



## Commission C Triennial Report 2021-2023

**Prof. Yves Louët**  
Chair Commission C

### I. Commission C officials

During the last URSI GASS held in Roma (August 2021), Prof. Yves Louët became Chair of URSI Comm. C. As a result, a new Vice-Chair was elected for 2021-23: Kumar Vijay Mishra (USA). Four candidates applied for Vice-Chair :

Debashis De (India)  
Hesham M. El-Badawy (Egypt)  
Kumar Vijay Mishra (India)  
Caiyun Wang (China)

Similarly, a new ECR position was open. Four applications were received :

Krzysztof K. Cwalina (Poland)  
Pape Abdoulaye Fam (Senegal)  
Yongzhe Li (China)  
Anwesha Mukherjee (India)

Krzysztof Cwalina was elected as the new ECR for Comm. C.  
As a result, the Commission C officials for 2021-2023 are :

Yves Louët (Chair)  
Kumar Vijay Mishra (Vice-Chair)  
Krzysztof Cwalina (ECR)  
Haijun Zhang (ECR)

### II. Radio Science Bulletin

Three members of Comm. C have been serving Radio Science Bulletin as Associate Editors:

Pape Abdoulaye Fam (Senegal)  
Ruisi He (former ECR of Comm C) (China)  
Alberto Tarable (Italy)



### III. Terms of reference of Comm. C

During GASS 2023, the list of the Terms of Reference of Commission C has been updated as follows :

Information theory, coding, modulation & detection  
Massive Multi-Input Multi-Output antenna systems  
Waveform for radar & communications  
Smart radio-communications: cognitive radio, software defined radio  
Reconfigurable intelligent surfaces  
Radar, sonar, navigation systems & positioning  
Artificial intelligence and machine learning  
Energy efficient communications and wireless power transfer  
Security & privacy in communications  
Quantum communications  
Wireless networks  
6G and future high frequency radio systems

### IV. URSI AT-RASC 2022

AT-RASC conference was held in Gran Canaria (May 2022). Commission C received 50 papers out of 826 for the all commissions (i.e. 6% for Comm. C). These papers were submitted in the nine following sessions:

C01	Radar & communication co-design (Amir Zaghloul Kumar Vijay Mishra)	8
C02	Concepts & ideas for new future consumer wireless commun. paradigms (Ganchev, Ji, Walker, O'droma)	3
C03	6G and future wireless systems (Haijun Zhang, Satoshi Tsukamoto)	3
C04	Reconfigurable intelligent surfaces (Alberto Tarable, Kumar Vijay Mishra, Amir Zaghloul)	10
C05	Advanced digital communications schemes (Yves Louet, Alberto Tarable)	3
C06	Wireless Power Transfer (Satoshi Tsukamoto, Guillaume Villemaud)	1
C07	Satellite Systems & positioning (Sanat K Biswas, Amitava Sen Gupta)	5
C08	Efficient & Green Communications (Pape Abdoulaye Fam, Yves Louet)	4
C09	AI & Machine learning in communications (Krzysztof Cwalina, Kumar Vijay Mishra)	8

Out of these 50 papers, 9 were submitted as Young Scientists (YS) and 9 for the Student Paper Competition (SPC). It has to be noted that sessions around RIS (Reconfigurable Intelligent Surfaces) or IA were very successful.

### V. URSI GASS 2023

URSI GASS 2023 will be held in Japan (Sapporo) in August 2023.

Commission C received 79 papers (oral, posters, online) out of 1652 (all commissions) (i.e. 4.7 % for commission



C).

These papers were submitted on the 11 following sessions :

		Oral	Poster	Online
C01	Low-Cost GNSS Receivers (Dinesh Manandhar, Anindya Bose)	5	0	1
C02	Artificial Intelligence for Communications (COST ACTION CA20120 INTERACT) (Krzysztof Cwalina, Kumar Mishra, Hiren KD Sarma)	1	2	1
C03	Emerging Technologies for Radar & Communications (Kumar Vijay Mishra, Amir Zaghloul)	17	6	2
C04	Reconfigurable intelligent surfaces (Amir Zaghloul, Kumar Vijay Mishra, Alberto Tarable)	4	0	0
C05	Satellite Systems & positioning (Sanat K Biswas, Amitava Sen Gupta)	4	1	1
C06	6G and future wireless systems (Haijun Zhang, Satoshi Tsukamoto)	14	1	0
C07	Security for Communications (Yves Louet, Hiren KD Sarma)	4	0	2
C08	Aerial Communications and V2X Communication (Seemanti Saha, Rajarshi Bhattacharya)	2	0	1
C09	Connected Healthcare Systems using Futuristic Technologies (Seemanti Saha, Prabhat Kumar Sharma)	1	0	0
C10	Wireless Power Transfer (Satoshi Tsukamoto, Yves Louet)	5	2	0
C11	Advances in wireless communications in transportation (Adrian Kliks, Thomas Blazek)	1	0	1

