Low Earth Orbit Satellites and Systems (LEO SatS)

MicroApps: IMS 2023

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IEEE LEO SatS

IEEE Advancing Technology for Humanity

Outline

1. Introduction
2. Engagement
3. Accomplishments
4. Plans for Future

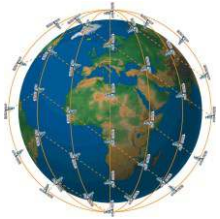
1. Introduction: Vision

Vision for IEEE LEO SatS Small Project

This project consolidates various distributed LEO SatS activities and provides a focus on technology, education and awareness.

The intended impact of this project is to:

1. Increase cooperation in LEO SatS between professionals in academia, industry and government.
2. Advancing relevant technologies.
3. Attract high-quality university and college students to IEEE through the colla with young and seasoned professionals.
4. Attract talented high-school students to provide them with the activities that they would not have otherwise.



1. Introduction: Global Picture of Space Sector

- The space sector has evolved critically over the last decade:
  - Many new players have emerged, driven by commercial interests;
  - Many start-ups/entrepreneurs welcome support from private sectors;
  - New technologies, applications, and markets.
- Some reasons for the Low Earth Orbit (LEO) focus:
  - Low-latency → Near-real time applications;
  - Lower-cost launchers → Cheaper access to space;
  - Shorter lifetime spacecraft → Less-demanding specs (COTS);
  - Constellations → redundancy at the system level;
  - Standardization of small-satellite platforms → easier dev & ops

1. Introduction: On-going Industrial Developments

- **SpaceX** → Starlink constellation (~42000 satellites in LEO) with user link in Ku-band and feeder link in Ka-band for Internet satellite services.
- **WorldVu satellites** → OneWeb constellation (~600 satellites in LEO) with similar links (Ku-band 12-18 GHz and Ka-band 26-40 GHz).
- **Spire** → LEMUR constellation (~200 satellites in LEO) embarking AIS receivers.
- **Aireon** → secondary payload on Iridium Next (~60 satellites in LEO) to provide ADS-B services with global coverage.
- **ELSE** → Astricast (64 CubeSats in LEO) enabling IoT services.
- **Swarm technologies** → SpaceBEEs constellation (~150 satellites in LEO) providing IoT services.

1. Introduction: Opportunities - Technology and Society

- Four billion people on Earth still do not have high-speed Internet access;
- Large economic drive
- Combining terrestrial networks and space segments
- Convergence of the terrestrial and space communications systems
- The space sector particularly benefits from the economy of scale associated with dual-use developments.
- There are many opportunities for advanced developments of various electronic hardware parts and network management and control software
- There are also demands for development on the **ground segment**

