

## **UNISEC-Global The 44th Virtual Meeting**

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## Table of Content

1. Opening Remarks	3
Tatsuaki Hashimoto, JAXA	3
2. Presentation on "Moon Valley 2040 - Expanding Opportunities for Lunar Exploration"	4
Masayuki Urata, ispace, inc	4
3. Presentation on "Yokogawa's Contribution to Lunar Exploration and Industrialization"	7
Satoru Kurosu, Yokogawa Electric Corporation and Cross Space & Sustainability, LLC	7
4. Presentation on "R&D for Construction on the Moon"	9
Yoji Ishikawa, Obayashi Corporation	9
5. Presentation on "JGC's Vision for a Lunar Society - Lumarnity® (Lunar Smart Community®)"	12
Kiho Fukaura, JGC	12
6. Presentation on "Toward the Interplanetary Internet ~ from the Moon, Mars and beyond~"	14
Yosuke Kaneko, Interplanetary Networking Special Interest Group (IPNSIG)	14
7. Announcement and Acknowledgment	16
Haruka Yasuda, UNISEC-Global	16
8. Participant Statistics	17

### 1. Opening Remarks

Tatsuaki Hashimoto, JAXA

Tatsuaki Hashimoto is a Professor at the Spacecraft Engineering Division, Institute of Space and Astronautical Science (ISAS) and, Department of Electrical Engineering and Information System, Graduate School of Engineering, The University of Tokyo. He is also affiliated with Japan Aerospace Exploration Agency (JAXA). In 1990, He graduated from Graduate School of Engineering, The University of Tokyo, and received a Ph.D. (Electrical Engineering). Since 1990, he has been working for the Institute of Space and Astronautical Science. In 1998, he was also a visiting scientist at the Jet Propulsion Laboratory, NASA. From June 2007 to March 2015, he served as the team leader of SELENE-2 pre-project. From September 2016 to March 2024, he served as the team leader of SLS launched CubeSats project, and from April 2022 to March 2024, he served at JAXA as The Chief Engineer (Science and Exploration).



Pictured: Tatsuaki Hashimoto while giving the opening remarks

- Talked about "Go to The Moon" missions using CubeSats
- Moon is about 1000x farther than Low Earth Orbits
- Yet about 1000x closer than Mars
- He had once looked after a large-scale lunar mission which included Lander, Rover, and Orbital System
- Was not carried due to budget issues
- OMOTENASHI was proposed for the Rideshare CubeSats Mission on Artemis-1, NASA
- The requirement was to have science and technology goals for human exploration
  - Be within 6U and <14 kg
- It would be placed in a lunar flyby orbit; trajectory information was provided later
- Crewed vehicle safety regulations were used
- Designed the smallest moon lander in the world
- Launched by the most powerful rocket in the world
- It was selected in 2016 after which it was developed and handed over to NASA on 2021
- 10 CubeSats were arranged in the spacecraft
- There were lots of launch delays but it was eventually launched in 2022 through the SLS Artemis-I launch
- The CubeSat, however, failed the initial sun acquisition control
- Since then, communication with the CubeSat was not possible
- Nevertheless, Radiation Environment was successfully measured for 30 minutes by an ultra-small sensor

- OMOTENASHI had to give up the landing experiment
- Hopeful of an increase in the opportunities for CubeSats and small observation instruments



Pictured: Tatsuaki Hashimoto giving a description of the mission

Q: Rei Kawashima: Professor Hashimoto, Thank you very much for your wonderful presentation. The OMOTENASHI was a 6U CubeSat. Do you think there is any possibility that a 1U CubeSat can contribute to a Lunar Mission?

*A: Tatsuaki Hashimoto:* That is a good question. That depends on the mission, I think. In the case of the lunar landing mission, I think 6U was too small. So, if I have the next chance, I would like to propose 12U or 24U but in case of an orbiting mission, 1U spacecraft may be possible. And if we go to the moon by the spacecraft itself, 1U is too small but if that CubeSat is released from Lunar Orbit or the Lunar Gateway, I think it will be possible.

#### Q: Marian Duval: What was the payload?

*A: Tatsuaki Hashimoto:* On the landing module, the payload was only an accelerometer because it was a landing experiment mission. The orbiting module had a radiation monitor.

