Rural Environmental Monitoring via ultra wide-ARea networKs And distriButed federated Learning

Organisation of project's knowledge sharing, networking and training events and dissemination opportunities

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Abstract

REMARKABLE is a Marie Curie Staff Exchange project whose main goal is to foster collaboration, networking and knowledge exchange among involved beneficiaries and associated partners in the domain of advanced information and communication technologies for deep rural environmental monitoring. The project defines a broad set of interactions between the participating organisations as detailed in Sec. 1.3 of the project description of action (DoA, Part B) in the Grant Agreement. The principal objective of WP5 is to plan and implement knowledge sharing activities and organise networking events. Seamless knowledge sharing between participating organisations will be executed by organising knowledge sharing and networking events such as workshops, summer schools, special sessions, training and demo events.

This document presents the overview of the organisation of training events (summer schools, training and demo events) and networking events (workshops, special sessions). This includes the description of activities related to the organisation of events as defined in DoA, Sec. 1.3: 1) the kick-off workshop, 2) two training and demo events, and 3) two project summer schools. Besides the planned events, the document describes all other opportunities the project partners executed to enhance knowledge sharing and networking within the consortium and with the outside community. The document will cover the activities done during the first project year and the plan for the second project year and will be accordingly updated each year.

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1. Introduction

REMARKABLE project will organise a set of knowledge sharing and networking events that will be a mixture of four types of activities:

- Research training: aiming at providing trainees with fundamental knowledge, current and emerging paradigms across multi-disciplinary research spectrum of ICT technologies in environmental monitoring applications focusing on IoT technologies and ML tools and applications.
- Complementary training: that will train researchers in basic transversal skills needed to progress their careers. The accent will be placed on young researchers and their future academic or industrial exposure, focusing on their innovation skills and possible start-up ventures.
- Integration sessions: activities that will expose researchers to integration activities for end-to-end IoT and ML applications in rural areas. The project researchers will use dedicated integration sessions during training events to fast-track progress of development of selected use cases and their deployment in one of the demonstration sites.
- Demonstration sessions: REMARKABLE will stimulate involvement of all researchers in prototyping and demonstration. Careful planning of project demonstration activities will take place during network events. Experimentation is tightly connected to data set production. Special care will be taken to encourage planning and production of relevant data sets.

1.1. Applicable Reference Material

[1] Grant Agreement Number: 101086387 — REMARKABLE — HORIZON-MSCA-2021-SE-01.

[2] Making the Most of Your H2020 Project - Boosting the impact of your project through effective communication, dissemination and exploitation, The European IPR Helpdesk, available at: https://op.europa.eu/en/publication-detail/-/publication/3bb7278e-ebf3-11e9-9c4e-01aa75ed71a1/language-en/format-PDF/source-164620962

[3] Communication, dissemination & exploitation: what is the difference and why they all matter, European Research Executive Agency, 16 June 2023.

1.2. List of Acronyms

Acronym	Definition
AI	Artificial Intelligence
IoT	Internet of Things
ICT	Information and Communication Technologies
MSCA	Marie Sklodowska-Curie Action
ML	Machine Learning

Table 1. List of acronyms.

2. Training Events

Training events during the project are planned to be organised as a blend of tutorial lectures, keynotes and panels given by invited distinguished researchers, problem-solving sessions, demonstration activities, interactive hands-on studies, self-learning, and team projects, endorsing co-analysis and experimental learning in a challenging multi-disciplinary surrounding. From these events, several new short courses will be produced, extending from research-specific courses to those developing transferable skills and promoting interdisciplinary research based on combining different approaches. These courses will arise from the events by identifying gaps in training provisions that need to be filled involving review of existing training provision. The main network-wide training events and contribution of beneficiaries and associated partners is presented in the table below.

	Main Training Events and Conferences	Leading Institution	Action Month
1	Kick-off workshop: IoT, ML Multilayer Communications and Edge/Cloud Integration	BEV	M3
2	Training and Demo Event 1: IoT Solutions for Connected Africa	FUT/UR	M21
3	Project Summer School 1: IoT for Eco-Friendly Tourism	UPV	M27
4	Training and Demo Event 2: IoT and Machine Learning in Vineyards	SU	M33
5	Project Summer School 2: Ultra-Wide Area IoT and Distributed Learning	UNS-FTN	M39
6	Final Outreach Event (OE): EU-Africa REMARKABLE Event	ULHT	M45
7	Project Workshops and Special Sessions	ALL	M9 - M45

Table 2. List of planned project training events.

