to lay blame at anyone, because they are planning similar tests in the future.
- 3) They were notified in advance by Russia, so they don't feel it's appropriate to make a statement on the topic.

Regarding 1), along with conducting an ASAT experiment using their Fengyun 1C in 2007, the Long March 5B rocket, which became uncontrollable in May this year, caused a situation of danger in its re-entry into the atmosphere, so it would look bad for China to decide to issue a statement of condemnation when the country itself has undertaken similar activities, thus possibly giving them even more of a bad name around town.

Next, 2) is a situation that I absolutely do not want to become a reality. Recently, the U.S. Space Force observed an object orbiting alongside the "Practice 21" debris mitigation satellite launched by China last month. It's possible that this is part of a debris capture experiment, but I am concerned about the trends and details of this case, as there is a relationship between the front and back of coins that can be replaced with a single command.

I personally think that 3) is most likely. Regarding space, China and Russia announced an agreement in March this year to collaborate on building a research center (i.e., a facility for experimentation and research on the surface of the moon and in lunar orbit) on the Moon. Also, although this is not space-related, just about a week ago, Chinese and Russian bombers jointly flew over Japan (Japan's Ministry of Defense announced a joint flight by China and Russia for the third time since December last year). Therefore, it is tempting to assume that China and Russia have made advance adjustments to ASAT testing as well.

Russia has also approved ASAT testing. There is also debate about whether rules of conduct in space should be non-binding "norms" or enforceable "treaties" and whether the details of such should be left to experts. Personally, in order to control criminality that believes it is altruistic, such as in this case, I think it is necessary to ensure stipulation and ratification, including valid sanctions clauses and performance standards (perhaps such provisions already exist, we just might not be aware of them).

In addition, in terms of space debris this month, and in addition to the activities of leading private-sector companies such as Astroscale, the U.S. Space Force will start its "Orbital Prime" program, wherein 10 space companies and organizations will aim to make great strides in reducing space debris, on an ongoing basis up to 2030. There were also things such as the signing of the "Net Zero Space" charter. In addition to ASAT testing, I think we should pay attention to these developments.

Editorial 03: About the trends of companies in the U.S. (Murakami)

In the United States, GAFA (Google, Apple, Facebook, and Amazon) exerts great impact on the world of IT and plays a large role in our daily lives. We search using Google, we use Apple's iPhone, we connect with people on Facebook, and we shop on Amazon. However, it is being said recently that fair competition is being

hindered because of the size of GAFA's monopoly. Against this backdrop, let's take a look at the demand for corporate M&As and how things are being divided up or consumed.

On one hand, for those involved in defense and space, M&As are progressing. For example, Lockheed Martin plans to acquire Aerojet in a major acquisition that will enable the largest systems manufacturer in the defense industry to integrate systems that include engines. Also, while the merger is expected to be approved next year, Raytheon has alleged that Lockheed Martin's power is too substantial in this situation and that this development could interfere with the provision of motors to Raytheon itself, as Raytheon is one of Lockheed Martin's competitors.

Lockheed Martin is also actively investing in smaller companies. In addition to investing in Rocket Lab, Lockheed Martin closed a large number of launch contracts with ABL, which is an emerging launch company. Indeed, Lockheed Martin has been investing in startups that aim to extend satellite life and is planning a monthly mission schedule in collaboration with Tyvak, which is a smallsat developer. It would seem that it would be difficult for such a large company like Lockheed Martin to develop these niche businesses alone in terms of the expense involved, and, from their point of view, it would indeed be interesting to work with startup companies.

In other news, recently, satellites are becoming smaller and more self-sustaining, and DARPA's Blackjack program is characteristic of this. However, Raytheon has acquired SEAKR Engineering, which specializes in systems and electronic devices, thus putting SEAKR under Raytheon's umbrella. Meanwhile, Blue Canyon, a smallsat developer that develops buses, was also acquired over last Christmas, and this means that Raytheon has acquired major companies toward participation in Blackjack. SEAKR is a company of about 600 people, and the company name comes from the name of its founder. Further, the company has a history going back 40 years. Considering how independent satellites are to become in the future, we can expect such efforts to play a big role. Finally, going back to Blue Canyon, the company has also responded to the development of smallsats, for everything from exploration missions to defense satellites, and its high technological capabilities are well known.

It seems that it would be quite difficult for Raytheon to acquire such technologies by itself, and, from the viewpoint of efficiency, it is thought that the acquisition of companies leading their field could lead to Raytheon's advancement in the satellite business in the future. As a result of such a situation, DARPA's Blackjack program was led by big companies such as Lockheed Martin and Raytheon, and in the future, in terms of defense satellite business operations and commercial satellites, it is essential to pay attention to the movements of these companies.

Anyways, it's the "survival of the fittest." These small businesses are home to top-level engineers and have provided excellent systems and products. For these big companies, this is the gravy on top of Christmas turkey.

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

OldSpace, etc.

Mixed space, etc.

NewSpace, etc.

