Nano-satellite IoT Constellation Program by International Collaboration

Opening remarks

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56th Virtual UNISEC-Global Meeting

The program

UNISEC heritage

41 universities joined
60 satellites launched

+

PoCs in 69 countries
Local Chapters in 29 countries

UNISEC Global heritage

Jointly design satellite bus (3-6U) with online guidance (**education**).

Each satellite will be developed by each country with its own funding or if difficult, we will jointly search for international funds.

Nanosatellite constellation program

→ Joint mission: IoT

All the satellites have the same mission payload to contribute to solving global problems or local problems, etc., as a **constellation**.

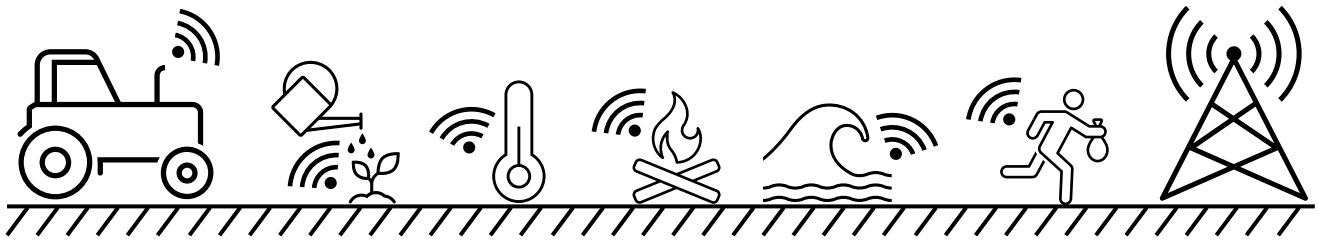
Each country can have **one specific mission payload** for its own interest.

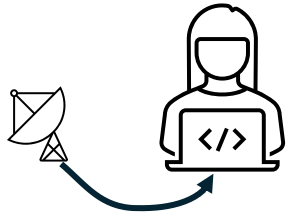
Why choose IoT for the joint mission?

What is IoT?

> "**Smart and connected objects** (…) able to massively collect valuable data for supporting informed decisions, **reducing operational costs** through **automation** (…), **tracking** objects and materials, **monitoring** assets and environmental parameters (…). Besides **data collection**, interconnecting things creates an ecosystem (…) for **optimizing processes and improving reliability**."

"A Survey on Technologies, Standards and Open Challenges in Satellite IoT", 2021 (open access!).





Example: IoT for agriculture

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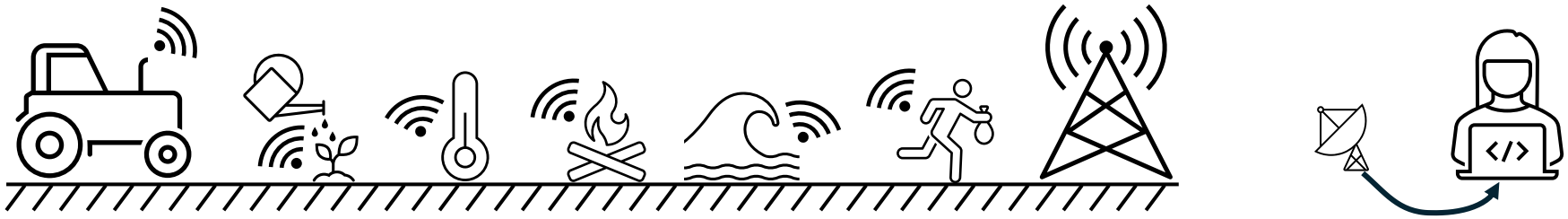
→ Potential limitations if rely only on ground infrastructure: hard / costly to install terrestrial communication infrastructure in remote areas, hard to communicate with sensors distributed over large area, etc.