# 2. Presentation on "Moon Valley 2040 - Expanding Opportunities for Lunar Exploration"

Masayuki Urata, ispace Inc

Masayuki Urata is a manager, based in Tokyo, with the Indo-Pacific Sales Group at ispace, Inc., a global lunar resource development company with the vision, "Expand our Planet. Expand our Future.", specializes in designing and building lunar landers and rovers. He leads business development and global sales in lunar transportation services, providing tailored solutions for customer's lunar missions in the Indo-Pacific region. Mr. Urata speaks multiple languages and has an extensive background in Asia, Europe, and North America. He completed his bachelor's degree in Private Law from the University of Tokyo and was involved with Mitsubishi Corporation before joining ispace. He has about 10 years of experience in Chemical Plant Construction Project Management and has successfully arranged JBIC Finance for 1 billion USD. He also has about 3 years of experience in the Lunar Industry and is responsible for international sales and business development in the Indo-Pacific region.



Pictured: Masayuki Urata during his presentation

#### **Highlights**:

- Brief introduction about ispace: a lunar transportation company
- Aims to explain the kinds of services being provided
- ispace tries to provide comprehensive services to execute lunar missions
- The vision of ispace is "Expand our Planet, Expand our Future"
- The first milestone for now is the moon create an ecosystem in the Moon
- Expects about 1000 people residing at Moon by 2040 the target is challenging
- Ispace was established in 2010
- Currently has about 300 employees in 3 countries Japan (HQ), USA and Luxembourg
- Developing Lunar Lander and Rover
- The operation center is located in Tokyo
- Payload cargo and Data services providing flight data are the main business
- Around 400 million USD has been raised and achieved IPO can now be called a global leading company
- Water resources utilization Lunar H2O
- Aims to conduct multiple missions provide opportunities to reach the moon
- The first mission was launched on December 2022 Falcon 9 Rocket
- Used low energy transfer took around 4 to 5 months to reach the lunar orbit



Pictured: Masayuki Urata sharing pictures and videos of the captured lunar surface

- 8 out of 10 milestones have been completed by ispace

- For milestone 9, the soft landing was opted but the hard landing was executed
- The root cause has been identified: software problem regarding the altitude measurement
- Improvements in the software are being made
- The next mission is targeted for winter 2024 (Mission 2)
- Mission 3 is being planned for 2026 using The Apex1.0 Lander with 2 relay satellites



Pictured: Masayuki Urata sharing the timeline of the 10 milestones targeted

- After mission 3, plans to develop the next series 3 lander
- Selected by the Ministry of Economy, Trade, and Industry (METI) for Small Business Innovation Research
- Received grants worth up to approx. \$80 million
- Plan to design, manufacture, and assemble a lunar lander with 100kg capability operate by 2027
- They currently have customers from all over the world like the US, Canada, Romania, Israel, UAE, etc.
- Specific facilities/ packages related to the lunar mission:
  - Mission planning/ consultations
    - Lunar Transportation Facilities
    - Facility set up such as Mission Control Center
    - Capacity Building through internships/ gain experience and learn
    - Financing coordinate with JBIC to arrange project-related loan programs
  - JBIC Finance Scheme Special Loan Program to cover overall mission cost
- Guarantee from the national government -
- Payback period is 10 years maximum eases up to plan out missions
- They also provide specific payload module assistance:
  - Water Analysis Module take samples and analyze water concentrations
    - Lunar Rover Mission Payloads
- Is open for further discussions: <u>m-urata@ispace-inc.com</u>, +81-80-6294-2672

## Q: Rei Kawashima: So, you or ispace, do you help to connect local government or African Countries to JBIC? Can you help?

*A: Masayuki Urata:* Yes, of course. So, I have connected with over 10 space agencies all over the world but if you have the chance to connect me to some other space agencies, I am very happy to give a presentation to seek such possibilities to The Lunar Missions.

#### Q: Marian Duval: Does ispace provide international internships?

A: Masayuki Urata: Yes, please refer to our website for detailed information: ispace, inc. (lever. co)

Q: Marian Duval: Have you considered launching a mission to study the Moon's minerals for mining purposes?

