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TERahertz ReconfigurABle METAsurfaces for ultra-high rate wireless communications

TERRAMETA

Deliverable D7.3 Report on Dissemination Standardisation and Exploitation Activities (interim)

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TERRAMETA D7.3 - Report on
Dissemination Standardisation and
Exploitation Activities (interim)

Leader in charge of deliverable: Thomas Kürner, TUBS

<i>Dissemination level</i>		
PU	Public – fully open	X
SEN	Sensitive – limited under the conditions of the Grant Agreement	

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Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union, SNS JU or UKRI. The European Union, SNS JU or UKRI cannot be held responsible for them.

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Change register

Version	Date	Author	Organization	Changes
A	06-12-2024	Georg Jensen	TUBS	Initial Draft
B	11-12-2024	Georg Jensen	TUBS	Added sections on standardisation an exploitation
C	19-12-2024	Georg Jensen	TUBS	Updated KPIs
D	30-12-2024	Luis Pessoa	INESC TEC	Minor corrections and formatting
E	08-01-2025	Georg Jensen	TUBS	Included presenters of papers

1. Statement of independence

The work described in this document is genuinely a result of efforts pertaining to the TERRAMETA project: any external source is properly referenced.

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Luis M. Pessoa
Georg Jensen

2. Executive summary

This deliverable summarizes the TERRAMETA's dissemination, standardisation and exploitation activities in the period from M1 to M24 of the project. The activity has been broad, extensive, and diverse. While D7.2 only presents the contributions from M1 to M12, D7.3 also includes the progress from M13 to M24 and compares this progress with that of the first year.

As already announced in deliverable 7.1, TERRAMETA has submitted contributions to many high-profile conferences and workshops. The goals for the targeted journal publications have also been achieved. Furthermore, the standardization objectives were met through TERRAMETA's involvement in the standardization groups IEEE 802.15 SC THz and ETSI (ISG THz), as well as participation in ETSI ISG RIS on Reflective Intelligent Surfaces.

The key points of this deliverable include the following:

- Overview of the project communication channels:
 - Website: <https://terrameta-project.eu/>
 - LinkedIn: <https://www.linkedin.com/company/terrameta/>
 - X: https://twitter.com/TERRAMETA_6GSNS
- Description of the participation in dissemination activities in a wide range of events all over the world, separating those that occurred in M1-M12 and M13-M24:
 - International conference presentations
 - Numerous other events including invited talks, lectureships, special sessions, and tutorials
 - Referred journal papers
 - Magazine papers
 - Overview of activities in collaboration with other projects
- Production of project newsletters and project flyer
- Organisation of workshops and special sessions at major scientific conferences, as well as of dedicated events, typically in collaboration with other SNS projects
- Standardisation contributions to IEEE 802.15 Standing Committee THz, ETSI Industry Specification Groups on THz and RIS
- Overview of exploitation activities, including the submission of patents

3. Dissemination Activities by M24

TERRAMETA has been very actively engaged in the dissemination activity over the first 24 months of the project. This section underscores all dissemination activities that have been performed within this period.

3.1. TERRAMETA communication channels

To effectively reach and captivate our target audience, TERRAMETA has strategically utilised a wide range of communication channels. This ensures that our work resonates across multiple platforms, maximising TERRAMETA's outreach.

3.1.1. TERRAMETA website

A website has been launched and is available at: <https://terrameta-project.eu/>

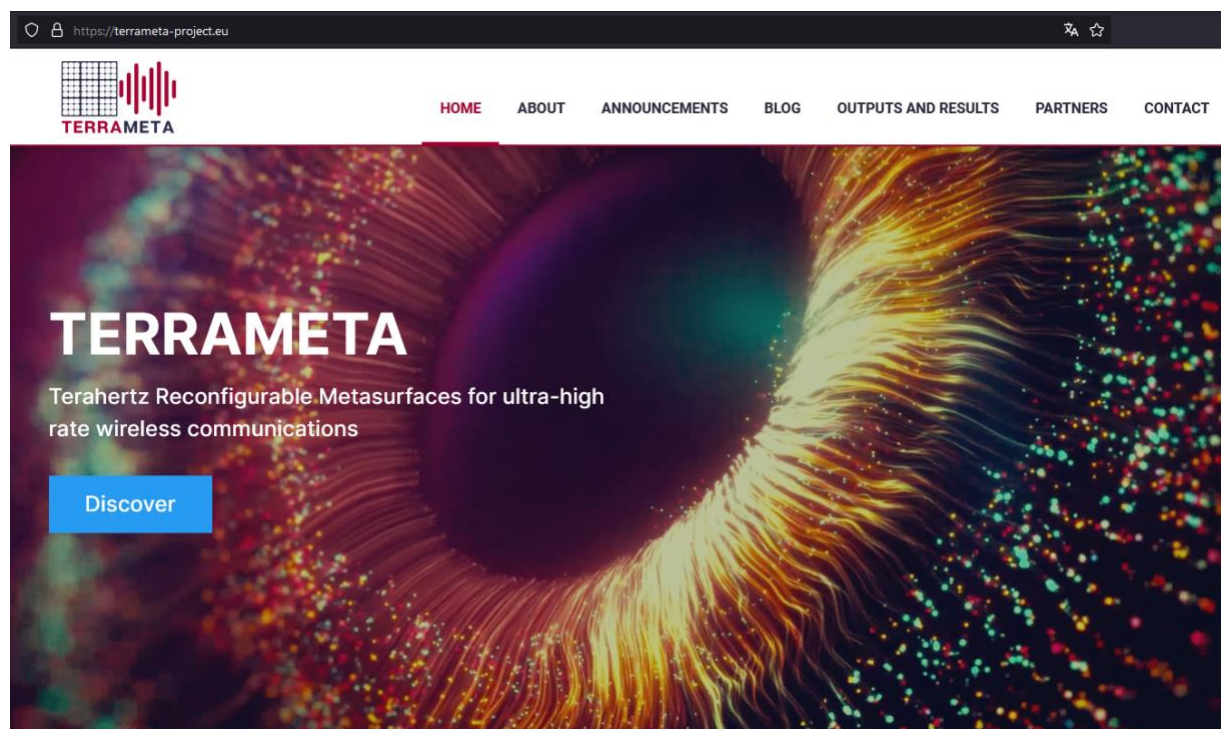


Figure 1 – View of the TERRAMETA website home page.

The website contains all relevant project details and presents an overview of the ongoing project including general project information, up-to-date news, and recent scientific findings and results.

The current structure of the website is organized as follows:

- Home
- About
- Announcements
- Blog
- Outputs and results
 - Scientific publications
 - Public deliverables
 - Dissemination & Communication
- Partners
- Contact

After the first year (Y1), the website had around 250 visits in total, and it has appeared on search results 1500 times based on the statistic provided by google analytics. In the second year (Y2) the website reached 826 visits and has appeared 12000 times. The website was updated with 67 scientific publications, 28 dissemination and communication activities, 14 blog posts, 1 public deliverable, and 1 newsletter.

The requirements, goals, and specifications of the website have been reported under D7.1.

3.1.2. ***TERRAMETA LinkedIn***

A LinkedIn page has been launched and is available at:

<https://www.linkedin.com/company/terrameta/>

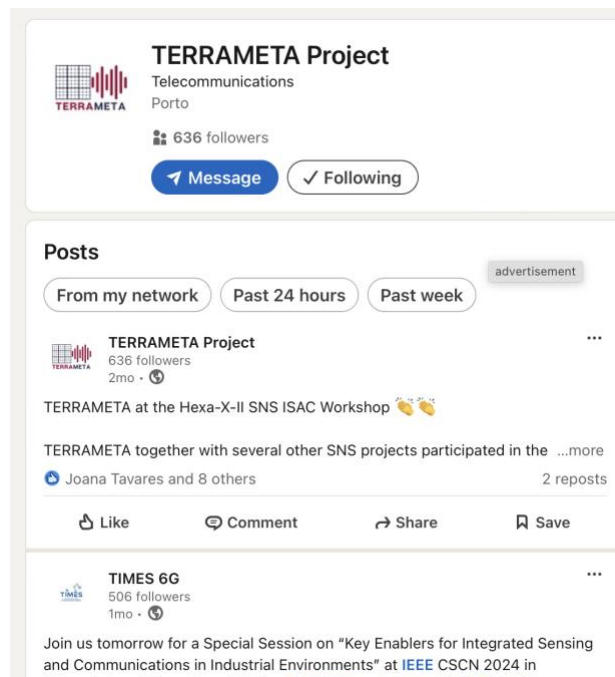


Figure 2 – View of TERRAMETA LinkedIn profile.

The LinkedIn page disseminates project-related news promptly and provides an opportunity to reach a wide variety of audience and to interact directly with them. The LinkedIn page already has more than 636 registered followers.

The LinkedIn page focuses on increasing TERRAMETA's reach by sharing important events such as the organization of special sessions and workshops, publishing newsletters, and any other relevant dissemination activities to attract the attention of other researchers in the same community and to look forward to the potential collaborations with them for synergy effects to make the TERRAMETA project a success.

While in Y1, there were 10 posts by TERRAMETA, in Y2, a total of 15 posts has been posted on the LinkedIn page. The post about the IEEE ICC 2024 workshops achieved the most attention with 2731 clicks and 117 likes at the time of the writing.

3.1.3. ***TERRAMETA X (formerly Twitter)***

A X page (formerly Twitter) has been launched and is available at:

https://twitter.com/TERRAMETA_6GSNS

The X page (formerly Twitter) facilitates the dissemination of project-related news promptly and provides an opportunity to engage with audiences from diverse backgrounds.

Capitalising on X's more direct and personal approach to posts, the content shared there is of a similar nature to LinkedIn, but phrased in a more friendly tone. Posts mainly include brief summaries of events (e.g., organising workshops, meetings and publications of a newsletter) to keep interested stakeholders informed of the dissemination activities of TERRAMETA so that the project does not reach researchers from its own community only, but people from different fields can also get information on the cutting-edge technologies tackled by TERRAMETA, such as sub-THz RIS technology.

At the time of writing, there are a total of five posts and two of which have over 260 views.