2.1. Summer Schools

The first project summer school will be organised in M27 by UPV in Valencia. At this stage of the project, the preparation for the school is only at the very beginning. However, participants and especially early-stage researchers in the consortium are encouraged to attend relevant summer schools organised by other project and organisations, as advised by their hosts or academic supervisors. For example, during July 2024, in Novi Sad (Serbia), the Institute of Artificial Intelligence R&D of Serbia is organising Eastern European School of Machine Learning (https://www.eeml.eu/home), high-quality summer school that will gather leading ML researchers as lecturers. During this period, several PhD students (e.g., two PhD students from University of Alicante) will visit Novi Sad (DunavNet and University of Novi Sad – Faculty of Technical Sciences) and have

applied to attend lectures and participate at this summer school. Similar opportunities will be explored by all partners involved in the consortium.

2.2. Training and Demo Events

Starting from the Kick-Off workshop meeting, the periodic training events will take place every 6 months, inserted with project meetings. This includes two Training and Demo (3-day) events organised at one of the associated partner institutions in Africa and two Summer Schools (3-day) events organised by European partners, followed by the Final Outreach REMARKABLE Event. In addition, the project will organise three research-oriented workshops/special sessions, either as stand-alone events or as a part of major conferences in the respective field. More details about the project-wide training events, their locations and the topics to be covered are listed in Table 2.

3. Networking Events

In Table 3, a preliminary schedule of third parties' events is delineated, presenting the envisioned calendarization of such scientific events. Naturally, further adjustments and updates will be carried out during the project's lifetime.

Event	Main area	Date	Place	Link
CIoT'23	Cloud IoT	March 20–22, 2023	Lisbon, Portugal	https://ciot.dnac.org/home/
Workshop on Widening Access to TinyML Network by Establishing Best Practices in Education	TinyML	July 3-7, 2023	Trieste, Italy	https://indico.ictp.it/event/10185
NET4us 2023 Workshop	NSS	October 6, 2023	Madrid, Spain	https://grc.webs.upv.es/events/net4us2023/
IEEE CCNC'24	ML, IoT, and CN	January 6–9, 2024	Las Vegas, NV, USA	https://ccnc2024.ieee-ccnc.org/

Table 3. List of selected events for REMARKABLE dissemination events.

3.1. Kick-Off Workshop

The REMARKABLE's Kick-Off workshop was held within the 6th Conference on Cloud and Internet of Things (CIoT'23) carried out between March 20th and March 22nd of 2023, at Lusófona University, Lisbon, Portugal. This blend of the two events was a natural choice for two reasons: 1) the main objective of the conference was to address challenges of clouds and IoT systems from sensors/machines to end-users attached to a Cloud, while considering the 6G network connecting both IoT and Cloud domains, which matches closely the project's main topic, and 2) the critical mass of the conference organizers was composed of researchers from Lusófona University.

The kick-off workshop had the following programme:

- Monday, March 20th, 17h00-17h30[1]: Round-table introduction - passing pertinent project information to partners (e.g., asking them to fill out the tables for each work package, possibly some financial information, secondments, etc.).

[1] Note that, due to CIoT's Welcome Reception (17h00-19h00), we proposed only a half an hour session on the first day.

- Tuesday, March 21st, 17h00-18h30[2]: Project discussion - brief introduction of the project to the open audience (by Prof. Dejan Vukobratovic), followed by a somewhat more technical presentation of each of the technical WPs (1 to 4) by the respective WP leaders (ULHT, FTN-UNS and UA).
- Wednesday, March 22nd, 17h00-18h00: Open floor - each partner (that volunteered) introduced the respective teams know how, as well as expertise and experiences related with the project's used cases.

Figure 1 gives a summary of the overall conference programme in which the kick-off workshop took place, where one can see clearly three sessions reserved and dedicated specifically to the REMARKABLE project, together with a couple of photos of the participants in these sessions.