*A: Masayuki Urata*: We have a plan to excavate lunar regolith using our rover in Mission 2 and we will conduct more studies for further missions step by step.

Q: Rei Kawashima: Do you (or ispace) help connecting to JBIC?

A: Masayuki Urata: Yes, we have contact with JBIC and are happy to coordinate with them.

Q: Castra Org: Thank you very much for the good presentation! What are the most relevant to your view Moon exploration business cases for small companies? From the funding scheme, it is seen that in 10 years the business is expected to return all bank loans, thus have established very successful Moon businesses? Is this possible? Why will customers pay to send something to the Moon?

*A: Masayuki Urata: As for JBIC finance scheme, it is intended to provide to Space Agency. Space agencies may select small companies as payload developers. In such a case, small companies will be able to realize lunar missions receiving support from Space agency.* 

Q: Rei Kawashima: Thanks for the presentation! Can we have different presentations after the meeting?

A: Masayuki Urata: Of course! We can keep communicating via LinkedIn if you don't mind.

# **3.** Presentation on "Yokogawa's Contribution to Lunar Exploration and Industrialization"

Satoru Kurosu, Yokogawa Electric Corporation and Cross Space & Sustainability, LLC

Satoru Kurosu is the Founder and Executive Mentor of Space Business Development Office, Yokogawa Electric Corporation where he has contributed for the past 40 years. He is also the advisory board member of UNISEC-Global and a supporter of CROSS U (Open Innovation Platform for The Space Business). He is also the Council Member of Lunar Industry Vision Council. He is currently the CEO Of Cross Space and Sustainability, LLC, and Director of Japan Marketing Academy. He recently authored a book, titled "Research and Intellectual Property Strategies for Winning as a Latecomer: How to Explain and Persuade Management," published by the Japan Technical Information Association. He was responsible for a chapter on, "Approaches and Success Stories of Companies Entering the Market as Latecomers," specifically section 6, "Entry into and Future Outlook of Space-related Business Utilizing Our Own Technology."



Pictured: Satoru Kurosu presenting about Yokogawa's contribution

- Yokogawa is one of the leading process automation companies in The LNG Industry
- Mainly deals with measurement, control, and information technologies
- It started as a space business back in 1961
- First, supplied the ionosphere sensor during the launch of Kappa and NASA's Nike Cajun
- The actual sensor was later put up for exhibition at SPACETIDE
- These were only project-based involvements and there was no continuity
- Space Business Development Office in Yokogawa was established in 2021
- With an aim to combine technology and processing of space-related projects



Pictured: Satoru Kurosu presenting about Recent developments for Space done by Yokogawa

- Developments in the space industry have been made along with the collaboration with JAXA
- Focus is primarily on the moon the closest celestial body
- Yokogawa aims to contribute to the lunar industry ->> measurement, control, information specialization
- 50+ Japanese private companies want to work on the lunar surfaces collaboration
- Aim to solve issues on Earth using:
  - Hydrogen-base supply chain
  - Reuse-recycle Circular Economy System
- Yokogawa has worked in The Lunar Industry since 2019
- Has collaborated with universities and other businesses, participated in Lunar-focused conferences
- Also joined EURO2MOON dedicated to sustainable lunar and space exploration
- Lunar Missions are largely focused on the hydrogen supply chain
- Yokogawa works in providing solutions for processing the collected data and developing control systems



Pictured: Satoru Kurosu presenting about Yokogawa's Products Lineup

- Tunable Diode Laser Spectrometer (TDLS) is their core technology
- Accurate measurement of gas and moisture
- More than 3000 units have been supplied to industries have been used in extreme environments
- Such technologies can be used on the moon
- They are currently working on the Water Analysis Module
- They are supported by ispace, University of Tokyo and Ibaraki University
- The goal is to create a lunar water-resource utilization plant in the 2030s
- Also closely working with JGC Corporation to develop a lunar plant control system
- Aim is to support ultra-remote communications
- JGC works mainly on energy plant control/operation
- Yokogawa works on control technology and remote monitoring
- Simulations have been created to experiment technologies in a challenging environment
- Concluding, Yokogawa aims to contribute to Lunar Industry
- Specializing through their strengths in Measurement, Control, and IT
- Further work on the technologies to solve other prevalent issues

#### Q: Marian Duval: What's your biggest challenge for the long-distance communications mission?

A: Satoru Kurosa: Yeah, the delay. So, we are talking about the ionosphere cloud. For example, you need to control the levels and if you start passing the levels, then it will be delayed and you cannot get the results in the time of let's say, 10 seconds. But if you can predict 5 or 10 seconds ahead, you can simplify this. So, Yokogawa has a subsidiary company for a series of technologies where we can have such a model in the portal system so we can simplify the time of delay.