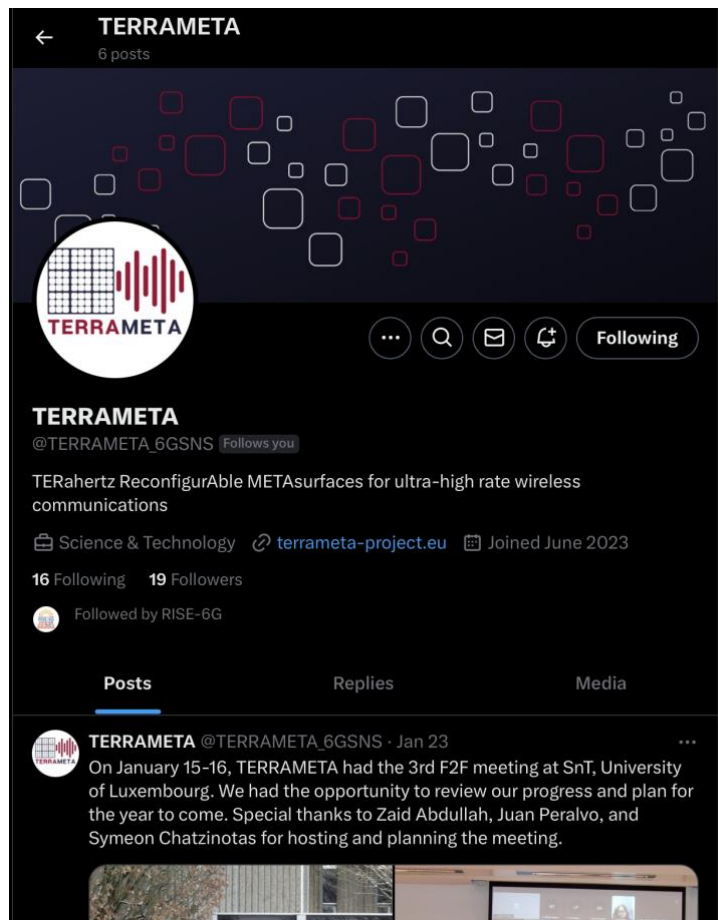


Figure 3 – View of TERRAMETA X profile.

3.2. TERRAMETA events

As it can be seen from the listed activities of this document, TERRAMETA partners, were very active in disseminating TERRAMETA's results by organising and participating in numerous conferences, workshops, and any other types of events, reaching 2000 participants in Y1 and 3500 participants in Y2. In the following we present the list of events where TERRAMETA was disseminated, dividing the two project periods, M1-M12 and M13-M24.

3.2.1. Conference and Workshop presentations M1-M12

EuCNC & 6G Summit 2023 Workshop

EuCNC & 6G Summit: Workshop on Reconfigurable Intelligent Surfaces from sub-6GHz to THz: Recent Advances and Open Challenges, 06 June 2023, Gothenburg, Sweden (approximately 100 attendees).

- “Reconfigurable Intelligent Surfaces from sub-6GHz to THz: Recent Advances and Open Challenges” (Workshop co-organizer: George C. Alexandropoulos)
- “Reconfigurable technologies for integrating RIS elements at THz: New approaches and challenges” (presented by Luis M. Pessoa, INESC TEC)
- THz RIS for ultra-high rate wireless communications: element design and synthesis (presented by Sergio Matos, IT)
- “Simulation scenarios for the assessment of reflective intelligent surfaces in THz backhaul applications” (presented by Bo Kum Jung, TUBS)
- “The RIS technology status, trends, and road to standardization” (discussion panel with participation from Luis M. Pessoa, INESC TEC)
- “Through the development of reconfigurable electromagnetic surfaces at sub-THz: Actual technology and future challenges” (presented by Antonio Clemente, CEA)

EuCAP 2023

17th European Conference on Antennas and Propagation, 26-31 March 2023, Florence, Italy (approximately 100 attendees).

- “Radio propagation characterizations and channel modelling for RIS and sub-THz channels” (presented by Qi Luo, UH)

ICEAA 2023

2023 International Conference on Electromagnetics in Advanced Applications, 09-13 October 2023, Venice, Italy (approximately 200 attendees).

- “Near-field Focusing with Transmitarrays: Impact of Phase Quantization” (presented by Marie Defives, CEA)

E-MRS

European material research society, 29 May - 02 June 2023, Strasbourg, France (approximately 500 attendees).

- “Application of memristor switches” (presented by Asal Kiazadeh, NOVA ID)

Euro Nano Forum

Euro Nano Forum 2023, 11-13 June 2023, Lund, Sweden (approximately 200 attendees).

- “Overview on memristor technology in power-efficient processing” (presented by Asal Kiazadeh, NOVA ID)
- “Sustainable printing methods of Memristor technology” (presented by Jonas Deuermeier, NOVA ID)

ETSI Research Conference

ETSI Research Conference: Maximizing the Impact of European 6G Research through Standardization, 6-8 February 2023, Sophia Antipolis, France (approximately 100 attendees).

- “Project overview and standardisation plans” (presented by George C. Alexandropoulos, Luis M. Pessoa)

EUSIPCO 2023

31st European Signal Processing Conference, 04-08 September 2023, Helsinki, Finland

- “Full Duplex Holographic MIMO for Near-Field Integrated Sensing and Communications” (presented by George Alexandropoulos, NKUA)
- “Full-Duplex-Enabled Joint Communications and Sensing with Reconfigurable Intelligent Surfaces” (presented by Chandan Kumar Sheemar, Uni.Lu)

URSI GASS 2023

International Union of Radio Science General Assembly and Scientific Symposium, 19-26 August 2023, Sapporo, Japan.

- “On the Requirements on Reflective Intelligent Surfaces in THz NLOS Backhaul” (presented by Thomas Kürner, TUBS)

ICC 2023

IEEE International Conference on Communications 2023, 28 May - 1 June 2023, Rome, Italy (approximately 200 attendees).

- “Channel modeling and multi-user precoding for tri-polarized holographic MIMO communications” (presented by Li Wei).
- Tutorial “Leveraging smart wireless environments for beyond 5G localization and sensing” (delivered by George C. Alexandropoulos, NKUA).

IEEE ICASSP 2023

IEEE International Conference on Acoustics, Speech, and Signal Processing, 4 June 2023, Rhodes, Greece (approximately 200 attendees).

- Tutorial “Machine learning for smart wireless environments” (delivered by George C. Alexandropoulos, NKUA)

NANOARCH 2023

18th ACM International Symposium on Nanoscale Architectures Association for computing machinery, NANOARCH, 18-20 December 2023, Dresden, Germany

- “Concept paper on novel radio frequency resistive switches” (presented by Asal Kiazadeh, NOVA ID)

IEEE RFIC Workshop

Scientific Workshop on Integration of 6G Systems from BB to Antennas for 6G Phased Arrays, International Microwave Symposium, Radio Frequency Integrated Circuits Symposium 2023, San Diego, USA, Jun. 11, 2023 (approximately 50 attendees).

- “Transmitarrays and in-package antenna solutions for future communication systems at millimeter wave and sub-THz frequencies” (presented by Antonio Clemente, CEA)

EuMC Workshop

Scientific Workshop on Integrated Antenna Systems: Technologies and Innovations for high-density antennas and phased arrays, European Microwave Week (EuMW 2023) conference, Berlin, Germany, Sep. 6, 2023 (approximately 50 attendees).

- A. Clemente, J. L. Gonzalez-Jiménez, “Advanced transceiver-antenna co-integration techniques at mmWave and sub-THz: recent achievements and future challenges” (presented by Antonio Clemente, CEA)

IEEE GLOBECOM 2023 Workshop

IEEE GLOBECOM Workshop on Reconfigurable Intelligent Surfaces-Empowered 3CLS for 6G and Beyond Communications, 04-08 December 2023, Kuala Lumpur, Malaysia (approximately 20 attendees).

- “Enhancing NLoS RIS-Aided Localization with Optimization and Machine Learning” (presented by Luis M. Pessoa, INESC TEC)

3.2.2. Conference and Workshop presentations M13-M24

EuCAP 2024

2024 18th European Conference on Antennas and Propagation (EuCAP), 17-22 March 2024, Glasgow, United Kingdom.

- “Automatic Planning Algorithm of 300 GHz Backhaul Links Using Mesh Topology” (presented by B. K. Jung, TUBS)
- “Performance Analysis of THz Backhaul Links Assisted by Reconfigurable Intelligent Surfaces” (presented by B. K. Jung, TUBS)
- “1-Bit SubTHz RIS with Planar Tightly Coupled Dipoles: Beam Shaping and Prototypes” (presented by Xianjun Ma, UH)
- “Adaptive Polynomial Chaos Expansion for Uncertainty Quantification of SubTHz Horn Antennas with Flat-Top Radiation Patterns” (presented by Qi Luo, UH)
- “Irregular Subarray with Gathered Elements for Sidelobe Suppression” (presented by Yihan Ma, UH)
- “Improved Performance of a 1-Bit RIS by Using Two Switches per Bit Implementation” (presented by Fábio Martinho Cardoso, IT)
- “Multibeam Antenna for Wide-Angle 95-Beam Coverage at Ka-Band Using a Multifocal Transmit-Array” (presented by Sérgio Matos, IT)
- “Novel Risley Prism Design Approach with Improved Side Lobe Levels Using Multi-Layer Transmit-Arrays” (presented by Sérgio Matos, IT)
- “Reconfigurable Intelligent Surfaces for THz: Hardware Design and Signal Processing Challenges” (presented by Luis M. Pessoa, INESC TEC)
- “Sub-THz Spatially Modulated Beam Splitting Reflectors for Potential RIS Implementations” (presented by Tung Duy Phan, UOULU)

ICASSP 2024

2024 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 14-19 April 2024, Seoul, Republic of Korea.

“Metasurface-based receivers with 1-bit ADCs for multi-user uplink communications” (presented by George Alexandropoulos, NKUA)

- “Leaky waveguide antennas for downlink wideband THz communications” (presented by Nir Shlezinger)
- “Near-field localization with 1-bit quantized hybrid A/D reception” (presented by George Alexandropoulos, NKUA)

- “Joint near-field target tracking and communications with full duplex holographic MIMO” (presented by George Alexandropoulos, NKUA)

EuCNC 2024 & 6G Summit

European Conference on Networks and Communications (EuCNC 2024) & 6G Summit, 03-06 June 2024, Antwerp, Belgium.

- “A Deep Learning Approach in RIS-based Indoor Localization” (presented by Luis M. Pessoa, INESC TEC)
- Contribution to Workshop on IMT-2030:
- "Integrated Sensing and Communications-Enabled 6G Networks"

Joint SNS Workshop 2024

SNS Workshop organised in cooperation among SNS projects TERRAMETA, TIMES 6G, and 6G-SHINE projects, in synergy with the Fondazione RESTART (IN project), in Bologna, Italy, 1 February 2024 (co-organiser Luis M. Pessoa, INESC TEC). TERRAMETA delivered the following talks:

- “Overview of the TERRAMETA Project” (presented by Luis M. Pessoa, INESC TEC)
- "Scalability Analysis of RIS in Terahertz" (presented by J. Vázquez Peralvo, UniLu)
- "RIS Application on THz X-haul Links from Simulation to Measurement" (presented by B. K. Jung, TUBS)
- “Advanced transceiver-antenna co-integration techniques at mmWave and sub-THz: recent achievements and future challenges” (presented by A. Clemente, CEA)

WCNC Workshop

2024 IEEE Wireless Communications and Networking Conference (WCNC), 21-24 April 2024, Dubai, United Arab Emirates.

- “Reflecting Intelligent Surfaces Assisted High-Rank Ultra Massive MIMO Terahertz Channels” (presented by C. Sheemar, UNILU)

AT-RASC

2024 4th URSI Atlantic Radio Science Meeting (AT-RASC), 19-24 May 2024, Meloneras, Spain.