1. Introduction: Good Alignment with IEEE Strategy

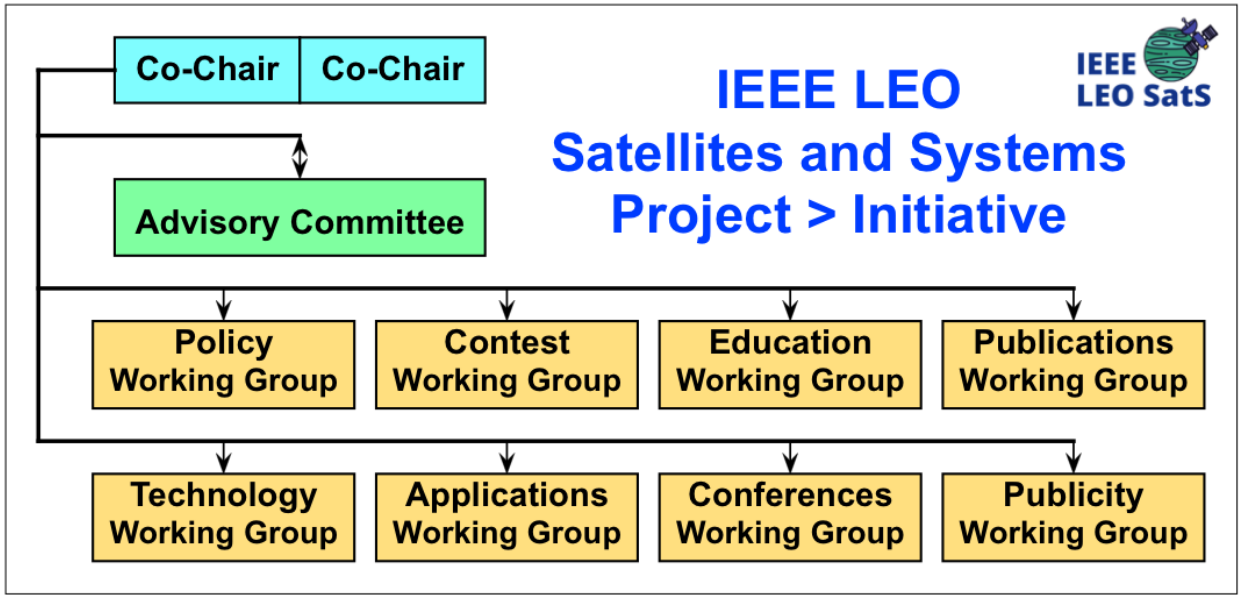
IEEE LEO SatS

1. Drive global innovation through broad collaboration and the sharing of knowledge.
2. Enhance public understanding of engineering and technology and pursue standards for their practical application.
3. Be a trusted source of educational services and resources to support lifelong learning.
4. Provide opportunities for career and professional development.
5. Inspire a worldwide audience by building communities that advance technical interests, inform public policy, and expand knowledge for the benefit of humanity.

1. LEO SatS Organization

Working Groups
Advisory Comm

- Universities
- Industry and R&D
- Government



2. Highlights of Significant Accomplishments

IEEE LEO SatS

Workshops

✓Hosted two virtual workshops with over **300** registrants and speakers from different domains and IEEE societies

Engagement

Engaged with the following groups:

- IEEE AESS (Witold Kinsner)
- IEEE MTT-S (Anding Zhu, Markus Gardill)
- IEEE Public Safety Task Force, FDC
  - (Mehmet Ulema, 210719; Brad Kloza, 210715)
- Canadian Satellite Design Challenge (Larry Reeves)
- High-School Students: Discovery Week (Witold Kinsner)

MTT-S
AESS
GRSS

Cooperation (Discussions)

- Canadian Space Agency, CSA (discussions in progress)
- European Space Agency, ESA (in progress)
- NASA JPL (in progress)
- National Research Council of Canada (in progress)
- IEEE Control Systems Soc, CSS (Kirsten Morris, Univ of Waterloo)
- Communications Society (in progress)
- Computer Society (in progress)
- Education Society (in progress)

Branding

✓Established virtual presence/brand (logo, landing page, LinkedIn, and IEEE campaigns)

IEEE LEO SatS

2. Highlights of Significant Accomplishments

Technical Activities 1:

- **2023 IEEE Space Hardware and Radio Conference**
  Las Vegas, NV, Jan 22-25, 2023 (Markus)
  Conference Chair and Organizer of "Space Night"
- **2023 OFC Space Optics Show Floor Panel**
  San Diego, CA, Mar 05 – 09, 2023 (Markus)
  Panelist and Representative of LEO SatS
- **2022 22nd IEEE Wireless and Microwave Technology Conference (WAMICON)**
  Clearwater, FL; Apr 27-28, 2022 (Jan, Markus)
  Exhibitor and speakers (Special Session)
- **2022 IEEE Summit on Communications Futures**
  (Honolulu, HI (virtual); Jan 14-15, 2022 (Witold, Others)
  "LEO Satellites and Systems for Near-real Time Applications

2. Highlights of Significant Accomplishments

Technical Activities 2:

- **2022 IEEE Intern. Conf. Cognitive Informatics and Cognitive Computing (ICCI*CC)**
  (Toronto, ON; Hybrid); Dec 8-10, 2022 (Witold, Others)
  "LEO Satellites and Systems and Edge Computing in Space"
- **2022 IEEE Intern Microwave Symposium (IMS);**
  Denver, CO, Jun 19-24, 2022 (Jan, Markus)
  Exhibitor and speakers (Special Session)
- **2022 IEEE Space Hardware and Radio Conference**
  Las Vegas, NV, Jan 16-20, 2022 (Markus)
  Conference Chair and Organizer of "Space Night"