#### Q: Haitham Akah: What is the data rate you can achieve and which frequency bands you are using?

A: Satoru Kurosa: Depends. In the case of just control, we are talking about less than 1Mb/s but in case you need to have image or video data, then this is a much different situation in the case of other communication but just control, 1Mb/s is enough.

#### Q: Rei Kawashima: I have a small question. Are you enjoying working for Lunar Mission? Personally?

A: Satoru Kurosa: Yes, May I ask your Background of why you are asking this question?

# Q: Rei Kawashima: Oh, well yes, you have been and are doing many different jobs related to space. Are there any differences in working for the LEO Missions and Lunar Mission?

A: Satoru Kurosa: I am going to say that the land is the main difference. I mean most of the missions and even ISS and space system missions are also using satellite data, so space is very limited. But in the case of the lunar

mission, we have land and even water is there, so some resources are there. So, this is very natural for me to think of sitting on the ground. Of course, there are going to be lots of challenges, but the same technologies can be utilized.

# Q: Jyh-Ching Juang: Do you then assume that there is a GPS on the moon for time delay control and synchronization?

A: Satoru Kurosa: There have been discussions about GPS on the Moon. Just one month ago, the American Government asked NASA to create a Lunar Time. So, Lunar time and Lunar GPS will be created, and this can be used to precisely synchronize the data between the Moon and Earth. So, this will happen. But no GPS yet so we need to start calculating time but if the GPS is created, it will be more precise and control is possible, I guess.

### 4. Presentation on "R&D for Construction on the Moon"

Yoji Ishikawa, Obayashi Corporation

Yoji Ishikawa is a Senior Chief Engineer, Future Technology Creation Department, Technology Headquarters at Obayashi Corporation. He joined The Obayashi Corporation in 1989 and currently oversees Obayashi Corporation's space-related projects. Previous affiliations of Yoji Ishikawa also include Japan Aerospace Exploration Agency and was a former NASA researcher. He is also an academic researcher and has contributed to various research on topics such as Mars exploration programs and space elevators. Yoji Ishikawa has co-authored 34 publications receiving 265 citations. His research background includes the origin of life in the universe, lunar and planetary habitation plans, space elevator construction plans, and earth environmental engineering.



Pictured: Yoji Ishikawa presenting about R&D Construction on the moon

#### <u>Highlights:</u>

- Talk focused on lunar constructions
- Obayashi Corporation is more than 130 years old one of the largest construction companies
- Experience in the construction of monuments and structures
- Overseas businesses like stadiums
- Yoji Ishikawa is from Obayashi Future Lab which looks after Space
- Space is one of the five factors Obayashi Future Lab looks after
- Collaborated with institutions and academia to pursue innovation
- "Space Habitat" designs published
  - Lunar City 2050 10,000 residents, 2,000 residents published 30+ years ago
  - New Lunar City in Lava Tube

- Mars Habitation designed in 1990- 200 residents 2057
- Space Station in Lagrange Point
- Space Elevator Concept 2012
- Obayashi aims to go to space, live in space, and use the space
- Collaborates with ventures for airborne rocket launches and sea launches
- Experiments for the space elevator have been carried out: materials testing in space and vehicle construction
- Numerical equations formulated to calculate the cable movements



Pictured: Snapshot from Yoji Ishikawa's presentation about the numerical calculations

- Interaction of the space elevator in the space environment is also being studied
- Living in Space vision includes bases in celestial bodies, cultivating compact agriculture and robotics
- Construction companies work on the architectural and engineering basis of building structures
- All data collected can be further used for human benefits
- For Moon, R&D->> Concept, Material, Construction, Resources, Food Production and Simulated Facility
- For Mars, R&D ->> Concept, Construction, Resource Utilization
- All lunar shelters are planned to have expandable structure multi-purpose
- Such structures protect from radiation, micrometeorites, extreme temperatures, and regolith
- Multi-torus shape the most stable structure while testing out
- The construction materials will be locally manufactured on the moon
- Simulants of lunar soil will be sintered and fused Microwave sintering
- 3D printers planned to make structures