- “On the Comparison of THz X-Haul Links using Generic Rain Cloud Movement” (presented by B. K. Jung, TUBS)

IEEE APS 2024

2024 IEEE International Symposium on Antennas and Propagation and INC/USNC-URSI Radio Science Meeting (AP-S/INC-USNC-URSI), 14-19 July 2024, Firenze, Italy.

- “Dual-band unit cell for electronically reconfigurable reflectarrays at mmWave” (presented by M. Bouslama, CEA)
- “Numerical tool for the analysis and synthesis of transmitarrays in Fresnel region” (presented by M. Defives, CEA)
- “Scalability Analysis of Reflective Intelligent Surfaces at THz Frequencies” (presented by J.A. Vasquez-Peralvo, UNILU)
- “Initial Study of a Sub-THz Reconfigurable Reflector Using Actuated Liquid Metal Droplet” (presented by Di Kong, UOULU)

2024 International Applied Computational Electromagnetics Society Symposium (ACES-China)

2024 International Applied Computational Electromagnetics Society Symposium (ACES-China). Special session entitled "Advances in Multi-Functional Antennas and Antenna Arrays", 16-19 August 2024, Xian, China, (approximately 1000 attendees).

- "A Gradient Descent Method for Phase Only Pattern synthesis of Irregular Subarray" (presented by Yihan Ma, UH)

IEEE SPAWC

2024 IEEE 25th International Workshop on Signal Processing Advances in Wireless Communications (SPAWC), 10-13 September 2024, Lucca, Italy.

- "Asymptotically Optimal Closed-Form Phase Configuration of 1-bit RISs via Sign Alignment" (presented by George Alexandropoulos, NKUA)

ICEAA 2024

2024 International Conference on Electromagnetics in Advanced Applications (ICEAA), 02-06 September 2024, Lisbon, Portugal.

- "Dual-band frequency selective surface in quartz for transmitarray applications at sub-THz" (presented by B. Ouadi, CEA)
- "Reconfigurable Intelligent Surfaces for THz: Hardware Impairments and Switching Technologies" (presented by Mohamed E. Ghatas, INESC TEC)
- "Memristor-Based 1-Bit Reconfigurable Intelligent Surface for 6G Communications at D-Band" (presented by Mohamed E. Ghatas, INESC TEC)

MTT-S IMS 2024

MTT-S International Microwave Symposium, 16-21 June 2024, Washington, China.

- "An energy efficient 56-Gb/s D-band point-to-point link based on CMOS TX and RX modules and transmitarray beamformers" (presented by J. L. Gonzalez-Jiménez, CEA)

IEEE ISAP 2024

The 29th International Symposium on Antennas and Propagation (ISAP 2024), 5-8 November 2024, Songdo Convensia, Republic of Korea.

- "Power Scalability Modeling of Reconfigurable Intelligent Surfaces for THz Applications" (presented by P. N. Vummadisetty, UNILU)
- "RIS Subset Selection/Assignment Based on Multi-Armed Bandit in Multi-RIS-Aided Communications" (presented by J.A. Vasquez-Peralvo, UNILU)

2024 IEEE International Electron Devices Meeting (IEDM 2024)

70th Annual IEEE International Electron Devices Meeting, 7-11 December 2024, San Francisco, USA.

- "CMOS compatible 200 mm GaN-on-Si HEMTs for RF switch applications with 36 dBm CW power handling and 200 fs RonCoff" (presented by L. Lucci, CEA)

EuCAP 2025

19th European Conference on Antennas and Propagation, 30 March – 4 April, Stockholm, Sweden. Accepted papers:

- "Enhancing Wireless Communications at 300 GHz using RIS in an Industrial Scenario" (to be presented by Georg Jensen, TUBS)
- "Channel Measurements Involving Passive RIS at 300 GHz" (to be presented by Lorenz Löser, TUBS)
- "T-RIS and R-RIS experimental characterization in the sub-THz band" (to be presented by B. K. Jung, TUBS)

- “A Phase Correcting Surface Based on a D-Band Transmitarray Antenna using Hybrid-PCB-CMOS Technology” (to be presented by Kumar, CEA)
- “Design and characterization of a transmitarray for near-field at sub-THz” (to be presented by M. Defives, CEA)
- “Multifunctional dual-band metasurface-based transmit- and reflect-arrays at sub-THz” (to be presented by B. Ouradi, CEA)
- “Analysis of Reconfigurable Reflective Unit Cells in Waveguide Environment for Ka and D Band” (to be presented by Luis M. Pessoa, INESC TEC)
- “1-Bit Reconfigurable Intelligent Surface Unit Cell Based on Non-Volatile Technology at D-Band” (to be presented by Luis M. Pessoa, INESC TEC)
- “Indoor Channel Characterization with Extremely Large Reconfigurable Intelligent Surfaces at 300 GHz” (to be presented by Sergio Matos, IT)

IEEE WCNC 2025

IEEE Wireless Communications and Networking Conference 2025, 24-27 March, Milan, Italy

- “Rate-Splitting Multiple Access for a Multi-RIS-Assisted Cell-Free Network with Low-Resolution DACs” (to be presented by M. R. Camana, UNILU)

3.2.3. Other events MI-M12

In addition to conferences and workshops, there were also many other events in which TERRAMETA took part. These events, which include webinars, invited talks and lectures, seminars and various meetings, can be found in this section.

Spanish URSI Symposium 2023

URSI 2023 - XXXVIII Simposio Nacional de la Unión Científica Internacional de Radio, 13-15 September 2023, Caceres, Spain (approximately 20 attendees).

- “Reconfigurable intelligent surfaces for communications and sensing” (presented by Luis M. Pessoa, INESC TEC)

SNS Lunchtime Webinar

Stream B2 & B3 projects addressing: Wireless Communications and Signal Processing & Communication Infrastructure and Devices, 06 March 2023, online (approximately 90 attendees).

- “Project overview presentation” (presented by Luis M. Pessoa, INESC TEC)

IEEE P802.15 Meeting

IEEE P802.15 Working Group for Wireless Speciality Networks (WSN), 13 March 2023, Atlanta, USA.

- “Overview on the Horizon Europe 6G SNS Project TERRAMETA” (presented by Thomas Kürner, TUBS)

Symat COST Action Meeting

COST Action CA18223 - SYMAT - Future Communications with higher symmetric engineered artificial materials, 04 May 2023, Lisbon, Portugal (approximately 50 attendees).

- “Overview of INESC TEC research activities including an overview of TERRAMETA Project” (presented by Luis M. Pessoa, INESC TEC)
- “Manipulation and control of electromagnetic waves using programmable surfaces” (presented by Antonio Clemente, CEA)

IEEE CSCN 2023

IEEE Conference on Standards for Communications and Networking, 11 August 2023, Munich, Germany (approximately 40 attendees).

- Special session: “Key challenges for enabling high-performance short-range communications in extreme propagation environments” (Organizer: Luis M. Pessoa, Panel participation: Sean Ahearne (EISI), George C. Alexandropoulos (NKUA))
- Invited Talk: “TERRAMETA – THz Reconfigurable Intelligent Surfaces for next generation communications and sensing” (presented by Sean Ahearne, EISI)

School of Advanced Studies

The Lake Como School of Advanced Studies, 4 July 2023, Lake Como, Italy (approximately 20 attendees).

- “Reconfigurable intelligent surfaces: From programmable wireless propagation to holographic MIMO” (presented by George C. Alexandropoulos, NKUA)
- “Programmable electromagnetic surfaces: from modelling to functional prototypes and PoCs” (presented by Antonio Clemente, CEA)

IEEE Signal Processing Society Summer School

The Summer School on Integrated Sensing and Communication sponsored by the IEEE Signal Processing Society, IEEE Aerospace and Electronic Systems Society, and EURASIP, 28 June 2023, Baiona, Spain (approximately 20 attendees).

- “Beamforming for joint radar and communication with self-interference cancellation constraints” (presented by George C. Alexandropoulos, NKUA)
- “RIS-aided joint radar and communication” (presented by George C. Alexandropoulos, NKUA)
- “Reconfigurable intelligent surfaces: From programmable wireless propagation to holographic MIMO” (presented by George C. Alexandropoulos, NKUA)

UK-Taiwan Joint Webinar

The UK-Taiwan Joint Webinar on Next Generation Multiple Access and AI for 6G, 1 May 2023, Online (approximately 15 attendees).

- Invited talk “Integrated sensing and communications with multi-functional reconfigurable metasurfaces” (presented by George C. Alexandropoulos, NKUA)

IEEE ComSoc Distinguished Lectureships

- IEEE ComSoc Distinguished Lectureship at the University of Glasgow, 30 March 2023, Glasgow, Scotland (approximately 20 attendees).
 - Lectureship “Reconfigurable metasurfaces for 6G wireless: Hardware architectures, modeling, optimization, and applications” (presented by George C. Alexandropoulos, NKUA)
- IEEE ComSoc Distinguished Lectureship at the Department of Electrical and Computer Engineering University of Illinois at Chicago, 10 March 2023, Chicago, USA (approximately 30 attendees).
 - Lectureship “Hybrid reconfigurable intelligent Surfaces: From channel estimation improvement to self-optimization” (presented by George C. Alexandropoulos, NKUA)
- IEEE ComSoc Distinguished Lectureship at EURECOM, 09 February 2023, Nice, France (approximately 20 attendees).

- Lectureship “Integrated sensing and communications with multi-functional reconfigurable metasurfaces” (presented by George C. Alexandropoulos, NKUA)
- IEEE ComSoc Distinguished Lectureship at the School of Physics, Engineering, and Computer Science, 14-15 September 2023, University of Hertfordshire, Cambridge, UK (approximately 15 attendees).
 - Lectureship “Hybrid reconfigurable intelligent surfaces: From conventional optimization to autonomous learning” (presented by George C. Alexandropoulos, NKUA)
“Reconfigurable intelligent surfaces: From programmable wireless propagation to holographic MIMO” (presented by George C. Alexandropoulos, NKUA)
- IEEE ComSoc Distinguished Lectureship at the Institute of Radiocommunications, Faculty of Computing and Telecommunications, 16 November 2023, Poznan University of Technology, Poznan, Poland (approximately 20 attendees).
 - Lecture “Joint sensing and communications with full duplex radios and reconfigurable metasurfaces” (presented by George C. Alexandropoulos, NKUA).