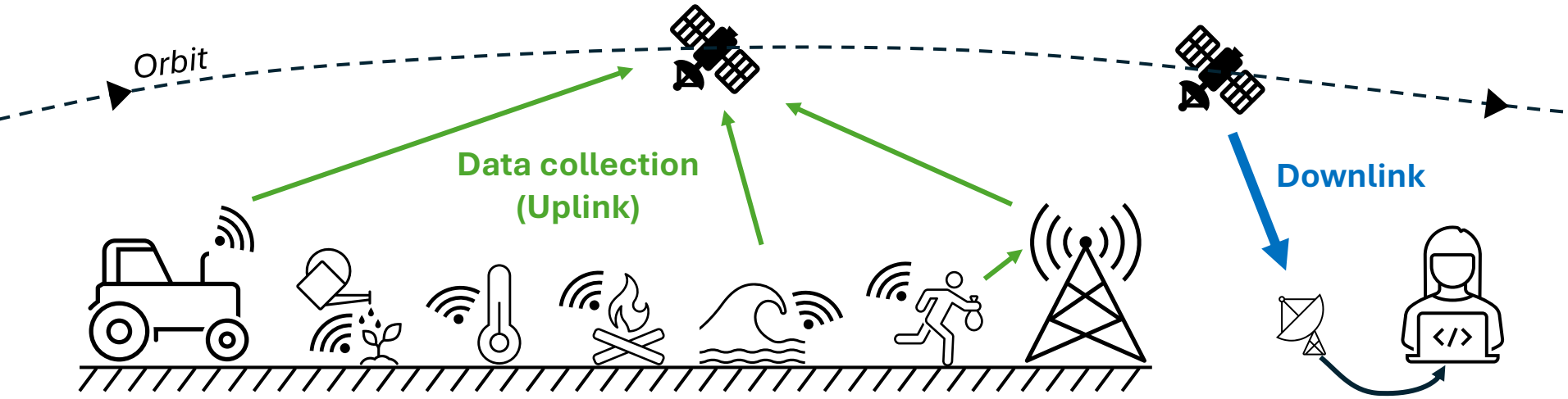
Example: IoT for agriculture

Why choose IoT for the joint mission?

What is satellite IoT?

"Satellites are (...) including in this ecosystem **remote geographical areas where terrestrial networks are unavailable or out of reach**, such as on remote land (...) as well as offshore (...) **cost-effective solution for IoT systems**, able to connect remote sites and sensors with the rest of the world."

"A Survey on Technologies, Standards and Open Challenges in Satellite IoT", 2021.



Example: ***Satellite*** IoT for agriculture

Why choose IoT for the joint mission?

Merits of IoT constellation?

IoT Satellite	IoT Constellation
✓ Low power transmission (10s ~ 100s mW of RF power)	
✓ Limited data rate (~100s of bps) still gives **valuable ground information**	
✓ Access to various data in remote areas with limited ground infrastructure	
✓ Quite simple, 3U-6U size bus can be used for IoT	
✓ Ground sensors can be improved / added even after satellite launch	
If satellite fails, no back-up	✓ **Back-ups** in case of failure
Limited communication service time to receive ground data (~ 40 mins/day)	✓ **Longer communication service time** (up to continuous)
Delay for downlinking data	✓ **Reduced delay** for data downlink
A participant can use a single satellite	✓ All **participants can use all satellites**

→ ***Local*** **pb solving (local, specific data) +** ***Global*** **pb solving (combine various world-wide data)**

Local use-cases?

Drought detection/monitoring

Oil spill detection/monitoring

Wildlife monitoring

Remote asset monitoring

Flood detection/monitoring

Fire detection/monitoring

Agricultural land monitoring

Landslide risk monitoring

...

→ Problem solving in your countries, which will appeal to your government

What information should be collected?

Application to global challenges?