Pictured: Snapshot from Yoji Ishikawa's presentation about construction for the moon

- Haptic Technology includes sending movement instructions to the machines
- Agriculture is also the goal
- Aim to cultivate plants using the soil of lunar simulants porous materials and microorganisms

- The simulated facility of the lunar base on Earth is required
- The Moon Park concept was proposed more than 30 years ago
- To facilitate research, training, education, and planning
- Similarly, Martian simulants are also being tested
- Construction of the initial Mars Base jointly with NASA and Stanford
- Currently, Japan's Stardust Program and Government's funds are helping conduct research
- Through the fund, Obayashi conducted research on Construction Materials, Energy and
- Construction Material Research Conclusions ->>
  - NO material to be imported from Earth Heating of Regolith
  - Strength of sintered materials are strong enough for applications
- Energy Conclusions ->>
  - Tower-type solar power generator is favorable
  - Single axis or polyhedral shape sun-tracking system
  - Tower >10m high, expandable
- A BBM model was created based on the findings using CFRP bistable boom, thin film solar cell
- Appreciated extended to partners and supporting organizations

Q: Titus Ou: I have a technical question. The photo of the laser heating, is that using the powder deposit layer by layer or is it just the powder directly on the sample? Because it looks like it is putting the powder directly on the sample and then heating it with a laser.

*A:* Yoji Ishikawa: Okay, we use two methods. We use the laser beam and carry out the powder into the laser beam. That is the one way and the other one is powder bed fusion. Did I answer you?

#### Q: Titus Ou: Yeah, because the photo is a direct powder inside the laser beam, right?

*A: Yoji Ishikawa:* The bottom one is the robot that moves the laser. That is a laser beam, okay? The 3D Printer one, the laser beam would be focused on the powder layer.

#### Q: Titus OU: And in the microwave heating, what kind of the material of the mold is?

#### A: Yoji Ishikawa: I don't remember right now.

Q: Samuel Ndayizeye: Hello to UNISEC Team and everybody here. I used to be with UNISEC before and it is good to see everyone again. First of all, thank you for the insightful and in-depth presentation. I have two questions. One is more related to health. Even though this is more related to space, there is a connection here. So, considering the construction you plan here, it would require some human resources and not just robots, and considering the fact that the moon's environment is different from what we have here on Earth, considering the higher radiation levels and the microgravity, there might be several health issues. So now, my question is, do you have some R&D projects in the pipeline to address some health concerns that might come if you put people in this space for construction? If not, are there some partners from the healthcare industry who you are working with who would help you to address the health issues? Now, the last one is, what is the timeline?

A: Yoji Ishikawa: Okay, alright, thank you. Well, I understand that health issues are very important for humans to work in space. There is radiation and microgravity and so on, but I live in Japan, and we don't have lots of knowledge and resources to find out what kind of health issues can arise and how we can solve the problem. So, right now, I did not touch that issue. I could not do that. Japan does not have its own land space mission yet, so we don't have the financial resources, either. So, I cannot touch it, I cannot do it, I do not have the operation to do it and you were asking about the partner and so, we do not have the partner in that program issue yet. That is the answer to the second question and the third question was the timeline. Well, our funding lasts until 2025, until next year. After that, we don't know what is going to happen to The Stardust Program so in that case, we would like to do some kind of verification either in The LEO or on the Lunar surface, but you know, it is very

expensive and there are not so many opportunities. So, I do not know yet after the termination of the research funds but hopefully, maybe in the 2030s, we might have some kind of demands and we might join some kind of lunar program. That is my personal opinion and maybe by 2040, we can upright our technology to the construction projects or business. That is my personal opinion. Alright?

