6GNTN23 "6G and NTN: Challenges and Solutions":

Giovanni Giambene
INGR Satellite WG co-Chair
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IEEE

Satellite Working Group Overview

- Mobile satellite communications are an important area of interest today by the Research and the Industry, as proven by the new satellite systems developed and deployed (e.g., Lightspeed, O3b, OneWeb, Starlink). Future systems will encompass a multi-layer architecture with Unmanned Aerial Vehicles (UAVs), High-Altitude Platforms (HAPs), Low Earth Orbit (LEO) satellites and Geostationary Orbit (GEO) ones.
- This WG aims to investigate critical challenges for the next 3, 5, and 10 years that need to be resolved for positive industry growth, innovation, and development in this area. The Satellite WG is focusing on the following new areas:
  - Satellite 6G and NTN architectures (including functional split, relation with Open-RAN)
  - Optical wireless communications including ISL
  - Routing in multi-layer 3D systems (NTN)
  - AI applications, AI algorithms
  - Edge computing
  - Security and quantum communications via satellite
  - Standardization and regulation activity (3GPP, ETSI, IEEE, CCSDS, ITU, WRC).
- Introduction: https://ieeetv.ieee.org/channels/ieee-future-networks/the-ingr-satellite-wg-activity

Some Details of our WG

- **Co-chairs**: Dr. Sastri Kota (SoHum Cons., USA) and Giovanni Giambene, (University of Siena, Italy).
- Number of **members** of the Satellite WG: 50+
- **Countries** involved: Argentina, Brazil, Canada, China, Germany, India, Ireland, Italy, Japan, Luxembourg, Nigeria, Portugal, Qatar, Saudi Arabia, Spain, Turkey, UK, US
- Web page: https://futurenetworks.ieee.org/roadmap/satellite-working-group
- Biweekly **meetings** via Webex telcos

Future Networks Technical Community:

Craig Polk
IEEE Future Networks Program Manager
Email – c.polk@comsoc.org

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Future Networks Technical Community

(A graduated initiative of Future Directions)

Steering Committee | 2 Subcommittees | 7 Committees | 15 Tech Working Group | +2k active participants

9 Sponsor Societies

Lead Sponsor: IEEE ComSoc

Major Sponsors: IEEE Antennas and Propagation Society, CAS, IEEE Electronics Packaging Society, ITSS, MTT-S, IEEE Reliability Society, SSCS, IEEE VTS