Invited talk at Lancaster University

Invited talk at School of Engineering - Lancaster University, 09 June 2023, Lancaster, UK.

- “Intelligent Reflective Surfaces in the Era of 6G” (presented by Henrique M. Salgado, INESC TEC)

National Conference on Communications

National Conference on Communications, Indian Institute of Technology Guwahati, 23 – 25 February 2023, Guwahati, India (approximately 40 attendees).

- Tutorial “Reconfigurable intelligent surfaces and holographic MIMO transceivers: Current status and future directions” (presented by George C. Alexandropoulos, NKUA)
- “Hybrid reconfigurable intelligent Surfaces: From channel estimation improvement to self-optimization” (presented by George C. Alexandropoulos, NKUA)

IEEE PIMRC 2023

IEEE International Symposium on Personal, Indoor and Mobile Radio Communications Workshop “6G Envisioned Reconfigurable Intelligent and Holographic Surfaces”, 05 September 2023, Toronto, ON, Canada (approximately 30 attendees).

- “Integrated sensing and communications with multi-functional reconfigurable metasurfaces” (presented by George C. Alexandropoulos, NKUA)

CMD30 FisMat 2023

CMD30 FisMat 2023, Minicolloquia, 04-08 September 2023, Milano, Italy (approximately 60 attendees).

- Invited lecture “New Insights on Emerging Materials and Concepts for Neuromorphic Computing” (presented by Asal Kiazadeh, NOVA ID)

E-MRS Spring

E-MRS Spring, 29 May – 02 June 2023, Strasbourg, France (approximately 500 attendees).

- Lecture “Sustainable Zinc tin oxide artificial synapses towards energy-efficient in-memory computation architecture” (presented by Asal Kiazadeh, NOVA ID)

- Lecture “Sustainable solution-processed oxide memristors: Approaches to interface analysis by XPS” (presented Jonas Deuermeier, NOVA ID)

Annual Conference on Global Nanotechnology

2nd Annual Conference on Global Nanotechnology, Instituto De Ciencia De Materiales De Madrid (ICMM-CSIC), 19-21 June 2023, Madrid, Spain (approximately 100 attendees).

- Invited lecture “Sustainable and viable processes to produce metal oxide devices in large scale manufacturing” (presented by Emanuel Carlos, NOVA ID)

International Conference on Memristive Materials, Devices & Systems

6th International Conference on Memristive Materials, Devices & Systems, 05-09 November 2023, Torino, Italy (approximately 500 attendees).

- Lecture “Cost-effective Solution-based metal oxide memristors” (presented by Raquel A. Martins, NOVA ID)
- Lecture “ZTO memristor devices and applications” (presented by Carlos Silva NOVA ID)

Congress of the Portuguese Committee of the URSI

17th Congress of the Portuguese Committee of the URSI, 24 November 2023, ANACOM's head office, Lisbon (approximately 40 attendees).

- Invited talk and panel session on “Smart materials for radioscience” (Asal Kiazadeh (NOVA ID) and Luis M. Pessoa (INESC TEC))

TED talk

Portuguese TED talk organized by Escola 42 Lisboa, 15 November 2023 (approximately 50 attendees on site).

- “AI hardware of future” (presented by Asal Kiazadeh, NOVA ID)
 - <https://www.youtube.com/watch?v=4SPi8zzbEbk>

ICT-52 and Hexa-X Workshop on 6G

Radio and sensing for 6G session of the ICT-52 and Hexa-X Workshop on 6G, 18 January 2023, online (approximately 50 attendees).

- Invited talk “Localization, sensing, and their integration with reconfigurable intelligent surfaces” (presented by George C. Alexandropoulos, NKUA)

RISE-6G Training Workshop

RISE-6G Training Workshop, 12 December 2023, online (104 attendees).

- Tutorial “The RIS technology: Today’s key pillars and open challenges” (presented by George C. Alexandropoulos, NKUA)

Expert Seminar on 6G

Expert Seminar on 6G: New PHY-layer solutions and spectrum, jointly organized by the Directorate-General for Research and Innovation of the European Commission and the National Science and Technology Council of Taiwan, 14 December 2023, online (approximately 50 attendees).

- Seminar “Multi-functional RISs, holographic MIMO, integrated sensing and communications, cell-free smart wireless environments” (presented by George C. Alexandropoulos, NKUA)

National SME Meeting Telecommunications

National SME Meeting Telecommunications, XXVII National SME Meeting in the sector of Telecommunications, 30 November 2023, Lisbon, Portugal (approximately 40 attendees).

- “The path towards 6G” (presented by Luis M. Pessoa, INESC TEC)

3.2.4. Other events M13-M24

Seminar at Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg (Luxembourg City, Luxembourg)

Seminar, 17. January, SnT University of Luxembourg (approximately 50 attendees).

- Seminar "Simultaneous sensing and communications with full duplex MIMO and reconfigurable intelligent surfaces" (presented by George C. Alexandropoulos)

Hexa-X II Workshop on 6G

Invited talk at Hexa-X II Workshop on 6G, 26 January 2024, (approximately 200 attendees).

- "The RIS potential for THz wireless applications: Feasibility study and open challenges" (presented by George C. Alexandropoulos)

IEEE ICASSP 2024

IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP2024), 14-19 April, Seoul, Korea

Special session:

- "Advancements in Integrated Sensing and Communication for Next-Generation Wireless Networks" (co-organiser George C. Alexandropoulos)

Satellite workshop:

- "Super-resolution integrated communications, localization, vision and radio mapping (SUPER- CLAM)" (co-organisers Luis M. Pessoa and George C. Alexandropoulos)

Hannover Messe 2024

Hannover Messe, trade fair dedicated to the topic of industry development in Germany, April 2024. This panel session was organized together with 6G-SHINE and TIMES 6G projects to discuss the future of 6G.

Participation in Panel: "Is Industry waiting for 6G?", presented by Luis M. Pessoa (INESC TEC)

InterView June 2024

- INTRACOM's newsletter "InterView June 2024". Short description of Intracom's contributions to Terrameta, 6 June 2024
- "Intracom Telecom and CEA-Leti Demonstrate D-band Link with RIS Technology" (presented by Evangelos Pikasis)

CMD31

31st General Conference of the Condensed Matter Division, 2-6 September 2024, Braga, Portugal.

- Invited talk: "Chemical and electrostatic surface characterization with photoelectron spectroscopy - a tutorial" (presented by Jonas Deuermeier) (approximately 50 attendees)
- Invited talk: "Memristors for computation and communication." (presented by Asal Kiazadeh)
- Conference presentation: "Development of conductive inks and memristive active material for printed electronic applications" (presented by Miguel Franco)

LOPEC 2024

Sustainable processes to produce metal oxide devices up to large scale manufacturing, LOPEC, 25-27 February, Munich, Germany. (approximately 100 attendees)

- Invited talk: "Sustainable processes to produce metal oxide devices up to large scale manufacturing" (presented by Jonas Deuermeier)

CIMTEC 2024

Global Conference “Materials in an Explosively Growing Informatics World”, 20-24 June, Montecatini Terme, Italy. (approximately 100 attendees)

- Invited talk: "Solution processing of metal oxide memristors: from coating to printing" (presented by Emanuel Carlos)

IEEE ICC 2024

IEEE International Conference on Communications, 9–13 June 2024, Denver, USA

- Tutorial: "Full-duplex MIMO for Simultaneous Communications and Sensing" (presented by George C. Alexandropoulos)

IEEE COMSOC

IEEE COMSOC Chicago, 14 June 2024, Chicago, USA

- Lecture: "Multi-RIS-empowered smart wireless networks: Capacity characterization and environment learning potential" (presented by George C. Alexandropoulos)

ECASIA 24

European Conference on Applications of Surface and Interface Analysis, 9-14 June, Gothenburg, Sweden.

- Oral talk: "XPS barrier height measurements without “busting the bank”: In-chamber metal deposition on solution-processed zinc-tin oxide." (presented by Jonas Deuermeier)

EuMW 2024

European Microwave Week, 22-27 September 2024, Paris expo Porte de Versailles, France. (approximately 5000 attendees)

- 6G-corner: CEA-LETI (TERRAMETA Demo) (presented by José Luis Gonzalez), (approximately 100 attendees)
- Demonstrator at the conference exhibition that showcased an advanced scenario tailored for mobile robots in factory environments, featuring real-time 3D reconstruction of surroundings (co-organisers CEA-Leti, Intracom and Dell). This cutting-edge setup included:
 - A baseband unit developed by *Intracom Telecom* with a 2 GHz baseband bandwidth.
 - A D-band transceiver operating at 145 GHz, supporting bandwidths up to 17 GHz.
 - Active RISs (developed by *CEA-Leti*), enabling seamless communication in NLOS scenarios.
- Workshop “Disruptive sub-THz antenna and transceiver systems for future sensing, localization and communication” (co-organizers Antonio Clemente and José-Luis González-Jiménez), (approximately 50 attendees)
 - Challenges of sub-THz RIS-based Systems: Contributions from the TERRAMETA Project, presented by Luis M. Pessoa (INESC TEC)
 - Channel Measurements and Modelling for 300 GHz Reconfigurable Intelligent Surfaces, presented by Bo Kum Jung (TUBS)
 - Microfluidic-based Reconfigurable Intelligent Surfaces for Joint Communication and Sensing at sub-THz, presented by Tung Phan (UOULU)
 - Efficient D-band Transceivers for Point to Point Links Based on Channel Aggregation and High Gain Antennas, presented by José Luis González Jiménez (CEA-Leti)

TCO2024

Transparten Conductive Oxides, 23-27 September, Leipzig, Germany. (approximately 100 attendees)

- Invited talk: "XPS barrier height measurements without “busting the bank”: In-chamber metal deposition on solution-processed zinc-tin oxide." (presented by Jonas Deuermeier)

HEXA-X-II

HEXA-X-II Online Workshop. (approximately 100 attendees)

- Invited talk at Hexa-X-II SNS ISAC Workshop: "THz multi-functional RISs and ISAC" (presented by George C. Alexandropoulos)

Symposium EP02

Symposium EP02- Memristor devices from theory to system level integration for next generation of computation and communication, 9-11 June 2024. (approximately 100 attendees)

- "2D-memristor-based RF switches for applications in reconfigurable intelligent surfaces." (Symposium organization: Jonas Deuermeier, Asal Kiazadeh and Emanuel Carlos)

B-MRS XXII

B-MRS XXII organized by the The Brazilian Materials Research Society (B-MRS), 29 September – 3 October, Santos - São Paulo, Brazil. (approximately 200 attendees)

- Invited talk: "Sustainable processes to produce metal oxide devices: from coating to printing" (presented by Emanuel Carlos)

5G Techritory 2024

5G Techritory 2024 29-31 October, Riga, Latvia. (approximately 1700 attendees)

- Terrameta video presentation included in the event.