CIoT'23 — 6th Conference on Cloud and Internet of Things

	Monday 20th	Tuesday 21th	Wednesday 22th
8h30 - 9h30	Secretariat	Secretariat	Secretariat
9h30 - 10h00	Opening Ceremony	Session #4	Session #7
10h00 - 10h30	Keynote Speech Prof. Susana Sargento		
10h30 - 11h00		Coffee Break	Coffee Break
11h00 - 11h30	Coffee Break	Keynote Speech Prof. Joel Rodrigues	Invited Speech Prof. Marius Balas
11h30 - 12h00	Session #1		Session #8
12h00 - 12h30		Invited Speech Prof. Mostafa Ezziyyani	Best Paper Award
12h30 - 13h00	Lunch	Lunch	Lunch
13h00 - 13h30			
13h30 - 14h00	Session #2	Session #5	Tutorial #1
14h00 - 14h30			
14h30 - 15h00			
15h00 - 15h30	Invited Speech Prof. Dário Pedro	Invited Speech Prof. Carla Oliveira	
15h30 - 16h00	Coffee Break	Coffee Break	Coffee Break
16h00 - 16h30	Session #3	Session #6	Tutorial #2
16h30 - 17h00			
17h00 - 17h30	Workshop REMARKABLE	Workshop REMARKABLE	Workshop REMARKABLE
17h30 - 18h00			
18h00 - 19h00	Welcome Reception	Gala Dinner	Closing Ceremony

[2] Note that, due to CIoT's Gala Dinner (19h00-22h00 on the previous day), we propose an hour and a half session to compensate the time from the first day.

Figure 1. Summary of the CIoT'23 conference programme (top), joint photo of all present REMARKABLE partners (middle) and a sample of a partner presentation in a REMARKABLE session (bottom)

3.2. Project Workshops

REMARKABLE will organize a workshop for the third week of July 2024 in Porto, as part of a summer school organized by the Intensive Program in Cyber Security (IPICS) and CyberSecPro (CSP) initiatives [3]. The workshop will be co-located with other MSCA projects and will be an opportunity for the REMARKABLE consortium to meet in person, as most of the partners will participate in the event.

3.3. Project Special Sessions

Special sessions will be organised as part of relevant conferences in the field. Special sessions, together with other dissemination events, represent a central opportunity for the partners to both disseminate and enhance their project work: they will not only share information with experts in the field, collecting feedback from technically qualified spectators, but also have the opportunity to internally coordinate their work. All partners will be encouraged to submit works to such events in order to promote the project and be proactive in generating opportunities for academic dissemination via publications and other relevant means.

AI/ML Empowered Connectivity in Rural Environments @ BalkanCom 2024

Special Session Title	AI/ML Empowered Connectivity in Rural Environments
Venue	BalkanCom 2024, Ljubljana (Slovenia)
Dates	03-06. June 2024.

[3] https://research.pdmfc.com

Link	https://www.balkancom.info/2024/ss-ai-ml-empovered-connectivity-in-rural.html
Organisers	• Dejan Vukobratović, University of Novi Sad • Marko Beko, Universidade de Lusofona • Marco Zennaro, Abdus Salam International Centre for Theoretical Physics
Session Scope	Rural areas are often exposed to connectivity issues due to sparse population density, geographical obstacles, and limited infrastructure. Geographic barriers like mountains and forests can further impede connectivity. These challenges make it difficult to establish reliable and high-speed internet connections, hindering the deployment and effectiveness of Internet of Things (IoT) devices. These devices are employed across various sectors such as agriculture (for soil moisture monitoring, livestock tracking), environmental monitoring (for water quality assessment, weather forecasting), and healthcare (for remote patient monitoring). Artificial Intelligence/Machine Learning (AI/ML) techniques can be used to optimize the use of available network resources in rural areas, enabling more efficient data transmission and reducing latency. Additionally, AI-powered algorithms can intelligently manage network connectivity, switching between different communication technologies (e.g., cellular, satellite, low-power wide-area networks) based on factors such as signal strength and cost-effectiveness. Moreover, predictive maintenance powered by AI/ML algorithms is essential for ensuring the reliability and performance of IoT devices in rural environments. By analyzing historical data from IoT sensors, AI models can predict equipment failures and maintenance needs, allowing operators to schedule maintenance proactively and prevent costly downtime. By implementing these AI-driven optimization techniques, rural communities can overcome connectivity challenges and unlock the full potential of IoT applications for agriculture, healthcare, infrastructure management, and other critical services, as well as bridging the gap between rural and urban environments.