Content

+ webinars, newsletter, podcasts, videos, articles

3 Major Events

IEEE Future Networks World Forum

IEEE Connecting the Unconnected Summit — An IEEE Future Networks Program

5G — First Responders & Tactical Networks

Research & Education

IEEE INGR International Network Generations Roadmap

+ eLearning, distinguished lectures, webinar series, white papers, tutorials

ORG STRUCTURE

Current Chair
Ashutosh Dutta

Vice Chair
Tim Lee

Chair-elect
Fawzi Behmann

Staff
Craig Polk

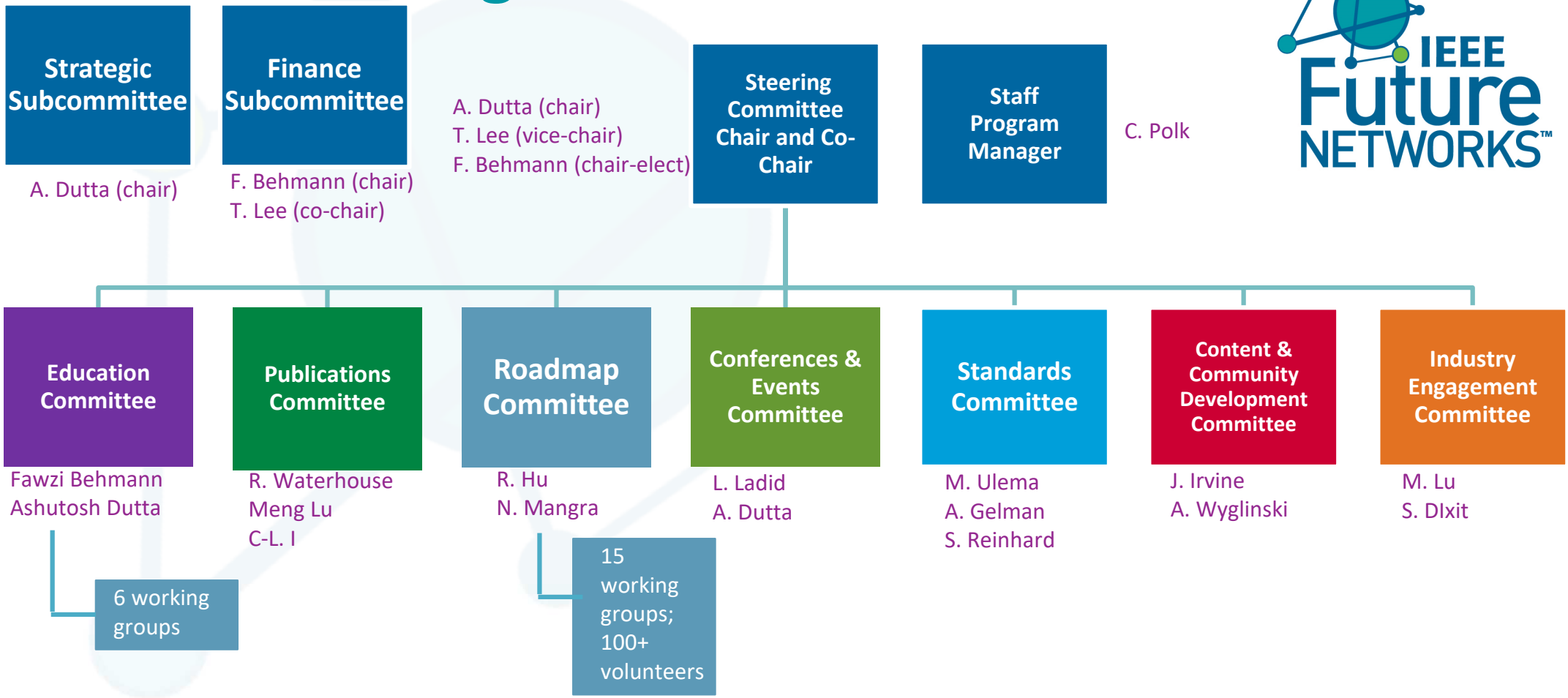
MILESTONES

2017 Founding
2018 1st event
2019 1st roadmap
2021 CTU
2022 Testbed
2023 graduation

STANDARDS

3 programs
2 PARs

Organizational Structure



IEEE INGR International Network Generations Roadmap

- Annual technical document highlighting network technology evolutions over 3-, 5- and 10-year horizons
- Created by 100+ international experts across 14 working groups
- 2023 Edition published – 14 chapters available
- Available for FREE to all FN community participants
- Archived in IEEE Xplore
- 14,500+ total INGR downloads
- Events and outreach:
  - Presentations and readouts at conferences
  - INGR Technical WG workshops
  - 2021-23 webinar series
  - Paid advertising campaigns
  - In 2022-23, FN's INGR webinar series compiled 2,300 registrants

+13 other chapters

Conferences and Events

IEEE Future Networks™ WORLD FORUM

- Active since 2018
- 700 attendees/year on average
- **Surplus every year**
- Proceedings, Panels, Workshops, Industry Fora, Tutorials, Topical/Vertical Sessions
- Baltimore, USA, 13-15 November 2023

IEEE Connecting the UNCONNECTED™ SUMMIT

4 December 2023 | Hybrid | Kuala Lumpur, Malaysia

- Co-located with Globecom | 470 in-person capacity
- 3 keynote talks | 3 invited talks | 3 panel sessions
- 4 lightning talks | 16 winner presentations