IEEE AWPL Special Cluster 2025

- "Reconfigurable and Multifunctional Electromagnetic Surfaces for Emerging Wireless Systems" (co-organizer: Ping Jack Soh, Tung Phan, Qi Luo, Sergio Matos, Antonio Clemente, Marco Di Renzo)

Workshops at IEEE International Conference on Communications 2024

Second and third Workshops in the framework of the IEEE International Conference on Communications (ICC), Denver, USA, on 13 June 2024.

- Second Workshop on "Near-Field Communications, Localization, and Sensing" (co-organizer: George C. Alexandropoulos, NKUA)
- Third Workshop on "Synergies of Communication, Localization, and Sensing towards 6G" (co-organizer: George C. Alexandropoulos, NKUA)

International Symposium on Joint Communications and Sensing 2024

International Symposium on Joint Communications and Sensing, Leuven, Belgium on 19 March 2024.

- Tutorial: "Integrated sensing and communications: Fundamental limits, signal design, and emerging PHY technologies" (presented by George C. Alexandropoulos, NKUA).

Seminar at the Department of Electronics Engineering, Chungnam National University

Research seminar at the Department of Electronics Engineering, Chungnam National University, Daejeon, South Korea on 11 April 2024 (approximately 30 attendees).

- Seminar: "Localization and sensing with multi-functional reconfigurable intelligent surfaces" (presented by George C. Alexandropoulos, NKUA).

5G Italy Conference 2024

Keynote talk at the 5G Italy conference, Rome, Italy, sponsored by the Italian National Inter-University Consortium for Telecommunications (CNIT), on 17 April 2024 (approximately 40 attendees).

- Keynote talk: "The RIS technology for beyond 5G wireless: Modeling, optimization, and applications" (presented by George C. Alexandropoulos, NKUA).

IEEE Wireless Communications and Networking Conference 2024

Tutorial at the IEEE Wireless Communications and Networking Conference (WCNC), Dubai, UAE on 21 April 2024 (approximately 15 attendees).

- Tutorial: "Integrated sensing and communications: Fundamental limits, signal design, and emerging PHY technologies" (presented by George C. Alexandropoulos, NKUA).

IEEE International Symposium on Intelligent Signal Processing and Communication Systems 2024

Keynote talk at the IEEE International Symposium on Intelligent Signal Processing and Communication Systems, Kaohsiung, Taiwan on 11 December 2024 (approximately 50 attendees).

- Keynote talk: "Hybrid reconfigurable intelligent surfaces: From programmable signal reflections to distributed intelligent sensing" (presented by George C. Alexandropoulos, NKUA).

IEM Distinguished Lectureships 2024

Invited talk in the framework of the IEM Distinguished Lectureships Seminar at the Institute of Electrical and Micro Engineering, EPFL, Lausanne, Switzerland on 12 November 2024 (approximately 30 attendees).

- Talk: "Reconfigurable intelligent surfaces for extending the limits of wireless communications" (presented by George C. Alexandropoulos, NKUA).

IEEE CSCN 2024

IEEE Conference on Standards for Communications and Networking, November 2024.

- Special session: "Key enablers for integrated sensing and communications in industrial environments" (Co-organizer: Luis M. Pessoa, in cooperation with projects TIMES and 6G-SHINE)

Joint Webinar on Sustainable Wireless Design

TERRAMETA, 6G-SHINE and SUPERIOT co-organised a joint online webinar on a shared topic: Sustainable Wireless Design, 29 November 2024 (co-organiser Luis M. Pessoa, INESC TEC). TERRAMETA delivered the following talk:

- "Reconfigurable intelligent surface-based networks", presented by Luis M. Pessoa (INESC TEC)

3.3. Journal publications M1-M12

9 journal papers have been published in 2023 acknowledging TERRAMETA.

- [1] B. Smida, A. Sabharwal, G. Fodor, G. C. Alexandropoulos, H. A. Suraweera, and C.-B. Chae, "Full-duplex wireless for 6G: Progress brings new opportunities and challenges," *IEEE Transactions on Wireless Communications*, vol. 41, no. 9, pp. 2729–2750, September 2023.
- [2] J. An, C. Xu, D. W. K. Ng, G. C. Alexandropoulos, C. Huang, C. Yuen, and L. Hanzo, "Stacked intelligent metasurfaces enabling efficient holographic MIMO communications for 6G," *IEEE Journal on Selected Areas in Communications*, vol. 41, no. 8, pp. 2380–2396, August 2023.
- [3] M. Perreira, P. barquinha, E. Fortunato, R. Matins, and A. Kiazadeh, "Recent progress in optoelectronic memristors for neuromorphic and in-memory computation," *Journal of Neuromorphic Computing and Engineering*, vol. 3, no. 2, pp. 2634-4386, May 2023.
- [4] L. Wei, C. Huang, G. C. Alexandropoulos, Z. Yang, J. Yang, W. E. I. Sha, Z. Zhang, M. Debbah, and C. Yuen, "Tri-polarized holographic MIMO surface in near-field: Channel modeling and precoding design," *IEEE Transactions on Wireless Communications*, 2023.

- [5] H. Kim, H. Chen, M. F. Keskin, Y. Ge, K. Keykhosravi, G. C. Alexandropoulos, S. Kim, and H. Wymeersch, "RIS-Enabled and Access-Point-Free Simultaneous Radio Localization and Mapping," *IEEE Transactions on Wireless Communications*, 2023.
- [6] A. Papazafeiropoulos, P. Kourtessis and S. Chatzinotas, "Max-Min SINR Analysis of STAR-RIS Assisted Massive MIMO Systems with Hardware Impairments," *IEEE Transactions on Wireless Communications*.
- [7] C. Silva, J. Deuermeier, W. Zhang, E. Carlos, P. Barquinha, R. Martins, A. Kiazadeh, "Perspective: Zinc-Tin Oxide based Memristors for Sustainable and Flexible In-memory computing edge devices," *Advanced Electronic Materials* (2023), pp. 1-16.
- [8] T. Gong, P. Gavriilidis, R. Ji, C. Huang, G. C. Alexandropoulos, L. Wei, M. Debbah, H. V. Poor, and C. Yuen, "Holographic MIMO communications: Theoretical foundations, enabling technologies, and future directions," *IEEE Communications Surveys & Tutorials*, to appear, 2023.
- [9] S. Gharbieh, J. Milbrandt, B. Reig, D. Mercier, M. Allain, and A. Clemente, "Design of a binary programmable transmitarray based on phase change material for beam steering applications in D-Band", *Scientific Reports*, to appear, 2023.

3.4. Journal publications M13-M24

19 journal papers have been published in 2024 acknowledging TERRAMETA.

- [1] Raquel Azevedo Martins, Emanuel Carlos, Asal Kiazadeh, Rodrigo Martins and Jonas Deuermeier, "Low-Temperature Solution-Based Molybdenum Oxide Memristors", *ACS Applied Engineering Materials*, January 2024.
- [2] S. Gharbieh, J. Milbrandt, B. Reig, D. Mercier, M. Allain and A. Clemente, "Design of a binary programmable transmitarray based on phase change material for beam steering applications in D-Band", *Scientific Reports*, February 2024.
- [3] Antonin Rabault, Luc Le Magoarou, Jérôme Sol, George C. Alexandropoulos, Nir Shlezinger, H. Vincent Poor and Philipp del Hougne, "On the Tacit Linearity Assumption in Common Cascaded Models of RIS-Parametrized Wireless Channels", *Transactions on Wireless Communications*, February 2024.
- [4] Miguel Franco, Asal Kiazadeh, Jonas Deuermeier, S. Lanceros-Méndez, Rodrigo Martins and Emanuel Carlos, "Inkjet printed IGZO memristors with volatile and non-volatile switching", *Scientific Reports*, March 2024.
- [5] J. Xu, L. You, G. C. Alexandropoulos, X. Yi, W. Wang and X. Gao, "Near-Field Wideband Extremely Large-Scale MIMO Transmissions With Holographic Metasurface-Based Antenna Arrays", *Transactions on Wireless Communications*, April 24.
- [6] J. L. Gonzalez-Jimenez, A. Siligaris, A. Hamani, F. Foglia Manzillo, P. Courouve, N. Cassiau, C. Dehos and A. Clemente, "An Energy-Efficient 56-Gb/s D -Band TX-to-RX Link Using CMOS ICs and Transmitarray Antennas", *Microwave and Wireless Technology Letters*, May 24.
- [7] R. Ghazalian, G. C. Alexandropoulos, G. Seco-Granados, H. Wymeersch and R. Jäntti, "Joint 3D user and 6D hybrid reconfigurable intelligent surface localization", *Transactions on Vehicular Technology*, June 24.
- [8] Maria Elias Pereira, Jonas Deuermeier, Rodrigo Martins, Pedro Barquinha and Asal Kiazadeh, "Unlocking Neuromorphic Vision: Advancements in IGZO-Based Optoelectronic Memristors with Visible Range Sensitivity", *Applied Electronic Materials*, July 24.
- [9] Miguel Franco, Asal Kiazadeh, Rodrigo Martins, Senentxu Lanceros-Méndez and Emanuel Carlos, "Printed Memristors: An Overview of Ink, Materials,