Satellites

- DARPA, NGA develop optics technology for battlefield use
- Bridging the digital divide with Hispasat capacity on the EUTELSAT KONNECT satellite
- US Space Development Agency reissues T1TL RFP
- China launches Yaogan No.32-2 satellite
- Boeing gets FCC approval for 147-satellite v-band constellation
- Object now orbiting alongside China's Shijian-21 debris mitigation satellite
- Space Development Agency to release RFP for constellation ground segment
- Viasat acquires Inmarsat for \$7.3B
- China succeeds in launching world's first SDG-focused satellite
- US Space Force procurement of 3 new GPS satellites from LM
- South Korea to develop 170 satellites by 2031 (Fig.1)
- Intelsat FlexMaritime now connects 8,000+ vessels
- Telesat goes public company
- SES orders two ASTRA satellites from TAS (Fig.2)
- China launches new Gaofen-11 high-resolution reconnaissance satellite
- SES, etc., to test high-speed connectivity via O3b satellite constellation
- APAC ka-band mobile backhaul debuts from Kacific BS
- Russia launches early warning satellite
- Intelsat and SES satisfy c-band clearance deadline ahead of schedule

- OneWeb and Tampnet agree to develop next-generation offshore connectivity capabilities
- Northrop Grumman selects Mynaric as "strategic supplier" of space laser communications
- Leonardo and OneWeb JV bid to provide global satellite link to Pentagon
- NRO starts new procurement of commercial satellite images
- Intelsat and OneWeb demo global multi-orbit satellite service to US DoD
- Capella to install optical terminals on imaging satellites to share data with DoD
- US government contract boosts BlackSky's financial performance
- US Air Force Research Lab awards Tyvak \$1M contract
- ICEEYE and US Army forge collaborative research pact
- French startup Kinéis wins business approval in the US (Fig.5)

- Exodus Orb pivots to satellite lease model after launch delay
- Amazon to launch two Kuiper prototype satellites in 2Q 2022
- Starlink in talks with two Philippine telcos
- Astra files FCC application for 13,600-satellite v-band constellation
- Ursa Space joins AWS partner network
- HawkEye 360 raises \$145M in series-D fundraising
- South Korean ground station operator orders first EO satellite
- Starlink now offering rectangular dish for LEO constellation (Fig.7)
- Mynaric starts trading on NASDAQ (Fig.8)
- BlackSky on track to significantly expand its constellation this year meeting an expanding demand for real-time global intelligence
- OneWeb loses satellite at altitude of 1,200 km (software problem)

Launches

- Arianespace signs "Net Zero Space" agreement
- Australia's Optus-11 satellite to be launched via Ariane 6 (Fig.3)
- ESA and CNES collaborate on a European space transportation hub

- SpaceX launches Crew-3 commercial crew mission for NASA

- Federal court rules against Blue Origin in HLS proceedings
- Space venture accelerates rocket via centrifugal force (Fig.9)
- Astra files application for satellite constellation, but focused on launch
- SpaceX launches Starlink satellites after upgrading user antennas
- Exolaunch signs multi-rideshare deal with SpaceX
- Rocket Lab launches two BlackSky satellites
- Astra's Rocket 3.3 reaches orbit on fourth attempt

Others

- U.S. Space Force launches "Orbital Prime" program (Fig.4)
- Advanced space composites market to be worth \$2.8819B by 2031
- Humans to revisit the moon, NASA pushes schedule to 2025
- Space industry feels varying effects of supply chain disruptions
- U.S. lays blame on Russia for danger of space junk from satellite destroyed by weapons test
- Industry looks to simplify policy challenges for orbital debris removal
- Swedish Space Corporation introduces global ka-band network

- Redwire acquires Techshot
- GMV wins contract for state-of-the-art space debris software for the German space agency
- Astroscale signs MOU with New Zealand on space safety and sustainability
- Space companies forge alliance to reduce in-orbit space debris by 2030
- Startups developing space traffic monitoring system to help manage increasing debris problem (Fig.6)
- Aon collaborates with ICEYE for climate risk management in Japan

- British startup Isotrop Systems announces successful field test of multi-orbit antenna (Fig.10)
- Leanspace emerges from stealth mode with new customers (Fig.11)
- SpaceFund invests in navigation system for "cis-lunar space"
- Space debris mission development agreement made between Digantara and OrbAstro
- Blue Danube enables broadband access for HAPS
- Virgin Galactic resumes ticket sales, add 100 customers
- Universal docking device debuts from Astroscale
- Virgin Orbit and Astroscale sign satellite service MOU
- Sierra Space raises \$1.4B
- Interest in SPAC mergers declining

Japan

- Major advances for spacecraft development, in-flight wireless (Fig.12)
- H2A rocket onboard British communications satellite "Tanegashima" to launch on Dec. 21
- Epsilon-5 rocket launched carrying 9 satellites into orbit (Fig.13)
- IHI shifts to actual test of methane engine for rockets
- Deployment of 2nd space operations unit in Yamaguchi Pref. (Fig.14)
- NTT focuses on "communications from the sky" via radio wave propagation demo in the stratosphere
- JAXA releases astronaut recruitment guidelines with a view toward lunar activities
- Japan's Ministry of Education, Culture, Sports, Science and Technology focuses on promoting space development through economic measures
- Three smallsat networks to be launched during the mid-2020s