Technically co-sponsored by US Dept. of Homeland Security, Dept. of Defense, and Johns Hopkins Applied Physics Lab

- Active since 2018, growing annually
- Free event funded by industry sponsorship
- Keynotes, Panels, Technology and Topical Tracks
- Laurel, Maryland, USA, 13 December

2023 CTU Challenge Metrics

- 296 submissions | 54 countries | 81% pre-screened success
- 240 submissions reviewed by 46 member Selection Committee
- 137 moved on to Phase II | 28 moved on to Phase III
- 18 prize available from a $140,000 prize pool
- Theme: Closing the gender digital divide

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Satellite Competition, "6G and NTN: Challenges and Solutions“ (6GNTN23)

- Rules and instructions: https://futurenetworks.ieee.org/6g-and-ntn-challenges-and-solutions-contest
- **Topics**:
  - Satellite 6G and NTN architectures (including functional splits and relation with Open-RAN)
  - Satellite IoT and multi-layer NTN architectures
  - Optical wireless communications, including inter-satellite links
  - Routing in 3D multi-orbit NTN systems
  - AI for optimization
  - Edge intelligence
  - Sensing and communications
  - Security via satellite
  - Quantum communications via satellite
  - Standardization and regulation activity (3GPP, ETSI, IEEE, CCSDS, ITU, WRC).

Satellite Competition, "6G and NTN: Challenges and Solutions“(6GNTN23)

TPC list:

- Joan Bas, CTTC, Spain
- Petros Bithas, National and Kapodistrian University of Athens, Greece
- Franco Davoli, University of Genoa, Italy
- Tomaso de Cola, DLR, Germany
- Marco Giordani, University of Padova, Italy
- Wael Jaafar, École de Technologie Supérieure (ÉTS), Montreal, Canada
- Andreas Knopp, Bundeswehr University Munich, Germany
- Craig Polk, IEEE, US
- Paresh Saxena, BITS Pilani, Hyderabad Campus, India
- Daniele Tarchi, University of Bologna, Italy
- Liang Zhao, Shenyang Aerospace University, China

Presentations of the Webinar

The following papers have been selected via the 6GNTN23 competition:

- "Ultra Reliable Low Latency Routing in LEO Satellite Constellations Under Stochastic Geometry Framework“ by Ruibo Wang (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)
- "Terrestrial-Airborne Cooperation for Unicast/Multicast Service Delivery over 6G O-RAN Framework“ by Claudia Carballo Gonzalez and Ernesto Fontes Pupo (University of Cagliari, Italy); Jon Montalban, Eneko Iradier and Pablo Angueira (University of the Basque Country, Spain); Maurizio Murroni (University of Cagliari, Italy)
- "Distributed Feeder Link Approach for 6G Multi-Shell Mega-Constellations“ by Oscar Martinez, Thomas Delamotte and Andreas Knopp (Bundeswehr University Munich, Germany)
- "NTNs for Urban Air Mobility Coverage: A Novel Probability of Line-of-Sight Model“ by Abdullah Abu Zaid, Baha Eddine Youcef Belmekki, and Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Ceremony of the Prize

1st classified, winner

- **"Ultra Reliable Low Latency Routing in LEO Satellite Constellations Under Stochastic Geometry Framework"** by Ruibo Wang (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Ceremony of the Prize

2nd classified

- **"Terrestrial-Airborne Cooperation for Unicast/Multicast Service Delivery over 6G O-RAN Framework"** by Claudia Carballo Gonzalez (University of Cagliari, Italy)

Ceremony of the Prize

3rd classified (ex aequo)

- **"Distributed Feeder Link Approach for 6G Multi-Shell Mega-Constellations"** by Oscar Martinez (Bundeswehr University Munich, Germany)
- **"NTNs for Urban Air Mobility Coverage: A Novel Probability of Line-of-Sight Model"** by Abdullah Abu Zaid (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Thank you!