- Deposition Techniques, and Applications", *Advanced Electronic Materials*, August 24.
- [10] Di Kong, Duy Tung Phan, Jaakko Palosaari, Jari Juuti, Aarno Pärssinen and Ping Jack Soh, "A Simplified Method for Designing Highly-Efficient Reflective Metasurfaces with Wide Steering Angles", *IEEE Antennas and Propagation Letters*, August 24.
- [11] Yonggang Zhou, Xianjun Ma, Qi Luo, Yihan Ma, George C. Alexandropoulos and Xinyu Yang, "Wideband sub-THz Reconfigurable Intelligent Surface Using Planar Tightly Coupled Dipoles", *IEEE Antennas and Wireless Propagation Letters*, August 24.
- [12] M. Merluzzi and A. Clemente, "Anomalous and specular reflections of reconfigurable intelligent surfaces: configuration strategies and system Performances", *Wireless Communications Letters*, August 24.
- [13] Li, Qiang, Yehuai Feng, Miaowen Wen, Jinming Wen, George C. Alexandropoulos, Ertugrul Basar and H. Vincent Poor, "Cooperative Backscatter Communications with Reconfigurable Intelligent Surfaces: An APSK Approach", *Transactions on Wireless Communications*, August 24
- [14] Y. Ma, Q. Luo, C. Zhang and G. Yang, "Deep Learning Enables Multifunctional Metasurfaces Design With Mutual Coupling Estimation", *Transactions on Antennas and Propagation*, August 24.
- [15] K. D. Katsanos, P. D. Lorenzo and G. C. Alexandropoulos, "Multi-RIS-Empowered Multiple Access: A Distributed Sum-Rate Maximization Approach", *Journal of Selected Topics in Signal Processing*, September 24.
- [16] A. Ghaneizadeh, P. Gavriilidis, M. Joodaki and G. C. Alexandropoulos, "Metasurface Energy Harvesters: State-of-the-Art Designs and Their Potential for Energy Sustainable Reconfigurable Intelligent Surfaces", *IEEE Access*, September 24.
- [17] A. L. Moustakas and G. C. Alexandropoulos, "MIMO MAC Empowered by Reconfigurable Intelligent Surfaces: Capacity Region and Large System Analysis", *Transactions on Wireless Communications*, Oktober 24
- [18] Evangelos Vlachos, Aryan Kaushik, Yonina C. Eldar and George C. Alexandropoulos, "Time-Domain Channel Estimation for Extremely Large MIMO THz Communication Systems Under Dual-Wideband Fading Conditions", *Transactions on Communications*, under review
- [19] A. D. Papadopoulos, Y. Ma, Q. Luo and G. C. Alexandropoulos, "Adaptive polynomial chaos expansion for uncertainty quantification and optimization of horn antennas at subTHz frequencies", *Transactions on Antennas and Propagation*, under review

3.5. Magazine publications M1-M12

Two magazine papers have been published acknowledging TERRAMETA.

- [1] G. C. Alexandropoulos, N. Shlezinger, I. Alamzadeh, M. F. Imani, H. Zhang, and Y. C. Eldar, "Hybrid reconfigurable intelligent metasurfaces: Enabling simultaneous tunable reflections and sensing for 6G wireless communications," *IEEE Vehicular Technology Magazine*, early access, 2023.
- [2] A. Masaracchia, D. V. Huynh, G. C. Alexandropoulos, B. Canberk, O. A. Dobre, and T. Q. Duong, "Towards the metaverse realization in 6G: Orchestration of RIS-enabled smart wireless environments via digital twins," *IEEE Internet of Things Magazine*, 2023.

3.6. Magazine publications M13-M24

- [1] Masaracchia, D. V. Huynh, G. C. Alexandropoulos, B. Canberk, O. A. Dobre and T. Q. Duong, "Toward the Metaverse Realization in 6G: Orchestration of RIS-Enabled Smart Wireless Environments via Digital Twins", *Internet of Things Magazine*, March 24.
- [2] T. Gong, L. Wei, C. Huang, G. C. Alexandropoulos, M. Debbah and C. Yuen, "Near-field channel modeling for holographic MIMO communications", *Wireless Communications Magazine*, June 24.
- [3] Ertugrul Basar, George C. Alexandropoulos, Yuanwei Liu, Qingqing Wu, Shi Jin, Chau Yuen, Octavia A. Dobre and Robert Schober, "Reconfigurable Intelligent Surfaces for 6G: Emerging Hardware Architectures, Applications, and Open Challenges", *Vehicular Technology Magazine*, July 2024.
- [4] A. M. Elbir, K. V. Mishra, S. Chatzinotas and M. Bennis, "Terahertz-Band Integrated Sensing and Communications: Challenges and Opportunities", *Aerospace and Electronic Systems Magazine*, Oktober 24.

3.7. Whitepapers

- M. Uusitalo, 'European Vision for the 6G Network Ecosystem'. Zenodo, Nov. 24, 2024. doi: 10.5281/zenodo.14230482.

3.8. Interactions with other projects M1-M12

As illustrated by the actions listed above, TERRAMETA has actively pursued collaborations and synergies with other ICT-52, H2020, and Horizon Europe SNS JU projects.

- In EuCNC & 6G Summit 2023 a workshop has been co-organised alongside ICT-52 projects RISE-6G and ARIADNE as well as the European Training Network project Meta Wireless.
- TERRAMETA partners were involved with the ICT-52 project RISE-6G Training Workshop by giving a tutorial speech on RIS technology and participating on a panel discussion on RIS commercialisation.
- TERRAMETA partnered with the SNS JU projects 6G-SHINE and TIMES to organize a special session on "Key challenges for enabling high-performance short-range communications in extreme propagation environments" at IEEE Conference on Standards for Communications and Networking (CSCN 2023).

3.9. Interactions with other projects M13-24

- TERRAMETA, TIMES 6G, and 6G-SHINE projects came together for a joint SNS Workshop in Bologna, Italy, an event that fostered new collaborations and identified opportunities for joint ventures in the field of high-frequency (THz) wireless communication.
- TERRAMETA partnered with the Horizon Europe CONVERGE project to propose one workshop at the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) in Seoul, South Korea, entitled "Super-resolution integrated communications, localization, vision and radio mapping (SUPER-CLAM)".
- TERRAMETA participated in a 6G industry panel at the Hannover Messe. The session, organized in collaboration with the 6G-SHINE and TIMES 6G projects, focused on discussing the future of 6G.
- TERRAMETA participated in the EuCNC & 6G Summit 2024, co-organising a shared booth with SUPER-IOT, CONVERGE, and TIMES 6G projects. Together, they showcased advancements towards intelligent wireless communications environments. Additionally, TERRAMETA contributed to the EuCNC 2024 Workshop on IMT 2030 in


articulation with projects 6G-BRICKS, 6G-DISAC, CENTRIC, TERRAMETA, BeGREEN, 6G-SENSES, 6G-GOALS.

- TERRAMETA, together with other SNS projects, participated in the Hexa-X-II SNS ISAC Workshop “Online workshop on integrated sensing and communication towards 6G. A presentation highlighted the key achievements of the TERRAMETA project to date, followed by the moderation of the workshop’s one-hour panel discussion.
- TERRAMETA organized a special session “Key enablers for integrated sensing and communications in industrial environments” at IEEE CSCN 2024 together with TIMES 6G and 6G-SHINE.
- TERRAMETA, 6G-SHINE and SUPERIOT co-organised a joint online webinar on a shared topic: Sustainable Wireless Design.

3.10. Other dissemination activity

3.10.1. TERRAMETA newsletters

TERRAMETA targets the production of newsletters every 6 months to disseminate key research achievements and events organised or attended by the project partners. The table below describes the 3 issues that were already produced.

Newsletter Issue/date	Contents	Front page/link
<p>#1 November 2023</p>	<ul style="list-style-type: none"> • Project Overview • Release of the 1st Public Deliverable • Planned Demos with THz Reconfigurable Intelligent Surfaces (RISs) • THz RIS Unit Cell Designs • THz Channel Measurement Setup with Multi-functional RISs • THz Channel Modelling and Signal Processing • Up-to-Date Scientific Contributions and Dissemination 	 <p>The screenshot shows the front page of Newsletter #1. It features the TERRAMETA logo, the SNS logo, and the text 'Co-funded by the European Union'. The main title is 'TERRAMETA 6GSNS'. Below this, it lists the project's focus: 'TERahertz Reconfigurable META surfaces for Ultra-high-rate wireless communications'. The content includes a bulleted list of project overview items, release of the 1st Public Deliverable, planned demos with THz Reconfigurable Intelligent Surfaces (RISs), THz RIS Unit Cell Designs, THz Channel Measurement Setup with Multi-functional RISs, THz Channel Modelling and Signal Processing, and up-to-date scientific contributions and dissemination. It also lists the Project Coordinator (Luís Manuel Piscoia) and Technical Coordinator (George Alexandropoulos). At the bottom, there are logos for various partners including INESC TEC, leti, University of Lille, University of Luxembourg, NVA, University of Hertfordshire, UH, BT, and INTRACOM. A link to the newsletter is provided at the bottom of the table cell.</p> <p>Link to newsletter</p>

<p>#2 June 2024</p>	<ul style="list-style-type: none"> • Bologna joint Workshop with TIMES 6G and 6G-SHINE • TERRAMETA at EuCAP 2024 • CEA/ICOM Demonstrator • Channel sounding campaign at TUBS • RF memristor work progress • Microfluidic-based sub-THz RIS • Simultaneous reflecting and sensing RIS • Signal processing for THz multi-functional RISs 	<p>Link to newsletter</p>
<p>#3 January 2025</p>	<ul style="list-style-type: none"> • THz RIS Architectures and System Design • New approach to RF switching • Amplitude modulator via Schottky diodes • Channel measurement campaign • Signal processing for THz multi-functional RISs • B-MRS memristor symposium • Special Session at IEEE CSCN 2024 • Workshop organization at EuMW 2024 • TERRAMETA demonstrator at EuMW 2024 • Panel at Hannover Messe • Announcements 	<p>Link to newsletter</p>

3.10.2. TERRAMETA flyer

The TERRAMETA flyer has been designed and printed in a trifold format for distribution. The targeted events for the distribution of the flyer are all forms of face-to-face events either organised by TERRAMETA or in which TERRAMETA participated such as workshops, conferences, and any other opportunities. The objective of distributing the flyer is to raise awareness of the project.