2. Highlights of Significant Accomplishments

Technical Activities 3:

- **IEEE 10th International Conference on Wireless for Space and Extreme Environments** (WiSEE21); Winnipeg, MB, Canada. October 12-14, 2022. (Witold, Others)
- **IEEE 9th International Conference on Wireless for Space and Extreme Environments** (WiSEE21); Cleveland, Cleveland OH, USA. October 12-14, 2021. (Witold, Others)

  (Update on the LEO SatS Small Project and Workshop).
- **IEEE 20th International Conference on Cognitive Informatics and Cognitive Computing** (ICCI*CC21); Banff, Alberta, Canada. October 29-30, 2021. (Witold, Others)

  (Update on the LEO SatS Small Project and Workshop).

Confirmed competitions:

- MTTSat Challenge

Here at IMS 2023

2. Highlights of Significant Accomplishments

Experiential Education Activities

- The Verna Kirkness Science and Engineering Program Discovery Week for Indigenous high-school students; Winnipeg, Canada, May 17-21, 2021 (W Kinsner + 12). Examples of tutorials include:

◊ T4: Rockets Large and Small: How Can I Build Them?

◊ T5: Drones Large and Small: How Can I Build Them?

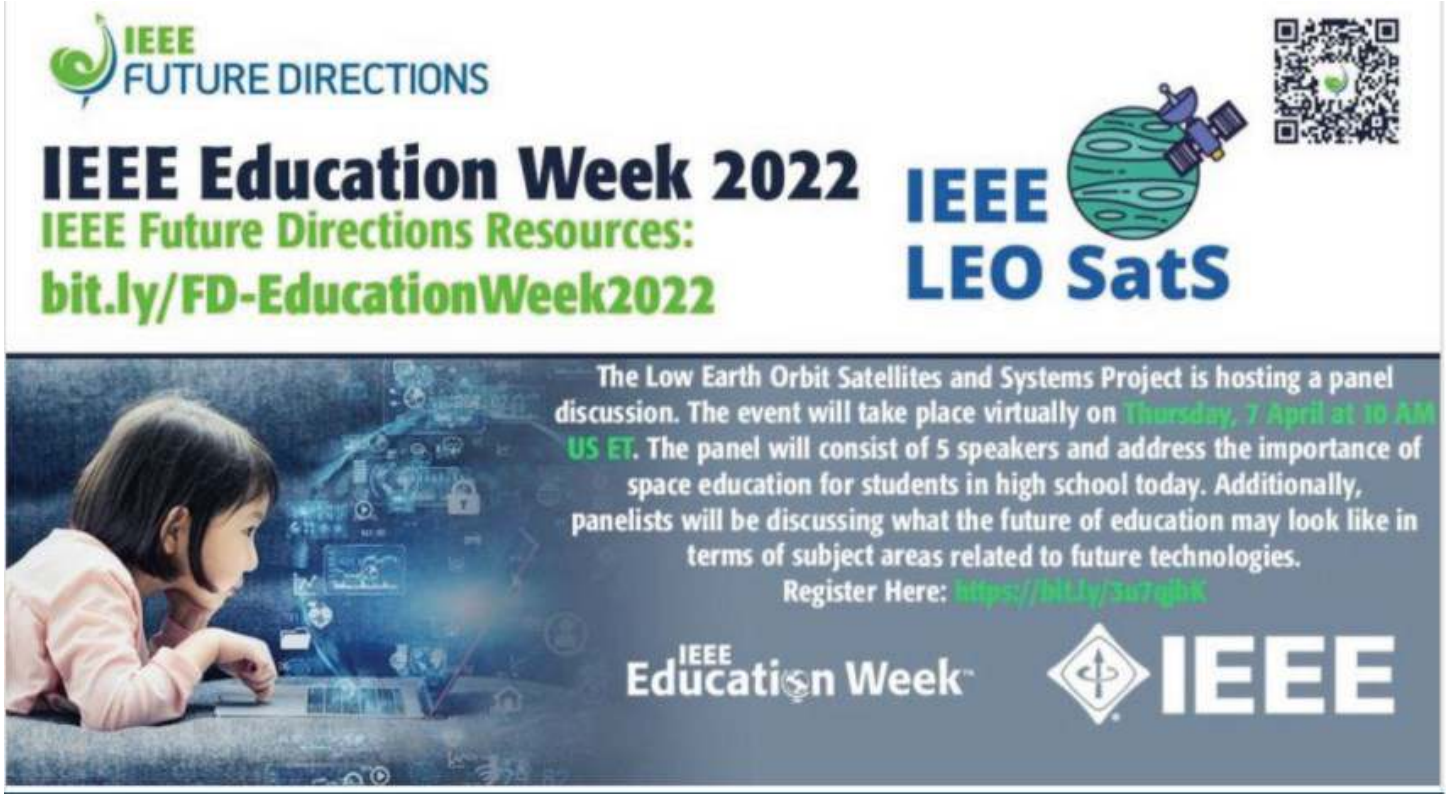
◊ T7: Satellites and Drones: Research & Design