# 5. Presentation on "JGC's Vision for a Lunar Society - Lumarnity® (Lunar Smart Community®)"

Kiho Fukaura, JGC

Kiho Fukaura is currently involved with JGC. He had previously participated in the 2<sup>nd</sup> UNISEC Global Meeting in Student Management which was held in 2014. He was also the Project Manager on the Student Rocket Project and was a student organizer of Noshiro Space Event. He has also participated in exchange programs in the Department of Aerospace Engineering, College of Engineering, Purdue University, and is involved in the Study of Non-Contact Temperature Measurement Methods. He has special interests in Running, Mountain Climbing, Diving, etc.

He joined JGC back in April 2015 and worked in the Piping Design Department as a Plant Engineer up to November 2020. He worked in Gas Treatment Plant in Bahrain for 2 years, Gas Pressure Boosting Plant in Algeria for 1.5 years, LNG Plant in Canada for 2 years, LNG Plant in Thailand for 6 months and Oil Refinery Plant in Okayama Pref for 3 months. In December 2020, he was affiliated with JGC's DPD Department, Lunar Plan Unity as The Unit Leader where he worked in close cooperation with JAXA for the Lunar ISRU Plan and was selected in a Government Project on "Space Utilization Acceleration program". He was also involved in the Human Spaceflight Technology Center, JAXA from June 2021 to May 2023.



Pictured: Kiho Fukaura during his presentation on "JCG's Vision"

- Started with a brief history of JGC
- JGC was previously a gasoline corporation
- Specialization is mostly in energy transition business models but aiming for new business development
- JGC is now JGC Holding Corporation which also looks after industrial and urban infrastructures
- The next aim is to "Go to The Moon"

- They have done about 20,000 projects in over 80 countries
- Main target is the water resources moon ice
- Aim to perform electrolysis on the H2O collected from the moon ice
- Reduce/Liquefy the minerals and use them up as building materials, Plant factories, mobility, etc
- Planned for the Lunar Plant



Pictured: Planned Lunar ISRU Plant to be developed on the moon by JGC

- The Lunar ISRU Plant's conceptual study was in cooperation agreement with JAXA 2021,2022
- Aim to identify technology elements, research, and study the R&D Plan
- Officially selected for the JAXA Project 2023
- JGC responsible for demonstration planning and study of pilot plan concept
- SPACE FOODSPHERE Participated in Stardust Program/ MAFF JGC as The System Integrator
- For MAFF Project ->> Create Close facility as a sustainable habitation
- Vision is to develop the Lunar Plant by 2040
- Also participates in Outreach Activities ->> Lunar Industry Vision Council
- Open for collaboration: <u>fukaura.kiho@jgc.com</u>

#### Q: Titus Ou: Is there mass/weight estimation for the first factory?

A: Kiho Fukaura: So, our first pilot plant is going to be first than expected because it is going to be just a pilot plant. First, these kinds of facilities are going to be several tons or kilograms. We need to launch once or twice because we need to minimize the number of launches. To get lighter and smaller is one of the challenges, obviously.

Q: Samuel Ndayizeye: So, it is a similar question I asked Ishikawa-San earlier. I see it is a very detailed presentation and this is the part where I say thank you, first of all, for the presentation. So, the question is what is the timeline? So, I see you have very clear details and what is going to be planted in the space but what is the timeline that you plan to do all of this?

A: Kiho Fukaura: So, our first expectation is to start the operation of this kind of pilot plant in the 2040s or middle of 2050s because it clearly shows in the JAXA's roadmap as well and this is the ending date of the government as well. But it also depends on the situation. So, putting the milestone for the 2030s or 2040s, we are going to develop and design the concept. So, now let's see if it is going to be achieved in the date or we be a bit later.

# 6. Presentation on "Toward the Interplanetary Internet ~ from the Moon, Mars and beyond~"

Yosuke Kaneko, Interplanetary Networking Special Interest Group (IPNSIG)

Yosuke Kaneko currently serves as the President of the **Interplanetary Networking Special Interest Group** (IPNSIG) of the Internet Society (ISOC), a US non-profit organization that envisions expanding networking to interplanetary space. Since he assumed President in September 2020, he has led the IPNSIG to promote its vision to establish a common Interplanetary Network for the benefit of humanity. With his engineering background in avionics and communications, he has about 20 years of experience in the space field. At the national space agency in Japan, JAXA, he has contributed to the development and operations of the International Space Station (ISS), including establishing a bi-directional communication link using Internet Protocol between the ISS and the Japanese ground system. He also led the Japanese flight control team as Flight Director between 2009 to 2010. From 2020 to 2022, he served at the Strategic Planning and Management Department of JAXA Headquarters, where he led the overall coordination of JAXA's human spaceflight, space science, and exploration programs. Today, he serves at JAXA's Space Exploration Innovation Hub Center, facilitating collaboration between non-space industries, academia, and JAXA to pioneer innovative technologies essential for future space exploration missions.