REMARK – AIoT for Rural Environmental Monitoring @ GoodIT 2024

Special Track Title	REMARK – AIoT for Rural Environmental Monitoring
Venue	GoodIT 2024, Bremen (Germany)
Dates	04-06. September 2024.
Link	https://grc.webs.upv.es/events/remark2024/
Organisers	• Pietro Manzoni, Universitat Politecnica de Valencia, SPAIN

	• Marco Zennaro, Abdus Salam International Centre for Theoretical Physics
Session Scope	Integrating Internet of Things (IoT) technologies and Artificial Intelligence (AI) capabilities is critical in the current global digital transformation, providing vast amounts of data on our environment and enabling the extraction of actionable insights. However, the benefits of AIoT systems are predominantly realized in urban and suburban settings, and this disparity exacerbates the urban-rural divide, as infrastructure is not universally accessible. Despite this, AIoT technologies promise to enhance the economy and quality of life in rural regions across developed and developing nations. Various efforts need to be targeted to deploy IoT and AI technologies in rural areas, focusing on bridging the gap in infrastructure availability. This Special Track wants to explore the requirements for bringing IoT and AI integrated solutions in rural and extreme environments. By doing so, we can unlock the potential of these technologies to stimulate economic growth, improve agricultural practices, enhance access to healthcare, and boost the overall quality of life in rural communities. Moreover, we can provide valuable data sources to tackle and better understand the growing environmental concerns, from local and regional (e.g., pollution monitoring) to global (e.g., climate change) issues. The connection of this Special Track with the main scope of the GoodIT conference stands in ensuring that the transformative benefits of digital technology are inclusive, reaching every corner of the globe and narrowing the digital divide between urban and rural areas. This Special Track aims also to be a showcase for the activities of the project REMARKABLE (Rural Environmental Monitoring via Ultra-Wide-Area Networks and Distributed Federated Learning) which is an action of HORIZON TMA MSCA Staff Exchanges for the call HORIZON-MSCA-2021-SE-01.

4. Dissemination Opportunities

REMARKABLE project is promoted and advertised by project beneficiaries and associated partners at many different opportunities. Different events, listed in Table 4, were used to inform the audience about the project through at least one slide and associated discussion.

Event, Date, Link	**Presenter**	**Topic**
IEEE IoT Technical Community webinar series, Friday, 10 Nov 2023; 9:00-10:00am EST https://iot.ieee.org/education.html	Pietro Manzoni (UPV)	IoT for Rural and Extreme Environments
Keynote speaker - III Rebralint North Meeting, Dec 11th – 13th 2023, the Institute of Computing of the Federal University of Amazonas, Manaus, Brazil https://www.youtube.com/watch?v=bWmcv9EtqP4	Pietro Manzoni (UPV)	Connected Technology for Remote and Challenging Environments
AGU IoT Webinar Series Thursday, 15 February 2024; 11:00am-12:00pm (GMT+3) via MS Teams	Pietro Manzoni (UPV)	IoT for Rural and Extreme Environments
Keynote at workshop IOT INTEROPERABILITY AND THE WEB OF THINGS (IIWOT) as part of the IEEE Consumer Communications & Networking Conference 6–9 January 2024 // Las Vegas, NV, USA https://ccnc2024.ieee-ccnc.org/workshop/ws-2-iot-interoperability-and-web-things-iiwot/program	Pietro Manzoni (UPV)	IoT Interoperability for Extreme Environments
COST PHYSEC CA 22168 Meeting, Padova, Italy, 31.01-02.02 https://6gphysec.org/	Dejan Vukobratovic (UNS-FTN)	Platforms for 3GPP NB-IoT Data Collection
Smart City Forum, Sarajevo, Bosnia and Herzegovina, https://bit-alliance.ba/sedmi-smart-city-forum-u-bih-buducnost-digitalne-	Dejan Vukobratovic (UNS-FTN)	The Role of Modern ICT Technologies in Future Smart City Developments