It has to be noted the large number of papers for sessions dedicated to Radar technologies (including RIS) and 6G systems

Ten papers have been submitted as YS and 4 as SPC.

The tutorial given for Comm. C was entitled « Multi-Port Based High-Frequency Measurement Technology ». Its abstract is :

Current vector network analyzer (VNA) is based on the super-heterodyne scheme because it is easy to expand measuring frequency. However, as measurement frequency will be higher and higher, this technique will be difficult in realization. An alternative homodyne scheme, so called six-port based high-frequency measurement technology, was proposed by Engen and Hore. After that a lot of papers, the six-port calibration methods, applications etc., were published and continues up to the present day. We call these technology “Multi-Port Based Measurement Technology.”

In this tutorial, the origin, the present and the future of this multi-port based high-frequency measurement technology, has been introduced.



This tutorial has been given by TOSHIYUKI YAKABE, Ph.D. from The University of Electro-Communications (UEC), Japan.

## **VI. Technical support for ISAP 2023**

URSI's Commission C has supported technically ISAP 2023 conference that provides a platform for the exchange of information on the progress of research, development and emerging technologies in antennas, propagation, electromagnetic theory and other related fields.

The ISAP2023 details are as follows:

- Date: 30th October 2023 to 2nd November 2023
- Venue: Berjaya Times Square Hotel, Kuala Lumpur, Malaysia.
- URSI member committee involved: Prof. Dr. Jiro Hirokawa (Tokyo Institute of Technology, Tokyo) - Chair of Commission B, Japan National Committee of URSI
- Event website: <https://isap2023.apmttemc.org/>

## **VII. Technical support for MaSAG23**

Commission C gave its technical support to MaSAG23 conference held in Roma (Italy), 15-20 May.

Given the success of the previous edition named “[Nonstationary Signal Analysis in Geophysics 2020](#)” (NoSAG20), it was organized in May 2023 a second edition (Summer School), which will start with a three-day Summer School (May 15 - 17, ref. [Program](#)). The goal of the Summer School is to bring out the knowledge about non-linear data analysis tools for signal processing to the next generation of researchers. The School will consist in three courses of 8 hours which will be given by international experts in the Mathematics for Signal Processing and Geophysical applications. Please find the Lecturer names in the [Invited Lecturers & Speakers](#) tab. The topics of the courses will include reviews of modern signal processing tools, such as Synchrosqueezing Wavelet, Empirical Mode Decomposition, Fast Iterative Filtering, et cetera. Each course will include tutorials focused on possible applications to geophysical systems and other applications. Hence the attendees will have the opportunity to learn about the most modern algorithms for non-linear data analysis directly from world experts and they will have a chance to practice their applications to real life problems. The Summer School will be followed by a 1-day Capacity Building workshop (May 18, ref. [Program](#)) about Radio Sciences techniques for Space Weather, in which the students will focus on how techniques for Time-Frequency analysis are applied in the Space Weather domain, with a particular regard to Radio Sciences.

The two-day Conference that will close the event (May 19 - 20, ref. [Program](#)) will give to the young researchers the opportunity to meet and listen to talks given by top researchers working both in the development of new tools for signal processing, their mathematical analysis, their applications to modern geophysical and other applied fields problems, as well as to discover new open problems in Geophysics and other fields of research. Talks will span from inverse problems, like the determination of the unknown number of active sub-signals of a blind-source composite signal, to separation methods for multicomponent nonstationary signals with crossing instantaneous frequencies and chirps, passing by the analysis of big data by means of machine learning and deep learning approaches, the development and analysis of multivariate and multidimensional data analysis



techniques, the time-frequency representation filtering and enhancing, and the development of comprehensive adaptive harmonic models to represent composite signals. We plan to have poster sessions throughout the conference, to provide young researchers the opportunity to showcase their work and research activities.