Pictured: Yosuke Kaneko during his presentation

- IPNSIG founded in 1998 by Vint Cerf co-invented the TCP IP Protocol
- More than 1000 members from across the globe development of the interplanetary network
- Today, we have more of point-to-point communication manner -> spacecraft and ground station
- Target -> develop an interplanetary internet -> network driven architecture / common structure
- LunaNet of NASA and Moonlight of ESA share a similar goal a common network
- Industries also plan to set up the Moon
- KDDI and Nokia plan to deploy a 4G Cellular Network on the lunar surface
- JAXA promotes research and common lunar navigation architecture
- China plans to establish an Earth-to-Moon Link
- Interplanetary network combines space agency, private sector, and academia network
- The main vision of IPNSIG is to have a common network infrastructure



Pictured: Snapshot of Yosuke Kaneko's presentation displaying the vision of Interplanetary Internet

- Solar flares, cosmic radiation, astronomical distance, natural disruptions ->> challenges
- DTN/ Bundle Protocol deal with high delays and disruptive environments
- IETF and CCSDS committees are also working towards developing protocol standards
- A link down in data transmission would need TCP/IP to start the data transfer all over again
- In DTN, each node will make a copy of the data transfer Store and Forward
- In this case, whenever link down/up happens, this helps ensure no further delay and disruption
- NASA, JAXA, IPNSIG working in R&D on this technology
- Several questions prevalent on having a Moon Internet
- IPNSIG Academy and Projects where you can get involved
- Conducts webinars on DTN/architecture/governance of Interplanetary Internet/ how to setup DTN
- Project examples that are currently demonstrating usages of DTN
- Details can be found at: <u>https://www.ipnsig.org/</u>
- These opportunities can also contribute to developing an UNISEC CubeSat with DTN Capabilities
- Other opportunities to get involved:
  - WIDE Widely integrated distributed Environment ->>
    - R&D, Space WG on Interplanetary Networking
    - Experts from Telco Companies
    - Networking from Tokyo University, Keio University
    - Space Networking working group in collaboration with IPNSIG
  - IETF Internet Engineering Task Force ->>
    - Open Forum, WGs on Interplanetary Networking Protocols
    - Two working groups working on space networking
    - DTNWG: https://datatracker.ietf.org/wg/dtn/about/
    - Deep Space IP: https://deepspaceip.github.io/

## Q: George Maeda: Kaneko San, this was a fascinating presentation, really amazing. Can you go to the DTN slide? So, you foresee the need for these interplanetary nodes. Can you say more about these nodes?

*A: Yosuke Kaneko:* Yeah, so these nodes are basically COM relay satellites, or it could be a base station on the moon. So, these are kind of like the intermediate nodes in between the source and the destination. So, the way that DTN works is that you will have to have a storage or a memory buffer within the satellites which stores the data that was sent from the source. So, that is what we call the custody transfer in DTN Terms but that is how the mechanics works here.

Q: George Maeda: And are there engineers that are actually working on these nodes? Can we say that?

A: Yosuke Kaneko: Yeah, actually JAXA is working on these nodes, and you know, DTN is basically a software suite so, it is basically a protocol suite. It is implemented over FPGAs or CPUs and it has been in business for roughly 25 years now. Actually, I have not mentioned this but Vin Cerf, actually was the inventor of TCP IP but he was actually the inventor of DTN as well because you know, humans are leaving this planet, and The TCP IP does not work well in these highly delayed environments. So, roughly 25 years, there have been a lot of experiments and demonstrations including on-orbit, basically done driven by NASA JPL and then afterwards JAXA and ESA also were working really hard to get this on board.

Q: George Maeda: I see, thank you. I guess the older people like me, we have to envy the young people. They will still be alive when these come to fruition, right?