- Expansion of public-private partnership through disaster prevention and mitigation: Utilization of startup technology, visualization for damage/evacuation congestion (Fig.15)
- ANA to team with U.S. biz for satellite launches, to use Oita Airport as a base (Fig.16)
- Starting of R&D of radio/optical hybrid communications technology for the construction of next-generation communications smallsat constellations (Fig.17)

- Softbank collaborates with Swiss company on positioning service
- Tokyo space venture GITAI succeeds in demonstrating technology for an autonomous robot arm in the International Space Station (Fig.18)
- Inclusive in capital tie-up with rocket development venture Interstellar Technologies
- Industry-academia professionals working toward lunar exploration positioning, with University of Fukui, etc. (Fig.19)
- Tenhijin utilizes satellite data for providing a rainfall information system for African farmers
- Astroscale raises \$109M in series-F fundraising effort

OldSpace, etc.



Fig.1: National space committee held at Korea Aerospace Research Institute (Yonhap News Agency) (Copyright 2021 Yonhap News Agency. All rights reserved.)



Fig.2: The ASTRA 1P ordered by SES is a conventional wide-beam satellite. On the other hand, the ASTRA 1Q is a next-generation digital satellite with a high-throughput spot beam.



Fig.3: Australia's Optus-11 communications satellite will be launched in 2023 via the Ariane 64 version of the Ariane 6 launcher.

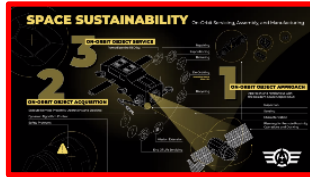


Fig.4: The U.S. Space Force's "Orbital Prime" focuses on the emerging market sector known as "Orbital Service, Assembly, and Manufacturing" (OSAM).

Mixed space, etc.



Fig.5: French smallsat builder Hemia will build the Kinéis constellation with payloads manufactured by TAS. (Credit: Hemia)

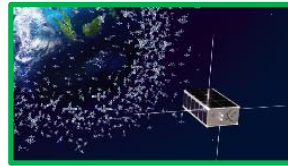


Fig.6: Scout's OVER-Sat observation satellite in orbit (Credit: Scout)



Fig.7: The Starlink rectangular dish antenna; the antenna is thinner and lighter than the circular antenna used in the Starlink beta user test.

NewSpace, etc.



Fig.8: Mynaric's CEO holding a mockup of the CONDOR Mk3 laser terminal; the company aims to sell a data relay satellite to constellation satellite manufacturers for a program under the US Space Development Agency. (Credit: Thomas Kimmell)



Fig.9: Centrifugal force now being used in acceleration in rocketing testing (suborbital accelerator) (Credit: ITmedia NEWS)



Fig.10: Isotropic Systems has said that one of the company's integrated terminals will reduce cost for multi-orbit constellations. (Credit: Isotropic Systems)



Fig.11: Leanspace, which builds future digital infrastructure for the space industry, announces its emergence from stealth mode.

From around the world

From Japan

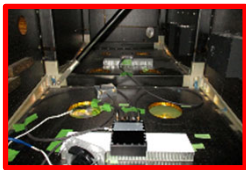


Fig.12: Experimental scene for the thermal structure model of a previous satellite regarding the "wirelessization" of spacecraft (Credit: JAXA)



Fig.13: Successful launch of the Epsilon No. 5 rocket, carrying 9 satellites developed by academia and the private sector

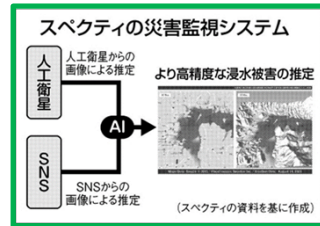


Fig.15: Spectee's disaster-monitoring system, combining satellite images and SNS



Fig.16: Rocket launched separately in-sky from an aircraft (Credit: Provided by ANA Holdings) (Copyright Jiji Press)

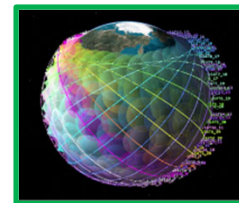


Fig.17: Axelspace, the University of Tokyo, etc., collaborate involving optical communications, etc., with proposal for a low-Earth-orbit communications constellation utilizing the results of R&D

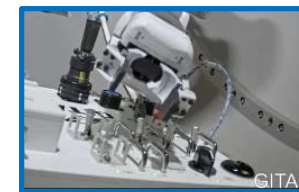


Fig.18: GITAI succeeds in demonstrating technology for an autonomous robot arm in the International Space Station (ISS)

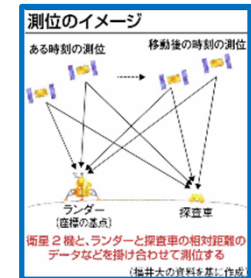


Fig.19: Image overview of lunar exploration positioning using microsattelites such as those from the University of Fukui, Japan

Fig.14: Japan's Minister of Defense Nobuo Kishi speaking on deploying the 2nd space operations unit in Yamaguchi Pref. and monitoring radio interference via satellite