The events took place both in Rome, [Istituto Nazionale di Geofisica e Vulcanologia, Rome Headquarters](#), Via di Vigna Murata 605 Roma, Italy and online, with access limited to registered users.

### **VIII. Technical support for RADIO23**

Commission C gave its technical support to RADIO 2023 conference held in Balaclava (Mauritius), 1-4 May 2023.

The 8th edition of the IEEE RADIO international conference was held at in Balaclava, Mauritius from Monday 1st to Thursday 4th May 2023. The aim of the conference was to discuss recent developments, theories and practical applications covering the whole scope of radio frequency engineering, including radio waves, antennas, propagation and electromagnetic compatibility.

Prospective authors were invited to submit original contributions on their latest research activities. Student papers are strongly encouraged. Prizes will be awarded for Best Student Papers, Young Scientist Paper and Best Industrial Engineering Paper. Proposals for special sessions, workshops and tutorials are welcome. A panel of distinguished researchers will deliver keynote speeches/invited talks on recent technology trends and advances.

The organizing committee was as follows :

General Chair :

Prof. Vikass MONEBHURRUN (*Associate-Professor - HDR, CentraleSupélec, France*)

Finance Chair :

Dr. Shailendra OREE (*Senior Lecturer, University of Mauritius*)

Conference Secretary :

Dr. Nitin RUGHOONATH (*Lecturer, University of Mauritius*)

Program Chair :

Prof. Alexandre DOUYERE (*Associate-Professor, University of Réunion*)

Publications Chair :

Prof. Vishwamitra OREE (*Associate-Professor, University of Mauritius*)

### **IX. Report from Brazil**

Report 2021-2023: Commission C – Telecommunications in Brazil

Author : Marcelo S. Alencar

Institute of Advanced Studies in Communications (Iecom)

Federal University of Rio Grande do Norte

Natal RN, Brazil

This section presents the status of the telecommunication activities in Brazil, for the triennium, regarding the statistics of telecom operators, number of service subscribers, revenue and market value of the sector. It also presents the activities of the main scientific societies, related to the mission of the Commission C.



The Brazilian telecommunication market increased in the past years. Brazil ended 2022 with 242 million smart phones in service, which is an increase of 5.2% regarding the previous URSI report, and represents a penetration of 95.5%, according to data from telecom regulator Anatel. The number of portable devices, which includes notebooks and tablets, amounts to 352 million, or 1.6 devices per person. The Brazilian population is 214 million people. The total number of digital devices in use in the Country is 447 million, including computers, notebooks tablets and smart phones, for corporate and personal use. The number of computers reached 216 million in 2023, an increase of 10% regarding the previous year [1]. The total number of cell phones in Brazil, in February 2023, is 250.6, including pre-paid and post-paid services, M2M, 5G, 4G, 3G and 2G in operation. The pre-paid share is 43.9% [2]. The number of 5G DSS (non-standalone) connections reached 7.3 million in February, 2023. This technology, however, is not considered full 5G, which is only considered to be in the standalone format and operating in the 3.5 GHz band.

Fiber transmission technology represents 67%, or 28.7 million, of all fixed broadband connections in Brazil, having grown by 5.5 million accesses in one year. The remainder are coaxial cable (21.1%), metal cable (7.3%), radio (3.9%) and satellite (0.7%) connections [3].

Regarding the composition of the telecom market for fixed broadband access, in terms of gross operational revenue, in 2022, the market leader Vivo (Telefonica Brasil) had 38.2% of the total mobile lines in the Country, compared with 38.3% in the previous year [4]. Figures indicate that the company is close to breaking the milestone of 100 million mobile accesses in Brazil. The telecom company is ahead of Claro (33.0%, down from 33.1%), TIM (26.5%, flat), Algar (1.6%, flat) and others (0.6%, up from 0.5%). The Claro company remains the leading single operator, with 22.8% of all fixed broadband connections, down from 23.2% in the previous year), followed by Telefonica Brasil (14.9%, down from 15.1%) and Oi (11.9%, down from 12.1%) [3]. Pay television subscriptions dropped to 14.8 million, from 15.1 million last year. Since 2021, the service has shed over 1.5 million accesses. The segment is led by Claro, with 43.2% of all subscriptions. Next is Sky (28%), Oi (19.2%), Telefonica (6.8%) and the remaining companies have (2.8%) of the market share. Oi has been authorized to sell its satellite DTH business to Sky, although both the conclusion of the deal and the transfer of clients are yet to take place. Satellite DTH accounted for 57.5% of all pay-television accesses, ahead of coaxial cable (33.6%) and fiber (8.9%) [3].