*A:* Yosuke Kaneko: Yeah, absolutely. So, it may not be my generation who is going to really build this thing. So, that is why it is really important that we reach out to the younger generation and keep this momentum up to speed, right? So, that is what we are doing at IPNSIG and we are really happy to be here today.

#### Q: Dip. Eng. Alexandar: How will the intermediate re-translators to Mars be kept in a stable orbit?

*A:* Yosuke Kaneko: Not an expert in orbit design, but having them on an orbit that has good visibility (line of sight) to Earth should be the way to go.

**Q: Dip. Eng. Alexandar:** There are no such orbits. All the re-translators have to rotate around the Sun not synchronized with Mars and Earth. Need thousands of equipment. No stable point in Space - if it stops - they will fall over the Sun. And we need 1000 or more re-translators rotating across the Sun

*A:* Yosuke Kaneko: We might need a lot of CubeSats for sure. Basically, there's no requirement. It's just your passion that is needed!

### 7. Announcement and Acknowledgment

Haruka Yasuda, UNISEC-Global



Pictured: Yasuda-san announcing the latest updates from UNISEC-Global

- Speech by UNISEC- Philippines: Charleston Dale M. Ambatali Introduced Last Month
- Introduction of New Point of Contact:
  - UNISEC Mexico: Dr. Hermes Moreno Álvarez Introductory Speech
  - UNISEC Malaysia: Fatima Zaharah Ali Introductory Speech
  - UNISEC Germany: Marco Schmidt
- CLTP13 (CubeSat Leader training Program)
  - Date: August 19-29, 2024

- Venue: Nihon University, Chiba, Japan
- Application Submission Due: May 20, 2024
- Notification of Acceptance: June 13, 2024
- CLTP Website: <u>http://cltp.info/index.html</u>

#### - 9<sup>th</sup> Mission Idea Contest

- The MIC9 theme is "Lunar Mission"
  - Category A: Lunar Orbit CubeSat Mission (LOCM)
  - Category B: Lunar Surface Rover Mission (LSRM)
  - Requirements can be downloaded at PreMIC9
- Website: <u>https://www.spacemic.net/</u>
- Important Dates:
  - Abstract Submission Due: July 24, 2024
  - Notification: September 10, 2024
  - Final Presentation: November 27, 2024 (South Africa)
- Contact: <u>info@spacemic.net</u>

#### - 13th Nano-Satellite Symposium

- Date: November 25-27, 2024
- Venue: Protea Hotel Technopark, Stellenbosch, South Africa
- Abstract Submission: July 7, 2024: <u>https://www0.sun.ac.za/UNISEC-SAR/nanosat13/call\_for\_papers/</u>
- Early Bird Registration: August 23, 2024: <u>https://www0.sun.ac.za/UNISEC-SAR/nanosat13/</u>

#### - Launch Opportunity: J-Cube

- Special Discounted opportunities
- 1U, 2U, 3U, deployment from International Space Station
- Collaborate with UNISEC-Japan's University
- Technical support will be provided
- Contact: <u>info-jcube@unisec.jp</u>, <u>http://unisec.jp/serviceen/j-cube</u>

#### Next Virtual Meeting

- Date: June 15, 2024
- Theme: T.B.D
- Host: T.B.D

### 8. Participant Statistics

**147** participants registered from **36** countries and regions for the 44<sup>th</sup> Virtual UNISEC-Global Meeting.

Country/Region	Number of registrations	Country/Region	Number of registrations
Argentina	1	Malaysia	2
Australia	1	Mexico	1
Bangladesh	2	Namibia	1

Belarus	3	Nepal	12
Bulgaria	4	Netherlands	1
Burkina Faso	3	Nigeria	2
Chile	2	Oman	1
Colombia	10	Paraguay	2
Côte d'Ivoire	1	Peru	2
Dominican Republic	3	Philippines	7
Egypt	3	Serbia	1
France	1	Spain	1
India	26	Taiwan	10
Indonesia	1	Tunisia	1
Italy	2	Turkey	6
Japan	29	Uganda	1
Jordan	1	UK	1
Kazakhstan	1	US	1

Student or professional?

147 responses



### Have you participated in the UNISEC-Global Meeting previously? 144 responses