Global warming

Deforestation

Desertification

Sea level rise

Drought

Crop health & disease

Earthquake

Tsunami

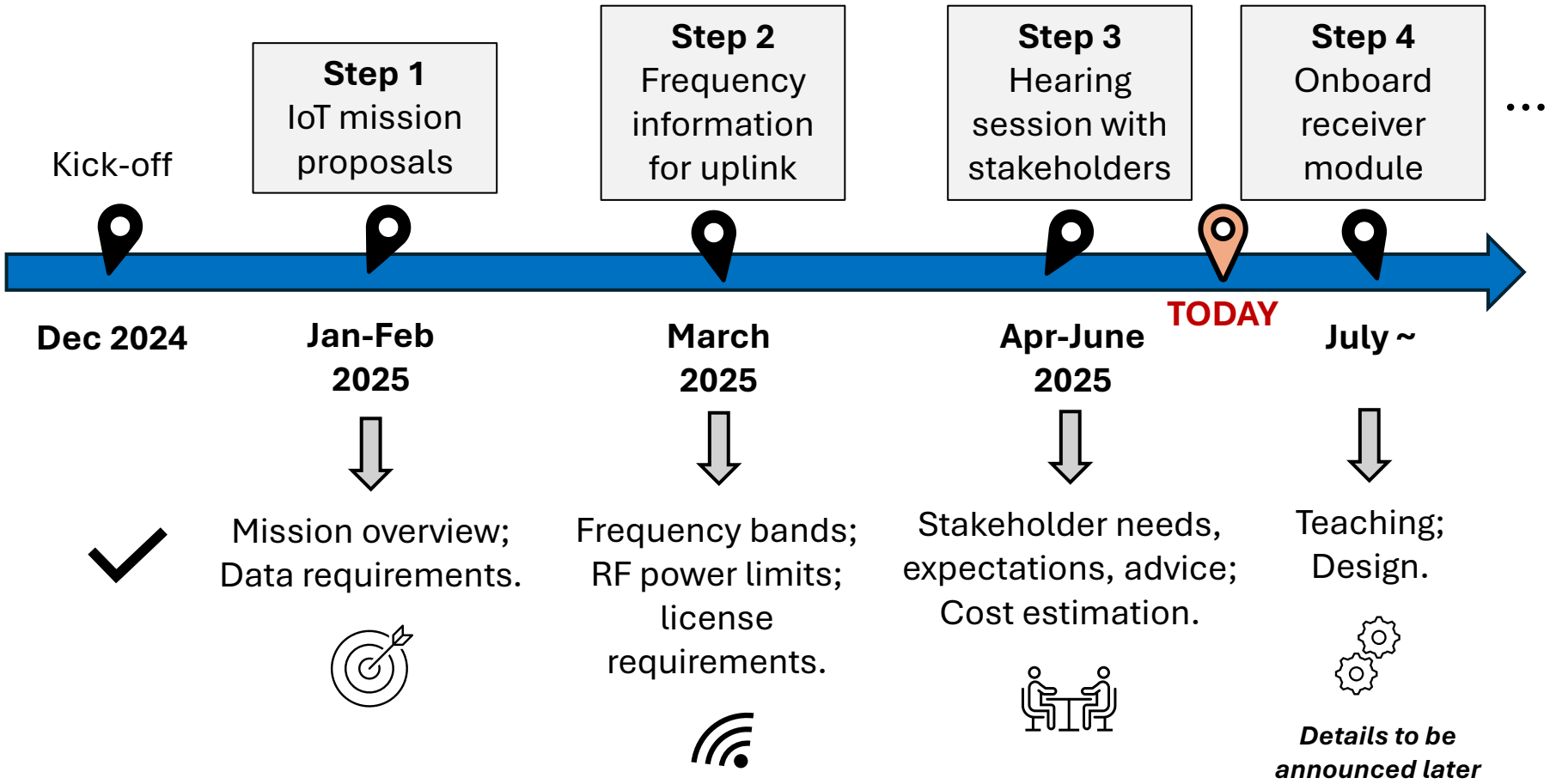
Air pollution

…

→ We, university community may be able to contribute to the world by obtaining world-wide data

What information should be collected?

Program timeline



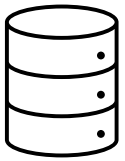
Step 1: IoT mission proposal

Mission overview (= use case)

- What kind of sensor data should be sent to the satellites?
- What kind of sensor is to be used for your IoT mission?
- Who will use the data?
- For what objectives?
- Contributions to society.