◊ T8: High-Altitude Balloons: Designing, Launching, & Tracking

◊ T9: Large Satellites & Space Suit Design

- Education Week, Pre-University STEM, University, and Continuing Professional Education; Proposal to Jennifer Fong, June 7, 2021; Presentation June 29, 2021. **More extensive participation in 2022.**

2. Highlights of Significant Accomplishments



4. LEO SatS Current Plans (1/2)

3a. What we want to achieve

- More volunteer commitment, including Young Professionals (YP) and Students.
- Enhanced space-related experiential education.
- A roadmap for Small-Satellite Development Education.
- A roadmap towards developing a global LEO-Sat Ground Stations Network.
- Use of LEO SatS in humanitarian activities.
- Increased cooperation between academia, industry and governments.

4. LEO SatS Current Plans (2/2)

3b. Cooperation

- Forming volunteer working groups on specific relevant topics.
- Liaising with relevant Regional developments
  (e.g., US, EU, China, India, Brazil)
- Liaising with major companies/agencies to form a network.
- Development of a global LEO-SatS Ground Stations Network.

4. LEO SatS – whats next?

- Summer Workshop on AI-Technologies for Space Applications
- Fall Workshop on Ground-Station Networks
- Further collaboration in between different IEEE societies
- Grow and expand our expertise with your help
- Representation at IEEE society-wide conferences
- Various technical activities
- Becoming a initiative of the IEEE Future Direction

Thank you

LEO Satellites and Systems

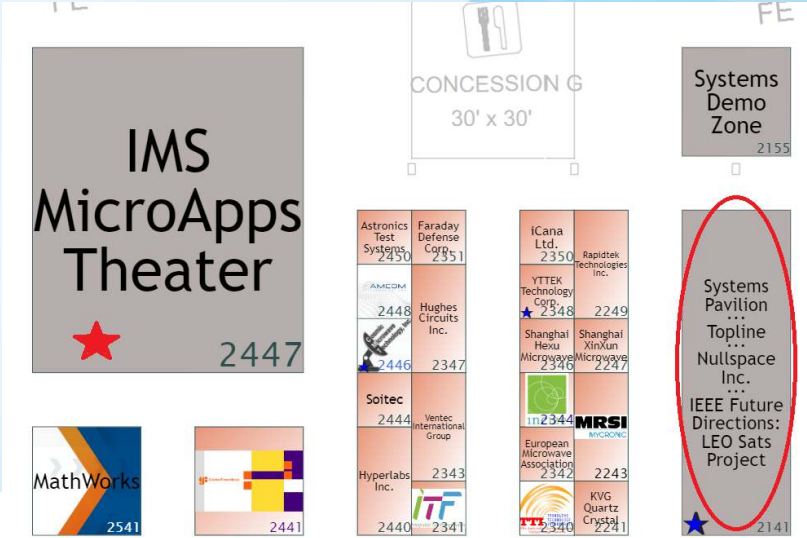
(IEEE Future Direction Project)

Meet us at Booth 10096 in the IMS System Pavilion

MTT-S Satellite Challenge:

Thursday, 15th (13:30-15:10)

Location: 31AB and at the system pavilion



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