The Brazilian Telecommunications Society (SBRT) sponsored the XXIX Brazilian Telecommunications Symposium (SBRT 2022). In its 40th edition, the symposium was held in Santa Rita do Sapuca, Brazil, between 25 and 28 of September, 2022, at the Instituto Nacional de Telecomunicações (Inatel). The general chair was Rausley A. A. de Souza (Inatel) and the technical program chairs were Christian Esteve Rothenberg (Unicamp), Luciano Leonel Mendes (Inatel) and Rodrigo C. de Lamare (PUC RJ) [5]. The Brazilian Symposium on Microwaves and Optoelectronics (SBMO 2022) occurred in Natal, Brazil, in 2022. The event was organized by the Universidade Federal do Rio Grande do Norte (UFRN). The event was supported by the Brazilian Microwave and Optoelectronics Society (SBMO). The general chair was Adaildo Gomes D'Assunção (UFRN). The venue was the Praia Mar Natal Hotel, and the conference presented five invited talks, six short courses, and several special sessions [6].

The SBMO/IEEE MTT-S International Microwave and Optoelectronics Conference (IMOC) is an international forum of telecommunication technologies organized by the Brazilian Microwave and Optoelectronics Society (SBMO) and co-sponsored by IEEE Microwave Theory and Techniques Society of the Institute of Electrical and Electronic Engineers (IEEE MTT-S). The XII Annual Meeting of the Iecom on Communications, Networks and Cryptography (ENCOM 2022) was held in Guaramiranga, Brazil, from October 14 to 16, 2022, under the sponsorship of the Institute for Advanced Studies in Communications (Iecom) IFCE, IFPE, UPE, UFPB and UFCG.



The general chairs were Marcelo Sampaio de Alencar (UFRN) and Jorge Fredericson de Macedo Costa da Silva (IFCE). The program chairs were Hugerles Sales Silva (UnB) and Francisco Madeiro Bernardino Junior (UPE) [7].

The Journal of the Brazilian Telecommunications Society (JBTS) was created in 1986 by the SBrT as a way to document and disseminate the results produced by Brazilian researchers. Effective December, 2005, the Board of the SBrT approved a new title for its publication, which became known as Journal of Communication and Information Systems (JCIS). The 2 Editors-in-Chief, for the first five years, were Marcelo S. Alencar (UFCG), Celia Desmond (IEEE ComSoc) and Elvino S. Sousa (UoFT).

The Journal of Communication and Information Systems (JCIS) features high-quality, peer-reviewed technical papers in several areas of communications and information systems. The JCIS is jointly sponsored by the Brazilian Telecommunications Society (SBrT) and the IEEE Communications Society (ComSoc). The JCIS aims at a larger international audience. The Steering Committee includes renowned scholars from the international and the Brazilian communities. Also, distinguished researchers in several fields of Communication and Information Science act as area editors. Since 2021, Lisandro Lovisolo (UERJ) is the Editor-in-Chief [5].

The Journal of Microwaves, Optoelectronics and Electromagnetic Applications (JMoe) is published by the Brazilian Microwave and Optoelectronics Society (SBMO) and Brazilian Society of Electromagnetism (SBMag). It is a refereed publication devoted to disseminating technical information in the areas of Microwaves, Optoelectronics, Photonics, and Electromagnetic Applications. The journal is published in electronic format since 1997. The editors are Maria Thereza Miranda Rocco Giralaldi (IME) and Renato Cardoso Mesquita (UFMG) [6]. The JMoe is indexed in the following bibliographic databases: SciELO, SCOPUS, SIMAGO, EMBASE, Engineering Village, Reaxys, Sumarios.org and Directory of Open Access Journals (DOAJ). It is also part of the Scientific Electronic Library Online-SciELO's collection.

The Journal of Information and Communications Technology (RTIC) is published by the Institute for Advanced Studies in Communications (Iecom). The journal is published in electronic and printed formats since 2011. The RTIC is registered by DOI and was awarded a Capes Qualis B5 classification. The editor-in-chief is Wamberto Jos'e Lira de Queiroz [7].