transformacije-u-bih-da-li-smo-spremni-za-naredne-korake/		
Criar Ciência e Fazer Inovação made in Lusófona, *2ª Edição,* Lisbon, Portugal, 16.01.2024 https://www.ulusofona.pt/evento/criar-ciencia-e-fazer-inovacao-made-in-lusofona-2-edicao	Slavisa Tomic (ULHT)	REMARKABLE project presentation
20th International Conference on Artificial Intelligence Applications & Innovations*, Corfu Greece, 27-30 June 2024, https://ifipaiai.org/*	Ioannis Karydis (Ionian University)	REMARKABLE project presentation
Special Speaker, FocusLab, at the College of Telecommunications and Information Engineering, Nanjing University of Guest Posts and Telecommunications, China, July 2023.	Bamidele Adebisi (Manchester Metropolitan University	REMARKABLE project presentation
Guest Speaker, King Fahd University of Petroleum & Minerals/ in Partnership with Saudi Aramco, Saudi Arabia, September, 2023.	Bamidele Adebisi (Manchester Metropolitan University	Connecting and Securing Smart Infrastructure
Guest Speaker, Invited Guest Speaker, at the Afe babalola University, Ado Ekiti (ABUAD), Nigeria, May 2023.	Bamidele Adebisi (Manchester Metropolitan University	Smart Infrastructure: Catalyst for national development'
Guest Speaker, Nigerian Society of Engineers, Manchester Branch, UK, July 22, 2023	Bamidele Adebisi (Manchester Metropolitan University	Connecting and Securing Smart Infrastructure
Co-Chair, AI Infrastructure and Ecosystem, Nigeria's National AI Strategy Workshop, Abuja, Nigeria, April 2024	Bamidele Adebisi (Manchester Metropolitan University)	AI Infrastructure and Ecosystem
Guest Speaker, Federal University of Technology Minna (FUT Minna), Nigeria, August – September 2023	Segun Popoola (Manchester Metropolitan University)	Machine Learning, Deep Learning, and Federated Learning for IoT Applications
Guest Speaker, King Fahd University of Petroleum and Minerals in partnership with Saudi Aramco, December 2023	Segun Popoola	Python for Federated Learning Applications in Internet of Things

	(Manchester Metropolitan University)	
Co-Chair, AI Ethics and Social Impacts, Nigeria's National AI Strategy Workshop, Abuja, Nigeria, April 2024	Segun Popoola (Manchester Metropolitan University)	AI Ethics and Social Impacts
Keynote Speaker – IEEE PES and CIGRE, UK and Sweden, April 2024 (https://cigre.org.uk/events/the-power-and-energy-systems-of-the-future-sustainable-digitalised-and/)	Olamide Jogunola (Manchester Metropolitan University)	Research and Development on Energy Transition, Digitalisation and Cybersecurity
Keynote Speaker – Africa Day Conference, Manchester, May 2023 (https://www.linkedin.com/posts/professor-erinma-bell-mbe-dl-jp-53997649_remember-to-book-your-seat-at-the-upcoming-activity-7064605154578190337-Mwyl?utm_source=share&utm_medium=member_desktop)	Olamide Jogunola (Manchester Metropolitan University)	Application of blockchain technology and cybersecurity to sustainable development and efficient infrastructure projects in Africa
Joint workshop paper publication with colleagues from Manchester Metropolitan University and Stellenbosch University, South Africa.	Jogunola, O., KJ, H., Mabitsela, M. M., Phiri, E. E., Adebisi, B., & Booysen, M. J. (2023).	Deep Learning-Enabled Temperature Simulation of a Greenhouse Tunnel.

Table 4. REMARKABLE events

5. Conclusion

In this report, we described the main project activities in the domain of knowledge sharing, networking and training events, and dissemination opportunities. The initial plan from the project GA has been restated and all activities described therein have been executed on time. The main activities during the first project year include organisation of the project kick-off workshop in March 2023 in Lisbon (collocated with CIoT 2023 conference), preparation of two special session proposals that are accepted and will take place on BalkanCom 2024 conference in Ljubljana (Slovenia) in June 2024, and GoodIT 2024 conference that will take place in Bremen (Germany) in September 2024. Several additional dissemination activities that included presentation of REMARKABLE project activities are also reported. The deliverable will be updated annually with the updated description of events executed during the project and including plans for the upcoming period.