Requirements for the IoT system

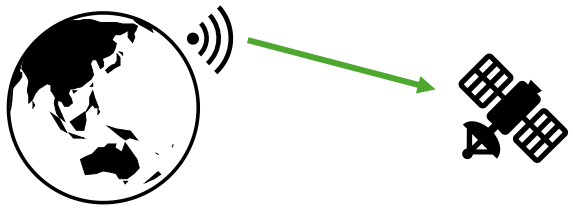
- How frequently should the data be sent to satellites?
- How much data is to be sent to the satellite? (byte)
- How much delay is allowed?
- How many sensors will be put in a 10km x 10km area?



Step 2: Frequency information for uplink

Research on specific low-power radio stations* in your country

- Frequency band(s)
- RF power limit
- Notes



* Allow usage of radio transmission without needing a license for each transmitter, under the condition of operating below a certain transmission power. A technical compliance certification must still be obtained, but once done, an individual license is not needed for each ground transmitter.

Step 3: Hearing session with stakeholders

Collect voices of stakeholders (= needs, expectations, advice)

- Data end-users
- Ground segment developer
- Telecommunications regulator
- Security providers
- Sponsors
- Media

Cost estimation (rough)

- Total cost of your IoT mission (focus on ground segment)
- Amount your government can afford, to tackle the target socio-economic issue

Current status

Proposals received from **20 countries around the world**!

Current status

Required sensor data

Objectives

Data end-users

Mission proposals cover **wide range** of objectives,
yet also have **important overlap**.

IoT presentations at Virtual UNISEC-Global Mtg.

IoT mission idea presentations

54th Virtual UNISEC-Global Meeting (March 2025)

• Dirk Slabber, isiLimela Space Systems	South Africa
• Modisa Mosalaosi, Botswana International U. of Sci. & Tech. (BIUST)	Botswana
• Fama Jallow, Hisia	Gambia
• Hajar Chouiyakh, International University of Rabat	Morocco
• Yu-Sheng Liu, National Taipei University of Technology	Taiwan
• Vicktoria Zlateva, Space Vision ltd.	Bulgaria
• Frank Fitzgerald Batin, Adamson University, STARLab	Philippines
• Joseph Matiko, Dar es Salaam Institute of Technology	Tanzania
• Giovanna Ramírez, Los Andes University	Colombia

56th Virtual UNISEC-Global Meeting (**today**)

• Bassem Boshra, SpimeSenseLabs	Egypt
• Essien Ewang, NASRDA	Nigeria
• Badis Ennejah, Monastir University	Tunisia

IoT company presentations

• Jon Pearce, Lacuna Space	UK
• Mutlu Ahmetoğlu, Plan-S Satellite & Space Technologies Inc.	Türkiye

Not yet submitted a proposal?

We encourage you to give it further thought,
and will warmly welcome your submission!

Join us!

Info page: https://unisec-global.org/iot.html

Q&A

- **Will there be inter-satellite links?**

It is one possibility, to reduce the delay from data acquisition to downlink. Still under consideration.

- **What type of communication protocol will be used for uplink?**

The final decision has not yet been made. Sigfox and LoRa are two strong candidates.

- **Do I need to develop my own satellite?**

It is not a must. It is possible to focus only on the ground segment, or on the satellite receiver module.

- **Will there be any training courses on IoT / satellite development?**

Yes, we are planning an online course as part of the IoT program. We will share more information in the coming months. The course will only be available to those who have made a mission proposal.

- **Can I still join the program?**

Yes, it is possible. Please submit your application and expression of interest on the UNISEC Global IoT program page.

- **Is the program only open to universities, or also companies?**

Anyone can apply. The main focus is capacity building and education.

- **How will the satellite handle multiple incoming signals at the same time?**

If receiving data from multiple sensors, the sensors can send signals at different times (= time division multiple access) or use different codes to distinguish them (= code division multiple access). The details are still under consideration.

- **If I want to develop my own satellite, am I eligible for a reduced launch fee?**

Yes, we can provide assistance to access support programs such as J-CUBE.