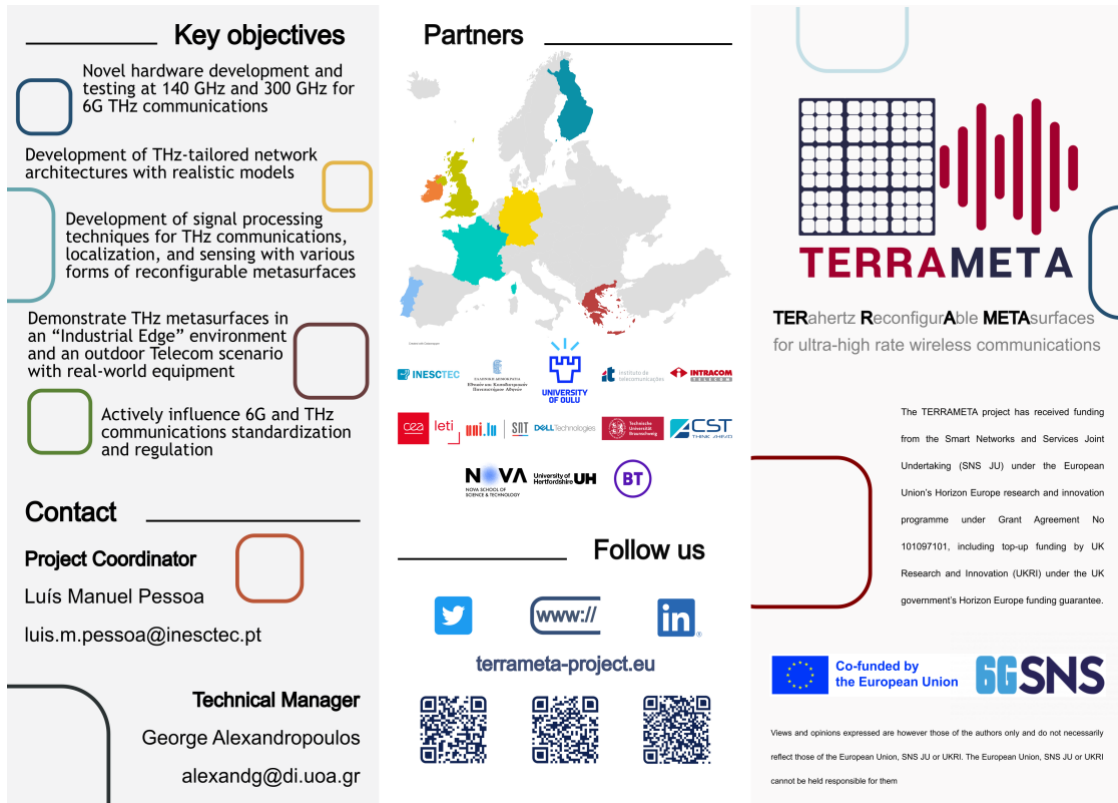


Figure 4 – View of the TERRAMETA flyer.

3.10.1. Organisation of activities

TERRAMETA has been actively involved in the organisation of activities, such as workshops, booths and special sessions in major scientific events, or even as dedicated events. The table below captures all the activities that have been organised or co-organised by the project in cooperation with other projects.

Table 1 – Overview of activities organised by the project

Period	Type of activity	Main Event	Description of activity
M1-M12	Workshop	EuCNC & 6G Summit 2023	Workshop entitled “Reconfigurable Intelligent Surfaces from sub-6GHz to THz: Recent Advances and Open Challenges” with the RISE-6G, Meta Wireless, and ARIADNE projects
M1-M12	Special Session	IEEE CSCN 2023	Special session entitled “Key challenges for enabling high-performance short-range communications in extreme propagation environments” with the 6G-SHINE and TIMES projects
M13-M24	Workshop	Dedicated event	Joint SNS Workshop focused on “High-frequency (THz) wireless communication”, co-organised with TIMES 6G, and 6G-SHINE and RESTART-IN
M13-M24	Workshop	ICASSP 2024	Workshop entitled “Super-resolution integrated communications, localization, vision and radio mapping (SUPER-CLAM)” with the CONVERGE projects

M13-M24	Special Session	ICASSP 2024	Special session entitled "Advancements in Integrated Sensing and Communication for Next-Generation Wireless Networks"
M13-M24	Booth	EuCNC 2024	Joint booth at the conference exhibition with projects TIMES 6G, SUPERIOT and CONVERGE
M13-M24	Workshop	ICC 2024	Co-organisation of the Second Workshop on "Near-Field Communications, Localization, and Sensing"
M13-M24	Workshop	ICC 2024	Co-organisation of the Third Workshop on "Synergies of Communication, Localization, and Sensing towards 6G"
M13-M24	Special Session	IEEE CSCN 2024	Special session entitled "Key enablers for integrated sensing and communications in industrial environments" with the 6G-SHINE and TIMES projects
M13-M24	Booth	EuMW 2024	Demonstrator at the conference exhibition that showcased an advanced scenario tailored for mobile robots in factory environments, featuring real-time 3D reconstruction of surroundings
M13-M24	Workshop	EuMW 2024	Workshop entitled "Disruptive sub-THz antenna and transceiver systems for future sensing, localization and communication"
M13-M24	Webinar	Dedicated event	Online webinar entitled "Sustainable Wireless Design" organised jointly with projects SUPERIOT and 6G-SHINE

4. Standardisation Activities

TERRAMETA has been actively contributing to two standardisation groups at IEEE 802 (IEEE 802.15 SC THz) and ETSI (ISG THz), which are both working towards pre-standardisation of THz communication systems. In addition, NKUA, INESC TEC and TUBS have participated in ETSI ISG RIS on reflective intelligent surfaces and ETSI ISG on Integrated Sensing And Communication (ISAC).

4.1. Contributions to IEEE 802.15 Standing Committee THz (IEEE 802.15 SC THz)

The IEEE 802.15 Standing Committee Terahertz is chartered to explore the feasibility of Terahertz for wireless communications (<https://www.ieee802.org/15/pub/SCTHz.html>). TERRAMETA partner TUBS is participating in this group and Prof. Kürner is the chair of the group.

In M1-M12, TERRAMETA has made two contributions, which provided an overview on the TERRAMETA project and introduced the simulation scenarios for the enhancement of THz backhaul links by Reconfigurable Intelligent Surfaces:

- T. Kürner, L. Pessoa; Overview on the Horizon Europe 6G SNS Project TERRAMETA, IEEE 802.15 doc.: 15-23-0132-01-0thz, IEEE 802 Plenary, Atlanta, 13 March 2023; <https://mentor.ieee.org/802.15/dcn/23/15-23-0132-01-0thz-overview-on-the-horizon-europe-6g-sns-project-terrameta.pdf>

- B. K. Jung, T. Kürner; Simulation Scenarios for the Assessment of Reflective Intelligent Surfaces in THz Backhaul, IEEE 802.15 doc.: 15-23-0342-00-0thz, IEEE 802 Plenary, Berlin, 9 July 2023, <https://mentor.ieee.org/802.15/dcn/23/15-23-0342-00-0thz-simulation-scenarios-for-the-assessment-of-reflective-intelligent-surfaces-in-thz-backhaul-applications.pptx>

In M13-M24, TERRAMETA has made two additional contributions focusing on assessment of the THz Indoor Channel including RIS as well Propagation Models for X-Haul Applications:

- Bo Kum Jung, Varvara Elesina, Sergio Matos, Raffaele D'Errico, Thomas Kürner; Initial Assessment of THz Indoor Channel with Passive Reflective Intelligent Surfaces, 15-24-0581-00-0thz, IEEE 802, Vancouver, Canada, Nov. 2024, [Microsoft PowerPoint - 15-24-0581-00-0thz Initial Assessment of THz Indoor Channel with Passive Reflective Intelligent Surfaces](#)
- Thomas Kürner, Bo Kum Jung, Christoph Herold; Propagation Models for X-Haul Applications taking into account Atmospheric Effects, 15-24-0029-00-0thz, IEEE 802.15 Interim Meeting, Panama City, Panama, Jan. 2024, [PowerPoint Presentation](#)

4.2. Contributions to ETSI Industry Specification group THz (ETSI ISG THz)

ETSI ISG THz performs pre-standards work currently covering four work items (WI), see <https://www.etsi.org/committee/2124-thz> and <https://www.etsi.org/newsroom/blogs/blog-thz>.

The four work items are:

- WI#1: Identification of use cases for THz communication systems
- WI#2: Identification of frequency bands of interests for THz communication systems
- WI#3: Channel measurements and modelling in THz bands
- WI#4: RF Hardware Modelling

TERRAMETA partners TUBS, INESC TEC, EISI, CEA, NKUA and IT are participating in this group and Prof. Kürner (TUBS) is the chair of the group.

In M1-M12, a total of six TERRAMETA contributions have been made with respect to WI#1 and WI#4:

- THz(23)000109 - *Use cases for RIS-based THz communications and sensing*
Contribution to WI#1 presenting 4 potential use cases for reconfigurable intelligent surface based THz communications and sensing, which have been defined in the context of the TERRAMETA project.
- THz(23)000201 - *Use case on Ultra-high throughput for indoor users*
Contribution to WI#1 to the Enabling Technologies section of the group report GR001, with a description regarding the use of Transmissive reconfigurable intelligent surfaces within this use case.
- THz(23)000159 - *Use case on cooperative mobile robots*
Contributed to WI#1 under the Enabling Technologies section of GR001, with a description on the use of THz RIS for directional THz communication links within this use case.
- THz(23)000110 - *Use case for Wireless Links in Data Centers*
Contributed to WI#1 under the Enabling Technologies section of GR001, with a description on the usage of RIS to improve wireless communications within Data Centre environments.
- THz(23)000168 - *Use case on Real-time industrial control*

Contributed to WI#1 under the Enabling Technologies section of GR001, with a description on the usage of RIS-based THz environment sensing applied to a factory environment.

- THz(23)000187 - *Input to Section 5 of GR 004*
Contributed to WI#4 with a text proposal for a section entitled “Beam squinting for Reconfigurable Intelligent Surfaces”, analysing the effects of beam squinting considering the use of Reconfigurable Intelligent Surfaces at 140 GHz, to be included in GR004.

In M13-M24 two additional contributions were achieved:

- From the contributions delivered in M1-M12, 4 specific contributions (THz(23)000110, THz(23)000159, THz(23)000168, THz(23)000201) were consolidated and incorporated in the ISG THz Group Report from WI#1, “TeraHertz technology (THz); Identification of use cases for THz communication systems,” GR001, published in January 2024.
- THz(24)000022r1 - Propagation Models for X-Haul Applications taking into account Atmospheric Effects, Oslo Norway/Online, March 2024.

4.3. Contributions to ETSI Industry Specification group RIS (ETSI ISG RIS)

In M13-M24 a first contribution to ISG RIS was achieved and several partners were engaged in the kick-off of an additional Work Item:

- RIS(24)015014 - *Text proposal for DGR/RIS-004 on the design of RIS control circuits.*
Contributed to WI#4 with a text proposal for a section presenting different possible RIS layouts and control schemes (e.g. serial, parallel, and multi-tile architectures).
- Several TERRAMETA partners were involved in the kick-off of a new Work Item in ETSI ISG RIS (WI#7) on RIS-aided near-field communication systems.