According to a report from the International Telecommunication Union (ITU), the telephone services in Brazil present one of the highest costs in the World. The blocking probability is high, which led the Brazilian National Telecommunication Agency (Anatel) to punish the several telecom operators, in previous years, by blocking the sales of new services. As a recommendation, it is important that the International Union of Radio Science (URSI), Commission C, begin to sponsor the conferences organized by the Institute of Advanced Studies in Communications (Iecom), by the Brazilian Telecommunications Society (SBrT) and by the Brazilian Microwave and Optoelectronics Society (SBMO).

[1] Fundacao Getulio Vargas. Relatorio anual. Internet site, <https://portal.fgv.br>, 2023.

[2] Teleco Inteligencia em Telecomunicacoes. Relatorio mensal. Internet site, <https://www.teleco.com.br/ncel.asp>, 2023.

[3] Bnamericas. Spotlight: The state of play in Brazil's telecoms market. Technical report, Endicott Growth Equity Partners, L.P (EGEP), [www.bnamericas.com/en/features/spotlight-the-state-of-play-in-brazils-telecoms-market](http://www.bnamericas.com/en/features/spotlight-the-state-of-play-in-brazils-telecoms-market), March 2023.

[4] Anatel. "Dados sobre Telecomunicacoes no Brasil". Internet webpage, Brazilian National Telecommunications

Agency (Anatel), [www.anatel.gov.br](http://www.anatel.gov.br), March 2023.

[5] Brazilian Telecommunications Society. "Portal of the Brazilian Telecommunications Society. Technical report, SBRT, December 2022.

[6] Brazilian Microwave and Optoelectronics Society. "Portal of the Brazilian Microwave and Optoelectronics Society. Technical report, SBMO, December 2022.

[7] Institute for Advanced Studies in Communications. "Report of the Institute for Advanced Studies in Communications (Iecom). Technical report, Iecom, December 2023.

## X. Report from Benelux

URSI in the Netherlands organizes, together with URSI Belgium, the annual URSI Benelux Forum. Unfortunately, this wasn't possible in 2021 due to the pandemic, but fortunately we were able to organize the Forum in 2022, on March 18 at Eindhoven University of Technology. The 29th URSI Benelux Forum offered a meeting opportunity to researchers preparing a PhD in the different scientific fields covered by URSI. Especially researchers with a PhD were welcome to present significant advances in their (postdoctoral) research. The meeting offered them and the academic and scientific staff of universities and institutes a unique opportunity to be informed about the different research programmes in Radio Science. The structure of the Forum consisted of Poster Sessions with contributions from all fields covered by every of the 10 URSI Commissions in addition to a plenary program around the theme "Past, present and future of Radio Science", highlighting the centennial of URSI and pitches by eminent researchers on ongoing developments and the future of Radio Science.

URSI sponsored the student poster prize. The first prize went to Anouk Hubrechsen from Eindhoven University of Technology on her work "A Novel mm-Wave Measurement Chamber for Antenna-Efficiency Measurements up to 130 GHz". Second prize went to Chenglong Li of Gent University on "DUDAR: Device-Free Pedestrian Tracking Using Commodity Ultra-Wideband Radios" and the third prize went to Niels Vertegaal, also from Eindhoven University of Technology on "Inflatable Sinuous Antenna for Radio Astronomy designed for CubeSat".



Student posters prizes at URSI Benelux Forum – March 2022





From left to right : 1st, 2nd and 3rd prizes

#### **XI. Report from France**

URSI France set up every year a two-days' workshop called « Journées d'URSI France ». This event has been held in Paris in 2022 and in Saclay in 2023.

In 2022 the topic was out of the scope of Commission C (nano electronics) and no paper from Comm. C was submitted.

In 2023, the topic was « energy and waves ». Three papers from Comm. C were submitted.

#### **XII. Report from Poland**

As part of the Polish Multi-Conference of the National Tele- and Radiocommunication Environment 2022 together with prof. Ambroziak from Committee F, Polish Comm. C organized a joint session with Comm. F entitled "Physical layer issues in modern radio communication networks".

Krzysztof Cwalina, ECR of URSI Comm. C chaired this session.

#### **XIII. Report from the USA**

K. V. Mishra, Vice Chair of URSI Comm. C gave the following tutorial "Joint radar-communications for beyond 5G era," at the USNC-URSI National Radio Science Meeting (NRSM), 10-14 January 2023, in Boulder, Colorado.