5. Exploitation Activities

Although exploitation activities typically don’t take-off during the first twelve months of the project, in M1-M12 many partners already have worked towards exploitation and achieved the following key points:

- **NKUA** has capitalized on the developed algorithmic approaches of the project, mainly under WP5, as well as the proposed deployment scenarios and use-cases for RISs in THz communications to enrich its portfolio, brand name, and expertise as leading academic experts on the field. The portfolio to be built by the end of the project is planned to be exploited for the pursue of further research grants and funded projects (national, European, or from the private sector) and enhance the quality of the education offered by the University by incorporating advancements and knowledge from TERRAMETA onto the educational material. So far, developments from TERRAMETA have contributed to the commencement of two relevant research projects, 6G-DISAC (SNS JU phase 2 project) and PRISM (funded under ESA-NAVSIP programme).
- **IT** conducted the design of a collection of passive R-RIS panels to be used in a joint measurement campaign with the SNS project TIMES at **TUBS** enabling further cross-exploitation among the two projects.
- **EISI** continues its engagement with Advanced Wireless Technologies business unit (BU), who are now investigating THz RIS themselves as well as its engagement

with the Manufacturing BU and the Smart edge EU project. Initial tests with robots have proven that WiFi is indeed unsuitable for their application. A higher speed wireless network is needed.

- **INESC TEC** developed together with **CEA** and **NOVA.ID** a novel unit cell for transmit or reflect-array, integrating one or more memristors that allow for controlling the state of the unit cell. The most important advantages of this technology lie in its non-volatility, allowing for the unit cell state to be kept without power consumption, as well as the small size of the devices allowing for high operating frequencies in the sub-THz range.
- **TUBS** has incorporated RIS-related simulations into his Simulator of Mobile Networks (SiMoNe).

The following additional Exploitation Activities were achieved in the period M13-24:

- **EISI, ICOM** and **CEA** integrated THz communication modules and RIS technology into mobile robots for real-time SLAM in manufacturing environments. This innovation allows for high-speed data transmission and robust connectivity, enhancing navigation and operational efficiency. This will result in improved operational efficiency, real-time navigation and mapping, reduced latency in communication, and enhanced overall productivity in manufacturing environments.
- **EISI, ICOM** and **CEA** developed wireless access points integrated with RIS control capabilities enabling adaptive beamforming and enhanced signal propagation in manufacturing environments, resulting in improved wireless network performance, reduced signal interference, enhanced coverage, and increased data transmission rates.
- **NKUA** has developed a new channel model for tri-polarised metasurfaces for near field communications. Therefore, a tri-polarised electric field different from the literature is considered, which typically considers single linear-polarised waves, and derive the corresponding channel model. Utilising this novel model new degrees of freedom and diversity of the channel can be exploited to simultaneously serve multiple users even when they are not physically separated.
- **NKUA** employed a physics-compliant modelling that incorporates the mutual coupling in RISs and proposed an efficient algorithm to optimise the structure of the RISs for joint active and passive beamforming. In this manner, the RISs can be optimised in the fabrication process based on the channel conditions tailored to the environment where they will be placed.
- **NKUA** analysed a near-field scenario with a metasurface-enabled BS and provided significant insights as to how frequent channel knowledge is required and how the user's SNR deteriorates due to imperfect channel knowledge. This is a promising approach to reduce estimation overheads and propose a novel communication protocol adhering to the changes in near-field communications. Additionally, capitalizing on the wide illumination approach for low-overhead RIS beam design in mobile scenarios, a variable-width hierarchical phase-shift codebook for near-field communications has been devised. The high performance achieved with such an extremely low overhead control, compared to full channel knowledge, implies a high practical appeal of the proposed beam management algorithm for RIS/metasurface-enabled sub-THz communication systems.
- **NOVA** developed a memristor switch for operation up to sub-THz. Experiments demonstrate that this reconfigurable low-power technology is advanced enough to be used in switches up to 170 GHz. In the future, **IT** intends to exploit these results to design a new class of non-volatile (i.e., no bias required) RIS designs for 5G FR2 applications.

- A passive and active sub-THz repeater architecture based on T-RIS has been developed, fabricated and integrated on the D-band Tx-to T-RIS repeater-to Rx wireless link developed at **CEA** Leti. This innovative technology can be used to mitigate the blockage of the direct communication link between the Tx and the Rx.
- Demonstration of an energy-efficient system by **CEA** with a transmitter and a receiver comprising multichannel integrated circuits (ICs) in 45-nm CMOS technology and antennas-in package feeding high-directivity planar lenses (T-RIS). Data rates up to 56 Gb/s are demonstrated over a 1-m point-to-point link using a full-digital communication system.
- Integration of **ICOM**'s baseband unit with **CEA-Leti**'s D-band RF front-end and RIS technology for an enhanced throughput use case compensating all the induced and combined impairments. This platform will be used as well in the final demonstration to generate a real-time communication link at D-band, and to showcase the TERRAMETA project results.
- A new method was developed by **UNILU** to achieve ultra-high rank THz channels by deploying RIS between Tx and Rx and controlling the antenna (at Tx/Rx) and the unit-cell (at RIS) element spacing.
- A new method was developed by **UNILU** to achieve fast beam alignment between two large antenna arrays at THz frequency band. The method deploys a trained neural network and only requires the measurement of received signal power for two distinct codewords to select the final steering vectors at Tx and Rx.
- Specifically designed and manufactured metallic structures acting as a mounting for a cross laser and a target onto the channel sounder nodes of **TUBS**. Reduction of time needed for alignment of measurement equipment as well as reduction of resulting errors due to misalignments of Tx and/or Rx during channel sounder measurements.
- **NOVA.ID** planarized the antenna substrate for implementing micro- and nanotechnology-based devices. This is crucial for the development of future 6G wireless networks, particularly when integrating advanced components such as memristors, rectennas, and other microelectronic devices into reconfigurable intelligent surfaces (RIS).
- **ACST** is providing Schottky diodes with great figure of merit for the demonstration of RIS unit cell designs, which will allow reconfigurability in D-Band with great characteristics. The discrete nature of the switching element and the proof of the semi-automated assembly process will enable scalability into a full RIS in the future and the possibility for scaling to higher frequency ranges dedicated to 6G. Moreover, proving this technology in D-Band opens the possibility to similar applications at lower frequencies, where more commercial opportunities might exist.
- **ACST** designed a pioneer 300GHz amplitude direct modulator which offers the possibility to high data rate communication for 6G, with high transmitted power. Moreover, the design has shown that the same, or very similar versions can be used for other applications like THz low Insertion Loss switching. Switchers at THz frequencies are necessary for space applications, where low losses are critical to maintain low noise figures of receivers. There is a lack of such devices at frequencies higher than 100GHz.
- **UH** developed a subarray synthesis and optimisation method using deep reinforced learning. For extremely large array antennas and reconfigurable metasurfaces, it is highly desirable to reduce the number of RF chains. The developed subarray synthesis and optimisation method effectively reduced the RF chain by 50% while maintaining promising radiation patterns/reflection patterns of the array antenna/Metasurface.

5.1. Patent applications

A total of 5 patent applications have already resulted from the project's exploitation activities:

- **INESC TEC, CEA and NOVA.ID** submitted a patent regarding the novel unit cell for transmit or reflect-array that integrate memristors and allow for controlling the state of the unit cell, and prototyping is ongoing.
- **CEA** submitted a patent for a unit cell for full-duplex transmitarray for sub-THz communications. A CMOS module including PA and LNA is integrated in an innovative unit cell architecture for T-RIS.
- **CEA** submitted a patent for an innovative unit cell for RIS integrating switches based on a phase change material. The switches are biased by an integrated optical signal to mitigate the interference between the antennas the bias network.
- **CEA** submitted a patent for a new unit cell architecture based on a hybrid stack-up based on dielectric and silicon based RFIC technologies. A RIS architecture has been design and prototyping is ongoing.
- **CEA** submitted a patent for a new multifunctional RIS technology operating in multi-band and in transmission and/or reflection mode has been defined by **CEA**. A passive RIS architecture has been designed and prototyping is ongoing.

6. Conclusion

In this deliverable, the dissemination, standardisation, and exploitation activities of the project over the first 24 months have been presented. In this period, TERRAMETA was very actively engaged in dissemination including 50 conference papers, 28 journal papers, 6 magazine papers, and numerous other activities in diverse fields, such as the co-organisation of 6 workshops, 3 special sessions and 2 booths. The activities are spread across the three communication channels of the website, LinkedIn, and X (formerly Twitter) to increase the TERRAMETA's reach to the society in various backgrounds. Furthermore, TERRAMETA was very active in collaborating with other projects investigating overlapping topics to generate synergy for the success of TERRAMETA. In total TERRAMETA was involved in 10 activities involving collaboration with other projects.

In terms of standardisation activities, TERRAMETA contributed to IEEE 802.15 SC THz and ETSI ISG THz and RIS. Especially for ETSI ISG THz, TERRAMETA achieved a total of 8 TERRAMETA contributions. TERRAMETA also delivered a total of 4 contributions to IEEE 802.15 SC THz and 2 contributions to ETSI ISG RIS.

For the exploitation activities, while in the first year only 5 exploitable results were identified, in the second year the number of exploitable results grew significantly to 21 identified results, including 5 patents.

TERRAMETA significantly expanded its activities in the second year as seen in Table 2. Particularly noteworthy is the significant increase in conference presentations from 12 to 38 and journal publications from 9 to 19 with 7 of them being open access. Activities in collaboration with other projects increased from 3 to 7 and the activities organised by the project increased from 2 to 10, while exploitation activities reached a new high of 21. These increases underline TERRAMETA's commitment to further advancing its research results and anchoring them in the scientific and industrial community. The additional activities in 2024 are clear evidence of the project's continued progress and increasing visibility.

Table 2 – Overview of the project dissemination, exploitation and standardisation KPIs

KPI	Year 1 (M1-M12)	Year 2 (M13-M24)	Total
Conference presentations	12	38	50
Journals	9	19	28
Magazines	2	4	6
Activities in collaboration with other projects	3	7	10
Activities organised by the project	2	10	12
Standardisation contributions	8	6	14
Exploitation activities	5	21	26

For the third year (M25-M26), several significant workshops are already scheduled. Among these, there are two workshops as part of IEEE ICC 2025 with TERRAMETA a co-organizer:

- "3rd Workshop on Near-Field Communications, Localization, and Sensing"
- "4th Workshop on Synergies of Communication, Localization, and Sensing towards 6G" will be held as part of IEEE ICC 2025

Moreover, at the European Conference on Antennas and Propagation (EuCAP) 2025, TERRAMETA will host two sessions:

- Joint Scientific Workshop entitled "Sub-THz Reconfigurable Intelligent Surfaces, RF Front-Ends, and Channels for 6G Networks" which will also count with the participation of additional 6G-SNS projects, namely TIMES, Tera6G, 6GTandem, and TeraGreen.
- Convened Session on "Extremely Large or Distributed Antenna Systems in Near-Field Environments".

Additionally, TERRAMETA will remain fully engaged in its third year in achieving further dissemination, exploitation and standardisation outputs, which will further enhance the visibility of the project and of the European funding among the scientific and industrial community, public associations/entities as well as near the general public.